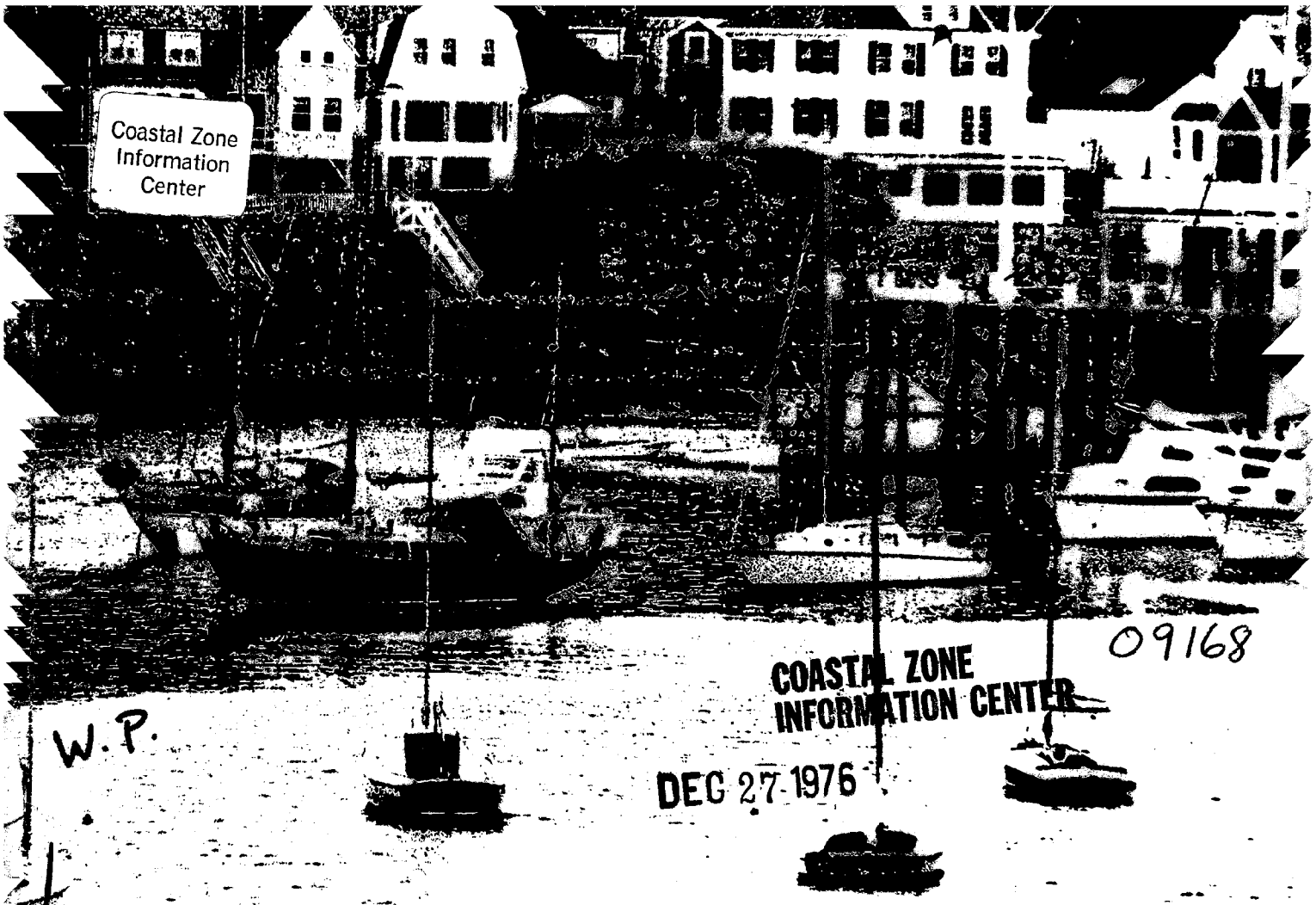

MASSACHUSETTS COASTAL ZONE MANAGEMENT PREVIEW

A Preliminary Program for Public Review

Coastal Zone Management

Commonwealth of Massachusetts
Michael S. Dukakis, Governor

Executive Office of Environmental Affairs
Evelyn F. Murphy, Secretary
Matthew B. Connolly, Director CZM

November 5, 1976

MASSACHUSETTS COASTAL ZONE MANAGEMENT PREVIEW

A Preliminary Program for Public Review

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EVELYN F. MURPHY
SECRETARY

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

November 5, 1976

Dear Reader,

From its earliest days two years ago, the Massachusetts Coastal Zone Management Program has represented a new direction on the part of state government. Governor Dukakis and I are committed to an open participatory CZM planning process. For example, public meetings were held early on in the development of Massachusetts CZM to learn about and meet the needs of citizens and coastal communities. Public information and involvement received high priority from the Governor's Task Force on Coastal Resources, the Board of Advisors to the CZM Program. Regional Citizen Advisory Committees were formed to insure ongoing local involvement in CZM.

It is with great pleasure that I present you with the Massachusetts Coastal Zone Management Preview-A Preliminary Program for Public Review. This document has been prepared specifically for public scrutiny and review.

The idea for a Program Preview is our own--we are the only coastal state in the nation to have prepared a "pre-draft plan" report for review by local, state and federal agencies, interested citizens, organized groups, and our own Citizen Advisory Committees. I encourage you to read and evaluate the objectives, background and proposed policies on the six subject areas of energy and energy facility siting, ports and harbors, the marine environment, the visual environment, coastal hazards like erosion and flooding, and recreation. The Introduction contains a summary of proposed policies, as well as the background information necessary for you to understand the history of coastal zone management in Massachusetts. The chapter on Management describes the mechanisms available to implement proposed CZM policies.

You will note that Chapter 4 on Coastal Regions is not completed. This chapter represents an opportunity for you--a place where your thoughts, values and experience can be brought to bear in coastal resource management. The ten regional units will be written in the coming months by Citizen Advisory Committee members with the help of the CZM staff. I invite you to work with local citizen advisory committees, the Task Force, and the CZM office on the regional chapters.

We have an opportunity in Massachusetts to bring a more reasoned perspective to decision making about future uses and activities along our finite coastline. Together, we can insure the viability of our coastal resources economically, and environmentally for this and succeeding generations.

Sincerely,

Evelyn F. Murphy
Secretary

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INTRODUCTION — SUMMARY OF OBJECTIVES AND POLICIES

THE PREMISE

In the course of two years of planning, the staff of the Massachusetts Coastal Zone Management Program, in the Executive Office of Environmental Affairs, has talked with and listened to hundreds of citizens. Residents of coastal communities, developers, public officials, commercial fishermen, and people who come to the Massachusetts coast for recreation, have come to CZM public meetings, joined regional Citizen Advisory Committees, or have otherwise expressed their needs and concerns to CZM staff members. The Office of State Planning has conducted an extensive local growth planning exercise in coastal communities. The Governor's Task Force on Coastal Resources has brought a wide and varied range of interests and concerns to the policy development aspects of Massachusetts Coastal Zone Management. The CZM program has conducted a statistically valid public opinion survey of coastal residents. CZM has examined the record of growth and development along the coastline of Massachusetts for the past several decades.

From these efforts and discussions, as well as others described further on in the introduction, a number of primary needs for management of the coastal zone have become evident:

-The natural resources of the Massachusetts Coastal Zone are among our most important economic resources. Businessmen, tourists, and residents alike are attracted to the coastal areas of Massachusetts. Coastal Zone communities experience sustained pressures for development. The coastal zone typically supports commerce, industry, transportation, housing, recreation, and aesthetic needs. However, the very resources which attract so many interests to the coastal zone, and support myriad activities and uses, are endangered.

-Many coastal communities claim they do not want extensive new growth and development. Most recently, Local Growth Policy Committees have expressed a sentiment against major new growth. But such feeling is not a recent phenomenon; it seems to have been the prevailing attitude of the last decade, as confirmed by the CZM public opinion survey.

-Development interests have typically prevailed, when conflicts between conservation and development proponents have occurred. Many people urging the protection and preservation of sensitive and valued ecological areas along the coast are often unheard. Coastal Zone Management provides an opportunity to elevate concern about the marine environment to a higher level in the public policy decision making process.

Therefore, many of the policies in this CZM program preview have a base in preserving and protecting rich and valuable coastal resources to which Massachusetts can still lay claim. This is an economic as well as an environmental position. If this were not the perspective of CZM, our coastline could lose its ability to nurture valuable fishing resources. It could lose its great recreational appeal, and its future economic viability could be impaired.

This is not to imply that coastal zone management will preclude development. But rather, given the fragile nature of much of the coastal zone and given the existent pressures for development, priorities for development and conservation must be established. Protection and preservation of certain critical resource areas must come first. Development types that depend upon the ocean, or access to the ocean, hold the next level of priority. Other development types receive third priority.

Over the long run, CZM's proposed policies to protect our coastline's natural riches ensures all the residents of the Commonwealth that the environmental and economic value of the Mass. Coastal Zone will be sustained, and even enhanced.

SUMMARY OF OBJECTIVES AND PROPOSED CZM POLICIES

MARINE ENVIRONMENT

MARINE ENVIRONMENT OBJECTIVES

1. To protect and enhance the productivity and values of the marine environment effecting the Commonwealth of Massachusetts.
2. To minimize the adverse impact of man's activities upon the marine environment
3. To guarantee continued production and harvest of renewable marine protein sources.
4. To insure man's continuing use and enjoyment of the Massachusetts coast.

MARINE ENVIRONMENT POLICIES

Policy (1) Conserve ecologically significant resource areas for their contributions to marine productivity and value as habitats.

Policy (2) Protect complexes of marine resource systems of unique productivity; ensure that activities in or adjacent to such complexes are designed and carried out to minimize adverse effects on marine productivity, habitat value, storm buffering and water quality of the entire complex.

Policy (3) Ensure that existing water quality standards for all point source discharge activities are stringently enforced and that the standards are continually upgraded to achieve the highest possible conformance with federally promulgated water quality criteria.

Policy (4) Ensure existing siting criteria, performance standards, and activity regulations are stringently enforced and upgraded to reflect advances in related technology and knowledge of adverse affects on marine productivity and public health.

Policy (5) Condition construction in water bodies to minimize interference with water circulation and sediment transport and to preserve water quality and marine productivity.

Policy (6) Ensure that dredging and disposal of dredged material minimize adverse effects on marine productivity.

Policy (7) Accomodate off-shore sand and gravel mining needs in areas and in ways that will not adversely effect marine resources and navigation.

Policy (8) Encourage and assist the development of aquaculture, commercial fisheries research and development, fish restoration, and anadromous fish enhancement.

COASTAL HAZARDS

COASTAL HAZARDS OBJECTIVES

1. To reduce current losses of property and lives and to prevent future losses;

2. To preserve and restore coastal landforms and natural processes which are essential to the protection of coastal environments and landward areas; and

3. To maximize the effectiveness and economic efficiency of public investment in hazard protection measures.

COASTAL HAZARD POLICIES

Policy (9) When acquiring coastal lands for recreation and open space purposes, priority should be given to areas that have a high propensity for tidal flooding and erosion and serve as buffers for landward areas.

Policy (10) Prevent further growth and development in high hazard areas and preserve natural buffers throughout the coastal zone.

Policy (11) Use all available review authorities to ensure that all publically subsidized development wihtin the 100 year tidal flood zone and private projects proposed for areas below mean high water will not:

a. exacerbate existing hazards
b. be damaged by flood and erosion-related forces
c. promote growth and development in damage prone areas or degrade natural buffers.

Policy (12) Provide funding and technical assistance for the restoration and stabilization of foreshore and shore areas in hazardous zones using non-structural measures.

Policy (13) a. Implement federal or state structural solutions to protect property and lives in Special Assistance Areas only when there will be widespread public benefits and minimal adverse environmental effects.

b. Approve permits for private flood or erosion control projects only when it has been determined that there will be no adverse effects on adjacent properties or down coast areas.

VISUAL ENVIRONMENT

VISUAL ENVIRONMENT OBJECTIVES

1. To preserve, enhance, and restore the integrity of the coastal zone as a visual unit with unique sensitivities and opportunities.

2. To increase opportunities for visual access to natural and man-made scenic features and contemporary waterfront activities

3. To ensure that the siting and design of major facilities that are of regional or state concern will be compatible with the inherent visual qualities of the coastal zone; and

4. To assist in improving compatability between small scale development and local visual charater.

VISUAL ENVIRONMENT POLICIES

Policy (14) Maintain a state level inventory of visually important areas within the coastal viewshed that are of regional, state, or national concern. Include natural areas and sites of historical, cultural, or commercial significance that are unique for their scenic and visual attributes or for their interest and educational value.

Policy (15) Incorporate visual concerns into the early stages of the planning and design of facilities proposed for siting in the coastal zone. Establish a design review process for development that is of regional, state, or national concern.

Policy (16) Provide funding or technical assistance to communities and local conservation commissions in the development of local zoning and land use controls which can be utilized to improve visual access and the compatability of proposed development with existing community character.

Policy (17) Expand visual access in urban areas and provide views of coastally dependent activities with significant educational or interest value.

Policy (18) a. Provide technical assistance to the Departments of Environmental Management and Public Works in the designation and management of Scenic and Recreational Rivers and Scenic Highways located in the coastal zone.

b. Petition the board of Outdoor Advertising to designate sign free areas and corridors in the coastal zone, support the development and implementation of a system of roadside information service directories, and provide technical assistance to communities in the development of local advertising and signage ordinances.

PORTS AND HARBORS

PORTS AND HARBORS OBJECTIVES

1. To allow for expansion of economically important water dependent activities, including fishing, shipping, and other marine industries;

2. To facilitate harbor improvements needed by fishermen, cruise and ferry services, and the general boating public;

3. To encourage revitalization and rehabilitation of developed harbor areas and promote physical and visual access to waterfront for the general public;

4. To protect the marine environment and conserve significant ecological resources; and

5. To maximize the economic return and public benefit from publicly supported port and harbor works.

PORTS AND HARBORS POLICIES

Policy (19) Encourage water-dependent industrial development in port areas. Deter preemptions of present and proposed water-dependent industrial uses by favoring the use which is the more limited in its physical or economic options. Permit non water-dependent industrial uses when such use would not preempt forseeable water-dependent industrial uses.

Policy (20) Promote the widest possible public benefit from port and harbor and channel dredging and ensure such proposals are consistent with marine environment policies.

Policy (21) Encourage, through technical and financial assistance, the expansion of water-dependent uses in port areas and developed harbors where the risks of damage to the marine environment are minimal.

Policy (22) Encourage urban waterfront redevelopment and renewal in developed harbors in order to link residential neighborhoods and commercial downtown areas with physical and visual access to the waterfront.

RECREATION

RECREATION OBJECTIVES

1. To improve the quantity and quality of coastal recreational opportunities for all citizens of the Commonwealth.

2. To improve public access to coastal recreation resources.

3. To ensure that the improved quantity and quality of coastal recreational opportunities are provided while minimizing conflicts, over-utilization and economic environmental impacts

4. To involve citizens and user groups in the further planning, development and management of public coastal recreational facilities.

5. To suggest, initiate and conduct research into areas of special needs for coastal recreation and to develop management standards and criteria for utilization in public recreational facilities and areas.

5. To promote tourism where appropriate through the provision, improvement, and diversification of coastal recreational amenities.

RECREATION POLICIES

Policy (23) Improve public access to coastal recreation facilities, and alleviate auto traffic and parking problems, through improvements in public transportation.

Policy (24) In addition to expanding major access, link existing coastal recreation sites to nearby coastal inland facilities via trails for bicycles, hikers and equestrians, and via rivers for boaters.

Policy (25) Expand existing state or local recreation facilities in regions with a high need.

Policy (26) Increase capacity of existing recreational areas by facilitating the multiple use of the site and by improving maintenance. Resolve conflicting uses whenever possible through improved management rather than through exclusion of uses.

Policy (27) Facilitate expansion and improvements of private recreational facilities and sites that provide public coastal access.

Policy (28) a. Acquire and develop new sites favoring small to moderate size facilities, in conjunction with transportation improvements, in deficient regions especially where there are few remaining opportunities.

b. Give lower priority to acquisition of larger sites except under the following circumstances:

1) When high recreation potential, waterfront military sites become available
2) When special floodplain purchases become available (refer to Coastal Hazards Section).
3) When sites with critical environmental visual, or other unique characteristics become available (refer to Areas for Preservation or Restoration in Management).

ENERGY

ENERGY OBJECTIVES

1. To provide adequate sites for needed energy facitilies
2. To allow for an adequate supply of energy
3. To ensure that coastal energy facilities are sited and designed to minimize impacts on the marine and visual environment.

ENERGY POLICIES

Policy (29) Maximize use of existing marine terminal capacity.

Policy (30) Discourage siting of tank farms on the coast.

Policy (31) Accomodate new base load LNG facilities or additional LNG deliveries where and when the risks to public safety and the environment are minimized.

Policy (32) Consider siting of electric generating facilities in non-coastal areas.

Policy (33) Evaluate refinery and deepwater ports and sites to ensure that proposed facilities and sites will cause minimum harm to the coastal environment. Ensure that facilities make use of technology that minimizes public health and safety risks.

THE SITUATION

Behind Massachusetts CZM's proposed policies are people--residents of the Commonwealth with varying needs, demands, and concerns tied to the coastal zone. In developing proposed policies, these are the kinds of concerns CZM addressed:

A Northshore fisherman: "I've fished out of Gloucester for 23 years and I know the commercial fishing industry is in trouble. Our ships are old, our children don't want to become fishermen. Many of our harbor facilities need to be repaired and expanded. We can't compete with the foreign fleet off-shore on Georges Bank. And now they're talking about off-shore oil development in our prime fishing area - Georges Bank! We need help. What can be done to help fishermen?"

A Boston area resident: "Sure I like the beach. My whole family likes to lie on the sand and to swim. But if I don't want to go to an MDC Beach in Boston, where can I go? A hundred miles to the Cape Cod National Seashore? 50 miles to Crane's Beach? I can't go to any other beaches -- they're mostly private or for town use only. I'd like to see more beaches open to everyone. What is CZM doing to solve this dilemma?"

A Southshore home builder and developer: "I think there has to be a change in the way towns and the state treat developers. You can't imagine how hard it is to put up a subdivision these days what with all the waiting periods, reports, permits, different forms... everybody wants something else. My carpenters and electricians want to work. What can you do to cut through all the red tape?"

A Southeastern Mass. planning board member: "I want my town to be a prosperous and growing community. But I want the town to be attractive too. It's hard making decisions sometimes when we don't have the exact expertise. It would be helpful to call upon a resource person like a lawyer, a planner, or a marine biologist - but the town just can't afford that. The state may have funds or people available, but can we trust the state? Can CZM help here?"

A Cape Cod conservationist: "I'm a member of the Association for the Preservation of Cape Cod (APCC), and several other civic groups. I don't want development to overrun Cape Cod. Most of us moved on to Cape Cod to get away from crowds, long lines, and traffic. We want to see Cape Cod preserved as a special part of Massachusetts, a rural open place. There's precious little room for large scale development here. Will CZM help us to preserve Cape Cod?"

A Worcester resident: "I don't live along the coast and that makes me a second class citizen when I want to go swimming, boating, or fishing along the ocean. I've been turned away or locked out of

beaches and launching areas. I've just about stopped going to the beach for the day - unhappily. Is it possible for CZM to help non-coastal residents too?"

Each of these citizens' examples have one thing in common -- they have a need or series of needs tied to coastal resources. The Massachusetts coast is a place for people - carpenters, sailors, sport and commercial fishermen, office workers, longshoremen, factory workers, business people, store owners, home owners -- and very often a place of conflict when the needs of different interests meet one another in an area of finite resources. Disputes arise: build vs. conserve, local vs. state control, private vs. public beach access, accept vs. reject onshore facilities tied to offshore oil development, protect vs. develop critical coastal ecosystems.

The Massachusetts coast supports commerce, transportation, industry, recreation, housing, tourism and energy facilities. The Massachusetts coast is rich in history and tradition and still serves as a preserve of open space, a place to contemplate the past, observe the present, and dream about the future. However, uses and values conflict in the coastal zone. Quite often differing activities demand the same resources, the same scarce or fragile piece of land and water. It is impossible to meet the needs of all of the conflicting demands for uses and activities along the coast in a finite resource area. The policies and proposals in this document attempt to resolve conflicts where possible, and to establish values and priorities for coastal areas and resources to help mitigate conflicts in the future.

THE MASSACHUSETTS COAST

The Massachusetts coast winds and meanders over an incredible 1,200 miles of rocky shore, sand beach, productive estuaries, fragile salt marshes, massive urban harbors, smaller town harbors and marinas, wide open spaces, tidal flats, and dozens of islands. It is one of the longest state coasts in the country - longer even than that of California.

For over 350 years, the Massachusetts coast has offered protective shelter, natural ports, and a means of commercial livelihood for generations of Americans new and old. Much of the history and evolution of the United States eminates from Massachusetts' ports of call -- Newburyport, Ipswich, Salem, Boston, Plymouth, Provincetown, New Bedford, Fair Haven, Fall River, Edgartown, and Nantucket.

Massachusetts' coastal traditions and values live on. Many of our people still live by the sea, work by the sea, and recreate by the sea. Some 40% of the state's population lives in Massachusetts' 87 coastal communities, an area representing less than a quarter of the land mass of the Commonwealth. More than half of all current development in the state occurs in the coastal zone. Many suburban and rural

coastal communities have experienced two-fold, three-fold, and in some cases four-fold increases in population over the past ten years. This is especially true for the south shore suburban communities and some of the towns on Cape Cod. Simultaneously, the former nerve centers of Massachusetts' life, our urban ports, have experienced declining populations and revenues. Boston, Salem, New Bedford and Fall River fall into this category.

The coast often supports facilities and industries important to the economy of the entire state. Three-fourths of all energy supplies enter Massachusetts through an urban port. 80% of all electric power generating plants in the state are located along the coast. Tourism is a $1.2 billion industry in Massachusetts. More than half of this income is generated through tourism in coastal areas. Commercial fishing, including fresh and frozen fish processing, and supporting transportation and marketing services, is a multi-million dollar industry.

Much of the growth and development in the Commonwealth since World War II has been unplanned and uncoordinated. The implications of this process are just beginning to surface.

Over the 20 year period, 1951-1971, 39% of the crop land and 26% of the pasture land in a coastal strip about a half mile wide, has been lost to other uses. The amount of land used for housing, commerce, and industry has increased 34%. Land consumed by transportation facilities has increased by 27%.

The long term implications of this growth pattern have come to haunt many coastal communities. For example:

--Boston's handsome urban waterfront was forgotten when the central artery cut the harbor off from the city in the mid 1950's.

--Many suburban coastal communities have found themselves in the seemingly endless cycle of accommodating new housing development, which in turn created new demands on municipal services such as schools, fire protection, police, water, sewer services, road maintenance, etc. Developments were often poorly planned, and valuable open space lost. To pay for new municipal services communities increased property tax rates and encouraged more new housing development. New development continues the cycle.

--Valuable wetlands were filled, shellfish flats polluted, and critical coastal areas lost; homes were built in hazardous flood prone and erosion prone areas along the coast, such as on barrier beaches.

--Many Massachusetts communities began to feel the impacts from developments in neighboring communities. Regional problems took on new importance.

Solutions to issues and problems of erosion, flooding, dredging, sewage treatment, protection of critical environmental areas and resources, transportation, economic development, port redevelopment, harbor management, marine development, air and water quality planning, improved recreation facilities and access, energy facilities siting, and large scale housing or industrial developments -- all call for a broader perspective, a regional or state perspective as opposed to a purely local perspective. The Massachusetts Office of Coastal Zone Management in the Executive Office of Environmental Affairs attempts to provide a regional or state wide perspective on issues and problems that transcend town boundaries. Massachusetts CZM will not interfere with traditional decision making important only to a single locale.

NATIONAL COASTAL ETHIC

More than half of the nation's population lives in the counties bordering the oceans and the Great Lakes. The 31 coastal and Great Lakes states contain more than 75% of the U.S. population. Commerce, jobs, recreation, climate, and a coastal aesthetic are among the reasons coastal areas are such people magnets. Large population aggregations often create additional problems.

Three national studies conducted during the mid 1960's-1970's (The National Pollution Study, 1969; The National Estuary Study, 1970; and Our Nation and the Sea, a report from the Federal Commission on Marine Science, Engineering and Resources) convinced Congress that coastal areas were in immediate danger and need. Pressures from population growth, water pollution, and large scale unplanned development were wreaking havoc on ecosystems and resources important for the natural protection of the coast, for maintaining future water quality and supplies, and essential for protecting productive ecosystems as a part of the ocean food chain. Our Nation and the Sea had stated, "The key to more effective use of our coastline is the introduction of a management system permitting conscious and informed choices among developed alternatives...for this productive region in order to ensure both its enjoyment and sound utilization."

In 1972, Congress passed the Coastal Zone Management Act (CZMA), which offered coastal states an opportunity to develop comprehensive land and water use management programs. All but one of the 34 states and territories eligible for the voluntary CZM program have requested CZM program assistance.

The language of the Coastal Zone Management Act is quite explicit. Congress declared it to be the national policy, "To preserve, protect, develop, and when possible to restore or enhance the resources of the nation's coastal zone for this and succeeding generations..." Ultimately, Congress passed CZM legislation to help states develop and implement "management programs to achieve wise use of land and water

resources of the coastal zone giving full consideration to ecological, cultural, historic and aesthetic values as well as to needs for economic development."

Like all coastal states, Massachusetts was allowed three years of funding to develop a CZM plan. Once a plan is reviewed by local citizens and officials, members of the legislature, and state and federal agencies, it is submitted by the Governor to the Secretary of the U.S. Department of Commerce for approval. Massachusetts will then receive large annual federal grants to implement the plan.

Congress was more concerned with the "process" devised by each state in developing management programs rather than with any specific land or water use decision. States must address six planning themes in preparing management programs. They include:

- an identification of the boundary of the coastal zone - how far inland and seaward does the area to be managed extend.

- a definition of land and water uses within the coastal zone which have a direct and significant impact on coastal waters.

- an identification of the means by which the state proposes to control those land and water uses having a direct and significant impact on coastal waters.

- an inventory and designation of critical areas within the coastal zone requiring special management for development or conservation.

- establishing priorities for uses in particular areas, including specifically those uses of lowest priority.

- a description of the organizational structure proposed to implement the management program including the responsibilities and interrelationships of local, regional, and state agencies in the management process.

While these six themes do not appear as chapter headings in this Program Preview, they serve as the underlying basis for the organization and content of the document.

MASSACHUSETTS COASTAL ETHIC

Massachusetts has a tradition of looking forward and of thinking about future programs, policies, and directions. The Commonwealth was first in the nation to pass legislation to protect irreplaceable coastal and inland wetlands. The establishment of local conservation commissions served as a model for the rest of the nation. The state was

first in establishing a series of town forests. Our rich and varied past supports this quality of thinking. One goal of the Massachusetts CZM Program is to establish a broad vision for the future of our coastal areas "for this and succeeding generations."

Rather than support past patterns of unplanned growth and development, many of the policies prepared in this Preview attempt to prescribe a vision of the Massachusetts coastline 20, 40, and 60 years from now. Proposed CZM policies have evolved from new information and insight, and new understandings on the part of citizens, local officials, scientists, and CZM planners. The overriding goal of CZM's proposed policies is to maximize coastal use, activities and development for the greatest number of people in the Commonwealth.

The coastal zone is a finite resource. Except for accretion and erosion, the size of our coastline remains relatively stable. Land use economics suggest that at some point the finite resources of the coast will become unaffordable to any but the very wealthy. Seventy years ago, beach land on Cape Cod sold for $7.00 an acre. Today, the same acre of ocean front land can cost $1 - 1.5 million. Land values will only increase. One part of the future vision of the Massachusetts coastline calls for a more accessible, more usable coastline by larger numbers of people. Increasing casual and active recreational opportunities can benefit large numbers of citizens.

Certain coastal resources must be conserved if they are to be reused in the future. Sport and commercial fishing, and recreation fit this category. Conserving those resources of the coastal zone important for maintaining water quality and supply is another example. The CZM vision for the coastal zone seeks to allocate wide use and development of the coast while recognizing the needs for replenishment of renewable resources.

Economic development of the Massachusetts coastline of the future is a must. However, the ways and means of development and expansion should recognize the aesthetic aspects of coastal areas, the natural systems of the coastal zone, and the need to replenish the living and non-living resources of the coastal zone.

The coastline of the future can be a place where uses and activities mix and support one another. Revitalizing urban port areas and providing for visual and physical access can make for a thrilling urban coastal experience. Watching a 50,000 ton ship pull into port, fishing from a harbor pier, or waiting for the fishing fleet to return from Georges Bank are exciting public events.

CITIZEN VALUES

Many of the values, priorities and policies in this Preview were developed with the help of hundreds of citizens. The Governor's Task Force on Coastal Resources, a group of 41 volunteers representing the Legislature, all levels of government, and major user groups in the coastal zone, served as CZM's Board of Advisors. A series of Citizen Advisory Committees representing coastal communities worked month by month to insure that CZM policies meet the needs of sub-areas of the coast. CZM conducted a statistically valid public opinion survey of 1000 randomly selected coastal residents to further ascertain the needs and desires of coastal citizens. Finally, CZM staff members have met with over 2000 citizens and officials in several series of public meetings.

GOVERNOR'S TASK FORCE

The Governor's Task Force established a series of goals which served to guide Task Force activities and the long term CZM planning effort. Many of the ideas in this Program Preview developed from these goals and from CZM work products directed by the Task Force. These goals are:

--to develop a coastal zone management program which builds upon the Commonwealth's strong tradition of local government, but which also allows the state to make decisions on matters with far-reaching impacts on the coastal zone, or on the state as a whole.

--to encourage commercial, industrial, port, and energy facility developments which are required to meet the Commonwealth's social and economic needs, and to locate such development in the areas which can best absorb those activities without damaging the coastal environment or conflicting with neighboring activities.

--to improve public access to coastal land and waters which are important for recreation and leisure activity, and to provide better opportunities for those people now restricted or prevented from enjoying the recreational use of coastal lands and waters.

--to protect coastal land, water, and living resources of major significance from pollution and over-use, and to preserve from development areas of natural productivity and areas prone to damage from floods and hurricanes.

--to protect and preserve areas of valued coastal scenic character, especially those areas providing clear unobstructed views of coastal lands and waters.

--to encourage economic revitalization of urban coastal waterfronts through siting of facilities, redeveloping and restoring ports,

and improving physical and visual access to urban waterfronts.

--to protect coastal water supply, coastal water quality, and coastal air quality as plans evolve for future growth and development.

--to insure a program that meets local needs by placing emphasis on citizen and community participation in the evolution of a CZM plan and management system.

--to begin to plan for the potential on-shore and near-shore aspects of Outer Continental Shelf (OCS) oil and gas development as a part of the Commonwealth's CZM program (though not yet a part of the CZM Preview).

--to encourage orderly growth in developing areas, and to encourage revitalization and new growth in urban areas with growth potential.

--to develop a management system sensitive to the Commonwealth's fragile natural resources, and recognizing future economic, social, environmental, aesthetic, and historic needs. The management system should provide for a careful review of developments of regional importance, and provide mechanisms to guide future growth and development.

These goals are consistent with the long term growth policies established by individual local growth policy committees, the Legislature through the Wetmore Commission, and the Commonwealth's long term growth and development needs established by Governor Michael S. Dukakis.

Each of these groups seek economic revitalization for the Commonwealth. However, they recognize the need to develop around existing institutional infrastructures such as energy and transportation facilities. They understand the need to slow urban and suburban sprawl and the concommitant need to protect remaining farm and pasture land from development. A consensus to develop future recreational opportunities close to population centers has developed. Overall, the benefits of planned economic development have been accepted by the Commonwealth. The Task Force's goals respond to this trend.

CZM SURVEY

Task Force goals parallel many citizen goals as established through the CZM public opinion survey. The survey supports the notion of a special Massachusetts Coastal Ethic.

CZM was told in its public opinion survey that people who live in the coastal zone enjoy where they live. Massachusetts' traditional seafaring character is an important factor in their enjoyment of the Massachusetts coast. Eighty-three percent of the people surveyed

expressed "character" to be a very important or somewhat important part of their enjoyment of the coast. This parallels the Task Force's goals of protecting and preserving areas of valued coastal character.

Citizens who live in the coastal zone are generally optimistic about their area. Thirty-five percent of those sampled said their area will "improve" (assumed to mean quality of life and economic well being) over the next five years, while 32% thought their area would remain the same.

Citizens expressed concern over natural problems like erosion and occasional flooding. Many more have concern over the siting of major industrial developments like power plants, refineries, and other energy related facilities. Consistent with the Task Force's goals, the great majority of people look to a combination of state and local authority to deal with the siting of major developments, and the resolution of some problems caused by natural forces.

When asked to order four potential coastal uses, citizens chose open space/conservation first, recreational facilities second, housing third, and industrial/commercial activities fourth.

The pattern held true when we asked how federal financial resources should be allocated in dealing with coastal issues. In the rank ordering, improved water quality came up first, beach and recreational improvements second, housing development third, and attracting commerce and industry fourth. Task Force goals on improving recreational facilities, maintaining coastal character, and maintaining coastal water quality, are supported by these survey results.

When choosing among six industrial/commercial uses, commercial fishing and fish processing, small shops and restaurants, and tourist accommodations, were chosen above electric power plants, heavy manufacturing and shopping centers.

Housing is a desired coastal use, but so is improved access to the shoreline for active and passive recreation. Citizens were generally in favor of opening up the entire shoreline between high and low tide to public use. Some 49% felt that "lateral rights of access" should exist, while some 30% were opposed to the idea. This response supports the Task Force's notion of improving access.

A majority of residents went to the beach last year (76%), and more than half went boating at least once.

Overall, the survey results support a future coastal image where people have opportunities for passive and active recreational pursuits, where the quality of life is high, where traditional values and activities can exist, and where, with careful planning and forethought, future growth and development can be accommodated.

CITIZEN ADVISORY COMMITTEES

CZM established a series of Citizen Advisory Committees (CAC) to meet the need of having an on-going, regular group of local-regional participants to evaluate, guide, and at times prepare parts of the CZM Preview. The CAC's served as a final check on the values and perspectives underlying Massachusetts CZM. The CAC's meet monthly on a regular basis and have a major role in the value and priority setting evidenced in the regional chapter of this plan which is now under preparation. CAC membership consists of an appointee of the mayor or board of selectmen, as well as representatives of the major user-interest groups in the area.

The seven Advisory Committees verified and updated maps and other planning documents, helped in setting local priorities and needs, and are helping to apply broad policies to regional areas. CAC members are responsible for making sure CZM meets the needs of their region of the coast.

PAST PLANNING AND COASTAL ZONE MANAGEMENT

The CZM staff was determined to draw upon all existing resources in its planning and participation activities. Early in the program's development, CZM staff planners visited and collected reports and documents pertinent to coastal zone management fron individual town halls, regional planning agencies, universities, state agencies, interstate agencies, and federal agencies. Much time was spent synthesizing and correlating this information. The process enabled CZM to view issues comprehensively, to know what information existed, and to know what information and data would have to be collected.

One of the most important of these resources proved to be the New England River Basins Commission's-Southeastern New England Study (SENE). SENE had established recommendations for growth and development for much of Southeastern Massachusetts and Rhode Island in a 3-1/2 year planning program. The SENE project had included wide public involvement and served as an introductory guide to citizen and community desires. Some 50% of Massachusetts CZM's initial planning data came from SENE, saving the Commonwealth much time and expense.

After reviewing the SENE Study, the Task Force directed the CZM staff to study past development trends, alternative means of guiding growth and development, and to evaluate the efficacy of using existing state and local laws to deal with problems and issues in coastal areas. The Task Force was interested in maximizing public investments, protecting fragile resources, preserving the coastal feel and tradition important to residents and tourists alike, and ways to make developmental opportunities more efficient and assured.

MANAGEMENT

After careful analysis, CZM has concluded that state and local governments have the basic administrative, legal, and institutional means available to do much of what is necessary to apply CZM policies and to manage future growth and development. Recognizing that Massachusetts has both strong state government and strong local government, what is needed is a new era of mutual support and cooperation between these two levels of government, and the development community which has had such a large say in the siting, scale and density of developments.

The SENE Study had stated "Municipalities should continue to make the bulk of land use decisions because they are of local significance. For these development decisions which because of their size or effect on certain critical resources will affect more than one community, a regional or state perspective will be needed." CZM agrees with this conclusion.

Under CZM, the state will play a more effective "resource role" to communities providing information, technical assistance, and specialized personnel when needed, on the local level. The state's role vis-à-vis certain developments of regional impact, including energy facilities, solid waste and sewage treatment plants, and new transportation systems, is clarified in this plan. With additional funding from CZM, communities can expect improved administration of existing state laws.

The Department of Environmental Quality Engineering has undergone an internal reorganization which will help CZM to reach many of its goals. Some regulatory laws will be administered on a regional basis, allowing state laws to better meet regional and local needs. A comprehensive permit tracking program will help to keep the state to a known time schedule. A comprehensive permit application form will simplify permit application procedures. Overall, these changes will help to streamline and unify the Commonwealth's environmental regulatory programs, and to reduce the amount of time necessary to receive state environmental decision on projects. This will all be accomplished without any loss in the depth or quality of state analysis in permit approvals.

State funded resource personnel will be available upon request to assist local units of government to respond quickly, reasonably, and in a more informed manner to local permit approvals. If desired, CZM will prepare a series of model land use by-laws which communities may choose to adopt to improve conditions in the locale.

Each of these improvements require a new era of cooperation between local government and state government. It is only through this

symbiotic relationship that government can effectively guide growth and development into those areas able to sustain development, and to protect and conserve critical environmental resources.

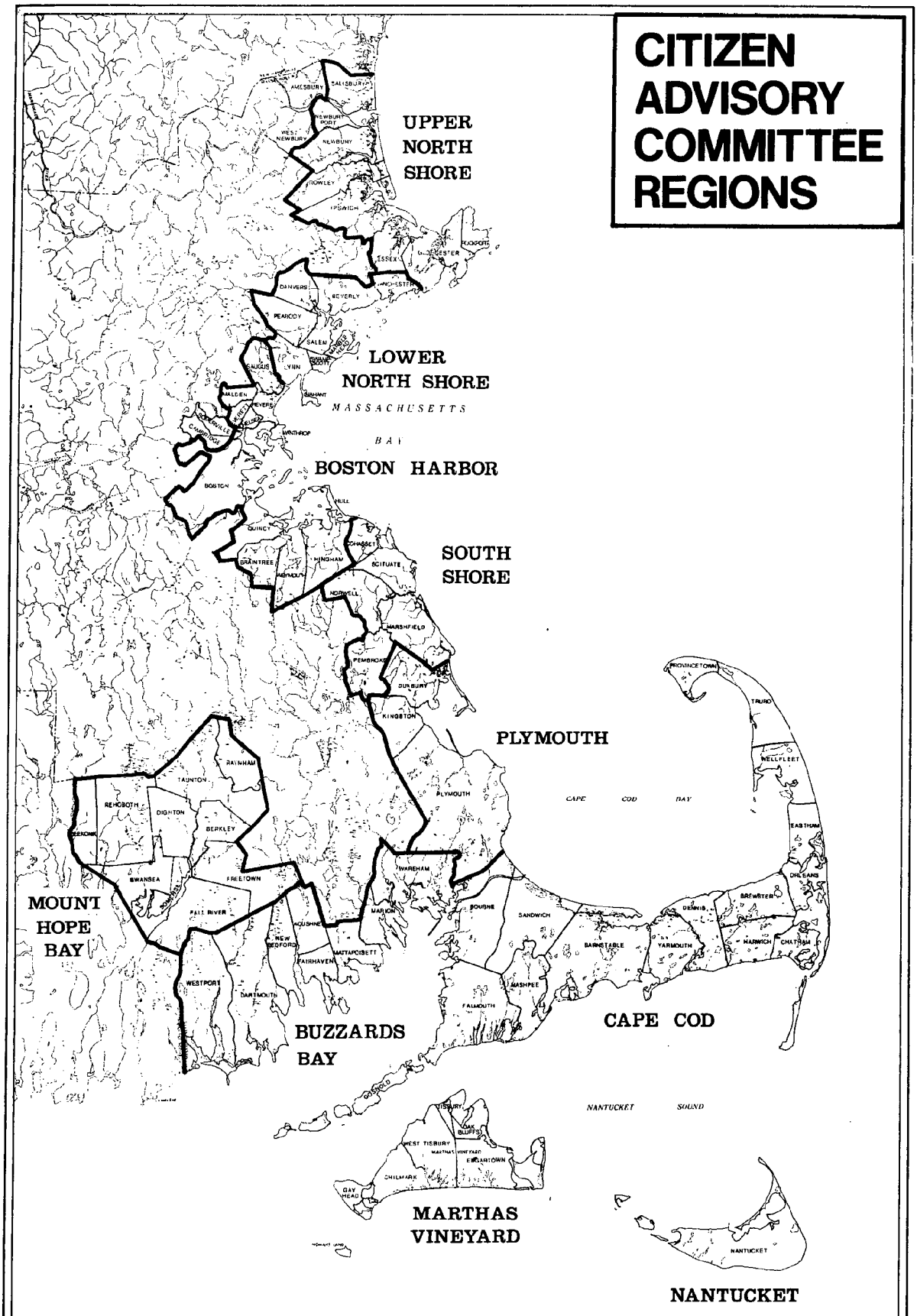
THE PROGRAM PREVIEW

Each chapter of this draft Massachusetts Coastal Zone Management Plan has a distinct purpose. Chapter II contains a series of long term state coastal policies on the marine environment, coastal hazards, visual access and quality, ports and harbors, recreation and physical access, and on energy related uses of the coastal zone. These statements of state policy will guide state programs and activities in coastal areas. Under the federal CZM Act of 1972, federal activities must be brought into compliance with these policies as well. This plan allows the state to have expanded influence over federal activities in the state's coastal zone. A summary of the policies and implementation measures for each section of Chapter II concludes the unit.

Chapter III of the plan is on Management, and includes an in-depth analysis of Coastal Zone Management under existing institutional and administrative structures. This Chapter deals with the central issue of how to implement broad coastal policies in moving from planning to action.

The policies in Chapter II are broad, and not applied to specific geographic areas. Overall coastal policies will be applied specifically to ten regions of the coast in Chapter IV. The regions include: Cape Ann-Ipswich Bay; Lower North Shore; Greater Boston Harbor; South Shore; Plymouth-Kingston-Duxbury; Buzzards Bay; Mt. Hope Bay; Cape Cod; Martha's Vineyard; and Nantucket. This part of the plan will be site specific in the application of policies, and will represent the combined efforts of Citizen Advisory Committee members. CAC's will lead the task of completing respective regional sections of Chapter IV. The CAC's have already done a substantial amount of work in establishing use and activity priorities for their communities.

Leaving much of the substance of the regional chapters incomplete places a special responsibility on you, the reader. As you read the chapter on state policies and concerns, think about how the policies might apply to your area. Then, join with your CAC to make sure that the final CZM plan meets the overall needs of your community. A list of CAC contacts is located on the reverse side of the map.


CITIZEN ADVISORY COMMITTEE REGIONS
UPPER NORTH SHORE
LOWER NORTH SHORE
BOSTON HARBOR
SOUTH SHORE
PLYMOUTH
MOUNT HOPE BAY
BUZZARDS BAY
CAPE COD
MARTHAS VINEYARD
NANTUCKET
MASSACHUSETTS BAY
CAPE COD BAY
NANTUCKET SOUND
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
COASTAL ZONE MANAGEMENT PROGRAM

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2

COASTAL POLICIES

INTRODUCTION

This Chapter is divided into seven separate sections. The first describes the coastal zone boundary. The other six present the proposed long-term coastal policies relating to the marine environment, coastal hazards, the visual environment, ports and harbors, recreation, and energy. These policies are to apply to the area within the Massachusetts coastal zone boundary.

Each of the policy sections opens with a concise summary of findings and coastal zone management concerns. These are followed by a discussion of problems, needs, and opportunities, which are then reflected in a listing of CZM objectives for each program element. Each section concludes with a set of proposed policies and recommendations and a description of the means by which these policies are to be implemented.

MASSACHUSETTS COASTAL ZONE BOUNDARY

A basic first step in the development of any management plan is the identification of the boundaries of the land and water areas that a) must be studied to develop effective management policies and b) will be affected by implementation of the plan. In most cases, these two types of areas will coincide, thus defining the overall boundary of the land and water resource study area.

Definition of the coastal zone boundary with which this management plan is concerned requires consideration of the complex interrelationships between natural components of the coastal zone system and between these components and the human activities which use and affect them. For example, waves and currents sculpt the barrier beaches, bluffs, embayments, and rocky shores that characterize our coast, linking them together through the transport of sediment material offshore. The tides support development of salt marshes, and distribute decomposed salt marsh grasses, called detritus, to coastal waters which in turn supports the primary species of the complex marine food chain upon which species harvested by man depend. Fresh water flows over the land into estuaries and salt ponds creating brackish habitats for the many fish and waterfowl harvested by sportsmen. Many of these same coastal embayments serve as vital transfer nodes between land and sea transportation systems, facilitating the import of energy supplies and raw material for Massachusetts industries outside the coastal zone. Other embayments serve as commercial fishing ports or as quiet harbors for recreational boaters. Beaches provide coastal zone residents with unmatched recreation opportunities and provide the stimulus for bringing in tourists from other parts of the Commonwealth.

In developing a definition of the boundary or boundaries within which these relationships can be adequately studied, CZM has drawn heavily on existing federal and state legal interpretations. The Coastal Zone Management Act defines the coastal zone as "the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder) (that are) strongly influenced by each other...and includes transitional and intertidal areas, salt marshes, wetlands, and beaches. The zone extends..seaward to the outer limits of the United States territorial sea. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on coastal waters." With this definition as a starting point, CZM is using a two tier approach to define the coastal zone with which it is concerned. The first tier of the coastal zone delineates all land extending from the three mile territorial sea boundary to the landward side of coastal wetlands. These coastal wetlands are defined by the Coastal Wetlands Restriction Act (Massachusetts G.L. Chapter 130, Section 105) as any "bank, marsh, swamp, meadow, flat, or other low land subject to tidal action or coastal storm flowage."

The second tier is less easily identified. The Coastal Zone Management Act stiplates that management should cover areas inland from the shoreline that are "necessary to control shorelands, the uses of which have a direct and significant impact on coastal waters." Existing Massachusetts law acknowledges the importance of some of these inland areas. The Wetlands Protection Act (Massachusetts G.L. Chapter 131, Section 40) includes within its jurisdiction "any bank..., wetland, beach, dune, flat, marsh, bordering on the ocean..." Regulations issued by the Commissioner of Environmental Quality Engineering under this Act define "bordering" as including the land 100 feet horizontally landward from the water elevation of the 100 year storm, or, if greater, 100 feet horizontally landward from the bank of any beach, dune, flat, marsh, meadow, or swamp. The Wetlands Restriction Act (MGLA, Chapter 130, Section 105) includes within its jurisdiction "such contiguous land as the Commissioner reasonably deems necessary to affect by any such order" carrying out the purposes of the Act.

The second tier should also encompass the inland portions of harbors. Maritime shipping and other harbor related uses can have a direct and significant impact on coastal waters because of the dredging, bulkheading, and land transportation development they require and because of the run-off from paved surfaces around them. The inland zone necessary to manage such activities effectively, generally speaking, is the area between waterfront transportation access routes and navigable channels. In adddition, to manage beach recreation the second tier should include the shore roads providing access to beaches. Finally, areas of scenic character or coastal vistas can be marred by unsuitable development or by structures blocking views of the coast. The second tier boundary therefore must also include the inland limit from which views of the coastline are possible.

Additionally, many citizen advisory groups participating in the development of the Massachusetts Coastal Zone Management Program have expressed a desire that the final coastal zone boundary be broad enough to include areas that might be impacted by major developments. Not all citizen advisory groups have had a full chance to define for their region the inland extent of these concerns. Since the Massachusetts Coastal Zone Management Program seeks major public input to help define this aspect of the boundary, the final determination of the boundary has not yet been made. However, once decided upon, the boundary should be clearly identifiable, and would encompass wetlands, uplands contiguous to coastal wetlands, inland sites within ports, major development areas and such other inland areas as the participation process deems significant to include.

Within both the first and second tiers, specific areas that contain important natural and man-made features have also been identified. These areas, which have been mentioned above, include different marine environments, potentially hazardous areas, recreation sites, scenic areas, developed commercial and industrial lands, and productive land and waters. Because of their role in the coastal environment all of the above sites are often referred to as critical areas. In order to clarify their significance, the CZM plan has created three levels of critical areas: Significant Resource Areas, Areas for Preservation and Restoration, and Special Assistance Areas.

Significant Resource Areas include the land and water areas mentioned above and have been broken down into general types for analysis and discussion purposes. They have been mapped and verified by the Citizen Advisory Committees and serve as the basic units to which the policy options expressed in later sections apply.

Areas for Preservation and Restoration are areas of greatest significance and represent only the most pristine natural Significant Resource Areas. These will also be designated as areas of critical environmental concern by the Secretary and will be subject to the strongest regulatory controls.

Special Assistance Areas are sites which warrant special planning and funding, primarily because of their development capabilities and their value as loci of coastally dependent activities. The purpose of identifying such areas is to ensure that public funds and programs will be used to promote wise use of coastal resources.

Each of these categories of areas are discussed in the following sections in terms of what makes them important and how they can best be managed. Policy options are generated for each category, but are not applied on a site specific basis until Chapter 4. In that chapter (now under preparation), maps, commentary, and specific management recommendations for areas with the regions of the Coastal Zone will be presented.

The Marine Environment

MARINE ENVIRONMENT

SUMMARY OF FINDINGS

The marine environment is one of the most valuable natural resources in Massachusetts. It provides a source of protein: finfish, shellfish, crustaceans, and algae. Unlike oil or coal, marine resources are renewable, provided stocks are well managed and habitats are not destroyed.

The port of New Bedford is one of the largest fresh fish ports on the east coast. Fish landed here is shipped west to market as far as the Mississippi. Massachusetts lobsters are air-freighted to California and to Europe. The southern waters of the state sustain the only commercial bay scallop fishery in New England.

The salt marsh complexes of our coast provide a nutrient source upon which the entire marine food chain depends. Estuaries, salt ponds and shallow coastal embayments also provide nutrients and energy for marine life. These water bodies are areas of high primary productivity - the conversion by plants of solar energy to chemical energy - and are valuable as spawning and nursery areas for finfish, shellfish, and crustaceans.

Migratory birds, particularly waterfowl and shorebirds, also are greatly dependent upon the salt marshes, tidal flats, and protected waters of Massachusetts for feeding and resting areas.

The salt marshes and barrier beaches of the state act as storm buffers for the land behind them. These same barrier beaches, along with sandy beaches are prime recreation areas. The coastal waters of the state are utilized not only for commercial fishing but for sport fishing, recreational boating, and swimming as well. All of these activities are dependent upon clean and productive waters; a degradation of water quality would restrict or lessen their availability and attractiveness for these activities - activities upon which many coastal communities rely for income and employment.

Man's activities can degrade or destroy the biological, buffering, and recreational qualities of the marine environment. If the fishery resources of the coast are to be maintained for the benefit of future generations, the coastal systems upon which they depend must be protected. Dredging and filling of salt marshes and tidal flats must continue to be halted or appropriately conditioned.

We must also guard against other adverse impacts on marine productivity: the chronic, sublethal effects upon marine organisms resulting from the discharge of hazardous substances into coastal waters, the stress of overloading semi-enclosed water bodies with nutrients from

municipal treatment facilities, and in estuaries in particular, the disruption of natural cycling and energy transport patterns through physical interference with natural water movements. Positive steps toward conditioning these activities will also serve to preserve and enhance the quality of our coastal waters upon which so much recreational activity depends.

If habitat for waterfowl and shorebirds is to be preserved and if the recreational and scenic attributes of the coast are to be kept for future generations, restriction of activities in barrier beach systems and other coastal environments will be necessary. If left intact, these environments will naturally protect existing inland areas.

Positive, more active steps must be taken to enhance the production of finfish, shellfish, crustaceans, and algae. Restoration of anadromous fish runs, promotion of aquaculture, and improved shellfish management can increase the benefits accrued by man from the marine environment.

COASTAL ENVIRONMENTS, THEIR VALUE AND IMPORTANCE

In the following section, the various marine environments comprising the Massachusetts coastal zone are discussed in terms of their ecological significance. These environments are: salt marshes, barrier beaches, estuaries, salt ponds/coastal embayments, open coastal waters and rocky shores.

SALT MARSHES

The salt marsh may be divided into two major zones: the high and low marsh. The high marsh, flooded during high tides and storms, is dominated by salt tolerant grasses, primarily salt meadow cordgrass, Spartina patens. Most of the organisms found in the high marsh belong to terrestrial groups such as fiddler crabs, insects, spiders, small mammals, and many birds which use it for nesting sites.

The high marsh acts as a landward buffer for the low marsh. Fresh water drainage from uplands is slowed by the more inland vegetation and absorbed by the sediment layers of the upland-high marsh border. This aids in retaining the saline influence necessary to the maintenance of the more seaward portion of the salt marsh.

The low marsh, flooded at each tide, is dominated by salt marsh cordgrass, Spartina alterniflora, and macroalgae such as rockweed, Fucus spp. It is the low marsh which contributes the greatest amount of organic matter to coastal waters. In association with S. alterniflora are the micro- and macro- scopic algae which live on the marsh bottom, and around the stems of the plants and which contribute to marsh productivity.

The organisms associated with the low marsh are primarily marine. They include polychaete worms, the filter feeding mussel, Modiolus demissus, an important phosphate cycler, and snails. Carnivorous fish and crabs enter the low marsh to feed at high tide, whereas birds and rodents are predators when the tide recedes.

The salt marsh system acts as a physical buffer. The network of roots and rhizomes binds large amounts of sediment together forming a hardened peat layer with successive years of growth. This peat layer is resistant to erosion and helps to dissipate storm wave energy, that would otherwise strike low lying developed areas. (see Coastal hazards section)

Salt marshes play a vital role in the production of organic matter and nutrients and their release into estuaries and coastal waters. In terms of organic output into other ecological systems, salt marshes are among the most productive in the world. Salt marshes produce 30-50 tons of organic matter/hectare/year as compared to annual agricultural plants which may produce 20-30 tons of organic matter/hectare/year.[1] It is in the role of organic exporters that salt marshes reach their greatest usefulness.[2] At least 45% of salt marsh production is removed by the tides. Therefore, maintenance of coastal shell-and finfisheries requires the protection of salt marshes.

The production of organic matter begins with light energy falling on the grasses of the open marsh. This energy, through photosynthesis, is converted to organic products. At summer's end stems and leaves of the marsh plants begin to die and break off. Incoming tides collect this material, called detritus, and carry it back and forth across the marsh. Eventually, the tides carry the detritus into estuaries and salt ponds, and subsequently into coastal waters.

Throughout this transport, microbes break down the plant material into smaller and smaller particles. Marine organisms ingest the particles of detritus, digest the microbes, and egest the particles. Once back in the water, the particles are recolonized by microbes, and ingested again in a continuing recycling process until the detrital particles are completely decomposed. These detrital particles are food for deposit feeding organisms, which receive their nutrition from consuming the top sediment layers for detritus, microalgae, and bacteria. The deposit feeders are in turn food for bottom feeding fishes such as winter flounder, tomcod, weakfish, and cunner.[3]

Many species of economic importance depend upon this type of coastal environment during all or part of their life cycles. For example, adult winter flounder move into coves, bays, and estuaries from January to April for spawning. Larvae, hatched from egg clusters deposited on the bottom, are not very mobile, and tend to stay in the general spawning area where they are dependent on marsh related food sources such as copepods, larval marine forms, and detritus. As the juveniles increase in size, the range of food species increases to

molluscs, polychaetes, and euphausids which, like the lesser components of the food chain are dependent on the primary productivity of the marsh.

As winter flounder get larger, they move out of the spawning and nursery areas in the summer to nearshore waters or considerably offshore and return for spawning in the late fall. During this movement, they are available to species higher up in the food chain including man, himself.[4]

BARRIER BEACHES

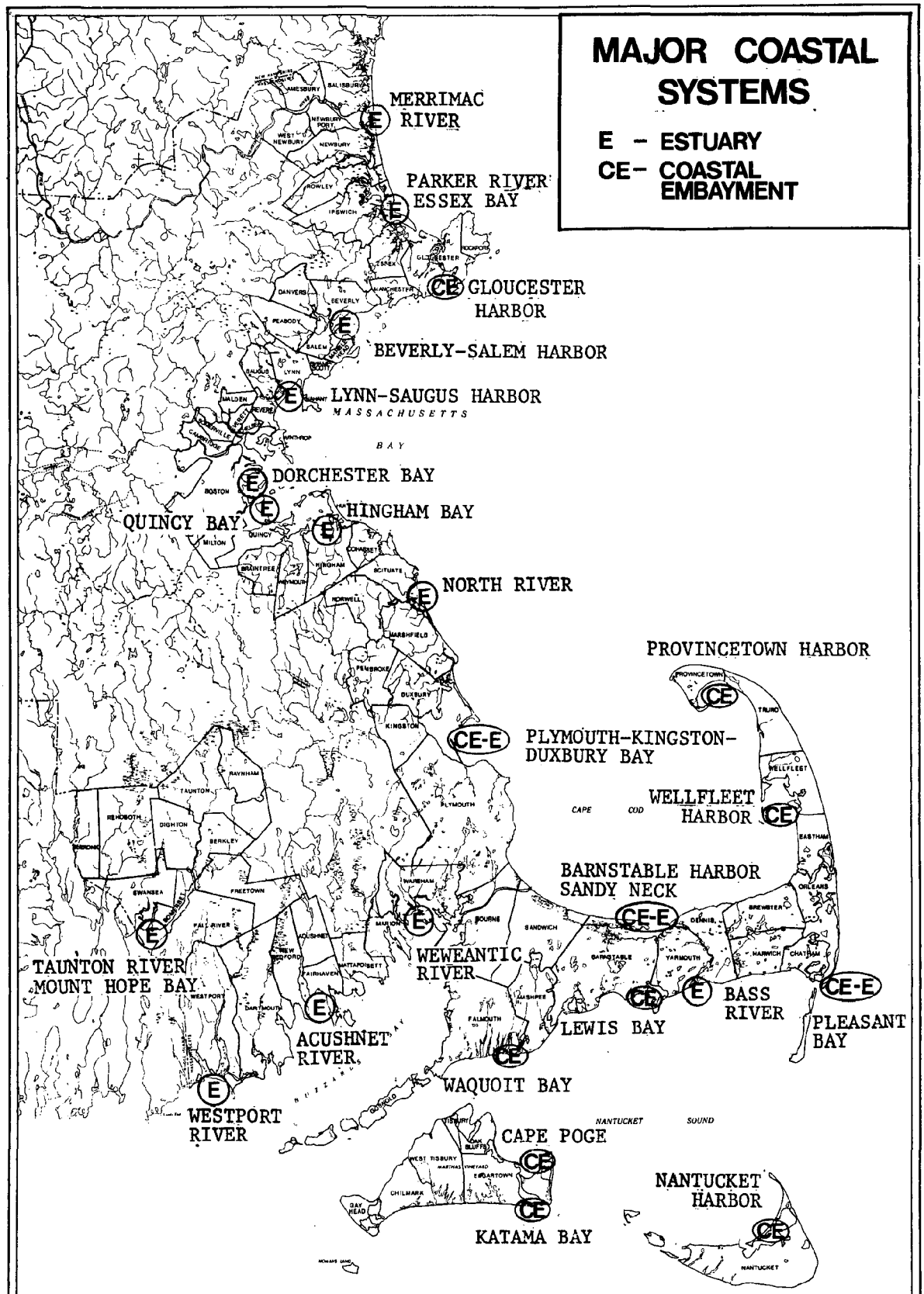
Barrier beaches are built by longshore transport of sand from up-current beaches. Lying between barrier beaches and the original shoreline are coastal embayments, estuary mouths, or salt ponds, and frequently associated with them are saltmarsh-tidal flat systems.

When unaltered by human activity and development, barrier beaches are among the most dynamic of coastal environments, constantly being reshaped by wind and wave forces and the effects of the slowly rising sea level. Sand is brought to barrier beaches by the littoral drift (currents parallel to the shore), washed up on the beach face, and then transported via wind landward when dry. Beach grass traps the sand and stabilizes dunes formed by wind transport. Dune sand can be redistributed by wind or overwash (the overtopping of the dunes by sea water during storms) and may be deposited in backshore areas or contribute to marsh development. Inlets may also be periodically formed when storms breach the dunes. If unaltered by human activity, inlets may eventually be closed by sand deposited by the littoral current. Thus, the barrier beach systems may be constantly shifting in shape and size.

Barrier beaches act as seaward buffers for the semi-enclosed water bodies, marsh systems, and inland areas behind them, maintaining necessary levels of salt-fresh water mixing and the transport and deposition of bottom sediments. Barrier beach systems and the marsh-flat systems usually associated with them are also extremely important as nesting areas for terns, gulls and other species as well as migratory stopover sites and feeding areas for many shorebirds. These shorebirds feed along the exposed flats and among the marsh grasses protected by the barrier beach.[5]

ESTUARIES

An estuary is a semi-enclosed coastal body of water which has a free connection with the open sea and is thus strongly affected by tidal action. Within the estuary sea water is mixed and measurably diluted with fresh water. Estuarine systems may include other coastal environments such as salt marshes, mud flats, eelgrass beds and/or barrier beaches. The major estuaries in Massachusetts are shown on the accompanying map.



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Because of the shallowness of the water in estuaries, light penetrates throughout most of the water column and water temperatures are warmer than in deeper, more open coastal water. Land runoff from fresh water inflow and organic matter produced by salt marshes supply carbon, nitrogen, and phosphorous compounds essential to marine productivity.

Estuaries also provide physical environments which support a variety of habitats for all types of marine life. In general, most estuarine bottoms consist of discrete areas of clay-silt, clay-silt sand, and sand-rock substrate. These bottom types in combination with the availability of nutrients, the water velocity, and salinity regime, determine the distribution of organisms within the estuary. For each habitat, the organisms living there have developed strategies for survival.

The clay-silt bottom is located where weak currents exist, which allow for the settling of fine substrate particles and organic matter. The upper few centimeters of this bottom are easily moved as detritus and broken fragments of seaweeds are continuously deposited.[6] This deposition makes clay-silt bottoms high in organic content.

The clay-silt community is composed primarily of deposit feeders. Deposit feeders ingest particles of organic matter found in or on the sediment layers of the bottom. Since currents are low here, organic matter settles out, providing nutrition for a large number of deposit feeders. Some of the most common organisms of this community are the bivalves, Nucula proxima, the polychaete worm, Nephthys incisa, and a variety of other polychaetes and amphipods.

Eelgrass establishes itself where the water velocity is low enough to allow its root system to take hold and is usually associated with clay silt bottoms. Benthic vegetation such as eelgrass stabilizes sediments and reduces turbidity which would reduce light penetration. This stabilization of sediments by eelgrass aids in enhancing nutrient cycling within the estuary. Less turbid water allows for an oxygen-less (anaerobic) sediment layer in which microbial degradation of chemical compounds takes place. The end products of this degradation are made readily available for uptake by plants and other marine organisms. These chemical reactions, since they have taken place in anaerobic sediments, do not tax the dissolved oxygen concentration of the estuary, which at times can be limiting to biological activities.

Beds of eelgrass provide habitat for larval and juvenile fishes as well as a surface for shellfish spat attachment particularly for the bay scallop. Sessile organisms, such as, hydroids, may also attach to eelgrass stalks and gather food from surrounding water. Eelgrass plants die and decay each year, providing a vital source of organic matter for consumption by deposit feeders, and for transport throughout the estuarine system and into coastal waters.

Clay-silt bottoms when either exposed at low tide (intertidal) or still covered with water at low tide (subtidal) comprise a mudflat.

The most common inhabitants of mudflats are the soft shell clam, Mya arenaria, the clam worm, Neries spp., mud crabs and mud snails, and seaweeds including sea lettuce, Ulva lactuca, and enteromorpha, Enteromorpha intestinalis.

Substrates consisting predominately of clay rather than sand offer more surface area for binding by organic matter. Therefore, clay-silt bottoms act as chemical "sinks," concentrating nutrients or chemicals within the sediments.[7] Certain seaweeds inhabitating clay-silt substrates also may act as receptors for much of the chemical, or nutrient, load produced by salt marshes. Some scientists theorize that these seaweeds are stimulated to release nutrients on the incoming and outgoing tides.[8]

Clay-silt-sand substrates are located in areas which are influenced by faster moving water currents than clay-silt areas. The clay-silt-sand community is made up primarily of filter feeders, organisms which pump water through their systems and remove microscopic algae and organic matter. These organisms feed on food particles suspended in the faster moving water, while organisms inhabiting clay-silt areas are dependent on deposition of food particles. Some of the dominant organisms in this community include amphipods, quahaugs and razor clams, and polychaete worms.

The clay component of clay-silt-sand substrate is significantly less than in the clay-silt substrate. Therefore there is less nutrient adsorption; the substrate supports fewer organisms to rework the sediments and resuspend some of the sediment-bound nutrients.

Sand-rock substrates are found in areas where there is an active current of water, which keeps the area in a dynamic state. Sand-rock substrate is often times located at the mouths of estuaries and most commonly in front of a beach system. Since these areas are too unstable for many deposit feeders, most organisms found there are mobile: crabs, small shrimp, and conchs.

The abundance of benthic and pelagic life in shallow water bodies attracts many fish species, that spend all or part of their life cycle here. Fish such as sticklebacks, killifish, and silversides spend all of their lives in an estuary and are important food fish for other fishes. Winter flounder, weakfish, smelt, menhaden, and sand launce utilize estuaries as spawning and nursery grounds.

Bluefish and striped bass are attracted to the mouth of estuaries because of the abundance of menhaden. Anadromous fish species, such as alewives, blueback herring, and shad utilize estuaries in their run to fresh water spawning grounds, and the juveniles use the estuaries as nurseries during outmigration.

SALT PONDS

In Massachusetts, salt ponds are found generally on the southern

side of Cape Cod and Martha's Vineyard. They were once fresh water bodies, and are now characterized by brackish water and a barrier beach system. Salt ponds are shallow water bodies affording light penetration to the bottom throughout most of their area, supporting dense stands of eelgrass and high shellfish productivity. Fishes commonly associated with salt ponds include the hogchoker and the white perch. The American eel and the alewife are also common to salt ponds, the former spending a few years in the fresh water source during maturation, the latter using salt ponds in its run to fresh water spawning areas. Salt ponds are typically fringed by Spartina alterniflora, but rarely bordered by a more developed marsh system.

COASTAL EMBAYMENTS

Coastal embayments are characterized by a restricted opening to the ocean and often a barrier beach system. They are shallow, and some support healthy stands of eelgrass and populations of shellfish. Most coastal embayments have well developed salt marsh systems, and may or may not be associated with an estuary. (See preceding map.)

Productivity, nutrient cycling, and benthic communities of salt ponds and coastal embayments are similar enough to estuaries that the reader is referred to that discussion for further detail.

OPEN COASTAL WATERS

There are two major surface water circulation patterns which effect the coast of Massachusetts. The general and seasonal variation of water movement along the coast is influenced by a combination of factors: 1) amount of river run-off, and its modification of horizontal salinity gradients; 2) horizontal temperature gradient; 3) frictional drag of the wind; and 4) effect of Coriolis force on tidal motion in restricted waters.

Figure Numbers refer to accompanying map.

FIG. 1 - The first pattern is a counter clockwise water current (gyre) in the Gulf of Maine. In the winter this gyre flows southerly, along the eastern side of Cape Cod and into Great South Channel, which lies between Nantucket Shoals and Goerges Bank.
FIG. 2 - In the spring, this gyre encompasses all of the Gulf of Maine and circulates water from the Scotian Shelf and Brown's Bank.
FIG. 3 - During the summer, it flows northerly into the Bay of Fundy or westward from southern Maine, into Massachusetts Bay, and diverts either into Cape Cod Bay or easterly to Georges Bank.
FIG. 4 - By autumn the southern side of the gyre breaks into a drift across Georges Bank.

The second major surface water circulation pattern is a clockwise gyre originating on Georges Bank.
FIG. 5 - In the winter, this water current has a westerly flow across Great South Channel circulating water around Nantucket, the south side of Cape Cod, Martha's Vineyard, and into Buzzards Bay.

FIGURE:

1

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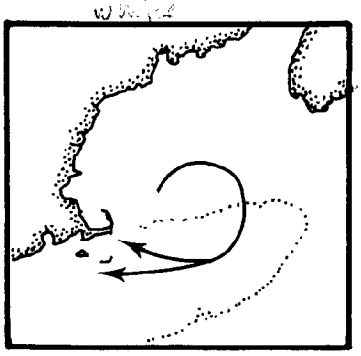
3

4



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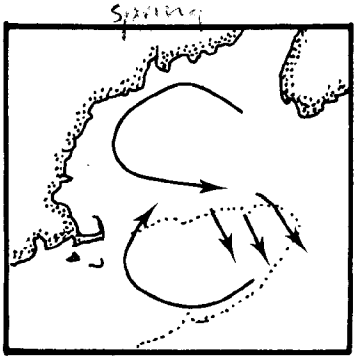

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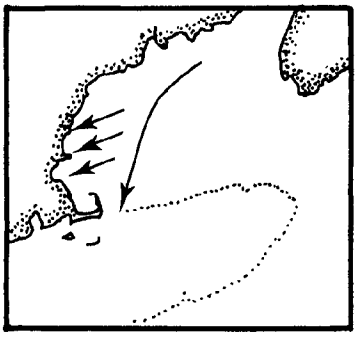

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10

FIG. 6 - By spring, the northerly side of this gyre converges with the Gulf of Maine gyre and flows south. In the summer, the eastern side veers southerly off shore.
FIG. 7 - By autumn the western side breaks down into a westerly and southerly drift. A bottom water circulation pattern tends to bring water back towards the shore, and may carry some sediments with it.
FIG. 8 - In the Gulf of Maine gyre, affecting Cape Ann-Ipswich Bay, Massachusetts Bay, and Cape Cod Bay, the bottom drift next to the coast tends to flow directly to shore. Further offshore, in deeper water (greater than 100 meters), the bottom drift tends to parallel the shore.
FIG. 9 - The eastern side of Cape Cod is influenced by the clockwise bottom drift of Georges Bank. There is a net drift to the west and across Great South Channel.
FIG. 10 - From Great South Channel to southern Rhode Island, there is a net bottom drift in a northwesterly direction. This influences Nantucket, Martha's Vineyard, the south side of Cape Cod, and Buzzards Bay.[9]

Water circulation patterns, temperature and salinity gradients, and bottom types help to determine the marine organisms living off the coast. Cape Ann-Ipswich Bay is typified by a mud bottom with scattered areas of sand. Certain areas within the Bay are spawning locations for haddock and red and white hake. Massachusetts Bay is characterized by a sand and sand-gravel bottom, and certain bottom areas are being considered for sand and gravel mining. Atlantic herring spawn in the Bay, and Stellwagen Bank is an important in-shore spawning site for haddock.

Cape Cod Bay has a center of mud, with sand along the Cape Cod rim, beyond the 60 foot curve. There are a few rocky areas and a large shoal on the eastern side, Billingsgate. Nantucket and Vineyard Sounds have sand bottoms and some shoal areas along the northeastern side of Martha's Vineyard and between Martha's Vineyard and Nantucket. Buzzard's Bay has a central strip of mud and sand, with rock along the northwestern and southeastern sides. Studies seem to indicate that Buzzard's Bay is an important area for lobster spawning and may contribute a large portion of larvae to Cape Cod Bay via the Canal. Fish such as weakfish, scup, and butterfish are caught in these waters.

The bottom along the eastern side of Cape Cod is sand and gravel, while the bottom south of Nantucket and Martha's Vineyard is sand with areas of mud. Extensive beds of ocean quahaugs and sea clams are common to this part of the Massachusetts coastline. There is a large shoal area between the two islands, as well as shoals off the southeastern end of Nantucket.

South of Cape Cod, Massachusetts waters are influenced by the warm water of the Gulf Stream; surface water temperatures reach 20C in summer months. North of the Cape is influenced by a cold water current, the Laborador. Surface water temperatures rarely reach 20C in the summer.

This difference in water temperature influences the distribution of marine species north and south of the Cape. This difference also influences the distribution of terrestrial flora and fauna.

ROCKY SHORES

The rocky shore of Massachusetts extends from Rockport to Scituate. In the geologic past the north shore was composed of granite hills which have been worn down, while the more southern rocky coast is glacial in origin.

The rocky shore is the most dynamic of coastal environments, and some plants and animals are uniquely adapted to survive there. The rocky shore affords no protection to its inhabitants, as does for instance, a mudflat.

Rocky shore life is distinctly zonated, from the splash zone of the rocks to the subtidal zone. The splash zone is that area which is not inundated by water, but sprayed. Blue-green algae and lichens make up the splash zone and give a black appearance to the rocks. The next zone is the balanus, comprised primarily of filter feeding arthropods (barnacles).

Below the balanus zone is the brown zone, dominated by rockweed, and knotted wrack. This zone is partially exposed at low tide. Here also are found blue mussels, dog whelks, and periwinkles.

Below the brown zone is the red zone, the beginning of the subtidal zone. Here are found the red seaweeds Irish moss, sea laver, and encrusting red algae. Below the red zone in the deeper subtidal area are the kelps. These large brown algae comprise the last zone, the laminarian. Here also are found sea squirts, species of starfish, and the sea urchins. Epiphytic organisms like the bryozoans and hydroids live attached to the fronds of the kelps and to rocks.

The organisms living here have adapted to most rigorous conditions, because they are continually subject to the ebb and flow of the tide and wave impacts. All the organisms in the black, balanus, and brown zone are exposed to the sun and dry air for hours each day. This exposure, although short, causes water loss and reduction or cessation of photosynthesis.

The plants of the rocky shore are fairly resistant to mechanical damage, though abrasion from sand in the water can be responsible for keeping algae from the rocks near sandy beaches. The algae of a rocky shore are sensitive to reduced light intensities and will soon die if subjected to high turbidity levels.[10]

MAJOR ACTIVITIES IMPACTING COASTAL ENVIRONMENTS

This section discusses certain activities and their effects upon the coastal marine environment:

- Physical Alteration
- Sewage Treatment Facilities
- Power Plant Siting
- Hazardous Substances
  - PCB's
  - Heavy Metals
  - Chlorine
  - Oil in the Marine Environment
- Hazardous Chemical and Solid
  - Waste Disposal
- Pesticides
- Septic Systems/Cesspools
- Recreational Boating
- Dredging/Dredge Disposal
- Offshore Sand and Gravel Mining

PHYSICAL ALTERATION

"The most productive zone in many estuaries is the zone of transition including the intertidal and adjacent subtidal areas. This is especially true where there is a minimum of wave generated turbulence and the sediments are stabilized. Such rich bands are found along the edges of salt marshes and may consist of tidally exposed mud banks. These intertidal banks and mudflats are more productive than most of the world's oceans."[11]

Bulkhead Construction

As discussed earlier, intertidal and adjacent subtidal areas are usually areas of high standing crops of organisms, and provide the initial habitat for many post-larval and juvenile fishes and crustaceans.

These shallow intertidal and subtidal fringe areas can be completely destroyed by bulkhead construction since the purpose of such construction, usually, is to provide deep water for boat access. Eliminating the shallow water areas reduces the concentration of detritus, the production of plankton, and, since the photic zone no longer extends to the bottom, the number of benthic organisms inhabiting the area.

Construction of bulkheads may also adversely alter natural circulation and create stagnant areas which can develop into "sinks" for pollutants. Over time, adjacent productive areas would be seriously

affected. Further, any type of marine construction which may restrict or prohibit the tidal flushing of salt marshes will cause slow death to the marsh and a drastic reduction in species diversity and biomass in surrounding waters.

Filling

The filling of salt marshes and intertidal areas is ecologically damaging. As discussed in a previous section, salt marshes are invaluable contributors to coastal productivity. Intertidal areas also contribute to coastal productivity, since these areas collect organic matter and support a biological community which is grazed on by juvenile fishes of many species.

The filling of a salt marsh results in death of the marsh plants, and cessation of organic matter export, since the tides can no longer flush the marsh. Filling of intertidal areas results in a direct loss of nursery areas and salt marsh behind. The benthic community is smothered by the fill, and tidal flushing of the marsh system behind is halted.

Ditching

The ditching of salt marshes for mosquito control is another activity which affects the tidal flow in marshes. Ditching began in the Great Depression days as a federal employment program and is continued today by county mosquito control projects. The purpose of ditching is to drain the high marsh, dominated by Spartina patens, in order to reduce areas of stagnant fresh water where mosquitoes breed and allow fishes which prey on mosquito larvae, such as sticklebacks and killifish, to enter the marsh on the tide.

Marsh ditches are usually cleaned out mechanically every three years. The ditch material is piled to one side or the other of the ditch. This deposition has two adverse effects: (1) the plants underneath are killed, and (2) the spoil is colonized by plant species not found there before since the area is no longer flooded on each tide.

If ditch spoil is improperly placed, it can create a depression which will trap salt water and create a panne. A panne is an area within the marsh which has a salt concentration too high for Spartina alterniflora or patens. These plants die and more salt tolerant plants, such as glasswort, colonize the panne. Along the sides of the ditch, spoil will slump towards the center, and S. alterniflora will colonize the slopes of the ditch.

From an ecological standpoint, evidence neither supports the premise that salt marsh ditching is beneficial, nor indicates it is harmful to the salt marsh community, if properly done. Environmentally, ditching of salt marshes for mosquito control is significantly less harmful and dangerous than the use of pesticides for control.

Alteration of Fresh Water Inflow

Fresh water inflow into estuarine systems is as important as salt water. Restriction or termination of fresh water inflow can have a number of serious effects. Less fresh water inflow results in increased salinity of waters within an estuary; this increase results in a loss of the area as a nursery ground for fishes and other organisms whose tolerance for saline waters in early life stages is low. Also, many of the forage organisms associated with estuarine waters cannot tolerate increased salinity levels.

Spawning areas for anadromous fish species such as alewife, shad, blueback herring, and the American eel, would be lost if fresh water inflow were restricted.[12] This loss of spawning area reduces the population numbers of these fish species.

Highway construction often impedes fresh water inflow into estuarine systems. Samll feeder streams will be filled and dammed, inhibiting natural flow, and permanently removing upland waters as anadromous fish spawning areas. At other times, culverts are used underneath a highway as replacements for the natural stream bed. These culverts can increase the water velocity enough to prevent the passage of fish upstream. Some fish species require specific bottom types for spawning activity; culverts replacing stream bottom may contribute to population reduction through destruction of spawning grounds.

Materials carried into estuaries by river flow and the plankton within the estuary, are two important food sources for fish. During the spring and autumn there are peaks in both sources which coincide with migratory fish movements. The construction of dams on rivers decreases the amount of fresh water flow into estuaries, and evens out the flow over time, eliminating the river "flooding" cycle and the food made available during fish migration.[13]

An increase in fresh water inflow to estuarine systems will also have adverse effects. A change in the salinity regime will cause a change in species composition. Changes in species composition of resident populations will be reflected in changes in those organisms which feed upon them.

For example, decreases in salinity of less than five parts per thousand in some cases, can result in a loss of soft shell clams and smaller molluscs. If salinity changes are sustained the loss of molluscs will result in a decrease in fish such as winter flounder.

Semi-permanent and permanent increases in fresh water inflow can be caused by an increase in highway and paved surfaces near a river and its estuary. Run-off from these impermeable surfaces adds more fresh water to the system, as well as transporting petroleum products and road salt.

SEWAGE TREATMENT FACILITIES

A national effort to improve water quality has resulted in the construction of municipal sewage treatment facilities in a number of communities. In most instances plants which have been constructed in coastal areas, or are in the final process of being constructed, use ocean outfalls to discharge liquid effluent from the treatment process.

This liquid effluent contains phosphorous and nitrogen compounds, which are the primary nutrient sources for marine life. Increased levels of phosphorous and nitrogen compounds can produce more phytoplankton resulting in higher zooplankton productivity and more food for larval fishes and shellfish.

Unfortunately this is not always the case. The effects of adding these two nutrient sources is dependent upon many variables: circulation pattern and flushing rates, bottom type, dissolved oxygen concentration of the receiving water body, to name only a few.

Phosphorous and nitrogen compounds are recycled in marine systems through bio-deposition, excretion, and decay. High clay content sediments, as found in estuaries, help recycle these nutrients through adsorption. Sediment bound nutrients in coastal waters are recycled through upwelling generated by high wind and wave action.

At each recycling step these two elements are found in specific chemical form, and can only be utilized by certain organisms. For example, nitrogen may be in the form of ammonia, a product of excretion. Certain bacteria species can oxidize ammonia to nitrates or nitrites. Nitrogen, in the form of nitrates and nitrites, is now available to certain marine plants for uptake. These plants are then eaten, and nitrogen again enters the system through excretion in another form.

In marine systems, nitrogen is a limiting factor, and is utilized as quickly as it is made available. Therefore, organisms who can utilize it in its earliest form have the advantage.

Most of the "food" phytoplankton species require nitrogen in the form of nitrite; while the more opportunistic, less "usable" phytoplankton species can use nitrogen in the form of urea, uric acid, or ammonia.

Increased nitrogen loads in the marine system, in the form of ammonia, stimulates the production of those phytoplankton species who can readily utilize nitrogen as ammonia. Increases in both phosphorous and nitrogen compounds can enhance the productivity of receiving water bodies. But, over a period of time this increased enrichment, termed eutrophication, causes oxygen depletion and subsequent adverse effects.

Open Coastal Waters: Some authorities claim that discharging treated sewage wastes into open coastal waters is acceptable. The thought is that the dynamics of these waters are such that phosphorous and nitrogen compounds would be quickly diluted and dispersed.

The distance from shore in combination with the water currents are critical factors in determining the best outfall location. Transport of waste material back towards shore will cause contamination and closure of public bathing beaches and shellfish beds.

Estuaries, Salt Ponds, Coastal Embayments: The ability of estuaries/salt ponds/coastal embayments to retain natural supplies of nutrients contributes to their high productivity. Because of their retentive ability, a result of their restricted openings to the sea and/or the flushing characteristics controlling fresh water inflow and tidal exchange, these water bodies are already heavily saturated with nutrients. Therefore, they are least desirable as receivers of sewage effluent. Increasingly greater nutrient loads will cause a marked decrease in biological productivity over time.

Organisms which are more tolerant of increased phosphorous and nitrogen loads would begin to dominate within a community, decreasing the species diversity. "In estuaries where enrichment is excessive fish may not die but a fishery may decline because suitable food organisms are unable to survive the unfavorable conditions which result from the excessive addition of nutrients."[14]

Another constituent of sewage effluent, fecal coliform bacteria, is of concern when locating sewer outfalls. Coliform bacteria, which flourish in the intestinal tract of humans, are a necessary component of digestion, and are excreted with unusable fiber. Coliform bacteria, easily detected and cultured, are used as indicators of the presence of viruses and other bacteria. These viruses and bacteria may be vectors of harmful diseases, such as hepatitis, which can be contracted through consumption of contaminated shellfish.

Total coliform counts are taken periodically in coastal waters, and if above a median of 70/100 ml, shellfish beds are closed to harvest, and bathing beaches are closed to the public. For example, the shellfish areas around greater Boston are closed due to coliform contamination from the treatment facilities on Deer and Nut Islands. The lack of harvest of shellfish beds over a period of time can and does cause massive mortalities causing the destruction of shellfish beds.

As the demand for protein continues to increase, the State of Massachusetts cannot afford possible decreases in the biological productivity of its coastal waters due to poor citing of sewage treatment facility outfalls.

POWER PLANT SITING

Significant increases in coastal water temperatures in Massachusetts can result from the discharge of cooling waters used in power generation. Most of the power plants in the state are located in the coastal zone. Water for cooling is removed from coastal waters and discharged at temperatures which may exceed 5.6 - 6.7C (10 - 12F) above ambient. A temperature increase may affect an organism directly by changing physiologic or behavioral processes, or it may affect it indirectly, by changing some part of the environment on which the organism depends.[15]

The severity of thermal effects is dependent upon the time required for complete mixing of thermal discharges in ambient water. In general, the more sudden and prolonged the organism's exposure to elevated temperatures, the more serious the effect. In shallow water bodies with a restricted flow, the mixing time can be quite long, compared to an open coast location.

Location of thermal discharges in estuarine waters poses serious problems to fish movements. Many fish enter the upper estuaries to spawn, and the young use these waters as a nursery until the late summer when the juveniles begin to move into the cooler, oceanic waters. Thermal discharges can create a temperature barrier of a few degrees or less which will effectively block out this migration of juveniles.

Prolonged periods at either extreme of the range can cause physiological changes which can be harmful to the species. Low temperatures may permit maintenance of life but inhibit spawning. Elevated temperatures may allow for spawning but can be high enough to kill the eggs.

Temperature increases may in fact increase productivity and enhance growth during times of the year when ambient temperatures are cool, predominately during the fall, winter, and early spring. As ambient temperatures increase, the added temperature increase from thermal discharges can cause water temperatures to reach the maximum tolerable limits for some marine organisms, particularly in shallow water bodies with a restricted flow. Further a plant shutdown may produce fish kills due to sudden temperature changes.

Entrainment of marine organisms at the plant's intake may also have deleterious effects. Large fish and invertebrates are entrapped on wire mesh screens placed in front of the intake, but egg, larval, and juvenile stages of many organisms, as well as the adult forms of smaller organisms, are taken into the plant and passed out in the discharge. Few organisms can move against the suction force of plant intakes, and many organisms cannot move at all (non-motile). Entrainment is particularly serious during spawning season, especially at plants which are located in estuaries or at the mouths of estuaries and other water bodies where spawning takes place.

On the other hand, the controlled use of thermal effluent for aquaculture may be beneficial. The culture of some marine organisms in warm water increases the growth over time; the metabolic rate remains high and the animals feed constantly. Therefore, an organism raised in warm water will be larger and will usually weigh more than an organism of the same species and age raised in ambient water. For certain species of marine organisms, aquacultural techniques may be used to replace that portion of the population which is lost due to the operation of the power plant.

HAZARDOUS SUBSTANCES

Polychlorinated Biphenyls (PCB's)

PCB's are used as insulating media in the production of transformers and capacitors. PCB's are also found in such products as carbonless carbon paper, paints, textiles, and hydraulic sealants.

PCB's are relatively insoluble in water and concentrate in bottom sediments and the food chain in marine environments. Through bioaccumulation PCB's are concentrated in animal tissue at levels up to 40,000 times greater than environmental background levels.[16]

PCB contamination causes a wide variety of problems within marine organisms, from physiological dysfunctioning, to reproductive failure, to death. In New York state alone, PCB contamination in the Hudson River has closed a $1.25 million per year commercial striped bass fishery.[17] The only known disposal method is incineration at temperatures exceeding 1316C (2400F).

Heavy Metals

Heavy metals are used extensively in metal finishing and electroplating industries. These metals can bind to components of living tissues. This binding alters or prevents the functioning of tissue components.[18]

This tendency of heavy metals to bind with cell components makes it difficult for an organism to rid its system of the metal. Consequently, the metal concentration increases in the tissues and is eventually passed through the food chain. A heavy metal concentration may not be lethal to adult forms, but may be lethal to larvae and juveniles.[19]

Over time, heavy metals in a marine system can cause a decrease in the number of species and population numbers. Species which can tolerate higher concentrations of a metal will begin to replace more sensitive organisms. Forage species whose food includes these more tolerant organisms will replace other forage species. These more tolerant organisms are generally those which are less valued by man than the more sensitive species.

Plants take up heavy metals through their root systems. Some plants such as eelgrass are not harmed, but the metals are cycled into the marine system when the plant breaks down into detritus. Some heavy metals are harmful to Spartina alterniflora. Copper and methyl mercury initially inhibit growth and eventually cause high mortality in these plants. High lead concentrations will inhibit the growth of Spartina.[20]

Sediments of high organic content, such as clay-silt bottoms, also tend to concentrate heavy metals. These sediments provide surfaces which adsorb heavy metals. Deposit feeders work over the sediments and concentrate and/or resuspend these metals, in effect recycling toxic substances through the marine food chain. Activities such as dredging which remove and cause suspension of sediments also cause some recycling of toxic substances.

Chlorine

There are two common uses of chlorine in coastal areas. Chlorine is used at power plants as a defouling agent for the condensor tubes. It is also used as a disinfectant in sewage treatment facilities as a last step in reducing bacterial and viral concentrations.

The metabolic pathways of chlorine and chlorine compounds are not known, but some lethal concentrations for marine organisms have been established.[21] In constant flow bioassays being conducted at the Woods Hole Oceanographic Institution, initial results indicate that fish and crustaceans have different responses to chlorine and chlorine compounds. Fish are sensitive to very low concentrations, while crustaceans and bivalve larvae tolerate higher concentrations. As a specific concentration, there will be a noticeable response to chlorine and chlorine compounds in fish, but no apparent response in crustaceans or bivalves. Chlorine and chlorine compounds are longer acting toxins for crustaceans and bivalve larvae than for fish.[22]

The residual concentration of chlorine and chlorine compounds differs for power plants and sewage treatment facilities. Power plants are allowed a maximum residual chlorine concentration at the discharge of 0.1 mg/l. On the other hand, sewage treatment facilities are required to have a minimum residual chlorine concentration of 1.0 mg/l at the outfall. At present, there appears to be no scientific data to support this minimum requirement at sewer outfalls, which is ten times the maximum allowable concentration at power plant discharges.

OIL IN THE MARINE ENVIRONMENT

Between 37.5 and 75 million barrels of crude oil and petroleum products are introduced into the world's oceans annually. Eighteen thousand barrels are discharged or spilled annually into New England ocean waters.[23] Catastrophic accidents account for only a small percentage of the oil that enters the oceans. The majority of oil is

introduced by routine discharge from tankers and other vessels, minor accidents in port or on the seas, accidents in exploration and production, pipeline breaks, incomplete combustion of fuel, and untreated sewage effluents. Most of these events occur onshore, in port, or in coastal waters where biological productivity is greatest.

Depending on its source, oil has varying chemical characteristics.[24] Refined oil has a higher percentage of aromatics, which are the more toxic compounds. After being spilled or discharged into the environment, oil can undergo weathering in four ways: (1) evaporation; (2) dissolution; (3) biological degradation, and (4) chemical degradation.

Both evaporation and dissolution selectively remove lighter, more volatile hydrocarbons. Dissolution also removes the more soluble aromatics. Microbial attack affects the simpler, straight- and branched-chained hydrocarbons and not the cyclic and aromatic compounds. On a weight by weight basis, oil that has weathered by microbial decay is more toxic than the original mixture because the toxic aromatics have not been degraded.

Chemically, oil is altered by oxidation of aromatic hydrocarbons. This occurs to a small extent and is the least important of the weathering processes.

There are several mechanisms by which oil and oil products can cause environmental damage: (1) immediate lethal toxicity; (2) smothering; (3) chronic sublethal effects on physiological and behavioral processes; (4) incorporation into organisms and spread through food webs; and (5) changes in habitats.

Immediate lethal toxicity affects a wide range of organisms. The effects are more pronounced when the oil has a higher aromatic content. The September, 1969 spill of 650,000 liters of oil with 41% aromatic content at West Falmouth, caused an immediate, massive kill of crabs, lobsters, and other crustaceans, molluscs, fish and polychaete worms.[25] Mortality was 95%. The spread of contaminated sediments compounded the problem causing continued, extensive mortality. By killing virtually all of the benthic community, the oil caused destabilization of sediments which were then mechanically transported. Seven years later, the sediments at Wild Harbor still carry oil from the spill, and local shellfisheries have remained closed.

The toxicity of hydrocarbons is not well understood. Those animals to which oil is lethal include the Ampeliscidae amphipods, crabs, the American lobster, many other crustaceans, many of the molluscs, polychaete worms, and the following fish: alewife, herring, killifish, Atlantic cod, and winter flounder. Oil is also toxic to the marsh plants Juncus gerardi, Spartina patens and Spartina alterniflora and the brown alga Laminaria.

In addition to toxicity, animals and plants are killed by smothering and coating. This is most evident in sea birds, particularly diving birds. A coating of oil causes a bird's feathers to lose their insulation and consequently, an oil-covered bird can freeze to death in any season. Furthermore, oil can result in a loss of buoyancy and cause birds to drown. Sea bird populations are, as a rule, smaller than populations of other species and are, therefore, more vulnerable to perturbation and extinction. Coating with oil also smothers sessile and other benthic organisms. The weight of an oil coating can cause the uprooting of marsh vegetation and macroalgae. A layer of oil significantly reduces benthic respiration and prevents photosynthesis, transpiration and translocation in plants.

The chronic sub-lethal effects of petroleum are perhaps the least obvious but are nonetheless significant. Oil becomes adsorbed by organisms and sediments and is incorporated into the lipid pool of many animals. The presence of oil in fish and shellfish causes tainting which affects market values. The West Falmouth spill caused a loss of $118,000 of shellfish sales during the first year alone. The shellfish beds at Wild Harbor have been closed ever since with a resulting loss of thousands of dollars in revenues. Tainting can be caused by only a small fraction of the total hydrocarbons incorporated by the organism, and after the tainting effect is gone, other deleterious effects of oil remain.

Some petroleum products are carcinogenic or mutagenic and their effects are not manifest for a long period of time. Oil can also inhibit, alter or interfere with physiological processes. For example, blue mussels, Mytilus edulis, that survived the West Falmouth spill were rendered sterile the following year. Oil has been demonstrated to reduce feeding and carbon assimilation and increase respiration in Mytilus and the ribbed mussel, Modiolus demissus. In diatoms and other phytoplankton, oil causes reduced growth and photosynthesis. Oil can interfere with behavior both by internal physiological disruption and external blockage of olfactory processes.

Biological transport through ecosystems magnifies chronic effects of oil pollution. Adsorbed and absorbed hydrocarbons concentrate as they pass through food webs. The resistance of hydrocarbons to biochemical breakdown increases the potential of physiological and behavioral disruption, carcinogenicity, and mutagenicity as they move up the food chain.

Oil causes both physical and biological changes in habitats. The mass mortality of organisms and the transport of oil-laden sediments cause drastic changes in community structures. For instance, if eel grass beds were smothered and eliminated by a spill, the affected area would lose its capacity for supporting bay scallops and other bivalves, crustaceans, and polychaete worms. In addition, the previously bound sediments, now oil-laden, are transported to adjacent areas spreading pollution.

Pollution of the marine environment, in addition to ecological costs, has high socioeconomic and aesthetic costs. An oil spill in a tourist area during the tourist season can have a devastating impact on the local economy. The 1969 Santa Barbara spill cost the regional tourist industry over $ 6 million in damages and lost income. The cost of cleaning up an oil spill is also high---cleanup following the Santa Barbara spill cost almost $ 5 million. The total social cost, cleanup, lost revenues, physical damage, etc., was over $ 16 million.[26]

HAZARDOUS CHEMICAL AND SOLID WASTE DISPOSAL

A hazardous waste is defined as any waste or combination of wastes that poses a substantial danger, now or in the future, to human, plant, or animal life and which therefore cannot be handled or disposed of without special precautions. A recent study indicates that 615,000 drums per year of hazardous wastes are generated in Massachusetts with metal sludges and plating solutions posing the most difficult disposal problem (approximately 55,000 drums per year).

Hazardous wastes may take the form of solids, gases, liquids, or sludges. Some wastes such as oils, pesticides, and organic sludges, can be incinerated at a high temperature. Some munitions and gases can be exploded as a means of disposal. Still other wastes can be chemically neutralized or biologically degraded. But many wastes, due to content or quantity, have no other available means of disposal other than disposal in a land site or at sea.

Both of these disposal methods pose potential problems to the coastal zone. Ocean dumping may release wastes which pose a threat to marine life. Disposal in sanitary landfills, by deep well injection, or by illegal dumping on land may pollute either surface streams or groundwater, through leaching and run-off, and pollutants may even find their way to the shoreline and the ocean environment through storm drains and sewer outfalls.

Knowledge of proper waste disposal practices is sorely lacking and disposal options are often not known.

PESTICIDES

The introduction of chemical pesticides into the environment has been steadily increasing since World War II. Pesticides enter the marine environment through direct application to coastal areas or transport by air, water and biota from more inland areas. Accumulation of pesticides in the marine environment, as in other environments, can cause insidious lethal and sub-lethal effects.

In coastal areas, pesticides are applied to marshes and bays to control mosquitoes, flies, weeds, and other pests. In Massachusetts, more than 20 types of pesticides are employed in cranberry production. Pesticides are also carried to the coast by rivers, washed in from sprayed lands and blown in as aerosols.

A pesticide is defined as any agent that can be used to kill pests. This definition includes insecticides, used for agricultural and public health purposes, fungicides, used agriculturally, herbicides, used in agriculture and public works, and rodenticides, used largely for public health reasons.

The progenitor of many modern pesticides is DDT (Dichlorodiphenyltrichloroethane), a chlorinated hydrocarbon (organochloride). Other organochlorides, which share many characteristics with DDT, are: aldrin, dieldrin, methoxychlor, chlordane, lindane, heptachlor, and the herbicides 2,4-D and 2,4,5-T. In addition to their toxicity, the organochlorides are dangerous because of their persistence in the environment and their tendency to be incorporated into fatty tissues which transports them through food chains.

As a substitute for organochlorides, the organophosphates were developed. These include: parathion, malathion, phosdrin, TEPP, methyl parathion, etc. The organophosphates are less persistent than the organochlorides but more acutely toxic to humans, pests and other organisms. The organophosphates are neurotoxins; they function by blocking nerve transmission.

The carbamates complement the organophosphates in that they are effective against many pests that are resistant to organophosphates. These substances also block nerve transmission but they are frequently safer to handle. Some of the commonly encountered carbamates are: carbaryl (Sevin), carbofuran, methomyl, aldicarb (Temik) and bufencarb.

The biological effects of pesticides are many. Despite many years of research, the mechanisms of organochloride toxicity are poorly understood. It is becoming increasingly apparent, however, that pesticides affect more than target organisms.

Persistence and biological and geochemical transport are the gravest dangers of pesticides. Discontinuing application does not guarantee the end of the problem. In several case studies, quantities of DDT residues in soils and biota increased for up to seven years after DDT spraying ceased. Moreover, over time, DDT and other organochlorides concentrate in animals at higher trophic levels. DDT, aldrin, dieldrin, heptachlor, and chlordane are all carcinogenic. DDE, a degradation product of DDT, causes thinning of the eggs of predatory birds which has decimated some populations. DDT also affects temperature tolerance in salmon; kills the mosquito fish, Gambusia, a natural mosquito predator; and inhibits photosynthesis in marine phytoplankton.

The organophosphates, whose use has been promoted as an alternative to organochlorides, also have serious, adverse impacts. Organophosphates are extremely hazardous to handle and cause damage to both the central nervous system and liver in humans. Moreover, in some cases, organophosphates can kill fish and other vertebrates yet not affect the target pest. Furthermore, upon breakdown, malathion and its degradation product

act synergistically with increased toxicity. Chronic exposure increases the sensitivity of some fish to malathion.

In recent years Sevin has been applied to shellfish beds along the Atlantic coast to control oyster "pests". Sevin, however, also kills juvenile clams, crabs of the genus Cancer, shrimp and fish. Sevin has also been linked to birth defects in test animals.

As the hazards of chemical pesticides are elucidated and quantified, new strategies for the control of pests must be developed. Some alternatives are available. To control mosquitoes in wetland areas, ditching is used to reduce the surface area of water and reduce the space available for mosquito eggs to develop. When properly done, the environmental impacts of ditching are significantly fewer than the use of chemical pesticides. And in the past several years insect hormones have been used to control selected pests. Compounds whose structure closely resemble mosquito hormones (hormone mimics) can be applied to wetlands and cause juvenile insects to prematurely metamorphose into adults which soon die. The major benefit of hormones is that they are, in general, species specific and do not affect vertebrates.

A recent National Academy of Sciences report on Pest Control has suggested four approaches to pest control that would prove most effective and least dangerous in the long run. The first is genetic manipulation. By breeding pest resistant plants and by releasing genetically altered individuals (sterile males), the need for chemical pesticides can be dramatically reduced. Second, the report suggests developing biological control methods that would be target specific and would, like genetic methods, reduce the need for synthetic, chemical pesticides. Among these methods are the introduction of natural predators and the introduction of bacterial and viral parasites. Third, the use of hormone mimics is in its infancy and can be further developed. Finally, integrated pest contol, combining several methods depending on a host of physical and biological parameters, offers the most rational approach.

SEPTIC SYSTEMS/CESSPOOLS

Nutrient enrichment of coastal waters can result from the improper siting or operation of individual domestic wastewater systems. This enrichment is particularly acute where a high density of individual systems is located near bodies of water which are shallow, poorly flushed, and/or semi-enclosed.

The primary determinants of contamination from domestic waste systems are the hydrogeologic conditions of the area: (1) nature of the soil; (2) position of site within the groundwater system; and for some areas, (3) amount of fracture and depth of bedrock. A further concern when near water bodies is the slope of the land towards the water, and the distance from the water to the individual system. The type of system must be considered as well.

A good soil allows the wastewater to travel through it at such a rate as to allow efficient filtration. A good soil type is well aerated to allow bacterial degradation of nutrients and offers space enough among the particles for filtration.

Distance to groundwater is important in this filtration, as a shallow ground water level would make soil absorption and filtration of nutrients very difficult and would result in groundwater contamination. A system should be sited in an area where the water table does not fluctuate enough to cause contamination during wet periods.

The gradient of the groundwater is somewhat dependent upon the slope of the land. The steeper the land slope, the more steep the groundwater slope. Cesspools and septic systems located on sloped ground run the risk of accelerating leachates into groundwater or surface water at the bottom of the slope. In addition, leachates break to the surface, becoming contaminated surface runoff. Bedrock in some portions of coastal Massachusetts is not far below the surface of the soil. The distance between the soil surface and the bedrock must be great enough, while considering other factors as well, to allow for good filtration.

There are two individual waste treatment systems which are most commonly used in Massachusetts: cesspools and septic systems. A cesspool is a subsurface disposal system, consisting of a large performated tank buried underground. Heavier solid materials tend to settle to the bottom and the liquid seeps through holes in the sides into the surrounding soil.

In a septic system, the settling out of sludge and the infiltration of liquid into the soil takes place in different areas. Wastewater flows first into a watertight septic tank where anaerobic decomposition takes place. The liquid is directed through a pipe to a leaching field, usually an area of prepared gravel trenches for good adsorption and filtration of material.[27]

These two waste treatment systems are dependent upon efficient soil absorption for removal of nutrients and other compounds. The removal ability of the soil is dependent upon the forms of compounds in the effluent, as well as on characteristics of the soil itself.

Nitrogen is found in four forms in domestic wastewater: organic, ammonia, nitrate, and nitrite. Nitrogen in the effluent leaving a septic system is usually organic and ammonia. Ammonia is adsorbed by soil particles in increasing amounts as particle size decreases.

Phosphorous is generally found in septic systems as phosphate. Most soils are capable of fixing phosphorous, through a combination of adsorption, change in the crystalline structure of the molecule, and precipitation. Chlorides are also found in domestic wastewater. Chlorides and nitrate migrate with groundwater over extended distances and undergo only

a moderate amount of vertical dispersion. As a consequence, these two compounds may be found close to the soil surface in the top six feet of soil, making nitrates readily available for plant uptake.

Groundwater contamination is dangerous since many coastal towns depend upon wells for supplying household water. Groundwater contamination and/or poorly operating waste systems in coastal areas can result in nutrient enrichment of coastal waters. Initially, this enrichment may have beneficial effects, but in the long term, sewage enrichment can be particularly damaging to shallow, poorly flushed water systems (see Sewage Treatment Facilities).[28]

RECREATIONAL BOATING

Recreational boating activity in the estuaries, bays, and offshore waters of the Massachusetts coastal zone is on the increase (see Recreation section).

Boating activity and related facility development may impact the marine environment in a number of ways. Physical impacts may include erosion of shorelines by boat generated wakes, increased turbidity due to resuspension of bottom sediments by prop wash, or the destruction or alteration of wetlands and other important coastal habitats through marina or launching ramp development and dredging of access channels.

The incidence of shoreline erosion will depend on the narrowness of waterways, the stability of shoreline soils and sediments, and the speed, magnitude, and frequency of recreational craft generating waves that will strike the shoreline. Other factors obviously affect shoreline erosion as well, including natural storms and waves and surface runoff. Therefore, it is difficult to assess exactly to what extent boating may have caused erosion of Massachusetts shorelines in the past. However, further expansion of boating activities in the narrow estuaries, rivers, and creeks where shoreline conditions render them susceptible to erosion should be viewed with caution.

Since most Massachusetts harbors and boating areas have depths substantially greater than six feet, it is unlikely that recreational boat prop wash could raise turbidity levels to harmful levels.[29] Encroachment of boating facilities into wetlands and other significant resource areas, however, may become more prevalent as waterfront property becomes more scarce. Facility development in these areas---marshes, tidal flats---may constrict water circulation, destroy productive habitat, and pollute local waters through spillage of fuels, acceleration of surface run-off, and discharge of human wastes.

Other adverse biological impacts related to boating activity may result from the overboard discharge of human wastes, or the emission of engine exhausts and unburned fuels through crankcase drainage. Federal regulations promulgated by EPA require the use of marine sanitation

devices which treat wastes on board and then discharge it overboard.[30] The degree to which discharges of human wastes will adversely impact water quality will be largely dependent on the intensity of boating activity, the size of the coastal water body, depth, existing water quality, the presence of other contributors to pollution, and the flushing capacity of the water body. In narrow, constricted estuaries or embayments where water quality may already be approaching threshold levels, intense boating activity on peak weekends may generate enough human wastes to produce adverse conditions such as nutrient enrichment or the introduction of hazardous bacteria or viruses. The operation of recreational boat engines discharges gases, complexed particulate lead compounds, hydrocarbons and organoleads present in unburned fuel, and rearranged hydrocarbons produced in the combustion process. Recent Environmental Protection Agency and Boating Industry Association studies show that the average outboard engine, when in use, contributes about 2.5% of its fuel to the water.[31] As explained in the section on oil pollution and heavy metals, some of these substances evaporate, some may adhere to bottom sediments, and others may build up in receiving waters (particularly when there is limited disturbance of bottom sediments to which these components can adhere). As with waste discharge, the severity of adverse effects will be dependent on water body size, existing water quality, other polluters, depth, and flushing characteristics.

It is unlikely recreational boating activity will result in substantial adverse biological or physical impacts when compared to other activities such as municipal sewage discharge or dredged material disposal. However, in situations where intense boating activity coincides with high sensitivity of marine resources to boating related impacts, some ecological damage may result.

DREDGING AND DREDGE DISPOSAL

Dredging is needed to clear channels of natural sedimentation in harbors and bays, sedimentation resulting from increased boat traffic, and to enlarge harbor channels for vessels with deeper drafts. Much of the dredging activity in Massachusetts is maintenance work, primarily that of retaining the width and/or depth of existing navigation and shipping channels.

Two dredging methods used are hydraulic and mechanical. Hydraulic dredging uses a centrifugal pump which picks up a slurry of bottom material and water, and transports it through a pipeline to either the disposal site or a vessel to carry it to a disposal site. This method is used primarily for onshore or near-shore disposal and is employed when the spoil is used for beach nourishment or dune creation. Hydraulic dredging and offshore disposal have not been used extensively in Massachusetts.

method

Mechanical dredging is the most prevalent dredge/in Massachusetts because many of the dredging projects in this state involve removal of bottom material which is unsuitable for beach nourishment and/or dune creation and must be ocean dumped. Mechanical dredging is similar to earth removal, using large bucket scoops or shovels that lift the spoil in a consolidated form and place it in a barge or scow. Material is then transported to offshore disposal sites where it is deposited by opening doors on the bottom of the scow.

Adverse effects of dredging activity are more severe in areas where: (1) water circulation is limited; (2) the bottom is rich in organic matter; (3) the sediments are polluted with heavy metals; and (4) salt marshes are nearby. Dredging activity in biologically productive areas, such as salt marshes and related tidal flat systems, can cause significant reductions in productivity. For example, in estuarine environments, dredging can cause changes that exceed the tolerance levels of the resident organisms.[32]

Mechanical dredging generates more suspended material at the dredge site than does standard hydraulic dredging, and impacts an area larger than the immediate site. As the shovel/scoop is raised to the surface, spillage may occur. This suspended sediment can have adverse impacts. It makes the water turbid and can cause the death of organisms by blocking the light necessary for photosynthesis and by clogging the gills and siphons of fish, molluscs, and other marine fauna.

Dredging removes organisms that live both on and within the sediments. This reduction in the number of organisms may lead to a decrease in the diversity of species with subsequent impact on dependent marine resources.[33] Dredging also removes benthic vegetation such as eelgrass which is used by the bay scallop for attachment and growth, by young eels and sculpin for protection from predators, and by brant as a major food source. Benthic vegetation also is important because it is a major cycle of nutrients through marine ecosystems and because it is a major source of detritus for deposit feeders.

In intertidal areas it may take at least eight years after dredging operations have occurred for the reestablishment of the original fauna 34.35. This reduction in an area's productivity will have serious effects upon the productivity of the whole water body, since many organisms depend upon the nutrient production and export of the salt marshes and the richness and diversity of tidal flat populations for feeding, spawning, and nursery activities.

The selection of a disposal site for dredge material designated as uncontaminated by the Division of Water Pollution Control is usually based upon the costs of available disposal methods and transportation. In order for most projects to be viable, a nearby land site or a relatively close ocean disposal site is required. Ordinarily, a land site is

sought first. If the material consists primarily of clean sand or gravel, it is usually ideal for beach replenishment. Mixed sand and gravel or crushed bedrock makes excellent fill. These materials usually find ready land sites for disposal. Unfortunately, little use has been found for the fine grained material (silt and clay) dredged in maintenance projects. Since filling coastal wetlands has been virtually eliminated because their value as highly productive resources has been recognized, this dredge material has often been disposed of at sea.

There are seven open water disposal areas along the Massachusetts coast approved for the dumping of clean dredge spoil. One of them, the Foul Area, is also for disposal of polluted spoils. The sites were chosen for their accessibility and proximity to coastal areas rather than their stability. Thus, dredge material is often disposed of at sites where erosion and transport of dredge spoil occurs. In many cases, coastal towns have complained that the distance to designated ocean disposal sites makes dredging projects economically unfeasible. Some areas must transport dredge material more than 15 nautical miles to the nearest approved disposal site.[36]

Massachusetts law requires that the Commissioner of the Department of Environmental Quality Engineering make a determination that disposal of dredge spoil will not adversely affect the environment before an ocean disposal site may be used (Massachusetts General Laws Chapter 347, Acts of 1976). The state's only open water disposal site for contaminated dredge disposal is located 22 nautical miles east of the port of Boston in Massachusetts, serving primarily the northern portion of the state. Due to the high costs of transporting dredge material from southern coastal communities, a second ocean disposal site in Rhode Island Sound is presently under study.

The movement of pollutants once dumped at ocean disposal sites depends upon (1) the nature and consistency of the dumped material, (2) the dumping method, and (3) the transport processes (wave and current erosion) affecting the dump site. Most contaminated dredge spoils are primarily fine-grained silt and clay. When dumped from a scow, some of the material falls directly to the bottom, some is carried laterally from the site by currents, and a portion is left near the survace to disperse. To prevent excessive mixing it is important that the material be dumped from a stationary position. If dumping occurs when the scow is approaching or leaving the disposal site, dispersal will be significantly increased.

Disposal of the spoil has both acute and chronic biological effects. Many benthic and free-swimming organisms are buried or suffocated by dumped spoil. Moreover, dredge spoil disposal causes significant perturbation in benthic habitats. Although recolonization of dump sites occurs to some extent, the biological balance of the community is permanently altered.

Much of the material dredged from the coastal harbors of Massachusetts contains concentrations of heavy metals, pesticides, and organic and petroleum wastes.

A potentially greater problem than burial and habitat destruction is the absorption, accumulation and recycling of heavy metals, pesticides and other contaminants by marine organisms. Some of these contaminants of dredge spoil are carcinogenic and/or mutagenic. Cycling of these contaminants depends on such factors as clay, organic and bacterial content, pH, and local currents.

The threat of contaminant release from open water disposal can be mitigated by an overlay of clean sediments. A sufficient quantity of clean sediments to adequately cover the polluted material would be required; however, such a quantity is not always readily available.

To phase out the use of ocean disposal for contaminated dredge materials, viable alternative disposal methods must be implemented in Massachusetts. One of the most common land disposal methods used is retention of spoils in a diked confinement area. If the spoil is compacted by mechanical dewatering and covered with humus, it could be used as landfill. However, shortage of land close to dredging operations will limit further dike construction. Other problems with confinement areas include odor, mosquitoes, groundwater contamination, changes in harbor currents, turbidity, noise during disposal activities, buildup of hydrogen sulfide, the long settlement time before reuse, and local opposition.

Use of spoil for landfill requires pumping or other transport inland which may be costly. Unless pre-treated with expensive neutralizing and stabilizing chemicals, this disposal may contaminate groundwater and generate odor. Combination with flyash waste from nearby power plants, however, may help solve two disposal problems while stabilizing spoil to the point where it can be built upon.

Inland pipeline transport of dredge spoils to reclaim strip mines, borrow pits, or other land is technically feasible up to 100 miles. However, substantial acreage may be necessary to make such a disposal option economically viable. Potential groundwater contamination is another limiting factor.

Artificial habitat creation by the construction of spoil islands and new marsh areas is one of the most promising alternatives, offering the ability to utilize large volumes of spoil with poor structural characteristics. One problem requiring further study is the potential uptake and cycling of contaminants from polluted sediments by marsh grasses.

Small volumes of dredge spoil might be usable as raw materials for bricks and building materials, though this alternative is not yet economically feasible.

OFFSHORE SAND AND GRAVEL MINING

There is currently a moratorium on all offshore mining in waters of the Commonwealth of Massachusetts. In addition, four ocean sanctuaries have been established by the Commonwealth that prohibit the removal of any sand, gravel, or other minerals except in certain areas for public shore protection or public beach restoration.

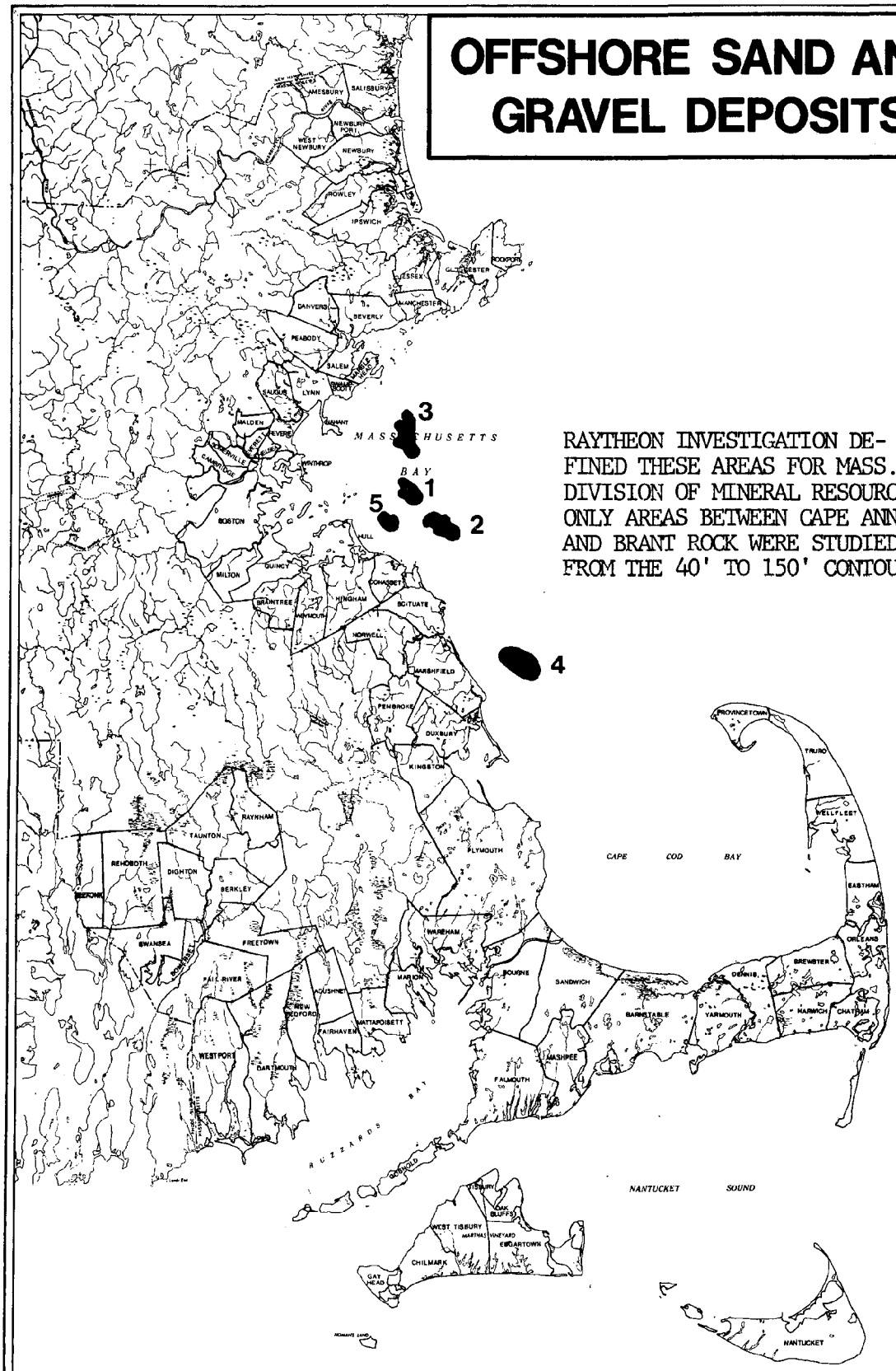
As a result, all sand and gravel aggregates in the Commonwealth of Massachusetts are derived from land-based deposits. The supply of deposits is decreasing rapidly due to an annual demand increase of more than 5% per year. In addition, land with potential mineable deposits is being rapidly consumed for residential and commercial use, especially near urban centers where the demand for aggregate is highest. The dwindling supply versus the increase in demand has caused the Boston prices for concrete sand to increase from $2.00 per ton at the plant in 1972 to $3.80 in 1976, and for gravel to increase from $3.00 per ton in 1972 to $4.50 in 1976. To these base prices transportation costs must be added.

Faced with these rising prices, the pressure for off-shore mining has caused the Commonwealth to study the availability of offshore sand and gravel deposits and the environmental harm that offshore mining might bring. Potential sand and gravel resources of Massachusetts waters between Cape Ann and Brant Rock (generally between the 40 and 150 foot contours) were investigated by Raytheon Company, Oceanographic and Environmental Services Division for the now defunct Division of Mineral Resources. The survey consisted of acoustical reconnaissance techniques (seismic, side scan sonar and precision echo sounding), bottom coring and sampling (Vibrocore and Shipek grab sampling) and bottom photography. The result of this survey was the identification of 15 areas with over 110 million cubic yards of potential economic sand and gravel deposits. Five of these areas were identified as containing appreciable quantities of aggregate (see accompanying map). However, Raytheon pointed out that additional data is necessary to definitely determine the economic value of these deposits.[37]

Mining of offshore sand and gravel can be performed by several different methods. Hydraulic dredging is the most efficient method currently available. Before the sand and gravel aggregate reaches the barge or hopper, water and silt and clay size material are removed from the slurry and discharged into the water column. The adverse effects of sand and gravel mining are similar to those of dredging. (See Dredging.)

Mining in areas with polluted sediments can cause a release of heavy metals, P.C.B.'s, hydrocarbons, pesticides, etc., to the water column. Most offshore areas in Massachusetts do not have polluted sediments; however, near harbors and areas where contaminated dredge spoil or other hazardous substances have been dumped, polluted sediments are present. These areas should be avoided in offshore sand and gravel recovery.

OFFSHORE SAND AND GRAVEL DEPOSITS



RAYTHEON INVESTIGATION DEFINED THESE AREAS FOR MASS. DIVISION OF MINERAL RESOURCES. ONLY AREAS BETWEEN CAPE ANN AND BRANT ROCK WERE STUDIED FROM THE 40' TO 150' CONTOUR.

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

COASTAL ZONE MANAGEMENT PROGRAM

Beaches depend on sand supply from both littoral currents which move sand parallel to the beach and the onshore movement of sand that occurs during gentle summer wave conditions. During the winter, storm wave conditions cause net sand transport offshore. Generally the movement of sand onshore equals the movement offshore; however, if sand is removed from offshore areas which are part of the natural beach replenishment system, then there will be a net loss of sand to the beach. Sand movement responsible for natural beach replenishment extends to the depth of 80 feet.[38]

Onshore facilities associated with offshore mining may consist of off-loading terminals, processing plants and storage areas. Potential environmental problems associated with these facilities are similar to those of land based sand and gravel operations such as: noise, air pollution, and any effects on the local flora and fauna. In addition, offshore sand and gravel aggregate will contain salt which can cause ground and surface water contamination. Thus siting of these facilities must be done with the utmost of care.

OBJECTIVES

The preceding discussion suggests that the management of the marine environment should encompass the following objectives:

1. To protect and enhance the productivity and values of the marine environment effecting the Commonwealth of Massachusetts.

2. To minimize the adverse impact of man's activities upon the marine environment.

3. To guarantee continued production and harvest of renewable marine protein sources.

4. To insure man's continuing use and enjoyment of the Massachusetts coast.

COASTAL ZONE MANAGEMENT POLICIES AND PROGRAM RECOMMENDATIONS

I. AREA SPECIFIC POLICIES

The following two policies will be applied to the named marine environment types whenever they occur along the coastline. As such, they supersede all the activity specific policies, numbers 3 through 8.

Policy (1) Conserve ecologically significant resource areas for their contributions to marine productivity and value as habitats.

A. Organic matter produced by salt marshes is the basic source of nutrition for all marine life in coastal waters. Salt marshes, shellfish flats, dune areas, and barrier beaches provide habitat for marine organisms upon which higher level species depend for food and provide nesting and feeding areas for migratory waterfowl and shore birds. The value of these resource areas can be destroyed by physical alterations, and Coastal Zone Management will work to ensure that activities proposed for salt marshes, dune areas, sandy beaches, barrier beaches, and shellfish flats (all ecologically significant resource areas as defined in Chapter III) abide by the following set of permitted and prohibited uses:

Permitted Uses:

a. the construction and maintenance of cat walks, observation decks, wharves, boathouses, boat shelters, fences, duckblinds,

wildlife management shelters, providing these structures are constructed on pilings to permit the reasonably unobstructed flow of the tide and preserve the natural contour of the area,

b. the cultivation and harvesting of shellfish and worms for bait, and the excavation and construction of areas for the cultivation of shellfish and other marine foods,

c. commercial and non-commercial outdoor recreation activities including hiking, boating, trapping, hunting, fishing, horseback riding, skeet and trap shooting, and shooting preserves, provided lead shot shall not be used,

d. salt marsh haying, dune and marsh grass planting,

e. the installation of floats,

f. the construction and maintenance of a minimum legal and practical width driveway providing an alternative means of access from a public way without building upon ecologically significant resource areas is unavailable. Such driveway shall be constructed in a manner which allows for the flow of the tide and shall be constructed of permeable material, and shall not be treated with any petroleum product or salt,

g. the enlargement to minimum legal and practical width and the maintenance of existing raised roadways, provided salt shall not be used at any time for snow removal purposes,

h. the installation and maintenance of underground utilities provided the surface vegetation is restored substantially to its original condition,

i. dredging, excavations, filling, and other construction for boat channels of a size limited to single family use; wildlife management improvements; the construction, expansion, and maintenance of beaches (i) for single family use, or (ii) other beaches except on salt marshes and shellfish beds; the construction and maintenance of boat launching ramps; ship channels in port areas (see Ports and Harbors section); and bank stabilization and shoreline protection works which meet the policy criteria set forth in the Coastal Hazards section.

Prohibited Uses: (other than above)

a. the filling, placing, or dumping of any soil, loam, peat, sand, gravel, rock or other mineral substance, refuse, trash, rubbish, or debris,

b. the draining, excavating, dredging, or removal of loam, peat, sand, gravel, soil, or other mineral substance,

c. the performance of any activity, action, project, act, or use etc., which would destroy the existing natural vegetation through physical alteration, pollution, or blockage of sunlight; alter existing patterns of tidal flow; contravene any other policy in this chapter; or have any impact upon the attributes making these categories of areas significant resources.

B. Salt ponds, because of their shallow bottoms, high light penetration, and low flushing rates, are particularly productive for shellfish, are geologically fragile and highly susceptible to eutrophication. For these reasons, Coastal Zone Management will work to ensure that additional protection is afforded to salt ponds. In addition to the activities permitted or prohibited in Policy (1)A, the following activities in salt ponds are prohibited:

a. the discharge of hazardous substances,

b. the disposal of dredge spoil,

c. the construction of solid fill piers, or extension or widening of existing solid fill piers,

d. the discharge from a municipal sewage treatment facility,

e. the discharge of thermal effluent, and

f. dredging for a purpose other than enhancement of shellfish and other marine food productivity.

Policy (2) <u>Protect complexes of marine resource systems of unique productivity; ensure that activities in or adjacent to such complexes are designed and carried out to minimize adverse effects on marine productivity, habitat value, storm buffering and water quality of the entire complex.</u>

Along the coast of Massachusetts are found complexes made up of a number of coastal environments which are unique for their contribution to marine productivity. A coastal complex shall be considered for special protection and restoration if it:

a. is high in natural productivity or potentially high in productivity, including but not limited to:

1) known spawning grounds for fish species,
2) shellfish beds,

3) anadromous fish runs, or
4) feeding and breeding areas for waterfowl or birds dependent upon coastal resources.

b. functions as a major natural protective buffer, and

c. meets or can meet the highest water quality standards.

Coastal complexes meeting these criteria shall be designated as Areas for Preservation or Restoration under the procedures and authorities described in Chapter III. An applicant for projects within such coastal complexes must file an Environmental Assessment Form. No EOEA agency shall permit or carry out any activity anywhere within the complex which would have an adverse effect on the values which make the complex an Area for Preservation or Restoration. In addition, the following activities will be categorically prohibited within the designated complex:

1. discharge of thermal effluent,
2. discharge from a municipal sewage treatment facility,
3. discharge of hazardous substances,
4. dredging and disposal of dredge spoil,
5. energy facilities.

Furthermore, if these activities are proposed for an area which is abutting, near, or related by natural processes (littoral currents, tides, etc.) to the complex, applicants shall be required to demonstrate that the proposed activity will not adversely affect values in (a), (b), and (c) which caused the area to be protected.

IMPLEMENTATION MEASURES (for Policy 1 and Policy 2)

When any agency within Environmental Affairs receives an application for any activity or if it proposes to conduct an activity within a Significant Resource Area or an Area for Preservation or Restoration, they will apply the preceding policies. The most relevant programs and authorities include those discussed below and others discussed after other marine environment policies.*

*NOTE: Other Environmental Affairs programs and authorities may also apply. For further information on the authorities mentioned in this and all other Implementation Measure sections, refer to Appendix A. For further information on the networking system, the definitions of areas, etc., refer to Chapter III on Management.

--Coastal Wetlands Restriction Program (MGLA Ch. 130, s. 105) authorizes the Commissioner of the Department of Environmental Management (DEM), after a public hearing, to restrict coastal wetland areas to protect public safety, health and welfare, public and private property, and wildlife and marine fisheries. Since its inception in 1968, this program and the one following have restricted over 30,000 acres of land in 27 towns, most of which are in coastal areas. Following a Memorandum of Understanding between DEM and CZM, the program will accelerate its activities in Significant Resource Areas and Areas for Preservation or Restoration, with highest priority given to restricting the latter. DEM will also promulgate regulations which will incorporate CZM's definition of areas and lists of permitted and prohibited uses (which is substantially similar to the one in current use). CZM will also provide staff support for the program.

--Inland Wetlands Restriction Program (MGLA Ch. 131, s. 40A) is similar to the above program only it applies to freshwater wetlands. The two programs are now being administered concurrently and all wetlands within a town are being restricted in the same process. Since freshwater ponds are also Significant Resource Areas, CZM will work with DEM to insure that adequate protection is provided to those ponds which lie in the coastal zone.

--Wetlands Program (MGLA Ch. 131, s. 40) gives local Conservation Commissions the authority to review proposals for projects in wetlands. All dredging, filling or other alteration of a wetland is unlawful without filing a Notice of Intent, both with the local Conservation Commission and with the Commissioner of the Department of Environmental Quality Engineering (DEQE). As this program is of key concern to CZM, it will work with the program in the following ways. CZM will provide significant assistance to Conservation Commissions to insure that they have the technical capacity to protect these areas and implement CZM policy through their initial reviews. It will also assist the Commissioner of DEQE in amending the state promulgated regulations and guidelines to the local Conservation Commissions to incorporate CZM policies for these areas. Also, Notices of Intent for all activities proposed for Areas for Preservation or Restoration will also go to CZM directly. The Commissioner will also issue a superseding order in all cases where the Order of Conditions is inconsistent with CZM policies.

--Waterways Program (MGLA Ch. 91, s. 1-59) the Waterways Program within DEQE, has authority over tidelands, harbors, and certain rivers below the high water mark. Among the activities covered by Chapter 91 are filling, construction of any structure, dredging, or removal of sand and vegetation. Approvals are in the form of a license, not permits, because the activity is taking place on public land and thus DEQE is acting as a trustee and not an ordinary regulatory agency. Under the law, all licenses expire after five years.

The agency has mainly been concerned with activities which result in physical alterations of waterways or obstructions to navigation. However, the authority is broader and requires that no license may be granted if there is an interference with the reserved public rights for fishing and fowling; this includes both the public right to traverse the area below the high water mark in order to fish or fowl and the assurance that an activity will not interfere with the wildlife resource habitat which could effectively limit the availability of fish or fowl.

CZM will continue its working relationship with the Waterways Program in several ways. Regulations will be prepared which will incorporate CZM criteria for license decisions in critical areas; all applications for activities in areas for preservation or restoration will cycle through CZM, and CZM will provide staff assistance to Waterways.

The Waterways Program also carries out projects with state funds such as dredging or shoreline protection works. CZM has already been working with this program to develop a ranking system for such requested projects. This system will also include the areas and activities covered by the Marine Environment section. Following a Memorandum of Understanding with Waterways, projects which are consistent with these policies will receive a higher priority for state funding. Projects inconsistent with these policies will not be performed.

--Ocean Sanctuaries (MGLA Ch. 132A, s. 13-17) have been created to protect all state waters except those from Swampscott to Marshfield and those in Mt. Hope Bay. While the terms of the five sanctuaries vary, in general such activities as removal of any sand, gravel or minerals, any dumping, or any waste discharge are prohibited, and shore protection, water navigation aids or fish harvesting are permitted. CZM is working with the Department of Environmental Management to prepare regulations and an interpretation of these acts, and with the Department of Environmental Quality Engineering to ensure that Ocean Sanctuaries provisions are entered through DEQE's permit procedures.

--Division of Marine Fisheries is responsible under Chapter 130 and related laws for the management and development of marine fisheries. Their jurisdiction covers all waters from the rise and fall of the tide to the seaward boundary of the Commonwealth. While certain statutes require other agencies to consult DMF before taking an action affecting fisheries, in order to insure that fisheries and related concerns are adequately protected in Significant Resource Areas and Areas for Preservation or Restoration, a joint Memorandum of Understanding with DEQE, DEM, and CZM will be prepared which will detail the ways DMF viewpoints will be incorporated into DEQE procedures. A Memorandum of Understanding between CZM and DMF will record the incorporation of CZM policies into DMF's authority over local fish

management programs, fish and shellfish permits, aquaculture grants and how the retained public rights of fishing will be incorporated into their procedures.

--Division of Marine and Recreational Vehicles (MGLA Ch. 90B) licenses such recreational vehicles as motorboats and dune buggies. Section 26 forbids operation of any snow or recreational vehicle in areas which could endanger property, planted areas or wildlife. A Memorandum of Understanding with the Division will incorporate CZM's concerns for the protection of critical areas with the Division's authority to regulate the use of such vehicles.

--Water Pollution Control and other water quality programs. See Implementation Measures following Policy (4).

--Hazardous Waste Program (MGLA, Ch. 21, s. 57-58) within DEQE licenses the disposal of chemical, explosive, reactive, and toxic substances which may constitute a danger to public health, safety or welfare or to the environment. CZM and the Division of Water Pollution Control will prepare a Memorandum of Understanding which will incorporate CZM concerns about the disposal of hazardous wastes into the marine environment in general and specifically into areas of critical environmental concern.

When any expenditure of state or federal funds or permit issued by a federal or state agency not within Environmental Affairs is involved in Significant Resource Areas or Areas for Preservation or Restoration, CZM will review and comment upon the type, location, design and impact of the proposed activity as a part of the A-95, MEPA and NEPA processes. Memoranda of Understanding will be signed for particular programs and when appropriate, CZM will deny federal consistency certification. Such state and federal programs include:

--Permits for Filling in Navigable Waters - Under Section 404 of the Federal Water Pollution Control Act of 1972 (U.S.C. 1344), the Corps of Engineers authorizes filling of navigable waters. Since the scope of jurisdiction over navigable waters is very broad, the Corps is implementing this program in three phases. It is, at present, exercising jurisdiction over coastal waters and coastal wetlands and freshwater wetlands contiguous or adjacent to coastal or inland navigable waters. In later phases, its jurisdiction will include tributaries, other inland waters adjacent to tributaries, and other navigable waters. Under the Corps regulations and the Federal Consistency regulations, the Corps may not issue a filling permit without a CZM certification of consistency. Since state and federal permit processing usually proceeds simultaneously, CZM will also have a direct Memorandum of Understanding with the Corps which will require incorporation of CZM policies and permitted uses early in the Corps procedures.

--Permits for Obstructions or Alterations in Navigable Waters of the United States - Are granted by the Corps of Engineers under Section 10 of the Rivers and Harbors Act of 1899. This permit covers such projects as sinking pilings, attaching moorings, placing outfall pipes, or digging tunnels. While the scope of jurisdiction under this permit is not as broad as for Section 404 permits, it does cover waters susceptible for use in interstate commerce up to their high water line. This includes all marine waters plus many inland waters. CZM's consistency certificate for projects proposed in Significant Resource Areas or Areas for Preservation or Restoration will be issued in the same way as for Section 404 permits.

--Energy Facilities Siting Council (MLGA Ch. 164) - The Council has jurisdiction over the siting of electric generating, gas and oil facilities and ancillary structures. The Council has override powers over permits issued by state and local agencies. As detailed in the Energy section, CZM and EFSC will continue their close working relationship to insure a uniform energy and environmental policy for the Commonwealth.

--Department of Public Works (DPW) - CZM will work with this agency and regional transportation planning agencies funded by DPW to influence the design, placement, construction, and maintenance of publicly funded roadways, culverts, bridges, etc. CZM will develop a Memorandum of Understanding with the transportation agencies detailing how CZM's marine environment policies affecting these transportation projects are to be carried out. This Memorandum of Understanding will also cover marine environment policy conditions to be incorporated in DPW's permitting authority (MGLA Ch. 81, s. 21) for "curb cuts" into state highways for private driveways as well as municipal roads.

II. ACTIVITY SPECIFIC POLICIES

Policy (3) Ensure that existing water quality standards for all point source discharge activities are stringently enforced and that the standards are continually upgraded to achieve the highest possible conformance with federally promulgated water quality criteria.

CZM shall undertake the following basic steps to implement this policy as it relates to thermal discharge from power plants and municipal and industrial waste discharge, including the discharge of hazardous substances:

1. work with the relevant federal and state agencies to evaluate and improve:

   a. discharge standards and locational criteria,
   b. treatment standards and methods,
   c. applicant and agency impact evaluation methods.

2. work with the relevant federal and state agencies and private industrial and scientific concerns to identify needed improvements in data required of applicants applying for state permits. Recommended improvements will be based on the findings of #1 above.

3. assist in integrating the findings of 1 and 2 into on-going governmental planning programs, e.g., 208 Areawide Waste Water Management Planning, relating to point source pollution and in informing private industry and development interests of revised procedures and data requirements.

CZM specifically recommends:

1. chlorine discharge at sewage treatment plant outfalls: The Division of Water Pollution Control should earmark a sufficient sum of money from its EPA demonstration funds for fiscal 1977-78 for research to determine the maximum residual chlorine concentration at a sewage treatment plant outfall.

2. sewage treatment plant outfalls: The Department of Environmental Quality Engineering should require applicants to furnish the following data:

   a. definition of the tidal excursion for the proposed outfall location,

   b. definition of the dilution of the sewage effluent which can be expected as a result of volumes of water passing the outfall under critical conditions,

   c. calculation of the maximum pollution parameter levels expected at the proposed outfall location, particularly total and fecal coliform bacteria, total nitrogen and total phosphorous.

   If DEQE finds that location of the outfall will produce adverse effects on marine productivity or public health, the applicant should be required to provide an alternative site.

   It is expected that further recommendations will be made on other aspects of point source discharge as the CZM program evolves.

Policy (4) Ensure existing siting criteria, performance standards, and activity regulations are stringently enforced and upgraded to reflect advances in related technology and knowledge of adverse effects on marine productivity and public health.

The same basic process as outlined in Policy (3) above will be undertaken to implement this policy, with the exception that greater emphasis will be placed on evaluating and formulating siting or locational criteria rather than evaluating discharge standards. Major activities to be evaluated include cesspools and septic systems, and discharges from recreational boating activities.

CZM specifically recommends that:

1. Cesspools and Septic Systems: Site specific guidelines for locating individual treatment systems adjacent to estuaries, salt ponds, and coastal embayments should be developed.

2. Recreational boating:

   a. Conformance with EPA requirements for marine sanitation devices should be enforced. All new boating facilities should be required to provide pump-out facilities to encourage use of holding tanks. Houseboats and other vessels berthed or moored for stationary use at dockside or within harbor zones should be required to be either equipped with holding tanks for use with pump-out facilities or with direct hookups to municipal or private sewage systems.

   b. Research should be conducted to evaluate the effects of recreational boat wake and prop wash on shoreline erosion and turbidity in Massachusetts coastal areas. If adverse effects can be conclusively attributed to recreational boating, criteria for identifying susceptible areas and appropriate activity regulations (e.g., speed limits) should be implemented.

IMPLEMENTATION MEASURES

--Division of Water Pollution Control (WPC) (MGLA Ch. 21), a unit of DEQE, administers the Federal Water Pollution Control Act (FWPCA) in Massachusetts and has authority over water quality as an integral part of the law of the Commonwealth. Its jurisdiction covers all waters within the Commonwealth--fresh water, salt water, and ground water. Under the FWPCA, Section 402 and 404, WPC issues discharge permits for both point and non-point source discharges and regulates such activities or facilities as sewage treatment plants, sewer

hook-ups, watercraft discharges, hazardous wastes, oil and certain industrial coolants and thermal effluents. CZM and WPC, in a Memorandum of Understanding, will mutually undertake the steps required to implement Policies (3) and (4) in order to improve the current methods of permit and project evaluations. Applications for projects or permits which are received in the interim will incorporate as much of these concerns as possible including any new recommendations developed as the CZM program evolves. Specific attention and careful scrutiny will be addressed by WPC to the effects of their permits on the areas discussed in Policies (1) and (2).

--Community Sanitation Program (MGLA Ch. 111; State Environmental Code, Title 5, Regulation 2) requires permits for all sub-surface discharges from septic tanks. Standards for percolation rates, distance from a water body, capacity of system, etc., are set by the Code. Local Boards of Health implement State Environmental Code for small-scale systems; the state retains authority for large systems. CZM and DEQE are currently working on an appendix to the Code to deal with the higher sensitivities of critical areas.

--Water Resources Commission (MGLA Ch. 21, s. 8-9) is an inter-departmental body made up of the Commissioners of each of the five Departments in Environmental Affairs and the Department of Commerce and Development. It functions as a water policy agency and coordinates the water conservation and flood prevention programs of the Commonwealth and implements the Federal Watershed Protection and Flood Prevention Act.

--Water Pollution Control, Marina Licenses (MGLA, Ch. 91, s. 59B) the Division of Water Pollution Control (DWPC) has specific authority to license marinas; no license is to be issued unless adequate facilities for the collection, treatment and disposal of sewage exist. Following a Memorandum of Understanding with DWPC, this program will be actively implemented.

--Marine Sanitation Device Standards (P.L. 92-500) have been promulgated by EPA as a part of the Federal Water Pollution Control Act. The standards allow the discharge of treated wastes from recreational vessels into coastal waters. By January 31, 1980, all recreational vessels must be equipped with Marine Sanitation Devices that will discharge effluent with a fecal coliform bacteria count not greater than 200/100 ml. and suspended solids not greater than 150 mg./l. Through application to the EPA Administrator, a state may also request that discharge be completely prohibited in certain waters, e.g., shellfish beds, fish spawning areas.

--Pesticide Board (MGLA, Ch. 94B, s. 11) - licenses people who apply pesticides to the lands of others. The licensing procedure involves testing applicants for their knowledge of various pesticides.

The Pesticide Board is also empowered to adopt rules and regulations relating to the use, sale or transportation of specific pesticides in order to protect public health, waters, wetlands, wildlife, etc. CZM will prepare a Memorandum of Understanding with the Board to insure that the use of pesticides in or near the coastal zone conform with sound marine biological principles. CZM will also assist the Board in its efforts to encourage users to apply alternative measures to pesticides.

Policy (5) Condition construction in water bodies to minimize interference with water circulation and sediment transport and to preserve water quality and marine productivity.

Estuaries and coastal embayments are particularly productive areas and prime habitat for a variety of marine species. Fresh water river discharge into estuaries helps to create favorable salinity regimes for certain marine species. Interference with natural river discharge, tidal flushing, and water circulation patterns can deny marine organisms water borne food, alter sediment transport, and create areas of stagnant, polluted water.

Thus construction of solid fill piers, bulkheads, or other permanent marine structures (see Coastal Hazards section for erosion control structures) shall be examined on a case by case basis and shall be permitted if:

a. in estuaries and coastal embayments, flushing rates and capacity are not reduced,

b. water quality and marine productivity are not affected,

c. alteration of wave generated littoral currents will not exacerbate or induce shoreline erosion or adversely alter depositional patterns.

Highway and road works, bridge construction and dams and impoundments will be required to ensure that they do not:

a. adversely affect the quantity of fresh water entering coastal receiving waters,

b. adversely affect water quality in the fresh water inflow and coastal receiving water, and

c. increase shoreline and adjacent upland erosion, induce or accelerate runoff of contaminants, or increase the turbidity of fresh water inflow and coastal receiving water.

IMPLEMENTATION MEASURES

The authorities in the state Wetlands, Waterways, and Ocean Sanctuaries programs, the Federal Corps of Engineer permits, and the MEPA, NEPA and A-95 review processes (discussed after Policies (1) and (2)) will all be applied to implement this policy.

--Department of Public Works both permits "curb cuts" into state highways for private driveways as well as municipal roads (MGLA, Ch. 81, s. 15-21) and constructs such transportation works as roads, bridges, culverts. CZM will prepare a Memorandum of Understanding with DPW to ensure that CZM concerns are incorporated in the permitting of "curb cuts" and the siting and design of transportation works.

--Division of Water Supply (MGLA Ch. 40) has permit authority over all proposed withdrawals from surfaces or groundwater sources in order to assure the availability of a safe and adequate source of water supply for public use. CZM and DWS will work together on appropriate occasions when an alteration in the supply of fresh water would affect the salinity of an area and its ability to function as a productive environment.

Policy (6) Ensure that dredging and disposal of dredged material minimize adverse effects on marine productivity.

In addition to the recommendations relating to dredging enumerated above in Policies (1) and (2), dredging shall be prohibited anywhere in the coastal zone during finfish and shellfish spawning seasons as specified by the Division of Marine Fisheries.

CZM will cooperate with communities and provide assistance to identify environmentally responsible dredge spoil sites for both clean and contaminated spoil. CZM will work with concerned state and federal agencies to ensure that the elutriate test is not used to distinguish between clean and contaminated spoil and that a test based on biological impacts is used.

By providing technical assistance and funding for feasibility studies, CZM will help to identify opportunities for in-harbor and land disposal, especially where beneficial re-use is possible. In the event that on land or in-harbor disposal capacity is limited, CZM will ensure that priority is given for use of this capacity for disposal of contaminated spoil. When land disposal of dredge material is proposed, CZM will work to ensure that hydraulic rather than mechanical dredge methods are employed.

CZM will also fund feasibility studies for identifying ocean disposal sites suitable for serving regional clean dredge disposal needs. Criteria for identification of such sites include:

a. ability to remain hydrodynamically stable after dredge disposal, and

b. the absence of significant fishery resources.

CZM is committed to the protection of the marine environment as a productive resource. CZM does not, therefore, favor the use of ocean sites for the disposal of contaminated dredge material. If, however, all alternatives, including limiting the extent of dredging, not dredging at all, or on land and in-harbor disposal are not feasible, CZM recommends the continued use of the Boston foul site for disposal of contaminated dredge spoils.

If a new regional ocean disposal site should be designated, CZM shall take an active role in coordinating the concerns of all involved state agencies and shall ensure that such a site:

a. be affected by currents of low enough velocity that appreciable erosion will not occur,

b. be at a depth sufficient to avoid wave base erosion,

c. be of insignificant importance to the fisheries resources of the Commonwealth, and

d. be limited only to priority projects meeting the benefit criteria set forth in Ports and Harbors Policy (20).

In addition, CZM shall continue to 1) seek alternative methods of disposal and 2) ensure that bio-uptake and concentration of contaminants through food chains will not represent a serious problem with ocean disposal.

For such a new regional site, CZM recommends that the Corps of Engineers periodically monitor bottom conditions. This should consist of periodic bathymetric and side scan sonar surveys over the disposal area to assess any changes in the configuration of the spoil mound. Monitoring of bottom water current velocity and underwater photography at the spoil area should be conducted periodically to determine if any dredge material is being eroded. In addition, submersible dives should be made to visually survey both the geological and biological changes. Several biological stations should also be maintained on and over the site to monitor bio-uptake of pollutants and recolonization by phytoplankton, zooplankton, indicator polychaete species (e.g., Capitella), molluscs, and other fauna.

In any dredge disposal operations to occur at an ocean site, the following conditions shall be applied to the disposal permit:

1. use of bucket dredges and hopper dredge scows using sudden, high volume release shall be required;

2. scows shall not be overloaded; measures shall be taken to ensure spoil is disposed of in areas below wave base depth. Scows must be dead in the water when the dump is made; and

3. fishermen must be notified of the time and route of dumping operations and be given LORAN bearings of the dump site so that interference with trawling activity can be avoided.

IMPLEMENTATION MEASURES

The regulatory and licensing authority in the Waterways, Wetlands, Ocean Sanctuaries and Corps of Engineers program can all be applied to prevent dredging. The key problem is sound disposal of contaminated spoil. Therefore, CZM will carry out the following actions to insure that its concerns are addressed by permissible dredging projects:

--Memoranda of Understanding with the forenamed agencies to incorporate CZM policies into their permit procedures and to accordingly condition or deny permits.

--CZM Funding (Section 306) to conduct dredge spoil disposal investigations. See the Program Incentives section of the Management chapter for further details.

--Continue the work of the Dredge Spoil Task Force (consisting of members from state agencies, the Corps, and chaired by CZM) to ensure coordinated policies. Encourage continued technical assistance on the part of participating agencies (the Corps has promised $25,000 worth of technical assistance).

--Actively promote all efforts to insure an economically and environmentally reasonable alternative to ocean disposal including championing such proposals before federal agencies and Congress in order to receive the necessary funds for land acquisition, engineering and construction costs, whether to be granted to state of federal agencies.

Policy (7) Accommodate off-shore sand and gravel mining needs in areas and in ways that will not adversely effect marine resources and navigation.

CZM recommends that the following locational guidelines be incorporated into regulations for offshore sand and gravel mining and ocean

sanctuary regulations where applicable:

1. mining should be prohibited in marine areas that serve as sources of sediment supply for coastal beaches or in areas where alteration of bottom contours would adversely modify wave and current patterns affecting shoreline areas. Generally these areas will be landward of the 80' contour.

2. mining should be prohibited in areas where contaminated dredge material has been deposited or other hazardous substances have been dumped.

3. mining should be prohibited within a specified distance of submarine cables and pipelines.

4. mining should be prohibited in navigation channels or anchorages unless shipping concerns can be safely accommodated.

5. mining should be prohibited in shellfish, finfish spawning and nursery areas or in other areas of productive sport or commercial fisheries.

CZM recommends the following operational guidelines also be incorporated in regulations:

1. all dredging vessels should be adequately lit and equipped with fog horns to prevent accidental collisions.

2. information on dredge's location, duration of mining and navigation lights should be included in Coast Guard's notices to mariners.

IMPLEMENTATION MEASURES

--Division of Mineral Resources (MGLA Ch. 21, s. 54) licenses exploration and extraction of mineral resources in the coastal waters of the state. Mineral resources include oil, gas, metals, ores, minerals, rock, soil, and sand and gravel, etc. Removal of materials for beach replenishment, navigation works, etc., are exempt from the law. CZM will work with this program to insure that the CZM recommendations will be enforced.

--Ocean Sanctuaries Acts, Waterways, Corps of Engineers programs will be coordinated via Memoranda of Understanding to insure that the preceding recommendations are incorporated into the regulations and operating procedures of these programs.

--MEPA, NEPA, and A-95 reviews will be continually conducted by CZM to monitor the activities of other state and federal agencies, and CZM will review proposals for offshore sand and gravel mining to ensure consistency with this policy.

Policy (8) Encourage and assist the development of aquaculture, commercial fisheries research and development, fish restoration, and anadromous fish enhancement.

The CZM program will actively participate with federal, state and private institutions to direct research, technology, and project development programs to solving fisheries problems and enhancing fisheries productivity. CZM will take an active role in supporting and coordinating the efforts of commercial fishery organizations seeking economic development and planning assistance from federal funding agencies. The CZM program will continue to work with the Lt. Governor's 200 Mile Work Group to identify and implement measures needed by the fishing industry.

IMPLEMENTATION MEASURES

A variety of federal programs provide research and project funds that are germane to this policy. The more important of these programs are:

--National Marine Fisheries Service administers federal fisheries management programs and studies the biological productivity of coastal and offshore waters. The Service also funds anadromous fish restoration programs and commercial fisheries research and development studies. Grants are extended to states for the development, implementation, administration, monitoring, and evaluation of fisheries management plans, for research on shellfish species which have or may have commercial value, and for research on shellfish pathological problems and mortality. The Service also administers loan programs to commercial fishermen. CZM will work with the Service and its state counterpart, the Division of Marine Fisheries, to ensure that these programs are adequately funded and directed toward meeting the needs of the Massachusetts fishing industry and toward enhancing fisheries productivity.

--Bureau of Sports Fisheries and Wildlife provides anadromous fish conservation grants to states and other entities to conserve, develop, and enhance anadromous fish resources. The Bureau also extends grants to state fish and game agencies to support projects to restore and maintain sport fish populations. CZM will work with the Bureau, the Massachusetts Fisheries and Wildlife Division and the Massachusetts Division of Marine Fisheries to promote restoration of anadromous fish runs in the coastal zone and will advocate adequate funding for such projects during A-95 and other reviews.

--Office of Sea Grant extends financial support to Sea Grant institutions. In Massachusetts these include the Massachusetts Institute of Technology and the Woods Hole Oceanographic Institution. CZM will work with the two institutions to ensure that their Sea Grant programs adequately reflect the research and extension needs of the commercial and sports fishing industry. Desirable Sea Grant programs for Massachusetts may include:

1. support for biological research on species that have commercial significance, on aquaculture methods, and on improving or devising techniques and methods used for harvesting and processing, and

2. advisory services for fishermen and fish processors on new techniques and methods of harvest, processing, and sale.

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31. U.S. Environmental Protection Agency and Boating Industry Association, 1973. "Analysis of Pollution from Marine Engines and Effects on Environment." Grant #R-801799, Program Element # 1BB038.

32. There is evidence that mass mortalities from temperature changes, oxygen depletion, and other causes have always occurred, even in the most pristine and unpolluted estuaries. This emphasizes the fact that many estuarine residents are living near the limit of

their tolerance range; any further alteration, no matter how slight it may seem, could exclude the organism permanently from the estuary. Such alterations come in the form of increased water temperatures, decreased oxygen concentration in the water from dredging and mining operations, or through the introduction of additional stress from low levels of pollutants.
Odum, W.E., 1970. "Insidious Alteration of the Estuarine Environment." Transactions of the American Fisheries Society, 4.

33. Removal of a species may leave an empty niche or else a niche which has been claimed by an ecologically less desirable species-- one replaces a forage organism, but itself is not a suitable food.
Ibid.

34. Castenholz, R.W., 1967. "Stability and Stresses in Intertidal Populations." In Pollution and Marine Ecology, T.H. Olsen and F.J. Burgess, editors. John Wiley and Sons.

35. Losses in productivity have been documented in a study done on a salt pond in New York. Investigators monitored the pond monthly during the period from ten months prior to initiation of channel dredging to eleven months after completion of the dredging. A 79% reduction in the number of organisms present was observed eleven months after the dredging. Further, faunal productivity, on a wet weight basis, decreased from 90 grams/ m^2/year to 31 grams/m^2/year, one year after channel dredging.
Kaplan, E. H., J. R. Walker, and M. G. Kraus, 1974. "Some Effects of Dredging on Populations of Macrobenthis Organisms." Fishery Bulletin, 72(2).

36. The U.S. Army Corps of Engineers has recommended disposal sites be located every 30 miles along the shoreline.

37. The N.O.M.E.S. (New England Offshore Mining Environmental Study) was a cooperative research effort between federal agencies and the Commonwealth of Massachusetts. Its purpose was to "evaluate the direct and indirect ecological effects of offshore sand and gravel mining...(and) to provide a scientific basis for the establishment of realistic environmental safeguards over potential future offshore mining operations." Unfortunately, the N.O.M.E.S. project was not completed and the environmental consequences of offshore mining have yet to be determined.

38. McMaster, Robert L., 1965. "Mineralogy as an Indicator of Beach Sand Movement along the Rhode Island Shore." Journal of Sedimentary Petrology, 30(3).

Emery, K.O., 1965. "Some Potential Mineral Resources of the Atlantic Continental Margin." U.S. Geological Survey Professional Paper 525-C.

Coastal Hazards

COASTAL HAZARDS

SUMMARY OF FINDINGS

The attractiveness of the Massachusetts coastline comes largely from the constant shaping and reworking of shoreline features by natural processes unique to the coastal zone. These same processes, however, periodically turn the coastal zone into a hostile environment where the powerful forces of flooding and erosion cause widespread damage to man-made structures and facilities. Consider, for example:

- The great hurricane of 1938 was estimated to have caused $56.9 million worth of damage to the communities bordering Buzzards Bay and $6.7 million in damages to the Cape Cod region.[1]

- In 1954, hurricane Carol caused damages of $46.9 million to the Buzzards Bay area and $7.0 million to the Cape Cod region.[1]

- A single northeast storm in the winter of 1959 caused $2.7 million worth of damages to Boston Harbor and $445,000 in damages to South Shore communities.[2]

- Northeast storms in 1961 and 1972, respectively, caused $300,000 in damages to the North Shore region and $1.3 million in damages to the Town of Scituate alone.[2]

While the increasing effectiveness of storm warning services and evacuation preparedness plans has substantially reduced the threat to human lives posed by coastal flooding and erosion, increased development of hazard prone areas exposes more and more structures to direct attack by storm forces.

Unwise development of coastal flood and erosion prone areas is commonly attributed to the public's ignorance of the potential risks to both lives and property. The recent public opinion survey conducted by the Massachusetts Coastal Zone Management Program finds to the contrary. Of the coastal residents polled, 55% felt that erosion of coastal areas was at least somewhat of a problem, 33% felt that coastal flooding is a threat to some areas, and 47% felt that development should be prohibited within coastal flood and erosion hazard areas. Additionally, as of March 31, 1976, $188 million of nationally subsidized flood insurance has been purchased by owners of property within the coastal communities, thus indicating the gravity of concern felt by coastal residents. Federal subsidies of the cost of this insurance currently amount to almost $3 million,[3] and annual subsidies of similar magnitude will continue for several years until the program progresses to its second phase in participating coastal communities.

Obviously, then, the threat of flood and erosion damage is perceived to be very real. However, as the value of their coastal properties continues to escalate, many coastal residents will continue to risk property damage in order to enjoy the economic and aesthetic amenities offered by coastal living.

Much of the damage from flooding and erosion could be avoided if owners of coastal property and developers would respect the value of natural buffers along the coast. Unfortunately, only recently has the protective role of coastal landforms and processes become more clearly understood. For example, beaches and marshes dissipate destructive storm waves over their gradual slopes; beach grasses and other coastal vegetation stabilize dune systems and prevent direct wave attack against inland areas; erosion of one segment of beach or bluffs provides sediment material for accretion of another. In short, all coastal systems function in a state of dynamic equilibrium to withstand wave and wind forces.

Development of these sensitive buffer areas for residential, commercial, or recreational uses has not only left structures and facilities exposed to destructive forces, but also seriously impaired the ability of these buffers to protect inland development areas, important wildlife habitat areas, scenic resources, and other unique aspects of the coastal zone.

In response to the need to protect development in hazardous areas, massive protective structures have been built and in some instances have been effective. However, they are becoming increasingly recognized as, at best, expensive short term solutions which may only exacerbate problems elsewhere along the coast. With the implementation of the National Flood Insurance Program and other recent federal programs, the federal government is putting greater emphasis on non-structural measures. However, the CZM Program finds that still stronger programs are needed to prevent unwise development of hazardous areas within the coastal zone and preserve and restore the natural protective functions of coastal landforms and processes.

A high degree of cooperation among federal, state, and local entities will be required to facilitate optimal use of remaining undeveloped buffer land along the coast, to restore previously impaired buffer areas, to prevent development that would exacerbate existing hazards, and to implement limited structural solutions in situations where the need for structural protection is unquestioned. Further, consistent with emerging federal policy that directs the burden of risk in hazardous areas to be shifted to owners of property within these areas,[4] the Massachusetts Coastal Zone Management Program aims to reduce the magnitude of public subsidies being used to support private development in damage prone areas, and to shift monies used for protective engineering works to more effective, beneficial uses.

In the following sections, the buffering functions of natural landforms, impacts of development on flood and erosion prone areas, existing programs to deal with the problems, and detailed CZM

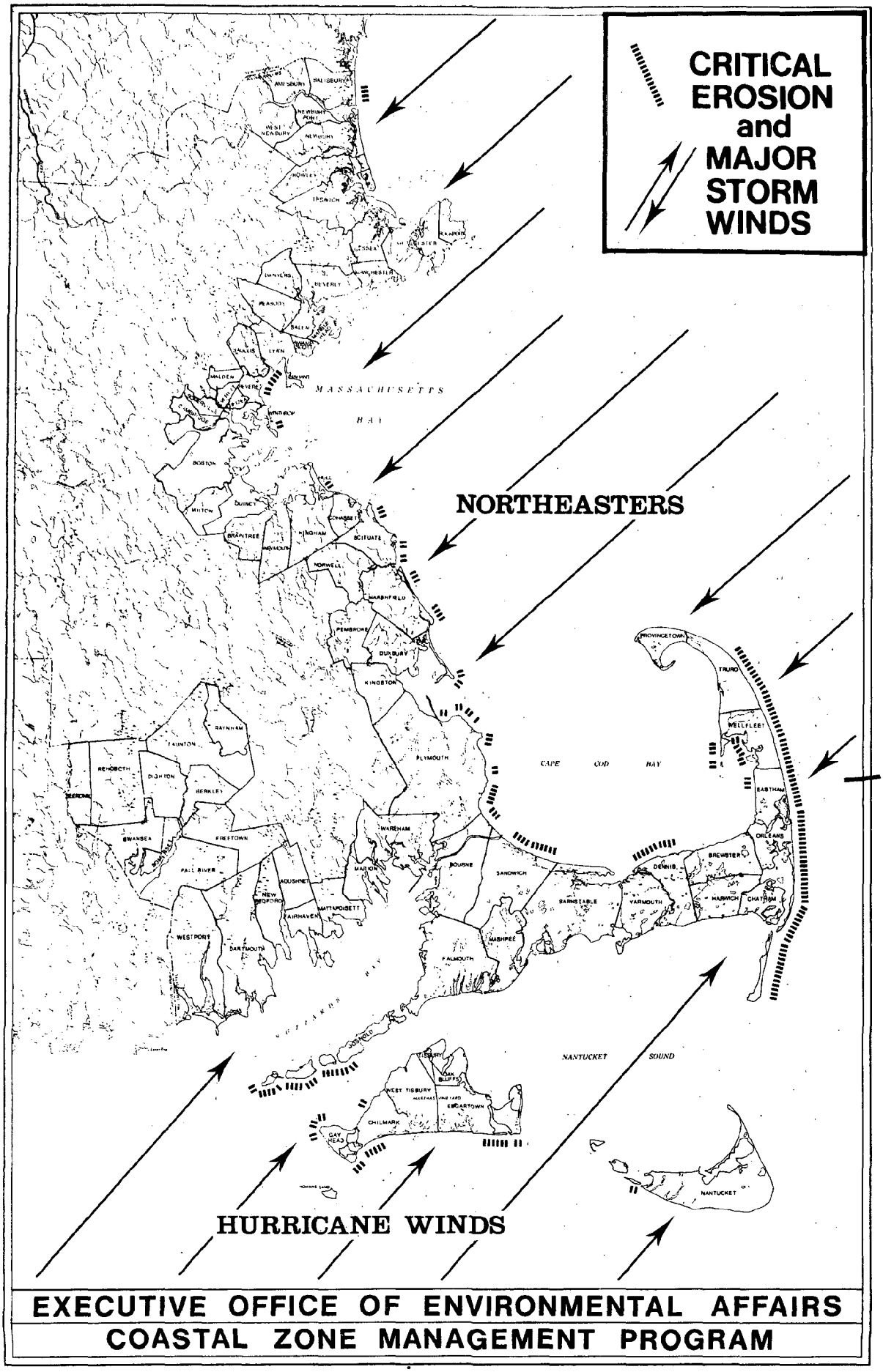
recommendations to supplement existing programs are discussed.

NATURAL PROCESSES RELATING TO FLOODING AND EROSION OF COASTAL AREAS

Two major types of storms affect the coastline of Massachusetts; hurricanes and northeast storms. Because these two types of storms attack the coast from different directions (see figure below), the magnitude of flood and erosion damage will vary with the exposure of coastal communities to the direction of storm approach. Thus, damage from hurricanes occurs chiefly along the southern Massachusetts coastline from the Rhode Island line into Buzzards Bay, the Elizabeth Islands, Martha's Vineyard, Nantucket, and the southern Cape Cod shoreline eastward to Chatham. The eastern stretch of the Cape Cod coast from Chatham north to Provincetown is more vulnerable to northeast storms. Shores along western stretches of the Cape from Provincetown to Brewster are generally unaffected by northeast storms, but are seriously eroding in certain areas. The remainder of the Massachusetts shoreline northward is highly susceptible to nor'easter flooding and suffers erosion in varying amounts depending on the severity of each storm. Of course, individual stretches of coastline within these broad ranges may vary significantly with respect to vulnerability to hurricanes, nor'easters, and storms striking the coast from other directions.

Maximum flooding along a particular coastline will occur when the storm winds blow onshore at or near the time of high tide (especially during spring tides) when water elevations reach their highest levels. Strong winds exerting pressure on the water's surface may cause it to "pile up" against the coast resulting in the effect called "storm surge."

While severe coastal flooding and erosion are typically the result of occasional tropical or nor'easters storms, shoreline areas are also subjected daily to normal wave and aeolian (wind) effects which cause constant shifts in the configuration of beaches, sand dunes, barrier beaches, and other coastal landforms. Through the transport of sediment material in the long shore current (littorial drift) all of these coastal formations are linked together as sources of sediment or areas of accretion. Thus, erosion of one stretch of sand cliff or beach may be supplying sand for replenishment of a beach situated down coast. Therefore, any action, either natural (such as a storm) or man-made--(such as the construction of a groin) affecting one segment of coast can cause detrimental or beneficial effects on another stretch of coast directly adjacent or miles down coast in the direction of the littoral flow. Sand also moves perpendicular to the beach--onshore during the summer when low energy waves prevail and offshore in the winter season due to higher energy conditions associated with storms. As with longshore movement, if the onshore-offshore dynamic process is disturbed, negative effects may occur to the beach.



EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

COASTAL ZONE MANAGEMENT PROGRAM

When left to develop and evolve in an unaltered natural state, the various types of coastal landforms will function to weaken and buffer the high energy effects of storm forces as follows:

Sand beaches and dune systems: The gradual slope of the beach face dissipates wave energy; sand deposited by littoral processes is transported via wind to form dunes, and is subsequently stabilized by vegetation. The natural buffer created protects inland areas from wave attack.

Barrier beaches: The beach and dune systems function as above, protecting landward estuaries, tidal flats, and salt ponds, as well as mainland shores. Overwashing of the dunes during storms causes deposition of sediment, redistributing substrate for sand dune formation and marsh development, maintaining the height of backshore areas, and causing slow landward migration. Natural inlets may also be breached in these systems periodically, providing increased circulation of salt ponds and lagoons and a redistribution of sediment material.

Offshore bars: The submerged bars dissipate winter wave energy during storms, and provide a sediment source for seasonal rebuilding of sand beaches and landward dunes.

Sand and Clay Bluffs: Erosion of bluff slopes provides sediment material to replenish downcoast beaches.

Wetlands: The gradual slope of the marsh beds and binding vegetation dissipates incoming wave energy during storm periods, causing deposition of additional sediment material. Marshes in estuaries also act as storage areas for flood waters.

ADVERSE EFFECTS OF DEVELOPMENT OF FLOOD AND EROSION PRONE AREAS

Unfortunately, intensive development of the coastal zone for tourism and recreation, housing, and other uses have often resulted in serious alteration of natural protective landforms and resulted in the implementation of futile attempts to combat nature through construction of massive engineering works. Because of economic incentives, ignorance, or willful disregard of the importance of maintaining natural buffering functions, building practices have left structures in many areas directly exposed to storm surge, wave attack, and erosive forces, and have resulted in the deterioration of coastal habitat, scenic attributes, and recreation resources. (See accompanying photographs.)

Principal adverse effects of construction of residential or commercial structures and ancillary facilities on beaches, sand dunes, and barrier beaches may include:

- Cutting of dunes: regrading of dune areas for construction of buildings and other facilities reduces the capabilities of the dune system to dissipate wave energy.

- Disruption of natural wind flow and depositional patterns: obstructing buildings cause scouring effects which may result in dune "blowouts" wherein vegetation is destroyed and the normal pattern of parallel dune ridges is adversely disrupted. The protective dune system is then more vulnerable to breaching by storm waves.

- Obstruction of overwash: obstruction by buildings and other facilities or improper restoration of dune areas will impair the "constructive" overwash of barrier beaches during storm periods. Landward deposition of sediment which builds up the interior and backshore areas of the beaches will be prevented.

- Acceleration of beach/dune face erosion: construction of sea walls or the cutting and steepening of foredune slopes will cause increased erosion of the beach face since wave energy will be concentrated rather than dissipated over a gradual slope.

- Acceleration of bluff erosion: building on the edges of bluff crests removes binding vegetation, increases surface runoff, loosens bluff material, and accelerates erosion of bluff slopes.

- Encroachment of development in coastal wetlands, estuaries, and tidal flats: filling of these shallow open expanses reduces the area over which wave energy can be dissipated. Their flood storage potential may also be reduced if located in mouths or embayments.

- Ground water withdrawal and contamination: human consumption of the ground water supply reduces the limited quantity of fresh water available to the dependent vegetation and increases the likelihood of salt water intrusion. Seepage from septic systems or storm-damaged sewer systems may seriously pollute local ground water supplies and adjacent marshlands and shellfish beds.

- Disruption of surface runoff and sub-surface infiltration: pavement of roads and parking lots with impermeable surfaces will increase surface runoff and reduce the infiltration of fresh water needed to support vegetation. Furthermore, recreational over-use of coastal areas may also degrade the buffering functions of natural landforms. For example, beach grass is acutely sensitive to trampelling--therefore excessive foot traffic in sand dune areas may cause erosion of dune slopes, as may heavy use of off-road recreational vehicles.

STATE AND FEDERAL STRUCTURAL PROGRAMS

Through the combined efforts of the United States Army Corps of Engineers, the Massachusetts Division of Waterways, and the Metropolitan District Commission, a number of structural protective measures, such as seawalls, groins, jetties, breakwaters, and dikes have been implemented over the years along the coast of Massachusetts to protect development in hazard prone areas.[5] Projects implemented by these agencies have met with varying degrees of success, and in some cases may even have accelerated erosion by depriving down drift beaches of sand or by concentrating energy on the beach face at the base of the structures.[6] The Division of Waterways receives no appropriation for maintenance of structures it builds. Responsibility for maintenance is placed on local communities who are often unable or reluctant to meet the substantial costs involved. Therefore, the Division of Waterways periodically must completely rebuild deteriorated structures.[7]

THE NATIONAL FLOOD INSURANCE PROGRAM AND OTHER NON-STRUCTURAL PROGRAMS

On the federal level, the major focus of flood plain management has been the 1968 National Flood Insurance Program (NFIP) amended in 1973 and administered by the Department of Housing and Urban Development. Created in the effort to shift the financial burden of flood risk to coastal landowners and away from federally appropriated disaster relief (for which the public at large must bear the costs), principal features of the program include:

1. Federally subsidized insurance coverage for existing structures in flood prone areas designated on preliminary hazard boundary maps.

2. Federal sanctions against the allocation of federal acquisition or construction funds unless the recipient community is a member of the national program.

3. Implementation of minimum management regulations by participating communities, consistent with federal standards for structure elevations and flood proofing.

4. Delineation on Flood Insurance Rate Maps (FIRM's) of special flood hazard areas (A zones-areas within the 100 year base flood zone) and areas of high hazard (V zones-special flood hazard areas subject to the effects of storm wave impact; E zones-areas vulnerable to the effects of flood-related erosion).*

*NOTE: The 100 year flood means "the flood having a one percent chance of being equalled or exceeded in any given year."

5. Actuarial insurance coverage for new construction and substantial improvements of existing structures located within flood prone areas of participating communities.

As of July, 1976, all of the Massachusetts coastal towns have joined the program, except five. Delineation of flood insurance rate maps has been completed for 15 towns. The remainder of the towns are using preliminary hazard boundary maps distributed by HUD, while their detailed rate maps are being prepared.[8]

Implementation of the NFIP will have the following effects:

1. minimum management criteria and structural standards established for the program may reduce loss of life and property over the short term, and private landowner financial losses will be substantially reduced.

2. the flood insurance rate mapping process being coordinated by HUD will provide an excellent data base to delineate flood and/or erosion prone areas for future management.

3. the provisions for inexpensive insurance (there is a maximum chargeable premium rate and costs are typically subsidized up to 90% by the federal government) may do little to encourage relocation or non-development of the flood and/or erosion prone areas. Conversion of seasonal housing to year round use as well as new development in these areas may in fact be encouraged.[9]

4. alteration of natural processes or destruction of natural buffers will not necessarily be prevented by minimum standards aimed at improving the structural capabilities of buildings located within flood or erosion prone areas.

Given its basic purpose, that of reducing loss of life and property, the NFIP represents a major step in the right direction. However, since the minimum structural standards required of communities participating in the program may be taken to be maximum level management controls, it is clear that additional guidance (e.g., technical assistance from CZM in developing zoning by-laws) may be needed to develop optimal solutions to effective hazard area management.

With the passage of the Water Resources Development Act of 1974, the federal government has directed that non-structural hazard area management measures be given equal consideration with traditional structural measures in the evaluation of flood protection alternatives. Section 73 of this Act directs that:

> . . . in survey, planning, or design by any federal agency of any project involving flood protection, consideration

> shall be given to non-structural alternatives to prevent or reduce flood damages. These non-structural alternatives would include such things as flood-proofing of structures; flood plain acquisition for recreational fish and wildlife, and other public purpose; and relocation.[10]

While awaiting development of a national strategy to optimize flood management benefits through combinations of the management techniques suggested in Section 73, the Office of Management and Budget has restricted appropriations related to this Act. However, when implementation of this Act on a larger scale becomes a reality, there may be opportunities for widespread benefits to flood-prone communities in the coastal zone.

Non-structural measures such as dune restoration and stabilization are supported by Conservation District and Resource Conservation and Development programs of the Soil Conservation Service, U.S. Department of Agriculture. Additionally, local conservation commissions sponsor dune restoration projects using plant materials supplied by private concerns. Also, the Massachusetts Coastal Zone Management Program has established a nursery to supply coastal plant materials for state park restoration programs. These types of non-structural measures are typically less expensive than structural measures, may more closely simulate effects of natural processes, and if development and access can be properly restricted on the project areas, the buffering functions of dunes and beaches can be significantly restored. Techniques that can be employed include, for example: the positioning of snow fences to trap wind-transported sediment, or the planting of vegetation to bind sediment and stabilize dunes. Artificial nourishment of beaches with sand extracted elsewhere has also been used effectively in some areas.

OBJECTIVES

The preceding discussion suggests that management of hazardous areas in the coastal zone should be designed to achieve the following objectives:

1. to reduce current losses of property and lives and to prevent future losses;

2. to preserve and restore coastal landforms and natural processes which are essential to the protection of coastal environments and landward areas; and

3. to maximize the effectiveness and economic efficiency of public investment in hazard protection measures.

CZM POLICY AND PROGRAM RECOMMENDATIONS

Policy (9) When acquiring coastal lands for recreation and open space purposes, priority should be given to areas that have a high propensity for tidal flooding and erosion and serve as buffers for landward areas.

Acquisition of land, either in full or in part through easement purchase, is a common means of preserving or expanding open space. It is also the most effective tool for preventing growth and development that would be vulnerable to storm damage or would impair the buffering functions of natural areas. Further, most open space uses will not require construction of extensive facilities and therefore are appropriate for damage prone areas.

It is unlikely that sufficient funds will be available for the acquisition of lands on the basis of hazard protection alone or that community attitudes would be favorable to such an approach. Therefore, CZM recommends that sites being considered for purchase through open space acquisition programs be given high priority if the sites are hazard prone or serve as natural buffers. Hazard-related criteria that would give such a site high priority include:

1. the area has been designated as a Significant Resource Area due to its location within the 100 year flood zone (the "A" zone, and especially if located within "V" or "E" zones), or, pending completion of Flood Insurance Rate Maps,* the area has been determined to be vulnerable to tidal flooding or erosion of the basis of historical data.

*NOTE: Flood Insurance Rate Maps are being prepared for communities participating in the National Flood Insurance Program.

2. presence of natural protective buffers, or high potential for effectively restoring lost buffering capabilities.

3. lack of local zoning laws that would prevent intensive structural development or in the case of damaged areas, redevelopment.

4. federal or state funds have been repeatedly allocated for flood proofing or repair of damaged structures, utilities, roads, bridges, and other public services not covered by the NFIP.

Acquisition can be either at the state or local level. Further, if a developed area is substantially damaged by storm forces and there is intense pressure for redevelopment that would again risk major losses or degrade natural buffering functions, it is recommended that the area be given even greater priority for acquisition. Acquisition of these areas will reduce the need for continued public subsidy (through either insurance or disaster relief) in high risk areas, while at the same time afford opportunities to open up new areas along the coast for public access.

In the acquisition of damaged areas, property owners would be reimbursed for structural damages by the federal insurance program, while compensation for land value and remaining structural and contents value would be the responsibility of the Commonwealth or the community acquiring the properties.

IMPLEMENTATION

--Land and Water Conservation Fund and the Massachusetts Self-Help Program:

The Land and Water Conservation Fund of the Bureau of Outdoor Recreation provides funding for acquisition of open space lands to the Department of Environmental Management and to towns via reimbursement through Conservation Services. State funding is also provided through the Massachusetts Self-Help Program (see Recreation Section).

In the case of state acquisition, losses to the community in tax revenue could be partially compensated by the Commonwealth under MGLA Chapter 58, Sections 13-17.

--Coastal Zone Management Act Amendments, 1976, Section 315 - During the implementation phase of the CZM program, CZM will have access to federal funds for the purchase of recreation lands in the coastal zone. CZM will ensure that, in addition to assigning priorities on the basis of potential recreation benefits, high priority is given to areas that are hazard prone (see Recreation Section).

--Water Resources Development Act, 1974, Section 73 - This Act authorizes federal agencies to consider non-structural measures as well

as structural measures in evaluating alternative flood protection strategies that would be implemented using federal funds. CZM will work with the Corps of Engineers and other federal agencies responsible for flood protection to explore the possibilities of using Section 73 to provide funding for acquisition of hazard prone areas.11

--Other Potential Funding Sources - In the event that it would be clearly in the interest of the public's safety to acquire damage prone areas, both the federal government (National Flood Insurance Act, 1968, Section 1362) and the Commonwealth (Civil Defense Act, 1950) are empowered to purchase areas substantially damaged by storms.

Policy (10) Prevent further growth and development in high hazard areas and preserve natural buffers throughout the coastal zone.

a. Restrict new development in identified V and E zones to the permitted uses defined under Policy (1), Marine Environment Section, and in the interim, encourage the establishment of setback restrictions for development in flood zone areas that are vulnerable to storm wave impact and in areas suffering critical erosion (especially in eroding bluff areas).

b. Consistent with Marine Environment Policy (1), restrict new development in barrier beach, sandy beach, primary dune, and salt marsh Significant Resources Areas to the permitted uses defined under that policy.

c. Within Designated Areas for Preservation or Restoration, restrict new development on lands within the 100 year flood zone to the specific permitted uses defined under Policy (1), Marine Environment Section, and to uses falling within the following general categories:

-- open space, outdoor recreation
-- agriculture, forestry, aquaculture
-- conservation, nature education
-- fishing, shellfishing, hunting

CZM recognizes that many of the hazardous areas within the coastal zone have already been extensively developed, and that it is unrealistic to expect or demand relocation of this development out of the flood zone or away from critically eroding areas. Furthermore, CZM accepts the need to protect owners of coastal property in these areas from losses due to major storms. However, for communities participating in the National Flood Insurance Program, protection against financial losses already exists, and the increasing effectiveness of storm warning services has substantially reduced the potential for loss of lives should a major storm strike the coast. Therefore,

CZM sees the need to concentrate on preventing new growth and development that would be prone to damage or would impair the ability of natural buffers to protect both existing development in hazardous zones and development in adjacent inland areas.* The above policies and policy (11) are structured to meet this need.

Policies (10a) and (10b) will be implemented using state wetlands restrictions authorities and new regulations promulgated by HUD for administration of the NFIP. Policy (10c) will involve imposition of state wetlands restriction authorities only in the event that local wetlands protection measures or flood plain zoning measures are inadequate to ensure compliance.

--National Flood Insurance Program, 1968, Amended 1973 - Regardless of the form of local or state action to control development in hazardous areas, communities participating in the NFIP must adopt minimum management criteria relating to floor elevations and flood proofing of new development. Under new regulations promulgated by HUD (Federal Register, Vol. 41, No. 207, October 26, 1976), alteration of sand dunes in V zones that would increase the potential for flood damage will be prohibited. All new development or proposed improvements in E zones will also be subject to local building permit denial or condition if they would not be safe from damage, cause flood-related erosion hazards, or otherwise exacerbate existing flood-related erosion hazards. Setbacks for new development to create a safety buffer zone will also be required.[12] CZM endorses these new regulations and will collaborate with the Federal Insurance Administration to ensure consistency between administration of the NFIP and the CZM program (CZMA, 1972, Section 307). Two means of doing this will be to evaluate the legal and scientific basis for further revising NFIP regulations to prevent issuance of insurance for new development in salt marshes, barrier beach systems, sandy beaches and primary dune areas regardless of their zone designation, and to develop model zoning by-laws or ordinances which reflect mutual CZM and FIA concerns for requiring development setbacks in high hazard areas.

--Coastal Wetlands Restriction Program (MGLA Ch. 130, s. 105) - Under this Act, "coastal wetlands" are defined as any land subject to "coastal storm flowage" and such contiguous land deemed necessary to affect in order to carry out the purposes of the Act. Therefore, barrier beach systems, primary sand dunes, sandy beaches, and salt marshes subject to storm flowage are fully covered by this Act, as will be V and E zone areas once they are designated on community Flood Insurance Rate Maps prepared for the HUD flood insurance program. Through Memorandum of Understanding with the Department of Environmental Management, CZM will ensure that hazard related concerns are given priority along with marine environment values in designating wetlands for restriction.

*NOTE: In extreme cases where there would be widespread public benefit, structural solutions may be appropriate to protect existing development. See Policy (13).

--Wetlands Program (MGLA Ch. 131, s. 40) - Empowers local Conservation Commissions to issue Orders of Conditions or deny permits for activities on "...any land subject to coastal storm flowage and flooding" if that land is significant to flood "control" or "storm damage prevention." In designated Areas for Preservation or Restoration (Policy (10c)), CZM will require that either this authority, local zoning, or voluntary conservation restrictions (see below), be used to restrict development within the 100 year flood zone, or state wetlands restrictions will be imposed for the contiguous land up to the limit of the 100 year flood zone. CZM will provide technical assistance in the development of model zoning by-laws or ordinances and conservation restrictions.

--Zoning Enabling Act (MGLA Ch. 40A, s. 2) - Authorizes local flood plain zoning and conservancy zoning whereby ordinances can be enacted to safeguard public health and safety on lands "subject to seasonal or periodic flooding."

--Conservation Restriction Program (MGLA Ch. 184, s. 31-33) - Authorizes voluntary conservation restrictions for flood or erosion control. Land restricted under this authority is assessed as a separate parcel for tax purposes (Acts of 1972, Chapter 719).

Policy (11) Use all available review authorities to ensure that all publicly subsidized development within the 100 year tidal flood zone and private projects proposed for areas below mean high water will not:

a. exacerbate existing hazards

b. be damaged by flood and erosion-related forces

c. promote growth and development in damage prone areas or degrade natural buffers.

Development in salt marsh, barrier beach, primary dune, and sandy beach Significant Resource Areas and V and E zones within the 100 year flood zone are covered under Policy (10). CZM will use its review powers to ensure that development on the remainder of lands within the 100 year flood zone is consistent with its hazard area management objectives.

Since the emphasis of the new Unified National Program for Flood Plain Management (P.L. 90-448, Section 1302(c) study)[13] is on shifting the burden of risk to coastal property owners, public subsidies to support private development in hazardous areas will be viewed with caution. Additionally, since public facilities are not covered under the National Flood Insurance Program, public development will be carefully

scrutinized to ensure that it will be reasonably safe from flood and erosion related forces.

IMPLEMENTATION

--A-95, NEPA, MEPA - Federal or state funded projects proposed for construction within the 100 year flood zone will be reviewed by CZM under these authorities.

--Federal Water Pollution Control Acts Amendments of 1972, Section 201 and 208 - Authorizes construction of waste treatment plants and areawide waste treatment planning. Ideally, the installation of permanent public utilities such as sewer and water supply systems should be discouraged, since construction of these types of facilities will tend to encourage new growth and development in hazardous areas and conversion of seasonal home use to permanent home use.[14] However, in areas where water quality is being adversely affected, pollution control may be of a higher priority. Therefore, decisions regarding this question must be made on a case by case basis. Consistency between the 208 and CZM planning programs will be ensured through development of Memoranda of Understanding with the appropriate agencies.

--Federal Permits for Filling (Federal Water Pollution Control Act of 1972 Section 404) and for Obstructions and Alterations in Navigable Waters of the United States (Rivers and Harbors Act of 1899, Section 10) - Authorizes the U.S. Army Corps of Engineers to issue permits for filling, sinking pilings, attached moorings, placing outfall pipes, digging tunnels and other activities in coastal waters. Under the Corps regulations and the Federal Consistency regulations, the Corps may not issue these permits without a CZM certification of consistency. CZM certification will be given only if proposed projects do not conflict with CZM concerns.

--Waterways Program (MGLA, Ch. 91, s. 14) - Authorizes the Waterways Program to license construction or extension of any structure, the filling of any lands or flats, the dumping of dredged or other materials in any of the tidewaters of the state. CZM will develop Memorandum of Understanding with the Waterways Program to ensure that review of proposed projects includes determination of potential effects on existing flooding or erosion hazards and that projects are appropriately conditioned or denied.

Policy (12) Provide funding and technical assistance for the restoration and stabilization of foreshore and shore areas in hazardous zones using non-structural measures.

In areas where natural sand dunes and beaches have been severely damaged through unwise development practices or uncontrolled use, restoration and stabilization measures such as dune rebuilding, stabilization of dunes by vegetation planting, and artificial beach nourishment should be considered. These measures are generally substantially

cheaper than structural measures, and if implemented properly can closely simulate the effects of natural conditions.[15]

The costs of implementing beach nourishment programs can be high, particularly when sand must be transported considerable distances to the nourishment site, and when the sand supply contributed by littoral and aeolian (wind) processes will be inadequate to prevent the need for frequent periodic re-nourishment.

Minimum criteria for implementing any of these types of measures through either federal, state, or local action should include:

1. the existence of adequate land use regulation or access controls to prevent deterioration of restored or stabilized areas;

2. the establishment of adequate design criteria to ensure proper height, slope, width, and sand size of restored dunes and beaches;

3. the assurance that future maintenance and replenishment requirements have been estimated and can be provided for.

IMPLEMENTATION

--Corps of Engineers Beach Nourishment Projects - The Corps is authorized to undertake beach nourishment projects in publicly owned recreation areas. CZM will solicit such projects where they are deemed economically feasible and where adequate sources of sand are available.

--Soil Conservation Service Erosion Control Projects - SCS provides technical and financial assistance through local conservation districts and the Pilgrim Area Resource Conservation and Development Project (PL 87-703) for upland erosion control, vegetation planting, and minor structural measures (less than 3 feet in height above mean high tide). CZM will work with local conservation commission and communities to secure assistance from SCS in implementing these types of measures.

--Waterways Program (MGLA Ch. 91, s. 11-13) - Is empowered to undertake the "improvement, development, maintenance, and protection" of foreshores and shores. While this authority has primarily been used to fund structural engineering works, sufficient flexibility exists to provide funding for beach and dune restoration and stabilization measures in Special Assistance Areas if there is clear public benefit to be gained.

--Ocean Sanctuaries Acts (MGLA Ch. 132A, s. 13-17) - Include various provisions for the five different sanctuaries along the coast relating to extraction of sand for beach or dune nourishment. Within

the North Shore Sanctuary, sand and gravel mining is prohibited, while in the Cape Cod Sanctuary it is restricted to use for nourishment of public beaches within the sanctuary.

--CZM Beach Grass Nursery - CZM has established a beach grass nursery at Myles Standish State Forest. Plants from this nursery will be made available to the Department of Environmental Management for the restoration of dune and beach areas managed by DEM.

Policy (13) a. Implement federal or state structural solutions to protect property and lives in Special Assistance Areas only when there will be widespread public benefits and minimal adverse environmental effects.

b. Approve permits for private flood or erosion control projects only when it has been determined that there will be no adverse effects on adjacent properties or down coast areas.

Policy (13a) should be implemented only when the following criteria are met:

1. Non-structural measures, such as acquisition, relocation, land use regulation, flood proofing, and dune/beach restoration or stabilization have been evaluated and rejected as being cost prohibitive, ineffective, or legally infeasible.

2. The area to be protected is of greater than local significance and substantial public benefit in the form of protection of existing public facilities or development of improved public access and expanded public use opportunities can be achieved in conjunction with construction of the proposed project.

3. Implementation of structural measures will not seriously impair the functioning of natural processes, nor adversely affect adjacent or down coast areas.

4. The value of the proposed project has been evaluated by means of a system structured around categories of cost and benefit which include economic, environmental, and social concerns. Maintenance costs have been estimated for the project and included in the cost/benefit evaluations. Agreements have been reached with recipient communities concerning maintenance responsibilities.

Implementation of structural solutions is probably most appropriate to urban areas where natural buffering functions have been irrevocably destroyed, where existing public lands are threatened,

where flood proofing of intensive development would be cost prohibitive and/or ineffective, and where commercial and industrial activities are dependent on proximity to the waterfront.

IMPLEMENTATION

--U.S. Army Corps of Engineers (PL 727 as amended) - The Corps is authorized to build structural projects for beach erosion control through specific project approval by Congress or through continuing authorities established by Congress, depending on the level of expenditures involved. For projects meeting the criteria above, CZM will work with the Corps of Engineers to seek necessary appropriations and ensure consistency with CZM hazard area management goals.

--Waterways Program (MGLA Ch. 91) - Authorizes the Waterways Program to undertake construction of erosion control projects. CZM and the Waterways Program are developing a new project evaluation system, consistent with the criteria specified above. This system will be formalized through a Memorandum of Understanding between the agencies which will enable both CZM and Waterways concerns to be accommodated in selecting projects for implementation.

Section 14 authorizes the Waterways Program to license all structures constructed below mean high water line along the Massachusetts coast. Through a Memorandum of Understanding, CZM will work with the Waterways Program to ensure that private erosion control projects will not adversely affect adjacent or downcoast areas by interrupting littoral processes or impairing other natural processes.

--Coastal Zone Management Act Amendments, 1976, Section 305(b) - Provides special funding for further study of erosion related problems. CZM will support a major study to identify sources, characteristics, and depositional areas of the sediment local transported by littoral processes off the Massachusetts coast. Results from this study will aid in evaluation of effects on downcoast areas and in locating sources of sediment for replenishment of eroded lands.

TECHNICAL NOTES AND SOURCES

1. "Hurricane Tidal Flood Damages," United States Army Corps of Engineers, New England Division, damage estimates inflated to 1964 price levels.

2. New England River Basins Commission, Report of the Southeastern New England Study, December, 1975.

3. "Cumulative State Report," March 31, 1976, N.F.I.A., Department of Housing and Urban Development.

4. Water Resources Council, Draft Report, "A Unified National Program for Flood Plain Management," June, 1975.

5. The authority of the Corps of Engineers is limited to construction of protective measures only where there is clear public benefit, the MDC initiates erosion control projects with both the Corps and Waterways for protection of MDC owned and operated beaches; and the Division of Waterways funds 50% of construction costs for protective structures requested by communities. Projects costing less than $15,000 are commonly undertaken by private landowners and require permits from the Division of Waterways.

6. No specific scientific studies concerning the effectiveness of engineering works constructed along the Massachusetts coast have been conducted to date. However, in a recent report to the Congress "National Efforts to Preserve the Nation's Beaches and Shorelines -- A Continuing Problem," June, 1977, the U.S. Army Corps of Engineers pointed out that their nationwide survey revealed that "in many cases where substantial and costly erosion control projects had been completed, they did not prove to be permanent solutions and continuing and costly project efforts were necessary to combat erosion." The report also concluded: although seawalls and bulkheads protect property behind them, "they often accelerate erosion on the ocean side" by concentrating wave energy on the bases of the structures where they meet the beach. A 1973 report, Guidelines for Long Island Coastal Management, by the Regional Marine Resources Council of the Nassau-Suffolk Regional Planning Board on Long Island, New York stated that development practices and "...shore protection structures have created a situation where the natural rate of erosion effecting both beaches and marshes has been increased." Adverse effects on downcoast areas caused by groin and jetty construction are also documented by Gary Sourcie in a January, 1974 Audubon article, "Here Today, Gone Tomorrow," (Vol. 76, No. 1, pp. 71-93).

7. Structures built and maintained by the Corps generally have a useful life of 50 years, while state projects typically have a useful life of 10-12 years.

8. Historical data is primarily used for delineating the 100 year flood elevation in the coastal towns. Application of computer modeling methods to predict flooding levels and wave run up effects in complex embayments is currently being evaluated by HUD, the Corps of Engineers, and other agencies and private firms involved in rate mapping process.

9. Encouragement of development in hazardous areas as a result of implementation of the National Flood Insurance Program was recently the focus of a symposium sponsored by the New England River Basins Commission. See The Ocean's Reach, Boston: New England River Basins Commission, February, 1976. A recent report sponsored by the Open Space Institute and Natural Resources Defense Council: "The Status of the Barrier Islands of the Southeast Coast," Longden Warner, May, 1976, also suggests that public funds are in fact providing a stimulus to "rapid and destructive development" of the barrier islands fringing the Southeast coast of the United States.

10. From the Committee report on P.L. 930251, House Report 93-541.

11. Acquisition of natural valley storage areas in the Charles River basin is currently being funded under Section 1 of the Water Resources Development Act of 1974.

12. Proposed Regulations, Part 1910, "Criteria for Minimum Land Management and Use," HUD, 1976. With regard to barrier islands, Robert Hunter, acting administrator of the Federal Insurance Administration, has declared, "FIA strongly discourages any development on barrier islands because of the significant dangers to life and property from flooding that is present there."

13. WRC, Draft Report, A Unified National Program for Flood Plain Management, June, 1975.

14. Two recent EPA studies have documented this relationship: EPA, "Secondary Impacts of Transportation and Wastewater Investments: Review and Bibliography," January, 1975 and EPA, "Secondary Impacts of Transportation and Wastewater Investments: Research Results," July, 1975.

15. Dune stabilization and beach nourishment programs have in some cases been found to adversely affect natural buffering functions. See Godfrey and Godfrey, "Comparison of Ecological and Geomorphic Interactions Between Altered and Unaltered Barrier Island Systems in North Carolina," and Dolan, "Barrier Islands: Natural and Controlled" in Coastal Geomorphology ed. by Donald Coates, Binghamton, New York, State University of New York, 1972.

The Visual Environment

VISUAL ENVIRONMENT

SUMMARY OF FINDINGS

From July 11 to July 15, 1976, 1.5 million people became aware that Boston had a waterfront. They also experienced the inaccessibility of the waterfront--to view the tall ships of Operation Sail, most people were forced to cram together in a few isolated corners of abandoned piers, vie for window spaces in high rise luxury apartment buildings, or pay fifteen to forty dollars for a ride on a harbor cruise ship.

The point: very little access to the scenic aspects of the coastal zone exists in the Boston Metropolitan Region, a situation paralleled in many other areas along the Massachusetts coast where the public's desire to enjoy the visual amenities of the coastal zone has been pre-empted by other values.

Of the many issues which concern Massachusetts Coastal Zone Management, protection of scenic values and opportunities is perhaps the least tangible. This does not mean, however, that management of visual quality should be ignored, especially since any alteration in the coastal zone will naturally have visual impacts. Whether these impacts are, in balance, beneficial, or adverse, depends in large part upon deliberate planning and management to make desired impacts actually happen. It is, therefore, essential that a comprehensive management program for the Massachusetts coastal zone include a visually-oriented element.

In contrast to other management decisions affecting the coastal zone for which quantifiable data can be used to determine levels of acceptability, resolution of visually related issues must often rely on qualitative values and judgements. Recent research, however, indicates that some degree of consensus exists in terms of the landscape qualities that people perceive to be visually appealing. There appears to be general agreement that visual quality is strongly linked to the level of complexity of the viewed scene--harmony of visual elements is desired, but there must be sufficient variety for the scene to be interesting and not monotonous.[1] The presence of water, as well as movement (two characteristics common to coastal views), have also been found to enhance preferences for visual quality.[2] Further, naturalistic landscapes are generally preferred over man-dominated ones[3]--physical modification of natural waterfront configurations, visual evidence of pollution or other forms of human intervention are undesirable qualities.[4]

These results suggest, as one would expect, that coastal landscapes which offer views of the water, a cohesive variety of natural elements, contrasting changes in topographic relief and interesting vegetational patterns, and are relatively free from disturbance by man's activities will be the most valued by local residents and

visitors alike. Identification of significant coastal scenic resources by CZM, as well as subsequent management, will be guided by these findings, and by values placed on scenic resources through the citizen advisory process.

On the state level, two basic concerns of Coastal Zone Management will be to increase visual access opportunities for the general public, especially in the more developed and urbanized areas, and to ensure that major facilities which require siting within the coastal viewshed are designed to be visually compatible with natural coastal characteristics.

Management of visual resources will require considerable input and implementation at the local level. Uses such as housing, for example, which are responsible for significant impairment of visual access, can best be regulated through community zoning. Conservation of "townscape" qualities and significant historical or cultural assets will require application of imaginative legal solutions to prevent visual degradation from adjacent environs.

While natural features and man-made features of historical, architectural, or cultural significance provide the coast with its greatest visual assets, coastal dependent activities, such as commercial shipping and fishing are also important integral elements of the visual environment of the coastal zone.[5] Their facilities and operations need not always be viewed as eyesores. If access to them is carefully designed, they can provide interesting visual and educational opportunities. Further, views of urban harbor areas can be increased if physical access to the waterfront is provided around facility perimeters.

Finally, management of visual resources may in some instances require application on a "corridor" basis, since both natural and man-made elements will be viewed as a continuous set of images along major transportation and recreation networks.

THE COASTAL VIEWSHED

Views of unique scenic attributes of the coastal zone, whether natural or man-made, are constrained by intervening topographic features, vegetation, or man-made elements. Natural ridges, dense stands of trees and understory shrubs, and man-made structures and facilities will block both views to the shoreline and water and views of the coastal landscape from the water. Typically the inland boundary of these views will be the first major ridge line or change in topographic relief (see diagram below).

When natural vegetation or man-made structures obstruct views within this zone, the visual boundary, or "viewshed" limit is moved toward the water (see diagram below). The latter condition defines

the existing viewshed, the former, the potential viewshed within which vistas of the coastline could be created through, for example, selective removal of vegetation, or the removal or modification of obstructing buildings and facilities. It is within these boundaries that management of coastal scenic and visual resources will be most relevant. Also of concern to CZM are elevated positions outside of the viewshed, such as hilltops or observation towers, since they may provide views (visual access) to elements within the viewshed, or may be visible from locations within the viewshed.

An approximation of the relative abundance of visual access to the shoreline is given in the chart below. The bar graphs display the ratio of acres of undeveloped land with existing or potential views to each mile of shoreline in the coastal regions, excluding the Boston urban area. As would be expected, the amount of visual access is generally less in the more densely developed areas, e.g., the lower North Shore and the South Shore. This type of analysis was not possible in the Boston Metropolitan area due to the difficulty in constructing an accurate viewshed in a heavily developed area. Obviously, however, such a graphical depiction for Boston city proper would show a limited amount of undeveloped land across which views of the shoreline would be possible.

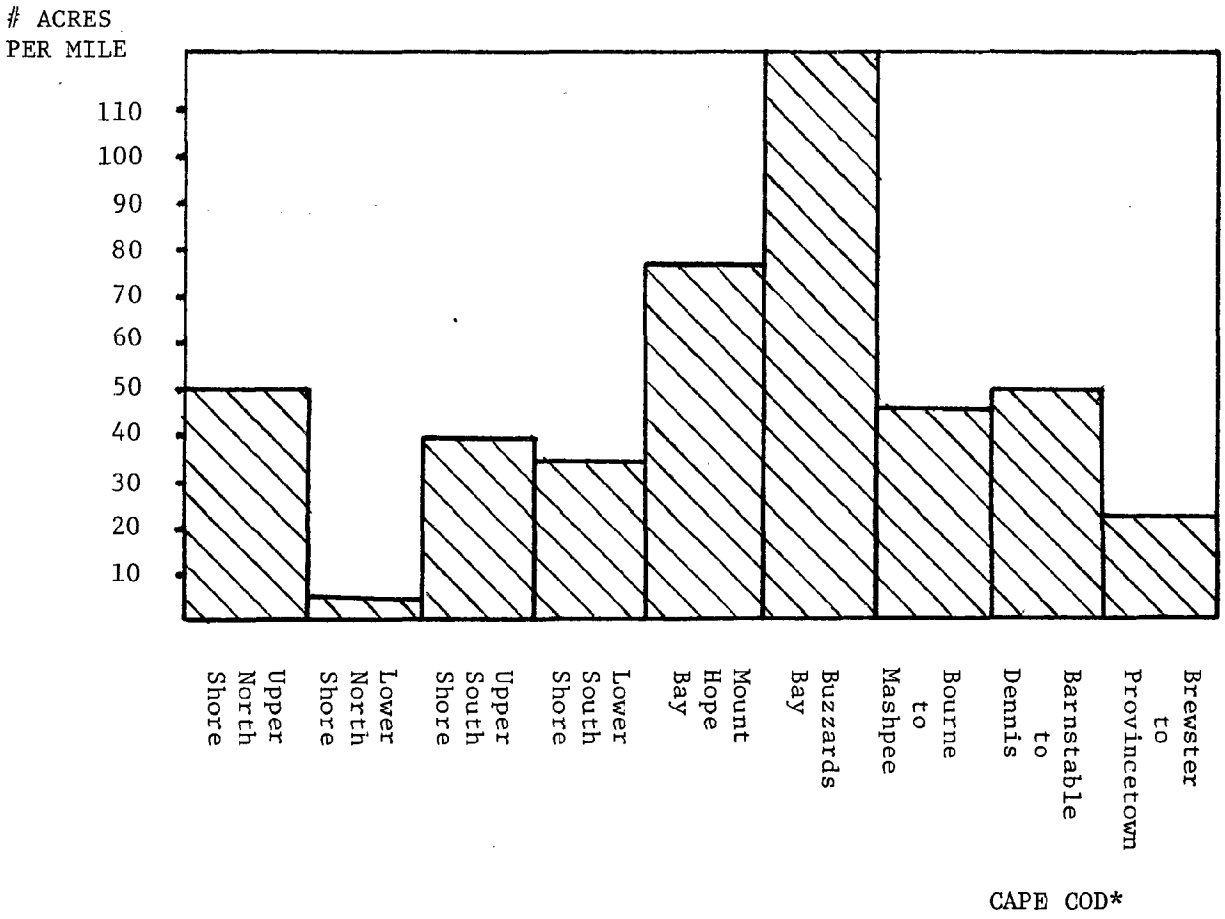
Within the coastal viewshed, natural and man-made visual elements may be either of a point (e.g., Boston Light), areal (e.g., Barnstable Marsh), or linear nature (e.g., the North River). In the following sections, visual attributes of point and areal features of natural, historical, architectural, or cultural significance are discussed, as well as impacts of contemporary human activities. Linear elements are then discussed in terms of their importance as visual corridors within the coastal zone.

VISUAL ATTRIBUTES OF NATURAL COASTAL FEATURES

Within the coastal viewshed, the wide variety of natural elements provide a great diversity of scenic attributes unique to the coastal zone. Individual perceptions of the visual quality of these features may vary considerably and may be greatly tempered by the psychological disposition and cultural background of the observer (e.g., their mood, educational background, geographical origin, etc.) as well as by other aesthetic or preference factors (e.g., odor, smell or suitability of the viewed area for recreational activity). For example, a salt marsh may be viewed as a pleasing, tranquil coastal scene by an infrequent visitor to the coastal zone, while the same marsh may be seen as an aesthetic nuisance by a local resident because of its odor or because a channel must be periodically dredged through it for recreational boat access.

Generally speaking, however, the research findings discussed earlier and the fact that a great number of Massachusetts residents

RELATIVE AMOUNTS OF UNDEVELOPED LAND WITHIN REGIONAL POTENTIAL VIEWSHEDS



* Figures do not include National Seashore.

flock to coastal areas in the summertime would seem to indicate that most coastal features are deemed visually appealing. Visual attributes of specific coastal environment types which contribute to their attractiveness are highlighted below:

Coastal Environment	Scenic Attributes
Beaches and Sand Dunes	* sense of infinite space, immense scale and rhythmic motion * soft, rolling forms, accentuated by the lack of tall vegetation * effects of wind and salt spray visibly evident in natural vegetation patterns
Bluffs and Rocky Shores	* high visibility of natural dynamic forces at work, constantly changing the face of land forms * appearance of great size and height when undeveloped * strong visual contrast between vertical headlands and horizontal beach * effects of wind and salt spray visibly evident in natural vegetation patterns on bluff crests
Points, Spits, Bars, Islands	* dramatic sense of visual contrast conveyed by narrow landforms against open expanses of water * focal points add variety and interest to coastal views provide a point of reference to boaters
Tidal Flats	* visual evidence of marine life patterns during periods of low tide
Salt Marshes and Ponds	* tranquil, open expanses of views to the water and interior areas framed by surrounding vegetation * interesting visual contrasts along marsh edges * visual evidence of the natural order of marine life * uniform, muted colors

Coves and Embayments	* sense of enclosure and of protection from natural forces (wind, waves, etc.) * visual evidence of marine life patterns when viewed from elevated observer positions--changing colors, depths, and bottom conditions * unseen elements provide sense of tranquil mystery and serenity
Estuaries and Lower River Reaches and Mouths	* strong visual evidence of natural dynamic forces--tides, fresh water flow, etc. * strong sense of enclosure and protection * visual evidence of changing patterns of marine life * visual access to inland areas
Flat Lands and Coastal Plains	* interspersed views of water and shoreline framed by vegetation and natural topographic relief * dense, low, uniform vegetation patterns visible in tiers perpendicular to the coast

MAN-MADE FEATURES OF HISTORICAL, ARCHITECTURAL, OR CULTURAL IMPORTANCE

The Massachusetts coastal zone is dotted with a number of man-made features of historical, architectural, or cultural significance that are as important to the visual quality of the coastal zone as the natural features discussed above. In an age characterized by the visual dominance of the automobile, proliferation of nationally standardized fast-food services, and general "plasticization" of the landscape, the real "sense of place" offered by many of the Massachusetts coastal communities, e.g., Marblehead, Rockport, Provincetown, and Nantucket, stands in vivid contrast. "Townscapes" such as these, as well as individual historic sites, such as Boston Naval Shipyard and Salem Maritime National Historic Site, or historic districts, such as Newburyport's Market Square and New Bedford's Fort Tabor, are important because of their visual continuity with the past, their harmony with natural coastal features, the pedestrian scale of the access they provide to the water and its activities, and because of their distinct ethnic or cultural characteristics. With their linkage to the past and their architectural beauty, they provide a diversity of special neighborhoods and places off the beaten path of contemporary society. Additionally, these types of man-made developments are typically major focal points for tourism and catalysts for urban

redevelopment (e.g., Boston, Newburyport, and Salem), thus contributing substantially to the economic viability of the coastal zone.

CONTEMPORARY DEVELOPMENT IMPACTS AND VISUAL ACCESS

Coastal scenic resources are acutely vulnerable to human activities and development. Through development of facilities and structures that either obstruct views or are visually unrelated to the coast, the scenic quality of the Massachusetts coastal zone has been and will continue to be seriously degraded. Conversely, balanced development of coastally dependent uses in selected areas along the coast would provide a wide diversity of visual experiences, as well as opportunities for the public's interaction with such commercial activities as fishing, maritime shipping, energy production, shipbuilding and recreational boat building, repair and storage.

Marine Terminals and Energy Facilities: Because of operational requirements which typically necessitate the use of flat, open, waterfront land, shipping and energy related facilities can be the most visually intruding facilities along the coast. Huge loading cranes, bulkheads, warehouses, exhause stacks, cooling towers, transmission lines, and tank farms can drastically block visual access and alter the visual impact of natural coastal features. Given their immense scale and industrial nature, however, it is unrealistic to propose that the larger facility components be screened or blended into the coastal landscape. Another approach would be to recognize that these facilities are integral elements of the coastal "scene"--their appearance and design reflects their functional relationship to the coast. Therefore, opportunities for visual access to them should be utilized. While views of harbors and natural features can be maintained through simple alignment of facilities perpendicular to the coast in the traditional wharf style, immense educational opportunities could be afforded to viewers of the facilities themselves. Through use of guided tours on overhead walkways or provision of observation platforms, viewers could observe berthing, loading, shipbuilding and repair, energy production, and pollution control operations. Naturally, visual access will be constrained by factors limiting physical access--safety, security, maintenance, production efficiency, and cost. Additionally, ancillary components, such as oil storage tanks, could be sited inland where natural land forms and vegetation can be used for screening, or they can be designed with imaginative exteriors (e.g., the "CORITA" gas tank in Dorchester).

Commercial Fishing Facilities: Commercial fishing facilities for berthing, handling, and processing operations represent another human use of the coast that can provide a rich diversity of visually contrasting and exciting elements. Unlike industrial uses, commercial fishing piers are generally perceived to enhance

the seafaring image of coastal communities, and in some areas, may generate considerable tourist interest. However, views of these activities may be partially or totally obstructed by the presence of processing plants which may or may not be waterfront dependent (see Ports and Harbors' section). To compensate for losses in direct visual access to the shoreline and open expanses of water, access to interesting aspects of facility interiors and operations could be provided, as well as to the shoreline along facility exteriors. Non-waterfront-dependent facilities should be located inland, where feasible.

Housing: Of the development types which constrain visual access along the Massachusetts coast, housing is by far the dominant activity--90% of all developed land in the Massachusetts coastal zone is consumed by housing. Since lot sizes are generally decreasing from one acre to ¼ or ½ acre plots, opportunities for visual access between structures across expanses of open space are becoming scarcer. Additionally, because residential activities are traditionally private, there is little of the visual interest and stimulation associated with port and fishing activities, except where historical or exceptional housing design exists and is open to view. In urban areas, however, the amenities associated with waterfront living may be essential to housing revitalization and the survival of downtown areas. Zoning and other land use controls can be used to maintain visual access to the coast in residential areas. Further, selective clearing of vegetation to provide views of the shoreline from inland sites within the viewshed could provide housing sites as equally appealing as waterfront locations and would minimize obstruction of visual access along the shoreline.

Recreation and Tourism: Extensive opportunities for visual access to natural amenities and sites of historic, architectural, or cultural significance are generally associated with recreation and tourism development. Cycling and hiking trails can provide physical access to scenic areas undisturbed by the visual dominance of the automobile, and boaters can gain exposure to coastal and riverine views unaccessible by other modes of travel. Unfortunately, the visual blight of strip development typically accompanies these uses, as do visually degrading parking and access facilities. To the extent that these ancillary facilities can be set back and screened with earth forms and vegetation without diminishing their utility, adverse impacts can be alleviated. Regulatory and zoning controls, such as sign ordinances can also be used to prevent the visual blight associated with strip development.

Public Service Systems: As growth inducers, transportaton networks and utilities significantly affect the visual environment of the coastal zone. Subdivision patterns based on geometric utility and road layouts rather than concern for natural site characteristics may diminish opportunities for visual access. The

visual appearance of natural features is also degraded when extensive clearing and regrading is done. Roads and rail corridors constructed parallel to and in close proximity to the shore restrict visual access from viewing points landward of the facilities. Similarly, these facilities restrict views of the coast from the water. On the other hand, properly designed roads with alignments and scenic overlooks that allow the traveler to sense the rhythm of the landscape, as well as view distant elements, offer innumerable visual and sensory experiences for the traveler.

Shoreline Protection Projects: Construction of coastal engineering works introduces materials and geometric forms that are sometimes inconsistent with natural shoreline configurations and elements. Obviously, protection of life and property will outweigh concern for visual quality in areas where these types of facilities can be justified. However, these structures should be designed to reflect natural forms and textures and provide as much visual access as possible. For example, use of rip-rap rather than poured concrete and steel, terracing of dikes and seawalls, and the use of salt tolerant vegetation plantings can help to minimize their impact.

Agriculture: Among all the human activities that take place in the coastal zone, agriculture typically provides the most opportunities for visual access; e.g., across cranberry bogs and salt marsh hayfields. Agricultural components of the rural landscape provide considerable visual diversity when interspersed between urban areas. Unfortunately consumption of agricultural land for housing and other uses remains prevalent. To the extent that the Agricultural Assessment Act and other incentives reduce pressure for the sale of farm land to developers, the visual assets of maintaining agricultural uses of coastal lands can be conserved.

VISUAL CORRIDORS

Each of the scenic features and contemporary activities discussed above will have positive or negative visual impacts when seen from specific viewing points within the viewshed or from elevated observer positions landward of the viewshed boundary. As motorists, rail passengers, cyclists, hikers, and boaters traverse the coastal viewshed, they will also experience these visual impacts sequentially. Contrasting development patterns, varying from sparsely settled agricultural areas to dense urban regions, will convey visual images that will vary with the speed of the traveler and the exposure of both natural and man-made elements to view. The design of a road or trail right-of-way, or the complexity of a river's course, will compliment visual quality to the degree that the motion or rhythm of the landscape can be felt while travelling along the corridor. Additionally, views of the everyday or commonplace landscape will be important for the

contrasts they provide to more unique and dramatic scenic features.

Therefore, protecting visual quality along these visual corridors, as well as at individual sites or point elements, will be relevant to management of coastal zone scenic resources. Specific corridors with outstanding visual attributes may merit designation as special "scenic corridors." If land use and development can be controlled within them or imaginative opportunities for visual access can be provided, scenic quality can be preserved for the benefit of the traveler or recreationist who enjoys the experience of "getting there" as well as "being there."

Of additional concern to the management of visual corridors is the control of billboards and other forms of outdoor advertising. Since they are designed to attract the eyes of travelers, they obviously will have significant visual impact and typically will detract from natural scenic values. Outright prohibition of billboard advertising, whether on-site or off-site, is unrealistic--the information provided to travelers concerning services is for the most part necessary. However, in areas where natural scenic quality might be seriously impaired by billboards and other forms of advertising, it may be necessary to restrict or completely prohibit their usage.

OBJECTIVES

The foregoing discussion suggests that a management program for the coast's visual environment should be designed to achieve the following objectives:

1. to preserve, enhance, and restore the integrity of the coastal zone as a visual unit with unique sensitivities and opportunities

2. to increase opportunities for visual access to natural and man-made scenic features and contemporary waterfront activities

3. To ensure that the siting and design of major facilities that are of regional or state concern will be compatible with the inherent visual qualities of the coastal zone; and

4. to assist in improving compatibility between small scale development and local visual character.

CZM POLICIES AND PROGRAM RECOMMENDATIONS

Policy (14) Maintain a state level inventory of visually important areas within the coastal viewshed that are of regional, state, or national concern. Include natural areas and sites of historical, cultural, or commercial significance that are unique for their scenic and visual attributes or for their interest and educational value.

Prior to the implementation of management measures dealing with visual access and quality in the coastal zone, it will be necessary to develop an adequate data base, whereby visually important areas can be identified, mapped and evaluated. Factors to consider for inclusion of areas in the inventory should include:

1. existence of the area within the boundaries of the coastal viewshed (both potential and existing)

2. evaluation of visual qualities by local citizenry

3. availability of visual access, including physical, operational, or institutional constraints

4. the size and seasonal aspects of existing and potential viewing populations

5. for natural areas, the scenic quality of the area, as evaluated for diversity of viewed elements, uniqueness, amount of disturbance by human activities, presence of

water views, and other factors

6. for developed areas, the historical, cultural, and/or educational value of the architectural elements or contemporary coastal activities.

IMPLEMENTATION

Using primary data sources, such as the Massachusetts Landscape and Natural Areas Survey, the National Registry of Historic Landmarks, and the Massachusetts Historical Commission, CZM has initiated this inventory process. Maps identifying visually important sites have been reviewed and updated by the CZM citizen advisory groups and have been supplemented with information provided by field verification and various knowledgeable experts. Evaluation of these point, areal, and linear sites provides the basis for assigning general priorities to areas in need of management at the state and local levels and for targeting specific areas to be included in CZM special assistance programs.

Policy (15) Incorporate visual concerns into the early stages of the planning and design of facilities proposed for siting in the coastal zone. Establish a design review process for development that is of regional, state, or national concern.

Because of their intangibility and supposed insignificance relative to other economic and environmental concerns, visual impact considerations are often overlooked or left to the last in the planning and design of both private and public development. In order to facilitate incorporation of design measures for minimizing adverse effects on visual access and existing scenic attributes at an early stage in the planning and design of proposed facilities, CZM will develop and distribute a conceptual guideline handbook. Basic concerns to be addressed in this handbook will include, for example:

1. recommendations on facility siting and design for specific coastal visual environment types

2. measures to minimize impairment of visual access or to enhance visual access through physical access provisions

3. measures to blend facilities with existing topography, vegetation, and other scenic qualities

4. legal and institutional measures available to communities to maintain visual access and quality

5. methods for evaluating potential visual impacts and identifying affected viewing populations.

As a prelude to development of such a handbook, general guidelines are presented below for the coastal environment types most likely to be subjected to intensive development:

Sand Dunes*:	Structures should be limited in height and setback behind primary dune ridges to avoid interruption of the visual forms of rolling dune ridges or impairment of views to the water. Residential units should be clustered in vegetated areas, and road construction should minimize cutting and filling of natural topography. Only indigenous vegetation should be planted.
Points, Spits, Islands:	Structures should be limited in height to avoid disruption of the silhouettes of natural promentories (except for lighthouses and other navigation aids). Construction materials should blend with indigenous colors, textures, and forms.
Coastal Plains and Flat Lands:	Development should be clustered in vegetated areas, setback from the shoreline, and mixed with open expanses of agricultural or undeveloped land. Topographic features should be used to screen development and ancillary facilities such as roads and parking lots. Development densities should vary, with occasional changes in building heights and mass to provide interest.
Developed Harbors and Embayments:	Boating facility and marine terminal development should conform to existing shoreline configurations to the maximum extent possible, and building heights should be limited to maintain views of the harbor. Pedestrian physical access should be provided around facility perimeters. "Seafaring" qualities should be maintained and enhanced.

In general, views of natural features and man-made features of historical and cultural importance should not be obstructed or degraded. Where coastally dependent facilities must be sited along the waterfront, views to interesting aspects of facility operations or physical access around facility perimeters to provide views to the water should be provided to compensate for negative visual effects. To the extent possible, construction materials should blend with indigenous colors and textures, or should enhance the visual quality of areas that have been degraded through previous development activity. Cutting and filling of natural topographic features should be minimized, and vegetation planting and complimentary earth forming techniques should be employed to screen unsightly facility components.

*NOTE: These recommendations relate only to visual concerns and as such do not reflect ecological considerations for facility siting and design.

Alignment of roads and other transportation corridors should conform to existing topography and avoid obstruction of coastal views from interior areas, while maximizing visual opportunities for the traveler. Utilities systems should be placed underground.

Based on the above considerations design review of proposed state and federally financed facilities will focus on the following concerns:

Facility Visibility:	Using the coastal viewshed delineation or by constructing a "local" viewshed around proposed facility sites the magnitude of affected viewing populations will be determined (e.g. approximate numbers of viewers can be estimated from aerial photos and census tract data, numbers of transient viewers can be estimated from average daily traffic volume data and identification of recreational boating patterns)
Visual Access:	Effects on visual access will be analyzed through identification of key viewing points within and outside of the local viewshed. Opportunities for enhancing physical access in conjunction with proposed development will be identified, as well as opportunities for providing views to facility interiors and operations.
Proximity to Visually Important SRA's	CZM's inventory of significant visual elements will be used to assess potential affects on adjacent sites of cultural, historic, or educational importance.
Compatibility with Existing Visual Character	Structural heights and masses will be assessed in relation to surrounding topographic relief, vegetation, and existing structures. Construction materials will be evaluated for compatibility with indigenous colors and textures.
Other Visual Impacts	Exhaust emissions and other impacting factors will be assessed for their effects on visual quality.

IMPLEMENTATION

--A-95, NEPA, MEPA Review - Distribution of the guideline handbook and CZM's maps of visually important SRA's and coastal viewsheds will facilitate incorporation of visually-related concerns into the siting and design of facilities financed with federal or state funds. CZM will network with the relevant agencies to ensure compliance to the maximum extent feasible and will use A-95, NEPA, and MEPA review processes to raise objections where visual access or quality would be significantly impaired. For major facilities, depending on their magnitude and location, CZM staff will elicit the assistance of a design review board composed of experts in the fields of environmental design, architecture, and landscape architecture.

Policy (16) Provide funding or technical assistance to communities and local conservation commissions in the development of local zoning and land use controls which can be utilized to improve visual access and the compatibility of proposed development with existing community character.

Among the legal tools that are applicable to achieving visual and aesthetic goals, the following are most relevant:

Cluster Zoning: PUD Zoning	Exceptions are granted to developers to aggregate housing units in exchange for providing open space. Overall density of development is maintained, but views to the coast can be provided across open space areas, and siting and design of clustered units can optimize integration of manmade elements with natural topographic and vegetation features.
Transfer Development Rights:	Development rights on one parcel are removed and transferred to a second parcel where more intensive development can take place. Development is limited on the first parcel. Can be used to regulate building heights and densities, providing for a stepped progression from low, sparse development along the shore to denser, higher development inland.
Density Bonus:	More intensive development rights are granted to developers in return for open space or other public amenity provisions. Visual or physical access to the shore can be provided across open space, or on-site recreation benefits can be gained.
Easements:	Development rights are purchased or tax incentives are granted the developer by the town to limit development and provide open space. Visual or physical access to the shoreline can be gained across open space areas.
Performance Zoning:	Stipulations are made as to allowable impacts of particular activities or as to design specifications to which proposed development must conform. Visual character of existing structures and community can be maintained over time.
Historic District Zoning:	Design of exteriors within public view are subject to local planning board or design review board approval. Negative intrusions on visual character of structures of historical significance can be prevented.

IMPLEMENTATION

--Zoning Enabling Act (Acts of 1975, Chapter 808) - Authorities to implement these measures are provided in this act. The Massachusetts courts have upheld that aesthetics alone may justify the exercise of the police power within the broad concept of protecting "general welfare."[6] Depending on local needs and desires, CZM will provide either funding or technical assistance to communities within Special Assistance Areas to develop model zoning codes and other forms of visually related controls (see Program Incentives section, Management chapter).

Policy (17) Expand visual access in urban areas and provide views of coastally dependent activities with significant educational or interest value.

Outright acquisition of waterfront land in urban areas or acquisition of easements should be utilized in conjunction with recreation and open space programs to expand visual access. These measures can be used to develop new waterfront parks in Special Assistance Areas and to provide pedestrian or bicycle access around facility perimeters to views of harbors and other coastal activities and natural features. Additionally, it may be feasible to procure physical access to afford views of marine terminal, ship building and repair, and commercial fishing operations.

Factors to be considered for determining target areas and facilities should include:

1. viewing population served
2. extent and quality of harbor views that would be offered by improved physical access.
3. potential educational value of viewing waterfront facility operations and components
4. maintenance, security, and safety problems that would result from expanded public access
5. cost feasibility

IMPLEMENTATION

--State Programs - Potential state level funding sources to improve visual access in urban areas in conjunction with new open space and recreation opportunities include the Self-Helf Program and capital outlay programs of the Department of Environmental Management the Metropolitan District Commission and the Public Access Board. (see Recreation section) CZM will also work with Massport, local

port authorities and private interests to investigate opportunities to provide visual access to contemporary coastal dependent facilities.

--Federal Programs - Potential sources include the disposition of surplus properties by the General Services Administration, the Land and Water Conservation Fund of the BOR, HUD's Community Development Block Grants Program, and Coastal Zone Management Act, Section 315 funds. (see Recreation section).

Policy (18) a. Provide technical assistance to the Departments of Environmental Management and Public Works in the designation and management of Scenic and Recreational Rivers and Scenic Highways located in the coastal zone.

b. Petition the Board of Outdoor Advertising to designate sign free areas and corridors in the coastal zone, support the development and implementation of a system of roadside information service directories, and provide technical assistance to communities in the development of local advertising and signage ordinances.

IMPLEMENTATION

Scenic Rivers

The Scenic and Recreational Rivers Act, M.G.L., Chapter 21, Section 17A provides for the designation and restriction of rivers of the Commonwealth for scenic and recreational purposes. As legislated, the authorities of this act include regulating the alteration or pollution of designated rivers and contiguous land within 100 yards of their banks. CZM recommends that segments of certain rivers within the coastal zone be included in this system and that restrictive orders be developed which will protect their irreplaceable scenic and recreational values. Designation and subsequent management should be strongly responsive to local interests and could vary from river to river. As a prerequisite to designation, community groups requesting designation should prepare preliminary management plans demonstrating how the concerns expressed in the act as well as local concerns would be incorporated into a program for managing future development and activities in the river corridor. Alternative controls that could be implemented include, for example:

1. require, as a minimum level of control, building setbacks which would allow for the preservation of a vegetated buffer strip to screen development along river banks. Adoption of minimum lot sizes, maximum heights, cluster zoning and exterior appearance performance standards should be encouraged as more effective means of control. Where these controls would be insufficient for preservation of

irreplaceable scenic qualities, land use zoning should be adopted that would permit only those uses consistent with existing visual character.

2. restrict construction of major dams or impoundment of water, except for fishery management and other uses which would not adversely affect scenic quality.

3. restrict development of major roads and river crossings, and suggest scenic road designations.

4. prohibit development in sensitive natural areas along the river course, e.g., floodplains, wetlands, steep slopes, exposed bedrock, unstable soils.

5. encourage access and shoreline recreational uses consistent with the aesthetic character of the river

6. encourage water activities consistent with the aesthetic character of the river, and where necessary impose speed limits, water surface zoning, or other restrictions.

CZM will develop a Memo of Understanding with the Department of Environmental Management concerning regulations and guidelines for implementation of the program in the coastal zone. Criteria to be considered in the selection of rivers for designation include:

1. local interest in scenic river designation.

2. accessibility of the river to existing and potential viewing populations and recreationists; availability of existing and potential access points.

3. the diversity of natural features and intactness of bank vegetation and other natural features - the degree of intrusion of adverse human development.

4. the degree of modification of the free flowing nature of the river.

5. suitability of water quality for recreation activities and ecological sensitivity to recreation-related impacts.

Furthermore, rivers and estuarine complexes located in designated Areas for Preservation and Restoration should be given highest priority in the Scenic River designation process.

Scenic Highways

Efforts to protect the state's scenic roads and highways have been limited to date, with the exception of the Scenic Roads Act. (MGLA, Chapter 40, Section 15C). Under this act, local planning boards are empowered to restrict the removal of vegetation or stone walls on designated local roads, exclusive of numbered routes or state highways. To the extent that these powers are complimented by local zoning, scenic qualities along local roads can be adequately protected.

On the state level, a scenic highway assessment process has been initiated by the Department of Public Works. In a preliminary study,[7] scenic qualities of primary roads throughout the state have been assessed to develop a preliminary ranking of roads meriting designation as Scenic Highways. Three major groups of criteria were used in this process:

1. Context: Scenic qualities were evaluated in terms of the number of landscape types encountered (diversity) and the degree to which landscape types differ (contrast).

2. Viewshed: Highway segments within bounded, open, unified viewsheds were evaluated quantitatively as to length, and qualitatively for openness of the highway corridor and the number of significant landscape features which can be seen by the traveler.

3. Corridor: Highway segments were evaluated for their alignment characteristics and the sequential arrangement of roadside landscape elements (e.g., vegetation, development, terrain, water).

These criteria have enabled a macro scale evaluation of potential scenic highways. As suggested in the study, further assessments at the micro scale are needed to make a final determination. CZM will assist further evaluation of coastal zone highway segments on the basis of criteria recommended in the study:

1. Resource linkage: CZM will use its maps of Significant Resource Areas, Special Assistance Areas, and Areas for Preservation and Restoration to identify the relationships of particular highway segments to significant coastal zone resources.

2. Field verification: CZM will use its mapped data and citizen value information to identify and evaluate visual "misfits" or eyesores, small scale focal points, character and quality of local development, traffic flow problems and safety hazards, and the quality and condition of road design.

3. Scenic potential: CZM, on the basis of its viewshed analysis and from its inventory of scenic elements and citizen evaluations, will recommend optimal locations for scenic overlooks, rest stops, and other roadside facilities, and will identify areas with potential for improving visual access through easement purchase and/or selective clearing of vegetation.

Alternative means for protecting visual quality in areas adjacent to designated scenic highways are currently being evaluated by the Department of Public Works. Basic existing authorities include powers of eminent domain or purchase in fee or lesser

interest in land within or adjacent to Federal-Aid Highways for the purpose of scenic enhancement. Whatever the management system adopted, CZM strongly recommends that designated scenic highways be exempted from statewide highway design standards which would necessitate the widening, straightening or flattening of road right of ways and alignments. The compatibility of scenic highways to the landscape - the fact that they "fit" with natural topographic and vegetation features - is basic to their scenic value.

Outdoor Advertising

Billboards, signs, and other advertising devices are currently regulated in Massachusetts through permit procedures administered by the Outdoor Advertising Board. Rules and regulations promulgated by this board prohibit the use of off-premise billboards and other forms of advertising along primary roads in areas that are not zoned commercial/industrial or are not of a predominant business character. The board also has the power to designate areas of historical, scenic, or environmental significance as Sign Free Areas or Sign Free Corridors, wherein no permits for advertising will be granted or renewed.

In order to reduce the adverse visual impacts of outdoor advertising in the coastal zone, MCZM will:

1. Petition the Board of Outdoor Advertising to designate specific sign free areas and corridors.

2. Support the development and implementation of a system of roadside information service directories in areas where outdoor advertising is prohibited.

3. Provide technical assistance to local communities in the development of advertising and signage ordinances which can improve the effectiveness of current state level controls.

TECHNICAL NOTES AND SOURCES

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   Zube, Ervin H. Scenic Resources and the Landscape Continuum: Identification and Measurement. Ph.D. dissertation, Graduate School of Geography, Clark University, 1973.

3. Kaplan Stephen, Kaplan, Rachel, and Wendt, John S. "Rated Preference and Complexity for Natural and Urban Visual Material," Perception and Psychophysics, vol. 12, no. 4 (1972).

   Lowenthal, David. "Not Every Prospect Pleases--What is our Criterion for Scenic Beauty?" Landscape, vol. 12, no. 2 (Winter, 1962-3), pp. 19.

   Zube, Op. cit.

4. Litton, Op. cit.

5. Results of the recent CZM public opinion survey indicated that 81% of the Massachusetts residents polled felt that views of the water and its activities were important.

6. In John Donnelly & Sons, Inc., vs. Outdoor Advertising Board (339 N.E. 2nd 709, 1875 Mass. Adv. Sh. 3450), the Court found that cities and towns may enact reasonable billboard regulations designed to preserve and improve their physical environment, thus establishing a precedent for zoning based on aesthetic or visual concerns.

7. DPW/U. MASS. Joint Transportation Program. A Scenic Highway Assessment Process for Massachusetts Highways. May 1975.

Ports and Harbors

PORTS AND HARBORS

SUMMARY OF FINDINGS

Protected bays and river mouths have special value to Massachusetts. Such coastal features have traditionally provided stable waterfront for piers, wharves, warehouses, and other facilities. Hence, these areas have developed into our major ports of water related industry and trade.

The contribution of ports to the Massachusetts economy is not merely a phenomenon of times past. Various water related industries now operating in the major ports directly employ approximately 50,000 persons. Some waterfront uses are predicted to decline or remain static; these include general cargo not shipped by container and dry bulk cargo. Others, including container shipping, ferry services, marine industry and recreational boating, exhibit a potential for development and a growing need for harborfront space. With the enactment of the 200-mile limit legislation, Massachusetts looks toward a significant revival in its fishing industry. And, if substantial quantities of oil and natural gas are discovered on the Georges Bank, we expect to accommodate this trade in our ports also.

Yet the traditional water related industries of our ports are not homogeneous. Fishing, maritime shipping of goods and people, other marine industry and services such as ships and boat yards and recreational boating are all vital port activities. All accrue economic benefits to the citizens of the state. Yet in some instances, these activities may compete for waterfront space and, at times, one use is not compatible with another.

The severest competition for harborfront space occurs in ports having navigable channels of 20 foot depth or more and a developed transportation infrastructure. These ports are most suitable for maritime shipping and marine industry. However, many of these areas are major fishing industry ports, and, as urban centers, face pressure for neighborhood and urban waterfront renewal. In addition, while the lack of deeper channels makes the siting of a marine terminal impossible in shallow harbors, no such constraint exists for recreational boating traffic or other uses requiring shallow drafts in deeper waters. Hence such ports face competition from the whole range of waterfront uses which may or may not have other siting options.

The cost of establishing other deepwater channels, with adequate infrastructure, and available sites abutting the channels is prohibitively high. Existing deepwater channels are ideally suited for accommodating uses which are of state or national importance

because they provide protein (fisheries), are key parts of the transportation network (maritime shipping) or support maritime shipping (tugboat services, ship repair yards) and energy exploration, development, and delivery (OCS support bases, etc.). Hence the navigable channels of 20 foot depth or more together with their abutting lands and inland transportation access routes should be treated as important state resources.

In port areas and smaller harbors lacking both the channel depth and the transportation and utility infrastructure to support major maritime shipping, marine industry, and the fishing industry, assistance is needed to help develop facilities for recreational boating, ferry services, and small-scale fishery operations. The mixture of recreational craft, fishing vessels, and ferry services lends an image of bustling harbor activity which makes views of the harbor highly attractive. Thus these kinds of waterfront dependent activities can enhance the character of waterfronts and can complement urban waterfront renewal.

Lastly, as discussed under the Marine Environment section, the dredging of relatively pristine coastal areas can have long lasting and severe adverse effects on marine productivity. By ensuring maximum use of existing ports and harbors and their facilities, benefits from public expenditures will be maximized, future public costs minimized, and the marine environment conserved. The creation of new ports and harbors should thus be discouraged unless the use to be accommodated cannot be met in existing port and harbor areas. First priority should be placed on maintaining existing channel depths and mooring and turnaround basins. Deepening of channels and expansion of mooring and turnaround basins should proceed only when essential to waterfront dependent uses of particular economic importance to the state or nation - fisheries, maritime shipping, and marine industry. In addition, both maintenance and deepening operations will necessitate provision of environmentally acceptable disposal solutions.

DEMAND PRESSURES AND DEVELOPMENT OPPORTUNITIES

This section presents the space needs of the fishing industry, maritime shipping, ferry and cruise services, other maritime industry and services, and recreation boating. All require waterfront locations; many have expansion possibilities. Also discussed are the opportunities for waterfront renewal -- a use of harborfront lands which competes with waterfront dependent uses.

THE FISHING INDUSTRY

The fishing industry requires harbor space for mooring and berthing fishing vessels, for unloading catch and taking on supplies, and storing and processing fresh fish.

The proximity of major fishing grounds to the Massachusetts coast makes unnecessary the complex factoryship technology employed by foreign fishing fleets. Massachusetts fishermen prefer to take and sell fresh fish, which, when sold as fresh tablefare, commands a higher price than frozen fish. Fishing vessels return to home port after, at most, a seven to eight day trip to off-shore fishing grounds. Longer stays would result in spoilage of fish stored in the hold. The vessels used in this fishery seldom exceed 100 feet in length and can draw up to fourteen feet of water. The day-tripping inshore fishermen and lobstermen employ boats and vessels of far smaller draft, usually drawing six to ten feet of water. Thus the ports and harbors of interest to fishermen are those with navigable channels ranging from roughly seven to twenty feet.

A single pier or wharf with road access and parking for trucks is sufficient for the simple and low volume processing and marketing operations where fresh fish is unloaded, perhaps eviscerated, and packed and iced for quick truck transport to market. For the more complex and high volume filleting operations, space for filleting houses or stalls is required, as is cold storage space and better truck access and parking. Single unloading points make possible more modern mechanized unloading techniques, and when large volumes of fish are unloaded and processed, concentration of processing facilities on one wharf or in one area minimizes transfer and spoilage costs.

Over the long-term, the amount of harbor space required depends on the size of anticipated Massachusetts landings and markets for fresh fish. Prospective landings and market outlook determine the number of vessels in the industry and the size and number of fish storage and processing plants.

Since foreign fleets began fishing off the coast of Massachusetts in the early 1960's, the catch brought ashore in Massachusetts has declined from 480 million pounds in 1960 to 258 million pounds in 1975, the number of Massachusetts fishing vessels has decreased from 512 to 410 over the same time and the number of fish wholesalers and processors has declined from 236 in 1960 to 209 in 1974.

The extension in 1976 of U.S. jurisdiction over fishery resources to 200 miles offshore, however, promises to spur a revitalization of the domestic fresh fishing industry. Depleted stocks will be allowed to recover. The off-shore catch by all nations will be limited so that reproduction can generate sufficient replenishment to sustain an equal volume of catch each year. Foreign fleets will only be permitted to harvest that amount of the total allowable catch for which the domestic fleet has insufficient capacity. Analysts contend that the domestic fish catch could double or triple over current levels and the fishing fleet could increase by 100%.[1] Others are less optimistic, but the fishing industry generally agrees that the 200-mile limit should at least return the fishing industry to its 1960 standing.

Since 1960, the traditional, major Massachusetts fishing ports - Gloucester, Boston, and New Bedford - have, however, either completed substantial port improvements for the fishing industry (as in the case of New Bedford) or are planning to expand facilities for the fishing industry (as in the case of Gloucester and MASSPORT for the Boston Fish Pier). Thus the capacities of these traditional fishing ports are substantially improved over conditions in 1960.

As wholesaling, cold storage, and processing facilities are concentrated in Gloucester, Boston, and New Bedford, these ports are likely to absorb most of the projected increases in vessels and landings.

Other ports may need improvements to accommodate growth. Offshore vessels are also based at such harbors as Provincetown, Chatham, Wood's Hole, Nantucket, Plymouth and Scituate. With the extension of the 200-mile limit, some of the facilities serving these vessels may require expansion and improvement to accommodate increased landings and newer vessels. These same harbors, as well as those of Martha's Vineyard, Cohasset, Rockport, Westport, Manchester, and others also serve as centers for inshore fisheries, lobstering, bay scalloping, and clamming. If Massachusetts is to retain and promote a healthy fishing industry, dockside improvements for many of these smaller ports and harbors will be necessary.

MARITIME SHIPPING

The maritime shipping industry requires deepwater channels and harbor space for short-term anchorage and mooring of vessels; berths for loading cargoes; storage areas, warehouses, tanks, or silos for cargo storage; and rail and road connectors to move goods efficiently from inland points to ports and vice-versa.

As merchant fleets of older "tramp" steamers and "T-2" tankers, and smaller bulk carriers are retired from service because of age and obsolescence, increasing proportions of merchant fleets will be comprised of larger tankers and bulk carriers and large specialized cargo ships like containerships. This new generation of ships generally requires deeper channels -- forty to sixty feet in depth. At the same time, barge and tugboat technology has advanced considerably over the past twenty years, and barges of nearly 40,000 DWT are now being constructed. The smaller investment costs for tugs and barges, compared to ships, their smaller manning needs, reduced labor costs, and lower drafts for equivalent tonnage makes barges ideally suited for short hauls and smaller harbors. Such barge traffic generally requires channels of twenty foot depth or more.

Under ideal conditions, maritime terminals should be located as close as possible to open water so as to minimize in-harbor maneuvering, the costs incurred for pilotage and tugboat services, and time in transit. In addition, turnaround basins should be large enough to eliminate time-consuming maneuvering to and from berthing

facilities. Normally, marginal wharves rather than finger piers are preferred, as bringing a ship to or from a berth can be accomplished with fewer maneuvers. Older, narrower finger piers do not provide the extensive depth of space required for today's mechanized cargo handling operations.

Ideally, the land area between the marginal pier and seaport road and rail connectors should be large enough to include all the operations required to transfer seaborne cargo to land transportation modes and vice-versa. These operations include storage of in- and out-bound cargo, freight consolidation, truck and rail car storage, handling equipment movement, and security and administrative services. For example, a single modern containerport berth requires 800 to 1000 feet of marginal pier and 20 to 25 acres of land storage area. Rail and road connectors to such terminals should provide direct linkage to major trunk lines and arterial road networks. Such connectors should be capable of bearing high traffic volumes without causing congestion, safety hazards, and delays.

The volume of shipping in any given port, and hence the industry's need for port space, is determined by prevailing economic conditions, by the costs of maritime shipping compared to other transportation modes and by the comparative shipping costs of one port versus another. Given the complexity of these variables, the future volume of maritime shipping cannot be easily predicted. However, many port facilities in Massachusetts could accommodate larger shipping volumes simply because existing capacity is under-utilized.

Petroleum products carried by tanker or barge and destined either for general distribution or power plants comprise the major volume of Massachusetts freight traffic. Through the existing network of petroleum product marine terminals, Massachusetts receives some 75% of its average daily consumption of 600,000 barrels of petroleum products. Berthing capacity for barges and normal sized tankers at the major Massachusetts petroleum terminals is sufficient to serve the increases in tanker traffic required to meet Massachusetts' future petroleum product needs.[2] However, as consumption of petroleum products grows with population increases, more tank farms will be necessary to maintain reasonable reserve stocks of petroleum products on hand. Given the area occupied by tank farms (17-20 acres for a one million barrel tank farm), however, many Massachusetts ports may be physically unable to accommodate substantial increases in tank farms.[3] Tank farms storing products for general uses, such as gasoline and home heating oil, need not be located on the waterfront; they could be moved inland with petroleum products fed to them by pipeline from marine terminals (see Energy below). Moreover, the use of available harborfront space for tank farms could prejudice meeting the future needs of waterfront dependent uses whose return in terms of employment, income generation, and local taxes are higher.

Liquid and dry bulk cargoes, other than petroleum products, do not figure largely in Massachusetts' maritime shipments or receipts. New York and the mid-Atlantic will remain the primary ports for large dry bulk cargoes. The probability that Massachusetts will become a major distribution center for such trade is slight. Indeed, existing berthing capacity in Massachusetts for bulk cargoes is much underutilized; any increase in chemical, other liquid or dry bulk cargoes could be accommodated at existing terminals by installing more modern cargo handling facilities and expanding storage space.[4]

In the past twenty-five years, general cargo shipment has been revolutionized. General cargo ships and tramp steamers are now relics of the past, and shipments by container or other unitized cargo methods are forecast to reach a level of 70-80% of all dry, general cargo in the U.S. east coast trade.[5] Boston is the only Massachusetts port equipped to handle containerships. In 1973, one-third of the total amount of non-fuel cargo moving through Boston could be shipped by container; 60% actually was.

Demand projections prepared for MASSPORT forecast that by 1990 container traffic in the port of Boston could justify facilities with an annual capacity ranging between a low of 98,200 containers to a high of 360,000 containers. A more recent study suggests that by 1990 a facility capable of handling 241,000 containers will be necessary.[6] The increased reliance on container services in foreign as well as coastal trade suggests that the usage of general cargo terminals, such as the state piers in New Bedford and Fall River and MASSPORT's East Boston facilities, will continue to decline thereby offering opportunities for reuse of waterfront land.

Success in containerport operations is dependent upon attracting a high volume of freight traffic through the port to justify frequent containership calls; frequent calls by containerships also attract a greater volume of freight traffic into the port. Containerships are far costlier to build and operate than the older generation of "tramp steamers." If their owners are to turn a profit, ship turnaround time must be faster and the pay-off from each port of call higher than was true for older general cargo ships. Thus containerships are made to operate at few ports of call and only those where freight volumes are sufficient to make such calls worthwhile. Boston has already established itself as a containerport, and the duplication of container facilities in other New England ports would undercut attempts to revitalize Boston as a seaport. Moreover, any new container facilities would have to compete for the same business with established services at Boston, thereby running a high risk of underutilization or failure.

FERRY AND CRUISE SERVICES

In Massachusetts, passenger movement by ship is confined to transoceanic liners calling at Boston's Commonwealth Pier and to local cruise and ferry services connecting the mainland with various

islands, along with commuter and recreational destinations. Regular service from Woods Hole to Martha's Vineyard and Nantucket is supplemented, during the busy summer months, by additional sailings and by ferry services operating from Hyannis and Falmouth Harbor. Goods and passengers are moved to Cuttyhunk by ferry from New Bedford. Hull and Provincetown are connected by ferry service from Boston; and commuter boat service between downtown Boston and Hingham is under experiment. Cruise services around Boston Harbor are increasingly popular. Charter and party boats for sportsfishermen operate out of such harbors as Newburyport, Lynn, Plymouth, and Hyannis.

Ferry and party boats seldom require channels deeper than eighteen feet. Proximity to public transit and parking lots and garages can make these services more accessible and minimize the need for extensive new parking areas.

By and large, existing passenger, ferry, cruise, and party boat terminals could accommodate substantially increased sailings. The growing ridership on the Boston Harbor cruises and heightened interest in commuter boat services suggest a latent demand for such travel. In particular, promotion of cruise, ferry, and party boat services to recreational destinations, or as a recreational pursuit themselves, could help to relieve coastal traffic congestion during the busy tourist summer season, open up coastal recreation to families without automobiles, and bolster tourist economies. If this potential is tapped, some redevelopment and relocation of berthing terminals and other facilities will be required.

OTHER MARINE INDUSTRY AND SERVICES

Industries relying on maritime shipping to transport bulk raw material or processed goods seek port locations in order to minimize transfer costs. These industries include the frozen fish industry which processes imported frozen fish blocks for distribution to the U.S. market, two Boston sugar refineries which refine raw sugar transported by ship, U.S. Gypsum which relies on maritime shipping to deliver gypsum and limestone to its Mystic River plant, and Proctor and Gamble which uses maritime shipping to deliver caustic soda to its Quincy plant.

Shipbuilding, ship and boat repairyards, marine service firms (tugboat services, marine construction firms) and offshore mining support services also require land along deepwater channels to carry out their activities. The Massachusetts shipbuilding and repair industry embraces 81 establishments and includes General Dynamics in Quincy (one of the largest shipyards on the East Coast); Bethlehem Steel, Bromfield Corporation, General Ship and Engine Works all in East Boston; Munro Drydock in Chelsea; Fairhaven Marine and D.N. Kelley both based in Fairhaven; Gladding-Hearn in Somerset; and smaller firms concentrating on boat building and repair, located in a large number of harbors including Gloucester, Dartmouth, Marion, Mattapoisett and Marblehead.

Marine industry covers a wide spectrum of activities, some of which, like boatbuilding, require only shallow channels of at most 10 to 12 feet in depth, while others, such as commercial shipbuilding, require water depths of 30 to 40 feet. For those marine industries that rely on maritime shipping, channel drafts must be as deep as those required for maritime shipping. Generally speaking, the harborfront space requirements and road and rail access needs are similar to those for maritime shipping, although space for the actual manufacturing activity must also be provided. In addition, proximity to public transit for the industry's work force is desirable. Like any other major industrial development, water and sewer services must be available.

The future harborfront space requirements of these varied industries differ. While the frozen fish industry has tended to concentrate in traditional fishing ports, a number of processing facilities are now located inland, relying on road or rail to transport frozen fish blocks from Canada or from Massachusetts ports of entry, such as Gloucester, Boston, or New Bedford. Thus the future requirements of this industry need not be met in port or harbor areas. The needs of other marine industries, reliant on maritime transportation, depend on individual locational decisions by firms and cannot be predicted.

Sufficient demand for a major, new (as opposed to an expanded) shipyard is unlikely. The eleven major U.S. shipyards (Quincy Dynamics among them) are likely to be able to meet whatever shipbuilding demand materializes for the entire nation.[7] With continued increases in recreational boating and the revitalization of the fishing fleet, Massachusetts should expect some increase in the size and number of small boatyards and repair facilities.

The future demands by offshore mining support services for port and harborfront space cannot yet be accurately foreseen. Exploring for oil and gas on Georges Bank and the development of whatever resources are discovered could lead to the location of extensive supply bases for offshore operations and platform rig construction and pipe coating yards in Massachusetts. During exploration stages, each offshore drilling rig is typically served by two to three supply vessels, relaying crew, drilling mud, water, cement, and piping offshore. In addition to berthing space for such supply vessels, storage areas for supplies are required. Assuming, for example, that in the early years of OCS exploration on Georges Bank a maximum of six to ten drilling rigs are located offshore, 1,000-3,000 feet of berth space and some 50 acres of storage area may be needed.

Should development of off-shore oil or gas occur, permanent service bases would be established and additional service-oriented firms would set up depots. These include cement companies, specialized drilling tool and equipment suppliers, well casing, well-head equipment, and wireline service companies. All of these also require

land in a port with some dock space, and they tend to locate in the same ports as service bases.

In the event of a major find on Georges Bank, oil or gas company demand for production platforms (from which production wells are drilled) may exceed the supply capacity of existing platform construction yards, and a platform construction yard may be sited in New England. Such a facility requires 100-300 acres of land, 500 feet of shoreline on a waterway with a minimum of 30 feet of draft with unobstructed access to the ocean so the platform can be easily transported to the OCS site.

Should an oil find on Georges Bank prove large, that is, an average flow rate of at least 150,000 to 200,000 barrels per day over a ten to fifteen year period, or should substantial gas reserves be discovered, a pipeline would probably be laid from the production platforms to shore. In this event, a pipe coating yard may be established. Such a facility, at which the pipe is coated to prevent corrosion and a layer of cement added to help the pipe sink to the ocean floor, typically requires 90 to 100 acres of waterfront land, 95% of which is used for pipe storage. The yard must have a minimum of 1000 linear feet of waterfront land that can be used for dock space with a minimum draft of up to ten feet at which pipelaying barges can onload coated pipe.[8]

In addition to offshore oil and gas development, other forms of offshore mining - for sand, gravel, manganese modules, other minerals - may materialize off Massachusetts. These, too, might create a demand to accommodate shipping and processing facilities along the Massachusetts coast.

RECREATIONAL BOATING

Most recreational boats seldom exceed ten feet in draft; thus harbor areas having navigable water depths between six and ten feet are ideally suited for such craft. Recreational boats either require mooring space in which to anchor boats while not in use, marinas at which boats are berthed in slips, or access ramps from which boats are trailered to and from the water. Necessary support services for recreational boating include fueling services, boat supply and repair yards, and pump-out stations for sewage. In addition, parking for those using marinas or access ramps is necessary.

Given the harshness of the winter climate in Massachusetts, recreational boating largely takes place in the late spring, summer, and early fall months. Boat storage needs during the winter months are met by on-land storage at marinas or boatyards or by trailering boats for storage at home.

Recreational boating demand has increased substantially over the past several decades, and recreational planners have projected

an unmet need for facilities roughly equivalent to present capacity. This demand can be met either by expanding mooring basins, encouraging marina development, or construction and expansion of access ramps (see further discussion under Recreation section).

URBAN WATERFRONT RENEWAL

Harborfronts provide vistas of the sea and views of harbor activities. These settings can attract a wide variety of uses and structures which do not depend on waterfront locations for their functioning. These include housing, parks, and urban recreational facilities, institutions, and a wide variety of commercial uses including restaurants, hotels, office buildings, and shops. The mixture of these uses in port and harbor areas can provide opportunities to the general public for visual and physical access to waterfronts. (See Visual Environment section.) In addition, by taking advantage of the visual assets of waterfront areas, communities can spur major redevelopment in otherwise deteriorating downtown areas. Some coastal communities, including Boston, Newburyport, and Nantucket, after years of neglecting their waterfronts and effectively turning their backs to the sea, are attempting to open up their neighborhoods and downtown areas to the sea, thereby creating new and revitalized urban environments. Similar opportunities for such redevelopment might occur in other port and harbor areas, but this development potential remains untapped.

The successful revitalization of waterfront neighborhoods and downtown areas depends on how well harbor views are made an integral part of redevelopment. If harborfront vistas are reserved for a few private developments and access to these viewpoints is restricted, the gains from redevelopment will not spread to surrounding neighborhoods and abutting downtown areas. The key to successful waterfront rehabilitation is to make the harborfront an inviting and significant attraction to residents and visitors alike. Small waterfront parks, open space abutting bulkheads, or piers accessible to the public, and walkways and pedestrian overpasses and ramps providing views of major harbor activities, can help to provide the accessibility to the waterfront that makes it attractive.

Those attracted to the waterfront as well as local residents provide a natural market for restaurants, cafes, hotels and stores. Such commercial establishments which serve the public also can help to provide additional visual and physical access to the waterfront and heighten vitality of the area. Public transit and public parking facilities are required if the renewal area is to draw large numbers of visitors, Ease of pedestrian access, inviting walkways linking shopping, restaurant areas with both the waterfront and residential neighborhoods and downtown areas also are prerequisites for successful waterfront redevelopment.

SUPPLY CONSIDERATIONS, SITE SUITABILITY, AND ENVIRONMENTAL CONSTRAINTS

The U.S. Army Corps of Engineers, the Massachusetts Division of Waterways, the Massachusetts Port Authority, the U.S. Coast Guard, municipalities, the U.S. Navy, the U.S. Economic Development Administration, and the Department of Housing and Urban Development have already expended nearly $400 million in public funds on port and harbor improvements in Massachusetts.[9] Many navigable channels, mooring basins, and facilities created by these investments are not fully utilized.

A number of ports contain vacant or under-utilized lands and docks adjoining channels of 20-foot depth or more. Examples include the South Boston Naval Shipyard, the Charlestown Navy Yard, the MASSPORT piers in East Boston, the Cordage Park in Plymouth, the North Terminal in New Bedford, and the lands abutting the state pier in Fall River. In other ports, developable land for waterfront dependent uses is no longer available or extremely limited. Such is the case in Salem, the Mystic River, Chelsea Creek, and Gloucester Inner Harbor.

In other harbors, where channel depths are not sufficient to accommodate ocean-going vessels, development potential for recreational boating, fisheries, and ferry and cruise services remains under-utilized. Beverly Harbor, Lynn, Plymouth, Hull, and the Mt. Hope Bay communities, for example, present such opportunities.

In yet other cases, port and harbor facilities could support heavier utilization through redevelopment, modernization, and employment of space saving techniques. Conversion of state piers for fishery operations, rehabilitating the Boston Fish Pier, or extension of town docks for fishermen could, for example, help to stimulate higher economic returns from these original investments.

Clearly the most efficient uses of these underutilized resources would be to promote usage of those sites from those waterfront dependent uses for which they are best suited. Simply put, extensive vacant lands (50-300 acres) adjoining large turnaround basins of up to 40 feet in depth with quick access to the open ocean and good road and rail connectors are ideally suited for the siting of a containerport or platform construction yard. In Massachusetts such sites are extremely rare. Smaller tracts adjoining channels of 20-40 feet in depth and with good road and rail access are suited for other forms of maritime shipping and marine industry. Many of the port areas with these characteristics, however, have also been developed as major fishing ports, thereby compounding the competition for space. Very small tracts adjoining shallow draft harbors (6-10 feet in depth) are suited for recreational boating development and

small-scale fishery operations. Approximately one hundred harbors possess these characteristics; and, since recreational boating can also be accommodated in deeper harbors, site requirement constraints for these activities are not as severe.

Determinations of site suitability for the varying waterfront uses must take into account the character of neighborhoods surrounding port and harbor areas. Siting a containerport, pipecoating yard, or an oil terminal, for example, in areas abutting residential neighborhoods might well affect the visual character of the area and cause severe truck traffic problems. On the other hand, some waterfront activities actually enhance neighborhood and harbor character. To many the presence of fishing fleets in sheltered harbors presents a desirable seafaring image and enhances the interest and character of the harbor. Recreational boating facilities - marinas, boatyards, marine supply stores - can lend vitality to commercial districts in harbor towns. Ferry services and the tourists and visitors they attract bolster the economy of commercial business activities in harbor areas.

Accommodating a variety of waterfront uses in one harbor can lead to conflicts. Recreational boating in a busy commercial harbor can clog shipping lanes, causing safety hazards and delays to shipping. Fishermen whose boats or vessels are their primary capital asset cannot afford to construct their own piers. Their efficiency is enhanced by the use of one pier for both unloading and taking on stores. They rely on fish processors, the state or community to provide such space. Yet, for the private developer or the community greater profit may accrue by converting such space to recreational boating or other use, forcing the fishing industry to move to other ports or harbors.

Market forces lead to these kinds of competition, and in planning for port and harbor usage, some notion of the overall significance of the various uses requiring waterfront space must be employed. From a national and state perspective, three waterfront uses - the fishing industry, maritime shipping, and support services for maritime shipping - stand out as meriting special preference in the allocation of port and harbor space.

The fishing industry capitalizes on the fisheries resources off the coast, which represent one of the few natural economic endowments Massachusetts enjoys. As a permanent indigenous industry, a significant supplier of the nation's protein, and a source of full and part-time employment for 15,000 people, the fishing industry deserves preference over most other uses competing for port and harbor space.

Transportation costs are kept at a competitive level by the availability of maritime shipping services which provide an alternative to other modes of transport - air, rail, and truck. The shipping industry also serves as a vital lifeline, providing the

Massachusetts economy with energy supplies and raw materials. Indirectly, the shipping industry induces substantial numbers of jobs and income: MASSPORT estimates that the port of Boston generates $250-$450 million annually in income and serves some 4000 firms. Boston's shipping services also provide the infrastructure for the export of manufactured goods; Massachusetts ranks eleventh in the nation in the export of such goods, the production of which accounts for an estimated 32,100 jobs. These attributes dictate that marine terminal development, when justified by demand, be given a preference along with the fishing industry over other competing uses for port space.

Some marine industry, such as tugboat services and ship and boatyards, provide needed support services for the fishing industry and maritime shipping and thus deserve preference in the allocation of port and harbor space. Support services for OCS exploration and development, while important to exploiting needed energy supplies, are short-lived, lasting only as long as the life of exploration or the life of discovered finds. Their temporary nature dictates that the preference afforded them in allocating port or harbor space should be carefully weighed against possible detrimental effects on more permanent uses such as maritime shipping and the fishing industry. Lastly, industry dependent on maritime shipping for receiving raw material or exporting products constitutes an important source of employment in Massachusetts, accounting for some 3,000 jobs. Such industry should be promoted in the ports of Massachusetts when accommodating such uses would not be prejudicial to the expansion of the fishing industry or maritime shipping.

Other waterfront uses - ferry services, recreational boating, and urban waterfront redevelopment - provide important benefits to tourism, the revitalization of downtown commercial centers, and neighborhood rehabilitation. However, these uses can be accommodated in conjunction with each other and in a variety of locations. Moreover, as mentioned previously, their site requirements, compatibility with general commercial and residential use, and need for developed transportation infrastructure is distinctly different from the heavier, more intensive waterfront dependent uses. Thus, these uses are best promoted in waterfront areas which do not have the potential to serve large-scale fishing industry operations, maritime shipping, and marine industry.

Maximizing the use of existing navigable channels minimizes the need for extensive new dredging and consequent impacts on the marine environment. Furthermore, the return from past public expenditures will be maximized. The cost of new public improvements will also be minimized because the costs of maintaining or deepening old channels are generally cheaper than the costs of creating new ones.[10] The marine environment will also be conserved, for existing ports and harbors already represent departures from natural conditions, and new disruptions to relatively untouched areas of the marine environment will be kept to a minimum.

In certain isolated instances, however, legitimate environmental concerns should constrain the expansion of port and harbor activities. As discussed in Marine Environment, the continuance or increased levels of waterfront dependent use can threaten the productivity of coastal reaches. Port and harbor activities are sometimes sited in those areas most sensitive to environmental damage, such as estuaries and coastal embayments containing salt marsh systems, eel grass beds, shellfish flats, fish spawning grounds, anadromous fish runs, shallow bottoms, and exhibiting poor circulation and flushing characteristics. These are identified in the regional chapters as significant marine ecosystem resource areas and areas for preservation or restoration.

OBJECTIVES

The preceding discussion suggests that the ports and harbors of Massachusetts should be managed so as to achieve the following objectives:

1. to allow for expansion of economically important water dependent activities, including fishing, shipping, and other marine industries;

2. to facilitate harbor improvements needed by fishermen, cruise and ferry services, and the general boating public;

3. to encourage revitalization and rehabilitation of developed harbor areas and promote physical and visual access to waterfront for the general public;

4. to protect the marine environment and conserve significant ecological resources; and

5. to maximize the economic return and public benefit from publicly supported port and harbor works.

MASSACHUSETTS CZM POLICIES AND PROGRAM RECOMMENDATIONS

Policy (19) Encourage water-dependent industrial development in port areas. Deter preemptions of present and proposed water-dependent industrial uses by favoring the use which is the more limited in its physical or economic options. Permit non water-dependent industrial uses when such use would not represent an irreversible commitment of sites and would not preempt foreseeable water-dependent industrial uses.

The existing port areas of Massachusetts represent a valuable economic resource ideally suited for large-scale maritime shipping, marine industry, and the fisheries industry. Many of the under-utilized lands abutting these deepwater channels are either in the hands of public agencies or have been or will be improved using public funds. The appropriateness of the uses of these lands is thus of legitimate public concern.

Water and land areas which exhibit the following characteristics are defined to be port areas:

1. navigable channels of 20 foot depth or more,

2. lands abutting such channels which are zoned for marine dependent or industrial use,

3. well-developed road and rail links to port areas leading to major trunk and arterial routes,

4. water and sewer services capable of accommodating major industrial needs, and

5. land that is separated or remote from residential neighborhoods and commercial business districts.

Water-dependent industrial development will include large-scale fishing operations, maritime shipping and other marine industries. These uses will be preferred because they require the space, facilities and infra-structure existing in such port areas. Furthermore, these industries are of economic importance to the state and the nation. All proposals for water-dependent industrial developments in port areas will be encouraged by CZM and will be facilitated as much as possible by EOEA agencies, unless the proposed use will seriously conflict with or preempt, either economically or physically, other existing water-dependent industrial uses in that port or other ports. Conflicts will be resolved by favoring the water-dependent industrial use which is more limited in its spatial, locational, or economic options.

Proposals for development in port areas which are not water-dependent industrial uses will also be facilitated unless:

1. public agencies and/or fishing, maritime shipping or marine industry spokesmen have expressed interest in the site for waterfront dependent uses of particular state or national economic importance; or

2. the proposed use would irreversibly commit the site to a use other than that for which it is ideally suited based on site size, availability of road and rail access, or other attributes.

IMPLEMENTATION MEASURES

When state or federal funds or state permits are involved, CZM will review and comment on the type, location, and design of proposed uses for such lands as part of A-95, MEPA, and NEPA review processes.

In addition, CZM will influence the use of port areas by networking with the permitting agencies within the Executive Office of Environmental Affairs and by issuing consistency certificates for federal permits. Among those permit and license authorities which are most likely to apply to port and harbor projects are:

-- --Waterways Program (MGLA Ch. 91) - Gives the Waterway Program authority over tidelands, harbors, and certain rivers below the high water mark. Activities covered by such licenses include filling, wharf construction, bridges, pipelines, etc. This power is based on the reserved public property rights of navigation and fishery. DEQE as trustee over these lands thus issues licenses, and not permits, for the permission to interfere with these public lands. Under the law, all licenses are to expire after five years or upon non-use.

Under a Memorandum of Understanding with Waterways, the preceding CZM policy will be implemented as follows. If, to secure financing, the developer needs to obtain an irrevocable license from the Legislature, CZM will actively support such legislation. Should the project be a non-water dependent development, it will still be licensed, provided the criteria relating to non-water dependent uses are met.

-- --Wetlands Program (MGLA Ch. 131, s. 40) - Gives local conservation commissions power to permit dredging and filling of wetlands, floodplains, beaches, etc., following guidelines established by the Commissioner of DEQE. Following a Memorandum of Understanding between the Commissioner and CZM, the CZM plan will be incorporated as a part of those guidelines and the Commissioner shall issue a superceding order when necessary to implement CZM policy.

-- --Marine Oil Terminal License (MGLA Ch. 21, s. 50) - Issued by the Division of Water Pollution Control in order to protect the public safety and to prevent oil spills. Following a Memorandum of Understanding, DWPC will license such facilities in port areas and deny or appropriately condition such facilities in identified sensitive environmental areas.

-- --Energy Facilities Siting Council (MGLA Ch. 164, s. 69f-69r) - Has jurisdiction over all siting and facility plans of major oil, gas and electric developments. A Memorandum of Understanding will be signed between CZM and EFSC which will detail the ways that the two agencies will coordinate and accept the policies of one another and will specifically relate to how the Council will exercise its over-ride over state and local permits and eminent domain powers where necessary to facilitate the siting of water-dependent energy facilities in port areas. The Council will encourage the inland siting of non-water dependent energy facilities.

-- --Permits for Filling in Navigable Waters - Under Section 404 of the Federal Water Pollution Control Act of 1972 (33U.S.C. 1344), the Corps of Engineers authorizes filling of navigable waters. Since the scope of jurisdiction over navigable waters is very broad, the Corps is implementing this program in three phases. It is, at present, exercising jurisdiction over coastal waters and coastal wetlands and freshwater wetlands contiguous or adjacent to coastal or inland navigable waters. In later phases its jurisdiction will include tributaries, other inland waters adjacent to tributaries, and other navigable waters.

Under the Corps regulations and the Federal Consistency regulations, the Corps may not issue a filling permit without a CZM certification of consistency. CZM will assign high priority for water-dependent industrial developments in port areas. It will more closely scrutinize and appropriately condition non-water-dependent industrial developments in port areas.

-- --Permits for Obstructions or Alterations in Navigable Waters of the United States - Are granted by the Corps of Engineers under Section 10 of the Rivers and Harbors Act of 1899. This permit covers such projects as sinking pilings, attaching moorings, placing outfall pipes, or digging tunnels. While the scope of jurisdiction under this permit is not broad as for Section 404 permits, it does cover waters susceptible for use in interstate commerce, up to their high water line; this includes all marine waters plus many inland waters. CZM's consistency certificate for developments in port areas will be issued on the same criteria as for Section 404 permits.

-- --CZM will also encourage water-dependent industrial uses in port areas through a number of technical and financial assistance programs discussed under policies (20) and (21).

Policy (20) Promote the widest possible public benefit from port and harbor and channel dredging and ensure such proposals are consistent with marine environment policies.

Adequate channel depths are a prerequisite for any kind of waterfront dependent activity. Given that public funding for dredge projects is limited, public agencies must, of necessity, allocate these funds to projects which provide the greatest public benefit and demonstrate the most pressing need. At the same time, dredging and disposal, especially of contaminated dredge material, can cause severe and lasting adverse impacts on the marine environment.

In order to minimize the adverse environmental impacts of dredging and dredge disposal, CZM will, as discussed further in the Marine Environment Policy section, network with state and federal agencies to:

1. work actively to explore and develop environmentally sound disposal practices and sites for contaminated dredge spoil;

2. restrict the dredging of significant resource areas (salt marshes, dunes, barrier beaches, shellfish flats, aquaculture areas and areas of finfish concentration); and

3. prohibit dredging and disposal in designated areas for preservation or restoration and salt ponds.

First priority for state or federal funding for dredge projects will presumptively be given to maintenance dredge proposals in port areas defined under Policy (19) and developed harbors. Developed harbors are defined as those:

1. providing public mooring space, berths, ships, ramps, and docks which serve a region-wide boating public;

2. hosting harbor facilities used by commercial fishermen;

3. serving cruise boat, ferries, and other marine industry; and/or

4. presenting unique development opportunities for the fishing industry or for waterfront renewal and revitalization.

Publicly funded maintenance dredging will be scheduled so that projects demonstrating the most pressing need, widest public benefit, and least environmental damage are carried out first.

Proposals in port areas or developed harbors for dredge projects involving deepening or expansion of channels, mooring basins, or turn-around basins beyond authorized or existing depth or size will be approved for state or federal funding if the project:

1. provides for recreational boating, broad public benefits which would not otherwise be possible, which are spread over a region, and which redound to the general public or identifiable groups to which entrance is open (e.g., the general boating public vs. yacht club members) and is necessary to resolve harbor conflicts between fishermen and recreational boaters;

2. enhances benefits to the commercial fishing industry;

3. produces economic returns to the maritime shipping and other marine industries by reducing turn-around times and in-harbor transit delays, and permits usage of more efficient sized vessels; and/or

4. reduces navigational safety risks.

In both port areas and development harbors, CZM will provide technical assistance, fund feasibility studies, and work actively with concerned agencies to arrive at environmentally responsible dredge and dredge disposal solutions.

Proposals for public funding of new channels, mooring basins, or other navigational improvements in other than port areas or developed harbors will only be deemed consistent with the Massachusetts CZM Program if:

1. the need to be met by the project is of national or statewide importance and cannot be accomplished in port areas or developed harbors or the project demonstrates that damage to the environment would be less than that caused by accommodating the need in port areas and developed harbors; and

2. the project demonstrates widespread public benefit to a region and/or to a wide class of potential users; and

3. the project does not conflict with other policies in the Massachusetts Coastal Zone Management Program (see Marine Environment section) and water quality standards.

Lastly, permits for privately funded dredge projects will be scrutinized to ensure conformance with CZM's marine environment policies.

IMPLEMENTATION MEASURES

-- --U.S. Army Corps of Engineers - Grants permits for dredging under Section 404 of the Federal Water Pollution Control Act of 1972 and under Section 10 of the River and Harbors Act of 1899 and funds and carries out channel and navigational works. CZM will only issue certifications of consistency for such permit applications and projects which meet the criteria described above. CZM will also work actively with communities, port authorities, and the Corps to ensure that dredge projects within ports and developed harbors meeting the benefit criteria described above, are authorized, funds appropriated, and work begun expeditiously.

-- --Waterways Program (MGLA Ch. 91) - Grants licenses for dredging and funds dredging projects. Through networking procedures and the evaluation system developed with the Division, CZM will ensure that such license applications and project funding meet the criteria described above.

-- --Ocean Sanctuaries Acts (MGLA Ch. 132A, S. 13-17) - Have been created to protect all state waters except those from Swampscott to Marshfield and those in Mt. Hope Bay. While the terms of the five sanctuaries vary, in general such activities as removal of any sand, gravel or minerals, any dumping, or any waste discharge are prohibited, and shore protection, water navigation aids or fish harvesting are permitted. A significant clause permits improvements approved by appropriate federal and state agencies; CZM networking and federal consistency mechanisms will insure that with the flexibility created by

this clause, the CZM policies will be carried out. CZM will also work with DEM to prepare regulations for administering the program.

-- --Coastal Zone Management Act, 1972, Section 306 - Once the Secretary of Commerce has approved the Massachusetts CZM Program, CZM may disburse a portion of its funding to support feasibility and project development studies aimed at arriving at environmentally sound dredge disposal practices and sites.

Policy (21) Encourage, through technical and financial assistance, the expansion of water-dependent uses in port areas and developed harbors where the risks of damage to the marine environment are minimal.

In addition to funding dredge projects, state and federal agencies provide planning and infrastructure development assistance that help make possible needed expansion in facilities for maritime shipping, the fishing industry, cruise and ferry services, other marine industry, and recreational boating. Such assistance is extended for both overall harbor planning and construction of piers, docks, bulkheading, ramps, navigational aids, and other harbor works.

In order to ensure that maximum use is made of existing infrastructure and that possible damage to the marine environment is kept to a minimum, CZM will actively promote extension of such assistance to:

1. port areas defined under Policy (19); and

2. developed harbors defined under Policy (20).

IMPLEMENTATION MEASURES

Many technical and financial assistance programs operated by state and federal agencies can be made supportive of water dependent development. CZM will network with these programs to ensure that they consistently encourage and facilitate water-dependent development. The more significant of these programs include:

-- --Waterways Program (MGLA Ch. 91, S. 10-11) - Projects are carried out to improve wharves, fund public piers, construct jetties, bulkheads, and shore protection works, dredge channels and remove wrecks. CZM has worked with the Waterways Program to develop a system for evaluating project requests from communities. Under this system, funding will be granted to projects that provide widespread public benefits and which rank high with respect to fishing, shipping, recreational, and environmental values. In addition, the Waterways Program under MGLA Chapter 91, Section 9A, may develop harbor plans through acquiring, improving and developing needed pier and terminal facilities. Such

facilities may then be leased for private sector operations. Upon request by a community, CZM will provide planning, legal, and technical help to acquire necessary rights and easements and to prepare such a harbor plan. CZM will also use its best efforts with the Legislature and federal and state funding agencies to garner the financing for acquisition and construction.

-- --Coastal Zone Management Act, 1972, Section 306 - Once the Secretary of Commerce has approved the Massachusetts CZM Program, CZM may disburse a portion of its funding to support preparation of port and harbor development plans, assessing facility needs and the economic return from such facilities; and conducting feasibility and preliminary engineering studies for public marinas, town wharves and docks, access ramps, and navigational improvements.

-- --Public Access Board (MGLA Ch. 21, S.17, 17A) - Is empowered to designate, acquire, and develop sites for boat ramps and other facilities providing recreational access to water. CZM will work with communities and the Board to develop boat ramps and related facilities in developed harbors. These efforts will reflect the priorities indicated in the Recreation section and the Regional Chapter.

-- --Massachusetts Division of Water Pollution Control (MGLA Ch. 21, s. 43) - Approves sewer hook-ups and treatment plant construction. It also supports the engineering and construction of municipal sewage treatment facilities with grant funds made available under Section 201 of the Federal Water Pollution Control Act. Both the Division and areawide waste water management planning agencies, funded by Section 208 of the Federal Water Pollution Control Act, plan for the location, capacity, and size of service area of municipal sewage treatment plants. CZM will work with communities, the areawide waste water management planning agencies, and the Division to improve sewage treatment infrastructure in existing port areas and developed harbors to support higher and desired levels of economic development without compromising water quality standards. It will also strive to ensure that opportunities for the construction of pump-out facilities for watercraft wastes are not overlooked.

-- --The Federal Highway Administration within the Department of Transportation, administers a federal aid highway program which provices financial assistance to states for highway construction in and among urban areas. CZM will work with Massachusetts' highway planning agency, the Department of Public Works, to promote investment of these urban systems funds in roadways which link port areas with existing population centers.

-- --Department of Public Works (MGLA Ch. 90) - Is authorized to construct, improve and maintain all non-federally funded roadways. In effect these include most urban and rural roads which do not provide direct access to a major population center or access between population centers within metropolitan areas. Thus communities wishing to construct or improve port and harbor access roads must usually seek state

funding or finance these public works themselves. CZM will work with the Department of Public Works and regional transportation planning agencies to ensure that port and harbor access road projects receive priority consideration for state funding.

-- --Economic Development Administration - Provides grants to public entities and loans to public and private entities for the construction or expansion of public work projects which offer substantial employment potential, improve the capacity for economic growth through the development of facilities conducive to the location of industrial and commercial enterprises, or provide essential services to the citizens of economically depressed areas. This program finances such projects as industrial parks, access roads, water and sewer systems, and the expansion of harbor and airport facilities. CZM will act as an advocate before the Economic Development Administration to support funding for water dependent development in port areas and developed harbors.

-- --In addition to the above programs, others described under Policy (22) (Housing and Urban Development, Urban Mass Transit) can be used to promote water-dependent development. For all these and other funding programs, CZM will affirmatively review under A-95, MEPA, and NEPA processes, issue federal consistency certificates, and work toward funding project developments which meet the policies of the plan.

Policy (22) Encourage urban waterfront redevelopment and renewal in developed harbors in order to link residential neighborhoods and commercial downtown areas with physical and visual access to the waterfront.

CZM will, through technical and financial assistance and through project review, promote this CZM policy in developed harbors and in other urban waterfronts. The latter includes shoreline areas which do not presently contain developed harbors but which are characterized by extremely dense, urban residential neighborhoods or commercial development.

IMPLEMENTATION MEASURES

Key among the many state and federal programs applicable to this policy which fund projects through planning, acquisition and construction stages are:

-- --Department of Housing and Urban Development provides, under the Housing and Community Development Act of 1974, direct grants to state, metropolitan, and regional planning agencies for land use, housing, urban, and redevelopment planning. In addition, formula and discretionary grants under the Community Development Block Grant Program, intended to help eliminate problems of low-income persons, may be used for

improving living conditions, conservation of expansion of housing and housing opportunities; for increased public services; for improved use of land, including recreational facilities; increased neighborhood diversity; and for preservation of property with special values. Under the A-95 review process, CZM will champion applications encompassing CZM's waterfront renewal policy and strive to ensure that adequate funding is provided by the Department of Housing and Urban Development.

-- --Coastal Zone Management Act, 1972, Section 306 - Once the Secretary of Commerce has approved the Massachusetts CZM Program, CZM may disburse a portion of its funding to support preparation of harborfront plans aimed at improving visual and physical access to waterfronts, identifying opportunities for waterfront parks, waterfront pedestrian ways, ramps, and other public access improvements; conducting feasibility, cost, and preliminary engineering studies for such waterfront improvement projects.

-- --U.S. Bureau of Outdoor Recreation provides matching grants to state and local communities for recreation planning, acquisition, and facilities development under its Land and Water Conservation Fund (P.L. 88-578) and reviews proposed federal water development proposals to ensure full consideration of outdoor recreational needs (P.L. 89-72). The Bureau is actively committed to enhancing urban recreation and access opportunities; CZM will act as an advocate before it for recreation development proposals which enhance development harbors and other urban waterfronts.

-- --Waterways Program (MGLA Ch. 91) - has authority to carry out projects for bulkheads, public piers, wharves, jetties, and shore protection works. Under a new procedure, developed in coordination with CZM, requests for project funding are systematically evaluated with respect to recreational benefits, secondary economic benefits, environmental enhancement, and consistency with state growth policy. Active support for waterfront renewal is given special recognition in the system since one of the evaluative criteria is whether the project contributes to redevelopment efforts.

-- --Urban Mass Transportation Administration provides grants and loans to states for transit planning, development, and operation. Transit systems act to spur development and revitalization by facilitating access between given areas. CZM will work with municipal planners, transit authorities, and the Department of Public Works to encourage the provision of transit projects which serve CZM's waterfront renewal policy. CZM will champion such projects before the Urban Mass Transportation Administration.

-- --Department of Public Works administers a Federal Highway Administration program which provides for planning and development of bicycle transportation and pedestrian walkways. Projects can be incidental

features of highway construction or can be independent walkways or bikeways. CZM will actively promote the use of this program to provide physical and visual access to developed harbors and other urban waterfronts. In addition, CZM will work with the Department, regional transportation planning agencies, and communities to ensure that opportunities to provide visual and physical access to urban waterfronts are not overlooked when designing new or improved roadways and bridges in developed harbors and other urban waterfronts.

-- --The siting of state and federally supported facilities such as educational institutions, subsidized housing, or museums as well as commercial shopping areas and tourist area accommodations can help to revitalize waterfront areas by providing opportunities for visual and physical access to the harbor. Through the information channels provided by the MEPA, NEPA and A-95 reviews, plus the networking mechanisms and other program authorities described under Policy (20), CZM will actively promote the use of such projects and programs in developed harbors and other urban waterfronts to help link residential neighborhoods and commercial downtown areas to waterfronts and will ensure that opportunities for providing such access are not overlooked.

TECHNICAL NOTES AND SOURCES

1. For information on and estimates of domestic fish catch under extended jurisdiction, see National Marine Fisheries Service, Staff Report, Fisheries Management Under Extended Jurisdiction, March, 1975, pp. 32-33, and Draft National Plan for Marine Fisheries, June, 1975, pp. 7-8, 44-51; and Olsen and Stevenson, Commercial Fish and Fisheries of Rhode Island, 1975, pp. 47-48. Olsen and Stevenson contend a doubling of the fleet together with substantial modernization will be necessary if the domestic fleet is to catch the entire potential harvest in ICNAF Area 5. This estimate is open to considerable question as, under extended jurisdiction, Canada and the United States will each control a portion of the area off their coasts and other nations which have traditionally fished these areas are likely to be given some fishing rights. In addition, securing the investment necessary for fleet expansion and modernization will take time. Hence, a 50% rather than a 100% increase in domestic fleet size is more likely to materialize.

2. See A.D. Little, Inc., Effects on New England of Petroleum-Related Industrial Development, 1975, Vol. III, pp. III-21, III-31, which estimates that the current average tanker berth occupancy rate for New England as a whole is 16% and for Boston (excluding Exxon's Mystic River terminal) 23% and which concludes that the risk of berth saturation in New England by the year 2000 is remote.

3. Data on petroleum products consumption compiled by the U.S. Bureau of Mines and on petroleum-bulk storage capacity compiled by the U.S. Bureau of Census, Census of Business and Intrametrics, Petroleum Terminals in Massachusetts, 1975, for the years 1963, 1967, and 1972 suggest that Massachusetts has maintained a relatively stable reserve storage capacity for petroleum products amounting on average to some 25 days consumption. If Massachusetts is to continue to have a similar ratio of petroleum products on hand, then, by 1990, assuming historic growth rates in fuel consumption developed by A.D. Little, Inc., Preliminary Projections of New England's Energy Requirements, 1974, new tank farm storage capacity of 41.3 million barrels will be required as compared to current capacity of 30.2 million barrels. With respect to expanding tank farms in existing ports and harbors, A.D. Little, Inc. found, for example, that, based on oil terminal land holdings, only a 20% increase in storage capacity (roughly three million barrels) was possible in greater Boston (see Preliminary Environmental Study of Alternative Methods of Supplying Petroleum Products to Eastern Massachusetts, 1973, Vol. III, p. III-6-III). Expansion possibilities at Salem, another deepwater port, are similarly constricted; all available space at the Salem Terminal Wharf is now taken up by New England Power

Recreation

RECREATION

SUMMARY OF FINDINGS

Americans are participating in outdoor recreation more than ever before. The U.S. Bureau of Outdoor Recreation found that increases in leisure activities, particularly water-related recreation, far outstrips population increases. For example, from 1960-65, demand for fishing increased by 12%, swimming by 18%, and boating by 15%, while population grew by only 8%. Projections for the 1960-1980 period indicate that swimming will increase by 72% while the population is likely to increase by only 29%.[1]

In Massachusetts, the State Comprehensive Outdoor Recreation Plan estimates that the demand for swimming is highest of all recreation demands and is likely to exceed by four times all other needs for recreation in the next 25 years.[2] Because of a simultaneous dwindling of undeveloped coastal resources, meeting recreation demands is more difficult in coastal areas than in any other Massachusetts region. The New England River Basins' SENE Study estimates that approximately 130,000 additional acres are needed in coastal counties to meet all future recreation demands.[3] But the amount of coastal town acreage developed for non-recreation uses has increased by up to 500% over the last twenty-five years.[4] Some coastal towns, previously considered rural, currently have little undeveloped coastal land remaining.[5] Urban areas, chronically deficient in coastal recreational facilities, have few small and expensive coastal sites left. Thus, options for redistributing recreation opportunities are limited.

The high cost of land is another facet of the recreation dilemma. Traditionally, beaches have been purchased by the public sector since private enterprise cannot make a reasonable profit on beach recreation given the limited season, the high acquisition and operating costs necessary, and low revenues. Recently, as the price of coastal land continues to escalate, other recreation ventures have begun to founder. Although marinas, boatyards, boat and motor sales have enjoyed high profits compared to other marine industries during the past few years,[6] marina owners say that they are having greater difficulties establishing and expanding their businesses; they cite lack of, or cost of, waterfront land as a primary cause.[7]

The immediacy of the recreation dilemma is critical. Solutions must be provided within the next decade or most remaining opportunities will be lost. Coastal recreation benefits cannot be narrowly construed: public land acquisition in the coastal zone can complement and help implement other Coastal Zone Management policies. Acquisition can, under proper management, conserve marine ecosystems and prevent property losses in flood damage areas as well as provide coastal recreational opportunities. Recreation sites and activities are good "gateway enterprises", attracting visitors who spend money on food, lodging, and tourist facilities.[8] Recreation can also spur development, and

impart high values to existing housing stock as well as remaining open lands.[9]

The detrimental impacts of recreation should not be overlooked. Recreation activities place high demands on transportation networks and other municipal services. Over-utilization and conflicting uses degrade the quality of the recreation experience as well as the surrounding natural and man-made environs, and the cost of maintenance and operation of the recreation facilities quickly approaches the cost of acquisition.

The Massachusetts shoreline as a whole is deficient in recreation facilities, particularly in Eastern Massachusetts (Boston Harbor and the North and South Shores) and on Martha's Vineyard and Nantucket. Eastern Massachusetts needs more opportunities for all recreation activities; Southeastern Massachusetts needs more public beaches for swimming; Cape Cod needs more facilities for boating and camping, but provides ample swimming opportunities, particularly on the National Seashore; and the Islands are deficient in all recreation activities.

Unfortunately, suitable new sites for recreation are not available in all of the regions. Opportunities in Eastern Massachusetts are the most limited, particularly for large sites such as state beaches and campgrounds: Acquisition of a few large military sites, however, could alleviate some of the shortages in this region. Buzzards Bay, Cape Code and the Islands offer a greater number of opportunities for developing large recreation sites. However, these sites are distant from major population centers, and serious transportation problems are caused by excessive numbers of people driving to recreation sites. Additional investment in sites far from population centers can further aggravate congestion and other transportation impacts. Therefore, it is essential that improvements in non-automobile public transportation be considered as critical first steps in providing or expanding recreatin opportunities.

Transportation improvements should foster greater use of underutilized or new recreational sites, should reduce the volume of the current transportation impacts of congestion and noise, and should be compatible with the capacity of recreational sites to accommodate visitors. Appropriate to the scale of these sites, jitneys, boat service, and bicycle and hiking trails should be developed and expanded. Such low intensity transportation can provide access without causing traffic impacts.

Acquisitions must also be sensitive to the scale of potential recreation appropriate on the site, as well as the scale of the surrounding community. For this reason, Coastal Zone Management finds that, generally, acquisition of small dispersed sites is preferable to acquisition of very large sites.

Similarly, small scale improvements at existing sites can mitigate existing impacts, and add to recreational opportunities. Such improvements include expansion, provisions for multiple use, and improved

maintenance. This strategy is particularly appropriate to Eastern Massachusetts and other urbanized areas where there is little undeveloped land and use of existing facilities is intense.

Coastal Zone Management's primary concern is to increase and enhance public use of the Massachusetts shoreline while improving existing facilities and minimizing future conflicts, over-utilization and environmental impacts. Our plan is to improve transportation and access; to acquire new sites in recreation poor areas; to expand suitable existing sites through small acquisitions or encouraging multiple uses; and to improve maintenance.

ACCESS: DISTRIBUTION AND TRANSPORTATION

Access to recreation is a function of the distribution of and transportation to recreation sites. When recreation opportunities are available near concentrations of people, the necessity for long trips becomes less acute: e.g., Boston Harbor beaches are within a 15-30 minute transit ride of most metropolitan area residents. However, where the distribution of recreation opportunities is not proportional to the concentration of residents, the need for transportation links is more critical.

In Massachusetts, coastal recreation sites, as well as coastal resources, water quality, and other requisites are not evenly distributed; transportation links, understandably, were not planned to ameliorate the recreation imbalance. The uneven distribution of existing recreation sites and needs is portrayed in Table 1 and the accompanying map.[10] The table indicates that the Eastern Massachusetts region, including the North and South Shore areas and greater Boston Harbor, is most deficient in recreation areas. The State Comprehensive Outdoor Recreation Plan, the Massachusetts Growth Policy and the Coastal Zone Management Public Opinion Survey corroborate this finding.[11] Conversely, Cape Cod and Southeastern Massachusetts collectively provide the greatest supply of major water related activities. Sixty-five percent of Massachusetts' population is located in Eastern Massachusetts, but only 25% of the public water-related facilities are located there. Furthermore, the situation is even more acute than the figures indicate, as Eastern Massachusetts residents participate more in outdoor recreation than do citizens of the rest of the state. In order to reach areas where recreation supply is more plentiful, week-end recreationalists have established a "commuting" pattern, based on the auto, which causes severe traffic jams and local congestion. This coastal recreation commuting is serviced primarily by the following routes: I-95 and Route 128 to the North Shore; Route 1 to the near North Shore; Routes 3 and 3A to the South Shore and beyond to Cape Cod and Buzzards Bay; 228 to the near South Shore; Routes 6, 6A and 28 through Cape Cod; and I-95, 6 and 25 through Buzzards Bay and Mount Hope Bay.

Some recent improvements in these major transportation links have been recreation oriented. For example, a proposed extension around Buttermilk Bay to connect with the Bourne Bridge may ease congestion; possible double barrelling of Route 6 from Dennis to Orleans could

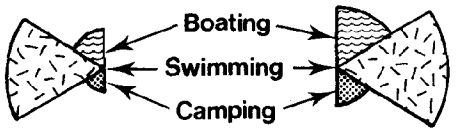
TABLE: RECREATION SUPPLY/DEMAND

	1975 Supply *(Activity Days)	1975 Demand (Activity Days)	Demand Currently Satisfied (%)	Needs (Demand not satisfied) (Activity Days)
BOATING				
**Eastern Mass.	2,800,000	9,100,000	30%	6,300,000
SoEa. Mass.	1,100,000	850,000	130%	none
Cape Cod	1,800,000	2,800,000	64%	1,000,000
Islands	90.000	1,400,000	6%	1,310,000
TOTAL	5,790,000	14,150,000	41%	8,360,000
SWIMMING				
Eastern Mass.	4,000,000	30,000,000	13%	26,100,000
SoEa. Mass.	1,700,000	3,900,000	44%	2,200,000
Cape Cod	29,700,000	9,200,000	323%	none
Islands	3,500,000	5,500,000	64%	2,000,000
TOTAL	38,900,000	48,700,000	80%	9,800,000
CAMPING				
Eastern Mass.	300,000	900,000	33%	600,000
SoEa. Mass.	400,000	100,000	400%	none
Cape Cod	500,000	1,400,000	36%	900,000
Islands	31,000	900,000	3%	869,000
TOTAL	1,231,000	3,300,000	37%	2,069,000
SALT WATER FISHING				
Eastern Mass.	Impossible to estimate, but presumed at least as high as boating	7,600,000		
SoEa. Mass.		900,000		
Cape Cod		1,800,000		
Islands		806,000		
TOTAL		11,106,000		

*Activity days are defined as the use of a facility for any period of time during a single day. Also known as user days.

** Statewide Comprehensive Outdoor Recreation Plan (SCORP) regions were used for demand figures and represent broad areas; e.g., Eastern Mass. covers metropolitan Boston, the South Shore and the North Shore and west to about Route 495. However, for supply, Coastal Zone Management figures, calculated for coastal towns only, were substituted. Thus, the table shows inland and coastal demand for the supply of coastal recreation resources.

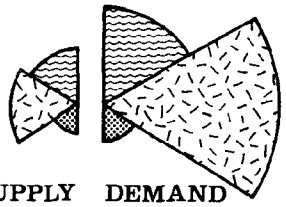
COASTAL RECREATION



SUPPLY **DEMAND**

SIZE OF SECTIONS REPRESENTS
1975 ACTIVITY DAYS.
FOR ACTUAL FIGURES SEE TABLE 1.

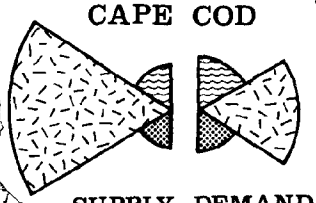
EASTERN MASS.*



SUPPLY DEMAND

* Demand in eastern Mass. includes coastal as well as inland towns west to approx. Rt. I-495.

CAPE COD



SUPPLY DEMAND

SOUTHEASTERN

SUPPLY DEMAND

ISLANDS

SUPPLY DEMAND

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

COASTAL ZONE MANAGEMENT PROGRAM

ease traffic problems on the Lower Cape; and widening of I-95 will increase use of North Shore recreation. Improvements like these, while increasing access to a broad area, will intensify impacts at the end of the recreational journey, since coastal towns are by nature geographic dead-ends and bottlenecks.[12]

Some non-auto alternatives complement or partly substitute for private vehicle transportation. The Boston Metropolitan Region is serviced by public transportation. City dwellers can take buses or subways to nearby beaches in Revere, Lynn, South Boston, Dorchester, and Quincy. Recently, the Southeast Region of the state has formed a transit authority which provides bus service for New Bedford, Fall River, Dartmouth, North Fairhaven, Mattapoisett and Somerset. Cape Cod has frequent bus service among towns on the Cape and from the Cape to Boston and the South Shore. Also, boat service from Boston to Provincetown offers transportation to recreation, as well as being a unique recreational experience itself.

Improvements like these are a necessary part of improving recreation access. Transportation must be planned for recreation. Creative alternatives to the automobile can be made more attractive. Prepackaged bus trips, well publicized weekend recreational transportation, increased use of boats to Boston Harbor Islands, to other parts of the Harbor, South and North Shores, and to Cape Cod National Seashore are alternatives which can be instituted now and as recreation sites are acquired or expanded.

MEETING COASTAL RECREATION NEEDS: SPACE AND SERVICES

The primary alternative to improving transportation to recreation is to acquire, develop or facilitate recreation development in the most deficient regions. Given unlimited funding, it might be an ideal solution. However, since coastal recreation is dependent upon amenities like clean water, undevloped sandy beaches, etc., finding the best sites in the needy regions is not always possible. This section identifies the requisites of major water-related activities and interprets from unmet "activity days" (Table 1) the land and water acreage necessary to satisfy needs.

BOATING

Recreational boating requires marine facilities and services, ships or moorings in a harbor or similarly protected embayment, or launching ramp access. Ancillary services include Coast Guard and Harbor Master protection and, often, security police protection. Clean water is desirable but by no means necessary. Requirements for minimum water depths and bottom types become more critical as boat sizes increase.

In Massachusetts, approximately 100 recreational harbors hold over 300 marinas whose slips and ramps provide about 20% of the total supply of coastal boating activity days; 30 coastal public access ramps pro-

vide another 20%; while private, town and marina moorings provide 40%.[13] Satisfying just the presently unmet coastal boating demand will require doubling these "access" facilities.

This demand could be met by the construction of 1000-1500 additional marinas, similar in size to existing marinas, at a probable private/public investment of $0.5 - 1 billion; or the construction of 150 additional public access ramps, at a probable public investment of $15-25 million;[14] or dredging for mooring space of 2500-5000 acres of harbor bottom, at a probable public cost of $2 billion;[15] or combinations of the above.

Clearly, the least costly and most timely public means of providing boating opportunities is through the public launching ramp. Also, the ramp provides opportunities for middle income, trailer boat owners who are increasing relative to other boat owners.[16] Marinas, which require as much area as ramps both on land and water, are becoming increasingly expensive to develop and operate, and thus, the private sector is unlikely to meet demand.[17] Also, dredging simply to provide mooring space has become prohibitively expensive.

Certainly, combinations of the three alternatives can serve the different regions in varying degrees of efficiency. For example, many harbor masters feel that their harbors are under-utilized, particularly in Greater Boston and Mount Hope Bay.[18] In these areas, marinas may be needed as facilities which attract people and provide services. Conversely, launching ramps and/or dredging may be the only feasible alternative in critically crowded harbors. Nonetheless, construction of public access ramps is the least expensive and most efficient way of meeting boating demand in deficient areas.

SWIMMING AND BEACH USE

Preferred characteristics for swimming include undeveloped sandy shoreline, safe surf and currents, and parking and service facilities. Clean water, as defined by public health standards, is mandatory.

By far, swimming has higher participation rates than all other recreation, although its recent growth in participation is not as high as boating and fishing.[19] Since beach use and swimming provide so many people of all different income levels with inexpensive recreation, advocacy for open beaches or public ownership of beaches has been strong. The Colonial Ordinance, which has been referred to in the Marine Environment Section, granted shoreline owners the land between the mean high and low water lines, but reserved for the public the rights to navigate, fish and fowl below the high water mark. In 1973, the Massachusetts Legislature asked the State Supreme Court for an opinion on whether these retained rights include walking as a lawful public use of the foreshore. The Court felt that such an interpretation was a taking without compensation and was thus unconstitutional. Responding to this decision, the Special Commission Relative to the Management, Operation and Accessibility of Public Beaches stated in its final report: "Acquisition of rights by express dedication, acquisition or other

such means is, in effect, the only way in which significant expansion of public beach resources will occur."[20]

Table 1 shows that 80% of the total demand for shoreline swimming is met but badly distributed, and limited to 250 miles of free or fee charged beaches.[21] Furthermore, the absolute numbers still seeking opportunities for coastal swimming is still higher than for any other activity.

In order to meet unfulfilled demand, roughly 50 miles or from 100-10,000 acres of additional beach is needed[22] (depending on whether "lineal" beach or major park beaches are developed). Some demand can also be met by substituting similar facilities, i.e., inland ponds and public pools instead of urban coastal beaches; although one survey indicates that ponds and pools cannot substitute for coastal beaches because of the special qualities of wind, waves and visual character of the shoreline.[23]

Along the Massachusetts shoreline, about 100 miles of undeveloped (without abutting residences) non-public sandy beach remain for possible addition to public supply.[24] Most of this beach is in small sections with about 5-10 sites suitable for large scale recreation facilities. Usually located away from population areas, these few large sites are located on Marth's Vineyard and Nantucket, in the Buzzards Bay region, and Cape Cod. The North and South Shore, and certainly Boston, have very few undeveloped sandy beaches left.

Another alternative to meeting needs is to open "resident only" beaches to all; however, this change would probably lead to crowded conditions. The Special Commission concurs, stating that "although the Commission believes that such restrictions (residents only) are generally not lawful or appropriate, it recognizes that such remedial action (lifting of all restrictions) would prevent or discourage resident recreation, pose difficult municipal finance problems and, more generally, only spread traffic, parking and other such problems from (other beaches)."[25]

In short, beyond what can be gained through transportation improvements, there is not much flexibility in meeting existing beach needs. Small, well distributed sites are not only desirable because they pose fewer traffic, social and other environmental impacts, but they also offer the only possible long-term option for meeting beach demand in a shoreline as developed as Massachusetts, particularly in Boston Harbor, the North and South Shores. Similarly, expansions of existing facilities can alleviate deficiencies in some regions, particularly if transportation to them can be improved. Finally, large sites can be purchased on an as-available basis, e.g., surplus federal properties.

SALT WATER FISHING

Salt water fishing has relatively few requirements that differ from boating and swimming. However, fishing needs can also be met in more flexible ways than by boat or beach use. People can fish from most piers, bridges or jetties -- places that might not be suitable for other forms of coastal recreation. Similarly, as mentioned before,

Massachusetts law allows beach passage between mean low and high tide for "navigation, fishing and fowling"; thus opportunities are limited by lack of shore access points.[26]

Since the supply of fishing opportunities is difficult to estimate it is specious to argue that there are unmet needs. However, studies indicate that salt water fishing participation has increased nationally by 45% since 1960. The value of fish caught by salt water sportsfishermen in Massachusetts are estimated at nearly $20 million.[27] Additionally, Massachusetts has higher amounts of fishing participation than the combined neighboring states of Maine, New Hampshire, and Rhode Island; fishermen in those states fish almost as frequently in Massachusetts as they do in their home states.[28]

Massachusetts salt water fishing is an increasing coastal activity which generates substantial income, and which makes further demands on coastal access. Alternatives for satisfying fishing demand include beach acquisition and construction or rehabilitation of usable piers for use by fishermen. Even the smallest access points along the coast are useful for fishermen. Thus highway and bridge projects, utilities, etc., can provide fishing opportunities at minimal expense.

OTHER OPPORTUNITIES AND CONSTRAINTS

This section explores combinations of coastal uses which together can enhance or degrade basic recreational experiences. For example, the tourist who is able to camp, swim and tour historic houses in the same area experiences more enjoyment than supply/demand statistics for individual activities illustrate. On the other hand, inappropriate combinations of activities, such as swimming or surf fishing occurring on the same beach can detract from the value of each individual activity. Although each conflict must be decided on a site-by-site basis, location, proximity of activities to one another, and timing and seasonalness of activities are important factors in planning for multiple uses. The following examples illustrate desirable multiple uses along the Massachusetts coast.

COMPLEMENTARY/MULTIPLE USES

Camping, Hiking and the Coastline

Campers and hikers require large areas for their trailers and tents, water supplies and sanitary facilities, and trails to lead them from camping areas to interesting destinations.

A system of coastal trails and campgrounds for hikers, bicyclists and equestrians would make more coast accessible to more people; could link population centers with recreational facilities; and would allow people to enjoy the scenic qualities of the coastline (refer to Visual Environment Section). Near-shore coastal campgrounds could function as origins for recreationalists, and trails would provide links to the

swimming, boating and fishing on the shore.

The demand for camping is rapidly increasing: 55,000 more people camped in state campgrounds in July 1975 than in July 1974.[29] The unmet demand for camping (Table 1) and the expense of near-shore land make unlikely the expansion of shoreside camping areas. However, opportunities for trail development are limitless, ranging from bike routes currently being developed by the Massachusetts Department of Public Works to scenic rivers to utility easements.

Tourism and the Coastline

The coastal zone attracts a large number of visitors who come to enjoy the swimming beaches, sailing and boating opportunities, and fishing experiences the coast offers. Rolling dunes, a craggy rock ledge, expanses of blue water, and the sights and sounds of a busy fishing harbor are probably some of the first things that come to people's minds when they think of the coast. Their ability to soothe, to humble, to excite, or just to pre-occupy makes the coast a primary tourist attraction.

The state's tourist industry sustains an estimated 74,400 full-time, year-round jobs. Income attributed to tourism is estimated at $1.2 billion annually.[30] The coast accounts for most of the jobs and much of the state's tourist income. For example, 56% of the state's hotels, motels, trailer parks, and campgrounds are located along the coast (excluding those in Boston).[31] Additionally, two of the most obviously coastal regions, Cape Cod and Martha's Vineyard, attribute 75% and 95% of their respective Gross National Products (GNP's) to the tourist industry.

Maintaining a healthy tourist industry, which for some regions is the primary source of income for residents, requires a continuing effort to provide the recreational facilities tourists demand -- swimming beaches, fishing and boating opportunities -- and to preserve those aspects of the coast's visual environment which serve to attract tourists.

Other Multiple Uses

Many other coastal uses can also coexist with recreation. For example, public utility rights-of-way can be used to provide access for shore fishing; institutions can provide access for general recreation and tourism; and port operations can serve as exciting focal points for sightseeing. The seasonal differences in Massachusetts also offer creative possibilities for multiple uses: parking lots at marinas can provide winter storage for boats; beaches used by swimmers in the summer can be used as campgrounds in the fall; tourist hotels change to winter convention centers.

CONFLICTING USES AND ENVIRONMENTAL IMPACTS

Conflicting uses and environmental impacts stem from inappropriate intensity and mixing of incompatible uses. Conflicts result from

physical competition for space, psychological incompatibility and destruction of resource-related values. Conflicts, if allowed to continue unmanaged, may result in reduced health and safety and deterioration of environmental and recreational qualities. Examples of such coastal conflicts include: boating (bacterial waste, danger) impact on swimming; boating (speed, wake, noise) impact on fishing; beach use with car (noise, visual) impact on adjacent private properties. Although there may be many possible conflicts under certain conditions, solutions can also be varied. Examples of types of solutions include:

--Conflicts are between the operational aspects of each activity, i.e., where equipment and space needs conflict or the speed or intensity of the activities conflict. Such conflicts may be resolved through mechanical manipulation, e.g., reduction of speed, separation of spaces, etc.
--Conflicts are in timing, seasonality and sequencing, i.e., where uses are incompatible at different times of the day or season. Solutions may involve separating uses in time rather than space.
--Conflicts may be resolved through minor management rules, e.g., leashing of dogs or other administrative and policing solutions.

Although resolution of some conflicts are only possible through prohibition of one use, many can be resolved by improved management.

MAINTENANCE AND PRICING

Throughout regional Coastal Zone Management public meetings, citizens cited maintenance of recreation areas and lack of facilities as major concerns.

While federal or state funds frequently support local acquisitions, once the community acquires an area, its maintenance is borne by or charged to the town. This practice partly accounts for frequent charging of fees to out-of-town residents.

Maintenance expenditures are not small. Last year the Department of Environmental Management spent $775,000 for the operation of its beaches (vs. $435,000 in revenue) and $3.8 million for parks (vs. $992,000 in revenue).[32] Maintenance cost problems are serious enough that the Special Legislative Commission, in recommending legislation to prohibit non-resident discrimination at beaches, consciously exempted pricing differentials "at municipal beaches where the municipality uses tax revenues to maintain and operate the beach facilities, and the fee differential reflects an adjustment in charges that effectively equalized resident and non-resident daily use payments."[33]

If communities are not allowed to recover tax funded maintenance expenses through differential pricing, town residents would either be subsidizing out-of-town users, or might not be able to maintain beaches adequately. Adequate maintenance is important because it increases

the capability of resources to support greater use. Thus, where a differential in access fee is necessary to cover maintenance, the well-maintained facility warrants the higher fee.

OBJECTIVES

The foregoing discussion suggests that CZM's recreation program should be designed to achieve the following objectives:

1. To improve the quantity and quality of coastal recreational opportunities for all citizens of the Commonwealth.

2. To improve public access to coastal recreation resources.

3. To ensure that the improved quantity and quality of coastal recreational opportunities are provided while minimizing conflicts, over-utilization and economic environmental impacts.

4. To involve citizens and user groups in the further planning, development and management of public coastal recreational facilities.

5. To suggest, initiate and conduct research into areas of special needs for coastal recreation and to develop management standards and criteria for utilization in public recreational facilities and areas.

6. To promote tourism where appropriate through the provision, improvement, and diversification of coastal recreational amenities.

CZM POLICIES AND PROGRAM RECOMMENDATIONS

Policy (23) Improve public access to coastal recreation facilities, and alleviate auto traffic and parking problems, through improvements in public transportation.

Because some existing coastal recreation sites are underutilized and/or badly distributed, or because resistance to an increase in recreation on the coast is often based on undesirable auto traffic impacts on communities, CZM believes that solving transportation access to recreation is the first step to improving coastal recreation opportunities. Thus, CZM will work to facilitate buses, boats or alternative public transportation from: (a) central points within regions to nearby coastal recreation facilities, e.g., from town centers to beaches and/or (b) direct from urban or inland areas to remote coastal recreation facilities, e.g., from Boston to the National Seashore. In addition, CZM will consider and facilitate bus service from the same distribution points to inland recreation in order to reduce pressure on the shoreline. To encourage ridership, public transportation should be designed to fit recreationists' needs, e.g., buses which carry bicycles. The development of demonstration or operational projects will be a priority where:

1. Existing transportation is inadequate, especially where there are congestion and traffic problems or other environmental impacts; or

2. The area is state or federally owned, since potential impacts from increased use can be more easily managed on public land; or

3. The area is underutilized; or

4. Benefits from public transportation to recreation might spill over into increased town commerce, tourism; or

5. Public transportation investments can service many recreation areas near each other.

IMPLEMENTATION MEASURES

CZM will work with the Department of Public Works, Public Transit Authorities, Regional Planning Agencies and community Planning Boards to ensure that recreational-related transportation improvements are given high priority in Annual Unified Work Programs submitted to the Federal Highway Administration and the Urban Mass Transportation Administration. Specifically, CZM will coordinate as follows:

--Urban Mass Transportation Administration (UMTA) provides, under the U.S. Department of Transportation, grants and loans to states for transit planning, development, and operation. Transit systems can provide inexpensive access to coastal recreation as well as reduce the traffic congestion and related impacts from automobile access. In order to qualify for transit funding, Massachusetts must submit an Annual Unified Work Program to UMTA which lists and sets priorities for transit projects. CZM will work with community and regional planners, and transit authorities, to ensure that transit projects which serve CZM's recreation-related transportation policy are included in the Annual Unified Work Program.

--Federal Highway Administration (FHWA), also an agency of the Department of Transportation, is responsible for the administration of grant programs for upgrading and construction of a national system of highways; the FHWA also reviews each state's Unified Annual Work Program and allocates funding accordingly. As well as sponsoring and supporting transit projects in the work program, CZM will, through "federal consistency" (Section 307, CZMA), coordinate with FHWA to ensure that coastal road construction does not overload coastal recreation and intensify auto related impacts.

--Executive Office of Transportation and Construction, and the Bureau of Transportation, Planning and Development (BTP&D) of the Department of Public Works comprise the state arm of transportation planning and development. Under the Executive Office, the BTP&D implements the 3C Transportation Planning Program, established by

the Federal Highway Act of 1962 and Urban Mass Transportation Act of 1974. CZM will establish memoranda of understanding with the Executive Office and BTP&D to coordinate inter-agency policies on recreation and transportation.

--Regional Planning Agencies and Transit Authorities are the primary authors of the state's Unified Work Programs. In producing the Work Programs, the RPA's are directed by the BTP&D to integrate transportation planning within a comprehensive framework and to show, specifically, the inter-relationship between other RPA planning tasks and those performed under transportation planning. In this context, CZM will coordinate recreation, open space and public transportation policies with RPA's by co-sponsoring project proposals to UMTA; to the National Parks Service for "Alternative Transportation Systems Research Program" grants, a program to fund demonstration projects for transportation within and to National Parks; and/or use CZM recreation planning funds to sponsor feasibility studies to evaluate public transportation projects to recreation facilities, particularly within Boston Harbor and to the National Seashore (discussed subsequently).

--A95, NEPA, MEPA - In addition to sponsoring and/or helping fund recreation related transportation projects, CZM will review all proposed recreation projects, including town and state acquisitions, for explicit consideration and resolution of transportation and access alternatives, as well as traffic and circulation plans. CZM will use A-95, MEPA and NEPA to review recreation projects and coastal transportation projects to negotiate compliance with recreation-transportation policies cited above. Specifically, through "federal consistency provisions" of the CZMA (Section 307, CZMA), and by reviewing projects under NEPA, CZM will coordinate with the U.S. Department of Transportation (DOT) in "providing public access to recreation", a goal set forth in a joint DOT-OCZM memo concerning national interest in the coastal zone. CZM will work with DOT to define more precisely how this goal can be attained.

--Additionally, CZM recommends changes in the state point evaluation system for outdoor recreation projects, promulgated under U.S. Bureau of Outdoor Recreation (BOR) guidelines, to reflect higher priority for proposals which demonstrate transportation improvements proposed in Policy (23). CZM will coordinate with the Division of Conservation Services to ensure that transportation and access alternatives have been considered and that the project would not generate significant traffic and noise problems and related environmental impacts.

Policy (24) In addition to expanding major access, link existing coastal recreation sites to nearby coastal inland facilities via trails for bicyclists, hikers and equestrians, and via rivers for boaters.

To relieve some transportation access problems, CZM finds that many existing coastal recreation facilities can be linked by trails which would both improve recreation access and enhance the overall recreation experience. Such trails and water routes should be established or developed when:

1. They are located on visually important rivers, roads and other visually significant areas;

2. The numbers of recreational sites joined by a trail and the trail itself can serve a region-wide public;

3. Historic landmarks cited for designation in the National Register or Massachusetts Historical Commission are found along the proposed trail;

4. The trail connects with other forms of public transportation;

5. The trail is compatible with the environmental sensitivity of the area.

IMPLEMENTATION MEASURES

In order to establish a trail system that links recreation sites, CZM proposes acquisition of easements under the following programs:

--Coastal Zone Management Act Amendments, 1976, Section 315 authorize 50% grants to states for the costs of acquiring access to public beaches and other coastal areas of environmental, recreation, historical, esthetic, ecological or cultural value. Massachusetts CZM will give high priority to the use of Section 315 funds for the purchase of trail easements that provide access to sites which meet the criteria of this policy. Such funds can either be expended at the state level or disbursed to communities.

--Land and Water Conservation Fund (P.L. 88-578) provides funds for the acquisition of lands for federally administered recreation areas; and matching grants for state recreation planning, and state and local land acquisition and development. The fund, which is administered by the Bureau of Outdoor Recreation of the Department of the Interior, is distributed through the Massachusetts Executive Office of Environmental Affairs. The Bureau of Outdoor Recreation has developed a posture on recreation in the coastal zone, basing its position on the following objectives: (a) recreation should be equal to all other coastal uses; (b) recreation should deserve equal consideration in planning and development; (c) acquisition of additional shoreline lands should be held in perpetuity for conservation, recreation, and compatible purposes should be given top priority by all land management agencies; and (d) the right of public access to coastal areas should be protected. In context of the BOR desire to secure access to coastal recreation, CZM will coordinate with the Massachusetts Division of Conservation Services and the Department of Environmental Management to ensure that high priority be given to acquisition of trail access and easements to coastal recreation.

--Self-Help Program, also administered with the Division of Conservation Services, Executive Office of Environmental Affairs, provides up to 50% reimbursement to communities for the acquisition of conservation or passive recreation land. Similar to the above procedure for the Land and Water Conservation Fund, CZM will work with Conservation Services to ensure that small scale trail access to existing conservation lands be given high priority among Self-Help projects.

--Public Access Board (MGLA Ch. 21, S-17, 17A) is empowered to acquire access to great ponds and other waters within the Commonwealth and develop trails and related facilities for hiking, skiing and other uses. CZM will recommend easements for Public Access Board acquisitions which provide access to coastal waters and link existing recreational sites. Additionally, a representative from the Coastal Zone Management program should be appointed to the Public Access Board in order to ensure implementation of this CZM policy.

--In addition to the purchase of trail easements, CZM recommends implementation of this policy through the designation of scenic corridors which can establish access routes and enhance the actual journey to the recreational site. Programs for such designation include:

--Scenic Rivers Program (MGLA Ch. 21, S-17B), administered by the Department of Environmental Management of the Executive Office of Environmental Affairs, provides for the management of rivers for scenic and recreational purposes. Where such rivers exist in the coastal zone, CZM will recommend designation and management guidelines for ensuring continued unspoiled recreation opportunities as well as boat access to coastal waters (refer to the Visual Environment section for further discussion of guidelines). In addition, CZM will provide technical assistance to communities who wish to make such designations.

--Scenic Roads Program (MGLA Ch. 40, S-15C) enables planning boards to restrict the removal of vegetation and stone walls on designated local roads. CZM will recommend designation of scenic roads which can complement other trails in a coastal trail system. In addition, CZM will provide technical assistance to communities who wish to designate such roads in the coastal zone.

--Bikeways Program, administered by the Department of Public Works provides funds for off-road construction of separated bike paths. Criteria for bikeways planning include: improved safety and circulation for road users, access to major trip generators, integration with existing bikeways systems, and coordination with transportation and land use plans of other regional and state agencies. Since these are similar criteria to guidelines for a trail system promulgated in this policy, CZM will work the DPW to ensure maximum construction of bike paths along the coastal edge. Such construction will be coordinated with future public transit destinations discussed in the first policy of this section.

Policy (25) Expand existing state or local recreation facilities in regions with a high need.

Every region of the Massachusetts coast is deficient in various types of recreation. As a concomitant step to transportation improvements, existing sites should be expanded under the following circumstances:

1. Undeveloped areas abutting or near existing recreation sites are suitable for expansion, and access will be made possible through improved transportation;

2. Existing sites are over-utilized and there is no nearby substitute which might shift demand for the activity and/or;

3. Other public improvements have been made or are proposed on/near existing recreation sites; for example, where state or federal funding has been used to slow or prevent erosion of beaches.

IMPLEMENTATION MEASURES

--Coastal Zone Management Act Amendments, 1976, Section 315, as previously discussed, provides states with funds for recreation acquisition. Similar to trail easement acquisition, CZM will give high priority to using Section 315 funding for small expansions which improve existing recreational sites' capacity.

--In reviewing applications for Land and Water Conservation and Self Help funds, through the Clearinghouse process (A-95) and through the Massachusetts Environmental Policy Act, CZM will favor sites which have potential for expansion as defined by the above criteria.

Policy (26) Increase capacity of existing recreational areas by facilitating the multiple use of the site and by improving maintenance. Resolve conflicting uses whenever possible through improved management rather than through exclusion of uses.

Many recreational sites, if managed more efficiently, could accommodate more and different uses without much change in physical characteristics. CZM intends to promote expanded use and maintenance under the following circumstances:

1. Opportunities for physical expansion are limited; or

2. The operational aspects of activities do not conflict, e.g., picnicking, and sunbathing; or

3. Improved management and maintenance can control operational conflicts between uses; or

4. The seasonality of the activities facilitates multiple use sequencing; or

5. Recreational use of non-recreational areas can be accommodated on weekends, e.g., boat launches at utility companies.

IMPLEMENTATION MEASURES

Recognizing the potential benefits of more efficient use of existing recreation sites, CZM will (a) seek and provide technical assistance to help design areas for multiple use; (b) ensure necessary expenditures for maintenance. CZM will seek demonstration grants to work with other state, federal and local agencies whose programs provide opportunities for multiple use recreation; e.g., fishing walkways on bridges over estuaries, launching ramps on roads which abut water, public walkways in urban renewal areas. Such programs include:

--Coastal Zone Management Act Amendments, 1976, Section 305(b) will be extended by the federal Office of Coastal Zone Management during 1977-78. The extended funding is intended "to give specific emphasis and support for these (recreation) areas." CZM will use this planning money to analyze specific recreation problems; the design of multiple use concepts and application is a high priority for this funding.

--Department of Housing and Urban Development provides, under the Housing and Community Development Act of 1974, direct grants to state, metropolitan, and regional planning agencies for land use, housing, urban, and redevelopment planning. In addition, discretionary grants awarded to urban communities may be used for eliminating blight, conservation or expansion of housing and housing opportunities, increased public services, and improved use of land. CZM will support HUD grants to demonstrate the potential and necessity for multiple recreation uses in waterfront renewal areas.

--Department of Public Works (MGLA Ch. 90) is authorized to construct, improve and maintain all non-federally funded roadways. In effect these include most urban and rural roads which do not provide direct access to a major population center or access between population centers within metropolitan areas. CZM will work the DPW in order to encourage the construction of small recreation oriented improvements during normal maintenance of their roads, e.g., fishing walkways on bridges.

In addition to such demonstration grants, CZM will use the following funds to provide increased maintenance to support multiple use projects or high capacity use of existing areas:

--Coastal Zone Management Act Amendments, 1976, Section 315, although intended for acquisition purposes, may be able to be used for increased maintenance. CZM will urge the Department of Commerce to allow use of this fund for maintenance in areas where no other expansion alternatives are possible and recreation needs are high.

--CZM will through A-95 and MEPA review procedures, ensure that applications for acquisition of coastal recreation sites have appropriately indicated sources for maintenance funds, and that multiple use of the proposed facility has been explored. "User-fee" revenue for maintenance will be considered an appropriate source of maintenance funds.

Policy (27) Facilitate expansion and improvements of private recreational facilities and sites that provide public coastal access.

Demand for the kinds of recreation experiences enjoyed on the coast is high; the facilities and sites required to provide these experiences are coastally dependent. Many of the facilities have adverse impacts on the marine environment. Yet, if Massachusetts is to allow the public to enjoy the benefits of a productive marine environment and visually pleasing coastal zone, both public and private means of securing general public access to the shore should be encouraged.

Thus, CZM's marine environment policies specifically exempt from restriction in salt marshes, dune areas, sandy beaches, and barrier beaches, the construction and maintenance of boat ramps, wharves built on timber pilings, the expansion or improvement of beaches, and hunting fishing, horseback riding, hiking, and other recreational uses.

IMPLEMENTATION MEASURES

CZM will offer technical assistance and fund feasibility studies in developed harbors to promote the construction of needed recreation boating facilities and to solve dredge and dredge spoil disposal problems. Such assistance will be provided, in particular, where it can be demonstrated that a marina will help to revitalize a developed harbor. In addition, CZM will prepare a design and construction practices handbook indicating how marinas, beaches, boat ramps and other recreational facilities could be designed, constructed, and operated to be consistent with CZM's marine environment, coastal hazards, visual environment, and ports and harbors policies. Such measures will be implemented through:

--Marine Environment and Port and Harbors Policies which allow for and encourage coastal recreation facilities construction/improvement.

--Coastal Zone Management Act Amendments, 1976, Section 305(b) Using funding provided in 1977-78 by the Department of Commerce for coastal recreation planning, CZM will prepare the design and construction practices handbook described above.

Policy (28) a. Acquire and develop new sites favoring small to moderate size recreation facilities, in conjunction with transportation improvements, in deficient regions especially where there are few remaining opportunities.

b. Give lower priority to acquisition of large sites except under the following circumstances:

1. When high recreation potential, waterfront military sites become available.

2. When special floodplain purchases become available (refer to Coastal Hazards Section).

3. When sites with critical environmental, visual, or other unique characteristics become available (refer to Areas for Preservation or Restoration in Management).

After transportation, expansion and maintenance policies have been implemented, small sites must still be acquired in order to satisfy a growing demand for coastal recreation. Of the specific recreation types analyzed, the following activities will be favored:

1. Swimming and beach use: Highest priority for small dispersed sandy beaches and beach easements in swimming deficient regions. In disbursing recreation funds, beaches for swimming will have highest priority for acquisition since they generate the highest recreation use.

2. Boating: Highest priority for the expenditure of state funds on boat ramps. State funds for dredging new mooring basins should not be used to meet recreation boating needs except where it is the only feasible alternative for resolving conflicts between recreational boating and commercial fishing (see Ports and Harbors, Policy (20).

3. Fishing: High priority for special easements, piers, and landings in conjunction with other recreation acquisitions or public improvements making full use of multiple use concepts.

4. Camping and hiking: High priority for inland sites in conjunction with transportation policies to provide near shore camping. Acquire easements for hikers and bicyclists to travel between existing/future inland sites and shoreline recreation.

IMPLEMENTATION MEASURES

Under special recreation planning funds during the first year of management, CZM will develop site and activity specific criteria for evaluating the potential sites for new acquisitions. Using these guidelines, as well as the design handbooks previously mentioned, CZM will work with local governments to acquire small sites under the following programs:

--Coastal Zone Management Act Amendments, 1976, Section 315, as previously discussed, makes funds available for the purchase of coastal recreation sites. Since CZM will also use this fund for expanding existing sites, thereby reducing it significantly, CZM will purchase new small sites on a very selective basis in the most deficient regions.

--Land and Water Conservation Fund, as administered through the Executive Office of Environmental Affairs, will also be used in part to purchase coastal sites. Although CZM favors purchase of small sites, it is also appropriate that this fund be used to purchase the few remaining large sites, particularly military, as discussed above.

TECHNICAL NOTES AND SOURCES

1. U.S. Bureau of Outdoor Recreation, Outdoor Recreation Trends, Washington, D.C.: U.S. Government Printing Office, 1967, pp. 20-24.

2. Department of Environmental Management, Executive Office of Environmental Affairs, State Comprehensive Outdoor Recreation Plan, Boston, Mass., 1976 Chapter VI.

3. New England River Basins Commission, Southeastern New England Study, Boston, Mass., 1975, pp. 6-4.

4. MacConnell, W.P., University of Massachusetts, College of Food and Natural Resources, Twenty Years of Change, Amherst, Mass., 1973.

5. MacConnell, Ibid. With special analyses on shoreline land for Massachusetts Coastal Zone Office, Boston, Mass., 1975.

6. W. Robert Patterson, The New England Marine Industry; A Study of the Marine Manufacturing and Services Companies, N.E. Marine Resources Information Program and New England Aquarium, Boston, Mass., 1971, p. i.

7. John L. Compton and Robert B. Ditton, A Feasibility, Management and Economic Study of Marinas on the Texas Gulf Coast, Department of Recreation and Parks, Texas A & M University, Sea Grant, Texas, 1975, p. 8.

8. Patterson, Op. Cit., pp. 3-7, 3-8. Indicates multiplier factors of charter fishing and marinas as 3.08 and 2.76 respectively, ranging slightly under fish processing and higher than other marine manufacturing.

9. Compton and Ditton, Op. Cit.

10. Table 1 presents information from two sources. Demand for recreation activities has been extrapolated from the State Comprehensive Outdoor Recreation Plan. Calculated as "activity days", (defined as use of a facility period of time during a single day), this estimate for demand has been determined using economic information developed in ORRCC, modified by survey information developed in SCORP. Supply figures, also translated into activity days, have been developed from a specific CZM recreation inventory, i.e., for sites only in/near the shoreline. Space requirements for activity days are subsequently developed in the rest of the text.

11. Massachusetts Office of State Planning, Towards a State Growth Policy, Boston, Mass., 1975; and Massachusetts CZM, "Citizen Survey" Boston, Mass., 1976.

12. Special Legislative Commission, "Report Relative to the Management, Operation and Accessibility of Public Beaches Along the Seacoast", Boston, Mass., 1975, p. 31; cites traffic and parking problems stated at public hearings.

13. Calculations were developed from a Massachusetts CZM inventory of all coastal harbors and access ramps. Besides the major public access ramps, there are over 100 additional small ramps which have been included under "marina slips and ramps;" over 60 of these small ramps are located in marinas on Cape Cod.

14. Calculations were based on the need for a five-fold increase in the amount of existing marinas or ramps in order to double total supply, as each currently provides 20% of the total boating supply. Assumptions for cost estimates include: $0.5 million for construction, dredging and land acquisition of one marina; $100,000 for major ramp construction and land acquisition for 10 parking spaces.

15. Calculations were based on assumptions that one acre of water at a depth of five feet was necessary to safely moor 15-20 small boats and dredging costs at approximately $8./cubic yard. Therefore, dredging one acre to minimum depth would cost $40,000; 5,000 acres would cost $2 billion.

16. David A. Storey, The Massachusetts Marina Boatyard Industry, Massachusetts Agricultural Experiment Station, University of Massachusetts, Amherst, Mass., 1972-73.

17. According to the National Association of Engine and Boat Manufacturers in an article called "Shoreline Recreation Resources of the U.S.", boats purchased nationwide increased from 2,440,000 in 1947 to 8,025,000 in 1960, or an increase by 220%. Marina development in Massachusetts has not similarly increased. Twenty years (MacConnell, op cit) of land use change corroborates this finding.

18. This information is based on an informal Massachusetts CZM telephone survey of harbormasters. Opinions were solicited regarding maintenance problems, harbor capacity and conflicting uses. Almost 50% of the harbormasters felt that their harbors could sustain more use.

19. SCORP, Loc. Cit., p. V-61.

20. The Special Legislative Commission Relative to the Management, Operation and Accessibility of Public Beaches, "Third Interim Report", Chapter 40 of the Resolves of 1972, prepared by David Rice, Boston, Mass., August, 1975, p. 11.

21. The amount, ownership, and access information of Massachusetts beaches was developed based on previous inventories including New England River Basins Commission's SENE, the Special Legislative Commission report, as well as field checking and Citizen Advisory Commissions' information and mapping.

22. Recreation beaches can be developed, at a minimum, as simple lineal access on sandy beaches, or at a maximum as major park beaches including parking, associated facilities, upland park, picnic tables, etc. Fifty miles of the latter type of recreation beach would require 10,000 acres, assuming 200 acres/mile of beach.

23. National Park Service, "Summary of Outdoor Recreation Activities in Preference of the Population Living in the Region of the Delaware Basin," prepared from report by Audience Research Inc., Princeton, New Jersey, January, 1958. The report documents information from a poll that indicated that 48% of the respondents chose the New Jersey seashore for the most preferable day outing.

24. Beach and shoreline inventory, Loc. Cit.

25. Special Legislative Commission, Loc. Cit., p. 33.

26. See Opinion of the Justices, State of Massachusetts, 313 NE 2nd 561, 1974.

27. David G. Deuel, "1970 Salt Water Angling Survey," current fish statistics #6200, Statistics and Marketing News Division, National Marine Fisheries Service, Sandy Hook, New Jersey. SENE estimated $20 million value, pp. 6-11. Estimate of value of sport fish caught from: personal communication with Christopher Mantzaris, National Marine Fisheries Service, Gloucester, Mass.

28. National Marine Fisheries Service, "Participation in Marine Recreation Fishing, N.E. US 1973-74", Department of Commerce, Washington, D.C. January, 1975, pp.4-5.

29. Commonwealth of Massachusetts, Department of Environmental Management, Division of Forests and Parks. Based on inventory of tourism statistics.

30. Department of Hotel, Restaurant and Travel Administration, University of Massachusetts at Amherst, Research Report, The Economic Impact of Tourism on the Commonwealth of Massachusetts, prepared for the Massachusetts Department of Commerce and Development, December, 1974. Part-time or seasonal jobs are adjusted to full-time, year-round equivalents, e.g., two full-time 6 month jobs equal one-full time year round job. Income attributed to tourism includes both direct, indirect and induced expenditures.

31. Of the state's 1308 hotels, motels, trailer parks, and camps, 736 or 56% are located in the Counties of Barnstable, Bristol, Dukes, Essex, Plymouth, and Nantucket. U.S. Bureau of the Census, 1972 Census of Selected Service Industries, Massachusetts.

32. Extrapolated from budget information on parks and beaches for the State of Massachusetts, Department of Environmental Management and Metropolitan District Commission.

33. Special Legislative Commission, Loc. Cit., p. 13.

ENERGY

SUMMARY OF FINDINGS

The Massachusetts coastal zone plays a major role in fulfilling the energy requirements of the state -- 80% of the Commonwealth's energy facilities are currently located there, and these provide 75% of the energy needs of the state. The coast accommodates sites for electric generating plants, gas facilities, marine terminals, and tank farms and could, in the future, be called upon to host a refinery or off-shore oil or gas (OCS) related facilities.

Energy facilities are located in the coastal zone for three basic reasons: utilization of free, abundant water for cooling purposes; proximity to fuel supply; and accessibility to market areas. Some of these facilities are by their nature coastally dependent, that is their successful functioning in some way requires that they be sited on the coast. Others can be sited inland, but inland locations may entail increased costs to the energy industry and energy consumers.

Massachusetts is and will remain dependent upon imported, product oil. Fifty-eight percent of this imported oil comes from foreign nations, all of which, along with the majority of domestic oil, is brought into the state via coastal marine terminals. For the foreseeable future, these products will continue to arrive in conventional coastal tankers and be stored in oil tank farms. While Massachusetts has sufficient marine terminal capacity to handle any projected increase in tanker traffic, additional oil storage facilities will be needed. CZM finds that, in many instances, ports which now host tank farms will be unable to accommodate additional storage. Tank farms could, however, be economically sited in areas outside the coastal zone.

In addition to oil, natural gas has become a widely used fuel, due to its efficiency and clean burning characteristics. Importation of liquified natural gas (LNG) through marine terminals has thus become important to supplying the energy needs of the state. LNG storage facilities, because of the economics and risk of transporting liquified gas, must be sited close to marine terminals. Thus, base load LNG marine terminals are more coastally dependent than many other energy facilities.

The coast, in addition to providing sites for receiving and processing facilities, also provides sites for 21 electric power plants. These facilities generate 75% of the total electric needs of the Commonwealth. Beyond the construction of an addition to the nuclear power plant at Plymouth, no new major generating facilities will be required to be constructed in the coastal zone until after 1990. However, by 1990 there will only be a limited amount of coastal land available for power plant siting and avoiding conflicts with other coastal uses and activities will be difficult. As a feasible alternative to coastal siting, many generating facilities could be sited inland, provided appropriate cooling technology is available and can be economically utilized.

Currently Massachusetts lacks any refining capability, and proponents argue that a refinery might be beneficial to the state's economy and establish surety of energy supply. A refinery would probably require a deepwater port, used to import, by deep draft vessels, large quantities of crude oil for refining. Refineries require substantial land and water which may preclude other uses if sited in coastal areas. In addition, while deepwater ports would reduce congestion and the frequency of tanker spills, the risk of very large spills would be higher. Refineries can be sited inland, and such locations are preferable.

The siting of energy facilities in the coastal zone may be affected by the sale of roughly one million acres of petroleum drilling rights in the North Atlantic Outer Continental Shelf (OCS) by the Department of Interior, scheduled for May 1977. If there is a find subsequent to this lease sale, the Commonwealth might well experience development pressure from OCS related activity. OCS exploration may require development of pipeline landfalls, gas processing facilities, tank farms and distribution facilities. Other OCS related activities such as supply bases, pipe coating yards, and platform fabrication yards might also be proposed for the coastal zone.

Construction and operation of each of the facilities entails numerous adverse environmental, social and economic impacts which the program seeks to ameliorate or control. Primary among the environmental impacts are those associated with air and water quality and land use conflicts. Emissions of sulfur, particulates and hydrocarbons from existing energy facilities have resulted in degraded air quality. Oil spills, chronic leaking and the need to dredge and fill coastal areas have had substantial adverse water quality impacts. The large acreage requirements of these facilities have pre-empted other coastal uses. In addition, these facilities can be visually obtrusive and block access to coastal areas.

Nuclear power plants and LNG facilities, in addition to contributing to the environmental impacts outlined above, present public safety concerns which must be addressed by appropriate agencies. The potential for release of radioactive material into the environment from a nuclear plant raises serious questions about the wisdom of siting such a facility in close proximity to densely populated areas. The prospect of a LNG spill which could result in an explosion and fire demands that extra scrutiny be given to the siting of such a facility as well.

All energy facilities entail adverse environmental impacts. But CZM recognizes that Massachusetts will need increased amounts of energy and that, in order to meet these needs, new facilities will be required. Thus, the CZM plan strives for a rational allocation of coastal land for the siting and accommodation of energy needs with a minimum impact on the environment.

ENERGY FACILITY NEEDS AND IMPACTS

The following sections deal with five specific energy facilities: oil terminals, tank farms, gas facilities, electric generating plants and refineries (see accompanying map for location of existing energy facilities). The section does not address OCS facilities, because, in the absence of exploration drilling, it is not yet possible to determine whether and where such facilities might be located. The Massachusetts CZM program, under an OCS supplemental grant, and grants extended for energy facility planning under the 1976 Amendments to the Coastal Zone Management Act, is investigating the likelihood of these facilities locating in Massachusetts, as well as carrying out further studies on siting policies, legal and institutional controls, and secondary impacts of energy facilities. The findings of these investigations will subsequently be incorporated into the plan.

OIL TERMINALS

Of the roughly 600,000 barrels per day (BPD) of refined petroleum products consumed each day in Massachusetts, 75% is off-loaded through petroleum terminals sited in the Massachusetts coastal zone.[1] The remaining petroleum requirements are met by (a) product pipelines from East Providence to Springfield and Worcester, and from New Haven to the Springfield area; (b) tank truck shipments from terminals in Albany to western Massachusetts; and (c) rail tank car shipments to the Connecticut Valley.

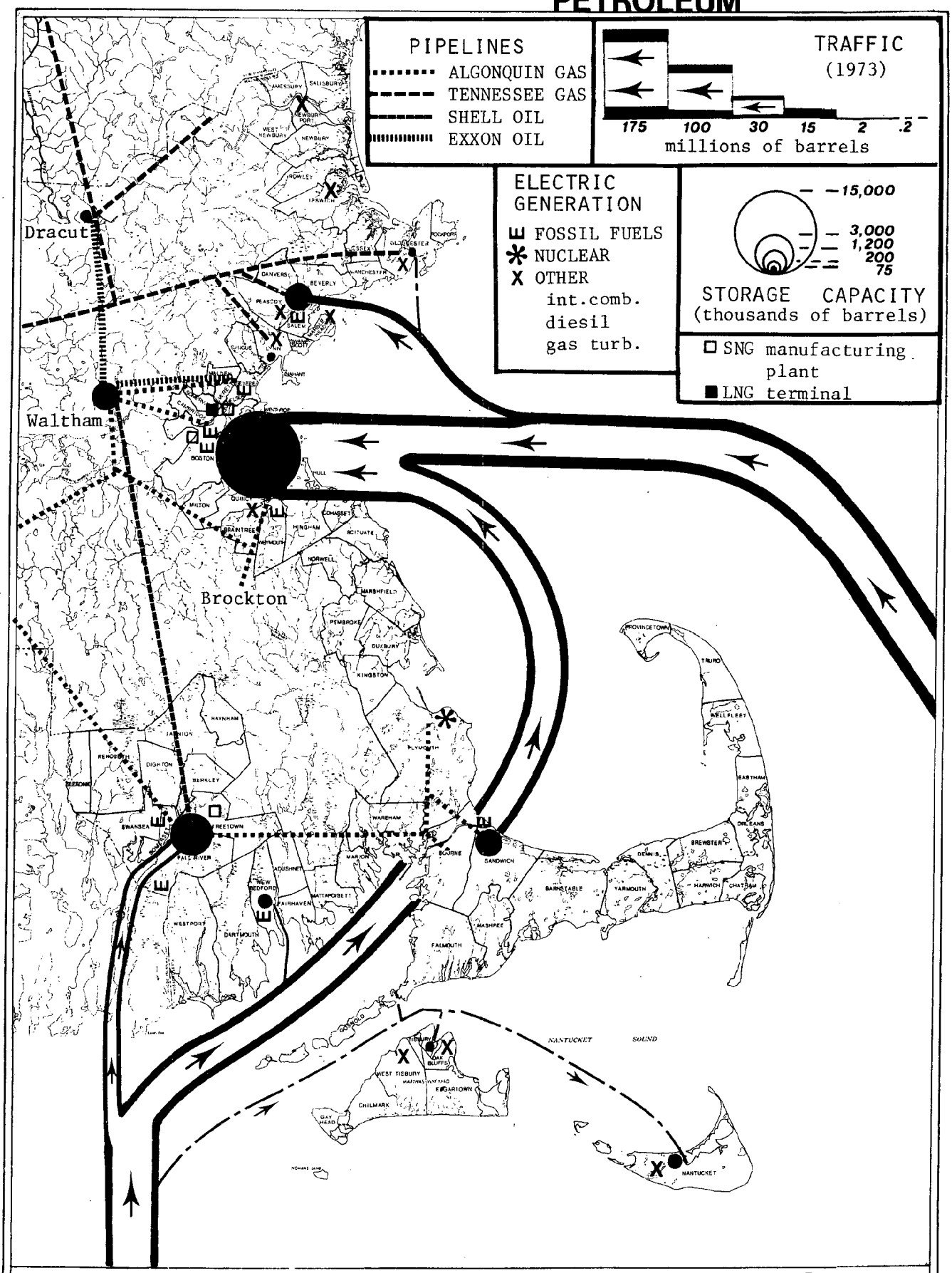
In the Boston demand region (see map) over 85% of the oil is off-loaded in Boston and the principal terminals are located in Chelsea Creek, the Mystic River, South Boston, and the Town-Fore Rivers area. Secondary ports are Salem, Weymouth, Beverly and Gloucester. The primary method of distribution from coastal points is by truck with a small percentage trans-shipped by barge. A portion of the oil received at the Mystic River is transported by pipeline to Waltham and the Lowell-Dracut area. Oil also enters the region by a pipeline from Fall River to Sherborn and Waltham.

The Providence demand region, which includes southeastern Massachusetts and the Cape, is serviced through the ports of Providence, Fall River, New Bedford, and Sandwich. Distribution within the region is primarily by truck.

The primary requirements for an oil terminal are a protected harbor, waterfront land on a deep draft channel (30-40 feet), access to oil storage facilities, and access via a distribution network (i.e., pipeline, highway or rail) to users of petroleum products.

While the terminal itself and a moderate amount of storage capacity for trans-shipment and surge storage is legitimately coastally dependent, the bulk of the oil storage traditionally associated with terminals is not.[2] Oil storage of this nature, used primarily for seasonal storage of heating fuel and to maintain a constant market supply, is discussed in the section on tank farms.

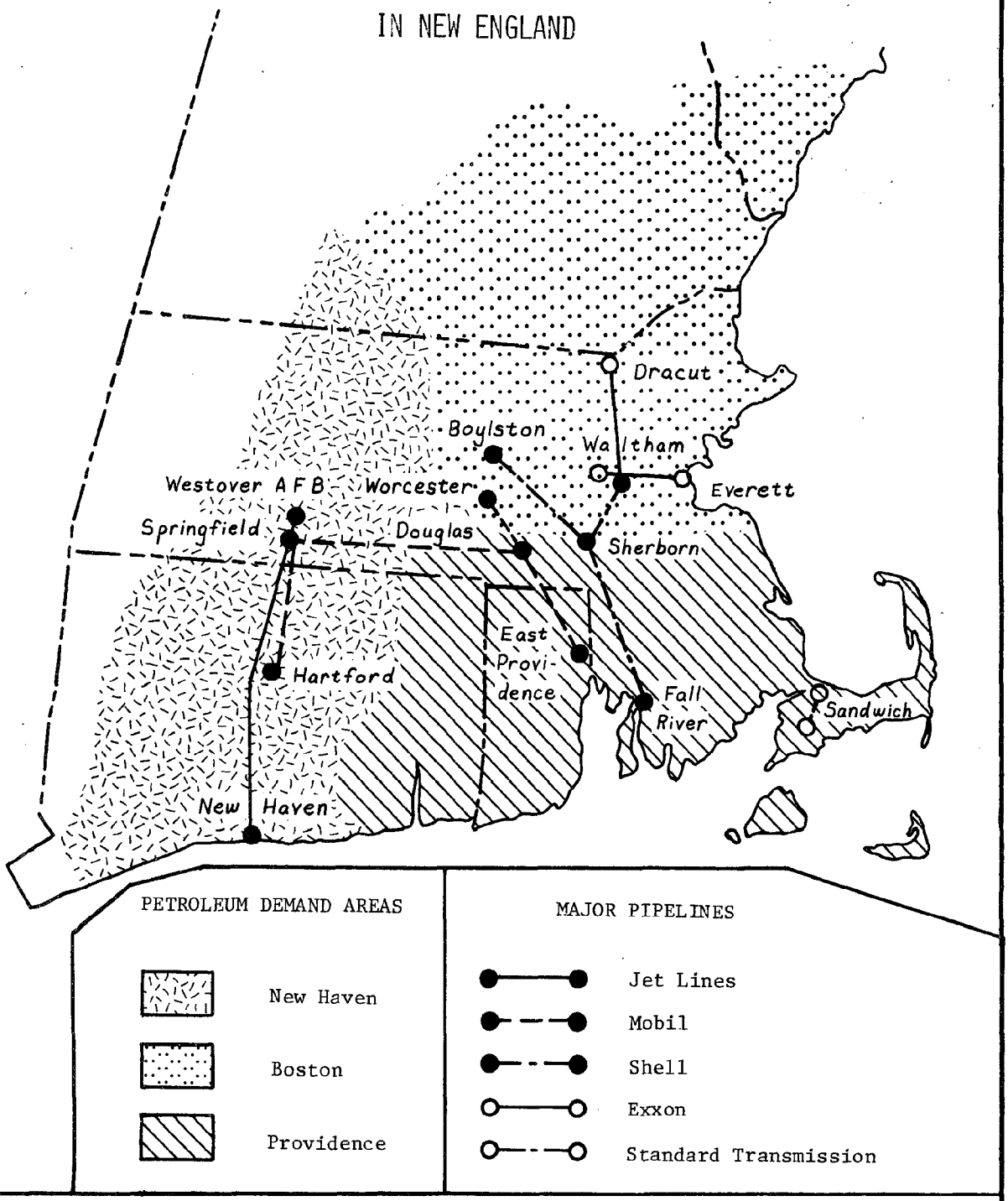
PETROLEUM



EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

COASTAL ZONE MANAGEMENT PROGRAM

MAJOR PIPELINES AND PETROLEUM DEMAND AREAS IN NEW ENGLAND



Sources: EPA, "Oil and Hazardous Substances Contingency Plan", May, 1972

A.D. Little, "Effects on N.E. of Petroleum Related Industrial Development", 1975, p. III 2.

Existing channel depths limit the size of tankers and barges currently serving Massachusetts ports to the 25,000 to 60,000 dead weight ton (DWT) class. Without extensive dredging or the construction of a deepwater port (see later section on refineries), Massachusetts will continue to import its petroleum in tankers of this size class.

The number of tankers arriving in Massachusetts ports will depend on the magnitude of future petroleum consumption. Assuming successful conservation efforts, petroleum consumption may grow by only 15% by 1990. If, on the other hand, historic growth rates are assumed, petroleum consumption is projected to rise by 100% to 1.2 million barrels daily.[3] In either case, the state will see a corresponding rise in tanker traffic.

These projected demands will not, in all likelihood, require additional berthing capacity, as currently, the average tanker berth occupancy rate is roughly 16% for New England as a whole while Boston's is approximately 23%. Thus even with high growth in petroleum consumption, no new berthing capacity would be needed until after year 2000.[4] The increase in tanker traffic may, however, cause congestion in ports and harbors.

As the oil throughput at terminals increases, we can expect an increase in the amount of oil spilled during the ship-shore transfer. The detrimental impacts of oil pollution are discussed in the Marine Environment section. While pollution control and clean-up measures can do much to minimize oil pollution, some petroleum spillage into coastal waters is unavoidable. By limiting petroleum delivery to the ports now hosting marine terminals, the risks of oil pollution will at least be confined, and high water quality in other areas can be maintained.

The air pollution effects of marine terminals are moderate and result primarily from hydrocarbon emissions. Hydrocarbons are released when petroleum is exposed to the air during unloading petroleum from ships, or filling tanks, or when it is spilled. Hydrocarbon emissions are an important ingredient in the formation of photochemical smog and are regulated by EPA. (For further discussion, see section on tank farms.)

To summarize, petroleum terminals form a key element in the energy supply network in Massachusetts. Terminals require a deep draft channel, waterfront land and access to a distribution network. The environmental effects on air and water are moderate and largely unavoidable. Sufficient capacity exists to meet future demand without expansion but additional tanker traffic may result in some congestion in ports and harbors.

TANK FARMS

Massachusetts depends on oil for 85% of its energy needs, and, because it has no indigenous source of supply, oil storage is a key concern. For the past fifteen years, Massachusetts has maintained a relatively stable reserve storage capacity of some 25 days supply.[5] The bulk of this storage capacity is located in the coastal zone for two reasons: first, because our oil arrives mainly via tankers; and

second, because a large part of the population is located near the coast. Although tank farms have traditionally been sited in the coastal zone, they are not coastally dependent.[6]

In order to maintain a month's storage (about the minimum to meet market fluctuations) and at the same time growing demands for oil products, additional storage capacity will be needed. Massachusetts currently has over 30 million barrels of storage capacity.[7] In order to meet 1990 forecasts for oil consumption, storage for an additional 6-30 million barrels will be required.

The Federal Energy Administration in its Strategic Petroleum Reserve Program has announced plans to store a three months supply of oil in New England to protect against another foreign oil embargo.[8] If these plans are implemented, Massachusetts may be called upon to maintain a strategic reserve of between 90 and 150 million barrels of petroleum. For security and economic reasons, this oil may be stored in underground caverns rather than in above ground steel tanks.

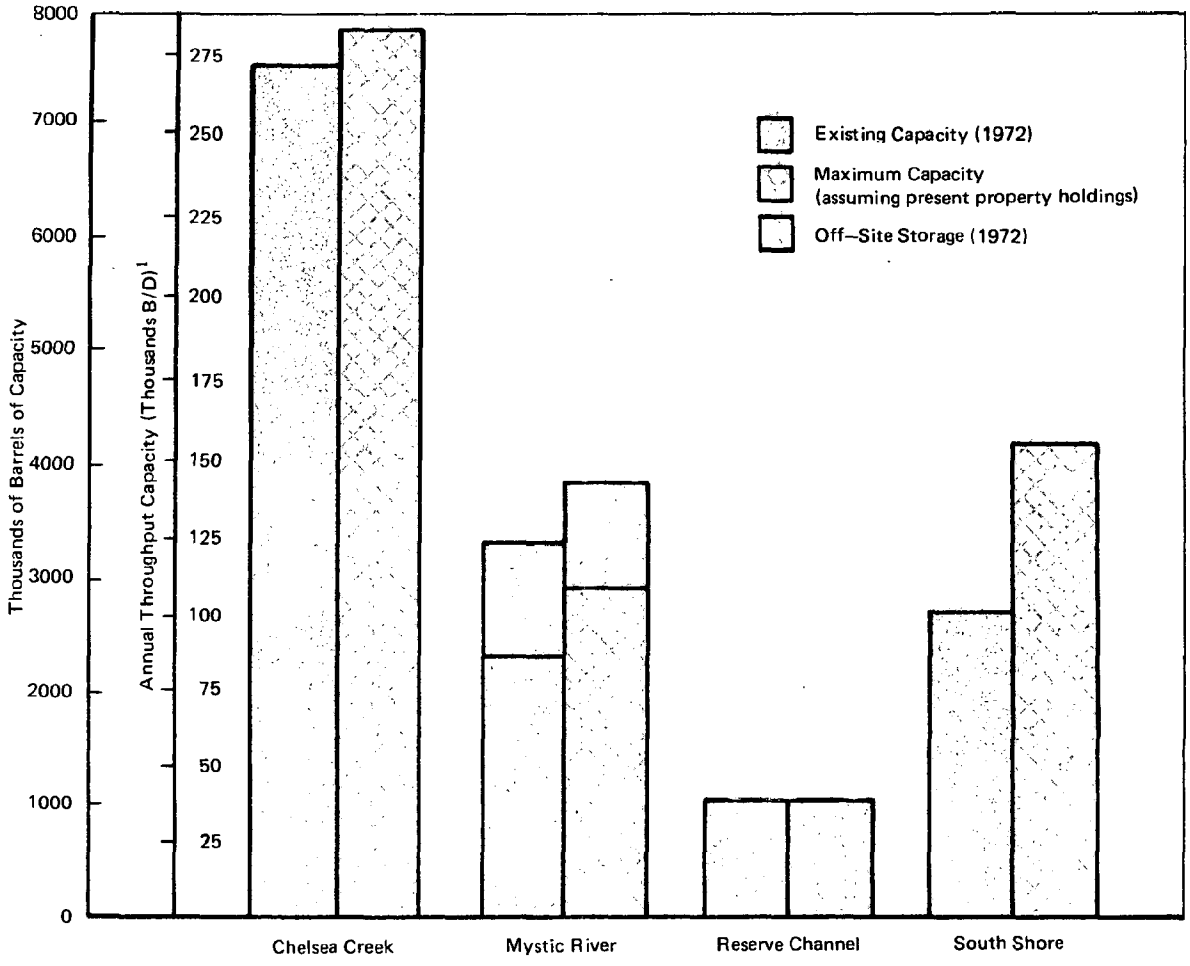
In order to meet the requirements of both increasing oil consumption and the Strategic Petroleum Reserve, Massachusetts will need to expand its oil storage facilities by three to six times the current capacity. Based on 1973 figures, there was only sufficient land for a 20% expansion in storage capacity in Boston.[9] (See chart below.) This is equivalent to approximately 3 million barrels of oil. A quick review of existing terminal centers, with the exception of Town-Fore Rivers area, indicates that the ability to construct additional storage capacity is extremely limited.

Outside existing terminal areas in greater Boston, other sites pose serious conflicts. East Boston has requested that the East Boston Pier be used for community purposes such as housing, recreation and open space; the South Boston Naval Annex is being devleoped into a marine industrial park to provide employment opportunities for Boston residents and may host additional containerport capacity. The Harbor Islands are being developed primarily as a recreational resource.

Some constraints are also present at other sites which have the capability to handle tankers (those harbors with a depth of 30' or more). The land adjacent to the Salem Terminal now accommodates the New England Power Company's electric power plant and 12 storage tanks. With the planned construction of an additional 7 tanks, with a storage capacity of roughly 1.2 million barrels, all remaining land will be consumed.[10] Any expansion proposed for New Bedford Harbor might well conflict with the needs of an expanding commercial fishing industry (see Ports and Harbors section) and because of the hurricane dike guarding the harbor, poses egress and exit problems which would inhibit New Bedford from becoming a major bulk petroleum port. While it would be feasible to expand at either Cape Cod Canal or Fall River, this would require the siting of storage capacity a long distance from principal areas of consumption - greater Boston.

Given that oil tank farms are not coastally dependent and that any major expansion in the coastal zone would conflict with other coastally dependent uses, inland siting of tank farms must be considered.

PETROLEUM TANKAGE IN BOSTON HARBOR



1. Based on 13 Turnovers per Year

Source: A.D.Little, Inc., Preliminary Economic Study of Alternative Methods of Supplying Petroleum Products to Eastern Massachusetts, prepared for MASSPORT, 1973, Vol. II, pp. II-78

The impacts associated with tank farms are serious and are primarily in the areas of land use and air and water pollution. Tank farms storing distillate oil are a major contributor to air pollution problems resulting from hydrocarbon emissions. Hydrocarbons are an important factor in the formation of photochemical smog and are released from leaks in tanks and valves and from emptying and filling storage tanks. Hydrocarbon limits are established by the Environmental Protection Agency (EPA) and if exceeded, can result in public health problems. Currently hydrocarbon emissions in metropolitan areas are high, and the EPA has requested the state to develop strategies for their reduction. Some of the strategies for tank farms could include strict requirements for advanced pollution control equipment on new tanks, retrofitting existing tanks, or prohibiting tank construction in metropolitan areas.

Although a properly designed tank farm can minimize impact on water quality, many tank farms chronically release petroleum into ground water. Generally this results from faulty equipment, inadequate treatment facilities or rain water run-off. In the coastal zone, this polluted ground water frequently ends up entering the marine environment. While containment dikes are designed to prevent major spills in the event of a tank rupturing, failure of these dikes could result from coastal storm flooding or earthquakes.[11] The result could be a major spill directly into coastal waters. While the likelihood of this occurance is admittedly small, it would be less so inland and oil would be contained by landforms rather than spread over water.

Tank farms also have a significant impact on adjacent uses. Briefly, tank farms have a high potential for fire and explosion resulting in public safety hazards. Because of their size (approximately 50-60 feet high and 100-150 feet across) tank farms form a visual as well as physical barrier to the enjoyment of the coastal zone. Tanker trucks, travelling to and from tank farms in existing built-up port areas, frequently must use small residential streets, resulting in noise and air pollution problems for local residents.

Inland siting can eliminate or minimize many of the above impacts. More space is available inland for buffer zones to minimize safety hazards; topography and vegetation may be used to limit visual impacts; and tank farms may be sited near major highways so that truck traffic through residential streets is avoided.

While inland siting of tank farms would reduce the environmental impacts in most cases, it would require an initial capital expenditure for pipeline construction and right-of-way acquisition. The construction costs for a 8"-12" pipeline (maximum size needed), based on 1976 completed pipeline costs, would be $75,000-$100,000 per mile.[12]

While this cost is considerable, it could be off-set by long-term savings in transportation costs, especially if the inland storage area is strategically located to minimize the number of tanker truck trips between markets.[13] Inland siting could also reduce air pollution and social costs currently associated with truck traffic and visual blight in dense, urban residential neighborhoods. It could provide opportunities

for visual and physical access to the coast, allow space for coastally dependent uses, and increase the tax base of coastal communities.[14]

GAS FACILITIES

Massachusetts' consumption of natural gas increased from approximately 24 billion cubic feet (BCF) in 1950 to 155 BCF in 1973.[15] Because gas is a clean, efficient fuel it has become a desirable energy source. However, as demand has grown, supplies of domestic gas were reduced requiring foreign and synthetic gas to be substituted for domestic pipeline gas. In order to import foreign gas, gas is liquified (achieved through cooling to to -259°F) thereby reducing its volume 600 fold. It can then be economically shipped in specially designed tankers and vaporized for distribution at its point of destination.

Liquified natural gas (LNG) has become an increasingly popular substitute for pipeline gas in the northeast and especially Massachusetts. Roughly 5% of Massachusetts' gas demand is now met[16] through LNG and, in the near future, this proportion is expected to rise to 7%-10%. The price of LNG is two-three times higher than natural gas and is likely to rise even higher.[17] Future price increases are likely, resulting both from the need to use imported LNG and the expected deregulation of natural gas prices. While these increases may dampen historic growth rates in gas demand, some growth will still take place, requiring importation of greater amounts of LNG.

In the long run, whether we will need more LNG facilities will hinge on three factors: first, whether natural gas is found on Georges Bank and is used in this region; second, whether future energy needs of Massachusetts are based on sound energy conservation programs aimed at reducing overall demand for gas; third, whether federal pricing policies will encourage development of new domestic gas reserves.

At present, four major facilities in Massachusetts depend upon marine transportation of LNG or feedstock for manufacturing synthetic natural gas (SNG) to supplement pipeline deliveries of natural gas. They are:

Boston Gas Company - Commercial Point, Dorchester - A liquefaction plant with a 611,000 barrel storage capacity which is used to store LNG transformed from pipeline gas. While Commercial Point can also receive LNG from small tankers, most of its LNG supply is derived from liquifying pipeline natural gas during off-peak periods.

Distrigas, Everett - A major LNG receiving terminal with a capacity for storing 900,000 bbls. of LNG. LNG shipped to Everett is used by companies throughout the northeast to meet peak demand.

Boston Gas Company - SNG Plant, Everett - With a capacity to produce 40 million cubic feet of SNG daily, the plant is able to supply up to 16% of Boston Gas' total annual sales. The plant manufactures SNG from liquid propane feedstock delivered by ship to terminals on the Mystic River.

Algonquin - SNG Plant, Freetown - The plant has a capacity to produce 120 million cubic feet of SNG daily and relies on delivery of liquid naptha feedstock landed at the Shell terminal in Fall River and piped to Algonquin storage tanks in Freetown.

Other LNG storage facilities in Massachusetts are either equipped with liquification facilities to convert pipeline gas to LNG for storage and use during peak periods or are supplied directly with LNG transported by truck from Canada or from one of the major base load LNG terminals such as Distrigas in Everett. A number of these storage facilities are located on the waterfront, e.g., Fall River Gas Company, Fall River, Massachusetts LNG Inc., Lynn, and New England Electric System, Salem.[18]

LNG tanks are primarily holding tanks, constructed in relation to the size of the tanker servicing it and the length of time between tanker arrivals. The tanks have associated vaporization facilities which allow the company to draw down gas as needed to meet demand. Thus, even if demand increases, a larger volume could be handled at existing facilities by adding additional vaporization equipment and drawing down inventories more rapidly.

In accommodating needs for greater LNG deliveries, a number of environmental and safety factors must be considered. LNG is a highly flammable and hazardous substance, and requires extreme care in handling. If LNG escapes, it forms a vapor plume and remains in a cloud-like formation until sufficiently heated to become gas. If found in quantities of 5%-15% vapor and air, it is highly flammable and in enclosed spaces it might explode.

If the vapor were to ignite, the flames might burn back to the source of the leaking gas and could endanger other tanks and result in substantial personal and property damage. A worst case analysis shows that an LNG fire could encompass a six-mile radius from the point of the spill.[19] Additionally, an LNG spill, due to its extremely low temperature, could kill marine and animal life.

Proper siting of baseload LNG facilities require large amounts of land. The tanks, in many instances, exceed 175 feet in height and over 300 feet in diameter. Containment dikes around each tank and a buffer zone for safety and green belt purposes raise the total land requirement to 100-200 acres. In addition, LNG sites should have low seismicity factors and the facilities themselves should be designed to stand credible seismic risk.

Baseload LNG facilities, like that at Everett, are highly coastally dependent. While it is technically feasible to site a facility inland, away from the marine terminal through which the LNG is imported, the expense involved would be prohibitive. In addition, using a cryogenic pipeline running from the marine terminal to inland storage tanks would increase the probability of an LNG accident. The coastal dependency of baseload LNG facilities thus limits available alternatives.

If additional facilities are expanded in built up port areas currently able to accommodate LNG tankers (which draw approximately 40 feet of water), the chance of harm resulting from a spill is increased because a large volume of LNG is stored and tanker arrivals are more frequent. If reliance is placed on using existing capacity to handle increased imports, tanker traffic will increase, thereby raising the potential for collision, accidents and spillage. Currently, the Coast Guard promulgates safety measures to minimize risk of collision of accidents. These include requirements on the numbers and kind of tugs used to bring tankers into port, special arrival notification procedures, and restrictions on other harbor traffic while tankers enter ports to off-load LNG. While these measures will reduce the potential for some sort of accident, that prospect, however slight, still exists.

If sited in remote, rural areas the magnitude of harm to life and property from an LNG accident would be less. However, coastal rural siting would (1) require dredging to accommodate tankers as well as construction of transportation access routes, (2) would obtrude on the visual charm of rural landscapes, and (3) would encourage peripheral development.

Each of these risks and environmental effects must be weighed against one another before deciding how Massachusetts is to meet future LNG requirements.

ELECTRIC GENERATING FACILITIES

The Massachusetts coastal zone currently hosts 21 electric generating facilities of various sizes and types (see accompanying chart). The most important of these are the 1 nuclear and 7 fossil fuel plants which combined produce 75% of the total electric supply in the state.

As demand for electricity increases, and power plants retired because of age, pressure to site more plants in the coastal zone may be experienced. Future demand will be affected by such variables as the future price of electricity, the success of energy conservation programs, and the availability of alternative forms of energy production such as solar and wind energy. Since World War II, electric energy consumption has been doubling approximately every 10 years. Following the 1973 energy crisis, however, growth in electric energy consumption has dropped from an annual rate of approximately 7%-8% to 4%-5%.[20] This dampening in demand has caused utility companies to either abandon or push-back the start-up times for a number of facilities originally slated for construction in the coastal zone. Only one facility of any major consequence is now proposed -- the addition (Pilgrim 2) to the nuclear power plant at Plymouth.

New England currently has a reserve generating capacity of approximately 46%, of which 20%-23% is necessary to maintain reliability and meet periods of peak demand. This reserve capacity was developed during the 1960's, when construction costs for new power plants were far lower than they are today. It is true that current excess reserve capacity does represent a carrying cost to New England ratepayers. However, as

a result of that excess capacity, New England will not have to add as much new generating equipment over the next decade as will other areas of the country. The escalating costs of new generating facilities and more expensive natural gas will raise the cost of electricity for Southern and mid-Western states significantly. By comparison, New England's electricity costs will begin to stabilize or rise more moderately, enhancing the ability of Massachusetts and the entire region to attract or retain new industry.[21]

The construction of Pilgrim 2 and existing excess reserve capacity will probably make major additions to electric generating capacity unnecessary in the coastal zone until about 1990. By that time, alternative sources of energy (solar, wind, etc.) may be more practicable and in wider use, and technology to mitigate the adverse environmental impacts of coastal power plants (discussed below) may have fewer problems. Under these circumstances, the controversy surrounding coastal power plant siting may be unwarranted and whether the Massachusetts coastal zone will need to host additional major power plants moot.

Power plants are drawn to the coast for a number of reasons: the free abundant cooling water supply; proximity to the fuel imported through marine terminals; and the fact that power plant equipment components are more easily transported to sites by barge than by road or rail. Power plants require extensive commitment of coastal land not only for the plant itself but also for attendant facilities and needs, e.g., tank farms, coal storage areas and buffer zones. A large oil fired plant typically requires 70 acres while substantially more is needed for a coal fired plant (approximately 250 acres) and nuclear (up to 400 acres). Structures housing the plant's boiler or reactor can be up to 20-25 stories high. Cooling towers or exhaust stacks can reach 50 to 100 stories in height, resulting in substantial visual impacts.

Existing facilities consume roughly 21% of all the oil, coal and natural gas brought into Massachusetts each year. As the majority of these products are imported through marine terminals, any increased construction of fossil fuel plants will result in the need to import more oil or coal. This in turn will result in the need to construct other facilities, i.e., storage tank farms and coal storage capacity. These facilities can have pronounced impacts on the coastal zone and such effects must also be weighed in evaluating a new electric power plant.

One of the major environmental impacts associated with electric generating plants is that on water quality resulting from discharge of thermal effluent from the plant's cooling systyem. (See Marine Environment section for discussion of thermal effluent impacts.) These impacts can be of different magnitude or type, however, depending upon the kind of system employed. The system, which results in the discharge of the greatest volume of heated water into coastal waters is the "once-through cooling" system.[22] In addition, effects of once-through cooling include those associated with the dredging of tidelands to construct channels and intake structures insuring sufficient water flow for cooling.

ELECTRIC GENERATING PLANTS IN COASTAL MASSACHUSETTS

PLANT	UTILITY SYSTEM	1975 CAPACITY (MW)	PROPOSED EXPANSION (MW) DATE OF OPERATION	TYPE OF PLANT	AVERAGE FLOW RATE O COOLING WATER DIS-CHARGE (CFS)
NEWBURYPORT	New England Electric	11	None	Diesel	NA
IPSWICH	Municipal	9	None	Internal Combustion	NA
GLOUCESTER	New England Electric	28	None	Diesel	NA
PEABODY	Municipal	31	75 (1980), 17 (1981)	Gas Turbine Diesel	NA
SALEM HARBOR, SALEM	New England Electric	775	None	Thermal-Oil	980
MARBLEHEAD	Municipal	6	None	Internal Combustion	NA
LYNN	New England Electric	23	None	Diesel	NA
MYSTIC, EVERETT	Boston Edison	1055	None	Thermal-Oil	1400
NEW BOSTON, BOSTON	Boston Edison	718	None	Thermal-Oil	640
"L" STREET, BOSTON	Boston Edison	49	None	Thermal-Oil	NA
BRAINTREE	Municipal	38	80 (1976), Combined Cycle	Thermal-Oil	NA
EDGAR STATION, WEYMOUTH	Boston Edison	300	None	Thermal-Oil	500
PILGRIM, PLYMOUTH	Boston Edison	655	1,180 (1982)	Nuclear	815-860 (with addition 2575-2820)
CANAL, SANDWICH	New England Gas & Electric	560	560 (1976)	Thermal-Oil	374 (within additio 800)
WEST TISBURY, MARTHA'S VINEYARD	New England Gas & Electric	6	3 (1979), 3 (1981), 3 (1983)	Diesel	NA
OAK BLUFFS, MARTHA'S VINEYARD	New England Gas & Electric	8	None	Diesel	NA
NANTUCKET	Nantucket Gas & Electric	8	None	Diesel	NA
CANNON, NEW BEDFORD	New England Gas & Electric	93	69 (1980), gas turbine	Thermal-Oil	152
BRAYTON PT., SOMERSET	New England Gas & Electric	1590	None	Thermal-Oil	1400
MONTAUP, SOMERSET	Eastern Utilities Associates	420	None	Thermal-Oil	380

SOURCE: Power Plant Environmental Impact Statements, Communications with Utility Companies, and NEPLAN, "New England Load and Capacity Report , 1975-86," January 1976.

Many of these impacts can be ameliorated or controlled if closed cycle cooling systems are employed. Since substantially less water is required, closed cycle systems would eliminate one of the needs to site generating facilities in coastal areas.

Closed cycle alternatives, which could be employed in inland locations, include (1) the use of cooling lagoons or spray ponds or (2) "wet" cooling towers. These methods need fresh water to replace evaporation losses, but the amount used is only 2%-4% of that needed in once-through cooling.

There are, however, certain disadvantages to using wet cooling towers, cooling lagoons, or spray ponds. First, a cooling pond requires approximately 1000 to 2000 acres for a 1000 MW plant, and "wet" towers may result in fog and vapor fumes, and chemical discharges. Both may also impact water supply availability. Another closed cycle alternative in the future may be a "dry" cooling tower which acts like an automobile radiator, blowing cool air over heated coolant. "Dry" cooling towers have no need for replacement water but their technology is still under development. Moreover, "dry" cooling towers can consume up to 25% of a power plant's output, thereby adding a substantial cost to their use. Cooling towers may range in size from 60' to over 550' high depending upon the technology employed. Thus, both "wet" and "dry" cooling towers can have substantial visual impacts.

In addition to the impacts on water and scenic quality, fossil fuel plants can be a major source of air pollution - the most significant being particulates and sulfur oxides. The disposal of fly ash and sulfur removed from scrubbers, installed to remove particulates and sulfur, also poses environmental problems.

Nuclear power plants add a whole new dimension to the problems associated with siting. Safety and public health problems due to the potential of highly radioactive releases from either a meltdown of the core reactor or from sabotage must also be considered. Moreover, the land acreage necessary to site the facility and associated structures is substantial.

Inland sites may, in some instances, be a feasible option to siting in coastal areas, if closed cycle forms of cooling, as described above, are employed. The costs associated with closed cycle cooling systems can, however, have an effect on electric generating costs. For a 1000 MW nuclear plant, the capital costs (including capitalization of operating costs) for a "wet" cooling tower system, are greater than double the costs of once-through cooling.[23] Circumstances may, however, bring the costs of once-through cooling systems to the levels of closed cycle systems. If, for example, to meet EPA standards, a once-through cooling system needs a lengthy inlet and outlet discharge channel running 1 to 2 miles off-shore, then the costs associated with such a system could approach the cost for a "wet" tower. The cost of transmission lines, while less of a determinant, might also equalize the attractiveness of inland alternatives. If a plant had to be constructed more than 100 miles from a substation

and existing transmission line corridors in order to employ once-through cooling, these circumstances would bring the costs in line with constructing a "wet" cooling tower.[24] [25]

Other alternatives to inland siting include underground siting (which is technically feasible but substantially more expensive) and off-shore siting (which is feasible but still under study). Inland siting is thus the prime alternative to coastal siting and should be given serious consideration when planning a new facility. Inland locations are not, however, free from problems - air pollution may be more severe inland than on the coast since the prevailing coast winds normally carry pollutants out to sea. In addition, both wet and dry cooling towers, as mentioned, are visually obstrusive, although topography may be used to mitigate visual impacts. "Wet" towers can also cause fogging problems. In eastern Massachusetts, if closed cycle systems are not employed, inland siting would be severely constrained because only the Merrimack River can provide the 500,000 gallons of water per minute needed to cool an average sized electric generating facility.[26]

REFINERIES AND DEEPWATER PORTS

Massachusetts presently lacks any refinery capacity, a paradoxical fact considering 85% of the Commonwealth's total energy requirements are met by petroleum products.

Several proposals have been made to site refineries in Massachusetts. A 1974 Massachusetts Port Authority study recommended an off-shore terminal for crude oil along the northern Massachusetts coast with a nearby refinery.[27] During the past year, the Governor has discussed with Venezuelan interests the establishment of a refinery in Massachusetts. With the advent of OCS oil and gas exploration, some speculate that a high find (2.4 billion barrels, total with a daily production rate of 200,000 barrels) would be adequate to support the construction of a refinery in New England.[28]

The refinery most commonly proposed for New England is one with a 250,000 barrel per day capacity, an above average sized refinery. Siting requirements and impacts of such a refinery have been the subject of numerous studies in New England and are summarized in the following table.

SITING REQUIREMENTS OF A 250,000 BARREL PER DAY REFINERY

RESOURCE REQUIREMENTS

Land	1,000-1,500 acres of clear, flat, industrially zoned land, 40% of which is buffer
Water	5-15 million gallons of water per day (amount depends largely on product mix and refinery design; 40%-80% is used for cooling; the remainder for processing)
Electric Energy	1.5 million kwh/day
Fuel Oil	15,000-25,000 barrels/day of low sulfur fuel

ECONOMIC REQUIREMENTS

Construction Manpower	1,800-2,200 (30% of which are relocated from other areas) (over 3 years). Average wage: $20,000
Operation and Maintenance Manpower	410 persons, 11%-14% of which are relocated from other areas. Average wage: $15,000
Capital	$690 million

TRANSPORTATION REQUIREMENTS

Pipeline from production platform and/or marine terminals to deliver crude oil.

Truck or rail for construction to deliver chemicals used in processing.

Pipelines or trucks to deliver refined products.

NOTE: Estimates assume a 250,000 barrel per day facility that would produce a product mix similar to the demand mix for the region (i.e., a high fuel oil percentage as opposed to a high gasoline percentage).

33% gas	27% distillate
4% kerosene/jet	36% residual

Sources: (1) Massachusetts CZM, Oil Refinery Development in Massachusetts, May 1976.
(2) NERBC/RALI, Onshore Facilities Related to Offshore Oil and Gas Development Factbook, August 1976.

Four major resource requirements must be met before a refinery is sited: first, a labor pool of about 2,000 employees during the 3 year construction phase must be available as well as housing and other social services to accommodate this work force; second, substantial land (1000-1500 acres) is required; third, availability of water for cooling and processing purposes (depending on the product mix refineries are major users of water, requiring about the same amount as a population of 13,000 people).[29] To meet federal and state water quality standards, a large, well-flushed water body is required so that federal and state mandated water quality standards can be met. According to one study, the Merrimack River north of Boston, is the only Massachusetts river with this capacity;[30] and fourth; a guaranteed supply source of crude oil for refining.

Of these four conditions, a guaranteed supply of crude is the most significant constraint on refinery siting. Crude oil can be imported directly from foreign nations; supplied from existing domestic sources; or, in the future, possibly supplied from the North Atlantic OCS. Changing federal policies on imports and the uncertain economics of exporting crude vs. refined products make foreign sources of crude oil unreliable, unless a foreign crude source has an equity stake in the refinery itself. Importation from existing domestic crude oil production areas to Massachusetts or New England by major oil companies is unlikely because thier Mid-Atlantic refineries are operating below full capacity. The possibility of crude from the North Atlantic OCS will depend on whether a major find is discovered. Even in the event of a major find, OCS oil will not be on line for at least 5-10 years after the first lease sale now scheduled for May 1977, and will probably be delivered to Mid-Atlantic refineries.

Any refinery proposal would require crude brought in through one of the following methods: a marine terminal, a deepwater port, or a pipeline from Georges Bank. Given the shallow depths of Massachusetts coastal waters, deliveries from shallow draft tankers to marine terminals would have to be frequent in order to supply adequate crude for a 250,000 barrel per day refinery. The greater the tanker traffic, the greater the likelihood of collisions and potential spills. An alternative is the construction of an offshore deepwater terminals, a receiving facility constructed far offshore in waters deep enough to handle larger tankers ranging from 60,000 to 250,000 deadweight tons. The oil would then be piped ashore to a tank farm and refinery complex. Accommodating fewer and larger tankers could mean lower transportation costs, and less probability of collisions and spills. However, if a spill did occur, the magnitude of the spill would likely be far larger, given the size of the tanker. In addition, the spill would most likely occur on the open ocean where, due to rough seas, spills are much harder to contain and clean-up than in harbors.

The table below enumerates the economic, environmental, and social impacts of refinery development. The major economic impacts are the increased local and state revenues from direct, indirect, and induced taxes and the increased spending power of residents,

particularly in the construction phase. The major social impacts are the costs for municipalities, particularly those adjacent to the refinery location which do not benefit from the expanded tax base. The Energy Impact Program authorized by the 1976 Coastal Zone Act Amendments provides several sources for funding public services and facilities needed to accommodate coastally dependent energy facilities, including refineries. (See Program Incentives description in Chapter III).

The major environmental impacts are the amount of land and water consumed and the effects on air and water quality. A 250,000 bbl. refinery requires 1,000-1,500 acres of land for processing, tank farm storage, and a "green belt" buffer zone. Vacant tracks of this size with suitable topography and load bearing characteristics are not readily available along the shore. In addition, siting a refinery along the shore could adversely impact any number of coastal resources -- important for public health, and safety, for recreation, for commercial and port activities, and for marine production. Thus, the siting of potential refineries inland, close to labor and demand centers, and in areas already served by transportation, communication, and water supply, should be considered.

The major effluents from refineries are thermal discharges from cooling water and chemical contaminants from processing water (detailed in Table 2). "Once-through cooling systems" (when all heated water is discharged) can produce up to 15 million gallons of water per day having temperatures high enough to kill marine organisms.[31] (See discussion of thermal effluent effects in Marine Environment section). Thermal discharges and the quantity of water consumed can be reduced by recycling cooling water, employment of air cooling systems, or a combination of both.

Processing water is a less significant refinery effluent by volume than cooling water, but more significant in terms of contaminants. By federal law, these discharges must meet specified effluent standards. By requiring segregation of clean waters (non-contaminated storm water and cooling water) from process waters, the recycling of cooling water could be encouraged and process wastewater discharge could be subject to a more stringent set of effluent guidelines.

The major emissions from refineries are carbon monoxide, sulfur oxides hydrocarbons, and particulates.[32]

Solid wastes from refineries are a final environmental concern, since these are frequently contaminated with oil and hazardous substances.

IMPACTS OF A 250,000 BARREL/DAY REFINERY

ECONOMIC

Indirect employment in construction (generated in industries and services supplying refineries)	182 persons
Induced employment (jobs created by increased consumer demand due to increased payroll and tax levels caused by refinery development)	1,045 persons
Total wages for the 3 year construction period assuming average annual income of $19,500 and 2,000 workers	$39 million
Total average annual wages for operation and maintenance (assuming $15,000 average annual wage and 410 workers)	$6.15 million
Income from taxes local, on total cost of construction	20% of $690 million
State, direct, indirect and induced taxes	$18 million per year

SOCIAL

Costs for services to municipalities (assumes refinery will supply its own services of fire, police, water and sewerage)	$291,000

ENVIRONMENTAL

Water Quality of Cooling Water	
sulfuric acid	ph. app.
chromate	30.0 ppm
zinc	3.0 ppm
chlorine	0.1 - 0.2 ppm

Water Quality of Process Water	Concentration, ppm
Floating and dissolved oil	1-1,000
Dissolved solids	0-5,000
Phenol and other dissolved organics	0-1,000
Cyanide	0-20
Chormate	0-60
Organic nitrogen	0-50
Phosphate	0-60
Sulfides and mercaptans	0-100
Caustics and acids	2-11 ph

Noise Levels	50 decibels
Solid Wastes	120 cubic feet of sludge per day

Sources: (1) Connecticut Governor's Fact Finding Task Force on Oil Refineries, Final Report, (Hartford, January 1975), p. 2.

(2) NERBC/RALI, Onshore Facilities Related to Offshore Oil and Gas Development Factbook, August 1976.

OBJECTIVES

The management program for energy facilities within the coastal zone should encompass the following objectives:

1. to provide adequate sites for needed energy facilities

2. to allow for an adequate supply of energy

3. to ensure that coastal energy facilities are sited and designed to minimize impacts on the marine and visual environment.

CZM POLICIES AND PROGRAM RECOMMENDATIONS

(Note that additional analysis will be undertaken on energy facility siting this coming year, in response to the 1976 Amendments to the federal Coastal Zone Management Act. This analysis will result in the incorporation of revised criteria into the policies below.)

Policy (29) Maximize use of existing marine terminal capacity.

Approval for the construction of a new or expanded marine terminal shall be given only after it can be shown that the increased petroleum demand cannot be met through existing marine terminals. If there is a demonstrable need for a new facility then it should be constructed in those ports which:

a) have existing marine terminals;

b) already have channels which are able to accommodate tankers;

c) can accommodate increased tanker traffic without causing congestion or navigation problems; and

d) are linked by existing or new pipelines to inland storage facilities.

When construction of a new terminal is necessary, it shall be given priority over non-coastally dependent uses.

IMPLEMENTATION MEASURES

-- Energy Facility Siting Council (EFSC) (MGLA Ch. 164, S. 69G-R) The Council is given jurisdiction over the siting of electric generating, gas and oil facilities. The Council's jurisdiction includes: a) any bulk generating unit, including associated buildings and structures with a design capacity of 100 MW or more; b) any new electric transmission line of more than one mile in length and 69KV or more designation; c) any ancillary structure to (a) and (b) including but

not limited to fuel storage facilities; d) any unit, including associated buildings designed for or capable of storage of gas; e) any pipeline for the transmission of gas; f) any unit including associated buildings designed for refining oil or refined oil products; g) any unit capable of storing more than 500,000 barrels of oil or refined oil products; h) any new pipeline for the transportation of oil or refined oil products greater than one mile in length. CZM will propose, through a Memorandum of Understanding, that the policy and criteria outlined above be adopted by the EFSC and used by them in considering proposed new facilities. CZM will provide the EFSC with technical assistance in reviewing applications to construct energy facilties in the coastal zone. The EFSC has the responsibility under Chapter 164, Section 69 to implement "current health, environmental protection and resource use policies as adopted by the Commonwealth." The CZM Plan, once adopted, will constitute such a policy, and the Council may then require energy facilities to be consistent with the CZM Plan.

The CZM Program will also provide the EFSC with maps delineating areas of the coastal zone which have been designated as critical. The Council will use these maps to identify areas where the siting of energy facilities would be inconsistent with the plan.

Lastly, CZM will intervene in the adjudicatory hearings of the Council to present evidence if a proposed facility does not in its estimation conform with CZM policies.

-- Marine Oil Terminal Licenses (MGLA Ch. 21, S. 50) - The Division of Water Pollution Control (DWPC) is given authority to license marine terminal in order to protect the public safety and prevent oil spills. Through networking, CZM will work to ensure that DWPC only licenses terminals in areas which meet this policy and criteria (see Ports and Harbors Policy (19) for further conditions) and deny or condition such licenses in areas identified to be environmentally sensitive.

-- Waterways Program - Chapter 91 of the Massachusetts General Laws gives the Waterways Program authority over tidelands, harbors, and certain rivers below the high water mark. Activities covered by such licenses include filling, wharf construction, bridges, pipelines, etc. This power is based on the reserved public property rights of navigation and fishery. DEQE as trustee over these lands thus issues licenses, and not permits, for the permission to interfere with these public lands. Under the law, all licenses are to expire after five years or upon non-use.

Under a Memorandum of Understanding with Waterways, the preceding CZM policy will be implemented as follows. Marine terminals in port areas will be given high priority (see Ports and Harbors Policy (19)). If, to secure financing, the developer needs to obtain an irrevocable license from the Legislature, CZM will actively support such legislation.

-- Ocean Sanctuaries Acts (MGLA Ch. 132A, S. 13-17) - Ocean sanctuaries protect all state waters except those from Lynn to Marshfield and those in Mt. Hope Bay. While the terms of the five sanctuaries vary, in general such activities as removal of any sand, gravel or minerals, any dumping, or any waste discharge are prohibited, and shore protection, water navigation aids or fish harvesting are permitted. A significant clause permits improvements approved by appropriate federal and state agencies; CZM networking and federal consistency mechanisms will insure that, with the flexibility created by this clause, the CZM policies will be carried out. CZM will also work with DEM to prepare regulations to implement the program.

-- Massachusetts Environmental Protection Agency (MEPA) (MGLA Ch. 30, S. 61-62) - CZM will monitor proposed energy facilities to guarantee that their design and construction are such as to minimize impacts on coastal resources. In addition, MEPA will be used to guarantee that alternatives to the proposed action are given serious consideration.

Policy (30) Discourage siting of tank farms on the coast.

Approval shall not be given to the construction of oil storage tanks in the coastal zone, unless the applicant can demonstrate that:

1. the storage tanks are legitimately coastally dependent (bunker fuel storage, storage of oil for coastal power plants, and surge storage), or

2. siting the tanks inland would result in greater adverse environmental impacts and undue economic costs.

If a storage tank is to be located in the coastal zone, the new storage facility must be sited: (a) abutting existing storage tanks, or if not possible, (b) in urban-industrial areas which can accommodate storage facilities with minimal impact.

IMPLEMENTATION MEASURES

-- Energy Facilities Siting Council (MGLA Ch. 164, S. 69F-R) - The Council has jurisdiction over major oil facilities, including the siting of tank farms (see detailed discussion under preceding policy). A Memorandum of Understanding will be signed between CZM and EFSC which will detail the inter-agency coordination of policies. More specifically, the Memorandum of Understanding will define how the Council will exercise its authority to deny permits and thereby encourage the inland siting of tank farms.

-- Local Licensing Authorities (MGLA Ch. 148, S. 13) - Local licensing authorities are empowered to license a parcel of land for the "keeping, storage, manufacture or sale" of inflammable materials, including oil and gas. CZM will work with local community licensing authorities to insure that, to the extent possible, licenses are granted consistent with the above policies.

-- Department of Public Safety (MGLA Ch. 148, S. 13, 37) - Licenses all tanks for the storage of all liquids other than water which exceed 10,000 gallons. CZM will prepare a Memorandum of Understanding with this Department to incorporate CZM concerns into their licensing procedures.

Policy (31) Accommodate new base load LNG facilities or additional LNG deliveries where and when the risks to public safety and the environment are minimized.

Approval to expand LNG deliveries or to construct new or expanded base load LNG facilities at existing sites will be given only if it can be demonstrated that: a) existing facilities cannot accommodate additional through put, and b) environmental assessments indicate that public safety risks and environmental damage would be less than accommodating larger deliveries or new facilities elsewhere.

Additional guidelines that should be applied to new or expanded facility construction include those for oil tank farms above and the following:

1. tanks must be sited away from areas of high population densities

2. design and operation techniques shall be used which reflect the highest state of the art; dikes must be constructed around tanks so as to contain any LNG which, if there was a rupture, might escape

3. adequate buffer zones must be provided in order to protect the public from dangers associated with a spill.

IMPLEMENTATION MEASURES

-- Energy Facility Siting Council (MGLA Ch. 164, S. 69F-R) - The Council has primary authority for the siting of gas facilities and associated structures. CZM will, as in the case of tank farms and terminals, work through the EFSC to ensure that gas facilities are sited in accordance with CZM policy.

-- The Air Quality Program, Division of Water Pollution Control, Waterways Program, Wetlands Program, Hazardous Wastes Program, Department of Public Safety, Corps of Engineers, Ocean Sanctuaries, Marine Oil Terminal License, and MEPA, NEPA and A-95 Reviews will also be utilized by CZM where relevant in order to insure consistency with this policy. (Please refer to appropriate discussions of these authorities after Policies (29), (30), and (33).

-- Federal Power Commission (16 USC 791 a-825r) - Regulates the interstate aspects of electric power and natural gas industries including construction of pipeline facilities and the importation of gas. The Commission's concerns include protection of the environment,

safety of facilities, equitable rates to consumers and energy conservation. CZM will employ the federal consistency clause to insure that LNG siting and design incorporate CZM's concerns.

Policy (32) Consider siting of electric generating facilities in non-coastal areas.

As discussed in the text, the need to accommodate new major power plants in the coastal zone may prove unnecessary until after 1990 because of existing excess reserve capacity. By then, power plant technology and alternative sources of energy can be expected to have advanced considerably, and the standards below should pose far less burden on the utility industry than if they had to be applied now.

All the following factors must be considered before power plants can be constructed in the coastal zone:

1. the use of coastal land for electric generating facilities shall be made available only after it is demonstrated that, on balance, use of inland sites would be more environmentally damaging or economically impractical

2. if a facility is to be sited in coastal areas, the following guidelines will be applied:

   (a) expansion at existing sites is given equal consideration with the construction of a new facility;

   (b) no construction shall be allowed on barrier beaches, in salt ponds, or in designated Areas for Preservation or Restoration. And applicants must demonstrate that Areas for Preservation or Restoration will not be affected by adjacent siting of an electric generating facility;

   (c) public access to the shoreline is provided to the maximum extent possible for the public's use;

   (d) the plant is sited so that natural topographic features and vegetation will screen the facility to the maximum extent possible; and

   (e) any new facility must be consistent with current air, water quality and public safety standards and will not result in any degradation of ambient air or water quality or pose undue risks to the public.

IMPLEMENTATION MEASURES

-- Energy Facilities Siting Council (MGLA Ch. 164, S. 69F-R) - Will again be the primary implementation authority for electric generating facilities.

-- The Air Quality Porgram, Waterways Program, Wetlands Program, Hazardous Wastes Program, Division of Water Pollution Control, Division of Water Supply, Ocean Sanctuaries Acts, Corps of Engineers, MEPA, NEPA and A-95 Reviews will also be applied by CZM where relevant. (Refer to descriptions following Policies (29) and (33)).

-- Nuclear Regulatory Commission (88 Stat. 1242; 42 USC 5841) - Is the federal agency which licenses nuclear power plants and regulates the safety, design, processing, shipment, and disposal of nuclear plants and materials. The purpose of the agency is to ensure that the use of nuclear materials is consistent with public health and safety, environmental quality, national security, and anti-trust laws. CZM will employ the federal consistency clause to insure that any federal approvals are consistent with the Plan.

Policy (33) Evaluate refinery and deepwater ports and sites to ensure that proposed facilities and sites will cause minimum harm to the coastal environment. Ensure that facilities make use of technology that minimizes public health and safety risks.

Approval for siting a refinery in the coastal zone will be granted only if alternative inland sites have been evaluated and after the social, economic, and environmental costs of coastal siting are fully weighed.

If after such evaluation, a coastal site is deemed preferable, the following conditions must be met:

1. sufficient acreage is allotted for a buffer zone

2. the site is not within an Area for Preservation or Restoration, and the applicant demonstrates that if such an area is near the facility, their resources will not be adversely effected

3. provision is made for the meeting of all applicable air and water quality standards

4. alternative cooling systems other than "once-through cooling" are evaluated and cooling and process waters are separated, and

5. a management program for solid waste and treatment of hazardous wastes is developed which ensures that such wastes will not be discharged into the marine environment.

Deepwater ports will be preferred to marine terminals if:

1. the conditions of the site (topography, currents, proximity to shore, and projected oil spill drift patterns), the technology employed, and the frequency of traffic to, from,

and around the site combine to present lower risk of both oil spills and damage to the environment;

2. neither the pipeline nor the pipeline landfall are placed in an Ocean Sanctuary, nor in Areas for Preservation or Restoration, nor in an area where it might adversely affect the Areas for Preservation or Restoration; and

3. The location, construction, and operation of the deepwater port are consistent with the policies of the Marine Environment section.

IMPLEMENTATION MEASURES

-- The Waterways Program, the Energy Facilities Siting Council, the Ocean Sanctuaries Acts, the Corps of Engineers, the Marine Oil Terminal License and MEPA, NEPA, and A-95 Reviews (all discussed above) will be used by CZM to implement its policies relating to refineries and deepwater ports. Other pertinent programs include:

-- Air Quality Program (MGLA Ch. 111, S. 142A-F) - Is authorized to create air pollution control districts, to adopt ambient air quality standards for such districts, prepare a plan for the implementation, maintenance, and attainment of such standards, and take necessary measures to monitor and enforce the standards. A Memorandum of Understanding will be prepared between CZM and the Air Quality Program to insure adequate protection, including revising the applicable implementation plans, if necessary, for Areas for Preservation or Restoration.

-- Hazardous Waste Program (MGLA Ch. 21, S. 57-58) - Licenses the disposal of chemical, explosive, reactive, and toxic substances which may constitute a danger to public health, safety or welfare or to the environment. CZM and the Division of Water Pollution Control will prepare a Memorandum of Understanding which will incorporate CZM's concerns regarding the disposal of such wastes into the marine environment in general and specifically into Areas for Preservation or Restoration.

-- Division of Water Pollution Control (MGLA Chapter 21) - Administers the Federal Water Pollution Control Act for Massachusetts and has jurisdiction over freshwater, salt water, and ground water. WPC's permit authority covers sewer hook-ups, certain industrial coolants, and thermal effluents. A Memorandum of Understanding with WPC will reflect CZM's policies regarding pollution of the marine environment, protection of critical areas, and disfavoring coastal siting except when it is preferable to inland siting.

-- Division of Water Supply (MGLA Chapter 40) - Has permit authority over all proposed withdrawals from surface or ground water sources in order to insure the availability of a safe and adequate supply of water for public use. CZM and DWS will work together on appropriate occasions when either (1) an alteration in the supply of fresh water would affect the salinity of an area and its attendant

ability to be an ecologically productive area, or (2) the proposed withdrawal is so significant that other economically beneficial uses found by the Plan may be foreclosed and thus the proposal should be closely reviewed.

-- Deepwater Port License (P.L. 93-627) - Is granted by the U.S. Secretary of Transportation. Conditions for licensing include joining an oil spill liability fund; consistency of the port with national interest and policy; non-interference with navigation and international law; use of best available technology to prevent adverse environmental impacts; consistency with the state Coastal Zone Management Program; and approval by the Governor of the adjacent state. Through this act CZM and the Commonwealth have direct authority to approve or deny a deepwater port, even beyond the three-mile limit. CZM will use this authority to insure that crude oil shipments are received in a means and at a site which will cause the least possible risk of environmental damage.

TECHNICAL NOTES AND SOURCES

1. Petroleum consumption figures are taken from A.D. Little, Inc., Historical Data on New England's Energy Requirements, prepared by NERCOM, 1974; estimate of proportion of Massachusetts demand served by marine terminals derived from share of population in eastern Massachusetts compared to state total and on petroleum share by county taken from U.S. Bureau of Census, 1967 Census of Business, "Petroleum Bulk Stations and Terminals", Washington, D.C.

2. Surge storage is that needed to hold oil as it is unloaded from a tanker, until it can be transferred to permanent storage. Capacity needed is roughly one to two times tanker size per berth.

3. Petroleum consumption projections taken from A.D. Little, Inc., Preliminary Projections of New England's Energy Requirements, prepared for NERCOM, 1974.

4. A.D. Little, Inc., Effects of New England of Petroleum-Related Industrial Development, prepared for NERCOM, 1975, Vol. III, pp. III-20, III-21.

5. See Ports and Harbors section, technical note number 3.

6. With the exception of storage of oil for use in the coastal zone, e.g., bunker fuel for commercial shipping, the oil fired power plants on the coast, for trans-shipment of oil, and surge storage at terminals.

7. Intermetric, The Petroleum Distribution Network for New England, prepared for NERCOM, 1974.

8. Federal Energy Administration, Strategic Petroleum Reserve Draft Environmental Impact Statement, June 1976.

9. A.D. Little, Inc., Preliminary Environmental Study of Alternative Methods of Supplying Petroleum Products to Eastern Massachusetts, prepared for MASSPORT, 1973, Vol. III, p. III-6-111.

10. U.S. Army Corps of Engineers, Draft Environmental Statement, Addition of Unit No. 5, Salem Harbor, March 1975.

11. The Massachusetts coast from the Cape northward is classified as an area with the potential for major destructive earthquakes. The California coast is in the same category. Coffman, J.L., and Von Hake, L., Earthquake History of the U.S., U.S. Department of Commerce, 1972.

12. Oil and Gas Journal, August 23, 1976, p. 83.

13. Costs to transport oil by pipeline are on the average 11% of the costs of truck transport; Hulbert R.C., "Principles of Pipeline Economics", Association of Oil Pipelines Educators Tour, July 1974.

14. "Relocating existing shorefront tanks inland can be phased over a period of ten-twenty years as tanks have to be replaced, waterfront property taxes increase, and alternative tax producing water-related development are proposed. Since tank farms provide less tax per acre than virtually any other industrial use, it should be possible for each city to maintain or increase its base through intensive development of only a portion of the relocated tank farm acreage, with the balance for recreation, public access to the water and other public uses." U.S. Army Corps of Engineers, People and the Sound, Marine Transportation, A Planning Report Prepared for the New England River Basins Commission, Long Island Sound Regional Study, February 1975, p. 62.

15. New England Regional Commission, Gas Industry Development in New England, Analysis of Alternatives, 1975, pp. 4, 6.

16. Massachusetts Energy Policy Office, Report on Natural Gas in Massachusetts, October 1975, p. 14.

17. Personal communication with Algonquin Gas Company.

18. Descriptions of existing gas facilities extracted from: New England Regional Commission, Gas Industry Development in New England, Analysis of Alternatives, 1975, and Massachusetts Energy Policy Office, Natural Gas, November 1975.

19. Testimony given by Dr. James Fay before a Federal Power Commission Hearing, Boston, Massachusetts, October 8, 1976.

20. Booz, Allen, Hamilton, Inc., Electric Power Demand and Supply in New England: A Review of Trends and Forecasts, prepared for NERCOM, 1975; NEPLAN, New England Load and Capacity Report, January 1976; and estimates developed by Massachusetts Energy Facilities Siting Council.

21. Taken directly from, Commonwealth of Massachusetts, An Economic Development Program for Massachusetts, 1976.

22. "Both fossil fuel and nuclear fired thermal electric generating plants operate on the same general principle. Steam is created by burning the fuel substance and used to power a turbine which turns an electric generator. The spent steam is condensed and the water returned to be revaporized into steam to start the cycle anew. The steam condenser is cooled with water that is either drawn continually from a natural water body (once-through cooling) or recirculated through an artificially constructed cooling system (closed cycle)." Taken from Clark and Brownell, Electric Power Plants in the Coastal Zone: Environmental Issues, American Littoral Society, 1973, p. III-1.

23. Personal communication with Boston Edison.

24. Ibid and Ball, R.H., and Salter, R.G., California's Electricity Quandry: Planning for Power Plant Siting, Volume II, the Rand Corporation, 1972, pp. 76-80.

25. For an excellent discussion of power plant costs, see Massachusetts Energy Policy Office, The Economics of Nuclear Power: A New England Perspective, December 1975.

26. Once-through cooling systems for a 1000 MW plant can use up to 500,000 gallons of water per minute, equivalent to 1100 cubic feet per second (cfs). Records kept by the U.S. Geological Survey show that average daily flow at the Merrimack River at Lowell is 7271 cfs.

27. Raytheon and Frederick R. Harris, Inc., MASSPORT Marine Water Terminal Study, May 1974.

28. New England River Basins Commission, Resource and Land Investigations Program, Estimates for New England, staff draft, August 1976.

29. Massachusetts Coastal Zone Management Program, Oil Refinery Development in Massachusetts, Draft, May 1976.

30. A.D. Little, Inc., Effects on New England of Petroleum-Related Industrial Development, Volume III, prepared for NERCOM, 1975.

31. New England River Basins Commission, Resource and Land Investigations Program, Onshore Facilities Related to Offshore Oil and Gas Development, Factbook, August 1976.

32. Emissions from oil refineries must meet the following air quality standards:

Particulates:	1.01b/1000 lbs of coke burnoff
Carbon Monoxide:	30% opacity 0.05% p by volume
Hydrogen Sulfide Content:	fuel utilized in processing machinery may not exceed 0.1 grams of hydrogen sulfide per dry cubic foot at standard conditions
Source:	40 CFR 50; 39 PR 9315, March 8, 1974

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MANAGEMENT

INTRODUCTION: CONSIDERATIONS IN THE DESIGN OF A MANAGEMENT SYSTEM

Three considerations have led the Massachusetts Coastal Zone Management Program to design the management scheme proposed in this chapter. First, it was important that the management scheme fit within the state's developing environmental and land use programs. In other words, it was important to understand where in the process of the state's history we were trying to fit a coastal zone management system. For if the system were out of sync with the times, no matter how inventive and virtuous our system might be, our ability to implement the management system would be weak and, quite possibly, fail.

Second, it was important to ensure that the management system we proposed would be useful and, in fact, would be used. Here, we were concerned with mechanics: under what institutional structure and management, with what training and what materials, will a management system get used by those whom the system is intended to serve?

Finally, we were concerned that, in its implementation, the management system be sufficiently resilient and institutionalized that the system would survive the tenure of any key political and administrative office holder -- Governor, Cabinet Secretary, Commissioner and the like.

The rest of this introduction explains each of these considerations in more detail.

A MANAGEMENT SYSTEM THAT FITS WITHIN THE TIMES IN MASSACHUSETTS

The recent history of environmental legislation passed in Massachusetts became the primary determining factor of the proposed management system. During the early 1970's, many progressive environmental statutes were passed. Wetlands protection was legislated; the protection of Scenic Rivers was guaranteed; dredging and filling of inland and coastal waterways became regulated; and more.

The pace with which this legislation was enacted made it practically impossible for the executive branch to keep pace with sound, efficient management of the newly enacted programs. Moreover, while legislation was forthcoming, appropriations to implement the programs lagged behind the enabling actions. So management of these programs, during the early 1970's was fragmented, uncoordinated, and in some instances, seemingly nonexistent.

The first step toward bringing some semblance of cohesion to the management of the state's environmental protection statutes came with the reorganization of Environmental Affairs, which took affect July 1975. The reorganization brought under one administrative head, the Secretary of Environmental Affairs, all the environmental regulatory programs, as well as the land use, land management program of the Commonwealth. Programs previously situated in the Department of Public Works and the Department of Public Health were consolidated into Environmental Affairs.

The Secretary of Environmental Affairs was given broad ranging responsibilities for setting environmental policy and for ensuring actions within all departments consistent with this policy. The year following reorganization was spent designing and implementing some measure of management reform and improvement. As with any corporate merger, two to three years will be needed to implement this reorganization completely, especially since the financial troubles of the state have imposed severe spending restrictions on all state programs. Even relatively easy adjustments to mergers, such as consolidating office space, have been slowed by the state's financial limitations.

Yet while Environmental Affairs has been progressing toward better management of environmental programs, there is no doubt that the confluence of three circumstances -- reorganization with its expanded responsibilities, the plethora of new statutes in need of good management, and the state's serious financial straits -- means that we have not progressed to the sophistication we should have in our management system. That is, we have not yet begun to manage the many pieces of statutory authority and responsibility as an integrated, coordinated whole.

So that is precisely what our concept of "networking" is. It is a management system representing the next step in the state's efforts at instituting enlightened management; it is a deliberate, systematic effort to bring all the state's legislative authority to bear on a specific region of the state -- the coastal zone; and it is a management system capable of assessing before anyone takes action, how, with all the incentives and disincentives that the state can bring to bear on any action, we act in ways most beneficial to the resources of the coastal zone.

However, this concept has an important, as yet unmentioned, assumption. It assumes that Massachusetts has sufficient statutory authorities that focus on a management plan that can rightly be placed on management rather than legislative measures. An extensive analysis of the statutes was undertaken by an independent contractor for fully six of the last twleve months to appraise this assumption. We are satisfied with the conclusions of this study, -- a strong and unequivical support for our premise.

A MANAGEMENT SYSTEM THAT IS USEFUL AND USED

Given the strong tradition of home rule in Massachusetts, a basic ingredient for the assurance that the system will be useful and used is strong citizen involvement in its design. The records of our research, meetings, presentations, discussions and negotiations with citizens along the coastline will clearly demonstrate the widespread, major involvement of Massachusetts residents in this plan.

For the past three years, CZM has been asking people what they would like to see in a coastal zone management porgram. We learned a number of things. People want a system where decisions will be made at the

local level if the issues affect only their town and no others. They want to protect natural resources because they recognize the important role that coastal ecosystems play in primary food production and storm protection. However, they perceive that if other communities are allowed free reign over all siting decisions, then undesirable but income - producing uses will be placed very near their borders and they may have to bear the pollution, traffic, and public service burdens without any of the attendent financial benefits. While they do not want to be forced into anything, they are willing to give up a measure of control over their own ability to site developments in exchange for being able to influence the siting decisions of neighboring communities.

Citizens want technical advice -- architectual, engineering, biological, geological and legal. They do not have the financial resources with which to hire full-time technical staffs, but feel the clear need at times for such expertise. Inland citizens have expressed the concern that their tax money is being used to support recreation, flood, erosion or navigation projects, and other coastal programs. But they do not trust local coastal town governments to represent their legitimate needs for access to beaches, boat ramps, and conservation areas.

People are suspicious of creating a new, potentially cumbersome, expansive bureaucracy, at either the state or regional level. They are suspicious of a formal regional entity due to past disenchantment with regional government. (They remain suspicious even though they understand the lack of authority which regional bodies have traditionally been given.)

They value state regulation in some instances because the state can implement programs uniformly and consistently but are skeptical of a state-level super agency because they fear that they will have little voice in its decisions and that it will be unresponsive to local differences and concerns. While essentially supportive of state programs they are, nonetheless, very critical of time delays and disorganization in state agencies. And, where they might be receptive to some new form of management in the future, people generally feel the first priority is for the state "to get itself together."

Clearly the networking scheme responds to these basic concerns of coastal residents, essentially by putting first priority on improving the state's own administration and by doing so without imposing a new layer of bureaucracy.

Next, to be a used and useful management system, the materials -- maps, data sheets, guidelines for implementing policy, and the like -- must be accessible to state and local interested parties. And these materials must be readily understood by the layman, devoid of jargon and formidable technical language wherever possible. The maps, commentary, technical information presented in this document give evidence to our sensitivity to the need for usable materials. Our experience to date in citizen participation has provided sufficient understanding and insight

into the tolerances and abilities of the general public so that our materials have already enjoyed wide distribution and use. In keeping with that measure of our own capabilities, we anticipate comparable usefulness of the materials for use in implementing the management system.

Finally, the assurance that the management system will be instituted hinges on the extent of commitment of the Commonwealth of Massachusetts to the program and the ability of the key administrators to turn that commitment into reality.

It should be noted that the document will only be submitted for federal approval under the Coastal Zone Management Act after receiving endorsement from the Governor's Economic Development Cabinet, the entire cabinet, the Governor and Lt. Governor, the Joint Committee on Natural Resources and Agriculture, key coastal legislators, the selectmen of towns, RPA's, mayors and city councils.

In short, prior to submission, the management plan must receive widespread, endorsement as being sensible, reasonable, and honoring the rights and responsibilities that various local and state authorities seek to maintain.

Since the primary responsibility for implementing the management system rests with the Secretary of Environmental Affairs, some comments on the Secretary's rôle in Massachusetts government are in order. First, the Secretary has direct and frequent access to the Governor as well as other cabinet secretaries. The cabinet meets weekly and serves as the Governor's board of policy advisors. Each cabinet secretary has a monthly review with the Governor of the entire secretariat; because of the impact of Environmental Affairs on all state activities, the Secretary of Environmental Affairs typically meets with the Governor another half dozen times each week on specific issues.

Second, the Secretary of Environmental Affairs took office almost two years ago with a specific opening statement about interest in bringing her private sector management and planning experience to bear on public administration. Finally, the Secretary has taken active part in the coastal zone planning throughout the last two years, thereby demonstrating sincere intent to make this program a vital persuasive force in Massachusetts.

A MANAGEMENT SYSTEM THAT SURVIVES THE TENURE OF STATE ADMINISTRATION

CZM is aware that to receive the endorsement of the public, the present political leadership of Massachusetts and the current Secretary of Environmental Affairs will not be sufficient to ensure the long-lasting viability of the program, CZM must institutionalize its concerns with the daily functions of the state bureaucracy. This cannot be icing glossed on the surface - it must be a fundamental integration of the CZM program with on-going programs in Environmental Affairs.

As described in full detail in later pages, CZM will utilize several mechanisms to ensure a desirable administrative structure. These will consist of new regulations relating to the coastal activities of various agencies and will be promulgated under the formal procedures of the Secretary of the Commonwealth. Regulations once promulgated, tend to have a tenure far beyond the administration which drafted them. The CZM program will also be fully integrated with a number of on-going programs by providing staff people to those agencies which are most critically underfunded or unfunded and which play a key role in coastal management. In particular, the Division of Environmental Quality Engineering is establishing regional offices which will now be the focus for a majority of the relevant premit processing plus CZM's reinforcement efforts. In addition, through these regional offices CZM will be providing significant technical assistance and grants to local communities, thereby improving their abilities to implement positive coastal developments and enabling a constituency of committed and informed local coastal zone decision-makers to develop.

CZM and appropriate agencies will also prepare Memoranda of Understanding and program guidelines which will be geared to individual programs and will detail agreed-upon priorities for agency actions, other agencies to be consulted in reaching certain decisions, or CZM's commitments for funding or staff support. There will also be the forementioned formal endorsements of the program via an Executive Order by the Governor and the adoption of the Plan as a part of the formal policy and regulations for Environmental Affairs by the Secretary.

In the federal sphere, the Coastal Zone Management Act gives to the states a significant new power over federal agency activities by requiring all federal agencies to administer their programs consistently with the state CZM Plan. CZM and each federal agency will work out agreements and operating procedures which will institutionalize this requirement and which will endure far beyond any political changes at the state level.

The management system which unfolds over the following pages has thus been designed to be a viable and practical system: one which improves the operation of existing state programs; one which responds to the needs and desires of the coastal actors -- the beach-goer, the ferry operator, the marine ecologist, the developer, the state administrator, and the town official; and one which shall endure, effectively promoting CZM policies but insulated from the vagaries of executive change-overs.

THE NETWORKING SYSTEM

Networking, in the first instance, is the use of existing EOEA laws and programs administered in a coordinated and uniform manner. The networking equipment includes inter-agency Memoranda of Understanding, guidelines, regulations, and a set of maps and commentary. These tools are designed to interface the policies which were presented in Chapter II

with the administrative procedures of the various agencies. For instance, when an applicant comes forward with a proposal for a certain activity, there is an activity matrix which quickly tells the administrator which policies apply to that activity. If CZM and the agency have worked out specific priorities or agreements regarding how either a regulatory or a funding program is to be administered, these procedures will be detailed in the Memoranda of Understanding, in the guidelines and in new or revised regulations.

The maps identify sensitive coastal areas critical to marine productivity, plus areas of natural hazard, existing development, and recreational opportunity. The major purpose of the maps, regulations and quidelines is to ensure adequate protection for these marine resources. When agencies are approached by a permit applicant or are deciding how to allocate their own project funds, they need simply refer to the CZM maps. If the project is located in or near an area identified on the maps, they will then refer to the commentary, policy sections, and revised regulations for further guidance. Thus, the maps will serve as internal "flags" to notify all agencies that this area is significant for some reason. The discussions in the policy sections will provide information on why such areas are significant while the site-by-site commentary and the regulations will provide additional guidance for deciding how to respond to the decision at hand.

The maps also indicate where these critical resources combine to form a more diverse and interdependent complex, such as an estuarine system, where activities must be reviewed for their impacts on the whole complex. A detailed commentary has been prepared for each of these complexes to advise decision-makers and the public on its sensitivities to, and opportunities for, development. A basic policy of the CZM Plan and of the Growth Policy for Massachusetts is that development should be guided into existing developed centers in order to maximize economic benefits and to preserve the environment by concentrating development in areas where alterations from the natural state have irrevocably occurred so that further ecological deterioration can be minimized. This policy will be reinforced throughout the management effort.

This system has also been designed to provide a significant new voice to the public. Over the past three years, hundreds of citizens have contributed their time in an effort to improve coastal zone management. The maps and the commentary record and reflect their concerns and their information. Through these maps, citizens will speak to the agency personnel who make the decisions affecting those areas of key concern. While CZM and agencies will review projects under the permit processes and through the National Enviornmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA) procedures, the intention of networking is to inform developers, decision-makers, and conservationists of the CZM policies before funds are spent for engineering or impact studies or project plans are solidified. Citizens are strongly urged to contact CZM early in their planning processes, and before sites have even been chosen, to determine whether the project is consistent with the

Plan and what sanctions or incentives are applicable to that proposal.

The second key element of the management system is the federal agencies who also have a vital role in the coastal zone. As discussed in the Federal Consistency section, all federal agencies will need to carry out their projects and permitting programs consistently with the Plan. While CZM and federal agencies will have their own administrative mechanism, the maps will also serve to emphasize to federal decision-makers the significance of the various areas and to indicate the policy, special regulations, or heightened concerns that the state attaches to them.

The third element of the CZM management system is the closer integration with local concerns. Through our public participation network CZM has repeatedly heard citizens voice the desire to redevelop their waterfront, acquire beaches, etc., but they frequently have felt hampered either by a lack of funds, a lack of ability to manipulate the myriad of state and federal programs, or a perceived disparity in the directions and focus of state vs. local procedures.

In those programs which are jointly administered by state and local units (such as Environmental Code, governing sub-surface sewage discharges or the guidelines for local Conservation Commissions where the state essentially sets standards for local implementation), these documents will be revised to reflect CZM concerns in order to insure more consistent management of critical areas by all levels.

It is a CZM goal to help state and local decision-making support one another. Many municipalities have areas zoned for water-dependent uses, for commercial and industrial use, or for conservation open space. While no project could come to the state without having received all prerequisite local approvals, the intention of EOEA networking is to expedite the state permit process and to reinforce local zoning policies when that development is consistent with the CZM Plan. Another purpose of the Plan is to assist communities in their protection of local resources. The Plan, the maps, and CZM's technical advisors can assist local officials in their decisions. CZM people will be available to answer questions -- ecological, geological, legal, etc. -- or to present information to Conservation Commissions and public bodies. Secondly, the CZM staff, savvy in the inter-workings of state and federal programs, will also be willing to promote and expedite local proposals, in the role of a general advisor/ombudsman.

And finally, through a program of special incentives, which will be funded by CZM with its Section 306 monies, local governments will be eligible to receive more incentive technical assistance, legal support and cash grants to facilitate implementation of those projects which CZM would like to encourage. Here is the opportunity for that desired harbor area renewal project to come to be.

THE CREATION OF THE EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS AND THE ENVIRONMENTAL POLICY FOR MASSACHUSETTS

The Executive Office of Environmental Affairs (EOEA) was established in 1969 as part of a major reorganization of Massachusetts state government. It and the other cabinet level offices were initially charged with the responsibility to develop recommendations for restructuring state government. Section 50 of Chapter 704 of the Acts of 1969 states in this respect that:

> "Such recommendations shall be made with a view to the elimination of duplication and overalpping in the functions, administrative practices and facilities of said agencies, the combination and coordination of information systems, the creation of administrative structures which will assure coordination of information systems, the creation of administrative structures which will assure coordinated and joint planning, the establishment of clear and readily identifiable lines of authority and allocations of responsibility, the coordination and consolidation of the delivery of state services at state and regional levels, and the enlargement of career opportunities."

Specifically, under Section 2, codified as MGLA Chapter 21A, Section 2, Environmental Affairs is charged with the following power and responsibilities:

"The office and its appropriate deaprtments and divisions shall carry out the state environmental policy and in so doing they shall:

1) develop policies, plans, and programs for carrying out their assigned duties;
2) provide for the management of air, water and land resources to assure the protection and balanced utilization of such resources within the commonwealth, realizing that providing safe water to drink and clean air to breath is a basic mandate;
3) provide for the propagation, protection, control and management of fish, other aquatic life, wildlife, and endangered species and promote and further develop hunting, fishing, recreational and competitive marksmanship, and trapping opportunities in the commonwealth;
4) aid in the promotion and development of the food and agricultural resources of the commonwealth to preserve agricultural lands, and insure an adequate supply of high quality farm products;
5) provide for the regulation and management of marine and coastal fisheries and natural resources including those located in the territorial waters, the economic zone waters and the continental shelf, wetlands, estuaries, shorelines, and interior of the commonwealth;
6) promote the perpetuation, extension, and proper management of the public and private forest lands of the commonwealth;

7) develop statewide policies regarding the acquisition, protection and use of areas of critical environmental concern to the commonwealth;
8) develop and administer programs relating to recreation including the acquisition of land, development of facilities, and the provision of advisory services to municipalities and private organizations;
9) promote the best usage of land, water, and air to optimize and preserve environmental quality by encouraging and providing for, in cooperation with other appropriate state agencies, planned industrial, commercial, recreational and community development;
10) provide for the preservation and abatement of water, land, air, noise, and other pollution or environmental degradation;
11) promote the preservation and enhancement of natural, scenic, historic, and aesthetic qualities in both urban and rural areas;
12) provide for the control of insects, plant diseases, and pests, and regulate the use and disposal of pesticides;
13) develop programs relating to the reclamation or disposal of solid waste material and the operation of sewer and water systems;
14) encourage the restoration and reclamation of degraded or despoiled areas, including harbors and inland and coastal waters;
15) manage all lands and properties acquired by or assigned to them to preserve their natural beauty, wilderness, or open character of hydrological, geological, historical, scientific, wildlife management, recreational or other significance value;
16) assist other state and regional agencies in developing appropriate programs and policies relating to land use planning and regulation in the commonwealth;
17) analyze and make recommendations, in cooperation with other state and regional agencies, concerning the development of energy policies and programs in the commonwealth;
18) advise, assist, and cooperate with such oher departments, agencies, authorities, officials, and institutions, including state institutions of higher learning, as may be concerned with or involved in matters under their control or supervision;
19) encourage recycling, resource recovery and environmentally sound purchasing practives to conserve resources and reduce waste;
20) monitor the environment to identify changes and to insure efficient and effective control practices;
21) develop environmental data management capabilities to aid environmental planning and decision-making;
22) encourage, support, and undertake research facilities to produce information relating to the ecological system, pollution preservation and abatement, resource management, and other areas essential to implementing the environmental policies of the commonwealth;
23) advise and assist local governments, private and public institutions, organizations and associations, businesses, industries, and individuals by providing and acting as a clearinghouse for environmental information, data and other materials;
24) promote the development of sound environmental education programs;

25) represent and act on behalf of the commonwealth in connection with federal grant programs;
26) keep accounts, records, personal data, enter into contracts, adjust claims, accept gifts, bequests and devices, and subject to appropriation acquire real or personal property by eminent domain or otherwise;
27) advise and assist state agencies, cities and towns, and other units of local government in the preparation or enhancement programs;
28) promulgate rules and regulations necessary to carry out their statutory responsibilities;

In order to assist the office in the discharge of its duties, the Secretary may request from any agency or political subdivision of the commonwealth any information relevant to the discharge of such duties. An information copy of each application submitted by any political subdivision to any public or private agency for a grant or loan with respect to any environmental protection or enhancement program, including the acquisition of land and facilities for these purposes shall be filed with the office not later than the twentieth day after submission. As the primary agency of the commonwealth for environmental planning, the office shall utilize the services and plans of regional planning agencies, conservation districts, conservation commissions and historical commissions in fulfilling its environmental planning responsibilities."

Of key significance is that these broad powers and responsibilities are given to the departments and divisions of Environmental Affairs in addition to the Office of the Secretary itself. Thus, while each line agency still has its own specific enabling legislation, Chapter 21A superimposes on the specific criteria in those individual acts the requirement that every EOEA agency carry out the state environmental policy in the manner directed by Section Two.

The State Environmental Policy is voiced in several places. Article 49/97 of the Constitution declares:

> "The people should have the right to clean air and water, freedom from excessive and unnecessary noise, and the natural scenic, historic and esthetic qualities of their environment; and the protection of the people in their right to the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources is hereby declared to be a public purpose."

Furthermore, in Chapter 30, Section 61, the Massachusetts Environmental Protection Act (MEPA) directs:

> "All agencies, departments, boards, commissions, and authorities (to) ... determine the impact on the natural environment of all works, projects or activities conducted by them and shall use all practicable means and measures to minimize damage to the environment ,,,, (which) shall mean any destruction, damage or impair-

ment and eutrophication of rivers, streams or subsurface water resources; destruction of seashores, dunes, marine resources, underwater archeological resources, wetlands, open spaces, natural areas, parks, historic districts or sites. Damage to the environment shall not be construed to include any unsignificant damage to or impairment of such resources."

Chapter 21A does not expand basic agency jurisdiction or authority. It does not require agencies to undertake new programs which are beyond the scope of their authorizing legislation. But Chapter 21A does impose an affirmative duty to implement the state environmental policy when they are acting within their existing jurisdiction, whether reviewing a permit or conducting some activity.

Where the grant of authority is broad or general (for instance, if the statute or case law uses such words as public welfare, good order, or care and control; where the state is to serve as a trustee; or where no guidance is provided), then Chapter 21A acts to focus the exercise of that discretion. Chapter 21A operates to prevent an agency from taking any action which would serve to contraveme its provisions.

Let us take as an example, a proposal for an activity in a critical area. The effect of Chapter 21A is that an administrator could not proceed in a manner which would be contrary to policies regarding the protection and use of areas of critical environmental concern to the Commonealth. Or if a project were to entail risks to marine resources, the administrator could not act in ways which would be inconsistent with the directives to "provide for the propagation, protection, control and management of fish, other aquatic life ..." or to "provide for the regulation and management of marine and coastal fisheries and natural resources including those located in the (open sea), wetlands, estuaries, shorelines,..." etc.

There are other cases in which the enabling elgislation is of a somewhat more limited nature in that it identifies several interests which are to be protected but gives no guidance for how those interests are to be protected or what constitutes protection. Here Chapter 21A will not expand the list of interests but it does serve to define the scope of those articulated interests. For example, the statute may call upon the administrator to address the protection of fisheries, the prevention of pollution, or the prevention of storm damage. Chapter 21A thus defines these grants of authority. In addition, there may be a very few statutes where administrators serve purely ministerial roles; Chapter 21A would not alter these limited grants of authority.

In sum, the Legislative mandate to the EOEA agencies requires an integrated approach towards critical areas, towards the balanced and best usage of all resources, and towards conflicting uses of land -- natural and commercial, urban and rural or historical and industrial. Chapter 21A thus furthers the essential purpose of Reorganization by ensuring that no agency can wilfully act in any way which would undermine the concerns of any other unit within EOEA.

The Coastal Zone Management Plan, which will receive full endorsement by the Governor of the Commonwealth and by his Cabinet (composed of the Secretaries of all of the Executive Offices of the Commonwealth), and the Growth Policy Plan (which received similar gubernatorial endorsement) are a part of the state environmental policy. These endorsements will, in effect, incorporate the CZM Plan into the Chapter 21A directive. Furthermore, as a part of the regulations for EOEA, the Secretary will adopt the CZM Plan. Thus, as a part of the internal operating policy of the Secretariat, EOEA agencies will be doubly bound to carry out the Plan's directives.

EOEA AGENCIES AND RESPONSIBILITIES

-The Executive Office of Environmental Affairs (EOEA) is the overall fiscal, policy, planning, and legal decision-making entity for environmental matters. Besides CZM, there are three units within the Executive Office: the Division of Law Enforcement, The Division of Conservation Services, and the Massachusetts Environmental Impact Review Program.

-The Division of Law Enforcement (DLE) has the responsibility of enforcing, through legal action if necessary, all of the Laws and regulations the Executive Office is empowered to enforce. The 70-member force ensures compliance with the Commonwealth's hunting, fishing, and trapping laws, as well as laws relating to forests, forest fires, and the operation of motorboats and snowmobiles. DLE is involved in the detection of inland and coastal wetland violations under the state's wetland protection laws. DLE officers work with the Division of Water Pollution Control in detecting oil spills and other pollution sources in an accelerated program to clean up Massachusetts' waters. CZM will work with this unit, and may supplement its staff, to ensure adequate protection of critical areas and enforcement of CZM policies.

-The Division of Conservation Services (DCS) assists regional local conservation commissions in their efforts to preserve and acquire open space land, including the administration of a program to provide partial reimbursement for lands purchased for conservation and public recreation. Conservation Services provides financial assistance to 15 regional conservation districts, and coordinates their activities with other agencies in establishing a team approach to environmental problem solving. Finally, Conservation Services administers a land conservation restriction program which allows property owners to retain title to property while remaining legally bound not to develop it. The land owner receives tax advantages for accepting such restrictions. CZM will work with DCS to insure that funding requests for acquisition of critical coastal areas will receive high priority.

-Environmental Impact Review This division of the Secretary's staff is responsible for the evaluating and monitoring of environmental

impact statements required by the Massachusetts Environmental Policy Act (MEPA). MEPA established an environmental review process for state actions, projects with state funding contributions, or projects requiring permits or licenses from state agencies. The intent of MEPA is to improve environmental planning and the design of activities so that they minimize damage to the natural environment, but not necessarily to stop them. As an informational device, MEPA attempts to provide full dsiclosure of the environmental consequences of state related activities. The MEPA staff also reviews and comments on appropriate federal projects filed under the National Environmental Policy Act (NEPA). There also are procedural protections for activities in designated critical areas. CZM will continue its close working relationship with the MEPA program, and will work out special procedures for review of projects in highly critical areas.

The majority of the regulatory and program authorities of EOEA are grouped into five major departments.

-Department of Environmental Quality Engineering, (DEQE) is basically Massachusetts' equivalent to the federal Environmental Protection Agency. DEQE serves as the state's principle environmental watchdog, continually monitoring the quality of our air and waters. DEQE also administers regulatory programs to reverse any current environmental degradation and to guarantee the future quality of our air, land, and water resources. This Department is of key concern to CZM. The programs noted under Implementation Measures in Chapter II reveal the ways in which CZM will coordinate with and supplement the activities of DEQE.

-The Department of Environmental Management (DEM) embodies the state's commitment to protect, enhance, develop, and manage the natural resources of Massachusetts for this and future generations. DEM manages lands which cover 255,000 acres and are held for timber, recreation and watershed purposes. CZM and DEM will be working together on those programs which relate to the coastal zone: Ocean Sanctuaries, Wetland Restrictions, and Scenic Rivers.

-The Department of Fisheries, Wildlife and Recreational Vehicles (DFW&RV) manages and studies inland and marine fish and wildlife resources. It works to improve markets and resources for commercial fisheries and opportunities for public access for recreational boaters and sports fishermen. It also enforces the state's laws concerning motorboats, snowmobiles, trail bikes, and other off-road vehicles. The programs in DFW and RV of major concern to CZM are Marine Fisheries and Public Access.

-Department of the Metropolitan District Commission (MDC) was the nation's first legally constituted metropolitan district. By utilizing economics of scale and efficienes not available to individual communities, it currently serves 54 cities and towns in the greater Boston area with one of the largest domestic water supply

and distribution systems in the world, a sewer system with thousands of miles of local and trunk sewer lines, and a recreation system exceeding 12,500 acres of land. Reservations, ice skating rinks, swimming pools, beaches, road and parkways, playgrounds, ball courts, zoos, and museums plus a substantial police force all fall under MDC control. Since many of these facilities lie in the coastal zone, CZM will ensure that they are managed consistently with the Plan.

-The Department of Food and Agriculture has the legislative mandate to "preserve agricultural lands, and to issue an adequate supply of high quality farm products." The Department inspects and grades food products and fairs, licenses producers, and investigates market prices. It administers the agricultural assessment program, of key interest for CZM's open-space policies, which provides farmers preferential tax rates in exchange for retaining land in agricultural production.

THE MEMORANDA OF UNDERSTANDING, REGULATIONS AND GUIDELINES

During the third year of the planning period and probably continuing into the implementation period, CZM and the EOEA agencies will be preparing regulations. Some agencies already have regulations, some have just procedural and not substantive regulations, and others have no regulations at all. Furthermore, no agency has regulations specifically addressing activities in critical coastal areas. In some cases significant work has already been done -- the Environmental Code covers subsurface sewage discharges and the Wetlands Restriction Programs lists permissible activities. For other cases like the Ocean Sanctuaries program, the Scenic Rivers Program, the Executive Office itself, or in integrating the Colonial Ordinance with the Waterways program, major efforts by the agencies and CZM will be required.

The Memoranda of Understanding will fill the general purpose of substantiating the cooperative relationship between CZM and other EOEA units. But they will contain far more. Where it is important for certain prorgams to incorporate views of other agencies, such as Marine Fisheries or Food and Agriculture in decisions made by DEQE, the Memoranda of Understanding will detail this. Where the CZM policies require a modification in administrative practices, the memoranda will outline the new procedures. Where priorities must be assigned due to limited staff or financial resources, such as which communities the Wetlands Restrictions Program will cover next of how Self-Help funds will be allocated, the Memoranda of Understanding addresses these. Since CZM will also be supplementing the staff of certain agenceis to ensure that there is adequate personnel to provide the requisite scrutiny for activities in critical areas, the Memoranda of Understanding will also record such agreements.

Some of the regulations will relate to specific activities which the policy sections addressed, as for example, the discharge of heavy metals or dredging of contaminated spoil. Other regulations will generally be

geared to the marine ecosystems which are identified in the discussion of CZM maps. For instance, an appendix to the new Environmental Code will deal with critical areas. Since the new regulations will address land types they will be applicable throughout the state where such an area is encountered. For example, rules governing setbacks from fresh-water bodies or percolation rates through soil types will apply inland as well as on the coast.

In other cases the work CZM has been doing with other agencies is really the preparation of guidelines, not regulations. CZM has been involved with the Division of Waterways in preparing a rating system to rank the relative benefits of navigation proposals. CZM and Waterways are also preparing a matrix to provide administrators with a quick guide to the impacts of their most frequently proposed activities upon the types of special areas.

Where the regulations, guidelines and Memoranda of Understanding have established new or higher thresholds for activities in coastal areas, the effect will be to shift the burden of proof from the government to the applicant. In other words, a general standard may apply in normal, non-critical areas. And for the highly critical areas, the regulations, etc., will require consideration of even broader areas and impacts and the burden of proof will be even higher. The essential reason for the stiffer standards is that as the degree of sensitivity and importance of these areas escalates, the need for stricter controls also escalates. These standards will be the guiding criteria for all agency actions. But, should a situation arise, on an individual site, where the concern attached to that area or by that activity would not in any way affect the concern addressed by the CZM policy, then in that isolated circumstance, the regulation would not apply. To put it in the language of lawyers, on the basis of scientific evidence it has been determined that these classes of areas are of particular environmental sensitivity and since the Legislature has mandated all EOEA agencies to promulgate regulations concerning the protection of areas of critical enviornmental concern and the general management of coastal resources, the new standards as contained in the CZM-EOEA Plan, maps, regulations, guidelines and Memoranda of Understanding, will be presumed necessary and will be applied; unless such presumption can be overcome by an affirmative showing by the applicant, an agency, or some other interested individual, that the result is unreasonable as applied to that site or activity in that it does not jeopardize the concern addressed by the statement of policy or by the identification and classification of the area.

CONFLICT RESOLUTION MECHANISM

EOEA processes several thousand permits per year for projects in the coastal zone. In addition, many agencies conduct numerous other activities--building shore protection works, acquiring parkland, etc. CZM's presence will require a re-analysis of priorities and a reweighing of decision-making criteria. There are bound to be conflicts. There have also always

been conflicts bewteen some programs, well before the coming of CZM.

CZM networking will serve to identify those conflicts early in decision-making process, so that they can be resolved without great time delay. Any disagreements will be resolved at the level of the Secretary.

Section 4 of the Reorganization Act gave to the Secretary the following powers:

> "In order to enable him to coordinate and improve the operations of all departments, divisions and other administrative units within the office, the secretary shall have the following powers and duties concerning any power of duty assigned to any such department, division or other administrative unit :
>
> (1) the power and duty to resolve administrative and jurisdictional conflicts between any such agencies or officers;
>
> (2) the power and duty to implement, upon request of any such agency of officer, programs jointly agreed to by the secretary and such an agency or officer;
>
> (3) the power and duty to coordinate and improve program activities involving two or more agencies or officers."

As mutually agreed to in the Memoranda of Understanding, all EOEA units will refer to the CZM policies and maps before taking any action in the coastal zone. Should that action be located in or near a special area, the agency will refer to the commentary and the regulations to determine why that area was considered important and by whom. Perhaps Marine Fisheries has identified it as a significant spawning ground, perhaps DEM's Wetlands Program has restricted it, perhaps the Federal Flood Insurance Porgram has mapped it as a hazard zone, perhaps citizens have identified it as a key historical and recreational spot, or perhaps CZM has determined that it is a valuable commercial port. If the action proposed by or to the acting agency is inconsistent with the reason the area has been designated, then the agency will contact the concerned party—be it another state agency, a federal agency, the local planning board, or CZM. All efforts will be made on the part of all affected parties to modify or otherwise resolve the dispute informally. CZM will assist in this process if requested.

But should the agency decide that it will proceed in a direction contrary to that outlined in the Plan, then a conflict will have arisen within EOEA. It will be at the level of the Office of the Secretary that the dispute will be resolved. CZM policy, because it has been adopted as an official part of EOEA policy, will be accorded the same presumption as were the regulations discussed above. The CZM policy may perhaps be over-ruled, perhaps the agency decision. But the key idea for all actors is that if conflicts develop after all units have

considered the appropriate criteria and guidelines, then that conflict is to be resolved at the Executive level. The essential goal is for EOEA to take a uniform position on any coastal issue.

THE CZM MAPS - DEFINITION OF SPECIAL AREAS

Some CZM policies relate to certain activities wherever they occur in the coastal zone. Others are to be applied just to certain coastal areas. In addition, since CZM policies vary, from providing incentives for development in some areas to protecting other areas, it was necessary to classify areas in several categories. The categories are: Significant Resource Areas (SRA's), Areas for Preservation and Restoration (APRA's) and Special Assistance Areas (SAA's). The sections below desribe these categories, define the boundaries, and outline how they will be managed.

SIGNIFICANT RESOURCE AREAS AND THE BASE MAPS (SPA's)

The CZM base map of the coastal zone identifies important resource areas, both natural and man-made, and areas that contain potential hazards.

Five categories of resource and hazard areas are given below and are defined by the subcategories they encompass. They have been defined and identified using definitions expressed in existing laws, information provided by citizens, and relevant data maps. For these subcategories the agencies or organizations which have generated the initial information are cited. While the maps reflect all coastal areas which fit the criteria, should land use change occur or new information arise, the maps will be corrected to conform to these definitions.

1) Marine Environment: The important role of marine ecosystems within the coastal zone has been thoroughly elaborated on in the policy chapter. Based on the systems and processes discussed there, the following types of marine enviroments have been defined and identified for management purposes.

    a. barrier beach system: a narrow strip of land or unconsolidated material extending roughly parallel to the general coast and either completely or partially separated from the mainland by a narrow body of fresh brackish, or saline water. In addition to its ocean facing beach, the system may include vegetation or unvegetated dunes and may be fringed on its landward side by marsh vegetation. Undeveloped (natural conditions intact and relatively free from alteration) and developed barrier beach systems are delineated on the basis of information provided by the Institute of Man and Environment (IME) at the University of Massachusetts for CZM.

    b. dune - a mound, ridge, or hill of wind blown or drifted sand which can be bare or vegetated, stabilized or migrating. These features have also been identified by IME and include both natural and altered dunes.

c. high saltwater marsh - lowlying coastal wetlands characterized by the presence of Spartina patens. These marshes are flooded by seasonal high tides. They have been identified and mapped for CZM by the Institute for Man and Environment.

d. low saltwater marsh - areas vegetated by Spartina alterniflora. This land is submerged by every high tide. These marshes also have been identified by IME.

e. shellfish beds - areas of bottom which, in combination with other environmental factors, favor the establishment and production of harvestable shellfish: blue mussel, oyster, quahog and soft shell clams, bay scallops, sea clam, and ocean quahog. Bottom areas with associated Zostera marina serve in places as bay scallop nurseries. These areas have been identified and mapped for CZM by the Division of Marine Fisheries.

f. salt ponds - a shallow enclosed or semi-enclosed bay of saline water formed as the result of glaciation or barrier beach formation at the mouth of a shallow bay. Salt ponds are subject to fresh water influence from small streams emptying into the upper reaches of the pond or springs along the periphery and/or in the pond itself. Salt marsh vegetation usually forms a fringe around the pond. Salt ponds have been identified by the CZM staff using the USGS quadrangle maps, air photos, and field knowledge.

g. sandy beaches - shoreline features made of unconsolidated sand and/or pebbles eroded from headlands or brought down rivers that carry the products of weathering and erosion from land masses or transported from offshore sources. Sandy beaches extend from mean low tide line landward across summer and winter berms to where vegetation begins. These beaches have been mapped by CZM using IME and Division of Mineral Resources data.

h. areas of finfish concentration - areas within estuaries, bays and coastal waters which are spawning, nursery or feeding grounds for finfish. Spawning areas within rivers are also shown for anadromous fish. All of these areas were identified and mapped by the Division of Marine Fisheries. for CZM.

i. estuary - a semi-enclosed body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from outflowing fresh water rivers. In most instances, the landward extent of the mixing of fresh and salt water is shown by the presence of saltwater marshes which form along the banks of the river. CZM has mapped the estuaries using McConnell, and IME vegetation maps. Where no salt marsh system is present, field

studies were made to determine the extent of salt water mixing. The CZM maps show only the surface water areas of the estuaries (not the wetlands) from the river headlands to the inland point where saltwater mixing is no longer evident.

j. coastal embayments - marine waters that have a restricted opening to the ocean due at least in part to the formation of a barrier beach. Unlike estuaries or salt ponds there is very little fresh water influence. Coastal embayments are shallow and may support healthy stands of eelgrass and populations of shellfish. Most coastal embayments support well developed salt marsh systems. CZM has identified and mapped the coastal embayments showing only those areas covered by marine waters from the headlands of the seaward opening landward to the mean low tide line. The associated marsh system is illustrated under the headings high saltwater marsh and low saltwater marsh.

k. freshwater ponds - enclosed bodies of fresh water which, within the Massachusetts' coastal zone, were formed primarily by glacial action. These ponds were created by blocks of stagnant ice that became isolated from the receding glacier. When the blocks melted depressions remained which later became filled with water. These ponds, which include the Great Ponds, were identified and mapped by CZM using USGS quadrangle maps and field investigation.

l. aquaculture land and water - tracts of land and water in estuaries and coastal embayments used for the propagation of shellfish. These areas have been identified by the Division of Marine Fisheries.

2) Hazardous Areas: The storm buffering capabilities of natural areas and the hazards posed to people and property located in damage prone areas has been discussed in Chapter II. In order to respond to the needs of such areas, the following criteria for site identification has been prepared:

a. Flood Plains - Coastal lands located within the 100 year tidal flood zone. If they had been completed, town Flood Insurance Rate Maps (FIRM) prepared by HUD under the National Flood Insurance Program were used to delineate A zones (areas subject to 100 year tidal floods) and V zones (area within the 100 year tidal flood zone that are subject to storm wave impact). For towns who's FIRM's had not been completed, tidal flood profile data compiled, by the U.S. Army Corps of Engineers and preliminary flood hazard boundary maps prepared by HUD were used to delineate the 100 year tidal flood zone.

b. Erosion - Areas where there is a loss of land along the shoreline caused either by natural forces or by the action of man. Critical erosion is defined as erosion of shorefront property that causes it to become unusable or imminently rendered unusable for its primary use or uses. All other erosion is termed moderate. Erosion areas are delineated on the basis of data collected and mapped by the U.S. Army Corps of Engineers for the Massachusetts Division of Mineral Resources. It is expected that this data will eventually be supplemented with information on E zones (flood related erosion areas) generated by HUD's Flood Insurance Rate Mapping process.

c. Areas of accretion - New land or shoals that are being formed along the coast due to the deposition of silt and sand by the littoral drift. These areas have been identified using data compiled by the U.S. Army Corps of Engineers the U.S. Geological Survey, and the Division of Mineral Resources.

d. Areas of mass wasting - Land subject to slow or sudden downslope movement of a massive amount of earth material (rock debris or unconsolidated sediments). In the coastal environment this most commonly occurs on sea cliffs or bluffs where the tow of the slope is being removed by wave action. These areas have been identified by Dr. Clifford Kaye of the USGS and by CZM staff.

3) Recreational Areas: One of the greatest assets of the coastline is the recreational opportunities it offers the citizens of the Commonwealth. In order to assess the supply and distribution of recreation facilities, a map of the existing sites was prepared, using inventories prepared by the Regional Planning Agencies, the Department of Environmental Management, Conservation Services, the SENE Report, and citizen input. CZM has identified and mapped all public and private boat marinas, boat launches, campgrounds, golf courses, amusement parks, beaches accessible to the public and public parks over 10 acres. The following characteristics define special resource areas.

a. existing recreation sites- which comprise the majority of beaches, campgrounds, large parks, marinas and boat ramps. These sites are sufficient in their present state, and and warrant no further improvements or expansions. Sources are the reports listed above.

b. existing recreation sites suitable for multiple use and/or increased maintenance - existing areas that are underutilized or whose use can be increased through improved maintenance or multiple use management. Developed from citizen comments and CZM's inventory of recreation sites.

c. existing recreation sites suitable for physical expansion - recreational facilities which can be expanded into adjacent undeveloped areas which are ideally suited for the expansion of such activities. Criteria for site selection will be developed under continued recreation planning funds (see Recreation section).

d. areas suitable for new recreation - areas whose undeveloped nature, proximity to populations, and suitable characteristics make them ideal for new acquisition. Developed in part through citizen comments and undeveloped "coastal" view land.

4) Visual: the characteristics and importance of the visual environment of the coastal zone were discussed in Chapter II. Areas that relate to the policies expressed in that section include:

a. coastal viewshed - the inland boundary of areas within which views of the shoreline and water are unobstructed by topography, vegetation, or development. The viewshed was constructed by CZM using USGS topographical maps.

b. undeveloped coastal view lands - agricultural or other open space areas that contain less than one unit of development per acre and across which views of the shoreline or coastal features (e.g. dunes, salt marshed) are possible. Undeveloped coastal view lands have been identified and mapped by CZM.

c. sites for historical or educational value - individual sites that are either illustrative of typical natural processes or environment types, representative of relatively unique natural occurrences,or important for their historical or cultural value. Major coastal dependent activities which could offer visual educational opportunities are also noted. Primary sources of data include the Massachusetts Landscape and Natural Areas Survey and the Massachusetts Historical Commission.

5) Developed Areas: The desire to concentrate development within areas where similar development now occurs has been demonstrated to be beneficial from many perspectives. Existing developed areas include marine transpotation and energy sites. In addition, some areas offer mineral resource potential that can be exploited for the benefit of the Commonwealth.

a. port areas - locations that include navigable channels of 20 foot depth or more, lands abutting such channels which are zoned for marine dependent or industrial use, and well-developed road and rail links leading to major arterial and trunk routes. Such locations are also served by public water supply and sewerage treatment systems capable of accommodating heavy industrial use and are separated or remote from residential neighborhoods and commercial business

districts. To identify these areas, zoning maps, urban renewal and port facility plans, and field investigations were used.

b. developed harbors - sheltered harbors and navigable channels which provide mooring space, berths, slips, ramps, and docks serving a regionwide boating public, commercial fishermen, cruise boats, ferries, or light marine industry. Such harbors may also present unique opportunities for the fishing industry or for waterfront renewal and revitalization. These areas have been identified by using zoning maps, navigation charts, McConnell land use maps, inventories of ramps, marinas and piers, community plans, surveys of habrormasters, and field investigations.

c. other urban waterfronts - shoreline areas which do not presently contain developed harbors but which are characterized by extremely dense, urban residential neighborhoods or commercial development. Such waterfront areas have been identified by using McConnell land use maps, zoning maps, community plans, and field investigations.

d. energy facilities - sites of existing major energy facilities in the coastal zone. These facilities have been identified in the Chapter II Energy Section.

e. offshore areas of potential mineral deposits - potential offshore sand and gravel deposits between Cape Ann and Brant Rock (generally between 40 and 150 foot contours) were identified by Raytheon Company, Oceanographic and Environmental Services Division for the Massachusetts Division of Mineral Resources. Other potential mineral resources (such as oil and gas and possibly coal) have yet to be identified.

The above lands and waters play a vital role in the functioning of the coast and thus have been identified by CZM, and in many instances by state laws, as areas which merit special consideration.

But the basic rule is that no EOEA agency is about to conduct nor permit any activity in or near an SRA which would be inconsistent with the reason the area has been considered significant and the policies applied to it.

Where networking and Chapter 21A will affect a significant change when an administrator is reviewing a project under a law which does not expressly address those resources, the effect of that project on those areas must now be considered.

Let us take for example, a proposal to construct a large solid fill pier. Construction of such a pier requires a tideland license from the

the Waterways Program. Prior to newworking, the license was granted or denied based on navigational considerations. Under networking, a principal CZM concern - that of impairing natural flushing rates and circulation patterns - must also be taken into account. To wit, in highly productive and environmentally sensitive enclosed water bodies such as estuaries and coastal embayments (both of which are SRA's), proposals for solid fill piers will only be licensed if reduction in flushing capabilities and circulation patterns will not adversely affect water quality or marine productivity. If the solid fill pier is to be located in a salt marsh or shellfish bed (both SRA's as well), the effects on marine productivity could be significant, and the project would need to be denied as it would contradict the requirements of Chapter 21A to protect fish, other aquatic life, and areas of critical environmental concern. If the proposal is for a timber piling pier the problem of interference with flushing capacity and circualtion patterns would not arise nor would the problem of filling or altering salt marshes. Thus, small piers on timber pilings will be categorically exempt undet the new CZM - Waterways Program regulations.

Preliminary SRA maps were reviewed at regional meetings during which citizens updated and corrected the data and outlined areas of special concern to them. CZM asked the citizens to include within these sites comments addressing public land that was being severely or moderately eroding,scenic areas that were subject to erosion, the use of public and private recreational sites, sites for potential new recreation, areas of high scenic quality within the coastal zone and sites which offered scenic views of the coast. In addition to these areas, many citizens designated other areas that were of special importance and interest to the town. Citizens' comments are recorded on the maps, further enhancing descriptions of SRA's and forming part of the basis for the identification of Areas for Preservation or Restoration and Special Assistance Areas.

AREAS FOR PRESERVATION OR RESTORATION(APR's)

Under the federal Coastal Zone Management Act, Massachusetts is required to designate areas whose conservation, recreational, ecological, and/or aesthetic values are so important that these characteristics must be preserved or when need be, restored.

Since changes introduced into one part of an ecosystem so frequently have an impact on other parts of the system, but may or may not be perceivable at the direct site of the change, it is of utmost importance that an APR be treated as interdependent system. Therefore, they will encompass more land area than SRA's and receive far closer scrutiny than SRA's.

Where several SRA's join and overlap one another and serve to define an interrelated marine complex, which may be high in marine productivity, contain storm buffering features, be particularly sensitive to ecological alteration, or have unique aesthetic values, that complex may acheive that high measure of importance which will permit its designation as an APR. A description of each APR will be provided which will enumerate

the factors from all of the policy sections which led to its designation.

APR's will then be designated by the Secretary of the Executive Office of Environmental Affairs as areas of critical environmental concern. For these areas the categorical exemptions granted to activities that fall within the MEPA review process (Chapter 30 MGL Sections 61 and 62) are suspended. (Section 8.3 of the MEPA Regulations) This will allow EOEA to review all projects proposed for an APR if they use state funds or need a state permit. Regulations and Memoranda of Understanding governing the permitted activities within the entire area will be formulated and will be more stringent than those applied to SRA's. Furthermore, no EOEA agency will be able to permit or conduct an activity adjacent to an APR which might, through currents, winds, or on-land activities, have a detrimental effect on the APR.

For example, extension of public sewer services may be encouraged in such SRA's as developed harbors. In APR's, however, the growth inducing effects of public sewer services may pose risks of damage to the resources deemed important to the area's designation as an APR. Thus, extension of sewer services will be carefully reviewed and may be denied or conditions placed on their capacity, design, and layout.

Sites recommended for APR designation will be outlined on the CZM base maps. The designation will serve to inform the public, before they embark on a development project, that a highly sensitive area exists and as such, all EOEA agencies and federal agencies will be administering their programs in full conformance and consistency with the policies established for those areas. Furthermore, CZM will be monitoring the actions taken by state and federal agencies to serve as an additional check. CZM will also take positive steps to protect these areas by promoting the wetlands restriction program, procuring Self-Help and other acquisition monies, and coordinating other assistance programs to insure that state and federal agencies provide the fullest and possible measure of protection and wise management to these areas.

Under the Reorganization legislation, the Secretary is charged, in Chapter 21A Section 2 to "develop state-wide policies regarding the acquisition, protection, and use of areas of critical environmental concern to the Commonwealth." She and her agencies are further enabled to "promulgate rules and regulations necessary to carry out their responsibilities." (Section 28) Under the MEPA legislation (Chapter 30, Sections 61 and 62) all the Secretaries of the Exeuctive Offices are to "promulgate rules and regulations approved by the Secretary of Environmental Affairs to ... minimize damage to the environment." These sections have been used in the interior of the Commonwealth to designate areas of critical environmental concern. This designation will have two effects. As an internal regulation it will substantively affect EOEA agencies in that they must now attach a high degree of scrutiny to their activities therein and may not proceed with any

action which might impair the values of the area. For agencies outside of EOEA, and for all EOEA agencies, the effect of such designations is to remove all activities in that area from the scope of the categorical exemptions under MEPA, therefore, environmental assessment forms will need to be completed for all activities conducted in APR's.

The Reorganization legislation which created EOEA and granted it such extensive new powers also addressed the issue of areas of critical environmental concern. In Chapter 806, Section 40(e) of the statutes of 1974, the Legislature charged the Secretary:

> "To conduct a study relative to land use so as to identify and designate areas of critical environmental concern where uncontrolled development could result in irreversible damage to the environment."

Areas cited by the Legislature included:" the coastal zone, inland and coastal wetlands; rare and valuable ecosystems and habitats; rivers, streams, and floodplains; natural areas and buildings, structures and sites of scenic, historical, architectural, archaeological, geological, biological, recreational significance; great ponds; lands of prime productivity; park, preservation, forest, recreation, or open space lands determined to be of regional significance; (and) fish, bird, and other wildlife management areas."

Here clearly is evidence of the Legislature's concern with critical areas, in particular the coastal zone, wetlands, rare ecosystems and floodplains, etc. Following the Legislative directives in this enactment and in Chapter 21A, the Secretary of Environmental Affairs will employ the following procedures. Individual public meetings will be held at each APR. Public notices will be provided at least 21 days before the meetings. The technical staff from CZM and EOEA will present information on why this area is so environmentally critical. Interested citizens will then have the opportunity to present data, views or arguments.

SPECIAL ASSISTANCE AREAS (SAA's)

Special Assistance Areas are sites which warrant special planning and funding. The following criteria will be used to designate SAA's:

1) The area contains at least one SRA and

   a. the area plays an important role in the economy of more that one town either through commerce or industry;

   b. the area or use of the area affects, is affected by, or is under the jurisdiction of two of more municipalities;

   c. the area is state owned;

   d. the impacts, concerns, or conditions associated with the are a result of state action; or

e. state and/or federal monies have been or will be expended to insure, protect, or aid investments, developments, or human safety within the area.

While these areas will still be subject to existing environmental laws, the purpose of designating the SAA's is to insure that public funds and programs will be used to promote wise use of developed coastal resources. Chapter 21A requires agencies to encourage the restoration of degraded areas, including harbors, to assist other state and regional agencies in appropriate programs and policies relating to land and water and to provide for planned industrial, commercial, recreational, and community development. A basic policy of CZM and of the Growth Policy of the Commonwealth is to encourage development in areas where the necessary infrastructure exists. In terms of economics, use of an existing infrasturcture is more efficient, reduces public and private costs and preserves the vitality of urban core areas. In terms of the environment, use of existing centers reduces the intrusion of development into open spaces, thus preserving untouched areas in their natural state and concentrating dsiruptions in areas where alterations from the natural state have already occurred.

Each SAA will be accompanied by a commentary tailored to that area. The commentaries will be mimi-plan and will describe the characteristics of the area and the kinds of development which CZM and citizens would welcome and the ways in which state and federal programs might be used to insure that these mini-plans come to fruition. The commentary may reflect conflicts between environmental and economic concerns, or within economic concerns such as between fishing and recreational boating. A key part of the commentary will be a discussion of applicable Program Incentives.

PROGRAM INCENTIVES

Meeting the objectives and policies of the Massachusetts Coastal Zone Management Plan will require more than the coordinated action made possible by networking with state agencies and federal consistency.

Maximizing the economic development potential of the port and harbor resources of Massachusetts, for example, will require the expenditure of public funds for channel improvements, pier and bulkhead construction, and other navigation works. Ameliorating coastal recreational opportunities will demand further public disbursements for improving facilities, acquisition, and construction of access trails and routes and parking areas. Choosing among future dredge spoil disposal methods and sites will require costly and sophisticated environmental assessments and technologically complex solutions. Enhancing the coastal visual environment will depend largely on assistance extended to communities for establishing procedures for site plan and design reviews, as well as zoning control.

To support these kinds of affirmative actions, which are essential to carrying out the policies and objectives of the plan, CZM will offer

four types of assistance:

1) assistance in securing federal and state funds needed to carry out development programs and projects which meet the policies and objectives of the CZM plan,

2) financing of feasibility studies and field investigations for waterfront renewal, port and harbor development, and dredge spoil disposal,

3) technical assistance to communities to provide needed marine biological, hydrological, geological, recreation, erosion, and general land use planning, and legal expertise, and

4) energy impact funding.

SECURING STATE AND FEDERAL PROJECT AND PROGRAM FUNDING

State and federal agencies offer a variety of financial assistance programs to communities for planning, acquisition, and facility improvement and construction. CZM will help communities to identify potential sources of funding for programs and projects meeting the policies and objectives of the plan; will champion such projects and programs before federal and state agencies to assure that they are given priority consideration for funding; and will work toward ensuring that eligibility requirements and funding levels set by federal and state agencies reflect the needs of coastal communities, inland users, and the priorities of the CZM Plan.

Federal agencies, because of the federal consistenty provisions, will pay special attention to review comments submitted by CZM on applications for federal grants. Where CZM gives special endorsement to program and project aplications, federal agencies are likely to act expeditiously in approving funding. Through networking, memoranda of understanding with state agencies, and the development of working relationships with the Development Cabinet, the Office of State Planning, and other state agencies, CZM will also seek to have a positive influence on allocation of state funds.

The principal federal and state assistance programs which are relevant to meeting the plan's policies and objectives are described in Chapter II. These range from Anadromous Fish Restoration to urban mass transit. They cover activities from acquisition of recreation and conservation lands to waterfront renewal.

FINANCING FEASIBILITY STUDIES AND FIELD INVESTIGATIONS

Massachusetts will receive a substantially increased federal grant to cover the administrative costs of implementing the Massachusetts Coastal Zone Management Plan. A portion of this grant will be set aside to fund action studies aimed at developing innovative solutions to

pressing coastal problems and needs.

The intent of such financing is to enable communities to undertake the studies and preparatory work which usually are necessary before any major project development proposal can be put together. Typically, state or federal funding is not available to finance such studies because their duration is too short and costs too small for agencies to absorb the overhead costs of administering a small grants-in-aid program. The use of the CZM management monies for such study purposes will thus fill a major gap in existing efedral and state assistance programs.

Once or twice a year municipal governments will be invited to submit study proposals for funding. The maximum amount to be awarded will not exceed $20,000; the minimum, $1,000. Grants will be awarded for no longer than one year. Funding requests will be weighed against one another, and those which demonstrate a pressing need and which best meet the policies and objectives of the CZM Plan will be selected for funding. Studies eligible for funding will include:

1) waterfront renewal and development studies: preparing harborfront plans aimed at improving visual and physical access to waterfronts; identifying opportunities for waterfront parks; waterfront pedestrian ways, ramps, and other public access improvements; conducting feasibility, cost, and preliminary engineering studies for such waterfront improvement projects.

2) port and harbor development studies: preparing overall port and harbor development plans; assessing future facility needs and the economic return from such facilities; conducting feasibility and preliminary engineering studies for public marinas, town wharfs, and docks, access ramps, and navigational improvements.

3) dredge spoil disposal investigations: identifying feasible land alternatives and sites for dredge spoil disposal; investigating costs; and preliminary engineering for innovative dredge spoil disposal practices including creating artificial salt marshes, using spoil as fill, and building containerized sites.

Grants for eligible study requests will be awarded to those applications which:

1) support the policies and objectives of the CZM Plan and which conform with specific Special Assistance Areas (SAA's) commentaries in the regional chapter,

2) provide at least one-third of total study costs in local funds,

3) demonstrate that funding is not available from any other federal or state agency and that reasonable attempts have been made to solicit assistance from other agencies, and

4) carry assurances that the study will lead directly to concrete project development plans and proposals which can be implemented.

TECHNICAL ASSISTANCE TO COMMUNITIES

Once the Massachusetts Coastal Zone Management Plan is approved by the U.S. Secretary of Commerce, Massachusetts will receive expanded federal funding to cover the administrative costs incurred in putting the plan into action. Some of these funds will be used to staff personnel in the two coastal regional DEQE offices in the coastal zone. These regional personnel together with core staff in Boston will include planning, legal, marine biology, geology, and hydrological experts. They will be available to communities to identify and solve problems.

What are the economic benefits to be gained from accomodating OCS supply bases in my community? What can a community expect if it approves an aquaculture grant? How might anadromous fish runs be improved? What can our community do to improve its visual environment? How can dredge spoil disposal costs be minimized? What alternatives are available? What environmental effects might be expected from raising the level of sea dikes, from enlarging salt pond breeches? To answer these and many other questions, CZM staff will be available to communities. In some cases, solutions will lie in directing communities to potential sources of state or federal funding. In other cases, answers may lie in funding special feasibility studies. In many other instances, CZM staff will, through its own research capabilities and field investigations, be able to help communities find needed naswers.

CZM staff will also aid communities in designing innovative zoning by-laws or ordinances. Municipalities, by taking the initiative themselves, can further many of the policies and objectives of the CZM Plan. The adoption of waterfront zoning districts encouraging water dependent uses serves to meet CZM's port and harbor policies. Site plan review and design review procedures can ensure that developments in developed harbors provide visual and physical access to waterfronts. The enactment of floodplain zoning and wetland and dune by-laws help to meet the marine environment and coastal hazard policies of the CZM Plan. Sign ordinances and the establishment of historic and scenic districts can serve to meet the Plan's visual environment objectives and policies.

Impact or performance controls allow communities to move away from rigid zoning districts and inflexible definitions of permissible uses. Instead, projects are reviewed against various standards. This review attempts to measure the impact various types of new development might have on the land itself and on municipal services required to accomodate the change. Standards may cover a percentage of impermeable cover, amount of cut and fill, type of building material, vegetation removal, and provision of open space. Such controls, if enacted, could go far to meeting CZM's marine environment, coastal hazards, and visual environment objectives. Cluster zoning or planned unit development procedures allow for more compact development patterns thereby economizing on municipal service and preserving coastal open space.

Legal research and planning skills will be offered to communities willing to take advantage of these innovative zoning techniques, and, in providing such services, CZM will work in close conjunction with the Office of Local Affairs in the Department of Community Affairs and regional planning agencies.

The 1976 amendments to the Coastal Zone Management Act extend and increase funding to CZM programs specifically for erosion and coastal recreational planning. The Massachusetts CZM Program will be using these funds to work with state agencies to coordinate management of erosion hazard areas and with communities in developing specific erosion control and protection measures, and in analyzing specific coastal recreation problems and opportunities.

CZM will provide specific help to communities in developing alternative ways to mitigate the adverse impacts of erosion problems. Analysing beach over-crowding problems and recommending solutions, designing better access ramps and trails to coastal recreation sites, examining how alternative boat mooring patterns can relieve congestion in crowded harbors, designing and implementing ways of reducing dependence on the automobile in getting to coastal recreation sites, and investigating and recommending possibilities for multiple use of recreation facilities are among the field studies CZM will carry out to assist communities in accomodating recreation seekers. (See Recreation policy section for further detail.)

ENERGY IMPACT FUNDING

The 1976 amandments to the Coastal Zone Management Act establish a new federal loan and grant program to assist coastal communities and states to shoulder the financial costs incurred by accomodating coastal energy facilities. Under this new program, coastal communities hosting new coastal energy facilities will be eligible to receive:

1) loans and loan guarantees to help cover the costs of both providing additional public services and constructing new public facilities (roads, water supply, sewage treatment works) made necessary by new coastal energy facilities;

2) refinancing and other financial assistance, including grants in extreme cases of hardship, to repay the above loans if the financial burden imposed on a community accomodating new coastal energy facilities is so severe as to cause substantial hardship; and

3) grants covering the full costs of environmental losses and damages sustained by the siting of a coastal energy facility.

This new program of federal assistance is only made available once the U.S. Secretary of Commerce either approves a state's coastal zone management program or determines that substantial progress has been

made to meet the planning and program approval requirements of the Coastal Zone Management Act.

The Massachusetts Coastal Zone Management Program will help affected coastal communities take advantage of this new program and will facilitate approval of eligible applications by establishing a continuing working relationship with the U.S. Department of Commerce.

FEDERAL CONSISTENCY

Concern for the future of the Massachusetts coast is by no means peculiar to the Massachusetts community. Federal, as well as state and local agencies help make those development and preservation decisions which ultimately impact our lands and waters. Because effective management of coastal resources demands a significant level of governmental coordination as well as a focus of control, the Coastal Zone Management Act provides that:

> "Each federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs."

Requirements within the Act which define the federal/state relationship are referred to as the federal consistency provisions. Under these provisions, the Massachusetts Coastal Zone Management Program has been authorized to work with federal agencies to delineate how federal activities must proceed to realize State objectives. While such authority is necessary to give management focus to the Plan, governmental coordination itself mandates consideration of local priorities, state goals and federal interests. As such, the disparate and common concerns of all participants must be resolved and accomodated.

This consistency process begins with the identification of all federal agencies which have or potentially hold direct interest in the coastal zone. Those agencies must be provided with the opportunity for ongoing participation in the development of the Plan. CZM, in turn, is required to acknowledge these views, consider the national interest, and establish a means for continuing coordination and consultation with these agencies.

The Act's consistency language is often vague, and formal federal regulations defining precisely the meaning of consistency have not yet been promulgated. The explication below is based upon draft regulations which have been issued by the Office of Coastal Zone Management (OCZM) in Washington as interim guidelines for federal participation. It should be noted that as these are subject to change, CZM's position on consistency is not fixed. Following is a synopsis of these requirements their implications, and CZM's response to them.

CZM must provide the opportunity for full participation by relevant federal agencies in the development and review of the Management Plan and demonstrate that the views of agencies principally affected have been adequately considered (306(c)(1),(b)).

Prior to initiating policy formulation within the Plan, CZM contacted some thirty-five agencies to solicit their views and concerns with respect to the coastal zone. Most requested some substantive information from CZM which would inform them of our intentions and thus structure their responses. This request will be met through submission of this document to federal agencies. In the interim, CZM has held interviews with each agency to acquire such policy statements and regulations as would enable us to infer federal interest and thus provide for these in the Program Preview. The intersections of state and federal interests are detailed primarily in the Implementation Measures discussed at the end of each policy in Chapter II.

Once federal agencies have had the opportunity to respond to this document, individual meetings with those agencies raising concerns will be held. Attempts to resolve any severe conflicts of interest will be an ongoing informal process between the affected agency and CZM. Should formal intervention be necessary, CZM will rely on mediation by the Secretary of Commerce as provided for within the Act. Under this provision, the Secretary may be called upon to settle those state and federal differences which appear irresolvable through independent processes.

Federal agencies must conduct and support their activities in a manner which is, to the maximum extent practicable, consistent with CZM's approved management plan (307(c)(1),(2),(3),307(d)).

Perhaps of greatest concern are the substantive regulations which define the level of state influence over federal investment and regulatory activities. OCZM has been particularly attentive to the focus of this authority and precise in its interpretation of these consistency sections. Implicit in the consistency procedures discussed below is OCZM's narrow construction of the term "to the maximum extent practicable." CZM will for all intents and pruposes, determine the extent of compliance.

FEDERAL ASSISTANCE (grants, loans, guarantees, insurance)

Federal agencies shall not approve any application for assistance in the coastal zone which CZM determines to be inconsistent with the management plan. The only exception is through an override by the Secretary of Commerce.

Mechanics:

The Intergovenmental Coordination Act of 1968 established state and regional clearinghouses to review applications for federal fundings. In Massachusetts, the state clearinghouse is the Office of State

Planning and the regional clearinghouses are the regional planning agencies. The review procedure is known as A-95 and is aimed at ensuring that federal agencies are made aware of state, regional, and local concerns about the application's compatability with other state or federal programs and objectives. Under the draft federal consistency regulations, the A-95 review procedure will serve as the venue through which determination of CZM consistency on federal assistance will be made.

Any applicant seeking federal assistance for a project located in the coastal zone must receive a CZM consistency determination (referred to as a certification statement). This certification, which includes reasons for CZM's determination, will accompany an application through the A-95 process as a part of the application. If CZM finds a project consistent, the applicant may proceed with the processing of an application and the federal funding agency may approve it.

If CZM determines that the proposal is inconsistent with the CZM Plan, the applicant must attempt to informally resolve any issues with CZM and the appropriate federal agency. It is hoped that such informal processes will resolve all such conflicts. If no such resolution appears possible, and the application is made to the federal agency with an inconsistent finding, an appeal to the Secretary of Commerce may be made by federal agency, CZM or the applicant.

Appellate Procedure:

Either the federal agency, CZM or the applicant may submit a request to OCZM for a Secretarial decision. Each party must then forward its findings and arguments to the Secretary of Commerce for his/her decision.

Secretarial override of a state's determination of inconsistency may only be based upon a finding that: (a) the proposal is consistent with the purposes of the Coastal Zone Management Act (meaning that the proposed activity is compatible with the requirements of the CZMA, and not Massachusetts' CZM Plan. The applicant is required, in this instance, to demonstrate that "complete adherence to the state program would cause the applicant to suffer a substantial burden and that the deviation, if permitted, would cause no more than a minor impact on the integrity of the state program") or; (b) that the proposal is necessary in the interest of national security. (This will be independently determined by the Secretary based on information supplied by the relevant federal agency.)

If neither (a) nor (b) can be argued persuasively, a proposal will not be approved.

FEDERAL LICENSES AND PERMITS

Federal agencies shall not approve any request for a federal license or permit in the coastal zone which CZM determines to be inconsistent with the management plan. The only exception is through an override by the Secretary of Commerce.

Mechanics:

CZM and federal agencies must identify all federal licenses and permits which are specifically to be reviewed by the state. This list will then be made available to federal agencies, OCZM and the Massachusetts public. Assessment criteria for every such permit or license must then be developed by CZM. These criteria, as outlined in CZM's policy statements, are necessary to give definition and justification to our interest in a given activity.

When an applicant intends to apply for any of these listed permits or licenses, he/she is encouraged to first consult with CZM for an initial consistency determination. While this is optional, it is clearly advisable. When submitting the request to CZM and the federal agency, the applicant must include a self-developed certification statement (based on CZM's permit criteria) which indicates that the proposed activity "will be conducted in a manner consistent with the management program" This statement will be accompanied by sufficient information to support the applicant's consistency determination.

CZM must then notify the public (relevant state and local bodies) of both the request and the certification statement, and invite public comment on the proposal. Based on this review, as well as its own review, CZM will make its consistency determination. If it is favorable, CZM, the federal agency, and the public will be informed of the decision and the permit or license may be processed. Alternatively, if CZM does not comment within a six month period, it is presumed that no objection exists and the request may be processed.

For those permits and licenses not listed, the federal agency will determine if a proposed activity is within the coastal zone and, if so, will direct the applicant to submit a certification statement for CZM comment. A waiting period of thirty days is observed before the federal agency presumes concurrance.

If a given application is found to be inconsistent with the CZM Plan an informal resolution may be sought. An issue which is clearly irresolvable may then be referred by any of the involved parties to the Secretary of Commerce.

Appellate Procedure:

As with issues of federal assistance, the Secretary, based on

information from all parties, may override the state's determination. Again, there are two bases for override: proposal's consistency with CZMA purposes or necessary for national security.

FEDERAL ACTIVITIES AND DEVELOPMENT (federal policies and regulations, direct federal development)

No directive, similar to that of permits and grants, is provided with respect to federal activities and developments under dispute. Cessation therefore, cannot be required. However, continued action which is inconsistent with the CZM plan may invite judicial action or intervention by the Secretary.

Mechanics:

CZM, together with federal agencies, must identify those types of activities which will come under review. While some types of activities may seem individually insignificant, it is important to capture those which incrementally may produce significant effects. These must be delineated during the planning period, but may be appended during the 306 implementation period.

For identified activities, the relevant federal agency must notify CZM of the proposed activity sixty days in advance of project start. If a positive or no response from CZM is submitted within forty-five days, the agency may proceed with the project.

An inconsistent finding by CZM may be presented to OCZM for mediation assistance. It is important to note, that this does not prevent an agency from proceding; It may, as noted above, discourage continued action given the liklihood of legal action or Secretarial intervnetion. If an appeal to OCZM is inadequate, OCZM may refer the issue to the Secretary of Commerce for resolution.

Appellate Procedure:

Upon OCZM request for Secretarial assistance, a hearing officer for the area is appointed by the Secretary. Presentations are made by CZM and the federal agency to the hearing officer who makes a recommended decision. It this is unsatisfactory, by virtue of state or federal rejection, the Office of the Secretary intervenes and hosts an additional mediation conference. A decision by the Secretary is then made which may again be argued by the state or the federal agency. If such a decision is rejected by either CZM or the federal agency, the Secretary makes a final determination together with OMB on the activity's inconsistency with the Massachusetts Plan. A Secretarial final determination of inconsistency mandates transmittal of the issue to Congress to uphold the decision and, thus, deny the activity.

When completed, Massachusetts' Coastal Zone Management Plan will be

distributed to all affected federal agencies for conflict identification. Maps, guidelines and policies will initially alert federal agencies to any concerns within CZM's jurisdiction.

While all federal activities within the coastal zone are encouraged to optimally conform to CZM objectives, the status of federally owned lands with respect to he coastal zone has been in question. The U.S. Attorney General's Office was asked what federal lands are included. An initial legal interpretation from that Office holds that "all lands owned by the United States", in whatever capacity, are excluded from a state's coastal zone. This includes the following categories of federal lands: exclusive legislative jurisdiction, concurrant jurisdiction, proprietary and trust lands.

CZM must give adequate consideration to the national interest in siting of facilities (306 (c)(8).

Definition of the national interest has been highly disputed among various federal agencies. The national interest can be defined to encompass a wealth of activities -- ranging from nationally important energy facilities to the protection of individual wildlife habitats. It is therefore imcumbent upon CZM to establish a process for determining where the national interest is clearly at issue while ensuring that federal activities are neither arbitrarily excluded nor unreasonably restricted. As indicated above, in specific instances the Secretary of Commerce may be called upon to determine national security interest. The national interest, however, extends beyond security concerns.

Ideally, those activities of national interest which are unquestionably coastally dependent will be facilitated by CZM. Their precise coastal location would, of course, be of concern to both local and state participants, and those affected will be involved in siting decisions when such instances arise. Other activities of national interest may be determined by CZM together with the locality as not being coastally dependent, but rather those which opt for a coastal location for reasons of economy or convenience. In these cases, CZM will present its findings to the appropriate federal agency and all attempts to resolve the issue will be made. Finally, CZM may assert that the national interest has been argued inappropriately. In such instances, CZM will provide opportunity for discussion and resolution with the involved federal agency, again relying upon all informal mechanisms before inviting Secretarial mediation.

CZM must incorporate the requirements of the national air and water pollution control acts (307 (f)).

The right to clean air and water must be ensured for all Massachusetts residents. Any activity under the Plan which might joepardize these standards is not acceptable. The responsibility for conforming to federal requirements reats with the state's Department of Environmental Quality Engineering, described earlier in this Chapter. To ensure that

requirements are met, CZM has established an ongoing working relationship with both DEQE and those federal and areawide programs involved in air and water pollution control. It is a firm CZM policy that no activity will be permitted which would degrade air or water quality below federal standards and that for critical areas, adequate protection may well require adherence to far higher standards.

CZM must establish an ongoing mechanism for continuing consultation and coordination with federal agencies (306)2)(b)).

Federal agencies' interest and involvement in the coastal zone clearly will not cease with the approval of the Management Plan. It has already been argued that federal participation in certain decision-making processes is mandatory and, in fact, essential to the state's effective administration of the CZM Plan. Not all activities and their implications however, can be defined and assessed within the state's Plan, nor can every instance of federal activity be predicted. Federal programs and activities, as much as state programs and activities, are not absolute. The relative impact of new or amended federal programs and policies will continue to be a priority concern to CZM in effecting a management plan which is accountable to both state and national interests.

As discussed within each of the policy chapters, there are several established mechanisms for review and comment of federal activities. These include the A-95 and A-85 (review of proposed federal regulations) processes at state and regional levels; the Massachusetts Environmental Policy Act, which requires an environmental assessment for any development requiring a state permit or involving state finance; and the National Environmental Policy Act, which requires federal environmental assessment for federally sponsored activities. In addition to these review mechanisms, the permitting, grant allocation, and development procedures outlined earlier will be utilized to stimulate an ongoing dialogue among local, state and federal participants.

The clear intent of the consistency provisions is to ensure a coordinated governmental network which will avert duplication or conflict of effort. At the same time, the Act encourages CZM to exercize its full authority over lands and water and thus, those agencies whose programs play a vital role in the coastal zone. The success of the management network will ultimately depend upon the continuing efforts of CZM, coastal communities, and federal agencies to render decisions which are responsive to present problems and accountable to future needs.

THE MECHANICS OF NETWORKING: DEQE COORDINATED PERMITTING AND REGIONAL OFFICES

In the fall of 1976 the Department of Environmental Quality Engineering instituted a significant change in their permit issuance

procedures. Since a majority of DEQE authorities are relevant to CZM implementation, CZM staff and procedures will be closely tied to the DEQE programs.

There will be four regional offices in the Commonwealth, two in the coastal zone. One office will include Boston and the North Shore, the other, located in Middleboro, will cover the South Shore, the Cape, and the Buzzards Bay area. For a routine permit all DEQE decisions will be made in the regional office. The applicant will be received by the District Engineers who will determine which DEQE authorities apply and the relevant staff people to evaluate the application for the region. Since all the staff will be housed together and located closer to the sties, the opportunity for integrated review and for streamlined decision-making is greatly increased. The MEPA review process and the water quality determination will continue to be performed in the Boston office.

Until 306 monies are received, the Coastal Review Center in CZM will continue to review proposals following MEPA procedures. Once implementation monies are available, CZM will provide staff in each of the two coastal regions. They will assist the agencies in their on-going review of permits in order to insure that the programs have the staff capability to conduct an adequate review of coastal areas. They will perform an informal informational and assistance role in helping agency personnel carry-out their new Chapter 21A responsibilities in addressing criteria beyond their traditional pre-organization roles. They will specifically assist the DEQE staff in their new responsibilities to integrate CZM maps and regulations into their on-going review of permits for SRA's. Permit applications in APR's will certainly be reviewed by the regional offices, but as with all non-DEQE EOEA agencies, CZM-Boston will also review the applications. If a project is consistent with the CZM Plan, then the regional CZM staff person will also issue the Certificate of Federal Consistency so that the applicant can proceed in the necessary federal reviews. Is short, for most small-scale projects, all necessary reviews will be conducted in the same office. CZM-Boston will house a reltively small staff who will continue, through A-95, MEPA and NEPA processes, to review other state and federal projects. Applications for grant assistance will be processed in Boston. The general "ombudsmen" staff people who will be promoting particular projects before other state and federal agencies will probably be in Boston although they may "float" in the regions. A few technical people may remain in Boston, but they will be primarily assigned to the regions.

For it will be through the regional offices that the Plan will come to the coastal zone. Through wide distribution of the Plan, people will be able to determine, when they are still just forming an idea, whether or not they fall within a significant coastal area. They will be able to learn what the special concerns for that area are. They will be able to go to a nearby office and get an estimate of their chances.

of success for permit approval. They will be able to receive technical assistance about modifying the proposal if advisable. If it is located in an area which could benefit by further development, they will be able to learn about the financial assistance, agency know-how, or the other incentives that CZM will be using to encourage coastal-dependent development.

The essential purpose of the DEQE regionalization is to provide swifter and more responsive decisions by the state. The essential purpose of CZM networking is to provide heightened awareness and institutionalization of CZM concerns in coastal decision-making. Not soley state decision-making; but the decisions that are made by individuals and communities before firm design plans ever reach the state.

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COASTAL REGIONS

COASTAL REGIONS

The Coastal Resources Chapter represents an opportunity for citizen involvement. It has not been written by the CZM staff. However, the chapter will be prepared in the coming months by the Citizens' Advisory Committees of each coastal region in conjunction with CZM staff to ensure that the variety of interests along the coast have an opportunity to shape the development of the plan. When completed, this chapter will discuss the application of state CZM policies to each of the ten coastal regions.

The Advisory Committees, comprised of representatives of community officials, fishermen, commercial interests, environmental interests and citizen groups, have been meeting over the past year to discuss regional concerns and interests in the CZM Program Preview. The knowledge and experience of Citizen Advisory Committee members will be called upon in the coming months as the regional chapters are prepared. The Advisory Committees, and other interested citizens, will translate CZM policies into viable, constructive action plans for the region. All interested citizens are invited to participate in the development of the policy application for their region and may do so by attending the Advisory Committee meetings which are held at least once a month, or by contacting the local CZM staff person. (A list of CZM contact people is at the end of Chapter 1 - Introduction).

The regional chapter will be divided into ten sections corresponding to the ten coastal regions. Each section will begin with a description of the region's natural and man-made features. The description will be followed by a discussion of citizens' desires for future use of the region's resources based on each community's Growth Policy Statement, the results of the CZM public opinion survey, and comments of citizens at CZM meetings. Finally, the application of state policies to the region's opportunities and problem areas will be detailed. The discussion will include how economically and environmentally important areas will be affected by the policies.

Eventually, the regional sections will include detailed maps of major coastal resources and areas, as a part of the management program.

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Massachusetts Office of Coastal Zone Management
Executive Office of Environmental Affairs