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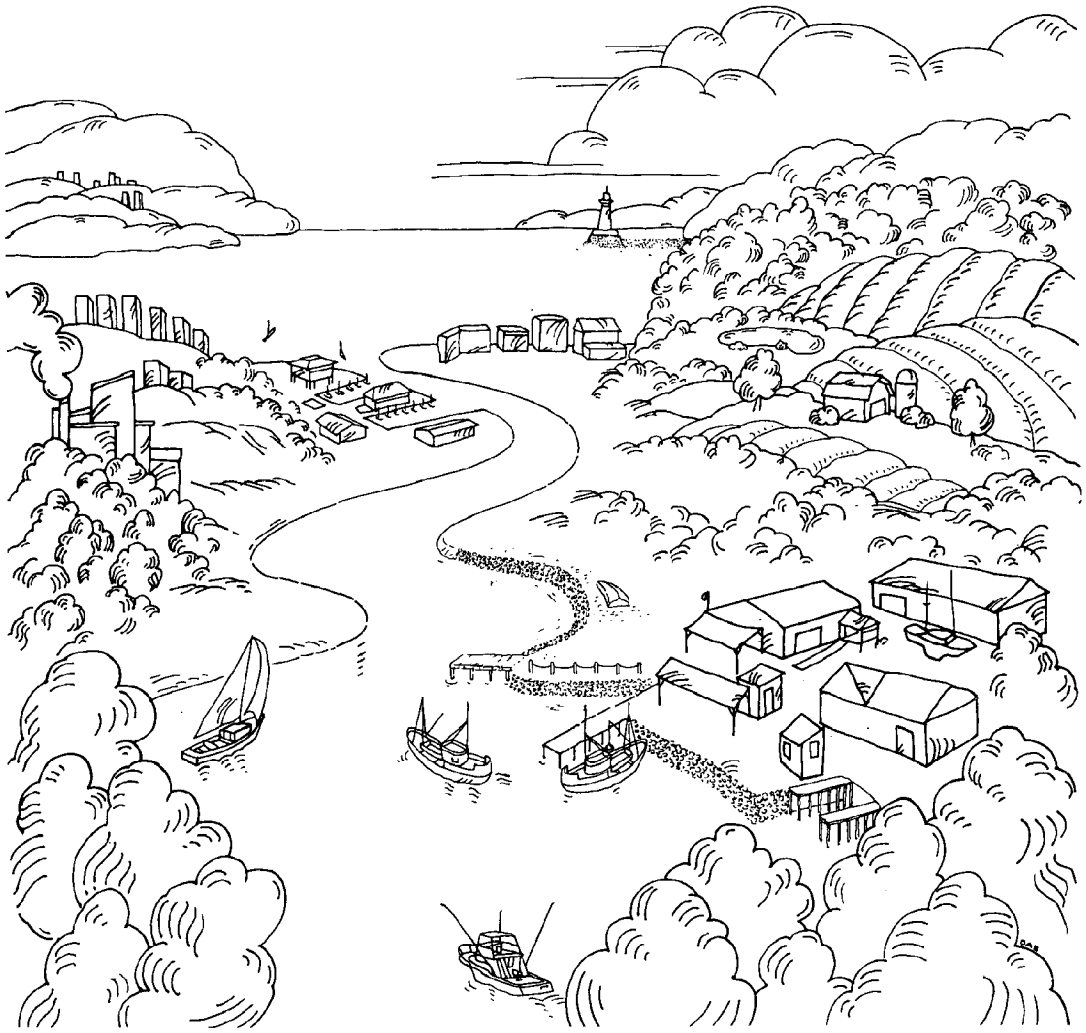
Saving Bays And Estuaries

A Primer For Establishing And Managing Estuary Programs Appendices G, H, And I



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Appendix G

The Economics of Improved Estuarine Water Quality: An NEP Manual for Measuring Benefits

This appendix of Saving Bays and Estuaries: A Primer for Establishing and Managing Estuary Projects presents a summary of The Economics of Improved Estuarine Water Quality: An NEP Manual for Measuring Benefits. The Primer, which describes the National Estuary Program's origin, statutary provisions, and approach, is designed for EPA's program and Regional offices, coastal States, and other interested parties. For more information, contact an EPA Regional office.

Introduction to The Manual

Section 320 of the Clean Water Act provides for the development of Comprehensive Conservation and Management Plans (CCMPs) for estuaries of National significance. To ensure the greatest return on resources spent, it is often necessary to document the economic benefits associated with alternative management strategies.

The Economics of Improved Estuarine Water Quality: An NEP Manual for Measuring Benefits is designed to assist estuary program managers and staff in evaluating the economic benefits of various water pollution abatement options. The manual defines economic benefit as the dollar value associated with incremental improvements in the use, or potential use, of an estuary. The concepts used to measure these benefits are derived from economic theory, according to which individuals acquire satisfaction (or utility) by consuming goods and services. The manual explains the concept of economic benefit, describes how pollution abatement projects generate such benefits, and how such benefits can be measured.

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Generating Economic Benefits

The economic benefits of water pollution controls are produced in stages. These stages, as shown in Figure 1, are interrelated, each affecting the other. Reducing the quantity of effluents discharged

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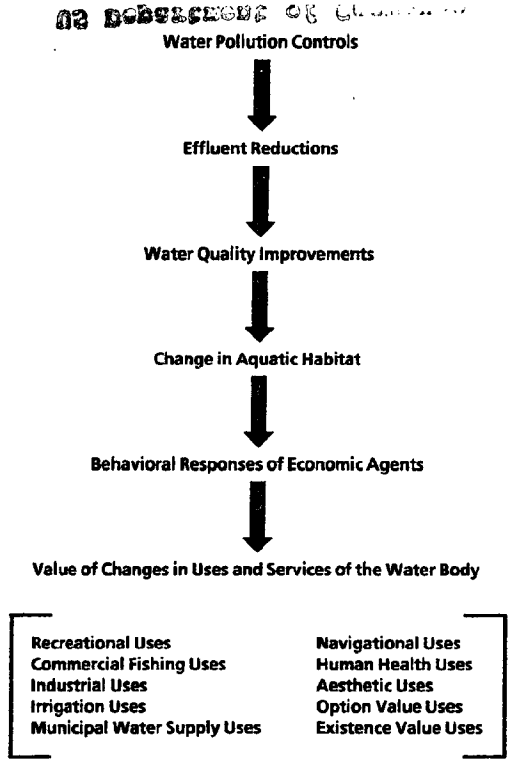

Figure 1. Causal Relationships and Economic Benefits

into a water body improves water quality, which in turn can lead to changes in the aquatic habitat. Once the economic agents directly affected by the water body (e.g., recreationists, commercial fishermen, and homeowners) perceive these changes, they may alter the way in which they use the body of water. The measured value associated with changes in use or potential use represents the economic benefits of the project.

The economic benefits created by water quality improvements can be grouped into two broad categories: user benefits and intrinsic benefits. User benefits are those benefits associated with the use of the resource and that affect industry, agriculture, the municipal water supply, commercial fishing, navigation, recreation, health, habitat, and aesthetics. These benefits can be measured by using commonly available market prices or can be inferred from the market prices.

Intrinsic benefits are benefits associated with a resource that are not directly related to the use of that resource. Intrinsic benefits express an individual's subjective perception of improved well-being and can be personal or intergenerational, short term or long term. The sources of benefits created by water quality improvements are categorized in Figure 2.

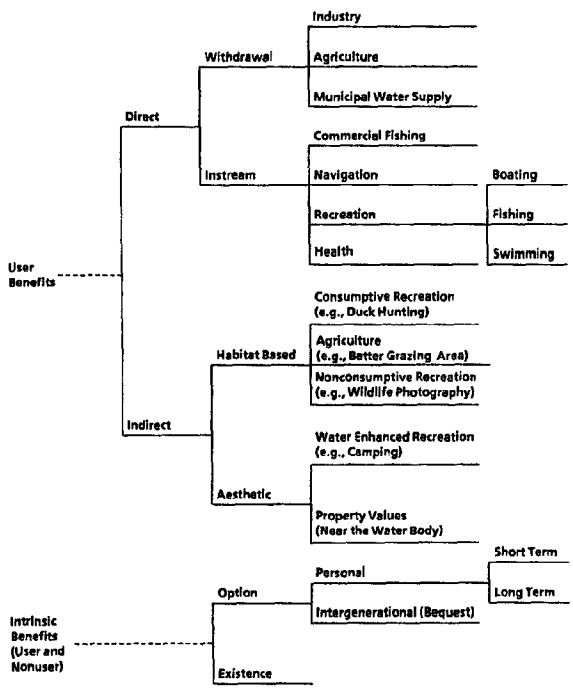

Figure 2. Sources of Benefits of Water Pollution Control

Evaluating Benefits

The incremental economic benefits generated by a proposed pollution abatement project are evaluated by comparing the situation with the project to the situation without it. The annual value of the uses or potential uses of the water body with the project, minus the annual value without the project, represents the incremental annual economic benefits created by pollution controls.

To evaluate pollution abatement projects, a distinction must be made between primary and secondary benefits. Primary benefits are the direct impacts of, or the increases in well-being resulting from, the proposed project. Secondary benefits are those benefits indirectly created by the project, either through the stimulative effect of additional activities generated by the project or through the demand-inducing effects of the expenditures required by the project.

A major difficulty in estimating benefits is that benefit categories and estimation methods are sometimes related in awkward and overlapping ways. One technique may measure the joint benefits of more than one category, or it may not capture all the benefits

accruing to that category. This introduces the possibility of double-counting some of the benefits of water pollution control and not fully counting others.

One way to avoid or reduce the possibility of double-counting is by gathering anecdotal data, for example about boating use. Marina operators have a good sense of who their customers are and what recreational habits they have. Talking with marina staff will yield anecdotal information on the split between boating and fishing, for example. These data can then be used to estimate various benefits more accurately.

Further, each situation that requires benefit estimation is unique: different types of data and different assumptions will be required for each. Moreover, each situation and selected methodology has its own level of uncertainty. If extreme uncertainty exists, no single method will yield reliable results. Instead, more than one model should be used and the information obtained should be correlated.

Another fundamental problem in water quality economics is that water is a common property resource (air, water, or another resource that is essentially free or available to many users). Such resources tend to be overused relative to some optimal level. To understand this phenomenon, it is necessary to understand the basic concepts of consumer surplus (demand curves or willingness to pay) and producer surplus (supply curves).

The difference between what individuals actually pay and the amount that they are willing to pay is the consumer surplus–the conventional dollar measure of the satisfaction that individuals derive from consuming a good or service, exclusive of what they pay for it. Producer surplus is the measure of a change in the well-being of any economically productive entity. The changes in consumer and producer surplus provide the conceptual basis for measuring economic benefits. The potential for numerous benefits resulting from improvements in water quality is addressed in the manual, and several examples are discussed. The document closely examines two major benefit categories: recreational benefits and commercial fishing benefits.

Recreational Benefits

The recreational benefits of pollution abatement projects include swimming, health, fishing, boating, and intrinsic benefits. The manual provides detailed methods to evaluate these benefits. The travel cost method, the contingent valuation survey method, or the participation/unit-day valuation method can be used to calculate swimming benefits. In the travel cost method, the key to calculating individual consumer surplus is to estimate the

demand for beach recreation. Ordinary demand curves are estimated by using price and quantity-demanded data. However, since there is no charge for using most public beaches, travel costs provide surrogate prices to estimate demand.

The essence of the travel cost method is that the combination of the number of day trips to a site and the round-trip travel cost for each recreationist permits an empirical estimate of the demand for a recreation site. More distant consumers bear heavier travel and related costs and usually will visit the site less frequently than those who live closer, all else being equal. Since the travel cost method is based on actual recreational visits, it is one of the most valuable techniques for estimating consumer surplus.

An alternative method for determining the willingness to pay for water pollution controls is the contingent valuation survey method. This method differs from the travel cost method in that it attempts to gather information directly about an individual's valuation of nonmarket goods, such as changes in water quality, by creating a hypothetical market through a survey questionnaire. An advantage of this approach is that it can be designed to elicit intrinsic values. However, considerable skill is required to design the survey.

The participation/unit-day valuation method relies on previously estimated values of individual consumer surplus (or willingness to pay) for an average day's recreation. By applying these values to the estimated daily use of a beach, the dollar value for an increase in the supply of recreational beach days can be approximated. The advantages of this method are its simplicity and minimal data requirements. The disadvantage is that it cannot be used to estimate the aggregate, annual consumer surplus for the increased attractiveness and safety of the beach.

Numerous potential health benefits are associated with water pollution abatement projects. Only swimming-related health effects associated with pathogens are discussed in the manual because this is an area where adequate data and dose/response information often exist. The method proposed in the manual to estimate swimming-related health effects (1) defines the population at risk, (2) applies a dose/response relationship to determine the likely incidence of gastroenteritis under current water quality conditions (without the pollution abatement project) and under the improved conditions (with the pollution abatement project), and (3) values the reduction in swimming-related illnesses.

To analyze the demand for various fishing activities, the manual recommends treating the recreationist's decision as a sequence of three choices. First, the person chooses whether to go fishing. Second, the person selects the types of fishing (surf, beach, small boat, pier, etc.) in which to participate. Third, the person chooses

the preferred level of participation. Each stage of this decision process may be influenced by a variety of economic and environmental factors.

To determine the economic benefit of a proposed action affecting recreational fishing, it is necessary to follow a four-step process: (1) define the affected fishing habitat, (2) determine how physical conditions affect recreational quality and quantity, (3) estimate the baseline recreational activity and value of recreational fishing, and (4) estimate changes in recreational activity and economic value.

Occasionally, gross fishing expenditures are used as a measure of the economic value of recreational fishing. While expenditures are prima facie evidence that recreationists place value on fishing, the expenditures on such recreational trips are not a useful estimate of that value. Gross expenditures represent a cost that detracts from the net economic value of the recreational experience. Many of the gross expenditures are not directly related to fishing. Further, striped bass fishermen, for example, might spend less per fishing trip in 1986 than in 1981 because of falling fuel prices. This, however, is not evidence that striped bass fishing has fallen in value.

Changes in recreational boating most likely will result from the increased use of a body of water by boat owners. The manual describes a two-step procedure to predict recreational boating benefits: (1) estimating the change in recreational boating participation and (2) determining the value of that change.

A contingent valuation approach is recommended to measure the intrinsic benefits of water quality improvements. Intrinsic benefits are all the benefits associated with a resource that are not directly related to the current use of that resource. Intrinsic benefits can be categorized as the sum of option (bequest) value and existence value. Option value is the amount of money that individuals are wiling to pay to ensure access to a resource (or a level of environmental quality) in the future, regardless of whether the individual is a current user. Existence value is an individual's willingness to pay for knowing that the resource exists, independent of any anticipated use.

Commercial Fishing Benefits

Estuaries provide spawning and nursery habitats for commercially valuable fish. Water quality improvements can increase these commercial fish stocks, resulting in expansion of the fishing industry. The economic benefits associated with this expansion can be determined by comparing the commercial fishing market under current water quality conditions with the market that could

develop if pollutant stresses were reduced or eliminated. The manual focuses on evaluating the benefit of pollution abatement programs on shellfishing.

Shellfishing may be totally restricted by states in areas where pollution levels exceed health standards. This can result in major revenue losses for the State's shellfishing industry. In areas that border the closed beds, firms may be required to keep the harvested shellfish in decontamination tanks for several days after harvesting, which increases production costs.

Water pollution controls have resulted in the reopening of shellfish beds in a number of states. In some cases, pollution controls may not reverse shellfish contamination sufficiently to reopen the beds. Consequently, any empirical estimate of these benefits must include adequate justification that the proposed controls would, in fact, lead to the reopening of the shellfish beds. The manual defines the economic benefits of reopening the beds for four different scenarios.

Conclusion

Because there are numerous and subtle factors to consider when estimating the benefits of pollution abatement, the manual describes types of analyses that can be made rather than dictating specific methodologies. To assist further in planning the best approach to measuring benefits, a list of technical publications that address industrial point-source effluent guidelines, limitations, and standards is provided.

Appendix H

Living Resources Appendices

A prime measure of the health of an estuary is the condition of its living resources. A decline in or impairment of living resources usually points to an underlying problem. The cause might be loss of habitat, poor water quality, overharvesting, or disease. The decline might also be the result of natural variability. The cause notwithstanding, it is essential that an estuary's Comprehensive Conservation and Management Plan (CCMP) include, as integral components, living-resources management and habitat-protection elements.

These appendices provide useful information to be used in incorporating living-resources management strategies and techniques into CCMPs.

- Appendix H1 includes case studies of three successful management programs for living resources. The management programs chosen address selected aspects of shellfish management, waterfowl management, and finfish management.
- Appendix H2 is a catalog of many Federal authorities and programs related to estuary living-resources management. It is a useful key in the support of living-resources management and habitat-protection goals and objectives of the National Estuary Program conferences.

Together, the two appendices provide an overview of some techniques and mechanisms available to estuary managers for the management of estuarine living resources.

Case Study 1

Interstate Fishery Management

Framework Amendment of the Salmon Fishery Management Plan for the Coasts of Washington, Oregon, and California

Estuaries serve as nurseries and spawning routes for important species of marine and anadromous fish whose commercial and recreational value reaches hundreds of millions of dollars per year. Many of these species, such as salmon, must be managed to ensure viability. Local management is difficult because salmon species and populations cross many jurisdictions. To provide an institutional framework for dealing with fisheries issues, Congress has established eight regional councils whose membership includes appropriate Federal and State officials, representatives of relevant Indian Nations, and fishery-conservation groups. These councils are responsible for developing, monitoring, and revising management plans for ocean fisheries operating from 3 to 200 nmi offshore.

This case study presents a fishery management plan for commercial and recreational salmon fishing off the coasts of California, Oregon, and Washington. The plan shows how a geographically wide-ranging species can be managed cooperatively among different jurisdictions while still addressing local fishery concerns.

Management Strategies

The Pacific Fishery Management Council (PFMC) recognized shortly after its establishment in 1976 that the steady decline in salmon stocks was due to conflicting and inconsistent management decisions among the States of California, Oregon, Idaho, and Washington. In response, the PFMC has developed an amendment to the current fishery management plan (FMP) structured to respond quickly to changing harvest and habitat conditions in the salmon fishery.[1]

Issues addressed by the plan include

- Determining harvest rates that are consistent with the needs of population replacement, treaty obligations, and maintenance of commercial and recreational fisheries, yet still achieve conservation goals

- Minimizing salmon mortality due to catch/release sportfishing and habitat degradation

- Coordinating agencies and interests representing member States, countries, Indian Nations, according to provisions in the United States/Canada Salmon Treaty to ensure fair, consistent management decisions

- Restoring or replacing natural habitat, including achieving water quality and quantity suitable for salmon, and maintaining access for migration, spawning, and rearing.

To resolve these issues, the PFMC depends on up-to-date biological data and advice from its advisory committees. (See Figure H1-1.)

Actual management is based on boundary zones determined by where along the coasts the spawning stock will return, although the specifics of the zones may change as new data on salmon stocks become available. Each boundary zone is managed to meet the

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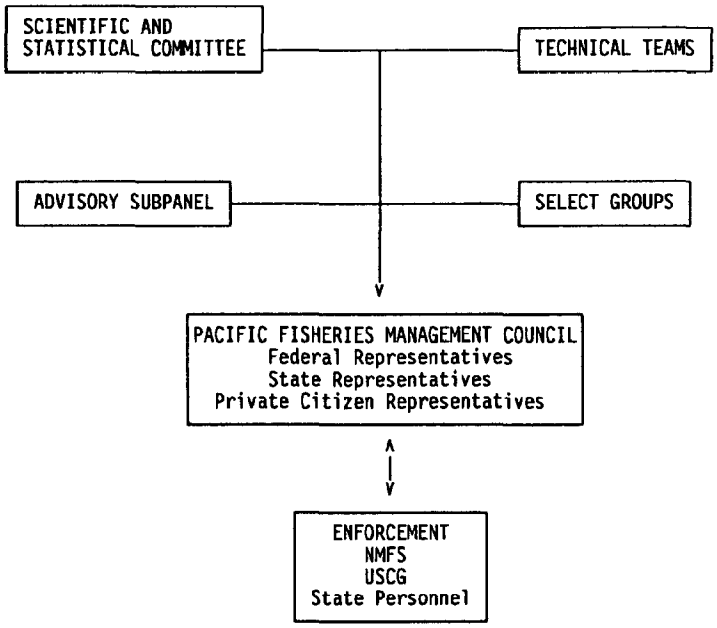
[1]Under original requirements of the PFMC authorizing legislation, any changes to fishery management plans were subject to lengthy and complex amendment procedures. These could add as many as 9 months to implementation of the plan revisions. In 1984, PFMC developed a comprehensive amendment to cover future plan adjustments quickly and with flexibility. This is the *Framework Amendment of the Salmon Fishery Management Plan for the Coasts of Washington, Oregon, and California.*



The PFMC consists of 13 voting members: the Regional Director of the National Marine Fisheries Service (NMFS), four chief fishery officials, one each from Washington, Oregon, California, and Idaho, and eight private citizens who are familiar with fishery conservation, management, and harvest in the PFMC area. These citizens are appointed by the Secretary of Commerce from lists submitted by each member State governor. Nonvoting members include representatives from the U.S. Coast Guard (USCG), the U.S. Department of State, the U.S. Fish and Wildlife Service, and the Alaska Department of Fish and Game. Decisions are enforced by the NMFS, the USCG, and the appropriate State enforcement personnel. These agencies also consult with the PFMC on regulatory changes and enforcement practices. The State enforcement personnel are crossdeputized and have the authority to enforce regulations from 0 to 200 nmi offshore.

Figure H1-1. Pacific Fishery Management Council (PFMC) Administrative Organization

goals of the overall management plan, but may also be managed to achieve local goals developed to satisfy regulatory needs or other special circumstances, such as treaties with specific Indian Nations or the United States/Canada Salmon Treaty. Each boundary zone has a harvest quota, based on a number of factors, including

- Age of uncaught fish (year-class escapement levels)
- Catch levels of previous years
- Assessment of two-year- and three-year-old fish populations
- Age distribution from prior years
- Environmental conditions
- Hatchery production levels.

The Washington Department of Fisheries (WDF)/National Bureau of Standards Regulation Analysis Model (Figure H1-2) has been developed to apply these factors to track the fishery population throughout the entire salmon life cycle. It and similar models provide a means to rapidly adjust fishing efforts, based on the most recent information, including seasonal and long-term data.

Regulatory adjustments can be based on daily telephone interviews, surveys of boat landing areas, aerial surveys, analysis of commercial sales transactions, analysis of fish scales, and recovered fish tags. Long-term and annual data are also collected from sources such as commercial fishing log books submitted to the State; punch cards completed by recreational fishermen to identify the species, size, location, and catch date of salmon; and the records of salmon processors, and public and private hatcheries.

Other methods for controlling the fishery are licensing, setting daily catch and size limits for recreational fisherman, limiting commercial and recreational fishing seasons, and restricting fishing gear.

Results

The FMPs and the Framework Amendment developed by the PFMC have promoted proactive management of salmon stocks. Some of the key steps in improving fisheries administration have included

- Basing management on geographic stock areas rather than on political boundaries
- Adjusting seasonal fishing efforts, based on the most recent short- and long-term data available

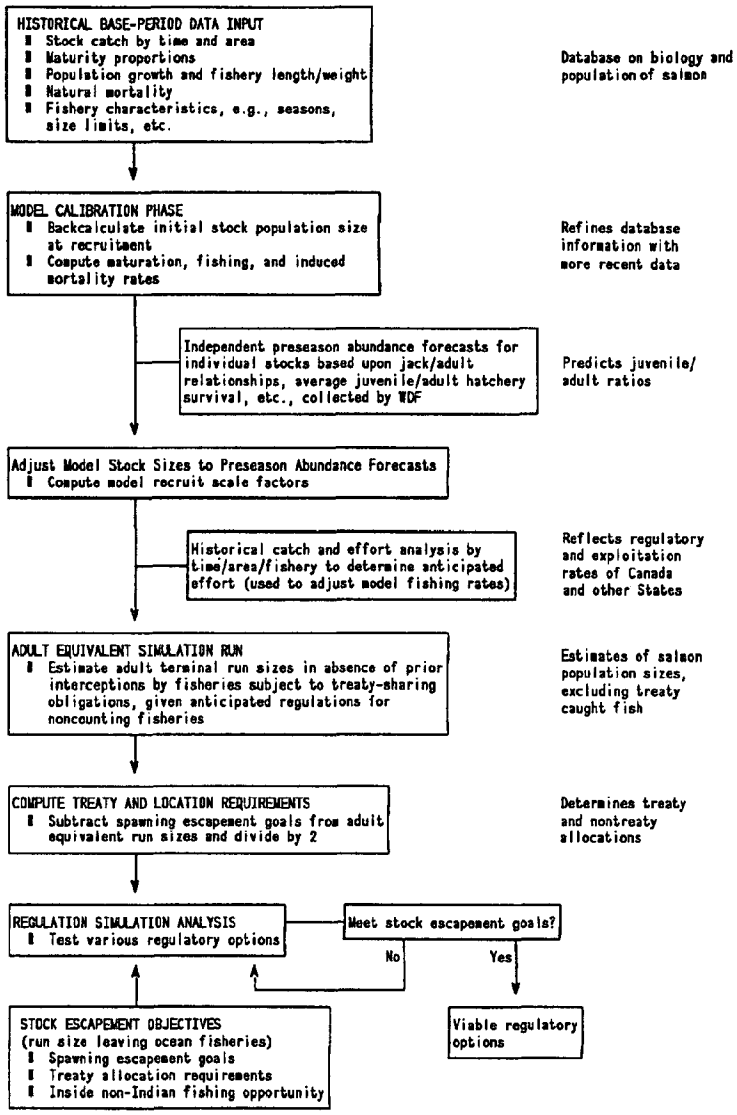


Figure H1-2. Washington Department of Fisheries/ National Bureau of Standards Regulation Analysis Model

- Considering important local needs, such as treaties with Indian Nations, in developing harvest quotas
- Provisions to allow rapid in-season adjustments to fishing effort
- Including affected parties in the decision-making process.

The FMP has provided an extremely helpful vehicle for responding to fluctuating salmon populations. For example, salmon landings north of Cape Falcon, Oregon, have remained at approximately 85% of the annual quotas since 1984. This stability was accomplished because of the FMP's ability to incorporate the most recent harvest and distribution data; in any given year, therefore, quotas may have ranged from as little as 9% to as much as 68% of the previous year's quota.

These results confirm the need for timely, high-quality data in making effective management decisions. Resource agencies must be able to estimate conditions such as stock size, reproductive capability, and juvenile escapement levels. The PFMC is specifically working to improve abilities to assess natural production of salmon species as well as artificial propagation techniques.

Summary

Many aspects of Framework Amendment are applicable to National Estuary Program (NEP) Comprehensive Conservation and Management Plans (CCMP). Management by stock areas instead of by political boundaries more accurately addresses the biological distribution of species, and can be especially important for anadromous and migratory species that inhabit several regulatory and jurisdictional areas. The flexibility to adjust goals and objectives is another positive component of PFMC planning that could be valuable to NEPs, as is the use of both short- and long-term data. The Framework Amendment has greatly reduced administrative costs, effort, and wasteful associated paperwork. The Framework Amendment permits changes in management strategies without issuing Supplemental Environmental Impact Statements, the Regulatory Flexibility Act (RFA), and Regulatory Impact Reviews (required by RFA and Executive Order 12291). However, these requirements must be met whenever major changes to the FMP Framework Amendment are needed. Finally, the PFMC has also learned how to consider the needs of user groups and resource managers in developing FMPs. Other fishery management plans have been implemented throughout the United States for species, including Atlantic mackerel, surf clams and quahogs, gulf shrimp, and groundfish.

For Additional Information

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Metro Center, #420
200 S.W. First Avenue
Portland, OR 97201
(503) 326-6352

Case Study 2

Cooperative Resource Management

Puget Sound Geoduck Clam Fishery Management Plan

Geoduck clams, the largest burrowing clam in the world, range from California to Alaska, with the largest populations being found in Puget Sound. Originally a recreational fishery, the geoduck fishery has become an important estuarine resource to the State of Washington, providing revenue opportunities and serving as an accurate indicator of water and habitat quality. This case study presents a multiagency approach to shellfish management that incorporates State regulatory, technical, and financial incentives to ensure sustainable harvests.

Management Strategies

Since the 1960s, geoduck clams have been a valuable commercial fishery in Puget Sound. Because harvested populations may take as many as 60 years to regenerate naturally, the State of Washington has carefully managed the geoduck fishery to sustain the resource and avoid population depletion.

The Puget Sound Geoduck Clam Fishery Management Plan is comanaged by the Washington Department of Fisheries (WDF) and Department of Natural Resources (DNR), with input from the Department of Social and Health Services (DSHS). The objectives of the plan are to

- Protect the geoduck resource, associated organisms, and the nearby marine environment
- Provide a stable fishery based on optimum sustainable yield

- Minimize social conflicts resulting from biological changes in the clam industry.

To encourage interagency cooperation and long-term commitment, WDF and DNR share in the revenue derived from clam bed leases, as well as in the responsibility for implementing and enforcing the plan.

In very general terms, WDF carries out licensing, regulatory, and monitoring activities, whereas DNR values the resource and manages the leasing of clam beds. Both agencies are involved in designating and marking geoduck harvest areas (tracts) and enforcing policy. (See Table H1-1.)

The WDF maintains a list of all geoduck clam beds suitable for commercial harvesting, based on estimates of optimum and maximum sustainable yields for given beds. Each site must meet specific legal, biological, and physical criteria for harvesting. Harvesting is controlled by limiting the number of commercial licenses and restricting types of harvesting gear. (See Table H1-2.) Additionally, all harvesting must meet criteria stipulated under the State Environmental Policy Act, including number of divers, hours of operation, noise levels, and lease periods. WDF also enforces regulations established under the geoduck plan; conducts studies on geoduck biology, ecology, and population dynamics; and operates a geoduck hatchery.

The DNR is responsible for protecting the State's interest in State-owned aquatic lands and for marking tracts with posts, buoys, and electronic equipment. The deepwater boundary is delineated at 60 ft for the safety of divers and to protect deeper clam stocks. Other responsibilities of the DNR include appraising the resource value and managing the auction and lease of appropriate tracts.

Site designation and leasing is an open public process. All appropriate governmental officials and relevant Indian Nations are involved in the review of potential lease sites, which are physically surveyed by divers for their suitability. No tracts are advertised for lease auction until all concerns or environmental conflicts have been satisfied at public hearings. In addition, the State strictly enforces regulations covering permissible harvesting technologies and other operating procedures. The unique aspect of this program is that the lead State agencies receive a portion of the revenue generated by the leases for programs such as hatcheries and enforcement. The remainder of the collected funds are returned to the State General Fund.

Table H1-1. State Agency Responsibilities

Washington Department of Fisheries
Perform site surveys
Assess sustainable yield
Assess level of effort
Set seasons and gear
Monitor
License
Operate hatchery
Department of Natural Resources
Value resources
Auction/lease harvest tracts
Washington Department of Fisheries and Department of Natural Resources
Designate tracts
Mark areas
Enforce policy
Department of Health and Social Services
Enforce shellfish sanitation standards
Lower potential pollution risks
Local Governments
Enforce Shoreline Management Act

Table H1-2. Harvest Criteria for Tract Designation, Maintenance, and Harvest

- The tract must be more than 200 yd from shore and between 18 and 60 ft deep.
- The abundance and quality of the clams must be enough to support a commercial harvest.
- The substrate must be capable of permitting the use of water-jet harvest equipment without causing significant environmental damage.
- The tract must be free from pollution and be certified by DSHS.
- All spatial or environmental conflicts pertaining to the tract must be resolved prior to any harvest period.
- There may be no long-term or adverse impacts on the surrounding environment or other important habitats by the fishing operation.
- The harvest areas within the tract must be rotated and, if possible, clustered in a single discrete area to lessen the environmental impact on any one area and to make enforcement easier.
- The harvest areas should have a variety of qualities and types of geoducks available for harvest to meet current market needs.
- All landing areas for the tract must be located where interference with public use facilities will be minimal, and convenient for enforcement.
- The tract must be surveyed at the end of the harvest season to assess the effect of the harvest, compliance with regulations, and the suitability for reharvest.
- Once a tract has been harvested, it cannot be rescheduled for harvest for at least 30-50 years.

Results

A preliminary study by WDF has concluded that, through natural repopulation, a properly harvested area may be successfully reharvested as soon as 10 years after the first harvest. In addition, WDF's enhanced hatchery techniques produce 30 million seed clams, of which 10% can be expected to reach harvestable size within 4 to 10 years. Overall, the WDF estimates the maximum sustainable yield at 2% of the harvestable stock.

Nevertheless, more information is needed. Geoduck clams have a very slow recruitment rate, and natural repopulation to preharvest levels may take as few as 10 and as many as 60 years. The State wants to improve this time frame. In addition, geoducks are filter feeders that can accumulate pathogenic bacteria, viruses, and other toxics. As a precautionary measure, the DSHS has closed large portions of Puget Sound to harvesting. The WDF and DNR are currently studying the biology, population dynamics, and new management techniques to protect the stock. They are also studying methods to reduce the input of toxics that pose a risk to the geoduck fishery and the Puget Sound as a whole.

Summary

The success of the geoduck management plan has depended on a steady supply of high- quality data on the fishery and on the cooperation of involved agencies. Together, the WDF and DNR collect data, determine harvests, enforce regulations, and maintain communication among all affected parties. The WDF and DNR are also taking the initiative for the ensuring a stable clam fishery by conducting basic research and developing a hatchery/spawning program.

This approach is adaptable to other shellfisheries, and several States with NEP sites have undertaken shellfish-tract management programs. The geoduck model of interagency cooperation is also helpful for managing interstate estuaries where different policies and regulations can lead to conflict.

Management techniques that are kept uncomplicated and easy to assess appear to have the highest likelihood of success. The geoduck management plan, for example, has stressed

- Constant data collection, surveying, and analysis
- Comprehensive site selection process
- Rotation of leased harvest areas

- Limited entry licensing
- Strict enforcement of regulations.

Its overall success can be attributed to efficient management, cooperation among different agencies and user groups, and the prospect of a steady revenue source for the regulatory participants.

For Additional Information

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Olympia, WA 98504
(206) 586-0208

Department of Fisheries
115 General Administration Building
Olympia, WA 98504
(206) 545-6756

Case Study 3

Geographic Targeting For Conservation

Gulf Coast Joint Venture Plan of the North American Waterfowl Management Plan

Waterfowl are excellent indicators of the environmental health of wetlands ecosystems. Changes in waterfowl population and diversity represent changes in the quality of their habitat. Over the past 200 years, 50% of the wetlands available to waterfowl in North America have been lost due to the impact of human activities such as dredging, filling, agriculture, and development. Toxic contamination, disease, and natural and introduced predators are also contributing to the decline of waterfowl in North America.

The United States and Canada have been managing migratory species for most of this century. More recently, treaties with Mexico and other countries have strengthened the foundation of international cooperation. Despite these tools, however, habitat alterations by agriculture, urbanization, and industrial activities have continued to reduce the distribution and abundance of many migratory species. This case study presents a wetlands restoration plan enacted by the United States and Canada in 1986 to slow and reverse the decline of native waterfowl species.

Management Strategies

The North American Waterfowl Management Plan (NAWMP) is administered through six Joint Ventures, which organizationally may cross international, Province, State, or local jurisdictional boundaries. Each Joint Venture brings together the appropriate governmental, private, and environmental interests to pool resources and information. The goal of the NAWMP is to restore waterfowl populations to levels that were common throughout the 1970s. This goal

is to be obtained through protection, enhancement, restoration, and development of wetland habitat by coordinating management activities on a wide scale.

The Gulf Coast Joint Venture (GCJV) encompasses the coastal zones of Texas, Louisiana, Mississippi, and Alabama and the coastal plains of Texas and Louisiana. The GCJV is administered through the Office of the Coordinator (Figure H1-3), which is responsible for disseminating information, coordinating activities, and facilitating project implementation. To allow site-specific management based on local wetlands characteristics and land uses, the GCJV includes six geographic Initiative Areas: Mobile Bay, Coastal Mississippi Wetlands, Mississippi River Coastal Wetlands, Chenier Plain, Texas Mid-Coast, and Laguna Madre. Included in these wetlands habitats are coastal wetlands, barrier islands, estuarine bays, sounds, lakes and ponds, and wetlands in adjacent agricultural or rangeland areas.

Key management actions have focused on habitat acquisition, conservation, and restoration. Some of the actions undertaken include

- Introduction of silviculture programs on private lands
- Use of dredged material to prevent coastal erosion and protect saltmarsh areas
- Cooperation among private organizations, businesses, and landowners to restore, maintain, and create waterfowl habitats
- Leverage of other Federal programs to induce landowners to restore, maintain, and create waterfowl habitats.

Mobile Bay Initiative Area

The management focus of the Mobile Bay Initiative Area is a combination of wildlife, silviculture, and water-resource development programs. A private-lands silviculture program has been developed to minimize damage to waterfowl nesting and wintering habitat on 270,000 acres of swamp and bottomland hardwoods. The program includes

- Retaining buffer strips adjacent to streams that provide food sources for waterfowl and brood habitat for wood ducks
- Managing for habitat diversity through staggered cutting areas and spread-out cuts

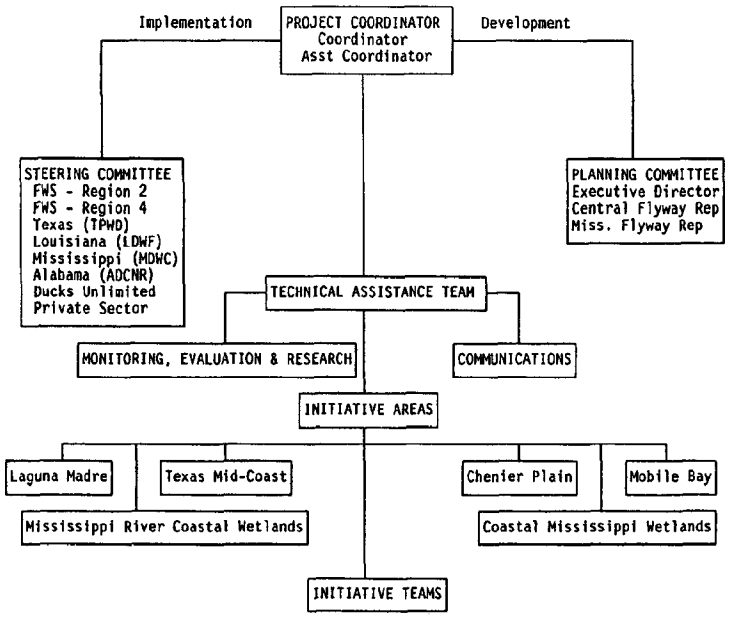

Figure H1-3. Gulf Coast Joint Venture (GCJV) Administrative Organization

- Retaining dead snag trees in areas slated for cutting
- Using aerial operations to remove cut trees and reduce ground disturbances
- Operating a wood duck nesting box program with the cooperation of State/Federal governments, private organizations, and landowners.

An agreement with a large paper manufacturing and processing corporation has enabled the advancement of this program as has a land-acquisition action used to increase the amount of waterfowl habitat. Through a provision in the Water Resources Development Act of 1986, the Secretary of the Army was authorized to acquire 88,000 acres of wildlife habitat in Mississippi and Alabama to compensate for the loss of habitat resulting from the construction of the Tennessee - Tombigee Waterway.

Coastal Mississippi Wetlands Initiative Area

Habitat protection, acquisition, enhancement, restoration, and development are the primary focus of this Initiative Area. The U.S. Army Corps of Engineers (COE) plans to use dredged material to prevent both coastal erosion and the further loss and degradation of waterfowl habitat on the Grand Batture Island Chain. This COE project will use material dredged from the widening of Pascagoula Harbor to reconstruct the eroded Grand Batture Island Chain. This reconstruction will help to protect the saltmarsh behind the island from wave erosion. In addition, the Mississippi Department of Wildlife, Fisheries, and Parks, and the USFWS will conduct rotational burning, create potholes, and introduce freshwater to create and maintain waterfowl habitat. A silviculture management plan on using private timber company lands has also been developed to improve waterfowl habitat.

Mississippi River Coastal Wetlands Initiative Area

This Initiative Area stresses the use of waterfowl habitat conservation measures and land- acquisition mechanisms. A private-lands restoration program is in place with an accelerated technical assistance program aimed at preserving, restoring, and/or enhancing the waterfowl habitat. Included is the restoration of 35,000 acres of drained wetlands that are currently being used for grazing and crop production. Through the use of existing levees and pumps, these farm areas may be restored to productive waterfowl brood areas by flooding them on a seasonal basis. Annual payments and cost-sharing incentives are provided by the Conservation Reserve Program (CRP), administered by the U.S. Department of Agriculture. Under 10-year contracts, the CRP pays eligible landowners to take highly erodible lands and farmed wetlands out of production, establish vegetative cover, and install water control structures that can restore shallow flooding. Ducks Unlimited, Inc., a private organization, is also helping to acquire about 4000 private acres and enhance waterfowl habitat on 25,000 acres of public land. A number of public works projects will also reduce the loss of waterfowl habitats and restore wetlands.

Chenier Plain Initiative Area

Land acquisition and habitat restoration and enhancement are the primary measures of waterfowl management in this Initiative Area. The goal is to eventually acquire 109,000 acres of high-value waterfowl habitat and to restore drained wetland areas. Landowners are

eligible for payments to restore drained wetlands through the U.S. Department of Agriculture Water Bank Program and possibly by the implementation of a wetland-restoration easement program.

Other projects and programs in this Initiative Area include funding through the U.S. Department of Agriculture and the USFWS to help landowners to flood drained wetlands during the winter to create waterfowl feeding areas. Public works projects by the COE, State, and local governments, to help to reduce saltwater intrusion are to be expanded and accelerated. Ducks Unlimited, Inc., will also help to increase the value of 100,000 acres of waterfowl habitat through the Matching Aid to Restore States' Habitat (MARSH) Program. This program contributes funds, on a 50/50 matching basis, to State wildlife agencies, for acquisition and development of waterfowl habitat projects.

Texas Mid-Coast Initiative Area

The greatest potential for improved waterfowl management in this Initiative Area is on privately owned wetlands and agricultural lands. A planned private-wetlands restoration project includes

- Supplying technical assistance to landowners
- Supporting legislation to provide tax incentives to landowners
- Coordinating acquisition, development, and enhancement of wetlands through conservation organizations
- Expediting permitting procedures for wetland enhancement projects
- Assisting private landowners to secure more equitable water rights for wildlife uses
- Ensuring that programs under the Department of Agriculture Federal Farm Program are beneficial to wildlife.

Also under way is a research project that integrates winter waterfowl management and ranching and farming practices on a demonstration area of the Texas A&M University farm. Other programs within this Initiative Area include land acquisition, working with regulatory agencies to solve saltwater intrusion problems, and accelerating waterfowl habitat development on National wildlife refuges and State wildlife management areas.

Laguna Madre Initiative Area

The protection of approximately 130,000 acres of wintering waterfowl habitat has been identified as the priority of this Initiative Area. Another goal is to increase waterfowl habitat on publicly owned wetlands. Key management actions in this area include public-works projects to control water on Laguna Atascosa National Wildlife Refuge and the enhancement and restoration of the seagrass beds in Laguna Madre. Other measures being taken to enhance wintering waterfowl habitat include coordination with the Department of Agriculture to

- Ensure that farm programs benefit waterfowl
- Provide increased technical assistance for wetland restoration and enhancement
- Encourage tax incentives for wetland restoration
- Expedite permitting and water-rights processes
- Develop a landowner demonstration project.

The restoration of former wetlands may be funded through the Water Bank Program and habitat easement programs.

Summary

The goal of the NAWMP is to protect, restore, and enhance waterfowl habitats. Many of the areas targeted for management action within the NAWMP are also sites included in the NEP and they therefore complement NEP objectives. Along with the importance of estuaries to waterfowl, estuaries are important nursery areas for marine and freshwater fish and provide a major economic contribution to the finfish and shellfish industries. Local communities also depend on healthy estuaries for recreational and economic resources. The management strategies used for the NAWMP can be adapted and refined for use with the NEP sites.

Cooperation among the agencies involved in habitat management is essential to the success of the program. The NAWMP has dealt with State or local jurisdictional conflicts on management strategies, regulations, and other issues. Involvement by the State personnel, local authorities, the business community, and concerned citizens in the decision-making process promotes understanding, helps to lessen conflicts, and promotes management solutions.

Interaction among Federal agencies also has proven to be of substantial help. Targeted incentive programs from the U.S. Department of Agriculture and its Water Bank Program, the CRP, and other habitat easement programs have resulted in larger areas of land suitable for waterfowl. The use of public works projects, such as the Grand Batture Island Restoration Project conducted by the COE, can be incorporated into the CCMPs of the NEP sites at minimal cost.

Community involvement in the NAWMP has contributed to the success of the plan. Each Initiative Area has a public outreach program to keep the local community informed of new programs and incentives. Private programs, such as the Ducks Unlimited, Inc., MARSH program, can also provide assistance to the NEP sites. Community involvement and private organizations increase public involvement and awareness of living resources problems and provide support toward achieving solutions.

For Additional Information

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Appendix H2

Catalog of Federal Living Resources Management Programs

Appendix H2 is a catalog of Federal authorities and programs that could support living- resources management and habitat-protection goals and objectives of National Estuary Program (NEP) management conferences. Key elements are outlined and the relevant lead agency is identified.

It is important to recognize that this catalog has limitations, however. The catalog does *not* cover State or local authorities and programs, which in some cases could be highly significant. Nor does it include *all* potentially relevant Federal authorities and programs. To be totally comprehensive, it would be necessary to list every Federal pollution control statute and program; every Government or Federal agency-specific pronouncement of resource conservation or environmental policy; every natural resource and environmental research and monitoring program; and every habitat and resource management, protection, and acquisition authority and activity.

Instead, what has been done, is to identify the

1. Roles of the key Federal agencies, including some of the major living-resources management and habitat-protection programs that they administer
2. Major resource-specific programs for managing and protecting key categories of living resources (i.e., finfish, shellfish, mammals, and waterfowl and other birds) and coastal habitat (i.e., wetlands, estuaries, barrier islands, and marine sanctuaries)
3. Most relevant broader regulatory and resource management statutes and programs (e.g., Clean Water Act; Marine Protection, Research, and Sanctuaries Act; Coastal Zone Management Act; Submerged Lands Act; Outer Continental Shelf Lands Act; Endangered Species Act; Fish and Wildlife Coordination Act; and Federal Food, Drug, and Cosmetic Act).

Federal Agency Roles and Programs

Table H2-1 (Key Federal Agency Roles) identifies the major living-resources management and habitat-protection programs that are administered by the Environmental Protection Agency, the National Oceanic and Atmospheric Administration (within the Department of Commerce), the United States Fish and Wildlife Service (within the Department of the Interior), the United States Army Corps of Engineers (within the Department of the Army), the Food and Drug Administration (within the Department of Health and Human Services), the Department of Agriculture, the Department of Transportation, and the Council on Environmental Quality (within the Executive Office of the President). The table indicates the nature and scope of the major relevant programs administered by these agencies, along with the legislative authorities under which they are carried out.

Resource-Specific Programs

Table H2-2 (Resource-Specific Programs) lists the major legislative programs that are geared specifically to particular living-marine resource and habitat-protection objectives. The accompanying matrix indicates each program's major thrust: regulatory, funding, acquisition, research and monitoring, or management, or a combination of these. Also specified is the lead agency (or agencies) concerned with program administration.

The programs included in this table range from broad, national programs (e.g., the Marine Mammal Protection Act) to geographically limited programs (e.g., Atlantic Striped Bass Conservation Act). Although the listing is not exhaustive, most major programs have been identified.

Broad Regulatory and Resource Management Programs

Table H2-3 (Broad Regulatory and Resource Management Programs) identifies the miscellaneous national programs (e.g., the Outer Continental Shelf Lands Act and the Submerged Lands Act) that do not necessarily fit neatly into one of the other two categories of programs (see Tables H2-1 and H2-2). Information is provided on the lead agency and program scope.

Conclusion

Appendix H2 is an overview of the more significant Federal living-resource management or coastal habitat-protection programs that have potential relevance to the development of management plans for NEP estuaries. Tables H2-1 through H2-3 provide users access to the information that they need in at least three different ways: by affected resource, by lead agency, and by statutory authority.

The CCMP must address living-resources management and habitat protection as integral elements. Knowledge of the applicable Federal statutory and regulatory framework is, clearly, essential to accomplishing this objective. Appendix H2 was designed to provide users with a "road map" for identifying and acquiring the detailed knowledge that they will need.

Table H2-1. Key Federal Agency Roles

FEDERAL AGENCY	SCOPE OF LIVING-RESOURCE MANAGEMENT/ HABITAT-PROTECTION RESPONSIBILITY	LEGISLATIVE AUTHORITY	MAJOR PROGRAMS
Environmental Protection Agency (EPA)	Protect, maintain, restore, and enhance water quality	Clean Water Act (P.L. 92-500), 33 U.S.C. 1251 et seq.	1. National Estuary Program (§ 320) 2. Discharge permits (NPDES) program (§ 402) 3. Oil and hazardous substance spills (§ 311) 4. Toxic (priority) pollutant and pretreatment program (§ 307) 5. Ocean discharge program [§§ 301(h), 403] 6. Nonpoint source control program (§ 319) 7. Chesapeake Bay Program (§ 117) 8. Combined sewer overflows in estuaries (§ 205) 9. Individual control strategies for toxic pollutants (§ 304) 10. In-place pollutants (§ 115) 11. Disposal of dredge and fill materials (§ 404)
	Avoid unreasonable degradation or endangerment of the marine environment or public health	Marine Protection, Research, and Sanctuaries Act (P.L. 92-532), 33 U.S.C. 1401 et seq., as amended by the Ocean Dumping Ban Act of 1988 (P.L. 100-688)	1. Permits for ocean dumping of municipal and industrial wastes (§ 102) 2. Site designation of ocean dumpsites for wastes and dredged material [§ 102(c)] 3. Veto of U.S. Army Corps of Engineers (COE) permits for dredged material ocean dumping (§ 103) 4. Ban on ocean dumping of sewage sludge or industrial waste after 1991 (§ 104B)
	Regulate the introduction into commerce of new hazardous chemical substances and mixtures; avoidance of unreasonable risk of injury to health or environment	Toxic Substances Control Act (P.L. 94-469), 15 U.S.C. 2601	1. Regulation of hazardous chemical substances and mixtures (§ 6) 2. Health and environmental data on toxic substances (§ 10) 3. Regulation of PCBs [§ 6(e)]
	Regulate pesticide chemicals	Federal Insecticide, Fungicide, and Rodenticide Act (P.L. 92-516), 7 U.S.C. 136 et seq.	1. Denial or cancellation of registrations of pesticides whose use would/does cause fish contamination 2. Collect data on pesticides that may be causing fish contamination 3. Setting of action levels or tolerances for unavoidable pesticide contaminants in fish and shellfish (Food, Drug and Cosmetic Act, § 408)
	Protect coastal waters from litter and pollution	Shore Protection Act of 1988 (P.L. 100-688), 33 U.S.C. 1401 et seq.	1. Permitting of vessels that transport municipal or commercial waste in coastal waters (§ 4102) 2. Regulation of waste-handling practices by waste sources, vessels and receiving facilities to minimize deposition of waste into coastal waster (§ 4103)
Department of Transportation (DOT)	Conserve marine life	Reefs for Marine Life Conservation (P.L. 92-402), National Fishing Enhancement Act of 1984 (P.L. 98-623), 16 U.S.C. 1220-1220d.	Use of obsolete ships as artificial reefs for the conservation of marine life
	Protect coastal water from litter and pollution	Marine Plastic Pollution Research and Control Act of 1987 (P.L. 100-220), 33 U.S.C. 1901 et seq.	Implements MARPOL Annex V Prohibits overboard disposal of garbage in coastal waters in violation of MARPOL restrictions Requires port reception facilities for shipboard garbage
	Enforcement of fisheries laws	(Magnuson) Fishery Conservation and Management Act (P.L. 94-265), 16 U.S.C. 1801 et seq.	Enforcement of restrictions on commercial fishing within the fishery conservation zone (Exclusive Economic Zone) (§ 311)

Table H2-1. Key Federal Agency Roles (continued)

FEDERAL AGENCY	SCOPE OF LIVING-RESOURCE MANAGEMENT/ HABITAT-PROTECTION RESPONSIBILITY	LEGISLATIVE AUTHORITY	MAJOR PROGRAMS
National Oceanic and Atmospheric Administration (NOAA)	Natural resource trustee for; marine fishery resources and supporting ecosystems; anadromous fish; certain endangered species and marine mammals; National Marine Sanctuaries; and Estuarine Research Reserves	CERCLA (P.L. 96-510), 42 U.S.C. 9607(f), 9601 (16)	1. Natural Resources Damage Assessment Program (CERCLA, § 107(f); CWA, § 311(f))
		Clean Water Act (P.L. 92-500), 33 U.S.C. 1321 (f)(5)	2. Remedial Action Program (CERCLA, § 104)
	Marine mammals	Marine Mammal Protection Act of 1972 (P.L. 92-522), 16 U.S.C. 1361 et seq.	Prohibition or strict regulation of the direct or indirect taking or importation of marine mammals
		Fur Seal Act of 1966 (P.L. 89-702), 16 U.S.C. 1151 et seq.	Prohibition of the taking of fur seals on lands or waters under U.S. jurisdiction
		Whale Conservation and Protection Study Act (P.L. 94-532)	Comprehensive studies of whales in waters subject to U.S. jurisdiction
	Anadromous fish	Anadromous Fish Conservation Act of 1965 (P.L. 89-304), 16 U.S.C. 757a-757g	Conservation, development, and enhancement of anadromous fishery resources
		Salmon & Steelhead Conservation and Enhancement Act of 1980 (P.L. 96-561), 16 U.S.C. 3301-3345	Management and enhancement of salmon and steelhead stocks
	Threatened and endangered species and their critical habitats	Endangered Species Act of 1973 (P.L. 93-205), 16 U.S.C. 1531 et seq.)	Insurance that any action authorized, funded, or carried out by any Federal agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat critical to such species (§ 7) (covers marine species)
	Marine fisheries	Magnuson Fishery Conservation And Management Act of 1976 (P.L. 94-265) 16 U.S.C. 1801 et seq.	Conservation of fish stocks throughout a 200-mile U.S. Fishery Conservation Zone through the development Fishery Management Plans by eight regional Fishery Management Councils
		Interjurisdictional Fisheries Act (P.L. 99-659), 16 U.S.C. 4101-4107	Promote and encourage management of interjurisdictional fishery resources throughout their range
		North Pacific Fisheries Act of 1954 (P.L. 65-114), 16 U.S.C. 1021-1032	Enforcement of the International Convention for the High Seas Fisheries of the North Pacific Ocean
		North Pacific Halibut Act of 1982, 16 U.S.C. 772-773k	Enforcement of the Convention between the U.S. and Canada for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea
	Marine sanctuaries	Marine, Protection, Research and Sanctuaries Act (Title III) (P.L. 92-532), 16 U.S.C. 1431-1439	National Marine Sanctuaries Program
	Protection of coastal natural resources, including wetlands, floodplains, estuaries, beaches, dunes, barrier islands, coral reefs and fish and wildlife and their habitat	Coastal Zone Management Act of 1972 (P.L. 92-583); 16 U.S.C. 1451 et seq.	1. Coastal zone management program grants (§ 305) 2. CZMP administrative grants (§ 306) 3. Review and approval of State CZMPs (§ 306) 4. Resource Management Improvement Grants (§ 306A) 5. Federal Consistency Determination (§ 307) 6. Coastal Energy Impact Program (§ 308) 7. Interstate grants (§ 309) 8. Review of State performance (§ 312) 9. Natural Estuarine Reserve Program (§ 315)

Table H2-1. Key Federal Agency Roles (continued)

FEDERAL AGENCY	SCOPE OF LIVING-RESOURCE MANAGEMENT/HABITAT-PROTECTION RESPONSIBILITY	LEGISLATIVE AUTHORITY	MAJOR PROGRAMS
U.S. Fish and Wildlife Service (USFWS) and Department of the Interior	Natural resource trustee for: migratory birds; certain anadromous fish, endangered species, and marine mammals; and certain Federally managed water resources	CERCLA (P.L. 96-510), 42 U.S.C. 9607(f), 9601 (16)	1. Natural Resources Damage Assessment Program [CERCLA, § 107(f), CWA. § 311 (f)]
		Clean Water Act (P.L. 92-500), 33 U.S.C. 1321 (f)(5)	2. Remedial Action Program (CERCLA, § 104)
	Land and water conservation	Land and Water Conservation Fund Act (P.L. 88-578), 16 U.S.C. 460 l-4 - 460 l-11	Establishment of fund to acquire land, waters, or interests in land or waters to promote outdoor recreation opportunities
	Coastal barrier islands	Coastal Barrier Resources Act of 1982 (P.L. 97-348), 16 U.S.C. 3501-3510	1. Establishment of coastal barrier resources system
			2. Coverage of undeveloped coastal barriers, including associated aquatic habitats
			3. Restriction of Federally subsidized development of underdeveloped coastal barriers along the Atlantic and Gulf coasts
	Threatened and endangered species and their critical habitat	Endangered Species Act of 1973 (P.L. 93-205), 16 U.S.C. 1531-1543	Insurance that any action authorized, funded, or carried out by any Federal Agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat critical to such species (§ 7) (covers nonmarine species)
	Estuarine areas	Estuarine Areas Act (P.L. 90-454), 16 U.S.C. 1221 et seq.	Conservation of estuarine areas
	Fish and wildlife conservation	Fish and Wildlife Coordination Act of 1958 (P.L. 85-624), 16 U.S.C. 661-666c	Consultation when Federal agency or Federal permittee proposes to modify a body of water
		Fish and Wildlife Conservation Act of 1980 (P.L. 96-366), 16 U.S.C. 2901 et seq.	Conservation and promotion of nongame fish and wildlife and their habitats, including grants to States
		Fish Restoration and Management Projects Act (P.L. 91-503) 16 U.S.C. 777-777l	Funding of State programs for the restoration and management of fishery resources
		National Wildlife Refuge System Administration Act (P.L. 91-135), 16 U.S.C. 668dd	Resource management programs for fish and wildlife habitat
	Migratory birds	Migratory Birds Hunting Stamp Act (P.L. 85-585), 16 U.S.C. 718-718h	Use of hunting stramp funds for acquisition of bird refuges and waterfowl production areas
		Migratory Bird Conservation Act (P.L. 87-812), 16 U.S.C. 715-715s	Acquisition of areas for the management and protection of migratory birds
		Migratory Bird Treaty Act (P.L. 86-732) 16 U.S.C. 701-711	Prohibitions against the taking of migratory birds protected under treaties with Great Britain, Mexico, and Japan
	Wetlands conservation	North American Wetlands Conservation Act (P.L. 101-233)	1. Funding for purchase of critical wetlands in the U.S., Canada and Mexico 2. Matching funds for wetlands conservation projects in North America

Table H2-1. Key Federal Agency Roles (continued)

FEDERAL AGENCY	SCOPE OF LIVING-RESOURCE MANAGEMENT/ HABITAT-PROTECTION RESPONSIBILITY	LEGISLATIVE AUTHORITY	MAJOR PROGRAMS
Other Department of the Interior (DOI)	Development of outer continental shelf, subject to environmental safeguards	Outer Continental Shelf Lands Act (P.L. 93-627), 43 U.S.C. 1331 et seq.	1. Environmental studies for assessment and management of OCS oil development impacts (§ 20) 2. Consideration of available relevant environmental information in making decisions (§ 20) 3. Preparation of environmental impact statements on major development and production plans (§ 25)
	Rights of States over submerged land and natural resources beneath navigable waters within State boundaries	Submerged Lands Act (P.L. 99-272), 43 U.S.C. 1301 et seq.	U.S. rights and interests in lands and national resources within the 3-Mile limit, transferred to the States
Council on Environmental Quality (CEQ)	Major Federal actions significantly affecting environmental quality	National Environmental Policy Act (P.L. 91-190), 42 U.S.C. 4321 et seq.	1. Review environmental impact statements 2. Promulgate regulations 3. Mediate interagency disputes

Table H2-1. Key Federal Agency Roles (continued)

FEDERAL AGENCY	SCOPE OF LIVING-RESOURCE MANAGEMENT/ HABITAT-PROTECTION RESPONSIBILITY	LEGISLATIVE AUTHORITY	MAJOR PROGRAMS
U.S. Army Corps of Engineers (COE)	Wetlands protection	Clean Water Act (§ 404) (P.L. 92-500), 33 U.S.C. 1251 et seq.	Dredge and fill permits
	Wetlands creation	Water Resources Development Act of 1976 (§ 150) (P.L. 94-587), 42 U.S.C. 1962d-5e	Authority to establish wetland areas as part of an authorized water resources development project
	Beach nourishment	Water Resources Development Act of 1976 (§ 150) (P.L. 94-587), 42 U.S.C. 1962d-5f	Authority to utilize suitable dredged material for beach nourishment
	Avoiding obstructions to navigation	Rivers and Harbors Appropriation Act of 1899, 33 U.S.C. 401	Regulation of construction activities in and adjoining navigable waters which alter the course, condition, location, or capacity of such waters
	Regulation of dredged material ocean dumping	Marine Protection Research and Sanctuaries Act (§ 103) (P.L. 92-532), 33 U.S.C. 1401 et seq.	1. Issuance of ocean dumping permits (§ 103) 2. Ocean dumpsite selection (§ 103)
	Fish and wildlife mitigation	Water Resources Development Act of 1986 (§ 906) (P.L. 99-622), 33 U.S.C. 2201, 2283	Mitigation of fish and wildlife losses associated with authorized water resources projects, including the acquisition of lands or interests in lands
		Fish and Wildlife Coordination Act of 1958 (P.L. 85-624), 16 U.S.C. 661-666c	Consultation with U.S. Fish and Wildlife Service
Food and Drug Administration (FDA) and Department of Health and Human Services (DHHS)	Healthfulness of fish and shellfish marketed in interstate commerce	Federal Food, Drug and Cosmetic Act, 21 U.S.C. 301-392	1. Setting standards of quality for foods, including seafood (§ 401) 2. Setting action levels and tolerances for unavoidable contaminants in foods, including seafood (§ 406)
		Public Health Service Act, 42 U.S.C. 201 et seq.	1. Federal assistance to States in preventing the interstate transmission of disease (§ 361) 2. Interstate Shellfish Sanitation Program
		P.L. 89-304, 16 U.S.C. 757f	Enforcement action to eliminate or reduce polluting substances detrimental to fish and wildlife in interstate or navigable waters
Department of Agriculture (USDA)	Control of pollution of surface waters owing to agricultural runoff	Department of Agriculture Organic Act of 16 U.S.C. 500 et seq.	1. Nonpoint Source Contaminants Research 2. Habitat Modification Program (Mitigation of adverse effects of land management activities) 3. Point source contaminants program (investigation of chemicals in bottom sediments)
	Wetlands protection	Water Bank Act (P.L. 91-559), 16 U.S.C. 1301-1311, 1501, 1503	Preserve, restore, and improve wetlands; conservation easements
		Food Security Act of 1985 (P.L. 99-198), 16 U.S.C. 3801 et seq.	Wetlands conservation program (§§ 3821-3823)

Table H2-2. Resource-Specific Programs

Resource	Legislative Program	Lead Agency	Regulatory	Funding	Acquisition	Research/ Monitoring	Management
Fish	Anadromous Fish Conservation Act	NOAA USFWS		✖	✖	✖	✖
	Salmon & Steelhead Conservation & Enhancement Act	NOAA			✖	✖	✖
	North Pacific Fisheries Act of 1954	NOAA					✖
	North Pacific Halibut Act of 1982	NOAA					✖
	Magnuson Fishery Conservation and Management Act	NOAA	✖	✖			✖
	National Fishing Enhancement Act of 1984	DOT					✖
	Interjurisdictional Fisheries Act	NOAA		✖			✖
	Fish Restoration and Management Project Act	USFWS		✖			✖
	Atlantic Salmon Conservation Act of 1982 (P.L. 97-389), 16 U.S.C. 3601-3608	NOAA	✖				✖
	Atlantic Striped Bass Conservation Act (P.L. 89-304), 16 U.S.C. 757g	USFWS		✖		✖	
	Atlantic Tunas Conservation Act of 1975, 16 U.S.C 971 - 971i	Dept. of State, NOAA	✖				✖
	Tuna Conventions Act of 1950, 16 U.S.C. 951 - 961	Dept. of State. NOAA	✖				✖
	Central, Western, and South Pacific Fisheries Develoement Act, 16 U.S.C. 758e - 758e - 5	NOAA		✖		✖	✖
	Commercial Fisheries Research and Development Act of 1964, 16 U.S.C. 742c, 779 - 779f	NOAA		✖		✖	
	National Fish and Wildlife Foundation Establishment Act, 16 U.S.C. 3701-3709	USFWS			✖		✖
	Pacific Salmon Treaty Act of 1985, 16 U.S.C. 3631-3644	Dept. of State, NOAA	✖				✖

Table H2-2. Resource-Specific Programs (continued)

Resource	Legislative Program	Lead Agency	Regulatory	Funding	Acquisition	Research/ Monitoring	Management
Shellfish	National Shellfish Sanitation Program	FDA	x			x	x
Mammals	Marine Mammal Protection Act	NOAA	x	x		x	
	Fur Seal Act	NOAA	x			x	
	Whale Conservation and Protection Study Act	NOAA				x	
Waterfowl and Other Birds	Migratory Bird Conservation Act	USFWS			x		x
	Migratory Bird Treaty Act	USFWS	x				
	Migratory Bird Hunting Stamp Act	USFWS		x	x		x
Wetlands	North American Wetlands Conservation Act	USFWS		x	x		
	Water Resources Development Act (Wetlands Creation)	COE			x		
	Water Bank Act	USDA		x	x		x
	Food Security Act of 1985	USDA		x			
Estuarine Areas	Clean Water Act (National Estuary Program)	EPA		x		x	x
	Coastal Zone Management Act (National Estuarine Reserve Program)	NOAA		x	x	x	x
	Estuarine Areas Act	USFWS		x	x	x	x
Barrier Islands U.S.C.	Coastal Barriers Resources Act, 16 U.S.C. 3501-3510	USFWS	x				x
Marine Sanctuaries	Marine Protection, Research, and Sanctuaries Act	NOAA	x	x			x

Table H2-3. Broad Regulatory and Resource Management Programs

Resource	Legislative Program	Lead Agency	Regulatory	Funding	Acquisition	Research/ Monitoring	Management
Surface waters, wetlands, and aquatic biota	Clean Water Act	EPA COE (§ 404)	✖ ✖			✖ ✖	
Ocean waters and marine biota	Marine Protection, Research, and Sanctuaries Act (Title I)	EPA COE	✖ ✖			✖ ✖	
Coastal resources	Coastal Zone Management Act	NOAA	✖	✖			✖
Submerged lands and benthic biota	Submerged Lands Act	Minerals Management Service					✖
Water and resources of the outer continental shelf	Outer Continental Shelf Lands Act	Minerals Management Service					✖
Endangered species and their critical habitat	Endangered Species Act	USFWS, NOAA	✖	✖		✖	✖
Fish and wildlife in their habitat	Fish and Wildlife Coordination Act	USFWS	✖			✖	✖
Safety of commercially marketed fish and shellfish products	Food, Drug & Cosmetic Act TSCA, FIFRA	FDA EPA	✖ ✖				✖

Appendix I

Tools to Manage Land and Water Resources

This appendix of A Primer for Establishing and Managing Estuary Projects introduces some of the more common management tools used to protect land and water resources. The Primer, which describes the National Estuary Program's origins, statutory provisions, and approach, is designed for EPA's program and regional offices, coastal states, and other interested parties. For more information, contact an EPA regional office.

An Overview

In light of increasing pressure from population growth and development, improved management of land and water resources is critical to the health of estuarine ecosystems. By the year 2000, it is expected that nearly 75 percent of the nation's population will live within 50 miles of a coast. Florida's coast, for example, is being settled at the rate of 3,000 to 4,000 people per week. Rapid population growth and accompanying development place increasing and substantial stress on land and water resources. The influence of these forces on the health of estuarine ecosystems is now widely recognized. For instance, a recent report to the Chesapeake Bay Executive Council, "Population Growth and Development in the Chesapeake Bay Watershed to the Year 2020," emphasizes that efforts to address growth and development in the Chesapeake Bay region are currently inadequate to curb the harmful effects of pollution and congestion on the estuary.

To effectively address problems associated with growth and development, estuary conferences must become familiar with the range of management tools used to confront and combat threats to land and water resources. This Appendix provides an overview of methods that may be employed to manage the use of land and water in an estuarine watershed. The particular tools or combinations of tools selected will vary greatly from estuary to estuary. This Appendix does not cover all tools and combinations. Rather, it is intended to equip Estuary Conferences with a checklist of actions and factors to consider when formulating Action Plans. Experts and additional guidance documents should be consulted for further information and advice on appropriate tools for a particular estuary.

The discussion is organized into three major sections: (1) Best Management Practices (BMPs) to combat nonpoint source problems, (2) land use tools and conservation measures to manage, reduce, and prevent harmful impacts of population growth and development, and (3) regulatory programs and other mechanisms to address point source pollutant loadings to estuaries. These distinctions should be interpreted loosely, however, since a particular tool may sometimes be used effectively to address more than one type of problem. Where available, examples are cited to illustrate a tool's application. Some sources for further information are also listed.

Tools to Control Nonpoint Source Pollutant Loadings to Estuaries

Nonpoint source (NPS) pollution occurs when runoff following rainfall or snowmelt transports sediment and other pollutants to a river, lake, or estuary. For many estuaries, NPS pollution poses the fastest-growing and most pervasive threat to water quality and the overall health of the ecosystem. Although background sources contribute part of the problem, nonpoint pollution results primarily from a variety of human activities. Major sources of nonpoint pollution include:

- Agricultural areas, including both cropland and animal waste, feeding, and grazing areas;
- Urban areas;
- Construction sites;
- Mining sites; and
- Silviculture or forestry areas.

Although pollutants transported in runoff vary with both the source and the terrain over which runoff travels, sediment (comprised of sand, silt, clay and organic material) is the largest constituent by volume. Other common nonpoint source pollutants include:

- Nutrients, primarily phosphorus and nitrogen, from septic systems and from fertilized lawns, parks, and golf courses;

- Bacteria, primarily from animal waste, sewage, and septic systems;

- Oil and grease from parking lots, roads, and service stations; and

- Trace metals, such as lead, copper, cadmium, chromium, zinc, arsenic, iron, and mercury, from worn pipes, roofing materials, paints, and numerous other sources.

The impacts of nonpoint source pollution are particularly severe in slower-flushing lakes, streams, and estuaries. Pollutants delivered to estuaries may build-up in bottom sediment and remain for long periods of time. Excess nutrients cause algae

blooms and accelerate eutrophication; oil, grease, and trace metals can be poisonous to aquatic life and may contaminate drinking water supplies; and chemicals in fertilizers, pesticides, and household products pose threats to human and aquatic health.

The 1987 amendments to the Clean Water Act recognized that the control of NPS pollution requires flexible, site-specific, and source-specific measures. For this reason, it mandates a framework for action rather than a set of required activities or standards. Under Section 319 of the Act, this framework requires each state to assess and report on the extent of its NPS problems and to develop an NPS management program. The assessment reports must identify:

- Navigable waters needing NPS control to attain or maintain water quality standards or goals;
- Categories and subcategories of NPS pollutants affecting these waters;
- Processes for identifying necessary NPS controls and for reducing NPS pollution; and
- State and local programs for implementing NPS controls.

Based on these assessments, the states must then develop NPS management programs that:

- Identify appropriate BMPs for nonpoint sources characterized in the assessment;
- Develop programs to implement BMPs, including schedules and milestones; and
- Identify existing authorities to implement the program(s), as well as federal, state, and local funding sources for program implementation.

These requirements under Section 319 can be valuable in helping NEP Management Conferences build on existing state NPS activities.

Implementation

NPS control activities generally include:

- **Targeting controls to priority areas in the watershed** that actively contribute to water quality problems. Targeting pollution control to critical areas within the watershed ensures greater efficiency in abating pollution.

- **Offering cost-sharing to defray part of the investment and/or operating costs of implementing BMPs.** This is a critical component in most agricultural nonpoint source control efforts. Cost-sharing provides added incentive for farmers to install pollution control equipment, particularly when controls benefit the environment but are costly to the farmer.

- **Providing technical assistance and training** to ensure the proper use and maintenance of BMPs.

- **Educating** the public about nonpoint source problems, and about the impact of certain activities or land uses on water quality.

- **Supporting NPS efforts with regulatory and enforcement backup.** Although most NPS programs are voluntary, some government entities, particularly at the local level, have implemented regulatory programs. Activities at construction sites, for example, are often regulated by local ordinances that require BMP implementation and site planning. Mining and forestry activities that can lead to NPS pollution may also be regulated by laws or ordinances. The effectiveness of regulatory programs, however, is influenced by how vigorously the laws and ordinances are enforced. Weak enforcement, due to staff or resource problems, can reduce considerably the benefits of regulatory efforts.

States also may choose to use their general permit authority through the NPDES program to control certain similar nonpoint sources. Some states have incorporated nonpoint source permits into the existing State regulatory structure. Florida, for example, regulates surface water storage and attendant runoff problems in the South Florida Water Management District. Pennsylvania's Department of Environmental Resources regulates earth disturbances involving greater than 26 acres, and the State of Maryland has introduced erosion and sediment controls as requirements for a variety of operating permits.

Source: U.S. Environmental Protection Agency, Office of Water. Coastal Water Programs Handbook (Draft). Washington, D.C.: February, 1990.

- **Sponsoring demonstration projects** to show the benefits and operation of particular BMPs. The most effective demonstration projects concentrate on showing clear results, rather than simply showing

how to implement a particular BMP. Demonstration projects may also evaluate existing management practices to determine the conditions under which each practice is most effective.

Numerous projects to demonstrate new and innovative management practices have been implemented around the country, including the following:

- Indian Town Farm, along the Chester River in Maryland, was the location of a project to demonstrate the effect of agricultural BMPs on water quality. The project educated local farm communities about the costs of installing BMPs and their effects on farm income, and about the effects of BMPs on water quality.

- Also in Maryland, urban demonstration projects have included several projects to demonstrate the effectiveness of shallow marshes to improve infiltration and the control of stormwater pollutants. In Queen Anne's County, state officials constructed an artificial marsh at a local high school. Students and teachers learned about NPS pollution, and the natural cleaning ability of wetlands, while doing part of the actual planting.

- In Virginia, demonstration projects for urban NPS control have included monitoring the effects of porous asphalt pavement and infiltration trenches on water quality; the use of porous pavement on parking lots; and a stream stabilization project using willow trees and other woody plants to bind soil and improve drainage.

- **Monitoring** during and after the implementation of BMPs to ensure they are properly installed and adequately maintained, as well as to provide feedback about the effect of BMPs on water quality.

Management Practices

There are literally hundreds of BMPs and combinations of BMPs used to address NPS problems. What follows is a brief overview of more common BMPs to address the most pervasive sources: runoff from agricultural, urban, and construction areas. Additional sources include runoff from abandoned mining areas and from silviculture or forestry activities. Although nonpoint pollution from these sources is generally not as pervasive as agricultural and urban sources, it nonetheless may cause serious water quality problems.

Urban NPS Pollution

Sources of urban runoff include rooftops, lawns, streets, industrial sites, parking lots, and other pervious and impervious surfaces. These contribute such pollutants as sediment from construction sites; fertilizers and pesticides from lawns, gardens, parks, and golf courses; salt and sand from winter de-icing programs; and oils and heavy metals, primarily from automobiles. In addition to degrading water quality, the sediment and debris carried in urban runoff can clog sewers, stormwater control systems, and waterways, increasing the chance of flooding.

The problems associated with urban NPS pollution can be particularly acute in heavily populated, extensively developed areas, where the high percentage of impervious surfaces increases runoff volume. Managing runoff in heavily developed areas, however, is often difficult and expensive. As a result, the greatest progress is often made in newly developing or undeveloped areas, where early planning and oversight can control or avoid harmful impacts.

Management practices for urban nonpoint sources can include both structural and nonstructural controls. Structural controls generally require construction or installation of devices to capture runoff, such as stormwater basins, porous pavement, and certain sediment controls on construction sites. Nonstructural controls typically emphasize good housekeeping practices and better management of infrastructure and development, including rooftop runoff controls and natural drainage systems.

Stormwater Basins

A variety of basins or ponds may be used to capture and hold stormwater for varying lengths of time, thereby reducing or minimizing runoff during heavy rainfall. These ponds or basins may be retrofitted in established urban areas, but often space limitations and the cost of siting and installation prohibit such efforts. Installation of stormwater basins, therefore, is most feasible in newly developing areas. Three types of basins commonly used to manage stormwater runoff are described below.

Detention Basins

Detention basins are "dry" ponds designed to attenuate peak runoff flow and reduce downstream flooding and erosion by holding stormwater runoff until peak rainfall has subsided.

Extended Detention Basins

Extended detention basins are designed to retain a predetermined amount of stormwater for longer periods than conventional detention ponds, and can be adjusted to allow the slow release of water over a given time. Extended detention ponds also allow sediment to settle, and may be installed with aquatic vegetation to help filter pollutants from runoff; however, detention ponds are not generally effective in removal of soluble pollutants. Conventional detention ponds can be converted to extended detention ponds at a relatively small cost.

> The Dillon Reservoir provides more than half of Denver's municipal water supply. Population growth, particularly during the summer vacation season, and the accompanying intensified land uses led to excess nutrient levels and related algae blooms. Phosphorus was identified as the primary source of nutrient enrichment in the reservoir. The Dillon Nonpoint Source Control Demonstration Project compared nonpoint source controls with point source controls and determined that holding ponds and an infiltration pit would reduce phosphorus loadings much more cost-effectively than point source controls.
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> Source: Industrial Economics, Incorporated, "Dillon Reservoir Case Study," September, 1983.

Wet Ponds/ Retention Ponds

Wet ponds are designed to maintain a permanent pool of water through controlled releases. If the basin is large enough to allow the release of only a small amount of overflow, these ponds can be extremely effective in controlling sediment and other pollutants. Most contain rooted vegetation, and the resulting biological processes are very effective in the removal of dissolved nutrients.

The amount of maintenance required increases with the sophistication of the basin. All require at least *some* maintenance to remove sediments and other pollutants, and to preserve the natural surroundings of the site. If runoff contains harmful substances, infiltration may also lead to contamination of soil and groundwater.

The success of all stormwater basins hinges on proper operation and adequate maintenance. At a minimum, maintenance should include:

- Periodic inspections;
- Removal of sediment and debris from basins and channels;
- Maintenance of pipes and pumps;
- Mosquito control; and
- Control of vegetation, if used.

Porous Pavement

Porous pavement is designed to increase infiltration of runoff water into the soil, thereby decreasing the volume and rate of runoff in addition to removing some pollutants. Water infiltrates the pores of a special permeable asphalt layer and enters a system of underground reservoirs. The reservoirs filter some pollutants from the runoff as it passes through to the underlying soil or to perforated drainage pipes. To ensure proper operation, it is important to maintain the pavement and filtering devices against build-up of oil, grease, dirt, and other pollutants.

A study by the Metropolitan Washington Council of Governments found that porous pavement may remove as much or more suspended sediment, phosphorus, nitrogen, and bacteria from runoff as detention and retention basins.

Managing Rooftop Runoff

Directing runoff from gutters and rooftop downspouts away from streets to grassy areas is a relatively simple yet effective tool in controlling urban runoff. Directing runoff to grassy areas has two important benefits: (1) runoff is diverted away from impervious surfaces where it could transport pollutants; and (2) diversion to natural drainage areas reduces the volume of runoff flow, and allows particulate pollutants to settle in the soil.

Natural Drainage Systems

Marshes, grasses, and other vegetation allow infiltration and settling of sediments and potential pollutants. Installing vegetative mounds along roadsides instead of curbs can significantly impede the velocity and impact of stormwater runoff, as can grass swales. Wetland areas can also serve as natural detention ponds.

Measures to Control Soil Erosion on Construction Sites

Construction activities can result in substantial amounts of sediment that can clog storm sewer and infiltration systems, and cause numerous water quality and flood problems. Examples of BMPs at construction sites include:

(1) Protective vegetation to cover disturbed soil during and after construction, reducing exposure to the erosive forces of water and wind;

(2) Filter fences or straw bales placed around the perimeter or in other critical areas of the site to contain runoff; and

(3) Settling basins to catch and detain runoff long enough for sediment to settle.

Because these BMPs can be expensive to builders or developers, they rarely are voluntarily implemented. As a result, many areas have amended state and local zoning and building ordinances to include performance standards and BMP requirements at construction sites.

Even where sediment and erosion control laws are in place, sediment from public construction projects can present serious problems. Highways are the single largest source of construction erosion. Although highway construction projects typically mandate the application of BMPs, implementation varies from state to state and depends largely on state enforcement mechanisms.

Good Housekeeping Practices

There are numerous ways that public and private actions can reduce NPS pollution from stormwater runoff. **Municipalities** can:

- Limit or reduce the amount of salt applied to roads;
- Increase and improve street cleaning;
- Enforce litter controls;
- Coordinate leaf removal; and
- Promote public awareness of NPS problems.

Madison, Wisconsin has introduced a comprehensive set of programs to reduce pollutants in stormwater runoff. The initiative includes a street-sweeping and leaf pickup program, an ordinance prohibiting rubbish in city streets, and a street-salt reduction program. Madison has reduced the amount of salt used for de-icing city streets by 50 percent since the mid-1970s. As a result, chlorine levels in the city's lakes are no longer rising.

Private households can:

- Resod or seed bare patches of lawn to limit soil erosion;
- Plant shrubs or trees to increase infiltration;
- Use wood decks, interlocking stones, or bricks instead of cement for walkways and patios;
- Reduce the use of pesticides and herbicides;
- Ensure that pesticides and fertilizers are used properly and disposed of appropriately;
- Use phosphate-free detergents;
- Properly manage and dispose of garden, yard, and animal wastes; and
- Properly handle and dispose of oil and other toxic substances.

Households can be encouraged to implement these practices through the use of educational pamphlets and advertisements that highlight the effects of poor housekeeping practices on water quality. In addition, households may need guidance on how to implement alternative yard and waste management practices. NEP Management Conferences may coordinate with state and local nonpoint source programs to raise public awareness of nonpoint source problems and solutions.

The Citizens Program for the Chesapeake Bay's Baybook: A Guide to Reducing Water Pollution at Home is an excellent guide that shows homeowners how they can improve urban housekeeping practices to improve the quality of urban runoff. Copies of this publication are available from the Citizens Program for the Chesapeake Bay, Inc., 6600 York Road, Baltimore, Maryland 21212.

Agricultural NPS Pollution

Agricultural runoff carries sediment, nutrients, toxics, and other pollutants to streams, rivers, lakes, and estuaries. Major sources include: (1) eroding cropland, (2) animal barnyards and grazing, feeding, or waste areas, and (3) chemical and nutrient applications. The specific volume and type of pollutants carried in runoff from agricultural areas depends on a number of variables, including:

- Local soil and hydrogeologic conditions;
- The type of crop planted;
- The method of planting used;
- The type, quantity, and frequency of nutrient or pesticide applications; and
- The location and intensity of livestock activity.

Programs to address agricultural NPS problems have generally been voluntary, emphasizing technical assistance, training, and cost-sharing to promote the use of BMPs. Agricultural BMPs vary widely in cost, relative effectiveness, and degree of benefit to farmers. The success of a particular BMP is not only measured by its absolute effectiveness in controlling a particular pollutant, but also by its cost, its ease of use, and its long-term impact on both crop yields and water quality. The following factors are typically considered when evaluating the effectiveness and appropriateness of agricultural BMPs:

- What is the likely impact of the BMP on both surface water and groundwater?
- How will the BMP affect sediment and nutrient travel and loss?
- What is the crop history: type, yield, pattern? What effect will the BMP have on future crop yields?
- Is the BMP technically feasible?
- Is it economically viable?

Below are some of the more common management practices used to control pollutants from cropland and livestock areas. The Soil Conservation Service, Agricultural Extension Service, or other entities that help farmers implement BMPs can provide detailed information that reflects local conditions on the cost, effectiveness, and overall feasibility of agricultural BMPs.

Successful BMPs to control agricultural runoff address:

- **The availability of pollutants.** Large volumes of pollutants on the soil surface can be more easily detached and carried in runoff. Better nutrient and pesticide management are common BMPs to reduce the availability of pollutants.

- **The detachability of pollutants.** If the soil surface is exposed, heavy rainfall can detach soil particles and other pollutants bound to the soil. BMPs to reduce detachability generally involve covering the soil surface with crop residue or plants.

- **The solubility of pollutants.** Water soluble pollutants are easily transported in runoff. BMPs that address pollutant solubility encourage the use of fertilizers with a less soluble or "slow release" form, which release nitrogen or phosphorus over an extended period of time.

- **The transportability of pollutants.** The volume and type of pollutants that actually reach a waterbody can be reduced by installing devices to capture or slow pollutants as they travel across the land.

Source: Adapted from U.S. EPA, Region 3, Chesapeake Bay Liaison Office, "Chesapeake Bay Nonpoint Source Programs," January 1988, p.76.

Livestock Areas

Controlling pollution from barnyards, feedlots, grazing areas, and waste storage areas can be as simple as covering the waste with a tarp or storing it until needed. Other strategies include diverting runoff away from concentrated waste areas or limiting the access of livestock to critical areas.

Streambank Fencing

Livestock grazing along streambanks can compact the soil, destroy surface vegetation, increase the exposure of streambanks to runoff, and introduce waste directly into the stream. Constructing fences to prevent animals from grazing along streambanks can reduce or eliminate problems.

To protect the streambanks of Wisconsin's Sugar River watershed, the Dane County Conservation League has focused heavily on streambank fencing. As a result, Mt. Vernon Creek and other streams in the watershed have been restored from marginal to Class I trout streams. To provide public access, the League buys 20-year easements from landowners for $1.00. In return, the League guarantees the landowner that it will maintain fences and the streambank area for the easement period.

Source: Anne Weinberg and Jim Arts. Local Government Options for Controlling Nonpoint Source Pollution. Wisconsin Department of Natural Resources, 1981.

Diversion Methods

More complex animal waste management methods divert rainwater runoff away from concentrated waste areas, commonly by channelling rainwater around barnyard areas to ponds or lagoons where it can infiltrate the soil or be applied to other land areas. The most common diversion practice is known as the "environmental eye" and utilizes a two-part diversion system: (1) water is prevented from crossing through the waste area through the construction of channels upstream from the barnyard, and (2) channels or ditches are constructed downstream from the barnyard to divert runoff away from the stream or receiving waterbody.

Dairy livestock wastes in the Tillamook Bay, Oregon drainage basin were creating severe bacterial pollution, threatening to force closure of shellfish beds. The cleanup plan organized for the bay relied on two principles: (1) preventing rainwater and clean surface water from coming into contact with manure, and (2) preventing contaminated surface water from reaching the streams or the bay. BMPs applied by farmers included installing solid and liquid manure storage facilities, roofing animal manure accumulation areas, erecting streambank fencing, and managing roofwater runoff. USDA's Rural Clean Water Program provided over $4 million to the local Agricultural Stabilization and Conservation Service to help dairy owners implement these BMPs. Farmers from the 118 dairy farms themselves contributed over $3 million to support this effort. By 1985, sampling in streams feeding Tillamook Bay showed that fecal bacteria levels were down 15 to 30 percent.

Source: U.S. EPA, Office of Water, National Estuary Program. "A Comprehensive Source Control Program for Protecting Shellfish Waters: Citizen Action Preserves Shellfish Resources." In Saving Bays and Estuaries: A Handbook of Tactics. Washington, DC: June 1988.

For more information, contact the Oregon Department of Environmental Quality, (503) 229-6035.

Cropland or Farmland Erosion Management

BMPs to control erosion from cropland depend on the type of soil, type of crops, and the hydrogeologic conditions surrounding the eroding area. There are four general categories of agricultural BMPs:

- Conservation tillage practices;
- Modified cropping patterns;
- Structural erosion control measures; and
- Conversion of cropland to less intensive uses.

Selection of the most appropriate and successful management practice(s) will generally require local expertise. The optimal mix may vary considerably from area to area.

Erosion and sediment loss are closely associated with the amount of exposed surface soil. Conventional tillage practices invert the top layer of soil prior to planting, turning the vegetated cover and exposing the soil. Conservation tillage helps reduce erosion by leaving at least 30 percent of the previous year's crop residue untilled (uninverted), promoting increased infiltration and thereby decreasing runoff. Types of conservation tillage include:

- **No Till.** The soil is undisturbed prior to planting, which is done in a narrow seedbed approximately 1-3 inches wide. Weeds are controlled primarily with herbicides.

- **Ridge Till.** Approximately one-third of previously undisturbed soil surface is tilled at planting with sweeps or a row cleaner. Seeds are then planted on ridges that are usually 4-6 inches higher than the row middles. A combination of herbicides and cultivation is used to control weeds. Cultivation is used to rebuild the ridges.

- **Strip Till.** Approximately one-third of previously undisturbed soil surface is tilled at planting time. Rows or strips are then tilled using a rototiller, in-row chisel, or similar tool. A combination of herbicides and cultivation is used to control weeds.

- **Mulch Till.** The soil surface is broken by tilling prior to planting, but the top cover is not turned over. Tillage tools such as chisels, field cultivators, discs, sweeps, or blades are used. Weeds are controlled with a combination of herbicides and cultivation.

- **Reduced Till.** Any tillage and planting system that leaves at least 30 percent of existing plant residue uninverted.

Source: Adapted from U.S. EPA, Region 3, "Chesapeake Bay Nonpoint Source Programs," January 1988, pp. 80-81.

Conservation tillage practices, particularly no-till, may require increased pesticide or herbicide applications to control weeds and insects, which may lead to surface water and groundwater pollution. No-till, however, clearly provides the greatest amount of protection against sediment erosion. In light of these concerns, local USDA or soil and water conservation experts can provide advice on the most appropriate conservation tillage practice for any given area.

The EPA and USDA are studying the effects of conservation tillage practices on groundwater and surface water. The goal of this effort is to identify the mix of management practices that best promotes agricultural conservation without contributing to nonpoint source pollution problems. The mix of practices -- conservation and nonpoint source -- may involve modifications to existing pollution or erosion control practices.

Modified Cropping Patterns

In addition to changing tillage practices, farmers can modify cropping patterns to reduce NPS pollution. Effective alternative cropping procedures include:

- **Contour Farming.** Tillage practices that follow the contour of the field, perpendicular to the slope of the land, are effective in reducing soil loss from stormwater runoff. Tilling along the contour of the land increases infiltration and decreases runoff velocity. Its effectiveness decreases as the steepness of the slope increases; for longer slopes, other methods such as diversion channels or terraces may be needed. Crop yields will also vary depending on the amount of rainfall and the period of time between rainfalls.

- **Contour Strip Cropping.** Row crops typically leave a large portion of the land uncovered and allow water to flow easily down the rows and off the field. For fields normally planted with row crops, alternative strips can be planted with close-grown crops such as grasses or legumes. This practice promotes greater filtration and reduces the overall velocity of runoff across the tilled area. Close-grown crops may also improve the organic content of the soil, improving the soil's ability to absorb water.

- **Cover Cropping.** For seasonal harvests, close-growing crops can be planted during the off-season to provide soil protection, reduce erosion, and increase infiltration.

Structural Erosion Control Measures

Farmers can also implement structural controls to reduce nonpoint source pollution. Such controls include:

- **Diversion and Terrace Systems.** Runoff can be diverted over long slopes in channels or a system of earthen ridges or terraces. Terrace systems are most suited to areas with a relatively even topography and a moderate slope angle.

- **Grass Filter Strips.** Filter strips are permanent strips of grass or other vegetation planted along a stream or around a pollution source to filter pollutants from runoff. These strips may also protect the streambank from structural damage. Filter strips are generally more effective in controlling particulate pollutants than soluble pollutants. In general, their effectiveness depends on the width of the filter, its slope, the type of vegetation, the size of the sediment, the flow rate, the initial concentration of pollutants, and the pattern of flow across the filter.

- **Tree Planting and Forest Buffer Strips.** Tree planting can increase infiltration, improve soil conditions, and protect against erosion, typically on marginal cropland with a high rate of erosion. Forest buffer strips are generally placed along streambanks to provide additional protection against the movement of groundwater contaminants to a surface waterbody, but also help reduce streambank erosion and provide some filtration of overland water.

Conversion of Cropland to Less Intensive Uses

An alternative to changed cropping practices or structural BMPs is to remove cropland from active cultivation, particularly in areas where erosion damage is severe or the potential for such damage is high and a body of water is near. Generally, this practice involves seeding, sodding, or mulching land removed from active agricultural production.

Conservation Reserve Program

Several programs created by the Food Security Act of 1985 (The Farm Bill) and administered by USDA aim to protect areas vulnerable to erosion damage. USDA's Conservation Reserve Program (CRP) removes highly erodible cropland from cultivation. Farmers enter into an agreement with USDA to install vegetative cover over the eroding soil, and participants receive 50 percent cost-sharing for the installation. Enrolled cropland cannot be planted for 10 years. As of 1988, approximately 45 million acres of highly erodible land were enrolled in CRP.

Virginia is now using a computer-based information system to identify farmland with a high erosion potential. VIRGIS -- the Virginia Geographic Information System -- is used as a screening tool to identify potential problem areas. The system integrates topographic, soil, watershed, and elevation information with factors for rainfall, vegetative cover, and land use practices. In the long term, staff expect to use the system to assist with setting priorities and with determining critical areas for programs such as the Conservation Reserve.

For more information, contact the Virginia Division of Soil and Water Conservation, (804) 786-8173.

Conservation Compliance Program

As part of its overall effort to protect highly erodible lands (HEL), USDA also administers the Conservation Compliance Program . There are an estimated 140 million acres of HEL in the U.S. The program requires farmers who produce on highly erodible fields but wish to remain eligible for most USDA farm support benefits to prepare and have approved a plan to reduce or prevent erosion. Plans must be fully implemented by 1995.

In addition to programs that address previously cultivated cropland, USDA also administers the "Sodbuster" program to discourage bringing highly erodible lands into production. Like Conservation Compliance, Sodbuster penalizes farmers who bring new HEL into production by making them ineligible for federal farm benefits.

USDA can help to identify highly erodible lands in the estuary's watershed, and to encourage participation in the various erosion control programs.

Improved Management of Agricultural Chemicals

Over-use or improper application of fertilizers and pesticides can lead to significant amounts of phosphorus, nitrogen, and agricultural chemicals in surface runoff. Improved nutrient and pesticide management involves controlling the rate, timing, and method of application to reduce the potential for applied nutrients and chemicals to be carried in runoff and infiltrated to groundwater. Properly using and storing animal waste, applying pesticides and nutrients based on specific crop requirements, and testing soils for existing nutrient levels are effective BMPs.

Sources of More Information on Nonpoint Source Control

U.S. EPA Regional Offices
Water Management Division

State Soil and Water
Conservation Divisions

U.S. EPA Headquarters
Office of Water Regulations and Standards
Nonpoint Source Control Branch
401 M Street, SW
Washington, DC 20460
(202) 382-7104

Citizens Program for the Chesapeake Bay, Baybook: A Guide to Reducing Water Pollution at Home, Baltimore, Maryland.

Hansen, Nancy R., et al. Controlling Nonpoint-Source Water Pollution: A Citizen's Handbook. The Conservation Foundation and National Audubon Society: 1988.

Metrolpolitan Washington Council of Governments, Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs, by Thomas R. Schueler, Department of Environmental Programs, Washington, DC: July 1987. For copies of report write to: The Metropolitan Information Center, MWCOG, 777 North Capitol St. NE, Suite 300, Washington, DC 20002, or call (202) 962-3256.

U.S. Environmental Protection Agency, Region III. Chesapeake Bay Nonpoint Source Programs. Annapolis, MD: January, 1988.

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Sources of More Information on Nonpoint Source Control

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U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Nonpoint Source Control Branch, Guide to Nonpoint Source Control, Washington, DC: 1987.

U.S. Environmental Protection Agency, Office of Water and Office of Policy, Planning and Evaluation. Share the Costs – Share the Benefits: Agricultural Nonpoint Source Cost Share Programs. Washington, DC: March, 1990.

Weinberg, Anne and Jim Arts. Local Government Options for Controlling Nonpoint Source Pollution. Wisconsin Department of Natural Resources: 1981.

Land Use Tools and Conservation Measures

The measures discussed earlier can address or mitigate existing pollution problems, but there are also many activities designed to prevent problems from happening. Prevention alone will not solve the problems facing degraded estuaries, but it can compliment traditional remediation strategies to control or reduce the magnitude of future point and nonpoint water pollution.

Unplanned or unguided growth and development in an estuarine basin area can lead to numerous water quality and ecosystem problems: sensitive areas and habitats destroyed or damaged; floodplains altered (affecting both water quality and wetland habitats); wetlands lost or polluted; fish and shellfish populations reduced or impaired; and recreational activities curtailed.

Unmanaged growth and development may also create sewage treatment problems, waste storage and treatment shortages, increased nonpoint source runoff, and other potential threats to estuarine ecosystems. In most areas, the solution to these problems will involve striking compromises between competing land use claims, directing development away from pristine areas and toward existing infrastructure, and encouraging or requiring certain management practices to be used with new development.

The following discussion focuses on management activities used primarily by state and local governments to prohibit, direct, or otherwise control land use practices. The tools vary in the degree of control exercised, with their use guided by cost, permanence, and the nature and extent of the current or potential problem.

Local Zoning Ordinances

Zoning ordinances, the basic tool by which communities regulate and direct land use, designate zones or districts in which various land uses are generally permitted, conditionally permitted, or prohibited. Such ordinances may apply to large tracts of land, and generally cost relatively little to develop. They can be readily employed to manage future growth so that development does not threaten estuarine ecosystems. Their effectiveness depends on the quality of their design and the rigor with which they are implemented and enforced.

This section discusses three types of zoning ordinances: those that restrict development; those that direct development to certain areas; and those that modify the structure of existing zoning ordinances.

Restricting Development to Protect Sensitive Habitats

Sensitive Area Ordinances

Habitats critical to the health of an estuarine ecosystem can be protected directly by imposing strict zoning regulations on the sensitive areas themselves. A sensitive area zoning ordinance creates a special district within which potentially damaging land-use practices are prohibited or special land-use management practices are required. For example, local governments can develop sensitive area ordinances for areas such as wetlands and all upland areas within 1,000 feet of an estuary's shore. A sensitive area ordinance may be incorporated into a community's comprehensive zoning regulations, or may stand alone. Regardless of its context, a sensitive area ordinance should, at minimum:

- State its purpose (e.g., estuarine protection);
- Map the area in which development will be regulated;
- Establish the types of use that will be prohibited and permitted in the critical area; and
- Set penalties for violating the terms of the ordinance.

For example, a sensitive area ordinance might limit permitted uses within the protected area to outdoor recreation and silviculture. It might conditionally permit other, more intensive activities, such as the building of roads or bridges, provided such activities are conducted in compliance with performance standards designed to minimize any adverse effects. Finally, the ordinance might prohibit harmful land uses, such as landfilling, dumping, or excavation; residential, commercial, or industrial construction; or discharge of lawn fertilizers or hazardous chemicals.

The Chesapeake Bay is the largest estuarine system in North America, with 425,000 acres of marshland adjoining the Bay itself. The watershed, stretching 64,000 square miles from New York to West Virginia, is subject to intense development pressure that has severely degraded the quality of the Bay ecosystem. To control the growth pressure, Maryland adopted the Chesapeake Bay Critical Areas Act in 1984, governing land use and development on the land within 1,000 feet of mean high tide of the Bay or the landward side of neighboring wetlands.

The Act requires local jurisdictions to enact zoning ordinances to protect sensitive environments critical to estuarine water quality. Each town maps critical areas within its boundaries and classifies them as Intense Development, Limited Development, or Resource Conservation areas, according to current housing density and use. All new development must occur in previously developed areas, and regulations encourage conservation techniques such as clustered development and limited impervious surfaces. In Resource Conservation Areas, new marinas are prohibited and only very low density development is permitted.

Localities must also employ stringent forest management techniques, control livestock feeding and watering at the water's edge, and set up 100-foot buffer zones around tidal waters. These strategies, developed by local governments, must be approved by the state Critical Areas Commission; if not accepted, the Commission may design a plan for the town.

Source: Environmental Law Institute, National Wetlands Newsletter, various issues, 1986-1988.

Communities can also regulate development in and around the estuarine ecosystem less directly by establishing conservation districts to exclude certain potentially harmful land uses. For example,

- Floodplain districts protect estuaries by restricting filling, dredging, drainage, and construction activities in areas nearest the water;

- Open space and conservation districts restrict activity in relatively undeveloped areas; and

- Buffer zone regulations restrict certain types of land use in a particular area of an estuarine watershed. The buffer zone criteria can apply to either a static, specified buffer, referred to as a "standard buffer," or to a "variable buffer," the width of which changes depending on the slope of the terrain, the vegetation, soil type, or other environmental variables. Buffer zones are sometimes used to ensure safe distances between septic systems, for example, and wetlands, surface waters, or other sensitive areas.

In Rhode Island, an ecologically important salt pond region was threatened by population growth and rapid development due to tourism. Under the auspices of Rhode Island's Coastal Zone Management and Sea Grant programs, the Coastal Resources Center at the University of Rhode Island convened an advisory panel to develop a comprehensive Special Area Management Plan for the ponds.

Land-use controls developed under the plan include:

- limits on new public water/sewer service in undeveloped areas;
- buffer strips;
- restrictions on navigational dredging and disposal;
- fisheries management measures; and
- storm damage controls.

Source: U.S. EPA, Office of Water, National Estuary Program. "Special Area Management Plan for Salt Pond Protection," in Saving Bays and Estuaries: A Handbook of Tactics. Washington, DC: June 1988.

Directing Development Away From Estuarine Environments

The interests of developers and preservationists may sometimes be accommodated with zoning techniques that shift development activity to certain zones while keeping others pristine.

Set Asides

Set asides establish a formula to calculate the distribution of developed and undeveloped land in a given area (e.g., an estuarine coastal area) based on characteristics of the critical area.

Large Lot Zoning

Large lot zoning limits the intensity of development by setting a minimum lot size, such as five acres, that exceeds normal lot requirements. It can be particularly effective in preserving open space or reducing septic system leachate to an estuary.

Cluster Zoning

Cluster zoning and density requirements permit lots in one part of a site to be smaller and more densely spaced in exchange for less development and more open space in another part of the site. These techniques can be used to preserve areas that serve important functions in supporting the estuarine ecosystem, and also reduce the degree to which infrastructure (such as roads and utility lines) must be extended for new developments.

Planned Unit Development

A planned unit development (PUD) is a carefully planned development scheme for an entire site -- generally a large, undeveloped tract of land. By employing clustering, open space provisions, or other approaches, a PUD can allow for preservation of ecologically vital areas from the outset of the development process.

Subdivision Controls

Subdivision controls, like PUDs, can protect previously undeveloped areas by imposing restrictive covenants on development projects. Subdivision controls can be a method of implementing other zoning techniques in specific areas; for example, they may require open space set asides or prohibitions on construction in areas with no sewer hook-ups. Subdivision controls can easily be structured to accommodate and protect sensitive areas, provided that they are designed with attention to the potential negative impacts of subdivision development on the estuary.

Transfers of Development Rights (TDRs)

TDRs are detailed, carefully planned programs designed to shift development from critical areas to targeted growth areas. A TDR program provides an incentive to owners of sensitive lands to sell their development rights, leaving the land in a *pristine* state. Others with less ecologically valuable land can then buy these rights if they wish to develop beyond the ordinary limits of the local zoning ordinance.

> The city of Hollywood, Florida initiated a mandatory Transfer of Development Rights (TDR) for North Beach Park, a 1400-acre undisturbed dune-shoreline area. The development company that owned the area sued the city of Hollywood on grounds that the TDR constituted the "taking" of private property by the city. The state Superior Court, however, upheld the TDR as constitutional, stating that the city's police powers allowed it to establish certain natural preserve areas. The court added that the TDR did not constitute a "taking" because no development had taken place.
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> Source: "Protecting the Coastal Zone Through Growth Management: The Experience of Five Coastal States." Kari Dolan and Heidi Bly Hendrickson. Prepared for the National Network for Environmental Management Studies, U.S. Environmental Protection Agency.

Modifying Existing Zones

Existing zoning ordinances often serve purposes other than environmental protection -- many towns, for example, zone residential areas separately from commercial areas. Local governments can modify these current zoning regulations to better protect the estuarine ecosystem. This section describes a number of modifications that may reduce threats to coastal environments.

Overlay Zones

Overlay zones add an extra layer of requirements to existing zoning; they are especially effective in amending existing zoning ordinances to impose environmentally protective measures. Overlay zones can be applied to any existing zoning regulation. Any proposed development must meet both zoning ordinances.

> Myrtle Beach, South Carolina's Coastal Protection Overlay Zone transfers density away from the shoreline, severely restricting land use activities within the 50-year erosion line.

Downzoning

Downzoning tightens the restrictions of existing zoning regulations by specifying less intensive uses than designated. It can be a valuable tool in communities where growth pressures have intensified and is used primarily in areas previously zoned but not yet intensively developed.

Bonus and Incentive Zoning

Bonus and incentive zoning award developers supplemental development rights, including greater density or building height, in exchange for public benefits, such as preservation of open space in a critical area.

Performance Standards

Performance standards may take the form of detailed criteria or general guidelines, and may address such development issues as:

- The placement of fill or the incline of slopes;
- The location and design of septic systems;
- Possible disturbance of vegetation and wildlife;
- Construction activities that may release sediments; or
- The quantity and quality of wastewater released into the estuary.

Such standards typically are embodied in building and sanitary codes, or site plan and design review. They may include, for example:

- Requirements that septic systems be designed with sufficient capacity and be sited to minimize potential adverse effects on estuary water quality;

- Regulations establishing minimum building setbacks from the boundaries of sensitive areas;
- Prohibitions on package sewage treatment plants;
- Requirements that developers employ best management practices to minimize sediment runoff during construction; or
- Limits on the proportion of a development site that may be surfaced with impervious materials.

Interim Development Controls

Interim development controls can serve to temporarily slow or halt development activity, protecting critical areas until they can be covered by permanent controls. They can give a community in transition time to reassess estuary protection needs and goals and complete its planning process. Examples of interim development controls include temporary ordinances pending revision of the current plan, building permit moratoria, and water and sewer moratoria.

State or Federal Designation of Protected Areas

The designation of protected areas by state or federal organizations can be instrumental in preserving an estuarine ecosystem. Under this approach, the estuary itself or certain sensitive environments critical to its water quality may be designated as protected areas. Depending on the administering body, the degree of control over a protected area is likely to fall somewhere between that found with zoning ordinances and that found with acquisition of the property. Protective designations may prove easier and cheaper to implement than acquisition; they may also prove more permanent than locally-administered zoning since state or federal agencies are likely to remain removed from local development pressures.

There are numerous programs that designate areas as protected, depending on the resources offered by the area. At the federal level, these programs include:

- **The National Estuarine Research Reserves Program** (formerly known as the National Estuarine Sanctuary Program), which is administered by the Office of Coastal Resources Management. The program provides federal and state funds for land acquisition, research, and

education. Typically, Advisory Councils are set up to coordinate among local interests, state environmental agencies, and the federal government.

- **The Wild and Scenic Rivers Program**, which protects natural free-flowing rivers possessing remarkable values from damming and other forms of development. The National Park Service manages all designated river segments, except those managed by states, the Forest Service, or the Bureau of Land Management.

- The provisions of the **Endangered Species Act**, which can protect estuarine ecosystems that are habitat for endangered species. Among other provisions, the Act requires federal agencies to ensure that any actions they authorize, fund, or carry out will not jeopardize the continued existence of any listed species, or result in the destruction or adverse modification of its designated critical habitat.

State programs offer similar forms of designation for critical resources, though the specific statutes and procedures vary from state to state. Several states have programs that go beyond federal efforts to protect Wild and Scenic Rivers, historic areas, endangered species, and other resources.

States may designate ecologically unique or significant waters as **Outstanding National Resource Waters (ONRW)**. This designation protects important, unique, or sensitive waters -- such as those within State or National Parks, certain swamps, or hot springs -- by adopting criteria that protect the essential characteristics of the waterbody.

Acquisition

Acquisition of estuarine environments and/or adjacent critical areas offers maximum control over resource management in these areas. While local ordinances can change with a change in administration or economic or political pressures, acquisition is permanent. Acquisition can benefit a community both financially and aesthetically, and often gains broad public support. Because the land value of shorelines and coastal wetlands is generally high, however, acquisition can be expensive.

Several factors should be considered before committing time, money, and energy to acquiring a parcel of land. These include deciding whether:

- The land is critical to the ecological health of the estuary;

- The acquisition can later be extended to other holdings, to preserve the ecological relationship of the acquired area with its surroundings;

- Responsibility for the protection and maintenance of the acquired area will later be transferred to another entity or organization; and

- There are sufficient financial and staff resources to monitor and protect the acquisition, both now and in the future.

Once the acquisition of a critical area is deemed necessary and viable, there are several techniques that the acquiring authority can employ. These include full acquisition and various methods of partial acquisition, discussed below.

The Appalachicola estuary, located on Florida's Gulf Coast, is a shallow lagoon and barrier island system covering approximately 210 square miles. In the early 1970s, the estuarine ecosystem faced threats from numerous sources: discharges from a sewage treatment plant; proposed dam construction that would substantially modify the Appalachicola River's hydrodynamics; proposed forest clear-cutting; and other development.

Protection of the estuary focused on three types of actions -- acquisition, protective designations, and basin management. Public land acquisition provided the cornerstone of the effort: over 100,000 acres of land along the river floodplain, lower portion of the river, and nearby islands were purchased for a variety of purposes. Two state acquisition programs orchestrated the purchases: the State Conservation and Recreation Lands Program (CARL) and the Save our Rivers Program.

Most of the Florida portion of the estuary's drainage basin has been designated an Outstanding Florida Water. This designation prevents a permanent point source discharge from degrading the receiving water, imposes reduced allowances for waste disposal and assimilation, and restricts new long-term pollutant discharges (such as sewage, industrial effluent, dredging, and filling).

The lower Appalachicola River and Bay is also a National Estuarine Research Reserve. Under this program, which is administered by the Office of Coastal Resources Management, basin-wide planning was required as a condition for receiving funds. At 193,758 acres, the Appalachicola Reserve is the largest in the country (twice the size of the other 17 reserves combined). It includes floodplain, fresh and saltwater marshes, open water, and barrier islands.

The estuary itself has been designated both an Area of Critical State Concern and a state Aquatic Preserve; these designations require the state to develop a management plan to ensure the long-term protection of the aquatic resource.

Source: U.S. Environmental Protection Agency, Office of Water, National Estuary Program. "Strategies for the Preservation of an Estuarine Watershed: Preserving Watersheds through Land Purchases and Protective Designations," in Saving Bays and Estuaries: A Handbook of Tactics. Washington, DC: June 1988.

Full Acquisition

Full acquisition refers to outright purchase of a critical area and assures complete control of and responsibility for the acquired land. The process involves:

- **Determining those areas in the estuary watershed not sufficiently protected by regulations.** These areas are candidates for acquisition.

- **Evaluating the area being considered for acquisition** to assess the threat of development or degradation, the habitat value and the value it holds for the estuary, and the amount that should be acquired to provide adequate protection.

- **Negotiating with landowners** to begin the acquisition process and appraise the value of the site.

- **Preparing environmental impact statements,** which discuss the environmental effect of development, any practical alternatives, and any required mitigation. If federal resources will fund part or all of the acquisition or if state law requires, a determination must be made as to whether an EIS is necessary.

- **Beginning the final negotiations** with the landowner.

- **Closing the deal**, including legal steps such as drawing and executing the deed, approving any exemptions to the title policy, and certifying the survey.

To protect water quality and preserve open space, the city of Sheboygan, Wisconsin created the Pigeon River Environmental Corridor, an area that provides a buffer between development and the river. By gradually acquiring property along the river over the last 25 years, the city has assembled a publicly-owned corridor of several hundred acres. Land has been acquired through direct city purchase and contributions received from private land owners and developers. One such donation led to the creation of a 135-acre environmental park.

Partial Acquisition

Because of the financial and administrative obstacles to full acquisition, partial acquisition of a critical area near an estuary can also be a viable option, especially if land prices are high or funding is limited. While not an absolute guarantee of protection in perpetuity, partial acquisition may adequately preserve the critical area from development and degradation. Three techniques -- conservation easements, deed restrictions, and post-acquisition disposal -- are briefly outlined below.

Greenways are linear parks and open spaces, often along rivers and shores, that preserve environmentally critical areas for flood management, open and recreational space, water quality protection, and wildlife habitat. By limiting development along rivers and shores, greenways may reduce nonpoint source pollution and preserve valuable wetlands, thereby enhancing estuarine ecosystems.

Conservation Easements

A conservation easement is a legal agreement by a property owner of a critical area to restrict the type and amount of development that takes place on the property. The owner retains basic ownership and use rights, but sells the development rights -- the right to develop or alter the land -- to a public agency, land trust, or historic organization. The easement can apply for a specified amount of time or for perpetuity, and is recorded at the town or county records office to inform any future owners of the land of the easement restrictions. Easements usually cost less than full acquisition, yet may accomplish the same purpose. They also may be attractive to land owners, since the sale or granting of an easement may make the property owner eligible for a tax deduction.

Deed Restrictions

Much like conservation easements, deed restrictions are clauses in a property deed that restrict development or uses by a new owner that would damage, destroy, or alter a critical area. Again, they may protect these areas as effectively as full acquisition, and offer tax advantages to the donor.

Post Acquisition Disposal

Post-acquisition disposal involves the outright purchase of a tract of land by a community or other organization, which then disposes of some or all of the property rights by either leasing or reselling the property. The lease or resale can be selective, accompanied by restrictions that limit future development. This allows the acquiring community to retain title to the land, while leasing it to other entities under conditions that mesh with the community's land management objectives. The community can recoup some of its initial cost, but still must monitor the area to ensure that the conditions of the disposal are met.

Financing Acquisition Efforts

Acquisition can be expensive. Several potential sources of funds include:

- **General funds** from state or local property or sales tax revenues.
- **Private funds** from organizations such as the Nature Conservancy or the Trust for Public Lands, which are also expert at facilitating the acquisition process.
- **Donations of funds or property from individuals or corporations**, which may qualify the donors for tax breaks. Even when the property is donated, however, funds are required for management and upkeep.

- **Federal funds**, such as matching grants or revenue-sharing from the U.S. Fish and Wildlife Service, which are available for wildlife area acquisition and management expenses.

- Some **state programs** offer funds for environmentally sensitive lands or lands that can be used for public recreation. Examples of such programs are Florida's Conservation and Recreational Lands program and California's Coastal Conservancy. Many states also have State Comprehensive Outdoor Recreation Programs (SCORPs), through which they purchase recreation lands with funds provided by the National Park Service.

Cooperative Acquisition Programs

While local governments traditionally have jurisdiction over land use policy, they often lack the means to use the techniques of acquisition described above. To bridge this gap, non-profit conservation and environmental organizations often work with landowners, government, and the general public to acquire, manage, and protect critical ecosystems. Many such groups provide legal advice, technical expertise, and/or financial support. In some cases, communities organize or work directly with a non-profit land trust to purchase critical areas. In others, local governments themselves may choose to organize land banks to finance acquisitions. Both approaches are described briefly below.

Land Trusts

A land trust is a non-profit, private organization formed solely to acquire ecologically valuable lands. There are 775 local land trusts in the United States, and national conservation organizations such as the Nature Conservancy, the Trust for Public Land, and the Izaak Walton League often contribute funds and advice to their efforts. Trusts are also funded by start-up grants and contributions from the public.

Land Banks

A land bank operates similarly to a land trust, acquiring critical areas to minimize or prevent development and preserve them in their natural state. A land bank, however, is a public agency, typically requiring approval by the state legislature and receiving state or local funding.

Land exchanges provide a way for public and private organizations to combine efforts in acquisition. If a critical area is privately owned, it is exchanged for economically productive land with little conservation value that is owned by the state or federal government. Exchanges work particularly well in areas where the government owns much of the land.

Resource Conservation

Despite the best efforts of land use planners, population growth and development will continue to increase stress on land and water resources. Population growth will generally increase the demand for waste management services, sewage, roads, water, and infrastructure. This increased demand can both directly and indirectly affect the health of an estuarine ecosystem. Some of this stress can be minimized, however, by encouraging resource conservation efforts. Doing so generally requires finding ways to motivate businesses, households and individual consumers to change behavior patterns. This is often a difficult challenge, requiring leadership, education, and in some cases the use of economic incentives. More than any of the approaches discussed thus far, resource conservation requires innovative and flexible solutions or tools.

Addressing the behavior of individuals and households is critical to the long-term survival of many estuarine ecosystems. In its report to the Chesapeake Executive Council, the Year 2020 Panel includes resource conservation efforts as one of six major recommendations for the Chesapeake Bay area. As the council states:

> A great many decisions by individuals over decades created incremental changes, imperceptible in their effects as isolated actions, but devastating in sum. The solution to the [Chesapeake] Bay's problems, and to other regional environmental problems, will come about in the same way, as the aggregate of thousands of daily decisions.
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> Source: Report of the Year 2020 Panel to the Chesapeake Executive Council. Population Growth and Development in the Chesapeake Bay Watershed to the Year 2020. December 1988.

Tax Incentives, Subsidies and Fees to Encourage Environmentally Sound Development

Tax policy can play a role in both the preservation and destruction of sensitive areas by encouraging activities and/or land uses with the lowest tax liability. Preservation of sensitive areas can be encouraged through the use of preferential tax policies that reward environmentally advantageous land uses. There are a number of drawbacks, however, to preferential tax policies. State and local governments may be reluctant to use subsidies to encourage preservation and conservation because they often translate into lower tax revenues for the community. Assessment and bookkeeping costs can also be high, as can administrative costs. Moreover, if the benefits of selling the land for development exceed the benefits from tax reductions or deferrals, landowners may decide to sell despite favorable tax policies. When development pressures are high, it is unlikely that tax incentives alone will preserve conservation uses.

As an alternative to tax incentives, impact fees, which impose some of the cost of environmental degradation on the developer or land-user, can be used to discourage destructive land-use practices. Designing, implementing, and enforcing fee systems, however, can be complicated and cumbersome. An important concern is the extent to which fees serve as an incentive to change behavior, versus simply as a source of revenue. Designing fee, subsidy, or tax systems to change behavior generally requires a clear understanding of both the factors affecting land use decisions and the changes required to promote environmental benefits. In addition, effective systems generally require a mechanism to adjust the fee imposed as economic and/or environmental factors change.

Water Consumption

The inefficient use of water resources can lead to a number of environmental problems, including:

- The destruction of wetlands due to the installment of new water supply projects;
- Reductions in the capacity of rivers and streams to assimilate pollutants;
- Reductions in the flow of groundwater to surface water, due to increased withdrawals from aquifers; and
- Excessive demands on wastewater treatment facilities.

In coastal areas, excessive withdrawals from groundwater aquifers can also lead to the intrusion of saltwater into the aquifer and decreased water levels in the estuary. Conservation efforts may involve educating consumers about the many ways that water use can be reduced or curtailed. Lawn watering and car-washing, for example, can be performed using less water or banned during dry spells. Consumers can be educated to install conservation faucets and showerheads that reduce the volume of waterflow, and to practice more conservative everyday water-use patterns.

Water usage in Nassau County in Long Island, New York is regulated by withdrawal caps that prevent overpumping and protect water supplies from saltwater intrusion. The county has also passed a Water Conservation Ordinance, and individual water suppliers have instituted restrictions on residential and commercial users. These restrictions include periodic bans on car washing, the filling of swimming pools, and lawn watering. Several towns in the county are developing ordinances to begin using individual water meters to regulate water use based on household size.

Source: U.S. EPA, Office of Water. Wellhead Protection Programs: Tools for Local Governments. Washington, D.C.: April, 1989.

On a larger scale, municipal pricing systems for water can be adjusted to more accurately reflect the full cost of its consumption. Water pricing frequently does not reflect the full operating, capital, and replacement costs of providing water services. Billing practices that accurately reflect peak loads and that increase with increased consumption would encourage more efficient use of the resource, thereby reducing the environmental degradation that accompanies expanding water demand.

Solid and Hazardous Waste Management

Numerous potential water quality problems are associated directly or indirectly with the disposal of solid and hazardous waste, including:

- The accidental or intentional dumping of waste materials directly into surface waters;

- Contamination of surface waters by landfill leachate; and

- Disruption of sensitive areas by waste management facilities.

The nature of these problems and some means of addressing them are described below.

Marine Debris

A primary source of debris in oceans and estuaries is believed to be the illegal dumping of waste from shore or at sea. The problem was recognized formally in 1978 by Annex V of the Protocol Relating to the International Convention of Pollution from Ships (MARPOL), which bans dumping from ships for signatory nations. Recent beach clean-ups across the nation, however, have revealed staggering volumes of washed-up debris in many coastal areas. A total of over 861 tons was collected during a week-long cleanup in the spring of 1989. Plastics were far and away the most prevalent items, due primarily to both their widespread availability and persistence. Plastic rings, fishing nets, and plastic pellets are particularly hazardous to many fish and wildlife species. Fish and birds can become entangled in nets and plastic beverage rings, leading to suffocation and injury. Plastic pellets are often mistaken for food, and ingestion can potentially lead to starvation. Debris washed ashore can also damage property values and affect tourism.

To address the problem of plastic debris, Congress enacted two pieces of legislation: the Marine Plastic Pollution Research and Control Act of 1987 (MPPRCA), and The Degradable Plastic Ring Carrier Act of 1988. The latter directs EPA to require through regulation that plastic ring carriers be made of naturally degradable material, unless byproducts from degradable rings are shown through current studies to pose a greater threat to the environment. MPPRCA requires EPA's Office of Solid Waste to conduct a study to determine methods to reduce plastic pollution. The study is to include:

- A list of improper disposal practices;

- A list of materials that may injure fish and wildlife or degrade the economic value of coastal areas;

- A description of EPA activities aimed at reducing plastic in marine environments;

- An evaluation of potential substitutes for plastic materials; and

- Recommendations for recycling incentives.

Medical Wastes

In addition to plastic debris, the presence of medical wastes in marine waters -- including syringes, bandages and dressings, blood vials, and diseased body parts -- has generated serious public concern. Based on public reaction to the medical waste found in New York, Boston, North Carolina, and the Great Lakes, Congress passed the Medical Waste Tracking Act of 1988, restricting the release of medical waste to the environment. Its provisions require a 24-month demonstration program for the tracking of medical wastes in New York, New Jersey, Connecticut, and the Great Lakes states. In addition, EPA efforts are currently underway to address the role of Combined Sewer Overflows (CSOs) as a source of medical waste in the marine environment.

Solid Waste Management

Many of the problems associated with marine debris would be alleviated by steps to decrease the quantity of solid and hazardous waste generated, and to improve the management of such wastes on land. According to EPA estimates, roughly 83 percent of municipal solid waste is currently landfilled, 6 percent is incinerated, and 11 percent is recycled through material recovery or energy programs. In contrast to current solid waste management practices, EPA has established the following preferred hierarchy:

(1) **Source Reduction** activities that reduce the toxicity and volume of materials used in products that are ultimately disposed. Improved design and packaging can prevent the need to manage some wastes.

(2) **Reuse** of packaging and other disposable goods, which can reduce demand for and consumption of virgin materials.

(3) **Recycling and Composting**, which can reduce the amount of waste sent to landfills and incinerators.

(4) **Incineration or Landfilling**, which as management practices are preferred only after source reduction, reuse, and recycling have been fully utilized.

Source: U.S. EPA, Office of Policy, Planning and Evaluation, Regulatory Innovations Staff. Promoting Source Reduction and Recyclability in the Marketplace: A Study of Consumer and Industry Response to Promotion of Source Reduced, Recycled, and Recyclable Products and Packaging. Washington, DC: September 1989.

Many believe that the volume of municipal waste generated could be reduced substantially by correcting the pricing mechanism used for waste disposal and management services. Current pricing practices for municipal waste disposal often do not reflect the full cost of disposal. Many communities currently charge a flat rate for disposal services. As a result, consumers see no price difference between decisions that generate more or less waste. Where tax revenues fully or partially support collection and disposal services, both the total and the marginal cost of these services are invisible or highly discounted from the perspective of individual residents. By correcting price structures to more accurately reflect the full cost of disposal, consumers may react to reduce the amount of waste generated.

Economic incentives, such as subsidies, rebates, and credits for manufacturing or purchasing products and packaging may also promote source reduction and reduce environmental degradation. Combined with consumer education programs to improve awareness of the solid waste problem and the environmental consequences of certain purchase decisions, even modest economic incentives may effectively influence consumers.

Numerous waste products can also be reused or recycled. By establishing recycling programs to collect and process these products, communities may reduce considerably the volume of waste disposed. If combined with more accurate pricing structures for waste disposal, recycling programs may provide communities with an effective mechanism to influence individual decisions. Recycling, however, is often more complex than the simple collection of recyclable materials. There must also be demand for the recycled product if the recycling effort is to be more than just an alternative waste management system. Communities need to investigate markets for recycled material to ensure that demand exists for the recycled products. It may be that factors such as packaging or labeling can influence demand for recycled products. If so, marketing and advertising professionals may need to be involved if the recycling effort is to be successful.

Disposal of household hazardous waste is also a problem in many areas. Illegal disposal in drains, sewers, and backyard areas can lead to contaminated groundwater and surface water, among other problems. Some areas have instituted hazardous waste removal programs, either curbside or at a central location. For some, education efforts may be enough to motivate better management and disposal of hazardous products.

Regulatory Programs to Control Point Source Pollutant Loadings To Estuaries

Water pollution control efforts historically have focused on point source discharges. These discharges, named for their localized and direct "point" of release to receiving waters, are amenable to regulatory controls to a much greater extent than the more dispersed and overlapping nonpoint source discharges. Numerous provisions of the Federal Water Pollution Control Act of 1972, also known as the Clean Water Act (CWA), and the Water Quality Act (WQA) of 1987 govern discharges to inland and coastal waters. These statutes establish treatment guidelines and water quality standards, and outline rigorous monitoring and reporting requirements.

Collectively, provisions of the CWA and WQA provide a comprehensive set of tools to protect against and to mitigate effluent pollutants. NEP Management Conferences at a minimum should ensure that these standards and controls are utilized, coordinated, and enforced. Point source controls cannot solve all an estuary's problems, but they do provide a vital baseline upon which added progress can be made. Furthermore, point source programs may also help to supplement or enhance non-regulatory strategies by providing information necessary to formulate and target effective control methods.

Establishing Water Quality Standards Under the Clean Water Act

Water quality standards are rules or laws adopted by states to protect public health and welfare, to enhance ambient water quality, to protect aquatic ecosystems, and to advance the goals of the Clean Water Act. In general, standards describe the maximum allowable ambient pollutant levels in a particular waterbody. Two major components of a water quality standard are (1) the designated use(s) assigned to the waterbody, and (2) water quality criteria that describe the quality of water that will support a particular use.

Section 303 State Designated Uses for Waterbodies

States are required to designate uses for all inter- and intrastate bodies of water within state borders. Each state develops its own use classification system, based on the generic uses cited in the Clean Water Act. These uses -- agriculture, industry, navigation, drinking water, fish and wildlife management, swimming, or boating -- are then protected and preserved by appropriate standards. At minimum, states must provide for, wherever attainable, the propagation of shellfish, finfish, wildlife

and recreation in and on the water. If a waterbody cannot be designated to include these uses, it must be reevaluated by the state every three years. If at this time one of the above uses has been attained, water quality standards must then be revised to ensure protection and preservation of this use. Existing uses -- those achieved on or after EPA promulgated its original water quality regulations (November 28, 1975) -- cannot be modified or changed unless the revised use requires more stringent criteria.

Unlike existing uses, designated uses can be modified or changed if one or more of the following prevents attainment of the designated use:

(1) Naturally occurring pollutant concentrations;

(2) Natural, intermittent, or low-flow water levels;

(3) Man-made conditions or pollution sources that cannot be corrected or would, if corrected, result in greater environmental degradation;

(4) Dams, diversions, or other hydrologic modifications;

(5) Physical conditions associated with natural features of the waterbody, unrelated to quality; or

(6) Required controls that would result in substantial and widespread social and economic impact.

Criteria and Standards

Water quality criteria are specific numeric or narrative pollutant limits used by EPA and states to establish legally binding water quality standards. Section 304(a) of the CWA directs EPA to develop and publish water quality criteria based on the latest scientific information available on the effect of a pollutant on human health and aquatic life. Section 304(a) criteria provide guidance for EPA Regions and the states in the development of state water quality standards. Information contained in EPA's section 304(a) guidance documents generally includes:

- Scientific data on the effects of pollutants on human health, aquatic life, and recreation; and

- Quantitative (e.g., micrograms per liter) or qualitative (e.g., "free from" toxics in toxic amounts) guidance on the general conditions required to ensure a level of water quality adequate to support a particular water use.

When incorporated into state water quality standards, criteria provide a basis for enforcing the standard; otherwise, 304(a) criteria hold no force of law. States may choose to do one of the following when establishing standards to protect designated uses for state waters:

(1) Adopt EPA's Section 304(a) criteria;

(2) Modify the 304(a) criteria to reflect site-specific factors; or

(3) Use other scientifically defensible methods to develop the criteria.

Site-specific factors that may necessitate modified criteria involve, for example, the presence of certain more sensitive species or habitats, or water chemistry (e.g., pH, hardness, temperature, suspended solids, etc.) that differs significantly from the conditions used in developing 304(a) criteria. EPA has developed a guidance document for states to use in deriving site-specific criteria. The document, Water Quality Standards Handbook, was published by EPA's Office of Water Regulations and Standards in December, 1983. States considering developing site-specific water quality criteria are urged to consult first with their EPA Regional office.

Source: U.S. EPA, Office of Water Regulations and Standards, Introduction to Water Quality Standards, Washington, DC: September 1988.

States are required to adopt as standards all EPA water quality criteria for toxic pollutants identified in Section 307(a) of the Act, provided the discharge or presence of the pollutant could reasonably be expected to hinder attainment of a waterbody's designated use. The Section 307(a) list of toxic pollutants contains 65 compounds and families of compounds, which the Agency has interpreted to include 126 "priority" toxic pollutants. As of 1988, EPA had published criteria for six of these pollutants.

Reporting Requirements

Under Section 304 of the CWA, states were required to report to EPA a list of all state waters that are impaired by any pollutant due to either point or nonpoint sources. This list was to have been accompanied by a shorter list of all waters that do not meet the numeric or water quality standards for the 126 priority toxic pollutants due to point source pollution. The lists were submitted to EPA by June, 1989.

In addition to the lists of impaired waters, Section 305(b) requires that states report on the ambient status of all their waterbodies. This report provides information on all river segments, lakes, and estuaries not meeting water quality standards, including information on the pollutants of concern and the causes or sources of any degradation. NEP programs may want to consult these reports to identify not only direct sources of estuary pollutants, but also problem waters that may feed into and contaminate the estuary. Furthermore, NEP Management Conferences may find that these reports support efforts to prohibit or restrict certain activities in and around problem waterbodies.

Controlling Point Source Discharges

Section 402 National Point Source Discharge Elimination System (NPDES)

The NPDES point source discharge system requires permits for all direct discharges to the nation's waters. It is the heart of the Clean Water Act and its primary control mechanism. Permits are issued by EPA or by states whose programs have been approved by EPA. As of 1990, EPA had delegated NPDES authority to 39 of the states.

NPDES permits, good for five years, are written to protect designated uses by setting either chemical-specific and/or whole-effluent limits, and must include the more stringent of either technology-based or water-quality based control requirements. The chemical-specific approach sets numeric limits on the toxicity, concentration, or mass of each conventional or toxic pollutant that may be discharged. In cases where the effluent cannot be fully characterized or the interaction of constituents assessed, limitations may be placed on the effluent as a whole.

Discharges excluded from NPDES requirements, most covered under alternative authorities, include:

- Discharges from ships or vessels;
- Discharges to POTWs that have a NPDES permit;
- Discharges from certain diffuse sources;

- Irrigation return flows; and

- Discharges authorized by a government authority in connection with the cleanup of oil or other hazardous waste under Superfund or Section 311 of the Clean Water Act.

NPDES permit applicants are required to test their effluent for a variety of toxics and other constituents and report any positive findings in the application. Although specific permit conditions will vary across outfalls and receiving waters, several basic requirements are imposed on all permittees:

- **Discharge Monitoring Reports (DMRs)** that record the pollutant content of effluent and provide proof both of compliance and of violations. Reports are sent to the permitting authority and entered into EPA's Permit Compliance System (PCS) where they provide valuable information for both the enforcement of discharge requirements and the assessment of pollutants in receiving waters.

- **Upsets and Bypasses** provisions that govern failures of a wastewater treatment facility (upsets) and the intentional directing of wastewater around the treatment system during maintenance (bypasses). The permittee is required to prove that such a discharge was necessary.

- **Antibacksliding Regulations** under Section 402 of the Clean Water Act that generally prohibit EPA from reissuing an NPDES permit containing effluent limitations, conditions, or standards that are less stringent than those contained in the previous permit except in certain specific circumstances. The requirement reinforces the antidegradation philosophy intended to prevent water quality from falling below existing levels.

Effluent Limitations for Direct Dischargers

The most important regulatory tools for regulating point source discharges are effluent limitations developed by EPA and incorporated into NPDES permits for individual direct discharges. These limitations include: (1) technology-based controls and (2) water-quality based controls.

At minimum, NPDES permit limits for discharges to waterways must meet EPA's technology-based standards. These standards reflect EPA's detailed assessment of the reliability, performance, cost, and other characteristics of existing pollution control technologies. The 1977 amendments to the Clean Water Act established technology-based treatment requirements based on the following considerations:

(1) The class of pollutants involved: conventional, nonconventional, or toxics; and

(2) Whether the source for the discharge is a new or existing facility.

The minimum control standard for all facilities was set initially at the Best Practicable Control Technology currently available (BPT), with the following legislative guidance:

- Effluent limitations must be uniform among similar industries;
- The degree of effluent reduction must be set independent of water quality; and
- The cost of applying a given technology in relation to its effluent reduction benefits must be considered.

Conventional pollutants -- biological oxygen demand, fecal coliform, suspended solids, and pH -- from existing sources are subject to the Best Conventional Pollutant Control Technology (BCT). This standard essentially considers the best available technology, moderated by a test of economic reasonableness. Nonconventional and toxic pollutants from existing sources are subject to the Best Available Control Technology (BAT). Finally, all new sources -- facilities on which construction commences after New Source Performance Standards are proposed -- are generally subject to BAT.

When technology-based discharge limits would fail to protect adequately the quality of ambient waters, NPDES permits may impose water-quality based limits. Unlike technology-based controls, water-quality based limits are derived by determining the degree of effluent control needed to meet ambient water quality standards. Water-quality based controls are not uniformly placed on all direct discharges; rather, they are used to provide an additional, more stringent limitation when needed to protect water quality.

From 1940 to the 1970s, population growth in the Upper Potomac estuary basin continually outstripped the capacity of sewage treatment plants. As a result, raw or potentially untreated sewage was regularly discharged into the Potomac. In 1965, the jurisdictions of the Washington metropolitan area agreed to adopt a fishable-swimmable standard for the upper estuary. Maryland, Virginia, and the District of Columbia imposed stringent controls on point source discharges, based on the assimilative capacity of the upper estuary and the capabilities of current wastewater treatment technology. These actions reduced BOD and phosphorous discharges to the upper estuary by 95 percent. The current effluent phosphorous limit for discharges to the upper estuary is 0.18 milligrams per liter, met by upgrading secondary treatment plants to advanced waste treatment facilities that use added filtration, nutrient removal processes, and chlorination.

Source: U.S. EPA, Office of Water, National Estuary Program. "Point Source Controls: The Potomac River Cleanup." In Saving Bays and Estuaries: A Handbook of Tactics. Washington, DC: June, 1988.

Section 303(d) Total Maximum Daily Load

Some waterbodies may not meet state water quality standards given currently available treatment technologies. For these waterbodies, states are directed to develop a quantitative estimate of the waterbodies' assimilative capacity and to account for all pollution sources and background inputs. Using this information, states estimate the Total Maximum Daily Load (TMDL), or the maximum pollutant load the waterbody is capable of assimilating. Based on this assessment, states are then required to allocate the waterbodies' pollutant assimilation capacity across permitted point sources (NPDES) and nonpoint sources, allowing an added margin of safety. This allocation, a Waste Load Allocation (WLA) for point sources and a Load Allocation (LA) for nonpoint sources, should result in the waterbody attaining its designated use status.

To combat phosphorus problems in the Great Lakes, water-quality based point source controls -- particularly on municipal wastewater treatment plants -- were essential. A treatment level of 1 milligram per liter of effluent phosphorus was set for all treatment plants handling more than 1 million gallons per day. In addition, the 1986 U.S. Phosphorus Management Plan states that if the nonpoint source controls planned for the Great Lakes do not result in the necessary phosphorus reductions, municipal treatment plants will be required to meet even more stringent phosphorus requirements.

Following the issuance of new or updated NPDES permits, EPA tracked performance with a compliance monitoring system, flagging frequent or large violations. Combined with dedicated federal and state enforcement efforts, as well as coordinated and concerted efforts by the Canadian Government, the Great Lakes Program successfully reduced phosphorus levels from point source discharges. Most municipal wastewater point sources handling over 1 million gallons per day have now met or reduced phosphorus discharges to below the 1 milligram per liter effluent phosphorus limit.

Source: U.S. EPA, Office of Water, National Estuary Program. "A Phosphorus Strategy for the Great Lakes: Improving Water Quality through Intergovernmental Agreements." In Saving Bays and Estuaries: A Handbook of Tactics. Washington, DC: June, 1988.

Section 304 Toxic Controls

Section 304 of the CWA requires states to:

- Identify "toxic hotspots," waters where existing technology-based and water-quality based controls are not adequate to meet water quality standards due to the presence of toxic constituents;

- Identify the specific point sources believed to be preventing the attainment of water quality standards; and

- Specify a toxic control strategy that will be used to bring about attainment as soon as possible or no later than three years after the control strategy is introduced.

EPA is required to develop a toxic control strategy that meets state requirements if the state fails to develop a strategy in a timely manner.

> In the 1980s Elliott Bay, on the eastern shore of central Puget Sound, was receiving major discharges of toxic substances, primarily from industrial facilities. The Elliott Bay Toxic Action Program integrated federal, state, and local activities involved with toxics control to devise solutions to the growing toxics problem. The core of this program was the Elliott Bay Action Team (EBAT), which carried out inspections of the Bay to identify contaminated sediments, analyzed these sediments to identify likely pollutant sources, and revised discharge permits to reduce or eliminate the entry of toxic pollutants into the Bay.
>
> Source: U.S. EPA, Office of Water, National Estuary Program. "An Action Plan for Containing and Reducing Pollutants: Controlling Toxic Contamination in an Urban Bay through Special Enforcement Teams and Interagency Coordination," In Saving Bays and Estuaries: A Handbook of Tactics. Washington, DC: June, 1988.

Toxicity Reduction Evaluations (TREs)

When toxicity testing of a particular effluent indicates unacceptable levels of toxic pollutants, permittees are required to reduce effluent toxicity to levels acceptable for applicable water quality criteria and standards. One method used to help dischargers identify the specific sources of toxic pollutants, and to assess the level of reduction associated with a change in process or outfall, is the Toxicity Reduction Evaluation (TRE). The TRE process generally uses toxicity tests, and physical and chemical analysis of the effluent, to determine:

- The toxic substances of concern;
- Any manufacturing processes that produce toxics of concern;
- Specific control options; and
- Monitoring practices that will verify and demonstrate the effectiveness of chosen control options.

The evaluation is considered complete when the permittee attains compliance with the effluent toxicity limitations specified in the NPDES permit.

To summarize the NPDES review and permitting process, permit writers:

(1) Consider the water quality standards and criteria that apply to the applicable receiving water;

(2) Determine if the appropriate technology-based limit will be adequate to protect and maintain the water quality standard and, if so, apply technology-based limits; or

(3) If a water-quality based limit is needed, establish the Total Maximum Daily Load (TMDL); then

(4) Translate this TMDL into specific numeric limits (the Waste Load Allocation) and write these limits into the NPDES permit.

Discharges to Marine Waters

Section 301(h) Waivers

Section 301(b)(1)(B) of the CWA requires all Publicly Owned Treatment Works (POTWs) to implement effluent limitations that meet secondary treatment standards. This requirement, however, may be waived for certain POTWs through provisions of Section 301(h). Specifically, POTWs that discharge to marine waters, including estuaries, may be issued a modified NPDES permit that waives secondary treatment requirements if the following conditions are met:

- The discharge of pollutants, alone or in combination with pollutants from other sources, will not interfere with attainment of water quality sufficient to (1) protect public water supplies, (2) protect the propagation of a balanced, indigenous population of shellfish, fish and wildlife, and (3) allow recreational activities in and on the water;

- A monitoring system is implemented to determine the effect of the discharge on aquatic ecosystems;

- The effluent discharge will not necessitate more stringent requirements for any other point or nonpoint discharge;

- The discharge meets at least the equivalent of primary treatment standards (removal of at least 30 percent of BOD material and suspended solids, and disinfection where appropriate), and the effluent meets criteria established under 304(a) after initial mixing in the waters adjacent to the point of discharge.

  Source: Section 301(h) of the Clean Water Act.

The deadline for waiver applications has passed. Currently, 48 POTWs have been granted waivers, 15 decisions are pending, and 145 applications have been denied. EPA's Office of Marine and Estuarine Protection (OMEP) oversees the 301(h) program and maintains the database that holds 301(h) monitoring information -- the Ocean Data Evaluation System (ODES). This information can be valuable to help NEP Management Conferences consider the impacts of POTWs with 301(h) waivers on their estuary.

Section 403(c) Criteria

Section 403(c) of the CWA establishes additional criteria for point source discharges outside the baseline of the territorial sea. It is intended to ensure that discharges to marine waters do not cause "unreasonable degradation" to the marine environment.

As part of its Ocean Discharge Criteria regulations (45 FR 65457), EPA has published a list of 10 factors or guidelines to be used in 403(c) evaluations. The regulations require decisions be made regarding the effects of the discharge on the marine environment. First, based on an evaluation of the 10 factors, a determination is made as to whether the discharge will lead to "unreasonable degradation" of the marine environment. If information available is insufficient to make this determination, then a decision is made as to whether the discharge will cause "irreparable harm." If the discharge will cause irreparable harm, the permit to discharge is denied. If irreparable harm is not shown, the permit will be granted with monitoring requirements.

Section 403(c) of the CWA requires EPA to consider the following factors when determining the likelihood of unreasonable degradation:

- The effect of disposal of pollutants on human health or welfare, including but not limited to plankton, fish, shellfish, wildlife, shorelines, and beaches;

- The effect of disposal of pollutants on marine life, including the transfer, concentration, and dispersal of pollutants or their byproducts; changes in marine ecosystem diversity, productivity, and stability; and species and community population changes;

- The effect of disposal of pollutants on aesthetic, recreation, and economic values;

- The persistence and permanence of the effects of disposal;

- The effect of disposal at varying rates, and of particular pollutant volumes and concentrations;

- Other possible locations and methods of disposal or recycling of pollutants, including land based alternatives; and

- The effect of disposal on alternate uses of the oceans, such as mineral exploitation and scientific study.

Source: Section 403(c), Clean Water Act.

The 403(c) process utilizes a fundamentally different approach to evaluate the impact of discharges on the environment. In essence, 403(c) regulations require consideration of virtually all major criteria -- with an emphasis on biologic criteria -- in determining the potential impact of the discharge; technology- or cost-based factors are not formally considered in the evaluation. Although currently the criteria apply only to discharges to the territorial sea, waters of the contiguous zone, and the ocean, Congress is considering whether or not to extend these requirements to estuarine waters.

To assist Congress, EPA's Office of Marine and Estuarine Protection has completed a Draft Supplemental Report that will identify the number, types, and potential environmental effects of estuarine discharges by state and by waterbody. The Final Report to Congress is expected to be completed in December, 1990.

For more information on either the 301(h) or the 403(c) programs, consult your Regional EPA office or the Office of Marine and Estuarine Protection, EPA Headquarters.

Pretreatment for Indirect Discharges

Municipal sewage treatment systems, also known as publicly owned treatment works (POTWs), are designed primarily to manage and treat domestic waste. If pollutants from commercial, industrial, and other non-domestic sources (indirect discharges) enter the treatment plant, they may cause such problems as:

(1) Interference with POTW operations. Non-domestic wastes may alter or inhibit the actual treatment process. Toxic pollutants, for example, may destroy or reduce the efficiency of the bacteria used in activated sludge systems or digesters, causing the discharge of untreated wastes into receiving waters.

(2) Pass-through of pollutants. Toxic and certain conventional pollutants may pass through the POTW system without being removed because the treatment system is not designed to remove them. Thus, even if an industrial source is prohibited from discharging these pollutants directly, pass-through can result in their release to receiving waters.

(3) Sludge contamination. Successful removal of certain non-domestic pollutants may result in contamination of sewage sludge by these pollutants. The contaminated sludge must then be handled and disposed of with more stringent and costly management practices than the POTW would otherwise incur.

Source: U.S. EPA, Office of Water Enforcement and Permits. Guidance Manual for POTW Pretreatment Development. Washington, DC: October, 1983.

EPA's National Pretreatment Program aims to protect both POTWs and the environment from the effects of these problems. Through the General Pretreatment Regulations for New and Existing Sources (40 FR 403), POTWs with a design flow greater than 5 million gallons per day (mgd) are required to establish a pretreatment program. In addition, other POTWs may be required to establish a pretreatment program if they are found to discharge nondomestic waste that causes upsets, sludge contamination, or violations of NPDES permit conditions. The regulations (1) prohibit the discharge of certain hazardous pollutants, regardless of the source, and (2) outline categorical pretreatment standards to control pollutant discharges to POTWs from specific categories of industrial and commercial sources determined to be the most significant sources of toxic pollutants. These standards, published as separate regulations for each industrial category, provide minimum control requirements for all discharges within these categories. Each categorical industry must comply with technology-based effluent limitations and monitor discharges to achieve and maintain compliance with the standards.

Although specific features of local pretreatment programs may vary, each is required to complete an Industrial Waste Survey of all non-domestic discharges to the treatment system. This survey can provide valuable information to NEP Management Conferences, as it includes:

- A master list of all potential industrial and commercial users located in the POTW service area; and
- An assessment of each source, to determine the types, quantities, and concentrations of pollutants discharged in wastewater.

Where POTWs are required to implement pretreatment programs, the Industrial Waste Survey should provide Estuary Management Conferences with comprehensive and detailed information on potential pollutant sources.

Stormwater Controls

Storm sewers and other urban stormwater discharges have historically been regulated as nonpoint source discharges. The Water Quality Act of 1987, however, brought many stormwater discharges under the authority of NPDES. Section 405 of the Act establishes permit requirements and deadlines for stormwater point sources. The amendment states that no permit will be required prior to October 1, 1992 except in the following cases:

(1) The discharge is already subject to permit requirements;

(2) The discharge is the result of industrial activity;

(3) The discharge is from a municipal separate sewer system serving a population of greater than 100,000 but less than 250,000;

(4) The discharge is from a municipal separate sewer system serving a population of greater than 250,000; or

(5) The discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to U.S. waters.

For groups two and four, EPA or the state must require permits by February, 1990. For group three, EPA must begin a control program by February, 1991. After October 1, 1992, all remaining unpermitted stormwater point sources will be required to obtain permits under the NPDES program.

Permits are required for all stormwater point source discharges except where stormwater is diverted around mining operations or oil and gas operations, and does not come into contact with overburden, raw material, product, or process waters. Agricultural stormwater discharges are also excluded from point source control under the NPDES program.

EPA is currently developing the rule for industrial and large municipal stormwater discharges, along with guidance documents for permit writers, and a guidance manual to help municipalities prepare stormwater permit applications. Both documents are expected to be finished by the end of 1990.

Combined Sewer Overflows

The primary objective of storm sewer systems is to mitigate the impact of stormwater volume and flow by diverting it to a waterbody with a minimum of erosion and pollutant runoff. Many older urban areas operate storm sewer systems that carry urban wastewater to a sewage treatment plant during dry weather and carry stormwater mixed with wastewater when it rains. During heavy rains, excess sewage-storm water bypasses the sewage treatment plant and enters the receiving waters directly. This "combined sewer overflow" (CSO) may introduce bacteria and other pathogens, toxics, medical waste, and other debris to receiving waters.

EPA recently developed a national strategy for controlling combined sewer overflows. The strategy aims to:

- Ensure that all CSO discharges occur as a result of wet weather;

- Ensure that all wet weather discharge points are in compliance with technology-based requirements of the Clean Water Act and applicable state water quality standards; and

- Minimize the impacts to water quality, aquatic biota, and human health from wet weather overflows that do occur.

A guidance document to implement this strategy is currently being developed. NEP Management Conferences may want to investigate local strategies to address CSO problems, to ensure that the objectives above are being met and to influence decisions regarding long-term storm sewer management plans.

Section 404 Regulatory Program

Section 404 of the CWA requires a permit from the Corps of Engineers prior to the discharge of dredged or fill material into waters of the U.S. Applicable waters include:

- All waters subject to the ebb and flow of the tide;

- The territorial sea;

- Interstate waters and wetlands;

- Intrastate lakes, rivers, streams, and wetlands whose use, degradation, or destruction could affect interstate or foreign commerce;

- Tributaries of waters or wetlands identified above; and

- Wetlands adjacent to waters identified above.

Permits generally specify the type and amount of dredged or fill material approved for discharge. EPA's responsibilities in this program include developing environmental guidelines by which permit applications are evaluated, reviewing proposed permits, and prohibiting discharges with unacceptable adverse impacts on specific aquatic resources. In general, the Corps will not issue a permit if a practicable alternative with less adverse impact on the aquatic environment exists.

An important provision of Section 404 allows for the issuance of "nationwide" general permits for activities that will have only minimal impacts on the environment. These general permits often specify that activities planned under the permit follow certain "Best Management Practices," but permittees are not generally required to notify the Corps of their activities, nor are they required to obtain a site-specific permit. Nationwide Permit 26, in particular, authorizes most discharges of dredged or fill material in isolated wetlands that affect fewer than 10 acres, unless the Corps determines that the discharge would result in more than minimal adverse environmental effects on the aquatic environment.

Because the process for permit review and analysis of alternatives can be quite time consuming, there are provisions that allow for early review of wetland areas. Advanced identification (ADID) is used to designate areas generally suitable and unsuitable for the discharge of dredged and fill material. This ADID process can help NEP management conferences to protect critical or sensitive wetland areas.

Mitigating Impacts to Wetlands Under Section 404

In the implementation of Section 404, EPA's Section 404(b)(1) Guidelines call for projects to avoid and minimize potential impacts on wetlands, according to the following set of priorities:

- First, impacts should be avoided to the maximum extent practicable;
- Second, all unavoidable impacts should be minimized to the maximum extext practicable; and
- Third, appropriate and practicable compensatory mitigation for impacts that cannot be avoided should be provided.

Compensatory mitigation typically involves the creation or restoration of other areas to replicate the functions of the lost area. Under the Section 404(b)(1) Guidelines, compensatory mitigation should only be used for unavoidable impacts -- if there are practicable alternatives to degrading the sensitive environment (such as developing a less sensitive site), permits for the development can be refused. Guidance on the type and level of mitigation required under the Section 404(b)(1) Guidelines is summarized in a recent Memorandum of Agreement between EPA and the Department of the Army concerning mitigation in the Section 404 regulatory program.

By participating in wetlands protection efforts, NEP Management Conferences can ensure that these efforts take into account broader impacts on the estuarine ecosystem. For example, Management Conferences might provide comments to the Corps of Engineers as part of the Section 404 permit review process for development projects that would have deleterious effects on the estuary, ensuring that estuarine water quality is included as a consideration when potential impacts are determined. Second, Management Conferences could encourage the use of compensatory mitigation to enhance or create wetlands that will improve the overall condition of the estuary. For example, as compensatory mitigation for development projects, a Management Conference might encourage the creation of a wetland that could filter pollutants or toxins that would otherwise degrade the estuary.

Washington state's Puget Sound drains over 10 million acres, supporting fisheries valued in 1984 at an estimated $74 million. The sound's estuarine wetlands, which provide habitat for several important species, occupy areas under severe pressure for development because of increasing population. To relieve this stress, several mitigation projects have taken place, chiefly around the cities of Seattle and Tacoma. They have included plans to use four different techniques:

- Substrate modification, through the placement of boulders, cobble, gravel, or fine sand;
- Shoreline creation, through excavation of upland areas or by filling areas of deeper water;
- Creation of eelgrass meadows through transplantation; and
- Creation of marsh habitat by planting emergent aquatic vegetation or excavating channels into upland areas.

Parties involved in the Puget Sound projects caution that compensatory mitigation is not a panacea. Strict one-to-one replacement of lost habitat is extremely difficult to achieve, and most mitigation plans seek simply to maintain fish and wildlife habitat, rather than to replace the full spectrum of wetlands values.

Section 401 Certification

Section 401 of the CWA provides each state with a comprehensive mechanism to review and approve, modify, or deny any permit or license granted by a federal agency or authority governing discharges to inter- or intrastate waters originating in that state. Applicants for a federal license or permit that will result in such discharge must provide the licensing or permitting authority with a certification from the state in which the discharge originates (or will originate) that the discharge will comply with all relevant state water quality provisions. This tool provides states an opportunity to oversee and influence federal permitting and licensing programs. In particular, states can influence a facility's location and operation by carefully exercising their Section 401 certification authority.

In Conclusion

This Appendix has introduced a number of approaches to address threats to land and water resources. NEP Management Conferences must individually evaluate these tools to determine what will likely work, what the public and political climate will bear, and what can be implemented within reasonable time and resource constraints. The process of selecting and evaluating management practices will be challenging, and it will require that Conference members have a shared understanding of the types of actions available, in addition to the factors to consider in evaluating these actions. This Appendix was designed to provide a baseline of information for Conference Members to build on, a checklist of actions and factors to consider. The next step is to consult experts and additional sources for detailed information on the particular actions that seem most promising in addressing the estuary's most significant problems.

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