

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution

Statement of Task

The committee will recommend actions that can help managers to achieve short-term reductions of eutrophication. The committee will:

- assess how coastal and watershed processes and their interactions affect eutrophication of coastal ecosystems;
- recommend ways to improve coordination and effectiveness of ongoing research, monitoring, and management activities being conducted at the federal, state, and local levels;
- identify means to remove barriers that impede implementation of existing techniques to reduce coastal eutrophication; and
- evaluate the effectiveness of existing strategies for monitoring watersheds, atmospheric deposition, and coastal areas and for managing watersheds.

The committee will also recommend actions that could provide a basis for better watershed management to reduce coastal eutrophication in the future. The committee will:

- delineate potential watershed management approaches for reducing eutrophication and its impacts on coastal ecosystems; and
- identify research needs for better understanding eutrophication and its effects, particularly focused on reducing the uncertainties in existing models and other methods.

Committee on the Causes and Management of Eutrophication

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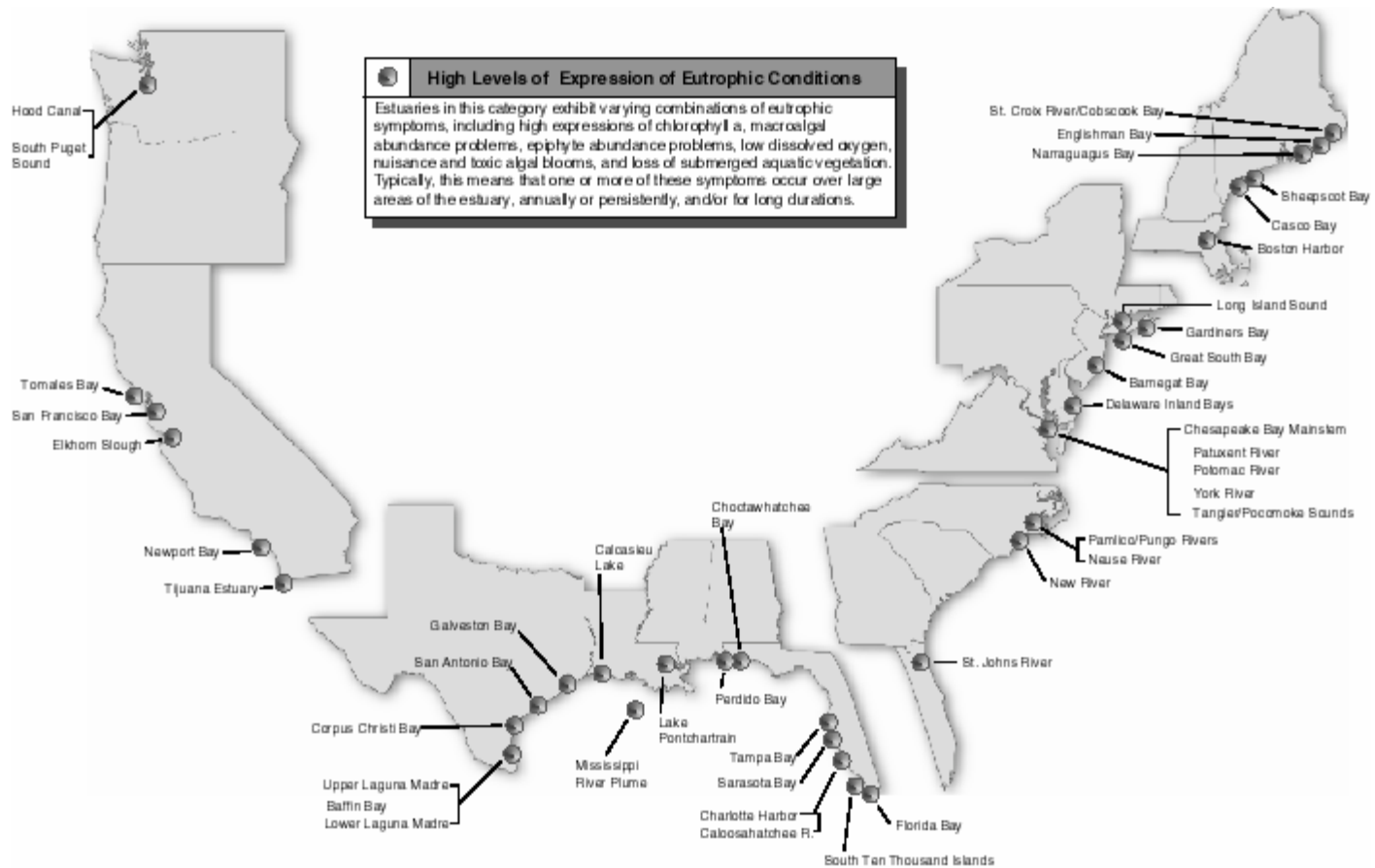
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Context

Eutrophication versus Nutrient Over-enrichment:

- report uses definition of Nixon (1995) that defines eutrophication in terms of increasing organic carbon (as opposed in increasing nutrient content); thus
- eutrophication is one of many effects that may be linked to nutrient over-enrichment

Non-point versus Point Sources

- The 1993 NRC report *Managing Wastewater in Coastal Urban Area* focused on point sources of nutrients; thus
- the predominant focus of this report is controlling non-point sources of nutrients through watershed management

Call for a Nationwide Effort

The severity of nutrient-related problems and the importance of the coastal areas at risk demand the development and implementation of a National Nutrient Management Strategy.

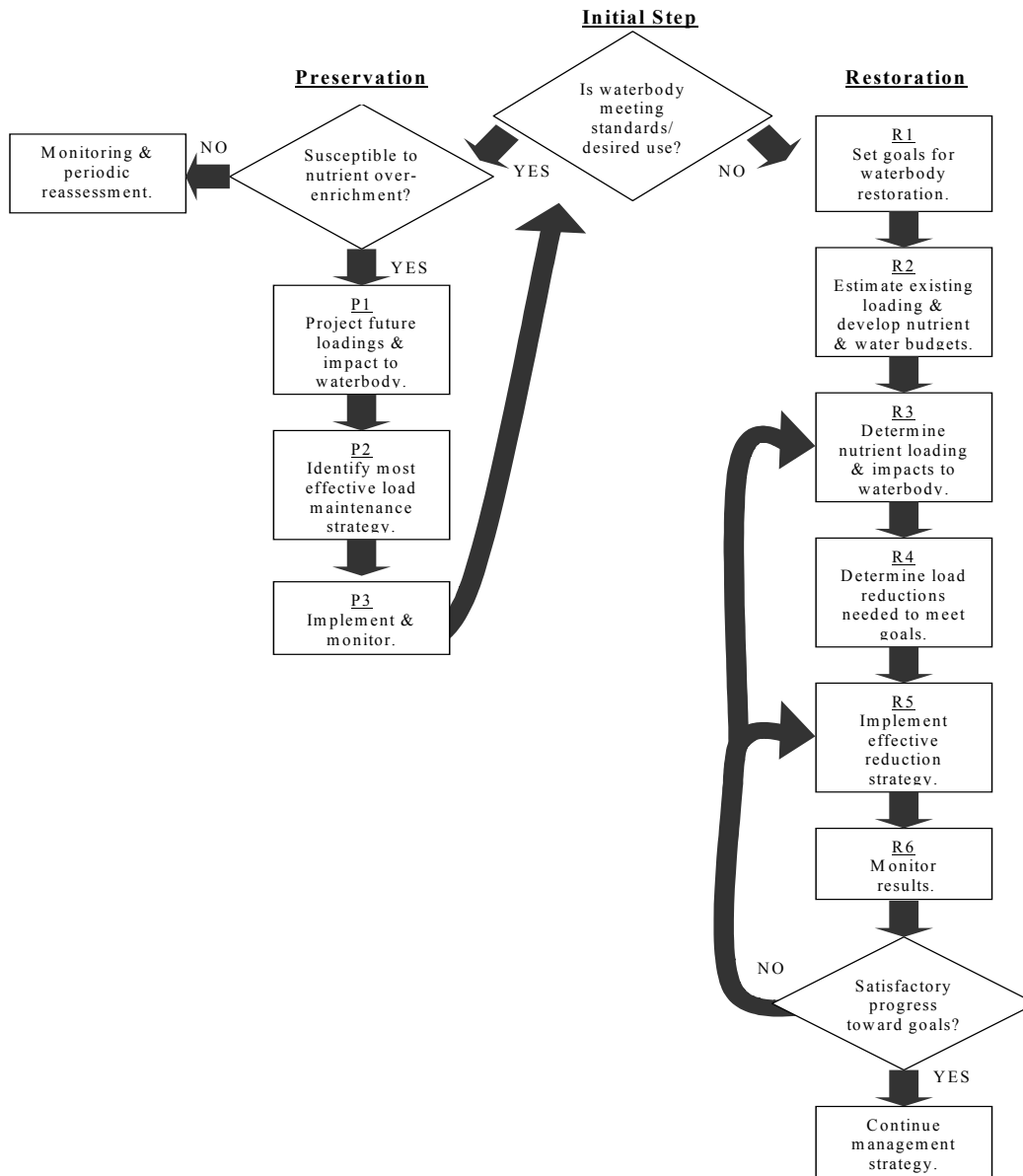
The National Nutrient Management Strategy should coordinate local, state, regional, and national efforts to combat nutrient over-enrichment in coastal areas, with the goal of seeing significant and measurable improvement in the environmental quality of impaired coastal ecosystems.

National Goals

What are reasonable goals for improvement? In the committee's opinion, at a minimum federal, state, and local authorities should work with academia and industry to:

- reduce the number of coastal water bodies demonstrating severe impacts of nutrient over-enrichment by at least 10 percent by 2010;
- further reduce the number of coastal water bodies demonstrating severe impacts of nutrient over-enrichment by at least 25 percent by 2020; and
- ensure that no coastal areas now ranked as “healthy” (showing no or low/infrequent nutrient-related symptoms) develop symptoms related to nutrient over-enrichment over the next 20 years.

Local and Regional Efforts



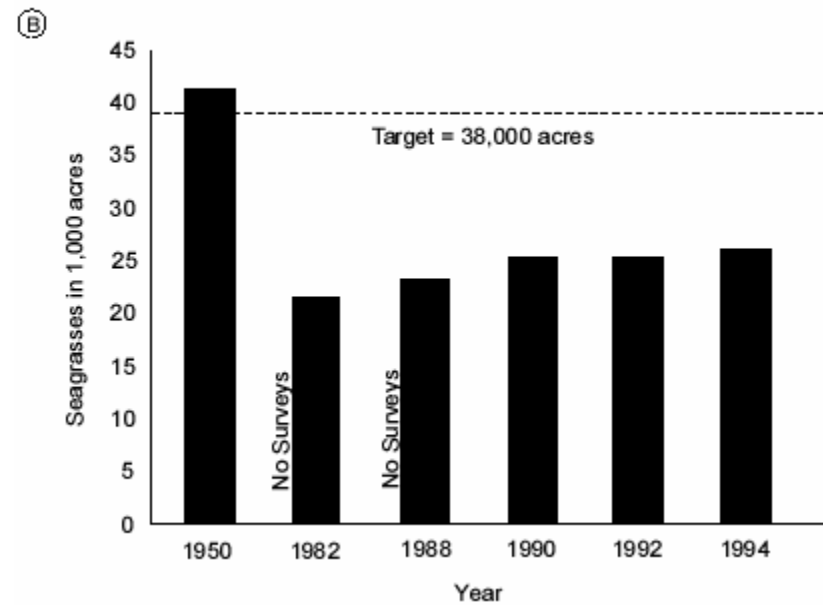
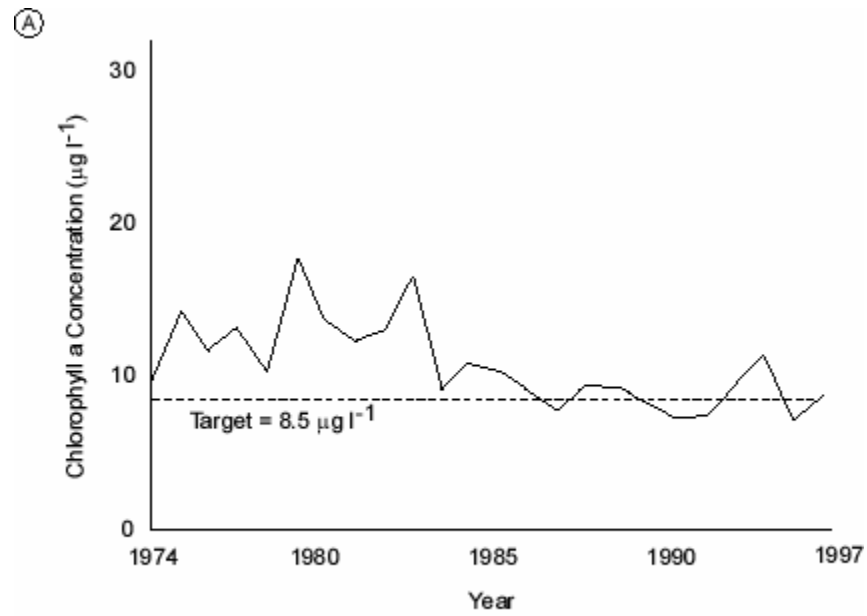
R1. Set Goals for Waterbody Restoration

If restoration is deemed appropriate, the first step is the setting of measurable goals for restoration. Goals can be regulatory (e.g., dissolved oxygen concentrations) or those adopted by stakeholders, such as seagrass acreage or water clarity (Chapter 8). If goals are stakeholder-determined, commitment by the stakeholders to participate in the process is essential for successful implementation.

Existing tools and information include guidance as summarized in a previous NRC report (NRC 1999a), guidance prepared for the National Estuary Programs (EPA 1989), and for lake managers (North American Lake Management Society 1988), and other guidance efforts (Schueler et al. 1996; ASCE and WEF 1998).

Needed resources and research include:

- historical information on the state of the water body in question (so that remediation goals can be more easily tied to previous conditions);
- a compilation of experience from existing programs (to capitalize on the success of other efforts); and
- ambient environmental data (to establish quantitative goals).

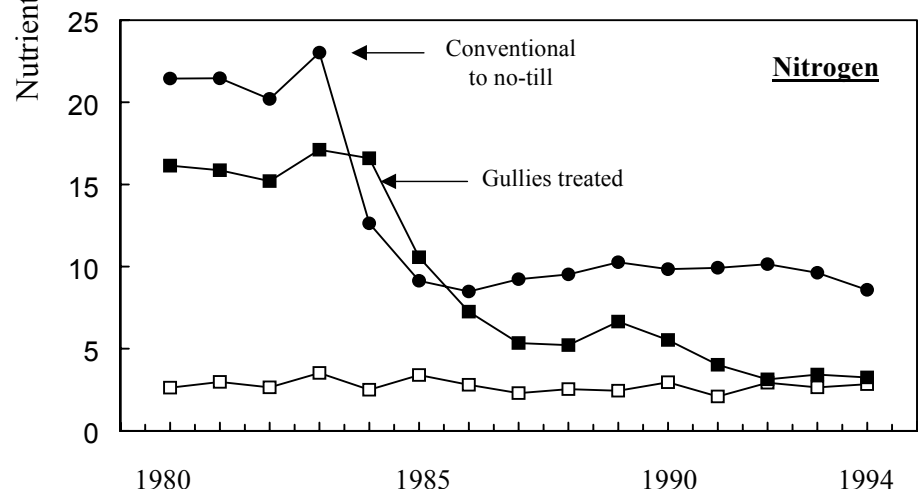
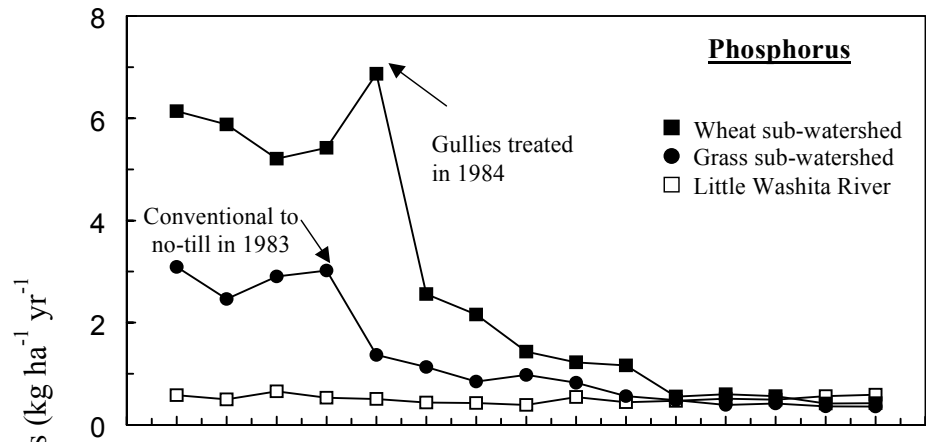


R5. Identify and Implement Most Effective Load Reduction Strategy and Projects

Each watershed and coastal water body will have unique sets of potential strategies (regulatory and non-regulatory) and projects to help meet goals. Strategy development should include consideration of the effectiveness of management practices (Chapter 9), economic assessments and incentives (Chapter 8), and an evaluation of the most cost-effective ways to meet goals (Chapter 8).

Needed resources and research, in addition to many of the recommendations listed in the previous steps, include (among others):

- compilation of economic studies that examine the relative costs of various approaches in a variety of settings, organized so that coastal decisionmakers can more readily identify relevant results and approaches;
- identification, compilation, and making accessible a list of potential management options for each type of source;
- continued development of improved best management practices (Chapter 9);
- evaluation of effective management structures for implementation (Chapter 8);
- and
- continued identification of potential barriers (local, state, and federal levels) and development of ways to address these barriers.



The Federal Role

- Expand monitoring and assessment programs.
- Exert federal leadership on issues that span multiple jurisdictions or threaten federally protected natural resources.
- Address overlaps and gaps in existing and proposed federal legislation and programs.
- Provide data, information, and technical assistance to state and local coastal authorities.

Expand Monitoring Capabilities

The United States lacks a coherent and consistent strategy to monitor the effects of nutrient over-enrichment in coastal settings on a regular and consistent basis. One consequence is that the full economic and ecological impact of nutrient over-enrichment is not currently demonstrable.

The best approach is probably to use a partnership effort by local, state, and federal agencies, as well as academic and research institutions where appropriate. Consistent procedures, criteria, quality control, and data management and reporting are essential.

Estimates of nutrient inputs to estuaries are essential for management, and data on long-term trends on nutrient inputs are invaluable for determining sources of nutrients.

Conduct Periodic Comprehensive Assessments of Coastal Environmental Quality

One key deficiency in the nation's approach to coastal water quality deficiencies is the lack of periodic, comprehensive analysis like the recent NOAA National Estuarine Eutrophication Assessment. In the future, such efforts will be particularly important because they would provide information about how systems have changed, which is critical for understanding whether policy and management choices have been effective in causing improvements.

Thus, the nation needs to conduct a periodic (every 10 years) reassessment of the status of eutrophication in the nation's coastal waters (similar in scope to NOAA's National Estuarine Eutrophication Assessment).

Set Clear Guidelines for Nutrient Load

The development of critical nutrient loads (above which nutrient over-enrichment and eutrophication symptoms may be expected) are essential to successful nutrient management strategies (Chapter 8). EPA's efforts to develop nutrient criteria and TMDLs should incorporate interaction among physical, chemical, and biological factors, seasonal and timing imports, and the nature of hydrologic forcing functions (Chapter 8).

These efforts should, however, focus on identifying sources and setting maximum loads, rather than on limiting the ambient concentration of a given nutrient in a receiving water body (Chapter 5).

Support Local Management Initiatives

The strategies used by local programs and agencies for minimizing the effects of nutrient over-enrichment range from entirely educational and non-regulatory to primarily regulatory. In many instances, the most appropriate approach is a combination of voluntary and regulatory approaches that grant flexibility and are designed to achieve goals at minimum costs.

The local, state, and federal elements of the proposed National Nutrient Management Strategy could provide information and assistance with the development and implementation of effective management at all levels, and a means for objective independent review.

An adaptive management approach, using accessible and emerging tools, knowledge of successful techniques, coupled with and supported by a strong monitoring program, appears to provide the highest probability of long-term success.

Expand and Target Research

The potential impacts of atmospheric deposition of nutrients on coastal waters and its contribution to the effects of nutrient over-enrichment is just beginning to be estimated and fully recognized by local, state, and federal agencies and managers.

In addition to the expanded monitoring effort called for earlier to address the atmospheric deposition of nutrients, additional efforts should also be directed by national programs toward quantifying sources, fate, transport, and impacts (including economic) of atmospheric deposition of nutrients on watersheds.

Furthermore, federal programs that fund basic research (such as EPA, the National Science Foundation [NSF], and NOAA) should provide competitive grants for academic support for research into the role atmospheric deposition plays in nutrient over-enrichment.

Expand and Target Research (cont.)

Additional research is needed to address the relative role that nitrogen and phosphorus nutrients play in specific freshwater and marine systems, and how those roles vary seasonally (Chapter 3).

Greater research effort is needed in order to better understand the role of specific nutrients in the occurrence of various harmful algal blooms, and how toxic algae of all types can endanger fish and birds, as well as humans and other organisms at higher levels of the food web (Chapter 4).

Finally, research is needed that builds understanding of the effects of nutrient inputs on economically valuable resources (e.g., oysters, fish stocks, etc) so we are better prepared to do the analyses necessary to compare costs and benefits and set acceptable restoration goals.