

Free Executive Summary

Nutrient Control Actions for Improving Water Quality in the Mississippi River Basin and Northern Gulf of Mexico

Committee on the Mississippi River and the Clean Water Act: Scientific, Modeling and Technical Aspects of Nutrient Pollutant Load Allocation and Implementation, National Research Council

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Summary

A large area of coastal waters in the northern Gulf of Mexico experiences seasonal conditions of low levels of dissolved oxygen, a condition known as hypoxia. This zone of hypoxia has been persistent since consistent data collection on its distribution and dynamics was begun in 1985. Excess discharge of nutrients—especially nitrogen and phosphorus—into the Gulf of Mexico from the Mississippi and Atchafalaya rivers causes nutrient overenrichment in the gulf's coastal waters and stimulates the growth of large algae blooms. When these algae die, the process of decomposition depletes dissolved oxygen from the water column and creates hypoxic conditions.

The nitrogen and phosphorus nutrient discharges into the gulf's coastal waters derive from many different sources and many different watersheds across the river basin. Numerous federal and state regulatory regimes, organizations, and water quality standards govern nutrient loadings across the river basin and water quality in the Mississippi River and its tributaries. Downstream impacts from specific upstream pollutants are difficult to track precisely and require years of monitoring to detect. The large land mass of the Mississippi River basin, and the large number of U.S. states (31) in the river basin, further complicate the water quality monitoring and management challenges associated with northern Gulf of Mexico hypoxia.

In considering how to implement provisions of the Clean Water Act to strengthen nutrient reduction objectives across the Mississippi River basin, the U.S. Environmental Protection Agency (EPA) requested advice from the National Research Council (NRC) in three areas: (1) initiating nutrient pollutant control programs, (2) identifying alternatives for allocating nutrient load reductions across the river basin, and (3) documenting the effectiveness of pollutant loading reduction strategies on the gulf hypoxic zone and state designated uses. (this committee's full statement of task is listed in Appendix A) Accordingly, the NRC Water Science and Technology Board (WSTB) organized a special committee for this assignment.

This report represents the results of the committee's investigations and deliberations. The committee carried out its project over the latter half of 2008, convening three meetings in the process: a first meeting in July; a second meeting in early September with several guest speakers who provided presentations at a public session; and a third meeting in late September that was closed to the public and at which the committee worked on its draft report.

This summary presents the report's findings and recommendations, which later are discussed in greater detail in the main body of the report.

TARGETING ACTIONS IN PRIORITY WATERSHEDS

Realizing progress toward reducing the areal extent of northern Gulf of Mexico hypoxia will require an acknowledgment that there will be a considerable time lag—roughly a decade, at a minimum—between nutrient reduction actions across the river basin and ecological and water quality responses downstream in the gulf.

Purposeful targeting of nutrient control efforts toward areas of higher nutrient loadings will be essential to realize the greatest initial reductions in nutrient loadings. EPA and the U.S. Department of Agriculture (USDA) should direct conservation programs and other nutrient management resources to priority Mississippi River basin watersheds within higher levels of nutrient loadings. In addition to targeting individual watersheds, those programs should identify specific areas within watersheds where expenditures and actions are more likely to produce initial, positive results.

To improve knowledge regarding point sources' relative contribution of nutrient pollution, EPA should require major municipal and industrial point source dischargers to monitor nutrient concentrations—nitrogen and phosphorus—in effluent at their discharge point as a condition of their National Pollutant Discharge Elimination System (NPDES) permits.

GETTING STARTED: A NUTRIENT IMPLEMENTATION CONTROL INITIATIVE

The EPA and the USDA should jointly establish a Mississippi River basin Nutrient Control Implementation Initiative (NCII). A new Mississippi River Basin Water Quality Center, discussed later in this summary and in more detail in the report, should administer the NCII.

Goals of the NCII should be to:

- Demonstrate the ability to achieve reduced nutrient loadings by implementing and testing a network of nutrient control pilot projects. These projects should be implemented in priority watersheds as part of an adaptive, nutrient control process;
- Evaluate local water quality and other benefits of nutrient control actions;
- Build an institutional model for cooperative research and nutrient control actions among federal, state, and local organizations;
- Evaluate the cost effectiveness, and strengthen the economic viability and community engagement, of various nutrient control actions;
- Compile and communicate best practices as revealed in the pilot projects.

A suite of well-designed NCII projects would represent a research-based effort that could contribute greatly to the development of more effective, cost-efficient solutions to nutrient export problems in the Mississippi River basin. In addition to their evaluative and research dimension, the NCII projects have the potential to contribute to local water quality improvements.

As part of the NCII, the EPA and USDA should identify a select group of Mississippi River basin priority watersheds for initial actions. The selection of priority watersheds should consider, but not necessarily be limited to, the following factors:

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- Watersheds of higher nutrient loadings as identified by results from the U.S. Geological Survey (USGS) SPARROW modeling efforts;
- Watersheds that are sites of current and previous water quality and land use monitoring and evaluation programs and activities, and that possess inventories such as cropland and animal populations; and
- Watersheds that are focal points of conservation activity and interest to the USDA and to state and local parties.

Resources from existing USDA conservation programs—the Conservation Reserve Program (CRP), the Conservation Security Program (CSP), and the Environmental Quality Incentives Program (EQIP)—should be drawn upon to help support NCII pilot projects. Other USDA watershed-based programs, such as the Agricultural Water Enhancement Program (AWEP) and the Cooperative Conservation Partnership Initiative (CCPI), also could be used to contribute to the NCII. The agencies also should consider deploying EPA resources. Although these resources are less than those of the USDA conservation programs, the NCII could use funds from, for example, EPA’s Clean Water Act Section 319 (which covers nonpoint source pollution management) grant program. The NCII also could leverage state matching funds and private sector funding in marshalling financial support for its program and projects.

The NCII projects recommended in this report would cover only a small portion of the higher nutrient yield areas in the river basin. Thus, in and of themselves, the collective reduction in nutrient loadings from NCII projects would have little effect on hypoxia. The NCII is a special, evaluative component of larger nutrient reduction allocation efforts (as described in the following section). Other nutrient control actions and programs across the river basin therefore should not pause or slow their progress in waiting for NCII project development and implementation.

ALLOCATING NUTRIENT LOAD REDUCTION TARGETS

In working toward a load reduction allocation scheme, the EPA, USDA, and the Mississippi River basin states should draw upon the experience in the Chesapeake Bay in allocating nutrient loading caps. In doing so, the following principles for allocating cap load reductions for the Mississippi River basin should be considered:

- Select an interim goal for nutrient load reductions as the first stage of an adaptive, incremental process toward subsequent reduction goals;
- Target watersheds to which load reductions are to be allocated;
- Adopt an allocation formula for distributing interim load reductions to targeted watersheds within the basin that balances equity and cost-effectiveness considerations;
- Allow credit for past progress; and
- Encourage the use of market-based approaches to allow jurisdictional flexibility in achieving allocated load reductions. It bears keeping in mind, however, that such markets do not automatically lead to satisfactory outcomes. Such markets require some regulatory caps on nutrient losses in order to operate.

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MONITORING THE EFFECTIVENESS OF NUTRIENT CONTROL ACTIONS AND POLICIES

Federal and state agencies across the Mississippi River basin sponsor a variety of water quality monitoring programs. At the federal level, much of the water quality monitoring across the Mississippi River basin is overseen by the U.S. Geological Survey. The U.S. Army Corps of Engineers also supports water quality monitoring of the upper Mississippi River. Other interstate bodies, including the Upper Mississippi River Sub-basin Hypoxia Nutrient Committee (UMRSHNC) and the Upper Mississippi River Basin Association (UMRBA) support communication and interstate coordination of many water quality activities. At the state level, state natural resources and water quality agencies conduct monitoring within state boundaries as part of their Clean Water Act responsibilities. There also are numerous experts in water chemistry, water quality modeling, nutrient management, agricultural economics, and water quality administration in the many land grant and other universities across the basin, and within numerous county extension programs in the basin's rural areas. Downstream in the northern Gulf of Mexico, many scientists conduct various monitoring activities within the hypoxic zone. There is a large and extensive body of water quality data for the Mississippi River basin and the northern Gulf of Mexico.

Despite this large body of information and expertise, the water quality database across the Mississippi River basin is uneven and not well coordinated. For example, monitoring of Mississippi River water quality in the ten states along the river is inconsistent, leading to a conclusion that the river is an “orphan” from a water quality monitoring and evaluation perspective (NRC, 2008). State-level water quality efforts cover only a portion—roughly 20 percent according to a 2000 report from the (former) U.S. General Accounting Office—of intrastate rivers and streams. Downstream in the northern Gulf of Mexico, although monitoring efforts there have been very useful in many respects, challenges remain in trying to construct and support a long-term hypoxia monitoring program. The existing data base and monitoring programs across the river basin do not have the level of coordination, resources, and focus required to support the NCII program.

A Mississippi River Basin Water Quality Center

To facilitate implementation of this report's recommendations, a center for Mississippi River Basin Water Quality should be established. The EPA and the USDA should jointly administer the center. The center should be located in the upper Mississippi River basin because this region is the main source of nutrient loadings. The center will represent the nexus of federal interagency, federal-state, and interstate cooperation. Participation of other bodies that play important roles in water quality monitoring—such as the USGS, the U.S. Army Corps of Engineers, and state natural resources and water quality agencies—will be vital to the center's operations and functions. The center should manage a basinwide water quality monitoring, assessment, and nutrient control program and should coordinate and facilitate the following

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functions:

- Plan and administer the Nutrient Control Implementation Initiative (NCII) projects, including financing, evaluation, reporting, and communication of findings;
- Conduct cooperative, basinwide water quality and land use monitoring and relevant analysis and research;
- Develop a land use and land cover data base for the river basin;
- Identify additional watersheds for future actions and inclusion in the NCII;
- Provide advice on water quality variables and statistical approaches to be used in evaluating effectiveness of nutrient control actions;
- Produce periodic reports on basinwide water quality assessment and on project implementation;
- Provide technical assistance and training.

Ensuring Adequate Monitoring in the Northern Gulf of Mexico

Comprehensive and sustained water monitoring in the northern Gulf of Mexico is an essential complement to water quality data from across the river basin and is crucial to documenting the effectiveness of upstream nutrient control actions. Current funding levels and programmatic arrangements, however, do not ensure a commitment to long-term monitoring of northern Gulf of Mexico water quality and the hypoxic zone. Therefore, to augment the efforts of the Mississippi River Basin Water Quality Center, the EPA, the USGS, NOAA, and the Mississippi River basin states should strengthen their commitment to systematic, evaluation-oriented water quality monitoring for the northern Gulf of Mexico.

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POLLUTANT LOAD REDUCTION ALLOCATION AND IMPLEMENTATION**

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This report was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise in accordance with the procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the NRC in making its published report as sound as possible, and to ensure that the report meets NRC institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

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Although these reviewers provided constructive comments and suggestions, they were not asked to endorse the report's conclusions and recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Dr. Frank Stillinger, Princeton University, who was appointed by the NRC Report Review Committee, and Dr. Patrick Brezonik, University of Minnesota, who was appointed by the NRC Division on Earth and Life Studies. They were responsible for ensuring that an independent examination of this report was conducted in accordance with NRC institutional procedures and that all review comments were carefully considered. Responsibility for this report's final contents rests entirely with the authoring committee and the NRC.

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