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Clean Water for Less

Integrated Planning Reduces the Cost of Meeting Water Quality Goals in New Hampshire

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Summary

Rising populations and increased development in New Hampshire coastal communities have led to a decline in water quality in the Great Bay Estuary. Responding effectively and affordably to new federal permit requirements for treating and discharging stormwater and wastewater will require innovative solutions from communities in the area. In March 2015, the Water Integration for Squamscott–Exeter (WISE) project completed an integrated planning framework through which the coastal communities of Exeter, Stratham, and Newfields could more affordably manage permits for wastewater and stormwater. However, meeting maximum goals for nitrogen reduction will require collaboration and commitment from all municipalities in the watershed, whether regulated under the Clean Water Act or not.

KEY FINDINGS

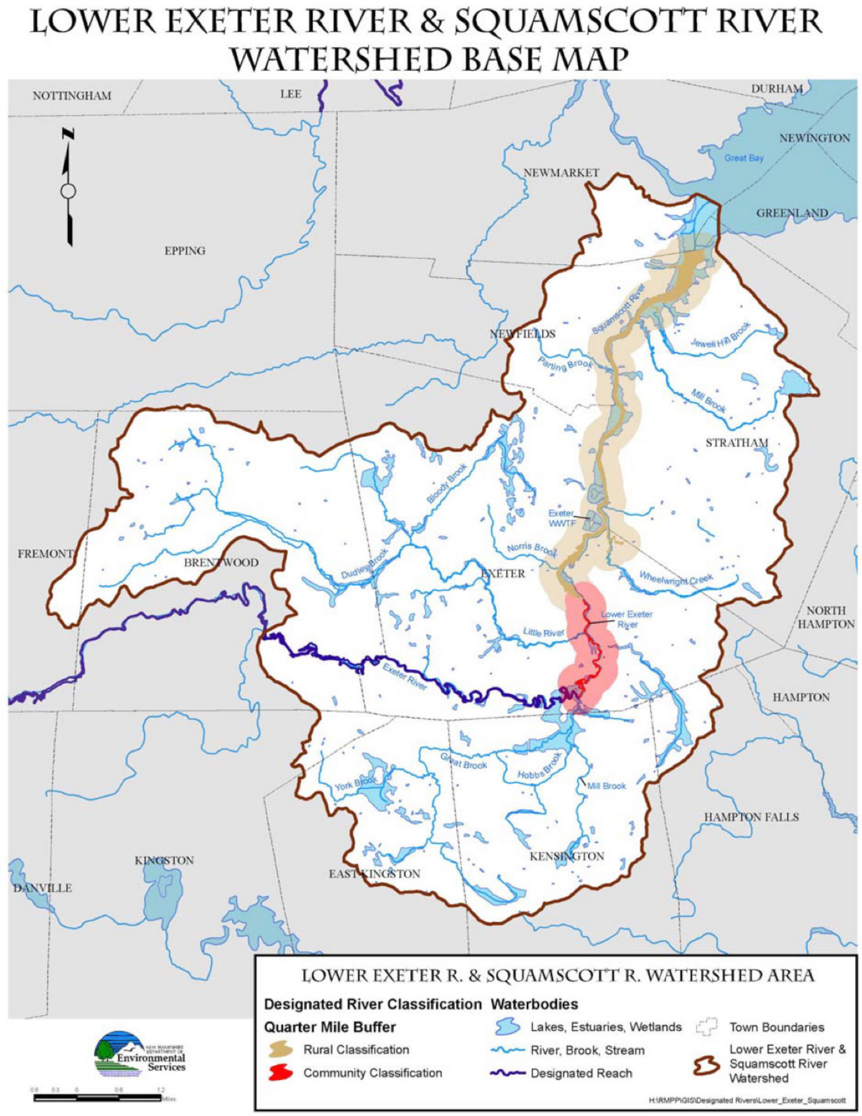
- Integrated planning could save the three New Hampshire communities of Exeter, Stratham, and Newfields over $100 million (in fifty-year lifecycle costs) by prioritizing high-impact, low-cost mitigation strategies across permit type and town boundaries.
- Attainment of water quality standards in the Exeter–Squamscott area will not be possible without substantial cooperation and investment from upstream communities, which are not currently subject to EPA permit requirements.
- Collaboration among communities in planning and implementing projects to meet clean water regulations can have significant cost and effectiveness benefits.

Introduction

The New Hampshire Great Bay Estuary and portions of the tidal rivers that flow into it have been negatively impacted by human development. The Piscataqua Region Estuaries Partnership has identified cautionary or negative conditions or trends in fifteen of twenty-two indicators of ecosystem health.[1] In 2009 many parts of the estuary were listed as "impaired" by the New Hampshire Department of Environmental Services (NHDES) on measures such as nitrogen over-enrichment. Though nitrogen is naturally present in estuarine water, excess amounts support algae growth, decrease oxygen, and ultimately damage aquatic species. Permits now issued by the U.S. Environmental Protection Agency (EPA), which regulates discharges to surface water, require nitrogen controls as low as 3 milligrams per liter (mg/l)—the lowest technically feasible level—on effluent from wastewater treatment plants.[2] Municipalities, EPA regulators, and community stakeholders are now discussing strategies that would allow communities flexibility to integrate permit requirements between wastewater and stormwater, and/or combine requirements among multiple permit holders in order to devise control options that might be more cost-effective.

The enactment of the Clean Water Act (CWA) in 1972, with its ambitious goals to restore the chemical, physical, and biological integrity of U.S. surface waters and to eliminate pollutant discharges by 1985, led to dramatic improvements in water quality, as wastewater and industrial discharges were treated or eliminated. These "point sources" (discharges from a single location, such as a pipe) are now largely regulated through permits that restrict pollutants based on the condition of the receiving water body. However, nonpoint sources, such as agricultural runoff, groundwater, atmospheric deposition, and diffuse runoff from the land are not generally restricted under the Clean Water Act. The regulation of sources generated by multiple parties is difficult, and federal and state agencies are currently working to develop more effective and pragmatic approaches. These include integration among permits, individual or regional watershed-based permitting, and the expansion of regulatory authority to control nonpoint sources. All of these methods are potentially applicable to the Great Bay region.

FIGURE 1. THE EXETER–SQUAMSCOTT WATERSHED



Note: The communities of Exeter, Stratham, and Newfields border the Exeter–Squamscott River. Municipal discharges to the river must comply with stringent nitrogen wastewater discharge permits.
Source: From: The Lower Exeter and Squamscott Rivers, A Report to the General Court New Hampshire Rivers Management and Protection Program, Department of Environmental Services Office of the Commissioner, Febrary 2011.

How Integrated Planning Works

Existing wastewater treatment facilities (WWTFs) in the Great Bay region currently operate under discharge permits which set effluent limits on harmful pollutants. Many communities in the region must also address the discharge of urban stormwater under a municipal separate storm sewer system (MS4) permit. Nonregulated discharges, such as stormwater outside of urban areas, are addressed only voluntarily, if at all, and may be a significant source of pollution. The MS4 permits are not connected to the wastewater treatment permits, and historically little coordination has occurred between the programs.

Integrated planning and integrated permitting allow municipalities to meet multiple permit requirements under an overarching structure that may encompass several municipalities or private parties (see Box 1). The EPA recognizes that meeting the goals of water-related permits individually narrows the options for more cost-efficient approaches to water management.[3] Consequently, the EPA has become receptive to municipal proposals for integrated plans that allow local officials to prioritize actions across multiple permits. Recently issued WWTF permits to the towns of Exeter and Newmarket in southern New Hampshire include provisions that allow nitrogen reductions from both regulated and nonregulated stormwater and nonpoint sources to be used to meet permit limits. The communities are still required to upgrade their wastewater facilities, but they may, for example, be able to avoid some costs associated with reducing nitrogen levels in wastewater by reducing nitrogen levels in stormwater. Additional cost savings could derive from a regional approach that meets targeted reductions by prioritizing lower-cost treatments across a larger landscape.

The Exeter–Squamscott Watershed

The Exeter River, in southeastern New Hampshire, runs approximately 30 miles from the town of Chester to the Great Dam in downtown Exeter. Below the dam the river is renamed the Squamscott, and forms part of the Great Bay tidal estuary (Figure 1).

The watershed encompasses 80,000 acres and includes portions of thirteen municipalities. The lower Exeter–Squamscott River subwatershed, which includes the communities of Exeter, Stratham, and Newfields, encompasses 19,000 acres—24 percent of the total—but generates nearly 50 percent of the nitrogen released to the river (Figure 2).

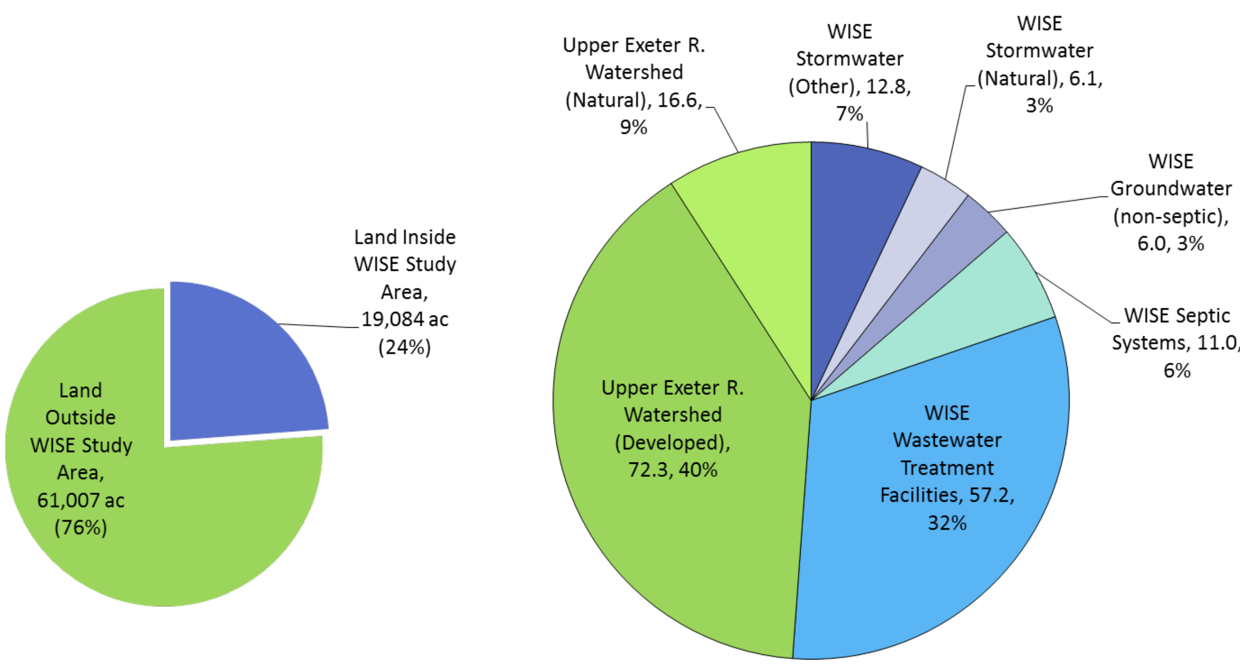
Box 1: Definitions

Integrated Planning—Individual permits are issued, but permit requirements are combined under a local agreement, such as a memorandum of understanding.

Integrated Permitting—A single permit combines obligations from multiple permits. The permittees are mutually obligated to meet requirements. For instance, stormwater and wastewater obligations for one or more communities could be combined.

Watershed-Based Permitting—A single permit is issued to all of the entities within a watershed region.

FIGURE 2. SOURCES OF NITROGEN IN THE SUBWATERSHED



Note: Exeter, Stratham, and Newfields generate approximately 50% of the nitrogen load to the Exeter–Squamscott River. The remaining inputs come from developed and natural land in the upper watershed. Loads are in tons per year.

Only two of these municipalities, Exeter and Newfields, currently generate wastewater discharges that require EPA permits. Stratham is unregulated now, but it has been notified of a pending MS4 permit requirement.

In 2013, the Water Integration for Squamscott–Exeter (WISE) project[4] was initiated to develop a framework for an integrated nitrogen control plan for these communities. The project brought together municipal decision makers, the Rockingham Planning Commission, the Great Bay Estuarine Reserve, university researchers, and engineering consultants to work with state and federal regulators to identify permit elements amenable for integration and to develop scenarios combining alternative levels of treatment that would be acceptable to the regulatory agencies. The project team developed nitrogen control strategies for a range of potential scenarios based on permit requirements, cost, effectiveness, and input from municipalities and agencies. Scenarios included a wastewater treatment facility upgrade that would reduce the total nitrogen concentration in effluent from 20mg/l to 8mg/l, and an option that would remove all effluent from the river through a regional treatment plant in another location. Each scenario also included optimized reduction strategies to address loads from stormwater (both MS4 and unregulated stormwater), septic systems, agriculture, and other nonpoint sources. All scenarios were reviewed by the participating municipalities and agencies to ensure that the alternatives were plausible and could potentially be implemented.

What Is the Advantage of Integrated Planning?

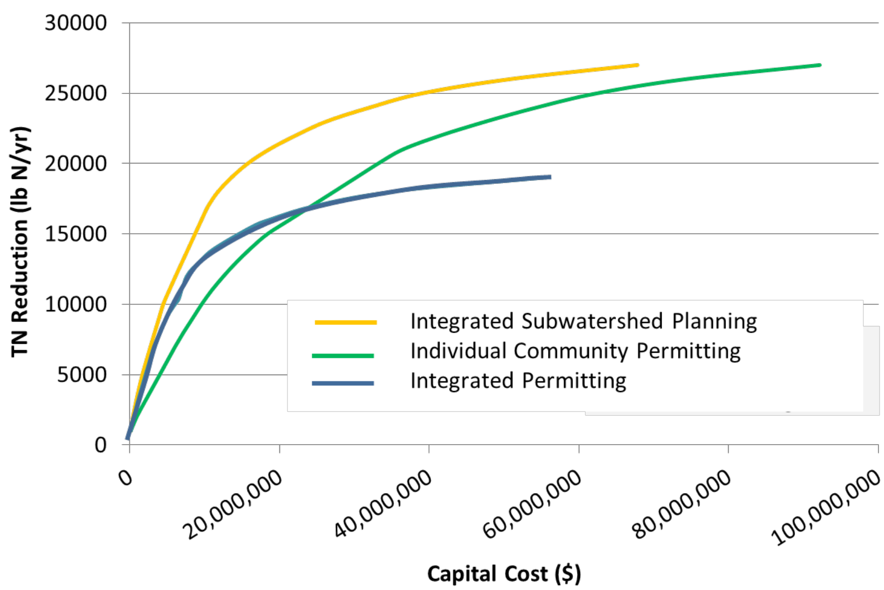
If communities work together, they can prioritize nitrogen reduction strategies across the watershed, starting with the most cost-effective actions. Figure 3 shows the capital cost associated with three scenarios: integrated subwatershed planning, where the three communities work to meet all permit requirements together; individual community permitting, where each community addresses each of its permits separately; and integrated permitting, where one community (Exeter) combines requirements for two permits, without coordinating with other communities. The WISE cost analysis found that the greatest degree of cooperation—integrated subwatershed planning—leads to the greatest cost savings.

Fifty-year lifecycle costs, which include facility operations and maintenance, are estimated at $100 million–$220 million for the three communities (Figure 4). Integrated subwatershed planning presents a potential cost benefit of over $100 million. Much of the savings is achieved by applying the most cost effective treatments first, regardless of municipal or permit boundaries.

What Are the Drawbacks to Integrated Planning?

Integrated planning allows flexibility in both the timing and methods used to meet the required pollutant load reductions, but it can be enforced only to entities that are *already subject to permits*. In order to meet recommended

FIGURE 3. COST DIFFERENTIAL ASSOCIATED WITH THREE PERMITTING APPROACHES



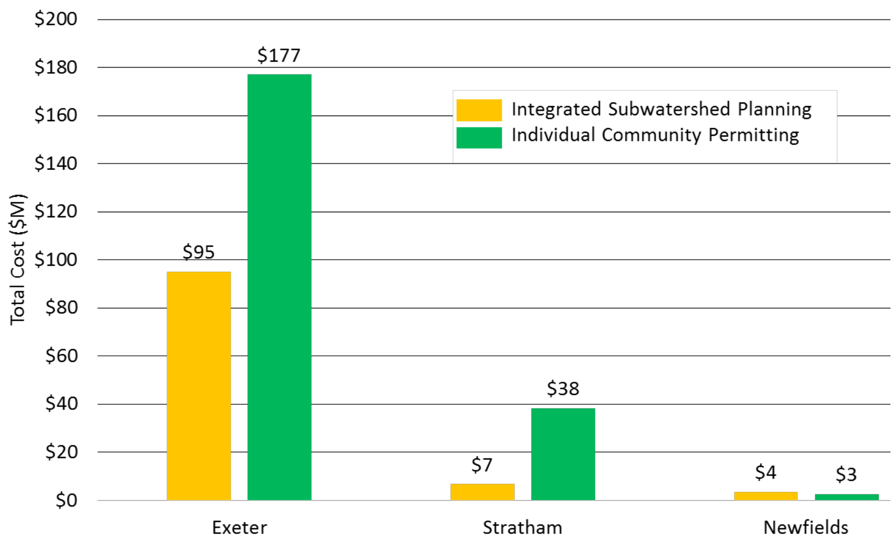
Note: Subwatershed integrated planning has a lower total capital cost and reaches maximum reduction more efficiently.

nitrogen pollutant load targets in Great Bay, load reductions in the range of 42 to 88 tons per year are needed in the Exeter–Squamscott River. If the three communities in this study extensively upgrade their wastewater plants and reduce stormwater and nonpoint source inputs from all impervious cover through intensive stormwater controls, they still will not be able to achieve the more stringent target. Attainment of the full 88-ton reduction in the Exeter–Squamscott watershed will require substantial cooperation and investment from upstream communities, none of which are currently subject to regulation (Figure 5).

Policy Implications

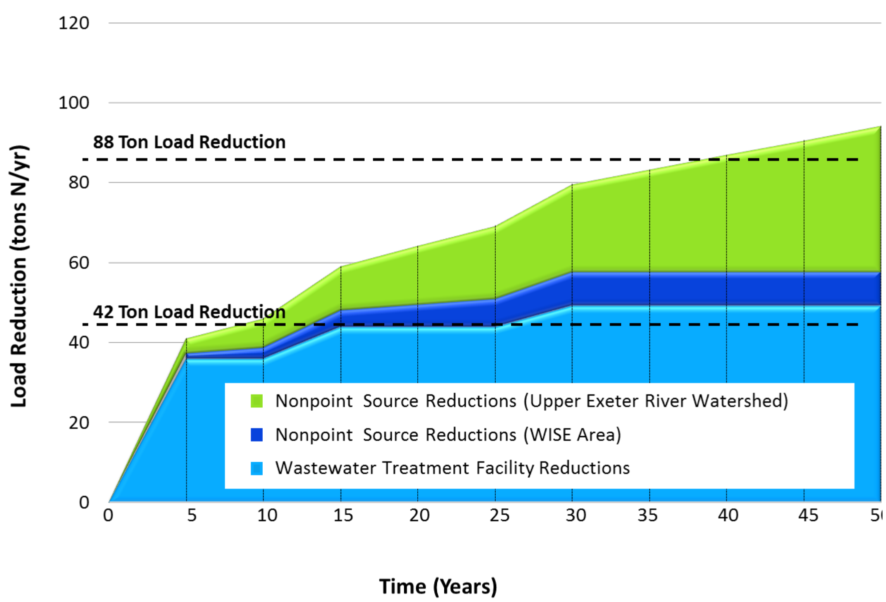
The long-term cost savings from integrated watershed approaches and the underlying flexibilities offered by the EPA support the adoption of integrated approaches for meeting water quality goals. However, this option requires collaboration and commitment from all municipalities in the watershed whether regulated under the Clean Water Act or not. Voluntary participation by nonregulated towns will require substantial financial investment that towns may be reluctant to support. Incentive programs that reward nonregulated communities could provide a mechanism for equitable sharing of management actions, but these incentives require substantial funding or innovative financing.

FIGURE 4. FIFTY-YEAR LIFECYCLE COSTS FOR WASTEWATER AND STORMWATER CONTROL IN THE SUBWATERSHED



Note: Long-term cost savings will exceed $100 million across the three towns.

FIGURE 5. SCOPE OF PARTICIPATION REQUIRED TO MEET MAXIMUM NITROGEN-LOAD-REDUCTION GOALS



Note: Upgrading wastewater treatment plants and addressing sources of nonpoint pollution in the three communities (blue) can attain a load reduction of approximately 55 tons/year. Reaching the more ambitious target of 88 tons (green) will require cooperation from unregulated upstream communities.

If cooperative planning and management ventures are not effective at meeting existing Clean Water Act requirements, federal or state regulatory authorities may be required to invoke additional elements of the Clean Water Act that could force the participation of nonregulated communities. These include residual designation authority, which puts unregulated nonpoint sources under a permit similar to a stormwater permit; application of state antidegradation policies, which can prohibit the discharge of any new sources of a pollutant to an impaired water, including sources related to development; and development of a total maximum daily load, which is the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.

The permitting alternatives discussed in the WISE plan are limited to meeting current and anticipated regulatory requirements for Exeter, Stratham, and Newfields, but these three regulated communities alone cannot achieve the highest nitrogen reductions currently proposed. Alternatives such as residual designation, which has been applied only in New England (and in only a few locations including Portland, Maine, and the Charles River in Boston) and antidegradation would impose significant management and enforcement burdens. Preemptive action through municipal collaboration and engagement of unregulated communities may be necessary to forestall the escalation of EPA enforcement mechanisms.

Methods and Data

This analysis is based on data gathered under a collaborative research program in which scientists and municipalities worked closely together to define the problem, develop the methods, and interpret the results. A coordinating team composed of staff from Geosyntec Consulting, the University of New Hampshire, the Great Bay National Estuarine Research Reserve, and the Rockingham Planning Commission led the project and developed technical information and products. The coordinating team met frequently with the full project team, which included decision makers from the municipalities, representatives from the Environmental Protection Agency, the New Hampshire Department of Environmental Services, and other parties (such as representatives from agriculture and local watershed groups) as appropriate. The collaborative process was facilitated by The Consensus Building Institute to ensure that project outcomes and outputs incorporated input from the full team. The authors of this brief were members of the coordinating team and have expertise in engineering, hydrology, and water resource management, representing consulting (Robert Roseen and Renee Bourdeau), the University of New Hampshire (Alison Watts), and the Great Bay National Estuarine Research Reserve (Paul Stacey).

The data presented in this brief are discussed in detail in *Appendix B – Pollutant Load Modeling Report* of the WISE Plan.[4] Cost data for the WWTF upgrades are based on reports commissioned by the towns of Exeter and Stratham.[5,6] Cost and performance data for nonpoint treatment were derived from a range of existing sources, and include information from national and local studies).[7,8,9,10,11] Pollutant load values were obtained from literature screened to select values appropriate for the region of interest,[12, 13, 14, 15] then averaged to yield a single value for each land use. All data input was reviewed by the full project team and additional stakeholders (for example, representatives from local agricultural operations) to ensure that the selected values were reasonable and appropriate for specific application in this study. Watershed pollutant loads were modeled using the EPA's SWMM model[16] and NHDES's Great Bay Nitrogen Non-Point Source Study.[9]

Endnotes

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