Appendix K

Case Studies

Appendix K-1
Surface Water Aeration Example

Area Residents Keep Shelburne Beach Open
Unnamed Tributary to Shelburne Beach, VT

Waterbody Improved

Bacteria leaking from residential septic systems caused exceedances of Vermont's *E. coli* criteria in a tributary to Shelburne Beach, resulting in occasional beach closures. As a result, Vermont placed the one-mile unnamed tributary on its section 303(d) list for *E. coli* in 1998. The Town of Shelburne identified the potential source of the bacteria, prompting improvements to a number of residential septic systems along the stream. Subsequent monitoring data showed that the stream and beach consistently met water quality standards, and the tributary was removed from the state's 303(d) list in 2004.

Problem

Shelburne Beach is a town swimming beach on a central portion of Lake Champlain in the town of Shelburne, Vermont. The state has classified the beach and the unnamed tributary to the beach as class B waters—a designation defined as "suitable for bathing and recreation, irrigation and agricultural uses; good fish habitat; good aesthetic value; acceptable for public water supply with filtration and disinfection."

The town monitors *E. coli* levels at the beach, including at a station at the mouth of the tributary, about 20 times a year during the swimming season, to check for compliance with Vermont's *E. coli* criteria. The criteria are 77 colony-forming units (cfu) per 100 milliliters for Class B waters. Among other purposes, the *E. coli* standard is designed to protect human health by preventing exposure to harmful levels of pathogens. Monitoring results for a number of years in the mid- to late 1990s indicated occasional exceedances of the *E. coli* standard at the monitoring station at the tributary mouth, causing occasional closures of the beach. The high *E. coli* counts resulted in the state's adding the unnamed tributary to the 303(d) list in 1998.

Coordinated efforts by area residents to control bacteria levels permit the continual enjoyment of Shelburne Beach

Project Highlights

In 1997 the town commissioned a study to find the source of the bacteria in the tributary, and the study identified six residential septic systems along the stream as the most likely source. Based on the findings of the study, the town encouraged the homeowners of concern to correct the deficiencies in their septic systems. Between 1998 and 2001, all six homeowners rebuilt their systems by installing new tanks and leach fields.

Results

The data summarized in Table 1 show that the *E. coli* standard was exceeded occasionally during the years 1996 to 1999. Although data are not available for 2000 and 2001, the data for 2002 and 2003 (following septic system improvements) show that the Vermont water quality standards for *E. coli* were met 100 percent of the time during those years. Accordingly, the state removed the tributary from the 303(d) list in 2004.

Partners and Funding

The restoration work in this case was funded by the Shelburne homeowners, who together spent approximately $90,000 to rebuild their on-site septic systems. The Town of Shelburne supported this work with seasonal bacteria monitoring and funding for the study that identified the bacteria source. Vermont Department of Environmental Conservation staff, funded with section 319 funds, provided some technical assistance to the town during the source-tracking phase.

Table 1. Summary of *E. coli* data at the mouth of the southern tributary to Shelburne Beach

Year	Number of samples taken throughout the season	Number of samples that exceeded Vermont's *E. coli* criterion of 77 CFU/100 mL	Average *E. coli* count for samples that exceeded criterion(CFU/100 mL)	Number of days beach was closed to swimming
1996	31	1	240	1
1997	28	3	197	1
1998	26	3	3,033	4
1999	16	1	130	0
2002	21	0	--	0
2003	21	0	--	0

U.S. Environmental Protection Agency
Office of Water
Washington, DC

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ALBEMARLE REGION, NORTH CAROLINA

PROBLEM

Rivers and streams of the Albemarle Region of North Carolina are nutrient-sensitive and require nutrient input controls such as upgrades for wastewater treatment plants and septic systems. Both strategies are being pursued by state and local officials. Much of the area is unsuitable for conventional gravity-flow individual systems due to low-permeability clay soils and high water tables. In past decades, these limitations prompted the extensive use of sand-lined trench leaching systems in the region. A 1991 study found that 30% of those systems were malfunctioning and posing risks to groundwater and surface water quality.

SOLUTION

Local governments authorized a regional management entity to inventory and monitor individual wastewater systems, improve system management, and develop site-specific design criteria for new and replacement systems incorporating advanced treatment technologies.

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OVERVIEW

Individual wastewater system malfunctions, water quality risks, and the explosive growth experienced in the Albemarle Region prompted 11 North Carolina counties to form the Albemarle Septic Management Entity (ASME) in 1993. ASME has instituted a management program that consists of:

- **Routine inspections**
- **Use of advanced treatment system designs for difficult site conditions**
- **Maintenance contract requirements and reminders**
- **Operating permit requirements for advanced units**
- **Alternating drainfields and reserve areas**

MAINTENANCE AND INSPECTION AGREEMENTS

ASME oversees individual and clustered systems in an 11-county area. ASME requires owners of all advanced and innovative systems to enter into inspection and maintenance agreements with the program. In addition, ASME requires that all repaired or replaced systems be included in the system management service area.

ASME works with low-income system owners to identify grant and low-interest loan funding to address repairs and replacements for problem systems using a combination of Community Development Block Grants, the North Carolina Clean Water Trust, and other sources.

ASME inspects systems in its jurisdiction at least annually. The system owner must complete all repair and maintenance activities. If an owner fails to make repairs, ASME is authorized to make the needed repairs and bill the owner and, if needed, place a lien on the property until payment is secured.

OPERATING PERMITS FOR ADVANCED SYSTEMS

ASME allows the use of advanced pressure-dosed systems, which incorporate fixed aerobic film and/or suspended growth pretreatment followed by soil absorption. Advanced systems require an operating permit. The local health department issues operating permits in accordance with state and local rules.

FUNDING SOURCES

The annual budget for the ASME wastewater program is $290,000. The program is sustained through its $300 per home permit fees, annual $50 system inspection fees, and county funds.

RESULTS

Local officials note that the management entity has prevented system malfunctions through more rigorous design, inspection, and operation/maintenance requirements. In the early 1990s, estimates of system malfunctions ranged as high as 30%. During 2007–2008, the program inspected 2,153 of the 4,240 systems under its management purview, and fewer than five of the newly installed systems were found to be malfunctioning.

New system installations and increasing the number of properly functioning systems through inspections will help to reduce nutrient pollution in the Albemarle watershed.

References and Resources

Hollowell, R. 2001. The Public Management Entity Program: Albemarle Regional Health Service. 2001 National Onsite Wastewater Recyclers Association Meeting, Preconference Workshop; Virginia Beach, VA.

Hughes J., and Simonson, A. 2005. Government Financing for Onsite Wastewater Treatment Facilities in North Carolina. **www.sog.unc.edu/pubs/electronicversions/pg/pgfal05/article4.pdf**.

FAIRFAX COUNTY, VIRGINIA

PROBLEM

During the past three decades, the population of Fairfax County has grown to more than one million people. With sanitary sewers at or near capacity, the number of individual wastewater systems began to multiply, eventually rising to more than 24,000. Inappropriately sited, improperly designed, and/or poorly managed individual systems have the potential to contribute to the pollution and degradation of the county's 900 miles of perennial and intermittent streams and a number of freshwater lakes and ponds.

SOLUTION

Fairfax County adopted an ordinance requiring routine pumping of septic tanks every five years and alternating drainfields and drainfield reserve areas to ensure system performance.

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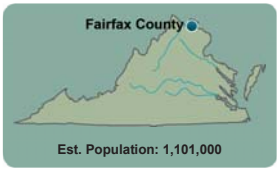

OVERVIEW

Fairfax County's decentralized wastewater management program has evolved since the first measures to improve onsite treatment were enacted in 1928. The program now includes:

- **A treatment system inventory and database**
- **Requirements for alternating drainfields and reserve areas**
- **Tank pump-outs at least once every five years, and pump-out manifests provided to the county health department**

ALTERNATING DRAINFIELDS AND RESERVE AREA

The Fairfax County Health Department issues permits and provides inspections and evaluations for new and existing individual wastewater system repairs and expansions. All new and repaired systems are designed with a flow diversion valve to allow portions of the drainfield to dry out; this improves treatment and avoids soil saturation problems. A suitable reserve area is required in the event that the system needs to be repaired or replaced.

FIVE-YEAR PUMP-OUT AND MANIFEST SYSTEM

An ordinance specifies that septic tanks must be pumped every five years. The service provider and the system owner both provide copies of the pump-out manifests to the county health department which tracks maintenance. The information is maintained in a database and is used to track compliance with the local ordinance. The database generates five-year pump-out reminder notices that the Health Department mails to system owners. The health department also offers $200 individual system inspections if required by a mortgage lender at the time of property transfer.

FUNDING SOURCES

Fairfax County sustains its annual $1.5 million onsite program through user fees and dedicated funds. The fees cover approximately 30% of the program costs. The remainder is financed through dedicated state and local funds.

RESULTS

A recent study found that the average malfunction rate for systems in the county was only 2.1% of the 15,401 systems reviewed. In addition, many systems thought to have outlived their life expectancy are still functioning satisfactorily.

The creation of a database for system inventory has allowed the county to track septic tank pump-outs and categorize all systems according to system type, greatly assisting the enforcement of existing codes and regulations. The use of alternating drainfields has increased the average lifespan of sewage disposal systems.

The five-year pump-out requirement has resulted in better maintained systems and the identification of system malfunctions that would otherwise go undetected. As a result of these measures, fewer owners are facing costly major repairs or system replacements.

Through its program, Fairfax County now better understands and manages its many onsite systems even in light of a fast-growing population.

References and Resources

Fairfax County Stream Quality Assessment Program. **www.fairfaxcounty.gov/dpwes/stormwater/streams/assessment.htm**.

Fairfax County, Virginia. 2008. Environmental Improvement Program (EIP) Section E: Fact Sheets. Fiscal Year 2010. **www.fairfaxcounty.gov/living/environment/eip/2010eip/factsheets.pdf.**

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JAMESTOWN, RHODE ISLAND

PROBLEM

Jamestown is a small, island town dependent on private drinking water wells and individual wastewater systems. Poorly maintained onsite wastewater systems on undersized lots with high seasonal water tables were affecting groundwater quality. Studies revealed that 32% of the wastewater treatment systems in the area were contributing to nutrient and pathogen problems in private water wells (Legislative Press and Public Information Bureau, 2006).

SOLUTION

Jamestown adopted an ordinance requiring routine inspections of individual wastewater systems. A High Groundwater Table District also guides future development to protect drinking water quality.

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OVERVIEW

Jamestown is located on a small island situated in the middle of Narragansett Bay in Rhode Island. It is approximately nine miles long and one mile wide. In 2001, Jamestown passed an ordinance to better accommodate growth and manage individual wastewater systems to protect its fresh water supplies. The program consists of:

- **Routine inspections**
- **Maintenance reminders**
- **Web-based system database**
- **Siting and installation rules**
- **Designation of a High Groundwater Table District**

MAINTENANCE INSPECTIONS AND WEB-BASED TRACKING

Jamestown's program provides a framework for the inspection, maintenance, and repair of individual wastewater systems. The town conducted an initial round of inspections in 2003 aimed at identifying and evaluating the condition of 1,608 individual systems. Jamestown then began a routine maintenance inspection program in 2006 under which systems are inspected every three or five years based on size, type of system, and water use. Inspectors record the inspection information in the town's web-based database. The town has the authority to pump tanks at the owner's expense and, if necessary, can place liens on property for failure to reimburse the town for the pump-out.

HIGH GROUNDWATER OVERLAY ZONE AND IMPERVIOUS LAYER DISTRICT

Jamestown adopted a High Groundwater Overlay Zone and Impervious Layer District Ordinance in 2003. The ordinance applies to designated areas in the town that have substandard-sized lots served by private wells. Provisions of the ordinance include a total impervious surface area limit of 15% (calculated for individual lots and excluding wetlands), a requirement to control runoff volume—using low-impact techniques—to maintain predevelopment infiltration for a 25-year storm, and a mandate to use advanced wastewater treatment technologies capable of 50% nitrogen removal.

FUNDING SOURCES

Jamestown's program is funded through an annual user fee of $30 paid by system owners. The fee funds the town's part-time wastewater management specialist.

RESULTS

- **To date, 94% of all septic systems have had an initial maintenance inspection.**
- **Of the systems inspected:**
  - **35 failed (2%)**
  - **85 (5%) were found to be substandard systems (e.g., cesspools, systems with steel tanks)**
  - **1,488 passed (93%)**
- **Since 2003, 50 systems have been subject to repair/replacement actions initiated by the town.**

Property owners are responsible for ensuring that their system is operating properly and that it is maintained in good repair. Systems that do not meet applicable performance requirements can be subject to a repair or replacement order. Addressing malfunctioning systems helps to reduce nitrogen and pathogen pollution that pose threats to Jamestown's drinking water sources.

References and Resources

Jamestown Source Water Assessment and Wastewater Needs Analysis. University of Rhode Island Cooperative Extension. **http://www.uri.edu/ce/wq/RESOURCES/dwater/Assessments/PDFs/James_Chapters%203,4.pdf.** Accessed August 9, 2010.

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KEUKA LAKE WATERSHED, NEW YORK

PROBLEM

Approximately 20,000 residents in the Keuka Lake watershed rely on groundwater and the lake for their drinking water. Nearly all of the residents in the watershed also depend on individual wastewater systems that are densely positioned and that discharge to the soil for treatment. However, testing revealed that poorly maintained individual onsite systems were contributing excessive levels of bacteria to the lake and contaminating drinking water wells.

SOLUTION

Eight municipalities formed a regional watershed cooperative that implemented a uniform permitting and inspection program to identify and repair or replace malfunctioning treatment systems. As a result, Keuka Lake's water quality ranks among the highest of the water bodies in the Finger Lakes region.

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OVERVIEW

In 1994, eight municipalities—Barrington, Jerusalem, Hammondsport, Milo, Penn Yan, Pulteney, Urbana, and Wayne—bordering Keuka Lake formed the Keuka Watershed Improvement Cooperative (KWIC) to better manage individual and decentralized wastewater systems in the region. KWIC has instituted a management program that consists of:

- **Uniform regional ordinances**
- **System inspection requirements based on health and environmental risk factors**
- **Maintenance contract requirements for mechanized units**
- **Operating permit requirements for new or modified systems**

ROUTINE INSPECTIONS AND MAINTENANCE CONTRACTS

Municipalities participating in the KWIC program must adopt a uniform wastewater management ordinance and hire a coordinator to inspect treatment systems in their communities. All 3,000 wastewater systems within 200 feet of Keuka Lake or its tributaries are inspected at least once every five years. Inspection reports are filed with KWIC. Aerobic and advanced treatment systems are inspected annually, at which time the system owner must show evidence of an active maintenance contract. Systems are also inspected when property is sold.

The regional ordinances require a KWIC operating permit for all new or modified individual wastewater systems. A system that is malfunctioning must be repaired to meet specific performance requirements. Additionally, KWIC could require the system owner to upgrade or replace the malfunctioning system using the best available technology.

KWIC utilizes a computerized database to track inspections and system compliance. KWIC reviews lake water quality information and evaluates the performance of advanced systems. KWIC's enforcement authority includes fines and compliance timetables in addition to corrective actions.

FUNDING SOURCES

The KWIC program is financed by permit fees and dedicated funds from each municipality's budget. The program's annual budget is $70,000.

RESULTS

Water quality monitoring results indicate very good lake conditions, though runoff from stormwater and agricultural sources after storm events can result in high bacteria levels. The relatively clear water in the lake contains low nutrient levels and supports excellent fisheries. Monitoring results from 2005–2009 show lake water quality improving or holding steady for nearly all parameters. The local lake association attributes this progress, in part, to the septic system inspection program.

References and Resources

Keuka Lake Association. 2001. Phase II, Keuka Lake Sewage Study. **www.keukalakeassoc.org**.

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