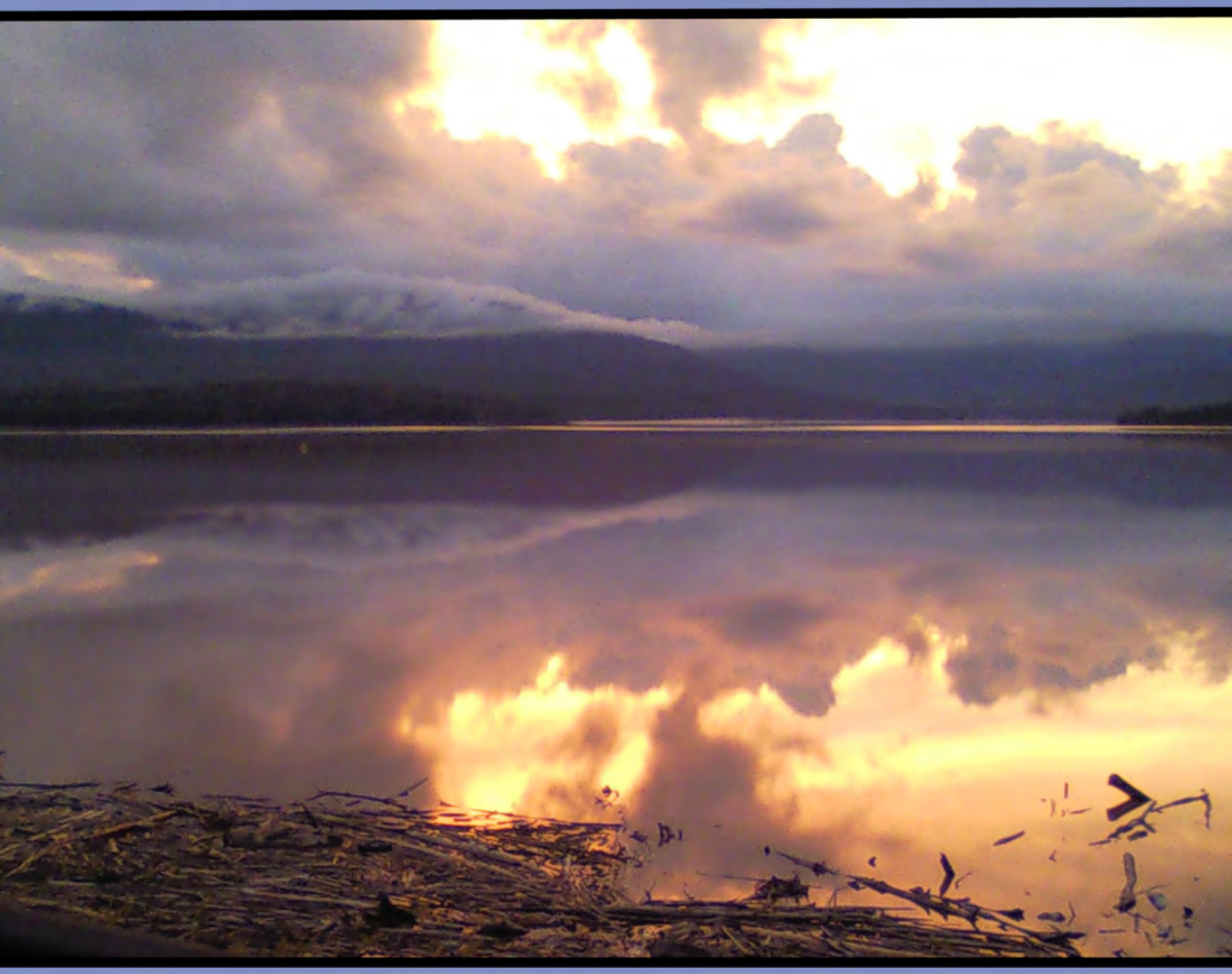
New York City Department of Environmental Protection



Filtration Avoidance Annual Report

for the period January 1 through December 31, 2013

March 2014

Prepared in accordance with the July 2007 Filtration Avoidance Determination

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Cover photo by Aron Thomas, NYCDEP

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1. Introduction

In 2013, New York City continued to implement a broad array of initiatives as part of the City's source water protection program. It marked the seventeenth year of program implementation since the signing of the landmark New York City Watershed Memorandum of Agreement (MOA) in 1997. Since then, DEP has committed more than $1.5 billion in capital funds, plus significant annual expenses and countless staff hours, to sustain the pristine quality of the source waters of the Catskill and Delaware watersheds.

Founded on the notion that the most cost-effective way to provide high quality water is to protect it at its natural source, DEP's programs have become a national and international model. Each year water and public health professionals come from around the globe to study the City's source water protection strategies. A key element of the success of the program has been the development of strong relationships with watershed communities, locally-based organizations, environmental groups, and federal, state, and local government agencies.

The cornerstone of DEP's source water protection program is extensive research by DEP scientists into existing and potential sources of water contamination. As part of DEP's source water monitoring program, tens of thousands of samples are collected annually throughout the watershed. Each year DEP performs hundreds of thousands of laboratory analyses. Based on the information collected through its monitoring and research efforts, DEP has crafted a watershed protection strategy that focuses on implementing initiatives that are both protective (antidegradation) and remedial (specific actions designed to reduce pollution generated from identified sources).

In the late 1980s and early 1990s, DEP's assessment of potential sources of pollutants pointed to several key areas: waterfowl on the reservoirs, wastewater treatment plants discharging into watershed streams, farms located throughout the watershed, and stormwater runoff from development. DEP's protection strategy targets and has had significant success controlling these primary pollution sources, as well as a number of secondary ones.

As reported last year, in 2011 DEP completed its most recent Watershed Protection Program Summary and Assessment (the Assessment) (DEP 2011a), and submitted a revised Long-Term Watershed Protection Plan (the Plan) (DEP 2011b) to the New York State Department of Health (NYSDOH). The Assessment summarized the previous five years of implementation of the source water protection program, and provided an in-depth analysis of water quality status and trends. All signs point to the continued effectiveness of the City's overall program; source water quality remains high. The Plan laid out DEP's proposed source water protection activities for 2012 through 2017, the second five years of the current Filtration Avoidance Determination (FAD) (USEPA 2007). The Plan builds on the existing programs and includes significant commit-

ments to continue implementation in the coming five years. DEP had anticipated that an update to the 2007 FAD, based on the 2011 Plan, would be issued in 2012 by NYSDOH. While the FAD update did not occur, DEP has continued to implement the core components of the watershed protection program without interruption. In addition, even in the absence of a revision to the FAD, DEP has committed significant funding and proceeded with key contracts to advance the program proposals contained in the 2011 Plan.

In August 2013, NYSDOH published a draft revised 2007 FAD for public review. NYSDOH initially set a 45-day public comment period, which was extended to 75 days based on requests from the public. The public comment period closed on November 15, 2013. As of the close of the reporting period, a revised FAD had not been issued.

Continued tough economic times keep pressure on resources at DEP. The agency strives to balance the need for strong source water protection and construction and maintenance of critical infrastructure with efforts to keep water rates affordable. During 2013, DEP sought ways to improve efficiency while continuing steady implementation of critical watershed protection projects. While New York City continues to dedicate significant funding and personnel to the watershed program, each program element will continue to be evaluated critically to ensure that resources are being deployed in the most effective and cost-effective way.

This annual report covers the period January 1, 2013, through December 31, 2013, and is compiled to satisfy the requirements of the 2007 FAD. Material in this report is organized to parallel the sections of the FAD.

While the report focuses primarily on the efforts of New York City, it is important to recognize that DEP works in partnership with many agencies, organizations, and communities throughout the region to achieve its goals (Figures 1.1 and 1.2). These partnerships are vital to the continued success of the source water protection program and recognize the need to strike a balance between protecting water quality and the fact that the watershed is home to tens of thousands of people. The contributions of many of these groups are acknowledged throughout this report. The other private, governmental, community, academic, and non-profit entities that share a role in this complex effort are too numerous to list. However, DEP gratefully acknowledges their ongoing help and support.

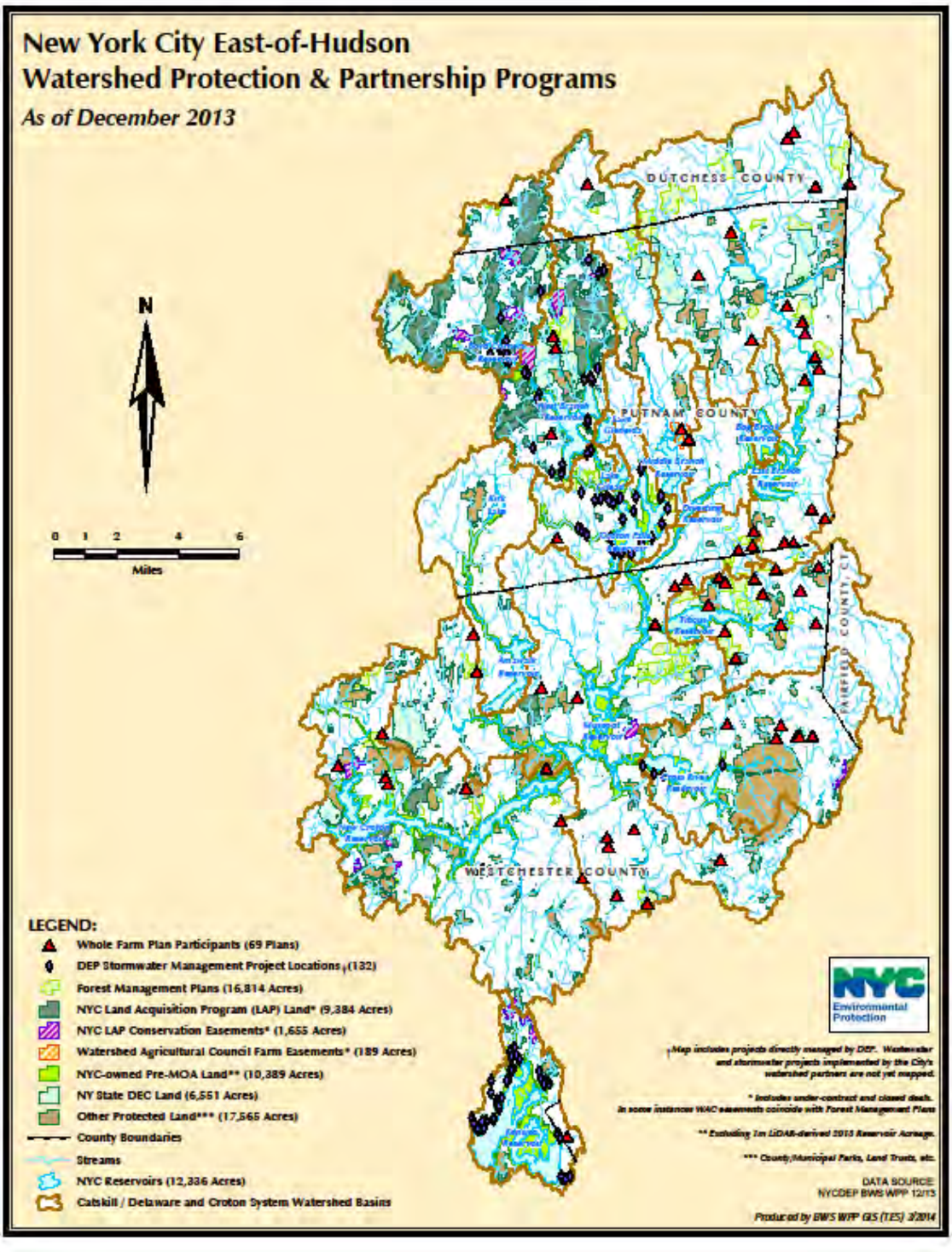

Figure 1.1. New York City East of Hudson watershed protection and partnership programs as of December 2013.

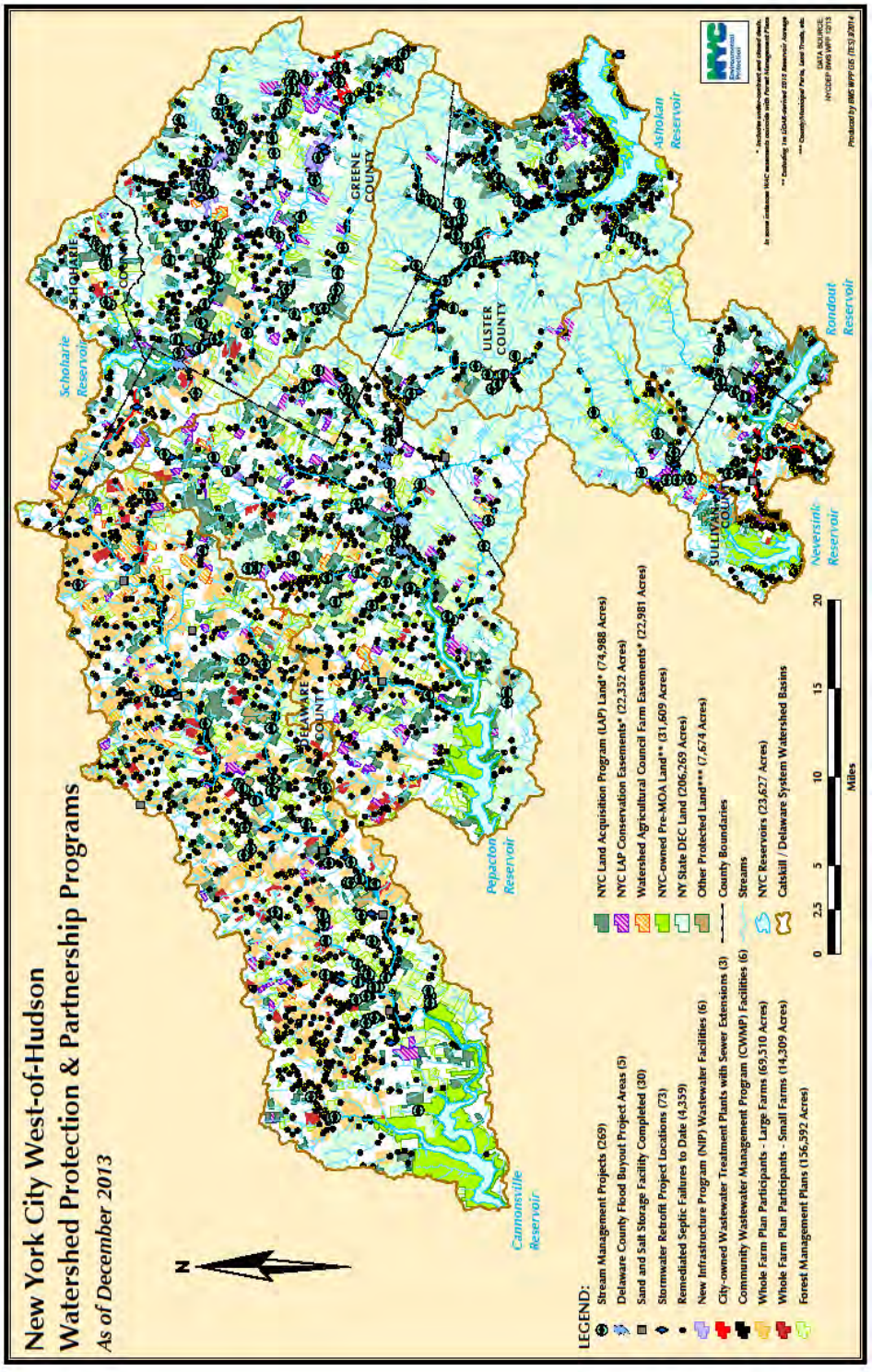

Figure 1.2 New York City West of Hudson watershed protection and partnership programs as of December 2013.

2. Federal and State Objective Water Quality Compliance

During 2013, DEP continued its comprehensive water quality monitoring efforts. New York City's (the City's) sampling program is far more extensive than is required by federal or state law. Each year, the City collects tens of thousands of samples in the watershed and in the distribution system. In 2013, DEP collected 48,242 samples and conducted 459,624 analyses. Of these, 30,938 samples were collected and 354,048 analyses were completed within the City. Once again, the results were impressive: the City complied with the objective criteria of the Surface Water Treatment Rule (SWTR) (USEPA 1989), only 0.2% of the 9,793 in-City compliance samples analyzed pursuant to the Total Coliform Rule (TCR) were total coliform positive, and all samples were negative for *E. coli*. Since 1995, DEP has collected more than 200,022 TCR compliance samples, and only 14 of them have tested positive for *E. coli.*

On the tenth of every month, DEP provides both USEPA and NYSDOH with the results of its enhanced monitoring program, which was developed to comply with the requirements of the SWTR, the TCR, and other federal regulations that have been in effect since 1991. The City, as an unfiltered surface drinking water supplier, must meet these objective criteria. The information provided below summarizes compliance monitoring conducted during the year.

2.1 Surface Water Treatment Rule Monitoring and Reporting

SWTR monitoring includes raw water monitoring for fecal coliform concentrations, turbidity, and disinfection/contact time (CT) values; entry point monitoring for chlorine residuals; distribution system monitoring for chlorine residuals and coliform bacteria levels; and quarterly monitoring in the distribution system for trihalomethanes and haloacetic acids. In 2013, all monitoring samples complied with thresholds defined by the SWTR.

2.1.1 Raw Water Fecal Coliform Concentrations (40 CFR Section 141.71 (a)(1))

In 2013, the Catskill Aqueduct south of Kensico Reservoir was offline; therefore, no Catskill Aqueduct effluent fecal coliform samples were collected for the year. The Delaware Aqueduct effluent from Kensico Reservoir exhibited fecal coliform concentrations in water prior to disinfection at levels less than or equal to 20 fecal coliforms $100ml^{-1}$ in at least 90% of the samples collected during the year, as calculated by six-month running percentages. In fact, the running percentage of samples for the Catskill/Delaware System never fell below 99.5%.

As shown in Figure 2.1, in 2013 the six-month running percentage of positive raw water fecal coliform samples at the Delaware Aqueduct effluent from Kensico Reservoir was well below the maximum percentage of positive samples allowed under the SWTR.

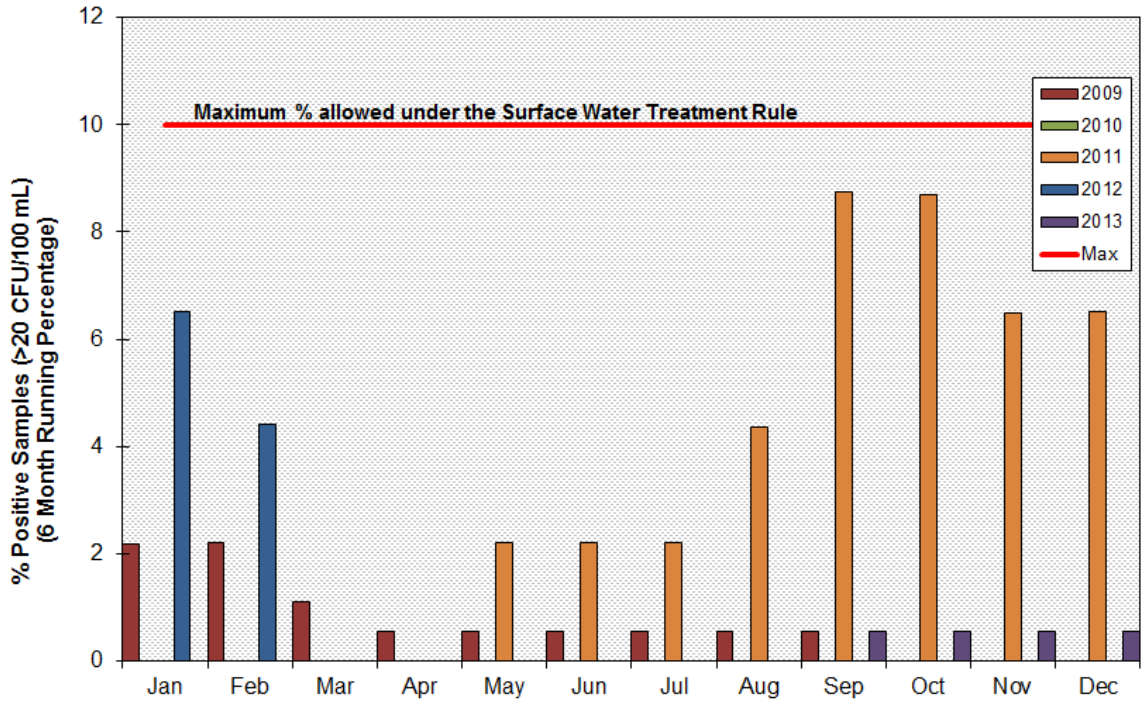

Figure 2.1. Positive fecal coliform samples, Kensico-Delaware System, 2009-2013. Years with 0% detection for the month do not appear on the graph.

2.1.2 Raw Water Turbidity (40 CFR Section 141.71(a)(2))

No Catskill Aqueduct effluent turbidity samples were collected in 2013 because the Catskill Aqueduct south of Kensico Reservoir was offline. The Delaware Aqueduct effluent from Kensico Reservoir exhibited turbidity levels less than or equal to 5 NTU in water prior to disinfection for the entire 2013 calendar year (Figure 2.2). No samples were collected from the Catskill Aqueduct.

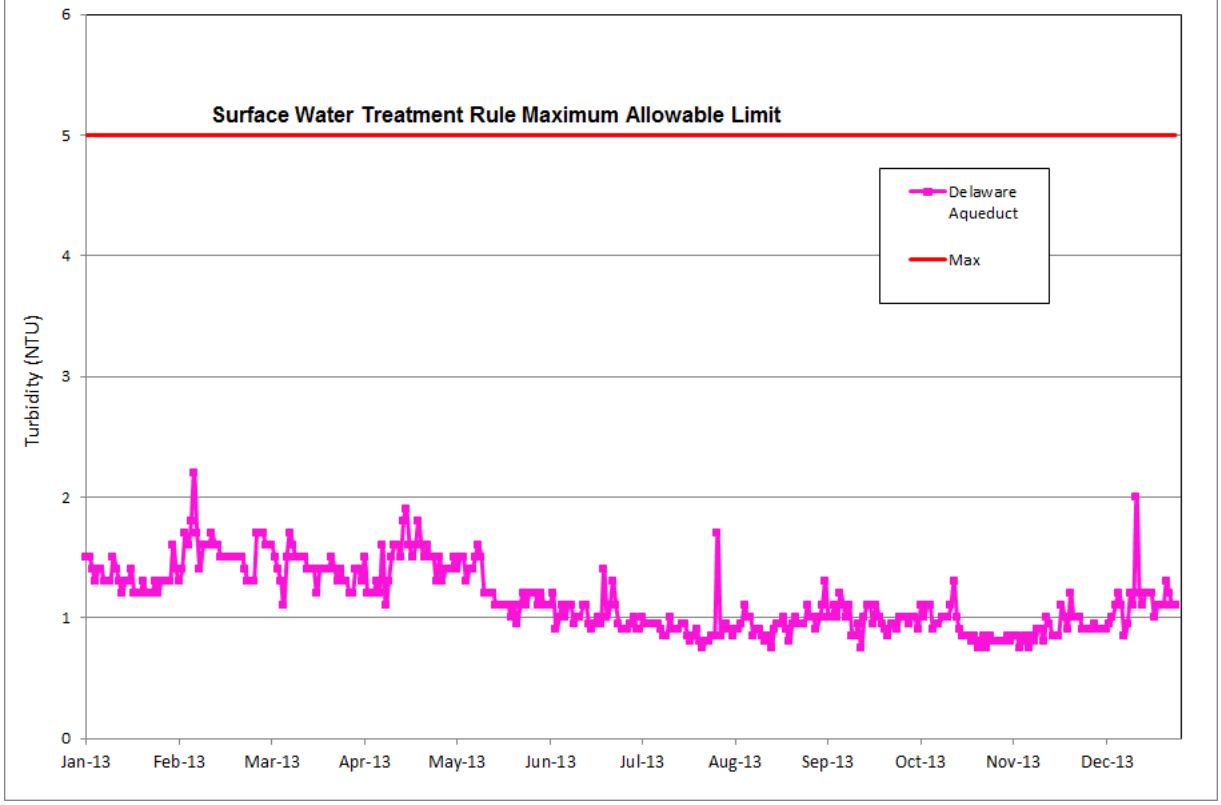

Figure 2.2. Delaware source water turbidity, January 1, 2013-December 31, 2013.

2.1.3 Raw Water Disinfection/CT Values (40 CFR Sections 141.71(b)(1)(i) and141.72(a)(1))

CT values recorded each day during the year for the Catskill and Delaware Systems produced net inactivation ratios (IAR) greater than or equal to 1.0. The first segment of the Catskill Aqueduct was offline from Kensico to Eastview at the Catskill/Delaware UV Treatment Plant (CDUV), so the net IAR was measured using the IAR from the first segment of the Delaware Aqueduct from Kensico to Shaft 19 at CDUV, and adding the IAR from the CDUV to Hillview (second segment). The actual lowest net IAR in 2013 was 1.1 for the Catskill Aqueduct and 1.2 for the Delaware Aqueduct.

2.1.4 Entry Point Chlorine Residual (40 CFR Sections 141.71(b)(1)(iii) and 141.72(a)(3))

As required, continuous monitoring for free chlorine residual was maintained at the distribution entry points throughout the year. On March 21, 2013, the power to a service water pump failed, causing an uneven delivery of chlorine to Tunnel 3. The chlorine feed system never stopped operating, but the entry point chlorine residual dropped below 0.20 mg L^{-1} for 33 min-

utes, with the lowest level reported as 0.10 mg L^{-1}. Because the drop in chlorine levels lasted less than 4 hours, this was not a violation; however, an investigation into the cause of the power failure and possible mitigative measures to prevent a reoccurrence was completed.

With the exception of this March 21, 2013 event, chlorine residuals were maintained at concentrations at or above 0.20 mg L^{-1} at all distribution entry points during the year. The lowest chlorine residual measured at an entry point was 0.33 mg L^{-1}.

2.1.5 Distribution System Disinfection Residuals (40 CFR Sections 141.71(b)(1)(iv) and 141.72(a)(4))

All chlorine residuals for the 15,052 samples measured within the distribution system during the year were detectable.

2.1.6 Trihalomethane Monitoring (40 CFR Section 141.71(b)(6)) and HAA5 Monitoring (40 CFR Section 141.171)

The analysis for trihalomethanes, performed on a quarterly basis, resulted in a maximum total trihalomethane (TTHM) value of 80 µg L^{-1}. The analysis for haloacetic acids, also performed on a quarterly basis, resulted in a maximum haloacetic acid five (HAA5) value of 61 µg L^{-1}.

The highest TTHM quarterly running annual average during the year, recorded during the fourth quarter, was 39 µg L^{-1} for the Catskill/Delaware Distribution Area, a level below the regulated level of 80 µg L^{-1}. The highest HAA5 quarterly running annual average, recorded during the third and fourth quarters, was 35 µg L^{-1}, a level below the regulated level of 60 µg L^{-1}.

2.2 Total Coliform Monitoring

2.2.1 Monthly Coliform Monitoring (40 CFR Section 141.71(b)(5))

Within the distribution system, coliform monitoring indicated monthly levels of total coliforms below the 5% maximum set forth in the TCR (Figure 2.3). The number of compliance samples analyzed for total coliforms was 9,793, of which 18 were total coliform positive. All resamples were coliform negative with one exception: in July, a distribution sample tested positive for total coliforms, and repeat sampling also tested positive at both an upstream and a random check location. A second round of repeat sampling at the random check location was again positive for coliforms. A third round of repeat sampling was negative for coliforms at all locations.

All samples were *E. coli* negative for the year. The annual percentage of compliance samples that were total coliform positive was 0.18% and the highest monthly average was 0.94%.

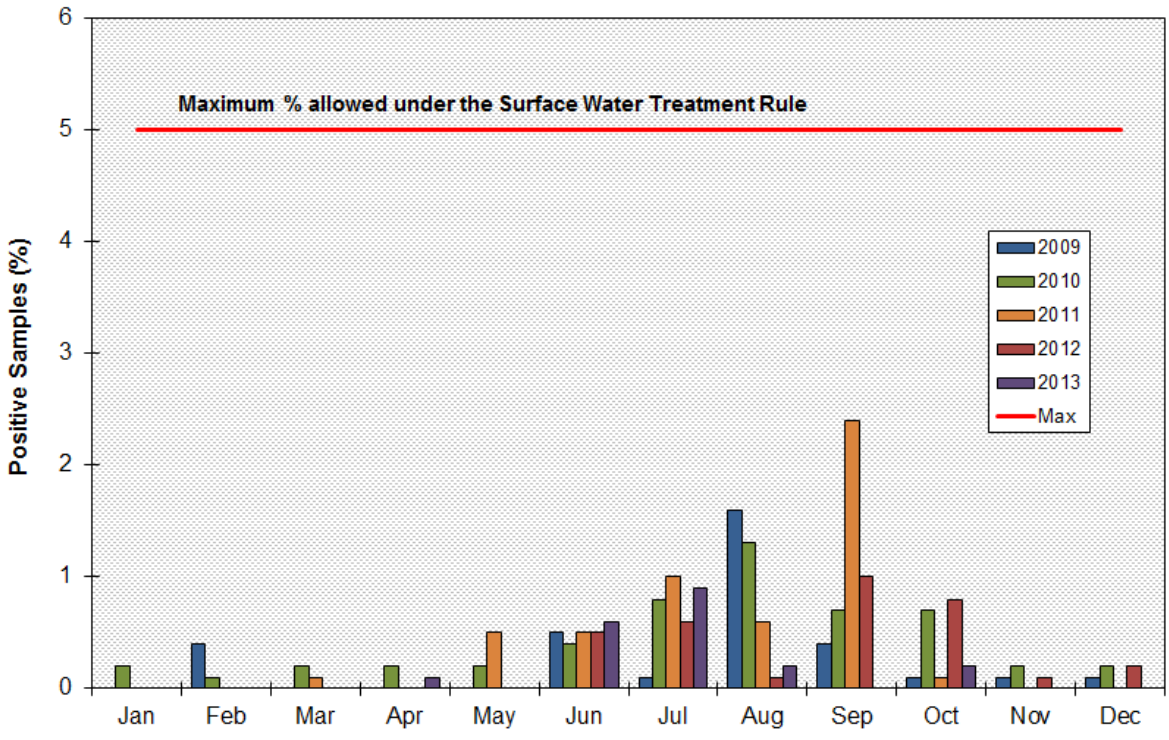

Figure 2.3. Positive total coliform samples, NYC distribution system, 2009-2013.

2.2.2 Chlorine Residual Maintenance in the Distribution System

During the year, DEP has continued a number of programs to ensure adequate levels of chlorine throughout the distribution system. These have included: (1) maintaining chlorination levels at the distribution system's entry points, (2) conducting spot flushing when necessary, and (3) providing local chlorination booster stations at remote locations. Three permanent chlorination booster stations were operated during the year to improve the chlorine residual levels for the Fort Tilden, Roxbury, and Breezy Point areas (Rockaway Peninsula) in Queens; City Island in the Bronx; and Staten Island. As a result of these steps taken, detectable chlorine residuals were maintained throughout the distribution system in 2013.

3. Environmental Infrastructure

3.1 Septic Programs

3.1.1 Septic Rehabilitation and Replacement Program

Since 1997, New York City has committed over $61 million in funding to rehabilitate, replace, and upgrade septic systems serving single- or two-family homes in the City's West of Hudson (WOH) watershed.

The Septic System Rehabilitation and Replacement Program is managed by the Catskill Watershed Corporation (CWC), a local not-for-profit organization created to manage watershed partnership and protection programs. It includes the following sub-programs: the Priority Area Program, the Hardship Program, and the Reimbursement Program.

The Priority Area Program is an inspection and repair program implemented geographically based on the proximity of septic systems to reservoirs and watercourses. The program was implemented by the CWC in July 1999 in the 60-Day Travel Time Area and has since expanded sequentially to include septic systems located within 250 feet of a watercourse. In 2013, the CWC funded the repair or replacement of 248 failing or likely-to-fail septic systems through this program. A total of 2,343 failing septic systems had been repaired or replaced under the program through the end of December 2013.

The Hardship Program funds septic repairs located in areas not covered by the Priority Area Program for applicants who meet certain income eligibility criteria. In 2013, the CWC funded the repair or replacement of seven failing septic systems under the Hardship Program.

The Reimbursement Program reimburses home owners who repair or replace failing septic systems in areas not covered by the Priority Area Program, depending on funding availability. Presently, home owners who fixed failing septic systems outside the priority areas between July 2, 1999, and December 27, 2013, are eligible for reimbursement. In 2013, the CWC funded the repair or replacement of 18 failing septic systems under the Reimbursement Program.

Under the various sub-programs discussed above, the CWC funded the repair or replacement of 273 septic systems in the WOH watershed in 2013. Since the program's inception, 4,359 failing or likely-to-fail septic systems have been repaired, replaced, or managed.

3.1.2 Septic Maintenance Program

The Septic Maintenance Program is a voluntary program intended to reduce the occurrence of septic system failures through regular pump-outs and maintenance. Under the program, the CWC pays 50% of eligible costs for pump-outs and maintenance. In 2013, the CWC subsidized 178 septic tank pump-outs, bringing to 1,018 the number of septic tank pump-outs subsidized since the program's inception.

3.1.3 Alternate Design Septic Systems Program

The Alternate Design Septic Systems Program (ADSSP) is a $3 million program to pay for the importation of fill material and/or pumping apparatus used in the construction of septic systems that have been required by DEP or its delegate solely to achieve compliance with the New York City Watershed Rules and Regulations (WR&R) (2010). No ADSSP activity occurred during 2013. Since 2001, the CWC board has authorized the transfer of $1,999,000 in ADSSP funding to other, more active, watershed protection and partnership programs.

3.1.4 Other Septic Programs

The Small Business Septic System Rehabilitation and Replacement Program helps pay for the repair or replacement of failed septic systems serving small businesses (those employing 100 or fewer people) in the Catskill/Delaware watershed. Eligible business owners are reimbursed 75% of the cost of septic repairs, up to a maximum of $40,000. To be eligible, failing commercial septic systems must be 250 feet or less from a watercourse, 500 feet or less from a reservoir, or within the 60-day Travel Time Area. The small business owner is responsible for securing an approved DEP design and for the construction of the septic system remediation. The small business owner then seeks reimbursement for these costs from the CWC Small Business Septic Program. The CWC Small Business Program does not require, nor does it pay for, pump-outs or other intermediary measures that may be required by state or local regulatory agencies. Appropriate pump-outs or other measures are required by DEP when a Notice of Violation (NOV) is issued to commercial systems. In 2013, three small businesses received reimbursement for the repair or replacement of a failing septic system under this program. Twelve failing septic systems have been replaced under the program since the program's inception.

The Cluster Septic System Program funds the planning, design, and construction of cluster systems in 13 communities in the WOH watershed. There was no project activity in this program during 2013.

3.2 Community Wastewater Management Program

The Community Wastewater Management Program (CWMP) provides funding for the design and construction of community septic systems, including related sewerage collection systems, and/or the creation of septic maintenance districts, including septic system replacement, rehabilitation and upgrades, and operation and maintenance of the districts.

To date, CWMP projects have been completed in Bovina, DeLancey, Bloomville, Hamden, Boiceville, and Ashland. CWMP projects are under design in the Hamlets of Lexington and South Kortright. In 2013, construction of the collection system and community septic system for the Hamlet of Trout Creek was completed.

The Lexington Town Board passed a resolution to establish the Lexington Sewer District in January 2013. The town board adopted a Sewer Use law in March 2013. A draft SPDES permit was issued by NYSDEC in August 2013. Final design was on hold during the balance of 2013 due to land acquisition issues. The town board commenced eminent domain proceedings for the treatment facility property in June 2013 and approved the eminent domain findings in September 2013. The eminent domain findings have been submitted to the Third Department, Appellate Division of the Supreme Court of the State of New York. It is anticipated that the court will render a decision on the eminent domain proceedings in 2014.

DEP accepted the revised Hobart WWTP Capacity Evaluation Report in May 2013 for the South Kortright CWMP project. The Facility Plan Report for the South Kortright large diameter gravity sewer and the Hobart WWTP upgrades was submitted to DEP for review and approval in July 2013. DEP accepted the Facility Plan Report in September 2013. The 65% Design Submission for the South Kortright CWMP project (South Kortright Collection System and Hobart WWTP Upgrades) was submitted to DEP in December 2013 and is under review.

Following winter shutdown of the Trout Creek CWMP project, LaFever Excavating commenced construction of the small diameter gravity sewer for the hamlet in April 2013 (Figure 3.1). Installation of the sewer was completed during the summer of 2013. Clean water start-up of the system was conducted in December 2013. It is anticipated that septic tank and lateral installations will begin in the spring of 2014.

Figure 3.1. Leach field installation in Trout Creek.

3.3 Sewer Extension Program

DEP continued to implement the Sewer Extension Program during 2013. Highlights of program activities in communities with projects still under way in 2013 are described below.

Town of Shandaken (Planned Sewer Extension to the City's Pine Hill Sewer System)

The planning and design of this sewer extension, located just south of the former Village of Pine Hill along NYS Route 28, is complete and has been approved by NYSDEC.

During the past year, DEP issued a land use permit to NYS Electric and Gas to install two electric utility poles on DEP's Pine Hill Wastewater Treatment Plant property in order to extend electric service to a planned wastewater pump station within the NYS Department of Transportation's right-of-way along NYS Route 28. DEP also obtained applicable local and state permits to ensure that they are in place prior to commencing construction.

A bid was let on the construction contract for the extension in October 2013. A pre-award meeting was held with the low bidder in November 2013. It is expected that the contract will be awarded in the first half of 2014.

Town of Hunter (Planned Sewer Extension to the City's Tannersville Sewer System)

During the reporting period, the planning and design of the sewer extension, to be constructed along County Route 23C and Showers Road, was finalized. DEP secured final approval from NYSDEC in March 2013.

DEP met with local officials representing the Town of Hunter and Greene County in May 2013 to review plans for a traffic detour that will be necessary due to the planned closure of County Route 23C during construction. DEP also obtained applicable local and state permits to ensure they are in place prior to commencing construction.

A bid was let on the construction contract for the extension in August 2013. A pre-award meeting was held with the low bidder in October 2013. It is anticipated that the contract will be awarded in the first half of 2014.

Village of Margaretville and Town of Middletown (Planned Sewer Extensions to the City's Margaretville Sewer System)

In 2013, DEP made progress in finalizing the planning and design issues, assessing the project's potential environmental impacts, and determining an acceptable method of construction for planned sewer mains and laterals along three roads in the project area: Harold Finch Road, Rosa Lane, and Hard Hack Drive. These activities resulted in the completion of the project's design plans and specifications. In April 2013, DEP received final approval from NYSDEC on the project's plans and specifications.

One of the notable achievements during the past year included resolving the planned sewer main along Hard Hack Drive, which is part of the Harold Finch West sewer extension. DEP was involved with identifying the owners of this road and working with the Town of Middletown's attorney to take appropriate steps to obtain an easement from the owners. The end result was that the owners signed the easement, allowing the residences along the road to be included in the project.

DEP also received final approval from the U.S. Fish and Wildlife Service for the project. DEP's proposed precautions will prevent potential environmental impacts to protected flora and fauna within the project area. In particular, construction will take place only during a specified time of year to protect the area.

It is anticipated that bids will be let on the project in the summer of 2014.

3.4 Stormwater Programs

3.4.1 Stormwater Cost-Sharing Programs

Costs of stormwater measures incurred as a result of complying with the WR&R are paid for by the Future Stormwater Controls Program to the extent they exceed costs sustained because of compliance with state and federal requirements. The program provides funding for the design, construction, and maintenance of stormwater measures included in stormwater pollution prevention plans and individual residential stormwater plans for new construction commencing after May 1, 1997.

Two separate programs have been developed to offset additional compliance costs incurred as a result of the implementation of the WR&R—the West of Hudson Future Stormwater Controls Program, administered by the CWC, and the Future Stormwater Controls Paid for by the City Program. Eligible components of future stormwater projects can receive 100% reimbursement. This funding can come completely from the West of Hudson Future Stormwater Controls Program (municipalities and large businesses) or completely from the Future Stormwater Controls Paid for by the City Program (low-income housing projects and single-family home owners), or it can come 50% from each program (small businesses).

The City provided $31.7 million to the CWC to administer the West of Hudson Future Stormwater Controls Program. From this allotment, the CWC has reimbursed $5,031,389 in eligible activity and transferred $16,676,724.18 to other eligible watershed protection programs. The fund balance was $16,141,594 at the end of October 2013, including interest. Table 3.1 provides details for projects approved for funding under the two future stormwater controls programs.

Table 3.1. 2013 Future stormwater controls projects.

Applicant	Project	Approval date	CWC funding	Percent funding CWC/DEP
O'Connor Hospital Andes Clinic	Stormwater controls associated with construction of Andes Medical Clinic	2/5/13	$83,618	100% CWC
Gerardo Mato	Additional costs to complete storm-water measures	2/5/13	$28,109	100% CWC
Scott Jaeger	Design of new stormwater controls related to three lot subdivisions	3/5/13	$27,957	100% CWC
Edward Kaplan	New stormwater controls related to building of law office	3/5/13	$5,862	50%/50%
Harold & Sharon Cole	Design costs related to improve-ments to road	4/2/13	$18,910	100% CWC
Gerry DeFrancesco	O&M funding for DEP-required stormwater BMPs	7/2/13	$5,500	100% CWC
O'Connor Hospital	Additional funding for stormwater controls	8/6/13	$9,658	100% CWC
Windham Car Wash, LLC	New stormwater controls related to construction of car wash	8/6/13	$112,500	50%/50%
Gerardo Mato	Additional funding for new storm-water controls	11/5/13	$65,674	100% CWC
O'Connor Hospital	Additional funding for new storm-water controls	11/5/13	$3,197	100% CWC
Windham Car Wash, LLC	Additional funding for new storm-water controls	11/5/13	$16,522	50%/50%
Prattsville Plaza JGJMS, LLC	Additional funding for new storm-water controls	12/3/13	$39,248	50%/50%

3.4.2 Stormwater Retrofit Program

The Stormwater Retrofit Program is administered jointly by the CWC and DEP and has three components: a construction grants (or capital projects) component, a maintenance compo-nent, and a planning and assessment component. The program provides funding for the design,

permitting, construction, and maintenance of stormwater best management practices to address existing stormwater retrofit runoff in concentrated areas of impervious surfaces, for the purpose of correcting or reducing existing erosion and/or pollutant loading.

The program currently maintains an open application timetable for construction grant project applications, evaluating each application as it is submitted. Funding preference is given to construction grant project applications where a planning and assessment project has already been successfully completed or where a CWMP project is in progress. The required "local share" contribution is 15% of the projected capital construction cost; however, in areas of preference—community wastewater project areas—the local share requirement has been eliminated to promote the synergistic effect of coordinated project schedules.

From 1999 to 2013, 72 stormwater retrofit projects were completed under the program. Of these, 60 were construction projects and 12 were planning and assessment projects. In 2013, 3 construction projects were completed. Presently, there are 8 open construction projects and 3 open planning and assessment projects. Projects of both types—construction (Tables 3.2 and 3.3) and planning and assessment (Table 3.4)—are presented below.

Table 3.2. Stormwater retrofit construction projects completed in 2013.

Applicant	Project description	Project cost	Closing date
Village of Andes	Delaware County Route 2 & Coulter Road—installation of collection, conveyance, and sedimentation devices for stormwater drainage from medium density residential, commercial, and county highway surfaces	$957,357.84	3/21/13
Town of Andes	High Street—design and installation of stormwater collection, conveyance, and treatment structures	$239,710.23	3/21/13
Mountain Top Library	Haines Falls Free Library—design and installation of stormwater collection, conveyance, and treatment structures	$195,983.07	3/21/13

Table 3.3. Stormwater retrofit construction projects open in 2013.

Applicant	Project area	Project description	Status
Village of Tannersville	Hunter Foundation	Design and installation of stormwater collection, conveyance, and treatment structures	90% complete

Table 3.3. (Continued) Stormwater retrofit construction projects open in 2013.

Applicant	Project area	Project description	Status
Village of Delhi	Village of Delhi	Implementation of stormwater mitigation practices to reduce inflow & infiltration into Delhi sanitary sewer collection system	Open
Town of Roxbury	Lake Street	Design of stormwater collection, conveyance, and treatment structures	Construction
Town of Ashland	Ashland	Design and installation of stormwater collection, conveyance, and treatment structures	Awaiting final billing
Town of Shandaken	Highway Garage	Design of stormwater collection, conveyance, and treatment structures	Design
Town of Shandaken	Pine Hill	Design of stormwater collection, conveyance, and treatment structures	Design
Town of Tompkins	Trout Creek	Design and installation of stormwater collection, conveyance, and treatment structures	Construction
Town of Lexington	Lexington	Design and installation of stormwater collection, conveyance, and treatment structures	Design

Table 3.4. Planning and assessment projects open in 2013.

Applicant	Grant amount	Funding round
Town of Andes	$35,275.00	2009
Village of Margaretville	$49,900	2006
Town of Ashland	$42,491.50	2009

4. Protection and Remediation Programs

4.1 Waterfowl Management Program

For information on the Waterfowl Management Program, see the Waterfowl Management Program Annual report, which will be available on the DEP website after its submittal on September 30, 2014 (http://www.nyc.gov/html/dep/html/watershed_protection/fad.shtml).

4.2 Land Acquisition

Between the 1860s, when New York City (the City) began to acquire land for construction of what would later be known as the Catskill/Delaware (Cat/Del) System, and 1957, when acquisition of such land ended, the City acquired roughly 34,200 acres of land surrounding the reservoirs that were eventually built. As of December 31, 2013, following 17 years of Land Acquisition Program (LAP) activity, an additional 129,709 acres in the Cat/Del watershed had been secured by the City, including land, conservation easements (CEs), and farm CEs acquired by the Watershed Agricultural Council (WAC). This represents an addition of more than three times the amount of land that had been acquired previously, in about one-eighth the time, and since 1997, all based on voluntary transactions. In many basins, City land holdings have increased dramatically compared with pre-1997 ownership patterns (see Figure 4.1). In Rondout, which is entirely Priority Areas 1A and 1B, the City has increased the number of protected acres by a factor of six. In West Branch/Boyd Corners, as well as in Schoharie, acreage under City control has increased by a factor of 12, while in the Ashokan basin, City-owned buffer land has almost tripled in size. Overall, City-controlled land in the Cat/Del watershed (including CEs secured by both DEP and WAC) has increased from 34,200 acres in 1996 to over 165,000 acres (including deals yet to close). In 1996, roughly 3.3% of the Cat-Del watershed (excluding reservoirs) was owned by the City and another 21% was protected by New York State and others; today, roughly 15.9% is City-controlled, a major component of the 37.1% of the Cat/Del watershed in total (excluding reservoirs) that is now under some form of permanent protection. Below are summaries of the main components of LAP's land acquisition activities during 2013.

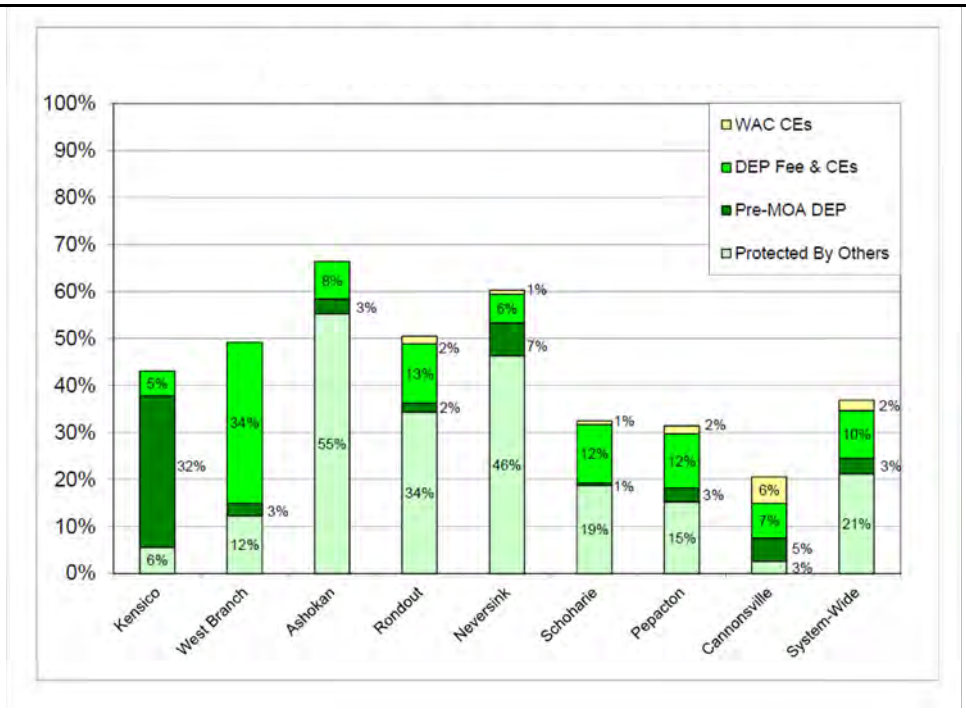

Figure 4.1. Percent of land protected in each Catskill/Delaware basin, by real estate type.

4.2.1 Solicitation/Resolicitation

Section 4.2 of the Draft Revision of the 2007 FAD requires a solicitation goal of 250,000 acres over the five-year period covering 2012-16. During 2013, 40,702 acres were solicited by DEP; adding 64,418 acres solicited during 2012, the total acreage solicited against the 250,000-acre goal now stands at 105,120. Total acreage solicited by DEP since signing of the Memorandum of Agreement (MOA) in 1997 is now over 475,000.

4.2.2 Purchase Contracts in the Catskill/Delaware System

Overall results for purchase contracts executed (i.e., contracts signed by both the City and landowner) and closed in 2013, on both fee simple and CEs, are described below, followed by data related to more specific components of the program.

By the end of calendar year 2013, DEP (excluding WAC farm CEs) had executed 1,381 purchase contracts comprising 106,729 acres throughout the Cat/Del watershed at a cost of $391.3 million (with additional "soft costs" for related site services of about $30 million). Of these, 1,304 contracts totaling 100,410 acres have been acquired (closed), with the remaining acres under purchase contract. During 2013, DEP closed 70 contracts comprising 5,283 acres and signed 40 purchase contracts accounting for 2,770 acres (see Figures 4.1 and 4.2). Two additional contracts were executed by WAC to secure another 329 acres in farm CEs during 2013.

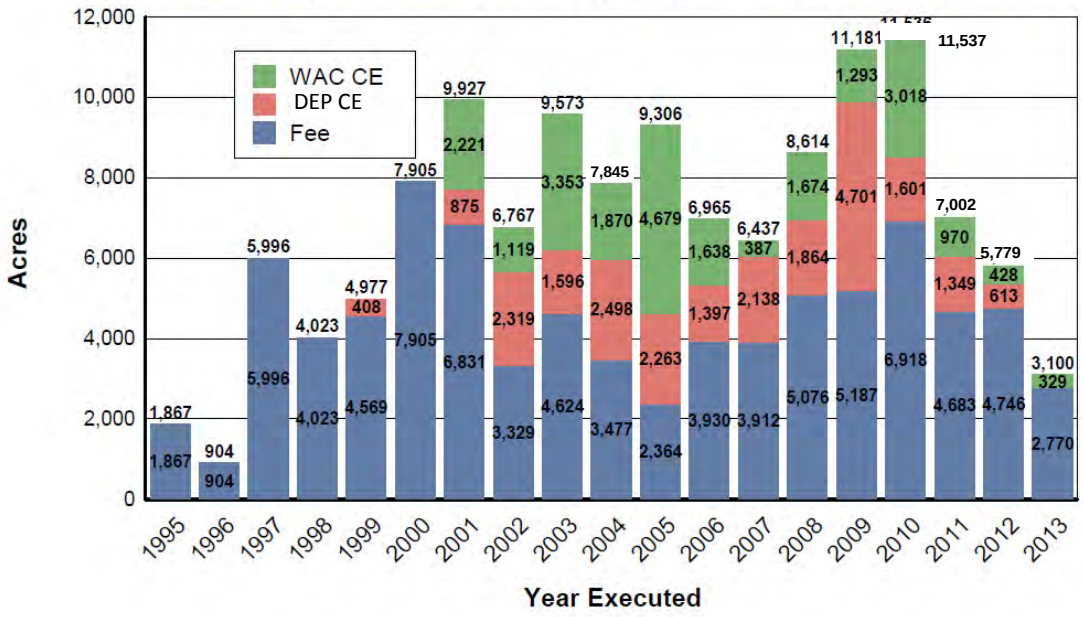

Figure 4.2. Acres signed by year and real estate type, Catskill/Delaware System.

Figure 4.3. A tributary to Thompson Hollow Creek in the Pepacton Reservoir watershed runs through a 10.8-acre property in the Town of Roxbury that the City signed to contract in 2013 (PIN 8667). The parcel will fill in a gap between City-owned land and a public road.

Figure 4.4. A tributary to Pepacton Reservoir meanders through a 235-acre property in the town of Middletown, which was signed to purchase contract during 2013.

Conservation Easements

DEP

During 2013, no CEs were signed to purchase contract by DEP, while five CEs totaling 622 acres were closed (Tables 4.1 and 4.2). Overall, 159 CEs in the Cat/Del watershed totaling 23,620 acres are now closed or under contract, equal to 23% of the acres protected by DEP (excluding WAC farm CEs).

Table 4.1. Contracts executed in the Catskill/Delaware watershed by reporting period and real estate type.

Real estate type	Number of contracts	Acres	Average size of project	Purchase price
Reporting Period: 1995 to 2012				
Fee	1,182	80,339	68	$312,201,291
CE	159	23,620	149	$68,731,923
WAC CE	123	22,651	184	$31,931,855
	1,464	126,610	86	$412,865,069
Reporting Period: 2013				
Fee	40	2,770	69	$10,354,998
WAC CE	2	329	165	$607,426
	42	3,099	74	$10,962,424
Program-to-date Subtotals				
Fee	1,222	83,109	68	$322,556,289
CE	159	23,620	149	$68,731,923
WAC CE	125	22,980	184	$32,539,281
Grand Total	1,506	129,709	86	$423,827,493

Table 4.2. Contracts closed in the Catskill/Delaware watershed by reporting period and real estate type.

Real estate type	Number of contracts	Acres	Average size of project	Purchase price
Reporting Period: 1995 to 2012				
Fee	1,083	72,480	67	$283,228,022
CE	151	22,648	150	$56,424,415
WAC CE	120	22,091	184	$30,520,824
	1,354	117,219	87	$370,173,261
Reporting Period: 2013				
Fee	65	4,661	72	$17,078,372
CE	5	622	124	$1,562,484
WAC CE	3	561	187	$1,411,031
	73	5,844	80	$20,051,887
Program-to-date Subtotals				
Fee	1,148	77,141	67	$300,306,394
CE	156	23,270	149	$57,986,899
WAC CE	123	22,652	184	$31,931,855
Grand Total	1,427	123,063	86	$390,225,148

WAC

During 2013, WAC executed two purchase contracts for 329 acres and closed three contracts totaling 561 acres in farm CEs. To date, WAC has closed on 123 CEs totaling 22,652 acres (although some CEs have been further subdivided since the original closings, raising the current number of CEs but not acreage).

WAC's Farm Easement Program—including the full cost of all CE acquisitions and program overhead, and the vast majority of stewardship costs—has been supported by the following allocations from DEP:

- $23 million was budgeted in 2008 as directed by NYS DOH in a letter dated April 30, 2008; these funds will be dedicated to acquisition of farm CEs under a new program contract that was executed in the summer of 2013.
- Pursuant to the 2010 WSP, DEP has allocated $6 million toward a new Forest Easement Program to be managed by WAC, a pilot program now subsumed under the program contract executed in 2013. Upon assignment of the new funds, the total committed to all easement programs managed by WAC will be $76 million.

Riparian Buffers

See Section 4.7.1 for information on riparian buffers protected through Land Acquisition and the pending Pilot Riparian Buffer Acquisition Program.

Wetlands

See Section 4.8.2 for more information on wetlands protected through Land Acquisition.

4.2.3 Transfer of Conservation Easements on Fee Acquisitions to New York State

During the reporting period, NYSDEC recorded five CE Deeds conveyed by DEP to NYS covering 77 LAP acquisition parcels on 5,641 acres.

DEP's program-to-date CE conveyances to NYSDEC total 58 CEs on 733 DEP properties comprising 48,135 acres. Counting CEs sent to the State but not yet recorded, DEP's program-to-date CE conveyances total 66 CEs on 885 DEP properties comprising 57,996 acres.

4.2.4 Technical Program Improvements

During 2013, DEP continued to implement improvements to program documents and policies, subject to requirements of the MOA, FAD, WSP, and City Charter, in order to maximize program competitiveness within the marketplace:

- Purchase Contract. Since 2008, many landowners have continued to take advantage of the City's contribution of up to $5,000 offered in the revised model purchase contract for subdivision costs. The incentive appears to have increased the rate of accepted offers from landowners whose properties require subdivision before conveyance of the vacant portion.

- Conservation Easement Policy. DEP continues to hone its policy with respect to criteria for consideration and design of CEs.

- Technology. The Watershed Land Information System (WaLIS) is continually being enhanced to support the evolution of components related to the issuance of the 2010 WSP. In particular, WaLIS is now addressing needs relating to the coordination of DEP activities with the Enhanced Land Trust Program, the Riparian Buffer Program, and the Forest CE Program, as well as LAP's growing efforts in the area of flood buyouts (see Section 4.2.7). The system can now provide information on natural features criteria, designated hamlet areas, and the constantly growing levels of protection in each sub-basin. These and other upgrades demonstrate how WaLIS offers tremendous productivity enhancement and efficiencies which impact every step of the acquisition process. In addition, in 2013 new basin boundary, stream, waterbody, and slope layers based on high resolution LiDAR data were incorporated into LAP operations, providing significant upgrades to natural features criteria and CE ranking analyses.

- Land Trusts. DEP continued to spend considerable time during 2013 seeking ways to augment involvement of land trusts in protecting watershed lands:

    - ***Educational Forums:***
        - Small Grants Program: DEP awarded $5,000 to the Land Trust Alliance for an educational forum focused on advanced CE stewardship and amendment issues; although the award was made in 2013, the event will be held in the spring of 2014.

- DEP is one of many lead sponsors supporting the forthcoming NYS Land Conservation Summit at West Point in April, 2014. The event brings together leaders, practitioners, and stakeholders in land protection issues, and covers diverse topics in this field.

- ***Transactions:*** During 2013, no projects were transacted between DEP and land trusts.

- ***Enhanced Land Trust Program (ELTP):***
  - DEP appraised a 728-acre property in Gilboa in partnership with the Schoharie Land Trust and The Nature Conservancy in March 2013; the land trusts extended a purchase offer but the landowner declined. No further activity under the ELTP is expected at least until 2016, when the many towns that did not "opt in" in 2011 will have the opportunity to do so.

4.2.5 Pilot Forest Easement Program

The 2007 FAD mandated that DEP fund a $6 million pilot program through which WAC would acquire CEs on "forested portions of non-agricultural" land. Negotiations between DEP and WAC began in earnest in late 2007 and culminated in an agreement that was executed during summer 2013. The program is expected to ramp up during 2014-2015.

4.2.6 Water Supply Permit

The current Water Supply Permit (WSP) was issued by NYS DEC on December 24, 2010, and authorizes a land acquisition program of up to 106,712 acres in the Cat-Del system through 2025 beyond what had been acquired as of January 1, 2010 (at which time 102,287 acres had been secured). Between 1/1/2010 and 12/31/13, LAP acquired 27,431 acres, leaving a "balance" of 79,281 acres remaining for potential acquisition pursuant to 2010 WSP limitation.

4.2.7 FEMA/SOEM 2012 Buy-Out Program

In the aftermath of Hurricane Irene and Tropical Storm Lee in August, 2012, DEP worked throughout the reporting period with numerous watershed stakeholders to partner on the acquisition of flood-damaged properties as part of FEMA's Hazard Mitigation Grant Program (HMGP). In October, 2013 DEP executed Flood Buyout Memoranda of Agreement ("Flood MOAs") with Delaware and Greene Counties.

Under these Flood MOAs, the City and Counties will work together to acquire properties approved for HMGP funding by FEMA. The Counties will be primarily responsible for landowner outreach, grant administration and demolition of structures once acquired. The City will cover soft costs, as well as paying for the land value of properties not eligible for the 25% match required by NYS's program. Properties will be owned by either the City or the local municipality. Under an agreement with watershed stakeholders, all properties to be acquired will be protected by both the standard FEMA deed restrictions as well as a conservation easement to be conveyed to NYS DEC.

Pursuant to the Flood Buyout MOAs, the City appraised 19 properties in Greene County (located in Ashland, Hunter, Jewett, Lexington, Prattsville and Windham) and 21 properties in Delaware County (all in the Town of Middletown).

4.3 Land Management

The City has made a significant investment in purchasing water supply lands and CEs. To manage these lands for water quality protection, DEP has developed a comprehensive, long-term plan for land management. Land management activities fall into four major categories, primarily focused on City lands:

- Property management of City water supply lands and CEs
- Beneficial use
- Forest management
- Invasive species management

4.3.1 Management of Water Supply Lands and Conservation Easements

Property Management of City Lands

The City now manages 131,530 acres of the lands it holds in fee simple; this includes reservoir buffer lands (pre-MOA), MOA lands, and land along aqueducts. All City lands owned in fee simple are inspected as per the DEP Fee-land Monitoring Policy (DEP 2010), which outlines procedures for property inspections and boundary maintenance on City lands. Property inspections are divided into three types: 5-year boundary inspections, focused inspections, and aerial inspections. The type of inspection a property receives depends on its priority, which is assigned based on its location and the various uses conducted on the property (e.g., recreation, land use permit). **"**High priority properties" include parcels on which recreational use is high, where there is a history of encroachments, where there are active land use permits or other projects, or where there are many adjacent landowners. These properties receive a focused inspection annually. "Standard priority properties" are those on which no trespass or encroachments have been observed, or which have little road frontage or low public use. These properties receive a focused or aerial inspection at least once every five years. In addition to focused and aerial inspections, all properties must receive a boundary line inspection every five years. Five-year boundary inspections are the most comprehensive type of inspection and include a traverse of all property boundary lines as well as the interior of the property; this ensures proper monumentation and maintenance of property boundary lines over the long term. Table 4.3 displays the number and acres of inspections completed in 2013.

Table 4.3. Number and acreage of inspections completed in 2013 by DEP field offices.

DEP field office	Property inspections (number/ acres)	5-year boundary inspections (number/miles of boundary line)	Site visits
Shokan	154/9,614	73/132	7
Downsville	84/17,983	61/123	46
Grahamsville	85/11,468	47/206	21
Schoharie	154/3,984	132/170	48
EOH	149/2,865	31/344	3
Total	626/45,914	344/975	125

Figure 4.5. Typical City watershed land boundary posting and marking.

DEP can change a property's priority at any time depending on changing circumstances (such as the discovery of encroachments) or perform additional site visits as needed. All inspections and site visits, along with journal notes, photos, encroachments, and observations, are recorded in WaLIS. Inspections are also scheduled using WaLIS. All City lands are posted as appropriate; signage includes "Posted," "Public Access Area," or "Entry By Permit." Other types of signs may be utilized as site-specific conditions dictate.

Figure 4.6. Sign posted to alert public that area is open for recreation but not hunting.

Conservation Easement Stewardship

At the end of 2013, DEP had 161 closed easement properties totaling 23,658 acres in the Catskill, Delaware, and Croton watersheds. DEP conducts two annual inspections of all its easements in compliance with the terms of the MOA. DEP continues to expand the use of aerial inspections for CEs because they provide an efficient alternative for inspecting properties, especially the larger ones. Potential violations which could have serious water quality impacts, such as land clearing, construction, and road building are evident using aerial inspections. Combined with an annual on-the-ground inspection, aerial inspections provide a high level of protection for the City's investment.

The number of easement term violations committed by landowners remained low, with two minor violations discovered during the fall 2013 monitoring. One additional violation occurred in 2013 from inadequate road repair at the end of a DEP-approved forest harvest. Requests to conduct activities that require DEP notice and approval remained low as well, with forestry typically the most requested activity. There were three requests for subdivisions, two of which were approved and one of which, a small 7-acre request, was denied. In 2013, DEP worked on its draft amendment policy. The policy will facilitate upgrading of the more restrictive easements (e.g., no farming), which were granted in the early days of the program, to the more recent version, which allows more activities as of right and with DEP approval (e.g., farming).

Watershed Agricultural Council Conservation Easements and Stewardship

At the end of 2013, the WAC had 122 easement properties totaling 22,727 acres in the Catskill, Delaware, and Croton watersheds. DEP continues to provide an oversight and advisory role with respect to the WAC's farm CE stewardship responsibilities, which continue to increase as the Council's portfolio grows. The WAC, with assistance from DEP, continued developing several stewardship policies in 2013 for the activation of reserved rights, including those related to future acceptable development areas, and to work related to water resources and streams, wind turbines, towers and communication devices, and the siting of septic systems.

4.3.2 Beneficial Use

Recreation

DEP's water supply lands provide outstanding public recreational opportunities at 19 reservoirs and 2 controlled lakes, and on water supply lands throughout the Catskill, Delaware, and Croton watersheds. These activities represent a way of life that many of the watershed communities want to see continued and are a large contributor to the local economy. Recreational access also expands the stewardship constituency for the water supply system and the lands that protect water quality. Increased involvement by the general public in using City land connects people with nature, helping to educate and foster an appreciation for protecting these natural assets. Some of the activities enjoyed by residents and tourists are deep water and in-stream fishing, ice fishing, boat fishing, hunting, hiking, cross-country skiing, and other similar low-

impact activities. Areas open to the public have increased in recent years due to the purchases of additional lands by DEP and by its attempt to allow "expanded recreational opportunities in the City's watershed," a specific goal of the agency's strategic plan 2011-2014 (DEP 2011c). DEP's management priority is to allow and enhance those recreational activities that are compatible with water quality.

In 2013, DEP opened an additional 5,979 acres of land to recreation, bringing the total lands and reservoirs available for public use to slightly over 120,000 acres. DEP continued to open West of Hudson (WOH) watershed lands as Public Access Areas (PAAs). On PAAs, users may hunt, hike, fish, or trap without a DEP Access Permit. DEP converted 1,771 acres of entry-by-permit lands to PAAs. Additionally, DEP opened the walkway over the Cross River Dam. Figure 4.7 provides a breakdown of the acres of land, by category, opened for recreation since 2003.

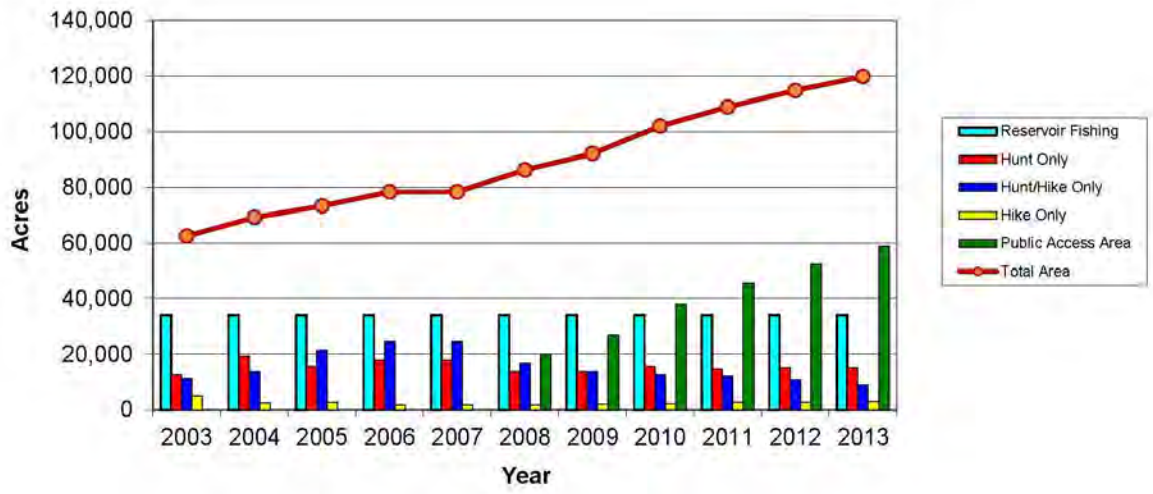

Figure 4.7. New York City-owned water supply land open for recreation as of December 31, 2013.Note that reservoir fishing includes shoreline fishing.

DEP provided revocable land use permits to several partners for projects on City land. This included a permit to the Putnam County Land Trust for a trail along Diverting Reservoir and a permit to the Catskill Watershed Corporation (CWC) to oversee a vendor rental program on recreational boating reservoirs. DEP works with partners to site, construct, and maintain trails and other projects in areas that are compatible with water quality protection. Trails are routed so as to avoid natural resources such as wetlands and constructed in a way that does not create erosion and sedimentation.

Figure 4.8. Recreation sign for the Shavertown trail adjacent to Pepacton Reservoir lands.

For the first time ever, DEP developed a program to allow NYS-licensed guides to take clients on DEP lands and waters for hunting, fishing, hiking, and other activities allowed by DEP's recreation rules. Permits were issued to 22 guides in 2013 and they were asked to complete surveys at the end of the season. Other activities to enhance recreational opportunities included a Kids Fishing Day on Ashokan Reservoir as part of Ulster County's Creek Week and a Wounded Warrior Deer Hunt in partnership with the Ruffed Grouse Society.

In 2013, DEP secured 100 Deer Management Assistance Permits (DMAPs) from NYSDEC. By providing hunters additional opportunities to harvest deer on Ashokan Reservoir lands, the DMAPs will help DEP resource managers reduce the negative impacts on forest regeneration from deer over-browsing. To help facilitate a higher success rate using the DMAPs, DEP opened 1,037 acres of Ashokan lands to DMAP-holders only. These lands have never been hunted before. Out of the 100 DMAPs, 20 antlerless deer were harvested, most out of the DMAP-only areas. This 20 percent success rate is a slight improvement over last year. DEP will continue to consider ways to improve DMAP success rates. Three DMAPs were filled by participants of the Wounded Warrior hunt.

Recreational Boating Program

Seven hundred fifty boat tags were issued by DEP for the four reservoirs covered by the program (Cannonsville, Pepacton, Neversink, Schoharie), with Pepacton being the most popular. A large percentage of participants were repeat users. Kayaks were by far the most popular vessel used, with canoes second. In addition, canoe and kayak rental vendors rented over 300 vessels. Thirty boat racks, to be used by vendors to store kayaks and canoes, were purchased by CWC in partnership with DEP, which installed them. The vessels were steam cleaned prior to the season and then stored on the racks: vendors were not allowed to remove vessels from their assigned reservoir. The intention of the rental program was to increase participation in recreational boating on the reservoirs by making vessels easily available. DEP staff regularly inspected boat launch areas, removed garbage, and performed routine maintenance as needed. The recreational boating program caused little

Figure 4.9. Sign to alert recreational boaters they must have proper documentation before launching their boats.

interference with existing boaters, who keep their rowboats stored on the reservoirs for fishing, nor were any safety issues, such as rescues, encountered. There were a few incidents of vessels being put into reservoirs without being properly steam cleaned. Both DEP staff and concerned recreation users approached the violators and informed them of the program requirements. DEP is stepping up outreach and installing additional signage at boat launch sites.

DEP, along with other partners, is finalizing a report demonstrating that the pilot program was a success and recommending it be expanded to other reservoirs.

Trolling Motor Program

In 2013, DEP initiated a pilot Trolling Motor Program on Cannonsville Reservoir. The program requires trolling motor users to use sealed marine type batteries; affix batteries to vessels to prevent spillage into the water; and have their trolling motors steam cleaned, with the propeller removed, by a DEP-trained and certified steam cleaning vendor. All trolling motor users had to secure a DEP trolling motor tag. For those who wished to keep the motor with their boat, a seasonal tag was issued; otherwise, users had to have the motor steam cleaned for each use. DEP developed a program evaluation to enable it to assess the 2013 season results and make recommendations for the future of the pilot.

Agricultural Use

DEP allows its land to be used for agricultural activities through a landowner-lease program, but sets certain conditions on landowners who choose to farm, such as a minimum 25-foot buffer along all streams and wetlands, a prohibition on spreading raw manure during frozen or snow-covered conditions, and, if fertilizers are to be used, an approved nutrient management plan. Most of the farmers using City lands are enrolled in the WAC's Whole Farm Plan Program. Farmers enrolled in this program adopt whole farm plans, which helps ensure good farming practices are utilized. These plans are generally developed for private land but can be adapted for use on City lands and include various agricultural BMPs such as soil stabilization techniques. Some of the agricultural lands the City purchases under the Land Acquisition Program (see Section 4.2) have Conservation Reserve Program (CRP) and/or Whole Farm Plan BMPs already installed on them, such as fencing and tree planting, which the City, as landowner, must maintain. The most common agricultural use on City land is the harvesting of hay. In 2013, DEP approved 18 new projects covering 313 acres for a total of 92 projects in 25 different towns covering 2,216 acres.

4.3.3 Forest Management

DEP has an active Forest Management Program staffed by four geographically-based foresters and one supervisor/coordinator. The program is responsible for the scientific assessment and active management of forest resources on City land, which includes conducting forest management projects, mostly timber harvests. The overall program goal is to promote forest vigor, resistance and resiliency to protect and enhance water quality. In 2013, the program

continued implementation of the 2011 Forest Management Plan (FMP), developed in conjunction with the United States Department of Agriculture's Forest Service (USFS) (DEP 2011d) to guide forest management activities on City-owned forest land.

During 2013, two semiannual FITT planning meetings were held for long-range planning, bringing together 30+ DEP resource specialists, and six field meetings were held to develop site-specific forest management project plans on five new forest management projects.

The table below lists the number of forest management projects that are currently in each phase of the development process as outlined in the City's Forest Management Plan Conservation Practices (CP), as well as the number of acres in each process phase (as of December 31, 2013):

Table 4.4. Status of forestry projects.

CP process phase	Number of projects	Acres
Initiation	5	756
Planning	7	577
Implementation	7	880
Completion	4	111
Total	23	2,324

On October 29, 2012, the watershed was impacted by Hurricane Sandy, which uprooted and snapped trees on sites across the watershed. The majority of the impacts occurred in the eastern portion of the Cat/Del watershed and throughout the EOH watershed, with the most significant impact in the Kensico basin. The harvesting and cleanup of over 250 acres of the weather-impacted areas within the Kensico, Ashokan and Rondout basins, and 120 acres in the Cannonsville basin caused by another weather event, were initiated in 2013. This work will continue into 2014.

DEP developed a forest re-planting plan for Kensico sites destroyed by Hurricane Sandy to re-vegetate the sites and protect water quality. DEP is also developed a deer fencing strategy to address the potential impact that the overabundance of deer in the region has on regeneration. Contracting for this work is under way.

Emerald ash borer (EAB), a non-native invasive insect, continued to spread westerly through the Ashokan basin, impacting all ash trees, which comprise 7% of City-owned forest land. In collaboration with NYSDEC and the USFS, DEP has developed an EAB mitigation strategy for the basin. The goal is to reduce the population of ash trees ahead of the EAB infestation to manage EAB spread, reduce potential hazards, and manage vegetation that will replace ash. DEP has also been exploring a partnership with the New York State Department of Transportation to reduce the hazards from trees situated near public roads that have been killed by EAB.(For more details on the EAB issue, see Section 4.3.4.)

4.3.4 Invasive Species Management

Invasive Species Working Group

The Invasive Species Working Group (ISWG) was formed in 2008 to develop and implement a science-based, comprehensive plan to identify, prioritize, and address invasive species threats to the water supply. The ISWG met four times in 2013 and continued implementation of portions of DEP's Early Detection and Rapid Response Plan (ED/RR) for invasive species and discussed strategies to deal with potential invasive species threats such as spiny water flea, Eurasian boar and *Hydrilla*.

Several ED/RR plan elements were implemented in 2013, as follows:

- Implementation of the education and outreach strategy (E/O strategy) began, with the establishment of an early detection invasive species hotline, and with training for DEP field staff from Operations, Police, Water Quality, and Watershed Protection Programs staff on early detection and species identification. Additionally, public outreach was conducted at recreational boat launches on Pepacton and Neversink Reservoirs, a family fishing day event on Ashokan Reservoir, the Ashokan promenade, the Grahamsville Little World's Fair and the Delaware County Fair. DEP staff and interns answered questions about the early detection of early detection species and preventing their spread, and distributed informational handouts.

Figure 4.10. DEP interns interacting with the public at the Ashokan walkway.

- A two-year contract was initiated with SUNY Oneonta to conduct aquatic invasive species (AIS) surveys for DEP's terminal reservoirs for the purpose of inventorying and mapping AIS occurrences. SUNY Oneonta will also develop and test molecular markers (primers) for select species to make it possible to detect environmental DNA (eDNA). eDNA are fragments of DNA free floating in water which may be amplified by these markers through the use of polymerase chain reaction (PCR) techniques. This detection method may make it possible to conduct broader surveys of reservoirs and lakes for the presence of AIS.
- Recreational boat launch areas on Cannonsville, Pepacton, Neversink and Schoharie Reservoirs were surveyed for aquatic and terrestrial invasive species in order to ensure that any new introductions that occur as a result of increased boating activities would be caught early. The only invasive species on DEP's priority list detected at the boat launch areas were the rusty crayfish and Japanese knotweed. These have likely been present for many years and were probably not the result of the increased boating activities.

Figure 4.11. DEP employee using a rake net to survey for aquatic invasive species on a City reservoir.

•Aquatic plant surveys were conducted on Titicus, Muscoot, Croton Falls, and Cross River reservoirs. Samples were collected from a selection of shallow coves on each reservoir using a double-sided rake toss methodology. Eurasian water milfoil and curly leaf pond weed were found in several reservoirs.

•Asian longhorned beetle tree surveys were completed at 13 private campgrounds in the WOH watershed as a follow-up to the 2009 survey conducted by DEP in partnership with The Nature Conservancy. Addition al follow-up surveys were proposed for every third year, with the next survey slated to occur in 2016. No beetles, or signs of them, were observed.

- DEP staff submitted two early detection invasive species reports. The first report was of mile-a-minute vine growing in potted plants held by a DEP contractor in the Ashokan basin. Survey work to delimit the extent of the introduction began in fall 2013. The second early detection was of swallow-wort near the Cannonsville Reservoir, reported by DEP staff mowing the area.
- The USDA's Animal Plant Health Inspection Service (APHIS) Wildlife Services worked with the ISWG to provide an initial training on regulations, procedures, and protocols to identify and properly deal with a sighting of Eurasian boar on City lands.

New York State Invasive Species Advisory Committee

DEP has a seat on the New York State Invasive Species Advisory Committee (ISAC), which was created through state invasive species legislation in 2007 to provide information, advice, and guidance to the New York State Invasive Species Council (ISC) on issues related to invasive species impacts, prevention, regulation, detection, and management in the state. In 2013, the committee continued to provide a forum for the exchange of information among the ISAC's member groups and the ISC. A major task of the ISAC in 2013 was providing feedback to NYSDEC on rule making for the Invasive Species Prevention Act, legislation enacted in 2012 to regulate and prohibit the sale of invasive species. A second major tasks was to plan for a Statewide Invasive Species Education and Outreach Campaign for 2014. DEP attended four ISAC meetings in 2013 and chaired the ISAC Education and Outreach Working Group.

Invasive Species Management

DEP continued treatment of priority invasive species on City land. A summary of these efforts follows.

Swallow-wort (Pepacton Reservoir)

Efforts to monitor and eradicate pale and black swallow-wort at one site on the eastern end of Pepacton Reservoir continued in 2013. This site has been managed since 2007, and swallow-wort density has now been reduced to a level where it is anticipated that monitoring and manual removal will be sufficient to maintain its low density there. In June and August 2013, before the plants set seed, 32 stems were monitored and removed. Monitoring will continue until no stems are detected for three consecutive years.

Emerald Ash Borer (Ashokan Reservoir)

In March 2013, the New York State Department of Agriculture and Markets expanded the EAB quarantine area due to the increasing number of locations with EAB; it now includes the bulk of southern New York State, including the entire New York City Watershed except for Westchester County. The quarantine zone expansion made the widespread movement of potentially EAB-infested ash wood within and through the watershed allowable under the law. Additionally, a number of new EAB detections were made during the summer several miles west of its previously known extent in the Ashokan Reservoir basin. Therefore, DEP's goal moving forward has shifted to minimizing hazards posed by dying trees and maximizing utilization of ash wood by planning forestry projects in areas where the percent cover of ash is very high. Further, DEP began exploring ways to regenerate forest stands where ash trees are the dominant species, by managing deer and invasive plants.

Figure 4.12. Ash trees showing woodpecker damage, a sign of EAB infestation.

Purple Loosestrife (Ashokan Reservoir)

Manual removal of purple loosestrife plants and flower heads was conducted on a wetland mitigation site near the Ashokan Reservoir, despite the fact that black-margined loosestrife beetles, a widespread biocontrol species, were observed feeding on them. The manual removal was necessary to fulfill U.S. Army Corps of Engineers permit requirements for percent cover by native plants.

Japanese Barberry and Multiflora Rose (West Branch and Ashokan Reservoirs)

DEP conducted invasive species management in advance of several forest management projects to help ensure the projects met their objective of increased forest regeneration. Foliar application of a 2% glyphosate solution (Bullzeye) was conducted by a certified applicator to control barberry at the Barrett Pond Forest Management Project site in Putnam County (West Branch Reservoir basin) as a repeat treatment for missed plants from the 2012 treatment. Similar chemical treatment, supplemented by manual control, was performed on barberry and multiflora rose at stands surrounding Ashokan Reservoir in Ulster County, including the Plank Road, Ashokan North, and Sand Hill Forest Management Project Sites.

Mile-a-minute Vine (Kensico, Croton Falls, and Cross River Reservoirs)

Manual control of mile-a-minute vine took place at several sites in the Kensico, Croton Fall, and Cross River Reservoir basins. Croton Falls Reservoir sites were very well suppressed, while challenges accessing sites at Cross River Reservoir inhibited the level of control achieved there. The site in the Kensico basin exhibited heavy feeding by mile-a-minute weevils, a biocontrol species that has been dispersing from release sites in Connecticut and the Hudson Valley since 2009, but since the site was very large, the vine could not be fully suppressed.

Invasive Plant Control (Kensico Reservoir)

Invasive plants were controlled using a combination of herbicide application by certified applicators and manual control at a tree planting project next to Whippoorwill Creek in the Kensico Reservoir basin. Work will be continuing in 2014 to allow planted trees to become established without pressure from invasive plants.

Catskill Regional Invasive Species Partnership

DEP continued to work regionally with partners on aquatic and terrestrial invasive species survey, education, and outreach in the Catskill Region. In 2013, the Catskill Regional Invasive Species Partnership (CRISP) worked with DEP to provide training and coordination for the recreational boat launch stewards, interns, and volunteers who provide non-regulatory outreach at boat launches on the importance of preventing the spread of invasive species. DEP participated in CRISP quarterly meetings, served on the Executive Committee, provided comments on draft strategic documents, and aided in decision making on project funding.

Lower Hudson Partnership for Regional Invasive Species Management (PRISM)

The contract was executed to formally create the Lower Hudson PRISM was executed in 2013 between NYSDEC and the New York New Jersey Trail Conference, which will serve as the host organization. DEP participated in three PRISM strategic planning meetings, served on a strategic planning work group for invasive species management, and aided in the development of a governance structure for the PRISM.

DEP also joined with NYSDEC to search for giant hogweed in watershed lands lying within the Lower Hudson PRISM, and with the NYS Office of Parks, Recreation and Historic Preservation to control Japanese barberry, Asiatic bittersweet, and multiflora rose on DEP lands adjacent to Fahnestock State Park and nearby Wonder Lake State Park (Putnam County).

Education and Outreach

In January 2013, DEP gave a poster presentation at the New York/New England Society of American Foresters annual meeting to disseminate the knowledge gained from EAB sampling, forest inventories, and implementing the EAB SLow Ash Mortality (SLAM) protocol on Ashokan water supply lands.

In May 2013, DEP helped NYSDEC with host the National Association of State Foresters's Forest Health Committee meeting, which focused on forest health issues, primarily in the Northeast. A key component of the meeting was a DEP field presentation on EAB issues and knowledge gained from the effort to slow the spread of EAB on Ashokan water supply lands. The information provided will be used to assist other states in the development of their responses to EAB.

In September 2013, DEP gave a presentation at the Watershed Science and Technical Conference on the successful eradication of swallow-wort on lands surrounding Pepacton Reservoir.

In November 2013, DEP gave a presentation at the Cornell Cooperative Extension In-Service Invasive Species Session in Ithaca, NY, on the ISAC's planned Education and Outreach Campaign, to increase awareness for this effort and gain support.

4.4 Watershed Agricultural Program

The Watershed Agricultural Program (WAP) is a partnership that supports the development of Whole Farm Plans (WFPs), the implementation of BMPs, and related initiatives. The WAP is administered by the Watershed Agricultural Council (WAC) using core funds provided by DEP along with technical and financial assistance from the United States Department of Agriculture (USDA), especially with regard to the Conservation Reserve Enhancement Program (CREP). Delaware County Soil and Water Conservation District (SWCD) and Cornell Cooperative Extension (CCE) provide planning and engineering services, educational programs, and other support to the WAP.

The 2013 accomplishments of the WAP are summarized in Table 4.5 and the subsequent narrative, with all FAD goals and metrics being met or exceeded. For information relating to the WAC Farm Easement Program, see Section 4.2.

Table 4.5. Summary of the WAP's accomplishments during 2013.

Accomplishments	Large farms	Small farms	EOH farms
New WFPs completed	0	10	6
Number of WFP revisions	32	10	8
Nutrient management plans completed	49	17	7
Annual status reviews completed	173	81	58
Number of new BMPs implemented	53	64	48
Cost of implementing new BMPs	$923,359	$363,211	$438,764
Number of existing BMPs repaired or replaced	46	13	4
Cost of repairing or replacing existing BMPs	$412,830	$40,090	$22,125
New CREP contracts developed	2	1	0
Acres enrolled in new CREP contracts	25.3	2.0	0
CREP re-enrollment contracts completed	2	0	0
Acres re-enrolled in CREP contracts	20.1	0	0

4.4.1 Whole Farm Planning

The WAP has identified 214 active large farms in the West of Hudson (WOH) watershed, of which 197 (92%) are enrolled in the WAP and 187 (87%) have WFPs. To date, the WAP has also developed 111 WFPs on small farms (of which 97 remain active) and 74 WFPs on East of Hudson (EOH) farms (of which 69 remain active). Although no new WFPs were completed on large farms during 2013, two WFPs were developed; one of these plans was tabled for approval until 2014 because of its unusually high cost (more than $1 million) and the second plan was approved but the farmer declined to sign off on it.

During 2013, the WAP conducted annual status reviews on a total of 312 large, small, and EOH farms, which represents more than 90% of all active WFPs. This process confirmed that 63 large farms, 13 small farms, and 5 EOH farms were inactive. The WAP also mailed a survey to 227 known small farms that do not yet have a WFP to determine if these farms still meet the WAP's eligibility criteria by having more than five animal units and earning more than $1,000 annually in gross agricultural sales. The WAP received 82 responses (36%) and found that, of those, only 17 small farms still meet the WAP's eligibility criteria.

4.4.2 BMP Implementation

As itemized in Table 4.6, the WAP implemented 228 best management practices (BMPs) on large, small, and EOH farms at a cost of $2,200,379. To date, 6,464 BMPs have been

implemented on all watershed farms at a total cost of $48.4 million. These figures include 4,900 BMPs on large farms ($39.1 million), 1,013 BMPs on small farms ($4.2 million), and 550 BMPs on EOH farms ($4.7 million).

Table 4.6. Implementation of BMPs on large, small, and EOH farms in 2013.

NRCS Code	BMP name	Large farms	Small farms	EOH farms
312	Waste Management System	1	0	0
313	Waste Storage Facility*	5	4	2
317	Manure Composting Facility*	1	0	2
330	Contour Farming	0	0	1
340	Cover & Green Manure Crop	0	0	2
360	Closure of a Waste Impoundment	1	0	0
362	Diversion*	0	2	1
382	Fencing*	11	27	6
390	Riparian Herbaceous Cover	0	0	2
391	Riparian Forest Buffer	4	3	0
393	Filter Strip*	2	0	0
412/468	Grassed Waterway/Lined Waterway	1	2	1
484	Mulching	0	0	2
512	Pasture and Hayland Planting	1	1	1
516	Pipeline	4	6	3
528	Prescribed Grazing	0	1	3
558	Roof Runoff Management*	2	3	3
560	Access Road*	4	1	1
561	Heavy Use Area Protection*	6	9	7
574	Spring Development*	7	4	0
575	Animal Trails and Walkway*	9	1	1
578	Stream Crossing	1	0	0
580	Stream bank Protection	2	2	0
587	Structure for Water Control	1	1	5
612	Tree & Shrub Planting	4	3	0
612.3	Tree & Shrub Planting - Natural Regeneration	3	3	0
614/642	Watering Facility/Well*	5	2	1
620	Underground Outlet	2	0	0
634	Waste Transfer System	4	0	0
635	Vegetated Treatment Area	1	0	6
798	Seasonal Hi-Tunnel	0	0	1

Table 4.6. (Continued) Implementation of BMPs on large, small, and EOH farms in 2013.

NRCS Code	BMP name	Large farms	Small farms	EOH farms
3010	Roofed Barnyard	2	1	0
3100	Calf Housing*	10	0	0
3178	Manure Transportation Credit	1	0	0
3210	Backflow System	1	0	0
3410	Manure Spreading Equipment	2	1	0
4200	Bio Retention Area	0	0	1
5002	Bridge*	1	0	0
	Total number of BMPs implemented	99	77	52
	Total cost of BMPs	$1,336,189	$403,301	$460,889

* Modification, emergency repair, or repair and replacement BMP.

4.4.3 Nutrient Management Planning

During 2013, the WAP completed 73 new or updated nutrient management plans (NMPs) on active large, small and EOH farms. A total of 180 large farms are following NMPs, of which 99% are considered current (i.e., developed within the last three years). A total of 79 small farms are following NMPs, of which 73% are considered current.

The WAP Nutrient Management Credit Program worked with 80 participating farmers in 2013 who received $347,782 worth of credits that can be applied towards their nutrient management expenses. An additional 33 farms received federal nutrient management incentive payments by enrolling in the USDA Agricultural Water Enhancement Program (AWEP).

4.4.4 Conservation Reserve Enhancement Program (CREP)

To date, 2,059.1 acres of riparian forest buffers are enrolled in a CREP contract, which includes 27.3 acres that were newly enrolled and 20.1 acres that were re-enrolled in 2013. Two contracts (22.2 acres) expired in 2013 and were not re-enrolled by choice of the landowners.

In 2013, the WAP developed a CREP re-enrollment report that assessed the CREP re-enrollment workload during 2014 and beyond. The report projected a significant spike of 91 CREP re-enrollment contracts during 2015-2016, with another 53 re-enrollment contracts during 2017-2019. Coupled with the WAP's existing BMP workload, the potentially high volume of CREP re-enrollment activity over the next several years may impact the WAP's ability to develop new WFPs and retain 90% farmer participation.

4.4.5 Farmer Education Program

The WAP conducted 26 farmer education programs that were attended by 723 participants, of which 41% were watershed farmers. At least 27% of the WAP's participants attended at least one farmer education program in 2013. Examples of key programs include the

annual Catskill Regional Agricultural Conference; four producer group meetings; one winter crop school; and various in-field grazing seminars, production workshops, and farm/agribusiness tours.

4.4.6 Farm-to-Market Program

The WAC continued to implement a Farm-to-Market Program, which includes the Pure Catskills Buy Local Campaign that reaches more than 50,000 people through its annual print guide, quarterly newsletters, periodic e-bursts, and marketing website (purecatskills.com). Other highlights for 2013 include the annual Farm-to-Market Conference, a series of seven farm tours for existing and aspiring farmers, a regional open house involving eight dairy farms that opened their creameries to the public, and continued development of an online retail store (Pure Catskills Marketplace) that was delayed in 2013 but is expected to be launched in 2014.

4.4.7 WAP Implementation Plan for 2013

The FAD requires DEP to report on the WAP implementation plan for the subsequent year, including the number and types of BMPs, estimated cost of these BMPs, NMPs to be created or revised, and WFPs to be completed or revised. The WAP plan for 2014 includes:

- Implementation of 213 BMPs on large farms at a total estimated cost of $2.2 million.
- Implementation of 129 BMPs on small farms at a total estimated cost of $1 million.
- Implementation of 30 BMPs on EOH farms at a total estimated cost of $407,000.
- Completion of new/updated NMPs on 72 large farms, 40 small farms, and six EOH farms.
- Revision of 25-28 large farm WFPs.
- Continued development of WFPs on small, large and EOH farms.

4.4.8 Related Research Activities

There were no WAP-related research activities to report on during 2013.

4.5 Watershed Forestry Program

The Watershed Forestry Program is a partnership between DEP, the WAC, and the United States Forest Service (USFS) that promotes and supports well-managed working forests as a beneficial land cover for watershed protection. The WAC utilizes core DEP contract funds and matching grants from the USFS to support the following initiatives: (1) forest management planning and stewardship, (2) best management practice (BMP) implementation, (3) logger and forester training, (4) model forest program, (5) forestry education, and (6) wood products marketing and utilization. The accomplishments of the Watershed Forestry Program are summarized in Table 4.7 and the subsequent narrative. For the first time, this narrative also summarizes DEP's and WAC's joint evaluation of the implementation status of five-year-old WAC forest management plans; this annual evaluation was previously submitted as a standalone FAD report.

Table 4.7. Summary of Watershed Forestry Program accomplishments in 2013 and to date.

	2013	To Date
Number of forest management plans completed	52	1,128
New plans (original enrollment)	31	995
Plan updates (re-enrollment)	21	134
Total acreage enrolled in forest management plans	12,586	209,853
Forested acreage only	10,590	163,950
Riparian plans completed	27	478
Riparian acreage	833	15,497
Number of forest road BMP projects completed	41	399
Number of portable bridge projects completed	8	121
Number of stream crossing BMP projects completed	12	63
Number of MAP projects completed	49	364
Timber stand improvement projects	23	200
Wildlife enhancement projects	18	85
Invasive species control projects	2	37
Riparian improvement projects	2	7
Tree planting/deer fencing projects	4	35
Number of Croton Trees For Tribs projects completed	6	34
Number of logger and forester training workshops conducted	13	275
Number of participants	116	2,714

4.5.1 Forest Management Planning and Stewardship

The Watershed Forestry Program continued to fund the development and implementation of forest management plans by private landowners. In 2013, this effort included the first-time enrollment of 31 properties under a WAC plan, the updating of 21 older plans to meet newer WAC specifications, the development of 27 riparian management plans, and the funding of 49 stewardship projects through the Management Assistance Program (MAP).

During 2013, the WAC conducted an internal assessment of its forest management planning program in order to achieve a more effective and cost-efficient program moving forward; as a result, the planning program is currently being redesigned so that two options will be available to forest landowners. First, for people who own at least 50 acres of forest land (i.e., the eligibility threshold for enrolling properties in the NYS Forest Tax Law Program, also called the 480-a program), the WAC will fund the development of a plan only if the landowner enrolls his property in the 480-a program; this enrollment requirement guarantees that the property will remain forested for at least 10 years and ensures the property will remain a working landscape

with periodic timber harvests, because both elements are enforceable requirements of the 480-a program. Second, for people who are not eligible for the 480-a program or do not wish to enroll even if they are eligible, the WAC is developing an interactive website that will allow landowners to create a personalized account and customize their own forest management plan by navigating through a series of educational modules covering dozens of topics and selecting those modules that best align with their long-term forest management goals. This new website will serve to keep a greater number of landowners engaged in their properties through frequent automatic notifications of the MAP and other forestry BMP programs via the website. With agreement from DEP and the USFS, the WAC believes that this new innovative online approach to forest management planning will garner greater participation and be more efficient than traditional methods. The WAC is planning to launch the 480-a planning option around July 2014, to be followed by the online option in 2015.

4.5.2 Best Management Practice Implementation

The Watershed Forestry Program continued to implement forestry BMP projects, including the installation of 40 timber harvest roads, the remediation of one forest road having erosion problems, the completion of 12 stream crossing BMP projects, and the temporary loan of eight portable bridges and/or arch culverts during active timber harvest operations. The WAC also distributed 30 free samples of BMP technologies to loggers, landowners, and foresters, including geotextile road fabric, non-petroleum chainsaw oil, traditional pipe culverts, silt fencing, straw wattles, erosion control blankets, hay bales, and grass seed.

The WAC also continued to implement the Croton Trees for Tribs Program, which is a voluntary riparian buffer restoration program that was launched in 2010. Trees for Tribs engages local volunteers in the planting of trees and shrubs, which serves the dual purpose of protecting water quality and educating watershed residents through their involvement in a local forest stewardship project. Six projects were completed in 2013, involving 55 volunteers who planted 113 trees and shrubs along 438 feet of streams, for a total of 0.5 acres of riparian planting. Thirty-four projects have been completed to date, involving 604 volunteers who planted 1,923 trees and shrubs along 6,886 feet of Croton streams, for a total of 7.4 acres of riparian planting.

4.5.3 Logger and Forester Training

The Watershed Forestry Program continued to sponsor and conduct professional training workshops in collaboration with the NYS Trained Logger Certification (TLC) Program. To promote this effort, the WAC produced an annual logger training calendar, distributed TLC road signs and other materials to watershed loggers, and exhibited at local fairs and festivals. Eleven logger training workshops were held in 2013 and attended by 238 participants. Over 100 loggers working in the Catskill/Lower Hudson region remained fully certified throughout 2013.

The Watershed Forestry Program also conducted one training workshop for nine consulting foresters. Fifty foresters were approved to write WAC forest management plans during 2013.

4.5.4 Model Forest Program

The Watershed Forestry Program continued to coordinate and support four watershed model forests: Lennox (Delaware County), Frost Valley (Ulster County), Siuslaw (Greene County), and Clearpool (Putnam County). Key accomplishments from 2013 include installation of a new weather station at Siuslaw, repair of a washed out portable bridge and other stream crossings at Frost Valley, establishment of permanent forest inventory plots at Clearpool, re-inventory of existing forest plots at both Frost Valley and Siuslaw, and the development of a work plan to establish an informational kiosk and BMP demonstration road at Clearpool (to be completed in 2014). More than 84 education/outreach events took place at the Frost Valley, Siuslaw and Clearpool Model Forests in 2013 reaching 4,500 people. No activities were conducted at the Lennox Model Forest because the project is currently on hold pending the renewal of a partnership agreement between the WAC and the host organization, Cornell Cooperative Extension (CCE) of Delaware County.

4.5.5 Forestry Education

The Watershed Forestry Program continued to implement an urban/rural school-based education program consisting of the Green Connections School Partnership Program, the Watershed Forestry Bus Tour Program, and the Catskill Stream and Watershed Education Program (CSWEP). Green Connections was conducted for 359 students from eight partner schools (four in the watershed and four in New York City). CSWEP was conducted for about 400 students from 30 classrooms in nine watershed schools. Fourteen watershed forestry bus tours were conducted for over 1,000 participants, primarily New York City students. The urban/rural school-based education program is about to undergo a comprehensive redesign in 2014 as recommended by a third-party evaluation completed in 2012; to lead this effort, the WAC hired a new environmental educator who is based in the East of Hudson watershed and will assume responsibility for managing, strengthening and potentially streamlining the WAC's forestry school-based programs.

The WAC also continued to partner with CCE to implement a Forest Landowner Education Strategy that includes a "You and Your Forest" informational letter series and a watershed-focused enhancement of the Cornell Master Forest Owners (MFO) Program. The "You and Your Forest" letter series educated 75 participating landowners. The MFO Program conducted 17 property site visits with landowners and recruited three new volunteers who were trained to engage with other landowners to teach their peers about the importance of forest management and stewardship. In addition, the Siuslaw and Clearpool Model Forests hosted 28 landowner education events that were attended by over 1,230 participants.

4.5.6 Wood Products Marketing and Utilization

The Watershed Forestry Program continued to oversee the Catskill WoodNet marketing website (catskillwoodnet.org) which represents 89 wood-using businesses, including one member who joined in 2013. The number of subscribers increased 12% in 2013, from 628 to 703, which is about the same number of people who receive the bimonthly Catskill Woodnet e-newsletter. During 2013, the Catskill Woodnet website received 1,630 visitors.

4.5.7 Evaluation of Five-Year Forest Management Plans

DEP and the WAC evaluated the implementation status of 62 WAC forest management plans that were completed in 2008 and turned five years old in 2013. To date, DEP and the WAC have evaluated 769 plans that were completed between 1998 and 2008. Seventeen different foresters wrote the 62 WAC plans in 2008, with two foresters writing more than half of all plans (53%). By comparison, 41 different foresters wrote all 769 WAC plans evaluated to date. One trend that has emerged from this evaluation is that only a portion of all foresters who are eligible to write plans actually perform this task in a given year. From 1998 to 2008, an average of 41 foresters were approved to write plans every year compared to an average of 16 foresters who actually wrote plans every year.

Seventy percent of the WAC plans completed in 2008 were on Delaware County properties, 10% were in Westchester County, 8% were in Greene County, and 5% or less were completed in each of the following counties: Putnam, Schoharie, Sullivan and Ulster. The average completion time for the 62 WAC plans was 9.8 months, which is slightly longer than the cumulative average completion time of 8.6 months for all 769 plans evaluated to date.

Ninety percent of the WAC plans completed during 2008 contain some type of silvicultural prescription in their 15-year work schedules, which is consistent with prior year evaluations. Also consistent with prior year evaluations are the types and frequency of silvicultural prescriptions, with commercial thinning, timber stand improvement (TSI), and pre-commercial thinning representing the most common prescriptions listed by foresters.

Sixty-nine percent of the WAC plans completed during 2008 had a stream located on the property, of which 30% had a stream crossing already in place (mostly fords) and 67% recommended that a new crossing would be needed during a future timber harvest. One trend that appears to be emerging from this evaluation is that portable bridges are being recommended in greater numbers over time. For the 62 WAC plans completed in 2008, portable bridges comprised 79% of all recommended stream crossings, whereas the cumulative statistic for all 769 plans completed from 1998 to 2008 is 55%. One possible explanation is that watershed foresters are increasingly becoming familiar with portable bridges and they know that WAC offers numerous portable bridge options to landowners and loggers.

Approximately 84% of the WAC plans completed during 2008 had an existing forest road located on the property, of which an estimated 21% were characterized as having erosion

problems or needing BMPs. Approximately 69% of the plans recommended that new roads be installed during future timber harvests. All of these statistics are consistent with the cumulative results from prior year evaluations.

Thirty-eight landowners returned a Year-1 Survey upon completion of their WAC plans in 2008, representing a 61% response rate, which exceeds the 47% cumulative response rate for all 769 landowners who completed WAC plans from 1998 to 2008. Ninety-five percent of respondents indicated they were satisfied with the forest management planning process, 97% felt that having a WAC plan would improve their stewardship, and 100% indicated they were satisfied with their foresters and also felt they had adequate input into the preparation of their plans. Ninety-two percent of respondents indicated they would retain the services of their forester for future activities, with the same percentage also indicating they would prefer to use a trained/ certified logger for a future timber sale. Of the 87% of respondents who expressed interest in other forestry programs or opportunities, 76% identified road/trail improvements, 55% identified educational workshops, and 36% identified conservation easements.

Forty-four landowners returned Year-5 Surveys in 2013, representing a 71% response rate, which greatly exceeds the 51% cumulative response rate for all 769 landowners who completed WAC plans from 1998 to 2008. Thirty-four of these surveys (77%) were returned by mail and 10 were completed online (23%). Of the 44 landowners who returned the Year-5 Surveys, 43 (98%) still own their property and one (2%) sold his land. Of the 43 respondents who still own their land, 93% indicated they have been satisfied with their plans during the past five years, 63% have consulted their plans since they were completed, 81% feel that owning their plans has improved their stewardship, and 26% have participated in workshops or other events during the past five years. All of these statistics are consistent with the cumulative results from prior year evaluations. However, only 33% of the 2013 survey respondents indicated they retained the services of their forester since completing their plans, which is lower than the 52% cumulative statistic for all Year-5 Surveys returned to date. For those respondents who indicated their plans recommended forestry activities and water quality protection practices, 72% and 78%, respectively, claimed to have completed these recommendations during the past five years; these statistics are slightly higher than the cumulative results from prior year evaluations (67% and 63%, respectively). A similar variance exists for the 2013 survey respondents who indicated they conducted a timber sale during the past five years: 100% claimed to have hired a professional forester and a trained/certified logger, a slightly higher statistic than the cumulative result from prior year evaluations (89%).

Finally, watershed landowners who adopt WAC forest management plans may choose to participate in several voluntary programs that promote forest stewardship. These include the MAP, Forest Road BMP Program, NYS Forest Tax Law, WAC's Farm Easement Program, and DEP's Land Acquisition Program. A total of 28 landowners (45%) who completed WAC plans

during 2008 took advantage of at least one or more of these programmatic opportunities as described below:

- Thirty-eight landowners (61%) were eligible to participate in the NYS Forest Tax Law Program by owning at least 50 acres of forest land. Twelve of these landowners (32%) actually enrolled all or part of their properties in this program, as confirmed by the NYSDEC. This figure is consistent with the 2013 Year-5 Survey results, in which 30% of respondents reported enrollment.
- Six of the plans (10%) evaluated this year had been updated since 2008, while two other landowners (3%) are currently in the process of updating their plans.
- Twelve landowners (19%) were approved to implement 14 forest road BMP projects; all of these projects have been completed.
- Fifteen landowners (24%) were approved to implement a total of 37 MAP projects, including 14 TSI projects, 13 wildlife improvement projects, four tree planting projects, four invasive species control projects, and two riparian planting projects. Twenty-eight of these projects (76%) were completed, five (14%) were cancelled, and four (11%) are still active.
- One landowner (2%) is currently in the process of selling 62 acres of land to New York City in fee simple. Two landowners (4%) entered into a conservation easement through DEP's Land Acquisition Program, covering a combined 188 acres.
- One landowner (2%) entered into a conservation easement through WAC's Farm Easement Program, covering 132 acres.

4.6 Stream Management Program

The DEP Stream Management Program (SMP) and its partners made considerable progress in 2013 toward its goal of restoring and protecting stream system stability and ecological integrity by facilitating the long term stewardship of watershed streams and floodplains. The SMP focus in 2013 was to complete construction of most flood recovery projects necessitated by Tropical Storms Irene and Lee, and substantially advance new flood hazard mitigation programming in the West of Hudson (WOH) watershed.

In 2012 and 2013, the SMP completed flood hazard mitigation projects equivalent to the combined effort expended on such projects in the previous 14 years. Prior to 2012, the SMP had funded all or part of 37 projects totaling $13 million, while since Tropical Storm Irene, the SMP has funded all or part of 47 projects at a cost of $16.4 million.

Significant accomplishments of 2013 include:

- Constructed 28 additional flood hazard mitigation projects cost shared with the United States Department of Agriculture's Natural Resources Conservation Service (NRCS), bringing the total since 2012 to 33. The projects stabilized 3.7 stream miles and represented an investment of $12.1 million in community flood hazard mitigation and City water quality objectives.
- Made substantial progress in negotiating new SMP implementation contracts with the five program primary partners. New contracts lay the contractual foundation for implementing the SMP's aspects of the Local Flood Hazard Mitigation Program (LFHMP) and provide a com-

bined funding level of $46.4M for the period 2014 to2019.

- In November, the SMP submitted its FAD deliverable, Training in Best Practices in Stream, Floodplain, and Watershed Management for Municipal Officials, a Plan and Schedule, providing key messages to municipal officials, a critical stakeholder group which undergoes turnover as frequently as every two years.
- The SMP and partners developed and participated in more than 70 individual educational activities (see Section 4.10 for a complete list of activities).
- Continued the training in the Post Flood Emergency Stream Intervention Protocol throughout the watershed and New York State. Delaware County Soil and Water Conservation District (DCSWCD) received an Environmental Excellence Award in December for this invaluable project.
- Finalized a Scope of Services for the Local Flood Analysis (LFA) initiative, completing an LFA for Prattsville, and initiating an LFA in the Towns of Walton and Lexington.
- Completed 34 Catskill Stream Buffer Initiative (CSBI) projects, through which 14 riparian acres were planted on over 3.0 linear miles of watershed stream.
- Substantially completed the Preliminary Flood Insurance Rate Maps for the WOH watershed, a FAD deliverable. The updated flood maps and their underlying hydraulic models provide critical tools for communities in identifying best flood hazard mitigation projects.

4.6.1 Stream Management Plans and their Implementation

Stream management plans have been completed for the mainstem WOH watershed streams. Municipal adoption of these plans is an eligibility requirement for Stream Management Implementation Program (SMIP) grant funding, including grants for the new LFA initiative and associated hazard mitigation projects.

Priority projects, including SMIP-funded projects, are described within annual Action Plans prepared by each sub-basin-scale SMP team. The Action Plans for all four basin SMPs were updated in May 2013 and can be viewed at http://catskillstreams.org/major-streams/. Following Tropical Storm Irene, program resources were transferred from SMIP projects to priority flood recovery projects under the NRCS's Emergency Watershed Protection (EWP) Program. With the completion of emergency projects, the program emphasis returns to completing the delayed SMIP- funded projects.

Delaware Basin

DEP and the DCSWCD, in partnership with the Delaware County Planning Department (DCPD), continued to implement the recommendations of the East and West Branch Delaware River Stream Management Plans through the Project Advisory Committee and its sub-committees. The focus of efforts in 2013 was the completion of EWP flood recovery projects, further extension of the Post Flood Emergency Stream Intervention Protocol, support for flood commissions in Walton and the East Branch Delaware, roll-out of the Third Brook Watershed Management Plan, and continued collaboration with the Watershed Agricultural Council on stream projects to enable CREP enrollment.

With DEP matching funds and design support from DEP and its engineering contractor MMI, Inc., the Delaware Basin program was able to complete designs and construct 24 flood recovery stream projects under the NRCS EWP. Significant effort was expended on the acquisition of landowner permissions and permits, and bidding and inspection of these projects, through the end of October.

The DCSWCD continued to provide its Emergency Stream Intervention Protocol training regionally and state-wide for NYSDEC and Soil and Water Conservation Districts. The DCSWCD was given an Environmental Excellence Award by NYSDEC and a commendation from the NY Association of Conservation Districts for its work in providing a "train the trainer" workshop series for DCSWCD staff from across the state. This effort completed the DEP-NYSDEC jointly funded project originally developed following the 2006 flood.

MMI, under a contract to the Village of Walton funded by DEP and the NYS Department of State, completed its final draft of the Third Brook Watershed Management Plan. The plan, which highlights the impacts of the 2006 flood event, identified numerous potential projects—including bank stabilization, stormwater, flood hazard mitigation, and infrastructure projects—for future consideration under the FHMP, SMIP and other grant programs. DCSWCD has received a Water Resources Development Act grant for $510,000 to stabilize landslides and bank failure in the watershed.

DEP and the DCSWCD also continued to support riparian buffer programs through the CSBI and provide advice and funding of stream bank projects associated with the WAC and the CREP. Additional information on these projects is available on http://catskillstreams.org/stream-management-program/project-maps. While the majority of SMIP projects were on hold due to EWP commitments, the DCPD continued to advance grants to design and construct recreational access sites along the West Branch Delaware at Walton, Hamden, and Delhi. A Request for Proposals for landscape architectural design services was let by the DCPD for a river walk and boat launch in the Village of Delhi at Hoyt Park.

Ashokan Basin

The SMP, in partnership with Cornell Cooperative Extension of Ulster County (CCEUC), Ulster County Soil and Water Conservation District (UCSWCD), the Stakeholder Council, and working groups advanced major educational, outreach and stream restoration projects in 2013. A main communication portal for the Ashokan Watershed Stream Management Program (AWSMP), www.ashokanstreams.org, was redesigned and updated to include project updates, Stakeholder Council, and working group meeting minutes, newsletters, technical reports, and SMIP grant project status. The team initiated and substantially completed production of two videos documenting the purpose, design, and construction of stream best management practices, including rock vanes, constructed riffles, root wads, and riparian buffer plantings. The videos will

describe the history and construction of the Stony Clove Creek at Chichester and the Warner Creek "Site 5" projects (see below at Section 4.6.3).

The fourth annual Ashokan Watershed Conference held in April continued a focus on strengthening community resilience to flooding. About 100 watershed residents and municipal officials attended the conference. In July, CCEUC organized a workshop for municipal officials in the Ashokan and Rondout/Neversink watersheds on changes to the National Flood Insurance Program; how these changes, in conjunction with the 2013 revised draft Flood Insurance Rate Maps, will affect their constituents; and how communities can take action to reduce flood losses.

There were no new SMIP grants issued in 2013, though an announcement soliciting grant applications was issued in November 2013 with grants to be awarded in early 2014. Work on several previously awarded SMIP projects advanced. A noteworthy accomplishment was the Town of Shandaken's adoption of its Flood Hazard Mitigation Plan, under a 2011 SMIP award. The plan, overseen by a Town authorized flood commission, identifies over 90 mitigation strategies for reducing Shandaken's hazard exposure and vulnerability. This positions Shandaken to follow through with a 2014 SMIP-funded LFA that will use additional hydraulic modeling to prioritize the most feasible and beneficial actions to reduce flood levels and damage in Phoenicia. Many of these actions can be partially or substantially funded in the next five years through SMIP grants and the Catskill Watershed Corporation (CWC), and possibly from federal funding sources. All existing and past SMIP projects, and their progress, can be reviewed at http://catskillstreams.org/stream-management-program/grants/.

The UCSWCD stream assessment team completed two stream feature inventories: Bushnellsville Creek, which flows alongside NYS Route 42, and which was assessed for the first time, and Stony Clove Creek, which was assessed for the second time, 12 years after the original assessment that formed the basis for the Stony Clove Creek Management Plan. The assessments will be documented and management recommendations will be incorporated into the AWSMP annual action planning process.

Schoharie Basin

DEP, the Greene County Soil and Water Conservation District (GCSWCD), Schoharie Watershed Advisory Committee (SWAC), and subcommittees made substantial progress implementing stream management plan recommendations within the Schoharie Reservoir basin. In 2013, four previously funded SMIP projects were completed, including the West Kill at County Route 6 (Landowner Assistance), County Route 6 Slope Failure (Highway/ Infrastructure), Manor Kill Acquisition Local Cost Share (Flood Hazard Mitigation), and West Kill at NYS Route 42 Stream Restoration (Flood Hazard Mitigation). Three new SMIP applications were funded in 2013, including a proposal by the Town of Lexington to undertake LFA. At year's end, a contract had been awarded to MMI to undertake the LFA. In total, 27 SMIP awards have been completed, two are open-ended (culvert design and road ditch seeding funds),

and the remaining nine are in process. Through the SMIP program, 38 proposals have been funded to the amount of $1,874,205. Full descriptions of the SMIP awards can be found at http://catskillstreams.org/stream-management-program/grants.

GCSWCD also successfully continued the Schoharie watershed education and outreach program that is designed around three key events developed by the basin's Education and Outreach subcommittee: the seventh annual watershed summit (learning and networking focus), the third annual watershed month (action focus), and the Batavia Kill stream celebration (appreciation focus). Despite inclement weather, the watershed summit was attended by approximately 140 stakeholders, and focused on flood mitigation, floodplain management at the local level, and how communities can best prepare for the next flood. May was Schoharie Watershed Month, which provided opportunities for over 250 Mountaintop residents and visitors to participate in a variety of public events focused on stream stewardship and watershed appreciation. The highlight of the month was the opening of the Windham Path along the Batavia Kill, which was partially funded through the SMIP. The Batavia Kill stream celebration was postponed in 2013 in order to focus resources on Irene recovery project efforts.

Rondout/Neversink Basins

The Upper Neversink River Stream Management Plan was adopted by the Towns of Denning and Neversink in February and a summary version of the Plan was published and distributed to key stakeholders, available at http://catskillstreams.org/stream-management-program/sm-implementation-program/. Plan adoption clears the way for the Sullivan County Soil and Water Conservation District (SCSWCD) and its Watershed Advisory Group to undertake implementation of the Rondout/Neversink SMIP. SMIP rules and application materials, scoring criteria, and process for award and contracting have been developed; the formal launch of the SMIP will follow registration of the implementation contract between DEP and SCSWCD in 2014.

The current contract funding level has enabled several projects implementing recommendations in the Rondout and Neversink Management Plans to be funded in 2013. Educational activities funded included several workshops on land use history in the basins as it relates to current stream condition, and a Japanese knotweed management initiative comprising three workshops for highway crew staff and development of an education poster for distribution to landowners. A flood hazard mitigation project in the Town of Denning—upgrading an undersized culvert that carries stormwater under Denning Road and which backed up during several recent flood flows and inundated the Town's emergency response facilities—was also funded.

In December, meetings were held with the Towns of Denning and Neversink explaining and laying the groundwork for the forthcoming LFA initiative, which will generate

recommendations for flood hazard mitigation projects in the population centers of Claryville, Sundown, and Grahamsville.

Throughout the field season, stream bank erosion assessments were conducted at nearly 60 sites on the Neversink River mainstem and its East and West Branches, and rapid reconnaissance for bank erosion sites was conducted on the Fall Brook and Biscuit Brook tributaries to the West Branch of the Neversink. These assessments will support prioritization of restoration work in the coming years, and also provide baseline data for establishing erosion rates and improving assessment methodologies.

4.6.2 Flood Recovery and Hazard Mitigation

Flood Recovery – Partnership with the NRCS Emergency Watershed Protection Program

The NRCS initiated the EWP Program following Tropical Storm Irene. The program is designed to relieve imminent hazards to life and property, and can provide up to 75 percent of the construction cost of emergency measures. For the first time, project eligibility included a new formula, developed by the NRCS, which factored suspended sediment into the benefit cost analysis, which in turn allowed available SMP funding to serve as the local match for many projects. As a result, eroding stream banks in remote areas, not adjacent to infrastructure or homes, became eligible for the program solely because of their suspended sediment contribution to a public drinking water supply.

The SMP teams and NRCS evaluated more than 100 potential project sites for eligibility. NRCS approved $16.2M in federal funds for 55 eligible project sites in the WOH watershed. DEP supported 42 of these projects, by providing engineering and design support using SMP teams and/or DEP's engineering consultant ($1.1 million). Five projects were discontinued due to landowner or local sponsor withdrawal, or because after further review they were deemed ineligible for the EWP Program by NRCS. Of the remaining 37 projects, construction has been completed on 33. To date, $8.5 million in federal funds and $3.6 million in DEP funds have been disbursed for the 33 completed projects. Upon construction of the remaining four projects, 4.3 miles of stream will have been treated under this program. Figure 4.13 depicts the locations of the EWP projects.

Several of these projects entail substantial adjacent hill slope stabilization that NRCS deemed ineligible for cost share. DEP shouldered the design and full cost of these stabilizations because of their importance in meeting the project's objectives of channel stabilization and isolation of suspended sediment sources. These additional costs have not been tallied at the time of this writing, so the overall investment accounting will change.

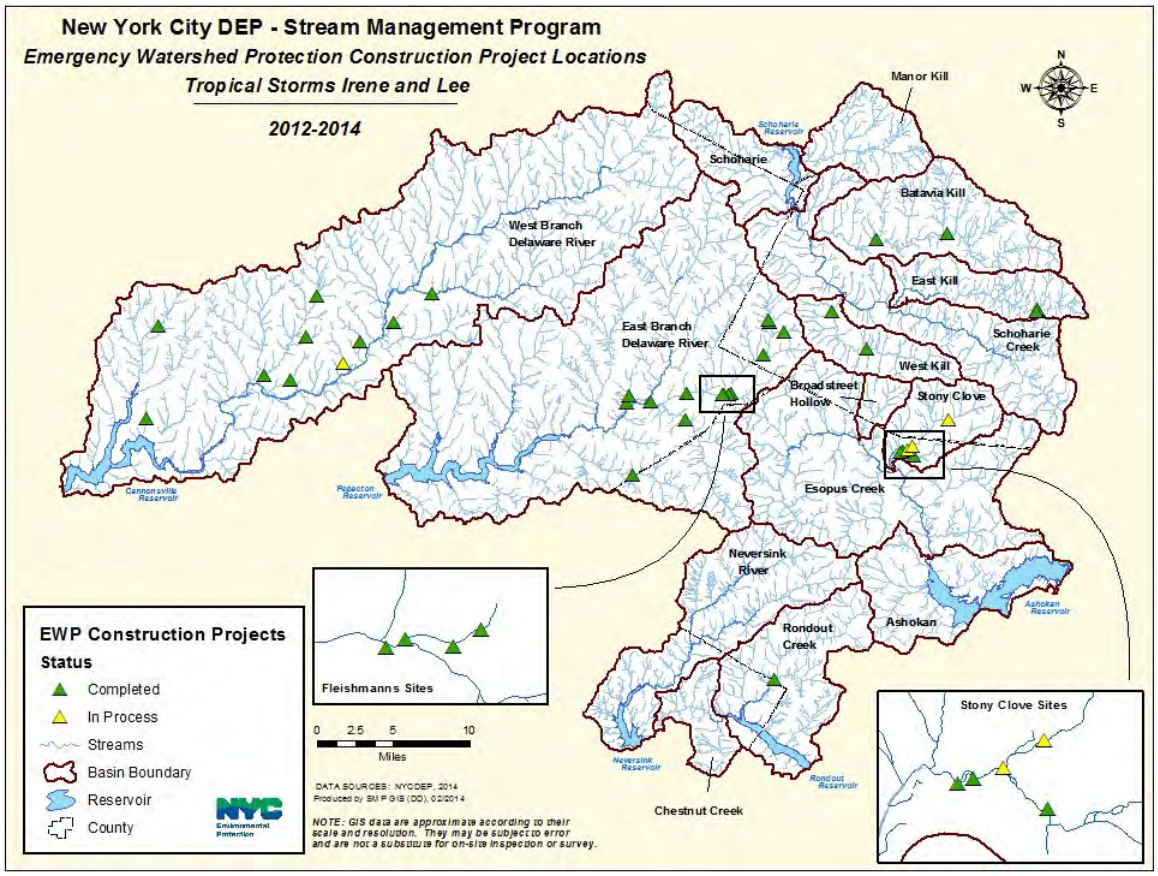

Figure 4.13. Emergency Watershed Protection construction project locations.

DEP and its partners continue to work with NRCS to build greater flexibility into their program in an effort to integrate a wider array of practices that fulfill multiple objectives and adopt a more comprehensive analysis of stream process issues during the design of projects.

Table 4.8. NRCS EWP projects supported by DEP in the WOH watershed, 2012-2014.

Basin	Total projects supported	Local cost share (DEP)	Construction		
			Completed 2012	Completed 2013	In progress 2014
Ashokan	8	6	1	2	3
Delaware	27	20	1	22	1
Rondout/Neversink	1	1	1	---	---
Schoharie	6	4	2	4	---
Total	42	31	5	28	4

Floodplain Mapping and Streams Geodatabase

FEMA continued work under its contract with Risk Assessment, Mapping and Planning Partners (RAMPP) to the map floodplains in the WOH watershed through 2013. FEMA is remapping floodplains along nearly 486 miles of stream, with over 192 miles mapped as detailed studies, under DEP's $7 million contract with FEMA Region II. FEMA is assisted in the outreach and education effort by NYSDEC's Floodplain Management Section, which coordinates quarterly Map Steering Committee meetings in the Catskill and Delaware basins.

In 2013, FEMA released the working maps (unofficial first draft) to all areas of the WOH watershed, providing municipalities an early opportunity to view the maps and understand the extent of the changes depicted before the official release of preliminary maps. Communities were invited to discuss with the RAMPP consultants any issues they found with these working maps, and RAMPP used this information to re-check the analysis and modify the results as warranted. Preliminary maps (official draft) were later released for Ulster, Greene, and Sullivan Counties, and community coordination meetings were organized by NYSDEC for each county with support from DEP and FEMA. The release of preliminary maps for Delaware County is anticipated in spring 2014.

FEMA is also providing DEP with complete copies of the digital hydraulic models, flood surveys, and all reports and photos related to the studies, for future use by communities engaged in LFHMP activities. Further, HEC RAS models have been released to DEP for all areas where preliminary maps have been released and selected areas where needed for floodplain analysis under the NY Rising Community Reconstruction Program. DEP has been actively sharing this information with consultants on an as needed basis. In addition to the HEC RAS models, FEMA's contractor is developing depth grids for the areas receiving detailed studies. Depth grids are GIS map layers of the depth of flood waters on the floodplain and are created for a range of recurrence intervals including the 10-, 25-, 50-, 100-, and 500-year events.

FEMA established 50 pairs of permanent survey monuments across the WOH watershed for use by surveyors who produce elevation certificates for home owners involved with the National Flood Insurance Program. This provides communities a critical tool for managing their floodplains.

To support the many ways DEP and its SMP partners use the Streams Geo-database, the SMP continued enhancement of the database's capacity with updated datasets employing the latest in GIS technology; this allows for higher level analysis and cartography. DEP and partners assisted the redesign and upgrade of www.CatskillStreams.org, allowing users to more easily access status reports on stream projects; watershed events; meetings; and funding opportunities such as SMIP, CSBI, and LFA.

Local Flood Hazard Mitigation Program

The emerging Local Flood Hazard Mitigation Program has three primary programs that together will enable watershed communities to reduce flood risks and damages, improve resiliency, and benefit water quality for New York City: the SMP's LFA initiative (project identification) combined with its SMIP grant program (implementation), the CWC's Flood Hazard Mitigation Implementation Program (FHMIP), and the Land Acquisition Program's Flood Buyout Program (see Section 4.2.7 for more on the LAP Flood Buyout Program).

The foundation of the emerging LFHMP is the Local Flood Analysis. The LFA is an engineering analysis for identifying the potential to reduce flood elevations and flood characteristics. The LFA uses the hydraulic models that underlie the recently updated preliminary flood insurance rate maps to:

- Confirm there is a significant flood hazard in a population center.
- Develop a range of hazard mitigation alternatives.
- Evaluate both the technical effectiveness and the benefit/cost effectiveness of each solution and compare different solutions to identify the most practical, sustainable outcome for flood hazard mitigation for the population center.

In 2013, DEP and its partners finalized a scope of services for the LFA, enabling it to be ready for use by watershed towns or their representatives. An early version of the LFA, commissioned by DEP at the request of the Village of Prattsville following Tropical Storm Irene, was completed and delivered to Prattsville in September. LFAs were contracted for in 2013 by Walton and Lexington. DEP worked very closely throughout the year with CWC to substantially advance a contract and set of program rules for the CWC FHMIP, and with the LAP and numerous stakeholders to advance the overall strategy for its new Flood Buyout Program.

4.6.3 Stream Projects

In 2013, the SMP project focus was on completing flood recovery projects cost shared by NRCS EWP, FEMA's Flood Hazard Mitigation Program, and NYSDEC. Twenty-eight EWP cost share projects, three FEMA cost shared repair projects, and one additional repair project was completed in 2013. It is beyond the scope of this annual report to document each project. Figure 4.13 depicts the locations of the EWP projects constructed in 2012 and 2013 those projects in process towards completion in 2014. Repair projects are noted below. For additional information on the EWP and repair projects, and all past SMP projects, visit www.catskillstreams.org/stream-management-program/project-maps/.

Delaware Basin

In the East Branch Delaware community of Fleischmanns, DEP funding through DCSWCD enabled several NRCS EWP projects (Site 2-3, 4, 5, 7) to be designed and constructed. DEP's engineering contractor, MMI, provided project designs and DCSWCD coordinated permitting, administration, and landowner permission with the municipality. The projects were

designed with a goal of providing flood elevation reduction through the reconnection of previously entrenched channels with their floodplains. DEP funds were used where necessary to construct the new floodplains because NRCS rules prevent the use of funds for this important element of flood hazard mitigation. Extensive descriptions of the projects, including before and after photos, are available on www.catskillstreams.org/stream-management-program/project-maps/.

On the West Branch of the Delaware, the DCSWCD and DEP continued working with the Watershed Agricultural Program technical team to design and construct two stream bank stabilization projects to facilitate additional enrollment of riparian land into the Conservation Reserve Enhancement Program (CREP). At the Swantak Farm in Kortright, the placement of rock riprap along 60 feet of stream bank will enable 5.8 acres to be enrolled in CREP's riparian buffer program. On the Frisbee Farm in Delhi, the first phase of a project to stabilize over 500 feet of stream bank will enable approximately 9 acres to be planted to riparian buffer under CREP. The first 120 feet of bank was restored using toe wood, root wads, and a log vane on the upstream portion of the site. This is the first use of toe wood, a Rosgen technique, in the New York City Watershed. With DCSWCD, the site will be monitored for effectiveness (Figures 4.14 and 4.15).

Figure 4.14. Frisbee Farm stream bank, pre-construction.

Figure 4.15. Frisbee Farm stream bank post-construction, stabilized with toe wood with live staked sod mats.

Ashokan Basin

In 2013, AWSMP completed the restoration of the Stony Clove Creek's Chichester reach, begun in 2012 (Sites 2, 3, and 4); completed a project on Warner Creek, referred to as Site 5; and began construction on the stabilization of the Warner Creek/Stony Clove Creek confluence area. Each of these projects was co-funded with NRCS EWP funds, and had as its primary objective the reduction of suspended sediment loading into the Ashokan watershed, as well as restoration of channel stability to address flood hazards to infrastructure and residential property.

Chichester Reach projects

This reach of the Stony Clove between the Silver Hollow Road bridge and the NYS Route 214 bridge in the Town of Shandaken, has been a chronic source of turbidity for many years and was identified in the 2005 Stony Clove Creek Management Plan as a high priority for stream restoration (Figure 4.16). The reach has been described as four distinct sites. The first site (650 feet) was restored in 2012. Sites 2, 3, and 4 (an additional 1,550 feet) were treated in 2013. DEP engaged the services of its engineering consultant, MMI, to undertake the design of the project, which included substantial re-elevation of the streambed, which had incised into clay and silt layers, incorporation of in-stream structures and constructed riffles to control hydraulics and prevent future incision, and realignment to move the channel away from failing hill slopes where possible. The project reach also employed extensive rock revetment to the banks along most of

the channel as a way to remove erosional forces from the toe of failing hill slopes and to protect residential properties and NYS Route 214. Hill slope treatment included re-grading the Site 2 hill slope (> 2 acres) and lining runoff channels that cut across the slope to prevent surface water infiltration and subsequent entrainment of suspended sediment (Figure 4.17). The total cost for the Chichester Sites 2-4 was $1,547,182. DEP supplied $635,351 of the total cost, and NRCS EWP funding provided the balance. The Town of Shandaken and the UCSWCD and CCEUC were critically important partners in the Chichester restoration projects.

Figure 4.16. The Stony Clove Creek at Chichester reach Site 2 was the largest mapped mass failure along the creek before project construction in 2013. The mass failures were initiated more than a decade ago as the stream cut down and incised into glacial lake deposits. It was considered to be the largest chronic source of turbidity loading during non-flooding conditions.

Figure 4.17. The Stony Clove Creek at Chichester reach Site 2, showing the hill slope and reconstructed stream channel that elevated the bed, stabilized the mass failure, and modified the slope drainage.

Warner Creek Site 5

In 2010, the AWSMP identified Warner Creek as a significant source of turbidity within the Stony Clove watershed. In 2011 Clear Creeks Consulting (CCC) was hired by UCSWCD to assess 7,000 feet of Warner Creek. CCC identified five distinct sites in need of restoration. Site 5 was identified as the highest water quality priority as it was a chronic contributor to turbidity even during low flow conditions, the result of stream erosion contact with glacial lake deposits and mass failure of the glacial material (Figure 4.18). Engineering design was provided by NRCS. The project realigned the creek, removing its contact with both a failing hill slope and Silver Hollow Road; this also mitigated a flood hazard. The project uses in-stream structures and constructed riffles to control the channel's grade and its hydraulics. The failing hill slope was treated through removal of much of the mass failing silty clay material, regrading the surface, and constructing a subsurface drainage system capped by a thick layer of topsoil planted with hundreds of trees (Figure 4.19). The total length of the project was approximately 800 feet and the total cost was $495,465 with DEP funds covering $285,762.

Figure 4.18. Warner Creek Site 5, pre-construction.

Figure 4.19. Treatment for Warner Creek Site 5 included channel realignment, in-stream rock structures, a rock terrace, and re-constructed hill slope.

Schoharie Basin

The Schoharie Watershed SMP completed three major repairs to past restoration projects (Conine, Maier Farm, and Shoemaker) damaged by Tropical Storm Irene, which was nearly a 500-year flood event. These are a subset of seven repairs scheduled, all eligible for 75 percent cost share by FEMA Flood Hazard Mitigation funding. The remaining repairs will proceed in 2014.

West Kill Creek Bank Stabilization at County Route 6

This bank restoration and stream stabilization project on the West Kill at County Route 6 (Spruceton Road) is located in Greene County, New York in the Town of Lexington. The project site is located near the midpoint of the West Kill, extending from a private unnamed bridge at the upstream end, approximately 1,800 feet downstream to a prior stabilization project at Shoemaker Road.The project repaired a mass failure along the creek's right bank, and mitigated in-stream headcuts that were threatening the stability of County Route 6 (Figures 4.20 and 4.21). Specifically, the project included modifications to the storm drainage system along County Route 6, raising of the channel to address an eroding bank segment, channel relocation and grading, and the installation of in-stream grade control features. The project was completed in 2013 in a partnership between the NRCS EWP Program and the SMP. Project cost was $2,429,869, with DEP contributing $607,467.

Figure 4.20. Incision into the bed causing slope failure at the West Kill bank stabilization at County Route 6 before the project was completed.

Figure 4.21. West Kill bank stabilization at County Route 6 following construction designed to stabilize the bed and banks.

West Kill Creek Bank Restoration at NYS Route 42

This streambank and bed stabilization project on the West Kill is located in Greene County, New York, in the Town of Lexington. The site is referenced as West Kill at NYS Route 42, reflective of the project reach, which begins at the Route 42 Bridge at Beech Ridge Road and extends downstream for approximately 1,500 feet. This reach was characterized by an undersized bridge, an entrenched channel confined by Route 42 on the left bank, and an unstable hill slope on the right (Figure 4.22). During Tropical Storm Irene, the bridge was destroyed by scour and displacement, as hundreds of feet of Route 42 were washed away. The steep natural right bank was undermined by channel widening, leading to landslides. Following Irene, the New York State Department of Transportation replaced the bridge and rebuilt the highway along the left bank. The steep high right bank remained unvegetated and untreated and prone to continued failure along an estimated 40-acre failure plane. The project was designed to stabilize the right bank and stream channel using rock revetment and in-stream grade control (Figure 4.23). It was completed in 2013 in a partnership between the NRCS EWP Program and the SMP. Project cost was $1,151,302, with DEP contributing $279,015.

Figure 4.22. West Kill bank stabilization at NYS Route 42 prior to construction.

Figure 4.23. West Kill bank stabilization at NYS Route 42 following construction of the project to slow this fine sediment-laden landslide of approximately 40 acres.

Rondout/Neversink Basins

In April and May 2013, the demonstration stream restoration project on the West Branch of the Neversink River at Frost Valley Road was repaired. Immediately following substantial completion of the project in August, 2012, a near 50-year flood flow resulting from the storm of September 18-19 had significantly damaged the project (Figure 4.24). Final grading and revegetation had been planned for October and November 2012 in conjunction with the bioengineering bank treatments that require dormant plant materials harvested after leaf-off. Repair of the project and planting was thus delayed until spring 2013 to allow for resurvey and development of construction contract change orders to facilitate the repair. The work was completed in May 2013 (Figure 4.25), and an unusually good growing season resulted in excellent establishment of the willow, tree, shrub, and ground cover plantings.

Figure 4.24. Neversink Demonstration Project, damaged by September 18, 2012 flood.

Figure 4.25. Completed restoration project, May 2013.

Further upstream, the same September 2012 storm also undermined Frost Valley Road (County Route 47) at the Round Pond outlet ("the S-turn"). The road had just been repaired following a complete washout resulting from Tropical Storms Irene and Lee. The Rondout/ Neversink Stream Program staff reached out to the county engineers to offer design assistance for a more sustainable channel restoration at the site, and to provide a range of conceptual designs and support for an application from the county for a FEMA Hazard Mitigation Grant to support the project. The grant request has proceeded to Level 5 review at FEMA, and the chosen alternative to a 60% design. Current plans anticipate an August 2014 construction start.

4.7 Riparian Buffer Protection Program

DEP values the importance of protecting and managing riparian buffers as an important component of an effective overall watershed protection program. To this end, many of DEP's watershed programs, partnerships, and research initiatives actively address the protection, management, and restoration of riparian buffers in the New York City Watershed. This report will provide an update on each of the milestones set forth in the 2007 FAD relating to riparian buffer protection, including the progress of existing DEP programs and the Catskill Streams Buffer Initiative.

4.7.1 Activities on City-owned or Controlled Land

Land Acquisition Program

For purposes of this report, riparian buffers are defined as land within 300 feet of stream banks, excluding shoreline around reservoirs, ponds, lakes, and wetlands. DEP's stream data identifies 254,523 acres of land in the Catskill/Delaware watershed falling within that category (24.9% of all land in the watershed, excluding reservoirs), of which DEP, through its Land Acquisition Program (LAP) has protected, by outright ownership or conservation easement, 32,636 acres (12.8% of all riparian buffers in the Cat/Del watershed). Of the land held by easement, roughly half has been secured by DEP and half by the Watershed Agricultural Council, whose acquisition of CEs on farms is funded by DEP. Including buffers protected not just by DEP and WAC, but also by NYSDEC and other public and private open space entities, 85,265 acres, 33.5% of all riparian buffers in the Cat/Del watershed, are now in protected status (see Table 4.10). Since 1997, DEP has increased the percentage of City-protected stream buffers from 2.9% to 15.8%.

Pilot Riparian Buffer Acquisition Program

The 2010 Water Supply Permit requires the City to implement a $5 million Pilot Riparian Buffer Acquisition Program (RBAP) by November 1, 2014. As a first step, the Catskill Center for Conservation and Development completed an RBAP feasibility report in 2013, with input from the City and many stakeholders. Following that, and using the report as guidance, DEP drafted a

Request for Proposals to hire a land trust to run the program. The RFP is expected to be issued in early 2014.

Table 4.9. Protected lands in the Catskill/Delaware System[1], including riparian buffers[2], as of 12/31/2013.

Land protection category	Total in Catskill/ Delaware System including reservoirs (acres)	% Total Catskill/ Delaware System area	% Total Catskill/ Delaware System stream miles	% Total Catskill/ Delaware System riparian buffers, by type
Publicly-owned or controlled lands				
NYC-owned non-LAP (Land Acquisition Program) property (Pre-1997 or facility-related)	61,204.9	5.8%	2.6%	2.9%
NYC-owned LAP property (Post-1997, fee simple)[3]	80,932.3	7.7%	8.1%	8.0%
Land protected by LAP NYC conservation easement[3]	23,480.5	2.2%	2.5%	2.4%
Land protected by LAP WAC conservation easement[3]	22,954.3	2.2%	2.6%	2.5%
Total NYC lands and easements	188,572.0	18.0%	15.9%	15.8%
New York State-owned land	208,833.7	19.9%	16.2%	16.6%
Other in protected status[4]	8,627.7	0.8%	1.1%	1.1%
Total Catskill/Delaware public land	406,033.4	38.7%	33.2%	33.5%
Private watershed lands	642,622.7	61.3%	66.8%	66.5%
Total Lands in Catskill/Delaware System	1,048,656.1	100.0%	100.0%	100.0%

[1]The Catskill/Delaware System includes all WOH basins plus West Branch, Boyd Corners, and Kensico.

[2] 300-foot area both sides of watercourses, which includes streams and rivers and excludes reservoirs, ponds, and lakes. Watercourses and basins have been updated from LiDAR-derived 2013 National Hydrography Dataset (NHD) as part of DEP contract CAT-393.

[3]Under contract or closed.

[4]"Protected status" means the land is believed to be under some form of permanent ownership by a land trust or municipal government.

Natural Resources Program

DEP gives great weight to the presence or absence of, or impacts to, riparian buffers when it reviews requests from outside parties or makes determinations with respect to the commencement of projects on DEP land. For example, DEP allows agricultural use of DEP land, but requires a minimum of a 25-foot buffer between farming activities and the stream. Proposals that plan on maintaining a buffer greater than 25 feet are given extra points in their rating. DEP reviews all land use permits and proposed projects, including stream crossings for silvicultural projects, for potential impacts to riparian buffers. SMP and other BWS staff are solicited for input and have the opportunity to provide suggestions on how to avoid or mitigate these impacts. Additionally, DEP secures stream crossing permits as required by NYSDEC, and extra measures

are taken by foresters to select the BMPs for the stream crossings (e.g., temporary bridges, temporary arch culverts) that have the least adverse impact on the stream and floodplain.

4.7.2 Activities on Privately-Owned Lands

Privately-owned lands contain approximately 66% of the total riparian buffer acreage (169,632.9) in the Cat/Del watershed. Privately-held riparian lands are most commonly found in the Cannonsville basin (82%) and are least common in the Neversink basin (43.7%). Many of these riparian buffers are also protected to some degree by various combinations of MOA programs. For instance, Whole Farm Plans and Watershed Forestry Plans have been developed and implemented largely in the Cannonsville and Pepacton basins, where private ownership is greatest. This section describes the ongoing activities of DEP programs that protect and enhance riparian buffers on privately-owned land.

Catskill Streams Buffer Initiative (CSBI)

The CSBI is an important component of the City's efforts to protect and enhance riparian buffers and is an integral component of the Stream Management Program (Section 4.6). The SMP and its regional partners address riparian buffers through the mapping of riparian vegetation, corridor planning, designing and constructing stream restoration projects, removing invasive plants, and conducting extensive education and outreach. The CSBI works to enhance the extent of riparian buffers where gaps in riparian forest are evident in the landscape and is designed to provide a program for sites not eligible for other programs.

Native Plant Materials

Plantings are an essential ingredient of natural stream bank stability and an important component of DEP's overall stream management mission to restore ecosystem integrity. Providing Catskill native plant material is one of the important aspects of the CSBI. Plant selection, propagation, and grow-out have and will continue to be considered by the CSBI. These efforts have led to local genotype planting stock being available not only to the CSBI, but also other stream restoration projects initiated by DEP and its partners. CSBI coordinators have established plant material holding areas to allow access to stock on an as needed basis. Once they reach these holding areas, the plants are carefully maintained to ensure the appropriate vigor, root strength, and overall health necessary to succeed in streamside restoration activities.

Plant Supply

After conducting a comprehensive solicitation of plant-related services to over 200 nurseries throughout the northeast, DEP identified New York City Parks and Recreation's Greenbelt Native Plant Nursery as the best entity to work with to collect, clean, and store Catskill native plant seed, and to propagate this seed for the CSBI.

In 2013, DEP received 1,831 gallon-sized trees and shrubs from Greenbelt. To date, Greenbelt has provided DEP with 72,000 herbaceous plugs, 24,530 gallon-sized trees and shrubs, and 17,500 tree and shrub tubelings. All of this material originates from the Catskill Mountains, providing locally-native stock that is adapted to regional conditions. That, in turn, gives it a competitive edge for survival, providing a range of ecological values beyond stream bank stability.

Implementation

Five CSBI coordinators at partnering SWCDs, along with one DEP coordinator, provide the base for implementing the CSBI. A landowner reaches out to his local coordinator, a plan is developed for the property, and if, the landowner concurs, he is invited to apply for funds and/ or technical assistance to implement the project. Applications are invited twice per year, on November 1 and June 1, to allow for project eligibility field assessments to be conducted during months when the sites are free of snow cover.

Riparian Corridor Management Plans

CSBI coordinators prepare Riparian Corridor Management Plans (RCMPs), which provide landowners with a detailed analysis of their property in relation to the broader watershed and to their streamside neighbors. The plans reference stream management plans where they have been completed and document landowner priorities and goals. After analyzing historic information and documents and landowner concerns, the plans propose a suite of recommendations that range from BMPs that landowners can do themselves to more substantial practices that require SWCD assistance. In 2013, CSBI coordinators completed 11 RCMPs, bringing the number completed since 2009 to 95. These plans are valuable tools for educating landowners about the importance of riparian buffers and for documenting landowner concerns and property management goals. The process of developing the plans and reviewing them with landowners helps bring landowner and CSBI goals closer together, prompting applications more likely to receive CSBI project approval.

Projects

In 2013, the CSBI successfully installed 34 riparian buffer restoration projects, depicted in Figure 4.26. These 34 projects enhanced riparian vegetation on over 14 acres of streamside property and over 3 miles of stream bank length. Altogether, 6,037 native Catskill plants were installed, along with over 1,800 linear feet of bioengineering treatments consisting of native willow species, most of which were harvested from within the watershed. Since the inception of the program, 138 projects have been completed, restoring over 77 acres of riparian buffer spanning over 12 miles of stream length. Through these projects, over 39,000 plants, all species native to the Catskills region, were planted within the watershed.

In addition to projects involving the installation of plants, the CSBI leads efforts within the watershed to remove significant stands of invasive plant species that threaten the viability of riparian plantings. Four of the CSBI projects from 2013 were specifically focused on the removal of Japanese knotweed from riparian buffers through stem injection of herbicides and/or mechanical pulling. Riparian planting activities also took place on five non-CSBI stream restoration projects in 2013, enhancing riparian vegetation by more than 13,200 trees and shrubs and installing over one mile of bioengineering treatments.

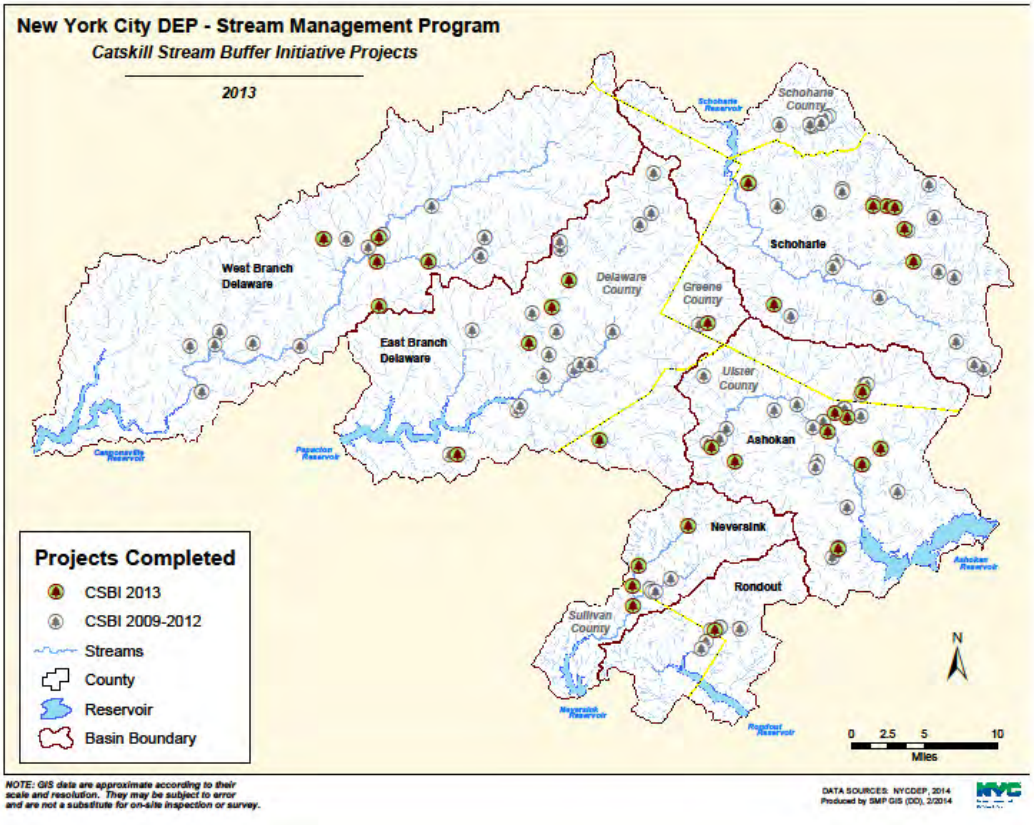

Figure 4.26. Catskill Stream Buffer Initiative projects.

Evaluation

CSBI projects are monitored in the years following installation using a protocol developed specifically for the program. The protocol's goals include the collection of data documenting the survival and growth rates of individual plant species, determining the effectiveness of installation techniques, and achieving an understanding of what factors have the greatest influence over project success. CSBI projects are monitored at regular intervals for a minimum of five years before conclusions are drawn regarding project success. Twenty-seven new monitoring sites were added in 2013, bringing the total number of active CSBI vegetation monitoring sites to 37.

Riparian Buffer Education and Outreach

Through partnerships with Ulster County Community College, and the State University of New York Research Foundation on behalf of SUNY Delhi, two crews of summer interns provided much of the labor needed in 2013 to install the various plantings across the West of Hudson watershed. The crews also assisted CSBI coordinators with loading and unloading material, site preparation, transplanting, plant material center maintenance, and vegetation monitoring. DEP and its partners plan to continue to work with these young adults to provide them with the opportunity to gain firsthand experience with stream restoration.

The CSBI engaged the public in a variety of forums in 2013 to support the program's goals as well as the overarching agency mission. Approximately 14 targeted activities—including volunteer plantings; tree identification; mailings; local fair demonstrations; and riparian workshops for students, families, and streamside landowners—reached well over 4,000 individuals. Countless watershed residents and visitors were also reached through non-targeted efforts like newsletter and newspaper articles, various native plant and invasive species brochures, and through www.CatskillStreams.org. See Section 4.10 for more information about education and outreach activities.

Watershed Agriculture Program and Watershed Forestry Program

See Section 4.4 for information about the riparian buffer protection efforts of the Watershed Agricultural Program, including an update on the Conservation Reserve Enhancement Program, and Section 4.5 for information about the riparian buffer protection efforts of the Watershed Forestry Program.

4.8 Wetlands Protection Program

DEP's Wetlands Protection Strategy, initiated in 1996 and most recently updated in 2012, is designed to collect information about the characteristics, distribution and functions of wetlands to inform regulatory and partnership protection programs. In 2013, DEP continued to develop a pilot project to advance wetland mapping techniques, and to collect data from reference wetlands throughout the Catskill/Delaware watershed. DEP also continued to protect wetlands through land acquisition, and reviewed wetland permit applications in the watershed.

4.8.1 Permit Review

DEP reviews wetland permit applications in the watershed and provides comments when alternatives that would avoid, minimize, or mitigate wetland and water quality impacts are identified. Project plans are often modified in response to DEP's comments, resulting in less wetland and/or adjacent area impact than originally proposed.

In 2013, DEP reviewed 32 wetland permit applications, all but one of which are located East of Hudson (Figure 4.27, Table 4.10). Twenty-three of those applications were submitted pursuant to the New York State Freshwater Wetlands Act (NYS Environmental Conservation

Law, Article 24), which regulates state-mapped wetlands as well as adjacent areas to a distance of 100 feet from such wetlands. Nine municipal wetland applications were also reviewed.

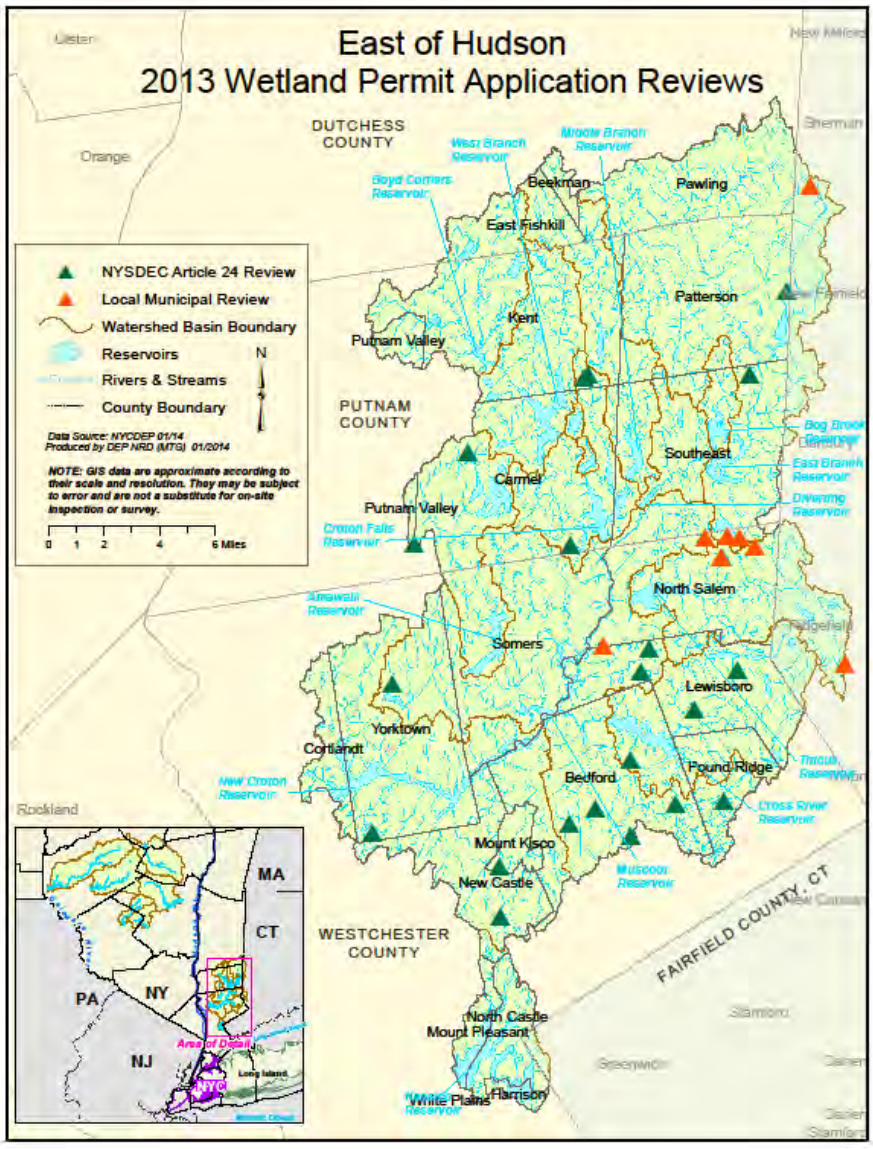

Figure 4.27. East of Hudson wetland permit application reviews, 2013.

Table 4.10. Wetland permit application reviews completed in 2013.

Project name	Permit type	Reservoir basin	Regulated activity
Dewn Subdivision	NYSDEC	Amawalk	Adjacent area disturbance
Woods Street Drainage Basin	NYSDEC	Amawalk	Wetland, adjacent area disturbance

Table 4.10. (Continued) Wetland permit application reviews completed in 2013.

Project name	Permit type	Reservoir basin	Regulated activity
Murphy Timber Harvest	NYSDEC	Cannonsville	Wetland fill, adjacent area disturbance
Cross River Westchester Associates	NYSDEC	Cross River	Adjacent area disturbance
Girdle Ridge Pond	NYSDEC	Cross River	Aquatic nuisance species management
Weisberg Residence	NYSDEC	Cross River	Dam replacement, adjacent area disturbance
Kent Sewer District, Route 52	NYSDEC	Croton Falls	Wetland fill, adjacent area disturbance
Putnam Stormwater Retrofit	NYSDEC	Croton Falls	Wetland, adjacent area disturbance
Solof Property	NYSDEC	Croton Falls	Wetland fill, adjacent area disturbance
Bloomerside Coop, Clove Road	Local	East Branch	Wetland disturbance
Bonnano Property	NYSDEC	East Branch	Adjacent area disturbance (reduced per DEP review)
Hall Residence	Local	East Branch	Adjacent area disturbance
Pietsch Gardens Cooperative	Local	East Branch	Wetland fill, adjacent area disturbance for bridge repair
Rivera Residence	NYSDEC	East Branch	Adjacent area disturbance
Ahmad-Nguyen Property	NYSDEC	Muscoot	Wetland, adjacent area disturbance
Bedford Center Road Pond	NYSDEC	Muscoot	Aquatic nuisance species management
Biennial Stormwater Retrofit	NYSDEC	Muscoot	Wetland, adjacent area disturbance
Cox Pond	NYSDEC	Muscoot	Aquatic nuisance species management
Falco Property	NYSDEC	Muscoot	Adjacent area disturbance (reduced per DEP review)
Homeland Towers-Goldens Bridge	NYSDEC	Muscoot	Wetland fill, adjacent area disturbance
Lewis Property Pond	NYSDEC	Muscoot	Aquatic nuisance species management
Miller Residence	Local	Muscoot	Adjacent area disturbance

Table 4.10. (Continued) Wetland permit application reviews completed in 2013.

Project name	Permit type	Reservoir basin	Regulated activity
Moreo-Candlewood Lake Community	Local	Muscoot	Adjacent area disturbance
Wing Tree Pond	NYSDEC	Muscoot	Aquatic nuisance species management
Mount Kisco Country Club	NYSDEC	New Croton	Pond dredging, adjacent area disturbance
Vernay Lake Dam Rehab	NYSDEC	New Croton	Dam repair, adjacent area disturbance
Whippoorwill Lake	NYSDEC	New Croton	Wetland fill, adjacent area disturbance
Baxter Hill LLC-173 Baxter Road	NYSDEC	Titicus	Adjacent area disturbance
Baxter Hill LLC-173 Baxter Road	Local	Titicus	Adjacent area disturbance
deVaulx Residence, 1 Lost Pond Lane	Local	Titicus	Adjacent area disturbance (reduced per DEP review)
Finch Farm - 25 Finch Road	Local	Titicus	Adjacent area disturbance
Ridgefield Modular Home	Local	Titicus	Wetland disturbance (avoided per DEP review)

No federal wetland applications (those applications filed under Section 404 of the Clean Water Act, P.L. 92-500, as amended by P.L. 95-217) were reviewed. This is likely due to minimization of wetland impacts through the local and state permitting process in advance of federal review, and the availability of nationwide permits in the federal program.

DEP reviewed the USEPA Science Advisory Board's draft report, Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence (http://yosemite.epa.gov/sab/sabproduct.nsf/fedrgstr_activites/Watershed%20Connectivity%20Report?OpenDocument). The Board issued the draft report to synthesize the scientific literature about how streams and wetlands are connected to larger water bodies such as rivers. The final version of the draft report will provide a technical basis for a future joint USEPA and Army Corps of Engineers rule making intended to clarify the extent of waters subject to federal jurisdiction under the Clean Water Act. The clarification is necessary in light of the United States Supreme Court's decisions in *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers*, 531 U.S. 159 (2001) and *Rapanos v. United States*, 547 U.S. 715 (2006), which reduced, and potentially removed, federal jurisdiction over isolated waters and non-relatively permanent, non-navigable tributaries and their adjacent wetlands. Through comments issued on the draft report on November 6, 2013, the City of New York

indicated its support of broad federal jurisdiction over streams and wetlands, the protection of which is critical to maintaining the high quality of the City's water supply.

4.8.2 Land Acquisition

According to the National Wetlands Inventory (NWI) and NYSDEC Freshwater Wetland maps, there are approximately 15,200 acres of wetlands in the Catskill/Delaware watershed. Since 1997, DEP has protected 2,655 acres, or 17.5%, of these wetlands through its Land Acquisition Program. (See Section 4.2 for details of the Land Acquisition Program.) Table 4.11 summarizes, for both the Catskill/Delaware and Croton watersheds, the number of acres of each type of wetland and the number of acres of each type that has been protected. Figure 4.28 depicts a wetland on a property in Conesville (Schoharie basin) that was brought under contract in 2013 for fee acquisition.

Table 4.11. Wetlands acquired or protected by the NYC Land Acquisition Program (LAP) in the Catskill/ Delaware and Croton Systems as of December 31, 2013.*

Description	Acres	Percent of total watershed acreage	Percent of total land acquired	Percent of total wetland type in system
Catskill/Delaware (Ashokan, Schoharie, Rondout, Neversink, Pepacton, Cannonsville, West Branch, Boyd Corners, Kensico watersheds):				
Entire Watershed	1,048,637			
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats**)	15,190	1.45%		
Inundated Aquatic Habitats	28,335	2.70%		
Total Wetlands and Inundated Aquatic Habitats	43,525	4.15%		
*Lands Under Contract or Closed by DEP as of 12/31/13†**	127,365	12.15%		
Wetlands (both NWI and DEC-regulated, excluding Inundated Aquatic Habitats**)	2,655		2.08%	17.48%
Inundated Aquatic Habitats**	185		0.15%	0.65%
Total Wetlands and Inundated Aquatic Habitats**	2,839		2.23%	6.52%
Croton				
Entire Watershed	212,696			
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats**)	20,025	9.41%		
Inundated Aquatic Habitats	10,808	5.08%		
Total Wetlands and Inundated Aquatic Habitats	30,833	14.50%		

Table 4.11. (Continued) Wetlands acquired or protected by the NYC Land Acquisition Program (LAP) in the Catskill/Delaware and Croton Systems as of December 31, 2013.*

Description	Acres	Percent of total watershed acreage	Percent of total land acquired	Percent of total wetland type in system
Lands Under Contract or Closed by DEP as of 12/31/13†:*	2,110	0.99%		
Wetlands (both NWI and DEC-regulated, excluding Inundated Aquatic Habitats**)	102		4.84%	0.51%
Inundated Aquatic Habitats**	2		0.08%	0.02%
Total Wetlands and Inundated Aquatic Habitats**	104		4.92%	0.34%

** Acres are calculated directly from areas of GIS polygons and therefore may not match exactly other acreage totals submitted by DEP. Watershed statistics calculated from LiDAR-derived 1-m basin boundaries updated Fall 2013.*

*** Categories considered "Inundated Aquatic Habitats" include reservoirs or large lakes (L1), unconsolidated bottom (L2UB), riverbeds (RUB and RRB), or streambeds (RSB), but exclude uplands (U), and unconsolidated shore (L2US). Categories considered wetlands exclude the Inundated Aquatic Habitats classes as well as all upland (U) and unconsolidated shore (L2US).*

† Includes fee, conservation easements, and farm easements. Excludes non-LAP and pre-MOA land.

Figure 4.28. Wetland protected through land acquisition.

4.8.3 Mapping and Monitoring

DEP finalized a contract with the Regional Application Center for the Northeast (RACNE) to conduct a pilot project to determine whether the 2009 Light Detection and Ranging

(LiDAR) and aerial photography collection will improve wetland mapping and connectivity assessment in the watershed. Work is expected to commence in early 2014.

The 2009 LiDAR and aerial photography collection improved the resolution, accuracy, and completeness of watershed hydrography, topography, and land use coverages, which may provide a richer source of wetland indicators than standard photointerpretation methods alone. Moreover, there are indications that LiDAR intensity data could improve the detection of inundated wetland area. The project will be conducted in three phases over two years to (1) assess variation in the quality of these data sources throughout the watershed, (2) develop protocols for applying these data to wetland mapping and connectivity assessment in pilot areas, and (3) assess the feasibility of applying the protocol to the entire watershed. Any gains in wetland mapping accuracy realized from these data sources would benefit the numerous watershed protection programs that rely on wetlands data. Further, the enhanced resolution of wetland connectivity would improve the ability to assess wetland function and federal regulatory status.

DEP also gains information on the characteristics and functions of watershed wetlands through its reference wetlands monitoring program. In 2013, DEP continued to collect data from automated monitoring wells installed in 21 reference wetlands throughout the Catskill/Delaware watershed. The wells measure water table level at 6-hour intervals and provide a long-term hydrologic record for various wetland types. Vegetation, soils, and water quality data were previously collected at these wetlands and are used in conjunction with the water level data to assess wetland condition. Reference wetland monitoring informs wetland mapping, protection, and management programs and is used to assess long-term trends in wetland condition and function.

4.8.4 DEP Forest Management Program

DEP conducts an interdisciplinary review of its proposed forest management projects on City lands to ensure long-term stewardship of the forest and all of the natural and cultural resources contained within it. As part of this review, DEP wetland scientists delineate on-site wetlands, which are treated as exclusion zones in which no disturbance is permitted under normal circumstances. Moreover, the 100-foot-wide area surrounding wetlands is considered a special management zone, within which limits are placed on tree removal and equipment operation. In 2013, DEP conducted delineations on three proposed forest management projects on City lands and mapped approximately 50 wetlands totaling 60 acres.

4.8.5 Education and Outreach

DEP continued to distribute the educational pamphlet *Wetlands in the Watersheds of the New York City Water Supply System* at public forums and upon request. DEP also presented findings from its wetlands mapping and monitoring programs at the Watershed Science and Technical Conference. In addition, DEP presented findings from its delineation of wetlands for the 264-acre Clearpool Model Forest Project at the Clearpool Adult Workshop Series. This

delineation project was conducted in support of the Clearpool Model Forest management objectives and provided educational outreach opportunities for both Clearpool and DEP (See Section 4.5.4 for details of DEP's Model Forest Program).

4.9 East of Hudson Non-Point Source Pollution Control Program

The East of Hudson (EOH) Nonpoint Source Pollution Control Program seeks to address nonpoint pollutant sources in the four EOH Catskill/Delaware watersheds (West Branch, Croton Falls, Cross River, and Boyd Corners). The program supplements DEP's existing regulatory efforts and nonpoint source management initiatives.

4.9.1 Wastewater-Related Nonpoint Source Pollution Management Programs

Septic Program East of Hudson

DEP is available to provide support to Westchester and Putnam Counties in their efforts to reduce the potential impacts of improperly functioning or maintained subsurface sewage treatment systems (SSTSs). In 2013, the Westchester County Health Department continued to operate its Septic System Management Program (SSMP) database and web-based SSMP database access tool. The database includes available information on septic applications, septic repairs, and pump-outs. Westchester County, Putnam County, and their respective municipalities continue to implement the septic requirements of the NYSDEC MS4 General Permit (GP-0-10-002) that became effective in May 2011. As required by the MS4 permit, programs are in place for inspection, maintenance, and rehabilitation of septic systems.

In December 2013, DEP submitted a proposal to implement the West Branch and Boyd Corners Septic System Rehabilitation Reimbursement Program. The voluntary program would be available to home owners with failing septic systems; under the program, DEP would provide funding to reimburse a portion of the costs to rehabilitate eligible failing SSTSs or connect those systems to an existing sewage collection system. It is anticipated that a voluntary program that provides a portion of the rehabilitation cost through reimbursement will motivate property owners to repair failing SSTSs. DEP has a contract with the New York State Environmental Facilities Corporation (EFC) for the existing septic reimbursement program that has been successfully implemented in the Kensico basin. The proposal calls for DEP to amend this contract to expand its geographic scope to include the West Branch and Boyd Corners Reservoir watersheds.

Once the program is established, participating home owners who repair their septic systems will be able to submit the documentation to EFC and receive up to a 50% cost share for the cost of the repair. The program rules will include a provision under which residents with a demonstrated financial hardship may have the home owner's share of the project cost reduced to 25% of the total repair cost. DEP will implement the program on a prioritized basis based on the anticipated risk of failing septic systems. The residential areas in the West Branch and Boyd Corners watersheds served by SSTSs and centralized sewer systems is shown in Figure 4.29.

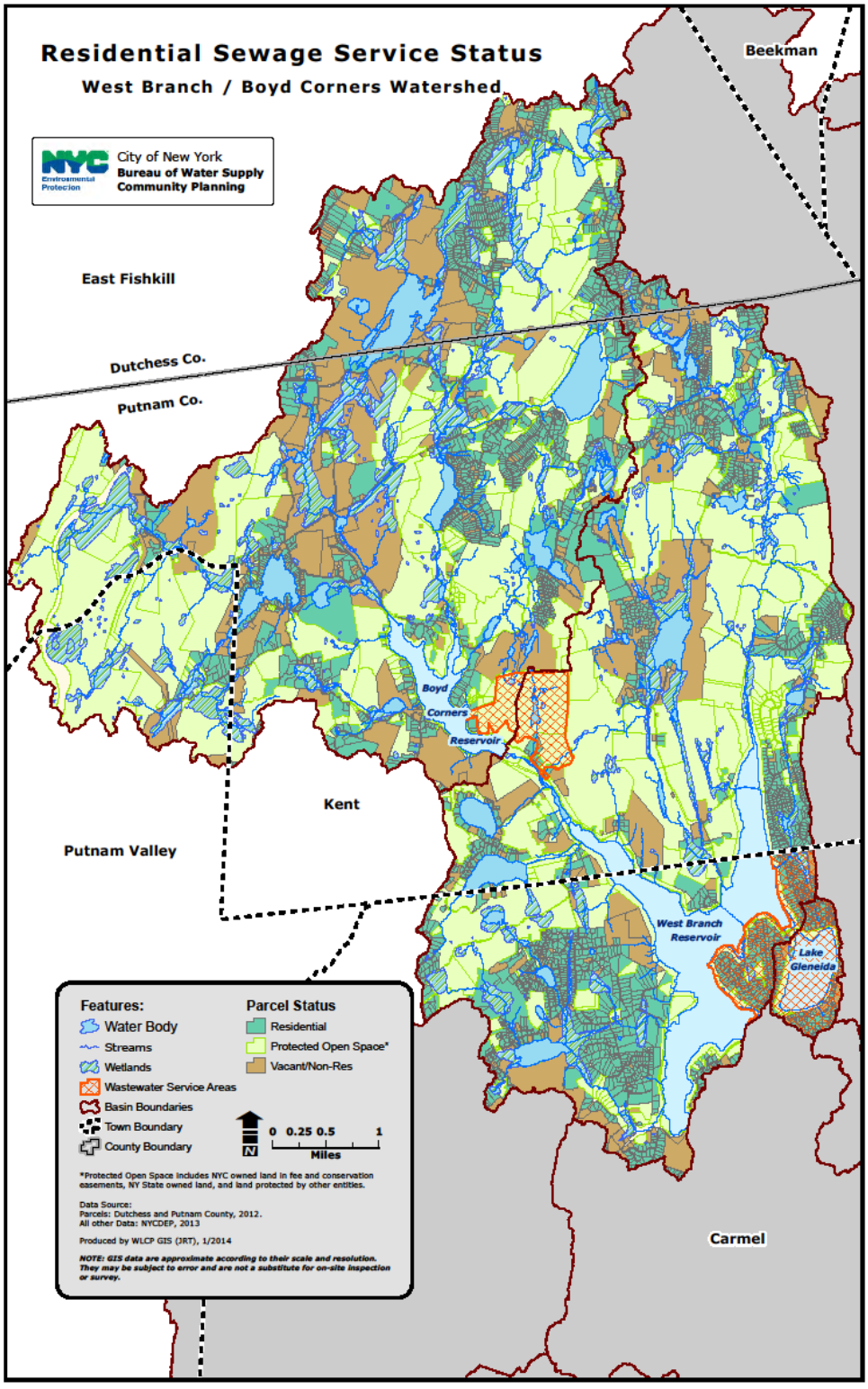

Figure 4.29. Residential sewage service status, West Branch/Boyd Corners watershed.

4.9.2 Stormwater-Related Nonpoint Source Pollution Management Programs

Stormwater Retrofit and Remediation

In an effort to further reduce pollutant loading from stormwater runoff, DEP is working on multiple nonpoint source reduction projects within the EOH Catskill/Delaware watersheds.

Stormwater Remediation Projects on City-Owned Property

Michael Brook, Town of Carmel, Putnam County: Construction began in September 2012. Trout habitat restrictions and higher than normal stream volumes in spring 2013 caused some construction delays but DEP was able to achieve substantial completion by September 2013. The project improves the drainage structure of a stream in the Croton Falls basin. Work on site included relocation of rock along the stream bank and the removal of fallen trees and a stone dam.

Maple Avenue, Town of Bedford, Westchester County: The project design plan and stormwater pollution prevention plan are complete. All permits are in place for this project. This project will be bid with the Drewville Road project.

Drewville Road, Town of Carmel, Putnam County: Due to changes in design at the request of the Town, the project is not yet approved. During the reporting period, the Town requested renderings of the retrofit with vegetative screening that would minimize visual impact. DEP chose evergreens to provide screening of the retrofit year round. The Town requested that DEP use deciduous trees rather than evergreens. DEP edited the designs and resubmitted them to the Town. The Town's requested changes made it necessary for DEP to amend its contract with its engineering design consultant. DEP is currently working to complete the necessary contract change order to the engineering design contract. Once the contracting changes are in place and the design is complete, DEP will schedule a meeting with the Town Environmental Control Board. This project will be bid with the Maple Avenue project.

Stormwater Remediation Projects on Privately-Owned Property

Sycamore Park, Long Pond Road/Crane Road, Town of Carmel, Putnam County: Construction began in September 2012. DEP achieved substantial completion in September 2013. The project reduces pollutant loading through stormwater improvements at a town park located within the West Branch basin. Work on site included construction of a culvert, bioretention system, and redesigned parking area.

Nemarest Club, Town of Kent, Putnam County: Construction began in September 2012. DEP achieved substantial completion in September 2013. The project addresses drainage issues at a private site within the Boyd Corners basin. Work on site included construction of the temporary road, diversion and piping of streamflow, tree removal, and replacing the collapsed culvert with a new pre-cast concrete box culvert.

Stormwater Facility Inspection and Maintenance

The Facility Inspection and Maintenance Program was developed to ensure that previously constructed stormwater remediation facilities continue to function as designed. New facilities continue to be brought on line and are added to the routine inspection program. Maintenance during the first year of a facility's life is completed under the warranty in the facility's construction contract and under DEP's maintenance contract thereafter. Inspection and maintenance follow procedures identified in the Operation and Maintenance Guidelines contained in the maintenance contract.

Funding Program—Croton Falls/Cross River

In November 2011, the majority of watershed communities in Putnam, Westchester, and Dutchess Counties established the EOH Watershed Corporation (EOHWC). In 2012, DEP and EOHWC reached final agreement on the contract that will allow the transfer to EOHWC of both the $4.5 million provided under the Croton Falls/Cross River Stormwater Retrofit Program and up to $15.5 million in additional funding. In the first half of 2013, EOHWC applied for and received the necessary registration with the NYS Charities Bureau. Following receipt of the registration, DEP issued to EOHWC the Advice of Award for the contract. In July 2013, DEP registered the contract with EOHWC, and in September 2013, DEP issued to EOHWC a payment of $10 million.

4.10 Kensico Water Quality Control Program

Kensico Reservoir, located in Westchester County, is the terminal reservoir for the City's Catskill/Delaware water supply system. Because it provides the last impoundment of Catskill/Delaware water prior to entering the City's distribution system, DEP has prioritized watershed protection in the Kensico basin.

4.10.1 Stormwater Management and Erosion Abatement Facilities

Best Management Practice (BMP) Construction, Operation, and Maintenance

DEP has constructed 46 stormwater management and erosion abatement facilities throughout the Kensico watershed to reduce pollutant loads conveyed to the reservoir by stormwater. The facilities, shown in Figure 4.30, were routinely inspected and maintained as needed throughout 2013 in accordance with the Operation and Maintenance Guidelines. Maintenance consisted of such activities as grass mowing, vegetation removal, tree removal, and sediment and debris removal. All BMPs are performing as designed.

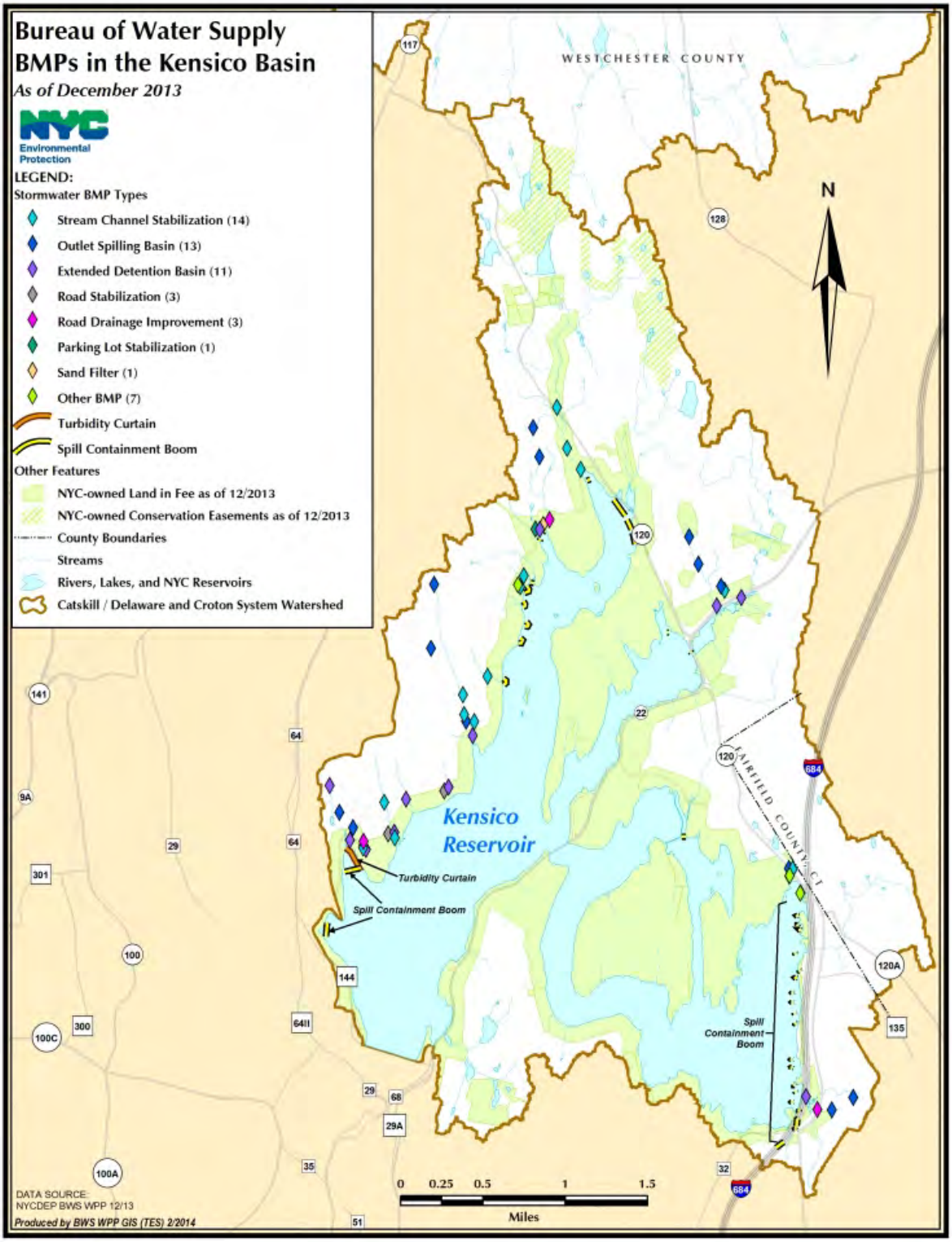

Figure 4.30. Location of BMPs in the Kensico watershed.

Spill Containment Facilities

DEP installed, and now maintains, spill containment facilities in and around Kensico Reservoir (see Figure 4.30). The facilities improve spill response and recovery, thereby minimizing water quality impacts in the event of a spill. In 2013, routine maintenance was completed at the spill boom sites. No spills were reported during the reporting period.

Turbidity Curtain

DEP continues to monitor the extended primary curtain and the back-up turbidity curtain, designed to direct flows from Malcolm and Young Brooks further out to the body of the reservoir and to provide enhanced protection for water entering the Catskill Upper Effluent Chamber. DEP's diving contractor performed inspections of both turbidity curtains in October 2013. Based on these inspections, no repair work was required and the turbidity curtains appear to be functioning as intended.

4.10.2 Kensico Action Plan

DEP completed implementation of the three remaining stormwater treatment facility plans proposed in the Kensico Action Plan. (The fourth, N1—West Lake Drive drainage improvements—was completed in 2012.) A summary of progress and current site status is as follows:

N7 - Sub-Basin Pipeline System

During the reporting period, the eroded hillside in the N7 sub-basin was excavated and regraded to install a 420-foot-long pipeline on a steep slope, ranging from 3:1 to 2:1. The pipeline includes a bypass for a water quality treatment unit, designed to remove solids from stormwater as it flows through the pipe before being discharged to the reservoir. All disturbed areas were seeded and steep sloped areas were stabilized with an erosion control product. Substantial completion of the N7 pipeline installation site was achieved in October 2013. Photos of the site before, during, and after construction are depicted in Figure 4.31.

A

B

C

Figure 4.31. A) N7 before construction, B) installation of N7 pipeline, and C) N7 after construction.

N12 – Extended Detention Basin

The geotechnical investigation in 2012 at the N12 site revealed the need for design changes to the basin. During the reporting period, the basin was redesigned to adjust for the soils on site that were found to be structurally unsuitable and unstable. DEP worked to register the necessary change order to the construction contract. Following the registration of the change order, construction of the basin commenced in June 2013.

Construction of the basin involved diverting the stream during construction; excavating to construct the key for the earthen embankment, the basins and shoring the roadside slope; building the earthen embankment, inlet and outlet chambers, flumes, and forebay; replacing and installing new piping; installing new security fence and guide rail; seeding all disturbed areas; and planting wetland plants within the basin and restoration plants in the upland areas. The layout of the maintenance access road was modified to provide additional restoration planting and screening, while still offering safe access to all parts of the basin (See Figure 4.32). Substantial completion of the N12 detention basin was achieved in fall 2013.

Figure 4.32. N12 after construction.

Whippoorwill Stream Rehabilitation

Construction work at the Whippoorwill site was completed in 2012. During 2013, some additional plantings were installed.

4.10.3 West Lake Sewer Trunk Line

The West Lake Sewer Trunk Line, owned and maintained by the Westchester County Department of Environmental Facilities (WCDEF), conveys untreated wastewater to treatment facilities located elsewhere in the county. Given the proximity of the collection system to Kensico Reservoir, potential defects or abnormal conditions within the sewer line and its components could lead to exfiltration or overflows of wastewater. The intent of this program is to work with the county to mitigate risks posed by the line while maintaining the collection system's location and gravity flow.

Sanitary Sewer Remote Monitoring System

DEP installed a sanitary sewer remote monitoring system for the trunk line in order to provide real-time detection of problem events such as leaks, system breaks, overflows, and

blockages. The Smart Cover technology for remote monitoring of manholes in the Westlake system was completed in July 2012. DEP and WCDEF have full access to the Smart Cover website which displays information on a variety of data including real-time liquid levels, summary of past liquid levels, alarms, notifications, and maintenance completed. There have been no overflows or indications of concern of high liquid levels in the manholes since the system's installation. There have been a few false alarms due to maintenance on the system, but DEP has always been notified immediately to stand down for them. DEP and WCDEF receive a test alarm on a monthly basis. WCDEF has a maintenance contract with the installer to service the units and replace the batteries on an annual basis. The units appear to be working well. As required by the NYSDEC and WCDEF Order on Consent (DEC Case No. 3-R3-20030228-17), the WCDEF submitted the results of its annual inspection and flushing of all associated pipelines to all relevant regulatory agencies. No problems within the line were reported.

Sewer Line Visual Inspection

DEP conducts an annual visual inspection of the trunk line in order to assess the condition of exposed infrastructure, including manholes, for irregularities. The annual full inspection was performed during September 2013. Routine partial inspections were also conducted at various times throughout the year in association with ongoing maintenance of Kensico stormwater BMPs in the vicinity of the line. No defects or abnormalities have been noted.

4.10.4 Video Inspection of Sanitary Sewers

DEP completed the project to inspect portions of the sanitary sewer system located within the Kensico watershed in 2011. None of the inspected pipe sections demonstrated any significant defects or deterioration. No additional work was necessary in 2013.

4.10.5 Septic Repair Program

DEP initiated the Kensico Septic System Rehabilitation Reimbursement Program to reduce potential water quality impacts to the reservoir that can occur through failing septic systems in its watershed. During 2013, construction was completed at four sites.

In May 2013, the New York State Environmental Facilities Corporation (EFC) mailed an annual reminder letter to eligible residents notifying them of the continuing availability of funding. Based on responses to that mailing, EFC continues to update the database and sign interested participants into the program as appropriate. Figure 4.33 shows the sewage service status of each parcel based on resident responses and other available records.

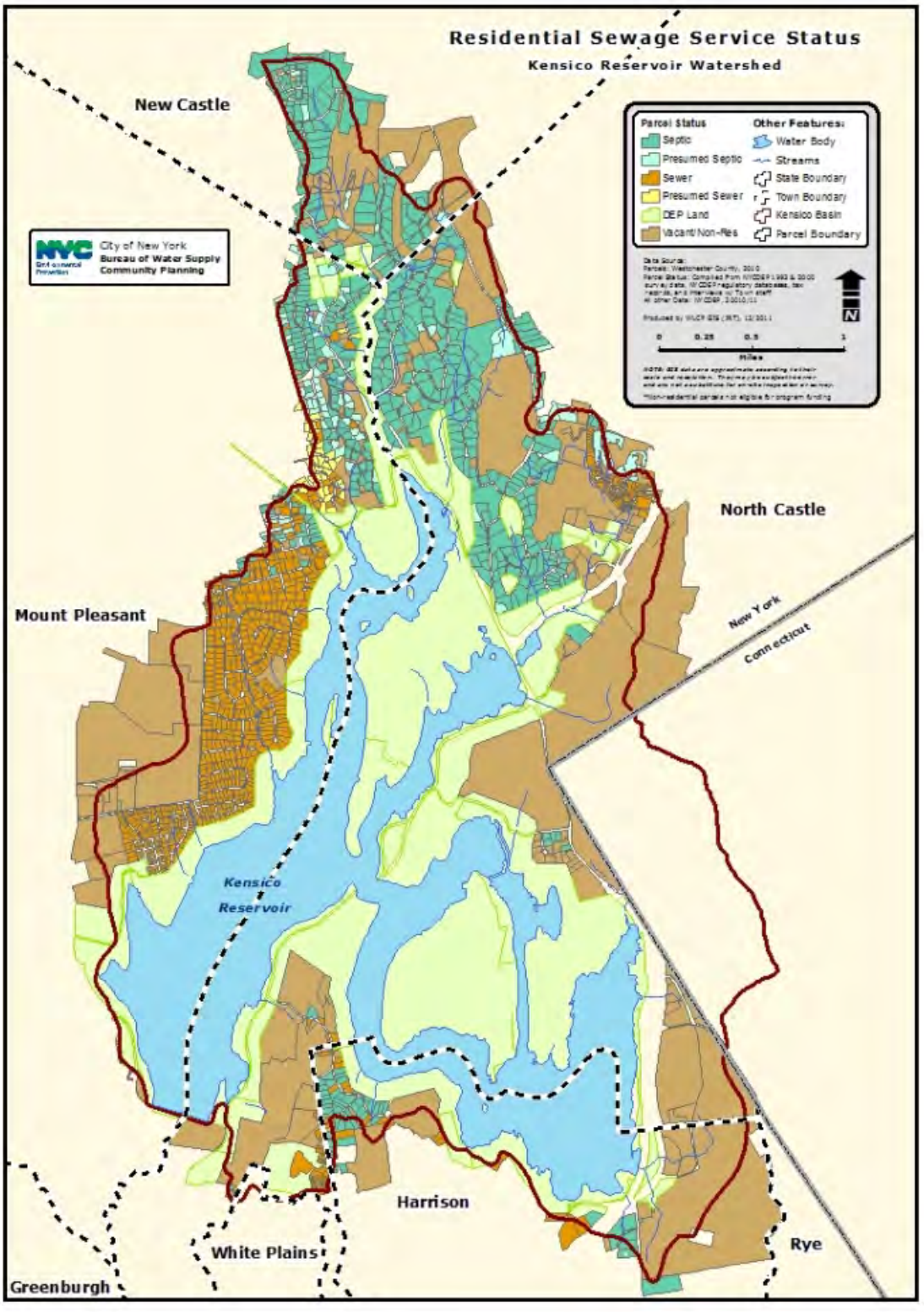

Figure 4.33. Residential sewage service status, Kensico Reservoir watershed.

4.10.6 Turbidity Reduction

The Catskill Upper Effluent Chamber (CATUEC) is situated along the shore of a cove in the southwest section of Kensico Reservoir. DEP had previously explored the possible need for a shoreline stabilization project in order to mitigate the resuspension of near-shore materials near CATUEC during wind events. However, the CATUEC went off-line after the Catskill/Delaware UV disinfection facility went into service in 2012, minimizing concerns regarding potential resuspension of near-shore materials near that facility. With CATUEC off-line, the concern of potential resuspension of near-shore materials near CATUEC is minimized. As part of the Catskill Aqueduct pressurization project, DEP will determine the most appropriate location for an intake and it is not known if CATUEC will be selected. Therefore, further review of a potential shoreline project is on hold until it is determined whether CATUEC would be selected as the future intake under the Catskill Aqueduct pressurization project.

4.10.7 Westchester County Airport

The Westchester County Airport is located east of Kensico Reservoir in close proximity to Rye Lake. Because of the airport's closeness to the reservoir, DEP continues to review any activities that are being proposed at the airport. The Westchester County Department of Public Works and Transportation is in the process of developing an Airport Master Plan, which is currently in the information-gathering phase. DEP attended a public meeting on the plan on July 17, 2013 at the Westchester County Center. There were no airport-related activities occurring in the Rye Lake drainage basin during the reporting period.

4.11 Catskill Turbidity Control

Due to the nature of its underlying geology, the Catskill watershed is prone to elevated levels of turbidity in streams and reservoirs. High turbidity levels are associated with high flow events, which can destabilize stream banks, mobilize streambeds, and suspend the glacial clays that underlie the streambed armor. The design of the Catskill System accounts for the local geology, and provides for settling within Schoharie, Ashokan West Basin, Ashokan East Basin, and the upper reaches of Kensico Reservoir. Under normal circumstances, the extended detention time in these reservoirs is sufficient to allow the turbidity-causing clay solids to settle out, and the system easily meets turbidity standards at the Kensico effluent. Periodically, however, the City has had to use chemical treatment to control high turbidity levels.

DEP undertook the Catskill Turbidity Control Study to provide a comprehensive analysis of potential engineering and structural alternatives to reduce turbidity levels in the Catskill System. DEP engaged the Gannett Fleming/Hazen and Sawyer Joint Venture (JV) to support this effort, along with JV subconsultants Upstate Freshwater Institute (UFI) and HydroLogics, Inc. The study was conducted in three phases. The Phase I study, completed in December 2004, provided a preliminary screening-level assessment of turbidity control alternatives at Schoharie and Ashokan Reservoirs, and identified potentially feasible, effective, and cost-effective

measures for subsequent detailed evaluation. Phase I results also showed that turbidity sources during high flows within the Ashokan watershed are the driver for elevated turbidity levels leaving the reservoir.

The Phase II study, completed in September 2006, consisted of detailed conceptual design, cost estimation, and performance evaluation of three alternatives for improving turbidity and temperature in diversions from Schoharie Reservoir: Multi-Level Intake, In-Reservoir Baffle, and Modification of Reservoir Operations. The performance evaluation relied on development and application of an integrated modeling framework that linked the OASIS water supply model of the entire NYC reservoir system and Delaware watershed with the W2 water quality model of Schoharie Reservoir. DEP selected Modification of Reservoir Operations (MRO) as the most feasible, effective, and cost-effective alternative for improving turbidity and temperature control at Schoharie Reservoir, and proposed in the December 2006 Phase II Implementation Plan to develop a systemwide Operations Support Tool (OST) to support implementation of this alternative. The MRO/OST plan was conditionally approved by regulatory agencies in August 2008, pending completion of additional analyses. DEP is currently proceeding with development of the OST.

The Phase III study, completed in December 2007, focused on alternatives at Ashokan Reservoir that could reduce turbidity levels entering Kensico Reservoir, including a West Basin Outlet Structure, Dividing Weir Crest Gates, East Basin Diversion Wall, Upper Gate Chamber Modifications, a new East Basin Intake, and Catskill Aqueduct Improvements and Modified Operations. The performance evaluation relied on an updated version of the OASIS-W2 model, which included water quality models of the West and East Basins of Ashokan Reservoir and Kensico Reservoir. The Phase III evaluation indicated that, when turbidity levels rise, taking the Catskill System offline (or operating the Catskill Aqueduct at the minimum flow rate needed to satisfy demand) is the most effective way to reduce the turbidity load transferred from Ashokan to Kensico and reduce the frequency of alum treatment. Releasing water from the West Basin prior to and during a storm event was also found to provide significant reductions in turbidity loading to the East Basin, and hence to Kensico.

DEP selected Catskill Aqueduct Improvements and Modified Operations as the most feasible, effective, and cost-effective alternative for reducing turbidity levels entering Kensico Reservoir, and proposed implementation of this alternative in the July 2008 Phase III Implementation Plan. the Phase III Implementation Plan also presented the results of extensive model sensitivity and uncertainty testing undertaken by DEP. These analyses demonstrated that while inherent uncertainty in some model parameters (e.g., Esopus Creek flow-turbidity relationship) influences the absolute performance of alternatives, it does not generally affect their relative performance.

4.11.1 Implementation of Catskill Turbidity Control Alternatives

Catskill Aqueduct Improvements

One operational strategy for controlling turbidity is to minimize delivery of turbid water via the Catskill Aqueduct from Ashokan Reservoir to Kensico Reservoir. However, certain outside communities take their water supplies from this section of the Aqueduct, which limits DEP's ability to decrease flows. Currently, to avoid service interruptions at outside community connections when reducing aqueduct flow below 275 million gallons per day (MGD), DEP installs stop shutters at five locations along the Aqueduct. The installation and removal of these stop shutters is labor intensive and time consuming. Further, because these old wooden shutters leak, DEP needs to run the Catskill Aqueduct at a minimum of 50 MGD to sustain pools of water behind each shutter at sufficient elevation to keep the outside community taps wetted. By upgrading the stop shutters, DEP will be able to reduce flow more quickly and to a lower level, thereby minimizing the delivery of turbid water to Kensico while meeting outside community demands.

Improvements to the stop shutter installation process consist of fabricating new lightweight aluminum stop shutters and building hoist system improvements that will allow DEP staff to install and remove stop shutters more quickly, and provide shutters that will seal more effectively. The improved stop shutter facilities will continue to require service personnel to operate on-site equipment and coordinate the timing of shutter installation and removal. The improved stop shutters will enable DEP to decrease the minimum flow in the Catskill Aqueduct to approximately 25 MGD.

In 2013, the 90% complete design was finalized. Revisions were made to the bid documents based on comments received for electrical components of the design, as well as scheduling and operational concerns. Independent constructability and bidability reviews were conducted and the permitting requirements of the project were finalized.

The construction schedule includes "black-out" periods (May 1-September 30) during which the contractor would not be allowed to shut down the Catskill Aqueduct to conduct the required performance testing of the new stop shutters. DEP operational requirements may also require that the Catskill Aqueduct remain in service, potentially delaying the performance testing and acceptance of the shutters. DEP cannot accept the new stop shutters until the performance testing is complete.

After all of the 90% comments were addressed, the construction cost estimate, drawings, and specifications were finalized. The 100% complete documents have been submitted for final legal review and acceptance.

4.11.2 Shaft 4 Project

The contractor (Halmar International) for the Shaft 4 Interconnection was given Notice to Proceed in April 2013. The contractor began setting up at the site in early summer 2013 and has since excavated the Catskill Aqueduct and fully encased it. The new Shaft 4 structure has also been started and walls have been constructed. The work remains on schedule for substantial completion in July 2015. The facility will allow Delaware Aqueduct water to be transferred into the Catskill Aqueduct in Gardiner, NY, where the two aqueducts cross.

4.11.3 Operation Support Tool (OST)

In November 2013, DEP accepted delivery of the recommended alternative for managing Catskill turbidity, the Operations Support Tool (OST). OST is a computer system that allows DEP to model water quantity and water quality in the future under different potential operational scenarios and, in conjunction with other information on system conditions and operating experience, choose the best course of action. OST was developed under a four-year, $7.6 million contract with a consultant team plus a $1 million contract with the National Weather Service to accelerate development of probabilistic streamflow forecasts from the Hydrologic Ensemble Forecast Service (HEFS) that are used as input to OST. HEFS forecasts include upcoming storm events and estimated snowmelt, and are thus physically realistic. OST is in daily use by DEP to inform and support operational decision making.

5. Watershed Monitoring, Modeling, and GIS

5.1 Watershed Monitoring Program

5.1.1 Routine Water Quality Monitoring

To ensure the delivery of high quality drinking water, DEP conducts extensive water quality monitoring that encompasses all areas of the watershed, including sites at aqueducts and water supply intakes (keypoints), streams, reservoirs, and wastewater treatment plant (WWTP) facilities. DEP's monitoring objectives for 2013 are documented in the 2009 Watershed Water Quality Monitoring Plan (WWQMP) (DEP 2009) and associated addenda, which are designed to meet the broad range of DEP's many regulatory and informational requirements. The plan prescribes monitoring to achieve compliance with all federal, state, and local regulations; meet the terms of the 2007 Filtration Avoidance Determination (FAD) (USEPA 2007); enhance the capability to make current and future predictions of watershed conditions and reservoir water quality; and ensure delivery of the best water quality to consumers through ongoing surveillance.

The overall goal of the plan is to establish an objective-based water quality monitoring network, which provides scientifically defensible information regarding the protection and management of the New York City water supply. The objectives of the plan have been defined by the requirements of those who ultimately require the information, including DEP program administrators, regulators, and other external agencies. As such, the monitoring regime prescribed in the plan is driven by legally binding mandates, stakeholder agreements, operations, and watershed management information needs. The plan covers four major areas that require ongoing attention: compliance, FAD program evaluation, modeling support, and surveillance monitoring, with many specific objectives within these major areas.

Compliance. The compliance objectives of the sampling plan are focused on meeting the regulatory compliance monitoring requirements for the New York City watershed. This includes the requirements of the Surface Water Treatment Rule (SWTR) (USEPA 1989) and its subsequent extensions, as well as the New York City Watershed Rules and Regulations (WR&R) (2010), the Croton Consent Decree (CCD), administrative orders, and State Pollutant Discharge Elimination System (SPDES) permits. The sampling sites, analytes, and frequencies are defined in each objective according to each specific permit, rule, or regulation.

FAD program evaluation. USEPA has specified many requirements in the 2007 FAD that must be met to protect public health. These requirements form the basis for the City's ongoing assessment of watershed conditions, changes in water quality, and ultimately any modifications to the strategies, management, and policies of the Long-Term Watershed Protection Program. The City also conducts a periodic assessment of the effectiveness of the program using, among other

information, DEP's water quality monitoring data. Program effects on water quality are reported in the Watershed Protection Summary and Assessment reports (e.g., DEP 2011a), which are produced approximately once every five years.

Modeling support. Modeling data are used to meet the long-term goals for water supply policy and protection and provide guidance for short-term operational strategies when unusual water quality events occur. These objectives are achieved through implementation of watershed and reservoir model improvements based on ongoing data analyses and research results; ongoing testing of DEP's watershed and reservoir models; updating of data necessary for the development of models; and development of data analysis tools to support modeling projects.

Stream, reservoir, aqueduct, and meteorological data are all needed to develop, calibrate, and validate models. Data acquired through stream monitoring include both flow and water quality data. Reservoir monitoring provides flow and reservoir operations data to support reservoir water balance calculations. The water balance and reservoir water quality data are required to test, apply, and further develop DEP's one- and two- dimensional modeling tools. The meteorological data collection effort provides critical input necessary to meet both watershed and reservoir modeling goals. The modeling program's activities in 2013 are summarized in the 2014 Multi-Tiered Modeling Program Annual Status Report. See Section 5.3.

Surveillance monitoring. The surveillance monitoring plan contains several objectives that provide information to guide the operation of the water supply system, other objectives to help track the status and trends of constituents and biota in the system, and specific objectives that include aqueduct monitoring for management and operational decisions. Another surveillance objective relates to developing a baseline understanding of potential contaminants such as trace metals, volatile organic compounds, and pesticides, while another summarizes how DEP monitors for the presence of zebra mussels in the system. Zebra mussel monitoring is meant to trigger actions to protect the infrastructure from becoming clogged by these organisms. The remaining objectives pertain to recent water quality status and long-term trends for reservoirs, streams, and benthic macroinvertebrates in the Croton System. It is important to track the water quality of the reservoirs to be aware of developing problems and to pursue appropriate actions.

5.1.2 Additional Water Quality Monitoring

In addition to the routine monitoring discussed above, events or incidents may occur during the year that necessitate additional water quality monitoring. In 2013, additional weather-related monitoring was conducted at Kensico Reservoir when a series of storm events occurred in June that met the criteria for triggering storm event monitoring as per the Kensico Storm Event Monitoring Plan. Over six inches of rain fell within a nine-day period. Samples were collected from selected stream and limnological sites as well as keypoints and were analyzed for turbidity, fecal coliform, and specific conductivity. Areas of elevated bacteria counts in the reservoir were found at the depth corresponding to the stream temperature. Microbial Source Tracking (MST)

was also performed. The goal of MST is to identify the source of fecal bacteria—human, wildlife, and/or domestic animals. Various methods can be used to attempt to identify the source, including molecular and biochemical techniques, as well as chemical methods that detect chemicals associated with human activities. In this case, all stream and reservoir samples tested were negative for human and bird markers, meaning that there was no evidence that humans or birds were the source. A few stream samples did test positive for the ruminant source marker, indicating deer as a fecal source.

The occurrence of a seiche (wind-induced internal wave) in Schoharie Reservoir in 2013 also required additional monitoring. The seiche activity caused turbidity oscillations at the Schoharie tunnel outlet. These were first observed in July, with spikes occurring approximately once per day. The spikes became very pronounced in August (>100NTU on at least one occasion). Several special investigation surveys were conducted on the reservoir, with samples taken at multiple longitudinal and latitudinal sites and during different times of day. Also, robotic monitoring buoys were deployed to conduct vertical profiles at discrete depths and at 1-meter intervals to better track the fluctuations in turbidity occurring near the reservoir outlet. The event came to an end by October with the breakdown of thermal stratification in the reservoir, ending the conditions necessary for the seiche to continue. Upstate Freshwater Institute was contracted to use the data collected by DEP to further document the oscillations in temperature and turbidity and to compare water quality model predictions to observed conditions. A report (Upstate Freshwater Institute 2014) of their findings was finalized in January 2014.

Additional special investigations were performed in 2013 to document manmade or natural events occurring in the watershed that had the potential to negatively affect water quality. These included continued monthly sampling of the Pepacton Release for diesel range organics (DRO) from January to May 2013, due to the discovery of a small leak from buried fuel tanks in Pepacton Reservoir. Although DRO was not detected in any of the 2013 samples, inspections in the area of the leak for the presence of sheen and odor, and measurement of the bubble rate when bubbles were present, were conducted during the 2013 routine limnological surveys of the reservoir. Other examples of special investigations included sampling a stormwater outfall pipe to Lake Gleneida that apparently had a dry weather discharge and identifying dead algae that was found in the Croton River downstream of the Cornell Dam.

5.1.3 Water Quality Reports

Pursuant to the City's Long-Term Watershed Protection Plan (DEP 2011b) and as a FAD requirement (Section 5.1 Watershed Monitoring Program), DEP produces a Watershed Water Quality Annual Report, which is submitted to USEPA in July of each year (e.g., DEP 2013a). This document contains chapters covering water quantity (e.g., the effects of droughts or excessive precipitation during the reporting period), water quality of streams and reservoirs, watershed management, and water quality models (terrestrial and reservoir). For the 2013 report (due July 2014), the limnology and hydrology components of the document will draw largely from informa-

tion obtained from approximately 197 routinely-sampled reservoir and stream sites, resulting in almost 6,200 samples and almost 67,000 analyses. For the pathogen component, 490 routine samples were collected at 38 sampling sites (including keypoints) and analyzed for *Giardia* and *Cryptosporidium*, along with turbidity, pH, and temperature, for a total of 1,960 analyses, while 167 samples were collected at seven sampling sites for human enteric virus (HEV) examination (173 analyses).

It is important that DEP monitor pathogen concentrations on an ongoing basis to be able to confirm their presence or absence in the water supply. To maintain a constant flow of information to DEP managers and regulators, pathogen data are reported frequently and in several different reports. The following reports are issued on a regular basis:

- Weekly results of *Cryptosporidium* and *Giardia* sampling at the three source waters are routinely posted on DEP's website and sent directly to regulators by email
- Monthly Croton Consent Decree report
- Annual mid-term report on DEP pathogen studies of G*iardia* spp., *Cryptosporidium* spp., and HEVs (e.g., DEP 2013b)
- Kensico Water Quality Annual Report (e.g., DEP 2013c)
- Watershed Water Quality Annual Report (e.g., DEP 2013a)
- Drinking Water Supply and Quality Annual Report (DEP 2013d)
- Filtration Avoidance Annual Report (e.g., DEP 2013e), or, every fifth year, the Watershed Protection Program Summary and Assessment (e.g., DEP 2011a)

5.2 Wastewater Treatment Plant Protozoan Monitoring

The purpose of the WWTP protozoan monitoring in the Filtration Avoidance watershed is to demonstrate that microfiltration, and technologies deemed equivalent, continue to perform well with respect to pathogen removal from the effluents of the plants. From July 2002 through December 2008, DEP monitored the same 10 WWTPs quarterly, as stated in the monitoring plan in effect during that period. A new plan, the WWQMP (DEP 2009), took effect in 2009 and outlined monitoring for five new WWTPs west of the Hudson River (Andes, Fleischmanns, Hunter, Prattsville, and Windham), while maintaining monitoring at three of the previous locations (Grahamsville, Hunter Highlands, and Stamford) (Figure 5.1). All eight plants were monitored quarterly for *Giardia* and *Cryptosporidium* in 2013.

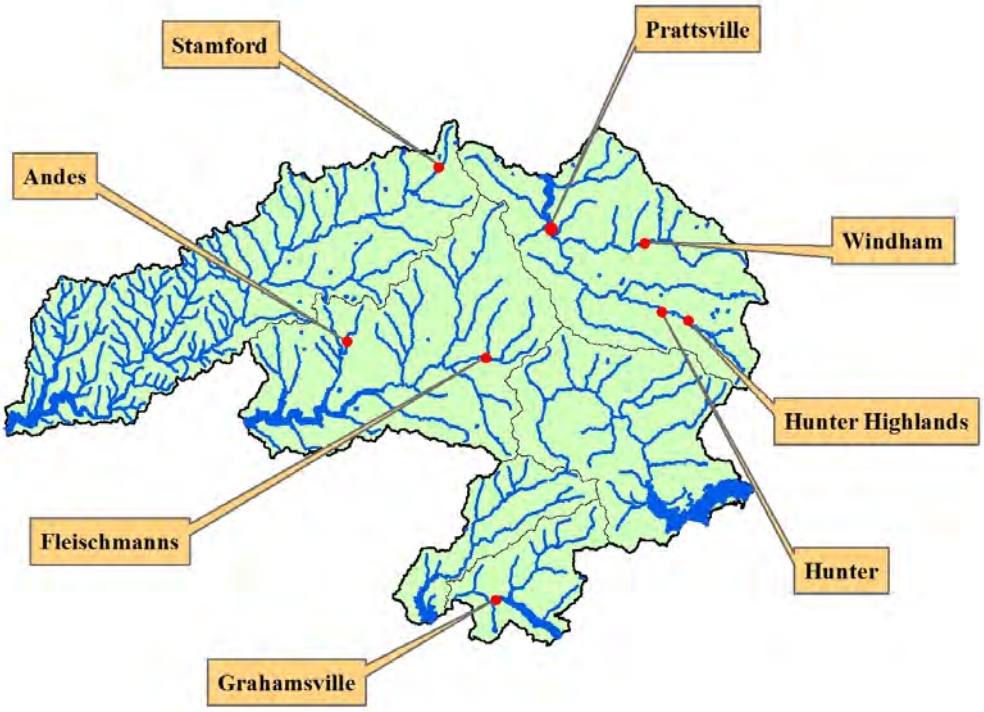

Figure 5.1. Wastewater treatment plants monitored for *Giardia* and *Cryptosporidium* in 2013.

Monitoring for *Cryptosporidium* and *Giardia* involved the field filtration of 50 liters of effluent water for each sample. Samples were analyzed by DEP according to USEPA Method 1623 (USEPA 2005). The 32 quarterly samples were taken as scheduled in 2013, and all samples were negative for *Cryptosporidium* oocysts. Only one sample, taken in January at the Hunter WWTP, was positive for *Giardia* cysts (2 cysts $50L^{-1}$). The Hunter plant was reported by operators to have been running normally at the time of sample collection, with a daily flow of 0.137 MG and no operational issues. It should be noted that this sample was taken a day after the Martin Luther King, Jr. holiday weekend, which is often a busy time for the ski resorts in the area.

5.3 Multi-Tiered Water Quality Modeling Program

For information on the work done by the water quality modeling group during 2013, please refer to the 2014 Multi-Tiered Modeling Program Annual Status Report, which will be available on the DEP website following its submittal on March 31, 2014 (http://www.nyc.gov/html/dep/html/watershed_protection/fad.shtml).

5.4 Geographic Information System

In fulfillment of the FAD requirement for an annual GIS status report, this section presents an overview of continued development and utilization of DEP's Geographic Information System (GIS) from January 1, 2013 to December 31, 2013. GIS activities support numerous FAD and New York City Memorandum of Agreement (MOA) (1997) watershed management applications. This report describes progress in providing GIS technical support for protection programs, monitoring programs, and modeling applications; the completion or acquisition of new GIS data layers and aerial products in the GIS spatial data libraries; GIS infrastructure improvement; and GIS data dissemination summaries.

DEP's GIS is used to manage the City's interests in the lands and facilities of the upstate water supply system, and to display and evaluate the potential efficacy of watershed protection programs through maps, queries, and spatial analyses. The GIS is also used to support watershed and reservoir modeling of water quantity and quality, as well as modeling of water supply system operations. GIS resources are utilized by DEP at offices throughout the watershed, either directly through a centralized geodatabase (the GIS library) or indirectly via the Watershed Lands Information System (WaLIS).

5.4.1 GIS Technical Support

During the reporting period, the GIS Program provided technical support and data development, including extensive Global Positioning System (GPS) fieldwork, for a variety of protection programs and modeling applications.

Watershed Protection Programs and Facilities

Significant quality assurance work was performed on a large set of watershed-wide seamless data products for hydrography, reservoir basin boundaries, topography, and all related data sets, as noted in Section 5.6.2. To further process these data into functional products, the GIS Program:

- Performed office or field verification of all discrepancies between new and old watershed boundary data amounting to more than 10 acres.
- Reviewed the new watershed boundary with DEP management and the NYC Law Department to ensure there were no major regulatory issues with its adoption.
- Edited and updated all hydrography-related data dependencies in GIS and WaLIS by recreating or updating GIS layers that contained attributes for basins or water feature criteria (e.g., 60- day travel-time basins, phosphorus-restricted basins, Land Acquisition Program criteria, regulatory buffers, and all FAD program locations tagged by basin);.
- Created all East of Hudson (EOH) and West of Hudson (WOH) sub-basin GIS delineations, using catchments derived from Light Detection and Ranging (LiDAR) data.
- Presented an overview of new LiDAR-derived hydrography and topography data to program managers, along with summary statistics highlighting differences from older, less accurate, data.

- Redirected all WaLIS maps to new hydrography and topography data, then released data into production databases for all GIS and WaLIS users.
- Provided guidance on data interpretation for users.
- Coordinated ground checkpoint data collection between surveyors from New York State Department of Transportation (NYSDOT) and DEP, to verify vertical accuracy of the source LiDAR data.
- Worked with Federal Emergency Management Agency (FEMA) project managers to verify that FEMA specifications for source LiDAR accuracy were met so data could be used in subsequent floodplain mapping contracts.

Other program analyses and ongoing efforts included the following:

- Update of surveys and spatial alignments for the Rondout-West Branch Tunnel (RWBT) Bypass Project
- Management of GPS data to support a long-term invasive species mapping project
- Compilation and analysis of Comprehensive Forest Inventory (CFI) plot location data and creation of GIS tools to facilitate importation of plot data from other formats
- Update of Catskill Watershed Corporation (CWC) Septic Repair Program prioritization based on proximity to newly-mapped streams
- Analysis of the Shokan hamlet to determine an optimal water quality sampling location for a sewer study

Watershed Water Quality Science and Research Programs

During the reporting period, the GIS Program:

- Created graphics for reports, posters, presentations, and peer-reviewed publications.
- Experimented with tools to import, run, and animate spatially-distributed, near-real-time meteorological data (e.g., MODIS, NLDAS) as input for water quality models.
- Created WOH hydrologic derivative rasters from the 1-meter Digital Elevation Model (DEM) to screen for stream reaches with greater stream power and potential erosion.
- Created graphics of Hillview Reservoir drainage area and protective fencing for a pathogen and reservoir cover study.
- Assisted with a Catskill Environmental Research and Monitoring (CERM) forest siting study.
- Provided GPS support to review EOH limnology water quality monitoring site locations.
- Completed registration of inter-governmental agreement with United States Geological Survey (USGS) for bathymetric surveys of WOH reservoirs, with initial work begun on Ashokan West Basin and Rondout Reservoir;.
- Revised first draft of Watershed Atlas to include new high-resolution DEMs, catchment boundaries, and land use/land cover data.

5.4.2 Completion or Acquisition of New GIS Data Layers and Aerial Products

A primary GIS accomplishment in 2013 was implementing watershed-wide data upgrades to the central GIS library for hydrography, reservoir basin boundaries, topography, and all related data sets. Derived from both 1-meter LiDAR and 1-foot orthoimagery, these data reveal significantly more features at a much higher resolution than previous GIS products. This marks the first

time DEP has updated hydrography data since the start of the GIS system in the early 1990s, where 1:24,000 scale USGS "Bluelines" (mainly derived from 1940-1970 aerial photos) were the primary source and best available data.

Major components of these data upgrades include:

- NYC Watershed and individual reservoir basin delineations at 1-meter resolution, now the new official representation
- Water features in USGS National Hydrography Dataset format:
  - Streams, rivers, lakes, ponds, and NYC reservoirs at 1-meter resolution
  - NYC reservoirs represented by their inundation areas when full, based on spillway height of each reservoir (This is the regulatory definition of each NYC reservoir boundary)
  - New streams mapped if their length between branches or tributaries exceeds 100 meters, or less if connected to a mapped lake or pond
  - New lakes or ponds mapped if they have a minimum area of 0.5 hectares, or smaller if already inline and connected to mapped stream network
  - Streams/rivers mapped as polygons if they are at least 5 meters wide for a length of at least 200 meters
  - New headwater streams mapped when their LiDAR-derived channel depth and catchment area meet minimum thresholds for their basins
  - All culverts represented along mapped streams where they cross roads or other surface terrain features
- Two-foot elevation contours as seamless data wall-to-wall for WOH and EOH watersheds, with index contours at 2-, 20-, and 100-foot levels, derived from the 1-meter DEM
- DEM and shaded relief models at 1-meter resolution

Some noteworthy changes in watershed statistics due to the newly mapped features are:

- 17.8% increase in stream miles (581 miles) for the Catskill/Delaware (Cat/Del) watershed, and a 9.3% increase (74 miles) for the Croton watershed.
- 51.6% increase in the acreage of non-reservoir lakes and ponds for the Cat/Del watershed and a 14.9% increase for the Croton watershed.
- Decrease in the total size of the NYC Watershed by about 708 acres, caused by a slight decrease (0.08%, or 828 acres) in the total acreage of Cat/Del basins and a very slight increase (0.06% or 120 acres) in the Croton basins. This is not a significant change (-0.06%). Some individual basins, however, did gain significant acreage at the expense of, or lost significant acreage to, their neighboring basins, due to more accurate mapping of the drainage.
- 4.7% increase in the acreage of Cat/Del reservoirs, assuming bankfull conditions, and a 10.8% increase for Croton reservoirs.

Final deliverables were also verified and received in 2013 for the GIS Program's 10-year update cycle of remotely-sensed data for land use, land cover, and impervious surfaces. Land cover data contain 16 categories, with a 0.5-acre minimum mapping unit (MMU) and calculated accuracy at 97%. Impervious surfaces are a subset of land cover and contain three categories (road, building, other impervious), with a 400-sq. ft. MMU and calculated accuracy at 93%. There are 34 land use categories available for each land cover category.

Several existing feature classes were updated or overhauled as part of ongoing data maintenance. These include mission-critical data sets for various DEP programs, such as annual digital tax parcel updates for all watershed counties, NYC-owned land or interests, New York State-owned land, DEP water supply facilities, stream restoration projects, septic repairs, and engineering project locations. Updates were also made to DEP water quality monitoring site locations for the Water Quality (WQ) Laboratory Information Management System (LIMS).

5.4.3 GIS Infrastructure Improvement

Hardware and Software

The migration of all GIS and WaLIS databases onto a new server cluster was completed in 2013. This required a significant amount of coordination and support from the DEP Office of Information Technology (OIT), and implementation of additional power sources in the Kingston building. All aerial imagery, elevation data, and WaLIS attachments were migrated to a large storage array for raster data. The migration also provided the best opportunity to upgrade ArcGIS Server software from version 10.0 to 10.1, after thorough testing was completed on a development server to ensure there were no conflicts with existing database structures. Scripts were written for users to automatically update their map projects to point to the new server location for GIS data.

All ESRI GIS software licensing continues to be coordinated and managed at the agency level by OIT through an ESRI Enterprise Licensing Agreement (ELA), which was renewed in 2013 after some proposed revisions were made by GIS staff. In addition to the ESRI ArcGIS User and Server applications, the ELA provides DEP with licenses of ESRI ArcEngine Runtime and ArcEngine Developer's Toolkit for use in continued development and deployment of the WaLIS application.

Maintenance was performed on numerous GPS units used by various programs, including updating data dictionaries, updating software, and inventorying all GPS hardware and software.

System and Database Administration

The GIS database administrator continues to manage the GIS library by creating and updating data sets, maintaining file geodatabase copies of the library, supporting spatial data development for WaLIS, updating schemas, and backing up all databases. At the same time, the following tasks were completed in 2013, many related to the final stages of the GIS server migration:

- Network timing tests on the new servers were performed.
- Automated Python scripts for database triggers or scheduled procedures were upgraded, and Python scripts for assigning privileges to feature data sets were developed.
- WaLIS map projects were updated; layer files, Crystal Reports, and WaLIS application software were pre-symbolized; and the central geodatabase on the new production GIS server was rebuilt.
- WaLIS and ArcMap software were updated on a new Microsoft Terminal Server cluster for remote access from field offices or Virtual Private Network (VPN).
- Mosaics, image services and layer files were created for all aerial image layers that were on an older Unix image server, after which the Unix server was decommissioned.
- DEM elevation, hill-shade and percent-slope mosaics, services, and layer files were built.
- Two-foot contour mosaics and layer files were created, and different methods were experimented with to display contours in WaLIS maps most efficiently.
- ESRI Tracking Analyst extension was installed for the WQ Modeling Group.

The GIS Program also develops, upgrades, and maintains WaLIS, which currently operates on the workstations of 247 distinct DEP users. Of those, 166 used WaLIS at least 10 or more times during 2013. WaLIS currently contains 49 different custom maps that collectively contain 1,719 GIS data layer representations. Feature class symbology was standardized in 2013 on most of those maps. WaLIS online “help” files were also overhauled. Workflow was modified to facilitate the updating of conservation easement properties, and to track locations of encroachment violations. New workflow was created to deal with the transfer of properties to New York State, and for prioritizing the issuance of deer management assistance permits on NYC-owned land. The GIS Program also began creating workflow and related GIS layers to track the chain of events leading to an emergency management preparedness incident. In order to facilitate field data entry into WaLIS by Regulatory and Engineering Program (REP) staff, a tablet application was completed in 2013 and is now actively working with several customized data forms. Tools were created to enable REP staff using WaLIS to access water quality data from DEP’s LIMS. New maps and data viewers were set up for the Community Water Group to begin to track upstate water connections to NYC aqueducts, as well as billing and consumption information related to those connections. Crystal Reports software is continually used to develop and maintain hundreds of built-in customized WaLIS server reports for all DEP user groups.

5.4.4 Data Dissemination to Stakeholders

Using data sharing policies developed in cooperation with DEP Legal, the GIS Program reviewed all outside requests for GIS data, and either emailed or wrote approved GIS data to CDs or portable drives as required for data sharing. Over 50 stakeholders and communities are currently on a schedule to receive semiannual data updates for newly-acquired and existing NYC Water Supply lands, and were sent these data via email in January and July. In late 2013, the GIS program began filling data sharing requests for the new 1-meter LiDAR-derived hydrography, topography, and reservoir basin data to partners and stakeholders such as the Watershed Agricultural Council, East of Hudson Watershed Corporation, NYSDEC, and various county soil and water conservation districts. These data were also shared with a CERM network sub-group working to identify a Catskill region catchment suitable for long-term research on climate change, air pollution, invasive species, biodiversity, and water quality. Numerous other individual GIS data layers were sent to contractors and consultants working on various DEP-related projects, including the RWBT Bypass Project and a project to inventory and track upstate water service connections.

6. Regulatory Programs

A primary component of DEP's overall watershed protection strategy is the enforcement of applicable environmental statutes and regulations, which include the New York City Watershed Rules and Regulations (WR&R) (2010), the federal Clean Water Act (33 U.S.C. §1251 et seq.), the National Pollutant Discharge Elimination System, and the State Environmental Quality Review Act (SEQRA) (N.Y.S. Environmental Conservation Law, Art. 8 (§8101 et seq.)), as well as local ordinances. Of these, the primary mechanism for protection of the water supply is the WR&R.

DEP's regulatory efforts are focused on three major areas: review and approval of projects within the watershed, environmental law and WR&R enforcement, and regulatory compliance and inspection of wastewater treatment plants (WWTPs).

6.1 Project Review

Each project proposed in the watershed, including those designed or sponsored by DEP, is reviewed to ensure compliance with the WR&R, as well as federal, state, and local laws. Projects that require DEP review and approval include all wastewater treatment systems, including WWTPs, sewer collection systems, and the installation of subsurface sewage treatment systems (SSTSs); the preparation of stormwater pollution prevention plans (SWPPPs); and the construction of certain impervious surfaces. In addition, DEP reviews and issues permits for individual residential stormwater plans (IRSPs) and for impervious surfaces associated with stream diversions or pipings. DEP also ensures that during and after construction, projects that require SWPPPs or IRSPs have the necessary best management practices (BMPs) installed, and that erosion controls are properly sited and maintained. In addition, DEP reviews applications that have been sent to NYSDEC for special permits involving mining operations, timber harvesting, stream crossings, and wetland issues. These applications are forwarded to DEP for review and comment as provided for in the DEP/NYSDEC Memorandum of Understanding.

Table 6.1 lists the number of new projects received in 2013 in the East of Hudson Filtration Avoidance Determination (FAD) basins. These projects are all stormwater and variance applications. The new, delegated, and remediated individual SSTSs for these basins are listed in Table 6.2.

Table 6.1. East of Hudson FAD basin new projects for 2013. Project summaries and maps showing project locations can be found in the biannual Filtration Avoidance 6.1 Project Activities reports. SP = stormwater and crossing, piping, diversion; VA = variance.

Reservoir	Town	SP	VA	Total
Cross River	Lewisboro	0	1	1
Croton Falls	Carmel	1	0	1
Kensico	North Castle	0	0	1
West Branch	Carmel	1	0	1
Totals		2	1	4

Table 6.2. East of Hudson FAD basin individual SSTSs for 2013.

Reservoir	Delegated SSTSs	New SSTSs	SSTS repairs	Approvals	Under construction
Boyd Corners	3	0	6	4	0
Cross River	5	0	5	9	8
Croton Falls	5	0	14	7	1
Kensico	4	0	1	5	3
West Branch	3	0	5	7	2
Totals	20	0	31	32	14

All new and repaired SSTS applications in the Kensico, West Branch, Boyd Corners, Croton Falls, and Cross River basins located in Putnam and Westchester Counties are subject to delegated review by the county health departments. (For more on delegation agreements, see Section 6.1.2.) The new and repaired individual SSTSs located in Dutchess County are reviewed and approved by DEP.

Table 6.3 lists new projects received in 2013 in the West of Hudson basins. These projects include new or repaired commercial, institutional, and multi-family SSTSs, and individual residential projects with advanced treatment units (ATUs). The “Other” projects consist of DOT projects, wetland and stream disturbances, mining applications from NYSDEC, timber harvesting, and stormwater retrofit projects. New, delegated, and remediated individual SSTSs are listed in Tables 6.4 (Catskill watersheds) and 6.5. (Delaware watersheds).

Table 6.3. West of Hudson new projects for 2013. Project summaries and maps showing project locations can be found in the biannual Filtration Avoidance 6.1 Project Activities reports. CR = intermediate repair; IS = intermediate SSTS; OT = other; SC = sewer collection; CN = sewer connection; SP = stormwater and crossing, piping, diversion; SD = stream disturbance.

Reservoir	Town	CR	IS	OT	SC	CN	SP	SD	Total
Ashokan	Olive	1		1					2
Ashokan	Shandaken	4		2					6
Cannonsville	Delhi						1	3	4
Cannonsville	Hamden					1	1	1	3
Cannonsville	Kortright						1	2	3
Cannonsville	Meredith						1		1
Cannonsville	Stamford							1	1
Cannonsville	Walton						2		2
Neversink	Neversink		1						1
Pepacton	Andes							1	1
Pepacton	Colchester	1							1
Pepacton	Fleischmanns					1	1	1	3
Pepacton	Middletown	1					2	3	6
Pepacton	Roxbury	1	1					1	3
Rondout	Neversink						1		1
Schoharie	Ashland		1				2		3
Schoharie	Gilboa						1		1
Schoharie	Hunter	1							1
Schoharie	Jewett	1						1	2
Schoharie	Lexington						5	3	8
Schoharie	Prattsville						2		2
Schoharie	Roxbury			1					1
Schoharie	Windham				1	1	2		4
Totals		10	3	4	1	3	22	17	60

Table 6.4. Ashokan and Schoharie Reservoirs individual SSTSs for 2013.

Reservoir	Delegated SSTSs	New SSTSs	SSTS repairs	Approvals	Under construction
Ashokan	13	N/A**	59	71	76
Schoharie	N/A*	28	40	65	79
Totals	13	28	99	136	155

*DEP does not have a Delegation Agreement with Greene or Schoharie County, so the number of delegated SSTSs is not applicable to this reservoir.

**Reviews of new SSTSs are delegated to Ulster County under that county's Delegation Agreement, so the results for new SSTSs are reported here as delegated SSTS results.

Table 6.5. Cannonsville, Neversink, Pepacton, and Rondout Reservoirs individual SSTSs for 2013.

Reservoir	Delegated SSTSs	New SSTSs	SSTS repairs	Approvals	Under construction
Cannonsville	N/A*	14	60	75	68
Neversink	1	1	11	14	14
Pepacton	N/A*	18	52	67	62
Rondout	0	4	10	17	14
Totals	1	37	133	173	158

*DEP does not have a Delegation Agreement with Delaware County, so the number of delegated SSTSs is not applicable to these reservoirs.

6.1.1 SEQRA Coordination

DEP conducts reviews of all SEQRA projects in the watershed. To manage these often large and complex projects, and the accompanying SEQRA environmental reviews, DEP tracks all SEQRA projects in the watershed, maintains a database of new projects and development trends in the watershed, and interacts with local, state, and federal officials and other parties.

Projects undergoing a SEQRA review may require the preparation of some or all of these documents: Notices of Intent to Act as Lead Agency, Determinations of Action Types, Environmental Assessment Forms (EAFs), Scoping Documents, Draft Environmental Impact Statements (DEISs), Final Environmental Impact Statements (FEISs), Supplemental Environmental Impact Statements (SEISs), Supplemental Draft Environmental Impact Statements (SDEISs), Draft Supplemental Environmental Impact Statements (DSEISs), and Findings to Approve or Deny. Table 6.6 presents a summary of SEQRA reviews in 2013.

Table 6.6. SEQRA reviews in 2013.

Received	Reviewed	Comment letters issued	Ongoing reviews*	SEQRA process closed*
86	86	72	73	96

*Includes certain reviews that DEP received prior to the beginning of the reporting period.

Table 6.7 provides a brief overview of the nature and status of significant, privately-sponsored, SEQRA Type I Actions that are currently undergoing, or have undergone, SEQRA environmental reviews during the reporting period. (SEQRA Type I Actions are those actions or projects that the Lead Agency determines may have a significant adverse impact on the environment and require the preparation of an EIS.)

Table 6.7. 2013 SEQRA review and status for significant Type I Actions.

Project name	Town/County	Reservoir	Description	Status
Hidden Meadows	Somers/ Westchester	Amawalk	Proposed 53 townhouse units in 9 buildings on 16.7-acre parcel to be served by municipal WWTP.	DEP received project notification and issued comment letter. Awaiting a determination from the Lead Agency.
Ridgeline Energy	Walton/ Delaware	Cannonsville	Proposed 8 wind turbines, access road, meteorological tower, and collection substation to connect to the electricity grid at the NYSEG River Road substation.	DEP issued comment letter and received Lead Agency Positive Declaration. DEP issued comments on draft Scoping Documents.
Meridale Subdivision	Meridith/ Delaware	Cannonsville	Proposed 120-lot residential subdivision on 1,000+-acre parcel located partially in NYC Watershed.	DEP issued comment letter on amended Negative Declaration.
Crossroads 312, LLC	Southeast/ Putnam	Diverting	The action involves a zone change from RC to HC-1, to construct a mixed-use commercial project on a 51.88-acre parcel. Proposed development of 186,000-sq.ft. retail, restaurant, and professional office services to be served by private WWTP.	DEP received and issued comment letter on the DEIS.

Table 6.7. (Continued) 2013 SEQRA review and status for significant Type I Actions.

Project name	Town/County	Reservoir	Description	Status
Castagna PDD	Pawling/Dutchess	East Branch	Proposed Planned Development District to consist of 80 senior housing units in two buildings, 120 parking spaces, medical building, and access road extension. Project to be served by Pawling Joint Sewer Works.	DEP received project notification and issued comment letter. DEP received Lead Agency Negative Declaration.
Algonquin Gas Transmission Line	Cortlandt & Somers/ Westchester Southeast/Putnam	Multiple	Replacement of ~31.4 miles of existing pipeline, adding 12.2 miles of new pipeline, upgrading 6 existing compressor stations, construction of 3 metering stations, and modification of numerous existing metering facilities in New York.	DEP received project notification and issued comment letters.
Tripi Subdivision	Bedford/ Westchester	Muscoot	Proposed 23-lot subdivision on 25.5-acre parcel to be served by community septic system.	DEP reviewed and issued comment letter on incomplete FEIS.
North Salem Highway Garage Offices	North Salem/ Westchester	Muscoot	Rehabilitation and replacement of cell tower sites.	DEP issued comment letter and received Lead Agency Negative Declaration.
Highgate Development	North Salem/ Westchester	Muscoot	Proposed 42 single-family homes and 76 townhouse units for people 55 and older in R-1 medium density residential zoning district to involve rezoning of ~39 acres. Project to be served by private subsurface SSTS.	DEP reviewed and commented on the SDEIS.
Somers Crossing	Somers/ Westchester	Muscoot	Petition for a new multi-family Residence Downtown Hamlet Zone District, and to construct, within the district, 60 multi-family residential housing units for active seniors, 19,000-sq. ft. grocery store, 75-bed Memory Care Facility, and 150 parking spaces on a 25.68-acre parcel to be served by a private WWTP.	DEP received project notification and issued comment letter. DEP received Lead Agency Positive Declaration and issued comments on draft Scoping Documents.
The Commons at Purdys	North Salem/ Westchester	Muscoot	Proposed 108 units of affordable housing for seniors and access road, to be served by private WWTP.	DEP received and issued comments on draft Scoping Documents.

Table 6.7. (Continued) 2013 SEQRA review and status for significant Type I Actions.

Project name	Town/County	Reservoir	Description	Status
Chappaqua Crossing	New Castle/ Westchester	New Croton	Redevelopment of the 120-acre Reader's Digest campus to include 348 new residential units and continuation of office space.	DEP received and issued comment letters on the DSEIS and FEIS.
The Spa at New Castle	New Castle/ Westchester	New Croton	Redevelopment of an existing estate house and construction of adjoining buildings to provide a mixed-use residential condominium, hotel, spa, restaurant, and associated recreational facilities.	DEP received project notification and issued comment letter. DEP received Lead Agency Positive Declaration and issued comments on draft Scoping Documents.
State Land Corp.	Yorktown/ Westchester	New Croton	Proposed 200,000-sq. ft. retail/ office building and 920-space parking lot, to be served by municipal water and sewer involving a change in zoning.	DEP reviewed and commented on supplemental information. DEP received Lead Agency Negative Declaration.
Crossroads Ventures	Shandaken/Ulster	Pepacton	Belleayre Mountain Ski Center UMP involves installation of new ski lifts, new ski trails, additional parking areas, expansion of the existing Discovery Lodge, construction of a new lodge and associated improvements. Belleayre Resort at Catskill Park involves Wildacres Resort—a 250-unit hotel, 163 lodging units, and 18-hole golf course. Highmount Spa Resort involves 120-unit hotel with spa facilities, 53 ownership units, and multi-level lodge that includes 27 units, 16 detached lodges, and 8 duplex buildings. Project to be served Pine Hill WWTP.	DEP reviewed and issued comments on the SDEIS.
Neversink Ballfields	Neversink/Sullivan	Rondout	Proposed four baseball fields, snack/concession shop, and 100 parking spaces, to be served by Grahamsville WWTP.	DEP received project notification and Lead Agency Negative Declaration.

6.1.2 Delegation Agreements

Westchester and Putnam Counties perform reviews of new, modified, and repaired SSTS systems in accordance with their Delegation Agreements. Ulster County performs reviews of new SSTSs in accordance with its Delegation Agreement.

DEP received documentation concerning the review of 256 delegated SSTSs during calendar year 2013. Sixty-nine of these reviews were for projects located in the West of Hudson watershed. The remaining 187 delegated SSTSs are located in the East of Hudson watershed.

6.2 Enforcement Activities

DEP investigates and confirms SSTS failures, issues Notices of Violation (NOVs), pursues enforcement actions on failed SSTSs, and refers certain criminal activity to the DEP Police. These activities are coordinated with DEP Legal and Corporation Counsel, county health departments, local building inspectors, and the Catskill Watershed Corporation if the activity is in a New York City Watershed Memorandum of Agreement (MOA) (1997) program area.

The DEP Police patrol the watershed on a daily basis. The police receive over 300 hours of training in environmental law and services, as well as 170 hours of practical field training in environmental and infrastructure protection. They have the authority to issue summonses or Notices of Warning for violations of the New York State Environmental Conservation Law and the WR&R, as well as other state and local laws. The DEP Police coordinate with other DEP divisions to ensure they are aware of ongoing construction sites in the watershed, and that areas of special concern are being monitored. Currently, members of the DEP Police attend the DEP monthly enforcement meetings for both the East of Hudson (EOH) and West of Hudson (WOH) watersheds.

In 2013, DEP Police:

- Completed 18,062.4 hours of training.
- Conducted 5,597 preliminary investigations.
- Conducted 313 long-term investigations related to pollution or terrorism.
- Patrolled 1,747,045.7 miles.
- Conducted 281,800 physical security inspections.

Also in 2013, the DEP Police made 35 arrests, issued 852 summonses, and served 469 Notices of Warning for violations of the New York State Penal Law, the New York State Environmental Conservation Law, the New York State Vehicle & Traffic Law, the WR&R, and various other state and local statutes.

6.3 Wastewater Treatment Plant Compliance and Inspection Program

DEP's Wastewater Treatment Plant Compliance and Inspection (WWTPCI) Program conducts a quarterly compliance inspection at each surface-discharging WWTP that operates on a year-round basis. A minimum of two compliance inspections per year are conducted during the operating season at seasonal surface-discharging facilities. Similarly, at least two compliance inspections per year are conducted at non-contact cooling water discharges to surface waters, groundwater remediation systems, landfills, and oil/water separators. Treated industrial waste discharges to groundwater, via ground surface application, are inspected four times per year. This does not preclude DEP from performing inspections with greater frequency. DEP may also periodically conduct unannounced facility inspections to manage instances of non-compliance, respond to abnormal or emergency operating conditions, react to mistakes or problems with self-monitoring data or record keeping, discuss DEP laboratory sampling results, oversee modifications or expansions to a facility, fulfill special requests by internal agency management.

When violations are identified at WWTPs, DEP coordinates enforcement activities with NYSDEC, USEPA, NYSDOH, and the New York State Attorney General's Office through the quarterly Watershed Enforcement Coordination Committee (WECC) meetings. At these meetings, the operational status of watershed WWTPs is discussed and steps are taken to ensure that adequate enforcement activities are pursued to achieve compliance.

Facility Compliance in the Catskill/Delaware Watershed

Thirty-five WOH WWTPs were inspected by DEP on a regular schedule in 2013. Of these, 28 are permitted for year-round discharge and 7 for seasonal discharge. Three of the 35 are wastewater treatment facilities permitted to discharge to groundwater. These are the Hamlet of Chichester, Mountainside Farms, and Hanah Country Club. Three other facilities are classified as industrial non-contact cooling water discharges. These are Ultra Dairy, Friesland Campina-DOMO, and Kraft Dairy. Altogether, DEP conducted 212 scheduled compliance, emergency response, and WWTP upgrade construction inspections in 2013.

Compliance with State Pollution Discharge Elimination System (SPDES) permits continued to improve among WWTPs in the Catskill/Delaware watersheds in 2013, due in large part to the WWTCPI Program. On June 8, 2013, staff received notice of an overflow at the Mountainside Farms WWTP. The spill, which originated from the clarifier, was caused by a power surge that shorted the Programmable Logic Controller (PLC), dial-up alarm, and the flow meter.An estimated 30,000 gallons of partially treated sewage was spilled, based on the amount of time that elapsed between the PLC short and the discovery of the overflow by the operator. Because of the site's topography, the partially treated wastewater remained within the perimeter of the clarifier and seeped into the ground, and was thus contained on the property. As a result, the spill did not reach a receiving stream and had no impact on water quality. The affected area was cleaned and all operating controls were restored.

DEP participates in Compliance Conferences (CC) with those facilities that continue to violate their SPDES permit limits and/or monitoring requirements. CCs are usually conducted after repeated attempts by DEP to remediate the problem with the facility owner and/or operator have failed. DEP, in conjunction with NYSDEC and local regulatory authorities, sends out an NOV letter prior to calling for a CC. DEP did not need to conduct any CCs in 2013 because many problematic and outdated facilities which used to exceed their permits on a regular basis have since been connected to another upgraded facility, upgraded as a standalone facility, converted to subsurface discharge, or totally abandoned; as a result, the number of failed WWTPs has decreased greatly.

The Mountainside Farms wastewater treatment facility is currently under an NYSDEC consent order requiring a full plant modification. DEP issued an approval for installation of a MBR on March 12, 2012. Construction remained on schedule through the 2013 monitoring period. Functional completion of the new facility is set for February 2014.

Tropical Storm Irene struck the Catskill region in August 2011. The Boiceville WWTP survived without any structural damage; water levels did reach the main floor level of the building. During the storm, the facility experienced a full bypass of the tertiary treatment process, the waste stream/flood water being diverted into an off-line sequencing batch reactor and discharged through the UV disinfection process. The flood also submerged and destroyed the sand filter air compressor and control boxes that provide the air lift for the filtration process. The facility was, however, able to manually operate one of the three sand filters (through installation of a temporary air compressor) and continued to do so during the lengthy deliberations that subsequently took place regarding FEMA and building insurance funding. While those deliberations were ongoing, DEP advanced over $110,000 to the town to expedite repairs, which the town will repay once it is in receipt of the insurance funding. The rehabilitation of the sand filters included removal of the spent sand and replacement with new media, and the installation of new mechanical parts for the sand filters, a new air compressor with auxiliary units, and a new electrical conduit, controls and panels. All compressors and electrical panels were installed above the flood elevation. The filters were successfully tested and fully restored by the summer of 2013.

Facility Compliance in the East of Hudson Watershed

The West Branch, Boyd Corners, Croton Falls, Cross River, and Kensico Reservoir basins are of special interest because they contribute to waters of the Delaware System. The following is a summary of the WWTPs and collection systems inspected within the West Branch, Croton Falls, and Cross River basins. There are no WWTPs in the Kensico and Boyd Corners basins, but DEP does perform inspections of the collection system/pump stations maintained by Westchester County and the Towns of North Castle and Harrison within the Kensico basin. In 2013, DEP conducted 43 scheduled compliance, emergency response, and WWTP upgrade construction inspections for the WWTPs in the EOH FAD basins.

There are eight WWTPs in the West Branch, Croton Falls, and Cross River basins. Most were in substantial compliance with their SPDES permit discharge limitations in 2013. Carmel Sewer District #2 WWTP did experience a sewage overflow from its collection on May 19, 2013, that was not entirely contained; water quality, however, was not impacted. The operator responded to a manhole overflow along Route 6 and Route 52 near Lake Gleneida, but the spill was estimated to be less than 500 gallons and did not make it to the lake shore. The manhole which overflowed was located, and the area was pumped and limed and a blockage cleared. Separately on this date, the collection system for the Carmel Sewer District #2 WWTP experienced an overflow from the lift station located on Stoneleigh Avenue. A Variable Frequency Drive (VFD) fault led to a shutdown, with the discharge from the wetwell estimated at 1,500 gallons. The VFD was immediately replaced and a vacuum t ruck removed the contents of the wetwell. Approximately 500 gallons of standing water and debris were recovered from the overflow.

The Michelle Estates WWTP experienced an excessive loss of media within its rapid sand filters. While this occurrence did not lead to a violation of the plant SPDES permit, it did provide an opportunity to troubleshoot the physical and operational parameters that led to this condition. There are a few possible causes for the media loss, including backwash pressure, flow and interval, controls sequence and maintenance of the filter bed. DEP, the facility operator and the design consultant were commissioned to identify the potential causes of the media loss, which have been occurring since the completion of the regulatory upgrade in 2009. The sand filter evaluation included reviewing the installation and control strategy, and observing the current operation together with the operator and sand filter manufacturer. The facility agreed to rebuild the filters with the proper layers of media, and have the manufacturer reprogram the controls. The design consultant will provide recommendations for proper operating procedures to maintain the sand filters in good working condition. The facility will continue to work with the WWTPCI and DEP Regulatory Upgrade Programs to establish a resolution.

For monitoring of the Westlake Sewer Trunk Line, see Section 4.10.3.

DEP performed compliance inspections of the Town of North Castle (Old Route 22, Cooney Hill Road, Route 120/Loudens Cove, New King Street, Old Orchard Street) and the Harrison (Park Lane) pump stations and collection system throughout the 2013 monitoring period. The inspections revealed no abnormal conditions.

6.3.1 Sampling of WWTP Effluents

Sampling of surface-discharging WWTP effluents is conducted by DEP's ELAP-approved laboratories. At non-City-owned WWTPs, grab samples are taken twice monthly. In addition, a composite sample is collected once a year from those plants that have composite sample monitoring requirements in their SPDES permits; these plants are listed in DEP's Watershed Water Quality Monitoring Plan (DEP 2009). Special cases are the non-contact cooling water discharges at Kraft, Morningstar Foods/Dairyvest, and Friesland Campina-DOMO, which are routinely sam-

pled quarterly, by composite sample. City-owned WWTPs are also sampled in accordance with SPDES permit monitoring requirements, and these samples, including grab samples, are analyzed by DEP laboratories, with the results reported in Discharge Monitoring Reports.

In the Catskill System, 14 WWTP effluents were sampled in 2013; composite samples were collected from 8 of the plants. In the Delaware System, 12 WWTP effluents and the 3 non-contact cooling water discharges (Kraft, Morningstar, and Friesland Campina-DOMO) were sampled. Composite samples were collected at 9 of the WWTPs as well as at the non-contact cooling water discharges. In the EOH System, 8 WWTPs were sampled; composite samples were collected at the Mahopac STP.

Overall in 2013, 2,385 analyses were performed on 436 effluent samples from WWTPs in the Catskill System. For the Delaware System, 2,558 analyses were performed on 373 effluent samples from WWTPs and at the 3 non-contact cooling water discharges. In the EOH System, 976 analyses were performed on 172 WWTP effluent samples.

Sampling data are shared regularly with DEP's WWTPCI Program for the purpose of tracking compliance with SPDES-permitted effluent limits.

7. Catskill/Delaware Filtration/UV Disinfection Facilities

DEP's UV Disinfection Facility has been constructed along the eastern side of the City-owned Eastview Parcel (Towns of Mount Pleasant and Greenburgh, Westchester County). Provision has been made for future connections from the Catskill Aqueduct, as well as from the proposed Kensico-City Tunnel and to/from the Catskill/Delaware water filtration facility, if built. The current design also includes design elements that facilitate connections for local consumers and the delivery of finished water to the Kensico-City Tunnel should it someday be constructed at this site.

To maintain its dual track approach for meeting the goals of the Surface Water Treatment Rule (USEPA 1989), DEP continues to perform biennial updates of the preliminary design of a Catskill/Delaware Ozone/Direct Filtration facility that can be advanced to final design and construction in the event that filtration of the Catskill/Delaware water supply is deemed necessary. These designs were most recently reviewed in September 2013.

7.1 Ultraviolet Disinfection Facilities

7.1.1 Facility Construction Contracts

Progress has been steady, allowing completion of Administrative Consent Order milestones on schedule. As of December 1, 2012, DEP achieved the milestone "Commence full operation of the UV Facility utilizing a UV dose of 40 mJ/cm^2 based on MS2 coliphage as the test surrogate or alternate dose as approved by NYSDOH." In 2013, the contractors conducted testing of various systems and control programs for the facility. Related upgrades and enhancements continue to be implemented. The major work items completed in 2013 include site security enhancements and paving and landscaping. Contractors have remained on site to provide assistance for process optimization and alarm management tasks and to correct any items that have been noted by DEP during the first year of operation.

7.1.2 Project Schedule

The project schedule is prescribed in both the 2007 Filtration Avoidance Determination and an Administrative Order on Consent between DEP and USEPA. Monthly reports are submitted in accordance with the Administrative Order on Consent and describe progress on the project while providing a mechanism for describing any known or anticipated non-compliant milestones. During testing it was observed that the existing milestones did not provide a way to account for performing iterations of testing required for acceptance of the facility. In August 2012, DEP, USEPA, and NYSDOH renegotiated the terms of the consent order. The revised milestones provided for additional validation testing (see Section 7.1.5), which was subsequently performed. Results of this work have been presented in a series of validation reports.

7.1.3 Design of Ancillary Projects

Wetland Mitigation

The contract to perform wetland work, CAT210WL, was issued to Halmar International, LLC, in an order to commence in July 2009. The contract calls for the creation, restoration, stabilization, and maintenance of wetland areas in accordance with U.S. Army Corps of Engineers Protection of Waters permit requirements. This work achieved substantial completion in the summer of 2012. The contractor will monitor the site, verifying plant viability, through 2014.

Mount Pleasant UV

As part of the site plan permit approval agreement, DEP was required to provide the Town of Mount Pleasant with UV-treated water. The project involved the installation of a new UV disinfection system within the Commerce Street pump station. In 2011, the contract was awarded to the FCM Group, Inc. The contract achieved substantial completion in December 2013 and the equipment is currently in operation.

7.1.4 Permitting

Greenburgh Work Permits

In 2012, the contractor completed construction of a small superstructure in the Town of Greenburgh related to the building permit. The structure provides access to the treated water connection to the Catskill Aqueduct. In 2013, modifications were made to the structure for added protection during heavy rain events.

7.1.5 Validation Testing

The Administrative Order on Consent was modified in September 2012 to establish additional milestones for UV validation. The revisions allowed for a two-phase testing program to address differences between the inlet piping on the validation test stand at Johnstown, NY and the installed inlet piping at the facility. Results of the Phase I testing were submitted to NYSDOH on November 5, 2012. The Phase II testing was completed in late 2012 and a revalidation report which summarized the results was submitted to USEPA and NYSDOH for their review. In correspondence dated November 1, 2013, NYSDOH in consultation with USEPA, acknowledged that the validation was in conformance with the Long Term II Enhanced Surface Water Treatment Rule and agreed that DEP could continue to operate the UV facility at a reduction equivalent dose (RED) of 40 mJ/cm^2. NYSDOH also indicated that DEP could operate the facility at an alternate dose that has been validated to provide at least 2-log inactivation of *Cryptosporidium* once certain requirements are met. A final report on the validation testing, incorporating minor edits concerning the history of the validation testing program, was submitted in January 2014.

7.2 Filtration Planning Design Update

In accordance with the terms for relief from completing final designs for a filtration facility, a preliminary design update was completed in September 2009 for a 2,110 MGD ozone/direct filtration facility for the Catskill/Delaware water supply. The design update was presented as a supplement to the 2003 Preliminary Design Update and incorporated all modifications previously presented in the 2005 design update. The changes included converting the previous design into a three-dimensional drawing platform. This change will facilitate additional coordination among the different design disciplines while resolving many conflicts before work begins on site. The 2013 biennial review of the Filtration Plant Design found that the previously submitted report is still valid as a complete preliminary design and that no significant site modifications have occurred since the 2009 update; as a result, there were no modifications to the report.

8. In-City Programs

8.1 Waterborne Disease Risk Assessment Program

New York City's Waterborne Disease Risk Assessment Program (WDRAP) is a joint agency program involving the Department of Health and Mental Hygiene (DOHMH) and DEP. The two major ongoing functions of WDRAP are to:

- Obtain data on the rates of giardiasis and cryptosporidiosis, along with demographic and risk factor information on case patients.

- Provide a system to track diarrheal illness to ensure rapid detection of any outbreaks.

Disease Surveillance

Active laboratory surveillance, involving regular visits to or telephone contact with parasitology laboratories by DOHMH staff members, began in July 1993 for giardiasis and November 1994 for cryptosporidiosis, and continued through 2010. In January 2011, active laboratory surveillance for giardiasis and cryptosporidiosis was discontinued, as it had been replaced by an electronic reporting system. By January 2011 almost all NYC clinical laboratories were fully enrolled in the Electronic Clinical Laboratory Reporting System (ECLRS), which was developed to ensure more rapid and complete reporting of reportable conditions, including giardiasis and cryptosporidiosis. Electronic reporting provides timelier data than active surveillance, and is more complete than typical paper-based systems.

For all cryptosporidiosis cases, and as needed for giardiasis cases, public health epidemiologists contact patients to verify the data provided on the case report, to collect additional demographic and clinical information, and to identify possible sources of exposure. During 2013, surveillance for giardiasis and cryptosporidiosis was ongoing, and interviews were conducted, per the above parameters. At the time of this writing, the 2013 *preliminary* count of cases reported to DOHMH among NYC residents was 775 cases of giardiasis and 80 cases of cryptosporidiosis. Four giardiasis case interviews and 46 cryptosporidiosis case patient interviews were completed.

Outbreak Detection/Syndromic Surveillance

New York City currently has four types of outbreak detection systems in operation, each one tracking a different indicator of gastrointestinal illness (GI) in the community. These systems are not specific to giardiasis or cryptosporidiosis nor are they specific for waterborne illness. All systems rely on the voluntary participation of the organizations providing the data. All systems were operational in 2013. One of them involves the tracking of chief complaints from hospital emergency department (ED) logs; under another, DOHMH monitors and assists in the investigation of GI outbreaks in eight sentinel nursing homes; and a third system tracks the number of stool specimens submitted to a clinical laboratory for microbiological testing.

The fourth type of outbreak detection system in operation in NYC involves monitoring of sales of over-the-counter (i.e., non-prescription) anti-diarrheal medications. The City's anti-diarrheal medication monitoring activities has had two components: the ADM system and the OTC system. The two systems have separately monitored daily sales of non-prescription antidiarrheal medications at different major store chains. The ADM system has been managed by DEP and the OTC system by DOHMH. In 2012 the two systems were merged, though DEP continued to run the ADM system into 2013 to ensure a smooth transition. An evaluation by NYC of the impact of the merger of the two systems has been completed and a summary report is in preparation.

Outreach and Education

Information on giardiasis and cryptosporidiosis, and on *Giardia* and *Cryptosporidium*, continue to be available on the DEP (http://www.nyc.gov/html/dep/html/home/home.shtml) and DOHMH (http://www.nyc.gov/html/doh/html/home/home.shtml) websites. Educational outreach talks in 2013 included a presentation by DEPon the WDRAP program at two conferences (Watershed Science and Technical Conference, and Westchester Water Works Conference), and two more general talks at New York University.

Additional Information and Results

Additional WDRAP results (including demographic data and case interview results for giardiasis and cryptosporidiosis cases), summary results from syndromic surveillance programs, and WDRAP program implementation information can be found in the WDRAP annual report at http://www.nyc.gov/html/dep/html/drinking_water/wdrap.shtml.

8.2 Cross Connection Control Program

DEP's Cross Connection Control Program includes three distinct but integrated components—inspections, plan review, enforcement—that are coordinated to ensure the appropriate level of protection for the water supply system. In 2013, as part of its continuous effort to improve efficiency and consistency, and to streamline and standardize overall operations, DEP performed an internal review of the program. That review concluded that the program is more than adequate and far exceeds the anticipated frequency milestones set forth in the FAD for all the report categories except two; in those cases, the milestones are tracking close to the anticipated frequency[1]. The review also have found that beneficial enhancements to the inspections program can be made and these will begin to be implemented in 2014. Table 8.1 presents the metrics for this reporting period and compares the data to previous years.

1. All report categories, with the exception of Perform Full Inspection of Hazardous Premises, have listed "anticipated frequencies" because they are performed to some extent on an as-needed basis. The Response to Cross Connection Complaints and Review Requests for Exemption are tracking close to, but below, FAD-anticipated frequencies. These two categories are counts of issues initiated by outside entities.

Table 8.1. Cross Connection FAD milestones.

Annual and semiannual periods	Responding to incidents	Facility "hazardous" inspections	Enforcement initiated for "hazardous" premises	Backflow preventer plans approved	Backflow preventer plans reviewed with self-certification (approved)	Exemption requests processed[2] (approved)	Notices of Violation issued for failure to test annually[3] (install)
Jan.-Dec. 2007	4	4,232	1,122	2,120	44	1,290	532
Jan -Dec. 2008	0	3,207	1,124	2,642	12	1,160	586
Jan.-Dec. 2009	0	2,812	1,064	3,021	0	792	568
Jan -Dec. 2010	3	9,262	2,887	3,280	1	472	474
Jan.-Dec. 2011	2	5,187	4,060	7,625	19(6)	445	57
Jan.-Dec 2012	2	4,318	4,348	6,115	7(4)	374(266)	413(1623)
New Reporting Protocol Jan.-Dec 2012	No Change	4,060	No change	No Change	7	374	413
Jan.-Dec. 2013	0	5,257	2,436	5,235	10	370	1,382
FAD Requirement	1-2/yr	300-450/yr	225/yr	400/yr	TBD*	400/yr	200/yr

*To be determined. No established minimum level of response.
[1]Exemption submissions have waned due to new fee schedule, policy changes and rejections.
[2]These were orders to submit the test reports. Failure to install are in parentheses. Number in parentheses will not be included in 2013.

Part of the internal review of the program included analysis of current reporting protocols for 2013. DEP is implementing some minor adjustments to the report to more closely align with the FAD target milestones. These changes are described in more detail below. To allow comparison of the order of magnitude of differences that are to be expected using the revised reporting protocol, DEP retroactively applied the new methods to the 2012 FAD numbers; the differences are shown in the New Reporting Protocol row of Table 8.1. The changes are as follows:

- For 2013 and moving forward, DEP is proposing to remove duplicative entries for the same report category. Accordingly, the numbers included in the parentheses for the report categories titled Backflow Preventer Plans Reviewed with Self Certification (Approved), Exemption Requests Processed (Approved), and Notices of Violation Issued for Failure to Test Annually (Approved) will no longer be included.

- In the category titled Perform Full Inspection of Potentially Hazardous Premises, the review revealed that this value has historically included a relatively small number of duplicate visits to a property and properties where only what DEP terms "re-inspections" or "spot inspections" to check a specific issue were performed. DEP will no longer include this type of inspection in this category, which asks for "full inspections".

These reporting changes have been applied to the numbers presented in Table 8.1 for 2013.

A significant development in the program this year was the launch of a pilot to accept online applications for cross connection plan review through DEP's Water and Sewer Permitting System (WSPS). Online filing allows users to file plans online for review; then, once the application is reviewed and approved, an electronic approval stamp is used to identify plans that have been accepted. The process streamlines the cross connection approval process, as well as the water service and meter permit processes. Findings from the pilot will help DEP refine the online experience for its applicants. Over time, it is expected that more and more cross connection reviews will be conducted online.

To facilitate startup of the online applications pilot, DEP performed targeted outreach to the applicant community and prepared written guidance to assist filers use the new system. A video was also placed on DEP's website to explain the importance of back flow prevention. The link to the video is: http://www.nyc.gov/html/dep/html/forms_and_permits/backflow.shtml.

9. Education and Outreach

DEP advances its watershed protection strategy through stakeholder collaboration, broad community outreach, and targeted educational programs for specific audiences. To achieve this, DEP partners with the Catskill Watershed Corporation (CWC), Watershed Agricultural Council (WAC), Cornell Cooperative Extension (CCE), Soil and Water Conservation Districts (SWCDs), Catskill Region Invasive Species Partnership (CRISP) and others to raise awareness about the water supply system, source water protection, water conservation, environmental stewardship, land use planning, stream corridor protection, stormwater and wastewater management, flood response and preparedness, invasive species, and other key topics.

During 2013, DEP estimates that approximately 665,500 people were exposed to information about the water supply system and watershed protection through more than 526 events that were attended by DEP or its partners. These events took place during every month of the year in all eight watershed counties (370 events reaching 27,538 people) as well as the five boroughs of New York City (120 events reaching 630,172 people). Additional outreach was achieved through more than 36 conferences and speaking engagements that took place elsewhere in New York and other states, reaching at least 7,757 people.

This chapter summarizes the education and outreach program accomplishments of DEP and its partners according to five major audience categories. A complete listing of all activities and events taking place during 2013 is available upon request.

9.1 Water Consumers

DEP and its partners attended or sponsored at least 182 events where water consumers were identified as the primary or secondary audience. DEP estimates that 630,952 water consumers were reached through these activities, including more than 600,000 City residents who visited DEP's "Water-On-The-Go" drinking water stations. Other examples include DEP or WAC exhibits at New York City farmers markets, attendance at New York City conferences and informational meetings, classroom visits to New York City schools, and dozens of educational presentations conducted at the Visitor Center at Newtown Creek in Brooklyn.

In addition, DEP's website (nyc.gov/dep) continued to feature a wealth of information about the water supply, watershed protection, drinking water quality, watershed recreation, and environmental education. DEP's website serves as a repository for key publications such as the annual consumer confidence report, program brochures and newsletters, watershed regulations and recreational rules, regulatory guidance documents, environmental education materials, and FAD reports. DEP also maintained an active presence on popular social media sites such as Twitter and Facebook, in addition to issuing 46 press releases on topics relating to the water supply system, watershed protection, and watershed recreation.

9.2 Watershed Landowners

DEP and its partners attended or sponsored at least 103 events where watershed landowners were identified as the primary or secondary audience. DEP estimates that 7,469 landowners were reached through these activities, the majority of which were conducted through the Watershed Agricultural Program (targeting farmers), the Watershed Forestry Program (targeting private forest landowners), and the Stream Management Program (targeting streamside landowners), as well as by the CWC (targeting home owners).

The Watershed Agricultural Program conducted 26 farmer education programs that were attended by 584 participants, of whom 298 (51%) were watershed farmers. The WAC also co-sponsored the annual Clean Sweep Chemical Disposal Day for Delaware County residents and continued to maintain its own website (nycwatershed.org), as well as those for Pure Catskills campaign (purecatskills.com), Catskill Woodnet campaign (catskillwoodnet.org), and the Catskill Farm Link project (catskillsfarmlink.org).

The Watershed Forestry Program conducted more than two dozen landowner education programs that were attended by over 1,200 participants; these events were held primarily at the Siuslaw Model Forest in Greene County and the Clearpool Model Forest in Putnam County. Other activities included the Master Forest Owners Program and an eight-week self-study course called "You and Your Forest", which attracted 76 landowners.

The Stream Management Program conducted more than a dozen educational programs for hundreds of streamside landowners, primarily through workshops, presentations, volunteer riparian planting efforts, interpretive hikes along streams, project advisory meetings, newsletters, and press releases. Flooding and emergency storm response and preparedness were the key topics addressed by the Stream Management Program during 2013.

The CWC sponsored one septic system maintenance workshop that was attended by two home owners in addition to keeping watershed residents informed through 22 press releases, *The Advocate* e-newsletter, the CWC website (cwconline.org), and exhibits at local community events that are regularly attended by watershed landowners and home owners.

9.3 School-based Audiences

DEP and its partners conducted more than 257 school-based educational programs in both the watershed and New York City. DEP estimates that approximately 20,612 students and teachers were reached through these activities, the majority of which were conducted through the Trout in the Classroom Program, the urban/rural school-based programs of the Watershed Forestry Program, and the CWC Public Education Grants Program.

The Watershed Forestry Program continued to implement the Green Connections School Partnership Program, the Watershed Forestry Bus Tour Program, and the Catskill Stream and Watershed Education Program (CSWEP). These programs collectively reached more than 1,700 students and teachers in New York City and the watershed.

The CWC Public Education Grants Program continued to fund watershed education projects for school-based audiences in both New York City and the West of Hudson watershed. In 2013, the CWC awarded 22 educational grants totaling $124,320; 15 of these grants (68%) were awarded to New York City-based recipients and 7 (32%) were awarded to watershed-based recipients. To date, the CWC has awarded 434 education grants totaling over $2.2 million. These grants were awarded to 179 individual schools and organizations and are estimated to have reached well over 200,000 people (primarily students).

Additional school-based audiences were reached through exhibits, presentations, and demonstrations at Greene County Environmental Awareness Days, Woodstock Elementary School “Go Green” Day, Blue Mountain Middle School Career Day, Rhinebeck Middle School Career Fair, Science Council of New York City Teacher Conference, NYU Environmental Education Expo, Frost Valley YMCA Healthy Kids Day, Bernard Harris Summer Science Camp, Ulster County Outdoor Youth Expo, NYSDEC Hudson River Snapshot Day, DEP’s Annual Water Conservation Art & Poetry Contest, and numerous performances of “City That Drinks The Mountain Sky” in both New York City and the watershed.

9.4 Elected Officials and Professionals

DEP and its partners attended or sponsored more than 140 events where elected officials and watershed professionals were identified as the primary or secondary audience. DEP estimates that 16,866 people were reached through these activities, the majority of which were conducted through the Stream Management Program (targeting local officials and highway departments), the Watershed Forestry Program (targeting loggers, foresters, and wood products businesses), and the CWC (targeting local officials and wastewater professionals).

The Stream Management Program conducted more than a dozen training workshops that addressed emergency flood response and related topics, in addition to participating in more than a dozen stakeholder advisory and local flood commission meetings. Other highlights include the Fourth Annual Ashokan Watershed Conference and the Seventh Annual Schoharie Watershed Summit that were collectively attended by 260 people.

The Watershed Forestry Program conducted 13 professional training workshops for loggers and foresters that attracted 116 participants, in addition to conducting two logger forums and a financial planning workshop for wood-using businesses. The WAC also exhibited at the NYS Forestry Awareness Day, Deposit Lumberjack Festival, Catskill Forest Festival, and NYS Woodsmen Field Days, which collectively attracted nearly 1,000 participants.

The CWC sponsored its annual Catskills Local Government Day, which was attended by 45 participants, in addition to three professional training workshops that were attended by nearly 100 local officials and watershed professionals. The workshops addressed the topics of municipal planning, SEQRA, and advanced septic system design.

Other events where DEP and its partners were able to reach local officials and professionals include the annual Watershed Science and Technical Conference, New York City International Restaurant and Food Show, Catskill Regional Dairy & Livestock Conference, Walton Regional Livestock Show, NYS Maple Producers Tour, New York City Food and Travel Expo, WAC Farm to Market Conference, New York-New England Society of American Foresters Annual Conference, American Farmland Trust's "No Farms No Food" Rally, and others.

9.5 Other Public Audiences

In addition to targeting specific audiences through individual programs, DEP and its partners attended dozens of community outreach events where watershed information was made available to the broader public. While it is difficult to estimate the direct educational impacts from large public events, they nevertheless serve as important venues for disseminating key messages and publications to thousands of constituents in both New York City and the watershed. Highlights for 2013 include the Delaware County Fair, Grahamsville Little World's Fair, Ulster County Fair, Ulster Creek Week, Old Salem Horse Show, Ellenville Blueberry Festival, West Kortright Fair, Schoharie County Sunshine Fair, Shandaken Day, Olive Day, Teatown Eaglefest, NYC Winter Jam, World Science Festival Street Fair, Margaretville Cauliflower Festival, and opening ceremonies that were held for the Time and The Valleys Museum in Grahamsville, the Catskill/Delaware UV Disinfection Facility, and the Shavertown Hiking Trail in Andes.

10. Miscellaneous Reporting Provisions

10.1 Water Conservation/Demand Management

DEP values the role of water conservation and demand management in the responsible long-term management of New York City's water supply. As a result, actual water demand is down 30% since the 1990s, despite consistent increases in population (Figure 10.1). With predictions of warmer temperatures and greater variability in precipitation due to climate change, however, DEP must consider this increasing uncertainty in its management of the City's water supply and the corresponding demand for this resource. Further, the leaking of the Delaware Aqueduct and its planned shutdown and repair in 2021 as part of DEP's Water for the Future Program is a near-term certain event that provides an imperative not only to proactively manage, but also explicitly reduce existing water demand in order to ensure adequate water supply through this period.

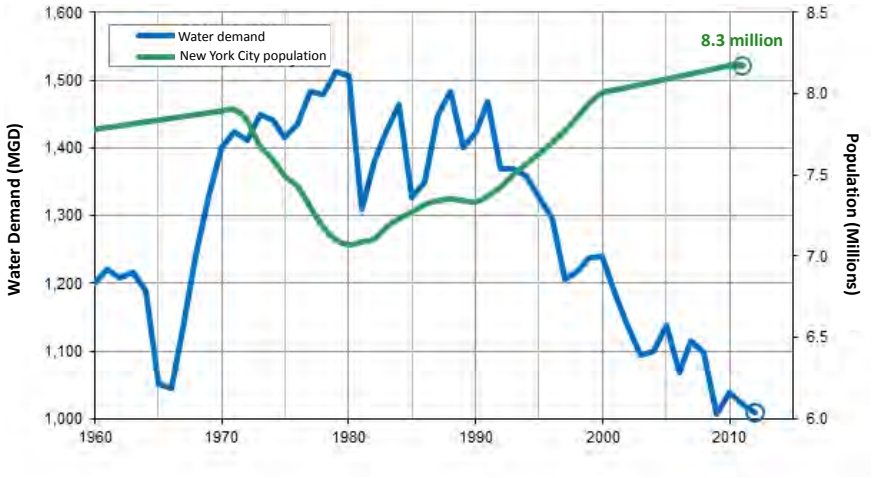

Figure 10.1. New York City water demand and population.

Water Demand Management Plan

DEP's water conservation efforts aim to reduce water use in New York City and upstate communities by 5% from the 2012 demand level by about the year 2020. This is equal to a reduction of approximately 50 million gallons of water per day. The Water Demand Management Plan sets forth the five major strategies that DEP will implement to reduce water use. They are:

- Municipal Water Efficiency Program, which involves retrofits of city-owned properties. This program will save up to nine million gallons of water per day.

- Residential Water Efficiency Program, which focuses primarily on the Toilet Replacement Program for multi-family buildings and other residential properties. This program will save up to 30 million gallons per day.

- Non-Residential Water Efficiency Program, involving collaboration with private sector organizations like businesses, hospitals, universities and theaters.

- Water Distribution System Optimization, entailing system repairs and upgrades, managing water pressure, and refining water meter accuracy and leak detection.

- Water Supply Shortage Management, which encompasses the review and revision of plans to prepare for a drought and other water shortages.

The following paragraphs summarize the progress DEP has made during 2013 in designing and implementing efforts to support each of the strategies listed above.

Municipal Water Efficiency Program

DEP made significant strides in this program, establishing working partnerships with two key municipal agencies—the NYC Department of Education (DOE) and the Department of Parks and Recreation (DPR)—and executing 112 individual retrofit projects with them. Through its new partnership with the DOE, DEP funded the replacement of over 1,000 old toilets and urinals with high-efficiency fixtures in nine schools in Brooklyn and Queens. As part of its new partnership with the DPR, DEP funded the retrofitting of spray showers in 103 parks across Brooklyn, the Bronx, Manhattan, and Queens with push-button activation features, to prevent water from being used (and, ultimately, wasted) when members of the public were not present to enjoy it.

Residential Water Efficiency Program

Progress under this program primarily involved the development of plans, a project management framework, and the contracting of partners required to prepare for the launch of the Residential Toilet Replacement Program, expected in early 2014. This program will offer $125 vouchers to eligible building owners who are part of the Multi-Family Conservation Program to replace old, inefficient toilets with high-efficiency, WaterSense-certified toilets. Preparations included negotiations with six toilet wholesale vendors to accept the vouchers and provide the toilets to consumers, the creation of an online application tool, and the design of a feasible solution to recycle the discarded toilets, among other activities. While the feasibility of recycling discarded toilets is still being explored, DEP is confident that all other aspects of the program have been well prepared and will soon be ready for launch.

In addition to establishing the Toilet Replacement Program, DEP directed its Honeywell, its contractor, to provide complimentary household water surveys to building owners to promote water conservation at their properties. The surveys help the building owners identify opportunities

for water savings, as well as any leaks which may exist. In 2013, Honeywell conducted surveys in 13,286 individual apartments in 433 apartment buildings. It also surveyed 3,086 1-3 unit properties, and 6,761 individual units within these properties. While residential properties are the primary focus of this service, 352 small commercial properties and 11 restaurants were also surveyed in 2013.

Non-Residential Water Efficiency Program

To advance efforts under this program, DEP explored several types of potential partnerships with private sector organizations. In June 2013, DEP officially launched an initiative in partnership with the Mayor's Office, the Hotel Association of New York, and 11 NYC hotels called The Mayor's Water Challenge to Hotels. The Challenge encourages participating hotels to reduce their annual water consumption by an average of 5% from their baseline year (measured as the 12-month period prior to the beginning of the Challenge). As part of the Challenge, DEP has hosted quarterly workshops to help participating hotels learn how to make their facilities more water efficient. DEP also prepares monthly reports for participants to help them track their own consumption and their performance against the other hotels in the Challenge. The Challenge is set to conclude in May 2014.

Water Distribution System Optimization

Water Distribution System Optimization entails system repairs and upgrades, managing water pressure, and refining water meter accuracy and leak detection. In 2013, DEP surveyed 3,866 miles of water mains for leaks; as a result of leaks proactively found and repaired, DEP estimates that 0.891 million gallons of water per day were saved. In addition, DEP recently implemented a more strategic approach to leak detection. In this new approach, local, borough-based teams properly trained in leak detection efforts target specific areas known to be served with older network mains that are more likely to need both preventive and corrective maintenance. These teams are able to respond rapidly to any identified problems, as opposed to the slower response times experienced in many locations when DEP relied upon one consolidated resource center.

Leaking and/or vandalized fire hydrants can also result in significant water waste, as an illegally opened fire hydrant can release more than 1,000 gallons per minute and drop pressure. In 2013, DEP repaired 10,764 hydrants, replaced 1,549, and provided other maintenance services to 5,267 more.

DEP's efforts to achieve universal metering of all DEP water and sewer accounts is motivated both by efforts to reduce non-revenue water and to promote conservation among water users by providing them with accurate information on their consumption. DEP's universal metering initiative is also critical to measuring the success of its many other demand management strategies. Accurate consumption data provided by newly installed or replaced meters enables DEP to determine whether projected reductions in consumption among target consumer groups have been

reached, or if not, how demand management strategies may need to be adapted in order to improve their effectiveness. In 2013, DEP installed 53 new meters and replaced 9,995 others, for a grand total of 10,048 meters, over nine times last year's total.

Water Supply Shortage Management

In 2013, DEP completed a fully revised draft of the Emergency Drought Rules. The draft's proposed regulations address the wider variety of drought and water shortage conditions that New York City may face over the next several years, whether weather-related or otherwise. DEP has proposed that these regulations be referred to as the "Water Shortage Rules", replacing the narrower focus of the previous title. The draft rules are currently under review by the Mayor's Office of Operations and the City Law Department. Stakeholders have had an opportunity to review them, and DEP has begun its review of their environmental impact. DEP anticipates formal approval of the rules in 2014.

The more detailed Water Demand Management Plan can be found at http://www.nyc.gov/html/dep/pdf/conservation/water-demand-management-plan-single-page.pdf.

10.2 Updates to Drought Management Plan

In 2013, it was not necessary to invoke any of the components of the City's Drought Management Plan, since precipitation, runoff, and storage levels all remained high.

The Drought Management Plan has three phases—Drought Watch, Drought Warning, and Drought Emergency—that are invoked sequentially as conditions dictate. The Drought Emergency phase is further subdivided into four stages with increasingly severe mandated use restrictions. Guidelines have been established to identify when a Drought Watch, Warning, or Emergency should be declared and when the appropriate responses should be implemented. These guidelines are based on prevalent hydrological and meteorological conditions, certain operational considerations, and other factors. In some cases, other circumstances may influence the timing of drought declarations.

- Drought Watch. Drought Watch is declared when there is less than a 50% probability that reservoirs in either of the two largest systems, the Delaware (Cannonsville, Neversink, Pepacton, and Rondout Reservoirs) or the Catskill (Ashokan and Schoharie Reservoirs), will fill by June 1, the start of the water year.
- Drought Warning. A Drought Warning is declared when there is less than a 33% probability that reservoirs in either the Catskill or Delaware System will fill by June 1.
- Drought Emergency. A Drought Emergency is declared when there is a reasonable probability that, without the implementation of stringent measures to reduce consumption, a protracted dry period would cause the City's reservoirs to be drained. This probability is estimated during dry periods in consultation with the New York State Drought Management Task Force and the New York State Disaster Preparedness Commission. The estimation is based on analyses of the historical record, the pattern of the dry period months, water quality, subsystem storage

balances, delivery system status, system construction, maintenance operations, snow cover, precipitation patterns, use forecasts, and other factors. Because no two droughts have identical characteristics, no single probability profile can be identified in advance that would generally apply to the declaration of a drought emergency.

DEP continues to encourage consumers to conserve water and to observe the City's year-round water use restrictions, which remain in effect. These restrictions include prohibition on watering sidewalks and lawns between November 1 and March 31 and illegally opening fire hydrants.

10.3 Delaware Aqueduct Leak

DEP efforts to repair the Delaware Aqueduct continued in 2013. Major activities included:

- Tunnel dewatering preparation
- Rondout-West Branch Tunnel (RWBT) repair—site and shaft construction (BT-1) and tunnel design (BT-2)
- Hydraulic investigations of the RWBT
- Autonomous Underwater Vehicle (AUV) inspection of the RWBT
- Remote Operated Vehicle (ROV) inspection of the RWBT
- Catskill Aqueduct repair and rehabilitation

Tunnel Dewatering Preparation

The new pumping station for Shaft 6 of the RWBT was installed and successfully tested in 2013. The 80 MGD pumping station, which is capable of dewatering the RWBT under any expected conditions, is now ready to operate.

RWBT Bypass and Repair—Site and Shafts (BT-1) and Bypass Tunnel (BT-2)

The RWBT bypass project is being implemented through two contracts. The BT-1 contract is well under way, with the majority of the site preparation work completed in 2013. Work on the sinking of the shafts started in November 2013, with approximately 50 feet of depth accomplished at the Shaft 5B site (Figure 10.2). The contract completion date is November 13, 2016.

Figure 10.2. Aerial view of the Shaft 5B site.

The bypass tunnel contract, BT-2, is scheduled to start in April 2015. Work performed under this contract will connect the shafts, and upon completion of this effort, the tie-in to the existing RWBT will commence. During the execution of the tie-in, the leaks in the Wawarsing area of the tunnel will be grouted from within the dewatered tunnel. The bypass project is expected to be completed in 2022.

Hydraulic Investigations of the RWBT

Investigations of the RWBT helped DEP assess the nature and degree of leakage stemming from the aqueduct. Various efforts in 2013 to study the nature of the leak are described below.

- The Tunnel Monitoring Program continued. The object of this program is to determine if tunnel conditions are changing. On a routine basis, DEP monitors tunnel flow rates, operational trends, and surface expressions to determine the quantity of the leak. The monitoring efforts detected no substantial change in the structural condition of the tunnel in 2013.
- Surface investigations continued in areas of Roseton and Wawarsing, where water is suspected to be leaking from the tunnel.
- An RFP was developed for a new contract (DEL-LTA) to ensure that investigations of the tunnel continue uninterruptedly and to support AUV and ROV operations (see below). The contract is expected to be registered in summer 2014.

Autonomous Underwater Vehicle Inspection of the RWBT

Periodically, under the AUV program, an independent robotic vehicle completely photographs the interior surface of the RWBT in one inspection lasting 12 hours. The 2009 inspection (the first since 2003) indicated that no significant changes in crack patterns had occurred between 2003 and 2009. The 2013 AUV run was postponed until October 2014 as a result of contractor scheduling and water supply needs.

Remote Operated Vehicle Inspection of the RWBT

DEP is moving forward with the ROV program and expects to perform a detailed inspection of the Wawarsing and Roseton areas in 2014. Unlike the AUV, the ROV will make it possible to capture real-time tunnel data, and will give DEP the ability to perform detailed, close-up investigations beyond the reach of the AUV. The ROV is, however, limited to suspect areas in the tunnel.

During 2013, an investigation of the Shaft 5A access point to the Roseton area was conducted to determine if it was suitable for a highly customized ROV to be launched there. The investigation determined that the vehicle would in fact be able to access the tunnel by navigating a 12-inch-wide annular space through a riser valve. For the Wawarsing area, a new ROV was under development for inspections in that location.

Catskill Aqueduct Repair and Rehabilitation

The Catskill repair and rehabilitation project is focused on the north section of the Catskill Aqueduct, which runs between Ashokan Reservoir and Kensico Reservoir (Figure 10.3). The goal of the project is to inspect the tunnel, repair any deficiencies (including tunnel and mechanical valves), and remove a biofilm layer that has accumulated on the tunnel walls. Removal of the biofilm will allow visual inspection of the tunnel walls and also improve the hydraulic characteristics

of the tunnel, which in turn will restore tunnel capacity. The notice to proceed on the design contract was issued in June 2013. The design effort in 2013 focused predominantly on field investigations. Construction is expected to commence in early 2017.

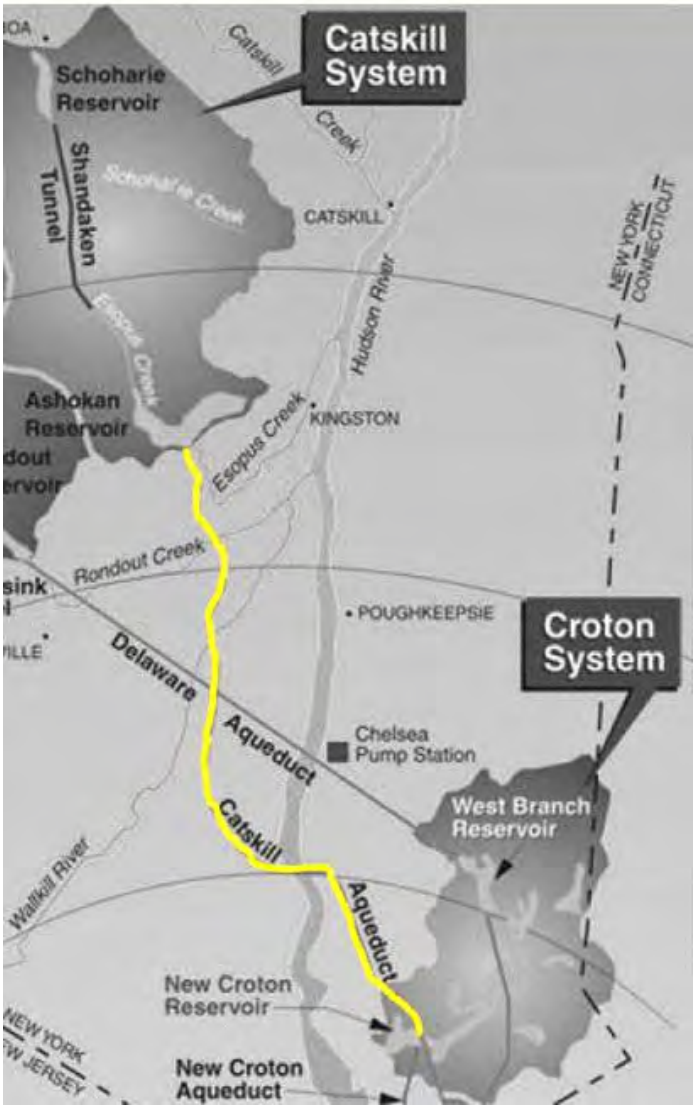

Figure 10.3. North section of the Catskill Aqueduct.

References

DEP. 2009. 2009 Watershed Water Quality Monitoring Plan. Bureau of Water Supply. Directorate of Water Quality (issued October 2008, revised May 2009). Valhalla, NY. 226 p. http://www.nyc.gov/html/dep/pdf/reports/2009-watershed-water-quality-monitoring-plan.pdf (accessed 3/26/14).

DEP. 2010. DEP Fee-Land Monitoring Policy. Bureau of Water Supply. Division of Watershed Lands and Community Planning. Kingston, NY. 11 p.

DEP. 2011a. 2011 Watershed Protection Program Summary and Assessment. Bureau of Water Supply. Valhalla, NY. 416 p. http://www.nyc.gov/html/dep/pdf/reports/fad51_wmp_2011_fad_assessment_report_03-11.pdf (accessed 3/26/14).

DEP. 2011b. 2011 Long-Term Watershed Protection Program Plan. Bureau of Water Supply. Valhalla, NY. 104 p. http://www.nyc.gov/html/dep/pdf/reports/2011_long_term_plan.pdf (accessed 3/26/14).

DEP. 2011c. DEP Strategy 2011-2014. Flushing, NY. 78 p. http://www.nyc.gov/html/dep/pdf/strategic_plan/dep_strategy_2011.pdf (accessed 3/26/14).

DEP. 2011d. New York City Watershed Forest Management Plan. 283 p. http://www.nyc.gov/html/dep/pdf/watershed_protection/dep_forest_management_plan_2011.pdf (accessed 3/26/14).

DEP. 2013a. 2012 Watershed Water Quality Annual Report. Bureau of Water Supply. Directorate of Water Quality. Valhalla, NY. 156 p. http://www.nyc.gov/html/dep/pdf/reports/5.1_watershed-monitoring-program-watershed-water-quality_annual-report_07-13.pdf (accessed 3/26/14).

DEP. 2013b. DEP Pathogen Mid-Term Surveillance Report on *Giardia* spp., *Cryptosporidium* spp., and Human Enteric Viruses. Valhalla, NY. 20 p. http://www.nyc.gov/html/dep/pdf/reports/fad_5.1_watershed_monitoring_program_-_mid-term_annual_report_01-13.pdf (accessed 3/26/14).

DEP. 2013c. 2012 Kensico Water Quality Annual Report. Bureau of Water Supply. Directorate of Water Quality. Valhalla, NY. 77 p. http://www.nyc.gov/html/dep/pdf/reports/4.10_kensico-water-quality-control-program_annual-report_03-13.pdf (accessed 3/26/14).

DEP. 2013d. New York City 2012 Drinking Water Supply and Quality Report. Directorate of Water Quality. Flushing, NY. 16 p. http://www.nyc.gov/html/dep/pdf/wsstate12.pdf

DEP. 2013e. Filtration Avoidance Annual Report for the period January 1 through December 31, 2012. Bureau of Water Supply. Valhalla, NY. 148 p. http://www.nyc.gov/html/dep/pdf/reports/11_reporting_fad-annual-report_03-13.pdf (accessed 3/26/14).

New York City Watershed Memorandum of Agreement. 1997. Environmental Facilities Corporation. http://www.nysefc.org/Default.aspx?TabID=76&fid=389 (accessed 3/26/14).

New York City Watershed Rules and Regulations. 1997, amended April 4, 2010. Rules and Regulations for the Protection from Contamination, Degradation and Pollution of the New York City Water Supply and its Sources. RCNY Title 15, chapter 18. http://www.nyc.gov/html/dep/pdf/recrules/regulations.pdf (accessed 3/26/14).

Upstate Freshwater Institute. 2014. Final Report: Short-Term Variations in Temperature and Turbidity at Shandaken Tunnel Intake: Internal Wave Activity in Schoharie Reservoir. Syracuse, NY. 40 p.

USEPA [U.S. Environmental Protection Agency]. 1989. Drinking Water: National Primary Drinking Water Regulations; Filtration, Disinfection; Turbidity, Giardia lamblia, Viruses, Legionella, and Heterotrophic Bacteria; Final Rule. 54 Fed. Reg. 27486. June 29, 1989. WH-FRL-3607-7.Washington, D.C.

USEPA [U.S. Environmental Protection Agency]. 2005. USEPA Method 1623: *Cryptosporidium* and *Giardia* in Water by filtration/IMS/FA. EPA/821-R-01-025.

USEPA [U.S. Environmental Protection Agency]. 2007. New York City Filgration Avoidance Determination. http://www.epa.gov/region2/water/nycshed/2007finalfad.pdf (accessed 3/26/14).