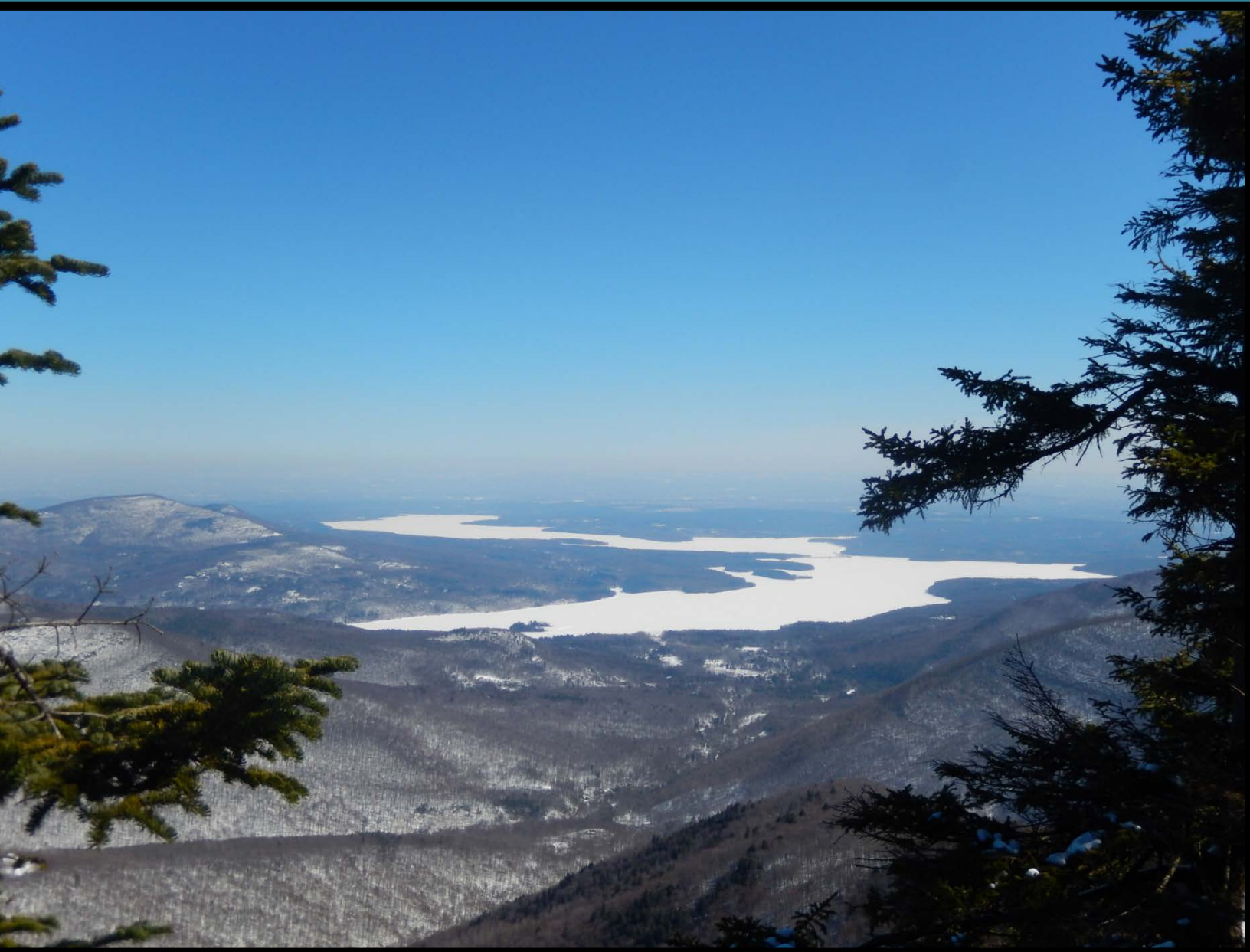


# **New York City Department of Environmental Protection**

## **Filtration Avoidance Annual Report**

for the period January 1 through December 31, 2014



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**Paul V. Rush, P.E., Deputy Commissioner**  
**Bureau of Water Supply**

Cover photo by Kevin Cwalina, NYCDEP  
(Ashokan Reservoir as seen from Balsam Cap)

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## **List of Acronyms**

AIS	aquatic invasive species
APHIS	Animal and Plant Health Inspection Service
ATU	advanced treatment unit
AUV	autonomous underwater vehicle
AWSMP	Ashokan Watershed Stream Management Program
BMP	best management practice
BODR	Basis of Design Report
C&D	construction and demolition
CAD	Computer Aided Design
CAT/DEL	Catskill/Delaware
CATUEC	Catskill Upper Effluent Chamber
CC	compliance conference
CCD	Croton Consent Decree
CCE	Cornell Cooperative Extension
CCEUC	Cornell Cooperative Extension of Ulster County
CDUV	Catskill/Delaware Ultraviolet Disinfection Facility
CE	conservation easement
CP	Forest Management Plan Conservation Practices
CREP	Conservation Reserve Enhancement Program
CRISP	Catskill Regional Invasive Species Partnership
CRP	Conservation Reserve Program
CSBI	Catskill Streams Buffer Initiative
CT	contact time
CUNY	City University of New York
CWC	Catskill Watershed Corporation
CWMP	Community Wastewater Management Program
DCPD	Delaware County Planning Department
DCSWCD	Delaware County Soil and Water Conservation District
DEIS	Draft Environmental Impact Statement
DEM	Digital Elevation Model
DEP	New York City Department of Environmental Protection
DFIRM	digital flood insurance rate map
DMAP	Deer Management Assistance Permit
DOE	New York City Department of Education
DOHMH	New York City Department of Health and Mental Hygiene
DPR	New York City Department of Parks and Recreation
DSEIS	Draft Supplemental Environmental Impact Statement
EAB	emerald ash borer
EAF	Environmental Assessment Form
ECLRS	Electronic Clinical Laboratory Reporting System

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EFC	New York State Environmental Facilities Corporation
EIS	environmental impact statement
ELAP	Environmental Laboratory Approval Program
ELTP	Enhanced Land Trust Program
EOH	East of Hudson
EOHWC	East of Hudson Watershed Corporation
EWP	Emergency Watershed Protection
FAD	Filtration Avoidance Determination
FDNY	New York City Fire Department
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FITT	Forestry Interdisciplinary Technical Team
FMP	New York City Forest Management Plan
GCSWCD	Greene County Soil and Water Conservation District
GI	gastrointestinal illness
GIS	Geographic Information System
GPS	Global Positioning System
HAA5	haloacetic acid five
HEC-RAS	Hydrologic Engineering Centers River Analysis System
HEFS	Hydrologic Ensemble Forecast Service
HEV	human enteric virus
HMGP	Hazard Mitigation Grant Program
IAR	inactivation ratio
IRSP	individual residential stormwater plan
ISAC	Invasive Species Advisory Committee
ISC	New York State Invasive Species Council
ISWG	Invasive Species Working Group
JV	Joint Venture
LAP	Land Acquisition Program
LFA	Local Flood Analysis
LFHMIP	Local Flood Hazard Mitigation Implementation Program
LiDAR	Light Detection and Ranging
LIMS	Laboratory Information Management System
MAP	Management Assistance Program
MFO	Master Forest Owner
MGD	million gallons per day
MMI	Milone & MacBroom, Inc.
MOA	New York City Memorandum of Agreement
MRO	Modification of Reservoir Operations
MST	Microbial Source Tracking
NHD	National Hydrography Dataset
NMP	nutrient management plan

NOV	Notice of Violation
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity unit
NWI	National Wetlands Inventory
NYC	New York City
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OIT	Office of Information Technology
OST	Operations Support Tool
PAA	Public Access Area
PCR	polymerase chain reaction
PRISM	Partnership for Regional Invasive Species Management
RBAP	Riparian Buffer Acquisition Program
RCMP	Riparian Corridor Management Plan
REP	Regulatory and Engineering Programs
RFP	Request for Proposals
RNSP	Rondout/Neversink Stream Program
ROV	remote operated vehicle
RWBT	Rondout-West Branch Tunnel
SAFARI	Shandaken Area Flood Assessment and Remediation Initiative
SBR	sequential batch reactor
SCSWCD	Sullivan County Soil and Water Conservation District
SDE	Spatial Database Engine
SDEIS	Supplemental Draft Environmental Impact Statement
SEIS	Supplemental Environmental Impact Statement
SEQRA	State Environmental Quality Review Act
SMIP	Stream Management Implementation Program
SMP	Stream Management Program
SPDES	State Pollutant Discharge Elimination System
SSMP	Septic System Management Program
SSTS	subsurface sewage treatment system
SUNY	State University of New York
SWAC	Schoharie Watershed Advisory Committee
SWCD	Soil and Water Conservation District
SWPPP	stormwater pollution prevention plan
SWTR	Surface Water Treatment Rule
TCR	Total Coliform Rule
TFS	Team Foundation Server
TKN	total kjeldahl nitrogen
TSI	timber stand improvement

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TTHM	trihalomethane
UCSWCD	Ulster County Soil and Water Conservation District
UFI	Upstate Freshwater Institute
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey
WAC	Watershed Agricultural Council
WaLIS	Watershed Lands Information System
WAP	Watershed Agricultural Program
WCDEF	Westchester County Department of Environmental Facilities
WDRAP	Waterborne Disease Risk Assessment Program
WECC	Watershed Enforcement Coordination Committee
WFP	whole farm plan
WOH	West of Hudson
WR&R	New York City Watershed Rules and Regulations
WSP	Water Supply Permit
WSPS	Water and Sewer Permitting System
WWQMP	Watershed Water Quality Monitoring Plan
WWTP	wastewater treatment plant
WWTPCI	Wastewater Treatment Plant Compliance and Inspection

# **1. Introduction**

In 2014, New York City continued to implement a broad array of initiatives as part of the City's source water protection program. More than two decades ago, the City initiated an ambitious plan to continue to provide affordable, high quality water by protecting it at its source. Since then, DEP has committed more than \$1.7 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. DEP's programs have become a national and international model. Each year, water and public health professionals come from around the world 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 address current potential pollution sources and prevents the creation of new 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.

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 source water protection program activities over the previous five years 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. Annual watershed water quality reports compiled by DEP continue to confirm this. The Plan laid out DEP's proposed source water protection activities for 2012 through 2017, the second five years of the 2007 Filtration Avoidance Determination (FAD) (USEPA 2007). In May 2014, NYSDOH issued the Revised 2007 FAD (NYSDOH 2014), which builds on the Plan and the existing programs.

DEP 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 2014, DEP sought ways to improve efficiency while continuing steady implementation of critical watershed protection projects. While New York City dedicates 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, 2014, through December 31, 2014, and is compiled to satisfy the requirements of the Revised 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 (Figure 1.1 and Figure 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.



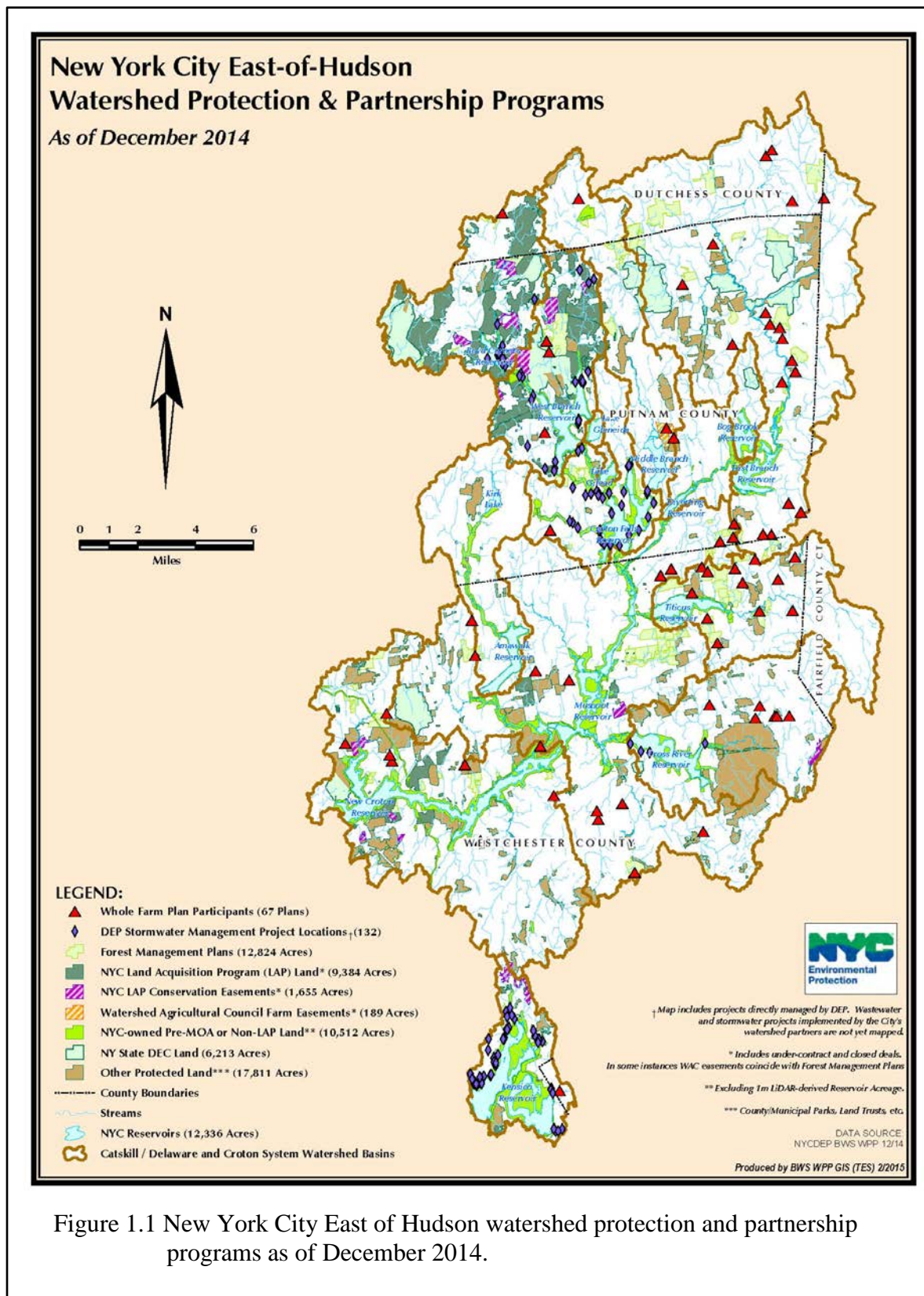


Figure 1.1 New York City East of Hudson watershed protection and partnership programs as of December 2014.

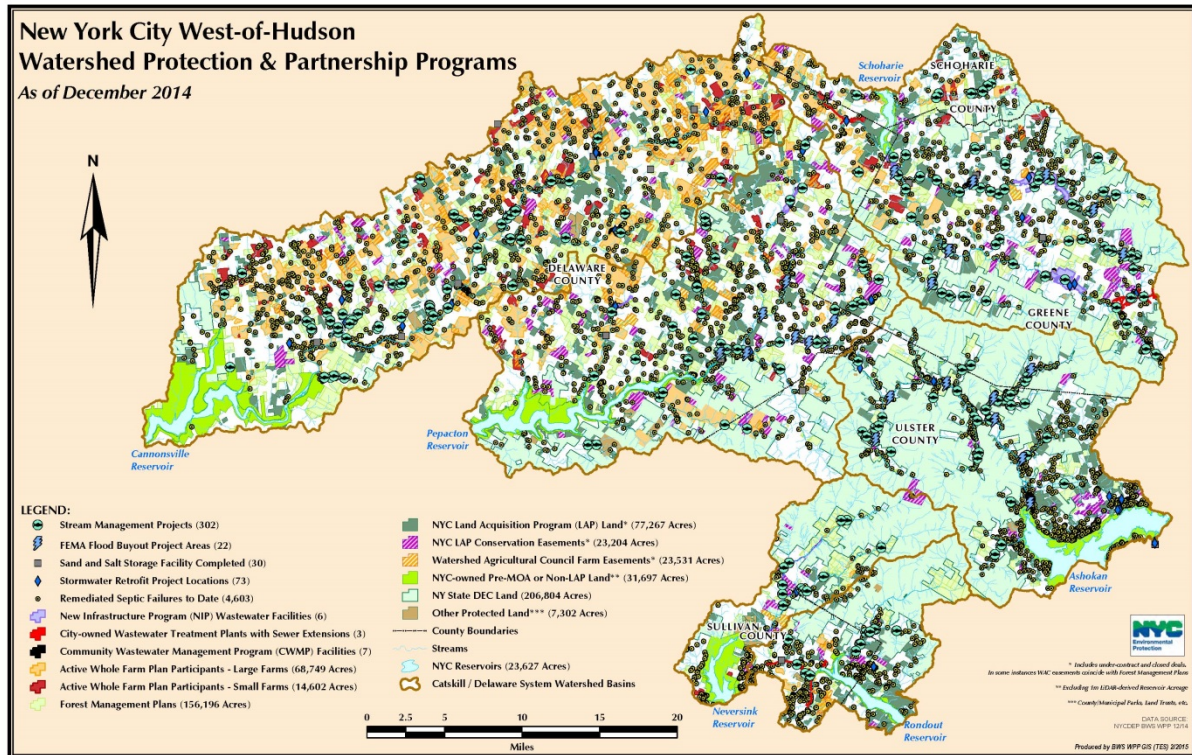


Figure 1.2 New York City West of Hudson watershed protection and partnership programs as of December 2014.

## 2. Federal and State Objective Water Quality Compliance

During 2014, 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 2014, DEP collected 44,400 samples and conducted 537,000 analyses. Of these, 30,000 samples were collected and 347,000 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 0.4% of the 9,818 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 209,840 TCR compliance samples, and only 14 of them have tested positive for *E. coli*.

By 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 2014, 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 2014, 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<sup>-1</sup> 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 2014 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.

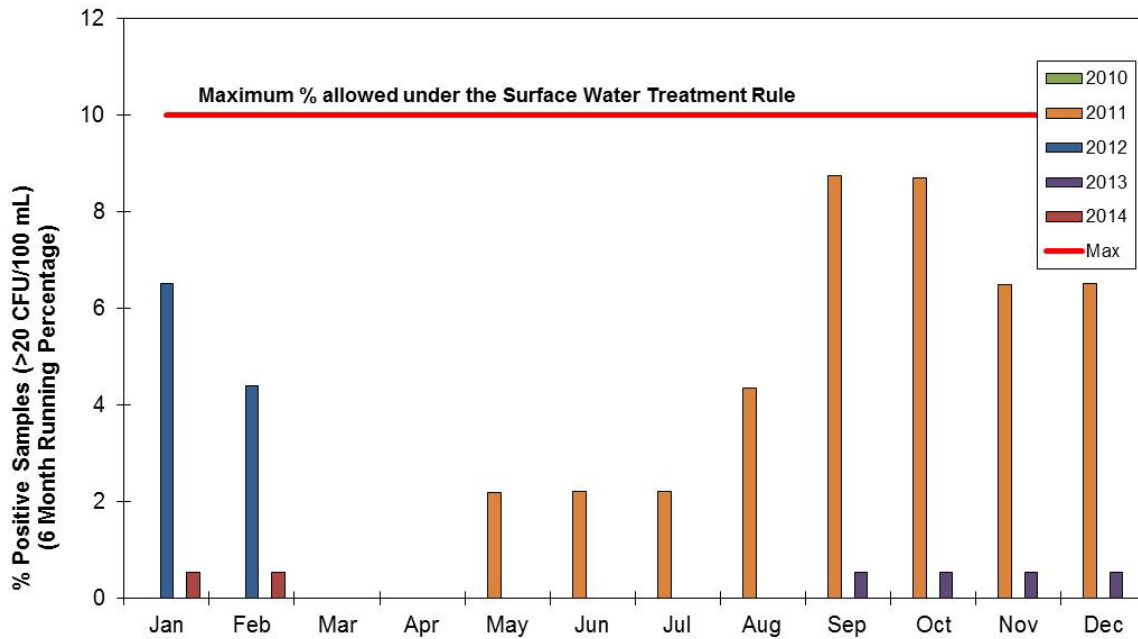
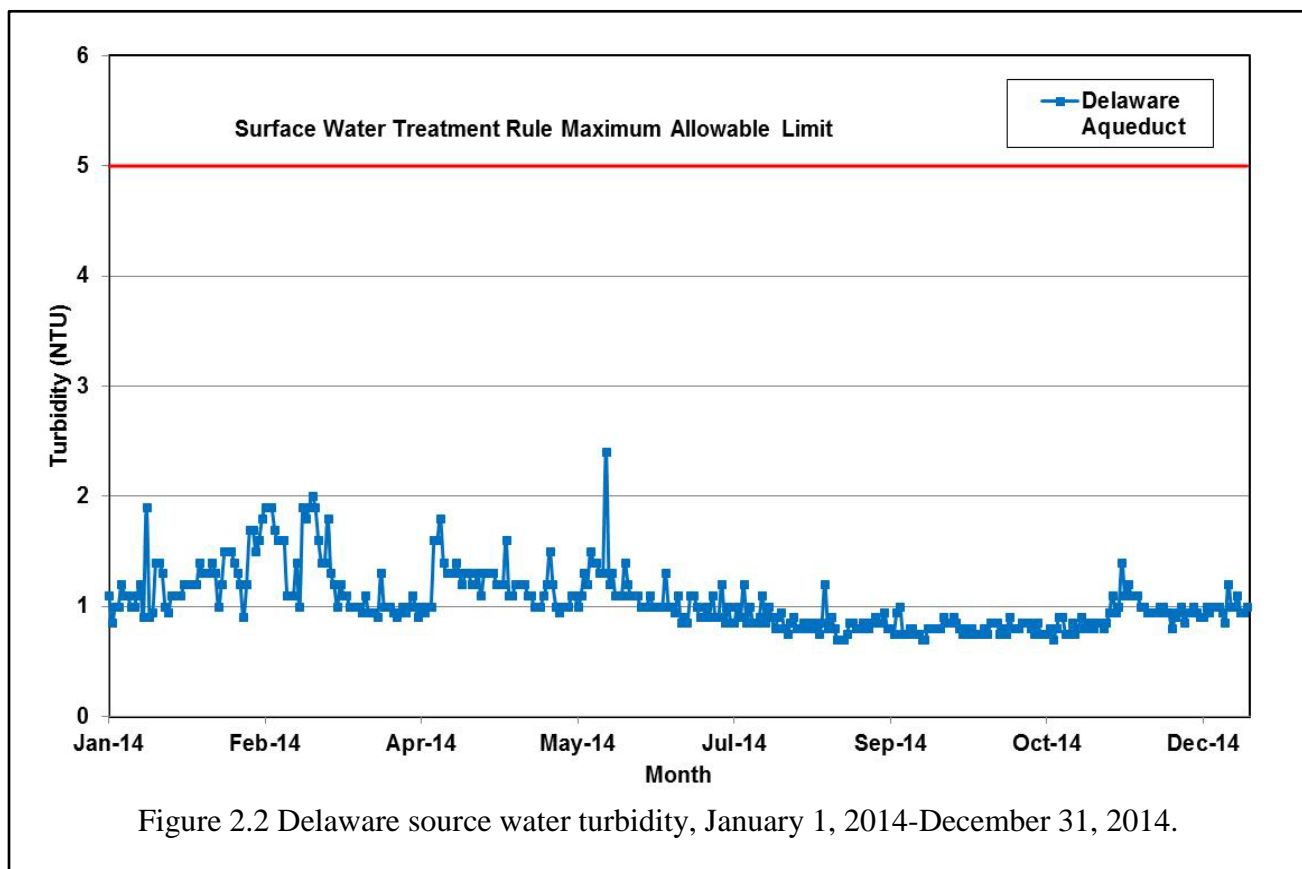


Figure 2.1 Positive fecal coliform samples, Kensico-Delaware System, 2010-2014.

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

No Catskill Aqueduct effluent turbidity samples were collected in 2014 because the Catskill Aqueduct from Kensico Reservoir to Eastview is 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 2014 calendar year (Figure 2.2).





### 2.1.3 Raw Water Disinfection/CT Values (40 CFR Sections 141.71(b)(1)(i) and 141.72(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 Disinfection Facility (CDUV), so the net IAR was measured using the IAR from the first segment of the Delaware Aqueduct from Kensico to Shaft 19 at the CDUV, and adding the IAR from the CDUV to Hillview (second segment). The actual lowest net IAR in 2014 was 1.1 for the Catskill Aqueduct and 1.0 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. Results show that chlorine residuals were maintained at concentrations at or above  $0.20 \text{ mg L}^{-1}$  at all distribution entry points during the year. The lowest chlorine residual measured at an entry point was  $0.47 \text{ mg L}^{-1}$ .

**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 15,023 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))**

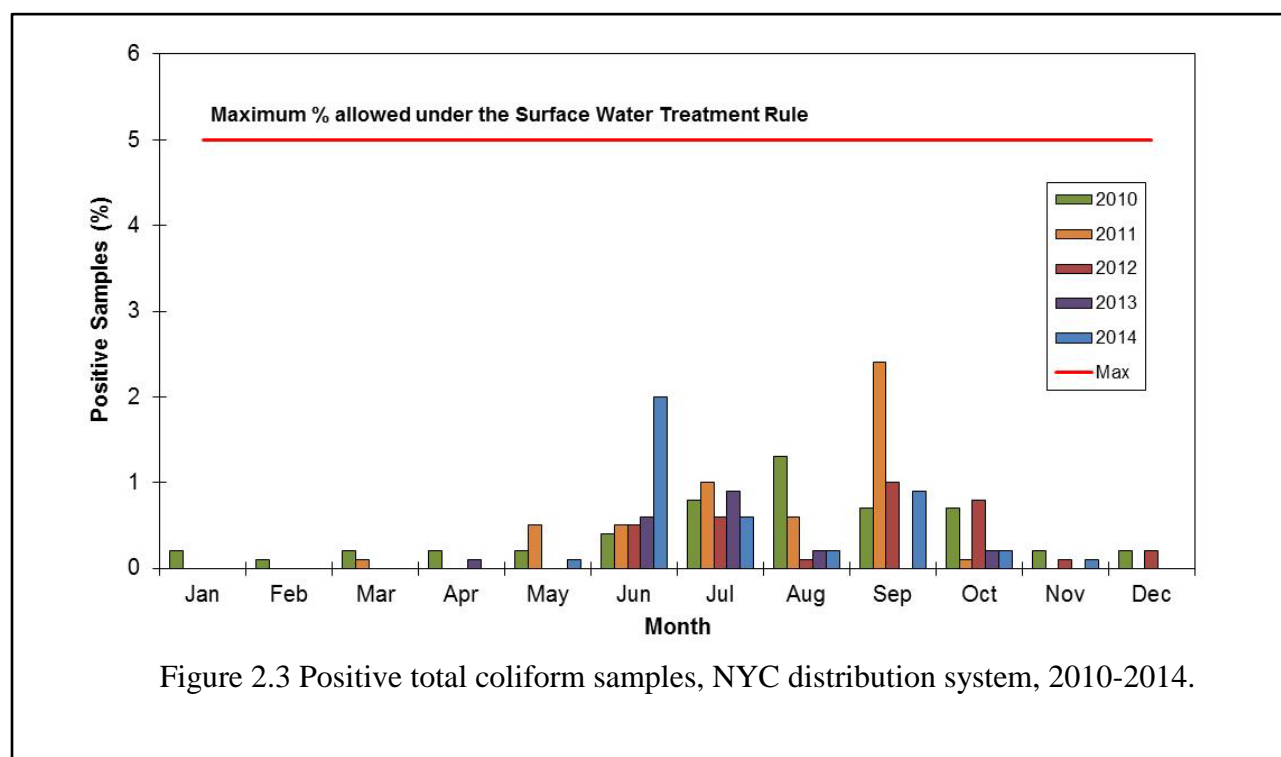
The analysis for trihalomethanes, performed on a quarterly basis, resulted in a maximum total trihalomethane (TTHM) value of  $52 \mu\text{g L}^{-1}$ . The analysis for haloacetic acids, also performed on a quarterly basis, resulted in a maximum haloacetic acid five (HAA5) value of  $59 \mu\text{g L}^{-1}$ .

The highest TTHM quarterly running annual average during the year, recorded during the first and second quarters, was  $40 \mu\text{g L}^{-1}$ , a level below the regulated level of  $80 \mu\text{g L}^{-1}$ . The highest HAA5 quarterly running annual average, recorded during the third quarter, was  $38 \mu\text{g L}^{-1}$ , a level below the regulated level of  $60 \mu\text{g L}^{-1}$ .

## 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 9,818, of which 35 were total coliform positive. All resamples were coliform negative with two exceptions. The first occurred in June, when a distribution sample tested positive for total coliforms, and repeat sampling also tested positive at the regular, upstream, downstream, and random hydrant locations. A second round of repeat sampling was negative for coliforms at all locations. The second occurred in July, when a distribution sample tested positive for total coliforms, and repeat sampling also tested positive at the upstream sampling location. A second 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 0.4% and the highest monthly average was 2.0%.

### 2.2.2 Chlorine Residual Maintenance in the Distribution System

During the year, DEP continued a number of programs to ensure adequate levels of chlorine throughout the distribution system. These 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, detectable chlorine residuals were maintained throughout the distribution system in 2014.



## **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 300 feet of a watercourse. In November 2014, the CWC board approved expanding the Priority Area Program to include septic systems between 300 feet and 700 feet of a watercourse. In 2014, the program funded the repair or replacement of 225 failing or likely-to-fail septic systems through this program.

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 2014, the Hardship Program funded the repair or replacement of two failing septic systems.

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 31, 2014, are eligible for reimbursement. In 2014, the Reimbursement Program funded the repair or replacement of nine failing septic systems.

In 2014, the Septic System Rehabilitation and Replacement Program funded the repair or replacement of 236 septic systems in the WOH watershed under the various sub-programs discussed above. Since the program's inception, over 4,600 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, DEP provides funding to the CWC in order to pay 50% of eligible costs for pump-outs and maintenance. In 2014, the program subsidized 209 septic tank pump-outs, bringing to 1,227 the number of septic tank pump-outs subsidized since the program's inception.

### **3.1.3 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. Through the CWC, 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 700 feet or less from a watercourse (expanded from 300 feet or less in November 2014), 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 program. The 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 2014, two small businesses received reimbursement for the repair or replacement of a failing septic system under this program. Fourteen failing septic systems have been replaced under the program since the program's inception.

## **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.

CWMP projects have been completed in Bovina, DeLancey, Bloomville, Hamden, Boiceville, Ashland, and Trout Creek.

The Trout Creek CWMP project consists of a septic tank effluent wastewater collection system that discharges to three areas of shallow cut-and-fill absorption bed system with pressure dosing. The community absorption beds were installed in 2013. Installation of new septic tanks and laterals connecting the individual properties to the collection system were completed in 2014 (Figure 3.1).



Figure 3.1 Installation of a grease trap as part of the Trout Creek CWMP project.

Design of the Lexington CWMP project continued in 2014, culminating with final design approval being issued by DEP on November 14, 2014. The project was advertised for bid in September and the construction contract for the community septic system was awarded by the Town of Lexington to F.P. Kane Construction on October 7, 2014. Construction of the absorption field beds commenced in December 2014.

For South Kortright, the process of moving the project forward from the approval of the South Kortright CWMP Preliminary Engineers Report to final design approval took longer than expected because of the time it took to negotiate the various agreements between the Town of South Kortright, the Village of Hobart (Hobart WWTP), and the New York State Office of Child and Family Services (Allen Residential Center). Additionally, issues with the design of the upgrades at the Hobart WWTP required the engineer to reevaluate the Hobart Wastewater Treatment Plant Capacity Evaluation (May 2012) and the overall approach to the WWTP

upgrade. NYSDEC issued a draft State Pollutant Discharge Elimination System (SPDES) permit for increasing the permitted flow at the Hobart WWTP to include the South Kortright flow on November 19, 2014. The Draft SPDES permit needed to be issued before DEP could approve project designs.

DEP issued final design approval for the South Kortright collection system and the planned improvements to the Village of Hobart WWTP on December 2, 2014. Advertisement for construction bids occurred in August 2014 and bids were opened in September. Due to higher than anticipated initial bids, the Town rebid some of the contracts. The second bid opening occurred on November 13, 2014 and construction contracts were awarded in December.

### 3.3 Sewer Extension Program

DEP continued to implement the Sewer Extension Program during 2014. Highlights of program activities in communities with projects still under way in 2014 are described below.

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

The construction phase of the sewer extension, located just south of the former Village of Pine Hill along NYS Route 28, commenced during the past year. DEP awarded the construction contract to Hubbell Inc. in February 2014 and issued the order to commence work in May 2014.

Construction of the extension commenced in September 2014. As of December, approximately one-third of the sewer extension, including the partial construction of new sewer mains, laterals, manholes, and a pump station, had been completed.

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

During the reporting period, DEP made significant progress on the construction of the sewer extension along Showers Road in Tannersville. DEP awarded the construction contract to Evergreen Mountain Contracting in January 2014 and issued the order to commence work in March 2014.

Construction of the extension began in the spring of 2014 and continued throughout the construction season. As of December, DEP had constructed the sewer mains, laterals, and manholes (Figure 3.2).

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

The sewer extension project is comprised of extensions along Academy Street in the Village of Margaretville, Bull Run Road in the Town of Middletown, and along Harold Finch Road in the Town of Middletown. In 2014, DEP transitioned the project from the planning and design phase to the construction phase. Construction bids were advertised in June 2014. DEP awarded the bid to Hubbell Inc. in August 2014 and issued the order to commence work in December.





Figure 3.2 Installation of Showers Road sewer extension in Tannersville.

## 3.4 Stormwater Programs

### 3.4.1 Stormwater Cost-Sharing Programs

Costs of stormwater measures incurred as a result of complying with the New York City Watershed Rules and Regulations (WR&R) (2010) 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.

The Program consists of two separate programs—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 the Future Stormwater Controls paid for by the City Program (low-income housing projects and single-family home owners), or 50% from each program (small businesses).

The City has provided \$31.7 million to the CWC to administer the West of Hudson Future Stormwater Controls Program. From this allotment, the CWC has reimbursed \$5,491,716 in eligible activity and transferred \$17,676,724 to other eligible watershed protection programs. The fund balance was \$14,822,076 at the end of November 2014, including interest. Table 3.1 provides details for projects approved for funding under the two future stormwater controls programs.

Table 3.1. 2014 Future Stormwater Controls Program projects.

Applicant	Project	Approval Date	CWC Funding	Percent Funding CWC/DEP
Windham Car Wash, LLC	Additional funding for new stormwater measures	1/7/14	\$2,256.23	50%/50%
Harold & Sharon Cole	Additional funding for design	2/4/14	\$7,200.00	100% CWC
Cannie D's Corner	Maintenance of stormwater controls	4/1/14	\$60,000.00	50%/50%
3115 Route 28, LLC	Design of new stormwater measures related to new parking lot; building extension	9/2/14	\$6,250.00	50%/50%
Town of Denning	Design of new stormwater controls related to paving of Town Hall parking lot	9/2/14	\$3,500.00	100% CWC
Village of Delhi River Walk	Design of new stormwater measures related to new river walk	9/2/14	\$26,190.00	100% CWC
Darlene Colandra	Design of new stormwater measures related to new storage units	10/7/14	\$5,975.00	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 component, 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 Stormwater Retrofit Program Phase II contract was executed in January 2014. DEP and the CWC worked on revisions to the Stormwater Retrofit Program rules related to the new contract in 2014.

From 1999 through 2014, 75 stormwater retrofit projects were completed under the program. Of these, 61 were construction projects and 14 were planning and assessment projects. In 2014, 3 construction projects were completed. Presently, there are 6 open construction projects and 1 open planning and assessment project. Projects of both types—construction (Table 3.2 and Table 3.3) and planning and assessment (Table 3.4)—are presented below.

Table 3.2. Stormwater retrofit construction projects completed in 2014.

Applicant	Project description	Project cost	Closing date
Town of Roxbury	Lake Street—installation of collection, conveyance, and treatment structures	\$1,352,965.92	11/17/14
Town of Ashland	Hamlet of Ashland stormwater improvements	\$365,965.57	12/2/14
Town of Tompkins	Hamlet of Trout Creek stormwater improvements	\$136,672.77	12/16/14

Table 3.3. Stormwater retrofit construction projects open in 2014.

Applicant	Project Area	Project description	Status
Margaretville Central School	School bus garage, parking lot, adjacent streets	Redesign of stormwater collection, conveyance, and treatment structures	In design
Village of Tannersville	Hunter Foundation	Design and installation of stormwater collection, conveyance, and treatment structures	90% complete
Village of Delhi	Village of Delhi	Implementation of stormwater mitigation practices to reduce inflow and infiltration into the Delhi sanitary sewer collection system	Open
Town of Shandaken	Town Highway Garage	Design of stormwater collection, conveyance, and treatment structures	In design
Town of Shandaken	Hamlet of Pine Hill	Design of Pine Hill stormwater collection, conveyance, and treatment structures	In design
Town of Lexington	Hamlet of Lexington	Design and installation of stormwater collection, conveyance, and treatment structures	Open

Table 3.4. Planning and assessment projects open in 2014.

Applicant	Grant amount	Funding round
Town of Andes	\$35,275.00	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, 2015 ([http://www.nyc.gov/html/dep/html/watershed\\_protection/fad.shtml](http://www.nyc.gov/html/dep/html/watershed_protection/fad.shtml)).

### **4.2 Land Acquisition**

Between the 1860s, when 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, 2014, following 18 years of Land Acquisition Program (LAP) activity, an additional 133,390 acres in the Cat/Del watershed had been secured, including land and conservation easements (CEs) acquired by the City and farm CEs acquired by the Watershed Agricultural Council (WAC). (This figure includes acquired land as defined in tax parcel maps; Tables Table 4.7 and Table 4.9 are based on GIS-calculated acreage and are somewhat different.) This represents an addition of almost four times the amount of land that had been acquired for purposes of reservoir construction, in about one-eighth the time, all based on voluntary transactions.

In many basins, City land holdings have increased dramatically compared with pre-1997 ownership patterns (Figure 4.1). In Rondout, which is comprised entirely of 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 175,000 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 16.2% is City-controlled, a major component of the 37.5% 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 2014.

#### **4.2.1 Solicitation/Resolicitation**

Section 4.2 of the Revised 2007 FAD (NYSDOH 2014) requires the City to solicit 300,000 acres over the six-year period covering 2012-2017. During 2014, 38,785 acres were solicited by DEP (the WAC acreage was not available at the time of writing); adding acreage solicited from 2012 to 2013, the total acreage solicited against the 300,000-acre goal now stands at 151,456. Total acreage solicited by DEP since the signing of the New York City Memorandum of Agreement (MOA) in 1997 is over 475,000.

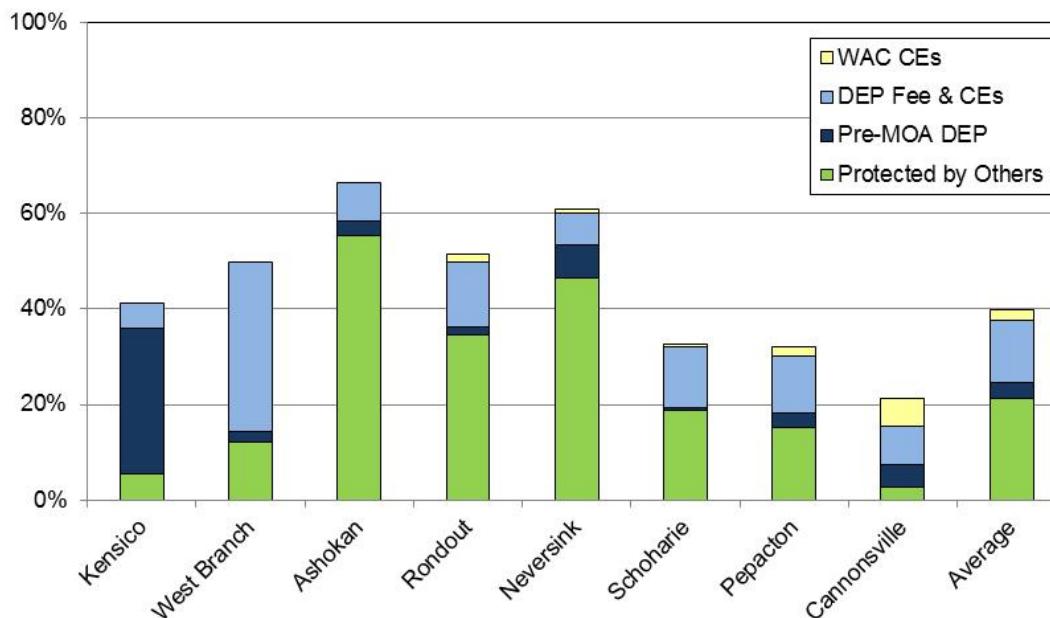


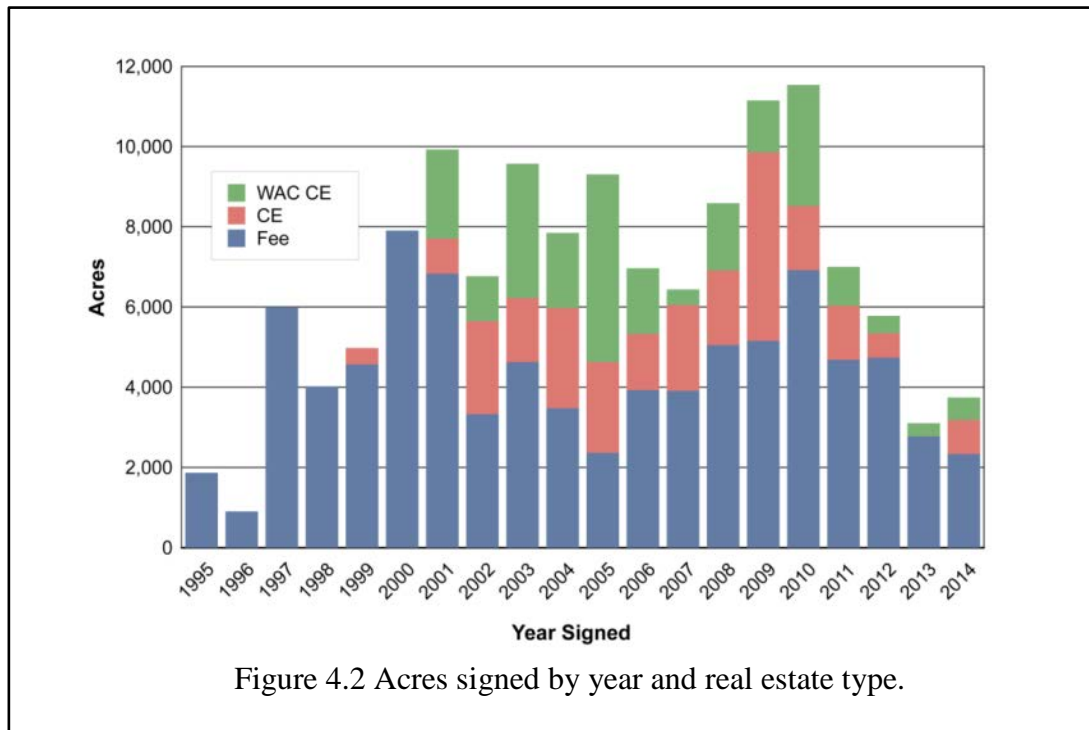
Figure 4.1 Percent of land protected in each Catskill/Delaware basin, by real estate type.

## 4.2.2 Purchase Contracts in the Catskill/Delaware System

### DEP

From 1997 to the end of calendar year 2014, DEP executed 1,432 purchase contracts comprising 109,859 acres (excluding WAC farm CEs) throughout the Cat/Del watershed, at a cost of \$399.3 million (with additional “soft costs” for related site services of about \$30 million). Of these, 1,353 contracts totaling 104,194 acres have been acquired (closed), with the remaining acres under purchase contract. During 2014, DEP closed 49 contracts comprising 3,783 acres and signed 53 purchase contracts accounting for 3,187 acres (Figure 4.1 and Figure 4.2).

For conservation easements alone, 24,471 acres, representing 164 CEs, are now closed or under contract in the Cat/Del watershed. This is equal to 22% of the acres protected by DEP (excluding WAC farm CEs). During 2014, DEP signed to purchase contract five CEs totaling 851 acres, while two CEs totaling 200 acres were closed (Figure 4.1 and Figure 4.2).



#### WAC

During 2014, WAC executed four purchase contracts for 555 acres. No CEs were closed by WAC in 2014, so the number of CEs and acres it acquired remains at 123 CEs and 22,651 acres (although some CEs have been further subdivided since the original closings, raising the current number of CEs but not the acreage).



Figure 4.3 A purchase contract was executed in 2014 to convey a conservation easement to the City on this 120-acre property in Conesville, NY, which has views of the Schoharie Reservoir less than half a mile to the west.



Figure 4.4 A purchase contract was executed in 2014 to purchase this 135-acre property in fee simple, including distant views and a 1,500-foot reach of the Little Delaware River in Bovina, NY.

#### 4. Protection and Remediation Programs

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 (acres)	Purchase price (in millions)
Reporting Period: 1995 to 2013				
Fee	1,220	83,052	68	\$322.1
CE	159	23,620	149	\$67.7
WAC CE	125	22,975	184	\$32.5
Reporting Period: 2014				
Fee	48	2,336	49	\$8.2
CE	5	851	170	\$1.2
WAC CE	4	555	139	\$1.0
Program-to-date Subtotals				
Fee	1,268	85,388	67	\$330.3
CE	164	24,471	149	\$69.0
WAC CE	129	23,531	182	\$33.5
Grand Total	1,561	133,390	85	\$432.9

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 (acres)	Purchase price (in millions)
Reporting Period: 1995 to 2013				
Fee	1,148	77,140	67	\$300.3
CE	156	23,270	149	\$58.0
WAC CE	123	22,651	184	\$31.9
Reporting Period: 2014				
Fee	47	3,583	76	\$13.6
CE	2	200	100	\$9.6
WAC CE	0	0	0	\$0
Program-to-date Subtotals				
Fee	1,195	80,723	68	\$313.9
CE	158	23,470	149	\$67.6
WAC CE	123	22,651	184	\$31.9
Grand Total	1,476	126,845	86	\$413.4

#### ***Riparian Buffers***

See Section 4.2.4 for information on the pending Pilot Riparian Buffer Acquisition Program, and Section 4.7.1 for information on riparian buffers protected through LAP.

#### ***Wetlands***

See Section 4.8.2 for more information on wetlands protected through LAP.

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

During the reporting period, NYSDEC recorded three CE Deeds conveyed by DEP to New York State, covering 46 LAP acquisition parcels on 2,101 acres.

DEP's program-to-date CE conveyances to NYSDEC total 60 CEs on 776 DEP properties comprising 49,781 acres. Counting CEs sent to the state but not yet recorded, DEP's program-to-date CE conveyances total 66 CEs on 875 DEP properties comprising 56,771 acres.

### 4.2.4 Technical Program Improvements

During 2014, DEP continued to implement improvements to program documents and policies, subject to requirements of the MOA, FAD, Water Supply Permit (WSP), and City Charter, in order to maximize program competitiveness within the marketplace, as follows:

- Purchase Contract. Since 2008, many landowners have continued to take advantage of the City's contribution of up to \$5,000 for subdivision costs offered in the revised model purchase contract. 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 apply policy developed in 2011 with respect to criteria for consideration and design of CEs.
- Technology. The Watershed Lands Information System (WaLIS) is continually being enhanced to support LAP. Work in 2014 primarily involved enhancements to the back-end database and an application to make the user experience more efficient and streamlined.
- Pilot Riparian Buffer Acquisition Program (RBAP). In 2014 DEP dedicated considerable time to developing basic program parameters for the RBAP and to find a land trust to administer the program. Negotiations with the land trust selected to manage the program, the Catskill Center for Conservation and Development, resulted in a program contract currently undergoing final review and processing by City agencies. DEP expects award and implementation of the contract by May 2015.
- Enhanced Land Trust Program (ELTP). During 2014 there was no activity within the five towns (six landowners) that "opted in" to the program in 2011. The next deadline for outreach efforts, through which interested land trusts will explain the program to towns in the hopes of encouraging others to "opt-in," is June 24, 2016.
- Land Acquisition Activities by Land Trust or Non-Governmental Organizations. Beyond activities under the four existing programs described above (ELTP, RBAP, and both WAC CE programs), there were no City-funded acquisitions by land trusts or non-governmental organizations during 2014. The director of the Land Acquisition Program delivered a presentation on DEP's initiatives to the national land trust conference in Providence, Rhode Island in late 2014.



#### **4.2.5 Water Supply Permit**

The current WSP was issued by NYSDEC on December 24, 2010, and authorizes a land acquisition program through 2015 in the Cat/Del System of up to 106,712 acres beyond what had been acquired as of January 1, 2010 (at which time 102,287 acres had been secured). Between January 1, 2010 and December 31, 2014, LAP acquired 31,162 acres, leaving a “balance” of 75,550 acres remaining for potential acquisition pursuant to the 2010 WSP limitation.

#### **4.2.6 Federal Emergency Management Agency (FEMA) 2012 Buy-Out Program**

Since Tropical Storms Irene and Lee in 2011, DEP has worked with numerous watershed stakeholders to partner on the acquisition of flood-damaged properties as part of FEMA’s Hazard Mitigation Grant Program (HMGP). In 2013 DEP executed Flood Buyout Memoranda of Agreement (Flood MOAs) with Delaware and Greene Counties, and signed a similar agreement with Ulster County in 2014.

Under the Flood MOAs, the City and counties have been working together to secure properties approved for HMGP funding by FEMA. The counties are primarily responsible for landowner outreach, grant administration, and demolition of structures once a property is conveyed. The City covers soft costs and pays for the land value of properties that are not eligible for the 25% match required by the FEMA buy-out 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 the standard FEMA deed restrictions filed locally and by a CE to be conveyed by the new owner (DEP or a local municipality) to NYSDEC.

Pursuant to procedures established in the Flood MOAs, the City appraised 19 properties in Greene County (located in Ashland, Hunter, Jewett, Lexington, Prattsville, and Windham), 28 in Delaware County (located in Middletown, Margaretville, and Fleischmanns), and 19 in Ulster County (located in Shandaken and Olive). As of this report, 15 of the 19 properties in Greene County have accepted offers, are under contract, or closed. Delaware County has asked to take title to 23 properties and for the City to assign remaining closing tasks to the County. In Ulster County, where the County sent offers to landowners in late November 2014, five property owners have accepted offers to date.

### 4.3 Land Management

The City has made a significant investment in purchasing water supply lands and conservation easements (CEs). To manage these lands for water quality protection, including beneficial uses, 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 162,752 acres of land and reservoirs it holds in fee simple; this includes reservoir buffer lands (pre-Memorandum of Agreement (MOA) (1997)), MOA lands, and land along aqueducts. While the average size of parcels acquired under the MOA since 1997 is 67 acres, assemblages of acquired land have reached up to 2,688 acres.

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: a) standard inspections, b) focused inspections, and c) aerial inspections. The type of inspection a property receives depends on its priority, which is assigned based on its location, number of adjacent properties, the various uses conducted on the property (e.g., recreation, land use permit) and any history of trespass or encroachments. Standard inspections are performed on “standard priority properties”, those on which little or no trespass or encroachments have been observed, or which have little road frontage or no or low public use. These properties receive a boundary inspection at least once 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 survey monumentation and maintenance of property boundary lines over the long term. Focused inspections are performed on “high priority properties”. These are parcels on which recreational use is high, where there is a history of encroachments or repeated trespass, where there are active land use permits or other projects, or where there are many adjacent landowners. Focused inspections are performed annually. DEP has conducted aerial inspections of conservation easements with great success, but it has not used them for fee lands. However, as the portfolio of lands continues to grow, it may be worthwhile to consider this approach for fee lands in the future. Table 4.3 displays the number and acres of focused property inspections, 5-year boundary inspections, and site visits completed in 2014.



#### 4. Protection and Remediation Programs

Table 4.3. Number and acreage of inspections completed in 2014 by DEP field offices.

DEP field office	Property inspections (number/ acres)	5-year boundary inspections (number/miles of boundary line)	Site visits
Shokan	130/12,676	52/101	2
Downsville	93/14,819	66/132	115
Grahamsville	101/9,027	32/135	43
Schoharie	222/19,961	108/137	25
EOH	162/16,748	14/24	0
Total	708/ 73,231	272/529	185

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 DEP's Watershed Lands Information System (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. In 2014, DEP installed "entering Reservoir Area" signs on several West of Hudson (WOH) reservoirs.

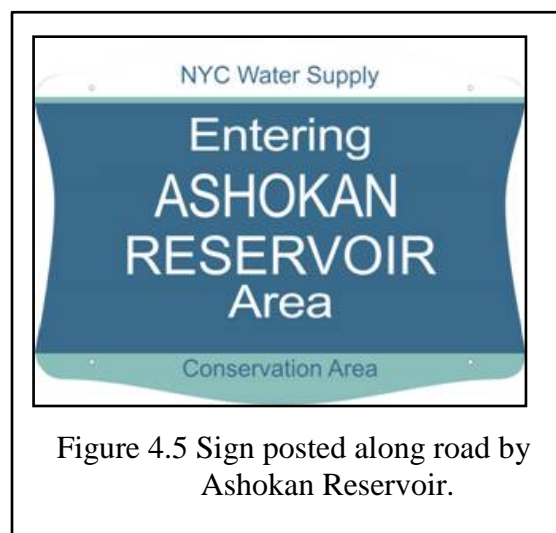


Figure 4.5 Sign posted along road by Ashokan Reservoir.

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## *Conservation Easement Stewardship*

### *DEP*

At the end of 2014, DEP had 163 closed CE properties totaling 23,858 acres in the Catskill, Delaware, and Croton watersheds. DEP conducts two annual inspections of all easements in compliance with the terms of the MOA. DEP continues to expand the use of aerial inspections for CEs since they provide an efficient alternative for inspecting properties, especially the larger ones, and because potential violations which could have serious water quality impacts such as land clearing, construction, and road building, are clearly visible using aerial inspections. Combined with an annual on-the-ground inspection (or subsequent ground check), aerial inspections provide a high level of protection for the City's investment.

The number of easement term violations committed by landowners remained very low, with one minor violation discovered during 2014 monitoring. One ongoing minor violation was addressed by the landowner with assistance from DEP staff but has not been closed out yet, pending re-inspection in spring 2015 to ensure that the road repair required to address the violation was successful. Requests to conduct activities that require DEP notice and approval remained low as well, with forestry typically the most requested activity. In 2014, DEP continued its work on its draft CE amendment policy. The policy will provide for amendments that include more uniform deed terms across the population of easement landowners, simplify administration and enforcement, and allow low-risk activities such as hobby farming that were banned by early deed versions but allowed in later versions.

### *Watershed Agricultural Council (WAC) Conservation Easements and Stewardship*

At the end of 2014, the WAC had 122 easement properties totaling 22,727 acres in the Catskill, Delaware, and Croton watersheds. DEP continues to play 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 2014 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 attempts to allow expanded recreational opportunities in the City's watershed. DEP's management priority is to allow and enhance those recreational activities that are compatible with water quality.

In 2014, DEP opened an additional 4,800 acres of land to recreation, bringing the total lands and reservoirs available for public use to slightly over 126,000 acres. DEP continued to open WOH watershed lands as Public Access Areas (PAAs). Users of these lands may hunt, hike, fish, or trap without a DEP Access Permit. Figure 4.6 provides a breakdown of the acres of land, by category, opened for recreation since 2003.

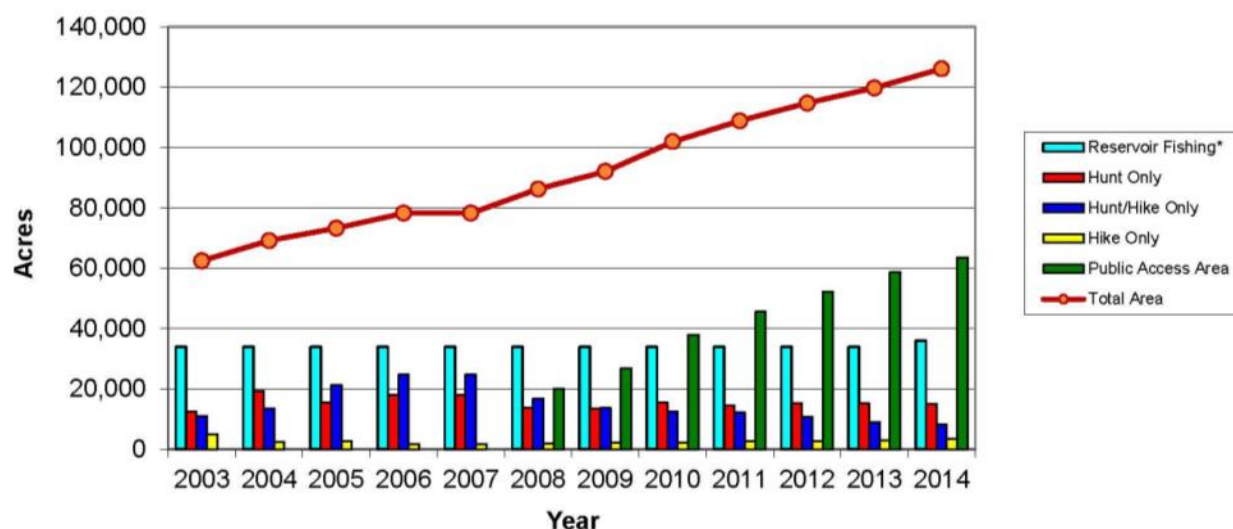


Figure 4.6. Acres of land opened for recreation.

DEP provided revocable land use permits to several partners for projects on City land. This included a permit to the City of Newburgh to allow access over City land to the Browns Pond Fishing Area. DEP also has several pending trail projects with the Catskill Mountain Club, the Town of Prattsville, and the NY/NJ Trail Conference. Hiking trails are routed so as to avoid natural resources such as wetlands and constructed in a way that does not create erosion and sedimentation.

DEP continued to develop its 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 an additional 7 guides in 2014, for a total of 29 approved guides. Other activities to enhance recreational opportunities included two public Fishing Days, one on Ashokan Reservoir as part of Ulster County's Creek Week and one on Lake Gleneida in Putnam County. Over 170 people attended the Ashokan event and 30 attended the event at Lake Gleneida. Additionally, DEP held a clean-up day on six reservoirs with several partner organizations and 171 volunteers. Over 2,500 pounds of debris and recyclables were removed.



Figure 4.7 Newly constructed kiosk along a DEP hiking trail in Putnam County.

In 2014, DEP secured 280 Deer Management Assistance Permits (DMAPs) from NYSDEC (<http://www.dec.ny.gov/animals/33973.html>) and the program was expanded from Ashokan Reservoir, now in its third year in the program, to Cannonsville and Neversink Reservoirs. By providing hunters additional opportunities to harvest deer on these reservoir lands, the DMAPs will help DEP resource managers reduce the negative impacts on forest regeneration from deer over-browsing. Out of the 280 DMAPs, 63 antlerless deer were harvested, a 22.5% success rate, but at Neversink Reservoir, a high 36% rate was achieved. DEP will continue to consider ways to improve DMAP success rates.

### *Recreational Boating Program*

Eight hundred twenty-seven recreational boat tags (canoes, kayaks, sailboats, sculls) 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 355 vessels. The intention of the rental program is to increase participation in recreational boating on the reservoirs by making vessels easily available to those who do not have their own or do not want to transport them. DEP

#### 4. Protection and Remediation Programs

purchased additional racks that will be installed at various boat launch areas in 2015, where the public can store vessels that have seasonal tags. DEP staff regularly inspected boat launch areas, removed garbage, and performed routine maintenance.

The recreational boating program caused very little, if any, 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 recreational 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 is in the process of revising its Recreation Rules to allow an expanded recreational boating season beginning on May 1 and ending on November 30.

##### *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, a seasonal one for those wishing to keep the motor with their boat for more than one day, a single-use tag for all others. In 2014, DEP discontinued issuing seasonal tags when it learned that some trolling motors may have been removed from the reservoir and then brought back without being steam cleaned. This presented an enforcement issue. As a result of the discontinuance, use for the year dropped to 64 tags, down from 112 in 2013.

##### *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



Figure 4.8 Examples of agricultural use on City land.

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 2014, DEP approved 6 new projects covering 150 acres for a total of 96 projects in 26 different towns covering 2,332 acres.

### 4.3.3 Forest Management

DEP has an active Forest Management Program staffed by four geographically-based foresters, an environmental planner, and one supervisor/coordinator. The environmental planner position was added in 2014 to support the implementation of the 2011 New York City Watershed Forest Management Plan (FMP) (DEP 2011c) and forest management projects. The program is responsible for the scientific assessment and active management of forest resources on City land, which includes conducting forest management projects. Most of these projects are timber harvests, but salvage and restoration projects are involved as well. The overall program goal is to promote forest vigor, resistance, and resiliency to protect and enhance water quality. In 2014, the program continued implementation of the FMP, which was developed in conjunction with the United States Department of Agriculture's Forest Service (USFS) to guide forest management activities on City-owned forest land.

During 2014, two semiannual Forestry Interdisciplinary Technical Team (FITT) planning meetings, bringing together more than 30 DEP resource specialists, were held to address long-range planning and project management. As part of the FITT process, field meetings were also held throughout 2014 to develop site-specific forest management project plans on five new forest management projects.

Table 4.4 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, 2014).

Table 4.4. Forest management projects by phase.

CP process phase	Number of projects	Acres
Initiation	3	294
Planning	9	1,005
Implementation	7	496
Completion	8	509
Total	27	2,304



#### *4. Protection and Remediation Programs*

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Throughout 2014, forest management staff implemented and managed seven reactive forest management projects across the watershed, all of which involved salvaging timber uprooted, damaged, and/or blown down by Hurricane Sandy and other storms. The majority of the impacts and responses occurred in the Kensico, Ashokan, Rondout, and Cannonsville basins (Figure 4.9). Salvage harvesting has been completed in the Ashokan, Rondout, and Kensico basins, and salvage harvesting continues in the Cannonsville basin.



Figure 4.9 Kensico blowdown salvage forest management project.

DEP developed a reforestation plan designed to revegetate and protect water quality at Kensico sites destroyed by Hurricane Sandy. DEP is also implementing a deer fencing strategy in Kensico to address the potential impact that the overabundance of deer in the region has on forest regeneration in the wake of Hurricane Sandy. Contracting for this work continued in 2014.

A reforestation plan was also developed and implemented for five acres at the Kensico Tornado Site, where a tornado destroyed trees in 2006. Natural regeneration failed on the site due to excessive deer herbivory and competition from non-native invasive plants. To implement the FMP's goal to promote diversity of species across the watershed, the reforestation plan emphasized the planting of a diversity of tree and shrub species that are suitable for the site. Site preparation was conducted and planting was completed in 2014. Tree tubes were installed for each tree to protect it from deer browsing (Figure 4.10), in advance of a fence to be installed in 2015.



Figure 4.10 Kensico tornado site reforestation planting.

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. Due to the rate of EAB spread in the Ashokan basin, DEP revised the basin's EAB mitigation strategy to concentrate on mitigating impacts as opposed to managing EAB spread. The strategy focuses on (1) ash harvesting from forest stands to give DEP control over the direction of forest change and to address health and safety concerns, and (2) reducing the potential public health and safety risk caused by the decline and death of roadside ash trees on City lands. To achieve these goals, DEP has been planning and implementing ash harvests in the Ashokan basin (Figure 4.11) and has developed a partnership with the New York State Department of Transportation to reduce the hazards from trees killed by EAB that are situated near public roads.



Figure 4.11 Harvesting EAB-infested ash in winter conditions at Ashokan.

#### 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 2014 and formed subcommittees to address topics including invasive species monitoring, the use of biological control, and working with watershed partners. Additionally in 2014, the group focused on developing the scope of a comprehensive Invasive Species Management Plan and discussed rapid responses to new detections of European water chestnut and *Hydrilla*.

Work continued to implement elements of an Early Detection and Rapid Response Plan that was adopted in 2013. Examples include:

- A training session on identification and response to Eurasian boar was held for the DEP Police trainers in partnership with USDA APHIS Wildlife Services on February 19, 2014. Additional training sessions were held for landowners in the WOH watershed in partnership with the Catskill Regional Invasive Species Partnership (CRISP).
- A training session on aquatic invasive plant identification was held at the Kingston DEP facility on June 13, 2014 in partnership with CRISP and the Cornell Cooperative Extension Invasive Species Program. Over 40 people participated, including a number of DEP field staff.
- Public outreach was conducted at recreational boat launches on Pepacton and Neversink Reservoirs, family fishing days on Ashokan Reservoir and Lake Gleneida, the Ashokan promenade, Muscoot Farm, the Grahamsville Little World's Fair, and the Delaware County Fair. DEP staff answered questions about the early detection of invasive species and preventing their spread, and distributed informational handouts (Figure 4.12).



Figure 4.12 DEP employee teaching a member of the public about invasive aquatic plants at Muscoot Farm.



- A spiny water flea monitoring program was developed to detect the potential arrival of invasive water fleas in the WOH reservoirs. Surveys are performed during routine water quality sampling runs using a plankton tow net when water temperatures reach levels suitable for water flea reproduction. No fleas were detected in 2014 (Figure 4.13).
- Contractors from SUNY Oneonta began aquatic invasive species (AIS) surveys for DEP's terminal reservoirs for the purpose of inventorying and mapping AIS occurrences. A method of surveying using molecular markers (primers) for selected species to detect environmental DNA (eDNA) was tested in 2014. 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. Preliminary results showed that this is not a feasible methodology for invasive species surveys at this time. Traditional survey techniques are still superior given the technology that is available.
- Recreational boat launch areas on Cannonsville, Pepacton, Neversink, and Schoharie Reservoirs were surveyed for aquatic and terrestrial invasive species to ensure that any new introductions that may 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, purple loosestrife, and Japanese knotweed. These have likely been present for many years and were likely not the result of the increased boating activities.
- Two early detection reports were made during 2014. The first detection, of European water chestnut in Muscote Reservoir, was made by DEP staff conducting routine waterfowl nest surveys. A rapid response was attempted over a four-day period, during which plants were hand-harvested by staff and interns. The second early detection was of *Hydrilla* in New Croton Reservoir. Survey work to delimit the extent of the infestation began in fall 2014.

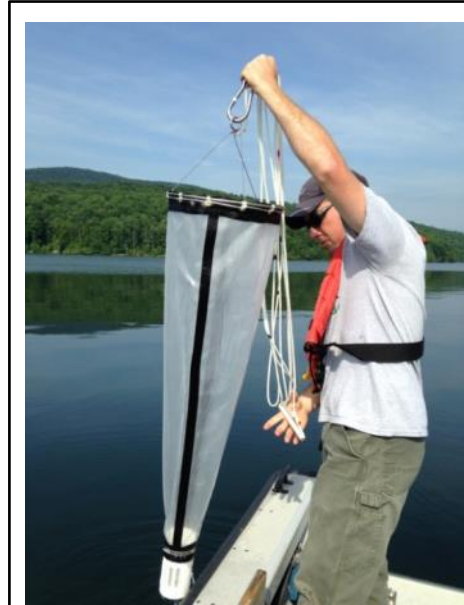


Figure 4.13 Spiny water flea survey on Rondout Reservoir.

### ***New York State Invasive Species Advisory Committee***

DEP is a member of 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 2014, 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 2014 was to develop the

groundwork for a statewide education and outreach campaign, which included initiating an Invasive Species Awareness Week. DEP attended four ISAC meetings in 2014 and DEP's Invasive Species Biologist was elected chair of the committee.

##### ***Invasive Species Management***

In 2014, DEP staff, interns, and contractors engaged in invasive species control at 45 sites on 184 acres in both the East and West of Hudson watersheds. Treatment included manual control using hand tools and hand-pulling, as well as chemical control by contracted certified pesticide applicators. This year, biological control was also used for control of mile-a-minute weed.

##### ***Emerald Ash Borer (Ashokan Reservoir)***

For information on management of Emerald Ash Borer, see Section 4.3.3.

##### ***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 2014. 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 2014, before the plants set seed, approximately 700 stems were monitored and removed. Monitoring will continue until no stems are detected for three consecutive years.

##### ***Purple Loosestrife (Ashokan Reservoir)***

Manual removal of purple loosestrife plants and flower heads was conducted again in 2014 on a wetland mitigation site near Ashokan Reservoir. Plants were removed to fulfill US Army Corps of Engineers permit requirements for percent cover by native plants.

##### ***Japanese Barberry and Multiflora Rose (New Croton 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 was conducted at the Turkey Mountain Forest Management Project in Westchester County (New Croton Reservoir) and as a repeat treatment for plants missed from the 2013 treatment at the Sand Hill Forest Management Project sites in Ulster County (Ashokan Reservoir). To supplement the 2014 chemical control work at Sand Hill, manual control was also performed at that location, as it was at Plank Road and Ashokan North to supplement the chemical control last performed at those sites in 2013.

##### ***Mile-a-minute Weed (Kensico, Croton Falls, and Cross River Reservoirs)***

Manual control of mile-a-minute weed took place at several sites in the Kensico, Croton Falls, and Cross River Reservoir basins. Croton Falls Reservoir sites were very well suppressed, but because of the plant's high density at the Cross River Reservoir site, only a low level of control was achieved there. Manual control in the Kensico basin was performed in areas where

tree seedlings were planted as part of a forest management project to increase tree regeneration at the site (see Section 4.3.3 for details on the project).

Biological control of mile-a-minute weed took place for the first time in 2014 at a site previously impacted by a tornado in the Kensico basin (see Section 4.3.3). The control agent, the Asian weevil *Rhinoncomimus latipes*, had been observed feeding on mile-a-minute plants throughout the site since 2010. In June, 2,500 weevils were released on the site to augment their population and suppress seed production.

#### *Additional Invasive Plant Control (Kensico Reservoir)*

Invasive plants including Japanese knotweed, Japanese angelica tree, and porcelain berry were controlled using a combination of herbicide application by certified applicators and manual control at two sites in the Kensico basin, one a stream restoration project next to Whippoorwill Creek, and the other at the Kensico tornado site. The goal of these projects is 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 2014, CRISP worked with DEP for a second year 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, and aided in decision making on project funding.

#### *Lower Hudson Partnership for Regional Invasive Species Management (PRISM)*

In 2014, DEP signed a partnership agreement with the Partners of the Lower Hudson Partnership for Regional Invasive Species Management, and participated in the Lower Hudson PRISM's strategic planning process. DEP will serve a three-year term on the Executive Committee of the partnership.

DEP also joined with NYSDEC to search for giant hogweed in watershed lands lying within the Lower Hudson PRISM, and, in the same region, with the NYS Office of Parks, Recreation and Historic Preservation and the NY/NJ Trail Conference to control invasive species.

## **4.4 Watershed Agricultural Program**

The Watershed Agricultural Program (WAP) supports the development and implementation of Whole Farm Plans (WFPs) and related initiatives that support active working farms. The WAP is administered by the Watershed Agricultural Council (WAC) using funds provided by DEP and technical assistance provided by the USDA Natural Resources Conservation Service (NRCS), Delaware County Soil and Water Conservation District, and



Cornell Cooperative Extension (CCE). The USDA Farm Service Agency also provides technical and financial assistance for the Conservation Reserve Enhancement Program (CREP).

The 2014 accomplishments of the WAP are summarized below based on the following core program areas: (1) whole farm planning, (2) best management practice (BMP) implementation, (3) nutrient management planning, (4) Conservation Reserve Enhancement Program, (5) Farmer Education Program, and (6) Farm-to-Market Program. There were no WAP-related research activities to report during 2014. For information relating to the WAC Farm Easement Program, see Section 4.2 (Land Acquisition Program). Additional details about the WAP's accomplishments can be found on the WAC website ([www.nycwatershed.org](http://www.nycwatershed.org)), where the internal WAP Annual Report is posted along with photos and other statistics.

### **4.4.1 Whole Farm Planning**

There are currently 211 known active large farms in the West of Hudson (WOH) watershed, of which 196 (92.9%) are enrolled in the WAP; of these, 186 (95%) have WFPs. During 2014, new WFPs were developed on two large farms, two small farms, and one East of Hudson (EOH) farm. The WAP also completed 37 WFP revisions. Of the 50 new WFPs the Revised 2007 FAD (NYSDOH 2014) requires the WAP to develop between 2012 and 2017, 33 have so far been developed.

To date, the WAP has developed 253 WFPs on large farms (186 remain active), 113 WFPs on small farms (100 remain active), and 75 WFPs on EOH farms (67 remain active). Of the 353 total active farms with WFPs, the WAP conducted annual status reviews on 325 (92%) during 2014, which exceeds the 90% FAD metric.

### **4.4.2 BMP Implementation**

In 2014, the WAP implemented 266 BMPs on large, small, and EOH farms at a total cost approaching \$4 million; these figures include 152 BMPs on large farms (\$2.6 million), 68 BMPs on small farms (\$0.58 million), and 46 BMPs on EOH farms (\$0.8 million). These figures also include the repair or replacement of 61 BMPs on large farms, 12 BMPs on small farms, and one BMP on an EOH farm.

To date, a total of 6,730 BMPs have been implemented on all watershed farms at a cost of approximately \$52 million; these figures include 5,052 BMPs on large farms (\$41.7 million), 1,081 BMPs on small farms (\$4.8 million), and 596 BMPs on EOH farms (\$5.5 million). In 2015, the WAP anticipates implementing approximately 200 BMPs on WOH farms (estimated cost of \$2.5 million) and approximately 30 BMPs on EOH farms (estimated cost of \$415,000).

### **4.4.3 Nutrient Management Planning**

During 2014, the WAP completed 66 new or updated nutrient management plans (NMPs) on active large, small, and EOH farms. One hundred seventy-nine large farms are following NMPs, of which 100% are considered current (i.e., developed within the last three years), while 75 small farms are following NMPs, of which 88% are considered current.

Also during 2014, 114 farmers participated in the WAP's Nutrient Management Credit Program, which allows farmers to receive credits that can be applied towards their nutrient management expenses; this program continues to be jointly funded by DEP and the USDA NRCS through the Agricultural Water Enhancement Program.

#### 4.4.4 Conservation Reserve Enhancement Program (CREP)

In 2014, eight new contracts (32.8 acres) were enrolled in the CREP, six contracts (45.1 acres) expired and were re-enrolled, and three contracts (22.0 acres) expired and were not re-enrolled by choice of the landowners. A total of 2,069.2 acres of riparian forest buffers are currently enrolled in 203 active CREP contracts representing 169 different landowners.

#### 4.4.5 Farmer Education Program

The WAP conducted 39 farmer education programs in 2014 that were attended by 820 participants, of which 39% were watershed farmers, 36% other farmers, and the rest students, agribusinesses, or agency staff. CCE estimates that 30% of the WAP's participants attended at least one farmer education program during 2014, with key highlights including the annual Catskill Regional Agricultural Conference, a calf health and nutrition conference, over a dozen producer group meetings and farm tours, and various workshops covering livestock production, soil health, calf health and internal parasites, and farm business succession.

#### 4.4.6 Farm-to-Market Program

In 2014, the Farm-to-Market Program continued to implement the Pure Catskills Buy Local Campaign that reaches more than 55,000 people through its annual print guide, e-newsletters, annual Farm-to-Market Conference, and marketing website ([www.purecatskills.com](http://www.purecatskills.com)). Pure Catskills was rebranded in 2014 with a new logo and marketing slogan, both of which were launched during a two-day Taste of the Catskills event held in October that was attended by approximately 5,000 people. Also in 2014, the Farm-to-Market Program increased support to a regional food hub in Hamden (Lucky Dog Farm); conducted a series of farm tours for existing and aspiring farmers; and supported the second annual "Travel the Milky Way" open house, which involved eight dairy farms and attracted approximately 2,000 visitors.

### 4.5 Watershed Forestry Program

The Watershed Forestry Program is a partnership between DEP, the Watershed Agricultural Council (WAC), and the United States Forest Service (USFS) that promotes and supports well-managed working forests through 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 2014 accomplishments of the Watershed Forestry Program are summarized below, along with the annual FAD-mandated evaluation of the implementation status of five-year-old WAC forest management plans.

### **4.5.1 Forest Management Planning and Stewardship**

In 2014, the Watershed Forestry Program funded the development of 100 forest management plans covering 20,220 total acres and 16,255 forested acres. Fifty-five of these plans were original enrollments by new landowners; the remaining 45, while already in place, were updated by the landowners' foresters in 2014. Fifty-four plans delineated riparian acres, 1,465 in total.

Beginning in July, the WAC discontinued funding traditional forest management plans for landowners having fewer than 50 acres while requiring that new WAC-funded plans must be enrolled in the NYS Forest Tax Law Program (480-a program). To be eligible for the 480-a program, landowners must have at least 50 acres of forest and commit to a 10-year management schedule that is enforced by the NYSDEC; requiring landowners to enroll their WAC plans in the 480-a program helps to ensure that greater numbers of watershed properties remain working forests with periodic harvests and related management activities, many of which are eligible for cost-sharing through the WAC's Management Assistance Program (MAP). Eighty-three MAP projects were completed in 2014, including 31 timber stand improvement projects, 28 wildlife improvement projects, 16 invasive species control projects, 7 tree planting/deer fencing projects, and 1 riparian improvement project.

In 2014, the WAC began development of an interactive website for landowners who are not eligible for the 480-a program or do not wish to enroll despite being eligible; when this new website is launched in 2015, it will allow watershed landowners to create customized forest management plans by navigating through online modules covering dozens of topics and selecting those modules that best align with their personal forest management goals. The intent of this website is to engage greater numbers of landowners in a more cost-effective and efficient planning process while allowing the WAC to target and promote specific cost-sharing programs to individual landowners based on their customized plans and implementation interests.

### **4.5.2 Best Management Practice Implementation**

The Watershed Forestry Program continued to implement forestry BMP projects in 2014, including the installation of 40 timber harvest roads, the remediation of 2 existing forest roads, the completion of 14 stream crossing projects associated with road projects, and the temporary loan of 7 portable bridges. The WAC also distributed 21 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 Watershed Forestry Program also continued to implement the Croton Trees for Tribes Program. Six projects were completed in 2014, involving 42 volunteers who planted 118 trees and shrubs along 99 linear feet of East of Hudson watershed streams, equaling about 0.15 acres.

#### **4.5.3 Logger and Forester Training**

In 2014, the Watershed Forestry Program continued to collaborate with Cornell Cooperative Extension and the NYS Trained Logger Certification Program to sponsor and conduct 11 professional training workshops that were attended by 149 participants. Approximately 104 loggers working in the Catskill/Lower Hudson region remained certified during 2014, while 48 consulting foresters were approved to write WAC forest management plans.

#### **4.5.4 Model Forest Program**

The Watershed Forestry Program coordinates and supports four model forests in collaboration with the SUNY College of Environmental Science and Forestry and various local partners: Lennox (Delaware County), Frost Valley (Ulster County), Siuslaw (Greene County), and Clearpool (Putnam County). All model forests had two-year work plans updated in 2014 to help guide the planning and implementation of demonstration, research, outreach, and maintenance. Additional accomplishments included the signing of a 10-year Lennox host agreement between the WAC and Cornell Cooperative Extension, the construction of an informational kiosk and BMP demonstration road at Clearpool, the post-harvest inventory of several timber stands at Siuslaw, and the creation of an advisory committee for Frost Valley. During 2014, the watershed model forests hosted more than 75 events reaching an estimated 3,500 youth and adult visitors; these events included logger training workshops, landowner education programs, watershed forestry bus tours, and environmental awareness days for school groups.

#### **4.5.5 Forestry Education**

The Watershed Forestry Program implements an urban/rural school-based education program comprised of the Green Connections School Partnership Program, the Watershed Forestry Bus Tour Program, and for the first time since 2011, the Watershed Forestry Institute for Teachers. During 2014, all of these programs were directly managed by the WAC. The 2013-2014 Green Connections program was completed in June for 210 students from six partner schools in the watershed and New York City, while the 2014-2015 Green Connections program was launched in September for 163 students from six partner schools. Twenty watershed forestry bus tours were conducted for approximately 1,368 participants and 24 teachers attended the Watershed Forestry Institute held at the Taconic Outdoor Education Center.

The Watershed Forestry Program also implements a Forest Landowner Education Program in collaboration with Cornell Cooperative Extension and the Cornell Master Forest Owners (MFO) Program. In 2014, a monthly “You and Your Forest” letter series was conducted for 75 landowners, while more than two dozen landowner events were conducted for over 1,000 participants; these events included workshops and wood walks that covered diverse topics such as maple production, apple tree pruning, invasive species, birding, mushrooms, ginseng, wildflowers, and pollination. During 2014, 17 volunteer MFOs served the Catskill region, of

whom 13 were based in the watershed; these MFOs conducted 28 property site visits with other landowners to better engage them in their forests and to promote forest stewardship.

### **4.5.6 Wood Products Marketing and Utilization**

The Watershed Forestry Program oversees the Catskill WoodNet marketing website ([catskillwoodnet.org](http://catskillwoodnet.org)), which represents 90 wood-using businesses. During 2014, this website attracted 1,869 visitors, while 698 people subscribed to the monthly e-newsletter.

### **4.5.7 Evaluation of Five-Year-Old Forest Management Plans**

In 2014, DEP and the WAC evaluated the five-year implementation status of 71 WAC forest management plans that were completed in 2009. Eighteen foresters wrote these plans, with half being written by just three foresters; these data confirm a trend in which only a small portion of all foresters who are eligible to write plans actually perform this task in a given year.

Sixty-six percent of the WAC plans completed in 2009 were on Delaware County properties, 8% were in Greene County, 8% were in Ulster County, 7% were in Westchester County, and 5% or less were completed in each of the following counties: Dutchess, Putnam, Schoharie and Sullivan. The average completion time for the 71 WAC plans was 6.2 months, which is a shorter timeframe than in previous years.

Eighty-three percent of the WAC plans completed during 2009 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 of silvicultural prescriptions, with commercial thinning, timber stand improvement (TSI), and pre-commercial or non-commercial thinning representing the most common prescriptions listed by foresters.

Approximately 58% of the WAC plans completed during 2009 had a stream located on the property, of which an estimated 29% had stream crossings already in place (mostly fords). Fifty-seven percent recommended that a new crossing would be needed during a future timber harvest, with portable bridges comprising 76% of the recommended stream crossings. One trend that continues to emerge from this evaluation is that portable bridges are being recommended by foresters in greater numbers over time, which is a very positive trend that is probably attributable to the many portable bridge opportunities offered by the Watershed Forestry Program.

Approximately 83% of the WAC plans completed during 2009 had an existing forest road on the property, of which an estimated 29% were characterized as having erosion problems or needing BMPs. Approximately 49% of the plans recommended that new roads be installed during future timber harvests; all of these statistics are consistent with prior year evaluations.

Thirty-one landowners returned a Year-1 Survey upon completion of their WAC plans in 2009, representing a 44% response rate (comparable to the 47% cumulative response rate for all landowners whose plans have been evaluated to date). One hundred percent of respondents indicated their satisfaction with both their plans and their foresters, while 93% felt that having a WAC plan would improve their stewardship. Ninety-three percent of respondents indicated they

would retain the services of their forester for future activities, while a slightly lower percentage (87%) indicated they would use a certified logger for a future timber sale. Eighty-seven percent of respondents expressed interest in other forestry programs, of which 70% indicated roads/trails improvements, 37% indicated education workshops, and 33% indicated conservation easements.

Forty-two landowners returned Year-5 Surveys in 2014, representing a 66% response rate. Of these 42 landowners, 38 (90%) still own their property. For those respondents who still own their land, 69% indicated they have consulted their plans during the past five years, 57% have retained the services of their foresters, 79% feel that having their plans has improved their stewardship, and 33% 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. For those respondents who indicated their plans recommended forestry activities and water quality protection practices during the past five years, 89% and 73%, respectively, indicated having completed these recommendations. For those respondents who indicated they conducted a timber sale during the past five years, 91% indicated hiring a professional forester, while 100% claimed to have hired a certified logger. Fifty-two percent of respondents indicated they had recommended the WAC Forestry Program to other landowners.

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, the Forest Road BMP Program, the NYS Forest Tax Law, the WAC's Farm Easement Program, and DEP's Land Acquisition Program. A total of 45 landowners (63%) who completed WAC plans during 2009 took advantage of at least one or more of these programmatic opportunities as described below:

- Fifty-four landowners (76%) were eligible to participate in the NYS Forest Tax Law Program by owning at least 50 acres of forest land. Twenty-seven of these landowners (50%) actually enrolled all or part of their properties in this program, as confirmed by the NYSDEC.
- Fifteen landowners (21%) have updated their original plans since 2009, while seven others (10%) are currently in the process of getting their plans updated.
- Seventeen landowners (24%) implemented 21 road BMP projects.
- Twenty-one landowners (30%) completed 80 MAP projects, including 28 TSI projects, 29 wildlife improvement projects, 14 invasive species control projects, 6 tree planting projects, and 3 riparian planting projects. Eleven projects were approved but subsequently cancelled by five different landowners.
- Three landowners (4%) sold 838 acres of land to DEP in fee simple, while five landowners (7%) entered into DEP conservation easements covering 1,070 acres.
- Two landowners (3%) enrolled 399 acres in a WAC farm easement.



## **4.6 Stream Management Program**

The DEP Stream Management Program (SMP) and its partners made considerable progress in 2014 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 2014 was to substantially complete the projects necessitated by Tropical Storms Irene and Lee and launch the Local Flood Analysis (LFA) component of the new flood hazard mitigation programming designed to reduce the severe effects of future flood events. Local flood analyses are intended to identify the most beneficial and feasible projects communities can advance to mitigate flood risks, an integral aspect of economic sustainability in a changing climate. The SMP also completed the groundwork for a new set of five partnership contracts that will carry the program forward through 2019.

Significant accomplishments of 2014 include:

- Completed negotiations for five new SMP implementation contracts with its five primary partners (Cornell Cooperative Extension of Ulster County and the Soil and Water Conservation Districts of Ulster County, Delaware County, Greene County, and Sullivan County) and commenced work on two of those five contracts.
- Received approval and commenced the hiring process for two new positions, a Flood Hazard Mitigation Coordinator and a Stream Planning Coordinator within the SMP.
- Provided training and/or funding for six new Certified Floodplain Managers in the watershed, bringing the total to 20.
- Completed a set of program rules for implementing the LFA and funding flood hazard mitigation projects through the Stream Management Implementation Program (SMIP).
- Completed program rules and contracting with the Catskill Watershed Corporation (CWC) for its Local Flood Hazard Mitigation Implementation Program.
- Substantially advanced LFAs in Walton, Lexington, and Windham (comprising six population centers), and established flood advisory committees and initiated LFAs in Shandaken, Denning, Olive, the Village of Fleischmanns, and the Town of Middletown (comprising seven population centers).
- Completed stream projects on nine sites treating more than 4,200 linear feet of stream in the Delaware, Ashokan, and Schoharie basins. Two of these are stream restoration projects in the Ashokan basin in fulfillment of the Catalum consent order.
- Substantially completed repairs to restoration projects primarily located in the Schoharie watershed, where Tropical Storms Irene and Lee's flooding approached or exceeded the 500-year flood event, and addressed channel stability on over 1.2 miles of watershed stream.
- Completed 16 Catskill Streams Buffer Initiative (CSBI) projects, through plantings installed on 11.9 acres on over 1.8 miles of watershed stream.

#### 4.6.1 Stream Management Plans and their Implementation

In 2014, the SMP and its partners continued implementation of the existing program, providing technical assistance to communities regarding stream issues, designing and constructing stream projects, administering grants under the SMIP, assessing and monitoring past stream projects, implementing the CSBI, and providing education and training opportunities to continue to build the foundation essential for implementing this community-driven program. Highlights within these program areas across each SMP basin are summarized below.

The SMP partners continued to meet with their advisory councils and working groups throughout the year to remain responsive to local concerns and prioritize their projects for funding through the SMIP. Priority projects, including SMIP-funded projects, are described in annual action plans and these plans were updated in May 2014 for all four SMP basins (Ashokan, Delaware, Rondout/Neversink, Schoharie). Some of the projects receiving the \$6 million of first-round (2007 FAD) SMIP funding (\$2 million each in Ashokan, Schoharie, and Delaware) remain active and will be completed in 2015. Table 4.5 summarizes the total number of SMIP projects by category funded to date within each basin. (The Rondout/Neversink Stream Program is not reflected in the table because its SMIP will formally launch in 2015.) More information, and descriptions of the projects funded through the SMIP, can be viewed at <http://catskillstreams.org/stream-management-program/grants/>.

The SMP and its partners met several times throughout 2014 to develop the SMP's guidance document for implementing LFAs and for determining eligibility for flood hazard mitigation project funding through the SMIP. The SMP partners facilitated establishment of flood advisory committees consisting of representatives from local communities, and launched LFAs in those communities where strong local interest met with available funding from existing contract sources. Flood advisory committee members received training to help them gain expertise in evaluating LFA proposals from consultants and engage in the LFA process. Progress in LFA roll-out among the various basins is reported below and an overview of LFA progress is provided in Section 4.6.2.

#### 4. Protection and Remediation Programs

Table 4.5. Stream Management Implementation Program projects, by category, 2009-2014.

SMIP Category	Schoharie	Ashokan	Delaware	Total
Education and Outreach	14	15	1	30
Recreation and Habitat Improvements	5	0	7	12
Stormwater and Critical Area Seeding	3	1	3	7
Highway/Infrastructure	8	6	16	30
Landowner Assistance/Stream Restoration	6	3	0	9
Planning and Research	4	21	2	27
Flood Hazard Mitigation	4	5	3	12
Total	44	51	32	127

#### *Ashokan Basin*

The Ashokan Watershed Stream Management Program (AWSMP), a partnership between Cornell Cooperative Extension of Ulster County (CCEUC), Ulster County Soil and Water Conservation District (UCSWCD), and DEP, advanced major educational, outreach, flood hazard mitigation planning, and stream restoration projects in 2014. The AWSMP website ([www.ashokanstreams.org](http://www.ashokanstreams.org)) continues to be an excellent portal for accessing the latest stream management news in the Ashokan watershed, recent research and management publications, announcements of upcoming events, and synopses of those events once they have concluded. All issues of the Esopus Creek News and the Trib (an email-distributed news brief launched in 2014) are also available for download.

In September, DEP kicked off its new five-year agreement with CCEUC to provide funding for four full-time staff, office space, a five-year shared services agreement with the Ulster County Department of Environment to hire a full-time flood hazard mitigation planner, education and outreach programming, and \$3 million for the SMIP grant program and the new LFA program. DEP's imminent five-year agreement with UCSWCD will continue funding for five full- and three part-time staff to lead the technical services of AWSMP. Funding for stream projects to restore stream channel integrity, reduce turbidity, and implement recommended flood hazard mitigation projects has been increased to \$4 million. The combined budget for these registered contracts, which will run from 2015-2019, is \$13.7 million.

The fifth annual Ashokan Watershed Conference held in April was the most highly attended conference to date, with over 120 people in attendance at the Ashokan Center. This year's theme took a historical perspective, with an introductory presentation by a regional historian talking about the cultural history of this part of the Catskills, followed by a keynote

presentation by a stream engineer working in Vermont on applying new methods to help communities in mountain stream settings deal with increasing flood hazards. Video clips from these talks are available for viewing and download on the AWSMP website.

New SMIP grants were issued in early 2014 covering a range of projects, from infrastructure protection and flood hazard mitigation planning to continued support for research in the watershed that can be used in stream management and aquatic ecosystem protection. These grants totaled about \$247,000, using the SMIP funds remaining from the first \$2 million grant program (2007 FAD). A new round of grants was solicited in late 2014 using the new DEP-funded agreement, which replenished the SMIP program with \$3 million. Grants will be awarded in early 2015.

The AWSMP supported the start of two LFA efforts in 2014. In the first, Shandaken's flood advisory committee (referred to as SAFARI) tasked town engineer Milone & MacBroom, Inc. (MMI) to implement the LFA scope of work for the population centers of Phoenicia (on Esopus Creek and Stony Clove Creek) and Mount Tremper (on Esopus Creek and Beaver Kill). The work is funded through the SMIP. CCEUC staff (joined by the Ulster County Department of the Environment planner in late 2014) participated in public meetings and worked with Shandaken and MMI to scope the effort and to participate in public meetings and convene SAFARI meetings. By the end of 2014, MMI had begun the process of evaluating various potential mitigation treatment efforts to reduce flood inundation levels in the population centers. The LFA is expected to be completed during the summer of 2015. In the second effort, AWSMP staff worked with the Town of Olive to establish a flood advisory committee in mid-2014 and to prepare for an LFA project for the population centers of West Shokan (on the Bush Kill) and Boiceville (on Esopus Creek). Olive was awarded a SMIP grant in early 2015 to fund the LFA and has selected the engineering firm Woidt Engineering Consultants of Binghamton, NY, to lead this effort.

The UCSWCD stream assessment team was very busy during the 2014 field season monitoring the five stream restoration projects constructed from 2011 to 2013. UCSWCD also worked extensively on processing, analyzing, and documenting stream assessments for Bushnellsville Creek and the Bush Kill, and on revising the draft Beaver Kill SMP, which will be released early in 2015.

### ***Delaware Basin***

DEP and the Delaware County Soil and Water Conservation District (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 created for that purpose and its sub-committees. The new-five year agreement with DCSWCD commenced on October 1, and provides \$13.3 million in funding to the program. The focus of efforts in 2014 included the launch of the LFA program; support for flood committees in Walton, Delhi, Trout Creek, Andes, Fleischmanns, and the East

#### *4. Protection and Remediation Programs*

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Branch Delaware watershed (including the Towns of Middletown, Halcott, and Hardenburgh, and the Villages of Margaretville and Fleischmanns); design and construction of the Third Brook hillslope stabilization and stream restoration project; completion of the Chambers Hollow Emergency Watershed Protection (EWP) hillslope stabilization project; completion of three SMIP construction projects; completion of six CSBI projects; and continued collaboration with the Watershed Agricultural Council (WAC) on two stream projects to make them eligible for enrollment in the CREP.

In 2014, the DCSWCD continued to teach its Emergency Stream Intervention protocol and provided training to NYSDOT and contractors at the Association of General Contractors conference in Saratoga, NY. The DCSWCD was given a Special Project Award by the NYS Conservation District Employees' Association, Inc. for its work in providing a "train the trainer" workshop series for SWCD staff from across New York State.

DEP and the DCSWCD also continued to support riparian buffer programs through the CSBI and provide advice and funding for stream bank projects associated with the WAC and the CREP. Additional information on these projects is available on [www.catskillstreams.org](http://www.catskillstreams.org) and in Section 4.7. DCSWCD and the DCPD continued implementation of SMIP program grants to design and construct recreational access sites along the West Branch Delaware River at Walton, Hamden, and Delhi. At Delhi, Haas Engineering, a landscape architectural consultant, was hired to design the plan for a river walk and boat launch at Hoyt Park.

Work on LFAs progressed in Walton and the Village of Fleischmanns in 2014. MMI was selected by both municipalities as their engineers for the analysis, using funds provided by SMIP grants. In both communities, the consultant modeled a range of scenarios to reduce flood elevations and presented its results to the respective flood committees. A draft benefit cost analysis was completed for Walton. Included in the final plan is the restoration of a floodplain adjoining Water Street and the removal of the old Walton Reporter building. A final public presentation to highlight the draft plan is scheduled for February 2015. MMI is also working to refine LFA scenarios for the Village of Fleischmanns. Upon completion of that task, a benefit cost analysis will be performed, followed by public review. The Delhi flood advisory committee was formed in late 2014 and developed a Request for Proposals (RFP) for a consultant to perform an LFA. The Towns of Andes and Hamden are also in the process of forming flood advisory committees, while the Trout Creek flood advisory committee in the Town of Tompkins is in the process of reviewing updated FEMA flood maps.

#### ***Rondout/Neversink Basins***

During 2014, the final year of the SMP's first contract with the Sullivan County Soil and Water Conservation District (SCSWCD) to establish a Rondout/Neversink Stream Program (RNSP) and develop stream management plans for Rondout Creek and the Neversink River, DEP began preparing for the successor contract, which will include funding for a SMIP grant program. This contract will provide four full-time and two part-time staff and provide \$6.6

million in funding for 2015 to 2019. Activities in 2014 also included continuing the stream feature inventory and bank erosion site assessments for tributaries to the Neversink River, development of bankfull channel hydraulic geometry curves specific to the high-runoff Neversink system to improve restoration design and flood recovery channel work, and initiating an LFA in Denning. An educational program designed to support these efforts also continued in 2014. In addition, the RNSP website was launched in December ([www.rondoutneversink.org](http://www.rondoutneversink.org)).

Stream feature inventories were conducted on High Falls Brook, Fall Brook, Hemlock Brook, Pigeon Brook, and Biscuit Brook. While these were being conducted, surveys were also undertaken to document a bankfull flow event in the West Branch and mainstem of the Neversink River that occurred in May. These surveys were used to refine DEP's understanding of bankfull channel dimensions in the Neversink system. The bank erosion site analysis continued to document current conditions at bed and suspended sediment supply sources, and to support prioritization of their treatment. A draft report on this bank erosion study can be found at [www.CatskillStreams.org/major-streams/neversink-river](http://www.CatskillStreams.org/major-streams/neversink-river).

Through the spring, RNSP project staff coordinated the establishment of an advisory committee to oversee development of an LFA for the Neversink River in Claryville, the flood hazard mitigation priority population center in the Rondout and Neversink basins. Because Claryville crosses the boundary between the towns of Denning and Neversink and between Ulster and Sullivan Counties, the two towns and counties were given joint representation on the committee. During the first half of the year, RNSP staff convened the committee six times. Consultants were brought in to give the committee educational presentations on stream processes and channel hydraulics analysis, the National Flood Insurance Program, and benefit cost analysis for flood hazard mitigation projects. The RNSP was given the lead by the two towns to prepare and issue an RFP for a consultant to conduct the LFA for Claryville. The committee interviewed four consultants, and selected Barton & LoGiudice, Ltd. to lead the LFA. A contract was executed in September and field assessments conducted from October through December. The Claryville LFA is expected to be completed in mid-2015.

DEP also coordinated educational programs on several topics intended to help build local knowledge related to the various funding categories of the SMIP grant program, which will launch in 2015. Workshops were conducted on the status of the hemlock woolly adelgid and management of Japanese knotweed in the Catskills, both of which reduce the resilience of riparian vegetation communities; on the ecological condition of the Neversink River as it affects the fishery; and on native pollinators and their role in the ecology of the riparian corridor.

### ***Schoharie Basin***

The Greene County Soil and Water Conservation District (GCSWCD), DEP, and the Schoharie Watershed Advisory Committee (SWAC) made substantial progress in implementing stream management plan recommendations within the Schoharie Reservoir basin in 2014. A new contract providing \$12.9 million in funding was successfully negotiated and will commence in



early 2015. The focus of GCSWCD this year was moving forward on repairs to several restoration projects that were damaged by Tropical Storm Irene, implementing SMIP projects, hosting the annual Watershed Summit and Schoharie Watershed Month, and launching LFAs in two communities.

The eighth annual Schoharie Watershed Summit, “Consequences of Inaction in a Changing Climate,” focused on meteorological factors that result in extreme rainfall in the Schoharie watershed, state funding programs that help communities recover from floods, and how LFAs can help communities minimize flood damage and leverage state and federal funds. Workshops providing planning credits for local officials included benefit cost analysis, changes to the National Flood Insurance Program, and revisions to SEQRA forms.

Completing its fifth year, Schoharie Watershed Month was again a great success, attracting more than 305 local residents, students, and visitors. Program partners created events that celebrated the region’s beauty and natural resources, while raising awareness of the New York City Watershed and the importance of protecting it. Highlights included an art gallery opening reception, “Earth, Wind, and Water: The Seasons”; an invasive species workshop, “Japanese Knotweed Not in my Backyard”; a tour of the Gilboa Dam; Windham Day on the Batavia Kill; a bus tour of Schoharie Reservoir and Gilboa Ancient Forest; and a guided paddle on Schoharie Reservoir.

GCSWCD made significant progress towards completing several active construction-related SMIP projects, including Kozak stream bank stabilization and riparian planting, Cranberry Road culvert upgrade, Glen Avenue culvert upgrade, Mitchell Hollow (CR 21) stormwater treatment, Town of Hunter land use regulation review and development guidelines, and Town of Lexington LFA.

Six new SMIP proposals were funded in 2014, including a proposal by the Town of Windham to undertake an LFA; Schoharie Watershed Month 2014; Windham Path, a multi-use/non-motorized trail on the Batavia Kill (phase 2); Kaaterskill United Methodist Church stormwater/rain harvesting project; replenishment of the Schoharie Watershed Stream Crossing/Culvert Engineering Fund (to hire an engineering firm to oversee construction of a replacement culvert on South Gilboa Road in Gilboa and address a stream stabilization issue in the West Kill along Beech Ridge Road in Lexington); and a Conesville Town Park community enhancement project, providing enhanced public access to the Manor Kill.

#### **4.6.2 Flood Recovery and Hazard Mitigation**

##### ***Flood Recovery***

The United States Department of Agriculture’s Natural Resources Conservation Service (NRCS) initiated the EWP Program following Tropical Storms Irene and Lee. The program is designed to relieve imminent hazards to life and property, and can provide up to 75% 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 \$16.2 million in federal funds for 55 eligible project sites in the West of Hudson (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 of these 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, DEP has provided the local cost share for 31, and provided engineering design support for the remainder through the SMP partner teams or its engineering consultant. To date, \$3.7 million has been disbursed by DEP and construction has been completed on 36 of the 37 projects. To view a map depicting all of the EWP cost-shared projects, visit <http://catskillstreams.org/stream-management-program/project-maps/>. Table 4.6 summarizes the annual progress of EWP project implementation since 2012.

Upon construction of the final remaining project, 4.3 miles of stream will have been treated under this program. In addition, several of these projects entailed substantial adjacent hill slope stabilization that NRCS deemed ineligible for EWP. 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.

Table 4.6. NRCS EWP projects supported by DEP in the WOH watershed, 2012-2014.

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

### ***Hazard Mitigation***

#### *Local Flood Analysis and SMIP Funding for Flood Hazard Mitigation Projects*

The basis of the DEP-sponsored flood hazard mitigation program is the LFA, an engineering analysis whose purpose is to identify the potential for reducing 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.

DEP is focusing on population centers to target flood mitigation benefits to the greatest number of people. Hamlets give an indication of where population centers are, but the analysis does not conform strictly to hamlet boundaries. The first LFA, prepared for the Village of Prattsville, is complete. LFAs for Lexington and Spruceton in Greene County and for the Village of Walton in Delaware County are nearing completion. Several other LFAs were initiated in 2014 and consultants are actively working with the local flood committees overseeing these LFAs in municipalities located in Ulster, Delaware, Greene, and Sullivan Counties. To view the communities undertaking LFAs at this time, visit [www.catskillstreams.org/LFA](http://www.catskillstreams.org/LFA). A first round of SMIP applications for LFA-recommended projects is expected in 2015. DEP is providing \$10.1 million through its partner contracts in support of the LFA process and LFA-recommended projects. A first round of SMIP applications for LFA-recommended projects is expected in 2015.

#### *Catskill Watershed Corporation Local Flood Hazard Mitigation Implementation Program*

In 2014, the CWC and DEP completed negotiations on a scope of work and contract to supplement existing funding sources for structural and nonstructural flood hazard mitigation projects. Projects funded by this program, the Local Flood Hazard Mitigation Implementation Program (LFHMIP), must, with limited exceptions (certain relocations and emergency stream debris removal) be identified through an LFA. The LFHMIP provides communities with funding assistance to support the relocation of critical community facilities (e.g., firehouses, medical offices) and anchor businesses (e.g., grocery stores and gas stations) to higher ground, thereby reducing future flood risk and damage, and speeding recovery from catastrophic flooding. For more information visit: [www.cwconline.org](http://www.cwconline.org).

#### *Floodplain Mapping and Streams Geodatabase*

In 2014, DEP, through its contract with FEMA Region II, completed revision of digital floodplain maps and flood studies with FEMA's release of preliminary maps. Assisted by NYSDEC's Floodplain Management Section, FEMA and its contractor delivered the map

products to watershed communities and held community coordination meetings for municipal leaders. These meetings were followed by open house meetings at which the public was able to review the revised maps with the project team and ask site-specific questions about the map changes and their implications for their participation in the National Flood Insurance Program. NYSDEC also provided four training sessions for floodplain administrators and technical support staff on the use of the new digital products, such as the digital flood insurance rate maps (DFIRMs), depth grids, and hazard mitigation database that accompanied the paper map and flood study reports. The SMP has been distributing these products, as well as Hydrologic Engineering Centers River Analysis System (HEC-RAS) models, to municipalities and consultants for use in planning and LFAs.

The SMP upgraded its streams geodatabase with the latest GIS technology, making it possible for the SMP and partners to perform a higher level of analysis, improved reporting, and enhanced mapping. DEP also incorporated into the geodatabase the field assessments for the Beaver Kill and Bushnellsville Creek in the Ashokan basin, and erosion hazard sites in the Neversink basin.

#### **4.6.3 Stream Projects**

Stream projects in 2014 continued to be dominated by work necessitated by Tropical Storms Irene and Lee. This work was substantially completed, with only a few projects extending into 2015. Figure 4.14 depicts stream projects completed in 2014.

##### ***Ashokan Basin***

In 2014, the AWSMP completed two stream restoration/stabilization projects in the Stony Clove Creek watershed. 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 and the restoration of channel stability to address flood hazards to infrastructure and residential property. The two projects, Stony Clove Creek at Stony Clove Lane and Stony Clove Creek-Warner Creek Confluence, also served as the two projects DEP was required to fund and implement by December 31, 2014 pursuant to the environmental benefit project provisions of the Catalum consent order (DEC Case No. D007-0001-1).

##### ***Stony Clove Creek at Stony Clove Lane***

An approximately 450-foot-long reach of Stony Clove Creek just above the Stony Clove Lane bridge was substantially eroded by Tropical Storms Irene and Lee flood flows in the fall of 2011. One house was rendered uninhabitable, and groundwater/surface water-entrained silt and clay, from a large glacial hill slope mass failure triggered by bank erosion, became a chronic source of turbidity. The site was included on a list of eligible EWP projects intended to reduce sediment loading. The Town of Shandaken was the official project sponsor and DEP provided the local match through its contract with UCSWCD.

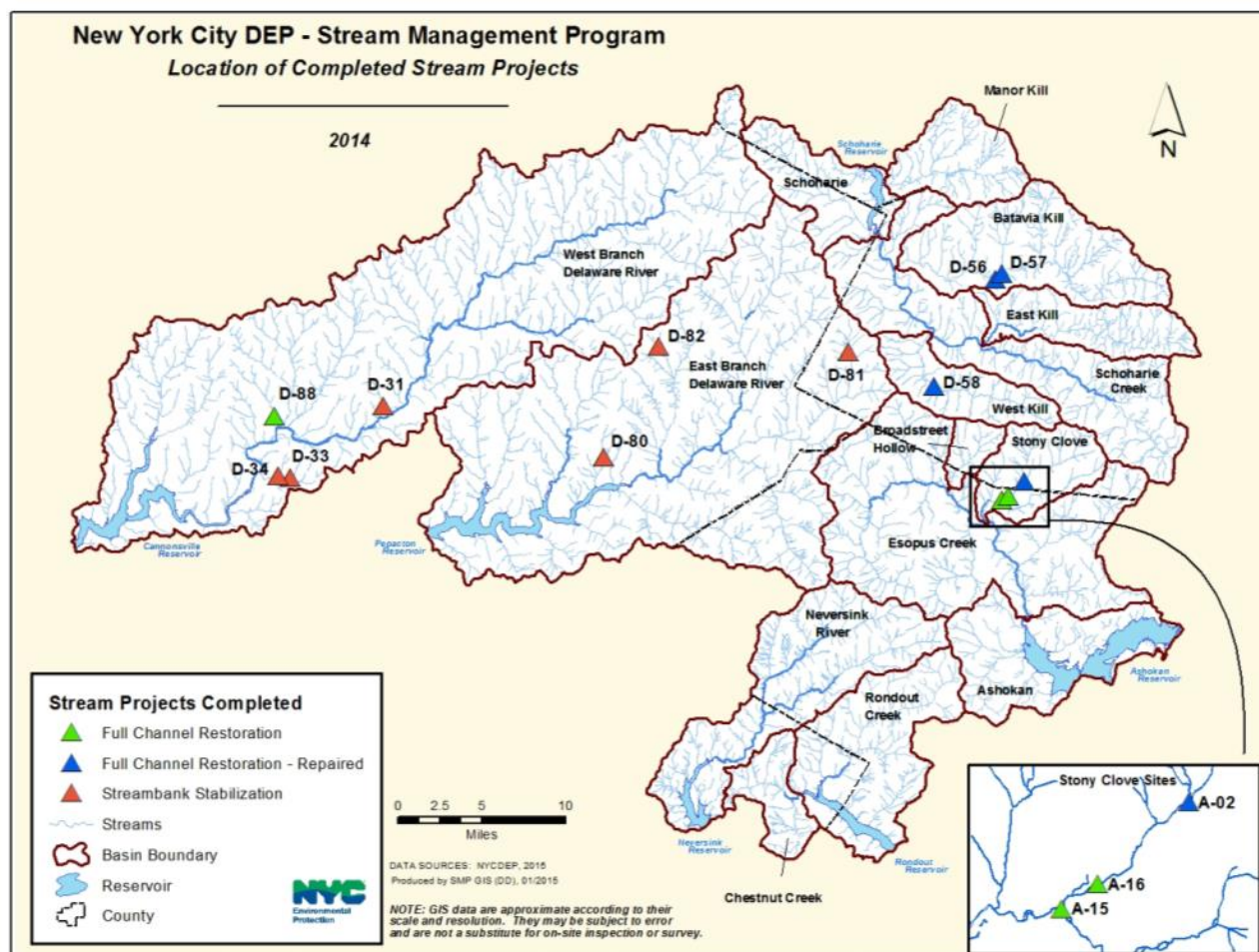


Figure 4.14. 2014 completed stream projects.

The regional NRCS engineer working in partnership with UCSWCD completed the site assessment and design work. UCSWCD managed the project bid for the town and provided construction inspection supervision. The mitigation strategy for treating the suspended sediment source was to reduce stream erosion by improving the channel geometry through channel reconstruction and locally modifying the slope. In-stream structures (cross vanes and constructed riffles) will locally control grade and manage channel erosive flows. A rock bench and wall adjacent to the mass failing hill slope were designed to mitigate fluvial erosion at or below a 1% probability (100-year) flood. The project was completed in October 2014, with construction costs totaling \$540,146. Design and construction inspection costs were funded solely by DEP.

### *Stony Clove Creek-Warner Creek Confluence*

The 2011 tropical storm floods drastically altered the confluence of Warner Creek with Stony Clove Creek in the hamlet of Chichester. Just upstream of the Silver Hollow Road bridge over Stony Clove Creek, a set of “headcuts”—localized incisions into the streambed that



destabilize the channel upstream—were significantly enhanced and migrated upstream to the confluence with Warner Creek. The streambed was lowered in places by more than 8 to 10 feet and cut into underlying glacial deposits thick with silt and clay. The adjacent Silver Hollow Road embankment was also destabilized and in places the road was experiencing geotechnical failure.

The Town of Shandaken was the official EWP local sponsor and DEP funded the design work by MMI engineers. The design consisted of a full-scale channel restoration that raised the channel bed back to a more stable elevation, and added in-stream structures and more hardened engineering techniques, such as buried metal sheet piling to prevent further bed degradation and high stacked rock walls to armor the road embankment. Because a landowner who owned property in the middle section of the project at the stream confluence refused his support, the project had to be split into two sections: one solely on Warner Creek and one at the downstream end of the damaged Stony Clove reach and extending upstream approximately 800 feet. A total of 1,300 feet of stream was reconstructed. The project was started in late 2013 and resumed in the summer of 2014. Managing the diversion of stream water during construction presented a significant challenge to the construction firm. Given the narrow and very entrenched channel corridor, the water had to be piped around the construction area, largely by gravity and using diverting structures constructed of metal sheet piling. Construction was complete by November 2014, with an estimated construction cost of \$1,585,454. DEP also provided funding for project design and construction inspection by MMI. Figure 4.15 and Figure 4.16 depict conditions before and after construction at the Warner Creek Confluence.





Figure 4.15 Stony Clove Creek below the confluence with Warner Creek, looking downstream prior to construction.



Figure 4.16 Stony Clove Creek looking upstream toward Warner Creek immediately after construction.

### ***Delaware Basin***

DEP's consulting engineer, MMI, designed the Third Brook hillslope stabilization and stream restoration project to address large slope failures caused by the 2006 flood along 1,125 feet of the brook in Walton. DCSWCD matched DEP funds and in-kind expenses in order to match a US Army Corps of Engineers' \$510,000 Water Resources Development Act grant to stabilize landslides and bank failure in the watershed. MMI completed its design and implemented the project on four failing slopes, numbered 3, 4, 5, and 6. Figure 4.17 and Figure 4.18 depict conditions before and after restoration at the Third Brook project site.



Figure 4.17 Third Brook, pre-restoration, Slope #3, showing sheet and rill erosion and the loss of trees. Tree loss becomes a woody debris hazard downstream.





Figure 4.18 Third Brook, post-restoration, Slope #3, showing use of stacked rock wall to protect the toe of the slope with fascines, and coir logs to capture sheet erosion.

Under the SMIP, the DCSWCD designed and implemented stream bank stabilization projects at Beers Brook Sites A (280 feet) and D (300 feet) in the Town of Walton to correct ongoing stream stability issues caused by the 2006 flood in the West Branch Delaware River basin. Riprap was placed along the toe of the stream bank in combination with constructed riffles to halt bank erosion and bed degradation. Through another SMIP grant, the DCSWCD helped the Delaware Electric Cooperative stabilize 150 feet of erosion on Lower Dingle Hill in the Pepacton basin. DEP continued work on designs for two other SMIP projects in Andes (Holiday Brook, Gulf Brook) and one project at the Bovina Highway Garage along the Little Delaware. Construction on these projects is scheduled for 2015.

The DCSWCD and DEP continued working with the Watershed Agricultural Program (WAP) technical team to design and construct two bank stabilization projects to facilitate additional enrollment of riparian land in the CREP. At the Gray Farm in New Kingston, 250 feet of stream bank treatment will enable 1.5 acres to be enrolled in the CREP. On the Johnson Farm in Halcott, the placement of rock riprap, a constructed riffle, and bioengineering along 150 feet of stream bank will allow 10.9 acres to be enrolled in the CREP. The WAP also completed

designs for the Siniscalchi Farm project, which will be constructed in 2015. DEP provided technical assistance to the WAP technical team at site visits on six additional farms.

With additional funding from NRCS under its EWP program, the Town of Hamden was able to complete a project that stabilized 200 feet of stream bank along Chambers Hollow to protect a public road from further erosion.

The County Route 22 EWP project constructed in 2013 along East Brook in the Town of Walton experienced a spring high water event and damage to the brook's newly constructed floodplain. The CSBI developed a riparian buffer plan to address the damages and will install vegetation in the spring of 2015. The CSBI also completed riparian buffer installations on three 2013 EWP sites in the Village of Fleischmanns.

### ***Rondout/Neversink Basins***

In the first half of 2014, work on the “the S-turn” project design to address repeated flood damage on Frost Valley Road (County Route 47) at the Round Pond outlet progressed to 60% completion. The road is one of only a few north/south arteries through the central Catskills, and provides access from the metropolitan areas to the south to Frost Valley YMCA, an educational resource center which represents a significant population center and economic asset in the basin. A determination from FEMA on an application from the Ulster County Department of Public Works for a hazard mitigation grant to fund project construction is pending. DEP will coordinate landowner permissions on the project, whose design is expected to be completed during the spring of 2015 to allow for construction later in the year, in the event a FEMA grant is awarded.

### ***Schoharie Basin***

The flooding from Tropical Storms Irene and Lee, an approximately 500-year event, exceeded the engineering design standards of many of the stream restoration projects built over the past decade. Professional opinion and observation holds that had the projects not been in place, the riverine erosion damages to channel, public, and private infrastructure and to water quality would have been far greater. In total, nine stream restoration projects were damaged by the storm; reconstruction of each was eligible for 75% reimbursement from FEMA. DEP provided GCSWCD with a \$3.7 million change order to provide the funding to reconstruct the necessary elements of these projects. This work, together with the 2013 EWP projects, has been the primary restoration emphasis of the GCSWCD since the storm.

GCSWCD completed four of the restoration projects in 2014 (Brandywine, Ashland Connector, Lanesville, Long Road), while one, the Shoemaker project, was initiated but not completed. (The others, the Conine, Maier, and Holden projects, all on the Batavia Kill, were restored in 2013.) Completion of the West Kill project at Shoemaker is planned for 2015, while construction is expected to begin, and conclude, on the Batavia Kill at Big Hollow the same year. Project reports for many of these original and restored projects are available on [www.CatskillStreams.org/major-streams/schoharie-creek](http://www.CatskillStreams.org/major-streams/schoharie-creek).

##### *Stony Clove Restoration at Lanesville (Ashokan Basin, Greene County)*

The original Lanesville Demonstration Project was constructed in 2003 and was 1,700 feet in length. Several rock structures were badly damaged, and a previously stabilized hillslope at the downstream end of the project was destabilized as a result of the storm. The new work entailed reconstructing rock j-hook vanes, installing one double-silled cross vane, stabilizing stream banks, and enhancing habitat. As an enhancement to the original design, several hundred feet of live stone revetment were installed to provide additional resistance to erosion and prevent channel migration into the high bank failure. Bioengineering included the installation of 3,600 live willow stakes and posts, and 2,010 feet of live willow fascines. Vegetative restoration included seeding with native riparian grasses and planting 846 tree and shrub saplings to establish a two-acre riparian buffer. The project measured approximately 1,025 linear feet in length and was completed in fall of 2014 by Fastracs Inc. at a cost of \$301,789. Figure 4.19 and Figure 4.20 depict conditions before and after restoration of the project.

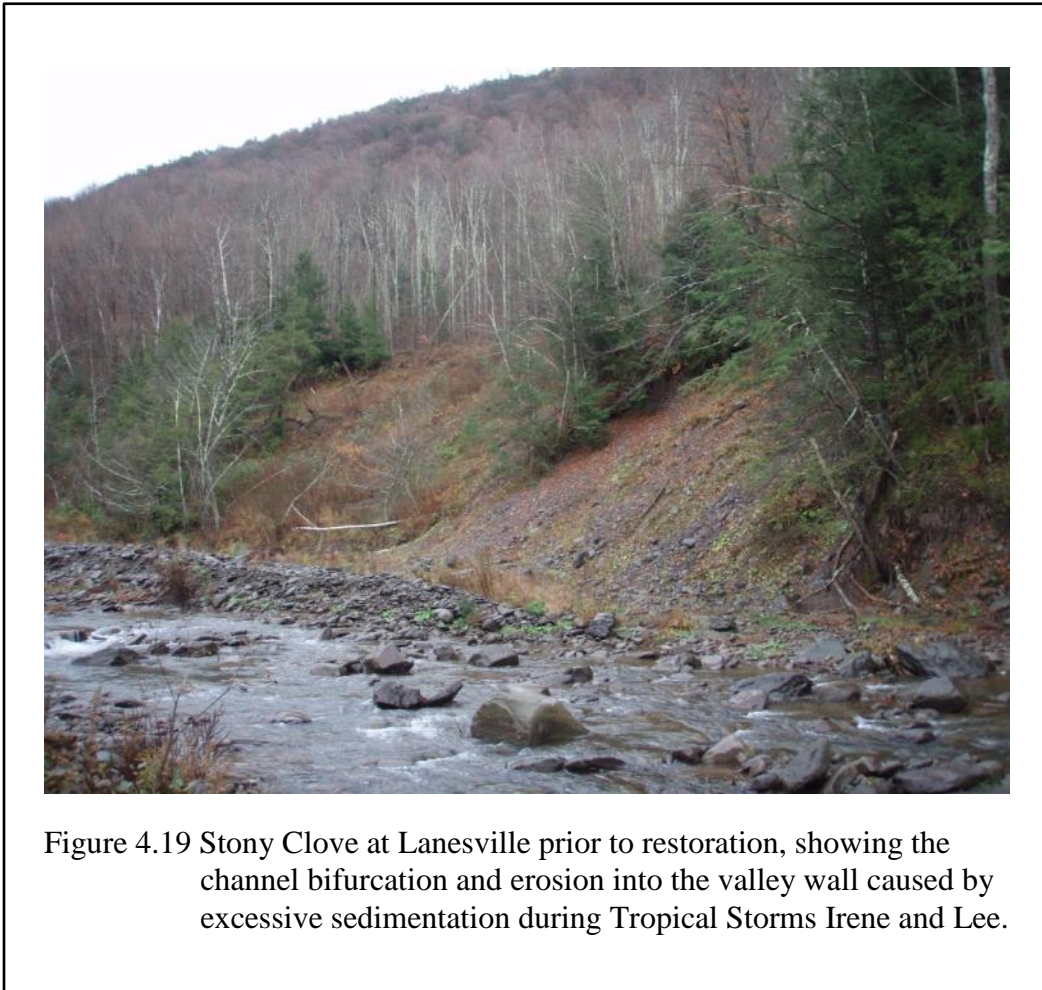


Figure 4.19 Stony Clove at Lanesville prior to restoration, showing the channel bifurcation and erosion into the valley wall caused by excessive sedimentation during Tropical Storms Irene and Lee.





Figure 4.20 Stony Clove at Lanesville after restoration, showing heavy planting and bioengineering along far bank, and cross vane (1) with double sill (2).

#### *West Kill Restoration at Long Road*

Inventories in 2000 and 2004 identified sections of the Long Road reach of the West Kill experiencing large-scale erosion and bank failure. In 2004, the reach contained more than 23% of all the clay exposures identified in the West Kill, and 40% of the reach was experiencing erosion. In 2009, GCSWCD completed a full channel restoration of the 3,000-foot reach at a cost of \$1,059,105. The 2014 work included the addition of three sections of live stone revetment on the outside of meander bends, repair of seven grade control cross vanes, and the addition of nine engineered rock riffles at a cost of \$647,918.

#### *West Kill Restoration at Shoemaker*

The 1,500-foot Shoemaker project, whose primary goal was to mitigate turbidity sources, was originally completed in 2004 and is located immediately downstream of the GCSWCD's 2013 County Route 6 EWP stream restoration project. Project repair required a reworking of the connection between the two projects. Construction was initiated in September 2014 in rare dry conditions, but was halted in late October as working conditions deteriorated. Construction will resume in 2015.



##### *Batavia Kill Restoration at Brandywine*

The original Brandywine stream restoration project measured approximately 3,800 feet and was completed in the fall of 1999. In 2014, GCSWCD restored 1,150 feet of the channel and an additional 160 feet of a major tributary, North Settlement Creek. Grade control and stream bank protection were accomplished with two cross vanes and five single arm rock vanes, and live stone revetment was placed and vegetated along the outside of meander bends. Bioengineering and plantings included 2,192 willow stakes, 2,320 feet of willow fascine, 2,808 containerized plants, and permanent native riparian grass. The project mitigated of 0.86 acres of wetland to offset wetland impacts during construction. Evergreen Mountain Contracting oversaw construction at a cost of \$395,902. Figure 4.21 and Figure 4.22 depict conditions before and after restoration of the project.



Figure 4.21 The Batavia Kill at Brandywine prior to restoration. During the recession of floodwaters during Tropical Storms Irene and Lee, a massive volume of sediment was deposited in the low gradient sections of the project reach, causing channel bifurcation and bank erosion.



Figure 4.22 The Batavia Kill at Brandywine following restoration.

#### *Batavia Kill Restoration at Ashland Connector*

The original 3,400-foot Ashland Connector project connected to the downstream end of the Brandywine project and was built in 2006. Evergreen Mountain Contracting restored 1,150 feet of the stream channel, repaired existing rock structures, and made strategic use of live stone revetment to enhance bank protection. Bioengineering and plantings included 1,500 willow stakes, 1,008 feet of willow fascines, 2,303 containerized plants, and riparian native grasses. One acre of wetland was created to offset wetland impacts during construction. The total project cost was \$176,332.

### **4.7 Riparian Buffer Protection Program**

DEP values the importance of protecting and managing riparian buffers as a critical 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 provides an update on each of the elements of riparian buffer protection, including the progress of existing DEP programs and the Catskill Streams Buffer Initiative (CSBI).

### 4.7.1 Activities on City-owned or Controlled Land

#### *Land Acquisition Program*

The Land Acquisition Program (LAP) seeks to prevent future degradation of water quality by acquiring permanent real property interests. The overarching goal of the program is to ensure that undeveloped, environmentally sensitive watershed lands remain permanently undeveloped. See Section 4.2 for details of LAP activity in 2014.

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. The best way to protect buffers is to secure fee simple ownership. The next best mechanism is to secure conservation easements on privately-held land. Through the end of 2014, 39.1% of the entire 1,048,660-acre Catskill/Delaware watershed system (including reservoirs) was protected by outright ownership or easement held by DEP, WAC, or DEC, or by other public or private open space entities, such as municipal parks or land trusts. This area includes roughly 33.9% (86,471 acres) of all stream buffers in the watershed. Since 2004, DEP has increased the percentage of City-protected stream buffers from 7.5% to 16.2%. Table 4.7 presents a breakdown of the total land area in the Catskill/Delaware watersheds by ownership.

Table 4.7. Catskill/Delaware riparian buffer<sup>1</sup> summary as of December 31, 2014.

Land Protection Category	Total in Cat/Del Watershed incl. reservoirs (acres)	Percent Total Cat/Del Watershed Area	Percent Total Cat/Del Stream Miles	Percent Total Cat/Del Riparian Buffers
Publicly-owned or Controlled lands <sup>2</sup>				
NYC-owned property (Pre-1997)	61,293	5.8	2.7	3.0
NYC-owned property (Post-1997, Fee Simple, Conservation Easement, WAC Conservation Easement)	130,834	7.9	8.4	8.2
Subtotal NYC Lands and Easements	192,127	18.3	16.3	16.2
NY State-owned Land	209,368	20.0	16.3	16.7
Other in Protected Status <sup>3</sup>	8,267	0.8	1.1	1.0
Total Cat/Del Public Land	409,763	39.1	33.7	33.9
Private Watershed Lands				
Private Land	638,897	60.9	66.3	66.1
Total All Cat/Del Privately-owned Land	638,897	60.9	66.3	66.1
Grand Total All Land in Cat/Del	1,048,660	100.0	100.0	100.0

Cat/Del includes all WOH basins plus West Branch, Boyd Corners, and Kensico.

<sup>1</sup>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.

<sup>2</sup>NYC-owned property pre-1997 includes the reservoir area controlled by NYC; post-1997 property includes properties under contract or closed as of 12/31/14.

<sup>3</sup>“Protected Status” means the land is believed to be under some form of permanent ownership by a land trust or municipal government.

Note: Land Ownership acreage categories are calculated directly from areas of GIS polygons and therefore may not match exactly other survey-based acreage totals submitted by DEP. Watershed statistics calculated from LiDAR-derived 1-m basin boundaries initially updated fall 2013 and refined during 2014.

### Land Management Activities

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 its land, but requires a minimum 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. Additionally, DEP secures permits for stream crossings as required by NYSDEC and selects those that have the least adverse impact on the stream and floodplain (e.g., temporary bridges, temporary arch culverts).

### 4.7.2 Activities on Privately-Owned Lands

Privately-owned lands contain approximately 66 % of the total riparian buffer acreage (168,709) in the Catskill/Delaware watershed. Privately-held riparian lands are most commonly found in the Cannonsville basin (81.4 %) 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 New York City Memorandum of Agreement (MOA) (1997) 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. The following sections describe the ongoing activities of DEP programs that protect and enhance riparian buffers on privately-owned land.

#### *Catskill Streams Buffer Initiative*

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 (SMP) (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 the riparian forest are evident, and is designed to provide a program for sites not eligible for other programs.

#### *Native Plant Materials and Plant Supply*

##### 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 continues to be one of the important aspects of CSBI. To provide this material, careful consideration is given to plant selection, propagation, and grow-out techniques. As a result of these efforts, local genotype planting stock are available not only to CSBI, but also to 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

The New York City Parks and Recreation's Greenbelt Native Plant Nursery continues to collect, clean, and store Catskill native plant seed, and to propagate this seed for use in CSBI and other riparian restoration efforts. In 2014, DEP and its partners received 20,273 gallon-sized trees and shrubs from Greenbelt, most of which are currently being overwintered for anticipated installation on 2015 projects. To date, 72,000 herbaceous plugs, 44,803 gallon-sized trees and

shrubs, and 17,500 tree and shrub tubelings have been received. All of this material originates from the Catskill Mountains, providing locally-native stock that is adapted to regional conditions, giving it a competitive edge for survival and providing a range of ecological values beyond stream bank stability.

### *Riparian Buffer Restoration Projects*

#### Implementation

Principal responsibility for implementing the CSBI rests with five CSBI coordinators at partnering Soil and Water Conservation Districts (SWCDs) and one DEP coordinator. 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 any completed stream management plans and document landowner priorities and goals, which are specifically tailored to each project site. After analyzing historic information and documents and landowner concerns, the plans propose a suite of recommendations that range from best management practices landowners can perform themselves to more substantial practices that require SWCD assistance. In 2014, CSBI coordinators completed 6 RCMPs, bringing the number completed since 2009 to 101. 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 2014, the CSBI successfully planned and completed 16 riparian buffer restoration projects, depicted in Figure 4.23. These 16 projects enhanced riparian vegetation on over 11.9 acres of streamside property and over 1.8 miles of stream bank length. Altogether, 3,810 native Catskill plants were installed, along with over 2,200 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, 154 projects have been completed, restoring over 88 acres of riparian buffer along 13 miles of stream length. Through these projects, nearly 43,000 plants, all species native to the Catskill region, were planted within the watershed.



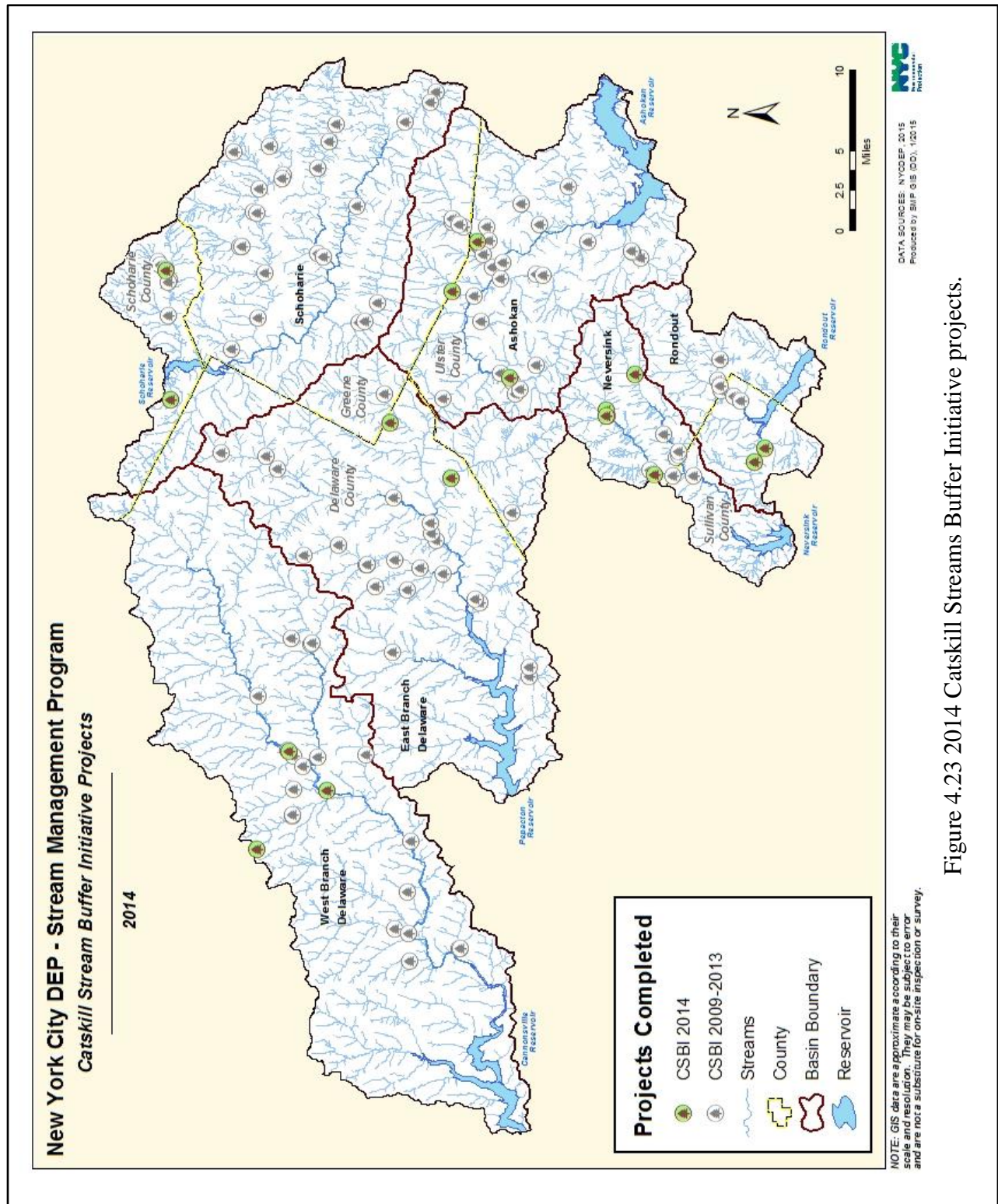


Figure 4.23 2014 Catskill Streams Buffer Initiative projects.

In addition to projects involving the installation of plants, 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 initiated in previous years were revisited in 2014, with specific focus given to the removal of Japanese knotweed from the riparian buffer. Invasive species removal techniques include both stem injection and foliar application of herbicides, as well as hand or mechanical pulling.

Riparian vegetation was also enhanced on five non-CSBI stream restoration projects in 2014, where more than 3,825 trees and shrubs were planted and over 4,000 feet of bioengineering treatments were installed.

### Evaluation

CSBI projects are monitored in the years following completion using a protocol developed specifically for the program. Monitoring plots at each site cover approximately 10% of the total area planted, providing a representative sample of plant conditions at each project. Data collected within each monitoring plot include plant height, stem diameter, vigor, predation, and overall survivability. The objective is to collect data documenting the survival and growth rates of individual plant species and the effectiveness of installation techniques, and to gain an understanding of the factors having the greatest influence over project success. The goal is to monitor projects at regular intervals for five years following installation, providing information on project success and/or the need for repairs. Eighteen new monitoring sites were added in 2014, bringing the number of active monitoring sites to 72. To date, most of these sites have been monitored only once, making any analysis of results premature.

### ***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 to maintain the volume of plant materials needed to supply restoration and CSBI projects. The crews assisted CSBI coordinators load and unload material, prepare sites, transplant, maintain plant material centers, and monitor vegetation. 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.

DEP organizes and hosts annual meetings of an interagency Riparian Buffer Working Group, whose goal is to keep members apprised of current riparian buffer management and restoration strategies. These meetings also provide a forum for local natural resource professionals to share progress updates and receive training on new techniques in the field. In 2014, presentations and discussions covered progress of the CSBI program, Hudson River Estuary Trees for Tribes, NYC Watershed Conservation Reserve Enhancement Program (CREP), the Catskill Regional Invasive Species Partnership, and the Catskill Center for Conservation and Development.

### ***Watershed Agriculture Program & Watershed Forestry Program***

See Sections 4.4 and 4.5 for information about the riparian buffer protection efforts of the Watershed Agricultural Program and the Watershed Forestry Program, respectively, including an update on the activities of the CREP in Section 4.4.4.

### **4.8 Wetlands Protection Program**

DEP's Wetlands Protection Program collects information about the characteristics, distribution, and functions of wetlands to inform regulatory and partnership protection programs. In 2014, DEP continued to protect wetlands through land acquisition and to review wetland permit applications in the watershed. DEP also implemented a pilot project to advance wetland mapping techniques using Light Detection and Ranging (LiDAR) technology. In addition, DEP summarized approximately 10 years of data collected from reference sites into a concise report detailing wetland conditions in the Catskill/Delaware watershed.

#### **4.8.1 Permit Review**

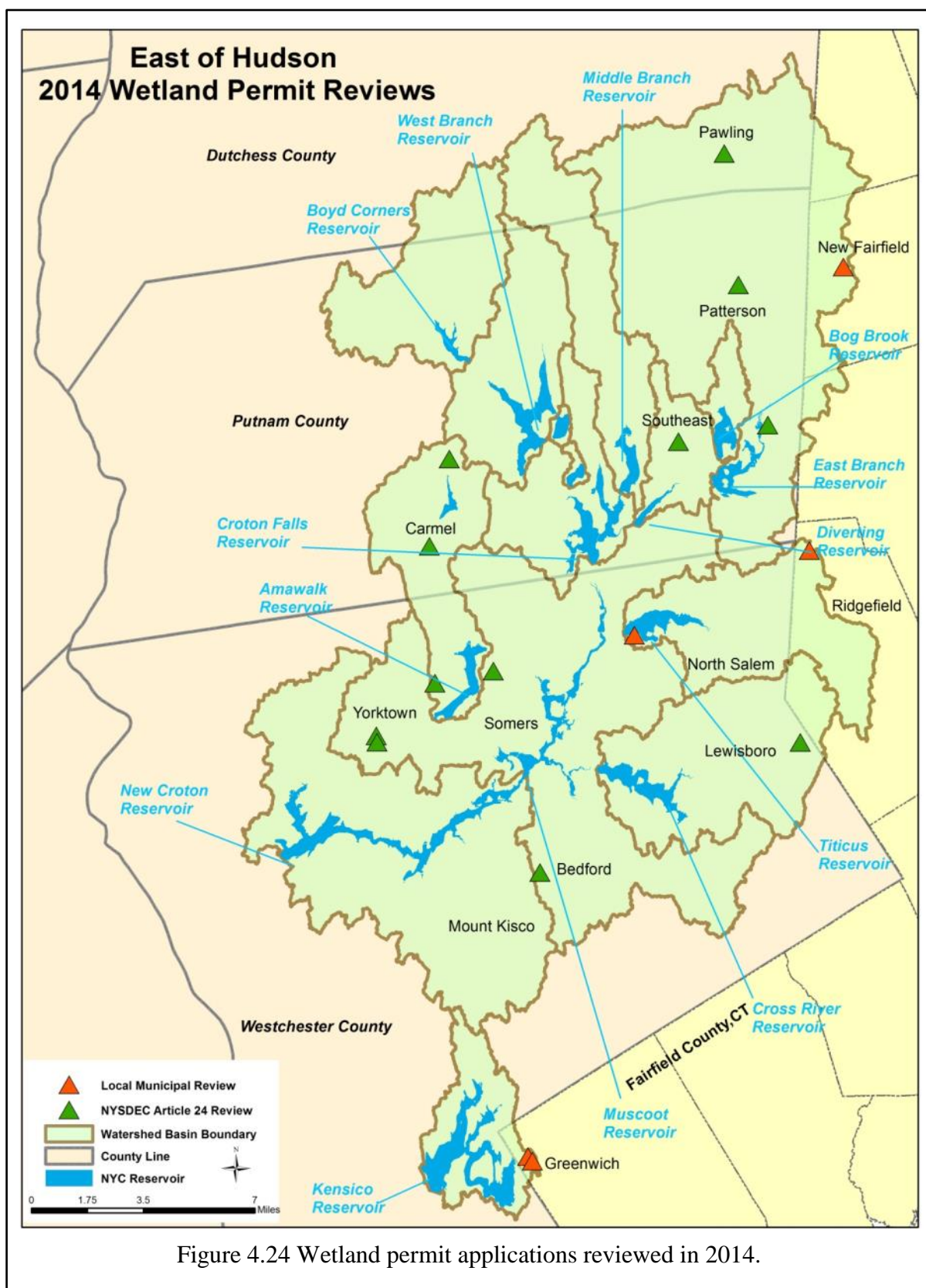
DEP reviews wetland permit applications in the watershed and provides comments when alternatives that would avoid, minimize, or mitigate wetland and water quality impacts are identified. Project plans are often modified in response to DEP's comments, resulting in less wetland and/or adjacent area impact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

In 2014, DEP reviewed 17 wetland permit applications, all of which were located in the East of Hudson (EOH) watersheds (Figure 4.24, Table 4.8). Twelve of those applications were submitted pursuant to the New York State Freshwater Wetlands Act (NYS Environmental Conservation Law, Article 24), which regulates both state-mapped wetlands and adjacent areas within 100 feet of such wetlands. Five municipal wetland applications were also reviewed. The majority of wetland applications were for disturbance within the adjacent area.

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 the minimization of wetland impacts in advance of federal review stemming from the State Environmental Quality Review Act (SEQRA) and the local and state permitting process, as well as to the availability of nationwide permits under the federal program.

DEP reviewed the USEPA's proposed rule on the definition of "waters of the United States" under the Clean Water Act. Using findings from reference wetlands monitoring, the National Wetlands Inventory (NWI), and the updated National Hydrography database for the watershed, the City indicated its support for broad federal jurisdiction over streams and wetlands, the protection of which is critical to maintaining the high quality of the City's water supply. The City issued its comments on the proposed rule in a November 14, 2014 letter to the USEPA.





## 4. Protection and Remediation Programs

Table 4.8. Wetland permit applications reviewed in 2014.

Project name	Permit type	Reservoir basin	Regulated activity
Hosch/Torres Subdivision	NYSDEC	Amawalk	Adjacent area disturbance
Summer Trails Pond	NYSDEC	Amawalk	Aquatic nuisance species management
Mazzola Property	NYSDEC	Amawalk	Adjacent area disturbance
Handler Property	NYSDEC	Cross River	Wetland, adjacent area disturbance
Solano Residence	NYSDEC	Diverting	Adjacent area disturbance
UPR Enterprises LLC	NYSDEC	East Branch	Adjacent area disturbance
Castagna Commerce Park	NYSDEC	East Branch	Wetland, adjacent area disturbance
Barn Brooke Estates	Local	East Branch	Wetland, adjacent area disturbance
Covino Residence	NYSDEC	East Branch	Adjacent area disturbance
Rosa Property	Local	Kensico	Adjacent area disturbance
40 Locust Road	Local	Kensico	Adjacent area disturbance
West Patent Elementary School	NYSDEC	Muscoot	Adjacent area disturbance
Valley Pond	NYSDEC	Muscoot	Aquatic nuisance species management
FDR State Park Trail	NYSDEC	Muscoot	Wetland, adjacent area disturbance
Yorktown Police Department	NYSDEC	Muscoot	Adjacent area disturbance
Voga Residence	Local	Titicus	Wetland, adjacent area disturbance
Jane Love	Local	Titicus	Adjacent area disturbance

### 4.8.2 Land Acquisition

According to the NWI and NYSDEC Freshwater Wetland maps, there are approximately 15,190 acres of wetlands in the Catskill/Delaware watershed. Since 1997, DEP has protected 2,687 acres, or 17.7%, of these wetlands through its Land Acquisition Program. (See Section 4.2 for details of the Land Acquisition Program.) Table 4.9 summarizes the number and acreage of wetlands that have been protected through acquisition for both the Catskill/Delaware and Croton watersheds. Figure 4.25 depicts a wetland on a property in Middletown (Pepacton basin) that was acquired in 2014.



Figure 4.25 Wetland protected in the Pepacton basin through land acquisition in 2014.

Table 4.9. Wetlands acquired or protected by the NYC Land Acquisition Program (LAP) in the Catskill/Delaware and Croton Systems as of December 31, 2014.<sup>1</sup>

Description	Acres	Percent of total watershed acreage	Percent of total land acquired	Percent of total wetland type in system
<b>Catskill/Delaware (Ashokan, Schoharie, Rondout, Neversink, Pepacton, Cannonsville, West Branch, Boyd Corners, Kensico basins)</b>				
<i>Entire Watershed</i>	1,048,660			
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats <sup>2</sup> )	15,190	1.5		
Inundated Aquatic Habitats <sup>2</sup>	28,336	2.7		
Total Wetlands and Inundated Aquatic Habitats <sup>2</sup>	43,526	4.2		
<i>Lands Under Contract or Closed by DEP as of 12/31/14<sup>1,3</sup></i>	130,834	12.5		
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats <sup>2</sup> )	2,687		2.1	17.7
Inundated Aquatic Habitats <sup>2</sup>	186		0.1	0.7
Total Wetlands and Inundated Aquatic Habitats <sup>2</sup>	2,873		2.2	6.6
<b>Croton</b>				
<i>Entire Watershed</i>	212,700			
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats <sup>2</sup> )	20,025	9.4		
Inundated Aquatic Habitats <sup>2</sup>	10,809	5.1		
Total Wetlands and Inundated Aquatic Habitats <sup>2</sup>	30,834	14.5		
<i>Lands under contract or closed by DEP as of 12/31/14<sup>1,3</sup></i>	19,901	0.9		
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats <sup>2</sup> )	98		4.9	0.5
Inundated Aquatic Habitats <sup>2</sup>	1		0.1	0.0
Total Wetlands and Inundated Aquatic Habitats <sup>2</sup>	99		5.0	0.3

<sup>1</sup>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 and refined during 2014.

<sup>2</sup>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).

<sup>3</sup>Includes fee, conservation easements, and farm easements. Excludes non-LAP and pre-MOA land. Note: Croton total LAP acreage reduced by 120 from December 2014 due to recategorization of Parcel ID8807 as non-LAP.



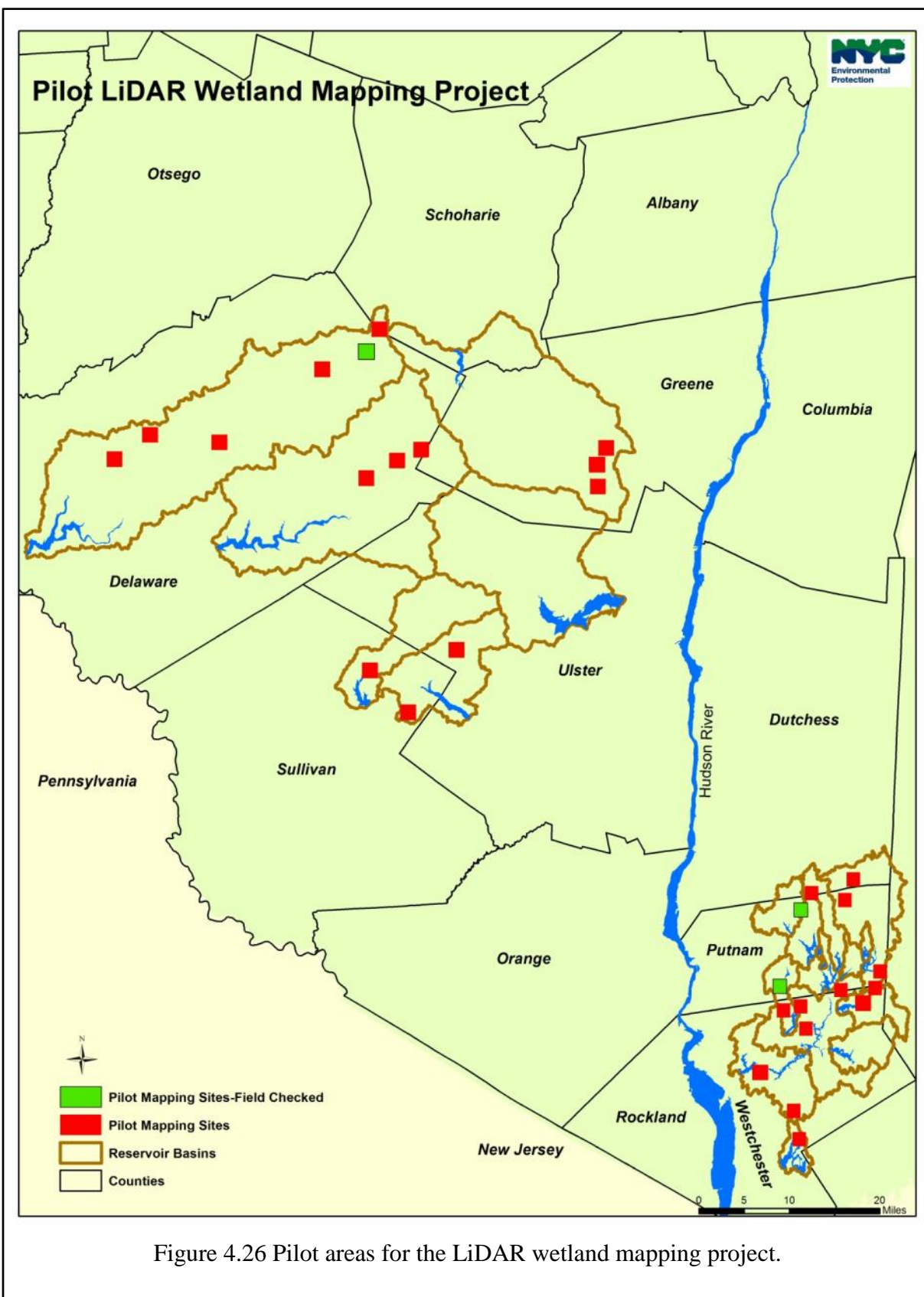
### **4.8.3 Wetland Mapping**

Work commenced on a contract with the Regional Application Center for the Northeast to explore using the 2009 Light Detection and Ranging (LiDAR) data to improve the accuracy of wetland mapping and connectivity assessment in the watershed. The LiDAR data and aerial photography collection may make it possible to achieve this because of the improved resolution, accuracy, and completeness of watershed hydrography, topography, and land use coverages they offer, which in turn may provide a richer source of wetland indicators than standard photointerpretation methods alone. Improvements in wetlands mapping would benefit the numerous watershed protection programs that rely on this information. Further, the enhanced resolution of wetland connectivity would improve the ability to assess wetland function and federal jurisdictional status.

The project is being conducted in four phases. The goal of the first phase was to assess spatial variation in the quality of the LiDAR data to identify issues that might negatively impact the development of automated wetland mapping protocols in the watershed. This step was completed in 2014, and because no significant issues were detected, Phase 2 was initiated later in the year.

The goal of Phase 2 is to develop modeling protocols that use LiDAR-derived data, imagery, and thematic GIS data to map wetlands in pilot areas in both the EOH and West of Hudson (WOH) watersheds. To this end, 30 pilot mapping areas were selected, 15 sites in the EOH and 15 in the WOH watersheds (Figure 4.26). Pilot areas ranged from 1,500 to 2,000 acres, and included five representatives of the three primary vegetated wetland types (emergent, scrub-shrub, and forested) across a variety of landscape positions. A preliminary modeling protocol was developed and run on the pilot areas. DEP field checked the preliminary model output at approximately 50 wetlands in three of the pilot areas, two in the EOH and one in the WOH watershed, in the fall of 2014 (Figure 4.26). Field data were provided to the contractors to help them refine the draft wetland modeling protocol. Revision of the modeling protocol will be completed in 2015.

Phases 3 and 4 will be completed in 2015.



### 4.8.4 Wetland Monitoring

DEP gains information on the characteristics and functions of watershed wetlands through long-term monitoring of 21 reference wetlands comprising 117 acres in the Catskill/Delaware watershed. Reference wetland monitoring provides data to support wetland mapping, protection, and management programs and is used to assess long-term trends in wetland condition and function.

In 2014, DEP continued to collect data from automated monitoring wells in the reference wetlands. The wells measure water table level at 6-hour intervals and provide a long-term hydrologic record for various wetland types. DEP also analyzed vegetation, soils, and water level data collected over a 10-year period from 129 reference wetland plots. The reference wetland database includes 216 plant species, 14,960 water level measurements, and multiple analytes from 50 soil samples. A report, summarizing these parameters for forested, scrub-shrub, and emergent reference wetlands in the Catskill/Delaware watershed, was issued in 2014.

### 4.8.5 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, including its natural and cultural resources. 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 2014, DEP delineated six wetlands on three proposed forest management projects on City lands. These delineations also provide DEP with field-scale data on the characteristics of wetlands on City lands, and support remote wetland mapping efforts such as the NWI and LiDAR pilot project.

### 4.8.6 Education and Outreach

DEP continued to distribute, both at forums and technical conferences, the educational pamphlet *Wetlands in the Watersheds of the New York City Water Supply System*. DEP also conducted an educational event at a wetland on City property in the town of New Kingston. The Wetlands Program also provided in-house training to DEP Operations staff on state and federal wetland regulations.

## 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***

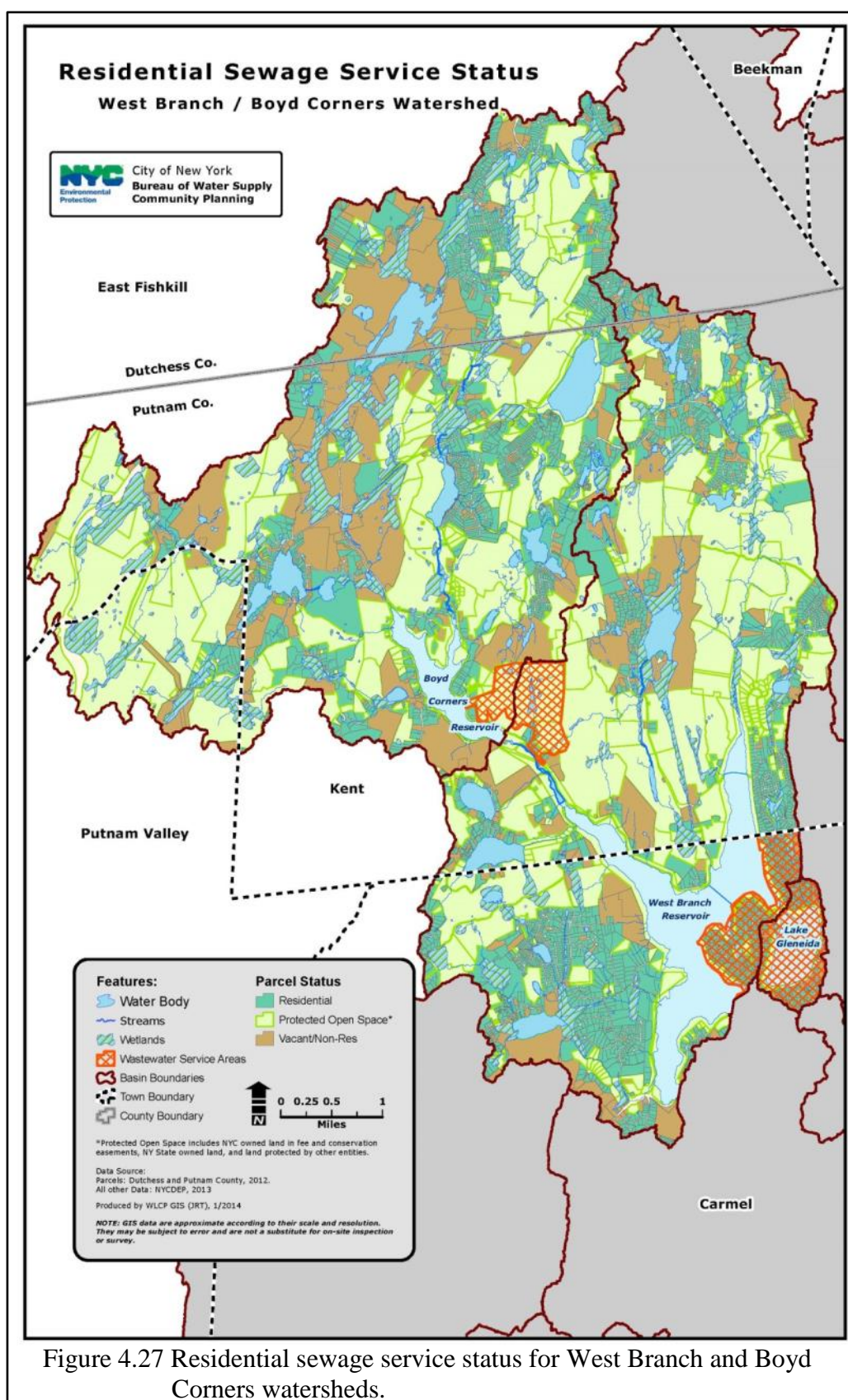
DEP is available to provide technical support to Westchester and Putnam Counties in their efforts to reduce the potential impacts of improperly functioning or maintained subsurface sewage treatment systems (SSTs). In 2014, the Westchester County Health Department continued to operate its Septic System 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 2013, DEP submitted a proposal to implement the West Branch and Boyd Corners Septic System Rehabilitation Reimbursement Program. During the reporting period, DEP received approval of the proposal and initiated the internal contracting process to enable the program to begin. This process involves amending the existing contract with the New York State Environmental Facilities Corporation (EFC) to allow for expansion of the Septic System Rehabilitation Reimbursement Program into the West Branch and Boyd Corners watershed basins.

Under the program, DEP will provide funding to reimburse a portion of the costs to rehabilitate eligible failing SSTs 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 SSTs.

Once the program is established, participating home owners who repair their septic systems will be able to submit documentation to EFC and receive up to a 50% cost share for the cost of the repair. 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 SSTs and centralized sewer systems are shown in Figure 4.27.





## 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*

##### 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, DEP worked on accommodating the Town's request for moving the basin and vegetative screening that would minimize visual impact. The Town requested that DEP use deciduous trees rather than evergreen. The Town's requested changes made it necessary for DEP to amend its contract with its engineering design consultant, which was accomplished in October 2014. Once the contracting changes were in place, the design consultant resumed work on design and addressing SEQR. Also, the necessary permits are being prepared for each appropriate agency. DEP will submit revised contract documents to the Town Environmental Control Board when all the appropriate permit applications are submitted. This project will be bid with the Maple Avenue project.

### *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 February 2014, DEP issued the \$4.5 million payment for the Croton Falls/Cross River Stormwater Retrofit Program.



#### **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 Wastewater-Related Nonpoint Source Pollution Management Programs**

###### ***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.

In spring 2014, 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. In 2014, one additional resident signed into the program. Figure 4.28 shows the sewage service status of each parcel based on resident responses and other available records.

###### ***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.

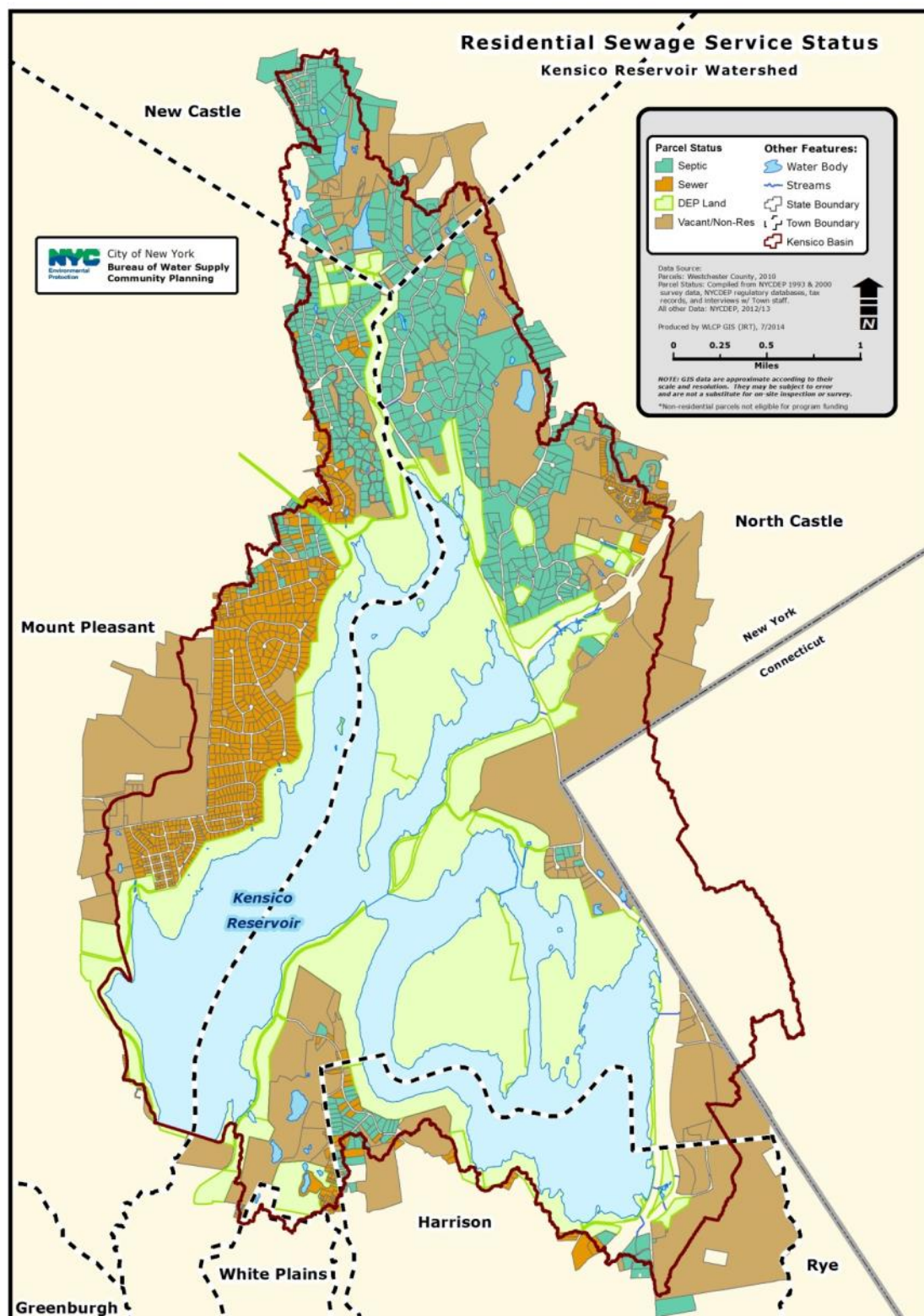


Figure 4.28 Residential sewer service status in the Kensico basin.

In 2012, 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. 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 consent order (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.

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 August 2014. Routine partial inspections were also conducted at various times throughout the year in association with ongoing maintenance of Kensico stormwater best management practices (BMPs) in the vicinity of the line. No defects or abnormalities were noted.

#### **4.10.2 Stormwater Management and Erosion Abatement Facilities**

##### ***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 4.29, were routinely inspected and maintained as needed throughout 2014 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.

##### ***Spill Containment Facilities***

DEP installed, and now maintains, spill containment facilities in and around Kensico Reservoir (Figure 4.29). The facilities improve spill response and recovery, thereby minimizing water quality impacts in the event of a spill. In 2014, routine maintenance was completed at the spill boom sites. There were no spills that required the deployment of booms.

***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. DEP's diving contractor performed inspections of both turbidity curtains in October 2014. Based on these inspections, no immediate repair work was required and the turbidity curtains appear to be functioning as intended.

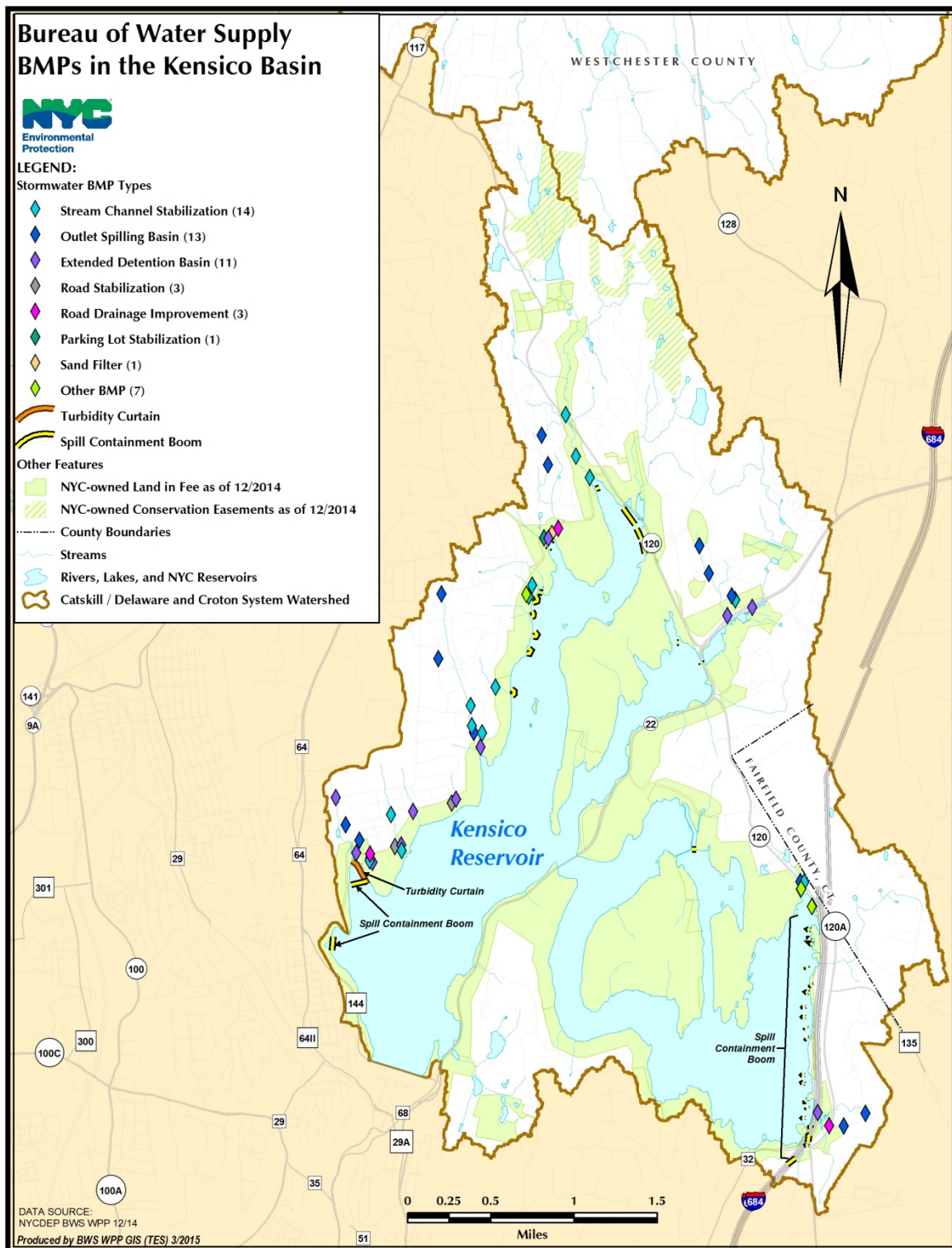


Figure 4.29 BMPs in the Kensico basin.



### ***Kensico Action Plan***

Project completed.

### **4.10.3 Other Watershed Programs**

#### ***Catskill Upper Effluent Chamber***

The Catskill Upper Effluent Chamber (CATUEC), situated along the shore of a cove in the southwest section of Kensico Reservoir, has been off-line since the Catskill/Delaware Ultraviolet (UV) Disinfection Facility went into service in 2012. DEP had previously explored the possible need for a shoreline stabilization project to mitigate the resuspension of near-shore materials near CATUEC during wind events. With CATUEC off-line, the concern for potential resuspension of near-shore materials near CATUEC has been minimized. As operation of the Catskill/Delaware UV Disinfection Facility is assessed, DEP will evaluate the proposed future use and location of CATUEC. That review and the assessment of a potential shoreline project is ongoing.

#### ***Shaft 18 Shoreline Stabilization***

Shaft 18 is situated along the shore in the southwest section of Kensico Reservoir. Since the Catskill/Delaware UV Disinfection Facility was placed in service, all water in the Kensico Reservoir has flowed through the Delaware effluent chamber at Shaft 18. This has changed the flow pattern in the reservoir, as a result of which water is now drawn from a larger area into the Delaware effluent at Shaft 18. Increased reliance on Shaft 18 as the sole effluent from Kensico Reservoir, together with changing weather patterns, has made it necessary to harden the shoreline in the vicinity of the effluent chamber.

DEP has begun to assess the scope of a project to stabilize the shoreline on both sides of Shaft 18. In 2014, DEP hired an engineering firm to study and design the proposed stabilization project. The firm has completed a technical memorandum on the design issues and has completed a draft Basis of Design Report (BODR). Based on the draft BODR, the project will implement shoreline stabilization and protection measures of approximately 700 linear feet at the western shoreline and approximately 475 linear feet at the cove area.

#### ***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 there. The Westchester County Department of Public Works and Transportation continued to develop its forthcoming Airport Master Plan. No airport-related activities occurred in the Rye Lake drainage basin during the reporting period.

#### ***Route 120***

Project completed.



### **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 off-line (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 minimize the frequency and duration of alum treatment. Drawing down the elevation of the West Basin, by utilizing water when quality is acceptable, and releasing water to the Lower Esopus Creek 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.

#### ***4. Protection and Remediation Programs***

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In early 2014, the 100% complete specifications and drawings were reviewed and approved for letting the construction contract out to bid. Advertisement for bidding began in April 2014. In May, four bids were received and reviewed for accuracy. It was determined that the low bidder, Jet Industries, met or exceeded all of the contract requirements and it was awarded the construction contract in October. After funding approval was received, the contract was registered and the contractor was issued a December 1, 2014 Order to Commence Work date.

The construction schedule includes “black-out” periods (May 1-September 30) during which the contractor will 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.

##### ***Shaft 4 Project***

The construction work at Shaft 4 has progressed steadily over the year. Early in the year, the Catskill Aqueduct was fully encased and the water supply was temporarily shut down to make final connections into the aqueduct in March 2014. During the shutdown, a temporary “community connection” pipe was activated to provide the downstream communities’ water supply throughout the shutdown period. Seven 48-inch diameter pipes were installed between the new Shaft 4 Distribution Chamber and the Catskill Aqueduct, and the area was backfilled. The new Shaft 4 addition structure was completed, all large diameter piping and valves were installed and tested, and electrical, HVAC and plumbing work started. Full facility testing is planned for this spring and summer. When complete, the facility will allow Delaware Aqueduct water to be transferred into the Catskill Aqueduct in Gardiner, NY, where the two aqueducts cross.

##### ***Operation Support Tool (OST)***

Since taking delivery of OST in late 2013, DEP has used the system on a nearly daily basis to better inform reservoir operations and planning. The National Weather Service has reliably provided ensemble inflow forecasts from the new Hydrologic Ensemble Forecast Service (HEFS) it is piloting in the NYC water supply basins as part of its partnership with DEP. These ensemble forecasts provide critically important information on range and likelihood of potential future conditions, which in turn provides additional context for water supply managers to make operating decisions.

In one noteworthy example of the use of probabilistic information, DEP made large releases from the west basin of Ashokan Reservoir from mid-February through March 2014 to accommodate spring runoff from a very large snowpack that had developed. The west basin dropped below the 10th percentile elevation before refilling and meeting the Conditional Seasonal Storage Objective in the spring. Without the probabilistic information provided by

OST with HEFS forecasts, managers would not have had the confidence to draw the reservoir down so low.

Water quality projections for the Catskill System and Kensico were also performed several times in 2014, though these were just routine projections, since no major turbidity events have occurred since OST was implemented. Staff continue to develop fluency and skill with OST for routine operations, and new features are planned pending availability of funding. The system is also being used for ongoing assessment of climate change impacts on the water supply, including water quality impacts, and potential mitigation strategies.

## 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 2014 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) and the Revised 2007 FAD (NYSDOH 2014); 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 had specified many requirements in the 2007 FAD that were meant to protect public health, and NYSDOH has continued to specify requirements in the Revised 2007 FAD. 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 (DEP 2011b). 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 2011c), 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. Aqueduct 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 models. The meteorological data collection effort provides critical input necessary to meet both watershed and reservoir modeling goals. The modeling program's activities in 2014 are summarized in the 2014 Multi-Tiered Modeling Program Annual Status Report. (See Section 5.3 for details on accessing the report.)

*Surveillance monitoring.* The surveillance monitoring plan contains several objectives that provide information to guide the short-term 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 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 that necessitate additional, non-routine water quality monitoring. For example, weather-related monitoring was conducted at Kensico Reservoir due to a significant storm event that occurred on July 14-15, 2014, with a rainfall total of 3.33 inches. The amount of precipitation received (> 2 inches) prompted the initiation of a special investigation. Analytes investigated included turbidity, coliform bacteria, and conductivity; in addition, Microbial Source Tracking (MST) was performed. MST testing indicated trace levels of ruminant fecal biomarkers in two of six stream samples, and one stream sample was positive for low levels of both ruminant and two different human fecal biomarkers. Although increases in turbidity and fecal coliform were seen at stream

sites, changes in these analytes were minimal at nearby reservoir sites. There were no turbidity or fecal coliform issues at the reservoir effluent (DEL18DT).

A second example of non-routine monitoring occurred in late June when an intense rainstorm in the Pepacton watershed resulted in a rise in turbidity at the aqueduct intake. This led to additional samples being collected at the Pepacton elevation taps and on the reservoir survey, which provided operators with information that allowed them to make decisions on gate changes to optimize water quality.

Another special investigation that was undertaken in 2014 was an effort to identify whether or not the leachate from septic systems in the hamlet of Shokan impacts stream water quality in the area. A sampling site was selected for the study that captures input from a portion of Shokan that has land use that might be expected to produce water quality impairments, if they exist. The land use includes high density of development, a relatively low number of vacant parcels, and a mix of both commercial and residential land use. The stream site drains a large portion of the hamlet of Shokan, and is a tributary of Ashokan Brook, which flows into the East Basin of Ashokan Reservoir. Twice-a-month sample collection began in August 2014 and will continue for a year. Also, selected storm events will be sampled. Analytes were selected based on their ability to help detect the presence of wastewater impacts from human sources. Fecal coliform results will serve as a screening tool and if contamination is indicated, Bacteroidales HF183 analysis is proposed as a source tracking tool to specifically identify human impact. Bacteroidales analysis will be used selectively only when fecal coliform counts are elevated. A report on the findings of this study will be prepared after the sampling has been completed in 2015.

Additional special investigations were performed in 2014 to document manmade or natural events occurring in the watershed that had the potential to negatively affect water quality. Other examples of special investigations included sampling to determine if aqueduct leaks can be identified, sampling for the presence of *Chrysosphaerella* (a potential taste-and-odor alga), and other sampling to assist with operation of the water supply.

### 5.1.3 Water Quality Reports

Pursuant to the City's Long-Term Watershed Protection Plan 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 2014a). 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 2014 report (due July 2015), the limnology and hydrology components of the document will draw largely from information obtained from approximately 218 routinely-sampled reservoir and stream sites, resulting in almost 5,200 samples and over 60,000 analyses. In addition, robotic limnological profiling added almost 56,000 analyses. For the pathogen component, 483 routine samples were collected

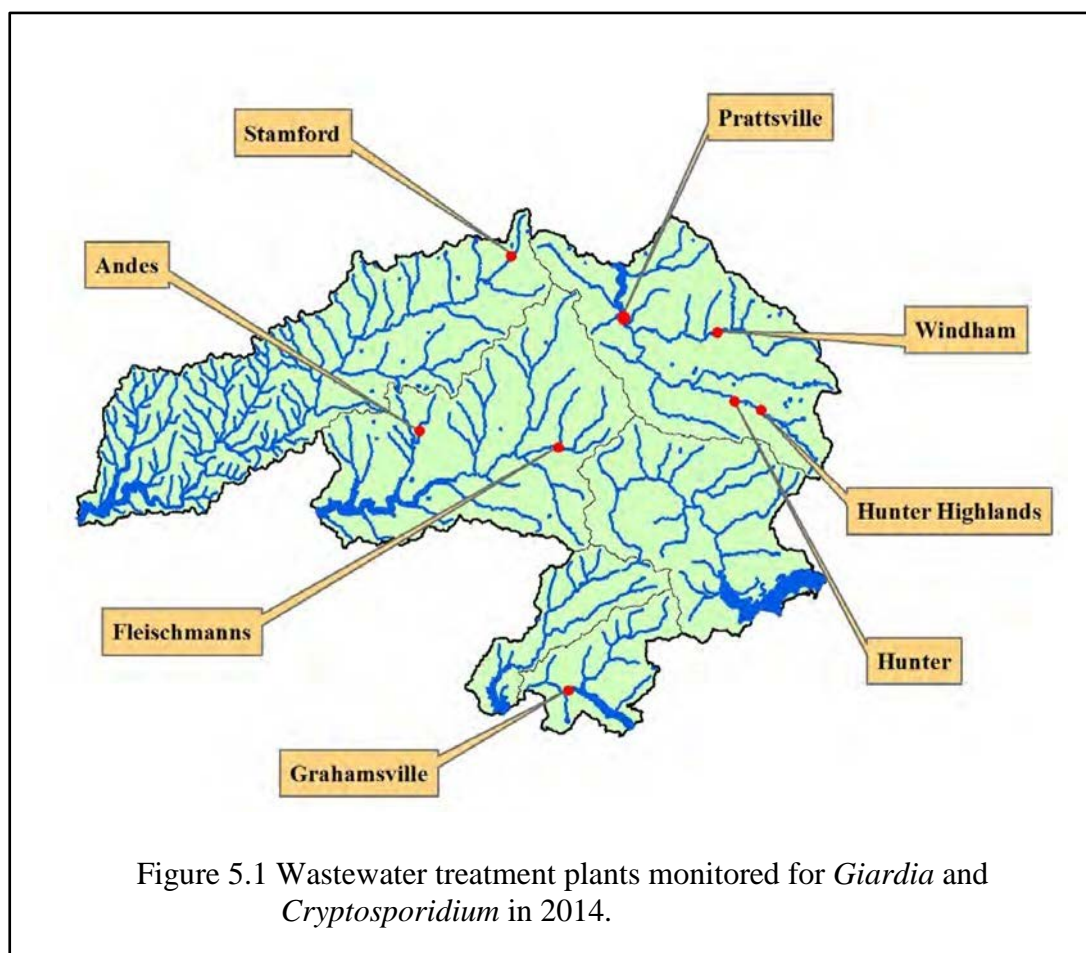
at 39 sampling sites (including keypoints) and analyzed for *Giardia* and *Cryptosporidium*, along with turbidity, pH, and temperature, for a total of 1,933 analyses. In addition, 165 samples were collected at eight sampling sites for human enteric virus (HEV) examination.

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 two source water keypoints are routinely posted on DEP's website (<http://www.nyc.gov/html/dep/pdf/pathogen/path.pdf>) and sent directly to regulators by email
- Monthly Croton Consent Decree Report
- Watershed Water Quality Annual Report
- Drinking Water Supply and Quality Annual Report (e.g., DEP 2014b)
- Filtration Avoidance Annual Report (e.g., DEP 2014c), or, every fifth year, the Watershed Protection Program Summary and Assessment

## **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. The revised WWQMP (DEP 2009), 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 2014.



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 2014, and all samples were negative for *Cryptosporidium* oocysts. Three of the 32 samples were positive for *Giardia*, one each from the Hunter, Hunter Highlands, and Windham plants, all in the Schoharie watershed.

The first positive *Giardia* sample (2 *Giardia* cysts 50L<sup>-1</sup>) was taken on January 15 at the Hunter WWTP. The Hunter plant reported no abnormalities in its treatment processes; however, the plant did push high flows through the system from January 14 through January 16 (bracketing the sample date) in an effort to reduce tank levels in preparation for the busy Martin Luther King, Jr. holiday ski weekend. Note that in 2013 the Hunter plant had a positive *Giardia* sample at the same time—just after the Martin Luther King, Jr. holiday weekend—suggesting that high flows may have played a role in detection.

A second sample with a positive *Giardia* result (1 *Giardia* cyst 50L<sup>-1</sup>) was taken at the Hunter Highlands plant on February 12. This detection may have been indirectly caused by a freeze up in the outdoor splitter box; this redirected all plant flow to one of two aeration trains, which in turn caused abnormal short-cycling of the dual sand filters. There were no other effluent violations at the time of the pathogen sample collection and no other operational abnormalities. The operator indicated that, during the ski season when the plant experiences heavy flows, it will increase the prescribed frequency at which it air lances the filters, from quarterly to monthly.

A third sample was positive for *Giardia* (1 *Giardia* cyst 50L<sup>-1</sup>) at the Windham plant on November 13. There were no malfunctions of the filtration process or the chemical addition system, nor were any turbidity spikes recorded. A daily turbidity report, used as a guideline to the proper functioning of the plant, revealed that of the 24 hourly samples collected that day, the maximum was 0.11 NTU, well under the instantaneous limit of 5.0 and within the 0.5 limit ninety-five percent of the time. The plant operator was conducting a sludge press run that day, which sends an extra 90 gallons per minute to the equalizing tank, but there were no known mechanical or process abnormalities which might have led to the positive detection.

### **5.3 Multi-Tiered Water Quality Modeling Program**

For information on the work done by the water quality modeling group during 2014, 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, 2015 ([http://www.nyc.gov/html/dep/html/watershed\\_protection/fad.shtml](http://www.nyc.gov/html/dep/html/watershed_protection/fad.shtml)).

### **5.4 Geographic Information System**

DEP's Geographic Information System (GIS) activities support numerous FAD (NYSDOH 2014) 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. Various requests were completed for customized statistical reports depicting the breakdown of land cover classes, including impervious surfaces, on NYC lands or particular watershed basins. Graphics were also created for reports, posters, presentations, and peer-reviewed publications. Staff continued to experiment with tools to import, run, and animate spatially-distributed, near-real-time meteorological data as input for water quality models. West of Hudson (WOH) hydrologic derivative rasters were created from the 1-meter Digital Elevation Model (DEM) to screen for stream reaches with greater stream power and potential erosion.

Under an intergovernmental agreement with the United States Geological Survey (USGS) for bathymetric surveys of WOH reservoirs, surveying work was initiated for Ashokan and Rondout Reservoirs. Draft data were delivered for the Ashokan West Basin. These data—a bathymetric DEM and resulting contours—were reviewed, and comments sent back to USGS. Data deliverables for each reservoir include raw and corrected survey points, a derived topographic surface of the reservoir bottom from those points, 2-foot contours of reservoir depth derived from the topographic surface, and a stage-area-volume table in 0.01-foot increments. The remaining work will be ongoing through 2015.

A contract scope and budget was completed for the 5-year update of 1-foot leaf-off aerial imagery from the New York State (NYS) Digital Orthoimagery Program. This contract is on target for commencing work during the window of opportunity for leaf-off data collection in March and April 2016.

A final version was completed of a New York City Water Supply Atlas, which includes recent high-resolution DEMs, catchment boundaries, and land use and land cover data. Atlas maps depicting Pepacton basin land cover and Pepacton Reservoir bathymetry are shown in Figure 5.2 and Figure 5.3, respectively.

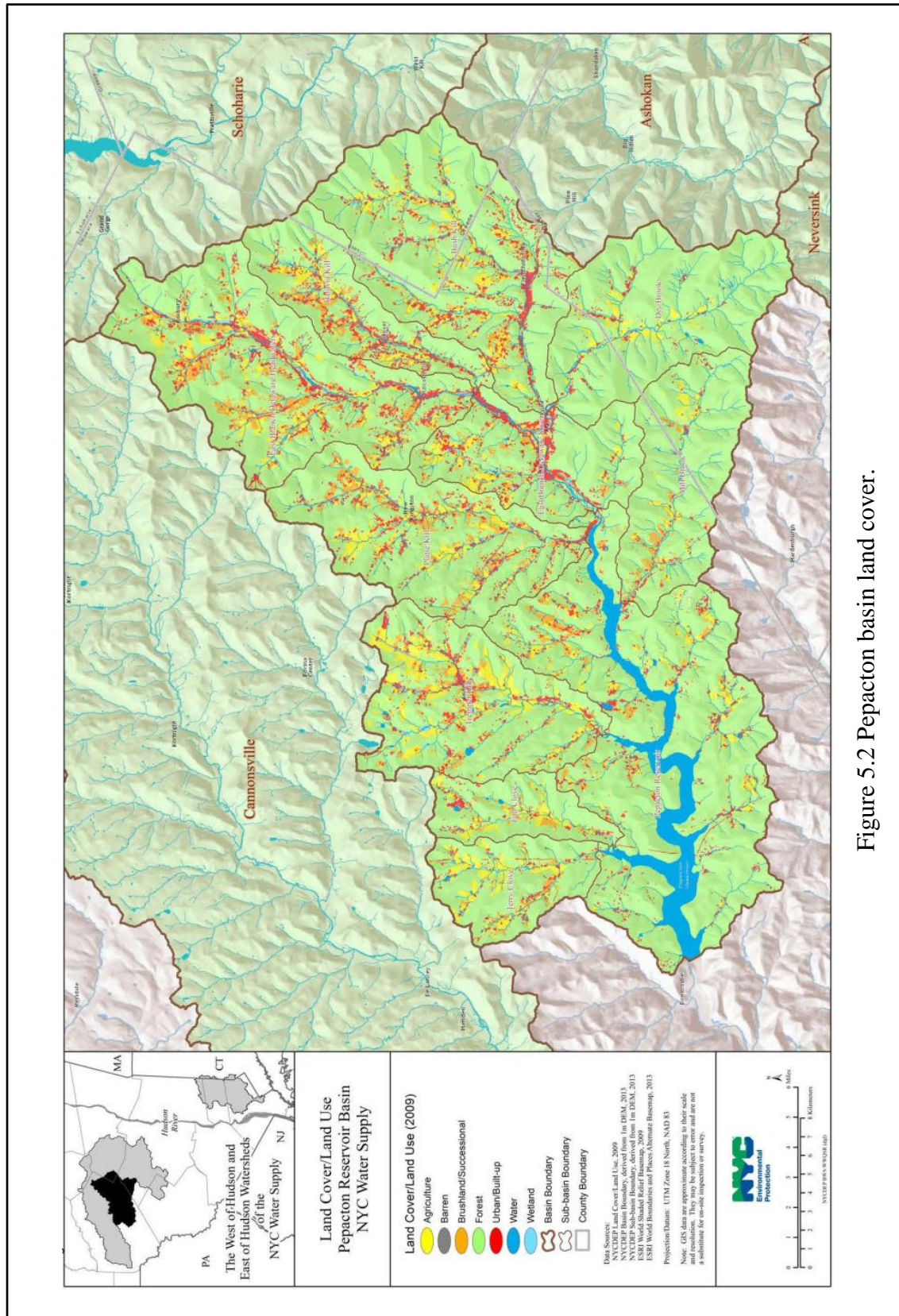


Figure 5.2 Pepacton basin land cover.



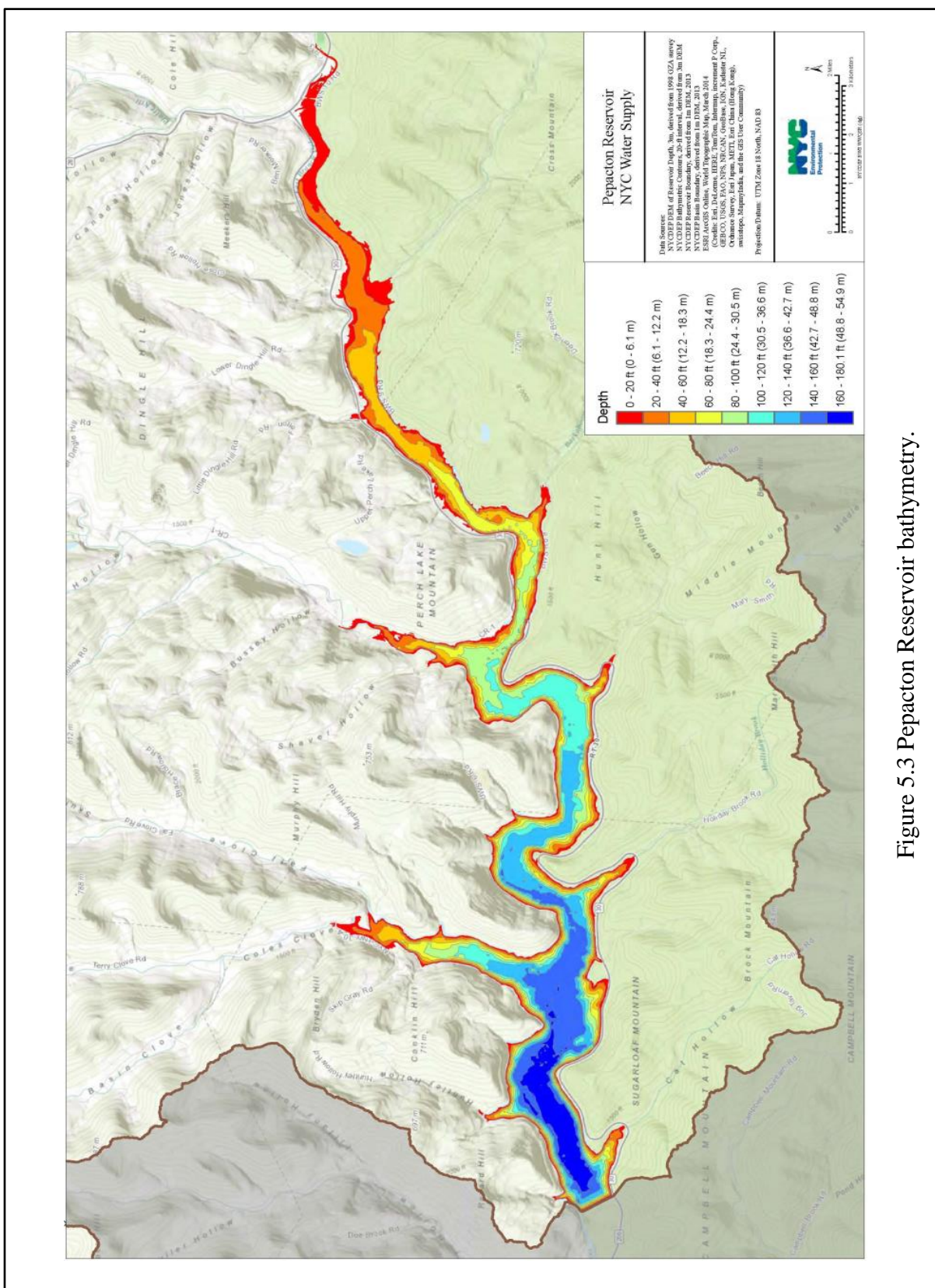


Figure 5.3 Pepacton Reservoir bathymetry.

In May 2014, DEP staff presented a paper on the development of DEP's recent high-resolution hydrography and topography GIS data at the American Water Resource Association's biennial specialty conference in Utah.

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

Major GIS data upgrades completed in 2014 included the roll-out into GIS and WaLIS of the latest Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Map (DFIRM) floodplain data for each watershed county. This also required updates to reports, maps, business tables, and derived GIS layers that have dependencies on floodplain data. Users, especially those in the Land Acquisition Program (LAP) and Regulatory and Engineering Programs (REP), were then notified of the changes and their implications. The recreation unit GIS layer was completely overhauled with the latest parcel outlines, and the reporting acres were then switched to GIS-calculated acres for improved accuracy. Statistics were generated comparing acreages between past and present versions for management review. All associated WaLIS reports and data dependencies related to recreation units were then updated as well.

Several other existing feature classes were updated or overhauled as part of ongoing annual data maintenance. These included mission-critical data sets for various DEP programs, such as annual digital tax parcels for all watershed counties, NYC-owned land or interests, NYS-owned land, DEP water supply facilities, stream restoration projects, septic repairs, and engineering project locations. Work continued on updating GIS layers for all water quality monitoring sites, biomonitoring sites, snow survey and snow pillow sites, and meteorological stations referenced in the Water Quality Laboratory Information Management System (LIMS).

#### 5.4.3 GIS Infrastructure Improvement

##### *Hardware and Software*

Several components of GIS infrastructure were upgraded during the reporting period. Forty GIS and modeling "power user" workstations were procured to replace aging equipment throughout all upstate DEP offices. A large format color plotter for map production was procured to replace an outdated model and is now operating within the Kingston GIS laboratory. A large format color scanner, to be used to digitize Computer Aided Design (CAD) drawings or other hard-copy map resources, was procured and is now operational at the Kingston site. Maintenance was performed on numerous GPS units used by various programs, including the updating of data dictionaries, updating of software, and inventorying of all GPS hardware and software.

Staff researched and documented causes of various network speed issues that affect the performance of GIS and WaLIS software in Kingston and remote offices. They identified and developed solutions to some known drawing speed issues related to newer and more dense spatial data layers now being used in GIS and accessed through WaLIS, including Light Detection and Ranging (LiDAR)-derived hydrography/topography and expansion of tax parcel coverage. They also proposed several long-term solutions for the Office of Information

Technology (OIT), requiring user computer upgrades and an increase in network bandwidth. As part of an overall disaster recovery plan, all current backup procedures were documented for all critical databases which reside solely in the Kingston building and a final report with recommendations was completed.

Support was expanded for WaLIS, GIS, and other Information Technology resources at remote field offices within various Operations and Natural Resources Division units. During spring and summer 2014, staff conducted field office visits during which they met with users to evaluate WaLIS use and any hardware, software, or connection problems, as well as answer any general WaLIS questions. Network speed and hardware issues were identified and documented. In general, users found it valuable to receive face time with the WaLIS developers even if no specific training was offered.

### ***System and Database Administration***

Management of the GIS library continued, with the creation and updating of data sets, maintenance of file geodatabase copies of the library, support of spatial data development for WaLIS, updating of schemas, and backing up of all databases. In 2014, The GIS program also:

- Upgraded the ArcGIS Desktop and Server on the image server to version 10.2.2.
- Upgraded ArcGIS to 10.2.2 on 49 of 74 workstations and servers.
- Created script to archive spatial views and executed that script for the semiannual spatial view backup job.
- Created script to create file geodatabase backup of the entire SDE geodatabase and executed that script to create full file geodatabase backup.
- Debugged automation scripts.
- Researched and reviewed data extraction tools.
- Updated DFIRM in development SDE and created file geodatabase.
- Ran timing tests of different scenarios for displaying large feature classes.
- Experimented with Query Layers and Database Views.
- Updated basins and sub-basin layers to the latest smoothed versions, then updated all WaLIS maps to use the new layers.
- Experimented with ways to link land use code attributes to the land use land cover layer.

The GIS program also develops, upgrades, and maintains WaLIS, which currently operates on the workstations of over 250 DEP users. During 2014, the WaLIS development team completed and closed out all outstanding software issues in the WaLIS Issues Tracker, and resolved any new issues as they came in, usually within a week. To comply with OIT



requirements, source code control was migrated for all WaLIS applications to Team Foundation Server (TFS) in Lefrak. TFS is a Microsoft product providing source code management, reporting, requirements management, and project management for the entire Application Lifecycle. Other WaLIS development goals were achieved in the following areas during the reporting period:

#### *Community Water*

- Evaluated mapping and tracking needs, following which a customized WaLIS module and map were created.
- Integrated all water connections data, including customer data, from various sources into SQL business tables linked to GPSed locations.
- Performed ongoing Wawarsing “Flood Buyout” WaLIS mapping.

#### *Capital Planning/Incident Management*

Completed an Incident Management module in WaLIS and began Crystal Report writing.

#### *Police*

Completed and released the expanded “Recreational Boat Tag” web application running in Lefrak to include access permit and fishing boat tag views.

#### *REP*

Released a new version of the tablet application to include field data logging of Soil Inspections, REP Inspections, LIMS Reports, and Engineering Tasks, as well as photo capture functionality.

#### *LAP*

Reviewed and overhauled all map documents and Crystal Reports to eliminate out-of-date or redundant items, and updated map symbology.

#### *WaLIS Thin Client*

In an effort to convert stand-alone software into a thin client browser application, a web-based “lite” version of the WaLIS parcel viewer was completed, with an interim name of “NYC Watershed Viewer”. The viewer was distributed to a limited set of users for initial testing and feedback.

### **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 2014. During the rest

## ***5. Watershed Monitoring, Modeling, and GIS***

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of the reporting period, the GIS program continued filling data sharing requests for 1-meter LiDAR-derived hydrography, topography, and reservoir basin data to partners and stakeholders, such as the NYS Office of the Attorney General Watershed Inspector, the Catskill Watershed Corporation, the State University of New York (SUNY) College of Environmental Science and Forestry, SUNY Albany, Columbia University, the New York Natural Heritage Program, The Nature Conservancy, and various watershed county and town offices. Numerous other individual GIS data layers were sent to contractors and consultants working on various DEP-related projects, including those for various road, bridge, or dam repairs, and the Rondout-West Branch Tunnel Bypass Project.



## 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 (33 U.S.C. §1342) and the State Environmental Quality Review Act (SEQRA) (N.Y.S. Environmental Conservation Law, Art. 8 (§8-0101 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 2014 in the East of Hudson (EOH) Filtration Avoidance Determination (FAD) basins. These projects are all stormwater and variance applications. (See the biannual Filtration Avoidance 6.1 Project Activities reports for project summaries and maps showing project locations.) The new, delegated, and remediated individual SSTSs for these basins are listed in Table 6.2.

Table 6.1 2014 new projects located in the EOH FAD basins. SP = stormwater and crossing, piping, diversion; VA = variance.

Reservoir	Town	SP	VA	Total
Boyd Corners	Kent	0	1	1
Cross River	Lewisboro	2	0	2
Croton Falls	Carmel	0	1	1
Kensico	Harrison	0	1	1
West Branch	Carmel	1	0	1
Total		3	3	6

Table 6.2 2014 new, delegated, and remediated individual SSTSs located in the EOH FAD basins.

Reservoir	Delegated SSTSs	New SSTSs	SSTS repairs	Approvals	Under construction
Boyd Corners	1	0	0	0	0
Cross River	5	0	1	10	7
Croton Falls	1	0	10	3	1
Kensico	0	0	1	3	0
West Branch	4	0	1	2	0
Total	11	0	13	18	8

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 information 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 2014 that are located in the West of Hudson (WOH) 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 New York State Department of Transportation (NYSDOT) projects, wetland and stream disturbances, mining applications from NYSDEC, timber harvesting, and stormwater retrofit projects. (See the biannual Filtration Avoidance 6.1 Project Activities reports for project summaries and maps showing project locations.) New, delegated, and remediated individual SSTSs are listed in Table 6.4 (Catskill basins) and Table 6.5 (Delaware basins).



## 6. Regulatory Programs

Table 6.3 2014 new projects located in the WOH basins. 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	Hunter						2	1	3
Ashokan	Olive			1					1
Ashokan	Shandaken	1					1		2
Cannonsville	Bovina						1		1
Cannonsville	Hamden		1	1		3		2	7
Cannonsville	Kortright				1		1		2
Cannonsville	Masonville							1	1
Cannonsville	Meredith		1						1
Cannonsville	Stamford			1					1
Cannonsville	Tompkins							3	3
Cannonsville	Walton						1	2	3
Neversink	Denning						1		1
Pepacton	Andes							2	2
Pepacton	Colchester							3	3
Pepacton	Halcott							1	1
Pepacton	Middletown	1						1	2
Rondout	Neversink			1			1		2
Schoharie	Ashland						2	2	4
Schoharie	Gilboa			1			1		2
Schoharie	Hunter		1			1	2	1	5
Schoharie	Jewett		1				1	1	3
Schoharie	Prattsville				1				1
Schoharie	Tannersville							1	1
Schoharie	Windham			1	2				3
Total		2	4	6	4	4	14	21	55

Table 6.4 2014 new, delegated, and remediated individual SSTs located in the Ashokan and Schoharie Reservoir basins.

Reservoir	Delegated SSTs	New SSTs	SST repairs	Approvals	Under construction
Ashokan	10	N/A <sup>2</sup>	67	72	66
Schoharie	N/A <sup>1</sup>	37	43	82	58
Total	10	37	110	154	124

<sup>1</sup>DEP does not have a Delegation Agreement with Greene or Schoharie County, so the number of delegated SSTs is not applicable to this reservoir.

<sup>2</sup>Reviews of new SSTs are delegated to Ulster County under that county's Delegation Agreement, so the results for new SSTs are reported here as delegated SST results.

Table 6.5 2014 new, delegated, and remediated individual SSTs located in the Cannonsville, Neversink, Pepacton, and Rondout Reservoir basins.

Reservoir	Delegated SSTs	New SSTs	SST repairs	Approvals
Cannonsville	N/A <sup>1</sup>	12	63	74
Neversink	1	2	5	7
Pepacton	N/A <sup>1</sup>	14	48	63
Rondout	1	1	7	8
Total	2	29	123	152

<sup>1</sup>DEP does not have a Delegation Agreement with Delaware County, so the number of delegated SSTs 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.

## 6. Regulatory Programs

Table 6.6 presents a summary of all SEQRA reviews that occurred in 2014.

Table 6.6 SEQRA reviews in 2014.

Received	Reviewed	Comment letters issued	Ongoing reviews	SEQRA process closed <sup>1</sup>
79	87	71	93	86

<sup>1</sup>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 2014 SEQRA review and status for significant Type I Actions.

Project Name	Town/County	Basin	Description	Status
Somers Comprehensive Master Plan	Somers/Westchester	Amawalk	Proposed modification to the 1994 Comprehensive Master Plan, specifically, Section II-Residential Development as it relates to multi-family units.	DEP received project notification and issued a comment letter. DEP is awaiting a determination from the Lead Agency.
Somers Realty Phase 3	Somers/Westchester	Amawalk	Proposed 152 residential units within 17 buildings and a recreational building (part of Somers Planned Hamlet).	DEP received project notification and issued a comment letter.
Clark Companies	Delhi/Delaware	Cannonsville	Proposed expansion of manufacturing facility.	DEP received project notification and issued a comment letter. DEP is awaiting a determination from the Lead Agency.
Crossroads 312, LLC	Southeast/Putnam	Diverting	Zone change from Rural Commercial to Highway Commercial-1, to construct a mixed-use commercial project on a 51.88-acre parcel. Proposed development of 186,000-sq.ft. large retail, restaurant, and professional office services to be served by a private WWTP.	DEP received and issued a comment letter on the FEIS.

Project Name	Town/County	Basin	Description	Status
Village of Brewster Comprehensive Plan	Brewster/Putnam	Diverting	Update to the Comprehensive Plan.	DEP received project notification and issued a comment letter. DEP is awaiting a determination from the Lead Agency.
Farm to Market Subdivision	Southeast/Putnam	East Branch	Proposed 11-lot single-family residential subdivision to be served by private wells and SSTs.	DEP received project notification and issued a comment letter. DEP is awaiting a determination from the Lead Agency.
Fox Run Adult Residential	Patterson/Putnam	Middle Branch	Proposed 80-unit condominium community for active adults with parking for 185 vehicles to be served by private on-site water supply and WWTP.	DEP received project notification and issued a comment letter. DEP is awaiting a determination from the Lead Agency.
Algonquin Gas Transmission Line	Cortlandt & Somers/ Westchester Southeast/Putnam	Multiple	Replacement of existing 26" pipeline with 42" pipe, addition of 12.2 miles of new pipeline, upgrading of 6 existing compressor stations, construction of 3 metering stations, and modification of numerous existing metering facilities in New York.	DEP received the DEIS and issued a comment letter on the DEIS.
Tripi Subdivision	Bedford/ Westchester	Muscoot	Proposed 23-lot conservation subdivision on 25.5-acre parcel to be served by community septic system.	DEP reviewed and issued a comment letter on the amended FEIS.
COSTCO	Yorktown/ Westchester	New Croton	Proposed 147,487-sq. ft. wholesale retail store, gasoline filling station, and 610 parking spaces to be served by municipal water and sewer.	DEP received and issued a comment letter on the FEIS. DEP attended the public hearing.
Croton Realty & Development Inc.	Cortlandt/ Westchester	New Croton	Proposed redevelopment of a 35.9-acre parcel into a 28-lot single-family residential subdivision to be served by private wells and an SSTs.	DEP received and issued a comment letter on the DEIS.
Rosehill (formerly The Spa at New Croton)	New Castle/ Westchester	New Croton	Proposed 60 condominium units, indoor and outdoor pools, 75-seat screening room, tennis courts, fitness center, and 150 parking spaces to be served by municipal water and sewer which will involve a change in zoning.	DEP received project notification and Lead Agency Positive Declaration and issued comment letters on notification documents and Draft Scope.

## 6. Regulatory Programs

Project Name	Town/County	Basin	Description	Status
Crossroads Ventures	Shandaken/Ulster Middletown/ Delaware	Pepacton	Belleayre Mountain Ski Center Unit Management Plan 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 an 18-hole golf course. Highmount Spa Resort includes a 120-unit hotel with spa facilities and 53 ownership units, and a multi-level lodge that includes 27 units, 16 detached lodges, and 8 duplex buildings. Project to be served by the Pine Hill WWTP.	DEP received the FEIS. NYC Law Department issued a letter supporting the motion to cancel the adjudicatory hearing and reaffirming DEP's regulatory jurisdiction.
Four Seasons	Village of Hunter/ Greene	Schoharie	Proposed 40-unit condominium complex (4 buildings) with 60 parking spaces to be served by municipal water and sewer.	DEP reviewed and commented on supplemental information and attended the public hearing. DEP is awaiting a determination from the Lead Agency.
Windham Mountain Sporting Club	Windham/Greene	Schoharie	Construction of 345 multi-phase residential units, two lodges, wellness center with swimming pool, roads, and two ski lifts on a 465-acre parcel.	DEP received and issued a comment letter on the FEIS.
Foxwoods Casino Resort	Liberty/Sullivan	Outside of Neversink watershed	Proposed casino resort complex to include an adventure sports center, lakeside recreation complex, 108 townhouses, 160 villas, clubhouses, and parking for 4,776 vehicles.	DEP reviewed the Draft Scope and issued a comment letter on potential impacts to NYC's watershed.



### 6.1.2 Delegation Agreements

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

DEP received documentation concerning the review of 164 delegated SSTs during 2014. Thirty-nine of these reviews were for projects located in the WOH watershed. The remaining 125 delegated SSTs were located in the EOH watershed.

## 6.2 Enforcement Activities

DEP investigates and confirms SST failures, issues Notices of Violations (NOVs), pursues enforcement actions on failed SSTs, and refers certain criminal activity to 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.

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. 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 EOH and WOH watersheds.

In 2014, DEP Police:

- Completed 11,932 hours of training.
- Conducted 6,681 preliminary investigations.
- Conducted 372 long-term investigations related to pollution or terrorism.
- Patrolled 1,593,773 miles.
- Conducted 285,591 physical security inspections.

Also in 2014, DEP Police made 39 arrests, issued 1,054 summonses, and served 649 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 quarterly compliance inspections 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 noncompliance, 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, or 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 2014. Of these, 28 are permitted for year-round discharge and seven are permitted for seasonal discharge. Three of the 35 are wastewater treatment facilities that are permitted to discharge to groundwater. These are the NYC DEP Chichester community septic system, 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 154 scheduled compliance, emergency response, and WWTP upgrade construction inspections in 2014.

Compliance with State Pollutant Discharge Elimination System (SPDES) permits continued to improve among WWTPs in the Catskill/Delaware watersheds in 2014, due in large part to the WWTPCI Program.

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 membrane bioreactor on March 12, 2012. Construction remained on schedule through 2013, and Functional Completion was certified in April 2014. The new WWTP is on line and treating all process flow from the dairy farm; residential sewage is separately conveyed to the Grand Gorge WWTP. Operation and maintenance appear satisfactory and the plant is in full compliance with its final SPDES permit requirements.

The Boiceville WWTP, located in the Town of Olive, employs a sequential batch reactor (SBR), a dual-tank, flow through process that integrates sedimentation, aeration, decant, and sludge thickening all within one process unit. The facility experienced difficulty during the settling stage of the process; solids loss led to sporadic violations of the SPDES permit limitation

for ammonia. DEP worked closely with the facility operator to troubleshoot the physical and operational parameters that led to this condition. DEP identified several possible causes for poor settling, including organic overload, flow and interval sequence, temperature, dissolved oxygen concentrations, and inadequate reactor capacity. Following DEP's assessment, the facility operator inspected the collection system to identify and mitigate sources of infiltration and inflow. The plant also performed microscopic analysis of the aerobic bacteria and conducted a sampling profile, including total kjeldahl nitrogen (TKN) and nitrate testing, during each SBR cycle to establish proper timing and a suitable solids inventory to optimize nitrification. Data for all operating seasons resulting from these analyses will be submitted to an independent consultant that the Town of Olive commissioned to analyze data and identify the potential cause of the solids loss. After completing its analysis, the consultant will produce a written recommendation for proper operation and maintenance of the SBR. The plant self-monitoring data and DEP laboratory data indicate full compliance with all SPDES parameters since the last recorded ammonia violation in April 2014.

### ***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 can contribute to waters of the Catskill/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 2014, 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 2014. Carmel Sewer District #2 WWTP did experience a sewage overflow on November 30, 2014 from the lift station located at 3670 Route 301 near West Branch Reservoir, but the spill was estimated to be less than 75 gallons and did not make it to the lake shore. A blown fuse led to the lift station shutdown. This lift station services two homes and is equipped with a level indicator that triggers an audible/visual alarm once the station wetwell is half-full. A resident witnessed the alarm several days prior to the spill, but because the resident misdialed the emergency contact number, he was unable to alert the authorities. The resident did report the event several days later when the overflow was observed. The wetwell was then pumped, the fuse replaced, the affected area cleaned and disinfected, and the resident was instructed about proper notification procedures.

Because the Lewisboro Elementary School is currently closed, its WWTP is not discharging (although its SPDES permit remains active). If the school district reopens the school, the WWTP will have to resume operation to process the wastewater. At that time, DEP will conduct monitoring inspections in accordance with its FAD requirements.

For monitoring of the West Lake Sewer Trunk Line, see Section 4.10.1.

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 2014 monitoring period. The inspections revealed no abnormal conditions.

### 6.3.1 Sampling of WWTP Effluents

Sampling of all surface-discharging WWTP effluents is conducted by DEP's ELAP-approved laboratories. At non-City-owned WWTPs, the frequency of grab samples, formerly twice monthly, was reduced to monthly in August 2014. In addition, one composite sample is collected annually 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 sampled monthly, although at Kraft composite samples are also required. City-owned WWTPs are sampled in accordance with SPDES permit monitoring requirements which, in most cases, is one sample per month. The samples are a combination of grab and composite, depending on the parameter, and are analyzed by DEP laboratories and contract laboratories, with the results reported to NYSDEC in SPDES Discharge Monitoring Reports.

In the Catskill System, 13 WWTP effluents were sampled in 2014, and annual composite samples were collected from 8 of the 9 plants that have the composite sampling requirement, the missing sample resulting from field collection errors. In the Delaware System, 12 WWTP effluents and the 3 non-contact cooling water discharges (Kraft, Morningstar, and Friesland Campina-DOMO) were sampled. Annual composite samples were collected at 9 of the Delaware WWTPs and at 1 of the non-contact cooling water discharges as required by their SPDES permits. In the EOH System, 8 WWTPs were sampled and composite samples were collected at the Mahopac WWTP.

Overall in 2014, 351 WWTP effluent samples were analyzed for 2,007 analytes in the Catskill System. For the Delaware System, analyses for 2,375 analytes were performed on 367 effluent samples from WWTPs and the 3 non-contact cooling water discharges. In the EOH System, 658 WWTP effluent samples were analyzed for 5,564 analytes.

Sampling data are shared regularly with the WWTPCI staff for the purpose of tracking compliance with SPDES-permitted effluent limits. WWTP Water Quality Sampling Monitoring Reports are submitted to USEPA and NYSDOH semiannually (February 28 and August 31) as specified in the current FAD (NYSDOH 2014).





## **7. Catskill/Delaware Filtration/UV Disinfection Facility**

DEP successfully operated the Catskill/Delaware Ultraviolet (UV) Disinfection Facility throughout 2014. The 2014 monthly average percentage of off-specification water was recorded at 0.02% (5% maximum allowance). Staff maintained proficiency of treatment operations through internal training programs, hands-on training with a simulator module, continuing education programs, and professional seminars. Four operators passed the Grade B water treatment plant state certification test in 2014. The water treatment plant maintained all calibration standards and verifications. Preventive and correction maintenance activities ensured reliability and performance of the plant processing systems. New access hatches were installed on disinfection units in three modules during the year to allow ease of access for inspection or cleaning as required. Further details on facility operations in 2014 can be found in DEP's monthly reports.



## 8. In-City Programs

### 8.1 Waterborne Disease Risk Assessment Program

New York City's Waterborne Disease Risk Assessment Program (WDRAP) is a joint effort of 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 WDRAP staff members, began in July 1993 for giardiasis and in 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 New York City 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. Collection of case data via ECLRS is ongoing.

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 2014, surveillance for giardiasis and cryptosporidiosis was ongoing, and interviews were conducted as per the above parameters. At the time of this writing, the 2014 preliminary count of cases reported to DOHMH among City residents was 860 cases of giardiasis and 102 cases of cryptosporidiosis. One giardiasis case patient interview had been completed, as well as 74 cryptosporidiosis case patient interviews.

#### *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 2014. One system involves the tracking of chief complaints from hospital emergency department 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 the City involves monitoring of sales of over-the-counter (i.e., non-prescription) anti-diarrheal medications at major chain stores. In the past, the City's anti-diarrheal medication monitoring activities had two components: the ADM system managed by DEP and the OTC system managed by DOHMH. In 2012, the ADM and OTC systems were merged. An evaluation report by New York City on the impact of the merger of the two systems was completed, and was sent to NYSDOH and USEPA on June 18, 2014. The evaluation report concluded that overall the combined system is equal to or better than the two systems previously in place.

### ***Additional Information and Results***

Additional WDRAP results and program information can be found in the WDRAP Annual Report, including demographic data on giardiasis and cryptosporidiosis cases, case interview summary results, summary results from syndromic surveillance programs, and other program information. The WDRAP annual report can be accessed at [http://www.nyc.gov/html/dep/html/drinking\\_water/wdrap.shtml](http://www.nyc.gov/html/dep/html/drinking_water/wdrap.shtml).

## **8.2 Cross Connection Control Program**

DEP has a robust water quality monitoring program and regularly performs sampling throughout the City to ensure all relevant state and federal standards are met. The Cross Connection Control and Backflow Prevention Program, authorized by Subpart 5-1.31 of the New York State Sanitary Code, is one of the tools DEP employs to complement its water quality sampling program.

During 2014, the Cross Connection Control Program continued to exceed the anticipated frequency milestones set forth in the Revised 2007 FAD (NYSDOH 2014), except for two categories which are tracking close to but below the anticipated frequency (Response to cross connection control complaints, Review requests for exemption from cross connection control requirements). DEP's rigorous oversight and regulation of cross connection control/backflow activity, which includes an inspection program, incident response, enforcement, and plan review, continues to provide an excellent level of protection for the City's water supply system. A notable change in the program this year was the implementation of the digital Notice of Violation (NOV) process to replace the handwritten notices that have previously been used; this expedites the violation process. As a result, DEP has been able to increase the number of NOV's issued to property owners who have not submitted required backflow prevention device annual test reports. To manage the increase, more staff have been dedicated to represent DEP at the Environmental Control Board hearings involving these issues.

Last year, DEP launched a pilot to accept online applications for cross connection plan review through its Water and Sewer Permitting System (WSPS), which is being developed in phases. Online filing allows users to file plans online for review; once the application is reviewed and approved, an electronic approval stamp is used to identify plans that have been accepted.

The process streamlines cross connection approval, as well as the water service and meter permitting processes. The pilot is ongoing.

The metrics for this reporting period are presented in Table 8.1.

Table 8.1 Cross Connection FAD milestones.

Annual and semi-annual 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 <sup>2</sup> (approved)	Notices of Violation issued for failure to test annually <sup>3</sup> (install)
Jan.-Dec. 2014	0	3,808	1,495	5,147	9	346	3,365
FAD requirement	1-2/yr	300-450/yr	225/yr	400/yr	TBD <sup>1</sup>	400/yr	200/yr

<sup>1</sup>To be determined. No established minimum level of response.

<sup>2</sup>Exemption submissions have waned due to a new fee schedule, policy changes, and rejections.

<sup>3</sup>These were orders to submit test reports.





## 9. Education and Outreach

Throughout 2014, DEP collaborated with the Catskill Watershed Corporation (CWC), the Watershed Agricultural Council (WAC), Cornell Cooperative Extension (CCE), county Soil and Water Conservation Districts (SWCDs), and other local partners to advance its watershed protection strategy through broad community outreach and targeted educational programs. These programs serve to raise awareness about the water supply, water conservation, environmental stewardship, land use planning, stream corridor protection, stormwater and wastewater management, flood response and preparedness, invasive species, and other topics.

DEP and its partners use numerous strategies to disseminate information about source water protection and related issues. For example, DEP's website ([www.nyc.gov/dep](http://www.nyc.gov/dep)) features detailed information about the water supply, drinking water quality, watershed protection, and watershed recreation. The website is also a repository for the annual consumer confidence report, watershed program brochures, newsletters, press releases, watershed regulations, recreational rules, regulatory guidance documents, environmental education materials, and Filtration Avoidance Determination reports. DEP also maintains a presence on popular social media sites, such as Twitter, Facebook, and Flickr. For example, a new DEP Facebook page devoted to the watershed was launched in 2014.

One of the most significant ways DEP and its partners educate specific audiences is through targeted programs that engage a particular constituency or stakeholder group. For example:

- The Land Acquisition Program works with land trusts and watershed communities to conduct outreach relating to active programs and acquisitions of real property interests, including conservation easements. During 2014, numerous local presentations were conducted relating to the Federal Emergency Management Agency and City-funded flood buyouts. For specific program accomplishments, see Section 4.2.
- The Land Management Program offers unique opportunities to recreationalists and the general public to access City lands for guided interpretive hikes, reservoir cleanups, family fishing days, and recreational boating, in addition to engaging with stakeholder groups interested in quality deer management and collaborating with both the Lower Hudson Partnership for Regional Invasive Species Management (PRISM) and the Catskill Region Invasive Species Partnership (CRISP). For specific program accomplishments, see Section 4.3.
- The Watershed Agricultural Program conducts dozens of farmer education programs, such as workshops, farm tours, and producer group meetings, while working closely with farms, restaurants, farmers markets, and agribusinesses to promote locally-produced watershed products through the Pure Catskills Campaign ([www.purecatskills.com](http://www.purecatskills.com)). The program also supports and participates in the annual Catskill Regional Dairy and Livestock Conference

and Delaware County Clean Sweep Chemical Disposal Day, both of which attract hundreds of farmers and agribusinesses, in addition to co-sponsoring the annual Old Salem Horse Show, which attracts about 5,000 participants over several months. For specific program accomplishments, see Section 4.4.

- The Watershed Forestry Program conducts education programs for forest landowners, such as workshops, forest walks, and model forest events; professional training workshops for loggers and foresters; and school-based education programs for students and teachers, such as the Green Connections School Partnership Program, the Watershed Forestry Bus Tour Program, and the Watershed Forestry Institute for Teachers. The program also promotes local forest products and wood-using businesses through Pure Catskills and the Catskill WoodNet website ([www.catskillwoodnet.org](http://www.catskillwoodnet.org)). For specific program accomplishments, see Section 4.5.
- The Stream Management Program conducts educational programs for streamside landowners, such as workshops, presentations, interpretive hikes, and volunteer planting events; training workshops for local officials, highway departments, and flood response professionals; and annual conferences for local officials, watershed professionals, landowners, and the scientific community, such as the Ashokan Watershed Conference, the Schoharie Watershed Summit, and the Catskill Environmental Research and Monitoring Conference. The program also supports and participates in numerous basin-specific project advisory committees and local flood committees, in addition to hosting a special website devoted to stream corridor protection ([www.catskillstreams.com](http://www.catskillstreams.com)). For specific program accomplishments, see Section 4.6.
- The CWC implements a Public Education Grants Program that awarded 33 grants in 2014 totaling \$217,803; these grants were awarded to schools and organizations in both New York City and the watershed and are estimated to impact more than 32,000 people (primarily school-based audiences) through classroom programs, water quality testing projects, visits to environmental education centers, special performances of “Arm of the Sea” Theater, audiovisuals, exhibits, interpretive outdoor programs, and various other projects pertaining to the water supply or watershed. The CWC also sponsored three septic system workshops that were attended by 72 home owners and professionals, along with three municipal training workshops attended by 86 local officials.
- Trout in the Classroom engages hundreds of New York City and watershed students of all ages in the raising of trout from eggs, while teaching about water quality, healthy ecosystems, and the connections between the upstate watershed and the City’s drinking water. The program culminates with many downstate students traveling to a watershed stream to release their trout during a full day of watershed education that includes macroinvertebrate sampling and interpretive forestry nature hikes. The 2014 Trout in the Classroom Fall Teacher Conference attracted nearly 150 participants.

- DEP's Annual Water Resources Art & Poetry Contest invites New York City and watershed students to create original artwork or poetry that reflects an appreciation for water resources. In 2014, this program engaged 675 students from 68 schools, with 900 people attending the awards ceremony in Manhattan.
- DEP's Water-On-The-Go Program educates New York City residents and tourists about the quality of the City's tap water by placing portable drinking fountains emblazoned with the "NYC Water" logo at busy pedestrian areas and public parks/plazas around the five boroughs during summer months. DEP estimates that in 2014, the Water-On-The-Go Program reached approximately 800,000 consumers, thereby raising public awareness about the source of their water and efforts to protect the upstate watershed.

Another important way that DEP and its partners educate specific audiences is through sponsoring or attending hundreds of events each year, where exhibits and demonstrations are used to disseminate information about the water supply and the partnership efforts being made to conserve and protect the watershed for future generations. Examples of these events include county fairs, local festivals, professional conferences, farmers markets, environmental awareness days, environmental education expos, classroom visits, college guest lectures, watershed tours, press events, and interpretive programs on DEP lands. While it is difficult to assess the educational impact from large public events—for example, although the Delaware County Fair attracts over 75,000 people, only a fraction may actually visit one of the several watershed exhibits on display—these events nevertheless represent important opportunities for DEP and its partners to meet with constituents in person and disseminate information to watershed stakeholders.

DEP estimates that in 2014, at least 611 events were sponsored or attended by DEP or its watershed partners during every month of the year, in every watershed county, and in all five boroughs of New York City. Most of these events were affiliated with a specific watershed program. Examples of other significant events from 2014 include the annual Watershed Science and Technical Conference, American Water Resources Association Conference, New England Society of American Foresters Conference, Grahamsville Little World's Fair, Margaretville Cauliflower Festival, Olive Day, Shandaken Day, Catskill Forest Festival, Earth Day New York, New York Times Travel Show, and the International Restaurant & Food Service Show.

DEP estimates that nearly 58,000 people were directly reached through these events by engaging with staff or receiving information about the water supply and watershed protection efforts; these statistics do not include the 800,000 people who visited DEP's Water-On-The-Go stations or the vast numbers of people who received information through DEP and partner website visits, press releases, newsletters, social media, and related forms of outreach. DEP directly attended or conducted at least 320 events during 2014, most of which consisted of classroom visits, educational programs held at the Visitor Center at Newtown Creek, presentations at public meetings and conferences, and assorted public events held on DEP lands.

DEP attempted to categorize the primary or secondary audience that was targeted by each of the 611 education/outreach events that took place during 2014, based on the following general categories: landowners, elected officials, professionals, students, teachers, recreationalists, and water consumers. Keeping in mind that multiple audience types are likely to attend an event, which presents a challenge for categorizing the audience in a definitive manner (for example, New York City students are categorized as both “students” and “water consumers”), DEP nevertheless estimates that 306 events targeted students as the primary or secondary audience; 264 events targeted water consumers; 184 events targeted landowners; 124 events targeted professionals; 104 events targeted elected officials; 15 events targeted teachers; and 11 events targeted recreationalists.

A detailed summary of 2014 education and outreach statistics and accomplishments is available upon request.



## 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 more than 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 2022 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.

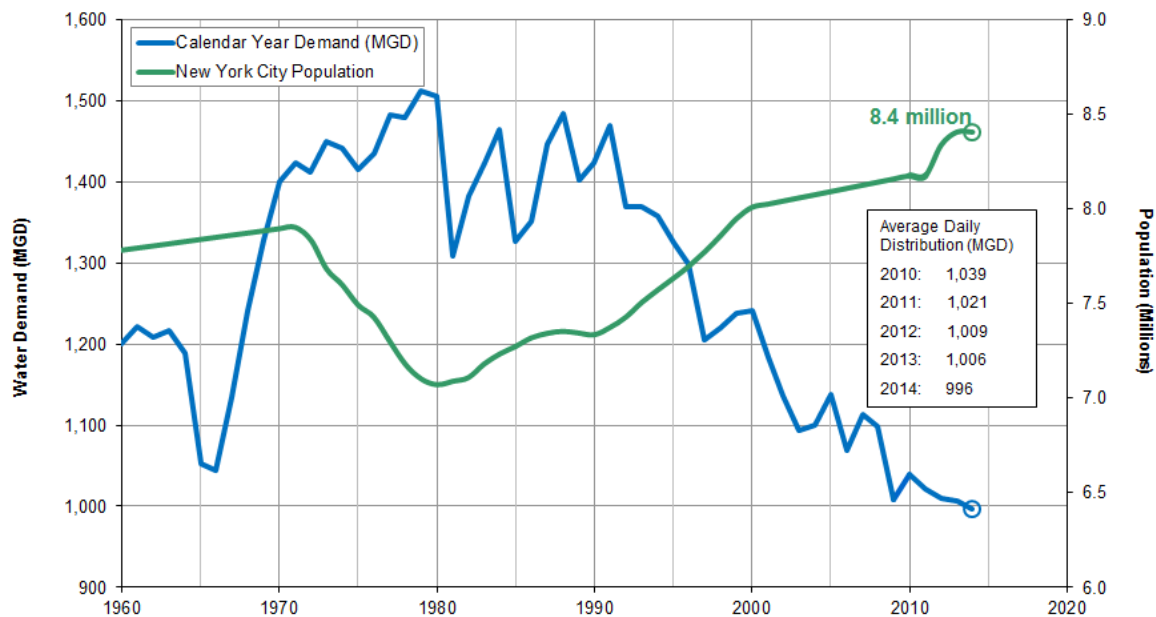


Figure 10.1 New York City water demand and population.

### ***Water Demand Management Plan***

DEP's water conservation efforts aim to reduce water use in New York City and upstate communities by 5%, or 50 million gallons of water per day, from the 2012 demand level by the year 2020. The Water Demand Management Plan, which can be found at <http://www.nyc.gov/html/dep/pdf/conservation/water-demand-management-plan-single-page.pdf>, sets forth five major strategies that DEP will implement to reduce water use. In the last year, DEP added an additional strategy. The six strategies are:

- Municipal Water Efficiency Program, which involves retrofits of city-owned properties. This program will save up to 9 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.
- Upstate Wholesale Customers Demand Management Program, which targets demand management planning and implementation for the wholesale customers north of the City. This program will save 5 million gallons a day.

The following paragraphs summarize the progress DEP has made during 2014 in designing and implementing efforts to support each of the strategies listed above.

#### **Municipal Water Efficiency Program**

DEP made significant strides in implementing this program, establishing working partnerships with several key municipal agencies and entities—the NYC Department of Education (DOE), the Department of Parks and Recreation (DPR), the New York City Fire Department (FDNY), and the City University of New York (CUNY)—to support water efficiency measures in their facilities. In partnership with the DPR, DEP funded 270 individual retrofit projects involving the replacement of running spray showers with push button activated ones. In addition, bathrooms and plumbing will be updated at two large recreation centers to reduce water consumption. Through its partnership with the DOE, DEP funded the replacement of over 12,300 old toilets and urinals with high-efficiency fixtures in 129 schools in all five boroughs, a project scheduled for completion in 2015. In its collaboration with CUNY, DEP funded the replacement of over 300 old toilets and urinals at the City College of New York campus, and through a partnership with the FDNY, DEP is funding a project to recycle water

used in training exercises at the FDNY Chauffeur School on Randall's Island. Finally, DEP kicked off its second Water Challenge at Wastewater Treatment Plants to encourage water reduction in its own facilities. As part of this program, DEP replaced water hoses used to clean equipment at every treatment plant with high-efficiency ones, reducing the amount of water used at every plant.

### Residential Water Efficiency Program

In early 2014, DEP put the finishing touches on the Residential Toilet Replacement Program's project management framework, and the program's contract partners were registered and trained. The program offers \$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 ones. DEP has contracted six toilet wholesale vendors to accept the vouchers and provide the toilets to consumers, through the program's online application tool. A pilot launch to test the system, involving 1,000 eligible owners, took place in July 2014, followed by the full program launch in early August 2014 incorporating all eligible 10,300 building owners.

Originally, the program was to have had a parallel toilet recycling program which would have accepted the discarded fixtures and process them into aggregate for bioswales and sidewalks. In 2014 the City Council passed a policy restricting the amount of construction and demolition (C&D) waste that can be processed in NYC facilities. As a result it is now less financially feasible for C&D facilities to take on the toilet recycling program. Currently, the feasibility of working with another city agency is being explored.

In addition to establishing the Toilet Replacement Program, DEP directed 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 2014, Honeywell conducted surveys in 12,934 individual apartments in 524 apartment buildings. It also surveyed 2,061 one- to three-unit properties, and 6,792 individual units within these properties. While residential properties are the primary focus of this service, 130 small commercial properties and 29 restaurants were also surveyed in 2014.

### Non-Residential Water Efficiency Program

The 2014 Mayor's Water Challenge to Hotels concluded in May, with four hotels managing to reduce their demand by over 10% from the previous year, significantly more than the target goal of 5%. In November 2014, building on the success of the 2014 Challenge, DEP, in partnership with USEPA, the Mayor's Office, the New York State Restaurant Association, and 30 NYC restaurants, officially launched an initiative called The New York City Water Challenge to Restaurants. As with the last challenge, participating restaurants are encouraged 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 will host quarterly workshops to help participating restaurants 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 restaurants in the Challenge. The Challenge is set to conclude in December 2015.

### Water Distribution System Optimization

Water distribution system optimization entails repairs and upgrades to the system, managing water pressure, and refining water meter accuracy and leak detection. In 2014, DEP surveyed 3,416 miles of water mains for leaks; as a result of leaks proactively found and repaired, DEP estimates that 1 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 by 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 on 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 2014, DEP repaired 11,075 hydrants, replaced 1,588, and provided other maintenance services to 9,072 more.

DEP's efforts to achieve universal metering of all DEP water and sewer accounts is motivated by the need to reduce non-revenue water and 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 2014, DEP replaced 15,100 large meters (i.e., those over two inches in diameter).

### Water Supply Shortage Management

In 2014, 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 2015.

Upstate Wholesale Customers Demand Management Program

In 2014, DEP kicked off the demand management program for wholesale customers located in upstate watershed communities. These customers make up 10% of the system's current consumption. DEP has started working with the 10 largest customers, who account for approximately 85% of the total upstate wholesale consumption, to develop demand management plans for their systems, the target being a 5% reduction in consumption.

## **10.2 Updates to Drought Management Plan**

In 2014, 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 a 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 2014. Major activities included:

- Tunnel dewatering preparation
- Rondout-West Branch Tunnel (RWBT) repair—site and shaft construction (contract BT-1) and tunnel design (contract 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 80 million gallons per day 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. Contract BT-1, for site and shaft construction, is on schedule (Figure 10.2). The contract completion date is November 13, 2016.

The bypass tunnel contract, BT-2, is scheduled to start in July 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.



Figure 10.2 Aerial view of the Shaft 5B site.



### ***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 2014 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 2014.
- Surface investigations continued in areas of Roseton and Wawarsing, where water is leaking from the tunnel.
- A Request for Proposals was developed for a new contract (DEL-LTA) to ensure that investigations of the tunnel continue without interruption and to support autonomous underwater vehicle (AUV) and remote operated vehicle (ROV) operations (see below). The contract is expected to be registered in January 2015.

### ***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 2014 AUV run was held in November. The data are being compiled and a report will be issued in the first quarter of 2015.

### ***Remote Operated Vehicle Inspection of the RWBT***

The ROV run at Wawarsing was completed in the fall and revealed the locations of two small leaks. This information is useful for future monitoring purposes and for targeting locations for repairs during the 2022 shutdown. The ROV run for Roseton is on hold pending the results of the spring 2015 AUV run.

### ***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. 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 make it possible to visually inspect the tunnel walls and also improve the hydraulic characteristics of the tunnel, which in turn will restore tunnel capacity. The Basis of Design Report is under review and is expected to be accepted in January 2015. Construction is expected to commence in July 2017.

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