

**New York City
Department of Environmental Protection**

**Filtration Avoidance Annual Report
For the period January 1 through December 31, 2009**

March 2010

Prepared in accordance with the July 2007 Filtration Avoidance Determination



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Table of Contents

Table of Contents	i
List of Figures	v
List of Tables	vii
1. Introduction.....	1
2. Federal and State Objective Water Quality Compliance	3
2.1 SWTR Monitoring and Reporting	3
2.1.1 Raw Water Fecal Coliform Concentrations (40 CFR Section 141.71 (a)(1))	3
2.1.2 Raw Water Turbidity (40 CFR Section 141.71(a)(2)).....	5
2.1.3 Raw Water Disinfection/CT Values (40 CFR Section 141.71(b)(1)(i) and 141.72(a)(1))	5
2.1.4 Entry Point Chlorine Residual (40 CFR Section 141.71(b)(1)(iii) and 141.72(a)(3)).....	5
2.1.5 Distribution System Disinfection Residuals (40 CFR Section 141.71(b)(1)(iv) and 141.72(a)(4))	6
2.1.6 Trihalomethane Monitoring (40 CFR Section 141.71(b)(6)) HAA5 Monitoring (40 CFR Section 141.171).....	6
2.2 Total Coliform Monitoring	6
2.2.1 Monthly Coliform Monitoring (40 CFR Section 141.71(b)(5))	6
2.2.2 Chlorine Residual Maintenance in the Distribution System.....	7
3. Environmental Infrastructure	9
3.1 Septic Programs	9
3.1.1 Septic Rehabilitation and Replacement Program	9
3.1.2 Septic Maintenance Program	10
3.1.3 Alternate Design Septic Systems Program	10
3.1.4 Other Septic Programs	10
3.2 New Sewage Treatment Infrastructure Program	11
3.3 Community Wastewater Management Program	12
3.4 Sewer Extension Program	13
3.5 WWTP Upgrade Program	15
3.6 Stormwater Programs	17
3.6.1 Stormwater Cost-Sharing Programs	17
3.6.2 Stormwater Retrofit Program.....	18
4. Protection and Remediation Programs	23
4.1 Waterfowl Management Program	23
4.2 Land Acquisition	23
4.2.1 Solicitation/Resolicitation.....	25
4.2.2 Purchase Contracts in Catskill/Delaware Watersheds	25
4.2.3 Land Acquisition in the Croton System.....	30
4.2.4 Transfer of Conservation Easements on Fee Acquisitions to NYS	31
4.2.5 Technical Program Improvements.....	31
4.2.6 Pilot Forest Easement Program.....	32
4.2.7 Water Supply Permit.....	32

4.3 Land Management	32
4.3.1 WaLIS	33
4.3.2 Conservation Easement Stewardship.....	33
4.3.3 Monitoring and Management of Water Supply Lands	35
4.3.4 Recreation	38
4.3.5 Forestry	39
4.3.6 Agricultural Use.....	41
4.3.7 Invasive Species Control	41
4.4 Watershed Agricultural Program	45
4.4.1 FAD Program Goals	46
4.4.2 Large Farm Program.....	46
4.4.3 WAC Farm Recruitment Efforts.....	49
4.4.4 Farmer Education Program.....	50
4.4.5 Small Farm Program (West of Hudson)	50
4.4.6 East of Hudson (EOH) Agricultural Program.....	52
4.4.7 Implementation Plan for 2010	54
4.4.8 Nutrient Management Planning	55
4.4.9 Conservation Reserve Enhancement Program (CREP).....	56
4.4.10 WAC Agricultural Easement Program	58
4.4.11 WAP Evaluation	58
4.4.12 Related Research Activities (City and non-City funds).....	58
4.5 Watershed Forestry Program	59
4.5.1 Forest Management Planning and Stewardship.....	60
4.5.2 Best Management Practice (BMP) Implementation	61
4.5.3 Logger and Forester Training	62
4.5.4 Model Forest Program	62
4.5.5 Watershed Forestry Education Program	63
4.5.6 Forest Products Marketing and Utilization.....	64
4.5.7 Other Accomplishments	65
4.5.8 Summary	66
4.6 Stream Management Program	66
4.6.1 Stream Management Plans and their Implementation	67
4.6.2 Education and Outreach.....	77
4.6.3 Floodplain Mapping.....	78
4.6.4 Stream Restoration Projects.....	78
4.6.5 Coordination with the CWC Stream Corridor Program	87
4.6.6 Stream Data Management.....	87
4.7 Riparian Buffer Protection Program	88
4.7.1 Activities on City-owned or Controlled Land	89
4.7.2 Activities on Privately-owned Land	91
4.7.3 Education, Outreach, and Marketing	97
4.7.4 Recommendations.....	98
4.8 Wetlands Protection Program	98
4.8.1 Permit Review Program	99
4.8.2 Non-Regulatory Programs	104
4.9 East of Hudson Non-Point Source Pollution Control Program	107

4.9.1 Wastewater-Related Nonpoint Source Pollution Management Programs	107
4.9.2 Stormwater-Related Nonpoint Source Pollution Management Programs	110
4.9.3 Other Activities.....	120
4.10 Kensico Water Quality Control Program	121
4.10.1 Stormwater Management and Erosion Abatement Facilities	121
4.10.2 Kensico Action Plan	130
4.10.3 West Lake Sewer Trunk Line	130
4.10.4 Video Inspection of Sanitary Sewers.....	131
4.10.5 Septic Repair Program	131
4.10.6 Turbidity Reduction.....	133
4.10.7 Route 120.....	134
4.10.8 Westchester County Airport	134
4.11 Catskill Turbidity Control	134
4.11.1 Phase II Schoharie Supporting Analyses	136
4.11.2 Implementation of Catskill Turbidity Control Alternatives	138
4.11.3 Reservoir Monitoring.....	139
4.12 Sand and Salt Storage	140
5. Watershed Monitoring, Modeling, and GIS	141
5.1 Watershed Monitoring Program	141
5.2 WWTP Pathogen Monitoring	145
5.3 Multi-Tiered Water Quality Modeling Program	148
5.4 Geographic Information System	152
5.4.1 Utilization of GIS for Watershed Management.....	153
5.4.2 Completion of New Data Layers	162
5.4.3 Incorporation of Data Layers into the Modeling Database.....	162
5.4.4 Data Dissemination to Stakeholders and the Public, Including Notification of Data Availability to Communities and Requests for Data	162
5.4.5 GIS Infrastructure Improvement.....	163
5.4.6 Hardware and Software	163
5.4.7 Professional Development	164
6. Regulatory Programs	165
6.1 Project Review	165
6.1.1 SEQRA Coordination	182
6.1.2 Delegation Agreements.....	186
6.2 Enforcement Activities	187
6.3 Wastewater Treatment Plant Compliance and Inspection Program	188
6.3.1 Sampling of Wastewater Treatment Plant Effluents.....	191
6.4 Winter Road Deicer Policy and Protection Development	192
7. Catskill/Delaware Filtration/UV Disinfection Facilities	193
7.1 Ultraviolet Disinfection Facilities	193
7.1.1 Site Preparation.....	193
7.1.2 Design of Ancillary Projects.....	194
7.1.3 Permitting.....	194
7.1.4 Project Schedule	194
7.1.5 Facility Construction Contracts	194

7.1.6 Pilot Studies	195
7.2 Filtration Planning Design Update	195
7.2.1 Facility Design Update	195
8. In-City Programs.....	197
8.1 Waterborne Disease Risk Assessment Program	197
8.2 Cross Connection Control Program	198
9. Education and Outreach.....	201
9.1 New York City Water Consumers	201
9.2 Watershed Residents, Landowners and Homeowners	203
9.3 School Groups (Teachers/Students) and Other Youth Audiences	204
9.4 Local Government Officials, Professionals, and Business Groups	205
9.5 Recreational Groups and Other Public Audiences	207
10. Miscellaneous Reporting Provisions	209
10.1 Water Conservation	209
10.2 Updates to Drought Management Plan	213
10.3 Delaware Aqueduct Leak	213
References.....	217
Appendix A: Map Production and Data Development in 2009.....	219

List of Figures

Figure 2.1.	Positive fecal coliform samples, Kensico-Delaware System, 2006–2009.	4
Figure 2.2.	Positive fecal coliform samples, Kensico-Catskill System, 2006–2009.	4
Figure 2.3.	Catskill and Delaware source water turbidity, January 1, 2009– December 31, 2009.	5
Figure 2.4.	Positive total coliform samples, NYC Distribution System, 2006–2009.	7
Figure 3.1.	Bloomville sand filter building.	12
Figure 3.2.	Hamden leach field and sand filter building.	12
Figure 3.3.	The Boiceville wastewater treatment plant.	13
Figure 4.1	Number of acres signed by basin, through 2009, Catskill/Delaware System.	24
Figure 4.2	Number of acres signed by year, Catskill/Delaware System.	27
Figure 4.3	Number of signed contracts by year, Catskill/Delaware System.	27
Figure 4.4	A 327-acre tract in Windham signed to contract during 2009.	28
Figure 4.5	A 448-acre tract in Halcott signed to contract during 2009.	28
Figure 4.6	A 245-acre tract in Kortright which closed in 2009 includes uplands, meadows, floodplains, and ¾-mile of frontage on the West Branch Delaware River.	28
Figure 4.7	Students who participated in a cleanup event on Pepacton Reservoir.	37
Figure 4.8	Participants planting trees on City land in Margaretville.	37
Figure 4.9	Students participating in a wetland planting project on Lake Gleneida.	37
Figure 4.10	New York City-owned land open for recreation.	38
Figure 4.11	Watershed Agricultural Program large farm activities, Catskill/Delaware Watersheds, as of December 31, 2009.	47
Figure 4.12	Annual status reviews on large farms, Catskill/Delaware Watershed, as of December 31, 2009.	49
Figure 4.13	Small Farm Program, Catskill/Delaware Watershed, as of December 31, 2009.	51
Figure 4.14	East of Hudson Farm Program, Catskill/Delaware and Croton Watersheds, as of December 31, 2009.	53
Figure 4.15	Conservation Reserve Enhancement Program (CREP) activities, Catskill/Delaware Watershed, as of December 31, 2009.	57
Figure 4.16	Stream Management Plan Adopting Municipalities, as of December 2009.	68
Figure 4.17	Planning basins and Stream Restoration Project sites - active 2009 projects.	69
Figure 4.18a	Long Road before restoration.	79
Figure 4.17b	Long Road during restoration.	80
Figure 4.17c	Long Road after restoration.	80
Figure 4.18a	Before Sugar Maples stream restoration.	81
Figure 4.18b	After Sugar Maples stream restoration.	81
Figure 4.19	Stony Clove at Chichester projects.	84
Figure 4.20a	Before the Loewenthal stream restoration project.	85
Figure 4.20b	After the Loewenthal stream restoration project.	85
Figure 4.21a	Horton Brook before floodplain restoration.	87
Figure 4.21b	Horton Brook after floodplain restoration.	87

Figure 4.22	Riparian Buffer Project sites as of December 31, 2009.	93
Figure 4.23	West of Hudson 2009 wetland permit application reviews.	100
Figure 4.24	East of Hudson 2009 wetland permit application reviews.	101
Figure 4.25	Putnam SRP Phased Priority Areas.	109
Figure 4.26	Stormwater remediation and retrofit sites.	111
Figure 4.27	Completed erosion protection on slope.	112
Figure 4.28	Completed drainage culvert with stone outfall protection.	112
Figure 4.29	Location of stormwater management facilities in Kensico Reservoir watershed.	122
Figure 4.30	Photo of accumulated sediment being removed.	126
Figure 4.31	Spill containment facilities in and around Kensico Reservoir.	128
Figure 4.32	Kensico spill boom.	129
Figure 4.33	Kensico Reservoir Septic Program priority areas.	132
Figure 5.1.	WOH WWTPs monitored in 2009 for <i>Giardia</i> , <i>Cryptosporidium</i> , and human enteric viruses.	145
Figure 5.2.	Shaded relief display of a portion of the 2009 LiDAR-generated 1-meter resolution “bald earth” (buildings and trees removed) digital terrain model for the Whippoorwill Lake area in the East of Hudson watershed.	155
Figure 5.3.	Example of the 2009 Leaf-off 1-foot resolution 4-band Ortho-rectified aerial imagery, displayed in Natural Color, for a farm in the East of Hudson watershed.	156
Figure 5.4.	Land management map produced to aid in adjusting the inspection priority of all pre-MOA and MOA properties, in accordance with the new monitoring policy taking effect in 2010.	158
Figure 5.5.	Sewage service status for all parcels in the Kensico Reservoir basin, in support of the implementation of the Kensico Septic Program.	161
Figure 6.1.	East of Hudson Catskill/Delaware new projects for 2009.	168
Figure 6.2.	East of Hudson Catskill/Delaware new individual SSTS locations for 2009.	169
Figure 6.3.	East of Hudson Catskill/Delaware repaired individual SSTS locations for 2009.	170
Figure 6.4.	West of Hudson Catskill/Delaware new projects for 2009.	179
Figure 6.5.	West of Hudson Catskill/Delaware new individual SSTS locations for 2009.	180
Figure 6.6.	West of Hudson Catskill/Delaware repaired individual SSTS locations for 2009.	181

List of Tables

Table 3.1.	2009 future stormwater controls projects.	17
Table 3.2.	Stormwater retrofit construction projects completed or substantially completed in 2009.....	19
Table 3.3.	Current open stormwater retrofit construction projects.	19
Table 3.4.	Completed planning and assessment projects.....	21
Table 3.5.	Current open planning and assessment projects.	21
Table 4.1.	Status of Cat/Del contracts signed in 2009, by reservoir basin.	23
Table 4.2.	Contracts signed and closed as of December 31, 2009 (including WAC farm easements), by priority area.	24
Table 4.3.	LAP 2009 solicitation status as of December 31, 2009.....	25
Table 4.4.	Contracts signed and closed in Cat/Del, 1995-2009, by reporting period and real estate type.	26
Table 4.5.	Contracts closed in Cat/Del, 1995-2009, by reporting period and real estate type.	26
Table 4.6.	Acres of riparian buffers in Cat/Del, by basin, through 2009.....	30
Table 4.7.	Percent of total riparian acreage privately-owned, by basin.....	30
Table 4.8.	Number and associated acres of DEP easement properties by field office.....	34
Table 4.9.	Number and types of reserved rights approved on DEP easements in 2009.	34
Table 4.10.	Land and water acreage monitored by each field office at the end of 2009.	35
Table 4.11.	Miles painted and posted and site visits made in 2009 by field office.	36
Table 4.12.	Number and acreage of full inspections completed in 2009 by field office.....	36
Table 4.13.	Forestry projects completed, in progress, and in the planning phase in 2009.	39
Table 4.14.	Projects initiated in 2009 for the agricultural use of City land.....	41
Table 4.15.	Summary of WAP accomplishments as of December 31, 2009.....	46
Table 4.16.	Implementation of BMPs on West of Hudson large farms during 2009.	48
Table 4.17.	Implementation of BMPs on West of Hudson small farms during 2009.....	51
Table 4.18.	Implementation of BMPs on East of Hudson small farms during 2009.....	54
Table 4.19.	SMP project name and identification by basin.	70
Table 4.20.	Catskill/Delaware riparian buffer summary as of December 2009.	90
Table 4.21.	2009 ACOE permit reviews.....	102
Table 4.22.	2009 DEC Article 24 permit reviews.	102
Table 4.23.	2009 local permit reviews.....	104
Table 4.24.	Wetlands protected (under contract or closed) by the NYC Land Acquisition Program in the Catskill/Delaware and Croton Systems as of December 31, 2009.....	105
Table 4.25.	Small stormwater remediation projects completed in 2007.....	115

Table 4.26.	Small stormwater remediation projects completed in 2009.....	116
Table 4.27.	Inspection checklist for extended detention basins.....	123
Table 4.28.	Kensico stormwater and erosion abatement facility maintenance activities.	124
Table 5.1.	Pathogen results for WOH WWTPs sampled in 2009.....	146
Table 6.1.	Project review and enforcement activities in 2009.....	165
Table 6.2.	Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoirs new projects for 2009.	166
Table 6.3.	Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoirs individual SSTs for 2009.....	166
Table 6.4.	Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2009.	171
Table 6.5.	Ashokan and Schoharie Reservoirs individual SSTs for 2009.....	177
Table 6.6.	Cannonsville, Pepacton, Rondout, Neversink Reservoirs individual SSTs for 2009.	178
Table 6.7.	SEQRA actions in 2009.....	182
Table 6.8.	2009 SEQRA activity and status for Type I Actions.....	183

1. Introduction

In 2009, New York City continued to implement a broad array of programs as part of the City's source water protection program. The City first applied for a waiver from the filtration requirements of the Surface Water Treatment Rule for the Catskill/Delaware system in 1991. Since then, the Department of Environmental Protection (DEP) has committed more than \$1.5 billion and countless staff hours to sustain the pristine quality of the source waters of the Catskill and Delaware watersheds.

DEP's comprehensive source water protection program is based on 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 upon the information collected through its monitoring and research efforts, DEP has crafted a watershed protection strategy that focuses on implementing initiatives that are both protective (antidegradation) and remedial (specific actions designed to reduce pollution generated from identified sources).

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

In 2006, DEP set forth a framework to continue its efforts in sustaining the high quality of New York City's Catskill/Delaware water supplies with the publication of the December 2006 Long-Term Watershed Protection Program report. This document outlined the City's programmatic commitments to continued watershed protection for the subsequent five years and served as the framework for the current Filtration Avoidance Determination, issued by EPA in July 2007. In 2009, DEP continued to comply with the substantive requirements of the 2007 FAD.

Over the past year, the world economic situation continued to place pressure on resources at DEP. The agency strives to balance the need for strong source water protection and construction and maintenance of critical infrastructure with efforts to keep water rates affordable. During 2009, DEP sought ways to improve efficiency while continuing steady implementation of critical watershed protection efforts. While New York City continues to dedicate significant funding and personnel to the watershed program, each program element will continue to be

evaluated critically to ensure that resources are being deployed in the most effective and cost-effective way.

This annual report covers the period January 1, 2009, through December 31, 2009, and is compiled to satisfy the requirements of the 2007 FAD. Material in this report is organized to parallel the sections of the FAD.

While this 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. 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.

2. Federal and State Objective Water Quality Compliance

During 2009, DEP continued its comprehensive water quality monitoring efforts. 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 2009, DEP collected a total of 45,662 samples and conducted a total of 482,764 analyses. Of these, 27,270 samples were collected and 330,162 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. Of the 10,043 in-City compliance samples analyzed pursuant to the Total Coliform Rule in 2009, only 0.28% were total coliform positive. All samples were negative for *E. coli*. All resamples were negative for total coliform. Since November 1994, DEP has collected more than 161,694 compliance samples and only 13 of those samples have tested positive for *E. coli*.

On the tenth of every month, DEP provides both EPA and DOH with the results of its enhanced monitoring program, developed to comply with the requirements of the Surface Water Treatment Rule (SWTR), the Total Coliform Rule, 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.

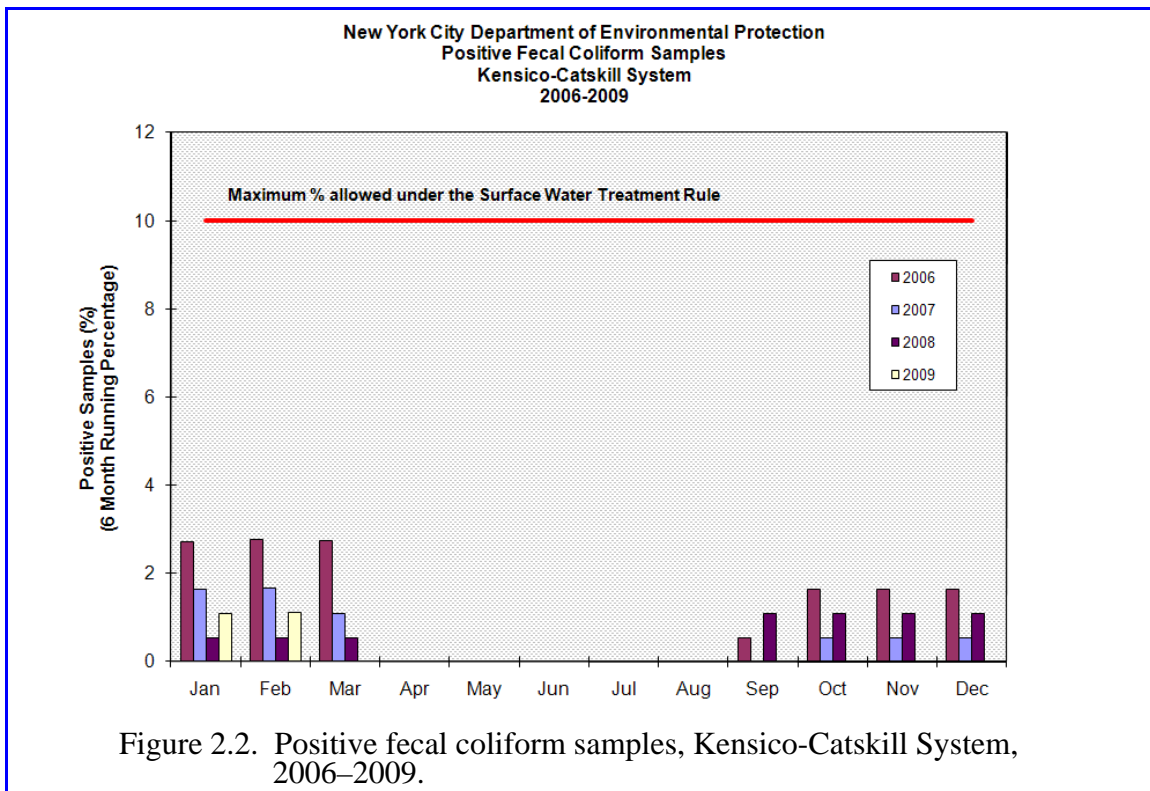
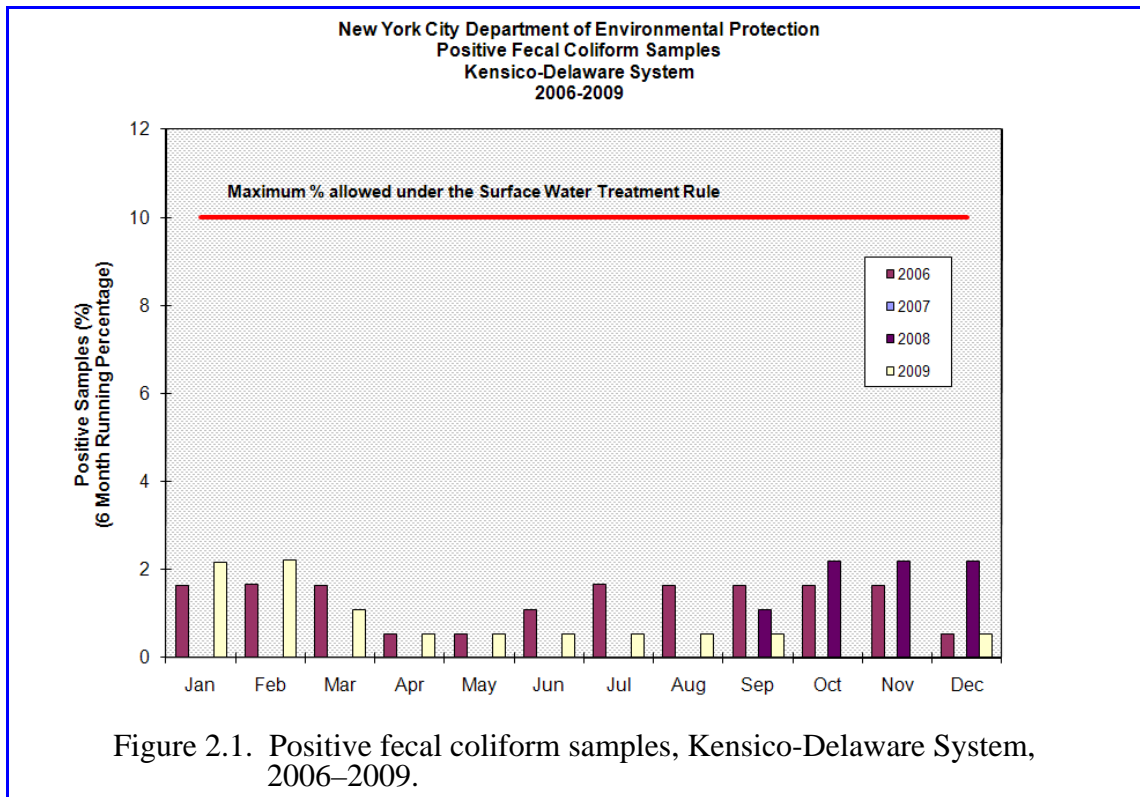
2.1 SWTR Monitoring and Reporting

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 2009, 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))

Both the Catskill and Delaware Aqueduct effluents from Kensico Reservoir exhibited fecal coliform concentrations in water prior to disinfection at levels less than or equal to 20 CFU 100 mL⁻¹ in at least 90% of the samples collected during the year, for six-month running percentages. In fact, the running percentage of samples for the Catskill and Delaware Systems never fell below 98.9% and 97.8%, respectively.

As shown in Figures 2.1 and 2.2, in 2009 the six-month running percentages of positive raw water fecal coliform samples at both the Catskill and Delaware Aqueduct effluents from Kensico Reservoir were well below the maximum percentage of positive samples allowed under the SWTR.



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

Both the Catskill and Delaware Aqueduct effluents from Kensico Reservoir exhibited turbidity levels less than or equal to 5 NTU in water prior to disinfection for the entire 2009 calendar year (Figure 2.3). Turbidity values did not exceed 3.6 NTU for the Catskill System and 3.1 NTU for the Delaware System.

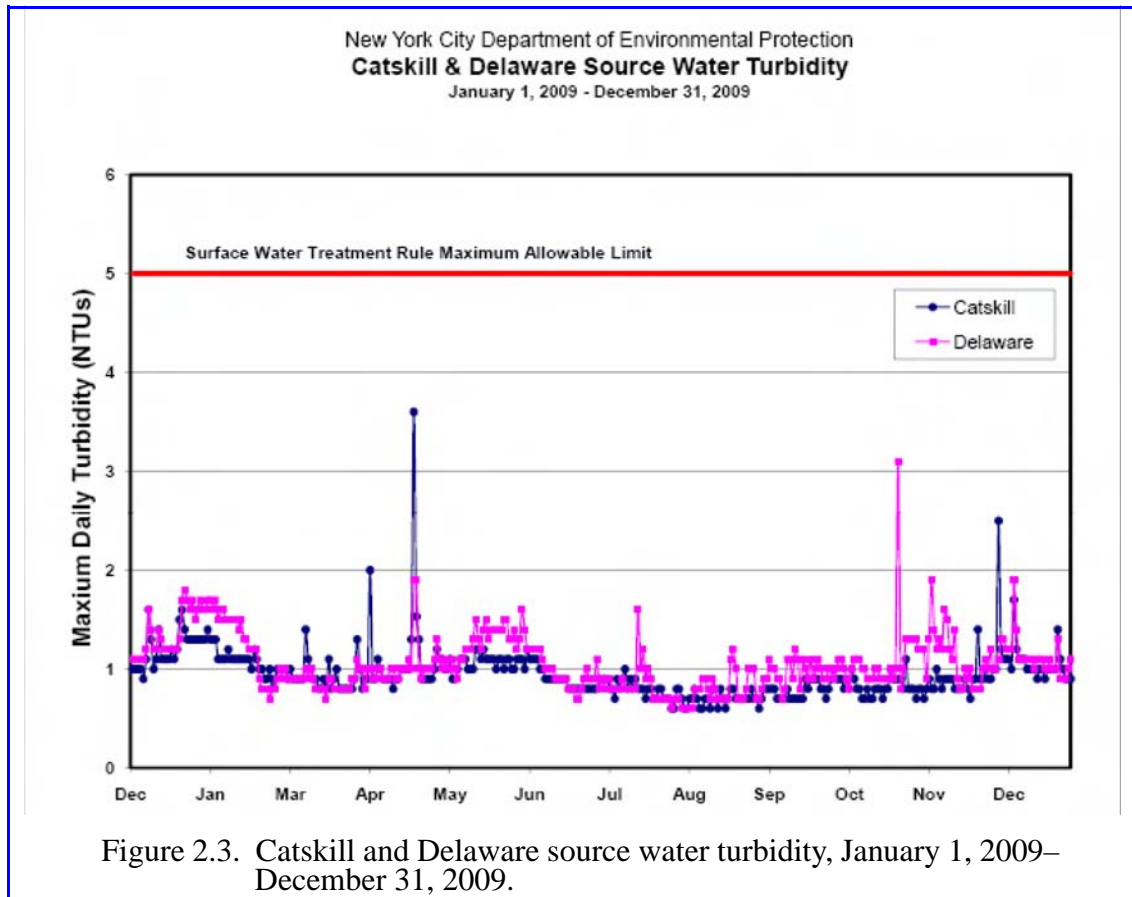


Figure 2.3. Catskill and Delaware source water turbidity, January 1, 2009–December 31, 2009.

2.1.3 Raw Water Disinfection/CT Values (40 CFR Section 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 greater than or equal to 1.0. The actual lowest net inactivation ratio was 1.7 for the Catskill System and 1.2 for the Delaware System.

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

Chlorine residuals were maintained at concentrations at or above 0.20 mg L⁻¹ at all Catskill/Delaware entry points during the year. The lowest chlorine residual measured at an entry point was 0.29 mg L⁻¹.

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

All chlorine residuals for the 23,201 samples measured within the distribution system during the year were detectable, with the exception of 5 samples. However, none of the 5 had a heterotrophic plate count (HPC) greater than 500 CFU mL⁻¹. Samples with an HPC less than or equal to 500 CFU mL⁻¹ are deemed to have a detectable disinfectant residual for purposes of determining compliance with this requirement. As such, no more than 5% of the samples had undetectable chlorine residuals in any two consecutive months of the year.

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

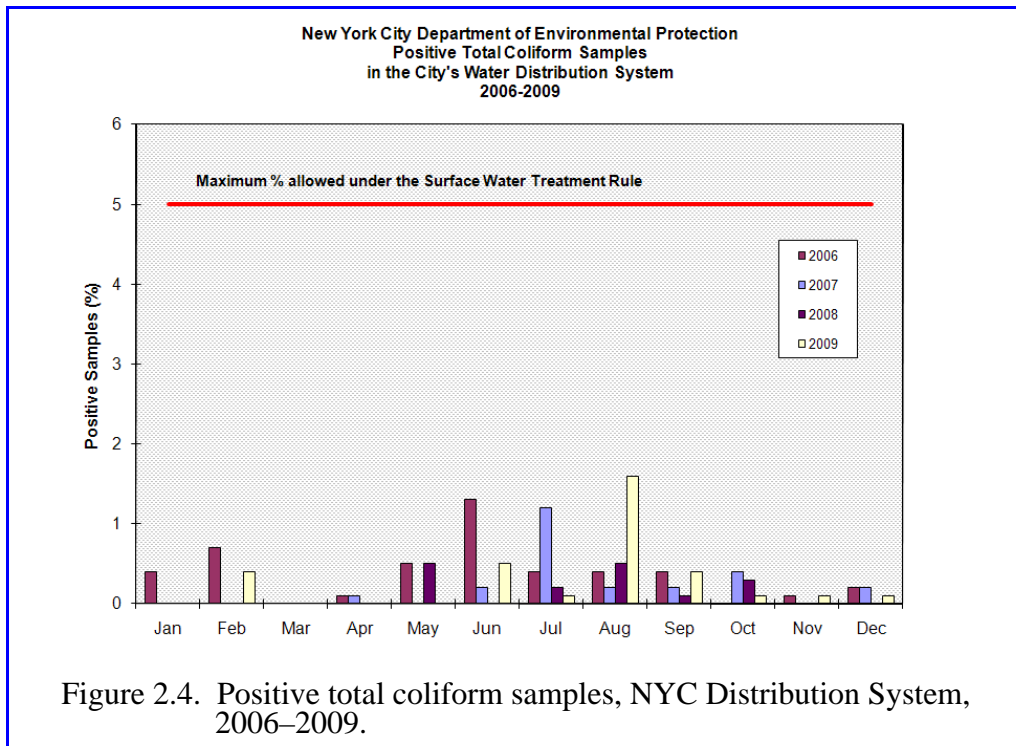
The analysis for trihalomethanes, performed on a quarterly basis, resulted in a maximum total trihalomethane (TTHM) value of 71 µg L⁻¹ in the Catskill/Delaware Distribution Area. The analysis for haloacetic acids, also performed on a quarterly basis, resulted in a maximum haloacetic acid five (HAA5) value of 70 µg L⁻¹ in the Catskill/Delaware Distribution Area.

The highest TTHM quarterly running average during the year, recorded during the fourth quarter, was 43 µg L⁻¹ for the Catskill/Delaware Distribution Area, a level below the regulated level of 80 µg L⁻¹. The highest HAA5 quarterly running average during the year, recorded during the fourth quarter, was 43 µg L⁻¹ for the Catskill/Delaware Distribution Area, a level below the regulated level of 60 µg L⁻¹.

2.2 Total Coliform Monitoring

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

Within the distribution system, coliform monitoring indicated monthly levels below the 5% maximum of the Total Coliform Rule (Figure 2.4). The number of compliance samples analyzed for total coliform was 10,043. Of these compliance samples, 28 were total coliform positive. All resamples were coliform negative, with the exception of 2 resamples in the month of August. However, the second round of resampling was coliform negative for all locations. All samples were *E. coli* negative for the year. The annual percentage of compliance samples that was total coliform positive was 0.28% and the highest monthly average was 1.56%.



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. Four permanent chlorination booster stations have been continuously operating to improve the chlorine residual levels for the Fort Tilden, Roxbury, and Breezy Point areas (Rockaway Peninsula) in Queens; City Island in the Bronx; Floyd Bennett Field in Brooklyn, and Staten Island. As a result of these steps, detectable chlorine residuals were maintained throughout the distribution system during the year.

3. Environmental Infrastructure

3.1 Septic Programs

3.1.1 Septic Rehabilitation and Replacement Program

Since 1997, New York City has committed \$54.6 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.

The CWC Septic System Rehabilitation and Replacement Program includes the following sub-programs: the Priority Area Program, the Hardship Program, the SDWA-Septic Monitoring Program, and the Reimbursement Program.

- The Priority Area Program is an inspection and repair program implemented geographically based upon the proximity of septic systems to reservoirs and watercourses. The program was implemented by CWC in July 1999 in the 60-Day Travel Time Area and has since expanded sequentially to include first septic systems located within 50 feet of a watercourse and/or 300 feet of a reservoir or reservoir stem, and then septic systems located between 50 and 100 feet of a watercourse. In 2009, CWC funded the repair or replacement of 327 failing or likely-to-fail septic systems through the program. A total of 1,283 failing septic systems have been repaired or replaced under the Priority Area Program through December 2009.
- The Hardship Program funds septic repairs outside the Priority Area Program for applicants who meet certain income eligibility criteria. In 2009, CWC funded the repair or replacement of 9 failing septic systems under the Hardship Program. A total of 69 failing septic systems have been replaced under the program through December 2009.
- The Septic Monitoring and Research Project, which provided information about the effectiveness of alternative on-site wastewater treatment technologies under local conditions to help designers and regulators select appropriate, cost-effective systems in the WOH Watershed, was concluded in 2008. Five different septic system designs were installed under this program: ATUs, sand filters with leach fields, peat filters with leach fields, raised systems, and conventional systems. The final report was presented to members of the Septic Monitoring Advisory Committee in June 2008. A total of 38 failing septic systems were repaired or replaced under the Septic Monitoring Program.
- The Reimbursement Program reimburses home owners who repair or replace failing septic systems outside the Priority Area Program, depending upon funding availability. Presently, home owners who fixed failing septic systems outside the priority areas between July 21, 2008 and December 31, 2009 are eligible for reimbursement.

Under the various sub-programs discussed above, CWC funded the repair or replacement of 363 septic systems in the WOH Watershed in 2009. Since program inception, a total of 3,227 failing or likely-to-fail septic systems have been repaired, replaced, or managed.

As required by the 2007 FAD, the Septic Rehabilitation and Replacement Program was expanded to include \$4 million in funding for commercial septic systems operated by small businesses and \$2 million in funding for repairing or replacing existing cluster systems or creating new cluster systems. These components of the Septic Rehabilitation and Replacement Program are reported on below in Section 3.1.4, Other Septic Programs.

3.1.2 Septic Maintenance Program

The Septic Maintenance Program is funded for \$1.5 million over 10 years. It is a voluntary program intended to reduce the occurrence of septic system failures through regular pump-outs and maintenance. CWC pays 50% of eligible costs for pump-outs and maintenance.

CWC subsidized a total of 84 septic tank pump-outs in 2009. Since program inception a total of 445 septic tank pump-outs have been subsidized.

3.1.3 Alternate Design Septic Systems Program

The Alternate Design Septic Systems Program is a \$3 million program to pay for the importation of fill material and/or pumping apparatus for the construction of septic systems where required solely by DEP or its delegate in order to comply with the Watershed Regulations. One project received Alternate Design Septic Program funding in 2009. Since 2001, the CWC Board has authorized the transfer of \$1,999,000 in Alternate Design Program funding to other, more active, watershed protection and partnership programs. The balance of Alternate Design Program funds as of October 31, 2009 was \$1,416,076.

3.1.4 Other Septic Programs

CWC adopted Small Business Septic System Rehabilitation and Replacement Program Rules in 2008. This 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. The CWC will reimburse such business owners 75% of the cost of septic repairs, up to a maximum of \$40,000. To be eligible, failing commercial septic systems must be within 100 feet of a watercourse or 500 feet of a reservoir, or within the 60-day Travel Time Priority Zone.

In 2009, CWC funded the repair or replacement of one failing septic system under this program. This is the only failing septic system that has so far been replaced under the program. Additionally, three other systems were designed and will be constructed in 2010.

DEP continued to work with CWC in 2009 on finalizing program rules for cluster systems. The one issue that remains to be resolved is the 25% cost share for small businesses. It is uncertain whether the 25% cost share for small businesses can be implemented in the context of

utilizing sewer districts to create cluster systems. Cluster System Program Rules will be finalized in 2010.

3.2 New Sewage Treatment Infrastructure Program

The New Sewage Treatment Infrastructure Program (NIP) funds the study, design, and construction of new wastewater projects in seven communities: Andes, Roxbury, Hunter, Windham, Fleischmanns, Phoenicia, and Prattsville.

The Andes WWTP project is complete. Project closeout occurred August 31, 2005.

The Roxbury pump station and force main project from the Hamlet of Roxbury to the Grand Gorge WWTP is complete. Sewer construction for the Hubbell's Corners Supplemental Service Area is at least 80% complete. The project is on schedule to be completed in the first half of 2010.

The Hunter WWTP and collection system are functionally complete. With the remaining funds from its block grant, the Village plans to purchase and install a flow control valve for the equalization tank to gain automatic and remote control for adjusting influent flow.

The Windham WWTP and collection system are functionally complete. The Town intends to spend remaining block grant funds on additions to the sewer collection system within the approved service area.

The Fleischmanns WWTP project is complete. Project closeout occurred January 15, 2010.

DEP authorized the Town of Shandaken on July 14, 2009 to move forward with a request for proposals for a membrane bioreactor (MBR) wastewater facility in Phoenicia. DEP will restart the one-year design period once the Town retains an engineering firm to complete the redesign of the WWTP and collection system. In October 2009, the Town of Shandaken requested that CWC provide assistance in managing this project. In November, a new Shandaken Town Supervisor was elected. It is anticipated that the Town will pass a resolution requesting CWC administration of the project during the first quarter of 2010. DEP will carefully evaluate the Town's progress in advancing a WWTP project in 2010. DEP may decide to reallocate funding to other projects if sufficient progress is not made by the town. DEP will also evaluate options for enforcement actions with the Town.

The Prattsville WWTP and collection system are functionally complete. The Town intends to spend the remainder of its block grant on reimbursements for lateral connections.

3.3 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 district.

As a requirement of the 2007 FAD, DEP provided an additional \$37.2 million in funding to complete existing CWMP projects and fund three additional CWMP projects.



Figure 3.1. Bloomville sand filter building.

To date, CWMP projects have been completed in Bovina, DeLancey, Bloomville, and Hamden.

The Bovina community septic system is complete.

The DeLancey Septic Maintenance District project is complete.

Construction of the sanitary collection system and community septic system for Bloomville was completed in 2009. All sanitary laterals (78) have been installed. The system is in full operation (Figure 3.1).

The Hamden sanitary collection system and community septic system were completed in 2009. All sanitary laterals (60) have been installed. The system is in full operation. Figure 3.2 depicts the leach field in the foreground with the sand filter building in the background.



Figure 3.2. Hamden leach field and sand filter building.

In Boiceville, construction of the sewer collection system was completed during 2009 and WWTP construction reached 50% completion. Construction is expected to be finished in the first half of 2010. The building housing the Boiceville WWTP is shown in Figure 3.3.



Figure 3.3. The Boiceville wastewater treatment plant.

The approved project for the Hamlet of Ashland is a re-circulating sand filter WWTP with small diameter gravity sewers. Design is complete and construction bids have been awarded. Construction will commence in 2010 as soon as weather permits.

Preliminary Engineer's Reports were completed for Trout Creek and Lexington in 2009. The Preliminary Engineer's Report for South Kortright is expected in the first quarter of 2010. The pre-construction phase for these projects is anticipated to begin following review of the Preliminary Engineer's Reports by DEP and CWC.

3.4 Sewer Extension Program

DEP continued to implement the Sewer Extension Program during 2009. Highlights of program activities in each participating community are described below.

Town of Neversink (Planned Extensions to the Grahamsville Sewer System)

Construction continued on this large sewer extension project involving four separate planned extensions and over 100 service connections.

Particular focus was directed toward resolving surface and sub-surface drainage concerns along one of the extensions where surface and groundwater were found to be entering the newly constructed lateral and sewer main trenches up-gradient from one of the pump stations. Once this matter was resolved the project reached "Substantial Completion".

Construction of the sewer extensions and associated laterals was completed in December 2009. Following the project's completion, DEP assumed ownership, operation, and maintenance of all the new extensions. It is anticipated that the Town of Neversink will authorize residents to make their house connections in the first half of 2010.

Town of Roxbury (Planned Sewer Extension to the Grand Gorge Sewer System)

Construction of the planned sewer extension along NYS Rt. 23 west of the Hamlet of Grand Gorge commenced in the spring of 2009. The most significant issue encountered during construction was that unforeseen circumstances resulted in several significant field change orders and cost overruns. For a brief period in late August and early September the contractor found it necessary to suspend work pending assurance that certain change orders would be approved. Once these matters were resolved, construction resumed through the remainder of the construction season.

Throughout the course of construction, DEP attended Construction Progress Meetings and oversaw all construction-related activities. By the end of the construction season most construction activities were complete. All that remained was the construction of a small section of new main to connect the extension with the existing sewer system, construction of a few remaining laterals, and completing the construction of a pump station. Construction is anticipated to be completed in the first half of 2010.

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

Significant progress was made in the planning and design of a planned sewer extension located just south of the former Village of Pine Hill along NYS Rt. 28 next to the City's Pine Hill WWTP.

During the first half of 2009, DEP completed its review of the project's 60% plans and specifications. Subsequently, in June 2009, DEP received and then commented on the project's 90% plans and specifications. At the end of December 2009, DEP's engineering consultant for the project was in the process of preparing responses to comments it received on the 90% project plans and specifications.

DEP was also active during the past year complying with SEQRA and working with the Town to procure easements on properties where the new sewer mains and laterals are planned. Additional activities that will need to occur prior to the start of construction on the extension include obtaining all applicable permits, assisting the Town in preparing and adopting a new Sewer Use Law, and preparing a construction contract.

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

Considerable progress was made on the planning and design of the sewer extension being planned along NYS Rt. 23C (Hill Street) and Showers Road. During the first half of 2009, DEP

completed its review of the project's 30% plans and specifications. In August 2009, DEP received the project's 60% plans and specifications. In December 2009, DEP's engineering consultant prepared its responses to comments on the 60% project plans and specifications and distributed it to staff for their final review and comment.

DEP was also active during the past year complying with SEQR and working with the Town to procure easements on properties where the new sewer mains and laterals are planned. DEP also met with residents upon request to discuss issues with the proposed location of laterals on their properties to serve their homes.

In addition to finalizing the project's plans and specifications, additional work that will need to be completed prior to commencing construction of the extension includes finalizing compliance with SEQR, obtaining all applicable permits, securing signed easements from all landowners that will be served by the extension, and preparing a construction contract.

Village of Margaretville & Town of Middletown (Planned Sewer Extensions to the Margaretville Sewer System)

The main focus of the past year has been working closely with the Village and Town to obtain the remaining easements needed to be able to resume the planning and design of the three planned extensions that have been suspended for several years. DEP and its engineering consultant attended information sessions that the Village and Town Building Inspector arranged to inform the residents of the importance of signing the easements. Following each of the meetings, DEP and its engineering consultant visited with the landowners who attended the meetings to discuss any concerns they had with signing the easements and to learn where they would like a lateral to be located on their property to serve their homes. Subsequently, these residents were provided with an updated easement and map which illustrates the location of the easement and proposed lateral on their property. Once the attorney's office representing the Village and the Town receives the signed easements from all of the affected landowners, and the easements are signed by the appropriate DEP representatives, the attorney's office will file all of the easements and the attached maps at the County Clerk's office.

As of December 31, DEP had received most of the easements. Once DEP receives the remaining easements, it will be able to move forward once again with the planning and design of the extension.

3.5 WWTP Upgrade Program

As part of the MOA, the City agreed to fund the upgrades of all existing non-City-owned WWTPs in the watershed. (As reported in previous annual reports, upgrades of City-owned WWTPs, which account for more than a third of WWTP flow in the Catskill/Delaware watershed, proceeded on a separate track and were completed in 1999.) The upgrades provide highly advanced treatment of WWTP effluent. The task of coordinating these complex projects with the

37 WWTP owners in the Catskill/Delaware watershed is enormous. Many of the owners are restaurateurs, hoteliers, camp operators, school administrators, and managers of recreational facilities, not professional WWTP operators and construction specialists. DEP has proceeded diligently with this vast undertaking and provided step-by-step guidance on a host of engineering, operating, contracting, and regulatory issues.

DEP has entered into a contract with the New York State Environmental Facilities Corporation (EFC) that identifies a wide range of tasks to be performed by both DEP and EFC to ensure comprehensive management of the overall WWTP Upgrade Program. DEP's and EFC's tasks have included, but are not limited to: program start-up, establishing contracts with each WWTP owner, providing technical assistance to each WWTP owner and its consulting engineer, change order administration, construction oversight, funds management (including invoice review and reconciliation), and extensive project management. DEP and EFC have continued to provide technical and program guidance to each of the owners and their engineers to assist them through the process of upgrading each unique facility.

The upgrade of non-City-owned WWTPs is divided into two distinct programs: Regulatory Upgrades and (WOH only) SPDES Upgrades. Although these programs are separate, both are encompassed by the Upgrade Agreement between EFC and the WWTP owner.

The Regulatory Upgrade Program is designed to assist WWTPs in meeting requirements imposed solely by the Watershed Rules and Regulations (WR&R). Treatment technologies required by the program include, but are not limited to: phosphorus removal, sand filtration with redundancy, back-up power, back-up disinfection, tertiary treatment via microfiltration (or DEP-approved equivalent), effluent flow metering, and alarm telemetering.

The SPDES Upgrade Program is designed to assist certain WWTPs in meeting the conditions of their current SPDES permits. Equipment that is unreliable or reaching the end of its useful life is eligible for replacement under this program. Certain SPDES improvements conducted at a facility after November 2, 1995, are also eligible for reimbursement under this program.

In 2009, efforts focused on completing regulatory upgrades for the remaining non-upgraded WWTPs. By the end of the year, 34 WWTPs, representing 99% of the total WOH flow, had achieved Functional Completion and now comply with the NYC WR&R, and 2 WWTPs, representing 1% of the flow, had finalized design and were preparing to begin construction. In addition, 1 WWTP was awaiting completion of the Boiceville Community Wastewater Project so it could be connected to it.

In addition to the efforts to achieve Functional Completion at all WOH WWTPs, efforts also focused on negotiating O&M Agreements and budgets as well as processing Start Up and

Performance payments and O&M payments. O&M agreements and budgets were successfully negotiated with all eligible WOH WWTPs.

Notable progress was also made in advancing the upgrades of nine EOH FAD-related WWTPs located in the Croton Falls-Cross River basin. Five of these upgrades, at WWTPs representing 97% (1.3 MGD) of the Croton Falls-Cross River basin flow, have been completed, while four have begun construction.

3.6 Stormwater Programs

3.6.1 Stormwater Cost-Sharing Programs

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

Two separate programs have been developed to offset additional compliance costs incurred as a result of the implementation of the WR&R. The West of Hudson Future Stormwater Controls Program (\$31.7 million) was established by Paragraph 128 of the MOA and is administered by the CWC, which reimburses municipalities and large businesses 100% and small businesses 50% for eligible costs. Paragraph 145 of the MOA is a separate program known as Future Stormwater Controls Paid for by the City, which reimburses low-income housing projects and single-family home owners 100% and small businesses 50% for eligible costs.

The City has fully funded the \$31.7 million West of Hudson Future Stormwater Controls Program. From this allotment, CWC has funded \$2,835,645 for construction projects and \$153,021 for maintenance projects, while \$12,176,724 has been transferred to other eligible watershed protection programs and \$19,935,086 plus interest income remains to be allocated. See Table 3.1 below.

Table 3.1. 2009 future stormwater controls projects.

Applicant	Project	Approval Date	CWC Funding	NYC Funding
Town of Olive	Boiceville WWTP SPPP stormwater detention pond	9/23/08	\$83,100	None
		6/2/09	49,400	None
Machne Tashbar	Camp Machne Tashbar WWTP SPPP stormwater controls	11/4/08	\$81,046.93	None

Table 3.1. (Continued) 2009 future stormwater controls projects.

Applicant	Project	Approval Date	CWC Funding	NYC Funding
Bovina Hwy. Garage	Consultant Construction and construction admin. and observation	7/7/09 8/4/09	\$15,000 \$324,500	None None
Wadler Bros., Inc.	SPPP design cost reimbursement	11/3/09	\$14,197.23	\$14,197
Reservoir United Methodist Church	SPPP stormwater controls	12/1/09	\$24,365.28	None
Masserson Properties	The Roxbury Motel Extension SPPP stormwater controls	12/1/09	\$42,000	\$42,000
Septic III Fund Transfer	General program funds	12/1/09	\$500,000	None

3.6.2 Stormwater Retrofit Program

The Stormwater Retrofit Program is administered jointly by CWC and DEP and has two components: a construction grants (or capital projects) component and a planning and assessment component. The total program budget is \$21,791,800—\$16,298,050 for capital expenditures, \$2,993,750 for maintenance activities, and \$2,500,000 to conduct community-wide stormwater infrastructure assessment and planning initiatives.

CWC currently maintains an open application timetable for construction grant project applications, evaluating each application as it is submitted. CWC gives funding preference to construction grant project applications where a Planning and Assessment project has already been successfully completed or where a New Infrastructure Program project or Community Wastewater Management Program project is in progress. The required “local share” contribution is 15% of the projected capital construction cost; however, in areas of preference—New Infrastructure and Community Wastewater project areas—the local share requirement has been eliminated to promote the synergistic effect of coordinated project schedules.

From 1999–2009, 95 stormwater retrofit project applications totaling \$15,467,563.37 were reviewed and approved for funding by CWC. Seventeen projects recommended for funding have subsequently been withdrawn and administratively closed out. Forty-five stormwater retrofit projects have been completed to date; 18 remain open. These numbers include both stormwater retrofit construction projects and planning and assessment projects. Completed and open projects

3. Environmental Infrastructure

of both types—construction (Tables 3.2 and 3.3) and planning and assessment (Tables 3.4 and 3.5)—are presented below.

Table 3.2. Stormwater retrofit construction projects completed or substantially completed in 2009.

Applicant	Project Description	Project Cost	Closing Date
Village of Delhi Various locations	Collection, conveyance, sedimentation (CDS)	\$170,222	7/15/09
Village of Delhi	Street sweeper	\$133,620	7/15/09

Table 3.3. Current open stormwater retrofit construction projects.

Applicant	Project Area	Project Description	Status
Village Of Andes	Delaware County Route 2	Installation of collection, conveyance and sedimentation devices for stormwater drainage from medium density residential, commercial, and county highway surfaces	Construction
Greene County SWCD	Windham Mountain	Installation of collection, conveyance and sedimentation of stormwater drainage from high and medium density residential and commercial surfaces	Design complete. Construction to start in 2010
Town of Hurley	Bristol Hill Subdivision	Design of collection, conveyance and treatment of stormwater from Bristol Hill in the Town of Hurley	Designed construction to begin in 2010
Village of Tannersville	Hunter Foundation	Design and installation of stormwater collection, conveyance, and treatment structures	90% Complete. Awaiting plantings
Village of Delhi	Delhi Stormwater Mitigation Measures	Implementation of stormwater mitigation practices to reduce inflow and infiltration into Delhi sanitary sewer collection system	Open
Town of Roxbury	Lake Street	Design of stormwater collection, conveyance, and treatment structures	Design
Town of Andes	High Street	Design and installation of stormwater collection, conveyance, and treatment structures	Design

Table 3.3. (Continued) Current open stormwater retrofit construction projects.

Applicant	Project Area	Project Description	Status
GCSW: Sugar Maples	Hamlet of Maplecrest—Sugar Maples	Design and installation of stormwater collection, conveyance, and treatment structures	Construction
Town of Ashland	Ashland Stormwater Improvements	Design and installation of stormwater collection, conveyance, and treatment structures	Design
Town of Walton	Bob Gould Road	Design and installation of stormwater collection, conveyance, and treatment structures	Design
Town of Walton	Oxbow Hollow	Design and installation of stormwater collection, conveyance, and treatment structures	Design
Town of Walton	Walton Mountain Road	Design and installation of stormwater collection, conveyance, and treatment structures	Design
Town of Shandaken	Highway Garage	Design of stormwater collection, conveyance, and treatment structures	Design
Town of Hunter	Brine Tanks	Equipment to mitigate sediment discharge during winter on Town highway	Open
Town of Windham	Masonic Temple Access Road	Design and installation of stormwater collection, conveyance, and treatment structures	Design
Village of Fleischmanns	Little Redkill and Schneider Avenue	Design and installation of stormwater collection, conveyance, and treatment structures	Construction
Town of Roxbury	Lake Street Land Acquisition	Purchase property above Lake Street, Roxbury to protect as a natural infiltration area	Open
Mountain Top Library	Haines Falls Free Library	Design and installation of stormwater collection, conveyance, and treatment structures	Design

Table 3.4. Completed planning and assessment projects.

Applicant	Amount Expended	Closing Date
Ulster County Highways	\$50,000.00	2/03/06
Village of Tannersville	\$28,899.99	6/28/06
Village of Hunter	33,906.28	7/09/06
Schoharie County	\$38,500.00	7/31/06
Town of Hurley/Glenford	\$4,000.00	9/19/06
Roxbury—Hamlet	\$32,007.11	9/01/08
Shandaken/Pine Hill	\$35,530.00	3/25/09
Village of Fleischmanns	\$28,616.68	Awaiting closing letter
Town of Windham	\$42,491.50	Awaiting closing letter

Table 3.5. Current open planning and assessment projects.

Applicant	Grant Amount	Funding Round
Town of Roxbury/Grand Gorge	\$34,000.00	2003
Ulster County	\$50,000.00	2006
Village of Margaretville	\$49,900.00	2006
Town of Andes	\$35,275.00	2009
Town of Conesville	\$37,700.00	2009
Town of Ashland	\$42,491.50	2009

Planning and assessment project applications now have an “open” enrollment period. Completed projects provide a basis for future capital construction projects. Through 2009, 18 planning and assessment projects were reviewed and approved, with a total funding allocation of \$648,643.11. Three planning and assessment projects have been closed without any expenditure. Nine planning and assessment projects have been completed, for a total expenditure of \$222,843.38, while six planning and assessment projects remained open at the end of 2009.

4. Protection and Remediation Programs

4.1 Waterfowl Management Program

Pursuant to the July 2007 FAD, the Waterfowl Management Program will submit a separate annual report on July 31, 2009.

4.2 Land Acquisition

As of 1996, the City owned 35,608 acres of land surrounding reservoirs in the Catskill/Delaware watersheds east and west of the Hudson River (Cat/Del). (East of Hudson, these watersheds include West Branch, Boyd Corners, and Kensico.) As of December 31, 2009, the City, through its Land Acquisition Program (LAP), had protected an additional 102,688 acres (including farm easements secured by the Watershed Agricultural Council (WAC)), a 290% increase over 1996. In many watersheds, City land holdings increased dramatically compared with pre-1997 ownership patterns (Tables 4.1 and 4.2, Figure 4.1). In Rondout, a high priority basin (entirely 1A or 1B), the City has increased the number of acres it controls 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; in Ashokan, City-owned buffer lands have tripled in size. Overall, during the last dozen years, City-controlled land (including easements secured by both DEP and WAC) has been expanded threefold to 138,197 acres. In 1996, roughly 3.5% of the watershed was owned by the City; today, roughly 13.5% is City-controlled.

The following report summarizes the main components of LAP's land acquisition activities in 2009.

Table 4.1. Status of Cat/Del contracts* signed in 2009, by reservoir basin.

Reservoir Basin	# of Contracts	Acres	Cost
<u>Signed</u>			
Ashokan	8	572	\$3,486,746
Cannonsville	26	3,219	\$6,760,893
Kensico	3	7	\$3,492,170
Neversink	1	195	\$976,430
Pepacton	28	3,119	\$9,376,068
Rondout	2	86	\$314,406
Schoharie	38	4,020	\$22,860,650
West Branch	8	56	\$2,737,626
Total signed not closed	114	11,273	\$50,004,989

Table 4.1. (Continued) Status of Cat/Del contracts* signed in 2009, by reservoir basin.

Reservoir Basin	# of Contracts	Acres	Cost
Closed			
Rondout	1	35	\$55,618
Total closed	1	35	\$55,618
Total signed not closed and closed			
	115	11,308	\$50,060,606

* Includes NYC Fee, NYC CE, and WAC CE transactions.

Table 4.2. Contracts signed and closed as of December 31, 2009 (including WAC farm easements), by priority area.

Priority Area	# of Parcels	Acres	Appraised Value
1A	114	4,941	\$33,653,323
1B	298	14,652	\$103,636,870
2	158	10,206	\$29,185,991
3	268	29,504	\$55,476,723
4	385	43,388	\$96,813,848
Total	1,223	102,691	\$318,766,755

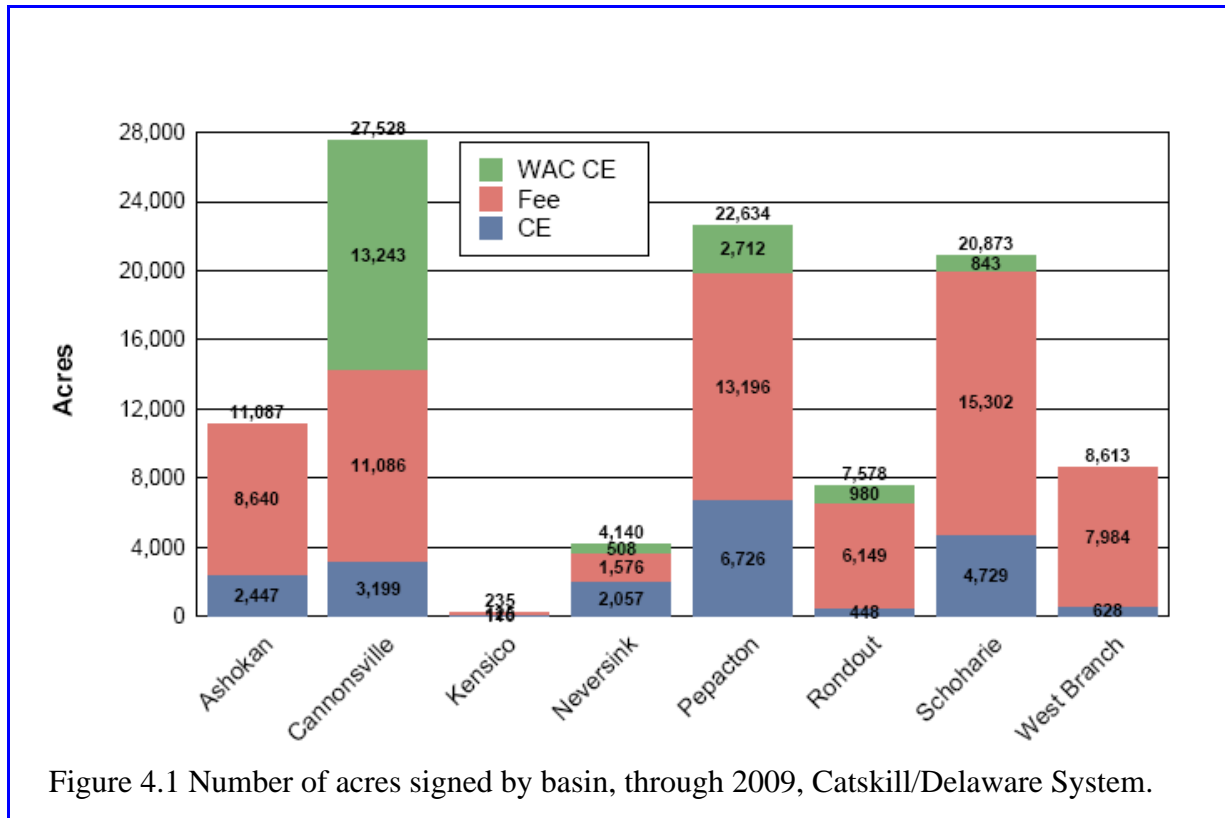


Figure 4.1 Number of acres signed by basin, through 2009, Catskill/Delaware System.

4.2.1 Solicitation/Resolicitation

The 2007 FAD required a solicitation plan for 2009-2010, which was submitted in 2007. Under this plan, DEP’s solicitation goal for 2009 was 92,500 acres (25,000 acres in new solicitations (land previously unsolicited) and 67,500 acres in resolicitations), while a further 5,000 acres of farmland were to be solicited by WAC. These goals were met and exceeded (Table 4.3). DEP resolicited 86,269 acres of land and solicited 26,383 acres of “new land”; WAC also exceeded its goal. Total acreage solicited by DEP since signing of the Memorandum of Agreement (MOA) in 1997 is now over 490,000 (excluding farms solicited by WAC). Experience continues to show that repeated solicitations of the same properties over time yield worthwhile results.

Table 4.3. LAP 2009 solicitation status as of December 31, 2009.

Solicitation Code	2009 Goals	Acres Solicited	Acres Remaining	Percent Complete
RESOL-DS	25,000	29,978	0	100%
RESOL-NS	15,000	24,842	0	100%
RESOL-RS	20,000	22,416	0	100%
RESOL-New Owner	7,500	9,034	0	100%
City	25,000	26,383	0	100%
TOTAL	92,500	112,652	0	100%

RESOL-DS = Dormant, no response, same owner

RESOL-NS = Dormant, owner not interested, same owner

RESOL-RS = Dormant, offer refused, same owner

RESOL-New Owner = Previously solicited, new owner

City = New solicitation (includes solicitations initiated by the City or in response to a call from an owner or broker)

4.2.2 Purchase Contracts in Catskill/Delaware Watersheds

Overall results for purchase contracts signed and closed in 2009, on both fee simple and conservation easements (CEs), are described below, followed by data related to more specific aspects of the program, namely, CEs, riparian buffers, and wetlands.

By the end of calendar year 2009, DEP (excluding WAC farm easements) had secured a total of 1,126 purchase contracts comprising 84,402 acres throughout Cat/Del at a cost of \$295.4 million (with additional “soft costs” for related site services of about \$27 million). Of these, 976 contracts totaling 71,200 acres have been acquired (closed), with the remaining acres under purchase contract. During 2009, DEP closed 92 contracts comprising 6,405 acres and signed to purchase contract 108 purchase contracts accounting for 10,003 acres (Tables 4.4 and 4.5). Another 1,306 acres were signed to contract by WAC. The 11,308-acre total makes 2009 the most productive year since the program began formally in 1997 for acres signed to contract in Cat/Del, both with and without WAC farm easements (Figure 4.2). 2009 also saw the highest number of CE contracts signed by DEP (25) (Figure 4.3) and was also the first year during which acres signed by DEP in CEs were roughly equal to the number of acres signed to fee simple (Figure 4.2).

Table 4.4. Contracts signed and closed in Cat/Del, 1995-2009, by reporting period and real estate type.

Real Estate Type	# of Contracts	Acres	Average Size of Project (acres)	Purchase Price
Reporting Period: 1995 to 2008				
NYC Fee	913	58,889	65	\$216,408,959
NYC CE	105	15,511	148	\$30,901,365
WAC CE	90	16,980	189	\$21,395,825
Total	1,108	91,380	82	\$268,706,149
Reporting Period: 2009				
NYC Fee	83	5,169	62	\$36,421,593
NYC CE	25	4,833	193	\$11,667,718
WAC CE	7	1,306	187	\$1,971,296
Total	115	11,308	98	\$50,060,606
Program-to-date Totals				
NYC Fee	996	64,058	64	\$252,830,552
NYC CE	130	20,344	156	\$42,569,083
WAC CE	97	18,286	189	\$23,367,121
Total	1,223	102,688	84	\$318,766,755

Table 4.5. Contracts closed in Cat/Del, 1995-2009, by reporting period and real estate type.

Real Estate Type	# of Contracts	Acres	Average Size of Project (acres)	Purchase Price
Reporting Period: 1995 to 2008				
NYC Fee	804	52,789	66	\$184,774,797
NYC CE	80	12,007	150	\$21,485,150
WAC CE	77	15,307	199	\$17,252,840
Total	961	80,102	83	\$223,512,786
Reporting Period: 2009				
NYC Fee	75	3,842	51	\$21,664,512
NYC CE	17	2,563	151	\$7,354,905
WAC CE	13	1,674	129	\$4,142,985
Total	105	8,078	77	\$33,162,403
Program-to-date Totals				
NYC Fee	879	56,631	64	\$206,439,309

4. Protection and Remediation Programs

Table 4.5. (Continued) Contracts closed in Cat/Del, 1995-2009, by reporting period and real estate type.

Real Estate Type	# of Contracts	Acres	Average Size of Project (acres)	Purchase Price
NYC CE	97	14,569	150	\$28,840,055
WAC CE	90	16,980	189	\$21,395,825
Total	1,066	88,180	83	\$256,675,189

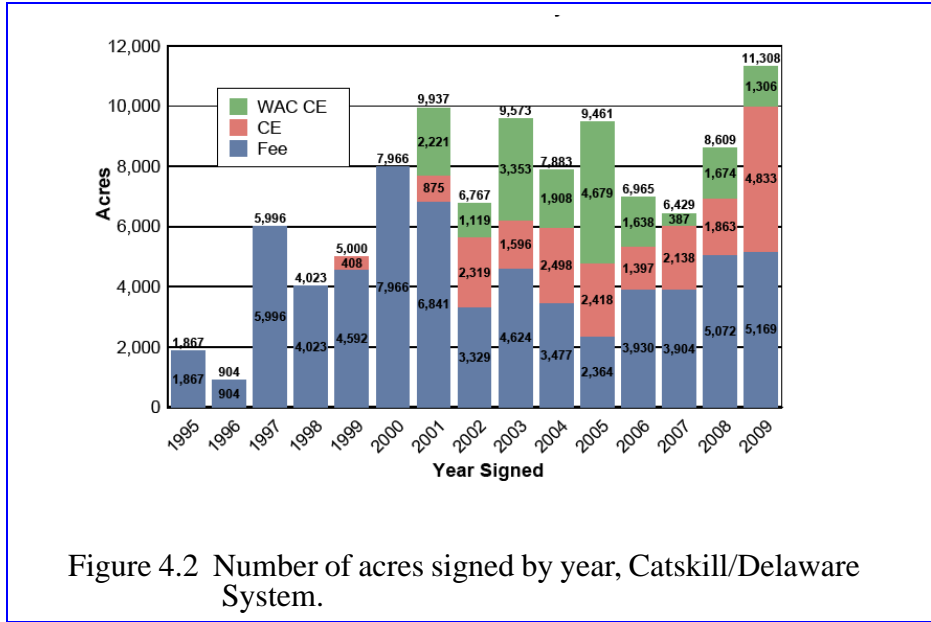


Figure 4.2 Number of acres signed by year, Catskill/Delaware System.

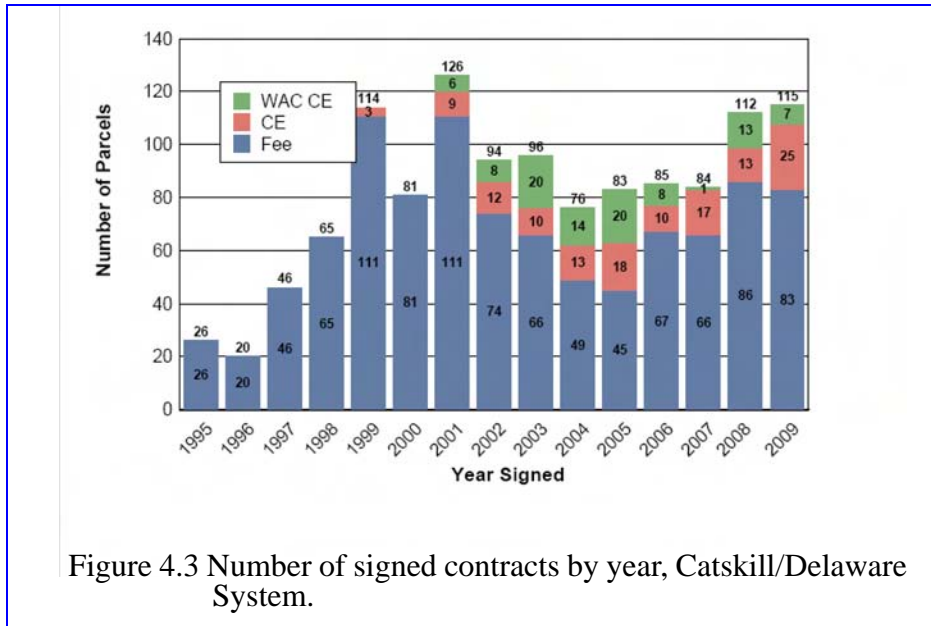


Figure 4.3 Number of signed contracts by year, Catskill/Delaware System.

Several important properties were signed to contract in 2009, including a 327-acre tract in Windham that abuts 815 acres of previously-acquired land and includes half of a 23-acre lake (Figure 4.4), and a 448-acre tract in Halcott that includes a mile of road frontage, meadows, hillside, and a mile of Vly and West Settlement Creeks (Figure 4.5). A number of important contracts were also closed in 2009, including a 245-acre tract which includes uplands, meadows, floodplains, and $\frac{3}{4}$ -mile of frontage on the West Branch Delaware River (Figure 4.6).



Figure 4.4 A 327-acre tract in Windham signed to contract during 2009.



Figure 4.5 A 448-acre tract in Halcott signed to contract during 2009.



Figure 4.6 A 245-acre tract in Kortright which closed in 2009 includes uplands, meadows, floodplains, and $\frac{3}{4}$ -mile of frontage on the West Branch Delaware River.



Conservation Easements

DEP

During 2009, 25 CEs totaling 4,833 acres were signed to purchase contract by DEP and 17 CEs totaling 2,563 acres were closed (Tables 4.4 and 4.5). The 25 CE contracts signed is the

highest number signed by DEP in a single year to date; 2009 was also the first year during which acres signed by DEP in CEs were roughly equal to the number of acres signed to fee simple. Overall, 130 easements in Cat/Del totaling 20,344 acres are now closed or under contract, equal to 24% of the acres protected by DEP (excluding WAC farm easements).

WAC

By the end of 2009, WAC held easements on 90 farms totaling 16,980 acres; in 2009, contracts were signed on 7 additional farm easements totaling 1,306 acres (Tables 4.4 and 4.5).

WAC's Farm Easement Program—including the costs of all easement acquisitions and program overhead, and most stewardship costs—has been supported by the following allocations from DEP:

- \$20 million in 1999 (including \$10 million for “agricultural easements” and \$10 million for “non-agricultural easements” land on farms) from the original \$250 million Land Acquisition Program fund
- \$7 million in 2006 from the \$50 million Supplementary Fund outlined in MOA section 74
- \$20 million in 2007 from the Supplementary Fund
- In a letter dated April 30, 2008, DOH directed DEP to allocate the remaining \$23 million from the Supplementary Fund to WAC farm easements; these funds have been budgeted. Time delays due to negotiating certain elements of the program contract have led to a postponement of the new program contract. However, there has been no interruption in the program because the existing contract has been extended through September 15, 2010, and will be extended again if needed before a new contract framing the \$23 million is finalized. Existing unspent funds are deemed sufficient by both WAC and DEP to carry the program through 2011.

Upon allocation of the new funds, the total committed to the Farm Easement Program will be \$70 million.

Riparian buffers

Prior to 1997, 1,490 acres of riparian buffers (defined here as land within 100 feet of streambanks) were within DEP land holdings. Since 1997, DEP has protected an additional 4,768 acres of buffers under fee simple acquisition and 1,534 acres under CEs, while WAC has protected 1,938 acres of buffers within farm easements. (It should be noted that WAC's model farm easement deed substantially protects riparian buffer strips within 25 feet of streambanks, areas which are protected from, and act as buffer to, intensive farm practices; the remaining 75 feet of buffer land within a Farm easement may be actively farmed but only in adherence to a Whole Farm Plan (a plan intended to protect water resources).) Including lands owned by the City before 1997, the City now protects 12.9% of acreage within the 100-foot stream buffers identified in Cat/Del, roughly consistent with the percent of the watershed protected by the City overall. When land owned by other entities (DEC, land trusts, etc.) is included, a total of 24,052 acres of identified 100-foot stream buffers are protected, or 31.5% of the 76,331 acres of the 100-foot stream buffers identified in Cat/Del (Tables 4.6 and 4.7).

Table 4.6. Acres of riparian buffers in Cat/Del*, by basin, through 2009.

Category	Ashokan	Boyd Corners	Cannonsville	Kensico	Neversink	Pepacton	Rondout	Schoharie	West Branch	Total Cat/Del
NYC pre-1997	304.8	10.0	508.2	100.7	319.3	442.9	72.0	117.1	63.6	1,938.5
NYC LAP Fee Simple**	530.8	395.1	713.5	11.9	141.4	932.8	372.1	1,240.9	429.2	4,767.9
NYC LAP CE**	175.4	52.3	193.6	20.7	230.3	441.1	50.3	417.7	34.7	1,616.1
WAC CE**	0.0	0.0	1,059.2	0.0	19.0	289.8	88.2	77.6	0.0	1,533.8
NY State	5,080.8	118.1	202.1	2,206.3	1,415.4	1,660.8	2,566.0	112.6	13,362.1	
Other in Protected Status***	170.3	19.5	106.9	29.5	168.2	160.4		139.6	38.9	833.4
Subtotal	6,262.1	594.9	2,783.5	162.8	3,084.7	3,682.4	2,243.4	4,558.9	679.0	24,051.8
Privately-owned	5,122.1	592.7	15,999.0	285.5	2,304.9	12,029.0	2,554.3	12,813.0	579.1	52,279.7
Total	11,384.2	1,187.7	18,782.6	448.3	5,389.6	15,711.4	4,797.7	17,371.9	1,258.2	76,331.5

*100-foot area both sides of watercourses, which includes streams and rivers and excludes reservoirs, ponds, and lakes.

**Under contract or closed as of December 2009.

***Land believed to be under some form of permanent ownership by a land trust or municipal government.

Table 4.7. Percent of total riparian acreage privately-owned, by basin.

Ashokan	Boyd Corners	Cannonsville	Kensico	Neversink	Pepacton	Rondout	Schoharie	West Branch
45.0%	49.9%	85.2%	63.7%	42.8%	76.6%	53.2%	73.8%	46.0%

Wetlands

Of the 1,049,465 acres that comprise Cat/Del, 43,539 acres (4.15%) are identified as wetland or inundated aquatic habitat (“Wetlands”). Of these Wetlands, 2,398 acres (5.5%) have been secured under LAP (including Farm easements). Wetlands represent roughly 2.4% of lands secured under LAP. (For more on DEP’s Wetlands Protection Program, see Section 4.8 of this report.)

4.2.3 Land Acquisition in the Croton System

With almost all of the \$38.5 million allocated to this program having been spent or committed in purchase contracts, DEP’s acquisition program in the Croton System as envisioned by the original FAD and MOA is virtually complete. A total of 1,637 acres (24 contracts) have been acquired using these funds. Another two projects remain under contract, one comprising 269 acres, the other, signed in 2009, comprising 13. In addition, approximately 788 acres of Croton acquisitions have been made by non-City entities using City funding from sources external to NYC’s dedicated “Croton” funds. These include lands acquired by DEC (using NYS funds) and then conveyed to NYC, and lands acquired by Putnam County using Water Quality Investment

Program funds derived from the City. The total number of acres secured in the Croton System through all NYC funding sources is thus 2,707, including the two contracts yet to close. With the exception of those contracts, no further acquisitions are foreseen in the Croton System.

4.2.4 Transfer of Conservation Easements on Fee Acquisitions to NYS

In 2009, DEP continued to convey CEs to DEC under Paragraph 82 of the MOA. A total of 8 CEs covering 110 properties acquired by DEP in fee simple (6,358 acres) were signed by the Deputy Mayor in December 2009, and are planned for submission to DEC early in 2010. DEP's program-to-date CE conveyances to the New York State (including the 8 CEs in process) total 53 CEs on 656 DEP properties, comprising a total of 42,394 acres. This represents 75% of all lands acquired in fee to date.

4.2.5 Technical Program Improvements

During 2009, DEP continued to seek ways to improve and revise program documents and policies, subject to requirements of the MOA, FAD, Water Supply Permit, and City Charter, in order to maximize program competitiveness within the marketplace.

- Purchase Contract. During 2009, roughly 30 landowners took advantage of the financial incentive (up to \$5,000) first offered in the revised model purchase contract in 2008. This incentive has appealed to landowners whose properties require subdivision before they can be conveyed to the City as a vacant parcel.
- Conservation Easements. DEP continued to refine the model document to provide greater appeal to potential sellers while continuing to protect NYC's interest in water quality. This year NYC's position on natural gas drilling was outlined in comments that were submitted to DEC in December; the CE program and model deed are being revised to address the issues raised by natural gas drilling as they relate to eased properties.
- Land Trusts. In 2009, DEP continued to seek ways to involve land trusts. One area that continues to be fruitful is the sponsoring of land trust-run education and outreach programs about land conservation options in the watershed. This year DEP became (1) a Lead Sponsor of the Northeast Land Trust Alliance Conference held at West Point in April, and (2) a "Platinum Sponsor" of the Delaware Highlands Conservancy Land Conservation Seminar held in September. DEP also reached agreement with a land trust to solicit landowners who were previously uninterested in selling real property interests to the City in the East of Hudson Cat/Del watershed. In addition, DEP initiated a review of the feasibility of a "Pilot Streamside Conservation Easement Program" in partnership with several stakeholders including the Greene County Land Trust. Finally, DEP is exploring the possibility of funding the purchase of CEs by land trusts from owners of very compelling properties in cases where owners have demonstrated unwillingness to work directly with the City.
- Information Technology. Further enhancements to the Watershed Land Information System (WaLIS) included full integration of the Land Acquisition Tracking System database into WaLIS. This system now offers tremendous productivity enhancement and efficiencies which impact every step of the acquisition process. A number of safety and security systems for field staff continue in use, including hand-held SPOT units (remote field-to-office communication that allows status reports to be made from the field) and high-band radios in vehicles.

4.2.6 Pilot Forest Easement Program

The 2007 FAD mandated that DEP fund a \$6 million pilot program through which WAC would acquire easements on “forested portions of non-agricultural” property. Negotiations between DEP and WAC began in earnest in late 2007 and continued through 2009, but the two organizations have been unable to proceed with this FAD deliverable due to differing positions on the committee voting structure. DEP has previously notified and discussed with EPA and DOH the status of this situation. DEP’s position is that non-implementation of this pilot program should not significantly hamper the success of its effort to permanently protect land through its own programs.

4.2.7 Water Supply Permit

The current permit remains active through January 20, 2012; the 2007 FAD requires DEP to apply to DEC for a new 10-year permit by January 21, 2010. During 2009, DEP initiated State Environmental Quality Review Act (SEQRA) review and analysis in advance of submission of the Public Water Supply Permit Application and associated environmental reviews.

4.3 Land Management

Background

As DEP’s portfolio of watershed lands has expanded, so have the responsibilities to manage that land. DEP has developed a comprehensive management approach for its holdings, focusing on six major areas:

- Property management
- Natural resources
- Recreational use
- Land use permits
- Land acquisition assistance
- Conservation easements

DEP has identified four major goals for managing City land:

- Monitor and coordinate the use of City lands to meet multiple objectives, including water supply infrastructure, forest and soil health, stream protection, and community benefits such as recreational use.
- Bring the power of the City’s GIS as a decision-support tool to field level operations in a way that maximizes the effectiveness of the City’s lands for filtration avoidance.
- Establish a goal-driven planning process for optimizing the contributions of the City’s forest lands to the protection of water quality and public health.
- Continue to monitor and enforce the growing portfolio of City watershed conservation easements to ensure long-term water quality benefits.

4.3.1 WaLIS

The Watershed Land Information System (WaLIS) is a key component in tracking property management and easement stewardship-related activities such as the scheduling of tasks and staff assignments of property and easement inspections, tracking the chronology of activities, identifying the responsible staff members, and recording all relevant project information. WaLIS also facilitates the sharing of information by a wide array of users in central and remote locations. WaLIS map preparation tools provide a way for DEP users of various skill levels to explore data and print quality maps, including maps showing aerial views of watershed lands and resources. WaLIS also enables users to review the data and the history of each particular area.

DEP continues to oversee the agreement with City University of New York - Hunter College (CUNY) to provide a Program Analyst/Data Manager to assist with WaLIS development. The Program Analyst/Data Manager is providing onsite services to act as the interface between DEP staff and PAR Government Services contractors for continued WaLIS development and data management. In 2009, a major focus was on data cleanup, revising reports and workflow, streamlining processes, assisting with the web-based access permit and boat tag functionality, organizing GIS and GPS data, and preliminary work on improvements to processing financial data for land use permits.

4.3.2 Conservation Easement Stewardship

DEP continues to monitor City watershed conservation easements to ensure long-term water quality benefits. DEP added 17 easement properties totaling 2,563 acres to its growing portfolio in 2009.

Baseline Documentation

DEP selects baseline documentation for all easements when the easement is acquired. This baseline identifies the condition of the property at the time the easement is placed on it and can be used to compare the condition of the property during subsequent inspections. Baseline documentation typically includes aerial photography, a map, and a survey of the property, photographs tied to GPS points of specific natural resources (e.g., streams, wetlands, steep slopes) and infrastructure (e.g., bridges, stream crossings, buildings), and areas where future activities or violations are likely to occur. The baseline documentation is then certified by the landowners to verify that the condition of the property is accurate. The certification is then filed with the County Clerk's Office as part of the easement agreement. Baseline reports are kept with a DEP stewardship file and placed in an archive file for that easement property.

Inspections

DEP easements are inspected regularly. The number and acreage of easements by DEP is shown in Table 4.8.

Table 4.8. Number and associated acres of DEP easement properties by field office.

Field office	Number and acres of easements
East of Hudson	14 / 1,126
Shokan	36 / 6,241
Downsville	26 / 3,089
Grahamsville	11 / 1,802
Gilboa	19 / 3,017
Total	106 / 15,275

DEP worked on revising its Conservation Easement Stewardship Policy in 2009 and a final version is expected in 2010. The new policy puts a greater emphasis on focused inspections that target high-risk areas on easement properties such as streams and riparian areas, wetlands, areas in which approved activities are occurring, and building envelopes.

DEP has expanded the use of aerial inspections as a useful tool for inspecting properties, especially the larger ones. Potential serious violations which could have water quality impacts such as land clearing, construction, and road building would be evident using aerial inspections. Aerial inspections, combined with an on-the-ground inspection, annually provide a high level of protection for the City’s investment. In 2009, DEP completed approximately 80 aerial inspections.

Activity Approvals

Many activities, such as forestry, bluestone mining, and agriculture, which are permitted by DEP easement, require notice to and approval by DEP. The landowner must submit a proposal for the activity; DEP must then review the proposal and render a decision on the request, either denying it or approving it with listed conditions. DEP has expanded the acceptable activities on newer easements to permit livestock, tilling, and planting of row crops, and the use of chemicals with notice to and approval by DEP. A breakdown of the types of activities approved on DEP easements in 2009 is shown in Table 4.9.

Table 4.9. Number and types of reserved rights approved on DEP easements in 2009. Pre-closing approvals are those completed while in the contract of sale phase.

Activity (exceeding thresholds)	Number pre-closing reviews/approvals	Number post-closing reviews/approvals
Forestry	2	9
Pond building and maintenance	0	1
Agricultural	3	2

Table 4.9. (Continued) Number and types of reserved rights approved on DEP easements in 2009. Pre-closing approvals are those completed while in the contract of sale phase.

Activity (exceeding thresholds)	Number pre-closing reviews/approvals	Number post-closing reviews/approvals
Livestock	1	1
Utilities	0	0
Surface Disturbance	1	1
Subdivision	1	0

Violations

Violations of the terms of the easements by landowners are a serious matter. Fortunately, the number of violations experienced thus far has been minimal. No violations were discovered in 2009.

Continued outreach and education is critical to reducing the instances of violations, whether intentional or by mistake. DEP utilizes each site visit and landowner contact as an opportunity to inform, answer questions, and provide easement interpretation assistance. In addition, DEP has developed a series of landowner guidelines to provide information and project planning tools for agriculture, forestry, bluestone mining, and stream and pond building.

Watershed Agricultural Council Farm Easements and Stewardship

DEP continues to provide an oversight and advisory role on WAC’s farm easement stewardship activities. As WAC’s farm easement portfolio continues to grow, its stewardship responsibilities are increasing as well. WAC, with assistance from DEP, developed several stewardship policies for activation of reserved rights including forest management and forest harvesting as well as a stewardship endowment policy.

4.3.3 Monitoring and Management of Water Supply Lands

Property Management

Once lands are acquired, they must be managed to ensure long-term water quality protection and proper usage. The total number of acres of land and water as well as a breakdown of acres of land and water within each field office are shown in Table 4.10.

Table 4.10. Land and water acreage monitored by each field office at the end of 2009. Pre-MOA land is reservoir buffer land owned before the 1997 MOA. MOA lands are those bought after the 1997 MOA.

Operations field office	Pre-MOA City-owned land in acres	MOA City-owned land in acres	Total land	Reservoirs/lakes in acres	Total land/water
EOH	11,392	9,092	20,484	11,344	31,828
Shokan	5,240	12,095	17,335	8,100	25,435
Gilboa	1,021	18,521	19,542	1,134	20,676

Table 4.10. (Continued) Land and water acreage monitored by each field office at the end of 2009. Pre-MOA land is reservoir buffer land owned before the 1997 MOA. MOA lands are those bought after the 1997 MOA.

Operations field office	Pre-MOA City-owned land in acres	MOA City-owned land in acres	Total land	Reservoirs/lakes in acres	Total land/water
Grahamsville	5,172	7,621	12,793	3,512	16,305
Downsville	21,233	10,360	31,593	9,795	41,388
Total	44,058	57,689	101,747	33,885	135,632

Annual Inspections

All City-owned lands are inspected as per the DEP Monitoring of City-owned Water Supply Policy. The policy not only outlines procedures for inspections but also addresses boundary maintenance, encroachments, hazards, and improvements. The types of property inspections are broken down into four categories, which include full inspections, focused inspections, site visits, and aerial inspections. For 2009, the miles of boundary line painted and posted, as well as site visits made to properties, is shown in Table 4.11. Table 4.12 shows the number and acreage of full inspections completed in 2009 by field office.

Table 4.11. Miles painted and posted and site visits made in 2009 by field office.

Operations Field Office	Number of miles painted	Number of miles posted	Number of site visits
Shokan	35	56	5
Downsville	75	82	86
Grahamsville	33	72	63
Schoharie	75	57	173
EOH	0	0	0
Total	218	267	327

Table 4.12. Number and acreage of full inspections completed in 2009 by field office.

Field Office	Number of inspections	Acres of full inspections
Shokan	240	26,237
Downsville	148	29,730
Grahamsville	126	12,886
Schoharie	143	9,375
EOH	130	10,407
Total	805	88,635

Reservoir Cleanups

DEP holds reservoir cleanup events with different partners annually. In 2009, DEP held three reservoir cleanups, which included: Pepacton Reservoir, with members of the Andes High School Environmental Club; Rondout Reservoir, with students from Rondout Valley School; and Neversink Reservoir with a local family. These events are important in helping to remove garbage and debris from reservoirs while at the same time building community relationships and fostering participation. These events are used as educational forums to talk about the importance of watershed protection. In addition, Rondout School students planted

several trees by one of DEP's boat launching sites and there was a wetland planting project on the shore of Lake Gleneida with students and teachers from Carmel High School. More information about additional activities can be found in the Section 4.9 of this report.



Figure 4.7 Students who participated in a cleanup event on Pepacton Reservoir.



Figure 4.8 Participants planting trees on City land in Margaretville.



Figure 4.9 Students participating in a wetland planting project on Lake Gleneida.

4.3.4 Recreation

The undeveloped lands that DEP owns can provide tremendous recreational opportunities for outdoor enthusiasts. In fact, for many of the watershed communities, such activities represent a way of life that they want to see continued. 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 source water protection lands and an attempt by DEP to allow expanded recreational opportunities on its lands. DEP’s management priority is to allow those recreational activities that are compatible with water quality.

In 2009, DEP continued to open WOH watershed lands as Public Access Areas (PAAs), which allows recreational users to utilize City lands without a DEP Access Permit, Hunting Tag, or Vehicle Mirror Hanger for fishing, hiking, hunting, and trapping. In 2009, 86 new PAAs were opened totaling over 7,600 acres. In addition to this effort, DEP reviewed its entire portfolio of lands to re-assess which ones were viable to open for recreation. The result of this assessment created an additional nine properties EOH open for “entry by permit” totaling over 1,000 acres. Due to the lack of public lands in this area, DEP’s contribution of public access is important. While the default for opening WOH lands is PAAs, some properties, such as those adjacent to reservoirs, lend themselves to be opened as “entry by permit.” An additional 2,366 acres were open under this designation, including 1,500 acres of lands on the east side of Neversink Reservoir. Figure 4.10 provides a breakdown of the acres of land, by category, opened for recreation since 2003.

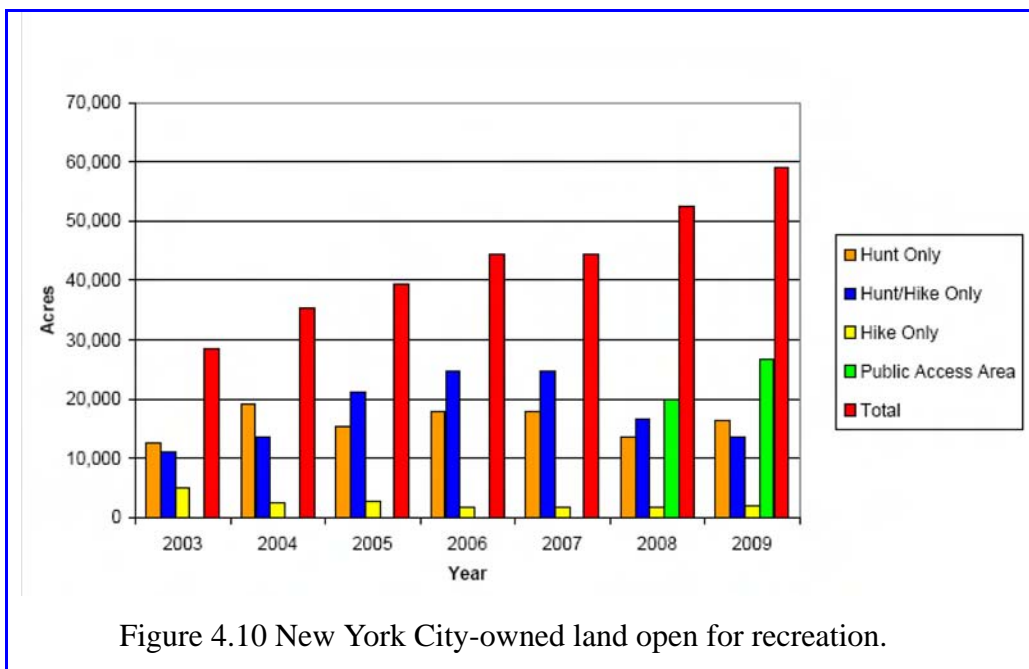


Figure 4.10 New York City-owned land open for recreation.

Cannonsville Boating Pilot Project

2009 marked the first full season of the pilot project. Four hundred seven recreational boating permits were issued to 185 individuals. This shows that a large percentage of the users were repeat users. Kayaks were by far the most popular vessel used, with canoes second. The majority of tags issued were for 1-7 days' use and only a small number of seasonal tags were issued. There were no major incidents related to the pilot program in 2009. DEP staff regularly inspected boat launch areas and removed garbage and performed routine maintenance as needed. Porta-potties were installed at several locations and regularly maintained. The response from recreational users and the community was very positive.

4.3.5 Forestry

DEP seeks to sustain a vigorous forest buffer around the reservoirs and on City-owned lands throughout the watershed.

In 2009, nine forest management projects were planned, implemented, or completed on City-owned lands (Table 4.13). The objectives of these projects included improving ecosystem functions, promoting forest regeneration, tending the forests through selective thinnings, and salvage from weather-related events. The treatments of a total of 155 acres were completed in 2009, while the treatments of an additional 455 acres were in operation or planning in 2009 and will continue into 2010. Approximately 816,200 board feet of timber are being harvested between projects completed in 2009 and those continuing into 2010.

Table 4.13. Forestry projects completed, in progress, and in the planning phase in 2009.

Project Name	Basin	Project Area	Estimated Board Feet
PROJECTS COMPLETED			
VanSteenburg Cove	Ashokan	90	245,000
Burns Cove	Ashokan	65	101,100
TOTALS		155	346,100
PROJECTS IN PROGRESS			
Murphy Hill #2	Pepacton	70	229,800
TOTALS		70	229,800
PROJECTS IN PLANNING PHASE			
Davis Bend	Ashokan	45	111,500
South Rondout	Rondout	60	128,800
Ol' McCume	Pepacton	75	NA

Table 4.13. (Continued) Forestry projects completed, in progress, and in the planning phase in 2009.

Project Name	Basin	Project Area	Estimated Board Feet
Acorn Hill	Ashokan	90	NA
Ashalter Fields	Neversink	40	NA
Hogsback	Neversink	75	NA
TOTALS		385	240,300

Note: Project area is the area in which trees were harvested.
 Board feet is the number of feet contained in the trees harvested.

Forest Management Plan

DEP continues to develop a forest management plan for City-owned lands. In March, 2009, DEP finalized an agreement with the United States Forest Service (USFS) TEAMS Enterprise group to conduct a systematic, comprehensive inventory on all City-owned watershed lands and develop a forest management plan.

A managed watershed forest following a comprehensive management plan can help the City promote forest vigor, species diversity, and forest structure diversity. By improving these aspects of the forest, the City can improve the watershed forest’s resistance to and recovery from catastrophic events, maximize nutrient uptake, enhance erosion control, create and maintain recreational opportunities, reduce liability exposure from forest safety hazards, and provide economic benefit to watershed communities. Comprehensive forest management planning enhances the protection of the ecological systems that provide the City’s drinking water by enabling landscape-level decision-making.

The initial part of the planning process is a comprehensive inventory of forest resources. The forest inventory was initiated in April 2009. During 2009, the forest inventory of the Kensico and Ashokan basins was completed, and the inventory of the Rondout, Neversink, and Schoharie basins was initiated. Approximately 2,300 plots of the estimated 9,400 proposed plots were completed. The selection of forest inventory analysis software was completed and analysis of data was initiated. Development of the plan will begin in early 2010. The Watershed Forest Management Plan will include analysis, summary, and presentation of the forest inventory data, and related land and natural resource information. The plan will provide directives for practical, sustainable, science-based management of City-owned watershed forest lands, with the overall goals of protecting public health through source water protection, maintaining or enhancing ecological integrity, and providing economic benefits to watershed communities.

4.3.6 Agricultural Use

To promote the concept of working lands, DEP allows use of its land for limited agricultural activities. The program was initially set up to allow the harvesting of hay and tapping of sugar maple trees for maple sap. No chemicals or fertilizers were permitted for use on these early projects. In 2005, DEP revised its Agricultural Use of City-owned Water Supply Lands to expand allowable agricultural activities on City-owned land. Farmers can now submit a proposal on how they would farm City-owned land while protecting water resources. Candidates for this expansion of agricultural activity are typically existing properties that were farmed up until the time they were sold to DEP. There are certain minimum requirements set by DEP for farming on City-owned land, 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-owned land are enrolled in the Watershed Agricultural Council’s Whole Farm Program. Plans developed under this program can be expanded to include City-owned land. For multiple proposals submitted by interested farmers on the same piece of land, the proposals are scored against each other, with those protecting water quality and using BMPs or low-impact farming (e.g., organic farming, wider buffers, no fertilizer use, no-till methods) receiving the highest scores. DEP currently has 25 crop and maple tapping projects in 10 different towns totaling over 661 acres. New agricultural projects for 2009 are shown in Table 4.14.

Table 4.14. Projects initiated in 2009 for the agricultural use of City land.

Project #	Type	Town	Acres
1879	Corn/hay	Kortright	24
1880	Hay	Roxbury	27
1881	Hay	Franklin	74
1882	Hay	Middletown	16
1883	Blueberries	Roxbury	7
1884	Hay	Prattsville	67

4.3.7 Invasive Species Control

Invasive Species Working Group

The Invasive Species Working Group (ISWG) was formed in 2008 to develop and implement an agency-wide, science-based, comprehensive plan to identify, prioritize, and respond to invasive species threats to the water supply. The ISWG met six times in 2009 and made significant progress in its first goal of developing a risk assessment process to evaluate invasive species threats to the water supply and watershed lands. Invasive species threats and impacts to water supply and watershed lands were identified and ranked, and a preliminary list of priority species to be assessed was developed. After evaluating several risk assessment methods, the NYS Invasiveness Ranking Method was selected and is now being applied to the preliminary list of DEP priority species.

In addition, the working group is developing a risk assessment module for invasive species impacts to drinking water quality, human health, and the local economy, as the NYS method does not address impacts in these sectors.

New York Invasive Species Advisory Committee

DEP has a seat on the New York Invasive Species Advisory Committee (NYISAC), which was created through state invasive species legislation in 2007 to provide information, advice, and guidance to the New York Invasive Species Council on issues related to invasive species impacts, prevention, regulation, detection, and management. Specifically, the committee advises the Council and DEC's Office of Invasive Species on the creation of a four-tiered classification system for non-native species and on the development of a state invasive species management plan. NYISAC consists of government agencies, non-governmental organizations, and trade groups, thus representing a broad range of constituencies.

The committee was constituted and held its first meeting in 2008. In 2009, the committee began work on reviewing the NYS Invasiveness Ranking Method that is being used to develop the four-tiered list. The ranking method is being assessed and comments and suggestions are being made to the Council. Species rankings will be assessed during 2010.

DEP sits on a subcommittee that is drafting a white paper outlining the need for and elements of a legislative proposal to regulate the transport of aquatic invasive species on private boats between water bodies in NYS and from out of state. The white paper was outlined and drafted in 2009 and will be finalized and submitted to the Council in early 2010.

NYS DEC Terrestrial Eradication Grant Award. In March 2008, the DEC Office of Invasive Species awarded \$50,000 in matching funds to the Eastern New York Chapter of The Nature Conservancy (TNC), in partnership with DEP and the Catskill Regional Invasive Species Partnership (CRISP), for a proposal entitled "Detecting and Eradicating High Threat Invasive Plant Species in the Catskill Region" that was co-authored by DEP and the Eastern New York Chapter of TNC.

The project has one eradication objective and two early detection/rapid response objectives: 1) eradication of Pale Swallow-wort on DEP land in the Pepacton Reservoir basin near Margaretville, NY, by 2010; 2) establishment of a regional early detection/rapid response program through invasive plant survey, followed by eradication efforts, for a set of priority invasive plant species with limited distributions; and 3) delineation of two large, unfragmented, forested "Weed Prevention Areas" in the Catskill region. In 2009, a survey of private campgrounds for Asian Longhorned Beetle (ALB) was added to the project's early detection strategy. Campground registration (by zip code) data indicate that many users of Catskill campgrounds live in and around areas infested with ALB (NYC, Long Island, Worcester, MA, and parts of New Jersey).

Historically, campers have carried firewood from their home regions to camping areas, increasing the risk of accidental introduction of invasive forest pests.

Survey and outreach for several priority invasive plant species continued in 2009. Pale Swallow-wort eradication efforts at the Pepacton Reservoir site continued, and a preliminary assessment of previous eradication efforts was conducted. Since 2007, swallow-wort treatment at the Pepacton site has employed a combination of manual seed pod removal and herbicide application. Pod removal was employed in spring and fall 2009 to prevent spread. Herbicide treatments (foliar spray with Roundup Pro, active ingredient glyphosate) have been applied since 2007. In August 2009, Garlon 4 (active ingredient triclopyr) was applied as a foliar spray to a limited area. The remainder of the site was treated with Roundup in early July and mid-August. In fall 2009, an additional treatment method was attempted—disrupting swallow-wort emergence with a cover crop of winter rye, raked in a small, cleared area adjacent to Pepacton Reservoir. While swallow-wort is still present at the site, treatment has resulted in large decreases in stem density. As in previous years, herbicide application was performed by a certified pesticide applicator under DEP supervision.

Invasive Species Management

DEP continued treatment of high priority invasive plants on city land, including Giant Hogweed in the Croton Falls Reservoir basin, and Japanese Barberry, wisteria, and Japanese Stiltgrass at forest management projects in the Ashokan Reservoir basin. Door-to-door outreach to residents was conducted in the vicinity of the Giant Hogweed site in an effort to increase public awareness and understanding of invasive species issues and DEP concerns.

The DEP Invasive Species Coordinator (ISC) continued working with regional invasive species partnership groups in the Catskill and Lower Hudson areas. In January 2009, the ISC co-organized a Catskill regional training and strategy session focused on ALB and Emerald Ash Borer (EAB) ecology, detection, and survey. The session was held at the Catskill Center, with training provided by the NYS Cooperative Agriculture Pest Survey.

In March, the ISC worked with regional, state, and federal partners to conduct a strategic planning session for a summer 2009 ALB survey in the Catskill region.

In May, DEP was a partner and participant in a one-day workshop, sponsored by DEC, the Catskill Watershed Corporation, CRISP, and TNC. Participants included representatives from the public, the Catskill Center for Conservation & Development, the Catskill Mountain Club, the Adirondack Mountain Club, the Coalition of Watershed Towns, and the Catskill Landowners Association. The workshop focused on ALB ecology and the status of eradication efforts in the northeast US, and involved participants in a simulated, multi-agency response to a hypothetical ALB infestation at the Kenneth L. Wilson Campground near Woodstock, NY. Participating groups offered their reactions to the simulated response and raised issues and concerns.

In June, the ISC arranged for the United States Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) to train 50 DEP field staff in ALB ecology, identification, and impacts.

In July, the ISC worked with TNC, the NYS Cooperative Agriculture Pest Survey, and USDA-APHIS to organize two full-day workshops on ALB ecology, identification, and survey methodology in Woodstock, NY. The trainings focused on the risks posed by ALB (classroom), and how to detect an infestation (classroom, followed by guided field exercise at the Kenneth L. Wilson Campground). Thirty-six individuals attended the two sessions. The ISC subsequently worked with TNC, USDA-APHIS, USDA-Forest Service, and interns to develop an ALB ground survey protocol, and to coordinate the surveys for ALB at private campgrounds in and around the WOH watershed. Seventeen campgrounds were surveyed over a six-week time period, and a total of 7,077 trees were inspected. Only one of the 7,077 trees inspected was listed as being a "suspect" tree, and was reported to USDA-APHIS for further review.

In 2009, DEP promulgated several internal policies to reduce the risk of introducing two aquatic invasive species that occur in and around the watershed. In April 2009, Didymo (aka "rock snot"), an invasive alga, was identified in the Ashokan Reservoir basin (Esopus Creek, Ulster County). In response, DEP adopted a preventive policy which resulted in the replacement of the felt-soled waders formerly used by field staff for water quality sample collection in the watersheds, and implemented a disinfection procedure for field equipment to minimize the risk of spread. DEP also strengthened its existing procedures for inspection, steam cleaning, and disinfection of its boats and related equipment to prevent the introduction and/or spread of zebra mussels and other aquatic invasives in NYC reservoirs. DEP also implemented a new policy and protocol to prevent the introduction of zebra mussels and other aquatic invasive species on contractor equipment and vessels, ballasted and otherwise, used on DEP reservoirs.

To support a higher level of water supply protection against aquatic and terrestrial invasive species, DEP commented on pending federal rulemaking and a pending state regulation. The City offered comments during the public comment period to the United States Coast Guard on its Draft Programmatic Environmental Impact Statement for Standards for Living Organisms in Ships' Ballast Water Discharges in U.S. Waters. These standards were proposed to help reduce introductions of aquatic invasive species into US waters through discharge of ballast waters from international shipping. DEP also provided comments to the DEC supporting its proposal to make permanent the emergency regulation restricting the movement of firewood to an area within a fifty-mile radius of the site of origin. This regulation is intended to reduce the spread of invasive forest pests and pathogens.

4.4 Watershed Agricultural Program

The Watershed Agricultural Program (WAP) is a comprehensive partnership between DEP and watershed farmers that supports the development and implementation of voluntary Whole Farm Plans (WFPs) on small and large farms in the New York City Water Supply Watershed. WFPs recommend specific water quality protective best management practices (BMPs) that control nonpoint sources of agricultural pollution—with a particular emphasis on waterborne pathogens, nutrients, and sediment—without compromising a farm’s economic viability.

The WAP is administered by the Watershed Agricultural Council (WAC) using core program funding provided by New York City. Over time, WAC and DEP have leveraged generous financial and technical support from non-City sources to complement and enhance the WAP, particularly from the US Department of Agriculture (USDA), EPA, and Army Corps of Engineers. Local, state, and federal agencies provide planning and engineering services, educational programs, and other forms of scientific support through WAC subcontracts, partnerships, and cooperative agreements.

In 2009, with DEP support, the WAP secured two new sources of federal funding that were made available by the USDA Natural Resources Conservation Service (NRCS) through the 2008 Farm Bill. The first opportunity is a \$2 million Agricultural Water Enhancement Program (AWEP) grant to WAC that will provide \$500,000 per year over a four-year period to support BMP implementation on farms. The second opportunity is the voluntary Conservation Stewardship Program (CSP) that will provide financial and technical assistance to WAP participants, many of whom will enter into 5-year contracts with the USDA in order to receive annual payments for installing new practices or maintaining/enhancing existing practices. More than 30 watershed farmers have already applied for the first round of CSP enrollment during the fall of 2009.

This report covers the following topics: progress in achieving FAD goals; status of the large farm, small farm, and East of Hudson (EOH) programs (including new WFPs and the implementation of existing WFPs); status and summary of annual status reviews for all participating farms; WAC farm recruitment activities; progress in soliciting new acres in the Conservation Reserve Enhancement Program (CREP); implementation plans for 2010 (including the number and types of BMPs to be implemented, estimated costs of those BMPs, nutrient management plans to be created or revised, and WFP revisions to be completed); progress in the WAC Agricultural Easement Program; a summary of related research activities (City and non-City funds); and an evaluation of the WAP based on certain criteria.

4.4.1 FAD Program Goals

Table 4.15 summarizes the accomplishments of the WAP through 2009. (See also Figures 4.11 and 4.12, which document the extent of WFPs with commenced implementation, large farms that are substantially implemented, and farms that completed annual status reviews in 2009.)

Table 4.15. Summary of WAP accomplishments as of December 31, 2009.

Task	Farms	Sub-Farms	Total Farms
Current number of known watershed large farms	267	40	307
Current number of eligible large farm sign-ups	256	40	296
Current number of WFP implementation agreements	251	40	291
Total WFPs substantially implemented	231	32	263
Active	169	31	200
Inactive	61	2	63
Number of WFP annual follow-ups (2009 only)	249	40	289
Total WFP implementation agreements on small farms	75	0	75
WFPs approved during 2009	10	0	10
Total WFP implementation agreements on EOH farms	50	0	50
WFPs approved during 2009	6	0	6

4.4.2 Large Farm Program

To date, there are 291 large farms (including 40 sub-farms) with WFP implementation agreements, representing 94.8% of all known large commercial farms in the West of Hudson Watershed and 98.3% of the large farms participating in the WAP. These figures include one new large farm that signed up for the WAP during 2009.

Farms Substantially Implemented (SI). Through 2009, 263 farms had reached the SI milestone at least once, which represents 85.7% of the 307 known large farms in the West of Hudson Watershed. The 2007 FAD requires that 90% of all large farms in the West of Hudson Watershed have SI WFPs by September 30, 2010. The WAP anticipates achieving this FAD milestone over the next several months through prioritized BMP implementation and targeted WFP revisions on farms that have not yet reached the SI milestone at least once.

As mentioned in previous reports, it is important to recognize that because farms are dynamic enterprises, a farm that meets the SI definition one year may not meet the SI definition the following year due to several reasons: a delay in implementation; a planner identifying new environmental issues on a farm; a farm expands or the farmer changes his/her enterprise; or a farmer is reluctant to proceed with a BMP project (Figure 4.11). As documentation, DEP and WAC have begun tracking the SI status of participating farms. Of the 263 farms that have reached

the SI milestone at least once, approximately 65 (including 5 sub-farms) no longer meet the definition. These 65 farms include:

- 22 farms that experienced a delay in implementation
- 35 farms with newly identified BMPs
- 8 farms which both experienced a delay in implementation and had newly identified BMPs

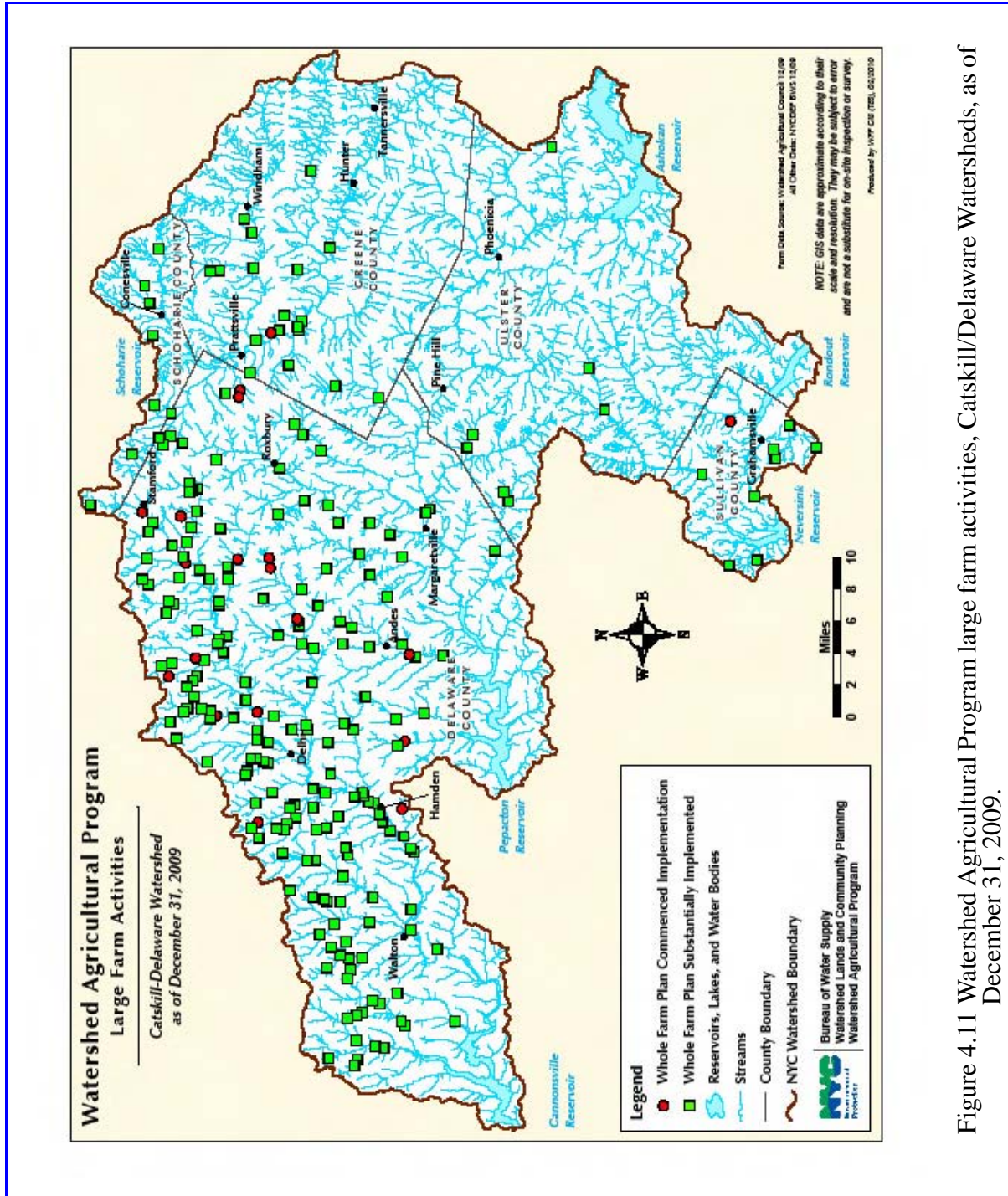


Figure 4.11 Watershed Agricultural Program large farm activities, Catskill/Delaware Watersheds, as of December 31, 2009.

During 2009, 20 WFP revisions were approved and 217 BMPs were installed on large farms in the West of Hudson Watershed, at a cost of \$2,500,970 (Table 4.16).

Table 4.16. Implementation of BMPs on West of Hudson large farms during 2009.

BMP Code	Best Management Practice	No. of BMPs
313	Waste Storage Facility (includes repair)	4
328	Conservation Crop Rotation	5
329	Conservation Tillage	1
342	Critical Area Planting	1
362	Diversion	2
382	Fencing	13
391	Riparian Forest Buffer	6
393	Filter Strip	3
511	Forage Harvest Management	1
512	Pasture and Hayland Planting	3
516	Pipeline and Trough	5
528	Prescribed Grazing	4
558	Roof Runoff Management System	2
560	Access Road	1
561	Heavy Use Area Protection	6
574	Spring Development	13
575	Animal Trails and Walkway	13
578	Stream Crossing	2
585	Contour Strip Cropping	2
590	Nutrient Management Plan	62
595	Pest Management	5
612	Tree and Shrub Planting and Natural Regeneration	8
614	Watering Facility	4
620	Underground Outlet	2
633	Waste Utilization	33
634	Waste Transfer System	4
707	Barnyard Water Management System	4
3100	Calf Kennel/Hutches	1
3175	Enhanced Nutrient Management Credit	2
3430	Manure Truck	3
3450	Manure Agitator Pump	1
3710	Water Wagon	1

Table 4.16. (Continued) Implementation of BMPs on West of Hudson large farms during 2009.

BMP Code	Best Management Practice	No. of BMPs
Total Large Farm BMPs Implemented		217
Total Large Farm BMP Cost		\$2,500,970

Annual Status Reviews. The 2007 FAD requires that annual status reviews be completed on all large farms with SI WFPs. Given that 252 large farms met the SI definition at least once during 2008, these farms required an annual status review in 2009. The WAP exceeded this requirement by completing 289 annual status reviews on large farms during 2009 (this includes 40 sub-farms), which included all 252 SI farms from 2008 (Figure 4.12).

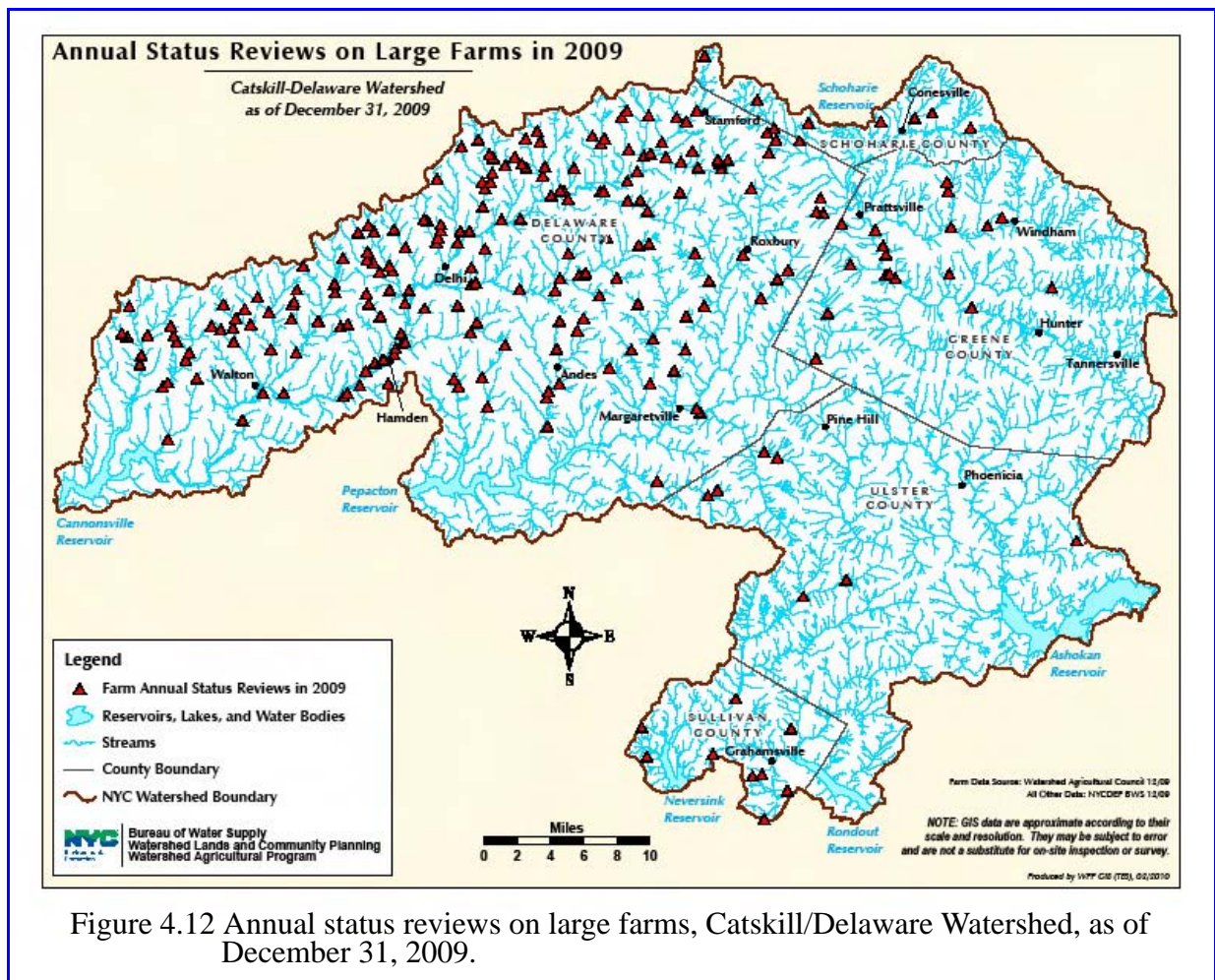


Figure 4.12 Annual status reviews on large farms, Catskill/Delaware Watershed, as of December 31, 2009.

4.4.3 WAC Farm Recruitment Efforts

One new large farm signed up to participate in the WAP during 2009 and WAC approved two new large farm WFPs. WAC also sponsored two annual WAP participant recognition events— one in the West of Hudson Watershed and one in the East of Hudson Watershed—which serve an important purpose of helping to recruit new farmers into the program. To date, WAC has

signed up 96.7% of all known large commercial farms in the West of Hudson Watershed, which greatly exceeds the original WAP goal of 85% farmer participation.

4.4.4 Farmer Education Program

The WAP provides educational opportunities for watershed farmers through its Farmer Education Program, implemented by WAC and Cornell Cooperative Extension (CCE). In 2009, 21 educational programs were sponsored, which included both classroom and field instruction on nutrient and pathogen management, no-till crop production, dairy and livestock grazing, website development, agri-tourism enterprises, and other topics that were attended by over 530 total participants, including 225 watershed farmers and 166 farmers from outside the watershed.

In 2009, the WAP launched a new initiative under which three producer groups were established—Dairy, Beef, and Small Livestock (sheep and goats)—to encourage and promote farmer-to-farmer exchange of information and experience. These volunteer producer groups provided a wide range of educational opportunities, from disease and parasite management to meat processing and marketing. Also during 2009, WAC sponsored and attended the Old Salem Spring and Winter Horse Shows, which collectively attracted about 3,000 participants. It also co-sponsored the thirteenth annual Clean Sweep Chemical Disposal Day for Delaware County residents, farmers, and small businesses, which attracted approximately 400 participants.

4.4.5 Small Farm Program (West of Hudson)

In 2009, WAC approved 10 new small farm WFPs, which meets the annual FAD goal. A total of 75 small farm WFPs have been approved to date (Figure 4.12), of which 60 have commenced BMP implementation. During 2009, 128 BMPs were implemented on small farms at a cost of \$536,435 (Table 4.17) and 65 annual status reviews were completed. To date, a total of 783 BMPs have been implemented on small farms at a cost of more than \$2.7 million.

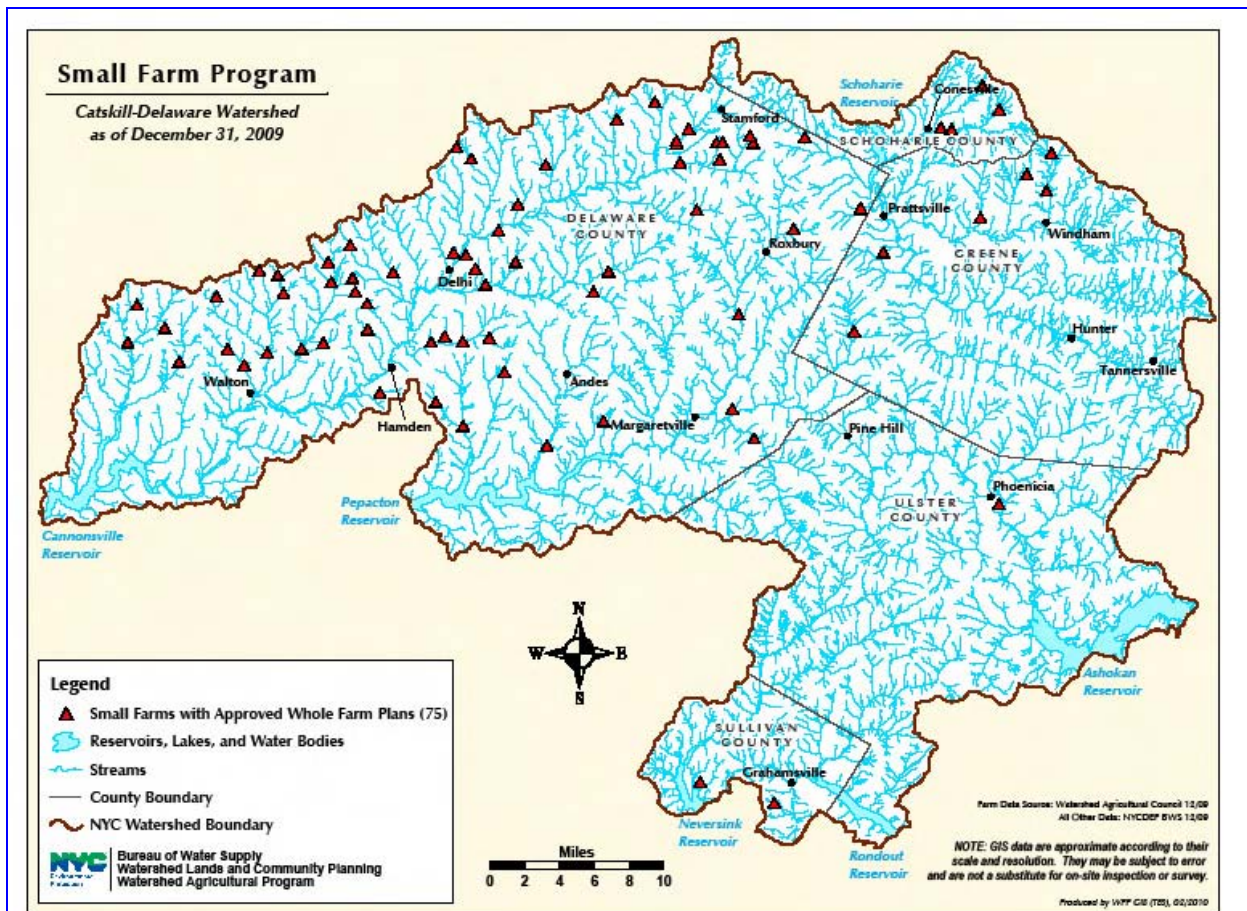


Figure 4.13 Small Farm Program, Catskill/Delaware Watershed, as of December 31, 2009.

Table 4.17. Implementation of BMPs on West of Hudson small farms during 2009.

BMP Code	Best Management Practice	No. of BMPs
312	Waste Management System	2
317	Manure Composting Facility	1
382	Fencing	17
391	Riparian Forest Buffer	1
412	Grassed Waterway	1
516	Pipeline	11
558	Roof Runoff Management System	1
560	Access Road Improvement	3
561	Heavy Use Area Protection	4
574	Spring Development	6

Table 4.17. (Continued) Implementation of BMPs on West of Hudson small farms during 2009.

BMP Code	Best Management Practice	No. of BMPs
575	Animal Trails and Walkway	8
578	Stream Crossing	2
587	Structure for Water Control	3
590	Nutrient Management Plan	33
612	Tree and Shrub Planting and Natural Regeneration	8
620	Underground Outlet	1
633	Waste Utilization	24
701	Barnyard Water Management System	1
3010	Roofed Barnyard	1
Total Small Farm BMPs Implemented		128
Total Small Farm Implementation Cost		\$536,435

In July 2009, DEP submitted a Small Farm Assessment FAD Report that documented the number, extent, and potential impact of small farms on water quality in the West of Hudson Watershed. DEP recommended that WAC continue prioritizing small farm planning efforts to address the highest ranked farms while considering farmer interest and eligibility for the CREP and for WAC’s Agricultural Easement Program. DEP also recommended that the WAP consider exploring a minimum number of animal units as one possible threshold for participant eligibility in the Small Farms Program, which might further help WAP staff to prioritize small farms for whole farm planning and BMP implementation given current staff capacity and resources.

4.4.6 East of Hudson (EOH) Agricultural Program

In 2009, WAC approved six new EOH WFPs, which meets the annual FAD goal. A total of 50 EOH WFPs have been approved to date (Figure 4.14), of which 39 have commenced BMP implementation. During 2009, 33 BMPs were implemented on EOH farms at a cost of \$349,927 (Table 4.18) and 40 annual status reviews were completed. To date, a total of 374 BMPs have been implemented on EOH farms at a cost of more than \$2.46 million.

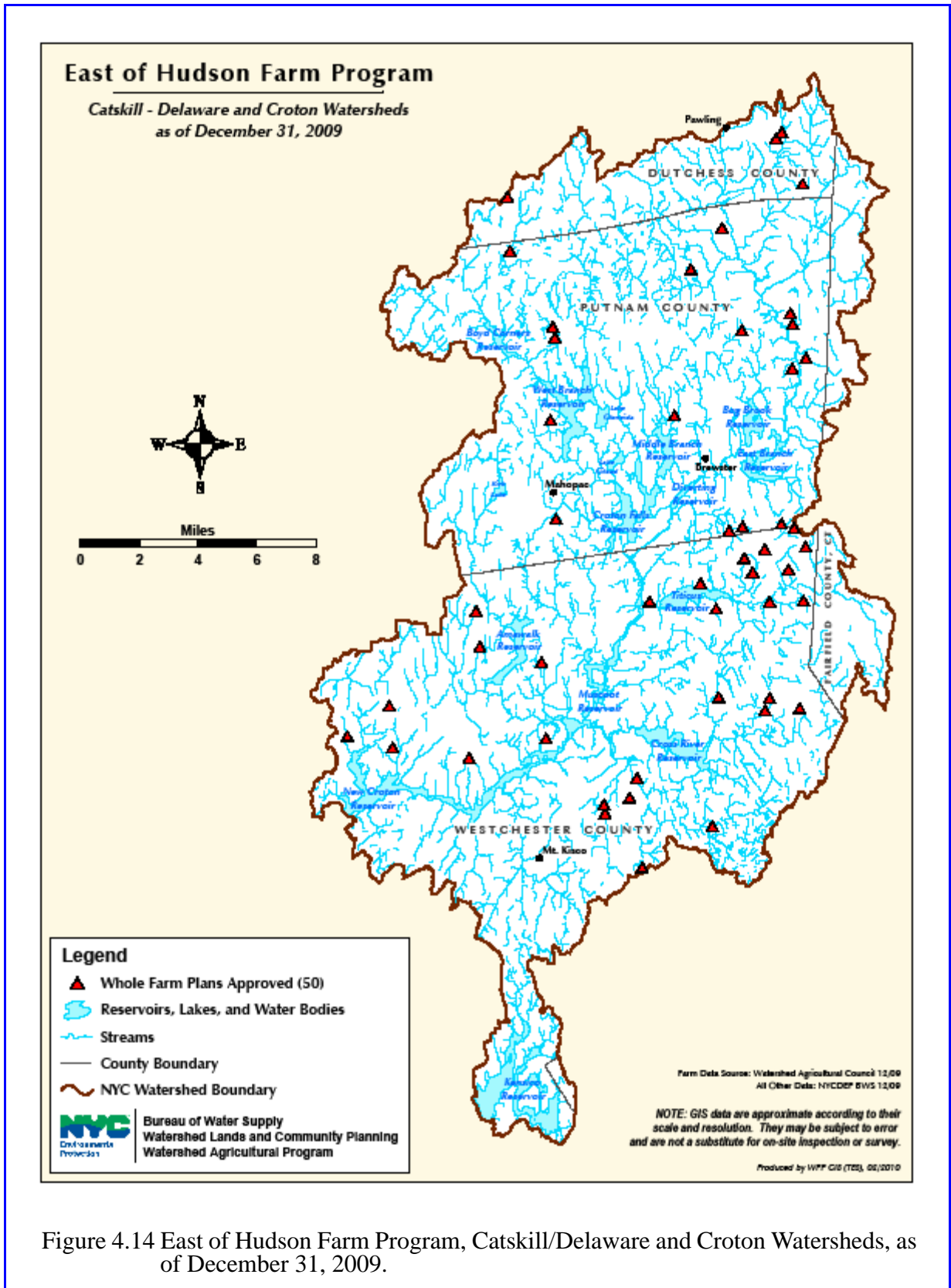


Figure 4.14 East of Hudson Farm Program, Catskill/Delaware and Croton Watersheds, as of December 31, 2009.

Table 4.18. Implementation of BMPs on East of Hudson small farms during 2009.

BMP Code	Best Management Practice	No. of BMPs
317	Manure Composting Facility	4
330	Contour Farming	1
340	Cover Crop	1
350	Sediment Basin	1
362	Diversion	1
382	Fencing	2
390	Riparian Herbaceous Cover	2
558	Roof Runoff Management System	1
560	Access Road Improvement	1
561	Heavy Use Area Protection	5
587	Structure for Water Control	1
590	Nutrient Management Plan	4
620	Underground Outlet	1
633	Waste Utilization	2
635	Wastewater Treatment Strip	2
643	Wash Water Infiltration System	2
719	Waste Infiltration Area	1
783	Pathogen Management	1
Total East of Hudson BMPs Implemented		33
Total East of Hudson BMP Cost		\$349,927

4.4.7 Implementation Plan for 2010

The 2007 FAD requires DEP to annually report on the WAP implementation plan for the subsequent year, including the numbers and types of BMPs to be implemented, estimated cost of these BMPs, nutrient management plans to be created or revised, and WFP revisions to be completed. During 2010, the WAP has the following goals:

- Implement 109 BMPs on large farms at a total estimated cost of \$2,107,770
- Implement 75 BMPs on small farms at a total estimated cost of \$451,580
- Implement 49 BMPs on EOH farms at a total estimated cost of \$622,740;
- Complete new or updated nutrient management plans on 64 large farms and 24 small farms
- Revise six high priority large farm WFPs

In the latter half of 2009, DEP worked with WAC to develop and approve a WAP staff restructuring proposal that will provide up to three additional technical staff positions to assist

with whole farm planning and BMP implementation workload. This restructuring proposal, which will continue to be implemented during the first half of 2010, will also provide increased staff support to the Small Farms Program to address its backlog of BMPs. In addition to increasing staff capacity, WAC also instituted a new governance structure which will streamline the WFP approval process and should further lead to increased efficiency and productivity.

4.4.8 Nutrient Management Planning

In 2009, the WAP Nutrient Management Team completed new and updated nutrient management plans on 63 large farms and 33 small farms. In total, 167 active large farms in the West of Hudson Watershed are following a nutrient management plan, of which 157 (94%) were developed within the last three years and represent 13,952 animal units. The WAP Nutrient Management Credit Program also had a successful year, with 84 participants submitting manure spreading records. The nutrient management plans on these 84 farms cover 25,101 acres of cropland, hayland, and pasture and represent more than 10,000 animal units. Participants earned \$307,485 worth of credits that they can use towards nutrient management expenses.

Precision Feed Management (PFM) Update. In January 2009, DEP submitted a FAD Evaluation Report of Delaware County's PFM Program, which included an assessment of costs and benefits as well as potential recommendations. In that report, DEP recommended that Delaware County continue to assess PFM accomplishments on the 30 currently participating pilot farms in order to develop clear guidelines and a more cost-effective and less staff-intensive framework for implementing PFM beyond these pilot farms. DEP also expressed interest in learning more about ways in which PFM might be advanced in collaboration with the efforts of the WAP Nutrient Management Team and/or the Farmer Education Program.

In August 2009, the PFM Team Leader from Delaware County CCE conducted a presentation for the WAC Agricultural Program Committee, which was well received and resulted in a useful dialogue among all parties. It is worth noting that one active component of the Delaware County PFM Program is the No-Till Planting Initiative, which receives educational funding support from WAC. Although the primary funding source for the PFM Program has been the Army Corps of Engineers, the WAP Nutrient Management Team is considered to be integral to the PFM Program with respect to the Team's forage planning efforts and its responsibilities for developing and implementing PFM goals on farms. According to Delaware County CCE,

Integrating Nutrient Management Planners into the PFM process provides a cohesive and effective link with Whole Farm Planning efforts. When a farm implements PFM, the animal manure contains less phosphorous and nitrogen which allows adjustments to the farm's Nutrient Management Plan. These adjustments both reduce the risk of nutrient loss and give the farm more flexibility in manure application. The implementation of WFP BMPs (e.g., prescribed grazing or crop rotations)...affects farm production practices. The Nutrient Management Team's crop production knowledge, added to the animal nutrition expertise of PFM staff, provides the farm manager a full range of support to realize both the environmental and economic benefits of these practices.

4.4.9 Conservation Reserve Enhancement Program (CREP)

A total of 1,998.6 acres of riparian forest buffers are currently enrolled in CREP contracts, which includes 67.1 new acres that were enrolled in 2009. In 2009, WAP also achieved its first CREP contract re-enrollment. An additional 100 acres of riparian buffers are currently approved and in the CREP contract development pipeline. Of the 191 CREP contracts developed to date, 180 are complete with all associated BMPs implemented (Figure 4.15). It is estimated that CREP has excluded approximately 11,000 head of livestock (mainly dairy and beef cows) from watershed streams and protected approximately 191 stream miles.

In December 2009, DEP submitted a CREP Evaluation FAD Report that included a thorough field assessment of CREP tree and shrub plantings and recommended potential modifications to the CREP Agreement between New York City, New York State, and the USDA that might lead to program improvements and enhanced CREP enrollment of cropland. During 2010, DEP plans to work with the WAP partner agencies to begin addressing the CREP recommendations.

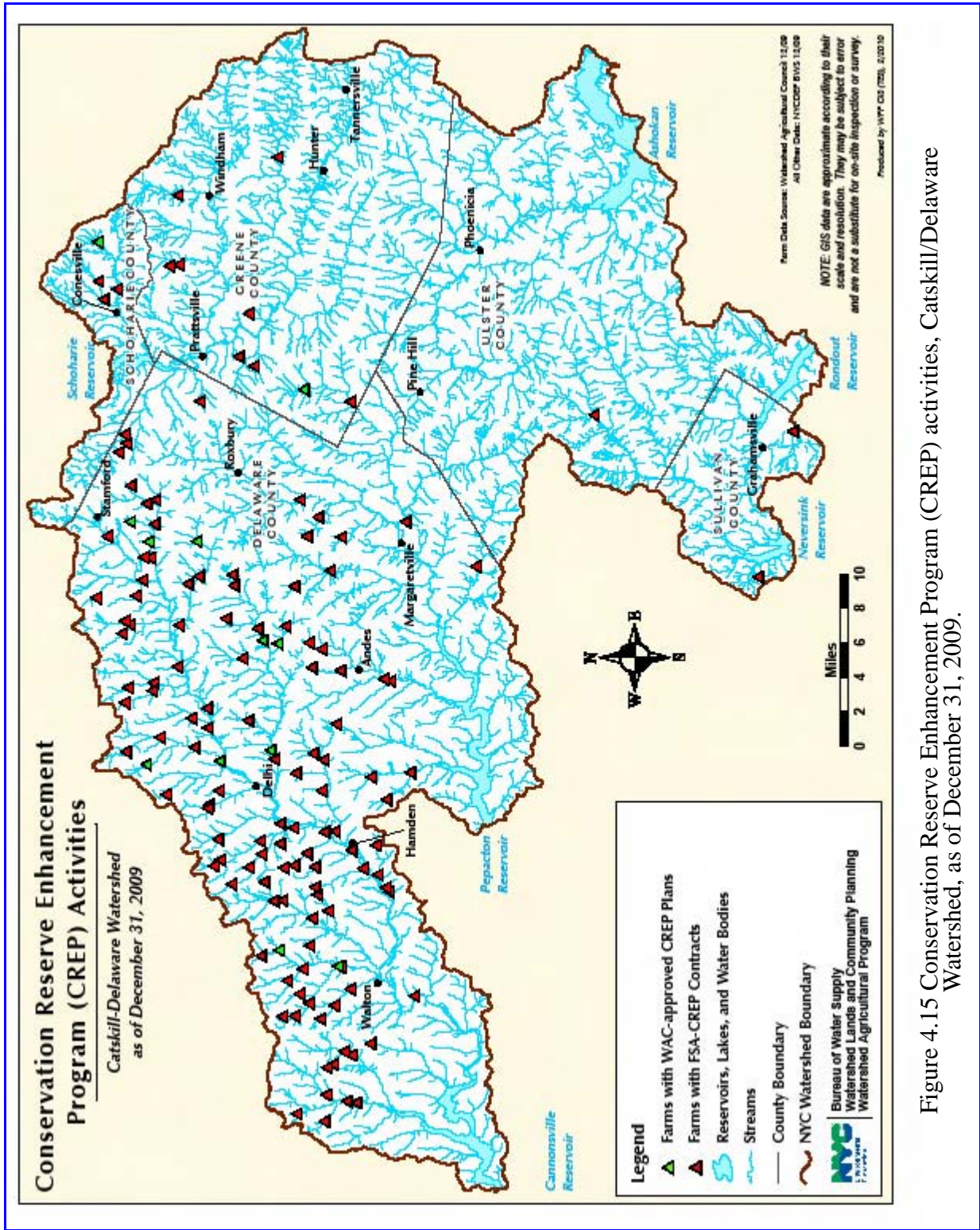


Figure 4.15 Conservation Reserve Enhancement Program (CREP) activities, Catskill/Delaware Watershed, as of December 31, 2009.

4.4.10 WAC Agricultural Easement Program

Please refer to the Land Acquisition Program chapter of the report (Section 4.2).

4.4.11 WAP Evaluation

The WAP continues to be an effective and successful pollution prevention partnership as measured by the current numeric FAD metrics described in this report and especially by the continued high level of participation and support within the watershed farming community.

The 2007 FAD requires DEP to conduct and submit a review of current WAP evaluation criteria, with input from the WAC Advisory Committee, by December 31, 2010. When the WAP Five-Year Plan was submitted in January 2008, DEP reaffirmed the importance of thoroughly reassessing the core metrics of program effectiveness, with a focus on developing and evaluating BMP prioritization methodologies, appropriate levels of treatment, and other reasonable standards for measuring a complex and constantly evolving program. In relation to the upcoming WAP evaluation deliverable at the end of 2010, and with particular respect to achieving the SI milestone a few months before then (9/30/10), it is DEP's hope—as shared by WAC and most other WAP partners—that a more appropriate metric can be established that better reflects the accomplishments and progress of the WAP moving forward.

4.4.12 Related Research Activities (City and non-City funds)

During 2009, WAC continued to work with PAR Government Systems Corporation to develop and implement a comprehensive database management system (CDBMS) that will provide a centralized approach to storing, managing, searching, and accessing data. The CDBMS will store all of WAC's programmatic and departmental data in order to better serve the needs of researchers in support of the WAP, as well as other needs for program evaluation and assessment. The current phase of the CDBMS project, which focuses on the WAP, is scheduled to be completed by the middle of 2010. The final phase, which includes WAC's Easement, Forestry, and Farm to Market Programs, is scheduled to be completed by the end of 2010.

Since the WAP strives to make effective planning and implementation decisions based on sound science, WAC works in concert with the USDA, Cornell University, and other agencies and institutions to support agricultural research projects where existing science is lacking or additional refinement is needed to help quantify, assess, and improve the environmental benefits of many farm conservation practices. The following is a bibliography of research papers that were released in 2009 related to agricultural research conducted in the watershed region.

- Bryant, R.B. 2009. Urban/Rural Connections: The New York City Watershed. From Dust Bowl to Mud Bowl: Sedimentation, Conservation Measures and the Future of Reservoirs, Final Program and Abstract Book. p. 28.
- Dahlke, H.E., Z.M. Easton, D.R. Fuka, N.S. Rao, and T.S. Steenhuis. 2009. Modeling variable source area dynamics in a CEAP watershed. *Ecohydrology* (submitted).

- Easton, Z.M., M.T. Walter, M. Zion, E.M. Schneiderman, and T.S. Steenhuis. 2009. Including source-specific phosphorus mobility in a nonpoint source pollution model for agricultural watersheds. *J. Environ. Eng-ASCE*. 135(1): 25-35, DOI: 10.1061/(ASCE)0733-9372(2009)135:1(25).
- Flores-López, F., Z.M. Easton, and T.S. Steenhuis. 2009. Assessing phosphorus and nitrate transport on a valley farm in the New York City source watersheds, USA. *Vadose Zone J.* (submitted).
- Flores-López, F., Z.M. Easton, and T.S. Steenhuis. 2009. Effect of near stream best management practices on soluble reactive phosphorus and nitrate concentrations on a dairy farm stream in a Catskill Mountain valley. *J. Environ. Qual.* (submitted).
- Ghebremichael, L.T., T.L. Veith, P.E. Cerosaletti, D.E. Dewing, and C.a. Rotz. 2009. Exploring economically and environmentally viable northeastern US dairy farm strategies for coping with rising corn grain prices. *J. Dairy Sci.* 92(8):4086-4099.
- Kleinman, P.J., A.N. Sharpley, L.S. Saporito, A. Buda, and R.B. Bryant. 2009. Application of manure to no-till soils: Phosphorus losses by sub-surface and surface pathways. *Nutr. Cycl. Agroecosys.* DOI:10.1007/s10705-008-9238-3.
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- Sanderson, M.A. and R.B. Bryant. 2009. Fact Sheet: Soil nutrient levels on grazing farms in the northeastern U.S. Northeast Pasture Consortium Fact Sheets. p. 1.
- Thurgood, J.M., P.C. Bagley, C.M. Comer, D.J. Flaherty, J. Karszes, and M. Kiraly. 2009. Bedded Pack Management System Case Study. E.B. 2009-16. Department of Applied Economics and Management, College of Agriculture and Life Sciences, Cornell University.
- Walter, M.T, J.A. Archibald, B. Buchanan, H. Dahlke, Z.M. Easton, R.D. Marjerison, A.N. Sharma, and S.B. Shaw. 2009. A new paradigm for sizing riparian buffers to reduce risks of polluted storm water: A practical synthesis. *J. Environ. Eng.-ASCE* (in press).
- Woodbury, J., C.A. Shoemaker, D.M. Cowan, and Z.M. Easton, 2009. A comparison of a SWAT model for the Cannonsville Watershed with and without Variable Source Area Hydrology. *In: Proceedings of ASCE-Environment and Water Resources Institute Conference 2009.*

4.5 Watershed Forestry Program

The Watershed Forestry Program is a partnership between DEP, WAC, and the United States Forest Service (USFS) that promotes and supports the economic viability of well-managed working forests as a beneficial land use for watershed protection. WAC utilizes core DEP contract funds to secure multi-year matching grants from the USFS to support the following major program areas: (1) forest management planning and stewardship, (2) best management practice (BMP) implementation, (3) logger and forester training, (4) model forest program, (5)

watershed forestry education program, and (6) forest products marketing and utilization. In January 2009, DEP entered into a 46-month contract with WAC to continue implementing the Watershed Forestry Program through October 2012 in tandem with WAP.

4.5.1 Forest Management Planning and Stewardship

One primary goal of the Watershed Forestry Program is to support, encourage, and assist private forest landowners with their adoption and implementation of long-term forest management plans that are written by trained professional foresters to meet enhanced watershed specifications. In 2009, 59 WAC forest management plans were completed covering approximately 8,678 total acres, of which an estimated 6,911 acres are forestland. In addition to these new plans, 10 existing/older WAC plans were updated to meet newer WAC plan specifications, and these plans cover 3,789 total acres (3,212 forested acres). To date, 838 WAC plans have been completed covering 150,051 acres (117,685 forested acres). This figure includes 36 plans (8,938 acres and 6,884 forested acres) that were originally enrolled in the Watershed Forestry Program and have subsequently been updated in some capacity because the plan was outdated and/or new forested parcels were added to the landowner's property.

Since 2002, riparian planning has increasingly been integrated into WAC's specifications for watershed forest management plans, with a primary focus on streamside protection and riparian forest management recommendations. Fifty-three of the 59 WAC plans completed in 2009 contain riparian plans covering a total of 1,275 riparian acres, while 3 of the 10 WAC plans updated in 2009 include riparian plans covering a total of 268 riparian acres. For all 838 WAC plans and plan updates completed to date, 268 contain a riparian plan, covering a total of 9,117 riparian acres.

Since 2005, many landowners having a WAC forest management plan have been eligible to receive funding through the WAC Management Assistance Program (MAP) to implement specific practices recommended in their WAC plans. These practices include timber stand improvements (TSI), tree planting (including deer fencing), riparian improvements, wildlife improvements, and invasive species control projects. In 2009, 55 landowners were approved to complete 75 MAP projects, including 42 TSI projects, 14 wildlife improvement projects, 14 invasive species control projects, and five tree planting projects. Nine of these projects were subsequently cancelled by the landowner, 43 projects were completed, and 23 projects are pending completion. To date, 129 landowners have been approved to complete 248 MAP projects, including 128 TSI projects (52%), 56 wildlife improvement projects (23%), 31 tree planting projects (13%), 27 invasive species control projects (11%), and 6 riparian improvement projects (2%). Forty-seven of these projects have been cancelled (19%), 177 have been completed (71%), and 24 (10%) are pending completion.

4.5.2 Best Management Practice (BMP) Implementation

Another goal of the Watershed Forestry Program is to promote and support the voluntary implementation of forestry BMPs during and after timber harvesting operations and especially during forestry stream crossings. To this end, WAC owns 10 portable bridges and 5 plastic arch culverts that are available for temporary loan to interested loggers for crossing watershed streams, along with 12 sets of rubber tire land mats that are used to stabilize the approaches to streams. WAC also provides cost-sharing, technical assistance, and other incentives for loggers, foresters, and landowners to properly install erosion control BMPs on forest roads and minimize the potential water quality impacts of logging equipment.

During 2009, 33 road BMP projects were completed, 4 of which included stream crossings where WAC provided cost-sharing and technical assistance. These 33 projects represent over 52 miles of properly constructed and/or remediated roads/trails, at least 2,147 water diversions (water bars and broad-based dips), 350 linear feet of geotextile fabric and/or silt fencing, 980 cubic yards of stone, 60 linear feet of culverts, 100 hay bales, and the post-harvest stabilization of 15 acres. To date, 242 road BMP projects have been completed, 7 of which included forestry stream crossings where WAC provided cost-sharing and technical assistance. (Note: this BMP cost-sharing component has only been available the past two years.) These 242 projects represent over 336 miles of properly constructed and/or remediated roads/trails, at least 12,415 water diversions, 7,788 linear feet of geotextile fabric and/or silt fencing, 10,256 cubic yards of stone, 3,351 linear feet of culverts, 1,399 hay bales, and the post-harvest stabilization of 149 acres.

In addition to the above, in 2009 WAC provided cost-sharing for the purchase/construction of one short-span (20') portable bridge, loaned out the WAC short-span (20') bridge once and the long-span (30') bridge twice, and cost-shared two additional forestry stream crossing projects that were not associated with a road BMP project. Six more stream crossing projects are currently approved and pending completion. To date, the Watershed Forestry Program has cost-shared the construction, purchase, or rental of 20 individual portable bridges while loaning out WAC-owned bridges on at least 49 different watershed logging jobs. Although no arch culverts were loaned out during 2009, 10 of these culverts have been utilized on forestry stream crossings to date since they were acquired by WAC in 2006.

Finally during 2009, the Watershed Forestry Program approved 15 applications for free BMP samples and erosion control technologies submitted by 11 different applicants. Thirty-three free samples were distributed, including straw wattles, geotextile road fabric, grass seed, hay bales, non-petroleum chainsaw oil, erosion control blankets, pipe culverts, rubber belt water deflectors, and silt fencing.

4.5.3 Logger and Forester Training

The Watershed Forestry Program promotes and supports voluntary logger participation in the NYS Trained Logger Certification (TLC) Program through a series of core workshops and continuing education courses that are coordinated by Cornell Cooperative Extension (CCE) of Greene County in partnership with New York Logger Training, Inc. WAC also produces an annual logger training calendar of events, distributes promotional TLC roadside signs and first aid kits, and participates in the annual Deposit Lumberjack Festival and NYS Woodsman Field Days. In 2009, WAC distributed 18 promotional TLC roadside signs and 12 first aid kits to watershed loggers who attended workshops and became fully certified.

The Watershed Forestry Program sponsored 11 logger training workshops during 2009 that were attended by 146 participants. These workshops included: two “Game of Logging” workshops (19 participants), three “Forest Ecology & Silviculture” workshops (56 participants including 24 students from the Grand Gorge BOCES Campus), two “First Aid & CPR” workshops (21 participants), one “GPS for Loggers” workshop (10 participants), one “Streams, Wetlands & BMPs” workshop (14 participants), and one “Hazard Tree” workshop (20 participants). Ninety-seven individuals working in the Catskill/Lower Hudson region are fully certified through December 31, 2009, representing a 43% increase from 2008 and a 67% increase from 2007. It is worth noting that the Catskill/Lower Hudson region has the second highest number of fully certified loggers of the six regions across New York State, trailing only the Eastern Adirondack region.

In 2009, WAC also sponsored three forester training workshops that attracted 17 participants. One of these workshops was held in the East of Hudson Watershed, one was held at the Lennox Model Forest in Delaware County, and one involved a field trip to the Bartlett Experimental Forest in New Hampshire, which is operated by the USFS. Fifty professional foresters are currently trained and approved to write WAC forest management plans and at least half of these foresters provide services to East of Hudson landowners.

4.5.4 Model Forest Program

WAC collaborates with SUNY College of Environmental Science and Forestry (ESF), CCE of Delaware and Greene Counties, Frost Valley YMCA, and other local and state partners to coordinate and support the following three watershed model forests: Lennox (Delaware County), Frost Valley (Ulster County), and Siuslaw (Greene County). Each model forest is designed to integrate forestry and water quality research with interpretive watershed educational opportunities and various BMP and silvicultural demonstrations. The watershed model forests essentially provide both a living laboratory and outdoor classroom where all types of target audiences may experience and learn first-hand about working forest landscapes.

During 2009, WAC and its partners continued to operate, maintain, and monitor all three model forests while utilizing them for a suite of education, outreach, and training events targeting

landowners, loggers, foresters, and others. Lennox Model Forest hosted two logger training workshops and one forester training workshop, in addition to a five-part landowner education series that was attended by 71 participants. Siuslaw Model Forest had a forest management plan completed while hosting at least 24 different events that attracted more than 700 participants (both adult and youth audiences). Frost Valley Model Forest hosted a series of educational events which attracted several thousand participants, primarily students and youth who attend the YMCA Camp. Also in 2009, SUNY ESF researchers completed regeneration surveys in two of the experimental treatment blocks at the Frost Valley Model Forest.

Pursuant to the 2007 FAD, which requires the Watershed Forestry Program to establish a model forest in the East of Hudson Watershed, WAC and DEP worked closely in 2009 with SUNY ESF and the existing three model forest host organizations to develop a comprehensive promotional packet about the model forest program. This packet—which includes desired host site attributes, criteria for selection, and a model forest questionnaire—was distributed to more than a dozen environmental education centers and other organizations in the East of Hudson Watershed to solicit their interest in hosting a model forest. The results from this solicitation will be reviewed in 2010 with a goal of selecting potential candidate sites and possibly conducting some initial public outreach to assess and build local community support. Although DEP and WAC are both committed to establishing an East of Hudson model forest, it is important to recognize that previous efforts proved unsuccessful. It is therefore the intent of both DEP and WAC to proceed with this effort in a cautious and deliberate manner on a suitable property that is not only fully endorsed by the host landowner but supported by the broader community as well.

4.5.5 Watershed Forestry Education Program

WAC collaborates with the Catskill Center for Conservation and Development, Common Ground Educational Consulting, DEP, and the USFS to implement a comprehensive urban/rural school-based education program comprised of the following core elements: Watershed Forestry Institute for Teachers, Green Connections (GC) School Partnership Program, Watershed Forestry Bus Tour Grants Program, and Catskill Stream & Watershed Education Program (CSWEP).

In 2009, the Catskill Center conducted the eleventh annual Watershed Forestry Institute for 20 teachers from NYC and watershed schools. Altogether, more than 210 individual teachers have participated in the Institute since 1999. The Catskill Center also completed the 2008-2009 GC Program and the 2008-2009 CSWEP in the spring, while launching the 2009-2010 CSWEP in the fall. Both programs involve classroom instruction coupled with outdoor field trips and forestry/stream educational activities that engage students in nature, encourage their “sense of place,” and promote environmental stewardship. The 2008-2009 GC Program involved 500 students from 6 NYC and 6 watershed schools, while the 2008-2009 CSWEP reached over 385 students from 32 classrooms in 11 watershed schools. Eight new teachers joined CSWEP during 2008-2009 while two new teachers joined the 2009-2010 CSWEP. The 2009-2010 CSWEP has already educated 336 students from 23 classrooms.

One noteworthy development that occurred during 2009 was a restructuring of the GC Program from a year-round school partnership that begins in the fall and continues through the spring, into a condensed single-semester program that takes place during the spring only. One reason for this adjustment stems from the logistical challenges of organizing both upstate and downstate field trips during the course of a school year, which in 2009 proved to be unusually challenging due to the outbreak of swine flu and many schools cancelling their field trips at the last minute. The other major reason was to reorganize the classroom educational component around an intensive 12-week period with six focused curriculum modules that more fully address forest and water resource themes while correlating better with NYS and NYC Learning Standards. The newly restructured GC Program is scheduled to begin during winter/spring 2010 with six partnering schools (three from NYC and three from the watershed).

The Watershed Forestry Bus Tour Grants Program held two funding rounds in 2009, with 22 grants awarded out of 37 applications. Nineteen forestry bus tours were completed in 2009 for approximately 960 participants, with several bus tour groups already approved and scheduled for 2010. To date, more than 120 bus tours have been completed for approximately 6,000 participants. In 2009, the Watershed Forestry Bus Tour Grants Program was selected by the USFS to participate in the development of a pilot online evaluation tool called MEERA (My Environmental Education Evaluation Resource Assessment) in collaboration with researchers from the University of Michigan. MEERA resulted in some good recommendations for strengthening and improving the Bus Tour Program, some of which have already been implemented; others will be explored further by WAC and DEP as part of an upcoming broader evaluation of the entire urban/rural school-based education program.

4.5.6 Forest Products Marketing and Utilization

The Watershed Forestry Program continues to support the “Catskill WoodNet” marketing website (www.catskillwoodnet.org), which currently represents nearly 80 businesses that utilize and/or sell locally harvested wood from the Catskill region. To further support and promote utilization and marketing of local wood products, in 2009 WAC attended and/or exhibited at the Northeast Forest Products Equipment Expo (Watkins Glen, NY); Vermont Wood Chip User Conference; NYS Forestry Awareness Day (Albany, NY); Mid-Atlantic Industrial Woodworking Expo (York, PA); Architectural Digest Home Design Show (NYC); “Heating the Northeast with Renewable Biomass” Conference (Nashua, NH); “Biomass Combined Heat & Power” Workshop (Troy, NY); and the NAASF Utilization & Marketing Committee Meeting (Sullivan, OH).

In 2009, the Watershed Forestry Program also undertook two major forestry economic development projects using grant funding from the USFS. The first project continued WAC’s collaboration with Richmond Energy Associates (a private consultant) to conduct a woody biomass feasibility study at five regional facilities selected in response to a Request for Proposals (RFP) issued by WAC in 2008: Catskill Craftsmen, Inc. (Stamford); O’Connor Hospital (Delhi); South Kortright Central School; Cairo-Durham Middle/High School; and Onteora Middle/High

School. The final study, “Biomass Opportunities in the Catskills,” can be found on the WAC website (http://www.nycwatershed.org/ei_forestry_grants.html). As a follow-up to this study, WAC issued a second RFP to conduct in-depth site assessments regarding the feasibility of installing a woody biomass boiler system at interested facilities and institutions. Three facilities were selected and WAC is currently working with the USFS and two private consultants to complete this phase of the woody biomass project and to plan the next steps for 2010.

The second project pursued by WAC explored the feasibility of developing a “Forest Bank” as one potential strategy for conserving working landscapes in the NYC Watershed. The Forest Bank concept was originally pioneered in 1998 through a series of research studies funded by the Great Lakes National Program Office of the EPA, which led to the creation of two Forest Banks by The Nature Conservancy in Clinch Valley, Virginia and Blue River Basin, Indiana. The latter has proven to be the most successful as well as the most applicable (potentially) to the NYC Watershed. A Forest Bank essentially pools the forest resources (timber assets) of multiple landowners into a single long-term investment portfolio that requires ongoing sustainable management by the landowners in return for annual payments based on a percentage of the appraised value of their standing timber. In 2009, WAC issued an RFP to conduct a financial feasibility study for creating a Forest Bank for the NYC Watershed. A private consultant was hired to conduct this analysis and a final report was submitted near the end of 2009. The next phase of the Watershed Forest Bank project will be a topic of discussion for 2010.

4.5.7 Other Accomplishments

Throughout 2009, the Watershed Forestry Program continued to support and participate in the Catskill Regional Invasive Species Partnership (CRISP) while seeking new dialogue and collaboration with diverse groups such as the Westchester County Deer Task Force, Hudson Hills and Highlands Environmental Leaders Learning Alliance, Temperate Forest Foundation, NYS Urban & Community Forestry Council, Empire State Forest Products Association, the new Catskill Streams Buffer Initiative (formerly the Streamside Assistance Program), and the Catskill Watershed Corporation (CWC), which administers a Public Education Grants Program that is complementary to the Watershed Forestry Bus Tour Grants Program. It is worth noting that CWC actively participates in WAC’s Urban/Rural Education Working Group and in turn has invited WAC to join the CWC Public Education Advisory Group (PEAG).

In addition to the above, the Watershed Forestry Program continues to support and conduct a forestry municipal officials training campaign. During 2009, WAC conducted a presentation and follow-up woods walk for members of the Town of North Salem Planning Board (Westchester County), in addition to presenting to the Stamford Town Board, Jewett Town Board, and the Board of Education at several local schools.

4.5.8 Summary

The Watershed Forestry Program continued to implement all major core tasks while meeting all related FAD deliverables during 2009. DEP gratefully acknowledges the invaluable role of the USFS in matching City contract funds with federal grants to enable WAC to successfully pursue its dual mission of protecting water quality and supporting economic viability.

4.6 Stream Management Program

The DEP Stream Management Program (SMP) made considerable progress in 2009 toward achieving its program mission to protect and/or restore achievable levels of stream system stability and ecological integrity by providing for the long-term stewardship of streams and floodplains. With the 1997 FAD, the SMP initiated a partnering and planning effort with County Soil and Water Conservation Districts (SWCDs) for each of the mainstem rivers in the West of Hudson (WOH) watershed. To date, stream management plans have been completed for all of the Catskill and Delaware System mainstem rivers, with the exception of Rondout Creek and Neversink River. With the 2007 FAD, the SMP has begun to transition from a program planning phase to a program implementation phase. Successful implementation of the strategies, policies, and projects within stream management plans can help Catskill communities live more harmoniously with their mountain rivers, and both improve and protect the quality of stream water that feeds the Catskill and Delaware watershed reservoirs.

As a partnership program, the SMP relies on contracts with partnering agencies as the primary vehicle for accomplishing program goals. Renegotiating 5-year contracts with program partners concluded in 2009 with the registration of the final two contracts for planning and implementation in the Rondout/Neversink and Ashokan basins, respectively. In total, the partnership contracts represent \$30.4 million in funding.

Stream management plans have raised to the highest priority the need for coordinated emergency flood response and training for those working in streams following floods, when waterways become clogged with wood, gravel, and items from floodplains (such as fuel tanks, equipment, vehicles, and structures). Excessive clearing of stream channels after floods, despite good intentions, can degrade water quality and exacerbate stream channel instability, erosion rates, and threats to infrastructure. In 2009, two major advances were made in the area of floodplain management. First, the SMP and Delaware County Soil and Water Conservation District (DCSWCD) developed and implemented the Post-Flood Stream Intervention Contractor Training program teaching highway managers and contractors the skills for this work. Second, DEP registered a \$7 million contract with FEMA for the update of floodplain maps for the WOH watershed. These maps will provide an essential floodplain management tool for the region.

The 2007 FAD directed DEP to address the programmatic gap in technical and financial assistance to private landowners for riparian buffer stewardship. In 2009, the SMP completed the

program development phase of the Catskill Streams Buffer Initiative (CSBI, formerly called the Streamside Assistance Program). This included establishment of staffing at SWCDs, program brochure, logo, marketing strategy, program rules, and application materials. The CSBI team also piloted a set of initial planting projects. The City has committed \$3.86 million to this effort. The CSBI summary for 2009 is included in Section 4.7 of this report.

Adoption of stream management plans by municipalities is required for the implementation of the plans and for CSBI funding provided in SMP partner contracts to flow. Progress toward adoption was substantial and is depicted in Figure 4.16. In 2009, all major municipalities in the Schoharie watershed had adopted their respective stream management plan, as had 17 of 25 towns in the Cannonsville and Pepacton watersheds, and 4 of 6 towns in the Ashokan watershed. All WOH towns except Colchester are moving toward adoption.

4.6.1 Stream Management Plans and their Implementation

Each stream management plan presents a comprehensive set of recommendations that provides a hierarchy of programmatic, policy, and action-related priorities, giving DEP and its partners a road map for accomplishing long-term stewardship objectives. Figure 4.16 illustrates the status of stream management plans and restoration projects throughout the WOH watershed. Table 4.19 identifies the name of each SMP project completed or advanced in 2009 as depicted in Figure 4.17. For a comprehensive listing of all stream management projects completed to date, go to www.catskillstreams.org/Stream_Management_Plans.html.

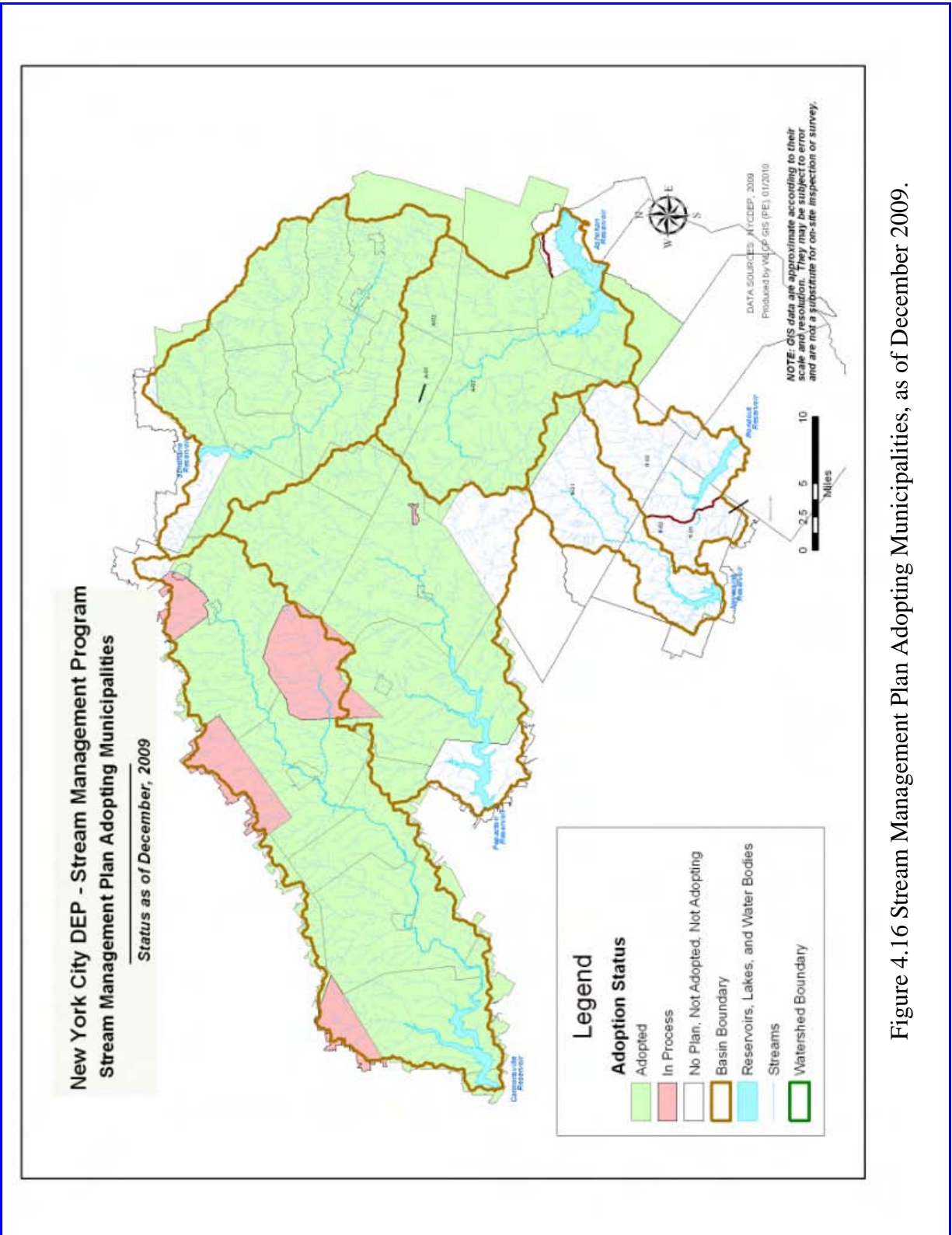


Figure 4.16 Stream Management Plan Adopting Municipalities, as of December 2009.

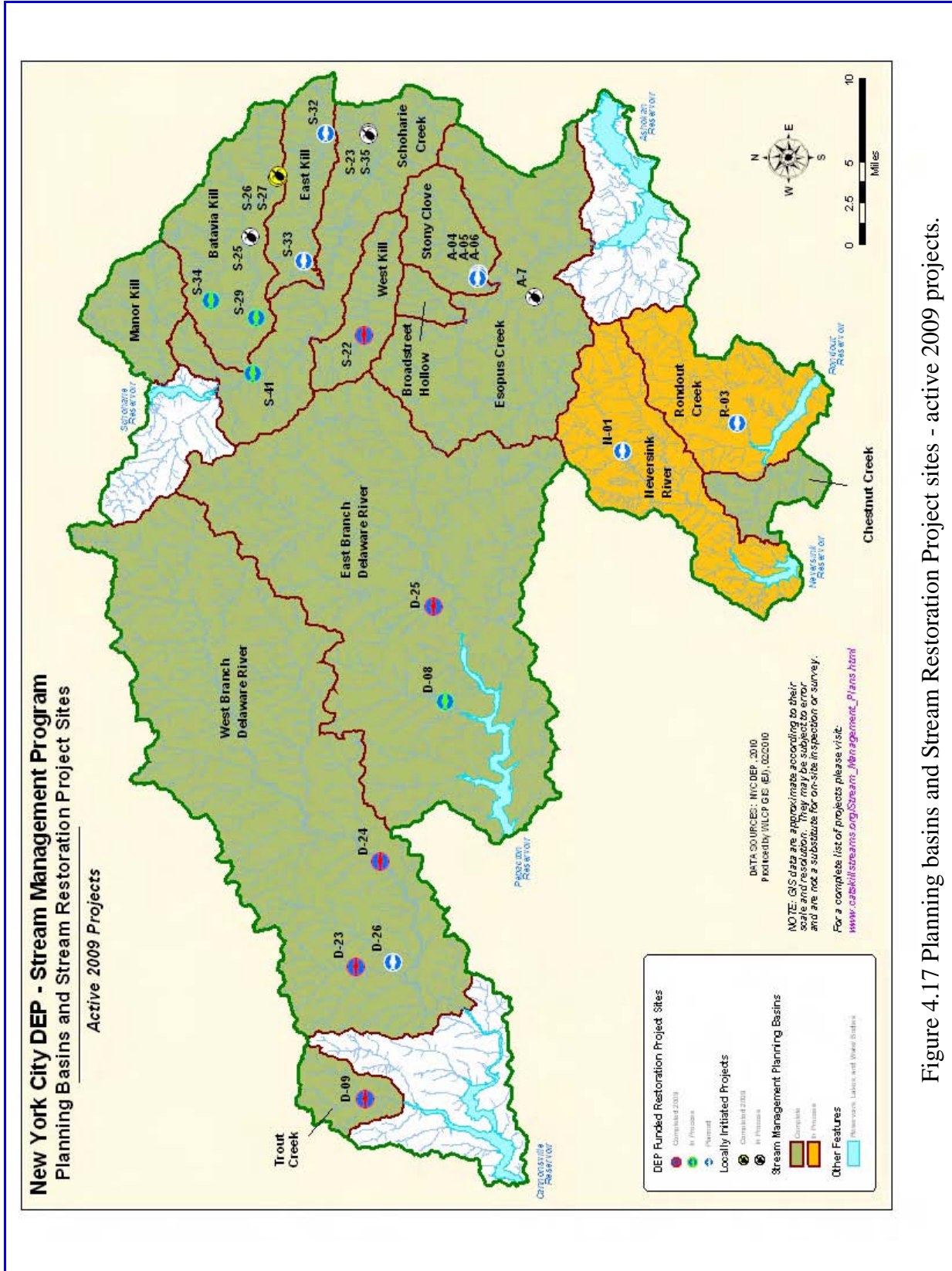


Figure 4.17 Planning basins and Stream Restoration Project sites - active 2009 projects.

Table 4.19. SMP project name and identification by basin.

Basin	Project ID	Type of Project	Name of Project
Schoharie Basin			
	S-29	Restoration	Batavia Kill, Holden Project, Phase 2
	S-22	Restoration	West Kill, Long Road
	S-23	Stormwater	Gooseberry Creek, Project Office
	S-25	Stormwater	Batavia Kill, Windham Mountain
	S-26	Stormwater	Batavia Kill, Sugar Maples 1
	S-27	Restoration	Batavia Kill, Sugar Maples 2
	S-32	Restoration	East Kill, Vista Ridge
	S-33	Restoration	East Kill, Mill Hollow
	S-34	Stormwater	Batavia Kill, Partridge Road Culvert
	S-35	Stormwater	Schoharie Creek, Mountain Top Library
	S-41	Bank Stabilization	Schoharie Creek, Wright
Delaware Basin			
	D-08	Bank Stabilization	Delaware EB, Tremper Kill, Liddle Farm
	D-09	Restoration	Delaware WB, Trout Creek, Loewentheil Farm
	D-23	Restoration	West Brook, Post-Flood Emergency Response
	D-24	Restoration	Launt Hollow, Post-Flood Emergency Response
	D-25	Restoration	Platte Kill, Post-Flood Emergency Response
	D-26	Restoration	East Brook, County Rte. 22
Ashokan Basin			
	A-04	Restoration	Stony Clove, Chichester, Asada
	A-05	Restoration	Stony Clove, Chichester, Walsh
	A-06	Restoration	Stony Clove, Chichester, Schmidt
	A-07	Bank Stabilization	Woodland Valley, Fawn Hill Road
Rondout Basin			
	R-03	Demonstration	Rondout Creek, Van Aken
Neversink Basin			
	N-01	Demonstration	Neversink River Demo Project

Ashokan Basin

The Ashokan Watershed Stream Management Program (AWSMP) is a partnership between DEP, Cornell Cooperative Extension–Ulster County (CCE), and Ulster County Soil and Water Conservation District (UCSWCD). Funds for the program are provided by DEP to the two contracting partner agencies for a total of \$8.1 million. Five-year contracts for implementation were registered with CCE in May 2008 and with UCSWCD in April 2009.

CCE provides the overall program coordination; leads stakeholder engagement through the Ashokan Watershed Advisory Council (AWAC) and associated working groups, and through

4. Protection and Remediation Programs

education and outreach activities; and oversees the development and distribution of the \$2 million Stream Management Plan Implementation Fund.

UCSWCD provides the lead technical service to the program, directing stream assessments, conducting site visits for streamside landowners, designing and constructing stream corridor projects ranging from culvert replacement and ditch management to full-scale stream restoration, and implementing the CSBI for the Ashokan watershed.

In 2009, AWSMP's emphasis was on program development—moving from a series of individual stream corridor management planning efforts to a watershed-wide implementation program that integrates previous plans and accommodates future assessments and management recommendations. CCE and UCSWCD opened a new program office at the end of February. In May, the 2009-2011 AWSMP Action Plan was completed. The Action Plan integrates the recommendations from the three previous stream management plans (Esopus Creek, 2007; Stony Clove, 2004; Broadstreet Hollow, 2003). The UCSWCD Program Manager was hired in July and the UCSWCD CSBI Coordinator was hired in November.

Major 2009 milestones in the Ashokan basin include:

Program Development

- CCE convened 4 AWAC meetings and expanded membership to include the Towns of Woodstock and Olive. Meetings primarily focused on Action Plan development/review, development of the \$2 million SMP Implementation Fund guidelines and application materials, and a review of the first pilot grant applications received in December 2009.
- The Town of Woodstock adopted the Esopus Creek plan in June 2009. The Towns remaining to adopt the plan are Hurley and Olive. (In January 2010, Olive adopted the plan).
- CCE continued the \$2 million SMP Implementation Fund program development through 2009. For the grant categories and their funding levels, see www.ashokanstreams/implementation%20fund.html.
- DEP provided funding for engineering services under its contract with UCSWCD. UCSWCD, NRCS, and DEP negotiated these engineering services between May and December 2009 and neared agreement at the close of the year.
- AWAC's Highway Managers subcommittee was launched in 2009 and has proven most productive. Meetings hosted all the watershed town highway superintendents, Ulster County DPW, and the New York State Department of Transportation (DOT). This working group will identify opportunities to provide funding or technical assistance in situations where stream and roadway management intersect. The subcommittee identified its first project as a streambank stabilization project on Woodland Creek (Section 4.6.4).

Stream Assessments and Stream Project Identification

- UCSWCD completed half of the stream feature inventory (SFI) for the Beaver Kill, a 12+-mile-long tributary to Esopus Creek that was significantly impacted by a flash flood in June 2006.

- UCSWCD initiated a remedial feasibility investigation into a set of three projects located over a 1-km segment of Stony Clove, which is a chronic source of suspended sediment (Section 4.6.4).
- CCE provided support to ongoing aquatic ecosystem research by providing its field office as a base of operations for USGS, DEP, and DEC staff and interns.
- CCE initiated a large woody debris (LWD) monitoring and assessment project. LWD management has long been identified as a hazard concern to highway managers and recreational users of Esopus Creek, as well as being a key ecological component of the aquatic ecosystem. Research is intended to help develop management strategies that can balance these competing LWD roles.

Education, Outreach, and Training

- In October, CCE and DEP hosted world-renowned restoration consultant and hydrologist Dr. David Rosgen for a five-day course on applied river morphology with a focus on the Ashokan watershed. Forty-five professionals were trained to better understand how streams are likely to respond to changes that they make to stream channels and floodplains. Participants included staff from town and county highway departments, SWCDs, DEC, DOT, USDA, the Natural Resources Conservation Service (NRCS), and regional consulting engineers.
- Dr. Rosgen also provided a public presentation about stream restoration entitled, “Stream Projects: The Good, the Bad, and the Ugly”, discussing examples of stream restoration projects that were installed with good intentions but failed. He illustrated ways to improve projects by using a “natural channel design” approach to stream restoration. Over 100 people attended the evening presentation.
- CCE continued the Youth Stream Stewards and Volunteer Stream Stewards projects started in 2008. Eleven Youth Stream Stewards from Onteora HS worked on weekly service projects. In the spring, six students learned to delineate a wetland, and in the fall, five students learned GIS and GPS skills that they applied to map Japanese Knotweed. The Volunteer Stream Stewards improved their skills in Japanese Knotweed eradication and control by developing a demonstration and photo monitoring site and hosting training for the community.
- CCE was part of a successful statewide grant, received by Cornell University, to develop a statewide Watershed Steward Program. Following program development in 2010, the Ashokan watershed will be a pilot site in 2011.
- Outreach included development of a fact sheet “A Guide to Stream Friendly Practices”, distribution of three “Esopus Creek News” newsletters to over 2,700 streamside residents, and participation by CCE at community events including Shandaken Day and the Ulster County Fair. All program outreach materials are available for download from the program website, www.ashokanstreams.org.

Schoharie Basin

Prior to 2009, DEP and the Greene County Soil and Water Conservation District (GCSWCD) had completed stream management plans for all major Schoharie Reservoir tributaries. These plans can be viewed at www.catskillstreams.org/Stream_Management_Plans.html.

4. Protection and Remediation Programs

The Schoharie Watershed Advisory Committee (SWAC), formalized in May 2008, represents the collective interests of local government, property owners, watershed agencies, and non-profit organizations in implementing the stream management plan recommendations. All 11 Schoharie basin municipalities are represented on SWAC, and its three subcommittees—Highway Superintendents, Education and Outreach, and Recreation and Habitat—have been very active this year. Ten of the 11 municipalities—9 in Greene County and 1 (Manor Kill) in Schoharie County—have completed the SEQRA process, adopted the relevant stream management plan, and signed an MOU with GCSWCD or SCSWCD (Manor Kill) to guide implementation in their town.

SWAC and GCSWCD's most significant 2009 accomplishment was the completion of all materials for the \$2 million competitive SMP Implementation Fund program and the program's subsequent launch. The first round of proposals was received on August 1 and funds were awarded by SWAC on September 23. Eleven proposals were awarded funding, totaling \$441,330, in the following categories: landowner stream assistance (2), highway and infrastructure (2), education and outreach (3), recreation and habitat (1), stormwater (1), and planning and assessment (2). The full details regarding these projects and their funding level can be found at <http://www.catskillstreams.org/SWAC.html>.

DEP and GCSWCD also completed the Long Road stream restoration project, which increased stability to 3,000 feet of the West Kill. This project was the first stream restoration project completed in fulfillment of the 2007 FAD mandate to implement five restoration projects.

Major 2009 milestones in the Schoharie basin include:

Program Development

- SWAC and GCSWCD hosted four meetings in 2009. Subcommittees under SWAC met throughout the year, including Education and Outreach (2), Habitat and Recreation (2), and the Highway Superintendents group (2).
- Completed the 2009 through 2011 Action Plan for the Schoharie watershed. This plan provides the road map for implementing stream management plan recommendations (available at www.catskillstreams.org/SWC.html).
- Worked towards meeting the relevant requirements of the Shandaken Tunnel SPDES permit, including establishing the locally driven funding program for stream management plan recommendations and repair of 5,000 linear feet of stream, including at least two restoration projects.
- Secured a general permit from DEC Region 4 for stream projects that are 300 feet or less in length.

Stream Assessments and Stream Project Prioritization

- Completed and advanced numerous stream projects (see Section 4.6.4).
- In 2009, GCSWCD planted riparian buffer or restored stability to 9,560 feet of stream, bringing the total to date in the Schoharie basin to 37,260 feet.

- DEP and the GCSWCD initiated requisite assessments, surveys, and permitting on the “Holden Phase 2” project, a 3,000-foot reach of the Batavia Kill, for potential future restoration, and assessments on two additional potential restoration projects on the East Kill at Mill Hollow and the East Kill at Vista Ridge.
- Secured four pre-qualified contractors available for quick turnaround on planting and restoration projects that are modest in size and scope.
- Completed a study with the NYS Natural Heritage Program to define the “target” riparian ecological communities for future floodplain restoration planting projects in the basin.
- Completed stream feature inventories on 17.5 miles of Batavia Kill tributaries, including Furnace Creek, Red Falls Creek, North Settlement Creek, and Mad Brook (aka Mitchell Hollow Brook). These inventories will enable GCSWCD to write mini-plans for these sub-watersheds.
- Provided technical assistance through stream issue consults to 31 landowners.
- Completed monitoring surveys for Ashland Connector, Conine, Farber, and Brandywine project reaches; and completed restoration monitoring reports for the Ashland connector reach and Conine projects. Completed the Long Road Restoration Project Summary Report (available at http://www.catskillstreams.org/majorstreams_sc.html).

Education, Outreach, and Training

- Hosted the 3rd Annual Water Quality Tour, June 20, 2009. In Windham, 48 attendees enjoyed the hands-on tour, highlighting innovative stormwater practices at the Sugar Maples project site, at a riparian buffer project addressing knotweed, and at a major stream restoration project on the East Kill.
- Hosted the 3rd Annual Watershed Summit, January 24, 2009. One hundred twenty-five attendees learned about low impact development, invasive species, SWAC, stormwater management and regulation, SEQRA, and floodplain management.
- Hosted the 3rd Annual Batavia Kill Stream Celebration. On August 1, 2009, more than 500 people attended this event at the Country Suite Bed and Breakfast in the town of Ashland. The festival is a collaborative effort involving public, private, government, and educational and non-profit institutions, organized to promote and celebrate the natural environment through watershed stewardship and education.
- Hosted two SPDES public meetings.
- Kiosk Series: Three kiosk structures were built and drafts of their educational materials were created. Kiosks will be based upon categories of water resource-related BMPs and provide information to the public on a host of programs available throughout the NYC watershed protection area.
- Schoharie Watershed Week (SWW): Planning for this new annual event, scheduled for May 15-23, 2010, was launched to enable stakeholders to get to know their stream and the resources available to them.

Delaware Basin

Following the completion of both the West Branch and East Branch Delaware Stream Corridor Management Plans, DCSWCD updated the Action Plan for the West Branch Delaware Stream Corridor Management Plan in spring of 2009 and advanced the community adoption of both plans. This adoption process necessitated a significant outreach effort to local, Village, and

4. Protection and Remediation Programs

Town planning boards. In 2009, staff from DCSWCD and its partnering agency, Delaware County Planning Department (DCPD), attended over 75 meetings and brought resolutions and memoranda of agreement through the adoption process with 14 municipalities. To date, 17 of the 25 municipalities within the basin have adopted their plans. Seven more communities are expected to adopt the plans in early 2010.

DCPD's (DCPD) Stream Planner worked closely with DEC and local floodplain administrators on the community review of newly-released flood studies and Flood Insurance Rate Maps in Delaware County (commissioned by FEMA for parts of the West Branch Delaware River following the June 2006 flood). DEC and DCPD hosted two open houses to review the maps with local property owners and discuss the implications of the map revisions. The Planner helped organize regular meetings of the Flood Issues subcommittee of the Delaware Basin SMP Project Advisory Committee (PAC), informing the group of the schedule and activities associated with the community review. PAC is encouraging training and certification of floodplain administrators, planning staff, and DCSWCD staff.

DEP, DCSWCD, and DCPD completed the development of the Delaware Watershed Stream Management Grant Program application and program guidelines. These documents were approved by DCSWCD and commented on PAC. DCSWCD will launch the grant program in 2010.

Major 2009 milestones in the Cannonsville basin include:

- Construction of the Loewenthal Streambank Stabilization and Floodplain Restoration Project on Trout Creek in the Town of Tompkins. The project restored 500 feet of channel and 900 feet of avulsed floodplain and established approximately 4.5 acres of riparian buffer on the restored floodplain.
- Organization and presentation of the Post-Flood Emergency Stream Intervention Contractor Training at three locations in Delaware County. The training involved classroom instruction on BMPs for post-flood stream stabilization, field assessment and application of the regional curves of hydraulic geometry for channel dimensioning, and demonstration of construction practices at three sites in the basin. A total of 98 trainees completed the three-session workshop, with 117 participating in the first session. The training was sponsored by DEP and DEC and is the second of five stream restoration projects mandated by the 2007 FAD.
- Design, permitting, and construction of two projects in the West Branch Delaware watershed associated with the post-flood stream intervention training on Launt Hollow and West Brook. Approximately 2,730 feet of channel were affected by the projects. The designs utilized no additional materials other than those available on site. A construction report and as-built surveys were produced to aid in monitoring project performance.
- Discussions initiated by DCSWCD with the Open Space Institute and a local landowner have led to an offer to purchase the Village of Walton parcel in the 100-year flood zone. The purchase would make it possible to restore the floodplain on the previously filled property.

- Organization and presentation of “Erosion and Sediment Control for Stream-related work” for 71 employees of DCDPW and local highway departments.
- Coordination of the Third Brook Working Group by DCSWCD, as it continued to seek solutions to flood water conveyance issues at the NY Rte. 209/10 bridge in the Village of Walton. Although DOT initially scheduled a redesign and construction of the bridge for 2014, the state budget has forced an indefinite delay. DCSWCD is seeking other funds for the project in an effort to resolve flood concerns at the Kraft Foods plant in Walton.

Major 2009 milestones in the Pepacton basin include:

- Construction of the Post-flood Emergency Stream Intervention Contractor Training project on the Platte Kill, located less than 1 mile above Pepacton Reservoir. The project addressed an avulsed channel and bank erosion that was created by the 2006 flood and was threatening NY Rte. 28.
- Design support for DEC and the Town of Andes as they sought to retrofit a 2006 flood recovery project on Close Hollow in which the Town’s contractor had rocklined a tributary to Pepacton Reservoir and impaired aquatic habitat/fish passage.
- Design support for the efforts of the PAC Recreation and Fisheries subcommittee as it continued to plan for a project to improve recreation opportunities and access to the East Branch Delaware River. The group prepared an administrative plan for its efforts under the current contract and drafted a grant proposal for the project.
- Completion of two riparian buffer plans and one planting by the CSBI Coordinator in the Pepacton basin. The Coordinator made contact with several landowners in the basin interested in establishing or improving their riparian buffers.

Neversink and Rondout Basins

DEP commenced stream management planning in the Rondout and Neversink basins, due in 2010 and 2011, respectively. DEP executed a contract with Sullivan County SWCD, which hired the two full-time staff supported by the contract (the Stream Program Coordinator and the Catskill Streams Buffer Coordinator) and opened a field office in Grahamsville.

DEP continued data collection to inform the Rondout Creek plan. After hosting a public meeting in the summer, DEP and an Ulster County Community College intern crew completed the stream feature inventory for the mainstem and selected tributaries. Additionally, DEP acquired the services of a planner to facilitate two stakeholders’ roundtable meetings to guide public survey development and to steer the plan’s direction. The public opinion survey was distributed, collected, and analyzed, providing valuable feedback on streamside landowner concerns and interests related to the stream environment for both the Rondout and Neversink basins. At the end of the year, another public meeting was held to engage landowners by sharing the results of the survey.

Major 2009 milestones in the Rondout basin include:

- Registered CAT-389 with Sullivan County SWCD.
- Hired two staff and established an office at Neversink Town Hall.
- Completed a stream feature inventory and helicopter reconnaissance of the Rondout Creek mainstem and selected tributaries. Three “Watershed Conservation Corps” interns conducted this stream feature inventory under DEP supervision.
- Distributed 175 public opinion surveys to streamside landowners along Rondout Creek, Sundown Creek, Sugarloaf Brook, and the West and East Branches of the Neversink River. Received and analyzed data from 76 returned surveys.
- Hosted two roundtable meetings for selected stakeholders and two public meetings.
- Engaged local and county highway departments in site visits of priority road/stream intersections of concern to identify potential stream restoration demonstration sites.
- Selected a stream restoration demonstration project site on Rondout Creek at the Van Aken property (Section 4.6.4).
- Inspired additional outreach events, including a stream walk in conjunction with DEC’s Lark in the Park, a Rondout and Neversink Stream History Day, and a Rondout Watershed Landowners Association meeting.

4.6.2 Education and Outreach

Education and outreach (E&O) is a mission-critical component of the SMP. As in past years, the SMP has reached the broad array of audiences identified in its E&O strategy through a variety of formats, including numerous public meetings, workshops, extensive classroom education, college intern programs, technical training programs, restoration project tours, and community festivals and forums. Section 4.9 of this report presents the SMP’s E&O efforts in the context of agency-wide efforts.

In 2009, the SMP convened its annual winter interbasin E&O planning meeting to coordinate the E&O items in each basin’s annual Action Plans. The marketing strategy for the CSBI was coordinated with all partners as well, to develop a unified outreach strategy and materials. Increasingly, these efforts facilitate more creative collaborations.

A major educational process regarding stream management is advanced during the dozens of watershed advisory council and subcommittee meetings convened to discuss project and program priorities and proposals. These committees provide a forum for sustained dialogue with the communities on a variety of stream management issues, and are a powerful outreach vehicle.

Improving stream work conducted in the course of emergency flood response and recovery continued to be a focal point for E&O activities this year. Building on efforts in Ulster and Delaware Counties in 2007 and 2008, DCSWCD conducted a set of workshops, repeated at three county locations, titled *Post-flood Emergency Stream Intervention Contractor Training*. Another technical workshop targeting a watershed-wide audience was *Applied River Morphology*, taught by internationally renowned hydrologist Dr. David Rosgen, who also hosted a public lecture, entitled “Stream Projects: the Good, the Bad, and the Ugly.” The management of riparian vegetation (in support of the developing CSBI program) led SMP and its partners to offer a

workshop on willow identification to support diversification of native willow species collected at the NRCS’s regional nursery. The SMP and its partners also gave or hosted several additional talks related to riparian buffers and Japanese Knotweed management, including Native Plant Seed Collection, Erosion and Sediment Control Training for Stream Managers, and Opportunities for Landowners: Coordinating Stream Buffer Programs in the NYC Watershed.

Stream-based community events nurture a broad-based stewardship ethic and recognition of the value of healthy streams. This is exemplified by the 3rd Annual Batavia Kill Stream Celebration, coordinated by GCSWCD. This well-attended event featured guided stream walks, plant and macroinvertebrate identification, fly casting and tying demonstrations, and other interactive activities for families. CWC sponsored the performance by Arm of the Sea Theatre, “Mutual Strangers: Henry Hudson and the River that Discovered Him.” Numerous other projects involving community groups in stream stewardship activities were initiated in 2009. In the Ashokan basin, adult and student Stream Stewards programs have initiated a variety of activities, from invasive species eradication to stream clean-ups, while in the Schoharie basin, the Schoharie Watershed Summit offered local municipal officials and community leaders a range of presentations, activities, and role plays addressing stream management issues. Stream walks, evening lectures, and presentations at community fairs on stream management concerns were conducted throughout the year.

DEP also made important contributions in 2009 to the partnership website, www.catskillstreams.org, which continued to serve a burgeoning internet audience, with nearly 465,000 individual “hits” and 337,000 files accessed, a 300% increase over 2008.

4.6.3 Floodplain Mapping

DEP completed negotiation of the \$7 million Cooperative Technical Partnership (CTP) agreement with FEMA Region II for the revision of flood studies and Flood Insurance Rate Maps (FIRMs) for over 500 miles of rivers and streams in the WOH watershed. The agreement was registered in October 2009.

FEMA delivered revised flood studies and FIRMs for Delaware County in August 2009. As previously noted, staff from DCPD assisted DEC with the community outreach associated with map adoption. Additional areas in Delaware County not covered by FEMA’s map release are proposed for restudy under the DEP-FEMA CTP.

4.6.4 Stream Restoration Projects

Figure 4.17 depicts the stream projects completed or advanced in 2009. Each 2009 project is listed in Table 4.19. Projects with a primarily riparian buffer objective are mapped in Figure 4.22 (see Section 4.7). For a comprehensive list of all SMP projects that have been completed since the program started in 2001, please visit www.catskillstreams.org/Stream_Management_Plans.html and click on the basin you are interested in.

Stream projects mapped in Figure 4.17 fall into one of two categories: Projects completed prior to the 2002 FAD, and demonstration restoration projects tied to the development of stream management plans in the 2002 FAD, the latter symbolized by a fish in Figure 4.17. Projects symbolized as turtles represent projects implementing recommendations in completed stream management plans or other locally initiated projects that the SMP is involved with, in their scoping, design review, partial funding or secondary sponsorship.

Schoharie Basin Projects

Schoharie basin projects fall into three categories, restoration, riparian buffer, and stormwater. Progress in each category is presented below.

Stream Restoration Projects

Long Road Stream Restoration Project (West Kill, S-22). Inventories in 2000 and 2004 identified sections of the Long Road reach of the West Kill experiencing large-scale erosion and bank failure negatively impacting water quality. The reach contained more than 23% of all the clay exposures identified in the West Kill corridor during a 2004 stream feature inventory, and 40% of the reach was experiencing erosion. In 2009, DEP and GCSWCD completed a full channel restoration project to restore stability to the 3,000-foot reach at a total cost of \$1,059,104 (Figures 4.18a-c). The project included dewatering the reach, meeting all necessary requirements (stream, wetland, and stormwater permitting, and archeological assessments), mitigation of fish passage barriers caused by existing sheet pile grade control structures, installation of 12 cross vanes, 3 single-arm vanes, 6 rock-drop structures, 8,000 willow stakes, and 716 trees and shrubs. The West Kill at Long Road project report is available at www.catskillstreams.org/majorstreams_sc.html.



Figure 4.18a Long Road before restoration.



Figure 4.17b Long Road during restoration.



Figure 4.17c Long Road after restoration.

Assessments were advanced at three other potential restoration sites, Batavia Kill at Holden (S-29), East Kill at Vista Ridge (S-32), and East Kill at Mill Hollow (S-33).

Sugar Maples Stream Restoration (tributary to the Batavia Kill, S-27). This project was designed to restore stream and wetland function to an area that was historically channelized with mortared stone walls in the Hamlet of Maplecrest (Figures 4.18a,b). These failing walls blocked the stream and created a flooding problem. Project goals included: reducing channel erosion, improving water quality, upgrading infrastructure (new culverts sized to properly convey storm runoff), developing and improving wetlands, improving public access, providing public education on natural channel design and wetlands, improving habitat, and protecting the adjacent farm fields. In 2008, GCSWCD completed the topographic survey, hydrology, hydraulics, and natural channel design and permitting. In 2009, 550 linear feet of stream were repaired, 2 culverts were replaced and installed with buried bottoms properly sized to convey a 10-year flow, approximately 1,200 sedge plugs were installed, and the entire disturbed area was seeded and mulched with rye for temporary stabilization and riparian mix for long-term vegetative development.



Figure 4.18a Before Sugar Maples stream restoration.



Figure 4.18b After Sugar Maples stream restoration.

Streambank Stabilization on Schoharie Creek at the Wright Property (S-41). The mainstem Schoharie Creek immediately upstream of its confluence with the Batavia Kill and in the Town of Prattsville has been experiencing extensive streambank erosion over a 380-foot-length of stream. Originating as a CWC Stream Corridor Program proposal, the bank stabilization project, designed and permitted by GCSWCD, will rely on simple bank grading, lining the slope toe with rock, and planting the bank and an additional riparian buffer over an approximately 2,000-foot reach of stream. The scale of the creek and landowner preferences precluded a natural channel design at the reach. The project's implementation in 2010 hinges on the landowner's signing the required landowner agreement with GCSWCD.

Additional Projects (Schoharie Creek and Batavia Kill). DEP and GCSWCD assisted with the Oakwood Pistol Club streambank protection and Windham Country Club streambank protection projects. These projects were funded through the CWC Stream Corridor Program, and project design and construction was led by GCSWCD.

Riparian Buffer Projects

Carr Road Project (Schoharie Creek, S-30). The Carr Road riparian project extends over 2,300 feet of Schoharie Creek in the Town of Jewett. Initiated in 2007, the project had three strategic components: stem injection treatment of Japanese Knotweed (*Fallopia japonica*) with glyphosate (Glypro) to prepare the locations for replanting with native vegetation; planting of a 100-foot-wide buffer from the top of the bank, establishing approximately 2.4 acres of buffer; and enhancing the existing buffer on the immediate streambank by tapering the bank and planting willow tubelings and stakes. In 2009, improvements were made to the DEC fishing access parking area and a walking path to the stream was improved.

Sugar Maples Riparian Restoration (Batavia Kill, S-42). In 2008, GCSWCD completed the design, permitting, bidding, and planting of several acres of riparian buffer along 800 feet of the Batavia Kill in Maplecrest. Prior to restoration, this section of the Batavia Kill was heavily colonized with several invasive species, including Japanese Knotweed and honeysuckle.

GCSWCD established an agreement with the owners that included a vegetative management plan to ensure plant establishment. In 2009, supplemental plantings, a walking path, educational gardens, and an interpretive kiosk were completed.

Additional Riparian Buffer Plantings. Additional riparian buffer plantings are described in Section 4.7 and include projects in the Manor Kill (3 projects), Batavia Kill (3 projects), and Schoharie Creek (1 project).

Riparian projects are depicted in Figure 4.22.

Stormwater Projects

Sugar Maples Stormwater Project (Mainstem Batavia Kill, S-26). This project is separate and distinct from the stream restoration project described above. It is designed to address stormwater runoff from 4.5 acres of high density buildings and County Rte. 56. The project will improve water quality by attenuating storm flows, providing a pervious handicap parking area, improving the storm sewer infrastructure along County Rte. 56, improving public access, and providing public education on stormwater management practices. In the fall of 2008, partners including the Greene County Highway Department installed an upgraded conveyance system and demolished a single building to reduce impervious surfaces and to allow for construction of the pervious grass handicap parking area. In 2009, the project was completed with the installation of a permeable grass parking lot (approximately 2400 sq. ft.), rain gardens (7 total), wetland (treats 4.7 acres of runoff), porous walkways, and riparian planting beds.

Hunter Foundation Stormwater Retrofit/GCSWCD Schoharie Watershed Field Office (Tributary to Schoharie Creek, S-23). Stormwater runoff from 1.2 acres of high density and commercial land use discharge directly to Gooseberry Creek. Field inspections confirmed that excessive runoff was causing erosion of existing parking surfaces and turbidity in the creek. Specific practices will include multiple rain gardens, stormwater planter, a new underground piping and TSS separator, porous parking areas, and extensive native plantings. In 2009, the underground components (TSS separator) and porous parking area (approximately 10,000 sq. ft.) were completed.

Windham Mountain Stormwater Retrofit (Batavia Kill, S-25). The 600 acres around Windham Mountain Ski Center that drain to the Batavia Kill are one of the most developed areas within the Schoharie basin. In 2006, project partners developed a plan to address impacts from stormwater from several areas containing limited or no stormwater controls. In 2008, partners began the design of a first phase that addresses runoff from 16 acres of commercial land use,

including the ski center's parking areas, maintenance facility, and several high priority locations. Both structural and non-structural stormwater management practices are planned. Treatments include reducing the natural slopes of the parking areas with terracing, resurfacing, and an improved conveyance to an existing snow making impoundment. Installation of a pond forebay and a new staged outlet structure will provide water quality treatment and extended detention of runoff, to upgrade several acres of impervious parking area to NYS standards for new construction. The removal of a large culvert located in a reach of an adjoining tributary is planned, to enhance stream stability and habitat. Several rock structures are also proposed to reduce further channel degradation, and erosion and sediment loading to the Batavia Kill. In 2009, the design was completed and the necessary permits were obtained. Project construction is anticipated to proceed in 2010.

Ashokan Basin Projects

To date, three restoration projects have been completed in the Ashokan basin to demonstrate natural channel design approaches to channel and bank stabilization. These projects were done in tandem with the completion of their stream management plans, and include the Broadstreet Hollow Restoration project (2000), the Stony Clove at Lanesville Restoration project (2003-2005), and the Esopus Creek at Woodland Valley Restoration project (2003). Each has been reported extensively in previous reports.

The AWSMP team's project-related efforts in 2009 focused on securing necessary engineering services and establishing AWAC's Highway Managers to identify and prioritize projects that meet eligibility criteria.

The Highway Managers subcommittee identified its first project as a streambank stabilization project on Woodland Creek where a high, eroding streambank threatens to undermine the Woodland Valley road (A-07). This site is a very high priority for Shandaken. UCSWCD and NRCS are providing assessment and engineering services and the project is anticipated to be one of the first to be funded by the AWSMP's \$2 million (locally-driven) Stream Management Implementation Fund. The project is targeted for a 2010 construction. Other potential highway manager partnership projects have been identified in Woodstock and Olive and will be reported as they are further developed.

In 2009, the AWSMP team began to consider several sites as restoration projects with the greatest potential for water quality benefit. To this end, UCSWCD initiated a remedial feasibility investigation into a 1-km stretch of Stony Clove in the Hamlet of Chichester. The engineering firm Milone & MacBroom, recognized nationally for its expertise in stream assessment and design, was hired to conduct a preliminary investigation to assess the fundamental nature of the instabilities that lead to chronic suspended sediment loading in this reach. The study report concluded that there are three distinct instabilities and sediment sources that need further investigation and should be treated as individual projects (Figure 4.17). Figure 4.19 illustrates the

three individual projects in this area. DEP and UCSWCD intend to continue working with Milone & MacBroom for potential implementation in the future.

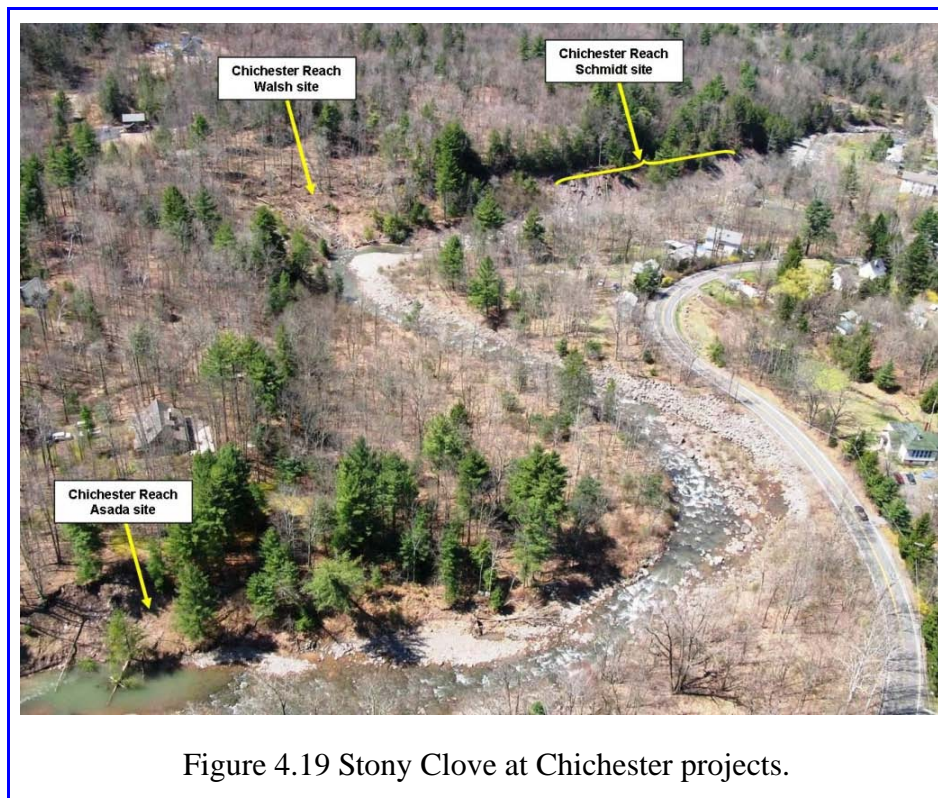


Figure 4.19 Stony Clove at Chichester projects.

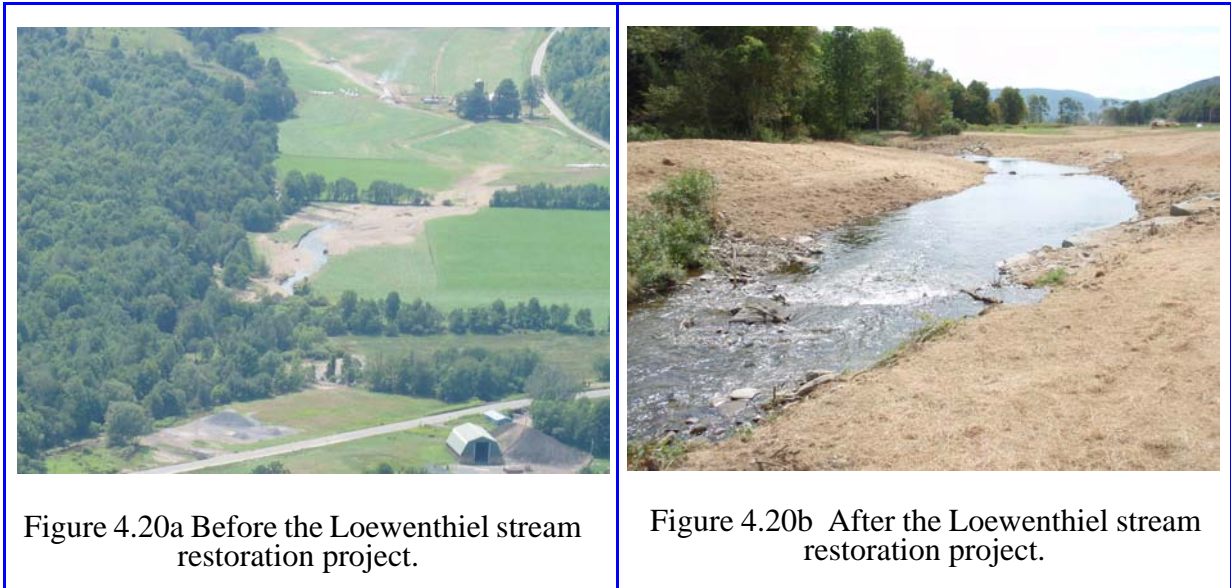
Pepacton Basin Projects

Platte Kill Post-Flood Emergency Stream Intervention Project (D-25). As part of the Post-Flood Emergency Stream Intervention Training, DCSWCD designed and restored 400 feet of avulsed channel created during the June 2006 flood. During the flood, a woody debris jam diverted flow across the floodplain through an unused barnyard, resulting in a new channel through the property that directed flows toward NY Rte. 28 and threatened to undermine the roadway. DCSWCD demonstrated appropriate channel dimensioning based upon the regional curves of hydraulic geometry, as well as proper work site dewatering and erosion/sediment control practices for post-flood stream remediation. Thirty-four participants attended this three-session training and observed construction.

Liddle Farm Streambank Stabilization Project (D-08). This project seeks to stabilize 650 feet of eroding streambank with bioengineering practices on the Tremper Kill. The project was postponed in 2009 pending landowner approval of the CREP plan. DCSWCD will continue to pursue this project in 2010.

Cannonsville Basin Projects

Loewenthal Stream Restoration Project (D-09). DCSWCD constructed the Loewenthal Farm stream restoration project on Trout Creek at a cost of \$115,305 (Figures 4.20a,b). 2006 flood flows resulted in debris blockage and channel avulsion at the site. The avulsion was repaired and the channel and floodplain reconnected through the removal of existing berms along the 1200-foot reach. Three J-hook vanes will prevent the channel from re-routing across the floodplain. Planting the 4.5-acre floodplain as a buffer is 60% complete and will be finalized in spring 2010. Funding was provided by DEP and the NYS Environmental Protection Fund.



West Brook Post-Flood Emergency Stream Intervention Project (D-23). At this Post-Flood Emergency Stream Intervention Training site, DCSWCD designed and restored 1,100 feet of channel to move the former channel away from a terrace slope and relocate it in the middle of the valley. This project provided an opportunity to demonstrate appropriate channel dimensioning and floodplain restoration. The site was later planted with trees, herbaceous plugs, and live stakes to further stabilize the streambanks. Thirty-four participants attended this three-session training and visited the site during construction.

Launt Hollow Post-Flood Emergency Stream Intervention Project (D-24). This site in Hamden represented a common post-flood issue: steep tributaries to the West Branch Delaware River deposit sediment on the alluvial fan prior to entering the mainstem of the river. This type of deposition frequently requires the local municipality to regularly maintain the channel. The 1,600-foot project required floodplain grading and channel dimensioning to ensure that higher than bankfull flows properly make use of the floodplain, while still maintaining sufficient energy to convey their sediment loads. DCSWCD will monitor the project performance and advise the

Town of Hamden on future maintenance requirements. Thirty-two participants attended this course and viewed the project construction.

East Brook, County Route 22 Restoration Project (D-26). DCSWCD is working closely with the DCDPW to restore an 800-foot reach of East Brook near the Village of Walton that experienced significant damage in the June 2006 flood. The project will address the existing threat to County Rte. 22, which is being undermined by East Brook, as well as stabilize the erosion along the adjacent field. The project proposes to restore appropriate channel dimensions along the reach, improve flood conveyance by increasing the width of the floodplain, and improve the physical habitat of the reach by promoting variation in channel bed form. The project will include the installation of several rock structures to increase bank stability and provide grade control, and is being considered for the potential demonstration of the use of toe wood, a restoration technique that employs submerged woody debris along the toe of streambanks to enhance streambank stability and promote fish habitat.

Rondout Basin Projects

During 2009, SCSWCD and DEP worked closely with local, county, and state highway managers in the Rondout and Neversink basins to identify chronic road-stream conflicts. This collaboration, taken together with the 2009 walkover of Rondout Creek, pointed to a reach that is severely compromised in its sediment transport capacity, contributes to suspended sediment loading, is braided, and threatens Sullivan County Rte. 153 (Sundown Road). Mitigating further undermining of the road is a top priority of the Sullivan County DPW. The reach of stream is approximately 3,000 feet in length. DEP, SCSWCD, and SCDPW propose a two-phased demonstration project. Training will be a key element of the project, with three trainings planned—post-flood emergency stream intervention techniques, appropriately sizing temporary diversion channels, and bioengineering. The first phase of the Rondout at Van Aken Demonstration project (R-03)—to stabilize the road embankment and conduct initial trainings in emergency stream intervention and bioengineering—is planned for completion in 2010. In 2011, provided landowner agreements and permits are successfully obtained, the remaining channel will be resized to correct natural channel dimensions and treated with extensive bioengineering works (combined with additional hands-on training).

DEP Internal Coordination—Floodplain Restoration at Horton Brook (O-1). DEP partnered with Trout Unlimited (TU) to restore the floodplain of Horton Brook, a tributary to the famed Beaverkill in Delaware County, Town of Colchester, by removing over 16,000 cubic yards of tunnel muck that had been deposited in the Horton Brook floodplain during construction of a siphon years ago (Figures 4.21a,b). Horton Brook is a key trout spawning habitat and thermal refuge and as such has been prioritized for projects of this nature. The project was completed deploying DEP staff and equipment, with remaining elements funded by TU National. Over 30 volunteers from TU and Theodore Gordon Flyfishers, in cooperation with DEP, installed 200

containerized native trees and 400 native tree tubelings to create a viable riparian buffer. The project's location is depicted in Figure 4.22.



Figure 4.21a Horton Brook before floodplain restoration.



Figure 4.21b Horton Brook after floodplain restoration.

4.6.5 Coordination with the CWC Stream Corridor Program

In 2008, DEP and the CWC developed and initiated a Stream Corridor Protection Program that is focused on projects that mitigate or correct existing conditions in hamlets, villages, or population centers that present imminent and substantial danger to persons or properties. The program was initiated with an approximately \$1 million budget, and was intended to rely partially upon the technical assistance provided through county SWCDs, which DEP has fostered and supported since 1995. In 2008, DEP, CWC, and county SWCD staff awarded funding to 13 projects, including 12 bank stabilizations and one undersized culvert replacement. Through the efforts of DEP, CWC, and SWCDs, seven projects were designed to incorporate vegetation to “soften” the project’s footprint. Three of the projects were completed by the close of 2008, four in 2009, and the remainder pushed back until 2010.

The 2009 projects completed include the Windham Country Club streambank protection project in the Batavia Kill, the Oakwood Pistol Club streambank protection project along Schoharie Creek, the Arkville railroad streambank repair project along the East Branch of the Delaware River, and the Gladstone Hollow culvert repair/upgrade. The 2008 FAD Annual Report includes a map indicating the location of these projects.

4.6.6 Stream Data Management

Through the creation of stream management plans, design and construction of stream restoration projects, and applied research into stream processes and project performance, DEP and its project partners have created significant quantities of information about Catskill streams. To ensure this information is available and useful to all its stream managers and partners for the

long term, DEP has developed a geodatabase of stream information for the WOH watershed. This GIS database integrates information from stream assessments, reference reach and design surveys, monitoring efforts, and other associated studies, and enables managers to review conditions across the watersheds where surveys have been completed.

In 2009, DEP made continued progress in populating the Stream Geodatabase with new assessment data from the Rondout Creek watershed assessment and previous data from the West Kill. The Stream Analyst toolset program code was rewritten to ensure future compatibility with GIS software updates. The Stream Geodatabase datasets were also made available for use by DEP through WALIS. Training and support continues to be provided for new users at DEP and the SWCDs.

A contract with CUNY Hunter College for three years of continued support of a Database Manager/Programmer was registered in December 2009. This contract will also support the production of a new stream alignment dataset for the NYC water supply watersheds in a USGS National Hydrography Dataset (NHD) format. The NHD is the next generation of GIS data structures for use in modeling, data management such as the Stream Geodatabase, and other web based applications such as Streamstats.

SMP's longstanding partnerships with the Student Conservation Association (SCA) to provide AmeriCorps members, and with Ulster County Community College (UCCC) to provide the "Watershed Conservation Corps", continue to support all aspects of stream management planning and restoration, both at DEP and with its partners. This year marked the tenth year of engagement with AmeriCorps, and the fourteenth year with UCCC; the length of both these terms speaks to the value of these longstanding relationships.

In 2009, AmeriCorps members were hosted at the SMP in Kingston, where they assisted with streams geodatabase management and development in the Rondout watershed; at CCE, where they assisted with stream assessment and management of large woody debris in the Ashokan watershed; and at GCSWCD, where they conducted extensive stream restoration and vegetation monitoring and stream feature inventories in the Schoharie watershed. This year, DEP negotiated acceptance into the SCA Hudson Valley Corps. Not only will SCA members benefit from more local, direct contact with SCA and peers, but DEP will benefit from a large reduction in member cost. SMP and its partners have agreed to host a minimum of three 10-month and one 5-month positions for the next four years.

4.7 Riparian Buffer Protection Program

DEP values the importance of protecting and managing riparian buffers as one component of an effective overall watershed protection program. To this end, many of DEP's watershed programs, partnerships, and research initiatives actively address the protection, management, and restoration of riparian buffers in the New York City Watershed.

This report will provide an update on each of the milestones set forth in the 2007 FAD relating to riparian buffer protection, including the progress of existing DEP programs, the Conservation Reserve Enhancement Program (CREP) evaluation and implementation effort, the new Catskill Streams Buffer Initiative (previously called Streamside Assistance Program), and education and outreach activities. The report concludes with recommendations for program improvement.

4.7.1 Activities on City-owned or Controlled Land

This section describes the ongoing activities of DEP programs that protect and enhance riparian buffers on DEP-owned or controlled land. Coordination and cooperation among these programs is covered as well.

Land Acquisition Program

The Land Acquisition Program (LAP), which is described in detail in the 1997 MOA, seeks to prevent future degradation of water quality by acquiring real property interests. The overarching goal of the program is to ensure that undeveloped, environmentally sensitive watershed lands receive permanent protection, and that the watershed continues in the long term to be a source of high-quality drinking water to the City and other upstate consumers. Section 4.2 of this report conveys the comprehensive progress of the Land Acquisition Program in 2009.

Riparian buffers are defined as land within 100 feet of streambanks, but excluding the length of “shoreline” around reservoirs, ponds, lakes, or wetlands. The best way to protect buffers is to secure fee simple ownership, with a secondary entity holding enforcement rights or reversionary interests. The next best mechanism is to secure conservation easements (CEs) on privately-held land. Through the end of 2009, 36% of the entire 1,049,810-acre Catskill/Delaware (Cat/Del) watershed system 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 31.5% (24,051.8 acres) of all stream buffers in the watershed. Since 2004, DEP has increased the percentage of protected stream buffers from 7.5% to 12.9%. Table 4.20 presents a breakdown of the total land area in the Cat/Del watersheds by ownership.

Table 4.20. Catskill/Delaware riparian buffer summary as of December 2009.

Category	Total in Cat/Del Watershed* * (acres)	% Cat/Del Watershed Area	Cat/Del 100-foot Riparian Buffer*** (acres)	% Cat/Del Riparian Buffers
<u>Publicly-owned or Controlled lands</u>				
NYC pre-1997	61,400.8	5.8	1,938.5	2.5
NYC LAP Fee Simple*	63,233.4	6.0	4,767.9	6.2
NYC LAP CE*	19,867.0	1.9	1,616.1	2.1
WAC CE*	18,174.3	1.7	1,533.8	2.0
Total NYC Lands and Easements	162,675.5	15.5	9,856.3	12.9
NY State-owned Land	206,680.3	19.7	13,362.1	17.5
Other Open Space (Land Trust, Municipal, etc.)	8,707.5	0.8	833.4	1.1
Total Cat/Del Public Land	378,063.2	36.0	24,051.8	31.5
<u>Private Watershed Lands</u>				
Private Land	671,746.5	64.0%	52,279.7	68.5%
Total Cat/Del Privately-owned Land	671,746.5	64.0%	52,279.7	68.5%
Total Land in Cat/Del	1,049,809.7	100.0%	76,331.5	100.0%

* Under contract or closed as of December 2009.

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

***Stream and river buffers only. Reservoirs and lakes are excluded.

DEP also funds WAC’s acquisition of CEs on farms. Such easements allow farming to continue under Whole Farm Plans, while prohibiting agricultural use within 25 feet of streams.

Natural Resource Management Program

DEP’s Natural Resource Management (NRM) program protects the riparian buffers on City-owned lands in a variety of ways. These include regular inspections of lands (based on a priority ranking), and a thorough evaluation of all applications for permitted activities, including applications for agricultural, silvicultural, or stream work. In evaluating these proposed activities, emphasis is placed on protection of riparian buffers. On lands where DEP is actively conducting forest management, buffers are afforded special protection, with particular consideration given to streambank stability, ecological function, and forest vigor. DEP scrutiny seeks to limit stream crossings to those that are most essential, prevent reductions in canopy cover, and promote practices that limit bed and bank disturbance.

In 2009, NRM entered into a partnership with the USFS's TEAMS Enterprise Unit to conduct a comprehensive forest inventory of all City watershed lands and to develop a Forest Management Plan to meet the City's watershed forest goals. An important component of this plan will be guidance on how to select, plan, and implement forestry projects with respect to riparian areas (including wetlands, springs, and seeps) and other critical resources.

4.7.2 Activities on Privately-owned Land

Privately-owned lands contain approximately 68.5% of the total riparian buffer acreage (52,279.7) in the Cat/Del watershed. Privately-held riparian lands are most commonly found in the Cannonsville basin (85.2%) and are least common in the Neversink basin (42.8%). Table 4.6 (see Section 4.2) reports riparian buffer acres within each basin and their respective ownership. Many of these riparian buffers are also protected to some degree by various combinations of MOA programs. For instance, Whole Farm Plans and Watershed Forestry Plans have been developed and implemented largely in the Cannonsville and Pepacton basins, where private ownership is greatest. This section describes the ongoing activities of DEP programs that protect and enhance riparian buffers on privately-owned land.

Stream Management Program

The Stream Management Program (SMP) is an important component of the City's efforts to protect and enhance riparian buffers. The SMP's mission is to restore stream stability and ecosystem integrity by encouraging long-term stewardship of Catskill Mountain streams and floodplains. The SMP and its regional partners address riparian buffers through corridor planning, mapping riparian vegetation, designing and constructing stream restoration projects, removing invasive plants, conducting extensive education and outreach, and developing and implementing the Catskill Streams Buffer Initiative (CSBI) (see below). The comprehensive effort of the SMP in 2009 is reported in Section 4.6.

By the close of 2009, stream management plans with corresponding riparian buffer mapping had been completed for the Batavia Kill, Broadstreet Hollow, Chestnut Creek, East Kill, Esopus Creek, Manor Kill, Schoharie Creek, Stony Clove, East and West Branch Delaware, and West Kill watersheds. To implement the requirements of the 2007 FAD DEP has re-entered into contracts with its Soil and Water Conservation District and Cornell Cooperative Extension-Ulster partners to implement stream management plan recommendations through annual Action Plans and the CSBI.

Significant accomplishments of the SMP and its program partners in 2009 include:

- Sponsored riparian activities at 14 restoration projects covering 12,316 feet of stream (approximately 19.5 acres). Activities included installation of over 5,000 native trees and shrubs, 8,910 willow posts, and 6,272 herbaceous plugs. Projects at which these activities were undertaken covered the full range of SMP 2009 program elements, including full channel restoration (Long Rd.), Emergency Flood Response Contractor training at West Brook, and pilot planting sites for Catskill Streams Buffer Initiative at the Kane and McRoberts properties)
- Secured more than 40 volunteers to install over 2,200 individual trees and shrubs
- Monitored vegetation at 10 restoration sites
- Received final report from Hudsonia regarding three Japanese Knotweed treatment methods employed on the Batavia Kill—“Experimental Management of Japanese Knotweed (*Fallopia japonica*) on the Batavia Kill, Greene County, New York”

Figure 4.22 shows recently completed and in-process riparian restoration projects in the Cat/Del watershed. For additional information about the projects, please visit: http://www.catskillstreams.org/stewardship_streamside_rb.html.

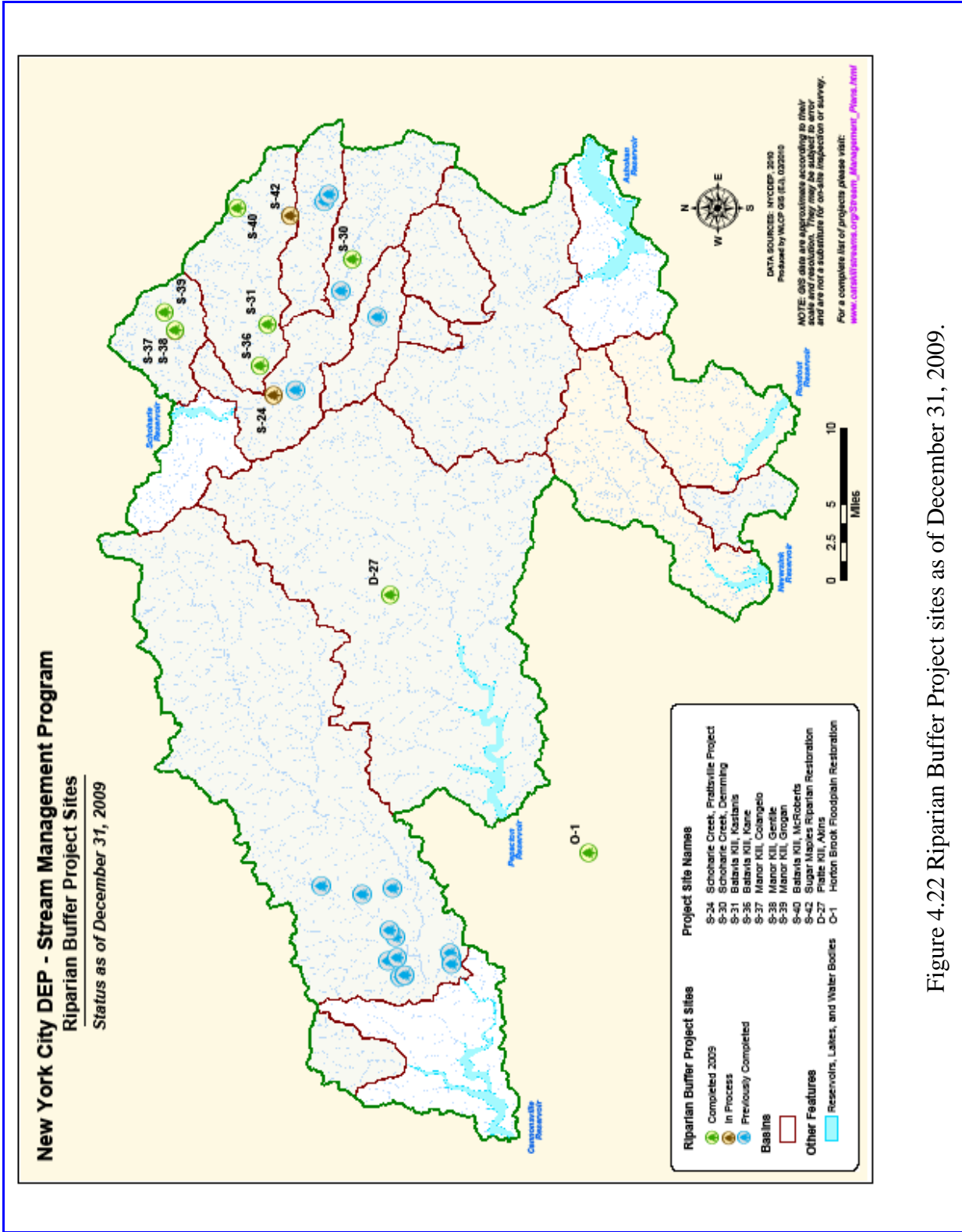


Figure 4.22 Riparian Buffer Project sites as of December 31, 2009.

Watershed Agricultural Council

The Watershed Agricultural Council (WAC) is a non-profit organization whose mission is to support the economic viability of agriculture and forestry through the protection of water quality and the promotion of land conservation in the New York City watershed. WAC operates through two main programs, the Watershed Agricultural Program (WAP) and the Watershed Forestry Program (WFP). Sections 4.4 and 4.5 report the broad range of accomplishments of WAP and WFP in 2009.

Watershed Agricultural Program

WAP is a voluntary partnership between watershed farmers and the City that develops and implements pollution prevention plans (e.g., Whole Farm Plans) on farms to protect water quality without negatively impacting the economic viability of the farm.

The Whole Farm Planning program uses a “multiple barrier” approach, involving three different types of BMPs, to address nonpoint source pollutants. Pollutant Source Controls, the first barrier, use BMPs that reduce or eliminate the source of pollutants. BMPs that prevent the transport of pollutants across the landscape and into watercourses constitute the second barrier, Landscape Controls. These two barriers help protect riparian buffer areas by reducing the amount of pollutants that reach the buffer. Stream Corridor Controls, the third barrier, rely on BMPs in riparian areas to stabilize streambanks by excluding livestock; they also establish riparian buffers to help filter out pollutants before they reach a stream. CREP addresses this barrier (see below).

To date, 96.4% of all commercial farms (307) in the WOH watershed have agreed to participate in WAP. There are presently 291 farms with approved whole farm plans, while five new farms will have a Whole Farm Plan developed in 2010.

Watershed Forestry Program

The Watershed Forestry Program (WFP) is a public-private partnership between DEP, WAC, and the USFS that supports well-managed working forests as a beneficial land use for watershed protection. The program supports several targeted pollution prevention and stewardship education initiatives that encourage loggers, foresters, and private forest landowners to properly manage riparian buffers. These initiatives include Forest Management Plans, the Management Assistance Program, and the Forestry BMP Program. The program also supports a comprehensive urban/rural school-based education program that teaches the next generation of watershed stewards about the importance of riparian buffers.

Significant accomplishments in 2009 include:

- Completed 59 new Forest Management Plans, covering approximately 8,678 total acres, of which an estimated 6,911 acres are forested. Fifty-three of these plans (90%) also contain riparian plans, which together cover 1,275 riparian acres

4. Protection and Remediation Programs

- Updated or upgraded 10 existing WAC plans to newer WAC plan specifications; 3 of these plans include riparian management recommendations covering 268 riparian acres
- Provided cost-sharing for the purchase/construction of 1 short-span portable bridge (20'), loaned WAC the 20' bridge once and the 30' long-span bridge twice, funded the completion of 33 road BMP projects, and supported the completion of 6 stream crossing projects (4 of which were associated with a road BMP project)

Catskill Watershed Corporation (CWC) Stream Program

The purpose of the CWC Stream Corridor Protection Program is to fund stream projects that mitigate or correct existing conditions in hamlets, villages, and population centers that present imminent and substantial danger to persons or properties. In order to be considered for funding under the program, a proposed project must be consistent with the recommendations set forth in any applicable Stream Management Plan. To this end, DEP and CWC encourage landowners to incorporate riparian buffer enhancement components into their proposed projects where applicable. Seven of the 13 projects funded through the program in 2007 proposed a riparian buffer; taken together, this amounted to 1.25 acres of proposed buffer enhancement. By the end of 2009, 0.17 acres of buffer were established on four of these seven projects that contained a riparian component. The remaining three were delayed until 2010 construction, primarily because of landowner issues.

Conservation Reserve Enhancement Program Evaluation and Implementation

In August 1998, DEP entered into a five-year MOA with DEC and the United States Department of Agriculture (USDA) to implement CREP in the Cat/Del watersheds. The agreement was later extended through the current Farm Bill.

The MOA allows watershed landowners to enter into 10- to 15-year contracts with the USDA to retire environmentally sensitive agricultural lands from production. Under these CREP contracts, farmers receive assistance in establishing forested riparian buffers and filter strips adjacent to streams and other water bodies. The USDA pays the farmer on average an enhanced rental rate of \$115 per acre per year as well as 50 percent of the cost of all BMPs associated with establishing riparian buffers and/or permanent vegetative cover. In federal fiscal year 2000, USDA added two significant financial incentives to install conservation practices, the Signup Incentive Payment (SIP) and the Practice Incentive Payment (PIP). DEP, through its agreement with WAC, pays the remaining 50 percent of BMP costs for participating farms, as well as technical and administrative assistance costs.

The buffer width, determined by the USDA standard for "Riparian Forest Buffer", varies between 35 and 180 feet. The majority of buffers implemented so far have been on pasture land, which requires additional conservation practices to ensure the success of the buffer. These

practices may include tree and shrub planting, fencing to exclude livestock, alternative water supply, and stream crossings.

Exclusion of livestock from the riparian buffer eliminates the direct deposit of manure into streams and protects streambanks from erosion caused by heavy hoof traffic. More than 11,000 head of livestock (mainly dairy and beef cows) have been excluded from streams in the watershed west of the Hudson River as a direct result of CREP. Trees and shrubs established in the buffer area help trap sediment, nutrients, and pathogens from adjacent agricultural lands. Farmers agree to maintain all conservation practices implemented by CREP for the full term of their CREP contract, which helps protect these newly established riparian buffers.

Significant 2009 accomplishments include:

- Through December 2009, 148 landowners (1,998 acres) were enrolled in 191 CREP contracts, with more than 100 additional acres (about a dozen contracts) currently in the CREP contract pipeline. Out of the 191 CREP contracts, 180 are complete, with all associated BMPs implemented. Two contracts have since been canceled
- Protected 71.5 acres of riparian agricultural land in 2009. This brings the total of stream miles protected by CREP to approximately 191
- Excluded more than 11,000 livestock from streams
- Completed, in consultation with WAP, a CREP Evaluation Report, which was submitted to DOH/EPA on December 31, 2009. This evaluation included a thorough field assessment of CREP tree and shrub plantings, as well as recommendations for enhancing establishment of plantings on future CREP projects and for strengthening the overall program

Catskill Streams Buffer Initiative (CSBI)

Within the framework of the SMP, DEP initiated the CSBI in 2009 to provide private landowners with enhanced education and training opportunities, as well as access to technical assistance with the design and installation of riparian buffer projects. The benefits of the CSBI have been cited in various Stream Management Plans, subsequent Action Plans, and by the regional Riparian Buffer Working Group (RBWG).

The program targets the 68.5% of all Cat/Del buffers held in private hands. DEP and its partners (County Soil & Water Conservation Districts and Cornell Cooperative Extension) will assist landowners by providing:

- Riparian Corridor Management Plans to create awareness about riparian management issues specific to individual properties
- Best management practice design and/or prescriptive measures and installation to encourage positive riparian stewardship

- Educational materials and activities to help landowners understand the critical role their buffers play and how to maintain them in optimal functioning condition

Significant progress toward CSBI implementation includes the following:

- Completed the hiring process for all four of the county-based CSBI Coordinators
- Hosted an RBWG meeting for 26 watershed partners and regulators
- Completed 15 Riparian Corridor Management Plans
- Completed, in consultation with CRSR Designs and RBWG, an “Enhanced Education, Outreach & Marketing Strategy for Riparian Landowners,” which was submitted to DOH/EPA on December 31, 2009. Development of the strategy included a needs assessment conducted with program partners and streamside landowners
- Developed, in consultation with RBWG, DEP, and CRSR Designs, a CSBI program logo, brochure, application, and graphics standards manual
- Hosted a workshop for watershed partners—“Opportunities for Streamside Landowners in the West of Hudson Watershed”
- Hosted a willow identification workshop for 10 program partners and received training in several subject areas related to riparian buffer protection (e.g., wetland delineation, biodiversity conservation)
- Received first installment of Catskill-provenance native herbaceous plugs from the Greenbelt Native Plant Nursery and began their installation
- Conducted competitive bid for growing out Greenbelt material and supplying restoration-size plant material for 2010 planting season. The bid was awarded to RPM Ecosystems, which holds a patented process for rapid root growth
- Received final report by NY Natural Heritage, “Inventory, Classification, and Description of Riparian Natural Community Reference Types for West Kill Watershed, New York”
- Updated www.CatskillStreams.org to include online information about CSBI
- Hosted SUNY Delhi summer interns, who assisted with CREP evaluation, vegetation monitoring, and invasive species removal
- Gave presentations or hosted information tables at five public events

In its first year, CSBI focused on developing marketing materials and establishing pilot projects prior to public release of the program. Figure 4.22 depicts CSBI pilot projects in addition to riparian restoration efforts associated with other project types. For additional information about the projects, please visit: http://www.catskillstreams.org/stewardship_streamside_rb.html.

4.7.3 Education, Outreach, and Marketing

Numerous education and outreach activities were undertaken in 2009 in support of riparian buffers and these are reported in Chapter 9 of this report as well as in program sections.

As previously mentioned, DEP developed and began implementing an enhanced education, outreach, and marketing strategy for riparian landowners through the CSBI, in accordance with the FAD.

4.7.4 Recommendations

Building upon a strong existing program framework for the protection, management, and enhancement of riparian buffers, DEP began to implement the Catskill Streams Buffer Initiative in 2009. In 2010, DEP will launch the CSBI using communications materials developed by CRSR Designs, developing additional Riparian Corridor Management Plans, and soliciting its first applications for the program. DEP will also scope additional educational materials, outreach, and training for streamside landowners and managers in support of CSBI's goals. To advance an ecologically-based effort, DEP will incorporate findings from the NYS Natural Heritage Study into the CSBI and commission additional studies in other watersheds. To provide a supply of native plant materials, DEP plans to continue receiving plant material from the Greenbelt Native Nursery and RPM Ecosystems.

DEP will continue support for small streambank stabilization projects so that properties on which such projects are located can qualify for CREP, enroll 100 riparian acres in CREP, and where possible, incorporate recommendations outlined in the CREP Evaluation Report.

Continued collaboration and integration of DEP and its partnering programs toward common goals is critical to effective, cohesive management of riparian buffers throughout the Catskill/Delaware Systems. To support these goals and its partnering agency efforts, DEP will continue to convene coordination initiatives such as the RBWG, the Invasive Species Working Group, Forest Management Plan, and the various extensive partnering projects documented throughout the FAD annual report, while continuing implementation of its existing watershed programs. The protection and enhancement of enhance riparian buffers will ultimately maintain high water quality for NYC, while providing a wealth of benefits to upstate residents and the wildlife associated with this unique natural resource.

4.8 Wetlands Protection Program

DEP's Wetlands Protection Strategy, initiated in 1996 and most recently updated in 2007, is designed to protect and preserve the water quality function of wetlands in the watershed (DEP 2007). The strategy integrates wetlands mapping, monitoring, protection, and partnership programs. In 2009, DEP continued to review federal, state, and municipal wetlands permit applications, as well as proposed land uses under SEQRA and the Watershed Rules and Regulations (WR&R). Data collection continued from automated monitoring wells in reference wetlands in the Catskill and Delaware (Cat/Del) watersheds. DEP also made strides in wetlands education and outreach, updating and producing the educational pamphlet, *Wetlands in the Watersheds of the New York City Water Supply System*; presenting findings of the National Wetlands Inventory, the Wetlands Status and Trends studies, and monitoring programs at two conferences; reconvening and hosting the New York State Wetlands Interagency meeting; and

providing wetlands training to high school students in partnership with Cornell Cooperative Extension of Ulster County.

4.8.1 Permit Review Program

A main component of DEP's Wetlands Protection Strategy is reviewing and commenting on applications for federal, state, and municipal wetlands permits, as well as proposals subject to environmental review under the SEQRA. DEP comments identify omissions in these documents and measures in the applications and project designs that should be incorporated into the proposal to protect wetland functions and water quality. In 2009, DEP continued to review applications for permits for activities on regulated wetlands and their regulated adjacent areas both EOH and WOH (Figures 4.23 and 4.24).

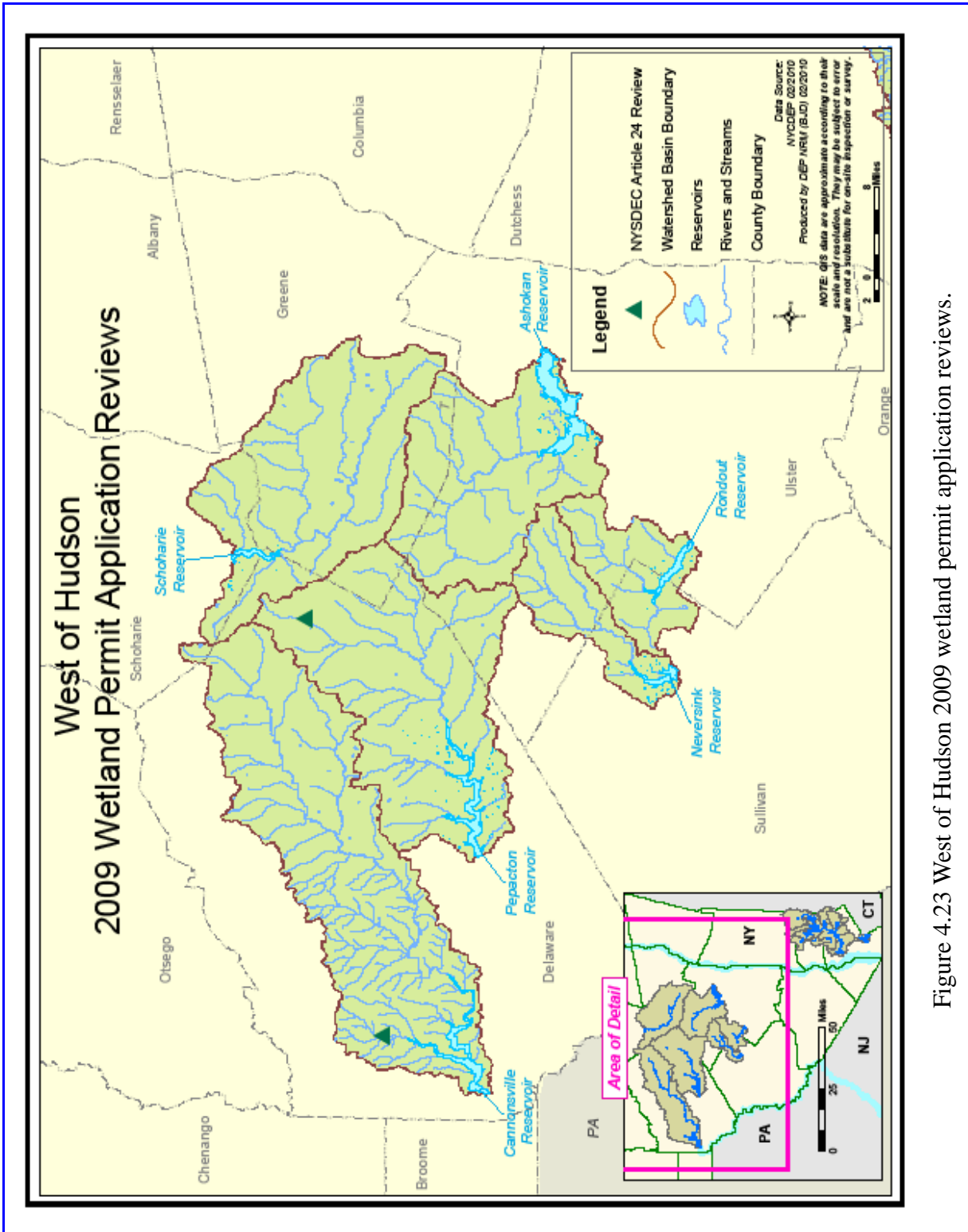


Figure 4.23 West of Hudson 2009 wetland permit application reviews.

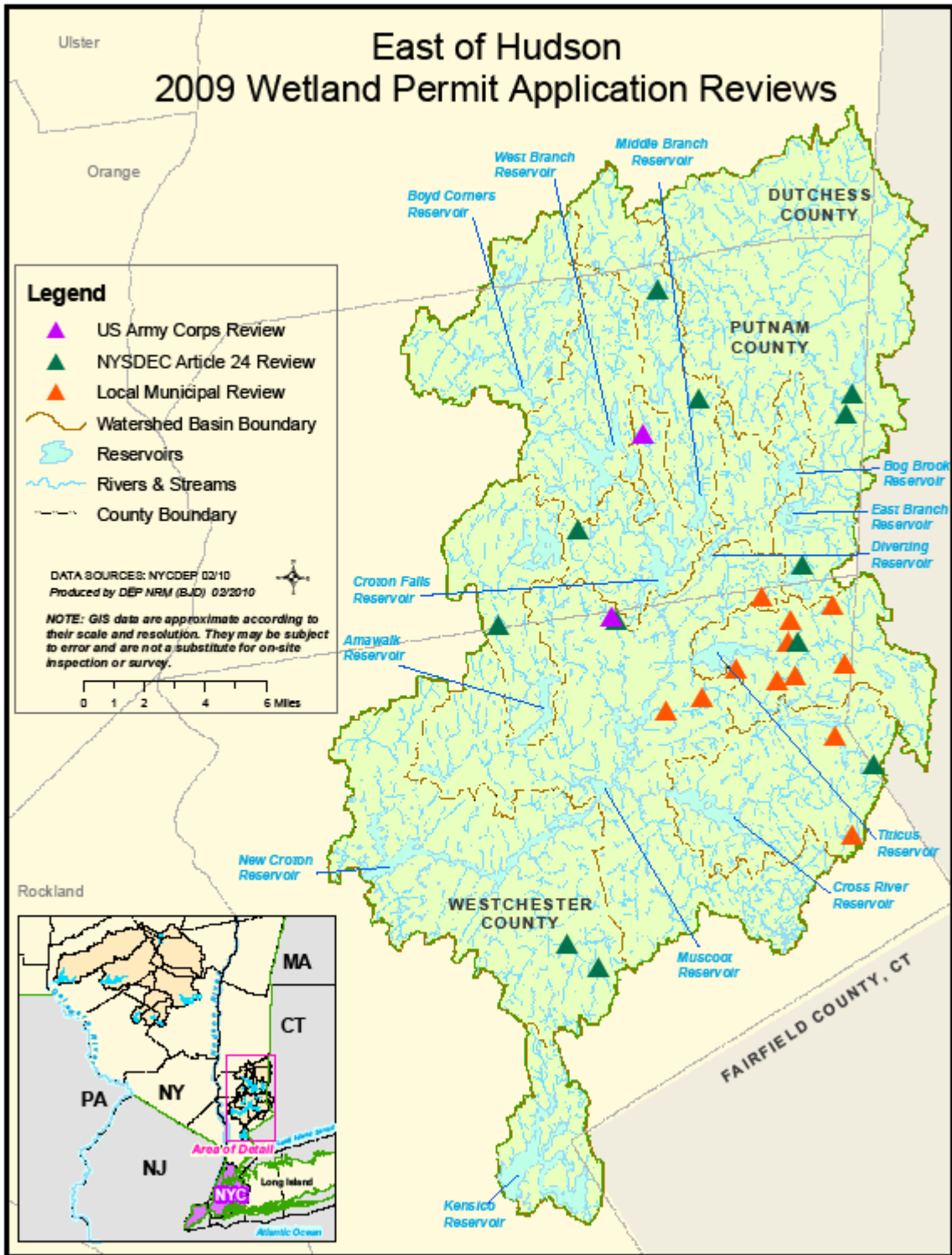


Figure 4.24 East of Hudson 2009 wetland permit application reviews.

United States Army Corps of Engineers (ACOE) Section 404 Permit Applications

During 2009, DEP continued to review Section 404 permit applications within the New York City Watershed. DEP comments to ACOE sought to avoid or minimize adverse impacts from projects to the extent practicable. DEP also assessed any proposed mitigation to make sure it would compensate for unavoidable wetland impacts resulting from the project. DEP commented on two proposals submitted to ACOE during 2009 (Table 4.21).

Table 4.21. 2009 ACOE permit reviews.

Project Name	NYC Basin	Regulated Activity
Algonquin Gas Transmission LLC	Muscoot	Excavation and temporary sidecasting of fill to provide corrosion protection to the existing gas transmission pipeline
Hillcrest Commons	Croton Falls	Discharge of fill material in connection with the construction of a senior housing development

DEC Article 24 Wetlands Permit Applications

DEP also reviewed DEC freshwater wetlands permit applications within the watershed. DEP’s review of these applications assessed the proposals’ impact on wetlands and their regulated adjacent areas, and identified measures to avoid, minimize, or mitigate those impacts. Elements of the proposed projects are often changed based on DEP’s comments, resulting in a project with less impact to the wetland and/or the adjacent area. DEP reviewed 14 DEC Article 24 freshwater wetlands permit applications during 2009 (Table 4.22).

Table 4.22. 2009 DEC Article 24 permit reviews.

Project Name	NYC Basin	Regulated Activity
Green Chimneys School	East Branch	Expansion of stormwater basin in wetland buffer
Heritage Development Group Kilian Parcel	Muscoot	Removal of debris, regrading of access road and soil stockpile, replacement of culvert, repair of erosion, revegetation of disturbed areas
River Run Farm (revised)	Kensico	Stabilization of streambank on East Branch Croton River
Pond View	Middle Branch	Access road, dam rehabilitation and emergency outflow construction. Riprap outlet structures for stormwater basins and grading
Loewentheil	Cannonsville	Stabilization of watercourse
Roxbury Sewer District	Pepacton	Sewer line extension, pump station, dewatering area, stream crossing
Handler	Cross River	Spraying of Rodeo herbicide
Peach Lake WWTP	East Branch	WWTP outfall pipe through wetland

4. Protection and Remediation Programs

Table 4.22. (Continued) 2009 DEC Article 24 permit reviews.

Project Name	NYC Basin	Regulated Activity
303 Mountainwood	Croton Falls	Redevelopment of disturbed site within 100-foot adjacent area of LC-32. Construction of building, parking, and stormwater management practices.
Tonery	Titicus	Dredging of pond, disposing of spoils on site
Kent Senior Center	Middle Branch	Disturbance within 100-foot wetland buffer
Linda Lucadamo	New Croton	Sanitary sewer pipe and vegetated swale in wetland. Grading for stormwater basin, storm drainage utilities and pervious parking in buffer
Blue Chip Houses	Amawalk	Construction of 10 stormwater outfalls to the 100-foot adjacent area of wetland to improve eroding channels
Boesky	New Croton	Widening of access drive and stormwater treatment structures at intersection of Elm Road and Byram Lake Road

In 2009, DEP and DEC updated Addendum A of the 1993 MOU. The revised Addendum A updates the goals and protocol for coordination of Article 24 freshwater wetlands permit and Article 15 protection of waters permit application reviews in the watershed. The Addendum stipulates that DEC will forward to DEP for its review all Article 24 and Article 15 permit applications for major activities and for a select subset of minor activities in the watershed. DEP and DEC will meet annually to review the permitting coordination activities outlined in the Addendum.

Municipal Reviews

DEP continued to review municipal wetlands applications from towns that forward applications to DEP. This includes permit applications from watershed towns in Connecticut, whose law requires applicants to notify DEP of applications for projects that lie within the NYC Watershed. As with the state and federal applications, DEP assesses the proposal's impact on wetlands and regulated adjacent areas and identifies measures to minimize and mitigate those impacts. Elements of the proposed projects are often modified based on DEP's comments. DEP reviewed 12 municipal wetlands applications during 2009 (Table 4.23).

Table 4.23. 2009 local permit reviews.

Project Name	NYC Basin	Permitting Authority	Regulated Activity
Wild Oaks WWTP	Muscoot	Town of North Salem	Culvert replacement over Horton Brook
Schwartz Residence Revisions	Muscoot	Town of North Salem	Construct pool house and extend existing stone terrace in buffer
US Chemical Cheese	Titicus	Town of North Salem	Install 8' high fence, gate, rock wall installation, removal and repair, landscape, grading and filling within the buffer
Dubin Property	Titicus	Town of North Salem	Dredging and restoration of existing ponds and replacement of existing foot bridges within Crook Brook wetland system and DEC wetland L-9
Laurence D. Fink (revised)	Titicus	Town of North Salem	Enlarge an existing man made pond (Wetland "B"), which is a town wetland, install concrete and stone veneer retaining wall and weir, install an equestrian bridge and associated landscape plantings
Boera	Cross River	Town of Lewisboro	Addition to existing residence, stormwater management system
Robert Abrams (revised)	Titicus	Town of North Salem	Erosion repair, footpath creation, retaining walls, remove existing tennis court, construct two ponds
Sullivan/Straus (revised)	Titicus	Town of North Salem	Dredging of pond, work in buffer
Theresa Havell	Muscoot	Town of North Salem	Grading within 100' wetland buffer
Lake Kitchawan	Cross River	Town of Lewisboro	Herbicide treatment with SONAR (Fluridone) for Eurasian Watermilfoil
de Vault	Titicus	Town of North Salem	Replacement of existing pool and patio with new pool, spa, cabana, walls, garden, and foot paths within 100 feet of a town-regulated wetland
Tonery	Titicus		Dredging of pond, disposing of spoils on site

4.8.2 Non- Regulatory Programs

Acquisition of Wetlands

DEP calculates there are 15,200 acres of wetlands within the Cat/Del System as mapped by DEC or the National Wetlands Inventory (NWI). Since 1997, DEP has protected 2,238 acres, or 14.7%, of the wetlands in the Cat/Del System through its Land Acquisition Program (see Section 4.2).

4. Protection and Remediation Programs

Table 4.24. Wetlands protected (under contract or closed) by the NYC Land Acquisition Program in the Catskill/Delaware and Croton Systems as of December 31, 2009*.

Description	Acres	% of Watershed Acreage	% of Land Acquired	% of Wetland Type in System
Catskill/Delaware (Ashokan, Schoharie, Rondout, Neversink, Pepacton, Cannonsville, West Branch, Boyd Corners, Kensico basins)				
<i>Entire Watershed</i>	1,049,465			
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats**)	15,200	1.45		
Inundated Aquatic Habitats	28,339	2.70		
Wetlands and Inundated Aquatic Habitats	43,539	4.15		
<i>Protected Lands†**:</i>	101,402	9.66		
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats**)	2,238		2.21	14.72
Inundated Aquatic Habitats**	160		0.16	0.56
Wetlands and Inundated Aquatic Habitats**	2,398		2.36	5.51
Croton				
<i>Entire Watershed</i>	212,577			
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats**)	20,038	9.43		
Inundated Aquatic Habitats	10,809	5.08		
Wetlands and Inundated Aquatic Habitats	30,846	14.51		
<i>Protected Lands†**:</i>	2,257	1.06		
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats**)	127		5.63	0.63
Inundated Aquatic Habitats**	2		0.07	0.02
Wetlands and Inundated Aquatic Habitats**	129		5.70	0.42

*Acres are calculated directly from areas of GIS polygons and therefore may not match exactly other acreage totals submitted by DEP.

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

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

Wetlands Mapping

DEP’s wetlands mapping and monitoring programs provide baseline data on the extent, condition, functions, and recent trends of watershed wetlands in support of the protection and partnership programs included in the Wetlands Protection Strategy (DEP 2007; Tiner and Stewart 2004; Tiner et al. 2004, 2005a). No additional wetlands mapping programs were conducted in 2009, because the NWI and EOH Wetlands Status and Trends Analysis were updated in 2005 (Tiner et al. 2005b) and the WOH Wetlands Status and Trends study was completed in 2008 (Tiner 2008). In 2009, DEP continued to rely on the NWI in its review of federal, state, and municipal wetlands permit applications, as well as applications received under the WR&R and SEQRA, and in its design and review of capital construction and land management programs.

In 2009, DEP conducted an extensive quality assurance review of the WOH Wetlands Status and Trends study completed in 2008. DEP reviewed 409 polygons randomly selected from the geodatabases produced by the US Fish and Wildlife Service (USFWS) for the two time frames analyzed in the trends analysis, 1984-1994 and 1994-2004. DEP’s review primarily identified inconsistencies in format between the two geodatabases. As a result, DEP required the USFWS to modify the two geodatabases to include the same fields, consistently and accurately code individual polygons, and include detailed metadata. The quality assurance review identified only incremental errors in the acreages reported. From 1984 to 2004, the USFWS reported a net loss of 83.5 acres of vegetated wetlands, which represents 1.3% of the 1980s’s wetlands base. After review of the geodatabases, the net loss was recalculated as 92.1 acres, or 1.4% of the 1980s’s wetlands base. A 635.7-acre increase in ponds—a 27.3% increase from the mid-1980s—was originally reported by the USFWS. DEP’s review identified previously undetected pond losses, changing the net gain to 624.6 acres, which is a 26.8% increase from the mid-1980s.

WOH Reference Wetlands Monitoring Program

DEP has installed automated monitoring wells in 22 reference wetlands throughout the Cat/Del watersheds. In 2009, DEP continued to download monitoring data and maintain these wells. DEP replaced malfunctioning wells with updated, more reliable models as they became available. These automated monitoring wells measure water table level at 6-hour increments and will provide a long-term hydrologic record of wetlands among various landscape settings throughout the Cat/Del watersheds. This record makes possible the analysis of hydrologic conditions and functions of various wetland types, and facilitates interpretation of previously collected water quality, vegetation, and soils data. DEP will continue to analyze wetlands monitoring data to establish reference wetland conditions for the Cat/Del watersheds. Reference wetland conditions provide standards for wetland assessment and mitigation site design that guide DEP’s review of applications received under federal, state, and municipal wetlands regulations, the WR&R, SEQRA, and capital and other land management proposals. In addition, much of the data collected has enabled DEP to characterize the conditions and functions of headwater wetlands. This information can help protect these wetland types, which currently require demonstration of a significant ecological or hydrologic “nexus” to receiving waters to be afforded

Clean Water Act protection (EPA 2008). Reference wetlands monitoring can also provide hydrologic data to support wetland determinations and delineation, and can support the development or validation of wetland assessment methodologies.

Wetlands Education and Outreach

In 2009, DEP updated and produced the educational pamphlet, *Wetlands in the Watersheds of the New York City Water Supply System* (Tiner 1996). The updated pamphlet is the first revision of the original document produced in 1996. It was revised to summarize the findings from the most recent (2005) NWI update, and to include information from additional DEP wetlands mapping, monitoring, and protection programs. Wetland landscape positions as mapped in the Wetland Characterization and Watershed-based Preliminary Analysis of Wetland Functions were included, as well as findings from the wetlands status and trends analyses conducted to date. The pamphlet also contained general educational information on the definition, characteristics, and functions of wetlands and on regulatory and non-regulatory methods of wetlands protection. DEP is distributing the pamphlet to stakeholders throughout the watershed, including local, state, and federal agencies; schools; partners; landowners; and the general public.

DEP also presented findings from the NWI, Wetlands Status and Trends studies, and Reference Wetlands Monitoring Program at the 2009 annual conference of the New York State Wetlands Forum, and at the 2009 Watershed Science and Technical Conference. DEP partnered with the Ulster County Cornell Cooperative Extension to provide wetlands training to five Ashokan Youth Stewards from the Onteora School District. DEP also hosted a meeting of the New York State Interagency Wetlands Group in October. The wetlands interagency group was established in the 1980s to provide a way for agency personnel to discuss wetlands issues on a quarterly basis. DEP reconvened the group after a 1½ year hiatus.

4.9 East of Hudson Non-Point Source Pollution Control Program

The East of Hudson Nonpoint Source Pollution Control Program is a comprehensive effort to address nonpoint pollutant sources in the four EOH Cat/Del watersheds (West Branch, Croton Falls, Cross River, and Boyd Corners). The program supplements DEP's existing regulatory efforts and nonpoint source management initiatives. The program generates data on the watershed and its infrastructure and uses that information to evaluate, eliminate, and remediate existing nonpoint pollutant sources, maintain system infrastructure, and evaluate DEP's programs.

4.9.1 Wastewater-Related Nonpoint Source Pollution Management Programs

Nonpoint sources of wastewater may include exfiltration or other releases from defective sewer lines, failing septic systems, and illicit connections to the stormwater collection system. The four target watersheds contain 12 wastewater treatment plant discharges and a system of sewer infrastructure within several sewer districts. Outside of the existing sewer districts, wastewater is treated by subsurface sewage disposal systems (SSDS).

Wastewater Infrastructure Mapping and Inspection Program

As part of its efforts to reduce potential pollutant loading from wastewater sources, DEP developed a program for the inspection and mapping of the sanitary infrastructure in the EOH Cat/Del basins. The inspection program includes identifying defects and assessing those that may result in exfiltration of effluent to surface water. Digitized data include sewer pipe size, estimated age, composition, and precise location; manhole location, size, and estimated age; pump station locations, size, and flow capacity; interceptor sewer location, size, and estimated age; and other pertinent data concerning cross and illicit connections.

DEP began infrastructure inspections in 2004. During the course of the inspection it was discovered that the number of structures and length of pipe were substantially more than initially estimated. The work to inspect and digitally map the remaining sewer pipe and structures will be completed under a contract that DEP awarded to Fred A. Cook, Inc. DEP issued an order to commence work in July 2009. Once the inspection and mapping are complete, DEP will coordinate the remediation of any identified failures with the responsible entity.

Septic Program East of Hudson

DEP provides ongoing support to Westchester County and Putnam County in their efforts to reduce the potential impacts of improperly functioning or maintained SSDSs. Within Westchester County, DEP continued to support the County Health Department in its efforts to train and license septic contractors as well as develop a Septic System Management Program (SSMP) database. Funding to continue the contractor training, contractor licensing, and septic repair database was provided through East of Hudson Water Quality Investment Program (WQIP) funds, as provided for in Section 140 of the 1997 MOA. To date, the county has developed a preliminary database of sewage service status and is currently conferring with local municipalities in order to increase the accuracy of the database. The county is also developing databases to track various septic program activities such as tank pumpouts, repairs, remediations, and new applications.

Within Putnam County, DEP continued to work with Septic Repair Program (SRP) staff to target repairs in priority areas as well as provide septic education information to residents. The SRP includes several phases of implementation that target priority areas within the Cat/Del watersheds located EOH (see Figure 4.25). Since the start of the SRP, Putnam County has allocated approximately \$5.5 million in WQIP funds for ongoing SRP implementation.

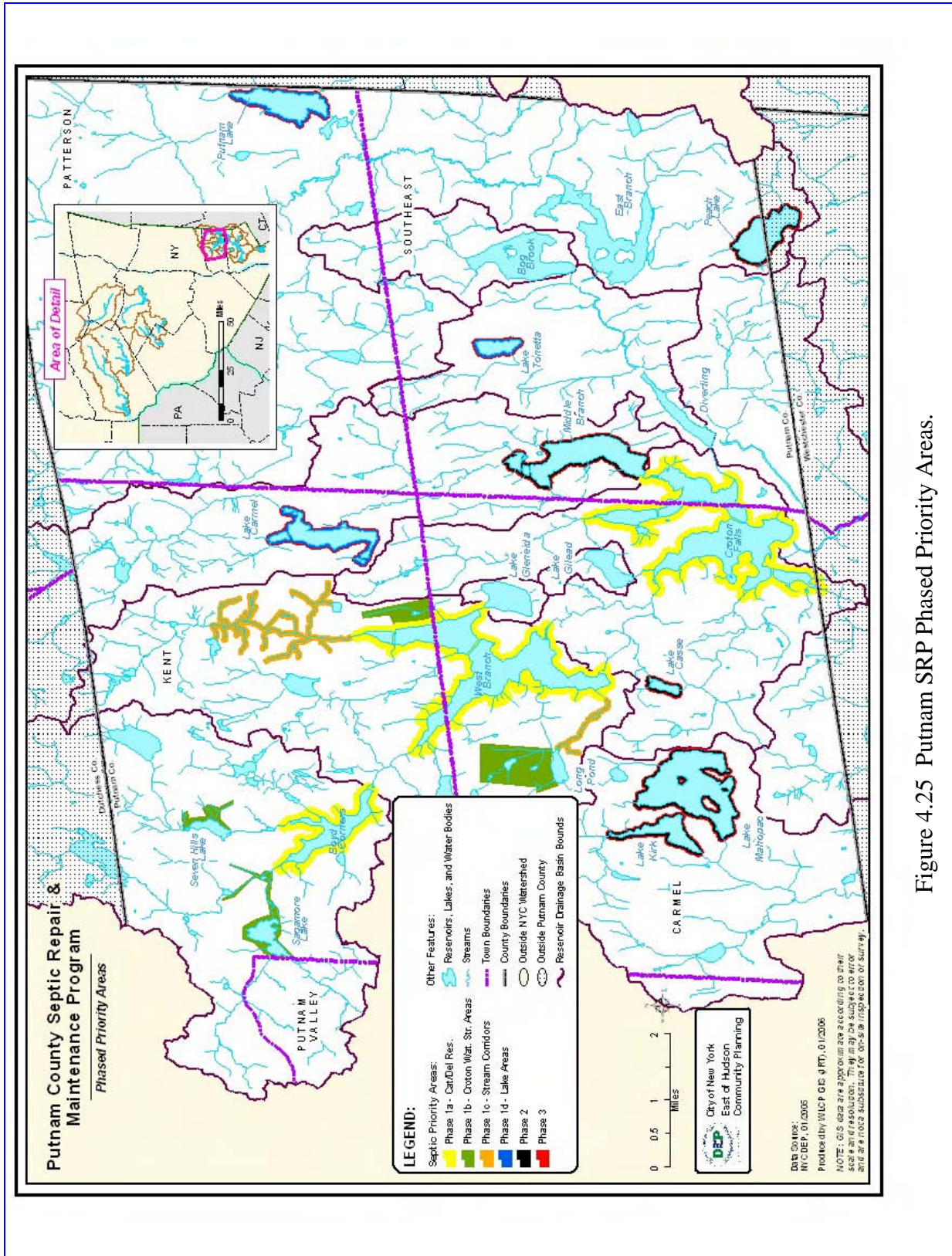


Figure 4.25 Putnam SRP Phased Priority Areas.

DEC previously issued its Phase II MS4 permit requirements, which call for specific measures to reduce the impacts of improperly functioning SSDSs. In particular, based on the current permit, EOH municipalities are required to “develop, implement and enforce a program that requires property owners to inspect, repair and/or replace failing septic systems that are tributary to the small MS4....” As part of the inspection program, homeowners are required to inspect their systems once every three years. As EOH MS4s implement these Phase II MS4 requirements, DEP will evaluate its existing activities in order to avoid duplicative or conflicting efforts.

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 Cat/Del basins. These projects include large retrofit and remediation projects as well as remediation of smaller erosion sites (See Figure 4.26). In addition, DEP is gathering new information through mapping that will further enhance pollutant reduction initiatives.

Stormwater Retrofit Projects

Hemlock Dam Road and Magnetic Mine Road are unpaved roads in the Town of Carmel that drain toward Croton Falls Reservoir. DEP identified possible roadway and drainage improvements in an effort to reduce erosion potential and turbidity in the Croton Falls watershed. The project involves making roadway improvements as well as improving the functionality of the existing stormwater conveyance system along the roadways.

In January 2009, DEP awarded Harrison Park Associates the construction contract, which covers the reconstruction of both Hemlock Dam Road and Magnetic Mine/Lower Mine Road. Following the Order to Commence Work in March 2009, the contractor made numerous submissions to expedite vendor and subcontractor approvals. The contractor’s Health & Safety Plan (HASP) was accepted in July 2009 and the contractor began mobilization and field operations in August 2009.

During construction, a private landowner approached the City and claimed that he owned land parcels on both sides of Lower Mine Road in the Town of Southeast within DEP’s project limits. A Stop Work Order (within the area of the private property) was issued to the contractor until confirmation of ownership and right-of-way (ROW) could be determined. Legal documents indicated that DEP does own a 50-foot-wide ROW corridor for the roadway through the private property. Mapping obtained from a licensed surveyor further confirmed that the existing and proposed roadways are within the 50-foot-wide ROW easement. However, several culvert outfalls and portions of the drainage swale were outside the ROW and encroach onto the private property. A field investigation confirmed that although the swales could be constructed within the

4. Protection and Remediation Programs

existing ROW with minor design modifications, most of the culvert outfalls could not be pulled back to within the ROW limits. It was determined that the City would seek an additional 60-foot-wide easement from the landowner, which would allow DEP to construct and maintain the required culvert outfalls. DEP is reviewing the appraisal and will contact the landowner with an offer to purchase the proposed ROW. Once DEP receives a response from the landowner, it will be possible to determine when construction activities within the area of the private property can resume.

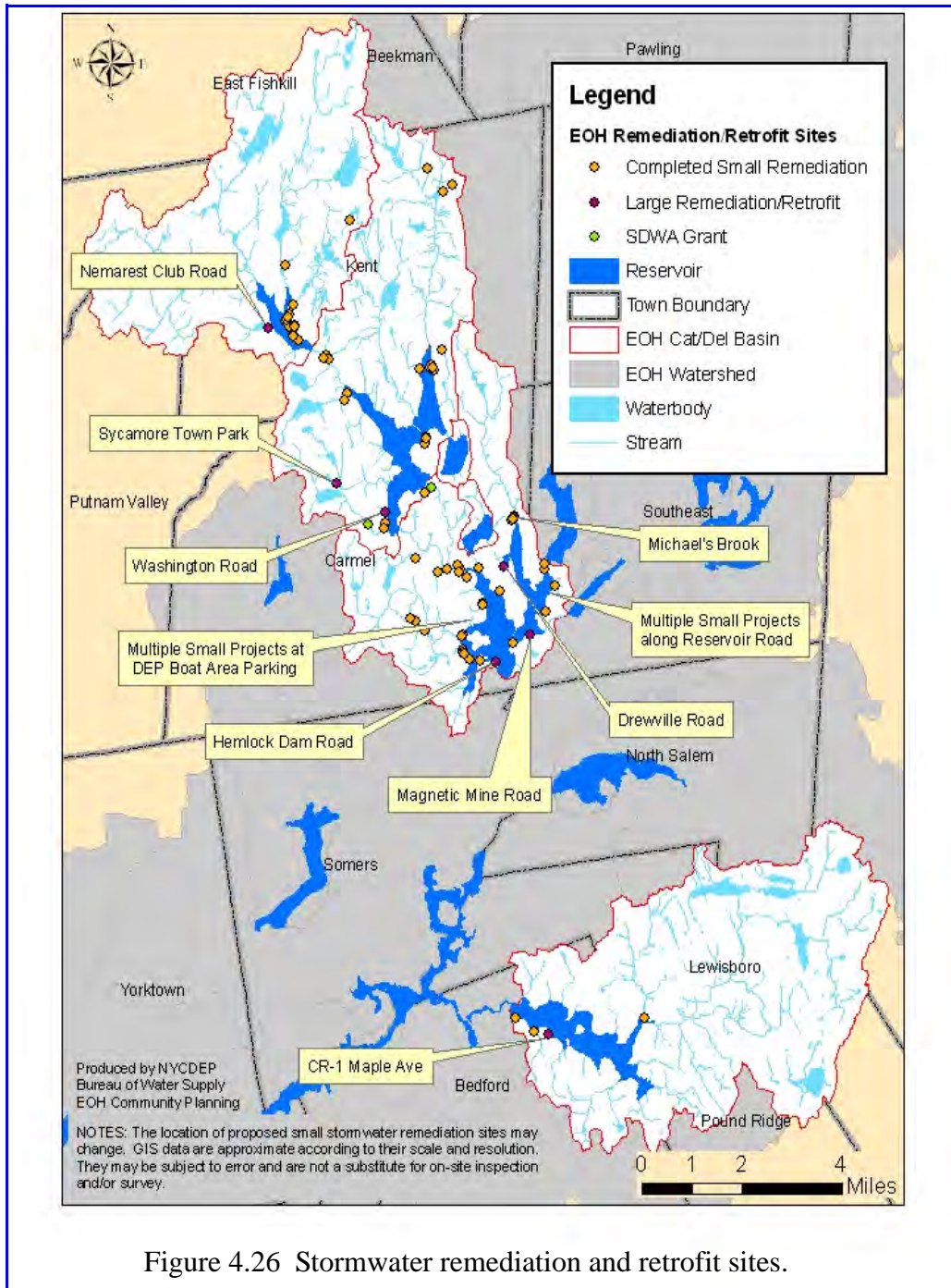


Figure 4.26 Stormwater remediation and retrofit sites.

DEP completed approximately 75% of the work on the project by the end of 2009 (See Figures 4.27 and 4.28). All culverts, swales, riprap outfalls, and erosion control materials were in place and functioning by the FAD deadline, with the exception of the work that needs to be performed within the boundaries of the private property. DEP will continue efforts to complete the work on private property in the first half of 2010.



Figure 4.27 Completed erosion protection on slope.



Figure 4.28 Completed drainage culvert with stone outfall protection.

Stormwater Remediation Projects

Five large remediation projects are undergoing design and environmental review as outlined below.

Remediation Projects on City-Owned Property

The following large remediation projects are located on DEP-owned property. The consultant is currently working on advancing the design documents. Concurrently, permitting and local municipal approval are progressing.

Maple Ave, Town of Bedford, Westchester County. The Maple Avenue site was chosen to replace the original site (CR-1) along a stretch of Maple Avenue that occasionally experienced accelerated erosion and sedimentation during periods of high precipitation. DEP worked with town officials in an attempt to find a suitable solution. However, ultimately it was the wish of local residents to maintain the road as unpaved as an expression of rural community character and, given that, a cost-effective solution was not possible. Therefore, DEP chose another site along Maple Avenue that will have a similar water quality benefit for Cross River Reservoir.

The Maple Avenue site consists of two roadside ditches carrying a significant amount of suspended solids that discharge into Cross River Reservoir. In order to prevent the continued buildup of sediment along the hillside and water's edge, a sediment and gravel collection system is being designed to concentrate deposition at a location where it can be easily accessed and periodically cleaned. The deposition control system may be in the form of a sediment basin, filter practice, hydrodynamic device, or other underground proprietary treatment structure. The system will be designed to handle the combined flow, with an engineered overflow controlling the flow of clean water over a weir and to the reservoir. The survey and preliminary design work for this project was initiated in December 2008. The 60% designs are complete for this site.

Michael Brook, Town of Carmel, Putnam County. DEP will repair a severely eroded drainage ditch along Hughson Road that drains directly into Croton Falls Reservoir. Numerous trees and other debris that have accumulated at the juncture of Croton Falls Reservoir and Michael Brook will be relocated outside the watercourse of Michael Brook.

The 90% designs for this stormwater management facility are complete.

Drewville Road, Town of Carmel, Putnam County. This site replaced the original Joseph Court site (WB-1) in the Town of Kent. Construction at that site would have required acquisition of an access agreement to cross through and demolish private property. Additionally, town surveying documents were inaccurate in depicting the location of several wells and septic locations. Due to these site constraints and access issues, DEP proposed to replace the original project with the Drewville Road project in 2008.

The Drewville Road site consists of a roadside drainage ditch that drains to Croton Falls Reservoir. The drainage ditch has eroded in several locations and is undermining the adjacent rock wall. The ditch will be improved to minimize erosion and repair areas where the wall is being undermined, and a micropool extended detention basin will be installed. The basin will be designed to maintain the existing conveyance way, with provision made for any established wetland- dependent species along the existing flow path. The 60% designs for this site are complete.

Remediation Projects on Privately-Owned Property

The following large remediation projects are located on privately-owned property. During 2009, DEP’s consultants continued progress on the design documents and regulatory requirements. Additionally, DEP is working with its Legal Department to obtain necessary easements.

Sycamore Park, Long Pond Road/Crane Road, Town of Carmel, Putnam County. DEP will remove gravel parking areas within the wetland buffer zone and replace with grass pave porous pavers. This will stabilize parking areas within the wetland buffer and remove the source of gravel migration into the wetlands. Landscape improvements and barriers will be installed to prevent parking from encroaching into the wetlands. Drainage improvements and swales will be constructed to contain runoff from the paved road and parking areas beyond the wetland buffer. Debris buildup within the current culvert located under the access road and draining directly to the wetlands will be removed and the culvert outfall will be reconstructed outside of the wetland. Stormwater treatment practices to be installed include two biofiltration areas to collect and treat runoff from the paved areas, as well as a vegetated drainage swale to provide additional water quality treatment. Preliminary site plans have been reviewed by the Town of Carmel Recreation Department and their comments are being incorporated into final design drawings. The 90% designs for this site are complete.

Nemarest Club, Town of Kent, Putnam County. Improvements to this site include replacing the existing partially collapsed culvert with a larger span concrete structure capable of conveying the 100-year storm, and minimizing sediment runoff from the damaged roadway entering the Boyd Corners Reservoir. Specifically, DEP will: 1) replace a defective and undersized road culvert where the stream crosses under a dirt road, 2) relocate large rocks that are currently in-channel near the road crossing, 3) install forebays adjacent to the culvert, and 4) replace guiderails along the culvert crossing. The 90% designs are complete.

Stormwater Remediation Small Projects

The Small Stormwater Remediation Projects Program involves the identification and remediation of smaller erosion sites in the four EOH Cat/Del basins. Typical erosion abatement

4. Protection and Remediation Programs

includes embankment stabilization, headwall repair, road drainage improvements, installation of stabilized outlet controls, and renovating dirt/gravel parking areas.

DEP remediated 7 of the proposed 30 sites during the 2007 construction season prior to contractor default in March 2008. Cassidy Excavating, Inc., became the prime contractor under the replacement contract, which was registered in April 2009. The agreement between Cassidy and DEP established a project completion deadline of December 31, 2009.

Construction commenced on initial sites in April 2009. By October 2009, Cassidy Excavating had completed construction of the 23 outstanding sites. Sites completed during 2007 are shown in Table 4.25 and those completed in 2009 are shown in Table 4.26.

Table 4.25. Small stormwater remediation projects completed in 2007.

Site No.	Reservoir Basin	Town	Street Name	Location	Description of Work
CF1-05	Croton Falls	Carmel	Crafts Road	Putnam County Bikeway	Watercourse erosion repair.
CF2-05	Croton Falls	Carmel	Hemlock Dam Road	West side of Croton Falls Road	Forebay construction, channel stabilization
CF3-05	Croton Falls	Carmel	Hemlock Dam Road	Southeast of Croton Falls Road	Headwall and endwall repair, embankment and channel stabilization
CF4-05b CF4-05a	Croton Falls	Carmel	Croton Falls Road	Stebbins, between Stebbins and Pigott Roads	Embankment and channel stabilization
CF 3-07	Croton Falls	Carmel	Stoneleigh Avenue	Magnetic Mine Road	Channel erosion stabilization, pipe outlet stilling basin
CF3-10	Croton Falls	Carmel	Croton Falls Road	Boat Area #6	Repair eroded swales
CF5-05	Croton Falls	Carmel	Stoneleigh Avenue	Vista on the Lake	Replace asphalt swale with water quality swale, repair eroded swale

Table 4.26. Small stormwater remediation projects completed in 2009.

Site No.	Reservoir Basin	Town	Street Name	Location	Description of Work
CF1-09	Croton Falls	Carmel	West Shore Drive	Intersection of Stebbins Road	Outfall channel stabilization, sediment stilling trap, stabilized roadway perimeter
CF2-09	Croton Falls	Carmel	Hughson Road	Intersection of Stoneleigh Avenue	Stabilization of roadside drainage channel
WB1-09	West Branch	Carmel	Belden Road	Intersection of Route 301 (@ Verizon pole #D8792)	Installation of deep sump catch basins; replacement of roadway cross culvert
WB2-09	West Branch	Carmel	Belden Road	Intersection of Route 301 (@ wastewater pump station)	Installation of deep sump catch basins, replacement of roadway cross culvert
CF3-09	Croton Falls	Carmel	Rock Mill Road	Intersection of Drewville Road	Installation of drainage network and deep sump catch basins, stabilization of existing outfalls
CF4-09	Croton Falls	Carmel	Seminary Hill Road	Intersection of Drewville Road	Installation of deep sump catch basins, stabilization of existing outfalls
CF5-09	Croton Falls	Carmel	Drewville Road	Between Weber Hill Road & Cherry Hill Road	Stabilization of roadside drainage channel, addition of stone check dams
CF6-09	Croton Falls	Carmel	West Shore Drive	@ 245 West Shore Drive	Installation of deep sump catch basin, outfall channel stabilization
CF7-09	Croton Falls	Carmel	West Shore Drive	Intersection of Croton Falls Road	Installation of deep sump catch basin, outfall channel stabilization
CF8-09	Croton Falls	Carmel	Croton Falls Road	Intersection of Union Valley Road (North)	Installation of deep sump catch basin, outfall channel stabilization
CF9-09	Croton Falls	Carmel	Croton Falls Road	Intersection of Union Valley Road (South)	Installation of deep sump catch basin; outfall channel stabilization

4. Protection and Remediation Programs

Table 4.26. (Continued) Small stormwater remediation projects completed in 2009.

Site No.	Reservoir Basin	Town	Street Name	Location	Description of Work
CF10-09	Croton Falls	Carmel	Cherry Hill Road	Intersection of Drewville Road	Installation of sediment tank/deep sump catch basins, stabilized parking area with pervious pavers
CF11-09	Croton Falls	Carmel	West Shore Drive	¼ Mile North of Farview Road	Installation of pipe and fill material within eroded gorge, outfall stabilization
CF12-09	Croton Falls	Carmel	Reservoir Road	Unpaved portion—Intersection of Lower Mine Road	Installation of drainage network and deep sump catch basins, stabilization of existing outfalls
CF13-09	Croton Falls	Carmel	Reservoir Road	Paved portion—Intersection of Drewville Road	Installation of drainage network and deep sump catch basins, stabilization of existing outfalls
WB3-09	West Branch	Kent	Farmers Mills Road	Intersection of Route 52	Stabilization of roadside drainage channel
WB4-09	West Branch	Kent	Meadow Court	Intersection of Farmers Mills Road	Installation of deep sump catch basins and pipe network within eroded channels, outfall stabilization
WB5-09	West Branch	Kent	Church Hill Road	Intersection of Daffodil Lane	Construction of sediment stilling basin and stabilized outfall
BC1-09	Boyd Corners	Kent	Gypsy Trail Road	Intersection of Kent Acres Road	Replacement of headwall, outfall stabilization
BC2-09	Boyd Corners	Kent	East Boyd's Road	@ 202 East Boyd's Road	Installation of deep sump catch basins, outfall stabilization
BC3-09	Boyd Corners	Kent	East Boyd's Road	@ 236 East Boyd's Road	Installation of deep sump catch basins, outfall stabilization
BC4-09	Boyd Corners	Kent	322 East Boyd's Road	@ 322 East Boyd's Road	Installation of deep sump catch basins, outfall stabilization

Table 4.26. (Continued) Small stormwater remediation projects completed in 2009.

Site No.	Reservoir Basin	Town	Street Name	Location	Description of Work
BC5-09	Boyd Corners	Kent	326 East Boyd's Road	@ 326 East Boyd's Road	Installation of deep sump catch basins, replacement of roadway cross culvert

Facility Inspection and Maintenance

The facility inspection and maintenance program was developed in order to ensure that previously constructed 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 promptly completed under the warranty in the facility's construction contract and under DEP's maintenance contract thereafter. Inspection and maintenance follows procedures identified in the Operation and Maintenance Guidelines; facility types not described in this document were incorporated into the facility maintenance contract with explicit maintenance instructions.

Stormwater Infrastructure Mapping and Inspection Program

Having already completed the contract to map Croton Falls, Cross River, and portions of the West Branch and Boyd Corners Reservoir basins, DEP implemented a program to digitally map and video inspect stormwater infrastructure in the remaining portion of the West Branch and Boyd Corners basins. In 2008, DEP completed all of the mapping, which included some 130,000 linear feet of stormwater infrastructure.

In 2009, digital mapping from the program was added to DEP's GIS system. DEP has notified the relevant municipalities that the mapping and inspection information is available to them so they can effectively plan for their compliance with the Phase II MS4 permit requirements.

Inspection and Illicit Connections

The video inspections of stormwater infrastructure revealed areas with deformation, breakage, and/or clogging. DEP notified the responsible municipality or county agency so that appropriate steps could be taken to eliminate all illicit inputs and remediate other sources as appropriate. Follow-up by DEP with local municipalities and/or county agencies indicated there were no illicit connections; instead, roof and footing drains, among others, were identified as the source of the inputs.

Stormwater Infrastructure Capacity Evaluation

With the completion of the digital mapping and inspection program, DEP initiated a study to evaluate the adequacy of infrastructure in the four EOH Cat/Del basins that were mapped and catalogued. The program is considering the adequacy of existing piping, swales, and drainage structures to safely convey stormwater to receiving waters. The information will be shared with

the agencies responsible for maintenance of the drainage systems. A scope of work for the program was developed and a consulting firm has been authorized to begin the study. The consultant is tasked with evaluating and organizing the available data, performing the infrastructure analysis, developing and applying prioritization criteria, and providing a final report. To facilitate proper analyses, DEP secured as-built information concerning a majority of the targeted structures from the New York State Department of Transportation.

Stormwater Prioritization Assessment—DEP Properties

Using information gathered from DEP's implementation of retrofit and remediation projects, DEP has developed prioritization criteria for potential future stormwater projects that could be located on City-owned property. Data that were used to create the prioritization included the EOH stormwater infrastructure mapping, GIS data layers, and the prioritization determination developed through the Croton Watershed Strategy. The final report was submitted in March 2009 and the anticipated implementation timeframe was submitted in September 2009.

Funding Program—Croton Falls/Cross River

To support the creation of a regional stormwater entity (RSE) in the EOH watershed, DEP and DEC submitted a joint proposal to reallocate a portion of the \$4.5 million in funds that were targeted to provide a grant program to reduce stormwater pollution in the Cross River, Croton Falls, and upstream hydrologically connected reservoirs. EOH municipalities in Westchester and Putnam Counties also previously secured grants to assess potential locations for stormwater retrofits as well as possible legal structures for the formation of an RSE. During the reporting period, the local municipalities in Westchester and Putnam Counties hired consulting firms to develop a list of potential stormwater retrofit locations and possible RSE structures.

In anticipation of the completion of these assessments, DEP worked with partners in the EOH watershed to finalize program rules and draft an Intermunicipal Agreement (IMA) that would allow for the allocation of grant monies pursuant to the Croton Falls/Cross River funding program. Final program rules were submitted in April 2009. The draft IMA was provided to municipalities in May 2009. Comments were received from the local municipalities and incorporated into the program documents in July 2009.

In November 2009, DEP sent notification letters to each municipality in the EOH watershed notifying them of the availability of funding under the Croton Falls/Cross River program. DEP subsequently responded to requests for grant applications from the Town of Somers, acting on behalf of the local municipalities in Westchester County, and from Putnam County, on behalf of the local municipalities in Putnam County.

4.9.3 Other Activities

Croton Watershed Strategy

The primary goal of the Croton Watershed Strategy project was to develop an integrated watershed management plan for the Croton System which would allow DEP to optimize management efforts and focus limited resources on critical areas to achieve maximum water quality benefit. The results were compiled in a series of documents and released in March 2003 as a FAD Deliverable.

The watershed assessment examined both existing and full build-out conditions in the watershed for 74 subbasins. The methodology focused on impairment from point and nonpoint watershed sources with regard to four critical indicator variables: total phosphorus, total suspended solids, pathogens, and toxic chemicals. The assessment did not model actual concentrations of water quality variables, but rather identified a subbasin's relative potential to impair water quality compared to other subbasins. The subbasin results were used to develop basin-specific management recommendations and watershed-wide prioritizations.

The Croton Watershed Strategy results have been used as guidance in several DEP management programs and SEQRA reviews of new development projects. The Croton Watershed Strategy was also used in response to a request from Putnam County to assist in prioritizing a phased approach for its Septic Repair Program.

Croton Planning

The City, Westchester County, and Putnam County agreed in the MOA that a cooperative comprehensive approach to watershed planning in the Croton System would identify significant sources of pollution in the Croton Watershed, recommend measures to improve water quality, and protect the character of Croton Watershed communities. Both Westchester and Putnam Counties requested that such planning efforts be undertaken in their respective counties. DEP committed to provide \$1 million to both Westchester County and Putnam County for the total costs and expenses of developing these plans. The plans are undertaken consistent with Section 18-82 of the WR&R.

Putnam County and Westchester County sought to complete Croton Planning within the same timeframe to enable the public comment periods to be coordinated and simultaneous. In 2009, Westchester County released the final version of the *Comprehensive Croton Watershed Water Quality Protection Plan for Westchester County*, and the county and municipalities are now in the process of formally adopting it.

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. By doing so, it ensures the continued success of past protection efforts while promoting the development of new source water protection initiatives specifically targeting stormwater and wastewater pollution sources.

4.10.1 Stormwater Management and Erosion Abatement Facilities

BMP Construction, Operation, and Maintenance

DEP constructed 45 stormwater management and erosion abatement facilities throughout the 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 the year. Maintenance and inspections were completed in accordance with the Operation and Maintenance Guidelines. Table 4.27 identifies the inspection requirements and maintenance needs for extended detention basins.

DEP updated the scope of the next 3-year maintenance contract and the new contract was in place in August 2008. Repairs and maintenance activities during 2009 are described in Table 4.28.

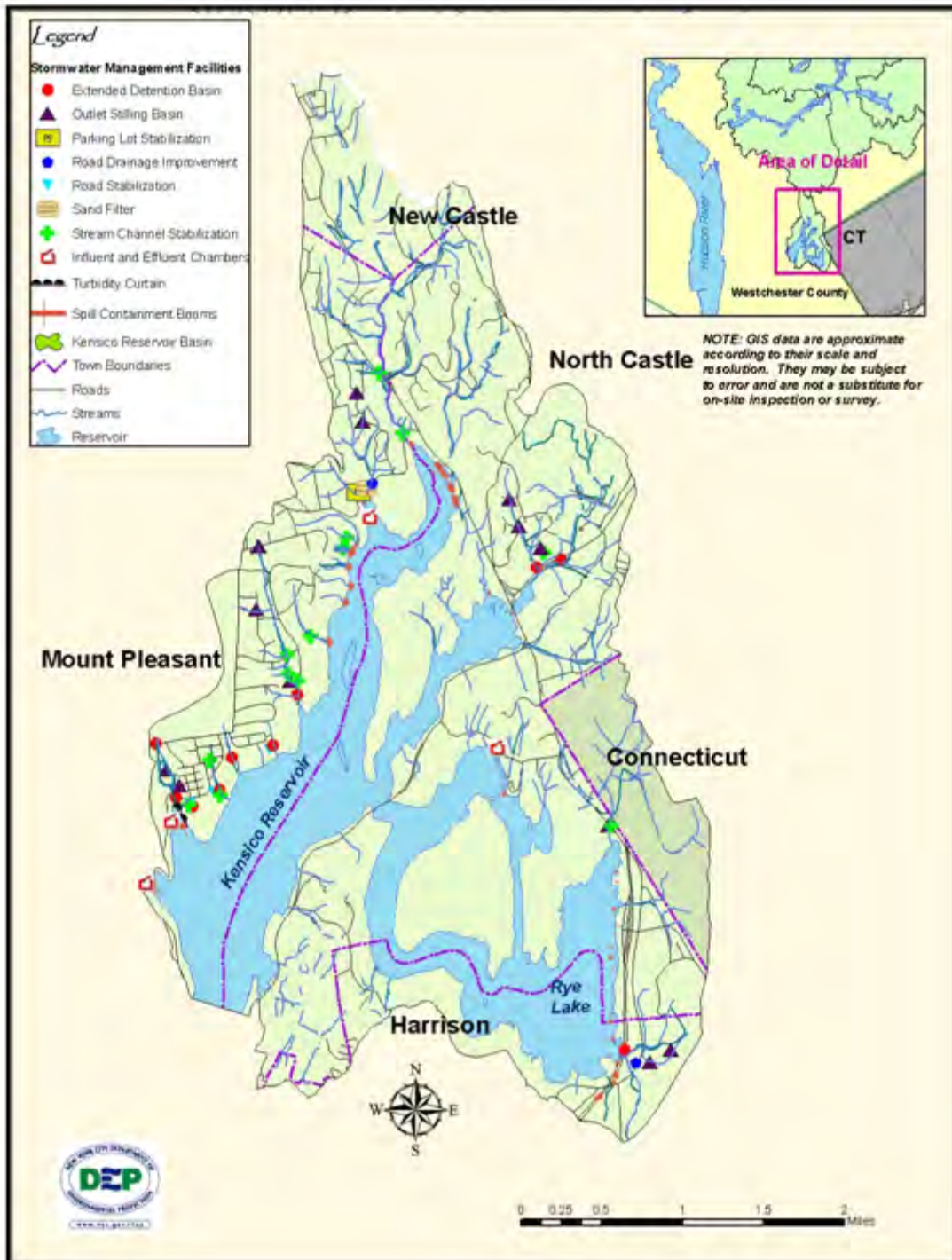


Figure 4.29 Location of stormwater management facilities in Kensico Reservoir watershed.

4. Protection and Remediation Programs

Table 4.27. Inspection checklist for extended detention basins.

Inspection Guidelines	Minimum Inspection Frequency	Maintenance Guidelines
Check access routes, basin structures (including riprap stabilized outlet) emergency spillway, headwalls, riser boxes, embankments, weirs, and handrails and trash racks for cracks, seepage, and settling of embankment.	Four times a year and after heavy storm events for erosion, structural damage, debris accumulation, and vegetative growth	Report access obstructions, damage to access route, damaged structures, and erosion to Project Manager and repair as advised. Remove debris, clogs, and vegetative growth promptly. Replace or remove debris and sediment accumulation from riprap when clogging becomes apparent. Replace filter fabric when riprap is replaced. Maintain clear access to manholes, gate valves, and catch basins.
Check inlet/outlets, basins, and maintenance access roads for debris and trash accumulation, obstructions, and clogging.	Monthly and after heavy rain or snowmelt for clogging	Remove debris, trash, and obstructions promptly using hand tools if tools are needed.
Vegetation—check health of planted vegetation (wetland, embankment, coconut rolls, and seeded areas), erosion of planted areas.	Monthly during growing season, quarterly during non-growing season.	Replace dead and dying wetland and planted vegetation, repair erosion, and prevent future erosion and reseed and mulch bare areas. Maintain/mow/prune embankment vegetation and remove tree growth from embankment bi-annually. Do not mow wetland vegetation.
Nuisances—odors, burrowing pests.	Monthly	Identify source and remove nuisance. Report nuisances to Project Manager and address as advised.
Gate Valve.	Yearly	Check integrity of the valve by fully opening and closing the valve to ensure it is functioning properly.
Check dams for structural integrity (seepage, settling, and erosion).	Annually	Report damage to Project Manager and repair structures as advised.
Sediment depth in forebay and detention basin—measure sediment depth with marked measuring stick. Once a year, drain pond to measure sediment depth.	Once a year and after significant storms.	Remove sediment from forebay every 5 years and from main basin every 15 years or when depth >50% of the basin depth. If basin does not contain a forebay, remove sediment at least every 15 years. A backhoe will be required to clean out the sediment. Dispose of the removed material in accordance with federal, state, and local regulations.

Table 4.28. Kensico stormwater and erosion abatement facility maintenance activities.

Location	Facility Number and Type	Date Construction Completed	2009 Maintenance Activities
Malcolm Brook	2, extended detention basin	11/21/00	Weed whacked, debris removal, sediment removal forebay (2CY), seed and hay
	4, stilling basins	8/31/99 9/13/99	
	8, drop pipe, velocity dissipation box, outlet stabilization	6/14/99 8/20/99	Remove/dispose of unwanted vegetation
	12, extended detention basin	4/12/99 11/5/99	Weed whacked 3 trees removed Sediment removal upstream (110CY)
Young Brook	13, extended detention basin	3/29/99 11/5/99	Sediment removal (1CY), debris removal (1CY), weed whacked
Young Brook	14, 15 Road, outlet and channel stabilization	3/29/99 11/5/99	
N2	16, outlet stabilization	10/27/99 10/27/99	
N2	18, 19, 20, extended detention basin, and road, outlet, and channel stabilization	9/28/99 9/14/00	Weed whacked
N3	2A, extended detention basin	10/12/99 9/14/00	Weed whacked
N4	23, 24, extended detention basin and road stabilization	12/22/99 9/14/00	Weed whacked, debris removal, sediment removal (42CY), remove clog in outlet pipe
N5	37, 39, and 40, extended detention basin, road stabilization, and channel stabilization	3/27/00 9/14/00	Weed whacked, BMP 40 sediment removal (1CY) BMP 37—Debris removal multiple times, sediment removal forebay (40CY)
N5	5A, drop pipe, manhole and stabilized outlet	3/27/00 4/25/00	
N5	35, outlet stabilization	5/24/00 5/25/00	
N5	34, stream channel stabilization	5/23/00 5/23/00	

4. Protection and Remediation Programs

Table 4.28. (Continued) Kensico stormwater and erosion abatement facility maintenance activities.

Location	Facility Number and Type	Date Construction Completed	2009 Maintenance Activities
N5	31, stream channel stabilization	10/25/99 11/22/99	
N5 tributary	28, outlet and stream channel stabilization	10/25/99 10/25/99	Weed whacked, debris removal (13CY), seed and mulch
N5	25, outlet stabilization	10/25/99 11/12/99	
N6	41, stream channel stabilization	12/8/99 12/28/99	Sediment removal (1CY), debris removal (1CY)
Bear Gutter	63, outlet stabilization	4/5/00 4/5/00	
Bear Gutter	64, outlet stabilization	5/26/00 5/26/00	
Bear Gutter	65, outlet stabilization	5/27/00 5/27/00	Debris removal (1CY)
Bear Gutter	66, extended detention basin	4/24/00 9/14/00	Weed whacked
Bear Gutter	67, extended detention basin	6/7/00 11/8/00	Weed whacked
Bear Gutter	8A, stream channel stabilization	4/18/00 4/20/00	
N8	43, stream channel stabilization	12/3/99 4/3/99	
N9	44, stream channel stabilization	4/18/00 4/18/00	
N12	7A, outlet stabilization	11/16/99 11/17/99	Sediment removal (4CY)
N12	47, outlet stabilization	11/17/99 11/18/99	Sediment removal (3CY)
N12	57, sand filter 58, road drainage improvements 59, parking area stabilization	1/11/00 12/15/00 (57) 8/2002 (58 & 59)	Weed whacked, debris removal (4CY) Sand filter—sediment removal (8CY)
Whip	60, stream channel stabilization	12/1/99 12/3/99	
Whip	61, stream channel stabilization	11/29/99 12/3/99	
E9	68	4/10/00 4/10/00	Sediment removal (5CY), debris removal

Table 4.28. (Continued) Kensico stormwater and erosion abatement facility maintenance activities.

Location	Facility Number and Type	Date Construction Completed	2009 Maintenance Activities
E9	68A	5/1/04 11/28/04	
E11	70, outlet stabilization	4/6/00 4/7/00	
E11	71, outlet stabilization	4/7/00 4/7/00	Sediment removal (1CY)
E11	74, 75	11/6/00 11/28/04	Weed whacked, sediment removal (6CY)
Turbidity curtains			New curtain sections added from station 0+00 through 5+50, new anchors and cable added. New 1,000 ft. secondary turbidity curtain installed



Spill Containment Facilities

DEP installed, and now maintains, spill containment facilities in and around Kensico Reservoir (see Figure 4.31). The facilities improve spill response, cleanup, and recovery, thereby minimizing water quality impacts in the event of a spill. In 2009, DEP continued to maintain the 39 spill containment facilities installed at the outlets of 26 storm drains along Interstate 684 and

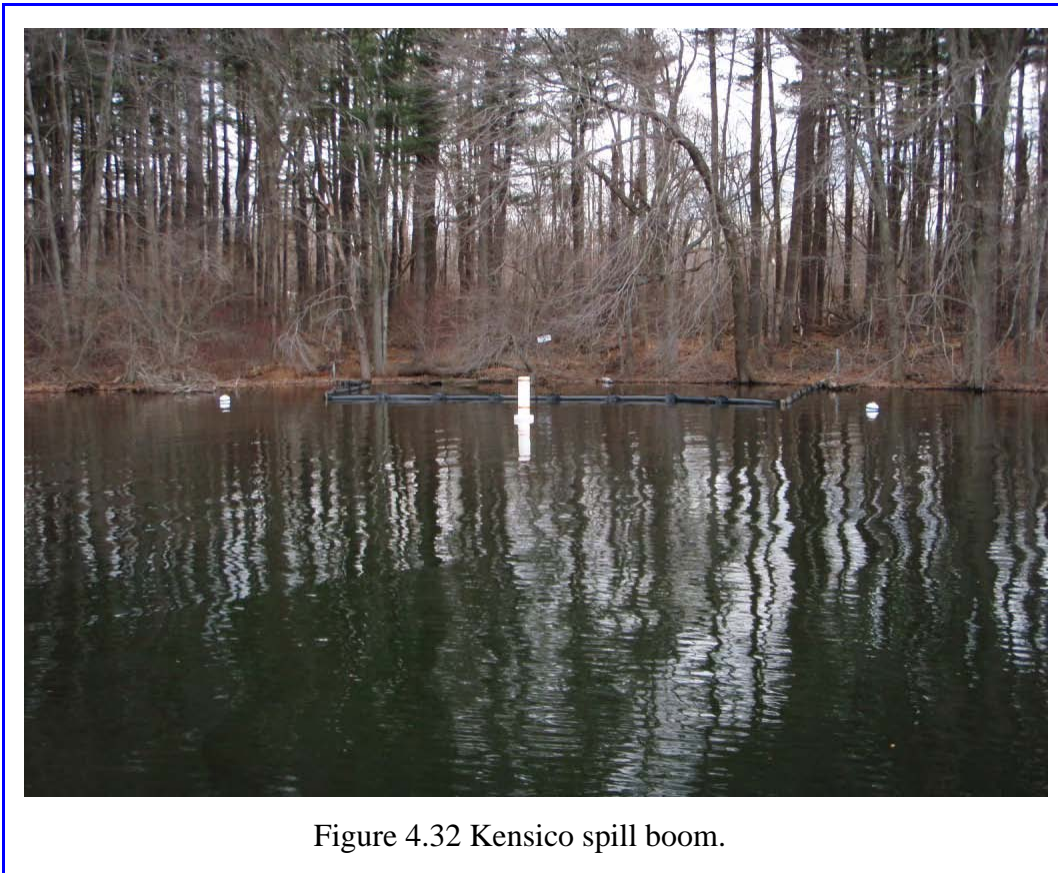
4. Protection and Remediation Programs

Route 120 (see Figure 4.32). Although no spills were reported on Interstate 684 or the roads surrounding Kensico since the booms were installed, the booms have functioned as designed.

Temporary booms located at the end of the boat ramp can encircle the ramp in the event of a spill. No spills or discharges occurred, nor was boom deployment required.



Figure 4.31 Spill containment facilities in and around Kensico Reservoir.



Turbidity Curtain

Along with the existing 1,100-foot-long turbidity curtain in the reservoir between the Catskill Upper Effluent Chamber and Malcolm and Young Brooks, a new 1,000-foot-long turbidity curtain was installed as a backup. This primary and secondary turbidity curtain system has effectively deflected discharges from the two watercourses away from the effluent chamber. In 2009, DEP monitored the extended turbidity curtain, and performed the following maintenance tasks:

- November 2009—A diving inspection was performed which generated a list of curtain sections requiring removal and replacement.
- November 2009—11 degraded curtain sections were removed and 11 new replacement curtain sections added. In addition, new stainless steel cables were added to the turbidity curtain.

BMP Monitoring

DEP conducted sampling at selected Kensico BMPs from 2000 to 2007. The goal of the monitoring was to quantify the fecal coliform, total suspended solids, and total phosphorus load reductions that can be attributed to four extended detention basins and one sand filter constructed

within Kensico catchments. Detailed findings of the monitoring can be found in Section 4.7 of this report.

4.10.2 Kensico Action Plan

Following completion of the Kensico Action Plan (KAP) in August 2007, DEP decided to implement the four proposed pollution remediation practices: 1) a pipeline system and engineering stormwater practice at N7, 2) an extended detention basin at N12, 3) stream stabilization at Whippoorwill Creek, and 4) drainage improvements along West Lake Drive to enhance the performance of BMPs 12 and 13.

During 2008, DEP reviewed the completed project specifications that were submitted by the design consultant. Design and contract documents were finalized and received legal review and approval. The first bid opening occurred in January 2009, but the project needed to be re-bid due to inadequate bids. DEP re-bid the project in April 2009 and selected a contractor. The selected contractor withdrew his bid in July 2009. DEP will bid the construction contract again once all permits are secured.

DEP secured all the necessary town permits in 2009. DEP was required to submit a separate permit application for each of the four sites. Additionally, the Whippoorwill site required permitting from the Town of Mt. Pleasant and the Town of North Castle. Still to be obtained are permits from ACOE; applications for these permits were submitted in October 2009. Approval of these permits will complete the permitting process.

4.10.3 West Lake Sewer Trunk Line

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

Sanitary Sewer Remote Monitoring System

DEP has proposed a sanitary sewer remote monitoring system for the West Lake Sewer Trunk Line, the purpose of which would be to provide real-time detection of problem events such as leaks, system breaks, overflows, and blockages, which in turn would facilitate a quick response to such problems. During the reporting period, DEP, the WCDEF Director of Maintenance, and Westchester County legal counsel established a project scope of work and a draft inter-municipal agreement (IMA). The IMA contains language that requires WCDEF to provide the contracting services for installation, monitoring, and maintenance of the system. The IMA also establishes a procurement process for reimbursement of capital expenses to Westchester County.

Sewer Line Visual Inspection

DEP conducts an annual visual inspection of the trunk line to assess the condition of exposed infrastructure, including manholes, for irregularities. The annual full inspection was performed in November 2009. Partial inspections were conducted throughout the year in association with ongoing routine maintenance of Kensico stormwater BMPs in the vicinity of the line. No defects or abnormalities were noted.

4.10.4 Video Inspection of Sanitary Sewers

DEP will establish a recurring inspection program for select portions of the sanitary sewer system located within the Kensico basin. This effort will be completed under the same contract as was entered into for the inspection and cleaning of the sanitary infrastructure contained within the EOH Cat/Del reservoir basins (see Section 4.9.2). The area that will be targeted includes several possible areas of concern that were identified during the prior video inspection of sanitary infrastructure in the Kensico basin.

4.10.5 Septic Repair Program

DEP initiated the Kensico Septic System Rehabilitation Reimbursement Program to reduce potential water quality impacts that can occur through failing septic systems. The program provides funding to reimburse a portion of the costs to rehabilitate eligible failing septic systems or connect those systems to an existing sewage collection system. The program is voluntary, with the goal of encouraging property owners to have their septic systems inspected, and if failing, rehabilitated. DEP is rolling out the program in three priority phases, with those properties located closest to Kensico Reservoir and watercourses given higher priority (Figure 4.33).

In 2008, DEP entered into an agreement with the New York State Environmental Facilities Corporation (EFC) to assist in implementing the program. In April 2009, EFC sent mailings to the 178 residents located in the Phase I priority area, which includes all residential properties thought to be served by an onsite wastewater system and located within 500 feet of the reservoir or reservoir stem or 100 feet of a watercourse. The letters notified residents of their eligibility for funding and provided a brief program overview. The mailing also included a response card that provides DEP with additional information on the status of the onsite wastewater system.

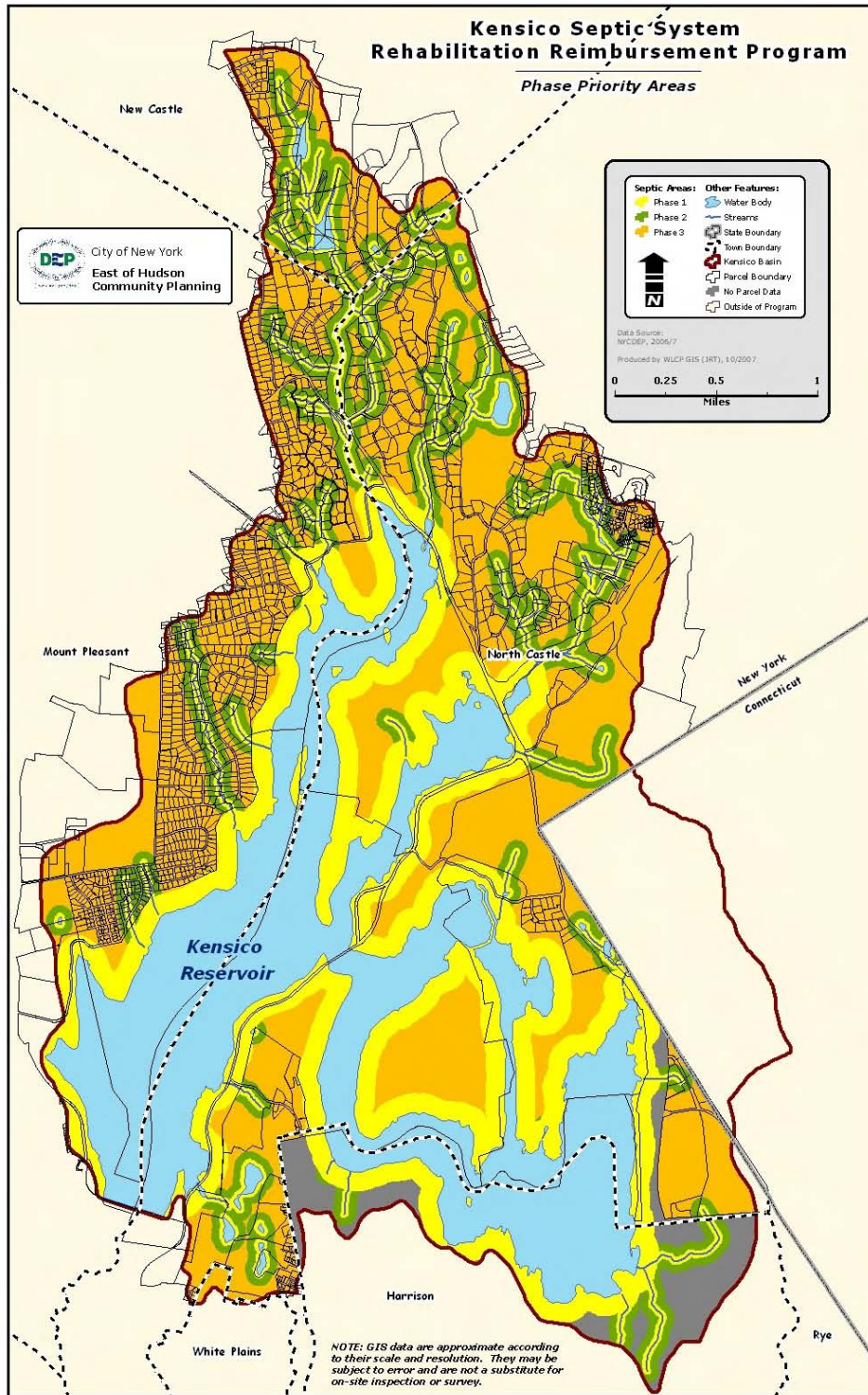


Figure 4.33 Kensico Reservoir Septic Program priority areas.

In October 2009, EFC mailed initial notification letters and response cards to 147 residents located in the Phase II priority area, which includes all residential properties located between 100 feet and 300 feet from a watercourse. At that time, EFC also mailed a follow-up notification to Phase I residents.

Several residents requested additional information about the program or indicated they did not know the status of their system. For these residents, EFC followed up with a telephone call and forwarded additional program information via mail.

Using data received from the mailed responses, DEP updated its database of parcels that are served by a municipal sewer system rather than an on-site wastewater system.

Initial notification letters will be sent to residents in the Phase III priority area in the first half of 2010. This priority area includes all remaining residential properties in the Kensico basin thought to be served by onsite wastewater treatment systems.

4.10.6 Turbidity Reduction

The Catskill Upper Effluent Chamber (CATUEC) is situated along the shore of a cove in the southwest section of Kensico Reservoir. The shoreline of this cove trends north to south, so that CATUEC faces east into the cove. The cove extends south and east into the main basin of the reservoir. Water from Kensico Reservoir enters CATUEC and is transported to the Catskill Lower Effluent Chamber (CATLEC) where Kensico Reservoir's Catskill Lower Effluent Chamber monitoring site (CATLEFF) is located. When wind velocities are sufficient to create wave action on the shoreline in the cove near CATUEC, sediment in this area may become resuspended and entrained into the Kensico Reservoir effluent that enters CATUEC, resulting in a short-term rise in turbidity values measured at CATLEFF.

DEP decided to implement a shoreline stabilization project south of the chamber to mitigate the erosion and possible resuspension of near-shore materials that may contribute to turbidity at CATUEC during wind events. After review of various alternatives, DEP determined that riprap would be the best material for stabilization and that a coffer dam would be the best way to dewater the work area adjacent to the shoreline during installation. The final design was completed in 2008.

During 2009, DEP spent significant time securing the necessary permits for the installation of the project. The Site Plan Approval package and Stormwater Pollution Prevention Plans (SPPP) were submitted to the Town of Mt. Pleasant in August 2009. All Town permitting approvals are dependent on a SEQRA Negative Declaration, which in turn is dependent on ACOE's approval of the Wetland Mitigation Plan. The Wetland Mitigation Plan for the shoreline stabilization was incorporated into the Conceptual Wetland Mitigation Plan that was originally developed for the KAP projects. The ACOE permit application was submitted in August 2009 and a Conceptual Wetland Mitigation Plan was submitted in December 2009.

4.10.7 Route 120

During 2009, there was no activity on the New York State Department of Transportation proposal for resurfacing I-684 and constructing stormwater treatment basins in the I-684 median from just south of the new Lake Street overpass in New York northward to the bridge over Tamarack Swamp in Connecticut. Due to a pending permit requirement from Connecticut, it is now anticipated that this project, which is a portion of the overall corridor project known as Routes 120 and 22/Exits 2 and 3 on I-684/Old Post Road, will begin in 2010.

4.10.8 Westchester County Airport

The Westchester County Airport is located east of Kensico Reservoir in close proximity to Rye Lake. As such, DEP continues to review any activities that are being proposed at the airport. Two projects were still pending in 2009. At this time, DEP has not identified serious problems with the proposals. The activities include the following:

- The relocation of the north perimeter road away from the northern end of Runway 16-34, and the removal of a portion of the existing north perimeter road. The north perimeter road will be relocated to increase safety at the north end of the runway, pursuant to FAA runway safety requirements. This project received SPPP approval in October 2009.
- Proposed improvements to the existing terminal area aircraft deicing system and related improvements. This proposal was initially part of a larger overall Airport Layout Plan modification, now being considered a separate project as requested by the Westchester County Planning Department. There was no new activity in 2009. A delay in obtaining federal grants to fund this project is contributing to project delays.

4.11 Catskill Turbidity Control

Due to the nature of the 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 stream beds, 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 has undertaken the Catskill Turbidity Control Study to provide a comprehensive analysis of engineering and structural alternatives to reduce turbidity levels in the Catskill System. DEP has 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 has been 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.

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: a 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 basin 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 system-wide 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 (described in more detail below). DEP is currently proceeding with development of the OST.

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

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

4.11.1 Phase II Schoharie Supporting Analyses

The focus of Catskill Turbidity Control Study activities in 2009 was additional analyses and performance evaluation of potentially feasible alternatives for improving turbidity and temperature control in diversions from Schoharie Reservoir. Key features of the Phase II Supporting Analyses (SA) included use of an updated version of the OASIS-W2 linked model, detailed sensitivity and uncertainty analyses comparable to those conducted under the Phase III study, and an updated performance evaluation of alternatives. This work is described in the *Phase II Implementation Plan: Updates and Supporting Analyses* submitted in July 2009.

Model Updates and Testing

In the 2006 Phase II study, the turbidity and temperature control performance of Schoharie alternatives was evaluated using an early version of the OASIS-W2 linked model. Numerous updates to this model were conducted under the Phase III study, including integration of Ashokan and Kensico water quality models, development of detailed operating rules for Ashokan hydraulic structures, and substantial revisions to Delaware basin release rules and system balancing rules. These model updates were included in the Phase II SA.

Additional model updates conducted for the Phase II SA included revisions to reflect the construction in 2006 of a spillway notch at Gilboa Dam, the planned installation of operable crest gates in the notch, and the planned construction of a Low-Level Outlet (LLO) at Gilboa Dam. These structures did not exist at the time of the original Phase II analysis. Provisional operating rules for these structures were developed and tested, and the linked OASIS-W2 was updated and tested accordingly.

Schoharie W2 water quality model work conducted for the Phase II SA included an analysis of system-specific paired turbidity and total suspended solids data to demonstrate the appropriateness of using turbidity as a model state variable at Schoharie Reservoir; updates to the Schoharie turbidity submodel to improve representation of particle sizes and deposition, consistent with the Ashokan and Kensico models; and correction of a coding error that generated false high turbidity predictions during periods of extreme drawdown. Additional testing, calibration, and validation of the turbidity submodel was conducted based on available monitoring data for Schoharie Creek, Schoharie Reservoir, and Shandaken Tunnel diversions. Detailed testing was also conducted for the Schoharie temperature submodel using available field data from 1989 to 2007 to characterize model performance under normal and drawdown conditions.

Sensitivity and Uncertainty Analyses

A detailed evaluation of the sensitivity of Schoharie W2 model predictions to uncertainty in model parameters and drivers was conducted under the Phase II SA. For parameters/inputs with substantial uncertainty, sensitivity testing was carried forward to extended time period W2 and linked OASIS-W2 model simulations. As with the Phase III work, the parameter with the greatest

impact on the absolute performance of alternatives was found to be the estimated turbidity level in Schoharie Creek. Available turbidity data for Schoharie Creek were evaluated along with available data for various potential drivers (e.g., flow, flow date, antecedent dry weather period) to investigate the potential for a more robust predictive expression for turbidity in this stream. The resulting turbidity-flow algorithms were used to estimate Schoharie Creek turbidity for the long-term simulation period based on daily average streamflow data. Sensitivity analyses on flow-turbidity relationships were conducted using the stand-alone W2 model and the linked OASIS-W2 model, based on alternative approaches for estimating Schoharie Creek turbidity loading and Monte Carlo analysis for representing uncorrelated variability. Long-term OASIS-W2 simulations of selected Schoharie turbidity control alternatives were carried out using several alternative flow-turbidity relationships.

An empirical model for predicting the turbidity of Esopus Creek at Allaben was also developed and integrated into the OASIS-W2 model to more accurately simulate operations under the delta-15 NTU turbidity threshold in the Shandaken Tunnel SPDES Permit, which requires that diversion turbidity be no more than 15 NTU greater than the ambient turbidity in Esopus Creek at Allaben.

Updated Performance Evaluation of Alternatives

Additional OASIS-W2 linked model simulations of alternatives were conducted to evaluate whether the various changes outlined above impacted the overall results and conclusions of the original Phase II analysis. Because of feasibility issues identified during Phase II, the in-reservoir baffle curtain was not carried forward under the Phase II SA. In addition to the MRO and MLI alternatives, the planned LLO was evaluated as a potential structure for providing turbidity control via increased downstream releases during periods of high turbidity in the reservoir.

Major findings of the Phase II SA include:

- No alternative will completely eliminate the occurrence of elevated diversion turbidity levels at Schoharie Reservoir. However, the predicted frequency of diversions that exceed the delta-15 NTU turbidity threshold is low over the 61-year simulation period, and all alternatives can be operated in compliance with the SPDES Permit limits.
- **Modified Reservoir Operations**: Consistent with Phase II findings, the Phase II SA found that operation of the existing intake can be modified to substantially reduce the frequency of diversions that exceed the delta-15 NTU and 70°F thresholds. Shutting off the Shandaken Tunnel when the turbidity exceeds 100 NTU and reducing flow to minimum required levels whenever turbidity exceeds delta-15 NTU can substantially reduce the load of turbidity-causing particles delivered to Esopus Creek. Further, hypolimnetic banking can be implemented as an additional component of MRO to reduce peak summer diversion temperatures and reduce the occurrence of diversions that exceed 70°F. Banking can also be combined with other alternatives to provide improved temperature control.

- **Multi-Level Intake:** Consistent with Phase II findings, the Phase II SA results indicate that an MLI at either the existing intake location (Site 3) or downstream at Site 1.5 would provide little additional turbidity control benefit beyond that provided by MRO. Both MLI sites provide similar overall turbidity performance. As was observed in Phase II, an MLI at either site is predicted to provide a slight reduction in diversion turbidity levels in early summer, relative to MRO. An MLI at either location can provide control over peak summer temperatures by allowing withdrawals from warmer upper strata in the spring and early summer, thereby conserving the cold water pool for late summer diversions.
- **Low-Level Outlet:** The planned LLO at Gilboa Dam could be operated to implement a snowpack management program at Schoharie Reservoir. This operation was included as a baseline operating rule for all alternatives. The Phase II SA also indicated that the LLO could potentially be operated to improve turbidity control in Shandaken Tunnel diversions by making releases from the reservoir subsequent to turbidity events. Operation of the LLO for turbidity control purposes was predicted to provide slightly better overall turbidity performance than either MRO or MLI, and could also be combined with hypolimnetic banking to control peak summer diversion temperatures. Operation of the LLO for turbidity control would require detailed analysis of potential downstream impacts, as well as further refinement and testing of operating rules that balance water quality and water supply reliability objectives.

Overall, the results of the Phase II SA performance evaluation were qualitatively similar to those of the original Phase II evaluation and corroborate the findings of the Phase II Final Report. MRO is the most feasible, effective, and cost-effective alternative for improving turbidity and temperature control at Schoharie Reservoir. The planned OST is expected to provide DEP with the monitoring and predictive capability necessary to refine, adopt, and implement formal operating rules for Schoharie Reservoir that balance turbidity and temperature control objectives while maintaining water supply reliability for the overall NYC water supply system.

4.11.2 Implementation of Catskill Turbidity Control Alternatives

DEP is proceeding with implementation of turbidity control measures at Schoharie and Ashokan Reservoirs consistent with the Phase II and Phase III Implementation Plans, respectively. A common feature of these plans is MRO, which will rely on the development of a system-wide OST. The OST is based on the OASIS-W2 linked model framework developed under the Phase II and Phase III studies, and includes links to real-time hydrologic and water quality data, as well as a substantial suite of enhancements that will allow operators to optimize reservoir release and diversion decisions at Schoharie and Ashokan Reservoirs, and throughout the system.

In 2008 DEP issued a Request for Proposals for the OST and selected a consultant team to develop the OST. The contract was finalized in early 2009, and work on the project began in November 2009. A beta-version of the OST will be deployed in October 2012, and the final version will be deployed in October 2013.

In addition to implementation of the OST, DEP is proceeding with implementation of additional turbidity control measures identified in the Phase III (Ashokan) Implementation Plan. These include:

- Catskill Aqueduct Improvements: Reducing diversions from the Catskill System during elevated turbidity conditions was found to be the most effective way to reduce the turbidity load entering Kensico Reservoir and reduce the frequency and duration of alum treatment events. DEP's ability to readily reduce diversions from the Catskill System during turbidity events could be substantially improved by physical improvements to the Catskill Aqueduct. Three improvement options have been identified: improvements to stop shutter locations, improvements to outside community taps, and/or a connection to Shaft 4 of the Delaware Aqueduct. Additional evaluation and refinement of these alternatives was initiated in 2009. Completion of the Croton WWTP in 2012 will also substantially increase DEP's ability to reduce diversions from the Catskill System during elevated turbidity conditions.
- Waste Channel Operation/West Basin Drawdown: Releasing water from the West Basin during or in anticipation of a turbidity event was found to be effective at reducing turbidity levels entering Kensico Reservoir and in reducing the frequency and duration of alum treatment events. Operation of the existing Ashokan Waste Channel is currently practiced on a provisional basis within applicable flow constraints. DEP continues to proceed with this alternative through valve improvements, development of operating protocols using the OST, and acquisition of low-lying portions of the Ashokan Field Campus and restoration of the stream channel.

4.11.3 Reservoir Monitoring

Routine Monitoring

UFI conducted a monitoring program on Ashokan Reservoir in 2009 that focused on robotic monitoring of turbidity-related water quality issues. The program covered the period from mid-May (May 15) through mid-December (Dec. 15). Full water column profiles of temperature, specific conductance, turbidity, and dissolved oxygen were made at 1 m intervals at three sites (Sites 1.4 and 3.1 in the West Basin and Site 4.2 in the East Basin) from the surface to near-bottom. Profiles were collected at least once per day, but were often collected at an interval of every six hours at each site. The data were collected and transmitted in near-real time to UFI and uploaded to a website accessible by DEP personnel.

An on-site meteorological station that measured air temperature, wind speed and direction, relative humidity, and solar radiation was maintained at the Site 1.4 robotic platform. Meteorological data were collected every 20 minutes, nearly continuously over the deployment interval. The data were collected and transmitted in near-real time to UFI and uploaded to a website accessible by DEP personnel.

The robotic platforms were maintained biweekly (total of 16 trips). Maintenance included sonde exchanges, verification of proper functioning, and verification of robotic profile data with a hand-held YSI sonde and datalogger.

Event Monitoring

UFI conducted runoff event monitoring in the West Basin on seven dates in 2009: June 23, July 31, August 3, August 6, October 27, December 4, and December 7. Event monitoring consisted of SeaBird profiles at approximately 30 locations (locations varied). SeaBird profile data included temperature, specific conductance, optical backscatter, and beam attenuation coefficient collected at 0.25 m intervals from the surface to near-bottom. Water samples were collected at 5 m intervals at several sites including the robotic platform sites, with locations varying depending upon event characteristics. Water samples were analyzed for turbidity, total suspended solids, and beam attenuation coefficient. A subset of samples was also analyzed for individual particle analysis (IPA) by scanning electron microscopy interfaced with automated image and x-ray analyses (SAX).

4.12 Sand and Salt Storage

During the first few months of 2009, DEP helped CWC draft the program rules for implementing the new Institutional Sand and Salt Storage Facilities Program. The rules were finalized and approved by CWC at its June 2009 Board of Directors meeting.

Subsequently, in the fall of 2009, CWC contacted institutional facilities (e.g., schools, camps, hospitals, places of worship) throughout the West of Hudson watershed to see if they were eligible to build new or rehabilitate existing sand and salt storage facilities pursuant to the threshold requirements in the WR&R. Eligible institutions were then encouraged to submit an application to CWC to receive program funding to construct a new, or refurbish an existing, sand and salt storage shed on their property. To date, CWC has not received applications from institutions in the WOH watershed to participate in the program.

5. Watershed Monitoring, Modeling, and GIS

5.1 Watershed Monitoring Program

In order to ensure high quality drinking water, DEP conducts extensive water quality monitoring that encompasses all areas of the watershed, including sites at aqueducts (keypoints), streams, and reservoirs. DEP's monitoring activities for 2009 are documented in the *2009 Watershed Water Quality Monitoring Plan (WWQMP)* (DEP 2009a). The monitoring plan is designed to meet the broad range of DEP's many regulatory and informational requirements. These requirements include: compliance with all federal, state, and local regulations to ensure safety of the water supply for public health; watershed protection and improvement to meet the terms of the 2007 FAD; the need for current and future predictions of watershed conditions and reservoir water quality to ensure that operational decisions and policies are fully supported over the long term; and the need for ongoing surveillance to ensure delivery of the best water quality to consumers.

The overall goal of the plan is to establish an objective-based water quality monitoring network, which provides scientifically defensible information regarding the understanding, protection, and management of the New York City water supply. The objectives of this monitoring 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, monitoring requirements were derived from 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.

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) and its subsequent extensions, as well as the New York City Watershed Rules and Regulations (WR&R), the Croton Consent Decree (CCD), Administrative Orders, and State Pollution Discharge Elimination System (SPDES) permits. The sampling sites, analytes, and frequencies are defined in each objective according to each specific rule or regulation and are driven by the need of the water supply as a public utility to comply with all regulations. Since this monitoring is mandatory, it must maintain compliance with all EPA, DOH, and DEP regulations.

As New York City's water supply is one of the few large water supplies in the country that qualifies for Filtration Avoidance, based on both objective water quality criteria and subjective watershed protection requirements, EPA has specified many requirements in the 2007 FAD that must be met to protect public health. These objectives 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. As

watershed protection programs develop and analytical techniques for key parameters change, it is necessary to reassess the monitoring program to ensure that it continues to support DEP's watershed management program. The periodic reassessment of the City's monitoring program is achieved by critical review and revision of the monitoring plan approximately every five years. The City also conducts a periodic assessment of the effectiveness of the watershed protection program. DEP's water quality monitoring data are essential to evaluate watershed programs. Program effects on water quality are reported in the Watershed Protection Summary and Assessment reports (e.g., DEP 2006a), also produced approximately every five years.

The 2007 FAD also requires that DEP's watershed-wide monitoring program meet the needs of the Long-Term Watershed Protection Program (DEP 2006b). The goals of this program are to:

- Provide an up-to-date, objective-based monitoring plan for the routine watershed water quality monitoring programs, including aqueducts, streams, reservoirs, and pathogens
- Provide routine water quality results for aqueduct, stream, reservoir, and pathogen programs to assess compliance, provide comparisons with established benchmarks, and describe ongoing research activities.
- Provide mid-term results from routine watershed (e.g., stream and WWTP) pathogen monitoring.
- Use water quality data to evaluate the source and fate of pollutants, and the effectiveness of watershed protection efforts at controlling pollutants.
- Provide a comprehensive evaluation of watershed water quality status and trends to support assessment of the effectiveness of watershed protection programs.

These goals are met by targeting specific watershed protection programs and examining overall status and trends of water quality. Water quality represents the cumulative effects of land use and DEP's watershed protection and remediation programs. The ultimate goal of the watershed protection programs is to maintain the status of the City's water supply, as one of the few large unfiltered systems in the nation, far into the future.

Modeling data are used to meet the long-term goals for water supply policy and protection and to provide guidance for short-term operational strategies when unusual water quality events occur. The modeling goals of FAD projects include: 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 models, including land use, watershed program implementation data, and time series of meteorological data, stream flow, and water chemistry; development of data analysis tools supporting modeling projects; and applications of DEP models to support watershed management, reservoir operations, climate change analysis, and long-term planning, as identified in DEP's Climate Change Task Force Action Plan (DEP 2008a).

There are several types of data needed to develop, calibrate, and validate models: stream, reservoir and aqueduct, and meteorological. Stream monitoring includes flow monitoring and targeted water quality sampling to support watershed and reservoir model development, testing, and applications. Reservoir monitoring provides flow and reservoir operations data to support reservoir water balance calculations. The water balance and reservoir water quality data are necessary model inputs, and are required to continue to test, apply, and further develop DEP's one- and two-dimensional modeling tools. The meteorological data collection effort provides critical input necessary to meet both watershed and reservoir modeling goals.

The surveillance monitoring plan contains several objectives that provide information to guide the operation of the water supply system, other objectives to help track the status and trends of constituents and biota in the system, and specific objectives that include aqueduct monitoring for management and operational decisions. The aqueduct network of sampling points consists of key locations along the aqueducts, developed to track the overall quality of water as it flows through the system. Data from these key aqueduct locations are supplemented by reservoir water quality data. Another surveillance objective relates to developing a baseline understanding of potential contaminants that include trace metals, volatile organic compounds, and pesticides, while another summarizes how DEP monitors for the presence of zebra mussels in the system, a surveillance activity meant to trigger actions to protect the infrastructure from becoming clogged by these mussels. 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. Together, these objectives allow DEP to maintain an awareness of water quality for the purpose of managing the watershed, developing protective programs and policies, and guiding operation of the supply to provide the highest quality drinking water possible.

Several non-routine events in 2009 led to additional monitoring requirements. These included a taste complaint issue that began in early October 2009 and was traced to an algal bloom in Kensico Reservoir. Changes in reservoir operations were made until the bloom subsided. Also, in 2009 the Rondout-West Branch section (RWBT) of the Delaware Aqueduct was shut down for repairs at Shaft 6. To supplement the water supply during the shut down of the RWBT, the Croton Falls Pumping Station was activated from December 5–28, 2009. Supplementary sampling was required during this operation and an after action report will be prepared. Extra sampling also occurred on the Cannonsville Reservoir in an effort to monitor potential water quality impacts from the Cannonsville Recreational Boating Pilot Program.

Finally, non-routine water quality monitoring, referred to as Special Investigations (SIs), are conducted when appropriate to document man-made or natural events occurring in the watershed that have the potential to negatively affect water quality. Sewage conveyance overflows and oil spills are anthropogenic events requiring monitoring. These events are documented in SI reports. Also, major storm and runoff events that impact the water supply may necessitate intense

water quality monitoring to forecast the movement of the contamination, provide guidance for operations to avoid treatment, or ensure the efficacy of treatment. These events are also documented in individual reports as appropriate.

Pursuant to the City’s Long-Term Watershed Protection Program (DEP 2006b) and as a FAD requirement (Section 5.1 Watershed Monitoring Program), DEP also produces a Watershed Water Quality Annual Report which is submitted to EPA in July of each year. 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 2009 report (due 2010), the limnology and hydrology components of the document will draw largely from information obtained from approximately 204 routinely-sampled reservoir and stream sites, resulting in almost 4,500 samples and over 61,000 analyses. For the pathogen component, a total of 623 routine samples were analyzed for *Giardia*, *Cryptosporidium*, turbidity, pH, and temperature (4,636 analyses) at 60 sampling sites (including keypoints), while 238 samples (as of September 2009) were collected for human enteric virus examination.

It is of great importance for DEP to remain aware of pathogenic protozoan concentrations in the water supply on an ongoing basis and to be able to confirm that pathogens do not threaten the safety of the water supply. For this reason, pathogen data are reported frequently and in several different reports to maintain a constant flow of information to DEP managers and regulators. The following reports on protozoan pathogens were issued in 2009:

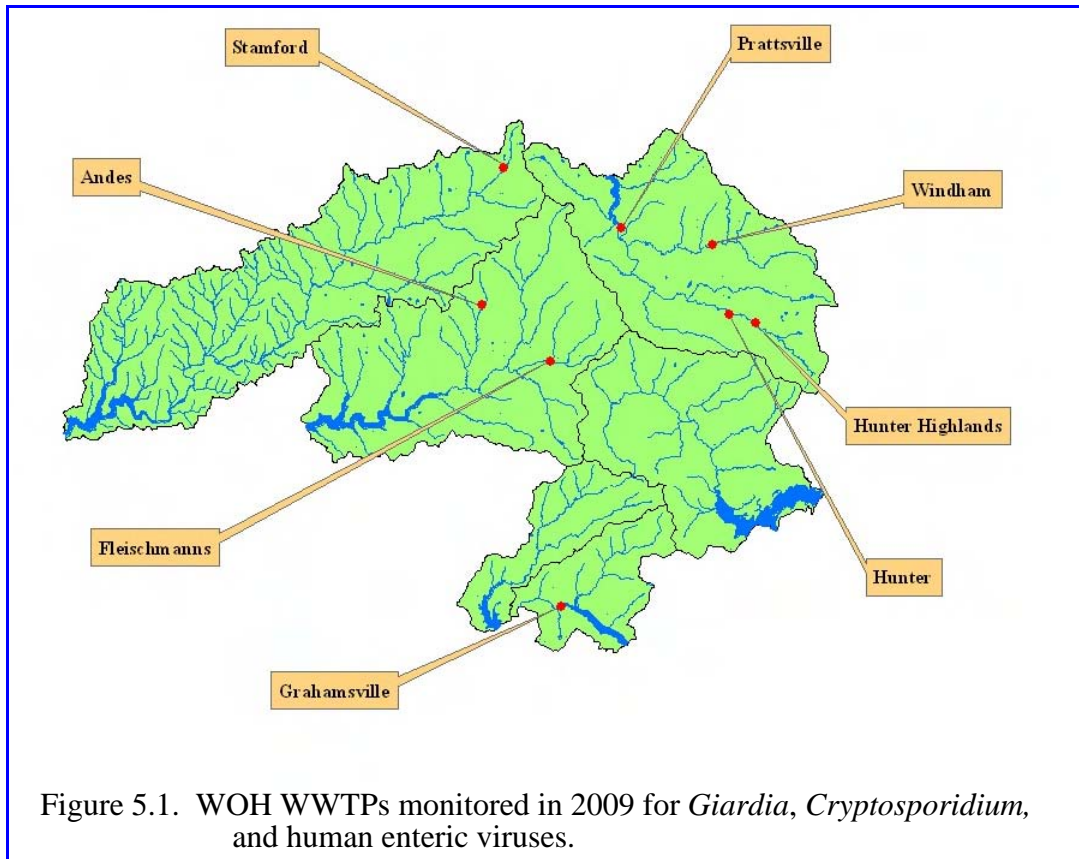
- Weekly results of *Cryptosporidium* and *Giardia* sampling at the three source waters are routinely posted on DEP’s website
- Monthly Filtration Avoidance Reports
- Monthly Croton Consent Decree Reports
- Mid-term report on DEP pathogen studies of *Giardia* spp., *Cryptosporidium* spp., and human enteric viruses (annual)
- Kensico Reservoir Report (annual)
- Watershed Water Quality Annual Report
- Drinking Water Supply and Quality Annual Report

Additional reports are submitted as part of FAD Section 4.10, Kensico Water Quality Control Program. DEP submits a Kensico Programs Annual Report to EPA in January which includes a section that presents, discusses, and analyzes monitoring data (e.g., keypoint, reservoir, stream, BMPs) from the Kensico watershed and provides an update on the status and application of the Kensico reservoir model. This report contains information such as fecal coliform bacteria and turbidity results obtained at various keypoint, stream, and reservoir locations. Additionally, the document reports observations from the assessment of Kensico BMPs, sampling for toxic substances,

and applications of the Kensico water quality model to guide operations. A Kensico Programs Semi-Annual Report is submitted in July that provides a brief report discussing material events in Kensico Program implementation.

5.2 WWTP Pathogen Monitoring

The purpose of the WWTP Pathogen Monitoring Program is to determine whether micro-filtration, and technologies deemed equivalent, continue to perform well by effectively removing pathogens from the effluents of the plants. From July 2002 through December 2008, DEP monitored the same 10 WWTPs quarterly, as stated in the previous monitoring plan. These sites included: Hunter Highlands, Delhi, Pine Hill, Hobart, Margaretville, Grahamsville, Grand Gorge, Tannersville, Stamford, and Walton. In 2009, the new Watershed Water Quality Monitoring Plan (WWQMP) (DEP 2009) took effect. The WWQMP outlines monitoring for five new WWTPs west of the Hudson River (WOH), while maintaining monitoring at three of the previous locations: Grahamsville (now RGMF), Hunter Highlands (now Hunter Highlands BD), and Stamford (STP). The five new plants are: Andes (PANDE), Fleischmanns (PFTP), Hunter (Hunter WTP), Prattsville (Prattsville WTP), and Windham (Windham WTP). (Site names in parentheses.) All plants are scheduled for quarterly monitoring. (See Figure 5.1 for plant locations.)



As scheduled, all plants were sampled at least four times in 2009, for *Giardia*, *Cryptosporidium*, and human enteric viruses (HEV). One plant, Andes, was sampled in January for *Giardia* and *Cryptosporidium*, and then again in March to collect a virus sample, at which time the protozoan samples were once more. This represented the second collection of protozoan samples in the quarter, totaling five for the year. Monitoring for *Cryptosporidium* and *Giardia* involved the collection of 50 L aliquots, and samples were analyzed by DEP according to EPA Method 1623 (EPA 2001). HEV samples involved the collection of 200-300 L aliquots, and samples were analyzed as per the ICR method (EPA 1996) at Environmental Associates Laboratory (EAL) Ltd.

Giardia

Seven of the eight WWTPs sampled in 2009 were negative for *Giardia* cysts during all four quarters (Table 5.1). The eighth plant was Fleischmanns, which had 2 positive detections out of four samples. The concentrations were 3 cysts and 7 cysts per 50L in March and September, respectively. Nothing out of the ordinary was reported by operators for the March detect; however, the sample leading to the September detection was collected within 30 minutes after the plant had been turned back on after not discharging for three days. This may have contributed to the result. In addition, the local population is known to increase in that area around that time period for the observance of a religious holiday. While the flow recorded at the time of sample collection did not show an increase, the increased population may have compounded the situation.

Table 5.1. Pathogen results for WOH WWTPs sampled in 2009.

Site Name*	Sample Date	<i>Cryptosporidium</i> (oocysts 50L ⁻¹)	<i>Giardia</i> (cysts 50L ⁻¹)	Analyzed Volume (Liters)	HEV (MPN 100L ⁻¹)
Hunter Highlands BD	16-Mar-09	0	0	50.0	NI
Hunter Highlands BD	26-May-09	0	0	50.0	NI
Hunter Highlands BD	24-Aug-09	0	0	50.0	NI
Hunter Highlands BD	02-Nov-09	0	0	50.5	NI
Hunter WTP	09-Feb-09	0	0	50.0	NI
Hunter WTP	27-Apr-09	0	0	50.0	NI
Hunter WTP	13-Jul-09	0	0	50.0	NI
Hunter WTP	26-Oct-09	0	0	50.0	NI
PANDE	20-Jan-09	0	0	50.0	nsr
PANDE	30-Mar-09	0	0	50.0	NI
PANDE	22-Jun-09	0	0	51.0	NI
PANDE	28-Sep-09	0	0	50.0	NI
PANDE	07-Dec-09	0	0	50.0	NI
PFTP	31-Mar-09	0	3	50.0	NI
PFTP	15-Jun-09	0	0	50.0	NI
PFTP	22-Sep-09	0	7	50.0	NI
PFTP	15-Dec-09	0	0	50.0	NI

Table 5.1. (Continued) Pathogen results for WOH WWTPs sampled in 2009.

Site Name*	Sample Date	<i>Cryptosporidium</i> (oocysts 50L ⁻¹)	<i>Giardia</i> (cysts 50L ⁻¹)	Analyzed Volume (Liters)	HEV (MPN 100L ⁻¹)
Prattsville WTP	26-Jan-09	0	0	50.0	NI
Prattsville WTP	06-Apr-09	0	0	50.0	NI
Prattsville WTP	20-Jul-09	0	0	50.0	NI
Prattsville WTP	20-Oct-09	0	0	50.0	NI
RGMF	17-Feb-09	0	0	50.0	NI
RGMF	18-May-09	0	0	50.0	NI
RGMF	18-Aug-09	0	0	50.0	1.03
RGMF	23-Nov-09	0	0	50.0	NI
STP	23-Mar-09	0	0	50.0	NI
STP	01-Jun-09	0	0	50.0	NI
STP	14-Sep-09	0	0	50.0	NI
STP	08-Dec-09	0	0	50.0	NI
Windham WTP	23-Feb-09	0	0	50.0	NI
Windham WTP	19-May-09	0	0	50.0	NI
Windham WTP	17-Aug-09	0	0	50.0	NI
Windham WTP	24-Nov-09	0	0	50.0	NI

*These are the site names as they appear in the official DEP database. For locations of sites not referenced in the site name, see p. 145.

NI = non-isolated

nsr = no sample required (protozoan and HEV samples were not always collected on the same day).

In 2008, the Grahamsville WWTP was positive for *Giardia* for each of the quarterly sampling events. However, as DEP has reported previously, Grahamsville has been the subject of additional sampling in the past due to positive results. DEP hypothesized that the previous routine sample location, which was located downstream of an uncovered chlorine contact tank, was the cause of the positive results, due to the potential for wildlife to contaminate the system post-microfiltration. Consequently, the sample location was shifted in 2009 to a location upstream of the uncovered chlorine contact tank. The sample location is now called RGMF, and the sample site is located just after microfiltration, but before the open tank. The RGMF site did not have any positive detections of cysts in 2009; however, it did have one positive HEV result, which is described below. Note that the Hunter Highlands sample location was also changed in 2009, since it too has a tank that can be contaminated post-treatment.

Cryptosporidium

All eight WWTPs sampled in 2009 were negative for *Cryptosporidium* oocysts (Table 5.1).

Human Enteric Viruses

Seven out of the eight WWTPs sampled in 2009 were negative for human enteric viruses during all four quarters (Table 5.1). The eighth site was at the Grahamsville plant (RGMF), which had a positive detect of 1.03 HEV MPN per 100L in August. As mentioned previously, this is a new location as of 2009, so this sample was collected right after microfiltration, but prior to chlorination and the open contact tank.

5.3 Multi-Tiered Water Quality Modeling Program

DEP’s Multi-Tiered Water Quality Modeling Program develops, maintains, and applies integrated watershed and reservoir modeling tools to support long-term watershed management, investigate effects of climate change on the water supply, and evaluate short-term operational strategies for maintaining high quality NYC drinking water. These modeling applications are supported by model and data development activities including the improvement and refinement of model algorithms and software, testing of models, acquisition of necessary model input data, and derivation of model parameters based on data.

During 2009, the Modeling Program focused efforts on the following modeling applications and development activities (DEP 2009b):

- Completion of Phase I of the Climate Change Integrated Modeling Project, including a preliminary analysis of possible effects of climate change on water quantity in the WOH reservoir system, turbidity in Schoharie Reservoir, and eutrophication in Cannonsville Reservoir
- Completion of the PROTBAS modeling project for Cannonsville and Pepacton Reservoirs
- Developing contract research positions with CUNY to advance model development and application
- GIS analyses for the development of a watershed/reservoir atlas and for calculation of reservoir storage
- Modeling data acquisition and organization
- Presentations of Modeling Program activities

Completion of Phase I of the Climate Change Integrated Modeling Project (CCIMP)

During 2009, DEP completed Phase I of the CCIMP. The project is a long-term effort to evaluate the effects of future climate change on the quantity and quality of water in the NYC water supply, and to evaluate how such effects could influence the use and operation of the water supply. Phase I focused on a “first-cut” analysis of water quantity in the WOH portion of the system, turbidity in Schoharie Reservoir, and eutrophication in Cannonsville Reservoir. Phase I was designed specifically with the goal of making an initial estimate of climate change impacts using available Global Climate Models (GCM) datasets and DEP’s present suite of watershed, reservoir, and system operation models. As part of meeting this goal, the DEP modeling unit made progress in developing the tools that will be necessary for carrying out these and other analyses in the future.

Some of the general findings of Phase I include:

- The timing of the snowmelt occurring during the spring under current conditions is predicted under future climate scenarios to shift from a distinct peak in late March and April to being more consistently distributed throughout the winter and fall. Increased winter temperatures are predicted to cause more precipitation to fall as rain and less as snow. The snowpack that develops will be smaller and melt faster. The consequent shift in streamflow drives many of the findings obtained from applications of the water system and reservoir water quality models.
- For the WOH system, drought seems to be less prevalent, as the GCM scenarios used in this study tended to increase precipitation throughout the year, which compensated for increased evapotranspiration due to higher temperatures.
- The shifting seasonal pattern in streamflow similarly affects the turbidity loads into Schoharie Reservoir, which in turn impacts the Schoharie withdrawals, with increased turbidity in the fall and winter and decreased turbidity in the spring.
- The nutrient loads to Cannonsville Reservoir also exhibited shifts similar to the streamflow shifts noted above. However, despite increased nutrient loads during the winter and fall, the response of the phytoplankton was small, presumably due to unfavorable growth conditions at this time of the year. The thermal structure of the reservoir was impacted by the warmer temperatures of the future climate, with thermal stratification beginning earlier in the spring and lasting longer into the fall. Phytoplankton levels increased slightly under the future climate scenarios. When looking at the relative importance of changes in reservoir hydrodynamics/thermal structure versus changes in watershed inputs, it seems that future water temperature more strongly influenced chlorophyll concentration in May, but during the other months the effect on chlorophyll is divided equally between the thermal and loading effects.

Phase II of the project will expand upon the results of Phase I and include the use of more detailed and refined data and models.

PROTBAS/One Dimensional Reservoir Hydrothermal and Eutrophication Model Upgrades

In July 2008, DEP completed a project to develop an improved eutrophication model for Cannonsville Reservoir by merging the best features of the PROTECH phytoplankton model as described by Reynolds et al. (2001) and the reservoir water quality models previously developed for DEP by the Upstate Freshwater Institute (UFI) (Upstate Freshwater Institute 2001). Based on the success of this effort (DEP 2008b), the contract was extended for an additional year to allow for several additional modeling tasks to be completed.

- Setting up calibration and testing of the new reservoir water quality model, including the PROTECH algorithms, on Pepacton Reservoir
- Running long-term simulations specifying changes in phytoplankton succession on Pepacton Reservoir under present conditions, as has been done for Cannonsville Reservoir
- Running long-term simulations of phytoplankton succession on Cannonsville and Pepacton Reservoirs under conditions of future climate change

All of the above tasks were completed during 2009 and a brief report describing the project results has been delivered to DEP (Upstate Freshwater Institute 2009).

The results demonstrated that the hybrid UFI-PROTBAS model was able to successfully simulate long-term variations in Pepacton Reservoir nutrient levels and chlorophyll concentrations, as judged by the match between simulated data and measurements made by DEP's routine reservoir monitoring program. Simulations of phytoplankton functional groups were not as successful as those made for Cannonsville Reservoir, suggesting that differences in nutrient loading and trophic status may make Cannonsville more suitable for the PROTBAS functional group algorithms.

Also as part of this project, preliminary future climate simulations were carried out for both Cannonsville and Pepacton Reservoirs using methods and future climate scenarios similar to those used in the CCIMP. Both reservoirs were impacted by future changes in the timing of nutrient delivery, which resulted in a significant increase in winter inputs followed by a significant decrease in spring loading rates, and small reductions in summer loading. These changes led to a different phytoplankton response, with somewhat greater levels of phytoplankton predicted during stratified conditions in Cannonsville and somewhat lower concentrations predicted in Pepacton. These differences appear to be at least partly explained by small inter-watershed differences in timing and magnitude of nutrient loading, and perhaps other factors related to in-reservoir processes. The different reservoir responses to similar scenarios of climate change illustrate how future climate predictions can be sensitive to small differences in model inputs and parameterization. This initial study highlights the need for more detailed studies to be carried out in Phase II of the CCIMP, which will, among other things, systematically investigate the sensitivity of processes that led to the inter-reservoir differences obtained by the Cannonsville and Pepacton PROTBAS simulations.

Postdoctoral Research Associates Supporting Water Quality Modeling

To achieve its modeling goals over the next several years, DEP has developed a contract with Hunter College of the City University of New York (CUNY). This contract provides CUNY with the funding needed to hire seven postdoctoral research associates (post docs) who are jointly advised by CUNY faculty and DEP scientists. The post docs are stationed in Kingston, New York, working with the Water Quality Modeling Section on a day-to-day basis. The positions are for an initial two-year period, with the possibility of an additional two-year extension. The positions are in the following areas of specialty, each of which is meant to fulfill necessary modeling goals in the areas of climate change evaluation, turbidity modeling, and watershed management program evaluation: (1) climate data analysis, (2) water system modeling, (3) watershed sediment modeling, (4) watershed hydrology and nutrient load modeling, (5) reservoir eutrophication modeling, (6) reservoir turbidity modeling, and (7) forest ecosystem modeling. During 2009, positions (1) through (4) were filled; plans are to fill the remaining three positions in 2010.

GIS Watershed and Reservoir Atlas and Reservoir Storage Calculations

During 2009, work continued on production of a NYC Watershed/Reservoir Atlas that presents information about the reservoirs and drainage basins of the NYC water supply system in map and tabular formats. At this initial stage of development, the atlas includes the six West of Hudson reservoirs (Ashokan, Cannonsville, Neversink, Pepacton, Rondout, and Schoharie) and two reservoirs in the East of Hudson (EOH) region (Kensico, West Branch). Bathymetric surveys of these water bodies were performed in the 1990s utilizing GPS and Sonar technologies. Bathymetric data for the remaining EOH reservoirs are either of poor quality or non-existent.

For each reservoir basin, the atlas includes a general map of the drainage area, which locates the basin in geographic space with roads, villages, and other points of interest, while also presenting an indication of basin topography. A second map shows the reservoir drainage area, illustrating the land cover/land use of each reservoir basin. To portray the bathymetry of each reservoir a large scale map is used. Tables of land cover/land use areas are also presented.

Also during 2009, tables of reservoir storage were derived from bathymetric data in the GIS Library and compared with storage tables used by the Operations Directorate and others in DEP. Based on the results of this preliminary analysis, work is continuing on evaluating the quality of the input data, the strengths and limitations of different GIS methods for calculating storage values, and visualization of output data. Reservoirs with poor-quality or non-existent bathymetry were not included in the review. A Capital Budget request has been approved to perform bathymetric surveys of these water bodies. Development of a scope of work is underway. Once final data products are available, this evaluation will be revisited as updated elevation/storage tables are prepared for reservoir modeling.

Modeling Data Acquisition and Organization

During 2009, modeling GIS staff supported an evaluation of the USGS stream monitoring network in the watershed region, including planning for future network design and funding. Additionally, GIS datasets to support modeling were added to DEP's Geodatabase; the possible use of NetCDF tools was investigated for the purposes of visualization, extraction and query of multi-dimensional arrays of GCM data; and detailed bathymetric calculations were performed for Kensico Reservoir for support of reservoir model development by UFI.

Historical time series data used for modeling are collected at specific locations within the watershed and placed in a modeling time series data library. During 2009, updates through 2008 of the following datasets were added to the time series data: meteorology data from the Northeast Regional Climate Center, USGS streamflow, DEP stream and limnology water quality, DEP key-point, and DEP reservoir operations.

In support of Phase II of the CCIMP, data from 21 GCMs were obtained from the World Climate Research Programme’s Coupled Model Intercomparison Project (CMIP3) multi-model dataset. These data will be processed and evaluated for use in Phase II of the CCIMP.

Modeling Program Presentations

Members of the water quality modeling section presented program descriptions and results at a number of scientific conferences during the year.

The focus of the New York City Watershed Science and Technical Conference, held at West Point, NY, September 14-15, 2009, was “Climate Change and its Effects on Watersheds.” The water quality modeling section conducted a set of five featured presentations describing the CCIMP and summarizing results to date. The presentations focused on: (1) an overview of the integrated modeling project; (2) development of climate change scenarios used for input to DEP’s integrated models; (3) results of system modeling using the OASIS model; (4) results of water quality modeling for turbidity in Schoharie Reservoir and eutrophication in Cannonsville Reservoir; and (5) results of potential climate change effects on the dynamics of phytoplankton functional groups in Cannonsville Reservoir.

Two presentations were made at the 2009 Joint Assembly of the American Geophysical Union (AGU), held in Toronto, Canada, May 24-27, 2009. The first presentation focused on DEP’s integrated modeling system and how that is being set up and used to investigate climate change effects on the quantity and quality of the water supply. The second poster presentation focused on potential improvements to the change factor methodology DEP is currently using to develop climate change input scenarios for its analyses.

Two more presentations were made by the CUNY postdoctoral researchers at the 2009 Fall Meeting of AGU, held in San Francisco, CA, December 14-18, 2009. One presentation focused on Phase I results of the CCIMP for water quantity in the WOH system. The other presentation presented evaluation strategies for selecting GCMs to use with climate change analysis.

The water quality modeling section represented DEP at the workshop on Advanced Climate Modeling and Decision-Making in Support of Climate Services, held in Aspen, CO, September 21-25, 2009. The conference focused on exploring linkages between climate modeling and water utility management. DEP’s integrated Modeling Program for investigating the potential effects of climate change on the WOH system was presented.

5.4 Geographic Information System

DEP’s GIS is used to create, store, visualize, and analyze spatial data of the watershed region in support of existing FAD and Memorandum of Agreement (MOA) programs. GIS resources support hardcopy mapping, geographic analyses, spatial data acquisition and development, visualization and analysis of remotely sensed imagery, data collection using Global Posi-

tioning System (GPS) technologies, and water quality modeling. This section presents an overview of GIS accomplishments during 2009 and a general description of ongoing GIS activity. Specifically, it describes the progress made in applying GIS to watershed management, the completion of new data layers, incorporation of data layers into the modeling database, dissemination of data to stakeholders and the public upon request, improvements in GIS infrastructure, acquisition of new hardware and software, and continuing professional development of GIS unit personnel. A list of significant map products created during 2009 can be found in Appendix A.1.

5.4.1 Utilization of GIS for Watershed Management

Wildlife Programs

Field data collection forms were updated using GIS for six of the eight reservoirs covered by the Waterfowl Management Program. GIS continues to display historic nesting sites, activity status, number of eggs, incubation status, and bird identification information to control Canada Goose and Mute Swan reproduction on 15 reservoirs. GIS supports the project review process, where federal and state endangered species are always considered, via visual representation of known Bald Eagle nesting areas. GIS-generated buffer zones provide guidance for both successful completion of projects and maximum fitness for this endangered species. During 2009, this was expanded to support a request by the Office of Strategic Projects to identify the proximity of bald eagle nesting activity to all WOH dams for a Federal Energy Regulatory Commission (FERC) application. The Wildlife Program used GIS/GPS to identify woodchuck burrows slated for mitigation in a woodchuck management project conducted at Hillview Reservoir in response to Dam Safety Compliance under DEC, which is an ongoing cooperative project with DEP Bureau of Water and Sewer Operations (BWSO).

Water Quality Operations

Sample sites were selected via GIS to characterize the source of elevated *Giardia* levels in the Manor Kill in Conesville. GIS was also used to determine ownership of land where DEP performs routine stream monitoring. Owners were contacted to obtain permission to grant DEP employees access to the stream through their property.

Water Quality Information System

DEP downloaded additional base map tiles, merged them with existing library data, and added coordinate information to a point feature class of keypoint monitoring sites for incorporation into the spatial data component of the water quality information system (WISKI) currently under development.

Modeling

DEP investigated the use of NetCDF tools found in ArcGIS ArcToolBox to extract, manage, and visualize GCM data stored in the NetCDF format.

Project Review

GIS was used to complete mapping and database management for 2007 FAD semi-annual and annual reporting requirements (6.1.1, 6.1.2, 308i), and the WR&R. In accordance with the EOH non-point source component of the FAD, DEP completed its required Stormwater Infrastructure Mapping and Inspection Program via two contracts, under which stormwater features in the Boyd Corners, Cross River, Croton Falls, and West Branch basins were located and mapped. The compiled data of approximately 130,000 linear feet of stormwater infrastructure includes size, location, nature and condition of pipes, catch basins, manholes, and outfalls. Data were reviewed by additional consultants for quality control, corrected as necessary, and added to the GIS system. DEP has disseminated the data to relevant municipalities in the EOH watershed.

GIS was regularly used in conjunction with site inspections and GPS data collected in the field to evaluate environmental site constraints for new development. Field maps were prepared showing hydrography, soils, watercourse limiting distances, steep slopes, and other potentially sensitive features. Data were compared with orthoimagery to reveal potentially unmapped drainage features. Guided by this information, locations of watercourses and wetlands were GPSed and downloaded back to the GIS. Development sites not covered under existing Stormwater Pollution Prevention Plans (SPPPs) were evaluated using GIS to determine if permit thresholds were exceeded, thereby triggering DEP or DEC regulatory review.

Significant project reviews supported with GIS and GPS during this period included:

- Windham Mountain Sporting Club Development, Windham. Location and extent of drainage features, wetlands, and existing culverts were identified. Field data were compared with geo-referenced plans showing proposed building and road locations and delineated wetlands.
- Proposed Ecklund Meat Processing Facility, Stamford. Possible watercourse locations in vicinity of proposed meat processing operation were identified.
- Catskill Mountain Camp and Cottage, Tannersville. GIS and aerial imagery were used to support review of planned 99-lot subdivision.
- Hubbell Corners Sewer Extension, Roxbury. Maps were prepared to assist in plan review and construction progress site inspections.
- Knarich Watercourse Determination, Colchester. Watercourse locations on applicant's property were identified.

Digital Orthoimagery and Light Detection and Ranging (LiDAR) Data Acquisition

DEP is collaborating with the New York State Office of Cyber Security and Critical Infrastructure Coordination (NYS CSCIC) to collect wall-to-wall aerial data products over all NYC watersheds and aqueducts as part of NYS CSCIC's Digital Orthoimagery Program. This program enables participating state municipalities to leverage their resources through cooperative data acquisition activities using cost-sharing and economies of scale. DEP's datasets encompass an area of approximately 2,700 square miles, and include 1-meter LiDAR-based topography as shown in Figure 5.2, 1-foot Leaf-off 4-band orthoimagery as shown in Figure 5.3, and 1-foot

Leaf-on 4-band orthoimagery. Aerial data were collected in spring and summer 2009; final quality assurance review and delivery began in fall 2009 and will continue throughout winter/spring 2010. Additional data products, such as enhanced hydrological stream networks, drainage delineations, a high resolution level 4 land use and land cover dataset, and impervious surface data set, will be derived from this aerial collection in late 2010.

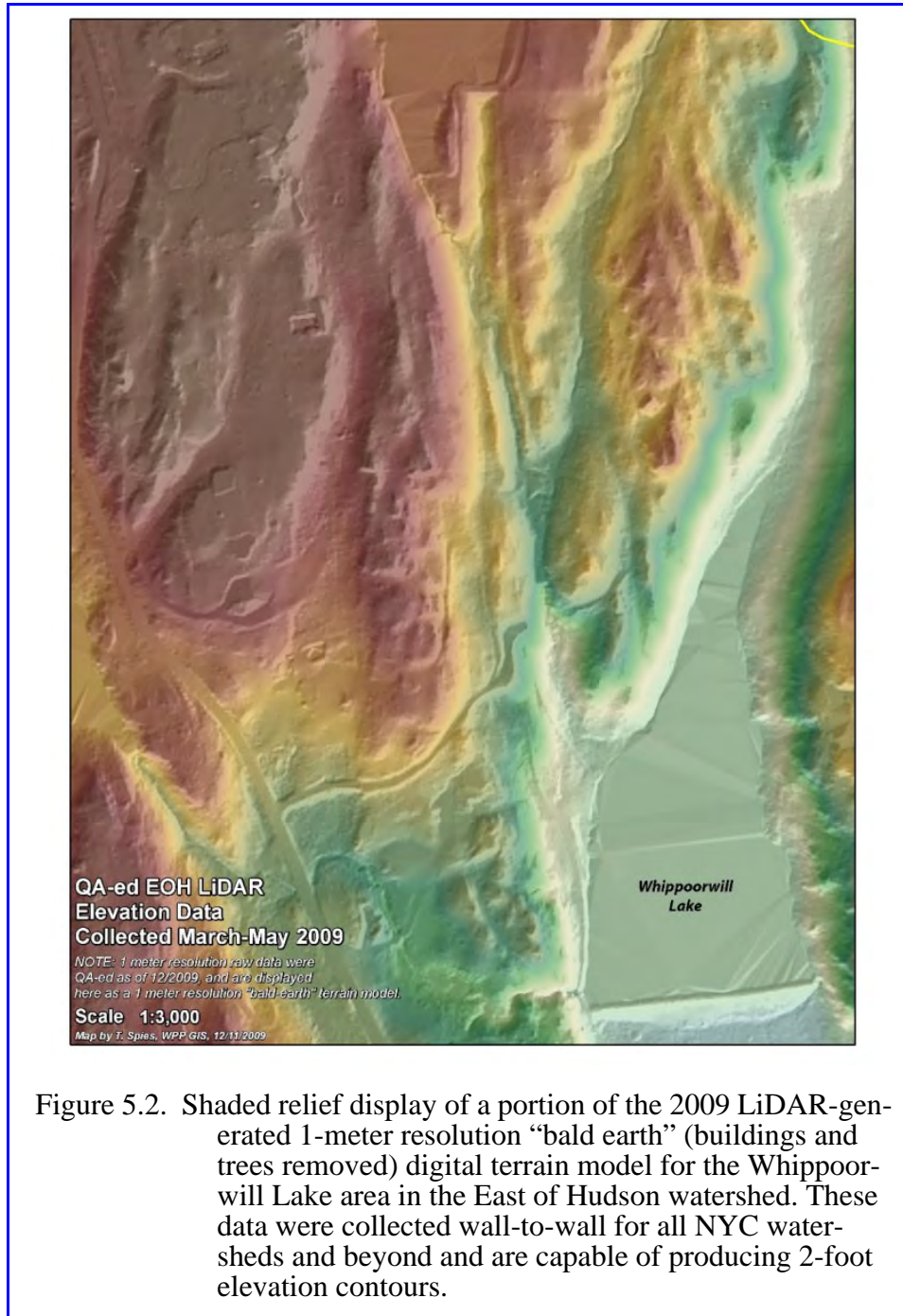
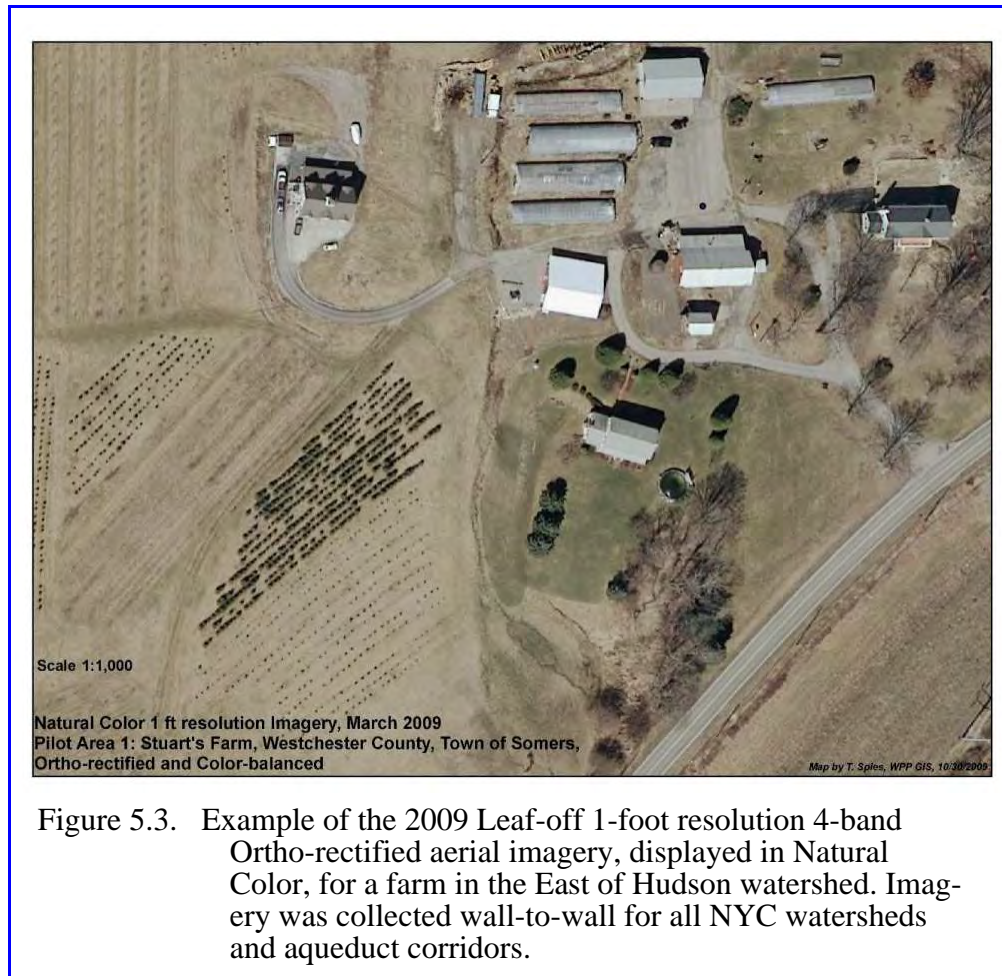


Figure 5.2. Shaded relief display of a portion of the 2009 LiDAR-generated 1-meter resolution “bald earth” (buildings and trees removed) digital terrain model for the Whippoorwill Lake area in the East of Hudson watershed. These data were collected wall-to-wall for all NYC watersheds and beyond and are capable of producing 2-foot elevation contours.



Watershed Lands Information System (WaLIS)

The development of version 4.1 of WaLIS, begun in 2008, will be ongoing through the end of June 2010, and will include final bug fixes, documentation, training, and full implementation of all modules. Most programming was completed during 2009, including the full integration into WaLIS of previously stand-alone applications such as the Land Acquisition Tracking System (LATS), Property Tax Payments (TAXIS), Engineering Project Review, and Land Use Permits databases. WaLIS currently operates on the workstations of approximately 200 registered DEP users, which will increase to 240+ users once version 4.1 is implemented in winter 2010.

Natural Resources Management (NRM)

GIS was used to produce a FAD deliverable pamphlet entitled “Wetlands in the Watersheds of the New York City Water Supply System,” describing distribution, recent trends, characteristics, and functions of wetlands throughout the NYC Watershed. GIS was used to map the Esopus Creek’s riparian corridor wetlands from the stream’s headwaters to the Ashokan Reservoir, and then to identify ownership of potential wetland areas so that permission could be sought to access owners’ property for the purpose of GPSing boundaries of all field-verified wetlands.

Results will guide stream management efforts and make it possible to assess federal National Wetland Inventory (NWI) and DEC wetland datasets. Invasive species management was targeted using GIS, and a regional strategy developed for Asian Longhorned Beetle (ALB) survey and outreach. GPS was used to record tree locations with evidence of ALB or other invasive forest pest damage. Occurrence data on NYC-owned land and beyond for several species of concern were mapped to direct subsequent monitoring and control efforts, and shared with regional invasive species organizations. NRM continues to use GIS and WaLIS to routinely produce maps and evaluate geographic data in support of forest science and management activities, including soils map and wetland evaluations, New York Natural Heritage data assessment, location of significant natural resources, forest stand reconnaissance, forest type location, inventory planning, deer management, project review on NYC and private lands, and evaluating conservation easement land management activities. The Forest Management Plan project, a FAD deliverable, relies heavily on GIS analysis of NYC lands and forests for forest inventory and project planning. As shown in Figure 5.4, GIS was used to adjust the inspection priority of all pre-MOA and MOA properties, in accordance with the new Fee Lands Monitoring Policy taking effect in 2010.

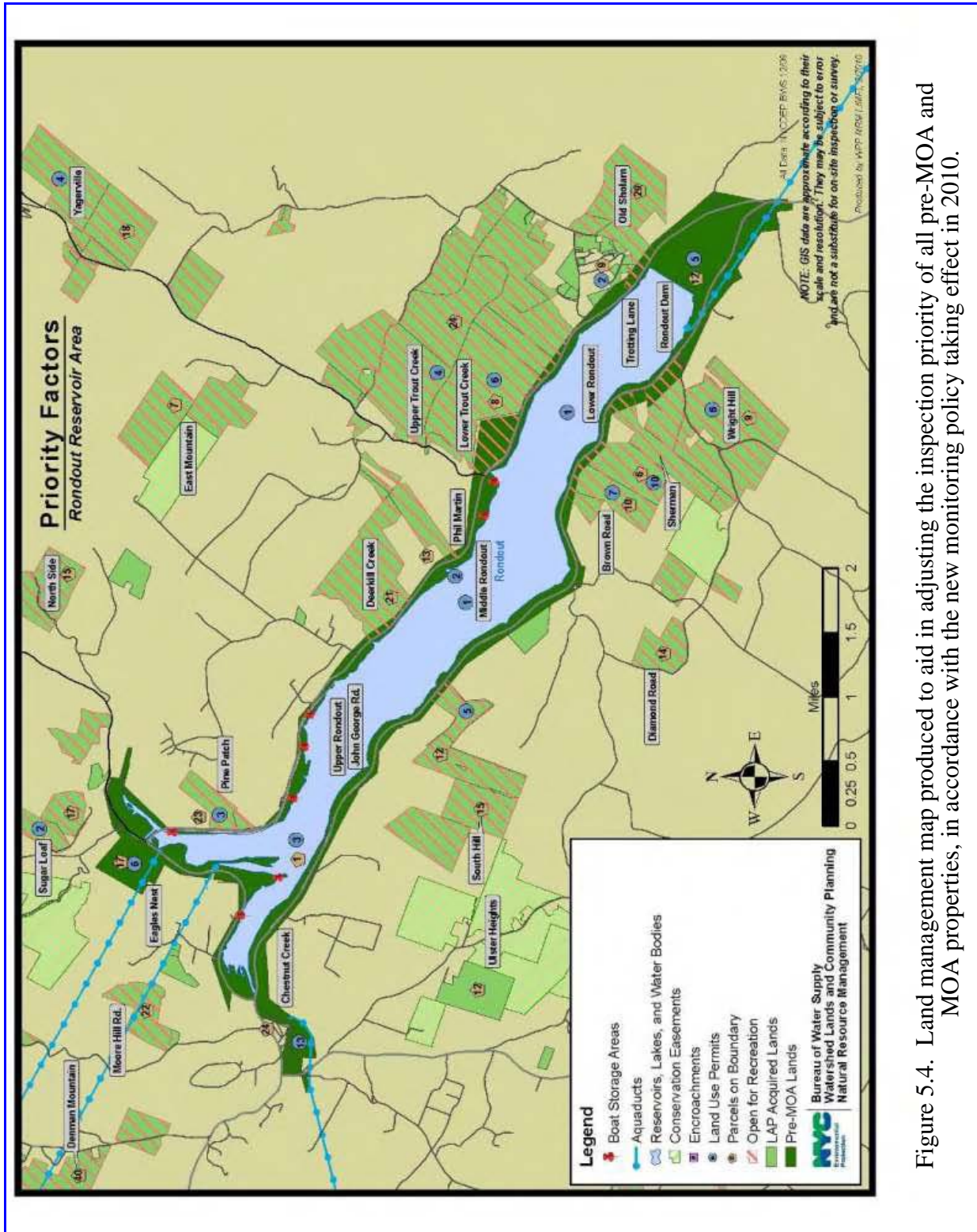


Figure 5.4. Land management map produced to aid in adjusting the inspection priority of all pre-MOA and MOA properties, in accordance with the new monitoring policy taking effect in 2010.

Stream Management Program (SMP)

SMP continued to use GIS to develop the Stream Geodatabase, a repository for stream feature inventory data used to support stream management plans. This is being expanded to include information on project sites and site visits associated with locally initiated stream management grant programs and the Catskill Streams Buffer Initiative. Stream Geodatabase layers were made available to other DEP groups through WaLIS. Data collected by program partners continues to be entered into the geodatabase, which now includes Esopus Creek, Woodland Valley, Stony Clove, Broadstreet Hollow, Schoharie Creek, Manor Kill, East Kill, West Kill, Rondout Creek, and the East and West Branches of the Delaware River. DEP and Soil and Water Conservation District (SWCD) partners further developed the riparian vegetation classification coverage, with Greene County SWCD initiating work on tributaries to the Batavia Kill, including North Settlement Creek, Mitchell Hollow, and Furnace Brook. This information will be utilized by the United State Forest Service as part of the forest management planning process where DEP partners with various SWCDs. DEP provided GIS support in producing stream management plans for priority sub-basins, including provision of GIS datasets, assistance with data management, map production for stream management plans, training in GIS and GPS technologies, and GIS/GPS equipment procurement. GIS was used to identify areas for revision of flood studies and the creation of revised Flood Insurance Rate Maps (FIRMs) under the DEP and Federal Emergency Management Agency (FEMA) Cooperative Technical Partnership (CTP) agreement of 2009. Under contract with DEP for flood studies to be conducted under the DEP-FEMA CTP, FEMA will utilize LiDAR-based topographic information provided by DEP via NYS CSCIC.

Land Acquisition Program (LAP)

LAP continues to use GIS in maintaining an open space geodatabase, and in conjunction with WaLIS for research on public and in-house real property inquiries. GIS and WaLIS continue to be used to design acquisition configurations and negotiate easements, where information is shared with land trusts and watershed towns for the local consultation process. GIS supported the assessment of LAP for the 2012-2022 Long-Term Plan, an important FAD deliverable, through the identification and confirmation of protected lands in NYC or state ownership, as well as lands protected by local government and private land trusts in the Catskill/Delaware System. Identification and confirmation of protected lands supports the plan's goal of raising the level of protection in those basins and sub-basins containing fewer protected lands.

DEP worked with outside consultants to support its environmental review of the 2010 Public Water Supply Permit application under SEQRA. GIS summary data for each town were developed, including area, lands acquired, and land use and protected lands, along with a "developable land" layer that included new data for the portions of each town outside the watershed boundary. LAP used the tax parcel dataset's "year built" data for residential parcels to develop estimates of housing construction rates from 1990–2008. These data elements, together with pro-

jected future acquisitions by town, were used by consultants to assess potential adverse socioeconomic or community character impacts. This environmental review is ongoing, with additional analyses required in 2010.

EOH Community Planning Program

GIS was used to support the implementation of the Kensico Septic Program. Data from various sources were compiled to map sewage service status for all parcels in the Kensico Reservoir basin, as shown in Figure 5.5. Resulting data were used to generate mailing lists to inform residents of their eligibility for the program, and resulting maps were used for FAD reporting. Data were developed for stormwater remediation and retrofit projects in the EOH Catskill/Delaware basins, with resulting maps and tables used for FAD reporting or forwarded to local municipalities for assistance in complying with their DEC Phase II Municipal Separate Storm Sewer System (MS4) Stormwater General Permit requirements. GIS was used to generate a preliminary list of DEP properties that met DEC's requirements under the Phase II MS4 General Stormwater Permit Compliance. DEP was required by the state to forward the list in June to allow DEC to determine if DEP was a regulated MS4 as per the permit definitions.

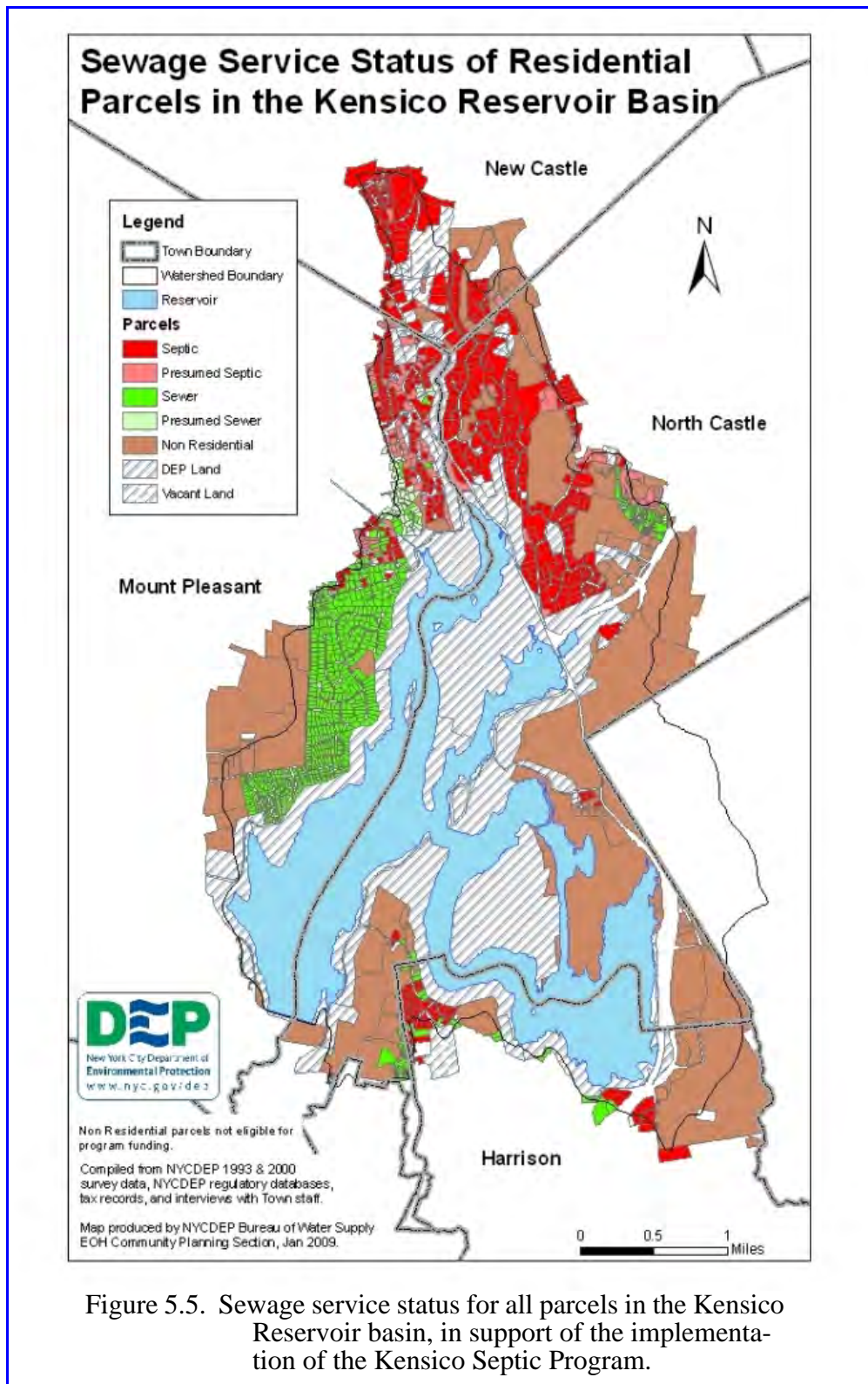


Figure 5.5. Sewage service status for all parcels in the Kensico Reservoir basin, in support of the implementation of the Kensico Septic Program.

WOH Community Planning Program

All sewer connections to buildings in Chichester (Ashokan Basin) were digitized and maps depicting tax parcels currently sewered were updated based on engineering drawings; these actions were related to a legal dispute in the area. DEP also updated locations and status of best management practices in the Catskill Watershed Corporation (CWC) Stormwater Retrofit program, and, for the CWC Septic Program Expansion, exported a list from GIS of all non-sewered residential properties WOH between 200 and 250 feet of streams and waterbodies.

5.4.2 Completion of New Data Layers

Several new feature classes and tables were created and placed in the GIS Library in 2009, while several existing feature classes were also updated during this period. A complete list of data developed and updated during 2009 can be found in Appendix A.2.

5.4.3 Incorporation of Data Layers into the Modeling Database

Watershed modeling staff continued to utilize existing GIS Library data layers and tables to derive inputs for watershed and reservoir loading models. No additional data were needed or added to the modeling database during the reporting period.

5.4.4 Data Dissemination to Stakeholders and the Public, Including Notification of Data Availability to Communities and Requests for Data

The GIS Program continues to review all outside requests for GIS data, forward requests for data deemed “sensitive” to appropriate upper management or security personnel, and either email or write approved GIS data to CDs as required for data sharing. Stakeholders and communities that are on a schedule to receive semi-annual data updates (e.g., regarding newly-acquired lands) are sent data via email or CD as they become available. In 2009, DEP created a detailed GIS data catalog that inventories all of the current QAed GIS holdings. The catalog describes each GIS dataset and whether it is shareable, proprietary, or confidential/sensitive. A separate “shareable to public” catalog has also been created as a subset which can be distributed to data requestors, such as stakeholders or consultants working on a DEP project who need to know what data exists. This inventory also satisfies a DEP-wide requirement for cataloging and providing inventory of GIS data to the DEP Office of Information Technology (OIT) and NYC Office of Emergency Management.

Newly-acquired and pre-MOA NYC land updates were distributed to DEC, SUNY ESF, Catskill Center for Conservation and Development, CWC, Watershed Agricultural Council, Scenic Hudson, Hudsonia, Columbia Land Trust, Delaware County Planning Department, Delaware County Soil and Water, Greene County Soil and Water, Ulster County Soil and Water, Sullivan County, Westchester County GIS, Open Space Institute, The Nature Conservancy, Trout Unlimited, New York/New Jersey Trail Conference, Appalachian Mountain Club, Adirondack Mountain Club, Frost Valley YMCA, National Park Service, and the Trust for Public Land. Bathymetry data were forwarded to UFI for use in reservoir model development and testing. Numerous other

individual GIS data layers were sent to contractors and consultants working on various DEP-related projects throughout the EOH and WOH Watersheds, including construction and engineering projects.

5.4.5 GIS Infrastructure Improvement

2009 marked the first year that all ESRI GIS software licensing has been coordinated and managed at the Agency level by OIT through an ESRI Enterprise Licensing Agreement (ELA). In addition to the ESRI ArcGIS User and Server applications, the ELA provides DEP with licenses of ESRI ArcEngine Runtime and ArcEngine Developer's Toolkit for use in continued development and deployment of WaLIS. OIT, working closely with GIS personnel, continues to support and administer the ESRI Spatial Data Engine (SDE) Geodatabase as well as provide ESRI software management enterprise-wide via the ELA. Throughout 2009, the ArcSDE database administrator has continued to manage the GIS library by creating and updating Geodatasets, maintaining file geodatabase copies of the library, and supporting spatial data development for WaLIS. GIS and OIT staff set up a GIS Sharepoint site in 2009 for all Bureau of Water Supply users to access. On this site, GIS staff post PDF files of most commonly requested maps, GIS data catalogs, announcements of major new datasets or updates, GIS technical tips and resolution of common problems, and track GPS equipment sign-out sheets.

Several data upgrades were performed in 2009 to streamline the central GIS Library, especially regarding GIS Layer Files, NYC-owned land and interests in the watersheds, and state land. Most GIS users now use the GIS Layer File Library for all of their base map needs rather than connecting directly to the central SDE Geodatabase itself. Layer Files are pre-symbolized pointers that link directly to the same data in the SDE Geodatabase, but are displayed to the end user in a more user-friendly format. Until recently, GIS updates of NYC-owned lands and easements were performed only twice per year, in January and June, to reflect newly-acquired lands via LAP. That process has been changed to have the NYC lands data ownership status updated on a daily basis automatically from WaLIS. This new "live" layer is also combined with pre-MOA and other non-LAP NYC land into a spatial view in the central SDE Geodatabase, and can be accessed via a pre-symbolized GIS Layer File. All state land can now be found in another spatial view within the central SDE Geodatabase, also updated whenever information is received on changes, and linked directly to the tax parcel data that make up all state land.

5.4.6 Hardware and Software

During 2009, users of ESRI ArcGIS were upgraded to Version 9.3.1.

During the reporting period, five printers were purchased to upgrade output capability of the upstate GIS. Four machines replaced older, similar models for which annual maintenance and support were no longer available. Two HP Color LaserJet 5550dtn machines (11"x17" maximum output) were purchased for Kingston; one was obtained for Valhalla. An HP B&W LaserJet

P30005x was placed in the Kingston GIS Lab. An HP Color LaserJet CP3525dn was obtained for the Watershed Modeling Unit. A new Garmin Venture HC handheld GPS unit was acquired by the Regulatory Review and Engineering Unit.

5.4.7 Professional Development

Training

During the reporting period two GIS unit staff members applied for and received certification as a “Geographic Information System Professional (GISP),” a nationally recognized accreditation. The ArcSDE database administrator earned the following certification: Microsoft Certified Technology Specialist (MCTS), SQL Server 2008 (Implementation and Maintenance). One staff member attended an ESRI-sponsored seminar in Albany on “Creating Effective Web Maps”. Key GIS and OIT staff restarted a monthly series of internal meetings designed for continued collaborative implementation and development of DEP’s GIS.

Conferences and User Groups

One staff member gave a presentation on the LiDAR data development project at DEP’s annual Technology Day in Lefrak. Since the theme for 2009 was “Cooperation and Simplification”, the presentation focused on how DEP worked in cooperation with NYS CSCIC via the Digital Orthoimagery Program to acquire these data via cost-sharing measures, and how LiDAR will simplify DEP’s work in the areas of regulatory mapping and hydro-mapping, and in reducing the need for field verification of watercourses, slopes, and elevations.

6. Regulatory Programs

A primary component of DEP's overall watershed protection strategy is the enforcement of applicable environmental regulations, which include the Watershed Rules and Regulations (WR&R), also promulgated as state law, the federal Clean Water Act, the National Pollutant Discharge Elimination System, and the State Environmental Quality Review Act (SEQRA), as well as local ordinances. Of these, the primary mechanism for protection of the water supply is the WR&R.

DEP's enforcement efforts are focused on three major areas: review and approval of projects within the watershed, environmental law enforcement, and regulatory compliance and inspection of wastewater treatment plants (WWTPs). A summary of DEP's project review and enforcement activities in 2009 is presented in Table 6.1. Note that East of Hudson activities are limited to the following FAD basins: Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico.

Table 6.1. Project review and enforcement activities in 2009.

Activity	East of Hudson	Catskill	Delaware
New or Delegated Onsite SSTs Design Approved	32	55	58
Remediated Onsite SSTs Design Approved	47	144	182
SSTs Construction Approved (New, Remediated or Delegated)	22	181	288
SPPP, IRSP, and CPDP Approvals	11	12	8
WWTP or Sewer Connection, Sewer Extension Approved	1	3	1
NOVs/NOFs for SSTs	4	21	17
NOVs/NOFs for SPPPs	1	5	0
Other Application Received (Non-Regulated)	6	24	27

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 wastewater treatment plants (WWTPs), the installation of subsurface sewage treatment systems (SSTs), sewer collection systems, the preparation of stormwater pollution prevention plans (SPPPs), 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 SPPPs 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 DEC 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/DEC Memorandum of Understanding (MOU).

Table 6.2 lists new projects received in 2009 in the Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoir basins. The new, delegated, and remediated individual septic systems for these basins are listed in Table 6.3. Figures 6.1 through 6.3 show the locations of these projects.

Table 6.2. Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoirs new projects for 2009.

Map No. (Figure 6.1)	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/09
1	Kensico	CAT-366 Shoreline Stabilization	Mount Pleasant	Other	No Application
2	Croton Falls	Day Road, LCC Commercial Development	Carmel	Stormwater	Approved
3	Kensico	Fordham University	North Castle	Stormwater	Complete
4	Kensico	Freedman Property	Greenwich	Other	No Application
5	Cross River	Gale Residence	Lewisboro	Variance	New
6	Croton Falls	Guidepost Associates, Inc.	Carmel	Stormwater	Approved
7	Croton Falls	Lupi Development Subdivision	Carmel	Stormwater	Approved
8	Cross River	Nhaissi/Gad subdivision	Bedford	Stormwater	Incomplete
9	Croton Falls	Putnam Hospital Center	Carmel	Stormwater	Approved
10	Kensico	Stonegate Road Culvert Replacement	Mount Pleasant	Other	No Application
11	Croton Falls	The Putnam Comm. Foundation Senior Housing	Carmel	Stormwater	Complete
12	Croton Falls	Wixon Pond Development	Carmel	Stormwater	New

Table 6.3. Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoirs individual SSTs for 2009.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Boyd Corners	East Fishkill	N/A	1	0	2	0
Boyd Corners	Kent	6	N/A	11	12	0
Boyd Corners	Putnam Valley	0	N/A	1	0	0

Table 6.3. (Continued) Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoirs individual SSTs for 2009.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Cross River	Bedford	1	N/A	0	3	6
Cross River	Lewisboro	7	N/A	0	10	2
Cross River	New Castle	1	N/A	0	0	0
Cross River	Pound Ridge	0	N/A	0	1	2
Croton Falls	Bedford	2	N/A	0	0	1
Croton Falls	Carmel	4	N/A	13	16	5
Croton Falls	Kent	1	N/A	0	1	0
Croton Falls	Lewisboro	1	N/A	0	0	0
Croton Falls	Southeast	1	N/A	0	0	0
Croton Falls	Somers	0	N/A	0	0	0
Croton Falls	Yorktown	0	N/A	0	0	0
Kensico	Mount Pleasant	0	N/A	0	0	0
Kensico	New Castle	0	N/A	0	1	0
Kensico	North Castle	3	N/A	0	2	0
Kensico	Harrison	0	N/A	0	0	0
Kensico	Greenwich, CT	N/A	0	0	0	0
West Branch	Carmel	0	N/A	12	17	6
West Branch	East Fishkill	N/A	1	0	2	0
West Branch	Kent	3	N/A	6	9	0
West Branch	Putnam Valley	0	N/A	0	0	0
Totals		30	2	43	76	22

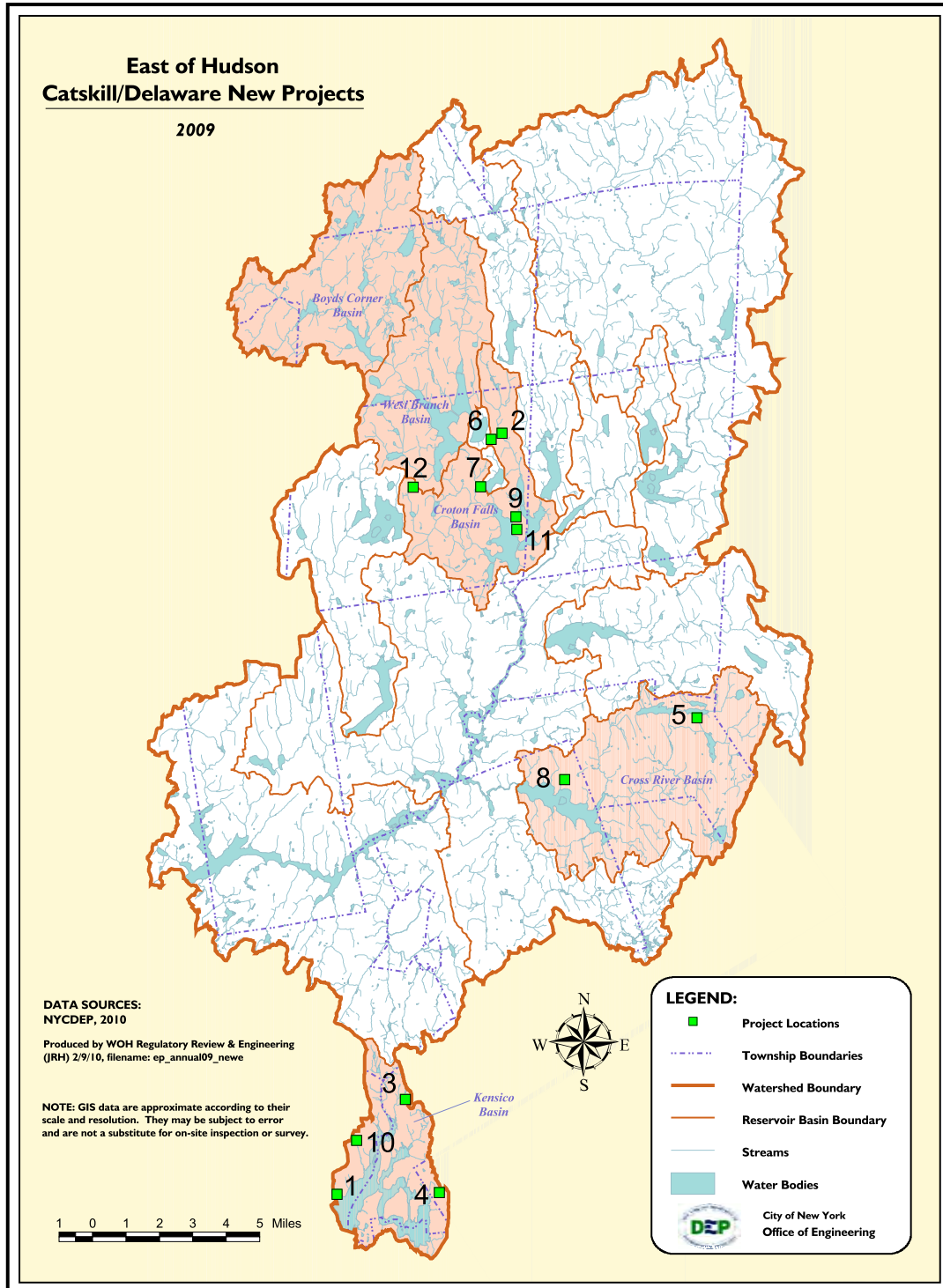


Figure 6.1. East of Hudson Catskill/Delaware new projects for 2009.

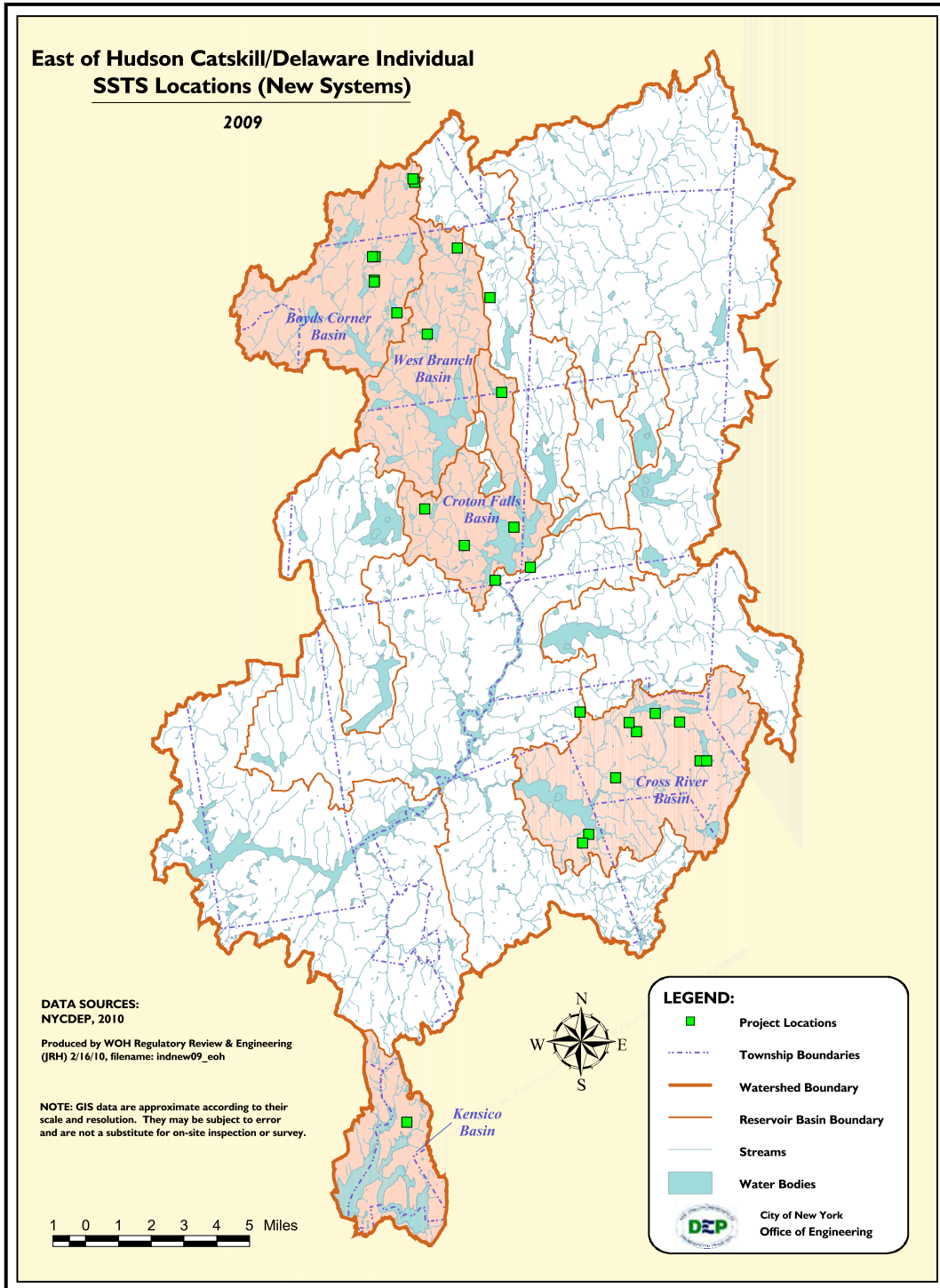


Figure 6.2. East of Hudson Catskill/Delaware new individual SSTS locations for 2009.

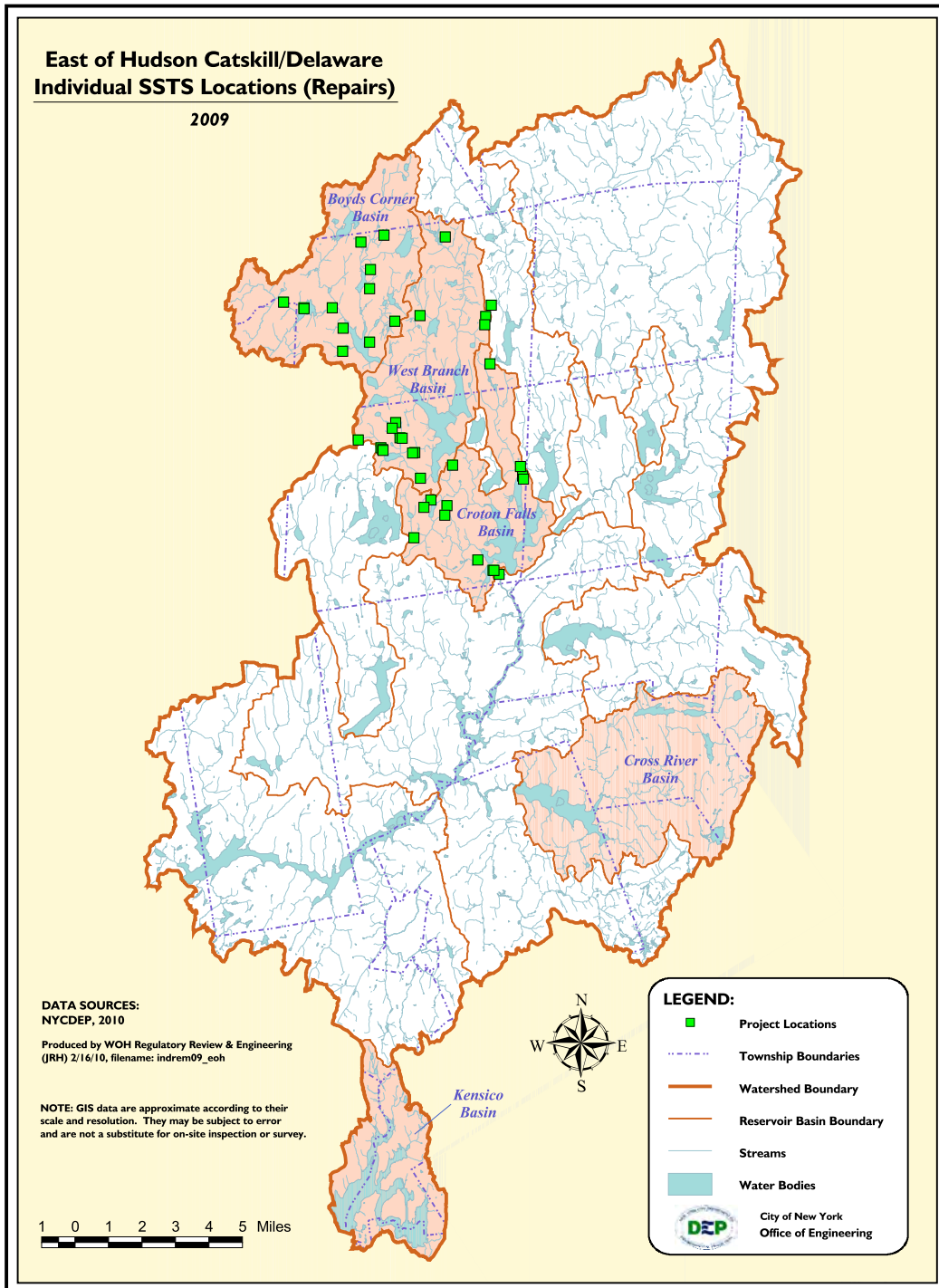


Figure 6.3. East of Hudson Catskill/Delaware repaired individual SSTS locations for 2009.

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

Table 6.4 lists new projects received in 2009 in the Cannonsville, Pepacton, Rondout, Neversink, Schoharie, and Ashokan basins. These projects include new or repaired commercial, institutional, and multi-family septic, or individual advanced treatment units (ATU). The “Other” projects consist of DOT projects, wetland and stream disturbances, mining applications from DEC, timber harvesting, and stormwater retrofit projects. New, delegated, and remediated individual septic systems are listed in Tables 6.5 and 6.6. Figures 6.4 through 6.6 show the locations of these projects.

Table 6.4. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2009.

Map No. (Figure 6.4)	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/09
1	Schoharie	Ashland-Proposed WWTF	Ashland	Sewer Collection	Approved
1	Schoharie	Ashland-Proposed WWTF	Ashland	Stream Disturbance	No Application
1	Schoharie	Ashland-Proposed WWTF	Ashland	Stormwater	Approved
2	Cannonsville	Balsamo Property	Walton	Stream Disturbance	No Application
3	Pepacton	Brenna Property	Colchester	Stream Disturbance	Closed
4	Cannonsville	Bright Property	Delhi (Town)	Stream Disturbance	No Application
5	Schoharie	Camp Oh-Neh-Tah	Windham	Stormwater	Incomplete
6	Cannonsville	Cannonsville Expanded Boating Pilot Study	Tompkins	Other	No Application
7	Schoharie	Carver Sand & Gravel	Conesville	Other	No Application
8	Schoharie	Catskill Revitalization Corp. Trail	Roxbury	Other	Closed
9	Schoharie	Champlin Road Bridge Repairs	Conesville	Stream Disturbance	No Application

Table 6.4. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2009.

Map No. (Figure 6.4)	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/09
10	Schoharie	Cherpelis, Areti	Lexington	Stream Disturbance	Closed
10	Schoharie	Cherpelis, Areti	Lexington	Stormwater	Approved
11	Schoharie	Christman's Windham House	Windham	Intermediate SSTS	New
12	Schoharie	Colangelo Streambank Stabilization	Conesville	Stream Disturbance	Closed
13	Pepacton	County Route 36 Stream Disturbance	Roxbury	Stream Disturbance	No Application
14	Neversink	Covered Bridge for Neversink Fairgrounds	Neversink	Other	Closed
15	Ashokan	Davis Bend Forest Management Project	Olive	Other	No Application
16	Pepacton	Dollar General Store (Lawrence Tillack)	Margaretville (Village)	Stormwater	Approved
17	Schoharie	DOT Streambank Stabilization- Lexington	Lexington	Stream Disturbance	Closed
18	Schoharie	DOT Streambank Stabilization- Prattsville	Prattsville	Stream Disturbance	Closed
19	Pepacton	Farrar, Henry (Post-Flood Training Program)	Middletown	Stream Disturbance	No Application
19	Pepacton	Farrar, Henry (Post-Flood Training Program)	Middletown	Stormwater	Approved
20	Pepacton	Hanah Country Inn (Kass)	Middletown	Stream Disturbance	Closed
21	Cannonsville	Houshmand, John	Stamford (Town)	Intermediate SSTS	Approved

Table 6.4. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2009.

Map No. (Figure 6.4)	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/09
22	Schoharie	Hunter Mountain Diversion Weir	Hunter	Stormwater	Complete
23	Cannonsville	J&J Bluestone Corp.	Hamden	Other	Closed
24	Schoharie	Kern, Henry	Lexington	Intermediate Repair	Complete
25	Cannonsville	Kleisner, Jonathan	Walton	Intermediate SSTS	Approved
26	Cannonsville	Kolodziej Property	Delhi (Village)	Stream Disturbance	No Application
27	Schoharie	Lake in the Sky - Lot #27 (Brothers Investments)	Gilboa	Stormwater	Approved
28	Schoharie	Lake in the Sky - Lot #32 (Murado)	Gilboa	Stormwater	Approved
29	Cannonsville	Lavell Property	Walton	Stream Disturbance	Closed
30	Schoharie	Lexington Hotel	Lexington	Intermediate Repair	Approved
31	Pepacton	Liddle, Martin	Andes	Stream Disturbance	No Application
32	Schoharie	Lighthouse on the Hill (Conforti, Michael) (Echo Valley Motel)	Lexington	Intermediate Repair	No Application
33	Cannonsville	Little Delaware Streambank Stabilization	Bovina	Stream Disturbance	Closed
34	Cannonsville	Loewentheil Property	Tompkins	Stream Disturbance	No Application
35	Schoharie	Long Road Stream Restoration Project	Lexington	Stream Disturbance	No Application
35	Schoharie	Long Road Stream Restoration Project	Lexington	Stormwater	Approved
36	Pepacton	Manhattan Country School, Inc.	Roxbury	Intermediate Repair	Closed
37	Cannonsville	Martin Property	Kortright	Stream Disturbance	Closed

Table 6.4. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2009.

Map No. (Figure 6.4)	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/09
38	Cannonsville	McMurdy Brook - Lot #15 (Defrancesco)	Kortright	Stormwater	New
39	Cannonsville	McMurdy Brook Farm - Lot #2 (Mugnai)	Kortright	Stormwater	Complete
40	Cannonsville	McMurdy Brook Farm (Alan Lord - NY Land & Lakes)	Kortright	Stormwater	Approved
41	Schoharie	Noe, Chaim	Hunter	Intermediate SSTS	Incomplete
42	Ashokan	NYSDOT - Bushnellsville Creek Bank Stabilization	Lexington	Other	No Application
43	Ashokan	NYSDOT - Guiderail Replacement - 8809.32	Shandaken	Other	No Application
44	Ashokan	NYSDOT - Sliding Block Failures	Shandaken	Other	No Application
45	Cannonsville	NYSDOT Bridge Washing 9805.79	Multiple	Other	No Application
46	Ashokan	NYSDOT Preventative Maintenance Initiative - Paving	Olive	Other	No Application
47	Schoharie	NYSDOT Route 23 - Grand Gorge	Roxbury	Other	No Application
48	Schoharie	Oakwood Rifle & Pistol Club	Prattsville	Stream Disturbance	Closed
49	Cannonsville	Phoenix House Foundation, Inc.- Belle Terre	Stamford (Town)	Intermediate Repair	Approved
50	Ashokan	Pine Hill Stormwater Assessment	Shandaken	Other	Closed

6. Regulatory Programs

Table 6.4. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2009.

Map No. (Figure 6.4)	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/09
51	Schoharie	Pine Island Lot #8 (Melia)	Gilboa	Stormwater	Approved
52	Schoharie	Platte Clove Communities	Hunter	Other	No Application
53	Pepacton	Porter Property	Andes	Stream Disturbance	No Application
54	Pepacton	Richard Gulde Property	Middletown	Stream Disturbance	No Application
55	Schoharie	Route 23 Culvert Carrying Lewis Creek	Ashland	Other	No Application
56	Pepacton	Roxbury Hotel (Masserson Properties)	Roxbury	Stormwater	Approved
56	Pepacton	Roxbury Hotel (Masserson Properties)	Roxbury	Stormwater	Approved
57	Ashokan	Rustic Guiderail Replacements- Stage 1	Various	Other	No Application
58	Schoharie	Sawicki Property	Jewett	Stream Disturbance	Closed
59	Ashokan	Schein, Peter	Woodstock	Stormwater	Approved
60	Schoharie	Schoharie Reservoir, Gilboa Dam & Associated Facilities; CAT- 212A	Gilboa	Stormwater	New
61	Cannonsville	Shlonsky Property	Tompkins	Stream Disturbance	No Application
62	Ashokan	Shokan Square	Olive	Intermediate Repair	Under Construction
63	Rondout	South Hill Promontory Forest Improvement	Wawarsing	Timber Harvest	Closed

Table 6.4. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2009.

Map No. (Figure 6.4)	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/09
64	Cannonsville	South Kortright Central School District	Kortright	Other	No Application
65	Rondout	South Rondout Forest Management Project	Wawarsing	Other	Closed
66	Ashokan	Stony Clove Brook Bank Stabilization	Shandaken	Stream Disturbance	Closed
67	Cannonsville	SUNY Delhi Golf Course WW Reclamation/ Irrigation Project	Delhi (Village)	Stream Disturbance	No Application
68	Cannonsville	The American Plum Tree, Inc. (David & Diana Dax)	Stamford (Town)	Intermediate Repair	Approved
69	Cannonsville	Town of Bovina Highway Garage	Bovina	Stormwater	Approved
70	Pepacton	Town of Roxbury- Lake Street Project	Roxbury	Stream Disturbance	No Application
70	Pepacton	Town of Roxbury- Lake Street Project	Roxbury	Stormwater	New
71	Cannonsville	Ultra Dairy/ Morningstar	Delhi (Town)	Stream Disturbance	Closed
72	Cannonsville	V/Delhi Reservoir Dam Stabilization	Delhi (Village)	Stream Disturbance	Closed
73	Pepacton	Village of Fleischmann's Water Supply	Fleischmanns (Village)	Other	No Application
74	Schoharie	Von Aweyden, LLC - Phase II	Jewett	Stormwater	Closed
74	Schoharie	Von Aweyden, LLC - Phase II	Jewett	Intermediate SSTS	New

6. Regulatory Programs

Table 6.4. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2009.

Map No. (Figure 6.4)	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/09
75	Schoharie	Windham Mountain Stormwater Retrofit	Windham	Stormwater	Approved
76	Cannonsville	Zammataro - DeLancey CWMP	Hamden	Sewer Connection	Approved

Table 6.5. Ashokan and Schoharie Reservoirs individual SSTs for 2009.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Ashokan	Hunter	0	0	2	2	3
Ashokan	Hurley	0	N/A	7	7	8
Ashokan	Lexington	0	0	2	2	3
Ashokan	Marbletown	0	N/A	0	0	0
Ashokan	Olive	3	N/A	30	31	25
Ashokan	Shandaken	0	N/A	36	46	45
Ashokan	Woodstock	5	N/A	12	18	16
Schoharie	Ashland	N/A	1	7	7	12
Schoharie	Conesville	N/A	5	6	10	5
Schoharie	Gilboa	N/A	2	6	8	7
Schoharie	Halcott	N/A	0	0	0	0
Schoharie	Hunter	N/A	4	5	7	10
Schoharie	Hunter (Village)	N/A	0	0	0	0
Schoharie	Jewett	N/A	6	7	12	9
Schoharie	Lexington	N/A	5	4	8	9
Schoharie	Prattsville	N/A	2	4	6	4
Schoharie	Roxbury	N/A	1	4	5	8
Schoharie	Stamford	N/A	0	0	0	0
Schoharie	Tannersville (Village)	N/A	0	1	1	0
Schoharie	Windham	N/A	13	11	21	18
Totals		8	39	144	191	182

Table 6.6. Cannonsville, Pepacton, Rondout, Neversink Reservoirs individual SSTs for 2009.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Cannonsville	Bovina	N/A	2	3	4	16
Cannonsville	Delhi	N/A	2	12	14	14
Cannonsville	Franklin	N/A	1	1	2	6
Cannonsville	Hamden	N/A	1	6	7	15
Cannonsville	Harpersfield	N/A	0	1	2	1
Cannonsville	Hobart (Village)	N/A	0	0	0	0
Cannonsville	Jefferson	N/A	1	0	1	2
Cannonsville	Kortright	N/A	13	3	7	11
Cannonsville	Masonville	N/A	0	1	1	2
Cannonsville	Meredith	N/A	1	9	10	13
Cannonsville	Sidney	N/A	0	0	0	0
Cannonsville	Stamford	N/A	5	11	16	14
Cannonsville	Tompkins	N/A	1	8	9	18
Cannonsville	Walton	N/A	8	19	28	32
Neversink	Denning	0	N/A	5	5	4
Neversink	Hardenburgh	0	N/A	0	0	0
Neversink	Liberty	0	N/A	2	2	0
Neversink	Neversink	N/A	0	4	4	5
Pepacton	Andes	N/A	7	15	22	28
Pepacton	Bovina	N/A	0	0	0	0
Pepacton	Colchester	N/A	0	1	1	6
Pepacton	Fleischmanns	N/A	0	0	0	0
Pepacton	Halcott	N/A	5	4	9	5
Pepacton	Hamden	N/A	0	0	0	5
Pepacton	Hardenburgh	N/A	0	2	2	2
Pepacton	Middletown	N/A	9	34	42	41
Pepacton	Roxbury	N/A	4	11	14	16
Pepacton	Wawarsing	N/A	0	0	0	0
Rondout	Denning	0	N/A	4	4	4
Rondout	Fallsburg	N/A	0	0	0	3
Rondout	Hardenburgh	0	N/A	0	0	0
Rondout	Neversink	N/A	5	16	20	16
Rondout	Rochester	0	N/A	0	0	2
Rondout	Wawarsing	2	N/A	5	7	6
Totals		2	65	177	233	287

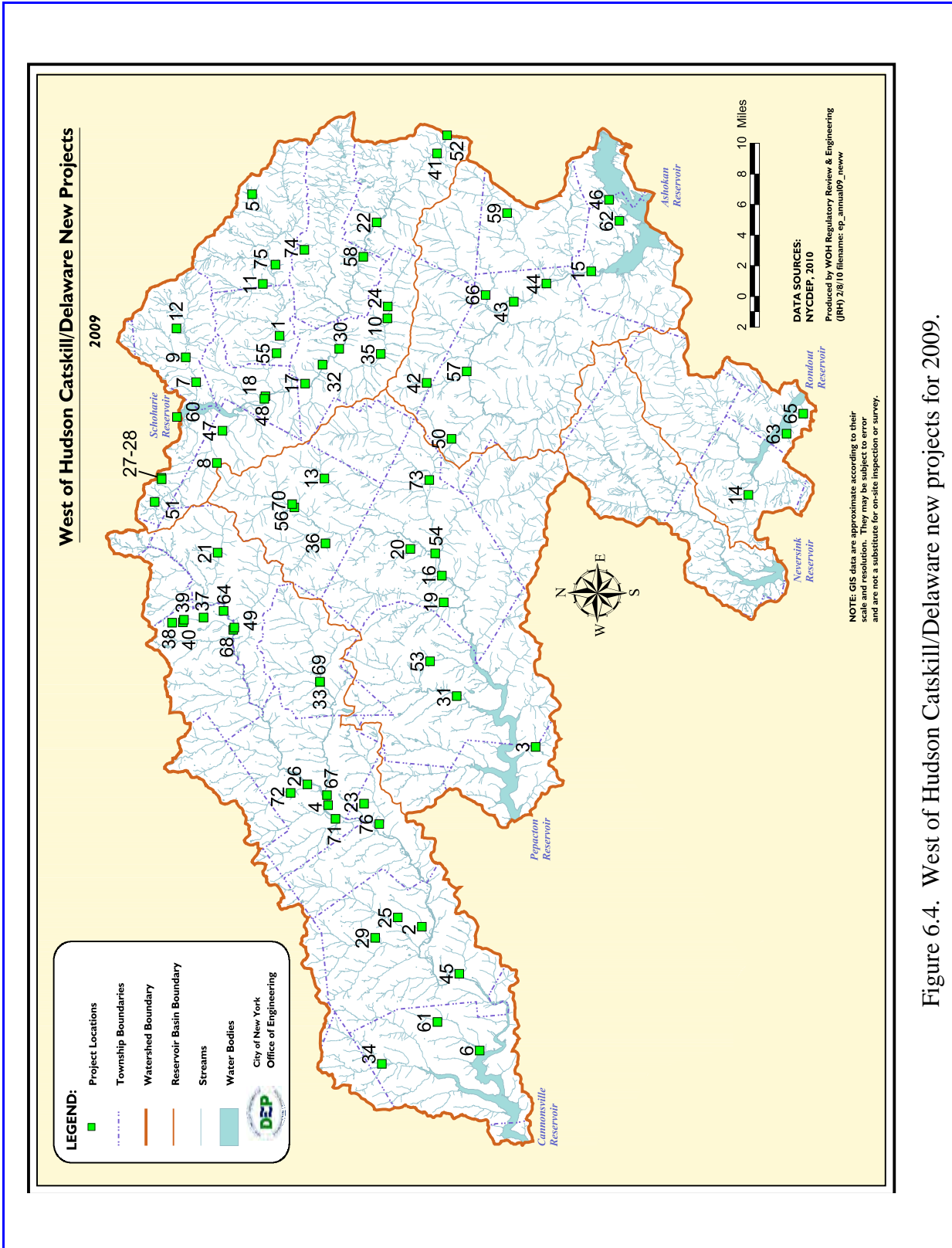


Figure 6.4. West of Hudson Catskill/Delaware new projects for 2009.

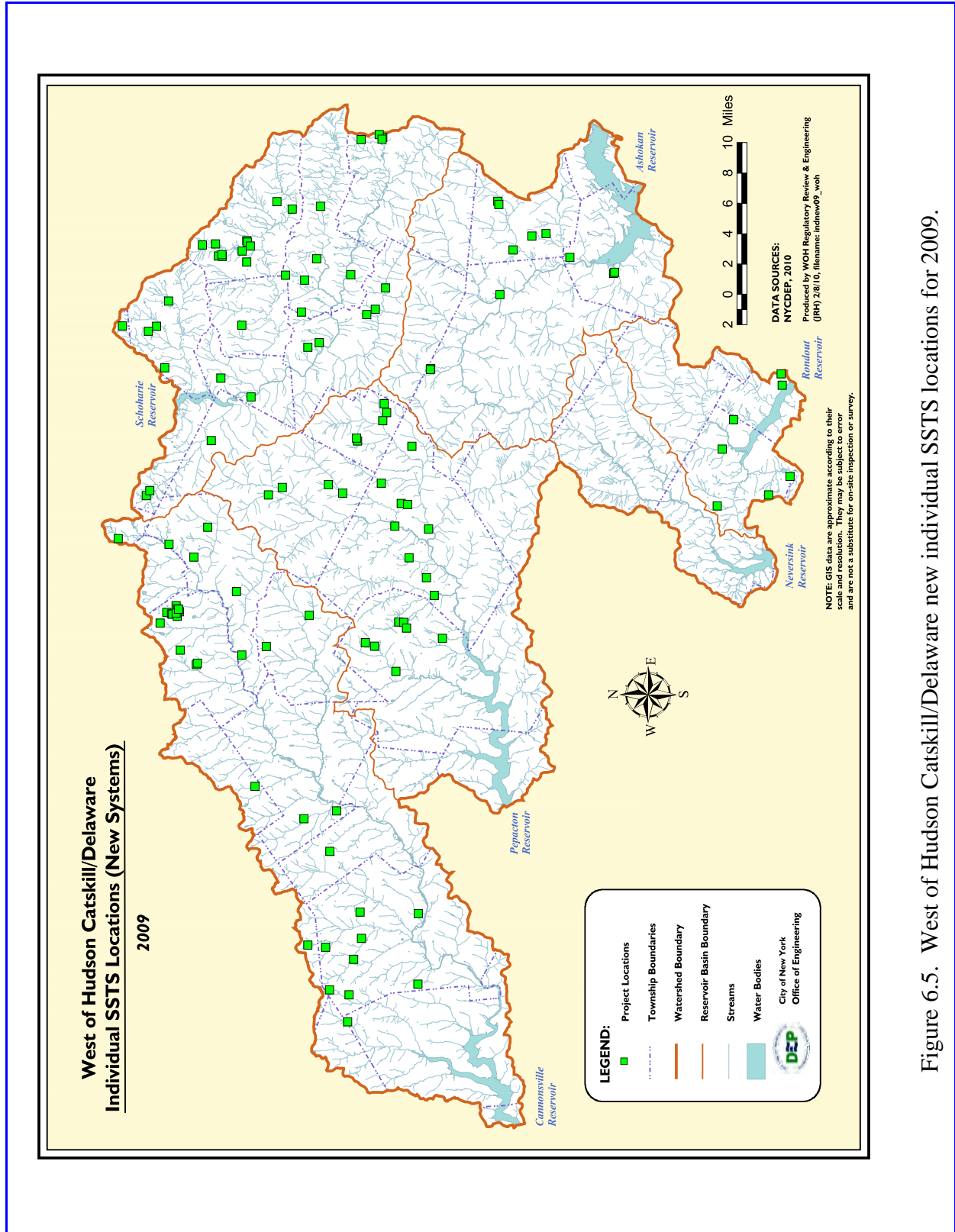


Figure 6.5. West of Hudson Catskill/Delaware new individual SSTS locations for 2009.

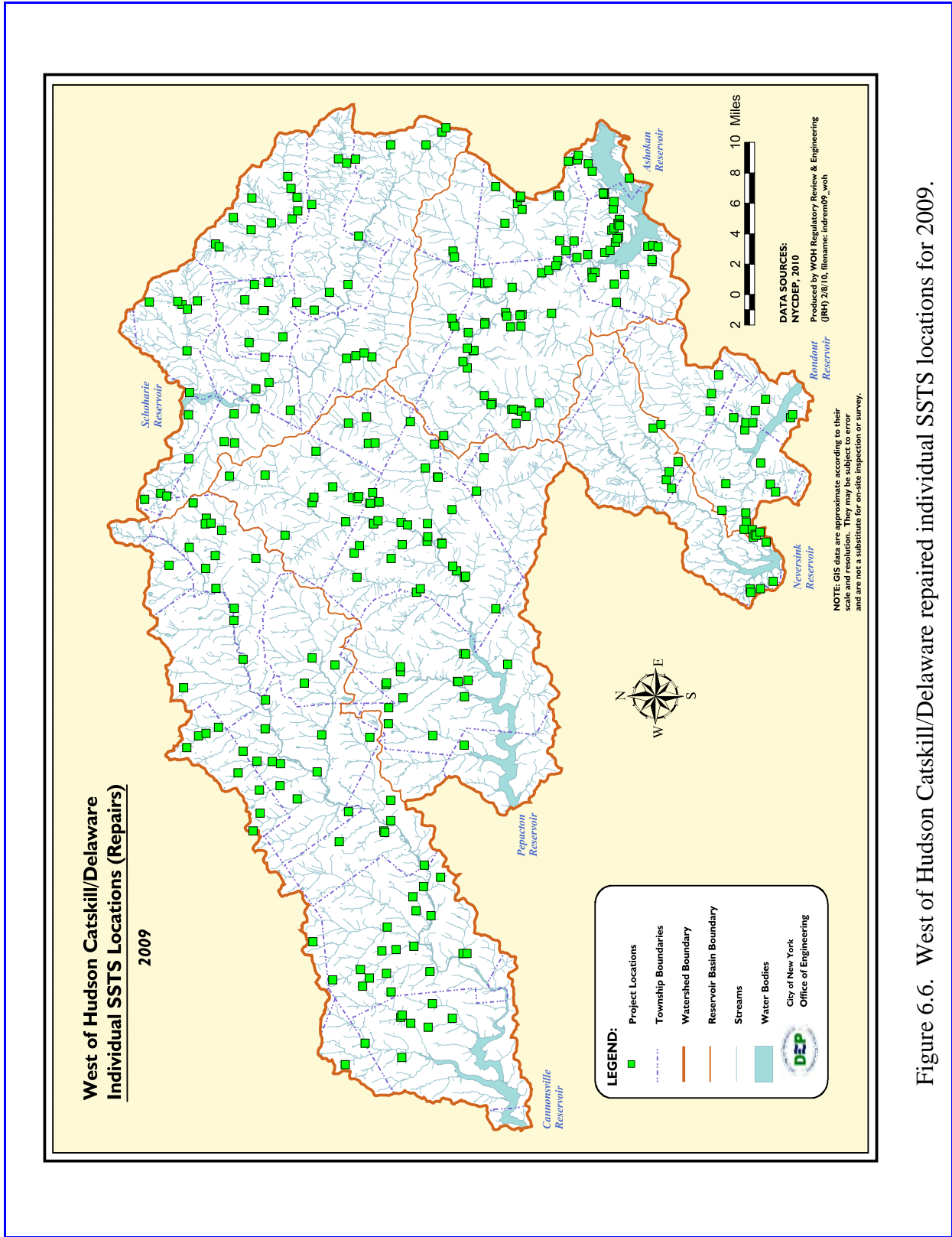


Figure 6.6. West of Hudson Catskill/Delaware repaired individual SSTS locations for 2009.

6.1.1 SEQRA Coordination

To better coordinate SEQRA activity in the watershed, DEP created the SEQRA Coordination Section in January 2004. This section ensures timely, thorough, and effective SEQRA environmental reviews 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, interacts with local, state, and federal officials and other parties interested in DEP’s involvement in SEQRA environmental reviews, and makes certain that the appropriate levels of DEP management are kept apprised of the presence and status of potentially controversial SEQRA reviews.

SEQRA Actions include 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, and Findings to Approve or Deny. Table 6.7 presents a summary of SEQRA actions in 2009.

Table 6.7. SEQRA actions in 2009.

Received	Reviewed	Comment Letters Issued	Ongoing Reviews	SEQRA Process Closed
101	101	92	62	70

Ongoing reviews and process closures include certain actions that DEP received prior to the beginning of the reporting period (i.e., prior to January 1, 2009).

Table 6.8 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 6.8. 2009 SEQRA activity and status for Type I Actions.

Project	Description	Town/County	Reservoir Basin	Project Status
11 New King Street	Construction of a multi-story 1,450-space parking garage to provide additional parking space for the Westchester County Airport and petition to amend the zoning code.	North Castle/ Westchester	Kensico	DEP issued comments during scoping session.
Bedford Water Filtration Plant	Construction of water filtration plant, driveway, 10-space parking lot and installation of distribution pipes. Water to be drawn from Shaft 13.	Bedford/ Westchester	Muscoot/ Cross River	DEP received and commented on EAF. Review is ongoing.
Camp Oh-Neh-Tah	Upgrade of WWTP and sewer lines.	Windham/ Greene	Schoharie	DEP received Lead Agency Negative Declaration.
Catskill Mountain Camp & Cottages	Proposed 99 lot subdivision on 82-acre parcel, access roads, private water supply, sewage collection system, and recreational area.	Tannersville/ Greene	Schoharie	DEP awaiting DEIS for review and comment.
Chappaqua Crossing	Redevelopment of the 120-acre Reader's Digest campus to include 348 new residential units and continuation of office space.	New Castle/ Westchester	New Croton	DEP received and commented on the DEIS. DEP held a meeting with the project applicant.
Coulter Brook Meadow Subdivision	Proposed 18-lot subdivision on 263-acre parcel.	Bovina/ Delaware	Cannonsville	DEP received Lead Agency Negative Declaration.
Cortina Mountain Estates	Proposed construction of 95 homes, community WWTP, private water supply, and access roads.	Hunter/Greene	Schoharie	DEP received Lead Agency Negative Declaration. DEP did not agree with the determination of significance. Article 78 petition filed in Greene County Clerk's office.

Table 6.8. (Continued) 2009 SEQRA activity and status for Type I Actions.

Project	Description	Town/County	Reservoir Basin	Project Status
Crossroads 312	Construction of a hotel/ conference center, restaurant, and large retail establishment, and zoning amendment.	Southeast/ Putnam	Diverting	DEP received Lead Agency Positive Declaration. DEP requested to participate in scoping session.
Estate Motors	Complete redevelopment of car dealership to include demolition and construction, parking for 369 vehicles, stormwater management facilities. Existing SSTS which is located under the existing parking lot is expected to be utilized.	Lewisboro/ Westchester	Muscoot	DEP received and commented on EAF. Review is ongoing.
Hillcrest Commons	Construction of six senior residential buildings including senior community center, 60,000 s.f. of office space in five buildings and associated driveway and parking.	Carmel & Kent/ Putnam	Croton Falls	DEP issued comment letter on the DEIS and received FEIS.
St. Joseph Church/JFK High School	Construction of a 720-seat church and 400-space parking lot. Reconfiguration of HS athletic fields.	Somers/ Westchester	Muscoot	DEP received Lead Agency Negative Declaration.
Seven Spring Subdivision	Proposed 17-lot subdivision and private equestrian facility.	Bedford & North Castle/ Westchester	New Croton	DEP issued comment letter on the FEIS.
Millwood Fire House	Proposed construction of new firehouse on Routes 120/133 in the Hamlet of Millwood.	New Castle/ Westchester	New Croton	DEP issued comments on the revised draft scoping document.
Moresville Energy LLC for Wind Energy Facilities	Proposal to construct a wind energy facility consisting of 33 wind turbines and ~8.27 miles of access roads.	Roxbury & Stamford/ Delaware	Multiple	DEP received and commented on the DEIS in June 2008. The Lead Agency has requested additional information from the applicant.

6. Regulatory Programs

Table 6.8. (Continued) 2009 SEQRA activity and status for Type I Actions.

Project	Description	Town/County	Reservoir Basin	Project Status
Patterson Crossing Retail Center	Proposal to construct ~439,000 s.f. of retail space and 2,097 parking spaces on a ~90-acre parcel.	Patterson/ Putnam	East Branch	DEP issued Findings to Approve.
Putnam Community Foundation	Construction of 60 apartment units and 60 townhouse units, community center, tennis courts, and multi-sport courts.	Carmel/ Putnam	Croton Falls	DEP received Lead Agency Findings to Approve.
Union Place	Mixed used development with walkable community center on ~303-acre parcel.	Carmel/ Putnam	Muscoot	DEP received copy of cease and desist order in March 2008 from Town of Carmel stemming from installation of roadway and wetland violation. DEP is awaiting DEIS for review and comment.
Bedford Community Church	Proposed new facility to include 720-seat church, 250-occupancy banquet facility, 12 classrooms, 240 off-street parking spaces and subsurface sewage treatment system.	Bedford/ Westchester	Muscoot	DEP received and commented on the DEIS. DEP awaiting FEIS.
Salem Hunt	Proposal to construct 75 condominium units in 15 buildings, a community building, pool, and associated parking.	North Salem/ Westchester	Muscoot	DEP issued Findings to Approve.
Somers Realty Planned Hamlet Development	Mixed use development including 154 residential units, congregate care living space, professional office space, medical offices, retail/restaurant space, and a public park.	Somers/ Westchester	Amawalk	DEP received Lead Agency Finding to Approve. DEP continues to monitor petition to the Westchester County Sewer District.

Table 6.8. (Continued) 2009 SEQRA activity and status for Type I Actions.

Project	Description	Town/County	Reservoir Basin	Project Status
Stateline Retail Center	Retail development including ~180,000 sq. ft. of retail space and 900+ parking spaces.	Southeast/ Putnam	East Branch	DEP issued Findings to Approve.
Twin Mountain Estates	Construction of 8 duplex residences and community building.	Hunter/Greene	Schoharie	DEP received and commented on EAF.
Ward Pound Ridge Comfort Station	Renovation and repair of existing comfort station to include new SSTS and UV equipment.	Lewisboro/ Westchester	Cross River	DEP received Lead Agency Negative Declaration.
Westchester Residence & Club	Proposed 129 residential units, fitness center, underground parking, private roadway.	Mt. Kisco/ Westchester	New Croton	DEP received Lead Agency Findings to Approve.
Town of Windham	Local Technical Assistance Program for Schoharie Watershed. Impact study of the development capacities with regard to sustainability of community through the creation of a diverse economy.	Windham/ Greene	Schoharie	DEP issued comment letter on the Generic DEIS.
Windham Mountain Sporting Club	Construction of 345 multiphase residential units, two lodges, wellness center with swimming pool, roads, and two ski lifts on 465-acre parcel.	Windham/ Greene	Schoharie	DEP received and commented on EAF.

6.1.2 Delegation Agreements

During 2010, the Westchester, Putnam, and Ulster County Delegation Agreements expire. DEP is currently reviewing these Delegation Agreements for renewal in July 2010. Westchester and Putnam Counties perform reviews of new and repaired septic systems in accordance with their Delegation Agreements. Ulster County performs reviews of new septic systems in accordance with its Delegation Agreement.

DEP received documentation concerning the review of 274 delegated systems during calendar year 2009. Of these, 91 were reviewed by county health departments in the Catskill and Delaware Systems. The remaining 183 delegated septic systems are located outside the Catskill and Delaware Systems.

6.2 Enforcement Activities

DEP continues to monitor activities in the watershed to ensure water supply protection. Part of that effort focuses on the management and protection of City-owned water supply lands. As of December 2009, these lands totaled approximately 156,471 acres. DEP inspects and maintains boundary limits on all City lands and conservation easements, prepares properties for purchase by the City, issues public access and boating permits, and refers violations to the DEP Police.

DEP is also responsible for reviewing designs to correct violations, conducting site visits, witnessing soil tests, and inspecting construction of all new individual septic systems in the Catskill and Delaware Districts. On a limited basis, DEP performs discovery and confirmation of septic failures, issues Notices of Violation (NOV), pursues enforcement actions on failed SSTs, and refers other criminal activity to the DEP Police. These activities are coordinated with DEP Legal and Corporation Counsel, county health departments, local building inspectors, and the Catskill Watershed Corporation if the activity is in a Memorandum of Agreement (MOA) program area.

The DEP Environmental Police patrol the entire 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 are prepared to issue summonses or Notices of Warning for violations of the New York State Environmental Conservation Law and the watershed regulations, as well as other state and local laws. The DEP Police coordinate with other DEP divisions to ensure they are aware of ongoing construction sites in the watershed, and that areas of special concern are being monitored. Currently, members of the DEP Environmental Police attend the DEP monthly enforcement meetings for both the East of Hudson (EOH) and West of Hudson (WOH) Watersheds.

In 2009, the DEP Police:

- Completed 17,409 hours of training
- Conducted 5,157 preliminary investigations
- Conducted 138 long-term investigations related to pollution crime or terrorism
- Conducted 10 suspicious incident investigations related to terrorism
- Patrolled 2,138,961 miles
- Conducted 176,281 physical security inspections

Also in 2009, the DEP Police made 79 arrests, issued 1,129 summonses, and served 130 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

At each surface discharging WWTP that operates on a year-round basis, the DEP's Wastewater Treatment Plant Compliance and Inspection (WWTP-CI) Program conducts a quarterly compliance inspection. At seasonal surface discharging facilities, a minimum of two compliance inspections are conducted during the operating season per year. 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.

In addition to compliance inspections, DEP also conducts reconnaissance inspections at facilities to meet with owners and/or operators to address special problems and provide operations assistance when necessary. Reconnaissance inspections may be prompted by violations or sampling results from biweekly DEP sampling and analyses. When needed, DEP laboratories are asked to collect samples and conduct special analyses to identify violations and assist in resolving operational issues.

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

Facility Compliance in the Catskill/Delaware Watershed

Thirty-six WOH WWTPs, including the New Infrastructure Program (NIP) facilities and their respective connections, were inspected by DEP on a regular schedule. Of these, 29 facilities are permitted for year-round discharge and 7 are permitted for seasonal discharge. Three of the 36 are wastewater treatment facilities permitted to discharge to groundwater. These are the Hamlet of Chichester, Mountainside Farms, and Hanah Country Club. Three other dischargers are industrial non-contact cooling water discharges. These include Ultra Dairy, DMV, and Kraft Non-Contact Cooling Water discharges. DEP conducted 186 scheduled compliance, emergency response, and WWTP upgrade construction inspections in 2009.

WWTPs in the Catskill/Delaware watershed continue to show improvement in compliance with their State Pollutant Discharge Elimination System (SPDES) Permits. This is due in large part to the WWTP-CI Program.

DEP participates in Compliance Conferences (CC) with those facilities that continue to violate their SPDES permit limits and/or monitoring requirements. CCs are usually conducted after repeated attempts by DEP to remediate the problem with the facility owner and/or operator have failed. DEP, in conjunction with DEC and local regulatory authorities, sends out an NOV letter prior to calling for a CC. Because many problematic and outdated facilities which exceeded their permits on a regular basis have been connected to another upgraded facility, upgraded as a stand-alone facility, converted to subsurface discharge, or totally abandoned, the number of these failed WWTPs has decreased greatly. Therefore, the number of CCs has also decreased.

A CC was held in November 2009 for the Oorah Catskill Retreat WWTP (SPDES# NY – 0069957). Although this facility was upgraded in 2006, it has been plagued by excessive hydraulic loads to the facility. The facility received a SPDES permit modification from DEC to operate during the 2009 operating season with an interim flow limitation of 15,000 gallons per day (gpd). The SPDES permit included a final effluent flow limitation of 18,000 gpd. DEP issued an approval to install an additional continuous microfiltration (CMF) unit, an additional ultraviolet (UV) disinfection chamber, and three pressurized sand filters to meet the final effluent flow limitation. During the 2009 camp season, the facility conveyed, on average, in excess of 21,000 gpd to the WWTP. In order to avoid any violations related to the excess flow, the facility instituted a pump and haul procedure to remove raw wastewater from the facility septic tanks. DEP also discovered a failed subsurface treatment system that received wastewater from a staff housing complex. The schedule of compliance indicated that the facility must investigate the source of the excess flow and determine if the failed subsurface treatment system can be rehabilitated and if an expansion area, in accordance with current codes and standards, can be constructed.

DEP reviewed, approved, and monitored the implementation and construction of the connections for several WWTPs to NIP facilities. The Crystal Pond Lift Station, conveying wastewater to the Town of Windham WWTP, was completed in July 2009, with decommissioning of the onsite WWTP beginning in December 2009.

WWTP-CI was instrumental in the progress made in DEP's Regulatory Upgrade Program. During 2009, more stringent SPDES limits were almost immediately met at WWTPs that completed their upgrades. WWTP-CI performed construction inspections and start-up surveillance, and reviewed performance testing data, operations and maintenance (O&M) budgets, and O&M manuals and record drawings. DEP issued a notice to proceed with construction for two remaining stand-alone upgrades, Camp Oh-Neh-Tah and Batavia Kill Recreation Area.

Facility Compliance in the East of Hudson Watershed

DEP ensures that adequate measures are taken to enforce compliance with the SPDES permits issued to the 72 WWTPs and the 38 groundwater remediation systems, landfills, oil/water separators, and wastewater collection systems that discharge into the EOH watershed. DEP conducted 436 scheduled compliance, emergency response, and WWTP upgrade construction inspections in 2009.

The West Branch, Boyd Corners, Croton Falls, Cross River, and Kensico Reservoir basins are of special interest because they contribute to waters of the Delaware System. The following is a summary of the WWTPs and collection systems inspected within the West Branch, Croton Falls, and Cross River basins. (There are no WWTPs in the Kensico and Boyd Corners basins, but DEP does perform inspections of the collection system/pump stations maintained by Westchester County and the Towns of North Castle and Harrison within the Kensico basin.)

There are nine active and one inactive WWTPs in the West Branch, Croton Falls, and Cross River basins. All of the active WWTPs were in substantial compliance with their SPDES permit discharge limitations. The Carmel Sewer District #2 WWTP did experience a sewage overflow from its collection system on July 13, 2009 that was not entirely contained but which did not impact water quality. A compliance conference was held in October 2009 with representatives of DEP, DEC, and the Town of Carmel. The Town established, based on the content of the debris removed such as beer cans/bottles, that the cause of the overflow was due largely to vandalism. The Town proposed to install locked manholes at these locations. A draft Order on Consent was forwarded to the Town for review. The Town responded with a protocol to inspect the collection system more frequently and to lock three manholes in the vicinity of the spill. DEC is currently reviewing the order.

DEP performed a Compliance Response Inspection of the Lewisboro Elementary School on November 24, 2009. DEP discovered that the temporary package WWTP, utilized during construction of the facility upgrade, did not have any filtration process installed prior to discharge. The school was unable to divert the treated waste stream to the existing buried sand filter beds because they were now the footprint for the facility upgrade. This oversight was brought to the attention of the DEP Upgrade Program and the upgrade consultant, O'Brien and Gere. A fabric filter was rented and installation was completed by the first quarter of 2010. The facility did not incur any SPDES permit effluent violations as a result of this oversight.

DEP reviewed, approved, and monitored the construction of the stand-alone upgrades for the Hill Sparrow, Meadows at Cross River, and Michelle Estates WWTPs. All three WWTPs were certified functionally complete during the fourth quarter of 2009. The Waccabuc Country Club WWTP upgrade project held a pre-construction meeting in December 2009. The Lake Plaza/ Ralph Morando service connection to the Carmel Sewer District #1 collection system, which conveys wastewater to the City-owned Mahopac WWTP, commenced on December 30, 2009.

DEP performed visual inspections of the West Lake Trunk Sewer monthly throughout 2009 in conjunction with regularly scheduled stormwater BMP inspections within the Kensico basin. The inspections revealed no abnormal conditions.

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 Harrison (Park Lane) pump stations and collection system throughout the 2009 monitoring period. The inspections revealed no abnormal conditions.

6.3.1 Sampling of Wastewater Treatment Plant Effluents

Sampling of surface-discharging WWTP effluents is conducted by DEP's ELAP-approved laboratories. At non-City-owned WWTPs, grab samples are taken twice monthly. In addition, a composite sample is collected once a year from those plants that have composite sample monitoring requirements in their SPDES permits; these plants are listed in the Watershed Water Quality Monitoring Plan (DEP 2009a). Special cases are the non-contact cooling water discharges at Kraft and Morningstar Foods/Dairyvest, which are routinely sampled quarterly, by composite sample. City-owned WWTPs are sampled in accordance with State Pollutant Discharge Elimination System (SPDES) permit monitoring requirements; these samples, including grab samples, are analyzed by DEP laboratories for reporting on Discharge Monitoring Reports.

In the Catskill System in 2009, 15 WWTP effluents were sampled; composite samples were collected from 13 of them. In the Delaware System, 12 WWTP effluents and the 2 non-contact cooling water discharges (Kraft and Morningstar) were sampled. Composite samples were collected at 10 of the WWTPs and at both non-contact cooling water discharges. No composite samples were collected at any of the EOH System's 59 WWTPs.

In 2009, 2,300 analyses were performed on 375 effluent samples from WWTPs in the Catskill System. For the Delaware System, there were 2,365 analyses performed on 261 effluent samples from WWTPs and non-contact cooling water discharges (e.g., Kraft). Lastly, 1,852 analyses were performed on 252 effluent samples from East of Hudson WWTPs.

Sampling data are shared regularly with DEP's Wastewater Treatment Plant Compliance and Inspection Program for the purpose of tracking compliance with SPDES-permitted effluent limits. In addition, total phosphorus concentration data are used to develop point source phosphorus loads.

6.4 Winter Road Deicer Policy and Protection Development

DEP is a member of the deicing task force of the Northern Westchester Watershed Committee, which includes representatives of local highway officials, Westchester County, Department of Transportation, New York Riverkeeper, and the New York Public Interest Research Group.

Members of the task force met in December 2009 as part of a Westchester County Parks discussion panel to provide information to the various towns in Westchester County about the more environmentally-friendly methods and products used to deice roads. The meeting included a range of presentations from a road superintendent, the owner of a road deicer technology company, and a local scientist from the Cary Institute of Ecosystem Studies who has performed research studies on environmental chloride levels in the New York City Watershed. The presentations can be viewed at: http://parks.westchestergov.com/index.php?option=com_content&task=view&id=1995&Itemid=4452.

The presentations included discussions on the recent advances in deicing methods, including the pre-application of a brine solution which has resulted in a significant reduction in the use of road salt and manpower. A presentation was also given on the different deicing agents on the market and their relative costs and benefits. Finally, a presentation was given on the state of the environment, specifically water quality, with respect to chloride levels. In some cases, chloride levels are increasing towards thresholds that can significantly impact aquatic biota and drinking water quality. Therefore, new methods for reducing salt application will be an important part of maintaining water quality for the ecosystem and in turn for human consumption.

As mentioned last year, several practices recommended by the Task Force are being considered, and have been enacted, at the local, county, and state levels. In addition, a bill under review by the NYS Senate (S. 2255) would designate sections of roadway in close proximity to East of Hudson reservoirs as environmentally sensitive, and require use of an environmentally benign substitute (potassium acetate) to deice them.

7. Catskill/Delaware Filtration/UV Disinfection Facilities

DEP's UV disinfection facility will be constructed along the eastern side of the City-owned Eastview parcel (Towns of Mount Pleasant and Greenburgh, Westchester County). At startup, water from the Delaware Aqueduct will enter the facility through the North Forebay and will be delivered to downstream consumers through the Catskill and Delaware Aqueducts. Provision has been made for future connections to be made from the Catskill Aqueduct once it is pressurized, as well as from the proposed Kensico City Tunnel and from the Catskill/Delaware water filtration facility, if built. The current design also provides design elements to facilitate connections for local consumers and for the delivery of finished water to the Kensico City Tunnel should it someday be constructed at this site.

To maintain its dual track approach for meeting the goals of the Surface Water Treatment Rule of the federal Safe Drinking Water Act, DEP continues to perform biennial updates of the preliminary designs for a Catskill/ Delaware Ozone/Direct Filtration facility that can be advanced to final design and construction in the event that filtration of the Catskill and Delaware water supplies is deemed necessary. The most recent update was completed in September 2009.

7.1 Ultraviolet Disinfection Facilities

7.1.1 Site Preparation

Eastview Project Site

In addition to the primary goal of excavating soil from the eastern side of the Eastview site, ECCO III Enterprises Inc. (ECCO III), the site preparation contractor, installed permanent soil erosion control and stormwater control measures, and stabilized large tracts of exposed soil. In preparation for future contractors, ECCO III was also responsible for the installation of site utilities, paved internal roadways, and site lighting. As of December 2008, these items were transferred to their respective contractors, who will perform the next phase of work.

Aerators at Kensico Reservoir

The subsurface conduits were dewatered and cleared of sediment. Once the remediation was completed the demolition of the Catskill and Delaware aerators commenced. To fill and landscape the aerators, ECCO III and its subcontractors transferred 100,000 cubic yards of soil from the Eastview site. As of the end of 2009, the aerators had been demolished, backfilled, and landscaped. This work has allowed the contract to achieve substantial completion as of the fall of 2009.

7.1.2 Design of Ancillary Projects

The contract to perform wetland work, CAT210WL, was issued to Halmar International, LLC, in an order to commence in July 2009. The contract calls for the creation, restoration, stabilization, and maintenance of wetland areas in accordance with U.S. Army Corps of Engineers Protection of Waters permit requirements. The portion of the work to be performed in North Castle has a completion milestone in the summer of 2010.

To meet certain requirements of the Mount Pleasant Site Plan Approval, DEP is planning to construct a pipeline between the Delaware Aqueduct on the Kensico campus and the Town's Commerce Street Pumping Station. The contract, CAT210WM, was issued to Northeast Remsco in November 2009, and the pipeline is under construction now.

7.1.3 Permitting

New York State Department of Transportation

The installation of the Catskill treated water conduits under route 100C was completed in 2009. Continuous meetings and correspondence between Town representatives and New York State Department of Transportation facilitated temporary partial road closures allowing for timely performance of work.

Greenburgh Work Permits

The contractor proceeded with site investigation work in the Town of Greenburgh, according to the building permit to construct a small superstructure that will provide access to the proposed treated water connection to the Catskill Aqueduct.

7.1.4 Project Schedule

The project schedule is prescribed in both the 2007 FAD and an Administrative Consent Order between DEP and EPA. Monthly reports are submitted in accordance with the Administrative Order of Consent and describe progress on the project, in addition to providing a mechanism for describing any known or anticipated non-compliant milestones.

7.1.5 Facility Construction Contracts

In 2009, all the prime contractors completed mobilization. Progress has been steady, allowing completion of Administrative Consent Order Milestones 4 and 5—Completion of the Underslab Piping and Completion of the Base Slab of the UV Building. In addition to the Consent Order milestones the contractor completed the installation of the 144-inch raw and treated water headers.

Work on the other buildings related to the facility continued. These buildings include the North Forebay, South Forebay, and the Energy Dissipating Valve Chamber.

The manufacture and shipment of key pieces of equipment continued throughout 2009. As of December 2009, 50 of the 56 UV units had been manufactured and accepted for shipping.

Due to delays related to the Kensico aerator remediation, the stockpile of soil exceeded the original design. This has led to the installation of additional sediment control basins to limit runoff during heavy rain events as part of an ongoing stormwater pollution prevention plan.

7.1.6 Pilot Studies

UV Lamp Fouling Study

The final report was submitted to DEP in 2009. Results presented in this report will be used to develop operation and maintenance procedures for the full-scale facility. The data have aided in preliminary staffing discussions.

Dyed Microsphere Study

A study to analyze the level of *Cryptosporidium* inactivation was performed at the Hydroqual facility in Johnstown, NY. Dyed microspheres were added to the water to simulate *Cryptosporidium*. The microspheres were analyzed before and after disinfection to measure the actual rate of inactivation. This study will provide additional information that will aid in the determination of appropriate UV dose during operation. The data are being further analyzed for inclusion in a final report to be submitted in late 2010.

7.2 Filtration Planning Design Update

7.2.1 Facility Design Update

In accordance with the terms for relief from completing final designs for a filtration facility, a preliminary design update was completed in September 2009 for a 2,110 MGD ozone/direct filtration facility for the Catskill/Delaware water supplies. The design update was presented as a supplement to the 2003 Preliminary Design Update and incorporated all modifications previously presented in the 2005 design update. The changes included converting the previous design into a three-dimensional drawing platform. This change will facilitate additional coordination among the different design disciplines while resolving many conflicts before work begins on-site.

The update also includes refinement of the post-chemical treatment building. Additional detail was added to the building to fully incorporate the 2005 update that would make this a mostly below grade structure. The orientation and size of the structure were further influenced by changes to the Catskill Venturi Chamber in the 2007 update.

8. In-City Programs

8.1 Waterborne Disease Risk Assessment Program

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

- 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

In 2009, active surveillance for giardiasis and cryptosporidiosis continued as in prior years. Forty-three clinical laboratories located in New York City performing parasitology examinations for *Giardia lamblia* and *Cryptosporidium*, as well as six laboratories in the NYC vicinity, were contacted on a regular basis to solicit case reports on all positive specimens. For all cryptosporidiosis cases, and as needed for giardiasis cases, public health epidemiologists contact patients to verify the data collected on the case report, to collect additional demographic and clinical information, and to identify possible sources of exposure. At the time of this writing, the 2009 *preliminary* count of cases reported to DOHMH among NYC residents is 839 cases of giardiasis, and 80 cases of cryptosporidiosis.

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. 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 sentinel nursing homes; and a third system tracks the number of stool specimens submitted to two clinical laboratories for microbiological testing. The fourth type includes monitoring of sales of anti-diarrheal medication (ADM). The City's ADM monitoring activities have two components: one in which the weekly volume of sales of non-prescription ADM at a major store chain are monitored, and the second, involving another major drug store chain, in which daily sales of non-prescription medications are monitored. Beginning in 2009, DEP began using its newly enhanced daily dataset and CDC's Early Aberration Reporting System (EARS) analysis program to provide additional analysis to the standard weekly one when unexplained signals of potential concern appeared in the other surveillance systems.

Educational outreach in 2009 included several presentations by DOHMH representatives at public health and/or medical schools located in NYC and a presentation (by A. Seeley, DEP) at the Annual American Public Health Association Conference. Additional results and program information can be found in the WDRAP semi-annual and annual reports.

8.2 Cross Connection Control Program

During 2009, DEP's Cross Connection Control Program greatly exceeded (by 200% to 700%) the revised calendar year milestones established in the 2007 FAD. This is the second year in a row the milestones have been met or greatly exceeded.

This year, DEP prepared and bid a backflow contract to retain the services of a consulting engineering firm to perform cross connection control inspections, review plans for new installations, review initial test reports, and prepare enforcement correspondence as required for DEP signatures. The primary purpose of this contract is to complete, over the course of its one-year term, the inspections of the properties originally designated as potentially high hazard from the list generated in 1998. The contract was awarded in October 2009 and work will commence in January 2010.

In anticipation of the contract award, DEP instituted drive-by verification inspections of premises listed as potentially high hazard in the cross connection control database, in addition to conducting detailed internal premises inspections. The purpose of the drive-bys was to verify that the use of the facility had not changed and still possessed a potential high hazard threat, thus providing more accurate and up to date information to the firm awarded the bid.

In 2009, DEP established a program in which informational letters and brochures were sent to premises considered potentially hazardous and which, it was expected, would require installation of a backflow prevention device. The correspondence explained the DEP Cross Connection Control Program and included a DEP website and telephone number where owners could make inquiries about the process and request information on how to comply with the requirements.

The Cross Connection Control Task Force met once in 2009, on September 10. In attendance were representatives from DEP, the Plumbing Foundation, the Master Plumbers Council, the Sub-Surface Plumbers Association of N.Y., and various individual plumbers and architects. Topics of discussion included the status of the cross connection control contract, the new education and informational program, and updates on other aspects of the Cross Connection Control Program.

At no time throughout the year were any reports received that could be considered potential cross connection control or backflow complaints.

DEP's rigorous oversight and regulation of cross connection control activity and the substantial inspection program continue to provide ample protection to the City's public water supply system. The Cross Connection Control Unit (CCCU) strives to provide a dynamic program, with constant improvements, by utilizing the following framework and direction:

1. Immediate surveillance and inspection, following an emergency, notification, or request, of all premises in a given area to determine the degree of hazard posed by a potential cross connection event.
2. Requiring high hazard premises to properly evaluate their potential for cross connection hazards and submit plans for the installation of all required cross connection control containment devices.
3. Swift assessment of plans submitted for review and approval to DEP, eliminating the need for applicants to submit their cross connection device plans to DOH for sign-off.
4. Approval for a wet connection or 2-inch tap permit will not be issued without a CCCU review or exemption.
5. Records of the proper installation and initial testing of the approved device, as well as the annual testing of any cross connection control containment device, are collected, tracked, and maintained by CCCU.

Regularly scheduled outreach and informational sessions, handouts, and dialogues with Professional Engineers, industry groups, and plumbing industry professionals regarding any changes in the DEP cross connection control policy and procedures are ongoing.

9. Education and Outreach

DEP advances the City’s long-term watershed protection strategy through active stakeholder collaboration, broad community outreach, and targeted educational programs for both upstate watershed residents and downstate water consumers. Towards this end, DEP works closely with the Catskill Watershed Corporation (CWC), Cornell Cooperative Extension (CCE), Soil and Water Conservation Districts (SWCDs), Watershed Agricultural Council (WAC), and numerous local, City, state and federal partners to inform constituents and raise public awareness about the water supply system, source water protection and conservation, and environmental stewardship.

The 2007 FAD requires DEP to report annually on the educational efforts of the Watershed Agricultural and Forestry Programs, Stream Management Program, and CWC Public Education Program, in addition to other school-based education efforts, general community outreach, and partnerships with regulatory and local government officials. The FAD specifically requires DEP to collaborate with local municipal officials on education, outreach, and training programs that promote land use planning, stream corridor protection, and stormwater management. This report summarizes key 2009 accomplishments organized around five consolidated audience categories.

9.1 New York City Water Consumers

DEP’s official website (nyc.gov/dep) features a wealth of information about the water supply system, watershed protection, water conservation, drinking water quality, and environmental education. In 2009, as part of the City’s tap water marketing campaign, DEP launched a new website (nyctapwater.org) to further educate the public about the City’s drinking water. DEP created a new water bottle, designed decals and promotional material, and purchased “water-on-the-go” stations to provide official tap water at special events throughout the City such as beach volleyball tournaments, marathons, “Summer Streets,” and various City park events.

In 2009, DEP published and distributed 870,000 copies of the *2008 New York City Water Supply and Quality Report*—a mandated annual consumer confidence report – in addition to several thousand copies of the following new/updated publications for water consumers: *Check the Facts, Follow the Tips! Save Hundreds of Gallons of Water a Day*; *How Restaurants Can Lower Their Water and Energy Bills*; *Safety Net Referral Program: Assistance Programs Offered to Eligible Water and Sewer Customers*; *Rooftop Detention*; *Important Information for Consumers of the New York City Croton Water Supply* (a mandated quarterly publication; 568,000 total copies published in 2009); *New York City Water Saver’s Workbook*; *How to Pay Your Water and Sewer Bill* (a quarterly bill insert; four million copies mailed in 2009); *2008 New York Harbor Survey Report* (print copies and CDs); *Once-Through Water-Cooled Refrigeration, Ice-Making and Air Conditioning*; and *Rain Barrel Giveaway Program*.

DEP worked with five Hydrant Education Action Teams (HEAT), comprised of 62 high school and college students who canvassed New York City neighborhoods disseminating information about the effects of illegally-opened fire hydrants on water pressure in the City's distribution system. DEP and HEAT also partnered with the Police Athletic League to pilot outreach programs at summer play streets in Manhattan and the Bronx.

In 2009, DEP completed the four-year restoration of the 27-piece watershed relief model that remains on long-term loan to the Queens Museum of Art (QMA). In support of this effort, DEP conducted a professional development workshop for QMA staff about the City's water supply system and how to incorporate watershed concepts into guided tours and hands-on lessons. DEP also coordinated a Watershed Environmental Education Alliance (WEEA) meeting at QMA to help upstate WEEA members learn more about watershed education resources in the City. Also in 2009, QMA utilized Watershed Forestry Program grant funding to conduct a watershed bus tour for about 50 QMA educators, administrators, curators, volunteers, and local artists.

DEP launched several water-related exhibitions throughout the City in 2009, including: "Growing and Greening New York" at the Museum of the City of New York; "The Future Beneath Us: Eight Great Projects Under New York" at the New York Public Library; and "From Mountaintop to Tap: A Watershed Trek" at the Brooklyn Public Library. To complement these prominent exhibitions, DEP also coordinated and hosted public programs such as "Sandhogs: The City on their Shoulders" and "Engineering Marvels: Old Croton Aqueduct and City Water Tunnel No. 3." In October, more than 600 people attended "Open House New York" held at the new Visitor Center at Newtown Creek Wastewater Treatment Plant, where DEP continues to develop a series of interpretive exhibitions and other programs for youth and adults. The Visitor Center is scheduled to officially open to the public during spring 2010.

DEP maintains an educational presence at several highly visible Greenmarkets throughout the City to increase public knowledge about the water supply, floatables reduction, proper grease disposal, and water conservation. In 2009, WAC also attended three of these events at the New Amsterdam Market to showcase the Watershed Agricultural and Forestry Programs and to promote watershed farm and forest products to in-City water consumers. DEP and WAC also participated in the 2009 NYC Winter Jam, which attracts about 5,000 visitors.

As part of ongoing efforts to promote in-City water conservation and reduce stormwater runoff, DEP continued its pilot Rain Barrel Giveaway Program for eligible homeowners in the Jamaica Bay watershed. In 2009, DEP distributed 250 rain barrels to homeowners in Queens and taught them how to capture stormwater from their roofs and store/use this water for landscaping and other purposes. DEP also kicked off 2009 World Water Week by supporting the NYC Tap Project Water Walk where hundreds of people walked one mile carrying containers of water. DEP also trained Charmin's Marketing Team about water supply and wastewater issues.

9.2 Watershed Residents, Landowners and Homeowners

The Watershed Agricultural Program (WAP) educates farmers about their Whole Farm Plans, nutrient management plans, best management practices, and various agribusiness topics. In 2009, WAC partnered with Delaware County CCE and others to conduct a year-long series of farmer education programs that reached more than 530 participants, of which at least 225 were watershed farmers. Highlights included the 2009 Catskill Regional Dairy, Livestock, and Grazing Conference; 2009 Farm to Market Conference; 14 producer group meetings (beef, dairy, sheep, and goats); two “Build Your Own Farm Website” workshops; one “Nutrient and Pathogen Management Credit” workshop; one “No Till Production” workshop; and one “Cultivating Agri-tourism Enterprise” workshop. WAC also sponsored two farmer recognition events for East of Hudson and West of Hudson program participants, in addition to sponsoring and attending the Old Salem Horse Shows, which collectively attract about 3,000 participants. In 2009, WAP partnered with several local agencies to co-sponsor the 13th annual Clean Sweep Chemical Disposal Day for Delaware County residents, farmers, and small businesses, that attracted approximately 400 participants.

The Watershed Forestry Program educates forest landowners about sustainable forest management planning and stewardship practices, primarily in collaboration with a watershed model forest host organization. One highlight from 2009 was a five-part landowner education series organized by Delaware County CCE at the Lennox Model Forest, which attracted more than 70 participants. Both the Siuslaw and Frost Valley Model Forests also hosted numerous education and outreach events targeting forest landowners in 2009.

The Stream Management Program educates streamside landowners about water quality protection and riparian buffer management, primarily through local partnerships with CCE and SWCDs but also through public presentations, volunteer planting efforts, watershed advisory committees, and the catskillstreams.org website. Highlights for 2009 included the Second Annual Batavia Kill Stream Celebration; Third Annual Schoharie Watershed Summit; Annual Schoharie Watershed Bus Tour; “The Bird’s Eye View: Aerial Video Footage of Esopus Creek” (public presentation); Ashokan Watershed Stream Management Program Open House; and a public presentation by renowned fluvial geomorphologist Dr. David Rosgen. Please refer to Section 4.6 (Stream Management Program) of this report for more information.

CWC sponsored three homeowner education workshops covering septic system maintenance topics that were attended by nearly 50 participants. One workshop was held in Olive, one in Walton, and one in Windham. CWC also kept watershed residents informed about its various programs and other watershed issues through 27 press releases, three issues of *The Advocate* newsletter, the CWC website (cwconline.org), and appearances at several special events in the region.

In 2009, with funding support from DEP, the Catskill Institute for the Environment (CIE) sponsored a series of public lectures at regional colleges that were attended by approximately 120 participants. These lectures were organized under the banner “Vision for 2020” and addressed the following topics: “Changing Demographics in the Catskills” (Bard College); “Climate Change at Mohonk Lake” (SUNY Ulster); “Geospatial Tools” (SUNY Sullivan); and “Snakehead Eradication” (SUNY Oneonta). In addition to these lectures, CWC, WAC, and the Catskill Water Discovery Center co-sponsored a presentation by Dr. Robert Glennon at SUNY Ulster entitled “Unquenchable: America’s Water Crisis and What To Do About It” that attracted about 120 people. The Kensico Environmental Enhancement Program (KEEP) also sponsored a lecture series at Pace University during 2009.

Also in 2009, DEP presented at the Catskill Landowners Association annual meeting about recent advances in recreational opportunities on City-owned watershed lands. During this meeting DEP also discussed its forestry programs for City-owned lands and a new partnership with the United States Forest Service to undertake a comprehensive forest inventory and develop the first watershed-wide management plan for all City-owned forest lands.

9.3 School Groups (Teachers/Students) and Other Youth Audiences

DEP sponsored the 23rd annual Water Conservation Art & Poetry Contest in 2009, which attracted more than 500 fourth, fifth, and sixth grade students from all five New York City boroughs. More than 900 people attended the annual awards ceremony. DEP also supported the KEEP Art & Poetry Contest for middle school students in the East of Hudson Watershed.

More than 1,800 New York City students attended multiple performances of “City That Drinks the Mountain Sky” at the Tribeca Performing Arts Center in Manhattan during 2009. DEP also conducted numerous in-City classroom presentations and coordinated in-City field trips for school groups to water-related places such as the Staten Island Bluebelt, High Bridge, Central Park Reservoir, and the Old Croton Aqueduct. Hundreds of students took self-guided interpretive tours of the Newtown Creek Nature Walk using DEP’s scavenger hunt activity book that educates visitors about source water protection and wastewater treatment issues.

Within the City, DEP reached out to teachers at the 2009 Science Council of New York City annual teacher conference, 2009 Environmental Expo, Operation Explore teacher trainings, Summer Science Discovery Institute, New York City Expeditionary Learning Curriculum Resource Fair, Bronx River Alliance Teacher Workshop, and other professional development programs. DEP also collaborated with the Department of Education, Intrepid Museum, South Street Seaport Museum, Council on the Environment, New York Hall of Science, Environmental Education Advisory Council, and New York City ReLeaf. One highlight from 2009 was a new collaboration between DEP and the Department of Design and Construction on a program called NICE (Neighborhood Infrastructure Curbside Education), in which students can tour a water main replacement construction site and learn about the water supply system directly below their feet.

DEP hosts and supervises the New York City coordinator of the Trout Unlimited Trout in the Classroom education program. More than 139 New York city public, private, and parochial schools participated, as well as about 30 in the Croton Watershed, and more than 50 in the Catskill/Delaware Watersheds. Spring teacher workshops were held in both the City and the Catskills, while the fall 2009 workshop in Hyde Park attracted more than 180 teachers.

In 2009, the Watershed Forestry Program continued to implement a comprehensive urban/rural school-based education program comprised of the following components: Watershed Forestry Institute for Teachers, Green Connections School Partnership Program, Watershed Forestry Bus Tour Grants Program, and the Catskill Stream & Watershed Education Program (CSWEP). Please refer to Section 4.5 (Watershed Forestry Program) of this report for more information.

The CWC Public Education Grants Program continued to support watershed education projects for both New York City and West of Hudson Watershed audiences. During its Round 12 grant cycle, CWC awarded 28 education grants totaling \$147,866, although one project was subsequently cancelled by the applicant. To date, CWC has awarded nearly 320 grants totaling over \$1.5 million. A majority of these grants support school-based education programs.

In 2009, DEP provided wetlands training to five Ashokan Youth Stewards from the Onteora School district. The training described the functions and values of wetlands and included a field trip to a wetland where the students examined soils, vegetation, and hydrologic conditions. DEP also participated in Ulster County Community College Career Day to provide students with an overview about the roles and responsibilities of a DEP fishery biologist, in addition to educating several hundred students at Woodstock Elementary School about the importance of watersheds.

9.4 Local Government Officials, Professionals, and Business Groups

In 2009, CWC sponsored the ninth annual Catskills Local Government Day at Belleayre Ski Center that attracted over 120 participants including planning board members, code enforcement officers, local government employees, highway department staff, and community leaders. This day-long event focused on the potential impacts of climate change on Catskill communities, businesses, and municipal operations. For the first time, all presentations (12 in total) plus video excerpts from the keynote address were posted on the CWC website to reach a wider audience.

The 2009 Watershed Science and Technical Conference was held at West Point Academy and attended by several hundred scientists, professionals, local officials, and watershed managers. This annual conference is organized and sponsored by the Watershed Protection and Partnership Council, New York Water Environmental Association, DEP, WAC, CWC, US Geological Survey, and the NYS Departments of State, Health, and Environmental Conservation.

The Watershed Forestry Program educates local officials and other municipal audiences about the importance of well-managed working forests. In 2009, WAC and DEP participated in New York State Forestry Awareness Day in Albany while co-sponsoring the annual Region 3 ReLeaf Conference in Westchester County that attracted more than 100 local officials and forestry professionals. Throughout 2009, WAC also conducted forestry presentations for members of the Town of North Salem Planning Board and Jewett Town Board, in addition to meeting with the boards of education at several watershed schools to discuss woody biomass issues.

DEP reaches out to multiple stakeholders, both directly and through land trusts, about the benefits of the Land Acquisition Program (LAP) and land conservation options in the watershed. In 2009, DEP became a lead sponsor of the Northeast Land Trust Alliance Conference held at West Point, which is a training program for conservation professionals. DEP's sponsorship allowed staff from two watershed land trusts to attend the training. DEP also sponsored a "Balancing Sustainable Growth and Land Conservation" workshop organized by Sullivan Renaissance and the Delaware Highlands Land Conservancy and featuring renowned author Ed McMahon from the Urban Land Institute. Finally during 2009, DEP discussed LAP at a Watershed Forest Protection Meeting held at Hilltop Hanover Farm in Westchester County that was hosted by WAC for several East of Hudson land trusts and other stakeholders.

DEP participates in the Catskill Regional Invasive Species Partnership (CRISP) and the Lower Hudson Partnership for Regional Invasive Species Management (PRISM) along with numerous local, state, and regional partners. In 2009, DEP worked with CRISP and especially The Nature Conservancy (TNC) to support and participate in a series of survey, training, and outreach activities targeting the Asian Long-horned Beetle (ALB), a priority invasive insect. Specific events included local training sessions for agency officials and forestry professionals held at the Catskill Center; a one-day workshop held at Belleayre Mountain that simulated a hypothetical ALB infestation near Woodstock and potential response efforts; and two full-day follow-up workshops held in Woodstock and attended by 36 individuals. DEP and TNC subsequently coordinated an ALB survey and outreach effort at 17 private campgrounds in the Catskill region, during which more than 7,000 trees were inspected and more than 3,500 pieces of ALB educational materials were distributed to campers and campground owners.

WAP promotes a "buy local" food campaign through the Pure Catskills marketing website (buypurecatskills.com), which boasts more than 348 member farms, stores, farmers' markets, restaurants, and caterers. In 2009, WAC updated and helped publish 35,000 copies of the *2009-2010 Guide to Farm Fresh Products*, in addition to sponsoring a series of 27 Pure Catskills education/outreach events held throughout the watershed region and attended by more than 12,000 participants. Two of these events included local screenings of the film "Food, Inc." in Walton and Oneonta. WAC also partnered with the New York State Cheesemakers Guild to sponsor two cheese making workshops for about 60 participants; attended both the Brooklyn Food Conference

and Manhattan's "Food For Thought" Film Festival, which were collectively attended by more than 3,000 people; and participated in several local farmers' market meetings in an effort to help strengthen local capacity.

The Watershed Forestry Program promotes a wood products marketing campaign through the Catskill WoodNet marketing website (catskillwoodnet.org), which boasts nearly 80 members. In 2009, the program also sponsored 11 logger training workshops attended by 122 participants and three forester training workshops attended by 17 participants.

The Stream Management Program develops implementation programs in cooperation with basin-level advisory groups comprised of local municipal officials, technical professionals, and other community representatives. Following local adoption of Stream Management Plans, these advisory groups prioritize the expenditure of funds to implement recommendations of local concern. Not only does this process create valuable outreach opportunities for promoting stewardship principles and best management practices to and through the advisory group members, but educational programming is an explicit category of implementation funding. In 2009, training for municipal officials, engineers, and local technical staff covered such topics as post-flood emergency stream work and "Applied River Morphology," a week-long professional seminar conducted by renowned fluvial geomorphologist Dr. David Rosgen and attended by 50 area professionals who play key roles in regional stream management activities.

9.5 Recreational Groups and Other Public Audiences

For the first time, DEP e-mailed electronic copies of the summer 2009 *Watershed Recreation* newsletter to over 60,000 DEP Access Permit holders while printing 4,000 hard copies for additional distribution. In 2009, DEP also updated and published 7,500 copies of the *Wetlands in the Watershed of the New York City Water Supply System* booklet and published pocket guides describing new 2009 Recreational Rules amendments. These pocket guides were posted on the DEP website and distributed to local town halls, sport shops, and other outlets frequented by recreationists. DEP also began posting thousands of newly designed signs (enhanced colors and graphics) on many City-owned watershed lands to delineate property boundaries and explain recreational access opportunities or restrictions. These attractive new signs are easy to understand and blend more easily into the surrounding landscape.

DEP supported numerous community-based activities on City-owned lands during 2009, including guided interpretive hikes, tree and wetland planting projects, reservoir cleanup projects, fishing demonstrations, and bald eagle observation sites. DEP also conducted various natural resource-related presentations (e.g., fisheries, invasive species, wetlands, forestry) to the following diverse audience groups in both the Catskill/Delaware and Croton Watersheds: Catskill Landowners Association, Catskill Forest Association, Oasis Road and Gun Club, Trout Unlimited (Croton Chapter and Ulster County Chapter), and others.

In collaboration with the Delaware County Chamber of Commerce, DEP launched the Cannonsville Reservoir Recreational Boating Pilot Project, which included a public kick-off event in early summer 2009 and significant press coverage. In support of this pilot project, DEP helped develop, and Delaware County published, thousands of copies of a promotional brochure that were made available throughout the Cannonsville basin and Delaware County.

DEP participates in numerous community outreach events throughout the Catskill/Delaware and Croton Watersheds, during which DEP displays an exhibit and distributes information pertaining to watershed protection, water conservation, and environmental stewardship. Highlights for 2009 included Bedford Environmental Summit, Chappaqua Community, Cobleskill Sunshine Fair, Delaware County Fair, FOL-DE-ROL Fair, Grahamsville Little World's Fair, Great Swamp Celebration, Hudson River Day, Lewisboro Library Fair, Mahopac Street Festival, Margaretville Cauliflower Festival, Muscoot Fair, Putnam County 4-H Fair, Teatown Eagle Fest, Teatown Lake Fall Festival, Ulster County Fair, Westchester County 4-H Fair, Westchester Earth Day, World Fishing and Outdoor Expo, Yorktown Community Day, and Yorktown Grange Fair. Thousands of visitors attended these events on a collective basis.

In addition to the above events where DEP directly participated, many watershed partners such as WAC, CWC, CCE, and SWCD also attended various local community events and regional venues where some aspect of New York City's watershed protection efforts were featured through exhibits, presentations, and informational handouts. Highlights for 2009 included Agstravaganza (Grahamsville), Architectural Digest Home Show (NYC), Belleayre Crafts Festival, Bethel Woods Harvest Festival, Eco-Heritage Festival (Ashokan), Greene County Environmental Awareness, John Burroughs Community Day (Roxbury), Meredith Dairy Fest, Northeast Organic Farming Association (NOFA) New York Winter Conference (Rochester), NYS Woodsmen's Field Days, Pennsylvania Association for Sustainable Agriculture (PASA) Annual Conference, Shandaken Day, Sullivan Community College Women's Conference, Sullivan Renaissance Winter Expo, and the Ulster County Business Showcase. Thousands of visitors attended these events on a collective basis.

10. Miscellaneous Reporting Provisions

10.1 Water Conservation

Water demand in the City of New York increased more than 1% per year through the 1950s, 1960s, 1970s, and early 1980s. Drought warnings and emergencies occurred during the 1980s, 1990s, and in 2002. At the same time, wastewater flows to the Wards Island, Newtown Creek, North River, and Coney Island water pollution control plants (WPCPs) either exceeded or approached permit levels. In an effort to avoid the capital cost of expanding the water supply and wastewater treatment infrastructure, and the costs incurred by droughts, New York City has developed a lower cost plan of conservation for water and sewer services.

With the City's population expected to rise to 9.1 million by 2030 from 8.3 million in 2005, water efficiency will continue to have an important role to play, not just to help assure supply but also to assist in meeting goals to reduce combined sewer overflows, maintain wastewater quality, and meet nitrogen removal goals.

Since 1990 water conservation programs implemented by DEP have resulted in a decrease of approximately 22% in the in-City water consumption and wastewater flow. At the same time the City's population increased by approximately 12%. All WPCPs that were exceeding dry weather flow limits in the 1980s are all operating well under their allowed flow rates. Average in-City water consumption and per capita consumption declined in 2009 to the lowest levels in more than a decade. Per capita use has declined from more than 200 gallons per capita per day (gcpd) around 1990 to 125.75 gcpd for year 2009.

Highlights of DEP's ongoing water efficiency program include leak detection, water metering, changes in water use rules, and educational and outreach programs. Events and advancements during 2009 are described below.

Main Replacement and Leak Detection

- In FY2009, DEP surveyed more than 4,060 miles of the City's water mains (59.7% of the mains' linear footage). Five hundred thirteen leaks and breaks were found and repaired and the average time to restore water to customers after confirming a break was 9.1 hours. The entire city is on a three-year survey schedule, while the drainage areas for the Wards Island, Newtown Creek, and North River Wastewater Treatment Plants are on a nine-month schedule. This area of concentrated attention covers all of Manhattan, half of the Bronx, and about one-quarter of Brooklyn. The leak detection program has brought the distribution system leakage rate down to about 10-15% of the rate in the 1980s.
- Each year since 1970, with a few exceptions, DEP has replaced an average of 55-60 miles of old cast iron water mains with ductile iron pipes. This is equal to 1-2% of the total water mains in the system.

- A review of system distribution losses was conducted during late 2006 as part of the department's "Dependability Program". That review is currently being studied by the Bureau of Water and Sewer Operations; once that's complete, the water balance table will be updated.

Water Conservation Program and Activity Updates

Water Metering - Advanced Metering Infrastructure

Installation of the rooftop Data Collection Units (DCUs) began in November 2008 and was substantially complete in 2009. The network provides close to double redundancy.

Large-scale installation of the transmitters (MTUs) on water meters, and the replacement of approximately 50% of pre-1997 small meters, began in March 2009. The system is generating a 97% actual read rate, with the remaining 3% attributable to installation errors that will be corrected. Most MTUs are programmed to read the meter and transmit the read four times a day. Meters 2" and larger will be read once an hour. Installation of the AMR/AMI system will not only improve customer service and collections but will also increase the volume of water use data by orders of magnitude. DEP will move from having meters read four times a year with an 85% actual read rate overall, to four times a day (for most customers) or hourly (for larger customers), with a 97+% actual read rate.

DEP plans to make consumption data available for most customers through its website.

Water Use and Demand Analysis

The Bureau of Environmental Planning and Analysis (BEPA) within DEP has been tasked with tracking and understanding current and past water consumption trends, which are largely based on consumption data dating from 2001 to the present. This consumption is estimated for each available borough, block, and lot, and verified through various analytical methods.

Given that New York City consists of over 850,000 lots, and approximately 97% of City accounts are metered, the generated volume of water consumption data requires extensive cleanup and verification. To properly manage and organize the data, Microsoft SQL server software is being used. The statistical analysis portion of BEPA's study of water consumption trends is performed using -® software, which is designed specifically for analysis of large databases. Additionally, geographic and spatial analyses are performed using ArcGIS software.

The data are used in conjunction with various planning efforts within the agency, such as emergency preparedness, study of the DEP's rate structure, and projecting water use into the future based on past trends and available population projections.

The Water Board hired a consultant in 2008 to examine advantages and disadvantages of several conservation rates along with practical issues that must be addressed to implement a stormwater rate, and to research possible incentives for stormwater management BMPs. The study has benchmarked NYC's rate structure against other municipalities across the country;

researched the types of stormwater, fixed/variable, and other rate structures implemented elsewhere; and identified data needs required to more fully understand the implications of potential implementation in NYC.

Changes in Water Use Rules

DEP has completed revisions to the City's water use rules (RCNY Title 15, Chapter 20). A final public hearing was held on June 16, 2008 and final approval from the City's Law Department was received in May 2009, following which the new rule was promulgated on June 22, 2009. The changes related to water conservation and quality include the following:

- A requirement that any lead or galvanized metal service pipe be completely replaced, rather than repaired, if it leaks. This is aimed at speeding the replacement of these types of services both for water quality purposes and to reduce distribution system losses.
- A requirement that water meters, service pipes, and associated valves and fittings be manufactured of a "no lead" alloy.
- A requirement, or clarification, that public fountains and sprays must have automatic shutoffs.
- A requirement that the water service pipe to a vacant building be disconnected after one year of vacancy and authorization for DEP to perform the work and charge the owner if the owner does not act. This is aimed at reducing leakage from service pipes.

Green Code Task Force

In 2008 Mayor Bloomberg established a task force of architects, engineers, and design professionals, in partnership with the New York City Chapter of the U.S. Green Building Council, to develop recommendations for changes in city codes and rules to improve energy and water efficiency and promote sustainable construction practices. The Task Force's technical committees submitted recommendations in late 2008, which are now being reviewed by the City and an industry advisory group prior to the introduction of legislation in the City Council (<http://usgbcny.org/advocacy/>).

The Council previously passed, and Mayor Bloomberg signed, Local Law 86 (passed in 2005), which requires new municipal buildings to be LEED-certified or LEED Silver depending on the size and value of the project. This requirement effectively commits designers to the use of "high efficiency" toilets and urinals.

Education and Outreach Programs

School Programs

DEP's Bureau of Community and Intergovernmental Affairs continues to develop and implement school-based education programs to help make young people and adults aware of the consequences of littering and the importance of conserving water. DEP provides classroom lessons, staff development workshops for teachers and administrators, printed material describing water issues, and assistance for curriculum development and student research projects. DEP continues to work in collaboration with the Department of Sanitation, Department of Parks and Rec-

reaction, DEC, and EPA to promote the “Clean Streets = Clean Beaches” campaign and other environmental education programs. Ongoing partnerships with education and environmental organizations, such as the New York City Soil and Water Conservation District, the Bronx River Alliance, Council on the Environment of New York City, the American Littoral Society, Children for Children, Going Coastal, and the South Street Seaport Museum, enable DEP to reach a diverse audience.

Other Education and Outreach Programs

DEP’s environmental education resources for New York City’s public, private, and parochial schools emphasize critical and creative thinking, decision-making skills, and communication and collaborative learning across disciplines. All programs are inquiry-based and are aligned with New York City Performance Standards in science, math, social studies, and applied learning, and with the New York City Department of Education’s new Science Scope and Sequence (<http://schools.nyc.gov/Documents/STEM/Science/K8ScienceSS.pdf>).

DEP, in partnership with Trout Unlimited, runs the Trout in the Classroom program, a watershed environmental education initiative for elementary through high school students. The purpose of Trout in the Classroom is to create partnerships between New York City and upstate watershed schools as they raise trout from eggs, observe and study them in the classroom, and release them into New York State-approved streams. These activities help students develop a conservation and anti-litter awareness that fosters an understanding of shared water resources.

Public Event-Based Programs

In 2008, DEP attended 229 public outreach events, averaging approximately 19 events per month. Events included table top displays and outreach at 6 fairs, festivals, and concerts (most of which were community based), 24 Greenmarket events, 6 beach cleanup events, the International Hotel/Motel Restaurant Trade Show, and National Night Out. Other events included a combination of community group outreach, presentations and table top displays at expos, and professional associations, as well as events conducted at City parks.

Hydrant Education Action Teams

DEP worked with six Hydrant Education Action Teams (HEAT), comprised of 75 high school and college students who canvassed neighborhoods in all five boroughs disseminating information about the effects of illegally-opened fire hydrants on water pressure in the City’s distribution system. DEP and HEAT were present at several public events throughout the summer to raise awareness about two priority topics: water conservation and illegally-opened fire hydrants. DEP set up hydration stations, distributed reusable water bottles, and provided educational materials.

10.2 Updates to Drought Management Plan

In 2009, it was not necessary to invoke any of the components of the City's Drought Management Plan, as 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 factors such as prevalent hydrological and meteorological conditions, as well as certain operational considerations. 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 either of the two largest reservoir 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 either the Catskill or Delaware Systems will fill by June 1.
- **Drought Emergency.** A Drought Emergency is declared when there is a reasonable probability that, without the implementation of stringent measures to reduce consumption, a protracted dry period would cause the City's reservoirs to be drained. This probability is estimated during dry periods in consultation with the New York State Drought Management Task Force and the New York State Disaster Preparedness Commission. The estimation is based on analyses of the historical record, the pattern of the dry period months, water quality, subsystem storage balances, delivery system status, system construction, maintenance operations, snow cover, precipitation patterns, use forecasts, and other factors. Because no two droughts have identical characteristics, no single probability profile can be identified in advance that would generally apply to the declaration of a drought emergency.

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

10.3 Delaware Aqueduct Leak

Efforts to evaluate the condition of, and to develop dewatering and repair plans for, the Rondout-West Branch Tunnel (RWBT) have been ongoing in 2009 and involve the following components:

- Hydraulic investigations of the RWBT
- Autonomous Underwater Vehicle (AUV) inspection of the RWBT
- Remote Operated Vehicle (ROV) inspection of the RWBT

- Tunnel and Shaft Rehabilitation Program
- Planning for a Roseton Bypass

Hydraulic Investigations of the RWBT

Investigations of the Rondout-West Branch Tunnel helped DEP assess the nature and degree of leakage stemming from the aqueduct. Various efforts in 2009 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 Tunnel Testing Program is also underway. During 2009, DEP conducted two hydrostatic tests and two backflow tests. The hydrostatic test involves shutting down the tunnel and isolating it from the reservoirs at each end. The water level in the tunnel drops due to the leakage. This is measured, and an accurate leakage rate is calculated. The backflow test involves shutting down the tunnel to allow water to flow backwards into the tunnel from West Branch Reservoir. Water flowing past the downstream flowmeter to “feed the leak” is measured as a negative number, and is interpreted as the net leakage. These tests indicate that the tunnel is stable.
- Surface investigations continued in areas of Roseton and Wawarsing, where water is suspected to be leaking from the tunnel.
- An underground water pathway mapping technique (by Willowstick Inc.) was developed to investigate leakage pathways in Roseton.

Autonomous Underwater Vehicle (AUV) Inspection of the RWBT

The AUV program allows for an independent robotic vehicle to completely photograph the interior surface of the RWBT in one inspection lasting 12 hours. In 2009, DEP completed a second AUV inspection of the interior surface of the tunnel. (The first inspection was performed in 2003.) The data are being evaluated for an upcoming report.

Remote Operated Vehicle (ROV) Inspection of the RWBT

DEP continued its efforts to develop an ROV to inspect the RWBT in 2009. Unlike the AUV, the ROV will allow capture of real-time tunnel data, and provide the ability to perform detailed, close-up investigations beyond the ability of the AUV, but limited to suspect areas in the tunnel. The ROV when fully developed will inspect the Roseton area of the RWBT by entering through the riser at Shaft 5A and performing ground penetrating radar and video inspections.

Tunnel and Shaft Rehabilitation Program

During 2009, work continued under the Tunnel and Shaft Rehabilitation Program construction contract. The work included substantial site improvements at various shaft locations to provide improved access to and ventilation of the tunnel, procurement of most of the “long-

lead” items that would be required for a tunnel emergency (such as steel liner and special vehicles for use in the tunnel), and dives to replace the existing bronze gate valve.

Planning for a Roseton Bypass

Planning for a Roseton Bypass Tunnel began in 2009. An engineering consultant team was procured to investigate and plan a new section of tunnel specifically to bypass the worst leak areas in Roseton. The tunnel is expected to be approximately 3 miles long and connect to the existing RWBT above and below the leakage area in Roseton.

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Appendix A: Map Production and Data Development in 2009

A.1 Map Production

Water Quality (WQ) Map Products

- Investigated incident sites (sewage/petrochemical spills) along with related water quality sample and/or cleanup sites for Special Investigation Reports
- Series of monitoring site plots (stream, wastewater treatment plants) for DEC/DEP MOU 2007 Addendum E report on stream water quality
- Series of USGS stream gauge site plots for use in DEP/USGS contract discussions regarding site renewal or deactivation
- Series of maps of West of Hudson, West Branch, and Kensico reservoir bathymetry and basin features (orthoimagery, land use) for the initial draft of a NYC Watershed Atlas
- Revised series of plots for the Watershed Monitoring Plan to show all reservoir monitoring sites
- Graphics for several presentations given by staff of the Watershed Water Quality Science & Research group at the 2009 Watershed Science Technical Conference
- Proximity of WOH dams to known eagle nesting locations for FERC application

Watershed Protection and Planning (WPP), Regulatory Review & Engineering (RRE) Map Products

- Catskill/Delaware Annual Individual New Subsurface Treatment Systems Map (FAD)
- Catskill/Delaware Annual Individual Subsurface Treatment System Repairs Map (FAD)
- Catskill/Delaware Semi-Annual Project Locations Map (FAD)
- Catskill/Delaware Semi-Annual Projects Under Construction (FAD)
- Catskill/Delaware Semi-Annual Major SEQRA Projects (FAD)
- Catskill/Delaware maps developed in support of project reviews (several)
- Catskill/Delaware maps developed in support of SEQRA reviews

WPP Watershed Lands and Community Planning (WLCP) Map Products

- Natural Gas Drilling Permits and Leases by Lat./Long. or Parcel Tax-map Number, for analysis of proximity of activities to NYC lands, infrastructure, and other potential environmental impacts
- NYC-owned LAP parcels for purpose of recreational use and management review
- Federal, state, and municipal permit application reviews, depicting wetland polygons, streams, basins, contours, parcels, municipal boundaries, orthoimagery, reservoirs, and roads
- General distribution of wetlands and deepwater habitats in the NYC Watershed, for a FAD-required educational pamphlet entitled “Wetlands in the Watersheds of the New York City Water Supply System”
- Esopus Creek Corridor maps depicting NWI and DEC wetland polygons, orthoimagery, and planimetrics, to identify potential wetlands for field verification

- Patterns of occurrence of terrestrial and aquatic invasive species in the WOH and EOH regions, to support strategies to prevent invasive species establishment and spread
- Land Management Property Prioritization maps to aid in adjusting the inspection priority of all Pre-MOA and MOA properties
- WLCP program status (FAD)
- Planning Basin & Stream Restoration Project Sites (FAD)
- Annual updates of all four large-format highly-detailed BWS facilities maps, covering the entire system from Delaware County to the Bronx
- Semi-annual status of NRM “Recreational Use” by basin
- Quarterly Forestry Management Plan status
- Quarterly Land Acquisition “Basin Status”
- Quarterly Public Access Recreation map for cooperative patrolling with DEP Police and DEC
- Monthly Land Acquisition “Community Review” of lands under contract by NYC
- Ongoing NRM digital-photo locations for conservation easements
- Ongoing Land Acquisition conservation easement contracts
- Ongoing Land Acquisition Schedule D NRM use
- Ongoing Land Acquisition Overview for potential easement or acquisition partners
- Status of Watershed Agricultural Program activities, including progress of all WAC programs: whole farm plans, forestry plans, BMP projects, model forests, WAC farm easements, and forestry economic projects

A.2 Data Development

New Data Sets

- WALIS_CEBaseline: vector version of baseline documentation developed for all conservation easements
- WALIS_CEPHotoPoint: photo locations as part of baseline documentation developed for all conservation easements, includes direction and description of photo, and link ID to photo in WaLIS
- WALIS_CEPlanimetric: vector version of planimetric that is part of baseline documentation developed for all conservation easements
- Forest Access Inventory GPS data: data collected for City-owned properties to assist USFS in accessing properties for the Forest Management Plan inventory
- WALIS_FAI_GPS_Access_Points: locations for property access, including type of access, condition, size, etc.
- WALIS_FAI_GPS_Intersections: road intersections with other property lines
- WALIS_FAI_GPS_Road_Grades: current or old road locations on properties, including accessibility and suitability
- WALIS_FAI_GPS_Water_Crossings: road intersections with water features, including type of crossing, size, and status
- PROJECT.CWC_Septic_Repair: point feature class using parcel centroids of new and remediated septic systems tracked by RRE, updated as of 12/2009
- ARCLIB_PEAK24WOH: major mountain peaks in WOH region
- ARCLIB_PRECINCT_DEP_POLICE: DEP Police precinct boundaries
- ARCLIB_RPS: assessment data for tax parcels

- PROJECT_LAQ_SURVEY: surveyed representation of Pre-MOA City lands in the West Branch and Kensico basins
- PROJECT_RIPARIAN_RIVERS: City-condemned riparian easements on land with frontage along the rivers downstream from reservoirs
- PROJECT_USGS_GAGE_SITE: point feature class of USGS stream monitoring sites in the watershed region for review of sites subject to contract renewal or deactivation
- SECURE_DEP_FACILITIES: secure/confidential GPSed point feature class of all DEP water supply facilities upstate, including staffing information, address, type, electrical meter, etc.
- WALIS_BUF3001000: hydro buffers used for LAP criteria
- WALIS_BUFFER_WATSTRM_100: hydro buffers used for regulatory activities
- WALIS_ENGPROJECT: RRE project locations
- WALIS_GASLEASE: WOH parcels with gas leases, as reported to DEP by DEC
- WALIS_SV_SOIL_DRAINCLASS: SSURGO soils data joined to table of drainage categories

Updated Data Sets

- Digital Tax Parcels for 2008 for all watershed counties
- DEP LAP fee and easement properties through 12/31/2009
- DEC Wildlife Management Units
- NY Natural Heritage Program GIS datasets on threatened and endangered species
- WALIS_Boat_A: boat storage area layer updated with new areas, invalid areas removed
- WALIS_Permit_L and WALIS_Permit_P: new land use permit GPS locations added for approximately 30 projects, significant cleanup done to remove duplicate features
- WALIS_Sub_CompD: land management properties layer modified to be updated automatically with latest parcel boundaries, daily syncs update all MOA property boundaries
- WALIS_RecUnit: recreation unit layer now automatically populated when new properties are opened for recreation
- Pre-1997 MOA land updates via takings maps and 2008 tax parcels
- NYS-owned land updated via 2008 tax parcels
- Protected Open Space
- Stream Management Planning Basins
- Stream Management Restoration Projects
- Sitehyd: point feature class of DEP routine stream monitoring sites revised to reflect updates to the recently-adopted Watershed Monitoring Plan
- Bathymetric feature classes for portions of Kensico Reservoir adjoining CATIC, CATUEC, and Shaft 18

