Implementation of New York City's Watershed Protection Program and Compliance with the 2007 Filtration Avoidance Determination

Status Review of the First Five-Year Period

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Acronyms

BMPs	Best Management Practices
BWS	Bureau of Water Supply
CATLEFF	Catskill Lower Effluent Chamber
CWC	Catskill Watershed Corporation
DEL18	Delaware Shaft 18
DOHMH	New York City Department of Health and Mental Hygiene
EFC	Environmental Facilities Corporation
EOH	East-of Hudson
EPA	U.S. Environmental Protection Agency
FAD	Filtration Avoidance Determination
GCSWCD	Greene County Soil & Water Conservation District
GIS	Geographic Information System
IMA	Inter-municipal Agreement
MAP	Management Assistance Program
MOA	Memorandum of Agreement
NIP	New Sewage Treatment Infrastructure Program
NOV	Notice of Violation
NTU	Nephelometric Turbidity Unit
NWI	National Wetlands Inventory
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OAG	New York State Attorney General's Office
OST	Operations Support Tool
SOP	Standard Operating Procedure
SPDES	State Pollutant Discharge Elimination System
SSC	NY State Sanitary Code
SWPPP	Stormwater Pollution Prevention Plan
SWTR	Surface Water Treatment Rule
UV	Ultraviolet
WAC	Watershed Agricultural Council
WAP	Watershed Agricultural Program
WCDEF	Westchester County Department of Environmental Facilities
WDRAP	Waterborne Disease Risk Assessment Program
WECC	Watershed Enforcement Coordination Committee
WFP	Whole Farm Plan
WOH	West-of-Hudson
WR&Rs	Watershed Rules and Regulations
WWTPs	Wastewater Treatment Plants

Background and Purpose

In a December 2006 the New York City Department of Environmental Protection (NYCDEP) submitted a plan for the long-term protection of the watershed for New York City's (City) Catskill/Delaware water supply. Implementation of the plan, which was entitled *New York City Department of Environmental Protection 2006 Long-Term Watershed Protection Program* ("2006 Long-Term Plan"), would ensure effective watershed protection and compliance with filtration avoidance criteria for the Catskill/Delaware water supply. In July 2007, upon completion of review of the plan and in consultation with the New York State Department of Health (NYSDOH), the U.S. Environmental Protection Agency (EPA) concluded that the City's plan would provide adequate watershed protection and consequently issued the 2007 Filtration Avoidance Determination (FAD). The 2007 FAD requires the City to implement the watershed protection plan outlined in its 2006 Long-Term Plan and includes certain additional requirements and clarifications. As a result, the City's commitments and obligations are defined by both the City's 2006 Long-Term Plan and the 2007 FAD.

The 2007 FAD requires the City to support a Land Acquisition Program for a ten-year period. The FAD also defines the requirements and milestones for a number of other watershed protection programs for the first five-year period of the FAD. The 2007 FAD describes that at the end of the first five-year period, with the primacy agency taking the lead, EPA and NYSDOH will conduct a review of the City's implementation of its 2006 Long-Term Plan and compliance with the requirements of the FAD. In September 2007, EPA granted NYSDOH primary regulatory responsibility for the Surface Water Treatment Rule as it applies to the Catskill/Delaware water supply, making NYSDOH the primacy agency for oversight of NYC's FAD. As such, this report has been prepared by NYSDOH, in consultation with EPA, as a summary of the findings of this compliance review.

This review, along with a number of other elements, will form the basis for a mid-term revision of the 2007 FAD. The FAD states that prior to the commencement of the second five-year period, EPA, NYSDOH, and the City will work together to develop the activities and milestones for the programs, other than the Land Acquisition Program, that the City will be required to undertake in the second five-year period. Programs from the first five-year period may be continued into the second five-year period, or programs may be revised, discontinued or replaced. By December 15, 2011, the City will submit to NYSDOH and EPA its *2011 Revised Long-Term Watershed Protection Program*, documenting the City's proposed commitments for the second five-year period. NYSDOH, in consultation with EPA, will then revise the 2007 FAD, formalizing the requirements for the City's watershed protection programs for the second five-year period of the FAD. In addition to this compliance review, other key components of the overall FAD revision process include:

- *2011 Watershed Protection Program Summary and Assessment* (March 2011) report by the City;
- Outreach to Watershed Stakeholders: EPA, NYSDOH and the New York State Department of Environmental Conservation (NYSDEC) have met with various watershed stakeholders over the past few months to gather input for development of FAD program requirements;
- Public Information Sessions in June and July of 2011, held in Delhi, Belleayre, Somers, and New York City; and
- Public Comment Period early 2012 to solicit comment on draft mid-term revisions of the 2007 FAD.

Although steps are being taken to develop a 2007 FAD revision, at any time the primacy agency may make a determination that the City no longer provides adequate protection of its Catskill/Delaware water supply and may require the City to filter that supply.

The remainder of this evaluation will address the City's progress in implementing major programs under the 2007 FAD, as well as certain regulatory compliance requirements.

Summary

Overall, the City has successfully satisfied the obligations specified in the 2007 FAD. For most programs, the City has met deadlines and, at times, even exceeded expectations. Notable accomplishments have been achieved in the Land Acquisition Program, in which the City has exceeded solicitation targets and, along with its partners, has successfully protected more than 41,000 additional watershed acres since the beginning of the 2007 FAD period. The Wastewater Treatment Plant (WWTP) Upgrade Program has achieved functional completion for all WWTPs that required upgrading in the West-of-Hudson (WOH) and East-of-Hudson (EOH) Catskill and Delaware watersheds. The Watershed Agricultural Program has successfully enrolled 96% of the large farms WOH and nearly all of these have developed Whole Farm Plans for addressing pollutant sources on farmlands. However, some FAD program elements have experienced delays in implementation. In many cases, these delays were due to circumstances outside of the City's control or due to extreme weather conditions. NYSDOH and EPA have generally accepted the City's explanations and justifications in such cases. The wastewater management projects have taken longer to complete than expected, due in large part to the extensive coordination needed between the City and the communities on both technical and administrative matters. In the Stream Management Program, some stream restoration projects were delayed due to wet weather conditions, which precluded stream access.

NYSDOH and EPA believe that the City has a comprehensive and robust watershed protection program, which, overall, is being effectively implemented by the City and its partners. The City continues to provide drinking water to NYC and upstate consumers that meets all requirements of the Surface Water Treatment Rule (SWTR).

Regulatory Requirements and Structure of the 2007 FAD

The conditions that a public water system must satisfy in order to avoid filtration of a surface water supply are defined in the SWTR and its amendments, specifically 40 CFR §141.71, §141.171, and §141.712 of the federal code of regulations and 10 NYCRR Part 5, Subpart 5-1, Section 1.30(c) of the NYS Sanitary Code (SSC). The federal code separates the filtration avoidance requirements into two categories: source water quality conditions and site-specific conditions. Source water quality conditions include fecal or total coliform levels and turbidity levels measured immediately prior to the first point of disinfection. Site-specific conditions include disinfection, watershed control program, inspection, and distribution water quality requirements, as well as a requirement that the system must not be identified as a source of a waterborne disease outbreak.

The 2007 FAD summarizes the programs, along with activities and schedules, that the City and its partners have committed to as part of their watershed protection and filtration avoidance efforts. The FAD programs are grouped into the following broad categories, which cover both the source water quality and site-specific conditions defined by the SWTR:

- Program to monitor/document compliance with filtration avoidance criteria ("Objective Criteria") (FAD Section 2);
- Comprehensive environmental infrastructure programs to reduce pollution from sewage and stormwater (FAD Sections 3.1 – 3.5);
- Various protection and remediation programs, such as Land Acquisition and Catskill Turbidity Control, to protect and improve water quality (FAD Sections 4.1 – 4.12);
- Watershed monitoring, modeling and Geographic Information Systems (FAD Sections 5.1 – 5.3);
- Regulatory programs to ensure compliance with Watershed Rules & Regulations (FAD Sections 6.1 – 6.2);
- Construction of the Catskill/Delaware UV Disinfection Facility (FAD Section 7);
- In-City programs to assess risk of waterborne disease and prevent cross connections between the water distribution system and contaminant sources (FAD Sections 8.1 – 8.2);
- Administrative Program to ensure adequate staffing and funding for FAD programs (FAD Section 9); and
- Education and Outreach to enhance understanding of and strengthen collaboration in watershed protection efforts (FAD Section10).

The inspection element of the SWTR's site-specific conditions, which is an on-site assessment of the adequacy of the water system's watershed control program and disinfection processes, is performed annually by NYSDOH and EPA staff.

Short evaluations of all FAD programs are provided below.

Evaluation of the NYC Water System's Performance by Program

Surface Water Treatment Rule Objective Criteria Compliance

FAD Section 2 - Surface Water Treatment Rule Objective Criteria Compliance

2007 FAD Requirements

The Objective Criteria include numeric requirements for turbidity, fecal coliform bacteria, and disinfection byproducts and also include requirements for system operations. The water system must provide adequate disinfection and must also have redundant disinfection system components. Under the 2007 FAD, the City must continue to meet all of the Objective Criteria in order to maintain its filtration avoidance status for the Catskill/Delaware water supply. The 2007 FAD also obligates the City to conduct a monitoring program and to report results in accordance with applicable State and federal regulations.

Evaluation of the NYC Water System's Performance

NYSDOH has evaluated the City's compliance with the Objective Criteria for maintaining filtration avoidance through review of the City's monthly monitoring reports and conducting annual inspections of water system infrastructure, treatment processes, and instrumentation. The SWTR specifies that compliance monitoring for source water quality shall be conducted immediately prior to the first or only point of disinfectant application. For the City's Catskill/Delaware water supply, under normal operating conditions, sampling of source water is performed at the Catskill Lower Effluent Chamber (CATLEFF) and at Delaware Shaft 18 (DEL18). Both CATLEFF and DEL18 are located near the south end of the Kensico Reservoir. As noted in Table 1, the City has satisfied the Objective Criteria's numeric requirements for source water turbidity and coliform bacteria for the Catskill/Delaware system.

Table 1. Catskill/Delaware System source water turbidity and fecal coliform levels 2007-2010.

	Catskill Lower Effluent Chamber		Delaware Shaft 18	
Year	Maximum 4-Hour Turbidity Measurement (NTU)[(1)]	Maximum Percent of Fecal Coliform Samples >20 CFU/100mL[(2)]	Maximum 4-Hour Turbidity Measurement (NTU)[(1)]	Maximum Percent of Fecal Coliform Samples >20 CFU/100mL[(2)]
2007	3.4	1.7	2.0	0.0
2008	4.4	1.1	2.2	2.2
2009	3.6	1.1	3.1	2.2
2010	4.3	0.6	2.7	0.0

Notes:
(1): To maintain filtration avoidance status, the Catskill/Delaware system's 4-hour compliance readings must exhibit turbidity levels no greater than 5 NTU, unless it is determined that the turbidity was caused by an unusual or unpredictable event. No more than two events of turbidity greater than 5 NTU in twelve months or five events in 120 months are allowed.
(2): To maintain filtration avoidance status, the Catskill/Delaware system must exhibit fecal coliform concentrations no greater than 20 CFU/100 mL in at least 90% of samples collected prior to disinfection in the previous 6 months of water service to the public.

In addition, the City has not exceeded the levels allowed for disinfection byproducts in the distribution system (i.e. 12-month running averages of 80 µg/L for total trihalomethanes and 60 µg/L for haloacetic acids). For the first five-year period, the running averages, evaluated quarterly, for total trihalomethanes and haloacetic acids have ranged from 36 – 43 µg/L and 34 – 45 µg/L, respectively. The City has also satisfied the system operation and reporting requirements as defined by the SWTR, and therefore has met the Objective Criteria required to maintain filtration avoidance status for the Catskill/Delaware system.

NYSDOH has issued seven Notices of Violation (NOVs) to the City during the first five-year period (Table 2). These were all monitoring violations. For example, the SSC (10 NYCRR Part 5, Subpart 5-1, section 5-1.30(c)(2)) requires the City to monitor the turbidity of its raw water every four hours. In accordance with the City's State-approved Standard Operating Procedure (SOP) for raw water turbidity monitoring, they are allowed a ten-minute window around those four hour time points within which they must collect their sample. In April 2008, there were ten instances when these turbidity compliance samples were not collected within the allowed time frame. This happened again for individual samples on: April 21, 2009; May 17, 2009; and December 27, 2010.

The remaining three violations were also related to raw water turbidity, but were incurred because the samples that the City collected were not representative of the source water. On March 10, 2010, roller gate operations caused a temporary spike in turbidity, which occurred near the collection of a turbidity compliance sample. This constituted a monitoring violation under SSC section 5-1.30(c)(2), because that four-hour compliance sample was not representative of the source water turbidity. On January 31, 2011, and the period of February 1 – 11, 2011, due to unusual water flows through DEL18, a chlorine residual could be detected at the raw water sampling location. However, according to federal regulation 40 CFR 141.71(a)(2), the source water turbidity must be measured prior to the first point of disinfection. Therefore, turbidity samples that contain a measurable chlorine residual cannot be considered representative of the source water.

NYSDOH required the City to submit Corrective Action Plans to document the steps taken to remedy the protocols, operations, and site conditions that led to these monitoring violations. At CATLEFF, these steps include adding a new transfer switch for a generator at the CATLEFF site, to allow easier site access during power outages. At DEL18, the City is in the process of installing a new chlorine solution pipe and modifying the raw water sampling intake location. The City continues to work collaboratively with the NYSDOH to minimize future occurrences of these violations.

Table 2. Catskill/Delaware System violations of 10 NYCRR Subpart 5-1 during first five-year period of the 2007 FAD.

Violation Number	Date(s)	Applicable Code Section	Remarks
2008-2008	April 1-30, 2008	5-1.75(a) - Additional Sampling Requirements	Failure to follow State-approved SOP
2009-2109	April 21, 2009	5-1.75(a) - Additional Sampling Requirements	Failure to follow State-approved SOP
2009-2110	May 17, 2009	5-1.75(a) - Additional Sampling Requirements	Failure to follow State-approved SOP
2010-2111	March 10, 2010	5-1.30(c)(2) - Raw Water Turbidity Monitoring	Failure to collect a representative sample
2011-2112	December 27, 2010	5-1.30(c)(2) - Raw Water Turbidity Monitoring	Failure to collect a representative sample
2011-2113	January 31, 2011	5-1.30(c)(2) - Raw Water Turbidity Monitoring	Failure to collect a representative sample
2011-2114	February 1-11, 2011	5-1.30(c)(2) - Raw Water Turbidity Monitoring	Failure to collect a representative sample

Environmental Infrastructure Programs

FAD Section 3.1 - Septic and Sewer Programs

2007 FAD Requirements

The identification and remediation of septic systems that have failed, or are likely to fail, is important for a number of reasons. First, an improperly working septic system does not protect against environmental exposure to pathogenic microorganisms and viruses that are present in sewage. This is not only a danger to the NYC water supply, but also to local residents who can be exposed to human waste. Second, a poorly functioning septic system can release nitrogen and phosphorus to waterways. These nutrients can lead to excessive growth of algae, which can be detrimental to water supplies and overall water quality.

The 2007 FAD requires the City to implement a Septic and Sewer Program aimed at preventing the potential impacts of improperly functioning septic systems. The City's overall septic and sewer effort is divided into five separate programs: Septic Remediation and Replacement Program, Septic Maintenance Program, Sewer Extension Program, New Sewage Treatment Infrastructure Program, and Community Wastewater Management Program. The latter two programs (New Sewage Treatment Infrastructure Program, and Community Wastewater Management Program) each have their own FAD sections, 3.2 and 3.3, respectively.

The City has worked closely with the Catskill Watershed Corporation (CWC) to implement this program WOH, as well as to implement the New York City Watershed Rules and Regulations (in effect since May 1, 1997 and revised April 4, 2010).

Evaluation of the NYC Water System's Performance

The City has largely been successful in dealing with ongoing elements and new initiatives in the Septic Remediation and Replacement Program. This program was initially designed to provide inspection, pump-outs, and, where necessary, repair or replacement of systems for single or two family residences in the WOH watershed that are failing or likely to fail. Separate septic programs are being implemented EOH partnering with county health departments. Details of these programs are provided in the Kensico and EOH sections of the 2007 FAD. This WOH program has been implemented since 1997 to prioritize addressing those septic systems most likely to impact the City's water supply (i.e. those closest to intakes and water courses), and the priority areas have expanded to a wider area over time. This ongoing part of this program is meeting its goals with 335 systems being remediated in 2010, and 3,562 systems overall since 1997. Furthermore, there is adequate funding for the program for the second five years of the 2007 FAD. The City was also successful in working with CWC to continue the hardship component of the Septic Remediation and Replacement Program for critical septic system remediations/replacements in non-priority areas under the January 2001 program rules. The CWC also started a program in 2009 that pays up to 75% of the cost of septic system remediations, with a cap of $40,000 per system, for small businesses (< 100 employees) within 100 feet of a waterway.

The 2007 FAD required the City to develop program rules and provide funding for repairing or creating new cluster systems. Cluster System Program rules were accepted by CWC and the City in April 2011. To date, no new cluster systems have been created in the watershed.

The Septic Maintenance Program has been effective during the first five years of the 2007 FAD. This is a voluntary program implemented by the CWC where residents are reimbursed 50% of the pump-out costs for participants in the septic repair program and systems constructed after 1997. This program also provides educational information to homeowners on septic use and the role of regular maintenance in avoiding expensive system failures and dangerous sewage releases.

The Sewer Extension Program was developed to extend lines to collect sewage in areas with failing septic systems. To date a number of deadlines have been missed, but work seems to be progressing in a reasonable manner for all outstanding projects. The projects in Neversink and Roxbury were completed in 2009 and 2010, respectively. As of the last semi-annual report, the projects in Shandaken and Hunter are near the 100% design, the towns continue to work on New Sewer Use Laws and on gaining the remaining easements, and the City is preparing bid documents (in Shandaken only). For the project in Margaretville, the 30% design plans are being reviewed, SEQR is underway, and the alignment of the extension is being considered.

NYSDOH and EPA believe that the Septic and Sewer Programs are an important and successful component of the City's watershed protection program, protecting the City's water supply from potential contamination from sewage inputs.

FAD Section 3.2 - New Sewage Treatment Infrastructure Program

2007 FAD Requirements

The goal of the New Sewage Treatment Infrastructure Program (NIP) is to protect water quality from contamination associated with failing and likely-to-fail septic systems constructed in small communities in the watershed and located in close proximity to a water course. The first seven of the 22 community projects listed in the 1997 Memorandum of Agreement (MOA) were required to meet certain milestones specified in Section 3.2 of the 2007 FAD. The City implements NIP in accordance with the City's December 2006 Long-Term Watershed Protection Program (Section 2.2.2) with the following clarifications specified in the 2007 FAD:

- The City will execute contract changes with New York State Environmental Facilities Corporation (EFC) and CWC that include funding levels sufficient to complete projects in Phoenicia and Hubbell Corners. Projects currently under construction at Fleischmanns and Prattsville shall be completed in accordance with their existing contracts;

- The City will provide approval of functional completion and authorization to begin start up and performance testing (to be followed by building/house sewer lateral installation along the sewer mains within the sewer district) within 45 days of the engineer's submittal of Functional Completion Certification;

- The City will work with communities to ensure milestones are met and will review and provide regulatory or document approval in a timely manner.

Evaluation of the NYC Water System's Performance

This voluntary program effectively protects water quality from the potential threat posed by failing and likely-to-fail septic systems. As of March 2011, the City has provided a total of $104 million in NIP funding. New wastewater projects have been functionally completed in six of the seven communities: Andes, Roxbury, Hunter, Windham, Fleischmanns, and Prattsville. In addition, the City executed a Change Order in 2007 to NIP in the amount of $1,500,000 to allow for the design and construction of a sewage collection system for the Hubbell Corners Supplemental Service Area (Roxbury NIP project). This project was completed in 2010.

All NIP requirements set forth in the 2007 FAD have been met. Due to circumstances beyond the City's control, construction of the Phoenicia project has been delayed. The City has granted a number of time extensions to the Town of Shandaken in support of their efforts to implement a wastewater project in Phoenicia. The Town of Shandaken executed a contract with CWC in September 2010 to manage the project and has begun the design review phase of the project. The contract specifies a 1-year review phase, followed by a 1-year design phase, a 6-month bid phase, and a 2-year construction phase. The City continues to work collaboratively with the community to ensure that NIP implementation is successful.

NYSDOH and EPA believe that NIP remains an important component of drinking water quality and public health protection, which are essential elements of the FAD.

FAD Section 3.3 - Community Wastewater Management Program

2007 FAD Requirements

The Community Wastewater Management Program 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 as well as operation and maintenance of the district. A number of communities are included under this program. In the 2002 FAD, a total of five communities were added to the program. These communities include Bloomville, Boiceville, Hamden, DeLancey, and Bovina. Ashland was added to the program in 2006. The first five-year period of the 2007 FAD provided funding for Trout Creek, Lexington, and South Kortright.

Evaluation of the NYC Water System's Performance

This program has deadlines that extend beyond the ending date of the 2007 FAD where communities have been added to the program. Wastewater management systems for all five communities from the 2002 FAD and Ashland have now been completed. The City has approved the recommended projects and funding for Trout Creek, Lexington, and South Kortright.

The Community Wastewater Management Program has been an effective tool for protecting the watershed from the potential for contamination from failing septic systems in relatively densely populated areas. NYSDOH and EPA support the continuation of this program to complete projects in Trout Creek, Lexington, and South Kortright, and to begin wastewater management projects for the next five communities listed in the 1997 MOA (Shandaken, West Conesville, Claryville, Halcottsville, and New Kingston).

FAD Section 3.4 - Wastewater Treatment Plant Upgrade Program

2007 FAD Requirements

In accordance with the NYC Watershed Rules and Regulations (WR&Rs), all surface water discharging wastewater treatment plants (WWTPs) in the watershed must include advanced tertiary treatment (microfiltration or approved equivalent), disinfection, and phosphorus removal treatment. In addition, subsurface discharging WWTPs must install sand filtration (or approved alternative), phosphorus removal, and disinfection, where applicable. The 2007 FAD requires that upgrades be completed at all remaining WWTPs in the watershed that do not meet the requirements of the WR&Rs, or that such WWTPs be decommissioned and connected to approved WWTPs.

Evaluation of the NYC Water System's Performance

Functional completion has been achieved for all WWTPs in the WOH and EOH Catskill/Delaware watersheds that required upgrades. Achievement of this FAD goal is a significant and critical component of the City's watershed protection plan. The City's ongoing support for proper operation and maintenance of these WWTPs will ensure the success of this protection measure.

FAD Section 3.5 - Stormwater Programs

2007 FAD Requirements

The 2007 FAD requires the City to implement the Stormwater Programs as described in its 2006 Long-Term Watershed Protection Program, and meet several other activity and reporting requirements for these programs. The Stormwater Programs are comprised of the Stormwater Retrofit Program, the Future Stormwater Controls Program, and the Local Technical Assistance Program. The Retrofit Program, administered by the CWC and the City, provides grants to implement BMPs and improve water quality for pre-1997 stormwater structures. The Future Stormwater Controls Program, administered by CWC, funds the incremental costs required by the City's WR&Rs, which are in addition to federal and State requirements. The Local Technical Assistance Program, administered by the CWC and the City, provides grants to support watershed protection and enhance quality of life in watershed communities. In addition, the City was required to fund an engineering position to assist applicants in complying with the City's WR&Rs.

Evaluation of the NYC Water System's Performance

The City has funded over $3.6 million in incremental costs for stormwater controls required by the NYC WR&Rs. Thirty-four (34) stormwater retrofit applications were funded and completed for a total of approximately $7.5 million. The funding has covered needs such as street sweepers, vacuum trucks, culvert replacements, and catch basins. Twelve (12) stormwater retrofit assessment and planning projects have been funded for a total of $400,000. Twenty-nine (29) Local Technical Assistance projects were approved since 2007 for a total of $1.5 million. These projects included generic environmental impact statements, land use plans, and zoning law updates. The CWC engineering position was funded for the first five-year period.

NYSDOH and EPA believe that the Stormwater Programs have been effective, and are an important part of the City's watershed protection program.

Protection and Remediation Programs

FAD Section 4.1 - Waterfowl Management Program

2007 FAD Requirements

The 2007 FAD requires the City to perform avian population monitoring, harassment and deterrence in key City reservoirs in order to minimize fecal coliform loading to reservoirs from roosting birds. The City's 2006 Long-Term Watershed Protection Program expanded the Waterfowl Management Program on an "as needed" basis to include avian harassment activities for the Hillview Reservoir as well as avian deterrent measures for Hillview and other City reservoirs.

Evaluation of the NYC Water System's Performance

The City has met all waterfowl management and reporting requirements for this program. Avian dispersal techniques were used on Kensico between August 1 and March 31 of each year and year round on a daily basis on Hillview Reservoir. Bird harassment was required in January through March of 2007 at West Branch Reservoir, but was not required in any of the City's other terminal reservoirs during the first five years of the 2007 FAD. Bird deterrent measures were practiced on all the City's terminal reservoirs as well as Cross River, Croton Falls, and Hillview Reservoirs.

The Waterfowl Management Program is a critical component of the City's watershed protection plan, effectively reducing levels of fecal coliform bacteria in the City's source waters.

FAD Section 4.2 - Land Acquisition Program

2007 FAD Requirements

The goal of the Land Acquisition Program is to ensure that environmentally-sensitive watershed lands remain undeveloped and protected. The 2007 FAD requires the City to undertake a ten-year Land Acquisition Program, during which the City commits to solicit to purchase, in fee simple or in conservation easement, at least 50,000 acres of land per year through 2012. To support this goal, the City has made available a total of $300 million dollars for use in purchasing watershed lands over the course of the ten-year period. The 2007 FAD also required the City to develop a strategy to enhance use of land trusts and other non-governmental organizations to help in land acquisition efforts, to commit funds to the Watershed Agriculture Council (WAC) for use in developing a program to acquire conservation easements on forested portions of non-agricultural land, to sequester $23 million of supplemental funds if so directed by EPA/NYSDOH, and to apply for a Water Supply Permit (WSP) from NYSDEC to cover a ten-year term.

Evaluation of the NYC Water System's Performance

The City continues to conduct a successful land acquisition program, exceeding their solicitation goals for the first five years of the 2007 FAD. From 2007 through the first half of 2011, the City solicited more than 450,000 acres and, with the WAC, protected through acquisition or easement 41,000 acres of sensitive watershed lands. In addition, as required, the City applied for a WSP from NYSDEC, and that permit was issued December 24, 2010. However, the City has missed

the due dates for completion of some of the other requirements of the Land Acquisition Program. The City has not yet completed a strategy for working with land trusts to enhance land acquisition efforts, but has met several times with selected land trusts to develop the details of such a program. The City has not yet come to agreement with WAC on the details of a forest easement program. EPA and NYSDOH requested that the City release the $23 million supplemental funds to WAC in April 2008. The City and WAC have not yet finalized the contract that will make these funds available for WAC's use. In sum, although certain elements of the land acquisition program have not yet been implemented, the NYCDEP's core program has been active and successful in protecting watershed lands in recent years.

FAD Section 4.3 - Land Management

2007 FAD Requirements

Reservoir water quality is largely dictated by human activities and the nature of the lands in the watershed. Therefore it is important to foster stewardship and regulate activities that could negatively impact water quality. Purchasing sensitive land and establishing conservation easements are an effective means to ensure lands are managed in a way that is protective of water quality.

The City has been very successful in its land acquisition efforts and in securing conservation easements and its holdings continue to grow. However, simply owning or controlling development rights to land is not enough. It is also important to manage land to optimize water quality protection, foster healthy forests and other natural resources, control invasive species, and allow recreational opportunities. For these reasons, the 2007 FAD included a new, separate program for Land Management.

The 2007 FAD requires the City to monitor water supply lands, enforce the conditions of conservation easements, maintain a watershed land information system, and develop a land management plan.

Evaluation of the NYC Water System's Performance

The City's reporting on this FAD deliverable is contained in the Filtration Avoidance Annual Reports, and it appears all goals continue to be met. Monitoring is very important to managing the watershed land holdings. All pertinent information on properties is stored in The Watershed Land Information System (WaLIS), and data are also used in a variety of GIS applications. City-owned lands are classified as being High or Standard priority, with inspections taking place annually and at least every five years, respectively. High priority lands consist of: places with an elevated security concern (e.g. intakes), areas with existing or future high intensity recreational uses, and properties with a history of trespass or encroachment. Easements are inspected twice each year. Properties are posted within 90 days of closing, and boundaries maintained during site visits and inspections. The City has also increased its use of aerial inspections, which takes less manpower and allows them to catch encroachments faster. It is likely the City's vigilance has played a major role in keeping encroachments and other problems relatively rare.

Managing forestry lands is particularly important in protecting water quality. The majority of the forests in the watershed are relatively old, and they will likely show a decline in condition without proper management. The City has worked with the United States Forest Service (USFS) to create a management plan. This plan is on track to be completed in November 2011. This plan is based on substantial forest inventory work and data analysis. Its goal is to maximize water quality protection while minimizing fire and other hazardous events, enhancing ecological integrity, controlling invasive species, and providing recreational opportunities and economic benefits to watershed communities.

The City is successfully increasing recreational opportunities in the watershed as its land holdings continue to increase. The City has eased administrative requirements to use City land, opened more lands to recreation without an access permit, and eliminated the need for a special DEP hunting permit. Hunting plays a very valuable role in reducing the deer population which helps with forest regeneration and increases road safety. The City also allows fishing from steam-cleaned (for zebra mussel control) and registered rowboats that have to remain on site for the season, and there is a five year pilot program underway that allows the use of other non-motorized boat types for both day and seasonal use. Reservoir cleanup days and other stewardship activities performed by various organizations are used to make improvements and serve as a valuable education tool.

In addition to recreation, the City allows watershed residents to use some of their holdings for economic benefit. This includes: bluestone mining, timber harvesting (for selective culling and blow down remediation), maple sap collection and some agriculture, primarily on land that was actively farmed at the time of purchase. The City has loosened some of its regulations on the types of activities that are allowed, but they review all proposed activity and take other measures to protect water quality such as maintaining large buffer strips near streams and not allowing manure spreading during the winter.

NYSDOH and EPA recognize that the City has a strong Land Management Program and has greatly enhanced access to its watershed lands for recreational use by the public. As the amount of City-owned lands increases, the importance of this watershed protection program will continue to grow.

FAD Section 4.4 - Watershed Agricultural Program

2007 FAD Requirements

The overall objective of the Watershed Agricultural Program (WAP) is to protect water quality from pollution associated with agricultural land use. This voluntary program is administered by the Watershed Agricultural Council (WAC) in cooperation with local, State, and federal partner organizations. WAP is designed to identify, prioritize, and mitigate environmental issues on each participating farm through development of Whole Farm Plans (WFPs) and the implementation of best management practices (BMPs).

The 2006 Long-Term Watershed Protection Program (Section 2.3.4) and the 2007 FAD (Section 4.4) contain a number of programmatic goals, including continual recruitment of non-participating large farms WOH, expansion of the Small Farms and the EOH programs, and development of a programmatic strategy for replacing aging/failing BMPs. The 2007 FAD also contains a new metric requiring 90% of all active large farms WOH to have and maintain "substantially implemented" status of their WFPs, beginning September 30, 2010. Furthermore, the City is required to conduct a review of current WAP evaluation criteria with input from the WAC Advisory Committee.

Other 2007 FAD requirements include preparation and submittal of a comprehensive annual report on the status of all programmatic activities; completion of annual status reviews on all farms with substantially implemented WFPs; inventorying all small farms to determine the number, extent and potential impact of small farms on water quality in the WOH watershed; and continuation of the Farmer Education and Outreach initiatives to address effective pathogen and nutrient management.

In addition, the 2007 FAD was enhanced by the City's commitment to evaluate and report on a study on the potential benefits of a Precision Feed Management Program conducted by Delaware County; continue and expand the Nutrient Management Credit program to approximately 80 participating farms in the Cannonsville Reservoir Basin; and provide funding and perpetually enforce long-term stewardship of Agricultural Easements.

Evaluation of the NYC Water System's Performance

The City's *2011 Watershed Protection Program Summary and Assessment* report describes the WAP and details specific programmatic achievements. The continued success of the WAP is accomplished through partnerships between the farmers and the WAC, as well as local agencies such as Cornell Cooperative Extensions, Soil and Water Conservation Districts, and federal/State agencies such as USDA/NRCS, and USDA/FSA.

Through 2010, 254 of the 265 known large farms in the WOH watershed signed up for the WAP (96% participation) and 248 of those participants (98%) have Whole Farm Plans. The six additional farms that recently signed up for the program are in the process of developing WFPs. NYSDOH and EPA are pleased with the increased level of program participation.

In accordance with the FAD, assessment of compliance with the 90% substantially implemented (SI) criterion began on September 30, 2010. On that date, DEP reported that 90% of all large farms in the WOH watershed had met the substantially implemented (SI) status at least once; however, after achieving SI, some farms subsequently experienced changes so that they no longer maintained SI status. As provided for in the 2007 FAD, WAC, in consultation with its partners, revisited and revised the SI metric to enhance program implementation flexibility and water quality protection. This has resulted in the development of alternative program metrics. The new metrics include: maintain at least 90% large farm participation in the program; maintain current nutrient management plans on 90% of farms; increase participation in the Conservation Reserve Enhancement Program (CREP) and WAC Easement and Forestry Programs; and complete annual status reviews for at least 90% of WFPs (with a goal of 100%).

In addition, a new BMP Prioritization Methodology has been developed to guide the selection of what new BMPs should be implemented and which existing BMPs should be repaired or replaced in order to optimize use of resources while effectively protecting water quality.

The WAP continues to conduct annual status reviews on all farms, and this practice became part of the WFP process. Excluding sub-farms, in 2009 and 2010 annual status reviews were conducted on 249 and 300 farms, respectively.

The implementation of the WOH small farm program continues to be successful. Through 2010, WAP staff have completed Tier I questionnaires for 310 small farms (currently known universe of small farms) and 85 of these small farms have WFPs, which represents 27% of all known small farms. As required by the 2007 FAD, the WAP has to develop new WFPs for 10 small farms annually and this goal was continuously met. In June 2009, the City submitted a Small Farms Assessment FAD report that contained a number of recommendations for prioritizing small farm planning efforts in the future, including a proposal to set a more flexible goal. Given the nature of small farming with its constant changes in operation, NYSDOH and EPA have agreed to set a more flexible goal, which would require the annual development of new WFPs on 6-10 small farms for the remainder of the 2007 FAD.

The EOH agricultural program continues to be successful as well. WAC provides a full-service staff in Yorktown Heights to serve the needs of agriculture and forestry landowners in the Croton Watershed. EOH agriculture is predominantly equine operations and horticulture, with small farms and cooperatives that address the region's increasing demand for fresh, organic and locally-grown produce. Through 2010, 56 WFPs were approved and 42 of those farms had commenced implementation of their WFPs.

NYSDOH and EPA believe that the agricultural program has successfully met expectations and that it remains an effective and important element of the City's watershed protection program. As the program continues to move forward with the new BMP Prioritization Methodology and revised metrics, NYSDOH and EPA think it is important to revisit the metrics to ensure that they are appropriate indicators for assessing the continued success of the WAP.

FAD Section 4.5 - Watershed Forestry Program

2007 FAD Requirements

The Watershed Forestry Program is a voluntary partnership between the City and the forestry community, which supports and maintains well-managed forests as a beneficial land use in the watershed. The Watershed Forestry Program is administered by WAC and its primary goal is to maintain unfragmented forested land and promote the use of management practices to prevent non-point source pollution during timber harvests.

The program provides financial incentives and technical assistance to loggers, foresters, and landowners to encourage the protection and restoration of riparian buffers through long-term forest stewardship. The Watershed Forestry Program includes: development of forest

management plans; logger training, support for model forests; research; demonstration projects and best management practices (BMP) implementation. The 2007 FAD carries forward all these elements and also provides additional support for BMP implementation through the newly established initiative called the Management Assistance Program (MAP).

The City's 2006 Long-Term Watershed Protection Program (Section 2.3.5) and the 2007 FAD (Section 4.5) detail programmatic requirements and due dates for their implementation. The City is required to continue to: fund the development of forest management plans for landowners, including training and educational opportunities for professional foresters who write the plans; sponsor sediment control trainings and other BMP workshops for watershed loggers, including cost sharing to become fully certified under the State-wide Trained Logger Certification Program; provide cost-sharing, technical assistance and other incentives to landowners, loggers and professional foresters for implementing specific forestry BMPs, including portable skidder bridges, new erosion control technology, and riparian forest buffers; coordinate the ongoing research, demonstration, continuing education and outreach projects at the three current Model Forests and establish an EOH model forest; and sponsor and support forestry education projects and programs for watershed landowners, environmental groups, youth and other upstate/downstate audiences, including the publication of newsletters, brochures and progress reports. The 2007 FAD also required the City to complete a pilot program, evaluate the pilot program, and expand the program on a watershed-wide basis for the MAP, which provides additional support for BMP implementation by forest landowners. The City also has various reporting and program planning requirements for the forestry program.

Specific projects and programs are implemented by WAC and its various partners, with the U.S. Department of Agriculture Forest Service providing a major source of matching grants and project funding. The City has provided funds to WAC for four major forestry tasks: (1) Logger Training, (2) Research, Demonstration and Forestry Education, (3) Forest Management Planning, and (4) BMP Implementation.

Evaluation of the NYC Water System's Performance

The 2007 FAD requires the City to annually evaluate the implementation status of five-year old Forest Management Plans that are adopted by landowners and submit reports to NYSDOH and EPA. This deliverable has been met.

The 2007 FAD also requires continuous enrollment of eligible landowners in the Watershed Forestry Program and providing financial and technical assistance to loggers, foresters, and landowners. In 2007, the Watershed Forestry Program expanded the pool of its BMPs to place a greater emphasis on stream crossings as an important erosion control measure. Part of this expansion included the purchase of new stream crossing BMPs, such as plastic arch culverts and additional portable bridges, which are available for loan to interested loggers and/or landowners. In addition, some innovative BMPs that are used to stabilize timber harvest roads as they approach streams can be qualified for cost-sharing if they are properly designed and constructed (e.g. rubber tire land mats).

As of March 2011, more than 900 landowners, covering approximately 164,000 watershed acres, have completed WAC forest management plans, with 74 of these landowners, covering over 14,000 total acres, located EOH. There are also 343 riparian buffer plans covering nearly 11,000 riparian acres. Currently, 51 private consulting foresters are trained and approved to write WAC forest management plans. The City continues to support the development of new forest management plans, focusing on riparian planning, 5-year updates, landowner evaluation surveys, and property site visits. In its *2011 Watershed Protection Program Summary and Assessment* the City stated that during the reporting period, WAC supported the completion of 19 stream crossing projects associated with a timber harvest. In addition, 27 portable bridges and 11 arch culverts have been loaned out to keep the logging equipment out of streams to minimize their disturbance.

The delineation of riparian areas in all WAC forest management plans as well as specific streamside protection recommendations for these delineated areas continue to be successful. During the current assessment period, 276 riparian plans were completed covering 7,900 riparian acres. These figures include 301 new WAC plans and 14 existing (older) WAC plans that were updated to meet current WAC plan specifications. It is worth noting that for all WAC plans and plan updates completed to date, 38% contain a riparian plan, covering nearly 11,000 riparian acres.

The Watershed Forestry Program initiated a pilot project in 2005 called the Management Assistance Program (MAP). This new program provides limited funding assistance to implement specific practices recommended in landowners' Forestry Management Plans to at least 20 watershed landowners per year. WAC and the City completed and evaluated this pilot program in 2008 and expanded the MAP on a watershed-wide basis to eligible landowners having a WAC forest management plan. As of March 2011, 233 MAP projects have been completed by 135 different landowners. These completed MAP projects include: timber stand improvements, tree plantings, riparian improvements, wildlife improvements, and invasive species control projects. The MAP will continue to be a priority of the Watershed Forestry Program in the future.

During the current assessment period, the Watershed Forestry Program continued to implement a wide range of forestry education and professional training programs for landowners, loggers, foresters, school groups, and other target audiences. One of the primary aims of these programs is to teach audiences about the importance of riparian buffers.

Model forests have been established in three locations WOH. The Lennox Memorial Forest, opened in 2001, is an 80-acre site owned by Delaware County and affiliated with the 4-H Camp Shankitunk in Delhi, NY. The Frost Valley Model Forest was opened in 2003, and is a 240-acre site owned by Frost Valley YMCA and connected to its environmental center in Ulster County. The Siuslaw Model Forest is a 140-acre site in Greene County hosted by Cornell Cooperative Extension of Greene County and the Agroforestry Resource Center. The Watershed Forestry Program is also working to establish a new model forest in the Croton Watershed located at the Clearpool Environmental Education Camp in Putnam County. All three established model forests contain various forest management practices, including informational kiosks and numerous interpretive signs, and are utilized year round by their respective host organizations

and various Watershed Forestry Program partners to conduct education and training programs for landowners, loggers, foresters, school groups, and other target audiences from both the watershed and New York City.

The City's *2011 Watershed Protection Program Summary and Assessment* report describes the forestry program and details additional specific program achievements. Overall, NYSDOH and EPA believe that the forestry program has successfully met expectations and remains an effective and important element of the City's watershed protection program.

FAD Section 4.6 - Stream Management Program

2007 FAD Requirements

The primary goal of the Stream Management Program (SMP) is to protect and/or restore stability of watershed streams and floodplains. This is accomplished using stream management plans, stream restoration demonstration projects, and locally-led implementation of plan recommendations. The result is long-term stream stewardship, guided by a strong network of partnering agencies and community participation, which seeks to improve water quality.

The 2006 Long-Term Watershed Protection Program (Section 2.3.6) and the 2007 FAD (Section 4.6) describe a number of requirements for the SMP. These include: to complete stream management plans for the East Branch Delaware River, Rondout Creek, and the Neversink River; to complete demonstration restoration projects for the East Branch Delaware River, the Schoharie Creek, the Batavia Kill, Rondout Creek and the Neversink River; to submit biennial action plans for implementation of stream management plan recommendations; to establish and implement a local funding program to implement stream management plans; to commit $2 million for implementation of stream management plans in the Ashokan Basin; to develop a program to provide technical assistance to streamside landowners; and to design and construct five stream restoration projects.

Evaluation of the NYC Water System's Performance

Stream management plans were completed for the East Branch Delaware River, the Rondout Creek, and the Neversink River. Demonstration restoration projects were completed for the East Branch Delaware River, the Schoharie Creek, and the Batavia Kill, while restoration projects for the Rondout Creek and Neversink River should be completed by early 2012.

The City has met annually with county partners to review SMP priorities and develop "action plans" to prioritize and implement stream management plan recommendations. Thirty-five stream projects have been completed in the Delaware and Schoharie Reservoir basins through the newly established Stream Management Implementation Grants Program (SMIP). In the Ashokan basin, twenty-one local implementation grants have been awarded, and the City expects to complete its required $2 million funding commitment by the end of 2012. A new streamside assistance program, the Catskill Stream Buffer Initiative, was developed to provide technical and financial assistance to non-agricultural riparian landowners. The CatskillStreams.org website

was developed, and is used as a repository for stream management plans and an outreach tool for interested community members. The City has completed two of its proposed stream restoration projects, and two others are in progress.

The City has worked collaboratively with local municipalities, key stakeholders and partnering agencies to develop a very active and successful stream management program. NYSDOH and EPA believe the SMP to be an effective tool for restoring and protecting stream stability, thereby reducing sediment contributions to watershed streams from erosion of stream banks and beds.

FAD Section 4.7 - Riparian Buffer Protection Program

2007 FAD Requirements

The Riparian Buffer Protection Program is a watershed-wide effort focused on improving buffers along privately-owned stream reaches. These efforts are coordinated through other programs (Land Acquisition, Watershed Agricultural, Stream Management, and Forestry). Technical assistance, education, and training are offered to riparian landowners on topics such as proper streamside management and riparian plantings.

As part of Riparian Buffers, the Conservation Reserve Enhancement Program (CREP) addresses environmental impacts to watercourses from agriculture by compensating farmers for taking riparian lands out of farm production. CREP is implemented in conjunction with Whole Farm Planning under the Watershed Agricultural Program. The 2007 FAD requires the City to evaluate CREP and continue its implementation. The City was also required to develop and implement a streamside assistance program (in coordination with the Stream Management Program).

Evaluation of the NYC Water System's Performance

The City completed an evaluation of CREP, concluding that the program was an important part of the Watershed Agricultural Program, but may need to be modified in future years to increase farmer participation. The City has continued with the use of enhanced management agreements for stream restoration projects, either through voluntary 10-year easements or purchase. Over 30 pilot and full-scale projects have been completed under the Catskill Stream Buffer Initiative (CSBI), the streamside assistance program developed by the City. CSBI coordinators have worked with the New York Natural Heritage Program to identify appropriate species selections for replanting efforts. A supply of native plant materials have been established, with local plant stock holding areas and a propagation agreement with NYC Parks and Recreation's Greenbelt Nursery.

The City has also coordinated with partners like county Soil and Water Conservation Districts, Cornell Cooperative Extension, WAC, CWC, Nature Conservancy, and Catskill Center for Conservation and Development. The City and its partners completed at least 44 Riparian Corridor Management Plans for individual landowners, conducted 35 public activities (such as

volunteer planting and riparian workshops), and developed program marketing and reference materials, including a dedicated CSBI website (http://www.catskillstreams.org/CSBI/).

The Riparian Buffer Protection Program is a valuable program directly impacting the protection of streamside lands by leveraging private landowner assistance, and in the case of CREP, federal dollars as well. NYSDOH and EPA support the continuation and expansion of all components of this program.

FAD Section 4.8 - Wetlands Protection Program

2007 FAD Requirements

Wetlands are recognized for the important role they play in maintaining and improving water quality, attenuating peak stormwater runoff, and maintaining baseflow in streams. The City's 2006 Long-Term Watershed Protection Program (Section 2.3.8) and the 2007 FAD (Section 4.8) include a Wetlands Protection Program. Requirements for this program include: monitor WOH reference wetlands, review federal, State and municipal wetland permit applications, complete a WOH Status and Trends Study, update the City's wetlands educational pamphlet, and revise the City's Wetlands Protection Strategy to reflect 2007 FAD requirements.

Evaluation of the NYC Water System's Performance

All 2007 FAD requirements for this program have been met. The City has continued to monitor reference wetlands and continues to review federal, State, and municipal wetland permit applications. The WOH Wetlands Status and Trends Report was submitted to NYSDOH/EPA on December 29, 2008. The report noted that many wetlands have been converted to man-made ponds.

The Wetlands Protection Program continues to be an important component of the City's overall watershed protection program.

FAD Section 4.9 - East-of-Hudson Nonpoint Source Pollution Control Program

2007 FAD Requirements

The East-of-Hudson (EOH) Nonpoint Source Pollution Control Program is a comprehensive effort to protect the four Catskill/Delaware basins that are located EOH from the impacts of nonpoint pollutant sources. West Branch and Boyd Corners are considered part of the Catskill/Delaware system because water from these reservoirs regularly blends with water from the Delaware Aqueduct. Croton Falls and Cross River are hydrologically part of the Croton System, but they have the ability to deliver water into the Delaware Aqueduct during emergencies or other designated times. The overall EOH nonpoint source control effort is broadly separated into wastewater and stormwater related programs. Specifically, the 2007 FAD requires the City to: complete a number of stormwater remediation projects; construct two large

retrofit projects on Hemlock Dam and Magnetic Mine Roads in the Croton Falls watershed; complete mapping and inspection of the stormwater infrastructure around Boyd Corners and West Branch Reservoirs; determine and prioritize the locations of future stormwater projects on City-owned property; establish a $4.5 million program to help fund the implementation of stormwater projects in the Cross River, Croton Falls and hydrologically connected basins; complete sanitary mapping and inspection of the EOH sanitary sewer infrastructure; and work with the EOH counties' septic programs.

Evaluation of the NYC Water System's Performance

The goals for the wastewater components of this FAD program have mostly been achieved. Sanitary infrastructure mapping was completed on time. Mapping data will be incorporated into the City's GIS library, and information will be made available to the responsible municipalities and private entities. The EOH septic program deliverable has been met. In Westchester County, the City supports the county Health Department's training and licensing of septic contractors, and the development of a Septic System Management Program database. In Putnam County, the City works with the county Septic Repair Program.

The City has experienced delays in meeting several requirements of the stormwater elements of the EOH Nonpoint Source Pollution Control Program. In general, these delays appear to be due to underestimating the amount of oversight and internal and local reviews these projects require, and/or issues with project impacts on private property. There have been numerous delays with the five Stormwater Remediation Projects outlined in the 2007 FAD. These projects had a completion deadline of December 31, 2009, but as of June 2011, all five projects were still not completed. All five projects have progressed to at least the 100% design stage. After considerable negotiation between the City and EOH communities that are subject to the NYSDEC's Municipal Separate Storm Sewer System (MS4) stormwater regulations, a grant program to address stormwater pollution in the Croton Falls and Cross River basins was developed. To date, none of the $4.5 million committed to this program has been allocated. Design and construction dates for the Stormwater Remediation Small Projects Program were not met. Delays could be attributed, in part, to a contractor who did not have an adequate experience or capacity to do this type of work. However, after a new contractor was selected all remaining projects have been completed. The City's continues to inspect, monitor, and maintain the completed project sites.

The two Stormwater Retrofit projects at Hemlock Dam Road and Magnetic Mine Road have been completed. The Stormwater Infrastructure Mapping and Inspection Program for the West Branch and Boyd Corners Reservoir basins was completed satisfactorily and on time. These infrastructure data have been added to the City's GIS system, and locations of all the noted structural problems and suspected illicit connections have been sent to the appropriate local municipalities for review and remediation, as needed. The stormwater infrastructure capacity evaluation and prioritization assessment for the entire EOH Catskill/Delaware System has been completed. Results of the stormwater infrastructure evaluation have been shared with EOH municipalities, which should help them in their efforts to comply with MS4 stormwater requirements.

The EOH Stormwater Prioritization Assessment (City-owned Properties) deliverable has been met. Four potential future stormwater sites were selected in March 2009. One site was subsequently addressed under the City's small projects program. The following three sites were selected to move into preliminary design to decide if the projects will move forward: Route 301 at Peekskill Hollow Road (Boyd Corners), Route 6 and Route 301 at Lake Gleneida (West Branch), and Croton Falls Reservoir at Lakeview Road (Croton Falls). The following schedule was established:

- Advertise Bid for Design Services – December 2010
- Initiate Design Contract – June 2011
- Initiate Construction Contract – January 2012

The proximity of the EOH FAD basins to the intakes for the NYC distribution system makes protection of these basins from pollutant sources particularly critical. While Cross River and Croton Falls Reservoirs are not generally used to supply the Catskill/Delaware system, the City may be relying on these sources during an extended period while the Rondout-West Branch tunnel is shut down for repairs. This shutdown is scheduled to begin in the latter part of 2018, and may last for approximately one year. NYSDOH and EPA recognize that robust wastewater and stormwater programs are critical to protecting water in the EOH basins and support continuation of these programs as part of the City's overall watershed protection plan. In addition, to ensure that the stormwater management projects the City has implemented continue to function as designed, the City should continue to maintain these projects as necessary.

FAD Section 4.10 - Kensico Water Quality Control Program

2007 FAD Requirements

Because the Kensico Reservoir is the last impoundment of Catskill/Delaware water prior to entering the City's distribution system, the protection of this reservoir is critically important to maintaining filtration avoidance for the City. The 1997 and 2002 FADs built a foundation of expanded watershed protection and pollution prevention initiatives for the Kensico basin. Under the 2007 FAD, the City instituted new watershed protection and remediation programs designed to ensure the continued success of past efforts while providing new protection initiatives that were specifically targeted toward stormwater and wastewater pollution sources.

The focus in the 2007 FAD for the Kensico Water Quality Control Program is:

- Long-Term Operation and Maintenance – the City is to continue to regularly inspect the existing storm water management facilities and determine maintenance needs of each identified facility in order to determine and maximize its removal efficiency;
- Complete Assessment of Kensico – through the Kensico Action Plan (KAP), the City was to make better strategic decisions on future storm water and dredging projects; and
- Reduce the Potential Risk– implementation of a Septic Repair Program, construction of an early warning sanitary sewer overflow protection system and the annual visual inspection of sanitary sewers planned to increase the City's ability to prevent possible discharges of wastewater to Kensico.

The 2007 FAD requires that the City implement its Kensico Water Quality Control Program in accordance with section 2.3.10 of the City's 2006 Long-Term Watershed Protection Program and the milestones contained therein.

Evaluation of the NYC Water System's Performance

The City has achieved most of the requirements of the first five year period of the 2007 FAD for the Kensico program. In its effort to maintain nonpoint management facilities around Kensico Reservoir, the City constructed 45 stormwater management/ erosion prevention facilities throughout the watershed; many are concentrated on the western edge of the main basin while other facilities are located in the Bear Gutter sub-basin and adjacent to Route 120. These facilities are routinely inspected and maintained as needed throughout the year.

There have been intermittent reports on the status of the turbidity curtain that diverts discharges from Malcolm Brook away from the Catskill Upper Effluent Chamber; especially after storms or in winter. An underwater assessment of the primary turbidity curtain was performed in May 2010. This resulted in a list of curtain repair needs. Two 50-foot sections of the primary turbidity curtain were replaced. Stainless steel ties replaced nylon ties on both the primary and secondary curtains. Minor repairs were also done on the secondary turbidity curtain in October 2010.

The City maintains spill containment facilities around Kensico Reservoir Basin. In 2010, the City continued to maintain the 39 spill containment facilities installed at the outlets of 26 storm drains along Interstate 684 and Route 120.

The 2007 FAD required the City to update the computer-assisted facilities management system (CAFM) to track, document and manage the Kensico watershed protection programs. An application was developed for the City staff to keep track of facility inspections and maintenance.

The City was required to monitor selected BMPs from 2000 through 2007 in order to assess their performance at reducing pollutant loading from stormwater runoff. Monitoring results indicated that the BMPs studied were effective at reducing loadings of sediment, turbidity, fecal coliform and total phosphorus to the reservoir.

The Kensico Action Plan (KAP) was completed as required by August 15, 2007. Key elements of the KAP program have been reported regularly in the Annual Report for the Kensico Water Quality Control Program (January) and The Filtration Avoidance Annual Report (March). In accordance with the KAP, the City has:

- completed a 2-ft contour map of the Kensico sub-basin;
- proposed four pollution remediation practices. These are: [1] Whippoorwill Creek stream stabilization; [2] an extended detention basin for N12; [3] drainage improvements on West Lake drive to enhance the performance of BMP 12 and BMP 13 (associated with Malcolm Brook); and [4] N7 pipeline systems and storm water stabilization. Implementation of these projects in accordance with the City's original

proposed schedule has been delayed due to issues with bidding; bidding and permitting to construct these projects is ongoing. The City will provide a revised schedule in 2011.

- assessed up to four water quality risks around Kensico Reservoir. Three assessments were selected: [1] potential impacts of the Westchester County Airport (e.g., surface runoff; glycol and other spills); [2] turf management chemicals in the N5 sub-basin (herbicides, pesticides and fertilizers); [3] impact of the Swiss Re office complex on the Rye Lake basin. The assessment determined that these potential risks to water quality were adequately mitigated or were not significant; and
- summarized the need for effluent chamber dredging. The Catskill Upper Effluent Chamber (CUEC) and Shaft 18 were last dredged in 1999. The CUEC was re-evaluated by divers in 2009 and it was determined that silt and sediment had re-accumulated and the levels warranted some turbidity controls (which were implemented). Dredging at CUEC will not be done until the Catskill Aqueduct is shut down for pressurization (approximately 2020). Shaft 18 was re-evaluated in November 2010, and only minor accumulations of solids were noted; there were no changes to operating conditions.

The 2007 FAD required the City to develop a septic repair program for the Kensico Reservoir watershed. The proposed program was submitted to NYSDOH and EPA in a report dated October 2007. The report included a prioritization of properties based on a survey of targeted homes. The City contracted with the New York State Environmental Facilities Corporation (EFC) in October 2008 to implement a septic system rehabilitation reimbursement program. Residents in targeted areas have been notified of the program. Five failing septic systems have been addressed since the program started in 2009.

In accordance with the FAD, the City has proposed a sanitary sewer remote monitoring system for the Westlake Sewer Trunk Line for real-time detection of events such as leaks, system breaks, overflows, and blockages. The purpose of the monitoring system is primarily rapid remediation response. The City and the Westchester County Department of Environmental Facilities (WCDEF) have continued to work on an inter-municipal agreement (IMA), a draft of which was submitted to Westchester County in March 2010. Contracting services for installation, monitoring, and maintenance of the system will be managed by WCDEF. WCDEF and the City have also selected a product for real-time monitoring. It is a self-contained, continuously monitoring, ultrasonic level sensor with satellite communication and web-based access and data management. Both agencies have agreed on manhole locations along the trunk line where the sensors should be installed. Regular updates on this project have been received by NYSDOH and EPA.

The City reported in August 2007 on the impacts of wind speed and wind direction on the creation of turbidity near the Catskill Lower Effluent Chamber. In an additional deliverable received in December 2008, the City reported that the wind-induced turbidity issue would be addressed by shoreline stabilization using rip rap. This work is on hold until the Catskill Aqueduct is shut down for rehabilitation.

The City has also conducted the following activities in accordance with 2007 FAD requirements:

- visual inspection of West Lake Sewer extension has been completed annually. The City has conducted an annual visual inspection of the trunk line to assess the condition of exposed infrastructure. The last annual full inspection was performed in December 2010;
- a sanitary sewer video inspection program has been initiated. A report on the inspection is pending (2011);
- the City continues to coordinate with the Westchester County Airport on proposed airport projects. Regular updates have been submitted to NYSDOH/EPA; and
- the City has continued to coordinate with the New York State Department of Transportation on the proposed resurfacing of I-684 and construction of storm water treatment basins in the I-684 median (south of the new Lake Street overpass in New York northward to the bridge over Tamarack Swamp in Connecticut). The project is being implemented in 2011.

The Kensico Water Quality Control Program is a key element of the City's watershed protection program as it works to provide adequate protection of the City's source water at its most vulnerable point. Components of the program have successfully protected the City's terminal reservoir from spills, stormwater runoff, and sewage inputs. While NYSDOH and EPA understand the City's reasoning for delaying implementation of the shoreline stabilization project at the CUEC, we urge the City to address this issue as soon as it becomes feasible to do so.

FAD Section 4.11 - Catskill Turbidity Control Program

2007 FAD Requirements

Elevated turbidity events within the Catskill system are not a new phenomenon and likely represent the greatest risk to the City maintaining its filtration avoidance. The majority of turbidity comes during short-term major flow events that result in excessively high turbidity levels in the upper Esopus channel. This turbidity is primarily generated within the channel itself, rather than the surrounding landscape, and this impact of the underlying geology on water quality was considered when the Catskill System was designed. For example, turbidity is given a chance to settle in the Schoharie Reservoir before it enters the Upper Esopus. Alternatively, turbid Schoharie Reservoir water can be isolated from the Catskill system by shutting down the Shandaken Tunnel. In addition, the dividing weir between the West and East Basins of the Ashokan Reservoir give turbidity another opportunity to settle in the West Basin and again in the East Basin before it moves down the Catskill Aqueduct and into Kensico Reservoir. Once in Kensico, there is additional time to allow turbidity to settle as water moves to the Kensico effluent chamber. While this is normally enough time to have turbidity settle, the system was built with the capacity to add alum above Kensico Reservoir during extreme turbidity events to coagulate and more rapidly settle the particles that cause turbidity.

The 2002 and 2007 FADs required the City to explore options that might reduce turbidity levels in the water entering the Catskill system, and thereby reduce use of alum. The City contracted with Gannett Fleming/Hazen and Sawyer Joint Venture (JV) (along with JV sub-consultants Upstate Freshwater Institute and HydroLogics, Inc.) to perform the Catskill Turbidity Control

Study. The overall goal of this extensive effort is to reduce the potential impact of turbidity levels in the Catskill system on finished water quality while reducing the frequency and duration of alum treatment events. To generalize, this effort involved the collection of tremendous amount of hydrological and water quality data on streams and reservoirs, and these data were used to quantify turbidity-flow relationships and solids loading. Next, the data were used to calibrate, verify, and utilize linked hydrodynamic and simulation water quality models, which were in turn related and linked to various water system operation scenarios using separate models.

This study was conducted in three phases. Phase I was completed in 2004 largely using existing data and formed the conceptual basis for the future work. Phase II was completed in 2006 and evaluated a Multi-Level Intake, In-Reservoir Baffle, and Modification of Reservoir Operations as a means to reduce the transport of turbidity from Schoharie Reservoir into the lower part of the Catskill system. Based on the Phase II study, modified reservoir operations was selected as the most effective and cost effective tool. The results of the Phase II study were implemented as a requirement of the 2007 FAD. In addition, the FAD required the City to conduct a Phase III study to evaluate engineering and structural alternatives at the Ashokan Reservoir to reduce the level of turbidity entering the Catskill Aqueduct, then develop a plan to implement the findings of the Phase III study. The 2007 FAD also required complete dredging of the Schoharie Reservoir intake channel.

Evaluation of the NYC Water System's Performance

The Phase I and II management options to control turbidity from exiting Schoharie Reservoir included dredging accumulated silt near the intake chamber and modified operations related to the Shandaken Tunnel SPDES permit, with a goal of banking cold water for late season conservation releases to the Upper Esopus. The dredging was completed in 2008.

The Phase III study, which was completed in December 2007, was designed to systematically evaluate and compare various options to reduce the amount of turbidity that enters Kensico from Ashokan Reservoir following major runoff events, thereby reducing the need for alum treatments. The evaluated options included: 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 that could help facilitate various Modified Operations.

The Phase III study concluded that modifying the overall water system's operations, in conjunction with implementing specific Catskill Aqueduct improvements, is the most effective and economical option to control turbidity entering Kensico Reservoir from the Catskill system. The goal of this option is to use the Catskill Aqueduct as little as possible when only high turbidity water is available. The West Basin Outlet Structure and Dividing Weir Crest Gates were deemed too costly and only marginally effective compare to the options ultimately selected. The East Basin Diversion Wall and a new East Basin Intake would have been very costly, and modeling demonstrated that these new structural elements would largely just change the direction of the turbidity plume on its way to the aqueduct intake.

Based on the results of the Phase III study, and in accordance with the 2007 FAD, the City developed the Catskill Turbidity Control Phase III Implementation Plan, which was submitted July 2008. This plan focused on the following tools to help minimize the amount of turbid water delivered from the Ashokan Reservoir to Kensico: 1) improving stop shutter facilities in the Catskill Aqueduct to minimize flow of turbid water down the aqueduct while still supplying communities that are served by the aqueduct (estimated completion December 2014); 2) constructing an interconnection between the Delaware and Catskill Aqueducts at Shaft 4 of the Delaware Aqueduct (estimated completion March 2015); 3) diverting low turbidity water from the West Basin down the aqueduct to maintain capacity in the basin to capture storm runoff; and 4) diverting turbid water from the West Basin using the existing waste channel. This plan was approved by NYSDOH, EPA, and NYSDEC in November 2010.

In order to optimize system operations to minimize use of turbid Catskill water while still maintaining water supply reliability, the City is developing an Operations Support Tool (OST). The OST is a computer model that allows the City to weigh its various water system management options with a goal of maximizing water quality while sustaining adequate water quantity. Work on the OST is underway, and the City has already used a preliminary version to manage systems operations during a number of turbidity events in the Catskill system and to aid planning of the Gilboa Dam construction project. Future versions of the OST will utilize real-time hydrologic, water quality, and meteorological data, and state-of-the-art forecasting. The final OST is expected to come on-line in October 2013.

NYSDOH and EPA believe that the City has adequately satisfied the requirements for the Catskill Turbidity Control Program for the first five-year period of the 2007 FAD. Use of the OST has already enabled the City to reduce use of alum during periods of high turbidity in the Catskill system. Completion of the stop shutter improvements, Shaft 4 interconnection, and the Croton Water Filtration Plant will increase the City's flexibility to maintain the quality and quantity of water serving the NYC system during these periods in the future. However, since the Catskill Turbidity Control Study was performed, a constraint on the City's use of the waste channel has developed that was not considered during development of the Catskill Turbidity Control Phase III Implementation Plan. Due to a series of severe storms in the Catskill watershed during the fall and winter of 2010, water in the Ashokan Reservoir remained highly turbid for months. In accordance with the City's plan, stop shutters were installed to minimize flow of Catskill water to Kensico, and turbid water from the West Basin was diverted down the waste channel to prevent that water from reaching the East Basin. As a result of this extended use of the waste channel, residents of the Lower Esopus Creek became concerned about the impacts of the sustained turbid discharge on the environment and the economy of the Lower Esopus region. The City is currently supporting an investigation of these potential impacts and is developing formal operating rules for use of the waste channel, which will be enforceable under the City's SPDES Permit for the Catskill Aqueduct Influent Chamber. Implementation of these operating rules may require the City to reevaluate its options for controlling Catskill turbidity.

Watershed Monitoring, Modeling, and GIS

FAD Section 5.1 - Watershed Monitoring Program

2007 FAD Requirements

Section 5.1 of the 2007 FAD requires that the City conduct a watershed-wide monitoring program in accordance with Section 2.4.1 of its Long-Term Watershed Protection Program and the milestones therein. The monitoring framework was originally defined by the Drinking Water Quality Control (DWQC) Integrated Monitoring Plan which was finalized by the City in October 2003. This Plan, now called the 'Watershed Water Quality Monitoring Plan' (WQMP), describes the City's hydrology, limnology, and pathogen monitoring and surveillance programs which support trend analysis, modeling efforts, and reservoir operations.

Pathogen reports are provided annually which summarize results at keypoints (Kensico Reservoir intakes) as well as in the WOH reservoirs. Annual updates on ongoing research activities are also provided. The City submits a monthly report which describes its compliance with the objective regulatory requirements for filtration avoidance, such as turbidity and coliform bacteria levels in source water, and disinfection.

As watershed programs and analytical techniques for key parameters evolve, all parties have recognized that it would be necessary to reassess the monitoring program to ensure that it continues to support the City's watershed management program and that it can be used to evaluate the effectiveness of programs established under the FAD and MOA. The 2007 FAD required the City to review the elements of the monitoring program and, based on this review, submit an updated monitoring plan in October 2008.

The City also committed to undertaking a comprehensive evaluation of its watershed protection program on a periodic basis. The last submission on this evaluation occurred on March 31, 2011. The data generated through the City's monitoring program, in conjunction with other defensible scientific findings, will be used to conduct the City's periodic assessment (next due in 2016) of the effectiveness of the watershed protection program.

Evaluation of the NYC Water System's Performance

In accordance with the 2007 FAD, the City has participated in educational seminars on watershed monitoring. The City has held an annual watershed conference each year at the Hotel Thayer in West Point, NY:

- September 10-11, 2007
- September 16-17, 2008
- September 14-15, 2009
- September 15-16, 2010

The City has also participated in the Annual Ashokan Watershed Conference.

The Pathogen Technical Working Group has convened and discussed pathogen research and detection methods in March of each year since 2008. The last two group meetings were held on:

- March 31, 2010
- March 24, 2011

Recent discussions have focused on improved methods for virus recovery and detection at keypoints.

The City discussed the draft contents of their Integrated Monitoring Plan (now called WQMP) with EPA, NYSDOH and NYSDEC and originally submitted the plan on October 31, 2008. After review and comment by NYSDOH and USEPA, a revised plan was submitted in May 2009.

All reporting requirements for this program have been met. Watershed Water Quality Annual Reports were regularly received in July on 2008, 2009, 2010 and 2011. Annual summaries of water quality, water quantity, pathogens, watershed management, model development and potential research are included in this comprehensive report. In addition, all the City's Pathogen Mid-Term Surveillance Reports have been received. The reports, received in January of each year, cover the period July 1 through December 31 of the previous year. Four targets of the water quality monitoring are: 1) Kensico Reservoir perennial streams; 2) wastewater treatment plants; 3) upstream water sources; and 4) watershed pathogen sources. Recent changes have included a shift in the monitoring plan for WOH WWTPs so that newer plants can be monitored (for virus) and those with sufficient data can be removed from the monitoring plan. Special studies have included focused sampling at upstream sites suspected of contributing pathogen loadings and method projects for improved identification of microorganisms. The ***2011 Watershed Protection Program Summary and Assessment*** report covering the first five-year period of the 2007 FAD was received in March 2011 and serves as a reference for this five-year FAD review.

FAD Section 5.2 - Multi-Tiered Water Quality Modeling Program

2007 FAD Requirements

The Multi-Tiered Water Quality Modeling Program is an ambitious effort to link together a number of simulation models that are used to assist in short and long-term planning and decision-making as it relates to both water quantity and quality. Briefly, this process involves using watershed land cover characteristics, climate, and weather data to simulate the quantity and quality of water entering City reservoirs. These inputs are then integrated with reservoir bathymetry, climatically-driven thermal structure, and operational flows to simulate reservoir water quality. Taken all together, this is a powerful water management tool to assist in operational decisions such as controlling the impact of Catskill turbidity on finished drinking water quality, as well as to evaluate potential impacts of climate change on water quality and water supply reliability in the future.

The 2007 FAD requires the City to update and test its models as new data, software, and research findings become available. The modeling program will continue to support the Catskill Turbidity Control Program and serve as a basis for operational decisions made in response to

high turbidity events. Modeling efforts will also be used to support other watershed management, reservoir operations, and long-term planning applications.

Evaluation of the NYC Water System's Performance

The Multi-tiered Water Quality Modeling Program has met the requirements of the first five-year period of the 2007 FAD, and continues to be a valuable component of the City's watershed protection program. Data updates appear to be made in a systematic manner as new information becomes available and data management infrastructure improves. As discussed in the section on the Catskill Turbidity Control Program, the City's modeling group has played an important role, through implementation of the OST, in helping system managers to make operational decisions during high turbidity events, thereby reducing the need for alum treatment.

All reporting requirements of this program have been met. The report on the Phytoplankton Functional Group Model Application to Cannonsville Reservoir was submitted. This report indicates that the Phytoplankton Functional Group Model predicts general shifts in functional groups fairly well, and will be useful in climate change planning. This work has been continued, with a one year extension being given to the Upstate Freshwater Institute to further develop the hybrid UFI-PROTBAS model. In addition, expansion of the Nutrient Management Eutrophication Modeling System capabilities to the Neversink, Rondout, West Branch, Ashokan, and Schoharie Reservoirs was completed in 2007.

FAD Section 5.3 - Geographic Information System

2007 FAD Requirements

The City utilizes an extensive Geographic Information System (GIS) in its watershed protection efforts. In addition to creating maps and illustrating environmental data; GIS is also used in data gathering, satellite imagery analysis, and complex environmental modeling. A few of the key areas where GIS plays a vital role include: land acquisition and management, Catskill turbidity control, water quality modeling, watershed protection evaluation, water system operations for system reliability and maximizing water quality, and long-term planning. Overall, there are few FAD programs where GIS is not used in some way.

The 2007 FAD requires the City to continue to maintain and update its GIS capabilities, and to report on use of GIS, GIS updates, and dissemination of GIS data to stakeholders as needed.

Evaluation of the NYC Water System's Performance

The City continues to have a robust and active GIS program, and has made the updates and improvements necessary to effectively use this technology in their watershed protection efforts.

Numerous acquisitions and improvements have been made to GIS data layers and infrastructure during the first five-year period of the 2007 FAD. High resolution areal satellite images were

acquired and many updates and enhancements were made to existing data layers used in terrestrial data analysis and various aspects of land management, as well as to FAD activity tracking data storage and utilization. The GIS library was migrated to an improved platform which improves system performance and saves substantial amounts of staff time.

In addition to serving as an important in-house resource to many programs, the GIS group also shares non-sensitive data with partners, stakeholders, and other interested parties. For example, the City updates communities on newly purchased watershed land holdings. The City also works with the New York State Office of Cyber Security and Critical Infrastructure Coordination and NYC's Office of Emergency Management.

Overall GIS has been and will remain a critical tool in FAD implementation and other aspects of watershed management and water system operations.

Regulatory Programs

FAD Section 6.1 - Watershed Rules and Regulations and Other Enforcement/Project Review

2007 FAD Requirements

Section 6.1 of the 2007 FAD listed seven activity or reporting requirements for the Watershed Rules and Regulations (WR&Rs) and Other Enforcement/Project Review Program. The 2007 FAD required the City, with the assistance of NYSDOH and NYSDEC, to administer the City's WR&Rs and other enforcement or project review commitments as specified in Section 2.5.1 of the City's 2006 Long-Term Watershed Protection Program. Included in the requirements of this program: the City was to review Best Management Practice (BMP) monitoring data and performance and revise guidance for preparation of storm water pollution prevention plans (SWPPPs) as appropriate, coordinate with NYSDEC and the State's Attorney General's Office (OAG) on enforcement of storm water regulations, and develop a timeline for revision of NYC's 1997 WR&Rs.

Evaluation of the NYC Water System's Performance

The City has reviewed BMP monitoring data and continued to refine assumptions used to select appropriate BMPs; has emphasized non-structural BMPs such as riparian buffers; and has encouraged innovative site designs to mitigate effects of construction. In addition, the City is developing a guidance document to assist applicants undertaking regulated activities in complying with the storm water provisions of the WR&Rs. This document is in the process of being completed. The period for public comment on the document ended July 8, 2011.

The Storm Water Enforcement Coordination Committee, which includes representatives from the City, NYSDEC, OAG, NYSDOH, and EPA, meets semi-annually to coordinate on storm water enforcement issues in the watershed. These meetings help ensure consistent and efficient enforcement of both City and State storm water regulations.

Amendments to the 1997 NYC WR&Rs were finalized and adopted into the City's rules on April 4, 2010. Among the revisions to the WR&Rs: NYSDEC's standards for their General Permit for Stormwater Discharges from Construction Activity, Permit No. GP-0-10-001, have been incorporated into the requirements for SWPPPs required by the City; a variance will be allowed, under certain conditions, for siting new wastewater treatment plants or expanding wastewater treatment plants that discharge to surface water in the Croton system within a 60-day travel time to a City intake; and the definition for "phosphorus-restricted basin" has been changed from 20 μg/L to 15 μg/L for NYC source water reservoir basins.

The NYC WR&Rs serve as the backbone to the City's watershed protection program. The City continues to actively enforce its WR&Rs, working in coordination with other regulatory agencies, to maximize effectiveness of this important protection tool.

FAD Section 6.2 - Wastewater Treatment Plant Inspection Program

2007 FAD Requirements

As outlined in its 2006 Long-Term Watershed Protection Program and the 2007 FAD (Sections 2.5.2 and 6.2, respectively), the City, with the assistance of NYSDEC, administers the Wastewater Treatment Plant (WWTP) Inspection Program. The Program is comprised of on-site inspections, monitoring of and assistance with SPDES compliance, and necessary enforcement actions associated with noncompliance.

The 2007 FAD requires that WWTP monitoring results are submitted to EPA and NYSDEC on a quarterly basis, along with inspection reports. In addition, enforcement actions against non-complying facilities are required to be taken in a timely and appropriate manner, with a quarterly reporting process via the Watershed Enforcement Coordination Committee (WECC). The FAD also requires the City to conduct annually at least four on-site inspections for all year-round SPDES-permitted facilities and at least two on-site inspections of all seasonal SPDES facilities. All inspection summaries and monitoring data with inspection reports are submitted to NYSDOH, EPA and NYSDEC either quarterly (the former) or annually (the latter). In addition, the 2007 FAD stipulates that technical assistance, operators' training, and certification are provided to the WWTP operators on as-needed basis, with summary reports submitted to NYSDOH and EPA annually.

Evaluation of the NYC Water System's Performance

The program continues to be successfully implemented since its inception. All milestone requirements and due dates have been met during the reporting period. In fact, quite frequently the City goes above and beyond the requirements to assure that all WWTPs discharging in the watershed are meeting their SPDES permit requirements.

As per the 2007 FAD, the City conducts one inspection during each calendar quarter. At a minimum, two inspections per year are conducted at seasonal surface-discharging facilities during the facility's operating season. Similarly, at least two 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 surface application, are inspected four times per year. In addition, when necessary, the City conducts follow-up inspections. If chronic violations of SPDES permit parameters are occurring, the City, in conjunction with NYSDEC and local health departments, will issue a Notice of Violation and will participate in a Compliance Conference with the owner/operator to discuss problems and possible corrective actions. Following such an enforcement initiative, the City may conduct a periodic follow-up unannounced visit to ensure that the WWTP is continuing in its efforts to remain in compliance.

In addition, the City coordinates enforcement activities with NYSDEC through quarterly WECC meetings, where the status of watershed WWTPs is discussed, and steps are taken to ensure compliance. Staff from NYSDOH, EPA, and the OAG also participate in these collaborative efforts to ensure compliance with regulatory requirements.

Another important component of this program is successfully implemented through technical assistance and WWTP operator training provided by the City. Not only do these outreach efforts improve operation of WWTPs and compliance with their SPDES permits, they also improve cooperation between the regulators and local communities.

NYSDOH and EPA strongly support the continuation of this program, which remains a vital component of source protection for the City's unfiltered water supply.

Catskill/Delaware Filtration and UV Disinfection Facilities

FAD Section 7 - Catskill/Delaware Filtration and UV Disinfection Facilities

2007 FAD Requirements

As relief from having to produce a final design for filtration facilities for the Catskill/Delaware water supply, the 2002 FAD required the City to design and construct an ultraviolet (UV) light disinfection facility and to provide biennial updates to the preliminary filtration plant design for the Catskill/Delaware system. An enforceable construction schedule was set for the Catskill/Delaware UV facility under an Administrative Order (AO) that was signed by EPA and NYSDOH in 2007. The UV plant is required to be in full operation by October 29, 2012. The 2007 FAD requires that the City implement its program for the Catskill/Delaware UV Disinfection Facility in accordance with Section 2.6 of the City's 2006 Long-Term Watershed Protection Program. Section 7 of the 2007 FAD specifically requires the City to provide a report biennially that updates the preliminary design for filtration facilities for Catskill/Delaware water, and to construct a UV disinfection facility in accordance with the AO schedule.

Evaluation of the NYC Water System's Performance

The City has met the requirements of this FAD program. In 2007 and 2009, the City provided update reports on preliminary filtration plans and gave presentations to NYSDOH and EPA on

the updates. In 2007, the City requested a two month extension to the milestone requiring that the City issue the notice to proceed for construction of the UV plant by October 31, 2007. An extension was subsequently granted by EPA. Construction of the UV plant is progressing well, with expectations that it will be in operation prior to the required completion date. NYSDOH and EPA believe that UV disinfection will be an important additional barrier in protecting the quality of NYC's water supply.

In-City Programs

FAD Section 8.1 - Waterborne Disease Risk Assessment Program

2007 FAD Requirements

As a condition of filtration avoidance, in accordance with the SWTR, a public utility must demonstrate that it has not been the source of a waterborne disease outbreak. The 2002 FAD required the City to maintain a system to detect the presence of waterborne disease outbreaks and to report any evidence of such an outbreak.

The City has a Disease Surveillance Program, the overall objective of which is to track the incidence of, and gather relevant epidemiological data on, two waterborne diseases: giardiasis and cryptosporidiosis. Key objectives of the City's Disease Surveillance Program include tracking the incidence of disease, and developing and maintaining systems to detect disease outbreaks and determine the possibility of waterborne transmission. It is important to know the endemic rates for giardiasis and cryptosporidiosis, as well as any possible association between these diseases and the NYC water supply. By knowing the endemic rate, any unexpected or unusual indicators of disease would allow the appropriate protective steps to be taken by health care professionals and water supply consumers. Surveillance that may help reveal early evidence of a possible waterborne disease outbreak could prevent disease from occurring on a widespread basis.

The City's 2006 Long-Term Watershed Protection Program includes a Waterborne Disease Risk Assessment Program (WDRAP) (Section 2.7.1). Section 8.1 of the 2007 FAD requires that the City implement and continue to operate the WDRAP in accordance with their long-term plan. Specifically, the 2007 FAD requires that the City: implement the *Cryptosporidium* Action Plan (CAP) when concentrations of *Cryptosporidium* oocysts detected in source water exceed trigger levels; provide syndromic surveillance system information, upon request by the regulators, in response to any water quality "event"; notify regulators when there is indication of significant levels of gastrointestinal (GI) illness that may be water supply related; and work with NYSDOH and EPA on developing a Turbidity Action Plan (TAP).

Evaluation of the NYC Water System's Performance

The City has met all the requirements of this FAD program. The WDRAP has continued to operate and assess City-wide conditions on a regular basis. The City submits an annual report and an interim report on the implementation and findings of this program.

The CAP protocol, which was developed and issued in 2002, is regularly reviewed and revised as needed. The last revision occurred on January 30, 2009. The CAP is an event-based protocol which is triggered by the recovery of *Cryptosporidium* oocysts in conjunction with other water quality and operations information. A single activation of the CAP occurred in November 2008 as a result of a laboratory error. High numbers of oocysts were reported in a sample from the New Croton Reservoir as a result of a manipulation error. However, the CAP was activated until the error was confirmed. De-escalation was simplified by the fact that there was no risk to the public.

NYSDOH and EPA have not requested syndromic surveillance information for identifiable water quality events since the 2007 FAD has been implemented. In the past, the New York City Department of Health and Mental Hygiene has issued Health Alerts when turbidity levels in the Kensico Reservoir could potentially impact the quality of water delivered to the City. No such alerts have been issued since 2005.

WDRAP has not identified any significant signs of community GI illness that could be attributed to the drinking water supply. Major and/or transient disease signals frequently coincide with localized and multi-site occurrences of norovirus on a seasonal basis.

The TAP was developed to establish an organized response to elevated turbidity levels in the source water of the City's drinking water supply prior to turbidity levels reaching the SWTR limit of 5 NTU. Turbidity is often used as a surrogate indicator of protozoan intrusions and, therefore, any response to unusual turbidity would be done with consideration of the implementation of the CAP. The final version of the TAP was issued in 2009, and was last revised April 2011. The TAP has been activated a number of times since adoption, and has worked well to ensure that key parties are informed when turbidity levels are elevated, and that consistent action is taken to address potential water quality issues.

NYSDOH and EPA believe that the City has a very strong and effective waterborne disease risk assessment and surveillance program. This program is key to assessing that the City's water is not a source of a waterborne disease outbreak, as required by the SWTR for filtration avoidance.

FAD Section 8.2 - Cross Connection Control Program

2007 FAD Requirements

Cross connections in the distribution system of a water supply can be a serious source of contamination. The City's 2006 Long-Term Watershed Protection Program contains a detailed inspection and reporting schedule for a Cross Connection Control Program (Section 2.7.2). The 2007 FAD requires the City to implement a Cross Connection Control Program in accordance with its long-term plan. Requirements of the 2007 FAD include: respond to cross connection control complaints, initiate enforcement for non-compliant hazardous premises, approve backflow preventer plans, accept backflow preventer plans with self-certification, issue Notices

of Violation for failure to test annually, review requests for exemption from cross connection control requirements, and perform full inspections of potentially hazardous premises.

Evaluation of the NYC Water System's Performance

The City has a very active cross connection control program, which has exceeded all the performance goals set by the 2007 FAD. The importance of this program has been demonstrated during some cross connection incidences that have occurred in the last five years. Since the beginning of the 2007 FAD term, cross connection investigations were activated by the following incidences:

- In January 2007, elevated pH readings in water from a sampling station in Staten Island led to an investigation. No cross connections were discovered, and an off-line concrete-lined 72-inch main adjacent to the sample station was identified as the source of the high pH water;
- In May 2007, the City received a report that ethylene glycol had entered the water supply for a high school in Manhattan through a cross connection with the school's air conditioning units. The problem was identified as a failed backflow prevention device in the school. Samples taken from nearby hydrants did not indicate that the City's water supply, outside of the school, had been impacted;
- Also in May 2007, a routine distribution water sample taken in Queens was found to contain tetrachloroethylene (PERC). Additional samples were confirmed for detection of PERC, and the City launched an intensive effort to find the source of the contamination. Cross connections were discovered at a car wash, but it was not clear that the facility was the source of the PERC. Flushing cleared the area of contamination, and inspections of "High Hazard" facilities continued in the area for several months.
- In November 2007, elevated conductivity was detected in water from sampling stations in Brooklyn. A car wash that was cross connected to a private well was found to be the source of the high conductivity. These latter two cross connection incidences prompted the City to focus on car wash inspections, inspecting approximately 130 car washes in all five NYC boroughs over the next few months.
- In April 2010, routine sampling detected unusual water quality that led to the discovery of cross connections at the Hutchinson Metro Tech Center in the Bronx. Backflow preventers were installed incorrectly at the facility and failed to work when a main break occurred in the area;
- In May 2010, complaints from a residence in Queens led to the detection of propanol and other contaminants in drinking water in the area. The City's cross connection inspectors found the source at a nearby vacant hotel with a defective check valve between the fire suppressant and potable water systems; and
- In June 2010, propylene glycol from an air conditioning system contaminated the water supply for a school in Queens, sickening a number of students. A reduced pressure zone backflow preventer installed on the service line to the school prevented contamination of the City's supply.

In all these cases, the City's cross connection control team, along with other NYCDEP staff, responded quickly to determine the nature, extent, and source of the contamination, and to minimize potential exposure of consumers to contaminated water.

Through inspections of potential sources of cross connections and follow-up enforcement to ensure backflow prevention devices are installed where necessary, the Cross Connection Control Program is also an important tool for preventing contamination of the City's water once it reaches the distribution system. During 2010, the City contracted with a consulting firm to perform cross connection control inspections, review plans for new installations, and prepare enforcement notices. While use of this contractor has helped the City address a backlog of inspections of potentially hazardous properties that were identified in 1998, the City is now left with a significant amount of follow-up work to ensure cross connection control is installed where necessary. NYSDOH and EPA feel that this program is a critical additional barrier to protecting the City's unfiltered water supply and encourage the City to provide the resources necessary to address this work load.

Administration

FAD Section 9 – Administration

2007 FAD Requirements

The 2007 FAD requires the City to maintain staffing and funding necessary to support the activities that constitute the City's watershed protection programs. Specifically, the 2007 FAD requires the City: to identify actual filled staff position levels versus available positions for each division and section involved in supporting the watershed protection program, and confirm that resource levels are adequate to ensure that all program goals/FAD requirements are met; and to report annually to the regulators on amount of money spent in the previous year and amount appropriated for the current year and following year for watershed protection programs.

Evaluation of the NYC Water System's Performance

FAD requirements for this program have been met. The City's July 2011 report on budget and staffing identified 1,051 budgeted positions, of which 987 were filled (94%). In general, NYSDOH and EPA believe that the City continues to adequately support its programs.

Education and Outreach

FAD Section 10 - Education and Outreach

2007 FAD Requirements

The purpose of the Education and Outreach Program is to enhance watershed protection through education of, and outreach to, the broad spectrum of watershed stakeholders. The 2006 Long-Term Watershed Protection Program (Section 2.9) and the 2007 FAD (Section 10) contain a number of programmatic goals, including specific educational and outreach efforts. To enhance understanding of and strengthen collaboration in watershed protection efforts, the 2007 FAD specifically requires the City to partner with upstate and downstate communities and local municipal and highway officials, embrace school-based education and training efforts, hold

general outreach events (e.g. fairs, exhibits, etc.) and publish relevant materials. In addition, the 2007 FAD requires the City to prepare and submit to regulators annual reports, summarizing the accomplishments of the Program.

Evaluation of the NYC Water System's Performance

In its *2011 Watershed Protection Program Summary and Assessment* report the City describes the Education and Outreach Program and details specific programmatic achievements. The report shows that the education and outreach efforts embrace a broad spectrum of community education and outreach. The Program is implemented through active collaboration of the City with the stakeholders, which are comprised of both upstate watershed residents and downstate water consumers. In addition, the City works closely with the Catskill Watershed Corporation (CWC), Cornell Cooperative Extension, Soil and Water Conservation Districts and numerous other partners in order to educate constituents and raise public awareness about the necessity of water pollution prevention for public health protection and the need for water conservation and environmental stewardship. Various programmatic components are incorporated into specific 2007 FAD programs and reported through them. They include, but are not limited to, the Watershed Agricultural and Forestry Programs (Sections 4.4 and 4.5, respectively), the Stormwater and Stream Management Programs (Sections 3.5 and 4.6, respectively), and the Riparian Buffer and Wetland Protection Programs (Sections 4.7 and 4.8, respectively). Another important component of the Program includes the school-based education efforts, general community outreach, and partnerships with regulatory and local government officials.

As required by the 2007 FAD, the City submitted annual reports on time and they were of satisfactory quality. In 2009, the City changed its reporting system format to address the primary targeted audiences. These audience categories were streamlined into the following categories: (1) New York City water consumers; (2) watershed residents, landowners, and homeowners; (3) school groups and youth audiences; (4) local government officials, professionals, and business groups; and (5) recreational groups and other public audiences. Those changes in the reporting system drastically improved the quality and clarity of the reports.

NYSDOH and EPA believe that the Education and Outreach Program continues to be successfully implemented and is a valuable component of the City's overall watershed protection program.

Conclusions

Overall, the City has successfully satisfied the obligations specified in the 2007 FAD. For most programs, the City has met deadlines and, at times, even exceeded expectations. NYSDOH and EPA believe that the City has a comprehensive and robust watershed protection program, which, overall, is being effectively implemented by the City and its partners. The City continues to provide drinking water to NYC and upstate consumers that meets all requirements of the Surface Water Treatment Rule (SWTR).