Report on the City of New York's Progress in Implementing the Watershed Protection Program, and Complying with the Filtration Avoidance Determination

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Background and Purpose

In a December 15, 2001 report entitled *New York City's 2001 Watershed Protection Plan Summary, Assessment and Long-term Plan*, the New York City Department of Environmental Protection (DEP) described its proposed plan to protect the watershed and maintain filtration avoidance for the Catskill/Delaware water supply. Following review of this report, the U.S. Environmental Protection Agency (EPA) concluded that New York City's (City) watershed protection plan was adequate and issued a Filtration Avoidance Determination (FAD) in November 2002. The FAD requires the City to implement the watershed protection plan outlined in its December 2001 report and includes certain additional requirements and clarifications. As a result, the City's commitments and obligations are defined by both the City's 2001 report and the FAD.

The 2002 FAD includes a brief explanation of how EPA, working in conjunction with the New York State Department of Health (DOH), will evaluate the City's performance and work towards the next revision of the FAD, expected in April 2007. This report constitutes the evaluation described in the 2002 FAD. In addition to this evaluation document, other key elements of the overall FAD revision process include:

- March 2006 Report by the City, focusing on water quality status and trends
- Outreach to Watershed Stakeholders: EPA, DOH and the New York State Department of Environmental Conservation (DEC) have met with various watershed stakeholders over the past few months to gather input
- Public Information Sessions in May and June of 2006 (Delhi, Belleayre, Mt. Kisco and New York City)
- Frequent meetings during the summer of 2006 to allow for discussion and negotiations among EPA, DOH, DEC and the City on various watershed protection program elements
- December 2006 Watershed Protection Plan from New York City which will define and describe the next round of watershed protection activities

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

The remainder of this evaluation will address the City's progress in implementing major programs under the 2002 FAD as well as certain regulatory compliance requirements.

Summary

The 2002 FAD summarizes the programs, along with milestones and schedules, which the City and its partners are implementing as part of the watershed protection and filtration avoidance efforts. Main elements include:

- Program to monitor/document compliance with filtration avoidance criteria
- Comprehensive environmental infrastructure programs, to reduce pollution from sewage and stormwater
- Various protection and remediation programs, such as land acquisition and Catskill Turbidity Control, to protect and improve water quality
- Regulatory programs to ensure compliance with Watershed Rules & Regulations
- Construction of Catskill/Delaware UV Disinfection Facility
- Waterborne Disease Risk Assessment Program

Overall, the City has successfully satisfied the obligations specified in the 2002 FAD.

For most programs, the City has met deadlines and expectations. Examples include land acquisition, in which the City has exceeded solicitation targets and has successfully protected 71,000 acres, and the small farm program, through which 42 whole farm plans have been developed.

In programs where there have been delays or shortfalls, the City's explanations and justifications have generally been accepted as adequate by EPA. For example, wastewater 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.

Short evaluations of all FAD programs are provided below.

Evaluation of City Performance

I. Surface Water Treatment Rule Objective Criteria Compliance

2002 FAD Requirements

With the promulgation of the Surface Water Treatment Rule (SWTR) and its amendments, EPA established objective criteria pertaining to source water quality, which must be met for filtration avoidance to be allowed. The objective criteria include numeric requirements for turbidity, coliform bacteria, and disinfection byproducts and also include requirements for system operations. Adequate disinfection must also be provided, including the maintenance of redundant disinfection (chlorination) facilities. Under the 2002 FAD the DEP must continue to meet all of the objective criteria in order to maintain its filtration avoidance status for the Catskill and Delaware systems. The 2002 FAD also obligates the DEP to conduct a monitoring program and to report results in accordance with applicable federal regulations.

Evaluation of City Performance

Under the 2002 FAD, the City has satisfied the objective criteria's numeric requirements for source water turbidity and coliform bacteria, and disinfection byproducts in the distribution system, for the Catskill/Delaware system. The City has also satisfied the

system operation and reporting requirements as defined by the SWTR and therefore has maintained its filtration avoidance status for the Catskill/Delaware system.

EPA regulations specify 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.

During 2005, the City briefly exceeded the 5 Nephelometric Turbidity Unit (NTU) source water turbidity limit established by the SWTR. However, the City did not violate the objective criteria because the duration did not extend over a two day period. In June 2005, locally heavy rains (5 inches over a few hours) within Kensico's watershed resulted in runoff from a construction site which adversely affected water quality at DEL 18 (11 NTU compliance sample). In April 2005, high flows resulting from spring snow melt coupled with unusually intense precipitation in the Catskill watershed resulted in elevated turbidity at CATLEFF (5.3 NTU compliance sample, which technically did not exceed the 5 NTU SWTR limit due to round-off). Operational measures (e.g., increased disinfection, aqueduct shutdown) were immediately employed by DEP and effectively dealt with these two occurrences. During the term of the 2002 FAD, there were two additional instances, in December 2002 and March 2006, in which operational changes (e.g., operation of gate valves by the City which disturbed sediments) resulted in elevated turbidity levels in compliance samples. All of the instances noted above can be characterized as short-term spikes in turbidity.

In November 2004, based on review of reports submitted by DEP, EPA raised concerns about the condition of the redundant (back-up) chlorine feed line serving the Catskill water supply. Following additional review and coordination with DEP and DOH, EPA concluded that the City could not reliably meet the redundant disinfection requirement included in the SWTR for the Catskill system. Temporary repairs were made and DEP issued an emergency contract to replace both the primary and redundant chlorine feed lines and to add a third line to the system. Work under the emergency contract was completed in October 2005.

II. Environmental Infrastructure

A. Septic and Sewer Programs

2002 FAD Requirements

EPA requires DEP to identify failing or potentially failing individual residential septic systems and to prioritize their rehabilitation or replacement throughout the watershed. This program is being implemented by the Catskill Watershed Corporation (CWC). The FAD requires the City to execute a contract with CWC that includes sufficient funding levels to address approximately 300 septic systems per year in priority areas and to work

with CWC to continue the hardship component of the program in non-priority areas. Secondly, the City is required to execute a separate contract with program rules to address the operation and maintenance of septic systems. Also integral to the program is the implementation and enforcement of the Rules and Regulations for the Protection from Contamination, Degradation, and Pollution of New York City's Water Supply and its Sources (commonly referred to as the Watershed Rules and Regulations.)

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall program and status. Following issuance of the 2002 FAD, the City successfully executed contract changes with the CWC to continue the program. The City previously committed $13.6 million for 1997-2002 (per the Watershed Memorandum of Agreement) and an additional $15 million was committed for 2002-2007. The City's prioritization plan first targeted septic systems within the 60-day travel time to water supply intakes followed by systems within defined distances to streams (e.g. within 50 feet, 100 feet, 300 feet etc.) and within 500 feet of a reservoir or reservoir stem. Since program inception in 1997, over 2,100 septic systems have been repaired or replaced.

By October 2003, the City also successfully executed a $1.5 million septic system operation and maintenance contract administered by the CWC that funds septic pump-outs at a 50/50 cost share arrangement with homeowners. It is a voluntary program intended to minimize the occurrence of septic system failures through regular maintenance every 3 - 5 years. Program implementation began in 2004 on a pilot program basis through solicitation letters mailed out to homeowners encouraging them to participate. By 2005, the program was revised to include targeted solicitation of homeowners who had completed repairs/replacements through CWC programs in prior years. This relatively new FAD program has yet to reach full potential. Nevertheless, a total of 148 septic systems have been pumped out since program inception.

A study is currently underway which will evaluate the effectiveness of "advanced" or "non-conventional" septic systems in areas where existing conventional systems cannot meet State standards due to location constraints and/or poor soils. This study is being funded by EPA through a grant to the DEC under the Safe Drinking Water Act and is being implemented by the CWC and research partners. Successful demonstration of non-conventional technologies in the watershed could lead to wider implementation of these units to overcome physical constraints that limit the use of conventional technology.

EPA and DOH believe that the Septic System Rehabilitation and Replacement Program has successfully met expectations and continues to be an effective and important part of the City's watershed protection/filtration avoidance program.

B. Sewer Extension Program

2002 FAD Requirements

The purpose of the Sewer Extension Program is to address failing or potentially failing septic systems within the sewer serviceable areas of existing City-owned wastewater treatment plants (WWTPs) in the west-of-Hudson watershed. City-owned WWTPs are located in Grahamsville, Margaretville, Pine Hill, Tannersville and Grand Gorge. The FAD requires that the City obtain signed agreements and schedules including sewer use ordinances with the communities of Hunter, Neversink, Roxbury, Shandaken, and Middletown that wish to have certain septic areas sewered and served by City-owned facilities. This is an optional, voluntary program, and a community may opt-out and pursue alternate solutions to address failing septics (e.g. septic system repair/replacement).

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall program and status. The City committed $10 million through the Watershed Memorandum of Agreement to implement the program, which will provide sewage collection and treatment at City-owned WWTPs to eliminate approximately 315 septic systems with a combined flow of more than 110,000 gallons per day.

Currently four out of the five communities have signed agreements with the City, adopted sewer use ordinances, and have implementation schedules. One community (Shandaken) previously opted-out but has recently expressed renewed interest in participating in the program.

Although this program has experienced significant delays in reaching agreements and finalizing sewer use ordinances, it is expected that construction of the planned sewer extensions will be completed during 2006 and 2007. EPA and DOH strongly support this program, which provides environmental and community benefits, and believe it is an important part of the City's watershed protection/filtration avoidance program.

C. New Infrastructure Program

2002 FAD Requirements

The New Sewage Treatment Infrastructure Program is intended to address septic system problems in small communities within the watershed in close proximity to watershed streams. This program addresses the first seven of the 22 communities listed in the Watershed Memorandum of Agreement (e.g., Hunter, Fleischmanns, Windham, Andes, Roxbury, Phoenicia, and Prattsville). The FAD requires that the City obtain signed service area agreements and schedules including sewer use ordinances and operation and maintenance agreements with the communities to design and construct advanced tertiary WWTPs. This is an optional, voluntary program for the targeted communities.

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall program and status. The City initially committed $75 million for 1997-2002 per the Watershed Memorandum of Agreement to allow block grant awards to communities 1-5 and committed an additional $12.125 million for 2002-2007 for communities 6 & 7. The program funds construction of regional, advanced tertiary WWTPs which will eliminate approximately 2050 failing, or soon to fail, residential and commercial septic systems at a combined flow of 903,000 gallons per day.

Out of the seven communities, two WWTPs (Andes and Roxbury) have been completed; three WWTPs (Hunter, Fleischmanns, and Windham) are under construction nearing completion in 2006; one WWTP (Prattsville) is under construction and is expected to be completed by the end of 2007; and one WWTP (Phoenicia) is in design phase and is expected to be completed in 2008 or later. Completion of these new regional WWTPs will allow for the decommissioning and connection of twelve existing small commercial WWTPs within their service areas.

Although this program has experienced delays in reaching agreements and sewer use ordinances, significant progress has been made over the past two years to complete five of the seven WWTPs within the course of the 2002 FAD. To successfully complete this program, the City should continue to work cooperatively with the communities to ensure that mutually beneficial solutions can be reached. EPA and DOH believe this is an important element of the City's watershed protection/filtration avoidance program.

D. Community Wastewater Management Program

2002 FAD Requirements

The Community Wastewater Management Program enables the implementation of wastewater solutions to address septic system problems in communities on the remainder of the Watershed Memorandum of Agreement list (communities 8-22) that are not being addressed with WWTPs through the New Sewage Treatment Infrastructure Program. The FAD requires the City to execute a contract with CWC, including implementation schedules, to sufficiently fund, through block grant awards, septic maintenance districts and/or community or cluster septic systems for five communities from the list of 8-22. This is an optional, voluntary program for the targeted communities.

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall program and status. The City committed $10 million for 2002-2007 in block grant awards to fund communities 8 -12 (Bloomville, Boiceville, Hamden, Delancy, and Bovina Center). The City successfully executed a contract with program rules and an implementation schedule by early 2003. By mid-2004, the City secured participation of all five communities. Prior to securing participation, Bovina Center and Hamden had already begun work on their wastewater projects through help of alternate funding sources. By August 2004, the City, through CWC, secured the engineering consultant

already retained for the Bovina Center and Hamden projects to work on the other three community projects. During 2005, Bovina Center completed its wastewater project with additional funds provided through CWC. The City completed the study phase of the remaining four communities by December 2005. If these communities elect to continue participation in this program, it is expected that the design phase will occur during 2007 with construction completed during 2008 and 2009.

As a result of a FAD modification in February 2006 to adjust the schedule for construction of the Catskill/Delaware Ultraviolet light disinfection facility, the City is required to add an additional $6 million to the program to fund a sixth community wastewater project (Ashland) and provide additional funding to Boiceville should the town elect to pursue a regional WWTP.

We note that some delay has occurred in completing the study phase for the Bloomville, Boiceville, Hamden, and Delancy projects. Additionally, based on the information provided in the studies, the design phase followed by construction for these facilities will take about two years longer than the 2002 FAD construction completion date of 11/30/06. Also, preliminary cost estimates obtained during the study phase indicate significant funding shortfalls exist to complete wastewater projects as intended.

Following the study phase, EPA, DOH, and DEC participated in an enhanced oversight initiative with the City to evaluate the adequacy of the projects to address the septic system problems within the communities. The City has agreed to entertain the recommendations made by the review group.

EPA and DOH support continued, steady progress in this program, which is an important element of the City's watershed protection/filtration avoidance program.

E. WWTP Upgrade Program

2002 FAD Requirements

The FAD requires the City to finance the upgrade and operation & maintenance costs of all existing municipal and small private/commercial surface-discharging WWTPs. The upgrades include advanced tertiary treatment consisting of microfiltration, or an approved equivalent technology, and phosphorus removal in accordance with the City's Watershed Rules and Regulations. There are a total of 42 surface-discharging WWTPs constituting a total combined permitted flow of approximately 5.5 million gallons per day (mgd) in the west-of-Hudson (WOH) watershed. The 2002 FAD contains facility-specific schedules for the functional completion of 37 WWTPs WOH (3.2 mgd, or 60%, of the total combined permitted flow) currently enrolled in the program. The other five WWTPs are City-owned municipal facilities (2.3 mgd, or 40%, of the total combined permitted flow) that completed their upgrades in 1997 under a previous FAD. The 2002 FAD references nine additional WWTPs in the Cross River and Croton Falls reservoir basins to be upgraded as part of the enhanced oversight of east-of-Hudson (EOH) watershed programs in these basins.

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall program and status. The City initially committed $75 million for the upgrades to the City-owned WWTPs and has continued investments upwards of $500 million to the program as a whole to complete all the upgrades.

In the WOH watershed, following completion of the City-owned WWTP upgrades (40% of the total 5.5 mgd permitted flow) in 1997, the City completed the largest non-City owned municipal WWTP upgrades (50% of the 5.5 mgd total) by May 2002. Of the remaining small non-City owned private and commercial facilities (10% of the 5.5 mgd total), 7% are receiving upgraded treatment under the 2002 FAD. The remaining 3% are expected to be upgraded or decommissioned and connected to larger municipal WWTPs currently being constructed under the New Sewage Treatment Infrastructure Program discussed above. As per the 2002 FAD, the City installed enhanced interim treatment (UV disinfection) at facilities being decommissioned and connected to the new regional WWTPs**.**

The 2002 FAD references nine additional WWTPs in the Cross River and Croton Falls reservoir basins totaling 1.34 mgd permitted flow to be upgraded as part of the enhanced programs in the EOH watershed. Of the nine WWTPs located in the Croton Falls and Cross River basins, one WWTP (Carmel SD#2), representing 1.10 mgd or 82% of the total permitted flow, is under construction. The other eight facilities are in the planning/design stages for upgrades or will be decommissioned and connected to a regional municipal WWTP**.**

As a result of these upgrades, there have been reductions in pathogen and phosphorus loadings to watershed streams. It is believed that these reductions contributed to the Cannonsville Reservoir being removed from the phosphorus-restricted basin status it was in prior to the upgrades being completed. The operation of the microfiltration or approved equivalent technology has proven to virtually eliminate the threat of discharges of human based *Giardia* and *Cryptosporidium* cysts/oocysts from these WWTPs.

EPA and DOH believe that the WWTP upgrade program has proven to be a worthwhile investment in protecting water quality and is an important part of the City's overall watershed protection program for the Catskill/Delaware water supply.

F. Stormwater Programs

2002 FAD Requirements

The City is required to report on the implementation of its stormwater programs established as a result of the Watershed Memorandum of Agreement. The program is made up of three sub-programs all administered through the CWC. The Stormwater Retrofit Program, administered jointly by CWC and DEP, funds stormwater best management practices for existing sites throughout the WOH watershed. The Future Stormwater Controls Program, administered by CWC, funds the incremental costs of

stormwater measures required solely by the City's Watershed Rules and Regulations which are over and above federal and state requirements. The Local Technical Assistance Program, which is administered jointly between CWC and DEP, provides grants to communities to help with eligible projects that support watershed protection, improve water quality and enhance quality of life for watershed communities.

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall program and status. The City has committed $13.9 million to CWC for the Stormwater Retrofit Program to cover capital expenditures, maintenance costs, and community-wide planning & assessment activities. Projects are prioritized with highest priority given to communities with ongoing projects in the New Sewage Treatment Infrastructure and Community Wastewater Management Programs. Of the $13.9 million, approximately $4.6 million has been expended on 46 construction projects, eleven planning & assessment projects, and one operation and maintenance project since program inception.

The City has committed a total of $31.7 million to the Future Stormwater Controls Program created under the Watershed Memorandum of Agreement. The CWC reimburses applicants for the design and construction costs exceeding what is required by state and federal stormwater standards. CWC reimburses 50% of eligible costs for small businesses (fewer than 100 employees) and 100% of eligible costs for low-income housing projects and single family homeowners, large businesses, municipalities and institutions. Operation and maintenance costs are also covered under contracts with project owners. As of December 31, 2005, CWC reported that approximately $2.36 million had been expended to address 39 commercial, municipal and school projects. Under CWC contract rules, funds from the program can be reallocated to certain other programs. To date, CWC has expended approximately $7.9 million to cover septic system repair in financial hardship cases, sewer lateral connections in the Community Wastewater Management Program, and to establish a new Stream Corridor Program. CWC's ability to reallocate these funds has proven to be a useful tool to address newly identified needs. CWC contract rules also provide for financial assistance to communities with emergency stormwater repairs as they arise.

The City has committed $1.25 million to CWC for the Local Technical Assistance Program to fund certain eligible projects that support watershed protection and enhance the quality of life in watershed communities. CWC received eight grant applications in the first call for proposals in 2006.

EPA and DOH believe that the Stormwater Program has been an effective and important part of the City's watershed protection program.

III. Protection and Remediation Programs

A. Waterfowl Management Program

2002 FAD Requirements

The Waterfowl Management Program was created to minimize the fecal coliform loading to the Kensico Reservoir resulting from roosting birds during the migratory season. This program consists of three activities: avian population monitoring, avian deterrence activities (motorboats, air boats, and pyrotechnics) and avian harassment (depredation of nests and eggs). The program is conducted under permits from the United States Department of the Interior and DEC. The 2002 FAD requires the City to implement this program for the Kensico Reservoir on a full time basis, consistent with the City's 2001 Long-Term Watershed Protection Program. The 2002 FAD also requires the City to expand, on an "as needed" basis, its Waterfowl Management Program to include five additional reservoirs. Three of these five reservoirs (West Branch, Rondout and Ashokan) routinely serve Kensico with its source water. Two of these reservoirs (Cross River and Croton Falls) may serve Kensico with source water under special circumstances. The specific criteria for utilizing waterfowl management measures on an as needed basis can be found in the 2002 FAD section 4.1.

Evaluation of City Performance

The Waterfowl Management Program has been successfully implemented by the City. Avian population monitoring has shown that low waterfowl counts on the Kensico Reservoir are directly attributed to the City's utilization of seasonal avian deterrence and harassment activities. Additionally, the City has demonstrated that bacteria levels in the Kensico as well as several other NYC reservoirs (West Branch, Rondout, Ashoken, Cross River and Croton Falls) are proportional to the population of waterfowl on these reservoirs and track closely with waterfowl migratory habits. Based on this evidence, EPA has concluded that the Waterfowl Management Program has played a significant role in keeping fecal coliform bacteria counts at the Kensico Reservoir's two main water intakes (DEL18 and CATLEFF) within the regulatory requirements established by EPA's Safe Drinking Water Act.

B. Land Acquisition

2002 FAD Requirements

The FAD requires the City to implement its land acquisition program, which is described in the Watershed Memorandum of Agreement, in order to protect environmentally sensitive lands and prevent future degradation. This is a $300 million program, which involves solicitation targets in priority areas, and is structured on a willing buyer/willing seller basis. The program includes purchase of lands as well as purchase of conservation easements and farm easements. Municipalities may exclude certain lands (generally within defined hamlets and villages and near defined road corridors) from purchase under the program to provide reasonable opportunities for growth.

Evaluation of City Performance

The City has met the specified solicitation and resolicitation targets and has actively implemented this program. In conjunction with the Watershed Agricultural Council (WAC), which implements the farm easement program, this program has protected more than 71,000 acres of Catskill/Delaware watershed lands at a cost of $174 million.

$50 million of the $300 million available for this program is considered supplemental funds. Following consultations with EPA and the State, the City is making $27 million of supplemental funds available to the WAC to allow continuation of the farm easement program ($7 million directed to the program in 2004, and an additional $20 million in 2006.) $23 million of supplemental funds remain available.

The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall program and documents program achievements in the major Catskill/Delaware basins. The Report summarizes the percentage of basin lands previously owned by the City; protected by other entities (mostly the State); and protected by the land acquisition program between 1997 and 2005. Overall, about 30% of the Catskill/Delaware watershed lands are controlled by the City, State, or other conservation entities. The Ashokan basin has the highest percentage of protected lands (63%), while the Cannonsville basin has the lowest (14%).

EPA and DOH believe that the land acquisition program has successfully met expectations and that it remains an effective and important element of the City's watershed protection program. Additional discussion about the size and scope of this program is expected over the next few months as negotiations on the 2007 FAD revision continue.

C. Watershed Agricultural Program

2002 FAD Requirements

The overall objective of the Watershed Agricultural Program (WAP) is to prevent pollution and improve water quality by reducing pollutants leaving the farm through the implementation of best management practices (BMPs). The program is a voluntary partnership, between the City and farmers in the watershed, resulting in the development and implementation of a Whole Farm Plan (WFP) for each farm enrolled in the program. Whole Farm Planning is a holistic approach to farm management used to identify and prioritize environmental issues on a farm without compromising the farm business. WFPs manage nonpoint sources of agricultural pollution, with particular emphasis on the reduction of waterborne pathogens, nutrients, and sediments. This program is implemented by the WAC, a local non-profit organization, using City funds.

The 2002 FAD requires the City to continue to develop, and update WFPs, as well as, implement BMPs recommended in those WFPs, on farms enrolled in the program. In addition the FAD states that the City will develop and submit a WOH Small Farms Program Plan (small farm is defined as an annual income from farm products less than

$10,000), implement the Croton Agricultural Program in accordance with the Croton Agricultural Program Plan, review the current WAP evaluation criteria with the Program Advisory Committee, continue the recruitment of large farms into the WAP, and complete various reporting and program planning requirements.

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* report describes the Agricultural program and details specific program achievements. As of March 2006, there were 290 (including 41 sub-farms) commercial farms signed up for the large farm program out of a possible 303 farms. This represents 95.4% of large farms located in the NYC Watershed. The continuous FAD goal is to have 85% of large farms in the watershed signed up for the program. All but two of these farms have WFP agreements in place.

The goal for 2005 was to have all participating (or 288) farms with commenced implementation. As of March 2006, the number of farms with WFPs that have commenced implementation of their plans is 276 farms (plus there are 7 farms that went out of business before any implementation occurred). The December 2005 FAD goal for farms substantially implemented is 257 and as of March 2006 there are 215 farms substantially implemented.

The implementation of the WOH small farm program has been successful. 224 farmers completed Tier I surveys submitted to WAC and the Small Farm Team has completed Tier II Environmental Reviews on 141 small farm operations. In addition, 42 whole farm plans have been approved covering more than 6,000 acres. To date over 345 BMPs have been implemented on 31 small farms and eleven of these farms have had all pollution issues addressed. The small farm program has a goal of developing ten new whole farm plans per year with farm selection based upon those farms with the greatest water quality concerns.

The EOH agricultural program has been 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. As of March 2006, 29 Whole Farm Plans were approved and 21 of those farms had commenced implementation of their WFP.

EPA and DOH 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. Although the numeric FAD goals for certain categories have not been met, WAC has been able to maintain a good rate of BMP implementation and has maintained steady progress towards meeting the FAD milestones. As the program continues to move forward and additional farms move into the substantially implemented category, EPA and DOH think it is important for the agricultural program to continue annual follow-up visits for those farms.

D. Watershed Forestry Program

2002 FAD Requirements

The Watershed Forestry Program supports and maintains well-managed forests as a beneficial land cover for watershed protection. The Program is a voluntary partnership between the City and the watershed forestry community. Representatives of the watershed forestry community helped develop the program based on the model of the Watershed Agricultural Program and since September 1997 the Forestry Program has been administered locally by the WAC. 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. DEP 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.

The 2002 FAD requires the City 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 administered by New York Logger Training; 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 four Model Forests; 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. DEP also has various reporting and program planning requirements for the forestry program.

Evaluation of City Performance

Following issuance of the 2002 FAD, the NYC Watershed Forestry Program has grown both in scope and staff people. As of March 2006 WAC conducted nineteen forester training workshops which were attended by more than 200 participants. These workshops resulted in 43 foresters that are trained to write WAC forest management plans EOH and WOH. More than 529 landowners, covering more than 94,100 watershed acres, have completed WAC forest management plans, with 28 of these landowners, covering 2,580 total acres, located EOH. There are also 66 riparian buffer plans covering 2,841 riparian acres located EOH. DEP 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 response to WAC forestry plan evaluations, the Watershed Forestry Program initiated a two-year pilot project in 2005 called the Management Assistance Program. 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 DEP plan to evaluate this pilot program during 2006-2007.

Model forests have been established in two locations WOH. The Lennox Memorial Forest was opened in 2001, and contains 167 forest inventory plots covering 80 acres. The Frost Valley Model Forest was opened in 2003, and contains 620 forest inventory plots covering 290 acres. Both model forests contain various forest management practices, including deer exclosure units, informational kiosks and numerous interpretive signs. The City's 2001 long term plan states that the forestry program will continue to coordinate four model forest sites throughout the watershed. The two other intended model forests, Mink Hollow Forest WOH (DEP owned) and Nimham Forest EOH (DEC owned), have been placed on hold. EPA and DOH think it is important to expeditiously pursue the establishment of a model forest EOH so the EOH community has a model forest available to serve their forest demonstration and education needs.

The City's *2006 Watershed Protection Program Summary and Assessment* report describes the forestry program and details additional specific program achievements. Overall, EPA and DOH believe that the forestry program has successfully met expectations and that it remains an effective and important element of the City's watershed protection program.

E. Stream Management Program

2002 FAD Requirements

The Stream Management Program as defined by the 2002 FAD is a multi-faceted program with three overarching objectives: (1) increase stability and ecological integrity of stream corridors through the development and implementation of stream management plans; (2) reduce streambank erosion and turbidity through the implementation of stream restoration demonstration projects; and (3) enhancement of a long-term stream stewardship ethic through increased community participation resulting from the establishment of partnerships, education and training.

With these objectives in mind, the 2002 FAD requires the preparation of nine stream management plans and the construction of twelve stream restoration demonstration projects. EPA intended that these demonstration projects would, in addition to reducing streambank erosion and its associated turbidity, form the nucleus of an ongoing educational and outreach program. A successful education, training and outreach program would build within the watershed community an informed constituency responsible for long-term stream stewardship and proper stream management.

Evaluation of City Performance

The City, working with its Stream Management Program partners, has met all 2002 FAD requirements with respect to the preparation of the stream management plans. To date stream management plans for the Batavia Kill, Broadstreet Hollow, Chestnut Creek, Stony Clove, the West Kill and the West Branch of the Delaware River have been

completed. Preparations of the remaining three plans (Esopus Creek, East Branch of the Delaware River, and the Schoharie Creek) are on schedule. By the end of the 2002 FAD, approximately 65% (657 square miles) of the watersheds west-of-Hudson will have plans.

With respect to the stream restoration demonstration projects, the City is using natural channel design, through the utilization of fluvial geomorphic principles, for stream channel restoration and stream bank stabilization. The primary goals of these projects include education, protection from water quality degradation, infrastructure and property restoration, and habitat enhancement through preservation of the ecological integrity of the stream corridors. Of the twelve projects required by the 2002 FAD, six have been constructed (Chestnut Creek, Stony Clove, Big Hollow, Post Farm, Shoemaker Road, and Woodland Valley), at a cost of approximately $2.7 million. The remaining six restoration projects include the Ashland Connector, Conine property, Red Falls, West Kill reach 2, and undetermined locations for the Schoharie Creek and East Branch of the Delaware River. The Ashland Connector project has been designed and is scheduled for completion in 2006. Unfortunately, due to complexities in design and construction and unanticipated severe storm events, the completion of the remaining five projects within the term of the 2002 FAD will not occur. EPA, in conjunction with State partners (DOH/DEC), are currently engaged in discussion with the City concerning the future of all remaining demonstration projects. EPA and DOH believe that schedule extensions are justified.

A watershed specific education and outreach program targeted for watershed stakeholders (state and local highway departments, riparian landowners, state and municipal officials/planners, contractors, academic institutions and special interest groups) has been successfully implemented by the City and its partner the Greene County Soil & Water and Conservation District (GCSWCD). Numerous workshops were held, and site tours to stream restoration demonstration sites were conducted. Fourteen unique educational publications were also developed and distributed to various stakeholders. A website documenting its stream restoration projects was developed by GCSWCD and provides technical information to those engaged in watershed research activities.

In summary, the Stream Management Program has advanced, with the timely development of stream management plans and the completion of some (but not all) of the stream restoration projects included in the 2002 FAD. Continued progress on plan development and restoration projects is expected. With regard to the implementation of recommendations included in the stream management plans, the 2007 FAD is expected to establish a framework for future actions. Discussions are also underway about potential new initiatives to further protect stream corridors and riparian buffers.

F. Wetlands Protection Program

2002 FAD Requirements

Wetlands are an important part of the natural features of the New York City watershed and are in part responsible for maintaining the high quality of surface waters in the water supply system.

In 2001, DEP modified its existing Wetlands Protection Program and revised its Wetlands Protection Strategy. The 2002 FAD requires the City to implement and report out on its updated Wetlands Protection Strategy which includes protecting wetlands through existing regulatory and non-regulatory programs, including Land Acquisition, the Stream Management Program, the Agricultural and Forestry Programs, protecting wetlands through enforcement of federal, State and municipal wetlands regulations, and continuing research efforts to better understand the roles wetlands play in protecting water quality. Other tasks required in the 2002 FAD include Wetland Characterization and Preliminary Assessment of Wetland Functions methodology, Wetland Mapping and Trend Analysis Projects,

Evaluation of City Performance

DEP's wetland strategy takes an interdisciplinary approach and is supported by extensive wetland mapping and research combined with regulatory and non-regulatory protection programs. DEP also reviews wetland permits at the federal, State, and municipal levels to ensure enforcement of existing regulations.

The City's *2006 Watershed Protection Program Summary and Assessment* report describes the Wetland program and details specific program achievements. In summary, the National Wetlands Inventory (NWI) was updated in 2005 for the entire watershed and provided the basis for an assessment of wetland trends and a watershed-scale wetland functional assessment. On the regulatory side, the effectiveness of the program was enhanced by increased intra- and inter-agency coordination, as well as, by the wetland mapping and research program.

While not specifically related to the 2002 FAD, it is worth noting that in April 2006 DEC amended original wetland maps in Putnam and Dutchess Counties. This effort resulted in the addition of 4150 regulated acres of wetlands in Putnam County and 1300 regulated acres of wetlands in Dutchess County. DEC wetland maps are amended for a number of reasons: wetlands are a changing natural resource and their boundaries vary over time; improved technology has given DEC the ability to detect wetlands that were originally missed when DEC did most of the wetlands mapping in the 1980s; the science of wetlands has matured in the past twenty years; and, amendments might occur when technical corrections to the maps are needed.

EPA and DOH believe that the DEP wetlands program has successfully met expectations set in the 2002 FAD. It remains an effective and important element of the City's watershed protection program.

G. East of Hudson Non-Point Source Pollution Control Program

2002 FAD Requirements

The City's East of Hudson Non-Point Source Control Program is comprised of various elements, including a septic system program, sanitary and storm sewer mapping, storm water infrastructure remediation program, spill containment program, hazardous materials audit program, and turf management. In addition, planning efforts by the City (Croton Watershed Strategy) and the two Counties (Westchester and Putnam Croton Plans) are referenced in the FAD.

Evaluation of City Performance

In accordance with the FAD, the City developed a Non-Point Source Management Plan and has begun implementation. Focus of this program is the Catskill/Delaware basins (Boyds Corner, West Branch, Cross River, Croton Falls.) While there have been some delays, many elements are being implemented. Highlights include: 1) Development and initial implementation (in 2006) of a septic system repair/replacement program by Putnam County, beginning in priority areas; 2) completion of three large remediation projects (Washington Road drainage improvements, Pennebrook Lane basin, Meadowbrook Drive basin); 3) selection and design for five additional remediation projects to reduce erosion; 4) completion of about ten small remediation per year since 2003 to address erosion concerns; 5) sanitary and storm sewer mapping to ensure integrity and identify illicit connections; 6) hazardous materials audit which evaluated conditions at 64 sites. While there have been some significant delays, EPA and DOH believe that there have been important accomplishments and we anticipate continued progress.

With regard to the County Croton Plans, progress has been slow. Completion of the two plans was meant to provide a blueprint for action, but the City and the Counties have not successfully completed the reports. With the recent development by DEC of the heightened requirements for municipal entities subject to the Phase 2 storm water permit, the City and the Counties may want to evaluate options that would use the Croton Plans to help guide decisions on necessary water quality improvement projects.

H. Kensico Water Quality Control Program

2002 FAD Requirements

Recognizing the importance that the Kensico Reservoir plays in the City's ability to maintain its filtration avoidance for the Catskill and Delaware systems, the 2002 FAD required that the City continue this multi-faceted program to protect the watershed and improve the water quality of this important reservoir. Specifically the FAD requires that DEP implement its Kensico Water Quality Control Program described in the City's 2001 Long-Term Watershed Protection Program. This program is designed to target fecal coliform bacteria, turbidity, pathogens and toxic chemicals. A key requirement of this program includes a long term commitment by the DEP to continue the elements of its Kensico Management Plan established prior to the 1997 FAD. The major programmatic

elements include installation and maintenance of the structural stormwater BMPs that surround the reservoir, repair and maintenance of the turbidity curtain at Malcolm Brook, installation of spill containment facilities along Interstate 684, Nanny Hagen Road and Routes 120 and 22, implementation of an enhanced spill containment plan for Kensico, completion of basin wide mapping of sanitary and stormwater infrastructure including recommendations for further action, completion of the house-to-house septic system survey, and evaluation of the need for future dredging near Delaware Shaft 18 and the Catskill Upper Effluent Chamber in accordance with the dredging criteria developed in 2002.

Evaluation of City Performance

The City's Kensico Water Quality Control Program has been successfully implemented and has contributed to the City's compliance with the requirements of EPA's Surface Water Treatment Rule relative to turbidity and fecal coliform bacteria.

All stormwater BMPs (45) have been completed. Together they have been effective in reducing the fecal coliform and turbidity loading to the Kensico. The DEP has established a three year stormwater BMP maintenance contract with a private contractor to ensure that these facilities continue to receive the necessary maintenance which includes the removal of accumulated sediment and debris. The turbidity curtain continues to function as designed, effectively diverting the discharges from Malcolm Brook and Young's Brook away from the Kensico's intakes (CATLEFF, DEL18). The City has completed inspections of the turbidity curtain; has completed repairs when necessary; and has extended the curtain by 400 feet to its current length of 1200 feet.

DEP has completed the installation of spill containment facilities at the 26 storm drains servicing Interstate 684, Routes 120 and 22. Around the Kensico Reservoir, thirteen additional spill containment facilities, which comprise the enhancements to the spill containment program, were also installed. Although no spills were reported the booms continue to function properly by trapping floatables. The installation of these booms will ensure that spills are contained so that they can be recovered thereby minimizing water quality impact.

Basin wide mapping and video inspection of the sanitary and stormwater infrastructure in Mount Pleasant was completed. No major structural deficiencies or illegal connections were uncovered. The program will continue throughout the remainder of the FAD and will move to the Towns of Harrison and North Castle.

In 1999, accumulated sediment was successfully removed from the intake channels of CATLEFF and DEL18. An evaluation of the need for future dredging at the Kensico intakes as well as the mouths of the perennial streams (Malcolm Brook, Young's Brook) will be made by DEP in accordance with the criteria developed in 2002. This evaluation which relies primarily upon underwater investigations that determine the type and depth of sediment will be performed in 2006.

I. Catskill Turbidity Control.

2002 FAD Requirements

DEP is required to implement a Catskill Turbidity Control Program in accordance with its December 2001, Long-Term Watershed Protection Program. A key element of that plan calls for a Catskill Turbidity Control Study which will assess all engineering, operational and structural alternatives that may be used at the Schoharie Reservoir to reduce turbidity levels entering Esopus Creek. The FAD also establishes additional milestones as well as specific reporting requirements. Specifically, these milestones include a two phased approach to the Catskill Turbidity Control Study. Phase 1 required a preliminary screening of all turbidity reduction measures. The surviving Phase 1 alternatives would form the core of the Phase 2 analysis. Phase 2 requirements included incorporation of a fully calibrated and verified reservoir model and preliminary design and detailed cost information necessary for final decision-making purposes. The FAD also requires dredging of the Schoharie Reservoir's intake channel and the addition of three stream restoration projects to the Stream Management Program (two in the Schoharie Reservoir basin and one restoration project in either the Schoharie or Ashokan reservoir basin.)

Evaluation of City Performance

Due to the underlying geology of the Catskill watershed, its streams and reservoirs are prone to high levels of turbidity. High flows, usually associated with extreme precipitation events, can often scour stream beds and destabilize stream banks exposing fine glacial clay deposits resulting in extremely high levels of turbidity. The fine particles produced by the glacial clays are typically responsible for prolonged turbidity events in the Catskill system. The City engineers designed the Catskill system to handle turbidity by providing for settling within the Schoharie, Ashokan West Basin, Ashokan East Basin and the Kensico reservoirs. Under normal circumstances the extended detention times offered by these reservoirs would satisfactorily remove the turbidity. Recently however, turbidities resulting from extreme weather events have overwhelmed the capacity for these reservoirs to effectively remove it. Currently, EPA considers these types of turbidity events as the greatest threat to filtration avoidance.

During 2005 three significant storm events over the Catskills resulted in major turbidity increases to the Ashokan Reservoir and exceeded the reservoir's capacity to remove them. By transport through the Catskill aqueduct the highly turbid water stored within the Ashokan Reservoir was transferred to the Kensico Reservoir and eventually threatened the City's ability to maintain the SWTR's 5 NTU turbidity limit at CATLEFF and DEL18. DEP ultimately found it necessary to treat the Catskill system's water with alum in order to maintain compliance with the regulatory limit. During these events, DEP successfully used two dimensional water quality models to predict the movement of the turbidity plume through the Kensico Reservoir and estimate its impact on the turbidity levels at CATLEFF and DEL18. These model simulations proved to be a valuable decision making tool, helping DEP make decisions regarding reservoir operations and define the appropriate duration for alum treatment.

At the writing of this report, heavy rain over the Catskills has again resulted in another sustained turbidity event within the Ashokan Reservoir. On June 28, 2006, DEP asked for and was granted emergency authorization by DOH and DEC to use alum at Kensico in the treatment of turbidity for the Catskill system.

In accordance with the FAD, the final Phase 1 Catskill Turbidity Control Study was submitted and approved by EPA. Six turbidity reduction alternatives were evaluated. The Phase 2 analysis due September 2006 is on schedule. Under the FAD the final turbidity reduction alternative(s) proposed by the City will be subject to EPA and DOH approval. EPA anticipates that the 2007 FAD will incorporate project implementation requirements, including a construction schedule with interim milestones as appropriate.

The FAD requirement to complete dredging of the Schoharie Reservoir's intake channel by December 2005 was not satisfied. Although the detailed plans were completed, the dredging activities were placed on hold necessitated by the emergency repairs to the Gilboa Dam. DEP plans to resume this task once the emergency repairs to the dam are completed.

IV. Watershed Monitoring, Modeling and GIS

A. Watershed Monitoring Program

2002 FAD Requirements

The FAD explains that DEP conducts extensive monitoring throughout the watershed and requires that the City develop an updated plan. The FAD also requires annual water quality indicator reports; annual research objectives report; annual pathogens report; and a comprehensive water quality/program evaluation report every five years.

Evaluation of City Performance

The City has provided all required reports, and more generally, continues to implement a comprehensive monitoring program.

The City finalized its Integrated Monitoring Report in October 2003. This report describes the City's hydrology, limnology and pathogens monitoring programs which support trend analysis, modeling efforts and reservoir operations.

Pathogens reports are provided annually which summarize results at keypoints (Kensico Reservoir intakes) as well as in the west-of-Hudson reservoirs.

An annual research objectives report is provided which focuses on studies of pollutant fate and transport and includes other important studies that address watershed protection.

The City also submits a monthly compliance report which focuses on EPA's regulatory requirements for filtration avoidance, such as turbidity and coliform bacteria levels in source water, and disinfection.

In March 2006, the City provided the *2006 Watershed Protection Summary and Assessment.* This report summarized ongoing watershed protection programs and focused on the water quality status and trends in the City's reservoirs, based on data through 2004. Reductions in phosphorus levels are documented in both the Catskill and Delaware systems, and some coliform reductions were identified in the Catskill system. Water quality in Kensico Reservoir was little changed. In general, this report documents the continuing good quality of the City's water supply. However, it must be noted that storm-induced turbidity events in 2005 and 2006 are not included in the study period of the report.

B. Multi-Tiered Water Quality Modeling Program

2002 FAD Requirements

DEP developed a Multi-Tiered Water Quality Modeling Program consisting of integrated reservoir and terrestrial models. Terrestrial models simulate water and nutrient loadings from the land area draining into the reservoirs, and apply relevant site conditions such as weather, watershed soils and topography, land use and watershed management. Reservoir models simulate in-lake water levels and flows, vertical temperature ranges, and nutrient and chlorophyll levels as a function of weather, reservoir depth, and nutrient loadings. These models are used to support long-term watershed management and short-term operational strategies.

The 2002 FAD requires that DEP implement the Multi-Tiered Water Quality Modeling Program in accordance with its December 2001, Long-Term Watershed Protection Program. Some of these tasks include continuing and expanding data acquisition to support model development, testing, and applications, continuing appropriate calibrations and verifications, enhancing and refining terrestrial and reservoir eutrophication models and model linkages, and continuing ongoing modeling research for pathogens and other particles. In addition, the City is required to implement specific TMDL-related modeling activities, as well as, report out on progress of milestones.

Evaluation of City Performance

Linking the reservoir and terrestrial models provides a powerful tool for simulating the effects of weather, land use, watershed management, and reservoir operations on water quality in the City's 19 reservoirs. DEP has continued to develop a eutrophication model, using the Generalized Watershed Loading Function (GWLF) watershed-loading model and a reservoir receiving water model. With this modeling program, DEP can evaluate the effects of land use, non-point source management practices and point source discharges. Recent model improvements include incorporation of additional Geographic Information System (GIS) data, improved runoff predictions based on soil wetness, and improved sediment re-suspension modeling which addresses reservoir nutrients and phytoplankton growth. Overall, the modeling program provides the City with important predictive tools and helps the City understand how certain programs affect water quality.

The City's *2006 Watershed Protection Program Summary and Assessment* includes a detailed description of the DEP's use of models to evaluate the effects of watershed protection programs on the Cannnonsville and Pepacton Reservoirs between 1990 and 2004. When compared to baseline conditions, reductions in phosphorus loadings and levels of chlorophyll *a* are attributed to land use changes (less intense farming and reduced numbers of animals), WWTP upgrades, application of agricultural BMPs, and septic system rehabilitation. Limited use of urban storm water BMPs correspond to insignificant reductions from these practices. Overall, the modeling demonstrates that both reservoirs have benefited from application of watershed protection programs, with Cannonsville exhibiting greater improvement.

Recently, model simulations were a valuable source of information that helped DEP make decisions regarding reservoir operations. During major storm events that led to elevated turbidity in Catskill system reservoirs, simulation models were used to predict the future turbidity at the Kensico Reservoir effluent chambers. Turbidity predictions were successfully made for different flows and for different conditions of reservoir thermal structure. This information helped justify the need for alum, as well as, to define the period over which alum treatment was required. In addition, as detailed in the December 2004 Catskill Turbidity Control Study Phase I Final Report, the City's modeling program continues to support turbidity control studies for the Catskill system.

EPA and DOH believe that the modeling program has met expectations to date. Continued work on the calibration and verification of the GWLF model and expansion of the Nutrient Management Eutrophication component for the Neversink, Rondout and Schoharie basins, scheduled for completion in 2007, will further enhance the City's overall watershed protection program.

C. Geographic Information System

2002 FAD Requirements

DEP's upstate GIS is designed for natural resource management applications of GIS and remote sensing, in particular, watershed management. The GIS program acquires, updates, or develops new GIS data, performs GIS analysis and research, and produces maps and statistical reports. The GIS is used to manipulate spatial data and create databases in support of existing program objectives and future evaluation of watershed protection programs. The GIS is also used to support terrestrial and reservoir modeling of water quantity and quality in the watersheds.

The 2002 FAD requires that DEP continue to upgrade and utilize its GIS capabilities and fully implement the GIS component of its 2001 Long-Term Watershed Protection Program.

Evaluation of City Performance

The upstate GIS is used throughout the DEP Bureau of Water Supply (BWS) for mapping, spatial analysis, data development, visualization and analysis of remotely

sensed imagery, and water quality modeling. These activities support numerous watershed management applications described in annual and semi-annual reports to EPA.

The DEP GIS system has grown and has experienced expanded use since the signing of the 2002 FAD. In the past four years, several DEP Divisions began using GIS applications for diverse program activities; significant hardware and software upgrades occurred; the system transitioned to an object-oriented data model; an automated library replication from a central server to distant sites was implemented; full-time, in-house contractual support were retained; an increased number of better-trained users accessed the system; and additional data was acquired and effectively managed and disseminated on a continuous basis.

The City's *2006 Watershed Protection Program Summary and Assessment* report describes the overall GIS program and details specific program achievements. In summary, thousands of GIS hardcopy and digital map products were used to plan, implement, track, and review FAD programs. Among others, these programs included: land acquisition, land management, watershed agricultural, and stream management programs; watershed management, wildlife, and wetland studies; water quality monitoring and impact assessment; terrestrial and reservoir modeling; stormwater and sewer infrastructure inspection and remediation; State Environmental Quality Review Act (SEQRA) review; project locations; project site constraints; and stormwater management and erosion abatement. The GIS was also used extensively for emergency planning, watershed communications, and security.

EPA and DOH believe that the GIS program has successfully met expectations and that it remains an effective and important element of the City's watershed protection program.

V. Regulatory Programs

A. Watershed Rules and Regulations and Other Enforcement/Project Review

2002 FAD Requirements

The 2002 FAD requires the DEP, with the assistance of the DOH and DEC, to administer its Watershed Rules and Regulations (WR&Rs) which were revised and adopted in January 1997 as a result of the New York City Watershed Memorandum of Agreement. The FAD contains several commitments with regard to enforcement and project review intended to increase the effectiveness of the City's implementation of the WR&Rs. These commitments include the prohibition of new galleys to be used as subsurface sewage treatment systems in the NYC watershed, improved internal/external guidance procedures for review/approval of stormwater pollution prevention plans (SPPPs) and earlier DEP involvement in SEQRA reviews. Other commitments include impervious surfaces mapping in east-of-Hudson Catskill/Delaware basins (including Cross River and Croton Falls), a new stormwater enforcement coordination committee pilot program, and revisions to the City's subsurface sewage treatment system guidance, in consultation with DOH, to include recommendations made in the Septic System Siting study. The City is

also required to report on any enacted or proposed modifications to the WR&Rs as they occur.

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall administration of the WR&Rs, enforcement and project review status. The City's WR&Rs have effectively provided DEP with the regulatory authority to control activities that occur in the NYC Watershed which have potential to degrade the water supply. Generally, the WR&Rs limit and control sewage collection and treatment, stormwater discharges, impervious surfaces, and erosion and sediment practices of proposed projects. DEP's efforts focus on three main areas: regulatory review and approval of projects; regulatory compliance and inspection; and environmental enforcement.

In June 2002, the City banned the use of galley systems in the NYC watershed. This ban was later adopted by the DOH and was incorporated into the State's septic system regulations. Concurrently, the City revised its subsurface sewage treatment system guidance document to include recommendations in the Septic Siting Study. This guidance is currently under review by watershed stakeholders with regard to the approval process by the City of septic systems under the new proposed guidance. In 2003, DEP took steps to revise and update its WR&Rs to accommodate the revised State General Stormwater Permit (GP-02-01), update and modify certain references, and make language clarifications. The proposed WR&Rs modifications are currently in the public review process and are expected to become effective by 2007.

During 2003, DEP improved its database of information concerning impervious surfaces and project locations in both the east and west-of-Hudson watersheds. Education and outreach activities relating to the WR&Rs through workshops for design professionals, planning boards and building inspectors and training of DEP police were conducted to increase the effectiveness of the WR&Rs. During this time DEP also developed internal guidance to help better define DEP's role and facilitate effective participation in the SEQRA process.

Starting in 2004, DEP, DEC, and the State Attorney General's office have successfully implemented a stormwater enforcement program to better coordinate stormwater enforcement efforts. This program was modeled on the previously established Watershed Enforcement Coordination Committee, described more fully below. By meeting regularly to discuss stormwater issues and enforcement cases, the agencies can quickly address non-compliance with regulatory requirements through prompt detection and remediation of water quality violations from stormwater runoff.

B. WWTP Inspection Program

2002 FAD Requirements
The WWTP Inspection Program involves the onsite inspection, sample monitoring, compliance assistance and enforcement of State Pollutant Discharge Elimination System (SPDES) permits of all WWTPs discharging in the NYC watershed.

Evaluation of City Performance
The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall program and status. The program is successfully implemented through an EPA-approved Memorandum of Understanding (MOU) between the DEC and DEP. DEP inspects year-round facilities once per quarter and all other facilities at least twice per year. Through this program, DEP provides effective technical assistance and assists with the prompt correction of operation and maintenance problems at watershed WWTPs. The MOU established the Watershed Enforcement Coordination Committee (WECC) which meets on a quarterly basis to coordinate additional WWTP inspections and sampling as needed, and/or compliance assistance/formal enforcement actions under specific inter-agency protocols. The goal of the WECC is to insure that all significant non-compliance (SNC) is addressed with aggressive technical assistance or through timely and appropriate enforcement actions and has resulted in a sustained SNC rate under 5%, down from about 20% since program inception in 1993.

Overall, DEP's implementation of regulatory programs (WR&Rs, SEQRA reviews, WWTP inspections/oversight) is a very important element of the City's watershed protection/filtration avoidance program. Close coordination among DEP, DEC and the Attorney General's office in these programs has proven to be effective. EPA and DOH support continuation of these programs.

VI. Catskill/Delaware Filtration/UV Disinfection Facilities

2002 FAD Requirements
A final preliminary design for the Catskill/Delaware filtration facilities was completed under the 1997 FAD. As a condition of relief from completing the final design of filtration facilities for the Catskill/Delaware systems, the DEP agreed to perform biennial updates to the filtration plant's preliminary design. The 2002 FAD requires a continuation of these biennial updates to the preliminary design thereby preserving EPA's concept of the "dual track" approach (comprehensive watershed protection/filtration design) for the protection of public health. In the future, should filtration be required, a current preliminary design will significantly minimize the overall time necessary to commence filtration.

Ultraviolet (UV) disinfection of the Catskill/Delaware supply is required under the 2002 FAD and is an additional condition of relief from completing the final design of filtration facilities for the Catskill/Delaware systems. The 2002 FAD originally scheduled completion and commencement of UV operations on or before August 31, 2009. This

date was extended by EPA in February 2006 by virtue of a FAD modification. The final date for commencement of full UV operations is now November 30, 2010. This extension was necessitated because of the design and construction difficulties associated with relocation of the project site from Kensico to Eastview and full scale validation of the UV disinfection units. Infrastructure has also been added to the UV disinfection facilities providing for connections of raw and finished water to Kensico City Tunnel 3 and a future Catskill/Delaware water filtration facility. It should be noted that the extended completion date is in advance of the date specified by the Long Term 2 Enhanced Surface Water Treatment Rule for completion of such facilities. The rule requires completion by April 1, 2012, but it allows the EPA/DOH to provide an additional 2 years for systems making substantial capital improvements.

Evaluation of City Performance

In accordance with the FAD due dates, DEP submitted updates to the preliminary design for the Catskill/Delaware filtration plant in September 2003 and 2005. The latest update focused on the changes to the filtration plant's layout and elevations necessitated by a new hydraulic gradient due to the change in the location the UV project site from Kensico to Eastview. The Eastview site now puts the UV facility downstream of a future Catskill/Delaware water filtration plant.

Although a computer based modeling effort for validation of the UV disinfection units was completed and considered by DEP to be within acceptable confidence levels, at the request of EPA and DOH the DEP completed full-scale validation of two different UV disinfection unit prototypes. Both disinfection units were shown to deliver the design dose of 40mJ/cm$^{2.}$ Trojan Technologies was selected to provide all 56 full scale UV disinfection units.

Final design of the UV disinfection facilities was completed and endorsed by DOH. A site preparation contract was awarded in June of 2005 but commencement of construction, originally planned for September 2005, was prevented due to a delay in securing a Section 404 permit from the US Army Corps of Engineers (ACOE). Although this permit has now been issued, DEP has informed EPA that the delay resulted in the loss of the original site preparation contractor. The loss of the original contractor necessitated that DEP take steps to secure a new one. A new site preparation contractor has been selected and work is planned to begin in summer 2006, approximately ten months beyond the original start date. DEP has formally requested that EPA consider both the delay in the issuance of the ACOE Section 404 permit and the associated loss of the original contractor as a force majeure event and that the appropriate schedule adjustments be made in the 2007 FAD. EPA is currently evaluating this request and will be discussing the schedule impacts with DEP in August 2006 as part of the 2007 FAD negotiations.

VII. In-City Programs

A. Waterborne Disease Risk Assessment Program

2002 FAD Requirements

New York City's Waterborne Disease Risk Assessment Program (WDRAP) was established in 1993. The objectives of the program are: 1) to determine rates of giardiasis and cryptosporidiosis in New York City and to collect demographic and risk factor information on case patients; 2) to provide a system to track diarrheal illness to assure rapid detection and investigation of outbreaks; and 3) to assess the feasibility of conducting studies to learn more about the nature of gastrointestinal illness (e.g., cryptosporidiosis) in the population, including risk factors for infection. Early detection of a waterborne disease outbreak may prevent disease from occurring on a widespread basis, and it may help limit the spread of the disease before it reaches epidemic proportions. Two City agencies are involved in this effort, the DEP and the New York City Department of Health and Mental Hygiene (DOHMH).

The 2002 FAD requires the City to continue implementation of the Disease Surveillance program including the active disease surveillance program, the syndromic surveillance/ outbreak protection program, and the implementation of the "Cryptosporidium Action Plan."

The active disease surveillance program includes ensuring the complete reporting of all laboratory-diagnosed cases of giardiasis and cryptosporidiosis, as well as, collecting demographic information and risk factor information on cases. Syndromic surveillance systems have been implemented with the aim of monitoring gastrointestinal disease trends in the general population via tracking of sentinel populations (e.g., people living in nursing homes) or surrogate indicators of disease (e.g., clinical laboratory monitoring, anti-diarrheal medication monitoring, and emergency room data). Finally, the Cryptosporidium Action Plan documents the procedures to be followed in response to test results for Cryptosporidium at the effluents from Kensico reservoir.

In addition, the City is required to submit semi-annual reports summarizing program results.

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* describes the overall disease surveillance program and documents program achievements. Since the last FAD assessment in 2001, there has been no evidence of a waterborne disease outbreak in NYC. Other highlights of the program include substantial changes to the WDRAP such as the addition of two pharmacy systems and the emergency department system in the syndromic surveillance program, and changes made in the nursing home sentinel surveillance, as well as, the clinical lab system to allow for more standardized analyses.

The WDRAP continues to evolve as necessary. This evolution occurs as a result of new technology, data, and information becoming available or when research is completed that indicates a piece of the program is not working as effectively as possible. For example, recently, for a variety of reasons, the DOHMH determined that syndromic surveillance has not been useful in detecting small, localized outbreaks of gastrointestinal outbreaks in NYC. Following this determination, DOHMH's syndromic surveillance unit is conducting on-going research and modeling of the data and is collaborating with outside agencies and academics that are looking at ways to make such systems more useful. In addition, a pilot project has been started with Bellevue Hospital to look at the feasibility of ways to more rapidly identify etiologic agents during citywide signals. In the near future DEP and DOHMH will also be working to further enhance the analyses of epidemiological data in order to identify any possible changes in the trends of giardiasis or cryptosporidiosis.

EPA and DOH believe that the disease surveillance program has successfully met expectations and that it remains an effective and important element of the City's filtration avoidance program.

B. Cross Connection Control Program

2002 FAD Requirements

The primary objective of the Cross Connection Control Program is the avoidance of any potential for backflow from within premises to the public water supply system. To accomplish this objective, property owners are required to install backflow prevention containment devices in water service lines for premises that pose a potential hazard. After installation, backflow prevention containment devices are required to be tested by a certified tester at least once a year.

The 2002 FAD requires the City to: respond to annual complaints indicating that backflow prevention containment devices are needed; continue to perform annual reviews regarding the need for backflow prevention containment devices in conjunction with tap and wet connection permit applications (this captures most new buildings, major renovations and water service line upgrades); continue preliminary non-entry inspections of 51,910 "high hazard" premises; perform full cross connection control inspection where need is indicated by preliminary inspections; direct property owners to install cross connection control containment devices where need is indicated by full cross connection inspections; and report semi-annually on the progress of the program.

Evaluation of City Performance

Since the promulgation of the 2002 FAD, DEP's Bureau of Water and Sewer Operations has achieved or exceeded most FAD goals for the program. Implementation of DEP's Cross Connection Control Enforcement procedures in September 2002, has accelerated the rate of achievement of compliance for "High Hazard" premises. The enforcement procedure involves issuance of letters, Commissioner's Orders, Notices of Violations, Environmental Control Board hearings, Cease and Desist Orders, and termination of

water service. To date, water service has been terminated for three buildings due to failure to install backflow preventers.

Since the last FAD, DEP has chosen to phase out the preliminary inspection step and opt for routine performance of full inspections at "High Hazard" locations. By concentrating efforts on "High Hazard" inspections and enforcement, DEP believes that the most hazardous premises will achieve compliance in a more effective and timely manner.

DEP also pursues enforcement of annual test requirements for cross connection control containment devices. Property owners who fail to submit annual test reports are issued a Notice of Violation. This new protocol has resulted in a significant increase in the number of test reports received. In 2005, DEP began a program of calendar year compliance for annual testing. This program ensures issuance of Notices of Violations to property owners who failed to submit annual test reports during the previous calendar year.

EPA and DOH believe that the cross connection program has successfully met expectations and that it remains an effective and important element of the City's filtration avoidance program.

VIII. Administration

2002 FAD Requirements

The FAD requires the City to maintain staffing and funding necessary to support the activities that constitute the City's protection programs. The FAD identifies a headcount of 912 positions and requires annual reporting on this topic.

Evaluation of City Performance

In the City's July 2005 report on budget and staffing, 940 budgeted positions were identified, of which 864 were filled (92%). The City also briefly reported out on funding for key programs, such as the New Infrastructure Program for wastewater facilities, and projected capital and operations costs through 2009.

In general, EPA and DOH believe that the City continues to adequately support its programs. An existing funding shortfall in the community wastewater management program, which is noted above, will need to be addressed by the City as part of the FAD revision in 2007.

IX. Education and Outreach

2002 FAD Requirements

The FAD describes a broad range of education and outreach activities – some program specific, such as agriculture, forestry and stream management, and some general, such as school-based education efforts. The FAD also identifies this program as a mechanism to

promote upstate/downstate cooperation and consensus building. The City is obligated to implement and support these programs, and report out on progress annually.

Evaluation of City Performance

The City's *2006 Watershed Protection Program Summary and Assessment* describes recent activities in the education and outreach area. Highlights include: 1) active participation by DEP at public events and county fairs; 2) support for the Watershed Agriculture Council programs, including the "Pure Catskills" buy local campaign; 3) support for forestry technical training and public outreach; 4) stream management workshops and training for watershed stakeholders; 5) CWC's active teacher training and student programs; and 6) lake association pilot program (focus on Lake Carmel).

In public meetings held by EPA and DOH in May and June of 2006, a number of comments were received in support of continuation and enhancement of education and outreach activities.

EPA and DOH believe that the City's (and its partners') implementation of education and outreach programs has been adequate.

Acronyms

ACOE	U.S. Army Corps of Engineers
BMPs	Best Management Practices
BWS	Bureau of Water Supply
CATLEFF	Catskill Lower Effluent Chamber
CWC	Catskill Watershed Corporation
DEC	New York State Department of Environmental Conservation
DEL18	Delaware Shaft 18
DEP	New York City Department of Environmental Protection
DOH	New York State Department of Health
DOHMH	New York City Department of Health and Mental Hygiene
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
GWLF	Generalized Watershed Loading Function
mgd	Million gallons per day
MOU	Memorandum of Understanding
NTU	Nephelometric Turbidity Unit
NWI	National Wetlands Inventory
SEQRA	State Environmental Quality Review Act
SNC	Significant non-compliance
SPDES	State Pollutant Discharge Elimination System
SPPP	Stormwater pollution prevention plan
SWTR	Surface Water Treatment Rule
UV	Ultraviolet
WAC	Watershed Agricultural Council
WAP	Watershed Agricultural Program
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