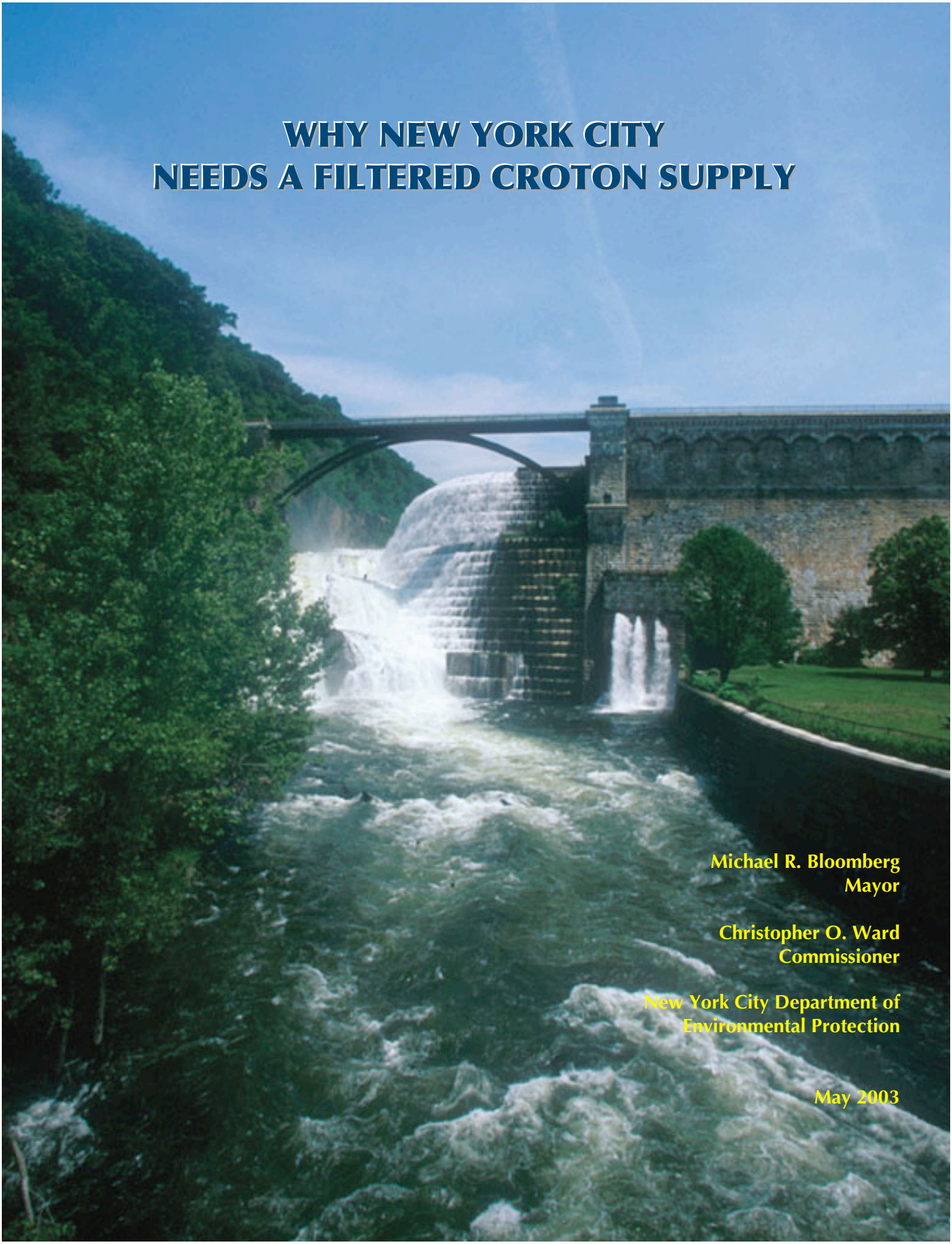
WHY NEW YORK CITY NEEDS A FILTERED CROTON SUPPLY



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EXECUTIVE SUMMARY

The Croton Reservoir System, with twelve reservoirs and three controlled lakes located in Westchester, Putnam and Dutchess Counties, provides essential flexibility and vital redundancy for the New York City water supply. The smallest of the City's three reservoir systems, the Croton ordinarily provides about 10% of New York City's total daily water needs. But in times of drought or during maintenance shutdowns or other system outages, the Croton supply can be relied upon for up to 30% of the City's total water supply. For these and other reasons, the Croton system is a vital part of New York City's critical infrastructure, and safeguarding this resource for future generations is a priority for Mayor Michael Bloomberg and the New York City Department of Environmental Protection.

Filtration of public drinking water supplies, such as New York City's Croton Reservoir System, is the standard and predominant method of treating drinking water across the country. Of the approximately 7,400 surface drinking water supplies in the U.S., at least 7,310 have filtration plants designed to insure that the water these systems provide to their consumers is safe. U.S. Environmental Protection Agency statistics reveal that eight times as many outbreaks of waterborne disease occur in unfiltered systems, as compared to filtered systems. Since 1989, when the federal Surface Water Treatment Rule took effect, more than 95% of the water supply systems that were then unfiltered have since added filtration protection to their water systems. Indeed, even some of the few large systems that remain unfiltered, such as Seattle, have installed filtration equipment for at least part of their systems. Around the world, filtration of water supplies is considered an integral part of a multi-barrier process to meet water quality and public health standards.

There are compelling reasons why New York City is now moving to filter the Croton System, and why the City has not requested a waiver from the federal Safe Drinking Water Act's filtration requirement.

- **Filtration of the Croton supply will significantly enhance the reliability of the Croton system in meeting downstate water needs in the 21st century.** New York City needs a reliable, year-round Croton water supply. In addition to supplying over 100,000,000 gallons of water on a daily basis, the Croton system must perform the critical role of providing much more water to New York City during drought periods or at times when necessary maintenance or other situations interfere with the ability of the City to take water from is two other reservoir systems (the Catskill and the Delaware). But over the past ten or fifteen years, the Croton system has been less reliable, with eutrophic conditions in many of its reservoirs and other problems necessitating that the system be shut down for months at a time, often during the peak periods of water demand -- the summer and fall.

- **Filtration will effectively address the Croton System's chronic problems such as taste, color and odor, will remove midge larva and will enhance public comfort with the adequacy of the Croton water supply.** Under present conditions, Croton water consumers may sometimes receive lower quality water then consumers receiving Catskill/Delaware water. Although Croton System water has continued to meet federal and State health-related water quality standards, during certain times of the year, Croton water is affected by seasonal problems that cause aesthetic concerns related to color, odor and taste. For example, Croton water periodically exceeds state

- water quality standards for color, as a result of elevated levels of iron and manganese caused by low oxygen conditions in the reservoirs. In addition, midge fly larva are occasionally found at the taps of Croton water consumers. Although such conditions do not represent a threat to public health, they do lead to more consumer complaints and affect public confidence in the water supply itself.

- **Filtration of the Croton System, by removing algae and other organic materials, will reduce the formation of disinfection by-products in the Croton water supply.** Croton System water may contain levels of harmful disinfection by-products that are likely to violate new federal water quality standards. Disinfection by-products are contaminants that form in water when disinfectants such as chlorine, which are added to kill microbial contaminants, combine with organic material that may be present in the water. The U. S. Environmental Protection Agency (EPA) has determined that disinfection by-products can increase the risk of several types of cancer and have been linked to reproductive problems and miscarriages. As a result, EPA has set several different standards to insure that the levels of disinfectants in drinking water distribution systems are sufficient to kill microbes, such as bacteria and viruses, but not high enough to form dangerous levels of disinfection by-products. While Croton water met the past disinfection by-product rule, it is not expected to meet the new federal standards.

- **Filtration of the Croton System will significantly reduce the potential threats posed by microbial contaminants, and help assure high water quality from the Croton System for decades to come.** Widespread development throughout the Croton watershed has made Croton System reservoirs more susceptible to microbial contamination. Microorganisms such as bacteria, viruses, *Cryptosporidium* and *Giardia* pose potential health risks. They can cause various gastrointestinal disorders and can be potentially life threatening for immunocompromised individuals, for the elderly and for children. For such reasons, the federal Surface Water Treatment Rule requires physical removal and inactivation through disinfection of microbial contaminants in drinking water supplies. The high level of development in the Croton watershed poses increased risk of microbial contamination of the Croton water supply. Approximately 190,000 people live within the Croton watershed, which also contains roughly 98,000 septic systems and 63 sewage treatment plants that discharge treated wastewater into Croton reservoir tributaries.

- **Filtration of the Croton System will insure that this reservoir system remains in full compliance with the federal Surface Water Treatment Rule.** The extensive development throughout much of the Croton watershed has resulted in a system that does not meet the federal Surface Water Treatment Rule requirement that the water supplier of an unfiltered system demonstrate ownership or control of the watershed to safeguard against human activities that may have an adverse impact on source water quality. Approximately 80% of the Croton watershed is suburbanized. More than half of the 190,000 people who live within the Croton watershed boundaries are located within the 60-day travel time distance to water supply intakes. Moreover, Croton watershed development has been accompanied by an extensive infrastructure of roads and highways, sewage treatment plants and septic systems. Such urbanized development patterns increase peak flows of stormwater runoff, leading to erosion and streambank instabilities and higher concentrations of pollutants, and also raise the risks from accidental spills.

- **Construction of the Croton filtration plant, in addition to the above-described benefits to New York City water consumers, is necessary for New York City to remain in compliance with the federal Safe Drinking Water Act and a federally enforceable Consent Decree.** For more than ten years, New York City has been legally obligated to filter the Croton supply. In 1992, the City entered a Stipulation with the New York State Department of Health, agreeing to filter the Croton water supply. In 1997, the United States and the State of New York brought an action against the City in U. S. District Court, alleging that the City had failed to filter Croton water, in violation of the federal Safe Drinking Water Act and the Surface Water Treatment Rule. In 1998, the parties to this action, including New York City, executed a Consent Decree in which the City agreed to construct a Croton filtration facility by 2006. The City was also required to pay a one million dollar civil penalty for the City's alleged past violations of the Act and Rule. Although a supplement to the Consent Decree, entered in 2002, extended the milestones for completion of construction and commencement of operations of a Croton filtration plant, New York City remains legally obligated to construct this facility.

- **Advancing a filtration plant for the Croton System reservoirs will not mean an end to watershed protection in this system.** New York City intends to continue, and even enhance, its ongoing program to safeguard the Croton watershed from pollution and development. Since the signing of the 1997 Memorandum of Understanding, New York City has committed to spend hundreds of millions of dollars on Croton watershed management programs, including $200 million for wastewater treatment plant upgrades, $20 million to implement a program to protect selected Croton system reservoirs from non-point sources of pollution and $13.5 million for land acquisition in the Croton watershed. The City and State are also continuing to advance important regulatory programs to protect water quality in the Croton against specific, future activities.

- **Several investigations have indicated that the combination of filtration and a strong watershed protection program is needed for the Croton system.** The challenge that the City has faced is how best to ensure that water delivered from the Croton System is safe, compliant with aesthetic standards, and available to water consumers on a reliable, year-round basis. In meeting this challenge the City has thoroughly evaluated existing conditions throughout the watershed, natural processes within the reservoirs and on surrounding landscape, existing water quality in streams and reservoirs, and various options for watershed management. The results of these efforts have clearly indicated that the appropriate long-term strategy for the Croton System combines filtration and a strong watershed protection program in a multiple barrier approach.

In sum, a Croton water treatment facility, in conjunction with a strong watershed protection program, is the most effective way of achieving public health protection, regulatory compliance and water supply reliability. In the remainder of this report, these conclusions are discussed in more detail. Part I provides a description of the Croton reservoir system and its watershed. Part II discusses the widespread use and benefits of filtration technology as a protective measure to safeguard public water supplies. Part III summarizes the major reasons why the Croton System must be filtered. Finally, Part IV highlights the existing and enhanced efforts the City is making, and will continue to make, to advance watershed protection in the Croton System.

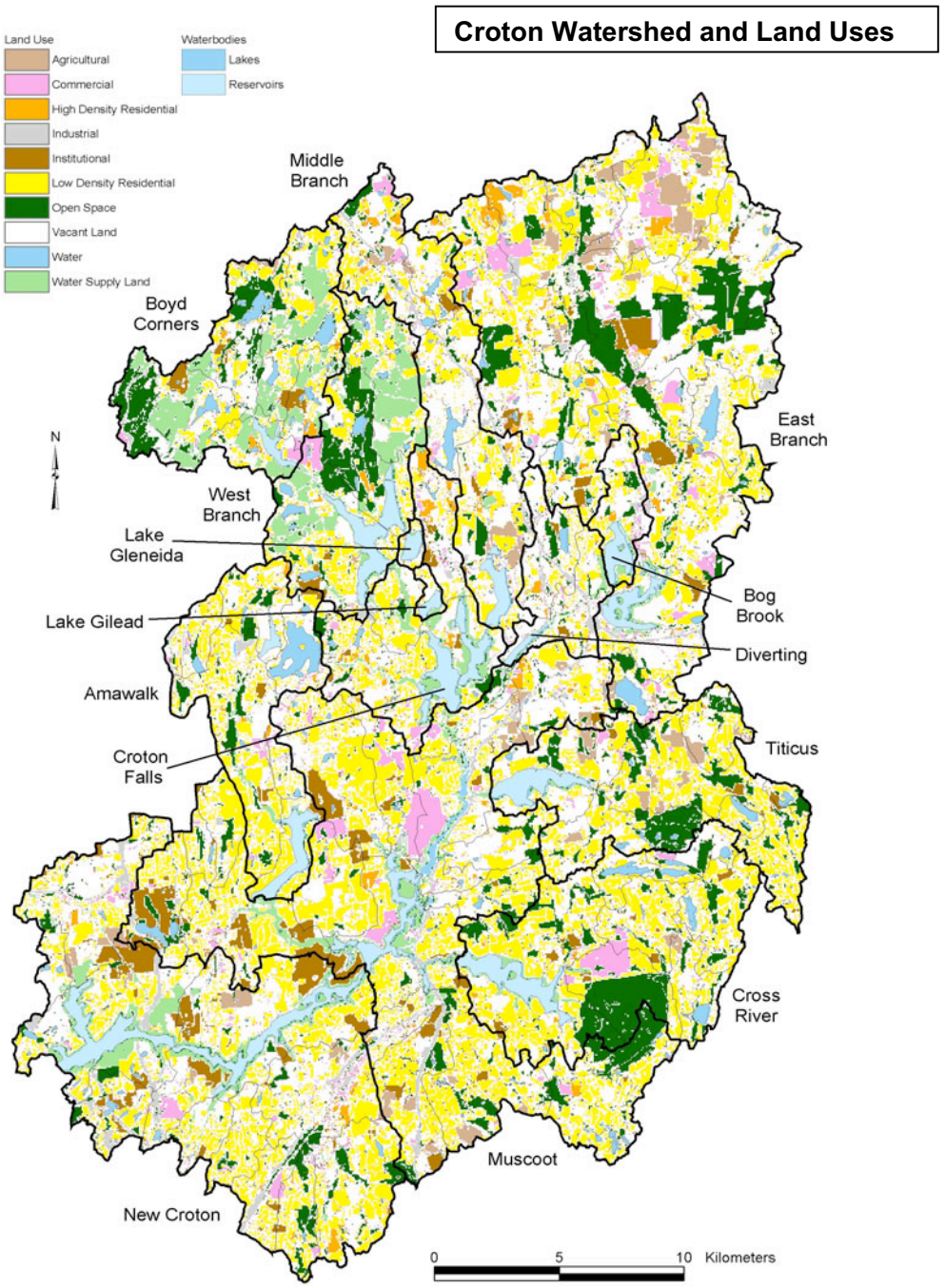
I. THE CROTON SYSTEM AND ITS WATERSHED

The Croton System, developed from 1842 to 1911, is composed of 12 reservoirs and three controlled lakes in a 375 square mile watershed located in Westchester, Putnam and Dutchess Counties of New York State. The system stores 86.6 billion gallons of water and can yield 240 million gallons per day.

The old Croton System was first put into service in 1842. By 1860, both capacity and quality problems had occurred, necessitating the need for expansion of the Croton System. In 1874, the development of additional storage reservoirs was begun, and by 1893, the New Croton Aqueduct was built, followed in 1906 by the completion of the New Croton Reservoir.

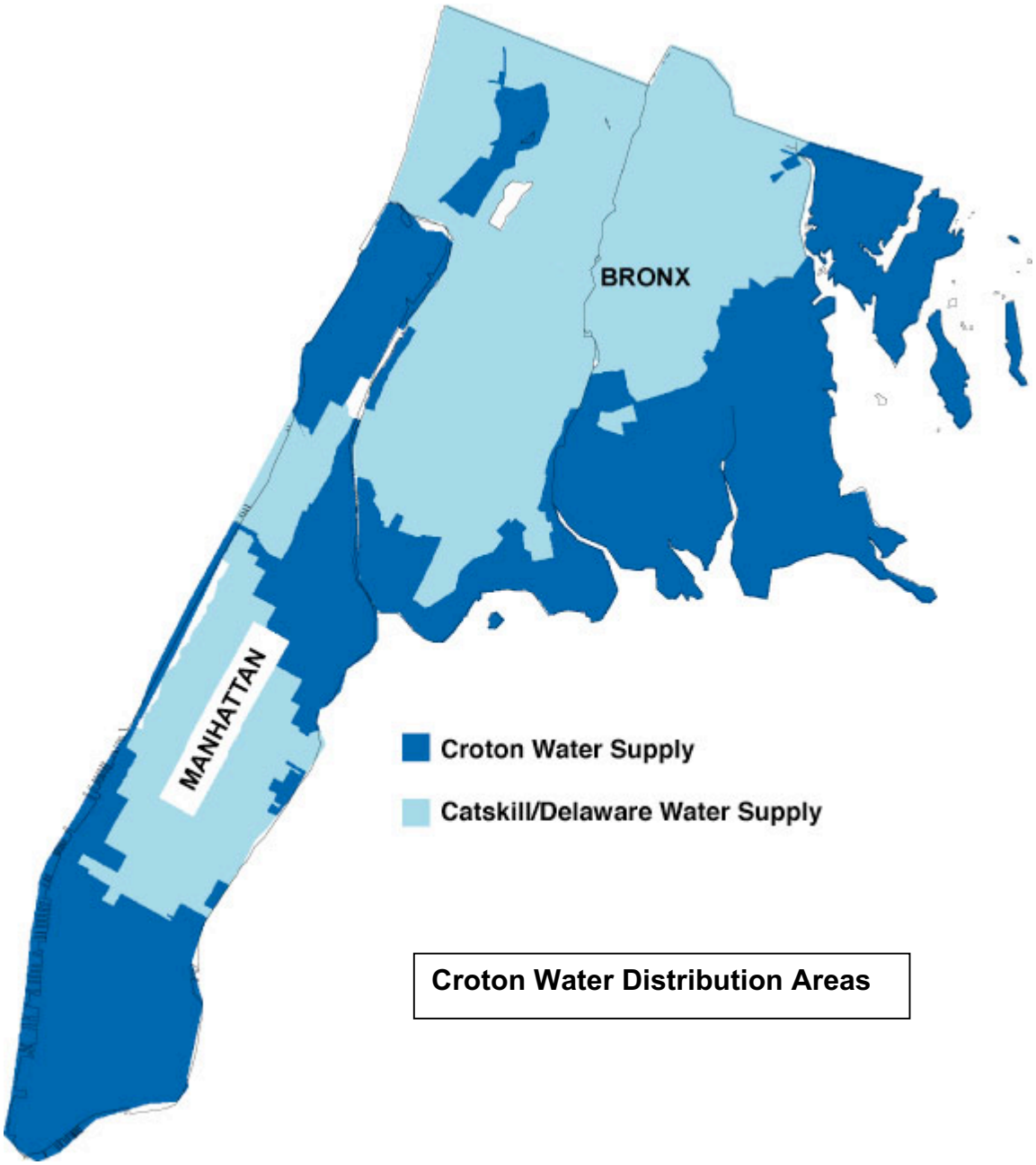
Shortly thereafter, the City determined that the Croton system would not provide enough water for a growing city, and began plans to site and construct a new reservoir system. After determining that areas north of Croton were not conducive for siting a new system (citing many of the same problems that exist in the Croton system), the City decided to build a new reservoir system west of the Hudson River. The components of the much larger Catskill System were completed between 1915 and 1927. The capacity needs of the City continued to steadily grow, necessitating the construction of the even larger Delaware System, which was brought on-line between 1950 and 1965. Not only did each new system increase the City's water supply capacity, they also allowed for shutdowns of the Croton System during late summer, when water quality deteriorates.

The Croton watershed consists of gently rolling hills and numerous wetlands (6.5% of the watershed). See the following figure of the Croton Watershed and its land uses. The soils (derived from glacial till) are well drained and highly erodible. Over the course of its existence as a water supply, the Croton watershed transitioned from a self-sustaining agricultural community to a suburban/residential community dependent on New York City. As it grew from the Old to the New Croton system, through the construction of more storage reservoirs, the "daisy-chain" structure of the Croton system helped mediate water quality at the terminal reservoir – New Croton. In other words, by changing the system from a straight river run to a series of lakes feeding one another, the retention time of the water was increased, allowing more time for particles to settle out of the water column and pathogens to die-off. This resulted in reduced bacteria and turbidity levels. Additionally, the greater reliance on modern wastewater treatment reduced the direct loadings of contaminants to the water. However, even with these improvements, the quality of the Croton System has never equaled that of the Catskill and Delaware Systems.



Today the Croton System reservoirs ordinarily provide 10% of the total downstate drinking water supply, except in times of drought when Croton water can contribute as much as 30% of the supply. As such, the Croton System supplies essential flexibility and necessary redundancy for safe and reliable operation and maintenance of the City's overall water supply system.

In its journey to New York City taps, Croton water is withdrawn from the New Croton Reservoir in Westchester County, chlorinated, and sent 25 miles through the New Croton Aqueduct to the Jerome Park Reservoir in the Bronx. From there it is distributed to consumers in the Bronx and Manhattan. Areas of the City that can receive Croton water are indicated in the following graphic and include southern and eastern portions of the Bronx and also Inwood, Harlem, East Harlem, Clinton, Chelsea, Kips Bay, Gramercy Park, East and West Villages and all of lower Manhattan.



Croton Water Distribution Areas

II. FILTRATION IS THE STANDARD METHOD FOR SAFEGUARDING PUBLIC WATER SUPPLIES

Filtration is the standard and predominant method of treating drinking water across the United States. In fact, 99% of all surface water supplies in the United States are filtered. Filtration was first used in the United States in the 1870's, even before disinfection. (Indeed, nearly 100 years ago City engineers designed a filtration plant for the Croton Supply, prior to the discovery and subsequent decision to use chlorine as a disinfectant instead.) Today filtration is an integral component of a multi-barrier process to meet water quality and health standards in developed countries throughout the world.

There are 7,400 surface water systems in the U.S., of which 7,310 have filtration plants. Of the 90 surface water systems that are unfiltered, most are very small and none receive water from areas as densely populated as the Croton watershed. U.S. EPA statistics show that eight times as many disease outbreaks occur in unfiltered systems as compared to filtered systems. More than 95% of the (~1,800) unfiltered systems in the United States in 1989 - the year the Surface Water Treatment Rule (SWTR) took effect - have since installed filtration. Even some of the larger unfiltered systems like Seattle, Washington, have since voluntarily installed filtration for at least parts of their systems.

The federal Safe Drinking Water Act, and the Surface Water Treatment Rule that implements it, require all surface water suppliers to filter their water unless a set of raw water quality requirements are met and the water supplier can demonstrate sufficient control over its watershed so as to minimize the potential for contamination of the water supply. One goal of the SWTR is to protect the public from exposure to microbial contaminants including *Giardia*. The rule has been revised twice, and the latest revision – the Long Term 2 Enhanced SWTR – will also address exposure to the chlorine-resistant pathogen *Cryptosporidium,* and will require some form of additional treatment.

The proposed water treatment plant for the Croton System incorporates standard treatment processes that are already in use in similar facilities around the country. The treatment process for the Croton treatment plant will include coagulation, flocculation, dissolved air flotation, and filtration. The purpose of these processes is to remove particles present in the raw water and to convert dissolved natural organic matter (NOM) into particulate form that can be removed by dissolved air flotation and filtration. The addition of a coagulant destabilizes particles so they will stick together. It also converts dissolved NOM into particles. Once the coagulant is added, the water is slowly mixed to promote particle contacts, which allows the destabilized particles to collide and stick together forming floc (flocculation), that can be removed in the dissolved air flotation process. In the dissolved air flotation tank, miniature air bubbles collide with the floc and float it to the surface where it is skimmed off. The floc particles that are not removed in the dissolved air flotation tank are removed by filtration through granular media (anthracite/sand).

Overall, these treatment process steps are designed to reduce color and turbidity and remove particulates as well as algae and microorganisms. In addition to filtration, the proposed Croton treatment plant design incorporates ultraviolet light treatment to provide an additional barrier against any microbial breakthrough.

Throughout the United States, water treatment plants have generally been considered "good neighbors" by their surrounding communities. Although the chemicals commonly used in treatment plants may be listed as hazardous, they are not flammable, not dangerous when diluted with water, and in the event of a spill can be readily cleaned up. Indeed, most of the chemicals used at a filtration plant are already in use in New York City's water supply.

III. WHY THE CROTON SYSTEM MUST BE FILTERED

There is a long history behind NYC's decision to filter the Croton System. As far back as 1908, City water officials were prompted by public health concerns to consider filtering the Croton supply, and evaluated several proposals at length before selecting chlorination as the most suitable alternative at that time. In the 1960's, City water supply officials decided that filtration was necessary for the Croton system based on water quality and the existing water quality standards of the time. There were, and still are, seasonal episodes when Croton had to be taken off line. The existence of a significant population in the watershed and all the associated impacts to the water supply were also of concern. In 1989, the U.S. EPA adopted the Surface Water Treatment Rule, mandating filtration of all surface drinking water supplies except under the most limited circumstances. At that time, City officials concluded that the Croton System would not meet the stringent criteria for watershed control required for filtration avoidance. The New York State Department of Health concurred in that determination. Accordingly, New York City did not apply to U.S. EPA for a filtration waiver for the Croton System.

This section summarizes seven reasons why DEP has concluded that it must now move forward with filtration of the Croton System.

A. New York City Needs a Reliable, Year-round Croton Water Supply

The Croton system is critical to meeting NYC's current and future water supply needs. Without full use of the Croton system, the City's water supply will have a shortfall of at least 400 million gallons per day by the year 2045. Computer simulations of the water supply from 1927-1993 indicate that, without the Croton System: drought emergency frequency would have been increased from an average of once every ten years to once every five years; it would have been necessary to use the Hudson River Pumping Station three times more often; and the City would have run out of water during the drought of the 1960's. Further, the need for the Croton supply during a drought emergency is even more critical today than in the past because, under the increasingly stringent federal environmental laws enacted since the 1970's, the Hudson River is no longer a viable alternative during a drought. The use of Hudson River water will either be completely precluded or severely restricted.

The operational strategy for the City's water supply is to maintain a balance between water quality and water quantity. In order to meet the considerable daily water demand of 1.2 billion gallons a day, the water supply must be managed as a whole, not as individual discrete systems. Ideally, all reservoirs in the system should be available for use at any time so that water quality problems or preventive maintenance can be accommodated. The seasonal water quality impairment of the Croton System often necessitates a shutdown of the Croton supply and occurs during the City's peak demand period.

Moreover, as the Catskill and Delaware Systems age, they will increasingly be in need of maintenance and repairs, which will take decades to complete. Since the Catskill and Delaware Systems each provide a significant portion of the daily supply of water that the City consumes, the City's needs cannot be met with only one of these two systems in operation. As components of these two systems are taken off-line, alternative sources of water become even more critical. Since the Croton system is the only other significant water supply for the City, it will be needed on a continuous and reliable basis for many years or even decades, in order to meet the water needs of the City, while the repairs to the other systems are implemented.

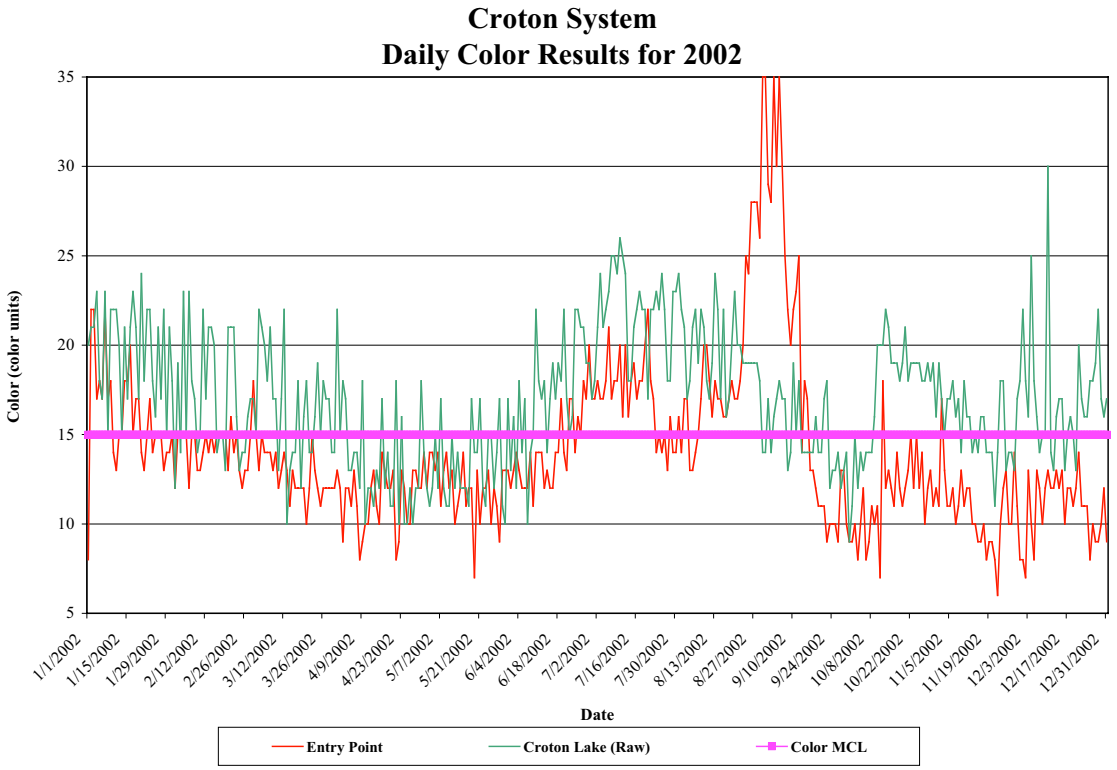
Unfortunately, while water quality in the Croton reservoirs is generally good, many Croton System reservoirs face problems of eutrophication. Eutrophic water bodies are rich in nutrients (e.g., phosphorus) resulting in excessive growth of algae, low transparency and low dissolved oxygen levels. Eutrophication leads to numerous water quality problems including: increased disinfection by-products, low dissolved oxygen concentrations, elevated metals concentrations, and unacceptable taste, odor and color. This water quality impairment is seasonal and usually peaks during the late summer and early fall (ironically, when demand is greatest). The Croton system contains more natural organic matter (typically measured as total organic carbon) than the Catskill and Delaware Systems. Natural organic matter is produced both within the reservoirs (algae/aquatic plants) and from the watershed (soil organic matter, leaf litter, wetlands). In 2002, the annual mean for total organic carbon in the Croton System was 2.8 mg/L, almost twice as much as the Catskill and Delaware Systems.

The presence of eutrophic conditions in the City's Croton reservoirs makes the Croton System a less reliable water source. Reservoir managers are often required to make operational changes such as withdrawing water from varying depths and at different intakes in an effort to obtain water of acceptable quality. Unfortunately, such manipulations of the intakes are rarely enough to maintain adequate water quality during the late summer when eutrophication is typically at its worst. (Generally, water suppliers prefer to draw from the deeper levels of the reservoir because of cooler temperatures and optimum water quality. However, due to eutrophication, the bottom waters of the New Croton Reservoir become anoxic and contain elevated color and metals concentrations. The surface water is usually of unacceptable quality due to high concentrations of algae and warm temperatures. The temperature and organic content combined lead to higher chlorine demand, and produce increased levels of disinfection by-products.) For these reasons the Croton System is often taken off-line, sometimes for months, in an effort to prevent violations of water quality standards in the distribution system.

Filtration of the Croton System would, however, significantly address these reliability problems. A filtered Croton water supply would provide higher quality water even during periods of eutrophication-related source water impairment since the treatment process would remove the constituents that cause color as well as organic material before chlorination, greatly reducing the formation of disinfection by-products.

B. Under Present Conditions Croton Water Consumers are Often Receiving Lower Quality Water

Although water from the Croton System has continued to meet current federal and state health-related drinking water quality standards, during certain times of the year consumers of Croton water receive lower quality water than those consumers who receive Catskill/Delaware water. During the summer months, when it would be ideal to maximize the use of Croton water in response to increased demand, the water quality historically degrades. Among the seasonal problems are aesthetic concerns related to color, odor and taste. Indeed, Croton water has exceeded state water quality standards for color on an annual basis, with seven such violations in 2002 (see graph on the next page). In addition, midge fly larva from Croton water turn up at some consumer taps. Color is an aesthetic issue, unrelated to public health, as is the presence of midge fly larva. But both are obviously important to the consumers of the drinking water. During periods of elevated color, for example, consumers register more frequent complaints about the unfavorable water quality at their taps. And the taste, color, odor, and midge larva problems associated with the Croton System have generally not appeared in waters taken from the Catskill and Delaware Systems.



In addition, the Croton System has, on occasion, violated the state turbidity standard. Turbidity is a measure of water quality related to the amount of suspended matter present. In 2002, for example, the standard was violated on two separate occasions. Turbidity in the water can interfere with disinfection, provide a medium for microbial growth and may indicate the presence of disease-causing organisms.

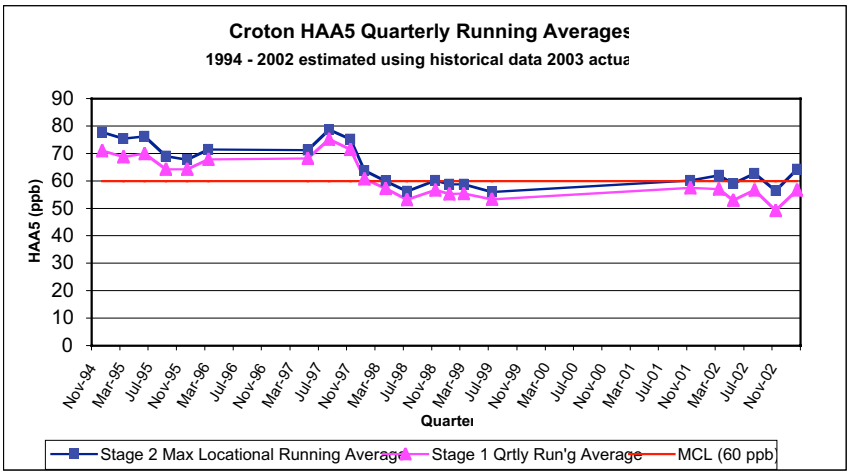
With filtration, the Croton System's problems of taste, odor, color, midge larva, and turbidity will be eliminated. This will allow the Croton supply to be used throughout the year. In addition, if the use of Croton could be maximized during the summer months, drawdown in the Catskill/Delaware System reservoirs could be avoided, which would help to maintain the water quality and quantity in those reservoirs as well.

C. Filtration Will Reduce Health Risks from Disinfection Byproducts

Filtration of the Croton System is needed to reduce the public's exposure to harmful byproducts of the disinfection process. Disinfection by-products (DBPs) are contaminants that form in water when added disinfectants such as chlorine combine with existing organic material. Some DBPs are believed to be carcinogens. EPA has concluded that DBPs increase the risk of bladder, colon and rectal cancers as well as adverse reproductive outcomes such as neural tube defects and miscarriages. The possible health risks from consuming higher levels of DBPs has prompted some consumers to file lawsuits against their municipal suppliers. In February 2002, twenty-five women from Chesapeake, VA filed a $1 billion dollar lawsuit claiming that spikes in the amount of chlorination byproducts in their water caused their pregnancies to terminate in miscarriages in the 1980s and 1990s.

With such concerns in mind EPA has adopted regulations limiting levels of DBPs in drinking water distribution systems. One group of DBPs, total trihalomethanes (THM), has been regulated since 1979. (The original MCL of 100 ug/L as a quarterly running average was lowered to 80 ug/L in 2002 under the Stage 1 Disinfectant By-products Rule). Generally, the rate and extent of THM formation increases with increasing temperature, pH, and concentrations of bromide, total organic carbon (TOC) and chlorine. Another group of five specific DBPs -- haloacetic acids (HAA5) -- has raised similar concerns and is now also regulated under more recently adopted EPA rules. EPA believes that the science supports regulatory safeguards that target peak DBP exposures. It is the consensus of scientists, the USEPA, and several independent peer reviews that DBPs pose a legitimate health risk.

While Croton water currently meets the existing THM standard, it is not likely to meet the newer standards for haloacetic acids (HAA5). Based on historical monitoring of HAA5 and the results from 2002, it is expected that the Stage 1 HAA5 MCL of 60 ug/L as a quarterly running average will be exceeded. In addition, there are even more stringent regulations for DBPs soon to be proposed by USEPA under a Stage 2 rule, which will regulate DBPs at specific times and locations in the distribution system instead of looking at the yearly average alone. With the existing water quality and treatment processes currently applied, Croton water will not be able to meet the even lower Stage 2 MCL for HAA5.



D. Filtration Will Reduce Risks from Microbial Contaminants

The main purpose of the SWTR is to insure that public drinking water supplies are protected from microbial contamination. Microorganisms such as bacteria, viruses and other organisms like *Giardia* and *Cryptosporidium* pose potential public health threats. These organisms can cause gastrointestinal disorders that include symptoms such as vomiting and diarrhea, and can be potentially life threatening for the immune-compromised, elderly and young. Both physical removal and inactivation through disinfection are methods of reducing microbial risk that are required under the SWTR.

The widespread development of the Croton watershed makes Croton reservoirs and their tributaries more susceptible to microbial contamination. There are today approximately 190,000 people living in the Croton watershed as well as roughly 98,000 septic systems and 63 sewage treatment plants. In total, more than five million gallons of treated sewage enters Croton Reservoir tributaries every day. In addition, a vast network of roads, parking lots and other paved surfaces flush stormwater contaminants into local waterways. Noting that population density in the Croton watershed is ten times that in the Catskill/Delaware watersheds, U.S. EPA concluded, "extensive development and increasing human activity in the Croton watershed necessitate filtration."

E. The Croton Watershed Does Not Meet the Surface Water Treatment Rule's Criteria for Filtration Avoidance

The highly developed Croton watershed does not meet the federal Surface Water Treatment Rule requirement that the water supplier demonstrate ownership or control of the watershed to safeguard against human activities that may have an adverse impact on source water quality.

A significant amount of the Croton watershed (approximately 80%) is suburbanized, as defined by population density. More than half of the 190,000 people currently living in the watershed are within the 60-day travel time distance to the water supply intakes. The majority of residents use septic systems (~98,000) and groundwater wells, but the watershed also contains 63 sewage treatment plants with a total discharge capacity of 5.53 million gallons per day.

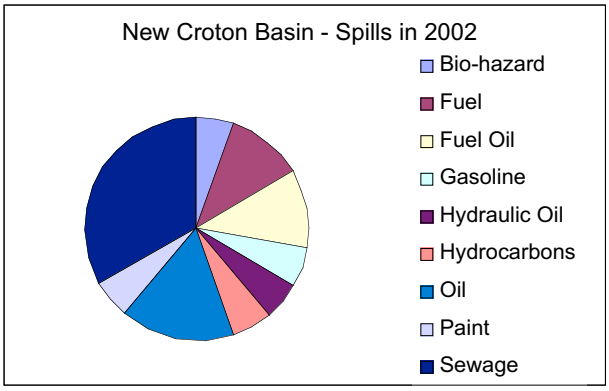
Croton watershed development has been accompanied by an extensive infrastructure of roads and highways, wastewater treatment plants, septic systems, and stormwater collection systems. The negative impacts of development on water quality have been known for decades. Most recently, DEP investigated the impacts of residential development as part of the Process Studies Research Project, which was conducted in the sub-basins of the Croton Watershed. The preliminary results indicate:

Hydrology – streams in urbanized watersheds have higher peak flows during storms, shorter time between the start of a storm and the peak stream flow ("flashy" response), greater surface runoff, and reduced infiltration to groundwater. Combined, these can result in greater stream volume and faster water velocities, leading to erosion and streambank instabilities.

Water Quality – streams in urbanized watersheds had consistently higher ammonia and nitrate concentrations (indicators of septic system discharges), total and dissolved phosphorus (causes of eutrophication), sodium and chloride (from road salt).

Stormwater from urbanized areas, and their associated impervious surfaces, is a leading cause of water quality impairment. DEP has been gathering watershed-specific information on the effect of urbanized areas through the Process Studies Project, conducted for DEP by an independent academic research consortium. The Process Studies Project confirmed higher storm-related flows and higher pollutant concentrations from urbanized watersheds. In addition, the research also confirmed earlier results from the United States Geological Survey (USGS), which showed that on an annual basis approximately 70% of the water in the streams is derived from baseflow entering the streams from shallow groundwater sources. The recent research further demonstrated that much of this water is influenced by septic systems, which are potential sources of microbes and other contaminants.

Moreover, the risk of accidental spills or releases negatively impacting water quality also rises with increases in population and the supporting infrastructure. For example, the DEP Hazardous Material Response Team was notified of 18 spills within the New Croton Reservoir basin in 2002. A third of these incidents involved sewage spills. The risk of pathogens entering the water supply from accidental sources such as this is serious since the entire New Croton basin lies within 60-day travel time distance to the intakes where treatment begins. The amounts and types of spills reported for the New Croton basin is given in the figure to the right.



In addition to threats from development and human activities within the watershed itself, water quality in the Croton System can also be threatened by spills in close proximity to the New Croton Aqueduct which lies outside of the Croton watershed. In the past 10 years, there have been over 700 reported spills within 1/4 mile of the aqueduct. One such incident, in 1996, closed the aqueduct several times for many months while the site was remediated, due to petroleum contamination.

In sum, the large number of people living within the Croton watershed and within 60-day travel time distance to water supply intakes, the extensive and highly developed infrastructure in the Croton watershed, and the ongoing risks from accidental spills or releases do not satisfy Surface Water Treatment Rule requirements for filtration avoidance.

F. Compliance with Safe Drinking Water Act and Federal Court Order

For more than ten years, New York City has been legally obligated to filter the Croton supply. In 1992, the City entered into a Stipulation with NYSDOH for filtration of Croton water. In 1993, the USEPA issued a written determination that the City must filter Croton water, and indicated its intention to monitor the City's compliance with the Safe Drinking Water Act and Surface Water Treatment Rule. In 1997, as a result of dissatisfaction with the City's progress, the United States and the State of New York brought an action against the City, alleging violations of the Act and Rule. After extensive negotiations, the United States, the State and the City entered into a Consent Decree, setting out an enforceable schedule for the design and construction of a Croton water filtration plant. In 2001, after an~~d~~ adverse court decision involving the siting of the filtration plant at the Mosholu Golf Course, the parties negotiated a supplement to the Consent Decree, requiring the City to examine sites in the Bronx and Westchester County, and setting out revised schedules. The supplement was entered by the court in 2002.

G. Non-Filtration Alternatives and/or Disinfectants are not Adequate

Even though filtering the Croton System would solve the existing water quality and public health risk issues, DEP extensively investigated and tested non-filtration alternatives. The Extended Special Study Program (ESSP), conducted by the Joint Venture of Metcalf & Eddy, Inc. and Hazen and Sawyer in 1996-1997, evaluated non-filtration alternatives for meeting water quality goals. The ESSP investigated watershed management practices, in-reservoir actions, chemical addition alternatives, combinations of disinfection processes and system operational constraints both separately and in combination. The evaluation of alternatives looked at implementability (e.g., technical feasibility, permit requirements) and effectiveness (e.g., improvement in water quality, reliability). A hydrodynamic/reservoir eutrophication model was specifically developed for the Muscoot and New Croton Reservoirs to aid in the evaluation of alternatives.

The Optimal Non-Filtration Plan recommended by the ESSP contained the following elements:

- Full-scale hypolimnetic aeration of the New Croton Reservoir;
- Continuous alum addition at the Muscoot Dam; and
- Microscreening for larvae removal at the Jerome Park Reservoir.

Hypolimnetic aeration of the reservoir was included to address internal sources of color and metals resulting from anoxic conditions in the reservoir. Continuous alum treatment was included to address phosphorus and organic carbon loading to New Croton Reservoir. An option that was considered for the Optimal Non-Filtration Plan was the construction of 300 acres of wetlands/extended detention ponds. However, modeling indicated little to no impact on the key water quality variables of phosphorus and organic carbon even if three times the amount of acreage was obtainable for wetlands

and extended detention basins. These best management practices (BMP) were primarily included as an option of the Optimal Non-Filtration Plan because they would protect the land acquired from future development.

The ESSP also conducted a "pristine" watershed analysis, removing all human influences such as wastewater treatment plants and developed land. The model runs indicated that the quality of the water generated from a completely forested Croton watershed would not meet the color water quality standard set by the State. Moreover, organic carbon levels increased as a result of this land use change.

After the ESSP ended, DEP continued to investigate watershed management alternatives in the Croton system, incorporating the results of the ESSP and certain peer review recommendations. In particular, DEP investigated the feasibility of the proposed technologies (hypolimnetic aeration, alum treatment) and the watershed-specific sources of color, nutrients and disinfection by-products in the Croton watershed. The results of all these investigations indicated that watershed management alone would not ensure a safe, reliable supply of water from the Croton System.

In addition to alternative treatments, alternative disinfection technologies were evaluated for the Croton supply. These included different combinations of disinfectants including chlorine, chloramines, ozone, and chlorine dioxide. Based on these evaluations, no disinfection alternatives were found to adequately address the water quality issues in the Croton system. Furthermore, during the subsequent development of the proposed LT2 Rule, chlorine dioxide was found to be even less advantageous in controlling *Cryptosporium* than originally thought; and coupled with the limitations on its dosage and by-products levels established in the Stage 2 Rule, made it unacceptable for use in the Croton System.

IV. DEP'S CROTON SYSTEM WATERSHED PROTECTION EFFORTS ARE CONTINUING

In advancing filtration of the Croton System, New York City has no intention of cutting back on watershed protection efforts in the Croton. Watershed protection is a critical component of the multiple barrier approach for protection of the water supply. A multiple barrier approach uses several lines of defense to ensure a high quality water supply. By optimizing raw water quality, watershed protection can minimize the risks of pathogens and other contaminants entering the distribution system. DEP believes that a strong watershed protection program will continue to be an essential part of safeguarding the Croton supply for future generations.

A. Ongoing Croton Watershed Protection Efforts

Indeed, DEP has had an extensive watershed management program in the Croton System, consisting of regulatory and non-regulatory components. For example, even after the Croton Consent Decree was signed, requiring a tight schedule for construction of a water treatment facility, DEP committed *hundreds of millions of dollars* to Croton watershed protection. A brief summary of key Croton watershed management programs is provided below.

Wastewater Treatment Plant Upgrades and Diversion ($200 million) – DEP has committed to fund the upgrades of all City-owned and non-City-owned wastewater treatment plants (WWTPs) to state-of-the-art tertiary treatment facilities. The City owns two WWTPs in the Croton watershed: one in Mahopac and the other in Brewster. Upgrade of the Mahopac facility was completed in 2002, and the City has entered into an agreement with the Village of Brewster to reconstruct that facility. DEP is working with the owners of the approximately 70 non-City-owned WWTPs to complete the necessary upgrades. In addition, the City has committed additional funds over and above the projected upgrade costs to support a project by Westchester County to divert four WWTPs, including the Yorktown WWTP, to discharge outside the watershed.

Land Acquisition ($13.5 million) – Through its land acquisition efforts, DEP has secured key parcels in the Croton Reservoir basin. The City has also worked with the State to direct State acquisition dollars and also with Putnam County to allow the County to use funds provided by the City to purchase lands in the watershed. In total, more that 1,000 acres have been permanently protected through acquisition.

East-of-Hudson Nonpoint Source Program ($20 million) – DEP is implementing a program to protect selected Croton basins from nonpoint sources of pollution. Key components of the program will include construction of stormwater management practices, and mapping, inspection and repair as necessary of storm and sanitary sewers. In addition, DEP has been coordinating with the State Department of Transportation and county and local officials to address a number of sites identified by Trout Unlimited as in need of stormwater retrofits or other erosion and sediment controls.

East-of-Hudson Watershed Agricultural Program ($3.3 million) – Modeled after the highly successful west of Hudson Agricultural Program, DEP and the Watershed Agricultural Council will work with farmers in the Croton watershed to design and install best management practices to reduce or eliminate polluted runoff from farms.

Croton Process Studies ($6 million) – DEP, through a contract with the State University of New York College of Environmental Studies and Forestry (SUNY-ESF), is gathering watershed-specific information on the sources and spatial and temporal characteristics of nutrients and precursors of disinfection by-products. The extensive sampling program includes baseflow and storm event sampling at sites located throughout the watershed and intensive in-reservoir sampling at key locations. This research into the sources of key water quality constituents will be

valuable in guiding management decisions and developing reservoir and terrestrial models for the Croton System. Several of the results of this study have been described above.

East-of-Hudson Reservoir and Terrestrial Models ($459,000) – DEP obtained several grants from federal funds allocated under the Safe Drinking Water Act to pursue the development of reservoir and terrestrial models for the Croton System. Most of these projects are currently in progress.

Croton Watershed Strategy ($2.6 million) - This project consists of watershed analyses at the subbasin scale (for phosphorus, suspended solids, pathogens, toxics and pesticides), and recommended management strategies and prioritization of efforts for the watershed. The analyses were also programmed into a GIS-based management tool.

Wetland Programs ($150,000) – Wetlands play an important role in water quality protection but they can also contribute to problems with disinfection by-product precursors, nutrients and color. DEP has a number of ongoing wetland programs, including updating the National Wetlands Inventory maps, investigating the water quality impacts of different functional wetland types, and documenting trends in wetland losses in the East-of-Hudson watershed.

THM Formation Potential Study ($115,400) – In addition to the routine monitoring of New Croton and Muscoot reservoirs for THM formation potential, DEP conducted a one year expanded monitoring program to further determine the origins of THM precursors within the Croton watershed.

Hypolimnetic Aeration Pilot ($1.5 million) – DEP conducted a two-year hypolimnetic aeration pilot program (1998 – 2000), employing three aerators in the New Croton Reservoir. Extensive reservoir monitoring was conducted to evaluate the water quality benefits of aeration and to further refine designs for full-scale aeration. The pilot demonstrated at least a minor water quality benefit due to aeration as well as providing useful information on aerator design and operations. However, additional information is needed from other ongoing research projects concerning the origins of color in the reservoir before a final determination can be made regarding the utility of hypolimnetic aeration in this system.

USGS Stream Gauging Monitoring Program ($1.3 million) – In the Croton System USGS and DEP have been installing and maintaining additional stream monitoring gauges for the past 6 years to help provide a deeper understanding of how the water in the Croton System moves through the system of reservoirs and to quantify the water in the watersheds. These water budgets then allow DEP to model pollutant loads to the reservoirs (such as nutrients and coliform bacteria) and provide~~s~~ a tool to anticipate problems and develop management strategies for addressing these problems.

DEP Source Water Monitoring Program ($3.2 million annually on Croton) – Each year, DEP collects more than 35,000 samples from 300 watershed sites and performs more than 300,000 laboratory analyses. The monitoring program's fundamental goals are to help manage the system to provide the best possible water, to develop a database through which water quality trends can be identified, and to identify water quality conditions of concern to focus watershed management efforts. The City's source water monitoring program was independently evaluated in 1997, by the National Research Council. The Council found the City's program to be "informed, extensive, and of high quality for a water supply of its size." The Council also noted that "the complexity of the multiple interacting reservoir ecosystems of the NYC water supply imposes major monitoring demands to allow for effective management responses to problems. In general, NYCDEP has been performing these formidable tasks excellently." Accordingly, findings of the City's peer-reviewed source water monitoring program have reliably served as the scientific basis for the City's watershed protection program.

DEP has also supported, with both funding and in-house resources, a number of outside programs related to the protection of the Croton watershed.

Phosphorus Total Maximum Daily Loads - TMDLs is a Clean Water Act program that integrates the management of point and nonpoint sources of a pollutant in order to meet water quality standards. DEP has for many years been providing technical support to NYSDEC for the development of phosphorus TMDLs for the NYC reservoirs.

Croton Planning and Water Quality Investment Funds – Many watershed management projects can only be implemented at the local level. Through the Watershed Memorandum of Agreement (MOA), Westchester and Putnam Counties are conducting watershed planning ("Croton Plans") to determine how to use the funds the City provided them for projects to protect and improve water quality (~$68 million).

Westchester County WWTP Diversion – As mentioned above, Westchester County is considering diversion of a municipal WWTP (Yorktown Heights WWTP) and several small WWTPs and septic areas to a treatment plant outside of the Croton watershed. This single WWTP accounts for more than half of the total WWTP flow in the Westchester portion of the Croton watershed.

B. Regulatory Protection

A number of entities have regulatory authority over particular activities in the Croton watershed, including local municipalities, county governments, New York State and New York City. The New York City Watershed Rules and Regulations (WR&Rs) apply uniformly across the City's entire watershed. These regulations protect the water quality against specific, future activities. A few key components of the WR&Rs include:

Project Review – New development projects that require a stormwater plan under the WR&Rs are reviewed and approved by DEP engineering staff. The project sites are initially evaluated by field visits, and DEP conducts follow-up inspections to confirm compliance with the approval conditions.

Regulatory Compliance – DEP's Regulatory Compliance and Inspection group conducts regular inspections of surface-discharging WWTPs, which have resulted in measurable improvements in treatment performance. This is demonstrated by an analysis of trends in flows and total phosphorus (TP) loads at WWTPs in the watershed for the period 1994-1999. Overall, estimated 1999 TP loads from WWTPs were about 65.7% less than in 1994. This was largely due to the attention paid to these facilities by DEP's Regulatory Compliance and Inspection group and corrective actions taken by WWTP operators.

Septic Systems – New septic system plans are also reviewed by DEP engineering staff in coordination with the County Departments of Health.

Phosphorus Restricted Basins – The WR&R give DEP the authority to designate reservoir basins as "phosphorus restricted" if monitoring data indicate that the reservoir exceeds the State guidance value for phosphorus. In a Phosphorus Restricted Basin, new or expanded WWTPs with surface discharges are prohibited and there are additional requirements for stormwater treatment and impact analysis. This regulation primarily protects the Croton System, and currently there are eight reservoirs and/or controlled lakes that are phosphorus restricted in the Croton System.

DEP Police – DEP has significantly expanded the DEP Police force in recent years. DEP's Environmental Police Officers provide security at DEP facilities and patrol the watershed to detect environmental infractions. Officers are receiving specialized training in the WR&Rs and the detection and investigation of potential threats to water quality. The Police coordinate closely with DEP's Project Review and Regulatory Compliance staff to ensure complete coverage of activities in the watershed.

DEP also works to enhance State and/or federal regulatory protection whenever possible. Recent efforts include:

SEQRA Reviews – The New York State Environmental Quality Review Act (SEQRA) provides DEP with an important mechanism, separate from the City's Watershed Regulations, to identify and mitigate potential impacts that certain actions, including proposed development projects, may have on the quality of the City's drinking water supply. By actively participating in the SEQRA environmental review process, DEP considers, at an early stage in a project's development, the wide range of factors that affect the nature and severity of a project's impact on water quality. These include factors that may not be directly regulated by DEP but which could have significant effects on water quality, such as impacts on local wetlands, percentage of impervious cover, amount of soil disturbance, impacts of secondary growth, and other issues of particular importance in the reservoir basin or project sub-basin. SEQRA also requires a project sponsor to explore alternatives that would minimize potential impacts, and to incorporate mitigation measures into a project to compensate for certain unavoidable impacts.

Wetland remapping and ULI designation – At DEP's request, DEC is currently revising the NYS Freshwater Maps for the East-of-Hudson watersheds, specifically locating additional wetlands that meet the regulatory threshold of 12.4 acres and identifying smaller wetlands of Unusual Local Importance (ULIs) that are adjacent to the reservoirs. Through DEP field checks, an additional 230 acres was added to the draft maps for Westchester County alone. If all revisions are adopted, the acreage of wetlands subject to both DEC and DEP regulations would increase from 5338 acres to 7731 acres in the Westchester County portion of the watershed. Putnam County field checks are scheduled for 2003.

Stream Reclassification – Trout and trout spawning streams have tighter water quality standards and enhanced compliance criteria under any regulated action. DEP has been conducting stream surveys in the watershed since 1996 to verify the presence of trout and/or trout spawning waters, and then petition DEC to upgrade the stream classification.

Stormwater Enforcement – DEP and DEC have modified their 1993 Memorandum of Understanding on Enforcement to provide for coordinated enforcement of certain stormwater violations. The new program, which reflects the recent practice of the agencies, is intended to maximize the effectiveness of DEC's administrative enforcement power by making use of DEP's inspection staff and technical expertise.

Phase II Stormwater Regulations, East-of-Hudson permits – The Phase II Stormwater Regulations contain new requirements for stormwater discharges from construction and municipal activities. DEP has been actively commenting on the regulations themselves and the proposed statewide permits. In particular, DEC accepted DEP's recommendation that the entire East-of-Hudson watershed be designated as an Urban Area. DEP is also working closely with DEC to develop special watershed-specific permits to enhance protection of the East-of-Hudson watershed

The City's watershed rules and regulations as well as the state and federal regulatory safeguards described above add to the protection of water quality in the Croton System by primarily addressing future development or other watershed activities. They cannot, unfortunately, overcome the impacts from existing development in the watershed. Together with filtration, they form a strong, multiple barrier strategy to preventing contamination of the critical water supply.