1. INTRODUCTION

The New York City Department of Environmental Protection (DEP) supplies clean drinking water to more than eight and a half million New York City (City) residents and one million upstate customers in Westchester, Putnam, Orange, and Ulster Counties, New York. DEP supplies this water in sufficient quantities to meet consumers' present water demands, while simultaneously maintaining and improving the City's water supply system to ensure it can meet all future water demands. The City must comply with all applicable New York State (State) and federal laws and regulations governing its water supply to protect public health and the environment. DEP achieves these mandates and objectives through its careful and coordinated management of the City's three upstate reservoir systems, which collectively comprise the New York City water supply system: the Catskill, Delaware, and Croton (**Figure 1-1**).

This Environmental Impact Statement (EIS) was prepared to evaluate modification of DEP's Catskill Aqueduct Influent Chamber State Pollutant Discharge Elimination System Permit (SPDES No. NY 026-4652) (CATIC or Catalum SPDES Permit). The Catalum SPDES Permit authorizes DEP to apply aluminum sulfate (alum) and sodium hydroxide (a buffering agent) to water diverted from Ashokan Reservoir[1] under certain circumstances, to reduce turbidity[2] – an element of water quality – and improve settling in the Kensico Reservoir water column. Alum attaches to the particles suspended in the water column that cause turbidity and causes them to settle. The Catalum SPDES Permit requires DEP to dredge the accumulated material (alum floc) from Kensico Reservoir.

In June 2012, DEP requested a modification to the Catalum SPDES Permit to incorporate turbidity control measures, including an operating protocol for Ashokan Reservoir and the Ashokan Release Channel, and to delay dredging of alum floc from Kensico Reservoir.[3] An Order on Consent was issued by the New York State Department of Environmental Conservation (NYSDEC) on October 4, 2013, and was amended in 2018 (2018 Modification) and in 2020 (2020 Modification) (collectively as modified, the Consent Order). The EIS evaluates potential benefits and impacts associated with use of the Ashokan Release Channel in accordance with the September 27, 2013 Interim Ashokan Release Protocol (IRP) and delay of dredging at Kensico Reservoir (Proposed Action). This EIS also includes a comparative analysis of the potential environmental benefits and adverse impacts for the following alternatives to the operation of Ashokan Reservoir in accordance with the IRP and to minimize the area of floc deposition in Kensico Reservoir: the No Action Alternative (no permit modification); reasonable infrastructure and operational alternatives at Ashokan Reservoir; reasonable alternatives for movement of water out of the Catskill Aqueduct prior to its reaching Kensico Reservoir; and reasonable structural alternatives for limiting alum floc deposition in Kensico Reservoir. As part of the EIS, DEP also evaluated the Water Quality Monitoring Plan incorporated into the IRP and developed a proposed Revised Operating Protocol and Revised Monitoring Plan.

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[1] The application of aluminum sulfate (alum) and sodium hydroxide to water in the Catskill Aqueduct at the Pleasantville Alum Plant (upstream of Kensico Reservoir) is referred to as alum application.

[2] Turbidity is an optical property of water influenced by the presence of higher concentrations of suspended particles that make water opaque or cloudy. This matter normally consists largely of suspended clay, silt, organic and inorganic material, and microscopic organisms. Turbidity is of concern primarily due to its potential impact on public health by making disinfection less effective, as the cloudiness could interfere with chlorine and ultraviolet-light disinfection, and potential contaminants may adhere to, or be encapsulated by the suspended particles.

[3] Alum attaches to particles suspended in the water column that cause turbidity and causes them to sink and settle on the floor of the water body. These coagulated/flocculated particles are referred to as "alum floc."

The proposed modification of the Catalum SPDES Permit would also relocate the phosphorus monitoring point used during alum application events from the Pleasantville Alum Plant to Site 5BRK within Kensico Reservoir (identified in the permit). This change would better reflect post treatment phosphorus concentrations and would be more representative of phosphorus levels entering the reservoir given alum has to react/mix with the turbid Catskill water in the Catskill Aqueduct during transit from the Pleasantville Alum Plant to the Reservoir. Moving the phosphorus monitoring point would allow this measurement to be taken concurrent with the turbidity measurements being taken at Site 5BRK during alum treatment events. In addition, the Catalum SPDES permit would also be modified to include a pH limit from 6.0 – 9.0 during periods of alum addition. As per 6 NYCRR Part 617.5(c) 24, these changes would be considered Type II actions related to information collection and, as such, have no significant impact on the environment.

The Consent Order establishes NYSDEC as the Lead Agency for this EIS. DEP worked cooperatively with NYSDEC to prepare this EIS consistent with the requirements of the Consent Order, and the State Environmental Quality Review Act (SEQRA) as set forth in 6 NYCRR Part 617 and authorized by Article 8 of the Environmental Conservation Law, and the City Environmental Quality Review (CEQR) process as set forth in 62 RCNY Chapter 5 and Executive Order 91 of 1977 and its amendments.

NYSDEC issued a Draft Scope of Work for this EIS on April 9, 2014. Public meetings were held on the Draft Scope of Work on May 12, 2014 and May 14, 2014; and the public comment period closed on August 29, 2014. A Final Scope of Work was subsequently issued by NYSDEC on March 22, 2017, which included revisions to the Draft Scope of Work made in response to comments received during the Draft Scope of Work's public notice and comment period.

This introduction describes the regulatory drivers of the Proposed Action, as well as other important contextual background information and a description of DEP's turbidity control measures, all of which are important to gain an understanding of the Proposed Action. The two sections that follow discuss the purpose and need of the Proposed Action and provide a more detailed summary of the Proposed Action.

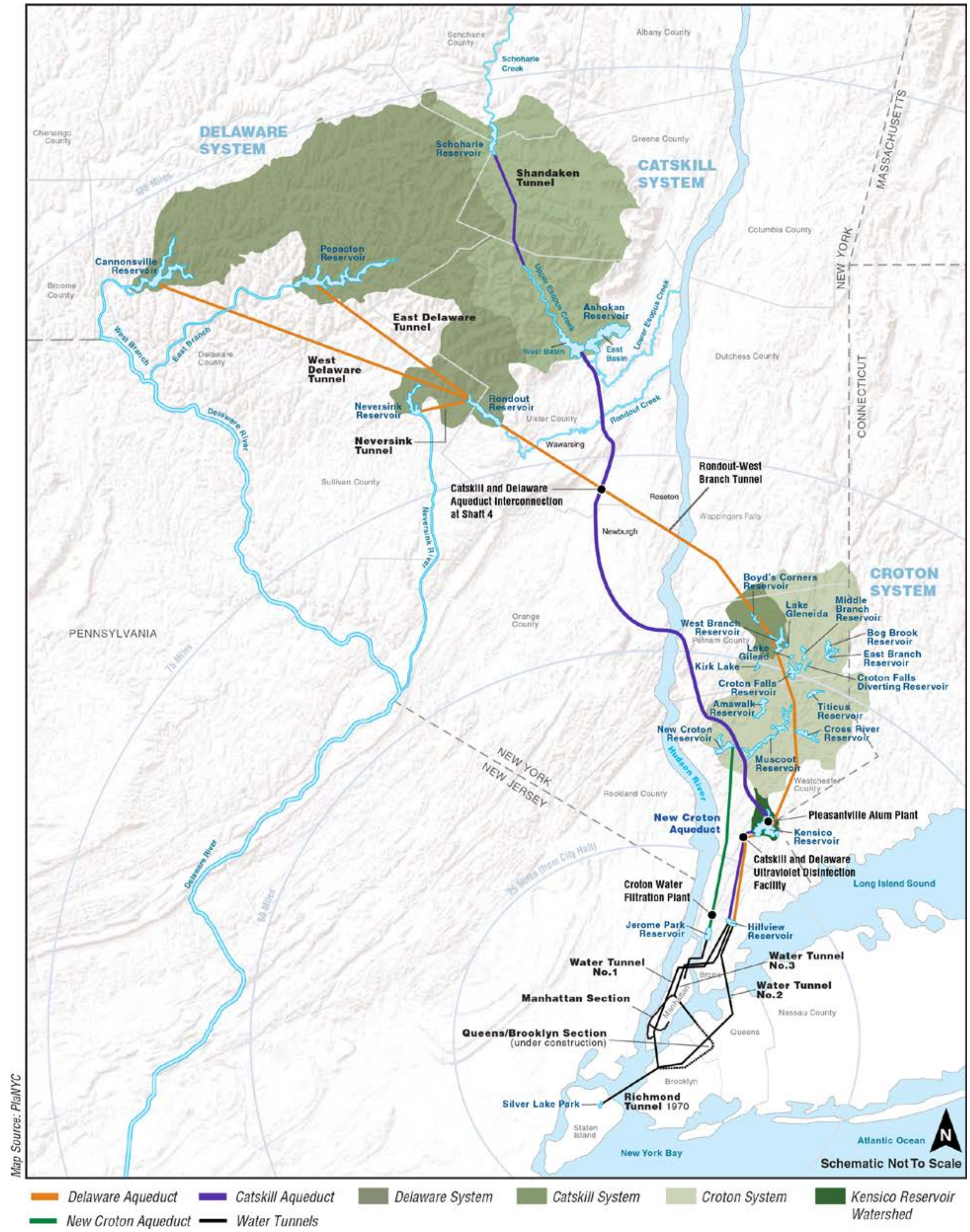

Figure 1-1
Water Supply System Overview

1.1 REGULATORY DRIVERS OF THE PROPOSED ACTION

New York City's Water Supply System is one of the largest surface water storage and supply complexes in the world, with watersheds covering 1,972 square miles. DEP employs a number of programs and protocols to manage these watersheds and the resulting water quality of the Catskill, Delaware, and Croton water supply systems (see Section 1.2, "Background"). Recognizing the need to protect the long-term viability and overall resilience of the water supply system, the City is committed to making systematic and sustained investments in the critical infrastructure that provides water to more than nine and a half million people each day. In addition, DEP seeks ways to optimize operation of this dynamic system in response to changing environmental and regulatory conditions, while balancing multiple objectives. To that end, this EIS evaluates potential benefits and impacts of DEP's operation of the Catskill System to address elevated concentrations of suspended particles that make receiving waters within the system opaque or cloudy (turbidity) in a manner that minimizes environmental impacts to the greatest extent practicable while meeting the requirements of both the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA).

The high quality of the Catskill/Delaware System source waters is attributable to the watershed's relatively pristine landscape and DEP's extensive Watershed Protection Program, which has allowed DEP to operate the system under a Filtration Avoidance Determination (FAD) from the New York State Department of Health (NYSDOH) and United States Environmental Protection Agency (EPA). The original FAD was granted in 1993 after EPA determined that the City's Catskill and Delaware systems satisfied the requirements for unfiltered surface water supply systems under the SDWA and the Surface Water Treatment Rule (SWTR). DEP currently operates the Catskill/Delaware System under the ten-year 2017 FAD, which establishes requirements for continued watershed protection efforts.

The Safe Drinking Water Act

The Safe Drinking Water Act protects public health through regulation of the nation's public drinking water supply. The United States Environmental Protection Agency sets national standards for drinking water to protect the public against water-related health risks, considering available technology and costs. For surface water systems, the Safe Drinking Water Act dictates a series of Surface Water Treatment Rules to reduce illnesses caused by pathogens in drinking water.

The Clean Water Act

The Clean Water Act establishes the framework for regulating the discharge of pollutants into waters of the United States and for designating uses and establishing quality standards for surface water.

What is the Filtration Avoidance Determination (FAD)?

Beginning in 1993, EPA determined that the City's Catskill and Delaware surface water supply systems satisfied the requirements for unfiltered surface water supply systems. Since the initial FAD in 1993, EPA issued a series of subsequent FADs, transferring primacy for regulatory oversight to the New York State Department of Health in 2007. The most recent ten-year FAD was issued in 2017 by NYSDOH. Through the FAD, the City must meet stringent source water quality, disinfection, and site-specific filtration avoidance criteria.

While the source waters of the City's water supply are generally of high quality, storm events within the Catskill System can disturb the naturally-occurring, clay-rich stream banks and channels in the Schoharie and Ashokan watersheds, which in turn can generate turbidity in the receiving reservoirs. At times, large storms can result in turbidity levels that are too high to be addressed by the natural settling processes within Ashokan Reservoir, resulting in elevated turbidity levels in the water entering the Catskill Aqueduct. To protect water quality within Kensico Reservoir, DEP has responded to elevated turbidity using a number of operational techniques (discussed further in Section 1.2.2, "Operation of the Catskill Water Supply System"), including application of water treatment chemicals at DEP's Pleasantville Alum Plant upstream of the point where water in the Catskill Aqueduct enters Kensico Reservoir. These chemicals include aluminum sulfate (alum) and sodium hydroxide (a buffering agent).

As stated above, the Proposed Action is a modification of the Catalum SPDES Permit to include use of the Ashokan Release Channel in accordance with the IRP and delay of dredging of accumulated alum floc from Kensico Reservoir. The Catalum SPDES Permit is discussed in Section 1.2.3, "Emergency Authorizations for Alum Application," following an overview of the water supply system and its operations and operation of the Catskill Water Supply System in Sections 1.2.1, "Overview of the Water Supply System and System Operations" and 1.2.2, "Operation of the Catskill Water Supply System." All future dredging would be subject to a Protection of Waters Permit for Excavation or Placement of Fill in Navigable Waters and 401 Water Quality Certification from NYSDEC.

1.2 BACKGROUND

1.2.1 OVERVIEW OF THE WATER SUPPLY SYSTEM AND SYSTEM OPERATIONS

DEP, on behalf of the City, maintains and operates a system of 19 reservoirs and three controlled lakes that provide more than one billion gallons of drinking water per day, to over eight and a half million City residents, and approximately 125 million gallons per day (MGD) for one million upstate residents in Westchester, Putnam, Ulster, and Orange counties. The City's reservoirs are located in the upstate Catskill, Delaware, and Croton watersheds. Water from these reservoirs flows by gravity through three water supply systems – comprised of three aqueducts named for each of the watersheds – into a system of reservoirs, and ultimately through the City's distribution system that delivers water directly to customers.

As stated above, approximately 40 percent of the City's average water demand has historically been provided by the Catskill System. The Delaware System has historically provided 50 percent of the City's average water demand and 10 percent has been supplied by the Croton System. The Croton System has the capacity to provide up to approximately 30 percent of the City's water demand. Water from both the Catskill and Delaware systems is normally routed through Kensico Reservoir before being conveyed through the Delaware Aqueduct to the Catskill/Delaware Ultraviolet (UV) Facility, located in the Town of Mount Pleasant in Westchester County. Water then flows through the portions of the Delaware and Catskill aqueducts located downstream of the UV Facility to Hillview Reservoir, and then via City tunnels to the water distribution system. Approximately 20 communities are supplied with water via the Catskill Aqueduct upstream of Kensico Reservoir through 15 water supply connections (outside community connections). Water from the Croton System is conveyed to the City via the New Croton Aqueduct to Jerome Park Reservoir.

To ensure the continual supply of reliable drinking water to all customers within the context of a complex regulatory framework, DEP must actively manage the water supply systems using multiple operating rules (or protocols) that make use of the systems' dynamic, redundant, and interconnected nature, which provides operational flexibility. This flexibility allows DEP to selectively divert, transfer, or release water from different reservoirs to help balance water quality criteria thresholds and water supply needs with other benefits such as flood attenuation. Among other parameters, operational protocols are largely driven by both current and projected hydrology and water demand.

1.2.2 OPERATION OF THE CATSKILL WATER SUPPLY SYSTEM

Completed in 1928, the Catskill System consists of two reservoirs: Schoharie Reservoir, in Schoharie and Green Counties, New York and Ashokan Reservoir in Ulster County, New York. The Catskill System also shares two reservoirs with the Delaware System, the Kensico and Hillview Reservoirs, located in Westchester County, New York.

Schoharie Reservoir diverts water to upper Esopus Creek via the Shandaken Tunnel. Upper Esopus Creek subsequently flows into Ashokan Reservoir. From there, water flows to the City's water supply system through the upper Catskill Aqueduct. The upper Catskill Aqueduct extends approximately 74 miles between Ashokan Reservoir and Kensico Reservoir and currently has a capacity of up to 590 MGD (913 cfs). It ends at Kensico Reservoir in Westchester County (**Figure 1-1**), which has its own small watershed (approximately 13 square miles) that contributes water to the system.

The engineers who designed the Catskill System were aware that the underlying geology of the region would result in periodic episodes of elevated turbidity. Ashokan Reservoir has a dual basin design, unique within the New York City water supply system, to allow for extended detention time to help address turbidity (**Figure 1-2**). During typical operating conditions, water enters the west basin and turbidity-causing particles settle to the bottom of the basin before water is transferred to the east basin and then diverted to the Catskill Aqueduct, discharging at Kensico Reservoir (**Figure 1-3**). When there is turbidity within the Catskill System, additional operational techniques can be used to prevent turbid water from being transported through the system, as follows:

- **Selective diversion.** The practice of selecting water from the reservoirs with the highest water quality is known as selective diversion. During turbidity events in the Catskill System, DEP typically minimizes diversions through the Catskill Aqueduct, making up the balance of water demand from the Delaware and Croton systems.
- **Selective withdrawal.** The practice of selecting the highest quality water from various depths and locations within a reservoir is known as selective withdrawal. DEP has the ability to withdraw and divert water from either the east or west basin of Ashokan Reservoir at various depths. However, the existing infrastructure configuration and hydraulics limit the precision of switching between various intake levels (depths).
- **West basin drawdown.** DEP can divert water of acceptable quality from the west basin to the east basin of Ashokan Reservoir via a dividing weir to create a void in the west basin of Ashokan Reservoir. The void allows the west basin to absorb some or all of the inflow to the Reservoir, thereby reducing the uncontrolled transfer of water across the dividing weir to the east basin, which also has the potential to reduce spill to lower Esopus Creek. When inflow to the Reservoir is turbid, the void in the west basin helps protect water quality by providing time for turbidity to settle in the west basin.
- **Releases.** DEP also releases water from Ashokan Reservoir via the Ashokan Release Channel in accordance with the IRP.

Additional measures to control turbidity, including infrastructure improvements, are described in Section 1.3, “Turbidity Control Measures.”

These operational techniques reduce turbidity levels in water entering the Catskill Aqueduct, and therefore reduce the need for alum application to water in the Catskill Aqueduct upstream of Kensico Reservoir. However, during large storm events, water with elevated turbidity levels can still enter Kensico Reservoir. When necessary to manage turbidity from unusually large storm events, alum may be applied.

Alum application addresses turbidity by binding with suspended particulate matter, so this matter can more readily settle out of the water column as alum floc (**Figure 1-4**). Alum floc has accumulated over time on the Kensico Reservoir bottom primarily in an area of the Reservoir known as the Catskill Influent Chamber (CATIC) Cove (**Figure 1-5)**. The application of these chemicals to drinking water supplies to address turbidity is a long standing, well accepted, and widely used practice throughout the United States.

Kensico Reservoir is a Class AA waterbody and discharges to the Reservoir are regulated under the CWA. The application of alum, which is considered a “pollutant” under the CWA, is regulated under the Catalum SPDES Permit. The Catalum SPDES Permit authorizes DEP to discharge alum applied for water treatment into Kensico Reservoir.

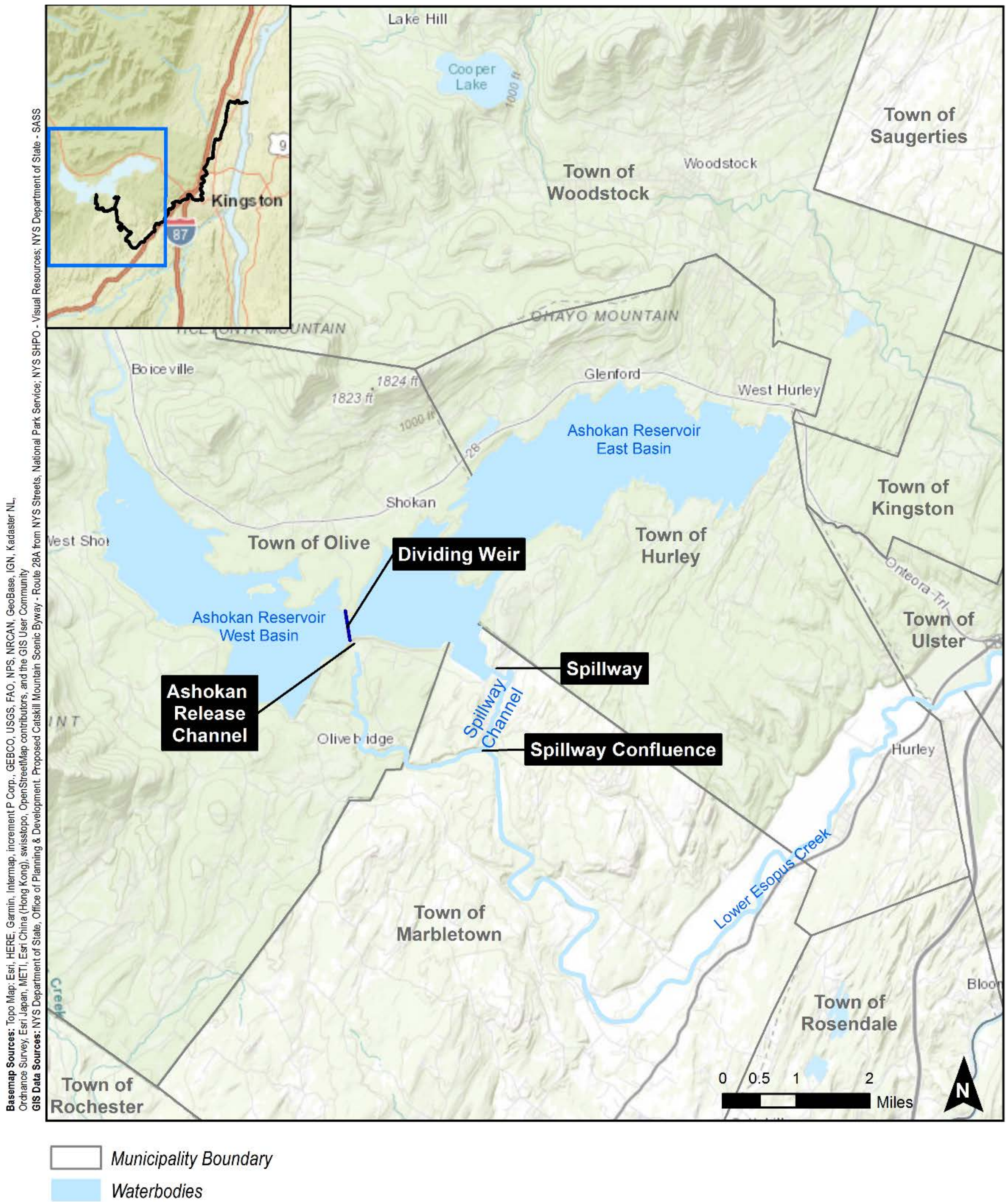

Figure 1-2
Ashokan Reservoir, Ashokan Release Channel, and Spillway

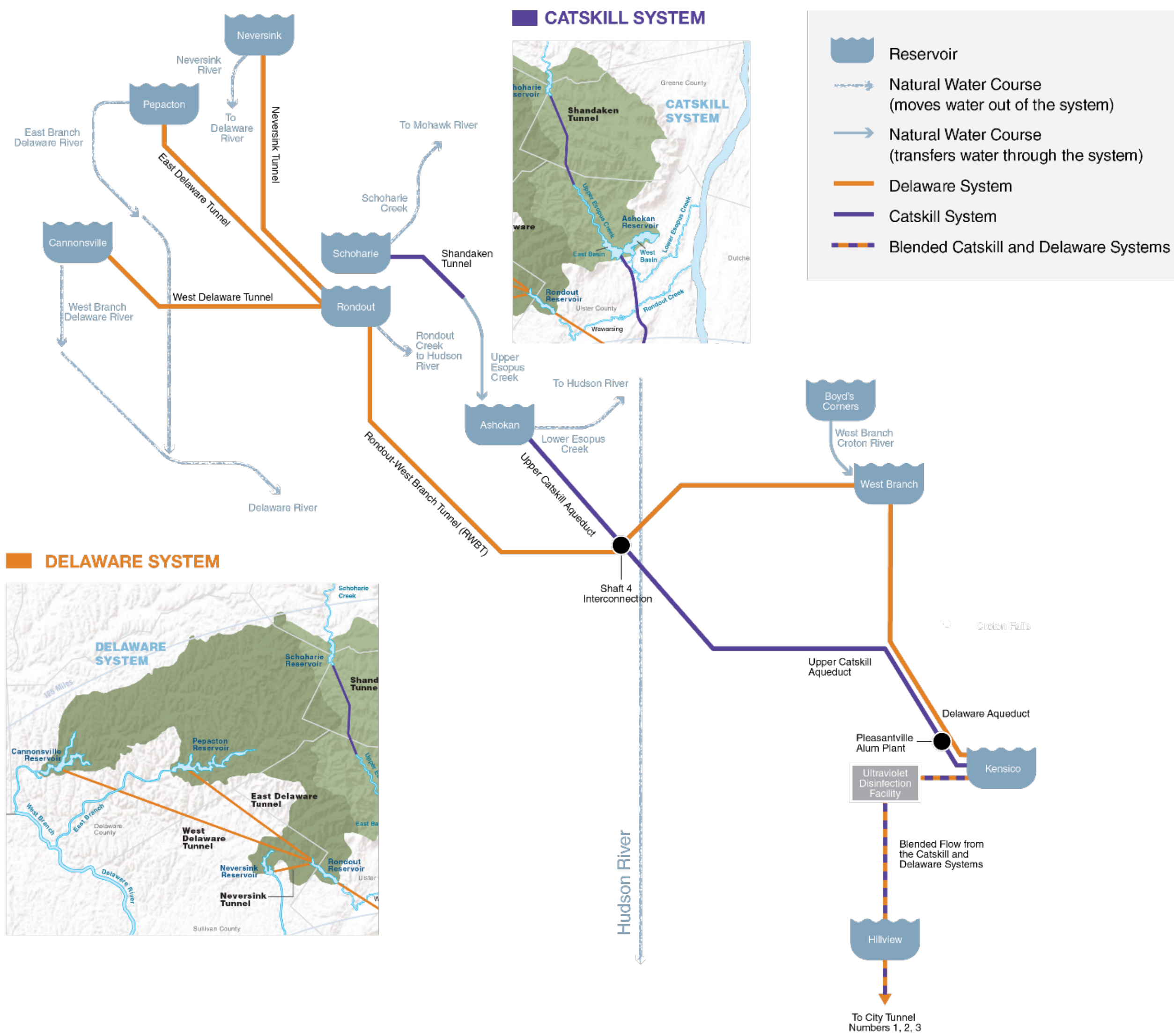

Figure 1-3
Schematic of the Catskill/Delaware Water Supply System

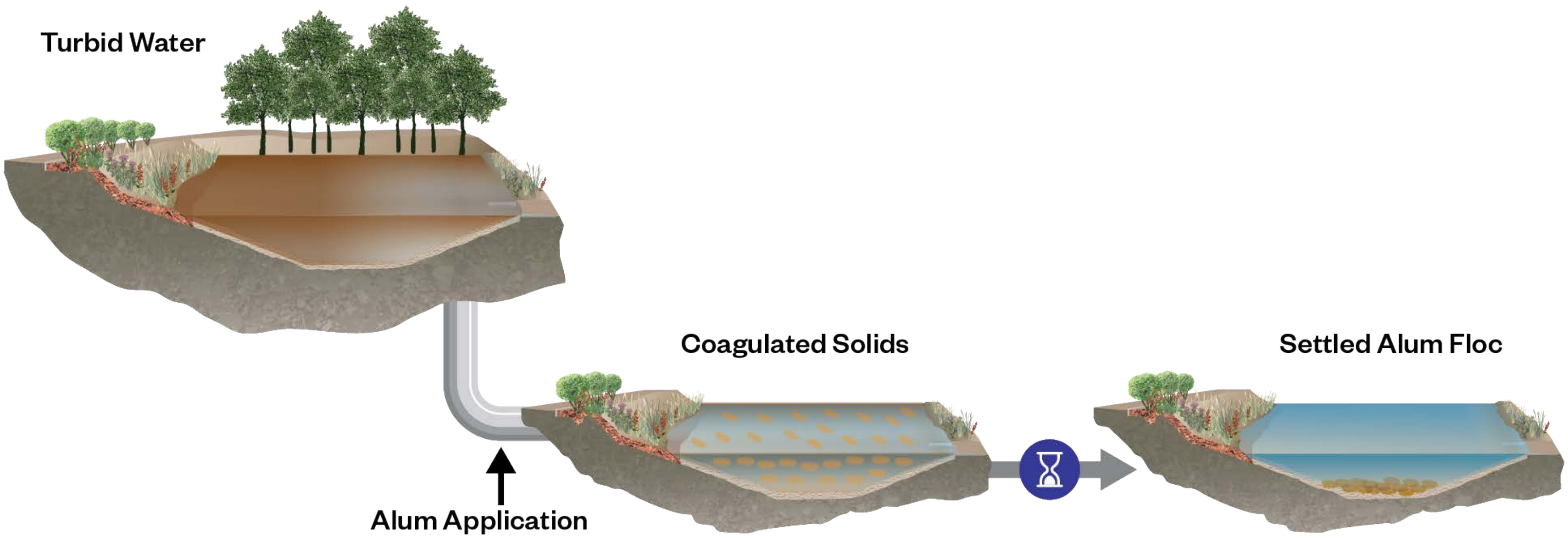

Figure 1-4
Conceptual Alum Application and Settling Process

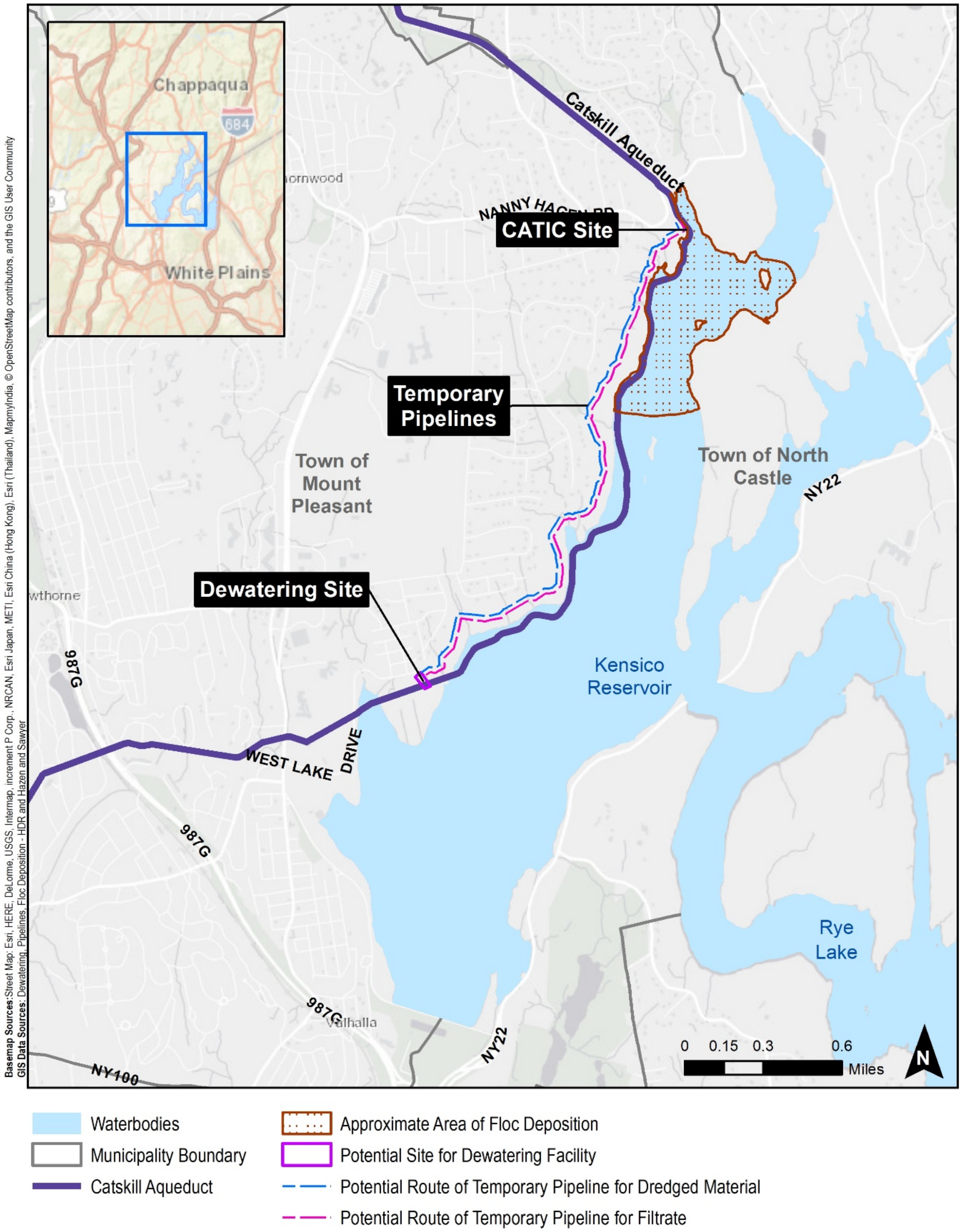

Figure 1-5
Kensico Reservoir Study Area

1.2.3 EMERGENCY AUTHORIZATIONS FOR ALUM APPLICATION

Addressing turbidity in DEP's Catskill System to protect water supply and the environment is informed by a long history of cooperation between EPA, NYSDOH, NYSDEC, DEP and stakeholders.

2005
Mar - Emergency authorization of alum application
Jun - City applies for Catalum SPDES Permit

2006
Mar - DEP activates ARC to support emergency work at Gilboa Dam

2007
Jan - EPA with NYSDOH issues 2007 FAD
July - NYSDEC issues the Catalum SPDES Permit

2010
Fall - DEP operates ARC and applies alum in response to fall storm events and ARWG is formed

2011
DEP enters negotiations with NYSDEC regarding use of the ARC, and initial IRP issued
Summer - DEP operates ARC and applies alum in response to Tropical Storms Irene and Lee

2012
Catalum SPDES Permit administratively renewed

2013
Oct - Consent Order issued with updated IRP requiring DEIS and SPDES Permit modification

2014
May - EPA with NYSDOH issues Revised 2007 FAD

2017
Catalum SPDES Permit administratively renewed
Dec - NYSDOH issued 2017 FAD

2018
Modification of the Consent Order

2020
Modification of the Consent Order

As noted above, DEP periodically applies alum to water in the Catskill Aqueduct upstream of Kensico Reservoir to address water quality concerns stemming from episodic turbidity events in the watershed in a manner consistent with federal and State regulatory turbidity limits for unfiltered surface water supplies (i.e., the FAD). From 1981 through 2006, there were eight storm events that resulted in turbidity levels that could not be managed by routine operational practices. Because the discharge of "pollutants" (including alum applied for water treatment) to surface water is regulated under the CWA, the application of alum triggered the need for authorization from NYSDEC. NYSDEC, in coordination with NYSDOH, issued several emergency authorizations to DEP, which allowed DEP to apply alum to water in the Catskill Aqueduct upstream of Kensico Reservoir. Through 2006, approximately 17.5 million pounds of alum were applied over eight discrete occasions, which varied in duration from 15 to 216 days (**Figure 1-6)**.

Following the expiration of these emergency authorizations, NYSDEC issued the Catalum SPDES Permit on January 1, 2007, which was initially valid for a period of five (5) years, but has since been administratively renewed pursuant to 6 NYCRR 750-1.16.

The Catalum SPDES Permit authorizes DEP to apply alum and sodium hydroxide to reduce turbidity in the Catskill Aqueduct upon NYSDEC receipt of a copy of a notice from the NYSDOH that there is a potential imminent development of a public health hazard related to the discharge of turbid water from Kensico Reservoir.

The Catalum SPDES Permit includes effluent limits for discharges to Kensico Reservoir and a compliance schedule with specific milestones related to alum application to address turbidity in the Catskill System. Specifically, the permit requires:

- Preparation of a report that analyzes alternatives to minimize the area of floc deposition in Kensico Reservoir resulting from application of alum and sodium hydroxide to water in the Catskill Aqueduct, identifies a selected alternative, and describes how and when the selected alternative would be implemented (completed in 2007);
- Preparation of a study of underwater topography (bathymetry) and conditions at the lowest level of Kensico Reservoir (benthic zone) to establish a scientific basis for the quantity of alum floc deposits that must be removed to meet the narrative water quality standards for suspended, colloidal and settleable solids in Kensico Reservoir (completed in 2007);
- Preparation of an engineering report describing the information gathered during the removal of alum floc deposits and to guide additional dredging activities in the future. The report is anticipated to be completed following dredging of alum floc at Kensico Reservoir;

- Development of a program to reduce the amount and duration of alum application by evaluating and implementing structural, operational, and erosion control measures to reduce turbidity in water flowing into the Catskill Aqueduct and to protect the water supply, fishery, and recreational uses within both Ashokan Reservoir basins and Kensico Reservoir (completed in 2007, and re-evaluated in this EIS);
- Identification and implementation of any short- and long-term structural measures that will achieve the above goals (completed in 2007 for Kensico Reservoir and 2008/2011 for Ashokan Reservoir); and
- Submittal of a report detailing the short- and long-term structural modifications evaluated in turbidity control studies required by the FAD and implementation of approved structural alternatives (report completed in 2007 and structural modifications are re-evaluated in this EIS as alternatives to the Proposed Action).

As part of its ongoing commitment to optimize water supply operations and to meet the Catalum SPDES Permit requirements, DEP has explored a number of engineering and operational alternatives to minimize the application of alum to water in the Catskill Aqueduct upstream of Kensico Reservoir, further described in Section 3, "Proposed Action." A summary of prior studies, including some of the alternatives evaluated within the EIS, are summarized in **Figure 1-7**.

1.2.4 ALUM APPLICATION AND ASHOKAN RELEASE CHANNEL USE

In October 2010, as a result of several large storm events that increased the turbidity of water entering Ashokan Reservoir's west basin, DEP began releasing water through the Ashokan Release Channel. A history of Ashokan Release Channel use, both prior to and following issuance of the Consent Order, is provided in **Figure 1-8**.

As demonstrated above, releases alone were insufficient to address turbidity in water diverted to Kensico Reservoir during extreme storm events, and the application of alum was required in these instances. Since the initial use of the Ashokan Release Channel for turbidity response in 2010, there have been alum application events associated with storm events that resulted in elevated levels of turbidity in the system, such as Tropical Storms Irene and Lee in 2011.

Ashokan Release Working Group (ARWG)

- Established on December 17, 2010.
- Comprised of representatives from EPA, NYSDEC, NYSDOH, DEP, Ulster County, local municipalities, landowners, environmental groups, and other stakeholders.
- Provided input on Draft Scope of Work for the Modification of the Catalum SPDES Permit EIS.

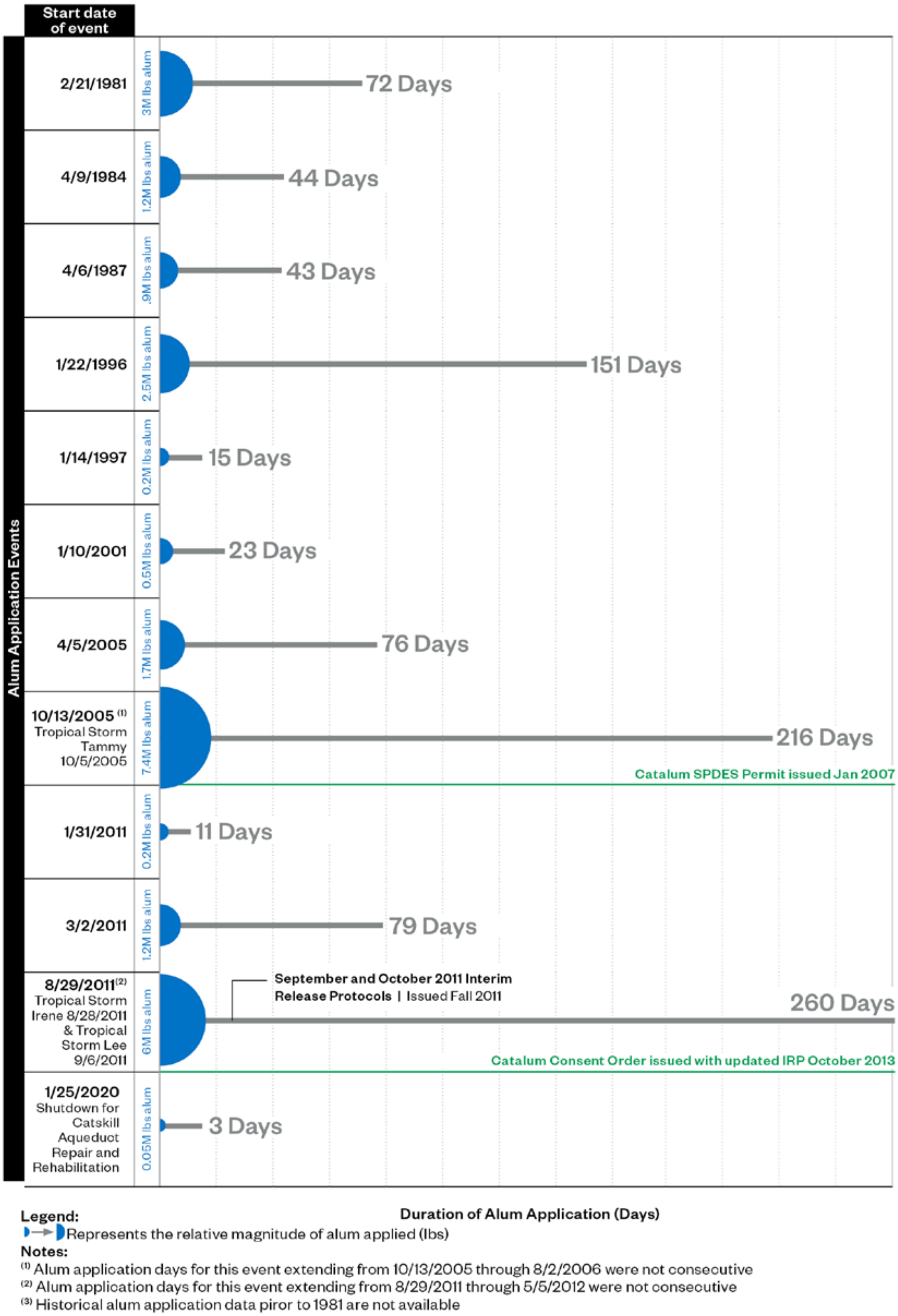

Figure 1-6
Historical Application of Alum at Kensico Reservoir

Study Summary

As part of DEP's ongoing program review to manage turbidity in the Catskill System and to meet requirements of the 2007 FAD, several studies were completed to examine engineering and operational modifications to address turbidity. The results of theses studies are used in the EIS, where applicable, to describe and evaluate the Proposed Action and its alternatives.

STUDY	SUMMARY
Phase I Catskill Turbidity Control Study *December 2004*	**GOAL:** Conduct a preliminary assessment of alternatives at ***Schoharie Reservoir*** that might reduce turbidity levels entering Esopus Creek where feasible and cost-effective. **OUTCOME:** Of the six alternatives identified, four alternatives were advanced for further study: multi-level intake in ***Schoharie Reservoir***; placement of an in-reservoir impermeable curtain baffle at ***Schoharie Reservoir***; modifications to ***Schohaire Reservoir's*** operations; and, turbidity removal operations downstream at ***Ashokan Reservoir***.
Phase II Final Report Catskill Turbidity Control Study *2006*	**GOAL:** Identify and evaluate feasible, effective, and cost-effective measures for reliably improving turbidity and temperature control in diversions from ***Schoharie Reservoir*** to Esopus Creek by comparing the three ***Schoharie Reservoir*** alternatives identified in the Phase I study. **OUTCOME:** Conceptual design and performance evaluation for the three ***Schoharie Reservoir*** alternatives identified in Phase I (see above).
Phase II Implementation Plan (for the Catskill Turbidity Control Study) *2006*	**GOAL:** Present DEP's final recommendations and guidelines for further development and implementation of the ***Schohaire Reservoir*** turbidity and temperature control measures alternatives evaluated in the Phase II final report (see above). **OUTCOME:** Of the three alternatives evaluated, modified operations at ***Schoharie Reservoir*** was identified as the most viable option for reducing the incidence of elevated turbidity levels, and to substantially lower solids loading to Esopus Creek. It was determined full implementation of operational changes would require development of the Operations Support Tool (OST).
Phase III Final Report Catskill Turbidity Control Study *2007*	**GOAL:** Identify and evaluate feasible, effective, and cost-effective measures for reliably reducing peak turbidity levels entering the Catskill Aqueduct, thereby reducing the frequency and duration of alum addition events. The Phase III study included conceptual design and performance evaluation of the six turbidity control alternatives at ***Ashokan Reservoir.*** **OUTCOME:** Operating the Catskill Aqueduct at minimum flow rates when turbidity levels were elevated was found to be the most effective way to reduce the turbidity load transferred from ***Ashokan Reservoir*** to Kensico Reservoir. Releasing water from ***Ashokan Reservoir's*** West Basin also provided significant reductions in turbidity loading to the East Basin, and hence to Kensico.
Phase III Value Engineering Report (for the Catskill Turbidity Control Studies) *April 2008*	**GOAL:** Conduct a value engineering (VE) study on behalf of DEP and the City office of Management and Budget (OMB) to review and evaluate the Catskill Turbidity Control Study Phase III Final Report and offer recommendations for further evaluation. **OUTCOME:** The VE panel identified 26 recommendations related to the design, implementation, or performance evaluation of alternatives for managing turbidity within or diverted from ***Ashokan Reservoir.*** Each of these recommendations was evaluated by DEP and assigned one of four categories (Accept, Partially Accept, Reject, or Further Study).
Phase III Implementation Plan (for the Catskill Turbidity Control Studies) *July 2008*	**GOAL:** Present DEP's proposed plan for implementing operational and structural measures to improve turbidity control in the Catskill System by reducing turbidity levels entering ***Kensico Reservoir***, based on the previous Phase III engineering analyses and reports (see above). **OUTCOME:** The plan made two major recommendations: (1) modifications to the operating rules at ***Ashokan Reservoir*** (supported by OST); (2) improvement to the Catskill Aqueduct including its interconnection to the Deleware Aqueduct at Shaft 4 ***(Catskill/Delaware Interconnection at Shaft 4)*** and improving ***stop shutters in the Catskill Aqueduct***, allowing for the reduction of flow within the Catskill System during periods of elevated turbidity.
Turbidity Control Alternatives Analysis *2011*	**GOAL:** Access the performance of the turbidity control alternatives recommended in the Phase III implementation plan. **OUTCOME:** Provided a summary of system modeling and analysis related to: (1) operation of the ***Ashokan Release Channel***; (2) Routine deployment of ***Catskill Aqueduct stop shutters***; (3) ***Operation of the proposed Catskill/Delaware Interconnection at Shaft 4***.

Figure 1-7
Summary of Turbidity Control Studies

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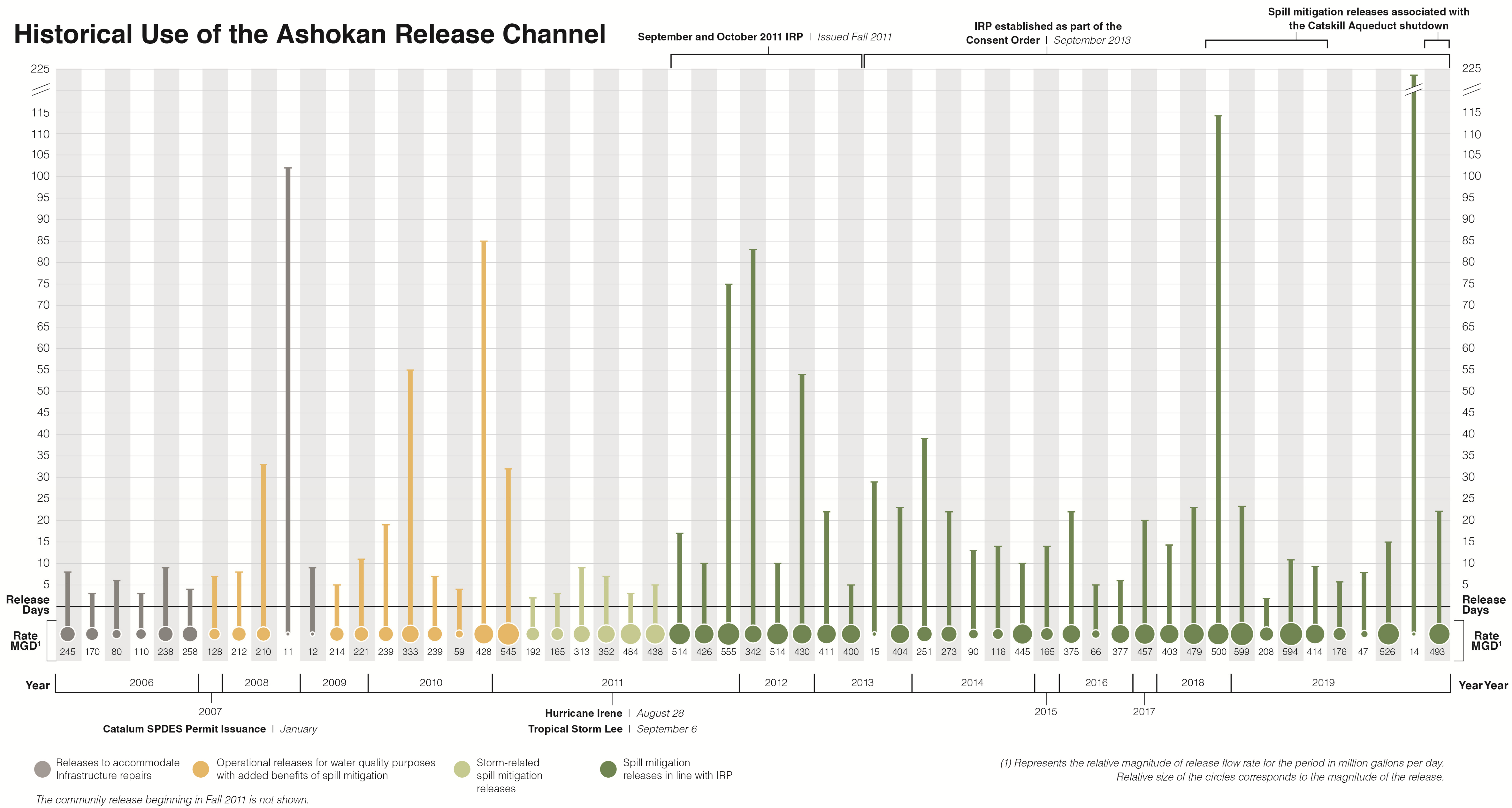

Figure 1-8
Historical Use of the Ashokan Release Channel

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1.3 TURBIDITY CONTROL MEASURES

DEP's turbidity control measures are intended to minimize alum application to water in the Catskill Aqueduct upstream of Kensico Reservoir through operational, engineering, and other non-treatment measures while also minimizing the potential for significant adverse impacts to the environment. As shown on **Figure 1-7**, DEP conducted an extensive study of engineering alternatives for the Catskill System that could help address turbidity. The study concluded that DEP could significantly reduce the need for alum application through certain infrastructure and operational modifications. Operational modifications, including selective diversion, west basin drawdown, and releases, are described in Section 1.2, "Background." DEP has also completed upgrades to certain water supply infrastructure and developed a unique operations support tool (OST) to assist in responding to turbidity in the Catskill System. While these turbidity control measures are a critical component of the operating assumptions for the Catskill System, they are not subject to evaluation in this EIS. These tools and infrastructure are described in further detail in this section.

Watershed Protection Program (WPP)
In support of DEP's Filtration Avoidance Determination, the Watershed Protection Program is a proactive way DEP prevents pollution from entering the water supply system. It includes best management practices for a wide range of watershed activities, administration and enforcement of watershed rules and regulations to protect the water supply from contamination, and a comprehensive Land Acquisition Program to preserve environmentally sensitive lands in the watershed. Under its Watershed Protection Program, DEP also guides and implements targeted programs to further protect water quality in the watershed, such as the Stream Management Program and Forest Management Program.

1.3.1 CATSKILL AQUEDUCT STOP SHUTTER IMPROVEMENTS

Catskill Aqueduct stop shutter improvements allow DEP to reduce flow within the Catskill Aqueduct during periods of elevated turbidity while still meeting the demand of outside community connections. In this way, the Catskill Aqueduct stop shutter improvements have provided DEP with greater flexibility when managing diversions from Ashokan Reservoir during turbidity events. The stop shutters are physical barriers installed along the Catskill Aqueduct to impound flow under low flow conditions at six locations between Ashokan and Kensico Reservoirs, as shown in **Figure 1-9.** This reduces turbidity load entering Kensico Reservoir, and in turn reduces alum application to water in the Catskill Aqueduct upstream of Kensico Reservoir.

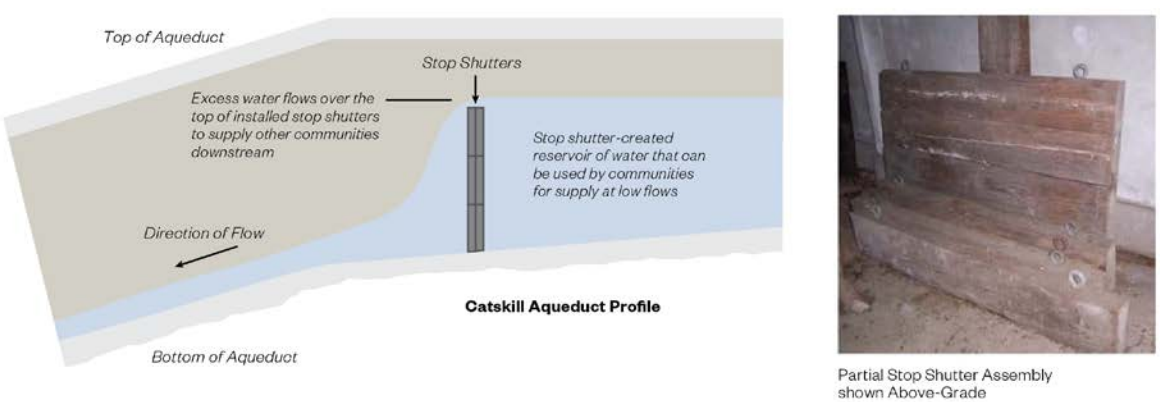

Figure 1-9. Stop Shutter Schematic

1.3.2 CATSKILL AND DELAWARE AQUEDUCTS INTERCONNECTION AT SHAFT 4

As shown in **Figure 1-1**, the interconnection between the Catskill Aqueduct and the Delaware System's Rondout West Branch Tunnel (RWBT) is located at Shaft 4 in Gardiner, Ulster County, New York. This interconnection, in operation since 2015, provides DEP greater operational flexibility. During turbidity events, the Catskill/Delaware Interconnection at Shaft 4 allows DEP to transfer water from the Delaware Aqueduct into the Catskill Aqueduct, thereby reducing diversions from the Catskill System. Delaware System water can also be blended with Catskill System water in the Catskill Aqueduct during periods of elevated turbidity. The Catskill/Delaware Interconnection at Shaft 4 also ensures continuity of water supply to most downstream Catskill System customers if the Catskill System water is unavailable.

1.3.3 CROTON WATER FILTRATION PLANT

The Croton Water Filtration Plant, which became operational in spring 2015, can treat and deliver up to 290 MGD (449 cfs) to the City's distribution system. The Croton Water Filtration Plant is located in the Bronx, New York. Operation of the Croton Water Filtration Plant has substantially reduced reliance on the amount of water needed from the Catskill System during turbidity events and enhances the flexibility of the system to respond to water quality events. DEP expects that filtered Croton System water used to supplement the City's Catskill/Delaware system will help minimize the need for alum application in the future.

1.3.4 OPERATIONS SUPPORT TOOL

Given the size and complexity of the water supply system, including the programmatic and operational components described above, DEP has worked to develop a system-specific model, the Operations Support Tool (OST), to better allow the agency to forecast operations and manage water supply decision making. The City's OST is a computer-based model that provides computational and predictive support for water supply operations and planning to facilitate DEP's management of the system. This support allows DEP to respond to changing hydrologic conditions and to planned and unplanned events, such as infrastructure improvements or storms and droughts (**Figure 1-10**). Operating scenarios within this model are used to manage the system. OST simulates the amount of water available in the City's reservoir system at any given time by accounting for dozens of variables such as weather forecasts, current demand for water, release requirements, and daily changes to the operation of the water supply system. OST has been in use since 2012 and has been instrumental in balancing the complex interplay between multiple objectives for the water supply system, including water supply reliability, drinking water quality, environmental and recreational releases, hydropower generation, and peak flow attenuation for downstream communities. While it is used to assist DEP with managing many different aspects of the water supply system, OST is also used to predict and subsequently respond to episodic turbidity events.

OST incorporates the following data sources when predicting system response to planned and unplanned events:

- Historical hydrologic data to represent the flow of water into and throughout the system from associated historical weather conditions.
- Estimated turbidity load based on a turbidity flow regression model.
- Physical infrastructure constraints and operating protocols that are simulated within the model.
- City and upstate customers' seasonal drinking water demand patterns.

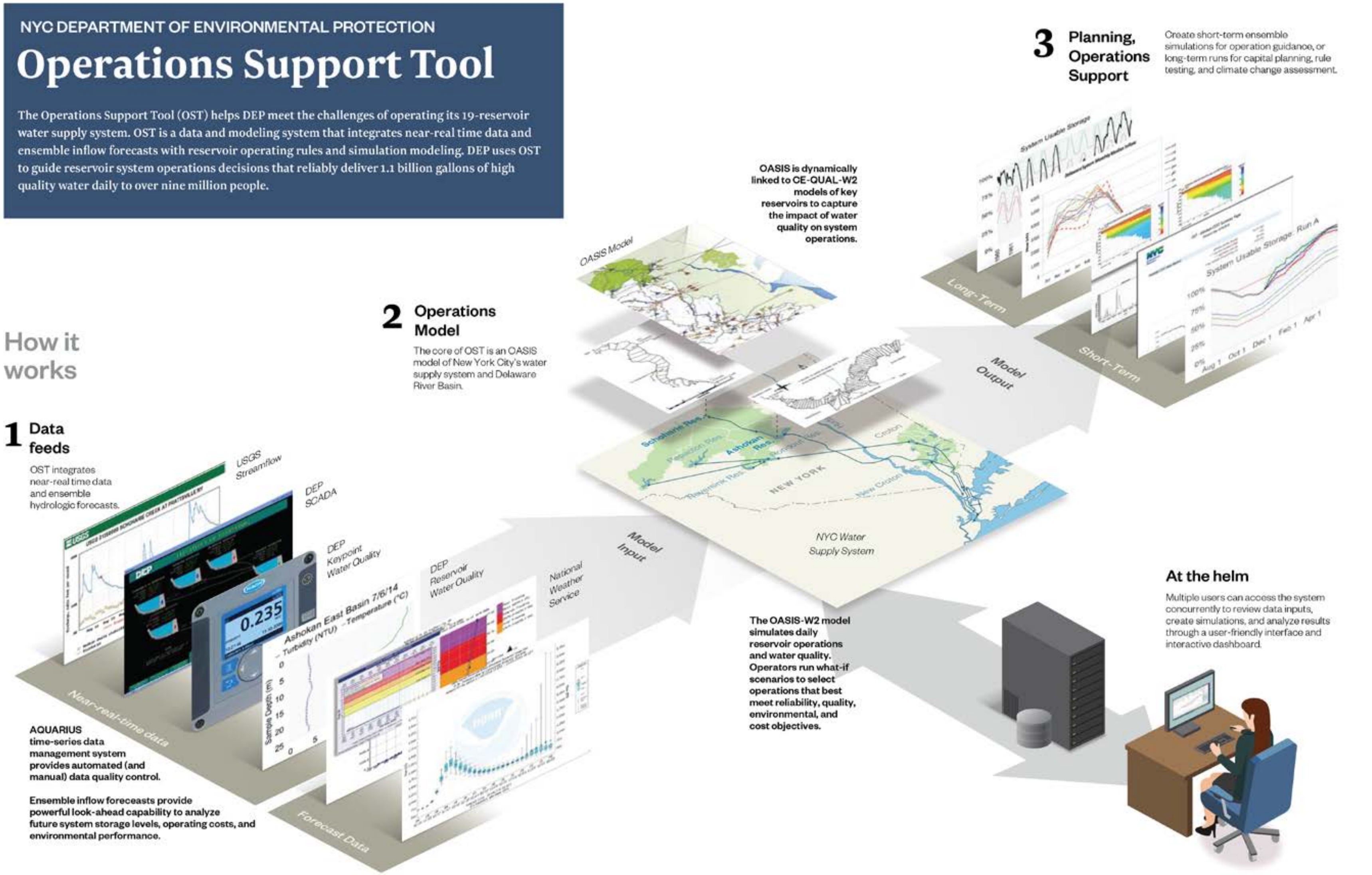

Figure 1-10
Overview of DEP's Operations Support Tool

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2. PURPOSE AND NEED

The proposed modification of the Catalum SPDES Permit would allow DEP to continue to provide reliable, clean, and safe drinking water, while potentially reducing reliance on alum application during episodic turbidity events. Periodically applying alum to drinking water supplies is a long standing, and well accepted practice that is used widely throughout the United States. The primary objective of DEP in applying alum is to judiciously protect public health and meet drinking water standards. DEP will continue to balance water supply requirements with the need to minimize the potential for impacts on Kensico Reservoir.

The proposed modification of the Catalum SPDES Permit also includes the delay of dredging alum floc at Kensico Reservoir until after DEP completes repairs to the Rondout West Branch Tunnel (RWBT) of the Delaware Aqueduct as part of DEP's Water for the Future (WFF) Program. To facilitate final repairs, the RWBT will be shut down, and DEP will be more heavily reliant upon the Catskill System to meet its daily demand. More reliance on the Catskill System increases the likelihood that the City would need to apply alum while the final RWBT repairs are completed. Therefore, pursuant to the Consent Order, NYSDEC and the City agreed that the dredging should not commence until RWBT repairs are complete.[4]

[4] Pursuant to the 2018 Modification to the Catalum Administrative Order on Consent, DEP is authorized to apply alum during the WFF Program in accordance with the WFF Alum Treatment Plan and requires that the associated alum floc be included in the Total Dredging Mass.

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3. PROPOSED ACTION

3.1 OPERATION OF ASHOKAN RESERVOIR IN ACCORDANCE WITH THE IRP

The Proposed Action includes the operation of Ashokan Reservoir in accordance with the IRP. The IRP has the potential to alter the magnitude, duration, frequency, seasonality, and quality of streamflow in lower Esopus Creek.

There are three types of releases in accordance with the IRP: community releases to provide recreational, environmental, and economic benefits to lower Esopus Creek; spill mitigation releases to enhance the flood attenuation benefit provided by Ashokan Reservoir; and operational releases which minimize transfer of more turbid west basin waters into the east basin of Ashokan Reservoir to protect water quality and enhance the flood attenuation benefit provided by the Reservoir (**Figure 3-1**). The IRP prescribes flow and duration criteria for community, spill (discharge) mitigation, and operational releases based on seasonality and turbidity levels. It is based, in part, on maintaining a storage void – based on a Conditional Seasonal Storage Objective (CSSO) – in Ashokan Reservoir to provide enhanced flood attenuation. The CSSO enhances the Reservoir's flood attenuation capacity by creating a void in Ashokan Reservoir to store runoff during storm events. Each of the elements of the IRP is shown on **Figure 3-1** and described in Section 7.1.3, "Summary of Effects of the Proposed Action on Flow Regime and Water Quality in Lower Esopus Creek."

3.2 DELAY OF DREDGING AT KENSICO RESERVOIR

The Proposed Action includes the delay of dredging of alum floc at Kensico Reservoir. DEP coordinated with NYSDEC to define the areal extent of alum floc deposition in Kensico Reservoir associated with alum application since 2005. To support this effort, DEP has conducted bathymetric studies, obtained sediment cores, collected benthic data, and prepared model simulations to characterize the potential areal extent and depth of historical alum floc deposits. The EIS evaluates potential benefits and environmental impacts of the delay of dredging until DEP completes certain infrastructure projects, previously described. The EIS also includes a discussion of the environmental considerations of dredging. Upon further advancement of a detailed dredging plan, an additional assessment of potential environmental impacts would be completed, as necessary.

Interim Ashokan Release Protocol (IRP)

NYSDEC and DEP have agreed to implement the IRP to enhance benefits to the community, improve flood attenuation, and provide better water quality as described in the Consent Order. The IRP prescribes flow and duration criteria for community, spill (discharge) mitigation, and operational releases based on seasonality and turbidity.

Community Release Protocol

Provides environmental, recreational, and economic benefits to lower Esopus Creek in a manner that will not adversely impact water supply. Community releases can range between 10 to 15 MGD (15 to 23 cfs) based on seasonality, hydrological conditions, and turbidity.

Spill (Discharge) Mitigation Release Protocol

Releases to reduce/minimize spills into the lower Esopus Creek, enhancing flood mitigation provided by the Ashokan Reservoir, subject to the Conditional Seasonal Storage Objective (CSSO) curve. Maximum flow allowable under discharge releases is 600 MGD (928 cfs), with a maximum of 1,000 MGD (1,547 cfs) in combination with spills.

Operational Release Protocol

Prevents or limits the spilling of more turbid west basin waters into the east basin of the Ashokan Reservoir to protect water quality and enhance flood mitigation benefit to lower Esopus Creek communities. Operational releases allow for release of up to a combined 1,000 MGD (1,547 cfs) of water from the Reservoir to the lower Esopus Creek via the Ashokan Release Channel and through uncontrolled spills over the east basin spillway.

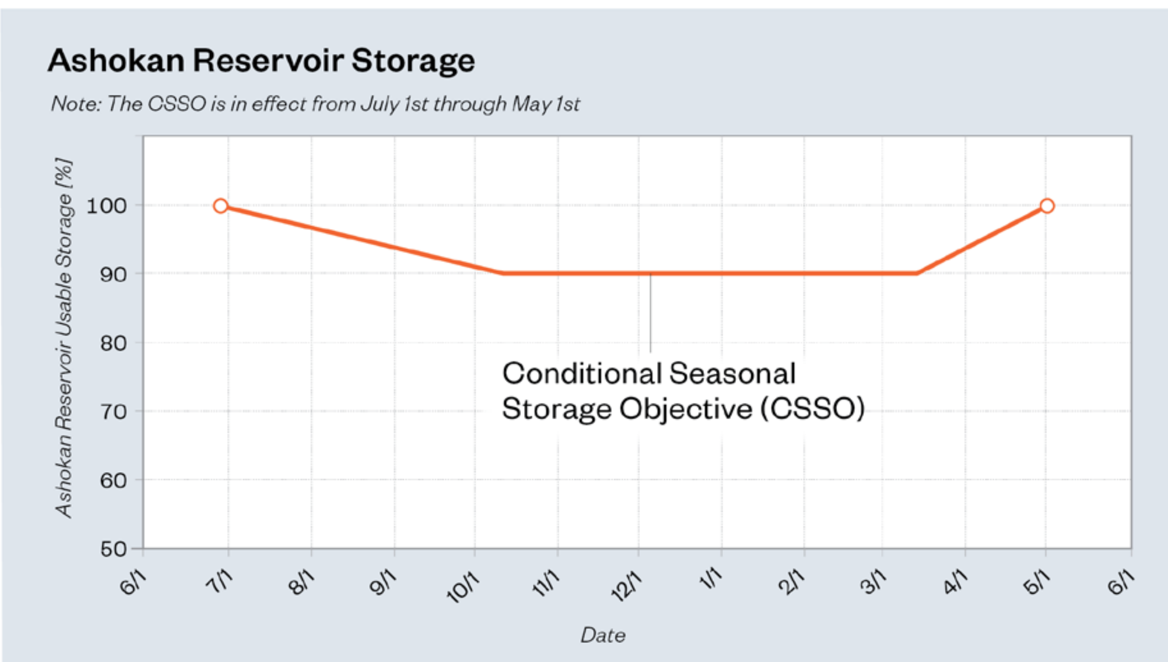

Figure 3-1
Overview of the Interim Ashokan Release Protocol (IRP)

4. ANALYTICAL FRAMEWORK

This section outlines the analytical framework that forms the basis for determining potential benefits and impacts associated with each of the project components. This EIS evaluated the potential for benefits and impacts of the Proposed Action on environmental resources, including potential cumulative impacts as described in subsequent sections. For the purposes of the EIS, resources that were evaluated are referred to as technical areas. For each technical area, the analysis includes a description of baseline conditions, and an assessment of conditions in the future without the Proposed Action and the future with the Proposed Action along with a methodology for conducting the assessment. Potential benefits and potential significant adverse environmental impacts were identified based on an evaluation of the incremental change to environmental conditions between the future without and with the Proposed Action for each technical area.

The Final Scope for this EIS presented two future scenarios that could be used to evaluate the Proposed Action. Given the time elapsed since issuance of the Final Scope and similarities in results of modeling conducted for this EIS between the two possible future scenarios, technical area assessments were evaluated only for the future condition when the Catskill and Delaware Interconnection at Shaft 4, improvements to the Catskill Aqueduct stop shutters, use of the Croton Water Filtration Plant, and repair of the RWBT are complete. Potential impacts associated with these planned infrastructure projects did not require or had already undergone separate environmental review. However, these elements are incorporated into the operating assumptions of the Proposed Action as they contribute to the use of the Ashokan Release Channel and alum application. The EIS assessed a range of hydrological conditions that could occur in the future without and with the Proposed Action.

Baseline Conditions. Baseline conditions were evaluated to establish a baseline from which future conditions could be projected. Generally, these conditions were based on data collected and assessed in the study areas most likely to be affected by the Proposed Action.

Future without the Proposed Action. The future without the Proposed Action describes the conditions in the study areas projected to occur without implementation of the Proposed Action. In the future without the Proposed Action there would be no use of the Ashokan Release Channel (No IRP) and no dredging.

Future with the Proposed Action. The future with the Proposed Action would include use of the Ashokan Release Channel in accordance with the IRP (IRP) and delay of dredging. Potential changes to the study areas resulting from the Proposed Action were compared to the future without the Proposed Action to assess the potential for benefits and significant adverse impacts. This comparison provides an understanding of the potential benefits and impacts that could result with implementation of the Proposed Action. This comparison can be found in each technical area assessment as well as the cumulative analysis, as applicable.

A summary of the components of the Proposed Action evaluated in the EIS is presented in **Table 4-1**. A summary of the infrastructure and operational assumptions used in the EIS is presented in **Table 4-2**.

Table 4-1. Components of the Proposed Action Evaluated in the EIS

Study Areas	Baseline Conditions	Future Without the Proposed Action	Future With the Proposed Action
Lower Esopus Creek Study Area	IRP	No IRP	IRP
Kensico Reservoir Study Area	Delay of dredging	No dredging	Delay of dredging and environmental considerations of dredging[1]

Note:
[1] Potential environmental considerations associated with dredging are discussed within the EIS. Upon the future completion of a detailed dredging plan and design, additional assessment of these activities would be completed, as necessary.

Table 4-2. Infrastructure and Operational Assumptions in the EIS

Other Turbidity Control Measures	Baseline Conditions	Future Without the Proposed Action	Future With the Proposed Action
Catskill and Delaware Interconnection at Shaft 4	Not On line	On line	On line
Catskill Aqueduct Stop Shutters	Not On line	On line	On line
Rondout West Branch Tunnel Repairs	Not complete	Complete	Complete
Croton Water Filtration Plant	On line	On line	On line
Alum Application[1]	If needed	If needed	If needed

Note:
[1] Alum application would be considered, if needed, to comply with NYSDOH drinking water quality standards. The quantity, duration, and frequency of alum applied for the future with the Proposed Action was compared to the future without the Proposed Action.