



Environmental
Protection

DELAWARE AQUEDUCT REPAIR PROJECT

Final Connection and Water Supply Management Plan

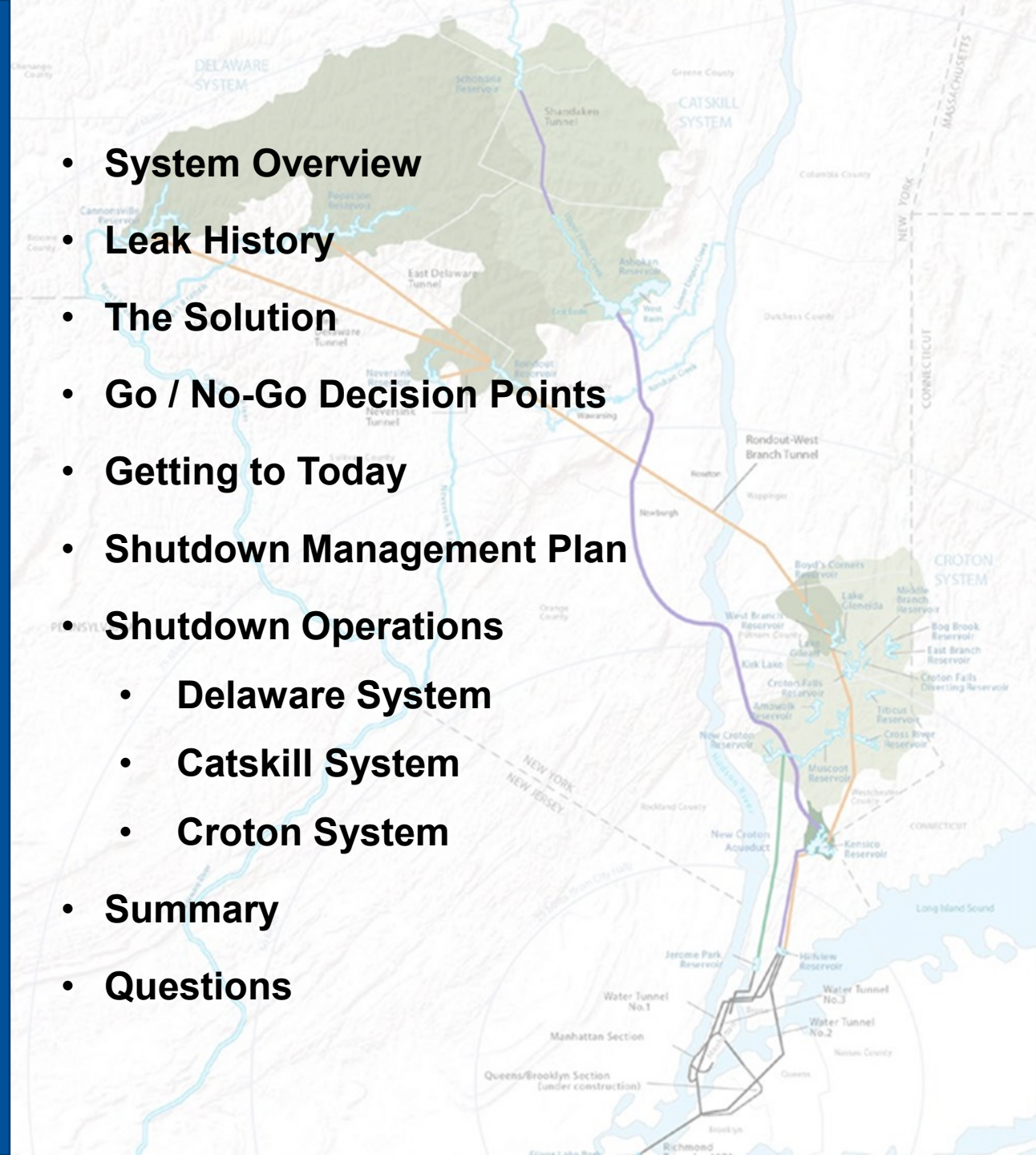


Agenda

John Milgrim

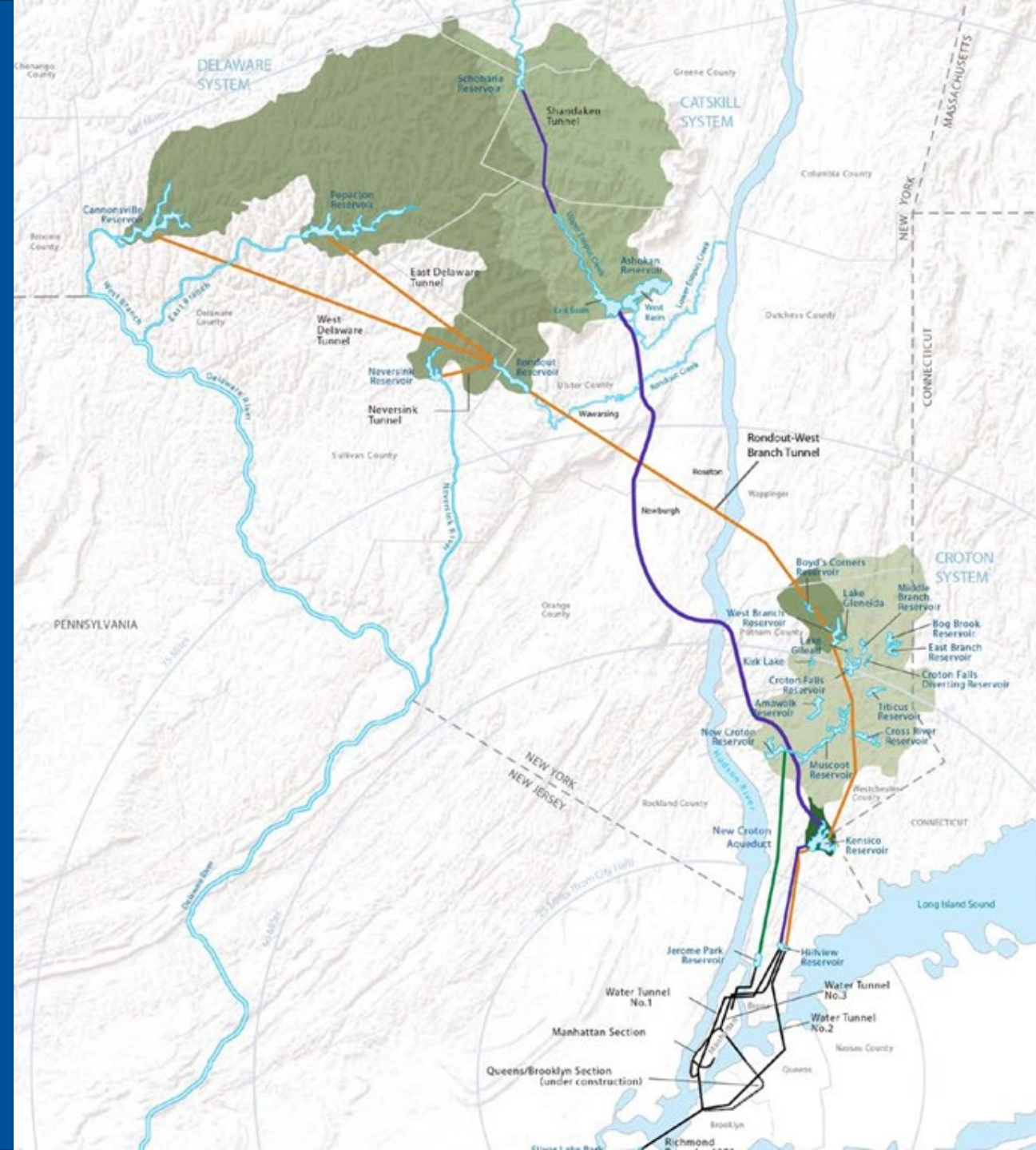
DIRECTOR OF OUTREACH
BUREAU OF WATER SUPPLY

- System Overview
- Leak History
- The Solution
- Go / No-Go Decision Points
- Getting to Today
- Shutdown Management Plan
- Shutdown Operations
 - Delaware System
 - Catskill System
 - Croton System
- Summary
- Questions



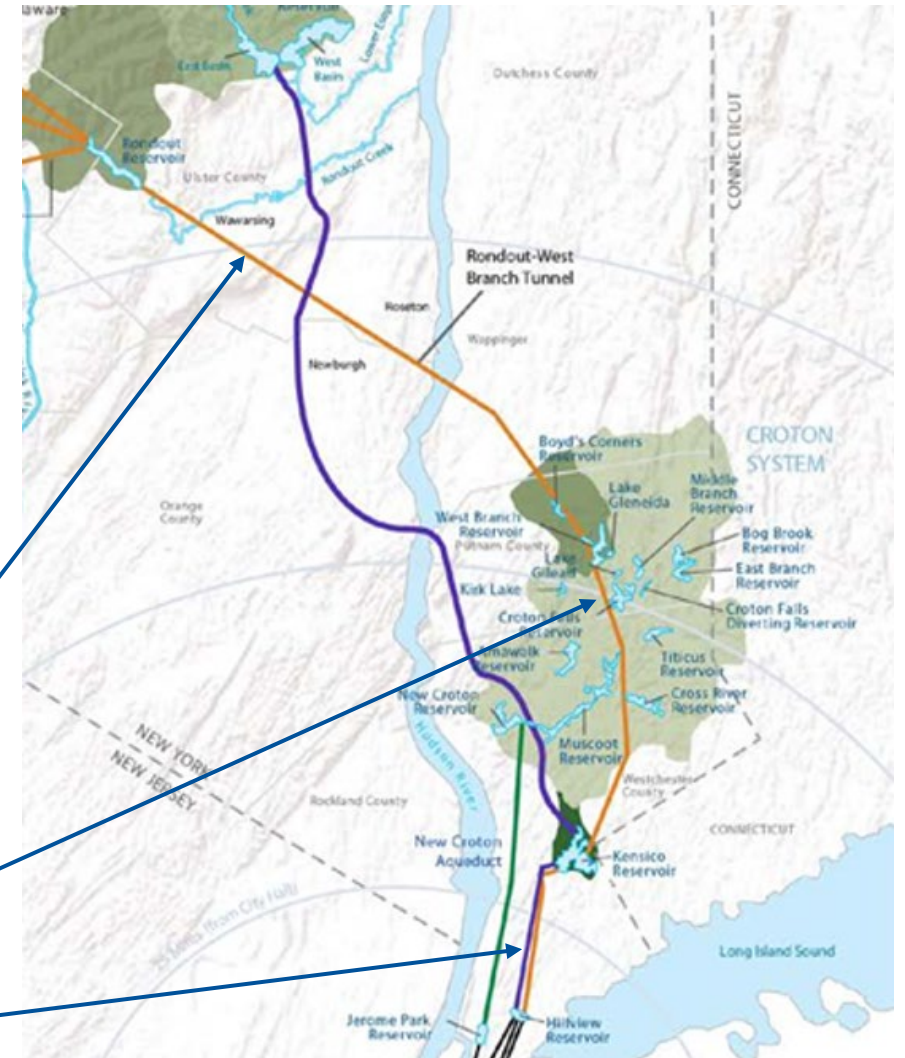
System Overview

- 19 reservoirs & 3 controlled lakes
- System Capacity: 570 billion gallons
- Delivers approx. 1.1 billion gallons per day to 9.8 million people in New York City and 4 counties north of the City.
- Source of water is a 2,000 square mile watershed (the size of the State of Delaware) spread across 8 upstate counties



Delaware Aqueduct

- 85 miles long from Rondout to Hillview Reservoir
- Longest tunnel in the world
- Conveys about 50 percent of NYC drinking water on average
- In service since 1944
- Last fully drained for inspection 1957-1958
- Critical system component
- Aqueduct consists of three segments
 - Rondout to West Branch (44 mi.)
 - West Branch to Kensico (27 mi.)
 - Kensico to Hillview (14 mi.)

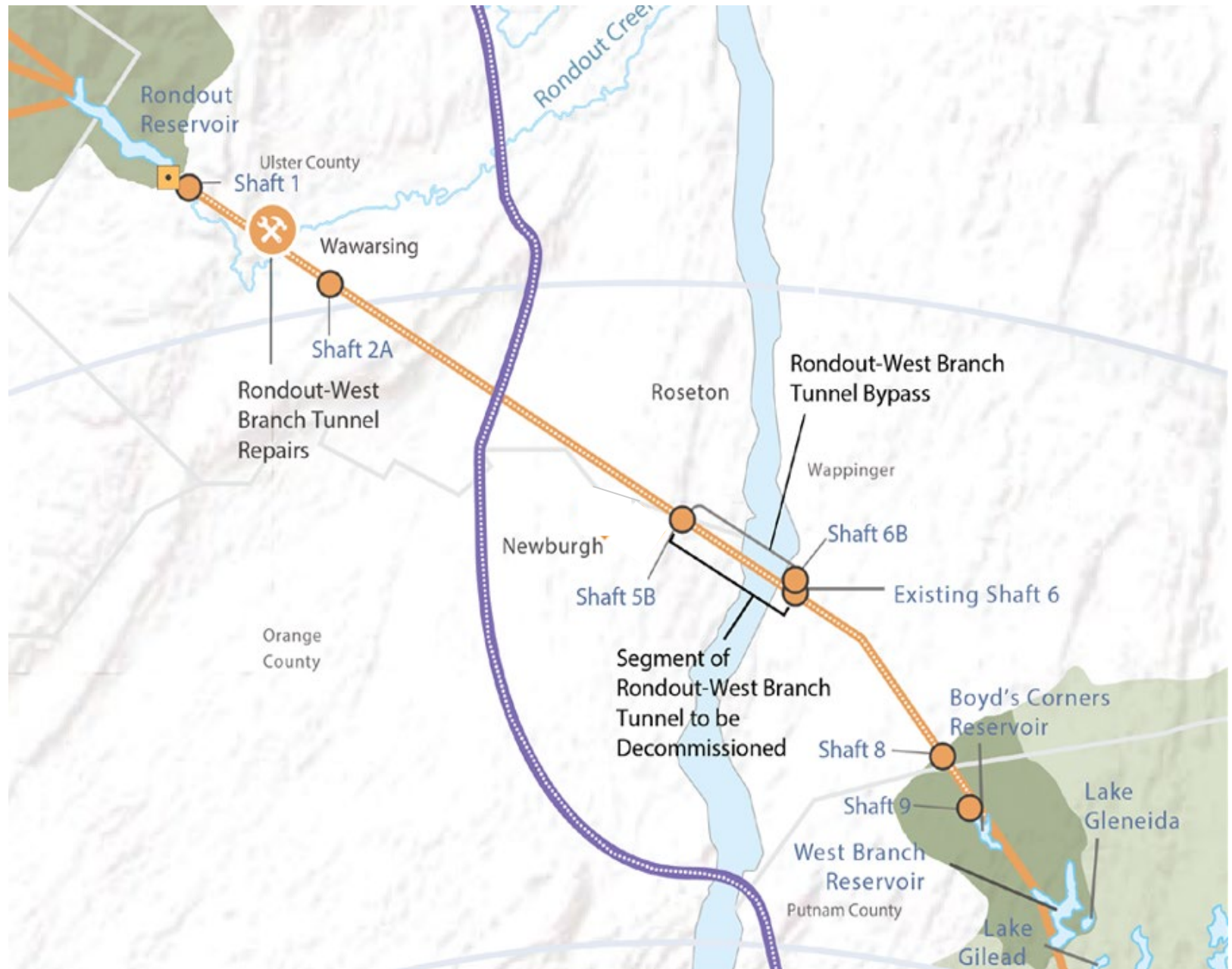


An aerial photograph showing a large reservoir in the foreground. In the middle ground, there is a residential area with many houses. In the background, there are industrial buildings and a power plant. The sky is blue with some clouds.

Leaks Discovered

- Leak identified in late 1990 at CHG&E Roseton generating station north of Newburgh
- Leak identified in 1992 in the Ulster County Town of Wawarsing
- Total leakage rate estimated at more than 30 million gallons per day
- About 95 percent of the leakage is from the area at Roseton near Newburgh
- Difficult conditions encountered during aqueduct construction – faulted limestone
- Steel inter-lining installed through these sections to provide support for the tunnel

Primary Areas of Concern



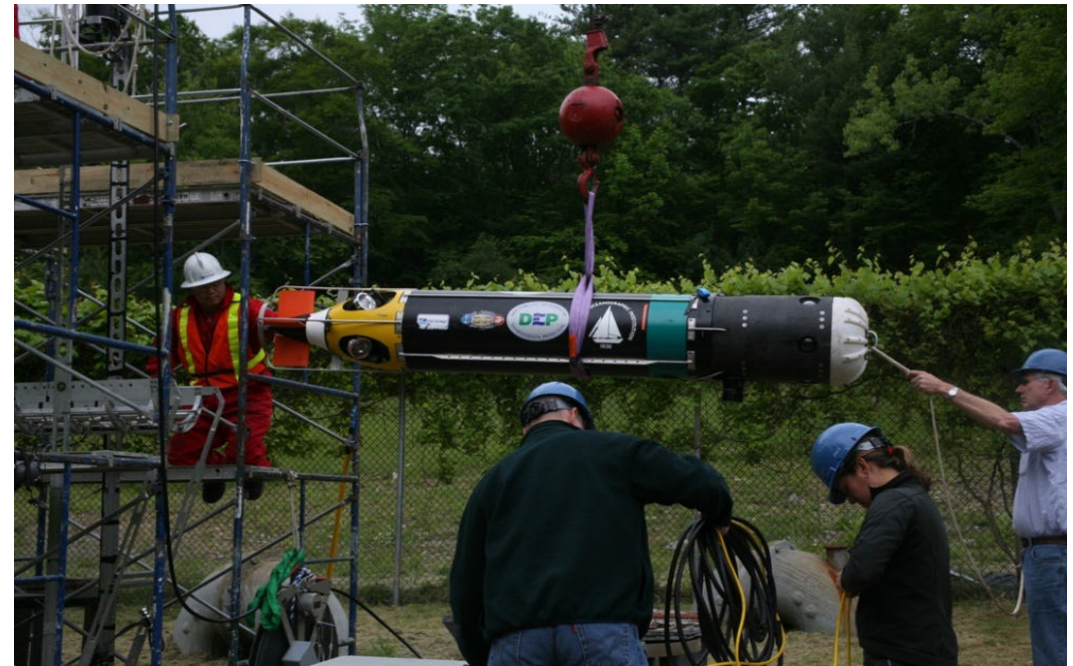
Leak Investigation



Top: Remotely Operated Vehicle (ROV) used in 2015 to investigate leak locations in Wawarsing

Bottom: Autonomous Underwater Vehicle (AUV) used in 2004, 2009, 2014 to investigate the Rondout-West Branch segment near Newburgh

March and October 2023 aqueduct shutdown and partial dewatering tests measuring groundwater infiltration (the first such draining in nearly 70 years).

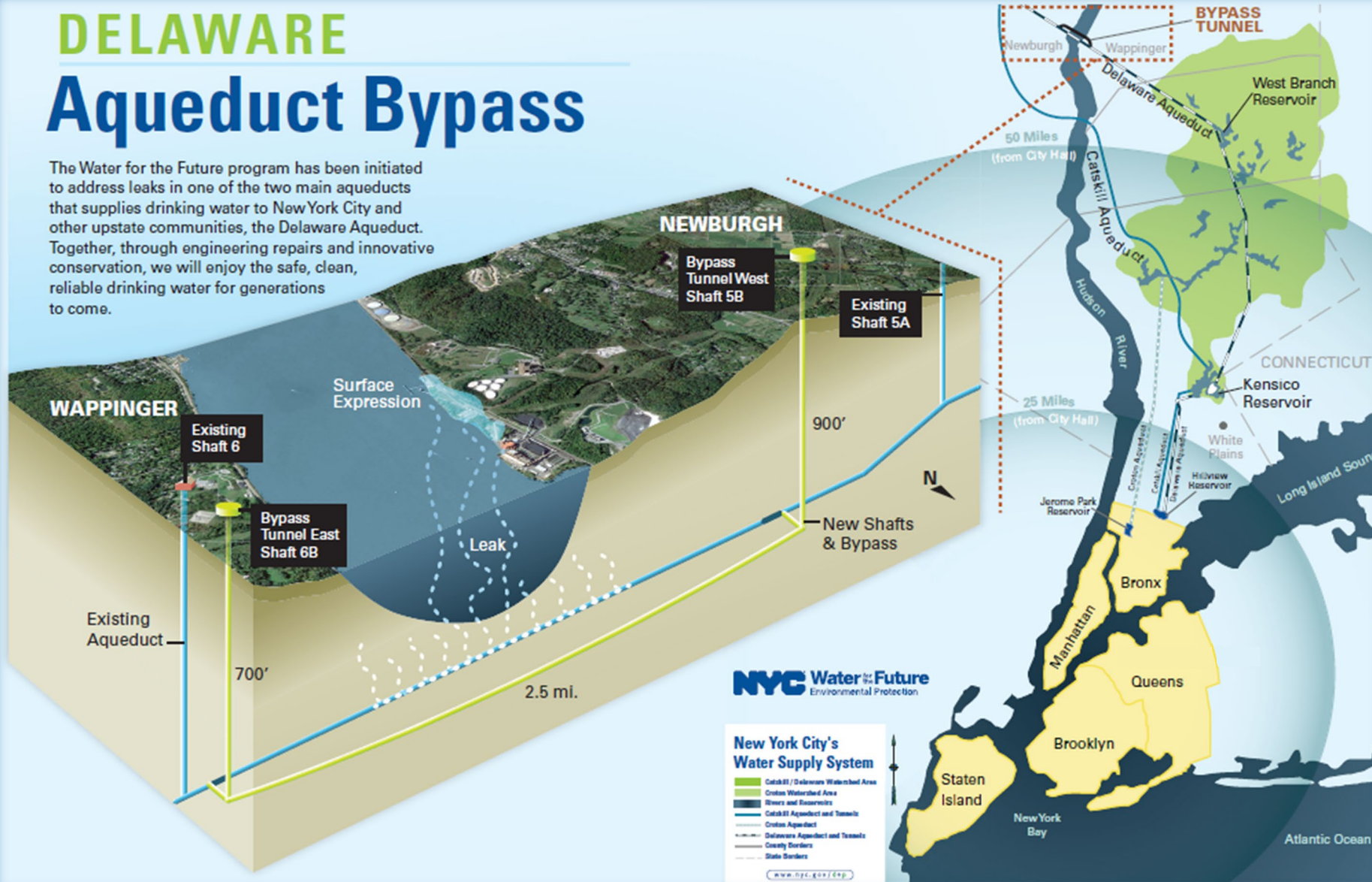


The Solution!

DELAWARE

Aqueduct Bypass

The Water for the Future program has been initiated to address leaks in one of the two main aqueducts that supplies drinking water to New York City and other upstate communities, the Delaware Aqueduct. Together, through engineering repairs and innovative conservation, we will enjoy the safe, clean, reliable drinking water for generations to come.



Delaware Aqueduct Bypass Tunnel

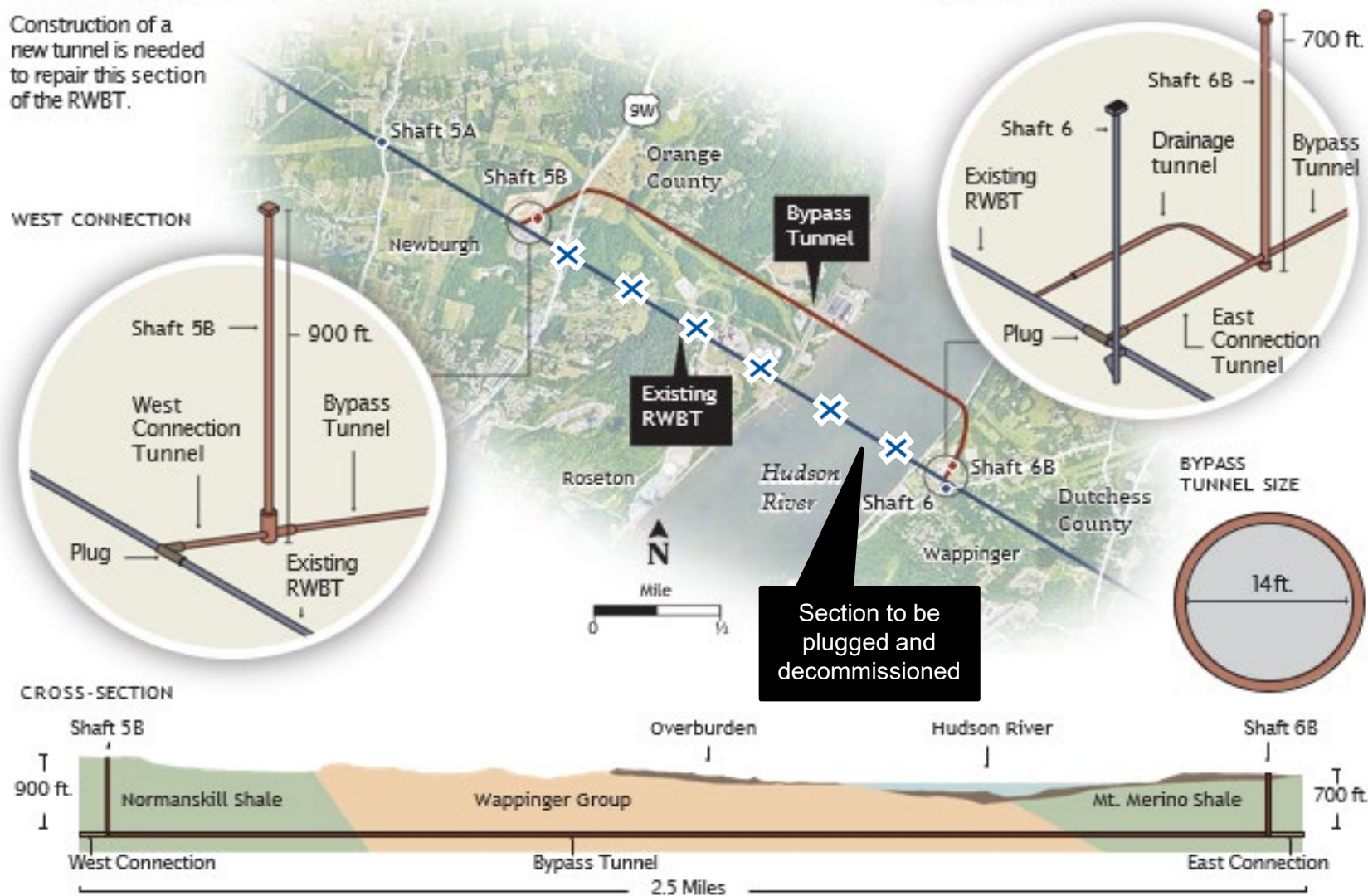
- Largest and most complex repair project in the 180-year history of NYC's municipal water supply
- Tunnel program cost \$1 billion
- Fixing or eliminating leaks in the Delaware Aqueduct
- Building and connecting a new 2.5-mile-long tunnel 600 feet below the Hudson River from Newburgh to Wappinger
- First tunnel under Hudson River since the south tube of the Lincoln Tunnel was completed in 1957



Bypass Tunnel to Connect at Both Ends Under Hudson

THE BYPASS TUNNEL AT ROSETON CROSSING

Construction of a new tunnel is needed to repair this section of the RWBT.



Delaware System Must Shut Down for Final Connection of Bypass Tunnel

- Bypass tunnel section mostly complete in 2021
- Ready to Connect
- Shutdown Delaware System and fully dewater compromised sections of tunnel
- Attach bypass to structurally sound sections and create new route around leak
- Plug and decommission compromised section under the Hudson
- Grout the Wawarsing Leak
- 8 months to complete connection work



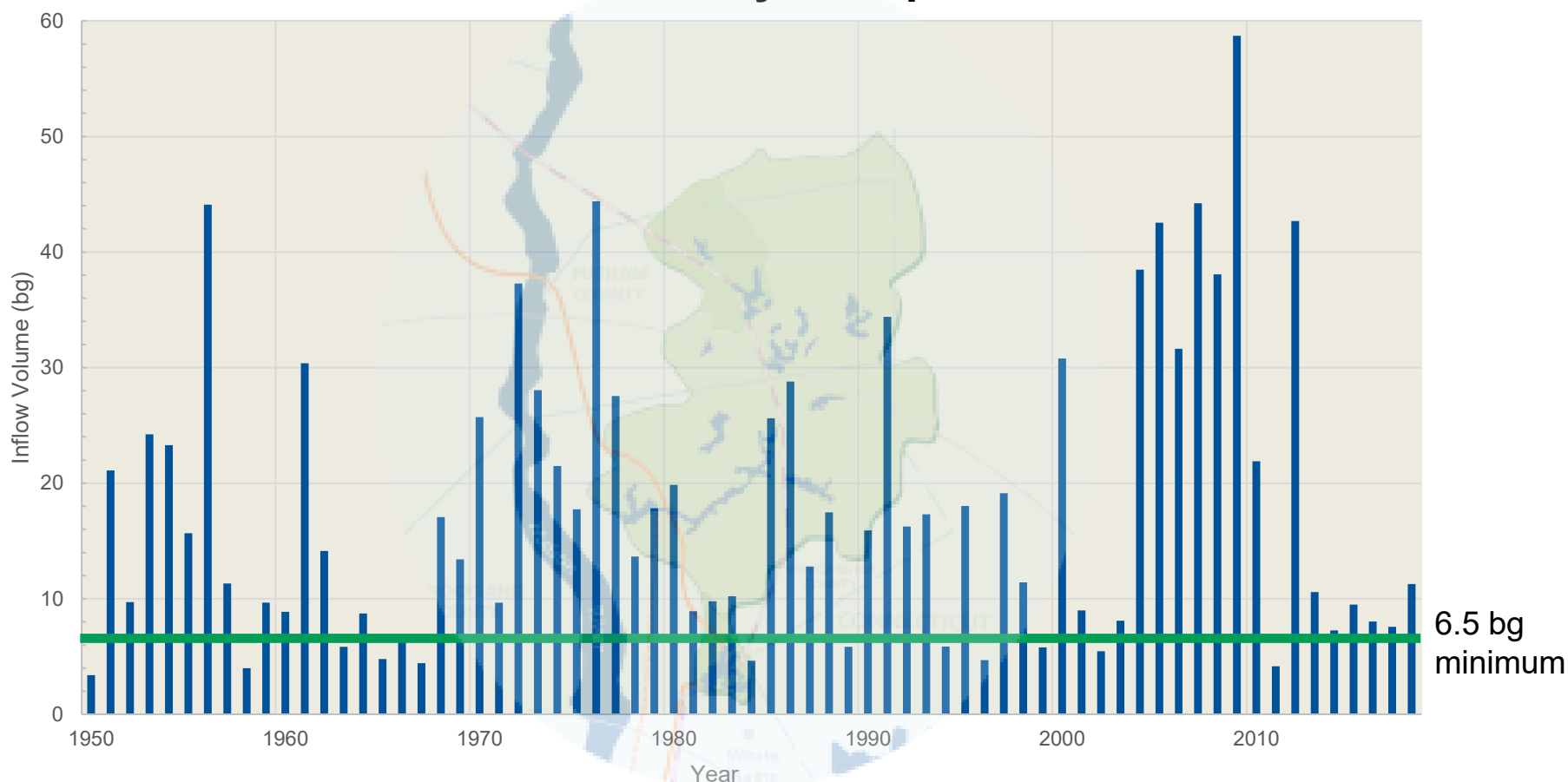
Go/No-Go Decision Points Leading Shutdown

- Water supply hydrological conditions
- Infrastructure conditions
- If “no go” decision is made plan would be for the same period the next year



- **East of Hudson (EOH) inflow must be greater than 6.5 billion gallons** to commence shutdown.
- Historically, July-September EOH inflow was above 6.5 billion gallons 80% of the time.

EOH Total Inflow: July to September



Go/No-Go Decision Points: Weather Prediction

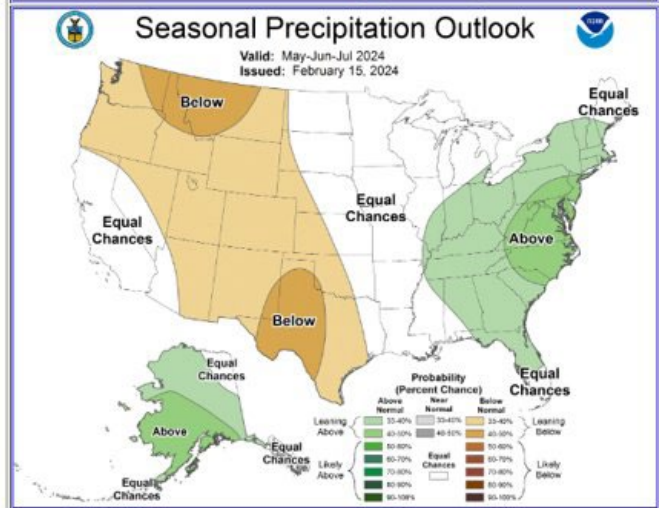
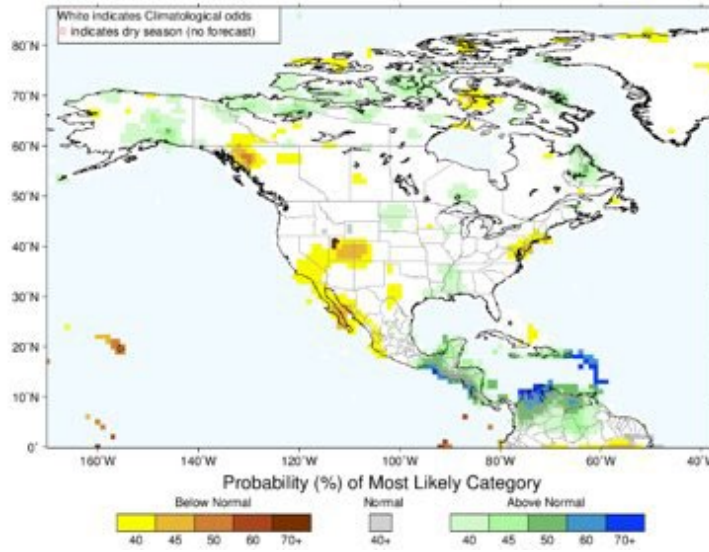
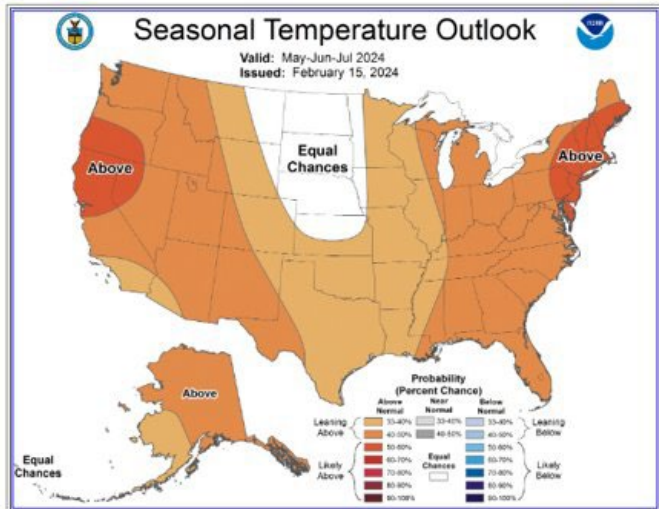
Extended Temperature and Precipitation Forecast May 2023 – Jul 2023

NOAA's Climate Prediction Center

IRI Multi-Model Probability Forecast for Precipitation for May-June-July 2024, Issued March 2024

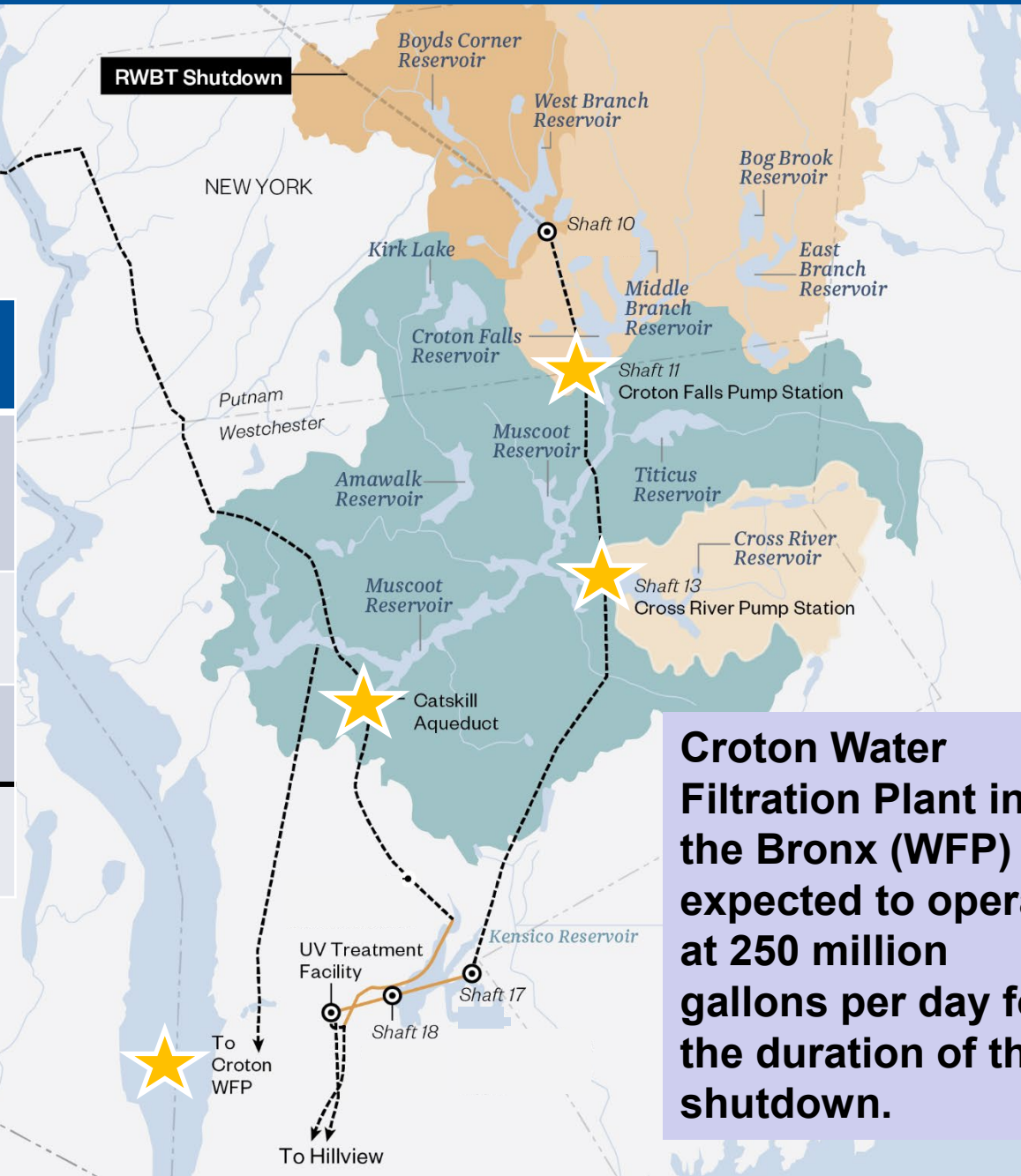
DEP is using multiple long-term weather prediction services to assist modeling shutdown operations

All “go” / “no go” and potential project bailout decisions are made in real time based on precision data and in coordination with expert and regulatory partners. Bailout return-to-service during shutdown can take between 1 and 9 weeks.



Go/No-Go Decision Points: Key Infrastructure

Key Infrastructure	Average Delivery	Maximum Delivery
Croton Falls and Cross River Pump Stations	180 mgd	240 mgd
Catskill Aqueduct	595 – 630 mgd	630 mgd
Croton WFP	250 mgd	290 mgd
Total	1025 – 1060 mgd	1130 mgd



Croton Water Filtration Plant in the Bronx (WFP) is expected to operate at 250 million gallons per day for the duration of the shutdown.

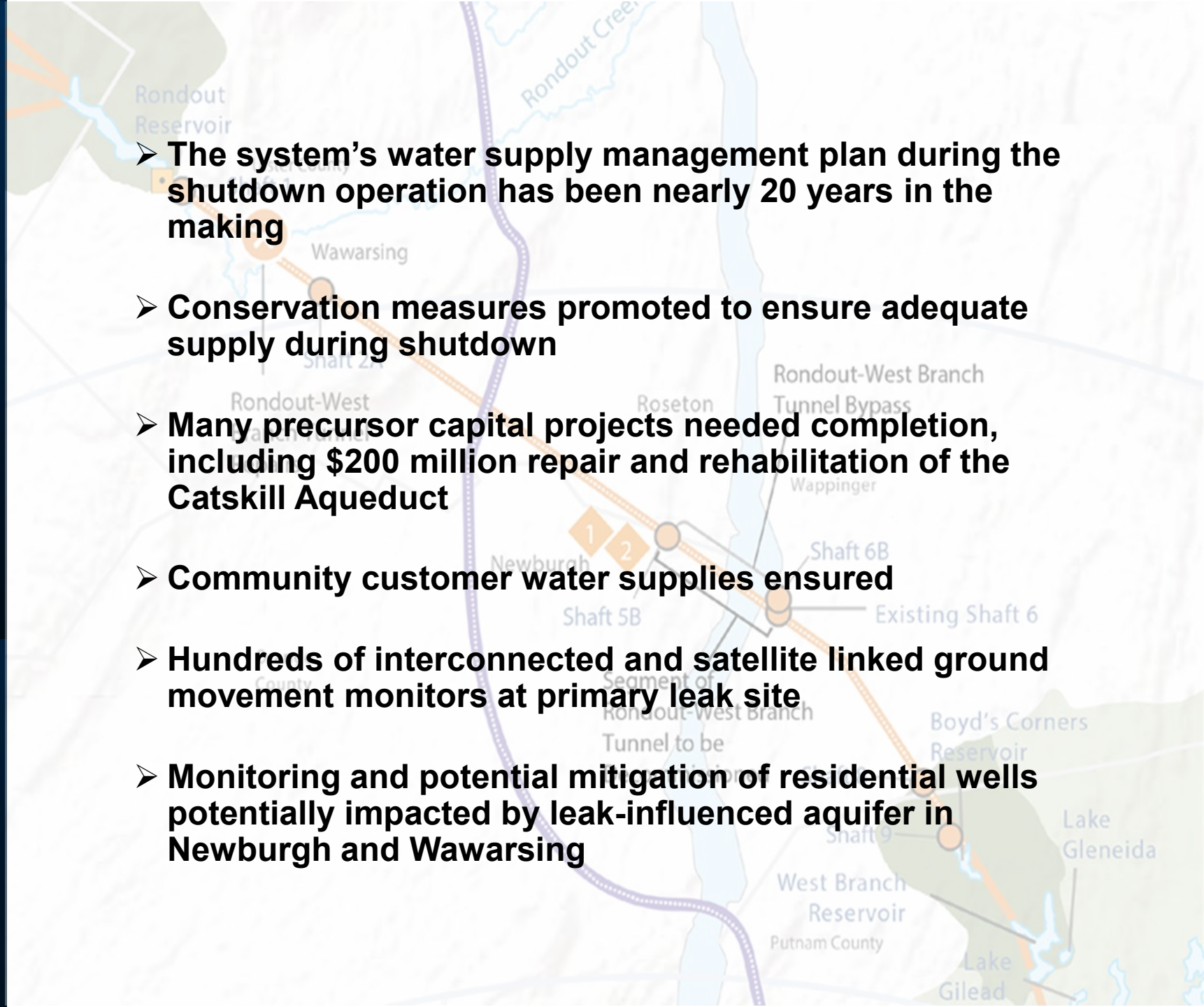
Getting to Today

The shutdown and bypass tunnel connection could not be completed when the bypass tunnel was constructed

- **to ensure adequacy and redundancy of several water supply systems in communities north of the City;**
- **to finalize a new connection between the Croton System and the City water supply in the Bronx; and**
- **for upgrades and testing of pump stations in the Hudson Valley.**

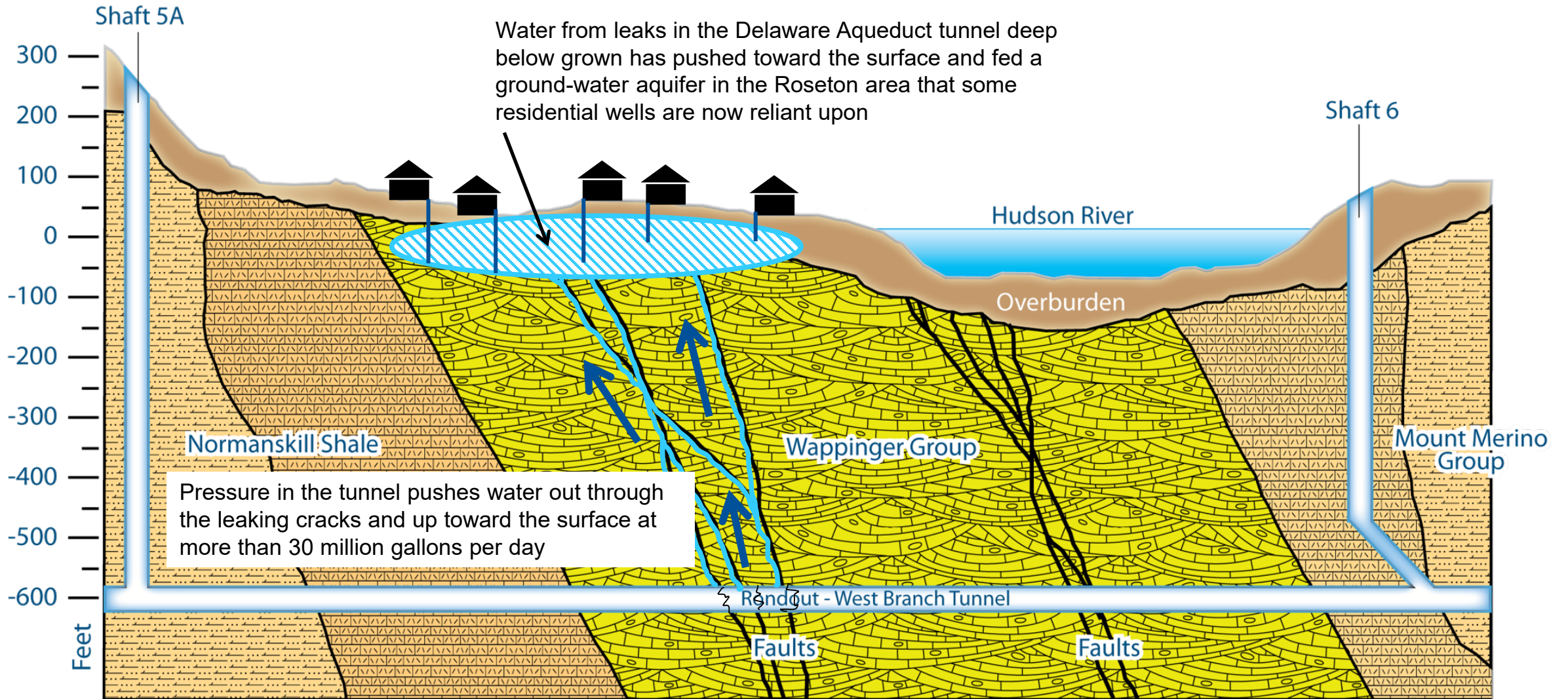
Getting to Today

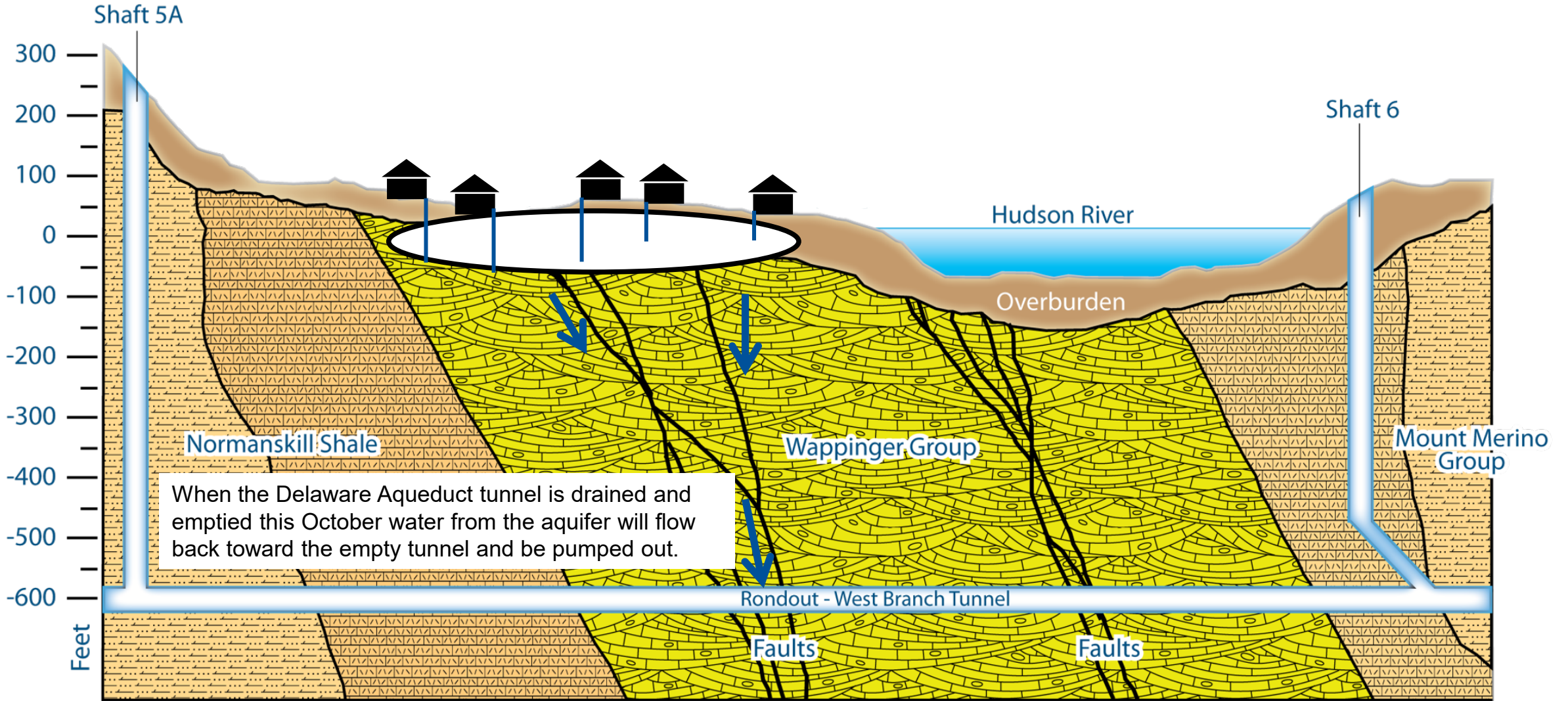
- **The system's water supply management plan during the shutdown operation has been nearly 20 years in the making**
- **Conservation measures promoted to ensure adequate supply during shutdown**
- **Many precursor capital projects needed completion, including \$200 million repair and rehabilitation of the Catskill Aqueduct**
- **Community customer water supplies ensured**
- **Hundreds of interconnected and satellite linked ground movement monitors at primary leak site**
- **Monitoring and potential mitigation of residential wells potentially impacted by leak-influenced aquifer in Newburgh and Wawarsing**



Requisite Dewatering Tests

- In March 2023, DEP shut down the Delaware Aqueduct and drained the tunnel to an elevation of **-90 feet below sea level** to perform critical infrastructure and hydrological tests, the first such draining in nearly 70 years
- An initial analysis from the shutdown showed potential groundwater infiltration into the tunnel at levels higher than originally anticipated
- DEP postponed the final bypass tunnel connection project by 12 months
- Subsequent draining test in October 2023 to **-250 feet below sea level** found infiltration subsided in longer drawdown with final infiltration rates closer to original design plans
- Both tests also showed potential and actual impacts on residential wells, among other features, in the Newburgh/Roseton area

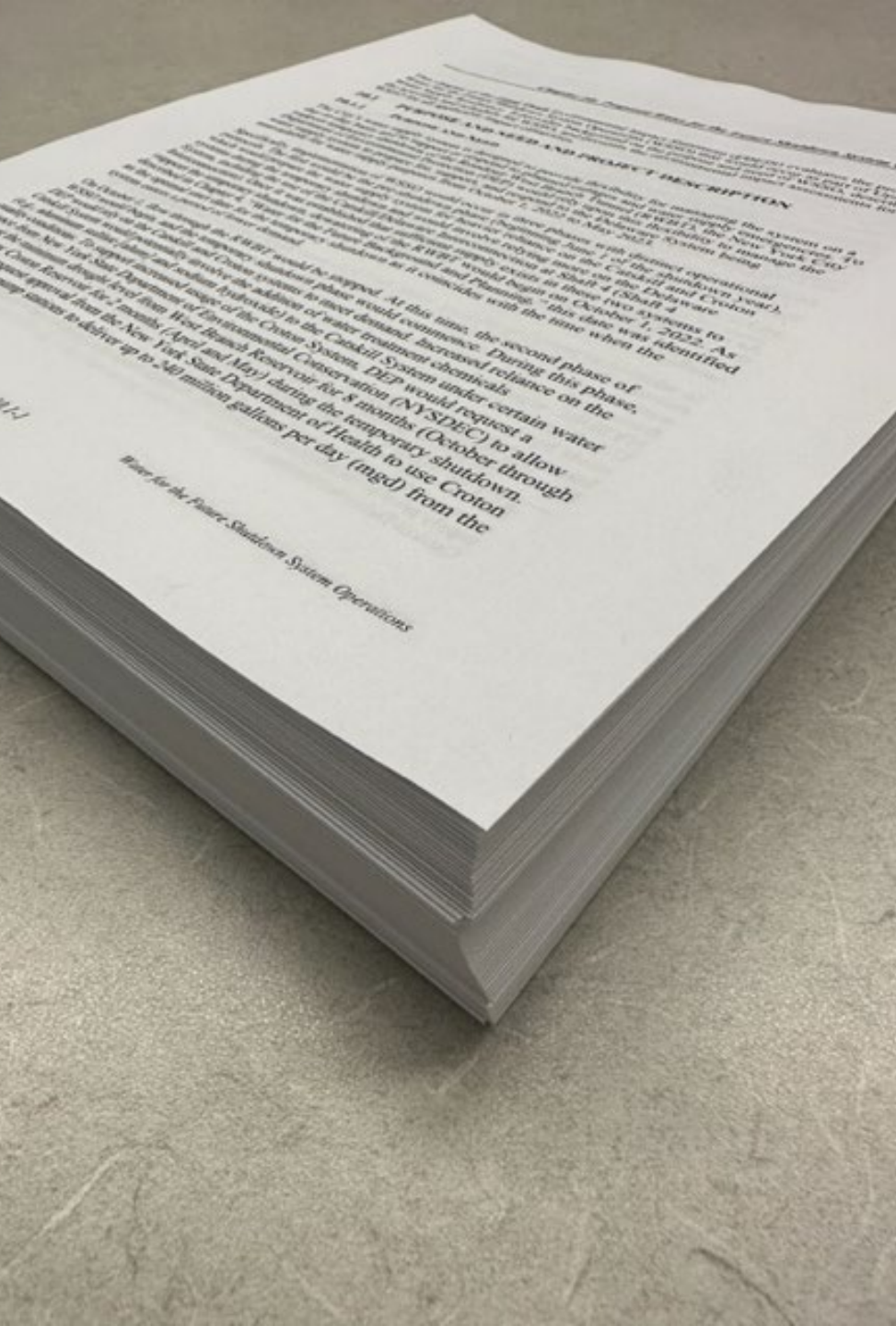






Getting to Today

- Precursor Projects Critical to RWBT Shutdown
- **CAT-212D**: Shandaken Tunnel Intake Chamber Improvements
- **CAT-213E/F**: Chemical Addition Facilities for the Catskill System
- **BT-2**: Rondout Siphons
- **DEL-424**: Structural Stabilization of Honk Falls Dam
- **CAT-RR**: Catskill Aqueduct Repair and Rehabilitation
- **DEL-418C**: Town of Newburgh Backup Supply
- **CRO-346CF**: Upgrades at Croton Falls Pump Station
- **CRO-543**: Shoreline Stabilization at Kensico Reservoir
- **CRO-521**: Jerome Park Reservoir Work

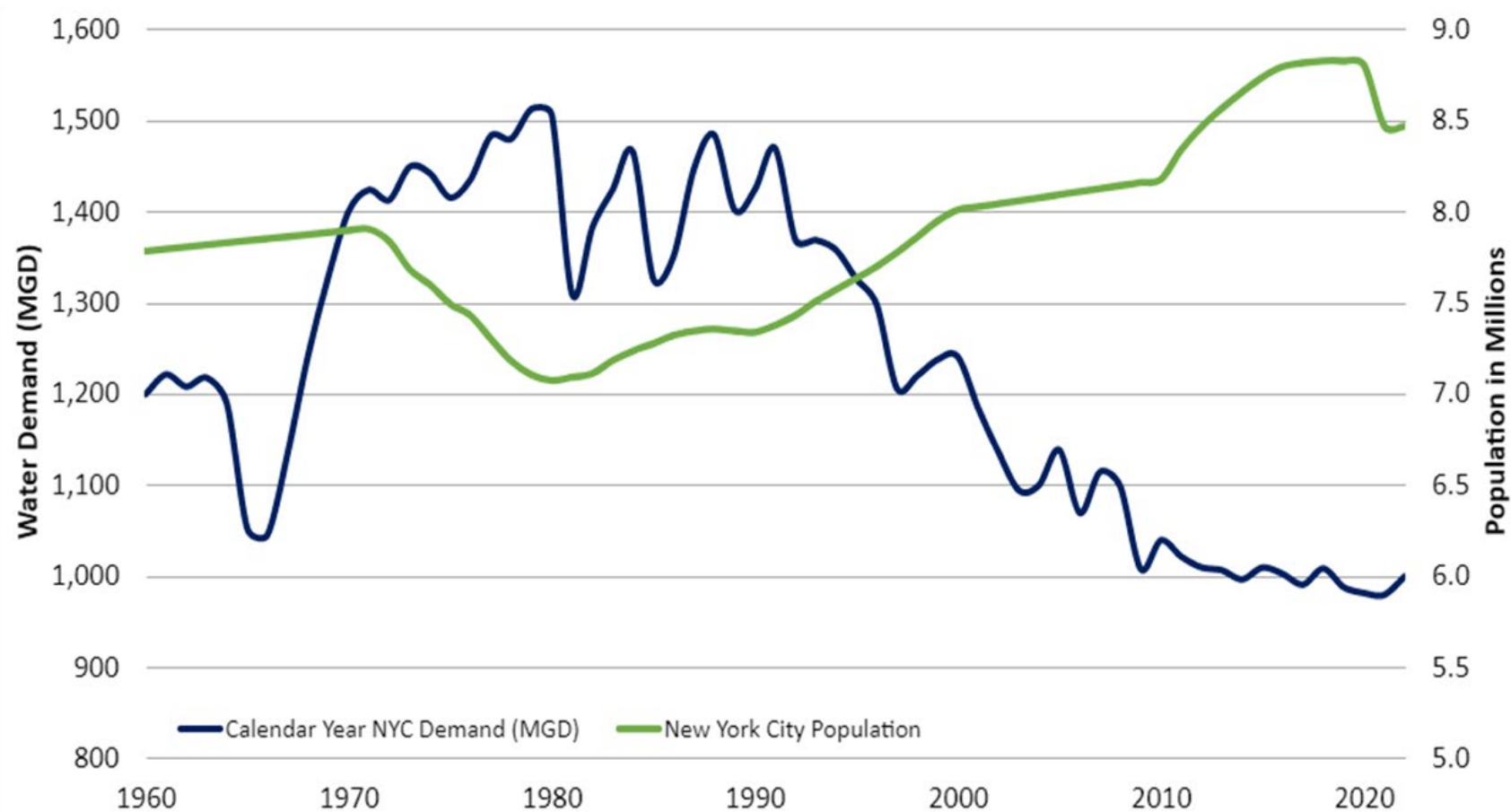


Getting to Today

- **Shutdown Management Plan was subject to a full environmental review process**
- Notice of Completion of Final Environmental Impact Statement was issued on December 15, 2017
- **Chapter 10: Proposed Water for the Future Shutdown System Operations 429 Pages**
- www.nyc.gov/assets/dep/downloads/pdf/environmental-reviews/upstate-water-supply-resiliency/chapter-10-wsso.pdf

Getting to Today

Conservation Savings



DEP instituted conservation strategies across residential, commercial, educational, industrial, and municipal customers that have reduced demand on the system to the lowest level in at least 60 years, even as population has increased.



**Meet water supply
demands during
the shutdown**



**Maintain high
quality water
during the
shutdown**



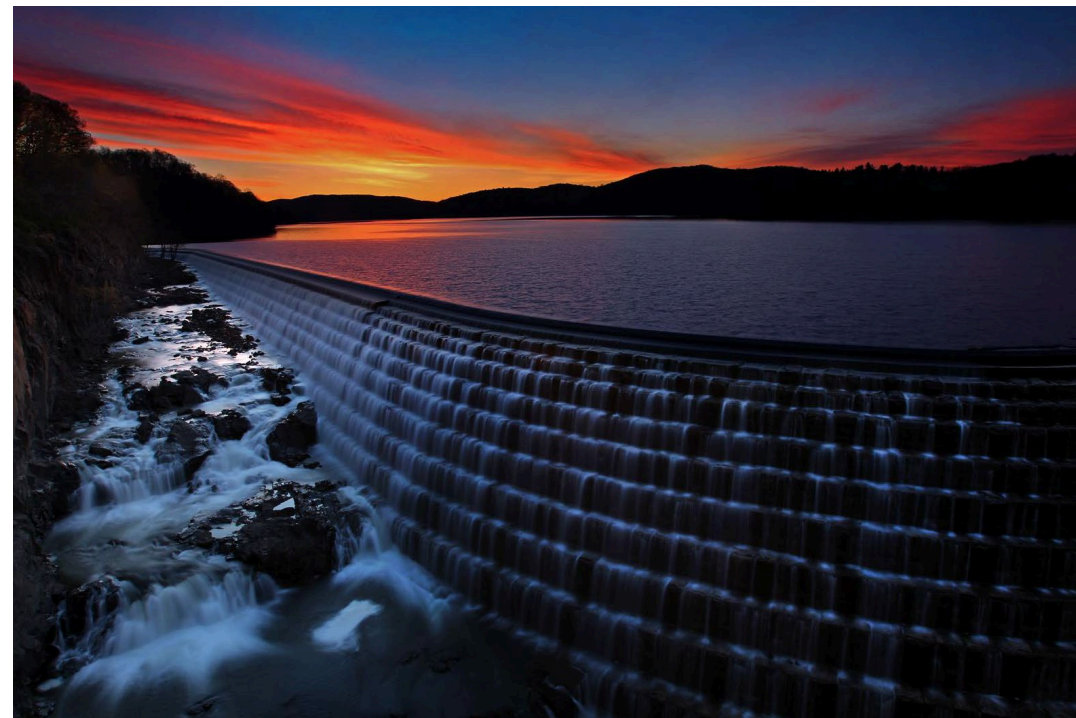
**Mitigate risks to
both water quality
and supply
reliability**

**A plan to provide uninterrupted, high-quality water to
DEP's customers during the Rondout West Branch
Tunnel bypass shutdown**

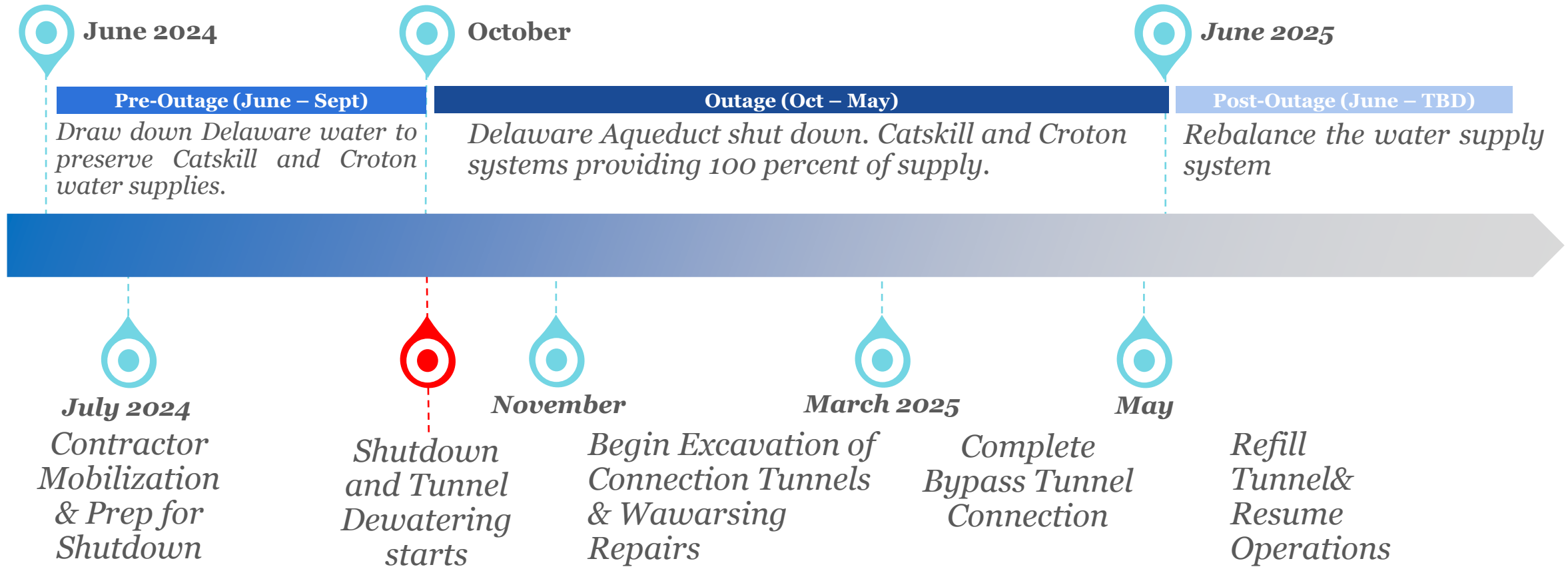
Water Supply Augmentation

During the 8-month shutdown how will New York City meet demand?

Source	Max. Capacity
Catskill System	600 MGD
Croton Pump Stations	240 MGD
Croton System	290 MGD



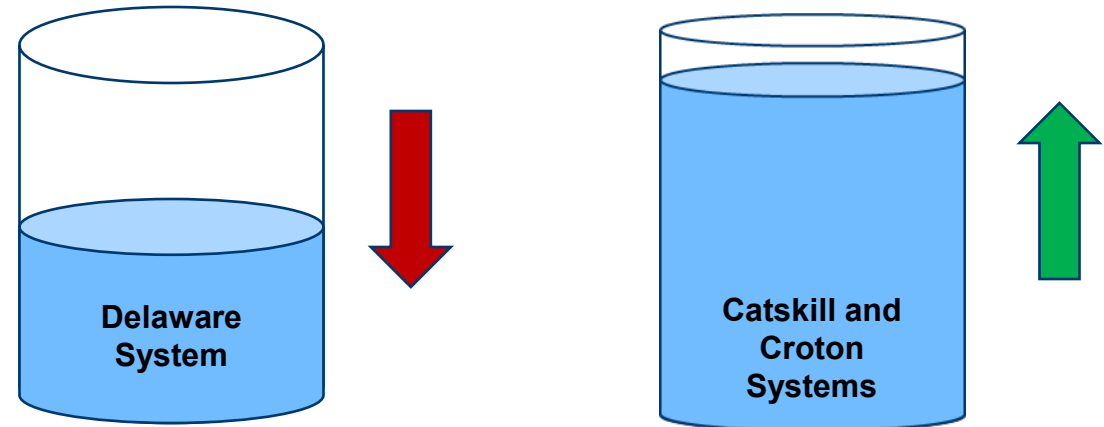
Shutdown Operations and Tunnel Connection Timeline



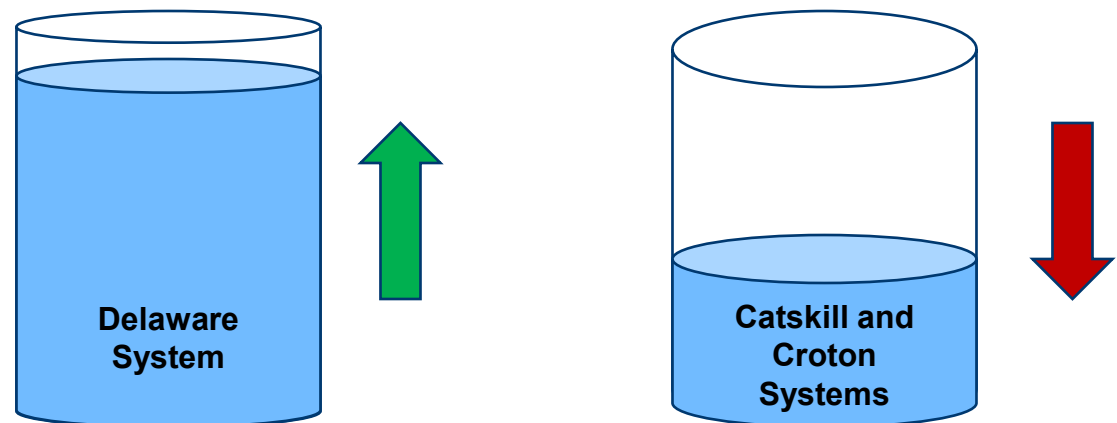
All “go” / “no-go” and potential project bailout decisions are made in real time based on precision data and in coordination with expert and regulatory partners. Bailout return-to-service during shutdown can take between 1 and 9 weeks.

Shutdown Operations

Before the aqueduct shutdown

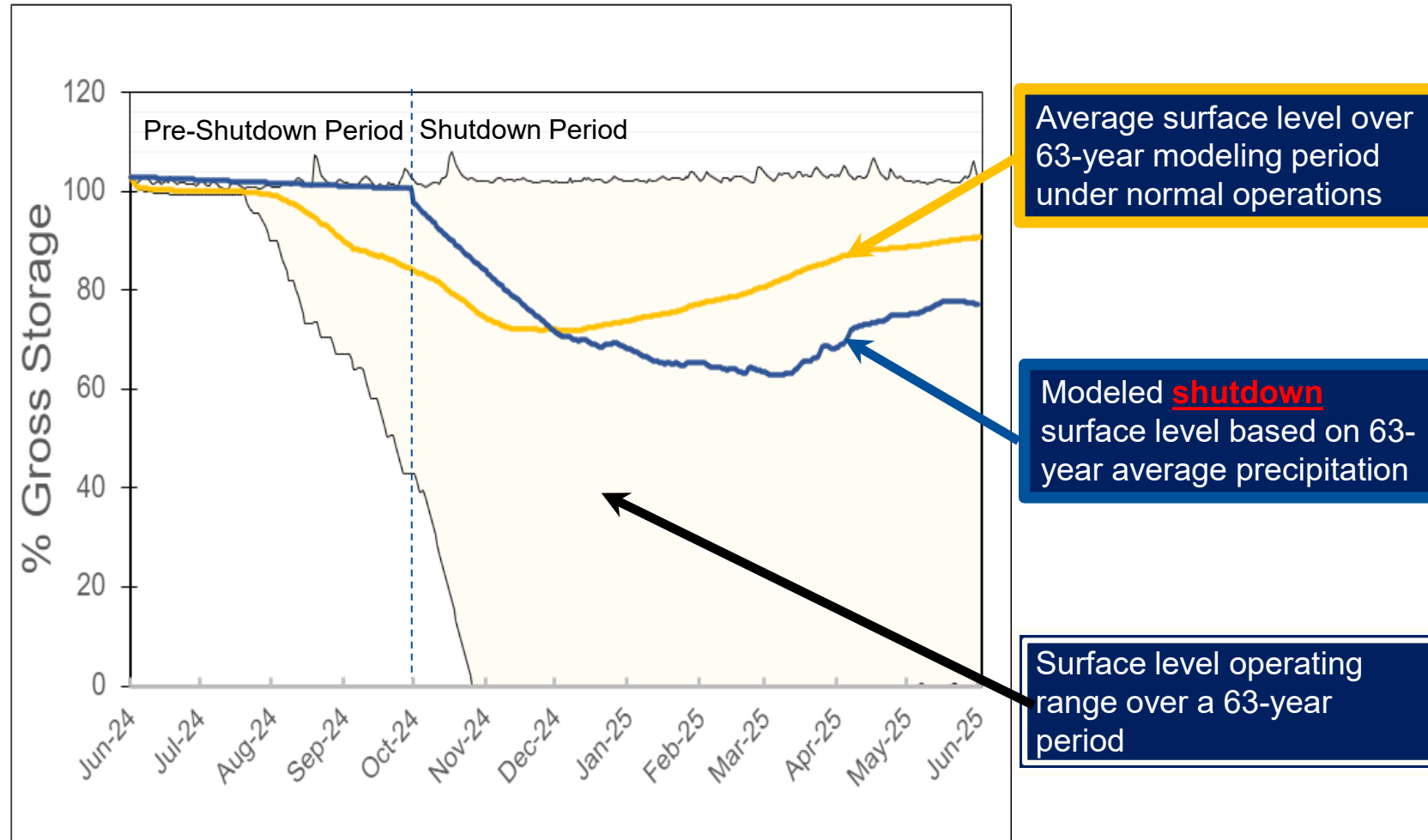


During the aqueduct shutdown



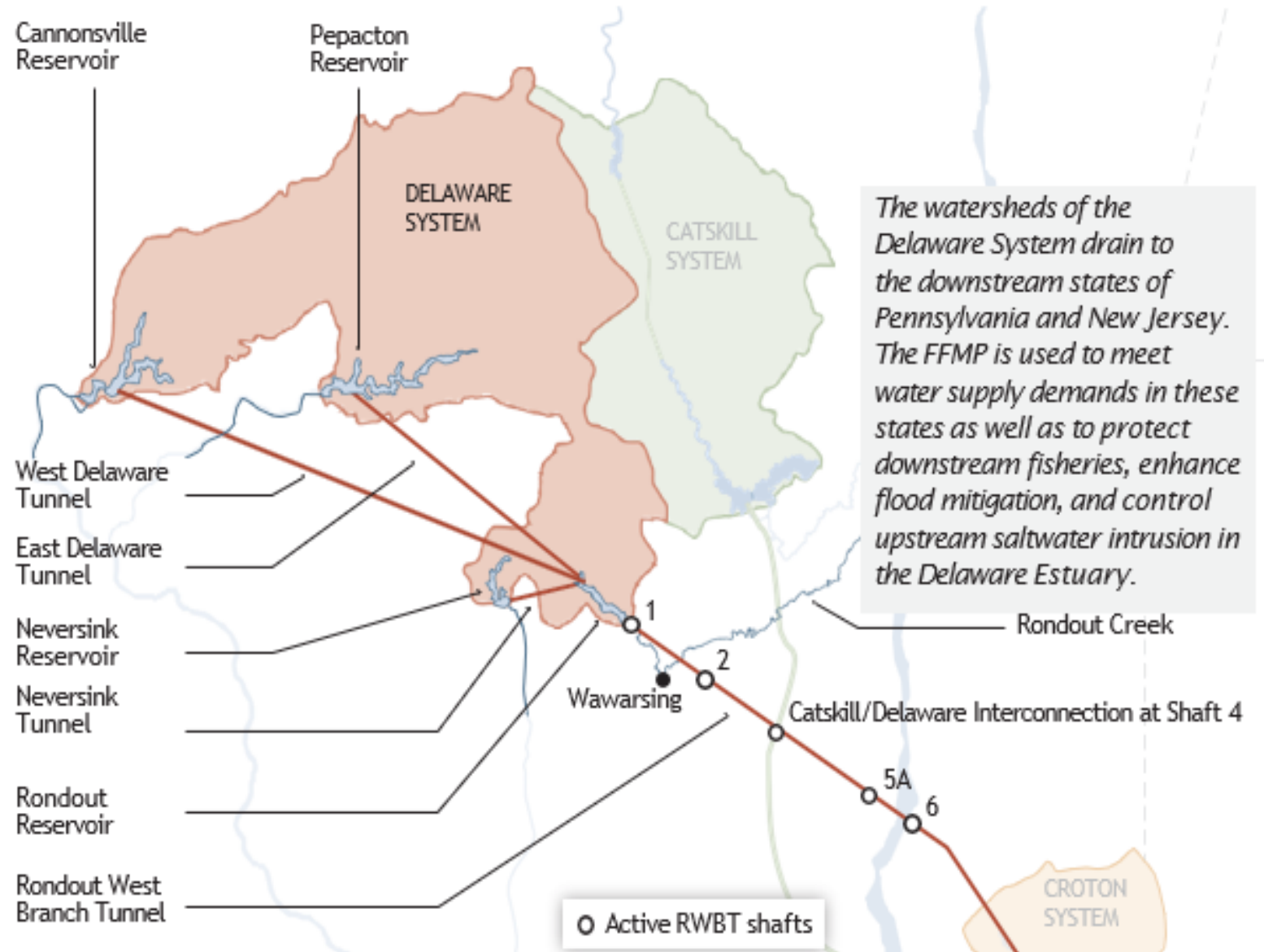
Reservoir Modeling leading up to and through the 8-month shutdown

The following visual graphs are based on predictive modeling and historic averages. Actual conditions will likely differ based on precipitation patterns and forecasts, storage conditions, operational releases and diversions, and various other factors throughout the year.



Delaware System Leading into the Shutdown

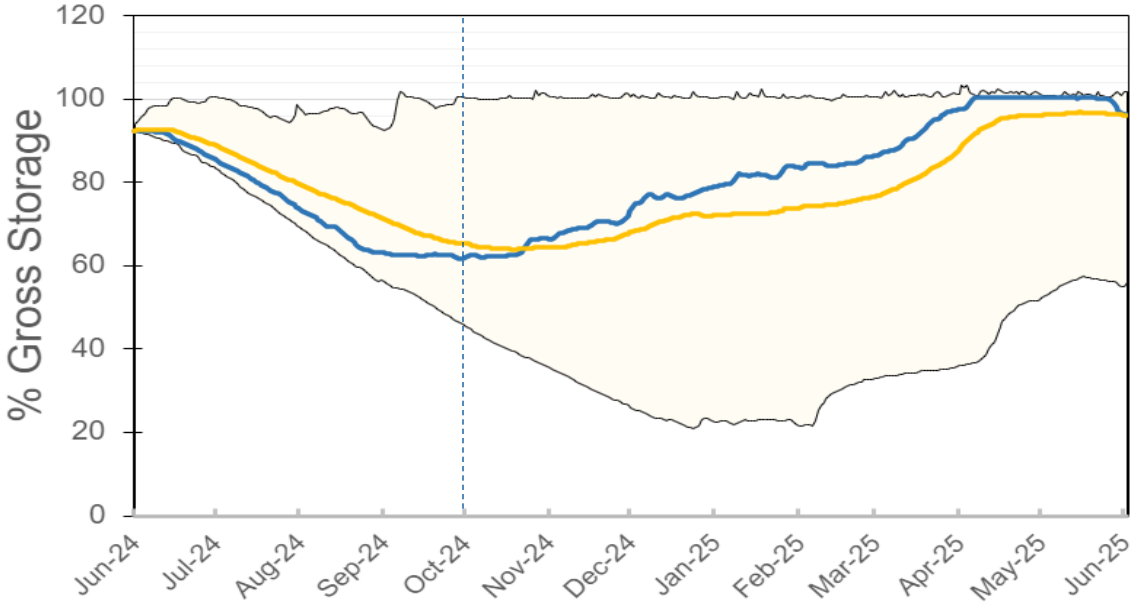
- Depending on rainfall, DEP expects to draw down the Cannonsville, Neversink and Pepacton reservoirs by 30 percent or more ahead of the shutdown
- Preserve Catskill system water for the shutdown



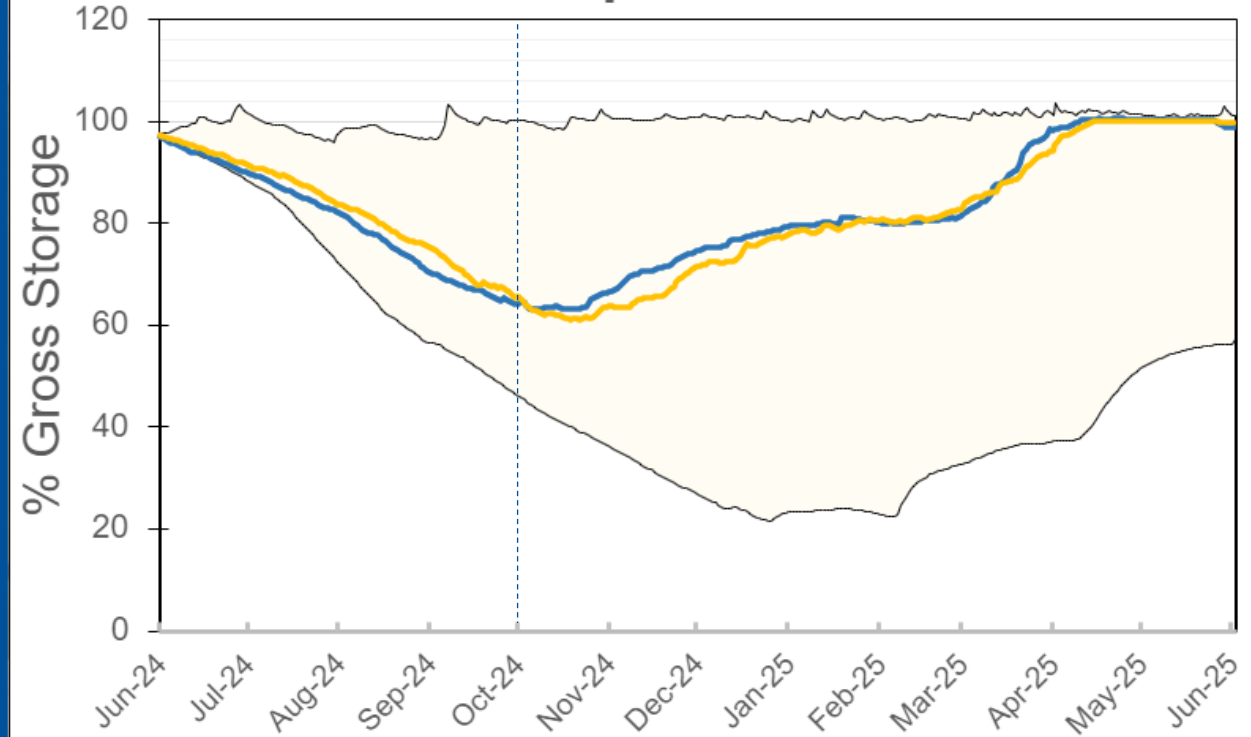
Prior to the shutdown, The Cannonsville, Pepacton and Neversink will be drawn down, leaving a substantial void for refill and spill attenuation

During shutdown operations, releases from each of those reservoirs into the Delaware River tributaries will continue pursuant to the Flexible Flow Management Program (FFMP). All diversions of water into the tunnels will be shut down

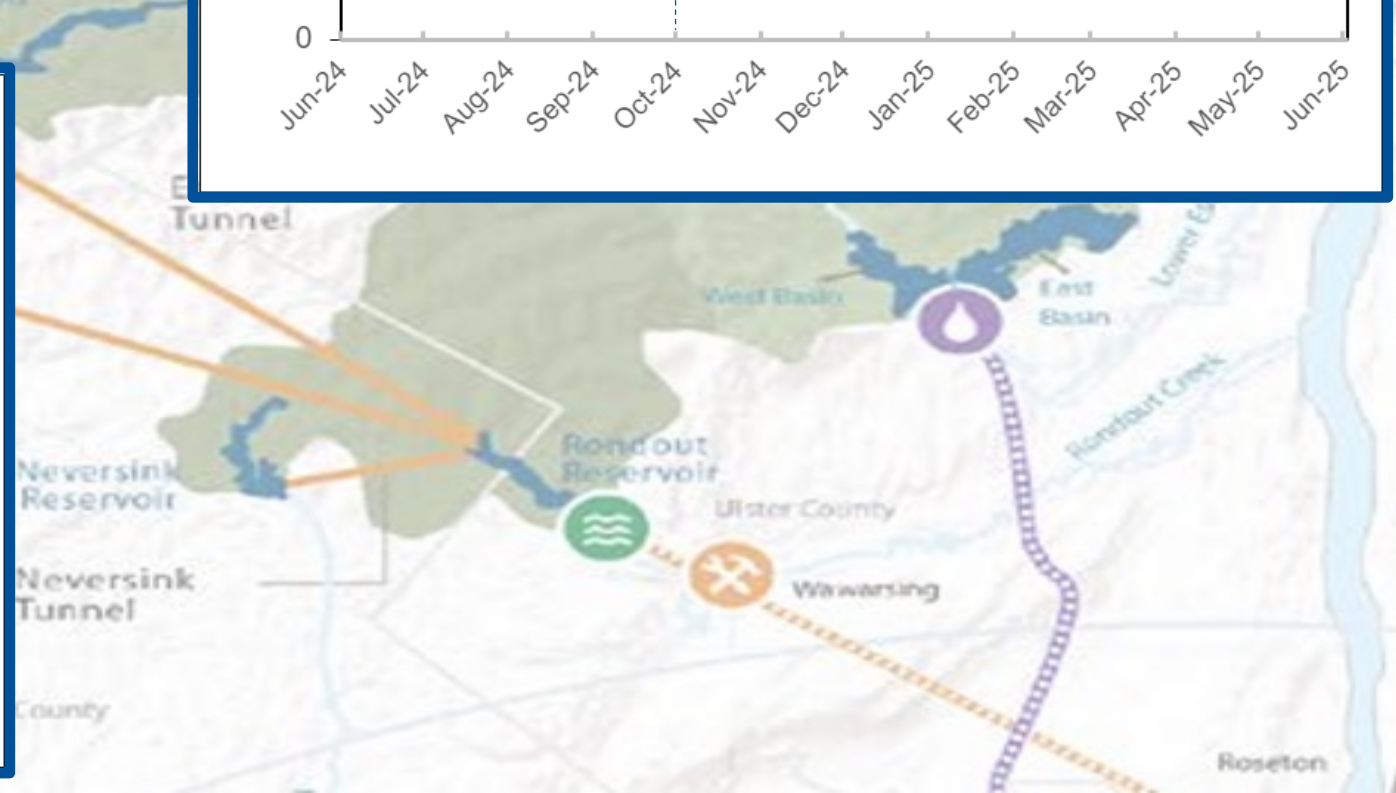
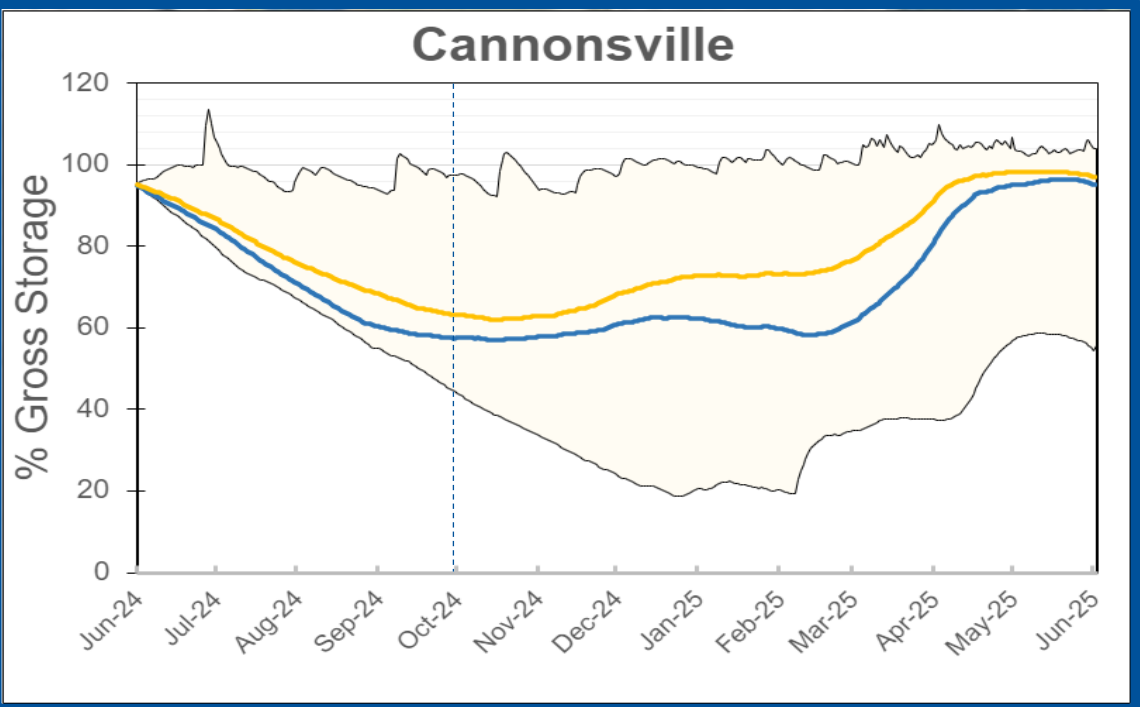
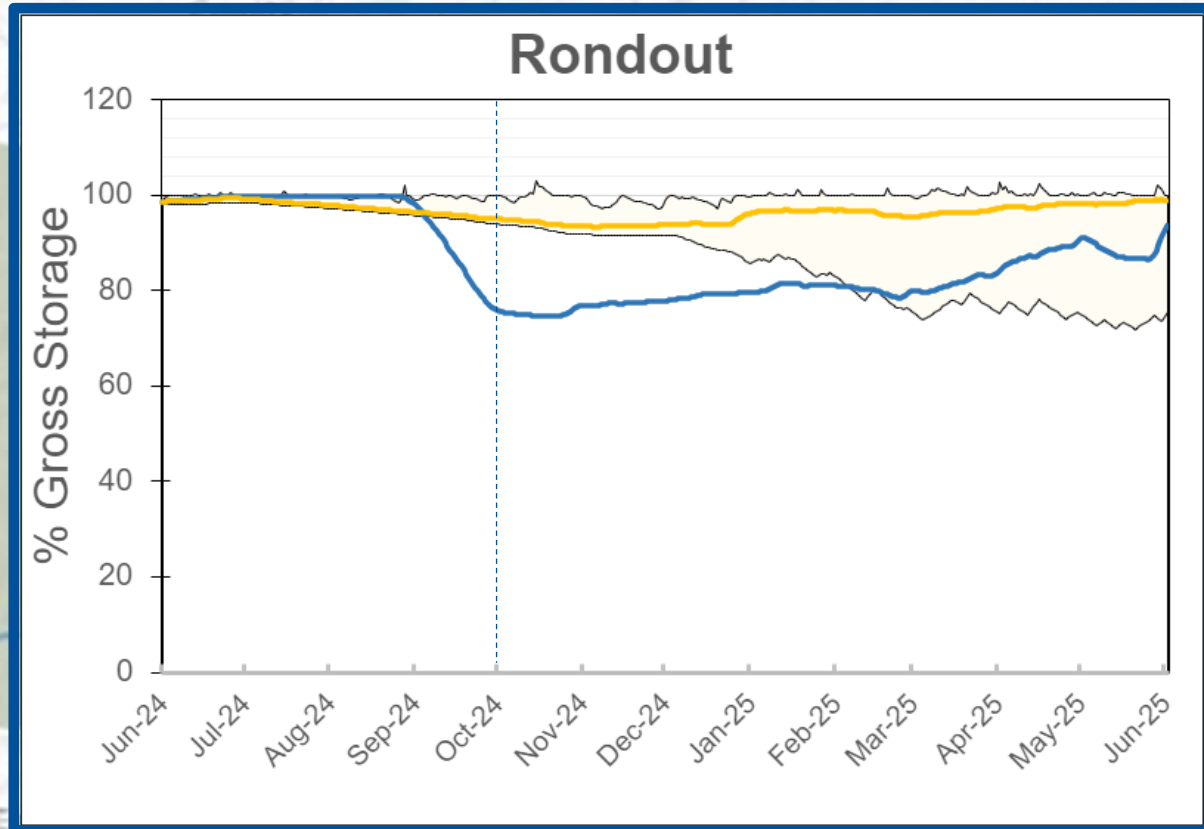
Neversink



Pepacton



During Delaware Aqueduct shutdown operations three new temporary siphons will be used to help manage the Rondout Reservoir's surface elevation by enabling the release of as much as 260 million gallons per day (similar to the flow of a small creek) into the Rondout Creek. Siphons cease operations within 1 foot of flood action stage on Rondout Creek



Delaware System Expanded Waterfowl Management Program



- Longstanding management program has been in place at Kensico and Hillview Reservoirs in Westchester to prevent contamination from wildlife waste
- Program includes monitoring of waterfowl and mitigating their effects on water quality
- Waterfowl are typically dispersed by motorboats combined with noisemakers (pyrotechnics)
- **At the end of the shutdown period, DEP may use same practices at Rondout Reservoir to minimize fecal coliform contributions as Delaware System is brought back on line**
- **All activities are conducted pursuant to an Environmental Impact Statement to minimize and mitigate impacts to nontarget species, such as Bald Eagles**
 - protective buffers are maintained for Bald Eagle Nest Sites, in consultation with DEC and USFWS as needed
- Concerns can be directed to Director of Outreach John Milgrim at (845) 334-7868 or jmilgrim@dep.nyc.gov

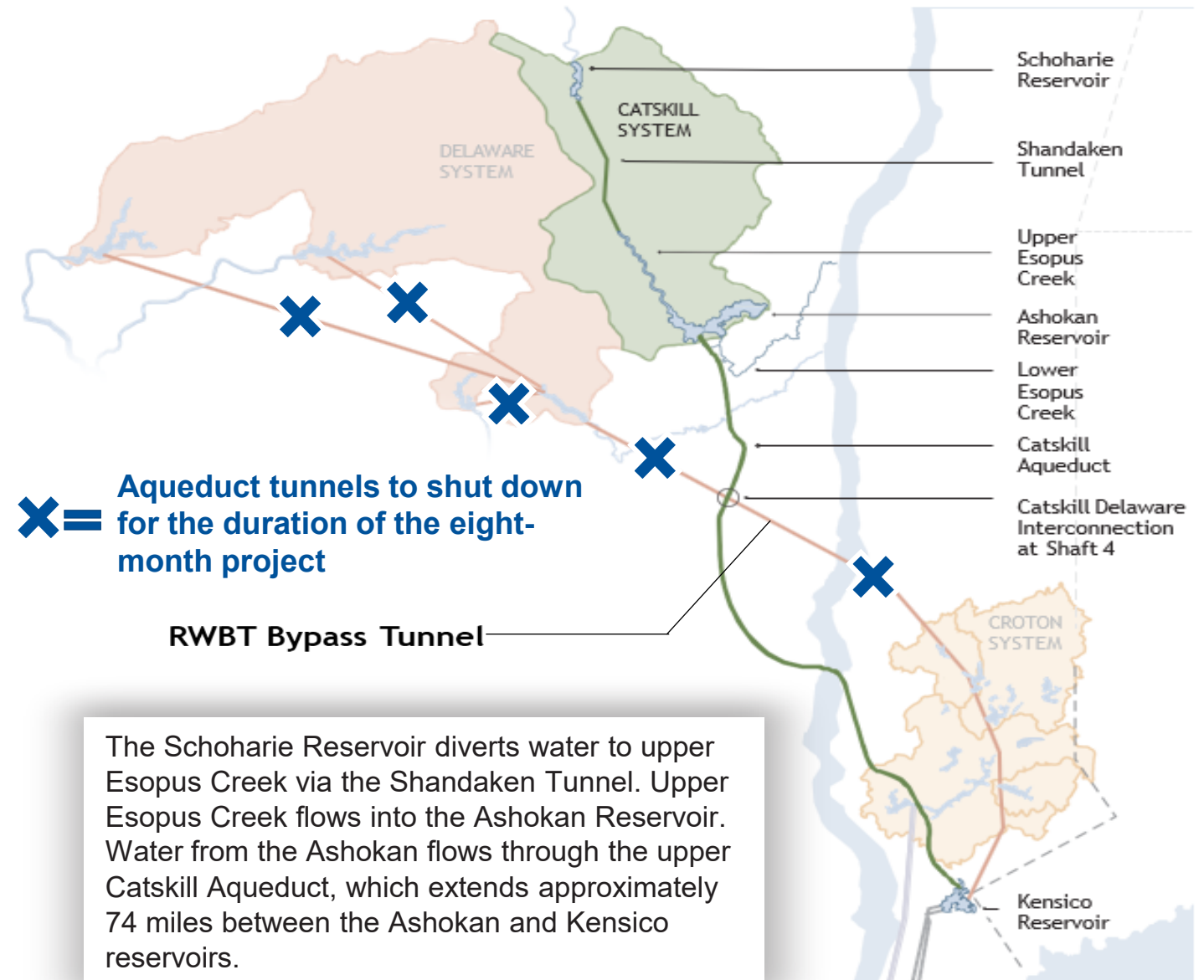
Delaware System Recreational Uses

- Permitted boating and fishing activities from shore or boat will be allowed on all reservoirs
- Boating (recreational and fishing) on the Neversink, Cannonsville, and Pepacton reservoirs will remain active for the entire season
- During periods with lower reservoir levels, access to the water may be more difficult for fishing and recreational boat users
- No restrictions will be placed on any land-based recreational activities, including hunting, hiking, or trapping



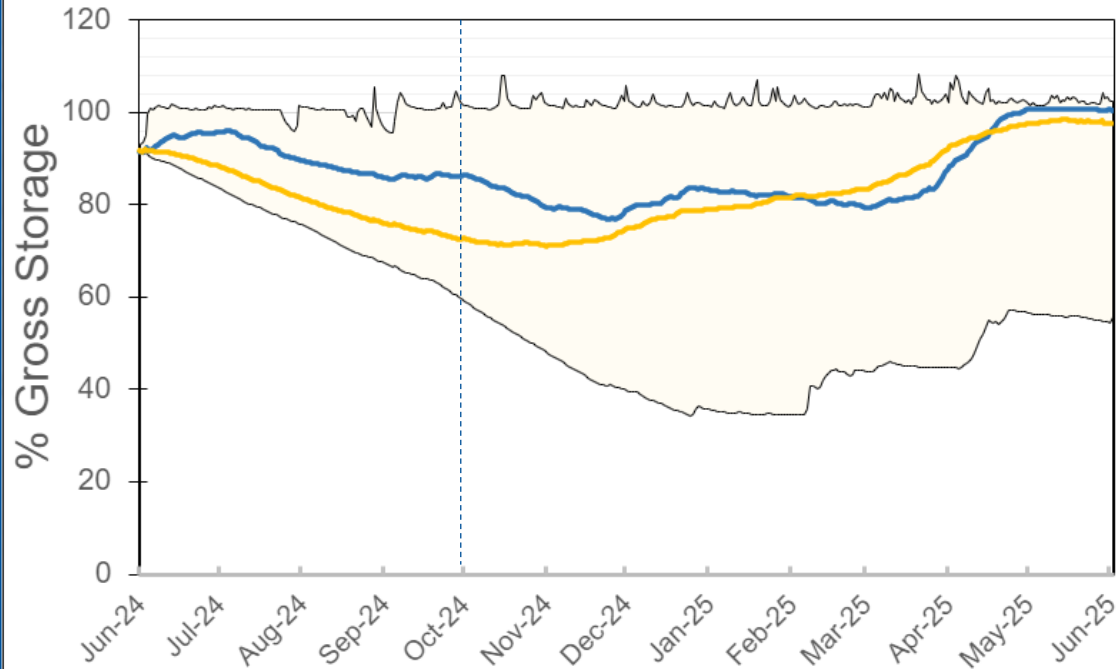
Catskill System During Delaware Shutdown

Starting October 1, 2024 the Delaware Aqueduct and tunnels from the Cannonsville, Pepacton and Neversink reservoirs to the Rondout Reservoir will shut down for up to eight months and the total City water supply will come from the Catskill System supplemented by the Croton System as contractors work to connect the bypass tunnel under the Hudson

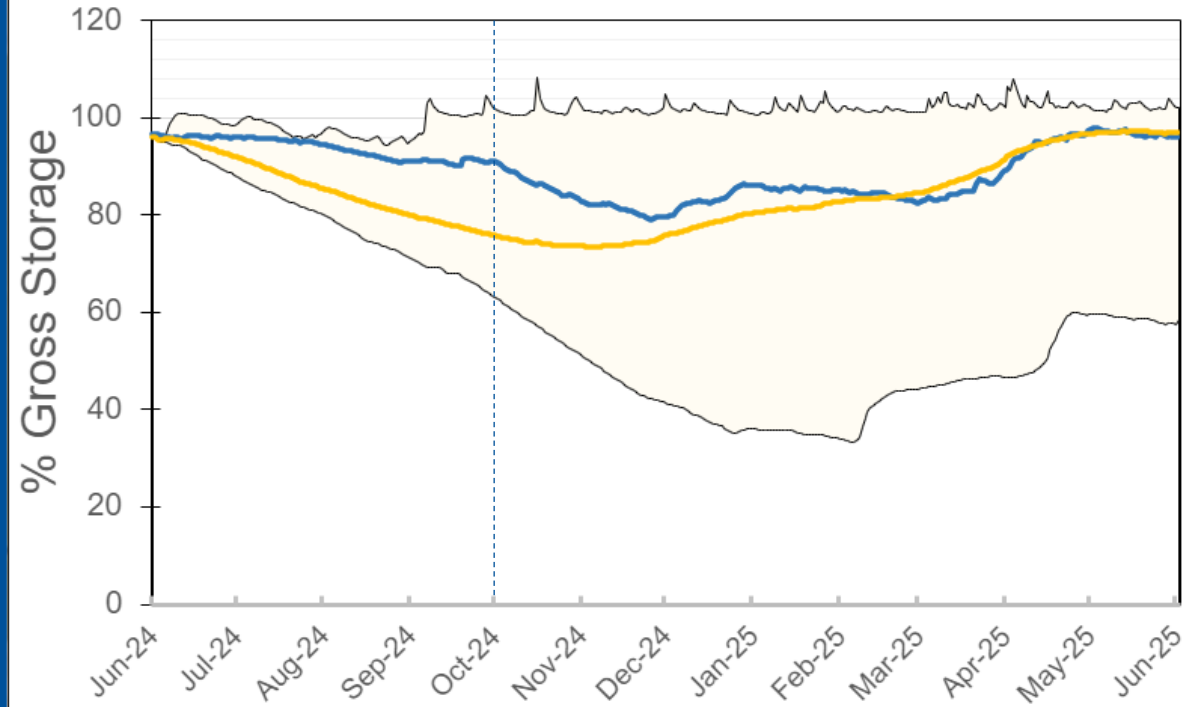


Releases to the lower Esopus Creek leading up to and during the Delaware Aqueduct shutdown will continue pursuant to the Interim Release Protocol, and DEP anticipates operating the Ashokan pursuant to the Conditional Seasonal Storage Objective maintaining a 10 percent void after October 15

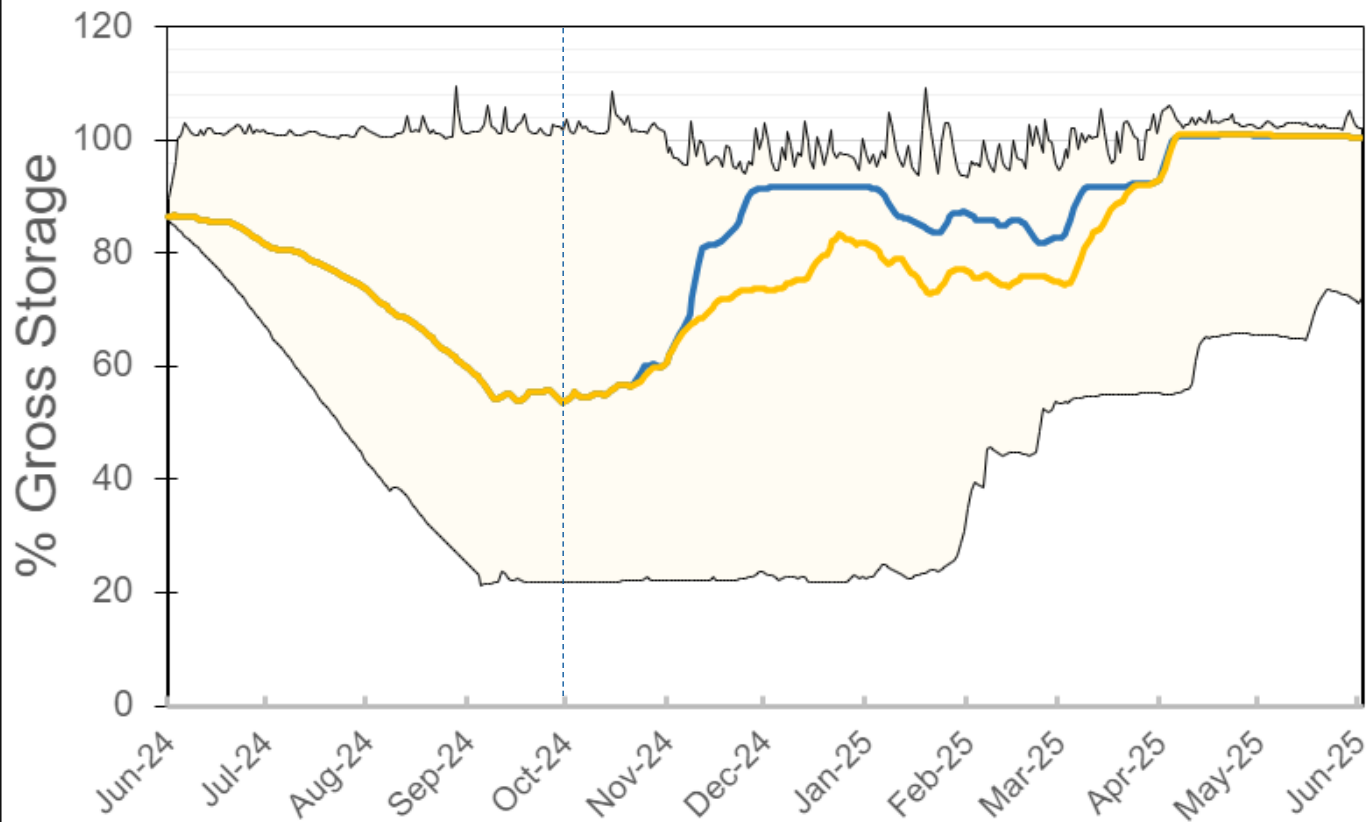
West Ashokan



East Ashokan



Schoharie



Diversions from the Schoharie through the Shandaken Tunnel to the Upper Esopus are expected to continue.

Catskill System Expanded Waterfowl Management Program



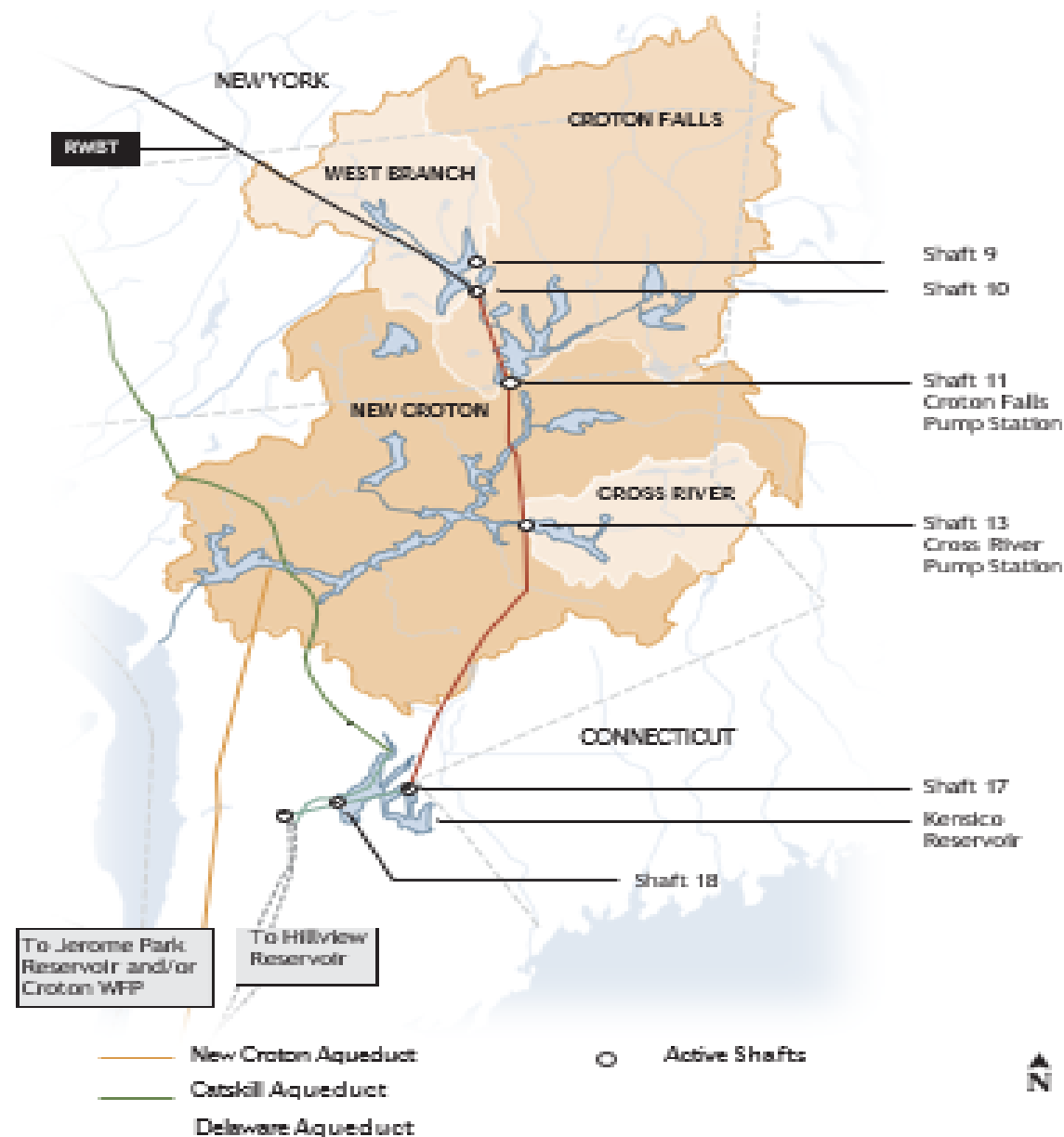
- Longstanding management program has been in place at Kensico and Hillview Reservoirs to prevent contamination from wildlife waste
- Program includes monitoring of waterfowl and mitigating their effects on water quality
- Waterfowl are typically dispersed by motorboats combined with noisemakers (pyrotechnics)
- **During the shutdown period, DEP will use same practices at Ashokan Reservoir as needed to protect water quality, and they may be noticeable from the Ashokan Rail Trail and Promenade**
- **All activities are conducted pursuant to an Environmental Impact Statement to minimize and mitigate impacts to nontarget species, such as Bald Eagles**
 - protective buffers are maintained for Bald Eagle Nest Sites, in consultation with DEC and USFWS as needed
- Concerns can be directed to Director of Outreach John Milgrim at (845) 334-7868 or jmilgrim@dep.nyc.gov

Catskill System Recreational Uses

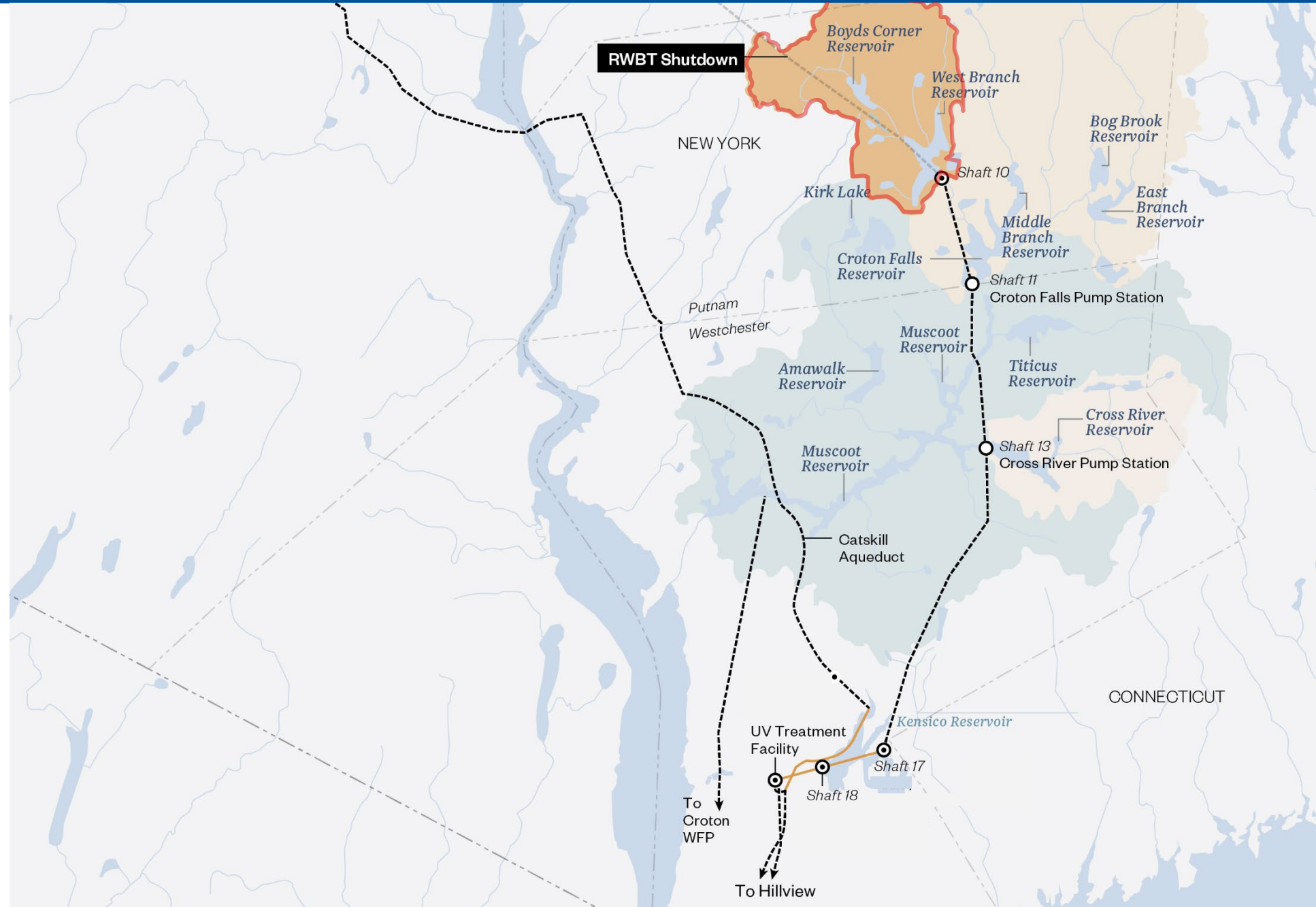
- Permitted fishing activities from shore or boat will be allowed on both the Schoharie and Ashokan reservoirs
- Recreational Boating on the Schoharie reservoir will remain active for the entire season
- During periods with lower reservoir levels, access to the water may be more difficult for fishing and recreational boat users
- No restrictions will be placed on any land-based recreational activities, including hunting, hiking, or trapping



The Croton System, the oldest watershed in the City's supply system, will be tapped at full capacity during the Delaware Shutdown period and treated as four separate subsystems. Additionally, pump stations will supplement water into the lower Delaware Aqueduct



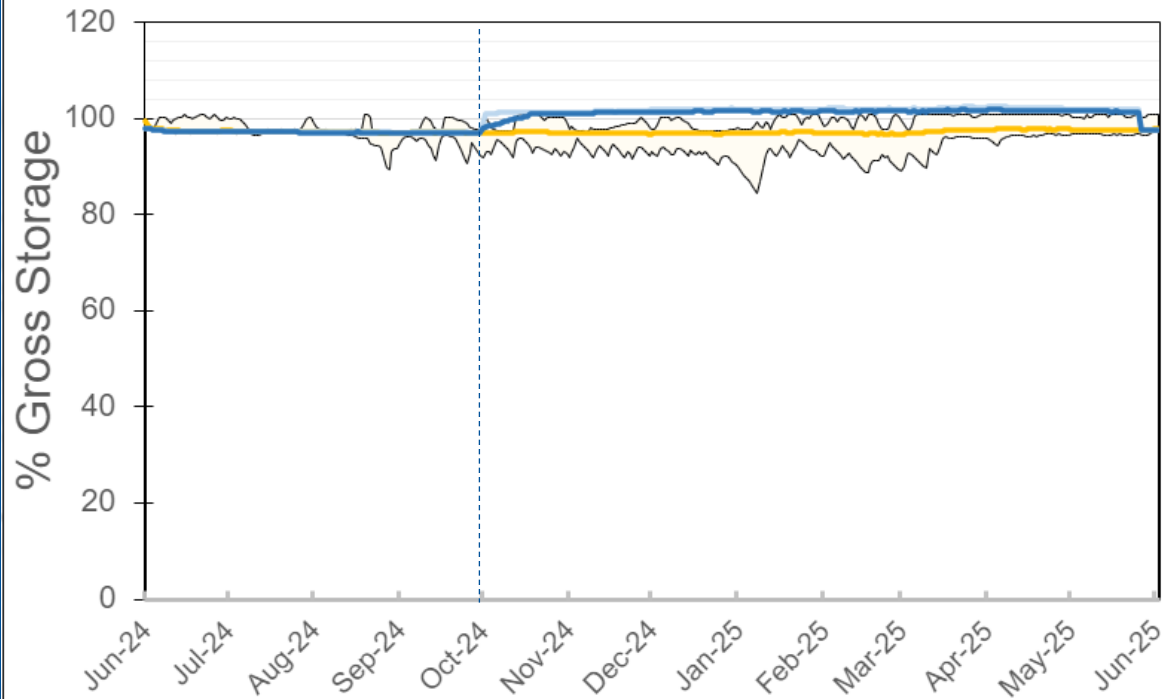
Outage Operations - Croton: West Branch Subsystem



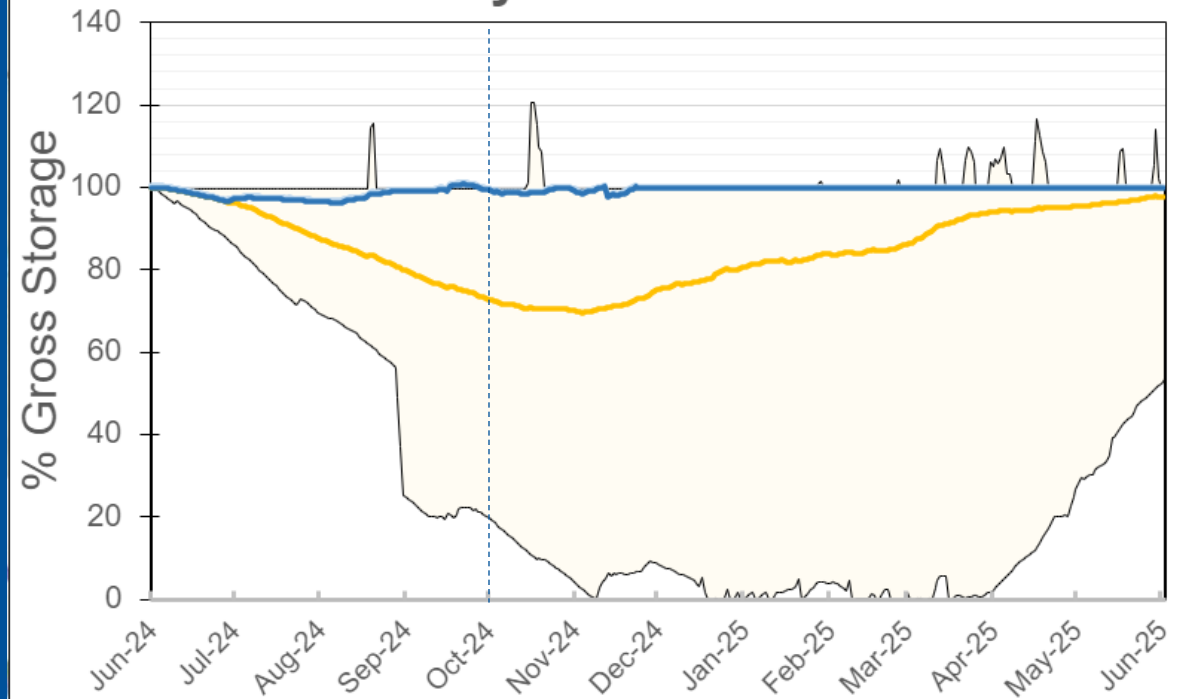
The Delaware Aqueduct will remain operational from the West Branch Reservoir to New York City throughout the shutdown and water in the West Branch and Boyds Corner reservoirs will be held as reserve up to and during the shutdown period with minimal downstream releases.



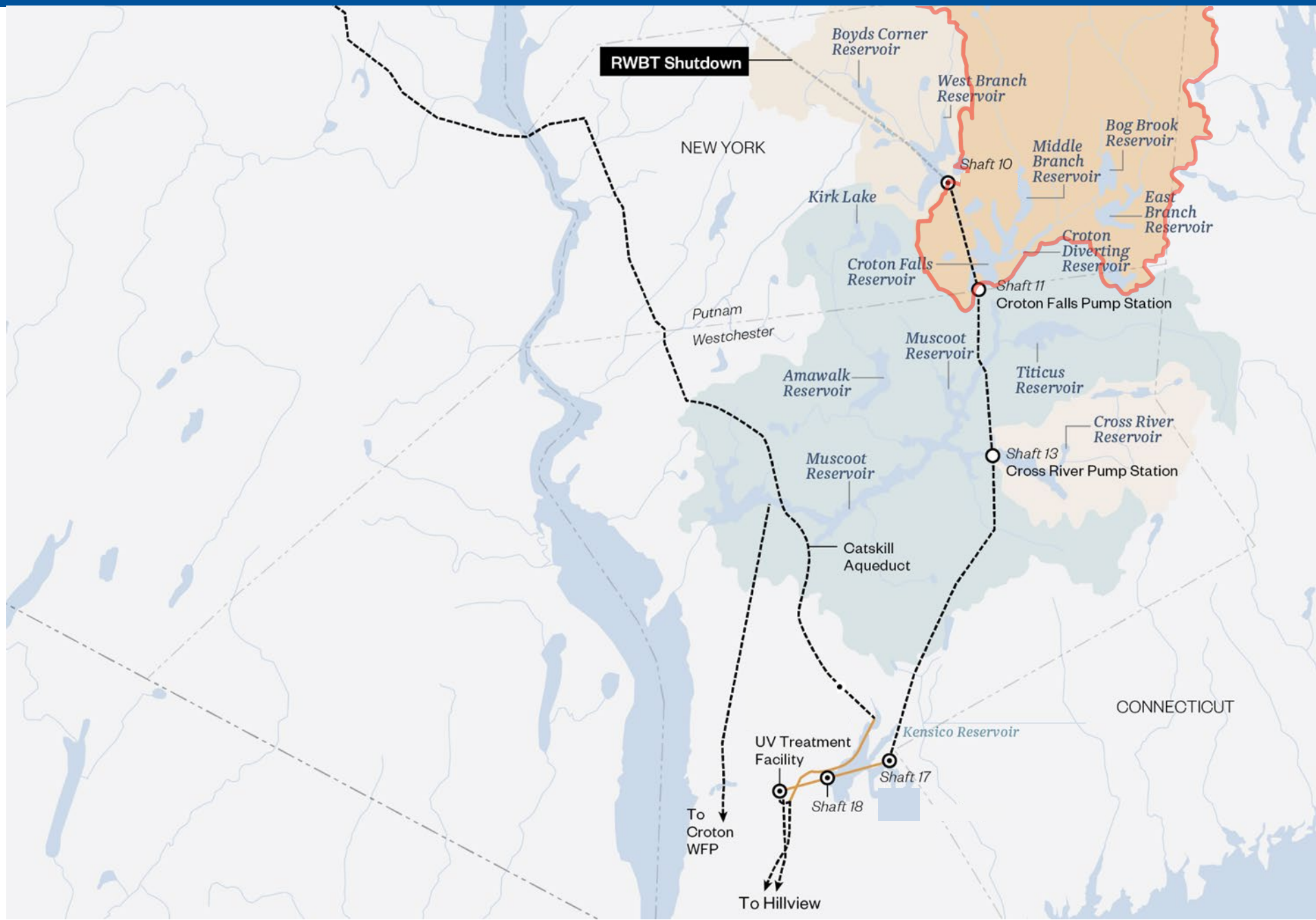
West Branch



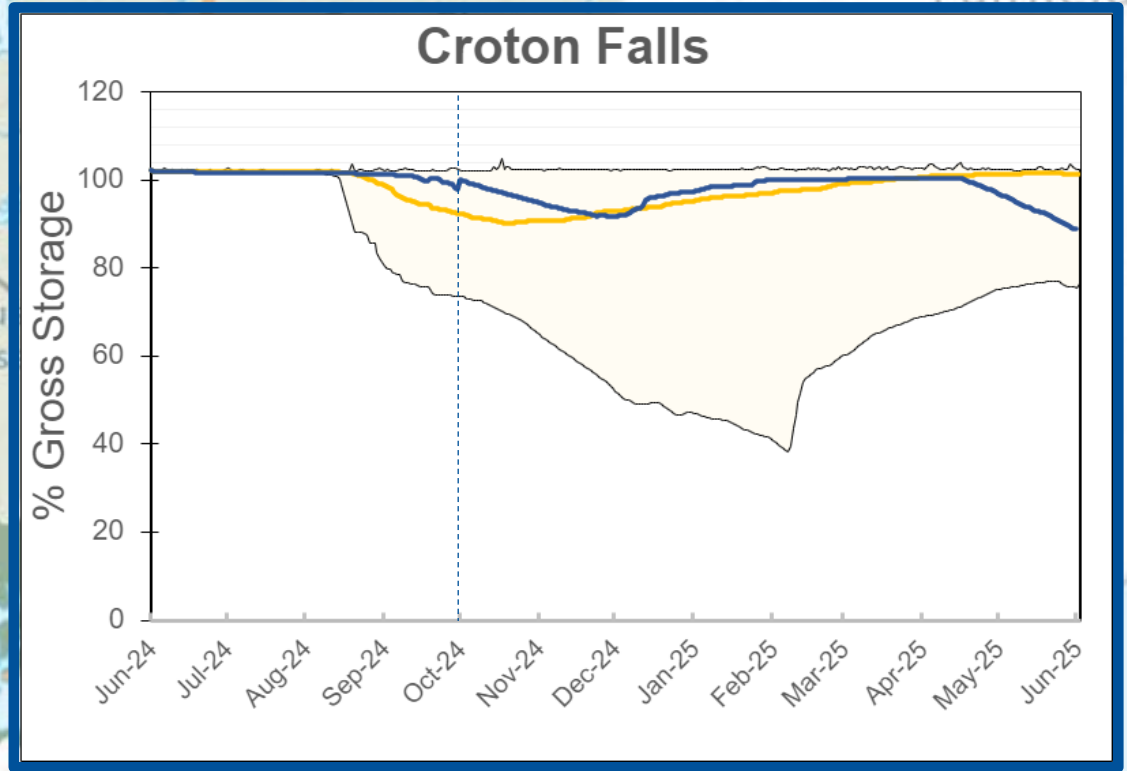
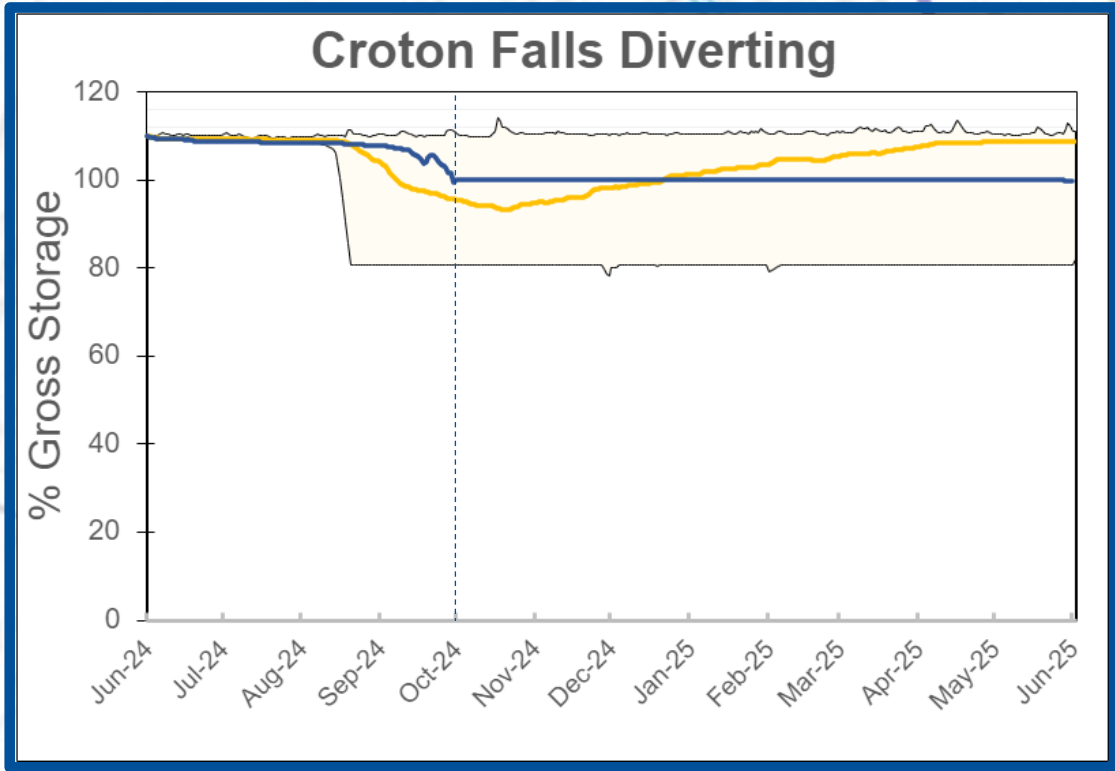
Boyds Corner



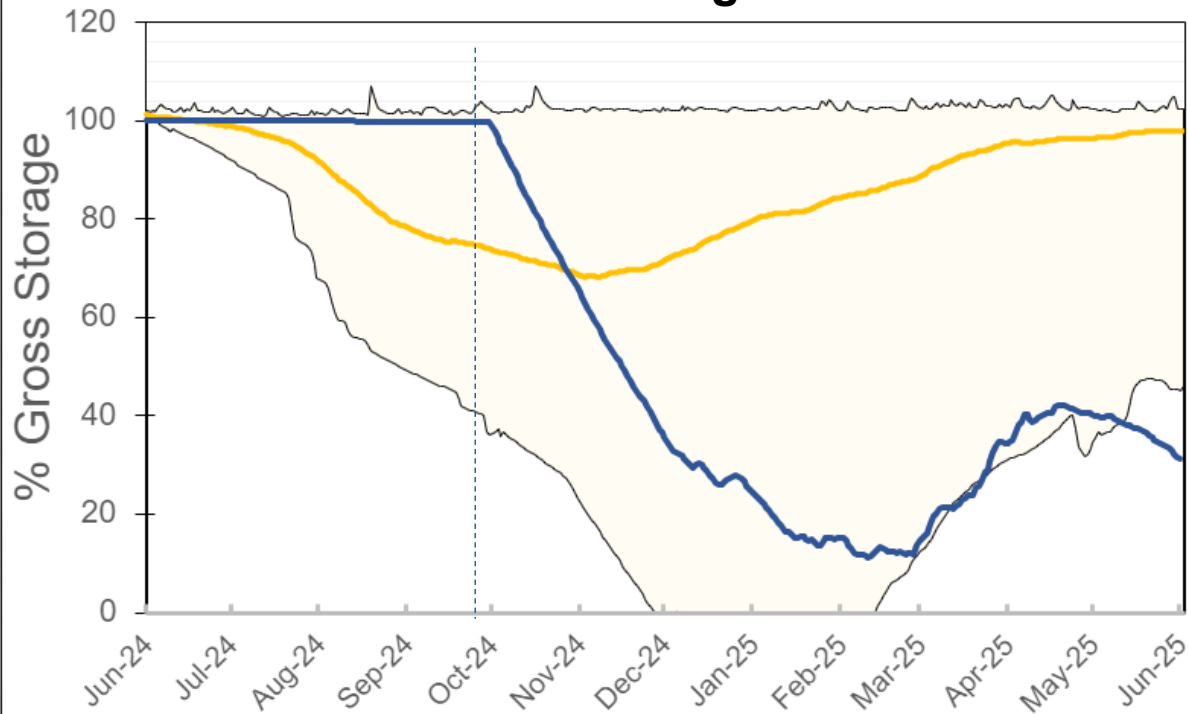
Outage Operations - Croton: Croton Falls Subsystem



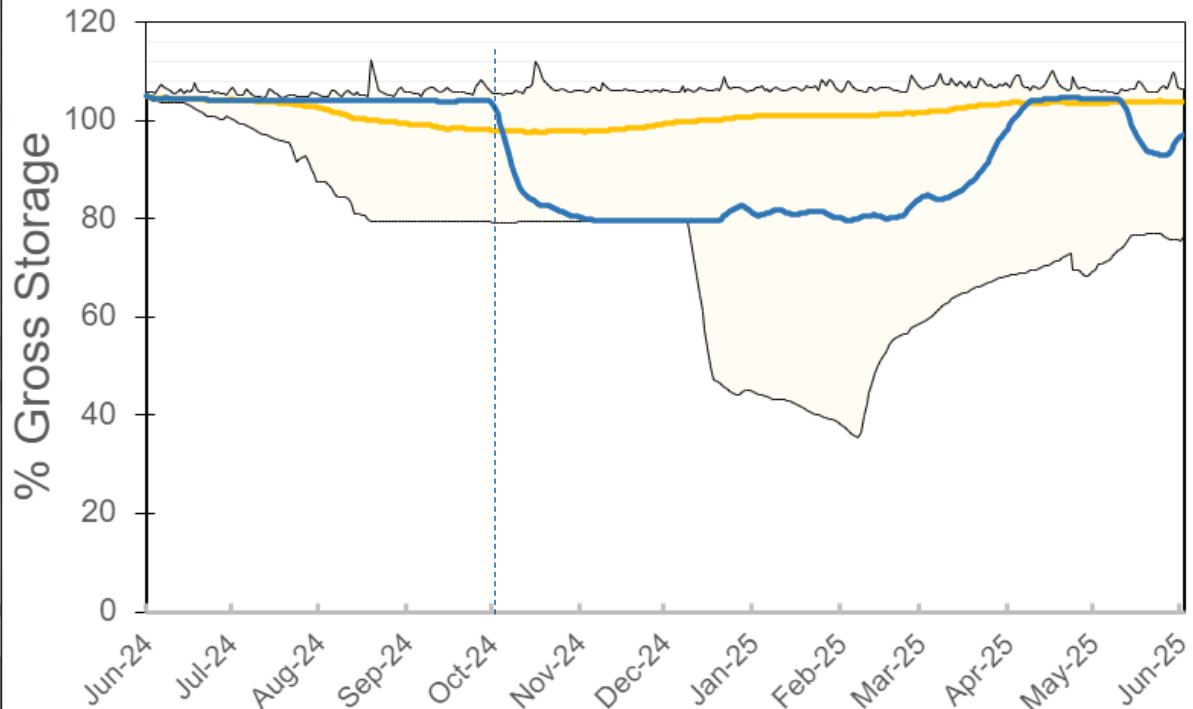
- Pump an average 150 million gallons a day (mgd) from Croton Falls Reservoir into Shaft 11 (Delaware Aqueduct) and send water to Kensico Reservoir.
- Reduce downstream releases from the Croton Falls and Croton Diverting during outage to maintain surface elevation and maximize pumping efficiency (Per 6 NYCRR Part 672-3).



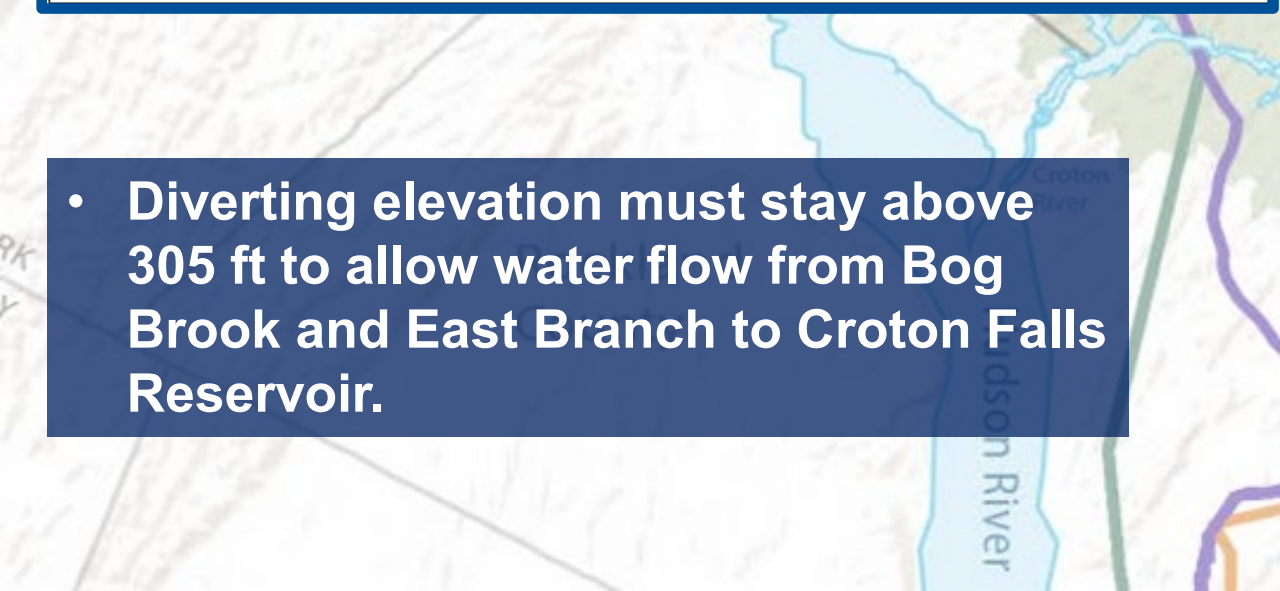
East Branch / Bog Brook



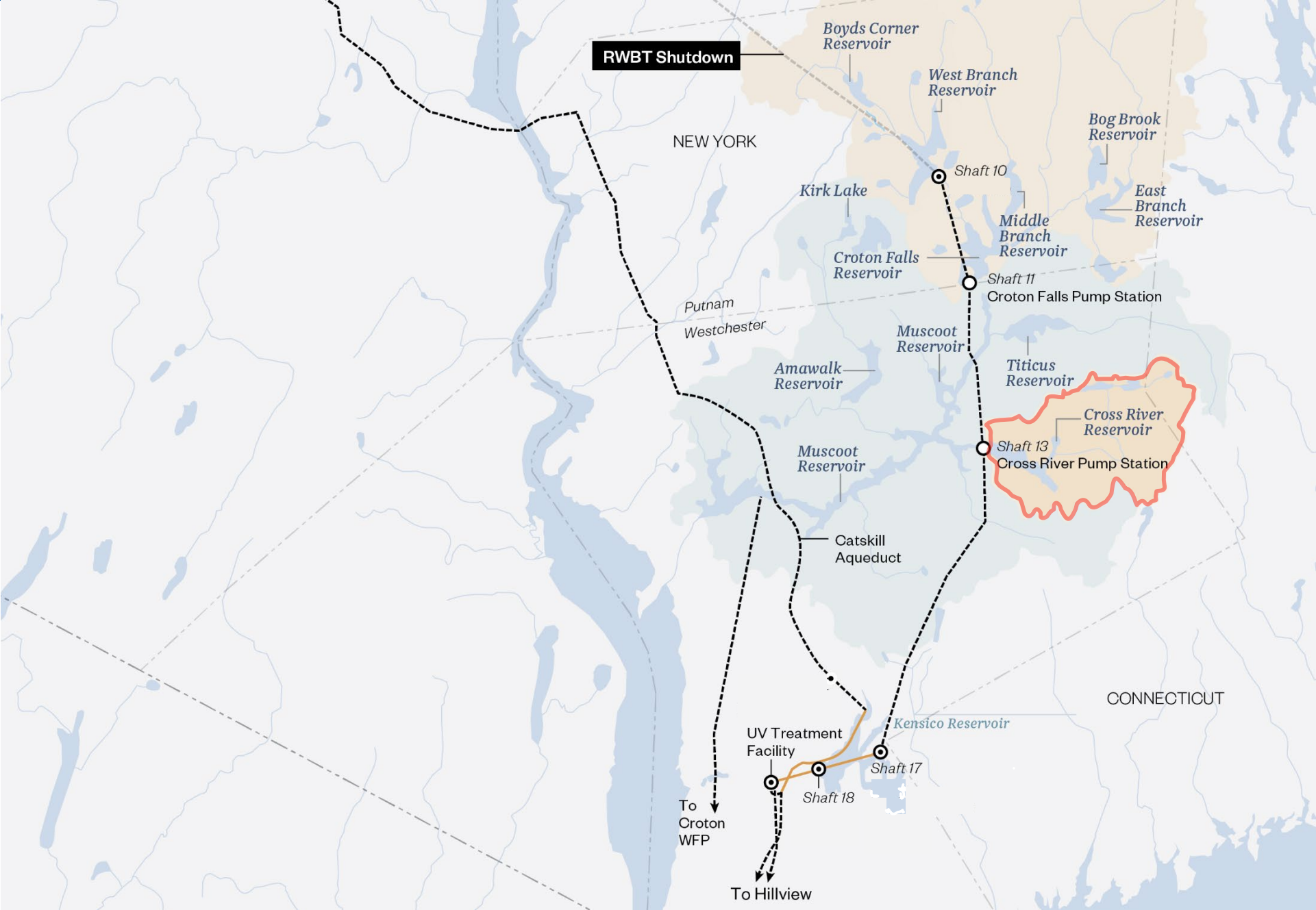
Middle Branch

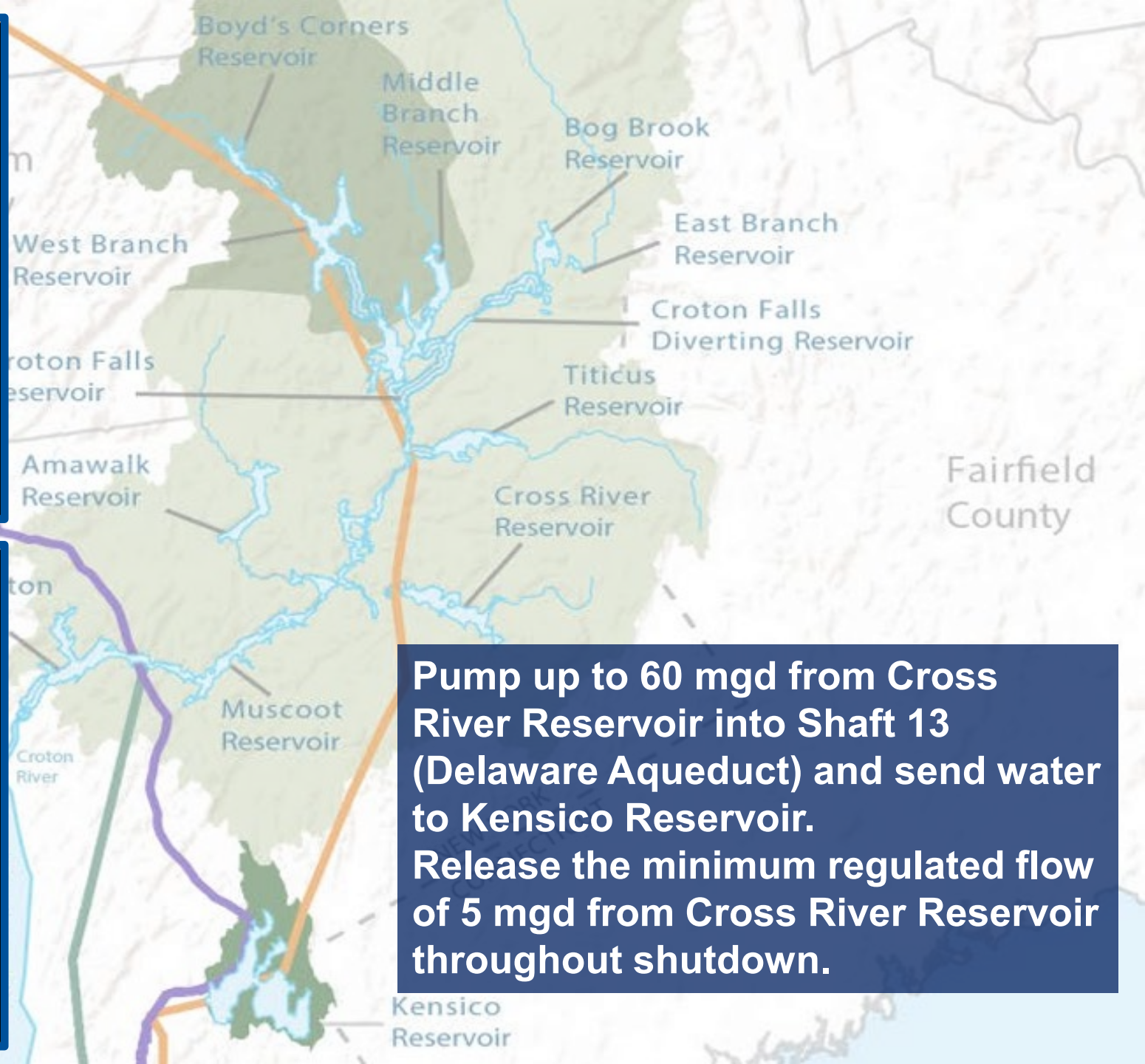
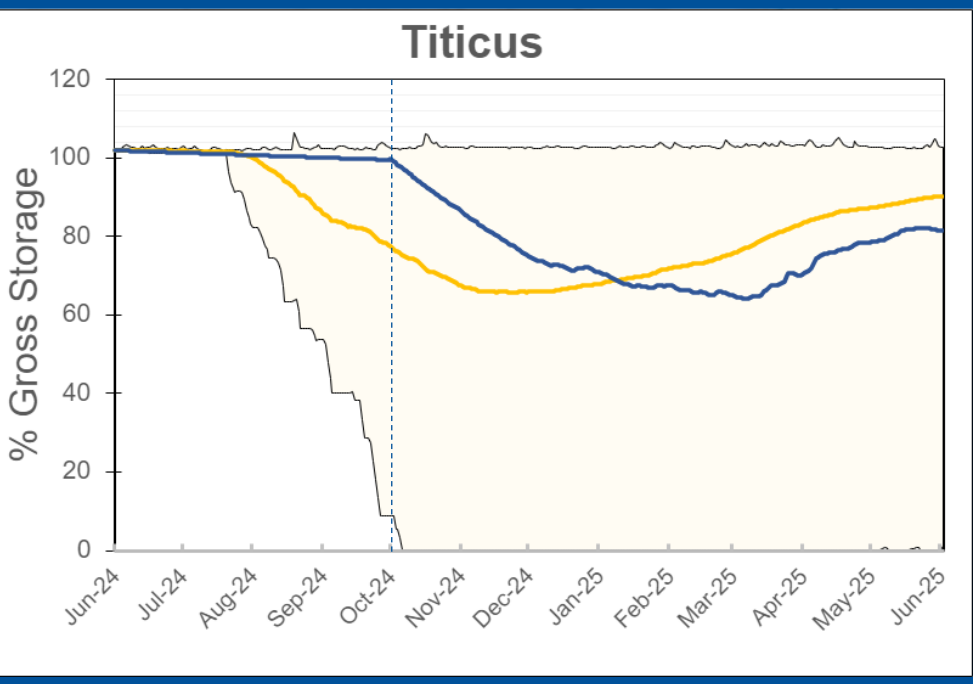
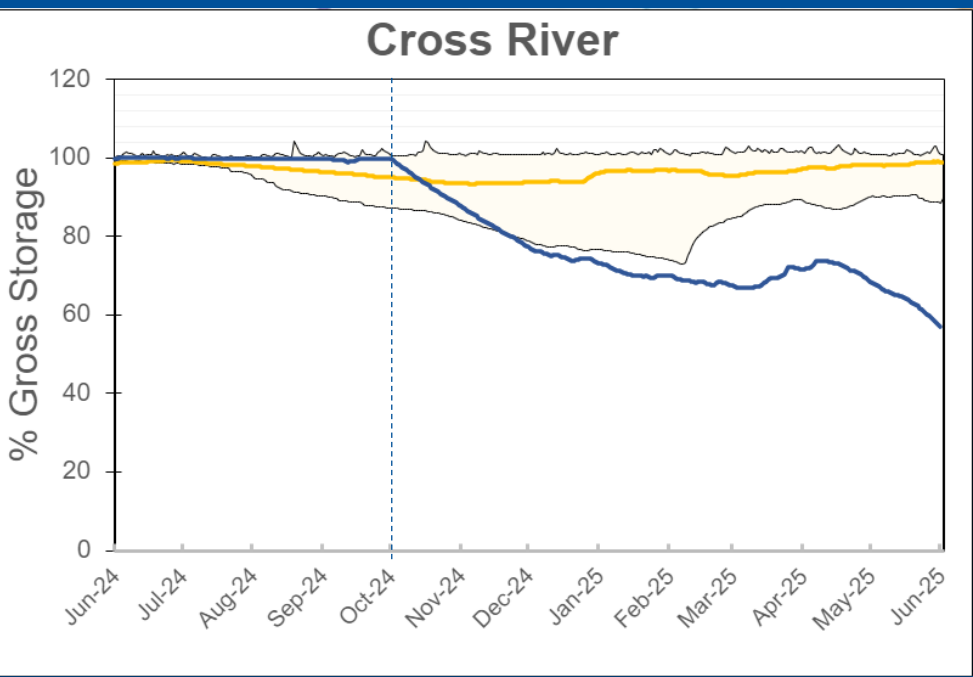


- Diverting elevation must stay above 305 ft to allow water flow from Bog Brook and East Branch to Croton Falls Reservoir.

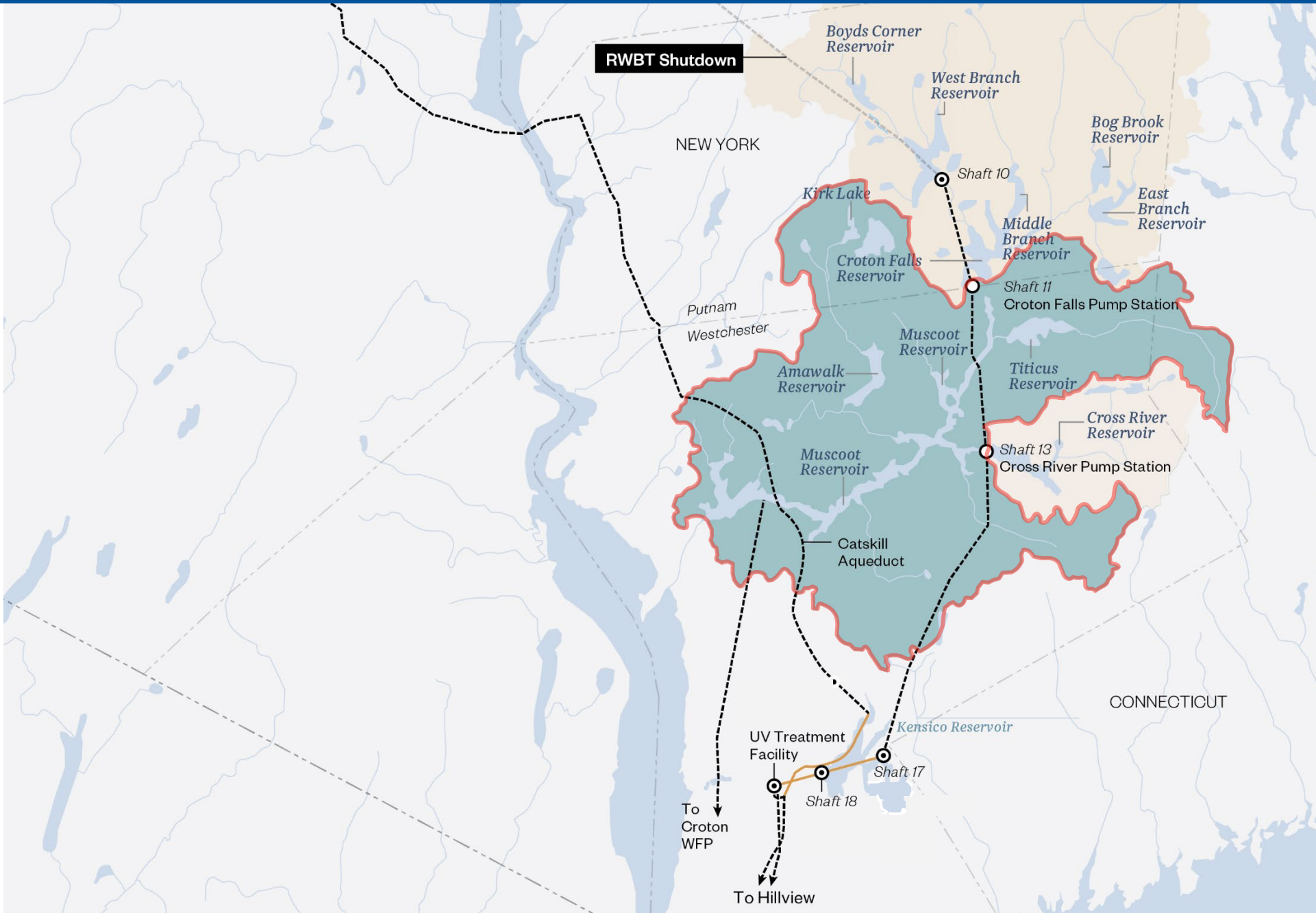


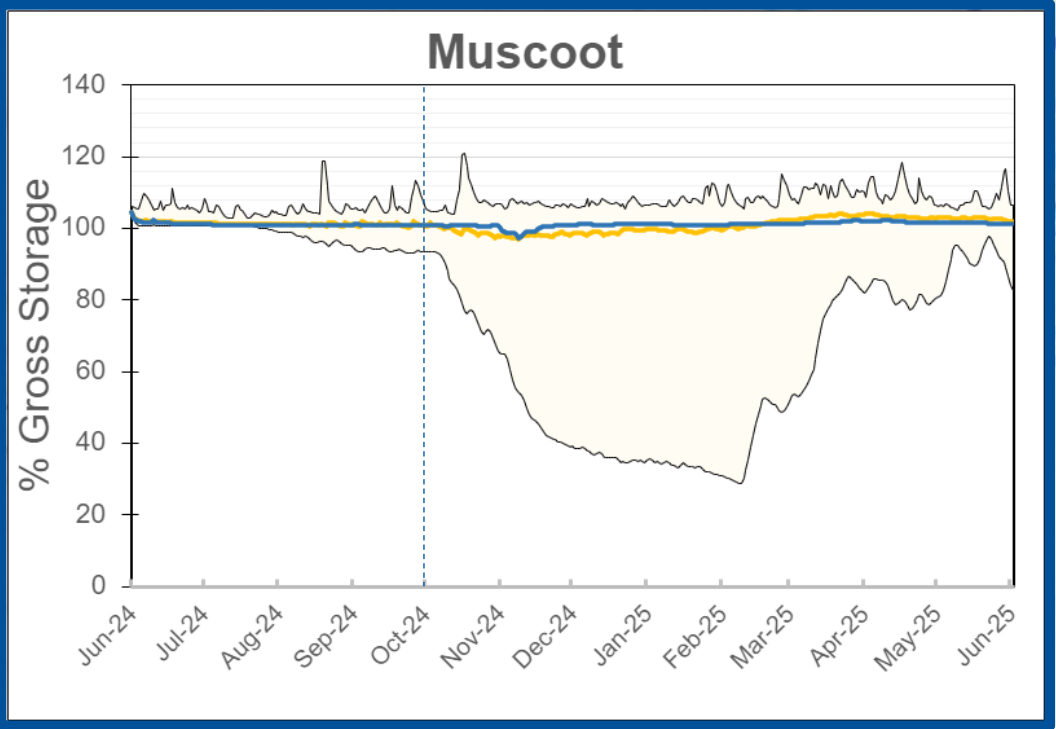
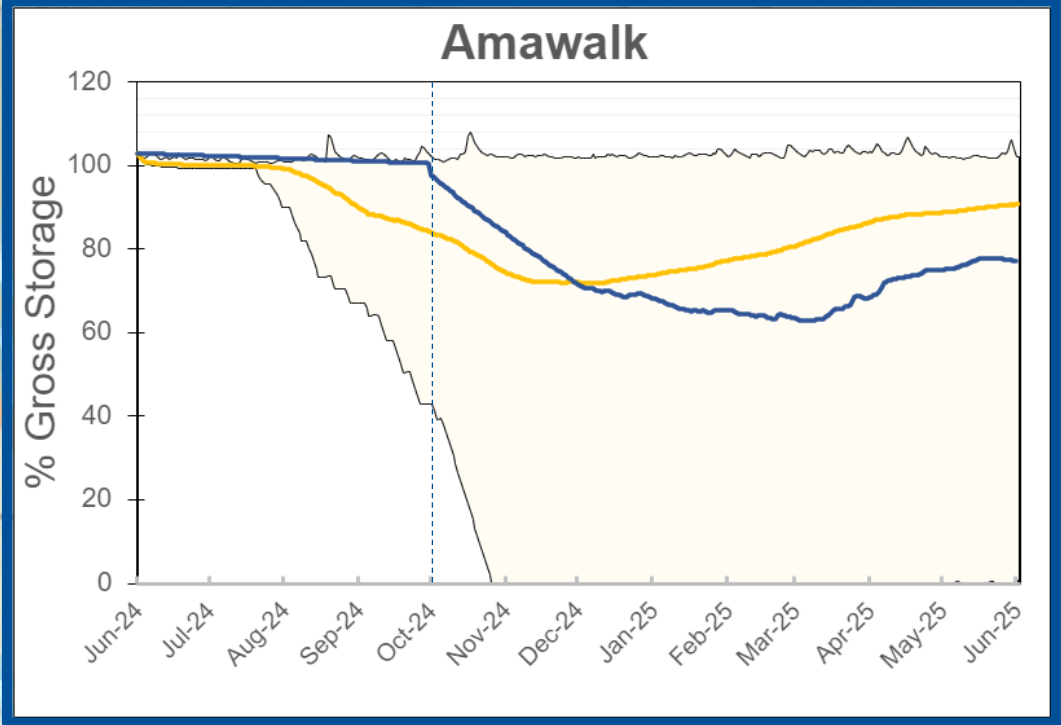
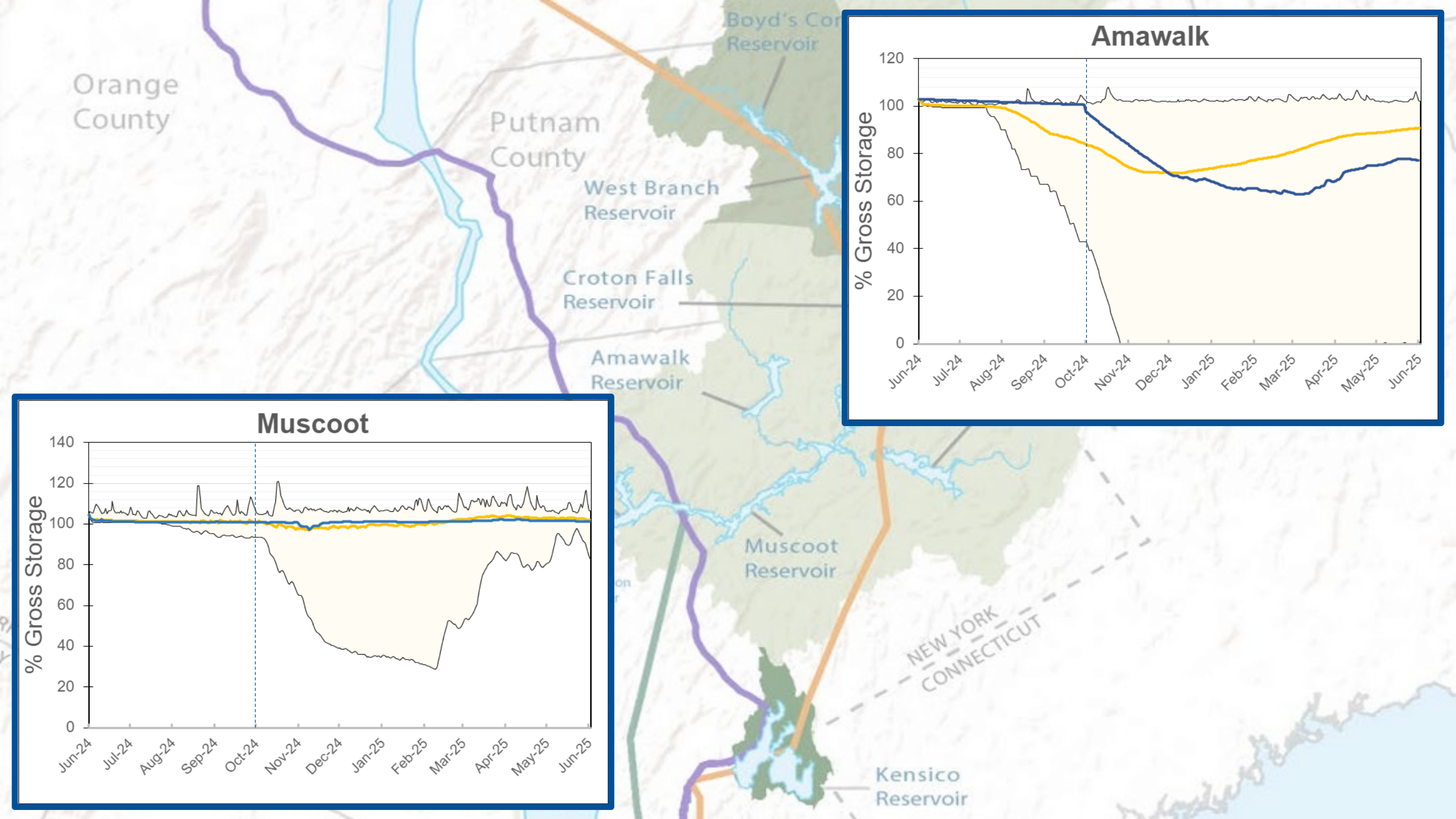
Outage Operations - Croton: Cross River Subsystem



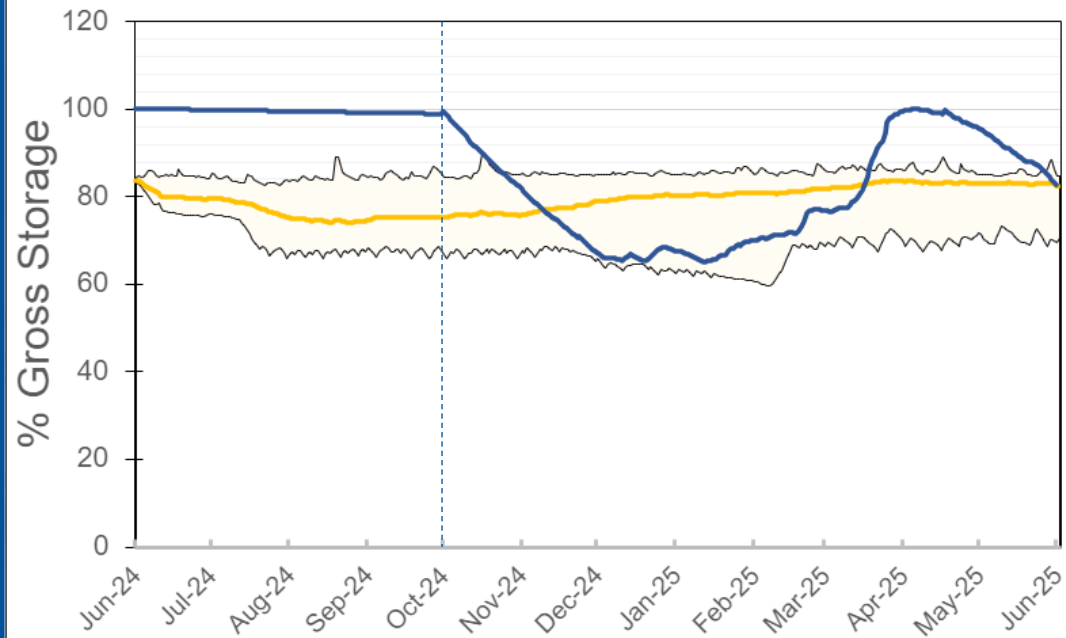


Outage Operations - Croton: New Croton Subsystem

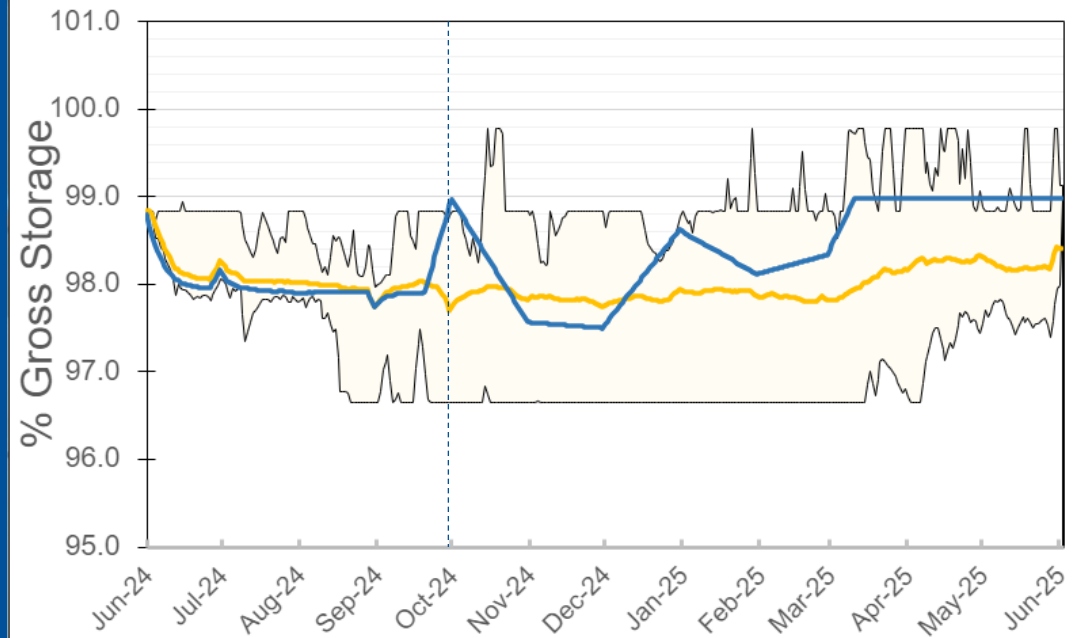




New Croton



Kensico



Release the minimum regulated flow of 5.5 million gallons a day (mgd) into the Croton River from the New Croton Reservoir from October through March 2025 (Per 6 NYCRR Part 672-3). April and May 2025 will release 11 mgd as opposed to 75 mgd with variance.



Croton System Episodic Taste and Odor Issues

- In recent years, there have been episodic taste and odor issues from the Croton System attributed to naturally occurring organic compounds
- Up to and during the shutdown period, DEP will enhance water quality monitoring as well as treat for any known nuisance algae that may have the potential to produce taste and odor compounds
- DEP has also installed granular activated carbon (GAC), an effective treatment for removal of taste and odor compounds, at its treatment plant to further mitigate any potential issues occurring during the project
- As the Croton System will be more heavily relied on to augment supply in the City and certain Westchester communities during the shutdown, it should be noted that ecologies in the different watershed systems can naturally result in subtle flavor variations in the water supply

Croton System Expanded Waterfowl Management Program



- Longstanding management program has been in place at Kensico and Hillview Reservoirs to prevent contamination from wildlife waste
- Program includes monitoring of waterfowl and mitigating their effects on water quality
- Waterfowl are typically dispersed by motorboats combined with noisemakers (pyrotechnics)
- During the shutdown period, DEP will use same practices at Boyd's Corners, West Branch, Cross River, and Croton Falls Reservoirs as needed to protect water quality
- All activities are conducted pursuant to an Environmental Impact Statement to minimize and mitigate impacts to nontarget species, such as Bald Eagles
 - Protective buffers are maintained for Bald Eagle Nest Sites, in consultation with DEC and USFWS as needed
- Concerns can be directed to Director of Outreach John Milgrim at (845) 334-7868 or jmilgrim@dep.nyc.gov

Croton System Recreational Uses

- Permitted fishing activities from shore or boat will be allowed on all reservoirs
- During periods with lower reservoir levels, access to the water may be more difficult for fishing boats
 - DEP will allow anglers to store fishing boats closer to the water during low water conditions
- No restrictions will be placed on any land-based recreational activities, including hunting, hiking, or trapping
- In-stream discharges (releases from reservoirs) will be reduced and may impact stream fishing
- Due to water level fluctuations, Ice fishing will be restricted on several Croton system reservoirs during the winter 2024-2025 season



Summary

- The Rondout to West Branch Tunnel shutdown planning started more than 20 years ago
- Multiple required predecessor projects needed to be successfully completed prior to this point
- The water supply management plan is based on extensive computer modeling and engineering experience and is subject to state and federal regulatory review and oversight
- DEP will continue reviewing multiple data points and projections, and conduct continuous systems monitoring and testing up to and throughout the shutdown



Questions?

