



Fall Foliage

Pepacton Reservoir - New York City Water Supply System



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DEP Unveils Design to Repair Leaks In the 85-Mile Delaware Aqueduct

Three Mile Bypass Tunnel to Be Built Around Leaks; Furthers PlaNYC Goal of Strengthening Critical Water Network Infrastructure

Environmental Protection Commissioner Cas Holloway today outlined a design and timeline to address leaks in the Delaware Aqueduct. The 85-mile aqueduct, completed in 1944, conveys approximately half of the city's drinking water—more than 500 million gallons per day—from four upstate reservoirs to more than eight million people in New York City, and one million people in Ulster, Orange, Putnam and Westchester counties who also rely on the City's high quality drinking water. Under the plan, DEP will build a three-mile bypass tunnel around a portion of the aqueduct that is leaking in Roseton in Orange County, and repair other leaks in Wawarsing, in Ulster County, from the inside of the existing tunnel. The three-mile bypass tunnel will run east from the Town of Newburgh in Orange County, under the Hudson River to the Town of Wappinger in Dutchess County, on the east side of the Hudson. The construction of the bypass tunnel and the repair of the lining will ensure that DEP can continue to deliver high quality drinking water every day for decades to come. Under the plan, DEP will break ground on the bypass tunnel in 2013, and complete the connection to the Delaware Aqueduct in 2019. The bypass tunnel and internal repairs will cost approximately \$1.2 billion, and water projects to supplement the city's supply during part of the construction period will cost approximately \$900 million. The tunnel repair and project is expected to create between 1,000 and 1,500 jobs.

"Ensuring the integrity of New York City's vital infrastructure is fundamental to our long-term growth and prosperity," said Commissioner Holloway. "From City Water Tunnel No. 3 to the Newtown Creek Wastewater Treatment Plant, Mayor Bloomberg has continued to invest in critical infrastructure projects, even in tough economic times. The Delaware Aqueduct is a primary water artery to the City, and fixing the leaks that have appeared since it went online more than 65 years ago is critical to supplying nine million New Yorkers with the high quality drinking water they need every day. DEP has already committed more than \$300

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million to determining the scope and location of the leaks, designing a solution, and beginning the preliminary construction necessary to undertake this complex, multi-faceted project. The result of this multi-year effort is a cost-effective solution that will minimize any disruption to the city's water supply, and ensure that DEP can continue to deliver the highest quality water to nine million New Yorkers for generations to come."

"Repairing the Delaware Aqueduct is a critical step towards meeting our PlaNYC goal of developing critical backup systems for our water network," said Director David Bragdon of the Mayor's Office of Long-Term Planning and Sustainability. "Taking care of our basic infrastructure will ensure a more reliable drinking water supply for New Yorkers and helps us build a greener, greater New York."

The Delaware Aqueduct

The Delaware water supply system originates more than 100 miles north of New York City and consists of four reservoirs: Cannonsville, Neversink, Pepacton, and Rondout. The 85-mile Delaware Aqueduct conveys drinking water from these reservoirs to the city's distribution system. It is designed to provide up to 900 million gallons of water a day, but typically meets about half of the city's daily water needs. The aqueduct, the world's longest continuous tunnel, was constructed between 1939 and 1944 and crosses Ulster, Orange, Dutchess, Putnam and Westchester counties. The aqueduct is a concrete-lined tunnel that varies in diameter from 13.5 to 19.5 feet and runs as deep as 1,500 feet beneath the ground. It was constructed by drilling and blasting, and in most areas, it is lined only with unreinforced concrete. In areas where the rock is not as strong, a steel reinforcement liner was added to the concrete liner.

Leak Investigation

Since the 1990s, DEP has been monitoring leaks in a portion of the aqueduct that connects the Rondout Reservoir in Ulster County to the West Branch Reservoir in Putnam County, specifically in the towns of Roseton and Wawarsing. The leaks release between 15 and 35 million gallons of water a day, depending on the amount of water the aqueduct is carrying. Years of comprehensive inspections, testing, and study indicate that cracking and leakage are occurring in the aqueduct where it passes through limestone, a rock more susceptible to wear and tear than sandstone, shale, gneiss and granite that form the vast majority of the tunnel.

DEP is continuously testing and monitoring the leaking areas using dye, backflow, and hydrostatic tests, and hourly flow monitors that provide near real-time data on the location and volume of the leak. The data clearly show that the rate of leakage has remained constant since DEP began monitoring in 1992. In 2003 and 2009, DEP launched an Autonomous Underwater Vehicle (AUV) — a cutting-edge, self-propelled submarine-shaped vehicle built in partnership with engineers at Woods Hole Oceanographic Institution in Massachusetts — to conduct a detailed survey of the entire 45-mile length of tunnel from Roundout to West Branch reservoirs. The AUV took 360-degree photographs every eight feet, while also gathering sonar, velocity, and pressure data to assist in determining the location, size, and characteristics of the leaks. During the same period, DEP considered a number of alternatives to fix the leaks, and has more than \$300 million of construction underway to build the equipment necessary to take water out of the tunnel to complete the repairs.

Leak Repair

DEP's construction experts and tunnel designers have prepared a plan to address the leaks by building a bypass tunnel around the most significant leaking portions of the aqueduct, and will repair parts of the concrete liner in the existing tunnel in other areas, including Wawarsing. The tunnel will need to be shut down and emptied for a period of time to facilitate the bypass connection and perform the repair work.

Preparation for the repair work is currently underway, including: purchasing equipment for the repair; working on the design of the repair; preparing contract documents for the repair, including the bypass tunnel; performing physical investigations of geology at the site of the shafts and bypass tunnel; and assessments of environmental impacts of the project. The current repair plan is based on the following schedule:

- ▶ Construction of new shafts that connect to the aqueduct and the bypass tunnel to begin in 2013 and to be completed in 2016. A shaft is a vertical pipe that connects the tunnel to the surface. There will be two shafts at both ends of the new three-mile bypass tunnel. These shafts will provide access points for construction of the bypass tunnel and to facilitate connecting the bypass to the existing tunnel. The shafts will be from 700 to 900 feet deep, and have a diameter of 15 to 20 feet and will be located in the Town of Newburgh, which is on the west side of the Hudson River and in Wappinger, which is on the east side of the river.
- ▶ Construction of the bypass tunnel to begin in 2015 and be completed in 2019. The new three-mile segment of tunnel will bypass the leaking portions of the existing tunnel in the Roseton area. DEP's ongoing testing program — including two AUV inspections of the interior of the tunnel and extensive geological investigations — has confirmed the location of primary leakage in this area. A tunnel boring machine will be used to drill the 22-foot diameter bypass tunnel. This segment of the tunnel will extend from a tunnel launching shaft to the tunnel reception shaft, each located approximately 150 feet away from the existing tunnel alignment. The machine is expected to advance at up to 50 feet per day. The existing tunnel will continue to operate while the bypass tunnel is under construction. When the new bypass tunnel is nearly complete and the water supply augmentation and conservation measures are in place, the existing tunnel will be taken out of service and excavation will begin to connect the new bypass section to the existing tunnel. About eight to 12 months are anticipated to complete the bypass connection. To make the connection, additional rock will be excavated to break through to the existing tunnel; two plugs will be installed to isolate the existing leaking portion of the tunnel; a connection chamber will be excavated and lined at the two connection points, and each of the construction shafts will be plugged. When that

work is complete, the tunnel will be refilled and returned to service.

- ▶ Eliminating the leaks in Wawarsing. During the construction of the bypass tunnel, the Delaware Aqueduct will be shut down, enabling DEP to enter upstream portions of the tunnel and fix cracking at three segments totaling nearly 500 feet in Wawarsing by injecting grouting from the inside of the tunnel near the affected areas. DEP has been investigating the potential leak impact in Wawarsing since the day it was first observed. While the investigation was underway, DEP, with the Ulster County Health Department, has taken water samples, photographs, met with homeowners, and, with the United States Geological Survey, created an extensive monitoring network and began hydrogeological mapping. DEP has also attended public meetings on the issue as well as forming a Public Advisory Committee to help keep the community informed about efforts to monitor and repair the tunnel. While studies have been ongoing, New York City has assisted homeowners with sump pumps, ultraviolet disinfection, bottled water, and funds for stormwater improvements.
- ▶ Preparing the water supply system to handle the repair. Before the repair is performed, DEP is building or upgrading several key pieces of crucial infrastructure that will help maintain the city's water supply capacity during the construction of the bypass tunnel, including: completing the construction of the Croton Filtration Plant in the Bronx, which will provide up to 290 million gallons per day of filtered water — up to 30% of the city's water needs; upgrading the Cross River and Croton Falls pumping stations to provide increased water capacity; upgrading the New Croton Dam, which will allow for increased water storage capacity; and the connection of the Catskill Aqueduct and Delaware Aqueduct, which will allow the city to send water from the Delaware Watershed system into the Catskill Aqueduct, providing increased capacity and flexibility for the water supply. The city is also upgrading its groundwater system in Queens to increase the water supply for the future, as part of its program for long-term reliability and sustainability of the water system.

Mayor Bloomberg has made planning for the repair of the Delaware Aqueduct a pivotal part of the PlaNYC goal to improve the reliability and long-term sustainability of New York City's water infrastructure. Mayor Bloomberg has made a larger commitment to maintaining and improving the City's water system than any administration in history. Approximately \$21 billion has been allocated for water system capital projects, including:

- ▶ \$2.5 billion invested and committed to City Water Tunnel No. 3 – more funding for the tunnel than the previous five administrations combined;
- ▶ Acquisition of nearly 79,000 acres of land upstate to

- protect the city's watershed – allowing New York City to remain one of only five large cities in the country to obtain the majority of its water from unfiltered sources;
- ▶ \$2.8 billion for the Croton Filtration Plant, which will filter drinking water from the Croton Watershed;
 - ▶ \$1.6 billion for the Ultraviolet Disinfection Facility, which will provide an extra level of drinking water protection for water from the Catskill and Delaware Watersheds;
 - ▶ and approximately \$6 billion for upgrading the city's 14 wastewater treatment plants and more than \$1 billion to reduce combined sewer overflows, which has helped bring harbor water quality to an all-time high since testing began 100 years ago and allowed wastewater treatment plants to meet the Federal Clean Water Act's secondary treatment standards for the first time ever.

DEP manages the city's water supply, providing more than 1 billion gallons of water each day to more than 9 million residents, including 8 million in New York City, and residents of Ulster, Orange, Putnam and Westchester counties. New York City's water is delivered from a watershed that extends more than 125 miles from the City, and comprises 19 reservoirs, and three controlled lakes. Approximately 7,000 miles of water mains, tunnels and aqueducts bring water to homes and businesses throughout the five boroughs, and 7,400 miles of sewer lines take wastewater to 14 in-city treatment plants. For more information, visit www.nyc.gov/dep or follow us on Facebook at www.facebook.com/nycwater.

Related Documents and Links

- ▶ [Illustration of New Bypass Tunnel Construction](#)
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