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Delaware Aqueduct leaks prompt state to study alternatives

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The Department of Environmental Protection has begun a \$50 million, 10-year effort to increase water storage capacity and conservation programs for the massive system that serves more than 9 million people in Westchester and Putnam counties and New York City.

The project was spurred by the deteriorating condition of the Delaware Aqueduct, the largest of three major underground water tunnels bringing fresh water from the three watersheds serving the New York City water system. Of the 1.4 billion gallons of water used daily, the Delaware provides 50 percent to 70 percent from reservoirs about 100 miles north of Putnam. The remainder is provided by the Catskill watershed upstate and the smaller Croton watershed in Westchester and Putnam.

Yet the Delaware Aqueduct is leaking up to 1.2 billion gallons per month, more than the combined daily water usage of 13 central and southern Westchester communities.

In June, engineers from the Woods Hole Oceanographic Institution in Massachusetts lowered a \$2.4 million autonomous sub down a 1,000-foot access shaft into the aqueduct at Wawarsing, letting it float through the West Branch Reservoir and taking 36,000 digital photographs of the water tunnel to try to pinpoint the leaks.

"There is not a single catastrophic failure point or hole in the tunnel," DEP Commissioner Christopher Ward said. "But it did find a whole long range of spider-pattern cracks and liner cracks stretching about 3,200 feet. There is no single failure. It looks like the lines of the face of an aged person, and perhaps this is just what a tunnel this old looks like."

A departmental study of the water system estimates that with existing conservation and alternative methods of obtaining drinking water, primarily from the Hudson River, a shutdown of the Delaware Aqueduct could trigger a shortage of more than 400 million gallons of water daily. Meeting that need would be difficult, DEP officials said, if the cracked section of the Delaware water tunnel either collapsed or was

closed for replacement or repairs.

The Woods Hole analysis found cracks ranging from one-tenth of an inch to 2 inches wide in the tunnel's steel and concrete lining. Most are on the western side of the Hudson River, but the deterioration continues under the riverbed. Tests of the rock structure immediately surrounding the tunnel on the western side found most of it to be intact.

"The notion of tunnel pressure blowing out a large portion of the wall is considered geologically impossible," Ward said. But the aqueduct's wall will not last indefinitely, he added. The DEP is gearing toward the possible need to shut down the aqueduct's Rondout-West Branch section in 2012 and replace it with a tunnel bypass from the West Branch Reservoir in Kent, under the Hudson River to the Roseton area in Orange County.

"Building a tunnel bypass would be such an expensive undertaking," Ward said. "It would cost \$4 billion to \$5 billion easily. It is definitely something we have to consider, but I'm just sort of choking on having to say it, given the price."

To get a better idea of how badly the tunnel has deteriorated, the department plans to develop a remote-controlled submarine with a 13-mile tether to perform close-up studies of the cracked wall.

"Nobody has ever built a tether that has to be as long as this tether," Ward said. "People have asked why we didn't do this sooner, and the answer was the technology just wasn't there. But I'm told such technology now exists, and we hope to have it fabricated in about a year."

The tethered sub would be able to hover next to the cracks, despite the fast-moving water, and provide more detailed photographic and sonar information about the breaks in the wall and, possibly, the health of the rock behind it. Ward said the new submarine could cost about \$4 million.

Ward's statements that the Delaware Aqueduct cannot be depended on to meet long-term regional needs mark a departure from the DEP's position during the administration of former Mayor Rudolph Giuliani that the leaks posed no long-term risk.

"We certainly commend Commissioner Ward for recognizing the seriousness of the infrastructure repair issues and committing the resources to developing solutions," said Mark Yaggi of the environmental group Riverkeeper, which frequently clashed with the DEP in court over its watershed policies. "No one will know if or when the Delaware Aqueduct may collapse. The only thing we know for sure is that it isn't going to fix itself, and a collapse will be catastrophic. These steps are reassuring in terms of securing the city's long-term drinking water needs."

Every component in the city's water system, which used hollowed-out tree trunks for pipes until the mid-1800s, has to remain in perfect condition during the years it takes for repairs, or the region would face even more serious water problems.

Yet, according to DEP documents, "many of these components are approaching 100 years of service without proper inspection, rehabilitation, or repair."

"The existing water supply system cannot meet system demands for the time during which the tunnel must be taken out of service for its repair," the documents said.

To meet those needs, Ward has ordered two "dependability studies" of conservation measures that may be taken to improve the region's water capacity. The \$50 million cost would be included in the department's capital budgets.

The issues to be studied range from giving residents rebates to purchase water-efficient home appliances to finding ways to capture excess water.

"Right now we are losing about 10 billion gallons of water daily out of the reservoirs because there is so much overcapacity," Ward said. "We could manage that water better. If we could capture it in times of plenty, we could let it out when times are lean."

During last year's drought, Ward said, residents saved 50 million to 100 million gallons of water daily with voluntary conservation. Conservation of as little as 5 percent, he said, represents a water savings of more than 50 million gallons a day.

"When you talk of dependability, you have to look at everywhere the water might be," Ward said. "We are trying to think more regionally than we have before."

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Proposed conservation measures

- * Pump up to 50 million gallons of water daily into Lloyd's Aquifer, which extends from Long Island Sound to central New Jersey's Pine Barrens. Because of heavy rains during the past year, the watershed's 18 reservoirs and three lakes are all overflowing.

- * An \$8 million study will determine if deep wells can be sunk throughout Brooklyn, Queens and Staten Island to tap into the aquifer and pump excess water into it. In five years, there would be enough water stored to allow New York City to draw 200 million gallons daily for two years, if needed. The state Department of Environmental Conservation has banned use of the aquifer for the past 18 years, and the city would need permission to use it.

- * A bypass tunnel and possible routes to take water from the Rondout Reservoir to the West Branch Reservoir.

- * Raise the height of two dams in the reservoir system, including the Croton Dam, by 3 to 5 feet.

- * Rebates to residents who purchase water-efficient dishwashers and washing machines.

- * Build desalinization plants on Long Island and along the Hudson River to convert seawater to drinking water. The Hudson is a saltwater tidal estuary that runs more than 150 miles from Manhattan to Troy.

- * Convert the Chelsea pumping station in Manhattan into a water filtration plant that could take water from the Hudson and add it to the Delaware Aqueduct's system.

The station would have to be capable of removing chemical contaminants such as polychlorinated biphenyls, or PCBs, from the Hudson as well as zebra mussels and other invasive organisms.

* Connect to water systems in Connecticut and New Jersey to augment shortfalls in the New York City system.