

PREPARING TO REPAIR:

The Delaware Aqueduct Leak and New York City's Efforts to Repair It*

***Update to *Finger in the Dike, Head in the Sand*, Riverkeeper, Inc., July 2001**

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RIVERKEEPER.

Riverkeeper is a member of the Clean Drinking Water Coalition

Riverkeeper prepared this report based upon a review of public documents, discussions with persons involved with the Delaware Aqueduct leaks, and information learned at public meetings. We intend to supplement this update as this issue evolves and as we learn more information.

Clean Drinking Water Coalition

The Clean Drinking Water Coalition consists of certain environmental signatories to the landmark 1997 New York City Watershed Memorandum of Agreement:

The Catskill Center for Conservation and Development
New York Public Interest Research Group
Riverkeeper, Inc.

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EXECUTIVE SUMMARY

In July 2001 Riverkeeper released *Finger in the Dike, Head in the Sand*. This landmark report lambasted the New York City Department of Environmental Protection (DEP) for its chronic neglect of the City's water supply delivery system, and exposed institutional problems within DEP. Since that time there have been many bureaucratic and personnel changes within DEP. However, the Delaware Aqueduct, carrying over half of New York City's daily water, still leaks up to 35 million gallons a day—over 1 million gallons an hour, or 1 billion gallons a month. In fact, since Riverkeeper's 2001 report the Delaware Aqueduct has leaked up to 97 billion gallons of drinking water.

In August 2007 the New York State Comptroller's Office released a scathing audit report of DEP's Delaware Aqueduct leak and detection program. The Comptroller found that DEP had made no repairs to the aqueduct and concluded that "DEP has not effectively ensured the safety and welfare of New York City residents and other communities dependent on the Delaware Aqueduct System."

Now, residents in Wawarsing, New York are living with impacts from the Delaware Aqueduct leaks. Their basements are flooding, their well water is no longer potable, and sinkholes are appearing on their property. In November 2008 DEP agreed to provide \$250,000 in "financial aid" for Wawarsing residents to purchase ultraviolet treatment systems, sump pumps and bottled water. In July 2008, DEP asked the U.S. Geological Survey to start a two-year monitoring program to determine what impact the Delaware Aqueduct leak may have on Wawarsing. Preliminary data from this monitoring indicates a direct relationship.

Fixing the leaks presents tremendous engineering problems for DEP. For example, DEP must dewater the tunnel (i.e., take it out of its pressurized state) to fix it and remains concerned about groundwater infiltration. On the other hand, fixing the leak with water in the tunnel presents its own problems. Before DEP can even begin to fix the leak it must do two critical things: (i) find an alternative source of water so it can shut down the Delaware Aqueduct, and (ii) make critical repairs to shafts within the aqueduct in order to drain the tunnel for repairs.

Mayor Bloomberg's PlaNYC 2030 recognizes the need to find an alternative water source and makes it one of the plan's initiatives. So far, DEP has identified three sources – tapping into groundwater in Queens, increasing use of the Catskill Aqueduct, and building a third tunnel under the Hudson River. Of these, only the third comes close to matching the Delaware Aqueduct's water supply. This third choice, however, is decades away.

DEP has started to prepare to repair the Delaware Aqueduct leak. In 2008, DEP shut down the Delaware Aqueduct twice to begin shaft repairs. During this time DEP relied upon water from the Croton System. This preliminary repair work is expected to take four years, and does not address the leaks themselves.

DEP has prepared an emergency response plan in the event the Delaware Aqueduct fails. While the Comptroller found that DEP did not have an adequate plan in place as of August 2007, Riverkeeper has learned that DEP is finalizing its plan and recently has conducted training exercises.

Recent studies and events present their own, unique challenges. Last year researchers at Columbia University released a report identifying active seismic faults in the greater New York City area, making the risk of earthquakes greater than believed previously. Some extensions of these faults cross beneath the Delaware and Catskill Aqueducts. In addition, the possibility of industrial gas drilling in the Catskills is very real. DEP has proposed a one-mile buffer zone around its infrastructure. However hydraulic fracturing involves drilling thousands of feet horizontally, potentially placing the fragile aqueducts at risk.

This report concludes with specific recommendations. Among them: DEP must make finding an alternate water supply and fixing the Delaware Aqueduct leaks an institutional priority; DEP should immediately pay money overdue to the Town of Wawarsing; DEP should pay for the Town of Wawarsing to connect to the Delaware Aqueduct; DEP should help pay for a sewer system in Wawarsing; and DEP should also increase its payments for stormwater control measures in Wawarsing. Riverkeeper also restates specific recommendations made eight years ago in *Finger in the Dike*.

INTRODUCTION

In July 2001 Riverkeeper released a landmark report – *Finger in the Dike, Head in the Sand: DEP’s Crumbling Water Supply Infrastructure*.¹ *Finger in the Dike* exposed institutional problems within the New York City Department of Environmental Protection (DEP) and highlighted DEP’s aging water supply infrastructure, including leaks in the Delaware Aqueduct. This update reports on the status of the Delaware Aqueduct leaks and discusses DEP’s efforts to fix the problem. Riverkeeper intends to supplement this update as we learn more information and as this issue evolves.

I. BACKGROUND

A. Delaware Aqueduct

The Delaware Aqueduct provides approximately 55% of the 1.2 billion gallons of water New York City consumes daily – water used for drinking, bathing, cooking, fire fighting, and other municipal purposes. The Delaware Aqueduct delivers water collected in the Cannonsville, Pepacton, Neversink and Rondout Reservoirs to the Hillview Reservoir in Yonkers, where it enters the City’s water supply distribution system. At 84 miles, the Delaware Aqueduct is the longest continuous tunnel in the world. Water flows through the aqueduct via gravity on an approximate 2 percent grade. At the Hamlet of Roseton the aqueduct runs 350 feet below the bottom of the Hudson River, before running down the east side of the Hudson.

The Delaware Aqueduct is a circular, concrete-lined tunnel 13.5 to 19.5 feet in diameter. It is actually three distinct pressurized tunnels through bedrock, built from 31 vertical shafts at depths from 300 to 1,550 feet below the surface. One of these tunnels, the Rondout-West Branch Tunnel (RWB Tunnel) conveys water from Rondout Reservoir in Ulster County, New York, under the Hudson River to the West Branch Reservoir in Putnam County, New York. The RWB Tunnel is the Delaware Aqueduct’s centerpiece and carries over half of New York City’s total water supply.

The Delaware Aqueduct, however, has been leaking for decades. For over twenty (20) years, DEP has known of leaks in the Delaware Aqueduct. Specifically, DEP’s own leak investigations show that the RWB Tunnel has been leaking up to 35 million gallons of water a day (mgd) at two known leak areas, or approximately 1 billion gallons a month. This amounts to over 1 million gallons an hour. Both of the leaks are near fault zones, one in the Town of Wawarsing and the other in the Hamlet of Roseton in the Town of Newburgh.

B. *Finger in the Dike, Head in the Sand*

Finger in the Dike, Head in the Sand lambasted DEP for both its chronic neglect of the City’s ever-deteriorating water supply system as well as the questionable integrity

¹ See Riverkeeper (Robert F. Kennedy, Jr., et al), *Finger in the Dike, Head in the Sand, DEP’s Crumbling Water Supply Infrastructure*, July 2001, Riverkeeper, Inc., available at, http://www.riverkeeper.org/special/Finger_in_the_Dike_full_document_v2.pdf

and honesty of its management at that time. Riverkeeper's report made headlines across the country, bringing the issue to the forefront of the public mind and putting pressure on DEP and political officials to take action. The message was clear: New York City enjoys one of the largest and most sophisticated unfiltered water supply systems in the world, but without proper maintenance and management from DEP the system could be in danger.

Three upstate watersheds—the Delaware, Catskill, and Croton—supply New York City's unfiltered drinking water to nine million City and upstate consumers at a daily average of 1.2 billion gallons.² Although the City has been blessed with an abundant water supply, it faces problems with its deteriorating supply system infrastructure. Riverkeeper's 2001 report identified major problem areas that included DEP's crumbling infrastructure, significant leaks in the Delaware Aqueduct, water contamination from toxic chemicals in DEP facilities, and turbidity in the supply system. Each of these issues poses a significant threat to New York City's supply of clean drinking water as well as its ability to continue operating under the Filtration Avoidance Determination, which exempts the City from a requirement to install a \$10-billion water filtration plant to meet federal water quality standards. *Finger in the Dike, Head in the Sand* provided recommendations as steps toward remediation of the water supply system with the hope that the City's supply of clean water could be maintained for future generations. Some of those recommendations urged DEP to:

- End 10 years of delay and inaction and immediately pursue concrete remedies to this potential crisis
- Repair leaks in the Catskill and Delaware Aqueducts
- Repair and remove toxics from the Croton Aqueduct
- Repair debilitated shafts and gatehouses
- Immediately begin planning alternative sources of water for use while the Delaware Aqueduct is out of service
- Begin planning a third Hudson River Tunnel to secure alternative sources of water delivery
- Contract with expert engineering consultants to develop guidance documents to operate and repair the City water system

² In addition to the 8.2 million New York City residents, over sixty upstate communities also tap into the City's water supply system. These connections provide roughly 120 million gallons of water daily to 1 million people. See DEP, NYC Water Supply Watersheds, Towns Served, *available at*, http://www.nyc.gov/html/dep/html/watershed_protection/html/townsserved.html (last visited March 19, 2009).

- Insure an orderly transition in the district engineer offices by recruiting and training high-quality replacement engineers
- Disclose critical information to elected officials and the public

After some delay, DEP has made progress on many of these recommendations.

C. Amount and Value of Water Lost

During the period between the release of *Finger in the Dike, Head in the Sand* (July 2001) and the release of this follow-up report (March 2009), the Delaware Aqueduct has leaked as much as 97 billion gallons of water at a computed rate of 35 million gallons per day. This amounts to nearly twice the capacity of the Rondout Reservoir, the terminal reservoir for the Delaware reservoir system (49.6 billion gallons.) Put in a linear context, this is the equivalent of 97 billion 1-gallon jugs, 1-foot tall, stacked end-to-end and would extend over 18 million miles: 38 trips to the moon and back, or halfway to Mars.³ As discussed in more detail below, the cost of this water loss amounts to as much as \$28 million per year.

D. Consequence of a failure of RWB Tunnel

The consequences of the RBW Tunnel failing are extreme and substantial. New York City would lose half of its daily water supply. Internal DEP documents acknowledge that failure “could lead to property loss and injury both Upstate and in-City.”⁴ In addition, reduced flow out of the Delaware Watershed could lead to increased flow and volume at dam spillways on the Cannonsville, Pepacton, Neversink, and Rondout reservoirs. DEP also acknowledges that tunnel failure may occur “with little or no warning” and “may not be initially evident” through DEP’s monitoring techniques.⁵

II. NEW YORK STATE COMPTROLLER REPORT

On August 15, 2007 the New York State Comptroller’s Office released a scathing audit report of DEP’s Delaware Aqueduct leak detection and repair program.⁶ The Comptroller concluded that “DEP has made no repairs to the RWB tunnel water leaks first discovered 18 years ago” and “DEP has not effectively ensured the safety and

³ Notably, this total does not include water lost since when DEP first learned of the leak (over twenty years ago), but only water lost since July 2001.

⁴ Internal DEP Document – Rondout-West Branch Tunnel Contingency Response Plan, Initial Training, January 2009.

⁵ *Id.*

⁶ See Office of New York State Comptroller, *New York City Dep’t of Environmental Prot., Delaware Aqueduct System: Water Leak Detection and Repair Program*, Report 2005-N-7, Aug. 15, 2007 (“Comptroller’s Audit Report”), available at, <http://osc.state.ny.us/audits/allaudits/093007/05n7.pdf>.

welfare of New York City residents and other communities dependent on the Delaware Aqueduct System.”⁷

The audit report’s three objectives were to determine whether DEP: (i) monitored the extent and nature of the leaks in the Delaware Aqueduct; (ii) initiated repair of the leaks; and (iii) established an emergency plan in the event of a sudden and unexpected loss of water from the Delaware Aqueduct.⁸ The comptroller concluded that the answer to each of these inquiries was “no.”

The audit report found that DEP has known since 1988 that the RWB Tunnel has been leaking.⁹ The Comptroller also concluded that DEP did not adequately monitor the extent and nature of the leaks in the manner DEP’s consultants recommended; DEP did not have a formal work plan in place to repair the leaks; DEP has taken only limited action to address the aqueduct component with known leaks; and DEP has not established an adequate emergency plan to protect the public from sudden water loss. The Comptroller’s office recommended that DEP fast-track RWB Tunnel’s repair.

The Comptroller found that in 1988 and 1989 a surface spring was observed above the RWB Tunnel, and that DEP confirmed that water in the spring originated from leaks in the Delaware Aqueduct.¹⁰ In 1992 DEP estimated the leak at 15-20 million gallons a day (mgd). The Comptroller found further that in 1999 DEP’s own consultant concluded that “the estimated likelihood of [Delaware Aqueduct] failure is low over the next five years and medium to high over the next 40 years. However, based on the limited data, there is the possibility the leakage will accelerate within the next few decades.”¹¹

The Comptroller further reported that if the RWB Tunnel continues to leak 30-35 mgd, the amount of water lost would have a *daily* value between \$66,000 and \$77,000, or between \$24 million and \$28 million *annually*.¹² It should be noted that this was computed before recent water rate increases, so the value in today’s depressed economic situation is actually much higher.

DEP reports to us that the amount of water lost is consistent with normal operations. However, we agree with the Comptroller that this is not water lost over a spillway from rain events, but is water already collected and contained within the City’s infrastructure. In addition, as the Comptroller notes, DEP has a very active and expensive water conservation program. It is hypocritical for DEP to urge demand side conservation in New York City while wasting millions of gallons of water daily. The

⁷ *Id.* at 2 and 5.

⁸ *See id.* at 2.

⁹ *See id.* at 2.

¹⁰ Comptroller’s Audit Report at 4.

¹¹ Comptroller’s Audit Report at 4.

¹² Comptroller’s Audit Report at 10.

Comptroller notes that if there were an extended drought, this lost water could become even more valuable.¹³ As Benjamin Franklin once said, “When the well is dry, we know the worth of water.”¹⁴

The Comptroller also found that since Riverkeeper broke the story on the Delaware Aqueduct leak, DEP has gathered much information about the leak (risk analyses, testing, and monitoring), but “DEP has made no repairs to the RWB Tunnel leaks first discovered 18 years ago.”¹⁵

On June 6, 2003 DEP investigated the interior of the Delaware Aqueduct using an automated underwater vehicle. This vehicle recorded images and other data. This investigation indicated a 7,000-foot section of the RWB Tunnel that is cracked heavily. Most of these cracks occurred “in two areas of the tunnel, which are adjacent to geological faults.”¹⁶ The Comptroller found that the vehicle’s inspection report indicates that “three areas of RWB Tunnel segments appear to have the type of diagonal cracks typically associated with stress/displacement in the concrete liner.”¹⁷

The Comptroller’s audit report makes seven recommendations:

1. DEP should adhere to a regular schedule of consultant-recommended monitoring tests for the leaks.
2. DEP should replace faulty or inadequate testing instruments.
3. DEP should prepare a work plan to fast-track the repair of the RWB Tunnel.
4. DEP should consider creating an internal committee or task force to oversee and coordinate all aspects of the RWB Tunnel leak.
5. DEP should focus their resources on repairing the RWB Tunnel leak, rather than comprehensive planning projects of long duration to allow DEP to repair the leak in a timely fashion.
6. DEP should acquire the equipment and other resources needed to unwater the RWB Tunnel in order to fast track the repairs.
7. DEP should revise its emergency response plan to address any failure of the Delaware Aqueduct, including each of its three tunnels. This should include identifying and prioritizing specific events that would trigger the need for varying response actions to water leaks within the Delaware Aqueduct.

¹³ Comptrollers’ Audit Report at 10.

¹⁴ Benjamin Franklin, *Poor Richard’s Almanac*, 1746.

¹⁵ Comptroller’s Audit Report at 5.

¹⁶ Comptroller’s Audit Report at 7.

¹⁷ Comptroller’s Audit Report at 7.

To its credit, DEP agreed with all of these recommendations.

III. WAWARSING SITUATION

A. Flooded Homes and Contaminated Drinking Water

Residents in Wawarsing, New York are living with the Delaware Aqueduct leaks' impacts. Wawarsing is an Ulster County town sitting directly above known leaks to the RWB Tunnel. Recently, basements have started to flood, sinkholes have appeared on residential property, and septic fields have contaminated groundwater drinking wells. The homeowners believe the cause to be excess water from the leaking Delaware Aqueduct. Indeed, in 1992 DEP concluded that the leaking Delaware Aqueduct caused flooding on Wawarsing properties.¹⁸

Approximately thirty properties have been affected. It is undisputed that the water table in and around Wawarsing has risen. Like many rural communities, homes in the area rely upon individual wells for their drinking water (the Town of Wawarsing does not tap into the Delaware Aqueduct for drinking water) and have septic fields for their sewage waste. The elevated water table has resulted in flooded septic fields contaminating well water. Consequently, residents are unable to drink their tap water because it is contaminated with bacteria.

While Wawarsing flooding has been ongoing for years, homeowners report that many of their problems began in March 2008, when DEP reactivated the Delaware Aqueduct after a two-week shutdown starting February 20, 2008.¹⁹ Shortly after DEP reactivated the aqueduct, residents reported that their tap water (originating from groundwater wells) turned cloudy and/or brown and tested positive for coliform and other bacteria. The rate and amount of flooding also increased after this shutdown, resulting in basements flooding and ponds appearing in fields.

Wawarsing residents report that the flooding is intense; water shoots up through cracks in the floor rather than seeping in through the basement walls. One resident reported pumping out 1 million gallons of water from his basement in a 48-hour period. Another couple reported that their concrete floor buckled from the pressure beneath it, and that even with a sump pump operating 24 hours a day the basement fills with 8 to 12 inches of water.

¹⁸ DEP Memorandum, Oct. 12, 1992. In this memo, DEP estimated water flow at one property to be "5,000 gallons per day."

¹⁹ DEP shutdown the Delaware Aqueduct on or around February 20, 2008 in order for a team of divers to inspect mechanical and structural components of the RWB Tunnel's unwatering shaft, 700 feet underground. See DEP Press Release, "Preparation Underway to Fix Leak in Delaware Aqueduct", March 6, 2008, available at, http://www.nyc.gov/html/dep/html/press_releases/08-04pr.shtml (last visited March 11, 2009).

Sinkholes are another problem Wawarsing residents face. One resident reported she first noticed them in 2006, while another reported that since March 2008 they have appeared all over her yard. They vary in size, starting small and growing to a few feet in depth and width.

These sinkholes are not unique to Wawarsing. They have been reported for years in the Hamlet of Roseton, in the Town of Newburgh, along with ponds and streams that had not existed previously. Recently, a new sinkhole appeared on River Road. Other sinkholes and ponding caused by the Roseton leak have persisted for a number of years.²⁰

Notably, Wawarsing residents have found that when DEP turns the Delaware Aqueduct off the flooding subsides. This was particularly true in November and December 2008 when DEP took the Delaware Aqueduct offline to begin to prepare to repair the leaks. During this time the flooding subsided. However, as soon as the Delaware Aqueduct came back online the flooding resumed. Specifically, one family reported that water level in their deep bedrock well dropped about 20 feet when DEP shut down the RWB Tunnel, and then rose the same amount when the tunnel was turned back on. The United States Geological Survey (USGS) confirmed this observation.

1. DEP to Pay for Sump Pumps, Ultraviolet Treatment, and Bottled Water

While DEP will not acknowledge any direct responsibility for this flooding, on November 20, 2008 DEP agreed to pay the Town of Wawarsing \$250,000 in “financial aid.”²¹ This money will be used to purchase ultraviolet treatment systems to disinfect well water, sump pumps to remove water from basements, bottled water so these homeowners will have access to potable water, and stormwater improvement projects for the community as a whole. In the words of one DEP official, the City is acting in good faith in case they are having an impact, but they don’t know yet.²² However, DEP officials have acknowledged publicly that “in [Wawarsing] in the past we have positively identified that there is water coming from the tunnel.”²³

This agreement specified that DEP would make an initial payment of \$125,000 within 45 days. Now, four months later, DEP has not made good on this payment.

²⁰ See Riverkeeper, *Finger in the Dike, Head in the Sand* (2001), at 21, 25.

²¹ See Agreement between DEP and Town of Wawarsing, as of November 20, 2008 (“Wawarsing Agreement”). While the Wawarsing Agreement was entered into as of November, 20, 2008, DEP did not get around to signing it until January 16, 2009.

²² Ira Stern, DEP, Regional Manager, Grahamsville Operations, Bureau of Water Supply, February 24, 2009 PAC Meeting.

²³ Paul V. Rush, DEP Deputy Commissioner, Bureau of Water Supply, *quoted in* “Aqueduct Tunnels are Suspected in Dry-Weather Flooding of Homes,” L. Foderaro, NY Times, April 12, 2008.

B. Wawarsing Project Advisory Committee

Because many Wawarsing residents face an unlivable situation, in August 2008 they convened the Wawarsing Project Advisory Committee (PAC). This ad-hoc group consists of local citizens, a DEP representative, a representative from Congressman Maurice Hinchey's office, Ulster County Health Department, the USGS, and other consultants. The monthly PAC meetings are open to the public.

Riverkeeper has attended these productive meetings. The degree of cooperation and openness, particular from DEP Regional Manager Ira Stern, Grahamsville Operations, has been impressive.

C. U.S. Geological Survey – Monitoring Study

To its credit, DEP recognized it needed to determine the source of the Wawarsing flooding, in part to learn the extent of the RWB Tunnel leak. Consequently, DEP decided to bring in an independent and credible expert to conduct a comprehensive monitoring project. For this task, DEP turned to the USGS, which has unsurpassed expertise in the area of geophysical mapping, hydrology, and modeling. For over a decade, USGS has assisted DEP in its work to build a third water tunnel below New York City. USGS has developed technology to “look into” bedrock and provide three-dimensional mapping of fractures in advance of DEP's drilling through Manhattan's bedrock.

DEP contacted USGS regarding the Wawarsing project in the summer of 2008. In September 2008 USGS began visually inspecting the many springs and other surface expressions around Wawarsing. In October 2008 USGS began their two-year monitoring project.

The purpose of the USGS study is to determine what impact the RWB Tunnel has on Wawarsing flooding; USGS is not examining leaks near the Roseton site. USGS started this program from scratch, with no monitoring equipment in place. They hope to install approximately thirty digital data monitors throughout the area, both above known leaks and outside the area. To date, USGS has installed six of these instruments: two are in shallow wells (approximately 10-15 feet deep); three in deep bedrock wells (of varying depth, one is approximately 275 feet deep); and one in a lake in Littman Park. The digital data monitors allow USGS to monitor water temperature and levels hourly. USGS simply lowers the monitors into active water wells; they do not impair drinking water quality.

Already, preliminary data demonstrate a strong correlation between the Delaware Aqueduct leak and Wawarsing flooding. For example, when DEP reactivated the Delaware Aqueduct in December 2008 after a shutdown, USGS saw an “instantaneous response” in one deep well. In this case, even with a sump pump running, the water level rose fifteen feet and the water temperature dropped approximately five degrees. DEP has agreed to provide USGS information and data regarding when the Delaware Aqueduct is shutdown or its flow reduced. USGS intends to map groundwater movements through the area, both vertically and horizontally.

USGS reports they did not expect the level of support they have received from Wawarsing residents. Many have opened their homes (and wells) to USGS to allow monitoring on their property. In order for this project to reach its full potential USGS needs this cooperation from local residents.

D. Malcolm Pirnie Report

Recently, DEP also contracted with its consultant, Malcolm Pirnie, Inc., to monitor the Wawarsing leak. In contrast to the wide-ranging, comprehensive two-year monitor plan of USGS, Malcom Pirnie conducted a seven-week monitoring program limited to a handful of “surface expressions” and streams in the Wawarsing area from October to December 2008. According to this limited study, any connections between the RWB Tunnel and the surface expressions studied were “indiscernible.”

IV. DELAWARE AQUEDUCT REMEDIATION STATUS – MOVING BEYOND PLANNING TO PLAN; NOW PREPARING TO REPAIR

Before DEP can fix the leaking aqueduct it must: (i) find an alternative water supply while it shuts down the Delaware Aqueduct, and (ii) make critical repairs to certain shafts within the RWB Tunnel in order to turn it off and drain it, or “dewater” the tunnel. Each of these tasks is expected to take at least several years. As DEP states: “Currently, there is not sufficient supplemental water supply to NYC to allow any portion of the 85-mile Delaware Aqeduct to be taken out-of-service for an extended period of time to perform rehabilitation work.”²⁴ New York City completed construction of the RWB Tunnel in 1944. It was designed to have a useful life of 100 years, and has not been emptied (or, “unwatered”) for inspection since 1957.²⁵

A. PlaNYC 2030

On December 12, 2006, Mayor Bloomberg released PlaNYC, a comprehensive and forward-thinking sustainability plan to address three fundamental areas over the next 25 years. PlaNYC addresses impacts from the City’s growing population (an estimated additional one million people will live in New York City by 2030), impacts from aging infrastructure, and increasing environmental risks.²⁶ This ambitious plan focuses on five key dimensions—land, air, water, energy, and transportation—and aims to be a model for cities in the 21st century.²⁷ Importantly, this plan identifies the need to obtain alternative water sources while the Delaware Aqueduct is out of service.

²⁴ DEP, Negative Declaration, The Rondout-West Branch Tunnel and Shaft Rehabilitation Project, March 26, 2007, available at, http://www.nyc.gov/html/dep/pdf/rondout-wb/negative_declaration.pdf (last visited March 12, 2009).

²⁵ See Comptroller’s Audit Report at 3.

²⁶ See PLANYC 2030 Background, The City of New York, available at, <http://www.nyc.gov/html/planyc2030/html/challenge/challenge.shtml> (last visited Feb. 5, 2009).

²⁷ PlaNYC, The City of New York, at 11.

One of PlaNYC's initiatives is to evaluate new water sources during a prolonged Delaware Aqueduct shutdown. We are pleased the City has adopted this recommendation Riverkeeper first made in *Finger in the Dike*.²⁸ In April 2008 the City reported that DEP started planning for three projects: (i) the use of in-city groundwater (up to 55 mgd); (ii) optimization of the Catskill Aqueduct (up to 60 mgd); and (iii) the construction of a parallel tunnel (min of 400 mgd).

Additionally, to mitigate the impact of an emergency, DEP has started reconstructing the Cross River and Croton Falls pumping stations to transfer water from the Croton Watershed to the Delaware Aqueduct.²⁹ These repairs are long overdue. Riverkeeper first recommended repairs and upgrades to the Croton system in *Finger in the Dike*.

In Jamaica, Queens, DEP is analyzing potential locations for production wells and treatment facilities and expects the design process to continue through 2012. For the Catskill Aqueduct project, DEP has been surveying the aqueduct, identifying any obstructions in the pressurized tunnel (such as air pockets) and expects the preliminary design phase to continue through 2010. As to construction of a tunnel parallel to the Delaware Aqueduct, the request for proposals for the design was released in April 2008.³⁰

B. DEP Actions

1. **RWB Tunnel and Shaft Rehabilitation Project – “Preparing to Repair”**

DEP has taken steps to prepare to repair the Delaware Aqueduct leaks, and has begun preliminary work needed before it can actually fix the leaks. Specifically, before DEP can address the leaks, it must perform work at six shafts along the RWB Tunnel and the Rondout effluent chamber. The shafts are located in the Towns of Wawarsing, Gardiner, Newburgh, Wappinger and Putnam Valley.³¹ As DEP explains, this shaft work is being done “to prepare the tunnel for maintenance and rehabilitation to extend the useable life of the Delaware Aqueduct and ensure the safe and reliable transmission of water from the watershed for years into the future.”³² In other words, DEP needs to do this preliminary work before it can start fixing the tunnel.

²⁸ See *Finger in the Dike*, Recommendation #14.

²⁹ PlaNYC, Progress Report, Water Network, April 22, 2008, available at, http://www.nyc.gov/html/planyc2030/downloads/pdf/progress_2008_water_network.pdf (last visited March 19, 2009).

³⁰ PlaNYC, Status Report Scorecard, April 22, 2008, at 6, available at, http://www.nyc.gov/html/planyc2030/downloads/pdf/one_year_status_report_scorecard.pdf

³¹ See DEP, Rondout-West Branch Tunnel and Shaft Rehabilitation Project, available at, http://home2.nyc.gov/html/dep/html/environmental_reviews/rondoutwb.shtml (last visited Feb. 17, 2009).

³² DEP, *Lead Agency Declaration and Notice of Intent to Conduct Environmental Review for the Rondout-West Branch Tunnel and Shaft Rehabilitation Project*, Aug. 8, 2006, (hereinafter “DEP Lead Agency Declaration”), available at, http://home2.nyc.gov/html/dep/html/environmental_reviews/rondoutwb.shtml.

In February 2007 a joint venture called Rondout Constructors was the low bidder for this \$240-million contract. This contract entails underwater inspection and construction in a 700-foot-deep shaft, construction of a filtration system for shaft water, replacement of gate valves, procurement and storage of tunnel repair materials, and shaft preparation.³³

The majority of this work will be at Shaft 6 along the shore of the Hudson River in the Town of Wappinger. This shaft contains valves that allow DEP to dewater the RWB Tunnel, releasing aqueduct water directly to the Hudson River. Preliminary construction work here is scheduled to take 48 months.³⁴ This is due largely to the complicated nature of this work—the bottom of this shaft is 700-feet below ground. Making repairs at that depth requires deep-sea divers. Once fixed, testing of the Shaft 6 pumping system “will discharge a maximum of 33,000 gpm into the Hudson River over a period of 24 hours.”³⁵ DEP states that there will be up to 15 individual tests during the period of 2009 to 2010. DEP has obtained a permit for this discharge of non-chlorinated drinking water.

On January 5, 2007 DEP issued a Revised Environmental Assessment Form (EAF) for this work. This comprehensive document describes the project this preliminary shaft work.³⁶ On March 26, 2007 DEP issued a “negative declaration” and found that this preliminary work would not have a significant impact on the environment.³⁷ In it, DEP confirmed that the RWB Tunnel is leaking and needs to be repaired. DEP stated that these preliminary actions are necessary “to prepare for a planned Tunnel repair and to be ready to respond to a Tunnel emergency condition.”³⁸ DEP made clear that “no repair work to the Tunnel is planned under this Project.”

2. February 2008 and November/December 2008 Shutdown

DEP took the first steps in its preliminary work to prepare to repair the leak on February 20, 2008. DEP shut down the Delaware Aqueduct for two weeks while deep-sea divers were lowered 700 feet (70 stories) into Shaft 6 to inspect mechanical and structural components of this dewatering shaft, including the drainage chamber, and to

³³ See Schiavone Construction & Engineers, Schiavone News, available at, <http://www.schiavoneconstruction.com/sn3.html> (last visited Feb. 17, 2009).

³⁴ See DEP, Revised EAF, Jan. 2007, at 1-4, available at, <http://www.nyc.gov/html/dep/pdf/rondout-wb/reviseddeaf.pdf>.

³⁵ EAF, Page 13 of 21.

³⁶ The EAF and related documents are available on DEP’s website: http://www.nyc.gov/html/dep/html/environmental_reviews/rondoutwb.shtml

³⁷ DEP, Negative Declaration, The Rondout-West Branch Tunnel and Shaft Rehabilitation Project, March 26, 2007, available at, http://www.nyc.gov/html/dep/pdf/rondout-wb/negative_declaration.pdf (last visited March 12, 2009).

³⁸ *Id.*

take measurements for new equipment.³⁹ These divers lived 24 hours a day in a sealed, pressurized environment, and worked in 24-hour shifts.

In November 2008 DEP again shut down the Delaware Aqueduct in order to “prepare for repairs on the Delaware Aqueduct.”⁴⁰ DEP again sent six divers down into Shaft 6 to fix the valve at the shaft’s bottom so pumps will be able to dewater the aqueduct.⁴¹ These divers lived for a month in a pressurized tank. DEP reported that the earliest they expect to dewater the Delaware Aqueduct for repairs is 2011.

a. Discolored Water – Service Advisory After November Shutdown

When DEP shutdown the Delaware Aqueduct, and to make up for the 600-700 million gallons per day the aqueduct delivers to consumers, DEP reactivated the Croton water supply system. This system had been offline for one year.⁴² DEP is under a court order to build a filtration plant for the Croton System. As a result, DEP is constructing the Croton Filtration Plant in Van Cortland Park in the Bronx.

When DEP reactivated the Croton System, Manhattan consumers, particularly on the East Side, reported brown water flowing out of their taps. DEP issued a Service Advisory regarding discolored water after receiving many complaints from Manhattan Community Board 6.⁴³ DEP attributed this problem to faulty valves in the little-used Croton System. On January 2, 2009 DEP issued a Notice to Croton Water Supply consumers explaining that for the month of November 2008 the average daily entry point turbidity was 1.5 Nephelometric Turbidity Units (NTU), which violated EPA’s Maximum Containment Level of 1.0 NTU.⁴⁴

DEP issued a second Discolored Water Advisory Update on December 4, 2008, and advised that the Croton System would be deactivated the next day.⁴⁵

Use of the Croton System highlights one of many challenges DEP faces as it begins to prepare to repair the Delaware Aqueduct. Relying on Croton System water as a

³⁹ DEP Press Release, March 6, 2008, available at, http://www.nyc.gov/html/dep/html/press_releases/08-04pr.shtml (last visited March 16, 2009).

⁴⁰ DEP Service Advisory, Statement on Discolored Water, Nov. 14, 2008 (no longer available on DEP’s website, on file with Riverkeeper, Inc.).

⁴¹ Ken Belson, *Plumber’s Job on a Giant’s Scale: Fixing New York’s Drinking Straw*, N.Y. Times, Nov. 23, 2008.

⁴² See DEP Notice to Consumers of Croton Water Supply System, Jan. 2, 2009, available at, http://www.nyc.gov/html/dep/pdf/croton/Croton_notice_01-02-09.pdf (last visited March 16, 2009).

⁴³ See DEP Service Advisory, Statement on Discolored Water, Nov. 14, 2008 (no longer available on DEP’s website, on file with Riverkeeper, Inc.).

⁴⁴ See DEP Notice to Consumers of Croton Water Supply System, Jan. 2, 2009, available at, http://www.nyc.gov/html/dep/pdf/croton/Croton_notice_01-02-09.pdf (last visited March 16, 2009).

⁴⁵ See DEP Service Advisory, Discolored Water Advisory Update as of December 4, 2008 (no longer available on DEP’s website, on file with Riverkeeper, Inc.).

replacement for Delaware Aqueduct water is not acceptable. For example, DEP explains that “turbidity [cloudiness caused by suspended sediment] can interfere with disinfection and provide a medium for microbial growth.”⁴⁶ Turbidity may also “indicate the presence of disease-causing organisms.”⁴⁷

C. Supply Issues

1. Dependability Study – Fixing a Catch-22

In order for DEP to repair the leaks it must take the Delaware Aqueduct out of service. But there is a catch: DEP does not have sufficient supplemental water supply to take the Delaware Aqueduct out of service.⁴⁸ After all, finding an extra 600-700 million gallons of water a day is no small task. Recognizing this dilemma, DEP is preparing a comprehensive Dependability Study for the City’s entire water supply and distribution system. Importantly, the Mayor’s office recognized this issue in PlaNYC.⁴⁹ According to the Comptroller, this study began in 2000.⁵⁰

Initial planning began in 1992 when DEP started developing a plan for the City to get drinking water from the Hudson River. DEP engineers have long lusted after Hudson River water. DEP awarded a new five-year contract for the Dependability Study in March 2005, with the Study expected to be complete in 2010. The Comptroller took issue with this time delay, noting that under this approach it could be a decade or more before the leak repairs are completed.⁵¹ In response to the Comptroller’s concern, DEP advised that it would step-up RWB Tunnel work, stating that short-term repairs on the RWB Tunnel could begin in 2011.

DEP expects its Dependability Study to identify and diversify water sources, and to develop demand side reductions. This relates to the PlaNYC initiative to identify secondary sources of water, but through the Dependability Study DEP is also considering “outside the box” ideas such as desalinating brackish water, purchasing water from Nassau County water utilities, and using Hudson River water.

Water conservation and efficiency is an important part of this program. For example, since 1990 water use has dropped by 20%, from 1.5 billion to 1.2 billion gallons a day. To put this 300 million gallon a day drop into perspective, the Catskill Aqueduct delivers between 350– 400 million gallons a day.

⁴⁶ See DEP Notice to Consumers of Croton Water Supply System, Jan. 2, 2009, *available at*, http://www.nyc.gov/html/dep/pdf/croton/Croton_notice_01-02-09.pdf (last visited March 16, 2009).

⁴⁷ *Id.*

⁴⁸ See DEP Lead Agency Declaration, *available at*, http://home2.nyc.gov/html/dep/html/environmental_reviews/rondoutwb.shtml.

⁴⁹ See Section IV.A, *supra*.

⁵⁰ Comptroller’s Audit Report at 8.

⁵¹ Comptroller’s Audit Report at 8-9.

In addition, the Green Code Task Force is studying new plumbing efficiency standards and other innovations to help build long-term efficiency for New York City buildings. In July 2008 Mayor Bloomberg and New York City Council Speaker Christine Quinn asked the U.S. Green Building Council New York to convene this task force to help “green” the laws and regulations governing New York City construction.⁵² The Green Code Task Force is expected to deliver its report in summer 2009. We hope the Green Code Task Force recommends strong efficiency measures, and that the City Council adopts these quickly.

2. Catskill Turbidity

Because water from the Catskill Aqueduct is high in turbidity, relying upon it as an alternative source while the Delaware Aqueduct is out of service is not a good long-term solution.

The Comptroller found that DEP’s 2004 risk analysis recommended maintaining flow through the Delaware Aqueduct at less than 750 mgd in order “to reduce the rate of cracking and leakage.”⁵³ The Comptroller calculated that the average flow of water through the RWB Tunnel from November 2000 through October 2005 was 682 mgd, but that previously flow would run as high as 900 mgd.⁵⁴ However, DEP cannot always maintain the lower flow because of excess turbidity in water flowing through the Catskill Aqueduct. This turbidity issue, which EPA calls the greatest threat to the City’s filtration avoidance determination, thus forces greater reliance on the Delaware Aqueduct.

V. DEP’S EMERGENCY RESPONSE PLAN

It is essential that DEP has a workable emergency/contingency⁵⁵ response plan in place, in the unfortunate event the RWB Tunnel fails or collapses.

The 2007 Comptroller’s Report “determined that DEP does not have an adequate emergency response plan in place.”⁵⁶ The Comptroller found that one reason for this is that DEP lacked adequate staffing to complete the plan, and because resources had been shifted to other priorities.⁵⁷ The Comptroller also found that should the tunnel fail or collapse, “there is no assurance that DEP is ready to respond to such an emergency event

⁵² Green Codes Task Force - USGBC New York Chapter, *available at*, <http://www.usgbcny.org/initiatives/green-codes-task-force.html> (last visited March 11, 2009).

⁵³ Comptroller’s Audit Report at 7.

⁵⁴ Comptroller’s Audit Report at 7.

⁵⁵ The Comptroller referred to this as an “emergency” response plan, while DEP continuously refers to this as a “contingency” response plan. We use both terms interchangeably for purposes of this report.

⁵⁶ Comptroller’s Audit Report at 11.

⁵⁷ Comptroller’s Audit Report at 11.

timely.”⁵⁸ DEP responded that it was in the process of preparing a “contingency response plan.”

On March 14, 2007 DEP awarded a contract to Ecology and Environment, Inc. to develop an emergency plan for the RWB Tunnel. According to the consultant’s proposal to prepare this plan, “The potential ramifications of a lack of coordination and planning or execution could be catastrophic given the resources at stake.”⁵⁹ DEP’s consultant’s proposal indicates that they will assess and enhance the emergency action and response plans in place for the RWB Tunnel, which DEP had identified as a “critical priority.”

DEP’s Scope of Services with this consultant indicates that Ecology and Environment’s primary task is to identify emergency action/response plans needed to address “adverse incidents” associated with the RWB Tunnel.⁶⁰

In response to a Riverkeeper Freedom of Information Law (FOIL) request, on December 31, 2008 DEP stated that its emergency response plan was “still in draft form.” However, Riverkeeper obtained internal DEP documents indicating that DEP has been conducting internal training and exercises as part of its contingency response plan.

DEP states that its contingency response plan’s intent is to provide a framework for DEP’s units “to work together swiftly and effectively in response to a RWBT incident.”⁶¹ The obvious goals of DEP’s emergency management include ensuring continuity of reliable water supply; maintaining a safe working environment for DEP personnel, operating partners, and stakeholders; and minimizing loss of life and property.⁶² Operational priorities include returning the RWB Tunnel to service, maximizing overall water supply output until repair, and reducing demand while supply is constrained.⁶³

DEP conducted training for the contingency response plan in January 2009. This training’s objective was to enable DEP managers to be able to implement the contingency response plan during a RWB Tunnel incident.⁶⁴

⁵⁸ Comptroller’s Audit Report at 11.

⁵⁹ Ecology and Environment, Inc. Proposal Letter to DEP, Jan. 9, 2007 (obtained from a Riverkeeper FOIL request).

⁶⁰ Agreement between DEP and Ecology and Environment, Inc., as of Feb. 27, 2007, Exhibit 2 (obtained from a Riverkeeper FOIL request).

⁶¹ Internal DEP Document – Rondout-West Branch Tunnel Contingency Response Plan, Initial Training, January 2009.

⁶² Internal DEP Document – Rondout-West Branch Tunnel Contingency Response Plan, Initial Training, January 2009.

⁶³ Internal DEP Document – Rondout-West Branch Tunnel Contingency Response Plan, Initial Training, January 2009.

⁶⁴ Internal DEP Document – Rondout-West Branch Tunnel Contingency Response Plan, Initial Training, January 2009.

The most recent training exercise occurred March 11-12, 2009. This exercise was “designed to provide a learning environment for DEP staff assigned incident management roles within the Rondout-West Branch Tunnel Contingency Response Plan.”⁶⁵ The exercise’s purpose was “to evaluate and validate the updated and revised [contingency response plan]” and to provide an opportunity to practice certain response actions.⁶⁶

VI. COLUMBIA’S EARTHQUAKE REPORT

In August 2008, the Earth Institute at Columbia University published a study identifying active seismic faults in the greater New York City area, making the risk of earthquakes there greater than previously believed. In addition, the group mapped the intersection of two active seismic zones directly beneath the Indian Point nuclear power plant. The researchers reported that magnitude 6 or 7 earthquakes are possible along the active faults they described, which could cost the New York Metro area close to \$200 billion in property damage and significant loss of human life.⁶⁷

As referred to above, in August 2008 Sykes et al. published in the Bulletin of the Seismological Society of America a report on earthquakes in the New York City-Philadelphia area from 1677-2006. The researchers cataloged a total of 383 quakes, including some that exceeded a magnitude of 5. Earthquakes of magnitude 3 or greater were recorded in New York City and the lower Hudson Valley, including Newburgh and the Hudson Highlands.⁶⁸

Earthquakes in and around the New York City Watershed are not far fetched notions. In February 2009, a 2.4 magnitude earthquake southeast of Albany prompted an inspection of the Gilboa Dam on the Schoharie Reservoir.⁶⁹

A. Issue of an aqueduct near a fault line

The Comptroller’s report found that a DEP investigation revealed cracks throughout the RWB Tunnel. Specifically, while the tunnel is heavily cracked throughout 7,000 linear feet, “the majority occurred in the limestone geology in two areas of the tunnel, which are adjacent to geological faults.”⁷⁰ The Ramapo fault branches into multiple extensions when it crosses the Hudson River from New Jersey into the Hudson Highlands. The area of the fault and its extensions comprise the Ramapo seismic zone (RSZ). Some of the extensions in the RSZ cross beneath both the Catskill and Delaware

⁶⁵ Internal DEP Document – DEP, Rondout-West Branch Tunnel Contingency Plan Functional Exercise: *Trouble with Dribbles*, March 11-12, 2009 at 1.

⁶⁶ *Id.*

⁶⁷ See <http://www.earth.columbia.edu/articles/view/2235>

⁶⁸ See <http://www.earth.columbia.edu/sitefiles/File/pressreleases/1696.pdf>

⁶⁹ Edward Munger, Jr., *Earthquake Triggers Gilboa Dam Inspection*, Daily Gazette, Feb. 21, 2009, available at, http://www.dailygazette.com/news/2009/feb/21/0221_quakedam/

⁷⁰ Comptroller’s Report at 7.

Aqueducts in Westchester County; the main Ramapo fault itself does not, as it begins branching at the Hudson near Peekskill.

VII. INDUSTRIAL GAS DRILLING – POTENTIAL IMPACTS TO FRAGILE AQUEDUCTS

The prospect of widespread industrial gas drilling throughout the Catskills and New York’s Southern Tier is very real. This invasive extraction procedure uses a technology called hydraulic fracturing. This involves the high pressured injection of water, sand, and toxic chemicals into a deep shale bed in order to “fracture” the shale and release natural gas. Riverkeeper believes this intensive activity is inconsistent with watershed protection, and has the probability to threaten the already fragile tunnels and aqueducts.⁷¹

DEP has proposed a one-mile buffer around the reservoirs and water supply infrastructure. However, because gas companies drill horizontally, thousands of feet away from a well pad, this one-mile buffer is insufficient to protect these fragile aqueducts, especially in light of existing cracks.

VIII. CONCLUSION AND RECOMMENDATIONS

After years of inaction and then years of planning to plan, DEP has taken steps to prepare to repair the leaks in the Delaware Aqueduct. We are encouraged that the City’s PlaNYC recognizes the need to plan for redundancy in its water supply system. Nevertheless, we urge DEP to expedite repairs to the Delaware Aqueduct.

Recommendation #1: DEP should make finding an alternative water supply and fixing the Delaware Aqueduct leaks institutional priorities.

We are relieved and pleased that the Mayor’s Office has made evaluating an alternative water source one of PlaNYC’s many initiatives. We are also relieved that after many years DEP has begun to prepare to repair the leaks. Nevertheless, DEP should make this a top priority and fast-track all steps necessary to both create redundancy in the system and fix the leaks. These are precisely the type of infrastructure-related improvements the federal government is looking to fund, provided they are “shovel ready.” At this stage, we see no indication that repairs to the leaks are anywhere near shovel ready.

⁷¹ See Riverkeeper Comments on Draft Scope of Review for NY State Department of Environmental Conservation Supplemental Generic Environmental Impact Statement on the Oil and Gas Regulatory Program, Dec. 15, 2008, available at, http://www.riverkeeper.org/document.php/873/Riverkeepers_Ga.pdf

Recommendation #2: DEP should immediately pay money overdue under the terms of its November 2008 agreement with Wawarsing.

Under the terms of its November 20, 2008 agreement with the Town of Wawarsing DEP was to make the first \$125,000 financial aid payment within 45 days. DEP has not made this payment. The Town could use this money to help residents use their well water and to help purchase and operate sump pumps to help control flooding. This money will also help provide stormwater improvement projects for the community as a whole.

Recommendation #3: DEP should pay for Wawarsing to connect to the Delaware Aqueduct.

DEP should pay for the Town of Wawarsing to tap into the New York City water supply. New York City is required to furnish drinking water supplies to municipalities and water districts in the eight northern counties that have aqueducts or tunnels or located within the New York City Watershed. There are more than sixty (60) connections upstate, with most of these occurring in Westchester County. These provide approximately 120 million gallons a day to 1 million people.⁷²

Under state law, DEP must allow towns along the aqueducts to connect, but at their own expense. Given the situation in Wawarsing and the time involved to repair the Delaware Aqueduct or construct a new tunnel, DEP should pay for Wawarsing to tap into the New York City Water Supply System.

Recommendation #4: DEP should pay for a sewer system in Wawarsing.

DEP should pay for a sewer system in Wawarsing to hook up to the Napanoch sewer district. The Napanoch system is near capacity; however, a study is underway to upgrade this treatment plant. The area of Wawarsing experiencing these issues is outside the New York City Watershed and therefore ineligible for certain programs and funding available through the Catskill Watershed Corporation and programs related to the 1997 New York City Watershed Memorandum of Agreement (MOA). However, the problems in Wawarsing are analogous to MOA-type issues and should be compensable.

Recommendation #5: DEP should provide additional funds for stormwater drainage in Wawarsing.

⁷² See, DEP, Watershed Protection, Towns Served, *available at*, http://www.nyc.gov/html/dep/html/watershed_protection/html/townsserved.html (last visited March 11, 2009).

Water pumped from basements and draining off of property must go somewhere. Some of this water may be contaminated with bacteria from septic fields. The City's "financial aid" package to Wawarsing allocates \$130,000 for stormwater improvements on Smith Road in Wawarsing. The City should retain an independent consultant to evaluate additional stormwater drainage issues, and implement measures to address those issues.

Recommendation #6: Immediately pursue concrete remedies to this potential crisis.⁷³

While the City has begun to prepare to repair the Delaware Aqueduct leak, we believe it can and should do more at a faster pace.

Recommendation #7: Immediately begin planning and securing alternative sources of water for use while the Delaware Aqueduct is out of service.⁷⁴

We recognize that one of Mayor Bloomberg's PlaNYC 2030 initiatives is to evaluate 39 projects to meet the City's shortfall needs during a prolonged Delaware Aqueduct shutdown. In addition, DEP has started planning for three infrastructure projects. We urge DEP to move beyond planning and immediately start securing alternative sources of water in order to expedite overdue repairs to the Delaware Aqueduct.

Recommendation #8: Begin planning a third Hudson River Tunnel to secure alternative sources of water delivery.⁷⁵

This tunnel must have the capacity to carry water from both the Delaware and Catskill Aqueducts in order to ensure a constant supply should either of these two lifelines suffer damage West-of-Hudson.

⁷³ Riverkeeper first made this recommendation in *Finger in the Dike*.

⁷⁴ Riverkeeper first made this recommendation in *Finger in the Dike*.

⁷⁵ Riverkeeper first made this recommendation in *Finger in the Dike*.