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Pawtucket, Rhode Island: A Drinking Water State Revolving Fund Success Story

Office of Water (4606M)
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Executive Summary

Despite providing water for over 100 years, by the end of the 1980s the City of Pawtucket, Rhode Island was struggling to provide safe drinking water and keep its customers happy. The water system faced the same challenges faced by many other water systems across the country, including a treatment plant that was approaching the end of its useful life and an aging distribution system that was literally falling apart. With strong political and technical leadership and working effectively with the state, the system received the largest Drinking Water State Revolving Fund (DWSRF) assistance package in state history and pursued an innovative design-build-operate (DBO) procurement strategy.

Aided by over $70 million in DWSRF funding, Pawtucket embarked on a comprehensive overhaul of its water system. The project was a partnership between the water system, local politicians, and the state and overcame substantial financial, legal, and political obstacles. Pawtucket now enjoys a state-of-the-art surface water treatment plant and is nearing completion of a project to rehabilitate or replace parts of its distribution system.

The severity of the problems started becoming apparent in 1987 when an EPA sanitary survey found major system deficiencies related to the old distribution system and the water treatment plant (built in 1938). In 1992, the system had an acute violation of the Total Coliform Rule (TCR) that resulted in a 2-month boil water order. Taste and odor issues related to the system's old pipes (some of which date to the 1800s) and a perpetual lack of funding added to the system's problems.

Pawtucket and its local government made the decision to move from a passive, repair-and-maintain mentality to actively address the root of the system's problems with large-scale improvement projects that included a new state-of-the-art treatment plant and the rehabilitation of approximately 204 miles of the distribution system. To make this plan a reality given its limited funds Pawtucket turned to the state to help obtain the necessary financing. Working together, Pawtucket and the state found a way to restructure the system's existing debt and secure low-interest DWSRF funding for the infrastructure improvements.

Despite setbacks along the way, Pawtucket's source-to-tap overhaul is now nearing completion. The new treatment plant came on line in March 2008 and has received positive feedback from customers. The distribution rehabilitation is approximately 73% complete, and customer complaints about water quality have decreased dramatically. Pawtucket has not had a TCR violation since 1992 and has been able to decrease its chlorine use and the level of disinfection byproducts (DBPs) in its water.

Pawtucket faced staggering obstacles but chose to deal with them proactively rather than wait for them to get worse. The system worked with the local government and the state to find flexible, low-cost financing for an ambitious project. The DWSRF was integral to the project's success. The below-market rate loans from the DWSRF made the overhaul possible by making the improvements affordable to Pawtucket and its ratepayers. Together, the state, city, and system have made investments that, with proper asset management and operation, will ensure safe drinking water for decades to come.

Pawtucket, RI

The City of Pawtucket was founded in 1671 at the falls of the Blackstone River and the upper tidewaters of Narragansett Bay. "Pawtucket" is the Algonquian word for "river fall," and the Blackstone River and its falls helped power the industries that located there. Many consider Pawtucket to be the city that started the American Industrial Revolution when the Slater Mill began using machines to spin yarn in 1793. Industry continued to expand in Pawtucket throughout the 19th century, and Pawtucket remains an important manufacturing center. The city is home to a diverse array of industrial businesses, including toymaker Hasbro.

With 73,000 residents, Pawtucket is the fourth largest city in Rhode Island. The city's average household income is $31,775, well below the Rhode Island average of $45,000. In addition, 16.8% of the city's population lives below the poverty line, compared to 11.3% in Rhode Island and 12.5% nationwide (2000 US Census).

Community leaders hope the local economy will improve as a result of the city's economic revitalization and urban renewal effort. Old vacant factory buildings are being converted to attractive condominiums, offices, and retail space in an effort to bring new residents and revenue to the city.

Pawtucket is actively promoting its arts community and cultural activities. The successes of the annual arts festival and the Pawtucket Red Sox baseball team (AAA affiliate of the Boston Red Sox) are evidence of the city's revitalization. The "PawSox" play in the newly renovated McCoy Stadium and draw record numbers of fans, frequently leading their league in attendance.

Pawtucket is also working hard to upgrade its infrastructure and municipal facilities. Projects are underway to improve the city's recreational areas; a senior center, library, and a new passenger train station have been proposed. Improving the quality of the city's drinking water is an integral part of Pawtucket's revitalization plan.

The water system has operated for more than 100 years with a strong record of protecting public health, but in recent decades Pawtucket has struggled with taste and odor issues and Safe Drinking Water Act (SDWA) compliance incidents. City leaders hope that the source-to-tap overhaul of the water system, including construction of a new water treatment plant, will not only resolve the problems created by aging, deteriorating infrastructure but also help attract and retain residents and businesses.

"The key to development is infrastructure. The Pawtucket Water Supply Board (PWSB) has had the foresight to undergo aggressive redevelopment of the infrastructure to revitalize the City."
— PWSB

History of the Drinking Water System

When Pawtucket began supplying water in 1878, the city provided, on an average day, 3.75 million gallons of water to 50,000 persons in Pawtucket and surrounding towns. (Pawtucket's population at the time was less than 20,000.) By 1924, the system had doubled its service population to 113,000. In 1938 Pawtucket built a filtration plant at Happy Hollow Pond in nearby Cumberland. For 70 years this plant was the system's sole treatment facility.

In the early 1970s, the Pawtucket Water Supply Board (PWSB) was created to take over management of the water system from the city's public works department. The PWSB acts as a semi-autonomous extension of the city and is run by an appointed board of directors.

There were two major events that set the stage for the system rehabilitation that is now nearing completion. The first was a 1987 sanitary survey that pointed out major system deficiencies. The second was the system's 1992 Total Coliform Rule (TCR) acute violation, which resulted in a 2-month boil water order.

In December 1987 U.S. EPA conducted a routine sanitary survey of the Pawtucket water system. The report had the following findings and garnered significant attention in the communities served by the system.

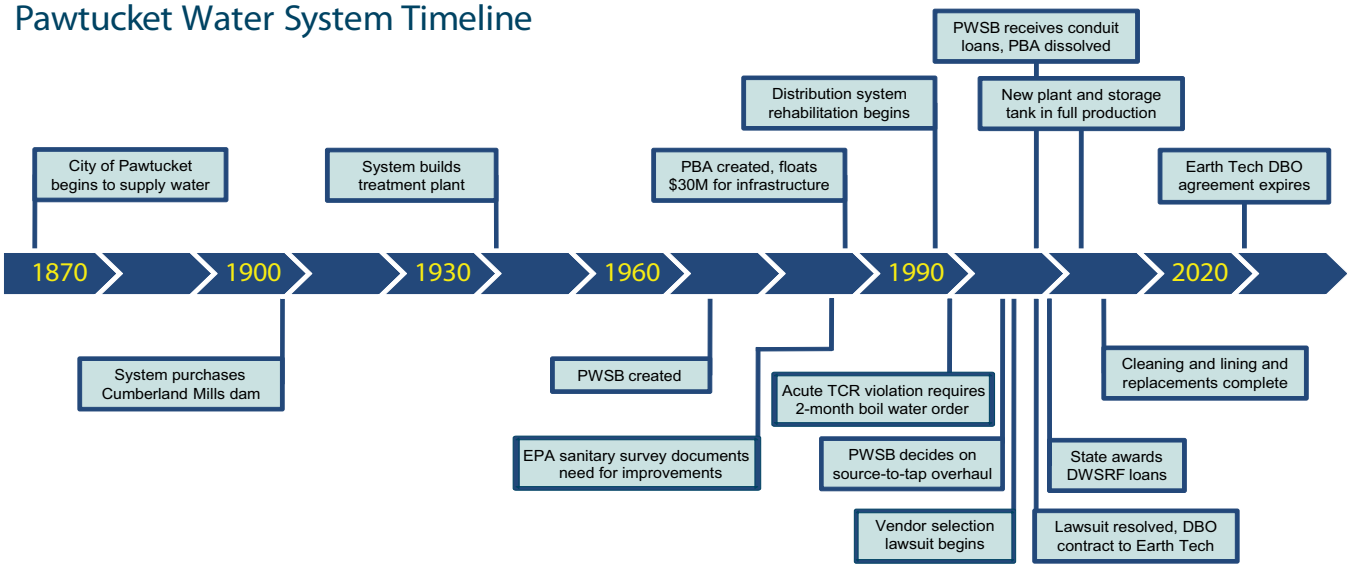
- The system needed to get activities within its watershed under greater control.
- Although the filtration plant was able to produce water of good quality most of the time, it was strained to do so and was approaching the end of its useful life to produce safe drinking water consistently and reliably.
- The distribution system was creating serious water quality challenges and operation and maintenance concerns.

In the face of these challenges, the sanitary survey noted that the Pawtucket water supply staff was doing an excellent job of keeping the system operational and producing good quality water.

As the sanitary survey pointed out, by the 1980s Pawtucket's water system was struggling, and Pawtucket could no longer afford the maintenance and investments the water system needed. The city created a separate entity, the Pawtucket Building Authority (PBA), in 1988 to manage the system's finances. Although the PBA was responsible for financing system improvements, the PWSB remained responsible for day-to-day system management. Ownership of the system's assets was transferred to the PBA so bonds could be issued without burdening the city with additional debt. In turn the PBA leased the water system back to the city. The PBA's financing capacity was limited by a debt ceiling of $50 million.

In 1990, prompted by sporadic bacteriological contamination, Rhode Island Department of

Pawtucket Water System Timeline



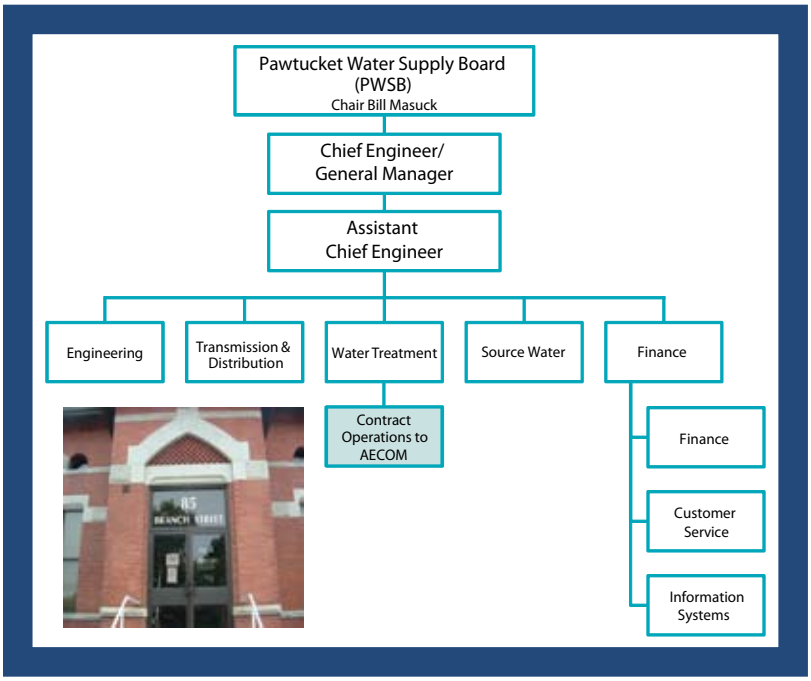
Public Health (RIDOH) conducted a survey on the Stump Hill Reservoir, the main storage storage facility of the Pawtucket Water Supply at the time. The State survey team found major deficiencies, including infiltration of rainwater, easy access for birds, insects, and animals via cracks, vents and seams, and structural integrity of the reservoir was a major concern. (Note: Stump Hill Reservoir was constructed in 1879, covered in 1957, and last cleaned in 1959.) In late 1990, RIDOH required that the water from Stump Hill Reservoir meet 3-log *Giardia lamblia* inactivation rate until the deficiencies found in the facility had been corrected. It was recommended that Stump Hill Reservoir be replaced.

To address some of the problems highlighted in the 1987 sanitary survey, in 1991 Pawtucket began the long process of rehabilitating its distribution system. The project, which is scheduled to be complete in 2014, involves either replacing or cleaning and relining approximately 77% of the system's pipe.

Based on test results and follow-up testing, Pawtucket's water was declared unsafe to drink in the summer of 1992 due to high counts of fecal coliform bacteria which constituted an acute violation of the TCR. Customers were required to boil water for approximately 2 months. The Federal Emergency Management Agency (FEMA) declared a state of emergency for the community, and it was estimated that the city spent $20,000 per day to provide bottled water for its customers. The mayor

of Pawtucket appointed a commission to investigate the cause of the coliform contamination, and it was concluded that distribution pipe relining and poor maintenance of the Central Falls' transmission system (which connects to Pawtucket's) were to blame.

When James Doyle was elected mayor in 1997, he made improving Pawtucket's water a high priority. Mayor Doyle reorganized the PWSB and appointed several new board members, including Mary Tetzner, who chaired the board until June 2007. The mayor and the PWSB agreed that improving water quality required a comprehensive renewal of the system.



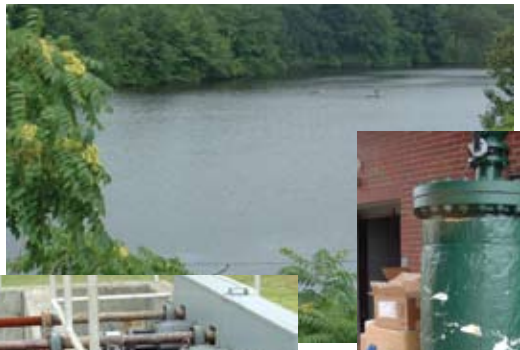
Because of the debt cap, the PBA could not borrow enough money to fund all of the necessary infrastructure upgrades. The city had the debt capacity to borrow the much-needed funds, but could not access low-interest loans through the DWSRF unless it owned the system's assets. Therefore, in 2003 the city council dissolved the PBA and transferred ownership of the water system, including its debt, back to Pawtucket.

Snapshot of the System

Today, Pawtucket's water system provides drinking water to approximately 100,000 customers in Pawtucket, Central Falls, and the Valley Falls section of Cumberland. Central Falls does not have its own source and, until the PWSB purchased its distribution system

in 2007, rented its distribution system to Pawtucket. Prior to the acquisition, Central Falls was responsible for maintaining its own distribution system, which was in worse shape than Pawtucket's.

Pawtucket's source water comes from surface water and groundwater in the Abbot Run watershed and its underlying aquifer. The watershed, which drains into the Blackstone River, is located in Cumberland and several neighboring towns in Massachusetts. The system owns about 10% of the watershed. The PWSB operates eight groundwater wells and four surface water reservoirs, which have a combined storage capacity of 5 billion gallons. The oldest reservoir dates back to the 1800s.



Source water from Happy Hollow Pond in Cumberland has a high level of total organic carbon (TOC), a precursor to disinfection byproducts (DBPs). Groundwater from the watershed has elevated levels of radon, manganese, and arsenic. The system relies primarily on its surface source and mixes in groundwater during periods of high demand during the hot summer months to manage DBP formation. Overall, the quantity of the source water is not a concern, and the quality, although not great, is manageable.

Three pumps deliver water to the system's sole treatment plant. The new plant, which came on line in March 2008, uses state-of-the-art treatment processes, including up-flow clarifiers, deep-bed granular activated carbon (GAC) filters, and ultraviolet (UV) disinfection. It replaced a 1938 treatment plant that used conventional treatment processes including aeration, chemical addition, flocculation, sedimentation, filtration, and chlorination. The old plant produced an average of 13.5 million gallons of finished water per day and a maximum of 25 million gallons per day (MGD). Although Pawtucket's average daily demand has decreased in recent years (demand was 11.4 MGD in 2007) due to loss of industry, the new plant has a maximum production of 25 MGD, which can be increased to 30 MGD. The system's three finished-water storage tanks have a total capacity of 18 million gallons.

Pawtucket has a 260-mile network of distribution mains, including 160 miles of 6- to 8-inch mains and approximately 100 miles of 12- to 36-inch mains. Many of the system's pipes date back to the 1800s. Pipes installed prior to 1958 are made of unlined, tar-coated cast iron. Since 1958, the system has used cement-lined ductile iron pipe. Pawtucket has approximately 1,700 fire hydrants, 6,000 line valves, and 22,000 service connections.

The PWSB's sole source of income is its water rates, which were the lowest in Rhode Island before the infrastructure improvement projects began—an average household paid roughly $164 annually in 2000.

An appointed, all-volunteer board of directors oversees the system. The PWSB's staff of 53 includes engineers and staff members assigned to administration and customer service, source water protection, and the operation and maintenance of the transmission and distribution system. Some individuals have worked for the utility for more than 30 years. The water treatment plant operators are no longer employed by the PWSB; they now work for AECOM (formerly Earth Tech), the design-build-operate (DBO) contractor for the new treatment plant.

Problems Faced

With the system's aging infrastructure, the PWSB had to wage an uphill battle to consistently provide safe water to its customers. The system faced major challenges in meeting increasingly stringent federal standards designed to protect the public against microbial disease. The system's water quality problems included a TCR acute violation, high turbidity, main breaks, and taste and odor issues related to rusty pipes and the high chlorine

"We couldn't just keep replacing everything in the plant. [Because of the age of the plant], all the replacements had to be custom-made—the parts just weren't around."
—Mary Tetzner, former PWSB chair

levels needed to control biofilm buildup in the distribution system. These issues and ratepayer frustration about the estimated cost to fix the problems, which increased dramatically as the years dragged on, led to the customers' low opinion of Pawtucket water.

Heavy rain caused turbidity problems for the old plant. Turbidity is the cloudiness of water caused by suspended solids and is an indicator of water quality. In October 2005, a boil water order was issued after a heavy rain caused extremely high turbidity levels in the source water. The system worked closely with the state after this incident and was quickly able to restore the provision of safe water.

The water leaving the old plant was usually of good quality but degraded as it traveled through the old, leaky distribution system. The system's unlined cast iron water mains are prone to rust and tuberculation, which causes discoloration and poor taste in the finished water. High water demand during the summer causes the entire system to experience rusty water for extended periods. In addition, these old pipes are prone to breaks, disrupting service and raising public health concerns about the intrusion of chemicals and biological contaminants.

The older pipes in the Pawtucket system also have biofilm buildup. Biofilm, a layer of biological and mineral material on the inside of distribution pipes, consumes disinfectants and can pose health risks.

To maintain an adequate level of disinfectant in the water and control biofilm buildup, the PWSB had to add large amounts of chlorine, which ensured that the water was disinfected but caused customers to complain about the taste and odor of the water. High chlorine levels also led to high levels of DBPs, carcinogenic byproducts of the chemical reaction between disinfectants and natural organic matter in water. Although the system's DBP levels are low enough to comply with the federal Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR), the Stage 2 DBPR would have presented significant compliance challenges.

In addition, the vintage 1938 plant's treatment processes, while adequate to meet the original Surface Water Treatment Rule (SWTR), would have had problems consistently meeting newer surface water treatment regulations such as the Interim Enhanced SWTR (IESWTR) and the Long Term 2 Enhanced SWTR (LT2ESWTR).

Customer dissatisfaction was exacerbated by financial issues. In 1989, ratepayers were given an extremely low estimate of $30 million to fix and replace aging infrastructure. Voters approved a $30 million bond issue, believing it would fix all the problems, and the PBA subsequently issued bonds for that amount.

A few years later, system leaders began to discuss the need for a new water treatment plant in addition to major distribution system improvements that included relining or replacing approximately 160 miles of 6-inch and 8-inch mains. New estimates of the total cost to cover all necessary improvements raised the price tag by $40 million. This increase frustrated customers who had previously been told that $30 million was sufficient.

	Retrofitting Old Plant	vs.	Building New Plant
Pros	• Less expensive in short term		• Cost effective in the long term • Would meet upcoming regulations • Greater capacity
Cons	• Would not meet upcoming regulations • Limited capacity • Disruption of service		• More expensive in short term

Options Considered

In 1998, the PWSB commissioned a $300,000 feasibility study (paid for by a grant) to determine the costs and benefits of retrofitting the 1938 plant. The study determined that it would cost $25 million to upgrade the old plant so it could continue to meet current regulations. Even with the upgrade, however, the plant could not meet the most recent regulations, such as the Stage 2 DBPR and LT2ESWTR, and would have limited capacity.

Later engineering studies commissioned by the PWSB found that the walls of some pipes in the treatment plant had deteriorated to less than 1/16 inch thick, making them vulnerable to breaks that would disrupt service and potentially endanger the plant staff.

The water system's engineers agreed that the system needed a new treatment plant to avoid structural failures, comply with drinking water standards, and ensure continued public health protection. In 1998, the PWSB decided to build a state-of-the-art treatment plant.

To help fund the necessary improvements, Pawtucket realized that it had to raise its water rates, which were the lowest in the state at the time. Pawtucket asked the state's Public Utilities Commission (PUC), which regulates the PWSB's rates, to adjust the system's water rates. The PUC recognized the need for improvements and approved a rate increase in 2002. PWSB water rates were raised again in 2003, the same year the PUC published the study "Investigation Into the Adequacy of the PWSB's Treatment Plant." The study noted several structural concerns, including the potential for: pipeline failures, equipment failure of major plant components, electrical short circuits, and pump failures at system pump stations. The most recent rate increase was in 2005. With these increases an average houshold's annual water bill increased from roughly $164 before the investment in infrastructure to $372.

The PWSB considered two locations for the new plant: in Cumberland near the source, and in Pawtucket near the administrative offices. The Cumberland site was larger, but the Town of Cumberland was proposing to levy heavy taxes on the plant and the land. Instead, the system chose to build the plant on a 1.36-acre, tax-free site adjacent to the PWSB's Branch Street Headquarters in Pawtucket. This parcel, sandwiched between a major interstate highway and a railroad track, was owned by the state. As part of the cooperative effort to improve Pawtucket's water, the state gave the system the land.

Municipal Employee Transfer

As part of the DBO agreement, Pawtucket's treatment plant operators and staff could transfer their employment to AECOM and continue working at the PWSB plant. AECOM worked with the PWSB and two Rhode Island unions to ensure a smooth employee transfer and low turnover. First, AECOM signed a Memorandum of Understanding (MOU) with the PWSB employees that accepted the terms of the current union contract and fostered good communication and an easy transition. The union employees were given incentives to transfer, including retirement compensation, a 25% salary increase, pension rights, and a guarantee not to be laid off for 8 years. In February 2003, 15 employees transferred to AECOM (three employees chose to not transfer and continued to work for the PWSB in another capacity). The early results from the transition were positive, and AECOM and the unions recently negotiated a new contract. Although the negotiations were contentious at times, AECOM was able to retain all incumbent staff members.

Pawtucket Chooses a DBO Contractor

Pawtucket hired the Eisenhardt Group, a consulting firm, to help choose a procurement method for construction of a new plant. The consultants recommended that the system hire one contractor to design, build, and operate (DBO) the new plant, an arrangement that can reduce construction costs by up to 25%. Although the DBO contractor would be responsible for the operation of the new plant, the city would own the plant and the distribution

system. After operating the plant for 20 years, the contractor must return it to the PWSB in its original condition. This requirement gives the contractor an incentive to perform exceptional plant maintenance and asset management. The PWSB voted unanimously to follow its consultant's recommendation.

The PWSB worked with The Eisenhardt Group to develop a request for proposals (RFP) for the DBO contract for the new plant. The detailed, 400-page RFP was advertised in February 2001. By August 2001, four potential vendors had submitted proposals. The Eisenhardt Group evaluated the proposals on a point scale based on technical plans, risk assignment and assessment, management, employee transition plans, and cost.

After an 18-month process, Pawtucket's engineers, including chief engineer Pam Marchand, chose the engineering firm AECOM. The PWSB felt that AECOM had the strongest proposal based on its experience, reputation, and proposed treatment technologies, which included GAC and UV light. AECOM's total bid was $42 million over 20 years, $3.5 million less than its closest competitor. In January 2002, the PWSB voted to recommend AECOM's proposal to the city purchasing board.

Although the PWSB and the purchasing board unanimously supported AECOM's DBO bid, Pawtucket's city council passed a resolution approving a different vendor for the new treatment plant. The PWSB, backed by Mayor Doyle, hired special legal counsel to fight this choice.

The lawsuit eventually went before the Rhode Island Superior Court for a declaratory judgment to interpret Pawtucket's charter and resolve whether the purchasing board or the city council has the final decision in vendor selection. On October 1, 2002, the Superior Court ruled that the purchasing board has the authority to select the DBO vendor.

Moving Forward: Implementing the **Grand Plan**

Once the vendor dispute was settled, Pawtucket was able to move ahead with constructing the new treatment plant. In addition to the new water treatment plant, AECOM's contract called for a pump station, residual lagoons, and a 5 million gallon storage tank. A source water protection plan and distribution system rehabilitation round out Pawtucket's comprehensive plan.

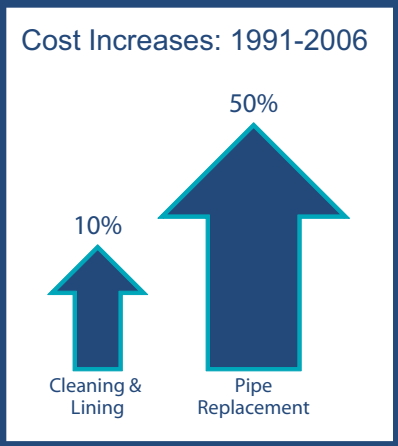
Pawtucket's source water protection plan is funded by Clean Water Act grant money, and the water system has worked closely with the state and neighboring towns to implement the plan. Pawtucket assisted the Town of Cumberland in rewriting ordinances (which are pending) to create

Cleaning and Lining

Due to rising construction costs, Pawtucket has had to rely increasingly on cleaning and lining, rather than replacing, its pipes to rehabilitate the distribution system and keep costs down. Since the project began in 1991, the average cost per foot for pipe replacement has increased from $103 to $155; cleaning and lining one foot of pipe costs an average of $72. The price of raw materials has also increased due to global economic conditions. The PWSB is concerned that the rising prices will drive up the total cost of the infrastructure improvements.

Pipes installed before 1920 are replaced, while newer pipes are cleaned and relined. Cost per foot for cleaning and lining has not risen as dramatically as the cost of line replacement. Life expectancy of new ductile pipe is over 100 years, while the life of distribution pipe less than 12 inches in diameter is approximately 80 years. The PWSB emphasizes that cleaning and lining can add many additional years to the useful life of a pipe, which reduces the burden on the water system and minimizes the cost of distribution system rehabilitation.

The PWSB expects to complete its pipe rehabilitation projects by 2014 at a cost of $80 million. The PWSB recommends cleaning and lining as an overlooked and cost-effective alternative for many systems.



an overlay district prohibiting underground storage tanks and certain industries, such as gas stations, from being built in the watershed, and requiring cesspools to be removed. The water system worked with the owner of a pond along the Abbot Run stream because the owner was willing to donate the pond to the PWSB, allowing it to restore the surrounding wetlands and nearby dam.

Pawtucket's new water treatment plant is designed to meet EPA drinking water standards. The plant's capacity can be increased from 25 MGD to 30 MGD. Its treatment processes include up-flow clarifiers, deep-bed GAC filters, and UV disinfection. The GAC filters remove particles (lowering turbidity) and extract organics, which can cause DBPs as well as taste and odor problems. The PWSB believes the GAC provides an extra measure of protection against synthetic organics, such as pesticides, that may be found in the watershed. The plant's UV disinfection adds another barrier against pathogens such as Cryptosporidium and Giardia. The UV technology gives the system enough additional disinfection capacity to safely reduce the amount of chemical disinfectants used, further reducing DBPs. In addition, the system plans to eventually switch to using chloramines instead of free chlorine for disinfection, further reducing DBP formation.

Pawtucket continues the exhaustive rehabilitation of the distribution system that began in 1991. The project includes replacing all water mains installed before 1920 and cleaning and relining the remaining mains with a fresh coat of cement. The system engineers have worked diligently with the Pawtucket Department of Public Works to minimize disruption of traffic by coordinating paving projects to ensure that streets are left in pristine condition after their work is complete.

To gain public support for its infrastructure improvements, the PWSB conducted numerous outreach activities. The PWSB issued press releases to local newspapers and cable television stations, sent letters with consumers' water bills, and held a series of public meetings to which elected officials from the surrounding towns were invited. The PWSB took the sparse attendance at the public meetings as a good sign; as one PWSB official noted, "You only see people when there's a problem."

Financing

The cost of the capital improvements for Pawtucket's water system is significant, but the city and its customers will save money in the long run by not waiting until their aging infrastructure undergoes a crisis. In addition, the public health benefits and customer satisfaction are immediate. Overall, the PWSB has undertaken projects and investments that total over $135 million. Here's the breakdown:

$27 M	Refinancing the remaining PBA debt, which paid for much of the distribution system improvements
+ $30 M	Additional funds borrowed to complete the distribution system and transmission main improvements
+ $44 M	Funds borrowed to finance the new treatment plant and storage tanks
+ $32 M	Pay-as-you-go financing for infrastructure replacements
+ $2 M	Water Resources Board
$135 M	**Total Financed**

Although the amount borrowed could be overwhelming for a city of Pawtucket's size, the leadership of the water system worked closely with the state's financing experts to tailor solutions to the city's situation. The result was a flexible package of financing assistance structured to minimize the impact on customers while maintaining the bond rating for the system and city.

"It's been nice to have a partnership with the Rhode Island Department of Health. They can see issues as they come up and have been a good source of technical and financial expertise." —PWSB

Legacy Debt from PBA

Of the $30 million borrowed in 1999, the PBA had $27 million in outstanding debt when the city decided that a more comprehensive strategy for upgrading the water system was needed. The PBA, however, had a debt ceiling of $50 million, which meant it could not access the financing needed to build a new treatment plant. The state was ready and willing to make DWSRF loans to cover the treatment plant and much of the other infrastructure costs, but it could not loan the money to the city (which had sufficient borrowing capacity) because the city did not own the infrastructure.

Working together, the city and state found a solution: the city would reacquire the system's assets from the PBA. The city, which has a much higher debt limit than the PBA had, structured the PWSB's debt so that the water revenue was pledged to cover all debt. City ownership also allowed the PWSB to access state DWSRF funds. But for the city to reacquire the system's capital assests, it would also need to take over the PBA's capital debt.

In 2003, Pawtucket reacquired its water system, used two conduit loans from the Rhode Island Clean Water Finance Agency to discharge the PBA's debt, and dissolved the PBA. The $27 million was refinanced outside the DWSRF through two bond issuances. One loan was for $19,340,000 at 4.94% interest to cover the tax-exempt portion of the debt. The other loan was for $7,655,000 at 6.13% to cover the taxable debt. The state charged a 1% origination fee and a 0.5% agency service fee on each loan.

The system and state were pleased with the interest rates for both loans, which were below the initial estimates and the market rate at the time. The state worked with the system to create a flexible repayment schedule for these non-DWSRF loans that enabled the system to pay only interest for the first 20 years (when the PWSB would be repaying the DWSRF loans) and then pay down the principal during the following 10 years. By staggering debt repayments, the state helped the system lessen the impact on its rate payers.

A second issue arose when Pawtucket was considering assuming the PBA's debt and taking out additional debt. A local ordinance required that all borrowing had to be approved by voters, which would have restricted the system to general obligation pledges. Pawtucket leaders were concerned that the voters would be unwilling to approve the money needed to restore the water system for several reasons. For one, voters remembered promises by the PBA that additional borrowing would not be necessary to rehabilitate the system. In addition, many of the system's customers were not voters in Pawtucket because they lived in neighboring communities. Therefore, the system and the state worked with the Pawtucket city council to change the ordinances to enable the system to issue a revenue pledge that did not need voter approval. The system was able to issue revenue pledges, which improved its bond rating and lowered its interest rates.

Financing Debt for New Infrastructure

Most of the money that the PWSB borrowed from the state is being used for the new treatment plant, waste residual lagoons, storage tanks, transmission mains, and distribution system upgrades. The PWSB worked with the state to complete the necessary DWSRF application and approval steps and, just 4 months after the PBA dissolved, the state awarded the system the first of two DWSRF loans. The low interest rates and flexible terms of the DWSRF loans, combined with limited grant

"The good thing about the DWSRF is the flexibility the State was able to demonstrate to help stabilize the rates and minimize rate shock ." **—PWSB**

funding ($748,400) for planning and supplemental funds from revenues, gave the PWSB the stability and support needed to implement its ambitious plans. Without assistance from the state's DWSRF program, the PWSB would not have been able to affordably finance its capital improvements.

In 2004, Rhode Island awarded the City of Pawtucket a two-part DWSRF loan for:

- $41,875,000 at 2.4% interest
- $31,909,000 at 2.8% interest

The DWSRF interest rates were far below the rates available from other financing sources considered at the time. The below-market interest rate will save the PWSB and its customers more than $10 million. Those savings were made possible by the DWSRF program as well as safeguards, such as repayment insurance, that the state and city worked to put in place and that improved the PWSB's credit rating. Refinancing the PBA's debt also expedited the loan process and improved the system's credit rating.

In addition to the significant savings from the below-market interest rates, the PWSB has benefited from the flexible terms of the DWSRF assistance. The state gave the city 3 years to draw down the loan funds, which reduced the loan costs because interest does not accrue until funds are drawn.

Debt Service

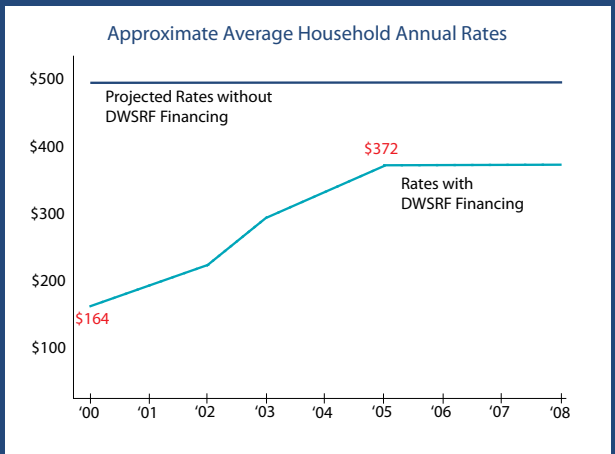
Pawtucket borrowed almost $108 million from the state, making the rehabilitation of its drinking water system the largest state-financed municipal project in Rhode Island history. Pawtucket has worked closely with the state to develop an affordable repayment plan for the DWSRF and conduit loans. During the first 20 years, Pawtucket will repay its DWSRF loans (which have a 20-year repayment period) and will pay only interest on the conduit loans. After the DWSRF loans are repaid, Pawtucket will repay the principal of the conduit loans, which have a 30-year repayment period. Without this flexible repayment schedule and the savings provided by the DWSRF, Pawtucket's yearly combined conduit and DWSRF debt service would have climbed from $2 million prior to the borrowing to $9 million. With assistance from the state, annual debt service will increase to $8 million.

Impact on Rates

Before Pawtucket began its rehabilitation project, its water rates were the lowest in Rhode Island. In 2000, an average household paid just $164 for water for the year. Rates have increased since the project began, but financing from the Rhode Island DWSRF has helped to minimize the project impact on customer water rates.

The PWSB hired financial consultant Chris Woodcock of Woodcock Associates, Inc. to assess the effect of the infrastructure improvement projects on the water system's rates. Mr. Woodcock concluded that consumer rates would have had to triple over 3 years without the low-interest (2.4% and 2.8%) DWSRF loans. With funding from the DWSRF, which will save the city and its customers $12 million over 24 to 26 years, Mr. Woodcock predicted the system would only need to double its rates. DWSRF financing also allows the system to spread out the rate increases over 10 years, lessening the pinch on consumers and reducing public resistance.

In April 2002, the PWSB raised water rates by 40% to pay for the increased debt service for the new infrastructure; the PWSB raised rates another 28% in January 2003. Rates were raised again in 2005, and in 2008 an average household paid $372 for water for the year. The PWSB has heard complaints about rate increases from its customers, but expects less resistance with the improved water quality and service.



Other Financing: Pay-as-You-Go

In addition to loans and bonds, Pawtucket is using "pay-as-you-go" Income Fund Reimbursable (IFR) funding to finance the system's remaining pipe replacement projects. (Funds from the Rhode Island DWSRF are used for the cleaning and lining projects.) Prior to 2003, the replacement projects and the cleaning and lining projects were funded by the PBA through general obligation bonds. By paying for some of the infrastructure improvements out of current revenue, the PWSB is able to keep its debt load from becoming too large.

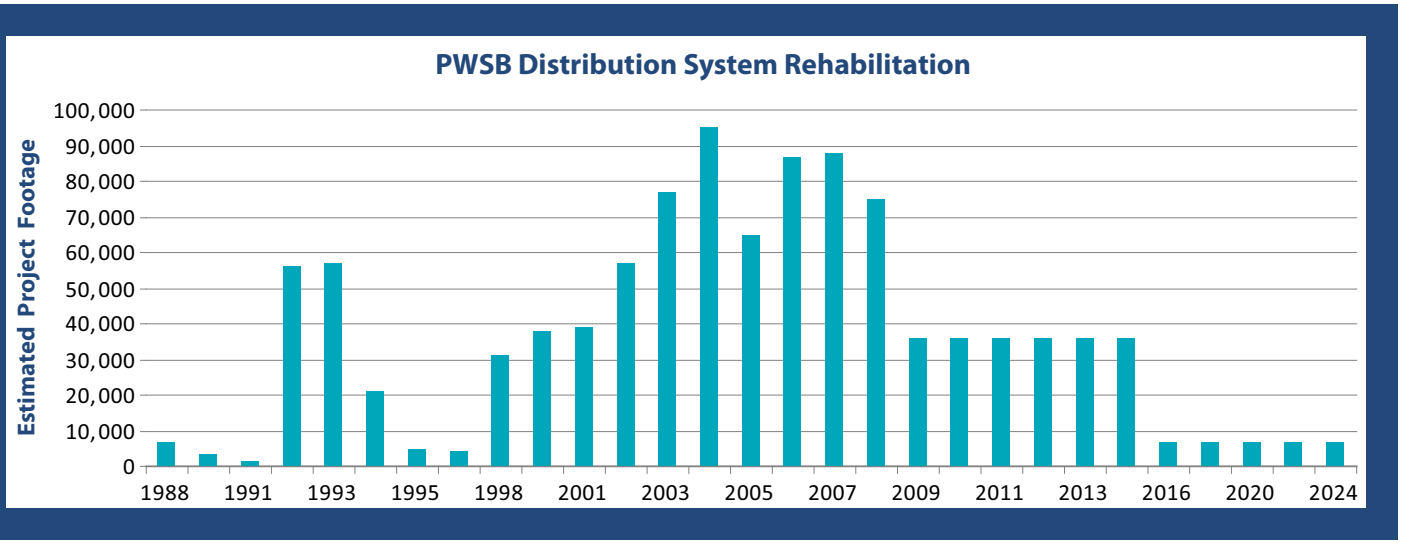
Current **Status**

Pawtucket is making progress in all aspects of its source-to-tap improvement plan. The system is working with surrounding towns to implement its source water protection plan. The watershed zoning ordinances are pending, and the system is seeking a Clean Water Act Section 319 grant to restore a degraded pond that was donated to it.

Pawtucket's new 25 MGD treatment plant was completed in early 2008, nearly 2 years behind schedule. The project faced many setbacks that contributed to the delay, including complications at the plant site. The site, which is adjacent to the PWSB headquarters, is small and bordered by a railroad and an interstate highway. This location poses liability and security issues, and soil contamination added to the project's cost and delayed construction. Additional setbacks included problematic pumps and a malfunctioning valve that caused brief periods of rusty water. Despite these challenges, the transfer to the new plant has been relatively smooth and the public response has been positive. Since the new plant came on line, the PWSB has received calls from customers praising the water's taste.

AECOM has also completed Pawtucket's new 5 million gallon storage tank and two new drinking water residual lagoons. AECOM is constructing a new raw water intake and converting the original plant's finished water line into a redundant raw water intake.

The cleaning, lining, and line replacement projects are approximately 73% complete. At the current pace and using pay-as-you-go financing, the PWSB expects to finish the remaining distribution system



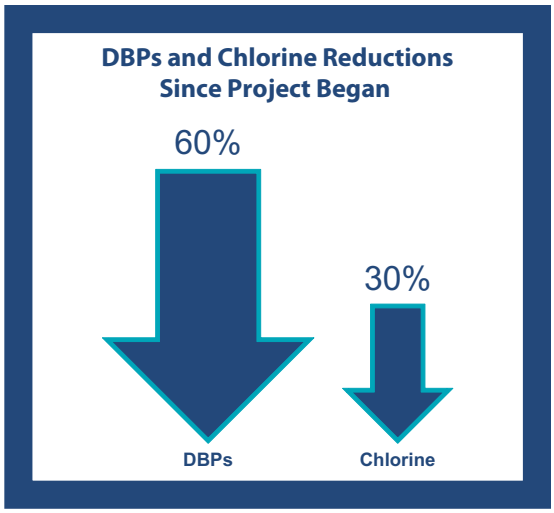
projects by 2014. The PWSB considers age, water-main upsizing, dead-end looping, accessibility, and paving issues in deciding whether to clean and line or replace pipes. Since 1988, 112 miles of pipe have been cleaned and lined and 37 miles have been replaced (approximately 55 miles remain to be cleaned and lined or replaced; 56 miles of the system's pipe did not need rehabilitation or replacement).

Results/Benefits

The PWSB's aggressive rehabilitation project has created significant benefits for the system and its customers. The distribution system improvements have increased the city's water quality, reduced customer complaints, and lowered pumping and pipe repair costs.

Although the system's surface water source remained the same after the new treatment plant was constructed, the PWSB has implemented significant safeguards that are improving source water quality. Proposed regulations of activities in the watershed will further improve source quality and should decrease the likelihood of turbidity problems.

Before the rehabilitation project, the entire water system regularly experienced rusty water for extended periods; now, thanks to cleaning and lining and pipe replacement, only small areas of the distribution system have chronic rust problems, and they are being rapidly addressed. The PWSB staff has noticed a dramatic decrease in the number of customer complaints. The water system used to receive up to 100 complaints about rusty water per day. After years of effort, the system now receives at most a few complaints a week.



In the past, biofilm buildup in the distribution pipes forced the system to rely on high levels of chlorine to maintain a disinfectant residual. The distribution system rehabilitation has significantly reduced biofilm levels, allowing the system to reduce the amount of chlorine in finished water from 1.8 mg/L to 1.0 mg/L. The distribution system upgrades have also helped to eliminate total coliform-positive bacterial samples.

Since the beginning of the rehabilitation project, DBP levels have dropped by 60%, and there have been no violations of the TCR. To further reduce DBP levels, the system plans to switch from chlorine to less reactive chloramines for disinfection.

The PWSB's pumping costs have decreased because water passes easily through the new and smoother pipes in the system. The water system reports lower electricity use and a 10% decrease in pumping pressure. AECOM estimates that the DBO arrangement will enable the system to save an additional 15 to 20% in operating costs.

Next Steps

In addition to completing the projects currently underway, Pawtucket has plans for further improvements, which include capital improvements to dams, wells, and expansion of

"There was a time when I had as many as 100 phone calls a day due to main breaks and rusty water. Now, well, I think I had one on Tuesday." —Allen Champagne, PWSB

wholesale options. The projects will improve the city's infrastructure, benefit both the city and its neighboring communities, and contribute to Pawtucket's revitalization.

Now that the new plant is complete, portions of the original plant will be converted to a facility for the distribution system operations and maintenance crew; the remainder might be turned into offices or decommissioned. The distribution system rehabilitation project is scheduled for completion in 2014, followed by several years of low-level line replacements. The PWSB plans to implement a preventive maintenance program to prolong the life of its new infrastructure once the distribution system upgrade is complete.

Pawtucket will continue to implement programs to improve source water quality. The PWSB also wants to create and implement public education and public relations programs. The system hopes these efforts will raise awareness about its water and customer service.

The PWSB is installing radio read meters, will implement monthly billing, and will eventually allow electronic debiting. Pawtucket hopes monthly bills will reduce the sticker shock that comes with traditional billing practices and help customers better understand the impacts of water consumption. The project should also help the system detect leaks and reduce unaccounted for water (currently 8 to 10% of the system's water).

Pawtucket's water system would like to sell water at wholesale rates to neighboring communities and perhaps develop a regionalization plan. The expandable capacity of the new treatment plant will enable the system to meet additional demand from new wholesale customers. The PWSB also recently acquired and consolidated with the Central Falls system. Pawtucket previously supplied water to Central Falls, but did not own the distribution system. In April 2008 the PWSB began rehabilitating the distribution system, which is old and degrades water quality in Central Falls and some other areas served by the system.

Central Falls

Central Falls is a small, separate community surrounded by Pawtucket and Cumberland. For years Pawtucket supplied all of Central Falls' drinking water, but the PWSB did not own or operate the Central Falls system. Central Falls did not have a municipal entity devoted to operating the water system, and its distribution system is old and deteriorating. The city's public works department operated and maintained the water system in addition to plowing the roads and paving the streets. Central Falls budgeted for the replacement of one valve per year, often salvaging components from the PWSB's discards.

The failing Central Falls distribution system affected more than just Central Falls' customers; finished water from Pawtucket is pumped through the Central Falls system to customers in the Valley Falls section of Cumberland and some areas of Pawtucket. Clean water from Pawtucket degrades as it travels through 20 miles of deteriorating pipe in Central Falls, eliminating for these customers many of the benefits of Pawtucket's infrastructure renewal.

For years, the PWSB wanted to buy the Central Falls water system and rehabilitate its distribution network to improve water quality and service for its Central Falls and Cumberland customers. Under a contract signed in 1938, Pawtucket paid Central Falls an annual fee equal to 25% of gross water sales in Central Falls to use the community's pipes. Central Falls sued the Pawtucket water system after Pawtucket failed to pay the franchise fee for several years; Pawtucket withheld payment because of the unacceptable condition of Central Fall's water mains. The franchise agreement ended in 2002, and Pawtucket attempted to buy the Central Falls system. The deal fell through, but negotiations resumed in 2005. In June 2007, the PWSB purchased the Central Falls system for $1.1 million. The acquisition was paid, in part, from funds that the PWSB had set aside with the approval of the state PUC. The PWSB began rehabilitating the Central Falls system in the spring of 2008, which should improve the quality of water for customers down-line.

Lessons Learned

The challenges facing Pawtucket's drinking water system are familiar to communities across the country. Pawtucket's years of hard work suggest lessons for others facing similar challenges.

Primary Lessons

1. Rhode Island's DWSRF Program played a central role in facilitating Pawtucket's drinking water system rehabilitation. The state worked closely with the city, the PWSB, and water system staff to make the ambitious plans to renew the water system a reality by finding creative, flexible funding solutions to finance the system's existing debt and pay for improvements. The low-interest DWSRF loans provided by the state kept the project affordable and softened the impact on rate payers. In addition, the state kept the projects from getting derailed by using a mix of DWSRF debt and other financing tools.

2. Pawtucket's water system problems had been building for decades, and like many systems and communities, it took years for leaders and the public to recognize the full scope and scale of the system's problems.

3. The city and system needed the technical leadership at the water system and the political leadership in the community to move away from a repair-and-maintain mentality to a comprehensive rehabilitation and replacement of the entire water system.

Other Important Lessons

- The state's health department was open to innovative technology that allowed the system to shoehorn a state-of-the-art treatment plant onto a very small parcel of land.
- The PUC recognized the need for the significant infrastructure investments and approved the rate increases the system needed to pay for the improvements.
- The water system decided to clean and reline significant portions of the distribution system rather than just replace all the mains. Cleaning and lining has proved to be a very cost-effective way to improve water quality for customers.
- By including an element of restructuring (acquiring the Central Falls water system), Pawtucket was able to improve the efficiency of water provision to both communities and improve public health protection for the residents of both communities.
- Pawtucket was open to using any and all options including an innovative DBO procurement approach and ultimately decided to pursue a public-private DBO partnership.

From left to right: Fred Ramos, Mary Tetzner, Rich Antonelli, Allen Champagne, William Masuck, Gary Chobanian, James DeCelles

"I've learned that everything takes longer than thought or planned. It takes patience. It requires not giving up." **—Mary Tetzner, former PWSB chair**

Technical Terms

- **MGD** – million gallons per day
- **Aeration** – water treatment process in which the turbulent exposure of water to air removes volatile contaminants
- **Flocculation** – one step in a large-scale water treatment process in which stirring is used to collect small particles into larger particles, whose weight causes them to settle to the bottom of the treatment tank
- **Sedimentation** – the settling of heavy solids to the bottom of a treatment tank after flocculation
- **DBPs** – disinfection byproducts; carcinogens formed when disinfectants used for water treatment react with naturally occurring organic matter in water
- **TTHMs** – total trihalomethanes (chloroform, bromoform, bromodichloromethane, and dibromochloromethane); DBPs
- **HAAs** – haloacetic acids; five DBPs
- **GAC** – granular activated carbon; medium used to filter water
- **UV** – ultraviolet; a form of disinfection in which biological contaminants are inactivated by ultraviolet light
- **Turbidity** – a measure of organic matter suspended in water

Finance Terms

- **General Obligation Pledge** – a municipal bond that will be repaid through any tax source or revenue; requires no assets for collateral
- **Revenue Pledge** – a municipal bond that is repaid from revenue streams, but not from tax revenues
- **Conduit Financing** – a financing arrangement for a large capital project in which a government uses its name to back the issuance of a fixed income security for another public entity

Rhode Island Drinking Water State Revolving Fund

The Safe Drinking Water Act (SDWA) Amendments of 1996 established the Drinking Water State Revolving Fund (DWSRF) to provide drinking water systems with below-market-rate loans to finance infrastructure improvements that can boost the quality of drinking water and better protect public health. The DWSRF gives each state flexibility in managing its SRF program so it can be tailored to the state's needs.

The Rhode Island Clean Water Finance Agency (RICWFA) works with the Rhode Island Department of Health (RIDOH) to manage the Rhode Island Drinking Water State Revolving Fund (RI DWSRF). Before a project can receive funding, it must be placed on the state's Project Priority List (PPL), which ranks projects based on a point system. Priority is given to projects that address the most serious risks to human health, are necessary to ensure compliance with the SDWA, and assist the systems most in need. Rhode Island updates its PPL at least once a year.

The State of Rhode Island has never declined DWSRF funding to any project on its PPL that met all the funding criteria. To increase the money available to water systems, Rhode Island chose to leverage its capitalization grants by issuing tax-exempt bonds. Pawtucket was the first community to borrow from the leveraged program. Pawtucket's new treatment plant and distribution system rehabilitation, which cost over $100 million, is the largest project ever funded by RICWFA.

85% of available RI DWSRF funds have already been committed to water systems

Special Thanks To:

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