

## FACTS ABOUT

# THE WALNUT HILL WATER TREATMENT PLANT PROJECT

## A MASSACHUSETTS WATER RESOURCES AUTHORITY PUBLICATION

The Walnut Hill Water Treatment Plant will provide state-of-the-art treatment to the drinking water for 41 communities in Eastern Massachusetts served by the MWRA. When completed in early 2005, the Marlborough plant will use **ozonation** and **chloramination** to treat up to 270 million gallons of water daily (up to 405 on a peak day). This treatment will improve drinking water quality and strengthen the region's ability to comply with the **Federal Safe Drinking Water Act**. When the new plant is completed, existing disinfection facilities at various MWRA locations will become backup systems. These changes, along with other improvements, mean that the MWRA will be able to drastically reduce the amount of chlorine used in the water treatment process.

The \$360 million treatment plant project consists of seven construction contracts. Construction is nearly complete on the intakes, piping and tunnels that will transport the water from the Quabbin and Wachusett Reservoirs to the Walnut Hill Plant and then to the distribution system. The treatment plant is a major element of the MWRA's \$1.7 billion Integrated Water Supply Improvement Program.

### WATER TREATMENT

MWRA communities are truly fortunate to receive high-quality water from two large reservoirs, the Quabbin and Wachusett. Working with the state watershed management division, MWRA supports **watershed protection** activities that shelter the lands around these reservoirs from development and pollution. While many water systems must filter their water to remove impurities, MWRA's pristine sources allow it to meet federal standards with aggressive protection and disinfection. The new Walnut Hill Treatment Plant will provide a double layer of disinfection protection before the water enters enclosed pipes and storage tanks that supply member communities.

**Ozone** is a powerful disinfectant that has been used for over a hundred years for water treatment, most extensively in Europe, and more recently in this country. Recent interest in ozone was prompted by its ability to provide strong disinfection without

producing the byproducts associated with chlorine. Ozone is a safe disinfectant that meets current and planned future state and federal regulations.

Ozone is a highly reactive gas that is created by passing a high-voltage discharge through oxygen, similar to a lightning discharge passing through air. In water treatment, however, the electrical discharge is confined to a dielectric tube housed in a stainless steel vessel to prevent any release of the ozone to the atmosphere (see photo on page 3). The ozone gas is then injected into a water tank, called a contactor. The ozone gas diffuses across the bottom of the contactor. It bubbles up through the incoming water as it passes through the tank, killing pathogens – such as viruses, bacteria and protozoa – in the water. This use of ozone is called **primary disinfection**. A contact time of 30 to 60 minutes ensures the ozone has enough time to react with all of the contaminants. Ozonation also improves the taste, odor and clarity of the water. Residual ozone gas is collected from the water surface in the contactor, piped out of the contactors, and treated to destroy any remaining ozone (turning it back to ordinary oxygen).

The next step is to treat the water with a mixture of chlorine and ammonia, a process known as **chloramination**, to provide **residual disinfection**. Residual disinfection protects the water from bacterial contamination as it passes through the lengthy distribution system to the consumer. Chloramination is used – like ozone – because it forms fewer byproducts than using chlorine by itself and it is long lasting. MWRA will add carbon dioxide gas and sodium carbonate to prevent



This artist's rendering shows the new Walnut Hill Water Treatment Plant.



High-voltage charges in these stainless steel tanks produce ozone gas from oxygen for primary disinfection.

corrosion of the pipes the water passes through on its journey to users, in particular to prevent copper and lead from being released from home plumbing. Fluoride is also added here to promote dental health.

## SITE WORK AND WATER STORAGE TANK

The first construction package awarded on the treatment plant project included site clearing and excavation of more than 400,000 cubic yards of earth to create a platform for the plant on Walnut Hill. Walnut Hill rises to an elevation of 440 feet above Crane Swamp at the intersection of three communities: Marlborough, Southborough and Westborough.

On May 5, 1999 the MWRA broke ground for the new water treatment plant. Contractors have already placed more than 55,000 cubic yards of concrete for the water storage facility and a mile of large diameter (10 and 12 foot) piping. They have completed leak tests of the covered storage facility and are finishing site preparation. Two connected storage tanks will hold nearly 50 million gallons of water and cover just over 6 acres. Storage allows the plant to operate at a stable rate while the tanks provide for peak demand periods, smoothing pressure fluctuations.

Connections from the tanks to the new MetroWest Tunnel, the Cosgrove Tunnel and the City of Marlborough have also been constructed. Contractors are also replicating wetlands at the site and will complete extensive landscaping around the buildings and massive tank.

### Benefits of the New Water Treatment Plant

- Compliance with state and federal regulations
- Improved clarity and taste and odor control
- Large reduction in disinfection byproducts
- Strong protection against microbes and viruses
- Facilities that can be upgraded, if needed

## DISINFECTION – OZONE AND POST TREATMENT FACILITIES

This contract includes facilities and piping to transport, treat, hold and monitor drinking water quality. The ozone building includes four ozone generators and four ozone contactors fitted with gas diffusers to distribute the gas within the contactors. Ozone destruct units convert residual ozone off-gas to oxygen before its release to the atmosphere.

Vaporizers convert the liquid oxygen into gaseous oxygen and push the feed gas to the ozone generators. Gaseous oxygen entering the generator is 99% pure oxygen. As oxygen passes through the generator, electricity applied to the dielectric tube creates ozone gas. (See photo.) Gas exiting the generator (typically 7% ozone by weight) is piped to the diffuser system located in the bottom of the contactors. The ozone gas bubbles up through the water and destroys pathogens.

After disinfection, pipes convey the ozonated water to the post treatment building. This building houses four large chemical storage silos and related feed/mixing equipment, four carbon dioxide mixing units and various chemical injection locations. The post treatment building sits on top of two 25-million gallon storage tanks. The treated water flows from the storage tanks into the MetroWest Water Supply Tunnel through a shaft located adjacent to the storage tanks.

To meet the Safe Drinking Water Act's rule for lead and copper, MWRA will continue to add sodium carbonate to adjust the alkalinity and carbon dioxide to stabilize the pH of the drinking water. These processes provide a stable and less corrosive drinking water all the way through home piping systems to the tap. Post treatment also includes the chloramination and fluoridation stages previously described.

This contract also includes an electrical substation capable of powering the entire ozone and post treatment facilities in the event that the building loses power.

## THE INTAKES AND TUNNELS

Water that enters the Quabbin Reservoir in Western Massachusetts spends up to four years in the massive, 412-billion gallon reservoir before it is released periodically down a 25-mile tunnel to replenish the Wachusett Reservoir in Clinton. At the Cosgrove Intake Facility water from the Wachusett Reservoir currently receives primary treatment with chlorine before entering the Cosgrove Tunnel, heading toward Eastern Massachusetts for distribution to local community systems. Water is now delivered to the eastern part of the system through the Hultman Aqueduct, which will soon be supplemented by the MetroWest Water Supply Tunnel.

Other elements of the water transmission system are being upgraded to prepare for the new water treatment plant and the addition of the new tunnel to carry the water east. Several other contracts are underway to complete these preparations, including the Cosgrove and Wachusett Intakes upgrades and the rehabilitation of the Wachusett Aqueduct.

## THE COSGROVE AND WACHUSETT INTAKES

The Cosgrove Intake conveys water from the Wachusett Reservoir to the Cosgrove Tunnel. This construction package provides for replacement of valves and rehabilitation of two 1960s-era hydroturbine generators at the intake. Water flowing through the channels in the intake building turns the turbine generators to produce electricity. Modifications to these facilities will also permit remote control of the water flows and generators, reducing operating costs.

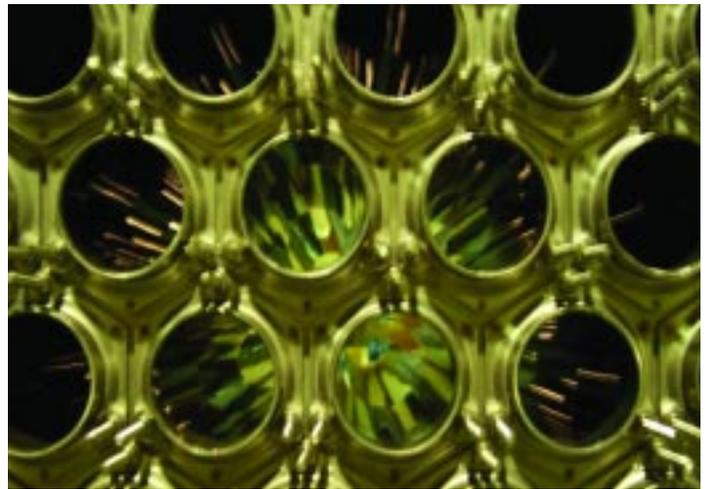
A second intake, the Wachusett Intake, provides water for the 9-mile Wachusett Aqueduct. This contract includes the installation of new valves and flow control equipment to replace obsolete equipment at the intake to prepare for the temporary use of the Wachusett Aqueduct while connections are made to the new Walnut Hill plant. Temporary chlorination facilities will disinfect the water during this period.

## THE WACHUSETT AQUEDUCT REHABILITATION

In the mid-1960s, this brick-lined aqueduct from the 1890s was removed from service as the primary water supply tunnel with the completion of the Cosgrove Tunnel. It has served as a backup to the Cosgrove Tunnel and provided direct water service to the Town of Northborough and Westborough State Hospital. The Cosgrove Tunnel must be taken out of service for several months, however, to make new connections to the Walnut Hill Plant. The Wachusett Aqueduct will be put into service while MWRA completes these connections.



The Wachusett Reservoir and Dam in Clinton



Closeup of the dielectric tubes where ozone gas is produced.

Contractors have repaired and relined the turn-of-the-century Wachusett Aqueduct so it will safely and reliably keep water flowing to metropolitan Boston during this changeover.

Seven miles of the 11-foot high horseshoe-shaped brick and concrete Wachusett Aqueduct were lined with 3 inches of reinforced shotcrete to enhance its structural integrity. Over 15,000 cubic yards of shotcrete were applied and hand finished to the exacting tolerances of smoothness needed to convey sufficient flow.

Two miles of the aqueduct's rock tunnel section close to the Wachusett Reservoir were also cleaned and drains carrying water under the aqueduct were repaired.

## REMAINING CONTRACTS

Two construction packages will provide site completion, including final landscaping, grading and access roads, and conversion of the Interim Corrosion Control (ICC) facility to another use. The ICC was built in 1996 to implement quick changes to water chemistry to minimize leaching of lead in home pipes.

### MWRA Communities That Benefit from the Walnut Hill Water Treatment Plant Project

Arlington	Lynn (GE Only)	Newton	Stoughton
Bedford	Lynnfield WD	Northborough	Swampscott
Belmont	Malden	Norwood	Wakefield
Boston	Marblehead	Peabody	Waltham
Brookline	Marlborough	Quincy	Watertown
Cambridge	Medford	Revere	Wellesley
Canton	Melrose	Saugus	Weston
Chelsea	Milton	Somerville	Winchester
Everett	Nahant	Southborough	Winthrop
Framingham	Needham	Stoneham	Woburn
Lexington			

## WATER SYSTEM SECURITY

Ensuring the safety of the public water supply system is MWRA's top priority. MWRA has recently enhanced its security to meet new state and federal guidelines. These actions include physical security measures, emergency planning, training and increased water supply testing and monitoring. The new covered storage tanks and treatment plant will be protected by the best security systems available.

## PUBLIC PARTICIPATION

Throughout the planning and construction of the Walnut Hill Water Treatment Plant Project, working groups have met regularly to discuss community concerns about construction activity. These groups have been instrumental in helping MWRA reduce impacts to residents abutting construction sites, plan public access for newly completed facilities, and review architectural and landscape designs.

## GLOSSARY

**Ozonation** – A method for disinfecting drinking water by combining oxygen gas and an electrical charge to produce ozone to kill pathogens and bacteria and improve the taste, odor and clarity of the water.

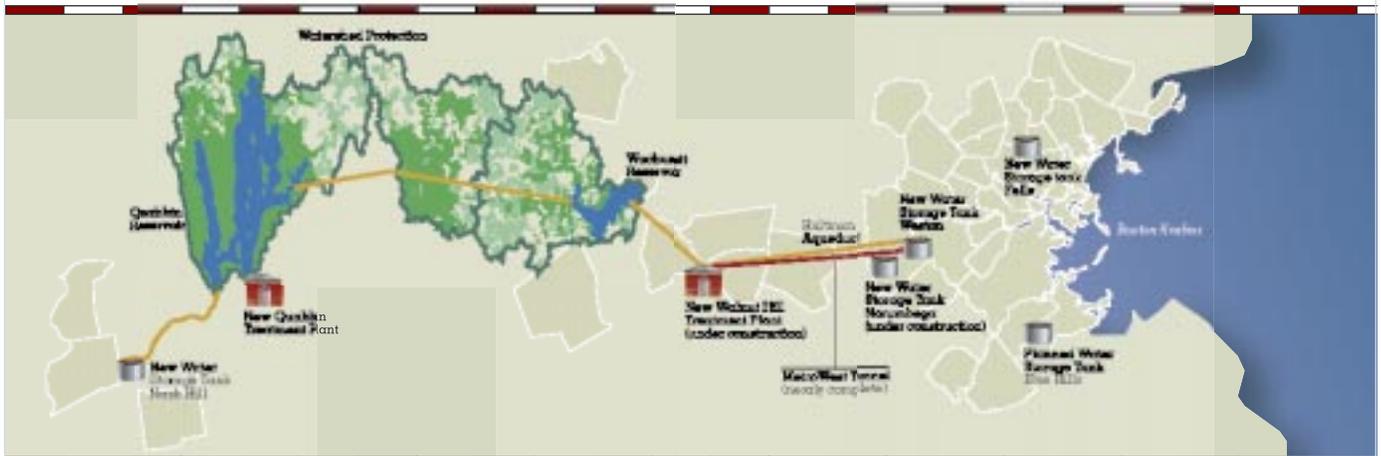
**Chloramination** – A process to treat water by combining chlorine and ammonia to form a long-lasting disinfectant called chloramine that remains stable through the distribution pipelines.

**Federal Safe Drinking Water Act** – A federal law requiring US EPA to establish national primary drinking water regulations for water suppliers that include maximum contaminant levels (MCLs) or treatment techniques.

**Watershed protection** – A means of maintaining high-quality drinking water by protecting the land that drains into a reservoir from contamination from such sources as bird droppings, stormwater runoff, septic systems and other pollutants.

**Primary and Residual Disinfection** – Steps in the drinking water treatment process designed (1) to kill disease-causing organisms and (2) to maintain a residual level of protection as the water passes through the MWRA's and the community pipeline systems to customers.

## MWRA'S INTEGRATED WATER SUPPLY IMPROVEMENT PROGRAM



The Walnut Hill Plant is just one part of the MWRA's 15-year Integrated Water Supply Improvement Program. In addition to the new plant, the MWRA: has built the MetroWest Water Supply Tunnel, a deep rock water tunnel that stretches 17.6 miles from Marlborough to Weston; is constructing six new covered water storage tanks that will replace existing open reservoirs to protect the treated water; is increasing watershed protection measures around the MWRA's two source reservoirs, the Quabbin and the Wachusett; and is undertaking an extensive program to rehabilitate the large pipelines that deliver water to the MWRA communities.



MWRA offers a wide variety of informational materials on the region's water and sewer systems and the natural environment. To find out what's available,

- **CALL US:**  
MWRA Public Affairs Department 617-788-1170  
Water Quality Hotline 617-242-5323
- **VISIT OUR WEB SITE:** [www.mwra.com](http://www.mwra.com)
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