



NOVEMBER 20 1997

## WATER QUALITY UPDATE

An analysis of October, 1997 water sampling data.

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This is a periodic report containing important information about the quality of water supplied by MWRA. We hope this report is useful to you as a local water supplier, public health official, water consumer or observer of MWRA's system performance.

MWRA provides about 250 million gallons of water each day to 46 cities and towns in eastern and central Massachusetts. Each municipality is responsible for distributing the water in its own community. Twenty-five of the customer communities are fully supplied by MWRA. The other communities use MWRA water to augment their own supplies, either on a regular basis or in times of water shortage. More than two million people are served by the MWRA water supply system.

### THE WATER SYSTEM

Quabbin Reservoir is the primary source of water for our system and one of the country's largest water supply impoundments with a capacity of 412 billion gallons. Water is transferred from the Quabbin Reservoir to the 65 billion gallon Wachusett Reservoir in Clinton via the Quabbin Aqueduct. The watersheds serving the Quabbin and Wachusett Reservoirs total 294 square miles. MWRA and the Metropolitan District Commission (MDC) are committed to protection of the water supply through aggressive watershed management as the first line of defense against water contamination.

Water is next piped from the Wachusett Reservoir to Norumbega and Weston Reservoirs in Weston via the

Hultman and Weston Aqueducts respectively. Most municipalities in the MWRA service area receive drinking water distributed directly from the Hultman Aqueduct, the Norumbega Reservoir and the Weston Reservoir. Six communities are supplied from Spot Pond and from Fells Reservoirs.

### INDICATORS OF WATER QUALITY

MWRA routinely uses six general indicators of water quality:

- Microbial (bacteria and algae)
- Turbidity
- Corrosiveness (pH and alkalinity)
- Disinfectant
- Chemical (inorganic and organic)
- Radionuclides

Tests are conducted on water sampled at the source reservoirs (source water) and also on water after treatment sampled from MWRA or community lines (treated water). Testing frequencies vary by parameter.

**Microbial:** Algal levels in reservoirs are monitored by MDC and MWRA. These results, along with taste and odor complaints, are used to make decisions on source water treatment for algae control.

Total coliform bacteria are monitored in both source and treated water to provide an indication of overall bacteriological activity. Since many members of the coliform bacteria group originate from the non-intestinal environment, such as soil, many coliform are harmless. A subclass of the coliform group which are identified by their growth at temperatures consistent with intestinal environments, the "fecal coliform bacteria," are indicators of possible intestinal contamination. *Escherichia coli* (*E. coli*) is a specific coliform

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For further information regarding health concerns, please contact the **Department of Public Health/Division of Epidemiology at (617) 983-6800** or **Boston Health and Hospitals at (617) 534-5611**.

species that is almost always present in fecal material and whose presence indicates likely bacterial contamination of intestinal origin.

**Turbidity:** Turbidity is a measure of suspended and colloidal particles including clay, silt, organic and inorganic matter, algae and microorganisms. The effects of turbidity depend on the nature of the matter which causes the turbidity. Particulate matter may have a chlorine demand or may protect bacteria from the disinfectant effects of chlorine, thereby interfering with the maintenance of a disinfectant residual throughout the distribution system.

**Corrosiveness:** In order to minimize the leaching of lead and copper in plumbing systems, the pH, or corrosivity, is monitored and adjusted. Water provided by MWRA is basically lead free when it leaves the reservoirs but individual building service lines that carry water from street mains, as well as household plumbing fixtures, can contain lead that is susceptible to corrosion and leaching into tap water. In June 1996, MWRA's Interim Corrosion Control (ICC) facility in Marlborough went on-line. MWRA believes the ICC provides the optimal corrosion control treatment now achievable for all MWRA customer communities east of and including Marlborough. The chemicals sodium carbonate (soda ash) and CO<sub>2</sub> (carbon dioxide) are added to increase the pH and buffering capacity of the water which should considerably reduce the lead levels found when you first use your tap.

**Disinfectant:** MWRA treats the water supplied to metropolitan Boston area communities using disinfection facilities at Quabbin, Norumbega, Weston, Spot Pond and Fells Reservoirs. At Norumbega and Weston Reservoirs, chlorine is used to inactivate pathogens coming from source waters and, with the further addition of ammonia, chloramines are formed to establish a sufficient level of residual disinfectant to protect against any new contaminants that may enter the distribution system. In the communities served by the Fells Reservoir, chlorine is added to protect against contamination that may have entered the water locally at these open surface reservoirs. The water fed downstream of these sources has a free chlorine residual. Some communities in the furthest parts of the MWRA delivery system also rechlorinate as added protection.

**Chemical:** Inorganics and nitrates are measured at Quabbin and Wachusett Reservoirs. Analyses of disinfection byproducts such as trihalomethanes are performed at seven locations throughout the distribution system. Volatile organic compounds are measured at the distribution reservoirs: Norumbega, Weston and Spot Pond. Synthetic organic compounds are measured at Wachusett Reservoir. MWRA generally meets applicable standards.

**Radionuclides:** Radionuclides are measured at three distribution locations. MWRA generally meets applicable standards.

## SAMPLING AND ANALYSIS

MWRA conducts all water sampling and testing required by federal and state law. We also conduct baseline and periodic research to help us improve water quality. Results of testing are compared to standards and guidelines prepared by DEP and recommendations for further action are made if reported levels are above the standards.

**Source water:** MWRA collects samples from the source water supply and reservoirs which are tested for coliform bacteria, turbidity, pH, chemical constituents and radionuclides.

**Treated water:** MWRA collects treated water samples throughout the system and conducts tests for pH, temperature, primary disinfectant levels, disinfectant residual and coliform bacteria. In addition, customer communities routinely collect treated water samples in compliance with federal Safe Drinking Water Act (SDWA) testing requirements including the Total Coliform Rule. These samples are analyzed for disinfectant residual and coliform bacteria.

Communities may bring their samples to the MWRA Water Quality Laboratory for analysis, or they may have samples analyzed elsewhere. MWRA Laboratories test samples for all customer communities except Bedford, Cambridge, Canton, Chicopee, Clinton, Leominster, Lynn, Marlborough, Northborough, Peabody, South Hadley, Wilbraham, Woburn and Worcester. Community data for these communities are not presented in this report.

**MWRA**

**SOURCE WATER - CHICOPEE VALLEY AQUEDUCT  
FECAL COLIFORM LEVELS AT QUABBIN (AS MEASURED AT WINSOR  
POWER STATION) AND NASH HILL RESERVOIRS  
OCTOBER 1997**

**Target**

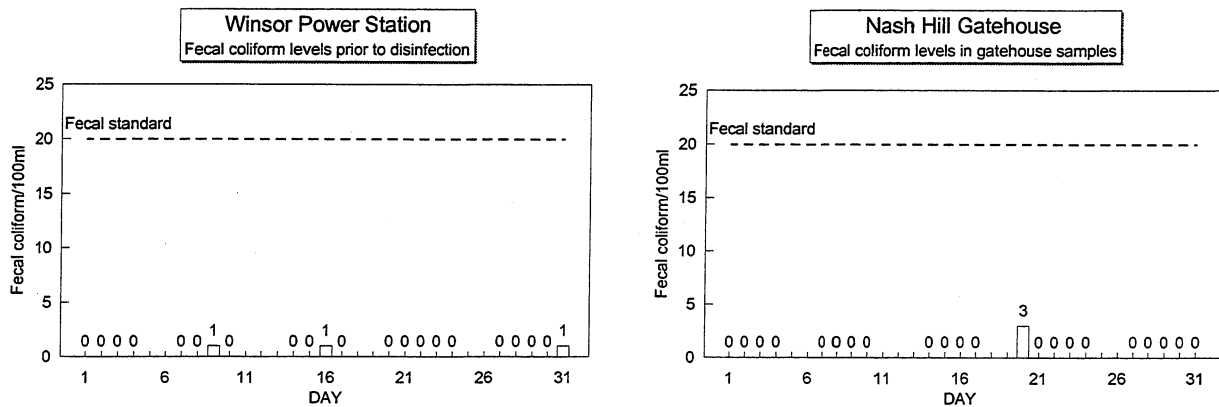
Quabbin Reservoir water is sampled at Winsor Power Station prior to chlorination and represents reservoir water entering the Chicopee Valley Aqueduct (CVA).

Samples from Nash Hill Reservoir are collected at a point where CVA water enters the gatehouse. Depending on whether the reservoir is filling or discharging, this sample may or may not contain a mix of aqueduct water with reservoir water. If the reservoir is filling, the sample will contain a chlorine residual from chlorination that occurs at Winsor Power Station.

The SDWA standard is that no more than 20 fecal coliform/100ml be present in 10% of samples over a 6-month period.

**Highlights**

Fecal coliform levels remained well below the standard at Winsor Power Station and at Nash Hill Reservoir.



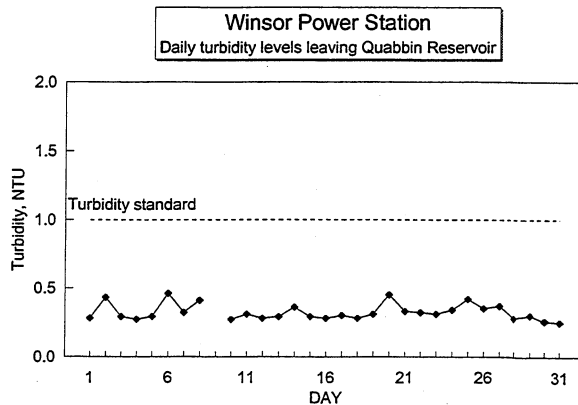
**SOURCE WATER - CHICOPEE VALLEY AQUEDUCT  
TURBIDITY LEVELS AT QUABBIN RESERVOIR (AS MEASURED AT  
WINSOR POWER STATION)  
OCTOBER 1997**

**Target**

Quabbin reservoir samples for turbidity are collected at Winsor Power Station prior to chlorination and represent reservoir water entering the CVA. The Massachusetts Department of Environmental Protection standard for source water turbidity is 1.0 NTU.

**Highlights**

Turbidity levels at Winsor Power Station have remained well below the DEP standard and averaged 0.32 NTU over the month.



**MWRA**

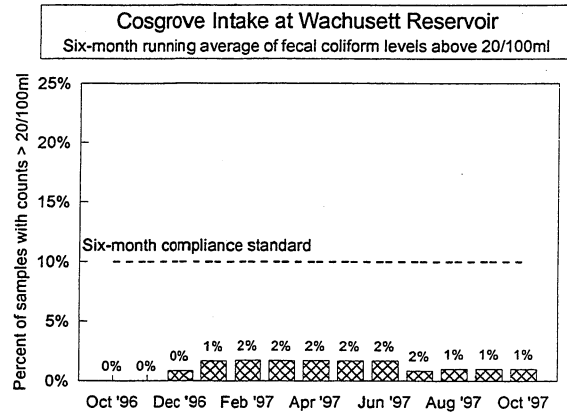
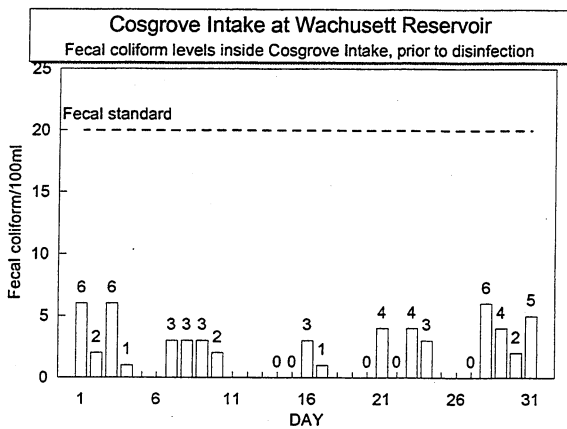
**SOURCE WATER  
FECAL COLIFORM LEVELS AT WACHUSETT RESERVOIR  
OCTOBER 1997**

**Target**

Samples from Wachusett Reservoir are collected at a location inside the Cosgrove Intake facility and represent water entering the Cosgrove Tunnel/Aqueduct. The Surface Water Treatment Rule (SWTR) standard of the SDWA for unfiltered surface supplies is that no more than 20 fecal coliform/100 ml be present in 10% of the samples over a 6-month period. The six month running average results present the percent of samples exceeding the standard during the previous 6 month period.

**Highlights**

Fecal coliform levels remained below the SDWA standards at Wachusett Reservoir.



**SOURCE WATER  
FECAL COLIFORMS IN NORUMBEGA RESERVOIR AND TURBIDITY  
LEVELS IN HULTMAN AQUEDUCT AT NORUMBEGA DISINFECTION  
FACILITY  
OCTOBER 1997**

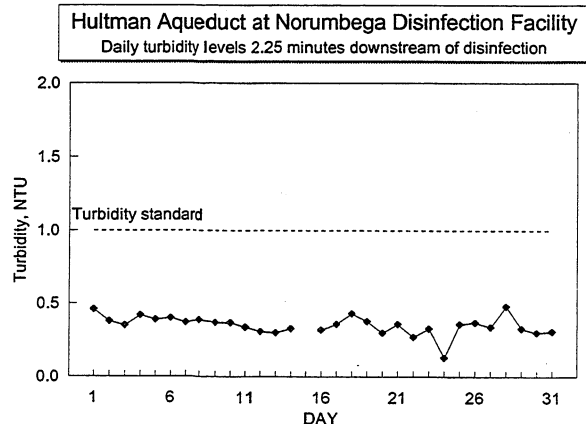
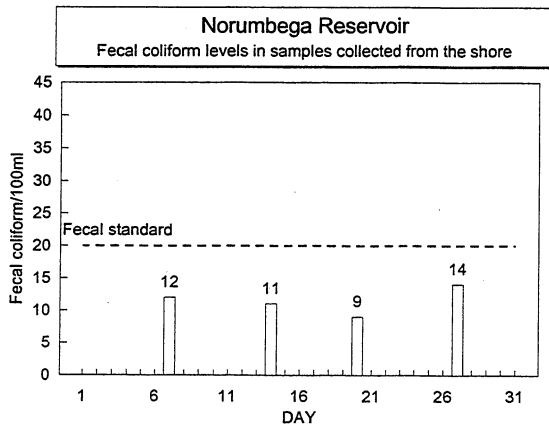
**Target**

Fecal coliform samples from Norumbega Reservoir are collected from the shore near the gatehouse. Flow from Norumbega Reservoir supplements flows from Wachusett Reservoir during periods of high demand. The SDWA standard is that no more than 20 fecal coliform/100 ml be present in 10% of the samples over a 6-month period.

Samples for turbidity are measured after chlorination in the Hultman Aqueduct. The Massachusetts Department of Environmental Protection standard for source water turbidity is 1.0 NTU.

**Highlights**

Fecal coliform levels remained well below the SDWA standard at Norumbega Reservoir. Turbidity levels in the aqueduct have remained well below the DEP standard and averaged 0.35 NTU over the month.



# MWRA

## TREATED WATER DISINFECTANT LEVELS IN HULTMAN AQUEDUCT AT NORUMBEGA DISINFECTION FACILITY AND COMMONWEALTH AVENUE PUMP STATION ( ENTRY POINT INTO CUSTOMER DISTRIBUTION SYSTEMS)

OCTOBER 1997

### Target

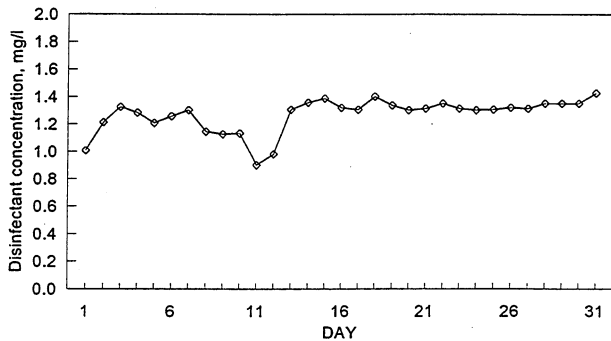
Disinfection at Norumbega Disinfection Facility has been improved to allow 3-8 minutes of contact time with free chlorine before adding ammonia. The chlorine:ammonia-N ratio has also been changed to 5:1 resulting in a more stable and longer lasting chlorine residual. The disinfectant inactivates bacteria that may be present in the water as it leaves the Wachusett and Norumbega Reservoirs.

Current plans are to increase the target residual at Commonwealth Avenue PS from 1.2 mg/l up to approximately 2.0 mg/l over the next several months.

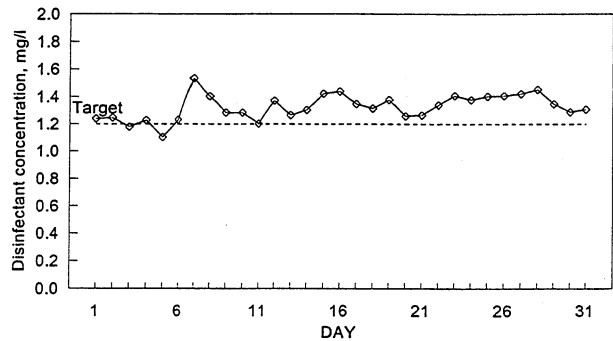
### Highlights

Free chlorine levels have averaged 1.3 mg/l 3-8 minutes downstream of disinfection. The total chlorine residual measured at Commonwealth Avenue Pumping Station, the entry point to customer distribution systems, has averaged 1.3 mg/l.

Hultman Aqueduct at Norumbega Disinfection Facility  
Free chlorine residual 3-8 minutes downstream of primary disinfection



Commonwealth Avenue Pump Station  
Total chlorine residual 2 hours downstream of primary disinfection



## TREATED WATER pH LEVELS AT COMMONWEALTH AVENUE PUMP STATION OCTOBER 1997

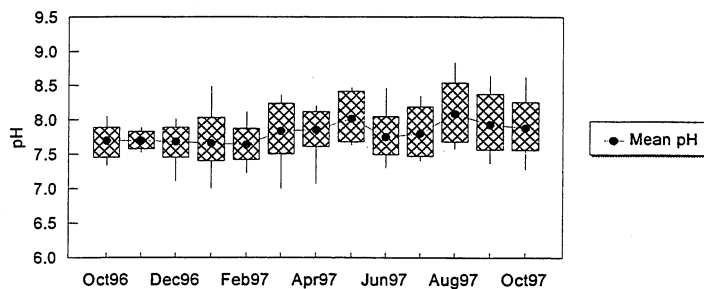
### Target

MWRA adjusts the alkalinity and pH of Wachusett water to reduce its corrosivity in order to minimize the leaching of lead and copper from service lines and home plumbing systems into the water. In June 1996, the Interim Corrosion Control (ICC) facility went on-line and is providing corrosion control to communities east of and including Marlborough. The target pH is 7.8 (target range between 7 and 8 pH units).

### Highlights

During the month, pH values ranged between 7.3 and 8.6. The average pH was 7.9.

Commonwealth Avenue Pump Station pH  
High, Low, 90th and 10th Percentile pH Values



**MWRA**  
**WATER QUALITY UPDATE FOR COMMUNITIES PARTICIPATING**  
**IN MWRA TESTING PROGRAM**  
**OCTOBER 1997**

**Target**

Thirty-two cities and towns use the MWRA Laboratory for Total Coliform Rule compliance testing. The communities collect samples for bacteriological analysis and measure chlorine residual at the time of collection. The other 14 MWRA customer communities have their samples tested elsewhere and these towns should be contacted directly for their results.

The SDWA requires that no more than 5% of all samples may be total coliform positive in a month (or no more than 1 positive when less than 40 samples are collected each month). Public notification is required if this standard is exceeded.

If E. coli are detected in a drinking water sample, this is considered evidence of a critical public health concern. Additional testing is conducted immediately and joint corrective action by DEP, MWRA, and the community are undertaken. Public notification is required if follow-up tests confirm the presence of E. coli or total coliform.

A disinfectant residual of 0.2 mg/l is considered a minimum target level at all points in the distribution system.

**Highlights**

During the month of October, thirty-one communities submitted samples with no coliform bacteria. One community had positive total coliform results. No E. coli were identified in any samples collected.

Twenty-one of the twenty-five communities submitting chlorine residual data maintained an average disinfectant residual of at least 0.2 mg/l. Twenty communities had 1 or more samples with a disinfectant residual of less than 0.2 mg/l.

TOWN	Samples Tested for Coliform (a)	Total Coliform % Positive	E. coli % Positive	Public Notification Required?	Average Chlorine Residual, mg/l	Minimum Chlorine Residual, mg/l
ARLINGTON	70				0.18	0.02
BELMONT	32				0.17	0.05
BOSTON	252				0.61	0.04
BROOKLINE	68				0.71	0.05
CHELSEA	32				0.27	0.20
EVERETT	40				0.47	0.05
FRAMINGHAM (b)	72					
LEXINGTON	36				0.39	0.10
LYNNFIELD (b)	17				0.26	0.10
MALDEN	60				0.23	0.00
MARBLEHEAD (b)	24				0.53	0.11
MEDFORD	68				0.26	0.00
MELROSE	36				0.25	0.05
MILTON	32				0.30	0.20
NAHANT (b)	10				0.17	0.05
NEEDHAM (b)	43					
NEWTON	88				0.31	0.06
NORWOOD	40				0.20	0.20
QUINCY	115				0.26	0.05
REVERE	52				0.24	0.10
SAUGUS	32				0.28	0.20
SOMERVILLE	100				0.17	0.10
SOUTHBOROUGH (b)	7					
STONEHAM	35				0.49	0.10
SWAMPSCOTT (b)	18					
WAKEFIELD (b)	55					
WALTHAM	81				0.54	0.20
WATERTOWN	50				0.24	0.10
WELLESEY (b)	42	4.8		No (c)		
WESTON (b)	12					
WINCHESTER (b)	20				0.45	0.1
WINTHROP	24				0.23	0.10
<b>TOTAL</b>	<b>1663</b>					

(a) The number of samples collected is dependent on the population served and the number of repeat samples required.

(b) These communities provide chlorination.

(c) Less than 5% total coliform positive, therefore public notification not required.

# MWRA

## SOURCE WATER FECAL COLIFORM LEVELS AT FELLS RESERVOIR OCTOBER 1997

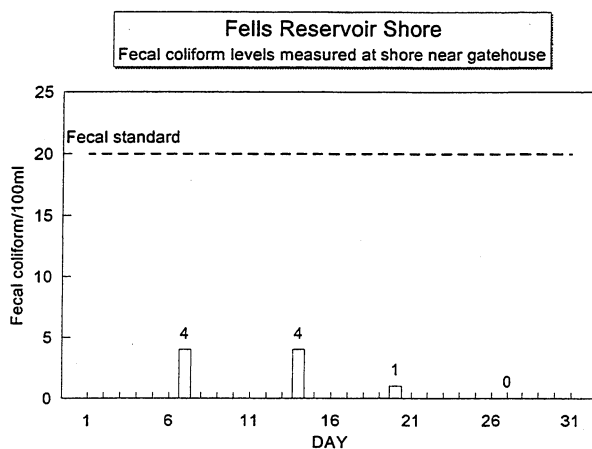
### Target

On September 29, 1997, MWRA discontinued use of Spot Pond. The new James L. Gillis Pump Station now repumps tunnel water to the Fells Reservoir and Bear Hill Standpipe service areas. This change significantly improves water quality by pumping chloraminated water to the area. Water leaving Fells Reservoir continues to require additional treatment (chlorination).

Fells Reservoir samples are collected from the shore at a point near the gatehouse. If Fells Reservoir is filling, samples may contain a chloramine residual from the treated water supplied by the James L. Gillis Pump Station. The SDWA standard is no more than 20 fecal coliform/100 ml be present in 10% of samples over a 6 month period.

### Highlights

Fecal coliform levels remained below the SDWA standard at Fells Reservoir throughout the month.



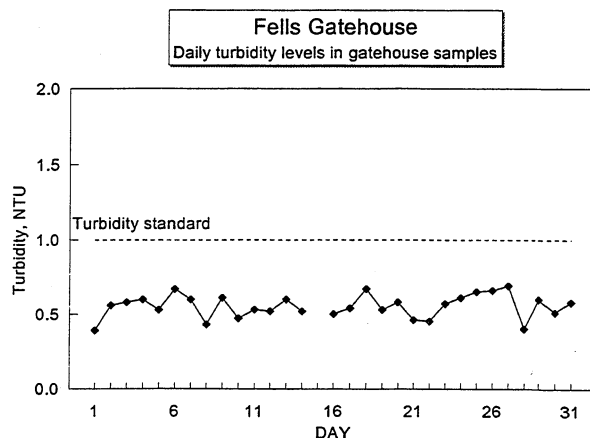
## SOURCE WATER TURBIDITY LEVELS AT FELLS RESERVOIR OCTOBER 1997

### Target

Fells Reservoir samples are collected in the gatehouse. The Massachusetts Department of Environmental Protection standard for source water turbidity is 1.0 NTU average for the month.

### Highlights

Turbidity levels at Fells Reservoir were variable during the month but did not exceed 1.0 NTU. Turbidity averaged 0.55 NTU over the month.



# MWRA

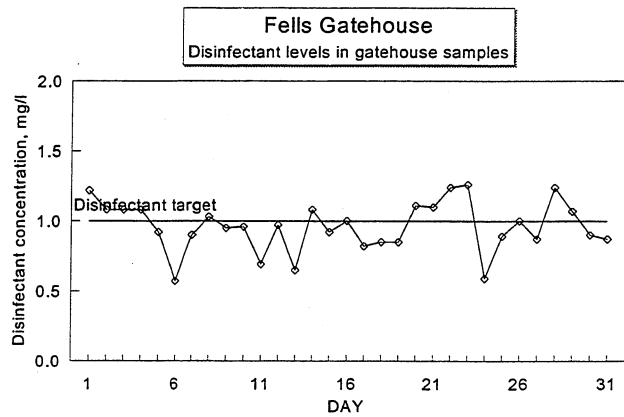
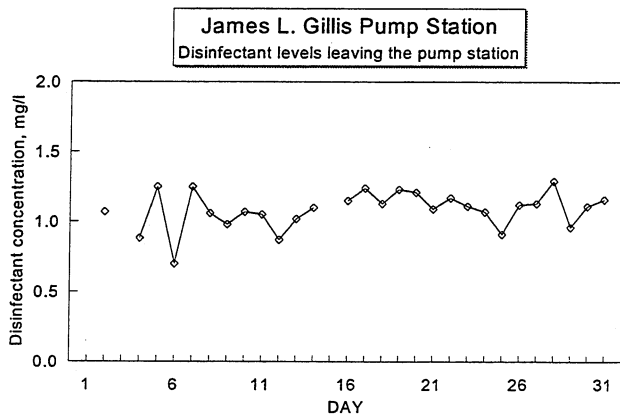
## TREATED WATER DISINFECTANT LEVELS AT FELLS RESERVOIR OCTOBER 1997

### Target

The Spot Pond Pump Station has been replaced by the new James L. Gillis Pump Station which now provides chloraminated tunnel water to the Spot Pond service area, significantly improving water quality to this area. Target chlorine levels are difficult to maintain at Fells Reservoir due to the type of chlorine feed equipment used and the highly variable flow at this location. Residuals are measured at a point immediately after disinfection.

### Highlights

Disinfectant residual levels at Gillis P.S. have been more stable than in the past because this station now pumps chloraminated tunnel water to the Fells and Bear Hill service area. Free chlorine is added to water as it leaves Fells Reservoir and levels are variable due to difficulty in obtaining representative samples at this location. The average chlorine residual leaving Gillis P.S. was 1.1 mg/l and for Fells Reservoir 1.0 mg/l.



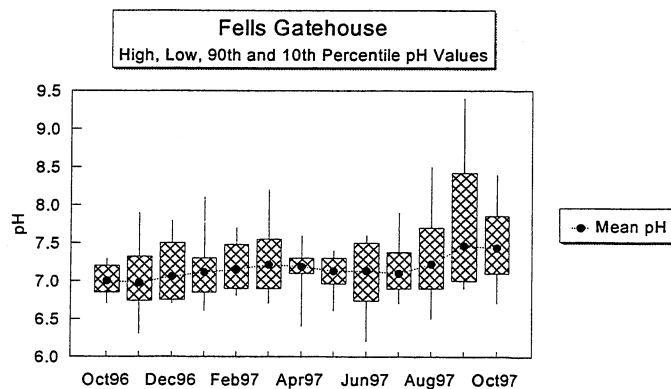
## TREATED WATER pH LEVELS AT FELLS RESERVOIR OCTOBER 1997

### Target

MWRA provides corrosion control at the ICC in Marlboro, however, the effects are not as pronounced or stable once the water leaves the open reservoir at Fells at the end of the MWRA system. Covered storage to replace the open Fells Reservoir is under construction and scheduled for completion in January 1999.

### Highlights

During the month of October, eighty percent of samples ranged between 7.1 and 7.9 at Fells Reservoir. The average pH was 7.4 pH units.





## A SPECIAL SUPPLEMENT TO THE NOVEMBER ISSUE OF THE WATER QUALITY UPDATE

*Relocation of Ammonia Feed at Norumbega Disinfection Facility.* In August, MWRA relocated the ammonia feed line to allow for a free chlorine residual to be in contact with the water for 3 - 8 minutes (depending on flows). This free chlorine contact time significantly improves primary disinfection. The addition of ammonia 3-8 minutes later provides a stable, longer-lasting chloramine residual that is maintained into community distribution systems. The chlorine to ammonia ratio has also been adjusted from 9:1 to 5:1. Many communities have observed higher residuals in the samples they collect routinely under the Total Coliform Rule (TCR). The October 1996 and 1997 total chlorine residuals for each community are presented on the reverse side. Communities that rechlorinate have been reevaluating their disinfection practices to minimize the occurrence of breakpoint chlorination, nitrification, and increased THM's. Recent THM results collected from seven locations in the MWRA service area indicate little or no increase in THM levels. The average THM level remains below 20 ug/l (the standard is currently set at 100 ug/l).

*Disinfection Improvements at Cosgrove Intake.* In September, MWRA began to apply free chlorine at Wachusett Reservoir (also known as Shaft A and Cosgrove Intake). Chlorine is currently added at very low doses in order to allow the system to adjust to this change. Initially, chlorine was added at 0.25 mg/l and this is now being increased by 0.1 mg/l per week. Currently (November 10, 1997), the dose is 0.45 mg/l. Four communities, Southborough, Framingham, Marlborough, and Weston are now supplied with water which has received some primary disinfection. As chlorine dosage increases, these communities will need to modify their rechlorination strategies in order to optimize disinfection and minimize formation of THM's. Because the water they receive has a long contact time with free chlorine, THM levels could increase. MWRA is working with these communities to adjust disinfection to make sure the THM levels are not increased above MCL's.

*James L. Gillis Pump Station at Spot Pond.* In October the James L. Gillis Pump Station went on-line for its 30 day test period. The results of the testing are being reviewed. The use of this new pump station allows for the use of Spot Pond water and associated chlorination facilities to be discontinued. The Spot Pond service area will now be supplied from Norumbega Disinfection facility. This should result in significant water quality improvements for Melrose, Saugus, Stoneham, Wakefield, Winchester, and Woburn. Close attention will be required in circumstances where the chloraminated water will be mixing with chlorinated supplies.

### Glossary:

**Breakpoint:** The addition of free chlorine to chloraminated water may result in the reduction in chlorine levels due to oxidation of the chloramines. The observation is that as more chlorine is added, a point is reached where instead of increasing the chlorine residual, the residual will decrease.

**Nitrification:** When chloramines are used for disinfection, the ammonia will, over time, dissociate from the chlorine. Excess ammonia in the system supports growth of bacteria that form nitrite from the ammonia. Nitrite has a very high chlorine demand, thereby reducing chlorine residuals. Nitrite also has been associated with adverse health effects. MWRA is monitoring the system to ensure nitrification is not occurring.

**THM's:** Trihalomethanes are a byproduct caused by the chlorination of water. The presence of high levels of trihalomethanes are thought to be associated with increased cancer risk. MWRA monitors THM levels on a routine basis. The use of chloramines minimizes the formation of THM's. Current levels are well below the DEP standard of 100 ug/l.

**MCL's:** Maximum Contaminant Levels. Certain compounds, including THM's, are regulated by DEP and must not exceed the MCL.

**COMMUNITY AVERAGE CHLORINE RESIDUALS,  
October 1996 and October 1997**

	1996	1997	% Change
ARLINGTON	0.22	0.18	-18%
BELMONT	0.1	0.17	70%
BOSTON	0.24	0.61	154%
BROOKLINE	0.23	0.71	209%
CHELSEA	0.15	0.27	80%
EVERETT	0.12	0.47	292%
FRAMINGHAM (b)			
LEXINGTON	0.17	0.39	129%
LYNNFIELD (b)	0.46	0.26	-43%
MALDEN	0.2	0.23	15%
MARBLEHEAD (b)	0.38	0.53	39%
MEDFORD	0.25	0.26	4%
MELROSE	0.21	0.25	19%
MILTON	0.33	0.3	-9%
NAHANT (b)	0.37	0.17	-54%
NEEDHAM (a)			
NEWTON	0.27	0.31	15%
NORWOOD	0.18	0.2	11%
QUINCY	0.14	0.26	86%
REVERE	0.11	0.24	118%
SAUGUS	0.2	0.28	40%
SOMERVILLE	0.12	0.17	42%
SOUTHBORO (b)			
STONEHAM	0.43	0.49	14%
SWAMPSCOTT (b)			
WAKEFIELD (a)			
WALTHAM	0.34	0.54	59%
WATERTOWN	0.12	0.24	100%
WELLESLEY (a)			
WESTON (b)			
WINCHESTER (a)	0.76	0.45	-41%
WINTHROP	0.14	0.23	64%

Samples collected by community samplers and reported to MWRA

(a) = partially supplied community

(b) = provide their own local rechlorination

Five communities, Arlington, Lynnfield, Milton, Nahant, and Winchester, have lower residuals in October 1997 than in October 1996. The remaining 20 communities show improved residuals. This improvement is most likely due to the changes in disinfection made at Norumbega disinfection facility; the ammonia feed line was relocated 1,800 ft downstream of chlorine addition, and the chlorine to ammonia-N ratio was adjusted to 5:1.

## FREQUENCY OF SOURCE WATER QUALITY SAMPLING PROGRAM

PARAMETER	MWRA SAMPLES
Total and Fecal coliform	daily at source reservoirs, weekly in distribution reservoirs
Turbidity	daily at source and distribution reservoirs
pH	daily at distribution reservoirs
Chemical analyses	periodically as required under SDWA
Radionuclides	as required, currently every five years

## FREQUENCY OF TREATED WATER QUALITY SAMPLING PROGRAM

PARAMETER	MWRA SAMPLES	COMMUNITY SAMPLES
Total coliform	weekly at select locations	frequency and number depends on population served
Disinfectant Residual	weekly at select locations	collected with total coliform samples
pH	weekly at select locations	

## FEDERAL SAFE DRINKING WATER ACT (SDWA)

The Surface Water Treatment Rule (SWTR) of the SDWA sets standards for unfiltered use of MWRA's source waters from the Quabbin and Wachusett Reservoirs. If such standards are not met, filtration could be required. The standards relate to coliform, turbidity, color, watershed protection, disinfection and monitoring, and the absence of waterborne disease outbreaks. Quabbin Reservoir has demonstrated compliance with the standards and has therefore been found to be exempt from the filtration requirement. A decision about filtration of Wachusett source water has been deferred until 1998 as part of the consideration of treatment process technology at the new MWRA treatment plant to be constructed at Walnut Hill.

Customer communities must also meet certain standards under the SDWA concerning distribution of treated drinking water. The Total Coliform Rule (TCR) helps to alert the local water suppliers to possible local distribution system issues as well as the adequacy of residual disinfection. MWRA provides testing services for many of the communities, and tests over 1500 samples per month. Under the SDWA, a violation of the TCR occurs when greater than 5% of the samples are positive for total coliform.

## DISINFECTANT RESIDUAL

The effectiveness of disinfection is calculated by determining the length of time water is in contact with a specific dosage of disinfectant. This calculated value is commonly called CT (Concentration multiplied by Time) and is derived mathematically from assumptions about the residual disinfectant dosage in the water as it reaches the user multiplied by the travel time from the point of application of the disinfectant.

The required CT to provide target inactivation varies somewhat due to ambient pH or temperature conditions, as well as the strength of the disinfectant, *e.g.* free chlorine has greater pathogen inactivation properties than chloramines in the same concentration. The calculated CT of the disinfection system is then compared to the required values necessary to achieve the desired level of inactivation of key pathogens such as bacteria, viruses, and protozoa. In this classification of pathogens, bacteria are the most prevalent

and are the first focus of disinfection. Fortunately, harmful bacteria are relatively easily inactivated by chlorination. Viruses are more resistant to chlorination. *Giardia* and *cryptosporidium* are examples of pathogenic protozoa that are particularly difficult to inactivate using normal dosages of chlorine but are less commonly found in source waters.

The reduction of residual disinfectant levels within a pipeline system is affected by a variety of factors including temperature, presence of organic matter in

the water or on the pipe surface and corrosion of the pipe surface. For residual disinfection, MWRA uses a chlorine-ammonia combination to form chloramines, a longer-lasting residual disinfectant than free chlorine alone. The level of the residual disinfectant is measured throughout the distribution system using a colorimetric test by which a color change in the sample is compared to a color chart in order to estimate the disinfectant concentration within a reasonable degree of accuracy.

## GLOSSARY

**CHLORINATION:** Disinfection by adding chlorine.

**CHLORAMINATION:** Disinfection by adding a mixture of chlorine and ammonia.

**COLIFORM BACTERIA:** Group of bacteria that indicate the possibility of contamination in a water supply. A subclass of the coliform group, fecal coliform bacteria, indicate possible contamination from intestinal sources.

**CORROSION CONTROL FACILITY:** Water quality facility that helps to stabilize both the water's pH and alkalinity by adding soda ash and carbon dioxide.

**CRYPTOSPORIDIUM:** Microscopic protozoa which, when ingested, can result in diarrhea and other flu-like symptoms.

**ESCHERICHIA COLI (E. COLI):** A bacterium that is a primary indicator of fecal contamination in a water supply. *E. coli* is a member of the coliform group of bacteria.

**GIARDIA LAMBLIA:** Microscopic protozoa which, when ingested, can result in diarrhea and other flu-like symptoms.

**NTU:** Nephelometric turbidity unit. A standard measure of turbidity in a water sample.

**PATHOGENS:** Disease-causing organisms.

**RESERVOIR:** A natural or man-made basin where water is collected and stored in large quantities before being supplied to a community.

**SAFE DRINKING WATER ACT (SDWA):** Federal drinking water quality regulations.

**TOTAL COLIFORM RULE (TCR):** SDWA standard that limits the level of total coliform positive results allowed each month in a community.

**TURBIDITY:** Measure of the particulate matter in a water sample.

## MWRA WATER SUPPLY AND TREATMENT

To view the level of treatment your water has received, locate your community on the chart.

