



# Massachusetts Water Resources Authority

APRIL 15, 1997

## WATER QUALITY UPDATE

An analysis of March, 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 bac-

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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**.

teria," are indicators of possible intestinal contamination. *Escherichia coli* (*E. coli*) is a specific coliform 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 Spot Pond and Fells Reservoirs, 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 FECAL COLIFORM LEVELS AT QUABBIN (AS MEASURED AT WINSOR POWER STATION) AND NASH HILL RESERVOIRS

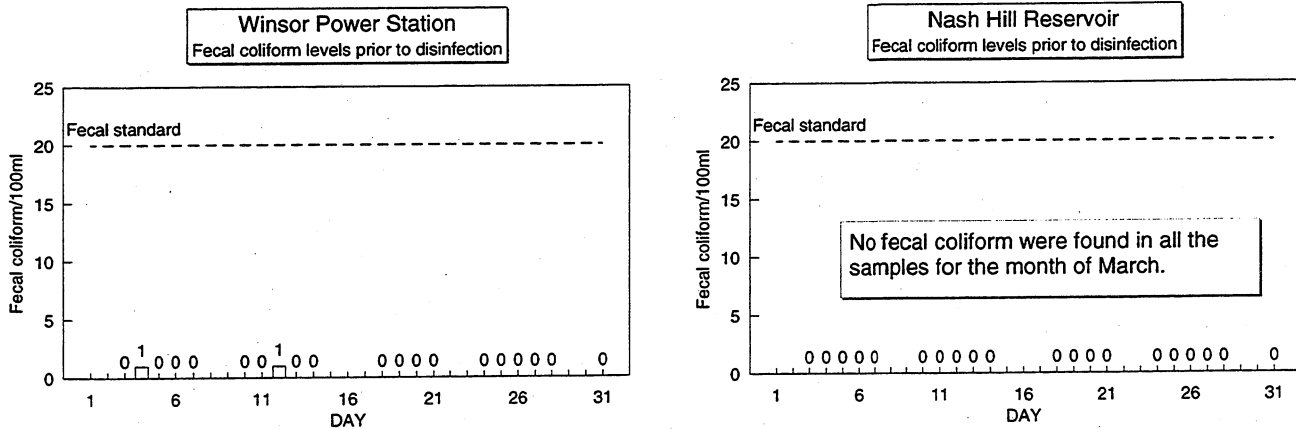
March 1997

### Target

Quabbin Reservoir water is sampled at Winsor Power Station. Samples from Nash Hill Reservoir are collected as the water enters the Chicopee Valley Aqueduct. These samples measure the extent of fecal contamination in the reservoirs. 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. No fecal coliform were present in samples collected from Nash Hill Reservoir throughout the month.



## SOURCE WATER TURBIDITY LEVELS AT QUABBIN RESERVOIR (AS MEASURED AT WINSOR POWER STATION)

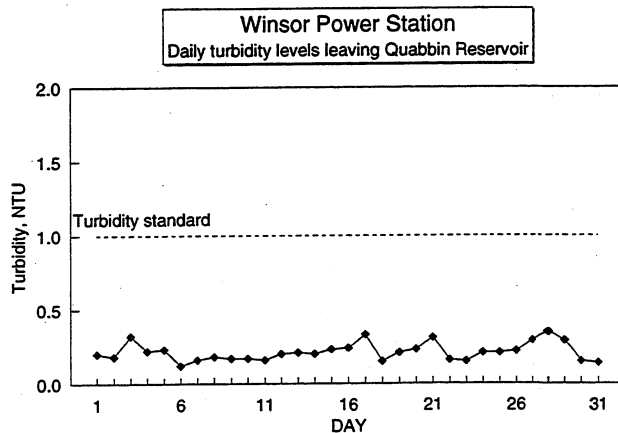
March 1997

### Target

Quabbin reservoir samples for turbidity are collected at Winsor Power Station. 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 0.21 NTU over the month.



**MWRA**

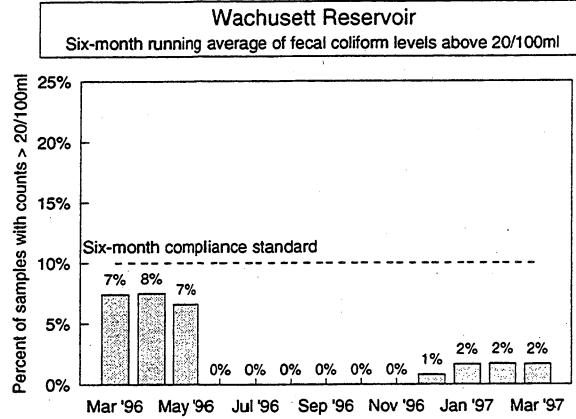
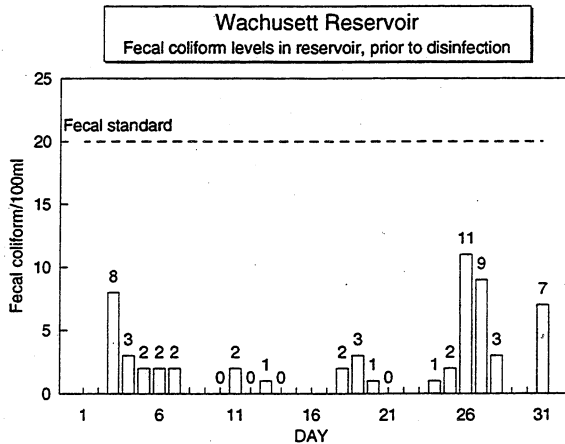
**SOURCE WATER  
FECAL COLIFORM LEVELS AT WACHUSETT RESERVOIR  
March 1997**

**Target**

Samples from Wachusett Reservoir are collected before chlorination as water enters the aqueduct. These samples measure the extent of fecal contamination in the reservoir. 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 have remained well below the SDWA standard at Wachusett Reservoir.



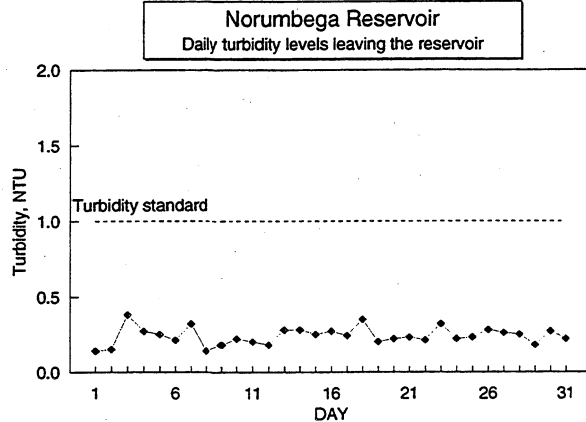
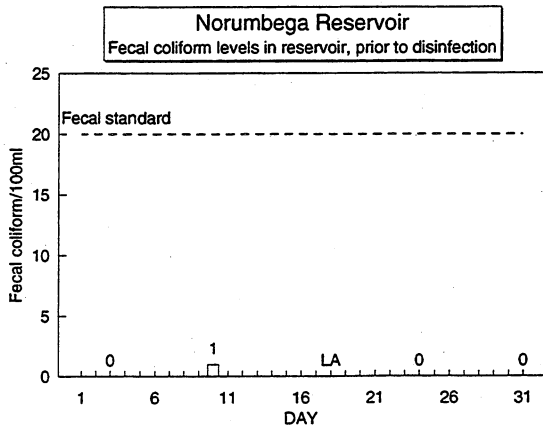
**SOURCE WATER  
FECAL COLIFORMS AND TURBIDITY LEVELS AT NORUMBEGA RESERVOIR  
March 1997**

**Target**

Samples from Norumbega Reservoir are collected from the reservoir itself before chlorination. These samples measure the extent of fecal contamination in the reservoir. 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 as the water leaves the reservoir. 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 in samples collected from Norumbega Reservoir. Turbidity levels at Norumbega have remained well below the DEP standard and averaged 0.24 NTU over the month.



LA = lab accident, no result

## MWRA

### TREATED WATER DISINFECTANT LEVELS AT NORUMBEGA RESERVOIR AND COMMONWEALTH AVENUE PUMP STATION ( ENTRY POINT INTO CUSTOMER DISTRIBUTION SYSTEMS)

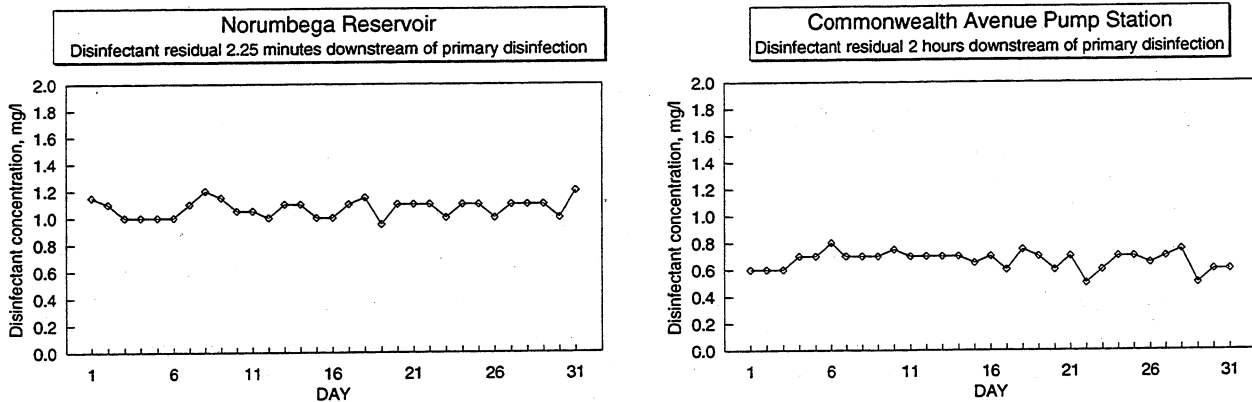
March 1997

#### Target

A primary disinfectant dosage of 1.2 mg/l is added to disinfect the source water. The disinfectant inactivates bacteria that may be present in the water as it leaves the Wachusett and Norumbega Reservoirs. The residual disinfectant is measured 2.25 minutes downstream of Norumbega Reservoir and two hours downstream of disinfection at Commonwealth Avenue Pumping Station in Newton, the first entry point into a customer distribution system.

#### Highlights

Disinfectant levels at Norumbega Reservoir have been at acceptable levels throughout the month, averaging 1.07 mg/l. The disinfectant residual as measured at Commonwealth Avenue Pumping Station provides an acceptable level of disinfectant as it enters customer distribution systems, averaging 0.67 mg/l.



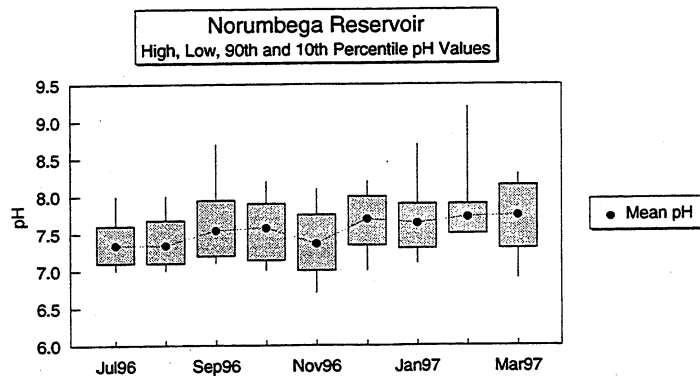
### TREATED WATER pH LEVELS AT NORUMBEGA RESERVOIR March 1997

#### 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 the optimal corrosion control now achievable to communities east of and including Marlborough. The target pH is between 7 and 8 pH units.

#### Highlights

During the month of March, pH levels ranged between 6.9 to 8.3 and averaged 7.7. Eighty percent of samples ranged between 7.3 to 8.2 pH units.



**MWRA**  
**WATER QUALITY UPDATE FOR COMMUNITIES PARTICIPATING**  
**IN MWRA TESTING PROGRAM**  
 March 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 March, all thirty-two communities submitted samples with no coliform bacteria. Fourteen of the twenty-five communities submitting chlorine residual data maintained an average disinfectant residual of at least 0.2 mg/l. Twenty-three 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        | 56                              |                           |                    |                               | 0.15                            | 0.00                            |
| BELMONT          | 40                              |                           |                    |                               | 0.11                            | 0.10                            |
| BOSTON           | 238                             |                           |                    |                               | 0.42                            | 0.03                            |
| BROOKLINE        | 68                              |                           |                    |                               | 0.36                            | 0.10                            |
| CHELSEA          | 40                              |                           |                    |                               | 0.18                            | 0.10                            |
| EVERETT          | 50                              |                           |                    |                               | 0.18                            | 0.10                            |
| FRAMINGHAM (b)   | 80                              |                           |                    |                               |                                 |                                 |
| LEXINGTON        | 45                              |                           |                    |                               | 0.21                            | 0.10                            |
| LYNNFIELD (b)    | 14                              |                           |                    |                               | 0.29                            | 0.04                            |
| MALDEN           | 75                              |                           |                    |                               | 0.18                            | 0.00                            |
| MARBLEHEAD (b)   | 24                              |                           |                    |                               | 0.36                            | 0.15                            |
| MEDFORD          | 68                              |                           |                    |                               | 0.21                            | 0.00                            |
| MELROSE          | 45                              |                           |                    |                               | 0.22                            | 0.10                            |
| MILTON           | 32                              |                           |                    |                               | 0.31                            | 0.20                            |
| NAHANT (b)       | 10                              |                           |                    |                               | 0.47                            | 0.10                            |
| NEEDHAM (b)      | 43                              |                           |                    |                               |                                 |                                 |
| NEWTON           | 88                              |                           |                    |                               | 0.30                            | 0.08                            |
| NORWOOD          | 50                              |                           |                    |                               | 0.18                            | 0.10                            |
| QUINCY           | 92                              |                           |                    |                               | 0.18                            | 0.10                            |
| REVERE           | 52                              |                           |                    |                               | 0.14                            | 0.10                            |
| SAUGUS           | 32                              |                           |                    |                               | 0.21                            | 0.10                            |
| SOMERVILLE       | 80                              |                           |                    |                               | 0.15                            | 0.10                            |
| SOUTHBOROUGH (b) | 7                               |                           |                    |                               |                                 |                                 |
| STONEHAM         | 28                              |                           |                    |                               | 0.60                            | 0.01                            |
| SWAMPSCOTT (b)   | 18                              |                           |                    |                               | 0.14                            | 0.05                            |
| WAKEFIELD (b)    | 43                              |                           |                    |                               |                                 |                                 |
| WALTHAM          | 65                              |                           |                    |                               | 0.39                            | 0.20                            |
| WATERTOWN        | 40                              |                           |                    |                               | 0.24                            | 0.10                            |
| WELLESEY (b)     | 36                              |                           |                    |                               |                                 |                                 |
| WESTON (b)       | 14                              |                           |                    |                               |                                 |                                 |
| WINCHESTER (b)   | 20                              |                           |                    |                               |                                 |                                 |
| WINTHROP         | 24                              |                           |                    |                               | 0.18                            | 0.10                            |
| <b>TOTAL</b>     | <b>1617</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.

# MWRA

## SOURCE WATER

### FECAL COLIFORM LEVELS AT SPOT POND AND FELLS RESERVOIRS

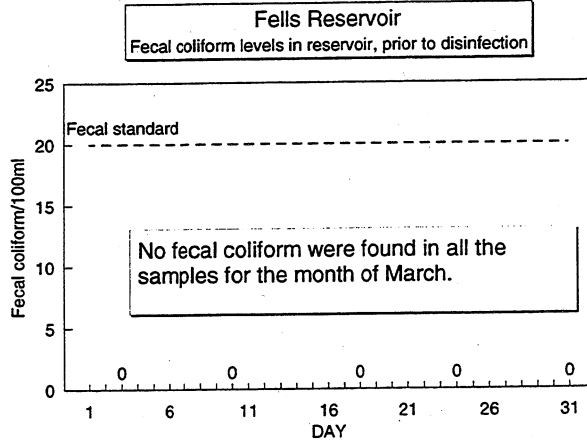
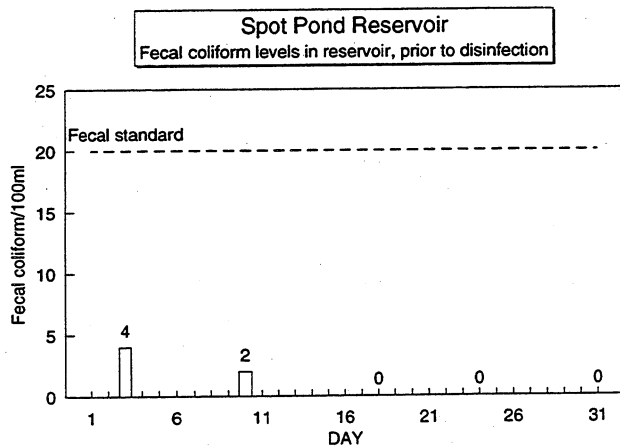
March 1997

#### Target

Samples from Spot Pond and Fells Reservoirs are collected in the reservoirs, prior to disinfection, to measure the extent and level of fecal contamination. The SDWA standard is that no more than 20 fecal coliform/100 ml be present in 10% of samples over a 6-month period.

#### Highlights

Fecal coliform levels have remained below the SDWA standard at Spot Pond Reservoir throughout the month. No fecal coliform were present in samples collected from Fells Reservoir.



## SOURCE WATER

### TURBIDITY LEVELS AT SPOT POND AND FELLS RESERVOIRS

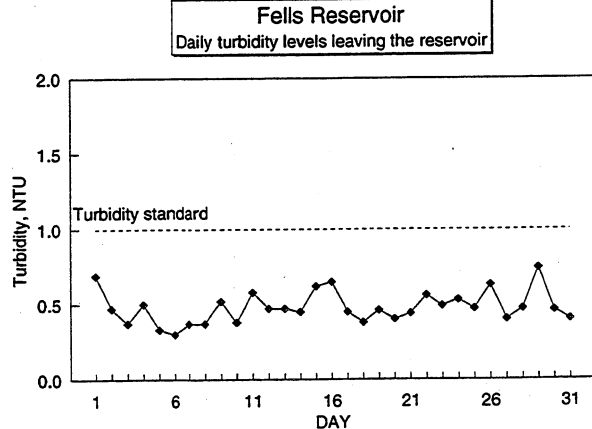
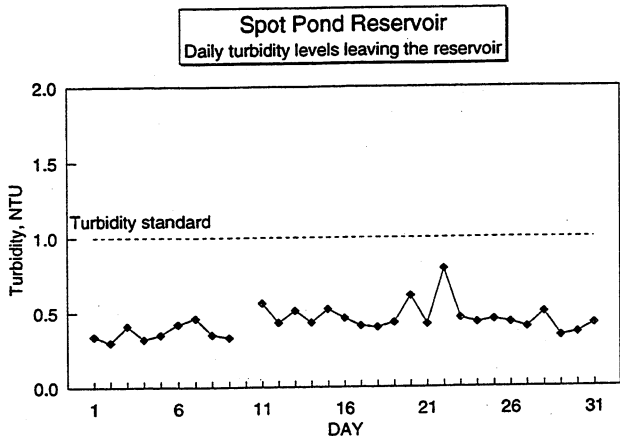
March 1997

#### Target

Turbidity values are highly variable at Spot Pond and Fells Reservoirs due to variability in water flow. Measurements are taken at a point immediately after the water leaves the reservoir. The Massachusetts Department of Environmental Protection standard for source water turbidity is 1.0 NTU.

#### Highlights

Turbidity levels at Spot Pond and Fells Reservoirs were variable but did not exceed the DEP standard. Spot Pond turbidity averaged 0.43 NTU and Fells Reservoir averaged 0.48 NTU over the month.



# MWRA

## TREATED WATER DISINFECTANT LEVELS AT SPOT POND AND FELLS RESERVOIRS

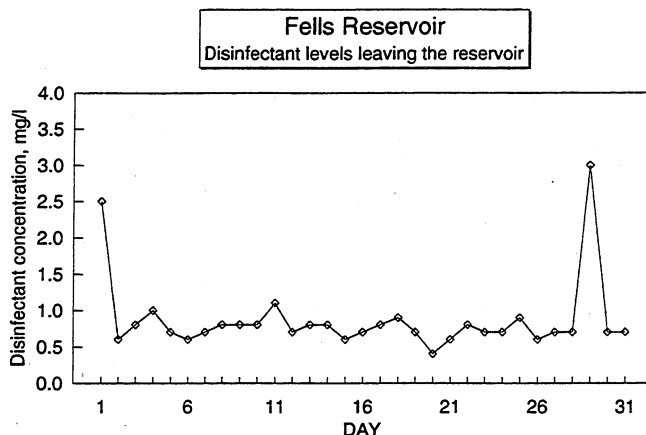
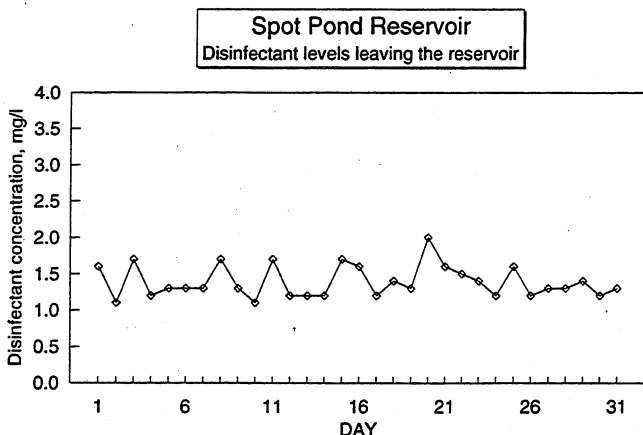
March 1997

### Target

Target disinfectant residual levels at Spot Pond and Fells Reservoirs are normally 1.0 mg/l although higher levels may be desired depending upon water temperature, presence of fecal coliform, or changing local conditions. Target levels are difficult to maintain due to the type of chlorine feed equipment used and the highly variable flow at these locations. Residuals are measured at a point immediately after disinfection.

### Highlights

Disinfectant residual levels at Spot Pond and Fells Reservoirs were highly variable throughout the month. Satisfactory residuals were maintained at all times.



## TREATED WATER pH LEVELS AT SPOT POND AND FELLS RESERVOIRS

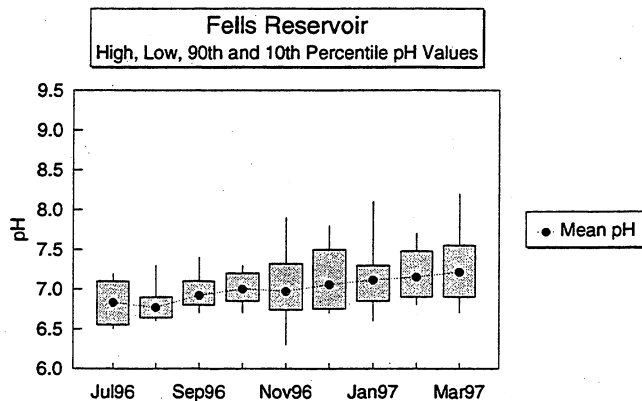
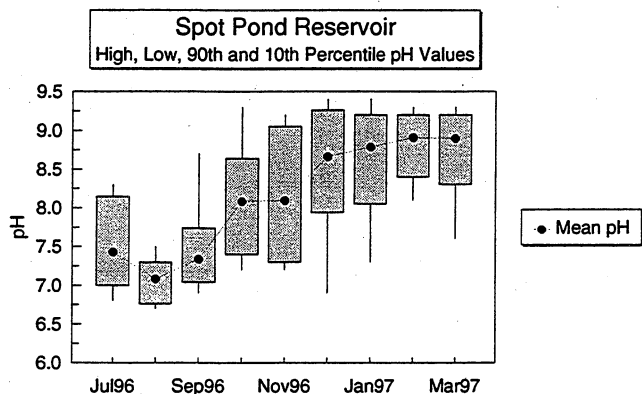
March 1997

### Target

The water MWRA supplies is monitored and adjusted to reduce corrosivity in order to minimize the leaching of lead and copper from service lines and home plumbing systems into the water. The target pH is between 7 and 8 pH units.

### Highlights

pH levels are variable at these locations. During the month of March, eighty percent of samples ranged between 8.3 and 9.2 pH units at Spot Pond Reservoir, and between 6.9 and 7.6 at Fells Reservoir. The average pH at Spot Pond was 8.9 and for Fells was 7.2 pH units.





## 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.

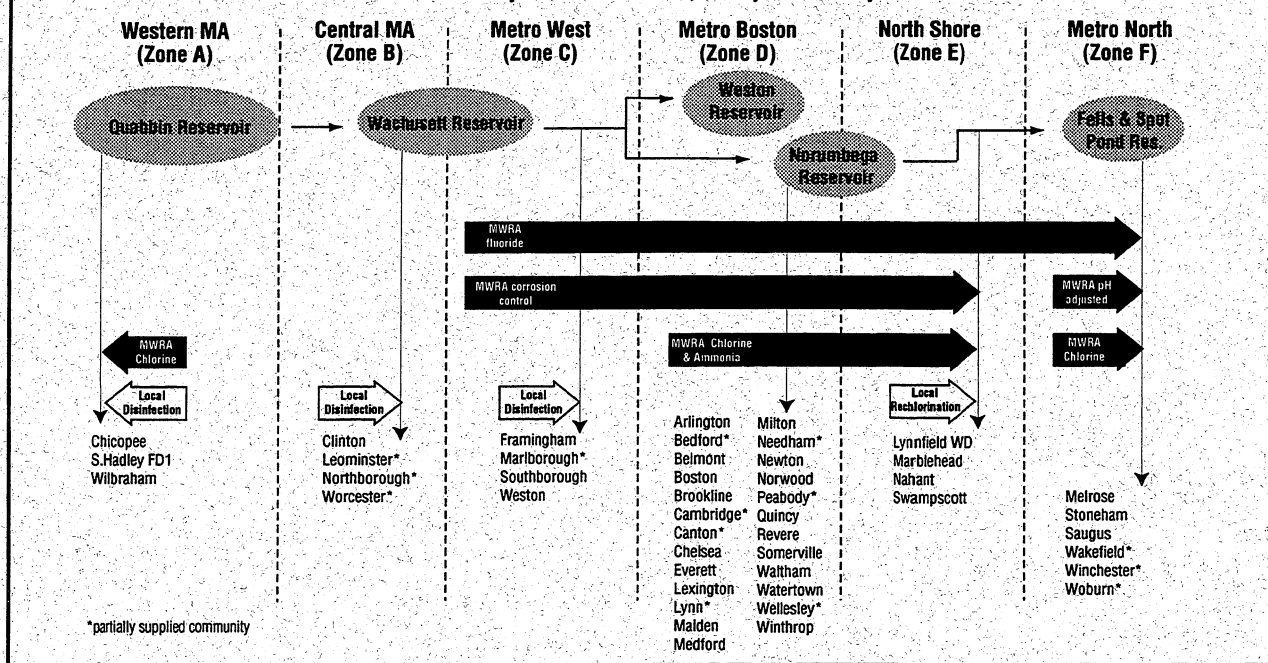
**SAFE DRINKING WATER ACT (SDWA):** Federal drinking water quality regulations.

**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.



Prepared under the direction of:  
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