



DECEMBER 20 1997

WATER QUALITY UPDATE

An Analysis of November, 1997 Sampling Data.

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November, 1997 Sampling Data pp. A-F
Special Supplement: Lab Results for Total Organic Carbon & a Comparison of Community Chlorine Residuals

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 CO₂ (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.

**A SPECIAL SUPPLEMENT TO THE DECEMBER 1997 ISSUE OF THE
WATER QUALITY UPDATE**

In this special supplement, laboratory results for total organic carbon and a comparison of community chlorine residuals (on the back of this page) are reported.

Total organic carbon (TOC) is a measure of the organic material present in the water. Organics are a concern because of the potential for formation of disinfection byproducts and regrowth of bacteria. The addition of chlorine for disinfection results in the formation of disinfection by-products, including trihalomethanes (THM's), which may be of health concern due to their association with increased cancer risk. Organic compounds also support the growth of bacteria in the water distribution system. These bacteria may present health risks, although the risks are uncertain.

There is no regulation for TOC, however EPA has initiated a program to look at the effectiveness of various treatment strategies to reduce levels of TOC. The Information Collection Rule (ICR) requires monthly monitoring of TOC levels in non-disinfected source water. Water systems with "low" TOC levels in their raw water (annual average less than 4.0 mg/l), are exempt from conducting these treatment studies. Water systems with "high" TOC levels must conduct treatment studies to remove TOC. The results of these studies will assist EPA in developing regulations for TOC.

MWRA collected monthly samples at Norumbega Gatehouse, Shaft 4, or Cosgrove Intake. These locations supplied non-disinfected water from Wachusett Reservoir. TOC levels are typically very low in the MWRA water system, and the annual average, based on the twelve samples collected from September 1996 through September 1997, was 2.56 mg/l. Because the average is below 4.0 mg/l, MWRA is not required to conduct a treatment study under the ICR.

| DATE* | TOC Result, mg/l |
|--------------------|-------------------------|
| September 27, 1996 | 2.30 |
| October 23, 1997 | 2.25 |
| November 21, 1996 | 2.15 |
| December 19, 1996 | 2.45 |
| January 30, 1997 | 2.85 |
| February 21, 1997 | 3.20 |
| March 20, 1997 | 3.25 |
| April 17, 1997 | 2.50 |
| May 8, 1997 | 2.70 |
| July 15, 1997 | 2.55 |
| August 6, 1997 | 2.45 |
| September 17, 1997 | 2.10 |
| Average | 2.56 |

* From September through October 1996, samples were collected at Norumbega Gatehouse. From November 1996 to August 1997, samples were collected from Shaft 4. The September 1997 sample was collected from Cosgrove Intake. No sample was collected in June 1997; an extra sample was collected in September 1997 to make up for this missing sample.

COMMUNITY AVERAGE TOTAL CHLORINE RESIDUALS
November 1996 and November 1997

| | 1996 | 1997 | % Change |
|----------------|------|------|----------|
| ARLINGTON | 0.11 | 0.33 | 200% |
| BELMONT | 0.10 | 0.25 | 150% |
| BOSTON | 0.29 | 0.90 | 210% |
| BROOKLINE | 0.30 | 0.89 | 197% |
| CHELSEA | 0.14 | 0.27 | 93% |
| EVERETT | 0.16 | 0.54 | 238% |
| FRAMINGHAM (b) | | | |
| LEXINGTON | 0.21 | 0.62 | 195% |
| LYNNFIELD (b) | 0.39 | 0.43 | 10% |
| MALDEN | 0.20 | 0.21 | 5% |
| MARBLEHEAD (b) | 0.39 | 0.66 | 69% |
| MEDFORD | 0.21 | 0.23 | 10% |
| MELROSE | 0.21 | 0.25 | 19% |
| MILTON | 0.28 | 0.29 | 4% |
| NAHANT (b) | 0.11 | 0.16 | 45% |
| NEEDHAM (a) | | | |
| NEWTON | 0.31 | 0.40 | 29% |
| NORWOOD | 0.18 | 0.20 | 11% |
| QUINCY | 0.25 | 0.38 | 52% |
| REVERE | 0.11 | 0.23 | 109% |
| SAUGUS | 0.20 | 0.28 | 40% |
| SOMERVILLE | 0.14 | 0.16 | 14% |
| SOUTHBORO (b) | | | |
| STONEHAM | 0.46 | 0.76 | 65% |
| SWAMPSCOTT (b) | 0.02 | | |
| WAKEFIELD (a) | 0.39 | | |
| WALTHAM | 0.35 | 0.73 | 109% |
| WATERTOWN | 0.12 | 0.24 | 100% |
| WELLESLEY (a) | | | |
| WESTON (b) | | | |
| WINCHESTER (a) | 0.84 | 0.26 | -69% |
| WINTHROP | 0.14 | 0.25 | 79% |

Samples collected by community samplers and reported to MWRA

(a) = partially supplied community

(b) = provide their own local rechlorination

Twenty-four of the twenty-five communities reporting on their chlorine residuals show improved levels. 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.

Only one community, Winchester, has lower residuals in November 1997 than in November 1996. This change has been intentional by the community as they optimize their new treatment plant operations. They have reduced their chlorine additions to obtain a target residual of approximately 0.2 mg/l in their system.

See the Supplement in the November issue of the Update for information concerning recent disinfection improvements by MWRA.

MWRA

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

November 1997

Target

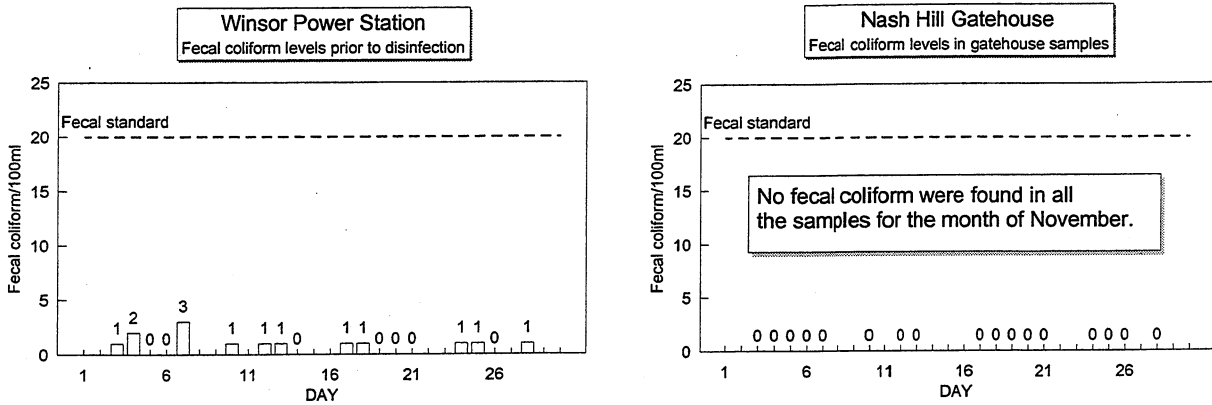
Quabbin Reservoir water is sampled at Winsor Power Station prior to chlorination and represents reservoir water entering the Chicopee Valley Aqueduct (CVA).

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. No fecal coliform were detected at Nash Hill Reservoir.



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

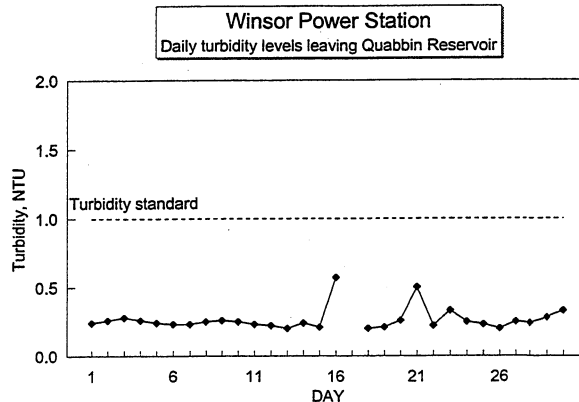
November 1997

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 0.26 NTU over the month.



MWRA

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

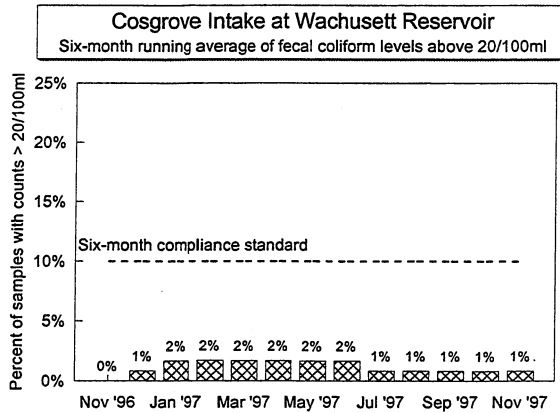
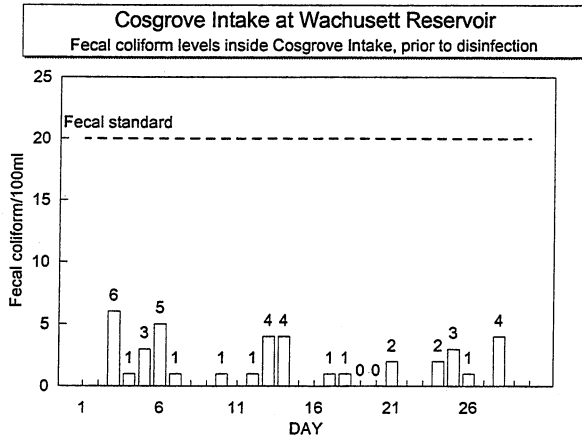
November 1997

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**

November 1997

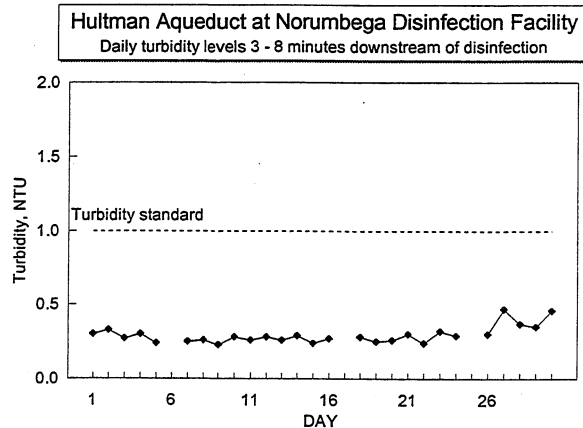
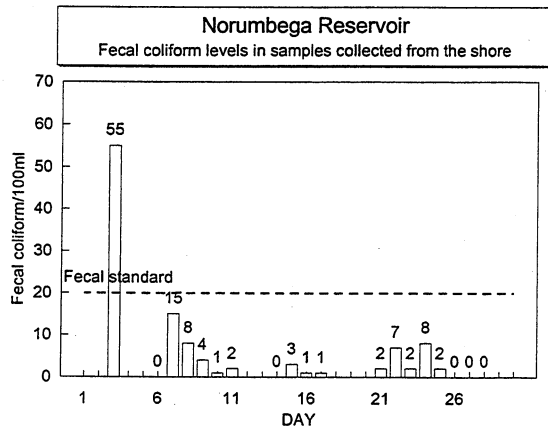
Target

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, except on one occasion. On November 3, fecal levels were 55 CFU/100 ml. Turbidity levels in the aqueduct have remained well below the DEP standard and averaged 0.29 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)

November 1997

Target

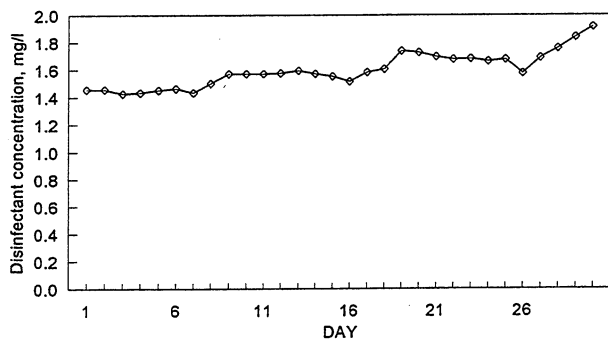
Disinfection at Norumbega Disinfection Facility has been improved to allow 3-8 minutes of contact time with free chlorine before adding ammonia. The chlorine:ammonia-N ratio has also been changed to 5:1 resulting in a more stable and longer lasting chlorine residual. The disinfectant inactivates bacteria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

The target residual at Commonwealth Avenue Pump Station is being slowly increased to reach a final target of between 2.0 to 2.5 mg/l Cl₂ over the next several months.

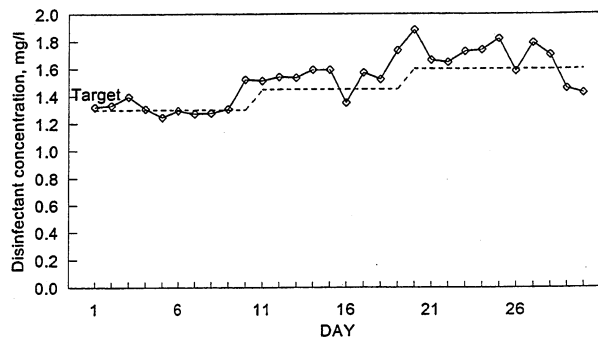
Highlights

Free chlorine levels have averaged 1.5 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 1.5 mg/l over the month.

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

November 1997

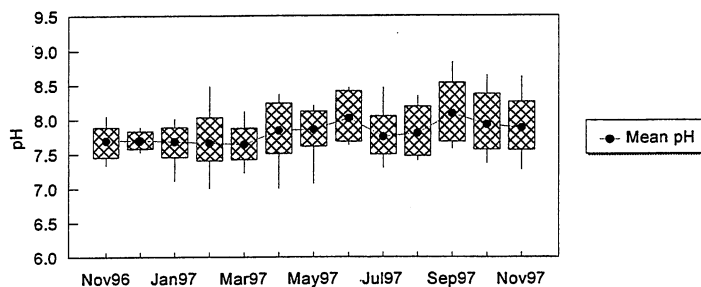
Target

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 7.2 and 8.1. The average pH was 7.8.

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



MWRA
WATER QUALITY UPDATE FOR COMMUNITIES PARTICIPATING
IN MWRA TESTING PROGRAM
 November 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 November, thirty-two communities submitted samples with no coliform bacteria. No positive total coliform were identified in any samples. No E. coli were identified in any samples collected.

Twenty-three of the twenty-five communities submitting chlorine residual data maintained an average disinfectant residual of at least 0.2 mg/l. Twenty-one communities had 1 or more samples with a disinfectant residual of less than 0.2 mg/l. During the colder weather, when coliform occurrences are down, MWRA is slowly increasing chlorine residuals in the system in an effort to minimize coliform positive samples next summer. Chlorine residuals have improved significantly in most communities.

| 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 | | | | 0.33 | 0.02 |
| BELMONT | 32 | | | | 0.25 | 0.05 |
| BOSTON | 224 | | | | 0.90 | 0.05 |
| BROOKLINE | 68 | | | | 0.89 | 0.05 |
| CHELSEA | 32 | | | | 0.27 | 0.20 |
| EVERETT | 40 | | | | 0.54 | 0.05 |
| FRAMINGHAM (b) | 72 | | | | | |
| LEXINGTON | 36 | | | | 0.62 | 0.10 |
| LYNNFIELD (b) | 14 | | | | 0.43 | 0.10 |
| MALDEN | 60 | | | | 0.21 | 0.00 |
| MARBLEHEAD (b) | 24 | | | | 0.66 | 0.09 |
| MEDFORD | 68 | | | | 0.23 | 0.00 |
| MELROSE | 36 | | | | 0.25 | 0.05 |
| MILTON | 32 | | | | 0.29 | 0.10 |
| NAHANT (b) | 10 | | | | 0.16 | 0.05 |
| NEEDHAM (b) | 43 | | | | | |
| NEWTON | 87 | | | | 0.40 | 0.06 |
| NORWOOD | 40 | | | | 0.20 | 0.20 |
| QUINCY | 92 | | | | 0.38 | 0.05 |
| REVERE | 52 | | | | 0.23 | 0.10 |
| SAUGUS | 32 | | | | 0.28 | 0.20 |
| SOMERVILLE | 80 | | | | 0.16 | 0.10 |
| SOUTHBOROUGH (b) | 7 | | | | | |
| STONEHAM | 28 | | | | 0.76 | 0.10 |
| SWAMPSCOTT (b) | 18 | | | | | |
| WAKEFIELD (b) | 44 | | | | | |
| WALTHAM | 66 | | | | 0.73 | 0.20 |
| WATERTOWN | 40 | | | | 0.24 | 0.10 |
| WELLESEY (b) | 36 | | | | | |
| WESTON (b) | 12 | | | | | |
| WINCHESTER (b) | 20 | | | | 0.26 | 0.03 |
| WINTHROP | 24 | | | | 0.25 | 0.10 |
| TOTAL | 1525 | | | | | |

(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 FELLS RESERVOIR

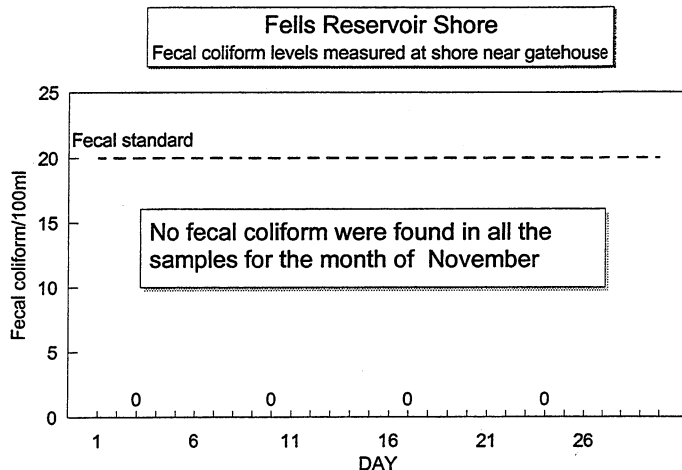
November 1997

Target

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

Highlights

No fecal coliform were detected at Fells Reservoir throughout the month.



SOURCE WATER TURBIDITY LEVELS AT FELLS RESERVOIR

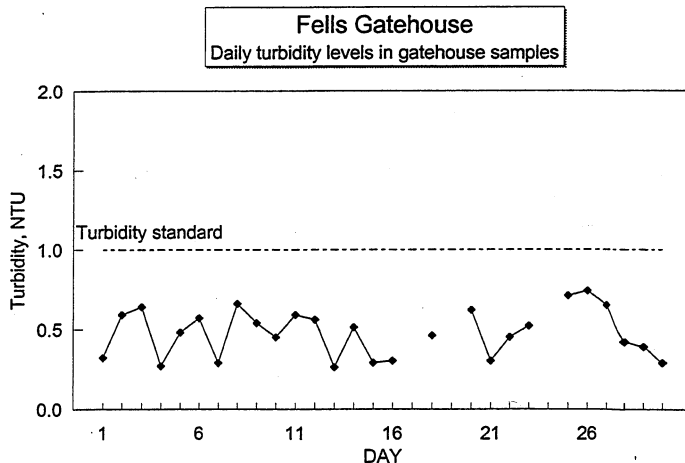
November 1997

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 0.48 NTU over the month.



MWRA

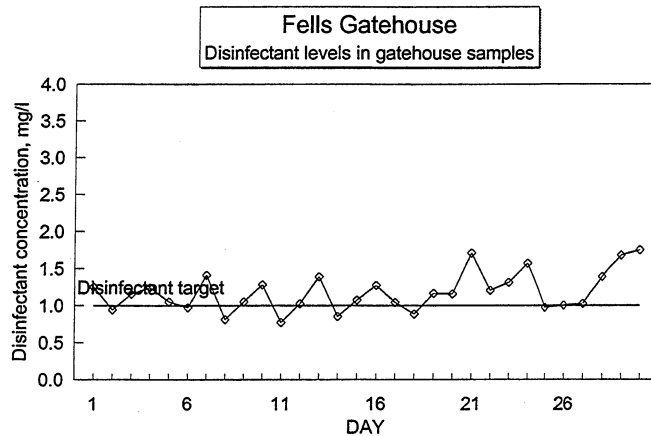
TREATED WATER DISINFECTANT LEVELS AT FELLS RESERVOIR November 1997

Target

Target levels are difficult to maintain 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

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 Fells Reservoir was 1.2 mg/l.



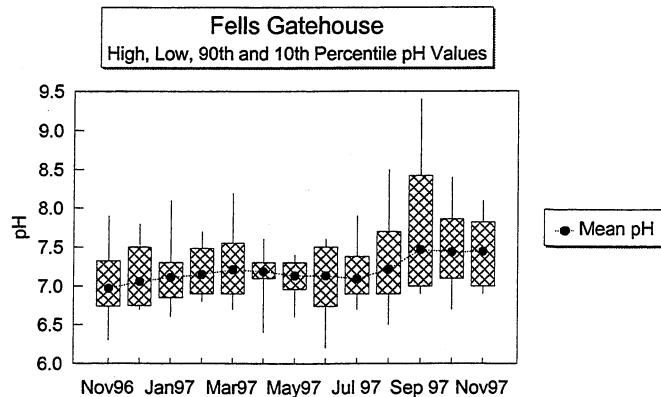
TREATED WATER pH LEVELS AT FELLS RESERVOIR November 1997

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). pH is not controlled at Fells Reservoir.

Highlights

During the month of November, eighty percent of samples ranged between 7.0 and 7.8 pH units at Fells Reservoir. The average pH was 7.4.



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.

