

# WATER QUALITY UPDATE

An Analysis of October, 2000 Sampling Data.

## IN THIS ISSUE. . .

October, 2000 Highlights and Sampling Data pp. A-G, including: Fecal Coliform, Turbidity & Primary Disinfection Levels, Community pH and Chlorine Residuals, Total Coliform Rule Results, Community Disinfection By-Product Levels and MWRA Monthly Mineral Analysis.

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.

Municipalities in the MWRA service area receive drinking water distributed directly from the Hultman Aqueduct, the Norumbega Reservoir and the Weston Reservoir.

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

For more information, please contact MWRA Public Affairs at (617) 788-1170.

100 First Avenue, Charlestown Navy Yard, Boston, MA 02129.

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

**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 using disinfection facilities at Quabbin, Wachusett, Norumbega and Weston Reservoirs. At Wachusett Reservoir, chlorine is added to provide primary disinfection necessary to inactivate pathogens that may be present in the source water. At Norumbega and Weston Reservoirs, chlorine also provides some additional primary disinfection. 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.

**Chemical:** Inorganics are measured at Quabbin and Wachusett Reservoirs. Analyses of disinfection byproducts such as trihalomethanes are performed at various locations throughout the distribution system. Volatile organic compounds are measured at the distribution reservoirs: Norumbega and Weston. 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 base-

line 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, 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.

## **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. The standards relate to coliform, turbidity, watershed protection, disinfection byproducts and the absence of waterborne disease outbreaks. Quabbin Reservoir has demonstrated compliance with the standards and has since 1992 been exempt from the filtration requirement. In October 1998, MWRA's Board of Directors voted to build an ozonation facility at MWRA's new water treatment plant to be constructed at Walnut Hill. This decision enables MWRA to add filtration technology at a later date, if the need arises, and to begin upgrading and replacing local pipes in MWRA and community distribution systems. The plan was approved by the Massachusetts Department of Environmental Protection but challenged by the U.S. Environmental Protection Agency. After trial, the Federal Court found that MWRA now met the standards for unfiltered systems, and that MWRA's new plant will improve inactivation of *Giardia*, viruses, *Cryptosporidium* and other pathogens, and reduce levels of disinfection byproducts.

## MWRA Water Quality Update Highlights October 2000

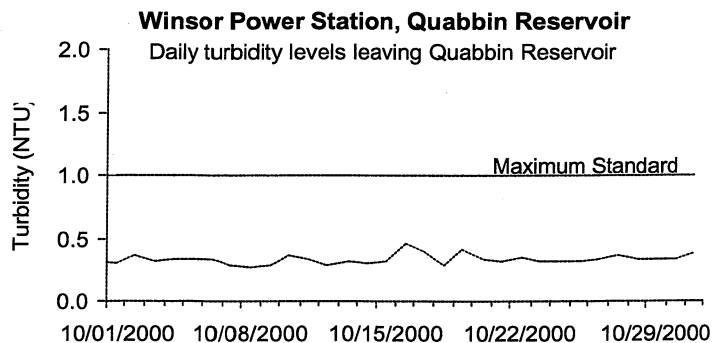
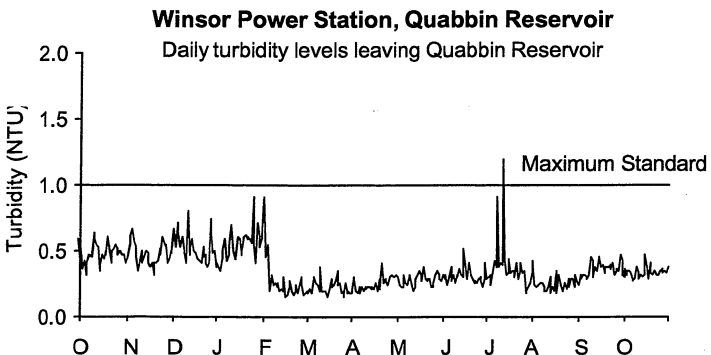
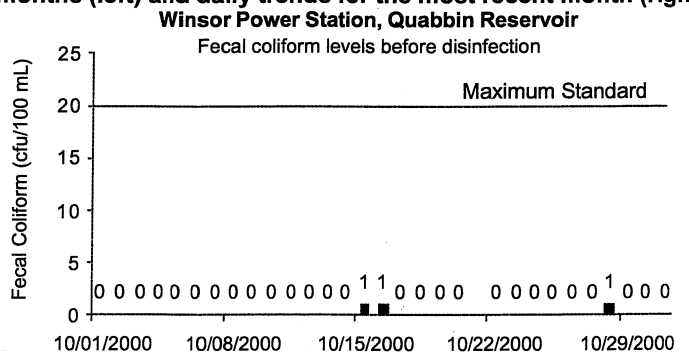
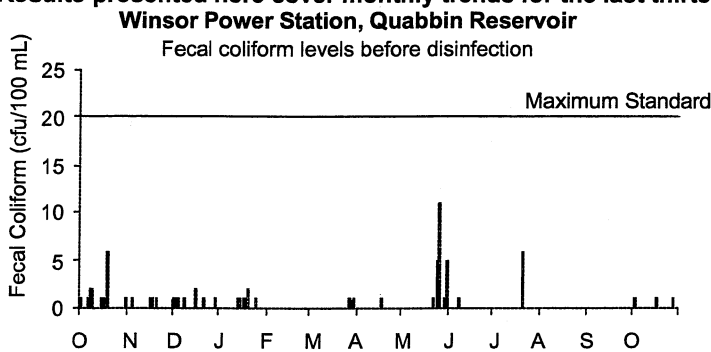
- **The chlorine dose at Cosgrove decreased** from 1.8 to 1.6 mg/L on 10/2. Dose at Ware Disinfection Facility, serving the CVA, decreased from 1.4 to 1.2 mg/L on 10/23.
- **DBPs declined due to lower chlorine doses, lower temperatures, and lower TOC levels.** TTHM numbers for the month are similar to those for 1998. On 10/2, MWRA's Department of Lab Services took over DBP testing from outside labs. See Page F for results.
- **Algae levels at Wachusett are low.** A rapid increase in *Anabaena*, occurring usually in July, did not appear this year. Diatoms are increasing as part of a regular seasonal pattern. Recently MWRA and MDC re-organized sample collection and analysis; MDC staff now analyze samples taken from the CVA system. See Page A for fecal coliform levels, Page B for algae results.
- **Wachusett waters are no longer stratified.** Raw water pH levels at ICC may be more stable as a result, as pH varied significantly between stratified layers. Raw water pH varied considerably early in the month, requiring operators to adjust corrosion control treatment daily. Transfer from Quabbin continues, helping to maintain water levels at Wachusett.
- **Full gull harassment at Wachusett started 9/25.** 3 MDC shore personnel and a 2-person MDC boat crew are working to keep gulls from roosting near Cosgrove Intake. Bird numbers are typical for this time of year.
- **MWRA met CT requirements at Cosgrove using the 2-point calculation method.** Results are on Page C.
- **2 samples for total coliform came up positive** at 2 locations in Boston, one on 10/11, one on 10/12. 1 sample in Wellesley tested positive on 10/24. Repeat samples were negative. No *E. coli* positives appeared in the distribution system during the month. See Page D for results.
- **MWRA progressed in water supply projects** that rehabilitate local pipelines, fix major leaks in the Hultman Aqueduct, & construct the MetroWest tunnel. See MWRA's Web site ([www.mwra.com](http://www.mwra.com)) for details.

### Source Water – Chicopee Valley Aqueduct Fecal Coliform and Turbidity Levels At Quabbin Reservoir (Winsor Power Station)

Quabbin Reservoir water sampled at Winsor Power Station before chlorination represents reservoir water entering the Chicopee Valley Aqueduct (CVA), serving South Hadley Fire District 1, Chicopee, and Wilbraham. The Surface Water Treatment Rule (SWTR) for unfiltered supplies requires that no more than 10% of samples over any six-month period have over 20 fecal coliforms per 100 ml. Fecal coliform levels tend to be low at the Winsor location. MWRA met the six-month running average standard for fecal coliform continuously at this location over the last year. In October, levels remained below detection limits for all but three days.

Samples for turbidity are collected at Winsor Power Station before chlorination and represent reservoir water entering the CVA. The Massachusetts Department of Environmental Protection standard for source water turbidity for unfiltered water supply systems is a maximum of 1.0 NTU; the EPA standard is a maximum of 5.0 NTU. Turbidity results beginning in February reflect improved procedures in calibrating the turbidimeter used to measure this important parameter. An unusually high turbidity result from a grab sample on July 12th was not corroborated by a continuous analyzer at the site and may have resulted from sampling error. Turbidity results for October were at normal levels.

Results presented here cover monthly trends for the last thirteen months (left) and daily trends for the most recent month (right).

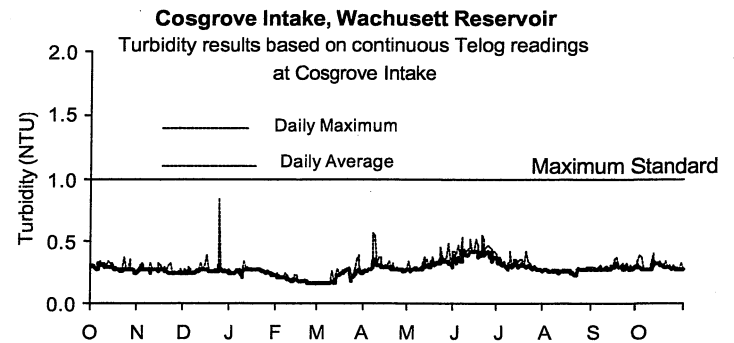
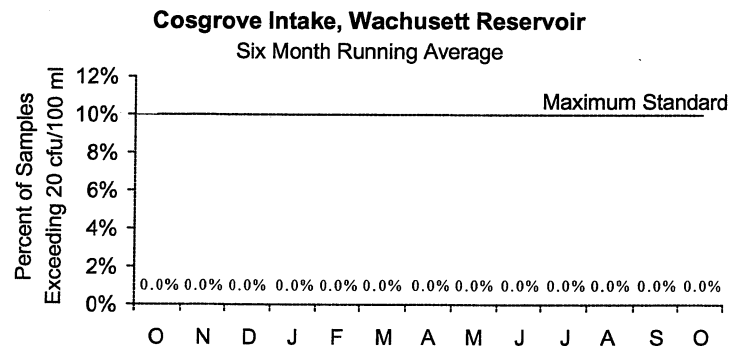
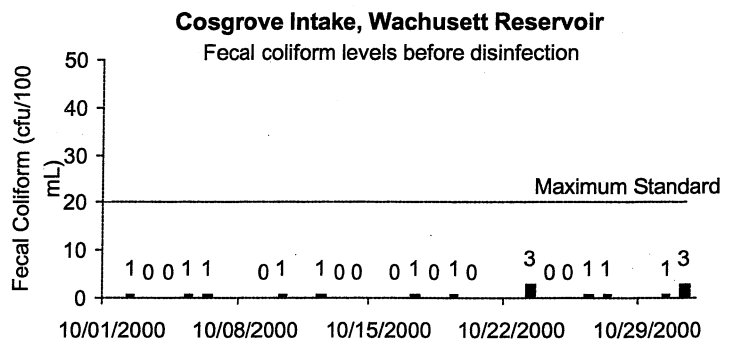
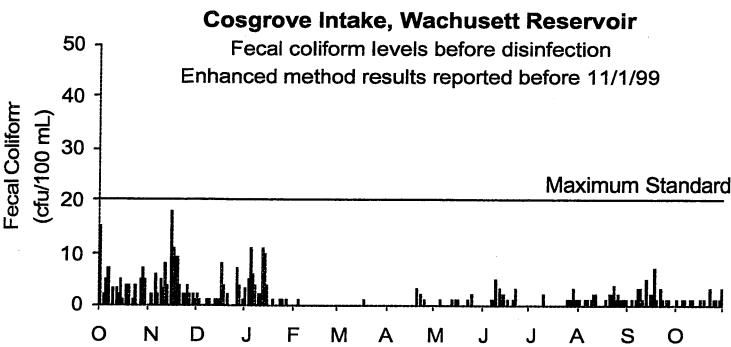


**Source Water -- Serving Metropolitan Boston**  
**Fecal Coliform Levels and Primary Disinfection at Wachusett Reservoir**  
 October 2000

Samples from Wachusett Reservoir are collected at a location inside the Cosgrove Intake facility and represent water entering the Cosgrove Aqueduct. The Surface Water Treatment Rule (SWTR) for unfiltered supplies requires that no more than 10% of samples over any six-month period have more than 20 fecal coliforms per 100 ml. The six-month running average results represent the percent of samples exceeding 20 cfu/100 ml during the previous 6-months. Turbidity samples are also taken from Cosgrove Intake, representing water quality before primary disinfection and corrosion control treatment. The DEP standard for source water turbidity for unfiltered water supply systems is a maximum of 1.0 NTU; the EPA standard is a maximum of 5.0 NTU.

Fecal coliform counts for the month were all below the 20 cfu/100 ml standard. Fecal coliform levels tend to increase during the winter, usually related to icing over of nearby water bodies and birds visiting Wachusett, which tends to freeze later in the year. The six-month running average this month is 0.0%; the standard is 10%. Results reported since November, 1999 derive from the standard method of measuring fecal coliform levels. Turbidity results were well within DEP standards.

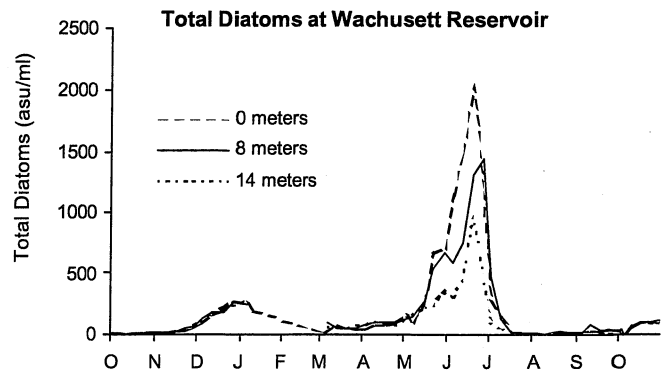
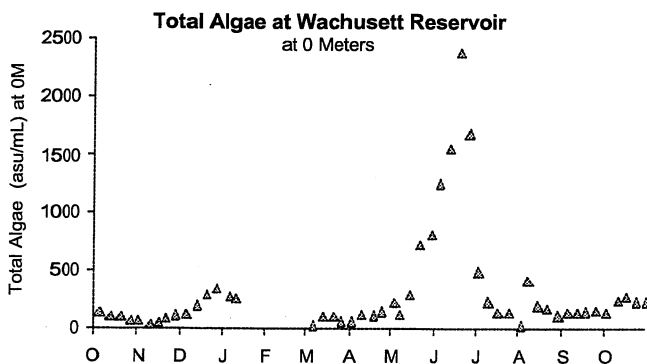
Results presented here cover monthly trends for the last thirteen months (left) and daily trends for the most recent month (right).



**Algae Levels at Wachusett Reservoir**

Taste and odor complaints at the tap are usually due to algae, which originate in source reservoirs, typically in trace amounts. Occasionally, a particular species grows rapidly, increasing its concentration in water. When *Synura*, *Anabaena*, or other nuisance algae blooms, MWRA treats the reservoirs with copper sulfate, an algaecide.

MWRA treated Wachusett for algae on 7/7/00. Sample results for algae levels after treatment are comparable to last year at this time. Of 104 complaints received during the month from local water departments, 5 concerning taste and odor or clogged filters may be due to algae. MDC and MWRA staff monitor algae levels closely to determine whether to treat.

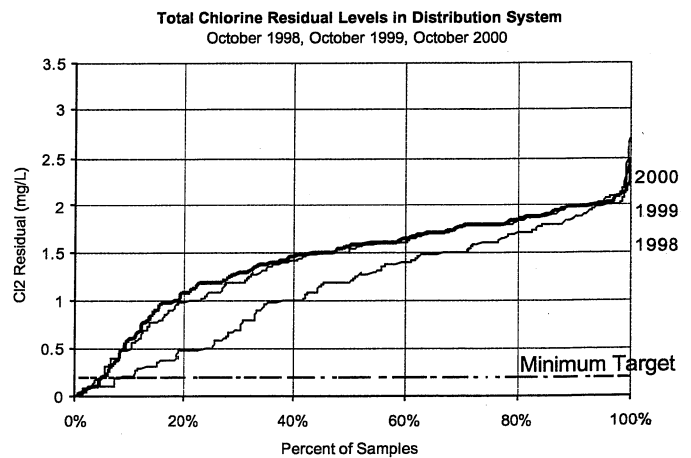
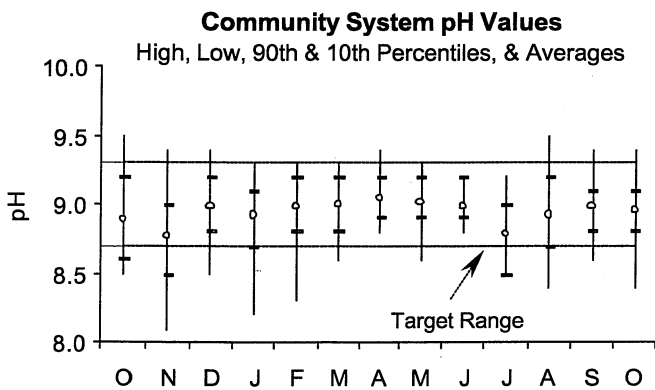


**Treated Water**  
**pH and Chlorine Residual Levels in Communities**  
 October 2000

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; this facility provides corrosion control to communities east of and including Marlborough. MWRA targets pH levels between 8.7 and 9.3 to minimize leaching of lead. MWRA staff have worked at improving processes for pH addition at the ICC with promising results for greater consistency in pH levels in communities. MWRA staff collect and analyze pH samples from 26 community locations on a biweekly schedule. The pH results for August and September on the left below show the effect of changes to both the chlorine dose and chlorine:ammonia ratio at Norumbega during those months.

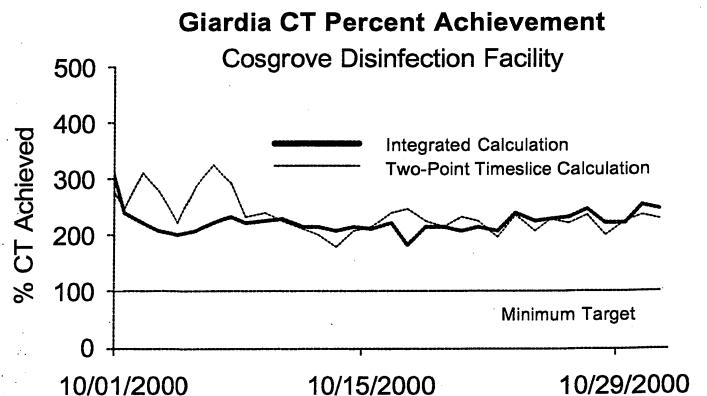
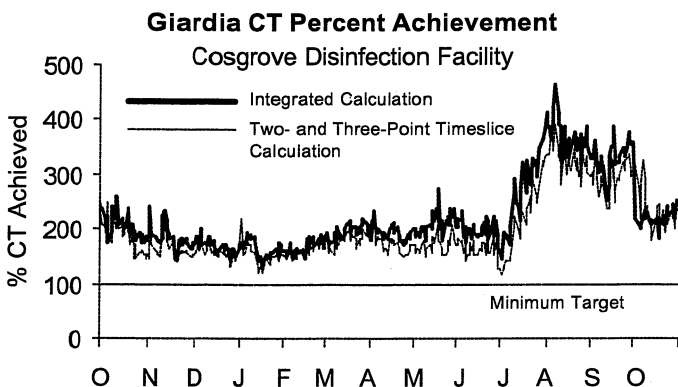
The chart below on the right compares community total chlorine residuals in October of 1998, 1999, and 2000. Each line on the chart describes the cumulative percentage of samples (on the x-axis) at various levels of total chlorine residual (on the y-axis) for a given year. MWRA has established a target for chlorine residuals throughout community distribution systems of 0.2 mg/L to control pipeline biofilm and bacterial regrowth in the distribution system. The graph shows how MWRA has progressed toward meeting this target. Results vary by month due to changes in chlorine dose, chlorine decay, and temperature. The trend over the last several years shows a significant increase in total chlorine residuals. These improvements are related to disinfection changes: chlorine ramp-up during summer 1997; ammonia separation in August 1997; and chlorine:ammonia ratio optimization begun in August 1997. In October 1997, about 55% of the samples met the chlorine residual target of 0.2 mg/L. By October 1998, 90% of all samples met this target. In October 1999, 95% of samples met this target, as was the case in October 2000. Almost 98% of all samples in October 2000 had residuals at or above 0.1 mg/L.

MWRA must meet regulations that require either detectable chlorine residuals in at least 95% of samples or that HPCs (Heterotrophic Plate Counts) be lower than 500 cfu/ml. In September, sample results from all communities participating in the MWRA program satisfied requirements for both chlorine residuals and HPCs.



**Primary Disinfection**  
**Cosgrove Disinfection Facility**

In October, MWRA provided disinfection adequate to achieve EPA's requirement of 99.9% inactivation of *Giardia* cysts and 99.99% inactivation of viruses in drinking water using a calculation based on two sample points that DEP approved in May, 1999. A sample pump at Shaft A failed, rendering calculation of CT by the 3-point CT method impossible for the time being. The 2-point calculation is more conservative than the 3-point method that DEP approved in June, 1999. The concentration (C) of the disinfectant in the water over time (T) yields a measure of the effectiveness of disinfection, CT. The required CT varies with water temperature, pH, and other factors. MWRA calculates daily CT inactivation rates at maximum flow, as specified by EPA regulations. CT achievement increased noticeably in July due to chlorine dose adjustments. CT was met each day this month, as well as every day for the last year.



**Total Coliform Rule Results for Communities Participating in  
MWRA Testing Program  
October 2000**

**Background**

Thirty-four cities and towns use the MWRA Laboratory for Total Coliform Rule compliance testing. These communities collect samples for bacteriological analysis and measure chlorine residual at the time of collection. Cambridge conducts their own monitoring and provides their data to MWRA. The other 12 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 that no more than 1 sample be 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 is undertaken. Public notification is required if follow-up tests confirm the presence of *E. coli* or total coliform.

MWRA considers a disinfectant residual of 0.2 mg/L a minimum target level at all points in the distribution system.

**Highlights**

Three of the 1890 samples (0.2%) tested were positive for total coliform during the month of October. No samples tested positive for *E. coli*. Public notification was not required by any city or town that uses MWRA laboratories.

All of the thirty-five communities that submitted chlorine residual data maintained an average disinfectant residual of at least 0.2 mg/L. 11 communities had one or more samples with a disinfectant residual lower than 0.2 mg/L. 2 fully-served communities had average residuals lower than last year by 15% or more.

Town	Samples Tested for Coliform (a)	Total Coliform % Positive	E.coli % Positive	Public Notification Required?	October 2000 Minimum Chlorine Residual (mg/L)	October 2000 Average Chlorine Residual (mg/L)	October 1999 Average Chlorine Residual (mg/L)
ARLINGTON	56				0.07	1.17	1.07
BELMONT	40				0.10	1.05	0.92
BOSTON	258	0.8%	0.0%	No	0.29	1.73	1.68
BROOKLINE	85				1.00	1.87	1.84
CAMBRIDGE	92				0.09	1.77	1.73
CHELSEA	40				0.86	1.70	1.35
CHICOPEE	45				0.30	0.68	1.66
EVERETT	50				0.50	1.52	
FRAMINGHAM (c)	72				0.34	1.47	1.19
LEXINGTON	45				1.13	1.65	1.80
LYNNFIELD	6				0.27	1.39	1.07
MALDEN	75				0.02	1.15	1.29
MARBLEHEAD	24				0.75	1.61	1.50
MARLBOROUGH (b) (c)	51				0.36	1.21	0.88
MEDFORD	85				0.10	1.14	1.05
MELROSE	45				0.10	1.20	1.29
MILTON	40				0.93	1.42	1.31
NAHANT	10				0.07	0.98	0.82
NEEDHAM (b)	51				0.01	0.53	0.97
NEWTON	88				1.12	1.59	1.48
NORWOOD	50				0.05	0.86	0.88
QUINCY	92				0.10	1.48	1.35
REVERE	52				0.61	1.63	1.57
SAUGUS	40				1.60	1.72	1.67
SOMERVILLE	80				0.30	1.34	0.99
SOUTHBORO (c)	10				0.40	0.99	0.55
STONEHAM	28				1.33	1.70	1.52
SWAMPSCOTT	18				0.43	1.17	1.07
WAKEFIELD (b)	44				0.86	1.54	1.21
WALTHAM	67				0.20	1.43	1.62
WATERTOWN	40				1.00	1.39	1.11
WELLESLEY (b)	41	2.4%	0.0%	No	0.10	0.37	0.36
WESTON (c)	21				0.40	1.07	1.18
WINCHESTER (b)	25				0.11	0.79	1.10
WINTHROP	24				0.40	1.37	1.39
WOBBURN	52				0.00	0.66	
Total:	1890	0.2%					

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

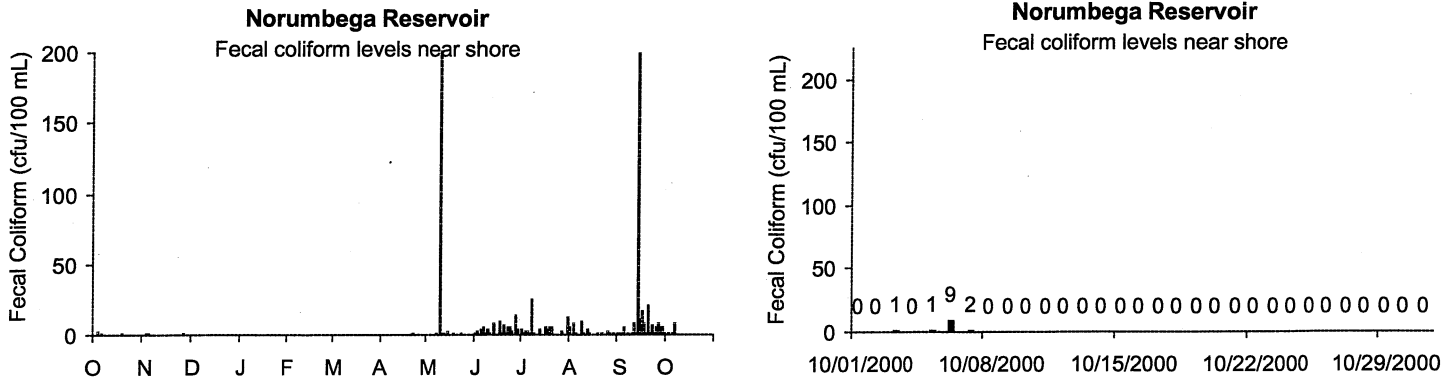
(b) These communities are partially supplied, and may mix their chlorinated supply with MWRA chloraminated supply.

(c) These communities chloramine

**Distribution Water  
Fecal Coliform Levels in Norumbega Reservoir  
October 2000**

Flow from Norumbega Reservoir supplements flows from Wachusett Reservoir daily at times of high demand. Norumbega receives flows from Wachusett for temporary storage at times of low demand. Fecal coliform samples from Norumbega Reservoir are collected from the shore near the gatehouse before disinfection. Coliform levels are elevated periodically, partly because samples collected from the shore of this small reservoir are more susceptible to local disturbances. Bird harassment and watershed protection programs were stepped up in September 1998 to minimize contamination. A fence has also been built around the reservoir to keep deer away from the water. And covered storage is scheduled to replace this open reservoir in 2004. Fecal coliform results along the shore were positive 4 times during October, mostly at low concentrations. These results are comparable to those of last October, as seen in the chart on the left below.

**Results presented here cover monthly trends for the last thirteen months (left) and daily trends for the most recent month (right).**

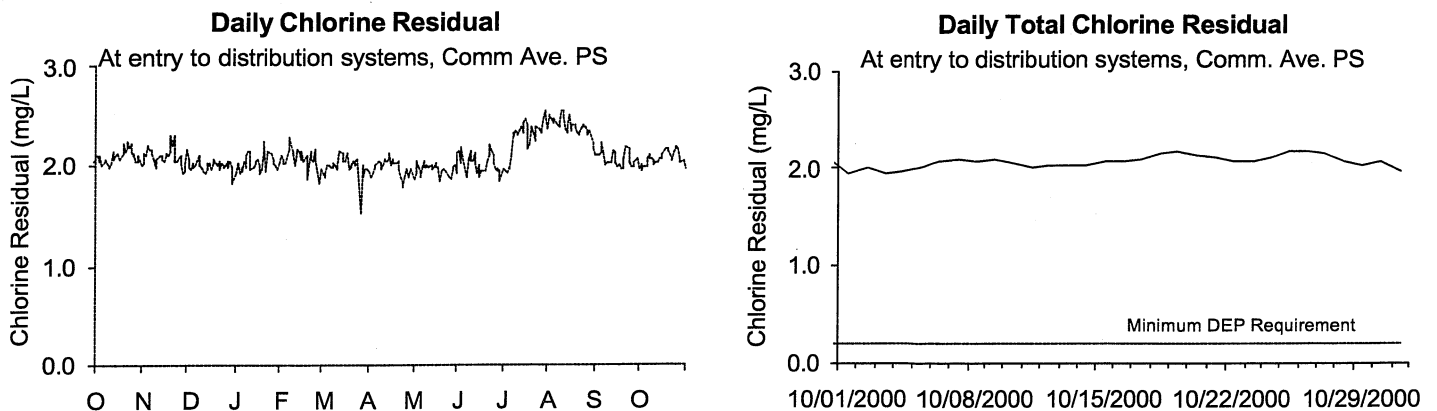


**Treated Water  
Disinfectant Levels in Hultman Aqueduct at Norumbega Disinfection Facility and  
Commonwealth Avenue Pump Station (Entry Point to Customer Distribution Systems)**

Chloramination at Norumbega Disinfection Facility provides 3-8 minutes of contact time with free chlorine before ammonia addition. Chloramination provides residual disinfection to minimize bacterial regrowth in the distribution system (primary disinfection is provided at Wachusett Reservoir/Cosgrove Intake). Process improvements to optimize chloramination at Norumbega are being tested so that ammonia additions ensure a stable chlorine residual throughout the distribution system without affecting taste and odor.

The target for total chlorine residual at Commonwealth Avenue Pump Station is adjusted periodically in an effort to optimize disinfection while minimizing concerns with nitrification, taste and odor, and disinfection by-product (DBP) formation. Seasonally, chlorine residuals fluctuate due to temperature and dosage changes. Chlorine residual sample results at this site represent levels of chlorine residuals in treated water at the entry to community distribution systems. Higher chlorine residuals from July 7 to August 30, 2000, reflect increased dosages at Cosgrove and at Norumbega Reservoir. Total chlorine residuals averaged 2.1 mg/l for the month. Target residual at Commonwealth Ave. was 2.0 mg/L for the entire month.

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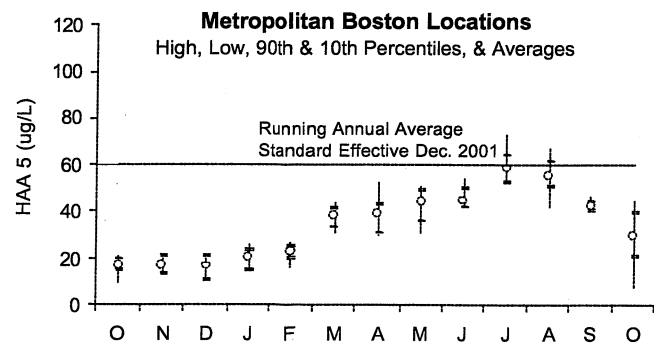
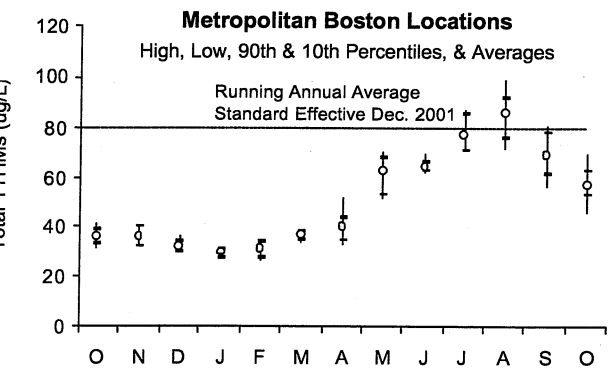
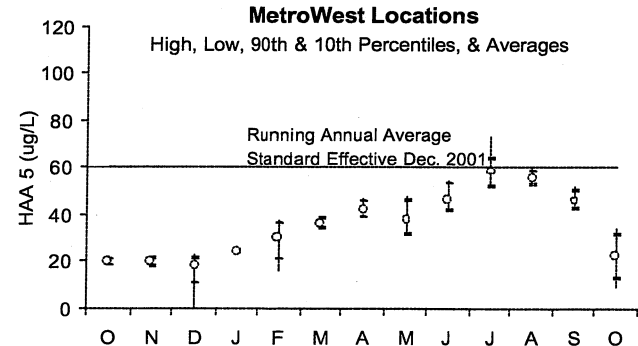
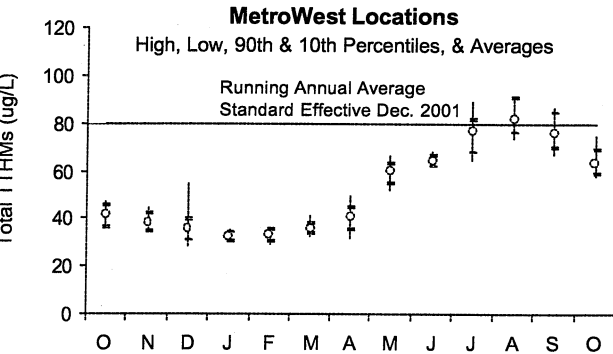
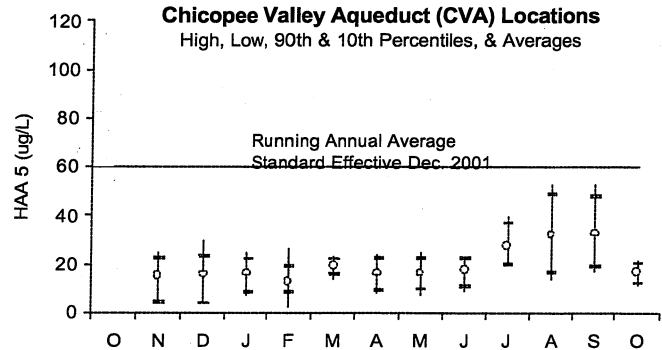
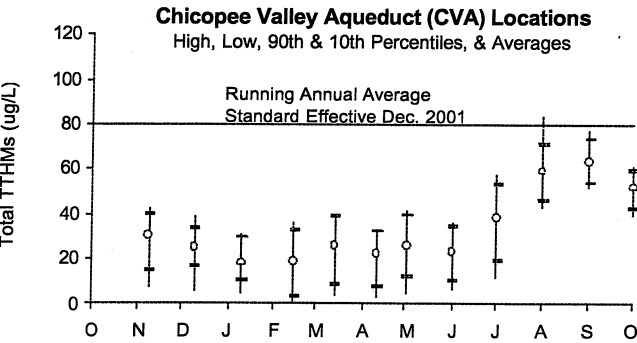
**Treated Water  
Disinfection By-Product (DBP) Levels in Communities  
October 2000**

Total Trihalomethanes (TTHMs) and Haloacetic Acids (HAAs) are by-products of disinfection treatment with chlorine. Chlorination levels, the presence of organic precursors, pH levels, the contact time of water with chlorine used for disinfection, and temperature all affect TTHM and HAA levels. TTHMs are of concern due to their potential adverse health effects at high levels. The TTHM standard currently is an annual running average of 100 ug/L for all sample locations combined; EPA recently established a new standard of 80 ug/L for TTHMs and 60 ug/L for HAA 5 that will take effect in 2001. DEP requires that samples be collected quarterly; MWRA samples weekly at some locations, monthly and quarterly at others. These graphs report results on a monthly, quarterly, and running annual average basis.

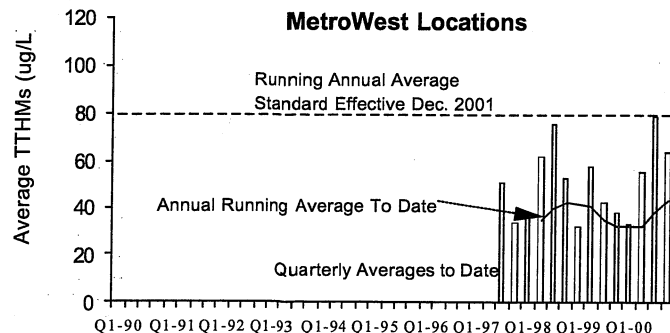
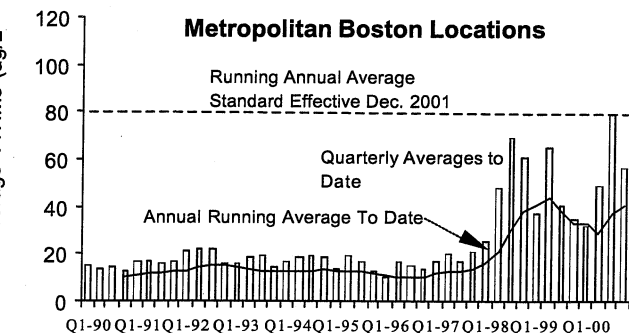
Average DBP levels, overall, decreased in October. TTHM levels are still above those of last year, but the running annual average for TTHMs, represented by the solid line in the two graphs at the bottom of the page, remained below both the current standard of 100 ug/L and more stringent standards that take effect in 2001. The difference in DBP levels in MetroWest and Metropolitan Boston locations between this year and last is due both to higher levels of TOC and UV-254 at Wachusett this year and to increased chlorine doses. TTHMs at CVA sites leveled off during September at the Ware Disinfection Facility. TTHM levels should decline as dose and temperature decline.

**TTHMs**

**HAA 5**



**TTHMs : Quarterly Averages & Annual Running Average**





## MWRA Monthly Mineral Analysis

October 2000

This page provides information on water quality at six locations in the MWRA transmission system. Results reflect a "snapshot" in time and may not represent typical conditions. Elevated levels of a particular parameter may occur from time to time. MWRA staff review these numbers carefully and follow-up unusual results by re-analyzing samples, collecting new samples, or auditing sample sites. More rigorous daily or weekly monitoring of select parameters at these and other locations provides a better overall picture of water quality. MWRA reports many of these results elsewhere in this document.

Component	Winsor Power Station at Quabbin Reservoir (Raw)	Nash Hill Storage Tank (Treated)	Cosgrove Intake at Wachusett Reservoir (Raw)	ICC, Marlboro (Treated)	Comm Ave., Newton (Treated)	Shaft 9A, Malden (Treated)	MCL Standard	Units	Exceedance
Alkalinity	2.9	3.7	5.7	31	31	30.9		MG/L	
Aluminum	< 15	< 15	< 15	< 15	< 15	< 15	50-200 (a)	UG/L	NO
Ammonia-N	0.006	< .005	0.006	0.006	0.445	0.459		MG/L	
Antimony	< .9	< .9	< .9	< .9	< .9	< .9		UG/L	
Arsenic	< .8	< .8	< .8	< .8	< .8	< .8	50 (b)	UG/L	NO
Barium	6.52	6.41	8.23	8.45	8.14	8.55	2000 (b)	UG/L	NO
Beryllium	< .2	< .2	< .2	< .2	< .2	< .2	4 (b)	UG/L	NO
Bromate	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	10	UG/L	
Bromide	11.0	< 2.5	10.8	6.04	4.7	3.5		UG/L	
Cadmium	< .2	< .2	< .2	< .2	< .2	< .2	5 (b)	UG/L	NO
Calcium	2050	2270	3850	3880	3800	3940		UG/L	
Chloride	5.1	6.6	15.3	15.4	16.4	16.8	250 (a)	MG/L	NO
Chlorine, Free	-	0.32	-	0.44	0.23	0.08		MG/L	
Chlorine, Total	-	-	-	0.60	2.08	2.06		MG/L	
Chromium	< .4	< .4	< .4	< .4	< .4	< .4	100 (b)	UG/L	NO
Coliform, Fecal, MF Method	0	-	1	-	-	-	20 (d)	CFU/100 mL	NO
Coliform, Total, MF Method	1100	0	0	0	0	0	100 (d)	CFU/100 mL	NO
Color	4	3	14	11	8	10	15 (a)	C.U.	NO
Copper **	45.5	16.3	< 1.8	9.3	< 1.8	< 1.8	1300 (b)	UG/L	NO
Cyanide	< .01	< .01	< .01	< .01	< .01	< .01	0.2 (b)	MG/L	NO
Fluoride	0.04	0.04	0.04	0.99	1.01	0.98	4 (b)	MG/L	NO
Hardness	7.2	7.6	12.7	12.8	12.5	12.9		MG/L	
Iron **	14.1	12.7	16.2	22.7	19.1	28.6	300 (a)	UG/L	NO
Lead	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	15 (b)	UG/L	NO
Magnesium	492	471	752	763	732	755		UG/L	
Manganese	5.1	3.5	9.8	17.4	10.2	17.8	50 (a)	UG/L	NO
Mercury	< .01	< .01	< .01	< .01	< .01	< .01	2 (b)	UG/L	NO
Nickel	< 1	< 1	< 1	< 1	< 1	< 1		UG/L	
Nitrate-N	< .005	0.006	0.027	0.030	0.043	0.027	10 (b)	MG/L	NO
Nitrite	< .005	< .005	< .005	< .005	< .005	< .005		MG/L	
Orthophosphate	0.002	0.004	0.003	0.007	0.007	0.006		MG/L	
pH	7.2	7.3	7.3	9.1	8.9	9.1		S.U.	
Potassium	436	476	759	778	792	795		UG/L	
Selenium	< .9	< .9	< .9	< .9	< .9	< .9	50 (b)	UG/L	NO
Silica (SiO2)	1060	1080	1480	2040	2100	1980		UG/L	
Silver	< .4	< .4	< .4	< .4	< .4	< .4	100 (a)	UG/L	NO
Sodium	3.6	4.8	8.8	21.3	21.7	21.6		MG/L	
Specific Conductance	-	-	88	132	131	138		UMHOS	
Standard Plate Count, HPC (48 Hrs @ 35C)	590	52	130	3	2	2	500 (d)	CFU/mL	NO
Sulfate (SO4)	5.4	5.1	6.8	6.8	6.8	6.8	250 (a)	MG/L	NO
Thallium	< 1	< 1	< 1	< 1	< 1	< 1	2 (b)	UG/L	NO
Total Dissolved Solids	29	29	44	74	73	90	500 (a)	MG/L	NO
Trihalomethanes, Total (TTHMS) (f)	-	(g)	-	40	54	53	100 (b) (e)	UG/L	NO
Turbidity	0.23	0.26	0.56	0.76	0.42	0.48	1 (c)	NTU	NO
Zinc **	< .4	3.9	1.1	1.3	2.3	4.5	5000 (a)	UG/L	NO

(a) = Secondary MCL standard (aesthetic related). DEP "Drinking Water Regulations", 310CMR 22.00.

(b) = Primary MCL standard (health related). DEP "Drinking Water Regulations", 310CMR 22.00.

(c) = Primary MCL standard (health related), applies to source water only. DEP "Drinking Water Regulations", 310CMR 22.00.

(d) = Primary MCL standard (health related). DEP "Drinking Water Regulations", 310CMR 22.00. Applies to samples downstream of Wachusett and Quabbin Reservoirs.

(e) = THM compliance is based on a running annual average of samples collected at DEP approved locations. A new standard of 80 UG/L goes into effect in December 2001.

(f) = Average TTHM result for weekly samples collected in the month of October 2000.

(g) = No sample taken at Nash Hill in October 2000.

MCL = Maximum Contaminant Level

C.U. = Color Unit

CFU = Colony Forming Unit

NTU = Nephelometric Turbidity Unit

S.U. = Standard Units

MG/L = milligrams per liter = parts per million

HPC = Heterotrophic Plate Count

UG/L = micrograms per liter = parts per billion

< = less than method detection limit

umhos = ohms/1000

NS = No sample

\*\* = Metal results may be elevated due to local plumbing at the sample tap.

Most results are based on single grab samples collected October 2 & 3, 2000 and analyzed by MWRA and contract laboratories.

## 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	

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 human-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

Communities that are fully supplied by MWRA receive water treated with chloramines. In those communities that are partially supplied by MWRA, information on treatment should be obtained from the local water department. To view the level of treatment your water has received, locate your community on the chart.

