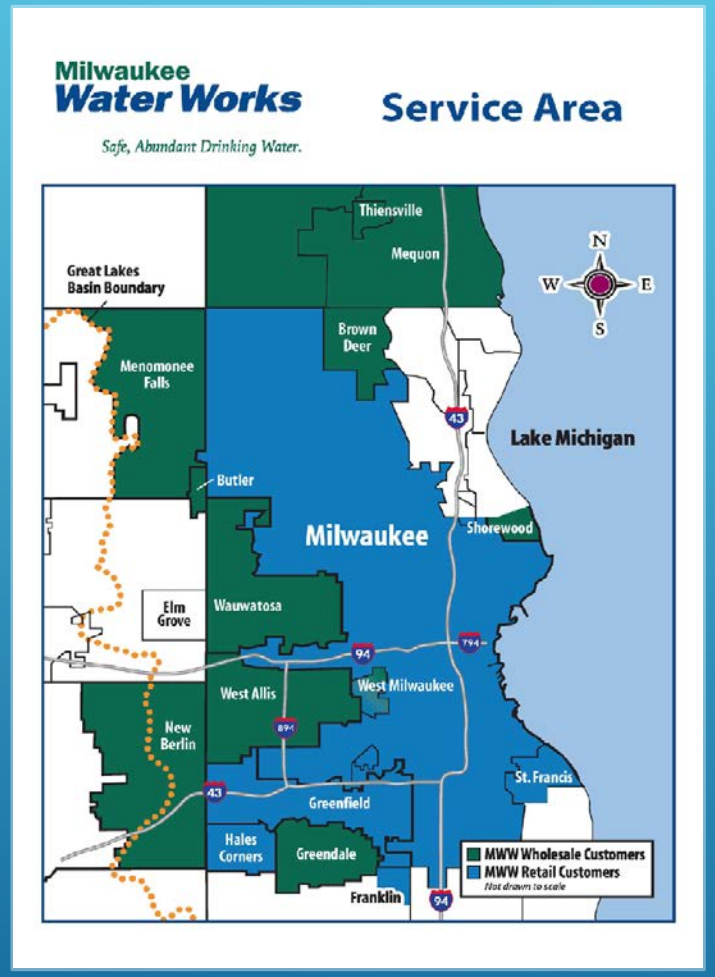
MILWAUKEE WATER WORKS

Water treatment process

Water Quality testing



UTILITY AND SERVICE AREA

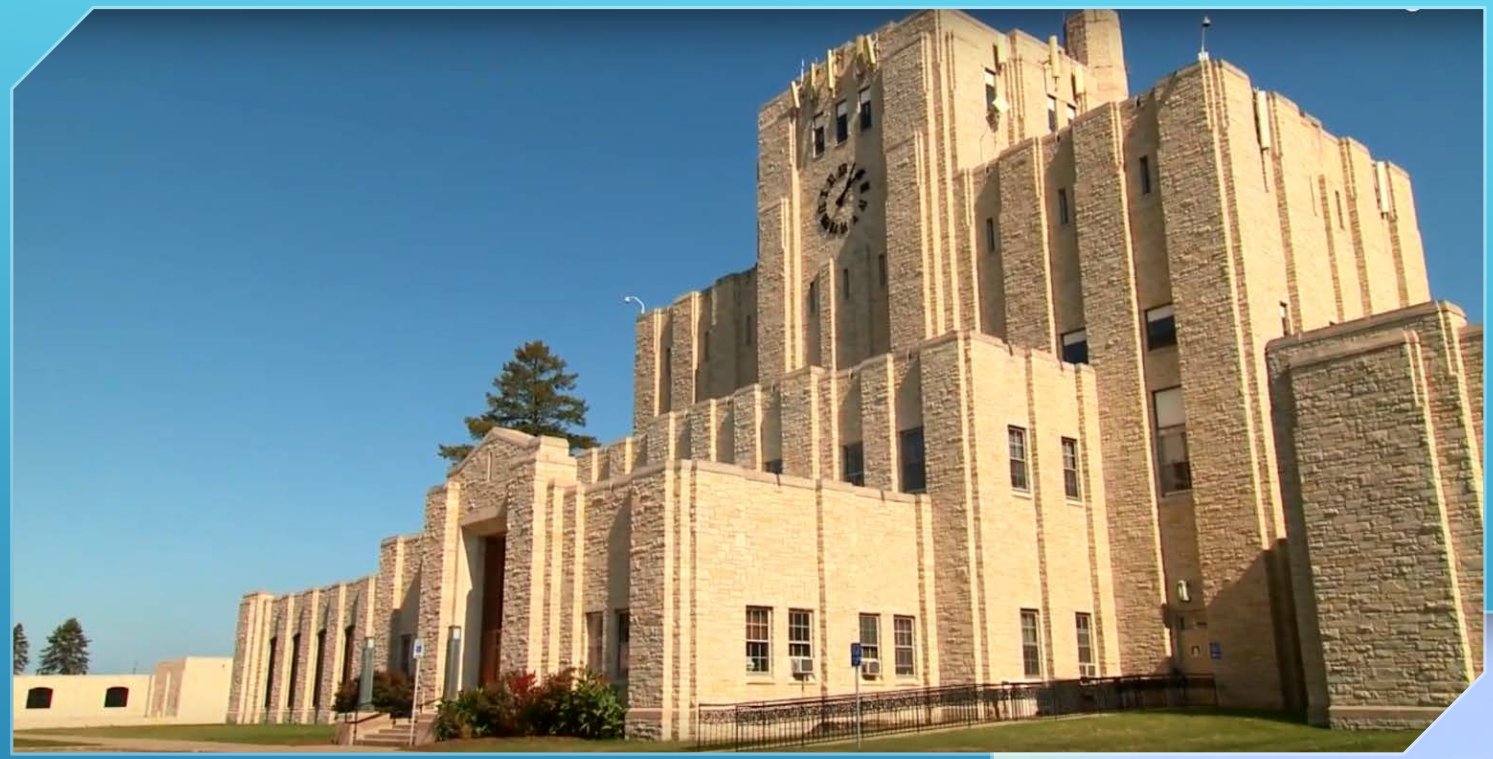
Provide water to over 860,000 people in Milwaukee, Brown Deer, Butler, Greendale, Greenfield, Hales Corners, Shorewood, St. Francis, Wauwatosa, West Allis and West Milwaukee. Also provide water to the Milwaukee County grounds, and portions of Franklin, Menomonee Falls, Mequon, New Berlin and Thiensville.

The Milwaukee Water Works (MWW) is a division of the Milwaukee Department of Public Works and is publicly owned

Utility is self supported from the water rates, not taxes. In 2014 the MWW made a $12.4 million payment in lieu of taxes to reduce the city tax rate. Since 1993 MWW has invested $459 million in its treatment plants, water mains and booster stations.

MWW operates two treatment plants, Linnwood Ave. and Howard Ave.

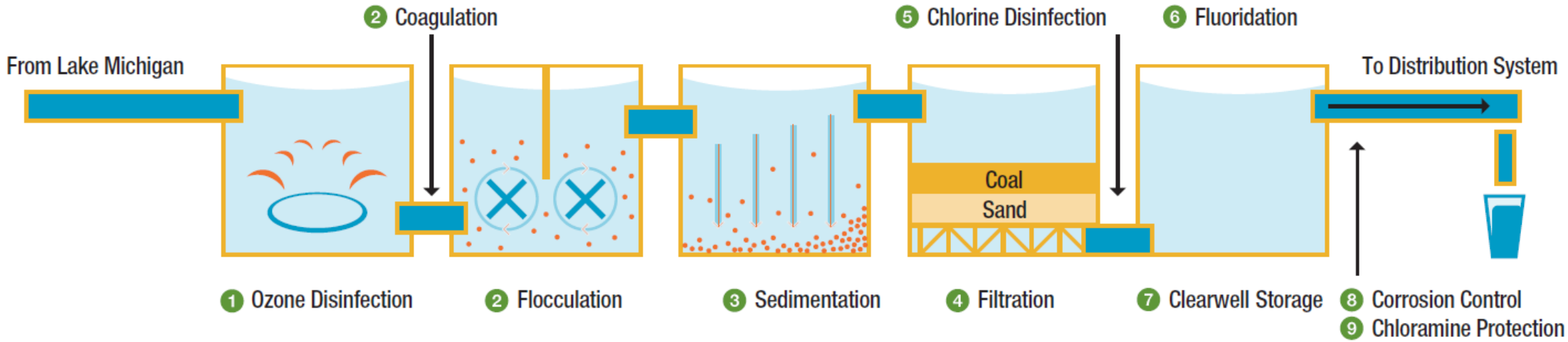
Treat 29.9 billion gallons of water per year, with average daily pumpage of 103 million gallons



Linnwood Purification Plant

Howard Ave. Purification Plant

Milwaukee Water Works Drinking Water Treatment Process



① **Ozone Disinfection** Ozone gas is bubbled through the incoming lake water. Ozone destroys disease-causing microorganisms including *Giardia* and *Cryptosporidium*, controls taste and odor, and reduces the formation of chlorinated disinfection byproducts.

② **Coagulation and Flocculation** Aluminum sulfate is added to the water to neutralize the charge on microscopic particles in the water. The water is then gently mixed to encourage the suspended particles to stick together to form floc.

③ **Sedimentation** Sedimentation is the process in which the floc settles out and is removed from the water.

④ **Biologically Active Filtration** The water is slowly filtered through 24" of anthracite coal and 12" of crushed sand to remove very small particles.

⑤ **Chlorine Disinfection** After filtration, chlorine is added as a secondary disinfectant. This provides extra protection from potentially harmful microorganisms.

⑥ **Fluoridation** Fluoride, when administered at low levels, is proven to help prevent tooth decay.

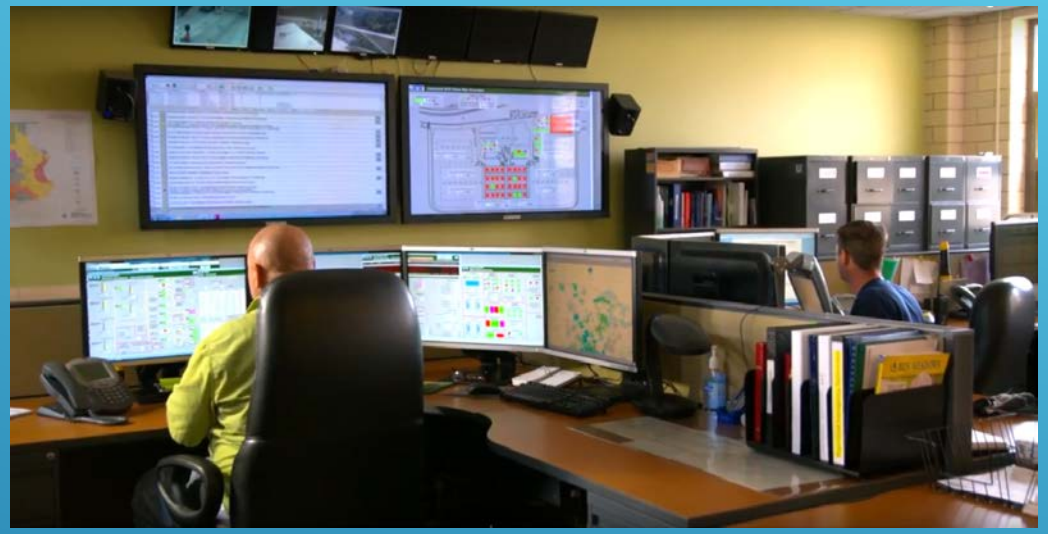
⑦ **Clearwell Storage** Treated water is stored in deep underground tanks and pumped as needed through the distribution system.

⑧ **Corrosion Control** A phosphorous compound is added to help control corrosion of pipes. This helps prevent lead and copper from leaching from plumbing into the water.

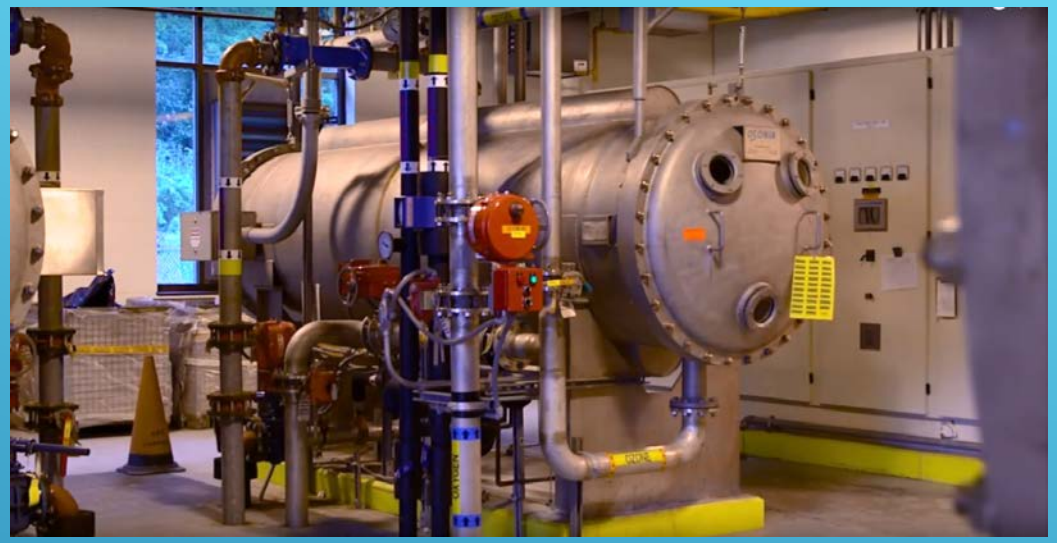
⑨ **Chloramine Protection** Ammonia changes the chlorine to chloramine, a disinfectant that maintains bacteriological protection in the distribution system.

The Milwaukee Water Works is a member of the American Water Works Association, the Association of Metropolitan Water Agencies, the Water Research Foundation, and the Wisconsin Water Association.

Control Center



Ozone Disinfection



Filtration

Pumping

WATER QUALITY TESTING

Operate water quality lab for process instrument control, microbiological testing and distribution system testing

TYPICAL VALUES FOR MILWAUKEE WATER

Parameter	Median Value	Range
Alkalinity	103 mg/L as $CaCo_3$	97 - 116 mg/L
Hardness, total	135 mg/L	131 – 152 mg/L
Hardness, Calcium	89 mg/L	86 – 96 mg/L
Hardness, Magnesium	46 mg/L	45 – 56 mg/L
Calcium	34 mg/L	34 - 34 mg/L
Magnesium	12 mg/L	12 – 12 mg/L
Sodium	9.45 mg/L	9.30 – 9.60 mg/L
Chloride	14.7 mg/L	Maximum 21.5 mg/L
Sulfate	26.5 mg/L	Maximum 27.0 mg/L
Chlorine	1.54 mg/L	1.30 - 1.84 mg/L
Conductivity	308 uS/cm	288 - 353 uS/cm
Fluoride	0.58 mg/L	0.09 - 0.73 mg/L
Iron	0.123 mg/L	0.119 – 0.126 mg/L
pH	7.64	7.38 – 7.79
Potassium	1.4 mg/L	1.4 – 1.4 mg/L
Temperature	47.3°F	36.3°F – 72.1°F

http://city.milwaukee.gov/WaterConsumerConfidenceReport
http://city.milwaukee.gov/ImageLibrary/Groups/WaterWorks/files/WaterQualityBasicsforMilwaukeeMakers2017.pdf
http://city.milwaukee.gov/ImageLibrary/Groups/WaterWorks/files/2017DistributionSystemWaterQualityReport.pdf

COMPARING BREWING WATER SAMPLES

	Hardness, Total	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee	135	103	34	12	34	15	27
Menomonee Falls	155	110	44	13	34 [a]	15	37
Colgate	413	292	65	71	< 41 [d,e]	119	54
New Berlin (Willow Creek)	420	338	102	47	< 41 [d,e]	48	45
New Berlin (Hillcrest Dr)	540	440	120	69	< 41 [d,e]	237	46
Waukegan	136	105	37	13	9 [b]	20	24
Ice Mountain	139	98	38	12	20 [c]	21	27
Distilled	3.8	8	.7	.6	0	.8	.7
Mequon (Baker)	170	160	31	26	< 41 [d,e]	5	49
Mequon (Baker Soft)	3	162	2	1	-	5	45
Mequon (Baker RO)	4	16	0	1	-	1	2

a. http://www.menomonee-falls.org/DocumentCenter/View/9682/2017-CCR-Surface-Water?bidId=
b. http://www.waukeganweb.net/ArchiveCenter/ViewFile/Item/48
c. http://www.evart.org/doc/2016%20City%20of%20Evart%20Consumer%20Confidence%20Report.pdf
d. https://pubs.usgs.gov/wsp/1229/report.pdf
e. http://waukesha-water.com/downloads/CCR2014_English.pdf

MATCHING A PROFILE – BURTON ON TRENT (Really Close)

	Amount	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee	-	103	34	12	34	15	27
Gypsum ($CaSO_4$)	17 g	-	209	-	-	-	500
Table Salt (NaCl)	0 g	-	-	-	-	-	-
Epsom Salt ($MgSO_4$)	9.4 g	-	-	49	-	-	194
Calcium Chloride ($CaCl_2$)	0.2 g	-	3	-	-	5	-
Baking Soda ($NaHCO_3$)	2.7 g	101	-	-	38	-	-
Chalk ($CaCO_3$)	2.8 g	89	60	-	-	-	-
Total	-	293	306	61	72	20	721
Target Profile	-	300	295	45	55	25	725
Difference	-	-7	11	16	17	-5	-4

For 5 gallons of water units in mg/L unless otherwise stated.

MATCHING A PROFILE – DUBLIN (Pretty Close)

	Amount	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee	-	103	34	12	34	15	27
Gypsum ($CaSO_4$)	1.0 g	-	12	-	-	-	29
Table Salt (NaCl)	0 g	-	-	-	-	-	-
Epsom Salt ($MgSO_4$)	0 g	-	-	-	-	-	-
Calcium Chloride ($CaCl_2$)	0.2 g	-	3	-	-	5	-
Baking Soda ($NaHCO_3$)	0 g	-	-	-	-	-	-
Chalk ($CaCO_3$)	3.1 g	98	65	-	-	-	-
Total	-	201	114	12	34	20	56
Target Profile	-	200	115	4	12	19	55
Difference	-	1	-1	8	22	1	1

For 5 gallons of water units in mg/L unless otherwise stated.

MATCHING A PROFILE – MUNICH (Reasonable)

	Amount	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee		103	34	12	34	15	27
Gypsum ($CaSO_4$)	0 g	-	0	-	-	-	0
Table Salt (NaCl)	0 g	-	-	-	0	0	-
Epsom Salt ($MgSO_4$)	0 g	-	-	0	-	-	0
Calcium Chloride ($CaCl_2$)	0 g	-	0	-	-	0	-
Baking Soda ($NaHCO_3$)	0.1 g	4	-	-	2	-	-
Chalk ($CaCO_3$)	2.5 g	83	56	-	-	-	-
Total	-	190	90	12	36	15	27
Target Profile	-	200	75	20	10	2	10
Difference	-	-10	15	-8	26	13	17

For 5 gallons of water units in mg/L unless otherwise stated.

MATCHING A PROFILE – PILSEN (Not Possible)

	Amount	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee	-	103	34	12	34	15	27
Gypsum ($CaSO_4$)	0 g	-	-	-	-	-	-
Table Salt (NaCl)	0 g	-	-	-	-	-	-
Epsom Salt ($MgSO_4$)	0 g	-	-	-	-	-	-
Calcium Chloride ($CaCl_2$)	0 g	-	-	-	-	-	-
Baking Soda ($NaHCO_3$)	0 g	-	-	-	-	-	-
Chalk ($CaCO_3$)	0 g	-	-	-	-	-	-
Total	-	103	34	12	34	15	27
Target Profile	-	15	7	2	2	5	5
Difference	-	88	27	10	32	10	22

For 5 gallons of water units in mg/L unless otherwise stated.

Water Profile Tool

Calculates water additions to match a given water profile

				Ions	Ca	Mg	Na	SO4	Cl	HCO3
				Recommended Range	(50-150)	(10-40)	(0-150)	(50-250)	(0-250)	(0-250)
Base Profile	5.00	gal	Name	Milwaukee, WI	96.0	47.0	7.0	26.0	16.0	107.0
			Gypsum (CaSO4)	0.0 g	0.0			0.0		
			Table Salt (NaCl)	0.0 g			0.0		0.0	
			Epsom Salt (MgSO4)	0.0 g		0.0		0.0		
			Calcium Chloride (CaCl)	0.0 g	0.0				0.0	
			Baking Soda (NaHCO3)	0.0 g			0.0			0.0
			Chalk (CaCO3)	0.0 g	0.0					0.0
Dilute With	0.00	gal	Name		0.0	0.0	0.0	0.0	0.0	0.0
Save Totals			Totals		96.0	47.0	7.0	26.0	16.0	107.0
Target Profile			Name		0.0	0.0	0.0	0.0	0.0	0.0
			Difference		96.0	47.0	7.0	26.0	16.0	107.0

Match Target Profile | Clear | Save Additions to Target

Analysis of 'Total' Water Profile Line

Alkalinity	88 ppm	Residual Alkalinity	-9 ppm	Sulfate/Chloride Ratio	1.6
Effective Hardness	96 ppm	Color Range	5-9 SRM	Sulfate/Chloride Balance	Slightly Bitter