

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***MONITORING AND RESEARCH
DEPARTMENT***

REPORT NO. 18-19

TUNNEL AND RESERVOIR PLAN

UPPER DES PLAINES TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2017

July 2018

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July 31, 2018

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Springfield, IL 62794-9276

Dear Sir or Madam:

Subject: Tunnel and Reservoir Plan, Upper Des Plaines Tunnel System, Annual
Groundwater Monitoring Report for 2017

Attached are three copies of "Tunnel and Reservoir Plan, Upper Des Plaines Tunnel
System, Annual Groundwater Monitoring Report for 2017."

Very truly yours,



Albert E. Cox
Environmental Monitoring and Research Manager
Monitoring and Research Department

AC:PS:cm
Attachment

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Mr. Podczerwinski
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Dr. Cox
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**TUNNEL AND RESERVOIR PLAN,
UPPER DES PLAINES TUNNEL SYSTEM,
ANNUAL GROUNDWATER MONITORING REPORT
FOR 2017**

**Monitoring and Research Department
Edward W. Podczewinski, Director**

July 2018

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LIST OF ABBREVIATIONS

°C	degrees Celsius
CCD	Chicago City Datum
CFU	colony forming units
UDP	Upper Des Plaines
Cl ⁻	chloride
District	Metropolitan Water Reclamation District of Greater Chicago
EC	electrical conductivity
FC	fecal coliform
ft	feet
hr	hour
IEPA	Illinois Environmental Protection Agency
L	liter
m	meter
mg	milligram
mS	millisiemens
NH ₃ -N	ammonia nitrogen
SO ₄ ²⁻	sulfate
TDS	total dissolved solids
Temp	temperature
TOC	total organic carbon

ANNUAL DATA FOR MONITORING WELLS

Introduction

This system consists of two subsystems, Upper Des Plaines (UDP) 20 and UDP 21. The UDP 20 contains six monitoring wells, MW-1 through MW-6, while the UDP 21 contains three monitoring wells, MW-7 through MW-9 ([Figure 1](#)). Groundwater elevations in the monitoring wells were measured during each sampling event. In addition, groundwater elevations were measured biweekly since these wells also function as observation wells. The monitoring wells were sampled based on the modified groundwater monitoring program for the Metropolitan Water Reclamation District of Greater Chicago (District)'s Tunnel and Reservoir Plan (TARP) as briefly described below.

Modified Groundwater Monitoring Program

In a letter dated July 13, 2017, the Illinois Environmental Protection Agency (IEPA) accepted the modifications for the District's TARP groundwater monitoring program effective in January 2017 for a period of three years (2017 – 2019). Under the revised monitoring plan, four wells (MW-5, -6, -7, and 8), which had fecal coliform detected in 10 percent or more of samples during the period 1995 – 2013, will be sampled for four events of TARP tunnel fills, based on the water levels in the TARP following storm events (fill event-based). The criterion that triggers a fill event sampling is that the level of water in the TARP Mainstream tunnels reaches -150 ft Chicago City Datum (CCD). At each event, sampling was done weekly for three weeks. The samples collected during the first week of sampling were analyzed for all parameters in the current monitoring program, including: pH, temperature, electrical conductivity, total dissolved solids, hardness, ammonia, total organic carbon, chloride, sulfate, and fecal coliform. However, the samples from the second and third weeks were analyzed for only fecal coliform.

The other five wells associated with the UDP Tunnel System were sampled once per year under the modified monitoring plan. These wells had fecal coliform detected in less than 10 percent of samples during the period 1995 – 2013.

Summary of Data for Monitoring Wells

The analytical data for groundwater sampled during 2017 from fill event-based monitoring wells MW-5 through MW-8, along with descriptive statistics, are presented in [Table 1](#). Physical characteristics, such as elevation, groundwater temperature, and estimated time of recharge for each well between initial drawdown and sampling, are also included. The fecal coliform data for groundwater sampled during 2017 from these monitoring wells are presented in [Table 2](#). The analytical data for groundwater from the wells sampled once per year are presented in [Table 3](#). Fecal coliform counts in all the annual sampling wells were undetectable (<1 CFU/100 mL).

FIGURE 1: MAP OF MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM

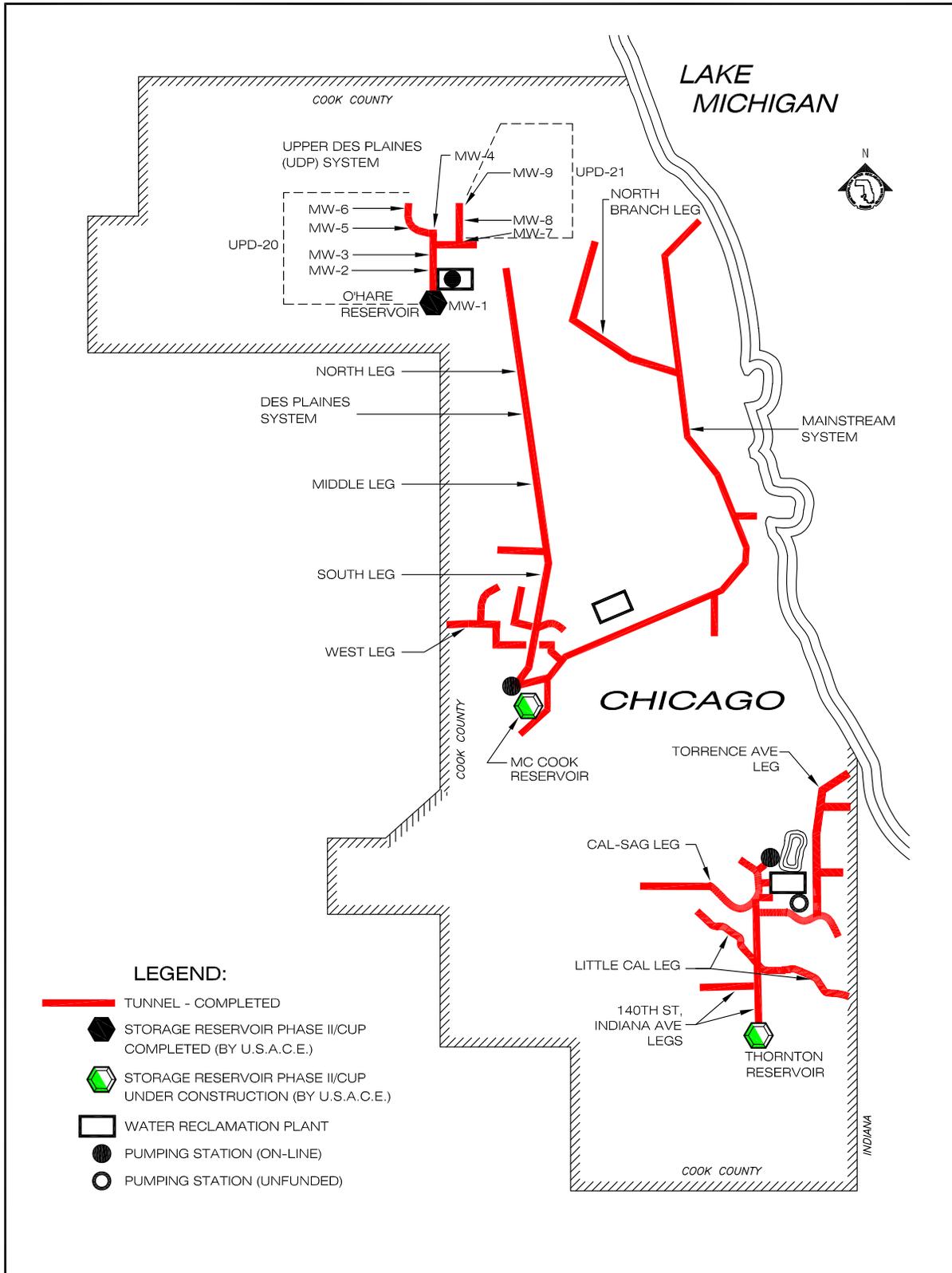


TABLE 1: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2017 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS

Wells	Fill Event	Sample Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Temp	Water Elevation ¹	Recharge Time	
				mS/m	----- mg/L -----					°C	ft	hr		
MW-5	F1	01/20/17	8.0	72	416	<1.0	64	129	<0.10	134	12.9	-136	<48	
	F2	03/03/17	7.9	96	620	<1.0	86	222	0.29	212	13.6	-138	<48	
	F3	04/06/17	6.5	103	744	<1.0	73	322	0.57	344	13.3	-141	<48	
	F4	05/04/17	7.7	107	754	<1.0	70	287	0.64	322	13.7	-134	<48	
	F5	07/19/17	7.9	87	682	<1.0	70	295	0.47	316	12.9	-143	<48	
	F6	10/18/17	7.3	105	720	1.5	63	303	0.67	325	14.9	-136	<48	
		Minimum		6.5	72	416	<1.0	63	129	<0.10	134	12.9	-136	
		Median		7.8	100	701	1.0	70	291	0.52	319	13.5	-137	
		Mean		7.6	95	656	1.1	71	259	0.46	276	13.6	-93	
		Maximum		8.0	107	754	1.5	86	322	0.67	344	14.9	-143	
	Standard deviation		0.6	13	127	0.20	8.0	72	0.20	84	0.7	-112		
	Coefficient of variation (%)		7.4	14	19	21	12	28	49	30	5.5	121		
MW-6	F1	01/19/17	7.7	99	700	1.6	39	329	0.59	362	13.3	-28	<48	
	F2	03/02/17	7.7	106	656	<1.0	34	338	0.73	374	13.2	-26	<48	
	F3	04/06/17	7.4	105	676	1.0	37	343	0.46	369	12.9	-26	<48	
	F4	05/04/17	8.1	107	714	<1.0	37	318	0.53	362	13.5	-27	<48	
	F5	07/21/17	7.9	78	716	<1.0	35	338	0.47	363	13.9	-26	<48	
	F6	10/20/17	7.0	84	640	1.5	35	344	0.49	352	14.3	-28	<48	
		Minimum		7.0	78	640	<1.0	34	318	0.46	352	12.9	-26	
		Median		7.7	102	688	1.0	36.0	338	0.51	363	13.4	-27	
		Mean		7.6	97	684	1.2	36.2	335	0.55	364	13.5	-27	
		Maximum		8.1	107	716	1.6	39.0	344	0.73	374	14.3	-28	
	Standard deviation		0.4	12	32	0.29	2.0	10	0.10	7	1	-1		
	Coefficient of variation (%)		5.2	13	5	24	5.0	3.0	19	2.0	3.8	3.7		

TABLE 1 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2017 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS

Well	Fill Event	Sample Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Temp	Water Elevation ¹	Recharge Time	
				mS/m	----- mg/L -----						°C	ft	hr	
MW-7	F1	01/19/17	7.2	113	798	<1.0	36	373	0.62	478	15.0	-54	<48	
	F2	03/02/17	7.3	119	646	<1.0	32	339	0.55	434	14.5	-53	<48	
	F5	07/21/17	7.5	120	924	<1.0	41	389	0.44	472	16.0	-52	<48	
	F6	10/18/17	7.2	115	828	1.2	36	399	0.53	473	15.9	-52	<48	
		Minimum		7.2	113	646	<1.0	32	339	0.44	434	14.5	-52	
		Median		7.2	117	813	1.0	36	381	0.54	473	15.5	-53	
		Mean		7.3	117	799	1.1	36	375	0.54	464	15.4	-53	
		Maximum		7.5	120	924	1.2	41	399	0.62	478	16.0	-54	
		Standard deviation		0.2	3	115	0.1	4	26	0.1	20	1.0	-1.0	
		Coefficient of variation (%)		2.2	2.8	14	10	10	7.0	14	4.0	4.7	1.8	
MW-8	F1	01/20/17	7.8	121	806	<1.0	88	322	<0.10	398	14.4	-106	<48	
	F2	03/03/17	8.1	108	694	<1.0	55	318	0.11	368	13.9	-138	<48	
	F3	04/13/17	7.9	110	610	1.6	61	273	<0.10	333	13.8	-128	<48	
	F4	05/04/17	8.1	107	696	<1.0	58	284	<0.10	369	14.2	-131	<48	
	F5	07/19/17	7.9	99	622	<1.0	51	282	<0.10	349	15.1	-130	<48	
	F6	10/18/17	7.8	87	596	2.3	43	257	<0.10	314	15.0	-134	<48	
		Minimum		7.8	87	596	<1.0	43	257	<0.10	314	13.8	-106	
		Median		7.9	108	658	1.0	57	283	0.10	359	14.3	-131	
		Mean		7.9	105	671	1.3	59	289	0.10	355	14.4	-128	
		Maximum		8.1	121	806	2.3	88	322	0.11	398	15.1	-138	
	Standard deviation		0.1	11	79	1.0	15	26	0.00	30	1.0	-11		
	Coefficient of variation (%)		1.6	11	12	21	26	9.0	4.0	8.0	3.8	8.8		

¹Relative to Chicago City Datum (579.48 ft above mean sea level) at intersection of State and Madison Streets.

TABLE 2: ANALYSIS OF FECAL COLIFORM IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2017 AND ITS DESCRIPTIVE STATISTICS

Well	Fill Event	Week 1 Sample Date	Week 1	Week 2	Week 3
----- CFU/100 mL -----					
MW-5	F1	01/20/17	2	6	<1
	F2	03/03/17	<1	<1	NR ¹
	F3	04/06/17	<1	4	<1
	F4	05/04/17	<1	<1	NR
	F5	07/19/17	17	58	4
	F6	10/18/17	1	10	4
		Minimum	<1	<1	<1
		Median	1	5	2.5
		Mean ²	2	5	2
		Maximum	17	58	4
MW-6	F1	01/19/17	<1	<1	NR
	F2	03/02/17	<1	13	<1
	F3	04/06/17	<1	<1	NR
	F4	05/04/17	1	<1	<1
	F5	07/21/17	25	140	5
	F6	10/20/17	49	7	6
		Minimum	<1	<1	<1
		Median	1	4	3
		Mean	3	5	2
		Maximum	49	140	6
MW-7	F1	01/19/17	<1	<1	NR
	F2	03/02/17	<1	N/S ³	N/S
	F5	07/21/17	5	<1	2
	F6	10/18/17	5	1	<1
		Minimum	<1	<1	<1
		Median	3	1	1.5
		Mean	2	1	1
	Maximum	5	1	2	

TABLE 2 (Continued): ANALYSIS OF FECAL COLIFORM IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2017 AND ITS DESCRIPTIVE STATISTICS

Well	Fill Event	Week 1 Sample Date	Week 1	Week 2	Week 3
			----- CFU/100 mL -----		
MW-8	F1	01/20/17	1	3	<1
	F2	03/03/17	<1	<1	NR
	F3	04/13/17	<1	<1	NR
	F4	05/04/17	<1	2	<1
	F5	07/19/17	100	47	110
	F6	10/18/17	55	4	3
		Minimum	<1	<1	<1
		Median	1	3	2
		Mean	4	3	4
		Maximum	100	47	110

¹NR: Not required since fecal coliform was below the detection limit in Week 1 and Week 2.

²Geometric mean calculated.

³NS: Cannot get sample from the well because recharge time of the well was long.

TABLE 3: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER FROM ANNUAL SAMPLING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2017

Well	Sample Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Temp	Water Elevation ¹	Fecal Coliform
			mS/m			----- mg/L -----				°C	ft	CFU/100 mL
MW-1	10/04/17	7.2	100	946	<1.0	NRR ²	381	0.33	430	15.5	-71	<1
MW-2	02/28/17	7.3	116	818	<1.0	49	425	0.81	481	14.0	-31	<1
MW-3	11/30/17	7.1	108	702	1.0	23	448	0.42	425	14.7	-58	<1
MW-4	10/04/17	7.6	128	1,118	<1.0	82	364	0.22	512	14.4	-84	<1
MW-9	11/30/17	7.5	102	642	1.3	30	324	0.41	331	14.7	-69	<1

¹Relative to Chicago City Datum (579.48 ft above mean sea level) at intersection of State and Madison Streets.

²NRR: No reportable result due to insufficient sample volume.

Adjusted groundwater elevations in monitoring Wells MW-1 through MW-9 were calculated relative to the CCD (579.48 ft. above mean sea level) at the intersection of Madison and State Streets (Table 4). The minimum, mean, and maximum values for each well were calculated and plotted to determine fluctuations in groundwater elevations during the year (Figure 2). Fluctuations were mainly evident in Wells MW-1, -3, -8, and -9 during the year.

TABLE 4: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2017

Date ¹	Observation Well No.								
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9
	----- Elevation (ft) ² -----								
01/13/17	37.8	43.8	39.6	-1.1	-43.6	67.6	21.7	-15.2	4.8
01/24/17	39.8	44.8	41.6	0.9	-56.6	64.6	20.7	-48.2	5.8
02/10/17	36.8	43.8	40.6	-1.1	-49.6	58.6	18.7	27.8	-11.2
02/24/17	37.8	45.8	41.6	0.9	-45.6	63.6	21.7	-16.2	-8.2
03/17/17	38.8	48.8	43.6	1.9	-50.6	65.6	21.7	-51.2	-6.2
03/24/17	37.8	45.8	41.6	1.9	-43.6	64.6	19.7	-18.2	-5.2
04/21/17	36.8	46.8	42.6	1.9	-54.6	64.6	20.7	-33.2	-7.2
04/28/17	38.8	45.8	41.6	0.9	-53.6	66.6	21.7	-50.2	4.8
05/05/17	NA ⁴	44.8	67.6	4.9	-56.6	66.6	19.7	-65.2	19.8
05/26/17	NA	45.8	38.6	3.9	-55.6	67.6	21.7	-61.2	18.8
06/02/17	NA	45.8	40.6	-1.1	-49.6	66.6	20.7	-49.2	6.8
06/23/17	NA	45.8	NA ³	2.9	-49.6	67.6	20.7	-52.2	18.8
07/12/17	39.8	44.8	NA	4.9	-53.6	67.6	26.7	-43.2	19.8
07/25/17	39.8	44.8	NA	5.9	-56.6	66.6	24.7	-46.2	18.8
08/18/17	37.8	44.8	NA	5.9	-48.6	67.6	21.7	-57.2	4.8
08/25/17	38.8	43.8	NA	-1.1	-48.6	67.6	20.7	-45.2	5.8
09/01/17	38.8	43.8	NA	2.9	-49.6	66.6	18.7	-47.2	4.8
09/08/17	37.8	44.8	NA	0.9	-49.6	66.6	19.7	-49.2	3.8
10/06/17	-2.2	45.8	NA	1.9	-47.6	67.6	21.7	-42.2	5.8
10/20/17	35.8	46.8	NA	0.9	-46.6	65.6	22.7	-39.2	4.8
11/09/17	37.8	45.8	NA	-0.1	-48.6	67.6	21.7	-52.2	4.8
11/17/17	36.8	44.8	NA	0.9	-47.6	67.6	20.7	-51.2	3.8
12/12/17	36.8	44.8	NA	1.9	-47.6	67.6	19.7	-30.2	9.8
12/14/17	37.8	44.8	NA	0.9	-46.6	67.6	20.7	-33.2	6.8

¹Date measurements were taken.

²Relative to Chicago City Datum (579.48' above mean sea level) at intersection of State and Madison Streets.

³No reading due to blockage in the well.

⁴Well was not accessible due to construction activity.

FIGURE 2: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATIONS FOR MONITORING/ OBSERVATION WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2017

