

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***MONITORING AND RESEARCH
DEPARTMENT***

REPORT NO. 19-17

TUNNEL AND RESERVOIR PLAN

UPPER DES PLAINES TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2018

July 2019

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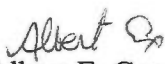
Chief
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Dear Sir or Madam:

Subject: Tunnel and Reservoir Plan, Upper Des Plaines Tunnel System, Annual
Groundwater Monitoring Report for 2018

Attached are three copies of "Tunnel and Reservoir Plan, Upper Des Plaines Tunnel
System, Annual Groundwater Monitoring Report for 2018."

Very truly yours,


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

AC:OO:cm
Attachment

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**TUNNEL AND RESERVOIR PLAN,
UPPER DES PLAINES TUNNEL SYSTEM,
ANNUAL GROUNDWATER MONITORING REPORT
FOR 2018**

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

July 2019

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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 modified monitoring program, 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 program. 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 2018 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 2018 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

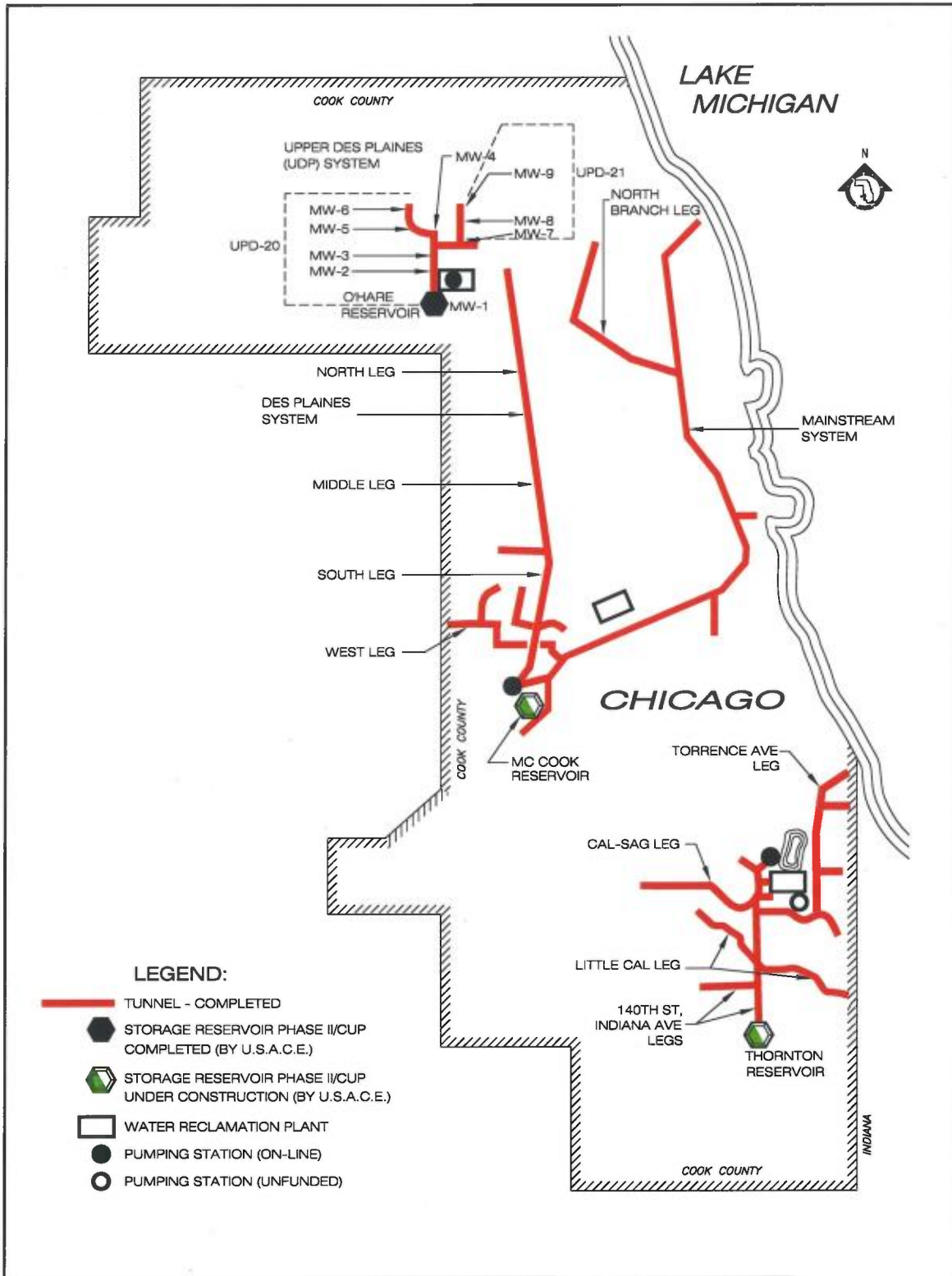


TABLE 1: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2018 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS¹

Wells	Fill Event	Sample Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N ²	Hardness	Temp	Water Elevation ³	Recharge Time
			mS/m		mg/L					°C	ft	hr	
MW-5	F1	02/23/18	8.1	105	1,036	<1.0	435	140	0.4	157	13.5	-20	<48
MW-5	F2	04/19/18	7.0	147	832	<1.0	169	279	0.5	309	14.3	-51	<48
MW-5	F3	05/17/18	8.0	123	780	<1.0	250	140	0.1	146	13.9	-52	<48
MW-5	F4	09/07/18	8.0	127	658	1.2	120	265	<0.5	271	14.5	-57	<48
MW-5	F5	10/11/18	8.6	128	680	1.2	160	111	<0.5	101	13.8	-56	<48
			Minimum	7.0	105	658	<1.0	120	111	<0.5	101	13.5	-57
			Median	8.0	127	780	1.0	169	140	0.5	157	13.9	-52
			Mean	8.0	126	797	1.1	227	187	0.4	197	14.0	-47
			Maximum	8.6	147	1,036	1.2	435	279	0.5	309	14.5	-20
			Standard deviation	0.6	15	151	0.1	126	79	0.2	89	0.4	15
			Coefficient of variation (%)	7.1	12	19	10.1	55	42	42.5	45	2.9	-33
MW-6	F1	02/22/18	7.5	101	708	<1.0	36	322	0.6	369	13.5	69	<4
MW-6	F2	04/18/18	7.4	81	676	1.1	39	481	0.6	365	13.5	67	<4
MW-6	F3	05/17/18	7.7	83	752	1.4	33	318	0.6	297	14.7	68	<4
MW-6	F4	09/05/18	7.5	100	608	1.4	38	320	1.1	311	14.3	67	<4
MW-6	F5	10/12/18	7.6	96	186	1.4	34	338	0.5	341	14.0	67	<4
			Minimum	7.4	81	186	<1.0	33	318	0.5	297	13.5	67
			Median	7.5	96	676	1.4	36	322	0.6	341	14.0	67
			Mean	7.5	92	586	1.3	36	356	0.7	337	14.0	68
			Maximum	7.7	101	752	1.4	39	481	1.1	369	14.7	69
			Standard deviation	0.1	10	230	0.2	3	70	0.2	32	0.5	0.9
			Coefficient of variation (%)	1.4	11	39	15.5	7	20	37.3	10	3.7	1.3
MW-7	F1	02/22/18	6.3	113	802	<1.0	40	353	0.6	471	15.0	27	<4
MW-7	F2	04/18/18	7.2	115	792	1.6	37	396	0.6	490	14.3	27	<4
MW-7	F3	05/18/18	7.8	113	962	1.6	38	403	0.5	484	15.0	19	<4

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 2018 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS¹

Wells	Fill Event	Sample Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N ²	Hardness	Temp	Water Elevation ³	Recharge Time
				mS/m	mg/L					°C	ft	hr	
MW-7	F4	09/05/18	7.1	102	642	1.1	35	355	0.5	437	16.6	20	<4
MW-7	F5	10/08/18	7.1	114	836	<1.0	37	403	0.6	476	16.6	24	<4
Minimum			6.3	102	642	<1.0	35	353	0.5	437	14.3	19	
Median			7.1	113	802	1.1	37	396	0.6	476	15.0	24	
Mean			7.1	111	807	1.3	37	382	0.6	472	15.5	23	
Maximum			7.8	115	962	1.6	40	403	0.6	490	16.6	27	
Standard deviation			0.5	5.5	114	0.3	1.8	26	0.0	21	1.0	3.8	
Coefficient of variation (%)			7.6	5.0	14	24.8	4.9	6.7	7.6	4.4	6.7	16	
MW-8	F1	02/23/18	7.9	105	650	1.2	79	248	0.3	346	11.4	-25	<48
MW-8	F2	04/19/18	7.8	112	758	1.1	43	376	0.1	449	11.9	-31	<48
MW-8	F3	05/17/18	7.7	111	916	1.0	47	369	0.2	434	12.4	-7.2	<48
MW-8	F4	09/07/18	7.8	100	378	1.7	65	264	<0.5	312	13.8	-28	<48
MW-8	F5	10/11/18	8.4	103	744	1.3	42	337	<0.5	416	12.5	-39	<48
Minimum			7.7	100	378	1.0	42	248	<0.5	312	11.4	-39	
Median			7.8	105	744	1.2	47	337	0.3	416	12.4	-28	
Mean			7.9	106	689	1.3	55	319	0.3	391	12.4	-26	
Maximum			8.4	112	916	1.7	79	376	0.5	449	13.8	-7.2	
Standard deviation			0.3	5.2	198	0.3	16	60	0.2	59	0.9	12	
Coefficient of variation (%)			3.5	4.6	29	21.4	29	19	58.3	15	7.2	-45	

¹For values less than reporting limits, the reporting limits were used in calculation of descriptive statistics.

²Reporting limits changed to 0.5 mg/L in July 2018 due to the change in the test equipment.

³Relative to Chicago City Datum (579.48 ft above mean sea level) at intersection of Madison and State 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 2018 AND ITS
 DESCRIPTIVE STATISTICS¹

Well	Fill Event	Sample Date	Week 1			Week 2			Week 3		
			CFU/100mL	NRR	NReq	CFU/100mL	NRR	NReq	CFU/100mL	NRR	NReq
MW-5	F1	02/23/18	<1	<1	<1	<1	<1	<1	<1	<1	NReq ⁴
	F2	04/19/18	<1	<1	4	4	<1	<1	<1	<1	<1
	F3	05/17/18	4	4	1	1	<1	<1	<1	<1	<1
	F4	09/07/18	4	4	15	15	47	47	47	47	47
	F5	10/11/18	<1	<1	<1	<1	<1	<1	<1	<1	NReq
		Minimum	<1	<1	<1	<1	<1	<1	<1	<1	<1
		Median	1	1	1	1	1	1	1	1	1
		Mean ²	2	2	2	2	2	2	2	2	2
		Maximum	4	4	15	15	47	47	47	47	47
MW-6	F1	02/22/18	NRR ³	<1	<1	<1	<1	<1	<1	<1	<1
	F2	04/18/18	<1	<1	<1	<1	<1	<1	<1	<1	<1
	F3	05/17/18	96	96	2,700	2,700	200	200	200	200	200
	F4	09/05/18	1	1	1	1	2	2	2	2	2
	F5	10/12/18	340	340	61	61	6	6	6	6	6
		Minimum	<1	<1	<1	<1	<1	<1	<1	<1	<1
		Median	49	49	1	1	4	4	4	4	4
		Mean	13	13	11	11	7	7	7	7	7
		Maximum	340	340	2,700	2,700	200	200	200	200	200
MW-7	F1	02/22/18	NRR	<1	4	4	4	4	4	4	4
	F2	04/18/18	1	1	<1	<1	1	1	1	1	1
	F3	05/18/18	23	23	3	3	<1	<1	<1	<1	<1
	F4	09/05/18	<1	<1	<1	<1	NReq	NReq	NReq	NReq	NReq
	F5	10/08/18	<1	<1	<1	<1	<1	<1	<1	<1	<1
		Minimum	<1	<1	<1	<1	<1	<1	<1	<1	<1
		Median	1	1	2	2	1	1	1	1	1
		Mean	2	2	3	3	1	1	1	1	1
		Maximum	23	23	4	4	4	4	4	4	4

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 2018 AND ITS
 DESCRIPTIVE STATISTICS

Well	Fill Event	Week 1 Sample Date	Week 1		
			Week 1	Week 2	Week 3
			----- CFU/100mL -----		
MW-8	F1	02/23/18	8,200	91	17
	F2	04/19/18	2	<1	<1
	F3	05/17/18	4	4	3
	F4	09/07/18	14	2	35
	F5	10/11/18	<1	1	<1
		Minimum	<1	<1	<1
		Median	4	2	3
		Mean	16	4	4
	Maximum	8,200	91	35	

¹For values less than minimum and greater than maximum reporting limits, the minimum and maximum reporting limits were used in calculation of descriptive statistics.

²Geometric mean calculated.

³NRR: No reportable result due to confluent growth of fecal coliform.

⁴NReq: Sampling was not required because fecal coliform was below reporting limit in the previous week.

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 2018

Well	Sample Date	pH	EC	TDS	TOC	Cl	SO ₄ ²⁻	NH ₃ -N ¹	Hardness	Temp	Water Elevation ²	Fecal Coliform
			mS/m	----- mg/L -----						°C	ft	CFU/100 mL
MW-1	06/13/18	7.5	102	958	<1.0	31	390	0.4	449	15.7	26	<1
MW-2	08/22/18	7.1	65	1,052	6.3	55	428	0.6	485	20.3	45	<1
MW-3	12/05/18	7.6	108	820	1.1	29	470	<0.5	459	14.2	36	<1
MW-4	12/05/18	7.5	116	896	1.1	73	373	<0.5	549	13.7	4	<1
MW-9	06/13/18	7.7	99	926	1.2	30	356	0.4	381	14.8	19	<1

¹Reporting limits changed to 0.5 mg/L in July 2018 due to the change in test equipment

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

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-4, -5, -7, -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 2018

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 -----								
01/03/18	37.8	46.8	NA ³	2.5	-48.2	68.3	52.7	-18.2	19.8
01/12/18	37.8	44.8	NA	-0.5	-48.2	68.3	52.7	-19.2	8.8
02/02/18	36.8	43.8	NA	-2.6	-48.2	67.3	20.7	-21.2	6.8
02/16/18	NA	45.8	NA	NA	NA	NA	50.7	NA	NA
03/16/18	35.8	43.8	NA	-1.6	-46.2	67.3	21.7	9.8	2.8
03/23/18	36.8	42.8	NA	-3.6	-48.2	68.3	20.7	24.8	4.8
04/06/18	37.8	46.8	NA	-0.5	-48.2	67.3	23.7	23.8	7.8
05/11/18	37.8	47.8	43.0	4.5	-41.2	68.3	NA	14.8	17.8
06/15/18	37.8	46.8	NA	0.5	-42.2	68.3	NA	22.8	8.8
06/21/18	NA	NA	44.0	-0.5	-41.2	69.3	NA	22.8	8.8
07/06/18	38.8	45.8	NA	-7.6	-49.2	65.3	NA	-11.2	0.8
07/31/18	37.8	45.8	NA	2.5	-40.2	64.3	NA	23.8	5.8
08/02/18	37.8	45.8	NA	2.5	-40.2	65.3	NA	22.8	7.8
08/17/18	39.8	47.8	NA	2.5	-38.2	67.3	NA	23.8	8.8
08/24/18	37.8	47.8	NA	1.5	-41.2	66.3	NA	0.8	-4.2
09/25/18	38.8	47.8	NA	4.5	-39.2	65.3	NA	2.8	5.8
10/05/18	38.8	45.8	NA	4.5	-39.2	65.3	NA	5.8	6.8
10/26/18	36.8	47.8	NA	3.5	-54.2	66.3	NA	-50.2	6.8

TABLE 4 (Continued): 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 2018

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 -----								
11/02/18	36.8	46.8	43.95	2.5	-51.2	67.3	NA	0.8	7.8
11/14/18	35.8	46.8	41.95	0.5	-50.2	68.3	NA	22.8	6.8

¹Date measurements were taken.

²Relative to Chicago city datum (579.48 ft above mean sea level) at intersection of State and Madison Streets.

³No reading: MW-3 and MW-7, probes were stuck, so some measurements were discontinued; Inaccessible to some observation wells due to snow coverage on 02/16/18 observation and construction activities in vicinity of wells for one June observation.

FIGURE 2: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATIONS FOR MONITORING/OBSERVATION WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2018

