MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 20-16

TUNNEL AND RESERVOIR PLAN

MAINSTREAM TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2019

July 2020

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

CECIL LUE-HING RESEARCH AND DEVELOPMENT COMPLEX
6001 WEST PERSHING ROAD CICERO, ILLINOIS 60804-4112

Edward W. Podczerwinski, P.E.
Director of Monitoring and Research

July 16, 2020

Chief
Bureau of Water
Illinois Environmental Protection Agency
P. O. Box 19276
Springfield, IL 62794-9276

Dear Sir or Madam:

Subject: Tunnel and Reservoir Plan, Mainstream Tunnel System, Annual Groundwater Monitoring Report for 2019

Attached are three copies of the "Tunnel and Reservoir Plan, Mainstream Tunnel System, Annual Groundwater Monitoring Report for 2019."

Very truly yours,

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

AC:EE:cm
Attachment
cc w/att: Mr. Ryan Bahr (USEPA Region 5 - WC15J) - (2)
Mr. E. Podczerwinski
Dr. H. Zhang
cc w/o att: Mr. J. Murray
Mr. T. Conway

Metropolitan Water Reclamation District of Greater Chicago
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TUNNEL AND RESERVOIR PLAN, MAINSTREAM TUNNEL SYSTEM, ANNUAL GROUNDWATER MONITORING REPORT FOR 2019

Monitoring and Research Department
Edward W. Podczerwinski, Director

July 2020

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LIST OF ABBREVIATIONS

°C	degrees Celsius
CCD	Chicago City Datum
CFU	colony forming units
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
TARP	Tunnel and Reservoir Plan
TDS	total dissolved solids
Temp	temperature
TOC	total organic carbon

ANNUAL DATA FOR MONITORING AND OBSERVATION WELLS

Introduction

The monitoring and observation wells are located along the length of the Mainstream Tunnel System between Morton Grove and Hodgkins, Illinois (Figures 1 and 2). The elevations for the observation wells were measured monthly during 2019. The monitoring wells were sampled based on the modified groundwater monitoring program for the Metropolitan Water Reclamation District of Greater Chicago's (District) 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 program, nine wells (QM-61, -62, -63, -64, -65, -67, -68, -75, and -77), which had fecal coliform (FC) 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 is done weekly for three weeks. The samples collected during the first week of sampling are analyzed for all parameters in the original monitoring program, including: pH, temperature, electrical conductivity, total dissolved solids, hardness, ammonia, dissolved organic carbon, chloride, sulfate, and FC. However, the samples from the second and third weeks are analyzed for only FC.

The other 13 monitoring wells associated with the Mainstream Tunnel System are sampled once per year. These wells had FC detected in less than 10 percent of samples during the period 1995 – 2013.

In 1994, the termination of monitoring for wells QM-51, -52, -54, -55, -57, and -60 was approved by the IEPA (memorandum dated May 4, 1994). Monitoring well QM-59 has been dry since February 1995 and is no longer monitored. Monitoring wells QM-56 and QM-58 will be properly abandoned as indicated in the modified program. Monitoring of observation well OM-17 was also discontinued with the approval of the IEPA (letter dated December 16, 2011). No samples were obtained from well QM-66 in 2019 because the well was dry.

Summary of Data

Monitoring Wells. The analytical data for groundwater sampled during 2019 from fill event-based monitoring wells QM-61 through QM-68 (except QM-66), QM-75 and -77, 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 FC data for groundwater sampled during 2019

FIGURE 1: MAP OF THE MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM

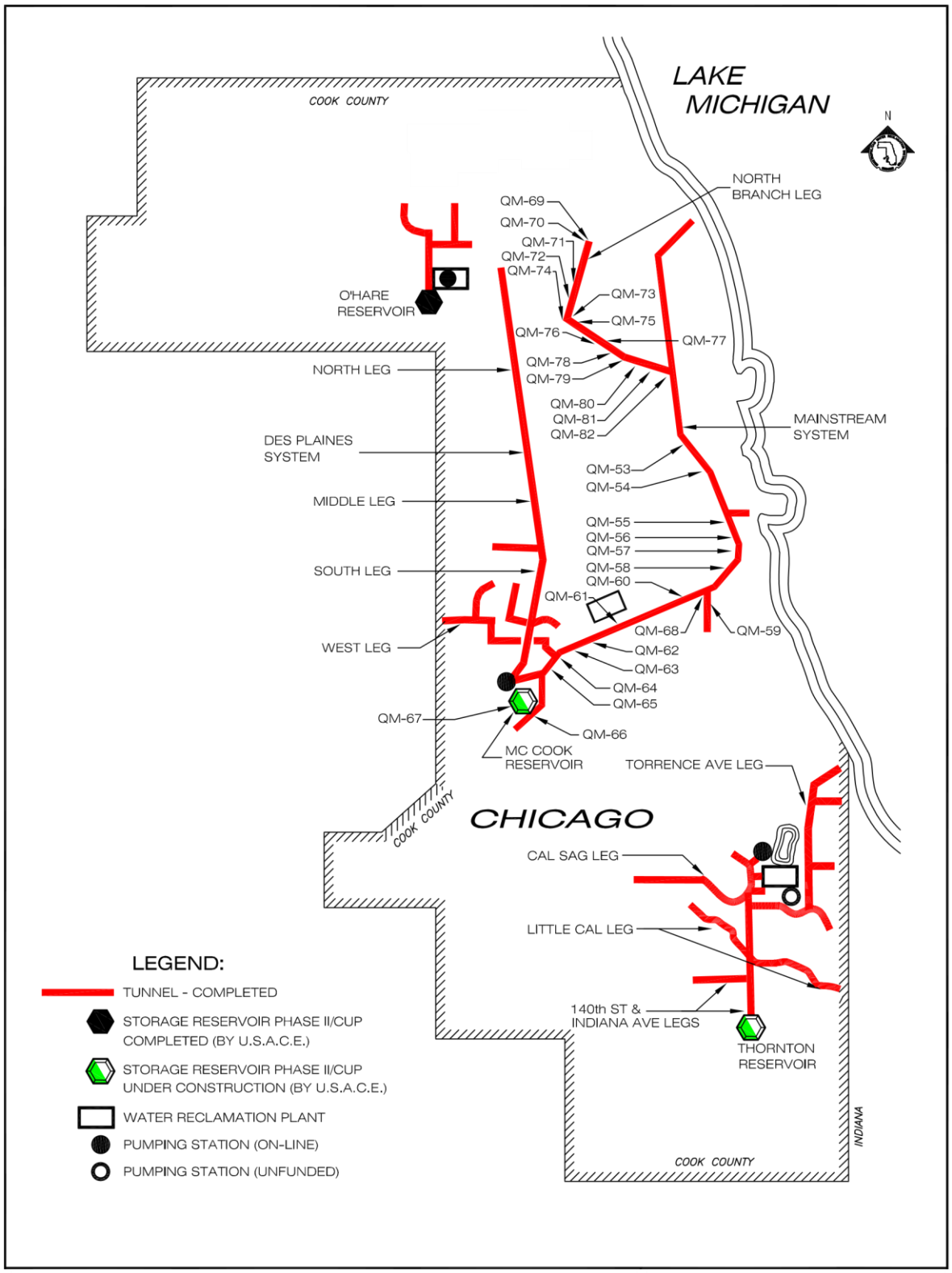


FIGURE 2: MAP OF THE OBSERVATION WELLS IN THE MAINSTREAM TUNNEL SYSTEM

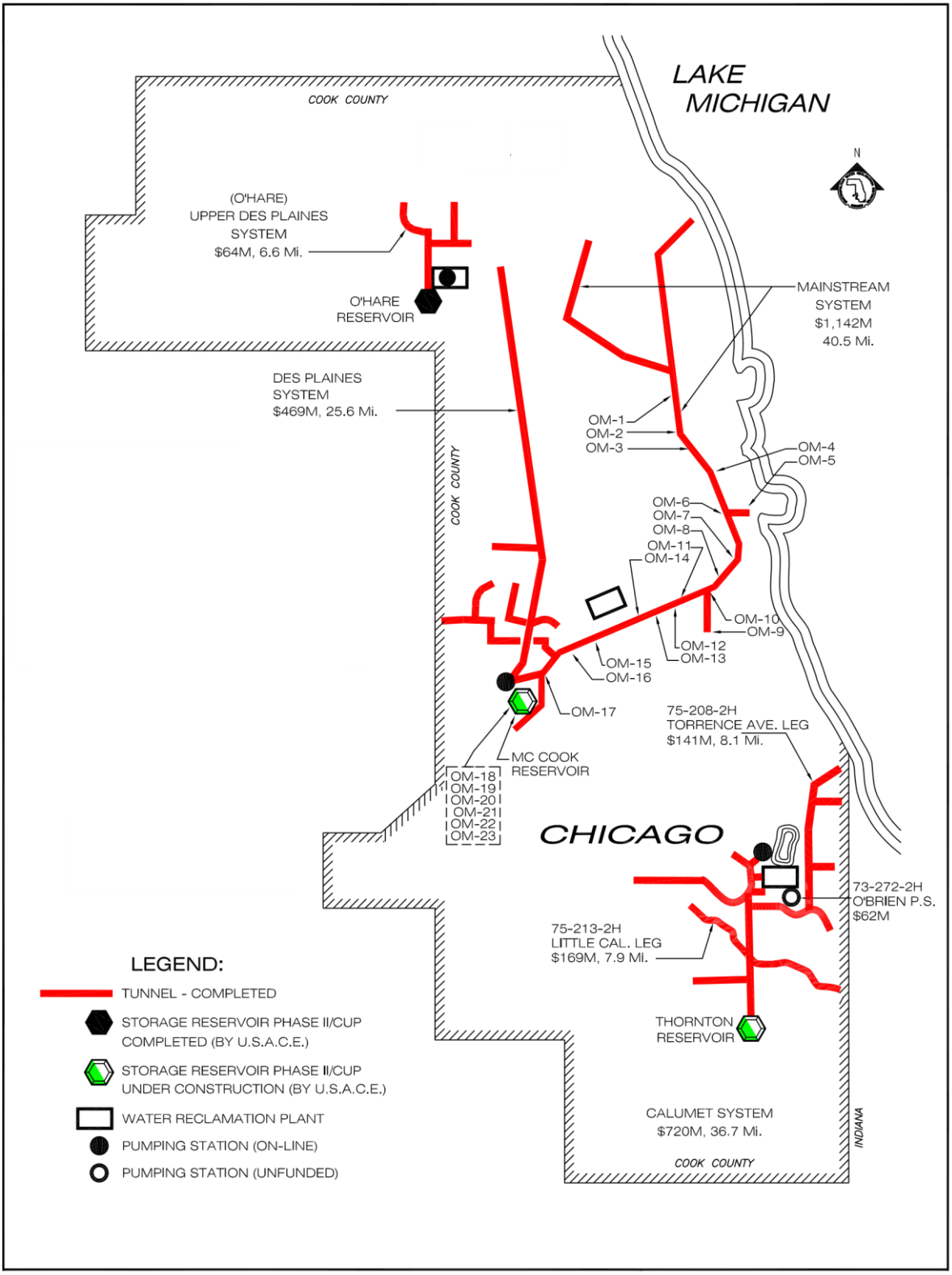


TABLE 1: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT IN MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2019 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS[1]

Well	Fill Event	Sampled Date	pH	EC	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N^2	Hardness	Temp	Water Elevation[3]	Recharge Time
				mS/m	---------- mg/L ----------						^0C	ft	hr
QM-61	F1	02/11/19	8.2	138	1,030	1.0	456	63	2.2	259	13.9	-115	<4
QM-61	F2	03/19/19	7.3	77	528	2.1	223	22	3.1	154	13.6	-109	<4
QM-61	F3	04/23/19	7.7	70	370	1.3	101	11	0.70	121	12.7	-123	<4
QM-61	F4	08/02/19	7.9	47	348	1.0	77	2.0	1.0	107	14.0	-114	<4
QM-61	F5	10/02/19	7.9	31	262	1.5	51	15	1.0	94	13.8	-107	<4
		Minimum	7.3	31	262	1.0	51	2.0	0.70	94	12.7	-123	
		Median	7.9	70	370	1.3	101	15	1.0	121	13.8	-114	
		Mean	7.8	73	508	1.4	182	23	1.6	147	13.6	-114	
		Maximum	8.2	138	1,030	2.1	456	63	3.1	259	14.0	-107	
		Standard deviation	0.3	41	307	0.5	167	24	1.0	66	0.52	6.0	
		Coefficient of variation (%)	4.0	56	61	33	92	105	63	45	4.0	5.0	
QM-62	F1	02/15/19	7.6	124	688	1.3	253	45	1.3	247	13.9	-116	<48
QM-62	F2	03/20/19	7.7	60	430	1.2	95	46	0.70	256	13.9	-107	<48
QM-62	F3	04/24/19	7.6	55	488	1.4	47	48	0.60	866	13.9	-132	<48
QM-62	F4	08/02/19	8.1	54	418	1.0	54	40	0.60	173	14.3	-118	<48
QM-62	F5	10/01/19	7.4	47	390	1.5	53	54	0.70	176	14.3	-111	<48
		Minimum	7.4	47	390	1.0	47	40	0.60	173	13.9	-132	
		Median	7.6	55	430	1.3	54	46	0.70	247	13.9	-116	
		Mean	7.7	68	483	1.3	100	47	0.80	344	14.1	-116	
		Maximum	8.1	124	688	1.5	253	54	1.30	866	14.3	-107	
		Standard deviation	0.3	32	120	0.2	87	5.0	0.30	296	0.20	10	
		Coefficient of variation (%)	3.0	47	25	15	87	11	36	86	2.0	8.0	

TABLE 1 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT IN MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2019 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS[1]

Well	Fill Event	Sampled Date	pH	EC	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N^2	Hardness	Temp	Water Elevation[3]	Recharge Time
				mS/m	---------- mg/L ----------						^0C	ft	hr
QM-63	F1	02/15/19	7.7	143	1,654	1.8	69	929	2.5	858	13.5	-105	<48
QM-63	F2	03/20/19	7.4	133	1,696	2.3	56	NDR[4]	2.7	985	13.7	-98	<48
QM-63	F3	04/24/19	7.3	158	1,694	2.5	49	997	2.5	864	13.9	-130	<48
QM-63	F4	08/02/19	7.7	144	1,830	2.0	50	1,025	2.5	946	14.0	-109	<48
QM-63	F5	10/01/19	7.4	116	1,606	2.3	48	914	2.3	826	14.4	-92	<48
		Minimum	7.3	116	1,606	1.8	48	914	2.3	826	13.5	-130	
		Median	7.4	143	1,694	2.3	50	963	2.5	864	13.9	-105	
		Mean	7.5	139	1,696	2.2	54	966	2.5	896	13.9	-107	
		Maximum	7.7	158	1,830	2.5	69	1,025	2.7	985	14.4	-92	
		Standard deviation	0.2	16	83	0.3	9.0	53	0.10	67	0.3	15	
		Coefficient of variation (%)	3.0	11	5.0	13	16	6.0	5.0	7.0	2.0	14	
QM-64	F1	02/11/19	7.5	56	402	<1.0	54	48	1.8	192	13.6	-125	<4
QM-64	F2	03/19/19	7.5	60	410	1.1	78	34	1.7	210	13.8	-107	<4
QM-64	F3	04/23/19	7.5	58	426	1.1	57	38	1.5	207	13.7	-123	<4
QM-64	F4	08/02/19	7.7	54	416	<1.0	55	32	1.4	196	14.2	-116	<4
QM-64	F5	10/02/19	7.8	47	410	1.1	51	36	1.4	200	14.1	-109	<4
		Minimum	7.5	47	402	<1.0	51	32	1.4	192	13.6	-125	
		Median	7.5	56	410	1.1	55	36	1.5	200	13.8	-116	
		Mean	7.6	55	413	1.1	59	38	1.6	201	13.9	-116	
		Maximum	7.8	60	426	1.1	78	48	1.8	210	14.2	-107	
		Standard deviation	0.1	5.0	8.9	0.1	11	6.0	0.20	7.5	0.3	8.0	
		Coefficient of variation (%)	2.0	9.0	2.0	5.0	18	17	12	4.0	2.0	7.0	

TABLE 1 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT IN MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2019 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS[1]

Well	Fill Event	Sampled Date	pH	EC	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N^2	Hardness	Temp	Water Elevation[3]	Recharge Time
				mS/m	mg/L						^{0}C	ft	hr
QM-65	F1	02/15/19	7.7	96	808	1.8	144	175	5.6	359	12.6	-130	<48
QM-65	F2	03/20/19	7.5	98	594	2.1	114	139	5.0	310	13.5	-120	<48
QM-65	F3	04/24/19	7.6	94	682	1.9	111	130	4.5	288	13.3	-147	<48
QM-65	F4	08/01/19	7.4	91	746	1.9	120	129	4.4	312	13.9	-135	<48
QM-65	F5	10/01/19	7.2	87	722	2.6	115	129	4.7	329	14.2	-137	<48
		Maximum	7.7	98	808	2.6	144	175	5.6	359	14.2	-120	
		Standard deviation	0.2	4.0	80	0.3	13	20	0.50	26	0.6	10	
		Coefficient of variation (%)	2.0	5.0	11	16	11	14	10	8.0	5.0	7.0	
QM-67	F1	02/15/19	7.3	94	722	3.0	217	24	13.9	271	12.4	-168	<48
QM-67	F2	03/20/19	7.3	135	1,054	2.3	417	48	13.9	369	11.9	-153	<48
QM-67	F3	04/24/19	7.2	153	1,022	2.9	387	54	13.0	331	13.9	-155	<48
QM-67	F4	08/01/19	7.2	101	782	3.0	226	7.0	12.2	288	14.8	-156	<48
QM-67	F5	10/01/19	7.3	100	732	3.7	180	5.0	13.0	285	14.5	-170	<48
		Minimum	7.2	94	722	2.3	180	5	12.2	271	11.9	-170	
		Median	7.3	101	782	3.0	226	24	13.0	288	13.9	-156	
		Mean	7.3	117	862	3.0	285	28	13.2	309	13.5	-161	
		Maximum	7.3	153	1,054	3.7	417	54	13.9	369	14.8	-153	
		Standard deviation	0.1	26	162	0.5	108	23	0.70	41	1.3	8.0	
		Coefficient of variation (%)	1.0	22	19	17	38	82	6.0	13	10	5.0	
QM-68	F1	02/15/19	7.3	90	662	1.3	160	55	0.90	408	12.5	-100	<48
QM-68	F2	03/20/19	7.3	81	584	1.4	155	51	1.0	428	13.3	-95	<48
QM-68	F3	04/24/19	7.3	89	656	1.8	151	50	0.80	379	13.5	-107	<48

TABLE 1 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT IN MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2019 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS[1]

Well	Fill Event	Sampled Date	pH	EC	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N^2	Hardness	Temp	Water Elevation[3]	Recharge Time
				mS/m	mg/L						^0C	ft	hr
QM-68	F4	08/01/19	7.5	84	712	1.3	150	55	0.80	394	13.8	-103	<48
QM-68	F5	10/04/19	7.3	87	628	1.6	144	52	1.0	429	13.1	99	<48
		Minimum	7.3	81	584	1.3	144	50	0.80	379	12.5	-107	
		Median	7.3	87	656	1.4	151	52	0.90	408	13.3	-100	
		Mean	7.3	86	648	1.5	152	53	0.90	408	13.2	-61	
		Maximum	7.5	90	712	1.8	160	55	1.0	429	13.8	99	
		Standard deviation	0.1	4.0	47	0.2	6.0	2.0	0.10	22	0.5	90	
		Coefficient of variation (%)	1.0	5.0	7.0	15	4.0	4.0	11	5.0	4.0	147	
QM-75	F1	02/15/19	8.0	25	220	<1.0	15	10	<0.50	63	10.8	-70	<48
QM-75	F2	03/21/19	7.9	27	196	<1.0	15	11	<0.50	58	11.4	-64	<48
QM-75	F3	04/25/19	7.7	28	210	<1.0	14	12	<0.30	61	12.4	-81	<48
QM-75	F4	08/01/19	7.9	26	240	<1.0	14	13	<0.30	62	13.1	-79	<48
QM-75	F5	10/04/19	8.1	24	232	<1.0	13	8.0	0.30	107	12.0	-43	<48
		Minimum	7.7	24	196	<1.0	13	8.0	<0.30	58	10.8	-81	
		Median	7.9	26	220	1.0	14	11	0.30	62	12.0	-70	
		Mean	7.9	26	220	1.0	14	11	0.40	70	11.9	-68	
		Maximum	8.1	28	240	<1.0	15	13	<0.50	107	13.1	-43	
		Standard deviation	0.2	1.0	17.5	0.0	1.0	2.0	0.10	21	0.9	15	
		Coefficient of variation (%)	2.0	6.0	8.0	0.0	6.0	18	27	29	7.0	22	
QM-77	F1	02/15/19	7.9	20	176	<1.0	20	2.0	<0.50	42	11.4	-104	<48
QM-77	F2	03/21/19	8.3	22	106	<1.0	19	2.0	<0.50	38	11.6	-107	<48
QM-77	F3	04/25/19	8.1	20	150	<1.0	12	2.0	<0.30	42	13.6	-173	<48

TABLE 1 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT IN MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2019 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS[1]

Well	Fill Event	Sampled Date	pH	EC	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N^2	Hardness	Temp	Water Elevation[3]	Recharge Time
				mS/m	---------- mg/L ----------						^0C	ft	hr
QM-77	F4	08/01/19	8.0	19	192	<1.0	12	2.0	<0.30	49	13.4	-142	<48
QM-77	F5	10/04/19	8.4	20	176	<1.0	13	2.0	<0.30	63	12	-55	<48
		Minimum	7.9	19	106	<1.0	12	2.0	<0.30	38	11.4	-173	
		Median	8.1	20	176	<1.0	13	2.0	0.30	42	12.0	-107	
		Mean	8.2	20	160	1.0	15	2.0	0.40	47	12.4	-116	
		Maximum	8.4	22	192	<1.0	20	2.0	<0.50	63	13.6	-55	
		Standard deviation	0.2	1.0	34	0.0	4.0	0.0	0.10	9.9	1.0	44	
		Coefficient of variation (%)	2.0	5.0	21	0.0	26	0.0	29	21	8.0	38	

[1]For values less than reporting limits, the reporting limits were used in calculation of descriptive statistics.
[2]Detection limit changed to <0.3 starting April 8, 2019.
[3]Relative to Chicago City Datum (579.48 ft above sea level) at intersection of Madison and State Streets.
[4]No reportable result due to failure of QA/QC checks during lab analysis.

from these monitoring wells, along with descriptive statistics, are presented in Table 2. The analytical data for groundwater from the 13 wells sampled once per year are presented in Table 3.

Observation Wells. Adjusted groundwater elevations were calculated relative to the CCD (579.48 ft above mean sea level) at the intersection of Madison and State Streets (Table 4). No measurement was conducted at well OM-2, as it is adjacent to a sinkhole, at well OM-12 due to blockage by construction, and well OM-13, which was damaged by a truck. The minimum, mean, and maximum values for each well were calculated and plotted to determine fluctuations in groundwater elevations during the year (Figure 3). Generally, these fluctuations appeared to be minimal throughout the year. However, there were significant fluctuations in groundwater elevations of 43, 76, 90, 70, and 131 ft in Wells OM-14, -18, -19, -20, and -23, respectively, which could indicate the possibility of exfiltration from the Mainstream tunnel during the year.

TABLE 2: ANALYSIS OF FECAL COLIFORM IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2019 AND ITS DESCRIPTIVE STATISTICS[1]

Well	Fill event	Week 1 Sample Date	Week 1	Week 2	Week 3
			----------CFU/100 mL----------		
QM-61	F1	02/11/19	42,000	350	160,000
	F2	03/19/19	23,000	100	46
	F3	04/23/19	4	110,000	36,000
	F4	08/02/19	1	<1	1
	F5	10/02/19	530	2,900	390
		Minimum	1	<1	1
		Median	530	350	390
		Mean[2]	290	409	635
		Maximum	42,000	110,000	160,000
QM-62	F1	02/15/19	7,600	55	26,000
	F2	03/20/19	690	48	10
	F3	04/24/19	1	75,000	40,000
	F4	08/02/19	18	100	16
	F5	10/01/19	3,500	7,200	220
		Minimum	1	48	10
		Median	690	100	220
		Mean	201	677	516
		Maximum	7,600	75,000	40,000
QM-63	F1	02/15/19	1,400	29	40,000
	F2	03/20/19	380	25	4
	F3	04/24/19	<1	58,000	24,000
	F4	08/02/19	<1	1	<1
	F5	10/01/19	860	36,000	550
		Minimum	<1	1	<1
		Median	380	29	550
		Mean	54	273	292
		Maximum	1,400	58,000	40,000
QM-64	F1	02/11/19	210	97	22
	F2	03/19/19	8	3	3

TABLE 2 (Continued): ANALYSIS OF FECAL COLIFORM IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2019 AND ITS DESCRIPTIVE STATISTICS[1]

Well	Fill event	Week 1 Sample Date	Week 1	Week 2	Week 3
			----------CFU/100 mL----------		
	F3	04/23/19	1	<1	15
	F4	08/02/19	2,000	530	110
	F5	10/02/19	4	83	9
		Minimum	1	<1	3
		Median	8	83	15
		Mean	27	26	16
		Maximum	2,000	530	110
QM-65	F1	02/15/19	3	2	14
	F2	03/20/19	4	2	1
	F3	04/24/19	<1	27	140
	F4	08/01/19	<1	<1	NReq[3]
	F5	10/01/19	11	53	6
		Minimum	<1	<1	1
		Median	3	2	10
		Mean	3	6	10
		Maximum	11	53	140
QM-67	F1	02/15/19	6,800	2,500	350
	F2	03/20/19	2,700	1,200	590
	F3	04/24/19	1,000	2,000	6,400
	F4	08/01/19	41,000	40,000	120,000
	F5	10/01/19	4,400	13,000	9,100
		Minimum	1,000	1,200	350
		Median	4,400	2,500	6,400
		Mean	5,059	4,998	4,284
		Maximum	41,000	40,000	120,000
QM-68	F1	02/15/19	<1	<1	NReq
	F2	03/20/19	<1	<1	NReq
	F3	04/24/19	<1	140	690
	F4	08/01/19	<1	<1	NReq
	F5	10/04/19	140	35	1

TABLE 2 (Continued): ANALYSIS OF FECAL COLIFORM IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2019 AND ITS DESCRIPTIVE STATISTICS[1]

Well	Fill event	Week 1 Sample Date	Week 1	Week 2	Week 3
			----------CFU/100 mL----------		
		Minimum	<1	<1	1
		Median	1	1	346
		Mean	3	5	26
		Maximum	140	140	690
QM-75	F1	02/15/19	<1	<1	NReq
	F2	03/21/19	<1	<1	NReq
	F3	04/25/19	<1	450	86
	F4	08/01/19	1	<1	3
	F5	10/04/19	9	20	1
		Minimum	<1	<1	1
		Median	1	1	3
		Mean	2	6	6
		Maximum	9	450	86
QM-77	F1	02/15/19	670	73	1,300
	F2	03/21/19	810	47	5
	F3	04/25/19	<1	4,900	740
	F4	08/01/19	2	1	17
	F5	10/04/19	5,000	330	17
		Minimum	<1	1	5
		Median	670	73	17
		Mean	88	89	67
		Maximum	5,000	4,900	1,300

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

[2]Geometric mean calculated.

[3]NReq: Sampling is not required because the fecal coliform level was below detection limit in the previous week.

TABLE 3: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER FROM ANNUAL SAMPLING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2019

Well	Sampled 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
QM-53	08/28/19	7.7	24	182	<1.0	17	40	<0.30	140	11.3	-33	<1
QM-69	09/25/19	8.1	33	284	1.3	37	32	0.90	131	11.8	-20	<1
QM-70	09/25/19	7.9	38	312	1.0	48	56	0.43	147	12.6	-58	<1
QM-71	09/25/19	7.8	55	438	1.0	122	71	0.48	189	12.0	-66	<1
QM-72	09/25/19	7.8	46	334	1.1	122	2.0	0.42	208	12.5	-73	<1
QM-73	09/25/19	7.3	36	290	1.4	38	3.0	0.42	152	13.3	-161	1
QM-74	06/20/19	8.2	32	240	1.2	57	1.0	<0.30	100	11.6	7.0	<1
QM-76	06/20/19	8.5	35	290	1.0	12	61	<0.30	57	12.6	-187	<1
QM-78	06/20/19	8.8	31	290	<1.0	11	45	<0.30	10	12.2	-172	<1
QM-79	06/20/19	8.8	30	250	<1.0	15	19	<0.30	12	11.4	-124	<1
QM-80	05/23/19	8.3	25	174	<1.0	13	2.0	<0.30	21	14.0	-128	<1
QM-81	05/23/19	8.6	41	224	<1.0	22	10	<0.30	30	13.0	-101	<1
QM-82	05/23/19	8.6	34	272	1.2	30	7.0	<0.30	16	13.1	-179	<1

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

TABLE 4: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2019

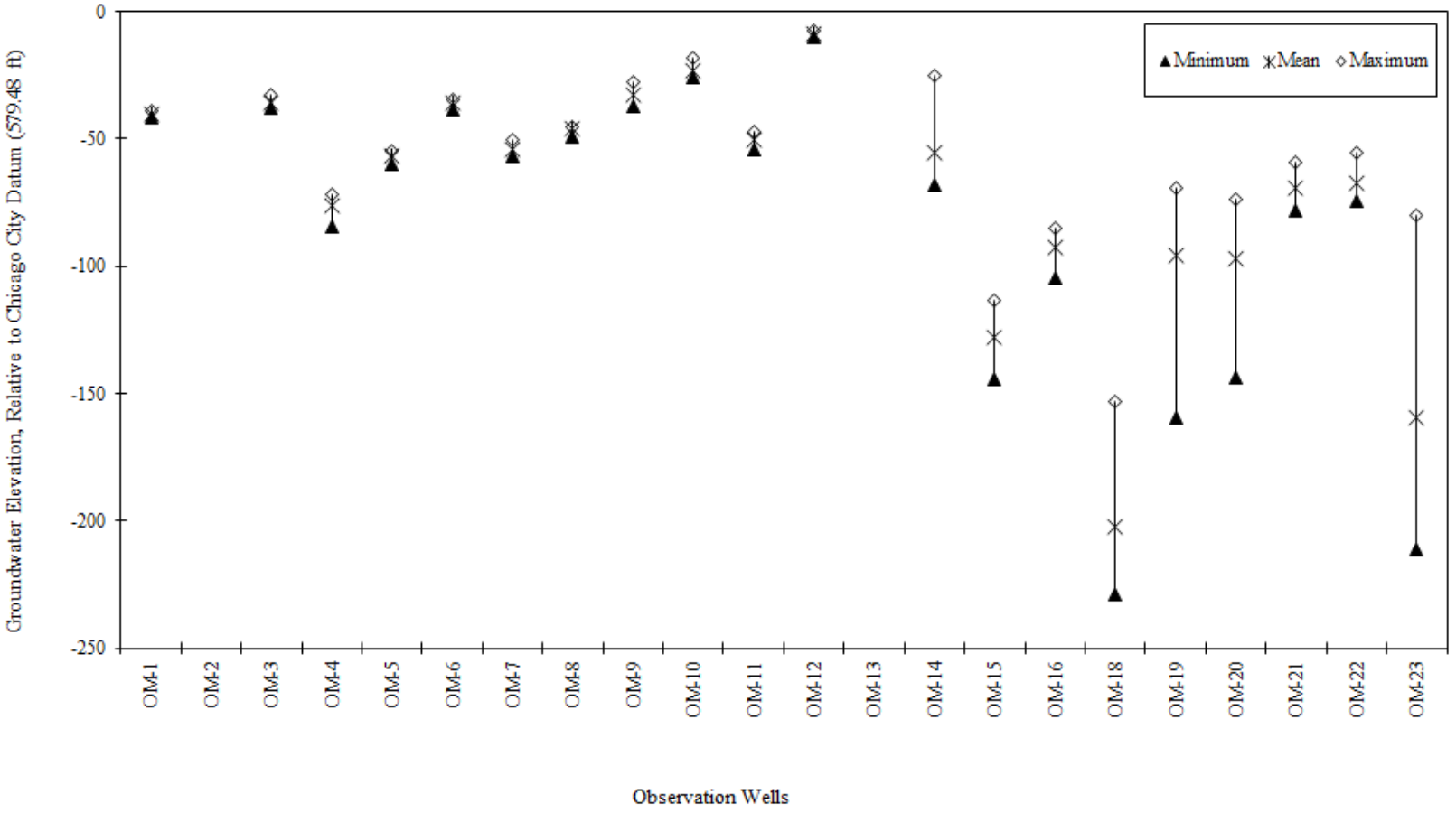
Date[1]	Observation Well No.										
	OM-1[3]	OM-2[3]	OM-3	OM-4	OM-5	OM-6	OM-7	OM-8	OM-9	OM-10	OM-11
	Elevation (ft)[2]										
01/18/19	-41.8	NA	-37.7	-80.6	-59.5	-35.4	-56.6	-47.2	-32.8	-26	-51.4
02/28/19	NA	NA	NA	-84.6	NA	NA	NA	-49.2	-33.8	-18	NA
03/29/19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-54.4
04/12/19	NA	NA	-36.7	-78.6	-58.5	-37.4	-55.6	-46.2	-31.8	-24	-47.4
06/14/19	NA	NA	-32.7	-71.6	-55.5	-38.4	-54.6	-45.2	-27.8	-19	-47.4
07/05/19	NA	NA	-35.7	-74.6	-56.5	-36.4	-54.6	-45.2	-28.8	-23	-50.4
08/28/19	NA	NA	-35.7	-73.6	-55.5	NA	-50.6	-46.2	-31.8	-24	-48.4
09/20/19	NA	NA	-36.7	-75.6	-56.5	-35.4	-54.6	-45.2	-33.8	-25	NA
10/18/19	-38.8	NA	-34.7	-73.6	-55.5	-34.4	-54.6	-45.2	-33.8	-25	NA
11/15/19	-39.8	NA	-35.7	-74.6	-54.5	-34.4	-53.6	-45.2	-36.8	-25	-51.4
12/06/19	NA	NA	-35.7	-74.6	-55.5	-35.4	NA	NA	NA	-26	NA
12/16/19	-41.8	NA	NA	NA	NA	NA	-54.6	-46.2	-36.8	NA	-51.4

TABLE 4 (Continued): GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2019

Date[1]	Observation Well No.										
	OM-12[3]	OM-13[3]	OM-14	OM-15	OM-16	OM-18	OM-19[3]	OM-20[3]	OM-21	OM-22	OM-23[3]
	Elevation (ft)[2]										
01/17/19	NA	NA	-66.8	-144.3	-104.7	-220	NA	-95.9	-68.9	-65.3	-211.7
02/08/19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
03/15/19	NA	NA	-49.8	-113.3	-97.7	-215	-159.5	-86.9	-68.9	-72.3	-157
04/18/19	NA	NA	NA	NA	NA	-229	-81.5	-94.9	-77.9	-74.3	-111
06/21/19	-7.7	NA	NA	-120.3	-87.7	-180	NA	NA	-69.9	-65.3	NA
07/02/19	NA	NA	-66.8	-125.3	-91.7	-200	NA	NA	-72.9	-69.3	NA
08/09/19	NA	NA	-67.8	-133.3	-94.7	-212	NA	-143.9	-72.9	-70.3	-186
09/12/19	NA	NA	-65.8	-142.3	-92.7	-214	NA	-84.9	-66.9	-70.3	-202
10/25/19	NA	NA	-24.8	-119.3	-84.7	-182	-69.5	-75.9	-58.9	-55.3	-86
11/01/19	NA	NA	-25.8	-124.3	-88.7	-153	-71.5	-73.9	-59.9	-60.3	-79.7
11/22/19	-9.7	NA	-65.8	-124.3	-91.7	-211	NA	-137.9	-70.9	-69.3	-196
12/16/19	NA	NA	-66.8	-129.3	-93.7	-210	NA	-80.9	-70.9	-71.3	-207

[1]Date measurements were taken.
[2]Relative to Chicago city datum (579.48' above mean sea level) at intersection of State and Madison Streets.
[3]No measurements done at well OM-2 due to a sinkhole, well OM-12 due to blockage by construction, and well OM-13 due to damaging by a truck, or not recorded by field staff.

FIGURE 3: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATION FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2019[1]



[1]No measurements were taken at OM-2 and OM-13, and two measurents were taken at OM-12.