Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 21-24

TUNNEL AND RESERVOIR PLAN MAINSTREAM TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT FOR 2020

July 2021

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

CECIL LUE-HING RESEARCH AND DEVELOPMENT COMPLEX
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July 19, 2021

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 2020

Attached are three copies of "Tunnel and Reservoir Plan Mainstream Tunnel System Annual Groundwater Monitoring Report for 2020."

Very truly yours,

Albert Cox

Albert Cox
Environmental Monitoring and Research Manager
Monitoring and Research Department

AC:EE:lf
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. S. Serafino

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TUNNEL AND RESERVOIR PLAN MAINSTREAM TUNNEL SYSTEM ANNUAL GROUNDWATER MONITORING REPORT FOR 2020

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July 2021

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°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
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 2020. The monitoring wells were sampled based on the modified groundwater monitoring program for the Metropolitan Water Reclamation District of Greater Chicago's (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 program, nine wells (QM-61through QM-65, QM-67, QM-68, QM-75, and QM-77) which had fecal coliform (FC) detected in 10 percent or more of samples during the period 1995–2013 will be sampled for four TARP tunnel fill events, 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 feet 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 FC only. The modified program continued to operate in 2020 and beyond until a new program structure is approved by IEPA in 2021.

The other 14 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, QM-52, QM-54, QM-55, QM-57, and QM-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).

Summary of Data

During 2020, there were three tunnel fill events observed at the following dates: April 30, 2020, May 15, 2020, and October 22, 2020. Sampling was not conducted during the first two fill events due to the suspension of the TARP monitoring program which was approved by the IEPA

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

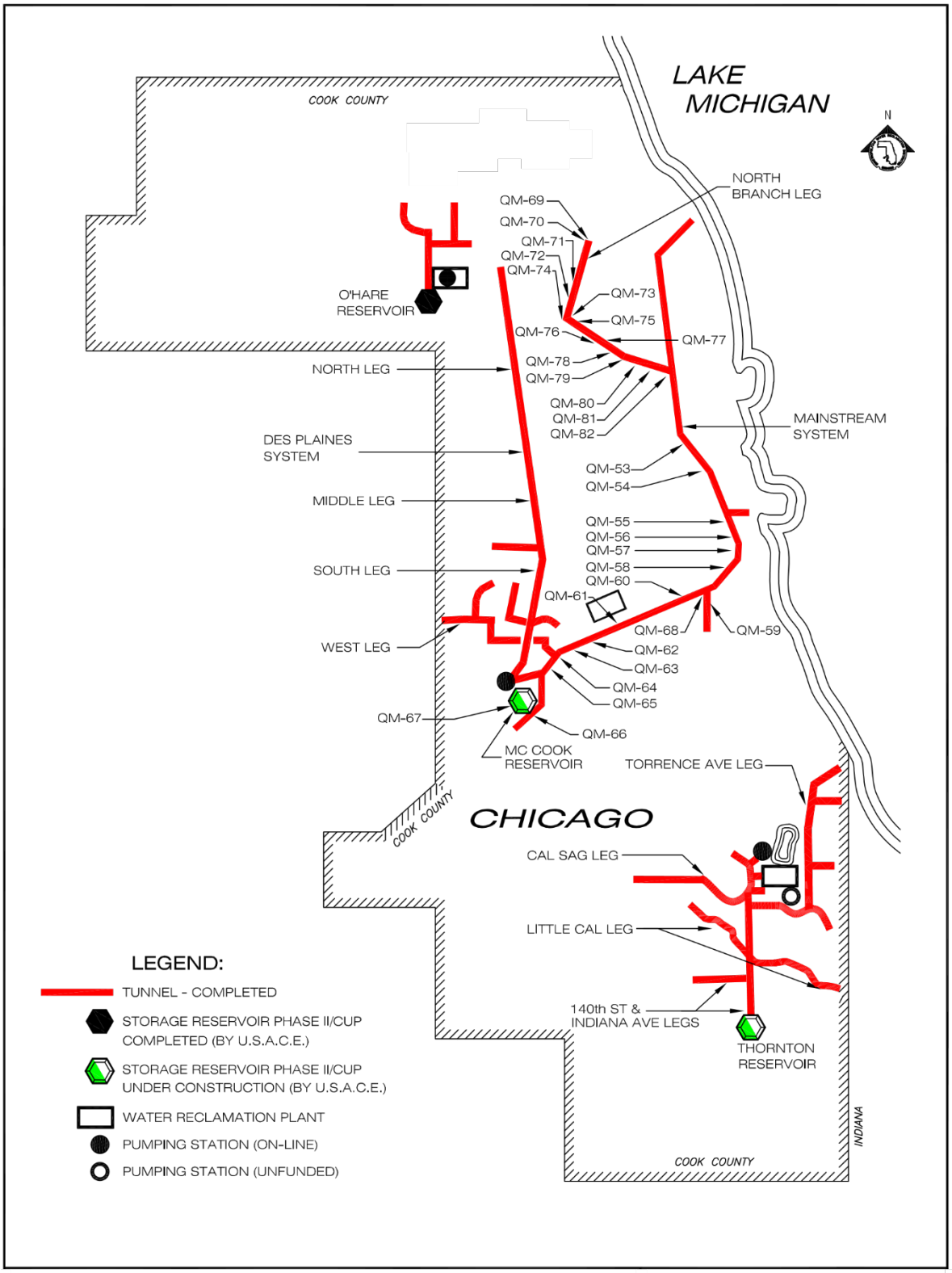
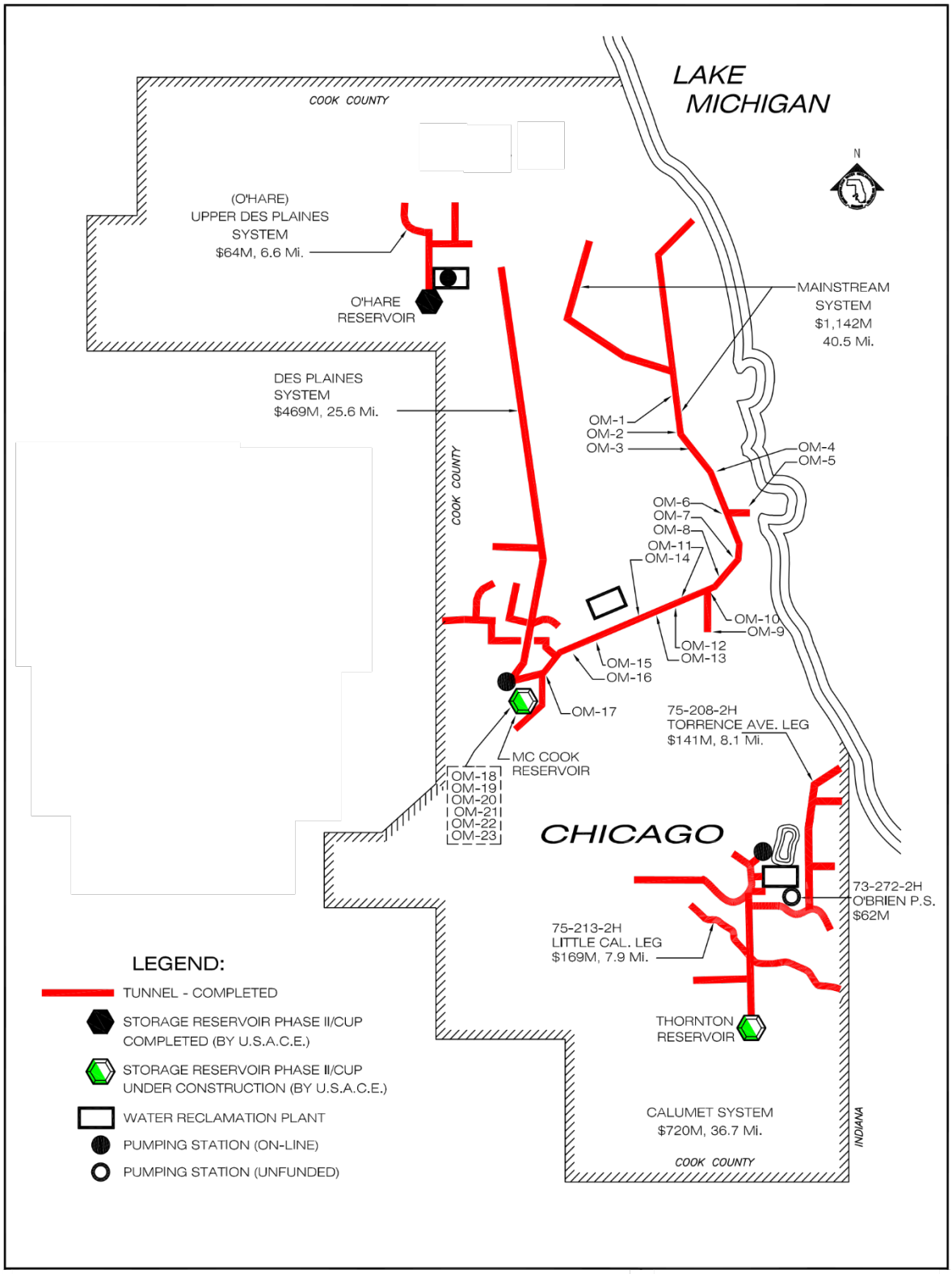


FIGURE 2: MAP OF THE OBSERVATION WELLS IN THE MAINSTREAM TUNNEL SYSTEM



due to the COVID-19 pandemic. Groundwater sampling was conducted only during the fill event observed on October 22, 2020.

Monitoring Wells. The analytical data for groundwater sampled during 2020 from fill event-based monitoring wells QM-61 through QM-68 (except QM-66), QM-75 and QM-77 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 2020 are presented in Table 2. The analytical data for groundwater from the 14 wells sampled once per year are presented in Table 3. FC counts in all the annual sampling wells were undetectable (<1 CFU/100 mL).

Observation Wells. Adjusted groundwater elevations were calculated relative to the CCD (579.48 feet above mean sea level) at the intersection of State and Madison Streets (Tables 4 and 5). No measurement was conducted at well OM-2 during the period from January to September due to restricted access to the well, as it is adjacent to a sinkhole, at well OM-12 during January 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 77, 25, and 14 feet in wells OM-18, OM-23, and both wells OM-20, and OM-21, respectively.

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 2020

Well	Fill Event[1]	Sample Date	pH	EC mS/m	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Temp. °C	Water Elevation[2] feet	Recharge Time hours
								mg/L					
QM-61	F3	10/26/20	7.3	32	442	<5.0	55	22	0.7	119	13.5	-108	<4
QM-62	F3	10/29/20	7.5	40	378	<5.0	48	37	0.8	171	14.0	-117	<48
QM-63	F3	10/29/20	7.7	96	1,572	<5.0	50	978	2.5	894	13.7	-115	<48
QM-64	F3	10/26/20	7.3	43	698	<5.0	51	37	1.5	192	13.6	-111	<4
QM-65	F3	10/29/20	7.3	85	620	<5.0	90	117	4.4	310	13.7	-141	<48
QM-67	F3	10/29/20	7.6	105	670	<5.0	177	6	15.0	278	13.1	-157	<48
QM-68	F3	10/29/20	7.4	86	626	<5.0	151	60	1.0	417	13.0	-101	<48
QM-75	F3	10/29/20	8.3	27	198	<5.0	14	8	0.3	69	11.9	-66	<48
QM-77	F3	10/29/20	8.4	20	166	<5.0	12	2	<0.30	43	11.7	-141	<48

[1]Fill events 1 and 2 were not sampled due to the COVID-19 pandemic.
[2]Relative to Chicago city datum (579.48 feet 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 MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2020

Well	Fill Event[1]	Week 1 Sample Date[2]	Week 1	Week 2	Week 3
QM-61	F3	10/26/20	63,000	460	140
QM-62	F3	10/29/20	260	18	4
QM-63	F3	10/29/20	450	20	5
QM-64	F3	10/26/20	70	8	8
QM-65	F3	10/29/20	1	<1	NReq[3]
QM-67	F3	10/29/20	1,400	2,500	15,000
QM-68	F3	10/29/20	<1	NReq	NReq
QM-75	F3	10/29/20	1	<1	NReq
QM-77	F3	10/29/20	840	91	4

[1]Fill events 1 and 2 were not sampled due to the COVID-19 pandemic.
[2]Sampling date of the first week of the fill event.
[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 2020

Well	Sample Date	pH	EC mS/m	TDS	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Temp. °C	Water Elevation[2] feet	Fecal Coliform CFU/100 mL
				mg/L								
QM-53	08/20/20	8.2	24	180	<5.0	16	38	<0.30	135	11.5	-37	<1
QM-66	02/20/20	7.4	152	1,326	4.0	132	118	1.3	9.0	10.3	-310	<1
QM-69	02/20/20	7.3	32	276	1.5	37	35	0.85	136	10.7	-22	<1
QM-70	02/20/20	7.2	34	306	1.1	48	56	0.40	139	11.8	-60	<1
QM-71	02/20/20	7.3	45	410	1.6	120	66	0.44	180	11.2	-67	<1
QM-72	02/20/20	7.2	41	332	1.6	125	3	0.37	217	10.8	-72	<1
QM-73	02/20/20	7.3	32	264	1.6	37	2	<0.30	142	11.1	-163	<1
QM-74	02/20/20	7.5	29	236	2.5	58	1	<0.30	100	11.5	5.0	<1
QM-76	06/24/20	8.4	34	278	<1.0	13	65	<0.30	35	13.3	-191	<1
QM-78	06/24/20	8.9	33	258	<1.0	12	45	<0.30	14	12.4	-173	<1
QM-79	06/24/20	8.6	30	234	<1.0	16	20	<0.30	20	12.0	-131	<1
QM-80	06/24/20	8.4	22	144	<1.0	14	2	<0.30	20	12.9	-129	<1
QM-81	06/24/20	8.0	28	214	<1.0	23	9	<0.30	28	13.5	-121	<1
QM-82	06/24/20	8.6	34	264	1.1	32	7	<0.30	16	13.3	-181	<1

[1]Detection limit changed from <1.0 mg/L to <5.0 mg/L due to a new instrument starting on August 1, 2020.
[2]Relative to Chicago City Datum (579.48 feet above sea level) at intersection of State and Madison Streets.

TABLE 4: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OM-1 THROUGH OM-11 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2020

Date[1]	Observation Well Number										
	OM-1	OM-2	OM-3	OM-4	OM-5	OM-6	OM-7	OM-8	OM-9	OM-10	OM-11
	Elevation (feet)[2]										
01/17/20	-41.8	NA[3]	-36.7	-74.6	-54.5	-35.4	-54.6	-45.2	-35.8	-25	-51.4
02/11/20	-40.8	NA	-35.7	-74.6	-55.5	-35.4	-53.6	-45.2	-34.8	-24.0	-53.4
06/11/20	-38.8	NA	-34.7	-71.6	-55.5	-35.4	-52.6	-44.2	-30.8	-22.0	-51.4
07/13/20	-39.8	NA	-35.7	-71.6	-55.5	-34.4	-52.6	-43.2	-31.8	-23.0	-50.4
08/17/20	-39.8	NA	-35.7	-72.6	-56.5	-34.4	-53.6	-44.2	-32.8	-24.0	-50.4
09/16/20	-39.8	NA	-38.7	-72.6	-56.5	-34.4	-53.6	-44.2	-31.8	-23.0	-50.4
10/14/20	-39.8	-32.7	-35.7	-72.6	-56.5	-35.4	-53.6	-44.2	-31.8	-24.0	-51.4
11/09/20	-38.8	-33.7	-35.7	-72.6	-56.5	-35.4	-52.6	-44.2	-31.8	-23.0	-50.4
12/08/20	-39.8	-32.7	-35.7	-72.6	-55.5	-35.4	-52.6	-45.2	-31.8	-23.0	-50.4

[1]Date measurements were taken. No measurements were conducted during the period from March to end of May due to COVID-19 pandemic.
[2]Relative to Chicago city datum (579.48 feet above mean sea level) at intersection of State and Madison Streets.
[3]No measurements were taken at well OM-2 due to restricted access.

TABLE 5: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OM-12 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2020

Date[1]	Observation Well No.										
	OM-12	OM-13	OM-14	OM-15	OM-16	OM-18	OM-19	OM-20	OM-21	OM-22	OM-23
	Elevation (feet)[2]										
01/10/20	NA[3]	NA	-67.8	-128.3	-93.7	-210.0	-80.5	-85.9	-71.9	-72.3	-202.7
02/05/20	-9.7	NA	-64.8	-131.3	-93.7	-195.0	-78.5	-81.9	-67.9	-72.3	-207.7
06/11/20	-8.7	NA	-63.8	-120.3	-91.7	-145.0	-73.5	-79.9	-64.9	-68.3	-188.7
07/13/20	-8.7	NA	-65.8	-126.3	-92.7	-192.0	NA	-84.9	-62.9	-72.3	-200.7
08/17/20	-8.7	NA	-64.8	-125.3	-92.7	-215.0	-80.5	-85.9	-72.9	-72.3	-183.7
09/17/20	-8.7	NA	-63.8	-125.3	-92.7	-215.0	NA	-86.9	-72.9	-71.3	-194.7
10/14/20	-9.7	NA	-64.8	-126.3	-93.7	-218.0	-82.5	-91.9	-74.9	-73.3	-196.7
11/09/20	-9.7	NA	-64.8	-124.8	-93.2	-215.5	-81.5	-91.9	-74.9	-75.3	-198.7
12/07/20[4]	-8.7	NA	-64.8	-128.3	-93.7	-222.0	-84.5	-93.9	-76.9	-76.3	-182.7

[1]Date measurements were taken. No measurements were conducted during the period from March to end of May due to COVID-19 pandemic.
[2]Relative to Chicago city datum (579.48 feet above mean sea level) at intersection of State and Madison Streets.
[3]No measurements were taken at wells OM-12 and OM-19 due to inaccessibility and at well OM-13 due to damage from a truck.
[4]For December measurements, depth measurements at wells OM-12, OM-14, and OM-15 were done on 12/08/20.

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 2020