MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 22-18

TUNNEL AND RESERVOIR PLAN

MAINSTREAM TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2021

July 2022

Protecting Our Water Environment

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

July 22, 2022

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

Dear Mr. Sofat:

Subject: Tunnel and Reservoir Plan Mainstream Tunnel System Annual Groundwater Monitoring Report for 2021

The report entitled "Tunnel and Reservoir Plan Mainstream Tunnel System Annual Groundwater Monitoring Report for 2021" is attached.

Very truly yours,

Albert Cox

Albert E. Cox, Ph.D.
Environmental Monitoring and Research Manager
Monitoring and Research Department

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

Metropolitan Water Reclamation District of Greater Chicago

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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
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 2021. 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 May 14, 2021, the Illinois Environmental Protection Agency (IEPA) approved a modified TARP groundwater monitoring program for the District's Calumet, Mainstream, Des Plaines, and Upper Des Plaines tunnel systems effective January 2021. The modification of TARP groundwater monitoring program was based on the key findings of a three-year fill event-based groundwater monitoring study conducted by the District from 2017 to 2019 and was submitted to IEPA in a report dated July 30, 2020.

Under the modified monitoring program, nine Mainstream fill event-based monitoring wells (QM-61, QM-62, QM-63, QM-64, QM-65, QM-67, QM-68, QM-75, and QM-77) are sampled for two tunnel fill events per year, usually following storm events. Fecal coliforms (FC) in these wells were detected in 10 percent or more of samples collected during the period 1995 – 2013. The criterion that triggers fill event sampling is that the level of water in the TARP Mainstream tunnels reaches -150 ft Chicago City Datum (CCD). Sampling is conducted during the second week following each fill event. For the first fill event, samples are analyzed for all parameters including pH, temperature (Temp.), electrical conductivity (EC), total dissolved solids (TDS), hardness, ammonia nitrogen (NH_3-N), total organic carbon (TOC), chloride (Cl^-), sulfate (SO_4^{2-}), and fecal coliform (FC). For the second fill event, samples are analyzed for FC only.

The other 13 monitoring wells associated with the Mainstream Tunnel System, referred to as annual monitoring wells, are sampled once per year. These wells had FC detected in less than 10 percent of samples during 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 were properly abandoned in the modified program. Monitoring of observation well OM-17 was also discontinued with the approval of the IEPA (letter dated December 16, 2011).

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

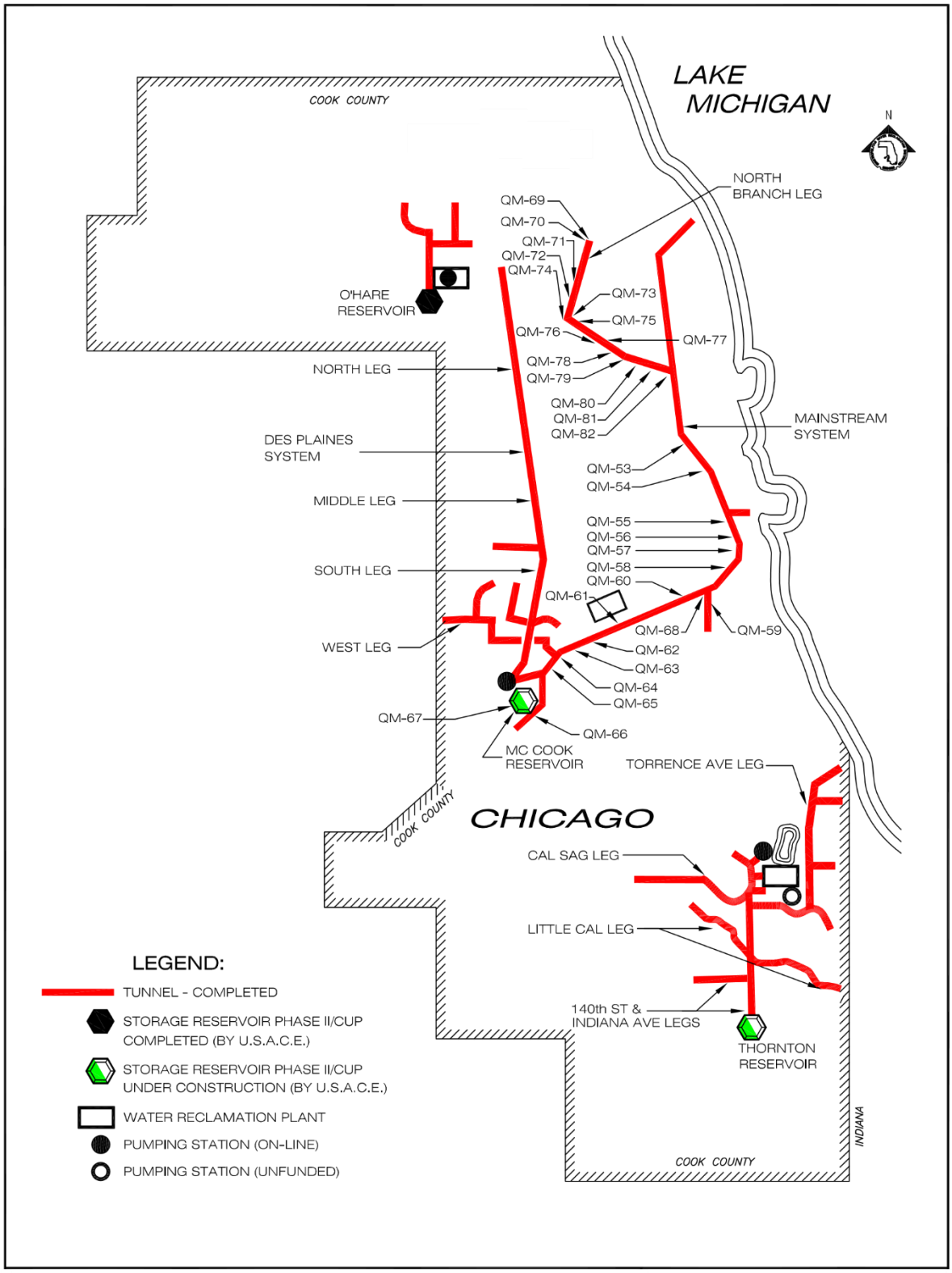
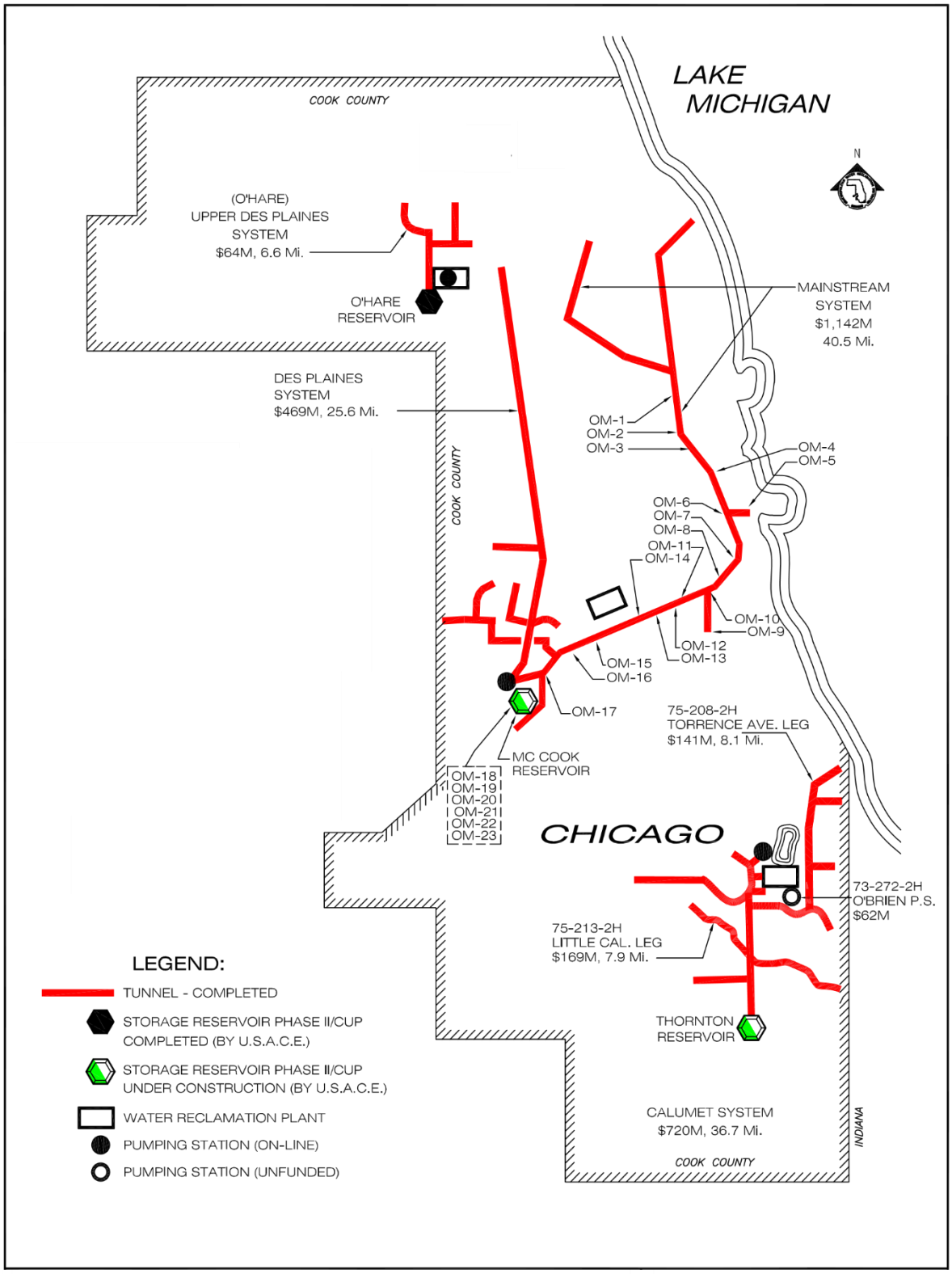


FIGURE 2: MAP OF THE OBSERVATION WELLS IN THE MAINSTREAM TUNNEL SYSTEM



Summary of Data

Monitoring Wells. During 2021, the fill event-based sampling was conducted in the second week of the two fill events that occurred on June 26 and October 25, 2021. The groundwater analytical data and physical parameters for fill event-based monitoring wells QM-61 through QM-68 (except QM-66), QM-75, and QM-77 are presented in Table 1. Fecal coliform was detected for the two monitored fill events at wells QM-61, QM-62, QM-63, QM-64, QM-65, QM-67, QM-68, and QM-77.

The analytical data for groundwater sampled from the 13 wells sampled once per year are presented in Table 2. Fecal coliforms were undetectable (<1 CFU/100 mL) in all annual wells except for wells QM-79, QM-80, and QM-81.

Observation Wells. Groundwater elevations were measured for observation wells OM-1 through OM-23 once per month. Groundwater elevations were calculated relative to the CCD (579.48 ft above mean sea level at the intersection of State and Madison Streets) and are presented in Table 3. The minimum, mean, and maximum values for each well were calculated and plotted to determine fluctuations in groundwater elevations during the year (Figure 3).

TABLE 1: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER SAMPLED FROM FILL EVENT MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2021[1]

Well	Sample Date	pH	EC mS/m	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Temp. °C	Water Elevation[2] ft	Fecal Coliform CFU/100 mL	Recharge Time hr
				mg/L									
QM-61	07/08/21	7.7	46	376	<5.0	67	49	0.48	145	14.3	-118	2,900	<4
	11/02/21	7.5	62	—	—	—	—	—	—	14.4	-104	80,000	<4
QM-62	07/08/21	7.6	48	408	<5.0	47	29	0.76	136	14.5	-121	340	<48
	11/03/21	7.8	49	—	—	—	—	—	—	14.1	-107	13,000	<48
QM-63	07/08/21	7.6	137	1,596	<5.0	47	828	2.28	740	14.7	-128	1,200	<48
	11/03/21	7.8	122	—	—	—	—	—	—	14.1	-98	39,000	<48
QM-64	07/08/21	7.4	52	446	<5.0	50	36	1.27	196	15.8	-114	6	<4
	11/02/21	7.7	57	—	—	—	—	—	—	14.3	-103	1	<4
QM-65	07/08/21	7.4	81	662	<5.0	82	113	4.19	299	14.7	-160	170	<48
	11/03/21	7.4	89	—	—	—	—	—	—	13.2	-127	230	<48
QM-67	07/08/21	7.8	122	840	<5.0	257	3	16.1	261	13.4	-155	210	<48
	11/03/21	7.7	111	—	—	—	—	—	—	13.8	-157	2,700	<48
QM-68	07/08/21	7.2	858	682	<5.0	146	63	0.94	412	14.9	-94	9	<48
	11/03/21	7.4	90	—	—	—	—	—	—	13.7	-90	11	<48
QM-75	07/08/21	8.1	37	300	<5.0	14	9	<0.30	61	12.7	-66	<1	<48
	11/03/21	8.2	29	—	—	—	—	—	—	12.6	-54	<1	<48

TABLE 1 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER SAMPLED FROM FILL EVENT MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2021[1]

Well	Sample Date	pH	EC mS/m	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Temp. °C	Water Elevation[2] ft	Fecal Coliform CFU/100 mL	Recharge Time hr
				mg/L									
QM-77	07/08/21	8.2	27	228	<5.0	11	2	<0.30	41	12.6	-155	75	<48
	11/03/21	8.3	21	—	—	—	—	—	—	12.2	-110	520	<48

[1]Two fill events on June 26 and October 25, 2021; chemistry parameters need to be analyzed for first fill event only.
[2]Relative to Chicago City Datum (579.48 ft above mean sea level) at intersection of State and Madison Streets.

TABLE 2: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER SAMPLED FROM ANNUAL MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2021

Well	Sample Date	pH	EC mS/m	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Temp. °C	Water Elevation[1] ft	Fecal Coliform CFU/100 mL
				mg/L								
QM-53	12/09/21	8.2	25	124	<5.0	17	39	<0.30	NRR[2]	11.2	-38	<1
QM-69	04/22/21	8.1	36	310	<5.0	49	54	0.47	148	11.9	-21	<1
QM-71	04/28/21	7.8	46	472	<5.0	126	70	0.54	188	11.3	-61	<1
QM-72	04/28/21	7.7	43	408	<5.0	129	1	0.49	212	11.2	-71	<1
QM-73	04/28/21	7.9	28	280	<5.0	39	2	0.35	142	12.1	-164	<1
QM-74	04/22/21	8.1	26	264	<5.0	61	<1.0	<0.30	100	11.4	5.0	<1
QM-76	04/22/21	7.8	43	412	<5.0	14	121	<0.30	91	12	-192	<1
QM-78	04/28/21	8.9	29	278	<5.0	11	44	<0.30	9	12.9	-176	<1
QM-79	10/13/21	8.6	27	268	<5.0	14	23	<0.30	16	12.5	-127	1,000
QM-80	10/13/21	8.8	21	198	<5.0	14	2	<0.30	20	13	-134	52
QM-81	10/13/21	8.6	27	234	<5.0	23	10	<0.30	30	13.1	-124	16
QM-82	10/13/21	8.4	30	288	<5.0	29	5	<0.30	18	13.8	-182	<1

[1]Relative to Chicago City Datum (579.48 ft above sea level) at intersection of State and Madison Streets.
[2]No reportable data due to analysis quality control failure.

TABLE 3: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2021

Date	Observation Well No.										
	OM-1	OM-2	OM-3	OM-4	OM-5	OM-6	OM-7	OM-8	OM-9	OM-10	OM-11
	Elevation (ft)[1]										
01/12/21	-38.8	-32.7	-34.7	-71.6	-56.5	-34.4	-52.6	-43.2	-31.8	-23.0	-50.4
02/25/21	NA[2]	NA	NA	NA	NA	NA	-52.6	NA	NA	NA	-52.4
03/17/21	NA	-31.7	-34.7	-70.6	-56.5	-34.4	-52.6	-43.2	-31.8	-24.0	-52.4
04/14/21	-38.8	-31.7	NA	-70.6	-56.5	-34.4	-52.6	-43.2	-30.8	-23.0	-42.4
05/12/21	NA	-30.7	-34.7	-71.6	-56.5	-35.4	-52.6	-44.2	-31.8	-23.0	-42.4
06/24/21	NA	-31.7	-34.7	-69.6	-55.5	-35.4	-52.6	-42.2	-30.8	-22.0	-51.4
07/15/21	-37.8	-32.7	-35.7	-69.6	-55.5	-34.4	-53.6	-43.2	-30.8	-23.0	-51.4
08/18/21	-38.8	-31.7	-34.7	-69.6	-55.5	-35.4	-51.6	-42.2	-30.8	-22.0	-51.4
09/09/21	-37.8	-31.7	-34.7	-69.6	-56.5	-35.4	-52.6	-42.2	-30.8	-23.0	-51.4
10/14/21	-36.8	-31.7	-33.7	-68.6	-55.5	-35.4	-51.6	-42.2	-29.8	-22.0	-48.4
11/08/21	-36.8	-29.7	-32.7	-67.6	-55.5	-34.4	-51.6	-42.2	-29.8	-22.0	-47.4
12/13/21	-38.8	-32.7	-34.7	-69.6	-55.5	-35.4	-52.6	-42.2	-30.8	-22.0	-47.4

TABLE 3 (Continued): GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2021

Date	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 (ft)[1]										
01/13/21	-8.7	42.4	-62.8	-128.3	-92.7	-222.0	-85.5	-90.9	-74.9	-75.3	-199.7
02/25/21	NA	42.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
03/18/21	-8.7	42.4	-61.8	-130.3	-92.7	-201.0	-83.5	-83.9	-68.9	-74.3	-195.7
04/13/21	-8.7	42.4	-61.8	-130.3	-92.7	-215.0	-85.5	-88.9	-69.9	-75.3	-192.7
05/11/21	-8.7	42.4	-60.8	-130.3	-92.7	-222.0	-86.5	-92.9	-72.9	-76.3	-193.7
06/23/21	-8.7	42.4	-56.8	-125.3	-91.7	-223.0	-85.5	-86.9	-70.9	-75.3	-159.7
07/15/21	-8.7	42.4	-64.8	-126.3	-91.7	-176.0	-80.5	-79.9	-65.9	-75.3	-181.7
08/18/21	-8.7	42.4	-61.8	-127.3	-91.7	-220.0	-83.5	-89.9	-59.9	-74.3	-188.7
09/09/21	-8.7	42.4	-61.8	-130.3	-91.7	-220.0	-83.5	-88.9	-69.9	-75.3	-189.7
10/12/21	-8.7	42.4	-59.8	-127.3	-90.7	—[3]	—	—	—	—	—
10/14/21	—	—	—	—	—	-223.0	-83.5	-90.9	-69.9	-74.3	-168.7
11/09/21	-7.7	42.4	-58.8	-118.3	-89.7	-197.0	-81.5	-78.9	-65.9	-74.3	-162.7
12/13/21	-8.7	42.4	-60.8	-130.3	-92.7	-220.0	-83.5	-86.9	-69.9	-76.3	-195.7

[1]Relative to Chicago city datum (579.48' above mean sea level) at intersection of State and Madison Streets.
[2]No measurements done due to inaccessibility and snow accumulation at well location.
[3]Measured at an alternative date.

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 2021