MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 22-16

TUNNEL AND RESERVOIR PLAN

CALUMET TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2021

July 2022

Protecting Our Water Environment

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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 Calumet Tunnel System Annual Groundwater Monitoring Report for 2021

The report entitled "Tunnel and Reservoir Plan Calumet 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

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Edward W. Podczerwinski, Director **July 2022**

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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

All monitoring and observation wells are located along the length of the Calumet Tunnel System (CTS). Four monitoring wells (QC-1, QC-2, QC-2-1, and QC-2-2) and 11 observation wells (OC-1 through OC-11) are located along the tunnel between Crawford Avenue and the Calumet Water Reclamation Plant. Seventeen monitoring wells (QC-3 through QC-19) are located between 140th Street and Indiana Avenue, nine (QC-20 through QC-28) are along Torrence Avenue, and nine (QC-29 through QC-37) are along the Little Calumet River (Figures 1 and 2). Monitoring well QC-3 was abandoned with the approval of the Illinois Environmental Protection Agency (IEPA).

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.

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 the TARP groundwater monitoring program was based on the key findings from a three-year fill event-based groundwater monitoring study conducted by the District from 2017 to 2019, which was submitted to the IEPA in a report dated July 30, 2020.

Under the modified monitoring program, three CTS fill event-based monitoring wells (QC-2, QC-4, and QC-17) 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 during the period 1995 – 2013. The criterion that triggers fill event sampling is that the water level in the Thornton Composite Reservoir, which receives water from the Calumet tunnel, reaches -280 ft Chicago City Datum. Sampling is conducted during the first week of 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 28 wells associated with the CTS, referred to as annual monitoring wells, are sampled once per year. These wells had FC detected in less than 10 percent of samples during the period 1995 – 2013.

Groundwater elevations in the monitoring wells were measured at each sampling event. The elevations in the observation wells were measured twice per month. The monitoring wells

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

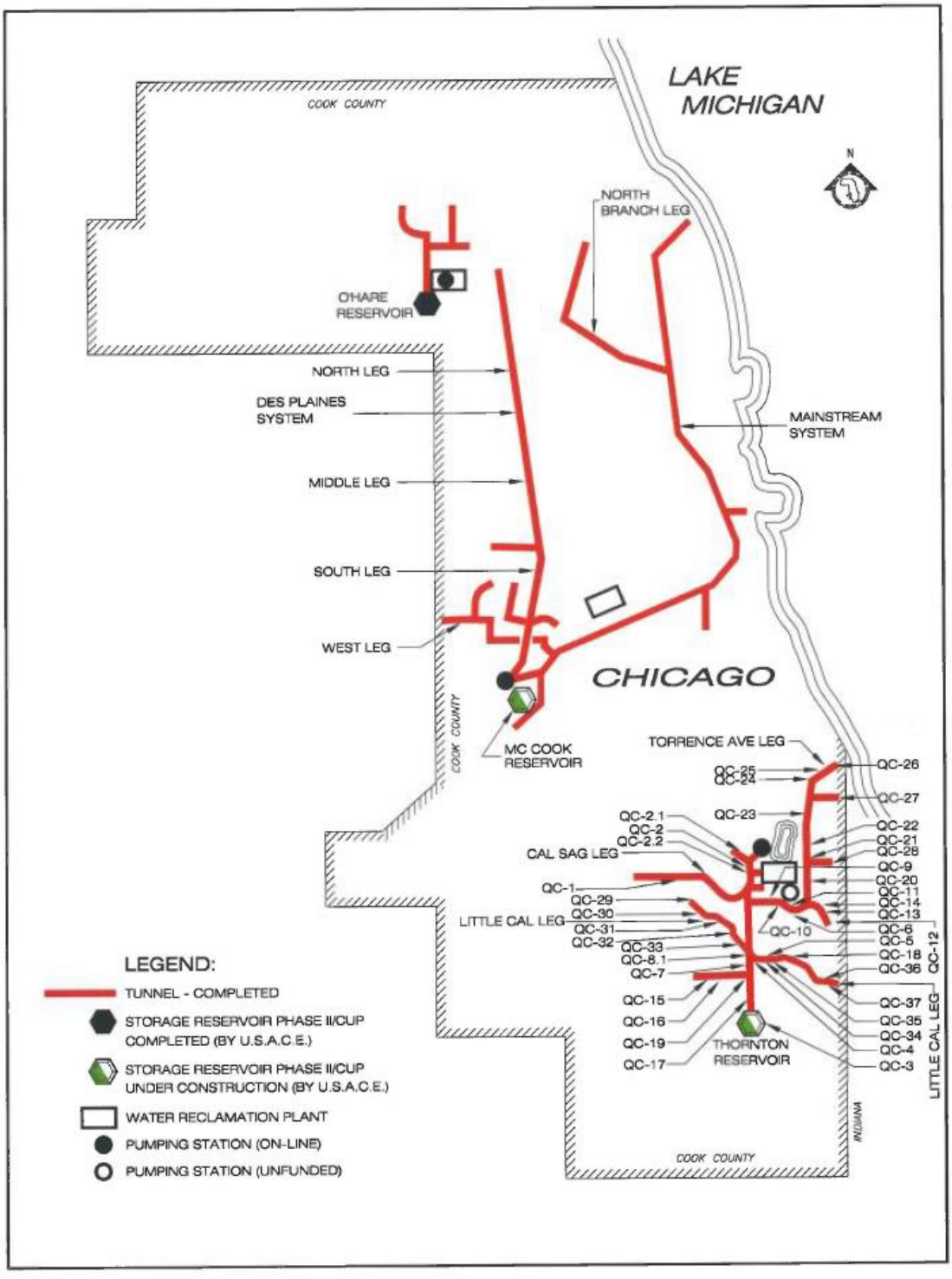
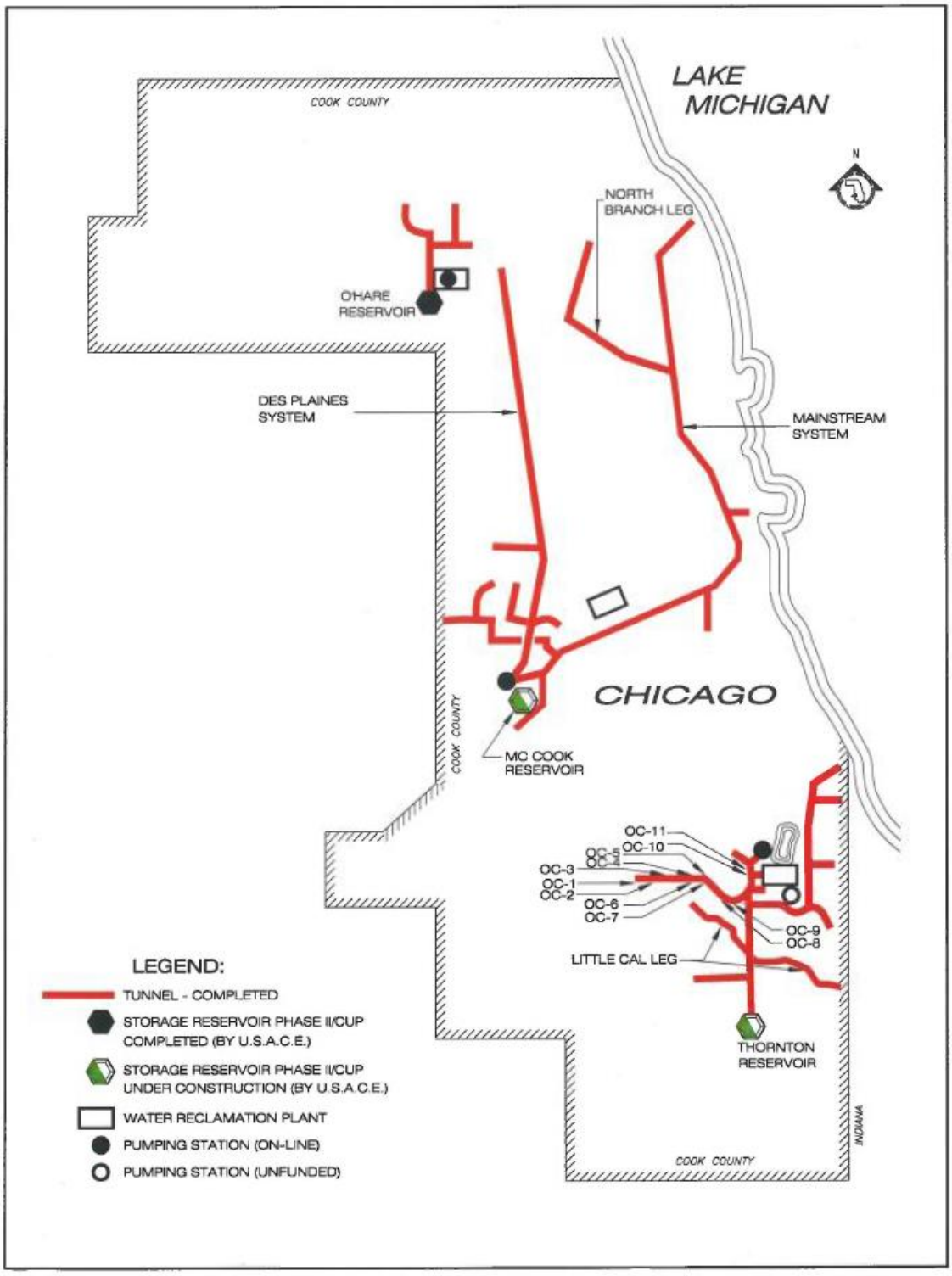


FIGURE 2: MAP OF OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM



(QC-1, QC-3, QC-8, QC-32, QC-33, QC-34, QC-36, and QC-37) were abandoned previously. Therefore, the monitoring requirement for this group of wells is discontinued under the modified groundwater monitoring program.

Summary of Data

Monitoring Wells. During the year of 2021, the fill event-based sampling was conducted at two fill events occurring on June 26 and August 19, 2021. The groundwater analytical data and physical parameters for fill event-based monitoring wells QC-2, QC-4 and QC-17 are presented in Table 1. For the two monitored fill events, FC was detected only at well QC-2: 30 CFU/100 mL for fill event one and 1 CFU/100 mL for fill event two (Table 1).

The analytical data for groundwater from the wells sampled once per year are presented in Table 2. No annual sampling was conducted at wells QC-15 and QC-27 due to well pump malfunction. Fecal coliforms were undetectable (<1 CFU/100 mL) in all annual wells, except for well QC-28 at 1 CFU/100 mL.

Observation Wells. Groundwater elevations were measured for observation wells OC-1 through OC-11 twice per month. Water elevations were calculated relative to 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 CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED 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									
QC-2	07/01/21	8.2	36	320	<5.0	24	26	<0.3	68	15.9	-255	30	<48
	08/19/21	8.2	44	—	—	—	—	—	—	16	NA[3]	1	<48
QC-4	07/01/21	8.5	43	410	<5.0	8	13	<0.3	11	14.5	-229	<1	<48
	08/19/21	8.5	49	—	—	—	—	—	—	13.4	-223	<1	<48
QC-17	07/01/21	7.9	42	492	<5.0	7	175	<0.3	147	13.8	-168	<1	<48
	08/19/21	7.9	61	—	—	—	—	—	—	13.8	-179	<1	<48

[1]Chemistry parameters need to be analyzed for 1st fill event only.
[2]Relative to Chicago City Datum (579.48 ft above mean sea level) at intersection of State and Madison Streets.
[3]Measurements were not obtained because depth probe got stuck.

TABLE 2: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER SAMPLED FROM ANNUAL MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED 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								
QC-2-1	02/04/21	8.3	58	478	<5.0	38	6	0.6	56	8.8	-299	<1
QC-2-2	02/04/21	8.4	40	320	<5.0	13	23	<0.3	39	11.7	-289	<1
QC-5	02/04/21	8.5	66	500	<5.0	53	12	<0.3	9	11.7	-216	<1
QC-6	02/04/21	8.4	56	442	<5.0	17	4	0.4	16	12.0	-209	<1
QC-7	09/15/21	8.5	42	340	<5.0	10	<1.0	<0.3	16	14.1	-148	<1
QC-9	09/15/21	8.3	35	278	<5.0	9	37	0.5	54	14.8	-252	<1
QC-10	12/08/21	8.7	49	336	<5.0	33	<1.0	<0.3	31	12.7	-166	<1
QC-11	04/21/21	8.5	33	266	<5.0	22	<1.0	<0.3	19	12.5	-188	<1
QC-12	04/21/21	8.4	81	686	<5.0	36	211	0.3	83	12.6	-223	<1
QC-13	03/31/21	8.0	46	424	<5.0	51	4	<0.3	31	12.4	-231	<1
QC-14	09/15/21	7.8	68	662	<5.0	155	<1.0	0.3	160	14.0	-204	<1
QC-15	12/09/21	NA[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
QC-16	12/09/21	8.9	56	446	<5.0	22	75	<0.3	54	11.4	-257	<1
QC-18	03/24/21	8.8	38	362	<5.0	8	29	<0.3	7	12.1	-197	<1
QC-19	03/24/21	8.3	46	418	<5.0	8	143	0.3	91	12.2	-154	<1
QC-20	03/24/21	8.4	34	276	<5.0	20	5	<0.3	25	12.5	-244	<1
QC-21	10/01/21	8.7	41	276	<5.0	18	29	0.5	33	13.2	-236	<1
QC-22	10/01/21	8.5	28	178	<5.0	15	7	<0.3	34	12.7	-233	<1
QC-23	10/01/21	9.2	38	268	<5.0	21	2	<0.3	7	12.9	-219	<1
QC-24	10/07/21	8.5	25	266	<5.0	28	<1.0	<0.3	15	13.3	-223	<1
QC-25	03/24/21	8.0	36	308	<5.0	14	70	<0.3	87	13.0	-224	<1
QC-26	10/01/21	9.2	31	210	<5.0	13	2	<0.3	8	13.2	-215	<1
QC-27	12/07/21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
QC-28	11/19/21	9.0	33	322	<5.0	13	<1.0	<0.3	15	13.2	-225	1

TABLE 2 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER FROM ANNUAL SAMPLING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED 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								
QC-29	03/31/21	7.2	105	1,050	NDR[3]	175	218	0.9	412	11.5	-37	<1
QC-30	03/31/21	8.2	59	548	<5.0	41	120	0.6	101	11.4	-111	<1
QC-31	03/31/21	8.3	49	574	<5.0	19	198	1.2	232	12.6	-39	<1
QC-35	03/10/21	8.6	106	898	<5.0	34	14	<0.3	16	12.7	-152	<1

[1]Relative to Chicago City Datum (579.48 ft above mean sea level) at intersection of State and Madison Streets.
[2]Well was not sampled due to well pump malfunction.
[3]No data reported due to instrument malfunction and rerun could not be done due to sample holding time exceedance.

TABLE 3: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2021

Date	Observation Well No.											
	OC-1	OC-2	OC-3	OC-4	OC-5	OC-6	OC-7	OC-8	OC-8.1	OC-9	OC-10	OC-11
	Elevation (ft)[1]											
01/05/21	-40	-25	-151	-153	-148	-72	-209	-177	-213	-211	-224	-224
01/29/20	-39	-24	-151	-152	-147	-72	-209	-177	-212	-211	-226	-224
02/05/21	NA[2]	-23	-151	NA	NA	-71	NA	NA	-212	-211	-226	-224
02/19/21	NA	-24	-151	NA	NA	-72	NA	NA	-212	-212	-224	-224
02/25/21	-39	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
03/05/21	-38	-24	-152	-153	-149	-72	NA	NA	-213	-212	-222	-224
03/19/21	-28	-23	-151	-152	-148	-72	-209	-177	-211	-211	-226	-224
04/02/21	-38	-23	-151	-152	-147	-72	-209	-177	-212	-211	-227	-224
04/16/21	-38	-23	-150	-151	-147	-72	-209	-176	-211	-211	-226	-224
05/07/21	-39	-34	-151	-152	-147	-72	-209	-177	-212	-212	-227	-225
05/21/21	-38	-23	-151	-151	-147	-72	-209	-176	-211	-209	-226	-224
06/04/21	-39	-23	-151	-151	-147	-72	-209	-176	-212	-212	-225	-224
06/18/21	-39	-23	-151	-151	-147	-71	-208	-175	-212	-211	-226	-223
07/01/21	—[3]	—	—	—	—	—	-209	-168	-211	-212	-218	-224
07/02/21	-40	-21	-147	-151	-147	-67	—	—	—	—	—	—
07/16/21	-29	-23	-150	-151	-147	-67	-206	-168	-211	-211	-219	-223
08/10/21	-41	-23	-170	-151	-147	-73	-207	-172	-211	-211	-218	-224
08/20/21	-39	-23	-150	-151	-146	-73	-207	-172	-211	-210	-218	-223
09/23/21	-40	-23	-151	-151	-146	-73	-208	-172	-211	-210	-218	-223
09/28/21	-41	-23	-152	-151	—	-74	-208	-173	-210	-212	-219	-223
09/29/21	—	—	—	—	-147	—	—	—	—	—	—	—
10/07/21	-40	-24	-151	-151	-147	-70	-208	-174	-210	-210	-222	-223
10/22/21	-40	-24	-151	-151	-146	-72	-209	-176	-211	-211	-217	-223
11/05/21	-39	-22	-151	-151	-146	-70	-208	-168	-210	-210	-221	-223
11/17/21	-39	-23	-152	-150	-147	-71	-208	-171	-212	-209	-222	-223

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

FIGURE 3: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATION FOR OBSERVATION WELLS OC-1 THROUGH OC-11 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2021