

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***MONITORING AND RESEARCH
DEPARTMENT***

REPORT NO. 19-20

TUNNEL AND RESERVOIR PLAN

CALUMET TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2018

Monitoring and Research Department
Edward W. Podczewinski, Director

July 2019

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July 26, 2019

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Dear Sir or Madam:

Subject: Tunnel and Reservoir Plan, Calumet Tunnel System, Annual
Groundwater Monitoring Report for 2018

Attached are three copies of "Tunnel and Reservoir Plan, Calumet 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

cc w/att: Ms. Sally K. Swanson (USEPA Region 5 - WC15J) - (2)
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**TUNNEL AND RESERVOIR PLAN
CALUMET TUNNEL SYSTEM
ANNUAL GROUNDWATER MONITORING REPORT
FOR 2018**

Monitoring and Research Department
Edward W. Podczewinski, Director

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LIST OF ABBREVIATIONS

°C	degrees Celsius
CCD	Chicago City Datum
CFU	colony forming units
CTS	Calumet Tunnel System
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 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, -2, -2-1, and -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) 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.

Modified Groundwater Monitoring Program

In a letter dated July 13, 2017, the IEPA accepted the modifications for the District's TARP groundwater monitoring program effective from January 2017 for a period of three years (2017 – 2019). Under the modified monitoring program, three wells (QC-2, QC-4, and QC-17), 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. The fill event-based criterion that triggers a fill event sampling is when the level of water in the TARP Calumet 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 current monitoring program, including: pH, temperature, electrical conductivity, total dissolved solids, hardness, ammonia nitrogen, total organic carbon, chloride, sulfate, and fecal coliform. However, the samples from the second and third week are analyzed for only fecal coliform.

The other 28 wells associated with the CTS are sampled once per year. These wells had fecal coliform detected in less than 10 percent of samples during the period 1995 – 2013.

Groundwater elevations in the monitoring wells were measured during each sampling event, while elevations in the observation wells were measured biweekly with a minor variation. The groundwater level in monitoring well (QC-8.1) no longer yields sufficient sample for analysis. However, this well was converted to an observation well several years ago, and its groundwater elevations are still measured biweekly.

Based on further evaluation of the monitoring wells, QC-1 did not function following repairs, and QC-3 and QC-8 were abandoned many years ago. Therefore, these wells will also be added to the group of other wells (QC-32, QC-33, QC-34, QC-36, and QC-37) discontinued for monitoring under the modified groundwater monitoring program.

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

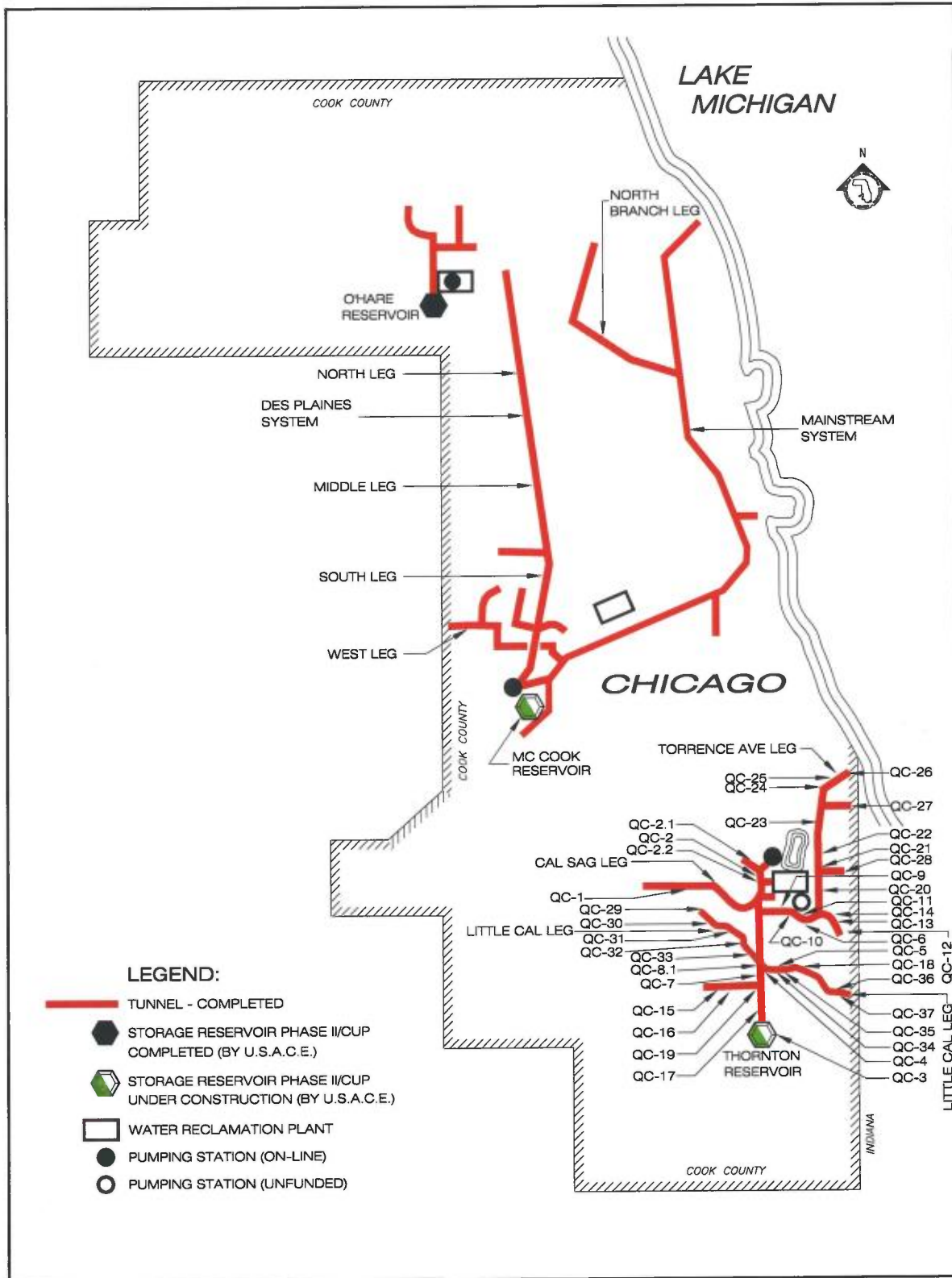
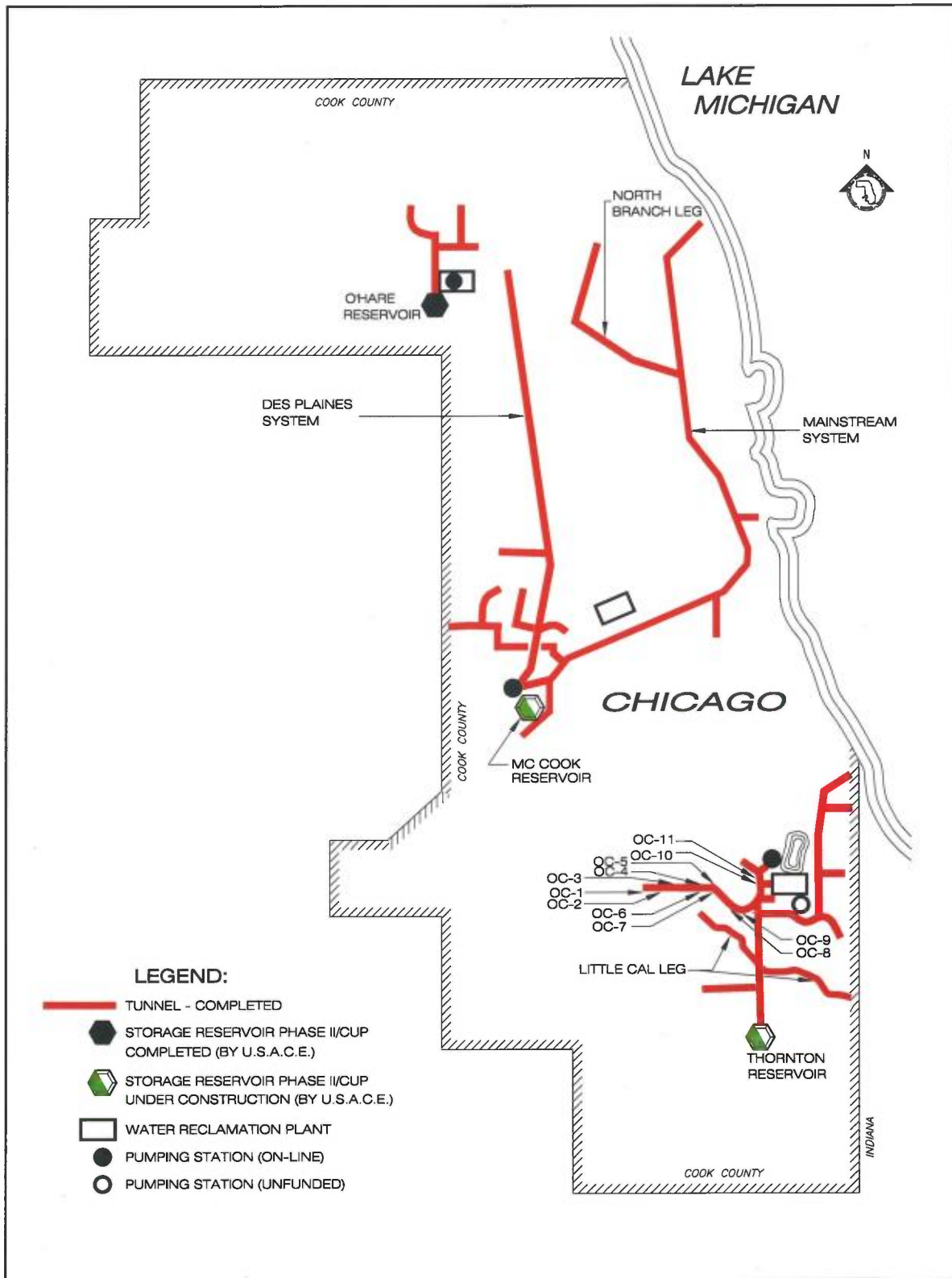


FIGURE 2: MAP OF OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM



Summary of Data

Monitoring Wells. The analytical data for groundwater sampled during 2018 from fill-based monitoring wells QC-2, QC-4 and QC-17, 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).

Observation Wells. Groundwater elevations for observation wells OC-1 through -11 were measured at the required frequencies. There was only one reading in March, April, August, September, and December due to personnel shortage because the highest priority was placed on fill event sampling of TARP wells. Adjusted elevations 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 3). Generally, these fluctuations appeared to be minimal or within expected ranges throughout the year in most wells. However, there were notable fluctuations in groundwater elevations of 32 ft at OC-6.

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

Well	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	
QC-2	F1	02/28/18	N/S ⁴	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S
QC-2	F2	03/08/18	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S
QC-2	F3	05/16/18	8.1	57	344	2.0	30	NRR ⁵	0.1	60	12.9	-302	<48
QC-2	F4	09/13/18	7.2	39	342	1.9	27	22	<0.5	68	16.4	-314	<48
QC-2	F5	10/11/18	8.1	63	352	1.7	28	46	<0.5	74	13.6	-314	<48
		Minimum	7.2	39	342	1.7	27	22	0.1	60	12.9	-314	
		Median	8.1	57	344	1.9	28	34	<0.5	68	13.6	-314	
		Mean	7.8	53	346	1.9	28	34	0.4	67	14.3	-310	
		Maximum	8.1	63	352	2.0	30	46	<0.5	74	16.4	-302	
		Standard deviation	0.5	12	5.3	0.2	1.5	17	0.2	7.0	1.9	6.9	
		Coefficient of variation	6.5	23	1.5	8.2	5.4	50	59	10	13.0	2.2	
QC-4	F1	02/28/18	8.5	67	422	<1.0	8	14	0.2	10	12.0	-239	<48
QC-4	F2	04/20/18	8.4	70	408	<1.0	8	18	0.2	12	11.9	-232	<48
QC-4	F3	05/16/18	8.7	65	422	<1.0	8	NRR	0.1	9	13.0	-231	<48
QC-4	F4	09/13/18	8.4	68	448	<1.0	8	17	<0.5	10	14.9	-230	<48
QC-4	F5	10/11/18	8.4	68	400	<1.0	8	16	<0.5	12	12.3	-232	<48
		Minimum	8.4	65	400	<1.0	8	14	<0.5	9	11.9	-239	
		Median	8.4	68	422	<1.0	8	16	0.2	10	12.3	-232	
		Mean	8.5	68	420	<1.0	8	16	0.3	11	12.8	-233	
		Maximum	8.7	70	448	<1.0	8	18	<0.5	12	14.9	-230	
		Standard deviation	0.1	1.7	18	0.0	0.0	1.5	0.2	1.3	1.2	3.6	
		Coefficient of variation	1.5	2.5	4.4	0.0	0.0	9.2	63	13	9.7	1.5	
QC-17	F1	02/28/18	8.1	74	472	2.2	6	176	0.2	140	12.3	-214	<48
QC-17	F2	04/20/18	7.8	77	470	<1.0	6	194	0.3	152	12.5	-204	<48
QC-17	F3	05/24/18	7.8	60	474	<1.0	6	188	0.3	158	13.0	-204	<48

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

Well	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
QC-17	F4	09/13/18	7.8	36	482	1	6	155	<0.5	150	14.7	-205	<48
QC-17	F5	10/11/18	7.9	78	482	<1.0	5	176	<0.5	150	12.5	-206	<48
		Minimum	7.8	36	470	<1.0	5	155	0.2	140	12.3	-214	
		Median	7.8	74	474	<1.0	6	176	0.3	150	12.5	-205	
		Mean	7.9	65	476	1.2	6	178	0.4	150	13.0	-207	
		Maximum	8.1	78	482	2.2	6	194	<0.5	158	14.7	-204	
		Standard deviation	0.1	17	5.7	0.5	0.4	15	0.1	6.5	1.0	4.2	
		Coefficient of variation	2	27	1.2	43	7.7	8.3	35	4.3	7.7	2.0	

¹For values less than reporting limits, the reporting limit 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.

⁴NS: Cannot get sample from the well due to pump malfunction.

⁵NRR: No reportable result due to failure of QA/QC checks during lab analysis.

TABLE 2: ANALYSIS OF FECAL COLIFORM IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2018 AND ITS DESCRIPTIVE STATISTICS¹

Well	Fill Event	Week 1 Sample Date	Week 1	Week 2	Week 3
----- CFU/100mL -----					
QC-2	F1	02/28/18	N/S ²	N/S	N/S
	F2	04/20/18	N/S	N/S	N/S
	F3	05/17/18	<1	NReq ⁴	NReq
	F4	09/07/18	4	N/S	<1
	F5	10/11/18	14	910	<1
		Minimum	<1	910	<1
		Median	4	910	<1
		Mean ³	4	910	<1
		Maximum	14	910	<1
	QC-4	F1	02/28/18	<1	<1
F2		04/20/18	<1	<1	NReq
F3		05/16/18	<1	<1	NReq
F4		09/13/18	<1	<1	NReq
F5		10/11/18	<1	<1	NReq
		Minimum	<1	<1	-
		Median	<1	<1	-
		Mean	<1	<1	-
		Maximum	<1	<1	-
QC-17		F1	02/28/18	<1	<1
	F2	04/20/18	<1	<1	NReq
	F3	NA	NA	<1	<1
	F4	09/13/18	<1	1	<1
	F5	10/11/18	<1	<1	<1
		Minimum	<1	<1	<1
		Median	<1	1	<1
		Mean	<1	1	<1
		Maximum	<1	1	<1

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

²Could not get sample from the well due to pump malfunction.

³Geometric mean calculated.

⁴NReq: Sampling is not required because fecal coliform level 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 CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2018

Well	Sampled Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N ¹	Hardness	Temp	Water Elevation ²	Fecal Coliform
			mS/m	-----mg/L-----							ft	CFU/100 mL
QC-2-1	11/29/18	N/S ³	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S
QC-2-2	11/29/18	8.6	46	340	1.9	13	23	<0.50	35	12.5	-290	<1
QC-5	01/10/18	8.2	87	456	1.9	223	13	0.12	7	12.5	-211	<1
QC-6	01/10/18	8.6	74	372	2.2	74	7	0.32	13	12.2	-209	<1
QC-7	01/10/18	8.3	69	370	2.2	50	<5	0.28	10	12.0	-158	<1
QC-9	01/11/18	8.3	52	288	1.6	10	39	0.11	63	13.0	-255	<1
QC-10	11/01/18	8.7	31	372	<1.0	31	<1	<0.50	10	12.9	-162	<1
QC-11	11/01/18	8.3	46	268	<1.0	NRR ⁴	<1	<0.50	19	12.7	-193	<1
QC-12	01/31/18	7.2	126	822	<1.0	34	289	0.59	147	11.8	-227	<1
QC-13	01/31/18	7.3	67	336	1.8	52	13	0.25	35	12.1	-236	<1
QC-14	01/11/18	7.4	119	666	3.4	137	5	0.32	145	13.2	-207	<1
QC-15	01/11/18	7.5	47	264	1.1	13	<5	0.22	13	13.2	-206	<1
QC-16	11/07/18	8.3	78	442	1.2	22	74	<0.50	64	12.3	-238	<1
QC-18	11/07/18	8.9	58	332	1.3	8	29	<0.50	8	12.0	-199	<1
QC-19	11/07/18	8.4	69	416	1.4	7	149	<0.50	106	12.1	-160	<1
QC-20	02/08/18	7.9	47	248	1.4	19	<5	0.17	23	10.5	-257	NA ⁵
QC-21	03/21/18	7.1	55	326	19.1	17	<5	<0.10	47	12.0	-264	<1
QC-22	03/21/18	7.7	42	278	1.7	14	<5	0.39	37	11.5	-265	<1
QC-23	03/21/18	8.8	53	310	1	19	<5	0.16	13	11.6	-242	<1
QC-24	12/06/18	8.5	38	238	<1.0	26	2	<0.50	15	12.0	-232	<1
QC-25	12/06/18	8.2	49	288	<1.0	12	58	<0.50	89	12.4	-232	<1

TABLE 3 (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 2018

Well	Sampled Date	pH	EC	TDS	TOC	Cl	SO ₄	NH ₃ -N	Hardness	Temp	Water Elevation ¹	Fecal Coliform
			mS/m	----- mg/L -----							ft	CFU/100 mL
QC-26	12/06/18	8.8	33	286	<1.0	11	2	<0.50	7	12.2	-225	<1
QC-27	12/06/18	8.5	34	252	<1.0	30	2	<0.50	23	12.5	-195	<1
QC-28	02/08/18	7.4	41	228	1.8	12	<5	0.12	15	10.3	-252	NA
QC-29	12/12/18	7.5	109	844	1.3	154	167	0.85	317	11.7	-46	<1
QC-30	12/12/18	8.1	55	428	1.0	22	91	<0.50	63	11.5	-112	<1
QC-31	12/12/18	7.9	65	496	1.4	18	174	1.18	189	12.5	-37	<1
QC-35	12/12/18	8.5	106	854	<1.0	34	23	<0.50	14	12.6	-112	<1

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

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

³Cannot get sample from the well (well dry).

⁴NRR: No reportable result due to failure of QA/QC checks during lab analysis.

⁵NA: Not analyzed due to early dismissal of staff for the heavy snow.

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TABLE 4: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2018

Date ¹	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) ² -----												
01/05/18	NA ³	-26	-158	-161	NA	-75	-209	NA	-223	NA	NA	NA
01/18/18	NA	-24	-151	NA	NA	-72	-209	NA	-220	NA	NA	-223
02/01/18	-37	-25	-156	-156	NA	-82	-207	NA	-218	NA	-219	-224
02/22/18	-36	-22	-150	-157	NA	-50	-210	NA	-219	NA	-224	-224
03/23/18	-38	-23	-152	-156	NA	-72	-209	NA	-219	NA	-224	-223
04/04/18	-38	-25	-158	-160	NA	-75	-209	NA	-224	NA	NA	NA
05/04/18	-35	-26	-153	NA	NA	-76	-207	NA	-218	NA	-221	-220
05/30/18	NA	-27	-161	NA	NA	-78	-206	NA	-227	NA	N/S	NA
06/13/18	-39	-23	-157	-156	NA	-72	-209	NA	-220	NA	NA	NA
06/22/18	NA	NA	-153	NA	NA	-63	-208	NA	-217	NA	NA	NA
07/13/18	-36	-25	-150	NA	NA	-76	-197	NA	-221	NA	NA	NA
07/25/18	NA	-23	NA	-157	NA	-71	-208	NA	-220	NA	NA	NA
08/10/18	-35	-24	-151	NA	NA	-78	-207	NA	-220	NA	NA	NA
09/28/18	-35	-26	-151	-157	NA	-79	-210	NA	-219	NA	NA	-225
10/26/18	-39	-26	-158	-161	NA	-74	-210	NA	-223	NA	NA	NA
10/31/18	-39	-23	-150	NA	NA	-72	-210	NA	-218	NA	NA	-217
11/09/18	-40	-23	-149	NA	NA	-73	-209	NA	-219	NA	NA	-218
11/30/18	-39	NA	-157	NA	NA	-72	-211	NA	-219	NA	NA	NA
12/07/18	NA	-23	-150	NA	NA	-73	-211	NA	-218	NA	-227	-225

¹Date measurements were taken.

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

³No reading. Well inaccessible due to overgrown vegetation, closed roads, snow accumulation or flooding in vicinity of well.

FIGURE 3: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATIONS FOR OBSERVATION WELLS OC-1 THROUGH OC-11 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2018

