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Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 22-20

TUNNEL AND RESERVOIR PLAN

THORNTON TRANSITIONAL FLOOD CONTROL RESERVOIR AND

WELLS ANNUAL GROUNDWATER MONITORING REPORT

FOR 2021

July 2022

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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 Thornton Transitional Flood Control Reservoir and Wells Annual Groundwater Monitoring Report for 2021

The report entitled "Tunnel and Reservoir Plan Thornton Transitional Flood Control Reservoir and Wells 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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TUNNEL AND RESERVOIR PLAN
THORNTON TRANSITIONAL FLOOD CONTROL RESERVOIR AND WELLS ANNUAL GROUNDWATER MONITORING REPORT FOR 2021

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July 2022

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LIST OF ABBREVIATIONS

°C	degrees Celsius
Ag	silver
As	arsenic
B	boron
Ba	barium
BG	billion gallons
BOD_5	five-day biological oxygen demand
Cd	cadmium
Cl^-	chloride
CN^-	cyanide
Cr	chromium
Cu	copper
EC	electrical conductivity
F^-	fluoride
FC	fecal coliform
Fe	iron
Hg	mercury
IEPA	Illinois Environmental Protection Agency
L	liter
mg	milligram
Mn	manganese
NH_3-N	ammonia nitrogen
Ni	nickel
Pb	lead
SO_4^{2-}	sulfate
TCR	Thornton Composite Reservoir
TDS	total dissolved solids
TTR	Thornton Transitional Reservoir

ANNUAL DATA FOR THORNTON TRANSITIONAL RESERVOIR AND MONITORING WELLS

Introduction

This report is submitted annually to fulfill the reporting requirements of the Illinois Environmental Protection Agency (IEPA) regarding the utilization of the Thornton Transitional Reservoir (TTR) for flood control. The reporting requirements for groundwater quality monitoring of the TTR and adjacent wells were stated in Section 7 of the Scope of Work approved by the IEPA on August 6, 2001, modified on May 9, 2005, and last modified on March 14, 2019. The current monitoring program requires the four wells, QT-1, QT-2, QT-3 and QT-4, and the TTR to be sampled one time at each fill event. In addition, the four wells, QT-1, QT-2, QT-3, and QT-4, need to be sampled once per quarter. This report includes:

1. Analytical data for the monitoring wells and TTR for 2021.

2. Review and comparison of analytical data for the monitoring wells with calculated statistical limits for previously analyzed background samples in order to evaluate exceedances in the concentrations of analytes.

Project Description

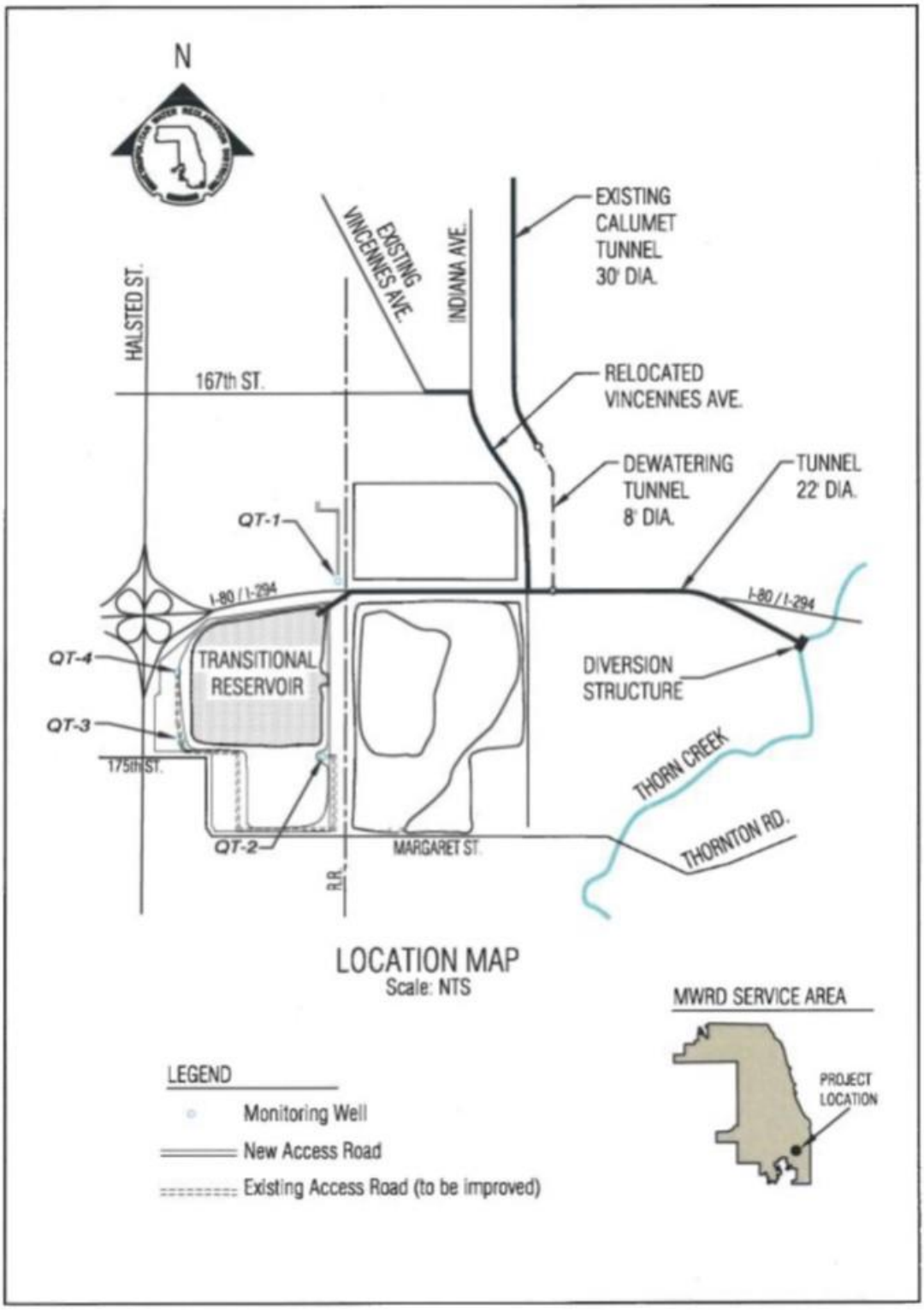
The TTR is located in the West Lobe of the Thornton Quarry, southeast of the intersection of the Tri-State Tollway and Halsted Street in Thornton, Illinois (Figure 1). The TTR was the final structure to be implemented for the Little Calumet River Watershed under the Natural Resources Conservation Service Little Calumet Watershed Plan of November 1998. The TTR provides 3.7 billion gallons (BG) of floodwater storage, increased from the original volume of 3.1 BG due to additional rock mining. This provides sufficient volume to capture a 100-year storm event from Thorn Creek at a point just south of the Tri-State Tollway. This project provides flood control benefits for 21 businesses and 4,400 residences. Within the Little Calumet watershed are the Illinois communities of Blue Island, Calumet City, Dixmoor, Dolton, Glenwood, Harvey, Lansing, Phoenix, Riverdale, and South Holland, which all benefit from the implemented flood control measures.

The TTR consists of a diversion structure at Thorn Creek, a 24-foot diameter dropshaft, and a 22-foot diameter conveyance tunnel to the Lower West Lobe of the Thornton Quarry. The project also includes an 8-foot diameter tunnel connected to the Calumet Tunnel and Reservoir Plan System that is utilized for TTR dewatering purposes only.

The analytes measured in these samples include:

1. pH, electrical conductivity (EC), total dissolved solids (TDS), five-day biological oxygen demand (BOD_5), cyanide (CN^-), fluoride (F^-), chloride (Cl^-), sulfate (SO_4^{2-}), ammonia nitrogen (NH_3-N), phenol, and trace metals silver (Ag), arsenic (As), boron (B), barium (Ba), cadmium (Cd), chromium (Cr),

FIGURE 1: THORNTON TRANSITIONAL RESERVOIR
MONITORING WELL LOCATIONS



copper (Cu), iron (Fe), mercury (Hg), manganese (Mn), nickel (Ni), and lead (Pb).

2. Other parameters: fecal coliform (FC), groundwater temperature, and water elevation.

There were three significant rain events in 2021 which resulted in the diversion of Thorn Creek water to the TTR (Table 1). Since the Thornton Composite Reservoir (TCR) was placed in service in October 2015, water accumulation in the TTR is generally used for flushing the TCR for odor control. As a result, water was impounded in the TTR between January and December 2021. According to the current monitoring plan approved in March 2019, the TTR should be sampled once at each fill event, and four monitoring wells sampled once at each fill event and quarterly. This required three sampling events for the reservoir and seven sampling events for the TTR wells.

Summary of Data for Monitoring Wells and Reservoir

Analytical data for all sampling events are presented in Tables 2 through 6 for wells QT-1, QT-2, QT-3, QT-4, and the TTR, respectively.

The parameters in the wells that exceeded the upper 95 percent confidence limits established from the background samples of respective wells are presented in Table 7. Total dissolved solids, chloride, and manganese exceeded the established limit in two wells, QT-1 and QT-3. Manganese also exceeded the established limit in well QT-2. Sulfate and barium exceeded the limit in well QT-3. Arsenic exceeded the limit in wells QT-1 and QT-2. Nickel exceeded the established limit in well QT-1. Cyanide exceeded the established limit in well QT-4 only. However, for nearly all exceedances, the corresponding concentration in the reservoir was much lower than that in the well.

TABLE 1: DIVERSIONS TO THE THORNTON TRANSITIONAL FLOOD CONTROL RESERVOIR DURING 2021

Date of Diversion	Volume Collected in Thornton Transitional Reservoir Million Gallons	Rainfall (Measured at Calumet WRP) Inches	Date Reservoir Completely Drained	Sample collected
05/09/21	192	1.37	NA[1]	Yes
06/26/21	2,151	5.4	NA	Yes
10/25/21	1,096	3.31	NA	Yes
Total	3,439	10.08		

[1]NA = Not available. Reservoir contained water from January through December 2021. Recent protocol for the operation of the Thornton Transitional Reservoir keeps the reservoir at approximately five percent full to allow make-up water to be fed into the Thornton Composite Reservoir.

TABLE 2: ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELL QT-1 AT THE THORNTON TRANSITIONAL RESERVOIR SITE DURING 2021

Event	Sample Date	pH	EC mS/m	TDS	BOD_5	CN^-	F^-	Cl^-	SO_4^{2-}	NH_3-N	Phenol	Ag	As	B	Ba
				mg/L											
Upper 95% Confidence Limit		7.6	NL[1]	2,408	NL	0.002	0.59	589	508	NL	NL	<0.0008	0.001	NL	0.095
1st Quarter	03/31/21	7.6	236	2,428	3	<0.005	0.32	921	310	0.46	0.013	<0.004	<0.002	0.26	0.073
Fill Event	05/20/21	7.1	227	2,396	<2	<0.005	0.31	916	303	0.32	0.005	<0.004	<0.002	0.26	0.074
2nd Quarter	06/03/21	7.0	187	2,392	<2	<0.005	0.33	876	286	0.46	<0.005	<0.004	<0.002	0.24	0.081
Fill Event	07/01/21	7.2	223	2,332	<2	<0.005	0.33	934	304	0.34	<0.005	<0.004	<0.002	0.23	0.076
3rd Quarter	08/12/21	7.1	285	2,304	<2	<0.005	0.32	891	304	0.36	<0.005	<0.004	0.002	0.26	0.079
Fill Event	10/28/21	7.2	303	2,306	<2	<0.005	0.32	899	NDR[2]	0.31	<0.005	<0.004	<0.002	0.24	0.078
4th Quarter	12/01/21	7.2	302	2,270	<2	<0.005	0.31	873	308	0.36	<0.005	<0.004	<0.002	0.23	0.074

TABLE 2 (Continued): ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELL QT-1 AT THE THORNTON TRANSITIONAL RESERVOIR SITE DURING 2021

Event	Sample Date	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Fecal Coliform	Temp.	Water Elevation[3]	Recharge Time
		mg/L								CFU/100 mL	°C	feet	hours
Upper 95% Confidence Limit		0.002	0.005	0.022	49	0.00005	0.094	0.005	0.019	NL	NL	NL	NL
1st Quarter	03/31/21	<0.002	<0.004	0.006	23	NDR[2]	0.287	0.005	<0.002	<1	13.1	-151	<48
Fill Event	05/20/21	<0.002	<0.004	0.006	18	<0.0005	0.128	<0.002	<0.002	<1	13.5	-151	<48
2nd Quarter	06/03/21	<0.002	<0.004	0.009	10	<0.0005	0.044	<0.002	<0.002	<1	12.8	-151	<48
Fill Event	07/01/21	<0.002	<0.004	0.005	13	<0.0005	0.068	<0.002	<0.002	<1	14.2	-138	<48
3rd Quarter	08/12/21	<0.002	<0.004	0.007	24	<0.0005	0.200	0.007	<0.002	<1	13.2	-146	<48
Fill Event	10/28/21	<0.002	<0.004	0.003	17	<0.0005	0.099	<0.002	<0.002	2	12.5	-151	<48
4th Quarter	12/01/21	<0.002	<0.004	<0.002	13	<0.0005	0.069	<0.002	<0.002	<1	12.4	-149	<48

[1]NL: No limit.

[2]No data reported because sample did not meet thermal preservation requirements for sulfate analysis; digestion thermometer was not calibrated for mercury analysis.

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

TABLE 3: ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELL QT-2 AT THE THORNTON TRANSITIONAL RESERVOIR SITE DURING 2021

Event	Sample Date	pH	EC mS/m	TDS	BOD_5	CN^-	F^-	Cl^-	SO_4^{2-}	NH_3-N	Phenol	Ag	As	B	Ba
				mg/L											
Upper 95% Confidence Limit		7.5	NL[1]	2,651	NL	0.002	0.38	478	757	NL	NL	0.0001	0.006	NL	0.069
1st Quarter	03/31/21	7.3	93	986	<2	<0.005	0.27	145	397	0.36	<0.005	<0.004	0.036	0.19	0.036
Fill Event	05/20/21	7.2	111	1,156	NDR[2]	<0.005	0.25	155	377	0.32	<0.005	<0.004	0.044	0.21	0.037
2nd Quarter	06/03/21	7.2	100	1,158	<2	<0.005	0.26	154	417	0.48	<0.005	<0.004	0.043	0.18	0.038
Fill Event	07/01/21	7.2	98	1,132	<2	<0.005	0.25	159	435	0.34	<0.005	<0.004	0.038	0.18	0.037
3rd Quarter	08/12/21	7.0	128	1,106	<2	<0.005	0.24	105	438	<0.300	<0.005	<0.004	0.031	0.17	0.034
Fill Event	10/28/21	7.3	128	1,108	<2	<0.005	0.25	144	NDR	<0.300	<0.005	<0.004	0.043	0.19	0.040
4th Quarter	12/01/21	7.2	128	1,074	<2	<0.005	0.23	121	486	0.34	<0.005	<0.004	0.031	0.16	0.034

TABLE 3 (Continued): ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELL QT-2 AT THE THORNTON TRANSITIONAL RESERVOIR SITE DURING 2021

Event	Sample Date	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Fecal Coliform	Temp.	Water Elevation[3]	Recharge Time
		mg/L								CFU/100 mL	°C	feet	hours
Upper 95% Confidence Limit		0.002	0.007	0.033	5.0	0.0003	0.063	NL	0.019	NL	NL	NL	NL
1st Quarter	03/31/21	<0.002	<0.004	0.002	2	NDR[2]	0.017	0.005	<0.002	<1	13.3	-193	<48
Fill Event	05/20/21	<0.002	0.004	<0.002	2	<0.0005	0.020	0.006	<0.002	<1	14.6	-192	<48
2nd Quarter	06/03/21	<0.002	<0.004	<0.002	2	<0.0005	0.019	0.004	<0.002	<1	14.4	-193	<48
Fill Event	07/01/21	<0.002	<0.004	<0.002	2	<0.0005	0.063	0.004	<0.002	<1	16.1	-161	<48
3rd Quarter	08/12/21	<0.002	<0.004	<0.002	3	<0.0005	0.072	0.006	<0.002	<1	15.0	-182	<48
Fill Event	10/28/21	<0.002	<0.004	<0.002	2	<0.0005	0.018	0.005	<0.002	<1	14.3	-187	<48
4th Quarter	12/01/21	<0.002	<0.004	<0.002	5	<0.0005	0.070	<0.002	<0.002	<1	13.7	-191	<48

[1]NL: No limit.
[2]NDR: No data reported due to sample duplicate failure for biological oxygen demand analysis; sample did not meet thermal preservation requirements for sulfate analysis; digestion thermometer was not calibrated for mercury analysis.
[3]Relative to Chicago City Datum (579.48 feet above mean sea level) at intersection of State and Madison Streets.

TABLE 4: ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELL QT-3 AT THE THORNTON TRANSITIONAL RESERVOIR SITE DURING 2021

Event	Sample Date	pH	EC mS/m	TDS	BOD_5	CN^-	F^-	Cl^-	SO_4^{2-}	NH_3-N	Phenol	Ag	As	B	Ba
				mg/L											
Upper 95% Confidence Limit		7.8	NL[1]	1,353	NL	0.002	0.36	190	238	NL	NL	0.0292	<0.002	NL	0.082
1st Quarter	03/31/21	6.9	147	1,586	<2	<0.005	0.21	455	260	0.44	<0.005	<0.004	<0.002	0.30	0.098
Fill Event	05/20/21	7.1	141	1,590	<2	<0.005	0.20	429	251	0.32	<0.005	<0.004	<0.002	0.31	0.095
2nd Quarter	06/03/21	6.8	134	1,512	<2	<0.005	0.23	430	248	0.49	<0.005	<0.004	<0.002	0.27	0.100
Fill Event	07/01/21	6.9	151	1,644	<2	<0.005	0.19	469	282	0.34	<0.005	<0.004	<0.002	0.25	0.107
3rd Quarter	08/12/21	7.0	189	1,590	<2	<0.005	0.19	435	250	0.38	<0.005	<0.004	<0.002	0.27	0.094
Fill Event	10/28/21	7.3	154	1,548	<2	<0.005	0.20	473	NDR[2]	0.33	<0.005	<0.004	<0.002	0.30	0.100
4th Quarter	12/01/21	7.3	171	1,748	<2	<0.005	0.19	488	287	0.39	<0.005	<0.004	<0.002	0.23	0.097

TABLE 4 (Continued): ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELL QT-3 AT THE THORNTON TRANSITIONAL RESERVOIR SITE DURING 2021

Event	Sample Date	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Fecal Coliform	Temp.	Water Elevation[3]	Recharge Time
		mg/L								CFU/100 mL	°C	feet	hours
Upper 95% Confidence Limit		0.001	0.006	0.022	21	0.00005	0.158	NL	0.014	NL	NL	NL	NL
1st Quarter	03/31/21	<0.002	<0.004	0.003	7	NDR[2]	0.090	0.002	<0.002	<1	12.0	-185	<48
Fill Event	05/20/21	<0.002	<0.004	<0.002	3	<0.0005	0.083	<0.002	<0.002	<1	13.2	-184	<48
2nd Quarter	06/03/21	<0.002	<0.004	0.004	9	<0.0005	0.099	<0.002	<0.002	<1	12.6	-184	<48
Fill Event	07/01/21	<0.002	<0.004	0.003	11	<0.0005	0.106	<0.002	<0.002	<1	13.2	-163	<48
3rd Quarter	08/12/21	<0.002	<0.004	<0.002	13	<0.0005	0.253	<0.002	<0.002	<1	12.8	-175	<48
Fill Event	10/28/21	<0.002	<0.004	0.003	4	<0.0005	0.110	0.003	<0.002	<1	12.7	-179	<48
4th Quarter	12/01/21	<0.002	<0.004	<0.002	3	<0.0005	0.100	<0.002	<0.002	<1	12.3	-180	<48

[1]NL: No limit.
[2]NDR: No data reported because sample did not meet thermal preservation requirements for sulfate analysis; digestion thermometer was not calibrated for mercury analysis.
[3]Relative to Chicago City Datum (579.48 feet above mean sea level) at intersection of State and Madison Streets.

TABLE 5: ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELL QT-4 AT THE THORNTON TRANSITIONAL RESERVOIR SITE DURING 2021

Event	Sample Date	pH	EC mS/m	TDS	BOD_5	CN^-	F^-	Cl^-	SO_4^{2-}	NH_3-N	Phenol	Ag	As	B	Ba
				mg/L											
Upper 95% Confidence Limit		7.7	NL[1]	2,034	NL	0.002	0.39	590	314	NL	NL	0.0033	NL	NL	0.181
1st Quarter	03/31/21	7.1	120	1,188	<2	0.005	0.25	298	227	0.41	<0.005	<0.004	<0.002	0.36	0.080
Fill Event	05/20/21	7.1	117	1,174	<2	<0.005	0.23	249	197	0.32	<0.005	<0.004	<0.002	0.35	0.069
2nd Quarter	06/03/21	7.1	109	1,212	<2	<0.005	0.24	277	220	0.49	<0.005	<0.004	<0.002	0.34	0.074
Fill Event	07/01/21	7.2	111	1,162	<2	<0.005	0.23	264	215	0.35	<0.005	<0.004	<0.002	0.37	0.074
3rd Quarter	08/12/21	7.2	135	1,042	<2	<0.005	0.24	212	199	0.37	<0.005	<0.004	<0.002	0.38	0.070
Fill Event	10/28/21	7.4	128	1,040	<2	<0.005	0.22	251	NDR[2]	<0.30	<0.005	<0.004	<0.002	0.34	0.073
4th Quarter	12/01/21	7.2	141	1,250	<2	<0.005	0.23	234	212	0.38	<0.005	<0.004	<0.002	0.33	0.069

TABLE 5 (Continued): ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELL QT-4 AT THE THORNTON TRANSITIONAL RESERVOIR SITE DURING 2021

Event	Sample Date	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Fecal Coliform CFU/100 mL	Temp. °C	Water Elevation[3] feet	Recharge Time hours
		mg/L											
Upper 95% Confidence Limit		0.001	0.022	0.035	24	0.00004	0.203	NL	0.018	NL	NL	NL	NL
1st Quarter	03/31/21	<0.002	<0.004	<0.002	8	NDR[2]	0.060	<0.002	<0.002	<1	13.8	-92	<48
Fill Event	05/20/21	<0.002	<0.004	<0.002	7	<0.0005	0.105	<0.002	<0.002	<1	13	-93	<48
2nd Quarter	06/03/21	<0.002	<0.004	0.002	10	<0.0005	0.075	<0.002	<0.002	<1	13	-92	<48
Fill Event	07/01/21	<0.002	<0.004	<0.002	8	<0.0005	0.080	<0.002	<0.002	<1	13.7	-92	<48
3rd Quarter	08/12/21	<0.002	<0.004	<0.002	9	<0.0005	0.079	<0.002	<0.002	<1	13.1	-93	<48
Fill Event	10/28/21	<0.002	<0.004	<0.002	7	<0.0005	0.054	<0.002	<0.002	<1	15	-146	<48
4th Quarter	12/01/21	<0.002	<0.004	<0.002	9	<0.0005	0.081	<0.002	<0.002	<1	14.5	-90	<48

[1]NL: No limit.
[2]NDR: No data reported because sample did not meet thermal preservation requirements for sulfate analysis; digestion thermometer was not calibrated for mercury analysis.
[3]Relative to Chicago City Datum (579.48 feet above mean sea level) at intersection of State and Madison Streets.

TABLE 6: ANALYSIS OF FILL EVENT WATER STORED IN THE THORNTON TRANSITIONAL RESERVOIR SAMPLED DURING 2021

Event	Sample Date	pH	TDS	BOD_5	CN^-	F^-	Cl^-	SO_4^{2-}	NH_3-N	Phenol	Ag	As	B	Ba
			mg/L											
1st Fill Event	05/11/21	7.8	916	3	<0.005	0.20	162	188	0.41	<0.005	<0.004	<0.002	0.09	0.037
2nd Fill Event	07/01/21	6.5	286	<2	0.005	0.18	51	49	0.58	<0.005	<0.004	0.002	0.07	0.026
3rd Fill Event	10/27/21	7.0	272	NDR[1]	<0.005	0.19	39	NDR	<0.30	<0.005	<0.004	<0.002	<0.01	<0.020

TABLE 6 (Continued): ANALYSIS OF FILL EVENT WATER STORED IN THE THORNTON TRANSITIONAL RESERVOIR SAMPLED DURING 2021

Event	Sample Date	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Fecal Coliform	Temp.	Water Elevation[2]
		mg/L								CFU/100 mL	°C	feet
1st Fill Event	05/11/21	<0.002	<0.004	0.005	2	<0.0005	0.056	0.007	0.003	2,500	12.0	-205
2nd Fill Event	07/01/21	<0.002	<0.004	0.005	1	<0.0005	0.027	0.004	0.002	930	23.2	-160
3rd Fill Event	10/27/21	<0.002	<0.004	<0.002	1	<0.0005	0.028	<0.002	<0.002	4,800	11.0	-184

[1]NDR: No data reported for biological oxygen demand because the batch laboratory control samples failed; sample did not meet thermal preservation requirements for sulfate analysis.
[2]Relative to Chicago City Datum (579.48 feet above mean sea level) at intersection of State and Madison Streets.

TABLE 7: EXCEEDANCES[1] DETECTED IN WELLS AT THE THORNTON TRANSITIONAL RESERVOIR SITE DURING 2021

Well Number	Parameter Exceeding Limit
QT-1	TDS, Cl^-, As, Mn, Ni
QT-2	As, Mn
QT-3	TDS, Cl^-, SO_4^{2-}, Ba, Mn
QT-4	CN^-

[1]Concentrations of analytes which exceeded upper limits of 95 percent confidence intervals for background samples.