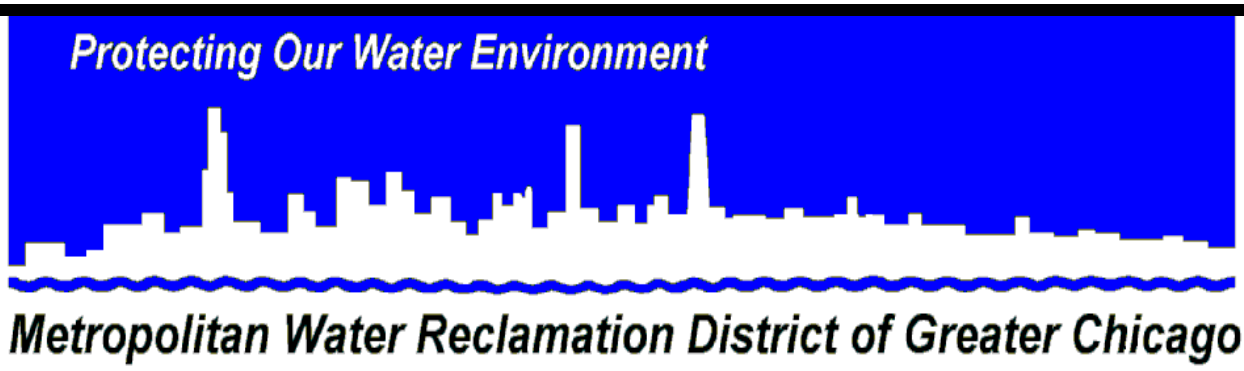

MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 19-25

THORNTON COMPOSITE RESERVOIR

GROUNDWATER MONITORING REPORT

SECOND QUARTER 2019

September 2019

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

CECIL LUE-HING RESEARCH AND DEVELOPMENT COMPLEX
6001 WEST PERSHING ROAD CICERO, ILLINOIS 60804-4112

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

September 12, 2019

Mr. Richard P. Cobb, P.G.
Acting Division Manager
Division of Public Water Supplies
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, IL 62794
RICK.COBB@Illinois.gov

Dear Mr. Cobb:

Subject: Transmittal of the Report "Thornton Composite Reservoir Groundwater Monitoring Report Second Quarter 2019"

Please find attached the report entitled "Thornton Composite Reservoir Groundwater Monitoring Report Second Quarter 2019" transmitted electronically. The report is prepared for transmittal to the Illinois Environmental Protection Agency (IEPA) in accordance with the Thornton Composite Reservoir Groundwater Monitoring Plan. Also attached is the Excel spreadsheet of the Thornton Composite Reservoir raw data as required by the IEPA.

If you have any questions or would like to have additional information, please contact Mr. Benjamin Morgan at at (708) 588-3743 or MorganB@mwrd.org.

Very truly yours,

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

AC:BM:cm
Attachment
cc: Mr. E. Podczerwinski

Metropolitan Water Reclamation District of Greater Chicago
100 East Erie Street Chicago, Illinois 60611-2803 (312) 751-5600

Thornton Composite Reservoir Groundwater Monitoring Report

Second Quarter 2019

By

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September 2019

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LIST OF ACRONYMS

Acronym	Definition
CCD	Chicago City Datum
CFU	Colony Forming Unit
CSF	Combined Sewer Flow
FC	Fecal Coliform
GMP	Groundwater Monitoring Plan
GPS	Groundwater Protection System
IAC	Illinois Administrative Code
M&R	Monitoring and Research
QC	Quality Control
TCR	Thornton Composite Reservoir
TDS	Total Dissolved Solids
TOC	Total Organic Carbon

ACKNOWLEDGMENT

This report for the Thornton Composite Reservoir Groundwater Monitoring was generated by the Monitoring and Research (M&R) Department. All samples were collected by Tetra Tech, Inc. (contractor) under the Thornton Composite Reservoir Contract 19-105-11. Analyses were performed by the Analytical Laboratories Division and the Analytical Bacteriology Laboratory of the Metropolitan Water Reclamation District of Greater Chicago (District). Special thanks are due to Ms. Coleen Maurovich for typing and formatting this report.

DISCLAIMER

Mention of proprietary equipment and chemicals in this report does not constitute endorsement by the District.

INTRODUCTION

A Groundwater Protection System (GPS) was constructed for the Thornton Composite Reservoir (TCR) to protect against the exfiltration of combined sewer flow (CSF) into the surrounding dolomite aquifers. The CSF and minimal amounts of stormwater are stored in the reservoir during and after large storm events. To monitor the performance of the GPS, a network of monitoring wells located outside the perimeter of the GPS is being monitored as discussed in the Revised Groundwater Monitoring Plan (GMP) (Black & Veatch, 2016). As explained in the Revised GMP, one sample of reservoir water, one of the Main Quarry Sump, and one from each of the seven wells are collected annually and analyzed for the Illinois Administrative Code (IAC) Title 35 Part 620 Class I groundwater constituents. In addition, following a reservoir fill event or during a routine quarterly event, groundwater is sampled from the seven wells and the Main Quarry Sump and tested for a targeted list of parameters that are more likely to be detected in CSF water.

The monitoring well system consists of one deep well, TB-124, which monitors the underlying Galena Aquifer, and six vertical Westbay multi-level monitoring wells: TB-118, TB-119, TB-120, TB-121, TB-122, and TB-123, which monitor the Silurian Dolomite aquifers. As discussed in the Revised GMP, following a reservoir fill event, bi-weekly sampling is required while the water in the reservoir remains above an elevation of -280 ft Chicago City Datum (CCD). Groundwater is sampled from each well at the first sample interval port immediately below the reservoir water elevation. Each of the multi-level monitoring wells is capable of monitoring four distinct 20-ft intervals in the Silurian Dolomite aquifer.

The locations of monitoring wells, quarry sump, TCR, and the GPS are presented in Figure 1. The Main Quarry Sump is located beyond the south boundary of the GPS and is not a component of the TCR but is an integral part of the Hanson Material Services mining quarry to the south of the TCR. This sump facilitates mining operations by minimizing the water level at the bottom of the quarry. It is possible that the bottom of this sump could extend beyond the lowest depth of the TCR (-297.5 CCD) ft. The sump contains mainly groundwater and small quantities of surface runoff, and it is sampled quarterly and during fill events, along with the wells, to evaluate the potential migration of contaminants from the TCR to the sump.

Table 1 lists the characteristics of all wells at the TCR site (well location coordinates, elevations and depths, and the sampling port interval elevations).

Prior to the TCR becoming operational in November 2015, eight (8) sampling events were conducted on a quarterly basis for two years (May 2012 through March 2014) to provide background data on the existing groundwater quality. In order to evaluate the effectiveness of the grout curtain and the GPS, the Revised GMP (2016) presents the analysis of data for all samples collected during the background monitoring period and provides a baseline for comparison with routine monitoring data. Changes over time in groundwater calcium and magnesium concentrations would also be useful in tracking the occurrence of infiltration/exfiltration. Groundwater analytical data routinely generated for the monitoring wells, reservoir, and sump

FIGURE 1: MONITORING WELL AND MAIN QUARRY SUMP LOCATIONS

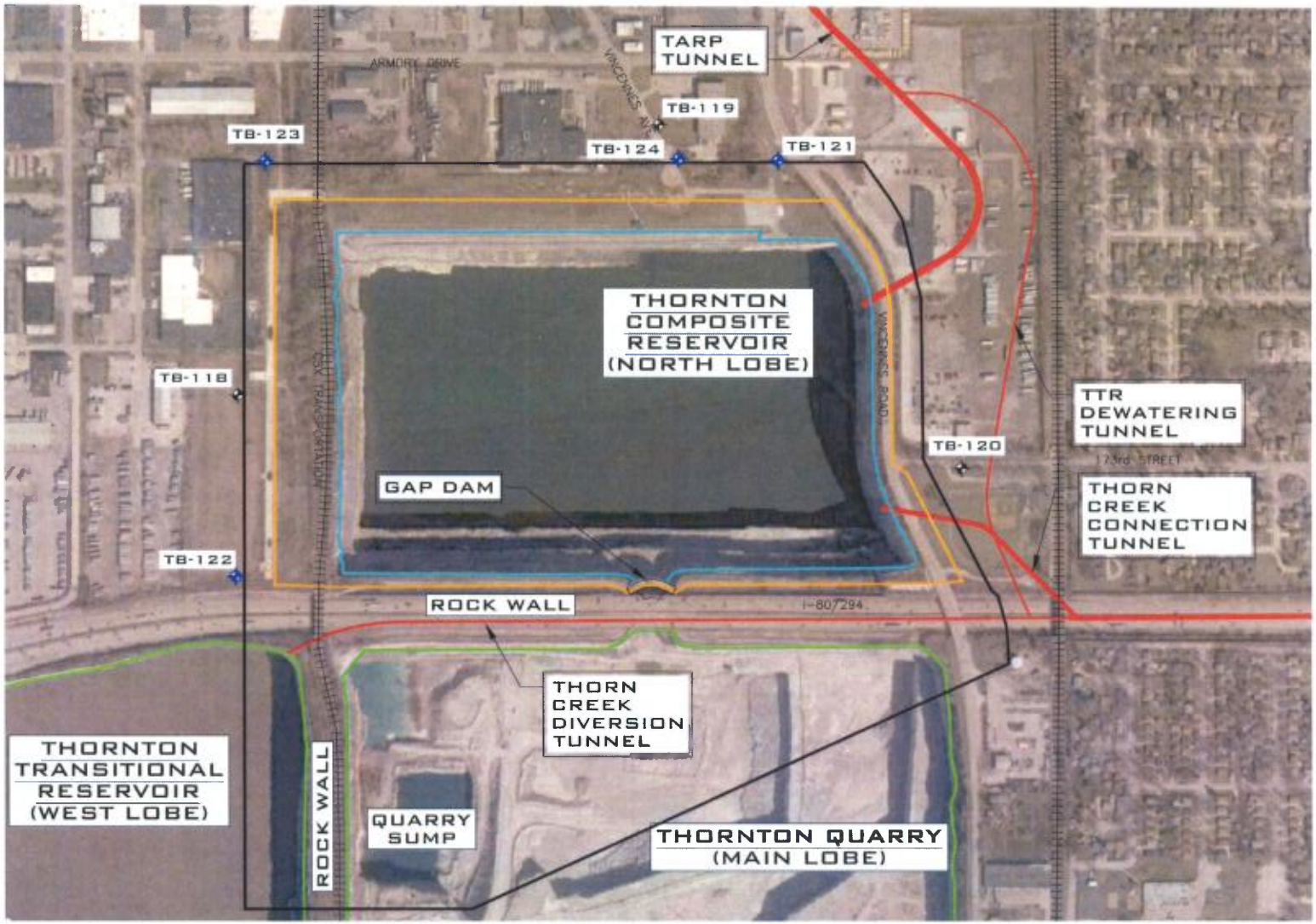

TABLE 1: CHARACTERISTICS OF MONITORING WELLS TB-118 THROUGH TB-124 AT THE THORNTON COMPOSITE RESERVOIR SITE

Well ID	Coordinates[1] Northing (ft)	Coordinates[1] Easting (ft)	Ground Surface El (ft, CCD[2])	Top of Riser El (ft, CCD[2])	Depth of Well (ft)	Sampling Port Interva (ft, CCD) Interval 1	Interval 2	Interval 3	Interval 4
TB-118	1,791,110.38	693,560.44	38.5	41.5	532	-85 to -105	-212 to -232	-283 to -303	-392 to -412
TB-119	1,792,316.63	695,509.39	27.9	29.5	529	-85 to -105	-212 to -232	-283 to -303	-392 to -412
TB-120	1,790,782.31	696,888.93	40.0	42.1	540	-86 to -106	-213 to -233	-284 to -304	-393 to -413
TB-121	1,792,193.10	696,044.98	29.4	30.4	461	-84 to -104	-211 to -231	-282 to -302	-391 to -411
TB-122	1,790,288.61	693,549.38	48.8	51.7	480	-85 to -105	-212 to -232	-283 to -303	-392 to -412
TB-123	1,792,185.60	693,685.69	28.9	31.8	460	-84 to -104	-211 to -231	-282 to -302	-391 to -411
TB-124	1,792,200.77	695,591.56	29.6	29.2	728	-663 to -698			

[1]Illinois State Plane Coordinate System (NAD 1927).
[2]Chicago City Datum (CCD).

will also be compared with the IAC Title 35 Part 620 Class I Groundwater Standards (IPCB, IEPA, 2013) to evaluate any exceedances in groundwater standards.

There was one fill event during the second quarter of 2019, beginning on April 29. This was the second fill event of 2019. One complete set of samples was collected at the Main Quarry Sump and all monitoring wells during this event on May 1 – 3, 2019. Water elevation in the reservoir remained above -280 ft CCD continuously through the end of the quarter. However, further samples could not be collected this quarter due to the equipment breakdown, which occurred at the completion of four monitoring wells sampling for the first subsequent bi-weekly fill event sampling, beginning on May 15, 2019. A quarterly sample was collected from the Main Quarry Sump and all monitoring wells from April 16 - April 18, 2019, while the reservoir was not experiencing a fill event.

This report presents field activities, observations, and analytical data for surface and groundwater monitoring samples taken at the Main Quarry Sump and at all monitoring wells during quarterly and fill event sampling conducted from April 16 to May 15, 2019.

FIELD ACTIVITIES

For this report period, a complete set of samples was collected at the sump, the deep well, and at sampling port interval 3 of all multi-level wells as part of a quarterly monitoring collection during a non-fill event from April 16 – 18, 2019 (Table 2). Another complete set of samples was collected at the sump, the deep well, and at sampling port interval 3 of all multi-level wells for fill event sampling from May 1 – 3, 2019. Four multi-level wells were sampled during bi-weekly fill event monitoring on May 15, but a sampling equipment malfunction prevented collection of any further samples during this quarter.

Using a WTW Multi 3400i pH/conductivity/temperature meter, the pH, electrical conductivity (EC), and temperature of each sample were measured and recorded immediately after collection.

Prior to sampling the multi-level wells, hydrostatic pressure was measured to calculate the groundwater elevation at Port 3 of each well. Table 3 lists the elevations at Port 3 of each well and the corresponding groundwater elevations during the quarterly sampling in April 2019. Table 4 lists the elevations at Port 3 of each well and the corresponding groundwater elevations during the fill event sampling in May 2019.

All samples were packed in ice and shipped to the District's Analytical Laboratories Division for the analysis of selected inorganic constituents (IAC Title 35 Part 620 Class I Groundwater Standards) in accordance with the revised GMP. Additional aliquots were also prepared in the field and shipped in ice to the District's Analytical Microbiology and Biomonitoring Laboratory for fecal coliform analysis.

TABLE 2: DEVICES AND CORRESPONDING DATES OF SAMPLING DURING FILL EVENT SAMPLING IN APRIL AND MAY 2019

Date of Sampling	Event	Device/Structure Sampled
04/16/2019	Quarterly	TB-122, TB-122 Dup
04/17/2019	Quarterly	TB-118, TB-120, TB-121, TB-123
04/18/2019	Quarterly	TB-119, TB-124, Sump
05/01/2019	Fill Event #2, Sampling #1	TB-118, TB-122, TB-123
05/02/2019	Fill Event #2, Sampling #1	TB-119, TB-120, TB-120 Dup, TB-121
05/03/2019	Fill Event #2, Sampling #1	TB-124, Sump
05/15/2019	Fill Event #2, Sampling #2[1]	TB-118, TB-120, TB-121, TB-122

[1] Further sampling during this fill event was not possible due to equipment malfunction.

TABLE 3: SUMMARY OF GROUNDWATER ELEVATIONS AT SAMPLING PORT 3 OF EACH WELL AND CORRESPONDING GROUNDWATER ELEVATIONS DURING QUARTERLY MONITORING IN APRIL 2019

Sample Date	Well ID	Sampling Port 003 Elevation	Groundwater Elevation
		---------- (ft CCD[1]) ----------	
04/17/2019	TB-118	-289	-90
04/18/2019	TB-119	-289	-164
04/17/2019	TB-120	-290	-210
04/17/2019	TB-121	-288	-171
04/16/2019	TB-122	-288	-162
04/17/2019	TB-123	-288	-50
04/18/2019	TB-124[2]	NA[3]	-342

[1]Chicago City Datum.

[2]TB-124 is a conventional well screened from -663 to -698 ft CCD. During April, one sample was taken at approximately 650 ft below ground surface.

[3]NA = Not Applicable.

TABLE 4: SUMMARY OF GROUNDWATER ELEVATIONS AT SAMPLING PORT 3 OF EACH WELL AND CORRESPONDING GROUNDWATER ELEVATIONS DURING FILL EVENT MONITORING IN MAY 2019

Fill Event	Sample Date	Well ID	Sampling Port 003 Elevation	Groundwater Elevation
			(ft CCD[1])	
2-1	05/01/2019	TB-118	-289	-90
	05/02/2019	TB-119	-289	-164
	05/02/2019	TB-120	-290	-177
	05/02/2019	TB-121	-288	-171
	05/01/2019	TB-122	-288	-161
	05/01/2019	TB-123	-288	-48
	05/03/2019	TB-124[2]	NA[3]	-339
2-2	05/15/2019	TB-118	ND[4]	ND
	05/15/2019	TB-120	ND	ND
	05/15/2019	TB-121	ND	ND
	05/15/2019	TB-122	ND	ND

[1]Chicago City Datum.
[2]TB-124 is a conventional well screened from -663 to -698 ft CCD. During May, one sample was taken at approximately 650 ft below ground surface.
[3]NA = Not Applicable.
[4]Not determined. Field data reporting inadvertently terminated following equipment malfunction.

ANALYTICAL RESULTS

Table 5 lists the analytical methods used by the laboratory for various parameters. Analytical results were reviewed to identify any analytes that exceeded the Illinois Class I Groundwater Standards (35 IAC Part 620).

The analytical data for all well samples and the Main Quarry Sump sample collected during quarterly monitoring from April 16 – April 18 are presented in Table 6. There were a few exceedances of the Part 620 groundwater standards, including pH, total dissolved solids (TDS), chloride, sulfate, and boron as indicated in bold font in Table 6. However, among these parameters, only pH showed a value higher than the background maximum.

The analytical data for all well samples and the Main Quarry Sump sample collected during the first sampling of fill event monitoring this quarter, from May 1 – May 3, are presented in Table 7. There were a few exceedances of the Part 620 groundwater standards, including pH, TDS, chloride, sulfate, and boron as indicated in bold font in Table 7. Again, among these parameters, only pH showed a value higher than the background maximum.

The analytical data for the four multi-level wells collected on May 15 prior to equipment breakdown during the second bi-weekly sampling of fill event monitoring this quarter are presented in Table 8. There were a few exceedances of the Part 620 groundwater standards, including TDS, chloride, and boron as indicated in bold font in Table 8. However, none of these parameters exceeded the background maximum.

Fecal coliform (FC) populations were detected at the Main Quarry Sump with low density, 3 CFU/100 mL at quarterly sampling in April (Table 6) and 22 CFU/100 mL at the first May fill event sampling (Table 7). FC populations were undetected in all monitoring wells except for TB-119 at the first May fill event sampling at 5 CFU/100 mL (Table 7).

TABLE 5: ANALYTICAL METHODS USED FOR REQUIRED PARAMETERS

Inorganic Chemical Parameters	Analytical Method
Chloride	SM 4500-Cl- D
Alkalinity, Bicarbonate	SM 2320 B
Total Dissolved Solids	SM 2540 C
Sulfate	USEPA 375.2R2.0,1993
TAL metals	SM3120B,1999
Ammonia (as N)	EPA 350.1
Hardness	SM 2340B,1997
TOC	SM 5310-C
Others:	
Phenols	EPA 420.4
Fecal Coliform	SM 9221E

TABLE 6: ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELLS TB-118 THROUGH TB-124 AND THE MAIN QUARRY SUMP AT THE THORNTON COMPOSITIE RESERVOIR SITE DURING QUARTERLY MONITORING IN APRIL 2019

Parameter	Unit	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well								Sump
					TB-118	TB-119	TB-120	TB-121	TB-122	TB-122-D[2]	TB-123	TB-124	
pH		6.5 - 9.0	8.4	NL[3]	8.3	**9.6**	**10.0**	8.8	8.0	8.0	**9.9**	9.2	8.7
EC	mS/m	NL	415	NL	1008	832	984	980	452	452	738	695	1,062
TDS	mg/L	1,200	2,960	25	**1,436**	500	786	1140	888	888	578	**1,620**	**1,446**
TOC	"	NL	1	1	2.5	1.4	1.7	1.6	1.9	1.9	1.6	1	1.2
Chloride	"	200	1,230	1	**420**	58	152	**265**	**219**	**217**	56	**268**	**207**
Sulfate	"	400	890	1	217	99	102	190	90	89	128	**583**	**514**
Ammonia as N	"	NL	ND[4]	0.30	0.501	0.436	0.35	0.614	0.566	0.545	0.662	1.143	<0.300
Total Phenol	"	0.1	0.06	0.005	0.008	0.006	0.007	0.005	0.009	<0.005	<0.005	0.006	<0.005
Fecal Coliform	CFU/100 mL	NL	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	3
Ag	mg/L	0.05	0.003	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
B	"	2	3.8	0.005	0.736	0.868	1.080	1.030	**2.357**	2.211	1.896	0.899	0.377
Be	"	0.004	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	"	1	0.035	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.011
Cr	"	0.1	86.4	0.002	<0.002	<0.002	<0.002	<0.002	0.010	<0.002	<0.002	<0.002	<0.002
Cu	"	0.65	0.004	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mn	"	0.15	0.183	0.001	0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Se	"	0.05	0.008	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.00257	0.003
V	"	0.049	ND	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	"	5	10	0.005	0.031	0.026	0.041	0.050	0.040	0.021	0.035	0.377	0.006
Ca	"	NL	276	0.5	178	87.1	101	135	68.1	67.5	78.4	67.8	152
Mg	"	NL	153	0.5	87.1	44.5	50.0	69.2	35.4	34.4	41.3	49.9	113

[1]Lab reporting limit.
[2]Duplicate sample.
[3]No existing limit.
[4]Not determined.

TABLE 7: ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELLS TB-118 THROUGH TB-124 AND THE MAIN QUARRY SUMP AT THE THORNTON COMPOSITIE RESERVOIR SITE FOR THE FIRST SAMPLING OF FILL EVENT MONITORING IN MAY 2019

Parameter	Unit	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well								Sump
					TB-118	TB-119	TB-120	TB-120-D[2]	TB-121	TB-122	TB-123	TB-124	
pH		6.5 - 9.0	8.4	NL[3]	7.9	8.7	8.6	8.6	**9.3**	8.5	8.6	8.6	7.6
EC	mS/m	NL	415	NL	238	84.9	133	133	133	599	92.8	270	208
TDS	mg/L	1,200	2,960	25	**1,346**	526	686	736	952	854	584	**1,482**	1,046
TOC	"	NL	1	1	2.3	1.3	1.6	1.6	1.4	1.8	1.4	<1.0	1.2
Chloride	"	200	1,230	1	**426**	58	151	151	**262**	199	57	**268**	162
Sulfate	"	400	890	1	218	98	104	104	191	83	129	**579**	**436**
Ammonia as N	"	NL	ND[4]	0.30	0.50	0.50	0.37	0.38	0.62	0.54	0.65	1.34	<0.30
Total Phenol	"	0.1	0.06	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005
Fecal Coliform	CFU/100 ml	NL	<1	1	<1	5	<1	<1	<1	<1	<1	<1	22
Ag	mg/L	0.05	0.003	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
B	"	2	3.8	0.005	0.690	0.843	0.958	0.922	0.910	**2.454**	1.708	0.965	0.315
Be	"	0.004	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	"	1	0.035	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.012
Cr	"	0.1	86.4	0.002	<0.002	<0.002	<0.002	0.004	<0.002	0.003	<0.002	0.0022	<0.002
Cu	"	0.65	0.004	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mn	"	0.15	0.183	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Se	"	0.05	0.008	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.00249	<0.002
V	"	0.049	ND	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	"	5	10	0.005	0.041	0.120	0.019	0.079	0.060	0.030	0.059	0.511	0.009
Ca	"	NL	276	0.5	185	81.8	99.5	96.6	131	72.6	82.3	86.7	125
Mg	"	NL	153	0.5	88.9	41.3	49.8	48.4	67.3	36.7	43.4	56.3	92.2

[1]Lab reporting limit.
[2]Duplicate sample.
[3]No existing limit.
[4]Not determined.

TABLE 8: ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELLS TB-118 THROUGH TB-124 AND THE MAIN QUARRY SUMP AT THE THORNTON COMPOSITIE RESERVOIR SITE FOR THE SECOND SAMPLING OF FILL EVENT MONITORING IN MAY 2019

Parameter	Unit	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well							
					TB-118	TB-119	TB-120	TB-121	TB-122	TB-123	TB-124	Sump
pH		6.5 - 9.0	8.4	NL[2]	NA[3]	NC[4]	NA	NA	NA	NC	NC	NC
EC	mS/m	NL	415	NL	NA	NC	NA	NA	NA	NC	NC	NC
TDS	mg/L	1,200	2,960	25	**1,578**	NC	784	1072	970	NC	NC	NC
TOC	"	NL	1	1	1.5	NC	1.3	<1.0	1.2	NC	NC	NC
Chloride	"	200	1,230	1	444	NC	154	**268**	**229**	NC	NC	NC
Sulfate	"	400	890	1	219	NC	104	192	94	NC	NC	NC
Ammonia as N	"	NL	ND[5]	0.30	0.488	NC	0.339	0.582	0.459	NC	NC	NC
Total Phenol	"	0.1	0.06	0.005	0.005	NC	<0.005	<0.005	<0.005	NC	NC	NC
Fecal Coliform	CFU/100 mL	NL	<1	1	NC	NC	<1	NC	NC	NC	NC	NC
Ag	mg/L	0.05	0.003	0.002	<0.002	NC	<0.002	<0.002	<0.002	NC	NC	NC
B	"	2	3.8	0.005	0.726	NC	0.981	1.004	**2.389**	NC	NC	NC
Be	"	0.004	0.002	0.001	<0.001	NC	<0.001	<0.001	<0.001	NC	NC	NC
Co	"	1	0.035	0.001	<0.001	NC	<0.001	<0.001	<0.001	NC	NC	NC
Cr	"	0.1	86.4	0.002	<0.002	NC	<0.002	<0.002	0.002	NC	NC	NC
Cu	"	0.65	0.004	0.001	<0.001	NC	<0.001	<0.001	<0.001	NC	NC	NC
Mn	"	0.15	0.183	0.001	<0.005	NC	<0.005	<0.005	<0.005	NC	NC	NC
Se	"	0.05	0.008	0.002	<0.002	NC	<0.002	<0.002	<0.002	NC	NC	NC
V	"	0.049	ND	0.001	<0.001	NC	<0.001	<0.001	<0.001	NC	NC	NC
Zn	"	5	10	0.005	0.038	NC	0.039	0.035	0.034	NC	NC	NC
Ca	"	NL	276	0.5	179	NC	98.6	136	69.2	NC	NC	NC
Mg	"	NL	153	0.5	85.6	NC	48.0	68.6	34.6	NC	NC	NC

[1]Lab reporting limit.
[2]No existing limit.
[3]Not available. Field data reporting inadvertently terminated following equipment breakdown.
[4]Samples not collected due to equipment breakdown.
[5]Not determined.

REFERENCES

Black & Veatch, 2014, "Background Groundwater Quality Report for Thornton Composite Reservoir," prepared for the Metropolitan Water Reclamation District of Greater Chicago, July 2014.

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