

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***MONITORING AND RESEARCH
DEPARTMENT***

REPORT NO. 11-38

TUNNEL AND RESERVOIR PLAN

THORNTON TRANSITIONAL FLOOD CONTROL RESERVOIR

WATER QUALITY MONITORING WELLS

2010 ANNUAL GROUNDWATER MONITORING REPORT

July 2011

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July 29, 2011

Ms. Marcia Willhite, Chief
Bureau of Water
Illinois Environmental Protection Agency
P. O. Box 19276
Springfield, IL 62794-9276

Dear Ms. Willhite:

Subject: Tunnel and Reservoir Plan, Thornton Transitional Flood Control Reservoir Water Quality Monitoring Wells, 2010 Annual Groundwater Monitoring Report

Enclosed are three copies of "Tunnel and Reservoir Plan, Thornton Transitional Flood Control Reservoir Water Quality Monitoring Wells, 2010 Annual Groundwater Monitoring Report."

Very truly yours,

Thomas C. Granato, Ph.D.
Acting Director
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TCG:DGM:lf

Enclosures

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TUNNEL AND RESERVOIR PLAN
THORNTON TRANSITIONAL FLOOD CONTROL RESERVOIR
WATER QUALITY MONITORING WELLS
2010 ANNUAL GROUNDWATER MONITORING REPORT

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INTRODUCTION

The purpose of this report is to meet the reporting requirements of the Illinois Environmental Protection Agency (IEPA) relative to annual flood control utilization of the Thornton Transitional Reservoir (Reservoir) for 2010. The specific informational requirements are described in the June 16, 2001, Scope of Work (SOW) for Groundwater Quality Monitoring of the Reservoir. The SOW was approved in a letter from the IEPA dated August 6, 2001.

The reporting requirements are found in Section 7 of the SOW. The requirements for the annual flood control utilization of the Reservoir shall include:

1. The year's monitoring well sample analysis results.
2. Reservoir content grab sample results.
3. Detailed review and comparison of the monitoring well sampling analysis results, utilizing the monitoring well statistical background determinations.

Objective

The objective of collecting groundwater quality data from the four monitoring wells QT-1, QT-2, QT-3, and QT-4 and Reservoir content grab samples is to assess any possible contamination of the monitoring wells which may result from seepage produced during the diversion event for any of the parameters indicated in Table 2 of the SOW (Table 1).

Project Description

The Reservoir is in the West Lobe of the Thornton Quarry southeast of the intersection of the Tri-State Tollway and Halsted Street in Thornton, Illinois, as shown in Figure 1. The Reservoir is the final structural measure to be implemented for the Little Calumet River Watershed under the Natural Resources Conservation Service Little Calumet Watershed Plan of November 1998. The Reservoir provides 3.7 billion gallons (BG) of floodwater storage, which has been expanded from the planned 3.1 BG due to additional rock mining and provides sufficient volume to capture a 100-year storm event from Thorn Creek at a point just south of the Tri-State Tollway.

The project provides flood control benefits for 21 businesses and 4,400 residences, for an average benefit of \$6.8 million per year. Within the Little Calumet watershed are the communities of Blue Island, Calumet City, Dixmoor, Dolton, Glenwood, Harvey, Lansing, Phoenix, Riverdale, and South Holland, which receive flood control benefits.

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

FIELD SAMPLING

There were three diversion events at the Reservoir during the year 2010, June 24–25, 2010, August 3–5, 2010, and December 31, 2010–January 1, 2011. The diversion events of 2010 are summarized in Table 2.

During these events, in accordance with the SOW, samples were collected from the four groundwater quality monitoring wells surrounding the Reservoir and grab samples were taken from the Reservoir, except for those instances when sampling equipment was malfunctioning or access to the sampling locations was impossible due to natural causes. The parameters to be analyzed for are found in Table 1, which presents all the parameters listed in Table 2 of the SOW.

ANALYTICAL DATA RESULTS

Tables 3 through 10 contain the results of the analyses of the four groundwater quality monitoring wells surrounding the Reservoir along with the calculated upper 95 percent confidence limits for the June 24–25, 2010, diversion event. The calculated upper 95 percent confidence limits were derived using ten samples from background monitoring between October 2002 and September 2004. These limits were updated from those using six samples collected from October 2002 and May 2003 which were reported in the Reservoir Pre-Operational Background Groundwater Quality Report (Research and Development Department Report No. 03-23). Tables 11 and 12 contain the results of the grab samples from the Reservoir for the June 24–25, 2010, diversion event. Tables 13 through 18 contain the results of the analyses of the four groundwater quality monitoring wells surrounding the Reservoir along with the calculated upper 95 percent confidence limits for the August 3–5, 2010, diversion event. Tables 19 and 20 contain the results of the grab samples from the Reservoir for the August 3–5, 2010, diversion event. Tables 21 through 28 contain the results of the analyses of the four groundwater quality monitoring wells surrounding the Reservoir along with the calculated upper 95 percent confidence limits for the December 31, 2010–January 1, 2011, diversion event. Tables 29 and 30 contain the results of the grab samples from the Reservoir for the December 31, 2010–January 1, 2011, diversion events.

DISCUSSION OF RESULTS

During all three diversion events samples of both the surrounding groundwater quality monitoring wells and the Reservoir itself were collected as long as there was water in the Reservoir per requirements of the SOW.

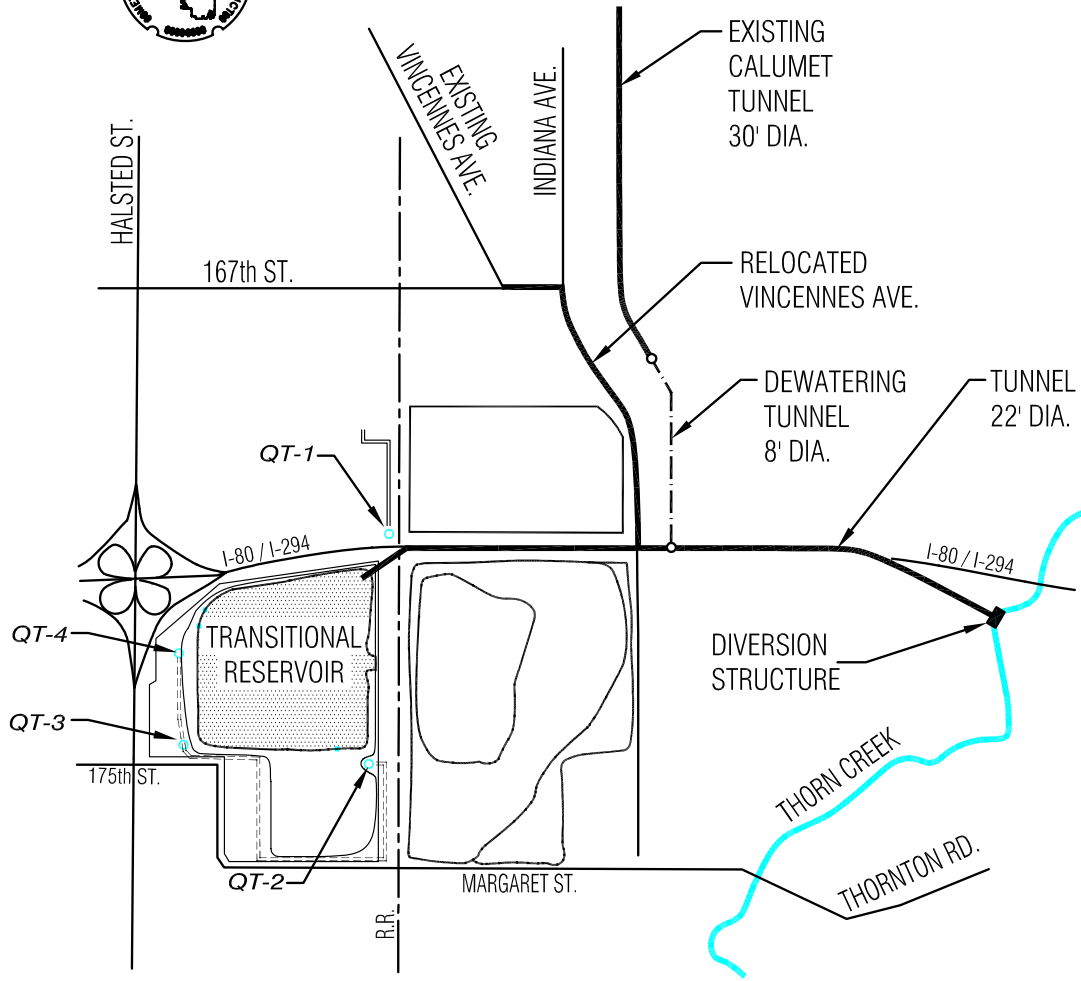
During the June 24–25, 2010, diversion event, the upper confidence limit from the background sampling was exceeded for the following parameters: QT-1 (Tables 3 and 4) chloride and manganese; no excursions were observed for QT-2 (Tables 5 and 6); QT-3 (Tables 7 and 8) chloride and sulfate; QT-4 (Tables 9 and 10) sulfate. The Reservoir was dewatered before July 6, 2010. The last sampling event took place on July 8, 2010. QT-1 could not be sampled on July 8, 2010, because construction in the area blocked access to the well. Although the number of parameters that exceeded the corresponding 95 percent upper confidence limit decreased, there were still some parameters that exceeded the 95 percent upper confidence limit from the background sampling after the Reservoir was dewatered. These parameters were chloride and sulfate from QT-3. It should be noted that the concentrations of all parameters in the reservoir sample were well below the 95th percentile upper confidence limit established for them in Table 2 of the SOW.

During the August 3–5, 2010, diversion event, the upper confidence limit from the background sampling was exceeded for the following parameters: QT-2 (Tables 13 and 14) iron, chromium and manganese; QT-3 (Tables 15 and 16) chloride, sulfate, total dissolved solids, chromium, cyanide, and manganese; QT-4 (Tables 17 and 18) cyanide. Groundwater quality monitoring well QT-1 could not be sampled during this event because construction in the area blocked access to the well. The Reservoir was dewatered before August 26, 2010. A last set of samples were collected from the groundwater quality monitoring wells on August 26, 2010. Although the number of parameters that exceeded the corresponding 95 percent upper confidence limit decreased, there were still some parameters that exceeded the 95 percent upper confidence limit from the background sampling after the Reservoir was dewatered. These parameters were chromium from QT-2, and chloride, sulfate, total dissolved solids, and manganese from QT-3. It should be noted that the concentrations of these parameters in the reservoir samples were well below the 95th percentile upper confidence limit established in Table 2 of the SOW.

During the December 31, 2010–January 1, 2011, diversion event, the upper 95 percent confidence limit was exceeded for the following parameters: QT-1 (Tables 21 and 22) chloride and manganese; QT-2 (Tables 23 and 24) silver; QT-3 (Tables 25 and 26) chloride and sulfate; no excursions were observed for QT-4 (Tables 27 and 28) during the fill. The Reservoir was dewatered by January 19, 2011. A last set of samples was collected on January 20, 2011, one day after the Reservoir was observed to have been dewatered. Although the number of parameters that exceeded the corresponding 95 percent upper confidence limit decreased, there were still some parameters that exceeded the 95 percent upper confidence limit from the background sampling after the Reservoir was dewatered. These parameters were chloride from QT-1, silver from QT-2, chloride and sulfate from QT-3, and silver from QT-4. It should be noted that the concentrations of these parameters in the reservoir samples were well below the 95th percentile upper confidence limit established in Table 2 of the SOW.



FIGURE 1

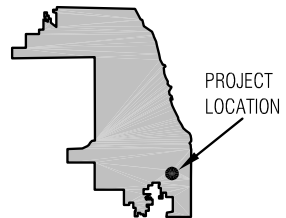


LOCATION MAP
Scale: NTS

LEGEND

- Monitoring Well
- ==== New Access Road
- - - - Existing Access Road (to be improved)

MWRD SERVICE AREA



**THORNTON TRANSITIONAL RESERVOIR
MONITORING WELL LOCATIONS**

METROPOLITAN WATER RECLAMATION
DISTRICT OF GREATER CHICAGO
ENGINEERING DEPARTMENT
11-03 PLANNING JJK

TABLE 1: LIST OF PARAMETERS TO BE ANALYZED ACCORDING TO TABLE 2
FROM THE SCOPE OF WORK APPROVED BY THE ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

Column A	Column B
Arsenic	Barium
Boron	Cadmium
Chloride	Chromium
Copper	Cyanide
Fecal Coliform	Fluoride
Iron	Manganese
Lead	Nickel
Mercury	Silver
Phenols	Temperature
Sulfate	Nitrate
Total Dissolved Solids	5-Day Biochemical Oxygen Demand
Ammonia	21-Day Biochemical Oxygen Demand

TABLE 2: SUMMARY OF DIVERSIONS TO THE THORNTON TRANSITIONAL FLOOD CONTROL RESERVOIR FROM JANUARY 2010 THROUGH DECEMBER 2010

Date of Diversion	Volume Transferred to Thornton Transitional Reservoir (million gallons)	Number of Weeks of Sample Collection
June 24–25, 2010	527	2
August 3–5, 2010	1,079	4
December 31, 2010–January 1, 2011	610	3

TABLE 3: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-1 DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
7/1/10 7/8/10*	ND	0.302	815	ND	<1	16.86	ND	ND	6	379	2,180	0.40
Limit of Quantification	0.050	0.045	15	0.007	DL	0.10	0.030	0.20	5	2	40	0.02
Upper 95% Confidence Limit	**	NA	552	**	NA	47.61	**	**	NA	489	2,279	NA
Excursion During Fill	No***		Yes	No***		No	No***	No***		No	No	
Excursion After Fill****												

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Construction in area blocked access to well.

**Value below reporting limit.

***Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

****Excursion of 95% confidence limit could not be evaluated due to lack of information.

TABLE 4: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-1 DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
7/1/10 7/8/10*	0.0855	ND	ND	ND	0.32	0.1836	ND	ND	13.9	ND	ND	2
Limit of Quantification	0.0030	0.010	0.003	0.005	0.10	0.0030	0.010	0.003	NA	0.003	2	2
Upper 95% Confidence Limit	0.0963	**	0.005	**	0.57	0.1460	NA	**	NA	0.024	NA	NA
Excursion During Fill	No	No***	No	No***	No	Yes		No***		No		
Excursion After Fill****												

NA = Not applicable.

ND = Not detected.

*Construction in area blocked access to well.

**Value below reporting limit.

***Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

****Excursion of 95% confidence limit could not be evaluated due to lack of information.

TABLE 5: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-2 DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
7/1/10	ND	0.260	218	ND	<1	2.51	ND	ND	ND	513	1,232	0.05
7/8/10	ND	0.252	218	ND	<1	2.12	ND	ND	ND	526	1,310	0.11
Limit of Quantification	0.050	0.045	15	0.007	DL	0.10	0.030	0.20	5	2	40	0.02
Upper 95% Confidence Limit	*	NA	420	0.027	NA	4.50	*	0.23	NA	718	2,485	NA
Excursion During Fill	No**		No	No		No	No**	No		No	No	
Excursion After Fill	No**		No	No		No	No**	No		No	No	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 6: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-2 DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
7/1/10	0.0408	ND	ND	ND	0.26	0.0419	ND	ND	14.7	ND	ND	ND
7/8/10	0.0413	ND	ND	ND	0.26	0.0305	ND	ND	11.0	0.007	ND	2
Limit of Quantification	0.0030	0.010	0.003	0.005	0.10	0.0030	0.010	0.003	NA	0.003	2	2
Upper 95% Confidence Limit	0.0742	*	0.0070	*	0.35	0.0574	NA	*	NA	4.416	NA	NA
Excursion During Fill	No	No**	No	No**	No	No		No**		No		
Excursion After Fill	No	No**	No	No**	No	No		No**		No		

NA = Not applicable.

ND = Not detected.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 7: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-3 DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
7/1/10	ND	0.233	228	ND	<1	10.58	ND	ND	ND	258	1,114	0.22
7/8/10	ND	0.202	219	ND	<1	8.80	ND	ND	ND	291	1,054	0.28
Limit of Quantification	0.050	0.045	15	0.007	DL	0.10	0.030	0.20	5	2	40	0.02
Upper 95% Confidence Limit	*	NA	180	0.022	NA	30.59	*	*	NA	224	1,270	NA
Excursion During Fill	No**		Yes	No		No	No**	No**		Yes	No	
Excursion After Fill	No**		Yes	No		No	No**	No**		Yes	No	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 8: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-3 DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
7/1/10	0.0707	ND	ND	ND	0.18	0.1079	ND	ND	12.9	ND	ND	2
7/8/10	0.0762	ND	ND	ND	0.16	0.0786	ND	ND	13.1	ND	ND	3
Limit of Quantification	0.0030	0.010	0.003	0.005	0.10	0.0030	0.010	0.003	NA	0.003	2	2
Upper 95% Confidence Limit	0.1000	*	0.0070	*	0.38	0.1793	NA	0.0196	NA	0.331	NA	NA
Excursion During Fill	No	No**	No	No**	No	No		No		No		
Excursion After Fill	No	No**	No	No**	No	No		No		No		

NA = Not applicable.

ND = Not detected.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 9: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-4 DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
7/1/10	ND	0.403	384	ND	<1	15.19	ND	ND	ND	331	1,398	0.43
7/8/10	ND	0.386	384	ND	<1	10.20	ND	ND	ND	266	1,406	0.49
Limit of Quantification	0.050	0.045	15	0.007	DL	0.10	0.030	0.20	5	2	40	0.02
Upper 95% Confidence Limit	*	NA	611	0.073	NA	31.510	*	*	NA	300	1,873	NA
Excursion During Fill	No**		No	No		No	No**	No**		Yes	No	
Excursion After Fill	No**		No	No		No	No**	No**		No	No	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 10: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-4 DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
7/1/10	0.0905	ND	ND	ND	0.21	0.1610	ND	ND	12.9	ND	ND	ND
7/8/10	0.0997	ND	ND	ND	0.23	0.0727	ND	ND	12.9	0.012	ND	4
Limit of Quantification	0.0030	0.010	0.003	0.005	0.10	0.0030	0.010	0.003	NA	0.003	2	2
Upper 95% Confidence Limit	0.1576	*	0.074	*	0.37	0.2332	NA	0.004	NA	0.262	NA	NA
Excursion During Fill	No	No**	No	No**	No	No		No		No		
Excursion After Fill	No	No**	No	No**	No	No		No		No		

NA = Not applicable.

ND = Not detected.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 11: PARAMETERS FROM COLUMN A OF TABLE 1 FOR THORNTON TRANSITIONAL RESERVOIR DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
6/28/10	ND	0.078	42	ND	840	0.87	ND	ND	ND	40.88	290	0.08
Limit of Quantification	0.050	0.045	15	0.007	DL	0.10	0.030	0.20	5	2	40	0.02

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

TABLE 12: PARAMETERS FROM COLUMN B OF TABLE 1 FOR THORNTON TRANSITIONAL RESERVOIR DURING THE JUNE 24–25, 2010, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
6/28/10	0.0216	ND	ND	ND	0.19	0.0124	ND	ND	27.5	0.388	3	9
Limit of Quantification	0.0030	0.010	0.003	0.005	0.10	0.0030	0.010	0.003	NA	0.003	2	2

NA = Not applicable.

ND = Not detected.

TABLE 13: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-2 DURING THE AUGUST 3–5, 2010, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
8/5/10	ND	0.271	209	ND	1	2.45	ND	ND	ND	515	1,368	0.17
8/12/10	ND	0.212	184	ND	3	10.69	ND	ND	ND	530	1,358	0.15
8/19/10	ND	0.247	*	ND	<1	5.42	ND	ND	ND	524	*	0.16
8/26/10	ND	0.259	*	ND	<1	3.06	ND	ND	ND	541	1,376	0.11
Limit of Quantification	0.050	0.045	15	0.007	DL	0.10	0.030	0.20	5	2	40	0.02
Upper 95% Confidence Limit	**	NA	420	0.027	NA	4.497	**	0.23	NA	718	2,485	NA
Excursion During Fill	No***		No	No		Yes	No***	No		No	No	
Excursion After Fill	No***		No	No		No	No***	No		No	No	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Insufficient sample for analysis.

**Values below reporting limit.

***Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 14: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-2 DURING THE AUGUST 3–5, 2010, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
8/5/10	0.0402	ND	ND	ND	0.27	0.0244	0.011	ND	16.2	0.014	ND	2
8/12/10	0.0380	ND	ND	ND	0.24	0.1126	0.022	ND	15.6	ND	ND	2
8/19/10	0.0396	ND	0.008	ND	0.26	0.0646	0.019	ND	15.8	ND	5	2
8/26/10	0.0404	ND	0.008	ND	0.26	0.0359	0.016	ND	15.3	0.005	ND	ND
Limit of Quantification	0.0030	0.010	0.003	0.005	0.10	0.0030	0.010	0.003	NA	0.003	2	2
Upper 95% Confidence Limit	0.0742	**	0.007	**	0.35	0.0574	NA	**	NA	4.416	NA	NA
Excursion During Fill	No	No***	Yes	No***	No	Yes		No***		No		
Excursion After Fill	No	No***	Yes	No***	No	No		No***		No		

NA = Not applicable.

ND = Not detected.

*Insufficient sample for analysis.

**Values below reporting limit.

***Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 15: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-3 DURING THE AUGUST 3–5, 2010, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
8/5/10	ND	0.165	222	ND	<1	14.02	ND	ND	5	322	1,230	0.35
8/12/10	ND	0.137	271	ND	<1	19.02	ND	ND	ND	314	1,366	0.27
8/19/10	ND	0.168	*	ND	<1	22.85	ND	ND	ND	313	*	0.25
8/26/10	ND	0.160	231	ND	<1	20.70	ND	ND	8	298	1,330	0.27
Limit of Quantification	0.050	0.045	15	0.007	DL	0.10	0.030	0.20	5	2	40	0.02
Upper 95% Confidence Limit	**	NA	180	0.022	NA	30.59	**	**	NA	224	1,270	NA
Excursion During Fill	No***		Yes	No		No	No***	No***		Yes	Yes	
Excursion After Fill	No***		Yes	No		No	No***	No***		Yes	Yes	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Insufficient sample for analysis.

**Values below reporting limit.

***Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 16: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-3 DURING THE AUGUST 3–5, 2010, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
8/5/10	0.0801	ND	ND	ND	0.15	0.1632	ND	ND	14.4	ND	ND	3
8/12/10	0.0822	ND	ND	0.005	0.15	0.2199	ND	ND	15.1	ND	ND	2
8/19/10	0.0858	ND	0.008	ND	0.17	0.2796	ND	ND	14.5	ND	ND	2
8/26/10	0.0831	ND	0.007	ND	0.16	0.2858	ND	ND	13.5	ND	ND	2
Limit of Quantification	0.0030	0.010	0.003	0.005	0.10	0.0030	0.010	0.003	NA	0.003	2	2
Upper 95% Confidence Limit	0.1000	*	0.007	*	0.38	0.1793	NA	0.0196	NA	0.331	NA	NA
Excursion During Fill	No	No**	Yes	Yes**	No	Yes		No		No		
Excursion After Fill	No	No**	No	No**	No	Yes		No		No		

NA = Not applicable.

ND = Not detected.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 17: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-4 DURING THE AUGUST 3–5, 2010, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
8/5/10	ND	0.398	372	ND	1	11.26	ND	ND	ND	281	1,456	0.60
8/12/10	ND	0.399	285	0.0117	<1	10.84	ND	ND	ND	270	1,252	0.43
8/19/10	ND	0.397	339	ND	<1	3.16	ND	ND	ND	261	1,464	0.38
8/26/10	ND	0.411	346	ND	<1	14.88	ND	ND	7	265	1,410	0.43
Limit of Quantification	0.050	0.045	15	0.007	DL	0.10	0.030	0.20	5	2	40	0.02
Upper 95% Confidence Limit	*	NA	611	0.073	NA	31.51	*	*	NA	300	1,873	NA
Excursion During Fill	No**		No	No		No	No**	No**		No	No	
Excursion After Fill	No**		No	No		No	No**	No**		No	No	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 18: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-4 DURING THE AUGUST 3–5, 2010, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
8/5/10	0.0966	ND	ND	ND	0.22	0.0885	ND	ND	15.1	ND	ND	2
8/12/10	0.0937	ND	ND	0.005	0.22	0.1252	ND	ND	14.2	ND	ND	2
8/19/10	0.0886	ND	0.006	ND	0.23	0.0685	ND	ND	15.5	ND	ND	2
8/26/10	0.0943	ND	0.006	ND	0.24	0.1356	ND	ND	13.6	ND	ND	2
Limit of Quantification	0.0030	0.010	0.003	0.005	0.10	0.0030	0.010	0.003	NA	0.003	2	2
Upper 95% Confidence Limit	0.1576	*	0.074	*	0.37	0.2332	NA	0.004	NA	0.262	NA	NA
Excursion During Fill	No	No**	No	Yes**	No	No		No		No		
Excursion After Fill	No	No**	No	No**	No	No		No		No		

NA = Not applicable.

ND = Not detected.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 19: PARAMETERS FROM COLUMN A OF TABLE 1 FOR THORNTON TRANSITIONAL RESERVOIR DURING THE AUGUST 3–5, 2010, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
8/5/10	ND	0.072	31	ND	2,400	1.75	ND	ND	ND	33.39	222	0.18
8/12/10	ND	0.079	38	ND	1,400	1.35	ND	ND	ND	42.96	242	0.06
8/20/10	ND	0.099	47	ND	190	0.41	ND	ND	ND	71.27	296	0.05
Limit of Quantification	0.050	0.045	15	0.007	DL	0.10	0.030	0.20	5	2	40	0.02

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

TABLE 20: PARAMETERS FROM COLUMN B OF TABLE 1 FOR THORNTON TRANSITIONAL RESERVOIR DURING THE AUGUST 3–5, 2010, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
8/5/10	0.0234	ND	ND	ND	0.18	0.0268	ND	ND	23.6	0.720	3	6
8/12/10	0.0221	ND	ND	0.006	0.17	0.0280	ND	ND	31.1	0.433	5	13
8/20/10	0.0212	ND	ND	ND	0.20	0.0090	ND	ND	27.9	0.145	5	15
Limit of Quantification	0.0030	0.010	0.003	0.005	0.10	0.0030	0.010	0.003	NA	0.003	2	2

NA = Not applicable.

ND = Not detected.

TABLE 21: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-1 DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
1/6/11*												
1/13/11	ND	0.318	759	ND	<1	22.21	ND	ND	ND	391	1,702	0.37
1/20/11	ND	0.303	837	ND	<1	22.38	ND	ND	ND	361	2,096	0.42
Limit of Quantification	0.050	0.06	10	0.020	DL	0.10	0.030	0.20	5	3	60	0.10
Upper 95% Confidence Limit	**	NA	552	**	NA	47.612	**	**	NA	489	2,279	NA
Excursion During Fill	No***	No	Yes	No***		No	No***	No***		No	No	
Excursion After Fill	No***	No	Yes	No***		No	No***	No***		No	No	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Frozen conditions blocked access to well.

**Values below reporting limit.

***Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 22: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-1 DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
1/6/11*												
1/13/11	0.0865	ND	ND	ND	0.20	0.2629	ND	ND	11.4	0.021	ND	3
1/20/11	0.0932	ND	ND	ND	0.30	0.0971	ND	ND	10.1	0.019	ND	3
Limit of Quantification	0.0040	0.001	0.010	0.005	0.10	0.0030	0.008	0.004	NA	0.003	2	2
Upper 95% Confidence Limit	0.0963	**	**	**	0.57	0.1460	NA	**	NA	0.024	NA	NA
Excursion During Fill	No	No***	No***	No***	No	Yes		No***		No		
Excursion After Fill	No	No***	No***	No***	No	No		No***		No		

NA = Not applicable.

ND = Not detected.

*Frozen conditions blocked access to well.

**Values below reporting limit.

***Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 23: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-2 DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
1/7/11	ND	0.269	242	ND	<1	3.530	ND	ND	ND	610	1,426	0.10
1/13/11	ND	0.279	242	ND	<1	2.290	ND	ND	ND	618	1,454	ND
1/20/11	ND	0.270	263	0.020	<1	2.410	ND	ND	ND	588	1,424	ND
Limit of Quantification	0.050	0.06	10	0.020	DL	0.10	0.030	0.20	5	3	60	0.10
Upper 95% Confidence Limit	*	NA	420	0.027	NA	4.497	*	0.23	NA	718	2,485	NA
Excursion During Fill	No**		No	No		No	No**	No		No	No	
Excursion After Fill	No**		No	No		No	No**	No		No	No	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 24: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-2 DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
1/7/11	0.0462	ND	ND	ND	0.30	0.0332	0.0116	0.004	13.0	0.004	ND	ND
1/13/11	0.0471	ND	ND	ND	0.31	0.0206	0.0114	ND	12.1	0.021	ND	5
1/20/11	0.0468	ND	ND	ND	0.32	0.0225	0.0126	0.004	10.7	0.059	ND	2
Limit of Quantification	0.0040	0.001	0.010	0.005	0.10	0.0030	0.008	0.004	NA	0.003	2	2
Upper 95% Confidence Limit	0.0742	*	0.0070	*	0.35	0.0574	NA	*	NA	4.416	NA	NA
Excursion During Fill	No	No**	No	No**	No	No		Yes**		No		
Excursion After Fill	No	No**	No	No**	No	No		Yes**		No		

NA = Not applicable.

ND = Not detected.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 25: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-3 DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
1/7/11	ND	0.190	238	ND	<1	15.25	ND	ND	7	329	1,228	0.28
1/13/11	ND	0.164	219	ND	<1	12.35	ND	ND	ND	332	1,186	0.23
1/20/11	ND	0.152	237	ND	<1	20.10	ND	ND	ND	330	1,210	0.27
Limit of Quantification	0.050	0.06	10	0.020	DL	0.10	0.030	0.20	5	3	60	0.10
Upper 95% Confidence Limit	*	NA	180	0.022	NA	30.588	*	*	NA	224	1,270	NA
Excursion During Fill	No**		Yes	No		No	No**	No**		Yes	No	
Excursion After Fill	No**		Yes	No		No	No**	No**		Yes	No	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Values below reporting limit.

**Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 26: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-3 DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
1/7/11	0.0761	ND	ND	ND	0.19	0.1454	ND	ND	11.3	ND	ND	2
1/13/11	0.0799	ND	ND	ND	0.16	0.1029	ND	ND	10.4	ND	ND	4
1/20/11	0.0816	ND	ND	ND	0.19	0.1496	ND	ND	10.2	ND	ND	2
Limit of Quantification	0.0040	0.001	0.010	0.005	0.10	0.0030	0.008	0.004	NA	0.003	2	2
Upper 95% Confidence Limit	0.1000	*	*	*	0.38	0.1793	NA	0.0196	NA	0.331	NA	NA
Excursion During Fill	No	No**	No	No**	No	No		No		No		
Excursion After Fill	No	No**	No	No**	No	No		No		No		

NA = Not applicable.

ND = Not detected.

*Values below reporting limit.

** Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 27: PARAMETERS FROM COLUMN A OF TABLE 1 FOR WATER QUALITY WELL QT-4 DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
1/7/11	ND	0.415	344	ND	<1	6.09	ND	ND	6	268	1,336	0.47
1/13/11	ND	0.351	404	ND	<1	0.77	ND	ND	ND	146	1,362	0.42
1/20/11	ND	0.408	447	ND	<1	0.71	ND	ND	5	267	1,412	0.45
Limit of Quantification	0.050	0.06	10	0.020	DL	0.10	0.030	0.20	5	3	60	0.10
Upper 95% Confidence Limit	*	NA	611	0.073	NA	31.510	*	*	NA	300	1,873	NA
Excursion During Fill	No**		No	No		No	No**	No**		No	No	
Excursion After Fill	No**		No	No		No	No**	No**		No	No	

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

*Values below reporting limit.

** Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 28: PARAMETERS FROM COLUMN B OF TABLE 1 FOR WATER QUALITY WELL QT-4 DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
1/7/11	0.0996	ND	ND	ND	0.24	0.0771	ND	ND	14.1	ND	ND	2
1/13/11	0.0307	ND	ND	ND	0.23	0.0781	0.018	ND	13.4	ND	ND	4
1/20/11	0.0994	ND	ND	ND	0.26	0.0516	ND	0.004	10.9	0.008	ND	ND
Limit of Quantification	0.0040	0.001	0.010	0.005	0.10	0.0030	0.008	0.004	NA	0.003	2	2
Upper 95% Confidence Limit	0.1576	*	0.074	*	0.37	0.2332	NA	0.004	NA	0.262	NA	NA
Excursion During Fill	No	No**	No	No**	No	No		No**		No		
Excursion After Fill	No	No**	No	No**	No	No		Yes**		No		

NA = Not applicable.

ND = Not detected.

*Values below reporting limit.

** Excursion of 95% confidence limit was calculated based on appropriate reporting limit.

TABLE 29: PARAMETERS FROM COLUMN A OF TABLE 1 FOR THORNTON TRANSITIONAL RESERVOIR DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Arsenic (mg/L)	Boron (mg/L)	Chloride (mg/L)	Copper (mg/L)	Fecal Coliform (cts/100 mL)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Phenols (µg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Ammonia Nitrogen (mg/L)
1/4/11	ND	ND	171	ND	2,000	4.77	ND	ND	ND	51.06	540	0.22
Limit of Quantification	0.050	0.06	10	0.020	DL	0.10	0.030	0.20	5	3	60	0.10

NA = Not applicable.

ND = Not detected.

DL = The detection limit for the FC analysis using the membrane filter method varies with actual sampling volume analyzed.

TABLE 30: PARAMETERS FROM COLUMN B OF TABLE 1 FOR THORNTON TRANSITIONAL RESERVOIR DURING THE DECEMBER 31, 2010–JANUARY 1, 2011, DIVERSION EVENT

Date	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cyanide (mg/L)	Fluoride (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silver (mg/L)	Temperature °C	Nitrate Nitrogen (mg/L)	BOD ₅ (mg/L)	BOD ₂₁ (mg/L)
1/4/11	0.0372	ND	ND	0.007	0.18	0.0895	ND	ND	2	1.793	6	11
Limit of Quantification	0.0040	0.001	0.010	0.005	0.10	0.0030	0.008	0.004	NA	0.003	2	2

NA = Not applicable.

ND = Not detected.