



2021 Annual Groundwater Monitoring Report

**Dairyland Power Cooperative
Alma Off-Site Disposal Facility
Phase IV Landfill
WDNR LIC#04126, FID#606043900
Town of Belvidere, Wisconsin**

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Executive Summary

This Annual Report presents the monitoring results and the statistical evaluation of the detection monitoring parameters (Appendix III to Title 40 Code of Federal Regulations Part 257) for the March and September 2021 semiannual groundwater monitoring at the Dairyland Power Cooperative (DPC) Alma Off-site Disposal Facility Phase IV Landfill (Landfill). This groundwater monitoring represents ongoing detection monitoring events performed to comply with Title 40 Code of Federal Regulations §257.94. The detection monitoring data were evaluated to identify statistically significant increases (SSIs) over background levels.

There were no potential SSIs over background limits for the Appendix III parameters during the 2021 monitoring events. Therefore, DPC will continue to conduct detection monitoring, and DPC is not required to take additional actions at this time. The next semiannual monitoring events at the Landfill are scheduled for March and September of 2022.

1.0 Introduction

1.1 Program Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) Subpart D - Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments (the CCR Rule). The CCR Rule, which became effective on October 19, 2015, applies to the Dairyland Power Cooperative (DPC) Alma Off-site Disposal Facility Phase IV Landfill (Landfill). Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with Title 40 Code of Federal Regulations (40 CFR) §257.90(e).

TRC Environmental Corporation (TRC), prepared this Annual Groundwater Monitoring Report (Annual Report) for the Landfill on behalf of DPC. This Annual Report was prepared in accordance with the requirements of 40 CFR §257.90(e) and presents the monitoring results and the statistical evaluation of the detection monitoring parameters (Appendix III to Part 257 of the CCR Rule) for the 2021 semiannual groundwater monitoring events for the Landfill. The monitoring was performed in accordance with the *Groundwater Monitoring Program for Compliance with the Federal Coal Combustion Rule* (GWMP) (TRC, 2017). As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify statistically significant increases (SSIs) of detection monitoring parameters compared to background levels.

1.2 Site Overview

The Landfill is owned and operated by DPC. The Landfill is located in the NE 1/4 of the NE 1/4 of Section 19 and portions of Sections 18 and 20, T21N, R12W, Town of Belvidere, Buffalo County, Wisconsin (Figure 1). The Landfill accepts CCR produced from electricity generation. DPC operates the Landfill in compliance with the Plan of Operation (RMT, 2000) as permitted by the Wisconsin Department of Natural Resources (WDNR, License Number 4126).

1.3 Geology/Hydrogeology

The site is located within the Western Upland physiographic region of South-Central Wisconsin adjacent to the Mississippi River (Figure 1). This area of Wisconsin was not previously glaciated and is known as the “Driftless Area” and is characterized by a significant amount of topographic relief. The facility is situated within a central valley area surrounded by steep slopes.

The thickness of unconsolidated soils beneath the Landfill ranges from approximately 15 to 60 feet. The predominant soil type includes fine- to coarse-grained silty sand, poorly graded sand with gravel, and/or poorly graded gravel with sand. The sandy soils range in thickness from 20 to 60 feet beneath the Landfill and are interpreted to be the result of fluvial deposition with limited sand deposited by in-situ weathering of underlying sandstone bedrock. In some areas beneath the Landfill, silts and clays ranging in thickness from a few feet to 40 feet overlie the sandy soils. The silt and clay soils were associated with loess deposits and, to a lesser degree, isolated lacustrine sediments.

Bedrock in the area is composed of the Prairie du Chien Group dolomite overlying Cambrian sandstone units. However, the Prairie du Chien group is absent beneath the Landfill due to erosion, so the sandy soil is directly underlain by Cambrian sandstone. The Cambrian sandstones were described as fine-grained, fissile, friable, and glauconitic with interbedded lenses of dark brown sandstone and calcareous shaley partings in boreholes performed during the Landfill siting.

The uppermost aquifer beneath the Landfill resides in the sandy soil and the underlying Cambrian sandstone. The saturated thickness of the aquifer ranges from 10 to 20 feet in the sandy soil. The Cambrian sandstone in the region is estimated to be approximately 400 feet in thickness (Young and Borman, 1973). Well drilling logs (WGNHS 2003 and WDNR 2015) in the vicinity of the Landfill present sandstone thicknesses of 338 feet to 435 feet. Precambrian igneous and metamorphic rock underlies the Cambrian sandstone.

Groundwater beneath the Landfill is first observed within the unconsolidated sandy deposits and the sandstone bedrock. A groundwater elevation map (Figure 2) shows that groundwater flows toward the central part of the valley occupied by the facility and then south toward the Mississippi River.

Historical and recent groundwater elevation data are comparable and indicate that groundwater flow at the site is consistent with little temporal variation. The approximate horizontal gradient determined for the Feasibility Report was 0.06 ft/ft (RMT, 1997) and is currently estimated at 0.05 ft/ft over the past several years (2013 through 2021). In-situ hydraulic conductivity data presented in the Feasibility Report (RMT, 1997) indicates a geometric mean hydraulic conductivity of 1.4×10^{-3} cm/s for the fluvial sand and gravel unit and 1.1×10^{-3} cm/s for the Cambrian sandstone.

Vertical gradients were also evaluated in the Feasibility Report (RMT, 1997) and indicated that the vertical gradients within the sand and sand-to-bedrock were generally upward (0.02 ft/ft to 0.05 ft/ft) and the vertical gradients within the bedrock were generally downward (0.2 ft/ft to 0.49 ft/ft). By applying the same methods used in the Feasibility Report to recent water level data (2015 through 2021), the vertical gradients within the fluvial sand and gravel unit, from sand to bedrock, and within the bedrock are generally downward, with the exception of a slight upward gradient observed from bedrock to sand at W42/P42A and flat vertical gradient observed at W101/W101A and W102R/W102AR during the 2021 monitoring period. Current observations suggest hydrogeologic conditions have not changed since the preparation of the Feasibility Report.

2.0 Groundwater Monitoring

2.1 Monitoring Well Network

A groundwater monitoring system has been established for the Landfill, as detailed in the GWMP (TRC, 2017). The detection monitoring well network for the Landfill consists of six water table monitoring wells and one piezometer (denoted with an “A” suffix). Three of the water table wells are upgradient (i.e. “background”) wells: one represents groundwater within the fluvial sand and gravel unit (W-102R) and the other two represent groundwater within the sandstone bedrock (W-101 and W-107). The four downgradient monitoring wells are W-100R, W-100AR, W-105, and W-106. The monitoring well locations are shown on Figure 2. There were no changes to the monitoring well network during 2021.

2.2 Background Sampling

Quarterly background groundwater monitoring was conducted at the Landfill from September 2015 through September 2017 in accordance with the GWMP. Groundwater data included eight background sampling events with field and laboratory analysis of the parameters required in the CCR Rule’s Appendix III and Appendix IV to Part 257 from both the upgradient and downgradient wells. Background data was included in the first Annual GW monitoring and corrective active report (TRC, 2018). The background dataset has been expanded to include the semiannual monitoring events from September 2017 to September 2019 (TRC, 2021).

2.3 Semiannual Groundwater Monitoring

The semiannual monitoring parameters for the detection groundwater monitoring program were selected per the CCR Rule’s Appendix III to Part 257 – Constituents for Detection Monitoring. The Appendix III indicator parameters consist of boron, calcium, chloride, fluoride, pH (field), sulfate, and total dissolved solids (TDS). These parameters were analyzed in accordance with the groundwater monitoring program described in the GWMP.

2.3.1 Data Summary

The semiannual detection monitoring groundwater sampling events were performed by DPC personnel on March 22-23, 2021 and September 22-23, 2021. Samples were analyzed by DPC’s Chemical Services Laboratory and Pace Analytical Services, LLC, in accordance with the GWMP. These laboratories are accredited with the WDNR. Static water elevation data were collected at the seven monitoring well locations during each sampling event. Groundwater samples were collected from each of the detection monitoring wells and analyzed for the Appendix III indicator parameters and field parameters. A summary of the groundwater data collected during the March and September 2021 events are provided in Appendix A, including static groundwater elevation data, analytical results, and field data.

2.3.2 Data Quality Review

Data from each round were evaluated for completeness and potential sample contamination. The data were found to be complete and usable for the purposes of the CCR monitoring program.

2.3.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the March and September 2021 sampling events show that groundwater within the uppermost aquifer generally flows to the south at the site. Groundwater potentiometric surface elevations measured across the Landfill during the September 2021 sampling event are provided on Table 2 and were used to construct a groundwater potentiometric surface map (Figure 2).

The map indicates that current groundwater flow is consistent with previous monitoring events. The average hydraulic gradient throughout the Landfill during this event is estimated at 0.05 ft/ft, resulting in an estimated average seepage velocity of approximately 0.9 ft/day or 347 ft/year for this event, using the average hydraulic conductivity of 4 ft/day (TRC, 2017) and an assumed effective porosity of 20 percent.

The general flow rate and direction in the uppermost aquifer is similar to that identified in previous monitoring and continues to demonstrate that the compliance wells are appropriately positioned to detect the presence of Appendix III parameters that could potentially migrate from the Landfill.

3.0 Statistical Evaluation

3.1 Establishing Background Limits

Background limits were established for the Appendix III indicator parameters following the collection of eight background monitoring events and established and described in the Annual Groundwater Monitoring Report (TRC, 2018). The background datasets and tolerance limits were updated for several parameters in 2020. These updates were performed in accordance with the Groundwater Monitoring Program (TRC, 2017), and additional detail on the updates is provided in Appendix B of the 2020 Annual Groundwater Monitoring Report (TRC, 2021).

3.2 Data Comparison to Background Limits

Concentrations of the indicator parameters in each of the detection monitoring wells (W-100R, W-100AR, W-105, and W-106) were compared to their respective statistical background limits. The comparisons are presented on Table 1 (March 22-23, 2021) and Table 2 (September 22-23, 2021).

The evaluation of the March and September 2021 Appendix III indicator parameters shows that there were no SSIs compared to background for boron, calcium, chloride, fluoride, pH, sulfate, or TDS. Since there were no SSIs in the tested parameters in 2021, the monitoring program has remained in detection monitoring.

4.0 Conclusions and Recommendations

DPC has established a monitoring program at the Landfill in accordance with the CCR Rule and has conducted compliance monitoring for 2021 in accordance with 40 CFR §257.94. There were no potential SSIs over background limits for the Appendix III parameters during the March and September 2021 monitoring events. Therefore, DPC will continue to conduct detection monitoring, and is not required to take additional action(s) at this time.

The next semiannual monitoring events at the Landfill are scheduled for March and September of 2022. Sampling and analytical results will be reported in January 2023.

5.0 References

RMT, Inc. 1997. Feasibility Report: Dairyland Power Cooperative Phase IV Disposal Area, Alma Off-Site Ash Disposal Facility. Town of Belvidere, Buffalo County, Wisconsin. September 1997.

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Young, H.L. and R.G. Borman. 1973. Water Resources of Wisconsin Trempealeau – Black River Basin. Hydrologic Investigations Atlas HA-474. U.S. Geological Survey. Washington, D.C. Maps. 4p.

Table 1: Comparison of Appendix III Parameter Results to Background Limits - March 22, 2021
Dairyland Power Cooperative - Off-Site Disposal Facility, Phase IV Landfill
Buffalo County, Wisconsin

Parameter	W-100R		W-100AR		W-105		W-106	
	Data	TL ⁽¹⁾	Data	TL ⁽¹⁾	Data	TL ⁽¹⁾	Data	TL ⁽¹⁾
Boron, total (µg/L)	<15	52.6	22	38.4	<15	20	<15	20
Calcium, total (µg/L)	70,000	92,200	75,000	89,100	65,400	80,700	68,800	80,700
Chloride, total (mg/L)	4.5	13.2	4.6	13.2	4.2	13.2	8.8	13.2
Fluoride, total (mg/L)	<0.095	0.21	<0.095	0.21	<0.095	0.21	<0.095	0.21
pH, field (SU)	7.45	6.61, 7.48	7.3	6.66, 7.60	7.51	6.80, 7.76	7.6	6.81, 7.91
Sulfate (mg/L)	16.9	32.7	16.8	29.0	15.7	29.0	19.3	29.0
Total Dissolved Solids (TDS) (mg/L)	346	488	371	551	323	448	356	448
Water elevation (Feet MSL)	727.74	--	718.30	--	734.07	--	774.04	--

Footnotes:

1. TL = tolerance limit for each parameter. Exceeding a tolerance limit would indicate a possible SSI.

Created By: S. Edwards, 5/4/2021

Checked By: J. Hotstream, 5/14/2021

**Table 2: Comparison of Appendix III Parameter Results to Background Limits - September 22-23, 2021
Dairyland Power Cooperative - Off-Site Disposal Facility, Phase IV Landfill
Buffalo County, Wisconsin**

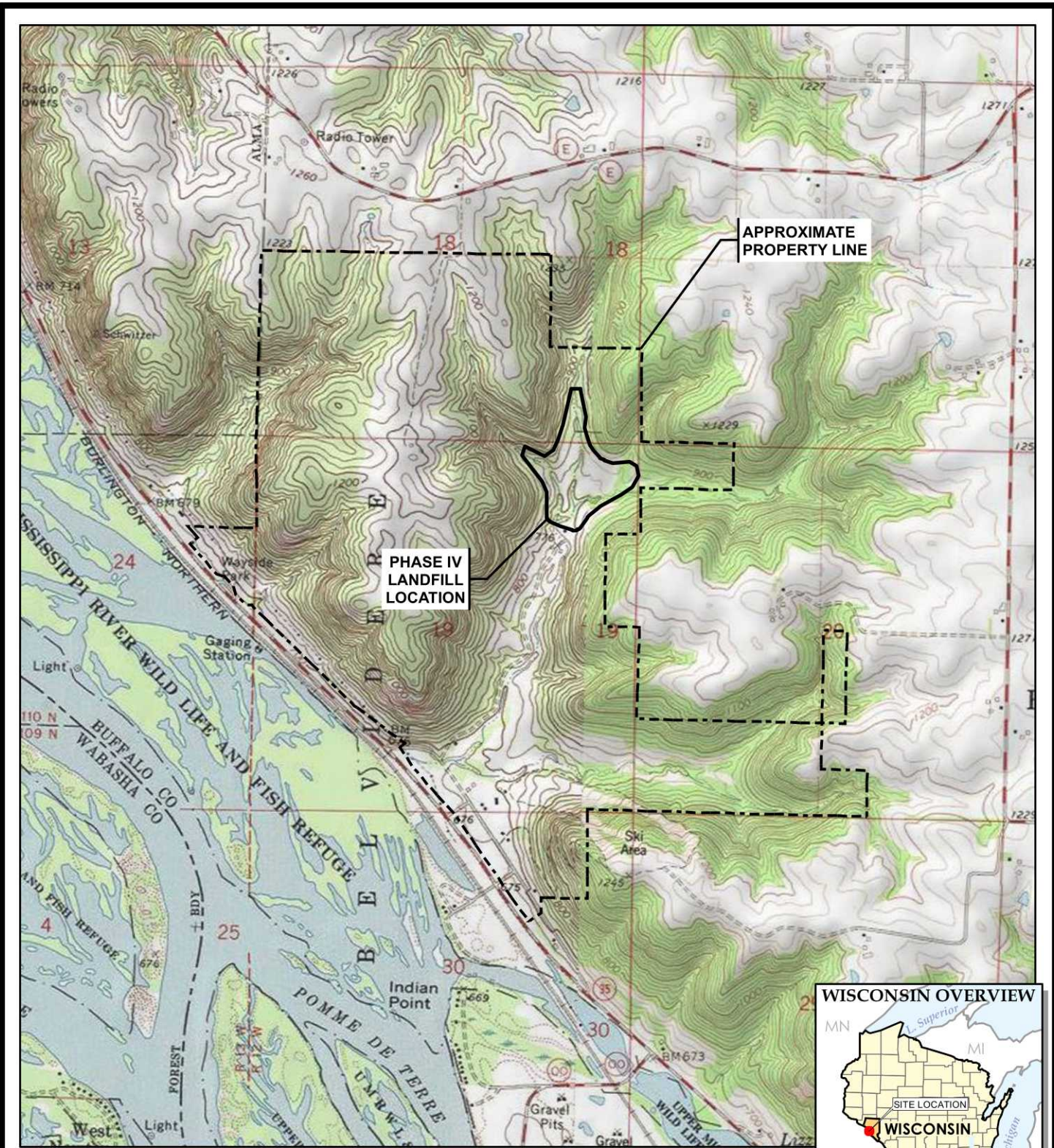
Parameter	W-100R		W-100AR		W-105		W-106	
	Data	TL ⁽¹⁾	Data	TL ⁽¹⁾	Data	TL ⁽¹⁾	Data	TL ⁽¹⁾
Boron, total (µg/L)	<15	52.6	17	38.4	<15	20	<15	20
Calcium, total (µg/L)	70,800	92,200	75,500	89,100	66,800	80,700	71,400	80,700
Chloride, total (mg/L)	4.7	13.2	4.6	13.2	4.3	13.2	9.6	13.2
Fluoride, total (mg/L)	<0.095	0.21	<0.095	0.21	<0.095	0.21	<0.095	0.21
pH, field (SU)	6.9	6.61, 7.48	6.86	6.66, 7.60	7.36	6.80, 7.76	7.4	6.81, 7.91
Sulfate (mg/L)	15	32.7	17	29.0	14	29.0	19	29.0
Total Dissolved Solids (TDS) (mg/L)	352	488	371	551	342	448	371	448
Water elevation (Feet MSL)	727.82	--	718.13	--	734.14	--	774.00	--

Footnotes:

1. TL = tolerance limit for each parameter. Exceeding a tolerance limit would indicate a possible SSI.

Created By: S. Edwards, 10/26/2021

Checked By: A. Hartzheim, 11/02/2021



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.




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TRC - GIS

PROJECT: **DAIRYLAND POWER COOPERATIVE
ALMA OFF-SITE DISPOSAL FACILITY, PHASE IV LANDFILL
ANNUAL GROUNDWATER MONITORING REPORT
BUFFALO COUNTY, WISCONSIN**

TITLE: **SITE LOCATION MAP**

DRAWN BY:	R. SUEMNIGHT
CHECKED BY:	S. EDWARDS
APPROVED BY:	J. HOTSTREAM
DATE:	JANUARY 2022
PROJ. NO.:	421717.0000
FILE:	421717-002slm.mxd

FIGURE 1

Appendix A: 2021 Detection Monitoring Data

Dairyland Power Cooperative - Alma Off-Site Groundwater Data

March 2021

			W-100R	W-100AR	W-105	W-106	W-101	W-102R	W-107
			3/22/2021	3/22/2021	3/23/2021	3/23/2021	3/22/2021	3/22/2021	3/22/2021
			2103-X02	2103-X01	2103-X05	2103-X06	2103-X04	2103-X03	2103-X07
Appendix III	Water elevation	Feet	727.74	718.3	734.07	774.04	820.17	820.78	832.84
	Boron, total	µg/L	< 15	21.5	< 15	< 15	< 15	< 15	< 15
	Calcium, total	µg/L	70000	75000	65400	68800	57500	61700	78100
	Chloride, total	mg/L	4.5	4.6	4.2	8.8	4.8	3.5	15.4
	Fluoride, total	mg/L	< 0.095	< 0.095	< 0.095	< 0.095	< 0.095	< 0.095	< 0.095
	pH, field	SU	7.45	7.3	7.51	7.6	7.64	7.67	7.54
	Sulfate	mg/L	16.9	16.8	15.7	19.3	27.6	15.6	21.4
	Total Dissolved Solids (TDS)	mg/L	346	371	323	356	307	321	401

September 2021

			W-100R	W-100AR	W-105	W-106	W-101	W-102R	W-107
			9/23/2021	9/23/2021	9/22/2021	9/22/2021	9/23/2021	9/23/2021	9/22/2021
			2109-X02	2109-X01	2109-X05	2109-X06	2109-X04	2109-X03	2109-X07
Appendix III	Water elevation	Feet	727.82	718.13	734.14	774	820.58	821.12	832.92
	Boron, total	µg/L	< 15	17.2	< 15	< 15	< 15	< 15	< 15
	Calcium, total	µg/L	70800	75500	66800	71400	59400	62700	79700
	Chloride, total	mg/L	4.7	4.6	4.3	9.6	5.1	3.6	16.7
	Fluoride, total	mg/L	< 0.095	< 0.095	< 0.095	< 0.095	< 0.095	< 0.095	< 0.095
	pH, field	SU	6.9	6.86	7.36	7.4	7.17	7.04	7.34
	Sulfate	mg/L	15.4	17.4	14.1	18.5	23.6	14.5	19.5
	Total Dissolved Solids (TDS)	mg/L	352	371	342	371	321	324	426