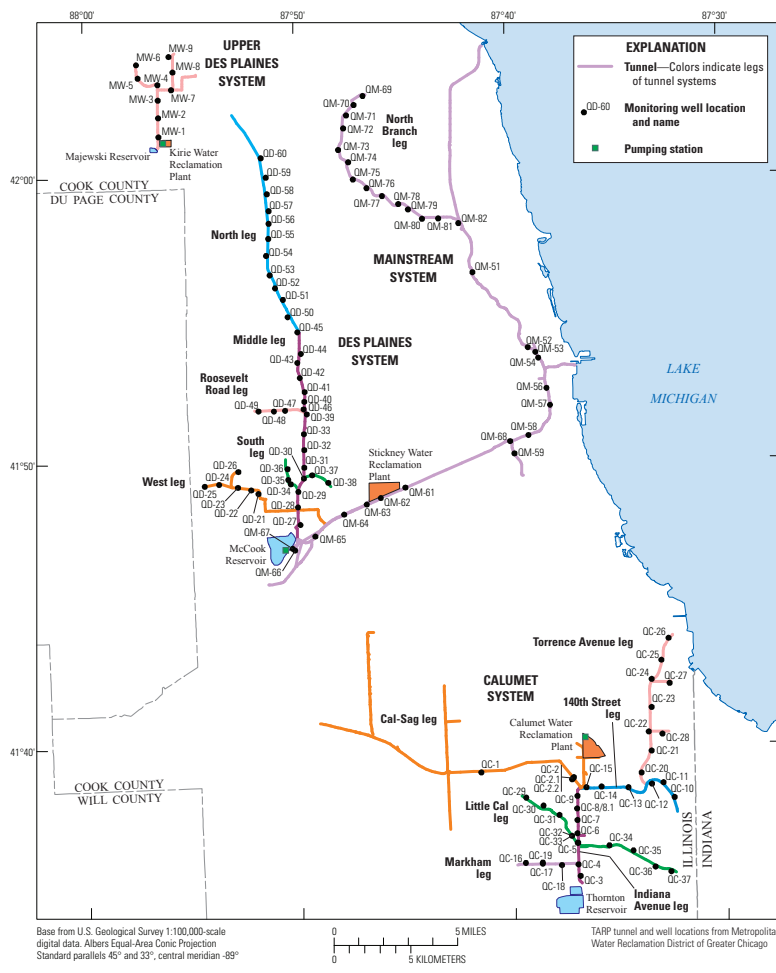


Prepared in cooperation with the Metropolitan Water Reclamation District of Greater Chicago

# Hydrogeology and Groundwater Quality at Monitoring Wells Installed for the Tunnel and Reservoir Plan System and Nearby Water-Supply Wells, Cook County, Illinois, 1995–2013



Scientific Investigations Report 2015–5186  
Version 1.1, May 2016

**Cover:** Map showing Tunnel and Reservoir Plan System, as shown in figure 3.

# **Hydrogeology and Groundwater Quality at Monitoring Wells Installed for the Tunnel and Reservoir Plan System and Nearby Water-Supply Wells, Cook County, Illinois, 1995–2013**

By Robert T. Kay

Prepared in cooperation with the Metropolitan Water Reclamation District  
of Greater Chicago

Scientific Investigations Report 2015–5186  
Version 1.1, May 2016

**U.S. Department of the Interior  
U.S. Geological Survey**

**U.S. Department of the Interior**  
SALLY JEWELL, Secretary

**U.S. Geological Survey**  
Suzette M. Kimball, Director

U.S. Geological Survey, Reston, Virginia  
First release: 2016  
Revised: May 2016 (ver. 1.1)

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment—visit <http://www.usgs.gov> or call 1–888–ASK–USGS.

For an overview of USGS information products, including maps, imagery, and publications, visit <http://www.usgs.gov/pubprod/>.

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Although this information product, for the most part, is in the public domain, it also may contain copyrighted materials as noted in the text. Permission to reproduce copyrighted items must be secured from the copyright owner.

Suggested citation:

Kay, R.T., 2016, Hydrogeology and groundwater quality at monitoring wells installed for the Tunnel and Reservoir Plan System and nearby water-supply wells, Cook County, Illinois, 1995–2013: (ver. 1.1, May 2016): U.S. Geological Survey Scientific Investigations Report 2015–5186, 347 p., <http://dx.doi.org/10.3133/sir20155186>

ISSN 2328-0328 (online)

# Contents

Abstract .....	1
Introduction.....	1
Purpose and Scope .....	2
Description of the Tunnel and Reservoir Plan System and Monitoring Wells.....	5
Methods of Study.....	12
Sample Collection, Laboratory Analysis, and Data Reporting .....	12
Data Analysis.....	13
Hydrogeology in the Vicinity of the Tunnel and Reservoir Plan System.....	14
Water Quality in Tunnel and Reservoir Plan System Monitoring Wells.....	21
Temperature.....	21
Fecal Coliform.....	22
Hardness .....	25
Sulfate.....	41
Chloride.....	44
Electrical Conductivity .....	48
Total Dissolved Solids .....	50
Ammonia.....	52
Dissolved Organic Carbon .....	54
pH.....	54
Analyte Correlations.....	58
Coliform Bacteria and <i>Escherichia coli</i> Data from Water-Supply Wells in the Vicinity of the Tunnel and Reservoir Plan System.....	59
Implications for Future Monitoring .....	59
Summary and Conclusions.....	62
Acknowledgments .....	63
References Cited.....	63
Appendixes	
1. Summary statistics for analytes and physical properties, by well, Tunnel and Reservoir Plan System, 1995–2013.....	65
2. Results of temporal trend analysis of analytes and physical properties, by well, Tunnel and Reservoir Plan System, 1995–2013 .....	173
3. Seasonality of analytes and physical properties, by well, Tunnel and Reservoir Plan System, 1995–2013.....	210
4. Analyte and physical property correlations, by well, Tunnel and Reservoir Plan System, 1995–2013.....	241

## Figures

1. Schematic diagram of Tunnel and Reservoir Plan System operation, Cook County, Illinois.....	2
2. Map showing location and selected features of the Tunnel and Reservoir Plan System, Cook County, Illinois .....	3
3. Map showing location of sampled monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois .....	4
4. Map showing location of surface-water bodies and selected geologic features in the vicinity of the Tunnel and Reservoir Plan System, Cook County, Illinois .....	6
5. Graph showing discharge from the Tunnel and Reservoir Plan System to the Stickney and Calumet Water Reclamation Plants, and precipitation at Midway Airport, Cook County, Illinois, 1995–2013.....	7
6. Map showing recharge rates for wells, Tunnel and Reservoir Plan System, Cook County, Illinois .....	15
7. Map showing geometric mean value of water levels and trends in Tunnel and Reservoir Plan System wells, Cook County, Illinois, 1995–2013 .....	16
8. Graph showing water levels in Tunnel and Reservoir Plan System well QC-26, Cook County, Illinois, 1999–2013 .....	17
9. Graph showing water levels in monitoring wells BH7D, BH16D, and BH18D, Cook County, Illinois, 1992–2014 .....	18
10. Graph showing water pressure in the Calumet and Des Plaines Tunnel Systems, Cook County, Illinois, January 1–December 31, 2010.....	18
11. Graph showing temperature of groundwater in samples from Calumet System well QC-2, Cook County, Illinois, 1995–2004 .....	22
12. Map showing percentage of samples in which fecal coliform was detected, and trends in population in Tunnel and Reservoir Plan System monitoring wells, Cook County, Illinois, 1995–2013 .....	23
13. Map showing maximum population of fecal coliform detected in samples from Tunnel and Reservoir Plan System monitoring wells, Cook County, Illinois, 1995–2013 .....	24
14. Graphs showing Tunnel and Reservoir Plan System discharge to the Calumet Water Reclamation Plant, and fecal coliform populations in well QC–2, Cook County, Illinois, 1995.....	26
15. Map showing hardness of water in samples from shallow drift and Silurian aquifers in Cook County, Illinois .....	28
16. Map showing geometric mean concentrations of hardness and trends in concentration in samples from Tunnel and Reservoir Plan System wells, Cook County, Illinois, 1995–2013 .....	29
17. Map showing concentration of sulfate in water from the Silurian aquifer in Cook County, Illinois .....	42
18. Map showing geometric mean concentrations of sulfate and trends in concentration in samples from Tunnel and Reservoir Plan System wells, Cook County, Illinois, 1995–2013 .....	43
19. Map showing concentrations of chloride in water from the Silurian aquifer in Cook County, Illinois .....	45
20. Graph showing concentrations of chloride in samples from Tunnel and Reservoir Plan System discharge to the Stickney Water Reclamation Plant, Cook County, Illinois, 1989–1991 .....	46

21. Map showing geometric mean concentrations of chloride and trends in concentration in samples from Tunnel and Reservoir Plan System wells, Cook County, Illinois 1995–2013 .....	47
22. Graph showing concentrations of chloride in samples from Tunnel and Reservoir Plan System well MW-5, Cook County, Illinois, 1994–2010 .....	48
23. Map showing geometric mean values of electrical conductivity and trends in samples from Tunnel and Reservoir Plan System wells, Cook County, Illinois, 1995–2013 .....	49
24. Map showing geometric mean concentrations of total dissolved solids and trends in samples from Tunnel and Reservoir Plan System wells, Cook County, Illinois, 1995–2013 .....	51
25. Map showing geometric mean concentrations of ammonia and trends in samples from Tunnel and Reservoir Plan System wells, Cook County, Illinois, 1995–2013 .....	53
26. Map showing geometric mean concentrations of dissolved organic carbon and trends in samples from Tunnel and Reservoir Plan System wells, Cook County, Illinois, 1995–2013 .....	55
27. Graph showing concentrations of dissolved organic carbon in samples from Tunnel and Reservoir Plan System well QD–28, Cook County, Illinois, 1995–2013.....	56
28. Map showing geometric mean values of pH and trends in samples from Tunnel and Reservoir Plan System wells, Cook County, Illinois, 1995–2013 .....	57
29. Map showing location of water-supply wells open to the Silurian aquifer within 5 miles of the Tunnel and Reservoir Plan System, northeast Illinois, with results of total coliform and <i>Escherichia coli</i> ( <i>E coli</i> ) analyses in raw water prior to treatment and before entering the water-distribution system, 1999–2015 .....	60

## Tables

1. Geometric mean discharge, by month, from the Tunnel and Reservoir Plan System to the Stickney and Calumet Water Reclamation Plants, 1995-2013, and average monthly precipitation at Midway Airport, 1981–2010, Cook County, Illinois.....	7
2. Description of monitoring wells and tunnels, Tunnel and Reservoir Plan System, Cook County, Illinois .....	8
3. Groundwater levels and fecal coliform populations at wells QC–1, QC–2, and QC–2.2 and discharge to the Calumet Water Reclamation Plant, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–1996.....	19
4. Correlation coefficients of fecal coliform populations in monitoring wells with a frequency of fecal coliform detection of 10 percent or greater, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.....	27
5. Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.....	31
6. Summary of correlation coefficients for all analytes in all monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.....	58
7. Summary of water-quality data indicating the presence of combined sewer flow effects in monitoring wells in which fecal coliform was detected in 10 percent or more of the samples, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013 .....	61

## Conversion Factors, Datums, and Abbreviations

### Inch/Pound to International System of Units

Multiply	By	To obtain
Length		
inch (jn.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Area		
square mile (mi <sup>2</sup> )	2.590	square kilometer (km <sup>2</sup> )
Volume		
gallon (gal)	3.785	liter (L)
Flow rate		
million gallons per day (Mgal/d)	0.06309	Million liters per day (Ml/d)
million gallons per month (Mgal/m)	0.06309	Million liters per month (Ml/m)
Hydraulic conductivity		
foot per day (ft/d)	0.00035	centimeter per second (cm/s)

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as  
 $^{\circ}\text{F} = (1.8^{\circ}\text{C}) + 32$ .

Vertical coordinate information is referenced to the Chicago City Datum (CCD). The CCD is 579.48 feet above the National Geodetic Vertical Datum of 1929 (NGVD 29).

Elevation, as used in this report, refers to distance above or below the CCD vertical datum.

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Abbreviated water-quality units used in this report: Concentrations of chemical constituents in water are given in milligrams per liter (mg/L). Milligrams per liter are considered equivalents to parts per million and the reported concentrations.

Electrical conductance of water is given in micromhos per centimeter ( $\mu\text{mho/cm}$ ).

pH of water is given in standard units.

Populations of fecal coliform are given in colony-forming units per 100 milliliter (CFU/100 mL).



# Hydrogeology and Groundwater Quality at Monitoring Wells Installed for the Tunnel and Reservoir Plan System and Nearby Water-Supply Wells, Cook County, Illinois, 1995–2013

By Robert T. Kay

## Abstract

Groundwater-quality data collected from 1995 through 2013 from 106 monitoring wells open to the base of the Silurian aquifer surrounding the Tunnel and Reservoir Plan (TARP) System in Cook County, Illinois, were analyzed by the U.S. Geological Survey, in cooperation with the Metropolitan Water Reclamation District of Greater Chicago, to assess the efficacy of the monitoring network and the effects of water movement from the tunnel system to the surrounding aquifer. Groundwater from the Silurian aquifer typically drains to the tunnel system so that analyte concentrations in most of the samples from most of the monitoring wells primarily reflect the concentration of the analyte in the nearby Silurian aquifer. Water quality in the Silurian aquifer is spatially variable because of a variety of natural and non-TARP anthropogenic processes. Therefore, the trends in analyte values at a given well from 1995 through 2013 are primarily a reflection of the spatial variation in the value of the analyte in groundwater within that part of the Silurian aquifer draining to the tunnels. Intermittent drainage of combined sewer flow from the tunnel system to the Silurian aquifer when flow in the tunnel system is greater than 80 million gallons per day may affect water quality in some nearby monitoring wells. Intermittent drainage of combined sewer flow from the tunnel system to the Silurian aquifer appears to affect the values of electrical conductivity, hardness, sulfate, chloride, dissolved organic carbon, ammonia, and fecal coliform in samples from many wells but typically during less than 5 percent of the sampling events. Drainage of combined sewer flow into the aquifer is most prevalent in the downstream parts of the tunnel systems because of the hydraulic pressures elevated above background values and long residence time of combined sewer flow in those areas. Elevated values of the analytes emplaced during intermittent migration of combined sewer flow into the Silurian aquifer decrease through time as water from the aquifer drains back into the tunnels in response to typical hydraulic conditions. Of the analytes sampled, fecal coliform provides the clearest indication of the location and timing of combined sewer flow into the Silurian aquifer surrounding the tunnel system.

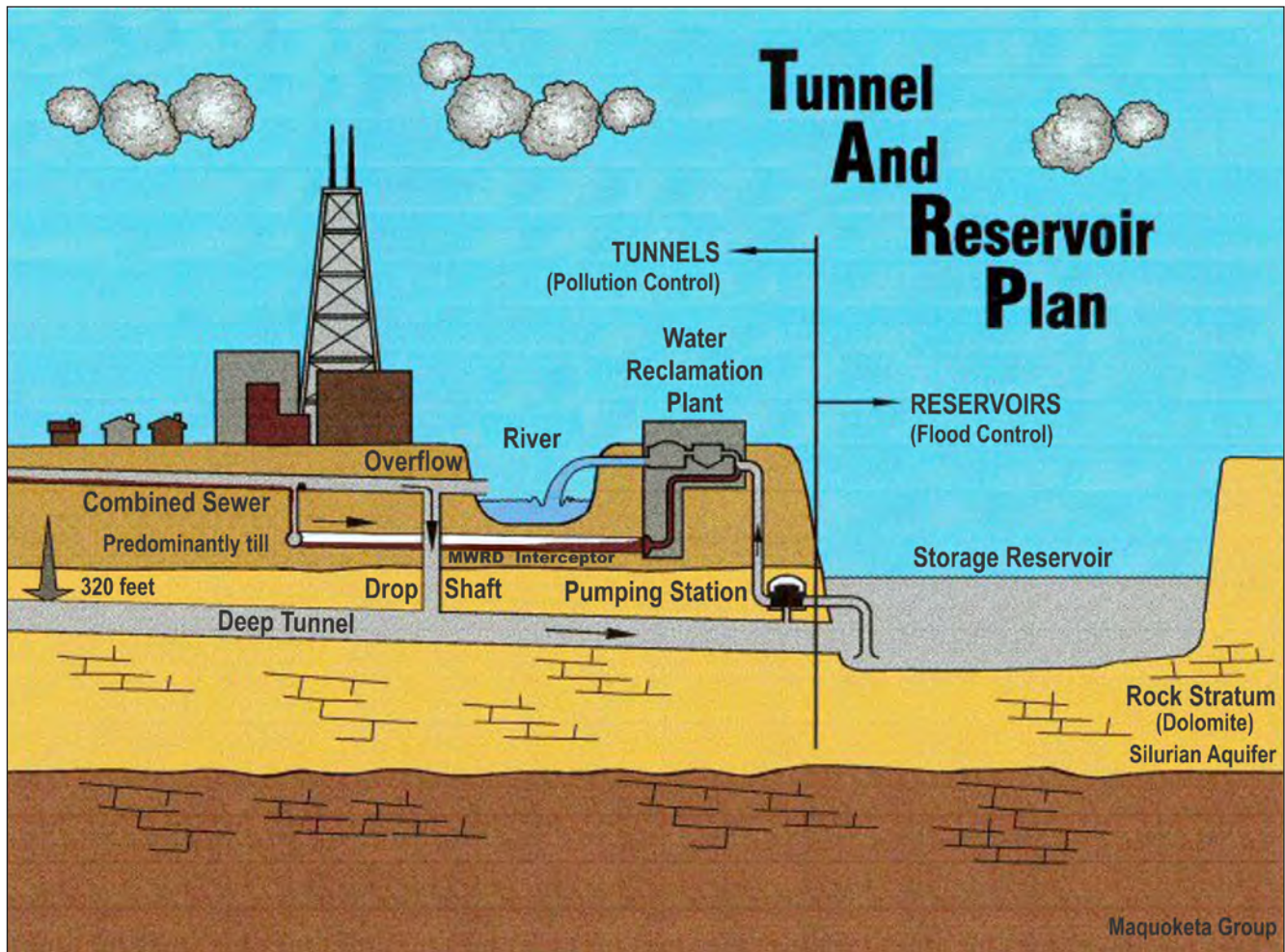
## Introduction

The Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) operates the Tunnel and Reservoir Plan (TARP) System, which is designed to transmit combined sewer flow (stormwater and wastewater) through tunnels in the lower part of the Silurian-aged bedrock to storage reservoirs during storms. After a precipitation event, water in the reservoirs is pumped to a water reclamation plant where it is treated before it is discharged to a nearby surface-water body (figs. 1 and 2).

The MWRDGC, at the request of the Illinois Environmental Protection Agency (IEPA), has performed ongoing periodic sampling of groundwater in more than 100 monitoring wells, all located approximately 200 feet (ft) from the center line of the TARP tunnels (fig. 3). This sampling is done to assess the effect that leakage of combined sewer flow (CSF) from the TARP tunnels to the surrounding Silurian aquifer has on water quality in the aquifer. For the purposes of this report, a CSF event occurs when water from the combined sewers is present in the TARP tunnels. These events may or may not result in the movement of water from the tunnels into the aquifer.

As part of the sampling effort, depth to water is measured, and water samples collected from the wells are analyzed for pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), hardness, ammonia as nitrogen (ammonia), dissolved organic carbon (DOC), chloride, sulfate, and fecal coliform. These constituents, along with water level, are collectively referred to as “analytes” in this report. Many of the analytes do not have units of concentration, so the word “values” is used to discuss the amount of an analyte whose units are not expressed as a concentration.

No analysis of the sampling data has been performed in more than 20 years of data collection. The MWRDGC sought technical assistance from the U.S. Geological Survey (USGS) to perform this analysis. Subsequently, the USGS conducted a study, in cooperation with the MWRDGC, to analyze the sampling data. The insights gained from this evaluation will be used by MWRDGC and IEPA to design a sampling



**Figure 1.** Schematic diagram of Tunnel and Reservoir Plan System operation, Cook County, Illinois (modified from Metropolitan Water Reclamation District of Greater Chicago, 2013).

regimen that more effectively monitors the effects of CSF on groundwater quality in the Silurian aquifer to ensure continued protection of human health and the environment.

Data from a small number of wells analyzed for this investigation were collected beginning in 1994, sampling in some monitoring wells did not begin until after 1995, and sampling in some wells ended prior to 2013 because of an approved monitoring reduction by the IEPA. The precise sampling dates for each well are provided in the tables, figures, and appendixes where feasible, but for ease of expression, the period of investigation is described as occurring from 1995 through 2013 regardless of the actual date of the beginning and end of data collection in a particular well. This time period was chosen because it encompassed the period of sampling in most of the wells.

## Purpose and Scope

This report summarizes the results of an analysis of water-level and water-quality data collected from more than 100 monitoring wells from 1995 through 2013. This

report provides a general overview of the TARP System and describes the hydraulics and water quality of CSF in the TARP System, the hydrogeology and water quality of the Silurian aquifer in Cook County, Illinois, and in the area surrounding the TARP System, and the hydraulic and chemical processes that affect water quality in the aquifer surrounding the TARP System. Summary statistics, correlation coefficients, and temporal trends during 1995–2013 calculated for each analyte in each well are presented. Dates associated with anomalous analyte values, if present, are identified for each well. The presence of seasonality (regular and predictable changes in data which recur at approximately the same time every calendar year) in the values of uncensored analytes (analytes whose values were greater than the specified detection limit in every sample) is discussed. Correlation coefficients for fecal coliform populations within selected groups of wells also have been calculated. Results of sampling for total coliform and *Escherichia coli* (*E. coli*) in water-supply wells near the TARP System also are discussed, as are ways to improve the efficacy of the monitoring program.

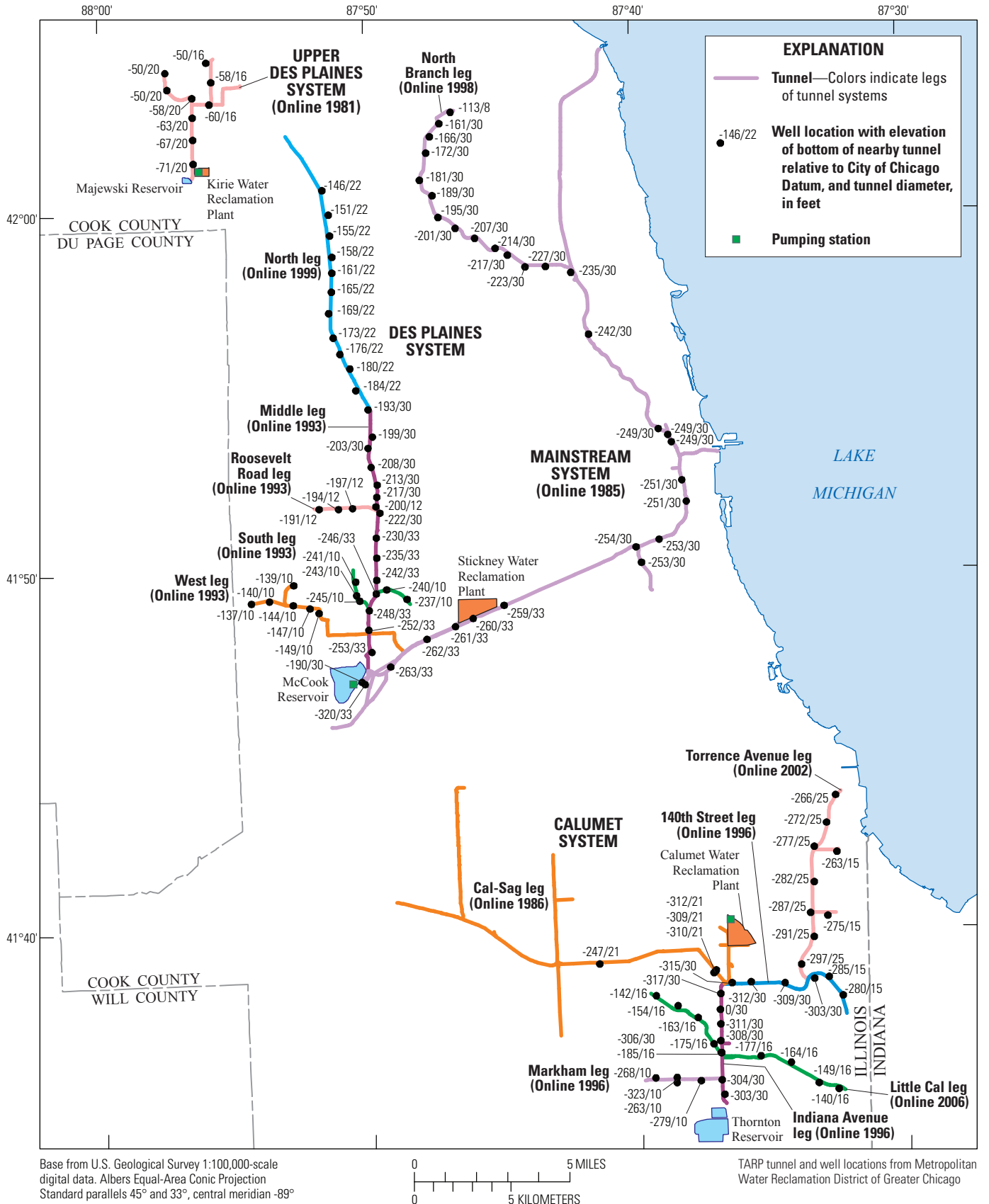


Figure 2. Location and selected features of the Tunnel and Reservoir Plan (TARP) System, Cook County, Illinois.

4 Hydrogeology and groundwater quality, Tunnel and Reservoir Plan System, Cook County, Ill., 1995–2013

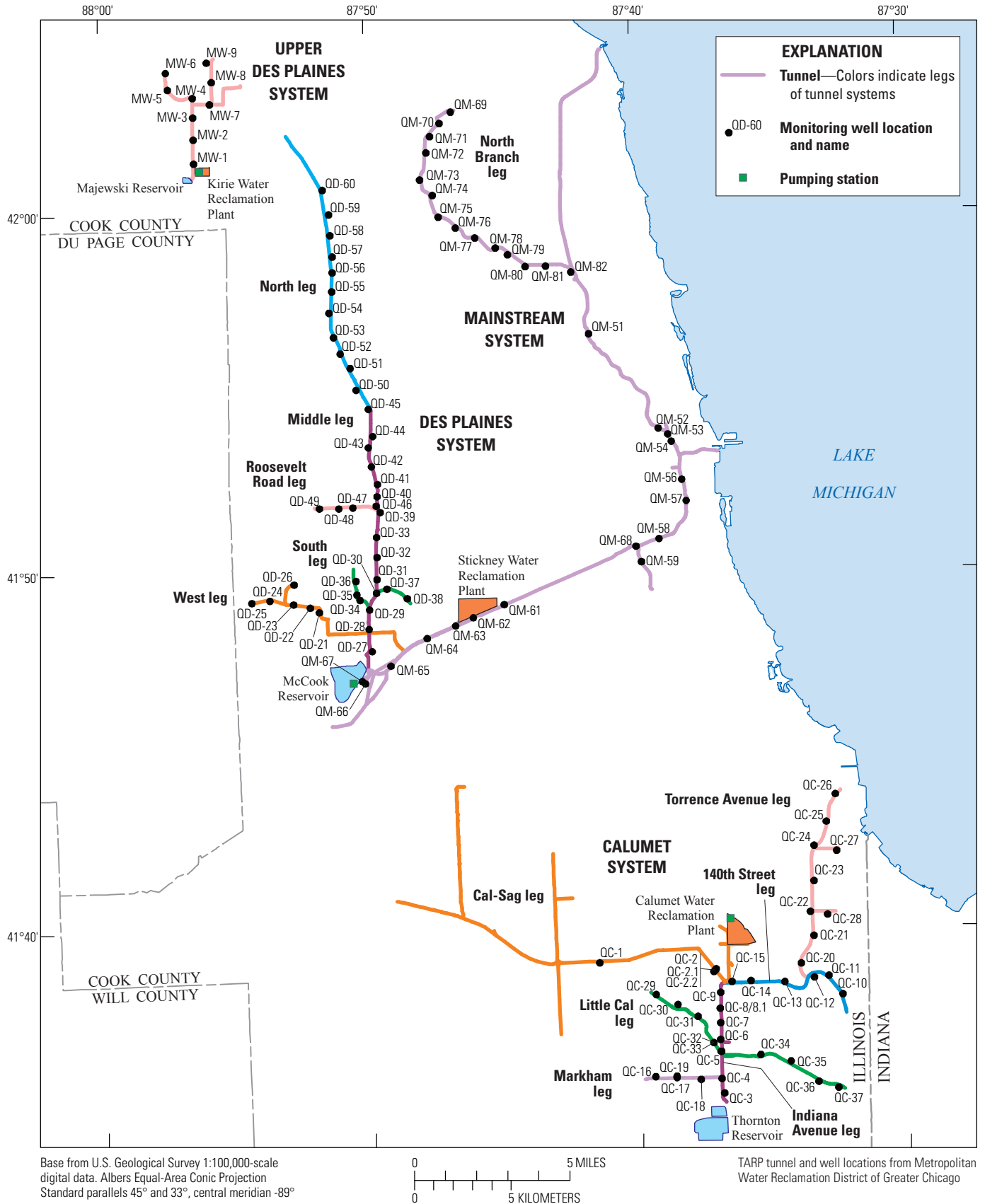


Figure 3. Location of sampled monitoring wells, Tunnel and Reservoir Plan (TARP) System, Cook County, Illinois.

## Description of the Tunnel and Reservoir Plan System and Monitoring Wells

The City of Chicago and 51 other municipalities in Cook County have combined sewer systems. These sewer systems collect a combination of stormwater runoff, domestic sewage, and industrial wastewater. The water reclamation plants in these municipalities were designed to treat about 2 billion gallons of wastewater per day in the 1950s (U.S. Environmental Protection Agency, 1988). However, as urbanization of the Chicago area increased, the volume of wastewater and stormwater runoff entering the sewer system increased to the point where the system would become inundated with more than 5 billion gallons of runoff following a 1-inch (in.) rainstorm (U.S. Environmental Protection Agency, 1988). These conditions would result in sewer outfalls discharging combined sewer overflow (CSO) to local waterways during a substantial portion of the year (U.S. Environmental Protection Agency, 1988). During particularly large precipitation events area waterways would reverse their direction of flow, releasing CSO into Lake Michigan. CSO releases resulted in frequent closings of the Lake Michigan beaches and the accumulation of contaminants in area waterways, leaving the ecosystem dominated by contamination-tolerant organisms (Hill and Butts, 1986).

To eliminate CSO effects, the MWRDGC constructed the TARP System. The TARP System is designed to prevent CSO discharge to surface water by diverting stormwater and wastewater from the near-surface sewers to the deeper Mainstream, Des Plaines, Calumet, and Upper Des Plaines tunnel systems constructed in the lower part of the Silurian dolomite beneath the Chicago metropolitan area (figs. 1, 2). In this report CSO is considered to be water that escaped from the combined sewers prior to construction of the TARP. CSF is the water diverted into the TARP System from the combined sewers.

The Des Plaines System is beneath the Des Plaines River (fig. 4). The Mainstream System is beneath the North Branch of the Chicago River, the North Shore Channel of the Chicago River, the Chicago River, and the Chicago Sanitary and Ship Canal. The Calumet System is beneath the Calumet River, Little Calumet River, Grand Calumet River, and the Calumet Sag Channel.

The tunnel system shown west of well QC-1 (fig. 3) is an interceptor sewer that drains to the TARP System. This sewer is not part of the TARP System and is omitted from the following summary of TARP characteristics. The TARP System consists of approximately 109 miles (mi) of tunnels. The tunnels (fig. 2) are 9–33 ft in diameter with bottom elevations from about -50 to -325 ft relative to the City of Chicago Datum (CCD). The tunnels are at about 150 to 300 ft below land surface and are excavated through dolomite bedrock (fig. 1). Fractures in the bedrock intercepting the tunnels have been filled with low-permeability grout, and the tunnels are lined with concrete to reduce the movement of water between the tunnels and the surrounding bedrock. Tunnel construction began in 1975, and all the tunnels were operational by 2006 (fig. 2).

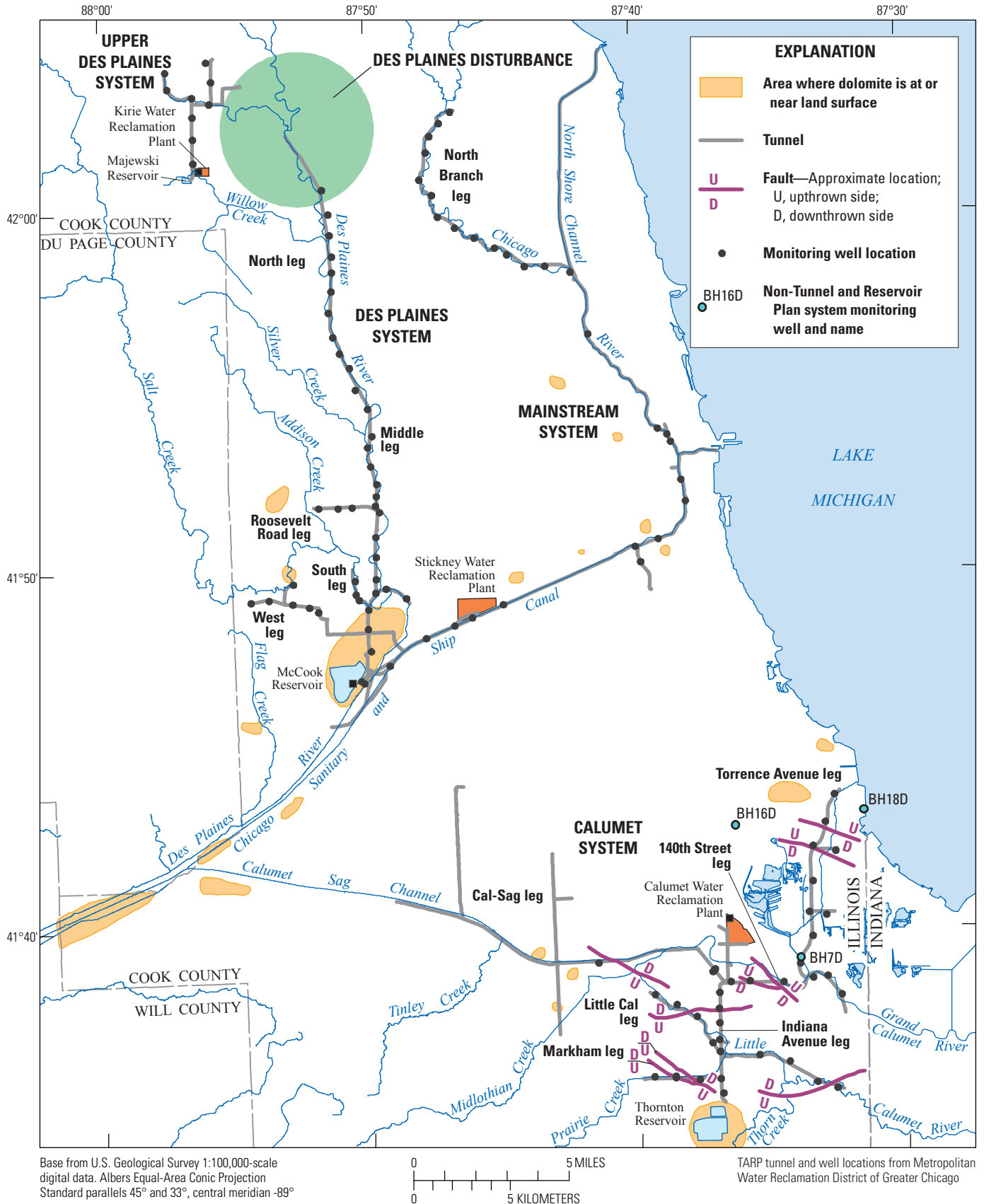
Flow in the individual tunnel systems is in the direction of decreasing elevation of the bottom of the tunnels (fig. 2). Flow in the tunnels is from north to south in the Upper Des Plaines, Des Plaines, and Mainstream Systems. Flow in the tunnels of the Calumet System is toward the Indiana Avenue leg.

The tunnels convey CSF to the Majewski, Thornton, and (future) McCook reservoirs for storage (figs. 1, 2, and 4) (Metropolitan Water Reclamation District of Greater Chicago, 2013). The Majewski Reservoir is a lined, above ground retention basin that began to receive CSF from the Upper Des Plaines System in 1998. The Thornton Reservoir occupies part of a quarry in the Silurian dolomite. The Thornton Reservoir was constructed in two stages. The first stage is a temporary reservoir in the western part of the quarry that began accepting stormwater runoff (which is distinct from CSF) from a nearby creek in March 2003. The second stage is a permanent reservoir in the northern part of the quarry that began to receive CSF from the Calumet System in August 2015. The McCook Reservoir also will occupy a quarry in the Silurian dolomite and is being constructed in two stages. Construction of the first stage of the future McCook Reservoir will occur in the southern part of the property, which is projected to begin receiving CSF from the Des Plaines and Mainstream Systems in 2017. Construction of the expanded reservoir is expected to be completed in 2029 after quarry operations have ceased.

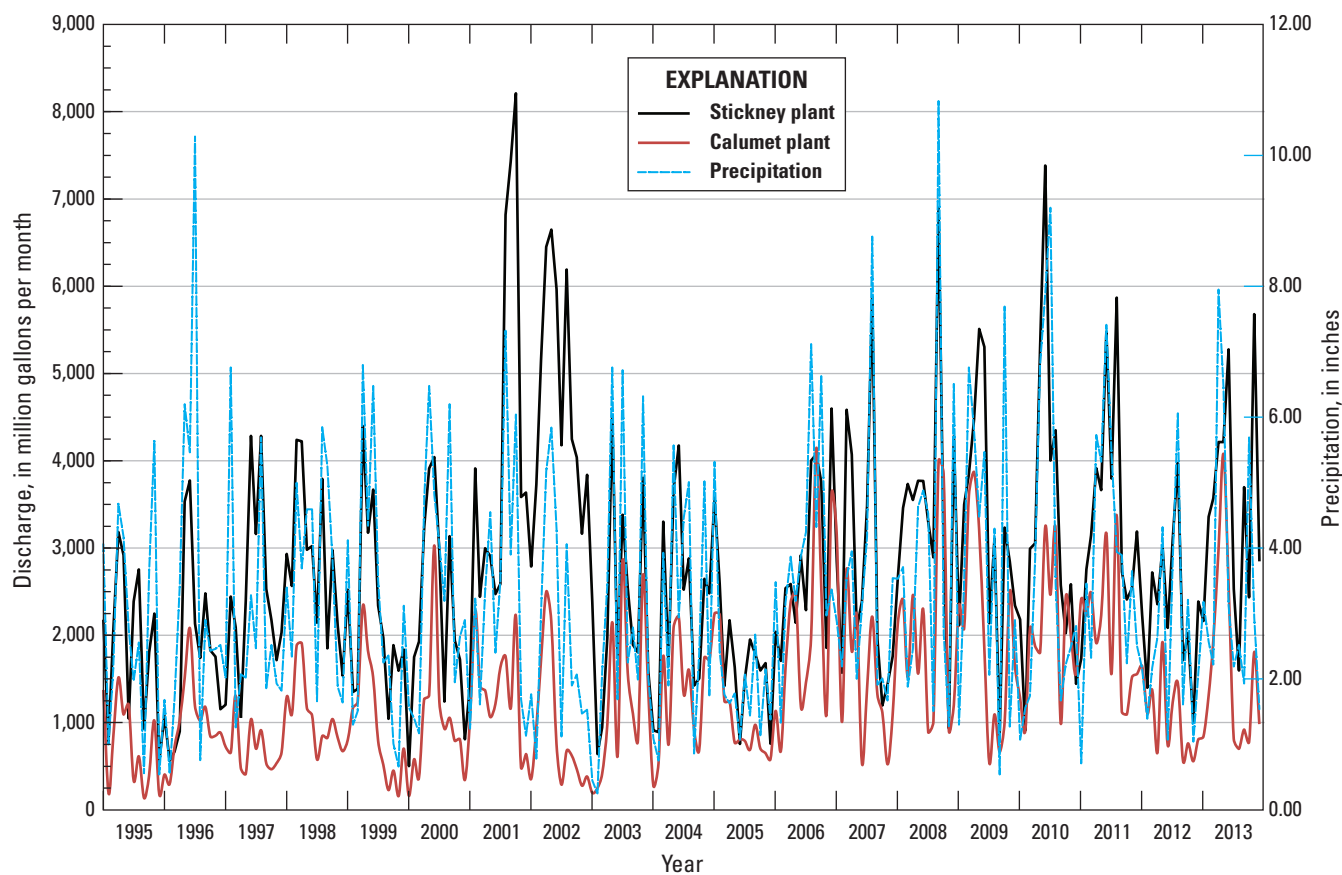
The tunnels are capable of storing 2.3 billion gallons of water. Because the McCook and Thornton Reservoirs were not connected to the Des Plaines, Mainstream, or Calumet System tunnels during 1995–2013, these tunnels were used for CSF storage during that period. As a consequence, water derived from CSF remained in these tunnels (particularly the downstream part of each tunnel system where the tunnel elevation is lowest) for a longer period of time than will occur once the tunnels are connected to the reservoirs. Tunnels in the Upper Des Plaines System also were used for storage prior to 1998.

Pumping stations dewater the tunnels and reservoirs as capacity at the Stickney, Calumet, and Kirie Water Reclamation Plants (WRPs) becomes available (fig. 2). Discharge from the TARP System to the Calumet and Stickney WRPs was recorded daily during 1995–2013 and closely tracks the timing and amount of precipitation near the Stickney WRP at Midway Airport (fig. 5), indicating that discharge to the WRPs can be used to indicate the timing and amount of CSF in the system. Discharge from the TARP System to the WRPs commonly exceeds 3 billion gallons (about 100 million gallons per day [Mgal/d]) in months with more than about 4 in. of precipitation. TARP discharge of about 200 million gallons per month (less than 7 Mgal/d) occurs during periods of minimal or absent precipitation because of drainage of groundwater from the Silurian dolomite into the tunnels. Geometric mean values of monthly discharge from the TARP System at the Calumet and Stickney WRPs during 1995–2013 varied during the year, with low discharge in January and February, increasing discharge from March through May, generally high discharge during May–August, and decreasing discharge from September through December (table 1).

6 Hydrogeology and groundwater quality, Tunnel and Reservoir Plan System, Cook County, Ill., 1995–2013



**Figure 4.** Location of surface-water bodies and selected geologic features in the vicinity of the Tunnel and Reservoir Plan (TARP) System, Cook County, Illinois.



**Figure 5.** Discharge from the Tunnel and Reservoir Plan System to the Stickney and Calumet Water Reclamation Plants, and precipitation at Midway Airport, Cook County, Illinois, 1995–2013.

**Table 1.** Geometric mean discharge, by month, from the Tunnel and Reservoir Plan System to the Stickney and Calumet Water Reclamation Plants, 1995-2013, and average monthly precipitation at Midway Airport, 1981–2010, Cook County, Illinois.

Month	Geometric mean discharge to Stickney Water Reclamation Plant <sup>1</sup> (million gallons per month)	Geometric mean discharge to Calumet Water Reclamation Plant <sup>1</sup> (million gallons per month)	Average precipitation <sup>2</sup> (inches)
January	1,898	928	2.06
February	1,774	914	1.94
March	2,463	1,388	2.72
April	2,870	1,544	3.64
May	3,377	1,650	4.13
June	3,194	1,411	4.06
July	2,751	990	4.01
August	3,199	1,186	3.99
September	2,351	886	3.31
October	2,355	953	3.24
November	2,146	877	3.42
December	1,949	879	2.57

<sup>1</sup>Discharge data provided by Kevin Fitzpatrick, Metropolitan Water Reclamation District of Greater Chicago, written commun., 2013.

<sup>2</sup>Precipitation data from National Weather Service <http://w2.weather.gov/climate/index.php?wfo=lot>; accessed July 26, 2014.

## 8 Hydrogeology and groundwater quality, Tunnel and Reservoir Plan System, Cook County, Ill., 1995–2013

The amount of discharge from the TARP System to the WRPs is affected by a variety of factors, including the availability of treatment capacity at the WRPs and the amount of water in the TARP System. Water draining into the tunnels from the Silurian aquifer during periods of dry weather flows by gravity to the downstream end of the tunnel systems near the reservoirs. This water accumulates in the tunnels until it is periodically discharged to the WRPs when the tunnels are near capacity or to provide storage capacity in anticipation of a CSF event. As a result, some dates of elevated discharge from the TARP System are associated with this “maintenance” removal of water derived from aquifer infiltration rather than removal of CSF from the System. Therefore, discharge from the TARP System to the WRPs is a useful, but not perfect, indicator of the volume and timing of CSF in the TARP System on any given day during 1995–2013. Once the tunnel systems were (for the Upper Des Plaines and Calumet Systems) or are to be (for the Des Plaines and Mainstream Systems) connected to the reservoirs, the capacity of the TARP System to hold CSF will be increased, the amount of CSF that will be stored in the tunnels will decrease, the amount of time that CSF will be stored in the tunnels will decrease, and the hydraulic pressure the CSF will generate in the tunnels will be lower. As a consequence the future relation between the volume and timing of CSF in the TARP System and discharge from the system to the WRPs is likely to differ from the historical relation. In addition, the volume of CSF

that will migrate from a given tunnel system to the aquifer is expected to decrease after the tunnel system is connected to its reservoir.

Measurement of water levels in the tunnels also was used to assess the timing and magnitude of CSF effects. The utility of the water-level data from the tunnels is limited for this assessment because the data collection did not begin until 2004.

CSF pumped to the WRPs is treated prior to being discharged. Discharge is to the nearest receiving water at Willow Creek, the Chicago Sanitary and Ship Canal, or the Calumet Sag Channel (fig. 4).

The TARP monitoring wells are open to the Silurian aquifer from an elevation typically about 30 ft above the top of the nearby tunnel to an elevation about 20 ft below the bottom of the tunnel (table 2). Above the open interval is a 6-in.-diameter steel casing that has been grouted into place. The casing extends 2 ft above ground level and is surrounded by a protective casing. Because the monitoring wells are open only to that part of the Silurian aquifer near the tunnel and are sealed off from the rest of the aquifer (as well as overlying units and surface runoff), the construction of the TARP wells allows the hydraulic and chemical conditions associated with the tunnel system (as opposed to the entire aquifer) to be analyzed. The TARP tunnels are excavated near the base of the Silurian aquifer, so the monitoring wells are open near the base of the aquifer.

**Table 2.** Description of monitoring wells and tunnels, Tunnel and Reservoir Plan System, Cook County, Illinois.—Continued

[—, no data, ?, unknown]

Well name	System monitored	Sampling dates	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Land-surface elevation (feet above City of Chicago datum)	Elevation top/bottom of open interval of well (feet below City of Chicago datum)	Elevation top/bottom of tunnel (feet below City of Chicago datum)
MW-1	Upper Des Plaines	1994–2013	42°1'27.9"	87°56'25.0"	79.8	-49/-89	-51/-71
MW-2	Upper Des Plaines	1994–2010	42°2'8.0"	87°56'25.6"	76.8	-45/-85	-47/-67
MW-3	Upper Des Plaines	1994–2013	42°2'45.4"	87°56'25.9"	83.6	-41/-81	-43/-63
MW-4	Upper Des Plaines	1994–2013	42°3'17.4"	87°56'26.3"	81.9	-36/-76	-38/-58
MW-5	Upper Des Plaines	1994–2010	42°3'31.9"	87°57'22.9"	88.4	-28/-68	-30/-50
MW-6	Upper Des Plaines	1994–2013	42°3'59.6"	87°57'26.0"	93.6	-22/-68	-30/-50
MW-7	Upper Des Plaines	1998–2013	42°3'6.7"	87°55'47.3"	73.7	-33/-78	-44/-60
MW-8	Upper Des Plaines	1997–2013	42°3'43.7"	87°55'42.8"	77.8	-31/-76	-42/-58



**Table 2.** Description of monitoring wells and tunnels, Tunnel and Reservoir Plan System, Cook County, Illinois.—Continued

[—, no data, ?, unknown]

Well name	System monitored	Sampling dates	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Land-surface elevation (feet above City of Chicago datum)	Elevation top/bottom of open interval of well (feet below City of Chicago datum)	Elevation top/bottom of tunnel (feet below City of Chicago datum)
MW-9	Upper Des Plaines	1997-2013	42°4'16.6"	87°55'53.2"	75.8	-28/-68	-34/-50
QD-21	Des Plaines	1995-2013	41°48'56.3"	87°51'52.8"	46.5	-109/-167	-139/-149
QD-22	Des Plaines	1995-2013	41°49'3.6"	87°52'13.0"	64.8	-106/-165	-137/-147
QD-23	Des Plaines	1995-2013	41°49'9.2"	87°52'51.2"	62.4	-104/-162	-134/-144
QD-24	Des Plaines	1995-2013	41°49'16.0"	87°53'43.9"	64.2	-100/-158	-130/-140
QD-25	Des Plaines	1995-2013	41°49'12.6"	87°54'24.6"	65.4	-97/-155	-127/-137
QD-26	Des Plaines	1995-2013	41°49'42.4"	87°52'49.3"	63.0	-99/-157	-128/-138
QD-27	Des Plaines	1995-2013	41°47'50.0"	87°49'55.4"	32.0	-200/-271	-220/-253
QD-28	Des Plaines	1995-2013	41°48'26.6"	87°50'1.8"	39.0	-199/-272	-119/-252
QD-29	Des Plaines	1995-2013	41°48'59.2"	87°49'59.8"	39.0	-195/-266	-215/-248
QD-30	Des Plaines	1995-2013	41°49'27.4"	87°49'44.3"	33.4	-193/-264	-213/-246
QD-31	Des Plaines	1995-2013	41°49'49.9"	87°49'42.7"	35.0	-189/-259	-209/-242
QD-32	Des Plaines	1995-2013	41°50'27.3"	87°49'41.8"	37.0	-182/-253	-202/-235
QD-33	Des Plaines	1995-2013	41°51'0.5"	87°49'42.9"	44.0	-177/-248	-197/-230
QD-34	Des Plaines	1995-2013	41°49'15.6"	87°50'20.5"	40.0	-215/-263	-235/-245
QD-35	Des Plaines	1995-2013	41°49'24.4"	87°50'27.8"	35.0	-213/-261	-233/-243
QD-36	Des Plaines	1995-2013	41°49'47.0"	87°50'29.2"	40.0	-211/-259	-231/-241
QD-37	Des Plaines	1995-2013	41°49'34.2"	87°49'21.0"	26.0	-210/-258	-230/-240
QD-38	Des Plaines	1995-2013	41°49'18.0"	87°48'35.0"	26.0	-207/-255	-227/-237
QD-39	Des Plaines	1995-2013	41°51'41.8"	87°49'34.0"	42.0	-172/-240	-192/-222
QD-40	Des Plaines	1995-2013	41°52'8.1"	87°49'40.3"	41.0	-167/-235	-187/-217
QD-41	Des Plaines	1995-2013	41°52'28.9"	87°49'38.8"	45.0	-163/-231	-183/-213
QD-42	Des Plaines	1995-2013	41°52'58.4"	87°49'52.0"	46.0	-158/-226	-178/-208
QD-43	Des Plaines	1995-2013	41°53'30.5"	87°49'57.9"	42.0	-153/-221	-173/-203
QD-44	Des Plaines	1995-2013	41°53'49.3"	87°49'47.6"	41.0	-149/-217	-169/-199
QD-45	Des Plaines	1995-2013	41°54'34.2"	87°49'57.2"	44.0	-143/-211	-163/-193
QD-46	Des Plaines	1995-2013	41°51'52.1"	87°49'42.3"	44.0	-150/-218	-188/-200
QD-47	Des Plaines	1995-2013	41°51'50.2"	87°50'34.7"	47.0	-147/-215	-185/-197
QD-48	Des Plaines	1995-2013	41°51'49.0"	87°51'6.1"	48.0	-144/-212	-182/-194
QD-49	Des Plaines	1995-2013	41°51'48.9"	87°51'50.6"	49.0	-141/-209	-179/-191
QD-50	Des Plaines	1996-2013	41°55'6.3"	87°50'24.3"	50.5	-141/-202	-171/-183
QD-51	Des Plaines	1996-2013	41°55'43.0"	87°50'36.8"	49.3	-137/-198	-157/-179
QD-52	Des Plaines	1996-2013	41°56'7.3"	87°50'58.7"	50.3	-134/-194	-154/-176
QD-53	Des Plaines	1995-2013	41°56'34.4"	87°51'13.5"	51.0	-131/-191	-151/-173
QD-54	Des Plaines	1996-2013	41°57'15.4"	87°51'23.6"	46.8	-126/-187	-146/-168

**10 Hydrogeology and groundwater quality, Tunnel and Reservoir Plan System, Cook County, Ill., 1995–2013**

**Table 2.** Description of monitoring wells and tunnels, Tunnel and Reservoir Plan System, Cook County, Illinois.—Continued

[—, no data, ?, unknown]

<b>Well name</b>	<b>System monitored</b>	<b>Sampling dates</b>	<b>Latitude (degrees, minutes, seconds)</b>	<b>Longitude (degrees, minutes, seconds)</b>	<b>Land-surface elevation (feet above City of Chicago datum)</b>	<b>Elevation top/bottom of open interval of well (feet below City of Chicago datum)</b>	<b>Elevation top/bottom of tunnel (feet below City of Chicago datum)</b>
QD-55	Des Plaines	1996–2013	41°57'52.0"	87°51'16.1"	49.9	-123/-183	-142/-164
QD-56	Des Plaines	1996–2013	41°58'23.4"	87°51'14.7"	55.7	-119/-179	-139/-161
QD-57	Des Plaines	1996–2013	41°58'49.9"	87°51'14.6"	55.3	-116/-176	-136/-158
QD-58	Des Plaines	1996–2013	41°59'25.4"	87°51'19.6"	54.3	-113/-173	-132/-154
QD-59	Des Plaines	1996–2013	42°0'0.3"	87°51'21.3"	58.6	-109/-169	-128/-150
QD-60	Des Plaines	1996–2013	42°0'41.8"	87°51'35.4"	59.9	-104/-164	-124/-146
QM-51	Mainstream	No Samples	41°56'35.8"	87°41'38.8"	10.5	-192/-260	-212/-242
QM-52	Mainstream	No Samples	41°53'57.0"	87°39'4.4"	7.3	-199/-267	-219/-249
QM-53	Mainstream	1995–2013	41°53'46.5"	87°38'43.3"	17.3	-199/-267	-219/-249
QM-54	Mainstream	No Samples	41°53'34.3"	87°38'35.3"	7.4	-199/-267	-219/-249
QM-55	Mainstream	No Samples	—	—	5.4	-199/-267	-219/-249
QM-56	Mainstream	1995–2009	41°52'30.8"	87°38'12.7"	6.4	-201/-269	-221/-251
QM-57	Mainstream	No Samples	41°51'55.1"	87°38'2.8"	8.3	-199/-268	-221/-251
QM-58	Mainstream	1995–2008	41°50'52.0"	87°39'5.4"	10.4	-203/-271	-223/-253
QM-59	Mainstream	1995	41°50'14.1"	87°39'46.4"	11.6	-203/-271	-223/-253
QM-60	Mainstream	No Samples	—	—	16.2	-197/-275	-227/-257
QM-61	Mainstream	1995–2013	41°49'5.3"	87°44'56.5"	17.2	-206/-277	-226/-259
QM-62	Mainstream	1995–2013	41°48'44.3"	87°46'6.3"	19.5	-206/-278	-227/-260
QM-63	Mainstream	1995–2013	41°48'31.2"	87°46'46.6"	10.1	-208/-279	-228/-261
QM-64	Mainstream	1995–2013	41°48'10.3"	87°47'50.8"	13.8	-209/-280	-229/-262
QM-65	Mainstream	1995–2010	41°47'25.1"	87°49'13.9"	12.6	-210/-281	-230/-263
QM-66	Mainstream	2006–2013	41°46'57.7"	87°50'11.3"	25.2	-284/-338	-287/-320
QM-67	Mainstream	1995–2013	41°47'0.5"	87°50'18.6"	24.1	-158/-208	-160/-190
QM-68	Mainstream	1995–2013	41°50'40.1"	87°39'58.0"	—	—	-224/-254
QM-69	Mainstream	1995–2013	42° 2'49.3"	87°46'43.0"	44.0	-85/-131	-105/-113
QM-70	Mainstream	1995–2013	42° 2'31.3"	87°47'8.9"	44.0	-121/-179	-131/-161
QM-71	Mainstream	1995–2013	42° 2'9.6"	87°47'31.4"	45.0	-126/-184	-136/-166
QM-72	Mainstream	1995–2013	42° 1'42.0"	87°47'40.2"	45.0	-132/-190	-142/-172
QM-73	Mainstream	1995–2013	42° 0'56.9"	87°47'54.9"	44.0	-141/-199	-151/-181
QM-74	Mainstream	1995–2013	42° 0'30.6"	87°47'26.6"	41.0	-149/-207	-159/-189
QM-75	Mainstream	1995–2013	41°59'54.2"	87°47'14.3"	41.0	-145/-213	-165/-195
QM-76	Mainstream	1995–2013	41°59'36.2"	87°46'35.8"	40.0	-151/-219	-171/-201
QM-77	Mainstream	1995–2013	41°59'18.8"	87°45'52.3"	31.0	-157/-225	-177/-207
QM-78	Mainstream	1995–2013	41°59'1.5"	87°45'6.1"	24.0	-164/-232	-184/-214
QM-79	Mainstream	1995–2013	41°58'50.2"	87°44'39.2"	30.0	-167/-235	-187/-217

**Table 2.** Description of monitoring wells and tunnels, Tunnel and Reservoir Plan System, Cook County, Illinois.—Continued

[—, no data, ?, unknown]

Well name	System monitored	Sampling dates	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Land-surface elevation (feet above City of Chicago datum)	Elevation top/bottom of open interval of well (feet below City of Chicago datum)	Elevation top/bottom of tunnel (feet below City of Chicago datum)
QM-80	Mainstream	1995-2013	41°58'30.4"	87°43'58.9"	25.0	-173/-241	-193/-223
QM-81	Mainstream	1995-2013	41°58'30.6"	87°43'12.9"	20.0	-177/-245	-197/-227
QM-82	Mainstream	1995-2013	41°58'20.0"	87°42'16.3"	16.0	-185/-253	--205/235
QC-1	Calumet	1995-2009	41°39'4.8"	87°41'33.8"	12.4	-206/-265	-226/-247
QC-2	Calumet	1995-2013	41°38'50.0"	87°37'14.0"	15.6	-271/-330	-291/-312
QC-2.1	Calumet	1995-2013	41°38'52.8"	87°37'12.3"	19.8	?/-327	-288/-309
QC-2.2	Calumet	1995-2013	41°38'44.6"	87°36'55.9"	17.7	?/-328	-289/-310
QC-3	Calumet	1995-2009	41°35'24.0"	87°36'56.7"	25.0	—	-272/-302
QC-4	Calumet	1995-2013	41°35'48.6"	87°37'2.7"	24.1	?/-322	-273/-303
QC-5	Calumet	1995-2013	41°36'32.8"	87°37'3.3"	16.6	?/-324	-276/-306
QC-6	Calumet	1995-2013	41°36'54.6"	87°37'4.2"	18.5	?/-326	-278/-308
QC-7	Calumet	1995-2013	41°37'22.5"	87°37'3.1"	19.2	?/-329	-281/-311
QC-8	Calumet	No samples	41°37'46.5"	87°37'3.7"	21.2	—	-281/-311
QC-9	Calumet	1995-2013	41°38'12.9"	87°37'2.8"	18.7	?/-335	-287/-317
QC-10	Calumet	1995-2013	41°38'7.3"	87°32'27.9"	3.5	?/-298	-265/-280
QC-11	Calumet	1995-2013	41°38'38.7"	87°32'58.4"	4.3	?/-303	-269/-284
QC-12	Calumet	1995-2013	41°38'36.6"	87°33'31.5"	4.2	?/-321	-272/-302
QC-13	Calumet	1995-2013	41°38'29.9"	87°34'37.9"	7.0	?/-327	-279/-309
QC-14	Calumet	1995-2013	41°38'31.7"	87°35'53.8"	9.9	?/-330	-282/-312
QC-15	Calumet	1995-2013	41°38'31.0"	87°36'36.3"	16.5	?/-333	-285/-315
QC-16	Calumet	1995-2013	41°35'53.1"	87°39'30.4"	28.5	?/-286	-257/-267
QC-17	Calumet	1995-2013	41°35'51.1"	87°38'42.9"	27.1	?/-281	-253/-263
QC-18	Calumet	1995-2013	41°35'47.9"	87°37'49.3"	24.2	?/-297	-269/-279
QC-19	Calumet	1996-2013	41°35'53.3"	87°38'42.9"	—	?/-342	-313/-323
QC-20	Calumet	1999-2013	41°39'0.4"	87°33'59.9"	10.5	-252/-315	-272/-297
QC-21	Calumet	1999-2013	41°39'46.0"	87°33'30.7"	6.0	-246/-309	-266/-291
QC-22	Calumet	1999-2013	41°40'26.0"	87°33'37.9"	10.8	-242/-305	-262/-287
QC-23	Calumet	1999-2013	41°41'17.5"	87°33'28.6"	11.1	-237/-300	-257/-282
QC-24	Calumet	1999-2013	41°42'16.5"	87°33'28.1"	9.6	-232/-295	-252/-277
QC-25	Calumet	1999-2013	41°42'55.9"	87°32'59.8"	11.7	-227/-290	-247/-272
QC-26	Calumet	1999-2013	41°43'41.7"	87°32'38.4"	15.3	-221/-284	-241/-266
QC-27	Calumet	1999-2013	41°42'7.7"	87°32'36.9"	9.3	-228/-281	-248/-263
QC-28	Calumet	1999-2013	41°40'21.4"	87°32'59.1"	9.2	-240/-293	-260/-275
QC-29	Calumet	2003-2013	41°38'11.2"	87°39'27.3"	17.5	-107/-160	-126/-142
QC-30	Calumet	2003-2013	41°37'53.8"	87°38'38.1"	18.1	-118/-172	-138/-154

**Table 2.** Description of monitoring wells and tunnels, Tunnel and Reservoir Plan System, Cook County, Illinois.—Continued

[—, no data, ?, unknown]

Well name	System monitored	Sampling dates	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Land-surface elevation (feet above City of Chicago datum)	Elevation top/bottom of open interval of well (feet below City of Chicago datum)	Elevation top/bottom of tunnel (feet below City of Chicago datum)
QC-31	Calumet	2003–2013	41°37'33.5"	87°37'53.9"	18.2	-128/-181	-147/-163
QC-32	Calumet	2003–2009	41°36'49.3"	87°37'19.2"	19.0	-140/-193	-159/-175
QC-33	Calumet	2008	41°36'33.6"	87°37'2.3"	11.7	-150/-203	-169/-185
QC-34	Calumet	2004–2010	41°36'27.6"	87°35'34.4"	13.3	-142/-195	-161/-177
QC-35	Calumet	2003–2012	41°36'16.0"	87°34'26.5"	18.7	-129/-182	-148/-164
QC-36	Calumet	2003–2012	41°35'41.4"	87°33'25.0"	20.6	-114/-167	-133/-149
QC-37	Calumet	2003–2010	41°35'31.5"	87°32'40.6"	18.7	-105/-158	-124/-140

## Methods of Study

### Sample Collection, Laboratory Analysis, and Data Reporting

The MWRDGC began collecting and analyzing water samples from 120 TARP monitoring wells (table 2) on a periodic basis in the mid-1970s. Seven wells became nonfunctional by 1995. As a result, 113 wells were sampled during the 1995–2013 period of investigation. The sampling frequency varied with the well, ranging from approximately every 2 weeks in wells QC-1, QC-2, QC-2.1, and QC-2.2 from 1995 through 2004 to more than a year between sampling events in some of the wells that were temporarily nonfunctional. The typical sampling frequency was approximately every 2 months. The intensive sampling in wells QC-1, QC-2, QC-2.1, and QC-2.2 during 1995–2004 was done to monitor the effect of CSF events. Sample collection in the remaining wells (and after 2004 in wells QC-1, QC-2, QC-2.1, and QC-2.2) occurred on a fixed schedule not related to the timing of CSF events.

Sampling procedures followed established protocols (Washington and others, 1981). Sample collection began with measurement of the water level in the well, and the volume of water in the well was calculated. The well was then purged of one well volume. If the yield was insufficient to allow sampling immediately after purging, the well was allowed to recharge for up to 48 hours, at which time the samples were collected. Temperature, electrical conductivity, and pH were measured at the well head immediately prior to sample collection. Field samples were poured into appropriate containers and transported on ice to the laboratory where, with the

exception of fecal coliform, the samples were filtered through a membrane with a 0.45-micron pore size. Aliquots were then poured into individual bottles containing the appropriate preservative.

Samples were submitted to the Analytical Laboratories Division (ALD) of the MWRDGC for analysis. Ammonia (NH<sub>3</sub>) and sulfate were analyzed using standard methods described by the U.S. Environmental Protection Agency (1993a, b). Chloride, total dissolved solids, fecal coliform, hardness, and dissolved organic carbon were analyzed using standard methods described by the American Public Health Association (2012). The ALD laboratories are certified by the National Environmental Laboratory Accreditation Conference (Pauline Lindo, MWRDGC, written commun., 2014).

Sample results have been compiled and published annually by the MWRDGC beginning in 1994 (for the Upper Des Plaines System wells) or 1995 (for the Mainstream, Des Plaines, and Calumet System wells). MWRDGC reported organic carbon results as total organic carbon. Because the samples were filtered prior to analysis, this report describes these analyses as dissolved organic carbon (DOC). Paper copies of the results of the analyses performed prior to 1994 or 1995 have been stored by the MWRDGC but have not been compiled or published. Published reports containing the sample results from 1995 to 2004 are available in hard copy from the MWRDGC. Reports containing the monitoring results during 2005–13 are available electronically from the MWRDGC website (<http://www.mwr.org/irj/portal/anonymouse?NavigationTarget=navurl://3eecfe6e95b61ff28d87eedb0c778236>). The 1995–2013 sampling results were compiled into one report and published by the MWRDGC (Brose and others, 2016) so that persons wishing to view the raw data that were analyzed for this investigation can more easily access the data.

Samples of raw water (water from a point in the distribution system prior to treatment and dispersal to the users) are collected by the IEPA from selected water-supply wells in Illinois and analyzed for a variety of constituents, including total coliform and *Escherichia coli* (*E. coli*), on a periodic basis in accordance with standard procedures (Illinois Environmental Protection Agency, 2012). The IEPA sampling is unrelated to the TARP System or to the TARP monitoring effort. Results of IEPA analysis of total coliform and *E. coli* in samples collected from selected water-supply wells open to the Silurian aquifer within 5 mi of the TARP tunnels were obtained from the IEPA website at <http://163.191.83.31/dww/>, accessed March 30, 2015. These data were plotted to identify the presence of total coliform and *E. coli* in the Silurian aquifer near the TARP System but were not subjected to the analyses described in the following section.

## Data Analysis

All data analyses presented in this report were performed by the USGS. Water-quality data were compiled from the 113 TARP System monitoring wells sampled by the MWRDGC during 1995–2013. Data from seven wells were compiled but not analyzed because fewer than 10 samples were collected from those wells. Wells with fewer than 10 samples were not analyzed because the data are not considered to be capable of providing statistically significant results. Data from the remaining 106 wells, each of which typically had 50 to 260 samples, were subjected to comprehensive statistical analysis (table 2).

The value of every analyte in wells with 10 or more samples was plotted through time. Potentially anomalous (outlier) values were checked against the original laboratory sheets, and erroneously reported values were corrected. Anomalous values were determined by the author on the basis of visual assessment of the data plots. Data anomalies were considered to be present if the value of an analyte was at least a factor of two greater than its typical value in the well in the years preceding and succeeding the date of the potential anomaly or if the value did not appear to be part of a long-term temporal trend.

Selected analytes were plotted using boxplots and normal and lognormal plots using graphic packages in the R statistical software package to assess the underlying data distribution. Plots for many of the analytes did not indicate a normal or lognormal distribution or have heterogeneous variance; therefore, nonparametric tests were used for the statistical analyses.

Summary statistics (number of samples, number of detections, percent detections, maximum value, minimum value, arithmetic mean value, geometric mean value, standard deviation, and coefficient of variation) were calculated for each analyte in each well. When calculating geometric mean, analytes whose values were less than the detection limit for a particular sample (censored values) were assigned a value

by assuming a triangular distribution for values less than the detection limit (Quinn and Keogh, 2003). This technique was deemed preferable to assuming a distribution for the entire dataset as other methods would (Helsel, 2012). Analytes with censored values were analyzed for the arithmetic mean and standard deviation using the flipped Kaplan-Meier estimator (Helsel, 2012). Analytes with a detection frequency of less than 10 percent in any given well were not subjected to statistical analysis for that well. Analytes with a substantial number of samples showing values less than the detection limit (censored values) frequently had geometric mean, arithmetic mean, standard deviation, or coefficient of variation values reported as being within a range of values.

Multiple detection limits were utilized for chloride, ammonia, sulfate, and DOC samples during the 1995–2013 period, which prevented the application of the triangular substitution method for these analytes for wells having results less than multiple detection limits. The samples for which analytes were not detected at the highest detection limits were retained for the statistical analyses using triangular substitution. The samples for which analytes were not detected at the lower detection limits were omitted. For example, if chloride was not detected in a sample from a well at a detection limit of 10 milligrams per liter (mg/L) and was not detected in another sample from that well at a detection limit of 5 mg/L, the less than (<) 10-mg/L sample was used in the analysis, and the <5-mg/L sample was not. The resulting calculated values are the maximum possible values; therefore, the value is reported as less than the calculated value.

Trend analysis for the 1995–2013 period was performed by use of Kendall's tau correlation with Sen's slope tests (Helsel and Hirsch, 2002). The magnitude of the trend is reported for all analytes and grouped by p-values of less than or equal to ( $\leq$ ) 0.05 or greater than ( $>$ ) 0.05. Trends with a p-value of  $\leq 0.05$  are considered a rejection of the null hypothesis of the analysis that the data are statistically independent (the occurrence of an analyte value does not affect the probability of another value) to a significance level of at least 95 percent and, therefore, are considered to show a statistically significant trend.

Seasonality in the values of uncensored analytes was assessed by grouping the values by month and applying periodic functions, sine and cosine, to determine if there was a statistically significant variation in the values of the monthly data (Helsel and Hirsch, 2002). All analyses with a calculated p-value of  $\leq 0.05$  (those analyses rejecting the null hypothesis that the data are independent to a significance level of at least 95 percent) were plotted to determine the timing of low and high values. Analytes with a p-value of  $\leq 0.05$ , showing consistent timing in high and low values that could not be attributed to random anomalous values and that were detected in the analyses of samples from at least five of the TARP wells, are discussed in this report.

Analyte values in samples from each well were correlated by use of Kendall's tau correlation with the Akritas-Theil-Sen slope estimator (Helsel, 2012). Populations of fecal coliform

in wells with a frequency of detection of 10 percent or greater also were correlated between wells located within each of the tunnel systems. Analytes with a tau-b value of 0.25 or greater or -0.25 or less were considered to indicate high correlation. Tau-b is a statistic used to measure the association between two measured quantities that makes adjustments for ties in the data, which makes this statistic useful for analyzing datasets with censored values (Helsel, 2012).

## Hydrogeology in the Vicinity of the Tunnel and Reservoir Plan System

The surficial geologic deposits in most of the TARP area are composed primarily of unconsolidated silt- and clay-rich tills. These deposits typically are 25–100 ft thick and function as a semiconfining unit, restricting groundwater flow to the underlying Silurian dolomite (Kay and others, 1996; 2002).

Northwest of the City of Chicago, the Des Plaines Disturbance (fig. 4) is present beneath the unconsolidated deposits (Willman, 1971; McHone and others, 1986). This feature is a meteorite effect crater about 5.5 mi in diameter, characterized by intensive faulting, surrounded by a 25-square mile (mi<sup>2</sup>) area of less intensive faulting. Within the most disturbed area, there is as much as 900 ft of vertical displacement of the bedrock. This feature intercepts small parts of the tunnel system, but fractures associated with the disturbance may promote groundwater flow and CSF migration.

The Silurian-aged dolomite bedrock surrounding the TARP tunnels composes the Silurian aquifer. The dolomite is the uppermost bedrock deposit in Cook County outside the Des Plaines Disturbance and is about 50–450 ft thick (Suter and others, 1959; Csallany and Walton, 1963). Silurian dolomite underlies the unconsolidated deposits in most of the TARP area but is at or near land surface in the vicinity of the Thornton and McCook Reservoirs and northwest of well QC–26. The Silurian dolomite also is present at or near land surface in the vicinity of well QC–1, near well QM–68, and west of well QM–51 (Willman, 1971) (figs. 3 and 4). Areas where the aquifer is at the land surface are more susceptible to anthropogenic contamination from, for example, road salts or septic systems than areas where the aquifer is overlain by the semiconfining unit (McKenna and Keefer, 1991).

The Silurian aquifer is underlain by the Maquoketa Group (Willman and others, 1975) (fig. 1). The deposits of the Maquoketa Group are composed primarily of shale and function as a semiconfining unit that restricts downward movement of groundwater from the Silurian aquifer to deeper water-supply aquifers.

Groundwater flow in the Silurian aquifer is primarily through secondary-permeability features (joints, fractures, faults, solution openings) that make up less than 1 percent of the aquifer by volume. Lower rates of flow occur through the porous matrix of the aquifer, which constitutes most of the aquifer volume. Secondary-permeability features tend to be

concentrated in the upper, more weathered, part of the aquifer but may also be present along shale beds in the deeper parts of the aquifer (Suter and others, 1959; Zeisel and others, 1962; Nicholas and Healy, 1988) and near the Des Plaines Disturbance. Vertical faults in the Calumet area (fig. 4) and an irregularly distributed network of vertical fractures also are conduits for groundwater flow (Zeisel and others, 1962; Kiefer and Associates, 1976; Morse and others, 2000). The Silurian aquifer has an average horizontal hydraulic conductivity (Kh) of about  $1.5 \times 10^{-1}$  feet per day (ft/d) in the TARP area (Harza Engineering Company, 1972; Kiefer and Associates, 1976; Kay and others, 1996).

Because the extent of CSF migration into the Silurian aquifer is likely to be greatest in areas where Kh is elevated above background values, the conductivity of the aquifer at the TARP wells was assessed by evaluating the time required for the water level in the well to recover to approximately hydrostatic levels after being purged for sampling. Recovery time is reported on the MWRDGC sampling sheets as being immediate, less than 4 hours, or less than 48 hours. For the purposes of this report, immediate recovery indicates the aquifer has high Kh within the open interval of the well. Recovery in less than 4 hours (but not immediately) indicates moderate Kh. Recovery in greater than 4 to less than 48 hours indicates low Kh.

Using these criteria, 75 percent of the TARP monitoring wells (and potentially the nearby tunnel system) are open to parts of the aquifer with low Kh (fig. 6). High Kh is present in parts of the Upper Des Plaines System. Moderate Kh is present along much of the southern parts of the Des Plaines and Mainstream Systems, and along much of the 140th Street leg of the Calumet System. Maintaining the integrity of the tunnel lining in these high-to-moderate Kh areas, therefore, is particularly important. The high Kh in parts of the Upper Des Plaines System may be related to fracturing associated with the nearby Des Plaines Disturbance. Faulting in the Calumet area (figs. 4 and 6) has no apparent effect on the Kh of the Silurian aquifer at the Calumet System wells.

Transport of CSF constituents through the Silurian aquifer is affected by the differences in water-level elevation between the TARP tunnels and the aquifer. Therefore, water levels in the TARP monitoring wells and the tunnel system were analyzed. These data provide substantial insight into the aquifer-tunnel flow dynamic.

The geometric mean value of the water levels in the TARP wells during 1995–2013 is spatially variable, but some overall patterns can be determined (fig. 7). Water levels typically were highest in the Upper Des Plaines System (above -50 ft CCD, or less than 50 ft below the CCD) and especially in the wells with high Kh. Water levels were lowest in the Calumet System (commonly more than -200 ft CCD). Water levels in the wells monitoring the Mainstream and Des Plaines tunnels typically were lowest (more than 150 ft below CCD) in the southern part of the system near the future McCook Reservoir. The lowest water levels are generally associated with the deepest parts of the Des Plaines, Mainstream, and

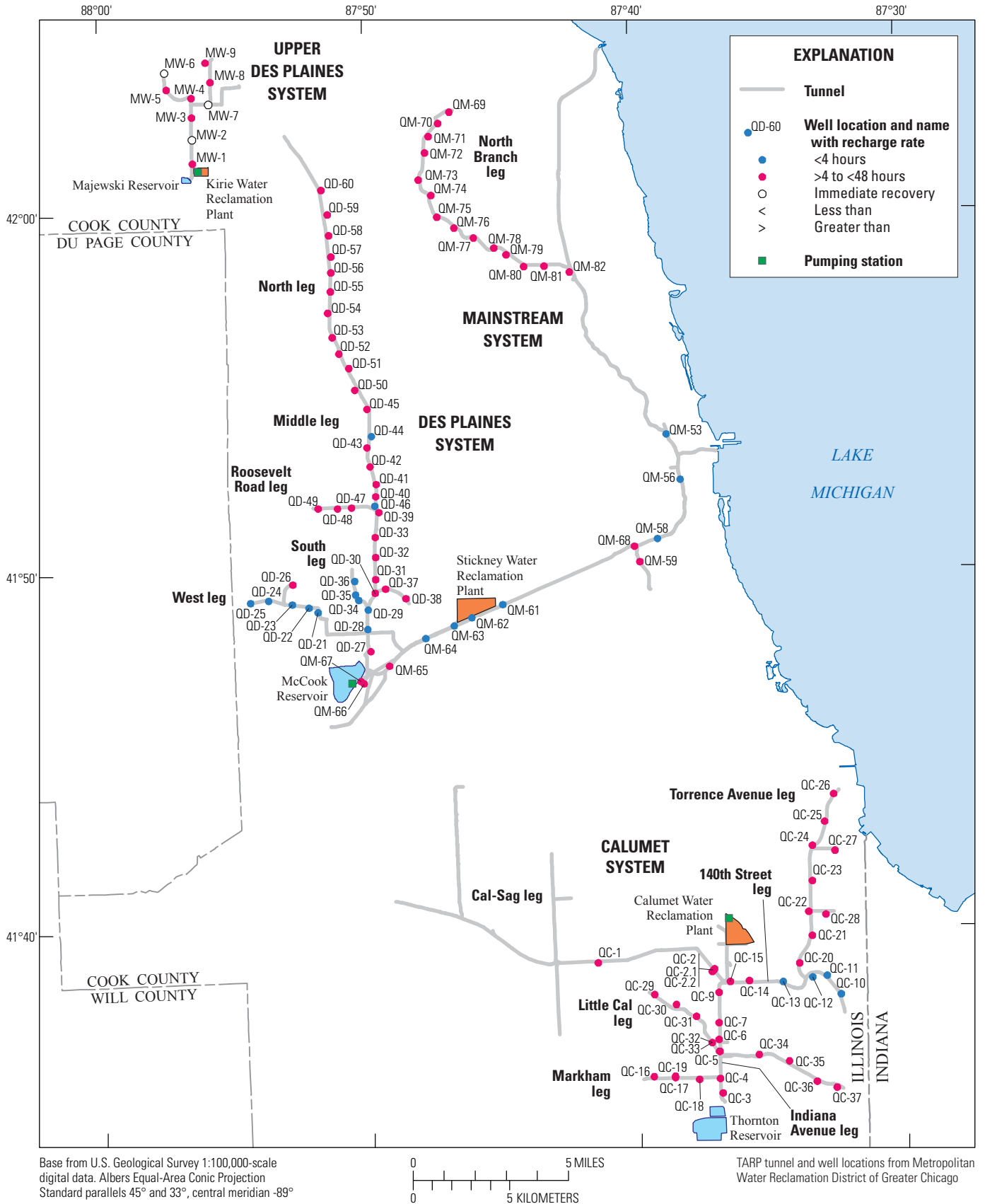
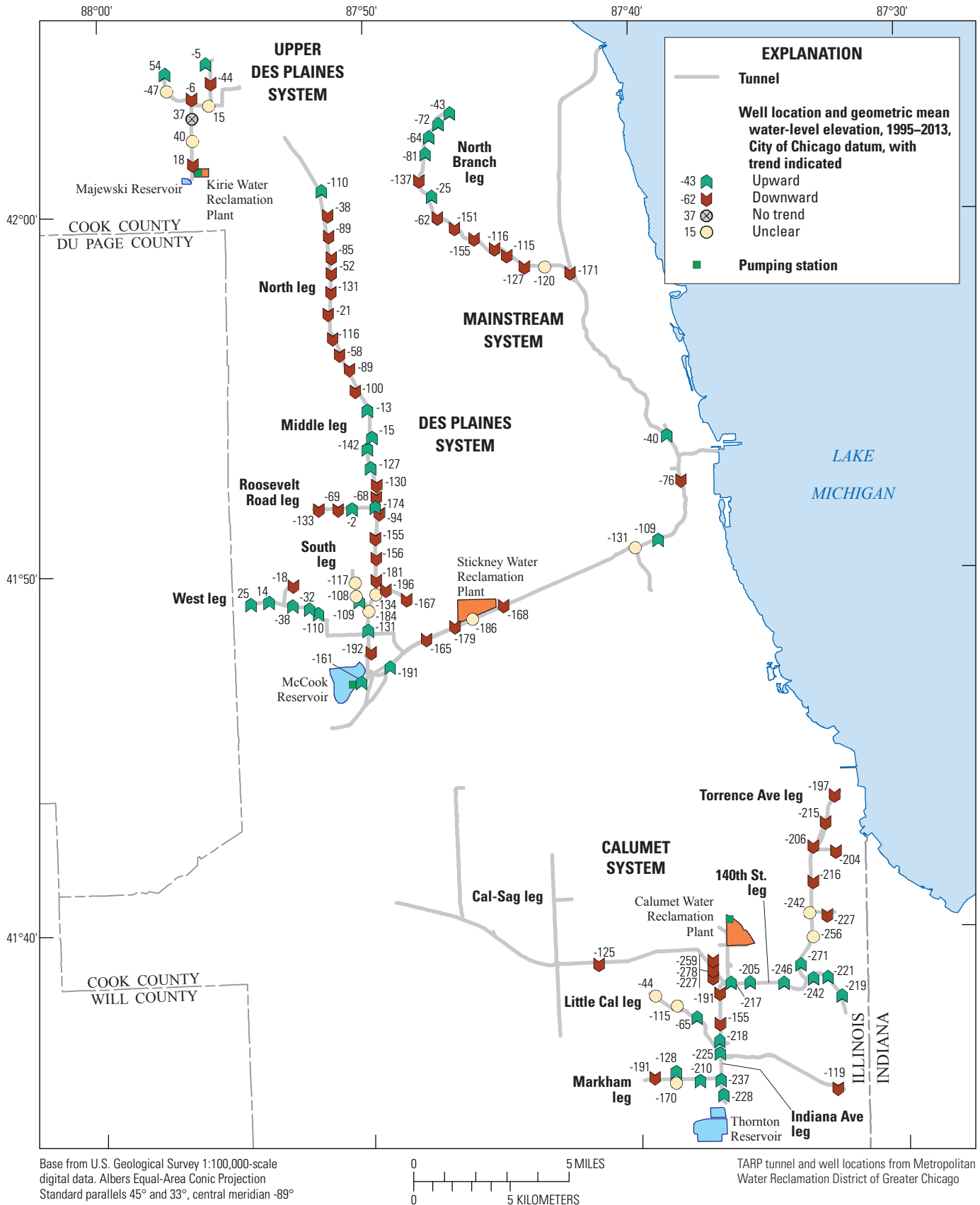


Figure 6. Recharge rates for wells, Tunnel and Reservoir Plan (TARP) System, Cook County, Illinois.



**Figure 7.** Geometric mean value of water levels and trends in Tunnel and Reservoir Plan (TARP) System wells, Cook County, Illinois, 1995–2013. Upward, downward, and no trends are significant with  $p$ -values  $\leq 0.05$ .



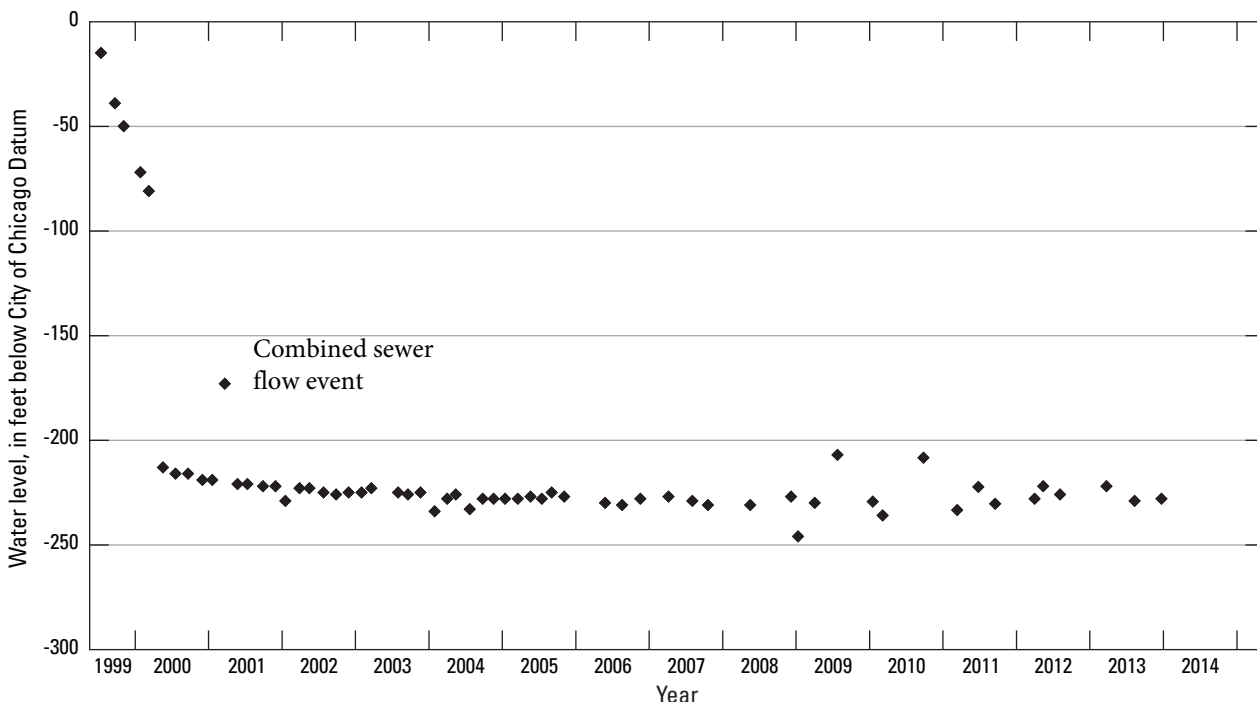
to a lesser degree Calumet, tunnel systems which are also where the Thornton and McCook Quarries are being dewatered. Dewatering occurs at about 75 gallons per minute (gal/min) for Thornton Quarry and 360 gal/min for McCook Quarry (Lakhwinder Hundal, Metropolitan Water Reclamation District of Greater Chicago, written commun., 2015), lowering water levels in the nearby Silurian aquifer (figs. 2 and 7). Dewatering of the Thornton Reservoir, and more prominently the future McCook Reservoir, may be lowering water levels in the Silurian aquifer near the downstream end of the Calumet, Des Plaines, and Mainstream Systems, which also could have enhanced movement of water from the TARP System to the aquifer during CSF events.

The elevation of the tunnel system affects the water level in the Silurian aquifer because groundwater from the aquifer drains into the TARP tunnels under typical (no CSF) hydraulic conditions. This drainage lowers water levels in the aquifer by an amount that is proportionate to the amount of drainage, the distance between the well and the location of the drainage, and the hydraulic properties of the aquifer in the vicinity of the drainage area. The normal aquifer-to-tunnel flow direction is indicated by the fact that geometric mean water levels are about 5 ft to more than 150 ft higher than the elevation of the top of the nearby tunnel (compare figs. 2 and 7), which typically is at least partly dewatered.

The presence and effect of drainage from the aquifer to the tunnel system is demonstrated by an analysis of groundwater levels in well QC-26 (fig. 8). Water-level trends in this well are consistent with many of the TARP monitoring wells constructed during 1995–2013 (appendix 1). Water levels in

these recently constructed wells tend to show a large decrease (approximately 200 ft) in response to the initiation of drainage to recently constructed tunnels (dates of tunnel construction shown in figure 2) near the well followed by relatively stable water levels once approximately steady-state flow to the tunnel has occurred. During the period of relatively stable water levels, occasional high water levels were observed during CSF events. It is likely that a large decrease in water levels occurred in most or all of the TARP wells in response to the initiation of drainage from the aquifer to the tunnels during and soon after tunnel construction. Excepting the North Branch leg of the Mainstream System and most of the Calumet System, tunnel construction was completed prior to 1995 (fig. 2). Therefore, the large decrease in water levels postulated for most of the TARP wells likely had already occurred before the beginning of the data analysis for this investigation (1995–2013) and was not observed.

The spatial extent of the effect of drainage to the tunnels on water levels in the Silurian aquifer is indicated by analysis of water levels in monitoring wells BH7D, BH18D, and BH16D. These wells are not part of the TARP monitoring network and have a sporadic measurement history. The wells are open to the upper part of the Silurian aquifer near the Torrence Avenue leg of the Calumet System (fig. 4). Construction of the southern part of the Torrence Avenue leg began in 1998, proceeded to the northern part of the leg in 1999, and was completed in 2002 (Kevin Fitzpatrick, Metropolitan Water Reclamation District of Greater Chicago, written commun., 2015).



**Figure 8.** Water levels in Tunnel and Reservoir Plan System well QC-26, Cook County, Illinois, 1999–2013.

Water levels in well BH16D differed by less than 2 ft from 1992 through 2014. The stable water levels at well BH16D, which is about 3 mi from the tunnel system (fig. 4), indicate this area is representative of “background” water levels in the Silurian aquifer and is not affected by the TARP System. Groundwater levels in well BH7D (the bottom of this well is about 240 ft directly above the top of the Torrence Avenue tunnel) declined from about -20 ft CCD in 1992 to -43 ft CCD in 1993 following construction of a TARP drop shaft west of the well, declined from about -43 ft CCD in 1997 to about -55 ft CCD in 2010, and have varied by less than 2 ft from 2010 through 2014 (fig. 9). Water levels in well BH18D (about 4,700 ft east of the Torrence Avenue tunnel) were stable from 1992 through 1997, declined by nearly 20 ft between 1997 and 2009, and have varied by less than 3 ft since 2009. The timing of the changes in the water levels at wells BH7D and BH18D is attributed to water drainage from the aquifer associated with construction and operation of the Torrence Avenue tunnel and indicates that water levels (and by implication flow directions) in the shallow part of the Silurian aquifer are substantially affected by drainage more than 4,700 ft

from the tunnel system. The water levels in wells BH7D and BH18D during 2013 (fig. 9) were approximately 160 and 215 ft, respectively, higher than the geometric mean of the water-level measurements from the nearest TARP monitoring wells—QC-26 and QC-20 (BH7D and BH18D shown in fig. 4; QC-26 and QC-20 shown in fig. 3 with their water levels in fig. 7)—further indicating the potential for flow from the upper part of the Silurian aquifer to the tunnels in the lower part of the aquifer during most or all of the 1995–2013 period.

Although groundwater typically flows from the Silurian aquifer to the TARP tunnels, for periods of hours to days after precipitation events, water pressure in the tunnels increases by the equivalent of tens to hundreds of feet (fig. 10) as CSF fills the tunnels. This transient high water pressure creates a substantial force that, depending on its magnitude, has the potential to overcome the typical aquifer-to-tunnel hydraulic gradient and move CSF-affected water from the tunnels into the surrounding Silurian aquifer.

The relation between the amount of discharge from the TARP System and the hydraulic potential for outflow from, and inflow to, the tunnels is indicated by comparison of

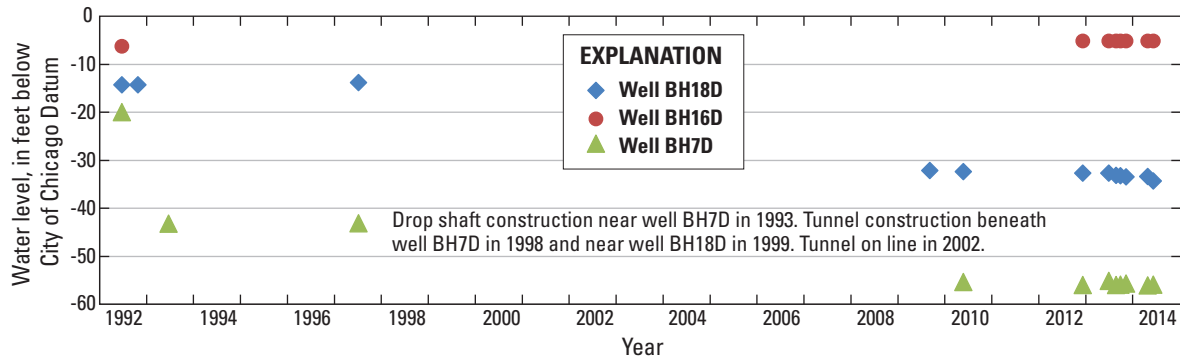


Figure 9. Water levels in monitoring wells BH7D, BH16D, and BH18D, Cook County, Illinois, 1992–2014.

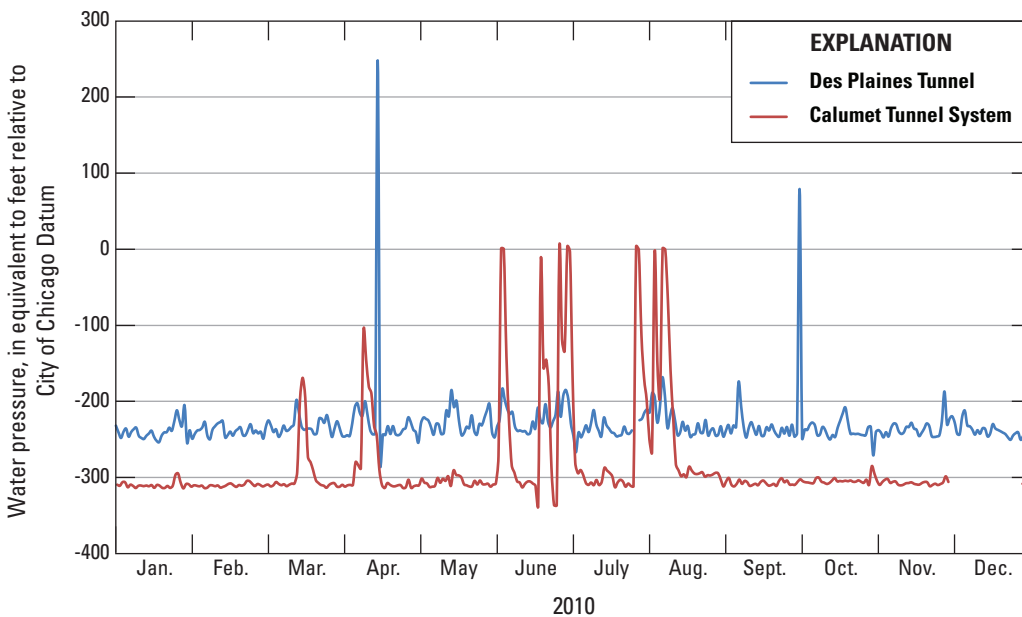


Figure 10. Water pressure in the Calumet and Des Plaines Tunnel Systems, Cook County, Illinois, January 1–December 31, 2010.

groundwater levels at wells QC-1, QC-2, and QC-2.2 with daily discharge from the TARP System to the Calumet WRP during 1995-96 (table 3). Water levels were measured approximately every 2 weeks in wells QC-1, QC-2, and QC-2.2 during 1995-96. Increases in groundwater levels of about 15 to 150 ft were observed in wells QC-1 and (or) QC-2 on January 25, April 19, and November 16, 1995, and May 16, May 30, June 13, June 27, July 25, and October 3, 1996, in comparison to preceding or succeeding dates. Groundwater levels in well QC-2.2 were higher on November 16, 1995, and June 13, 1996, in comparison to preceding and succeeding dates. These increases typically occurred during or shortly after periods of discharge from the TARP System to the Calumet WRP of greater than about 80 million gallons per day (Mgal/d), indicating that a large, short-term, pressure gradient affected the flow regime in the aquifer on or near these dates. This pressure gradient may have driven CSF water from the tunnels into the Silurian aquifer. The high groundwater level in the wells typically dissipated over a period of 2-4 weeks, with most of the dissipation occurring within 2 weeks. Periods of elevated TARP discharge to the WRPs were associated with most, but not all, increases in groundwater levels, indicating that some of these discharge events were not CSF related but

may have been discharge of water derived from drainage from the aquifer to the tunnels.

From 1995 through 2013, water levels in the TARP System monitoring wells varied by more than 60 ft in 83 wells, by 20 to 60 ft in 21 wells, and by less than 20 ft in 2 wells (appendix 1). Data from non-TARP monitoring well BH16D indicates that background groundwater levels in the Silurian aquifer varied by about 2 ft during the study period. These variations indicate that nearly every well in the TARP System responded to CSF-induced pressure gradients that may have at least occasionally been sufficient to overcome the typical aquifer-to-tunnel hydraulic gradient and induce flow from the TARP System into the Silurian aquifer.

Some indication of the change in the aquifer-to-tunnel flow pattern was obtained from analysis of temporal trends in groundwater levels during 1995-2013. Trend analysis indicates that 91 wells (about 86 percent of the 106 wells analyzed) showed a statistically significant trend. Of those 91 wells, groundwater levels decreased in 51 and increased in 39; no trend was indicated in 1 (fig. 7). A statistically significant trend was not observed in 15 wells. These wells are considered to show an unclear trend.

**Table 3.** Groundwater levels and fecal coliform populations at wells QC-1, QC-2, and QC-2.2 and discharge to the Calumet Water Reclamation Plant, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-1996.

[<, less than; ns, no sample collected; underline denotes period of elevated water level or discharge, as well as initial elevation of fecal coliform population]

Sampling date (month/day/ year)	QC-1	QC-1	QC-2	QC-2	QC-2.2	QC-2.2	Discharge from Tunnel and Reservoir Plan system to Calumet Water Reclamation Plant (million gallons per day)
	Groundwater level (feet from City of Chicago datum)	Fecal coliform (colony forming units per 100 milliliter)	Groundwater level (feet from City of Chicago datum)	Fecal coliform (colony forming units per 100 milliliter)	Groundwater level (feet from City of Chicago datum)	Fecal coliform (colony forming units per 100 milliliter)	
1/11/1995	-121	<1	-260	15	ns	ns	1
1/25/1995	<u>-94</u>	<1	<u>-137</u>	<u>500</u>	ns	ns	<u>99</u>
2/9/1995	-117	<1	-252	60	<u>-180</u>	<1	10
2/23/1995	-122	<1	-264	<1	-261	14	8
3/9/1995	-121	<1	-260	<1	-218	<1	41
3/23/1995	-122	<1	-261	<1	-210	<1	11
4/6/1995	-122	<1	-265	<1	-219	<1	12
4/19/1995	<u>-107</u>	<1	<u>-206</u>	<u>3,600</u>	-212	<1	<u>87</u>
5/4/1995	-119	<1	-252	1,200	-205	<1	42
5/18/1995	-120	<1	-260	150	-212	<1	20
6/1/1995	-121	<1	-260	<1	-215	<1	<u>106</u>
6/15/1995	-120	<1	-262	3	-214	<1	8
6/29/1995	-120	<1	-264	<1	-214	<1	<u>95</u>
7/13/1995	-121	<1	-264	<1	-217	<1	2
7/27/1995	-122	<1	-259	<1	-224	<1	20
8/10/1995	-122	<1	-263	<1	-220	<1	18

20 Hydrogeology and groundwater quality, Tunnel and Reservoir Plan System, Cook County, Ill., 1995–2013

**Table 3.** Groundwater levels and fecal coliform populations at wells QC-1, QC-2, and QC-2.2 and discharge to the Calumet Water Reclamation Plant, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–1996.—Continued

[<, less than; ns, no sample collected; underline denotes period of elevated water level or discharge, as well as initial elevation of fecal coliform population]

Sampling date (month/day/ year)	QC-1	QC-1	QC-2	QC-2	QC-2.2	QC-2.2	Discharge from Tunnel and Reservoir Plan system to Calumet Water Reclamation Plant (million gallons per day)
	Groundwater level (feet from City of Chicago datum)	Fecal coliform (colony forming units per 100 milliliter)	Groundwater level (feet from City of Chicago datum)	Fecal coliform (colony forming units per 100 milliliter)	Groundwater level (feet from City of Chicago datum)	Fecal coliform (colony forming units per 100 milliliter)	
8/24/1995	-121	<1	-264	<1	-221	<1	12
9/7/1995	-122	<1	-266	<1	-224	<1	1
9/21/1995	-118	<1	-266	<1	-225	<1	4
10/5/1995	-122	<1	-265	<1	-228	<1	4
10/19/1995	-124	<1	-266	<1	-281	<1	9
11/2/1995	-122	<1	-266	<1	-231	<1	22
11/16/1995	<u>-98</u>	<1	<u>-159</u>	<1	<u>-201</u>	<1	<u>81</u>
11/30/1995	-119	<1	-252	<u>750</u>	-218	<1	11
12/14/1995	-122	<1	-262	38	-231	<1	1
12/28/1995	-122	<1	-266	3	-228	<1	4
1/11/1996	-123	<1	-267	<1	-227	<1	8
1/25/1996	-122	<1	-270	<1	-232	<1	9
2/7/1996	-122	<1	-271	<1	ns	ns	26
2/22/1996	-122	<1	-269	<1	-240	<1	2
3/7/1996	-122	<1	-272	<1	-244	<1	18
3/21/1996	-122	<1	-271	<1	-247	<1	11
4/4/1996	-122	<1	-275	<1	-240	<1	6
4/18/1996	-122	<1	-273	<1	-248	<1	15
5/2/1996	-122	<1	-273	<1	-248	<1	64
5/16/1996	-248	<1	<u>-108</u>	<u>4,000</u>	-248	<1	<u>94</u>
5/30/1996	-120	<1	-254	8,500	-240	<1	3
6/13/1996	<u>-108</u>	<1	<u>-234</u>	<1	<u>-225</u>	<u>1,100</u>	<u>111</u>
6/27/1996	<u>-111</u>	<1	<u>-229</u>	<u>2,000</u>	-247	<1	20*
7/11/1996	-119	<1	-255	260	-238	<1	18
7/25/1996	<u>-90</u>	<1	<u>-102</u>	<u>3,600</u>	ns	ns	<u>80</u>
8/8/1996	-111	<1	<u>-230</u>	<u>3,100</u>	<u>-204</u>	<1	65
8/22/1996	-119	<1	-258	210	-249	<1	12
9/5/1996	-121	<1	-260	19	-246	<1	43
9/19/1996	-121	<1	-266	2	-235	<1	9
10/3/1996	-188	<1	<u>-235</u>	<u>2,600</u>	ns	ns	21**
10/17/1996	-122	<1	-262	300	ns	ns	31
10/31/1996	-123	<1	-266	68	ns	ns	13
11/14/1996	-122	<1	-268	4	ns	ns	20
11/27/1996	-123	<1	-272	<1	ns	ns	7
12/12/1996	-123	<1	-272	<1	ns	ns	43
12/26/1996	-123	<1	-277	<1	ns	ns	41

\*Discharge greater than 95 million gallons per day on June 22, 23, and 24, 1996.

\*\*Discharge 77 million gallons per day on September 29, 1996.

## Water Quality in Tunnel and Reservoir Plan System Monitoring Wells

Water levels in the monitoring wells near the TARP System indicate that CSF in the tunnel systems migrates into the Silurian aquifer on an intermittent basis lasting less than 2–4 weeks during periods of at least 80 Mgal/d discharge into the TARP System. However, water typically drains from the aquifer to the tunnels throughout the TARP System so that any CSF-affected water typically would be flushed from the aquifer back into the tunnels. Therefore, water quality at any TARP well is likely to reflect the water quality of the Silurian aquifer within the drainage area to that well with potential intermittent influxes of CSF-derived water. The amount of CSF water entering the aquifer, and the changes in water quality it produces, will likely depend on a number of factors, including

- The location of exfiltration points in the tunnel. The greater the distance between the well and the point of leakage from the tunnel, the less likely analytes derived from CSF would be present, the lower the concentrations of those analytes would be, and the shorter the period the analyte would be present.
- The hydraulic gradient between the tunnel and the aquifer near the monitoring well. The smaller the difference between the water level in the monitoring well and the hydraulic pressure in the tunnel, the more readily the typical aquifer-to-tunnel flow direction can be reversed and the larger the amount of CSF migration into the aquifer.
- The hydraulic properties of the Silurian aquifer between the tunnel and the monitoring wells. The lower the Kh of the aquifer material, the shorter the distance CSF could migrate into the aquifer and the smaller the volume of water moving from the aquifer to the tunnels to flush out CSF-affected water.
- Water quality of the CSF water and in the Silurian aquifer within the drainage area to the tunnels. Spatial variation of water quality within the part of the aquifer draining to the tunnel monitored by a well or a large difference between the values of an analyte in groundwater and CSF could result in substantial temporal variation in the water quality of the samples collected from the TARP wells. This variation could have short-term (1–4 weeks), long-term (1995–2013), or seasonal aspects.
- The magnitude and duration of the CSF event within the TARP Systems. CSF discharge to the Silurian aquifer likely was maximized by long or frequent periods of high hydraulic pressure in the tunnels. A minimum TARP discharge and associated high hydraulic pressure in the tunnel system appears to be required to reverse the typical aquifer-to-tunnel flow direction. CSF was

likely to be present longer, and under higher hydraulic pressure, in the downstream parts of the tunnel systems, especially the Des Plaines and Mainstream Systems, potentially resulting in increased CSF flow into the aquifer in these areas.

These factors were considered when the water-quality data were analyzed and provided a context for assessing the processes affecting water quality and the timing of the effects. The basis for these assessments is provided in the appendixes. Summary statistics for the individual analytes in each well are presented in appendix 1. Analysis of temporal trends in the values of each analyte in each well is presented in appendix 2. Results of analyses of seasonality in analyte values are presented in appendix 3. Kendall's tau correlation coefficients are listed in appendix 4.

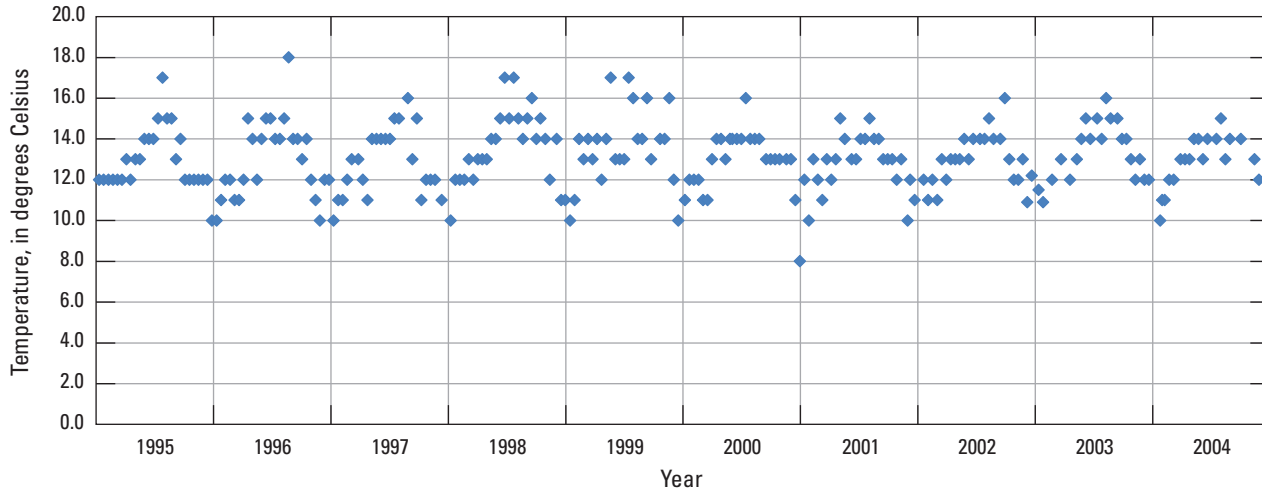
### Temperature

The water temperature in the Silurian aquifer should be similar to the mean atmospheric temperature of about 10.5 degrees Celsius (°C) and is likely to vary by less than 0.5 °C on an annual basis (Suter and others, 1959; Bundschuh, 1993). The temperature of the CSF water discharged from the TARP System was not measured but is likely to have approximated the range of temperature in rain or snowmelt, from near 0 °C to more than 30 °C (Harmeson and Schnepper, 1965). Abnormally high, low, or variable temperatures in groundwater from the TARP monitoring wells could indicate the presence of CSF-affected water in the aquifer.

The temperature of the samples from the TARP monitoring wells from 1995 through 2013 ranged from 4.1 to 25 °C, with the range in a given well typically exceeding 8 °C (appendix 1). Temperature measurements of 8.0 °C or less typically were measured during the fall, winter, and early spring. Temperature measurements of 20.0 °C or greater typically were measured during the summer.

Temperature values measured during sampling of well QC-2 were analyzed to assess the sources of temperature variation in the TARP samples. Temperature values varied by more than 5 °C in a year and showed a cyclic pattern of highs during the summer and lows during the winter (fig. 11). These variations were too large to be natural and were too consistent in their timing to be caused by CSF migration from the TARP System into the Silurian aquifer, indicating the readings were affected by interaction with atmospheric temperature during sampling.

Analysis of seasonality in temperature readings indicates that groundwater samples from every TARP monitoring well had high temperatures in summer and low in winter to a significance level of at least 95 percent (appendix 3). This analysis indicates that reported groundwater temperatures for every sample were affected by the atmospheric temperature at the time of sampling and were not an accurate measurement of groundwater temperatures in the Silurian aquifer. Further analysis of these data provides no meaningful insights into



**Figure 11.** Temperature of groundwater in samples from Calumet System well QC-2, Cook County, Illinois, 1995–2004.

conditions in the CSF or the aquifer and was not attempted. Accurate measurement of groundwater temperature within the open interval of the wells on a continuous basis could be a useful indicator of the timing and presence of CSF-affected water in the aquifer.

## Fecal Coliform

Fecal coliform (FC) is a bacterium that typically originates in the intestines of warm-blooded animals and is excreted in feces. Although generally not harmful in itself, these bacteria can indicate the presence of disease causing bacteria, viruses, and protozoans in the sample. FC is not naturally occurring in the Silurian aquifer, making it the only analyte among those sampled whose presence in samples from the TARP wells can be attributed solely to anthropogenic sources. FC detection is an unambiguous indication of the presence of CSF-affected water in a well on a particular sampling date. However, the absence of FC does not necessarily prove the absence of CSF-affected water.

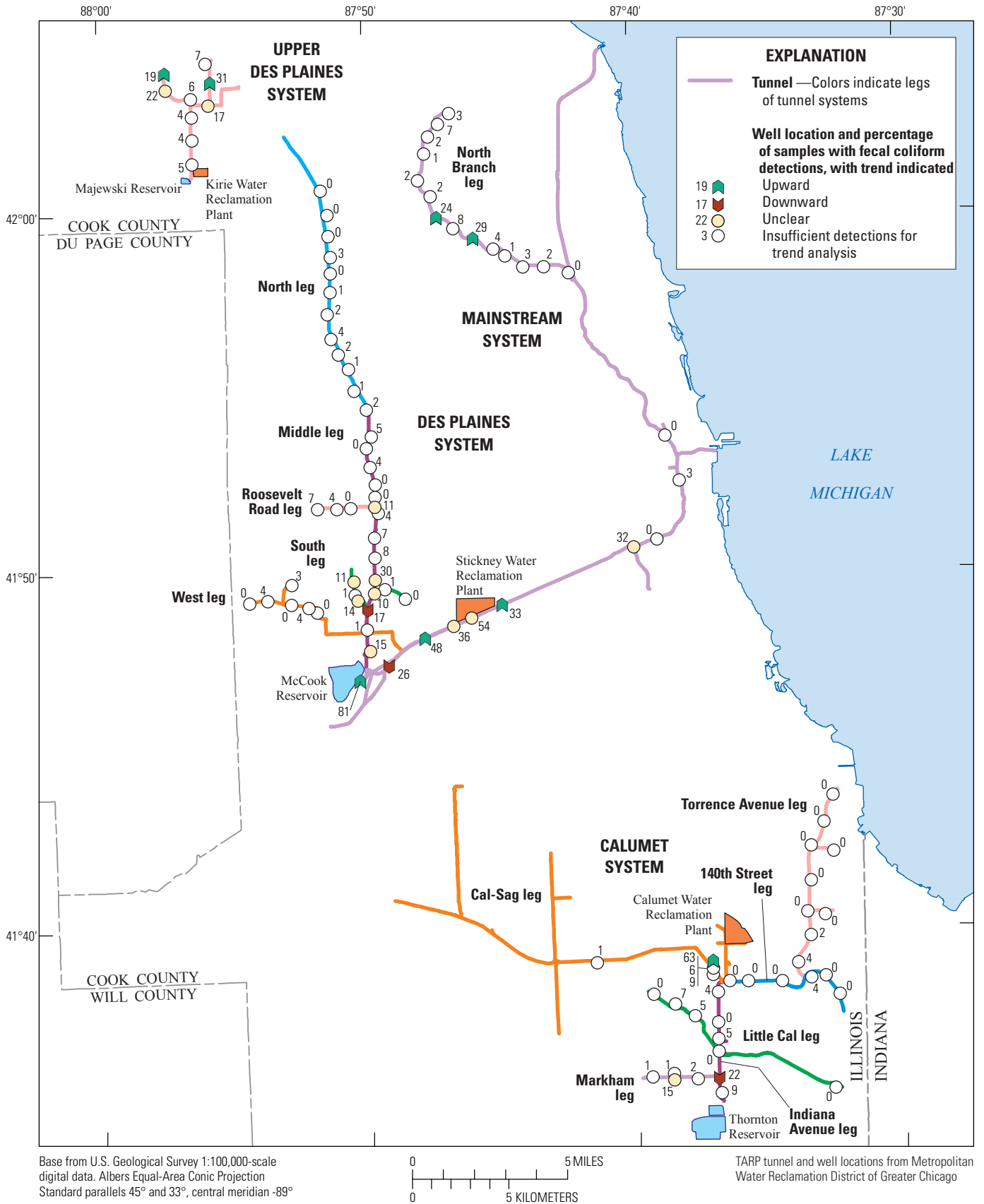
FC was not detected in samples from 31 of the 106 TARP monitoring wells analyzed (appendix 1), was detected in 1–2 percent of the samples in 19 wells, was detected in 10 percent or more of the samples collected from 23 monitoring wells, and was detected in more than 50 percent of the samples collected from 3 wells (fig. 12). FC was detected in fewer than 10 percent of the samples from nearly 80 percent of the wells. Because of the lack of detections, a meaningful discussion of the spatial patterns in the geometric mean FC populations was not possible. This discussion focuses on spatial patterns in the frequency of detection and the maximum FC populations during 1995–2013.

Wells in which FC was detected in 2 percent or less of the samples are scattered throughout the TARP System but tend to be located in the Mainstream System north of well

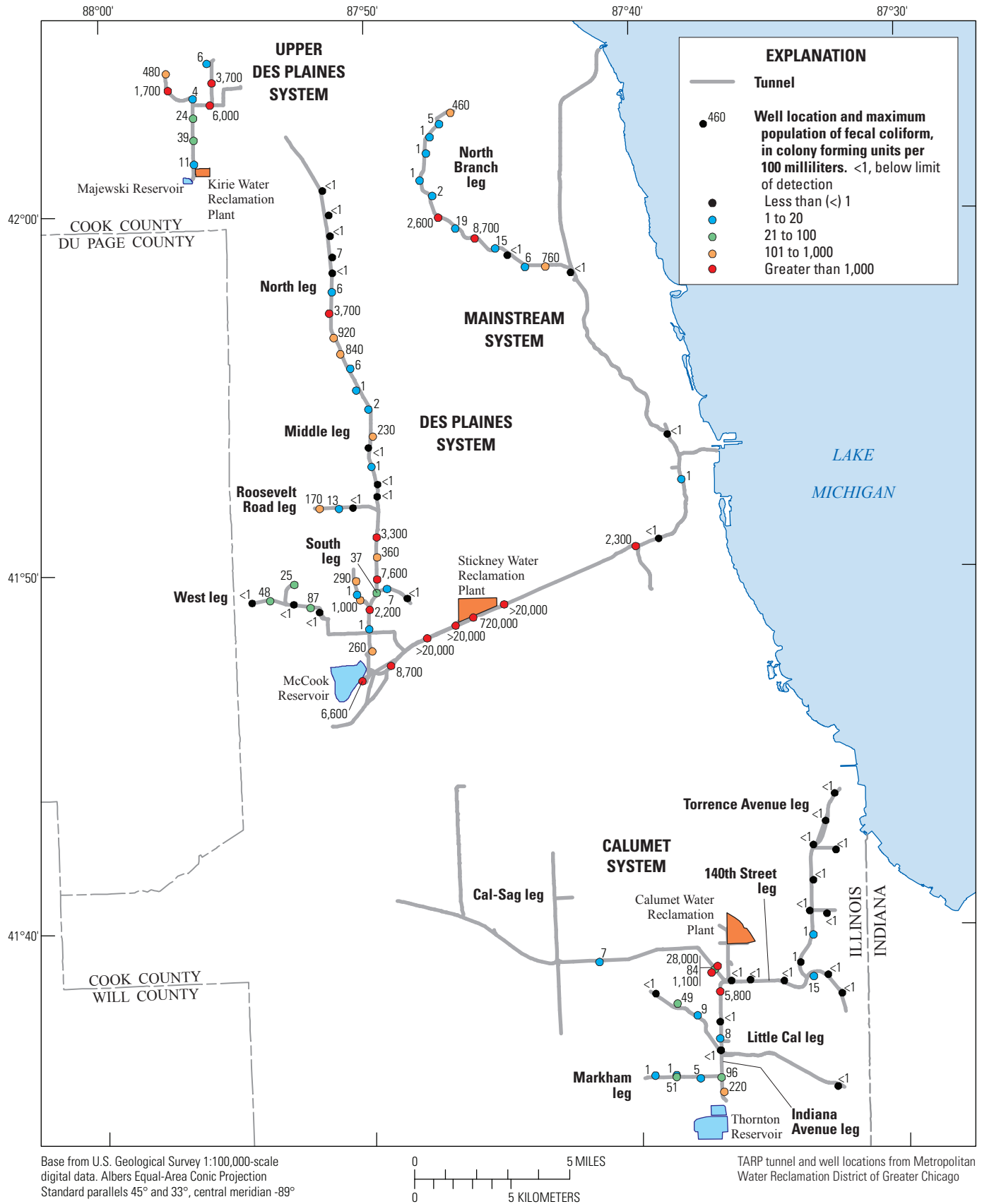
QM-58 (fig. 3), in much of the northern and central parts of the Des Plaines System, and along the Torrence Avenue and 140th Street legs of the Calumet System. Wells in which FC was detected in 10 percent or more of the samples tend to be located in the middle of the North Branch leg of the Mainstream System, in most of the Mainstream System near the Sanitary and Ship Canal from well QM-68 to the future McCook Reservoir, in the northern part of the Upper Des Plaines System, in much of the southern part of the Des Plaines System, and at wells QC-2, QC-4, and QC-17 in the Calumet System (fig. 12). Wells in which FC was detected in 10 percent or more of the samples tended to have high or moderate Kh, particularly outside the Calumet System (figs. 6 and 12). The percentage of FC detections also tended to be highest in the downstream parts of the Des Plaines, Mainstream, and Calumet Systems, most likely because of the increased hydraulic pressure and residence time of CSF in these parts of the tunnel systems.

Samples with maximum FC populations greater than 1,000 colony forming units per 100 milliliters (CFU/100 mL) were present in wells along the Sanitary and Ship Canal from well QM-68 to the future McCook Reservoir, in wells QM-75 and QM-77 in the North Leg of the Mainstream System, in much of the southern part of the Des Plaines System, in the middle part of the Upper Des Plaines System, and near the confluence of the Indiana Avenue and Cal-Sag legs of the Calumet System at wells QC-2, QC-2.2, and QC-9 (fig. 13; appendix 1). Populations of FC greater than 100 CFU/100 mL were present in samples from wells QM-69 and QM-81 on the North leg of the Mainstream System; wells QD-52, QD-53, and QD-54 in the Des Plaines System; and well QC-3 near the Thornton Reservoir.

FC populations in samples from the TARP monitoring wells typically were less than the detection limit of 1 CFU/100 mL. When FC was detected in a well, it tended to



**Figure 12.** Percentage of samples in which fecal coliform was detected, and trends in population in Tunnel and Reservoir Plan (TARP) System monitoring wells, Cook County, Illinois, 1995-2013. Upward, downward, and no trends are significant with  $p$ -values  $\leq 0.05$ .



**Figure 13.** Maximum population of fecal coliform detected in samples from Tunnel and Reservoir Plan (TARP) System monitoring wells, Cook County, Illinois, 1995–2013.



be at a relatively large population that would decrease with time, eventually returning to non-detect. These trends are consistent with the effects of the intermittent movement of FC-containing CSF from the TARP tunnels into the Silurian aquifer followed by the typical flow of FC-free aquifer water into the tunnels flushing CSF-affected water from the aquifer.

The relation between FC populations and outflow from, and inflow to, the TARP tunnels is supported by comparison of FC populations and groundwater levels during the period of intensive data collection in 1995 and 1996 at wells QC-1, QC-2, and QC-2.2 (table 3). FC was not detected in well QC-1 during this time period, but large (15–25 ft) increases in the groundwater level were periodically observed during periods of elevated discharge from the TARP. FC was detected 23 times in well QC-2 during 1995 and 1996. The initial detections of FC in well QC-2 occurred during or shortly after periods of increased groundwater levels (often in excess of 100 ft) associated with increased TARP discharge. FC populations in well QC-2 would then decrease through time, often increasing when another high-discharge event occurred. FC was detected twice in well QC-2.2 during 1995 and 1996, both times within 1 month of the occurrence of large (about 15 to 80 ft) increases in water level and TARP discharge exceeding 95 Mgal/d.

Trends in FC populations at well QC-2 indicate that FC had migrated more than 200 ft (the distance from the tunnel to the monitoring well) into the Silurian aquifer within 1–2 weeks of discharge from the TARP tunnels in excess of about 80 Mgal/d (table 3; fig. 14A, B, F). FC populations then decreased to less than the detection limit (typically) within 4–6 weeks (fig. 14A, B, C, F). Fecal coliform populations were below the detection limit during prolonged periods when TARP discharge was less than 60 Mgal/d (fig. 14C, D, E), as well as during sustained periods of discharge from the TARP tunnels in excess of 100 Mgal/d during parts of May, June, and November (fig. 14C, F). Periods of high discharge from the TARP to the WRPs in late May, June, and early November that were not associated with elevated FC populations may have resulted from the removal of water that drained from the aquifer to the tunnels rather than CSF events. The relation between trends in FC populations, groundwater levels (low and high), and flow directions to and from the aquifer observed at well QC-2 are consistent with that of other wells, accounting for differences in the frequency of sample collection. The processes that affect FC populations also are likely to affect the values of other analytes. However, not all analytes can be expected to behave identically. For example, elevated groundwater levels associated with CSF events dissipate quickly in comparison to elevated FC populations associated with the same event.

Analysis of trends in FC populations from 1995 through 2013 was restricted to the 23 wells in which FC was detected in at least 10 percent of the samples. Of these wells 8 showed an upward trend, 3 showed a downward trend, and 12 did not indicate a statistically significant trend (trend unclear

(fig. 12). Because CSF is the only source of FC to these wells, all of these trends (upward, downward, no trend) are a reflection of the number of times CSF-affected water was sampled in the TARP wells each year from 1995 through 2013.

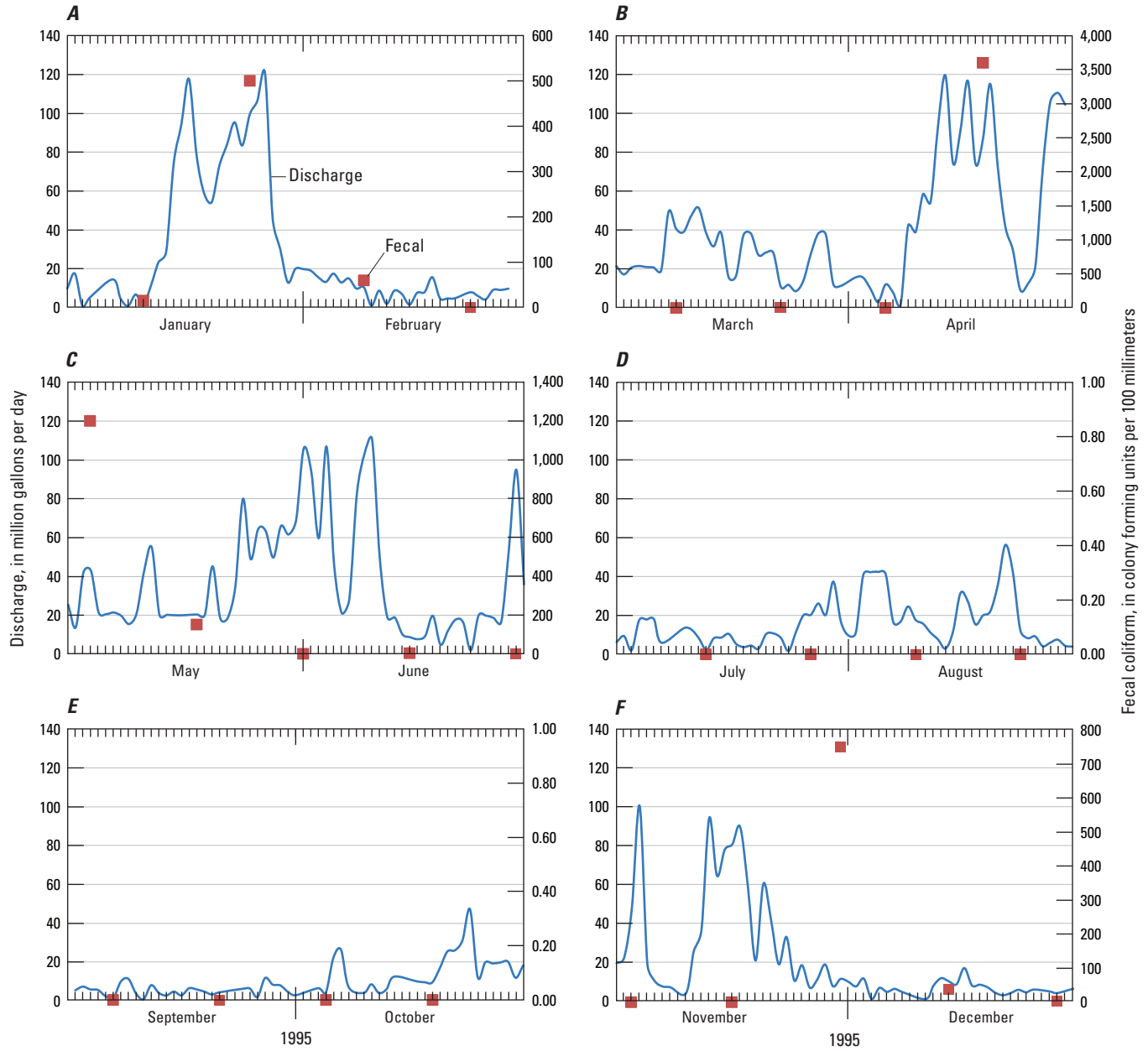
FC populations were correlated between each well in a given tunnel system in which FC was detected in at least 10 percent of the samples (table 4). From a total of 68 correlations, 57 were highly positively correlated (tau-b greater than 0.24; appendix 4). These correlations indicate that, at least within that part of the TARP System, trends in FC populations through time were similar between wells. Correlations indicate that a representative assessment of FC populations in the monitoring wells associated with the various tunnel systems can be obtained by sampling an appropriate subset of the wells.

## Hardness

Hardness (measured as calcium carbonate [ $\text{CaCO}_3$ ]) is the measure of the concentration of dissolved calcium and magnesium in a sample, along with smaller amounts of divalent cation complexes associated with iron, manganese, aluminum, and some other compounds. Hardness measured in samples collected from water-supply wells open to the chemically associated glacial drift and Silurian aquifer throughout Cook County between about 1900 and 1958 ranged from less than 100 to more than 1,000 mg/L as  $\text{CaCO}_3$  and decreased overall from west to east (fig. 15) (Hanson and others, 1943; Suter and others, 1959). The highest hardness values were detected in groundwater samples collected near what is now the southern part of the Des Plaines System in the general area where the Silurian aquifer is at or near land surface (fig. 4). These samples were collected prior to construction of the TARP System from wells that are not part of the TARP monitoring network. These data indicate that hardness values in the Silurian aquifer in Cook County, which includes the area of the TARP System, are spatially variable.

Hardness values through time were analyzed in groundwater samples collected from wells open to the Silurian aquifer that are not part of the TARP monitoring network at LaGrange in Cook County, Libertyville in Lake County, and Naperville in DuPage County (locations shown in fig. 15) (Gibb and O'Hearn, 1980). Hardness values were determined to have remained stable through time at LaGrange but increased through time at Libertyville and Naperville. Hardness values at Naperville and Libertyville began to increase from about 1968 to 1970, prior to construction of the TARP System. These data indicate that the hardness values in the Silurian aquifer within the greater Chicago area may be affected by non-TARP natural and anthropogenic processes.

The geometric mean values of hardness in the samples from the TARP monitoring wells during 1995–2013 ranged from 5 to 854 mg/L as  $\text{CaCO}_3$  (fig. 16). Wells with a geometric mean hardness of less than 50 mg/L as  $\text{CaCO}_3$  are located in much of the central part of the Des Plaines System, in the



**Figure 14.** Tunnel and Reservoir Plan System discharge to the Calumet Water Reclamation Plant, and fecal coliform populations in well QC-2, Cook County, Illinois, 1995. *A*, January–February, *B*, March–April, *C*, May–June, *D*, July–August, *E*, September–October, and *F*, November–December. Note variation in scale of fecal coliform population between plots.

**Table 4.** Correlation coefficients of fecal coliform populations in monitoring wells with a frequency of fecal coliform detection of 10 percent or greater, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** indicates tau-b greater than 0.24; —, not applicable]

<b>Correlation coefficients—Fecal coliform populations in Upper Des Plaines system wells using Kendall’s tau with slope estimator</b>								
<b>Well</b>	<b>MW-5</b>	<b>MW-6</b>	<b>MW-7</b>					
MW-6	0.21	—	—	—	—	—	—	—
MW-7	<b>0.34</b>	<b>0.36</b>	—	—	—	—	—	—
MW-8	<b>0.41</b>	<b>0.27</b>	<b>0.30</b>	—	—	—	—	—

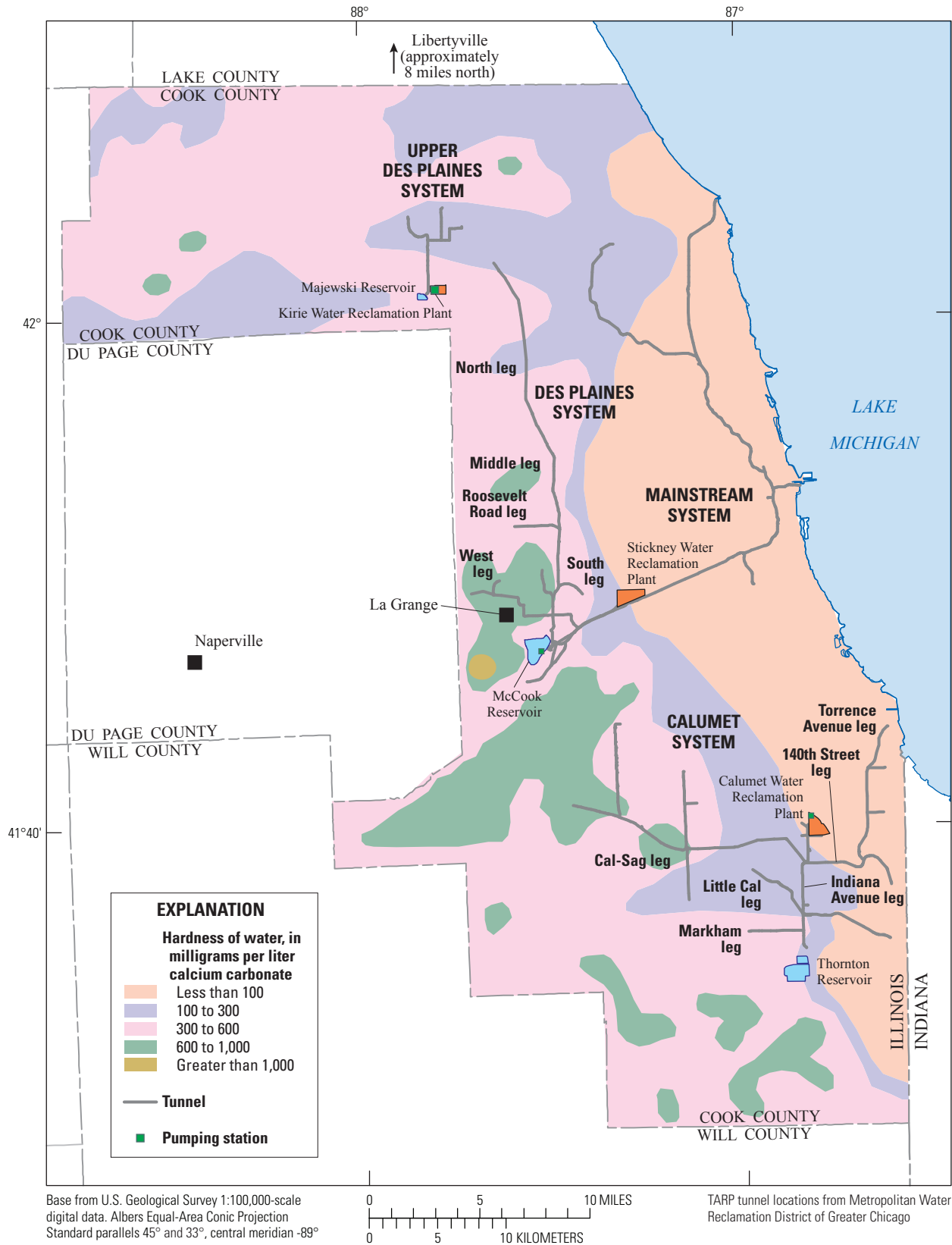
<b>Correlation coefficients—Fecal coliform populations in Calumet system wells using Kendall’s tau with slope estimator</b>								
<b>Well</b>	<b>QC-2</b>	<b>QC-4</b>						
QC-4	<b>0.53</b>	—	—	—	—	—	—	—
QC-17	<b>0.30</b>	-0.11	—	—	—	—	—	—

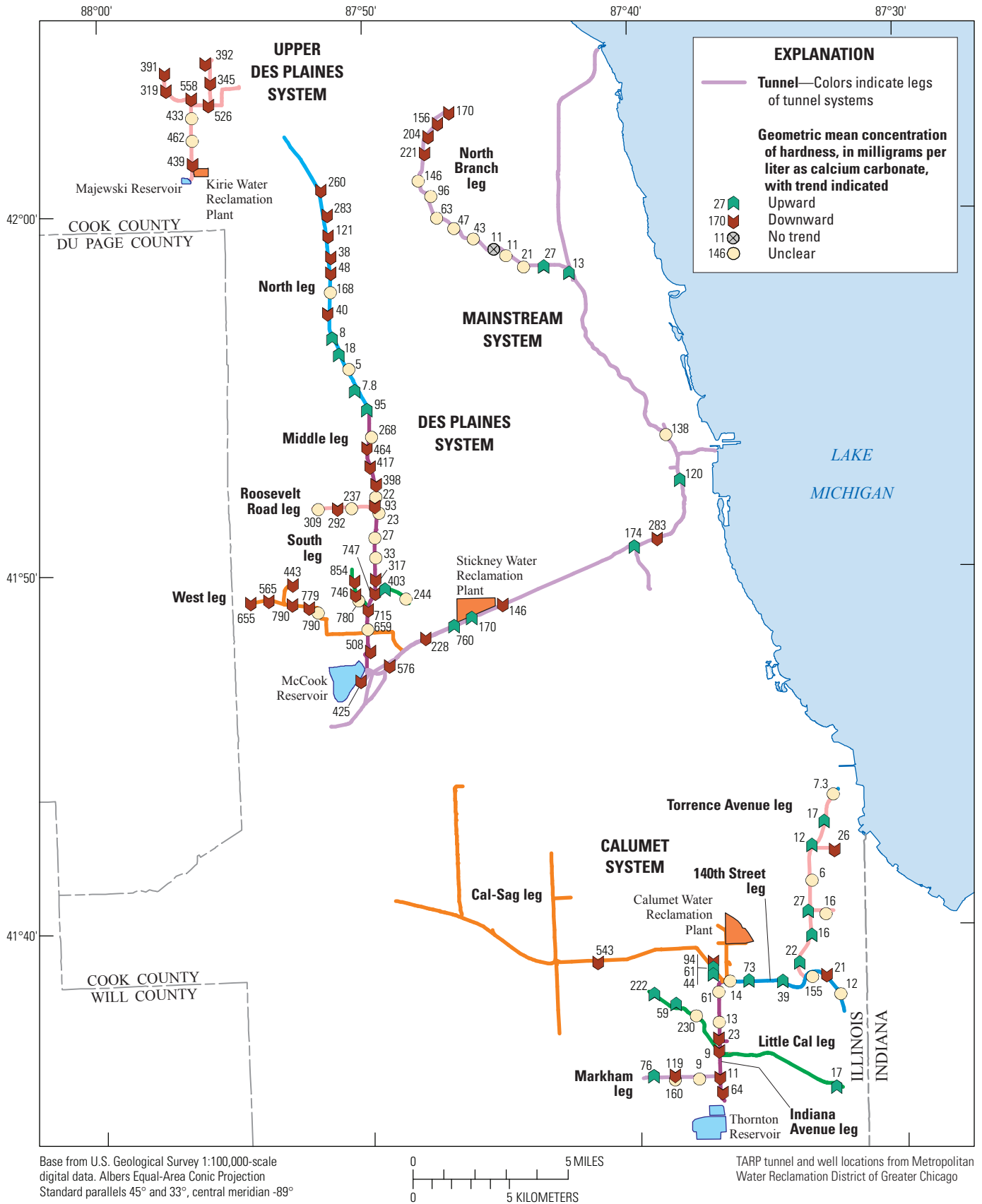
<b>Correlation coefficients—Fecal coliform populations in Mainstream system wells using Kendall’s tau with slope estimator</b>								
<b>Well</b>	<b>QM-61</b>	<b>QM-62</b>	<b>QM-63</b>	<b>QM-64</b>	<b>QM-65</b>	<b>QM-67</b>	<b>QM-68</b>	<b>QM-75</b>
QM-62	<b>0.70</b>	—	—	—	—	—	—	—
QM-63	<b>0.76</b>	<b>0.79</b>	—	—	—	—	—	—
QM-64	<b>0.65</b>	<b>0.60</b>	<b>0.56</b>	—	—	—	—	—
QM-65	<b>0.27</b>	<b>0.49</b>	<b>0.58</b>	0.17	—	—	—	—
QM-67	<b>0.29</b>	<b>0.34</b>	<b>0.29</b>	0.17	0.12	—	—	—
QM-68	<b>0.83</b>	<b>0.56</b>	<b>0.69</b>	<b>0.44</b>	<b>0.72</b>	<b>0.31</b>	—	—
QM-75	<b>0.35</b>	<b>0.65</b>	<b>0.54</b>	<b>0.49</b>	<b>0.08</b>	0.14	<b>0.68</b>	—
QM-77	<b>0.27</b>	<b>0.25</b>	<b>0.43</b>	<b>0.43</b>	<b>0.31</b>	0.17	<b>0.55</b>	<b>0.70</b>

<b>Correlation coefficients—Fecal coliform populations in Des Plaines system wells using Kendall’s tau with slope estimator</b>								
<b>Well</b>	<b>QD-27</b>	<b>QD-29</b>	<b>QD-30</b>	<b>QD-31</b>	<b>QD-34</b>	<b>QD-36</b>		
QD-29	<b>0.49</b>	—	—	—	—	—	—	—
QD-30	0.19	<b>0.25</b>	—	—	—	—	—	—
QD-31	<b>0.55</b>	<b>0.48</b>	<b>0.49</b>	—	—	—	—	—
QD-34	<b>0.75</b>	<b>0.59</b>	<b>0.72</b>	<b>0.57</b>	—	—	—	—
QD-36	<b>0.65</b>	<b>0.41</b>	0.24	<b>0.56</b>	<b>0.35</b>	—	—	—
QD-46	0.24	<b>0.37</b>	<b>0.38</b>	<b>0.66</b>	<b>0.72</b>	<b>0.37</b>	—	—



**Figure 15.** Hardness of water in samples from shallow drift and Silurian aquifers in Cook County, Illinois (Modified from figure 47 in Suter and others, 1959).



**Figure 16.** Geometric mean concentrations of hardness and trends in concentration in samples from Tunnel and Reservoir Plan (TARP) System wells, Cook County, Illinois, 1995–2013. Upward, downward, and no trends are significant with  $p$ -values  $\leq 0.05$ .

southern part of the North Branch of the Mainstream System, and in much of the eastern part of the Calumet System. Wells with a geometric mean hardness of greater than 300 mg/L as CaCO<sub>3</sub> are located in most of the southern (downstream) part of the Des Plaines and Mainstream Systems, at well QC-1 in the western edge of the Calumet System, and throughout the Upper Des Plaines System. Spatial patterns in hardness values in samples from the TARP monitoring wells are generally consistent with the patterns of hardness measured in the glacial drift and Silurian deposits in Cook County prior to construction of the TARP System (fig. 15), indicating that the hardness values in the TARP wells are affected primarily by the hardness values within the nearby Silurian aquifer. This result was expected because, for fixed-schedule sampling events, most of the samples are collected during typical (aquifer to tunnel) flow conditions that reflect the chemistry of the aquifer water rather than the intermittent CSF discharge.

Hardness values for the TARP discharge were not measured, so the effect of CSF on hardness values in samples from the TARP monitoring wells is unknown. However, anomalously low hardness values were measured in samples from six wells in the Des Plaines (QD-26, QD-27, QD-38) and Calumet Systems (QC-1, QC-2, QC-2.1) on June 25, 1998 (table 5). TARP discharge measured at the Stickney WRP exceeded 100 Mgal/d five times (and exceeded 300 Mgal/d three times) from June 11 to June 25, 1998, indicating that CSF discharge to the Silurian aquifer may have occurred during this period and caused the lower hardness. Anomalous hardness values were detected in approximately 118 samples (42 with low values) from the 106 monitoring wells analyzed for this investigation. Of these samples, 54 were associated with the detection of anomalous values of other analytes, particularly chloride and TDS, including six dates when elevated FC populations were present (table 5). The presence of anomalous values of multiple analytes in a sample, especially FC, tends to indicate the anomalous values are

the result of CSF migration to the well. Anomalous hardness values were not detected in more than five samples from any well. This result was expected because, for fixed-schedule sampling events, only a minority of the samples are collected during atypical (tunnel to aquifer) flow conditions that reflect the transient effect of CSF in the aquifer.

Of the 72 wells whose samples exhibited a statistically significant trend in hardness from 1995 through 2013, 47 showed a downward trend, 24 showed an upward trend, and 1 had stable values (fig. 16). Trends in the remaining 34 wells had a significance level of less than 95 percent, indicating no clear trend. Wells in the Upper Des Plaines and Des Plaines Systems, as well as the northern part of the North Branch leg of the Mainstream System and the central part of the Calumet System, tended to have downward trends in hardness. Upward trends were prevalent in the central part of the Mainstream System and in the Calumet System at the Torrence Avenue, 140th Street, and Little Cal legs. Many of the wells with upward trends had geometric mean hardness values of less than 30 mg/L as CaCO<sub>3</sub>. These data do not clearly indicate a cause for the hardness trends, but tend to indicate that trends are primarily due to the drainage of water from the aquifer through time with spatially variable (higher, lower, and consistent) hardness values. For example, the hardness value in water from the Silurian aquifer at a well in 1995 may have had a value of 50 mg/L as CaCO<sub>3</sub>, but the hardness value in that part of the aquifer 500 ft from the well that drains to the well may have had a value of 100 mg/L as CaCO<sub>3</sub>. Because aquifer water drains to the TARP System, the 50 mg/L water present in 1995 would eventually be replaced by the 100 mg/L water, resulting in an upward trend in hardness. These patterns differ from the short-term water-quality effects associated with individual CSF events because the hardness in the aquifer water draining to the monitoring well would not vary appreciably during the short period associated with the CSF event.

**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[Dates are expressed as month/day/year; regular font indicates anomalously high value; underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
MW-1 (98)	01/26/2012 07/10/2013 05/23/2013	—	<u>10/17/2012</u>	12/01/2011	—	—	—	08/28/2003	<i>06/11/2009</i>	<i>08/16/2012</i>
MW-2 (73)	<i>02/10/2009</i>	—	<u>06/12/2002</u>	02/14/2001 09/17/2008	—	<u>08/27/1997</u>	—	06/19/2000	—	—
MW-3 (119)	01/26/2012	06/12/1997	—	06/13/2002 <b>08/15/2002</b> 09/22/2011	—	<b>08/15/2002</b>	—	02/18/1999 02/09/2006	<i>06/11/2009</i>	<i>08/16/2012</i>
MW-4 (113)	08/18/1999 <u>05/23/2013</u>	04/07/94	—	—	—	08/18/2005	—	10/08/1998	11/19/2008	08/16/2012
MW-5 (96)	02/27/1997 <b>03/15/2007</b>	—	—	06/13/2002 08/09/2007	—	—	—	<u>06/26/1996</u>	<b>03/15/2007</b> <i>06/11/2009</i>	—
MW-6 (117)	<b>08/28/2002</b>	—	—	10/04/2001 <b>08/28/2002</b> 10/04/2006 09/13/2007 05/25/2009 08/19/2011 06/19/2013	—	—	<u>06/13/2007</u>	<u>02/14/1995</u> <u>12/12/2001</u>	<u>10/20/2011</u> <u>01/19/2012</u>	08/13/1997
MW-7 (86)	02/09/2010	10/02/2002 04/23/2003	—	<b>04/27/2000</b> 10/02/2001 06/12/2002 12/10/2003 09/11/2007 09/17/2008 07/27/2011 06/27/2012 04/29/2013	—	—	—	<u>10/12/2006</u>	06/28/2006	<b>04/27/2000</b> 06/19/2000
MW-8 (85)	02/22/2001 <i>02/25/2009</i>	—	—	10/04/2000 10/02/2001 10/03/2002 10/30/2003 09/14/2006 09/11/2008 08/12/2010 08/28/2013	—	<u>12/05/2001</u> <u>03/29/2007</u>	—	<b>08/19/2004</b> 12/15/2005	<i>06/11/2009</i>	<b>08/19/2004</b>

**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.—Continued

[Dates are expressed as month/day/year; regular font indicates anomalously high value, underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
MW-9 (90)	11/17/2005 <i>03/29/2007</i> <i>02/25/2009</i> <b>06/11/2009</b> 06/20/2013	—	—	06/06/2002 08/15/2002 07/20/2006	—	—	—	12/15/2005	<i>06/11/2009</i>	—
QD-21 (87)	11/28/2006	12/13/2000	—	—	—	—	—	—	—	02/05/1997 08/20/1997
QD-22 (91)	—	12/13/2000	—	02/15/2012 06/20/2012 12/18/2012	—	04/14/1999	<u>08/24/2005</u>	06/03/1998 <i>08/16/2006</i>	—	—
QD-23 (91)	02/24/2000 <i>03/28/2012</i>	—	—	—	06/24/2010	—	—	04/05/1995 <i>08/16/2006</i>	—	—
QD-24 (91)	<b>07/08/2010</b> <i>06/26/2013</i>	<b>04/17/2000</b>	<u>04/08/2013</u>	06/11/2002	<b>07/08/2010</b>	<b>06/11/1997</b> <b>08/05/1998</b>	02/06/2002	08/16/2006	<b>06/11/1997</b> <b>08/05/1998</b>	<b>04/17/2000</b>
QD-25 (89)	02/24/2000 <b>10/14/2004</b> <i>03/28/2012</i> <u>04/08/2013</u>	07/08/2010 07/07/2011 02/16/2012 <b>03/28/2012</b>	—	—	<b>10/14/2004</b>	08/20/2003 <u>02/13/2008</u>	—	08/16/2006	08/30/1995 <u>02/26/2004</u>	08/20/1997
QD-26 (87)	08/09/2001 <b>10/04/2001</b> 02/13/2003 02/05/2004 <b>11/08/2007</b>	—	—	08/14/2008 07/05/2012	<i>06/25/1998</i> 06/07/2001	<b>10/04/2001</b> <b>11/08/2007</b>	—	<u>04/01/2004</u>	<b>10/04/2001</b>	<b>10/04/2001</b> <b>11/08/2007</b>
QD-27 (114)	—	12/16/1999 06/03/2004 05/26/2011	—	<b>02/27/1997</b> 08/21/1997 06/05/2003 02/17/2005 10/02/2008 06/06/2013	<b>02/27/1997</b> <i>06/25/1998</i> <b>08/03/2000</b>	<b>02/27/1997</b> <b>08/03/2000</b>	12/06/1995	<b>08/03/2000</b>	<u>02/27/1997</u> <u>10/04/2001</u>	<b>02/27/1997</b> <b>08/03/2000</b>
QD-28 (89)	<u>03/28/2012</u>	10/25/1995 10/14/1998	—	—	10/09/1996	—	—	<u>04/03/2001</u>	06/07/2000	07/18/2012
QD-29 (88)	—	04/17/2002	—	06/05/1996 08/14/1996 04/26/2000 <i>10/10/2001</i>	—	—	—	—	—	07/18/2012



**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.—Continued

[Dates are expressed as month/day/year; regular font indicates anomalously high value, underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
QD-30 (80)	<b>06/17/1999</b>	—	<u>12/12/2013</u>	06/13/1996 08/08/1996 08/28/1997 <i>10/10/2001</i> 08/05/2004	<b>06/17/1999</b>	08/11/2005 10/06/2005 05/25/2006 05/25/2011	—	<u>10/21/2010</u>	—	—
QD-31 (87)	12/09/1999	08/10/2000 <b>10/10/2001</b> 07/05/2012	—	08/08/1996 08/28/1997 04/27/2000 <b>10/10/2001</b>	<b>06/17/1999</b>	03/01/2007	—	<b>06/17/1999</b>	<b>06/17/1999</b> <u>10/19/2000</u>	—
QD-32 (85)	<b>06/17/1999</b> <u>03/01/2012</u>	—	<b>10/21/2004</b> <u>06/07/2007</u>	<b>08/28/1997</b>	<b>06/17/1999</b>	10/17/2002	—	02/04/1999 <i>10/30/2003</i> 04/22/2004	<u>04/17/2003</u> <b>10/21/2004</b>	<b>08/28/1997</b>
QD-33 (113)	02/13/2004	—	—	<i>10/25/2001</i>	06/10/2010	03/23/2006 10/18/2006 03/29/2007 05/17/2007	—	<u>12/03/1998</u>	—	08/28/1997 04/27/2000
QD-34 (70)	—	—	—	04/23/1997 <i>10/17/2001</i> 10/05/2006	—	<u>10/07/1999</u>	—	1/23/2007	—	08/21/1996 <i>07/18/2012</i>
QD-35 (78)	—	—	—	—	—	—	—	<u>12/05/1996</u>	—	<i>07/18/2012</i>
QD-36 (91)	<u>02/10/2009</u>	—	—	<i>10/17/2001</i> 08/30/2010 05/20/2013	—	10/31/2005	—	—	—	<i>07/18/2012</i>
QD-37 (112)	—	<b>02/27/1997</b> 08/21/1997 12/16/1999	—	09/01/2005	<u>12/28/2000</u> 04/04/2002	<b>02/27/1997</b> <b>08/03/2000</b>	—	<u>10/17/1996</u> <b>12/19/1996</b> <b>02/27/1997</b> <b>08/03/2000</b>	<b>12/19/1996</b> <u>10/04/2001</u> 10/21/2004	<b>02/27/1997</b> <b>08/03/2000</b>
QD-38 (90)	<u>03/07/2013</u>	12/16/1999	—	—	08/29/1996 <u>06/25/1998</u>	<b>12/19/1996</b> <b>02/27/1997</b>	—	<u>04/10/1996</u>	<b>12/19/1996</b> <b>02/27/1997</b> <u>06/03/2004</u>	08/03/2000
QD-39 (52)	05/25/2006	—	—	04/07/2005	12/13/1995 <b>08/13/2009</b>	<b>08/13/2009</b>	—	<b>08/13/2009</b>	—	04/20/2000
QD-40 (39)	06/08/2006	—	—	—	—	<b>08/29/2013</b>	—	<b>08/29/2013</b>	—	—
QD-41 (50)	06/08/2006	—	<u>04/08/2004</u>	—	<u>12/07/1995</u> <b>08/13/2009</b>	—	04/09/1997	<b>08/13/2009</b>	—	—

**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.—Continued

[Dates are expressed as month/day/year; regular font indicates anomalously high value, underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
QD-42 (53)	<i>04/08/2004</i>	—	—	—	04/19/1995	—	04/25/1996	—	06/10/2010 08/05/2011	—
QD-43 (50)	<i>04/08/2004</i>	08/31/1995 10/17/2002	—	—	06/24/2010	<u>10/08/1999</u>	—	06/22/1995	—	—
QD-44 (55)	03/07/2013	—	<u>02/14/1996</u>	08/14/1996	02/09/1995	—	—	—	—	—
QD-45 (48)	<i>04/08/2004</i>	—	—	—	06/24/2010 03/07/2013	—	—	—	—	—
QD-46 (87)	<b>07/08/2010</b> <b>11/08/2012</b>	06/23/2004 <b>11/08/2012</b>	02/21/2001 08/29/2001	06/05/1996 04/16/1997 02/10/1999 08/14/1996 04/26/2000 10/10/2001	06/07/1995 10/09/1996 08/14/1996 <b>07/08/2010</b> 07/15/2010	<b>07/08/2010</b>	08/29/2005	<b>11/08/2012</b>	<b>07/08/2010</b> <b>11/08/2012</b>	<i>07/18/2012</i>
QD-47 (52)	<i>04/08/2004</i>	—	06/19/2008	—	04/11/2001	—	04/9/1997	—	—	—
QD-48 (45)	—	—	—	08/17/1995 09/25/2008	<u>03/07/2013</u>	—	—	—	—	—
QD-49 (44)	—	—	—	10/13/2011 02/28/2013	<u>02/15/1996</u>	<b>02/15/1996</b>	—	—	—	—
QD-50 (84)	02/10/2000 <i>04/15/2004</i> 12/09/2004	—	—	—	<b>02/15/1996</b>	<b>02/15/1996</b>	—	12/05/2001 <u>04/14/2005</u>	06/05/1997 <u>02/08/2001</u>	—
QD-51 (84)	08/12/1999 <i>04/15/2004</i>	—	—	07/15/2010	08/23/2001	—	—	<u>12/03/1998</u> 12/05/2001 04/14/2005	—	—
QD-52 (82)	02/10/2000	—	—	06/28/2012	—	—	—	08/02/2006	10/31/2001	—
QD-53 (83)	—	—	—	10/07/2004 06/28/2012	—	—	—	—	—	—
QD-54 (83)	06/28/2001 <i>04/15/2004</i> <b>12/15/2004</b> 05/11/2006	08/09/2001 <b>12/15/2004</b>	07/15/2010	09/25/2008	—	—	—	08/02/2006	—	—
QD-55 (83)	—	—	—	06/28/2012	—	<u>04/23/2009</u>	<u>05/15/2010</u> 07/15/2010	08/02/2006	—	—

**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.—Continued

[Dates are expressed as month/day/year; regular font indicates anomalously high value, underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
QD-56 (83)	04/12/2001 08/09/2001	—	<u>02/18/1999</u>	—	12/19/2001	05/26/2005	12/04/1996	06/26/1997 10/08/1998 <i>08/02/2006</i>	—	—
QD-57 (74)	10/12/2000	12/02/1999	—	09/25/2008 05/30/2013	—	—	12/04/1996	<i>08/02/2006</i>	—	06/17/2004
QD-58 (75)	06/27/2002 10/17/2002 08/20/2003 04/15/2004 <b>06/30/2005</b>	—	—	—	—	<b>06/30/2005</b>	10/22/1998	10/02/1997 <i>08/03/2006</i>	02/26/2004 08/02/2007	—
QD-59 (77)	<u>02/26/2004</u> <u>04/15/2004</u> <b>06/28/2012</b>	—	—	—	<b>05/30/2013</b>	—	<b>05/30/2013</b>	<i>08/03/2006</i> <b>06/28/2012</b>	—	—
QD-60 (82)	04/15/2004 05/02/2007 <b>06/28/2012</b>	—	—	—	—	<u>10/24/1996</u>	—	<i>08/03/2006</i> <b>06/28/2012</b>	12/07/2000 02/26/2004	08/26/2004
QM-53 (54)	03/23/2011	—	—	—	—	01/02/2002 01/08/2003	—	—	<i>11/01/1995</i> 01/03/1996 07/14/2004	<i>08/09/2012</i>
QM-56 (40)	—	<b>07/14/2004</b>	—	—	<b>05/10/1995</b>	—	—	<b>05/10/1995</b>	<b>07/14/2004</b>	—
QM-58 (53)	07/26/2001 <b>01/17/2002</b>	01/28/1999 11/08/2008	01/04/1996 <u>01/15/2004</u> <u>06/22/2006</u>	—	<b>03/06/1996</b> <u>11/08/2007</u>	<b>03/06/1996</b> <b>01/17/2002</b>	—	<b>03/06/1996</b>	<b>03/06/1996</b> <b>01/17/2002</b>	—
QM-61 (83)	<b>05/15/2002</b> <b>02/05/2008</b> <b>04/02/2009</b> <b>03/29/2010</b>	<b>05/15/2002</b> <b>09/04/2008</b> <b>08/05/2010</b> 07/07/2011	<b>09/04/2008</b>	<b>05/07/2003</b> <b>02/05/2008</b>	<b>05/15/2002</b> <b>02/05/2008</b>	<b>05/15/2002</b> 12/02/2004 <b>04/02/2009</b> <b>03/29/2010</b> <b>08/05/2010</b>	—	<b>05/15/2002</b> <b>02/05/2008</b>	<b>03/26/2002</b> <b>05/15/2002</b> <b>04/02/2009</b> <b>03/29/2010</b>	—
QM-62 (59)	03/11/1997 <b>03/02/1999</b>	03/06/1996 05/15/2012 09/18/2013	<b>03/02/1999</b>	01/18/1995 <b>11/04/1998</b> 09/06/2001 11/07/2013	<b>11/04/1998</b> <b>01/21/1999</b>	07/12/2000	03/26/2002	<b>01/21/1999</b>	<b>01/21/1999</b> 09/07/2000	—

**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.—Continued

[Dates are expressed as month/day/year; regular font indicates anomalously high value, underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
QM-63 (113)	04/02/2009	07/29/2011 09/16/2011	—	Too numerous to list	<u>11/06/1996</u> <u>11/04/1998</u> <u>01/21/1999</u> <u>07/12/2000</u>	10/23/2008 11/17/2010	03/26/2002	01/19/2006 01/23/2007	<u>11/06/1996</u> <u>01/21/1999</u> 07/12/2000 <u>09/07/2000</u>	08/09/2012
QM-64 (112)	<b>02/21/2008</b> 10/26/2010	05/15/2002 10/05/2006 <b>08/05/2010</b>	—	09/12/2001 11/01/2001 09/04/2002 10/24/2006 08/23/2007 <b>02/21/2008</b> 11/04/2009 <b>08/05/2010</b>	<u>11/06/1996</u> <u>07/12/2000</u>	—	—	<b>11/06/1996</b> <b>07/12/2000</b> <i>11/05/2003</i>	<u>11/06/1996</u> <b>07/12/2000</b>	08/09/2012
QM-65 (100)	<b>04/02/2009</b>	03/20/1997 10/18/2006	<u>01/29/1998</u>	05/30/1996 <b>04/02/2009</b>	<b>04/02/2009</b>	09/23/2004 <b>04/02/2009</b>	—	<i>08/03/2006</i> <b>04/02/2009</b>	05/02/2002 <b>04/02/2009</b>	<b>04/02/2009</b>
QM-67 (118)	<b>03/18/1999</b> <u>01/04/2001</u>	11/15/2001	—	Too numerous to list	<b>03/18/1999</b> <b>05/26/1999</b>	07/17/1997 <b>03/18/1999</b> <b>05/26/1999</b>	01/04/1996	<b>03/18/1999</b> <b>05/26/1999</b>	07/17/1997 <u>05/02/2002</u>	08/09/2012
QM-68 (70)	05/12/2005	—	—	11/16/1995 05/30/1996 07/25/1996 05/14/1998 10/09/2013	—	—	—	03/23/2011	01/17/2002	11/20/1996 08/09/2012
QM-69 (89)	09/12/2002	09/28/1995	—	07/26/1995	—	—	—	—	—	08/15/2012
QM-70 (44)	—	—	—	08/20/2009	—	—	—	—	—	05/25/2000 08/15/2012
QM-71 (51)	<u>03/24/2011</u>	—	—	—	—	—	10/30/1995	<u>03/03/2010</u>	—	08/15/2012
QM-72 (91)	—	—	—	—	—	<b>11/28/2001</b>	10/30/1995	<b>11/28/2001</b>	—	08/15/2012
QM-73 (50)	<b>12/14/2000</b>	—	—	—	<b>12/14/2000</b>	—	<u>05/16/2002</u>	<b>12/14/2000</b>	—	06/22/2006 08/16/2012
QM-74 (48)	<u>05/24/2001</u> <u>04/11/2013</u>	—	—	—	01/12/1995 03/16/1995	—	<u>05/16/2002</u>	07/12/1995	05/25/1995	08/16/2012
QM-75 (74)	05/24/2001	<b>05/16/2002</b> <b>09/18/2008</b>	—	<b>05/16/2002</b> <b>09/18/2008</b> <b>07/29/2010</b> 10/09/2013	01/31/2013	2/07/2008	<b>05/16/2002</b>	07/23/2009	<b>07/29/2010</b>	09/13/2012

**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.—Continued

[Dates are expressed as month/day/year; regular font indicates anomalously high value, underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
QM-76 (49)	<u>12/14/2000</u> 04/14/2005	—	—	<i>07/28/2011</i>	<b>12/14/2000</b>	—	<u>07/12/1995</u> <i>05/16/2002</i>	—	07/29/2010	<i>08/16/2012</i>
QM-77 (51)	—	<b>09/18/2008</b>	—	<b>09/18/2008</b> 07/29/2010 <i>07/28/2011</i>	—	—	—	—	<i>07/27/1995</i>	<i>08/16/2012</i>
QM-78 (75)	03/01/2007 <i>03/29/2007</i> 12/15/2011	—	<u>09/27/1995</u> <b>11/28/2001</b> <u>05/20/2010</u>	09/26/1996 <i>07/28/2011</i>	01/31/2013	09/14/2006	<b>11/28/2001</b>	—	07/29/2010	<i>09/13/2012</i>
QM-79 (72)	<u>03/25/2010</u>	—	—	<b>07/28/2011</b>	05/27/2010 01/31/2013	09/14/2006	—	—	<i>07/27/1995</i> 05/02/2002	<b>07/28/2011</b> <i>09/13/2012</i>
QM-80 (77)	04/17/2008	—	—	<i>07/28/2011</i>	11/18/2010	—	—	05/18/1995 07/24/2006 06/19/2008	08/09/2007	<i>09/13/2012</i>
QM-81 (87)	—	03/29/2001 11/08/2001 09/12/2002	09/20/1995 <b>01/30/1996</b> 01/30/1997	09/19/2013	<b>01/25/1996</b> <u>03/26/2009</u>	—	—	—	09/13/2001	—
QM-82 (6)	—	—	—	—	03/26/2009	—	—	04/11/2013	08/09/2007	<i>09/13/2012</i>
QC-1 (263)	10/10/2002 12/19/2002 03/15/2007	—	—	10/11/2001 03/30/2006	<b>04/18/1996</b> <b>11/27/1996</b> <u>06/25/1998</u> <b>10/14/1998</b>	—	11/16/2000	<b>04/18/1996</b> <b>11/27/1996</b> 07/23/1998 <b>10/14/1998</b> <u>11/06/2003</u> 07/15/2004	—	—
QC-2 (294)	<u>02/23/1995</u> 12/14/1995 <u>04/18/1996</u> <u>05/06/1999</u> 10/12/2000 06/07/2001 03/14/2002 12/19/2002 <u>03/17/2010</u>	Too numerous to list	—	Too numerous to list	<b>11/27/1996</b> <b>05/28/1998</b> <i>06/25/1998</i> <b>01/23/2003</b> <b>06/03/2004</b>	03/20/2003	<u>08/07/2003</u>	<b>11/27/1996</b> 10/14/1998 <u>07/11/2002</u> <b>01/23/2003</b> 07/24/2003 <i>11/06/2003</i> <b>06/03/2004</b>	<i>07/27/1995</i> <b>11/27/1996</b> <b>05/28/1998</b> 10/14/1998	02/22/1996

**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.—Continued

[Dates are expressed as month/day/year; regular font indicates anomalously high value, underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
QC-2.1 (226)	07/01/1999	—	—	<b>08/28/1997</b>	<b>08/28/1997</b>	<u>07/29/2004</u>	12/28/1995	07/11/2002	<u>07/27/1995</u>	05/08/1997
	12/19/2002	—	—	07/29/1999	04/16/1998	—	—	07/24/2003	—	—
	<i>04/08/2004</i>	—	—	06/17/2004	<i>06/25/1998</i>	—	—	<b>03/02/2006</b>	—	—
	<b>03/02/2006</b>	—	—	11/10/2004	12/17/1998	—	—	<b>08/21/2008</b>	—	—
	<u>02/08/2007</u>	—	—	11/24/2004	—	—	—	—	—	—
	<b>08/21/2008</b>	—	—	—	—	—	—	—	—	—
QC-2.2 (87)	<b>02/09/1995</b>	11/04/1999	<b>02/09/1995</b>	<b>02/23/1995</b>	<b>02/23/1995</b>	<b>02/09/1995</b>	—	04/06/1995	<b>04/18/1996</b>	<b>02/09/1995</b>
	<b>02/23/1995</b>	—	—	06/13/1996	<b>12/14/1995</b>	—	—	05/19/2005	<u>09/09/2010</u>	05/11/2000
	12/14/1995	—	—	<b>05/06/1999</b>	<b>04/18/1996</b>	—	—	—	—	11/16/2000
	04/18/1996	—	—	06/12/2008	—	—	—	—	—	—
	<b>05/06/1999</b>	—	—	<b>08/18/2011</b>	—	—	—	—	—	—
	03/02/2006	—	—	—	—	—	—	—	—	—
01/10/2008	—	—	—	—	—	—	—	—	—	
<b>08/18/2011</b>	—	—	—	—	—	—	—	—	—	—
QC-3 (75)	—	<b>05/15/1996</b>	—	<b>05/15/1996</b>	—	03/19/2003	—	—	—	05/17/2000
	—	<b>03/05/1997</b>	—	<b>03/05/1997</b>	—	—	—	—	—	—
QC-4 (87)	—	<b>03/26/1998</b>	—	<b>03/26/1998</b>	—	—	—	—	—	—
	—	<b>03/26/1998</b>	—	<b>03/26/1998</b>	—	—	—	—	—	—
QC-5 (86)	—	03/05/1997	—	05/15/1996	01/12/1995	03/19/2003	—	05/03/2012	—	05/17/2000
	—	03/26/1998	—	05/30/1996	—	—	—	—	—	—
QC-6 (87)	—	11/07/2002	<u>11/06/2003</u>	—	—	<b>04/05/2012</b>	—	—	—	—
	—	08/31/2006	—	—	—	—	—	—	—	—
QC-7 (80)	—	<b>03/05/1997</b>	—	<b>03/05/1997</b>	—	<u>07/02/1998</u>	—	05/21/1997	<u>03/28/1996</u>	—
	—	<b>03/26/1998</b>	—	<b>03/26/1998</b>	—	—	—	—	—	—
QC-9 (74)	—	01/19/1995	—	—	<b>07/24/1996</b>	11/21/1996	—	—	09/20/2001	—
	—	11/16/1995	—	—	—	<b>05/17/2006</b>	—	—	—	—
QC-10 (88)	—	<b>07/24/1996</b>	—	—	—	—	—	—	—	—
	—	03/06/1997	—	—	—	—	—	—	—	—
QC-11 (52)	—	03/06/1997	—	—	—	—	—	—	—	—
	—	03/19/1998	—	—	—	—	—	—	—	—
QC-11 (52)	—	—	—	—	11/03/2004	—	—	—	—	07/12/2012
	—	—	—	—	<u>03/28/2007</u>	—	—	—	—	—

**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.—Continued

[Dates are expressed as month/day/year; regular font indicates anomalously high value, underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
QC-12 (52)	—	—	—	11/21/1995	04/29/2008 06/04/2008	—	—	01/17/2007	—	01/03/1996 07/12/2012
QC-13 (50)	—	—	—	—	06/04/2008	<b>07/06/1995</b>	—	—	—	—
QC-14 (53)	09/26/2013	11/08/2001	—	—	—	—	—	—	01/18/1996	—
QC-15 (50)	03/14/2013	—	—	—	11/06/2003	01/19/1995	—	—	—	07/19/2012
QC-16 (85)	03/23/2000	11/29/2001	—	—	03/14/1996	11/14/1996	—	07/18/1996 09/17/1998 09/12/2012	07/22/2009	07/12/2012
QC-17 (47)	—	—	09/18/1996	09/07/1995 12/07/2006 06/03/2010 06/02/2011 <b>07/26/2012</b>	03/21/2013	—	07/13/1995	05/13/1999	07/22/2009	<b>07/26/2012</b>
QC-18 (50)	03/13/2008	—	09/18/1996	05/04/1995	03/14/1996 06/03/2010 08/31/2011	—	—	—	07/22/2009	07/26/2012
QC-19 (78)	<b>09/20/2001</b>	—	11/20/2003	—	03/21/2013	<b>09/20/2001</b>	—	09/12/2012	07/22/2009	07/26/2012
QC-20 (46)	—	03/08/2001	<b>06/16/2011</b>	—	12/04/2008 06/16/2011 08/31/2011 <b>05/09/2013</b>	—	—	12/04/2008 06/16/2011 05/09/2013	<b>06/16/2011</b>	07/26/2012
QC-21 (58)	—	03/08/2001	—	—	11/29/2001	01/13/2005	—	12/04/2008 04/01/2009 06/16/2011 08/31/2011	—	07/26/2012
QC-22 (59)	—	11/09/2006 04/05/2007	11/14/2002	—	11/29/2001	—	—	07/21/2004	06/16/2011	07/26/2012
QC-23 (63)	—	03/08/2001	—	—	06/16/2011	—	—	—	07/25/2002	07/26/2012
QC-24 (63)	<b>09/23/2004</b>	03/22/2001	05/25/2006	—	<b>06/16/2011</b> 03/21/2013	<b>09/23/2004</b>	—	—	<b>06/16/2011</b>	07/26/2012
QC-25 (58)	—	03/22/2001	—	—	<b>09/15/2011</b>	—	—	12/04/2008 <b>09/15/2011</b> 03/29/2012	—	08/02/2012

**Table 5.** Dates of detection of anomalous analyte values in samples from monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.—Continued

[Dates are expressed as month/day/year; regular font indicates anomalously high value, underline indicates anomalously low value; —, no anomalous value; italics denote anomalous value of an analyte in at least four wells within a 1-month period; **bold** denotes anomalous value for two or more analytes in a well on a given date]

Well (number of samples)	Chloride	Groundwater level	Electrical conductivity	Fecal coliform	Hardness	Ammonia NH <sub>3</sub> as nitrogen	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
QC-26 (61)	11/16/2006	03/22/2001	—	—	06/23/2011	07/31/2003	—	<b>03/21/2013</b>	01/17/2002	05/18/2000
	09/15/2011	07/23/2009	—	—	<b>03/21/2013</b>	—	—	—	—	08/02/2012
	—	09/23/2010	—	—	—	—	—	—	—	—
QC-27 (60)	<u>01/11/2001</u>	03/09/2001	—	—	<u>01/11/2001</u>	—	—	—	—	08/02/2012
	<u>07/05/2001</u>	—	—	—	<u>07/05/2001</u>	—	—	—	—	—
	03/14/2005	—	—	—	03/21/2013	—	—	—	—	—
	<u>09/23/2010</u>	—	—	—	—	—	—	—	—	—
QC-28 (58)	<b>01/11/2001</b>	—	08/21/2008	—	<b>01/11/2001</b>	—	—	05/26/2004	—	08/02/2012
	03/14/2002	—	03/10/2010	—	—	—	—	07/22/2004	—	—
	03/17/2005	—	09/23/2010	—	—	—	—	—	—	—
QC-29 (63)	11/15/2012	—	—	—	<u>07/18/2013</u>	<u>07/18/2013</u>	—	<u>07/18/2013</u>	<u>07/18/2013</u>	08/02/2012
	<u>07/18/2013</u>	—	—	—	—	—	—	—	—	—
QC-30 (60)	<b>07/18/2013</b>	03/12/2009	—	04/19/2006	<b>04/28/2011</b>	—	—	08/07/2008	<b>07/18/2013</b>	03/11/2004
	—	—	—	09/21/2006	08/26/2011	—	—	<u>04/28/2011</u>	—	08/02/2012
	—	—	—	01/17/2008	<b>07/18/2013</b>	—	—	<b>07/18/2013</b>	—	—
QC-31 (65)	—	—	—	01/11/2007	—	—	10/01/2008	07/01/2009	—	08/02/2012
	—	—	—	05/24/2007	—	—	—	—	—	—
	—	—	—	01/17/2008	—	—	—	—	—	—
QC-37 (12)	—	—	—	—	12/30/2009	01/09/2003	—	—	03/11/2004	



## Sulfate

Sulfate ( $\text{SO}_4^{2-}$ ) is a naturally occurring ion that typically is present in groundwater because of the dissolution of sulfate minerals or the oxidation of sulfide minerals in geologic deposits. Sulfate concentrations in samples collected from non-TARP monitoring wells (Duwelius and others, 1996) and from water-supply wells open to the Silurian aquifer in Cook County (Voelker, 1986; Voelker and others, 1988) during the mid-1980s through early 1990s tended to be less than 150 mg/L near Lake Michigan and in the northwestern part of Cook County and more than 300 mg/L near the Majewski and future McCook Reservoirs (fig. 17). Wells in figure 17 are designated Voelker and Duwelius, which refer to the data from those authors (Voelker, 1986; Voelker and others, 1988; Duwelius and others, 1996). The conversion of sulfate to sulfide ( $\text{S}^{2-}$ ) has been observed within the upper part of the Silurian aquifer in the Calumet area (Duwelius and others, 1996), which may explain the absence of detectable sulfate in some of the samples from wells near the Calumet WRP. These samples typically were collected prior to construction of the TARP System in the area sampled and were collected from wells that are not part of the TARP monitoring network. These data indicate that background sulfate concentrations in the Silurian aquifer in Cook County are spatially variable. Concentrations of sulfate in samples from TARP wells are listed in appendix 1.

Sulfate concentrations in CSF water discharged from the Calumet WRP during 1989–93 ranged from about 80 to 210 mg/L, with a geometric mean concentration of 150 mg/L (Dominic Brose, Metropolitan Water Reclamation District of Greater Chicago, written commun., 2014). The conversion of sulfate to sulfide has been observed in CSF within the TARP tunnels (Washington and others, 1981), although sulfide concentrations typically were less than 1.0 mg/L in TARP discharge, so the effect of sulfate reduction on sulfate concentrations in CSF is negligible.

Because sulfate concentrations in the water from the Silurian aquifer are not well defined in the immediate vicinity of the TARP System, vary substantially with location, and encompass the range of sulfate concentrations in CSF, sulfate concentrations may be of limited use in identifying CSF effects on groundwater at the TARP wells. Conversion of sulfate to sulfide in the Silurian aquifer also may confound assessment of the presence of CSF in the TARP monitoring wells.

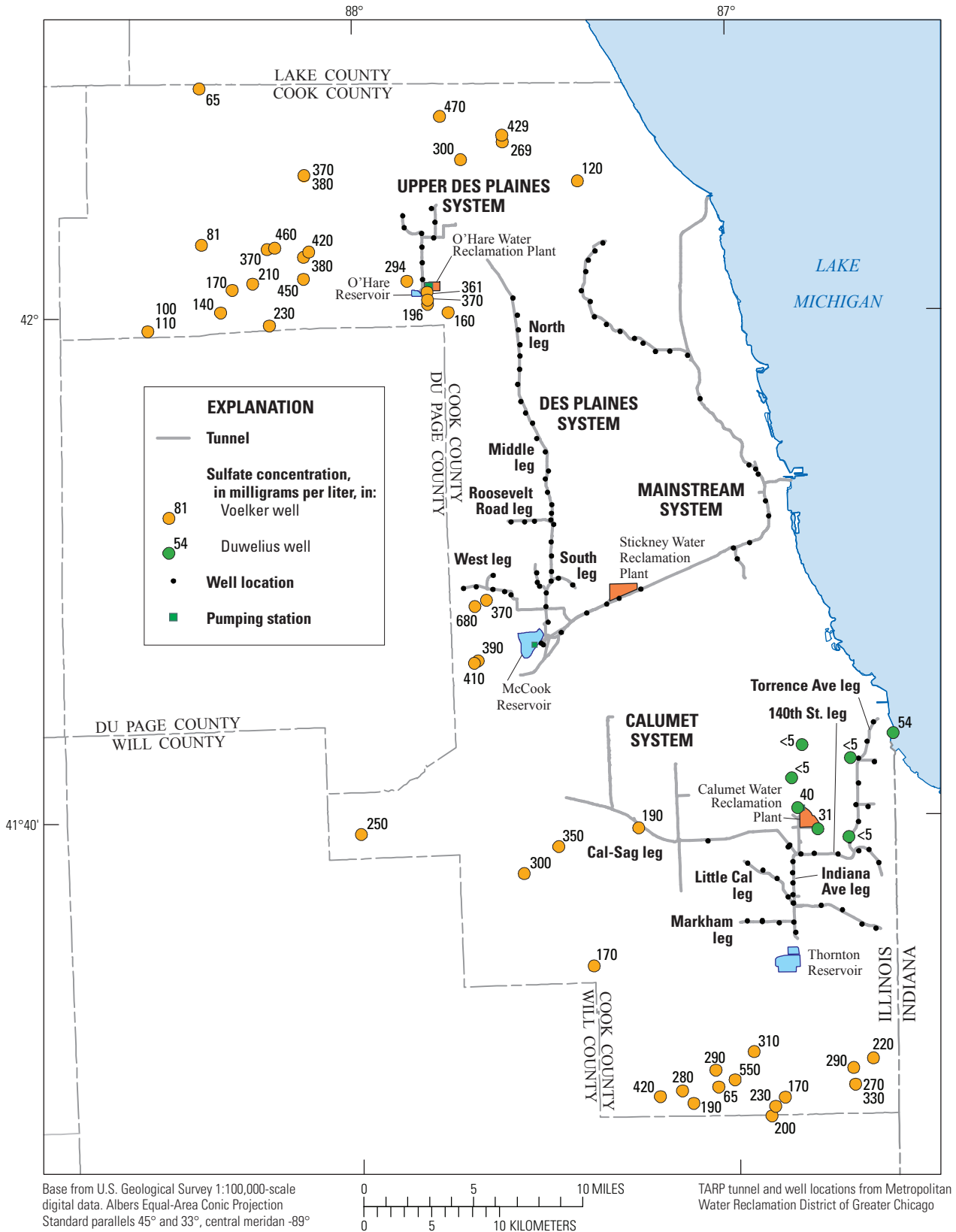
The geometric mean concentration of sulfate in samples from the TARP monitoring wells during 1995–2013 ranged from 1 to 746 mg/L (fig. 18). Geometric mean concentrations of sulfate less than 25 mg/L were detected in isolated wells in the northern part of the Des Plaines System, in much of the North Branch of the Mainstream System, and in much of the Calumet System outside of the Little Calumet leg and wells

QC–16 through QC–19. Geometric mean concentrations of sulfate greater than 250 mg/L were detected in most of the central and southern parts of the Des Plaines System and throughout the Upper Des Plaines System. Spatial patterns in geometric mean sulfate concentrations in the TARP monitoring wells are consistent with patterns in background sulfate concentrations in the Silurian aquifer within Cook County (fig. 17). Sulfate concentrations in the TARP wells appear to primarily reflect the sulfate concentration within the Silurian aquifer near the well. This result was expected because fixed-schedule sampling events obtain most of their samples during typical (aquifer to tunnel) flow conditions that reflect the chemistry of the aquifer water.

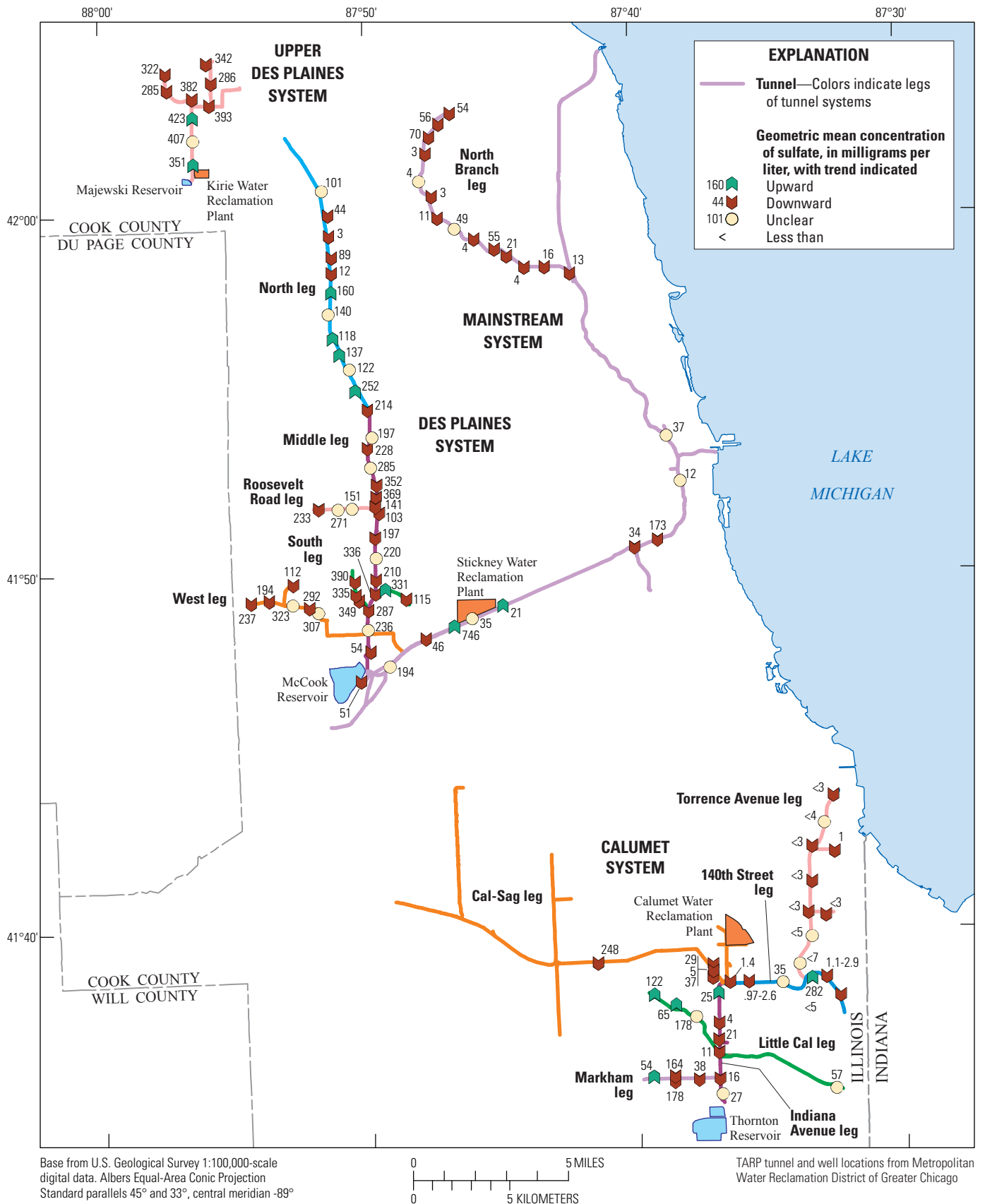
Anomalously high concentrations of sulfate were measured in the north leg of the Des Plaines System at wells QD–52, QD–54 through QD–60, and Mainstream well QM–65 on August 2 and 3, 2006 (table 5). Elevated concentrations of sulfate also were measured in the West leg of the Des Plaines System at wells QD–22 through QD–25 on August 16, 2006. Elevated concentrations of sulfate were measured at wells QC–1, QC–2, QM–64, and QD–32 from October 30 through November 6, 2003. TARP discharge to the WRPs exceeded 80 Mgal/d at least five times in the 2 weeks preceding each of these dates, indicating that CSF flow into the Silurian aquifer may have occurred prior to these sampling events.

Anomalous sulfate concentrations were detected in 129 samples from the 106 TARP wells. Of these 129 samples, 36 had low concentrations that probably are not related to CSF events (table 5). A total of 40 samples with anomalous sulfate concentrations, including low values, also had anomalous values of other analytes, particularly hardness and chloride. Only two samples had an anomalous concentration of sulfate and an elevated FC population. In no well were anomalous sulfate concentrations detected in more than seven samples.

Of the 81 wells exhibiting a statistically significant trend in sulfate concentration from 1995 through 2013, 67 (63 percent of the 106 wells analyzed) showed a downward trend, and 14 showed an upward trend (fig. 18). Sulfate concentrations in the samples from the remaining wells did not indicate a statistically significant trend, so the trend in these wells is unclear. Although downward trends are present throughout the TARP System, upward trends were observed in the southern part of the Upper Des Plaines System, in the middle of the Des Plaines System, near the Stickney WRP on the Mainstream System, and the western part of the Little Calumet leg of the Calumet System. The downward trend in sulfate concentrations in most of the TARP wells is consistent with the presence of higher sulfate water in the deeper part of the Silurian aquifer monitored by the TARP wells during the early part of the 1995–2013 period being replaced through time with lower sulfate water (perhaps affected by sulfate reduction in the upper part of the aquifer) from more distant parts of the aquifer within the drainage area to the tunnels.



**Figure 17.** Concentration of sulfate in water from the Silurian aquifer in Cook County, Illinois (compiled from Voelker, 1986; Voelker and others, 1988; Duwelius and others, 1996).



**Figure 18.** Geometric mean concentrations of sulfate and trends in concentration in samples from Tunnel and Reservoir Plan (TARP) System wells, Cook County, Illinois, 1995–2013. Upward, downward, and no trends are significant with  $p$ -values  $\leq 0.05$ .

## Chloride

Chloride is a naturally occurring ion in groundwater. However, its presence in some groundwater in the Chicago area also can be attributed to the dissolution of road salt. Concentrations of chloride in samples collected from monitoring wells and water-supply wells that were open to the Silurian aquifer throughout Cook County during the mid-1980s and early 1990s (Voelker, 1986; Voelker and others, 1988; Duwelius and others, 1996) are shown in figure 19. These wells are not part of the TARP monitoring network, and these samples typically were collected prior to construction of the TARP tunnels in the area being sampled. Background chloride concentrations in the Silurian aquifer determined from this non-TARP sampling were usually less than 20 mg/L in the southwestern and northwestern parts of Cook County, exceeded 100 mg/L near the future McCook Reservoir, and were 20–50 mg/L in the remainder of the county (fig. 19).

Chloride concentrations were determined to have increased through time in non-TARP wells open to the Silurian aquifer at LaGrange, Libertyville, and Naperville (locations shown in fig. 15) with concentrations beginning to increase in about 1960–70, depending on location (Gibb and O’Hearn, 1980). The increases have been attributed to recharge of snowmelt and precipitation that contains dissolved road salts and indicate that chloride concentrations in the Silurian aquifer within the greater Chicago area may be affected by non-TARP anthropogenic processes, especially in the vicinity of the McCook reservoir where the aquifer is near the land surface (fig. 4).

Road salt dissolution also results in the presence of high chloride concentrations in CSF water. Chloride concentrations in CSF discharged from the TARP System during 1989–91 ranged from about 25 to 600 mg/L with a geometric mean concentration of about 170 mg/L. Chloride concentrations in CSF were highest during the winter and spring and lowest in the summer and fall (fig. 20), coincident with the timing of road salt application.

The geometric mean concentration of chloride in samples from the TARP monitoring wells from 1995 through 2013 ranged from 5 to 480 mg/L (fig. 21). Concentrations of chloride with geometric means of less than 30 mg/L were detected in most of the wells in the central and northern parts of the Des Plaines System, in most of the Mainstream System from well QM–68 upstream to well QM–75, and in much of the Torrence Avenue and Indiana Avenue legs of the Calumet System. Concentrations of chloride with geometric means greater than 100 mg/L were detected at wells QM–71 and QM–72 in the North Branch of the Mainstream System, as well as in most of the southern parts of the Des Plaines and Mainstream Systems. Spatial patterns in concentrations of chloride in the samples from the TARP monitoring wells are generally consistent with patterns in the background concentrations in the Silurian aquifer in the greater Chicago area (fig. 19), indicating

that concentrations of chloride in the TARP wells are affected primarily by the concentration in the surrounding aquifer. This result was expected because most of the samples collected during fixed-schedule sampling events reflect the chemistry of typical (aquifer to tunnel) flow conditions.

Anomalous (mostly elevated) chloride concentrations were detected in 10 wells in the Middle and North legs of the Des Plaines System and at well QC–2.1 on April 8 and 15, 2004 (table 5). Elevated chloride concentrations also were observed on March 15 or 29, 2007 (QC–1, MW–5, MW–9, QM–78), on February 10 or 25, 2009 (QD–36, MW–2, MW–8, MW–9), and on March 28 or April 5, 2012 (QD–23, QD–25, QC–5, QC–6). Each of these sample dates was in the winter or early spring, indicating a seasonal component to the high concentrations. These dates were preceded by TARP discharge to the Stickney WRP in excess of 90 Mgal/d during at least 2 of the 14 days before sample collection, indicating that CSF discharge to the Silurian aquifer may have occurred prior to each of the dates and resulted in the elevated chloride concentrations in the aquifer.

Anomalous chloride concentrations were detected in 154 samples from the 106 TARP wells (table 5). Of these anomalies, 43 were low concentrations potentially not related to TARP events. A total of 44 samples with anomalous chloride concentrations also contained anomalous values of other analytes, particularly TDS, ammonia, and hardness. Seven samples with high chloride concentrations also had elevated FC populations. In no well were anomalous chloride concentrations detected in more than nine samples.

Statistical analysis indicates that wells MW–5, MW–8, and MW–9 in the Upper Des Plaines System; wells QM–62, QM–68, and QM–80 in the Mainstream System; well QD–25 in the Des Plaines System; and well QC–2.2 in the Calumet System (appendix 3) had a seasonal variation in chloride concentration to a significance level of at least 95 percent. This seasonality reflects a tendency for elevated chloride concentrations in most of these wells (well MW–5 is the clearest example and is shown in figure 22) during the winter and spring to decrease to a lower background concentration in the summer and fall. The timing of the variation in chloride concentration in the wells was consistent with the seasonal variation in concentration in the TARP discharge to the WRPs (fig. 20). TARP discharge to the Stickney WRP exceeded 140 Mgal/d for at least 1 of the 14 days preceding detection of seasonally high chloride concentrations on the dates highlighted in figure 22. This relation indicates that chloride in road salts entered the TARP System dissolved in CSF and migrated into parts of the Silurian aquifer when hydraulic pressures in the TARP System were elevated following substantial precipitation or snowmelt events during the winter and spring. Migration of chloride from the tunnels to the monitoring wells appears to have occurred within 2 weeks and appears to have required 4–6 months to fully dissipate.

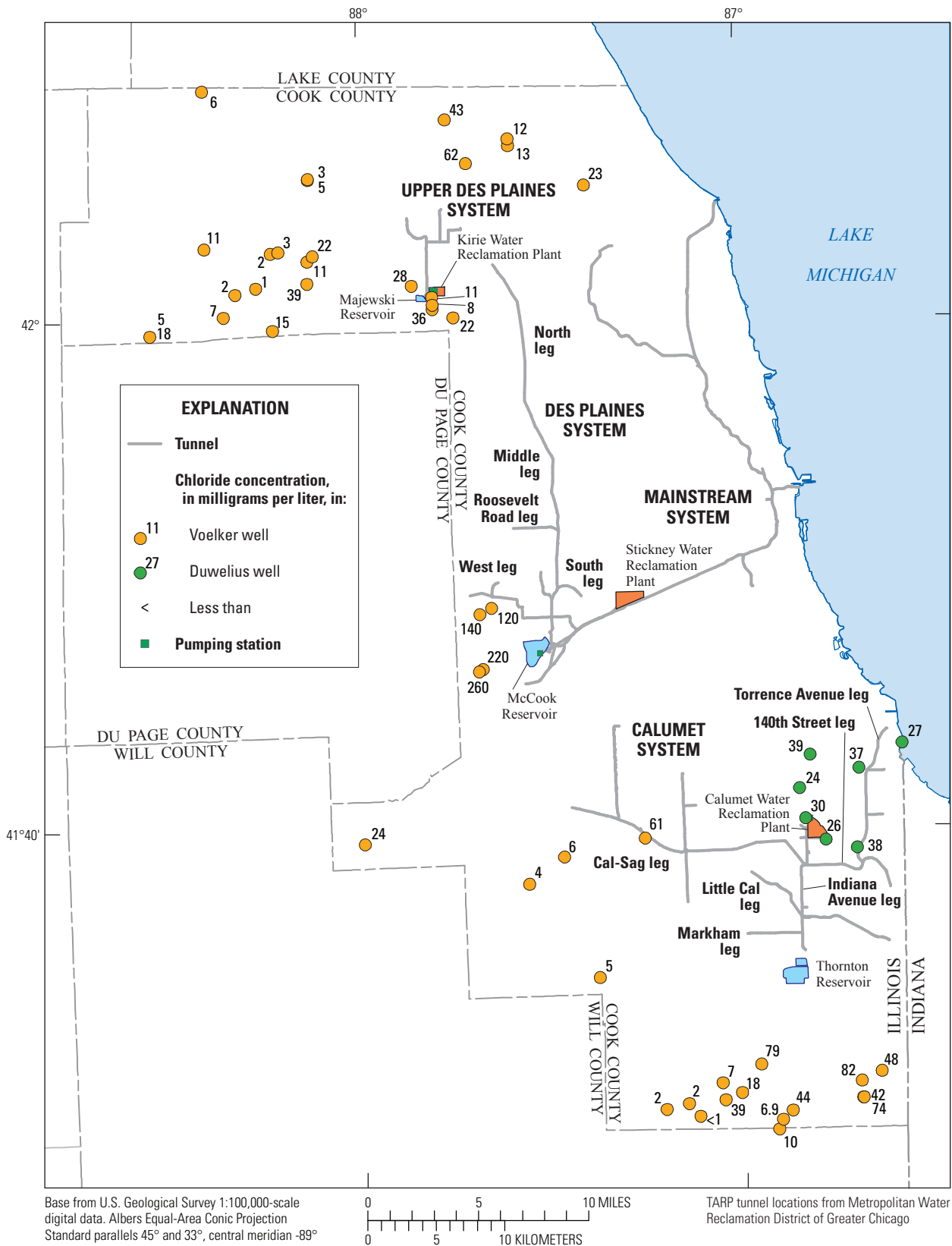
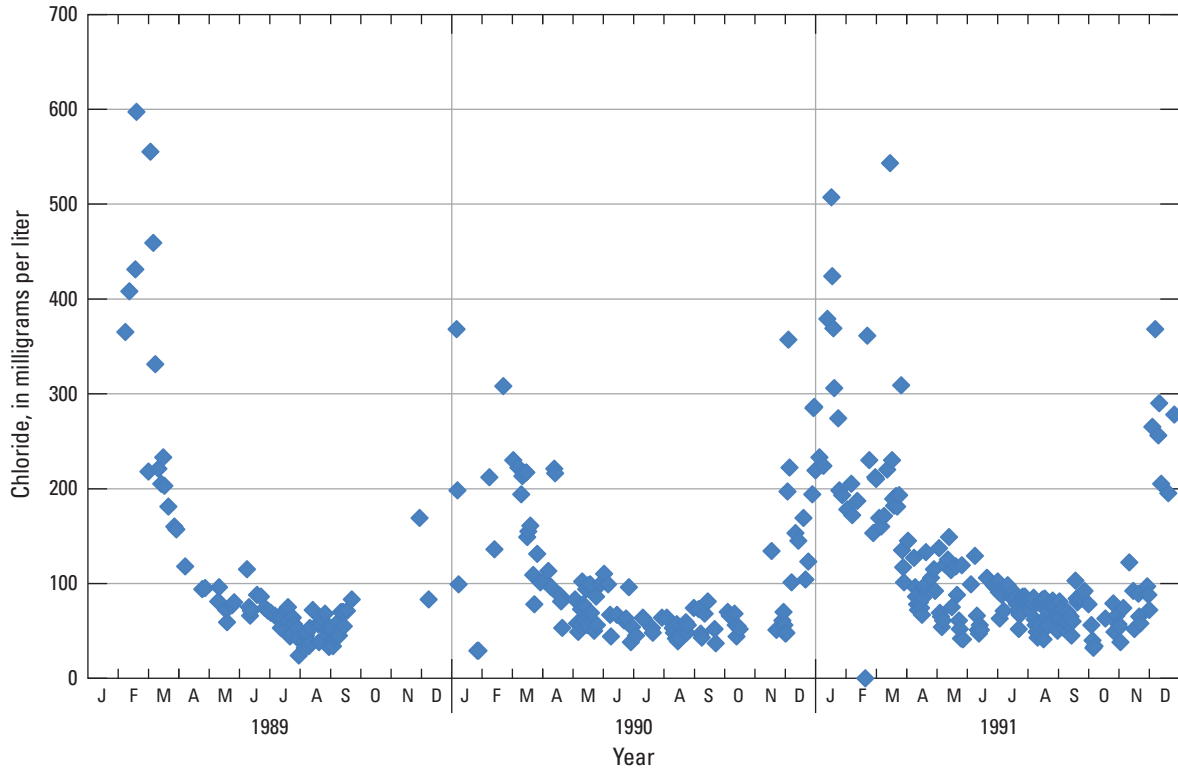
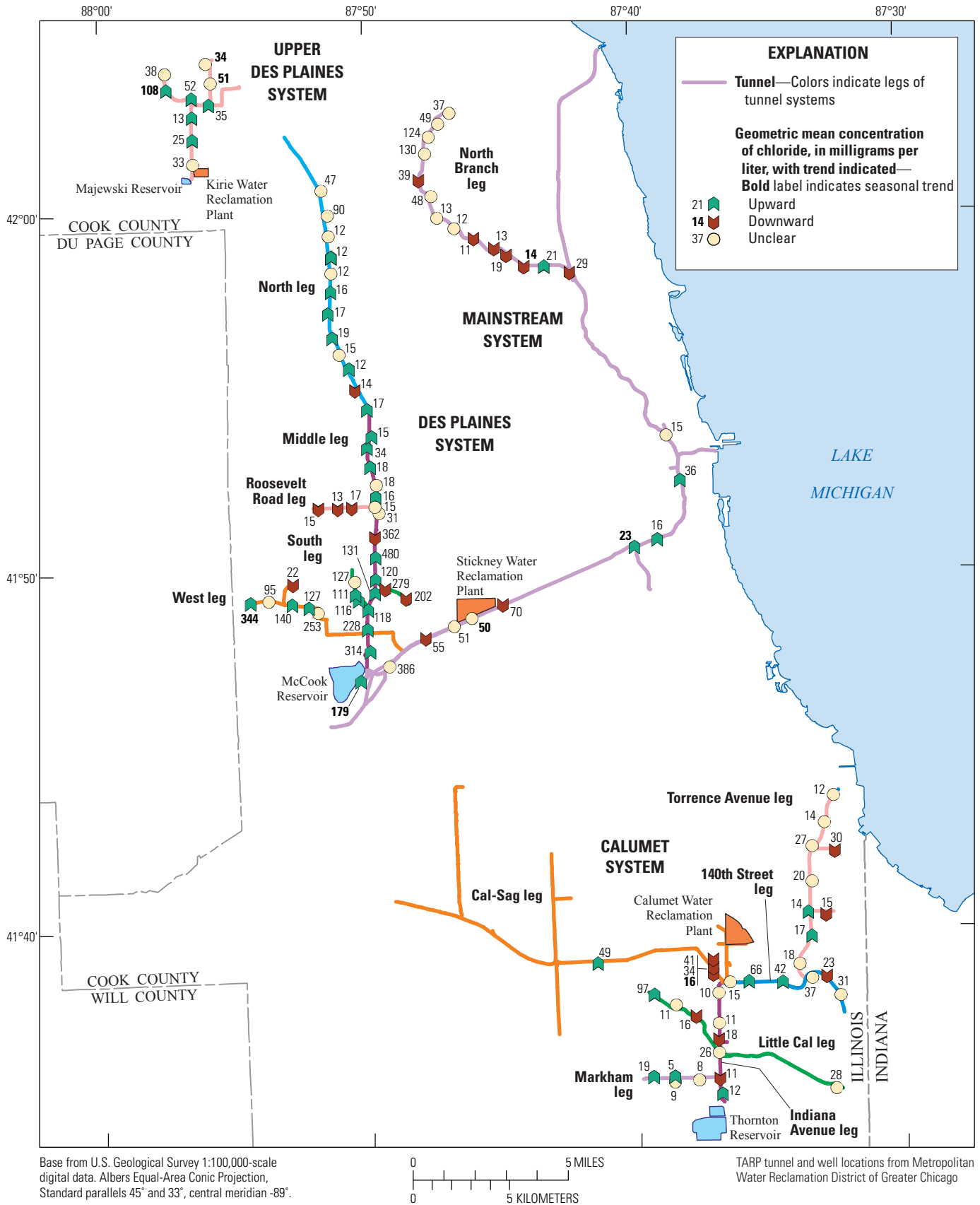


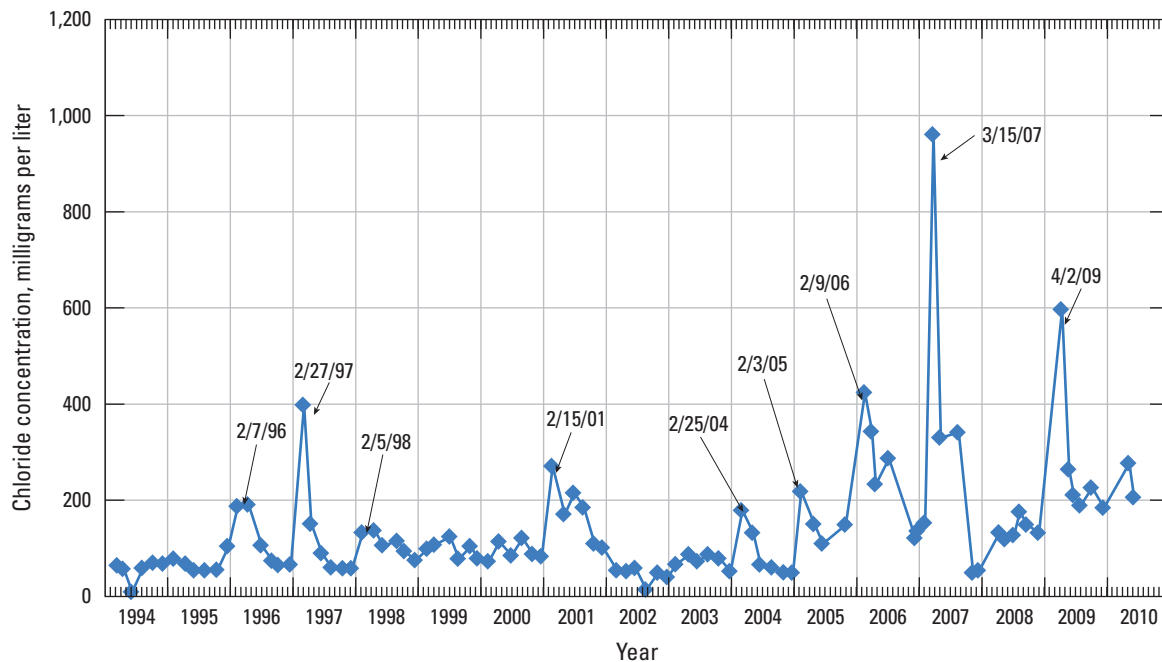
Figure 19. Concentrations of chloride in water from the Silurian aquifer in Cook County, Illinois.



**Figure 20.** Concentrations of chloride in samples from Tunnel and Reservoir Plan System discharge to the Stickney Water Reclamation Plant, Cook County, Illinois, 1989–1991 (data from Metropolitan Water Reclamation District of Greater Chicago, written commun., 2013).



**Figure 21.** Geometric mean concentrations of chloride and trends in concentration in samples from Tunnel and Reservoir Plan (TARP) System wells, Cook County, Illinois, 1995-2013. Upward, downward, and no trends are significant with  $p$ -values  $\leq 0.05$ .



**Figure 22.** Concentrations of chloride in samples from Tunnel and Reservoir Plan System well MW-5, Cook County, Illinois, 1994–2010.

Of the 65 wells with a statistically significant trend in chloride concentration from 1995 through 2013, 40 (38 percent of the 106 wells sampled) showed an upward trend, and 25 showed a downward trend (fig. 21). The trends in the remaining 41 wells had a significance level of less than 95 percent and did not indicate a clear trend. Wells with upward trends tended to be located in the Des Plaines and Upper Des Plaines Systems and in the central part of the Mainstream System. Wells with downward trends tended to be located in the northern and southern parts of the Mainstream System, along the Roosevelt Road and eastern parts of the South leg of the Des Plaines System, and along the Indiana Avenue leg of the Calumet System. Increased chloride concentrations during 1995–2013 may be partly attributable to the periodic migration of high-chloride CSF into the Silurian aquifer. Increases in chloride concentration in the Silurian aquifer because of road salt application in the greater Chicago area, especially near the McCook Reservoir, also may be affecting long-term trends in chloride concentrations (Gibbs and O’Hearn, 1980).

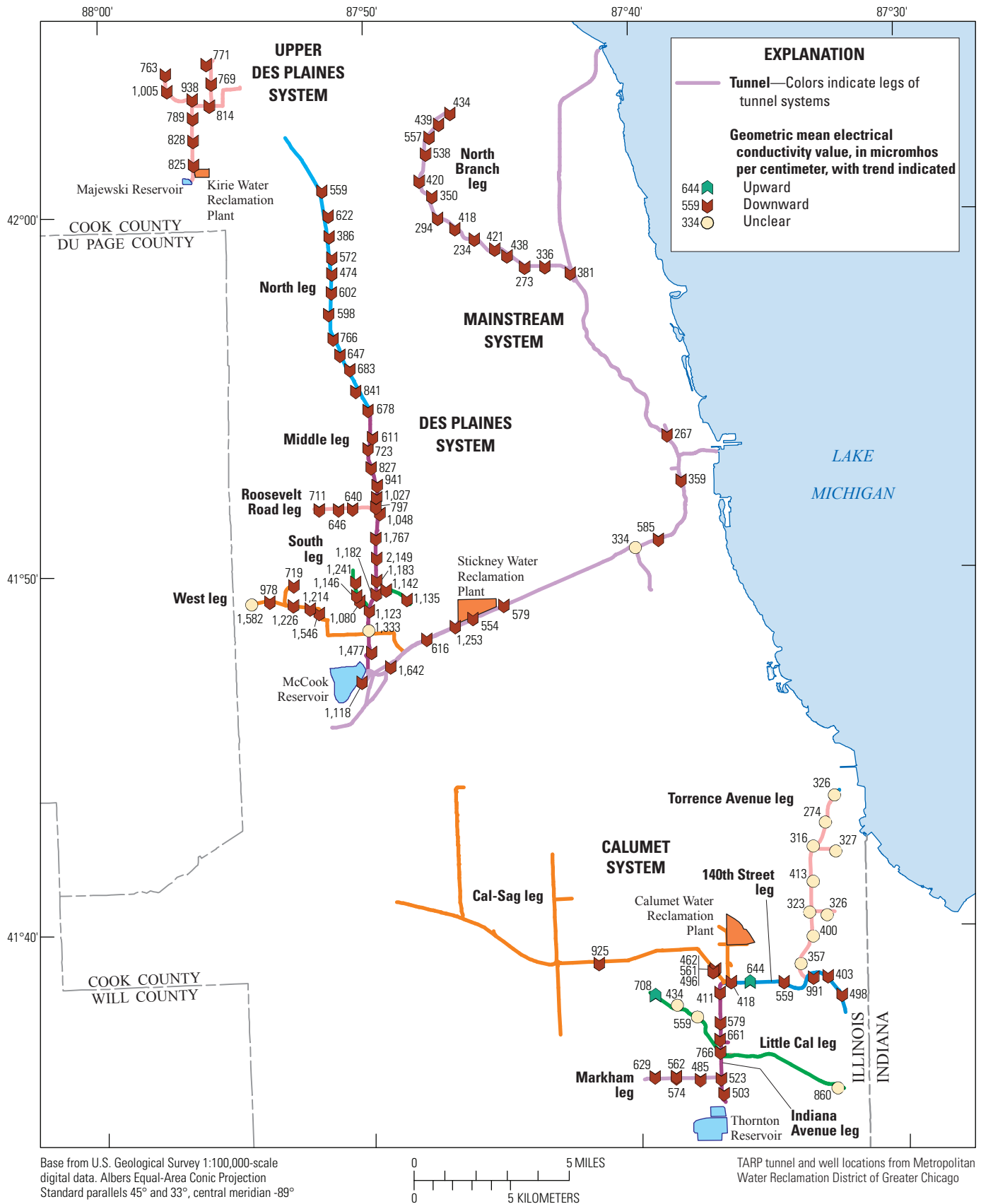
## Electrical Conductivity

EC is a field measurement of the capacity of a water sample to transmit electrical current. EC typically increases as the concentration of dissolved ions, especially calcium, magnesium, sodium, potassium, sulfate, chloride, and bicarbonate, in the sample increases, making it an indicator of general water quality. EC is commonly referred to as specific conductivity, reported as microsiemens per centimeter ( $\mu\text{S}/\text{cm}$ ), and the conversion factor is 1 or 1 micromho/cm ( $\mu\text{mho}/\text{cm}$ )

= 1 microsiemen/cm. EC is described in this report because it was the constituent measured and reported by MWRDGC. EC values in groundwater from non-TARP monitoring wells open to the upper part of the Silurian aquifer in the Calumet area ranged from 290 to 3,630  $\mu\text{mho}/\text{cm}$ , with a median value of 484  $\mu\text{mho}/\text{cm}$  (Duwelius and others, 1996). Annual geometric mean values of EC in discharge from the TARP System to the Calumet WRP during 1989–93 ranged from 1,010 to 1,224  $\mu\text{mho}/\text{cm}$ , indicating that typical EC values in CSF water are substantially higher than the typical EC values in the Silurian aquifer. Elevated EC values may indicate the presence of CSF in the samples from the TARP monitoring wells.

Geometric mean values of EC in the samples from the TARP monitoring wells during 1995–2013 ranged from 234 to 2,149  $\mu\text{mho}/\text{cm}$  (fig. 23). Geometric mean EC values were less than 500  $\mu\text{mho}/\text{cm}$  in samples from monitoring wells in the Torrence Avenue leg of the Calumet System and less than 750  $\mu\text{mho}/\text{cm}$  in samples from monitoring wells in the rest of the Calumet System, except wells QC-1 and QC-12. EC values in samples from monitoring wells in the Des Plaines System increased from typically less than 625  $\mu\text{mho}/\text{cm}$  in the northern (upstream) part of the system to typically more than 1,000  $\mu\text{mho}/\text{cm}$  in the southern (downstream) part of the system. EC values in samples from monitoring wells in the Mainstream System also increased overall from north to south; EC values were less than 500  $\mu\text{mho}/\text{cm}$  north of well QM-58, typically between 500 and 600  $\mu\text{mho}/\text{cm}$  in the center of the system at wells QM-58 through QM-62, and typically greater than 1,000  $\mu\text{mho}/\text{cm}$  in the southern (downstream) part of the system west of the Stickney WRP. Geometric mean EC values exceeded 750  $\mu\text{mho}/\text{cm}$  in samples from monitoring wells in the Upper Des Plaines System.





**Figure 23.** Geometric mean values of electrical conductivity and trends in samples from Tunnel and Reservoir Plan (TARP) System wells, Cook County, Illinois, 1995-2013. Upward, downward, and no trends are significant with p-values  $\leq 0.05$ .

Spatial patterns in EC values in the TARP monitoring wells are generally consistent with patterns in the background values of several of the major chemical components in groundwater from the Silurian aquifer in Cook County (hardness, sulfate, and chloride; figs. 15, 17, and 19). Because EC values are an indication of the general water quality, patterns in overall water quality within the Silurian aquifer are likely to be similar to EC patterns in the aquifer. For this reason, the EC values in the TARP wells appear to be affected primarily by the natural variation of EC within the Silurian aquifer rather than CSF.

Anomalous EC values were observed in 38 samples from the 106 TARP monitoring wells (table 5). One-half of the anomalies were low, indicating they were not affected by CSF. Only seven samples with anomalous EC values also had anomalous values of other analytes, most commonly chloride, TDS, or hardness. No sample with anomalous EC values also had an elevated FC population.

Of the 91 wells with a statistically significant trend in EC values during 1995–2013, 89 (84 percent of the 106 wells analyzed) showed a downward trend, and 2 showed an upward trend (fig. 23). The EC trends in the remaining 15 wells had a significance level of less than 95 percent and did not indicate a clearly defined trend (no trend). Downward trends in EC were present throughout the TARP System, with the exception of the entire Torrence Avenue leg of the Calumet System and much of the Little Cal leg of the Calumet System, where statistically significant trends were not present.

The downward trend in EC values in more than 80 percent of the wells sampled is consistent with the higher EC water present in the deeper part of the Silurian aquifer being replaced through time with lower EC water that flows into the monitoring wells from more distant (including shallow) parts of the aquifer in response to the drainage of aquifer water into the tunnels. The decrease in EC may be related to the decrease in sulfate concentrations observed in many of the TARP wells during 1995–2013. In the wells along the Torrence Avenue and Little Calumet legs of the Calumet System, where statistically significant trends in EC were not observed (fig. 23), EC values within the Silurian aquifer might not have differed enough to induce a trend. Alternatively, Torrence Avenue and Little Calumet are the two newest tunnel systems (fig. 2), so the lack of EC trends in the samples from the wells near these tunnels may indicate that substantial volumes of lower EC water may not have had time to migrate to the deeper part of the Silurian aquifer in these areas by 2013.

## Total Dissolved Solids

TDS is a measurement of the amount of inorganic salts, organic matter, and particulate material in solution. TDS, like EC, is an indicator of general water quality and typically increases as the concentrations of the major ions (calcium, magnesium, sodium, potassium, sulfate, chloride, and bicarbonate) in the sample increase. TDS analyses of background water samples from the Silurian aquifer in Cook County are

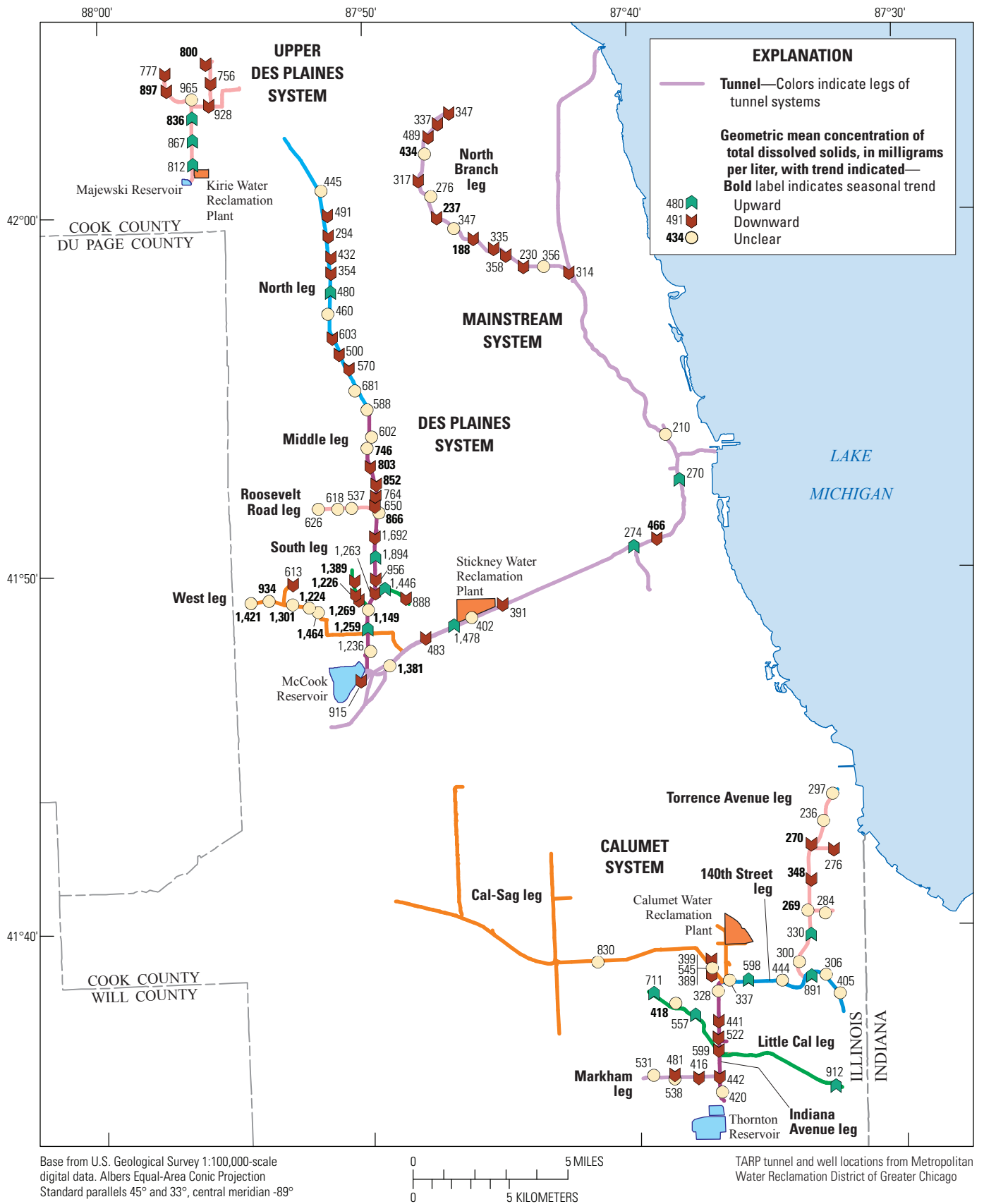
not readily available, and TDS was not measured in CSF discharged from the TARP. However, TDS concentrations in CSF are likely to be elevated in comparison with water in the Silurian aquifer on the basis of their relative EC values.

TDS concentrations were determined to have increased through time in groundwater samples from wells open to the Silurian aquifer at LaGrange and Naperville (Gibb and O’Hearn, 1980). TDS concentrations began to increase before construction of the TARP system, indicating that TDS concentrations in parts of the Silurian aquifer in the Chicago area are affected by non-TARP anthropogenic processes.

The geometric mean concentration of TDS in samples collected from the TARP monitoring wells from 1995 through 2013 ranged from 188 to 1,894 mg/L (fig. 24). TDS concentrations were less than 350 mg/L in the Torrence Avenue leg of the Calumet System and less than 600 mg/L in the rest of the Calumet System, except for wells QC–1, QC–12, and QC–29 where concentrations exceeded 700 mg/L. Geometric mean TDS concentrations less than 500 mg/L were detected in the Mainstream System upstream (north and east) from the Stickney WRP and were more than 900 mg/L in most of the wells downstream from the plant. The geometric mean concentrations of TDS in the Des Plaines System show an overall increase from north to south, in the direction of flow in the tunnel system. The TDS concentration was less than 500 mg/L north of well QD–53, typically between 500 and 1,000 mg/L from well QD–53 south through well QD–39, and typically exceeded 1,000 mg/L south of well QD–39. Geometric mean TDS concentrations greater than 750 mg/L were detected in samples from the wells in the Upper Des Plaines System. Spatial patterns in TDS concentrations are generally consistent with patterns in concentration of other analytes in the Silurian aquifer (figs. 15, 17, and 19), indicating that TDS concentrations in the TARP wells are primarily affected by the TDS concentrations in the aquifer.

Although TDS concentrations appear to primarily be affected by the aquifer chemistry, TDS concentrations also had a statistically significant seasonal variation in samples from 26 of the TARP monitoring wells (fig. 24), with concentrations showing a tendency to have been highest in the summer and lowest in the winter in most of these wells. Wells showing seasonality were present mostly in the upper part of the Upper Des Plaines System, the downstream part of the Des Plaines System, and North Branch leg of the Mainstream System, and the Torrence Avenue leg of the Calumet System (appendix 3).

Seasonal variation in TDS concentrations may be related to seasonal patterns in discharge from the TARP tunnels to the WRPs, which may be associated with increased movement of CSF from the TARP System to the Silurian aquifer, particularly in the downstream part of the Des Plaines System. This discharge tended to be highest in the summer months (table 3). Many of the wells with seasonality in TDS concentrations are near areas where the Silurian aquifer is at or near land surface (fig. 4) and in the LaGrange area where TDS concentrations have been showing non-TARP related increases (Gibbs and O’Hearn, 1980).



**Figure 24.** Geometric mean concentrations of total dissolved solids and trends in samples from Tunnel and Reservoir Plan (TARP) System wells, Cook County, Illinois, 1995–2013. Upward, downward, and no trends are significant with  $p$ -values  $\leq 0.05$ .

The seasonality indicated by the TDS concentrations was not observed for the other analytes. Other analytes that are related to TDS (such as EC) or are substantial components of TDS (chloride, hardness, and sulfate) did not indicate seasonal variation (except chloride), did not exhibit seasonal variation in most of the wells with seasonal variation in TDS, and did not indicate high values in summer and low values in winter (including chloride).

Anomalously high concentrations of TDS were identified on June 11, 2009, at wells MW-1, MW-3, MW-5, MW-8, and MW-9 in the Upper Des Plaines System (table 5). Anomalous TDS concentrations also were detected in samples from four wells collected on July 27, 1995, (QM-77, QM-79, QC-2, QC-2.1) and July 22, 2009 (QC-16 through QC-19). Discharge from the TARP System to the WRPs exceeded 100 Mgal/d at least five times in the 2 weeks preceding each of these events. These dates are all during the summer months and may have contributed to the calculated seasonality in the TDS concentrations. CSF discharge to the Silurian aquifer may have occurred prior to each of the dates, resulting in the elevated TDS concentrations in the aquifer.

Anomalous TDS concentrations were detected in 94 samples from the 106 TARP wells (table 5). Of these anomalies, 26 were low concentrations potentially not related to CSF events. A total of 33 samples with anomalous TDS concentrations also had anomalous values of other analytes. Analytes with anomalous values in a sample on the same date that anomalous TDS concentrations were observed typically were general indicators of water quality, such as EC; probable major components of TDS, such as chloride and hardness; and CSF indicators, such as ammonia. Samples from well QD-27 collected on February 27, 1997, and QM-65 collected on April 2, 2009, were the only samples with an anomalous (low for QD-27) TDS concentration and an elevated FC population. In no well were anomalous TDS concentrations detected in more than four samples.

A statistically significant trend in TDS concentrations was observed in samples collected from 65 wells during 1995–2013. Of these wells, 49 indicated a downward trend, and 16 indicated an upward trend (fig. 24). TDS trends in the 41 remaining wells had a significance level of less than 95 percent and did not indicate a clear trend. Downward trends are indicated in wells in the upper part of the Upper Des Plaines System, in most of the Mainstream and Des Plaines Systems, and in most of the Indiana Avenue and Markham legs of the Calumet System. Upward trends are indicated in wells in the downstream part of the Upper Des Plaines System, appear to be present in the downstream parts of the Mainstream and Des Plaines Systems, and are indicated in the Little Cal and 140th Street legs of the Calumet System. The trends were too variable and inconsistent to clearly indicate a cause for TDS variations. However, if CSF discharge to the Silurian aquifer affected the TDS concentrations, it is expected that TDS concentrations typically would increase. The result indicates the trends were primarily due to natural variations in TDS within the Silurian aquifer.

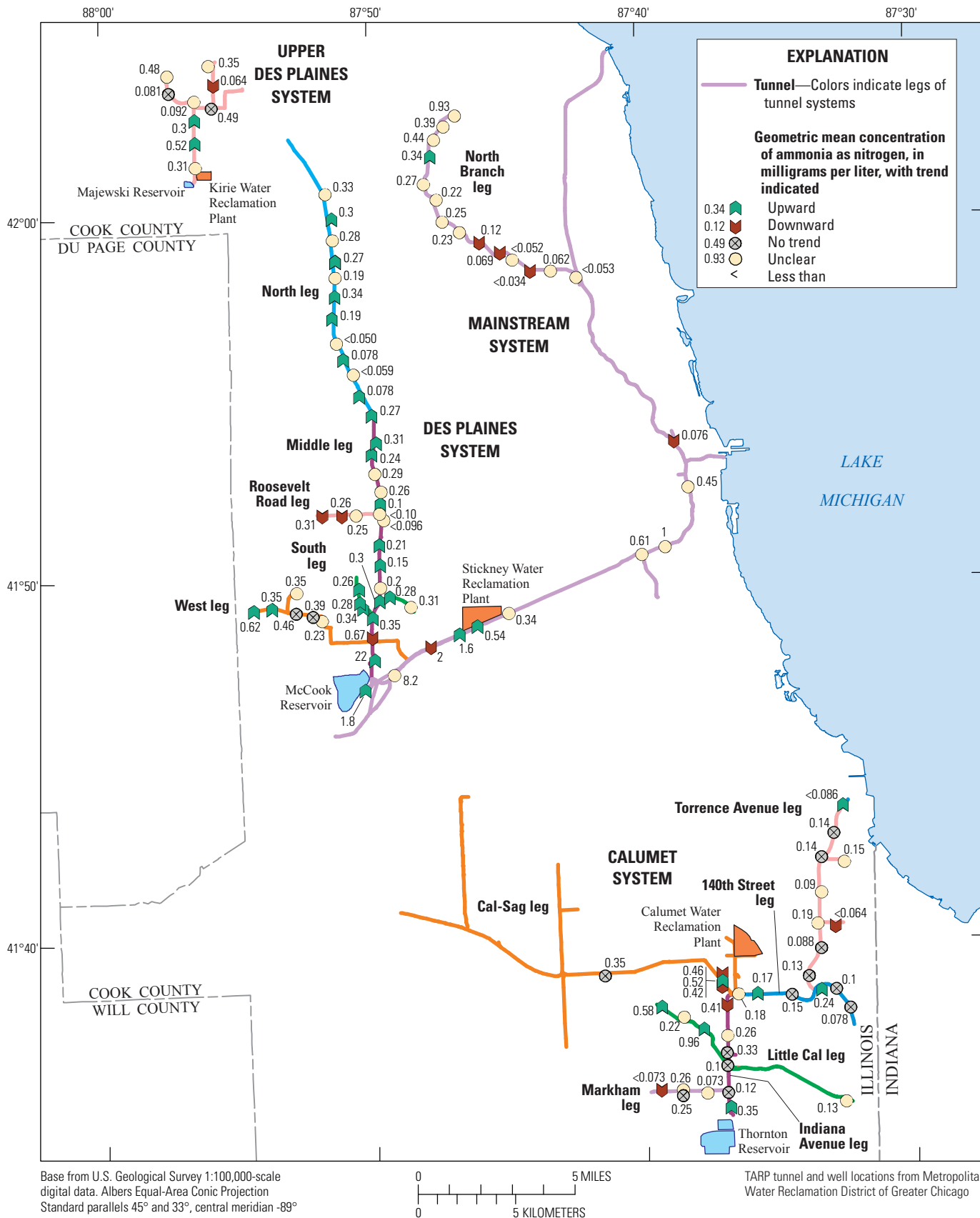
## Ammonia

Ammonia ( $\text{NH}_3$ ) is a naturally occurring compound, but large quantities are produced anthropogenically by the breakdown of human waste and as a component of fertilizer. Ammonia concentrations in samples collected from monitoring wells open to the upper part of the Silurian aquifer in the Calumet area ranged from 0.1 to 0.9 mg/L during 1993 with a median concentration of 0.3 mg/L (Duwelius and others, 1996). Ammonia concentrations in samples collected from water-supply wells open to the Silurian aquifer in suburban Cook County during the mid-1980s ranged from less than the detection limit of 0.1 mg/L to 0.72 mg/L, with an arithmetic mean concentration of about 0.40 mg/L (Voelker and others, 1988). Annual geometric mean concentrations of ammonia in TARP discharge during 1995–2013 ranged from 9 to 30 mg/L. Ammonia concentrations are likely to be elevated in CSF-affected samples from the TARP wells.

The geometric mean concentration of ammonia in samples collected from the TARP monitoring wells during 1995–2013 ranged from below the detection limit to 22 mg/L (fig. 25) with approximately 95 percent of the concentrations being less than 1.0 mg/L. Most of these ammonia concentrations are consistent with background concentrations in the Silurian aquifer. Geometric mean ammonia concentrations greater than 1.5 mg/L were detected near the future McCook Reservoir at monitoring wells QM-63, QM-64, QM-65, and QM-67, including a concentration of 22 mg/L at well QD-27.

Because water was stored in the tunnels of the Des Plaines and Mainstream Systems prior to discharge for treatment during 1995–2013, the downstream part of these systems is where CSF-affected water is likely to have been present for the longest period of time and under the highest hydraulic pressure. These conditions would have promoted CSF flow from the TARP System to the Silurian aquifer and may have caused the elevated (greater than 1 mg/L) ammonia concentrations detected in this area. When the McCook Reservoir is placed on line, CSF will flow to the reservoir rather than remain in the tunnels, so the conditions that result in CSF migration to the aquifer will abate, and ammonia concentrations in the aquifer may decrease.

Anomalous concentrations of ammonia were detected in fewer than four TARP monitoring wells on any given date during 1995–2013, indicating that spatially extensive CSF migration of ammonia into the Silurian aquifer did not occur (table 5). Anomalous ammonia concentrations were detected in 79 samples from the 106 TARP wells. Of these anomalies 16 were low concentrations potentially not related to TARP events. A total of 34 samples with anomalous ammonia concentrations also contained anomalous values of other analytes, particularly DOC, TDS, sulfate, and hardness. Only one sample with high ammonia concentrations also had high FC populations. In no well were anomalous ammonia concentrations detected in more than five samples.



**Figure 25.** Geometric mean concentrations of ammonia and trends in samples from Tunnel and Reservoir Plan (TARP) System wells, Cook County, Illinois, 1995–2013. Upward, downward, and no trends are significant with p-values  $\leq 0.05$ .

Of the 64 wells with a statistically significant trend in ammonia concentration from 1995 through 2013, 34 (32 percent of the 106 wells analyzed) showed an upward trend, 14 showed a downward trend, and 16 showed stable concentrations (fig. 25). The 42 remaining wells (the single biggest category) did not exhibit a statistically significant trend in ammonia concentration and are considered to show an unclear trend. Upward trends were present in most of the wells in the Des Plaines System, the downstream part of the Mainstream System, and in much of the Calumet System. The variability in the trends, including the high number of wells with either statistically stable concentrations or an unclear trend, is consistent with drainage of water with spatially variable ammonia concentrations migrating to the lower part of the aquifer in response to drainage from the Silurian aquifer into the tunnel system. Increasing ammonia concentrations in the vicinity of the McCook Reservoir may reflect the increased presence of CSF-affected water in this area from 1995 through 2013, although the possibility of non-TARP anthropogenic processes having an effect where the Silurian aquifer is at and near the land surface cannot be discounted.

## Dissolved Organic Carbon

Dissolved organic carbon is a measure of the amount of organic material dissolved in water. DOC derived from residential and industrial wastewater results in high concentrations of DOC in CSF water; annual geometric mean concentrations in TARP discharge to the Calumet WRP during 2003–13 ranged from about 21 to 51 mg/L. DOC concentrations in samples from non-TARP monitoring wells are not available. However concentrations of total organic carbon (TOC) in samples collected from the upper part of the Silurian aquifer in the Calumet area ranged from <2 to 87 mg/L during 1993 with a median concentration of 7.1 mg/L (Duwelius and others, 1996). Concentrations of DOC should be less than or equal to those of TOC, indicating that DOC concentrations are likely to be elevated in CSF-affected samples from the TARP monitoring wells.

The geometric mean concentration of DOC in samples from the TARP monitoring wells from 1995 through 2013 ranged from 0.70 to 22 mg/L (fig. 26) with more than 80 percent of the concentrations being less than 3.0 mg/L. Geometric mean concentrations of DOC greater than 4.5 mg/L were detected near the future McCook Reservoir at wells QD–27, QM–65, and QM–67, and at the eastern edge of the Little Cal leg of the Calumet System at well QC–37.

Anomalously high DOC concentrations were detected in samples from 47 wells located throughout the TARP System from mid-July through mid-September 2012 (table 5; fig. 27). During the 62-day period from July 1, 2012, through August 31, 2012, discharge from the TARP System to the Stickney WRP exceeded 100 Mgal/d a total of 26 days, including 15 days with more than 200 Mgal/d discharge. The high

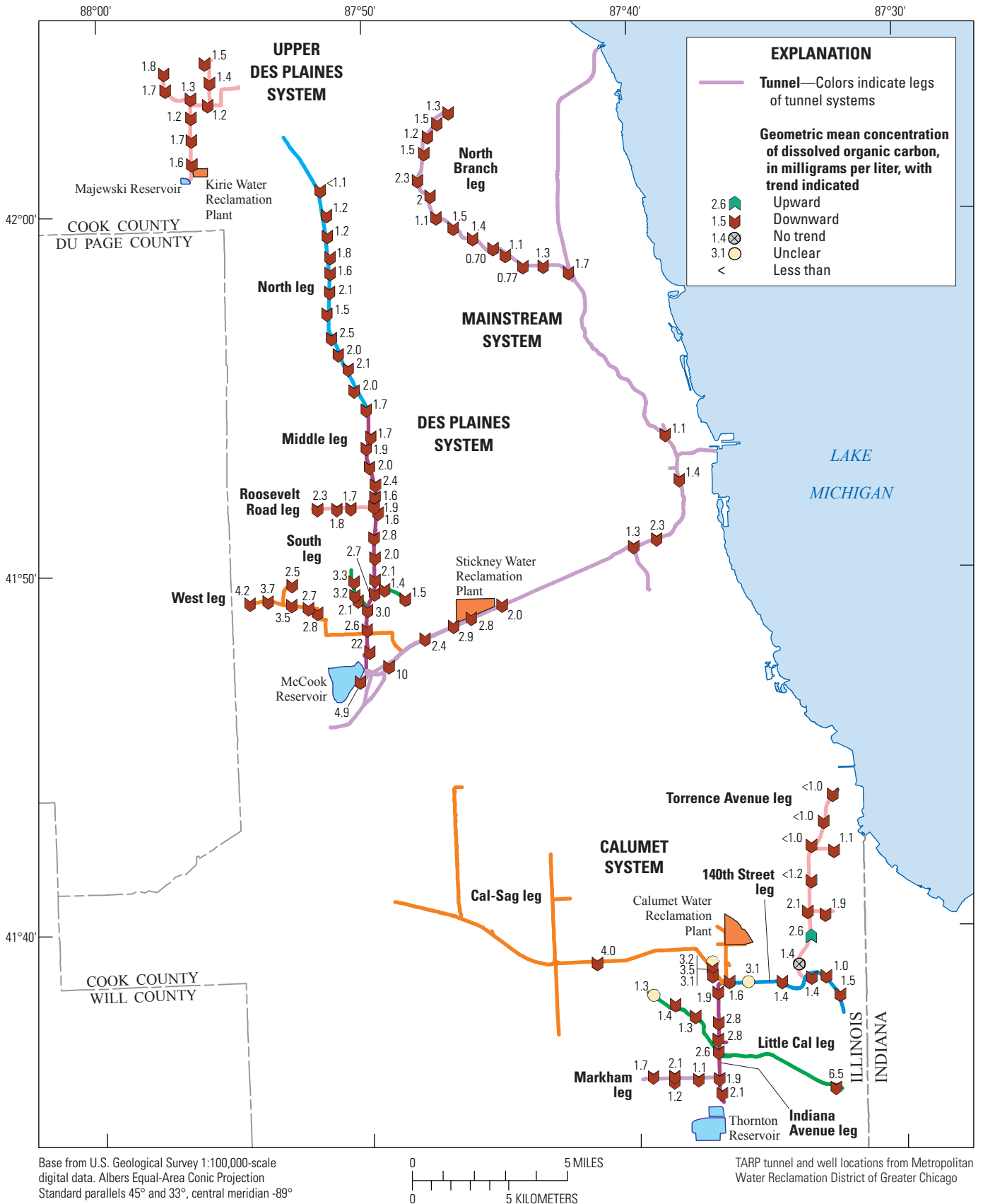
discharge from the Stickney WRP during much of the summer of 2012 indicates there may have been CSF events capable of reversing the flow directions and producing high DOC concentrations in the samples from the aquifer at these 47 wells. However, discharge from the TARP System to the Calumet WRP during July and August 2012 exceeded 80 Mgal/d for only 8 days, and water levels measured in the Calumet and Des Plaines tunnels during this period indicate CSF events occurred only on July 19 and August 27, 2012. It is likely that most of the high-discharge events measured at the Stickney WRP were discharge of drainage from the aquifer to the tunnel system rather than discharge of CSF.

Anomalous DOC concentrations were detected in 85 samples from the 106 TARP wells, including the 47 samples collected during the summer of 2012 (table 5). Of these anomalies, three were low concentrations potentially not related to TARP events. Fourteen samples with anomalous concentrations of DOC also had anomalous values of other analytes, particularly ammonia and hardness. Five samples with high DOC concentrations also had elevated FC populations. However, anomalous values of other analytes were detected in samples from only one well during the high DOC event in summer 2012. Anomalous DOC concentrations were not detected in more than three samples from any well.

Statistically significant trends in DOC concentrations were observed in 103 of the 106 wells. Downward trends were indicated in 101 wells, an upward trend in 1 well, and no trend in 1 well (fig. 26). The downward trends may be related to a 2005 upgrade of the instrument used to measure DOC concentrations, which marks a shift in the DOC concentrations from comparatively high and variable to low and stable (fig. 27). Because of the uncertainty in the cause of the downward trends, the DOC data are of limited utility for the assessment of CSF effects.

## pH

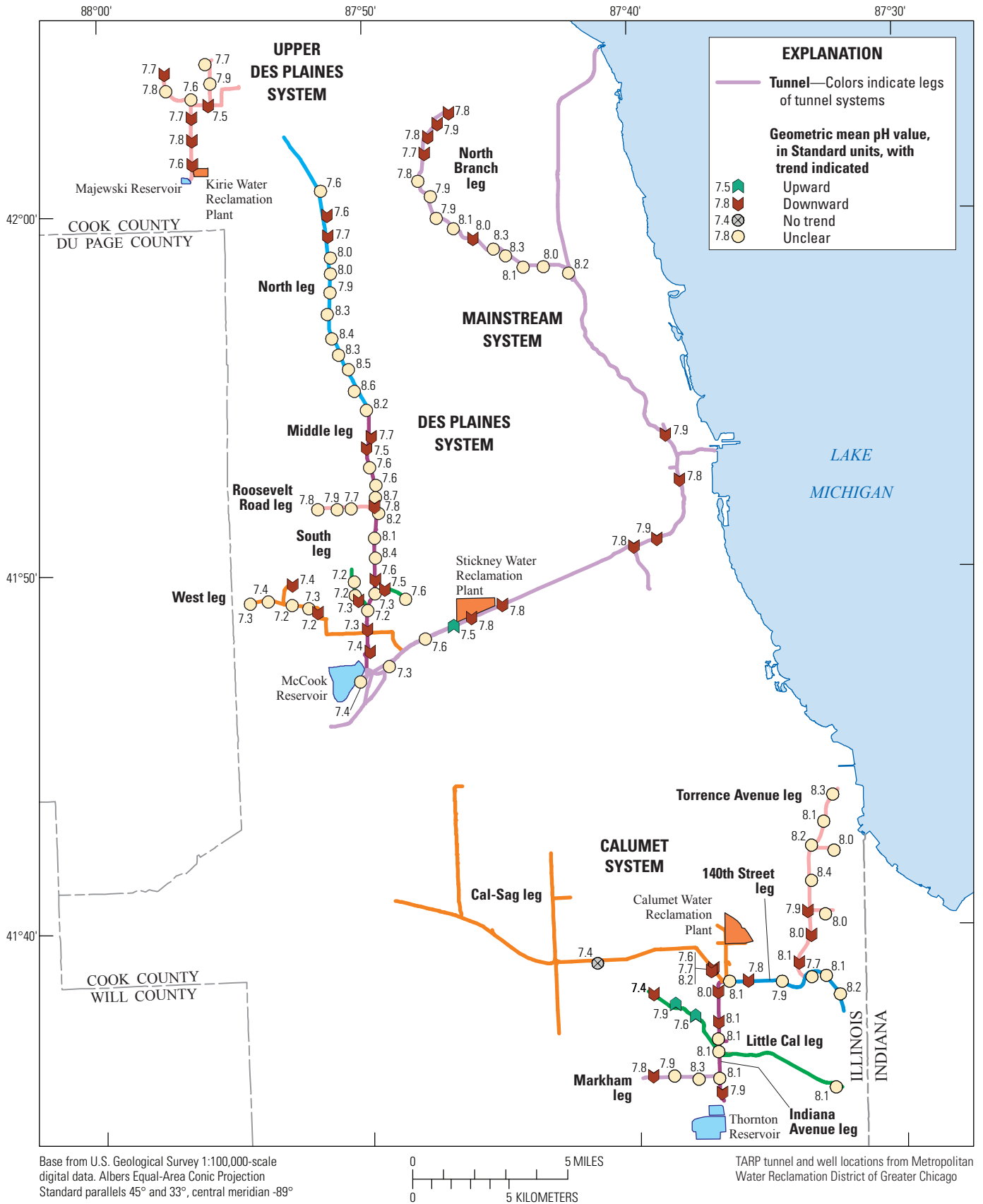
pH is a field measurement of the negative log of the concentration of hydrogen ions in water. The pH of samples from non-TARP monitoring wells open to the upper part of the Silurian aquifer in the Calumet area ranged from about 6.7 to 9.1, with a median value of about 8.0 (Duwelius and others, 1996). Samples from water-supply wells open to the Silurian aquifer in suburban Cook County during the mid-1980s had a pH range of 6.7–8.3, with an arithmetic mean value of 7.2 (Voelker, 1986; Voelker and others, 1988). The pH of CSF water discharged from the TARP System ranged from 7.2–7.7. Because the background range of pH values for groundwater in the Silurian aquifer encompassed the range of pH in the CSF, pH is likely to be of limited use identifying groundwater from wells with substantial CSF effects. However, samples with pH values greater than 7.7 are likely to contain little or no CSF.



**Figure 26.** Geometric mean concentrations of dissolved organic carbon and trends in samples from Tunnel and Reservoir Plan (TARP) System wells, Cook County, Illinois, 1995–2013. Upward, downward, and no trends are significant with  $p$ -values  $\leq 0.05$ .







**Figure 28.** Geometric mean values of pH and trends in samples from Tunnel and Reservoir Plan (TARP) System wells, Cook County, Illinois, 1995–2013. Upward, downward, and no trends are significant with p-values  $\leq 0.05$ .

## Analyte Correlations

The value of every analyte in every sample obtained from a TARP monitoring well during 1995–2013 was correlated with the value of every other analyte in the sample. Correlation coefficients from the individual analyses are presented in appendix 4 and are summarized in table 6.

Ammonia concentrations, pH values, and FC populations showed either high degrees of positive or negative correlations in a small number of wells or did not indicate a preponderance of either positive or negative correlations. To a lesser degree, chloride concentrations and groundwater levels also did not indicate a preponderance of either positive or negative correlations. The lack of substantial correlation between FC populations and the values of other analytes indicates that none of the other analytes, by themselves, can be used as a surrogate for FC to identify the presence of CSF-affected water in the TARP wells if the sampling procedures are not changed.

Values of hardness, sulfate, EC, TDS, and DOC tended to show a high degree of positive correlation with each other in at least 24 of the 106 wells sampled. These analytes (with the exception of DOC) are major chemical constituents in groundwater or are general indicators of water quality whose values are affected by the amount of the major constituents. However, no analyte pair (except EC and DOC) was highly correlated in samples from more than 50 wells (only one analyte pair was highly correlated in at least half of the wells). EC and DOC were the only analytes that indicated downward trends in concentration in most of the wells.

The results of this analysis indicate that water quality in samples from most of the wells was affected by processes that likely reduced the degree of correlation between the major analytes. These processes include the periodic migration of CSF into the Silurian aquifer, as well as spatial and temporal variations in the water chemistry in that part of the Silurian aquifer draining to a well because of natural phenomena (such as sulfate reduction) and non-TARP anthropogenic activities (such as road salt application).

**Table 6.** Summary of correlation coefficients for all analytes in all monitoring wells, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[Numbers are wells that display Kendall tau-b correlation coefficient for the analyte pair of greater than 0.25 or less than -0.25, +number of wells/–number of wells; —, not applicable]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon
Electrical conductivity	+9/-9	—	—	—	—	—	—	—	—
Fecal coliform	+0/-0	+0/-1	—	—	—	—	—	—	—
Hardness	+19/-14	+34/-4	+1/-2	—	—	—	—	—	—
Ammonia	+18/-3	+9/-8	+2/-0	+17/-6	—	—	—	—	—
pH	+0/-12	+6/-1	+0/-0	+4/-6	+1/-6	—	—	—	—
Sulfate	+15/-11	+39/-3	+1/-2	+50/-5	+11/-11	+10/-2	—	—	—
Total dissolved solids	+24/-2	+24/-0	+0/-1	+41/-1	+13/-4	+2/-5	+45/-1	—	—
Dissolved organic carbon	+14/-22	+63/-1	+1/-1	+39/-10	+12/-4	+10/-2	+50/-7	+35/-2	—
Groundwater level	+21/-13	+22/-17	+5/-1	+12/-19	+20/-4	+2/-3	+20/-23	+16/-10	+42/-19

## Coliform Bacteria and *Escherichia coli* Data from Water-Supply Wells in the Vicinity of the Tunnel and Reservoir Plan System

The Silurian aquifer has historically been used for municipal, commercial, and industrial water supply in northeastern Illinois. The City of Chicago, which is where most of the TARP System is located, passed an ordinance in 1997 (Chicago Municipal Code 11–8–390) that effectively precludes groundwater use for public water supply. However, there are 51 water-supply wells within 5 mi of the TARP System but outside of the Chicago City limits that obtained water from the Silurian aquifer from 1999 through 2015. Of these 51 wells, 18 have been abandoned and 4 are inactive, leaving 29 active water-supply wells within 5 mi of the TARP System that were sampled by the IEPA in 2015 (fig. 29). This sampling is part of the routine statewide monitoring effort performed by the IEPA in selected water-supply wells and is not part of the TARP System monitoring effort.

More than 4,850 total coliform analyses (which includes FC) were performed on samples of raw water from these water-supply wells beginning in 1999 and continuing through the time of report preparation (March 2015). These samples (taken prior to treatment and before water enters the distribution system for transmission to the public) were analyzed only for the presence or absence of total coliform; the number of colonies was not counted. Total coliform was detected in 145 samples, including 14 wells with repeat detections in the northern part of Cook County and west of the future McCook Reservoir (fig. 29).

More than 2,600 samples of raw water from these water-supply wells were tested for *Escherichia coli* (*E. coli*), resulting in 28 detections (fig. 29). *E. coli* were detected in more than one sample from an abandoned well in east-central DuPage County about 6.5 mi northwest of the future McCook Reservoir and from two active wells about 0.4 mi east of the Majewski Reservoir (fig. 2).

Some of the water-supply wells with detections of total coliform and *E. coli* are in the LaGrange area, where sampling indicates increasing concentrations of chloride and TDS in the Silurian aquifer that predates construction of the TARP System (Gibb and O’Hearn, 1980). These increased concentrations were attributed to the application of road salts, but their presence indicates that other anthropogenic compounds applied at or near the land surface—such as septic wastes—may be capable of migrating to the Silurian aquifer in parts of northeastern Illinois.

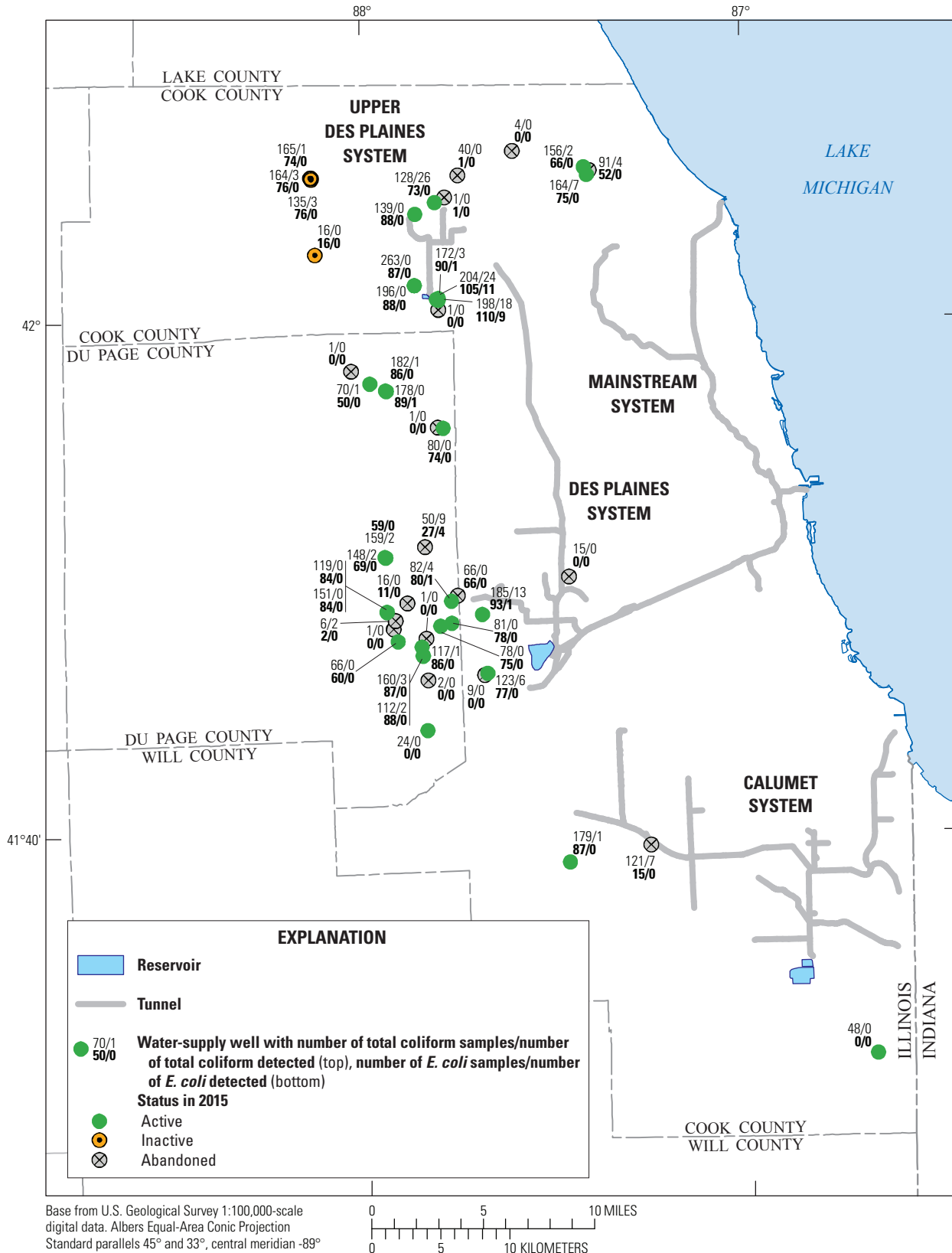
## Implications for Future Monitoring

Data analysis presented in this report indicates that most of the samples collected during the 1995–2013 monitoring period were affected by the chemistry of the Silurian aquifer in the vicinity of the monitoring well. Anomalous values of most of the analytes were detected in all of the monitoring wells, particularly those with a high frequency of detection for FC (table 7), but typically during less than 5 percent of the sampling events (fig. 12, table 5). Dates during which anomalous values of an analyte were detected in a well (or in multiple wells) usually were not associated with the detection of anomalous values of other analytes, especially FC. Therefore, many of the identified anomalies in analyte values may not have been caused by CSF migration into the aquifer. These data indicate that CSF-affected water was present in a small percentage of the samples collected from most of the monitoring wells. This result is likely due to the fact that monitoring occurred on a fixed schedule, which would only occasionally coincide with the random CSF events.

CSF discharge to the aquifer is expected to occur over a smaller part of the TARP System for shorter periods of time once the Thornton and McCook reservoirs are connected to the TARP System. Improved efficiency of the monitoring effort will be needed to define the (likely) smaller future spatial and temporal effects of CSF on the water quality of the aquifer.

The efficacy of the monitoring program could be improved by focusing future sampling efforts on those wells where analytes related to the presence of CSF were detected in a substantial number of samples during the 1995–2013 sampling period. Groundwater levels and FC populations are clear indicators of the presence (and to a lesser degree absence) of CSF effects. Chloride, TDS, EC, ammonia, and DOC concentrations can indicate the presence of CSF in a sample but typically only on a periodic or seasonal basis or in a small number of wells where the difference between their concentration in aquifer water and the CSF is particularly high. Hardness, sulfate, pH, and temperature (measured at the well head) provide limited insight into the effects of CSF events on groundwater quality.

Data from wells located at the boundaries of the monitoring system nearest water-supply wells might yield more valuable information than data from wells in the middle of the TARP System as a result of their proximity to potential points of exposure. In addition, many of the wells showing greater CSF effects are located in similar areas, often the downstream parts of the tunnel systems, and yield data with a high degree of correlation. Sampling from a few representative monitoring wells during CSF events may be a more effective use of resources than sampling all wells on a fixed schedule.



**Figure 29.** Location of water-supply wells open to the Silurian aquifer within 5 miles of the Tunnel and Reservoir Plan System, northeast Illinois, with results of total coliform and *Escherichia coli* (*E. coli*) analyses in raw water prior to treatment and before entering the water-distribution system, 1999–2015.

**Table 7.** Summary of water-quality data indicating the presence of combined sewer flow effects in monitoring wells in which fecal coliform was detected in 10 percent or more of the samples, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

Well	Percentage of samples with fecal coliform detections	Analyte with anomalously high values <sup>1</sup>	Analyte displaying seasonality <sup>2</sup>	Analyte with elevated geometric mean concentration
MW-5	22	Chloride, total dissolved solids	Chloride, total dissolved solids	None
MW-6	19	Chloride	None	None
MW-7	17	None	None	None
MW-8	31	None	Chloride	None
QD-27	15	Ammonia, dissolved organic carbon, hardness, sulfate, total dissolved solids	None	Ammonia, dissolved organic carbon
QD-29	17	Dissolved organic carbon	Total dissolved solids	None
QD-30	10	Chloride, hardness	None	None
QD-31	30	Groundwater elevation, total dissolved solids	None	None
QD-34	14	Dissolved organic carbon	Total dissolved solids	None
QD-36	11	Chloride, dissolved organic carbon	Total dissolved solids	None
QD-46	13	Groundwater elevation, chloride, dissolved organic carbon, hardness, total dissolved solids, sulfate	None	None
QM-61	33	Chloride, groundwater elevation, electrical conductivity, hardness, ammonia, sulfate, total dissolved solids	None	None
QM-62	54	Chloride, electrical conductivity, hardness, sulfate, total dissolved solids	Chloride	None
QM-63	36	Hardness, total dissolved solids, dissolved organic carbon	None	Ammonia
QM-64	48	Chloride, hardness, sulfate, total dissolved solids, dissolved organic carbon	None	Ammonia
QM-65	26	Chloride, hardness, sulfate, total dissolved solids, dissolved organic carbon	Total dissolved solids	Ammonia, dissolved organic carbon
QM-67	81	Chloride, hardness, ammonia, sulfate, total dissolved solids, dissolved organic carbon	Chloride	Ammonia, dissolved organic carbon
QM-68	32	Dissolved organic carbon	Chloride	None
QM-75	24	Groundwater elevation, hardness, pH, dissolved organic carbon	Total dissolved solids	None
QM-77	29	Groundwater elevation, total dissolved solids, dissolved organic carbon	Total dissolved solids	None
QC-2	63	Hardness, sulfate, total dissolved solids	None	None
QC-4	22	None	None	None
QC-17	15	Total dissolved solids, dissolved organic carbon	None	None

<sup>1</sup>Anomalously high values detected in multiple wells on a given sampling date or anomalously high values of multiple analytes in a particular sample.

<sup>2</sup>Analytes demonstrating seasonal variation in concentration.

Finally, the efficacy of the monitoring program would be improved by sample collection during and after CSF events rather than on a fixed schedule. Improvement of the timing of sample collection would be aided by hourly measurement of water levels in the tunnel systems; continuous monitoring of water temperature, water level, specific conductance, and perhaps organic carbon using devices located within the open interval of selected monitoring wells; and real time reporting of that data. These water-quality data need to be combined with some initial intensive data collection to verify the utility of these analytes in the detection of CSF effects on the aquifer (from initial to maximum effect to the eventual return to background conditions).

## Summary and Conclusions

The U.S. Geological Survey, in cooperation with the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), performed statistical analysis of samples collected from 106 Tunnel and Reservoir Project (TARP) System monitoring wells sampled by the MWRDGC from 1995 through 2013. This analysis was done to assess the efficacy of the monitoring effort. Analysis was performed on groundwater levels, pH, temperature, electrical conductivity, total dissolved solids, hardness, ammonia as nitrogen (ammonia), dissolved organic carbon, chloride, sulfate, and fecal coliform data.

Groundwater typically drains from the Silurian aquifer into the TARP tunnels, inducing flow within the aquifer towards the tunnel system over a distance of thousands of feet. As a consequence, analyte values in the samples from the monitoring wells are primarily affected by their values in that part of the aquifer draining to the tunnels being monitored by a particular well. If a precipitation event induces combined sewer flow (CSF) in the tunnel system in excess of about 80 million gallons per day, the hydraulic pressure in the tunnel system can be large enough to overcome the normal hydraulic gradient and induce flow from the tunnels to the Silurian aquifer for a period of hours to days. These effects appear to occur throughout the TARP System but are particularly substantial in the downstream part of the tunnel systems.

Tunnel-to-aquifer flow can cause analytes dissolved in the CSF to migrate into the aquifer, resulting in high levels of fecal coliform, chloride, hardness, ammonia, total dissolved solids, dissolved organic carbon, and electrical conductivity in parts of the aquifer, but typically less than 5 percent of the samples from a particular well contained elevated values of these analytes because of the inefficiency of the fixed sampling schedules. Migration of analytes from the tunnels to the nearby monitoring wells may occur within 2 weeks of a CSF event. Once the aquifer-to-tunnel hydraulic gradient is reestablished, the temporarily elevated values of the analytes emplaced in the aquifer during the CSF event return to background levels. Groundwater levels tend to return to background levels within 2 weeks of a CSF event. Fecal coliform

populations can return background levels within about 4 to 6 weeks, whereas chloride concentrations can take 4 to 6 months to return to background levels.

Values of electrical conductivity, sulfate, and dissolved organic carbon showed a statistically significant decrease in at least 60 percent of the TARP wells from 1995 through 2013. The trend in dissolved organic carbon concentrations may be related to an upgrade of the device used to quantify dissolved organic carbon concentrations during the period of analysis. Values of hardness, chloride, total dissolved solids, ammonia, and pH did not show a statistically significant increase or decrease in more than 50 percent of the wells from 1995 through 2013. Water quality in the Silurian aquifer is spatially variable owing to a variety of natural and non-TARP anthropogenic processes. Therefore, the trend in the values of an analyte at a well likely was primarily a reflection of the spatial variation in the value of the analyte within that part of the Silurian aquifer draining to the tunnel near the well.

In addition to the water quality-effects associated with drainage from the Silurian aquifer to the tunnel at a well, there were short-term effects associated with the periodic migration of CSF into the aquifer. Depending on the well and the analyte, these short-term effects could be observed during only one or two sampling events or repeated on a seasonal basis for several years. Short-term CSF events appear to have affected fecal coliform populations in at least one sample collected from 77 of the 106 wells sampled from 1995 through 2013. Clearly identifiable CSF effects in the form of fecal coliform detections were present in 23 wells during 10 percent or more of the sampling events; only 3 wells had fecal coliform populations during most of the sampling events. The wells with fecal coliform present in at least 10 percent of the samples tend to be in the upper part of the Upper Des Plaines System, the downstream parts of the Des Plaines and Mainstream Systems near the Stickney Water Reclamation Plant and the future McCook Reservoir, and near the Thornton Reservoir in the Calumet System.

The movement of groundwater and CSF between the tunnel system and the Silurian aquifer is dependent on a number of factors, including the relative hydraulic pressure in the aquifer and the tunnel system, the integrity of the tunnel liner, and the hydraulic properties of the aquifer between the tunnel and the well. Migration of CSF into the Silurian aquifer is likely to be greatest in the downstream parts of most of the tunnel systems because these parts of the tunnel system tend to contain CSF-affected water under the highest pressure for the longest periods of time. The amount of CSF movement into the aquifer is expected to be reduced when the McCook and Thornton Reservoirs are connected to the tunnel systems.

Temperature (if measured outside of the well, as per this monitoring effort), pH, sulfate, and hardness were of limited value for identifying the presence of CSF because they were affected by atmospheric interaction or have values that did not differ appreciably between the CSF and groundwater. Chloride, electrical conductivity, total dissolved solids, ammonia,

and dissolved organic carbon can indicate the presence of CSF, but separating analyte values related to CSF from those related to background water quality in the Silurian aquifer can be difficult. Future temperature measurements taken within the open interval of the well, if attempted, may be useful for identifying the presence of CSF.

High groundwater levels appear to be a good indicator of the initiation of a CSF event, but the relation between groundwater levels and analyte values is indirect, and groundwater levels are elevated for a short period of time (days) relative to the duration of water-quality effects (weeks to months). As a consequence, groundwater levels cannot be used to assess the full nature (analyte, concentration, duration) of CSF effects.

Because of its natural absence from the Silurian aquifer, fecal coliform is the only analyte whose detection can be attributed solely to the presence of water affected by CSF. The absence of fecal coliform in a sample is a good, but not conclusive, indication that CSF is not affecting water quality. Of the analytes tested, fecal coliform is the most useful for assessing the effects of CSF in the Silurian aquifer near the TARP System. The lack of correlation between fecal coliform populations and the values of other analytes indicates that the other analytes cannot be used as a surrogate for fecal coliform to identify the presence of CSF effects. Fecal coliform populations within the various tunnel systems tend to be highly correlated between wells in which fecal coliform was detected in at least 10 percent of the samples.

## Acknowledgments

The author thanks Dave Lorenz of the U.S. Geological Survey for his guidance with the statistical software used to obtain the results presented in this report.

## References Cited

- American Public Health Association, 2012, Standard methods for the examination of water and wastewater (22d ed.), Rice, E.W., Baird, R.B., Easton, A.D., Clesceri, L.S., eds.: Washington, D.C., variously paginated.
- Brose, D., Lindo, P., Hundal, L., Cox, A., Zhang, H., Granato, T.C., 2016, Compilation of groundwater quality monitoring data for the Tunnel and Reservoir Plan collected from monitoring wells from 1995-2013: Metropolitan Water Reclamation District of Greater Chicago Monitoring and Research Department Report 16-01, 145 p.
- Bundschuh, J., 1993, Modeling annual variations of spring and groundwater temperatures associated with shallow aquifer systems: *Journal of Hydrology*, v. 142, p. 427-444.
- Csallany, S., and Walton, W.C., 1963, Yields of shallow dolomite wells in northern Illinois: Illinois State Water Survey Report of Investigation 46, 43 p.
- Duwelius, R.F., Kay, R.T., and Prinos, S.T., 1996, Groundwater quality in the Calumet region of northwestern Indiana and northeastern Illinois, June 1993: U.S. Geological Survey Water-Resources Investigations Report 95-4244, 179 p.
- Gibb, J.P., and O'Hearn, M., 1980, Illinois groundwater quality data summary: Illinois State Water Survey Circular 230, 60 p.
- Hanson, R., Gerber, W.D., and Larson, T.E., 1943, Groundwater supplies of the Chicago-Joliet-Chicago Heights area: Illinois State Water Survey Bulletin 35, 285 p.
- Harmeson, R.H., and Schnepfer, V.M., 1965, Temperature of surface waters in Illinois: Illinois State Water Survey Report of Investigation 49, 45 p.
- Harza Engineering Company, 1972, Development of a flood and pollution control plan for the Chicago land area: geology and water supply, technical report 4: Prepared for the Water Reclamation District of Greater Chicago, Chicago, Illinois, variously paginated.
- Helsel, D.R., 2012, *Statistics for Censored Environmental Data Using Minitab and R*: New York, Wiley Publishing, 324 p.
- Helsel, D.R., and Hirsch, R.M., 2002, Statistical methods in water resources: U.S. Geological Survey Techniques of Water-Resources Investigations, book 4, chap. A3, 522 p.
- Hill, T.E., and Butts, T.A., 1986, An assessment of benthic sediments and an inventory of sewer outfalls and land use for selected Chicago-area streams: Illinois State Water Survey Contract Report 399, 267 p.

- Illinois Environmental Protection Agency, 2012, Standard operating procedure for groundwater sampling: Springfield, Illinois, IEPA BOW SOP015-00-1212, 45 p.
- Illinois Environmental Protection Agency, 2015, Database of public-water supply system sampling results for Cook and DuPage counties accessed March 30, 2015, at <http://163.191.83.31/dww/>.
- Kay, R.T., Duwelius, R.F., Brown, T.A., Micke, F.A., and Witt-Smith, C., 1996, Geohydrology, water levels and direction of flow, and occurrence of light non-aqueous phase liquids on ground water in northwestern Indiana and the Lake Calumet area of northeastern Illinois: U.S. Geological Survey Water-Resources Investigations Report 95-4253, 84 p.
- Kay, R.T., Bayless, E.R., and Solak, R.A., 2002, Use of isotopes to identify sources of ground water, estimate ground-water flow rates, and assess aquifer vulnerability in the Calumet region of northwestern Indiana and northeastern Illinois: U.S. Geological Survey Water-Resources Investigations Report 02-4213, 60 p.
- Kiefer and Assoc., Inc, 1976, Geotechnical design report for the Calumet System of the tunnel and reservoir plan: Prepared for the Water Reclamation District of Greater Chicago, Chicago, Illinois, [variously paginated].
- McKenna, D.P., and Keefer, D.A., 1991, Potential for agricultural contamination of aquifers in Illinois: Illinois State Geological Survey Open File Series 1991-7R, 16 p.
- McHone, J. F., Sargent, M.L. and Nelson, W.J., 1986, Shatter cones in Illinois: Evidence for meteoritic effects at Glasford and Des Plaines [abs]: *Meteoritics*, v. 21, p. 446.
- Metropolitan Water Reclamation District of Greater Chicago, 2013, TARP status report as of December 1, 2013: Chicago, Ill., 12 p.
- Morse, D.G., Hasenmueller, N.R., and Nuttal, B.C., 2000, Major structural features of the Illinois Basin: Illinois Basin Consortium, 1 p.
- National Weather Service, 2014, Average monthly precipitation, Midway Airport, Illinois, accessed July 26, 2014, at <http://w2.weather.gov/climate/index.php?wfo=lot>.
- Nicholas J.R., and Healy, R.W., 1988, Tritium migration from a low-level radioactive-waste disposal site near Chicago, Illinois: U.S. Geological Survey Water-Supply Paper 2333, 46 p.
- Quinn, G.P., and Keogh, M.J., 2003, Experimental design and data analysis for biologists: Cambridge, UK, Cambridge University Press, 539 p.
- Suter, Max, Bergstrom, R.E., Smith, H.F., Emrich, G.H., Walton, W.C., and Larson, T.E., 1959, Summary of the preliminary report on ground-water resources of the Chicago region, Illinois: Illinois State Water Survey Cooperative Ground-Water Report 1-S, 18 p.
- U. S. Environmental Protection Agency, 1988, Metropolitan Sanitary District of greater Chicago tunnel and reservoir plan, special evaluation project: Interim Report: Chicago, Ill., 67 p.
- U. S. Environmental Protection Agency, 1993a, Method 250.1 determination of ammonia nitrogen by semi-automated colorimetry, revision 2.0: Cincinnati, Ohio, U.S. Environmental Protection Agency Environmental Monitoring System Laboratory Office of Research and Development, 15 p.
- U. S. Environmental Protection Agency, 1993b, Method 250.1 determination of sulfate by automated colorimetry, revision 2.0: Cincinnati, Ohio, U.S. Environmental Protection Agency Environmental Monitoring System Laboratory Office of Research and Development, 13 p.
- Voelker, D.C., 1986, Observation-well network in Illinois, 1984: U.S. Geological Survey Open-File Report 86-416, 108 p.
- Voelker, D.C., Oberg, D.J., and Grober, M.J., 1988, Water-quality data from the observation-well network in Illinois, 1985-87: U.S. Geological Survey Open-File Report 87-538, 475 p.
- Washington, B., Sawyer, B., Zenz, D.R., 1981, Southwest-13A deep rock tunnel water quality sampling and odor monitoring study: Metropolitan Water Reclamation District of Greater Chicago Department of Research and Development Report 81-15, 43 p.
- Willman, H.B., 1971, Summary of the geology of the Chicago area: Illinois State Geological Survey Circular 460, 77 p.
- Willman, H.B., Atherton, E., Buschbach, T.C., Collinson, C., Frye, J.C., Hopkins, M.E., Lineback J.A., and Simon, J.A., 1975, Handbook of Illinois Stratigraphy: Illinois State Geological Survey Bulletin 95, 261 p.
- Zeisel, A.J., Walton, W.C., Sasman, R.T., and Prickett, T.A., 1962, Ground-water resources of DuPage County, Illinois: Illinois State Water and Geological Surveys Cooperative Ground-Water Report 2, 103 p.



# Appendix 1. Summary statistics for analytes and physical properties, by well, Tunnel and Reservoir Plan System, 1995–2013

---

Each appendix has four Tunnel and Reservoir Plan Systems, each with multiple tables of varying sizes.

Table 1–1 to table 1–34. Summary statistics for analytes and physical properties in samples from wells, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 1–35 to table 1–74. Summary statistics for analytes and physical properties in samples from wells, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 1–75 to table 1–98. Summary statistics for analytes and physical properties in samples from wells, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 1–99 to table 1–107. Summary statistics for analytes and physical properties in samples from wells, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois.

**Table 1–1.** Summary statistics for analytes and physical properties in samples from monitoring well QC–1, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2009.

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	259	1,505	7.0	669	0.69	8.9	585	1,204	13.0	21.0	-86
Minimum value	37	286	<1	62	0.16	6.4	30	384	1.0	7.2	-248
Geometric mean value	49	925	na	543	0.35	7.4	248	830	4.0	12.3	-125
Arithmetic mean value	51	949	na	551	0.36	7.5	253	837	4.4	12.4	-126
Standard deviation	20	189	na	63	0.059	0.32	40	96	2.1	1.3	18
Coefficient of variation	0.39	0.19	na	0.11	0.16	0.043	0.16	0.11	0.47	0.11	-0.14
Number of samples	263	263	263	263	263	263	263	263	263	263	263
Number of detections	263	263	3	263	263	263	263	263	263	263	263
Percent detections	100	100	1	100	100	100	100	100	100	100	100

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

**Table 1-2.** Summary statistics for analytes and physical properties in samples from monitoring well QC-2, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	391	1,091	28,000	579	3.0	8.9	258	850	57	22.0	-85
Minimum value	<15	210	<1	25	0.050	6.1	0.34	204	<1	6.8	-314
Geometric mean value	41	462	19	94	0.46	7.6	29	399	3.2	13.0	-259
Arithmetic mean value	2	551	1,086	112	0.67	7.8	31	415	3.8	13.1	-262
Standard deviation	23	121	3,362	57	0.30	0.42	23	72	3.6	1.7	31
Coefficient of variation	0.54	0.22	3.1	0.51	0.45	0.054	0.74	0.17	0.94	0.13	-0.12
Number of samples	294	294	294	294	294	294	294	294	294	294	294
Number of detections	293	294	185	294	294	294	294	294	293	294	294
Percent detections	>99	100	63	100	100	100	100	100	>99	100	100

**Table 1–3.** Summary statistics for analytes and physical properties in samples from monitoring well QC–2.1, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	97	870	84	100	0.85	8.7	40	744	9.0	17.1	-271
Minimum value	5	276	<1	39	0.040	6.6	<0.4	366	0.8	9.0	-296
Geometric mean value	34	561	na	61	0.50	7.7	5.3	545	3.5	12.8	-278
Arithmetic mean value	36	582	na	61	0.52	7.7	9.5–9.6	548	4.1	12.9	-290
Standard deviation	10	152	na	8.4	0.13	0.41	9.0–9.1	62	2.8	1.8	4.9
Coefficient of variation	0.29	0.26	na	0.14	0.25	0.054	1.1	0.11	0.68	0.14	-0.02
Number of samples	226	226	226	226	226	225	226	226	226	226	226
Number of detections	226	226	14	226	226	225	191	226	225	226	226
Percent detections	100	100	6	100	100	100	85	100	100	100	100



**Table 1–5.** Summary statistics for analytes and physical properties in samples from monitoring well QC–3, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2009.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	30	694	220	96	1.43	8.7	50	528	9.0	16.0	-99
Minimum value	3	238	<1	54	0.02	6.7	19	368	0.4	9.0	-267
Geometric mean value	12	502	0.79	64	0.35	7.8	27	420	2.1	12.5	-227
Arithmetic mean value	12	512	3.7–4.6	64	0.39	7.9	27	422	2.7	12.5	-229
Standard deviation	3.7	101	25.5–25.6	5.4	0.16	0.48	6.3	30	1.7	1.3	24
Coefficient of variation	0.30	0.20	5.5–6.9	0.085	0.40	0.061	0.23	0.071	0.64	0.10	-0.10
Number of samples	75	75	75	75	75	75	75	75	75	75	75
Number of detections	74	74	9	74	74	74	74	74	73	74	74
Percent detections	99	99	12	99	99	99	99	99	97	99	99

**Table 1-6.** Summary statistics for analytes and physical properties in samples from monitoring well QC-4, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed; e, estimated]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	20	703	96	17	1.72	9.0	48	518	7.0	18.3	-196
Minimum value	1	339	<1	9	0.06	6.9	8	392	0.4	10.0	-262
Geometric mean value	<11	523	1.3	11	0.12	8.1	16	442	1.9	12.3	-237
Arithmetic mean value	<12	534	82-83	11	0.16	8.1	19	442	2.8	12.3	-235
Standard deviation	<3.5	107	624	1.6	0.18	0.58	10	27	2.6	1.4	12
Coefficient of variation	0.29e	0.20	7.5-7.6	0.15	1.1	0.072	0.53	0.062	0.93	0.11	-0.050
Number of samples	87	88	89	88	89	88	89	89	89	88	87
Number of detections	77	88	20	88	86	88	85	89	74	88	87
Percent detections	89	100	22	100	97	100	96	100	83	100	100

**Table 1–7.** Summary statistics for analytes and physical properties in samples from monitoring well QC–5, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	39	1,334	<1	16	0.41	9.0	43	726	15	15.0	-129
Minimum value	<15	357	<1	1	<0.01	6.8	2	458	1	9.0	-267
Geometric mean value	26	766	na	9.0	0.10	8.1	11	599	2.6	12.2	-225
Arithmetic mean value	27	785	na	10	0.13	8.1	13	601	3.4	12.2	-226
Standard deviation	3.8	167.5	na	2.3	0.07	0.53	7.8	45	2.6	1.2	25
Coefficient of variation	0.14	0.21	na	0.23	0.54	0.065	0.58	0.075	0.76	0.10	-0.11
Number of samples	86	87	87	87	87	87	87	87	87	87	87
Number of detections	85	87	0	85	81	87	84	87	85	87	87
Percent detections	99	100	0	98	93	100	97	100	98	100	100



**Table 1-8.** Summary statistics for analytes and physical properties in samples from monitoring well QC-6, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	35	950	8	51	0.60	9.0	564	674	12	16.0	-151
Minimum value	13	318	<1	8	0.02	6.7	4	186	1	7.5	-259
Geometric mean value	18	661	na	23	0.33	8.1	21	522	2.8	12.4	-218
Arithmetic mean value	19	678	na	25	0.35	8.1	38	527	3.5	12.4	-219
Standard deviation	4.7	145	na	10	0.076	0.55	83	66	2.4	1.2	21
Coefficient of variation	0.25	0.21	na	0.41	0.22	0.067	2.2	0.13	0.70	0.10	-0.10
Number of samples	87	86	87	86	87	86	87	87	87	86	86
Number of detections	83	86	4	86	87	86	83	87	87	86	86
Percent detections	95	100	5	100	100	100	95	100	100	100	100

**Table 1–9.** Summary statistics for analytes and physical properties in samples from monitoring well QC-7, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	27	859	<1	501	0.70	9.1	32	1,130	10	18.0	-101
Minimum value	2	312	<1	5	0.11	6.4	0.40	322	0.9	10.0	-189
Geometric mean value	11	579	na	13	0.26	8.1	3.7	441	2.8	12.4	-155
Arithmetic mean value	11	589	na	18	0.27	8.1	6.7	446	3.3	12.5	-156
Standard deviation	3.1	104	na	55	0.080	0.58	7.0	88	1.9	1.3	16
Coefficient of variation	0.27	0.18	na	3.0	0.30	0.071	1.0	0.20	0.56	0.10	-0.10
Number of samples	80	80	81	80	81	80	81	81	81	80	80
Number of detections	80	80	0	80	81	79	67	81	80	80	80
Percent detections	100	100	0	100	100	99	83	100	99	100	100

**Table 1–10.** Summary statistics for analytes and physical properties in samples from monitoring well QC–9, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed; e, estimated]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	26	731	5,800	107	0.77	9.6	49	550	7.0	18.0	-75
Minimum value	6	248	<1	44	0.11	6.4	10	268	0.7	9.2	-255
Geometric mean value	<10	411	na	61	0.41	8.0	25	328	1.9	12.7	-191
Arithmetic mean value	<10	418	na	62	0.49	8.0	26	330	2.3	12.8	-194
Standard deviation	<2.6	77	na	6.7	0.22	0.53	8.5	38	1.4	1.3	37
Coefficient of variation	0.26e	0.18	na	0.11	0.45	0.067	0.32	0.11	0.60	0.10	-0.19
Number of samples	74	75	75	75	75	75	75	75	75	75	75
Number of detections	64	75	3	75	73	75	75	75	75	75	75
Percent detections	86	100	4	100	97	100	100	100	100	100	100

**Table 1–11.** Summary statistics for analytes and physical properties in samples from monitoring well QC–10, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed; e, estimated]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	40	1,132	<1	21	0.37	9.4	64	506	10.0	18.0	-124
Minimum value	24	190	<1	9	0.02	7.0	<1	286	0.3	10.0	-250
Geometric mean value	31	498	na	12	0.078	8.2	<5.2	405	1.5	12.5	-219
Arithmetic mean value	31	512	na	12	0.097–0.098	8.2	<8.5	407	2.0	12.6	-220
Standard deviation	2.6	125	na	2.1	0.058–0.059	0.5	<9.6	37	1.8	1.2	21
Coefficient of variation	0.084	0.24	na	0.17	0.59–0.61	0.07	1.1e	0.091	0.90	0.10	-0.093
Number of samples	88	88	88	88	88	88	88	88	88	88	88
Number of detections	88	88	0	88	77	88	67	88	68	88	88
Percent detections	100	100	0	100	88	100	76	100	77	100	100

**Table 1–12.** Summary statistics for analytes and physical properties in samples from monitoring well QC–11, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	40	565	<1	26	0.19	9.1	30	452	7.0	15.0	-186
Minimum value	14	289	<1	11	<0.01	7.1	<0.4	214	0.2	11.0	-241
Geometric mean value	23	403	na	21	0.10	8.1	<2.1	306	1.0	12.8	-221
Arithmetic mean value	23	408	na	21	0.10	8.2	5.4–5.5	309	1.4	12.8	-222
Standard deviation	4.2	65	na	2.6	0.039	0.57	7.3	39	1.5	1.1	13
Coefficient of variation	0.18	0.16	na	0.12	0.39	0.070	1.3–1.4	0.13	1.1	0.084	-0.058
Number of samples	52	52	52	52	52	52	52	52	52	52	52
Number of detections	52	52	0	51	50	52	32	52	37	52	52
Percent detections	100	100	0	98	96	100	62	100	71	100	100

**Table 1–13.** Summary statistics for analytes and physical properties in samples from monitoring well QC–12, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	47	1,500	15	286	0.56	8.6	844	1,088	10.0	25.0	-209
Minimum value	23	526	<1	21	<0.01	6.6	28	574	0.3	5.4	-274
Geometric mean value	37	991	na	155	0.24	7.7	282	891	1.4	12.6	-242
Arithmetic mean value	37	1021	na	167	0.27	7.7	304	896	2.1	12.8	-242
Standard deviation	4.6	245	na	54	0.10	0.43	109	96	2.1	2.4	15
Coefficient of variation	0.12	0.24	na	0.32	0.37	0.056	0.36	0.11	1.0	0.19	-0.062
Number of samples	52	52	52	52	52	52	52	52	52	52	52
Number of detections	52	52	2	52	51	52	52	52	37	52	52
Percent detections	100	100	4	100	98	100	100	100	71	100	100

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

**Table 1-14.** Summary statistics for analytes and physical properties in monitoring well QC-13, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	63	890	<1	2,692	0.25	9.6	70	554	8.0	15.1	-210
Minimum value	21	300	<1	21	0.05	7.1	8.0	304	0.5	10.0	-285
Geometric mean value	42	559	na	39	0.15	7.9	35	444	1.4	13.0	-246
Arithmetic mean value	43	572	na	90	0.16	7.9	38	447	1.9	13.0	-246
Standard deviation	11	120	na	376	0.049	0.51	12	50	1.7	1.1	19
Coefficient of variation	0.26	0.21	na	4.2	0.31	0.064	0.32	0.11	0.89	0.086	-0.075
Number of samples	50	50	50	50	50	50	50	50	50	50	50
Number of detections	50	50	0	50	50	50	50	50	39	50	50
Percent detections	100	100	0	100	100	100	100	100	78	100	100

**Table 1–15.** Summary statistics for analytes and physical properties in samples from monitoring well QC–13, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	63	890	<1	2,692	0.25	9.6	70	554	8.0	15.1	-210
Minimum value	21	300	<1	21	0.05	7.1	8.0	304	0.5	10.0	-285
Geometric mean value	42	559	na	39	0.15	7.9	35	444	1.4	13.0	-246
Arithmetic mean value	43	572	na	90	0.16	7.9	38	447	1.9	13.0	-246
Standard deviation	11	120	na	376	0.049	0.51	12	50	1.7	1.1	19
Coefficient of variation	0.26	0.21	na	4.2	0.31	0.064	0.32	0.11	0.89	0.086	-0.075
Number of samples	50	50	50	50	50	50	50	50	50	50	50
Number of detections	50	50	0	50	50	50	50	50	39	50	50
Percent detections	100	100	0	100	100	100	100	100	78	100	100

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]



**Table 1-16.** Summary statistics for analytes and physical properties in samples from monitoring well QC-14, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	312	1,040	<1	164	0.32	9.2	34	3,982	9.0	16.0	-19
Minimum value	19	442	<1	12	0.02	6.8	0.4	330	1.9	8.0	-248
Geometric mean value	66	644	na	73	0.17	7.8	0.97-2.6	598	3.1	12.7	-205
Arithmetic mean value	83	665	na	90	0.19	7.8	7.6	659	3.4	12.7	-212
Standard deviation	53	172	na	47	0.079	0.5	9.4	486	1.6	1.3	29
Coefficient of variation	0.64	0.26	na	0.52	0.42	0.06	1.2	0.74	0.47	0.10	-0.14
Number of samples	53	53	53	53	53	53	53	53	53	53	53
Number of detections	53	53	0	53	52	53	36	53	53	53	53
Percent detections	100	100	0	100	98	100	68	100	100	100	100

**Table 1–17.** Summary statistics for analytes and physical properties in samples from monitoring well QC–15, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	54	679	<1	62	0.28	9.2	48	464	7.0	18.8	-215
Minimum value	12	249	<1	5	0.01	7.0	<0.4	244	0.7	10.9	-240
Geometric mean value	15	418	na	14	0.18	8.1	1.4	337	1.6	12.9	-217
Arithmetic mean value	16	426	na	15	0.20	8.1	5.8–5.9	339	2.6	13.0	-227
Standard deviation	6.6–7.0	84	na	7.2	0.053	0.5	10	38	2.0	1.5	7.3
Coefficient of variation	0.41–0.44	0.20	na	0.47	0.27	0.07	1.8	0.11	0.77	0.11	-0.032
Number of samples	50	50	50	50	50	50	50	50	50	50	50
Number of detections	47	50	0	50	50	50	28	50	42	50	50
Percent detections	94	100	0	100	100	100	56	100	84	100	100

**Table 1-18.** Summary statistics for analytes and physical properties in samples from monitoring well QC-16, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	253	999	1	126	0.95	9.0	219	1,148	8.0	17.8	-5
Minimum value	8	329	<1	7	0.01	6.7	15.0	354	0.4	9.0	-262
Geometric mean value	19	629	na	76	<0.073	7.8	54	531	1.7	12.1	-191
Arithmetic mean value	22	647	na	78	0.088	7.8	57	536	2.2	12.2	-200
Standard deviation	26	147	na	11.5	0.11	0.4	22	82	1.7	1.6	40
Coefficient of variation	1.2	0.23	na	0.15	1.3	0.06	0.39	0.15	0.77	0.13	-0.20
Number of samples	85	85	85	85	85	85	85	85	85	85	85
Number of detections	85	85	1	85	66	85	85	85	75	85	85
Percent detections	100	100	1	100	78	100	100	100	88	100	100

**Table 1–19.** Summary statistics for analytes and physical properties in samples from monitoring well QC–17, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	20	835	51	198	0.37	8.6	222	980	8.3	23.0	-130
Minimum value	3	263	<1	17	0.09	6.2	10	388	0.5	9.0	-207
Geometric mean value	<8.0	574	0.89	160	0.25	7.7	178	538	1.2	12.5	-170
Arithmetic mean value	8.4	594	2.1–3.0	166	0.26	7.8	186	542	1.7	12.6	-170
Standard deviation	5.1–5.2	147	7.9–8.1	27	0.047	0.48	30	74	1.7	1.9	15
Coefficient of variation	0.61–0.62	0.25	2.6–3.9	0.16	0.18	0.062	0.16	0.14	1.0	0.15	-0.087
Number of samples	47	47	47	47	47	47	47	47	47	47	47
Number of detections	35	47	7	47	47	47	47	47	35	47	47
Percent detections	74	100	15	100	100	100	100	100	74	100	100

**Table 1-20.** Summary statistics for analytes and physical properties in samples from monitoring well QC-18, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	124	723	5	76	0.25	9.4	63	744	6.9	21.5	-188
Minimum value	2	260	<1	5	0.02	6.8	25.0	358	0.3	6.0	-229
Geometric mean value	8.1	485	na	9	0.073	8.3	38.0	416	1.1	12.3	-210
Arithmetic mean value	10	497	na	11	0.089	8.4	39	421	1.5	12.5	-211
Standard deviation	17	106	na	13	0.043-0.044	0.70	8.9	71.2	1.6	2.0	11
Coefficient of variation	1.7	0.21	na	1.2	0.48-0.49	0.083	0.23	0.17	1.1	0.16	-0.054
Number of samples	50	50	50	50	50	50	50	50	50	50	50
Number of detections	36	50	1	50	43	50	50	50	34	50	50
Percent detections	72	100	2	100	86	100	100	100	68	100	100

**Table 1–21.** Summary statistics for analytes and physical properties in samples from monitoring well QC–19, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed; e, estimated]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	53	787	1	160	1.58	9.1	206	1,040	12.6	15.0	-87
Minimum value	1	266	<1	6	<0.10	6.6	64.6	366	0.5	7.5	-183
Geometric mean value	4.9	562	na	119	0.26	7.9	164	481	1.5	12.0	-128
Arithmetic mean value	<5.3	573	na	123	0.28	7.9	165	484	2.1	12.1	-129
Standard deviation	<6.0	112	na	19	0.16	0.53	18	71	2.0	1.2	16
Coefficient of variation	1.1e	0.20	na	0.15	0.57	0.066	0.11	0.15	0.95	0.10	-0.12
Number of samples	78	79	79	79	79	79	79	79	79	79	79
Number of detections	64	79	1	79	78	79	79	79	66	79	79
Percent detections	82	100	1	100	99	100	100	100	84	100	100

**Table 1–22.** Summary statistics for analytes and physical properties in samples from monitoring well QC–20, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	33	730	1	158	0.25	9.2	108	606	7.3	18.9	-217
Maximum value	33	730	1	158	0.25	9.2	108	606	7.3	18.9	-217
Geometric mean value	18	357	na	22	0.13	8.1	<6.6	300	1.4	12.5	-271
Arithmetic mean value	18	365	na	27	0.15	8.1	10	304	1.5–1.7	12.6	-271
Standard deviation	3.0	86	na	25	0.042	0.60	22	58	1.2–1.4	1.7	9.9
Coefficient of variation	0.16	0.24	na	0.93	0.28	0.074	2.2	0.19	0.71–0.93	0.13	-0.036
Number of samples	46	46	46	46	46	46	46	46	46	46	45
Number of detections	46	46	2	46	45	46	28	46	35	46	45
Percent detections	100	100	4	100	98	100	61	100	76	100	100

**Table 1–23.** Summary statistics for analytes and physical properties in samples from monitoring well QC–21, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	29	679	1	114	0.63	9.1	126	582	18.0	20.2	-43
Minimum value	12	212	<1	6	0.01	6.6	<0.4	102	0.7	11.0	-280
Geometric mean value	17	400	na	16	0.088	8.0	<4.7	330	2.6	13.0	-256
Arithmetic mean value	17	409	na	24	0.11	8.0	9.8	340	3.5	13.1	-261
Standard deviation	3.1	89	na	24	0.088	0.63	20	79.0	3.2	1.6	31
Coefficient of variation	0.18	0.22	na	1.0	0.80	0.078	2.0	0.23	0.91	0.13	-0.12
Number of samples	58	58	58	58	58	58	58	58	58	58	58
Number of detections	58	58	1	58	49	58	46	58	58	58	58
Percent detections	100	100	2	100	84	100	79	100	100	100	100



**Table 1–24.** Summary statistics for analytes and physical properties in samples from monitoring well QC–22, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	19	465	<1	57	0.34	9.0	537	414	9.0	15.0	-27
Minimum value	10	153	<1	10	0.08	6.8	0.4	172	0.5	10.0	-299
Geometric mean value	14	323	na	27	0.19	7.9	<3.6	269	2.1	12.4	-242
Arithmetic mean value	14	328	na	28	0.20	8.0	13	271	2.4	12.5	-252
Standard deviation	1.8	61	na	7.4	0.056	0.53	70	34.3	1.4	1.3	43
Coefficient of variation	0.13	0.18	na	0.26	0.29	0.066	5.4	0.13	0.57	0.11	-0.17
Number of samples	59	59	59	59	59	59	59	59	59	59	59
Number of detections	58	59	0	59	59	59	43	59	59	59	59
Percent detections	98	100	0	100	100	100	73	100	100	100	100

**Table 1–25.** Summary statistics for analytes and physical properties in samples from monitoring well QC–23, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	28	581	<1	17	0.24	9.5	14	508	7.3	16.3	-22
Minimum value	14	268	<1	4	0.01	7.0	<0.4	292	<0.3	11.0	-249
Geometric mean value	20	413	na	6	0.090	8.4	<2.7	348	<1.2	12.4	-216
Arithmetic mean value	20	420	na	6	0.10	8.4	2.8–2.9	350	1.5	12.5	-227
Standard deviation	1.9	76	na	1.5	0.051	0.70	3.6–3.7	35	1.5	1.1	41
Coefficient of variation	0.093	0.18	na	0.24	0.51	0.083	1.2–1.3	0.10	1.0	0.087	-0.18
Number of samples	63	63	63	63	63	63	63	63	63	63	63
Number of detections	63	63	0	63	56	63	37	63	44	63	63
Percent detections	100	100	0	100	89	100	59	100	70	100	100

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

**Table 1–26.** Summary statistics for analytes and physical properties in samples from monitoring well QC–24, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	49	993	<1	40	0.87	9.2	11	490	9.6	15.0	-22
Minimum value	23	215	<1	8	0.07	7.1	<0.4	198	0.2	10.8	-241
Geometric mean value	27	316	na	12	0.14	8.2	<3.4	270	<1.0	12.5	-206
Arithmetic mean value	28	325	na	13	0.16	8.2	0.16	273	2.3–2.5	12.5	-220
Standard deviation	3.5	100	na	4.2	0.10	0.61	0.10	41.5	3.2–3.3	0.92	46
Coefficient of variation	0.13	0.31	na	0.33	0.63	0.075	0.63	0.15	1.3–1.4	0.073	-0.21
Number of samples	63	63	63	63	63	63	63	63	63	63	63
Number of detections	63	63	0	63	62	63	29	63	45	63	63
Percent detections	100	100	0	100	98	100	46	100	71	100	100

**Table 1–27.** Summary statistics for analytes and physical properties in samples from monitoring well QC–25, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	20	377	<1	48	0.29	9.6	30	352	7.5	22.4	-17
Minimum value	11	194	<1	8	0.01	6.9	<0.4	178	<0.2	10.8	-243
Geometric mean value	14	274	na	17	0.14	8.1	<4.0	236	<1.0	13.0	-215
Arithmetic mean value	14	277	na	17	0.15	8.1	5.1	238	1.3	13.1	-225
Standard deviation	1.8	43	na	6.5	0.048	0.63	5.9	31.1	1.4	2.0	38
Coefficient of variation	0.12	0.15	na	0.37	0.32	0.078	1.2	0.13	1.1	0.15	-0.17
Number of samples	58	58	58	58	58	58	58	58	58	58	58
Number of detections	54	57	0	57	57	57	47	57	40	57	57
Percent detections	93	98	0	98	98	98	81	98	69	98	98

**Table 1–28.** Summary statistics for analytes physical properties in samples from monitoring well QC–26, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground-water level (feet from City of Chicago Datum)
Maximum value	36	468	<1	68	0.97	9.3	17	1,322	10.9	14.0	-15
Minimum value	10	218	<1	4	<0.01	7.1	1.0	214	0.2	10.0	-246
Geometric mean value	12	326	na	7.3	<0.086	8.3	<3.2	297	<1.0	12.3	-197
Arithmetic mean value	13	331	na	8.7	0.10	8.3	3.0–3.2	308	1.1	12.4	-211
Standard deviation	4.2	59	na	10	0.12	0.59	4.3–4.4	138	1.6	0.92	49
Coefficient of variation	0.33	0.18	na	1.2	1.2	0.071	1.3–1.5	0.45	1.5	0.075	-0.23
Number of samples	61	61	61	61	61	61	61	61	61	61	61
Number of detections	56	61	0	61	50	61	34	61	39	61	61
Percent detections	92	100	0	100	82	100	56	100	64	100	100

**Table 1-29.** Summary statistics for analytes and physical properties in samples from monitoring well QC-27, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	43	502	<1	48	0.29	9.2	12	352	6.0	16.0	-136
Minimum value	13	188	<1	10	0.06	6.8	<0.4	204	0.2	10.0	-248
Geometric mean value	30	327	na	26	0.15	8.0	1.0	276	1.1	12.6	-204
Arithmetic mean value	31	333	na	26	0.16	8.0	2.4–2.6	278	1.1	12.7	-205
Standard deviation	5.6	65	na	5.3	0.048	0.52	3.2–3.3	34	1.1	1.1	20
Coefficient of variation	0.18	0.20	na	0.20	0.29	0.066	1.2–1.4	0.12	1.0	0.087	-0.10
Number of samples	60	60	60	60	60	60	60	60	60	60	60
Number of detections	59	60	0	60	59	60	28	60	41	60	60
Percent detections	98	100	0	100	98	100	47	100	68	100	100

**Table 1–30.** Summary statistics for analytes properties in samples from monitoring well QC–28, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	38	870	<1	34	0.25	8.9	589	408	6.0	17.0	-49
Minimum value	11	166	<1	8	<0.01	6.4	<0.4	228	0.8	10.7	-255
Geometric mean value	15	326	na	16	<0.064	8.0	<3.6	284	1.9	13.1	-227
Arithmetic mean value	15	339	na	16	0.071–0.072	8.0	15	286	2.1	13.1	-232
Standard deviation	4.8–5.2	112	na	3.3	0.062–0.063	0.59	4.8–5.2	36	1.1	1.3	37
Coefficient of variation	0.32–0.35	0.33	na	0.20	0.86–0.89	0.073	0.32–0.35	0.12	0.54	0.10	-0.16
Number of samples	58	58	58	58	58	58	58	58	58	58	58
Number of detections	54	58	0	58	42	58	33	58	57	58	58
Percent detections	93	100	0	100	72	100	57	100	98	100	100

**Table 1–31.** Summary statistics for analytes and physical properties in samples from monitoring well QC–29, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	228	1,480	<1	518	0.80	8.2	203	1,102	6.5	15.3	0
Minimum value	9	260	<1	40	0.27	6.7	33	342	0.5	7.0	-78
Geometric mean value	97	708	na	222	0.58	7.4	122	711	1.3	12.0	-44
Arithmetic mean value	127	760	na	262	0.60	7.4	130	739	1.5	12.1	-56
Standard deviation	63	274	na	120	0.14	0.32	41	194	1.0	1.3	19
Coefficient of variation	0.50	0.36	na	0.46	0.23	0.043	0.31	0.26	0.68	0.10	-0.33
Number of samples	63	64	64	64	64	64	64	64	64	63	64
Number of detections	62	64	0	64	64	64	64	64	63	63	64
Percent detections	98	100	0	100	100	100	100	100	98	100	100



**Table 1-32.** Summary statistics for analytes and physical properties in samples from monitoring well QC-30, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed; e, estimated]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	161	700	49	352	0.77	8.7	175	892	10.2	24.1	-6
Minimum value	5	220	<1	42	<0.02	6.8	1.0	204	0.7	5.0	-150
Geometric mean value	11	434	na	59	0.22	7.9	65.1	418	1.4	11.9	-115
Arithmetic mean value	<14	446	na	64	0.28	7.9	71.3	425	1.9	12.0	-128
Standard deviation	<21	102	na	45	0.15	0.42	24	84	1.8	2.2	34
Coefficient of variation	1.5e	0.23	na	0.70	0.54	0.053	0.34	0.20	0.96	0.18	-0.27
Number of samples	60	61	60	61	61	61	61	61	61	61	61
Number of detections	38	61	4	61	58	61	61	61	47	61	61
Percent detections	63	100	7	100	95	100	100	100	77	100	100

**Table 1–33.** Summary statistics for analytes physical properties in samples from monitoring well QC–31, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2013.

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	37	941	9	264	1.10	8.8	229	636	7.3	17.1	-1
Minimum value	8	280	<1	182	0.59	6.8	81	482	0.6	10.0	-122
Geometric mean value	16	559	0.66	230	0.96	7.6	178	557	1.3	12.7	-65
Arithmetic mean value	17	577	na	230	0.96	7.6	179	558	1.5	12.7	-79
Standard deviation	<6.4	147	na	16	0.10	0.30	19	28	1.2	1.3	27
Coefficient of variation	0.35e	0.25	na	0.069	0.10	0.039	0.11	0.05	0.83	0.10	-0.35
Number of samples	65	66	65	66	66	66	66	66	66	66	66
Number of detections	60	66	3	66	66	66	66	66	61	66	66
Percent detections	92	100	5	100	100	100	100	100	92	100	100

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

**Table 1-34.** Summary statistics for analytes and physical properties in samples from monitoring well QC-37, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003-2010.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Tem- perature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	35	1,399	<1	25	0.41	9.5	121	1,126	53	15.0	-47
Minimum value	24	355	<1	11	0.01	6.9	15	662	1.7	8.8	-136
Geometric mean value	28	860	na	17	0.13	8.1	57	912	6.5	12.4	-119
Arithmetic mean value	28	919	na	17	0.17	8.1	66	924	12	12.6	-123
Standard deviation	3.1	323	na	4.8	0.10	0.73	31	153	15	2.1	24
Coefficient of variation	0.11	0.35	na	0.28	0.59	0.090	0.47	0.17	1.26	0.17	-0.20
Number of samples	12	12	12	11	12	12	12	12	12	12	12
Number of detections	12	12	0	11	12	12	12	12	12	12	12
Percent detections	100	100	0	100	100	100	100	100	100	100	100





**Table 1–37.** Summary statistics for analytes and physical properties in samples from monitoring well QD–23, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	313	870	84	100	0.85	8.7	40	744	9.0	17.1	-271
Minimum value	5	276	<1	39	0.040	6.6	<0.4	366	0.8	9.0	-296
Geometric mean value	34	561	na	61	0.50	7.7	5.3	545	3.5	12.8	-278
Arithmetic mean value	36	582	na	61	0.52	7.7	9.5-9.6	548	4.1	12.9	-290
Standard deviation	10	152	na	8.4	0.13	0.41	9.0-9.1	62	2.8	1.8	4.9
Coefficient of variation	0.29	0.26	na	0.14	0.25	0.054	1.1	0.11	0.68	0.14	-0.02
Number of samples	226	226	226	226	226	225	226	226	226	226	226
Number of detections	226	226	14	226	226	225	191	226	225	226	226
Percent detections	100	100	6	100	100	100	85	100	100	100	100

**Table 1–38.** Summary statistics for analytes and physical properties in samples from monitoring well QD–24, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	168	1,562	48	810	0.76	8.0	830	1,798	14.0	14.0	89
Minimum value	14	185	<1	66	<0.01	6.1	91	634	1.0	9.0	-12
Geometric mean value	95	978	na	565	0.35	7.4	194	934	3.7	11.5	14
Arithmetic mean value	99	1,020	na	580	0.40	7.4	203	952	4.4	11.5	14
Standard deviation	24	265	na	100	0.14	0.33	79	193	2.7	1.0	10
Coefficient of variation	0.24	0.26	na	0.17	0.35	0.044	0.39	0.20	0.60	0.087	0.69
Number of samples	91	91	91	91	91	91	91	91	91	91	91
Number of detections	90	91	4	91	90	91	91	91	91	91	91
Percent detections	99	100	4	100	99	100	100	100	100	100	100

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]





**Table 1-40.** Summary statistics for analytes and physical properties in samples from monitoring well QD-26, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground-water level (feet from City of Chicago Datum)
Maximum value	83	1,405	25	755	3.53	8.2	237	1,330	8.0	16.1	-8
Minimum value	4	355	<1	326	0.23	6.7	<0.4	424	0.4	10.0	-108
Geometric mean value	22	719	na	443	0.35	7.4	112	613	<2.5	12.2	-18
Arithmetic mean value	24	760	na	446	0.40	7.4	120	619	<3.2	12.2	-20
Standard deviation	12	250	na	55	0.43	0.28	27	97	<2.1	1.1	12
Coefficient of variation	0.50	0.33	na	0.12	1.1	0.038	0.22	0.16	<0.66	0.090	-0.59
Number of samples	87	87	87	87	87	87	87	87	87	87	87
Number of detections	83	87	3	87	87	87	86	87	74	87	87
Percent detections	95	100	3	100	100	100	99	100	85	100	100









**Table 1–45.** Summary statistics for analytes and physical properties in samples from monitoring well QD–31, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	507	1,722	7,600	882	2.58	8.4	402	1,358	13.0	15.0	-118
Minimum value	102	483	<1	222	0.09	6.8	146	206	0.3	9.8	-200
Geometric mean value	120	1,183	1.5	317	0.20	7.6	210	956	2.1	11.6	-181
Arithmetic mean value	123	1,219	186–187	328	0.24	7.6	213	967	2.9	11.6	-183
Standard deviation	43	269	1050	96	0.26	0.27	38	108	2.5	1.0	23
Coefficient of variation	0.35	0.22	5.6	0.29	1.1	0.036	0.18	0.11	0.86	0.085	-0.12
Number of samples	87	87	87	87	87	87	87	87	87	87	87
Number of detections	87	87	26	87	86	87	87	87	73	87	87
Percent detections	100	100	30	100	99	100	100	100	84	100	100

**Table 1-46.** Summary statistics for analytes and physical properties in samples from monitoring well QD-32, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	576	3,510	360	427	0.58	9.6	335	2,854	36.0	16.0	-115
Minimum value	122	221	<1	17	0.03	6.8	149	420	0.3	9.0	-218
Geometric mean value	480	2,149	na	33	0.15	8.4	220	1,894	2.0	11.6	-156
Arithmetic mean value	487	2,283	na	38	0.18	8.4	222	1,924	3.8	11.7	-161
Standard deviation	67	629	na	43	0.082	0.56	28	274	4.7	1.2	38
Coefficient of variation	0.14	0.28	na	1.1	0.46	0.067	0.13	0.14	1.2	0.10	-0.24
Number of samples	85	85	85	85	85	85	85	85	85	85	85
Number of detections	85	85	7	85	80	85	85	85	68	85	85
Percent detections	100	100	8	100	94	100	100	100	80	100	100

**Table 1–47.** Summary statistics for analytes and physical properties in samples from monitoring well QD–33, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	567	2,731	3,300	82	3.04	9.1	252	2,046	26.0	19.9	-98
Minimum value	327	481	<1	17	0.06	6.8	24	1,474	0.2	5.9	-205
Geometric mean value	362	1,767	na	27	0.21	8.1	197	1,692	1.3	12.1	-155
Arithmetic mean value	363	1,881	na	28	0.30	8.1	200	1,694	2.8	12.2	-157
Standard deviation	26	562	na	6.1	0.44	0.46	24	90	3.7	1.5	25
Coefficient of variation	0.072	0.30	na	0.22	1.5	0.056	0.12	0.053	1.3	0.12	-0.16
Number of samples	113	113	113	113	112	113	113	113	113	113	113
Number of detections	113	113	8	113	110	113	113	113	85	113	113
Percent detections	100	100	7	100	98	100	100	100	75	100	100









**Table 1–51.** Summary statistics for analytes and physical properties in samples from monitoring well QD–37, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	372	2,330	7	969	26	8.4	567	2,282	30.0	16.3	-7
Minimum value	213	384	<1	1	<0.01	6.6	66	820	0.3	4.7	-244
Geometric mean value	279	1,442	na	403	0.28	7.5	331	1,446	1.4	12.6	-196
Arithmetic mean value	280	1,537	na	446	0.96	7.5	341	1,452	2.7	12.7	-201
Standard deviation	32	481	na	144	2.9	0.35	70	127	4.1	1.2	23
Coefficient of variation	0.11	0.31	na	0.32	3.0	0.05	0.20	0.087	1.5	0.10	-0.11
Number of samples	112	111	112	112	112	112	112	112	112	112	112
Number of detections	112	111	1	112	108	112	112	112	84	112	112
Percent detections	100	100	1	100	96	100	100	100	75	100	100

**Table 1–52.** Summary statistics for analytes and physical properties in samples from monitoring well QD–38, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	319	1,702	<1	437	0.60	8.4	253	1,534	10.0	16.0	-53
Minimum value	21	451	<1	59	0.02	6.7	9	562	0.3	4.3	-236
Geometric mean value	202	1,135	na	244	0.31	7.6	115	888	1.5	12.0	-167
Arithmetic mean value	207	1,194	na	249	0.34	7.6	121	895	2.2	12.1	-171
Standard deviation	34	343	na	41	0.079	0.34	37	114	1.7	1.4	32
Coefficient of variation	0.16	0.29	na	0.17	0.23	0.045	0.30	0.13	0.76	0.11	-0.19
Number of samples	90	90	90	90	90	90	90	90	90	90	90
Number of detections	90	90	0	90	89	90	90	90	77	90	90
Percent detections	100	100	0	100	99	100	100	100	86	100	100

**Table 1–53.** Summary statistics for analytes and physical properties in samples from monitoring well QD–39, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	77	1,600	3	532	0.32	9.2	349	1,242	10.0	14.3	3
Minimum value	20	526	<1	15	<0.01	7.1	24	760	0.3	9.0	-159
Geometric mean value	31	1,048	na	23	<0.096	8.2	103	866	1.6	11.9	-94
Arithmetic mean value	32	1,072	na	38	0.073–0.074	8.3	108	870	2.5	11.9	-74
Standard deviation	9.9	221	na	87	0.057–0.060	0.48	40	92	2.4	1.0	68
Coefficient of variation	0.31	0.21	na	2.3	0.77–0.82	0.058	0.37	0.11	0.97	0.082	-0.93
Number of samples	52	52	52	52	52	52	52	52	52	52	52
Number of detections	52	52	2	52	33	52	52	52	38	52	52
Percent detections	100	100	4	100	63	100	100	100	73	100	100



**Table 1–55.** Summary statistics for analytes and physical properties in samples from monitoring well QD–41, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	132	1,640	<1	555	0.37	9.2	493	1,090	9.0	20.0	-116
Minimum value	<10	373	<1	18	<0.10	6.9	96.7	752	0.9	9.0	-216
Geometric mean value	18	941	na	398	0.26	7.6	352	852	2.4	12.4	-130
Arithmetic mean value	20	969	na	436	0.27	7.6	358	854	3.0	12.5	-131
Standard deviation	17	225	na	95	0.048	0.35	54	72	1.8	1.4	15
Coefficient of variation	0.83	0.23	na	0.22	0.18	0.05	0.15	0.084	0.62	0.11	-0.12
Number of samples	50	50	50	50	50	50	50	50	50	50	50
Number of detections	48	50	0	50	49	50	50	50	49	50	50
Percent detections	96	100	0	100	98	100	100	100	98	100	100





**Table 1–57.** Summary statistics for analytes and physical properties in samples from monitoring well QD–43, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	79	1,087	<1	701	0.37	8.0	423	960	13.0	14.8	2
Minimum value	16	8	<1	394	0.01	6.9	157	598	0.7	10.0	-162
Geometric mean value	34	723	na	464	0.24	7.5	228	746	1.9	11.8	-142
Arithmetic mean value	36	805	na	466	0.26	7.5	230	749	2.6	11.8	-141
Standard deviation	11	233	na	51	0.071	0.24	38	66	2.5	1.0	28
Coefficient of variation	0.31	0.29	na	0.11	0.27	0.032	0.17	0.088	0.94	0.087	-0.20
Number of samples	50	50	50	50	50	50	50	50	50	50	49
Number of detections	50	50	0	50	50	50	50	50	48	50	49
Percent detections	100	100	0	100	100	100	100	100	96	100	100

**Table 1–58.** Summary statistics for analytes and physical properties in samples from monitoring well QD–44, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	158	961	230	715	0.53	8.9	273	898	7.0	15.0	-3
Minimum value	7	250	<1	79	0.19	6.4	92	392	0.7	9.0	-172
Geometric mean value	15	611	na	268	0.31	7.7	197	602	1.7	11.6	-15
Arithmetic mean value	18	640	na	282	0.32	7.7	201	608	2.1	11.6	-19
Standard deviation	20	184	na	87	0.059	0.44	36	86	1.5	1.2	22
Coefficient of variation	1.1	0.29	na	0.31	0.18	0.057	0.18	0.14	0.69	0.10	-1.2
Number of samples	55	55	55	55	55	55	55	55	55	55	55
Number of detections	54	55	3	55	55	55	55	55	51	55	55
Percent detections	98	100	5	100	100	100	100	100	93	100	100



**Table 1-60.** Summary statistics for analytes and physical properties in samples from monitoring well QD-46, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	151	1,755	470	700	0.74	8.8	277	1,296	10.0	16.0	-70
Minimum value	8	443	<1	21	0.01	6.4	95	540	0.4	9.9	-194
Geometric mean value	15	797	0.75	93	0.21	7.8	141	650	1.9	12.1	-174
Arithmetic mean value	19	824	0.81-1.7	107	0.23	7.9	144	656	2.5	12.2	-175
Standard deviation	20	225	3.6-3.8	96	0.087	0.41	32	108	2.0	1.2	16
Coefficient of variation	1.1	0.27	2.1-4.7	0.90	0.37	0.052	0.23	0.17	0.79	0.10	-0.09
Number of samples	87	88	88	87	88	88	88	88	88	88	87
Number of detections	84	88	11	87	88	88	88	88	79	88	87
Percent detections	97	100	13	100	100	100	100	100	90	100	100

**Table 1–61.** Summary statistics for analytes and physical properties in samples from monitoring well QD–47, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	58	4,680	<1	281	0.46	9.3	202	620	9	17.0	7
Minimum value	11	296	<1	130	0.14	7.0	127	484	1	10.0	-20
Geometric mean value	17	640	na	237	0.25	7.7	151	537	1.7	13.2	-2
Arithmetic mean value	17	713	na	238	0.25	7.7	151	538	2.2	13.2	-2
Standard deviation	6.1	580	na	19	0.051	0.33	14	28	1.6	1.3	7.3
Coefficient of variation	0.35	0.81	na	0.081	0.20	0.043	0.10	0.052	0.75	0.10	-4.5
Number of samples	52	52	52	52	52	52	52	52	52	52	52
Number of detections	52	52	0	52	52	52	52	52	48	52	52
Percent detections	100	100	0	100	100	100	100	100	92	100	100

**Table 1-62.** Summary statistics for analytes and physical properties in samples from monitoring well QD-48, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	47	1,030	13	467	0.61	8.8	356	826	8.0	18.0	1
Minimum value	<10	260	<1	101	0.10	6.8	194	428	1.0	10.0	-187
Geometric mean value	13	646	8.8	292	0.26	7.9	271	618	1.8	13.2	-69
Arithmetic mean value	13-15	688	10	302	0.28	7.9	273	624	2.1-2.2	13.3	-112
Standard deviation	6.9-9.1	230	4.9	73	0.11	0.41	30	86	1.5-1.6	1.6	74
Coefficient of variation	0.46-0.70	0.33	0.52	0.24	0.38	0.052	0.11	0.14	0.68-0.76	0.12	-0.66
Number of samples	45	45	45	45	45	45	45	45	45	45	45
Number of detections	34	45	2	45	45	45	45	45	41	45	45
Percent detections	76	100	4	100	100	100	100	100	91	100	100

**Table 1–63.** Summary statistics for analytes and physical properties in samples from monitoring well QD–49, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	28	1,210	170	517	0.60	8.9	333	836	11.0	23.5	16
Minimum value	9	280	<1	8	<0.10	7.0	172	460	<1	10.0	-186
Geometric mean value	15	711	na	309	0.31	7.8	233	626	2.3	13.3	-133
Arithmetic mean value	16	752	na	338	0.35	7.8	236	632	3.0	13.5	-93
Standard deviation	3.2	228	na	93	0.15	0.46	33	87	2.3	2.5	80
Coefficient of variation	0.20	0.30	na	0.27	0.43	0.059	0.14	0.14	0.77	0.19	-0.87
Number of samples	44	44	44	44	44	44	44	44	44	44	44
Number of detections	41	44	3	44	43	44	44	44	41	44	44
Percent detections	93	100	7	100	98	100	100	100	93	100	100



**Table 1-64.** Summary statistics for analytes and physical properties in samples from monitoring well QD-50, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	215	1,158	1	497	0.48	10.0	321	762	9.0	15.0	-58
Minimum value	1	394	<1	<0.5	<0.01	6.6	116.0	374	0.7	9.0	-140
Geometric mean value	14	841	na	7.8	0.078	8.6	252	681	2.0	12.0	-100
Arithmetic mean value	18	867	na	14	0.098-0.099	8.6	255	685	2.4	12.1	-103
Standard deviation	23	195	na	54	0.060-0.061	0.83	33	60	1.5	1.1	27
Coefficient of variation	1.3	0.23	na	3.8	0.60-0.62	0.10	0.13	0.087	0.63	0.091	-0.26
Number of samples	84	84	84	84	84	84	84	84	84	84	84
Number of detections	80	84	1	83	70	84	84	84	81	84	84
Percent detections	95	100	1	99	83	100	100	100	96	100	100

**Table 1–65.** Summary statistics for analytes and physical properties in samples from monitoring well QD–51, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	52	1,030	6	39	0.15	9.8	272	764	8.0	15.0	4
Minimum value	1	300	<1	4	<0.01	6.9	24	466	0.7	10.0	-120
Geometric mean value	12	683	na	5.4	<0.059	8.5	122	570	2.1	12.0	-89
Arithmetic mean value	13	703	na	6.1	0.053–0.055	8.6	125	572	2.6	12.1	-87
Standard deviation	6.7	156	na	4.6	0.040–0.043	0.78	29	52	1.6	1.0	22
Coefficient of variation	0.53	0.22	na	0.75	0.73–1.1	0.091	0.23	0.092	0.62	0.087	-0.25
Number of samples	84	84	84	84	84	84	84	84	84	84	84
Number of detections	81	84	1	83	53	84	84	84	83	84	84
Percent detections	96	100	1	99	63	100	100	100	99	100	100

**Table 1–66.** Summary statistics for analytes and physical properties in samples from monitoring well QD–52, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	32	918	840	26	0.20	9.7	265	686	6.0	16.1	25
Minimum value	1	325	<1	8	<0.01	6.8	58	198	0.7	9.0	-106
Geometric mean value	15	647	na	18	0.078	8.3	137	500	2.0	13.2	-58
Arithmetic mean value	15	660	na	19	0.097–0.098	8.4	139	503	2.3	13.3	-53
Standard deviation	3.1	122	na	4.3	0.049–0.051	0.68	24	53	1.3	1.2	21
Coefficient of variation	0.20	0.18	na	0.23	0.50–0.53	0.081	0.17	0.11	0.55	0.093	-0.41
Number of samples	82	82	82	82	82	82	82	81	82	82	82
Number of detections	82	82	2	82	71	82	82	81	79	82	82
Percent detections	100	100	2	100	87	100	100	100	96	100	100

**Table 1–67.** Summary statistics for analytes and physical properties in samples from monitoring well QD–53, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	38	1,030	920	15	0.20	9.7	251	680	9.0	17.1	-18
Minimum value	13	354	<1	2	<0.01	6.7	12	520	0.9	9.0	-169
Geometric mean value	19	766	na	8.2	<0.050	8.4	118	603	2.5	12.8	-116
Arithmetic mean value	19	780	na	8.7	0.037–0.040	8.4	136	604	3.0	12.9	-125
Standard deviation	3.9	142	na	2.7	0.039–0.042	0.70	50	34	1.9	1.5	39
Coefficient of variation	0.20	0.19	na	2.7	0.98–1.1	0.70	50	34	1.9	1.5	-0.33
Number of samples	83	83	83	83	83	83	83	83	83	83	83
Number of detections	83	83	3	83	43	83	83	83	82	83	83
Percent detections	100	100	4	100	52	100	100	100	99	100	100

**Table 1–68.** Summary statistics for analytes and physical properties in samples from monitoring well QD–54, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	60	1,216	3,700	61	0.37	9.6	443	582	6	19.0	34
Minimum value	10	336	<1	20	<0.01	6.7	70	404	0.4	5.0	-33
Geometric mean value	17	598	na	40	0.19	8.3	140	460	1.5	12.1	-21
Arithmetic mean value	19	613	na	40	0.21	8.3	145	461	1.8	12.2	-21
Standard deviation	8.6	139	na	8.4	0.066	0.73	42	33	1.2	1.6	12
Coefficient of variation	0.46	0.23	na	0.21	0.31	0.087	0.29	0.071	0.64	0.13	-0.60
Number of samples	83	83	83	83	83	83	83	83	83	83	83
Number of detections	83	83	2	83	82	83	83	83	71	83	83
Percent detections	100	100	2	100	99	100	100	100	86	100	100

**Table 1–69.** Summary statistics for analytes and physical properties in samples from monitoring well QD–55, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	28	947	6	231	0.47	10.5	477	848	7.0	15.4	33
Minimum value	10	288	<1	83	0.13	4.6	34	302	0.4	5.0	-147
Geometric mean value	16	602	na	168	0.34	7.9	160	480	2.1	11.8	-131
Arithmetic mean value	16	616	na	172	0.34	7.9	171	485	2.4	11.9	-126
Standard deviation	2.9	127	na	38	0.062	0.78	57	67	1.3	1.5	40
Coefficient of variation	0.18	0.21	na	0.22	0.18	0.10	0.33	0.14	0.55	0.13	-0.31
Number of samples	83	83	83	83	83	83	83	83	83	83	83
Number of detections	83	83	1	83	83	83	83	83	81	83	83
Percent detections	100	100	1	100	100	100	100	100	98	100	100

**Table 1–70.** Summary statistics for analytes and physical properties in samples from monitoring well QD–56, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	64	875	<1	123	0.94	9.5	257	534	8.0	14.0	34
Minimum value	9	210	<1	19	<0.01	6.4	2	256	0.3	6.0	-83
Geometric mean value	12	474	na	48	0.19	8.0	12	354	1.6	11.3	-52
Arithmetic mean value	13	487	na	50	0.22	8.0	20	357	2.2	11.4	-48
Standard deviation	6.8	112	na	12	0.10	0.60	35	48	1.7	1.3	22
Coefficient of variation	0.54	0.23	na	0.23	0.46	0.074	1.8	0.13	0.79	0.11	-0.45
Number of samples	83	83	83	83	83	83	83	83	83	83	83
Number of detections	79	83	0	83	82	83	81	83	67	83	83
Percent detections	95	100	0	100	99	100	98	100	81	100	100

**Table 1–71.** Summary statistics for analytes and physical properties in samples from monitoring well QD–57, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	105	1,010	7	238	0.50	9.6	363	848	9.0	14.2	32
Minimum value	8	230	<1	16	0.14	6.5	47	278	0.6	9.0	-120
Geometric mean value	12	572	na	38	0.27	8.0	89	432	1.8	11.4	-85
Arithmetic mean value	13	598	na	58	0.28	8.0	110	439	2.2	11.5	-81
Standard deviation	11	174	na	54	0.085	0.58	77	89	1.5	1.1	34
Coefficient of variation	0.82	0.29	na	0.94	0.31	0.07	0.70	0.20	0.67	0.10	-0.42
Number of samples	74	74	74	74	74	74	74	74	74	74	74
Number of detections	73	74	2	74	74	74	73	74	65	74	74
Percent detections	99	100	3	100	100	100	99	100	88	100	100



**Table 1-72.** Summary statistics for analytes and physical properties in samples from monitoring well QD-58, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	49	620	<1	145	0.96	8.9	38	602	8.0	16.0	32
Minimum value	1	170	<1	90	0.14	6.9	0.4	180	0.20	9.0	-112
Geometric mean value	12	386	na	121	0.28	7.7	<5.7	294	1.2	11.6	-89
Arithmetic mean value	14	395	na	121	0.29	7.8	7.1	299	1.7	11.6	-84
Standard deviation	8.3	82	na	8.8	0.10	0.40	7.2	60	1.5	1.1	33
Coefficient of variation	0.60	0.21	na	0.073	0.32	0.051	1.0	0.20	0.84	0.090	-0.39
Number of samples	75	75	75	75	75	75	75	75	75	75	75
Number of detections	74	75	0	75	75	75	60	75	62	75	75
Percent detections	99	100	0	100	100	100	80	100	83	100	100

**Table 1–73.** Summary statistics for analytes and physical properties in samples from monitoring well QD–59, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	190	1,080	<1	446	0.55	8.8	139	796	9.0	14.0	36
Minimum value	10	230	<1	162	0.05	6.6	5	246	0.4	9.0	-66
Geometric mean value	90	622	na	283	0.30	7.6	44	491	1.2	11.6	-38
Arithmetic mean value	108	652	na	288	0.32	7.6	54	510	1.7	11.7	-35
Standard deviation	50	196	na	54	0.090	0.36	29	133	1.5	0.95	20
Coefficient of variation	0.46	0.30	na	0.19	0.28	0.05	0.53	0.26	0.84	0.081	-0.57
Number of samples	77	77	77	77	77	77	77	77	77	77	77
Number of detections	77	77	0	77	77	77	77	77	66	77	77
Percent detections	100	100	0	100	100	100	100	100	86	100	100

**Table 1-74.** Summary statistics for analytes and physical properties in samples from monitoring well QD-60, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	114	818	<1	300	0.45	8.5	190	966	8.0	16.0	20
Minimum value	39	284	<1	223	0.01	6.6	44.0	318	0.2	10.0	-131
Geometric mean value	47	559	na	260	0.33	7.6	101	445	<1.1	12.2	-110
Arithmetic mean value	48	575	na	260	0.35	7.6	103	450	1.4	12.2	-106
Standard deviation	10	126	na	17	0.066	0.35	18	76	1.6	1.1	33
Coefficient of variation	0.22	0.22	na	0.065	0.19	0.046	0.17	0.17	<1.1	0.091	-0.31
Number of samples	82	82	82	82	82	82	82	82	82	82	82
Number of detections	82	82	0	82	82	82	82	82	62	82	82
Percent detections	100	100	0	100	100	100	100	100	76	100	100

**Table 1–75.** Summary statistics for analytes and physical properties in samples from monitoring well QM–53, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	35	513	<1	165	0.43	9.1	59	500	13.7	15	-22
Minimum value	10	150	<1	100	0.01	6.8	27	12	0.3	8.8	-62
Geometric mean value	15	267	<1	138	0.08	7.9	37	210	1.1	11.6	-40
Arithmetic mean value	16	276	na	138	0.10	8.0	37	225	1.5	11.7	-41
Standard deviation	3.6	74	na	14	0.070	0.50	6.0	73	1.9	1.2	5.6
Coefficient of variation	0.23	0.27	na	0.10	0.69	0.063	0.16	0.32	1.3	0.10	-0.14
Number of samples	54	52	54	52	54	52	55	55	55	52	52
Number of detections	53	52	0	52	50	52	55	55	42	52	52
Percent detections	98	100	0	100	93	100	100	100	76	100	100

**Table 1–76.** Summary statistics for analytes and physical properties in samples from monitoring well QM–56, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	47	505	1	145	0.54	8.5	37	462	5	17.0	-71
Minimum value	29	218	<1	97	0.37	6.6	3	188	0.3	10.0	-79
Geometric mean value	36	359	na	120	0.45	7.8	12	270	1.4	13.4	-76
Arithmetic mean value	36	364	na	120	0.46	7.8	13	274	1.8	13.5	-76
Standard deviation	3.3	63	na	11	0.036	0.44	6.1	49	1.3	1.4	2.0
Coefficient of variation	0.091	0.17	na	0.088	0.079	0.056	0.46	0.18	0.71	0.10	-0.026
Number of samples	40	38	40	38	40	38	40	40	40	38	38
Number of detections	40	38	1	38	40	38	40	40	37	38	38
Percent detections	100	100	3	100	100	100	100	100	93	100	100



**Table 1–78.** Summary statistics for analytes and physical properties in samples from monitoring well QM–61, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	163	1,240	>20,000	320	1.1	8.7	81	736	8.0	24.3	-79
Minimum value	41	220	<1	108	0.19	6.9	5	262	0.6	6.8	-186
Geometric mean value	70	579	4.9	146	0.34	7.8	21	391	2.0	13.3	-168
Arithmetic mean value	75	630	1,204	150	0.37	7.8	27	402	2.6	13.4	-169
Standard deviation	29	260	4,190	37	0.19	0.38	19	102	1.9	2.0	15
Coefficient of variation	0.39	0.41	3.5	0.24	0.51	0.049	0.69	0.25	0.74	0.15	-0.092
Number of samples	83	81	83	81	83	81	83	83	83	81	81
Number of detections	83	81	27	81	83	81	83	83	77	81	81
Percent detections	100	100	33	100	100	100	100	100	93	100	100





**Table 1–80.** Summary statistics for analytes and physical properties in samples from monitoring well QM–63, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	78	2,205	>20,000	1,051	10.47	9.1	4,277	2,070	11.8	17.0	-68
Minimum value	38	317	<1	156	<0.01	6.8	30	394	1.4	10.0	-217
Geometric mean value	51	1,253	3.8	760	1.6	7.5	746	1,478	2.9	13.4	-179
Arithmetic mean value	51	1,327	629	787	1.8	7.5	822	1,524	3.2	13.5	-181
Standard deviation	5.0	413	2,821	166	1.1	0.33	402	310	1.4	1.3	20
Coefficient of variation	0.10	0.31	4.5	0.21	0.59	0.04	0.49	0.20	0.45	0.10	-0.11
Number of samples	113	113	112	113	113	113	113	113	113	113	113
Number of detections	113	113	40	113	112	113	113	113	113	113	113
Percent detections	100	100	36	100	99	100	100	100	100	100	100

**Table 1–81.** Summary statistics for analytes and physical properties in samples from monitoring well QM–64, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	151	993	>20,000	860	3.0	8.2	763	1,424	10	18.0	-107
Minimum value	45	281	<1	162	1.5	7.0	24	162	0.9	10.0	-199
Geometric mean value	57	616	3.3	228	2.0	7.6	46	483	2.4	13.7	-165
Arithmetic mean value	58	635	663	236	2.0	7.6	56	493	2.9	13.7	-165
Standard deviation	13	152	2,522	86	0.31	0.23	77	119	2.0	1.3	10
Coefficient of variation	0.23	0.24	3.8	0.36	0.15	0.031	1.4	0.24	0.68	0.10	-0.061
Number of samples	112	112	111	112	112	112	112	112	112	112	112
Number of detections	112	112	53	112	112	112	112	112	111	112	112
Percent detections	100	100	48	100	100	100	100	100	99	100	100



**Table 1–83.** Summary statistics for analytes and physical properties in samples from monitoring well QM–67, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	324	1,975	6,600	836	12.64	9.0	285	1,726	14	18.0	-60
Minimum value	18	563	<1	205	<0.01	6.6	1.4	330	<1	9.0	-202
Geometric mean value	179	1,118	49	425	1.8	7.4	51	915	4.9	13.5	-161
Arithmetic mean value	187	1,172	571	464	5.3	7.4	101	942	5.6	13.6	-161
Standard deviation	50	346	1,111	185	4.4	0.37	88	217	2.9	1.4	13
Coefficient of variation	0.27	0.30	1.9	0.40	0.82	0.050	0.87	0.23	0.52	0.11	-0.079
Number of samples	118	114	117	115	118	114	116	118	116	114	114
Number of detections	118	114	95	115	112	114	116	115	115	114	114
Percent detections	100	100	81	100	95	100	100	97	99	100	100

**Table 1–84.** Summary statistics for analytes and physical properties in samples from monitoring well QM–68, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	379	670	2,300	212	1.9	9.0	244	550	12.7	17.0	-110
Minimum value	12	166	<1	142	0.23	6.7	0.5	178	0.3	10.0	-185
Geometric mean value	23	334	1.9	174	0.61	7.8	34	274	1.3	13.0	-131
Arithmetic mean value	29	344	63	175	0.65	7.8	41	280	1.7	13.0	-132
Standard deviation	44	88	293	18	0.26	0.49	27	63	1.9	1.3	9.9
Coefficient of variation	1.5	0.26	4.6	0.10	0.40	0.063	0.65	0.22	1.1	0.10	-0.075
Number of samples	70	69	69	69	70	69	70	70	70	69	69
Number of detections	70	69	22	69	70	69	70	70	54	69	69
Percent detections	100	100	32	100	100	100	100	100	77	100	100

**Table 1–85.** Summary statistics for analytes and physical properties in samples from monitoring well QM–69, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	75	754	460	213	1.1	8.8	84	472	11.8	15.0	-16
Minimum value	32	246	<1	134	0.81	6.6	36	290	<1	9.0	-139
Geometric mean value	37	434	na	170	0.93	7.8	54	347	1.3	11.5	43
Arithmetic mean value	37	449	na	171	0.93	7.8	55	349	2.6	11.5	-46
Standard deviation	5.1	114	na	17	0.047	0.48	12	33	1.6	1.3	21
Coefficient of variation	0.14	0.25	na	0.10	0.051	0.061	0.22	0.094	0.61	0.11	-0.45
Number of samples	89	87	88	87	89	87	88	88	89	87	87
Number of detections	89	87	3	87	89	87	88	88	88	87	87
Percent detections	100	100	3	100	100	100	100	100	99	100	100

**Table 1–86.** Summary statistics for analytes and physical properties in samples from monitoring well QM–70, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	65	740	5.0	181	0.57	8.8	71	412	10.6	19.1	-52
Minimum value	44	240	<1	127	0.3	6.8	49	218	0.7	9.0	-93
Geometric mean value	49	439	na	156	0.39	7.9	56	337	1.5	11.7	-72
Arithmetic mean value	50	454	na	156	0.40	7.9	56	338	2.1	11.8	-73
Standard deviation	3.9	115	na	11	0.05	0.42	5.53	30	1.9	1.5	11
Coefficient of variation	0.078	0.25	na	0.074	0.14	0.054	0.098	0.09	0.92	0.12	-0.16
Number of samples	44	43	44	43	44	43	43	43	44	43	43
Number of detections	44	43	3	43	44	43	43	43	32	43	43
Percent detections	100	100	7	100	100	100	100	100	73	100	100

**Table 1–87.** Summary statistics for analytes and physical properties in samples from monitoring well QM–71, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	144	997	1.0	238	0.56	9.2	89	588	6.7	15	-52
Minimum value	48	218	<1	159	0.24	6.8	33	314	0.4	9	-126
Geometric mean value	124	557	na	204	0.44	7.8	70	489	1.2	11.5	64
Arithmetic mean value	125	594	na	205	0.44	7.8	71	492	1.6	11.6	-65
Standard deviation	12	209	na	16	0.048	0.43	9.5	51	1.2	1.2	12
Coefficient of variation	0.10	0.35	na	0.080	0.11	0.055	0.13	0.10	0.75	0.10	-0.19
Number of samples	51	51	51	51	51	51	50	50	51	51	51
Number of detections	51	51	1	51	51	51	50	50	37	51	51
Percent detections	100	100	2	100	100	100	100	100	73	100	100



**Table 1–88.** Summary statistics for analytes and physical properties in samples from monitoring well QM–72, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	147	899	1	272	34	9.4	102	560	10.6	16.0	-65
Minimum value	118	242	<1	176	0.08	6.7	0.34	274	0.40	9.0	-95
Geometric mean value	130	538	na	221	0.34	7.7	3.3	434	1.5	11.5	-81
Arithmetic mean value	130	562	na	221	0.71	7.7	6.4	438	1.9	11.6	-81
Standard deviation	5.8	152	na	14	3.5	0.48	11	57	1.4	1.2	7.1
Coefficient of variation	0.045	0.27	na	0.064	5.0	0.063	1.8	0.13	0.74	0.11	-0.09
Number of samples	91	87	90	87	91	87	91	91	91	87	87
Number of detections	91	87	1	87	90	87	77	91	81	87	87
Percent detections	100	100	1	100	99	100	85	100	89	100	100

**Table 1–89.** Summary statistics for analytes and physical properties in samples from monitoring well QM–73, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	57	584	1	169	0.45	9.3	61	442	11.0	20.9	-86
Minimum value	16	254	<1	48	0.15	5.2	0.64	244	0.7	9.0	-167
Geometric mean value	39	420	na	146	0.27	7.8	3.6	317	2.3	12.3	-137
Arithmetic mean value	40	431	na	148	0.28	7.8	6.6	320	3.1	12.4	-139
Standard deviation	7.5	96	na	18	0.065	0.51	10	42	2.6	1.7	21
Coefficient of variation	0.19	0.22	na	0.12	0.23	0.065	1.5	0.13	0.84	0.14	-0.15
Number of samples	50	50	50	50	50	50	50	50	50	50	50
Number of detections	50	50	1	50	50	50	41	50	50	50	50
Percent detections	100	100	2	100	100	100	82	100	100	100	100

**Table 1–90.** Summary statistics for analytes and physical properties in samples from monitoring well QM–74, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	66	457	2	117	0.34	8.9	50	562	8.9	14.7	-6
Minimum value	10	232	<1	63	0.12	5.4	0.31	226	0.9	9.0	-68
Geometric mean value	48	350	na	96	0.22	7.9	3.3	276	2.0	11.8	-25
Arithmetic mean value	49	357	na	97	0.22	7.9	6.3	280	2.2	11.9	-28
Standard deviation	8.7	70	na	8.8	0.047	0.61	8.7	58	1.4	1.1	14
Coefficient of variation	0.18	0.20	na	0.091	0.21	0.077	1.4	0.21	0.62	0.094	-0.49
Number of samples	48	48	48	48	48	48	48	48	48	48	48
Number of detections	48	48	1	48	48	48	41	48	47	48	48
Percent detections	100	100	2	100	100	100	85	100	98	100	100

**Table 1–91.** Summary statistics for analytes and physical properties in samples from monitoring well QM–75, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	47	402	2,600	707	0.61	8.9	42	428	10	15	-35
Minimum value	8.6	140	<1	20	0.10	5.1	2.7	166	0.40	7.7	-81
Geometric mean value	13	294	1.3	63	0.25	7.9	11	237	1.1	11.8	-62
Arithmetic mean value	14	301	71–72	70	0.26	7.9	12	239	1.4	11.8	-62
Standard deviation	4.8	60	386	75	0.062	0.59	5.1	35	1.5	1.1	9.0
Coefficient of variation	0.34	0.20	5.4	1.1	0.24	0.075	0.42	0.15	1.0	0.090	-0.14
Number of samples	74	74	74	74	74	74	74	74	74	74	74
Number of detections	70	74	18	74	74	74	74	74	50	74	74
Percent detections	95	100	24	100	100	100	100	100	68	100	100

**Table 1–92.** Summary statistics for analytes and physical properties in samples from monitoring well QM–76, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	47	608	19	162	0.36	9.2	97	564	7	16.0	-97
Minimum value	<10	241	<1	12	0.09	5.6	4	234	0.5	9.0	-188
Geometric mean value	12	418	na	47	0.23	8.1	49	347	1.5	12.4	-151
Arithmetic mean value	13	428	na	50	0.24	8.2	56	351	1.9	12.4	-155
Standard deviation	5.7–6.1	89	na	21	0.066	0.74	23	58	1.4	1.3	32
Coefficient of variation	0.44–0.47	0.21	na	0.43	0.28	0.091	0.41	0.16	0.71	0.10	-0.21
Number of samples	49	48	49	48	49	48	49	49	49	48	48
Number of detections	45	48	4	48	49	48	49	49	43	48	48
Percent detections	92	100	8	100	100	100	100	100	88	100	100

**Table 1–93.** Summary statistics for analytes and physical properties in samples from monitoring well QM–77, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	18	329	8,700	51	0.22	8.8	29	378	12.7	15.1	-6
Minimum value	3.6	135	<1	37	0.04	6.2	1.0	92	0.4	10.0	-185
Geometric mean value	11	234	1.9	43	0.12	8.0	3.8	188	1.4	11.7	-155
Arithmetic mean value	11	239	316	43	0.13	8.0	6.2	193	2.0	11.8	-164
Standard deviation	2.7	46	1,497	3.4	0.041	0.6	7.0	48	2.0	1.2	29
Coefficient of variation	0.24	0.19	4.7	0.080	0.31	0.07	1.1	0.25	1.0	0.10	-0.17
Number of samples	51	50	51	50	51	50	51	51	51	50	50
Number of detections	46	50	15	50	46	50	41	51	41	50	50
Percent detections	90	100	29	100	90	100	80	100	80	100	100

**Table 1–94.** Summary statistics for analytes and physical properties in samples from monitoring well QM–78, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	55	855	15	782	0.31	9.4	135	540	10.1	19	-21
Minimum value	8	131	<1	3	0.02	6.2	35	198	0.1	6.4	-166
Geometric mean value	13	421	na	11	0.069	8.3	55	335	0.72	11.5	-116
Arithmetic mean value	15	440	na	21	0.08	8.3	57	340	1.1	11.5	-128
Standard deviation	7.9	131	na	89	0.042	0.6	18	62	1.7	1.5	46
Coefficient of variation	0.53	0.30	na	4.28	0.50	0.08	0.32	0.18	1.6	0.13	-0.36
Number of samples	75	75	75	75	75	75	75	75	75	75	75
Number of detections	68	75	3	75	64	75	75	75	47	75	75
Percent detections	91	100	4	100	85	100	100	100	63	100	100

**Table 1–95.** Summary statistics for analytes and physical properties in samples from monitoring well QM–79, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	33	740	11	415	0.25	9.5	50	1,458	11	20.7	-15
Minimum value	15	190	<1	7	<0.01	6.9	14	198	0.4	9.1	-215
Geometric mean value	19	438	na	11	<0.052	8.3	21	358	1.1	11.5	-115
Arithmetic mean value	19–20	455	na	18	0.051	8.4	21	375	1.7	11.5	-125
Standard deviation	3.3–4.0	122	na	49	0.039	0.69	6.7	157	2.1	1.4	37
Coefficient of variation	0.17–0.21	0.27	na	2.8	0.76	0.08	0.31	0.42	1.3	0.12	-0.29
Number of samples	72	72	72	72	72	72	72	72	72	72	72
Number of detections	71	72	1	72	53	72	72	72	47	72	72
Percent detections	99	100	1	100	74	100	100	100	65	100	100



**Table 1–96.** Summary statistics for analytes and physical properties in samples from monitoring well QM–80, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	30	471	6	44	0.14	9.3	244	7,690	9.7	23	-23
Minimum value	11	130	1	12	<0.01	7.0	0.37	172	0.1	9.9	-157
Geometric mean value	14	273	2.4	21	<0.034	8.1	4.0	230	0.77	12.2	-127
Arithmetic mean value	14	280	3.5	21	0.039	8.2	11	327	1.0	12.3	-131
Standard deviation	2.4–3.3	60	3.5	3.1	0.026	0.59	32	857	1.4	1.7	23
Coefficient of variation	0.17–0.24	0.22	1.01	0.15	0.67	0.072	2.9	2.62	1.4	0.14	-0.18
Number of samples	77	77	76	77	77	77	77	77	77	77	77
Number of detections	71	77	2	77	53	77	63	77	47	77	77
Percent detections	92	100	3	100	69	100	82	100	61	100	100

**Table 1–97.** Summary statistics for analytes and physical properties in samples from monitoring well QM–81, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	39	842	760	37	0.27	9.1	55	598	5	16.0	-32
Minimum value	13	191	<1	8	0.02	6.7	7	196	0.2	10.0	-152
Geometric mean value	21	336	na	27	0.062	8.0	16	256	1.3	12.4	-120
Arithmetic mean value	22	348	na	27	0.077	8.0	18	261	1.7	12.5	-125
Standard deviation	5.7	110	na	4.7	0.048	0.59	8.9	59	1.1	1.1	26
Coefficient of variation	0.26	0.32	na	0.17	0.62	0.073	0.49	0.23	0.66	0.089	-0.21
Number of samples	87	84	87	84	87	84	87	87	87	84	84
Number of detections	86	84	2	84	74	84	87	87	76	84	84
Percent detections	99	100	2	100	85	100	100	100	87	100	100

**Table 1–98.** Summary statistics for analytes and physical properties in samples from monitoring well QM–82, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	46	545	<1	28	0.15	9.2	800	3,956	10.8	15.1	-141
Minimum value	14	150	<1	3	<0.01	7.1	<5	226	0.7	11.0	-200
Geometric mean value	29	381	na	13	<0.053	8.2	13	314	1.7	12.6	-171
Arithmetic mean value	30	392	na	13	0.050–0.051	8.2	28	363	2.2	12.7	-172
Standard deviation	4.0	87	na	3.1	0.032–0.034	0.57	102	473	1.8	1.1	17
Coefficient of variation	0.14	0.22	na	0.24	0.63–0.68	0.069	3.6	1.3	0.85	0.08	-0.10
Number of samples	60	59	60	59	60	59	60	60	60	59	59
Number of detections	60	59	0	59	44	59	59	60	56	59	59
Percent detections	100	100	0	100	73	100	98	100	93	100	100

**Table 1–99.** Summary statistics for analytes and physical properties in samples from monitoring well MW–1, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	248	1,075	11	571	0.81	8.5	587	1,576	10.0	21.0	33
Minimum value	<10	310	<1	374	0.14	6.8	273	684	0.6	10.9	-27
Geometric mean value	33	825	na	439	0.31	7.6	351	812	1.6	14.0	18
Arithmetic mean value	35	848	na	440	0.32	7.6	353	816	2.0	14.0	19
Standard deviation	25	181	na	28	0.085	0.39	35	91	1.7	1.5	12
Coefficient of variation	0.71	0.21	na	0.064	0.27	0.052	0.10	0.11	0.85	0.11	0.65
Number of samples	98	99	99	99	99	99	98	98	99	99	99
Number of detections	97	99	5	99	99	99	98	98	84	99	99
Percent detections	99	100	5	100	100	100	100	100	85	100	100

**Table 1-100.** Summary statistics for analytes and physical properties in samples from monitoring well MW-2, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	1,149	1,324	39	605	0.63	8.7	583	1,042	6.0	18.0	45
Minimum value	7	328	<1	398	0.15	6.8	343	792	0.6	11.0	33
Geometric mean value	25	828	na	462	0.52	7.8	407	865	1.7	13.6	40
Arithmetic mean value	41	872	na	463	0.53	7.9	408	866	2.0	13.7	40
Standard deviation	132	249	na	30	0.06	0.42	35	46	1.1	1.1	2
Coefficient of variation	3.2	0.29	na	0.064	0.12	0.053	0.087	0.053	0.56	0.081	0.051
Number of samples	73	73	73	73	73	73	72	73	73	73	73
Number of detections	73	73	3	73	73	73	72	73	70	73	73
Percent detections	100	100	4	100	100	100	100	100	96	100	100

**Table 1–101.** Summary statistics for analytes and physical properties in samples from monitoring well MW–3, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	99	1,130	24	487	0.67	8.6	588	1,576	9.0	19.8	89
Minimum value	6	316	<1	363	0.04	6.8	339	756	0.4	11.0	30
Geometric mean value	13	789	na	437	0.29	7.7	423	836	1.2	14.3	37
Arithmetic mean value	15	817	na	437	0.30	7.7	424	839	1.5	14.3	37
Standard deviation	11	199	na	19	0.074	0.37	34	81	1.1	1.2	5.1
Coefficient of variation	0.73	0.24	na	0.044	0.25	0.05	0.081	0.10	0.74	0.086	0.14
Number of samples	119	119	119	119	119	119	118	119	119	119	119
Number of detections	113	119	5	119	119	119	118	119	95	119	119
Percent detections	95	100	4	100	100	100	100	100	80	100	100

**Table 1-102.** Summary statistics for analytes and physical properties in samples from monitoring well MW-4, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	97	1,347	4	649	2.24	8.8	649	2,486	9.0	21.5	21
Minimum value	<10	357	<1	482	<0.01	6.8	311	820	0.3	10.0	-75
Geometric mean value	52	938	na	558	0.091	7.6	382	965	1.3	13.6	-6.5
Arithmetic mean value	54	973	na	559	0.11	7.6	383	972	1.8	13.7	-6
Standard deviation	9.9-10.4	239	na	36	0.21	0.29	38	152	1.5	1.4	10
Coefficient of variation	5.1-5.4	0.25	na	0.064	1.9	0.039	0.10	0.16	0.86	0.10	-1.8
Number of samples	113	113	113	113	113	113	112	113	113	113	113
Number of detections	112	113	7	113	92	113	112	113	87	113	113
Percent detections	99	100	6	100	81	100	100	100	77	100	100

**Table 1–103.** Summary statistics for analytes and physical properties in samples from monitoring well MW–5, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	961	1,830	1,700	607	0.48	9.0	476	2,166	7.0	19.0	-25
Minimum value	9	333	<1	66	<0.01	6.8	15	606	0.4	11.0	-122
Geometric mean value	108	1,005	0.96	319	0.081	7.8	286	897	1.7	14.2	-48
Arithmetic mean value	140	1,046	20	340	0.010	7.8	303	917	2.1	14.3	-49
Standard deviation	128	275	173	118	0.11	0.46	80	224	1.3	1.5	10
Coefficient of variation	0.92	0.26	8.7	0.35	11	0.059	0.27	0.24	0.61	0.11	-0.21
Number of samples	96	96	96	96	96	96	95	96	96	96	96
Number of detections	96	96	21	96	76	96	95	96	90	96	96
Percent detections	100	100	22	100	79	100	100	100	94	100	100



**Table 1-104.** Summary statistics for analytes and physical properties in samples from monitoring well MW-6, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	93	1,304	480	572	0.62	8.9	472	1,044	9.0	18.1	64
Minimum value	15	218	<1	240	0.31	6.3	55	412	0.3	6.0	12
Geometric mean value	38	764	0.96	392	0.48	7.7	322	777	1.8	13.3	54
Arithmetic mean value	38	812	6.7-7.5	394	0.48	7.7	328	782	2.2	13.4	55
Standard deviation	7.7	251	45	47	0.052	0.42	54	93	1.2	1.5	7.6
Coefficient of variation	0.20	0.31	6.0-6.7	0.12	0.11	0.055	0.16	0.12	0.56	0.11	0.14
Number of samples	117	117	117	117	117	117	116	117	117	117	117
Number of detections	117	117	22	117	117	117	116	117	115	117	117
Percent detections	100	100	19	100	100	100	100	100	98	100	100

**Table 1–105.** Summary statistics for analytes and physical properties in samples from monitoring well MW–7, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	99	1,236	6,000	652	1	8.1	492	1,220	7	18.0	67
Minimum value	21	354	<1	375	0.30	6.8	32	454	0.4	9.8	5
Geometric mean value	35	814	1.3	526	0.49	7.5	393	928	1.2	14.7	15
Arithmetic mean value	36	855	142	528	0.50	7.5	402	932	1.5	14.8	16
Standard deviation	8.0	250	843	47	0.066	0.30	55	89	1.3	1.3	6.5
Coefficient of variation	0.22	0.29	5.9	0.089	0.13	0.04	0.14	0.10	0.85	0.086	0.42
Number of samples	86	86	86	86	86	86	86	86	86	86	86
Number of detections	86	86	15	86	86	86	86	86	69	86	86
Percent detections	100	100	17	100	100	100	100	100	80	100	100

**Table 1-106.** Summary statistics for analytes and physical properties in samples from monitoring well MW-8, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994-2013.

[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	352	1,318	3,700	502	0.48	8.9	680	1,536	35	16.9	19
Minimum value	18	366	<1	90	<0.01	6.9	25	360	0.6	10.0	-63
Geometric mean value	51	769	1.4	345	0.064	7.9	286	756	1.4	14.5	-44
Arithmetic mean value	58	802	25-26	359	0.073-0.075	8.0	307	770	1.9	14	-40
Standard deviation	45	228	123	85	0.10	0.50	94	151	3.7	1.0	23
Coefficient of variation	0.76	0.28	4.7-4.9	0.24	1.3-1.4	0.063	0.31	0.20	1.9	0.072	-0.57
Number of samples	85	85	85	85	85	85	85	85	85	85	85
Number of detections	85	85	26	85	57	85	85	85	79	85	85
Percent detections	100	100	31	100	67	100	100	100	93	100	100

**Table 1–107.** Summary statistics for analytes and physical properties in samples from monitoring well MW–9, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.[CaCO<sub>3</sub>, calcium carbonate; <, less than; na, not analyzed]

	Chloride (milligrams per liter)	Electrical conductivity (micromhos per centimeter)	Fecal coliform (colony forming units per 100 milliliter)	Hardness (milligrams per liter as CaCO <sub>3</sub> )	Ammonia (milligrams per liter)	pH (standard units)	Sulfate (milligrams per liter)	Total dissolved solids (milligrams per liter)	Dissolved organic carbon (milligrams per liter)	Temperature (degrees Celsius)	Ground- water level (feet from City of Chicago Datum)
Maximum value	81	1,136	6	465	1	8.5	737	1,536	10	18.0	4
Minimum value	3	360	<1	250	<0.02	6.8	209	542	0.7	11.0	-73
Geometric mean value	34	771	na	392	0.35	7.7	342	800	1.5	14.3	-5
Arithmetic mean value	36	800	na	394	0.37	7.7	345	805	1.7	14.3	-4
Standard deviation	9.2	207	na	37	0.077	0.32	53	105	1.4	0.93	8.1
Coefficient of variation	0.26	0.26	na	0.094	0.21	0.041	0.15	0.13	0.79	0.065	-1.9
Number of samples	90	90	90	90	90	90	90	90	90	90	90
Number of detections	90	90	6	90	89	90	90	90	88	90	90
Percent detections	100	100	7	100	99	100	100	100	98	100	100

## **Appendix 2. Results of temporal trend analysis of analytes and physical properties, by well, Tunnel and Reservoir Plan System, 1995–2013**

---

Each appendix has four Tunnel and Reservoir Plan Systems, each with multiple tables of varying sizes.

Table 2–1 to table 2–33. Kendall’s tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, by well, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 2–34 to table 2–73. Kendall’s tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, by well, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 2–74 to table 2–97. Kendall’s tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, by well, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 2–98 to table 2–106. Kendall’s tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, by well, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois.

**Table 2-1.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-1, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2009.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	2.1	-31	1.2	-3.3	0.00	0.00	-1.5	—	-0.16	—	-0.44
p>0.05	—	—	—	—	—	—	—	-0.51	—	0.00	—

**Table 2-2.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-2, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.38	-12	—	-2.2	-0.020	-0.030	-0.35	—	—	—	-1.1
p>0.05	—	—	1.1	—	—	—	—	-0.82	-0.16	0.00	—

**Table 2-3.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-2.1, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.25	-24	3.2	0.52	0.010	-0.040	-1.5	-3.3	-0.18	—	-3.5
p>0.05	—	—	—	—	—	—	—	—	—	0.000	—

**Table 2-4.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-2.2, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.10	-13	—	0.59	-0.010	-0.020	-1.5	-3.4	-0.18	—	-3.1
p>0.05	—	—	0.69	—	—	—	—	—	—	0.000	—

**Table 2-5.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-3, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.12	-20	-2.1	0.19	0.35	-0.040	—	—	-0.21	—	2.9
p>0.05	—	—	—	—	—	—	0.00	-1.1	—	0.00	—

**Table 2-6.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-4, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.20	-11.0	-3.1	0.00	0.000	—	-0.94	-2.1	-0.36	—	1.4
p>0.05	—	—	—	—	—	0.000	—	—	—	0.00	—

**Table 2-7.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-5, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-19	na	-0.10	0.00	—	-0.98	-3.7	-0.24	—	3.0
p>0.05	0.00	—	na	—	—	0.00	—	—	—	0.00	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-8.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-6, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.60	-20	-1.2	-1.4	0.00	—	-3.9	-7.8	-0.22	—	3.2
p>0.05	—	—	—	—	—	0.00	—	—	—	0.00	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-9.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-7, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-10	na	—	—	-0.030	-1.4	-2.2	-0.18	—	-1.6
p>0.05	0.00	—	na	0.00	0.00	—	—	—	—	0.00	—

[<, less than; >, greater than; na, not analyzed; —, no data]



**Table 2-10.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-9, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-6.3	—	—	-0.40	-0.02	1.1	—	-0.11	—	-0.45
p>0.05	0.010	—	0.10	0.00	—	—	—	0.00	—	0.00	—

**Table 2-11.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-10, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-10	na	—	0.00	—	-1.4	—	-0.20	—	1.8
p>0.05	0.00	—	na	0.00	—	-0.01	—	0.00	—	0.00	—

**Table 2-12.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-11, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.20	-4.2	na	-0.12	0.00	—	-1.3	—	-0.20	—	-0.99
p>0.05	—	—	na	—	—	-0.02	—	-0.66	—	0.00	—

**Table 2-13.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-12, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-17	-14	—	0.01	—	5.4	5.3	-0.32	—	1.6
p>0.05	0.00	—	—	2.20	—	0.00	—	—	—	0.00	—

**Table 2-14.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-13, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	1.7	-6.9	na	0.40	0.00	—	—	—	-0.19	—	2.1
p>0.05	—	—	na	—	—	-0.02	0.00	1.6	—	0.10	—

**Table 2-15.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-14, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	7.0	11	na	0.84	0.01	-0.41	-1.1	20	—	0.00	0.92
p>0.05	—	—	na	—	—	—	—	—	0.00	—	—

**Table 2-16.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-15, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-6.5	na	—	—	—	-1.5	—	-0.17	—	0.81
p>0.05	-0.063	—	na	0.00	0.00	-0.027	—	-1.2	—	0.00	—

**Table 2-17.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-16, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.69	-14	na	0.46	-0.01	-0.02	1.1	—	-0.19	0.09	-5.6
p>0.05	—	—	na	—	—	—	—	-1.0	—	—	—

**Table 2-18.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-17, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-13	—	—	0.00	—	-1.4	—	-0.17	0.048	—
p>0.05	0.28	—	0.31	-0.39	—	0.00	—	-0.49	—	—	-0.89

**Table 2–19.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–18, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-8.0	na	—	—	—	-1.3	-1.8	-0.20	0.055	1.1
p>0.05	0.00	—	na	0.00	0.00	0.023	—	—	—	—	—

**Table 2–20.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–19, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.22	-13	na	-2.4	—	—	-1.4	-1.9	-0.23	—	1.2
p>0.05	—	—	na	—	0.00	0.000	—	—	—	0.00	—

**Table 2–21.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–20, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	—	na	0.28	0.00	-0.05	—	—	0.00	—	0.50
p>0.05	0.00	0.00	na	—	—	—	0.00	0.00	—	0.052	—

**Table 2-22.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-21, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.37	—	na	2.3	0.00	-0.065	—	6.4	0.11	—	—
p>0.05	—	4.6	na	—	—	—	0.00	—	—	0.00	0.00

**Table 2-23.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-22, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.26	—	na	0.88	—	-0.049	-0.28	—	-0.10	—	—
p>0.05	—	1.6	na	—	0.00	—	—	0.77	—	0.00	-0.27

**Table 2-24.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC-23, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	—	na	—	-0.01	—	-0.64	-1.7	-0.29	—	-1.3
p>0.05	0.00	-2.5	na	0.00	—	0.00	—	—	—	0.00	—

**Table 2–25.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–24, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[&lt;, less than; &gt;, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	—	na	0.19	0.00	—	-1.0	-3.1	-0.15	—	-0.90
p>0.05	0.00	-1.5	na	—	—	0.00	—	—	—	0.00	—

**Table 2–26.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–25, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[&lt;, less than; &gt;, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	—	na	0.77	0.00	—	—	—	-0.17	—	-1.1
p>0.05	0.00	-0.58	na	—	—	0.00	0.12	0.00	—	0.00	—

**Table 2–27.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–26, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[&lt;, less than; &gt;, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	—	na	—	0.01	—	-0.79	—	-0.15	—	-0.51
p>0.05	0.00	-1.1	na	0.00	—	-0.01	—	-1.3	—	0.00	—

**Table 2–28.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–27, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.37	—	na	-0.39	—	—	-0.94	-4.1	-0.13	—	-0.86
p>0.05	—	-3.6	na	—	-0.17	0.00	—	—	—	0.01	—

**Table 2–29.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–28, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.18	—	na	—	-0.01	—	-0.51	—	-0.12	—	-0.86
p>0.05	—	-0.25	na	0.00	—	0.00	—	-0.13	—	0.00	—

**Table 2–30.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–29, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013. .

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	18	38	na	35	0.039	-0.032	12	56	—	0.049	—
p>0.05	—	—	na	—	—	—	—	—	0.000	—	-0.73

**Table 2–31.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–30, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	—	—	0.91	—	0.048	1.3	—	-0.15	—	—
p>0.05	-0.47	-0.066	-0.53	—	0.00	—	—	-0.57	—	0.00	0.00

**Table 2–32.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–31, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.68	—	—	—	0.015	0.018	—	3.8	-0.042	—	4.1
p>0.05	—	-3.8	0.00	0.97	—	—	0.66	—	—	0.00	—

**Table 2–33.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QC–37, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2010.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	—	na	1.3	—	—	—	47	-1.4	—	-2.0
p>0.05	-0.38	59	na	—	0.010	0.080	6.0	—	—	-0.38	—



**Table 2-34.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-21, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-44	na	—	—	-0.026	—	—	-0.27	—	0.69
p>0.05	1.6	—	na	-1.5	0.00	—	0.52	0.00	—	0.00	—

**Table 2-35.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-22, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	1.4	-38	8.7	-5.8	0.00	—	-2.8	—	-0.28	—	0.21
p>0.05	—	—	—	—	—	-0.01	—	-3.8	—	0.00	—

**Table 2-36.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-23, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	3.4	-26	na	-3.7	0.00	—	—	—	-0.24	0.00	0.28
p>0.05	—	—	na	—	—	0.00	0.00	3.5	—	—	—

**Table 2–37.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–24, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-26	0.00	-7.6	0.014	—	-3.8	—	-0.25	0.00	0.35
p>0.05	0.66	—	—	—	—	-0.068	—	-0.12	—	—	—

**Table 2–38.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–25, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	11	—	na	-10	0.0038	—	-5.2	—	-0.39	—	0.13
p>0.05	—	-10	na	—	—	0.00	—	6.6	—	0.00	—

**Table 2–39.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–26, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-1.4	-33	2.7	-7.0	—	-0.012	-3.0	-8.2	-0.28	—	-0.50
p>0.05	—	—	—	—	0.0011	—	—	—	—	0.00	—

**Table 2-40.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-27, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	1.6	-50	—	-2.0	0.51	-0.015	-2.3	—	-1.1	—	-1.0
p>0.05	—	—	0.000	—	—	—	—	-2.2	—	0.000	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-41.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-28, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	9.6	—	na	—	-0.011	-0.012	—	17	-0.22	0.080	1.0
p>0.05	—	-9.1	na	-0.93	—	—	-1.3	—	—	—	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-42.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-26, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	3.0	-29	-3.9	-7.2	0.0095	—	-6.7	—	-0.13	0.020	—
p>0.05	—	—	—	—	—	-0.011	—	-2.8	—	—	0.000

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2–43.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–30, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	1.5	-40	—	-12	0.0069	—	-8.3	-12	-0.20	—	—
p>0.05	—	—	-1.5	—	—	0.000	—	—	—	0.075	0.000

**Table 2–44.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–31, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.90	-29	—	-11	—	-0.015	-4.3	-5.4	-0.31	—	-0.62
p>0.05	—	—	0.000	—	0.000	—	—	—	—	0.000	—

**Table 2–45.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–32, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	4.0	-31	—	—	0.0030	—	—	8.0	-0.47	—	-4.5
p>0.05	—	—	0.000	0.13	—	0.000	0.74	—	—	0.000	—

**Table 2-46.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-33, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.95	-33	—	—	0.0038	—	-0.61	-5.1	-0.41	—	-1.7
p>0.05	—	—	0.000	0.000	—	-0.011	—	—	—	0.000	—

**Table 2-47.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-34, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	1.4	-30	—	-12	0.0069	-0.015	-9.7	-12	-0.15	—	1.0
p>0.05	—	—	0.000	—	—	—	—	—	—	0.073	—

**Table 2-48.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-35, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.76	-37	na	-16	0.0051	—	-11	-18	-0.091	—	—
p>0.05	—	—	na	—	—	0.000	—	—	—	0.000	0.000

**Table 2-49.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-36, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-45	—	-16	0.0055	—	-12	-20	-0.18	—	—
p>0.05	0.10	—	-0.18	—	—	0.000	—	—	—	0.000	0.000

**Table 2-50.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-37, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-2.9	-42	na	17	0.012	-0.012	6.0	2.7	-0.37	—	-0.70
p>0.05	—	—	na	—	—	—	—	—	—	0.000	—

**Table 2-51.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-38, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-3.9	-50	na	—	—	—	-1.8	-7.9	-0.21	—	-4.6
p>0.05	—	—	na	-0.30	0.000	0.000	—	—	—	0.000	—

**Table 2-52.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-39, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-24	na	—	—	—	-2.0	—	-0.34	—	-5.1
p>0.05	0.000	—	na	0.000	0.000	-0.011	—	-0.67	—	0.000	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-53.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-40, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.47	-17	na	—	0.0017	—	-3.2	-3.2	-0.096	—	-2.1
p>0.05	—	—	na	0.12	—	0.0058	—	—	—	0.10	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-54.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-41, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-22	na	-5.0	—	—	-3.9	-6.6	-0.19	0.026	-1.0
p>0.05	0.000	—	na	—	0.000	0.0080	—	—	—	—	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2–55.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–42, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.11	-16	na	-3.3	—	0.023	—	-1.8	-0.18	0.000	0.60
p>0.05	—	—	na	—	0.0015	—	-0.50	—	—	—	—

**Table 2–56.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–43, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	1.2	-21	na	-2.3	0.0066	-0.012	-2.8	—	-0.18	—	1.7
p>0.05	—	—	na	—	—	—	—	-1.2	—	0.000	—

**Table 2–57.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–44, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.50	-19	—	—	0.0025	-0.018	—	—	-0.15	—	0.98
p>0.05	—	—	-0.21	0.16	—	—	-0.85	0.60	—	0.000	—



**Table 2-58.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-45, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.15	-17	na	0.75	0.0041	—	-1.4	—	-0.11	—	1.1
p>0.05	—	—	na	—	—	-0.022	—	-0.16	—	0.013	—

**Table 2-59.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-46, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-21	—	-2.3	—	-0.027	-1.8	-1.2	-0.19	—	0.92
p>0.05	0.080	—	0.000	—	0.000	—	—	—	—	0.000	—

**Table 2-60.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-47, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.15	-17	na	—	—	—	—	—	-0.16	—	0.89
p>0.05	—	—	na	0.14	0.000	0.000	0.000	-0.78	—	0.000	—

**Table 2-61.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-48, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.42	-28	na	-3.5	-0.41	0.021	—	—	-0.14	—	-8.0
p>0.05	—	—	na	—	—	—	-0.44	-3.2	—	0.000	—

**Table 2-62.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-49, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.12	-35	16	—	-0.015	—	-3.1	—	-0.17	—	-11
p>0.05	—	—	—	-3.4	—	0.0000	—	-2.8	—	0.072	—

**Table 2-63.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-50, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.072	-22	na	0.11	0.0026	—	2.5	—	-0.18	—	-3.6
p>0.05	—	—	na	—	—	-0.020	—	-0.74	—	0.000	—

**Table 2-64.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-48, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.074	-17	na	—	—	—	—	-4.4	-0.19	—	-2.8
p>0.05	—	—	na	0.000	-0.0013	-0.010	0.000	—	—	0.000	—

**Table 2-65.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-49, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-12	na	0.59	0.0039	—	0.70	-3.3	-0.15	—	-1.9
p>0.05	0.000	—	na	—	—	-0.0079	—	—	—	0.000	—

**Table 2-66.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-50, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.12	-14	128	0.34	—	—	6.2	-1.7	-0.23	0.018	-5.9
p>0.05	—	—	—	—	-0.0023	0.0000	—	—	—	—	—

**Table 2–67.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–54, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.21	-7.7	460	-0.41	0.0045	—	—	—	-0.16	0.000	-0.23
p>0.05	—	—	—	—	—	-0.014	0.69	-0.57	—	—	—

**Table 2–68.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–55, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.35	-8.3	na	—	0.0033	—	5.5	3.4	-0.14	0.048	-0.62
p>0.05	—	—	na	0.88	—	-0.014	—	—	—	—	—

**Table 2–69.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD–56, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-1.5	na	-0.31	—	—	-0.47	-4.8	-0.31	—	-1.9
p>0.05	0.000	—	na	—	0.0015	-0.0061	—	—	—	0.000	—

**Table 2-70.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-57, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.16	-26	na	-6.0	0.0099	—	-8.4	-8.2	-0.17	0.024	-3.0
p>0.05	—	—	na	—	—	0.000	—	—	—	—	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-71.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-58, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-8.5	na	-0.99	—	-0.019	-1.2	-1.8	-0.20	—	-2.6
p>0.05	0.000	—	na	—	0.0020	—	—	—	—	0.000	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-72.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-59, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-8.5	na	-0.99	0.0020	-0.019	-1.1	-1.8	-0.20	—	-2.6
p>0.05	0.00	—	na	—	—	—	—	—	—	0.000	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-73.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QD-60, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-10	na	-2.5	—	—	—	—	-0.18	—	1.0
p>0.05	0.14	—	na	—	0.00	-0.012	0.00	-0.39	—	0.00	—

**Table 2-74.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-53, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2009.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-5.8	na	—	-0.0026	-0.020	—	—	-0.10	—	0.20
p>0.05	0.000	—	na	-0.36	—	—	-0.16	-0.17	—	0.000	—

**Table 2-75.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-56, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2009.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.32	-5.7	na	1.3	—	-0.044	—	3.0	-0.19	—	-0.11
p>0.05	—	—	na	—	0.0021	—	0.00	—	—	0.000	—

**Table 2-76.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-58, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2008.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.26	-12	na	-3.9	—	-0.046	-1.6	-2.9	-0.14	—	1.6
p>0.05	—	—	na	—	0.00	—	—	—	—	0.00	—

**Table 2-77.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-61, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-3.1	-38	7.1	-4.1	—	-0.030	2.1	-13	-0.19	—	-0.31
p>0.05	—	—	—	—	-0.0026	—	—	—	—	0.00	—

**Table 2-78.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-62, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-4.8	—	1.3	0.012	-0.023	—	—	-0.13	—	—
p>0.05	0.085	—	1.2	—	—	—	0.082	1.8	—	0.000	-0.19

**Table 2-79.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-63, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-24	—	13	0.043	0.021	16	25	-0.088	—	-0.42
p>0.05	0.00	—	0.81	—	—	—	—	—	—	0.00	—



**Table 2-80.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-64, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.48	-16	0.94	-4.4	-0.032	—	-1.1	-3.7	-0.19	—	-0.30
p>0.05	—	—	—	—	—	0.000	—	—	—	0.000	—

**Table 2-81.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-65, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2010.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-54	-0.91	-6.7	—	—	—	—	-0.81	—	0.62
p>0.05	1.8	—	—	—	0.0080	0.000	-0.99	-1.8	—	0.000	—

**Table 2-82.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-67, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	4.4	-42	22	-30	0.74	—	-1.5	-32	-0.31	—	0.29
p>0.05	—	—	—	—	—	0.000	—	—	—	0.000	—

**Table 2–83.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM–68, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.99	—	—	2.2	—	-0.041	-0.33	4.6	-0.10	0.033	—
p>0.05	—	1.9	0.42	—	0.0019	—	—	—	—	—	0.000

**Table 2–84.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM–69, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-1.4	na	-2.6	—	-0.022	-1.9	-3.2	-0.13	—	1.0
p>0.05	0.00	—	na	—	-0.0012	—	—	—	—	0.00	—

**Table 2–85.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM–70, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-1.3	na	-0.70	—	-0.025	-0.55	-2.2	-0.13	—	1.8
p>0.05	-0.11	—	na	—	0.00	—	—	—	—	0.000	—

**Table 2-86.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-71, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-20	na	-1.6	—	-0.018	-0.83	-2.5	-0.12	—	0.73
p>0.05	-0.23	—	na	—	0.000	—	—	—	—	0.000	—

**Table 2-87.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-72, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-15	na	-1.3	0.0031	-0.032	-0.80	—	-0.11	—	1.1
p>0.05	-0.18	—	na	—	—	—	—	-1.8	—	0.000	—

**Table 2-88.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-73, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.57	-10	na	—	—	—	-0.68	-3.3	-0.15	0.032	-2.2
p>0.05	—	—	na	0.28	-0.0018	-0.0081	—	—	—	—	—

**Table 2–89.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM–74, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-6.1	na	—	—	—	-0.80	—	-0.087	—	1.1
p>0.05	0.000	—	na	0.31	-0.0022	-0.0073	—	-0.96	—	0.000	—

[&lt;, less than; &gt;, greater than; na, not analyzed; —, no data]

**Table 2–90.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM–75, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-4.9	2.0	—	—	—	-0.37	-1.6	-0.14	—	-1.3
p>0.05	0.000	—	—	0.054	0.00	-0.012	—	—	—	0.00	—

[&lt;, less than; &gt;, greater than; na, not analyzed; —, no data]

**Table 2–91.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM–76, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-10	—	—	—	—	—	—	-0.13	—	-1.9
p>0.05	0.000	—	0.14	0.53	0.000	-0.028	0.000	-2.0	—	0.0056	—

[&lt;, less than; &gt;, greater than; na, not analyzed; —, no data]

**Table 2-92.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-77, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.13	-5.3	4.8	—	-0.0026	-0.024	-0.82	-2.0	-0.11	0.085	-1.7
p>0.05	—	—	—	-0.11	—	—	—	—	—	—	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-93.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-78, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.19	-18	na	0.000	-0.0031	—	-2.4	-6.9	-0.17	0.000	-3.7
p>0.05	—	—	na	—	—	0.012	—	—	—	—	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2-94.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM-79, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.33	-16	na	—	—	—	-0.68	-6.9	-0.23	0.045	-4.1
p>0.05	—	—	na	0.000	0.000	0.014	—	—	—	—	—

[<, less than; >, greater than; na, not analyzed; —, no data]

**Table 2–95.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM–80, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.055	-5.8	na	—	-0.0019	—	-0.72	-2.4	-0.14	—	-1.0
p>0.05	—	—	na	0.000	—	0.000	—	—	—	0.000	—

**Table 2–96.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM–81, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.25	-5.1	na	0.52	—	—	-0.93	—	-0.14	—	—
p>0.05	—	—	na	—	-0.0015	-0.022	—	-0.35	—	0.000	-0.15

**Table 2–97.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well QM–82, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	-0.10	-6.6	na	0.31	—	—	-0.73	-3.3	-0.16	0.016	-2.6
p>0.05	—	—	na	—	0.000	0.000	—	—	—	—	—

**Table 2-98.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well MW-1, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois, 1994-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-16	na	-1.3	—	-0.026	0.86	1.3	-0.12	0.00	-0.73
p>0.05	0.08	—	na	—	0.00	—	—	—	—	—	—

**Table 2-99.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well MW-2, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois, 1994-2010.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	1.8	-24	na	—	0.0023	-0.043	—	2.7	-0.10	—	—
p>0.05	—	—	na	-1.0	—	—	0.23	—	—	0.0	0.0

**Table 2-100.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well MW-3, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois, 1994-2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.21	-20	na	—	0.0057	-0.025	1.2	1.7	-0.11	0.00	0.00
p>0.05	—	—	na	0.00	—	—	—	—	—	—	—

**Table 2-101.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well MW-4, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois, 1994–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.91	-21	na	-3.5	—	—	-1.2	—	-0.18	—	-0.44
p>0.05	—	—	na	—	0.00	0.00	—	-1.1	—	0.00	—

**Table 2-102.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well MW-5, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois, 1994–2010.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	6.8	-19	—	-17	0.00	—	-12	-6.9	-0.11	—	—
p>0.05	—	—	0.21	—	—	-0.012	—	—	—	0.00	0.00

**Table 2-103.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well MW-6, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois, 1994–2013.

[<, less than; >, greater than; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-27	1.9	-4.5	—	-0.02	-3.0	-6.0	-0.11	—	0.50
p>0.05	0.00	—	—	—	0.00	—	—	—	—	0.00	—



**Table 2-104.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well MW-7, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois, 1998-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	0.28	-26	—	-7.6	0.00	-0.04	-5.2	-10	-0.15	—	—
p>0.05	—	—	0.77	—	—	—	—	—	—	0.00	0.08

**Table 2-105.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well MW-8, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois, 1997-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-24	5.3	-10	-0.01	—	-5.8	-9.2	-0.09	—	-3.3
p>0.05	0.50	—	—	—	—	0.02	—	—	—	0.00	—

**Table 2-106.** Kendall's tau correlation coefficient with slope estimator for overall trends in analytes and physical properties, monitoring well MW-9, Upper Des Plaines System, Tunnel and Reservoir Plan system, Cook County, Illinois, 1997-2013.

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Ground-water level
p<0.05	—	-23	—	-5.2	—	—	-1.4	-4.0	-0.10	—	0.45
p>0.05	-0.09	—	0.00	—	3.2	0.00	—	—	—	0.00	—

[<, less than; >, greater than; na, not analyzed; —, no data]

[<, less than; >, greater than; na, not analyzed; —, no data]

[<, less than; >, greater than; na, not analyzed; —, no data]

## **Appendix 3. Seasonality of analytes and physical properties, by well, Tunnel and Reservoir Plan System, 1995–2013**

---

Each appendix has four Tunnel and Reservoir Plan Systems, each with multiple tables of varying sizes.

Table 3–1 to table 3–33. Seasonality of analytes and physical properties in samples from wells, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 3–34 to table 3–73. Seasonality of analytes and physical properties in samples from wells, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 3–74 to table 3–97. Seasonality of analytes and physical properties in samples from wells, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 3–98 to table 3–106. Seasonality of analytes and physical properties in samples from wells, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois.

**Table 3-1.** Seasonality of analytes and physical properties in samples from monitoring well QC-1, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2009.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.51	0.27	na	0.75	0.60	0.65	0.58	0.46	0.77	<0.00	0.09

**Table 3-2.** Seasonality of analytes and physical properties in samples from monitoring well QC-2, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.32	0.39	na	0.51	<0.00	0.71	0.17	0.46	0.66	<0.00	na

**Table 3-3.** Seasonality of analytes and physical properties in samples from monitoring well QC-2.1, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.84	0.24	na	<0.00	0.80	0.52	na	0.67	na	<0.00	0.69

**Table 3-4.** Seasonality of analytes and physical properties in samples from monitoring well QC-2.2, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	<0.00	0.47	na	0.69	0.41	0.75	na	0.35	0.96	<0.00	0.83

**Table 3-5.** Seasonality of analytes and physical properties in samples from monitoring well QC-3, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.54	0.49	na	0.82	0.45	0.79	0.92	0.48	na	<0.00	0.19

**Table 3-6.** Seasonality of analytes and physical properties in samples from monitoring well QC-4, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.72	na	0.37	na	0.62	na	0.18	na	<0.00	0.10

**Table 3-7.** Seasonality of analytes and physical properties in samples from monitoring well QC-5, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.65	na	0.28	na	0.36	na	0.23	na	<0.00	0.79

**Table 3-8.** Seasonality of analytes and physical properties in samples from monitoring well QC-6, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.77	na	0.95	0.45	0.64	na	0.35	0.71	<0.00	0.23

**Table 3-9.** Seasonality of analytes and physical properties in samples from monitoring well QC-7, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.67	0.63	na	0.27	0.99	0.81	na	0.10	na	<0.00	0.74

**Table 3-10.** Seasonality of analytes and physical properties in samples from monitoring well QC-9, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.66	na	0.73	na	0.97	0.90	0.06	0.91	<0.00	0.62

**Table 3-11.** Seasonality of analytes and physical properties in samples from monitoring well QC-10, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.97	0.89	na	0.30	na	0.46	na	0.14	0.91	<0.00	0.01

**Table 3-12.** Seasonality of analytes and physical properties in samples from monitoring well QC-11, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.33	0.76	na	0.83	na	0.15	na	0.50	na	<0.00	0.95

**Table 3–13.** Seasonality of analytes and physical properties in samples from monitoring well QC–12, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.31	0.90	na	0.24	na	0.19	0.39	0.47	na	<0.00	0.86

**Table 3–14.** Seasonality of analytes and physical properties in samples from monitoring well QC–13, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.80	0.29	na	0.38	0.50	0.27	0.52	0.79	na	<0.00	0.78

**Table 3–15.** Seasonality of analytes and physical properties in samples from monitoring well QC–14, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.78	<0.00	na	0.87	na	0.95	na	0.37	0.88	<0.00	0.36

**Table 3–16.** Seasonality of analytes and physical properties in samples from monitoring well QC–15, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.50	na	0.76	0.24	0.92	na	0.52	na	<0.00	0.44

**Table 3-17.** Seasonality of analytes and physical properties in samples from monitoring well QC-16, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.71	0.69	na	0.41	na	0.82	0.52	0.22	na	<0.00	0.29

**Table 3-18.** Seasonality of analytes and physical properties in samples from monitoring well QC-17, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.77	na	0.38	0.75	<0.00	0.48	0.85	na	<0.00	0.89

**Table 3-19.** Seasonality of analytes and physical properties in samples from monitoring well QC-18, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.40	na	0.52	na	0.06	0.27	0.46	na	<0.00	0.97

**Table 3-20.** Seasonality of analytes and physical properties in samples from monitoring well QC-19, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.45	na	0.50	na	0.58	0.79	0.32	na	<0.00	0.94

**Table 3–21.** Seasonality of analytes and physical properties in samples from monitoring well QC–20, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.41	0.46	na	0.43	na	0.19	na	0.49	na	<0.00	0.58

**Table 3–22.** Seasonality of analytes and physical properties in samples from monitoring well QC–21, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.82	0.36	na	0.62	na	0.53	na	0.10	0.96	<0.00	0.43

**Table 3–23.** Seasonality of analytes and physical properties in samples from monitoring well QC–22, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.91	na	0.61	0.13	0.82	na	<0.00	0.63	<0.00	0.31

**Table 3–24.** Seasonality of analytes and physical properties in samples from monitoring well QC–23, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.25	0.97	na	0.54	na	0.64	na	<0.00	0.92	<0.00	0.36



**Table 3-25.** Seasonality of analytes and physical properties in samples from monitoring well QC-24, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.99	0.91	na	0.05	na	0.86	na	<0.00	0.92	<0.00	0.31

**Table 3-26.** Seasonality of analytes and physical properties in samples from monitoring well QC-25, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.75	na	0.49	0.36	0.89	na	0.17	na	<0.00	0.89

**Table 3-27.** Seasonality of analytes and physical properties in samples from monitoring well QC-26, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.49	na	0.21	na	0.44	na	0.74	na	<0.00	0.76

**Table 3-28.** Seasonality of analytes and physical properties in samples from monitoring well QC-27, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.16	na	0.97	na	0.16	na	0.21	na	<0.00	0.69



**Table 3–33.** Seasonality of analytes and physical properties in samples from monitoring well QC–37, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2010.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>	<b>Groundwater level</b>
p value	0.82	0.74	na	0.36	0.39	0.34	0.61	0.51	0.84	<0.00	0.74

**Table 3–34.** Seasonality of analytes and physical properties in samples from monitoring well QD–21, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.16	0.63	na	0.04	0.97	0.31	<0.00	<0.00	0.99	<0.00	0.78

**Table 3–35.** Seasonality of analytes and physical properties in samples from monitoring well QD–22, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.32	0.54	na	0.73	0.55	0.16	<0.00	<0.00	0.97	<0.00	0.79

**Table 3–36.** Seasonality of analytes and physical properties in samples from monitoring well QD–23, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.85	0.23	na	0.94	0.83	0.43	<0.00	<0.00	0.98	<0.00	<0.00

**Table 3–37.** Seasonality of analytes and physical properties in samples from monitoring well QD–24, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.30	na	0.48	na	0.64	0.43	<0.00	0.82	<0.00	0.23

**Table 3–38.** Seasonality of analytes and physical properties in samples from monitoring well QD–25, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	<u>0.02</u>	0.72	na	0.28	0.89	0.80	0.35	<u>&lt;0.00</u>	0.66	<u>&lt;0.00</u>	0.31

**Table 3–39.** Seasonality of analytes and physical properties in samples from monitoring well QD–26, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.71	na	0.65	0.44	0.69	<u>na</u>	0.64	na	<u>&lt;0.00</u>	<u>0.01</u>

**Table 3–40.** Seasonality of analytes and physical properties in samples from monitoring well QD–27, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.75	0.40	na	0.89	0.92	0.49	0.29	0.73	0.91	<u>&lt;0.00</u>	0.88

**Table 3–41.** Seasonality of analytes and physical properties in samples from monitoring well QD–28, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.51	0.58	na	0.19	0.29	0.24	na	<u>&lt;0.00</u>	0.88	<u>&lt;0.00</u>	0.15

**Table 3-42.** Seasonality of analytes and physical properties in samples from monitoring well QD-29, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.75	0.69	na	0.21	0.47	0.45	0.40	<0.00	0.48	<0.00	0.50

**Table 3-43.** Seasonality of analytes and physical properties in samples from monitoring well QD-30, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.73	0.74	na	0.45	0.26	0.82	0.39	0.10	0.59	<0.00	0.71

**Table 3-44.** Seasonality of analytes and physical properties in samples from monitoring well QD-31, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.27	0.98	na	0.78	na	0.87	0.75	0.17	na	<0.00	0.60

**Table 3-45.** Seasonality of analytes and physical properties in samples from monitoring well QD-32, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.37	0.52	na	0.65	0.66	0.87	0.81	0.14	na	<0.00	0.91

**Table 3–46.** Seasonality of analytes and physical properties in samples from monitoring well QD–33, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.50	0.28	na	0.08	na	0.96	0.57	0.26	na	<0.00	0.68

**Table 3–47.** Seasonality of analytes and physical properties in samples from monitoring well QD–34, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.46	<u>0.03</u>	na	0.31	0.47	0.32	0.38	<0.00	0.51	<0.00	0.78

**Table 3–48.** Seasonality of analytes and physical properties in samples from monitoring well QD–35, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.67	0.41	na	0.89	0.40	0.18	0.72	<0.00	0.51	<0.00	0.28

**Table 3–49.** Seasonality of analytes and physical properties in samples from monitoring well QD–36, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.74	0.39	na	0.59	0.50	0.99	na	<0.00	0.99	<0.00	0.41

**Table 3–50.** Seasonality of analytes and physical properties in samples from monitoring well QD–37, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.21	0.67	na	0.47	na	0.36	0.95	0.80	na	<0.00	0.47

**Table 3–51.** Seasonality of analytes and physical properties in samples from monitoring well QD–38, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.53	0.93	na	0.19	na	0.28	0.55	0.52	na	<0.00	0.57

**Table 3–52.** Seasonality of analytes and physical properties in samples from monitoring well QD–39, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.82	0.35	na	0.69	na	0.96	0.65	<0.00	na	<0.00	0.51

**Table 3–53.** Seasonality of analytes and physical properties in samples from monitoring well QD–40, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.74	0.35	na	0.47	na	0.36	0.51	0.23	0.81	<0.00	0.50



**Table 3–54.** Seasonality of analytes and physical properties in samples from monitoring well QD–41, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.29	na	0.58	na	0.16	0.27	<u>0.04</u>	na	< <u>0.00</u>	0.93

**Table 3–55.** Seasonality of analytes and physical properties in samples from monitoring well QD–42, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.42	0.60	na	0.31	0.44	0.50	0.51	<u>0.03</u>	0.56	< <u>0.00</u>	0.49

**Table 3–56.** Seasonality of analytes and physical properties in samples from monitoring well QD–43, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.98	0.35	na	0.19	0.44	0.18	0.87	<u>0.03</u>	na	< <u>0.00</u>	0.35

**Table 3–57.** Seasonality of analytes and physical properties in samples from monitoring well QD–44, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.35	na	0.06	<u>0.03</u>	0.96	0.10	0.22	na	< <u>0.00</u>	0.15

**Table 3-58.** Seasonality of analytes and physical properties in samples from monitoring well QD-45, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.87	0.56	na	0.68	0.99	0.82	0.69	0.06	0.16	<0.00	0.49

**Table 3-59.** Seasonality of analytes and physical properties in samples from monitoring well QD-46, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.85	na	0.44	0.41	0.93	0.51	0.13	na	<0.00	na

**Table 3-60.** Seasonality of analytes and physical properties in samples from monitoring well QD-47, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.51	0.32	na	0.43	0.96	0.68	0.65	0.60	na	<0.00	0.99

**Table 3-61.** Seasonality of analytes and physical properties in samples from monitoring well QD-48, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.37	na	0.21	0.99	0.98	0.07	0.30	na	<0.00	0.98



**Table 3-66.** Seasonality of analytes and physical properties in samples from monitoring well QD-53, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.20	0.61	na	0.23	na	0.16	0.37	0.25	na	<0.00	0.07

**Table 3-67.** Seasonality of analytes and physical properties in samples from monitoring well QD-54, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.50	0.70	na	0.94	na	0.41	0.68	0.88	na	<0.00	0.11

**Table 3-68.** Seasonality of analytes and physical properties in samples from monitoring well QD-55, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.92	0.56	na	0.99	0.52	0.28	0.37	0.11	na	<0.00	0.25

**Table 3-69.** Seasonality of analytes and physical properties in samples from monitoring well QD-56, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.50	0.26	na	0.69	na	0.21	0.11	0.13	na	<0.00	0.09



**Table 3-74.** Seasonality of analytes and physical properties in samples from monitoring well QM-53, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.93	na	0.28	na	0.36	0.38	0.16	na	<0.00	0.22

**Table 3-75.** Seasonality of analytes and physical properties in samples from monitoring well QM-56, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2009.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.36	0.23	na	0.95	0.44	0.71	0.55	0.09	na	<0.00	0.53

**Table 3-76.** Seasonality of analytes and physical properties in samples from monitoring well QM-58, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2008.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.96	0.90	na	0.68	0.42	0.08	0.15	0.03	0.19	<0.00	0.35

**Table 3-77.** S-Seasonality of analytes and physical properties in samples from monitoring well QM-61, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.10	0.83	na	0.49	0.91	0.60	na	0.69	0.77	<0.00	0.08

**Table 3–78.** Seasonality of analytes and physical properties in samples from monitoring well QM–62, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	<u>0.01</u>	0.26	na	0.45	0.64	0.37	0.95	0.96	0.39	<u>&lt;0.00</u>	0.90

**Table 3–79.** Seasonality of analytes and physical properties in samples from monitoring well QM–63, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.23	0.28	na	0.63	na	0.19	0.79	0.81	0.84	<u>&lt;0.00</u>	0.25

**Table 3–80.** Seasonality of analytes and physical properties in samples from monitoring well QM–64, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.16	0.41	na	0.75	0.48	0.12	0.89	0.15	nc	<u>&lt;0.00</u>	0.42

**Table 3–81.** Seasonality of analytes and physical properties in samples from monitoring well QM–65, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.07	<u>0.04</u>	na	0.12	0.96	0.28	0.60	<u>0.05</u>	0.88	<u>&lt;0.00</u>	0.19

**Table 3–82.** Seasonality of analytes and physical properties in samples from monitoring well QM–67, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	<0.00	0.75	na	0.46	na	0.89	na	0.49	na	<0.00	0.41

**Table 3–83.** Seasonality of analytes and physical properties in samples from monitoring well QM–68, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.05	0.17	na	0.05	0.99	0.18	0.41	0.15	na	<0.00	0.32

**Table 3–84.** Seasonality of analytes and physical properties in samples from monitoring well QM–69, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.78	0.48	na	0.58	0.69	0.97	0.69	0.84	na	<0.00	0.84

**Table 3–85.** Seasonality of analytes and physical properties in samples from monitoring well QM–70, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.15	0.85	na	0.26	0.70	0.31	0.66	0.41	na	<0.00	0.86



**Table 3–86.** Seasonality of analytes and physical properties in samples from monitoring well QM–71, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.80	0.88	na	0.43	0.10	0.10	0.58	0.07	na	<0.00	0.06

**Table 3–87.** Seasonality of analytes and physical properties in samples from monitoring well QM–72, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.51	0.76	na	0.64	na	0.40	na	<0.00	na	<0.00	0.99

**Table 3–88.** Seasonality of analytes and physical properties in samples from monitoring well QM–73, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.99	0.64	na	0.19	0.53	0.94	na	0.77	0.84	<0.00	0.99

**Table 3–89.** Seasonality of analytes and physical properties in samples from monitoring well QM–74, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.37	0.74	na	0.60	0.12	0.48	na	0.31	0.51	<0.00	0.74

**Table 3–90.** Seasonality of analytes and physical properties in samples from monitoring well QM–75, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.12	na	0.59	0.53	0.94	0.75	<0.00	na	<0.00	0.74

**Table 3–91.** Seasonality of analytes and physical properties in samples from monitoring well QM–76, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.56	na	0.36	0.58	0.31	0.31	0.42	na	<0.00	0.57

**Table 3–92.** Seasonality of analytes and physical properties in samples from monitoring well QM–77, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.78	0.84	na	0.28	na	0.96	na	0.04	na	<0.00	0.18

**Table 3–93.** Seasonality of analytes and physical properties in samples from monitoring well QM–78, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.78	na	0.66	na	0.33	0.55	0.17	na	<0.00	0.86

**Table 3–94.** Seasonality of analytes and physical properties in samples from monitoring well QM–79, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.32	0.76	na	0.34	na	0.77	0.27	0.54	na	<0.00	0.57

**Table 3–95.** Seasonality of analytes and physical properties in samples from monitoring well QM–80, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	<u>0.02</u>	<u>0.83</u>	na	0.92	na	0.85	na	0.14	na	<0.00	0.42

**Table 3–96.** Seasonality of analytes and physical properties in samples from monitoring well QM–81, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.99	0.32	na	0.63	na	0.92	0.61	0.09	na	<0.00	0.68

**Table 3–97.** Seasonality of analytes and physical properties in samples from monitoring well QM–82, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.78	0.75	na	0.47	na	0.94	na	0.19	na	<0.00	0.96

**Table 3-98.** Seasonality of analytes and physical properties in samples from monitoring well MW-1, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.20	0.77	na	0.99	0.40	0.32	0.95	0.52	na	<0.00	0.71

**Table 3-99.** Seasonality of analytes and physical properties in samples from monitoring well MW-2, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994-2010.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.45	0.24	na	0.92	0.56	0.62	0.76	0.09	na	<0.00	0.03

**Table 3-100.** Seasonality of analytes and physical properties in samples from monitoring well MW-3, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	na	0.16	na	0.40	0.38	0.63	0.67	<0.01	na	<0.00	0.01

**Table 3-101.** Seasonality of analytes and physical properties in samples from monitoring well MW-4, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994-2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.92	0.24	na	0.91	na	0.59	0.60	0.33	na	<0.00	0.33

**Table 3–102.** Seasonality of analytes and physical properties in samples from monitoring well MW–5, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2010.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	<u>&lt;0.01</u>	0.06	na	0.37	na	0.45	0.41	<u>0.02</u>	na	<u>&lt;0.00</u>	0.12

**Table 3–103.** Seasonality of analytes and physical properties in samples from monitoring well MW–6, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.50	0.48	na	0.40	0.09	0.34	<u>0.04</u>	0.06	na	<u>&lt;0.00</u>	0.10

**Table 3–104.** Seasonality of analytes and physical properties in samples from monitoring well MW–7, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1998–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	0.19	<u>0.02</u>	na	0.69	0.89	0.31	0.54	0.67	na	<u>&lt;0.00</u>	0.41

**Table 3–105.** Seasonality of analytes and physical properties in samples from monitoring well MW–8, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1997–2013.[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature	Groundwater level
p value	<u>&lt;0.01</u>	0.12	na	0.32	na	0.33	0.85	0.20	na	<u>&lt;0.00</u>	0.77

**Table 3–106.** Seasonality of analytes and physical properties in samples from monitoring well MW–9, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1997–2013.

[<, less than; na, data not analyzed; underline denotes seasonality indicated to 95 percent or higher level of significance]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>	<b>Groundwater level</b>
p value	<u>0.02</u>	0.08	na	0.31	na	0.68	0.22	<u>0.04</u>	na	<u>&lt;0.00</u>	0.42



## Appendix 4. Analyte and physical property correlations, by well, Tunnel and Reservoir Plan System, 1995–2013

---

Each appendix has four Tunnel and Reservoir Plan Systems, each with multiple tables of varying sizes.

Table 4–1 to table 4–33. Kendall’s tau-b correlation coefficient for analytes and physical properties, by well, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 4–34 to table 4–73. Kendall’s tau-b correlation coefficient for analytes and physical properties, by well, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 4–74 to table 4–97. Kendall’s tau-b correlation coefficient for analytes and physical properties, by wells, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois.

Table 4–98 to table 4–106. Kendall’s tau-b correlation coefficient for analytes and physical properties, by wells, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois.



**Table 4-1.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC-1, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2009.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.01	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.16	0.22	na	—	—	—	—	—	—	—
Ammonia	-0.03	0.19	na	0.07	—	—	—	—	—	—
pH	-0.09	0.08	na	0.18	-0.08	—	—	—	—	—
Sulfate	0.23	0.11	na	-0.08	0.16	-0.08	—	—	—	—
Total dissolved solids	0.11	0.12	na	0.03	-0.02	0.04	-0.06	—	—	—
Dissolved organic carbon	-0.12	<b>0.26</b>	na	<b>0.39</b>	0.04	0.05	0.01	0.05	—	—
Temperature	-0.01	0.05	na	0.07	0.04	-0.03	-0.03	0.09	-0.03	—
Groundwater level	-0.02	-0.21	na	-0.16	0.06	-0.07	-0.11	-0.07	-0.23	-0.04

**Table 4-2.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC-2, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2009.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.24	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.22	-0.02	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.47</b>	<b>0.28</b>	0.12	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.37</b>	0.12	<b>0.34</b>	<b>0.31</b>	—	—	—	—	—	—
<b>pH</b>	0.03	0.06	0.05	0.16	0.19	—	—	—	—	—
<b>Sulfate</b>	0.15	0.07	0.04	0.11	0.07	0.04	—	—	—	—
<b>Total dissolved solids</b>	0.12	0.17	0.02	0.11	-0.03	-0.08	-0.01	—	—	—
<b>Dissolved organic carbon</b>	<b>0.29</b>	0.23	0.04	<b>0.37</b>	0.17	0.11	0.10	0.20	—	—
<b>Temperature</b>	-0.03	-0.08	0.11	-0.02	0.14	0.03	0.04	-0.03	-0.01	—
<b>Groundwater level</b>	<b>0.31</b>	0.09	<b>0.34</b>	<b>0.25</b>	<b>0.50</b>	0.10	0.16	0.03	<b>0.25</b>	0.11

**Table 4–3.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–2.1, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.16	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.02	-0.10	na	—	—	—	—	—	—	—
Ammonia	-0.12	-0.18	na	0.21	—	—	—	—	—	—
pH	0.05	0.15	na	-0.04	-0.11	—	—	—	—	—
Sulfate	<b>0.29</b>	<b>0.25</b>	na	-0.21	<b>-0.27</b>	0.17	—	—	—	—
Total dissolved solids	0.06	0.19	na	0.00	-0.15	0.03	0.08	—	—	—
Dissolved organic carbon	0.07	0.20	na	-0.10	-0.18	0.08	0.23	0.22	—	—
Temperature	-0.06	0.00	na	0.02	-0.02	0.00	0.01	-0.02	-0.07	—
Groundwater level	0.15	<b>0.35</b>	na	<b>-0.27</b>	-0.17	<b>0.25</b>	<b>0.44</b>	0.10	0.20	-0.02

**Table 4-4.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC-2.2, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.15	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.02	-0.11	na	—	—	—	—	—	—	—
Ammonia	0.15	0.10	na	<b>-0.37</b>	—	—	—	—	—	—
pH	-0.01	0.14	na	-0.03	0.01	—	—	—	—	—
Sulfate	0.02	<b>0.31</b>	na	-0.19	0.05	0.19	—	—	—	—
Total dissolved solids	0.24	0.14	na	0.04	0.06	0.09	0.22	—	—	—
Dissolved organic carbon	0.12	<b>0.28</b>	na	-0.08	0.09	0.24	<b>0.34</b>	<b>0.30</b>	—	—
Temperature	-0.20	0.02	na	0.03	0.08	0.00	0.04	0.00	-0.07	—
Groundwater level	0.04	0.04	na	<b>-0.31</b>	<b>0.36</b>	0.05	0.23	0.05	<b>0.27</b>	0.03

**Table 4–5.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–3, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2009.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.05	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.03	-0.11	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.12	<b>-0.33</b>	na	0.07	—	—	—	—	—	—
<b>pH</b>	-0.15	0.14	na	-0.03	-0.17	—	—	—	—	—
<b>Sulfate</b>	0.22	0.01	na	-0.06	0.00	-0.04	—	—	—	—
<b>Total dissolved solids</b>	<b>0.27</b>	<b>0.26</b>	na	-0.04	-0.03	-0.03	0.13	—	—	—
<b>Dissolved organic carbon</b>	-0.23	0.24	na	-0.12	-0.23	0.22	0.06	0.12	—	—
<b>Temperature</b>	0.04	0.09	na	0.02	0.07	-0.07	0.00	-0.03	-0.14	—
<b>Groundwater level</b>	-0.04	-0.07	na	0.05	0.22	-0.07	-0.23	-0.16	0.20	0.20

**Table 4-6.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC-4, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.12	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	-0.06	0.13	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.10	0.13	0.10	—	—	—	—	—	—	—
<b>Ammonia</b>	0.14	-0.07	-0.08	-0.12	—	—	—	—	—	—
<b>pH</b>	0.03	0.00	0.05	0.18	-0.10	—	—	—	—	—
<b>Sulfate</b>	0.11	<b>0.25</b>	0.14	0.22	-0.19	0.00	—	—	—	—
<b>Total dissolved solids</b>	0.07	<b>0.32</b>	0.05	0.11	-0.11	-0.03	<b>0.29</b>	—	—	—
<b>Dissolved organic carbon</b>	0.15	<b>0.34</b>	0.17	0.11	-0.03	-0.11	<b>0.42</b>	<b>0.30</b>	—	—
<b>Temperature</b>	-0.05	-0.04	0.02	-0.06	-0.09	0.10	0.03	-0.01	-0.20	—
<b>Groundwater level</b>	-0.04	-0.17	0.13	-0.22	0.12	-0.13	-0.20	-0.14	-0.24	0.03

**Table 4-7.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC-5, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.01	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	<b>-0.28</b>	0.21	na	—	—	—	—	—	—	—
Ammonia	-0.09	-0.20	na	-0.08	—	—	—	—	—	—
pH	-0.05	-0.01	na	0.11	-0.07	—	—	—	—	—
Sulfate	0.04	<b>0.28</b>	na	<b>0.28</b>	-0.16	0.04	—	—	—	—
Total dissolved solids	0.02	0.22	na	0.18	-0.22	-0.06	<b>0.26</b>	—	—	—
Dissolved organic carbon	-0.07	<b>0.28</b>	na	0.20	-0.09	-0.02	<b>0.31</b>	<b>0.25</b>	—	—
Temperature	-0.03	0.03	na	-0.04	-0.05	0.12	0.02	0.07	-0.13	—
Groundwater level	-0.04	<b>-0.34</b>	na	<b>-0.28</b>	0.19	-0.06	<b>-0.40</b>	<b>-0.26</b>	<b>-0.39</b>	0.03

**Table 4-8.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC-6, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.35	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.59</b>	<b>0.43</b>	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.22	0.11	na	0.24	—	—	—	—	—	—
<b>pH</b>	0.01	0.03	na	0.04	-0.07	—	—	—	—	—
<b>Sulfate</b>	<b>0.62</b>	<b>0.47</b>	na	<b>0.72</b>	0.23	0.01	—	—	—	—
<b>Total dissolved solids</b>	<b>0.53</b>	<b>0.43</b>	na	<b>0.56</b>	0.15	-0.05	<b>0.57</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>0.37</b>	<b>0.37</b>	na	<b>0.50</b>	0.22	0.00	<b>0.48</b>	<b>0.45</b>	—	—
<b>Temperature</b>	0.08	0.10	na	0.06	-0.02	0.11	0.05	0.08	-0.05	—
<b>Groundwater level</b>	<b>-0.39</b>	<b>-0.39</b>	na	<b>-0.48</b>	-0.18	-0.10	<b>-0.54</b>	<b>-0.38</b>	<b>-0.41</b>	0.09



**Table 4–9.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–7, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.10	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.03	0.13	na	—	—	—	—	—	—	—
Ammonia	-0.06	0.08	na	0.07	—	—	—	—	—	—
pH	0.00	0.08	na	-0.08	-0.06	—	—	—	—	—
Sulfate	-0.04	<b>0.25</b>	na	-0.01	-0.14	<b>0.37</b>	—	—	—	—
Total dissolved solids	0.10	0.14	na	0.08	-0.03	0.14	0.15	—	—	—
Dissolved organic carbon	-0.10	<b>0.28</b>	na	0.07	0.11	0.15	<b>0.34</b>	0.02	—	—
Temperature	-0.05	-0.03	na	0.05	-0.04	0.01	-0.01	0.12	-0.20	—
Groundwater level	-0.19	<b>0.28</b>	na	0.13	0.11	0.07	<b>0.31</b>	0.05	<b>0.40</b>	-0.09

**Table 4–10.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC-9, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.04	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.16	0.04	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.04	0.18	na	-0.20	—	—	—	—	—	—
<b>pH</b>	-0.01	0.04	na	0.00	<b>0.34</b>	—	—	—	—	—
<b>Sulfate</b>	0.07	<b>-0.31</b>	na	-0.11	<b>-0.27</b>	-0.18	—	—	—	—
<b>Total dissolved solids</b>	-0.03	-0.18	na	0.09	-0.05	0.05	0.03	—	—	—
<b>Dissolved organic carbon</b>	-0.04	0.19	na	0.03	<b>0.33</b>	0.19	<b>-0.35</b>	0.07	—	—
<b>Temperature</b>	-0.19	-0.08	na	0.09	-0.17	-0.03	0.12	0.23	-0.09	—
<b>Groundwater level</b>	-0.02	0.23	na	-0.07	<b>0.30</b>	0.05	<b>-0.31</b>	-0.05	<b>0.35</b>	-0.09

**Table 4–11.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–10, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.09	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.05	0.15	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.16	-0.18	na	-0.03	—	—	—	—	—	—
<b>pH</b>	-0.03	0.08	na	0.05	0.08	—	—	—	—	—
<b>Sulfate</b>	0.00	<b>0.31</b>	na	0.07	-0.14	0.14	—	—	—	—
<b>Total dissolved solids</b>	0.05	-0.02	na	-0.05	0.07	-0.01	0.02	—	—	—
<b>Dissolved organic carbon</b>	-0.02	0.24	na	0.03	-0.16	-0.09	<b>0.42</b>	0.06	—	—
<b>Temperature</b>	-0.04	-0.02	na	-0.01	0.06	0.09	-0.01	0.05	-0.10	—
<b>Groundwater level</b>	0.09	-0.19	na	-0.03	0.07	-0.08	<b>-0.44</b>	-0.01	-0.24	-0.10

**Table 4–12.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–11, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.09	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.01	0.06	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.22	-0.02	na	-0.02	—	—	—	—	—	—
<b>pH</b>	-0.04	0.01	na	-0.14	0.06	—	—	—	—	—
<b>Sulfate</b>	0.13	0.24	na	0.18	-0.18	0.23	—	—	—	—
<b>Total dissolved solids</b>	0.19	0.06	na	0.04	-0.12	-0.06	0.06	—	—	—
<b>Dissolved organic carbon</b>	0.20	<b>0.27</b>	na	<b>0.29</b>	-0.17	0.13	<b>0.57</b>	0.22	—	—
<b>Temperature</b>	0.08	-0.08	na	0.02	-0.05	0.14	0.00	0.09	0.06	—
<b>Groundwater level</b>	-0.18	<b>-0.36</b>	na	-0.13	0.03	-0.03	<b>-0.39</b>	-0.18	<b>-0.33</b>	0.12

**Table 4–13.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–12, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.06	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.17	-0.12	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.12	-0.18	na	0.15	—	—	—	—	—	—
<b>pH</b>	-0.02	-0.20	na	-0.12	0.04	—	—	—	—	—
<b>Sulfate</b>	0.15	0.02	na	<b>0.55</b>	<b>0.28</b>	-0.10	—	—	—	—
<b>Total dissolved solids</b>	0.09	0.02	na	<b>0.61</b>	<b>0.29</b>	-0.17	<b>0.69</b>	—	—	—
<b>Dissolved organic carbon</b>	-0.10	<b>0.28</b>	na	-0.08	<b>-0.51</b>	-0.06	-0.23	-0.18	—	—
<b>Temperature</b>	-0.11	0.02	na	0.02	-0.05	0.01	-0.11	-0.04	0.13	—
<b>Groundwater level</b>	<b>-0.29</b>	<b>-0.26</b>	na	0.01	<b>0.34</b>	0.07	0.04	-0.05	<b>-0.48</b>	0.04

**Table 4–14.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–13, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.21	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.30</b>	-0.05	na	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.40</b>	-0.07	na	<b>0.30</b>	—	—	—	—	—	—
<b>pH</b>	-0.12	0.04	na	-0.07	-0.03	—	—	—	—	—
<b>Sulfate</b>	0.07	0.03	na	0.24	0.17	-0.04	—	—	—	—
<b>Total dissolved solids</b>	0.19	-0.07	na	0.08	-0.03	<b>-0.26</b>	<b>0.33</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.58</b>	0.22	na	<b>-0.38</b>	-0.22	0.07	-0.14	-0.18	—	—
<b>Temperature</b>	0.19	-0.19	na	0.09	0.01	0.14	-0.02	0.09	-0.12	—
<b>Groundwater level</b>	<b>0.53</b>	<b>-0.25</b>	na	0.19	<b>0.26</b>	-0.14	0.09	0.19	<b>-0.45</b>	<b>0.25</b>

**Table 4–15.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–14, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	<b>0.29</b>	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.85</b>	<b>0.29</b>	na	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.64</b>	0.20	na	<b>0.58</b>	—	—	—	—	—	—
<b>pH</b>	<b>-0.36</b>	-0.18	na	<b>-0.39</b>	<b>-0.43</b>	—	—	—	—	—
<b>Sulfate</b>	<b>-0.61</b>	<b>-0.38</b>	na	<b>-0.67</b>	<b>-0.51</b>	<b>0.46</b>	—	—	—	—
<b>Total dissolved solids</b>	<b>0.68</b>	0.18	na	<b>0.70</b>	<b>0.49</b>	<b>-0.27</b>	<b>-0.51</b>	—	—	—
<b>Dissolved organic carbon</b>	-0.08	-0.10	na	-0.06	0.03	0.13	0.14	-0.06	—	—
<b>Temperature</b>	<b>0.28</b>	<b>0.26</b>	na	<b>0.31</b>	0.19	-0.12	<b>-0.33</b>	<b>0.32</b>	-0.01	—
<b>Groundwater level</b>	<b>0.32</b>	0.22	na	<b>0.29</b>	0.19	-0.18	<b>-0.25</b>	0.24	-0.11	0.24

**Table 4–16.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–15, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.02	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.21	-0.13	na	—	—	—	—	—	—	—
Ammonia	-0.08	0.08	na	0.02	—	—	—	—	—	—
pH	-0.07	0.12	na	-0.07	0.15	—	—	—	—	—
Sulfate	-0.06	<b>0.35</b>	na	-0.13	<b>0.03</b>	<b>0.34</b>	—	—	—	—
Total dissolved solids	0.23	-0.06	na	-0.11	0.02	-0.07	0.20	—	—	—
Dissolved organic carbon	-0.07	<b>0.28</b>	na	-0.08	0.21	<b>0.25</b>	<b>0.47</b>	0.14	—	—
Temperature	-0.17	-0.02	na	-0.05	0.10	0.10	-0.15	0.02	0.01	—
Groundwater level	0.06	-0.19	na	-0.20	-0.03	-0.05	<b>-0.32</b>	-0.21	<b>-0.31</b>	0.07



**Table 4–17.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–16, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.19	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.18	0.00	na	—	—	—	—	—	—	—
Ammonia	-0.24	0.11	na	-0.06	—	—	—	—	—	—
pH	-0.19	0.04	na	-0.02	0.06	—	—	—	—	—
Sulfate	<b>0.35</b>	-0.04	na	<b>0.31</b>	-0.02	-0.11	—	—	—	—
Total dissolved solids	-0.01	0.03	na	0.14	-0.04	0.06	0.00	—	—	—
Dissolved organic carbon	<b>-0.52</b>	0.10	na	<b>-0.33</b>	0.12	0.22	<b>-0.41</b>	0.00	—	—
Temperature	0.16	-0.03	na	0.15	-0.12	-0.05	0.22	0.01	-0.22	—
Groundwater level	<b>-0.60</b>	0.15	na	-0.22	0.22	0.15	<b>-0.38</b>	0.02	<b>0.39</b>	-0.22

**Table 4–18.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–17, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.25	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.12	0.06	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.27</b>	0.07	-0.04	—	—	—	—	—	—	—
<b>Ammonia</b>	0.13	<b>-0.33</b>	0.23	-0.10	—	—	—	—	—	—
<b>pH</b>	-0.15	0.13	0.07	0.02	-0.18	—	—	—	—	—
<b>Sulfate</b>	0.01	0.10	0.03	0.18	-0.04	0.02	—	—	—	—
<b>Total dissolved solids</b>	<b>0.27</b>	0.10	0.08	0.24	0.06	-0.10	0.10	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.33</b>	<b>0.29</b>	0.19	0.07	-0.20	0.04	<b>0.30</b>	0.06	—	—
<b>Temperature</b>	0.00	-0.16	0.10	0.01	0.12	-0.03	-0.03	-0.18	-0.14	—
<b>Groundwater level</b>	<b>0.46</b>	-0.04	0.04	0.23	0.00	-0.13	0.17	<b>0.35</b>	0.01	-0.08

**Table 4–19.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–18, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.06	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.01	-0.15	na	—	—	—	—	—	—	—
Ammonia	-0.09	<b>-0.37</b>	na	0.18	—	—	—	—	—	—
pH	-0.01	-0.14	na	0.04	0.06	—	—	—	—	—
Sulfate	0.03	0.20	na	-0.01	-0.02	-0.04	—	—	—	—
Total dissolved solids	0.04	0.06	na	0.08	0.14	-0.02	0.20	—	—	—
Dissolved organic carbon	-0.16	<b>0.25</b>	na	0.00	-0.02	-0.05	<b>0.49</b>	<b>0.39</b>	—	—
Temperature	-0.10	0.06	na	0.05	0.00	-0.08	<b>-0.25</b>	-0.03	-0.20	—
Groundwater level	-0.20	<b>-0.32</b>	na	0.16	0.04	0.03	<b>-0.37</b>	<b>-0.25</b>	-0.21	0.03

**Table 4–20.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–19, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.07	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.23	<b>0.40</b>	na	—	—	—	—	—	—	—
Ammonia	-0.12	-0.14	na	0.05	—	—	—	—	—	—
pH	-0.15	-0.08	na	-0.01	-0.01	—	—	—	—	—
Sulfate	-0.10	<b>0.36</b>	na	-0.08	-0.02	-0.08	—	—	—	—
Total dissolved solids	-0.11	0.17	na	-0.06	0.01	-0.06	<b>0.28</b>	—	—	—
Dissolved organic carbon	-0.19	0.23	na	0.05	0.00	0.05	<b>0.38</b>	0.20	—	—
Temperature	-0.15	-0.01	na	0.15	-0.05	0.15	-0.04	-0.03	-0.02	—
Groundwater level	0.12	-0.03	na	-0.11	-0.11	-0.11	0.09	-0.06	-0.12	0.04

**Table 4–21.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–20, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.07	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.23	<b>0.40</b>	na	—	—	—	—	—	—	—
Ammonia	-0.12	-0.14	na	0.05	—	—	—	—	—	—
pH	-0.15	-0.08	na	-0.01	-0.01	—	—	—	—	—
Sulfate	-0.10	<b>0.36</b>	na	-0.08	-0.02	-0.08	—	—	—	—
Total dissolved solids	-0.11	0.17	na	-0.06	0.01	-0.06	<b>0.28</b>	—	—	—
Dissolved organic carbon	-0.19	0.23	na	0.05	0.00	0.05	<b>0.38</b>	0.20	—	—
Temperature	-0.15	-0.01	na	0.15	-0.05	0.15	-0.04	-0.03	-0.02	—
Groundwater level	0.12	-0.03	na	-0.11	-0.11	-0.11	0.09	-0.06	-0.12	0.04

**Table 4-22.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC-21, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.15	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.41</b>	0.21	na	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>-0.29</b>	-0.11	na	<b>-0.33</b>	—	—	—	—	—	—
<b>pH</b>	<b>-0.35</b>	-0.04	na	-0.14	0.15	—	—	—	—	—
<b>Sulfate</b>	0.06	0.13	na	0.16	-0.08	0.13	—	—	—	—
<b>Total dissolved solids</b>	<b>0.32</b>	0.19	na	<b>0.49</b>	-0.17	-0.15	<b>0.28</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>0.26</b>	0.24	na	0.24	-0.14	-0.12	<b>0.31</b>	<b>0.33</b>	—	—
<b>Temperature</b>	-0.03	0.14	na	0.06	-0.06	0.11	0.09	0.20	0.09	—
<b>Groundwater level</b>	-0.01	-0.03	na	0.03	-0.01	-0.05	0.19	0.08	0.06	0.09

**Table 4–23.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–22, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.15	-	-	-	-	-	-	-	-	-
Fecal coliform	na	na	-	-	-	-	-	-	-	-
Hardness	0.22	0.10	na	-	-	-	-	-	-	-
Ammonia	<b>-0.26</b>	-0.13	na	-0.02	-	-	-	-	-	-
pH	<b>-0.30</b>	-0.16	na	-0.04	0.23	-	-	-	-	-
Sulfate	<b>-0.27</b>	0.07	na	-0.13	0.04	0.03	-	-	-	-
Total dissolved solids	0.15	0.07	na	0.08	0.04	0.16	-0.01	-	-	-
Dissolved organic carbon	<b>-0.29</b>	-0.05	na	-0.22	0.14	0.13	0.12	0.00	-	-
Temperature	-0.01	0.06	na	-0.03	0.14	0.10	0.04	0.21	0.01	-
Groundwater level	<b>-0.32</b>	0.04	na	0.01	<b>0.25</b>	<b>0.28</b>	0.17	0.16	0.21	0.14

**Table 4–24.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–23, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.03	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.06	0.05	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.03	0.10	na	0.03	—	—	—	—	—	—
<b>pH</b>	0.02	0.07	na	-0.10	0.08	—	—	—	—	—
<b>Sulfate</b>	0.01	0.02	na	0.20	0.15	0.09	—	—	—	—
<b>Total dissolved solids</b>	0.01	-0.03	na	0.04	0.16	0.19	0.21	—	—	—
<b>Dissolved organic carbon</b>	-0.09	-0.03	na	0.05	0.22	-0.08	0.20	0.11	—	—
<b>Temperature</b>	-0.20	0.05	na	-0.11	0.10	0.11	0.02	0.23	-0.03	—
<b>Groundwater level</b>	-0.16	0.11	na	0.14	<b>0.31</b>	0.11	0.22	0.23	<b>0.35</b>	0.17



**Table 4–25.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–24, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.09	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.06	0.05	na	—	—	—	—	—	—	—
Ammonia	-0.10	0.09	na	-0.04	—	—	—	—	—	—
pH	-0.16	0.09	na	0.09	0.14	—	—	—	—	—
Sulfate	-0.10	0.10	na	<b>-0.27</b>	0.06	0.03	—	—	—	—
Total dissolved solids	0.13	0.12	na	-0.14	0.02	-0.07	0.11	—	—	—
Dissolved organic carbon	-0.05	-0.02	na	<b>-0.31</b>	0.20	-0.07	<b>0.37</b>	<b>0.26</b>	—	—
Temperature	-0.01	0.10	na	0.02	0.13	-0.03	0.01	0.17	0.11	—
Groundwater level	-0.12	0.05	na	-0.08	<b>0.26</b>	0.16	0.17	0.22	<b>0.35</b>	0.08

**Table 4–26.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–25, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.01	-	-	-	-	-	-	-	-	-
<b>Fecal coliform</b>	na	na	-	-	-	-	-	-	-	-
<b>Hardness</b>	0.10	-0.06	na	-	-	-	-	-	-	-
<b>Ammonia</b>	-0.16	0.12	na	-0.24	-	-	-	-	-	-
<b>pH</b>	<b>-0.32</b>	-0.07	na	-0.05	0.11	-	-	-	-	-
<b>Sulfate</b>	<b>-0.32</b>	0.24	na	0.05	-0.04	0.22	-	-	-	-
<b>Total dissolved solids</b>	0.16	0.07	na	-0.06	-0.02	-0.12	0.15	-	-	-
<b>Dissolved organic carbon</b>	0.01	0.02	na	<b>-0.54</b>	0.22	-0.11	-0.17	0.09	-	-
<b>Temperature</b>	0.03	-0.11	na	0.16	-0.07	0.03	-0.04	0.02	-0.02	-
<b>Groundwater level</b>	-0.18	0.04	na	<b>-0.58</b>	<b>0.30</b>	0.17	-0.02	-0.04	<b>0.41</b>	-0.04

**Table 4–27.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–26, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.09	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.10	0.10	na	—	—	—	—	—	—	—
Ammonia	-0.18	0.07	na	0.08	—	—	—	—	—	—
pH	-0.07	-0.02	na	-0.13	0.23	—	—	—	—	—
Sulfate	-0.21	-0.01	na	0.05	0.14	0.08	—	—	—	—
Total dissolved solids	0.16	0.02	na	-0.13	-0.06	0.03	0.10	—	—	—
Dissolved organic carbon	-0.11	0.02	na	-0.04	<b>0.37</b>	0.00	0.19	0.04	—	—
Temperature	0.16	0.07	na	0.04	-0.01	-0.06	-0.08	0.11	0.05	—
Groundwater level	<b>-0.29</b>	0.21	na	0.14	<b>0.35</b>	0.07	<b>0.33</b>	0.00	<b>0.36</b>	0.01

**Table 4–28.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–27, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.11	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	<b>0.35</b>	0.22	na	—	—	—	—	—	—	—
Ammonia	0.12	0.13	na	0.17	—	—	—	—	—	—
pH	-0.10	0.00	na	-0.13	0.02	—	—	—	—	—
Sulfate	0.08	0.11	na	<b>0.26</b>	<b>0.27</b>	0.06	—	—	—	—
Total dissolved solids	0.15	0.23	na	<b>0.28</b>	0.03	-0.07	<b>0.26</b>	—	—	—
Dissolved organic carbon	0.21	0.15	na	<b>0.36</b>	0.16	-0.07	<b>0.30</b>	<b>0.36</b>	—	—
Temperature	-0.03	0.17	na	0.05	0.02	-0.14	0.15	<b>0.30</b>	0.24	—
Groundwater level	<b>0.28</b>	0.13	na	<b>0.41</b>	0.19	-0.05	<b>0.37</b>	<b>0.31</b>	<b>0.35</b>	0.11

**Table 4–29.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–28, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1999–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.06	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.02	0.13	na	—	—	—	—	—	—	—
Ammonia	-0.03	0.10	na	-0.02	—	—	—	—	—	—
pH	-0.12	0.18	na	-0.01	0.14	—	—	—	—	—
Sulfate	-0.17	0.09	na	-0.23	<b>0.26</b>	0.07	—	—	—	—
Total dissolved solids	0.20	0.03	na	-0.05	0.15	0.04	0.17	—	—	—
Dissolved organic carbon	0.16	-0.05	na	0.03	0.21	-0.15	<b>0.25</b>	0.17	—	—
Temperature	0.04	0.14	na	-0.10	0.03	0.04	0.17	0.17	-0.04	—
Groundwater level	-0.04	0.11	na	-0.13	<b>0.45</b>	0.24	0.20	0.17	0.23	-0.04

**Table 4–30.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–29, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	<b>0.32</b>	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.82</b>	<b>0.35</b>	na	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.75</b>	<b>0.35</b>	na	<b>0.80</b>	—	—	—	—	—	—
<b>pH</b>	<b>-0.26</b>	-0.10	na	<b>-0.27</b>	<b>-0.30</b>	—	—	—	—	—
<b>Sulfate</b>	<b>0.76</b>	<b>0.35</b>	na	<b>0.82</b>	<b>0.78</b>	<b>-0.29</b>	—	—	—	—
<b>Total dissolved solids</b>	<b>0.80</b>	<b>0.31</b>	na	<b>0.86</b>	<b>0.79</b>	<b>-0.26</b>	<b>0.79</b>	—	—	—
<b>Dissolved organic carbon</b>	0.02	<b>-0.36</b>	na	0.03	0.04	-0.14	<b>0.05</b>	0.08	—	—
<b>Temperature</b>	0.11	0.20	na	0.15	0.15	0.00	0.16	0.15	0.06	—
<b>Groundwater level</b>	<b>-0.35</b>	-0.20	na	<b>-0.26</b>	<b>-0.29</b>	0.18	<b>-0.29</b>	<b>-0.31</b>	0.11	0.02

**Table 4–31.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–30, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.19	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.14	0.04	na	—	—	—	—	—	—	—
Ammonia	-0.17	-0.09	na	0.07	—	—	—	—	—	—
pH	-0.05	0.04	na	-0.03	0.15	—	—	—	—	—
Sulfate	0.05	0.02	na	<b>0.38</b>	<b>0.31</b>	0.09	—	—	—	—
Total dissolved solids	0.20	-0.08	na	<b>0.28</b>	0.10	-0.17	<b>0.29</b>	—	—	—
Dissolved organic carbon	0.10	-0.14	na	-0.22	0.10	-0.02	-0.11	0.11	—	—
Temperature	0.18	0.15	na	0.21	-0.01	0.05	0.09	0.19	-0.04	—
Groundwater level	-0.20	-0.05	na	0.02	0.14	-0.12	0.13	0.06	-0.01	0.05

**Table 4–32.** Kendall’s tau-b correlation coefficient for analytes and physical properties, monitoring well QC–31, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.12	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.10	-0.03	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.20	-0.23	na	<b>0.25</b>	—	—	—	—	—	—
<b>pH</b>	-0.17	-0.07	na	0.01	0.01	—	—	—	—	—
<b>Sulfate</b>	-0.24	-0.08	na	0.05	0.11	<b>0.25</b>	—	—	—	—
<b>Total dissolved solids</b>	-0.01	-0.21	na	<b>0.37</b>	<b>0.41</b>	0.01	0.07	—	—	—
<b>Dissolved organic carbon</b>	-0.10	-0.21	na	0.04	0.07	-0.17	0.05	0.00	—	—
<b>Temperature</b>	0.00	0.06	na	-0.01	-0.03	0.00	-0.10	0.12	-0.08	—
<b>Groundwater level</b>	<b>-0.50</b>	-0.10	na	-0.11	0.16	0.00	0.02	0.00	0.10	0.11



**Table 4–33.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QC–37, Calumet System, Tunnel and Reservoir Plan System, Cook County, Illinois, 2003–2010.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.03	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.09	<b>0.42</b>	na	—	—	—	—	—	—	—
Ammonia	-0.05	0.23	na	<b>0.37</b>	—	—	—	—	—	—
pH	0.03	0.06	na	-0.17	-0.20	—	—	—	—	—
Sulfate	-0.16	-0.05	na	0.15	-0.25	0.11	—	—	—	—
Total dissolved solids	0.12	<b>0.35</b>	na	<b>0.83</b>	0.23	-0.12	<b>0.26</b>	—	—	—
Dissolved organic carbon	0.09	-0.06	na	-0.17	0.14	<b>-0.31</b>	<b>-0.44</b>	-0.18	—	—
Temperature	<b>-0.31</b>	0.08	na	-0.24	-0.13	0.00	-0.06	-0.21	0.18	—
Groundwater level	<b>0.30</b>	<b>-0.45</b>	na	<b>-0.53</b>	-0.09	-0.22	<b>-0.44</b>	<b>-0.51</b>	<b>0.48</b>	0.15

**Table 4–34.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QD–21, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.06	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.11	<b>0.10</b>	na	—	—	—	—	—	—	—
Ammonia	0.23	-0.01	na	0.14	—	—	—	—	—	—
pH	-0.08	0.06	na	0.01	-0.13	—	—	—	—	—
Sulfate	0.13	-0.04	na	<b>0.45</b>	-0.05	-0.01	—	—	—	—
Total dissolved solids	0.21	0.07	na	<b>0.43</b>	0.13	-0.04	<b>0.33</b>	—	—	—
Dissolved organic carbon	-0.11	<b>0.32</b>	na	0.01	0.00	<b>0.26</b>	-0.11	-0.10	—	—
Temperature	-0.22	0.01	na	0.16	0.00	-0.05	0.15	<b>0.32</b>	-0.04	—
Groundwater level	0.00	-0.14	na	-0.03	-0.15	-0.14	0.05	0.01	<b>-0.25</b>	0.05

**Table 4–35.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–22, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.24	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.21	<b>0.28</b>	na	—	—	—	—	—	—	—
Ammonia	0.23	-0.17	na	-0.07	—	—	—	—	—	—
pH	-0.03	0.06	na	-0.01	-0.01	—	—	—	—	—
Sulfate	0.06	0.20	na	0.24	-0.02	0.07	—	—	—	—
Total dissolved solids	0.02	0.19	na	0.18	-0.06	-0.10	0.13	—	—	—
Dissolved organic carbon	-0.24	<b>0.35</b>	na	<b>0.36</b>	-0.13	0.09	0.21	0.08	—	—
Temperature	0.04	-0.03	na	0.04	0.07	-0.19	0.03	<b>0.42</b>	-0.07	—
Groundwater level	-0.01	-0.13	na	-0.05	-0.12	-0.08	-0.03	0.02	-0.22	0.13

**Table 4–36.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–23, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	<b>-0.25</b>	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.20	0.12	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.11	-0.11	na	-0.06	—	—	—	—	—	—
<b>pH</b>	-0.15	0.00	na	-0.01	-0.07	—	—	—	—	—
<b>Sulfate</b>	0.01	0.02	na	0.16	-0.01	-0.01	—	—	—	—
<b>Total dissolved solids</b>	0.18	0.04	na	0.19	0.05	-0.08	0.12	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.39</b>	0.24	na	0.14	-0.10	0.15	-0.04	-0.10	—	—
<b>Temperature</b>	0.13	0.03	na	0.05	0.10	-0.15	0.02	<b>0.37</b>	-0.14	—
<b>Groundwater level</b>	<b>0.32</b>	-0.09	na	0.14	-0.09	-0.07	0.21	0.22	-0.23	0.12

**Table 4–37.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–24, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.08	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.33</b>	0.18	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.22	-0.13	na	-0.01	—	—	—	—	—	—
<b>pH</b>	-0.13	-0.17	na	-0.13	-0.14	—	—	—	—	—
<b>Sulfate</b>	<b>0.33</b>	0.21	na	<b>0.57</b>	-0.03	-0.02	—	—	—	—
<b>Total dissolved solids</b>	<b>0.40</b>	0.16	na	<b>0.56</b>	0.17	-0.12	<b>0.52</b>	—	—	—
<b>Dissolved organic carbon</b>	0.08	<b>0.25</b>	na	<b>0.39</b>	-0.15	0.05	<b>0.26</b>	0.22	—	—
<b>Temperature</b>	-0.07	-0.07	na	-0.13	0.08	-0.07	-0.10	0.05	-0.17	—
<b>Groundwater level</b>	-0.09	-0.18	na	-0.18	0.20	-0.15	-0.22	-0.12	-0.22	0.22

**Table 4–38.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–25, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.02	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	<b>-0.25</b>	0.15	na	—	—	—	—	—	—	—
Ammonia	0.23	-0.07	na	0.01	—	—	—	—	—	—
pH	-0.05	-0.12	na	-0.02	-0.01	—	—	—	—	—
Sulfate	-0.22	0.09	na	<b>0.43</b>	-0.02	-0.02	—	—	—	—
Total dissolved solids	<b>0.32</b>	0.08	na	0.17	0.20	-0.04	0.12	—	—	—
Dissolved organic carbon	<b>-0.47</b>	0.13	na	<b>0.41</b>	-0.19	0.01	<b>0.28</b>	-0.09	—	—
Temperature	0.17	0.13	na	-0.02	0.12	-0.10	0.08	<b>0.40</b>	-0.13	—
Groundwater level	<b>0.25</b>	0.04	na	0.00	<b>0.27</b>	-0.06	-0.01	0.18	-0.18	0.21

**Table 4–39.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–26, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	<b>0.31</b>	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	<b>0.38</b>	<b>0.44</b>	na	—	—	—	—	—	—	—
Ammonia	-0.05	-0.02	na	-0.08	—	—	—	—	—	—
pH	0.11	0.08	na	0.20	0.06	—	—	—	—	—
Sulfate	<b>0.51</b>	<b>0.37</b>	na	<b>0.47</b>	-0.17	0.15	—	—	—	—
Total dissolved solids	<b>0.65</b>	<b>0.37</b>	na	<b>0.49</b>	-0.07	0.08	<b>0.52</b>	—	—	—
Dissolved organic carbon	<b>0.41</b>	<b>0.32</b>	na	<b>0.39</b>	-0.03	0.01	<b>0.34</b>	<b>0.40</b>	—	—
Temperature	-0.19	0.06	na	-0.04	-0.05	-0.14	0.00	-0.11	-0.18	—
Groundwater level	<b>0.26</b>	<b>0.36</b>	na	<b>0.32</b>	-0.13	0.06	<b>0.31</b>	<b>0.31</b>	0.10	0.14

**Table 4-40.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD-27, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.01	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	-0.02	0.02	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.14	0.13	-0.14	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.42</b>	-0.13	0.04	0.11	—	—	—	—	—	—
<b>pH</b>	-0.14	-0.06	0.14	0.08	-0.08	—	—	—	—	—
<b>Sulfate</b>	-0.14	0.21	-0.04	0.08	<b>-0.41</b>	0.14	—	—	—	—
<b>Total dissolved solids</b>	<b>0.55</b>	0.18	0.01	<b>0.34</b>	<b>0.26</b>	-0.07	0.07	—	—	—
<b>Dissolved organic carbon</b>	-0.14	<b>0.27</b>	0.04	<b>0.25</b>	-0.23	0.15	<b>0.40</b>	0.16	—	—
<b>Temperature</b>	0.14	0.13	-0.03	-0.01	0.03	-0.22	-0.06	0.11	-0.08	—
<b>Groundwater level</b>	-0.07	<b>0.33</b>	0.03	0.16	<b>-0.29</b>	0.03	<b>0.32</b>	0.09	<b>0.27</b>	0.04



**Table 4-41.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD-28, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.01	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.15	0.06	na	—	—	—	—	—	—	—
Ammonia	-0.24	0.11	na	0.02	—	—	—	—	—	—
pH	-0.08	-0.06	na	0.01	0.11	—	—	—	—	—
Sulfate	-0.08	0.15	na	<b>0.29</b>	-0.07	-0.02	—	—	—	—
Total dissolved solids	<b>0.47</b>	0.07	na	0.16	-0.21	-0.05	-0.01	—	—	—
Dissolved organic carbon	<b>-0.38</b>	0.04	na	0.00	<b>0.42</b>	0.19	-0.09	<b>-0.29</b>	—	—
Temperature	0.10	0.06	na	-0.01	-0.20	-0.22	-0.04	<b>0.32</b>	-0.20	—
Groundwater level	<b>0.31</b>	-0.09	na	0.01	<b>-0.27</b>	-0.01	-0.04	<b>0.31</b>	<b>-0.32</b>	<b>0.33</b>

**Table 4-42.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD-29, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.34	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	-0.11	0.14	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.27	<b>0.28</b>	0.23	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.47</b>	-0.20	0.01	-0.15	—	—	—	—	—	—
<b>pH</b>	-0.22	-0.15	-0.08	-0.08	-0.21	—	—	—	—	—
<b>Sulfate</b>	-0.37	<b>0.26</b>	0.16	<b>0.42</b>	-0.29	0.02	—	—	—	—
<b>Total dissolved solids</b>	-0.03	0.06	0.13	0.15	0.02	-0.10	0.09	—	—	—
<b>Dissolved organic carbon</b>	-0.24	0.15	0.19	<b>0.32</b>	-0.05	0.01	<b>0.27</b>	0.12	—	—
<b>Temperature</b>	0.14	-0.06	0.07	-0.07	0.08	-0.17	-0.17	<b>0.35</b>	-0.05	—
<b>Groundwater level</b>	-0.04	0.04	-0.19	-0.03	-0.16	-0.04	-0.02	-0.04	-0.03	0.10

**Table 4–43.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–30, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.10	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	-0.08	-0.02	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.11	<b>0.31</b>	0.02	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.32</b>	-0.19	-0.04	-0.14	—	—	—	—	—	—
<b>pH</b>	0.02	-0.13	0.03	0.08	-0.03	—	—	—	—	—
<b>Sulfate</b>	-0.11	<b>0.28</b>	0.10	<b>0.68</b>	-0.15	0.10	—	—	—	—
<b>Total dissolved solids</b>	0.07	<b>0.28</b>	0.11	<b>0.53</b>	-0.07	-0.04	<b>0.51</b>	—	—	—
<b>Dissolved organic carbon</b>	-0.19	<b>0.32</b>	<b>0.26</b>	<b>0.32</b>	-0.12	-0.08	<b>0.28</b>	0.20	—	—
<b>Temperature</b>	-0.05	0.04	0.10	-0.11	0.02	-0.09	-0.12	0.08	-0.08	—
<b>Groundwater level</b>	0.00	-0.09	0.10	0.02	0.02	-0.04	0.09	0.10	-0.07	-0.04

**Table 4-44.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD-31, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.12	—	—	—	—	—	—	—	—	—
Fecal coliform	-0.12	0.06	—	—	—	—	—	—	—	—
Hardness	-0.23	<b>0.46</b>	0.02	—	—	—	—	—	—	—
Ammonia	0.07	0.06	0.02	0.06	—	—	—	—	—	—
pH	-0.16	-0.01	-0.02	0.13	-0.03	—	—	—	—	—
Sulfate	-0.23	<b>0.34</b>	-0.05	<b>0.61</b>	0.05	0.08	—	—	—	—
Total dissolved solids	0.13	<b>0.29</b>	-0.03	<b>0.49</b>	0.02	0.06	<b>0.37</b>	—	—	—
Dissolved organic carbon	-0.24	<b>0.41</b>	0.13	<b>0.46</b>	0.07	0.12	<b>0.34</b>	0.21	—	—
Temperature	0.07	-0.06	-0.01	0.00	0.00	-0.04	-0.01	0.06	-0.02	—
Groundwater level	<b>-0.27</b>	0.14	-0.04	0.15	-0.14	0.09	0.15	-0.03	0.23	0.06

**Table 4–45.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–32, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.13	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.38</b>	0.11	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.24	0.02	na	<b>0.31</b>	—	—	—	—	—	—
<b>pH</b>	0.02	0.14	na	-0.09	0.06	—	—	—	—	—
<b>Sulfate</b>	<b>0.32</b>	0.08	na	<b>0.30</b>	0.14	0.06	—	—	—	—
<b>Total dissolved solids</b>	<b>0.58</b>	0.03	na	<b>0.34</b>	<b>0.25</b>	0.01	0.20	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.26</b>	0.11	na	-0.06	-0.08	-0.15	-0.15	-0.22	—	—
<b>Temperature</b>	-0.02	-0.01	na	-0.09	-0.07	0.00	-0.02	0.00	0.01	—
<b>Groundwater level</b>	-0.17	0.11	na	-0.02	0.04	-0.16	0.03	-0.13	<b>0.42</b>	0.01

**Table 4-46.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD-33, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.10	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.11	-0.13	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.07	-0.03	na	0.14	—	—	—	—	—	—
<b>pH</b>	0.05	0.11	na	-0.15	-0.06	—	—	—	—	—
<b>Sulfate</b>	0.11	0.14	na	-0.05	-0.07	0.15	—	—	—	—
<b>Total dissolved solids</b>	0.15	0.09	na	0.06	-0.04	0.08	0.08	—	—	—
<b>Dissolved organic carbon</b>	<b>0.29</b>	0.22	na	-0.12	-0.17	0.11	0.16	<b>0.33</b>	—	—
<b>Temperature</b>	-0.06	0.10	na	0.07	-0.03	0.03	-0.05	-0.02	-0.02	—
<b>Groundwater level</b>	<b>0.30</b>	0.09	na	-0.07	-0.09	-0.05	0.10	0.20	<b>0.43</b>	-0.14

**Table 4–47.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–34, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.18	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.05	-0.01	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>-0.54</b>	<b>0.40</b>	-0.14	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.32</b>	-0.24	0.18	<b>-0.45</b>	—	—	—	—	—	—
<b>pH</b>	-0.23	-0.10	-0.09	0.11	-0.19	—	—	—	—	—
<b>Sulfate</b>	<b>-0.47</b>	<b>0.35</b>	-0.05	<b>0.61</b>	<b>-0.48</b>	0.06	—	—	—	—
<b>Total dissolved solids</b>	<b>-0.33</b>	0.22	-0.21	<b>0.47</b>	<b>-0.25</b>	0.14	<b>0.35</b>	—	—	—
<b>Dissolved organic carbon</b>	-0.17	<b>0.32</b>	0.03	<b>0.36</b>	-0.12	0.04	0.23	<b>0.26</b>	—	—
<b>Temperature</b>	-0.12	0.06	-0.03	0.04	0.01	-0.14	0.01	0.22	-0.08	—
<b>Groundwater level</b>	0.21	-0.18	0.04	-0.18	<b>0.32</b>	-0.22	<b>-0.30</b>	0.02	0.01	0.09

**Table 4-48.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD-35, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.15	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	<b>-0.31</b>	<b>0.35</b>	na	—	—	—	—	—	—	—
Ammonia	0.03	-0.22	na	-0.21	—	—	—	—	—	—
pH	0.01	<b>-0.25</b>	na	0.04	-0.02	—	—	—	—	—
Sulfate	-0.21	<b>0.39</b>	na	<b>0.60</b>	-0.20	0.02	—	—	—	—
Total dissolved solids	-0.16	0.24	na	<b>0.47</b>	-0.12	0.11	<b>0.43</b>	—	—	—
Dissolved organic carbon	-0.21	0.10	na	0.21	-0.13	0.07	0.21	0.20	—	—
Temperature	0.09	0.05	na	-0.01	0.05	-0.13	-0.02	0.18	0.12	—
Groundwater level	-0.14	-0.10	na	0.02	0.00	-0.01	-0.06	0.07	-0.07	0.11



**Table 4–49.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–36, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.09	—	—	—	—	—	—	—	—	—
Fecal coliform	-0.01	0.05	—	—	—	—	—	—	—	—
Hardness	0.10	<b>0.43</b>	0.08	—	—	—	—	—	—	—
Ammonia	0.04	<b>-0.26</b>	-0.03	-0.21	—	—	—	—	—	—
pH	0.02	-0.20	-0.12	-0.11	-0.04	—	—	—	—	—
Sulfate	0.12	<b>0.36</b>	0.05	<b>0.60</b>	-0.24	-0.03	—	—	—	—
Total dissolved solids	0.08	<b>0.32</b>	0.15	<b>0.50</b>	-0.06	-0.12	<b>0.45</b>	—	—	—
Dissolved organic carbon	0.04	<b>0.26</b>	0.09	<b>0.33</b>	-0.12	0.05	<b>0.34</b>	<b>0.30</b>	—	—
Temperature	-0.11	0.05	0.07	0.01	0.03	-0.03	-0.03	<b>0.25</b>	-0.04	—
Groundwater level	<b>-0.41</b>	-0.11	-0.02	-0.11	-0.02	-0.04	-0.11	-0.07	0.06	0.00

**Table 4–50.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–37, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.18	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	<b>-0.44</b>	<b>-0.27</b>	na	—	—	—	—	—	—	—
Ammonia	-0.16	<b>-0.27</b>	na	<b>0.42</b>	—	—	—	—	—	—
pH	-0.03	0.00	na	-0.13	-0.17	—	—	—	—	—
Sulfate	<b>-0.36</b>	-0.19	na	<b>0.49</b>	<b>0.34</b>	-0.19	—	—	—	—
Total dissolved solids	0.03	-0.04	na	0.19	0.18	-0.03	0.22	—	—	—
Dissolved organic carbon	<b>0.36</b>	0.23	na	<b>-0.35</b>	-0.06	0.08	<b>-0.42</b>	-0.14	—	—
Temperature	-0.13	0.10	na	0.05	0.07	0.01	0.09	0.17	-0.10	—
Groundwater level	0.18	0.19	na	-0.22	-0.04	0.03	-0.19	-0.13	<b>0.36</b>	-0.05

**Table 4–51.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–38, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	<b>0.40</b>	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.19	0.06	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.01	0.09	na	0.21	—	—	—	—	—	—
<b>pH</b>	-0.08	0.11	na	-0.02	-0.01	—	—	—	—	—
<b>Sulfate</b>	<b>0.45</b>	<b>0.36</b>	na	0.08	0.01	-0.13	—	—	—	—
<b>Total dissolved solids</b>	<b>0.67</b>	<b>0.27</b>	na	0.19	-0.04	-0.10	<b>0.35</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>0.49</b>	<b>0.44</b>	na	0.06	0.03	-0.08	<b>0.43</b>	<b>0.37</b>	—	—
<b>Temperature</b>	-0.06	-0.09	na	0.01	0.04	0.11	-0.03	-0.05	-0.07	—
<b>Groundwater level</b>	<b>0.47</b>	<b>0.51</b>	na	-0.03	-0.05	-0.03	<b>0.41</b>	<b>0.32</b>	<b>0.55</b>	-0.08

**Table 4–52.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–39, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.07	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.15	0.15	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.10	-0.09	na	-0.01	—	—	—	—	—	—
<b>pH</b>	-0.23	0.24	na	0.02	0.03	—	—	—	—	—
<b>Sulfate</b>	0.03	<b>0.34</b>	na	0.11	0.08	0.05	—	—	—	—
<b>Total dissolved solids</b>	0.00	0.09	na	<b>0.29</b>	-0.08	-0.09	0.01	—	—	—
<b>Dissolved organic carbon</b>	-0.09	<b>0.51</b>	na	0.13	0.12	0.22	<b>0.50</b>	-0.04	—	—
<b>Temperature</b>	-0.12	0.04	na	0.17	0.10	0.03	0.03	0.23	0.05	—
<b>Groundwater level</b>	-0.05	<b>0.31</b>	na	0.06	0.15	0.08	<b>0.32</b>	0.00	<b>0.57</b>	0.12

**Table 4–53.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–40, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.31	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.04	-0.10	na	—	—	—	—	—	—	—
Ammonia	0.01	-0.05	na	0.18	—	—	—	—	—	—
pH	-0.27	0.11	na	0.13	0.00	—	—	—	—	—
Sulfate	-0.33	0.23	na	-0.05	-0.20	-0.04	—	—	—	—
Total dissolved solids	-0.23	0.22	na	0.04	-0.18	-0.05	<b>0.32</b>	—	—	—
Dissolved organic carbon	-0.38	<b>0.42</b>	na	0.03	0.05	0.06	0.20	<b>0.28</b>	—	—
Temperature	0.04	-0.23	na	-0.01	0.21	0.04	-0.12	-0.24	-0.14	—
Groundwater level	-0.29	<b>0.32</b>	na	-0.04	0.08	0.10	0.19	<b>0.27</b>	<b>0.54</b>	-0.04

**Table 4–54.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–41, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.14	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.10	<b>0.42</b>	na	—	—	—	—	—	—	—
Ammonia	0.03	-0.03	na	-0.12	—	—	—	—	—	—
pH	-0.07	0.16	na	0.11	-0.11	—	—	—	—	—
Sulfate	-0.10	<b>0.36</b>	na	<b>0.37</b>	-0.20	0.10	—	—	—	—
Total dissolved solids	-0.02	<b>0.31</b>	na	<b>0.36</b>	0.02	-0.05	<b>0.33</b>	—	—	—
Dissolved organic carbon	-0.13	<b>0.37</b>	na	<b>0.43</b>	0.10	0.11	<b>0.39</b>	<b>0.32</b>	—	—
Temperature	0.09	-0.17	na	-0.21	-0.03	-0.18	<b>-0.32</b>	-0.14	<b>-0.32</b>	—
Groundwater level	0.19	<b>0.32</b>	na	<b>0.27</b>	-0.04	-0.02	<b>0.31</b>	<b>0.27</b>	<b>0.40</b>	-0.21

**Table 4–55.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–42, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.33	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.30	<b>0.40</b>	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.03	-0.20	na	-0.18	—	—	—	—	—	—
<b>pH</b>	-0.10	<b>0.25</b>	na	<b>0.29</b>	-0.15	—	—	—	—	—
<b>Sulfate</b>	0.04	0.09	na	0.14	-0.17	0.04	—	—	—	—
<b>Total dissolved solids</b>	-0.12	0.24	na	<b>0.32</b>	<b>-0.36</b>	0.13	0.18	—	—	—
<b>Dissolved organic carbon</b>	-0.34	<b>0.35</b>	na	<b>0.44</b>	-0.06	0.04	0.19	0.23	—	—
<b>Temperature</b>	0.06	-0.16	na	-0.09	0.07	0.06	-0.05	0.03	-0.09	—
<b>Groundwater level</b>	0.14	<b>-0.28</b>	na	<b>-0.37</b>	0.02	-0.12	-0.10	-0.21	<b>-0.35</b>	0.13

**Table 4–56.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–43, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.27	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.19	0.16	na	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.54</b>	<b>-0.34</b>	na	-0.12	—	—	—	—	—	—
<b>pH</b>	-0.21	0.22	na	0.15	<b>-0.33</b>	—	—	—	—	—
<b>Sulfate</b>	<b>-0.38</b>	<b>0.36</b>	na	<b>0.38</b>	<b>-0.28</b>	0.10	—	—	—	—
<b>Total dissolved solids</b>	-0.06	0.05	na	<b>0.49</b>	-0.01	0.04	<b>0.29</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.36</b>	<b>0.30</b>	na	<b>0.35</b>	<b>-0.27</b>	0.06	<b>0.45</b>	0.24	—	—
<b>Temperature</b>	0.05	-0.11	na	0.13	0.06	-0.12	-0.03	0.23	-0.08	—
<b>Groundwater level</b>	<b>0.30</b>	<b>-0.35</b>	na	<b>-0.35</b>	<b>0.32</b>	-0.13	<b>-0.39</b>	-0.18	<b>-0.52</b>	0.03



**Table 4–57.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–44, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.29	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.18	0.04	na	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.25</b>	-0.14	na	-0.06	—	—	—	—	—	—
<b>pH</b>	-0.06	-0.06	na	-0.02	-0.14	—	—	—	—	—
<b>Sulfate</b>	-0.20	<b>0.08</b>	na	<b>0.45</b>	-0.06	0.09	—	—	—	—
<b>Total dissolved solids</b>	-0.07	0.08	na	<b>0.35</b>	0.03	-0.15	<b>0.37</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.33</b>	<b>0.29</b>	na	-0.10	-0.13	0.22	0.09	-0.11	—	—
<b>Temperature</b>	-0.04	-0.01	na	-0.04	0.08	-0.04	-0.10	-0.01	0.03	—
<b>Groundwater level</b>	0.22	<b>-0.31</b>	na	0.00	0.08	<b>-0.25</b>	-0.08	0.00	<b>-0.43</b>	0.03

**Table 4–58.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–45, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.12	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.04	-0.14	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.07	-0.23	na	0.10	—	—	—	—	—	—
<b>pH</b>	<b>-0.31</b>	0.19	na	0.07	-0.20	—	—	—	—	—
<b>Sulfate</b>	0.03	0.15	na	-0.07	-0.11	0.07	—	—	—	—
<b>Total dissolved solids</b>	0.04	0.09	na	0.19	0.02	0.04	0.10	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.27</b>	<b>0.25</b>	na	-0.15	-0.20	0.16	<b>0.37</b>	0.13	—	—
<b>Temperature</b>	-0.04	-0.12	na	0.22	0.07	0.02	0.00	<b>0.27</b>	<b>-0.25</b>	—
<b>Groundwater level</b>	0.15	<b>-0.28</b>	na	0.23	0.19	-0.12	<b>-0.38</b>	0.00	<b>-0.44</b>	-0.01

**Table 4–59.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–46, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.08	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.06	0.00	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.13	<b>0.31</b>	-0.08	—	—	—	—	—	—	—
<b>Ammonia</b>	0.04	0.07	-0.09	0.08	—	—	—	—	—	—
<b>pH</b>	-0.12	0.15	0.11	<b>0.26</b>	-0.13	—	—	—	—	—
<b>Sulfate</b>	0.10	<b>0.30</b>	-0.21	<b>0.47</b>	0.21	0.11	—	—	—	—
<b>Total dissolved solids</b>	<b>0.47</b>	0.13	-0.04	0.01	0.06	-0.08	0.25	—	—	—
<b>Dissolved organic carbon</b>	-0.01	<b>0.28</b>	-0.02	<b>0.29</b>	-0.03	<b>0.32</b>	0.19	0.20	—	—
<b>Temperature</b>	-0.15	0.01	0.13	-0.01	0.07	-0.02	-0.11	-0.02	-0.02	—
<b>Groundwater level</b>	0.05	-0.07	-0.13	<b>-0.27</b>	0.12	<b>-0.27</b>	-0.12	0.09	-0.23	0.09

**Table 4–60.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–47, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.22	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>-0.26</b>	-0.04	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.06	0.00	na	0.01	—	—	—	—	—	—
<b>pH</b>	-0.01	0.08	na	0.00	-0.08	—	—	—	—	—
<b>Sulfate</b>	0.12	-0.07	na	-0.09	<b>0.27</b>	<b>-0.25</b>	—	—	—	—
<b>Total dissolved solids</b>	0.17	0.13	na	-0.06	0.16	-0.17	0.05	—	—	—
<b>Dissolved organic carbon</b>	<b>0.32</b>	<b>0.40</b>	na	0.07	0.12	0.01	0.08	<b>0.27</b>	—	—
<b>Temperature</b>	0.02	0.00	na	-0.19	-0.02	0.08	-0.10	0.01	-0.12	—
<b>Groundwater level</b>	-0.23	<b>-0.36</b>	na	0.03	0.21	0.00	0.06	-0.04	<b>-0.46</b>	0.09

**Table 4–61.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–48, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	<b>0.30</b>	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.16	0.30	na	—	—	—	—	—	—	—
Ammonia	<b>0.26</b>	<b>0.36</b>	na	-0.01	—	—	—	—	—	—
pH	<b>-0.34</b>	-0.10	na	-0.19	-0.09	—	—	—	—	—
Sulfate	0.02	0.00	na	0.21	-0.03	-0.03	—	—	—	—
Total dissolved solids	0.20	<b>0.26</b>	na	<b>0.58</b>	-0.05	-0.23	0.16	—	—	—
Dissolved organic carbon	<b>0.48</b>	<b>0.46</b>	na	0.21	<b>0.39</b>	-0.14	0.06	0.14	—	—
Temperature	-0.01	0.01	na	0.00	0.08	0.05	-0.15	0.07	-0.04	—
Groundwater level	<b>0.42</b>	<b>0.28</b>	na	0.00	<b>0.40</b>	-0.05	-0.03	-0.08	<b>0.57</b>	0.11

**Table 4–62.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–49, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.22	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.24	<b>0.27</b>	na	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.34</b>	<b>0.32</b>	na	<b>0.31</b>	—	—	—	—	—	—
<b>pH</b>	-0.02	-0.01	na	0.04	0.09	—	—	—	—	—
<b>Sulfate</b>	0.11	<b>0.33</b>	na	0.12	0.12	-0.12	—	—	—	—
<b>Total dissolved solids</b>	0.11	<b>0.30</b>	na	<b>0.67</b>	0.17	0.01	0.08	—	—	—
<b>Dissolved organic carbon</b>	0.22	<b>0.48</b>	na	<b>0.32</b>	<b>0.43</b>	-0.04	<b>0.39</b>	<b>0.28</b>	—	—
<b>Temperature</b>	-0.07	-0.21	na	0.03	<b>-0.27</b>	-0.07	-0.09	0.13	-0.18	—
<b>Groundwater level</b>	0.15	<b>0.55</b>	na	0.21	<b>0.39</b>	-0.03	<b>0.42</b>	0.23	<b>0.57</b>	-0.12

**Table 4–63.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–50, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.03	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.19	-0.09	na	—	—	—	—	—	—	—
Ammonia	-0.02	-0.02	na	<b>0.27</b>	—	—	—	—	—	—
pH	-0.07	0.08	na	0.06	0.07	—	—	—	—	—
Sulfate	-0.17	-0.19	na	<b>0.30</b>	0.22	0.03	—	—	—	—
Total dissolved solids	0.15	0.15	na	0.01	0.02	0.12	0.11	—	—	—
Dissolved organic carbon	0.21	<b>0.38</b>	na	-0.17	<b>-0.13</b>	0.16	<b>-0.31</b>	0.12	—	—
Temperature	-0.07	-0.16	na	0.00	0.00	0.16	0.08	0.01	-0.15	—
Groundwater level	0.18	<b>0.38</b>	na	-0.23	-0.11	0.07	<b>-0.31</b>	0.10	<b>0.61</b>	-0.13

**Table 4-64.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD-51, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.20	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.03	0.03	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.14	0.14	na	0.11	—	—	—	—	—	—
<b>pH</b>	-0.16	0.06	na	0.05	0.00	—	—	—	—	—
<b>Sulfate</b>	-0.05	-0.05	na	0.18	0.15	0.06	—	—	—	—
<b>Total dissolved solids</b>	-0.07	0.15	na	0.13	0.08	0.08	0.18	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.29</b>	<b>0.25</b>	na	0.17	0.10	0.09	-0.01	<b>0.39</b>	—	—
<b>Temperature</b>	-0.14	-0.03	na	-0.03	0.08	0.09	-0.08	-0.01	-0.02	—
<b>Groundwater level</b>	-0.20	<b>0.34</b>	na	0.13	0.03	0.00	0.04	<b>0.35</b>	<b>0.58</b>	-0.16



**Table 4–65.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–52, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.08	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.19	<b>-0.29</b>	na	—	—	—	—	—	—	—
Ammonia	-0.07	0.05	na	0.17	—	—	—	—	—	—
pH	0.14	0.00	na	-0.24	0.00	—	—	—	—	—
Sulfate	-0.19	-0.06	na	<b>0.26</b>	0.22	-0.05	—	—	—	—
Total dissolved solids	-0.02	0.19	na	-0.21	-0.13	0.06	-0.04	—	—	—
Dissolved organic carbon	-0.13	<b>0.26</b>	na	-0.22	-0.18	0.05	-0.08	<b>0.29</b>	—	—
Temperature	0.08	-0.12	na	-0.07	0.00	0.05	0.04	0.21	-0.11	—
Groundwater level	-0.06	0.14	na	-0.06	-0.14	-0.14	-0.11	0.18	<b>0.41</b>	-0.10

**Table 4-66.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD-53, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.06	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.31</b>	-0.19	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.10	<b>0.25</b>	na	-0.12	—	—	—	—	—	—
<b>pH</b>	-0.10	0.09	na	-0.15	0.08	—	—	—	—	—
<b>Sulfate</b>	<b>0.31</b>	<b>-0.28</b>	na	<b>0.46</b>	-0.04	-0.04	—	—	—	—
<b>Total dissolved solids</b>	-0.14	0.16	na	-0.22	0.03	0.12	-0.22	—	—	—
<b>Dissolved organic carbon</b>	-0.10	<b>0.41</b>	na	-0.22	0.20	0.00	<b>-0.43</b>	0.20	—	—
<b>Temperature</b>	-0.06	-0.18	na	-0.01	-0.10	-0.03	0.15	0.05	-0.19	—
<b>Groundwater level</b>	-0.18	<b>0.29</b>	na	<b>-0.38</b>	0.07	-0.06	<b>-0.52</b>	0.13	<b>0.55</b>	-0.18

**Table 4–67.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–54, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.11	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.12	-0.04	na	—	—	—	—	—	—	—
Ammonia	0.16	0.01	na	0.14	—	—	—	—	—	—
pH	-0.05	0.04	na	-0.11	-0.07	—	—	—	—	—
Sulfate	0.19	-0.08	na	<b>0.41</b>	0.18	-0.21	—	—	—	—
Total dissolved solids	0.12	0.00	na	0.21	0.14	-0.20	<b>0.25</b>	—	—	—
Dissolved organic carbon	<b>-0.28</b>	<b>0.32</b>	na	0.06	-0.15	-0.04	-0.13	0.13	—	—
Temperature	0.04	-0.15	na	-0.02	0.00	0.00	0.04	-0.05	-0.23	—
Groundwater level	0.07	0.08	na	0.15	-0.02	-0.10	0.20	0.24	0.23	-0.16

**Table 4–68.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–55, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.09	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.25</b>	0.05	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.22	0.00	na	<b>0.38</b>	—	—	—	—	—	—
<b>pH</b>	<b>-0.26</b>	-0.08	na	<b>-0.32</b>	-0.10	—	—	—	—	—
<b>Sulfate</b>	<b>0.50</b>	-0.09	na	<b>0.33</b>	<b>0.25</b>	-0.24	—	—	—	—
<b>Total dissolved solids</b>	<b>0.34</b>	0.06	na	<b>0.38</b>	<b>0.25</b>	-0.22	<b>0.46</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.28</b>	<b>0.33</b>	na	0.11	0.04	-0.06	-0.21	-0.01	—	—
<b>Temperature</b>	0.08	-0.10	na	-0.05	0.04	-0.05	0.09	0.07	<b>-0.29</b>	—
<b>Groundwater level</b>	-0.17	0.08	na	-0.22	-0.17	0.23	<b>-0.27</b>	-0.10	0.13	-0.07

**Table 4–69.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–56, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.02	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.15	0.09	na	—	—	—	—	—	—	—
Ammonia	-0.04	-0.05	na	0.12	—	—	—	—	—	—
pH	-0.10	0.13	na	0.10	-0.03	—	—	—	—	—
Sulfate	-0.10	0.22	na	0.22	-0.20	<b>0.33</b>	—	—	—	—
Total dissolved solids	0.07	<b>0.37</b>	na	-0.05	-0.04	-0.08	0.10	—	—	—
Dissolved organic carbon	-0.08	<b>0.45</b>	na	0.15	0.01	-0.02	0.12	<b>0.39</b>	—	—
Temperature	-0.01	-0.11	na	0.12	-0.03	0.04	0.13	-0.03	-0.16	—
Groundwater level	0.16	<b>0.37</b>	na	0.14	0.10	0.00	0.19	<b>0.35</b>	<b>0.44</b>	-0.10

**Table 4–70.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–57, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.32	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.40	<b>0.52</b>	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.31	<b>0.36</b>	na	<b>0.49</b>	—	—	—	—	—	—
<b>pH</b>	-0.05	0.08	na	0.23	0.18	—	—	—	—	—
<b>Sulfate</b>	-0.33	<b>0.49</b>	na	<b>0.52</b>	<b>0.39</b>	0.13	—	—	—	—
<b>Total dissolved solids</b>	-0.27	<b>0.52</b>	na	<b>0.51</b>	<b>0.33</b>	0.03	<b>0.40</b>	—	—	—
<b>Dissolved organic carbon</b>	-0.27	<b>0.46</b>	na	<b>0.36</b>	<b>0.27</b>	-0.18	<b>0.36</b>	<b>0.40</b>	—	—
<b>Temperature</b>	-0.04	-0.17	na	-0.02	0.01	0.11	-0.13	-0.18	<b>-0.25</b>	—
<b>Groundwater level</b>	-0.21	<b>0.51</b>	na	<b>0.53</b>	<b>0.40</b>	0.02	<b>0.52</b>	<b>0.46</b>	<b>0.46</b>	-0.12

**Table 4–71.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–58, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.05	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.20	<b>0.28</b>	na	—	—	—	—	—	—	—
Ammonia	-0.05	0.04	na	-0.03	—	—	—	—	—	—
pH	-0.11	0.12	na	0.14	0.00	—	—	—	—	—
Sulfate	-0.10	<b>0.35</b>	na	<b>0.40</b>	-0.15	<b>0.28</b>	—	—	—	—
Total dissolved solids	0.18	0.17	na	0.03	0.01	-0.01	0.13	—	—	—
Dissolved organic carbon	-0.09	<b>0.47</b>	na	<b>0.41</b>	-0.06	0.13	<b>0.48</b>	<b>0.29</b>	—	—
Temperature	-0.10	-0.14	na	0.04	0.08	0.00	-0.08	-0.11	-0.07	—
Groundwater level	-0.11	<b>0.43</b>	na	<b>0.43</b>	-0.08	0.19	<b>0.65</b>	0.18	<b>0.56</b>	-0.06

**Table 4–72.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–59, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.06	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.21	<b>0.28</b>	na	—	—	—	—	—	—	—
Ammonia	-0.05	0.04	na	-0.03	—	—	—	—	—	—
pH	-0.12	0.12	na	0.14	0.00	—	—	—	—	—
Sulfate	-0.15	<b>0.36</b>	na	<b>0.45</b>	-0.14	<b>0.28</b>	—	—	—	—
Total dissolved solids	0.18	0.17	na	0.03	0.01	-0.02	0.14	—	—	—
Dissolved organic carbon	-0.10	<b>0.47</b>	na	<b>0.41</b>	-0.06	0.13	<b>0.50</b>	<b>0.29</b>	—	—
Temperature	-0.10	-0.14	na	0.04	0.08	0.00	-0.02	-0.11	-0.07	—
Groundwater level	-0.11	<b>0.43</b>	na	<b>0.43</b>	-0.08	0.19	<b>0.65</b>	0.18	<b>0.56</b>	-0.06



**Table 4–73.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring QD–60, Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1996–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.01	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.16	0.22	na	—	—	—	—	—	—	—
Ammonia	-0.03	0.19	na	0.07	—	—	—	—	—	—
pH	-0.09	0.08	na	0.18	-0.08	—	—	—	—	—
Sulfate	0.23	0.11	na	-0.08	0.16	-0.08	—	—	—	—
Total dissolved solids	0.11	0.12	na	0.03	-0.02	0.04	-0.06	—	—	—
Dissolved organic carbon	-0.12	<b>0.26</b>	na	<b>0.39</b>	0.04	0.05	0.01	0.05	—	—
Temperature	-0.01	0.05	na	0.07	0.04	-0.03	-0.03	0.09	-0.03	—
Groundwater level	-0.02	-0.21	na	-0.16	0.06	-0.07	-0.11	-0.07	-0.23	-0.04

**Table 4–74.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–53, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.01	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.13	<b>0.32</b>	na	—	—	—	—	—	—	—
Ammonia	0.04	<b>0.46</b>	na	0.22	—	—	—	—	—	—
pH	-0.12	<b>0.27</b>	na	0.15	0.15	—	—	—	—	—
Sulfate	-0.03	0.11	na	0.16	0.07	0.00	—	—	—	—
Total dissolved solids	0.11	0.16	na	0.15	0.07	0.00	0.05	—	—	—
Dissolved organic carbon	-0.07	<b>0.25</b>	na	<b>0.25</b>	0.23	<b>0.29</b>	0.13	<b>0.27</b>	—	—
Temperature	0.08	0.04	na	0.20	0.07	0.01	0.00	<b>0.27</b>	0.15	—
Groundwater level	0.19	-0.09	na	-0.18	0.05	-0.15	-0.16	-0.09	<b>-0.28</b>	-0.11

**Table 4–75.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–56, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2009.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.21	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	<b>0.44</b>	-0.10	na	—	—	—	—	—	—	—
Ammonia	0.11	0.07	na	<b>0.28</b>	—	—	—	—	—	—
pH	<b>-0.28</b>	0.06	na	<b>-0.36</b>	<b>-0.31</b>	—	—	—	—	—
Sulfate	-0.07	-0.06	na	0.07	-0.11	-0.17	—	—	—	—
Total dissolved solids	<b>0.32</b>	-0.09	na	0.14	0.19	<b>-0.29</b>	-0.03	—	—	—
Dissolved organic carbon	<b>-0.25</b>	0.15	na	<b>-0.27</b>	-0.11	<b>0.25</b>	-0.16	-0.05	—	—
Temperature	-0.26	0.24	na	-0.20	0.04	-0.03	-0.12	0.13	0.12	—
Groundwater level	<b>-0.31</b>	<b>0.26</b>	na	<b>-0.28</b>	0.00	0.10	0.00	-0.09	<b>0.27</b>	0.15

**Table 4-76.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM-58, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995-2008.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.22	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	<b>-0.37</b>	<b>0.26</b>	na	—	—	—	—	—	—	—
Ammonia	0.02	0.07	na	0.00	—	—	—	—	—	—
pH	-0.20	0.06	na	<b>0.28</b>	-0.03	—	—	—	—	—
Sulfate	-0.24	0.10	na	<b>0.34</b>	0.00	0.13	—	—	—	—
Total dissolved solids	-0.10	0.14	na	<b>0.36</b>	-0.05	-0.05	<b>0.33</b>	—	—	—
Dissolved organic carbon	<b>-0.41</b>	0.15	na	<b>0.30</b>	0.11	<b>0.32</b>	0.23	0.10	—	—
Temperature	-0.06	-0.06	na	0.07	<b>-0.34</b>	-0.14	0.06	<b>0.25</b>	-0.18	—
Groundwater level	0.20	<b>-0.39</b>	na	-0.20	-0.06	-0.08	-0.23	-0.12	<b>-0.22</b>	0.07

**Table 4–77.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–61, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	<b>0.42</b>	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.07	-0.08	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.70</b>	<b>0.52</b>	0.09	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.25</b>	0.09	0.18	0.24	—	—	—	—	—	—
<b>pH</b>	0.16	<b>0.28</b>	-0.17	0.22	-0.08	—	—	—	—	—
<b>Sulfate</b>	<b>0.62</b>	<b>0.40</b>	0.18	<b>0.57</b>	0.15	0.16	—	—	—	—
<b>Total dissolved solids</b>	<b>0.75</b>	<b>0.51</b>	0.01	<b>0.64</b>	0.23	0.13	<b>0.56</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>0.38</b>	<b>0.51</b>	-0.01	<b>0.45</b>	<b>0.28</b>	0.16	<b>0.40</b>	<b>0.44</b>	—	—
<b>Temperature</b>	-0.09	0.05	0.14	-0.02	-0.01	0.16	0.05	0.00	0.03	—
<b>Groundwater level</b>	<b>0.25</b>	0.18	<b>0.37</b>	<b>0.28</b>	<b>0.31</b>	0.03	<b>0.30</b>	<b>0.25</b>	<b>0.25</b>	0.20

**Table 4–78.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–62, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.18	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.02	-0.03	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.32</b>	0.06	<b>0.25</b>	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.38</b>	0.09	0.14	<b>0.45</b>	—	—	—	—	—	—
<b>pH</b>	0.00	-0.05	-0.17	-0.20	-0.22	—	—	—	—	—
<b>Sulfate</b>	-0.07	0.00	<b>0.46</b>	<b>0.26</b>	0.08	-0.12	—	—	—	—
<b>Total dissolved solids</b>	<b>0.33</b>	0.11	0.14	<b>0.45</b>	<b>0.36</b>	-0.13	0.14	—	—	—
<b>Dissolved organic carbon</b>	-0.02	0.16	-0.12	-0.14	-0.22	<b>0.26</b>	-0.07	-0.09	—	—
<b>Temperature</b>	-0.20	-0.08	0.22	0.07	-0.03	0.00	0.23	0.03	-0.06	—
<b>Groundwater level</b>	0.10	-0.10	<b>0.31</b>	0.07	0.02	-0.01	<b>0.29</b>	0.01	-0.07	0.08

**Table 4–79.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–63, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.09	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.01	-0.11	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.13	0.00	-0.13	—	—	—	—	—	—	—
<b>Ammonia</b>	0.08	-0.03	-0.02	<b>0.56</b>	—	—	—	—	—	—
<b>pH</b>	-0.02	0.10	-0.08	-0.20	-0.21	—	—	—	—	—
<b>Sulfate</b>	0.13	0.02	-0.13	<b>0.66</b>	<b>0.54</b>	-0.23	—	—	—	—
<b>Total dissolved solids</b>	0.20	-0.06	-0.01	<b>0.71</b>	<b>0.59</b>	-0.24	<b>0.66</b>	—	—	—
<b>Dissolved organic carbon</b>	0.03	0.05	-0.07	-0.18	<b>-0.35</b>	0.03	<b>-0.31</b>	-0.21	—	—
<b>Temperature</b>	-0.05	0.01	0.11	0.07	0.07	-0.04	0.07	0.15	-0.04	—
<b>Groundwater level</b>	0.04	-0.11	0.15	<b>-0.28</b>	<b>-0.31</b>	0.08	<b>-0.30</b>	<b>-0.31</b>	0.13	-0.07

**Table 4–80.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–64, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.17	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.06	-0.09	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.40</b>	<b>0.38</b>	-0.08	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.45</b>	<b>0.27</b>	-0.05	<b>0.54</b>	—	—	—	—	—	—
<b>pH</b>	0.08	-0.10	0.04	0.07	-0.04	—	—	—	—	—
<b>Sulfate</b>	0.12	<b>0.33</b>	-0.12	<b>0.43</b>	0.18	0.03	—	—	—	—
<b>Total dissolved solids</b>	0.15	0.16	-0.07	0.17	0.15	-0.07	0.17	—	—	—
<b>Dissolved organic carbon</b>	0.06	<b>0.38</b>	-0.11	<b>0.41</b>	<b>0.37</b>	-0.03	<b>0.31</b>	0.17	—	—
<b>Temperature</b>	0.00	-0.08	0.09	-0.02	0.05	-0.04	-0.09	0.04	0.02	—
<b>Groundwater level</b>	0.16	0.02	-0.02	0.16	0.08	0.05	0.17	0.01	0.03	0.03



**Table 4–81.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–65, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2010.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.13	—	—	—	—	—	—	—	—	—
Fecal coliform	-0.15	0.13	—	—	—	—	—	—	—	—
Hardness	<b>0.31</b>	0.20	-0.14	—	—	—	—	—	—	—
Ammonia	<b>0.62</b>	0.15	-0.05	<b>0.29</b>	—	—	—	—	—	—
pH	-0.10	-0.13	0.07	-0.07	-0.10	—	—	—	—	—
Sulfate	-0.18	-0.15	-0.12	0.05	<b>-0.30</b>	0.08	—	—	—	—
Total dissolved solids	<b>0.67</b>	0.13	-0.14	<b>0.43</b>	<b>0.51</b>	-0.05	-0.12	—	—	—
Dissolved organic carbon	0.24	<b>0.28</b>	0.03	<b>0.51</b>	<b>0.39</b>	-0.03	0.00	<b>0.28</b>	—	—
Temperature	0.09	-0.02	0.05	-0.07	0.00	-0.05	-0.05	0.09	-0.11	—
Groundwater level	0.00	-0.12	0.08	-0.08	-0.06	-0.13	0.00	0.00	-0.12	<b>0.28</b>

**Table 4–82.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–67, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.20	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.19	<b>-0.26</b>	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>-0.25</b>	<b>0.49</b>	<b>-0.37</b>	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.34</b>	<b>-0.41</b>	<b>0.41</b>	<b>-0.64</b>	—	—	—	—	—	—
<b>pH</b>	0.06	-0.11	0.16	-0.19	0.06	—	—	—	—	—
<b>Sulfate</b>	<b>-0.36</b>	<b>0.45</b>	<b>-0.36</b>	<b>0.74</b>	<b>-0.73</b>	<b>-0.07</b>	—	—	—	—
<b>Total dissolved solids</b>	-0.13	<b>0.47</b>	<b>-0.38</b>	<b>0.75</b>	<b>-0.59</b>	-0.13	<b>0.66</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.30</b>	<b>0.33</b>	<b>-0.26</b>	<b>0.50</b>	<b>-0.38</b>	<b>-0.27</b>	<b>0.47</b>	<b>0.46</b>	—	—
<b>Temperature</b>	0.14	0.14	-0.04	0.04	-0.02	-0.04	-0.03	0.09	0.02	—
<b>Groundwater level</b>	0.02	-0.06	0.05	-0.07	0.13	-0.07	-0.11	-0.08	0.12	0.00

**Table 4–83.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–68, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.11	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	-0.08	-0.05	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>0.49</b>	0.05	0.00	—	—	—	—	—	—	—
<b>Ammonia</b>	0.15	0.00	-0.21	0.06	—	—	—	—	—	—
<b>pH</b>	<b>-0.36</b>	0.00	0.03	<b>-0.34</b>	0.02	—	—	—	—	—
<b>Sulfate</b>	<b>-0.26</b>	-0.05	-0.04	<b>-0.26</b>	0.00	0.20	—	—	—	—
<b>Total dissolved solids</b>	<b>0.49</b>	-0.06	0.02	<b>0.42</b>	0.12	<b>-0.27</b>	-0.24	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.46</b>	0.05	-0.13	<b>-0.35</b>	0.03	<b>0.39</b>	<b>0.29</b>	<b>-0.25</b>	—	—
<b>Temperature</b>	0.12	-0.01	0.13	0.17	-0.16	-0.09	-0.13	<b>0.26</b>	-0.17	—
<b>Groundwater level</b>	-0.04	0.09	<b>0.38</b>	-0.02	0.00	0.13	0.02	0.09	0.02	0.11

**Table 4–84.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–69, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.02	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.01	<b>0.30</b>	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.03	0.03	na	0.01	—	—	—	—	—	—
<b>pH</b>	-0.04	<b>0.04</b>	na	0.11	0.11	—	—	—	—	—
<b>Sulfate</b>	0.05	0.42	na	<b>0.47</b>	0.16	0.16	—	—	—	—
<b>Total dissolved solids</b>	0.15	0.19	na	<b>0.36</b>	0.03	0.04	<b>0.41</b>	—	—	—
<b>Dissolved organic carbon</b>	0.04	<b>0.26</b>	na	<b>0.37</b>	0.08	0.10	<b>0.45</b>	<b>0.30</b>	—	—
<b>Temperature</b>	0.01	-0.09	na	-0.05	0.04	0.00	-0.09	-0.07	-0.16	—
<b>Groundwater level</b>	0.07	<b>-0.42</b>	na	<b>-0.41</b>	-0.14	-0.08	<b>-0.51</b>	<b>-0.26</b>	<b>-0.28</b>	0.13

**Table 4–85.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–70, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.05	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.08	0.16	na	—	—	—	—	—	—	—
Ammonia	-0.01	-0.08	na	0.01	—	—	—	—	—	—
pH	-0.13	<b>0.30</b>	na	0.17	-0.05	—	—	—	—	—
Sulfate	0.16	<b>0.39</b>	na	<b>0.25</b>	0.04	<b>0.25</b>	—	—	—	—
Total dissolved solids	0.11	<b>0.30</b>	na	0.17	-0.06	<b>0.30</b>	<b>0.34</b>	—	—	—
Dissolved organic carbon	0.08	<b>0.28</b>	na	<b>0.49</b>	0.10	<b>0.26</b>	<b>0.49</b>	<b>0.27</b>	—	—
Temperature	-0.11	-0.13	na	-0.15	-0.01	-0.18	-0.17	-0.04	-0.16	—
Groundwater level	-0.20	<b>-0.51</b>	na	<b>-0.37</b>	0.06	-0.24	<b>-0.62</b>	<b>-0.36</b>	<b>-0.60</b>	<b>0.26</b>

**Table 4–86.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–71, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.02	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.08	0.16	na	—	—	—	—	—	—	—
Ammonia	-0.10	0.00	na	0.15	—	—	—	—	—	—
pH	0.06	<b>0.26</b>	na	0.14	0.06	—	—	—	—	—
Sulfate	0.10	0.20	na	<b>0.33</b>	-0.04	0.13	—	—	—	—
Total dissolved solids	0.02	0.02	na	0.22	0.10	0.14	0.24	—	—	—
Dissolved organic carbon	0.07	0.16	na	<b>0.38</b>	0.18	0.09	<b>0.35</b>	0.19	—	—
Temperature	-0.06	-0.04	na	0.04	0.18	-0.02	-0.07	0.20	-0.07	—
Groundwater level	-0.09	-0.15	na	-0.20	-0.09	-0.15	-0.19	-0.05	<b>-0.43</b>	0.09

**Table 4–87.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–72, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.00	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.07	0.15	na	—	—	—	—	—	—	—
Ammonia	-0.07	-0.09	na	-0.19	—	—	—	—	—	—
pH	0.15	0.16	na	0.17	<b>-0.35</b>	—	—	—	—	—
Sulfate	0.16	0.12	na	<b>0.34</b>	-0.23	<b>0.41</b>	—	—	—	—
Total dissolved solids	0.02	0.09	na	0.06	0.07	0.04	0.12	—	—	—
Dissolved organic carbon	0.13	<b>0.29</b>	na	<b>0.36</b>	0.01	0.23	<b>0.36</b>	0.12	—	—
Temperature	-0.04	-0.04	na	-0.02	0.02	0.06	-0.03	<b>0.32</b>	-0.04	—
Groundwater level	-0.03	-0.21	na	<b>-0.38</b>	<b>0.29</b>	<b>-0.34</b>	<b>-0.53</b>	-0.10	<b>-0.41</b>	0.01

**Table 4–88.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–73, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.26	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.16	-0.03	na	—	—	—	—	—	—	—
Ammonia	0.14	0.27	na	0.17	—	—	—	—	—	—
pH	0.14	0.08	na	-0.11	0.02	—	—	—	—	—
Sulfate	0.31	0.35	na	-0.06	0.18	0.23	—	—	—	—
Total dissolved solids	0.28	0.29	na	-0.08	0.29	0.06	0.39	—	—	—
Dissolved organic carbon	0.45	0.35	na	0.02	0.13	0.07	0.36	0.24	—	—
Temperature	-0.19	-0.19	na	-0.09	-0.04	-0.05	-0.18	-0.10	-0.08	—
Groundwater level	0.26	0.30	na	-0.04	0.16	0.02	0.21	0.26	0.42	-0.09



**Table 4–89.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–74, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.21	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.07	-0.08	na	—	—	—	—	—	—	—
Ammonia	0.06	0.10	na	0.17	—	—	—	—	—	—
pH	-0.05	0.09	na	-0.01	-0.15	—	—	—	—	—
Sulfate	0.11	<b>0.31</b>	na	0.05	0.22	0.08	—	—	—	—
Total dissolved solids	0.07	0.12	na	0.01	0.09	-0.15	0.21	—	—	—
Dissolved organic carbon	0.08	0.18	na	0.12	<b>0.35</b>	0.06	<b>0.40</b>	0.23	—	—
Temperature	0.03	-0.08	na	0.07	-0.11	0.06	0.00	0.21	0.01	—
Groundwater level	-0.11	<b>-0.30</b>	na	0.08	-0.13	-0.11	<b>-0.27</b>	-0.13	-0.24	0.09

**Table 4–90.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–75, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.08	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.01	-0.07	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.17	-0.13	-0.04	—	—	—	—	—	—	—
<b>Ammonia</b>	0.10	0.06	0.00	-0.02	—	—	—	—	—	—
<b>pH</b>	-0.02	0.00	-0.05	-0.05	-0.08	—	—	—	—	—
<b>Sulfate</b>	0.05	0.18	-0.18	0.01	-0.07	0.13	—	—	—	—
<b>Total dissolved solids</b>	0.07	-0.07	-0.16	-0.03	0.18	0.13	0.19	—	—	—
<b>Dissolved organic carbon</b>	-0.04	0.22	-0.14	0.07	0.04	0.08	<b>0.43</b>	<b>0.29</b>	—	—
<b>Temperature</b>	0.08	-0.01	0.21	-0.21	-0.04	0.06	0.00	0.17	0.10	—
<b>Groundwater level</b>	0.10	0.24	-0.11	-0.07	0.04	0.04	<b>0.34</b>	0.15	<b>0.35</b>	-0.01

**Table 4–91.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–76, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.03	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.11	-0.03	na	—	—	—	—	—	—	—
Ammonia	-0.04	-0.08	na	<b>-0.39</b>	—	—	—	—	—	—
pH	0.05	0.22	na	<b>-0.40</b>	0.13	—	—	—	—	—
Sulfate	-0.11	-0.04	na	<b>0.43</b>	<b>-0.43</b>	-0.14	—	—	—	—
Total dissolved solids	-0.08	0.14	na	0.17	<b>-0.27</b>	0.04	<b>0.29</b>	—	—	—
Dissolved organic carbon	-0.16	0.24	na	-0.11	0.08	0.14	-0.08	0.09	—	—
Temperature	0.08	0.02	na	0.08	-0.17	-0.10	-0.01	0.01	-0.13	—
Groundwater level	-0.09	0.20	na	-0.15	0.15	0.12	-0.03	-0.05	<b>0.43</b>	-0.14

**Table 4–92.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–77, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.23	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	-0.22	-0.17	—	—	—	—	—	—	—	—
<b>Hardness</b>	0.09	0.16	0.01	—	—	—	—	—	—	—
<b>Ammonia</b>	<b>0.28</b>	0.07	-0.10	-0.02	—	—	—	—	—	—
<b>pH</b>	0.09	<b>0.32</b>	-0.10	-0.03	0.08	—	—	—	—	—
<b>Sulfate</b>	<b>0.26</b>	<b>0.40</b>	-0.06	<b>0.28</b>	0.06	0.11	—	—	—	—
<b>Total dissolved solids</b>	0.24	0.07	-0.18	-0.03	0.19	-0.04	0.15	—	—	—
<b>Dissolved organic carbon</b>	0.13	<b>0.34</b>	-0.03	0.04	0.15	0.19	<b>0.31</b>	0.18	—	—
<b>Temperature</b>	-0.26	-0.18	0.17	-0.11	-0.28	-0.10	-0.28	0.05	-0.23	—
<b>Groundwater level</b>	<b>0.35</b>	<b>0.37</b>	-0.21	0.15	0.22	0.21	<b>0.40</b>	0.21	0.19	-0.28

**Table 4–93.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–78, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.24	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.01	0.20	na	—	—	—	—	—	—	—
Ammonia	0.13	<b>0.28</b>	na	0.20	—	—	—	—	—	—
pH	-0.15	0.09	na	0.08	0.06	—	—	—	—	—
Sulfate	<b>0.33</b>	<b>0.45</b>	na	0.23	<b>0.30</b>	-0.13	—	—	—	—
Total dissolved solids	0.24	0.22	na	0.12	0.15	-0.01	<b>0.44</b>	—	—	—
Dissolved organic carbon	0.18	<b>0.42</b>	na	0.22	<b>0.43</b>	0.05	<b>0.56</b>	<b>0.41</b>	—	—
Temperature	-0.17	-0.02	na	-0.13	-0.11	0.18	-0.16	0.04	-0.12	—
Groundwater level	<b>0.31</b>	<b>0.34</b>	na	0.17	<b>0.27</b>	-0.01	<b>0.48</b>	<b>0.53</b>	<b>0.46</b>	-0.01

**Table 4–94.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–79, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	<b>0.50</b>	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.12	0.00	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.12	0.11	na	-0.01	—	—	—	—	—	—
<b>pH</b>	-0.13	0.05	na	0.05	0.09	—	—	—	—	—
<b>Sulfate</b>	<b>0.31</b>	<b>0.42</b>	na	0.18	0.00	-0.07	—	—	—	—
<b>Total dissolved solids</b>	<b>0.38</b>	<b>0.39</b>	na	-0.08	<b>0.26</b>	0.04	<b>0.36</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>0.27</b>	<b>0.32</b>	na	-0.02	0.22	-0.04	<b>0.41</b>	<b>0.44</b>	—	—
<b>Temperature</b>	-0.13	-0.07	na	0.07	-0.08	0.01	-0.08	-0.10	-0.14	—
<b>Groundwater level</b>	<b>0.44</b>	<b>0.46</b>	na	-0.10	0.07	-0.09	<b>0.46</b>	<b>0.42</b>	<b>0.54</b>	-0.12

**Table 4–95.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–80, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.15	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.17	-0.04	na	—	—	—	—	—	—	—
Ammonia	0.06	0.17	na	-0.01	—	—	—	—	—	—
pH	-0.11	0.16	na	0.14	-0.03	—	—	—	—	—
Sulfate	0.18	<b>0.33</b>	na	0.19	0.15	0.18	—	—	—	—
Total dissolved solids	0.03	0.17	na	-0.05	0.12	0.07	<b>0.26</b>	—	—	—
Dissolved organic carbon	0.06	<b>0.39</b>	na	0.17	<b>0.31</b>	0.06	<b>0.37</b>	<b>0.37</b>	—	—
Temperature	-0.18	0.03	na	-0.01	-0.04	-0.07	-0.17	0.04	-0.05	—
Groundwater level	<b>0.28</b>	0.23	na	-0.05	0.19	-0.15	0.20	0.22	<b>0.35</b>	0.00

**Table 4–96.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–81, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.08	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	0.22	<b>-0.26</b>	na	—	—	—	—	—	—	—
Ammonia	0.18	-0.09	na	0.06	—	—	—	—	—	—
pH	-0.21	0.08	na	-0.02	-0.17	—	—	—	—	—
Sulfate	-0.19	0.20	na	<b>-0.40</b>	-0.11	0.12	—	—	—	—
Total dissolved solids	0.10	-0.02	na	0.04	0.20	-0.06	0.00	—	—	—
Dissolved organic carbon	-0.15	0.10	na	<b>-0.26</b>	<b>0.25</b>	0.07	<b>0.39</b>	0.11	—	—
Temperature	0.10	0.02	na	0.04	-0.05	0.09	-0.06	0.08	<b>-0.26</b>	—
Groundwater level	-0.17	<b>0.35</b>	na	<b>-0.27</b>	-0.12	0.03	0.18	-0.05	0.00	0.01



**Table 4–97.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well QM–82, Mainstream System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1995–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.24	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>-0.27</b>	<b>-0.26</b>	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.01	-0.07	na	0.03	—	—	—	—	—	—
<b>pH</b>	0.08	0.18	na	-0.03	0.09	—	—	—	—	—
<b>Sulfate</b>	0.24	<b>0.28</b>	na	<b>-0.34</b>	0.03	0.11	—	—	—	—
<b>Total dissolved solids</b>	0.22	0.17	na	<b>-0.50</b>	0.02	0.11	<b>0.28</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>0.25</b>	0.17	na	<b>-0.55</b>	0.02	0.02	<b>0.26</b>	<b>0.39</b>	—	—
<b>Temperature</b>	-0.07	0.08	na	0.18	-0.02	0.03	-0.12	0.03	-0.13	—
<b>Groundwater level</b>	<b>0.30</b>	0.24	na	<b>-0.62</b>	-0.02	0.06	<b>0.38</b>	<b>0.45</b>	<b>0.56</b>	-0.18

**Table 4–98.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well MW–1, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.13	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.19	0.23	na	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.04	0.06	na	-0.01	—	—	—	—	—	—
<b>pH</b>	0.03	0.07	na	0.11	-0.07	—	—	—	—	—
<b>Sulfate</b>	0.00	-0.11	na	-0.08	-0.08	-0.05	—	—	—	—
<b>Total dissolved solids</b>	-0.04	-0.03	na	-0.10	-0.07	-0.06	0.09	—	—	—
<b>Dissolved organic carbon</b>	-0.11	<b>0.34</b>	na	0.20	0.13	0.17	-0.10	-0.08	—	—
<b>Temperature</b>	-0.12	-0.11	na	0.02	-0.08	-0.15	-0.03	0.01	-0.08	—
<b>Groundwater level</b>	-0.01	0.21	na	0.05	0.20	0.09	-0.13	-0.04	<b>0.38</b>	-0.12

**Table 4–99.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well MW–2, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2010.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.26	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.26	0.09	na	—	—	—	—	—	—	—
Ammonia	0.14	0.03	na	-0.12	—	—	—	—	—	—
pH	-0.30	0.24	na	0.04	-0.03	—	—	—	—	—
Sulfate	-0.04	-0.09	na	0.10	-0.23	-0.03	—	—	—	—
Total dissolved solids	0.29	-0.15	na	0.00	-0.10	-0.11	0.06	—	—	—
Dissolved organic carbon	-0.51	0.29	na	0.17	0.04	0.27	-0.10	-0.24	—	—
Temperature	0.08	-0.11	na	0.03	0.12	-0.12	-0.03	0.16	-0.07	—
Groundwater level	-0.12	0.12	na	-0.16	0.17	0.11	-0.17	-0.30	0.10	-0.02

**Table 4–100.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well MW–3, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	-0.03	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	na	na	—	—	—	—	—	—	—	—
<b>Hardness</b>	-0.01	0.00	na	—	—	—	—	—	—	—
<b>Ammonia</b>	0.16	<b>-0.25</b>	na	0.04	—	—	—	—	—	—
<b>pH</b>	-0.18	0.20	na	0.15	-0.16	—	—	—	—	—
<b>Sulfate</b>	-0.02	-0.14	na	-0.05	0.15	0.03	—	—	—	—
<b>Total dissolved solids</b>	0.18	-0.07	na	-0.08	0.10	-0.15	0.01	—	—	—
<b>Dissolved organic carbon</b>	-0.11	<b>0.30</b>	na	-0.01	-0.16	0.20	-0.23	-0.10	—	—
<b>Temperature</b>	-0.06	-0.02	na	0.01	0.05	-0.01	0.06	0.06	-0.18	—
<b>Groundwater level</b>	0.11	-0.06	na	-0.01	0.16	-0.06	0.11	0.14	-0.12	<b>0.30</b>

**Table 4–101.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well MW–4, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.24	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.21	<b>0.29</b>	na	—	—	—	—	—	—	—
Ammonia	-0.03	0.03	na	0.04	—	—	—	—	—	—
pH	0.02	0.10	na	0.08	-0.04	—	—	—	—	—
Sulfate	-0.22	0.06	na	0.15	0.08	0.03	—	—	—	—
Total dissolved solids	-0.07	0.08	na	0.09	0.08	-0.03	0.03	—	—	—
Dissolved organic carbon	<b>-0.45</b>	<b>0.34</b>	na	<b>0.37</b>	0.12	0.04	0.19	0.17	—	—
Temperature	0.10	-0.02	na	-0.03	-0.05	0.03	0.01	0.12	-0.05	—
Groundwater level	<b>-0.35</b>	0.19	na	0.21	0.04	0.07	0.13	0.11	<b>0.39</b>	0.06

**Table 4–102.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well MW–5, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2010.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	<b>Chloride</b>	<b>Electrical conductivity</b>	<b>Fecal coliform</b>	<b>Hardness</b>	<b>Ammonia</b>	<b>pH</b>	<b>Sulfate</b>	<b>Total dissolved solids</b>	<b>Dissolved organic carbon</b>	<b>Temperature</b>
<b>Electrical conductivity</b>	0.16	—	—	—	—	—	—	—	—	—
<b>Fecal coliform</b>	0.14	0.17	—	—	—	—	—	—	—	—
<b>Hardness</b>	<b>-0.25</b>	<b>0.25</b>	-0.02	—	—	—	—	—	—	—
<b>Ammonia</b>	-0.18	-0.07	0.01	0.12	—	—	—	—	—	—
<b>pH</b>	0.02	0.04	-0.03	-0.05	-0.01	—	—	—	—	—
<b>Sulfate</b>	-0.24	0.19	-0.07	<b>0.66</b>	0.09	0.03	—	—	—	—
<b>Total dissolved solids</b>	<b>0.29</b>	<b>0.38</b>	0.13	<b>0.39</b>	-0.04	-0.04	<b>0.33</b>	—	—	—
<b>Dissolved organic carbon</b>	<b>-0.35</b>	0.03	-0.14	<b>0.29</b>	0.12	0.01	0.24	-0.03	—	—
<b>Temperature</b>	-0.02	0.04	0.23	0.04	0.08	-0.03	-0.02	-0.03	0.06	—
<b>Groundwater level</b>	<b>-0.30</b>	0.06	-0.11	<b>0.31</b>	0.04	-0.10	0.19	-0.01	<b>0.38</b>	0.07

**Table 4–103.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well MW–6, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1994–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.00	—	—	—	—	—	—	—	—	—
Fecal coliform	-0.14	-0.21	—	—	—	—	—	—	—	—
Hardness	0.02	<b>0.46</b>	<b>-0.34</b>	—	—	—	—	—	—	—
Ammonia	0.20	0.01	0.01	0.07	—	—	—	—	—	—
pH	-0.05	0.23	-0.11	0.20	-0.12	—	—	—	—	—
Sulfate	0.05	0.23	<b>-0.28</b>	<b>0.41</b>	0.14	0.03	—	—	—	—
Total dissolved solids	0.10	<b>0.31</b>	-0.23	<b>0.43</b>	0.14	0.11	<b>0.38</b>	—	—	—
Dissolved organic carbon	-0.14	0.23	-0.09	<b>0.32</b>	0.01	0.17	0.13	0.22	—	—
Temperature	-0.10	-0.05	0.22	0.02	0.10	-0.06	0.08	0.10	-0.06	—
Groundwater level	-0.05	<b>-0.39</b>	<b>0.28</b>	<b>-0.48</b>	0.01	-0.13	<b>-0.39</b>	<b>-0.43</b>	<b>-0.34</b>	-0.05

**Table 4–104.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well MW–7, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1998–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	-0.19	—	—	—	—	—	—	—	—	—
Fecal coliform	0.16	0.10	—	—	—	—	—	—	—	—
Hardness	-0.24	<b>0.28</b>	-0.10	—	—	—	—	—	—	—
Ammonia	0.16	-0.17	0.20	-0.27	—	—	—	—	—	—
pH	-0.12	0.22	-0.06	<b>0.28</b>	-0.32	—	—	—	—	—
Sulfate	-0.22	<b>0.29</b>	-0.07	<b>0.48</b>	-0.31	<b>0.30</b>	—	—	—	—
Total dissolved solids	-0.20	<b>0.28</b>	0.05	<b>0.43</b>	-0.19	<b>0.26</b>	<b>0.37</b>	—	—	—
Dissolved organic carbon	-0.20	<b>0.31</b>	0.08	<b>0.41</b>	-0.02	0.10	<b>0.31</b>	<b>0.32</b>	—	—
Temperature	-0.10	0.09	0.13	-0.02	-0.03	-0.04	0.06	0.10	0.07	—
Groundwater level	0.19	0.07	-0.02	0.08	0.02	0.02	-0.06	0.02	-0.05	0.08



**Table 4–105.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well MW–8, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1997–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.00	—	—	—	—	—	—	—	—	—
Fecal coliform	-0.06	-0.12	—	—	—	—	—	—	—	—
Hardness	-0.16	<b>0.29</b>	-0.18	—	—	—	—	—	—	—
Ammonia	0.01	0.20	-0.07	0.15	—	—	—	—	—	—
pH	0.08	-0.06	0.07	-0.18	0.07	—	—	—	—	—
Sulfate	-0.16	0.17	-0.22	<b>0.55</b>	-0.04	-0.18	—	—	—	—
Total dissolved solids	0.03	<b>0.29</b>	-0.24	<b>0.61</b>	0.23	-0.09	<b>0.45</b>	—	—	—
Dissolved organic carbon	-0.01	<b>0.26</b>	-0.13	0.22	0.23	-0.09	0.19	0.22	—	—
Temperature	-0.04	0.09	0.24	0.03	-0.03	0.13	-0.06	0.01	0.08	—
Groundwater level	0.04	0.22	<b>-0.33</b>	<b>0.41</b>	<b>0.25</b>	-0.10	<b>0.27</b>	<b>0.34</b>	<b>0.40</b>	-0.03

**Table 4–106.** Kendall's tau-b correlation coefficient for analytes and physical properties, monitoring well MW–9, Upper Des Plaines System, Tunnel and Reservoir Plan System, Cook County, Illinois, 1997–2013.

[**Bold** denotes tau-b greater than 0.25 or less than -0.25; na, not analyzed; —, no data]

	Chloride	Electrical conductivity	Fecal coliform	Hardness	Ammonia	pH	Sulfate	Total dissolved solids	Dissolved organic carbon	Temperature
Electrical conductivity	0.00	—	—	—	—	—	—	—	—	—
Fecal coliform	na	na	—	—	—	—	—	—	—	—
Hardness	-0.07	<b>0.34</b>	na	—	—	—	—	—	—	—
Ammonia	-0.22	0.06	na	0.18	—	—	—	—	—	—
pH	-0.03	0.05	na	0.13	0.06	—	—	—	—	—
Sulfate	-0.18	0.05	na	<b>0.26</b>	0.10	0.05	—	—	—	—
Total dissolved solids	0.10	0.24	na	<b>0.33</b>	0.18	0.03	0.14	—	—	—
Dissolved organic carbon	0.07	<b>0.27</b>	na	<b>0.33</b>	0.07	0.07	0.07	0.22	—	—
Temperature	-0.02	0.03	na	-0.04	0.09	0.03	-0.07	0.06	0.05	—
Groundwater level	-0.01	-0.11	na	-0.11	0.03	0.10	-0.04	0.07	<b>0.35</b>	0.16





