Water Quality and Biological Monitoring Trend Analysis

Madison-Missouri Water Quality Monitoring Program

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Executive Summary

Water quality has been monitored at 10 stations in the Madison-Missouri River Basin from 1997 through 2016. During this period the monitoring program has been updated with the most recent version being documented in the Water Quality and Biological Monitoring Plan for the Years 2012 – 2021 established under FERC license 2188. This report presents the data collected from the most recent 10-year period (2007 – 2016), and the statistical analyses of data based on monitoring objectives outlined in the Plan. Briefly, water quality data included field measured parameters such as specific conductivity, pH, temperature, dissolved oxygen, and turbidity, and analytical laboratory measurements of ionic chemistry (total and dissolved fractions for calcium, magnesium, sodium, chloride, potassium, sulfate, alkalinity/bicarbonate), total suspended/dissolved solids, nutrient chemistry (total phosphorus and total/inorganic nitrogen) and a suite of metals data (total fractions for arsenic, cadmium, copper, iron, lead, manganese and zinc). Water quality data were routinely collected on a quarterly basis, except for 2011 when monthly water quality samples were collected monthly.

In addition to water chemistry, periphyton, macroinvertebrate, and fish tissue samples were collected annually at a subset of 7 biological monitoring stations. Periphyton measures included chlorophyll-a content in addition to identification and enumeration of algae species which provided metrics describing the diatom communities. Macroinvertebrate samples included identification and enumeration of individuals as well as composite metrics reflecting community structure. Fish tissue analyses focused on metals and organochlorine compounds including a suite of pesticide and PCB congeners.

The following summary and recommendations are based on analyses of monitoring data from 2007-2016.

ES 1.1 Water Quality

Concentrations for many water quality parameters generally increased or decreased in the downstream direction throughout the monitoring period. The observations in spatial patterns were consistent with previous studies (Land & Water 1999, PBS&J 2011). The change in water quality conditions in the downstream direction are largely attributed to geologic factors in the headwaters of the Madison River, or source water inputs from the Jefferson, Gallatin, and Sun rivers. For example, elevated concentrations of total arsenic, total sodium, and total chloride observed at Station 1 are due to the geothermal activity in Yellowstone National Park whereas the increase in total suspended solids at Station 9, at Great Falls, is due to watershed/agricultural practices in the Sun River. The longitudinal increase in total calcium, total sulfates, and nutrients are due to shifts in the geological conditions of the various watersheds, anthropogenic influences of treated wastewater, and irrigation return flows, with the largest influence on water quality observed downstream of the Three Forks confluence. The observed differences in concentrations between the two 10-year monitoring periods is largely due to the different hydrological regimes.

Statistically significant changes in concentrations of constituents between monitoring stations was common between upstream stations 1 through 5. These shifts were largely a function of the corresponding dilution of constituents from hydrological gains, losses due to reservoir sinks, and gains due to changing geological sources. Stations lower in the watershed, especially those from immediately downstream of Canyon Ferry Dam and Holter Dam tended to show consistent patterns and stability in water quality concentrations with few significant differences between stations. Few changes in water quality appeared to be directly related to hydroelectric operations, except for total suspended solids/turbidity and dissolved oxygen content. Both Station 4 and Station 6 revealed lower dissolved oxygen content relative to their respective upstream station.

Concentrations of many constituents were strongly correlated with one another. These correlations included geology-related factors (e.g. a strong association of sodium, chloride, and arsenic) and ionic chemistry, specific conductance, and total dissolved solids. Other erosion based watershed parameters such as total suspended solids and metals (e.g. iron) were strongly correlated. Furthermore, many parameter concentrations were strongly correlated to flow and flow percentile via dilution or watershed inputs. These parameters included total calcium, total chloride, dissolved sodium, total arsenic, total iron, total suspended solids, and specific conductance.

Temporal trends in both field and analytical parameters were analyzed for non-flow adjusted and flow-adjusted data from 2007 to 2016. There were few statistically significant increasing trends in non-flow adjusted concentrations. Total alkalinity and bicarbonate significantly increased over time at stations 1, 2, and 3 in the Madison River, and only Station 10 in the Missouri River. Dissolved magnesium and total potassium concentrations revealed significantly increasing trends over time for stations in the lower portion of the Madison and Missouri rivers. While total and inorganic nitrogen generally decreased over time and most stations, the only statistically significant decreasing trend was observed at Station 10. However, total phosphorus concentrations revealed significant decreasing trends over time at multiple stations in both the Madison and Missouri rivers. There were no significant trends in flow over time, and in fact, hydrological conditions represented more typical flow conditions during the last 10-year monitoring period, whereas the flow conditions during the first 10-year period represented extreme dry and wet year type flow conditions.

Of the seven flow-adjusted parameters, only dissolved sodium concentrations at stations 9 and 10 exhibited significant increasing trends over time (2007-2016) which likely stem from watershed sources in the Sun River, rather than the Madison-Missouri system. Overall, the effects of watershed influence or hydroelectric dams had little to no effect on water quality conditions outside of the effects of flow from 2007-2016. For the stations that did exhibit significant trends over time, there was a downstream carry-over effect observed at successive downstream stations.

ES 1.2 Periphyton

From 2007 to 2016, median chlorophyll-a concentrations were less 100 mg/m^2 at all stations except for at Station B5 at which the concentration was substantially greater (160 mg/m^2). Streams with concentrations greater than 120 mg/m2 are often considered nutrient impaired by the State of Montana.

No longitudinal trend was apparent among stations with each station exhibiting a high degree of intra/inter annual variability, except for Station B2. The direction of change (e.g. decrease or increase) in median chlorophyll-a concentrations between paired stations alternated longitudinally between stations. The median concentration was the lowest at Station B2, downstream of the Hebgen Dam, and the greatest at Station B5, a background control station for the headwaters of the Missouri River. Stations downstream of Hauser and Holter dams exhibited algal biomass conditions similar to stations in the Madison River, upstream of Ennis Lake and downstream of Madison Dam.

Over the monitoring period, the biological integrity ratings of all diatom metrics at all stations were “Excellent” or “Good” except for one “Fair” rating at Station B10 which is downstream from Great Falls reservoir, the city of Great Falls, and Sun and Smith Rivers. Station B2, exhibited more “Good” ratings for the diatom community than any other station which is reflected in its overall impairment rating of “Severe” in two of the last 10 years of data. The cause of these low ratings were mainly high results for siltation index and abundances of dominant species. The Mountain Streams siltation index was also an issue at Station B10 which was rated as “Moderate” impairment in 6 of the last 10 years and “Severe” impairment in 1 of the last 10 years. All other stations in all years were rated with a minimal number of “Moderate” impairment years and mostly “Minor” impairment or “None.”

From 2007 to 2016, no longitudinal increasing or decreasing trends in diatom metrics were apparent except for a decrease in abnormal cells (%) in a downstream direction. However, many metrics followed similar patterns between stations indicating improving and declining diatom community health from one station to the next. Multiple metrics were statistically different between stations B2/B3 and B3/4, indicating an improvement in biological integrity for the diatom communities in the Madison River.

Many correlations between metrics at individual stations were observed but few relationships among metrics at all stations occurred indicating that the periphyton communities differ greatly between stations.

There were few significant temporal trends in diatom metrics and most represented very minor changes over time. Only the diatom disturbance index exhibited significant increasing trends at more than one station (B8 and B10), which characterize the poorer assemblages in these downstream reaches of the Missouri River. Overall, the results indicate little change in the diatom community at each station from 2007 to 2016 and little to no direct influence from the hydroelectric facilities.

ES 1.3 Macroinvertebrates

From 2007 to 2015, no longitudinal increasing or decreasing trends in macroinvertebrate metrics were apparent. Most metrics, including the multimetric assessment, followed a similar pattern of improving and declining macroinvertebrate health from one station to the next station. The biological monitoring stations upstream of Ennis Lake and Canyon Ferry Reservoir revealed the most robust macroinvertebrate assemblages based on the multimetric index. The similar decreasing patterns among the metrics downstream of these locations highlight the negative effects of Ennis Lake and Madison Dam on the community in the Madison River, and the negative effects of Canyon Ferry Reservoir/Dam on community in the Missouri River. Macroinvertebrate community health was poorer for the stations downstream of Hauser and Holter dams, but improved by the last station downstream of Morony Dam.

This abundance of significant correlations within and among stations highlights the descriptive ability of the metrics, especially in the context of the multimetric assessment index. The macroinvertebrate metrics are good descriptors of the biological integrity at each station and reveal consistent improving or declining conditions at successive stations.

Significant temporal trends of macroinvertebrate metrics were limited and all had relatively shallow slopes. These results indicate little change in the macroinvertebrate community over time at each station from 2007 to 2016.

ES 1.4 Fish Tissue

From 2007 to 2015, fish tissues were collected from eight biological monitoring stations ranging from downstream of Hebgen Dam to downstream of the Great Falls Dams. However, fish tissue sampling did not occur at all stations within the same year, and instead occurred on a rotational basis targeting the upstream-downstream stations in different years. Most fish tissue biocontaminants were not detected in any predator or bottom dwelling fish. No organochlorine pesticides were detected and only one PCB congener was detected in predator and bottom dwelling fish at relatively low levels. Eleven of 13 metals were commonly detected but only zinc was detected in all predator and bottom dwelling samples while iron was detected in all predator fish sampled.

The lack of detectable organochlorine pesticide concentrations in fish tissue samples is consistent with the relatively low number of detectable concentrations in a national fish survey of over 500 lakes and reservoirs sampled in the lower 48 states. Aroclor 1254 (PCB congener) concentrations in both predators and bottom dwelling fish were often greater than the concentrations found in respective fish types for the national survey, while detectable mercury concentrations in both predator and bottom dwelling fish were less than their respective fish tissue concentrations sampled during the national lake survey.

Few patterns were observed in the percent changes between mean fish tissue biocontaminant concentrations and indicates a large variability in the data between years and between feeding styles. A statistical significant increase in the iron concentration of bottom dwelling fish was observed between stations B7 and B8, while a statistically significant decrease in Aroclor 1254 concentrations in both predator and bottom dwelling fish were observed for the same station pair.

1. Introduction

Northwestern Energy (formerly PPL Montana) filed a plan with the Federal Energy Regulatory Commission (FERC) for a water quality monitoring program in the Madison-Missouri Rivers on June 15, 2001. On January 16, 2002, the FERC approved the plan with the requirement that an updated water quality monitoring plan will be provided to the Montana Department of Environmental Quality for its approval and to other specified agencies for their comments by May 15, 2011 which was extended to December 30, 2011 by FERC order of May 19, 2011.

The Water Quality and Biological Monitoring Plan for the Years 2012 -2021 ([Plan], PPLMT, 2011) incorporated recommendations from the 2011 Water Quality and Biological Monitoring Trend Analysis – Missouri-Madison Water Monitoring Program (PBS&J, 2011) and reviewing agencies. The overall objectives of the monitoring plan include:

1. Identify long-term trends and spatial variation of water quality and biological parameters in the study area.
2. Evaluate the effects of the operation and maintenance of hydroelectric facilities along the Madison and upper Missouri rivers.

The study area covered by the Plan extends from the headwaters of the Madison River in Yellowstone National Park through the upper reaches of the Missouri River, confluence of the Madison, Jefferson, and Gallatin rivers, and downstream of Morony Dam in Great Falls (Figure 1-1). Included in the study area are nine hydroelectric facilities operated by Northwestern Energy plus one dam operated by the Bureau of Reclamation, Canyon Ferry Dam. The Northwestern Energy dams include Hebgen and Madison dams on the Madison River, and Canyon Ferry, Hauser, Holter, and the five Great Falls dams (Black Eagle, Rainbow, Cochrane, Ryan, and Morony) on the upper Missouri River. In addition to documenting the water quality and biological conditions for stations that bracket (upstream-downstream) these hydroelectric facilities, the Plan outlined a comprehensive statistical analysis approach to evaluate the downstream effects of these facilities, and other watershed influences, over time.

Monitoring objectives for the study area were previously identified by the Montana Department of Environmental Quality (MDHES 1993), the 2188 Water Quality Technical Committee, and by the terms of the license issued by FERC. These objectives have been combined into the following:

1. Provide a statistical analysis of long-term trends in water quality and biological data.
2. Evaluate the potential influence of dam facilities on water quality and biological parameters with upstream-downstream comparisons.
3. Monitor the effects of operation and maintenance of dam facilities on water quality and biological parameters.

4. Evaluate the behavior of the entire system with respect to water quality and biological parameters.
5. Determine whether the effects measured above indicate an improvement or deterioration of water quality, biological integrity, and ecological health of the Madison and Missouri river system.

The duration of the monitoring program detailed in the Plan is ten years, and per FERC relicensing agreements, a comprehensive analysis of water quality and biological data is to be provided every ten-years. The first ten-year analysis report summarized the monitoring data and statistical analyses of the data collected from 1997 through 2006 (PBS&J 2011) and the analyses of the most recent ten-year period is presented herein.

1.1 Purpose

The purpose of this report is to summarize the monitoring data collected from 2007 through 2016, and to present the results of the comprehensive statistical analyses evaluating whether water quality or biological conditions improved or deteriorated over this period. The statistical approached outlined in the Plan is intended to characterize significant differences among adjacent stations, as well as trends over time for selected water quality, periphyton, macroinvertebrate, and fish tissue parameters. This report has been organized into seven main sections and six appendices:

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Section 2 Monitoring Objectives
Section 3 Data Collection and Sample Analysis
Section 4 Data Management and Analysis Methodology
Section 5 Statistical Analyses
Section 6 Summary
Section 7 References
Appendix A Monitoring
Appendix B Water Quality
Appendix C Chlorophyll-a
Appendix D Diatom Metrics
Appendix E Macroinvertebrate Metrics
Appendix F Fish Tissue Biocontaminants

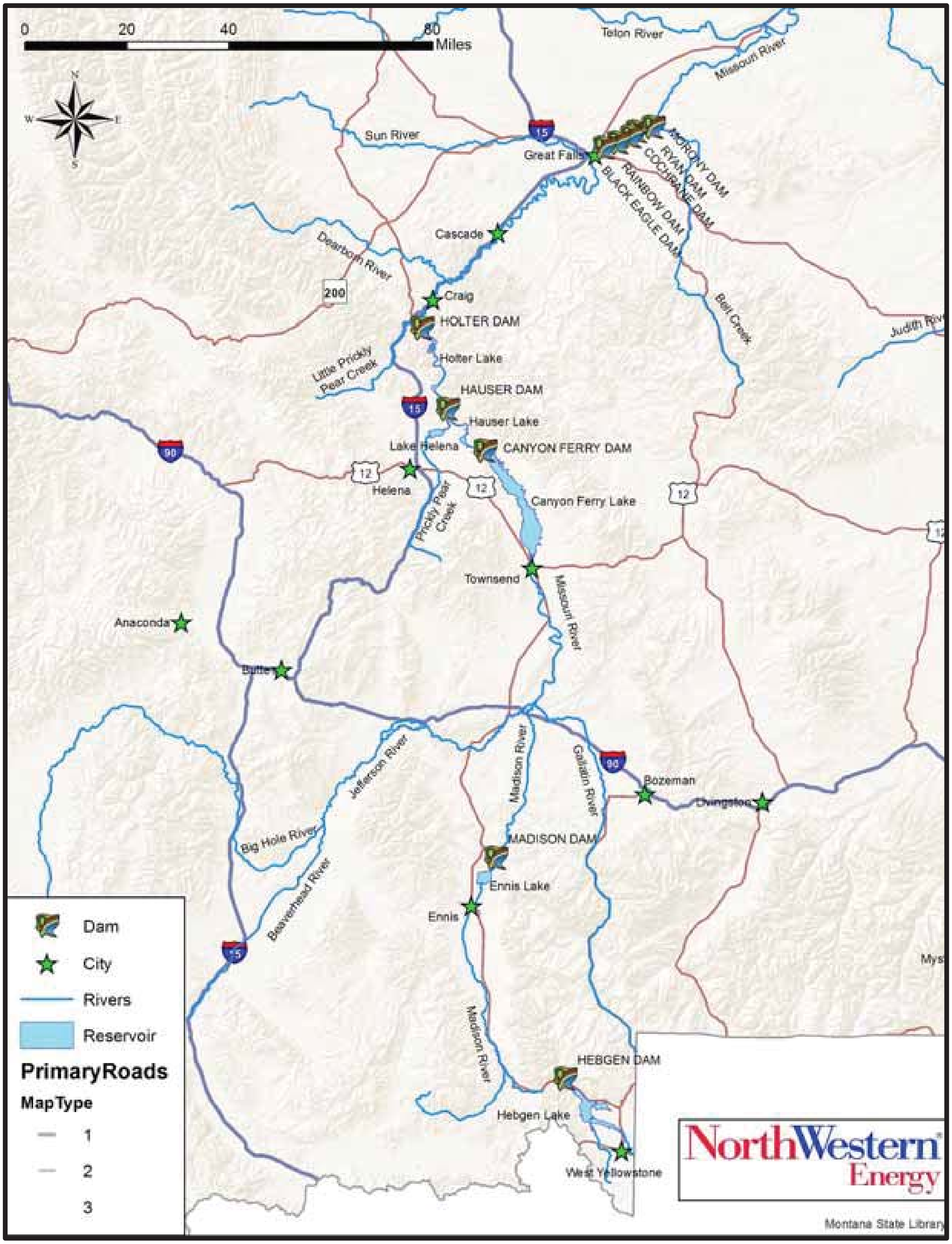


Figure 1-1: Study area from West Yellowstone downstream to Great Falls, Montana.

1.2 Reservoirs and Monitoring Stations

Monitoring stations were selected to evaluate the potential impacts of dams on the Madison and Missouri rivers (Figure 1-2). These stations consist of 10 water quality and 10 biological monitoring stations. The biological monitoring “flushing” stations are part of a separate monitoring program managed by Northwestern Energy, but were included in this report because macroinvertebrate data were available. Water quality and biological monitoring stations often differ slightly due to physical requirements for collecting representative samples. A summary of the monitoring stations is presented in Table 1-1 and a complete description is in Appendix A. Stations 12 and 30 are included in Figure 1-2 but are not discussed because data from these sites were not included in this report.

Table 1-1: Sampling station descriptions. Stations are ordered from upstream to downstream. Macroinvertebrate samples were collecting at “Flushing” stations.

River	Station	Name	Description	Water Quality					Biological					Lat.	Long.
				Ion Chemistry	Solids/Turbidity	Metals	Nutrients	Physicochemical	Chlorophyll-a	Periphyton	Macroinvertebrate	Flushing	Fish Tissue		
Madison	B1	YNP	Yellowstone National Park						X		X			44.65724	-111.06832
	1	HWY 287	Upstream from Hebgen Reservoir	X	X		X	X						44.71564	-111.10260
	2	Hebgen	Downstream from Hebgen Dam	X	X		X	X						44.86653	-111.33844
	B2								X	X	X		X	44.86468	-111.35105
	F1	Kirby	Near Kirby									X		44.87058	-111.56497
	3	Varney	Upstream from Madison Reservoir	X	X		X	X						45.23263	-111.75168
	B3	Ennis	Ennis Campground						X	X	X	X	X	45.34368	-111.72511
	4	Madison	Downstream from Madison Dam/ Madison Powerhouse	X	X		X	X	X	X	X		X	45.48891	-111.63438
	F3	Norris	Downstream from Warm Springs FA Site									X		45.60117	-111.57405
	F4	Greycliff	Greycliff FA Site									X		45.71805	-111.51877
Missouri	B5	Toston	Upstream from Canyon Ferry Reservoir						X	X	X			46.14419	-111.41351
	5			X	X		X	X						46.17181	-111.44350
	6	Canyon Ferry	Downstream from Canyon Ferry Dam	X	X		X	X						46.64909	-111.72813
	7	Hauser	Downstream from Hauser Dam	X	X		X	X						46.76507	-111.88905
	B7								X	X	X		X	46.76657	-111.89092
	8	Holter	Downstream from Holter Dam	X	X		X	X						46.99478	-112.01091
	B8								X	X	X		X	46.99989	-112.00498
	9	Black Eagle/ Central Ave Bridge	Upstream from Great Falls Reservoirs	X	X	X	X	X					X	47.50678	-111.31251
	10	Morony	Downstream from Great Falls Dams	X	X	X	X	X						47.58168	-111.06024
	B10									X	X		X	47.58428	-111.06034

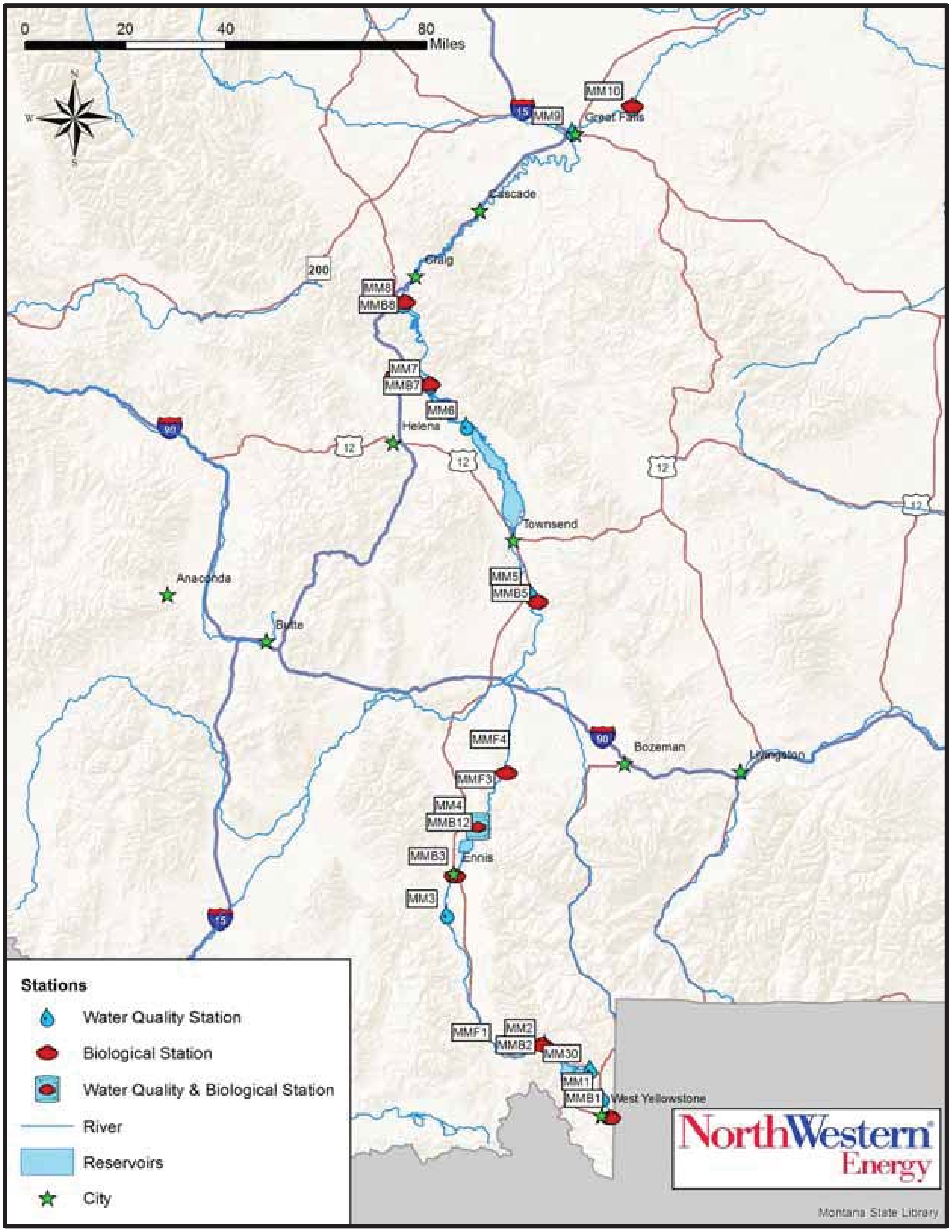


Figure 1-2: Water quality and biology monitoring stations on the Madison-Missouri River from 2007 to 2016.

1.2.1 Hebgen Dam on the Madison River

Hebgen Reservoir, formed by the completion of Hebgen Dam in 1915, is located about 22 miles northwest of West Yellowstone, Montana. The reservoir intercepts a drainage area of about 905 square miles. The earth filled dam is 85 feet high and 721 feet long, with a broad crested weir spillway on the right bank that is 47 feet wide. The dam impounds 387,195 acre-feet of storage in the reservoir, with 379,869 acre-feet of useable storage between elevations 6,473 and 6,535 feet. Releases from the dam are made through intake gates with a single vertical opening of 9 feet from 41.5 to 50.5 feet deep and then through a 12-foot diameter discharge pipe located 68 feet below full pool.

The depth of the reservoir is 75 feet near the dam and 81 feet maximum (about a mile upstream), with a mean depth of 27 feet. At full pool, the reservoir surface area is 19.8 square miles. The mean water retention time in the reservoir is 172 days.

The biological monitoring station above Hebgen Reservoir (Station B1, YNP) is located approximately 2 miles East of West Yellowstone (Figure 1-3). The water quality monitoring station above the reservoir (Station 1, HWY 287) is located at the Highway 287 bridge (Figure 1-4) and is a depth integrated, equal width increment composite. These stations are considered control stations because they are located on a relatively “unregulated” reach of the Madison River and are intended to establish natural background variability in biological and water quality data where no effect from reservoir discharges upstream occurs. The water quality monitoring station below Hebgen Dam (Station 2, Hebgen) is roughly 0.3 miles below the dam, at the United States Geological Survey (USGS) gaging station #6038500 on the right bank (Figure 1-5). Sampling is a depth integrated point sample. The biological monitoring station downstream from Hebgen Dam (Station B2, Hebgen) is located about 1.25 miles downstream of the facility on the right bank (Figure 1-6). A flushing station (Station F1, Kirby) is also located about 16 miles downstream of Hebgen Dam (Figure 1-7).

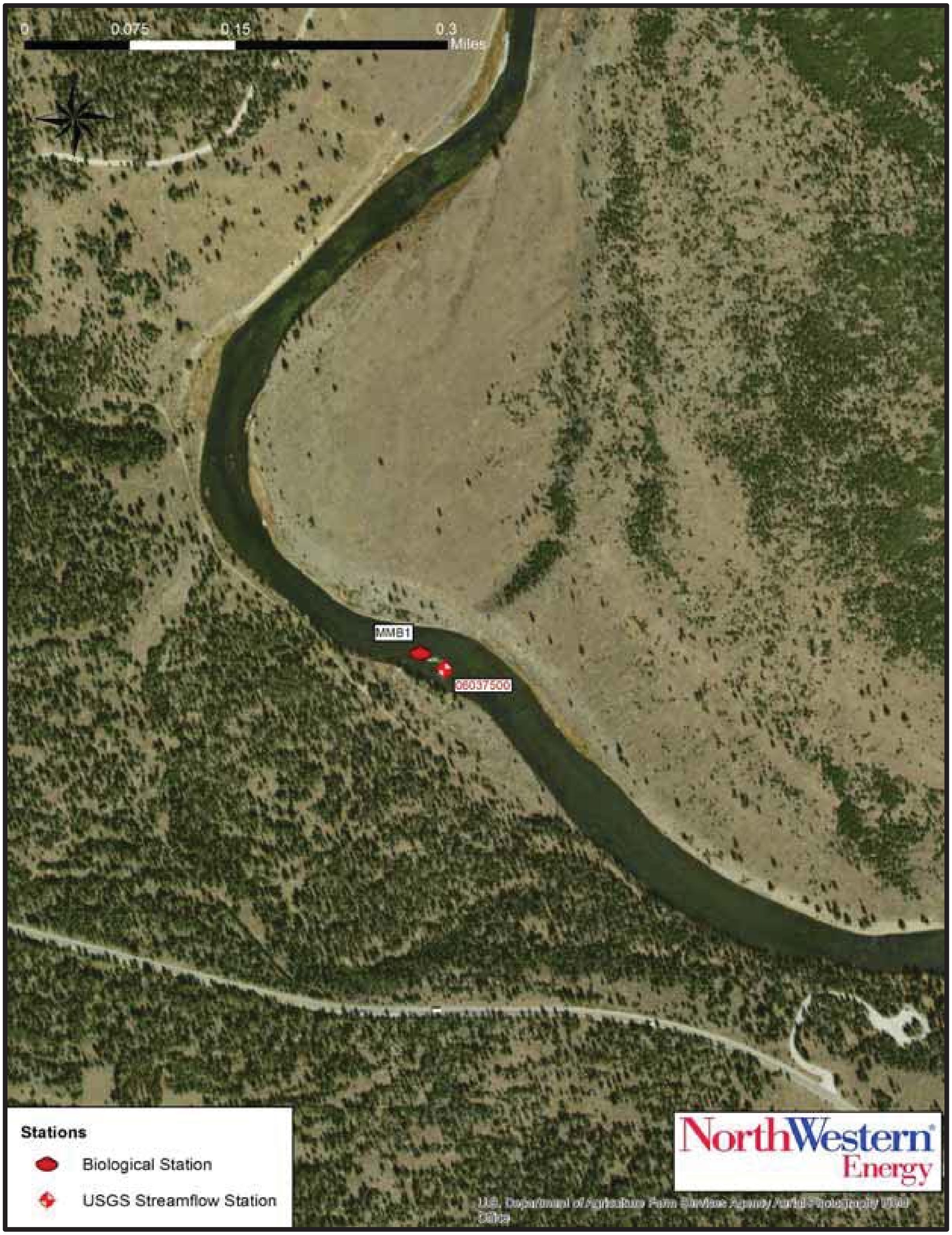


Figure 1-3: Station B1, YNP on the Madison River.

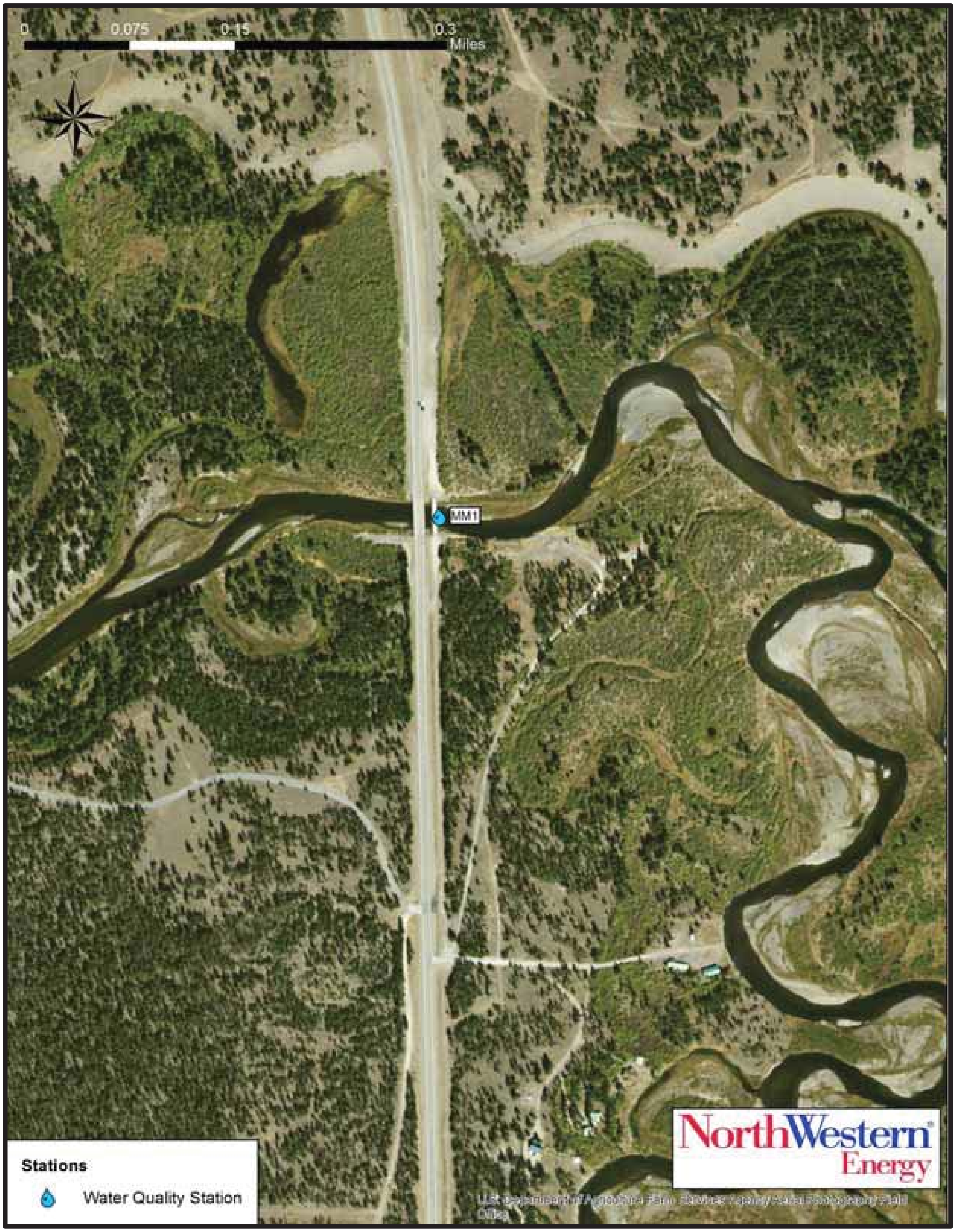


Figure 1-4: Station 1, HWY 287 on the Madison River.

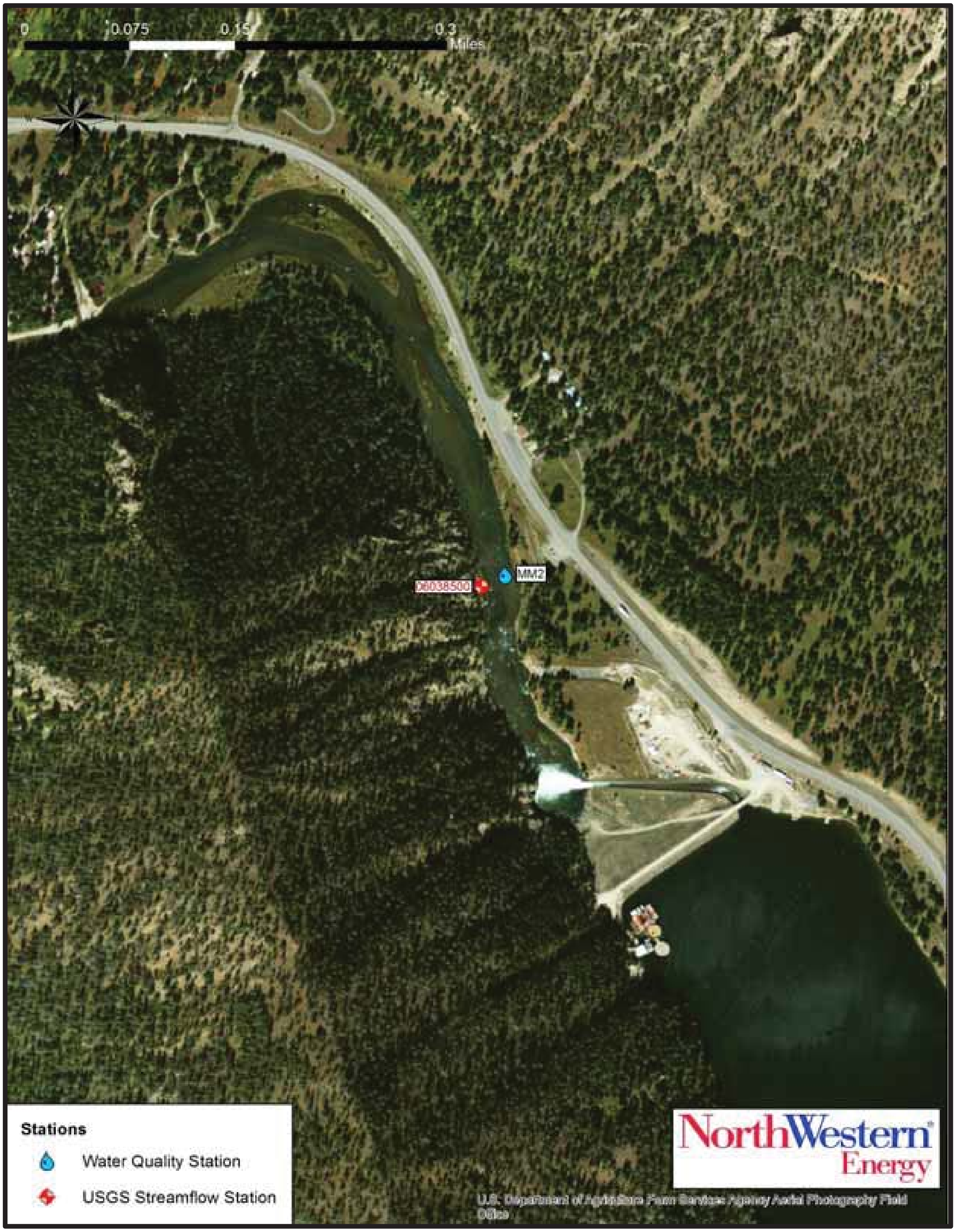


Figure 1-5: Station 2, Hebgen on the Madison River.

Figure 1-6: Station B2, Hebgen on the Madison River.

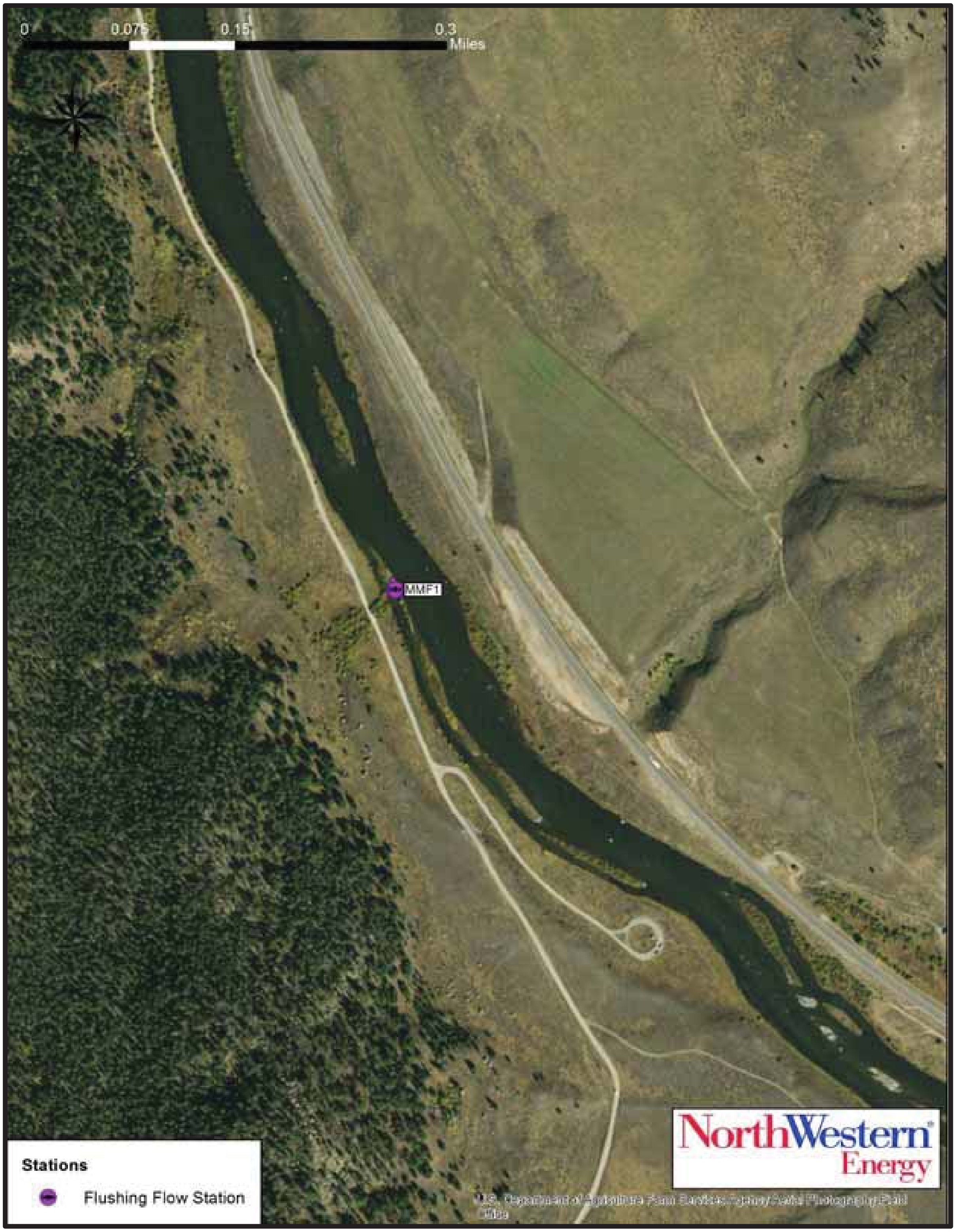


Figure 1-7: **Station F1, Kirby on the Madison River.**

1.2.2 Madison Dam on the Madison River

Ennis Lake is located roughly 5 miles northeast of Ennis, Montana. Madison dam is located 68.8 miles downstream of Hebgen Dam, and 40.2 miles upstream of the Missouri River headwaters at Three Forks, Montana. The reservoir intercepts a drainage area of about 2,181 square miles. The dam is a 38.5-foot high rock-filled crib structure that is operated primarily as a run-of-the river facility. The dam impounds 39,115 acre-feet of useable storage between elevations 4,826 and 4,841 feet.

A concrete intake structure, 26 feet deep in front of the dam, provides water to a 13-foot diameter flow line. The flow line extends 7,500 feet down the canyon to the powerhouse, which has a hydraulic capacity of 1,650 cfs. Maximum depth of the reservoir is 32 feet near the dam, with a mean depth of 12 feet. Mean water residence time in the reservoir is 15 days.

The water quality monitoring station (Station 3, Varney) is located at the Varney Bridge and is a depth integrated, equal width interval composite (Figure 1-8). The biological monitoring station (Station B3, Ennis) is at Ennis Campground and is also a flushing station (Figure 1-9). The biological and water quality monitoring stations below Ennis Lake (Station 4, Madison) are at the same location (Figure 1-10). The water quality monitoring station is a depth integrated, single point sample composite of the turbine and bypass channel at the footbridge and the biological monitoring station is located downstream from the junction of the powerhouse and bypass channel. Flushing stations are also located approximately 11 miles (Station F3, Norris; Figure 1-11) and approximately 21 miles (Station F4, Greycliff; Figure 1-12) downstream of the Madison Powerhouse. No additional flushing locations are located downstream.

Figure 1-8: Station 3, Varney on the Madison River.

Figure 1-9: Station B3, Ennis on the Madison River.

Figure 1-10: Station 4, Madison on the Madison River.

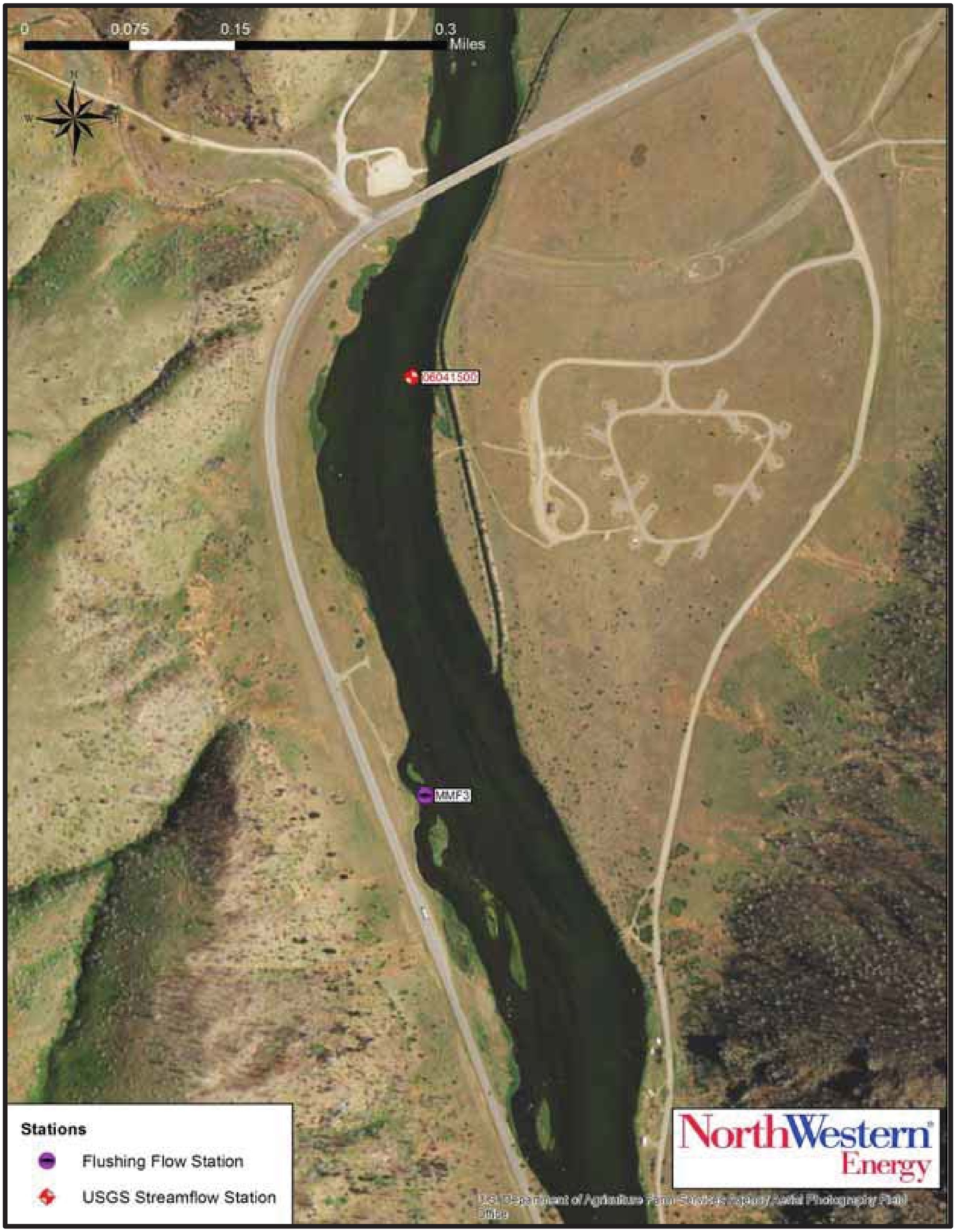


Figure 1-11: Station F3, Norris on the Madison River.

Figure 1-12: Station F4, Greycliff on the Madison River.

1.2.3 Canyon Ferry Dam on the Missouri River

Canyon Ferry Dam is owned and operated by the Bureau of Reclamation and was built between 1949 and 1954. The facility is used for power supply, flood control, irrigation, and recreation. The dam is constructed of concrete and is roughly 1,000 feet long and 225 feet high. The reservoir storage capacity is 2,050,900 acre-feet (at an elevation of 3,800 feet).

The biological monitoring station above Canyon Ferry Lake (Station B5, Toston) is located approximately 3 miles upstream of the Hwy 287 Bypass bridge in Toston on the left bank (Figure 1-13). The water quality monitoring station (Station 5, Toston) is located at the bridge (Figure 1-14), and is a depth integrated, equal width interval composite. These stations are considered control stations because they are located in a relatively “unregulated” reach of the Madison River and are intended to establish natural background variability in water quality and biological data where little or no effect from reservoir discharges upstream would be expected. The water quality monitoring station below the dam (Station 6, Canyon Ferry) is located at the penstock discharge, and is sampled as a single point, depth integrated sample (Figure 1-15). It is not possible to proportionally sample spill/turbine flow, and high flow samples are limited to turbine discharge only. No biological monitoring station is located below the dam.

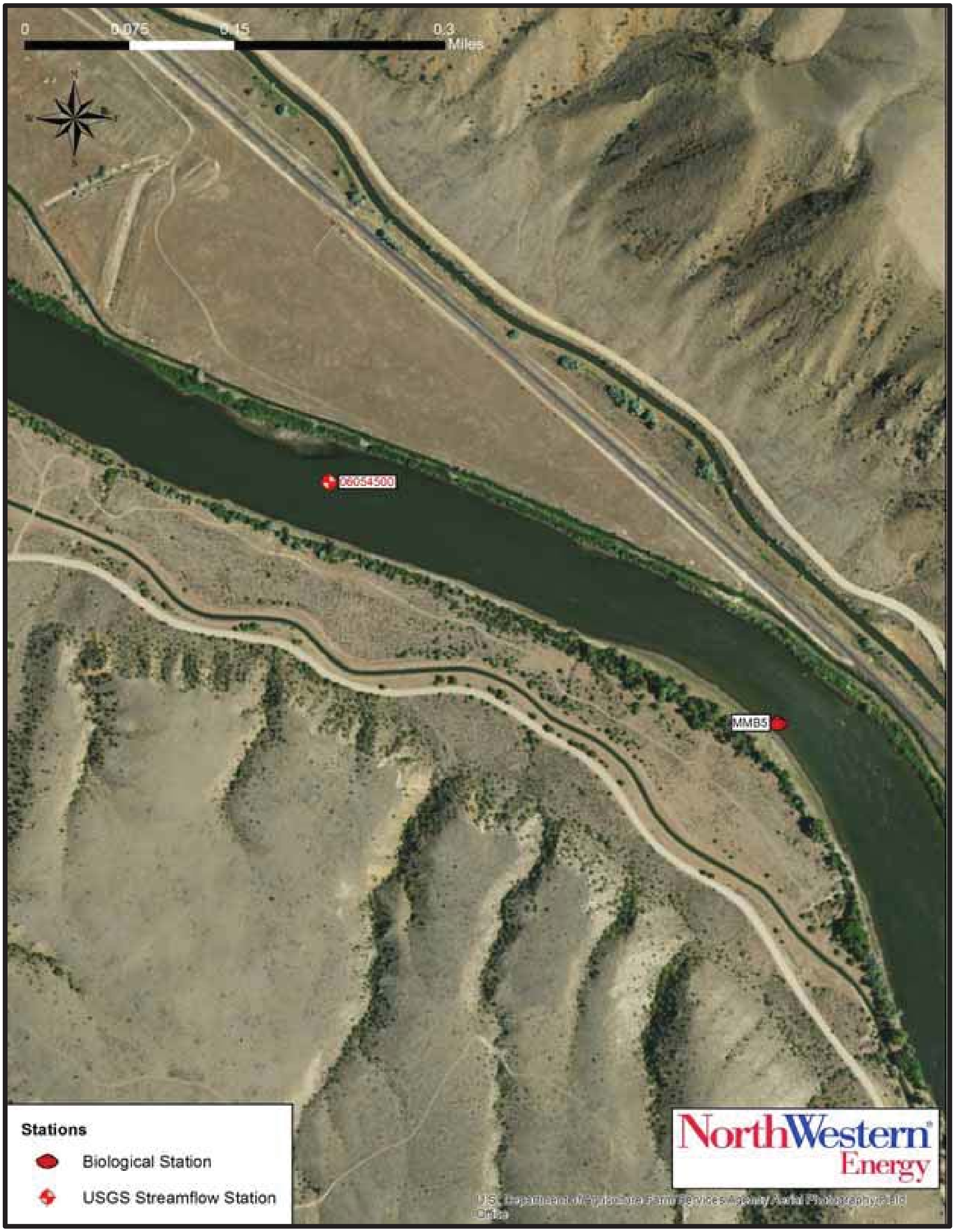


Figure 1-13: Station B5, Toston on the Missouri River.

Figure 1-14: Station 5, Toston on the Missouri River.

Figure 1-15: Station 6, Canyon Ferry on the Missouri River.

1.2.4 Hauser Dam on the Missouri River

Hauser Reservoir is located about 14 miles northeast of Helena, Montana and 14 miles downstream of Canyon Ferry Dam. The reservoir intercepts a drainage area of about 16,876 square miles. The dam is a concrete gravity structure with a 445-foot long overflow spillway and non-overflow sections at each abutment.

The reservoir is comprised of two connected bodies of water. The main water body, Hauser Reservoir, has a useable storage of 52,893 acre-feet. A smaller water body, Lake Helena, has 11,360 acre-feet of useable storage. Mean depth of the reservoir is 25.8 feet at full pool with a mean water residence time of about 9 days.

The monitoring station below Canyon Ferry Dam (Station 6, Canyon Ferry; Figure 1-15) is used to define water quality parameters above Hauser Lake. The water quality monitoring station below Hauser Dam (Station 7, Hauser) is approximately 0.1 miles below the power plant on the left bank (Figure 1-16), and is a single point, depth integrated sample. The biological monitoring station (Station B7, Hauser) is approximately 0.2 miles below the power plant (Figure 1-16).

Figure 1-16: Stations 7 and B7, Hauser on the Missouri River.

1.2.5 Holter Dam on the Missouri River

Holter Reservoir is located about 27.7 miles downstream of Hauser Dam, and 43 miles northeast of Helena, Montana. The reservoir intercepts a drainage area of about 17,150 square miles. The dam is a 124-foot high, straight concrete gravity structure with an ogee spillway section that is 682 feet long. The dam impounds 81,920 acre-feet of useable storage with a surface area of 4,550 acres and is operated primarily as a run-of-the river facility. Mean water residence time in the reservoir is 22 days.

The monitoring station below Hauser Dam (Station B7, Hauser; Figure 1-16) is used to define water quality above Holter Lake. The water quality monitoring station below Holter Dam (Station 8, Holter) is approximately 0.4 miles below the power plant on the left bank (Figure 1-17), and taken as a single point, depth integrated sample. The biological monitoring station (Station B8, Holter) is approximately 0.9 miles below the power plant (Figure 1-17).

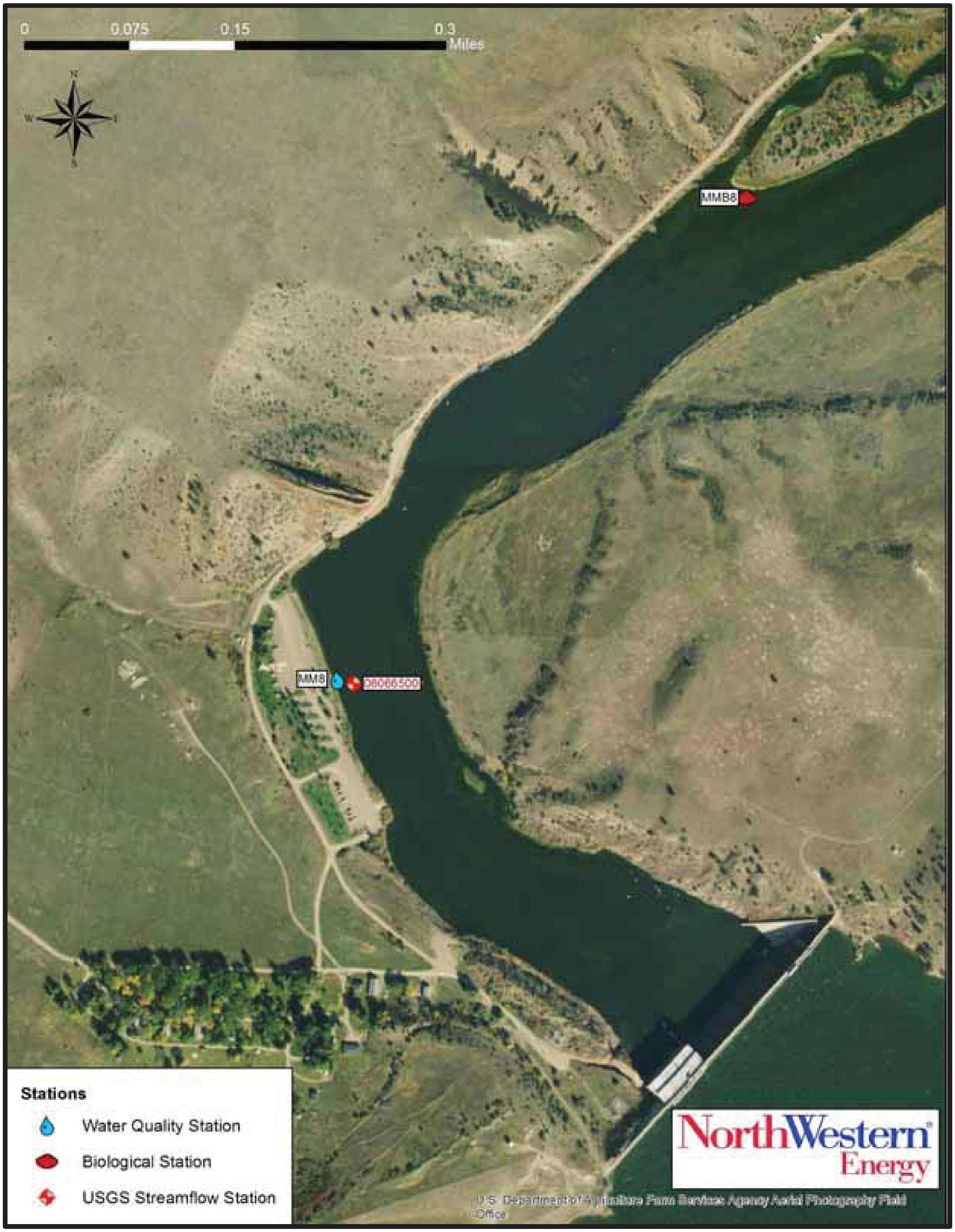


Figure 1-17: Stations 8 and B8, Holter on the Missouri River.

1.2.6 Great Falls Dams on the Missouri River

The Great Falls dams consist of a series of five hydroelectric developments within a 12.1- mile section of the Missouri River. The cumulative effects of the five Great Falls dams (Black Eagle, Rainbow, Cochrane, Ryan, and Morony) are evaluated using monitoring stations above Black Eagle and below the Morony dams. Brief descriptions of each of the dams are presented below, along with a description of the monitoring stations for this study.

Black Eagle Dam is located in Great Falls, 93 miles downstream from Holter Dam. The Sun River empties into Black Eagle Reservoir 3.8 miles upstream from Black Eagle Dam. The reservoir intercepts a drainage area of about 22,100 square miles. The dam is operated as a run-of-the river facility. The dam impounds 1,710 acre-feet of useable storage between elevations 3,279 and 3,290 feet, with a surface area of 402 acres.

The Rainbow Development is located 6 miles northeast of Great Falls, 3.2 miles downstream from Black Eagle Dam. The reservoir intercepts a drainage area of about 22,920 square miles. The dam is operated as a run-of-the river facility. The dam impounds 1,170 acre-feet of useable storage, with a surface area of 126 acres.

The Cochrane Development is located northeast of Great Falls, 3.2 miles downstream from Rainbow Dam. The reservoir intercepts a drainage area of about 23,270 square miles. The dam is operated as a run-of-the river facility. The dam impounds 4,503 acre-feet of useable storage, with a surface area of 249 acres.

The Ryan Development is located northeast of Great Falls, 1.9 miles downstream from Cochrane Dam. The reservoir intercepts a drainage area of about 23,080 square miles. The dam is operated as a run-of-the river facility. The dam impounds 3,653 acre-feet, of which 2,440 acre-feet is useable storage, with a surface area of 168 acres.

The last of the five dams, Morony Dam, is located northeast of Great Falls, 3.9 miles downstream from Ryan Dam. The reservoir intercepts a drainage area of about 23,292 square miles. The dam is operated as a run-of-the river facility. The dam impounds 7,595 acre-feet of useable storage, with a surface area of 304 acres.

The Great Falls dams and reservoirs are treated as one unit for water quality monitoring purposes. The water quality monitoring station (Station 9, Black Eagle/ Central Ave Bridge) is located above the dams at the Central Avenue Bridge in Great Falls (Figure 1-18) and sampling is comprised of 12 equal width, depth integrated samples. The water quality monitoring station (Station 10, Morony) is located off the penstock discharge structure of the Morony Dam (Figure 1-19) and is a single point depth integrated sample. The biological monitoring station (Station B10, Morony) is 0.2 miles below the Morony Dam on the left bank (Figure 1-19).

Figure 1-18: Station 9, Black Eagle/Central Ave Bridge on the Missouri River.

Figure 1-19: Stations 10 and B10, Morony on the Missouri River.

2. Monitoring Objectives

Monitoring objectives for the study area were previously identified by the Montana Department of Environmental Quality (MDHES 1993), the 2188 Water Quality Technical Committee, and by the terms of the license issued by FERC. These objectives have been combined into the following:

1. Provide a statistical analysis of long-term trends in water quality and biological data.
2. Evaluate the potential influence of dam facilities on water quality and biological parameters with upstream-downstream comparisons.
3. Monitor the effects of operation and maintenance of dam facilities on water quality and biological parameters.
4. Evaluate the behavior of the entire system with respect to water quality and biological parameters.
5. Determine whether the effects measured above indicate an improvement or deterioration of water quality, biological integrity, and ecological health of the Water Quality Monitoring

2.1 Water Quality

Monitoring objectives are outlined in formal structure below and are summarized in Appendix A. Referenced statistical methodologies are outlined in Section 4.3

2.1.1 Long-term Trend Identification

MANAGEMENT GOAL:	Maintain or improve water quality.
MONITORING GOAL:	Detect significant temporal (5 to 10 year) trends in water quality parameters.
DEFINITION OF WATER QUALITY:	Analysis of nutrient, metals, and other parameters defined in Table 3-1.
DEFINITION OF TREND:	Correlation between concentration and time at the 0.05 significance level.
STATISTICAL METHODOLOGY:	Kendall non-parametric test applied to flow and seasonally adjusted data as appropriate.
STATISTICAL HYPOTHESIS:	No trend exists.
DATA ANALYSIS RESULT:	Conclusions regarding presence and nature of trends (statistical significance of +- correlation); provide estimate of trend magnitude (Sen slope estimate).
INFORMATION PRODUCT:	Management goal met when no trend exists, or indicates improvement in water quality (e.g. decreasing trend for nutrient concentration)

2.1.2 Parameter Correlation

MANAGEMENT GOAL:	Optimize monitoring program, define covariate behavior.
MONITORING GOAL:	Detect significant correlations between water quality parameters.
DEFINITION OF WATER QUALITY:	Analysis parameters defined below in Table 3-1.
DEFINITION OF EFFECT:	Correlation between parameters, 0.05 significance level.
STATISTICAL METHODOLOGY:	Spearman's non-parametric correlation applied to paired parameter data.
STATISTICAL HYPOTHESIS:	No correlation exists.
DATA ANALYSIS RESULT:	Conclusions regarding potential use of surrogates to optimize monitoring. Conclusions regarding covariate behavior of parameters.
INFORMATION PRODUCT:	Management goal met when no benefits would result from modifications to monitoring program. Improved understanding of inter-relationships between water quality measures.

2.1.3 Dam Baseline Evaluation, Routine Operations

MANAGEMENT GOAL:	Maintain or improve water quality downstream of dam facilities.
MONITORING GOAL:	Detect and quantify significant differences in parameters upstream-downstream of each dam. Determine if differences suggest dam-related improvement or impact on water quality.
DEFINITION OF WATER QUALITY:	Analysis parameters defined below in Table 3-1.
DEFINITION OF EFFECT:	Differences in median response, 0.05 significance level.
STATISTICAL METHODOLOGY:	Kruskal-Wallis non-parametric test applied to paired parameter data, seasonally stratified as appropriate.
STATISTICAL HYPOTHESIS:	No differences in median values exist.
DATA ANALYSIS RESULT:	Conclusions regarding presence and nature of facility effects.
INFORMATION PRODUCT:	Management goal met when no upstream-downstream differences exist, or results indicate stability or improvement in water quality over time.

2.1.4 Dam Evaluation, Non-Routine Operations

MANAGEMENT GOAL:	Minimize any detrimental dam operation effects on water quality.
MONITORING GOAL:	Detect significant correlations between dam operations and water quality parameters. Determine if effects vary with magnitude/duration or timing of operation event.
DEFINITION OF WATER QUALITY:	Analysis parameters defined below in Table 3-1.
DEFINITION OF EFFECT:	Correlation between parameters and dam operations, 0.05 significance level.
STATISTICAL METHODOLOGY:	Spearman's non-parametric correlation applied to paired parameter/operation data.
STATISTICAL HYPOTHESIS:	No correlation exists.
DATA ANALYSIS RESULT:	Conclusions regarding the effect (magnitude/duration) of operation events on water quality. This analysis may employ additional statistical methods such as multivariate analysis to evaluate water quality effects.
INFORMATION PRODUCT:	Management goal met if operation effects are not statistically significant, or are deemed to be within acceptable levels.

2.1.5 Site Specific Evaluations

Canyon Ferry/ Madison Powerhouse Dissolved Oxygen

MANAGEMENT GOAL:	Maintain or improve water quality downstream of dam facilities with respect to dissolved oxygen.
MONITORING GOAL:	Detect and quantify significant differences in annual/seasonal dissolved oxygen above and below dam facilities.
DEFINITION OF WATER QUALITY:	Analysis parameters defined below in Table 3-1.
DEFINITION OF TREND:	Differences in median response, 0.05 significance level.
STATISTICAL METHODOLOGY:	Kruskal-Wallis non-parametric test applied to paired parameter data, seasonally or temporally stratified as appropriate.
STATISTICAL HYPOTHESIS:	No differences in median values exist.
DATA ANALYSIS RESULT:	Conclusions regarding presence and nature of facility effects.
INFORMATION PRODUCT:	Management goal met when no differences exist, or analysis indicates stability or improvement in water quality.

2.2 Biological Monitoring

The objectives of the biological monitoring portion of this plan are presented below and follow the format presented in Appendix A.

2.2.1 Periphyton Long-term Trend Identification

MANAGEMENT GOAL:	Maintain or improve periphyton integrity.
MONITORING GOAL:	Detect significant trends in periphyton standing crop. Determine if trends suggest dam related improvement or deterioration of water quality.
DEFINITION OF WATER QUALITY:	Chlorophyll-a, various metrics.
DEFINITION OF TREND:	Correlation between parameter and time to the 0.10 significance level.
STATISTICAL METHODOLOGY:	Kendall non-parametric test applied to seasonal or covariate-adjusted data as necessary.
STATISTICAL HYPOTHESIS:	No trend exists.
DATA ANALYSIS RESULT:	Conclusions regarding presence and nature of trends in periphyton biomass or metrics, and provide estimate of trend magnitude(s).
INFORMATION PRODUCT:	Management goal met when no trend exists, or indicates improvement (i.e. a reduction in biomass for most sites)

2.2.2 Periphyton Targets

MANAGEMENT GOAL:	Maintain or improve periphyton integrity.
MONITORING GOAL:	Evaluate annual compliance with site specific targets.
DEFINITION OF WATER QUALITY:	Analysis of metrics defined below in Section 3.1.2.
DEFINITION OF TREND:	Comparison of median values with target limits established by baseline monitoring.
STATISTICAL METHODOLOGY:	Comparison of median values to baseline targets.
STATISTICAL HYPOTHESIS:	Median values are within one standard deviation of baseline.
DATA ANALYSIS RESULT:	Conclusions regarding compliance with respect to periphyton biomass targets.
INFORMATION PRODUCT:	Management goal met when annual periphyton measures are within baseline targets.

2.2.3 Macroinvertebrate Long-term Trend Identification

MANAGEMENT GOAL:	Maintain or improve macroinvertebrate integrity.
MONITORING GOAL:	Detect significant trends in composite (“multimetric”) measures of macroinvertebrates. Determine if trends suggest an improvement or deterioration of water quality.
DEFINITION OF WATER QUALITY:	Multimetric scores.
DEFINITION OF TREND:	Correlation between parameter and time to the 0.10 significance level.
STATISTICAL METHODOLOGY:	Kendall non-parametric test applied to seasonal or covariate-adjusted data (as necessary).
STATISTICAL HYPOTHESIS:	No trend exists.
DATA ANALYSIS RESULT:	Conclusions regarding presence and nature of trends. Provide estimate of trend magnitude.
INFORMATION PRODUCT:	Management goal met when no trend exists, or indicates improvement in benthic community integrity

2.2.4 Macroinvertebrate Targets

MANAGEMENT GOAL:	Maintain or improve macroinvertebrate community integrity.
MONITORING GOAL:	Compare annual results with site specific targets established by baseline monitoring.
DEFINITION OF WATER QUALITY:	Analysis of metrics defined below in Section 3.1.2.
DEFINITION OF TREND:	Comparison of annual values with target limits for individual macroinvertebrate metrics.
STATISTICAL METHODOLOGY:	Numerical comparison of annual to baseline targets.
STATISTICAL HYPOTHESIS:	Median values are within one standard deviation of baseline.
DATA ANALYSIS RESULT:	Conclusions regarding achievement of targets with respect to macroinvertebrate metric targets.
INFORMATION PRODUCT:	Management goal met when macroinvertebrate metrics measures are within baseline targets.

2.2.5 Fish Tissue Biocontaminants

MANAGEMENT GOAL:	Maintain or improve (i.e. reduce) biocontaminant levels in fish tissue.
MONITORING GOAL:	Detect significant differences in biocontaminant levels over 4 year period[1].
DEFINITION OF WATER QUALITY:	Analysis of organochlorine and metal parameters defined in Section 3.1.2.
DEFINITION OF TREND:	Detect a 40% difference in mean or median concentrations at 80% power, 90% confidence.
STATISTICAL METHODOLOGY:	Wilcoxon rank sum test (or Kruskal-Wallis), confidence level set at 0.10.
STATISTICAL HYPOTHESIS:	No statistical difference exists between mean or median values.
DATA ANALYSIS RESULT:	Conclusions regarding potential changes in biocontaminant levels in fish tissue.
INFORMATION PRODUCT:	Management goal met when no statistically significant increases occur in biocontaminant levels.

1. Trace metals are sampled every three years; organochlorine compounds every 9 years

3. Data Collection and Sample Analysis

This section outlines the methodology for the collection of water quality and biological samples, sample analysis, and the measurement of dam operation parameters. These components of the monitoring program are discussed separately below.

3.1 Sample Collection

Sample collection methodology for water quality and biological data is summarized below and in Appendix A.

3.1.1 Water Quality

Water quality sampling consisted of either single point depth integrated samples, or depth integrated, equal width increment composites at each monitoring location. Grab samples were collected from the bank in a well-mixed portion of the river. Sample bottles were rinsed three times with native water (or filtered native water) prior to sampling. Samples were collected in the upstream direction to avoid entrainment of sediment disturbed by wading. During sampling, the sampling device was drawn through the water column once, carefully avoiding any disturbance of bottom sediments.

Samples were transferred to a decontaminated teflon churn splitter, stored with blue ice, and sealed in a secure container (wrapped in plastic in a soft cooler) until processing. Processing and splitting of sample aliquots into sample bottles occurred at the end of each day in a clean indoor location. Filtration with a 0.45µm filter for dissolved parameters was done as a batch process within 8 hours of sampling. All sample bottles were virgin polyethylene bottles supplied by Energy Labs.

Samples were clearly labeled with a waterproof marker or a preprinted label. Label information included the site identification, date and time, sample type, preservative, and sampler's initials. Field notebooks were completed for each location along with appropriate chain-of-custody forms. All samples were immediately placed in a cooler chilled to 4°C for transport to the lab.

Quality control samples were also analyzed for water quality parameters. These samples consisted of one replicate for every ten samples, and one equipment blank for each sampling event. The replicate was a sequential sample taken at one of the locations as a control measure of both field variability, sample processing procedures, and laboratory methodology. The equipment blank was a deionized water sample run through the sampling apparatus after standard decontamination procedures and analyzed for the full suite of water quality parameters. The blank primarily represented a quality control measure of lab methodology, but also integrated procedural aspects such as decontamination and sample handling.

The sampling methodology described above conforms to current standard operating procedures described in the document "*Water Quality Planning Bureau Field Procedures Manual for Water Quality Assessment Monitoring*" (MTDEQ 2012a), available online at the Montana Department of Environmental Quality web site.

3.1.2 Biological Monitoring

Periphyton samples were collected at seven chlorophyll-a monitoring stations using the scrape and whole rock methods. The scrape method consisted of selecting a spatially representative set of ten substrate materials and removing material within a template placed on the rocks. This method was performed in August of 2007 to 2009 and 2011 but was ended because the whole rock method reduced variability and sampler bias inherent with placing the template on the substrate. The whole rock method involved selecting four to nine rocks (typically four) each August from 2007 to 2016 and submitting the entire rock for analysis. The surface area of the exposed substrate was calculated and the resulting metrics reflect an integrated measure of Chlorophyll-a. Ash free dry weight cannot be determined from whole rock samples and the measurements calculated from the scrape samples are not included in this report.

Separate periphyton samples were also collected at each diatom monitoring station in August from 2007 to 2016. A composite sample from a variety of microhabitats was collected and preserved with Lugol's to provide a representative sample for periphyton species composition analysis.

Macroinvertebrate sampling methods were initially identified in the Biological Monitoring Plan (MDHES 1993). These methods were modified after field testing (McGuire 1997). The modified sampling consisted of collecting five replicate samples enclosing 0.25 m^2 at each site in August from 2007 to 2016. The samples were collected using a fine 560 micron mesh kicknet, and the entire sample (macroinvertebrates, vegetation, sediment, and debris) were preserved in 90% ethanol for macroinvertebrate species composition analysis.

Fish tissue biocontaminants were evaluated for both Predator species (Brown Trout [*Salmo trutta*], Rainbow Trout [*Oncorhynchus mykiss*], and Walleye [*Sander vitreus*]), and Bottom dwellers (Utah Chub [*Gila atraria*] and White Sucker [*Catostomus commersonii*]). An effort was made to obtain a sample of 4 individuals of similar size class (length within 25%) for analysis as filets for "predators" or whole body samples for Bottom. Approximately 560 grams of tissue was needed for each analysis and required a composite of multiple fish if size classes did not provide enough tissue from individuals. Fish were captured with electrofishing equipment, weighed, measured, wrapped in aluminum foil, and placed in double plastic bags. Fish were placed on ice in the field, frozen as soon as practicable, and kept frozen until chemical analyses were performed by the laboratory.

3.2 Sample Analyses

Sample analysis methodologies for the water quality and biological samples are summarized below and in Appendix A.

3.2.1 Water Quality

Water quality samples were analyzed for various parameters both in the field and laboratory (Table 3-1). Ion chemistry, solids/turbidity, nutrients, and physicochemical analysis (sonde) was performed on water samples from each water quality station while metals analysis was routinely performed on samples from stations 9 and 10 (Table 1-1). Laboratory analysis was conducted by Energy Laboratories, Billings, MT.

Table 3-1: Water quality parameters analyzed in the laboratory and measured in the field, 2007-2016.

Ion Chemistry	Solids/Turbidity	Metals	Nutrients	Physicochemical
Alkalinity as CaCO3, Total	Dissolved Solids, Total	Arsenic, Total	Nitrite-Nitrate, Total	Dissolved Oxygen
Bicarbonate as HCO3, Total	Suspended Solids Total	Cadmium, Total	Nitrite-Nitrate, Dissolved	Water Temperature
Calcium, Total	Turbidity	Copper, Total	Nitrogen, Total	Specific Conductance
Calcium, Dissolved		Iron, Total	Phosphorus, Total	pH
Chloride, Total		Lead, Total		
Magnesium, Dissolved		Manganese, Total		
Potassium, Total		Zinc, Total		
Potassium, Dissolved				
Sodium, Dissolved				
Sulfate, Total				

Note: Turbidity was measured in the field with the other physicochemical parameters while all other parameters were analyzed in the laboratory.

3.2.2 Biological Monitoring

Periphyton sample analysis consisted of chlorophyll-a determination, diatom species count, and identification of soft bodied algae. The methodology for these followed U.S. Environmental protection Agency (EPA) guidance (Barbour et. al. 1999). Chlorophyll-a was measured from samples collected at biological monitoring stations using a spectrophotometer or fluorimeter on samples extracted in acetone. Chlorophyll-a optical density was measured both before and after acidification to correct for the error associated with pheophytin. In addition to the periphyton identification and enumeration, periphyton metrics were calculated by the analyst and provided for statistical analysis described in Section 5.2.1.2.

Sample processing for macroinvertebrates was described by McGuire (1999) and follows the EPA Rapid Bioassessment Protocols (Plafkin et. al.1989) for a 300-count subsample. The entire sample was placed in a US Standard #30 sieve, rinsed with water, and evenly distributed in a gridded pan (9” x 12” or 14” x 20”). All macroinvertebrates in a randomly selected grid were removed. This process was repeated until 270 to 330 macroinvertebrates had been picked. The total number of macroinvertebrates in the sample was estimated from the percentage of sample used to obtain 300 organisms. Rare taxa, which might have been missed by subsampling, were removed from the remainder of the sample to determine taxa richness and EPT richness for the composite sample. Macroinvertebrates in the subsample were then identified to taxonomic levels specified in the document "*Sample Collection, Sorting, Taxonomic Identification, and Analysis of Benthic Macroinvertebrate Communities Standard Operating Procedure*" (MTDEQ 2012b), available online at the Montana Department of Environmental Quality web site.

All collected fish in 2009 were individually analyzed for biocontaminants while fish collected in 2013 to 2015 were composited by site and year and then analyzed. Fish tissue samples were analyzed for a suite of organochlorine pesticides, polychlorinated biphenyl (PCBs, [Aroclor congeners]), and metals as listed in Table 3-2. This list of analytes conforms to reporting requirements of the USFWS. Laboratory analysis was conducted by Energy Laboratories, Billings, MT and reported on a wet weight basis.

Table 3-2: Biocontaminants analyzed in fish tissue samples from fish monitoring sites in 2009 and 2013 to 2015.

Organochlorine Pesticides	PCBs (Aroclor)	Metals
Aldrin	1016	Aluminum
alpha-BHC	1221	Arsenic
beta-BHC	1232	Cadmium
delta-BHC	1242	Chromium
Chlordane	1248	Copper
DDD	1254	Iron
DDE	1260	Lead
DDT		Manganese
Dieldrin		Mercury
Endosulfan I		Nickel
Endosulfan II		Selenium
Endosulfan Sulfate		Strontium
Endrin		Zinc
Endrin Aldehyde		
Heptachlor		
Heptachlor Epoxide		
Isodrin		
Kepone		
Methoxychlor		
Toxaphene		

Note: Gamma-BHC (Lindane) data was not available and chlordane data was not separated into alpha-chlordane (technical), alpha-chlordane, and gamma-chlordane.

3.3 Sampling and Data Collection Schedule

The schedule for collecting water quality and biological samples is presented in Appendix A. The schedule consisted of routine water quality sampling conducted on a quarterly basis, generally during the third week of February, May, August, and November, and routine biological sampling conducted annually during the second week of August. Fish tissue biocontaminant sampling occurred on a rotational basis at stations B2, 4, B7, B8, and B10 in 2009; at stations B2 and B3 in 2013; at stations B7 and B8 in 2014; and at stations 9 and B10 in 2015.

Notably, data were not available for non-routine dam operations, unusual runoff conditions, or special site-specific studies, outside of the conditions documented during routine sampling. Therefore, data analysis was not performed for specific objectives as identified in the Water Quality and Biological Monitoring Plan for the Years 2012-2021 ([SAP], PPLMT 2001) or in Section 2.1.4 of this report.

4. Data Management and Analysis Methodology

Data quality control, management, and analysis methods are summarized below.

4.1 Data QA/QC

Data quality assurance and quality control (QA/QC) were accomplished per standard QA/QC procedures. These methods included:

- Validation: reviewed analytical laboratory techniques including lab duplicate, matrix spikes, blanks, and surrogate recoveries to determine if the methods were within acceptable limits.
- Replicates: each sampling event included the collection of one replicate per ten samples for water quality, and the collection of replicate samples for the biological monitoring. Replicate variability was analyzed using standard methods with the objective of obtaining Relative Percent Differences within 10% for values greater than 5 times the method detection limit.
- Splits: Splits were collected using a churn splitter to achieve equal aliquots, and samples were analyzed for the full suite of parameters.
- Field methodology: field blanks were collected for each water quality event to monitor field methodology. Methods and field sampling forms were reviewed to assure consistency.
- Individual data which fails to achieve QA/QC objectives were flagged with appropriate qualifiers in the database.
- If QA/QC review suggests widespread problems with QA/QC for a sampling run, the sampling run (or individual samples) was repeated at the discretion of the project manager.

Quality control measures were also employed for the statistical analyses. These measures included:

- Evaluating the data for normality when parametric tests were performed, using transformed data when appropriate, and adjusting for seasonal/flow effects.
- Assigning one-half the detection limit to non-detect water quality and fish tissue, chlorophyll-a, and biocontaminant values and evaluating the methodology/detection limits to assure the analyses were valid.
- Addressing missing values and trend analyses in a consistent manner that avoided biasing the results.

4.2 Database

GEI was provided the data in multiple Excel files that spanned the 20 years of data collection, including a file exported from the Montana DEQ's eWQX database that contained water quality data prior to 2011. The monitoring data was organized by date from 1996 through 2016, and assembled into six Excel Workbooks – Water Quality, Physicochemical, Algal Biomass, Periphyton Metrics, Macroinvertebrate Metrics, and Fish Tissue Biocontaminants. These six data files have been formatted per Montana DEQ's EQuIS Water Quality Exchange Guidance Manual (MTDEQ 2015) and will be submitted for inclusion into the MT-eWQX database. In addition, the monitoring data will be compiled in an Access Database that will include a function to upload analytical laboratory EDDs, and to generate a data file for updating MT-eWQX database. Development of a common database will provide an easily accessible repository for the Missouri-Madison system that will facilitate future analyses.

4.3 Data Analysis and Statistical Approach

Statistical analysis differed between water quality and biological data. Methods were designed to meet the objectives described in Section 2, and have been presented in previous data evaluations (Land & Water 1999; Bahls 1999, McGuire 1999). Data observations and statistical analyses are also summarized in Appendix A.

Statistical analyses evaluated improvements and deteriorations in water quality. Analyses examined changes in water quality and biological conditions at each site, between upstream-downstream pairs at each dam, and for the study area. The methods identified statistically significant temporal and spatial variability. Observed differences were related to dam operations if the change was not accompanied by an equivalent response above the dam. Similar change identified concurrently at multiple sites were considered as indicators of systemic or basin-wide effects.

Inter-correlations of parameters and metrics were also valuable in identifying those factors that behave in a similar fashion (i.e. covariates). This information was useful for interpreting water quality response, and was previously used to streamline the monitoring program and reduce redundant parameters, and analytical costs.

4.3.1 Water Quality

Water quality data were summarized using basic exploratory data analysis approaches for evaluating the central tendency (i.e., mean or median) and variability (standard deviation or inter-quartiles) of the data, including sample size. The percentage of non-detect values for each parameter by station was also calculated to provide information relative to the central tendency value. Non-detect values were substituted with one-half the method detection limit for purposes of statistical analysis. Because non-parametric statistical tests were used to evaluate un-transformed or non-adjusted data relationships, test of normality were not performed. For the few parametric tests, the data was transformed and the expected normal probability plots and residuals plots of raw data were evaluated to assess whether the distribution of the data affected the results. Data summaries are provided for each station on an annual basis and the 10-year basis (2007-2016).

Graphical summaries of the data are presented using boxplots by station (longitudinal) or by year (temporal) for each station to evaluate patterns in the data. The boxes represent the 25^{th}, 50^{th}, and 75^{th} percentiles of the data and the whiskers represent the upper and lower 90 % confidence intervals for each parameter. Each parameter was analyzed using non-parametric statistical tests to determine whether hydroelectric facilities or major tributary inputs had a significant effect on downstream water quality conditions. In addition, each parameter was statistically analyzed using Seasonal Kendall Trend analysis with year and month (seasonal covariate) to evaluate whether concentrations have increased – decreased – or stayed the same over time. The magnitude of a trend (i.e., slope) that can be detected is a function of inherent data variability and sample size. As sample size increases with continued monitoring, the power to detect trends will improve for long-term analyses (e.g. 1996 to the present). However, if 10-year blocks of data are evaluated, the power to detect trends will remain the same if the sampling frequency remains the same. These analyses helped to determine if there were statistical differences between stations with respect to watershed inputs, reservoirs or hydroelectric facilities. The water quality statistical analysis methodology is summarized in Appendix A.

4.3.1.1 Flow Adjusted Analysis

Background water quality conditions in the Madison River are largely affected by geothermal activity in Yellowstone National Park (YNP), whereas the background water quality conditions in the Missouri River are largely affected by urbanization in the Gallatin River watershed and agricultural practices in both the Gallatin and Jefferson watersheds. The confluence of these rivers with the Madison River, at Three Forks, MT, establishes the background water quality conditions for the headwaters of the Missouri River. In both the Madison and Missouri rivers, water quantity also affects background water quality conditions. Water quantity is primarily driven by snow-melt runoff and depending on seasonal conditions in each watershed (i.e., dry or wet), stream flow can greatly effect water quality conditions. Unseasonably low flows in the Madison River reduce the dilution potential for geothermal constituents, whereas high flows dilute concentrations. In addition, the various watershed and hydrological inputs along the Madison-Missouri continuum affect concentration – flow relationships. Therefore, removing the effect of flow on water quality provides insight to long-term trends in water quality that may result from influence of reservoirs, operational effects of hydroelectric dams, or other anthropogenic effects.

Previously, analytes were adjusted for the effects of flow by regressing (inverse or linear relationship depending on parameter) concentrations with measured discharge during sample collection. This approach may weight the magnitude of the measured flow, especially if flow conditions represent the extremes (i.e., dry or wet) and potentially bias the relationship as well as over simplify potential non-linear relationships that may be missed relative to seasonal flow conditions or influence of other watersheds. Furthermore, if flow conditions changed during the last 10-year period (2007-2016), data relationships may not depict appropriate conditions across the full range of flow conditions measured at a station. Because flow tended to decrease over time for the first 10-year period (1996-2006) we wanted to place the flow conditions of the last 10-year period (2007-2016) in context with the previous flow conditions. Therefore, we used a slightly different approach that incorporates information about the entire flow record and places the flow conditions measured during the sampling event in the context of the entire flow record.

Mean daily discharge records from January 1, 1996 to December 30, 2016 were downloaded from the USGS Water Data for Montana webpage (https://waterdata.usgs.gov/mt/nwis/nwis) and the Bureau of Land Management HydroMet webpage (https://www.usbr.gov/gp/hydromet/hydromet_arcread.html) for the gage closest to each water quality monitoring station. For each gage dataset, mean daily discharge (cfs) was ranked from the largest value to the smallest value for the period from 1996 through 2016. The Weibull probability value was calculated for each ranked mean daily discharge value to create an exceedance probability value. Exceedance probabilities were converted to a percentile for evaluating the relationship between concentration and flow. For each sampling event at each station, the exceedance probability for the mean daily flow reported on that date was paired with the measured parameter concentration. The data relationships were re-examined to determine the influence of results reported at or near the method detection limits, measured results that exhibit repetitive patterns in the data, as well as other potential non-linear relationships.

Water quality parameters (untransformed) that revealed a strong relationship to flow probability (percentile) across multiple stations were selected for the flow-adjusted analysis. The Kendall-tau correlation test of concentration and flow probability was performed at each station, with a strong relationship being defined by a correlation coefficient > 0.5 and a statistically significant p-value (i.e., <0.1). Selected water quality parameters were transformed (natural logarithm) and regressed (least squares regression) with flow percentile to estimate flow-adjusted concentrations (i.e., residuals). Pearson correlation of flow-adjusted concentration with decimal year was used to determine whether there was a significant increasing or decreasing trend over time. Locally weighted scatterplot smoothing (LOESS) regression was performed on flow-adjusted parameters of interest to evaluate non-monotonic relationships over time. Lastly, percent change between the 2007-2009 mean flow-adjusted concentration and 2014-2016 mean flow-adjusted concentration at each station was calculated to provide some context to the magnitude of change over time for significant and non-significant relationships.

Statistical analysis of water quality data included:

1. Summary Data
    a. Minimum, maximum, and mean values; standard deviations; and percentages of non-detect data for each station and year
    b. Graphical presentation and observations of longitudinal patterns in the data
    c. Kendall-tau correlation analysis between non-adjusted parameters and flow

2. Dam Effect Evaluation
    a. Graphical presentation and evaluation of data patterns
    b. Mann-Whitney U non-parametric test between stations (0.05 significance level)
    c. Mean Rank differences and evaluation of 10-year medians to confirm significant differences between stations
    d. Percent change of 10-year median between stations
3. Long-term Trend Identification
    a. Raw Data
        i. Graphical presentation and evaluation of temporal patterns in the data
        ii. Seasonal Kendall non-parametric test of trend using non-flow-adjusted data over time for each station
        iii. Percent change between 2007-2009 mean water quality concentration and 2014-2016 mean water quality concentration for each station
    b. Flow-adjusted Data
        i. Graphical presentation and evaluation of temporal patterns in the data
        ii. Least Squares Regression analysis and calculation of residuals (flow-adjusted values)
        iii. Pearson correlation analysis of flow-adjusted values with decimal year
        iv. Locally weighted scatterplot smoothing (LOESS) regression
        v. Percent change between 2007-2009 mean flow-adjusted concentration and 2014-2016 mean flow-adjusted concentration at each station
4. Special Studies – Dissolved Oxygen
    a. Graphical presentation and evaluation of data patterns
    b. Mann-Whitney U non-parametric test between stations (0.05 significance level)
    c. Kruskal-Wallis H non-parametric test of seasonal effects within a station (0.05 significance level)

4.3.2 Biological Data

Data analysis methods for evaluating the 2007 to 2016 periphyton and macroinvertebrate data are summarized below.

4.3.2.1 Periphyton Data

Periphyton data included laboratory measured chlorophyll-a that is a surrogate for algal biomass, or standing crop, of a periphyton community. Chlorophyll-a typically ranges from 0.5-2% of total algal biomass, depending on taxonomy, light, and nutrients (Barbour et al. 1999). Generally, streams with concentrations greater than 120 mg/m^2 are considered nutrient impaired (MTDEQ 2011; Suplee and Sada de Suplee 2011).

Statistical analysis of chlorophyll-a data included:

5. Summary Data
   a. Minimum, maximum, and mean values; standard deviations; and percentages of non-detect data were calculated for each station and year
   b. Graphical presentation and observations of longitudinal patterns in the data
   c. Results were compared to guidelines established by Montana Department of Water quality
   d. Concentrations at potentially impacted stations were compared to background control stations (B1 and B5)
6. Dam Effect Evaluation
   a. Mann-Whitney U non-parametric statistical comparisons of data between paired stations upstream-downstream of reservoirs and dams
   b. Graphical presentation and observations of longitudinal patterns in the data
   c. Percent change in median concentrations were calculated between paired stations upstream-downstream of reservoirs and dams
7. Long-term Trend Identification
   a. Mann-Kendall non-parametric trend analysis of temporal data for each station
   b. Graphical presentation and observations of longitudinal patterns in the data

Periphyton data also included various diatom metrics calculated from taxa and species counts. The metrics used generally follow EPA guidance (EPA 1998; Barbour et al. 1999) and include:

- Shannon Diversity. Measurement of diversity calculated using taxa richness and distribution (evenness) of individuals among taxa (Weber 1973). It is a measure of the effects of stress on invertebrate communities. Diversity is expected to be higher in unimpacted sites.
- Pollution Tolerance Index (PTI). Resembles the Hilsenhoff Biotic Index (described below for macroinvertebrates) and categorizes diatoms according to their tolerance to increased pollution (Bahls 1993). PTI is a sum of values assigned to three categories of diatoms where a value of 1 is assigned to the most pollution-tolerant taxa, 2 to less tolerant taxa, and 3 to sensitive taxa. This metric is expected to be higher in degraded streams.
- Siltation Index (%). Percentage of motile species that live in the sediment and are capable of holding their position on unstable substrates (Bahls 1993). The percentage is expected to increase with sedimentation.
- Disturbance Index (%). Percentage of generalist diatom species that are often pioneer species at scour or polluted locations (Barbour et al. 1999). This metric is expected to be higher in area of increased natural or anthropogenic disturbance.

- Species Richness. Number of species counted per sample is indicative of water quality. This metric increases with number of species.
- Abundance of Dominant Species (%). Percentage of the dominant (tolerant) species. This metric increases with stress to the environment.
- Abnormal Cells (%). Percent of diatoms that have anomalies in striae patterns or frustule shape. This metric has been positively correlated with heavy metals contamination (Barbour et al. 1999) and increases with pollution.

Note: Individual taxonomic count data that is required for the calculation of percent community similarity was not available.

Mean diatom metric data by station were scored and rated per biological integrity thresholds used for Montana mountain and plain stream ecoregions (Table 4-1, Bahls 1993; Teply and Bahls 2005). These thresholds correspond to a 1 to 4 score, "Poor" to "Excellent" rating of the score, and a "None" to "Severe" impairment evaluation of the diatom community. In addition, the lowest scoring metric at each station in a year was considered the overall rating and impairment assessments of that station in that year.

Data observations and statistical analysis of diatom metric data included:

8. Summary Data
    a. Minimum, maximum, and mean values and standard deviations by metric were calculated for each station and year
    b. Graphical presentation and observations of longitudinal patterns in the data Biological integrity ratings for each metric and impairment ratings for each station and year were determined
    c. Concentrations at potentially impacted stations were compared to background control stations (B1 and B5)
9. Dam Effect Evaluation
    a. Mann-Whitney U non-parametric statistical comparisons of data between paired stations upstream-downstream of reservoirs and dams.
    b. Percent change in in median metric values were calculated between paired stations upstream-downstream of reservoirs and dams.
10. Metric Relationships
    a. Scatter plot matrices were used to evaluate metric relationships
    b. Kendall-tau non-parametric correlation analysis between metrics was performed for each station
11. Long-term Trend Identification
    a. Least Squares Regression analysis for trends in each metric at each station

Table 4-1: Diatom metrics biological integrity thresholds and ratings used for Montana stream ecoregions.

Metric	Mountains				Plains			
	Thresholds	Score	Rating	Impairment	Thresholds	Score	Rating	Impairment
Shannon Diversity[a]	< 1	1	Poor	Severe	< 1.5	1	Poor	Severe
	1 - 1.75	2	Fair	Moderate	1.5 - 2.5	2	Fair	Moderate
	1.75 - 2.5	3	Good	Minor	2.5 - 3.5	3	Good	Minor
	≥ 2.5	4	Excellent	None	≥ 3.5	4	Excellent	None
Pollution Tolerance Index[a]	< 1.5	1	Poor	Severe	< 1	1	Poor	Severe
	1.5 - 2	2	Fair	Moderate	1 - 1.5	2	Fair	Moderate
	2 - 2.5	3	Good	Minor	1.5 - 2	3	Good	Minor
	≥ 2.5	4	Excellent	None	≥ 2	4	Excellent	None
Siltation Index (%)[a]	< 20	4	Excellent	None	< 60	4	Excellent	None
	20 - 40	3	Good	Minor	60 - 70	3	Good	Minor
	40 - 60	2	Fair	Moderate	70 - 80	2	Fair	Moderate
	≥ 60	1	Poor	Severe	≥ 80	1	Poor	Severe
Disturbance Index (%)[b]	< 25	4	Excellent	None	< 25	4	Excellent	None
	25 - 50	3	Good	Minor	25 - 50	3	Good	Minor
	50 - 75	2	Fair	Moderate	50 - 75	2	Fair	Moderate
	≥ 75	1	Poor	Severe	≥ 75	1	Poor	Severe
Species Richness[b]	< 10	1	Poor	Severe	< 20	1	Poor	Severe
	10 - 20	2	Fair	Moderate	20 - 30	2	Fair	Moderate
	20 - 30	3	Good	Minor	30 - 40	3	Good	Minor
	≥ 30	4	Excellent	None	≥ 40	4	Excellent	None
Abundance of Dominant Species (%)[b]	< 25	4	Excellent	None	< 25	4	Excellent	None
	25 - 50	3	Good	Minor	25 - 50	3	Good	Minor
	50 - 75	2	Fair	Moderate	50 - 75	2	Fair	Moderate
	≥ 75	1	Poor	Severe	≥ 75	1	Poor	Severe
Abnormal Cells (%)[b]	0	4	Excellent	None	Not assessed			
	> 0 - 3	3	Good	Minor				
	3 - 10	2	Fair	Moderate				
	≥ 10	1	Poor	Severe				

[a]Bahls 1993
[b]Teply and Bahls 2005

4.3.2.2 Macroinvertebrate Data

Various metrics associated with water quality and flow regimes below dams were calculated from median macroinvertebrate taxa and species count data. These metrics generally follow EPA guidance (Plafkin et al. 1989) and include:

- Taxa Richness. Number of taxa counted per sample is indicative of water quality. Loss of most sensitive species to any stress affects index. This metric increases with number of taxa.
- Shannon Diversity. Measurement of diversity and stress of invertebrate communities and is calculated using taxa richness and distribution (evenness) of individuals among taxa (Weber 1973). Diversity is expected to be higher in unimpacted sites.

- Biotic Index (Hilsenhoff 1988; tolerance values from Bukantis 1996). Community index that uses tolerance values to weight abundance in an estimate of overall pollution. It is also known as the Modified Family Biotic Index. The index on a scale of 0-10, with higher values indicating more eutrophic conditions.
- EPT Richness. Total number of distinct taxa in EPT taxa (Ephemeroptera [mayfly], Plecoptera [stonefly], and Trichoptera [caddisfly]) which are primarily intolerant species. It is also known as an EPT Index. The index increases with improving water quality.
- Relative Abundance of EPT (%). Percent of population consisting of EPT taxa. Percent increases with improving water quality.
- Relative Abundance of Chironomidae (%). Percent of population consisting of chironomid (midge) larvae which are a very pollution tolerant species. Increased abundance is indicative of stress.
- Ratio of Amphipoda to Isopoda. Ratio of Amphipods, which require high oxygen concentrations, to Isopods, which are tolerant of low oxygen levels. Ration ranges from 0 to 1, with lower values indicating more eutrophic/reduced oxygen conditions.
- Community Density. Number of organisms assessed per 0.25 m^2 sample and not by subsample of 300. Density increases in response to organic and/or nutrient enrichment and can be used as measure of trophic status.
- Multimetric Assessment (Total). Composite (multimetric) assessment of benthic macroinvertebrate assemblage composition and structure. Scores ranging from 0 to 5 are assigned to metric results according to predefined threshold and added together for total multimetric score (Table 4-2).
- Multimetric Assessment (% of possible). Multimetric Assessment (Total) score divided by highest potential score of 30.

Note: Data required to calculate ordinal relative abundance and percent community similarity was not available.

Table 4-2: Benthic macroinvertebrate assemblages scoring thresholds.

Metric	Score					
	0	1	2	3	4	5
Taxa Richness	< 13	17 - 13	22 - 18	27 - 23	32 - 28	> 32
Shannon Diversity	< 2.2	2.4 - 2.2	2.7 - 2.5	3.0 - 2.8	3.3 - 3.1	> 3.3
Biotic Index	> 6.4	5.9 - 6.4	5.3 - 5.8	4.7 - 5.2	4.1 - 4.6	< 4.1
EPT Richness	0	4 - 1	8 - 5	12 - 9	16 - 13	> 16
Relative Abundance of EPT (%)	< 31	40 - 31	50 - 41	60 - 51	70 - 61	> 70
Relative Abundance of Chironomidae (%)	> 40	36 - 40	31 - 35	26 - 30	21 - 25	< 21
Ratio of Amphipoda to Isopoda*	0.0	0.13 - 0.01	0.26 - 0.14	0.39 - 0.27	0.52 - 0.40	> 0.52

*Not calculated when crustaceans represent less than one percent of the fauna.

Data observations and statistical analysis of macroinvertebrate metric data included:

12. Summary Data
    a. Minimum, maximum, and mean values and standard deviations by metric were calculated for each station and year
    b. Graphical presentation and observations of longitudinal patterns in the data
    c. Concentrations at potentially impacted stations were compared to control stations (B1 and B5)
13. Dam effect Evaluation
    a. Mann-Whitney U non-parametric test of comparison for metric data between stations paired upstream-downstream of reservoirs and dams
    b. Percent change in 10-year median metric values were calculated between paired stations upstream-downstream of reservoirs and dams
14. Metric Relationships
    a. Relationship observations were made using a scatter plot matrix of metrics
    b. Kendall-tau non-parametric correlation analysis between metrics was conducted for each station
15. Long-term Trend Identification
    a. Least Squares Regression analysis for trends in each metric at each station

4.3.2.3 Fish Tissue Biocontaminant Data

Data observations and statistical analysis of fish tissue biocontaminant data included:

16. Summary Data
    a. Minimum, maximum, mean values and standard deviations for fish length and weight were calculated for Predator and Bottom fish for each station and year
    b. Number of fish tissue biocontaminant concentration detections above the detection limit, number or non-detects, and percentage of non-detects and mean biocontaminant concentrations were calculated for Predator and Bottom fish for each station.
    c. Results compared to national median concentrations and Montana and EPA fish consumption guidelines
    d. Observations of differences between Predator and Bottom fish concentrations and longitudinal patterns by metric were made
17. Dam Effect Evaluation
    a. Percent changes in mean Predator and Bottom concentrations above detection limit were calculated between paired stations upstream-downstream of reservoirs and dams

b. Mann-Whitney U non-parametric statistical comparisons of biocontaminant data between paired stations upstream-downstream of reservoirs and dams were made for Predator and Bottom fish

c. Percent change in in median Predator and Bottom concentrations were calculated between paired stations upstream-downstream of reservoirs and dams

Note: Metric relationships and long-term trend analysis could not be performed due to the small sample size.

5. Statistical Analyses

Spatial and temporal analyses of water quality, periphyton and macroinvertebrates are presented in the following sections. The first step in the analyses was to perform the basic summary statistics and graphical display of parameters for the period of record (2007-2016), followed by statistical comparisons of stations that bracket (upstream-downstream) the hydroelectric facilities. The last component was the temporal trend and flow-adjusted analyses for selected water quality parameters.

Many of the graphical displays are presented in a format that sequentially represents Station 1 through Station 10, a river mile distance of nearly 350 miles. However, the stations are not represented on a river mile scale, and instead bracket the hydroelectric facilities from Hebgen Dam downstream to Morony Dam. The following schematic (Figure 5-1) provides some context to the water quality and biological stations that bracket hydroelectric facilities and other important hydrologic inputs.

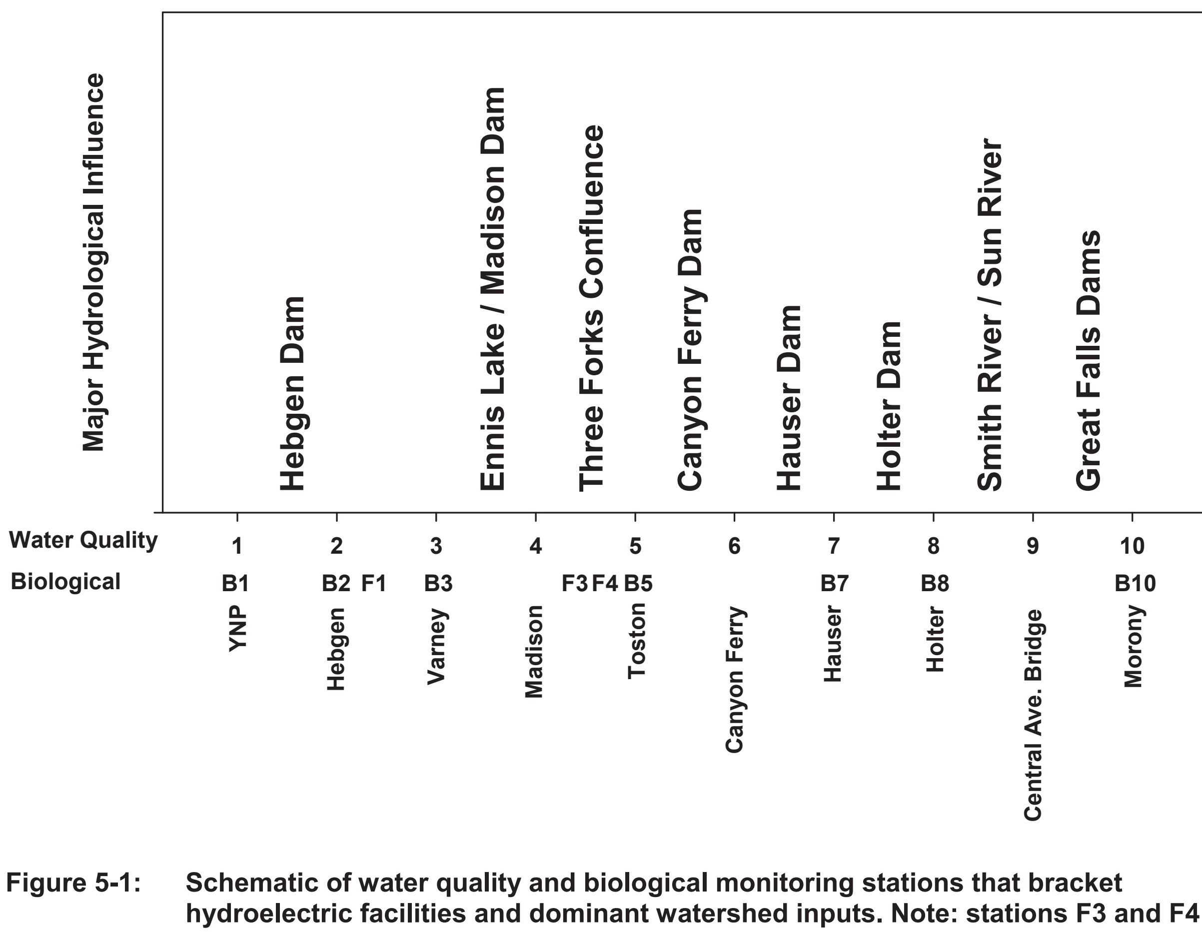


Figure 5-1: Schematic of water quality and biological monitoring stations that bracket hydroelectric facilities and dominant watershed inputs. Note: stations F3 and F4 are upstream of the Three Forks Confluence.

5.1 Water Quality Analyses

5.1.1 Spatial Analyte Summary

Water quality parameters were generally collected on a quarterly basis with sampling occurring during the third week of February, May, August, and November for each year. The notable exception to the sampling frequency was in 2011 when monthly samples were collected at each site. This sampling routine resulted in up to a total of 48 samples per station. In general, the ion chemistry, solids/turbidity, nutrients, and physicochemical (e.g. pH, specific conductance) measurements were performed at all stations each year, whereas the metals analyses were only performed at stations 9 and 10. Again, the notable exception for most metal parameters was for years 2008 when only one sample was collected and in 2011 when monthly samples were collected from all sites for a total of 13 samples. Additionally, total arsenic was measured for each station for each year. A summary of water quality results is presented below in Table 5-1. These data represent the sample size, mean values, and percentage of the results that were non-detects for each parameter by station over the ten-year monitoring period from 2007 to 2016. A high percentage of the results (i.e., > 50%) were less than detection limits for total suspended solids, total cadmium, total zinc, total lead, total copper. Complete descriptive statistics can be found in Appendix B, including summary annual statistics by station and parameter.

Table 5-1: Water quality parameter descriptive statistics from 2007 to 2016 at all stations. N = sample size and % ND = percent of non-detect results.

Parameter	Station 1			Station 2			Station 3			Station 4			Station 5		
	N	Mean	% ND	N	Mean	% ND	N	Mean	% ND	N	Mean	% ND	N	Mean	% ND
Ion Chemistry															
Alkalinity as CaCO3, Total (mg/L)	48	99.8	0	48	83.4	0	48	89.2	0	48	102.0	0	48	125.4	0
Bicarbonate as HCO3, Total (mg/L)	48	121.3	0	48	101.5	0	48	108.5	0	48	123.2	0	48	150.7	0
Calcium, Total (mg/L)	36	6.0	0	36	10.3	0	36	15.7	0	36	20.7	0	36	34.7	0
Calcium, Dissolved (mg/L)	8	6.6	0	8	10.6	0	8	17.3	0	8	22.1	0	8	34.1	0
Chloride, Total (mg/L)	48	52.2	0	48	29.3	0	48	21.0	0	48	18.6	0	48	11.1	0
Magnesium, Dissolved (mg/L)	44	0.5	100	44	2.2	0	44	4.1	0	44	5.7	0	44	10.3	0
Potassium, Total (mg/L)	36	7.6	0	36	5.0	0	36	4.1	0	36	3.9	0	36	3.6	0
Potassium, Dissolved (mg/L)	8	8.4	0	8	5.5	0	8	4.0	0	8	3.8	0	8	3.4	0
Sodium, Dissolved (mg/L)	44	76.9	0	44	46.0	0	44	33.9	0	44	30.8	0	44	19.4	0
Sulfate, Total (mg/L)	48	11.8	0	48	8.9	0	48	9.9	0	48	13.1	0	48	29.0	0
Solids/Turbidity															
Dissolved Solids, Total (mg/L)	48	288.5	0	48	194.4	0	48	175.0	0	48	182.3	0	48	205.9	0
Suspended Solids Total (mg/L)	48	13.9	75	48	5.0	100	48	11.0	81	48	7.2	77	48	35.5	31
Turbidity (NTU)	48	5.0	--	48	1.0	--	48	5.9	--	48	5.7	--	48	19.2	--
Metals															
Arsenic, Total (mg/L)	48	0.243	0	48	0.132	0	48	0.092	0	48	0.077	0	48	0.032	0
Cadmium, Total (mg/L)	13	0.000	100	13	0.000	100	13	0.000	100	13	0.000	92	13	0.000	85
Copper, Total (mg/L)	13	0.001	38	13	0.001	92	13	0.001	54	13	0.001	62	13	0.004	0
Iron, Total (mg/L)	13	0.223	0	13	0.082	0	13	0.233	0	13	0.238	0	13	0.902	0
Lead, Total (mg/L)	13	0.001	92	13	0.001	100	13	0.001	92	13	0.001	100	13	0.003	69
Manganese, Total (mg/L)	13	0.035	23	13	0.028	38	13	0.022	77	13	0.035	8	13	0.055	0
Zinc, Total (mg/L)	13	0.005	100	13	0.005	100	13	0.005	100	13	0.005	100	13	0.008	85
Nutrients															
Nitrite-Nitrate, Total (mg/L)	36	0.030	19	36	0.021	56	36	0.036	36	36	0.030	53	36	0.119	8
Nitrite-Nitrate, Dissolved (mg/L)	28	0.036	21	28	0.028	57	28	0.049	29	28	0.040	54	28	0.131	7
Nitrogen, Total (mg/L)	48	0.154	15	48	0.172	4	48	0.188	8	48	0.212	2	48	0.387	0
Phosphorus, Total (mg/L)	48	0.033	0	48	0.029	0	48	0.034	0	48	0.030	0	48	0.062	0
Physicochemical															
Dissolved Oxygen (mg/L)	26	7.5	--	26	8.2	--	26	9.2	--	26	8.5	--	26	8.4	--
Dissolved Oxygen (% Sat)	26	80.9	--	26	88.5	--	26	89.8	--	26	85.8	--	26	82.5	--
pH, Field (s.u.)	48	7.8	--	48	8.0	--	48	8.2	--	48	8.2	--	48	8.3	--
Specific Conductance (µS/cm)	48	400	--	48	279	--	48	264	--	48	286	--	48	327	--

Table 5-1 (cont.): Water quality parameter descriptive statistics from 2007 to 2016 at all stations. N = sample size and % ND = percent of non-detect results.

Parameter	Station 6			Station 7			Station 8			Station 9			Station 10		
	N	Mean	% ND	N	Mean	% ND	N	Mean	% ND	N	Mean	% ND	N	Mean	% ND
Ion Chemistry															
Alkalinity as CaCO3, Total (mg/L)	48	126.5	0	48	127.6	0	48	131.0	0	47	137.0	0	48	139.2	0
Bicarbonate as HCO3, Total (mg/L)	48	153.6	0	48	154.6	0	48	158.1	0	47	164.6	0	48	167.4	0
Calcium, Total (mg/L)	36	35.4	0	36	36.0	0	36	36.2	0	40	38.4	0	39	40.9	0
Calcium, Dissolved (mg/L)	8	36.4	0	8	37.4	0	8	37.8	0	8	39.9	0	9	43.3	0
Chloride, Total (mg/L)	48	9.5	0	48	9.6	0	48	9.5	0	48	8.0	0	48	8.0	0
Magnesium, Dissolved (mg/L)	44	10.4	0	44	10.5	0	44	10.7	0	48	12.7	0	48	13.9	0
Potassium, Total (mg/L)	36	3.3	0	37	3.3	0	36	3.3	0	40	3.0	0	39	3.1	0
Potassium, Dissolved (mg/L)	8	3.3	0	7	3.3	0	8	3.4	0	8	3.0	0	9	3.1	0
Sodium, Dissolved (mg/L)	44	17.7	0	44	17.9	0	44	17.8	0	48	17.5	0	48	17.0	0
Sulfate, Total (mg/L)	48	28.8	0	48	29.8	0	48	30.6	0	48	37.6	0	48	47.1	0
Solids/Turbidity															
Dissolved Solids, Total (mg/L)	48	202	0	48	204	0	48	205	0	48	216	0	48	229	0
Suspended Solids Total (mg/L)	48	5.0	100	48	5.0	100	48	5.0	100	48	20.2	42	48	14.3	46
Turbidity (NTU)	49	2.8	--	48	3.0	--	48	1.9	--	48	12.9	--	48	11.7	--
Metals															
Arsenic, Total (mg/L)	48	0.025	0	48	0.024	0	48	0.024	0	48	0.019	0	48	0.018	0
Cadmium, Total (mg/L)	13	0.000	100	13	0.000	85	13	0.000	92	44	0.000	95	44	0.000	91
Copper, Total (mg/L)	13	0.002	0	13	0.002	8	13	0.002	8	44	0.003	5	44	0.002	5
Iron, Total (mg/L)	13	0.130	23	13	0.126	0	13	0.071	8	44	0.440	0	44	0.338	0
Lead, Total (mg/L)	13	0.002	77	13	0.001	100	13	0.001	100	44	0.004	55	44	0.002	52
Manganese, Total (mg/L)	13	0.032	8	13	0.030	15	13	0.020	54	44	0.027	20	44	0.023	27
Zinc, Total (mg/L)	13	0.005	100	13	0.005	100	14	0.005	100	44	0.005	98	44	0.005	98
Nutrients															
Nitrite-Nitrate, Total (mg/L)	36	0.175	0	36	0.148	3	36	0.113	19	36	0.118	11	35	0.146	0
Nitrite-Nitrate, Dissolved (mg/L)	28	0.191	0	28	0.166	4	28	0.141	14	28	0.157	7	28	0.168	4
Nitrogen, Total (mg/L)	48	0.413	0	48	0.418	0	48	0.394	0	48	0.379	0	48	0.415	0
Phosphorus, Total (mg/L)	48	0.038	0	48	0.041	0	48	0.040	2	48	0.050	0	48	0.046	0
Physicochemical															
Dissolved Oxygen (mg/L)	26	6.9	--	26	8.3	--	26	8.4	--	26	8.6	--	26	8.5	--
Dissolved Oxygen (% Sat)	26	65.9	--	26	80.9	--	26	84.3	--	26	83.1	--	26	82.5	--
pH, Field (s.u.)	49	8.0	--	48	8.2	--	48	8.3	--	48	8.2	--	48	8.3	--
Specific Conductance (µS/cm)	49	324	--	48	328	--	48	331	--	48	348	--	48	373	--

Longitudinal patterns in water quality conditions are presented in the following box plots that identify the median concentration for each parameter (center bar) and data distribution (25^{th} & 75^{th} percentiles [box], and the 10^{th} & 90^{th} percentiles [whiskers]). These figures illustrate the spatial distributions of data from Station 1 (Upstream of Hebgen Lake) to Station 10 (Downstream of Great Falls Dams) for each 10-year period.

5.1.1.1 Ion Chemistry

The carbonate and bicarbonate concentrations at Station 1 have typically been approximately 100 mg/L and 120 mg/L, respectively, over the long-term and as streamflow passes through Hebgen Lake concentrations decrease by approximately -22 % (Figure 5-2and Figure 5-3). The lake acts as a sink for inorganic carbon, although concentrations gradually increase in a downstream pattern due to watershed sources. At Station 5, downstream of the Three Forks confluence reach, the carbonate and bicarbonate concentrations steps up due to the influence of the other source waters. From Station 5 downstream to Station 10 concentrations remain relatively constant with little change between sites that bracket hydroelectric facilities. Carbonate and bicarbonate concentrations in the Madison River have shown little change between the two periods, but concentrations in the Missouri River have shown a -5 to -7 % decrease for the last ten-year period.

Calcium and magnesium concentrations are the lowest at Station 1, near detection limits, and gradually increase through Station 4, then notably steps up in concentrations at Station 5 downstream of the Three Forks confluence reach (Figure 5-4 and Figure 5-5 and Figure 5-7). Concentrations remain relatively constant from Station 5 through Station 10, with the last station exhibiting the highest concentration (~40 mg/L). Total calcium concentrations in the Madison River have shown little change between the two periods, but concentrations in the Missouri River have shown a -4 to -6 % decrease for the last ten-year period.

Chloride, potassium and sodium all exhibit the highest concentration at Station 1 and gradually decrease by Station 4, at which point the streamflow concentrations remain relatively constant, near the detection limits (Figure 5-6, Figure 5-8, Figure 5-9, and Figure 5-10). Chloride (+4 to 10 %) and sodium (+9 to 16 %) concentrations in the Madison River have shown an increase over the last ten-year period, while decreasing by up to -16 % in the Missouri River. This pattern of increase in sodium and chloride may be attributed to changes in highway management practices and the increase in road salting that has been in observed many regions of the U.S. (Corsi et al. 2015, GEI 2015, Fallon and Chaplin). This trend was also documented in a Colorado Department of Transportation Report that attributed the increasing chloride concentrations in many front-range Colorado watersheds to the use of road de-icing agents. The USGS study (Corsi et al. 2015) noted that chloride concentrations have outpaced the urbanization rate in many watersheds and that the de-icing agents used in winter time are likely stored in the shallow alluvium and slowly released throughout the year.

Sulfate concentrations are relatively low (~12 mg/L) in Madison River, and notably increase downstream of the Three Forks confluence at Station 5 (Figure 5-11). Sulfate concentrations remain relatively constant at 30 mg/L downstream to Station 8, and begin to gradually increase at stations 9 and 10 where the typical concentration is approximately 50 mg/L. Total sulfate concentrations in both the Madison and Missouri rivers have shown a decrease between the two periods, ranging between -7 and -13 % change.

Figure 5-2: Longitudinal pattern for total alkalinity grouped by 10-year periods for each station.

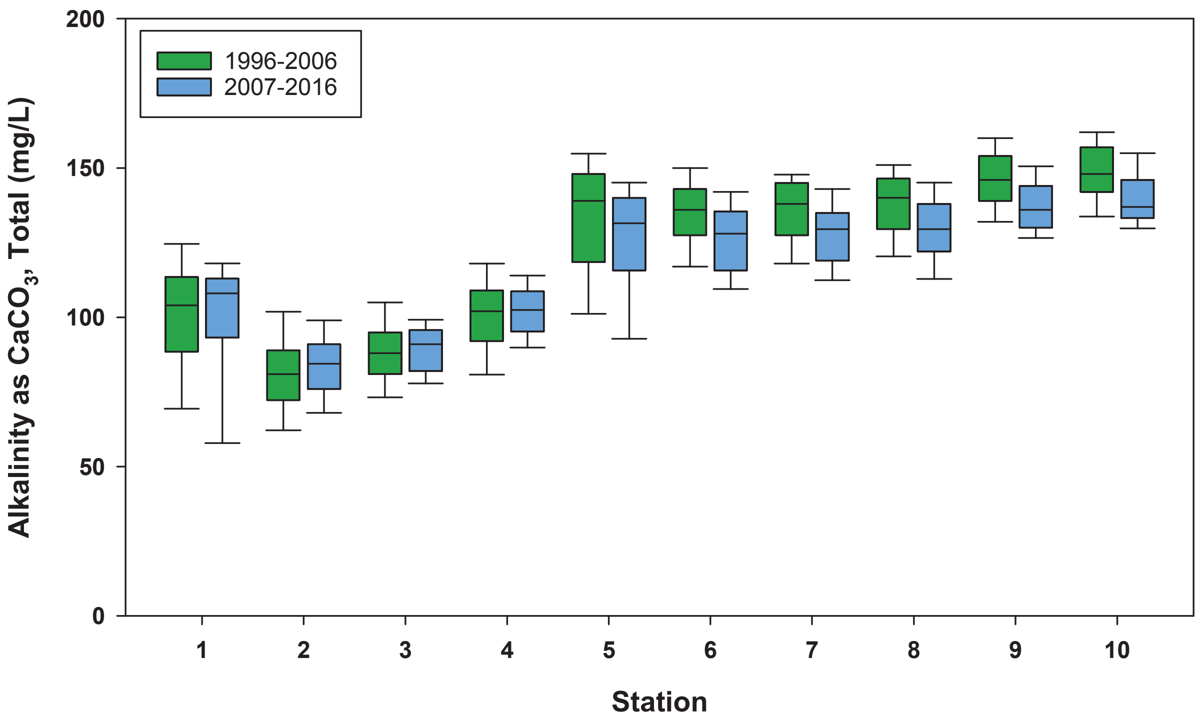


Figure 5-3: Longitudinal pattern for total bicarbonate grouped by 10-year periods for each station.

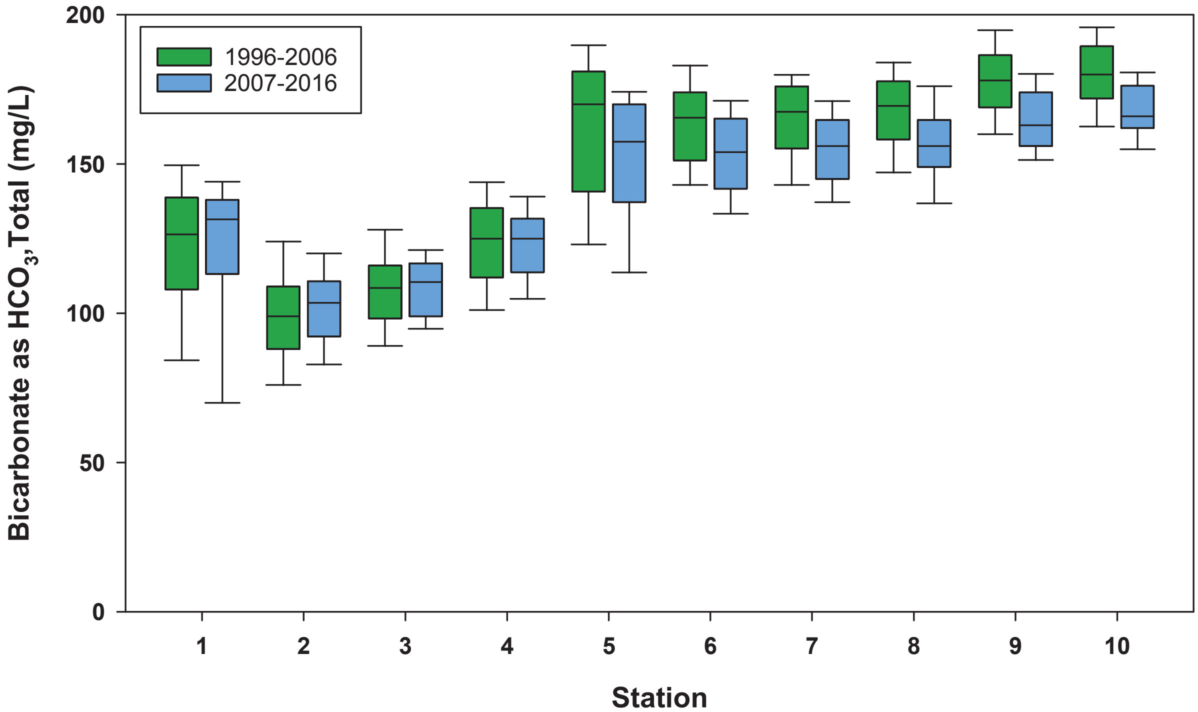


Figure 5-4: Longitudinal pattern for total calcium grouped by 10-year periods for each station.

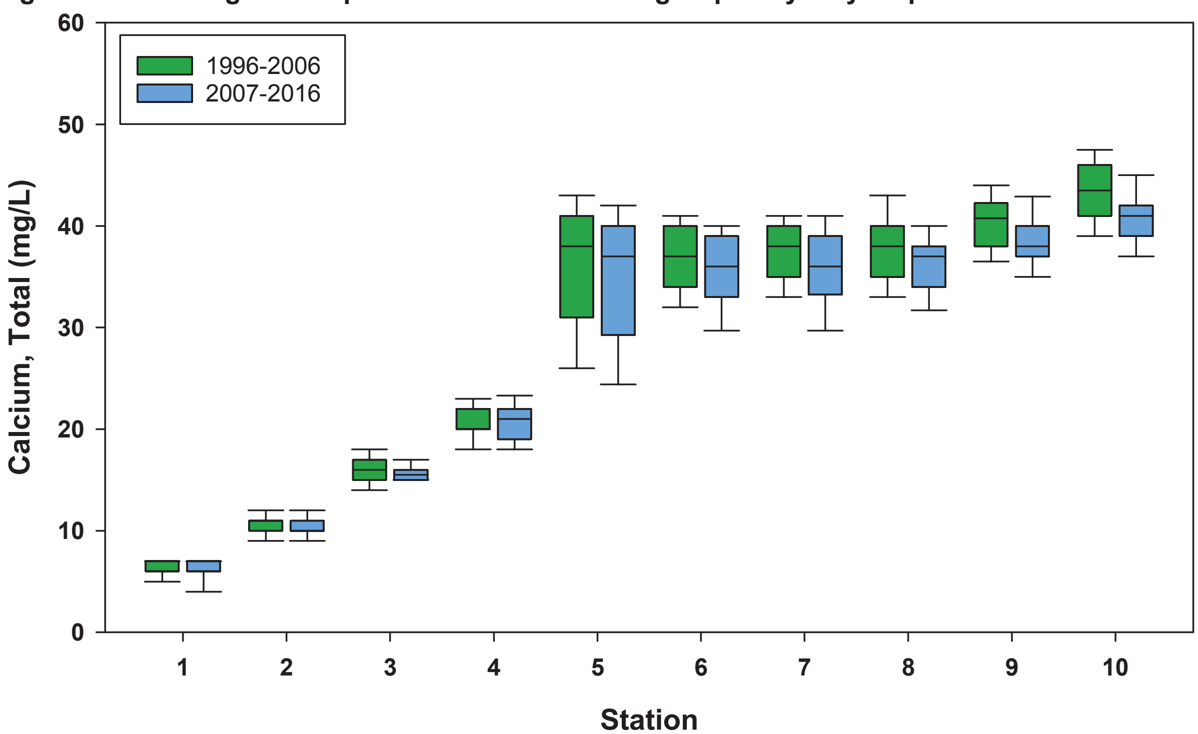


Figure 5-5: Longitudinal pattern for dissolved calcium grouped by 10-year periods for each station.

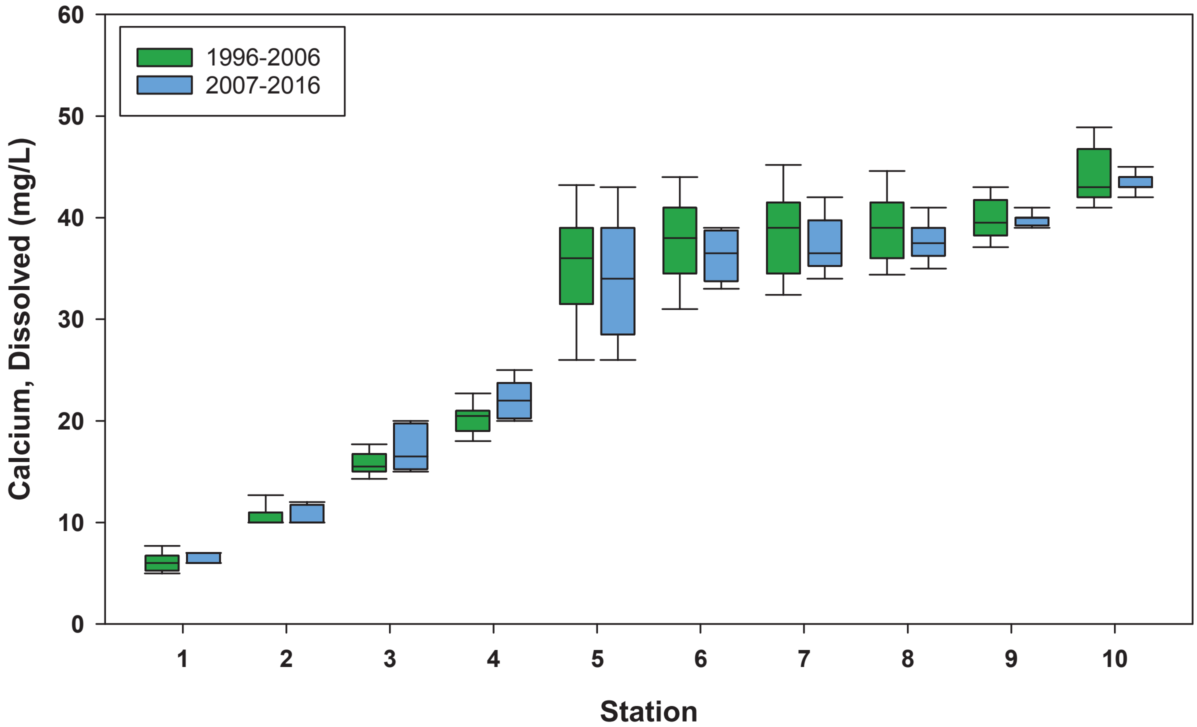


Figure 5-6: Longitudinal pattern for total chloride grouped by 10-year periods for each station.

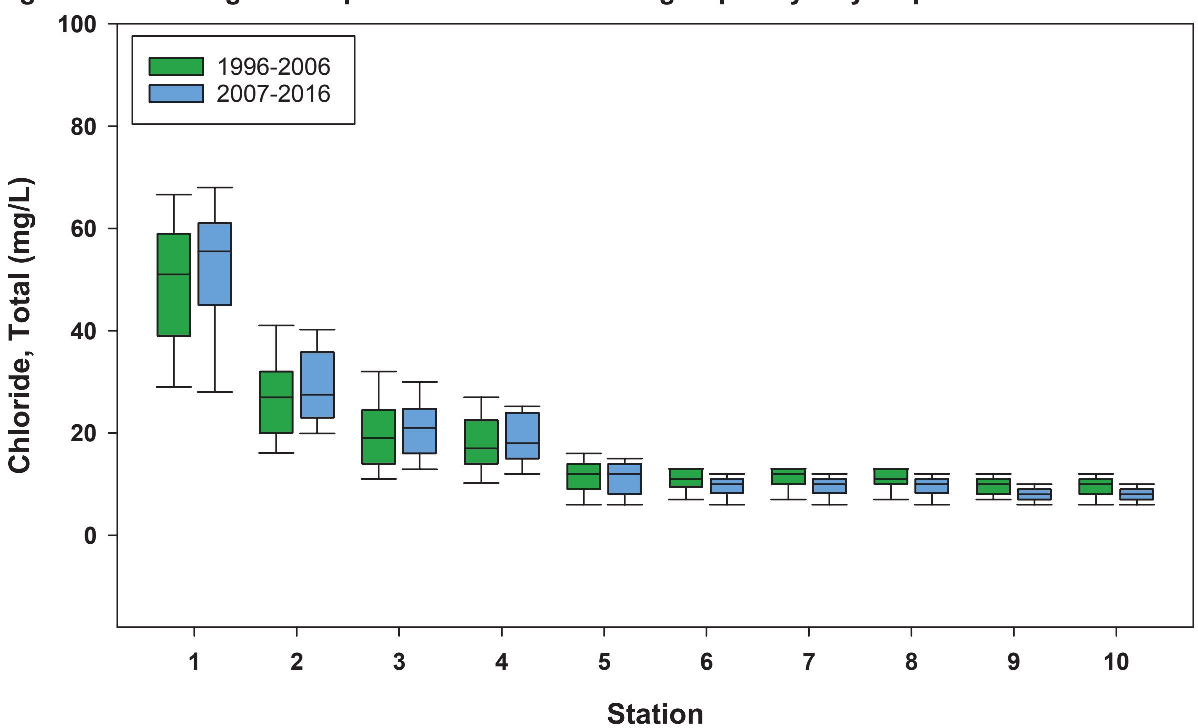


Figure 5-7: Longitudinal pattern for dissolved magnesium grouped by 10-year periods for each station.

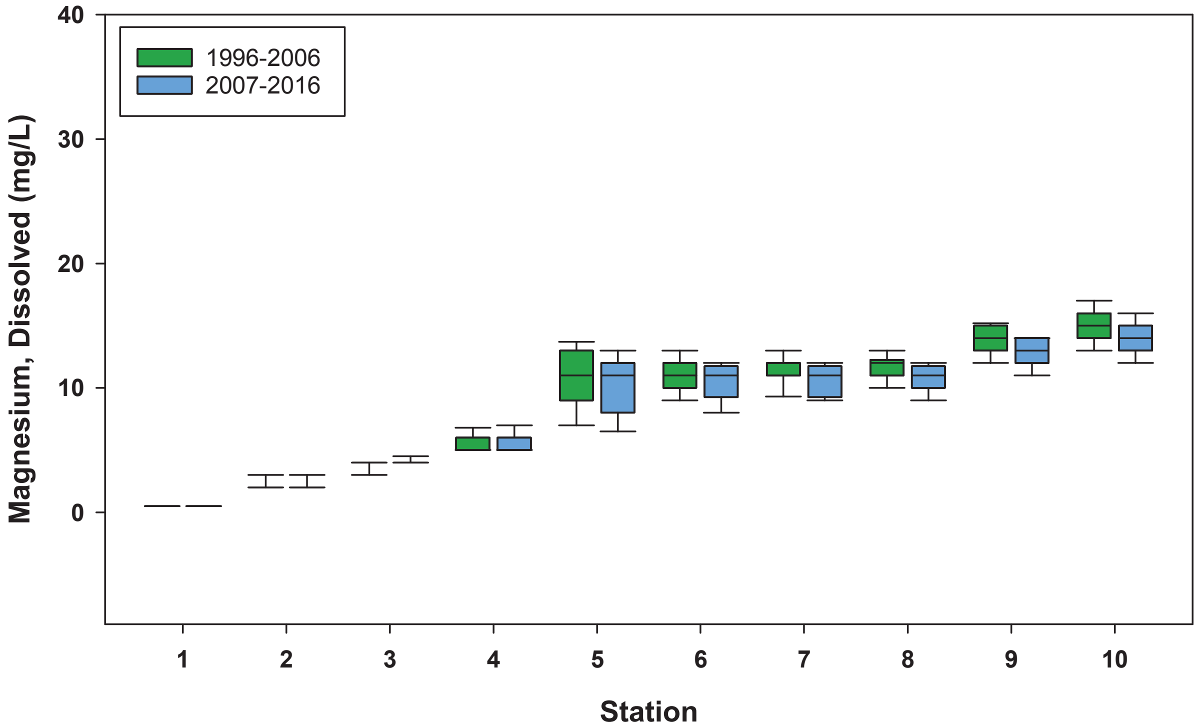


Figure 5-8: Longitudinal pattern for total potassium grouped by 10-year periods for each station.

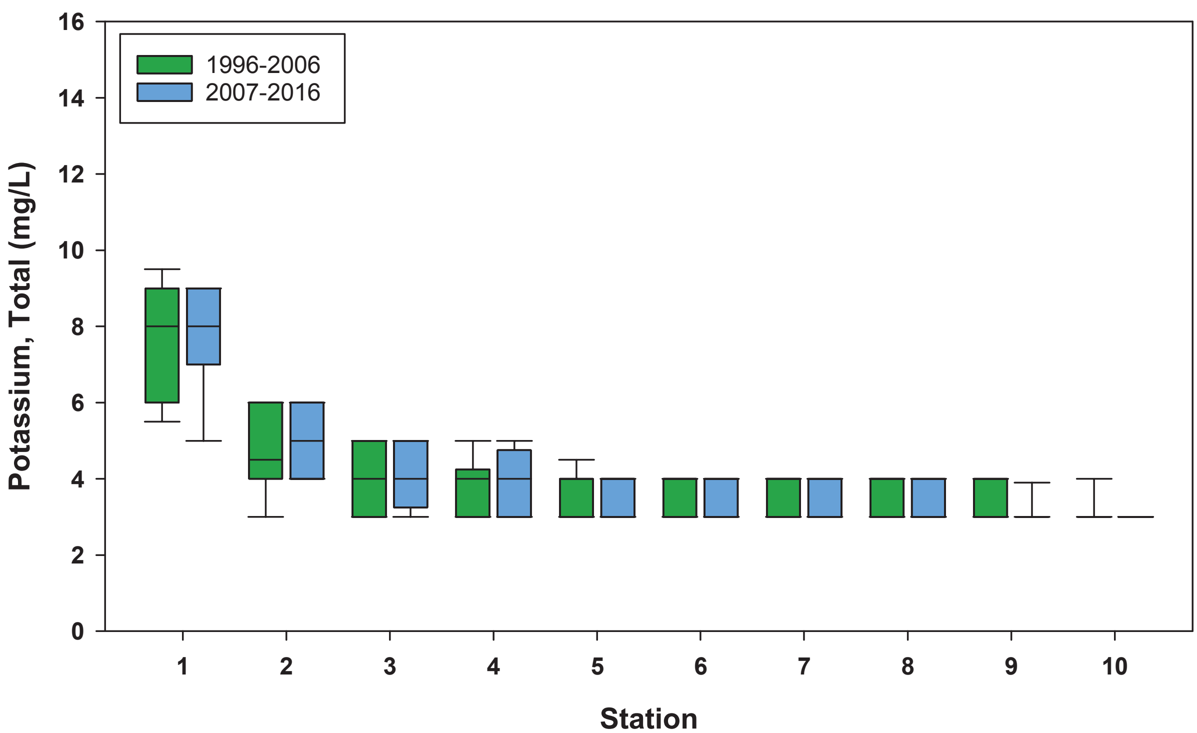


Figure 5-9: Longitudinal pattern for dissolved potassium grouped by 10-year periods for each station.

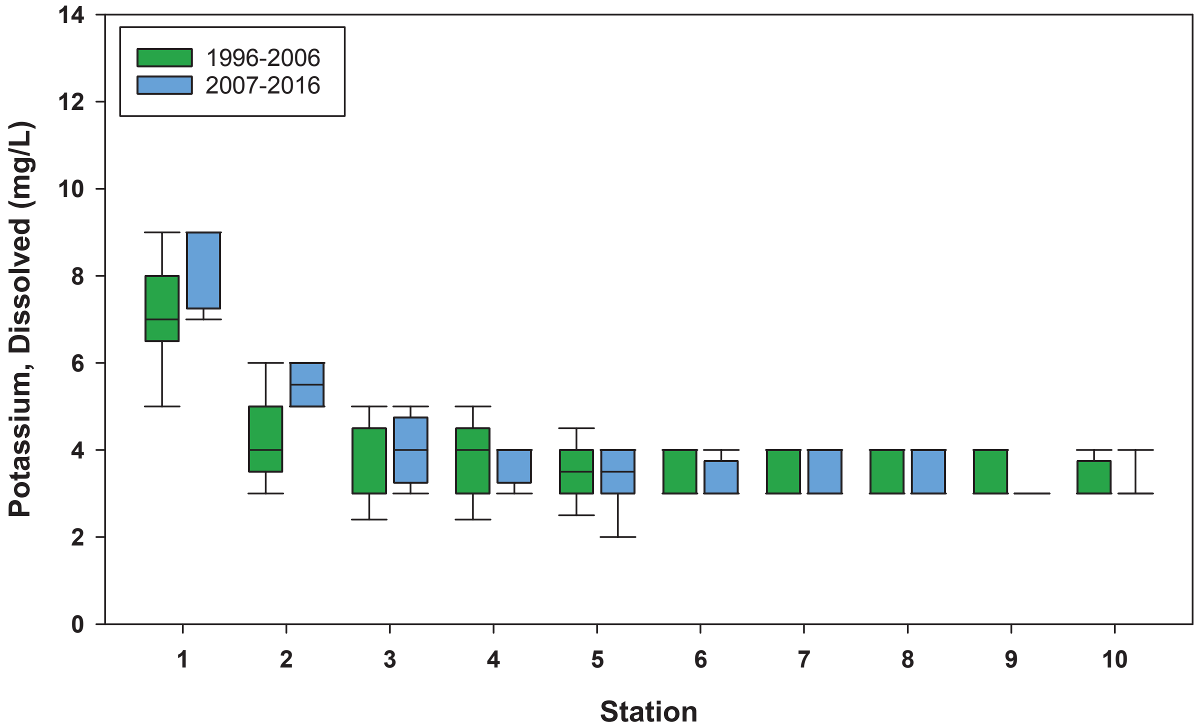


Figure 5-10: Longitudinal pattern for dissolved sodium grouped by 10-year periods for each station.

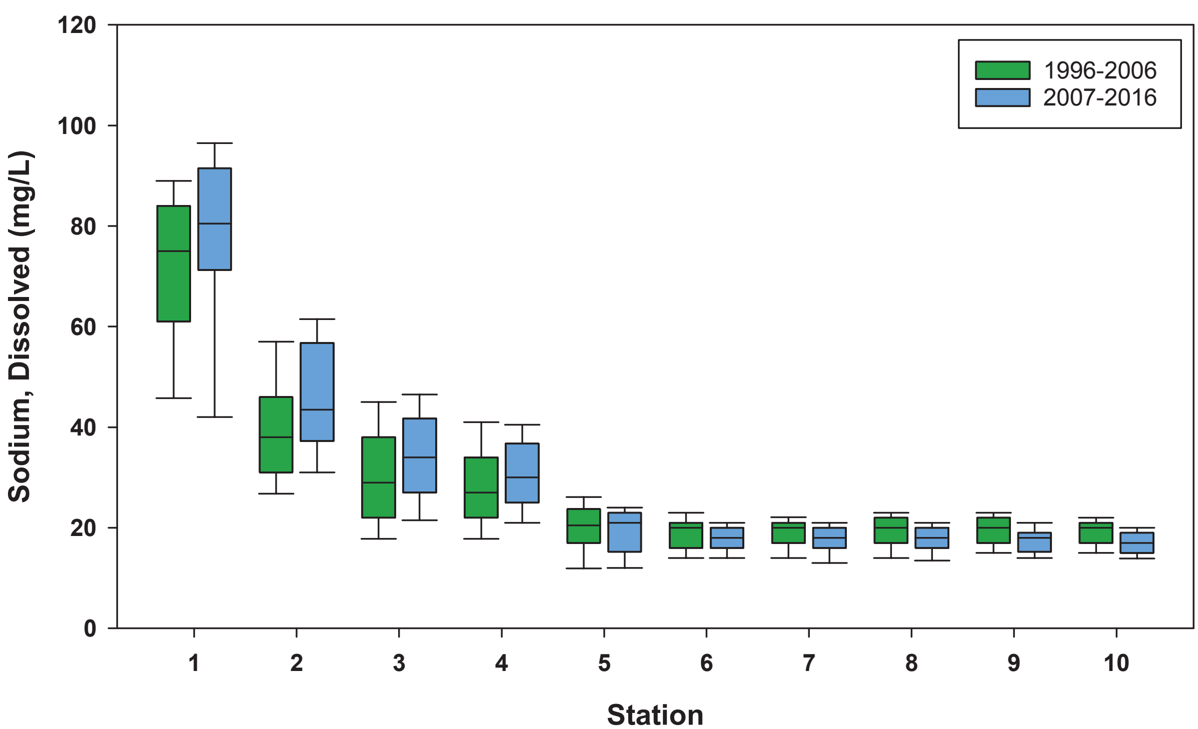
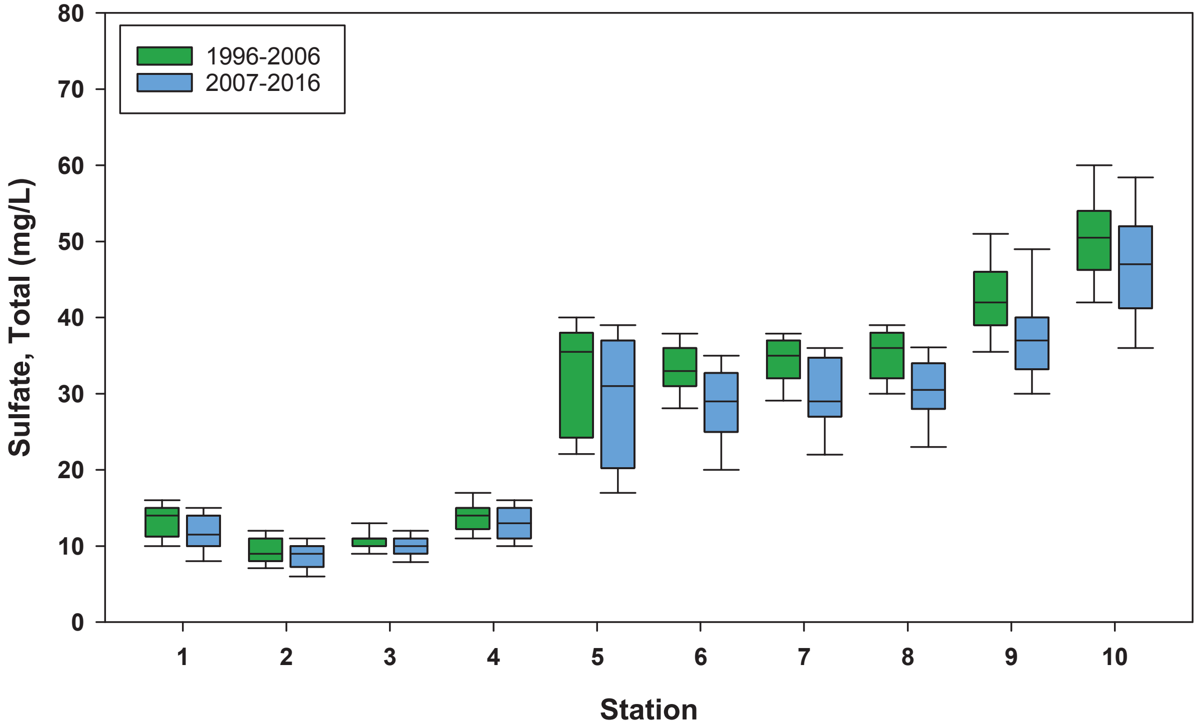


Figure 5-11: Longitudinal pattern for total sulfate grouped by 10-year periods for each station.



5.1.1.2 Solids/Turbidity

The total dissolved solids concentrations are the highest at Station 1 (300 mg/L) and reflect the geothermal influence on ion chemistry as noted above for certain parameters. As streamflow passes through Hebgen Lake, the dissolved solids concentration is reduced by -38 % and remains relative constant through the Madison River sites (Figure 5-12). An increase in total dissolved solids is observed at Station 5, downstream of the Three Forks confluences, and remains relatively constant through Station 10 where the typical concentration is 230 mg/L. Total dissolved solids concentrations in the Madison River have shown little change between the two periods, although concentrations for the Missouri River stations have shown a -5 % decrease for the last ten-year period. Measurable amounts of total suspended solids are typically reported for stations 1, 5, 9, and 10 while results are typically less than the detection limits for the remaining stations (Figure 5-13). Hebgen Lake and Canyon Ferry greatly reduce the solids content in streamflow which is also evident in the water clarity (turbidity) measurements for stations 2 and 6 (Figure 5-14). Turbidity generally increases in the Madison River in a downstream fashion and peaks at Station 5 (~20 NTU). Turbidity remains relatively low through stations 7 and 8, and notably increases in streamflow upstream of the Great Falls. Total suspended solids and turbidity have remained relatively constant for both 10-year periods.

Figure 5-12: Longitudinal pattern for total dissolved solids grouped by 10-year periods for each station.

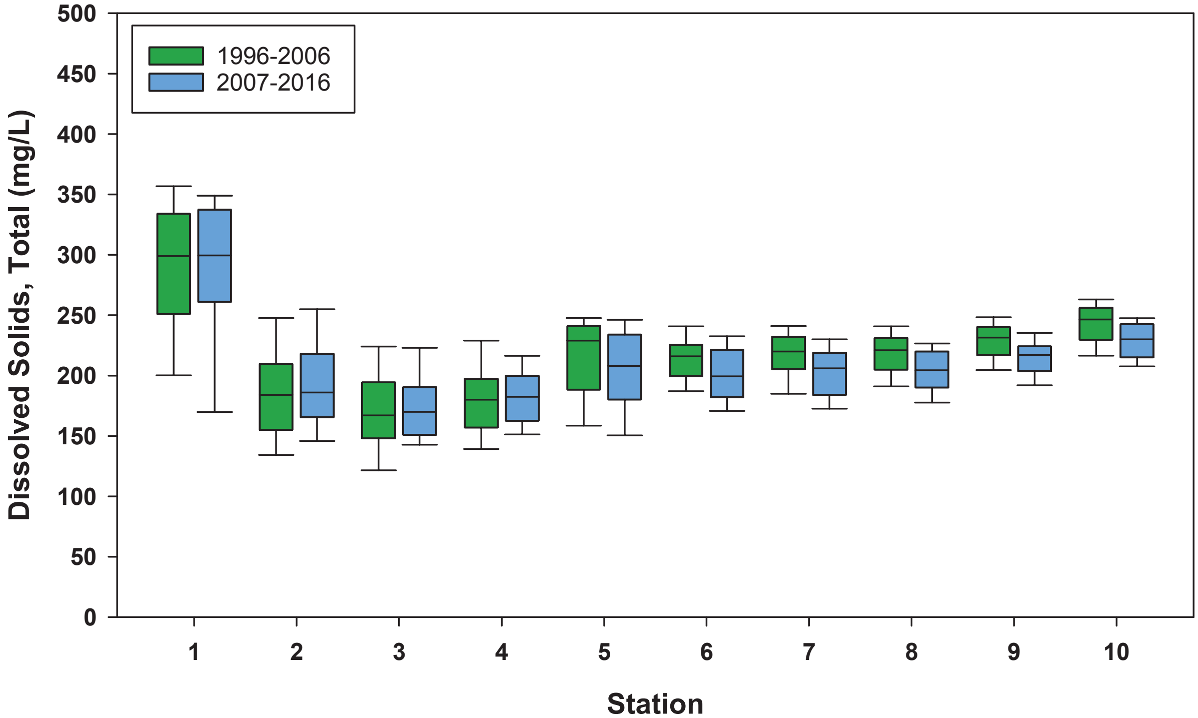


Figure 5-13: Longitudinal pattern for total suspended solids grouped by 10-year periods for each station.

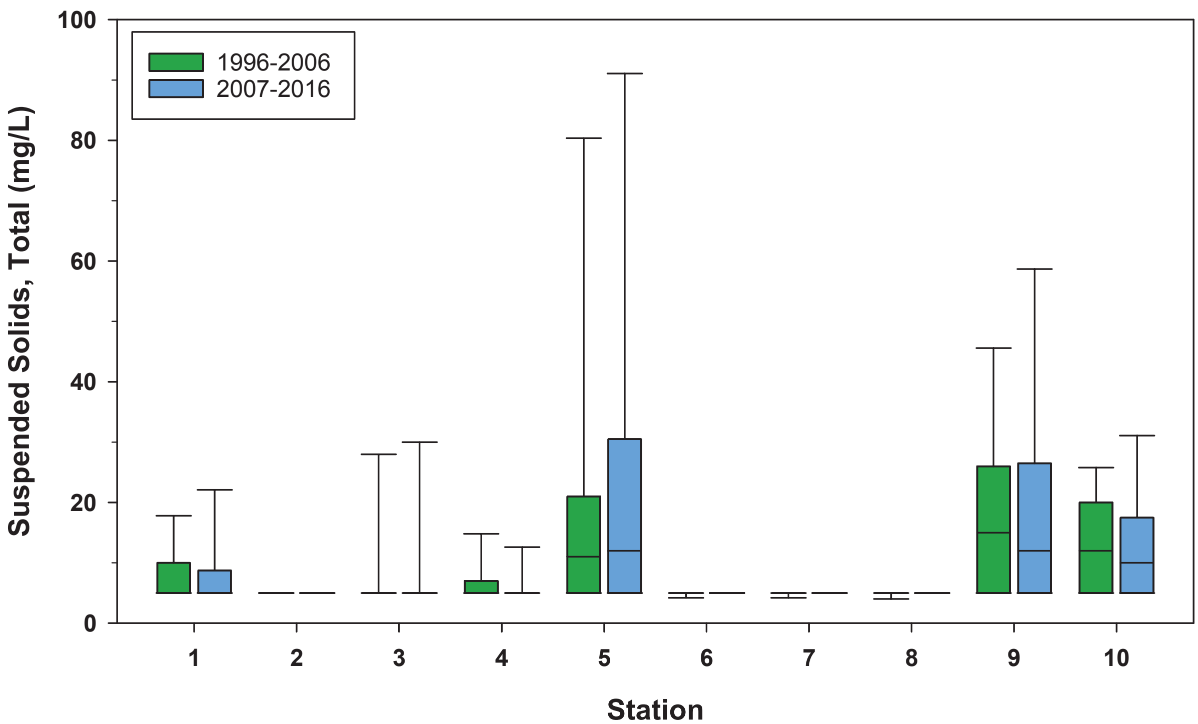
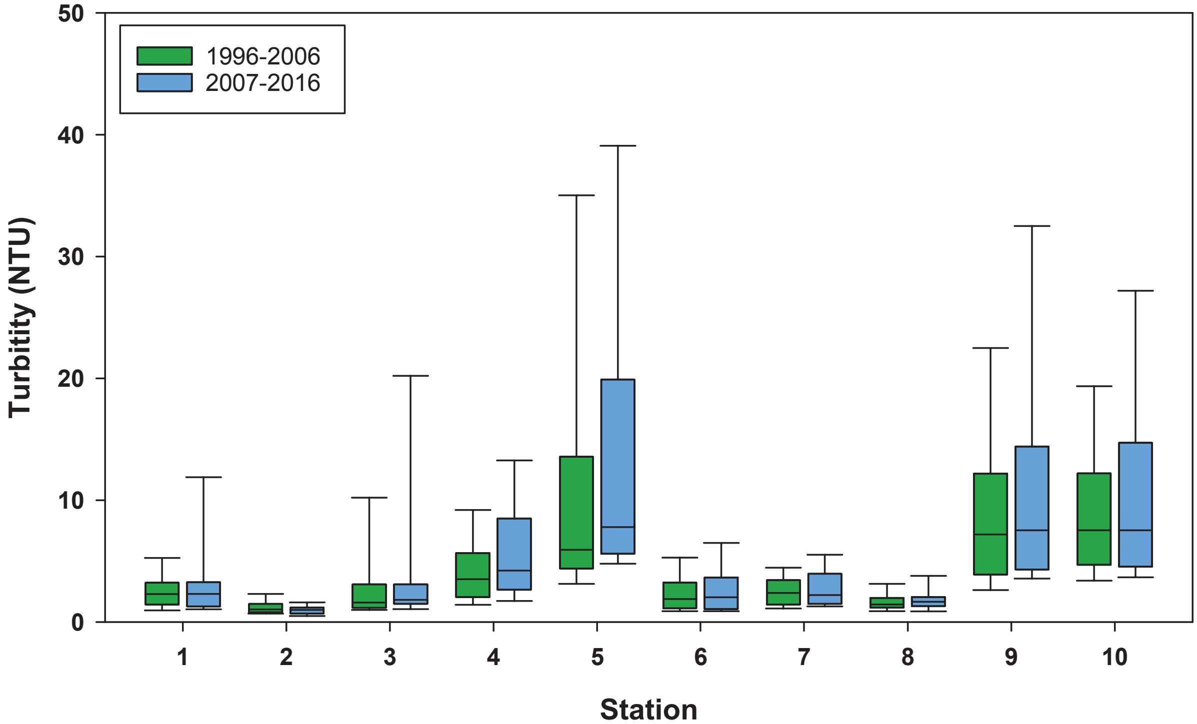


Figure 5-14: Longitudinal pattern for turbidity grouped by 10-year periods for each station.



5.1.1.3 Metals

Total arsenic is routinely measured at all sites due to the geothermal influence from the headwaters of the Madison River. Mean arsenic concentrations are the highest at Station 1 (0.24 mg/L) and exhibit a decreasing pattern in concentrations through the Madison River Stations (Figure 5-15). This decreasing pattern is attributed to the sorption potential with suspended solids that converts arsenic from an aqueous phase to solid phase (Nimick et al. 1998). Arsenic concentrations notably decrease downstream of the Three Forks confluence due to the increased dilution potential that the Jefferson and Gallatin rivers provide. Arsenic concentrations are further reduced downstream of Canyon Ferry and remain relatively constant through Station 10 where concentrations represent a 10-fold decrease from Station 1. Total arsenic concentrations in the Madison River, and upstream of Canyon Ferry, have increased approximately +10 % during the last 10-year period, which is attributed to the decreased streamflow. However, concentrations in the Missouri River, downstream of Canyon Ferry, have decreased by approximately -11 % for the last ten-year period.

Total copper, total iron, and total manganese were the only other parameters that generally exhibited detectable concentrations at multiple stations along the Madison and Missouri rivers (Figure 5-17, Figure 5-18, and Figure 5-20). Notably, stations 9 and 10 are the only stations currently sampled under the 2011 SAP, although all stations were sampled in 2008 and 2011. Measured concentrations for these parameters were slightly above detection limits. Concentrations for total cadmium, total lead, and total zinc were generally less than detection limits (Figure 5-16, Figure 5-19, and Figure 5-21).

Figure 5-15: Longitudinal pattern for total arsenic grouped by 10-year periods for each station.

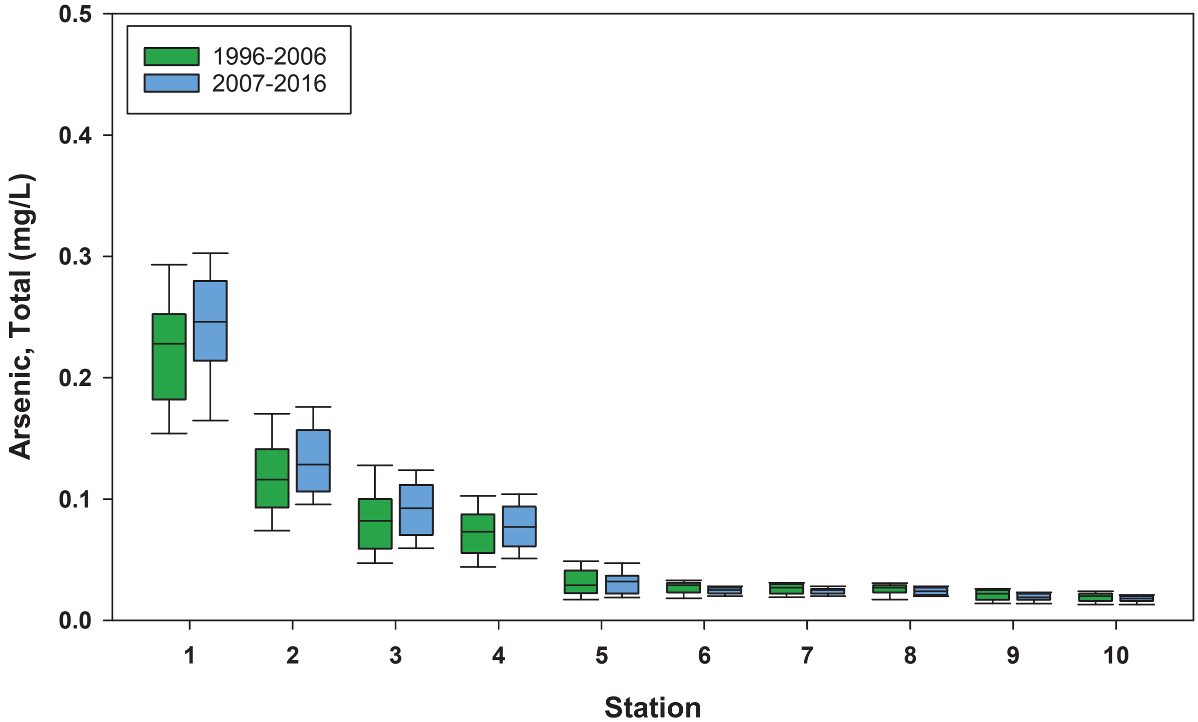


Figure 5-16: Longitudinal pattern for total cadmium grouped by 10-year periods for each station.

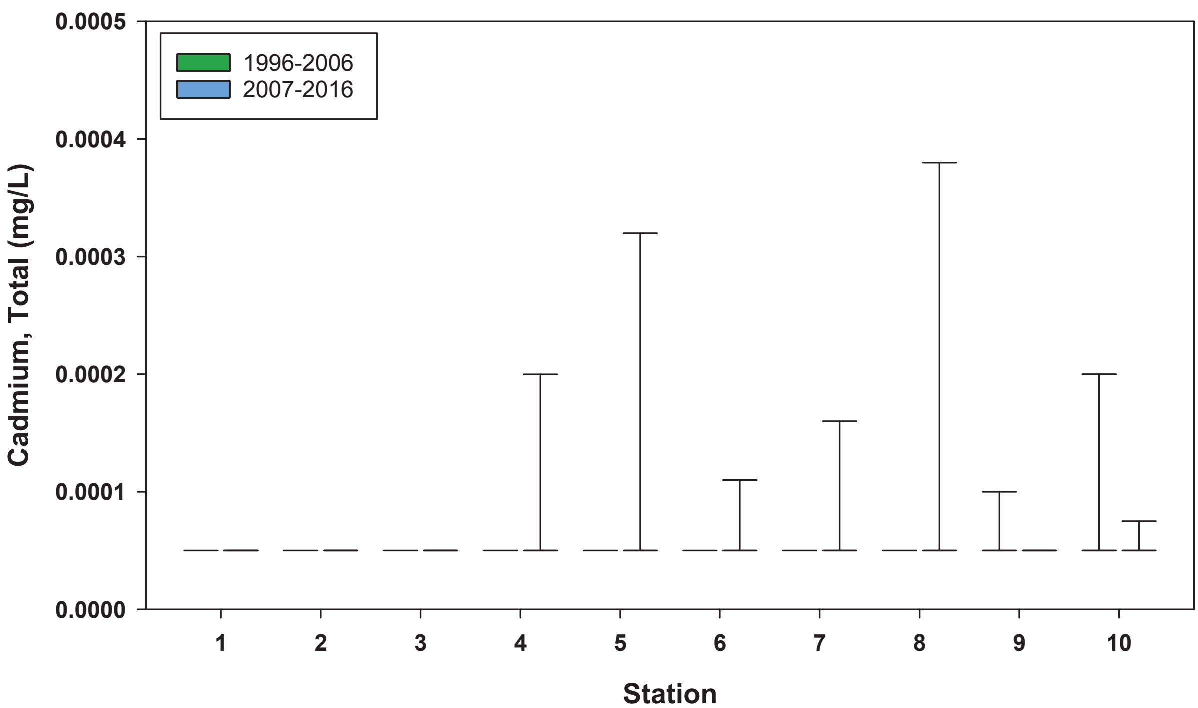


Figure 5-17: Longitudinal pattern for total copper grouped by 10-year periods for each station.

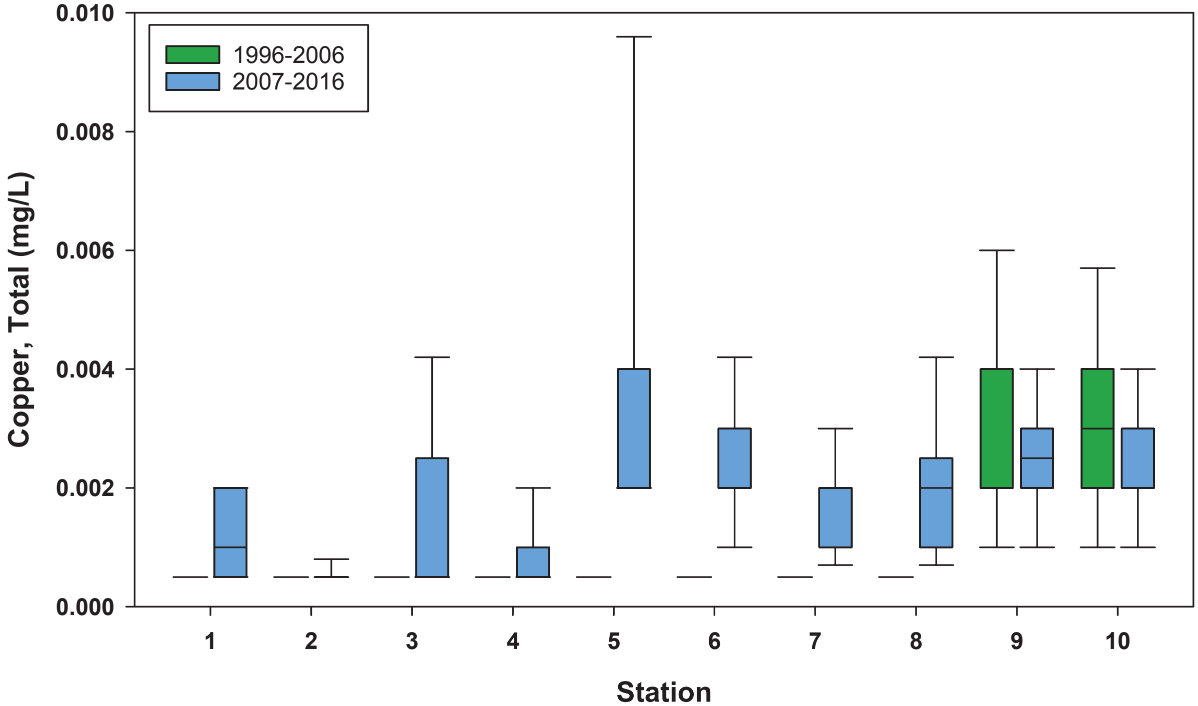


Figure 5-18: Longitudinal pattern for total iron grouped by 10-year periods for each station.

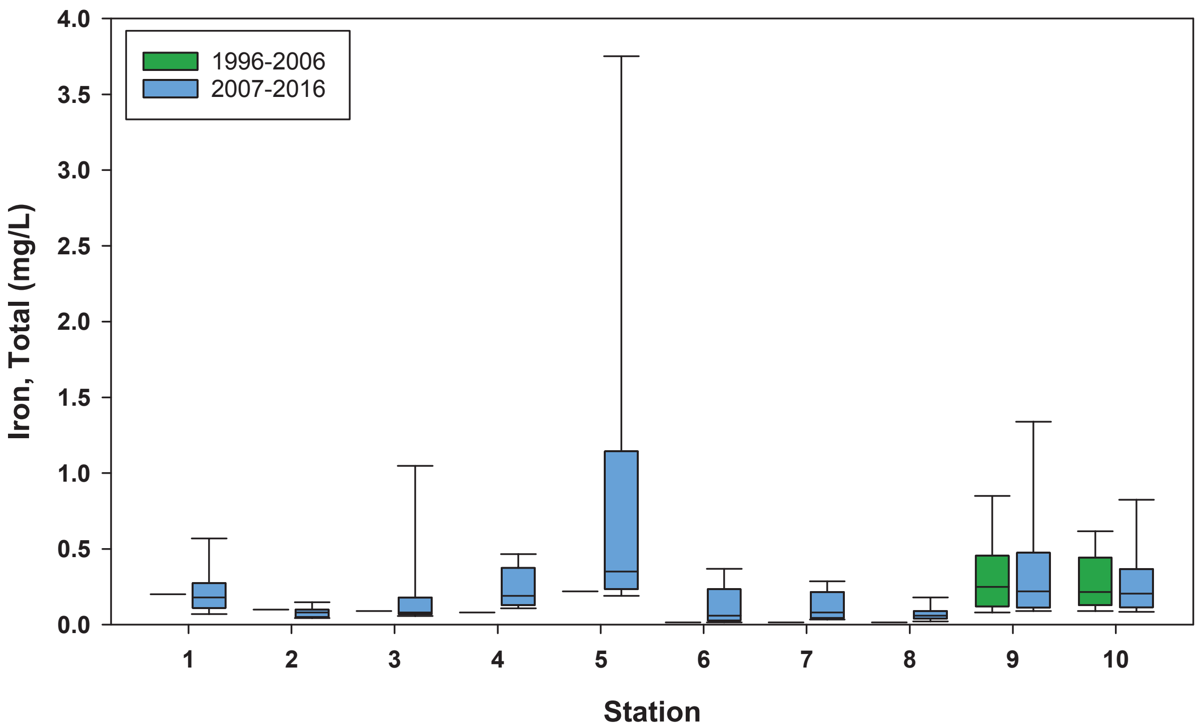


Figure 5-19: Longitudinal pattern for total lead grouped by 10-year periods for each station.

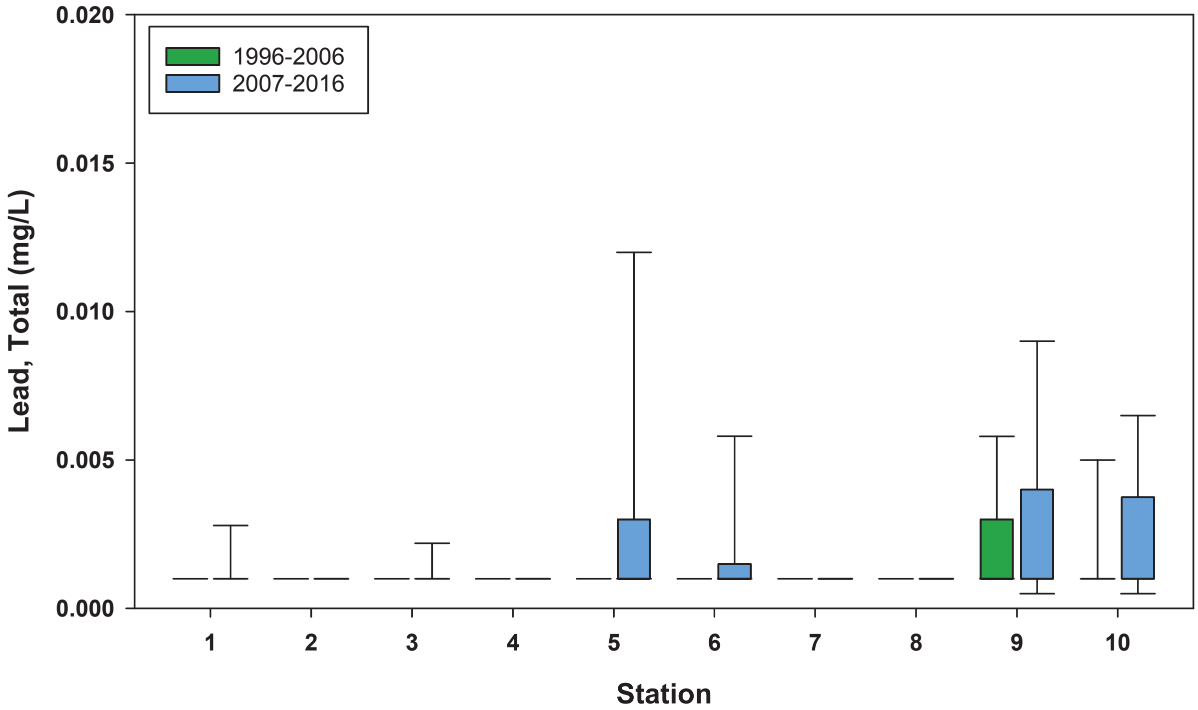


Figure 5-20: Longitudinal pattern for total manganese grouped by 10-year periods for each station.

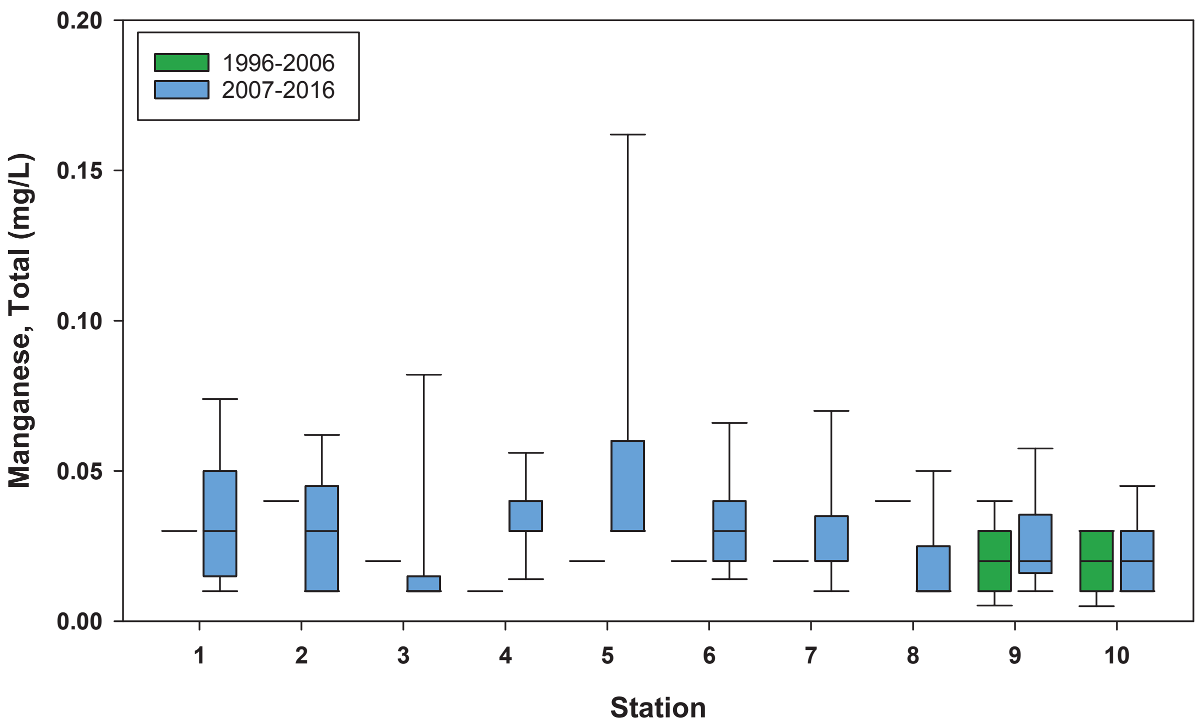
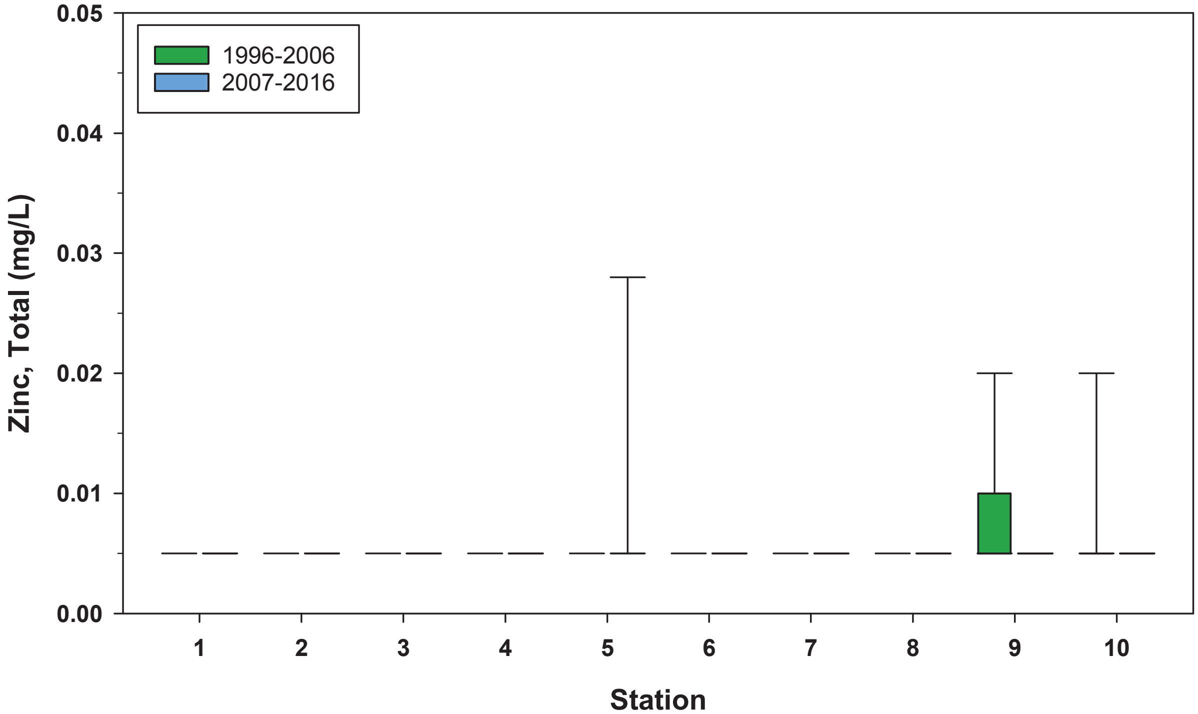


Figure 5-21: Longitudinal pattern for total zinc grouped by 10-year periods for each station.



5.1.1.4 Nutrients

The mean total nitrogen concentration typically ranged from 0.1 to 0.2 mg/L in the Madison River and notably increased in the Missouri River remaining relatively consistent at 0.4 mg/L from Station 5 through Station 10 (Figure 5-22). Total nitrogen concentrations in the Madison River have indicated a +30 % increase between the two 10-year periods, while concentrations in the Missouri River have increased between +27 and 67 % depending on the station location. Nitrite-nitrate concentrations revealed similar patterns in concentrations for both the Madison and Missouri river stations (Figure 5-23 and Figure 5-24).

The mean total phosphorus concentration was approximately 0.03 mg/L in the Madison River, and while there was a slight increase in concentrations for the Missouri River, the mean concentration remained less than 0.06 mg/L. The variability in total phosphorus concentrations was notably greater at Station 5, yet remained relatively consistent for stations further downstream (Figure 5-25).

Figure 5-22: Longitudinal pattern for total nitrogen grouped by 10-year periods for each station.

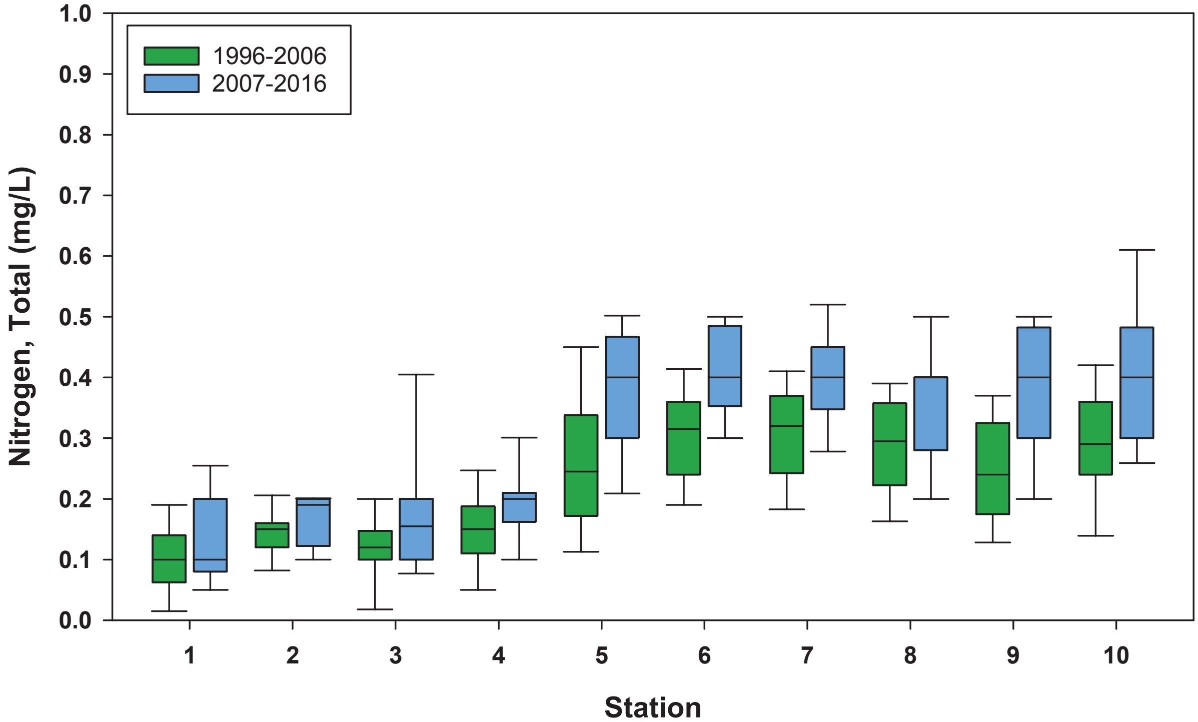


Figure 5-23: Longitudinal pattern for total nitrite-nitrate grouped by 10-year periods for each station.

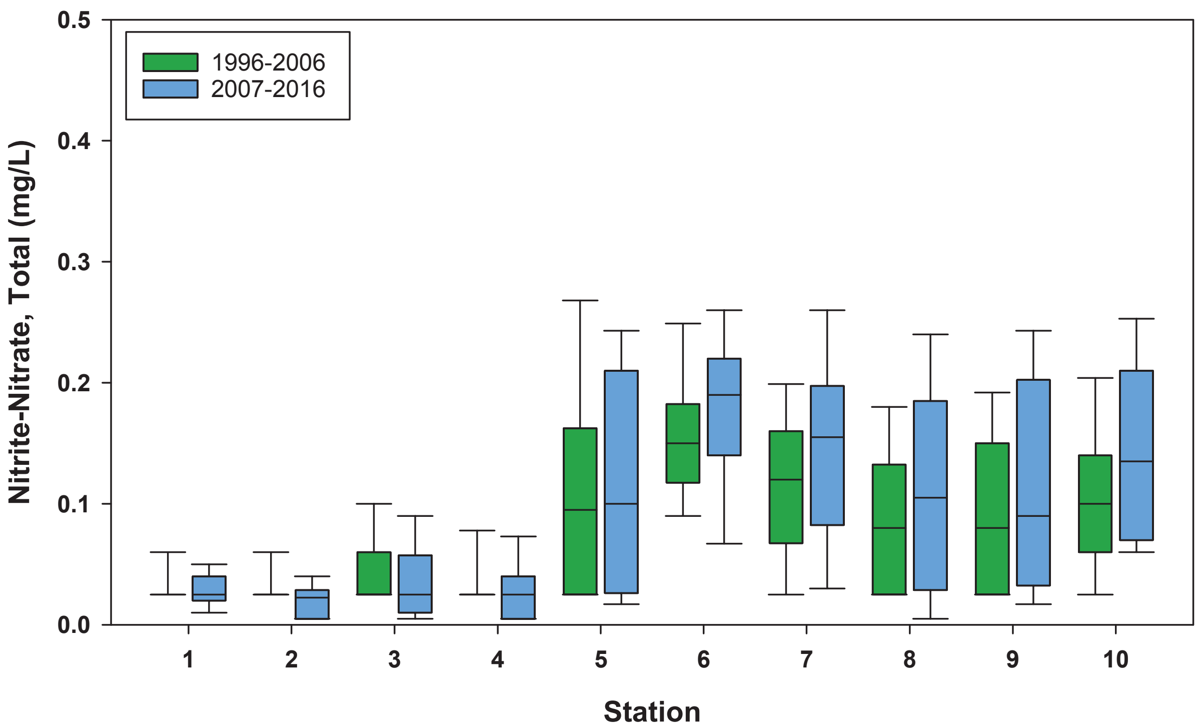


Figure 5-24: Longitudinal pattern for dissolved nitrite-nitrate grouped by 10-year periods for each station.

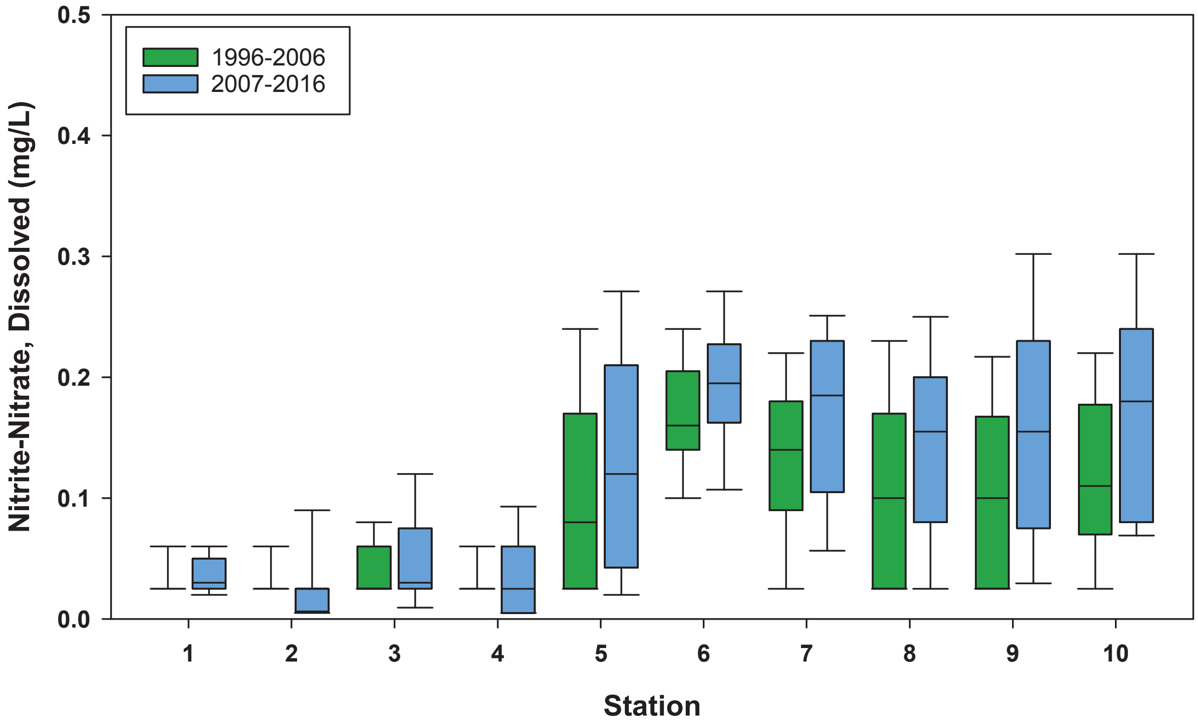
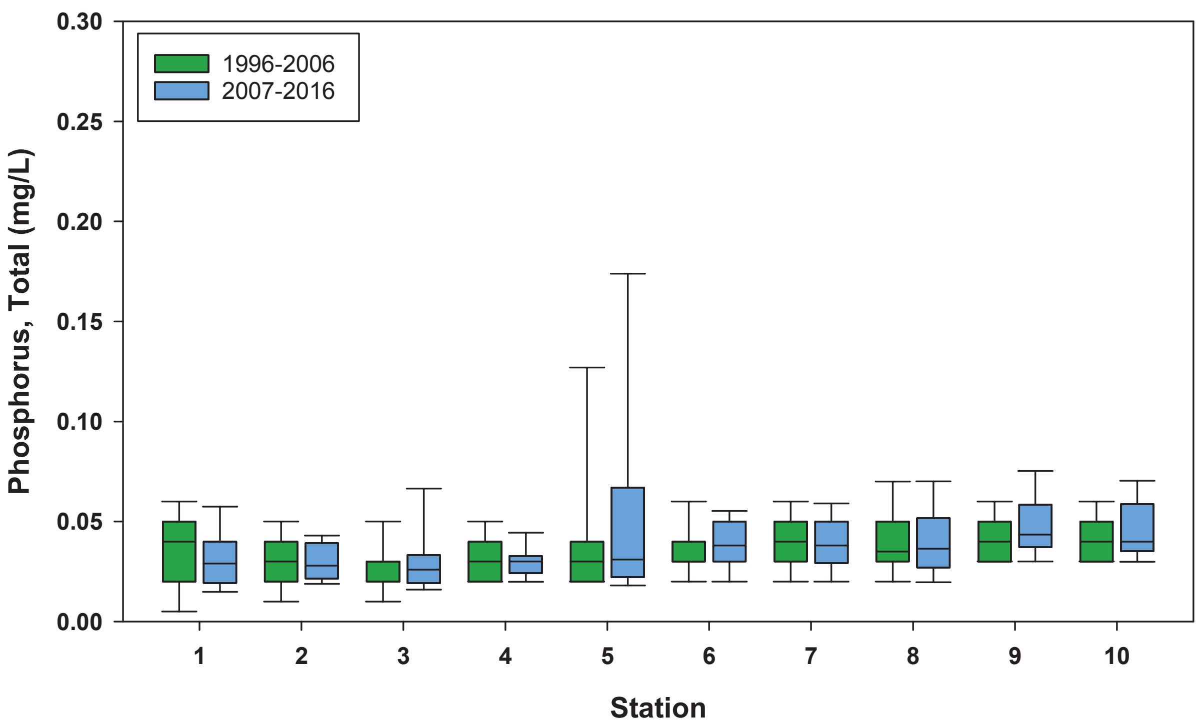


Figure 5-25: Longitudinal pattern for total phosphorus grouped by 10-year periods for each station.



5.1.1.5 Physicochemical

Dissolved oxygen concentrations revealed an increasing pattern from Station 1 through Station 3 in the Madison River, and decreased slightly at Station 4 and remained consistent through Station 5 in the Missouri River (Figure 5-26 and Figure 5-27). Station 6, immediately downstream of Canyon Ferry Dam, revealed the lowest mean dissolved oxygen concentration (6.9 mg/L, 66 percent saturation) for the 10-year period, while stations further downstream revealed conditions similar to Station 5 which represents background for the Missouri River. The dissolved oxygen conditions in both the Madison and Missouri rivers are discussed in more detail in Section 5.1.7.

The mean hydrogen ion concentrations (pH) varied little throughout the study reach and were the lowest at Station 1 (7.8 s.u.) and were less than 8.3 s.u. for all stations further downstream (Figure 5-28). Notably, the mean pH was relatively consistent between stations 4 and 5 that bracket the Three Forks confluence reach. The mean specific conductance was greatest at Station 1 (400 µS/cm) and decreased notably as flows passed through Hebgen Lake (Figure 5-29). Specific conductance levels remained relatively consistent through Station 4 and increased by +18 % downstream of the Three Forks confluence reach. Specific conductance levels remained relatively consistent through Stations 6, 7, and 8, and slightly increased at stations 9 and 10, near Great Falls. In the Madison River, specific conductance has increased by approximately +5 % for the last 10-year period, while levels have decreased in the Missouri River by approximately -5 %.

Many of the patterns in the water quality data are closely associated with flow conditions. For example, the increase in specific conductance, as noted for the Madison River stations, is closely tied to the decrease in flow conditions observed during the last 10-year period which have a concentrating effect on this parameter. As to be expected, based on the increasing watershed size upstream of each station, daily mean flows over the 10-year period increased from Station 1 (408 cfs) to Station 10 (5,680 cfs) with the Jefferson and Gallatin rivers increasing the 10-year median flow by 2,160 cfs (Figure 5-30). In the Madison River, the median flow conditions for the last 10-year period have decreased by -12 % at stations 1 and 2, and by -5 % at Station 4, whereas, the median flow conditions in the Missouri River have increased by +2 % for stations 5 through 8, and +5 % in the last two stations. The influence of Jefferson, Gallatin, and Sun river watersheds have provided more flow during the last 10-year period as compared to the upper Madison watershed.

The variability in flow conditions (2007-2016) at each station have not been as great as observed during the 1996-2006 period which exhibited more extreme low and high flow conditions. The median annual flow was calculated for stations 1 and 5 (1996-2016), and ranked from lowest to highest to evaluate the relative flow conditions based on the commonly used wet year type (i.e., >75th percentile flow), dry year type (<25th percentile flow) and the typical flow conditions that range from the 25th to the 75th percentile flow. Based on Station 1's median annual flow condition for each year of the monitoring program (1996-2016), the first 10-year period contained all 5 wet year types, 2 of the 5 dry year types, and 4 of the 11 years that would be characterized as typical flow conditions. Whereas the last 10-year period contained 3 of the 5 dry year types, and 7 of the 11 typical flow years. Similarly, at Station 5, the first 10-year period contained 4 of the 5 wet year types, all 5 dry year types, and 2 of the 11 typical flow years, while the last 10-year period contained 1 of the 5 wet year types and 9 of 11 typical flow years. The flow conditions during the last 10-year period are characterized as being more typical of the monitoring period and not exhibiting the extremes as noted during the first 10-year period (PBS&J 2011).

Figure 5-26: Longitudinal pattern for dissolved oxygen grouped by 10-year periods for each station.

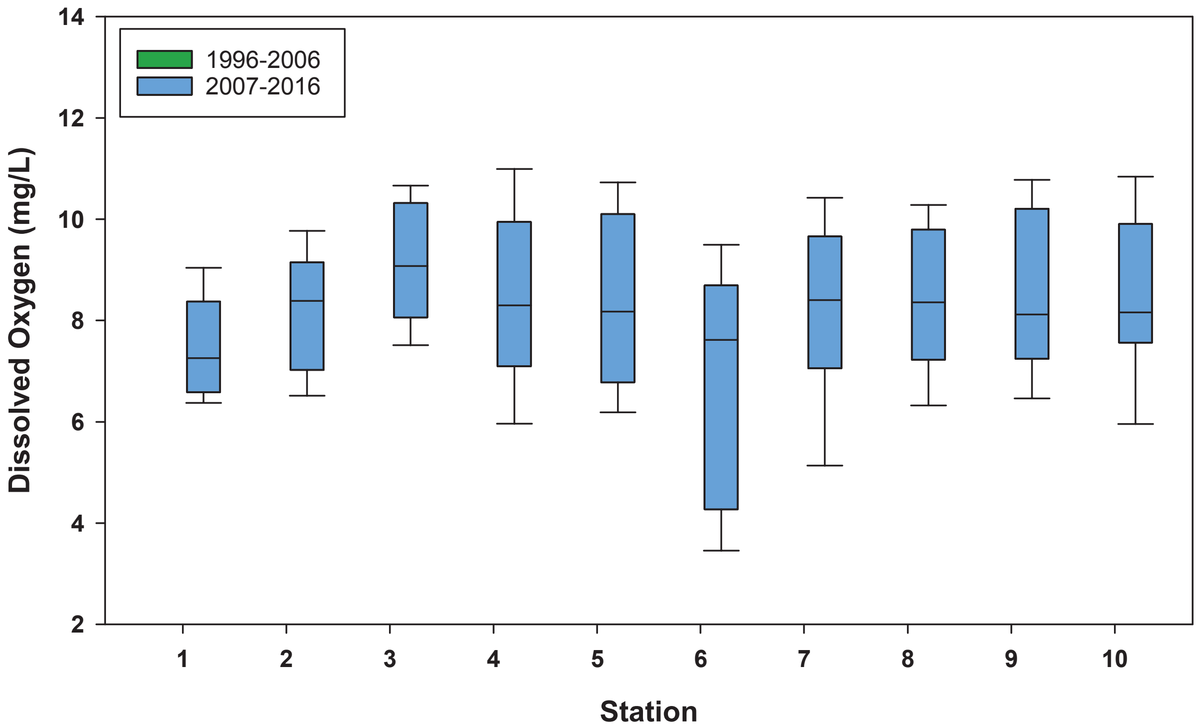


Figure 5-27: Longitudinal pattern for percent saturated dissolved oxygen grouped by 10-year periods for each station.

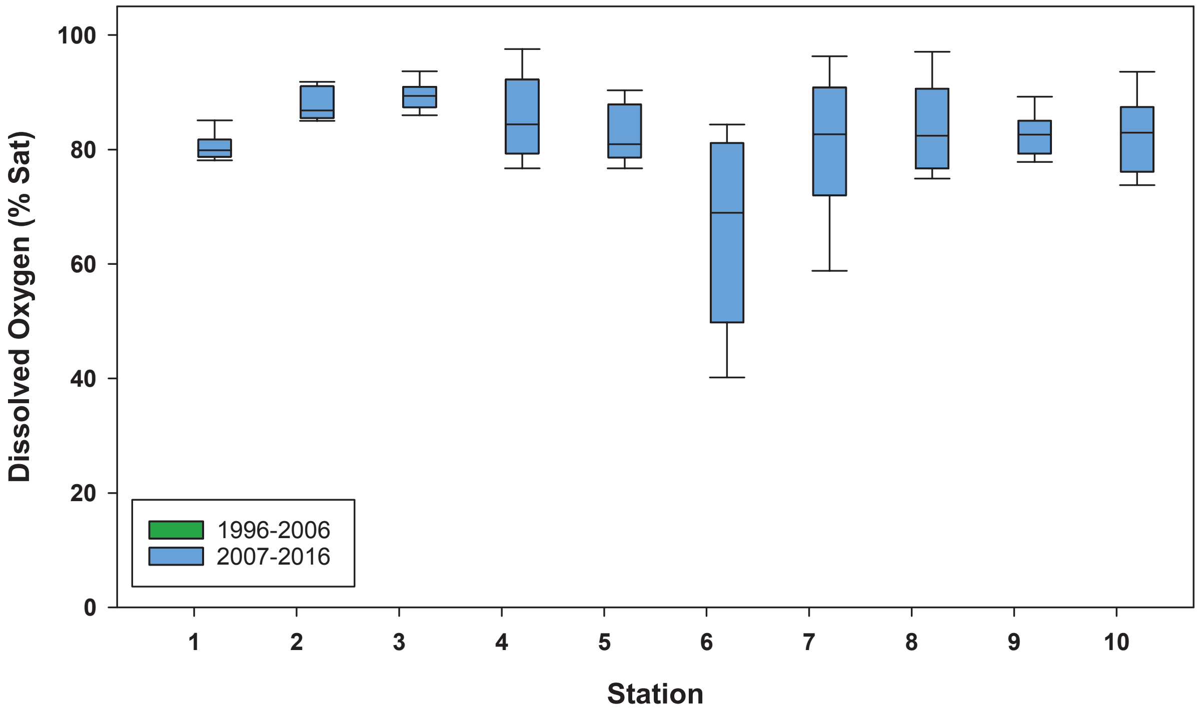


Figure 5-28: Longitudinal pattern for pH grouped by 10-year periods for each station.

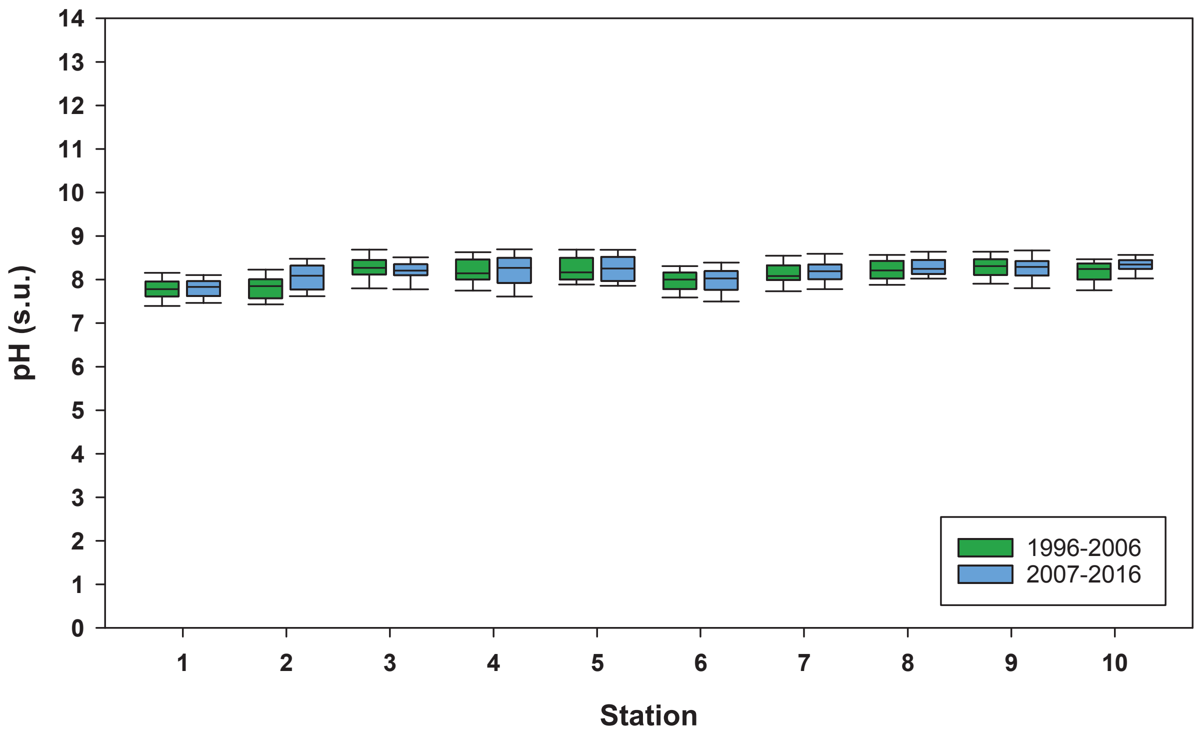


Figure 5-29: Longitudinal pattern for specific conductance grouped by 10-year periods for each station.

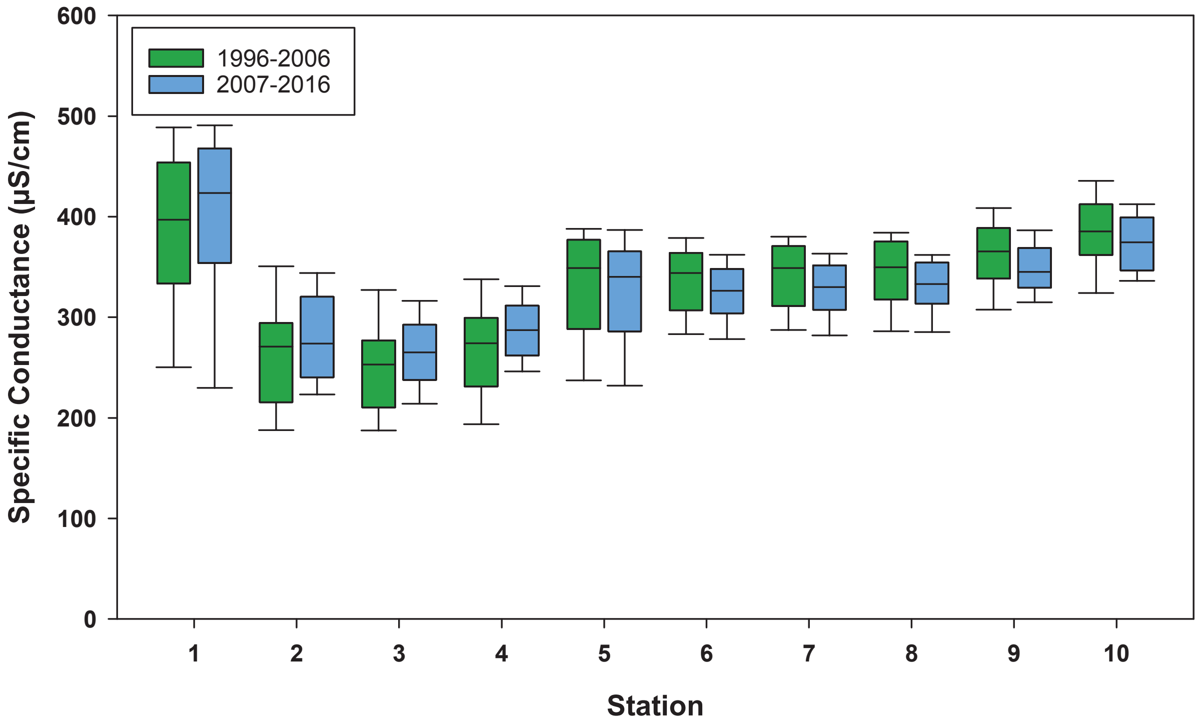
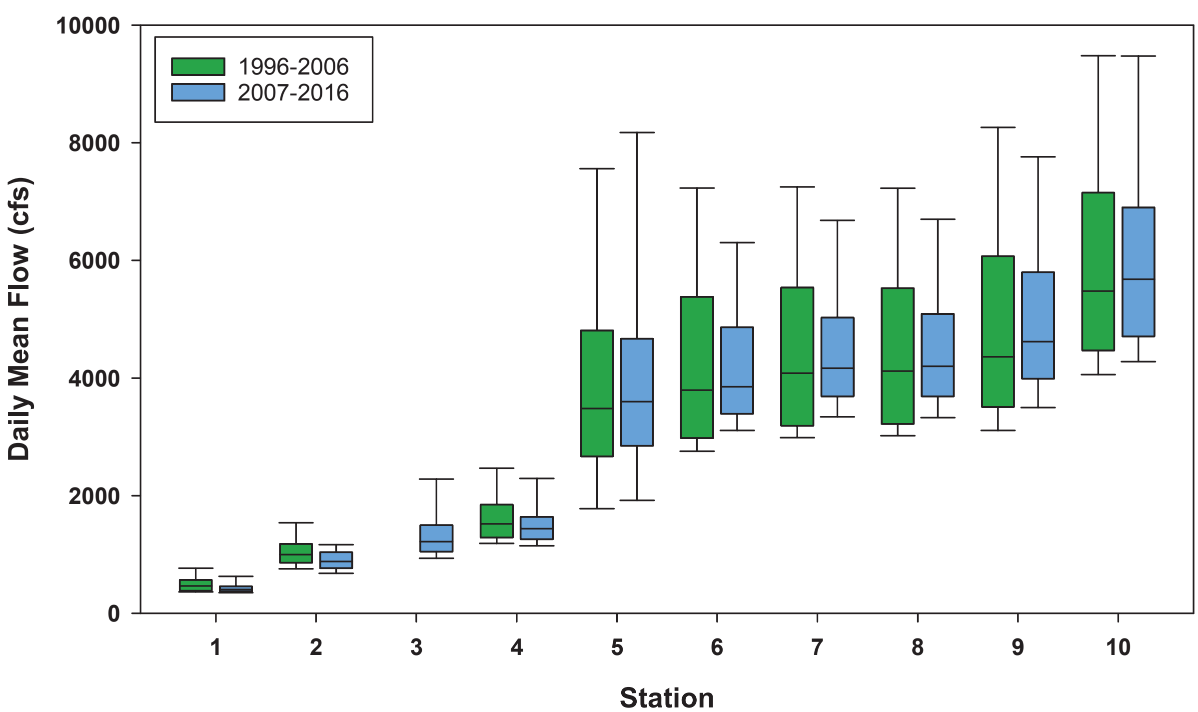


Figure 5-30: Longitudinal pattern for daily mean flow grouped by 10-year periods for each station.



5.1.2 Upstream-Downstream Comparisons

Comparisons of adjacent station pairs (upstream/downstream) were made using the non-parametric Mann-Whitney test for each parameter to identify significant differences between the median values for data collected from 2007 - 2016. The percent change for each parameter between station pairs was calculated to quantify the magnitude and direction of change (Table 5-2). Percent change was calculated by subtracting the median value for the downstream station from the upstream station, divided by the upstream value. Those values highlighted in the table indicate statistically significant differences between stations for a given parameter. Complete test statistics for each comparison (e.g., sample size, Mean Rank and Sum of Rank) are presented in Appendix B. Notably, parameters that contain a large percentage of non-detect values, including parameters for which the median value is near the non-detect limits, may result in spurious statistical results when comparing station pairs. For example, stations that exhibit the same median value (i.e., zero percent change in Table 5-2) even though the distribution characteristics are different (see figures above) may result in a statistical difference based on the non-parametric ranking of values. In these cases, where the percent change in the median values was zero, yet a statistical difference was noted, the significance was removed from Table 5-2. This occurred 5 times among the analyses (total potassium station pair 8/9; total suspended solids station pairs 1/2, 2/3; total copper station pairs 2/3; and total lead station pairs 4/5) A graphical representation of the station comparisons discussed below is shown on box plots presented in above, and note the comparisons are only for the 2007-2016 box plot data.

5.1.2.1 Ion Chemistry

Total alkalinity and bicarbonate were statistically different between station pairs 1/2, 2/3, 3/4, 4/5 and 8/9. The largest decrease in concentration was for stations 1/2 at -22 %, whereas the largest increase was observed for and stations 4/5 at +27 %. The median calcium (total and dissolved) and magnesium (dissolved) concentrations exhibited a similar pattern of statistical differences, with the addition of station pair 9/10. However, both calcium and magnesium concentrations increased in all the downstream station pairs. Total calcium increased +67 % for station pairs 1/2, +55 % between stations 2/3, +36 % between 3/4, and +76 % between 4/5. Dissolved magnesium concentrations were very low near detection limits for stations in the Madison River, thus large percent changes (i.e., statistical differences) were noted for the station pairs, including the stations that bracket the Three Forks confluence reach.

Total chloride, dissolved sodium, and potassium (total and dissolved) concentrations generally revealed statistically significant decreases for station pairs 1/2, 2/3, 4/5, and 5/6. The differences observed between stations 5/6 were the only statistically significant changes for ion concentrations. Notably, the differences observed between stations 3/4 were not statistically significant.

Total sulfate generally exhibited a pattern similar to alkalinity and bicarbonate with respect to statistical differences observed between upper station pairs. A significant decrease (-22 %) in concentrations was observed for stations pairs 1/2, while statistically significant increases in concentrations were observed for station pairs 2/3, 3/4, 4/5, 8/9, and 9/10. The largest increase in concentration (+139 %) occurred between the stations that bracket the Three Forks confluence reach. Notably, there were no statistically significant differences noted between station pairs 6/7 and 7/8 for anion/cation parameters which are the stations that bracket Hauser and Holter dams. It is worthwhile to note that alkalinity, calcium, chloride, magnesium, potassium, sodium, and sulfate and TDS were not generally influenced by the Canyon Ferry, Hauser, Holter, or Morony hydro facilities. Shifts in these parameters were generally observed at Central Ave (8/9 pair) and were related to the influence of the Sun River.

5.1.2.2 Solids/Turbidity

Total dissolved solids concentrations exhibited a similar pattern in statistical differences between station pairs that was observed for alkalinity and bicarbonate. The largest significant decrease was observed between station pairs 1/2 at -38 % and concentrations continued to decrease between station pairs 2/3 (Table 5-2). The largest significant increase in concentration (14 %) was observed for stations pairs 4/5 that bracket the Three Forks confluence reach. Total suspended solids exhibited significant differences between station pairs 4/5 (140 %), 5/6 (-58 %), and 8/9 (+140 %). The increase is suspended solids at stations 5 and 9 are due to the tributary inputs from the Three Forks confluence reach and the Sun River/Muddy Creek, respectively. The significant decrease between stations 5/6 is due to the storage effects of Canyon Ferry.

Turbidity was statistically different between all station pairs with the exception of 6/7 and 9/10. The percent change in median values between stations ranged from -74 to +348 %. Turbidity was the most highly variable analyte between stations. Turbidity decreased by -56 % downstream of Hebgen Lake, and increased +56 and +132 % at Varney and the Madison Ennis stations, respectively. Turbidity increased +84 % at Toston, and decreased -74 % downstream of Canyon Ferry. A decrease was also observed downstream of Holter Dam (-25 %). The largest increase (+348 %) was noted at Station 9 due to the influence of the Sun River and Muddy Creek.

5.1.2.3 Metals

Total arsenic concentrations exhibited statistically significant decreases between all station pairs except 6/7 and 7/8. The largest decrease (-58 %) occurred between stations 4/5 that bracket the Three Forks confluence reach (Table 5-2). This decrease primarily related to the increased dilution potential from the tributary inputs. The second largest decrease (-48 %) was observed downstream of Hebgen Lake. Additional decreases of -22 % and -21 % were apparent downstream of Canyon Ferry and Central Avenue, respectively. The decreases downstream of Hebgen Lake, Canyon Ferry, and Central Avenue likely reflected the additional loss due to the sorption of arsenic with suspended solids. Remaining metals (not shown for brevity) showed no statistical differences between stations 9 and 10.

While total copper, total iron, and total manganese were the only other parameters that generally exhibited detectable concentrations at multiple stations along the Madison and Missouri rivers, only stations 9 and 10 contained a sufficient sample size to evaluate the change in median concentrations. Both total copper and total iron exhibited a statistically significant increase in concentrations between station pair 8/9, although concentrations remain relatively low, near detection limits.

5.1.2.4 Nutrients

Total nitrite-nitrate was statistically different between station pairs 1/2, 4/5, and 5/6, while dissolved nitrite-nitrate was statistically different between pairs 1/2, 2/3, 4/5, and 5/6 (Table 5-2). The noted differences between the Madison River stations are largely due to very low concentrations, often near the detection limits, whereas the significant differences noted between stations 4/5 reflect the nitrogen inputs from the Jefferson and Gallatin rivers. These inputs increased the total and dissolved nitrite-nitrate by +300 and +380 %, respectively at Toston. Total and dissolved nitrite-nitrate nitrogen also increased 63 to 90 % downstream of Canyon Ferry. These increases likely reflect the influence of reservoir nutrient cycling, as well as watershed point and non-point sources.

Total nitrogen was variable between station pairs upstream of Toston with statistical differences between station pairs 1/2 (+90 %), 3/4 (+29 %), and 4/5 (+100 %). Notably, unlike nitrite-nitrate, total nitrogen did not show a significant increase downstream of Canyon Ferry and in fact, no changes were observed in the median concentrations further downstream. In addition, the change in concentrations between total nitrogen and nitrite-nitrate was typically in the opposite direction for stations upstream of Madison. The only statistical difference between station pairs for total phosphorus occurred between 8/9, with an increase of +19 %.

5.1.2.5 Physicochemical

Hydrogen ion concentrations (pH) exhibited statistical differences between station pairs 1/2, 2/3, 5/6, and 6/7. These pH differences were generally small, ranging from -2.7 to +3.3 % (Table 5-2). Specific conductance exhibited statistical differences between station pairs 1/2, 3/4, 4/5, 8/9, and 9/10, with the only decrease in conductivity occurring between stations 1/2 (-35 %) and reflect the influence of Hebgen Lake on the ionic concentrations and total dissolved solids. Conductivity increased +18 % between stations 4/5 and reflected the influence from the major tributaries at the Three Forks confluence reach.

Dissolved oxygen (mg/L and percent saturation) concentrations were statistically different between station pairs 1/2, 5/6, and 6/7, whereas one or the other parameter was statistically different between station pairs 2/3 and 3/4 (Table 5-2). Dissolved oxygen concentrations decreased significantly between station pair 5/6 revealing the effect of Canyon Ferry Dam on these parameters. Decreased concentrations were also observed downstream of Madison Dam, although the significant effects were mixed as noted above. The annual and seasonal effects of these dams are discussed in greater detail in Section 5.1.7. Dissolved oxygen concentrations increased downstream at Hauser Dam (+10 %) with no significant change occurring further downstream.

Flow was statistically different between station pairs 1/2, 2/3, 4/5, 8/9, and 9/10 which reflected the influence of increasing watershed area. The increase in flow was especially notable between station pair 4/5 (+169 %) which is downstream of the Jefferson, Madison and Gallatin rivers confluence reach.

Table 5-2: Change (%) in median water quality analyte values between stations upstream and downstream of dams from 2007 to 2016. Grey cells indicate a statistically significant ($p < 0.05$) difference in mean ranks as determined by Mann–Whitney *U* tests.

Analyte	1 and 2	2 and 3	3 and 4	4 and 5	5 and 6	6 and 7	7 and 8	8 and 9	9 and 10
Alkalinity as CaCO3, Total (mg/L)	-21.8	7.7	12.6	28.3	-2.7	1.2	0.0	5.0	0.7
Bicarbonate as HCO3, Total (mg/L)	-21.3	6.8	13.1	26.0	-2.2	1.3	0.0	4.5	1.8
Calcium, Total (mg/L)	66.7	55.0	35.5	76.2	-2.7	0.0	2.8	2.7	7.9
Calcium, Dissolved (mg/L)	42.9	65.0	33.3	54.5	7.4	0.0	2.7	6.7	7.5
Chloride, Total (mg/L)	-50.5	-23.6	-14.3	-33.3	-16.7	0.0	0.0	-20.0	0.0
Magnesium, Dissolved (mg/L)	300.0	100.0	50.0	83.3	0.0	0.0	0.0	18.2	7.7
Potassium, Total (mg/L)	-37.5	-20.0	0.0	0.0	-25.0	0.0	0.0	0.0	0.0
Potassium, Dissolved (mg/L)	-38.9	-27.3	0.0	-12.5	-14.3	0.0	0.0	0.0	0.0
Sodium, Dissolved (mg/L)	-46.0	-21.8	-11.8	-30.0	-14.3	0.0	0.0	0.0	-5.6
Sulfate, Total (mg/L)	-21.7	11.1	30.0	138.5	-6.5	0.0	5.2	21.3	27.0
Dissolved Solids, Total (mg/L)	-37.9	-8.6	7.4	14.0	-4.1	3.3	-0.7	6.1	6.0
Suspended Solids, Total (mg/L)	0.0	0.0	0.0	140.0	-58.3	0.0	0.0	140.0	-16.7
Turbidity (NTU)	-57.0	83.0	131.7	84.0	-73.8	9.3	-24.6	348.1	0.0
Arsenic, Total (mg/L)	-47.8	-28.0	-16.8	-58.4	-21.9	0.0	-4.0	-20.8	-5.3
Cadmium, Total (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copper, Total (mg/L)	-50.0	0.0	0.0	300.0	0.0	0.0	0.0	25.0	-20.0
Iron, Total (mg/L)	-55.6	0.0	137.5	84.2	-82.9	33.3	-25.0	266.7	-6.8
Lead, Total (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manganese, Total (mg/L)	0.0	-66.7	200.0	0.0	0.0	-33.3	-50.0	100.0	0.0
Zinc, Total (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrite Nitrate, Total (mg/L)	-10.0	11.1	0.0	300.0	90.0	-18.4	-32.3	-14.3	50.0
Nitrite Nitrate, Dissolved (mg/L)	-16.7	20.0	-16.7	380.0	62.5	-5.1	-16.2	0.0	16.1
Nitrogen, Total (mg/L)	90.0	-18.4	29.0	100.0	0.0	0.0	0.0	0.0	0.0
Phosphorus, Total (mg/L)	-3.4	-7.1	15.4	3.3	22.6	0.0	-3.9	19.2	-8.0
Dissolved Oxygen (mg/L)	15.6	8.2	-8.5	-1.5	-6.8	10.3	-0.5	-2.8	0.5
Dissolved Oxygen (% Sat.)	8.7	2.9	-5.5	-4.1	-14.8	19.9	-0.3	0.2	0.4
pH, Taken in field	3.3	1.5	0.7	-0.2	-2.7	2.1	0.7	0.5	0.7
Specific Conductance (µS/cm)	-35.3	-3.2	8.4	18.4	-4.0	1.1	0.9	3.7	8.5
Flow (CFS)	116.3	50.8	11.9	168.9	-0.7	11.5	2.6	15.1	19.8

5.1.3 Parameter Correlations

Correlation between individual parameters by station was evaluated using the non-parametric Kendall-tau statistic. This provided an assessment establishing which parameters were statistically associated. A combination of a strong relationship (i.e., correlation coefficient > 0.5) and a statistically significant p-value (i.e., <0.1) between concentration and flow and flow percentile provided the rationale for "flow adjustment" of selected trend analyses. The 2007-2016 data record was used to evaluate data relationships among parameters.

The water quality matrices of cross-correlations are quite extensive and are not detailed in narrative form, suffice to say that significant correlations between ionic chemistry, specific conductance and total dissolved solids, or metals and total suspended solids, or dissolved oxygen and water temperature were expected based on their physicochemical or thermodynamic relationships. There were many other inter-parameter correlations that indicated relationships such as dissolved nitrite-nitrate and dissolved oxygen. The complete results of cross-correlations (e.g., correlation coefficient, significance, and sample size) for individual stations and parameters are presented in Appendix B.

Parameters that were strongly correlated to flow across multiple stations include:

- total calcium
- total chloride
- dissolved sodium
- total arsenic
- total iron
- total suspended solids, and
- specific conductance

Other parameters such as total nitrogen and total phosphorus exhibited significant relationships to flow, but the correlation coefficients indicated a high degree of variability in the relationship; therefore, these parameters were not included in the flow-adjusted analyses. Other parameters that exhibited a significant but weak relationship to flow included dissolved oxygen (percent saturation, but not concentration), total manganese, total sulfate, alkalinity, bicarbonate and total dissolved solids. However, these relationships were only apparent for a few sites and most all parameters were strongly correlated to the selected parameters above or either a small sample size affected the relationship; therefore, these parameters were not included for flow-adjustment either.

5.1.4 Trend Analysis Non-Flow-Adjusted Parameters

Trend analysis for the Missouri-Madison monitoring stations 1-10 was conducted using the Seasonal Kendall nonparametric test of correlation between date and analyte result. Results less than the detection limits were substituted with a value equal to one-half of the detection limit for trend analyses. The "seasonal" covariate for the trend analysis was based on the raw quarterly data, and in the case of the 2011 monthly data, only the data from February, May, August, and November were selected to minimize sample size bias. No adjustments were made for potential influence of autocorrelation. Autocorrelation is the tendency for sequential data points to be related and not fully independent. e.g. high values tend to follow highs. Autocorrelation can lead to a tendency to identify trends more frequently, and some of these apparent trends may be an artifact of autocorrelation. Seasonal adjustment is a common approach to address this issue if the sampling frequency is relatively high (i.e., weekly or bi-monthly). However, for analyses using less than ten years of quarterly data, the seasonally adjustment is generally not beneficial due to the small sample size. On the other hand, because the hydrological cycle is driven by snowmelt runoff and corresponds roughly to the seasonal component, the flow-adjustment will help minimize the effect of autocorrelation, although the sampling frequency reduces possibility too. The results for trend tests not adjusted for flow are summarized in Table 5-3. Box plots for parameter/station combinations over time show the trends graphically and are presented in Appendix B. Notably, the Seasonal Kendall Trend analysis evaluates the relationship sequentially over time (year) and season (month) rather than combining data by year as presented in the boxplots. Therefore, trend lines are not included on the box plots as parameters did not necessarily show uniform monotonic trends in concentration over time (2007 – 2016).

To provide some context to the relative change in concentrations over time, the mean concentration for the first three-years was compared to the mean concentration for last three-years for each parameter and station. Note that the reported magnitude of change may have suggested a large change but was not statistically significant using the time series analysis. This resulted in part from underlying high variability in the data and number of non-detect data that provided little variability in the data for some parameters. Notably, the magnitude of change was calculated using the average of three-year endpoints and excluded four years of data in the middle of the monitoring cycle that was greatly affected by flow conditions.

5.1.4.1 Ion Chemistry

Total alkalinity and total bicarbonate concentrations exhibited statistically significant increasing trends over time for stations 1, 2, and 3 in the Madison River, while Station 10 only exhibited a statistically significant ($p < 0.05$) increasing trend for total alkalinity. The pattern of significantly increasing trends for alkalinity and bicarbonate across multiple adjacent stations may be due to carryover effect from the most upstream station. The percent change in the median concentration from the first three years compared to the last three years of the 10-year period are very similar and ranging from a +9.4 to +7.0 % increase (Table 5-4) for stations 1 to 3. Dissolved magnesium and total potassium exhibited statistically significant trends over time for a select few stations, although the stations did not overlap. At Station 9, the trend in dissolved magnesium concentrations was statistically significant over time even though there was no change in the median concentration between the first three years and last three years of the 10-year period (Table 5-3, Table 5-4, and Appendix B). For total potassium, the most consistent pattern of increasing trends occurred at stations 3, 4, and 5. The percent increase in the median potassium concentration from the first three years compared to the last three years of the 10-year period ranged from +10.2 % at Station 3 to +14.9 % for Station 4 (Table 5-4). Total sulfate concentrations did not indicate any trends over time at any of the Madison-Missouri stations.

Overall, the consistent increasing trends for anions/cations over time (2007-2016) were observed in the Madison River, primarily stations 1, 2, and 3, with only three significant increasing trends observed in the most downstream stations of the Missouri River. In general, the non-adjusted anions/cations exhibited no trends in the upper Missouri River stations 5 through 8, which bracket Canyon Ferry, Hauser, and Holter dams.

5.1.4.2 Solids/Turbidity

Total dissolved solids concentrations exhibited a significantly increasing trend over time at Station 1, but no trends were observed for the remaining downstream stations. The total dissolved solids increased by +8.2 % between the first three years and last three years of the 10-year period for Station 1. No significant trends for turbidity measurements over time were observed for any Madison-Missouri stations.

Overall, the total dissolved solids and turbidity content exhibited no trends and remained relatively consistent throughout the monitoring network from 2007 through 2016.

5.1.4.3 Metals

Trend analysis of total manganese revealed a significant increasing trend over time at Station 10, while the other metals – total cadmium, total copper, total lead, and total zinc – exhibited no trends for either station 9 or 10. The percent increase in total manganese concentrations over time was +17.8 % (Table 5-4). The small sample size for metal analyses throughout the monitoring network hindered the analyses for stations upstream of Great Falls.

5.1.4.4 Nutrients

Patterns in nutrient concentrations were generally decreasing over time but there are few significant trends in the data (Table 5-3). Notably, dissolved nitrite-nitrate was only collected from 2007-2011, therefore the trend analysis over time 2007-2016 is biased due to the sample size and period of record so the significant trends observed at stations 9 and 10 should be interpreted in the appropriate context. The total nitrite-nitrate data patterns are more reflective of the conditions over time (2007-2016) which indicate a decreasing pattern in the data but not a significant trend over time for any of the stations. Total nitrogen concentrations revealed a significant decreasing trend over time at Station 10, with the median concentration decreasing -5.7 % from the first three-year period to the last three-year period (Table 5-4). Total phosphorus concentrations exhibited significant decreasing trends over time at stations 1, 3, 5, and 9. All other stations exhibited decreasing patterns in the data, although no significant trends over time.

Overall, nitrogen and phosphorus concentrations exhibited decreasing patterns over time; however, there were few significant trends in the data. Total phosphorus concentrations did significantly decrease over time (2007-2016) for two sites in the Madison River, and one site on the Missouri River. At stations 1, 3, and 5, the percent decrease in phosphorus concentration from the first three-year period to the last three-year period was -59.5 %, -42.2 %, and -38.6 %, respectively (Table 5-4).

5.1.4.5 Physicochemical

Dissolved oxygen data was also only available for a portion of the 10-year period with data being collected from 2011 through 2016, thus the trend analysis results should be interpreted in the context of the sampling period rather than the full period of record. Dissolved oxygen data (mg/L and % saturation) revealed statistically significant trends at all stations, except stations 3 and 5, with decreasing trends over time (2011-2016). At stations 1 and 8, either the dissolved oxygen concentration or percent saturation revealed a significant decreasing trend, but not both parameters. The percent change in the dissolved oxygen content could not be calculated due to the sampling frequency.

Several stations also revealed significant trends in pH and water temperature (Table 5-3). Significant decreasing trends in pH were observed at stations 6, 7, and 8, although percent changes only ranged from +2.8 % to +3.2 %. Water temperature significantly increased over time at stations 2, 5, 6, and 8. The percent change in water temperature ranged from +7.7 % at Station 5 to +15.3 % at Station 6. The stations downstream of Hebgen Dam and Canyon Ferry Dam exhibited the largest increase in temperature over time, with the stations bracketing the Great Falls dams exhibiting a similar increase in water temperature, though not statistically significant. The only site that revealed a decreasing pattern in water temperature was Station 1, albeit not statistically significant (Table 5-3 and Table 5-4).

Table 5-3: Seasonal Kendall trends analyses for non-flow adjusted concentrations from 2007 to 2016 at all stations.

Parameter	Statistic	1	2	3	4	5	6	7	8	9	10
Alkalinity as CaCO3, Total (mg/L)	Tau Correlation Coefficient	0.272	0.311	0.328	0.041	-0.050	0.217	0.156	0.078	0.247	0.281
	Sig.	0.031	0.014	0.009	0.780	0.717	0.086	0.225	0.558	0.061	0.028
	Slope	1.333	1.000	0.804	0.143	0.000	1.000	0.750	0.417	1.000	1.000
	N	40	40	40	40	40	40	40	40	39	40
Bicarbonate as HCO3, Total (mg/L)	Tau Correlation Coefficient	0.261	0.261	0.322	0.083	-0.072	0.172	0.111	-0.017	0.154	0.199
	Sig.	0.039	0.039	0.011	0.530	0.587	0.178	0.394	0.929	0.247	0.124
	Slope	1.646	1.000	1.000	0.583	-0.167	1.000	0.775	-0.063	1.062	1.000
	N	40	40	40	40	40	40	40	40	39	40
Calcium, Dissolved (mg/L)	Tau Correlation Coefficient	--	--	--	--	--	--	--	--	--	0.141
	Sig.	--	--	--	--	--	--	--	--	--	0.469
	Slope	--	--	--	--	--	--	--	--	--	1.000
	N	8	8	8	8	8	8	8	8	8	9
Magnesium, Dissolved (mg/L)	Tau Correlation Coefficient	--	0.250	0.111	0.049	0.056	0.099	0.142	0.123	0.257	0.228
	Sig.	--	0.040	0.178	0.655	0.682	0.439	0.266	0.329	0.036	0.059
	Slope	--	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.000
	N	36	36	36	36	36	36	36	36	40	40
Potassium, Total (mg/L)	Tau Correlation Coefficient	0.159	-0.189	0.311	0.303	0.318	0.212	0.062	0.212	0.194	0.271
	Sig.	0.236	0.115	0.016	0.022	0.008	0.082	0.629	0.086	0.068	0.009
	Slope	0.000	0.000	0.167	0.183	0.000	0.000	0.000	0.000	0.000	0.000
	N	28	28	28	28	28	28	29	28	32	31
Potassium, Dissolved (mg/L)	Tau Correlation Coefficient	--	--	--	--	--	--	--	--	--	0.141
	Sig.	--	--	--	--	--	--	--	--	--	0.466
	Slope	--	--	--	--	--	--	--	--	--	1.000
	N	8	8	8	8	8	8	7	8	8	9

Parameter	Statistic	1	2	3	4	5	6	7	8	9	10
Sulfate, Total (mg/L)	Tau Correlation Coefficient	0.022	0.144	0.028	-0.106	-0.017	0.028	0.033	0.044	0.123	0.228
	Sig.	0.890	0.246	0.852	0.411	0.926	0.856	0.821	0.752	0.350	0.077
	Slope	0.000	0.000	0.000	-0.056	0.000	0.000	0.000	0.000	0.333	1.000
	N	40	40	40	40	40	40	40	40	40	40
Dissolved Solids, Total (mg/L)	Tau Correlation Coefficient	0.250	0.200	0.100	0.039	-0.150	-0.056	0.033	0.111	0.053	0.088
	Sig.	0.049	0.117	0.446	0.787	0.244	0.685	0.822	0.396	0.711	0.516
	Slope	3.450	2.536	1.000	0.143	-0.937	-0.125	0.278	0.900	0.428	0.500
	N	40	40	40	40	40	40	40	40	40	40
Turbidity (NTU)	Tau Correlation Coefficient	-0.144	0.083	0.206	0.144	-0.033	0.161	0.206	0.072	0.047	0.199
	Sig.	0.263	0.529	0.106	0.263	0.823	0.209	0.107	0.589	0.745	0.126
	Slope	-0.027	0.012	0.062	0.117	-0.077	0.033	0.039	0.021	0.007	0.180
	N	40	40	40	40	40	40	40	40	40	40
Cadmium, Total (mg/L)	Tau Correlation Coefficient	--	--	--	--	--	--	--	--	0.069	--
	Sig.	--	--	--	--	--	--	--	--	0.385	--
	Slope	--	--	--	--	--	--	--	--	--	--
	N	5	5	5	5	5	5	5	5	36	36
Copper, Total (mg/L)	Tau Correlation Coefficient	--	--	--	--	--	--	--	--	-0.186	-0.200
	Sig.	--	--	--	--	--	--	--	--	0.137	0.124
	Slope	--	--	--	--	--	--	--	--	--	0.000
	N	5	5	5	5	5	5	5	5	36	36
Lead, Total (mg/L)	Tau Correlation Coefficient	--	--	--	--	--	--	--	--	0.076	0.138
	Sig.	--	--	--	--	--	--	--	--	0.591	0.310
	Slope	--	--	--	--	--	--	--	--	--	0.000
	N	5	5	5	5	5	5	5	5	36	36
Manganese, Total (mg/L)	Tau Correlation Coefficient	--	--	--	--	--	--	--	--	0.193	0.303
	Sig.	--	--	--	--	--	--	--	--	0.154	0.022
	Slope	--	--	--	--	--	--	--	--	--	0.001
	N	5	5	5	5	5	5	5	5	36	36
Zinc, Total (mg/L)	Tau Correlation Coefficient	--	--	--	--	--	--	--	--	--	--
	Sig.	--	--	--	--	--	--	--	--	--	--
	Slope	--	--	--	--	--	--	--	--	--	--
	N	5	5	5	5	5	5	5	6	36	36
Nitrate Nitrate, Total (mg/L)	Tau Correlation Coefficient	-0.210	-0.074	-0.167	-0.235	-0.222	-0.136	-0.099	-0.204	-0.221	-0.045
	Sig.	0.098	0.581	0.204	0.059	0.085	0.309	0.468	0.116	0.100	0.761
	Slope	0.001	0.000	-0.001	-0.001	-0.002	-0.003	-0.002	-0.003	-0.005	0.000
	N	36	36	36	36	36	36	36	36	36	36
Nitrate Nitrite, Dissolved (mg/L)	Tau Correlation Coefficient	-0.075	-0.325	0.025	-0.050	0.000	0.025	0.100	0.275	0.500	0.444
	Sig.	0.785	0.118	1.000	0.893	1.000	1.000	0.709	0.200	0.024	0.046
	Slope	0.000	-0.003	0.000	0.000	0.000	0.000	0.007	0.010	0.018	0.015
	N	20	20	20	20	20	20	20	20	20	20
Nitrogen, Total (mg/L)	Tau Correlation Coefficient	-0.156	0.022	-0.033	0.050	-0.117	-0.128	-0.222	-0.094	-0.216	-0.269
	Sig.	0.218	0.889	0.819	0.716	0.352	0.318	0.077	0.463	0.087	0.029
	Slope	-0.003	0.000	0.000	0.000	0.000	-0.002	-0.007	-0.002	-0.010	-0.005
	N	40	40	40	40	40	40	40	40	40	40
Phosphorus, Total (mg/L)	Tau Correlation Coefficient	-0.417	-0.189	-0.289	-0.050	-0.244	-0.089	-0.106	-0.094	-0.298	-0.211
	Sig.	0.001	0.115	0.011	0.678	0.030	0.459	0.372	0.431	0.013	0.085
	Slope	-0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000
	N	40	40	40	40	40	40	40	40	40	40
Dissolved Oxygen (mg/L)	Tau Correlation Coefficient	-0.160	-0.440	0.180	-0.480	-0.320	-0.680	-0.480	-0.440	-0.440	-0.400
	Sig.	0.461	0.027	0.396	0.015	0.114	0.001	0.015	0.027	0.027	0.045
	Slope	-0.042	-0.120	0.039	-0.285	-0.275	-0.265	-0.289	-0.194	-0.207	-0.357
	N	22	22	22	22	22	22	22	22	22	22
Dissolved Oxygen (% Sat)	Tau Correlation Coefficient	-0.580	-0.640	-0.120	-0.560	-0.280	-0.680	-0.480	-0.280	-0.560	-0.400
	Sig.	0.003	0.001	0.598	0.004	0.171	0.001	0.015	0.171	0.004	0.045
	Slope	-0.605	-1.278	-0.380	-3.090	-0.983	-2.112	-2.560	-1.369	-1.362	-1.953
	N	22	22	22	22	22	22	22	22	22	22
pH, Field (s.u.)	Tau Correlation Coefficient	-0.183	-0.094	-0.189	-0.200	-0.117	-0.361	-0.317	-0.339	-0.023	-0.123
	Sig.	0.151	0.474	0.140	0.117	0.371	0.004	0.012	0.007	0.889	0.353
	Slope	-0.018	-0.030	-0.021	-0.027	-0.016	-0.035	-0.026	-0.023	-0.002	-0.007
	N	40	40	40	40	40	40	40	40	40	40

Parameter	Statistic	1	2	3	4	5	6	7	8	9	10
Temperature, Water (°C)	Tau Correlation Coefficient	-0.022	0.344	0.067	0.067	0.250	0.383	0.206	0.344	0.240	0.251
	Sig.	0.893	0.006	0.623	0.623	0.049	0.002	0.107	0.006	0.064	0.052
	Slope	-0.029	0.139	0.490	0.073	0.057	0.122	0.095	0.105	0.216	0.166
	N	40	40	40	40	40	40	40	40	40	40
Discharge (CFS)	Tau Correlation Coefficient	-0.128	0.022	-0.093	0.083	0.022	-0.089	-0.022	-0.078	-0.088	-0.135
	Sig.	0.324	0.893	0.650	0.531	0.893	0.502	0.893	0.560	0.517	0.309
	Slope	-2.310	2.861	-30.000	6.667	16.070	-35.860	-21.670	-37.500	-45.710	-97.140
	N	40	40	40	40	40	40	40	40	40	40
Discharge Percentile	Tau Correlation Coefficient	-0.128	0.022	-0.093	0.083	0.022	-0.089	-0.022	-0.078	-0.088	-0.135
	Sig.	0.324	0.893	0.650	0.531	0.893	0.502	0.893	0.560	0.517	0.309
	Slope	-0.006	0.004	-0.031	0.006	0.001	-0.009	-0.006	-0.010	-0.011	-0.015
	N	40	40	40	40	40	40	40	40	40	40

Sulfate, Dissolved and Magnesium, Total were not collected between 1997 and 2015.
-- Not calculated due to low number of samples or high number of not detected analysis results.
*Correlation is significant at the 0.05 level.

Table 5-4: Percent change (%) between the 2007-2009 mean water quality concentration and the 2014-2016 mean water quality concentration at each station. -- = Not part of the 2011 SAP data collection effort.

Parameter	1	2	3	4	5	6	7	8	9	10
Ion Chemistry										
Alkalinity as CaCO3, Total (mg/L)	9.4	8.8	7.0	2.8	1.5	5.1	3.2	-1.6	5.8	4.8
Bicarbonate as HCO3, Total (mg/L)	9.1	8.3	7.0	2.1	1.1	4.6	2.5	-3.5	4.1	3.6
Calcium, Total (mg/L)	-1.4	-3.1	-6.6	-6.5	0.5	-1.2	2.1	4.0	-1.7	-0.6
Chloride, Total (mg/L)	7.2	7.7	1.9	-4.7	-2.2	-1.6	-2.4	-0.8	3.0	2.0
Magnesium, Dissolved (mg/L)	0.0	8.0	6.3	1.4	5.0	5.0	5.6	7.3	7.5	7.4
Potassium, Total (mg/L)	-3.2	3.3	10.2	14.9	14.3	5.0	2.0	5.0	0.0	0.0
Sodium, Dissolved (mg/L)	10.4	13.9	11.7	6.4	7.0	5.6	6.0	6.0	9.7	10.4
Sulfate, Total (mg/L)	2.8	6.5	-0.8	-5.5	8.1	3.6	4.0	5.6	9.7	12.9
Solids/Turbidity										
Dissolved Solids, Total (mg/L)	8.2	4.1	1.5	0.2	-2.0	-0.7	0.1	2.9	3.7	2.3
Suspended Solids, Total (mg/L)	-70.4	0.0	-62.6	-3.3	-46.6	0.0	0.0	0.0	-22.0	5.2
Turbidity (NTU)	-68.3	5.1	-54.1	24.8	-43.0	14.6	8.4	29.8	-21.9	-5.2
Metals										
Arsenic, Total (mg/L)	4.8	6.8	6.2	2.4	1.5	0.0	1.0	-1.3	2.0	0.9
Cadmium, Total (mg/L)	--	--	--	--	--	--	--	--	-38.9	100.0
Copper, Total (mg/L)	--	--	--	--	--	--	--	--	-30.2	-21.8
Iron, Total (mg/L)	--	--	--	--	--	--	--	--	-30.4	-22.1
Lead, Total (mg/L)	--	--	--	--	--	--	--	--	-35.4	40.8
Manganese, Total (mg/L)	--	--	--	--	--	--	--	--	4.6	17.8
Zinc, Total (mg/L)	--	--	--	--	--	--	--	--	-8.3	-8.3
Nutrients										
Nitrite Nitrate, Total (mg/L)	-3.9	-19.7	-18.8	-45.4	-5.6	-7.4	-10.5	-19.3	-26.2	-8.5
Nitrogen, Total (mg/L)	-19.4	25.5	5.9	28.3	3.3	1.1	-0.8	-2.9	-13.4	-5.7
Phosphorus, Total (mg/L)	-59.5	-17.3	-42.2	-7.9	-38.6	-10.5	-25.9	-9.0	-24.0	-24.1
Physicochemical										
pH, Field	-2.7	-2.1	-1.8	-2.6	-2.0	-3.2	-3.0	-2.8	-1.9	-1.4
Specific Conductance (µS/cm)	2.6	2.3	-0.6	-4.9	-4.8	-4.8	-4.4	-3.8	-1.9	-2.1
Water Temperature (°C)	-3.5	13.7	4.5	-2.0	7.7	15.3	8.8	10.0	13.6	12.3

Calcium, Dissolved; Magnesium, Total; Potassium, Dissolved; Sulfate, Dissolved; Nitrite Nitrate, Dissolved; Dissolved Oxygen (mg/L); and Dissolved Oxygen (% Sat.) were not included in the analysis because sampling did not occur one or both three year time period.

5.1.5 Concentration and Flow Relationships

The initial correlation analyses (Appendix B) indicated that parameters including total calcium, total chloride, dissolved sodium, total arsenic, total iron, total suspended solids, and specific conductance were generally correlated to flow for most stations in the monitoring network (Section 5.1.3). These seven parameters were examined more closely in the context of flow conditions observed over time from 1996 through 2016. The initial subset of analytes included five analytes that overlapped with the previous 10-year analysis - total chloride, dissolved sodium, total suspended solids, total arsenic, and specific conductance.

The following figures display the relationships between the selected parameters and percentile flow conditions for the complete data record 1996-2016, by station. For each station, the 20-year percentile flow figure is depicted in the upper left panel, such that the smallest mean daily flow value is assigned a value that approaches zero (0.0) and the largest daily flow value is assigned a value that approaches one (1.0). The upper left panel is a flow exceedance probability figure, except that the exceedance value has been translated to a percentile value. The flow percentile value normalizes the range of flow conditions and removes the effect of magnitude on the relationship during the trend analyses. This approach of evaluating water quality – flow duration relationships is commonly used in the development of total maximum daily loads (EPA 2007, EPA 2008) and estimating flow-adjusted concentrations (USGS 2012).

5.1.5.1 Station 1 Yellowstone National Park

Despite significant correlations between total calcium and percentile flow, this analyte highlights some of the issues with significant data correlations with flow or flow percentile. At Station 1, total calcium concentrations exhibit a repetitive pattern of results (6 and 7 mg/L) across the range of flow conditions that skews the flow relationship (Figure 5-31). Total calcium concentrations vary little from a range of flow conditions and it's not until flow reaches approximately the 90th percentile level (710 cfs) before concentrations begin to decrease due to dilution potential from discharge.

Total chloride, dissolved sodium and the surrogate measurement – specific conductance – all reveal a decreasing pattern in concentration as flow increases. Similarly, total arsenic exhibits a decreasing pattern in concentration as flow increase. The total iron data reveals no relationship with flow at Station 1, although significant relationships were observed further downstream. Total suspended solids also vary little over the range of flow conditions observed at Station 1, and it's not until flow reached the 80th percentile condition (560 cfs) before concentrations begin to increase due to flow.

5.1.5.2 Station 2 Downstream from Hebgen Lake

The effects of Hebgen Lake on the relationships between concentrations and flow is more apparent with the scatter of data being more variable across the range of flow conditions (Figure 5-32). There is no relationship between total calcium and percentile flow, even at the highest flow levels at Station 2. Like Station 1, there is a repetitive pattern of concentrations across the full range of flow conditions.

Total chloride, dissolved sodium and specific conductance data all exhibit more variability across the range of flow conditions, yet there is a significant decreasing relationship with increasing flow. Similarly, total arsenic exhibits a significant decreasing relationship with increasing flow although the strength of the relationship is less apparent. The total iron data and total suspended solids data reveal no relationships with flow at Station 2, although significant relationships were observed further downstream.

5.1.5.3 Station 3 Upstream from Ennis Lake

There was insufficient flow data to evaluate the relationships between selected parameters and flow at Station 3 (Figure 5-33). Regardless, the relationships for the available data are presented in Figure 5-33. The limited data does provide some indication that total suspended solids and total iron concentrations increase when flow conditions are greater than the 80th percentile level (1,660 cfs), yet remain relatively consistent for lower flow conditions.

5.1.5.4 Station 4 Downstream from Madison Dam

The effects of Ennis Lake/Madison Dam on the relationships between concentrations and flow is more apparent with the scatter of data being more variable across the range of flow conditions (Figure 5-34). There is a significant decreasing relationship between total calcium and percentile flow, although the variability of the data is greater. A threshold level (wedge shape) for total chloride and dissolved sodium concentrations is apparent, and to a lesser extent specific conductance, when flow conditions are less than the 40th percentile level (1,390 cfs).

Total arsenic exhibits a significant decreasing wedge shape relationship with increasing flow although the strength of the relationship is less apparent. The total iron data, albeit limited, reveals a significant increasing relationship with flow at Station 4, while the total suspended solids data reveal no relationship to flow conditions.

5.1.5.5 Station 5 Upstream from Canyon Ferry

The patterns in the concentration-flow relationships begin to change downstream of the Three Forks confluence reach with some parameters exhibiting a unimodal relationship with flow (Figure 5-35). These relationships are likely due to the influence of one of the major tributaries under a certain range of flow conditions that were not apparent in the Madison River stations. Total calcium and specific conductance data reveal this pattern such that concentrations are relatively lower at low flow conditions and increase at mid-range flow conditions (i.e., 50th percentile, 3,500 cfs) then begin to decrease with flow conditions greater than the 50th percentile.

Total iron and total suspended solids concentrations exhibit no relationship to flow conditions less than the 80th percentile level (5,230 cfs), which is also supported by the large number of non-detect values for total suspended solids. However, as flow increases beyond the 80th percentile condition, concentrations rapidly increase.

5.1.5.6 Station 6 Downstream of Canyon Ferry Dam

A wedge shape relationship becomes more apparent in the concentration-flow relationships downstream of Canyon Ferry Dam. Generally, there is a threshold level in concentration, depending on the parameter when flow conditions are less than the 60th percentile level (4,100 cfs). Five of the seven parameters exhibit the wedge relationship indicating other watershed conditions or reservoir storage conditions are affecting the relationship in addition to flow (Figure 5-36). Total iron and total suspended solids concentrations exhibit no relationship to flow conditions downstream of Canyon Ferry Dam, and again there are many non-detect values across the full range of flow conditions. This relationship highlights the sediment accumulation affect (i.e., sink) that the reservoir and dam have on flows.

5.1.5.7 Station 7 Downstream of Hauser Dam

The concentration-flow relationships downstream of Hauser Dam are nearly identical to relationships observed downstream of Canyon Ferry Dam (Figure 5-37). Again, there is a threshold level in concentration, depending on the parameter, when flow conditions are less than the 60-80th percentile level (4,300 – 5,600 cfs). Total iron and total suspended solids concentrations exhibit no relationship to flow conditions downstream of Hauser Dam, and again there are many non-detect values across the full range of flow conditions for total suspended solids.

5.1.5.8 Station 8 Downstream of Holter Dam

The concentration-flow relationships downstream of Holter Dam are nearly identical to relationships observed for downstream of Canyon Ferry and Hauser dams (Figure 5-38). Again, there is a threshold level in concentration, depending on the parameter, when flow conditions are less than the 60-80th percentile level (4,400 – 5,600 cfs). Total iron and total suspended solids concentrations exhibit no relationship to flow conditions downstream of Canyon Ferry Dam, and there are many non-detect values across the full range of flow conditions for total suspended solids.

5.1.5.9 Station 9 Upstream from Great Falls

The patterns in the concentration-flow relationships change downstream of the of the three dams and indicate less variability in the data across the full range of flow conditions (Figure 5-39). The ionic parameters including total arsenic and specific conductance all reveal a significant decreasing relationship with increasing flow conditions. The strength of the relationships for these parameters (i.e. correlation coefficient) is similar to conditions observed at Station 1. Total iron and total suspended solids concentrations exhibit a significant increasing relationship to flow conditions and concentration begin to increase when flow conditions are greater than the

50^{th} percentile level (4,500 cfs), and the greater percentage of measurable values indicates a source of suspended sediment as compared to conditions further upstream on the Missouri.

5.1.5.10 Station 10 Downstream from Great Falls

The patterns in the concentration-flow relationships downstream of Great Falls is very similar to conditions observed at Station 9. Out of the 10 monitoring stations, the data at Station 10 exhibits less variability and the strongest relationships across the full range of flow conditions (Figure 5-40). The ionic parameters including total arsenic and specific conductance all reveal a significant decreasing relationship with increasing flow conditions. Total iron and total suspended solids concentrations exhibit a significant increasing relationship to flow conditions and concentrations begin to increase when flow conditions are greater than the 80^{th} percentile level (7,500 cfs). Again, the greater percentage of measurable suspended solids concentrations across the full range of flow conditions indicates a source of suspended sediment further upstream (Sun River/Muddy Creek).

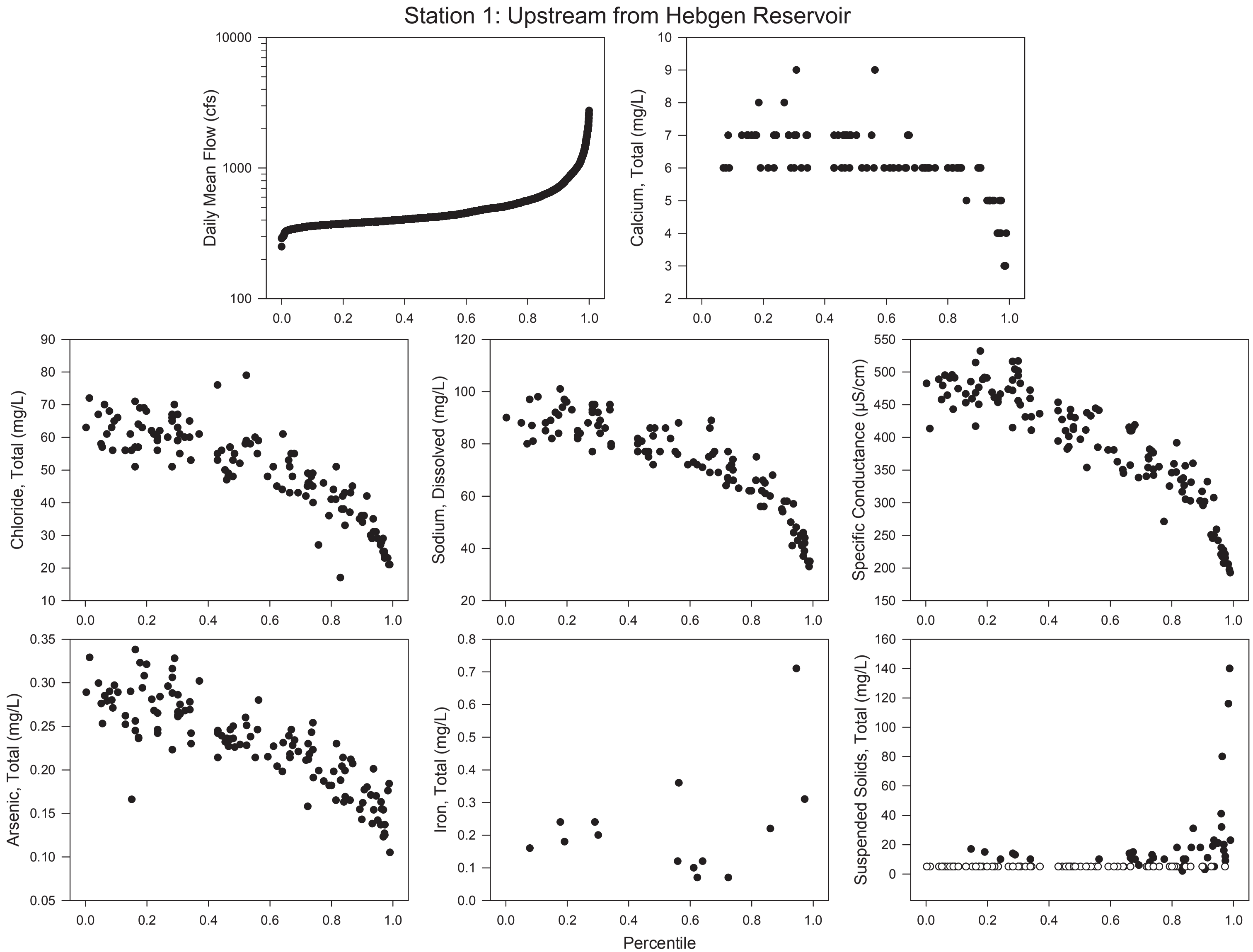


Figure 5-31: Relationships between selected parameters and percentile flow conditions at Station 1 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

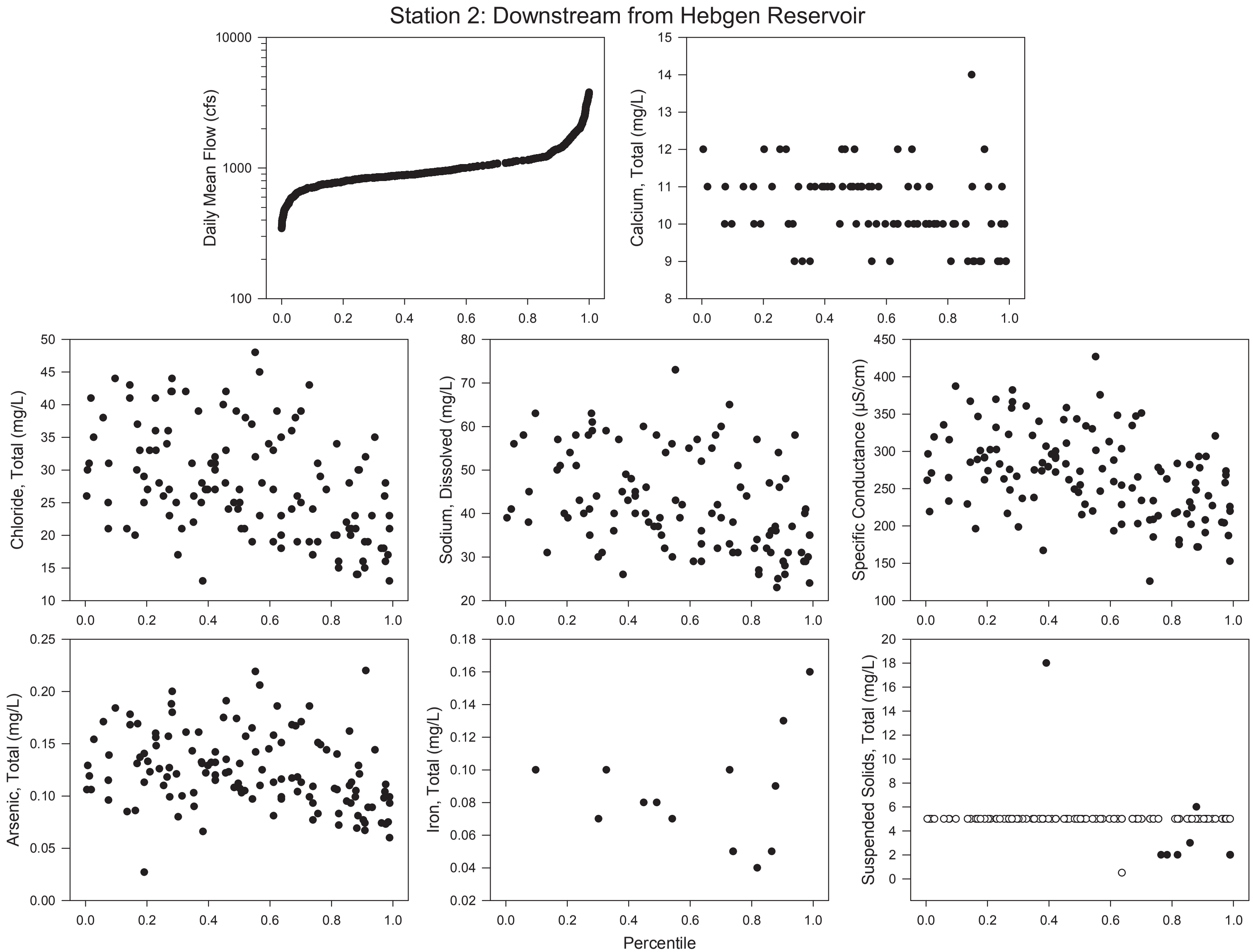


Figure 5-32: Relationships between selected parameters and percentile flow conditions at Station 2 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

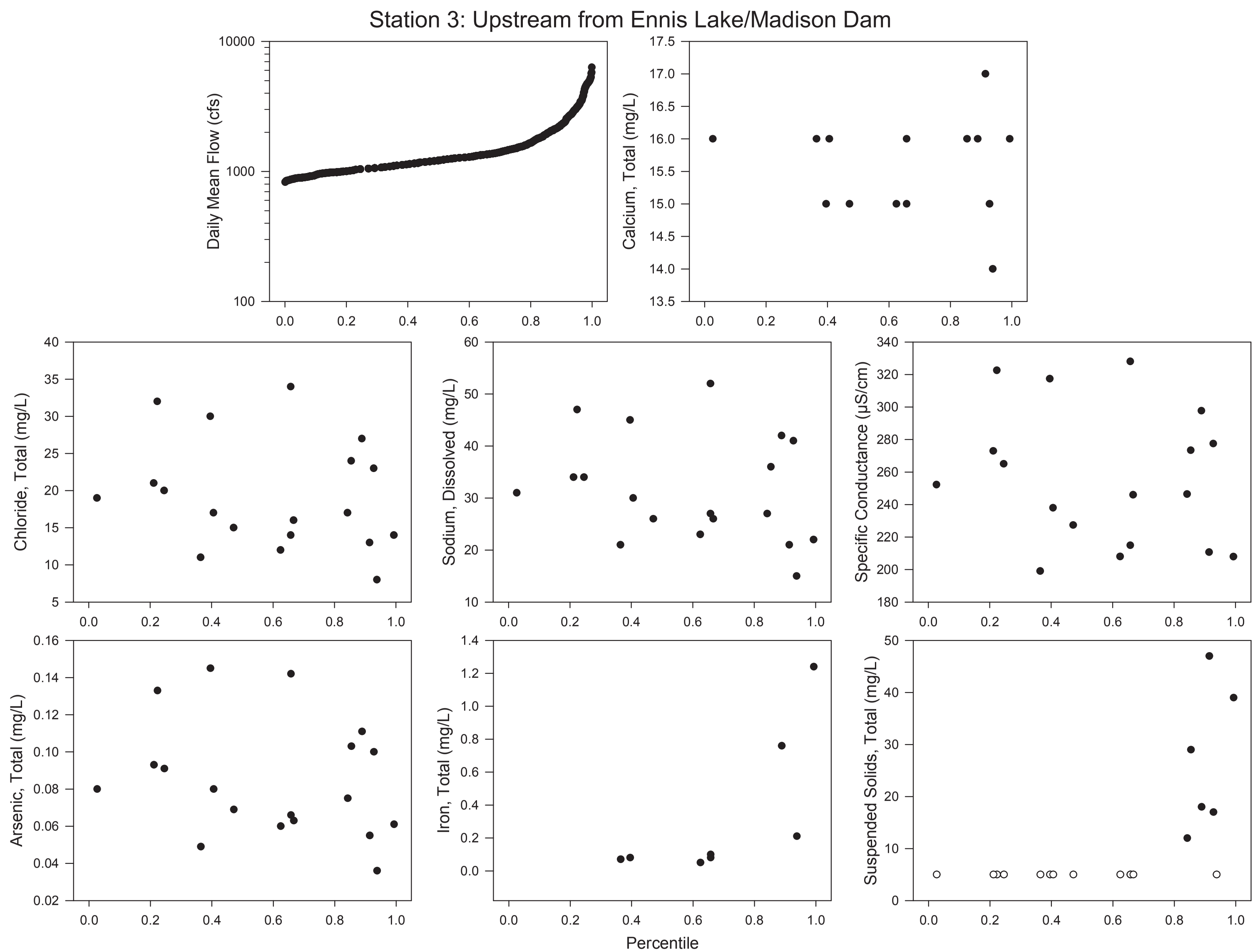


Figure 5-33: Relationships between selected parameters and percentile flow conditions at Station 3 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

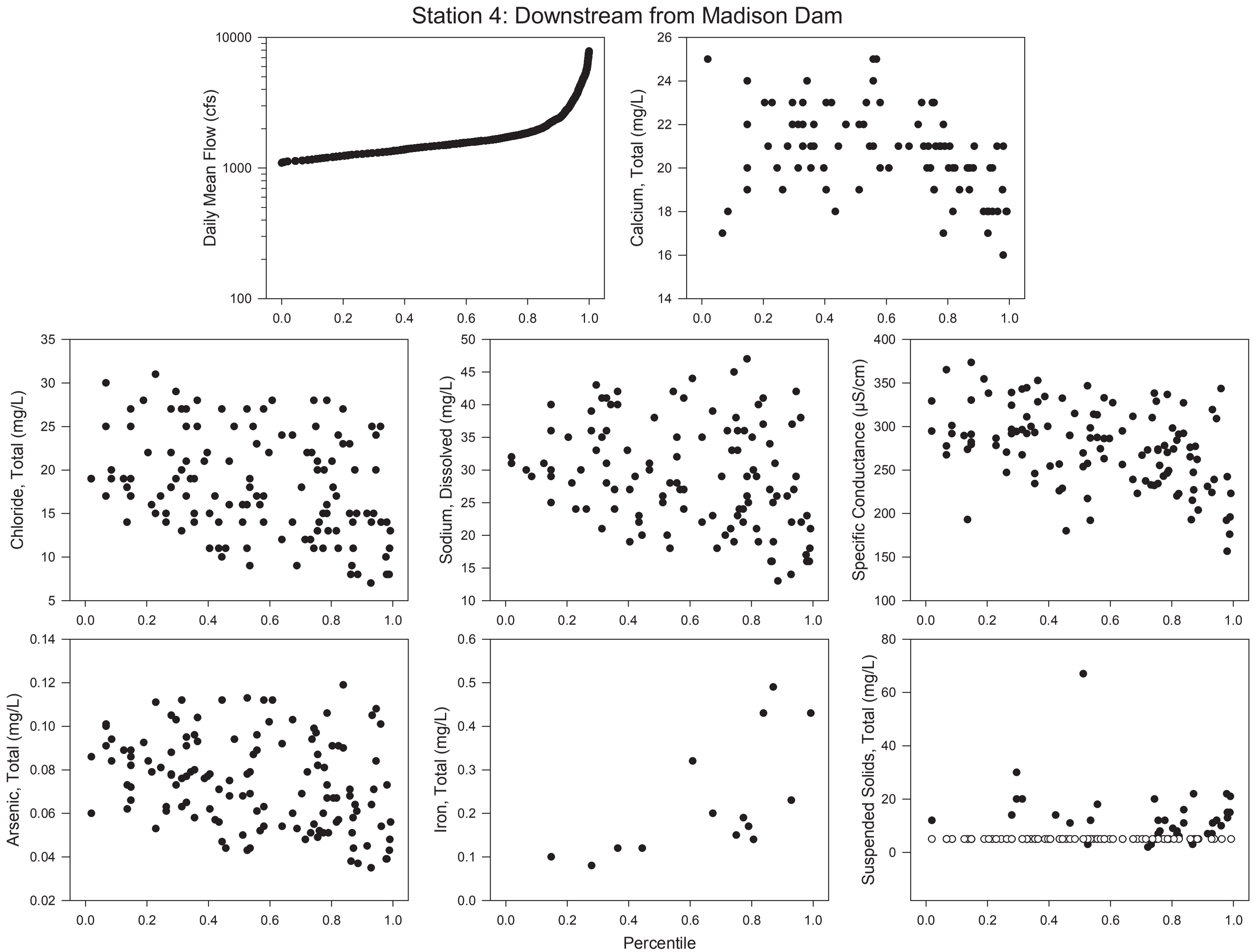


Figure 5-34: Relationships between selected parameters and percentile flow conditions at Station 4 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

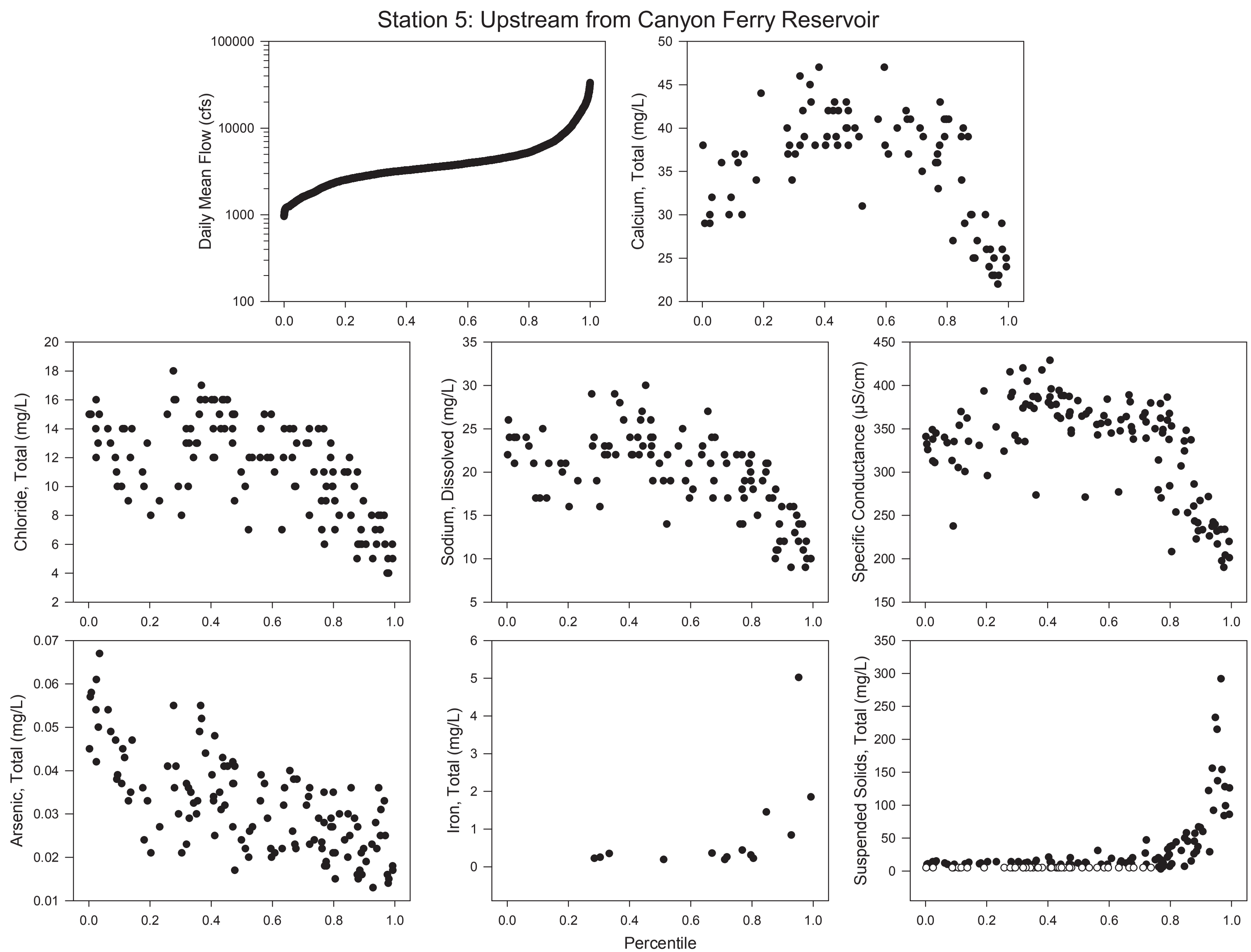


Figure 5-35: Relationships between selected parameters and percentile flow conditions at Station 5 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

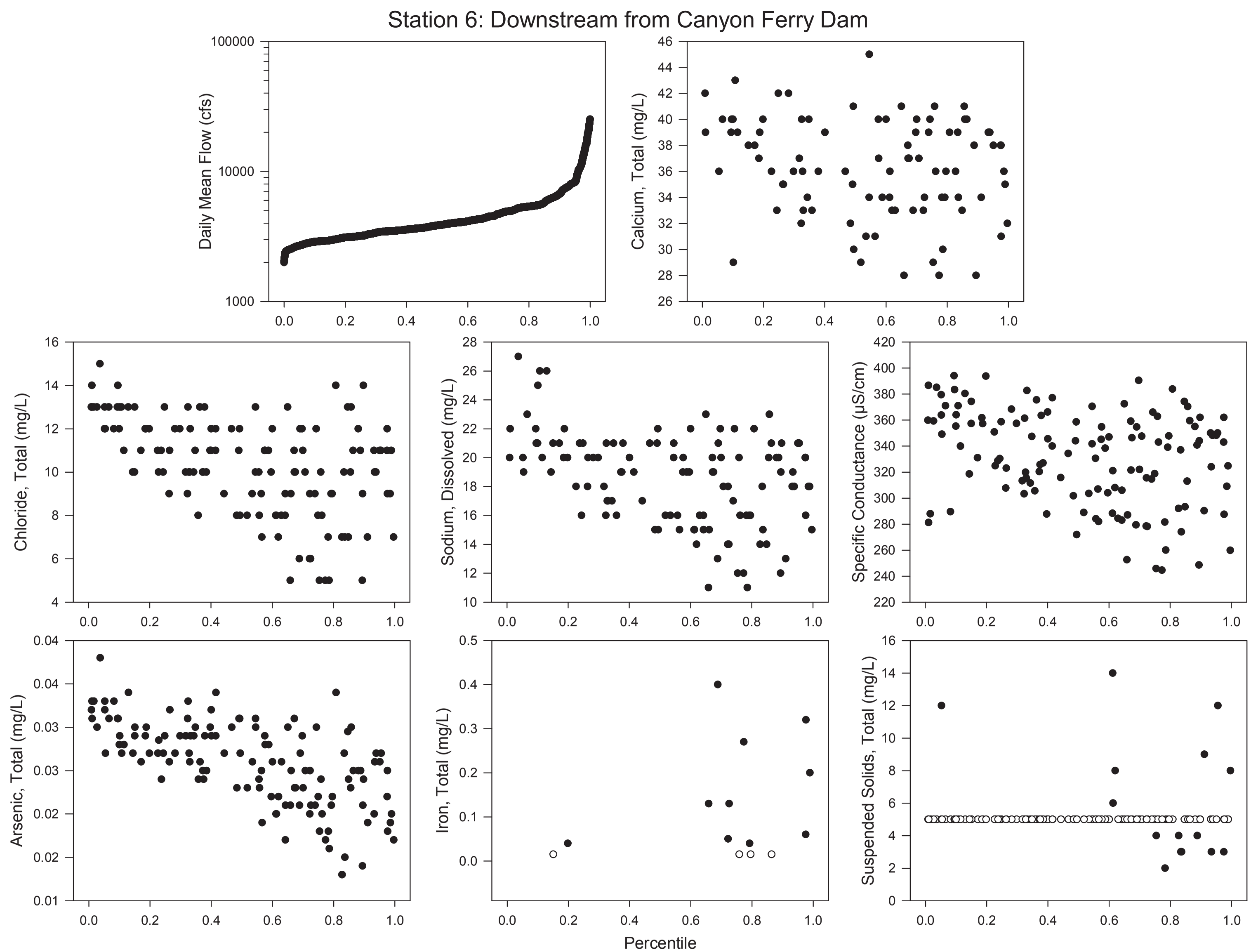


Figure 5-36: Relationships between selected parameters and percentile flow conditions at Station 6 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

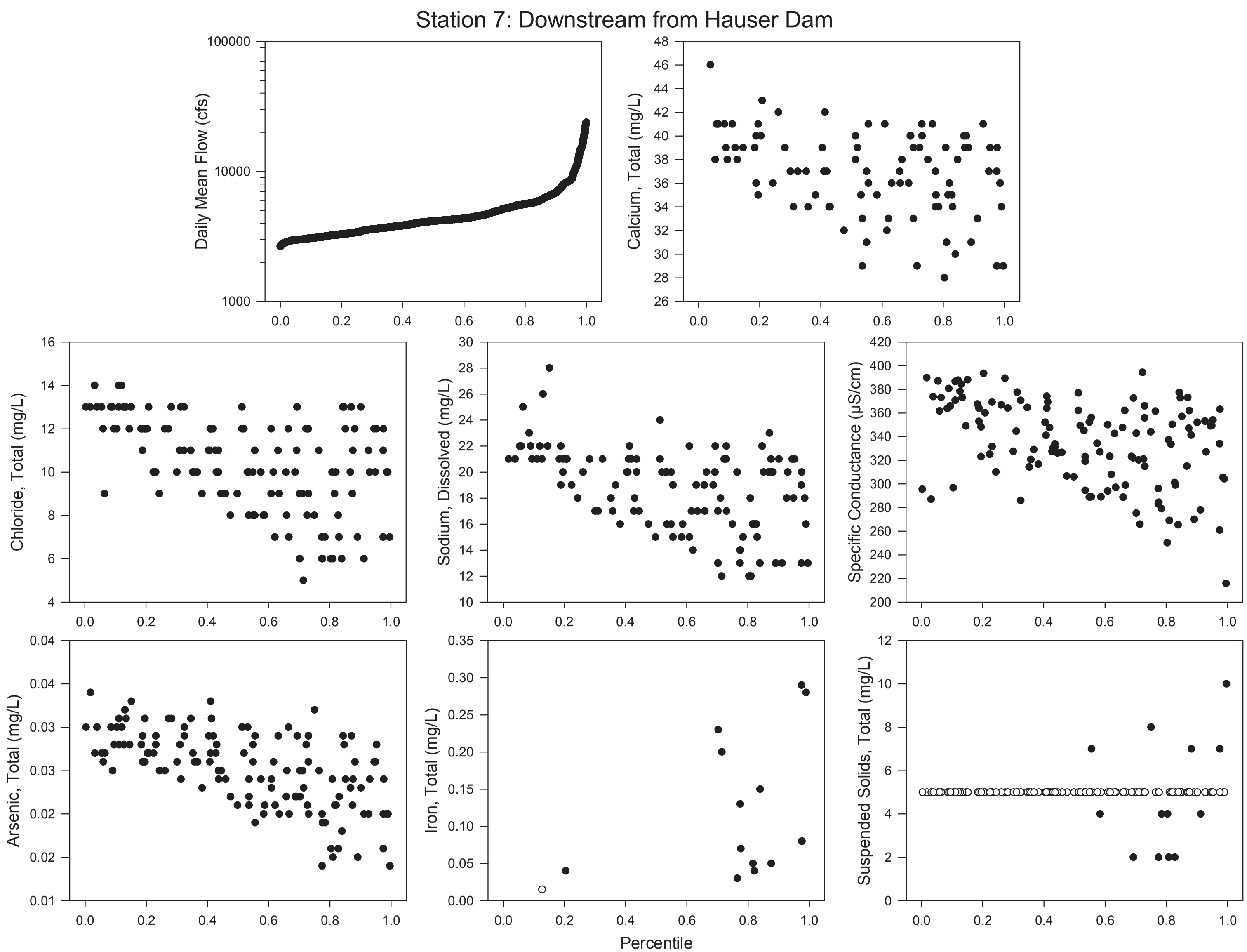


Figure 5-37: Relationships between selected parameters and percentile flow conditions at Station 7 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

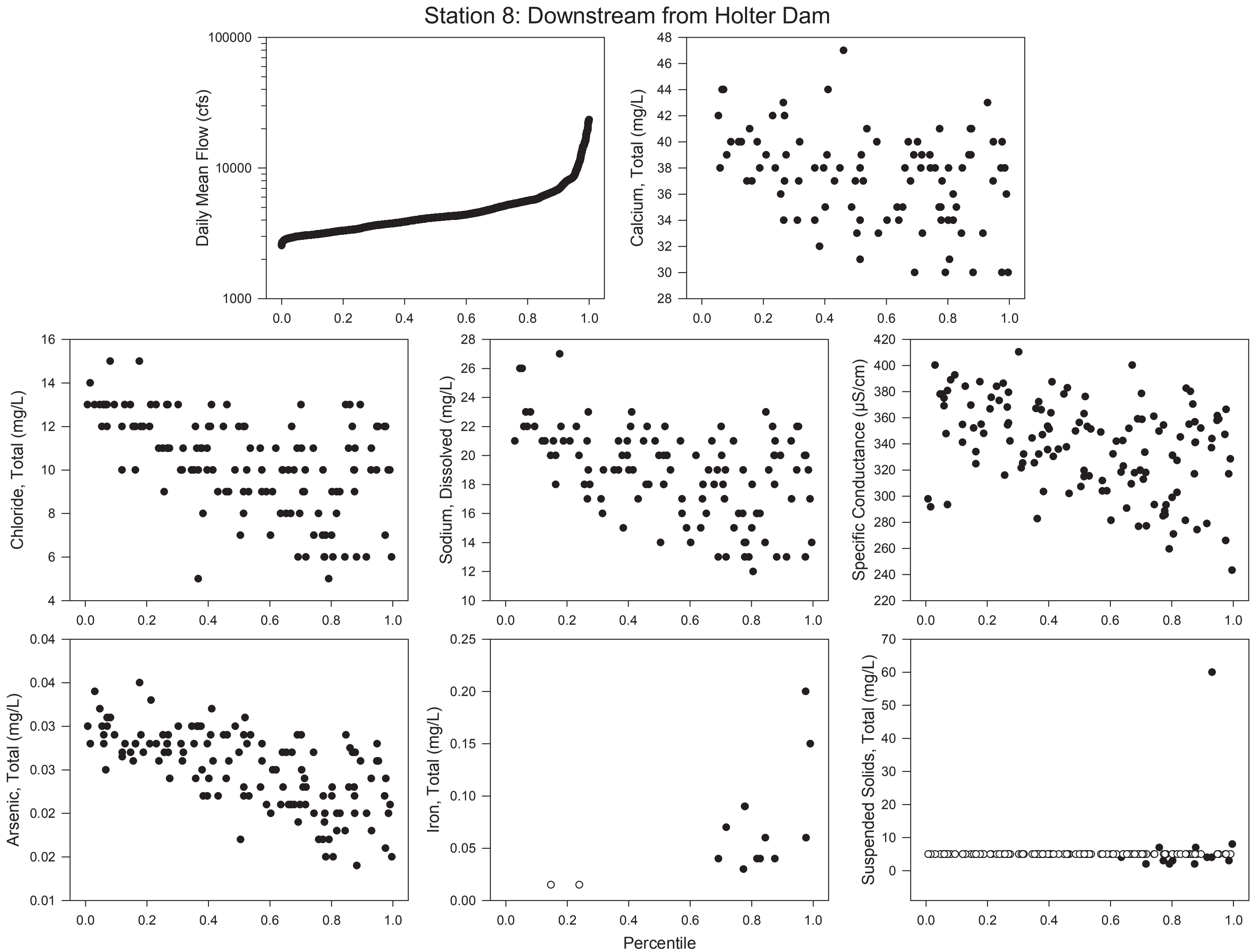


Figure 5-38: Relationships between selected parameters and percentile flow conditions at Station 8 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

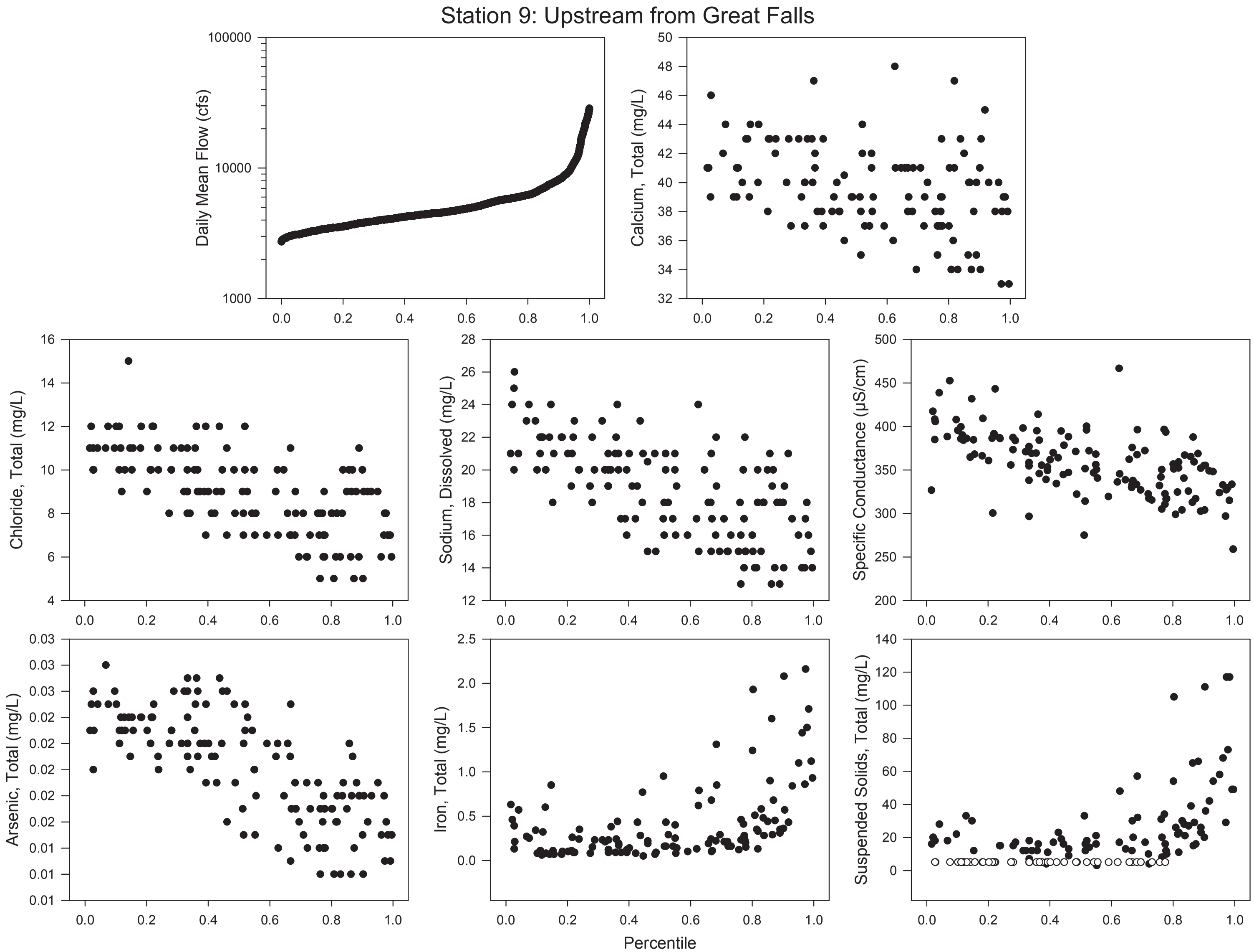


Figure 5-39: Relationships between selected parameters and percentile flow conditions at Station 9 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

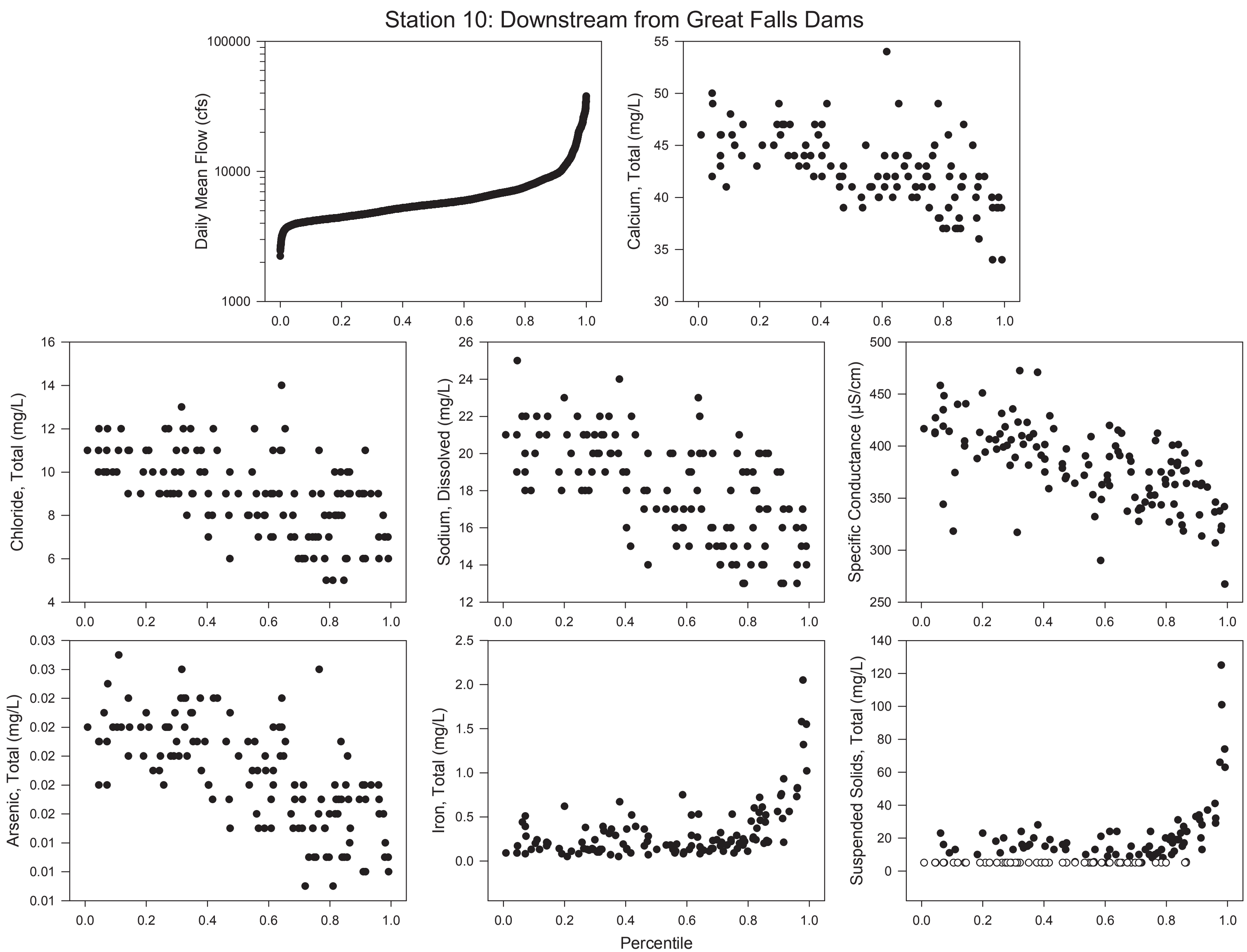


Figure 5-40: Relationships between selected parameters and percentile flow conditions at Station 10 from 1996 to 2016. Open circles represent non-detects which were replaced with values half of the MDL.

5.1.6 Flow Adjusted Trends

The figures presented above provide the basis for the flow-adjustment approach and addresses the objective of whether there was a trend over time for the last 10-year period of record (2007-2016), these data relationships were filtered to only include the last ten years of data as depicted in Figure 5-41, keeping the concentrations and flow percentiles paired. The filtered data pairs revealed that measured concentrations spanned the entire flow range for each station, and that there were no gaps in the relationships used to evaluate the effects of flow on each parameter. Due to the patterns in the data such as the calcium and specific conductance relationships at Station 5 and total suspended solids at Station 9, the chemistry data were transformed (natural logarithm) for the flow-adjusted analysis. This transformation also paired well with the normalized flow data, and ordinary least squares (OLS) regression analysis was performed on each data pair for each station. This analysis yielded pairs of estimated and measured concentrations (ln transformed) from which the residual values (i.e., difference) were calculated. These residual values represent the flow-adjusted data that were plotted over time (decimal year) to evaluate temporal trends (Figure 5-42). Pearson Correlation analysis was performed to evaluate the strength of the relationship and to determine whether there was a significant increasing or decreasing trend over time (2007-2016). Locally weighted scatterplot smoothing (LOESS) regression was also performed on flow-adjusted parameters of interest to identify non-linear patterns in the data and to corroborate the results. The flow-adjusted analyses removed the effect due to dilution, and allowed for testing of trends independent of flow that may result from other physical watershed processes. Total suspended solids and total iron tend to increase with discharge, while total calcium, total chloride, dissolved sodium, specific conductance and total arsenic tend to decrease with discharge (i.e. dilution).

Arsenic concentrations (as well as several other parameters) did not show uniform, linear monotonic trends over the monitoring period (Figure 5-42, Figure 5-43, Figure 5-44, and Figure 5-45). Instead, non-adjusted concentrations remained relative consistent over the period from 2007-2010, then following the high flow conditions in 2011, concentrations established a new baseline and generally increased over time from 2012 through 2016. This pattern in the data remains evident in the flow-adjusted data. To provide some context to the relative change in concentrations over time, the mean flow-adjusted concentrations for the first three-years was compared to the mean flow-adjusted concentrations for last three-years (Table 5-6). The flow-adjusted data were back-transformed to remove the effects of the natural logarithm for the percent change analysis which introduces a source or error in the analyses and increases the magnitude of change which remains relative to the parameter of interest. For example, the percent change in the flow-adjusted specific conductance at Station 10 was -46.4 % which is supported by Figure 5-43, but was not statistically significant (Table 5-6). Again, the results depend on the endpoints selected rather than an averaging or smoothing function, the calculated magnitude of change can be misleading and does not incorporate information about specific years such as 2011 that greatly affected concentrations throughout the Madison-Missouri stations.

Results of the flow adjusted analysis identified that only dissolved sodium at stations 9 and 10 exhibited significantly increasing trends over time (Table 5-5, Figure 5-44, Figure 5-45). All other flow-adjusted parameters that were strongly correlated to flow did not exhibit statistically significant trends over time. The dissolved sodium concentrations observed at Station 9 are likely the result of watershed processes such as agricultural practices in the Sun River system. The percent change in the flow-adjusted dissolved sodium concentrations was 126 % and 130 % change over time, respectively for stations 9 and 10.

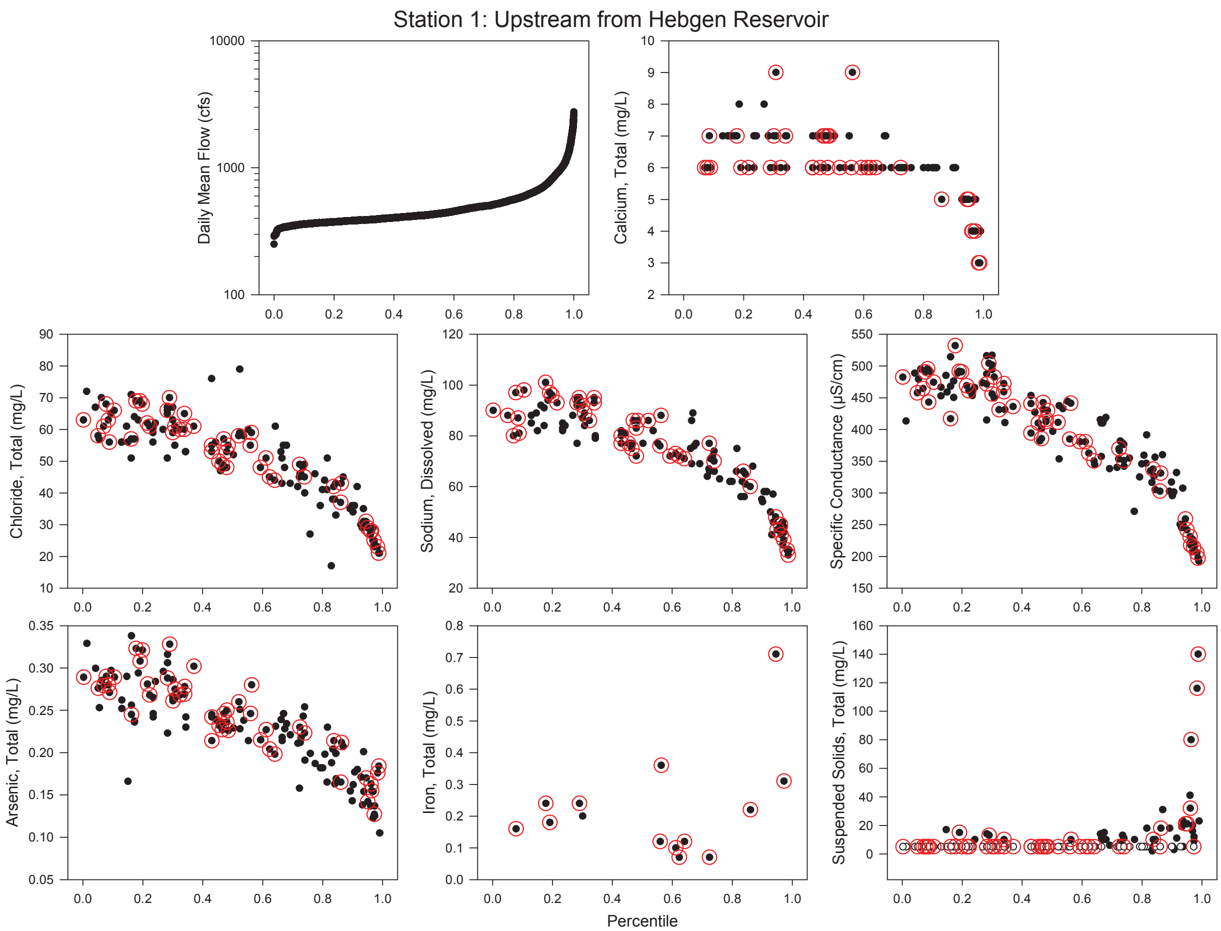


Figure 5-41: Filtered data used to calculate the flow-adjusted concentrations for Station 1. Open red circles identify 2007-2016 data and open black circles represent non-detects which were replaced with values one-half of the MDL.

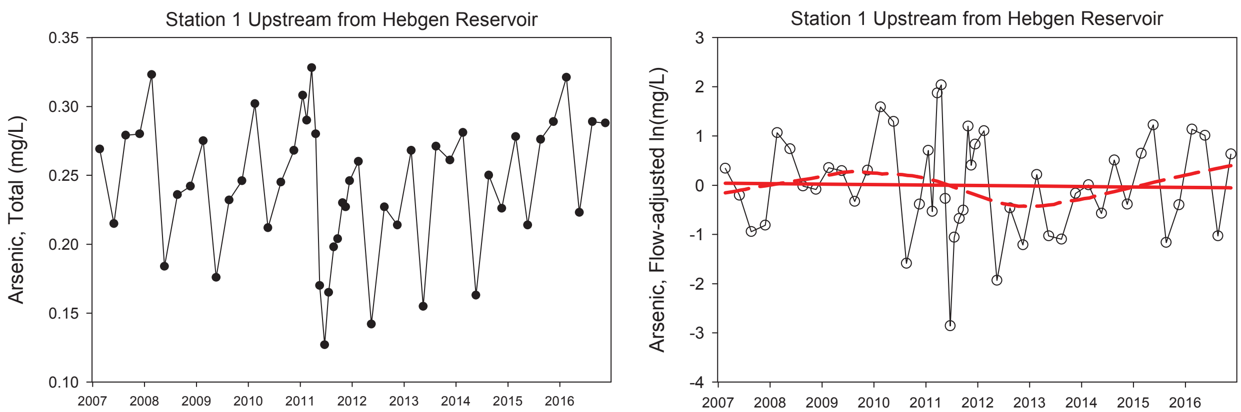


Figure 5-42: Total arsenic concentrations (A) and the flow-adjusted total arsenic concentrations (B) over time at Station 1. Solid red line represents linear regression and red dashed line represents LOESS regression at 50% smoothing (non-significant trend).

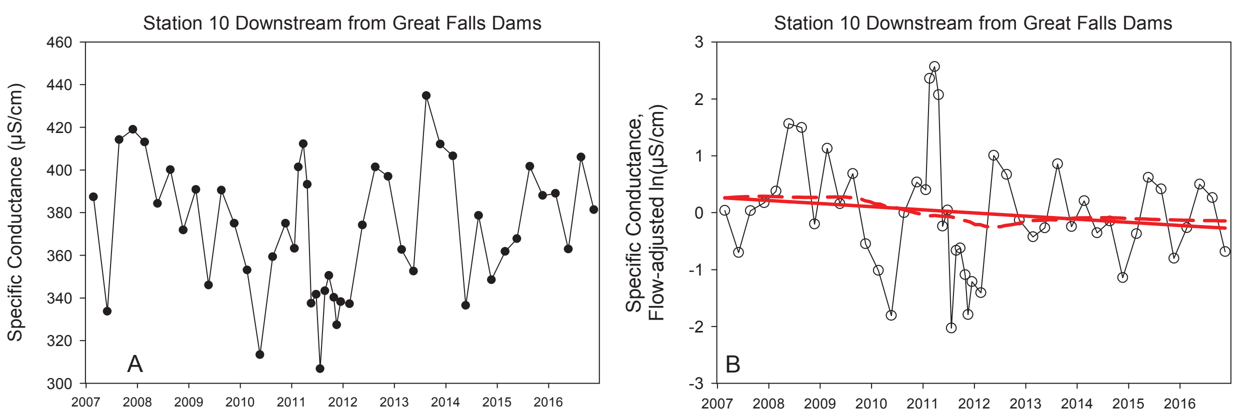


Figure 5-43: Specific conductance (A) and the flow-adjusted Specific conductance (B) over time at Station 10. Solid red line represents linear regression and red dashed line represents LOESS regression at 50% smoothing (non-significant trend).

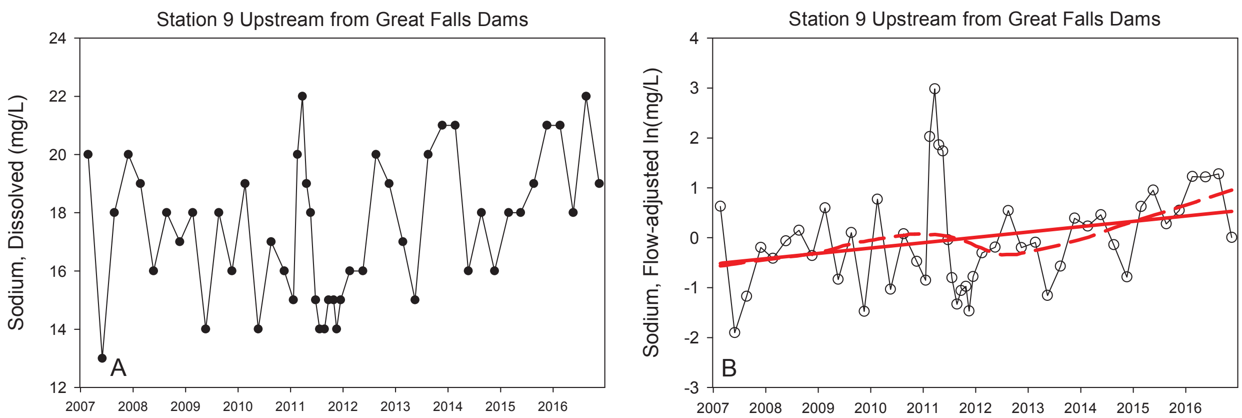


Figure 5-44: Dissolved sodium concentrations (A) and the flow-adjusted dissolved sodium concentrations (B) over time at Station 9. Solid red line represents linear regression and red dashed line represents LOESS regression at 50% smoothing (significant trend).

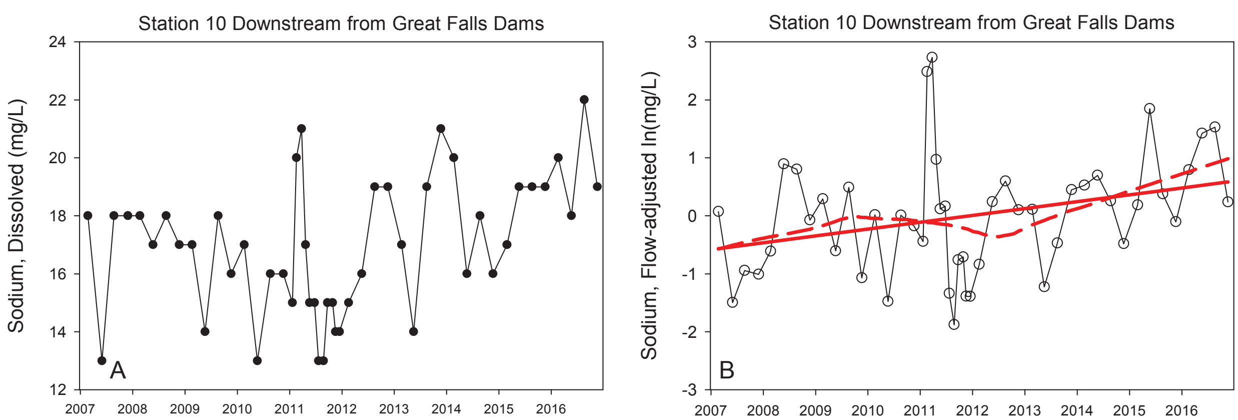


Figure 5-45: Dissolved sodium concentrations (A) and the flow-adjusted dissolved sodium concentrations (B) over time at Station 10. Solid red line represents linear regression and red dashed line represents LOESS regression at 50% smoothing (significant trend).

Overall, the effects of watershed influence or hydroelectric dams had little to no effect on water quality conditions outside of the effects of flow from 2007-2016. In the Madison River, there were few significant increasing trends for the non-adjusted ionic chemistry parameters such as total alkalinity, total bicarbonate, and total potassium, and these significant trends were generally limited to the upper three stations. There was likely a downstream carry-over effect observed for these three parameters stemming from changes that occurred at the most upstream station. In both the Madison and Missouri rivers, there were significant decreasing trends in total phosphorus. The most notable decreasing trends were observed for dissolved oxygen content (mg/l or percent saturation), which significantly decreased over time at all stations, except for stations 3 and 5. For the flow-adjusted parameters, only dissolved sodium exhibited significantly increasing trends over time at stations 9 and 10. Adjusting for flow effects can assist in evaluating long-term trends in water quality.

Table 5-5: Pearson's correlation trends analyses of flow adjusted concentrations from 2007 to 2016 at all stations.

Parameter	Statistic	1	2	3	4	5	6	7	8	9	10
Calcium, Total (mg/L)	Pearson Coefficient	0.130	-0.116	0.189	-0.210	0.032	-0.062	0.021	0.120	0.036	0.253
	Significance (2-tailed)	0.451	0.501	0.518	0.219	0.850	0.719	0.901	0.488	0.827	0.120
	N	36	36	14	36	36	36	36	36	40	39
Chloride, Total (mg/L)	Pearson Coefficient	0.054	0.068	0.155	-0.058	-0.020	-0.034	-0.048	-0.028	0.078	-0.004
	Significance (2-tailed)	0.714	0.645	0.526	0.698	0.892	0.805	0.747	0.851	0.597	0.976
	N	48	48	19	48	48	48	48	48	48	48
Sodium, Dissolved (mg/L)	Pearson Coefficient	0.142	0.167	0.124	0.075	0.127	0.126	0.138	0.155	0.283*	0.312*
	Significance (2-tailed)	0.359	0.278	0.613	0.626	0.413	0.414	0.373	0.314	0.051	0.031
	N	44	44	19	44	44	44	44	44	48	48
Suspended Solids, Total (mg/L)	Pearson Coefficient	-0.137	--	0.137	0.005	-0.072	--	--	--	0.009	0.095
	Significance (2-tailed)	0.352	--	0.575	0.971	0.627	--	--	--	0.949	0.520
	N	48	--	19	48	48	--	--	--	48	48
Arsenic, Total (mg/L)	Pearson Coefficient	-0.025	0.072	0.111	0.019	0.046	0.010	0.048	-0.027	0.085	0.042
	Significance (2-tailed)	0.865	0.625	0.650	0.900	0.758	0.944	0.748	0.855	0.567	0.776
	N	48	48	19	48	48	48	48	48	48	48
Iron, Total (mg/L)	Pearson Coefficient	-0.386	-0.404	-0.494	-0.155	-0.413	0.243	0.189	0.113	-0.075	-0.014
	Significance (2-tailed)	0.194	0.171	0.213	0.614	0.161	0.423	0.535	0.713	0.630	0.930
	N	13	13	8	13	13	13	13	13	44	44
Specific Conductance (µS/cm)	Pearson Coefficient	-0.040	0.033	0.167	-0.147	-0.108	-0.181	-0.182	-0.161	-0.117	-0.146
	Significance (2-tailed)	0.786	0.825	0.500	0.324	0.463	0.218	0.217	0.275	0.430	0.324
	N	48	47	18	47	48	48	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
-- Flow adjust values were not calculated because all values were the same (one-half the MDL).

Table 5-6: Relative percent change (%) between the 2007-2009 mean flow-adjusted concentration and the 2014-2016 mean flow-adjusted concentration at each station. -- = Not part of the 2011 SAP data collection effort or flow data was available (Station 3).

Parameter	1	2	3	4	5	6	7	8	9	10
Flow Adjusted Data										
Calcium, Total (mg/L)	8.6	-46.7	--	-52.7	-1.7	-9.8	22.8	67.4	-48.7	47.7
Chloride, Total (mg/L)	23.3	-5.4	--	-19.9	-5.6	-7.6	-0.3	2.5	58.6	12.3
Sodium, Dissolved (mg/L)	45.2	15.7	--	20.2	50.2	29.5	51.2	57.9	126.4	129.9
Suspended Solids, Total (mg/L)	-73.8	--	--	3.2	-36.4	--	--	--	-15.4	29.2
Arsenic, Total (mg/L)	23.7	-14.3	--	-1.0	-19.7	-13.3	10.2	0.7	-1.0	-17.9
Iron, Total (mg/L)	--	--	--	--	--	--	--	--	-18	-11.4
Specific Conductance (µS/cm)	-4.5	-23.9	--	-50.3	-21.5	-46.6	-44.6	-43.7	-35	-46.4

5.1.7 Site Specific Evaluations – Madison Dam and Canyon Ferry Dam

Site-specific dissolved oxygen conditions were examined in greater detail to evaluate the seasonal effects of the Madison Dam/Powerhouse and the Canyon Ferry Dam. As previously noted in the upstream-downstream comparisons, the change in dissolved oxygen content between stations 3 and 4 for the last 10-year period was not statistically significant with respect to the concentration, even though concentrations were less downstream. However, once the effects of water temperature and atmospheric pressure are considered, the relative percent saturation was significantly less downstream of the Madison Dam at Station 4 (Table 5-2). The upstream-downstream comparisons between stations 5 and 6 revealed that both dissolved oxygen concentration and percent saturation were statistically different over the last 10-year period.

When examined on a seasonal basis using the four quarterly sampling periods at each station, the Kruskal-Wallis test indicates a significant difference among the four seasonal quarters with respect to dissolved oxygen concentrations for all stations (Table 5-7). However, when the effects of water temperature and atmospheric pressure are considered on dissolved oxygen, the Kruskal-Wallis test revealed only a significant difference at Station 6, downstream of Canyon Ferry Dam. At stations 3 and 4, there is a gradual decline in concentration through the spring and summer months, although concentrations at Station 4 generally remain greater than 6 mg/L. The median dissolved oxygen concentrations by season are always less at Station 4 as compared to Station 3. While the median dissolved oxygen percent saturation values are also lower downstream, there is no seasonal effect for either Station 3 or Station 4. Percent saturation values generally remain greater than 80% downstream of the Madison Dam.

Table 5-7: Kruskal-Wallis seasonal analysis of dissolved oxygen content upstream and downstream of Madison Dam and Canyon Ferry Dam for 2007-2016.

Parameter	Statistic	3	4	5	6
Dissolved Oxygen (mg/L)	Chi-Square	21.00	19.73	18.41	19.22
	df	3	3	3	3
	Asymp. Sig.	0.000	0.000	0.000	0.000
Dissolved Oxygen (% Saturation)	Chi-Square	5.17	0.16	2.87	18.52
	df	3	3	3	3
	Asymp. Sig.	0.159	0.983	0.411	0.000*

At the stations that bracket the Canyon Ferry Dam, there is a significant seasonal effect as well as a downstream effect, albeit not a consistent negative impact on dissolved oxygen concentrations (Figure 5-46). During the spring season (Apr-Jun), dissolved oxygen concentrations are greater downstream of the dam which is a result of spilling surface flows that mitigate deep water releases. During the summer season (Jul-Sep), the deep-water releases significantly reduce both dissolved oxygen concentrations and percent saturation downstream of the dam, with a median concentration of 3.7 mg/L and percent saturation of 42%. The cooler fall water temperatures along with fall turnover, improve dissolved oxygen content with a median concentration of 6.9 mg/L (67 % saturation).

Overall, the Madison Dam/Powerhouse has a negligible effect on dissolved oxygen content with concentrations exhibiting a similar seasonal pattern that is observed for the upstream station. Percent saturation remains greater than 80% at Station 4 for all seasons. In contrast, the Canyon Ferry Dam significantly effects dissolved oxygen content downstream of the dam, albeit mixed effects. Even though conditions improved during the spring due to reservoir spilling, the summer and fall reservoir/operating conditions significantly reduce dissolved oxygen content downstream of the dam.

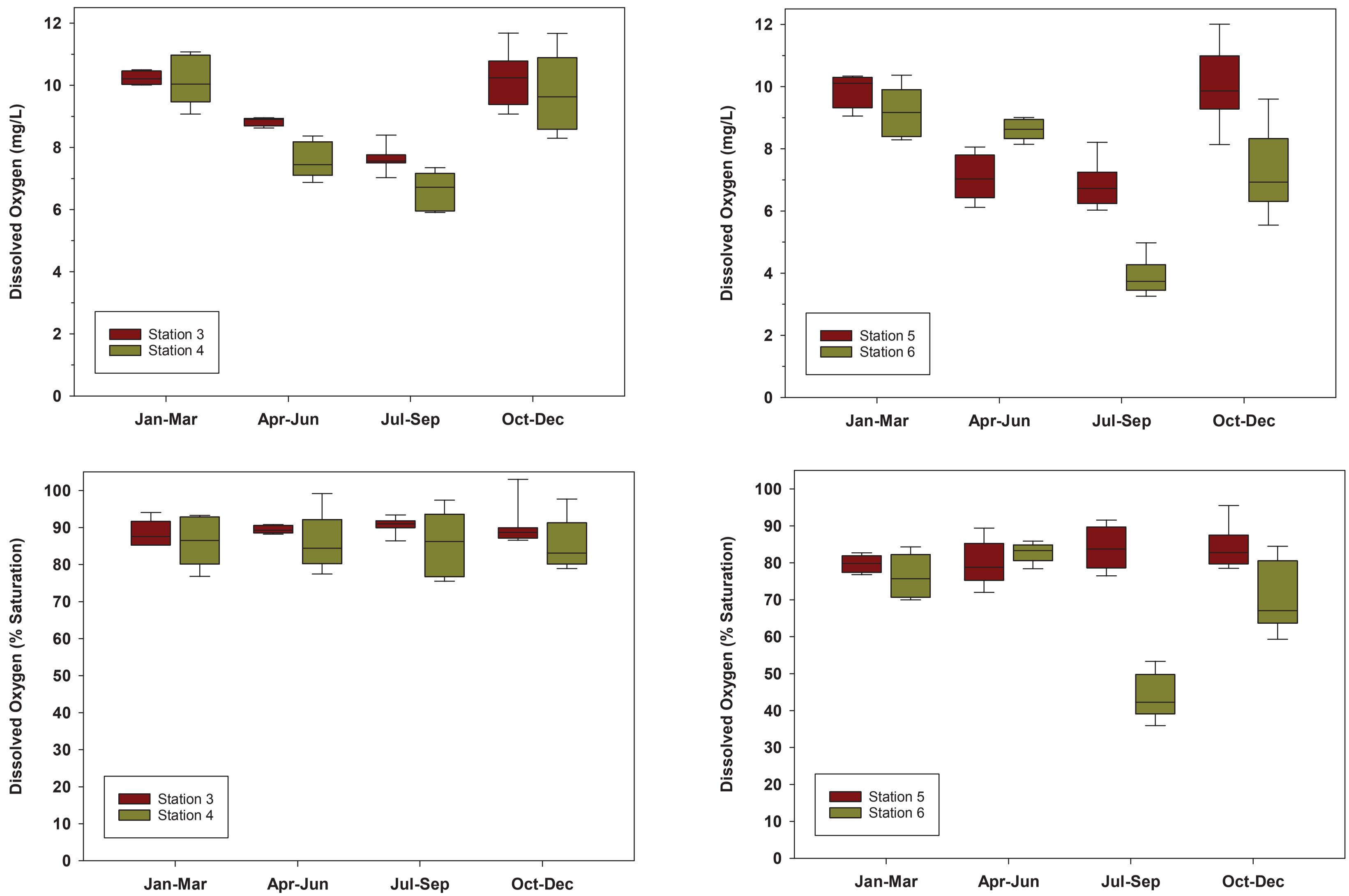


Figure 5-46: Dissolved oxygen conditions upstream and downstream of Madison Dam (stations 3 and 4) and Canyon Ferry Dam (stations 5 and 6).

5.2 Biological Analyses

5.2.1 Periphyton

5.2.1.1 Chlorophyll-a

Excessive periphyton biomass can be determined through analysis of chlorophyll-a content in periphyton samples. Ten replicate chlorophyll-a samples were collected in August at the seven chlorophyll-a monitoring stations using the scrape method from 2007 to 2009 and 2011. Results from these data are included in data tables and figures but will not be discussed as the method was discontinued in 2011. Four to nine replicate chlorophyll-a samples were also collected using the whole rock method from 2007 to 2016. Measurements below the detection limit were substituted with values one-half of the detection limit for statistical analysis.

5.2.1.1.1 Spatial Summary

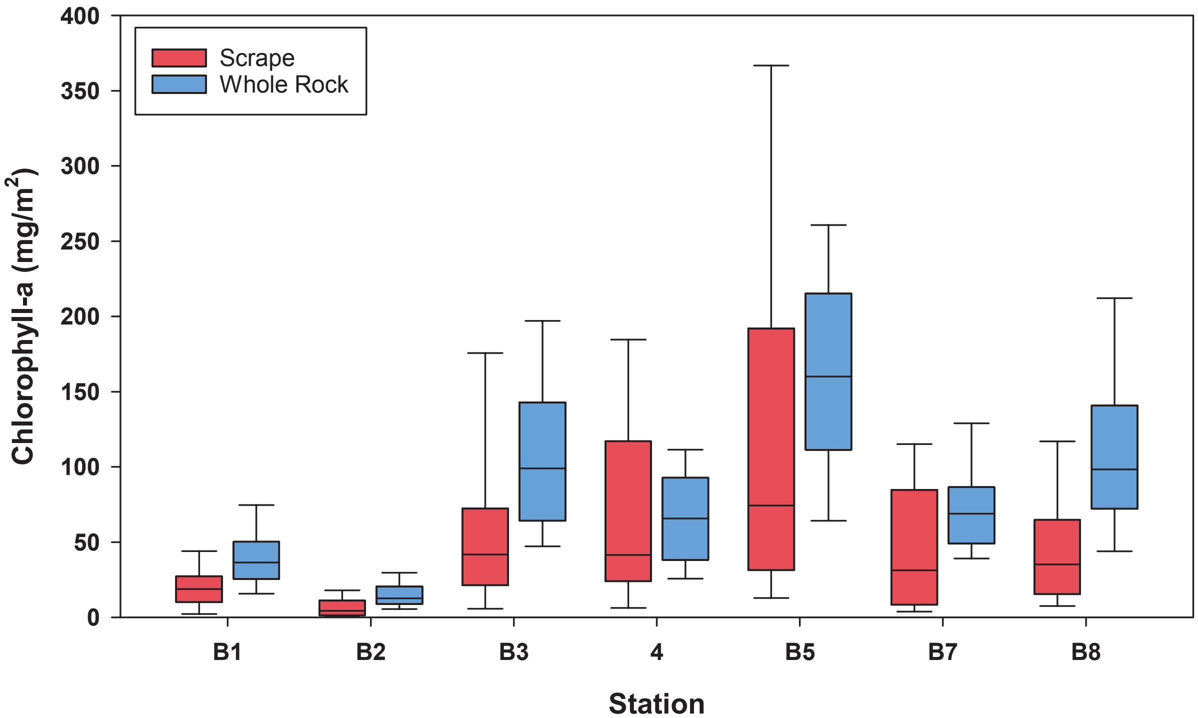
A summary of chlorophyll-a concentration results is presented in Table 5-8 and complete descriptive statistics are provided in Appendix C. Chlorophyll-a was detected in most samples and non-detects did not occur at the three downstream sites (Table 5-8). Mean whole rock chlorophyll-a concentrations were less than 120 mg/m^2 at all stations except for at Station B5, a background control station, at which the concentration was substantially greater (165 mg/m^2; Figure 5-47). Streams with concentrations greater than 120 mg/m^2 are often considered nutrient impaired (MTDEQ 2011; Suplee and Sada de Suplee 2011). This high algal biomass is likely due to increased nutrient concentrations, specifically nitrogen, from source waters in the Jefferson and Gallatin rivers.

Table 5-8: Chlorophyll-a (mg/m^2) descriptive statistics of replicate samples grouped by sampling method at all chlorophyll-a monitoring stations in August, 2007 to 2016. N = sample size and % ND = percent of non-detect results.

Station	Sample Type	N	Mean	Standard Deviation	% ND
B1	Scrape	40	20.7	14.1	12.5
	Whole Rock	57	40.2	21.9	0.0
B2	Scrape	40	7.4	9.0	2.5
	Whole Rock	53	14.7	8.4	0.0
B3	Scrape	40	65.8	84.7	2.5
	Whole Rock	57	112.2	67.6	0.0
4	Scrape	40	69.3	63.5	5.0
	Whole Rock	57	66.8	31.6	1.8
B5	Scrape	40	134.1	148.6	0.0
	Whole Rock	57	165.3	78.4	0.0
B7	Scrape	40	52.9	62.1	0.0
	Whole Rock	57	76.2	40.9	0.0
B8	Scrape	40	49.9	49.5	0.0
	Whole Rock	53	116.2	70.3	0.0

Longitudinal patterns of median chlorophyll-a concentrations are presented in Figure 5-47 and illustrate the spatial distributions of data collected from Station B1 (Yellowstone National Park) to Station B8 (Downstream of Holter Dam) for the 2007 to 2016 period. No longitudinal trend was apparent for the whole rock method (Figure 5-47) with each station exhibiting a high degree of intra/inter annual variability, except for Station B2. The median concentration was the lowest at Station B2, downstream of the Hebgen Dam, and the greatest at Station B5, a background control station for the headwaters of the Missouri River. Stations downstream of Hauser and Holter dams exhibited algal biomass conditions similar to stations in the Madison River, upstream of Ennis Lake and downstream of Madison Dam.

Figure 5-47: Chlorophyll-a (mg/m^2) boxplots of replicate samples grouped by sampling method for each station in August, 2007 to 2016.



5.2.1.1.2 Upstream-Downstream Comparisons

Comparisons of median chlorophyll-a concentrations for paired stations upstream-downstream of the reservoirs and dams were made using the non-parametric Mann-Whitney *U* test. This analysis was performed to identify persistent statistical differences from 2007 to 2016. A summary of significance and percent change is presented in Table 5-9 and complete statistical results are found in Appendix C.

Median whole rock method chlorophyll-a concentrations were significantly different at all upstream-downstream paired stations ($p < 0.00$; Table 5-9). Direction of change in whole rock method median chlorophyll-a concentrations between paired stations alternated longitudinally between decreasing and increasing and appears to have been influenced by total and dissolved nitrite-nitrate concentrations in the upper portion of the study area through Station B5. The largest significant increase in median chlorophyll-a concentration occurred between stations B2 and B3 (+685.7 %), which is a section of the Madison River between the Hebgen Dam and the Ennis campground, with a smaller increase also occurring between stations 4 and B5 (+143.2 %), which is a section of the Madison River between the Madison Dam and Canyon Ferry Reservoir that brackets the Three Forks confluence. Both increases correspond with an increase in total and dissolved nitrite-nitrate and neither of these station pairs are separated by a reservoir and dam. Decreases in median chlorophyll-a concentration occurred between stations B1 and B2 (-65.5 %) which are above and below Hebgen Reservoir with a smaller decrease also occurring between stations B3 and 4 (-33.5 %) which are above and below Ennis Reservoir. Both decreases correspond with a decrease in total nitrite-nitrate. In general, portions of the Madison River are affected by inorganic nitrogen and more favorable growing conditions (e.g. water temperature and light availability) in reaches where the river transitions through the more alluvial channel as compared to reaches downstream of the hydroelectric dams that are more geologically confined.

Table 5-9: Change (%) in median chlorophyll-a (mg/m^2) values between chlorophyll-a monitoring stations upstream-downstream of reservoirs and dams from 2007 to 2016. Grey cells indicate a statistically significant ($p < 0.05$) difference in mean ranks as determined by Mann–Whitney *U* tests.

Sample Type	B1 and B2	B2 and B3	B3 and 4	4 and B5	B5 and B7	B7 and B8
Scrape	-76.7	855.7	-0.6	78.9	-58.0	13.0
Whole Rock	-65.5	685.7	-33.5	143.2	-56.9	42.5

However, this relationship between nutrients and chlorophyll-a does not persist downstream of Station B5. Median chlorophyll-a concentration from the whole rock method decreased significantly between stations B5 and B7 (-56.9 %; Table 5-9), which are above and below Canyon Ferry and Hauser Reservoirs, despite the increase in total nitrite-nitrate between these stations. Multiple factors such as water temperature and turbulent mixing, may hinder algal growth in downstream of Canyon Ferry and Hauser dams.

5.2.1.1.3 Trend Analysis

Temporal trends in whole rock method chlorophyll-a replicate concentrations for each station were determined using the Mann-Kendall non-parametric trend analysis on data from 2007 to 2016. This analysis evaluated the monotonic trend (increasing or decreasing) over time provides the Tau correlation coefficient that provides information relative to the strength of the relationship between data pairs (Helsel et al. 2005, McBride 2005). Summary of chlorophyll-a concentration trends are presented in Table 5-10. Results from the scrape methodology were not analyzed due to the 2011 change in monitoring objectives for algal biomass. Bar graphs of Station B1 (Yellowstone National Park) to Station B8 (Downstream of Holter Dam) illustrating the temporal distributions of data for the 2007 to 2016 are found in Appendix C.

Chlorophyll-a concentrations significantly increased by 10.03 mg/L per year at Station B3 (Tau = 0.45, $p < 0.000$, slope = 10.03), the Ennis Campground, and by 3.8 mg/L per year at

Station 4 (Tau = 0.28, $p < 0.002$, slope = 3.8), downstream from Madison Dam, between 2007 and 2016 (Table 5-10). No statistically significant trends occurred at the remaining stations.

Table 5-10: Trends analyses of whole rock method mean chlorophyll-a (mg/m^2) replicate samples in August, 2007 to 2016 at all chlorophyll-a monitoring stations. Grey cells indicate statistically significant ($p < 0.05$) trends as determined by the Mann-Kendall trend analyses.

Statistic	B1	B2	B3	4	B5	B7	B8
Tau Correlation Coefficient	-0.110	0.080	0.454	0.276	0.100	0.070	-0.020
Significance	0.242	0.370	0.000	0.002	0.280	0.430	0.811
Slope	-0.200	0.000	10.030	3.858	0.395	0.000	0.000
N	57	53	57	57	57	57	53

5.2.1.2 Diatoms

Excessive periphyton growth often indicates impairment of the aquatic ecosystem and can be evaluated through analysis of diatom metrics. Replicate periphyton samples were collected and composited to create one sample in August from 2007 to 2016 at the biological monitoring stations. Species were identified and enumerated, metrics were calculated, and biological integrity and impairment for mountain and plains streams were assessed.

5.2.1.2.1 Spatial Metrics Summary

A summary of biological integrity ratings and descriptive statistics by diatom metrics is presented in Table 5-11. Overall biological integrity and impairment ratings by diatom monitoring station and year from 2007 to 2016 are also provided in Appendix D.

Throughout the study period, the biological integrity rating for the diatom metrics for the Mountains and Plains Streams – Shannon diversity, pollution tolerance index, disturbance index, species richness and abundance of dominant species – at all stations has been categorized as “Excellent”, as well as the siltation index in Plains Streams has been “Excellent” (Table 5-11). The exception to this was at Station B2, downstream from Hebgen Reservoir, where the pollution tolerance index for the Mountain Streams and the abundance of dominant species in both Mountain and Plains streams was “Good”. Percent abnormal cells was “Good” at all stations in Mountain streams while siltation index was “Good” at all stations except for “Fair” at B10, downstream from Great Falls reservoir, the city of Great Falls, and Sun and Smith Rivers.

Table 5-11: Biological integrity ratings descriptive statistics by diatom metrics at all diatom monitoring stations in August, 2007 to 2016.

Station	Metric	N	Min.	Max.	Mean	Stand. Dev.	Mountain Streams	Plains Streams
B2	Shannon Diversity	10	3.41	4.82	4.11	0.56	Excellent	Excellent
	Pollution Tolerance Index	10	2.31	2.58	2.43	0.08	Good	Excellent
	Siltation Index (%)	10	9.75	64.18	29.97	18.32	Good	Excellent
	Disturbance Index (%)	10	1.25	17.75	6.33	4.81	Excellent	Excellent
	Species Richness	10	40.00	60.00	49.20	6.94	Excellent	Excellent
	Abundance of Dominant Species (%)	10	16.00	46.75	27.71	11.08	Good	Good
	Abnormal Cells (%)[a]	10	0.00	1.50	0.75	0.48	Good	--
B3	Shannon Diversity	10	4.11	4.92	4.56	0.29	Excellent	Excellent
	Pollution Tolerance Index	10	2.54	2.70	2.63	0.05	Excellent	Excellent
	Siltation Index (%)	10	19.25	38.13	32.19	5.30	Good	Excellent
	Disturbance Index (%)	10	2.13	23.63	9.31	6.87	Excellent	Excellent
	Species Richness	10	46.00	66.00	57.70	7.35	Excellent	Excellent
	Abundance of Dominant Species (%)	10	11.13	23.63	16.77	4.38	Excellent	Excellent
	Abnormal Cells (%)[a]	10	0.00	0.88	0.34	0.31	Good	--
4	Shannon Diversity	10	4.39	5.43	5.04	0.33	Excellent	Excellent
	Pollution Tolerance Index	10	2.51	2.79	2.64	0.09	Excellent	Excellent
	Siltation Index (%)	10	7.25	51.04	28.80	12.98	Good	Excellent
	Disturbance Index (%)	10	1.88	5.72	3.63	1.23	Excellent	Excellent
	Species Richness	10	53.00	94.00	72.90	11.37	Excellent	Excellent
	Abundance of Dominant Species (%)	10	8.88	19.75	12.72	3.30	Excellent	Excellent
	Abnormal Cells (%)[a]	10	0.00	0.63	0.10	0.20	Good	--
B5	Shannon Diversity	10	4.18	5.02	4.68	0.34	Excellent	Excellent
	Pollution Tolerance Index	10	2.48	2.83	2.64	0.09	Excellent	Excellent
	Siltation Index (%)	10	13.63	55.38	30.58	14.76	Good	Excellent
	Disturbance Index (%)	10	1.13	13.38	5.26	4.17	Excellent	Excellent
	Species Richness	10	45.00	85.00	62.90	10.55	Excellent	Excellent
	Abundance of Dominant Species (%)	10	9.00	24.00	15.32	5.03	Excellent	Excellent
	Abnormal Cells (%)[a]	10	0.00	0.25	0.03	0.08	Good	--
B7	Shannon Diversity	10	3.22	4.48	4.05	0.39	Excellent	Excellent
	Pollution Tolerance Index	10	2.59	2.90	2.75	0.09	Excellent	Excellent
	Siltation Index (%)	10	14.13	38.00	22.49	8.56	Good	Excellent
	Disturbance Index (%)	10	0.38	14.04	6.21	4.43	Excellent	Excellent
	Species Richness	10	31.00	52.00	41.70	7.26	Excellent	Excellent
	Abundance of Dominant Species (%)	10	11.13	42.00	21.50	8.99	Excellent	Excellent
	Abnormal Cells (%)[a]	10	0.00	0.63	0.11	0.21	Good	--
B8	Shannon Diversity	10	3.46	4.67	4.04	0.32	Excellent	Excellent
	Pollution Tolerance Index	10	2.51	2.82	2.68	0.11	Excellent	Excellent
	Siltation Index (%)	10	8.13	45.75	26.65	10.98	Good	Excellent
	Disturbance Index (%)	10	0.25	31.26	12.92	10.63	Excellent	Excellent
	Species Richness	10	34.00	48.00	40.80	5.22	Excellent	Excellent
	Abundance of Dominant Species (%)	10	8.63	31.26	20.98	7.45	Excellent	Excellent
	Abnormal Cells (%)[a]	10	0.00	0.50	0.06	0.16	Good	--
B10	Shannon Diversity	10	3.37	5.33	4.59	0.63	Excellent	Excellent
	Pollution Tolerance Index	10	2.38	2.83	2.54	0.15	Excellent	Excellent
	Siltation Index (%)	10	13.38	62.13	44.66	16.92	Fair	Excellent
	Disturbance Index (%)	10	1.13	8.13	4.44	2.11	Excellent	Excellent
	Species Richness	10	44.00	88.00	67.50	14.68	Excellent	Excellent
	Abundance of Dominant Species (%)	10	11.22	36.75	20.25	9.74	Excellent	Excellent
	Abnormal Cells (%)[a]	10	0.00	0.13	0.01	0.04	Good	--

[a]Biological integrity ratings have not been established for abnormal cell (%) in plains streams.

The slightly lower ratings at Station B2 for Mountain Streams are reflected in that station's overall impairment rating of "Severe" in two of the previous 10 years which were caused mainly by poor scores for the siltation index and abundances of dominant species (Appendix D). This station has limited habitat due to increased channel braiding and the poorer metric scores may have been the result of a side channel being included in sampling (personal communication with Andy Welch). The Mountain Streams siltation index was also an issue at Station B10 which was rated with "Moderate" impairment in 6 of the 10 years and "Severe" impairment in 1 of the 10 years. Certainly, the size of the Missouri River at Station B10 (i.e., large river) and substrate characteristics are more characteristic of a Plains Stream than a Mountain Stream, so the metric rating should be considered in context. All other stations in all years were rated with a minimal number of "Moderate" impairment years and mostly "Minor" impairment or "None."

From 2007 to 2016, no longitudinal increasing or decreasing trends in diatom metrics were apparent except for a decrease in abnormal cells (%) in a downstream direction (Table 5-11; Figure 5-48 to Figure 5-54). This decrease may have been the result of increased ice and geothermal effects at the upstream stations. Both Shannon diversity, species richness, and abundance of dominant species (%) followed a general pattern of improved diatom community health from Station B2 to Station B4, a decline in health after the Three Forks confluence to stations B7 and B8 downstream of Upper Holter and Holter Reservoirs, respectively, and an improvement to Station B10, downstream from Great Falls reservoir, the city of Great Falls, and Sun and Smith Rivers. These similar patterns are expected as many diatom taxa are involved in multiple metrics.

Longitudinal patterns of median diatom metric values are presented in the following box plots (center bar) and data distributions (25^{th} & 75^{th} percentiles [box], and the 10^{th} & 90^{th} percentiles [whiskers]). These figures illustrate the spatial distributions of data from Station B2 (Downstream from Hebgen Dam) to Station B10 (Downstream from Great Falls Dams) for the 2007 to 2016 period.

Figure 5-48: Shannon diversity for each biological monitoring station in August, 2007 to 2016.

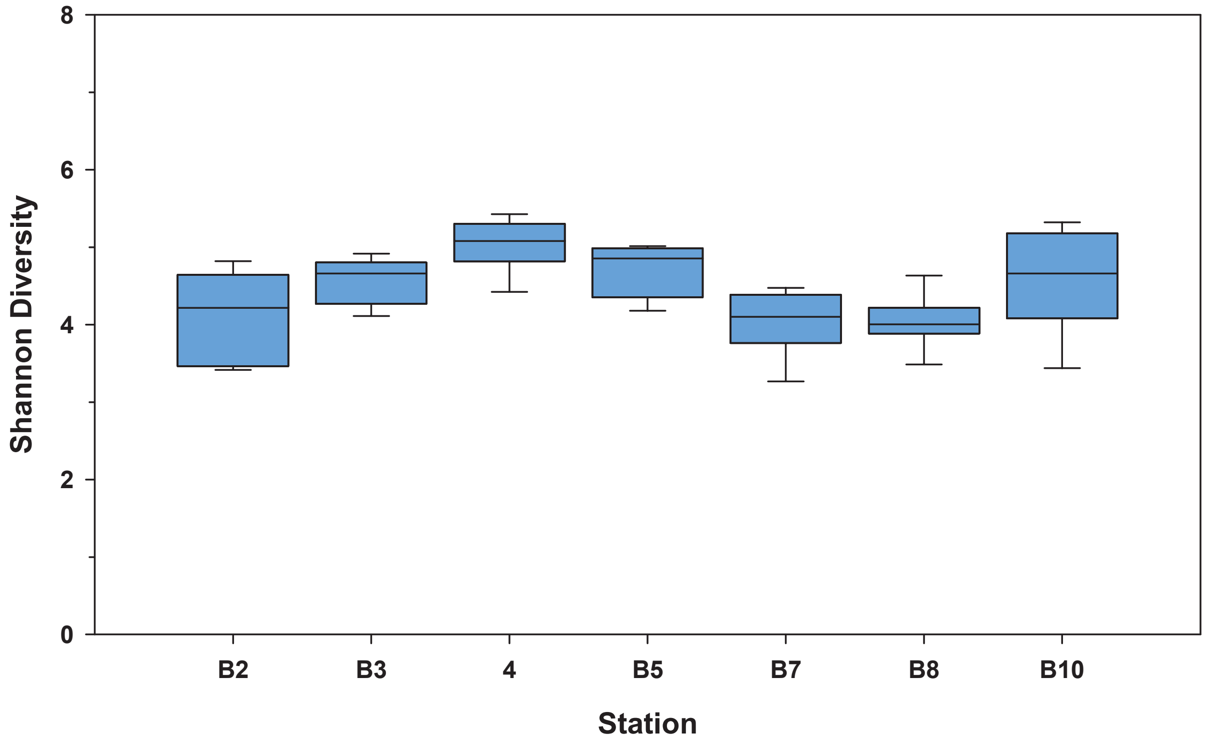


Figure 5-49: Pollution tolerance index for each biological monitoring station in August, 2007 to 2016.

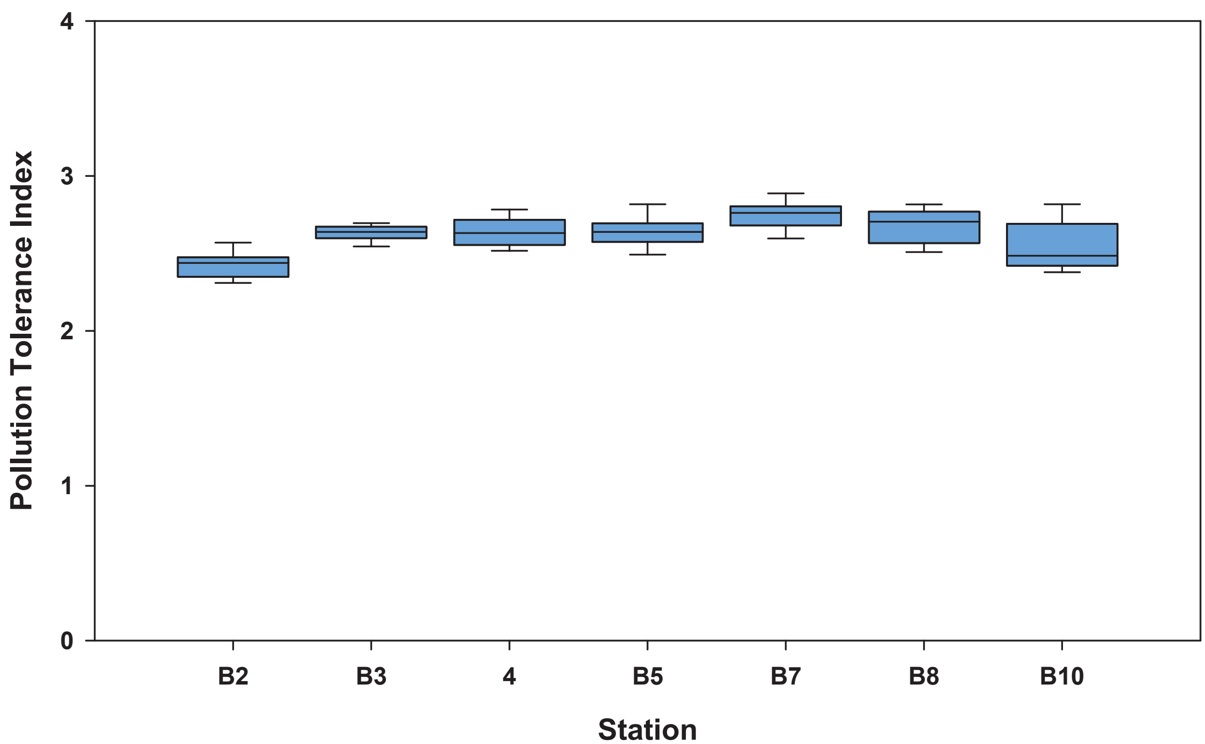


Figure 5-50: Siltation index (%) for each biological monitoring station in August, 2007 to 2016.

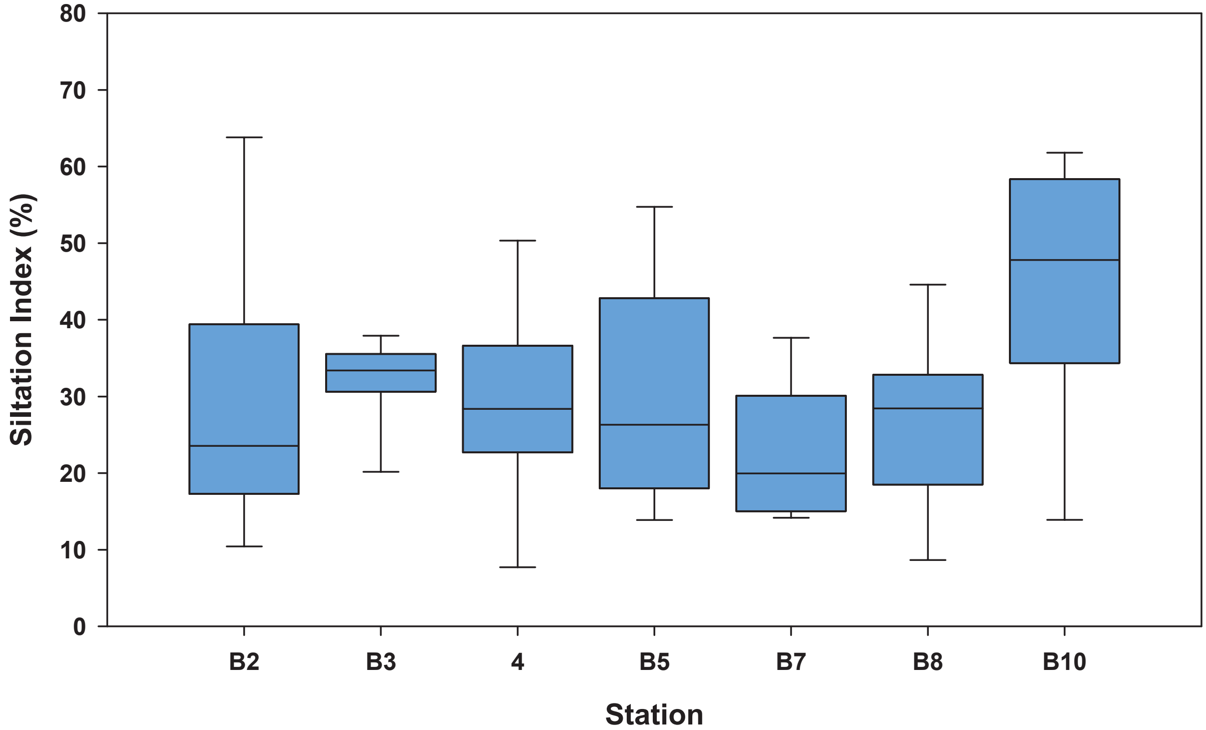


Figure 5-51: Disturbance index (%) for each biological monitoring station in August, 2007 to 2016.

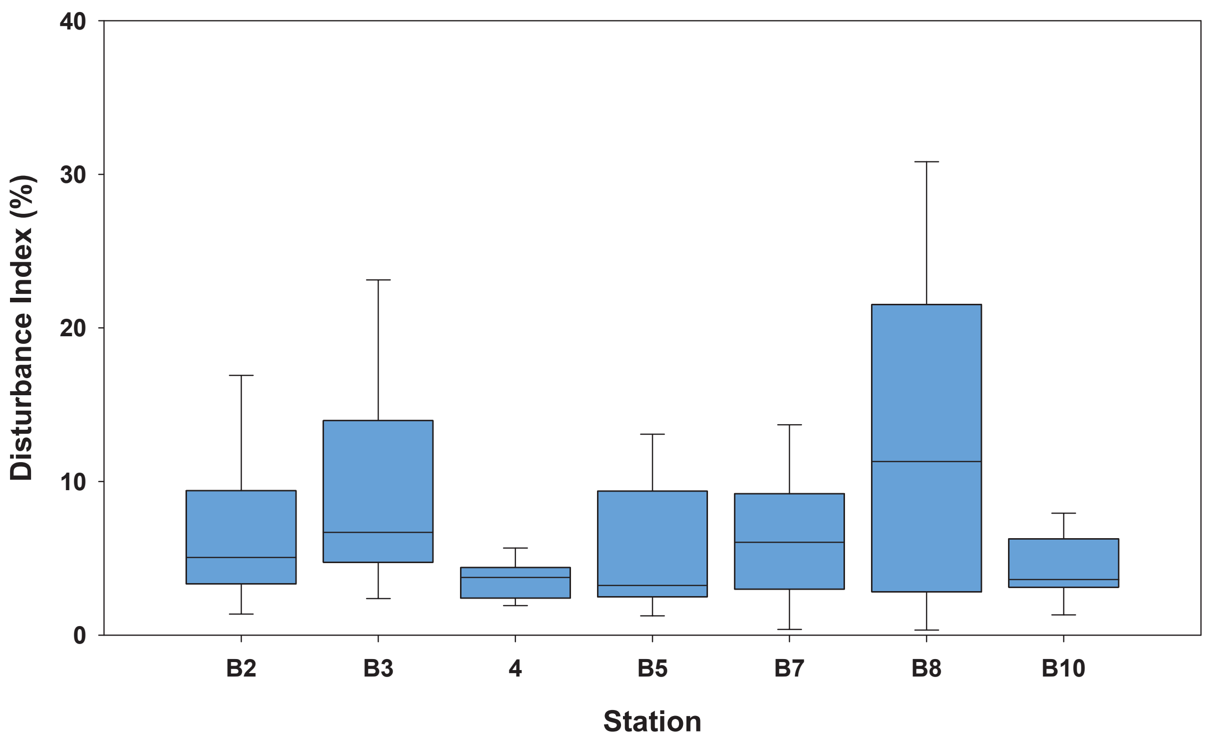


Figure 5-52: Species richness for each biological monitoring station in August, 2007 to 2016.

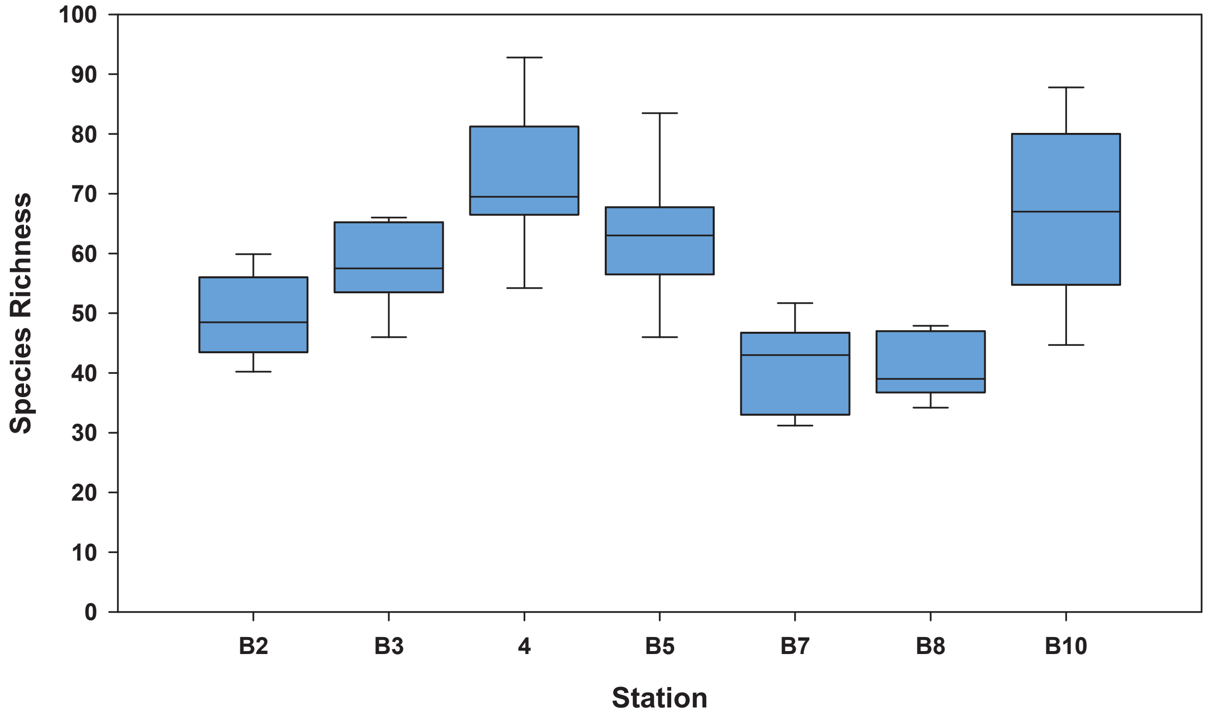


Figure 5-53: Abundance of dominant species (%) for each biological monitoring station in August, 2007 to 2016.

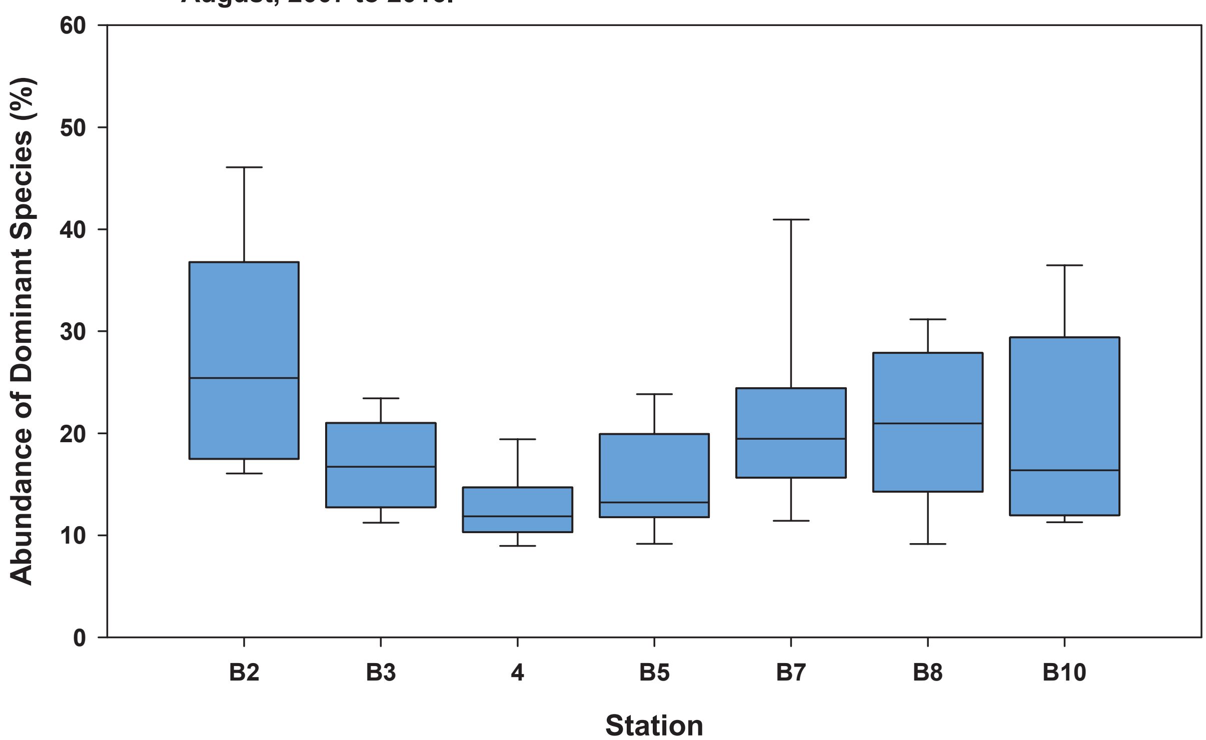
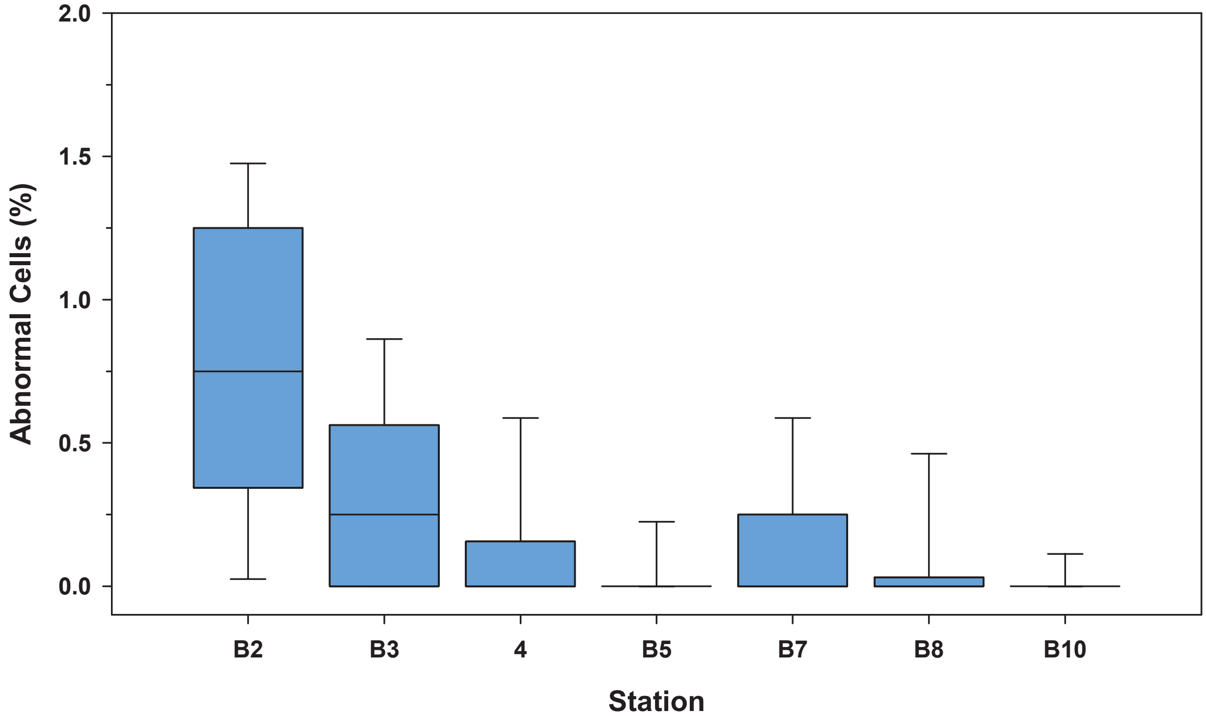


Figure 5-54: Abnormal cells (%) for each biological monitoring station in August, 2007 to 2016.



5.2.1.2.2 Upstream-Downstream Comparisons

Comparisons of median diatom metric values at paired biological monitoring stations directly upstream-downstream of the reservoirs and dams were made using the Mann-Whitney *U* non-parametric test. This analysis was performed to identify persistent statistical differences from 2007 to 2016. A summary of significance and percent change is presented in Table 5-12 and complete statistical results are provided in Appendix D.

Statistically significantly differences occurred for multiple metrics at all station pairs except between stations B7 and B8, downstream of Upper Holter and Holter Reservoirs, respectively ($p < 0.05$; Table 5-12). However, no more than four of the seven metrics were statistically different between any of the paired stations. Pollution tolerance index, species richness, and abundance of dominant species (%) were statistically different between stations B2 and B3 and indicate an improvement in diatom community biological integrity. In addition, Shannon diversity, disturbance index (%), species richness, and abundance of dominant species (%) were statistically different between stations B3 and 4, and also indicate an improvement in diatom community biological integrity. The significant changes between all other paired station were not consistently in the same direction and represented a mix of improving or declining conditions.

Table 5-12: Change (%) in median diatom metric values between diatom monitoring stations upstream-downstream of reservoirs and dams from 2007 to 2016. Grey cells indicate a statistically significant ($p < 0.05$) difference in mean ranks as determined by Mann–Whitney *U* tests.

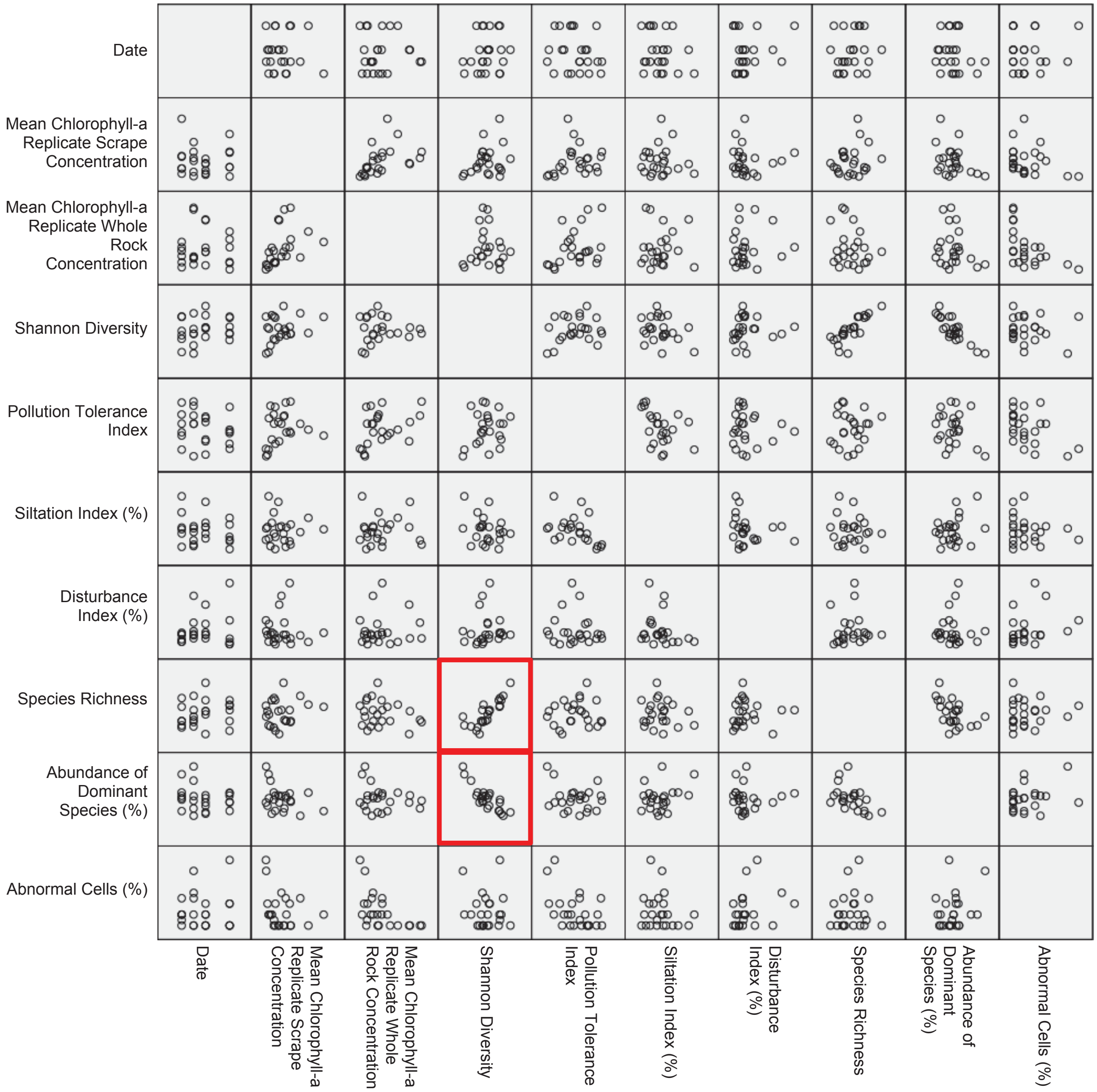
Metric	B2 and B3	B3 and 4	4 and B5	B5 and B7	B7 and B8	B8 and B10
Shannon Diversity	10.6	8.9	-4.4	-15.5	-2.3	16.3
Pollution Tolerance Index	8.2	-0.3	0.3	4.6	-2.0	-8.2
Siltation Index (%)	41.7	-15.0	-7.3	-24.1	42.4	68.1
Disturbance Index (%)	32.1	-43.9	-13.5	86.5	87.1	-68.0
Species Richness	18.6	20.9	-9.4	-31.7	-9.3	71.8
Abundance of Dominant Species (%)	-34.2	-29.0	11.6	46.9	7.8	-21.9
Abnormal Cells (%)	-66.7	-100.0	0.0	0.0	0.0	0.0

5.2.1.2.3 Metric Correlations

Correlations between diatom metrics and scrape and whole rock methods mean chlorophyll-a concentrations were evaluated using the non-parametric Kendall-tau statistic at each diatom monitoring station on data from 2007 to 2016. This analysis identified parameters that were statistically correlated and the strength of the relationship was determined based on a correlation coefficient > 0.5 and a statistically significant relationship ($p < 0.05$). A summary of these results in the form of a scatterplot matrix is presented in Figure 5-55 and the complete statistical results are presented in Appendix D. The scatter plot matrix incorporates multiple scatter plot relationships from multiple variable combinations into one table. Variables are listed along the rows and columns of the table. Results from scrape method are included in data tables and figures but will not be discussed as the method was discontinued in 2011.

The diatom metrics matrices of cross-correlations are quite extensive and are not detailed in narrative form, suffice to say that significant correlations between metrics were expected at each station as many diatom taxa are involved in multiple metrics. Specifically, Shannon diversity, abundance of dominant species (%), and mean chlorophyll-a replicate whole rock concentration were often correlated with other metrics at the same station (Appendix D). However, throughout all stations, metric relationships occurred between species richness and Shannon diversity and between species richness and abundance of dominant species (Figure 5-55). This abundance of correlations at specific stations but scarcity of metric relationships among all stations indicates that relationships between metrics differ greatly between stations.

Figure 5-55: Diatom metrics scatterplot matrix for all diatom monitoring stations in August, 2007-2016. Red boxes indicate a significant relationship between parameters.



5.2.1.2.4 Trend Analysis

Temporal trends in diatom metric values over time for each station were evaluated using Least Squares Regression analysis on data from 2007 to 2016. This analysis provides a coefficient of determination indicating the relative degree of association between paired diatom metric and year values. Summary of diatom metric trends are presented in Table 5-13. Bar graphs of Station B2 (Downstream from Hebgen Dam) to Station B10 (Downstream from Great Falls Dams) illustrating the temporal distributions of data and overall biological integrity and impairment ratings by diatom monitoring station and year from 2007 to 2016 are also presented in Appendix D.

Significant temporal trends ($p < 0.05$) of diatom metrics were limited in number and sporadic throughout the diatom monitoring stations (Table 5-13). These trends were all relatively flat indicating the metrics remained relatively consistent from 2007 to 2016 and did not increase or decrease. Only disturbance index (%) had trends significant at more than one station. No statistically significant trends occurred at stations B2 or B5 or for siltation index (%), species richness, or abundance of dominant species (%). These results indicate little change in the diatom community at each station from 2007 to 2016.

Table 5-13: Trend analyses of diatom metrics in August, 2007 to 2016 at all diatom monitoring stations. Grey cells indicate statistically significant ($p < 0.05$) trends as determined by Least Squares Regression.

Metric	Statistics	B-2	B-3	4	B-5	B-7	B-8	B-10
Shannon Diversity	Coefficient of determination	0.134	0.472	0.152	0.376	0.000	0.000	0.010
	Significance	0.299	0.028	0.266	0.059	0.993	0.993	0.785
	Slope	0.068	0.066	0.042	0.069	0.000	0.000	0.021
	N	10	10	10	10	10	10	10
Pollution Tolerance Index	Coefficient of determination	0.036	0.156	0.401	0.264	0.079	0.004	0.079
	Significance	0.600	0.258	0.049	0.129	0.432	0.862	0.433
	Slope	-0.005	0.006	-0.019	-0.016	-0.008	0.002	-0.014
	N	10	10	10	10	10	10	10
Siltation Index (%)	Coefficient of determination	0.009	0.033	0.294	0.031	0.162	0.009	0.162
	Significance	0.796	0.614	0.106	0.629	0.249	0.794	0.249
	Slope	-0.571	0.320	2.323	0.853	1.136	-0.345	2.245
	N	10	10	10	10	10	10	10
Disturbance Index (%)	Coefficient of determination	0.305	0.005	0.086	0.222	0.270	0.570	0.468
	Significance	0.098	0.847	0.412	0.169	0.124	0.012	0.029
	Slope	0.877	-0.159	0.119	0.649	0.760	2.650	0.477
	N	10	10	10	10	10	10	10
Species Richness	Coefficient of determination	0.005	0.321	0.046	0.312	0.253	0.068	0.083
	Significance	0.839	0.088	0.551	0.093	0.138	0.468	0.419
	Slope	-0.170	1.376	0.806	1.945	-1.206	0.448	-1.400
	N	10	10	10	10	10	10	10
Abundance of Dominant Species (%)	Coefficient of determination	0.020	0.153	0.332	0.156	0.257	0.032	0.050
	Significance	0.700	0.264	0.082	0.259	0.135	0.621	0.534
	Slope	-0.511	-0.566	-0.628	-0.656	-1.505	0.440	-0.721
	N	10	10	10	10	10	10	10
Abnormal Cells (%)	Coefficient of determination	0.048	0.320	0.227	0.273	0.579	0.000	0.003
	Significance	0.544	0.088	0.164	0.122	0.011	0.968	0.873
	Slope	-0.035	-0.058	-0.032	-0.014	-0.052	0.001	-0.001
	N	10	10	10	10	10	10	10

5.2.2 Macroinvertebrate

The health of an aquatic ecosystem is often assessed via the macroinvertebrate community and their associated metrics. Nine macroinvertebrate samples were collected and composited in August from 2007 to 2015 at each of the 11 biological monitoring stations. Macroinvertebrates were not collected at stations F3 and F4 in 2007 and the 2016 data for all stations were not available at time of analysis. Species were identified, enumerated and metrics were calculated by the taxonomist.

5.2.2.1.1 Spatial Metrics Summary

A summary of descriptive statistics by macroinvertebrate metrics is presented in Table 5-14. From 2007 to 2015, no longitudinal increasing or decreasing trends in macroinvertebrate metrics were apparent (Table 5-14; Figure 5-56 to Figure 5-63). All metrics, including multimetric assessment (% of possible score) but not relative abundance of Chironomidae (%), followed a general pattern of a consistent or decline in macroinvertebrate community health from Station B1 to Station F1, improved community health to Station B3, declined community health to Station 4, improved community health to Station F3, declined community health through Station B7, and improved community health through Station B10. These similar patterns among the metrics highlight the effects of Ennis Lake and Madison Dam on the community in the Madison River, and the effects of Canyon Ferry Reservoir/Dam on community in the Missouri River. Macroinvertebrate community health was poorer for the stations downstream of Hauser and Holter dams (B7 and B8), but improved by Station B10. The standard deviation for community density (0.25 m^2) was very high at all stations indicating a large variability in the number of organisms collected per year. Metrics at the biological control Station B5 often depicted a healthier community than stations downstream of the reservoirs on the Missouri River. Overall, the metrics, including multimetric assessment (% of possible), indicated a pattern of improving and declining macroinvertebrate health throughout the stations which is largely tied to the effects of Ennis Lake/Madison Dam and Canyon Ferry, Hauser, and Holter dams.

Longitudinal patterns of median macroinvertebrate metric values are presented in the following box plots (center bar) and data distributions (25^{th} & 75^{th} percentiles [box], and the 10^{th} & 90^{th} percentiles [whiskers]). These figures illustrate the spatial distributions of data from Station B1 (Yellowstone National Park) to Station B10 (Downstream from Great Falls Dams) including flush stations for 2007 to 2015.

Table 5-14: Macroinvertebrate metrics descriptive statistics of samples at all macroinvertebrate monitoring stations in August, 2007 to 2015.

Station	Metric	N	Min.	Max.	Mean	Stand. Dev.
B1	Taxa Richness[a]	9	23.60	34.20	28.75	3.62
	Shannon Diversity[a]	9	3.08	4.07	3.48	0.31
	Biotic Index[a]	9	3.88	4.91	4.60	0.33
	EPT Richness[a]	9	11.80	16.00	13.66	1.29
	Relative Abundance of EPT (%)[a]	9	56.00	84.00	66.22	8.77
	Relative Abundance of Chironomidae (%)[a]	9	4.00	13.00	7.89	2.67
	Community Density (0.25 m^2)[b]	9	287.00	796.00	522.89	197.86
	Multimetric Assessment (Total)[c]	9	21.00	27.00	25.00	1.73
	Multimetric Assessment (% of Possible)[c]	9	70.00	90.00	83.33	5.77
B2	Taxa Richness[a]	9	21.60	35.40	28.78	4.60
	Shannon Diversity[a]	9	2.68	3.97	3.41	0.41
	Biotic Index[a]	9	4.17	5.05	4.58	0.30
	EPT Richness[a]	9	8.00	15.60	12.60	2.51
	Relative Abundance of EPT (%)[a]	9	37.00	64.00	50.89	8.85
	Relative Abundance of Chironomidae (%)[a]	9	2.00	52.00	19.33	16.81
	Community Density (0.25 m^2)[b]	9	504.00	1,164.00	740.56	237.61
	Multimetric Assessment (Total)[c]	9	18.00	26.00	21.11	3.10
	Multimetric Assessment (% of Possible)[c]	9	60.00	86.67	70.37	10.33
F1	Taxa Richness[a]	9	23.60	33.80	29.09	3.05
	Shannon Diversity[a]	9	3.24	3.96	3.45	0.21
	Biotic Index[a]	9	4.70	5.71	5.16	0.33
	EPT Richness[a]	9	9.20	15.60	12.93	1.92
	Relative Abundance of EPT (%)[a]	9	24.00	40.00	29.89	5.13
	Relative Abundance of Chironomidae (%)[a]	9	6.00	38.00	17.78	10.86
	Community Density (0.25 m^2)[b]	9	658.00	1,811.00	1,240.44	452.16
	Multimetric Assessment (Total)[c]	9	16.00	22.00	19.11	1.90
	Multimetric Assessment (% of Possible)[c]	9	53.33	73.33	63.70	6.33
B3	Taxa Richness[a]	9	28.20	37.80	34.78	3.10
	Shannon Diversity[a]	9	3.39	4.14	3.89	0.23
	Biotic Index[a]	9	3.26	4.48	3.92	0.39
	EPT Richness[a]	9	16.60	19.20	17.87	0.98
	Relative Abundance of EPT (%)[a]	9	43.00	70.00	58.00	9.03
	Relative Abundance of Chironomidae (%)[a]	9	4.00	14.00	8.00	3.20
	Community Density (0.25 m^2)[b]	9	470.00	1,223.00	701.11	250.79
	Multimetric Assessment (Total)[c]	9	26.00	29.00	27.78	0.97
	Multimetric Assessment (% of Possible)[c]	9	86.67	96.67	92.59	3.24
4	Taxa Richness[a]	9	20.60	29.80	25.18	2.70
	Shannon Diversity[a]	9	2.62	3.28	2.93	0.24
	Biotic Index[a]	9	5.63	6.75	6.31	0.39
	EPT Richness[a]	9	5.40	8.80	6.82	1.31
	Relative Abundance of EPT (%)[a]	9	9.00	54.00	24.56	15.18
	Relative Abundance of Chironomidae (%)[a]	9	8.00	28.00	20.00	6.61
	Community Density (0.25 m^2)[b]	9	1,672.00	4,722.00	2,814.33	1,036.03
	Multimetric Assessment (Total)[c]	9	10.00	20.00	13.67	3.16
	Multimetric Assessment (% of Possible)[c]	9	33.33	66.67	45.56	10.54
F3	Taxa Richness[a]	8	28.00	36.40	32.68	3.46
	Shannon Diversity[a]	8	3.37	3.95	3.75	0.21
	Biotic Index[a]	8	3.83	5.73	4.56	0.59
	EPT Richness[a]	8	11.40	18.00	15.63	2.15
	Relative Abundance of EPT (%)[a]	8	32.00	81.00	61.25	15.06
	Relative Abundance of Chironomidae (%)[a]	8	7.00	26.00	16.00	7.39

Station	Metric	N	Min.	Max.	Mean	Stand. Dev.
	Community Density (0.25 m^2)[b]	8	495.00	1,489.00	950.50	350.85
	Multimetric Assessment (Total)[c]	8	18.00	30.00	25.75	3.77
	Multimetric Assessment (% of Possible)[c]	8	60.00	100.00	85.83	12.57
F4	Taxa Richness[a]	8	25.40	35.60	31.68	2.96
	Shannon Diversity[a]	8	3.50	4.02	3.77	0.19
	Biotic Index[a]	8	4.01	4.73	4.36	0.23
	EPT Richness[a]	8	11.80	18.20	15.63	2.05
	Relative Abundance of EPT (%)[a]	8	64.00	77.00	72.13	3.98
	Relative Abundance of Chironomidae (%)[a]	8	7.00	15.00	10.00	2.62
	Community Density (0.25 m^2)[b]	8	902.00	2,641.00	1,620.38	608.56
	Multimetric Assessment (Total)[c]	8	25.00	29.00	27.13	1.46
	Multimetric Assessment (% of Possible)[c]	8	83.33	96.67	90.42	4.86
B5	Taxa Richness[a]	9	28.00	33.80	30.69	2.04
	Shannon Diversity[a]	9	3.38	4.03	3.76	0.23
	Biotic Index[a]	9	4.33	5.53	4.77	0.37
	EPT Richness[a]	9	14.00	22.00	16.64	2.65
	Relative Abundance of EPT (%)[a]	9	33.00	85.00	66.00	18.39
	Relative Abundance of Chironomidae (%)[a]	9	4.00	51.00	20.00	14.64
	Community Density (0.25 m^2)[b]	9	765.00	2,309.00	1,396.67	625.99
	Multimetric Assessment (Total)[c]	9	16.00	29.00	24.78	4.24
	Multimetric Assessment (% of Possible)[c]	9	53.33	96.67	82.59	14.12
B7	Taxa Richness[a]	9	14.20	20.00	17.20	1.76
	Shannon Diversity[a]	9	2.08	3.10	2.67	0.38
	Biotic Index[a]	9	5.34	6.73	5.91	0.46
	EPT Richness[a]	9	3.20	5.20	4.13	0.66
	Relative Abundance of EPT (%)[a]	9	5.00	33.00	13.00	10.38
	Relative Abundance of Chironomidae (%)[a]	9	5.00	36.00	18.44	9.23
	Community Density (0.25 m^2)[b]	9	2,525.00	10,227.00	4,797.22	3,004.10
	Multimetric Assessment (Total)[c]	9	9.00	15.00	11.11	2.37
	Multimetric Assessment (% of Possible)[c]	9	30.00	50.00	37.04	7.90
B8	Taxa Richness[a]	9	16.80	24.40	19.53	2.18
	Shannon Diversity[a]	9	2.57	3.45	2.95	0.28
	Biotic Index[a]	9	5.43	6.15	5.81	0.25
	EPT Richness[a]	9	3.80	7.00	5.22	0.89
	Relative Abundance of EPT (%)[a]	9	7.00	58.00	32.22	17.57
	Relative Abundance of Chironomidae (%)[a]	9	5.00	47.00	14.00	12.73
	Community Density (0.25 m^2)[b]	9	1,996.00	5,631.00	3,841.22	1,115.96
	Multimetric Assessment (Total)[c]	9	11.00	18.00	14.00	2.74
	Multimetric Assessment (% of Possible)[c]	9	36.67	60.00	46.67	9.13
B10	Taxa Richness[a]	9	22.60	33.20	26.93	3.15
	Shannon Diversity[a]	9	2.87	3.88	3.34	0.28
	Biotic Index[a]	9	4.59	5.81	5.26	0.42
	EPT Richness[a]	9	11.00	15.00	12.73	1.46
	Relative Abundance of EPT (%)[a]	9	48.00	89.00	64.44	15.53
	Relative Abundance of Chironomidae (%)[a]	9	7.00	40.00	26.44	12.31
	Community Density (0.25 m^2)[b]	9	697.00	2,186.00	1,166.89	443.17
	Multimetric Assessment (Total)[c]	9	16.00	25.00	20.67	3.39
	Multimetric Assessment (% of Possible)[c]	9	53.33	83.33	68.89	11.30

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No amphipoda or isopoda collected at all sites.

Figure 5-56: Taxa richness boxplot for each macroinvertebrate monitoring station in August, 2007 to 2015.

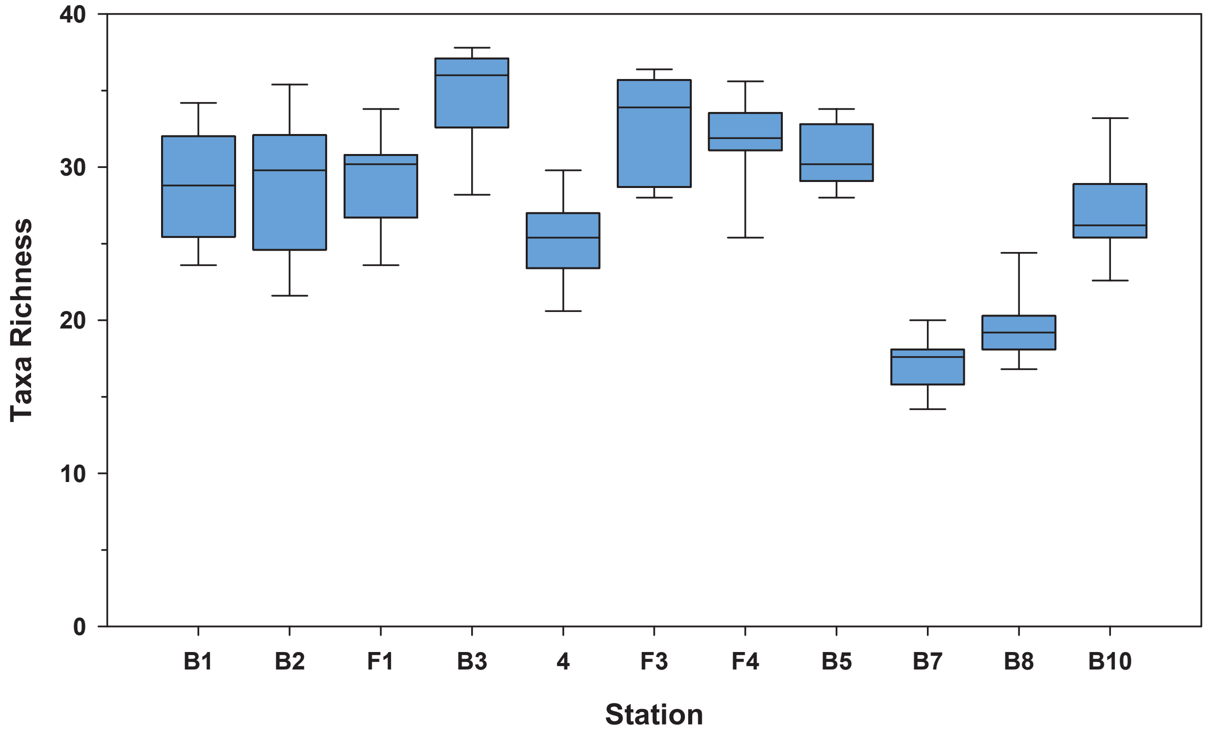


Figure 5-57: Shannon diversity boxplot for each macroinvertebrate monitoring station in August, 2007 to 2015.

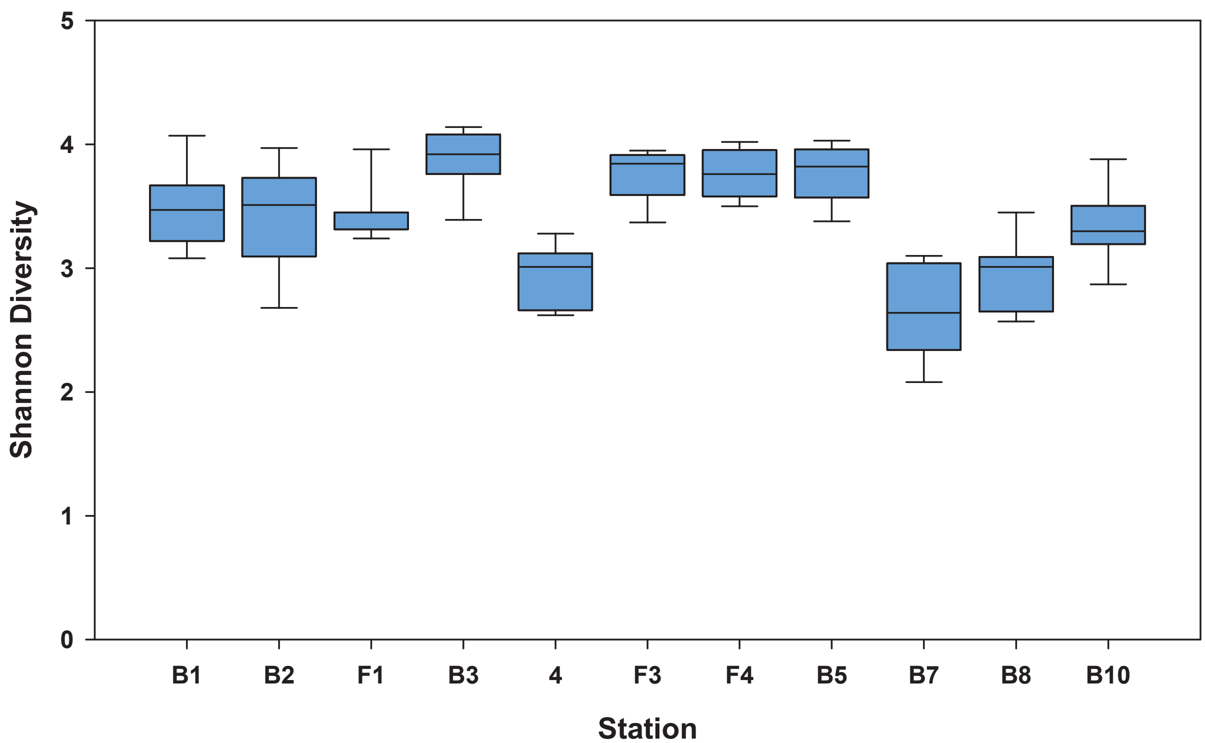


Figure 5-58: Biotic index boxplot for each macroinvertebrate monitoring station in August, 2007 to 2015.

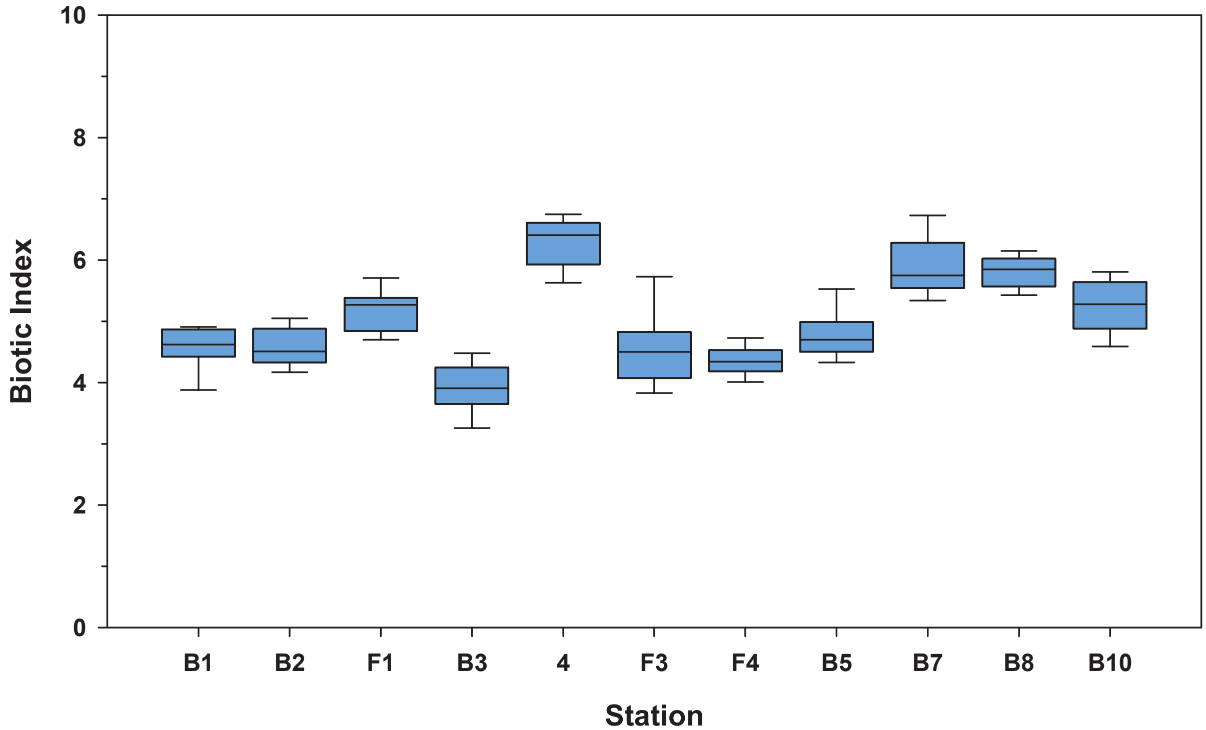


Figure 5-59: EPT richness boxplot for each macroinvertebrate monitoring station in August, 2007 to 2015.

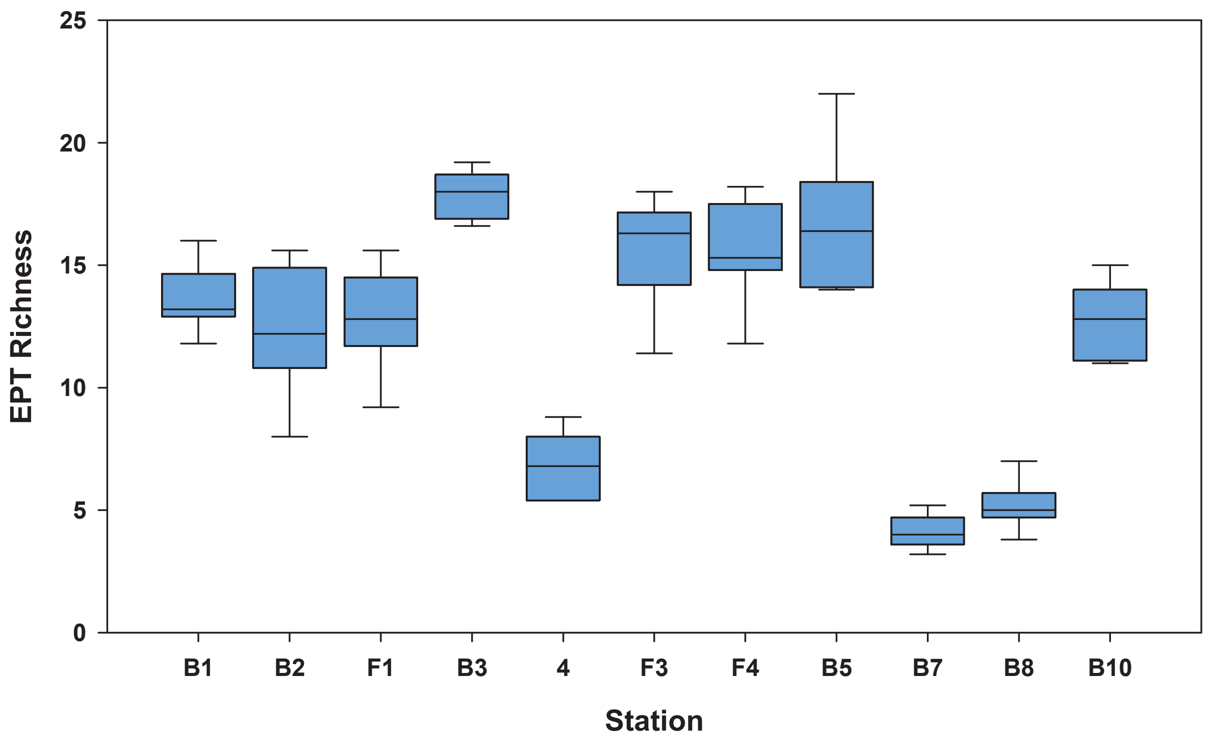


Figure 5-60: Relative abundance of EPT (%) boxplot for each macroinvertebrate monitoring station in August, 2007 to 2015.

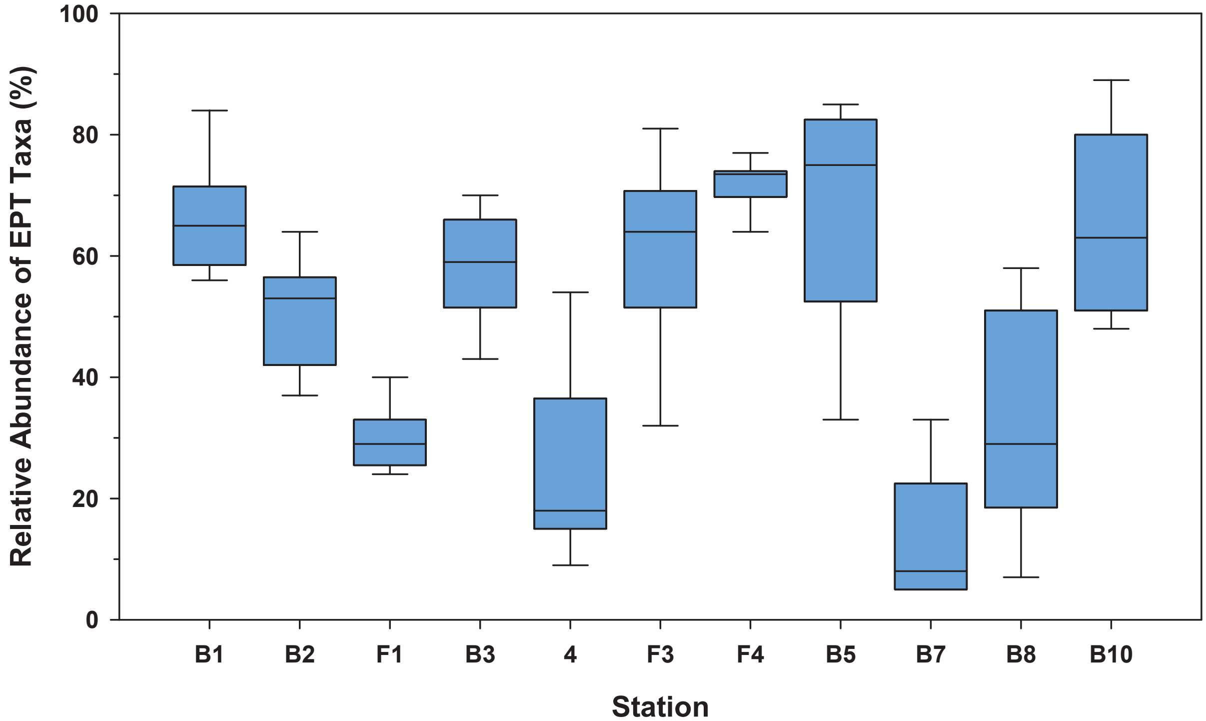


Figure 5-61: Relative abundance of chironomidae (%) boxplot for each macroinvertebrate monitoring station in August, 2007 to 2015.

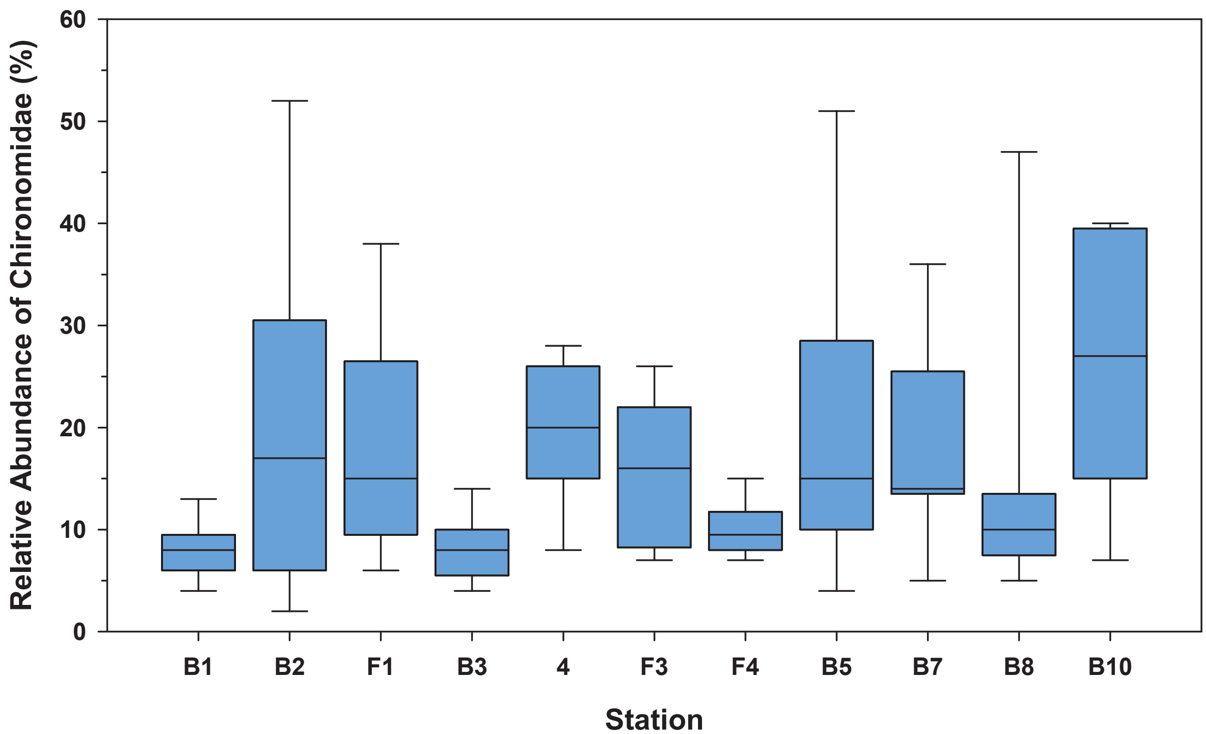


Figure 5-62: Community density (0.25 m²) boxplot for each macroinvertebrate monitoring station in August, 2007 to 2015.

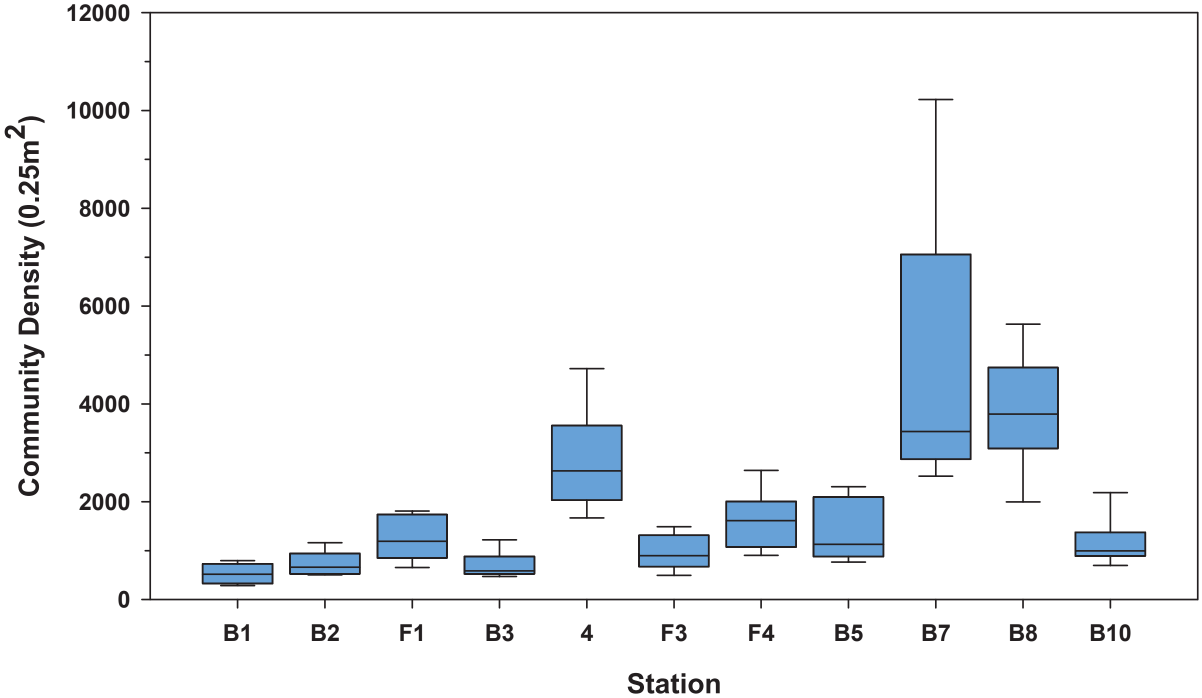
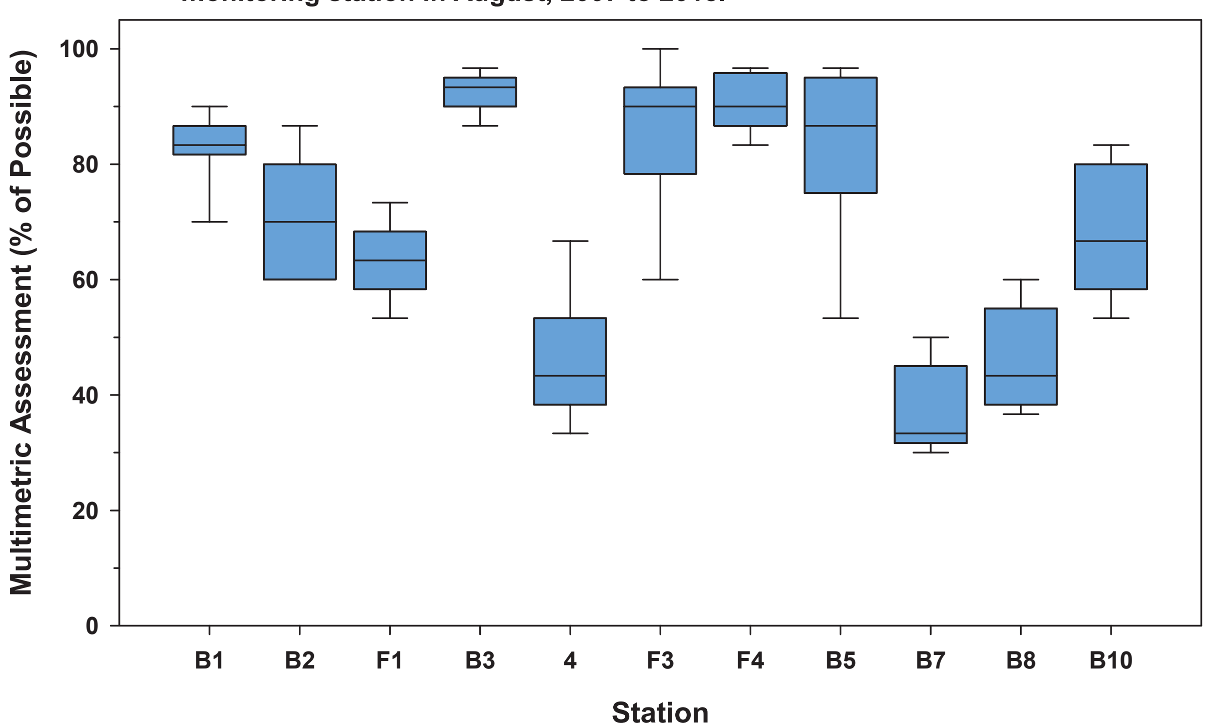


Figure 5-63: Multimetric assessment (% of possible) boxplot for each macroinvertebrate monitoring station in August, 2007 to 2015.



5.2.2.1.2 Upstream-Downstream Comparisons

Comparisons of median macroinvertebrate metric values at paired macroinvertebrate monitoring stations directly upstream-downstream of the reservoirs and dams were made using the Mann-Whitney *U* non-parametric test. This analysis was performed to identify persistent statistical differences from 2007 to 2015. A summary of significance and percent change is presented in Table 5-15 and complete statistical results are provided in Appendix E.

Statistically significantly differences occurred at all station pairs ($p < 0.05$; Table 5-15). A significant increase in the macroinvertebrate community health, including multimetric assessment (% of possible), was observed between stations F1 and B3, a section of the Madison River between Kirby and the Ennis campground, and between stations 4 and F3, a section of the Madison River downstream of the Madison Dam to downstream of the Warm Springs FA site. In addition, a conclusive decline in health, including multimetric assessment (% of possible), was observed between stations B3 and 4, upstream-downstream of Ennis Reservoir, respectively, and between stations B5 and B7, upstream-downstream of Canyon Ferry and Hauser Reservoirs, respectively. Significant differences were observed between other station pairs but they did not display the same consistency in metric changes. Multimetric assessment (% of possible) declined between stations B1 and B2 (-16%), upstream-downstream of Hebgen Reservoir, respectively, and increased between B7 and B8 (+30%), upstream-downstream of Holter Reservoir, respectively, but differences between few other metrics were statistically significant. These data indicate that sections of the river absent of direct reservoir influence maintain healthier macroinvertebrate assemblages while the larger reservoirs, Ennis, Canyon Ferry, Hauser, and Hebgen, negatively affected the macroinvertebrate assemblages.

Table 5-15: Change (%) in median macroinvertebrate metric values between macroinvertebrate monitoring stations upstream-downstream of reservoirs and dams from 2007 to 2015. Grey cells indicate a statistically significant ($p < 0.05$) difference in mean ranks as determined by Mann–Whitney *U* tests.

Metric	B1 and B2	B2 and F1	F1 and B3	B3 and 4	4 and F3	F3 and F4	F4 and B5	B5 and B7	B7 and B8
Taxa Richness[a]	3.5	1.3	19.2	-29.4	33.5	-5.9	-5.3	-41.7	9.1
Shannon Diversity[a]	1.2	-1.7	13.6	-23.2	27.7	-2.2	1.6	-30.9	14.0
Biotic Index[a]	-2.4	16.9	-25.8	63.9	-29.8	-3.4	8.2	22.3	1.7
EPT Richness[a]	-7.6	4.9	40.6	-62.2	139.7	-6.1	7.2	-75.6	25.0
Relative Abundance of EPT (%)[a]	-18.5	-45.3	103.4	-69.5	255.6	14.8	2.0	-89.3	262.5
Relative Abundance of Chironomidae (%)[a]	112.5	-11.8	-46.7	150.0	-20.0	-40.6	57.9	-6.7	-28.6
Community Density (0.25 m^2)[b]	27.8	79.9	-50.6	347.8	-66.0	80.1	-30.0	204.6	10.4
Multimetric Assessment (Total)[c]	-16.0	-9.5	47.4	-53.6	107.7	0.0	-3.7	-61.5	30.0
Multimetric Assessment (% of Possible)[c]	-16.0	-9.5	47.4	-53.6	107.7	0.0	-3.7	-61.5	30.0

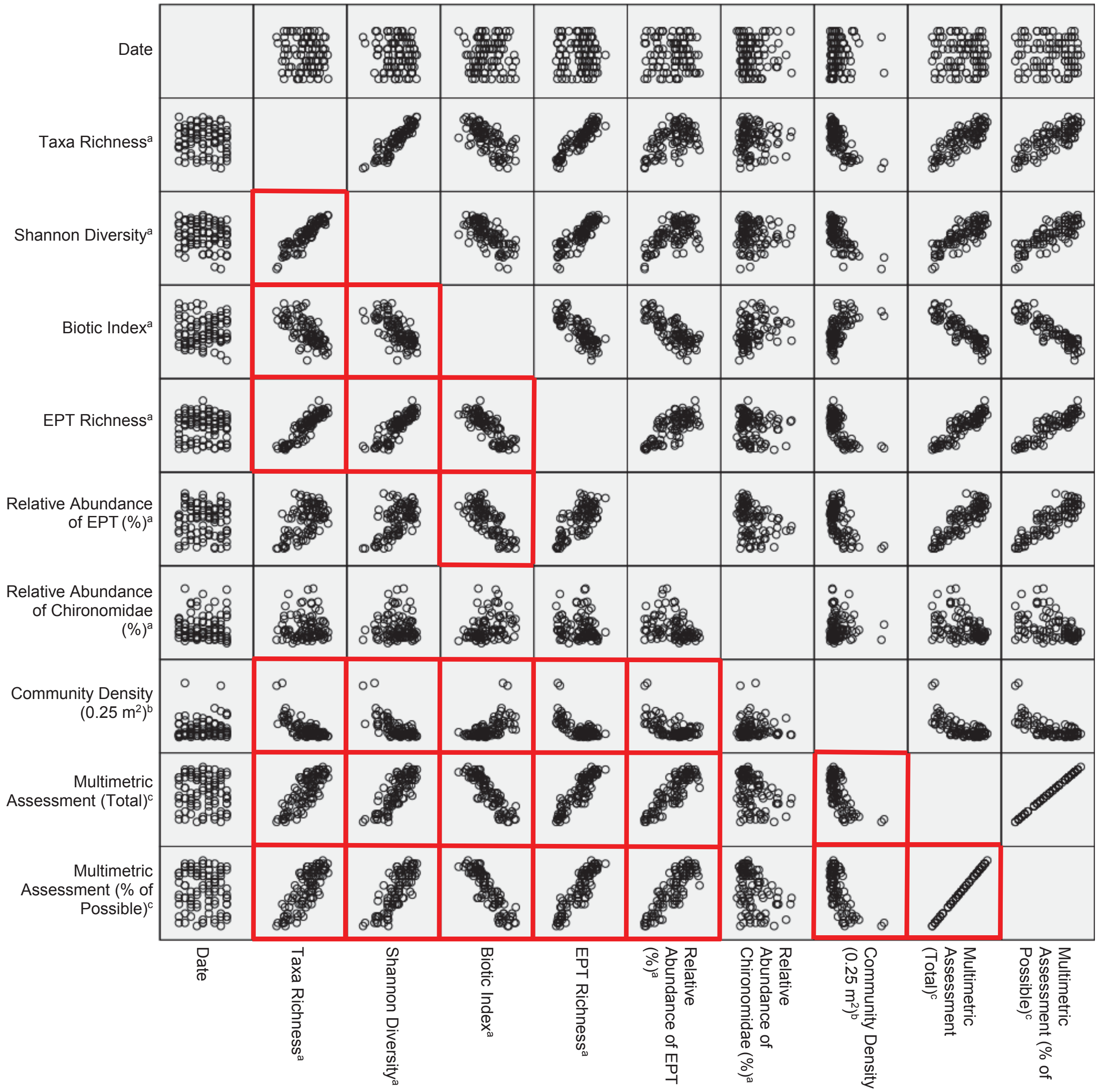
[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No amphipoda or isopoda collected at all sites.

5.2.2.1.3 Metric Correlations

Correlations between macroinvertebrate metrics were evaluated using the Kendall-tau non-parametric test at each macroinvertebrate monitoring station on data from 2007 to 2015. This analysis identified parameters that were statistically correlated and the strength of the relationship was determined based on a correlation coefficient > 0.5 and a statistically significant relationship ($p < 0.05$). A summary of these results in the form of a metric scatterplot is presented in Figure 5-64 and complete statistical results are provided in Appendix E. The scatter plot matrix incorporates multiple scatter plot relationships from multiple variable combinations into one table. Variables are listed along the row and column of the table. Results from multimetric assessment (Total) are included in data tables and figures but will not be discussed as the metric is simply the score which is placed into context of the total possible score – multimetric assessment (% of possible).

The macroinvertebrate metrics matrices of cross-correlations are quite extensive and are not detailed in narrative form, suffice to say that significant correlations between metrics and the multimetric assessment index were expected among all sites because these metrics were selected based on their descriptive ability of the macroinvertebrate assemblages. All metrics except for date and community density (0.25 m^2) were often correlated with other metrics at the same station (Appendix E). In addition, throughout all stations, metric relationships occurred between all metrics except for date and percent relative abundance of chironomidae (Figure 5-64). This abundance of correlations at specific stations among all stations indicates that relationships between metrics are similar between stations.

Figure 5-64: Macroinvertebrate metrics scatterplot matrix for all macroinvertebrate monitoring stations in August, 2007-2015. Red boxes indicate a relationship between parameters.



[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No Amphipoda or Isopoda collected at all sites.

5.2.2.1.4 Trend Analysis

Temporal trends in macroinvertebrate metric values over time for each station were evaluated using Least Squares Regression analysis on data from 2007 to 2015. This analysis provides a coefficient of determination indicating the relative degree of association between paired macroinvertebrate metric and year values. Summary of macroinvertebrate metric trends are presented in Table 5-16. Box plots of Station B1 (Yellowstone National Park) to Station B10 (Downstream from Great Falls Dams), including flush stations, illustrating the temporal distributions of multimetric assessment (% of possible) data for the 2006 to 2015 are found in Figure 5-65 to Figure 5-75 while box plots for all other metrics are found in Appendix E.

Significant temporal trends ($p < 0.05$) in macroinvertebrate metrics were limited in number and sporadic throughout the macroinvertebrate monitoring stations (Table 5-16). Most trends were relatively flat indicating the metrics remained relatively consistent from 2007 to 2015 and did not substantially increase or decrease. The exception was community density (0.25 m2) which significantly increased at Station B3 ($R^2 = 0.68$, $p < 0.01$, slope = 75 individuals / 0.25 m^2/ year) and at Station B8 ($R^2 = 0.53$, $p < 0.03$, slope = 297 individuals / 0.25 m^2/ year). No statistically significant trends occurred at stations B1, 4, F4, B7, or B10. In addition, multimetric assessment (% of possible) remained relatively consistent at Station B8 from 2007 to 2015 while no significant trends were observed at any other station (Figure 5-65 to Figure 5-75). Overall, these results indicate little change in the macroinvertebrate community health at each station from 2007 to 2015.

Table 5-16: Trend analyses of macroinvertebrate metrics in August, 2007 to 2015 at all macroinvertebrate monitoring stations. Grey cells indicate statistically significant ($p < 0.05$) trends as determined by Least Squares Regression.

Metric	Statistics	B-1	B-2	F-1	B-3	4	F-3	F-4	B-5	B-7	B-8	B-10
Taxa Richness[a]	Coefficient of determination	0.097	0.527	0.230	0.253	0.059	0.108	0.007	0.134	0.227	0.389	0.016
	Significance	0.415	0.027	0.192	0.168	0.527	0.427	0.842	0.333	0.195	0.072	0.744
	Slope	-0.411	-1.220	0.533	-0.570	-0.240	0.464	-0.102	-0.273	-0.307	-0.497	0.147
	N	9	9	9	9	9	8	8	9	9	9	9
Shannon Diversity[a]	Coefficient of determination	0.095	0.292	0.272	0.513	0.129	0.106	0.109	0.493	0.294	0.821	0.120
	Significance	0.421	0.133	0.150	0.030	0.342	0.432	0.424	0.035	0.131	0.001	0.361
	Slope	-0.035	-0.081	0.039	-0.061	0.032	0.028	-0.026	-0.060	-0.075	-0.093	0.036
	N	9	9	9	9	9	8	8	9	9	9	9
Biotic Index[a]	Coefficient of determination	0.081	0.325	0.013	0.455	0.273	0.481	0.401	0.416	0.113	0.196	0.000
	Significance	0.457	0.109	0.766	0.046	0.149	0.057	0.092	0.061	0.376	0.233	0.976
	Slope	0.034	0.063	0.014	-0.095	-0.074	0.167	0.060	0.087	-0.056	0.040	-0.002
	N	9	9	9	9	9	8	8	9	9	9	9
EPT Richness[a]	Coefficient of determination	0.186	0.757	0.455	0.035	0.000	0.056	0.096	0.060	0.028	0.341	0.008
	Significance	0.247	0.002	0.046	0.631	0.986	0.573	0.455	0.526	0.667	0.099	0.823
	Slope	-0.203	-0.797	0.473	-0.067	0.003	-0.207	-0.260	-0.237	0.040	-0.190	-0.047
	N	9	9	9	9	9	8	8	9	9	9	9
Relative Abundance of EPT (%)[a]	Coefficient of determination	0.088	0.188	0.086	0.276	0.290	0.693	0.012	0.137	0.004	0.470	0.064
	Significance	0.438	0.244	0.444	0.146	0.135	0.010	0.796	0.327	0.875	0.041	0.512
	Slope	-0.950	1.400	-0.550	1.733	2.983	-5.119	0.179	-2.483	-0.233	-4.400	-1.433
	N	9	9	9	9	9	8	8	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Coefficient of determination	0.380	0.554	0.018	0.046	0.043	0.868	0.008	0.308	0.285	0.000	0.135
	Significance	0.077	0.022	0.730	0.581	0.593	0.001	0.834	0.121	0.139	0.971	0.331
	Slope	-0.600	-4.567	0.533	-0.250	0.500	2.810	-0.095	2.967	-1.800	-0.067	1.650
	N	9	9	9	9	9	8	8	9	9	9	9
Community Density ($0.25\ m^2$)[b]	Coefficient of determination	0.020	0.035	0.391	0.679	0.059	0.057	0.374	0.001	0.000	0.530	0.176
	Significance	0.716	0.632	0.072	0.006	0.527	0.568	0.107	0.937	0.980	0.026	0.261
	Slope	10.233	16.117	103.200	75.433	92.250	34.262	151.940	7.050	10.550	296.617	-67.867
	N	9	9	9	9	9	8	8	9	9	9	9
Multimetric Assessment, Total[c]	Coefficient of determination	0.367	0.063	0.001	0.221	0.041	0.422	0.090	0.256	0.000	0.667	0.012
	Significance	0.084	0.516	0.951	0.202	0.602	0.081	0.470	0.164	0.961	0.007	0.783
	Slope	-0.383	-0.283	0.017	0.167	0.233	-1.000	-0.179	-0.783	0.017	-0.817	-0.133
	N	9	9	9	9	9	8	8	9	9	9	9
Multimetric Assessment, % of Possible[c]	Coefficient of determination	0.367	0.063	0.001	0.221	0.041	0.422	0.090	0.256	0.000	0.667	0.012
	Significance	0.084	0.516	0.951	0.202	0.602	0.081	0.470	0.164	0.961	0.007	0.783
	Slope	-1.278	-0.944	0.056	0.556	0.778	-3.333	-0.595	-2.611	0.056	-2.722	-0.444
	N	9	9	9	9	9	8	8	9	9	9	9

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No Amphipoda or Isopoda collected at all sites.

Figure 5-65: Multimetric Assessment (% of Possible) for Station B1 from August, 2007 to 2015.

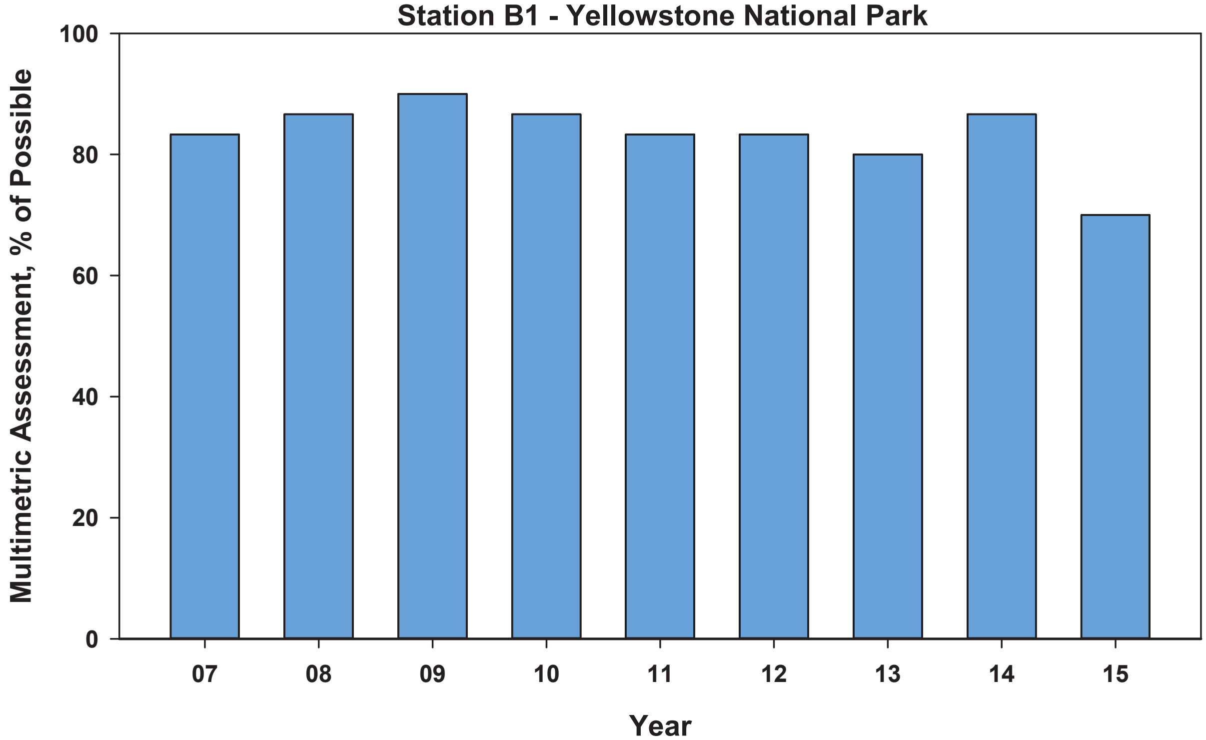


Figure 5-66: Multimetric Assessment (% of Possible) for Station B2 from August, 2007 to 2015.

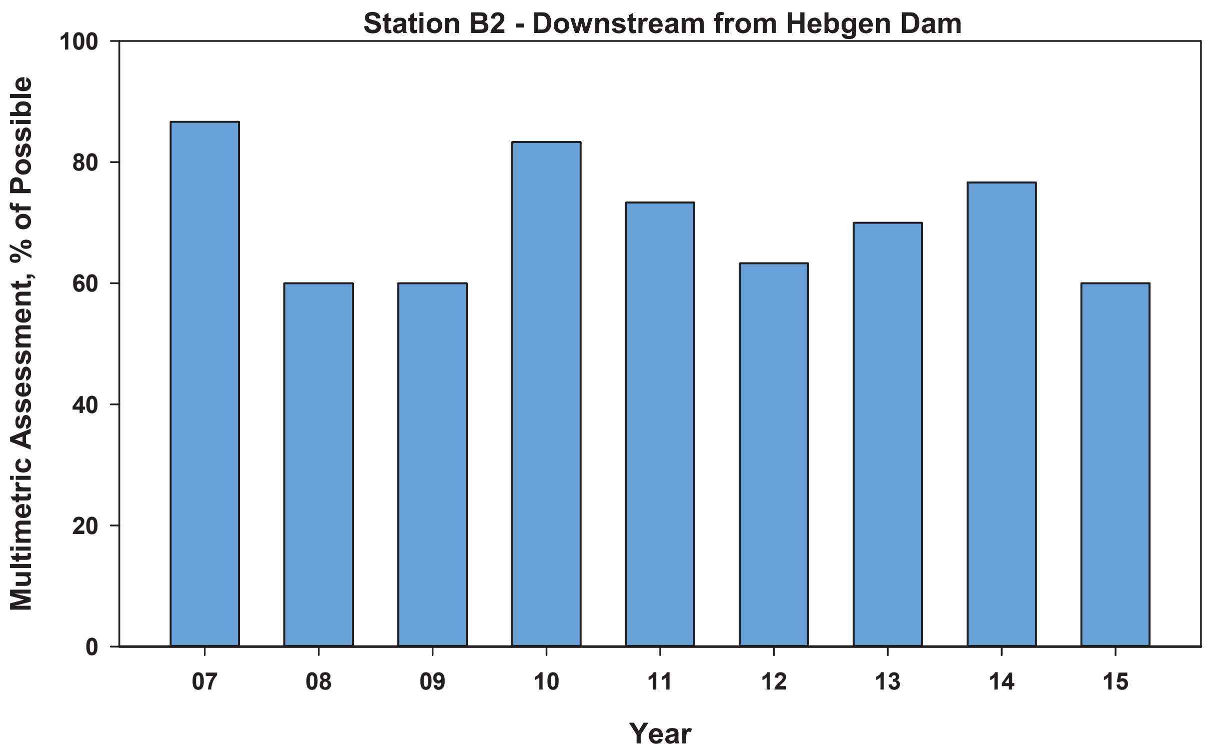


Figure 5-67: Multimetric Assessment (% of Possible) for Station F1 from August, 2007 to 2015.

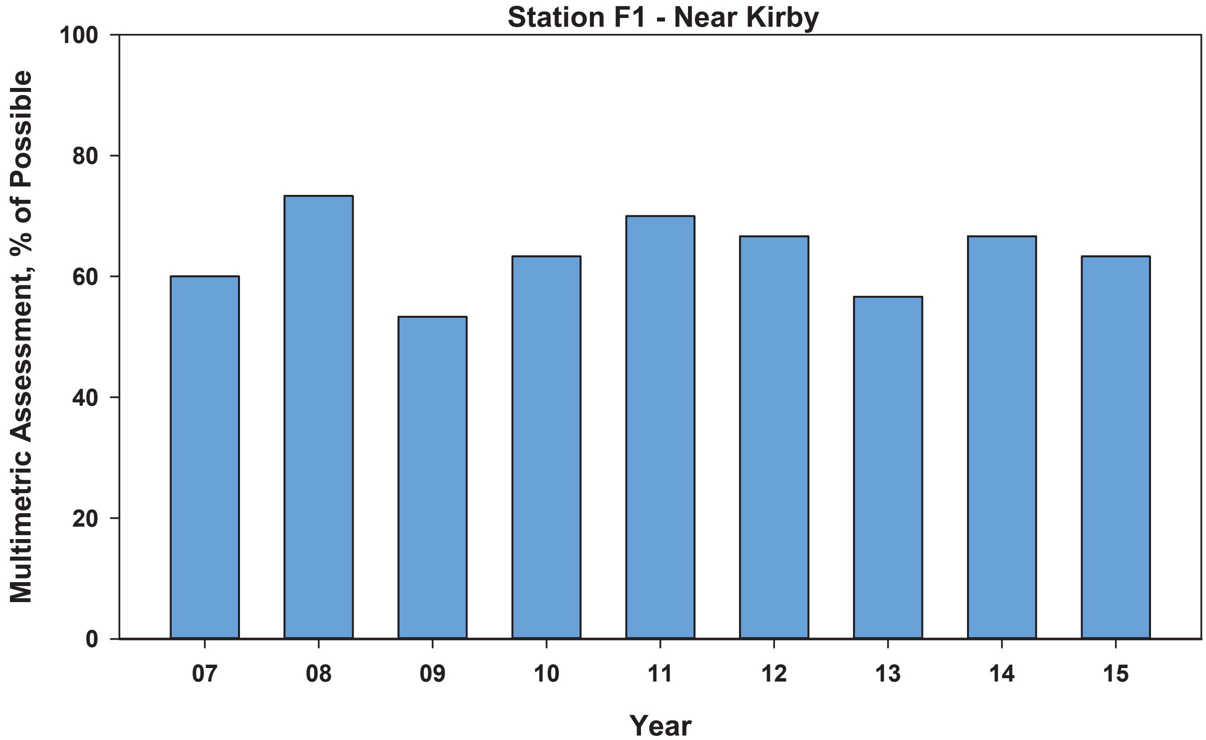


Figure 5-68: Multimetric Assessment (% of Possible) for Station B3 from August, 2007 to 2015.

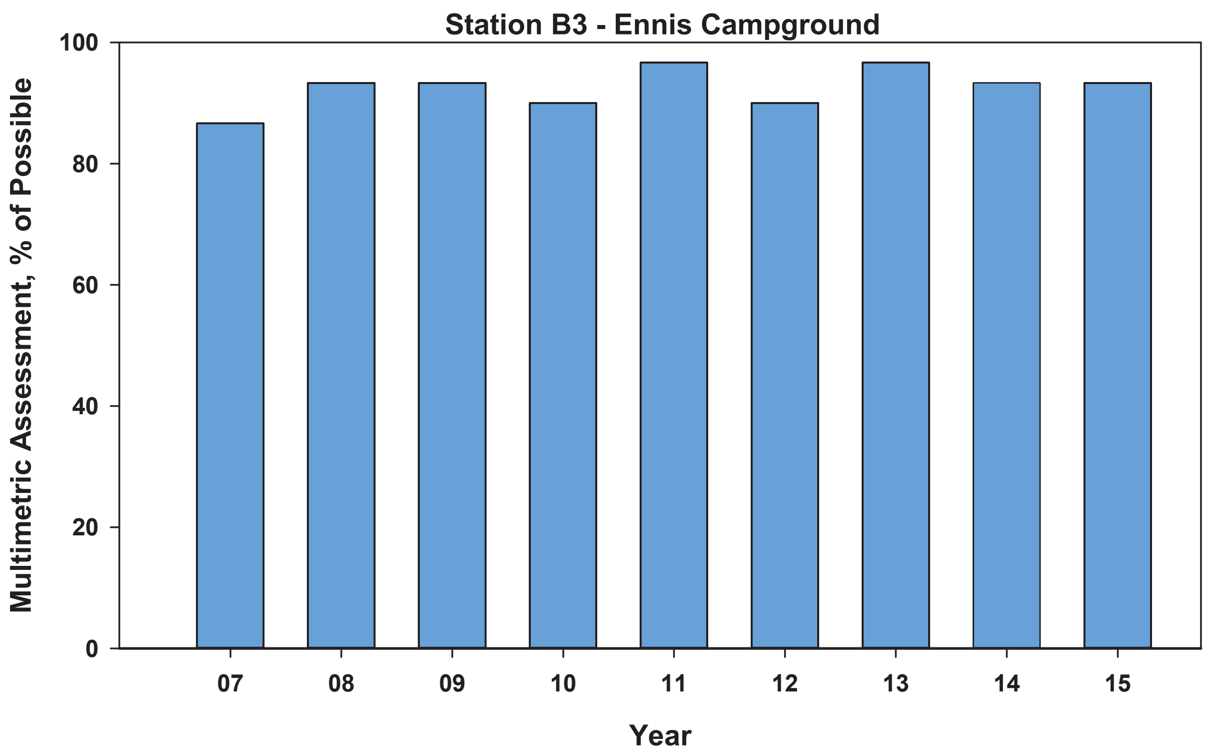


Figure 5-69: Multimetric Assessment (% of Possible) for Station 4 from August, 2007 to 2015.

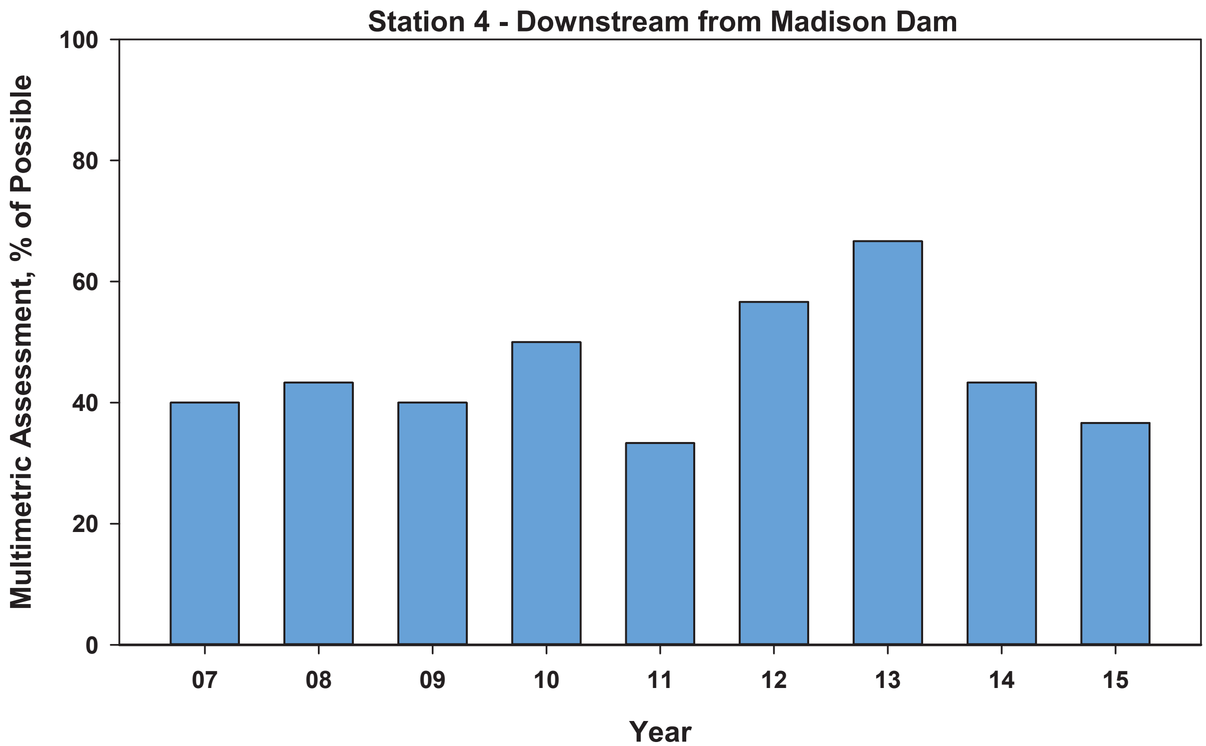


Figure 5-70: Multimetric Assessment (% of Possible) for Station F3 from August, 2007 to 2015. NS = Not Sampled.

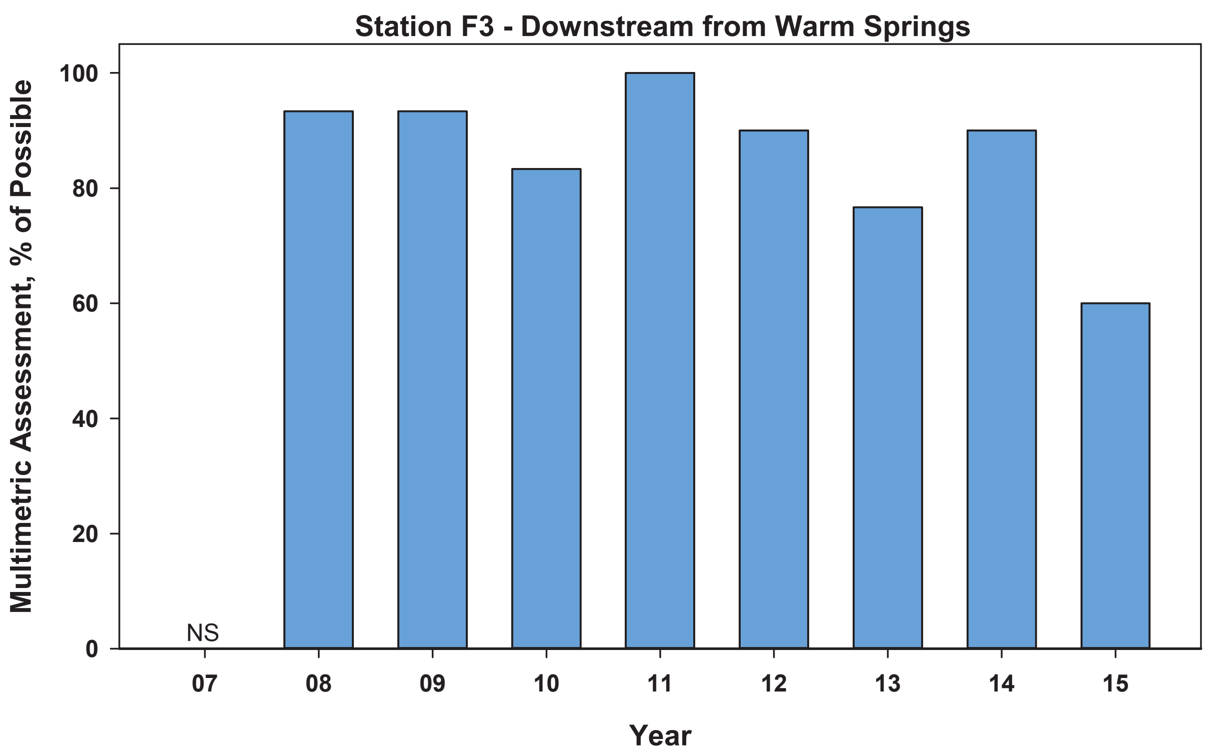


Figure 5-71: Multimetric Assessment (% of Possible) for Station F4 from August, 2007 to 2015. NS = Not Sampled.

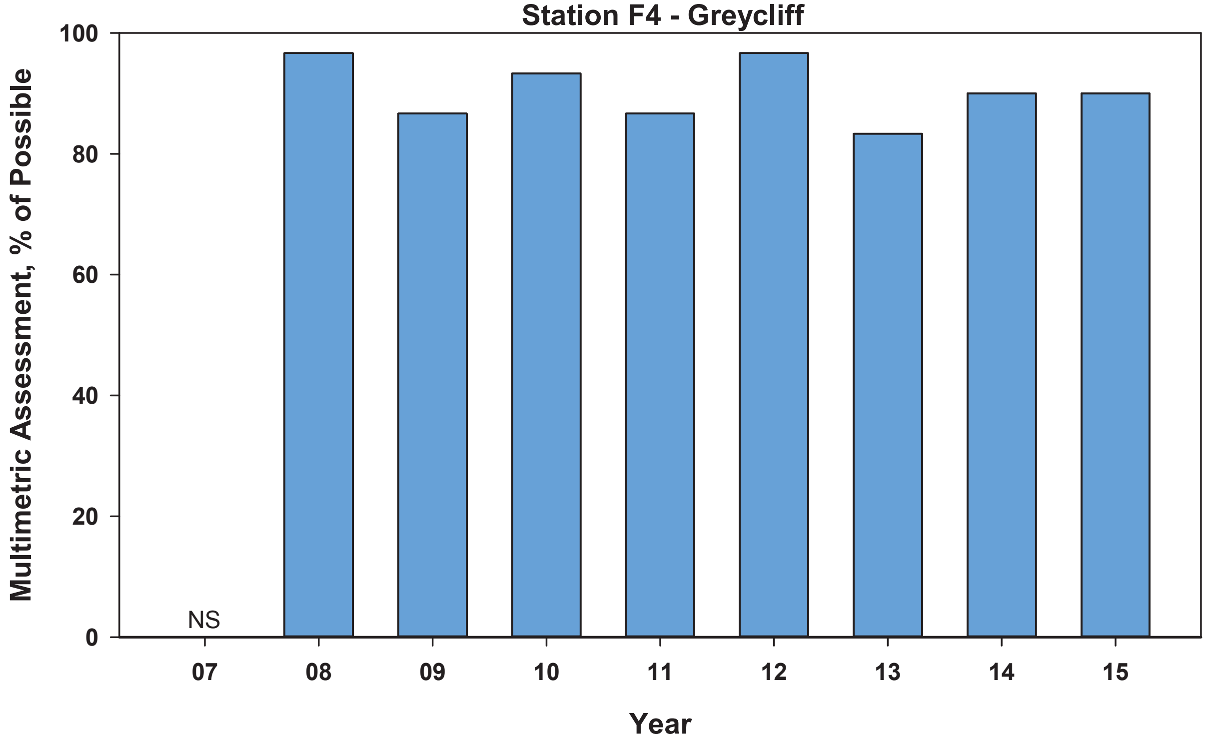


Figure 5-72: Multimetric Assessment (% of Possible) for Station B5 from August, 2007 to 2015.

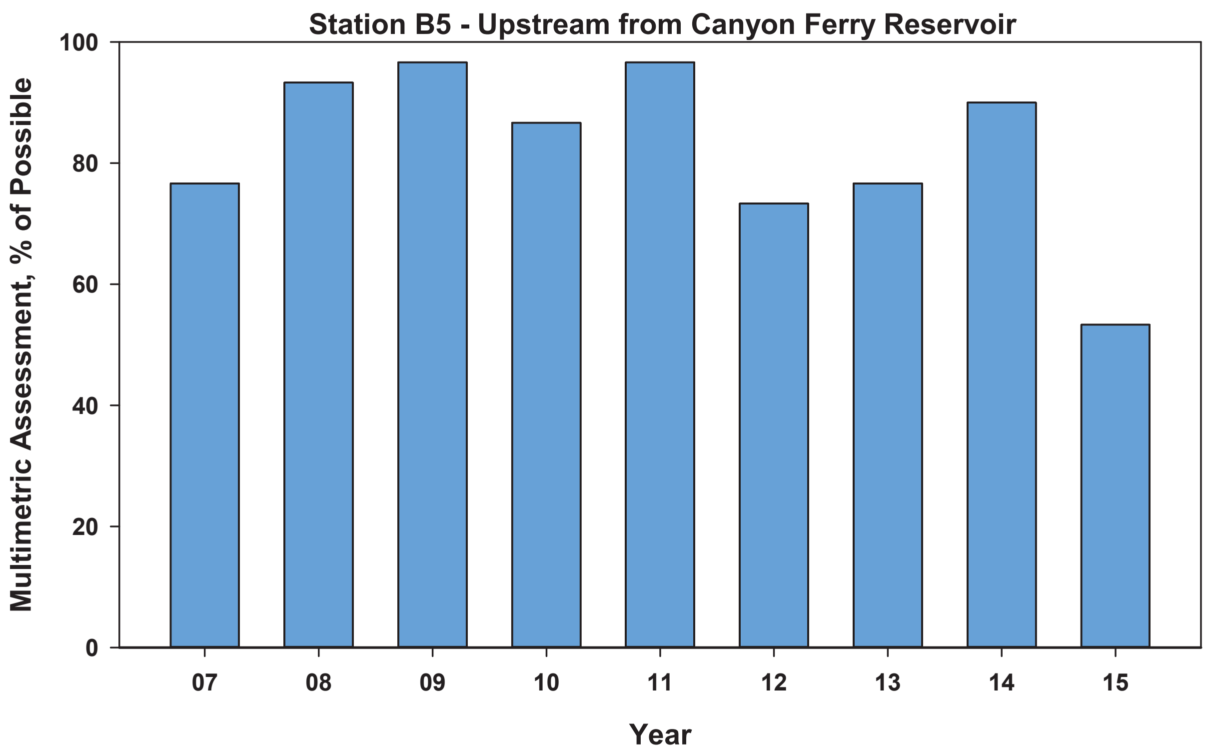


Figure 5-73: Multimetric Assessment (% of Possible) for Station B7 from August, 2007 to 2015.

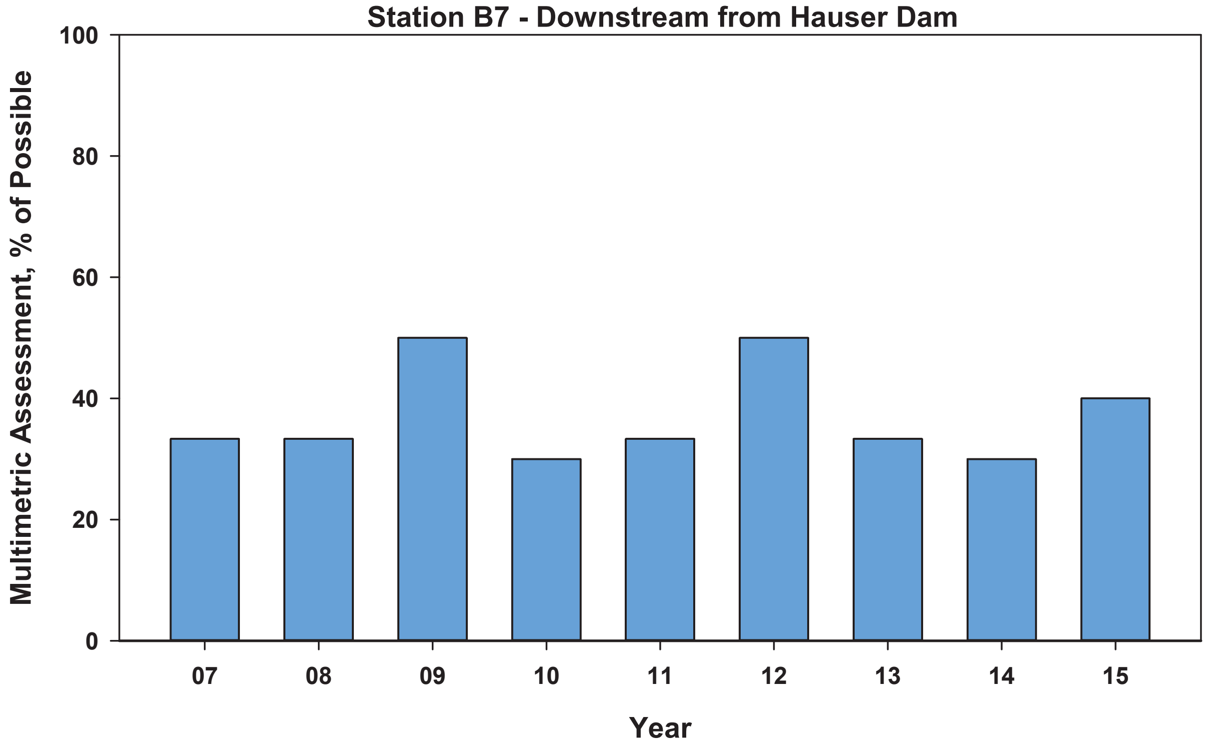


Figure 5-74: Multimetric Assessment (% of Possible) for Station B8 from August, 2007 to 2015.

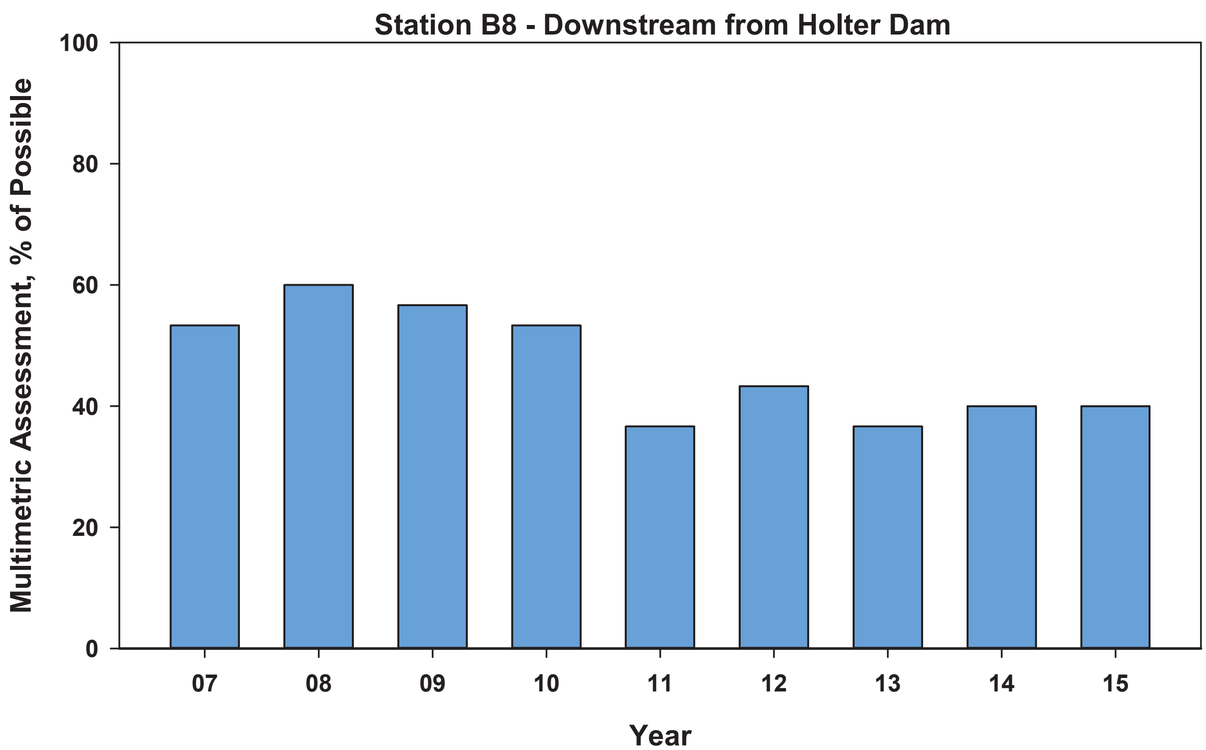
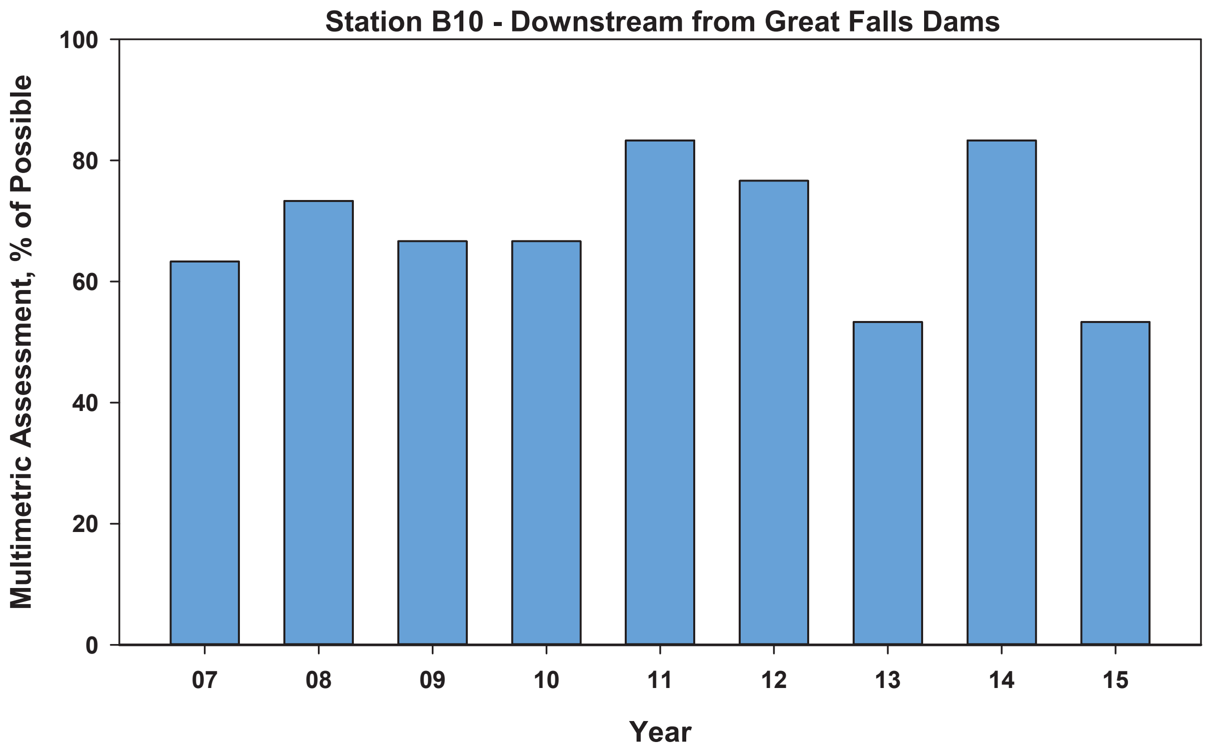


Figure 5-75: Multimetric Assessment (% of Possible) for Station B10 from August, 2007 to 2015.



5.2.3 Fish Tissue Analysis

Fish were collected at eight fish monitoring stations in 2009 and 2013 to 2015. Brown Trout (*Salmo trutta*), Rainbow Trout (*Oncorhynchus mykiss*), and, Walleye (*Sander vitreus*) were categorized as Predator while Utah Chub (*Gila atraria*) and White Sucker (*Catostomus commersonii*) were categorized as "Bottom Dwelling" (Bottom) according to feeding styles.

5.2.3.1.1 Spatial Fish Data Summary

Length and weight measurements were only available at stations B7 and B8 for 2009. A summary of the size of fish samples is presented in Table 5-17. Comparative data was not available for fish collected in 2013, 2014, and 2015.

Table 5-17: Fish descriptive statistics grouped by life history traits, 2009.

Title	Life History	Length				Weight			
		Min. (in.)	Max. (in.)	Mean (in.)	Stand. Dev.	Min. (in.)	Max. (in.)	Mean (in.)	Stand. Dev.
B7	Predator	14.9	16.0	15.5	0.37	1.4	1.8	1.6	0.13
	Bottom	14.8	15.9	15.2	0.42	1.5	1.9	1.7	0.10
B8	Predator	17.7	19.2	18.4	0.51	2.3	2.6	2.5	0.12
	Bottom	14.1	14.7	14.4	0.21	1.3	1.7	1.5	0.13

Note: Length and weight was not available for stations B2, B3, B4, 9, or B10 in any year.

5.2.3.1.2 *Spatial Biocontaminants Data Summary*

Fish tissue samples, fillets from Predator fish and whole body for Bottom fish, were analyzed for a variety of biocontaminants (Table 3-2). There was a high number of non-detect values for the biocontaminants across all stations for both Predator and Bottom fish (Table 5-18). Detectable concentrations which included Aroclor 1254 and most metals, are summarized in Table 5-19 for both Predator and Bottom fish. Due to the small sample size, high number of non-detects, and rotational sampling schedule (i.e., different stations in different years), the correlations analysis and trends analysis were not performed on fish tissue data.

Most fish tissue biocontaminants were not detected in either fish type, and in fact, no organochlorine pesticides were detected in any Predator or Bottom fish collected since 2009. Aroclor (1254) was the only PCB variant measured in a little over one-half of the Predator and Bottom fish samples. Eleven of 13 metals were detected but only zinc was detected in all Predator and Bottom samples while iron was detected in all Predator samples.

Table 5-18: Mean fish tissue biocontaminant detections grouped by life history traits at all fish monitoring stations in 2009 and 2013 to 2015.

Biocontaminants	Predator			Bottom		
	Above MDL	Non-detect	Non-detect (%)	Above MDL	Non-detect	Non-detect (%)
Organochlorine Pesticides						
Aldrin	--	19	100.0	--	19	100.0
alpha-BHC	--	19	100.0	--	19	100.0
beta-BHC	--	19	100.0	--	19	100.0
delta-BHC	--	19	100.0	--	19	100.0
Chlordane	--	57	100.0	--	57	100.0
DDD	--	19	100.0	--	19	100.0
DDE	--	19	100.0	--	19	100.0
DDT	--	19	100.0	--	19	100.0
Dieldrin	--	6	100.0	--	6	100.0
Endosulfan I	--	19	100.0	--	19	100.0
Endosulfan II	--	19	100.0	--	19	100.0
Endosulfan Sulfate	--	19	100.0	--	19	100.0
Endrin	--	19	100.0	--	19	100.0
Endrin Aldehyde	--	19	100.0	--	19	100.0
Heptachlor	--	19	100.0	--	19	100.0
Heptachlor Epoxide	--	19	100.0	--	19	100.0
Isodrin	--	6	100.0	--	6	100.0
Kepone	--	6	100.0	--	6	100.0
Methoxychlor	--	19	100.0	--	19	100.0
Toxaphene	--	19	100.0	--	19	100.0
PCBs (Aroclor)						
1016	--	19	100.0	--	19	100.0
1221	--	19	100.0	--	19	100.0
1232	--	19	100.0	--	19	100.0
1242	--	19	100.0	--	19	100.0
1248	--	19	100.0	--	19	100.0
1254	11	8	42.1	10	9	47.4

Biocontaminants	Predator			Bottom		
	Above MDL	Non-detect	Non-detect (%)	Above MDL	Non-detect	Non-detect (%)
1260	--	19	100.0	--	19	100.0
Metals						
Aluminum	15	4	21.1	8	11	57.9
Arsenic	4	15	78.9	3	16	84.2
Cadmium	--	19	100.0	--	19	100.0
Chromium	4	15	78.9	3	16	84.2
Copper	6	13	68.4	6	13	68.4
Iron	19	--	0.0	18	1	5.3
Lead	--	19	100.0	--	19	100.0
Manganese	11	8	42.1	5	14	73.7
Mercury	4	15	78.9	6	13	68.4
Nickel	3	16	84.2	1	18	94.7
Selenium	4	15	78.9	5	14	73.7
Strontium	18	1	5.3	14	5	26.3
Zinc	19	--	0.0	19	--	0.0

In general, Predator fish tissue contained less iron and strontium and more mercury, selenium, and zinc than Bottom fish tissue at most stations in which both Predator and Bottom fish were captured (Table 5-19). Predator fish tissue at Station B8, downstream from Holter Dam, often contained greater concentrations of metals than at other stations. However, the fish tissue collected from other stations were not consistently higher or lower with respect to fish type.

Table 5-19: Mean fish tissue biocontaminant concentrations (mg/kg dry weight) at fish monitoring stations in 2009 and 2013 to 2015. Only concentrations above detection limit were included. Pred. = Predator fish, Bot. = Bottom fish.

Biocontaminants	B2		B3		4		B7		B8		9		B10	
	Pred.	Bot.	Pred.	Bot.	Pred.	Bot.	Pred.	Bot.	Pred.	Bot.	Pred.	Bot.	Pred.	Bot.
PCBs (Aroclor)														
1254	--	--	--	--	--	--	0.07	0.11	0.03	0.03	--	--	--	--
Metals														
Aluminum	8.00	7.00	8.00	13.00	10.00	11.00	31.00	14.33	53.00	44.80	--	189.00	13	55.50
Arsenic	0.60	0.40	0.50	0.50	--	--	--	--	--	--	--	2.00	--	3.00
Chromium	1.50	--	--	1.00	--	--	0.60	0.90	3.00	0.50	--	--	--	1.00
Copper	2.00	7.00	3.00	3.00	--	--	2.00	4.00	2.00	3.00	--	3.00	7	3.00
Iron	32.33	44.00	28.00	45.00	40.00	36.00	26.50	27.50	28.00	70.67	--	300.00	22	123.50
Manganese	7.00	8.00	2.00	--	--	9.00	1.70	1.20	4.50	16.04	--	10.00	--	9.00
Mercury	0.60	0.50	0.30	0.30	--	--	0.60	0.40	1.30	0.30	--	--	0.7	--
Nickel	--	0.50	--	--	--	--	0.50	0.80	--	0.60	--	--	--	--
Selenium	0.70	1.10	1.50	1.30	--	--	1.30	1.10	1.70	1.50	--	--	--	--
Strontium	1.15	12.00	3.00	3.00	8.00	18.00	6.13	12.98	11.00	11.92	--	21.00	21.5	30.00
Zinc	33.27	50.95	24.10	19.10	47.00	22.00	42.00	18.83	34.83	18.33	--	34.00	22.5	28.50

Note: The organochlorine pesticides aldrin, alpha-BHC, beta-BHC, delta-BHC, chlordane, DDD, DDE, DDT, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, isodrin, kepone, methoxychlor, and toxaphene; the PCBs (aroclor) 1016, 1221, 1232, 1242, 1248, and 1260; and the metals cadmium and lead were not detected any site in any year.

Few longitudinal trends of fish tissue biocontaminants were observed. Aluminum concentrations in Predator fish tissue increased in a downstream direction through Station B8 while concentrations in Bottom fish tissue increased through Station B9. Strontium concentrations in Predator fish tissue and arsenic concentrations in Bottom fish tissue increased in a downstream direction through all stations.

The lack of organochlorine pesticide detections at fish monitoring stations (Table 5-18) is consistent with the low level of detections in fish from 500 lakes and reservoirs sampled in the lower 48 states (Stahl et al. 2009). In this national level survey, the median DDT concentration was 0.001 mg/kg in Predator fish and 0.013 mg/kg in Bottom fish. Chlordane was detected in Predator fish but the median was below the detection limit while the concentration was 0.002 mg/kg in Bottom fish. In the Missouri and Madison rivers, both DDT and Chlordane were not detected in any fish sample.

The median Aroclor 1254 (PCB) concentrations in Predator and Bottom fish were greater than the national medians of 0.002 mg/kg and 0.014 mg/kg, respectively (Stahl et al. 2009) at all stations revealing fish tissue concentrations greater than the detection limit (Table 5-19). Arsenic was detected infrequently in fish tissue samples which is consistent with the national survey (Stahl et al. 2009). The mean mercury concentration at stations with detectable concentrations in Predator fish (when converted from dry weight to wet weight) was less than the mean of 0.352 mg/kg-wet weight for the national lakes survey (Stahl et al. 2009, Table 5-19). Mean mercury concentrations in Bottom fish (when converted from dry weight to wet weight) were also less than the national mean of 0.096 mg/kg-wet (Stahl et al. 2009) at all stations with detectable concentrations.

5.2.3.1.3 Upstream-Downstream Comparisons

Percent change in mean Predator and Bottom fish concentrations between stations upstream-downstream of reservoirs and dams are presented in Table 5-20. Means were compared as opposed to medians due to the small sample size and low number of values above detection limits. Comparisons of Predator and Bottom fish sample biocontaminant concentrations at stations B7 and B8 were made using the non-parametric Mann-Whitney *U* test. This analysis was performed to identify persistent statistical differences for 2009 and 2013 to 2015. Mann-Whitney *U* test comparisons of other stations were not made due to low number of samples. A summary of significance and percent change is presented in Table 5-21 and complete statistical results are provided in 0.

Few patterns were observed in the percent changes between mean fish tissue biocontaminant concentrations (Table 5-20). This indicates a large variability in the data between years and between feeding style of the Predator and Bottom fish. Very large increases of aluminum were observed in Bottom fish between stations B-7 and B-8 in 2009 (+510.0 %) and of chromium in Predator fish between stations B-7 and B-8 in 2014 (+400.0 %). No decreases observed between stations were of the same magnitude.

Table 5-20: Change (%) in mean fish tissue biocontaminant concentrations between fish monitoring stations upstream-downstream of reservoirs and dams in 2009 and 2013 to 2015. Only concentrations above detection limit were included. -- = one or both stations in a pair were not sampled or no biocontaminant was detected.

	B-7 and B-8 (2009)		B-2 and B-3 (2013)		B-7 and B-8 (2014)		9 and B-10 (2015)
Biocontaminant	Predator	Bottom	Predator	Bottom	Predator	Bottom	Bottom
PCBs (Aroclor)							
1254	-54.6	-73.9	--	--	--	--	--
Metals							
Aluminum	--	510.0	0.0	85.7	71.0	46.4	-54.0
Arsenic	--	--	-16.7	25.0	--	--	50.0
Chromium	--	--	--	--	400.0	-44.4	--
Copper	--	--	50.0	-57.1	0.0	-25.0	0.0
Iron	2.8	195.0	0.0	-2.2	31.3	58.7	-31.7
Manganese	--	--	--	--	-41.2	83.3	-10.0
Mercury	--	--	-50.0	-40.0	116.7	-25.0	--
Nickel	--	--	--	--	--	-25.0	--
Selenium	--	--	114.3	18.2	30.8	36.4	--
Strontium	80.0	-4.2	160.9	-62.5	-70.6	-33.3	28.6
Zinc	-19.2	-6.5	5.2	-70.1	4.3	14.3	5.9

Significant statistical differences in median fish tissue biocontaminant concentrations between stations B7 and B8 are consistent with those observed between mean concentrations presented above. Significant decreases in Aroclor 1254 fish tissue concentrations between stations B7 and B8 were observed in Predator (-57.9 %) and Bottom (-69.3 %) fish while a significant increase was observed for iron in Bottom fish (+236.4 %).

Table 5-21: Change (%) in median fish tissue biocontaminant concentrations between stations B7 and B8 in 2009 and 2013 to 2015. Grey cells indicate a statistically significant (p <0.05) difference in mean ranks as determined by Mann–Whitney *U* tests. Measurements below the detection limit were substituted with values one half the detection limit for analysis.

Biocontaminant	Predator	Bottom
PCBs (Aroclor)		
1254	-57.9	-69.3
Metals		
Iron	-5.4	236.4
Strontium	289.8	-3.4
Zinc	-22.9	-2.7

6. Summary

6.1 Water Quality

Concentrations of numerous constituents tended to either increase or decrease in the downstream direction throughout the monitoring period. These observations in spatial trends were consistent with previous studies (Land & Water 1999, PBS&J 2011). The change in water quality conditions in the downstream direction are largely attributed to geologic factors in the headwaters of the Madison River, or source water inputs from the Jefferson, Gallatin, and Sun rivers. For example, elevated concentrations of total arsenic, total sodium, and total chloride observed at Station 1 are due to the geothermal activity in Yellowstone National Park whereas the increase in total suspended solids at Station 9 is due to watershed/agricultural practices in the Sun River. The longitudinal increase in total calcium, total sulfates, and nutrients are due to shifts in the geological conditions of the various watersheds, anthropogenic influences of treated wastewater, and irrigation return flows, with the largest influence on water quality observed downstream of the Three Forks confluence. The observed differences in concentrations between the two 10-year monitoring periods is largely due to the different hydrological regimes.

Statistically significant changes in concentrations of constituents between monitoring stations was common between upstream stations 1 through 5. These shifts were largely a function of the corresponding dilution of constituents from hydrological gains, losses due to reservoir sinks, gains due to changing geological sources. Stations lower in the watershed, especially those from immediately downstream of Canyon Ferry Dam and Holter Dam tended to show consistent patterns and stability in water quality concentrations with few significant differences between stations. Few changes in water quality appeared to be directly related to hydroelectric operations, except for total suspended solids/turbidity and dissolved oxygen content. Both Station 4 and Station 6 revealed lower dissolved oxygen content relative to their respective upstream station.

Concentrations of many constituents were strongly correlated with one another. These correlations included geology-related factors (e.g. a strong association of sodium, chloride, and arsenic) and ionic chemistry, specific conductance, and total dissolved solids. Other erosion based watershed parameters such as total suspended solids and metals (e.g. iron) were strongly correlated. Furthermore, many parameter concentrations were strongly correlated to flow and flow percentile via dilution or watershed inputs. These parameters included total calcium, total chloride, dissolved sodium, total arsenic, total iron, total suspended solids, and specific conductance.

Temporal trends in both field and analytical parameters were analyzed for non-flow adjusted and flow-adjusted data from 2007 to 2016. There were few statistically significant increasing trends in non-flow adjusted concentrations. Total alkalinity and bicarbonate significantly increased over time at stations 1, 2, and 3 in the Madison River, and only Station 10 in the Missouri River.

Dissolved magnesium and total potassium concentrations revealed significantly increasing trends over time for stations in the lower portion of the Madison and Missouri rivers. While total and inorganic nitrogen generally decreased over time and most stations, the only statistically significant decreasing trend was observed at Station 10. However, total phosphorus concentrations revealed significant decreasing trends over time at multiple stations in both the Madison and Missouri rivers. There were no significant trends in flow over time, and in fact, hydrological conditions represented more typical flow conditions during the last 10-year monitoring period, whereas the flow conditions during the first 10-year period represented extreme dry and wet year type flow conditions.

Of the seven flow-adjusted parameters, only dissolved sodium concentrations at stations 9 and 10 exhibited significant increasing trends over time (2007-2016) which likely stem from watershed sources in the Sun River, rather than the Madison-Missouri system. Overall, the effects of watershed influence or hydroelectric dams had little to no effect on water quality conditions outside of the effects of flow from 2007-2016. For the stations that did exhibit significant trends over time, there was a downstream carry-over effect observed at successive downstream stations.

6.2 Periphyton

From 2007 to 2016, median chlorophyll-a concentrations were less 100 mg/m2 at all stations except for at Station B5 at which the concentration was substantially higher (160 mg/m2). Streams with concentrations greater than 120 mg/m2 are often considered nutrient impaired by the State of Montana.

No longitudinal trend was apparent among stations with each station exhibiting a high degree of intra/inter annual variability, except for Station B2. The direction of change (e.g. decrease or increase) in median chlorophyll-a concentrations between paired stations alternated longitudinally between stations. The median concentration was the lowest at Station B2, downstream of the Hebgen Dam, and the greatest at Station B5, a background control station for the headwaters of the Missouri River. Stations downstream of Hauser and Holter dams exhibited algal biomass conditions similar to stations in the Madison River, upstream of Ennis Lake and downstream of Madison Dam.

Though out the study period, the biological integrity ratings of all diatom metrics at all stations were “Excellent” or “Good” except for one “Fair” rating at Station B10 which is downstream from Great Falls reservoir, the city of Great Falls, and Sun and Smith Rivers. Station B2, exhibited more “Good” ratings for the diatom community than any other station which is reflected in it’s overall impairment rating of “Severe” in two of the last 10 years of data. The cause of these low ratings were mainly high results for siltation index and abundances of dominant species. The Mountain Streams siltation index was also an issue at Station B10 which was rated as “Moderate” impairment in 6 of the last 10 years and “Severe” impairment in 1 of the last 10 years. All other stations in all years were rated with a minimal number of “Moderate” impairment years and mostly “Minor” impairment or “None.”

From 2007 to 2016, no longitudinal increasing or decreasing trends in diatom metrics were apparent except for a decrease in abnormal Cells (%) in a downstream direction. However, many metrics followed similar patterns between stations indicating improving and declining diatom community health from one station to the next. Multiple metrics were statistically different between stations B2/B3 and B3/4, indicating an improvement in biological integrity for the diatom communities in the Madison River.

Many correlations between metrics at individual stations were observed but few relationships among metrics at all stations occurred indicating that the periphyton communities differ greatly between stations.

There were few significant temporal trends in diatom metrics and most represented very minor changes over time. Only the diatom disturbance index exhibited significant increasing trends at more than one station (B8 and B10), which characterize the poorer assemblages in these downstream reaches of the Missouri River. Overall, the results indicate little change in the diatom community at each station from 2007 to 2016 and little to no direct influence from the hydroelectric facilities.

6.3 Macroinvertebrates

From 2007 to 2015, no longitudinal increasing or decreasing trends in macroinvertebrate metrics were apparent. Most metrics, including the multimetric assessment, followed a similar pattern of improving and declining macroinvertebrate health from one station to the next station. The biological monitoring stations upstream of Ennis Lake and Canyon Ferry Reservoir revealed the most robust macroinvertebrate assemblages based on the multimetric index. The similar decreasing patterns among the metrics downstream of these locations highlight the negative effects of Ennis Lake and Madison Dam on the community in the Madison River, and the negative effects of Canyon Ferry Reservoir/Dam on community in the Missouri River. Macroinvertebrate community health was poorer for the stations downstream of Hauser and Holter dams, but improved by the last station downstream of Morony Dam.

This abundance of significant correlations within and among stations highlights the descriptive ability of the metrics, especially in the context of the multimetric assessment index. The macroinvertebrate metrics are good descriptors of the biological integrity at each station and reveal consistent improving or declining conditions at successive stations.

Significant temporal trends of macroinvertebrate metrics were limited and all had relatively shallow slopes. These results indicate little change in the macroinvertebrate community over time at each station from 2007 to 2016.

6.4 Fish Tissue

From 2007 to 2015, fish tissues were collected from eight biological monitoring stations ranging from downstream of Hebgen Dam to downstream of the Great Falls Dams. However, fish tissue sampling did not occur at all stations within the same year, and instead occurred on a rotational basis targeting the upstream-downstream stations in different years. Most fish tissue biocontaminants were not detected in any predator or bottom dwelling fish. No organochlorine pesticides were detected and only one PCB congener was detected in predator and bottom dwelling fish at relatively low levels. Eleven of 13 metals were commonly detected but only zinc was detected in all predator and bottom dwelling samples while iron was detected in all predator fish sampled.

The lack of detectable organochlorine pesticide concentrations in fish tissue samples is consistent with the relatively low number of detectable concentrations in a national fish survey of over 500 lakes and reservoirs sampled in the lower 48 states. Aroclor 1254 (PCB congener) concentrations in both predators and bottom dwelling fish were often greater than the concentrations found in respective fish types for the national survey, while detectable mercury concentrations in both predator and bottom dwelling fish were less than their respective fish tissue concentrations sampled during the national lake survey.

Few patterns were observed in the percent changes between mean fish tissue biocontaminant concentrations and indicates a large variability in the data between years and between feeding styles. A statistical significant increase in the iron concentration of bottom dwelling was observed between stations B7 and B8, while a statistically significant decrease in Aroclor 1254 concentrations in both predator and bottom dwelling fish were observed for the same station pair.

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Appendix A Monitoring Objectives

Table A-1: Summary of monitoring objectives and methodology for 2007 to 2016.

Objective	Description	Sub-Objectives	Sampling	Methodology
Water quality				
Long-Term Trend Identification	Change in parameters at monitoring locations over time.	■ Identification of a trend. ■ Determine if trend is positive or negative. ■ Estimate trend magnitude. ■ Evaluate trend relationship to dam operation.	Quarterly	■ Statistical trend analysis of parameter data over time. Analyzed for each parameter at each location.
Parameter Correlation	Relationship between parameters.	■ Determine if relationship exists between parameters.	Quarterly	■ Correlation analysis between parameters/metrics. Analyzed for each parameter/metric at each location.
Dam Effect Evaluation	Difference in parameters between paired (upstream-downstream of a dam) monitoring locations.	■ Quantify differences. ■ Determine if differences are a function of time (season or year). ■ Determine if differences vary spatially.	Quarterly	■ Statistical comparison of parameter data between upstream-downstream locations. Analyzed for each parameter at each paired location for each time (quarter or annual); ■ Statistical comparison of computed parameter differences at each location for different times. ■ Analyzed for seasonal (water quality only) and annual variations for each parameter; ■ Statistical comparison of computed parameter differences between paired locations.
Site Specific Special Studies	Dissolved oxygen downstream of Canyon Ferry and Madison dams.	■ Evaluate spatial and seasonal related dissolved oxygen characteristics below dams.	Quarterly	■ Up/downstream spatial comparison; ■ Statistical analysis of dissolved oxygen data daily, seasonally, and min/max variations.
Biological				
Periphyton Long-Term Trend Identification	Change in metrics at monitoring locations over time.	■ Identification of a trend. ■ Determine if trend is positive or negative. ■ Estimate trend magnitude.	Annual	■ Statistical trend analysis of metrics data over time. Analyzed for each metrics at each location.
Periphyton Targets	Comparison of median values with target limits.	■ Identification of values exceeding targets.	Annual	■ Comparison of median values with target limits. Analyzed for each parameter at each location.
Macroinvertebrate Long-Term Trend Identification	Change in multimetric assessment over time.	■ Identification of a trend. ■ Determine if trend is positive or negative. ■ Estimate trend magnitude.	Annual	■ Statistical trend analysis of composite (multimetric) measures of macroinvertebrate data over time. Analyzed for multimetric set at each location.
Macroinvertebrate Targets	Comparison of median values with target limits.	■ Identification of values exceeding targets.	Annual	■ Comparison of median values with target limits. Analyzed for each metric at each location.
Fish Tissue Biocontaminants	Detect differences in means/medians between years.	■ Compare differences between stations. ■ Compare to targets. ■ Compare to Human Health Standards.	Once every 3 to 9 years	■ Parametric or non-parametric comparison of means/medians between sample events. ■ Comparison to reference values.

Table A-2: Summary of water quality data statistical analysis methodology for 2007 to 2016.

Objective	Description	Statistics and Data Evaluations
Summary Data	Summarize spatially collected data, background control stations, and longitudinal patterns	▪ Minimum, maximum, and mean values; standard deviations; and percentages of non-detect data for each station and year ▪ Graphical presentation and observations of longitudinal patterns in the data
Parameter Correlation	Evaluation of correlation between parameters	▪ Kendall-tau correlation analysis between non-adjusted parameters and flow. ▪ A combination of a strong relationship (i.e., correlation coefficient > 0.5) and a statistically significant p-value (i.e., <0.1) between concentration and flow or flow percentile provided the rationale for "flow adjustment" of parameters.
Long-Term Trend Identification	Raw Data Identification of trend, summary of positive and negative trends for non-flow adjusted and flow-adjusted parameters	▪ Graphical presentation and evaluation of temporal patterns in the data ▪ Non-detect values were substituted with one-half of method detection limit. ▪ Seasonal Kendall non-parametric test of trend using non-flow-adjusted data over time. The seasonal covariate was based on month. ▪ Seasonal Kendall test for trend (0.05 significance level) ▪ Sen slope estimate of trend magnitude ▪ Percent change between 2007-2009 mean water quality concentration and 2014-2016 mean water quality concentration at each station
	Flow-Adjusted Data Identification of trend, summary of positive and negative trends	▪ Graphical presentation and evaluation of temporal patterns in the data ▪ Non-detect values were substituted with one-half of method detection limit ▪ Natural logarithm transformation of chemistry results paired with probability of flow for respective sample date ▪ Least Squares Regression analysis and calculation of residuals (flow-adjusted values) ▪ Pearson correlation analysis of flow-adjusted values with decimal year (0.10 significance level) ▪ Locally weighted scatterplot smoothing (LOESS) regression was performed on flow-adjusted parameters of interest to evaluate non-monotonic relationships ▪ Percent change between 2007-2009 mean flow-adjusted concentration and 2014-2016 mean flow-adjusted concentration at each station
Dam effect evaluation	Compared data between paired stations upstream-downstream of reservoirs and dams	▪ Graphical presentation and evaluation of data patterns ▪ Non-detect values were substituted with one-half of method detection limit ▪ Mann-Whitney U non-parametric test between stations (0.05 significance level) ▪ Mean Rank differences and evaluation of 10-year medians to confirm significant differences ▪ Percent change of 10-year median between stations
Special Studies Dissolved Oxygen	Evaluation of spatial and seasonal dissolve oxygen characteristics downstream of Madison Dam and Canyon Ferry Dam	▪ Graphical presentation and evaluation of data patterns ▪ Mann-Whitney U non-parametric test between stations (0.05 significance level) ▪ Kruskal-Wallis H non-parametric test of seasonal effects within a station (0.05 significance level)

Table A-3: Summary of biological data statistical analysis methodology for 2007 to 2016.

Objective	Description	Data	Statistics and Data Evaluations
Summary data	Summarization of collected data, guidelines, control stations, and longitudinal patterns	Chlorophyll-a	■ Minimum, maximum, and mean values; standard deviations; and percentages of non-detect data for each station and year ■ Compared to guidelines established by Montana Department of Water quality ■ Potentially impacted stations compared to background control stations (B1 and B5) ■ Observations of longitudinal patterns
		Diatoms	■ Minimum, maximum, and mean values and standard deviations by metric for each station and year ■ Biological integrity ratings for each metric and impairment ratings for each station and year ■ Potentially impacted stations compared to control stations (B1 and B5) ■ Observations of longitudinal patterns
		Macroinvertebrates	■ Minimum, maximum, and mean values and standard deviations by metric for each station and year ■ Potentially impacted stations compared to control stations (B1 and B5) ■ Observations of longitudinal patterns
		Fish tissue	■ Minimum, maximum, and mean values and standard deviations for fish length and weight for Predator and Bottom fish for each station and year ■ Number of fish tissue biocontaminant concentration detections above the detection limit, number or non-detects, and percentage of non-detects and mean biocontaminant concentrations for Predator and Bottom fish for each station ■ Compared to national median concentrations and Montana and EPA fish consumption guidelines ■ Observations of differences between Predator and Bottom fish concentrations and longitudinal patterns by metric
Dam effect evaluation	Compared data between paired stations upstream-downstream of reservoirs and dams	Chlorophyll-a	■ Non-parametric Mann-Whitney U test between stations ■ Percent change of median between stations
		Diatoms and macroinvertebrates	■ Mann-Whitney U Non-parametric test between stations for each metric ■ Percent change of median between stations for each metric
		Fish tissue	■ Percent change in means for Predator and Bottom fish between stations for biocontaminants detected above detection limit ■ Mann-Whitney U Non-parametric test between stations for each biocontaminant
Metric relationships	Determined relationships between metrics and slope	Diatoms and macroinvertebrates	■ Scatter plot matrix of metrics of all data ■ Correlation analysis between metrics each station using the non-parametric Kendall-tau statistic
Long-term trend identification	Determined long-term trends in data	Chlorophyll-a	■ Mann-Kendall trends analysis at each station
		Diatoms	■ Least Squares Regression analysis for trends in each metric at each station
		Macroinvertebrates	■ Least Squares Regression analysis for trends in each metric at each station

Appendix B Water Quality

Appendix B.1 Descriptive Statistics

Table B-1: Water quality analyte descriptive statistics at Station 1 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.7	8.5	8.0	0.39
Specific Conductance (µS/cm)	4	381	496	453	50
Temperature, Water (°C)	4	3.1	14.4	8.0	5.7
Turbidity (NTU)	4	0.6	3.2	1.9	1.2
Alkalinity as $CaCO_3$, Total (mg/L)	4	93.0	113.0	107.0	9.42
Bicarbonate as HCO_3, Total (mg/L)	4	113.0	138.0	130.5	11.79
Calcium, Total (mg/L)	4	6.0	7.0	6.5	0.58
Chloride, Total (mg/L)	4	48.0	65.0	59.3	7.68
Magnesium, Dissolved (mg/L)	4	0.5	0.5	0.5	0.00
Potassium, Total (mg/L)	4	7.0	9.0	8.3	0.96
Sodium, Dissolved (mg/L)	4	72.0	95.0	83.5	9.81
Sulfate, Total (mg/L)	4	11.0	15.0	13.5	1.91
Dissolved Solids, Total (mg/L)	4	281.0	340.0	323.0	28.08
Suspended Solids, Total (mg/L)	4	5.0	10.0	6.3	2.50
Arsenic, Total (mg/L)	4	0.215	0.280	0.261	0.031
Nitrite Nitrate, Total (mg/L)	4	0.025	0.060	0.040	0.018
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.060	0.040	0.018
Nitrogen, Total (mg/L)	4	0.080	0.160	0.115	0.033
Phosphorus, Total (mg/L)	4	0.040	0.100	0.060	0.027

Table B-2: Water quality analyte descriptive statistics at Station 1 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.5	8.0	7.7	0.22
Specific Conductance (µS/cm)	4	197	532	397	142
Temperature, Water (°C)	4	1.8	15.5	8.9	6.1
Turbidity (NTU)	4	1.4	57.4	15.9	27.7
Alkalinity as $CaCO_3$, Total (mg/L)	4	43.0	118.0	94.5	35.16
Bicarbonate as HCO_3, Total (mg/L)	4	53.0	144.0	115.3	42.52
Calcium, Total (mg/L)	4	3.0	7.0	5.5	1.73
Chloride, Total (mg/L)	4	21.0	69.0	48.3	20.16
Magnesium, Dissolved (mg/L)	4	0.5	0.5	0.5	0.00
Potassium, Total (mg/L)	4	5.0	9.0	7.3	1.71
Sodium, Dissolved (mg/L)	4	33.0	101.0	71.5	28.43
Sulfate, Total (mg/L)	4	11.0	16.0	13.0	2.45
Dissolved Solids, Total (mg/L)	4	135.0	367.0	269.5	97.59
Suspended Solids, Total (mg/L)	4	5.0	140.0	38.8	67.50
Arsenic, Total (mg/L)	4	0.184	0.323	0.246	0.057
Cadmium, Total (mg/L)	1	0.000	0.000	0.000	--
Copper, Total (mg/L)	1	0.001	0.001	0.001	--
Iron, Total (mg/L)	1	0.240	0.240	0.240	--
Lead, Total (mg/L)	1	0.001	0.001	0.001	--
Manganese, Total (mg/L)	1	0.050	0.050	0.050	--
Zinc, Total (mg/L)	1	0.005	0.005	0.005	--
Nitrite Nitrate, Total (mg/L)	4	0.025	0.050	0.031	0.013
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.050	0.031	0.013
Nitrogen, Total (mg/L)	4	0.050	0.890	0.298	0.397
Phosphorus, Total (mg/L)	4	0.020	0.080	0.050	0.024

Table B-3: Water quality analyte descriptive statistics at Station 1 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.5	8.1	7.8	0.26
Specific Conductance (µS/cm)	4	206	483	386	123
Temperature, Water (°C)	4	2.1	14.3	8.8	6.0
Turbidity (NTU)	4	1.2	37.1	10.5	17.8
Alkalinity as $CaCO_3$, Total (mg/L)	4	53.0	108.0	91.0	25.55
Bicarbonate as HCO_3, Total (mg/L)	4	65.0	132.0	111.3	31.11
Calcium, Total (mg/L)	4	3.0	9.0	6.3	2.50
Chloride, Total (mg/L)	4	23.0	61.0	47.8	17.11
Magnesium, Dissolved (mg/L)	4	0.5	0.5	0.5	0.00
Potassium, Total (mg/L)	4	5.0	9.0	7.8	1.89
Sodium, Dissolved (mg/L)	4	35.0	89.0	71.8	25.02
Sulfate, Total (mg/L)	4	7.0	11.0	9.0	1.83
Dissolved Solids, Total (mg/L)	4	167.0	308.0	262.5	64.46
Suspended Solids, Total (mg/L)	4	5.0	116.0	32.8	55.50
Arsenic, Total (mg/L)	4	0.176	0.275	0.232	0.042
Nitrite Nitrate, Total (mg/L)	4	0.020	0.030	0.025	0.004
Nitrite Nitrate, Dissolved (mg/L)	4	0.020	0.050	0.031	0.013
Nitrogen, Total (mg/L)	4	0.050	0.400	0.188	0.155
Phosphorus, Total (mg/L)	4	0.020	0.090	0.041	0.033

Table B-4: Water quality analyte descriptive statistics at Station 1 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.9	8.2	8.0	0.14
Specific Conductance (µS/cm)	4	331	461	411	56
Temperature, Water (°C)	4	5.2	15.5	10.4	5.3
Turbidity (NTU)	4	1.0	6.2	2.6	2.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	83.0	111.0	102.5	13.10
Bicarbonate as HCO_3, Total (mg/L)	4	101.0	135.0	125.0	16.08
Chloride, Total (mg/L)	4	43.0	61.0	55.5	8.54
Sulfate, Total (mg/L)	4	9.0	14.0	10.8	2.36
Dissolved Solids, Total (mg/L)	4	230.0	315.0	291.0	40.85
Suspended Solids, Total (mg/L)	4	5.0	18.0	8.3	6.50
Arsenic, Total (mg/L)	4	0.212	0.302	0.257	0.038
Nitrite Nitrate, Total (mg/L)	4	0.010	0.040	0.028	0.015
Nitrite Nitrate, Dissolved (mg/L)	4	0.010	0.040	0.028	0.015
Nitrogen, Total (mg/L)	4	0.050	0.200	0.113	0.063
Phosphorus, Total (mg/L)	4	0.020	0.035	0.029	0.006

Table B-5: Water quality analyte descriptive statistics at Station 1 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	6.4	9.0	7.6	1.1
Dissolved Oxygen (% Sat.)	6	81	86	83	2
pH, (s.u.)	12	7.5	8.0	7.9	0.17
Specific Conductance (µS/cm)	12	214	504	380	92
Temperature, Water (°C)	12	1.4	18.2	8.6	5.2
Turbidity (NTU)	12	1.1	11.9	3.4	2.9
Alkalinity as $CaCO_3$, Total (mg/L)	12	57.0	114.0	95.6	18.45
Bicarbonate as HCO_3, Total (mg/L)	12	70.0	139.0	115.4	21.75
Calcium, Total (mg/L)	12	4.0	9.0	5.9	1.16
Chloride, Total (mg/L)	12	25.0	70.0	50.3	14.80
Magnesium, Dissolved (mg/L)	12	0.5	0.5	0.5	0.00
Potassium, Total (mg/L)	12	5.0	9.0	7.6	1.38
Sodium, Dissolved (mg/L)	12	39.0	97.0	74.4	18.63
Sulfate, Total (mg/L)	12	7.0	16.0	11.8	3.04
Dissolved Solids, Total (mg/L)	12	165.0	368.0	285.5	63.53
Suspended Solids, Total (mg/L)	12	5.0	21.0	8.3	5.38
Arsenic, Total (mg/L)	12	0.127	0.328	0.231	0.062
Cadmium, Total (mg/L)	12	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	12	0.001	0.002	0.001	0.001
Iron, Total (mg/L)	12	0.070	0.710	0.222	0.179
Lead, Total (mg/L)	12	0.001	0.004	0.001	0.001
Manganese, Total (mg/L)	12	0.010	0.090	0.034	0.024
Zinc, Total (mg/L)	12	0.005	0.005	0.005	0.000
Nitrite Nitrate, Dissolved (mg/L)	12	0.020	0.060	0.040	0.016
Nitrogen, Total (mg/L)	12	0.050	0.300	0.150	0.077
Phosphorus, Total (mg/L)	12	0.017	0.038	0.025	0.007

Table B-6: Water quality analyte descriptive statistics at Station 1 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.5	9.8	7.7	1.5
Dissolved Oxygen (% Sat.)	4	81	96	85	8
pH, (s.u.)	4	7.5	7.8	7.7	0.15
Specific Conductance (µS/cm)	4	242	411	358	78
Temperature, Water (°C)	4	4.8	15.0	9.8	5.0
Turbidity (NTU)	4	1.2	7.1	3.0	2.8
Alkalinity as $CaCO_3$, Total (mg/L)	4	61.0	114.0	98.3	25.00
Bicarbonate as HCO_3, Total (mg/L)	4	74.0	139.0	119.8	30.73
Calcium, Total (mg/L)	4	5.0	7.0	6.0	0.82
Chloride, Total (mg/L)	4	29.0	58.0	47.3	12.71
Magnesium, Dissolved (mg/L)	4	0.5	0.5	0.5	0.00
Potassium, Total (mg/L)	4	5.0	8.0	7.3	1.50
Sodium, Dissolved (mg/L)	4	43.0	86.0	70.3	18.79
Sulfate, Total (mg/L)	4	8.0	14.0	11.5	2.52
Dissolved Solids, Total (mg/L)	4	187.0	299.0	256.8	49.16
Suspended Solids, Total (mg/L)	4	5.0	21.0	9.0	8.00
Arsenic, Total (mg/L)	4	0.142	0.260	0.211	0.050
Nitrite Nitrate, Total (mg/L)	4	0.010	0.040	0.025	0.013
Nitrogen, Total (mg/L)	4	0.060	0.140	0.088	0.036
Phosphorus, Total (mg/L)	4	0.030	0.040	0.035	0.004

Table B-7: Water quality analyte descriptive statistics at Station 1 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.3	8.5	7.3	1.0
Dissolved Oxygen (% Sat.)	4	78	80	79	1
pH, (s.u.)	4	7.5	8.2	7.8	0.31
Specific Conductance (µS/cm)	4	218	456	387	113
Temperature, Water (°C)	4	2.5	14.0	9.1	5.5
Turbidity (NTU)	4	1.1	23.0	7.0	10.7
Alkalinity as $CaCO_3$, Total (mg/L)	4	53.0	115.0	97.0	29.53
Bicarbonate as HCO_3, Total (mg/L)	4	65.0	140.0	118.5	35.87
Calcium, Total (mg/L)	4	4.0	7.0	5.8	1.26
Chloride, Total (mg/L)	4	28.0	60.0	50.8	15.26
Magnesium, Dissolved (mg/L)	4	0.5	0.5	0.5	0.00
Potassium, Total (mg/L)	4	5.0	9.0	7.5	1.73
Sodium, Dissolved (mg/L)	4	41.0	92.0	75.0	23.11
Sulfate, Total (mg/L)	4	7.0	15.0	11.5	3.32
Dissolved Solids, Total (mg/L)	4	169.0	327.0	277.8	73.49
Suspended Solids, Total (mg/L)	4	5.0	80.0	23.8	37.50
Arsenic, Total (mg/L)	4	0.155	0.271	0.239	0.056
Nitrite Nitrate, Total (mg/L)	4	0.020	0.050	0.033	0.013
Nitrogen, Total (mg/L)	4	0.005	0.220	0.111	0.088
Phosphorus, Total (mg/L)	4	0.029	0.082	0.049	0.023

Table B-8: Water quality analyte descriptive statistics at Station 1 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.4	9.1	7.7	1.3
Dissolved Oxygen (% Sat.)	4	78	80	79	1
pH, (s.u.)	4	6.8	8.0	7.4	0.49
Specific Conductance (µS/cm)	4	231	469	386	106
Temperature, Water (°C)	4	0.3	14.4	6.9	6.7
Turbidity (NTU)	4	1.2	11.9	4.6	4.9
Alkalinity as $CaCO_3$, Total (mg/L)	4	58.0	118.0	97.8	26.99
Bicarbonate as HCO_3, Total (mg/L)	4	70.0	143.0	118.8	33.03
Calcium, Total (mg/L)	4	4.0	7.0	6.0	1.41
Chloride, Total (mg/L)	4	28.0	62.0	49.5	14.84
Magnesium, Dissolved (mg/L)	4	0.5	0.5	0.5	0.00
Potassium, Total (mg/L)	4	5.0	9.0	7.5	1.73
Sodium, Dissolved (mg/L)	4	45.0	93.0	76.8	21.58
Sulfate, Total (mg/L)	4	10.0	15.0	11.3	2.50
Dissolved Solids, Total (mg/L)	4	170.0	327.0	277.5	72.92
Suspended Solids, Total (mg/L)	4	5.0	32.0	11.8	13.50
Arsenic, Total (mg/L)	4	0.163	0.281	0.230	0.050
Nitrite Nitrate, Total (mg/L)	4	0.010	0.080	0.038	0.031
Nitrogen, Total (mg/L)	4	0.100	0.600	0.250	0.238
Phosphorus, Total (mg/L)	4	0.017	0.055	0.033	0.017

Table B-9: Water quality analyte descriptive statistics at Station 1 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.7	8.4	7.5	1.0
Dissolved Oxygen (% Sat.)	4	78	80	79	1
pH, (s.u.)	4	7.2	8.1	7.7	0.45
Specific Conductance (µS/cm)	4	338	474	432	63
Temperature, Water (°C)	4	2.9	12.7	7.8	5.5
Turbidity (NTU)	4	0.9	4.4	2.4	1.5
Alkalinity as $CaCO_3$, Total (mg/L)	4	85.0	120.0	107.5	15.84
Bicarbonate as HCO_3, Total (mg/L)	4	104.0	147.0	131.3	19.21
Calcium, Dissolved (mg/L)	4	6.0	7.0	6.5	0.58
Chloride, Total (mg/L)	4	42.0	66.0	56.5	10.25
Magnesium, Dissolved (mg/L)	4	0.5	0.5	0.5	0.00
Potassium, Dissolved (mg/L)	4	7.0	9.0	8.3	0.96
Sodium, Dissolved (mg/L)	4	66.0	98.0	86.3	14.10
Sulfate, Total (mg/L)	4	11.0	14.0	12.8	1.50
Dissolved Solids, Total (mg/L)	4	250.0	348.0	315.0	44.97
Suspended Solids, Total (mg/L)	4	5.0	10.0	6.3	2.50
Arsenic, Total (mg/L)	4	0.214	0.289	0.264	0.034
Nitrite Nitrate, Total (mg/L)	4	0.010	0.050	0.030	0.018
Nitrogen, Total (mg/L)	4	0.060	0.250	0.128	0.084
Phosphorus, Total (mg/L)	4	0.008	0.019	0.016	0.005

Table B-10: Water quality analyte descriptive statistics at Station 1 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.3	7.7	7.1	0.6
Dissolved Oxygen (% Sat.)	4	78	80	79	1
pH, (s.u.)	4	7.7	7.9	7.8	0.10
Specific Conductance (µS/cm)	4	351	491	449	66
Temperature, Water (°C)	4	5.6	14.9	10.1	4.0
Turbidity (NTU)	4	0.9	3.0	2.0	1.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	91.0	127.0	114.8	16.17
Bicarbonate as HCO_3, Total (mg/L)	4	110.0	154.0	139.5	20.01
Calcium, Dissolved (mg/L)	4	6.0	7.0	6.8	0.50
Chloride, Total (mg/L)	4	45.0	68.0	60.5	10.54
Magnesium, Dissolved (mg/L)	4	0.5	0.5	0.5	0.00
Potassium, Dissolved (mg/L)	4	7.0	9.0	8.5	1.00
Sodium, Dissolved (mg/L)	4	70.0	96.0	87.3	11.76
Sulfate, Total (mg/L)	4	10.0	15.0	12.5	2.38
Dissolved Solids, Total (mg/L)	4	266.0	360.0	333.0	44.97
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.223	0.321	0.280	0.041
Nitrite Nitrate, Total (mg/L)	4	0.010	0.050	0.025	0.017
Nitrogen, Total (mg/L)	4	0.015	0.190	0.106	0.087
Phosphorus, Total (mg/L)	4	0.010	0.015	0.013	0.002

Table B-11: Water quality analyte descriptive statistics at Station 2 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.7	8.5	8.1	0.35
Specific Conductance (µS/cm)	4	261	334	296	34
Temperature, Water (°C)	4	1.8	17.3	8.2	7.2
Turbidity (NTU)	4	0.5	1.8	1.0	0.6
Alkalinity as $CaCO_3$, Total (mg/L)	4	77.0	90.0	83.5	5.69
Bicarbonate as HCO_3, Total (mg/L)	4	94.0	110.0	101.8	6.85
Calcium, Total (mg/L)	4	11.0	12.0	11.5	0.58
Chloride, Total (mg/L)	4	26.0	38.0	30.5	5.45
Magnesium, Dissolved (mg/L)	4	2.0	2.0	2.0	0.00
Potassium, Total (mg/L)	4	4.0	6.0	5.0	0.82
Sodium, Dissolved (mg/L)	4	39.0	54.0	44.3	7.09
Sulfate, Total (mg/L)	4	9.0	11.0	9.8	0.96
Dissolved Solids, Total (mg/L)	4	185.0	236.0	203.0	23.85
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.106	0.157	0.134	0.021
Nitrite Nitrate, Total (mg/L)	4	0.025	0.025	0.025	0.000
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.025	0.025	0.000
Nitrogen, Total (mg/L)	4	0.130	0.180	0.160	0.022
Phosphorus, Total (mg/L)	4	0.030	0.050	0.040	0.008

Table B-12: Water quality analyte descriptive statistics at Station 2 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.6	8.3	7.8	0.35
Specific Conductance (µS/cm)	4	237	427	329	92
Temperature, Water (°C)	4	1.5	15.0	6.2	6.1
Turbidity (NTU)	4	0.6	1.4	1.1	0.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	68.0	106.0	87.3	17.73
Bicarbonate as HCO_3, Total (mg/L)	4	83.0	129.0	106.3	21.38
Calcium, Total (mg/L)	4	9.0	11.0	10.0	0.82
Chloride, Total (mg/L)	4	21.0	48.0	34.5	13.48
Magnesium, Dissolved (mg/L)	4	2.0	2.0	2.0	0.00
Potassium, Total (mg/L)	4	4.0	7.0	5.5	1.29
Sodium, Dissolved (mg/L)	4	31.0	73.0	51.3	19.97
Sulfate, Total (mg/L)	4	8.0	14.0	10.8	2.75
Dissolved Solids, Total (mg/L)	4	139.0	266.0	206.5	63.02
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.100	0.219	0.155	0.056
Cadmium, Total (mg/L)	1	0.000	0.000	0.000	--
Copper, Total (mg/L)	1	0.001	0.001	0.001	--
Iron, Total (mg/L)	1	0.100	0.100	0.100	--
Lead, Total (mg/L)	1	0.001	0.001	0.001	--
Manganese, Total (mg/L)	1	0.050	0.050	0.050	--
Zinc, Total (mg/L)	1	0.005	0.005	0.005	--
Nitrite Nitrate, Total (mg/L)	4	0.025	0.080	0.039	0.028
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.090	0.041	0.033
Nitrogen, Total (mg/L)	4	0.100	0.200	0.160	0.049
Phosphorus, Total (mg/L)	4	0.010	0.040	0.033	0.015

Table B-13: Water quality analyte descriptive statistics at Station 2 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.1	8.3	8.2	0.08
Specific Conductance (µS/cm)	4	238	347	273	51
Temperature, Water (°C)	4	2.6	16.2	6.8	6.3
Turbidity (NTU)	4	0.6	1.1	0.9	0.2
Alkalinity as $CaCO_3$, Total (mg/L)	4	67.0	90.0	75.3	10.40
Bicarbonate as HCO_3, Total (mg/L)	4	82.0	110.0	92.0	12.75
Calcium, Total (mg/L)	4	9.0	12.0	10.3	1.26
Chloride, Total (mg/L)	4	19.0	37.0	26.0	7.87
Magnesium, Dissolved (mg/L)	4	2.0	3.0	2.3	0.50
Potassium, Total (mg/L)	4	4.0	6.0	4.8	0.96
Sodium, Dissolved (mg/L)	4	31.0	57.0	41.5	11.27
Sulfate, Total (mg/L)	4	6.0	8.0	6.5	1.00
Dissolved Solids, Total (mg/L)	4	157.0	220.0	181.0	27.65
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.089	0.169	0.120	0.035
Nitrite Nitrate, Total (mg/L)	4	0.005	0.025	0.019	0.009
Nitrite Nitrate, Dissolved (mg/L)	4	0.005	0.025	0.019	0.009
Nitrogen, Total (mg/L)	4	0.100	0.200	0.150	0.058
Phosphorus, Total (mg/L)	4	0.020	0.041	0.030	0.009

Table B-14: Water quality analyte descriptive statistics at Station 2 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.0	8.6	8.3	0.25
Specific Conductance (µS/cm)	4	233	300	270	30
Temperature, Water (°C)	4	2.3	17.3	7.9	6.5
Turbidity (NTU)	4	0.5	1.6	1.0	0.5
Alkalinity as $CaCO_3$, Total (mg/L)	4	76.0	85.0	80.3	4.92
Bicarbonate as HCO_3, Total (mg/L)	4	93.0	104.0	98.3	6.08
Chloride, Total (mg/L)	4	21.0	33.0	28.3	5.50
Sulfate, Total (mg/L)	4	7.0	9.0	7.8	0.96
Dissolved Solids, Total (mg/L)	4	165.0	193.0	182.3	12.04
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.096	0.158	0.127	0.028
Nitrite Nitrate, Total (mg/L)	4	0.005	0.020	0.010	0.007
Nitrite Nitrate, Dissolved (mg/L)	4	0.005	0.020	0.013	0.009
Nitrogen, Total (mg/L)	4	0.100	0.200	0.150	0.058
Phosphorus, Total (mg/L)	4	0.020	0.028	0.023	0.004

Table B-15: Water quality analyte descriptive statistics at Station 2 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	6.7	9.9	8.0	1.3
Dissolved Oxygen (% Sat.)	6	91	92	92	0
pH, (s.u.)	12	7.7	8.3	8.0	0.20
Specific Conductance (µS/cm)	12	126	343	242	66
Temperature, Water (°C)	12	1.9	19.4	7.9	6.8
Turbidity (NTU)	12	0.4	1.9	1.0	0.5
Alkalinity as $CaCO_3$, Total (mg/L)	12	62.0	105.0	82.2	13.84
Bicarbonate as HCO_3, Total (mg/L)	12	76.0	128.0	99.9	16.70
Calcium, Total (mg/L)	12	9.0	14.0	10.1	1.38
Chloride, Total (mg/L)	12	16.0	43.0	26.7	10.07
Magnesium, Dissolved (mg/L)	12	2.0	3.0	2.1	0.29
Potassium, Total (mg/L)	12	4.0	7.0	4.9	1.08
Sodium, Dissolved (mg/L)	12	29.0	65.0	42.4	13.24
Sulfate, Total (mg/L)	12	6.0	11.0	8.3	1.83
Dissolved Solids, Total (mg/L)	12	142.0	271.0	191.8	51.62
Suspended Solids, Total (mg/L)	12	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	12	0.077	0.186	0.123	0.040
Cadmium, Total (mg/L)	12	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	12	0.001	0.001	0.001	0.000
Iron, Total (mg/L)	12	0.040	0.160	0.081	0.036
Lead, Total (mg/L)	12	0.001	0.001	0.001	0.000
Manganese, Total (mg/L)	12	0.010	0.070	0.027	0.019
Zinc, Total (mg/L)	12	0.005	0.005	0.005	0.000
Nitrite Nitrate, Dissolved (mg/L)	12	0.005	0.110	0.032	0.035
Nitrogen, Total (mg/L)	12	0.050	0.200	0.179	0.050
Phosphorus, Total (mg/L)	12	0.016	0.031	0.024	0.005

Table B-16: Water quality analyte descriptive statistics at Station 2 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.7	10.5	8.8	1.7
Dissolved Oxygen (% Sat.)	4	90	104	94	7
pH, (s.u.)	4	7.8	8.5	8.2	0.35
Specific Conductance (µS/cm)	4	228	278	253	20
Temperature, Water (°C)	4	2.6	18.6	9.0	7.0
Turbidity (NTU)	4	0.7	1.7	1.2	0.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	68.0	86.0	78.3	8.34
Bicarbonate as HCO_3, Total (mg/L)	4	83.0	105.0	95.8	10.24
Calcium, Total (mg/L)	4	10.0	10.0	10.0	0.00
Chloride, Total (mg/L)	4	20.0	31.0	25.0	4.55
Magnesium, Dissolved (mg/L)	4	2.0	2.0	2.0	0.00
Potassium, Total (mg/L)	4	4.0	6.0	5.0	0.82
Sodium, Dissolved (mg/L)	4	33.0	51.0	40.8	7.50
Sulfate, Total (mg/L)	4	8.0	10.0	9.0	0.82
Dissolved Solids, Total (mg/L)	4	146.0	203.0	180.5	27.38
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.097	0.151	0.118	0.023
Nitrite Nitrate, Total (mg/L)	4	0.005	0.040	0.014	0.018
Nitrogen, Total (mg/L)	4	0.100	0.210	0.165	0.051
Phosphorus, Total (mg/L)	4	0.019	0.043	0.030	0.010

Table B-17: Water quality analyte descriptive statistics at Station 2 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.4	9.4	8.2	1.3
Dissolved Oxygen (% Sat.)	4	86	88	87	1
pH, (s.u.)	4	7.8	8.7	8.2	0.44
Specific Conductance (µS/cm)	4	262	303	279	20
Temperature, Water (°C)	4	2.1	18.7	8.2	7.3
Turbidity (NTU)	4	0.8	1.2	1.0	0.2
Alkalinity as $CaCO_3$, Total (mg/L)	4	76.0	87.0	81.8	5.12
Bicarbonate as HCO_3, Total (mg/L)	4	91.0	107.0	99.5	7.33
Calcium, Total (mg/L)	4	10.0	12.0	10.8	0.96
Chloride, Total (mg/L)	4	25.0	35.0	29.0	4.55
Magnesium, Dissolved (mg/L)	4	2.0	3.0	2.5	0.58
Potassium, Total (mg/L)	4	4.0	6.0	5.0	0.82
Sodium, Dissolved (mg/L)	4	40.0	52.0	45.5	6.40
Sulfate, Total (mg/L)	4	9.0	11.0	9.5	1.00
Dissolved Solids, Total (mg/L)	4	164.0	213.0	189.3	20.82
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.110	0.151	0.126	0.019
Nitrite Nitrate, Total (mg/L)	4	0.005	0.040	0.020	0.018
Nitrogen, Total (mg/L)	4	0.080	0.250	0.153	0.073
Phosphorus, Total (mg/L)	4	0.028	0.056	0.040	0.012

Table B-18: Water quality analyte descriptive statistics at Station 2 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.4	9.1	8.4	1.3
Dissolved Oxygen (% Sat.)	4	85	87	86	1
pH, (s.u.)	4	6.6	8.4	7.7	0.77
Specific Conductance (µS/cm)	4	247	332	292	41
Temperature, Water (°C)	4	2.8	19.0	7.5	7.7
Turbidity (NTU)	4	0.5	1.4	1.0	0.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	72.0	96.0	84.8	11.18
Bicarbonate as HCO_3, Total (mg/L)	4	81.0	117.0	101.8	16.24
Calcium, Total (mg/L)	4	10.0	11.0	10.3	0.50
Chloride, Total (mg/L)	4	23.0	36.0	29.8	6.70
Magnesium, Dissolved (mg/L)	4	2.0	2.0	2.0	0.00
Potassium, Total (mg/L)	4	4.0	6.0	5.3	0.96
Sodium, Dissolved (mg/L)	4	39.0	58.0	49.8	9.74
Sulfate, Total (mg/L)	4	7.0	12.0	9.3	2.63
Dissolved Solids, Total (mg/L)	4	159.0	222.0	193.5	27.33
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.110	0.156	0.133	0.021
Nitrite Nitrate, Total (mg/L)	4	0.005	0.030	0.016	0.011
Nitrogen, Total (mg/L)	4	0.050	0.600	0.238	0.250
Phosphorus, Total (mg/L)	4	0.020	0.059	0.036	0.018

Table B-19: Water quality analyte descriptive statistics at Station 2 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.6	9.2	8.1	1.1
Dissolved Oxygen (% Sat.)	4	84	86	85	1
pH, (s.u.)	4	7.4	8.6	8.0	0.49
Specific Conductance (μS/cm)	4	285	323	307	17
Temperature, Water (°C)	4	2.8	16.9	8.1	6.1
Turbidity (NTU)	4	0.7	1.2	1.0	0.2
Alkalinity as $CaCO_3$, Total (mg/L)	4	80.0	94.0	88.0	6.06
Bicarbonate as HCO_3, Total (mg/L)	4	98.0	115.0	107.8	7.50
Calcium, Dissolved (mg/L)	4	10.0	10.0	10.0	0.00
Chloride, Total (mg/L)	4	28.0	36.0	33.0	3.56
Magnesium, Dissolved (mg/L)	4	2.0	2.0	2.0	0.00
Potassium, Dissolved (mg/L)	4	5.0	6.0	5.5	0.58
Sodium, Dissolved (mg/L)	4	45.0	58.0	52.5	5.80
Sulfate, Total (mg/L)	4	8.0	11.0	9.8	1.50
Dissolved Solids, Total (mg/L)	4	186.0	238.0	207.5	21.92
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.131	0.157	0.148	0.012
Nitrite Nitrate, Total (mg/L)	4	0.005	0.060	0.029	0.026
Nitrogen, Total (mg/L)	4	0.150	0.230	0.183	0.036
Phosphorus, Total (mg/L)	4	0.012	0.027	0.021	0.006

Table B-20: Water quality analyte descriptive statistics at Station 2 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.6	9.2	8.1	1.1
Dissolved Oxygen (% Sat.)	4	85	86	86	1
pH, (s.u.)	4	7.7	8.1	7.9	0.17
Specific Conductance (µS/cm)	4	283	358	319	34
Temperature, Water (°C)	4	2.6	16.9	8.3	6.1
Turbidity (NTU)	4	0.6	1.9	1.2	0.5
Alkalinity as $CaCO_3$, Total (mg/L)	4	86.0	104.0	95.0	8.04
Bicarbonate as HCO_3, Total (mg/L)	4	105.0	126.0	115.5	9.33
Calcium, Dissolved (mg/L)	4	10.0	12.0	11.3	0.96
Chloride, Total (mg/L)	4	28.0	42.0	35.3	6.08
Magnesium, Dissolved (mg/L)	4	2.0	3.0	2.8	0.50
Potassium, Dissolved (mg/L)	4	5.0	6.0	5.5	0.58
Sodium, Dissolved (mg/L)	4	43.0	63.0	53.8	8.69
Sulfate, Total (mg/L)	4	8.0	11.0	9.8	1.26
Dissolved Solids, Total (mg/L)	4	181.0	239.0	214.0	29.13
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.126	0.188	0.156	0.029
Nitrite Nitrate, Total (mg/L)	4	0.005	0.030	0.021	0.012
Nitrogen, Total (mg/L)	4	0.140	0.200	0.170	0.029
Phosphorus, Total (mg/L)	4	0.019	0.037	0.028	0.008

Table B-21: Water quality analyte descriptive statistics at Station 3 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.1	8.8	8.4	0.32
Specific Conductance (µS/cm)	4	221	311	272	39
Temperature, Water (°C)	4	-0.3	14.1	6.4	7.4
Turbidity (NTU)	4	0.8	3.1	1.9	1.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	82.0	93.0	89.5	5.07
Bicarbonate as HCO_3, Total (mg/L)	4	100.0	113.0	108.8	5.97
Calcium, Total (mg/L)	4	15.0	21.0	16.8	2.87
Chloride, Total (mg/L)	4	12.0	30.0	21.5	7.42
Magnesium, Dissolved (mg/L)	4	4.0	4.0	4.0	0.00
Potassium, Total (mg/L)	4	3.0	5.0	4.0	0.82
Sodium, Dissolved (mg/L)	4	19.0	43.0	31.8	10.05
Sulfate, Total (mg/L)	4	10.0	12.0	11.0	0.82
Dissolved Solids, Total (mg/L)	4	149.0	194.0	174.8	20.45
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.047	0.115	0.089	0.029
Nitrite Nitrate, Total (mg/L)	4	0.025	0.025	0.025	0.000
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.025	0.025	0.000
Nitrogen, Total (mg/L)	4	0.110	0.160	0.138	0.022
Phosphorus, Total (mg/L)	4	0.030	0.040	0.035	0.006

Table B-22: Water quality analyte descriptive statistics at Station 3 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.1	8.4	8.2	0.15
Specific Conductance (µS/cm)	4	240	360	286	52
Temperature, Water (°C)	4	-0.2	15.2	6.5	6.5
Turbidity (NTU)	4	1.0	52.3	14.2	25.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	80.0	104.0	90.3	10.01
Bicarbonate as HCO_3, Total (mg/L)	4	98.0	126.0	110.0	11.66
Calcium, Total (mg/L)	4	16.0	17.0	16.5	0.58
Chloride, Total (mg/L)	4	15.0	34.0	22.3	8.54
Magnesium, Dissolved (mg/L)	4	4.0	4.0	4.0	0.00
Potassium, Total (mg/L)	4	3.0	6.0	4.3	1.26
Sodium, Dissolved (mg/L)	4	23.0	48.0	33.0	10.80
Sulfate, Total (mg/L)	4	11.0	13.0	11.8	0.96
Dissolved Solids, Total (mg/L)	4	128.0	234.0	173.5	44.40
Suspended Solids, Total (mg/L)	4	5.0	86.0	25.3	40.50
Arsenic, Total (mg/L)	4	0.064	0.132	0.092	0.030
Cadmium, Total (mg/L)	1	0.000	0.000	0.000	--
Copper, Total (mg/L)	1	0.001	0.001	0.001	--
Iron, Total (mg/L)	1	0.150	0.150	0.150	--
Lead, Total (mg/L)	1	0.001	0.001	0.001	--
Manganese, Total (mg/L)	1	0.020	0.020	0.020	--
Zinc, Total (mg/L)	1	0.005	0.005	0.005	--
Nitrite Nitrate, Total (mg/L)	4	0.025	0.090	0.050	0.031
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.100	0.053	0.036
Nitrogen, Total (mg/L)	4	0.050	0.450	0.190	0.179
Phosphorus, Total (mg/L)	4	0.020	0.120	0.053	0.046

Table B-23: Water quality analyte descriptive statistics at Station 3 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.2	8.5	8.3	0.15
Specific Conductance (µS/cm)	4	236	311	269	32
Temperature, Water (°C)	4	0.4	13.4	6.1	6.4
Turbidity (NTU)	4	1.5	40.0	11.4	19.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	77.0	92.0	82.8	6.65
Bicarbonate as HCO_3, Total (mg/L)	4	93.0	112.0	100.5	8.35
Calcium, Total (mg/L)	4	15.0	16.0	15.8	0.50
Chloride, Total (mg/L)	4	15.0	27.0	20.8	4.92
Magnesium, Dissolved (mg/L)	4	4.0	4.0	4.0	0.00
Potassium, Total (mg/L)	4	3.0	5.0	4.0	0.82
Sodium, Dissolved (mg/L)	4	25.0	42.0	33.3	6.99
Sulfate, Total (mg/L)	4	7.0	9.0	7.8	0.96
Dissolved Solids, Total (mg/L)	4	143.0	189.0	172.5	21.52
Suspended Solids, Total (mg/L)	4	5.0	75.0	22.5	35.00
Arsenic, Total (mg/L)	4	0.069	0.112	0.091	0.018
Nitrite Nitrate, Total (mg/L)	4	0.005	0.130	0.051	0.056
Nitrite Nitrate, Dissolved (mg/L)	4	0.005	0.100	0.041	0.044
Nitrogen, Total (mg/L)	4	0.100	0.400	0.225	0.126
Phosphorus, Total (mg/L)	4	0.022	0.140	0.054	0.058

Table B-24: Water quality analyte descriptive statistics at Station 3 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.2	8.6	8.4	0.17
Specific Conductance (µS/cm)	4	222	276	254	26
Temperature, Water (°C)	4	0.8	16.6	7.6	7.1
Turbidity (NTU)	4	0.9	5.4	3.1	2.0
Alkalinity as $CaCO_3$, Total (mg/L)	4	81.0	98.0	91.3	7.41
Bicarbonate as HCO_3, Total (mg/L)	4	98.0	119.0	111.0	9.27
Chloride, Total (mg/L)	4	13.0	23.0	19.3	4.50
Sulfate, Total (mg/L)	4	7.0	10.0	8.0	1.41
Dissolved Solids, Total (mg/L)	4	156.0	197.0	172.8	17.29
Suspended Solids, Total (mg/L)	4	5.0	12.0	6.8	3.50
Arsenic, Total (mg/L)	4	0.060	0.123	0.092	0.026
Nitrite Nitrate, Total (mg/L)	4	0.005	0.040	0.021	0.017
Nitrite Nitrate, Dissolved (mg/L)	4	0.005	0.040	0.021	0.017
Nitrogen, Total (mg/L)	4	0.100	0.200	0.150	0.058
Phosphorus, Total (mg/L)	4	0.019	0.031	0.024	0.006

Table B-25: Water quality analyte descriptive statistics at Station 3 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	7.5	10.5	8.9	1.2
Dissolved Oxygen (% Sat.)	6	87	93	90	2
pH, (s.u.)	12	7.6	8.4	8.2	0.25
Specific Conductance (µS/cm)	12	170	328	252	56
Temperature, Water (°C)	12	0.0	16.8	6.2	5.5
Turbidity (NTU)	12	1.1	24.3	4.9	7.5
Alkalinity as $CaCO_3$, Total (mg/L)	12	64.0	108.0	86.8	13.08
Bicarbonate as HCO_3, Total (mg/L)	12	78.0	132.0	105.8	16.04
Calcium, Total (mg/L)	12	14.0	16.0	15.2	0.72
Chloride, Total (mg/L)	12	8.0	34.0	20.3	8.98
Magnesium, Dissolved (mg/L)	12	3.0	4.0	3.9	0.29
Potassium, Total (mg/L)	12	2.0	6.0	4.0	1.21
Sodium, Dissolved (mg/L)	12	15.0	52.0	33.1	12.16
Sulfate, Total (mg/L)	12	8.0	12.0	9.7	1.37
Dissolved Solids, Total (mg/L)	12	135.0	237.0	179.4	41.99
Suspended Solids, Total (mg/L)	12	5.0	39.0	8.9	10.18
Arsenic, Total (mg/L)	12	0.036	0.145	0.090	0.037
Cadmium, Total (mg/L)	12	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	12	0.001	0.005	0.002	0.001
Iron, Total (mg/L)	12	0.050	1.240	0.240	0.372
Lead, Total (mg/L)	12	0.001	0.003	0.001	0.001
Manganese, Total (mg/L)	12	0.010	0.090	0.022	0.028
Zinc, Total (mg/L)	12	0.005	0.005	0.005	0.000
Nitrite Nitrate, Dissolved (mg/L)	12	0.020	0.130	0.068	0.042
Nitrogen, Total (mg/L)	12	0.050	0.600	0.238	0.182
Phosphorus, Total (mg/L)	12	0.015	0.065	0.028	0.018

Table B-26: Water quality analyte descriptive statistics at Station 3 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.6	11.7	9.5	1.8
Dissolved Oxygen (% Sat.)	4	89	103	93	6
pH, (s.u.)	4	7.9	8.3	8.1	0.17
Specific Conductance (µS/cm)	4	211	264	237	23
Temperature, Water (°C)	4	2.5	15.3	7.3	6.1
Turbidity (NTU)	4	1.0	23.4	7.0	11.0
Alkalinity as $CaCO_3$, Total (mg/L)	4	78.0	93.0	85.0	7.62
Bicarbonate as HCO_3, Total (mg/L)	4	95.0	113.0	103.5	9.33
Calcium, Total (mg/L)	4	15.0	17.0	15.5	1.00
Chloride, Total (mg/L)	4	13.0	25.0	18.3	5.38
Magnesium, Dissolved (mg/L)	4	4.0	4.0	4.0	0.00
Potassium, Total (mg/L)	4	3.0	4.0	3.8	0.50
Sodium, Dissolved (mg/L)	4	21.0	40.0	30.3	8.42
Sulfate, Total (mg/L)	4	9.0	11.0	10.3	0.96
Dissolved Solids, Total (mg/L)	4	144.0	184.0	159.5	17.62
Suspended Solids, Total (mg/L)	4	5.0	47.0	15.5	21.00
Arsenic, Total (mg/L)	4	0.055	0.106	0.081	0.023
Nitrite Nitrate, Total (mg/L)	4	0.010	0.060	0.028	0.024
Nitrogen, Total (mg/L)	4	0.110	0.150	0.128	0.017
Phosphorus, Total (mg/L)	4	0.018	0.080	0.035	0.030

Table B-27: Water quality analyte descriptive statistics at Station 3 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.6	10.2	9.0	1.1
Dissolved Oxygen (% Sat.)	4	85	90	88	2
pH, (s.u.)	4	7.6	8.5	8.1	0.39
Specific Conductance (µS/cm)	4	252	286	271	14
Temperature, Water (°C)	4	0.1	15.2	6.8	6.6
Turbidity (NTU)	4	1.3	19.4	6.2	8.8
Alkalinity as $CaCO_3$, Total (mg/L)	4	86.0	93.0	90.0	3.16
Bicarbonate as HCO_3, Total (mg/L)	4	105.0	113.0	109.8	3.95
Calcium, Total (mg/L)	4	15.0	17.0	16.0	0.82
Chloride, Total (mg/L)	4	19.0	28.0	23.5	3.70
Magnesium, Dissolved (mg/L)	4	4.0	5.0	4.3	0.50
Potassium, Total (mg/L)	4	4.0	5.0	4.3	0.50
Sodium, Dissolved (mg/L)	4	31.0	40.0	36.0	3.74
Sulfate, Total (mg/L)	4	10.0	11.0	10.3	0.50
Dissolved Solids, Total (mg/L)	4	161.0	193.0	179.5	15.26
Suspended Solids, Total (mg/L)	4	5.0	29.0	11.0	12.00
Arsenic, Total (mg/L)	4	0.080	0.118	0.099	0.016
Nitrite Nitrate, Total (mg/L)	4	0.005	0.080	0.046	0.039
Nitrogen, Total (mg/L)	4	0.050	0.210	0.133	0.071
Phosphorus, Total (mg/L)	4	0.025	0.087	0.042	0.030

Table B-28: Water quality analyte descriptive statistics at Station 3 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.0	10.5	9.2	1.6
Dissolved Oxygen (% Sat.)	4	85	89	87	2
pH, (s.u.)	4	7.7	8.3	8.1	0.27
Specific Conductance (µS/cm)	4	238	307	272	29
Temperature, Water (°C)	4	0.0	16.0	6.0	7.4
Turbidity (NTU)	4	1.8	10.4	4.0	4.3
Alkalinity as $CaCO_3$, Total (mg/L)	4	82.0	99.0	90.5	7.05
Bicarbonate as HCO_3, Total (mg/L)	4	99.0	121.0	110.3	9.07
Calcium, Total (mg/L)	4	15.0	16.0	15.3	0.50
Chloride, Total (mg/L)	4	17.0	28.0	21.8	4.86
Magnesium, Dissolved (mg/L)	4	4.0	4.0	4.0	0.00
Potassium, Total (mg/L)	4	4.0	5.0	4.5	0.58
Sodium, Dissolved (mg/L)	4	30.0	46.0	37.8	7.14
Sulfate, Total (mg/L)	4	8.0	11.0	9.5	1.73
Dissolved Solids, Total (mg/L)	4	149.0	182.0	165.5	14.48
Suspended Solids, Total (mg/L)	4	5.0	17.0	8.0	6.00
Arsenic, Total (mg/L)	4	0.080	0.116	0.097	0.015
Nitrite Nitrate, Total (mg/L)	4	0.005	0.100	0.044	0.042
Nitrogen, Total (mg/L)	4	0.050	0.700	0.263	0.298
Phosphorus, Total (mg/L)	4	0.023	0.065	0.037	0.019

Table B-29: Water quality analyte descriptive statistics at Station 3 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.7	10.9	9.5	1.5
Dissolved Oxygen (% Sat.)	4	88	90	89	1
pH, (s.u.)	4	7.8	8.5	8.2	0.33
Specific Conductance (µS/cm)	4	246	299	272	22
Temperature, Water (°C)	4	0.2	13.9	5.4	6.5
Turbidity (NTU)	4	1.4	9.1	3.8	3.6
Alkalinity as $CaCO_3$, Total (mg/L)	4	83.0	99.0	92.3	6.70
Bicarbonate as HCO_3, Total (mg/L)	4	101.0	120.0	112.5	8.10
Calcium, Dissolved (mg/L)	4	15.0	20.0	16.5	2.38
Chloride, Total (mg/L)	4	16.0	24.0	21.0	3.83
Magnesium, Dissolved (mg/L)	4	4.0	5.0	4.3	0.50
Potassium, Dissolved (mg/L)	4	3.0	5.0	4.0	0.82
Sodium, Dissolved (mg/L)	4	26.0	45.0	36.0	8.04
Sulfate, Total (mg/L)	4	9.0	12.0	10.5	1.29
Dissolved Solids, Total (mg/L)	4	146.0	214.0	178.8	28.65
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.063	0.118	0.094	0.024
Nitrite Nitrate, Total (mg/L)	4	0.005	0.090	0.039	0.037
Nitrogen, Total (mg/L)	4	0.130	0.220	0.178	0.038
Phosphorus, Total (mg/L)	4	0.012	0.029	0.022	0.007

Table B-30: Water quality analyte descriptive statistics at Station 3 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.5	10.4	9.0	1.2
Dissolved Oxygen (% Sat.)	4	89	94	92	2
pH, (s.u.)	4	8.0	8.4	8.2	0.21
Specific Conductance (µS/cm)	4	246	323	278	32
Temperature, Water (°C)	4	3.2	16.1	8.5	5.5
Turbidity (NTU)	4	1.7	12.8	4.9	5.3
Alkalinity as $CaCO_3$, Total (mg/L)	4	95.0	105.0	98.3	4.57
Bicarbonate as HCO_3, Total (mg/L)	4	115.0	125.0	118.8	4.35
Calcium, Dissolved (mg/L)	4	16.0	20.0	18.0	1.83
Chloride, Total (mg/L)	4	17.0	32.0	23.0	6.38
Magnesium, Dissolved (mg/L)	4	4.0	5.0	4.5	0.58
Potassium, Dissolved (mg/L)	4	3.0	5.0	4.0	0.82
Sodium, Dissolved (mg/L)	4	27.0	47.0	35.8	8.30
Sulfate, Total (mg/L)	4	9.0	12.0	10.3	1.50
Dissolved Solids, Total (mg/L)	4	170.0	212.0	184.5	18.79
Suspended Solids, Total (mg/L)	4	5.0	12.0	6.8	3.50
Arsenic, Total (mg/L)	4	0.075	0.133	0.097	0.025
Nitrite Nitrate, Total (mg/L)	4	0.005	0.060	0.020	0.027
Nitrogen, Total (mg/L)	4	0.080	0.250	0.145	0.073
Phosphorus, Total (mg/L)	4	0.015	0.044	0.023	0.014

Table B-31: Water quality analyte descriptive statistics at Station 4 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.5	8.7	8.2	0.60
Specific Conductance (µS/cm)	4	237	329	292	40
Temperature, Water (°C)	4	0.7	17.4	8.4	8.3
Turbidity (NTU)	4	2.4	14.8	6.1	5.9
Alkalinity as $CaCO_3$, Total (mg/L)	4	89.0	112.0	101.0	9.42
Bicarbonate as HCO_3, Total (mg/L)	4	109.0	137.0	123.3	11.44
Calcium, Total (mg/L)	4	18.0	25.0	21.8	2.99
Chloride, Total (mg/L)	4	12.0	25.0	19.0	5.35
Magnesium, Dissolved (mg/L)	4	5.0	7.0	5.8	0.96
Potassium, Total (mg/L)	4	3.0	5.0	4.0	0.82
Sodium, Dissolved (mg/L)	4	20.0	36.0	29.0	6.68
Sulfate, Total (mg/L)	4	12.0	18.0	14.5	2.65
Dissolved Solids, Total (mg/L)	4	152.0	210.0	183.8	23.98
Suspended Solids, Total (mg/L)	4	5.0	12.0	6.8	3.50
Arsenic, Total (mg/L)	4	0.048	0.094	0.073	0.023
Nitrite Nitrate, Total (mg/L)	4	0.025	0.070	0.036	0.023
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.060	0.034	0.018
Nitrogen, Total (mg/L)	4	0.160	0.310	0.213	0.068
Phosphorus, Total (mg/L)	4	0.030	0.060	0.043	0.015

Table B-32: Water quality analyte descriptive statistics at Station 4 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.9	8.5	8.3	0.26
Specific Conductance (µS/cm)	4	267	374	318	50
Temperature, Water (°C)	4	2.2	20.7	10.4	9.0
Turbidity (NTU)	4	1.7	10.0	4.7	3.7
Alkalinity as $CaCO_3$, Total (mg/L)	4	95.0	118.0	106.5	9.61
Bicarbonate as HCO_3, Total (mg/L)	4	108.0	145.0	128.0	15.34
Calcium, Total (mg/L)	4	21.0	24.0	22.5	1.29
Chloride, Total (mg/L)	4	13.0	27.0	20.0	7.02
Magnesium, Dissolved (mg/L)	4	5.0	7.0	5.8	0.96
Potassium, Total (mg/L)	4	3.0	5.0	4.0	1.15
Sodium, Dissolved (mg/L)	4	21.0	40.0	30.8	9.64
Sulfate, Total (mg/L)	4	14.0	18.0	16.0	1.63
Dissolved Solids, Total (mg/L)	4	145.0	237.0	187.5	40.84
Suspended Solids, Total (mg/L)	4	5.0	10.0	6.3	2.50
Arsenic, Total (mg/L)	4	0.053	0.101	0.077	0.022
Cadmium, Total (mg/L)	1	0.000	0.000	0.000	--
Copper, Total (mg/L)	1	0.001	0.001	0.001	--
Iron, Total (mg/L)	1	0.100	0.100	0.100	--
Lead, Total (mg/L)	1	0.001	0.001	0.001	--
Manganese, Total (mg/L)	1	0.020	0.020	0.020	--
Zinc, Total (mg/L)	1	0.005	0.005	0.005	--
Nitrite Nitrate, Total (mg/L)	4	0.025	0.070	0.036	0.023
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.070	0.036	0.023
Nitrogen, Total (mg/L)	4	0.100	0.200	0.170	0.048
Phosphorus, Total (mg/L)	4	0.020	0.030	0.028	0.005

Table B-33: Water quality analyte descriptive statistics at Station 4 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.2	8.6	8.4	0.18
Specific Conductance (µS/cm)	4	257	338	300	36
Temperature, Water (°C)	4	0.1	17.7	8.6	8.6
Turbidity (NTU)	4	1.7	10.1	5.3	4.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	87.0	107.0	96.5	9.15
Bicarbonate as HCO_3, Total (mg/L)	4	107.0	131.0	118.3	11.18
Calcium, Total (mg/L)	4	18.0	24.0	20.8	3.20
Chloride, Total (mg/L)	4	14.0	25.0	19.5	4.93
Magnesium, Dissolved (mg/L)	4	5.0	7.0	5.8	0.96
Potassium, Total (mg/L)	4	3.0	4.0	3.8	0.50
Sodium, Dissolved (mg/L)	4	23.0	37.0	30.8	6.45
Sulfate, Total (mg/L)	4	9.0	12.0	10.8	1.26
Dissolved Solids, Total (mg/L)	4	157.0	201.0	178.5	20.47
Suspended Solids, Total (mg/L)	4	5.0	18.0	9.8	6.18
Arsenic, Total (mg/L)	4	0.061	0.105	0.080	0.019
Nitrite Nitrate, Total (mg/L)	4	0.005	0.160	0.049	0.075
Nitrite Nitrate, Dissolved (mg/L)	4	0.005	0.090	0.031	0.040
Nitrogen, Total (mg/L)	4	0.100	0.200	0.175	0.050
Phosphorus, Total (mg/L)	4	0.020	0.034	0.028	0.006

Table B-34: Water quality analyte descriptive statistics at Station 4 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.2	8.7	8.5	0.24
Specific Conductance (µS/cm)	4	257	298	278	18
Temperature, Water (°C)	4	1.1	18.6	9.3	8.7
Turbidity (NTU)	4	1.5	8.9	4.1	3.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	93.0	106.0	101.3	5.74
Bicarbonate as HCO_3, Total (mg/L)	4	105.0	129.0	121.5	11.12
Chloride, Total (mg/L)	4	15.0	22.0	17.8	3.10
Sulfate, Total (mg/L)	4	10.0	15.0	11.8	2.22
Dissolved Solids, Total (mg/L)	4	174.0	186.0	178.3	5.68
Suspended Solids, Total (mg/L)	4	5.0	12.0	6.8	3.50
Arsenic, Total (mg/L)	4	0.063	0.102	0.078	0.017
Nitrite Nitrate, Total (mg/L)	4	0.005	0.060	0.030	0.029
Nitrite Nitrate, Dissolved (mg/L)	4	0.005	0.060	0.028	0.027
Nitrogen, Total (mg/L)	4	0.100	0.200	0.175	0.050
Phosphorus, Total (mg/L)	4	0.016	0.031	0.025	0.007

Table B-35: Water quality analyte descriptive statistics at Station 4 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	6.8	10.9	8.6	1.8
Dissolved Oxygen (% Sat.)	6	84	97	89	5
pH, (s.u.)	12	7.8	8.7	8.3	0.32
Specific Conductance (µS/cm)	12	185	353	275	53
Temperature, Water (°C)	12	0.5	20.5	8.5	7.4
Turbidity (NTU)	12	2.2	14.2	6.5	4.2
Alkalinity as $CaCO_3$, Total (mg/L)	12	73.0	122.0	100.9	13.61
Bicarbonate as HCO_3, Total (mg/L)	12	89.0	147.0	122.8	16.37
Calcium, Total (mg/L)	12	18.0	23.0	20.3	1.48
Chloride, Total (mg/L)	12	7.0	28.0	18.2	7.78
Magnesium, Dissolved (mg/L)	12	4.0	6.0	5.3	0.78
Potassium, Total (mg/L)	12	2.0	5.0	3.8	1.03
Sodium, Dissolved (mg/L)	12	14.0	44.0	30.1	10.26
Sulfate, Total (mg/L)	12	9.0	15.0	12.9	2.19
Dissolved Solids, Total (mg/L)	12	123.0	238.0	184.5	38.94
Suspended Solids, Total (mg/L)	12	5.0	22.0	6.9	5.05
Arsenic, Total (mg/L)	12	0.035	0.119	0.075	0.030
Cadmium, Total (mg/L)	12	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	12	0.001	0.002	0.001	0.001
Iron, Total (mg/L)	12	0.120	0.490	0.249	0.134
Lead, Total (mg/L)	12	0.001	0.001	0.001	0.000
Manganese, Total (mg/L)	12	0.010	0.060	0.036	0.012
Zinc, Total (mg/L)	12	0.005	0.005	0.005	0.000
Nitrite Nitrate, Dissolved (mg/L)	12	0.005	0.130	0.050	0.046
Nitrogen, Total (mg/L)	12	0.100	0.500	0.250	0.109
Phosphorus, Total (mg/L)	12	0.021	0.048	0.028	0.007

Table B-36: Water quality analyte descriptive statistics at Station 4 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.7	11.7	9.5	2.3
Dissolved Oxygen (% Sat.)	4	90	99	95	4
pH, (s.u.)	4	7.6	8.4	8.1	0.38
Specific Conductance (µS/cm)	4	254	273	265	9
Temperature, Water (°C)	4	1.0	21.2	9.7	10.1
Turbidity (NTU)	4	1.5	5.3	3.0	1.7
Alkalinity as $CaCO_3$, Total (mg/L)	4	95.0	110.0	101.5	6.24
Bicarbonate as HCO_3, Total (mg/L)	4	113.0	134.0	121.3	9.29
Calcium, Total (mg/L)	4	19.0	22.0	20.0	1.41
Chloride, Total (mg/L)	4	14.0	21.0	16.5	3.11
Magnesium, Dissolved (mg/L)	4	5.0	6.0	5.5	0.58
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	25.0	36.0	29.0	4.97
Sulfate, Total (mg/L)	4	12.0	14.0	13.0	1.15
Dissolved Solids, Total (mg/L)	4	162.0	191.0	172.3	13.72
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.061	0.087	0.071	0.011
Nitrite Nitrate, Total (mg/L)	4	0.005	0.060	0.023	0.026
Nitrogen, Total (mg/L)	4	0.090	0.190	0.148	0.042
Phosphorus, Total (mg/L)	4	0.019	0.030	0.026	0.005

Table B-37: Water quality analyte descriptive statistics at Station 4 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.0	10.9	8.3	2.3
Dissolved Oxygen (% Sat.)	4	77	92	84	6
pH, (s.u.)	4	7.5	8.9	8.2	0.66
Specific Conductance (µS/cm)	4	267	310	292	18
Temperature, Water (°C)	4	1.2	19.7	9.9	9.7
Turbidity (NTU)	4	1.8	14.1	6.1	5.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	92.0	108.0	102.0	6.98
Bicarbonate as HCO_3, Total (mg/L)	4	103.0	131.0	120.3	12.04
Calcium, Total (mg/L)	4	17.0	23.0	20.5	2.52
Chloride, Total (mg/L)	4	17.0	24.0	20.5	3.11
Magnesium, Dissolved (mg/L)	4	5.0	7.0	6.0	0.82
Potassium, Total (mg/L)	4	4.0	4.0	4.0	0.00
Sodium, Dissolved (mg/L)	4	30.0	35.0	32.8	2.06
Sulfate, Total (mg/L)	4	12.0	16.0	13.8	1.71
Dissolved Solids, Total (mg/L)	4	155.0	197.0	182.5	18.79
Suspended Solids, Total (mg/L)	4	5.0	20.0	8.8	7.50
Arsenic, Total (mg/L)	4	0.073	0.094	0.088	0.010
Nitrite Nitrate, Total (mg/L)	4	0.005	0.080	0.034	0.033
Nitrogen, Total (mg/L)	4	0.150	0.300	0.200	0.068
Phosphorus, Total (mg/L)	4	0.020	0.044	0.036	0.011

Table B-38: Water quality analyte descriptive statistics at Station 4 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.0	9.7	8.3	1.3
Dissolved Oxygen (% Sat.)	4	77	95	84	8
pH, (s.u.)	4	6.8	8.7	7.8	0.94
Specific Conductance (µS/cm)	4	254	328	295	32
Temperature, Water (°C)	4	0.5	21.8	9.3	10.2
Turbidity (NTU)	4	2.1	13.1	6.4	5.0
Alkalinity as $CaCO_3$, Total (mg/L)	4	90.0	115.0	104.0	10.74
Bicarbonate as HCO_3, Total (mg/L)	4	92.0	140.0	122.5	21.24
Calcium, Total (mg/L)	4	18.0	22.0	20.3	2.06
Chloride, Total (mg/L)	4	15.0	25.0	20.0	5.23
Magnesium, Dissolved (mg/L)	4	5.0	6.0	5.5	0.58
Potassium, Total (mg/L)	4	4.0	5.0	4.5	0.58
Sodium, Dissolved (mg/L)	4	27.0	42.0	34.8	7.37
Sulfate, Total (mg/L)	4	10.0	16.0	12.8	2.75
Dissolved Solids, Total (mg/L)	4	145.0	211.0	188.8	30.66
Suspended Solids, Total (mg/L)	4	5.0	12.0	8.3	3.77
Arsenic, Total (mg/L)	4	0.068	0.108	0.087	0.018
Nitrite Nitrate, Total (mg/L)	4	0.005	0.080	0.034	0.034
Nitrogen, Total (mg/L)	4	0.050	0.700	0.313	0.278
Phosphorus, Total (mg/L)	4	0.031	0.049	0.037	0.008

Table B-39: Water quality analyte descriptive statistics at Station 4 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	5.9	9.9	8.1	1.9
Dissolved Oxygen (% Sat.)	4	76	84	79	3
pH, (s.u.)	4	8.0	8.6	8.3	0.24
Specific Conductance (µS/cm)	4	256	296	282	18
Temperature, Water (°C)	4	1.0	19.1	8.0	8.5
Turbidity (NTU)	4	3.1	14.1	8.0	4.7
Alkalinity as $CaCO_3$, Total (mg/L)	4	92.0	107.0	101.3	6.65
Bicarbonate as HCO_3, Total (mg/L)	4	113.0	130.0	123.8	7.59
Calcium, Dissolved (mg/L)	4	20.0	23.0	21.8	1.26
Chloride, Total (mg/L)	4	12.0	20.0	16.8	3.40
Magnesium, Dissolved (mg/L)	4	6.0	6.0	6.0	0.00
Potassium, Dissolved (mg/L)	4	3.0	4.0	3.8	0.50
Sodium, Dissolved (mg/L)	4	22.0	36.0	30.8	6.40
Sulfate, Total (mg/L)	4	11.0	15.0	13.5	1.91
Dissolved Solids, Total (mg/L)	4	160.0	191.0	179.0	14.02
Suspended Solids, Total (mg/L)	4	5.0	20.0	8.8	7.50
Arsenic, Total (mg/L)	4	0.054	0.082	0.073	0.013
Nitrite Nitrate, Total (mg/L)	4	0.005	0.040	0.019	0.015
Nitrogen, Total (mg/L)	4	0.120	0.250	0.198	0.055
Phosphorus, Total (mg/L)	4	0.021	0.033	0.028	0.005

Table B-40: Water quality analyte descriptive statistics at Station 4 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	5.9	10.0	8.1	1.7
Dissolved Oxygen (% Sat.)	4	77	87	82	4
pH, (s.u.)	4	7.9	8.3	8.1	0.17
Specific Conductance (µS/cm)	4	265	315	289	21
Temperature, Water (°C)	4	2.1	19.2	9.5	7.2
Turbidity (NTU)	4	2.7	9.7	5.7	2.9
Alkalinity as $CaCO_3$, Total (mg/L)	4	102.0	114.0	107.3	5.74
Bicarbonate as HCO_3, Total (mg/L)	4	125.0	139.0	131.0	6.68
Calcium, Dissolved (mg/L)	4	20.0	25.0	22.5	2.38
Chloride, Total (mg/L)	4	15.0	25.0	19.0	4.32
Magnesium, Dissolved (mg/L)	4	5.0	7.0	6.0	0.82
Potassium, Dissolved (mg/L)	4	3.0	4.0	3.8	0.50
Sodium, Dissolved (mg/L)	4	27.0	38.0	30.8	5.19
Sulfate, Total (mg/L)	4	11.0	15.0	12.8	2.06
Dissolved Solids, Total (mg/L)	4	172.0	202.0	183.3	13.05
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.054	0.094	0.076	0.019
Nitrite Nitrate, Total (mg/L)	4	0.005	0.040	0.014	0.018
Nitrogen, Total (mg/L)	4	0.140	0.290	0.205	0.066
Phosphorus, Total (mg/L)	4	0.011	0.041	0.025	0.013

Table B-41: Water quality analyte descriptive statistics at Station 5 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.9	9.3	8.5	0.65
Specific Conductance (µS/cm)	4	243	420	343	74
Temperature, Water (°C)	4	0.0	16.3	7.8	8.9
Turbidity (NTU)	4	4.8	28.0	13.0	10.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	97.0	148.0	124.8	21.12
Bicarbonate as HCO_3, Total (mg/L)	4	118.0	180.0	150.8	25.94
Calcium, Total (mg/L)	4	30.0	46.0	36.5	7.90
Chloride, Total (mg/L)	4	6.0	16.0	12.5	4.51
Magnesium, Dissolved (mg/L)	4	7.0	14.0	10.3	3.30
Potassium, Total (mg/L)	4	3.0	4.0	3.8	0.50
Sodium, Dissolved (mg/L)	4	11.0	24.0	20.0	6.06
Sulfate, Total (mg/L)	4	20.0	43.0	31.0	10.80
Dissolved Solids, Total (mg/L)	4	163.0	257.0	217.3	41.52
Suspended Solids, Total (mg/L)	4	5.0	57.0	23.0	23.51
Arsenic, Total (mg/L)	4	0.015	0.061	0.034	0.020
Nitrite Nitrate, Total (mg/L)	4	0.025	0.250	0.141	0.110
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.270	0.146	0.117
Nitrogen, Total (mg/L)	4	0.230	0.490	0.403	0.119
Phosphorus, Total (mg/L)	4	0.020	0.090	0.053	0.030

Table B-42: Water quality analyte descriptive statistics at Station 5 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.9	8.6	8.2	0.33
Specific Conductance (µS/cm)	4	234	405	333	72
Temperature, Water (°C)	4	0.1	20.6	10.0	9.1
Turbidity (NTU)	4	4.8	139.3	39.7	66.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	85.0	141.0	120.3	24.51
Bicarbonate as HCO_3, Total (mg/L)	4	104.0	172.0	143.3	29.93
Calcium, Total (mg/L)	4	22.0	39.0	32.8	7.80
Chloride, Total (mg/L)	4	8.0	15.0	11.8	3.30
Magnesium, Dissolved (mg/L)	4	5.0	12.0	9.3	3.10
Potassium, Total (mg/L)	4	3.0	4.0	3.3	0.50
Sodium, Dissolved (mg/L)	4	14.0	23.0	17.8	3.77
Sulfate, Total (mg/L)	4	16.0	36.0	23.8	9.67
Dissolved Solids, Total (mg/L)	4	143.0	248.0	194.8	43.37
Suspended Solids, Total (mg/L)	4	5.0	292.0	80.0	141.37
Arsenic, Total (mg/L)	4	0.020	0.039	0.032	0.008
Cadmium, Total (mg/L)	1	0.000	0.000	0.000	--
Copper, Total (mg/L)	1	0.002	0.002	0.002	--
Iron, Total (mg/L)	1	0.350	0.350	0.350	--
Lead, Total (mg/L)	1	0.001	0.001	0.001	--
Manganese, Total (mg/L)	1	0.030	0.030	0.030	--
Zinc, Total (mg/L)	1	0.005	0.005	0.005	--
Nitrite Nitrate, Total (mg/L)	4	0.025	0.240	0.121	0.095
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.240	0.124	0.093
Nitrogen, Total (mg/L)	4	0.200	0.890	0.443	0.307
Phosphorus, Total (mg/L)	4	0.020	0.320	0.103	0.145

Table B-43: Water quality analyte descriptive statistics at Station 5 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.0	8.8	8.4	0.34
Specific Conductance (µS/cm)	4	240	389	340	70
Temperature, Water (°C)	4	0.0	17.5	7.8	9.0
Turbidity (NTU)	4	5.0	109.0	32.5	51.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	86.0	140.0	121.8	24.42
Bicarbonate as HCO_3, Total (mg/L)	4	105.0	171.0	148.5	29.73
Calcium, Total (mg/L)	4	23.0	42.0	34.5	8.35
Chloride, Total (mg/L)	4	8.0	12.0	10.5	1.91
Magnesium, Dissolved (mg/L)	4	6.0	13.0	10.3	2.99
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	15.0	22.0	19.3	3.10
Sulfate, Total (mg/L)	4	12.0	35.0	25.5	10.08
Dissolved Solids, Total (mg/L)	4	167.0	234.0	206.3	30.38
Suspended Solids, Total (mg/L)	4	5.0	233.0	64.3	112.58
Arsenic, Total (mg/L)	4	0.026	0.036	0.031	0.004
Nitrite Nitrate, Total (mg/L)	4	0.020	0.230	0.118	0.090
Nitrite Nitrate, Dissolved (mg/L)	4	0.020	0.240	0.120	0.094
Nitrogen, Total (mg/L)	4	0.300	0.500	0.375	0.096
Phosphorus, Total (mg/L)	4	0.024	0.290	0.096	0.130

Table B-44: Water quality analyte descriptive statistics at Station 5 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.1	8.7	8.4	0.25
Specific Conductance (µS/cm)	4	277	380	334	43
Temperature, Water (°C)	4	0.0	20.1	9.6	9.8
Turbidity (NTU)	4	5.7	26.3	13.3	9.8
Alkalinity as $CaCO_3$, Total (mg/L)	4	115.0	144.0	133.0	13.29
Bicarbonate as HCO_3, Total (mg/L)	4	141.0	176.0	160.3	17.00
Chloride, Total (mg/L)	4	7.0	14.0	10.5	2.89
Sulfate, Total (mg/L)	4	18.0	40.0	29.3	9.07
Dissolved Solids, Total (mg/L)	4	179.0	246.0	213.5	28.05
Suspended Solids, Total (mg/L)	4	5.0	31.0	13.3	12.28
Arsenic, Total (mg/L)	4	0.022	0.039	0.030	0.009
Nitrite Nitrate, Total (mg/L)	4	0.020	0.180	0.118	0.074
Nitrite Nitrate, Dissolved (mg/L)	4	0.020	0.180	0.118	0.074
Nitrogen, Total (mg/L)	4	0.300	0.400	0.325	0.050
Phosphorus, Total (mg/L)	4	0.020	0.068	0.039	0.021

Table B-45: Water quality analyte descriptive statistics at Station 5 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	7.1	11.1	8.9	1.7
Dissolved Oxygen (% Sat.)	6	84	92	88	3
pH, (s.u.)	12	7.8	8.7	8.2	0.31
Specific Conductance (µS/cm)	12	220	381	324	61
Temperature, Water (°C)	12	-0.1	19.8	8.1	7.5
Turbidity (NTU)	12	4.3	105.7	20.7	28.5
Alkalinity as $CaCO_3$, Total (mg/L)	12	91.0	146.0	127.9	21.64
Bicarbonate as HCO_3, Total (mg/L)	12	111.0	177.0	153.8	25.26
Calcium, Total (mg/L)	12	25.0	41.0	35.1	6.32
Chloride, Total (mg/L)	12	5.0	14.0	10.0	3.10
Magnesium, Dissolved (mg/L)	12	6.0	13.0	10.5	2.43
Potassium, Total (mg/L)	12	2.0	4.0	3.7	0.65
Sodium, Dissolved (mg/L)	12	9.0	24.0	17.8	5.01
Sulfate, Total (mg/L)	12	17.0	39.0	31.4	8.41
Dissolved Solids, Total (mg/L)	12	134.0	274.0	210.8	40.91
Suspended Solids, Total (mg/L)	12	5.0	215.0	41.7	59.08
Arsenic, Total (mg/L)	12	0.013	0.038	0.026	0.008
Cadmium, Total (mg/L)	12	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	12	0.002	0.012	0.004	0.003
Iron, Total (mg/L)	12	0.190	5.020	0.948	1.392
Lead, Total (mg/L)	12	0.001	0.016	0.003	0.004
Manganese, Total (mg/L)	12	0.030	0.210	0.057	0.052
Zinc, Total (mg/L)	12	0.005	0.040	0.008	0.010
Nitrite Nitrate, Dissolved (mg/L)	12	0.020	0.330	0.138	0.104
Nitrogen, Total (mg/L)	12	0.200	0.600	0.408	0.124
Phosphorus, Total (mg/L)	12	0.014	0.273	0.065	0.073

Table B-46: Water quality analyte descriptive statistics at Station 5 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.0	12.0	8.8	2.9
Dissolved Oxygen (% Sat.)	4	77	96	84	8
pH, (s.u.)	4	7.4	8.5	8.1	0.48
Specific Conductance (µS/cm)	4	242	348	310	48
Temperature, Water (°C)	4	0.1	20.3	9.5	10.8
Turbidity (NTU)	4	6.2	21.4	10.7	7.2
Alkalinity as $CaCO_3$, Total (mg/L)	4	93.0	147.0	126.5	23.80
Bicarbonate as HCO_3, Total (mg/L)	4	114.0	174.0	151.0	27.59
Calcium, Total (mg/L)	4	25.0	41.0	34.0	7.79
Chloride, Total (mg/L)	4	7.0	13.0	11.0	2.71
Magnesium, Dissolved (mg/L)	4	8.0	12.0	10.5	1.91
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	14.0	24.0	20.3	4.35
Sulfate, Total (mg/L)	4	19.0	37.0	29.3	9.18
Dissolved Solids, Total (mg/L)	4	151.0	242.0	199.0	39.91
Suspended Solids, Total (mg/L)	4	5.0	37.0	14.8	15.20
Arsenic, Total (mg/L)	4	0.021	0.047	0.035	0.011
Nitrite Nitrate, Total (mg/L)	4	0.010	0.220	0.110	0.106
Nitrogen, Total (mg/L)	4	0.210	0.430	0.333	0.098
Phosphorus, Total (mg/L)	4	0.023	0.170	0.061	0.073

Table B-47: Water quality analyte descriptive statistics at Station 5 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.1	10.3	8.0	2.1
Dissolved Oxygen (% Sat.)	4	72	83	79	5
pH, (s.u.)	4	8.3	9.0	8.6	0.29
Specific Conductance (µS/cm)	4	254	365	323	49
Temperature, Water (°C)	4	0.3	19.2	9.9	9.3
Turbidity (NTU)	4	5.2	26.9	11.1	10.6
Alkalinity as $CaCO_3$, Total (mg/L)	4	95.0	140.0	122.3	19.60
Bicarbonate as HCO_3, Total (mg/L)	4	116.0	170.0	146.0	22.69
Calcium, Total (mg/L)	4	27.0	43.0	34.3	7.54
Chloride, Total (mg/L)	4	8.0	15.0	12.8	3.30
Magnesium, Dissolved (mg/L)	4	7.0	13.0	10.3	2.75
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	15.0	24.0	21.3	4.27
Sulfate, Total (mg/L)	4	17.0	39.0	28.5	9.88
Dissolved Solids, Total (mg/L)	4	158.0	234.0	201.5	32.34
Suspended Solids, Total (mg/L)	4	5.0	44.0	16.3	18.71
Arsenic, Total (mg/L)	4	0.027	0.058	0.039	0.014
Nitrite Nitrate, Total (mg/L)	4	0.020	0.170	0.108	0.071
Nitrogen, Total (mg/L)	4	0.230	0.400	0.285	0.080
Phosphorus, Total (mg/L)	4	0.019	0.085	0.041	0.030

Table B-48: Water quality analyte descriptive statistics at Station 5 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.8	10.1	8.7	1.5
Dissolved Oxygen (% Sat.)	4	77	89	83	6
pH, (s.u.)	4	7.5	8.8	8.1	0.56
Specific Conductance (µS/cm)	4	217	388	326	76
Temperature, Water (°C)	4	0.1	20.7	8.7	10.2
Turbidity (NTU)	4	3.9	69.8	20.9	32.6
Alkalinity as $CaCO_3$, Total (mg/L)	4	84.0	152.0	125.8	29.51
Bicarbonate as HCO_3, Total (mg/L)	4	103.0	186.0	149.3	36.45
Calcium, Total (mg/L)	4	23.0	42.0	34.8	8.54
Chloride, Total (mg/L)	4	8.0	15.0	12.0	3.16
Magnesium, Dissolved (mg/L)	4	6.0	12.0	10.3	2.87
Potassium, Total (mg/L)	4	3.0	5.0	4.0	0.82
Sodium, Dissolved (mg/L)	4	14.0	26.0	21.0	5.10
Sulfate, Total (mg/L)	4	17.0	39.0	29.3	10.14
Dissolved Solids, Total (mg/L)	4	143.0	259.0	198.3	47.76
Suspended Solids, Total (mg/L)	4	5.0	137.0	39.5	65.06
Arsenic, Total (mg/L)	4	0.031	0.037	0.034	0.003
Nitrite Nitrate, Total (mg/L)	4	0.010	0.280	0.145	0.145
Nitrogen, Total (mg/L)	4	0.300	1.100	0.575	0.359
Phosphorus, Total (mg/L)	4	0.019	0.209	0.072	0.092

Table B-49: Water quality analyte descriptive statistics at Station 5 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.7	10.1	8.5	1.6
Dissolved Oxygen (% Sat.)	4	79	81	79	1
pH, (s.u.)	4	7.9	8.7	8.3	0.34
Specific Conductance (µS/cm)	4	232	367	322	62
Temperature, Water (°C)	4	0.3	16.6	7.5	7.7
Turbidity (NTU)	4	5.3	33.5	13.2	13.6
Alkalinity as $CaCO_3$, Total (mg/L)	4	93.0	139.0	122.3	21.87
Bicarbonate as HCO_3, Total (mg/L)	4	114.0	170.0	147.8	26.96
Calcium, Dissolved (mg/L)	4	28.0	43.0	35.3	6.95
Chloride, Total (mg/L)	4	6.0	13.0	10.8	3.20
Magnesium, Dissolved (mg/L)	4	8.0	13.0	11.0	2.16
Potassium, Dissolved (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	12.0	23.0	20.0	5.35
Sulfate, Total (mg/L)	4	21.0	37.0	29.5	8.70
Dissolved Solids, Total (mg/L)	4	165.0	236.0	211.8	33.01
Suspended Solids, Total (mg/L)	4	5.0	67.0	23.5	29.15
Arsenic, Total (mg/L)	4	0.016	0.049	0.031	0.014
Nitrite Nitrate, Total (mg/L)	4	0.020	0.220	0.115	0.088
Nitrogen, Total (mg/L)	4	0.220	0.460	0.345	0.106
Phosphorus, Total (mg/L)	4	0.018	0.087	0.038	0.033

Table B-50: Water quality analyte descriptive statistics at Station 5 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.2	9.1	7.6	1.3
Dissolved Oxygen (% Sat.)	4	78	80	79	1
pH, (s.u.)	4	7.9	8.4	8.2	0.21
Specific Conductance (µS/cm)	4	233	360	318	58
Temperature, Water (°C)	4	3.0	20.6	11.3	7.7
Turbidity (NTU)	4	6.0	30.3	14.5	10.9
Alkalinity as $CaCO_3$, Total (mg/L)	4	97.0	138.0	124.3	19.10
Bicarbonate as HCO_3, Total (mg/L)	4	118.0	168.0	150.5	23.63
Calcium, Dissolved (mg/L)	4	26.0	39.0	33.0	6.06
Chloride, Total (mg/L)	4	6.0	15.0	11.3	4.11
Magnesium, Dissolved (mg/L)	4	7.0	12.0	10.0	2.16
Potassium, Dissolved (mg/L)	4	2.0	4.0	3.3	0.96
Sodium, Dissolved (mg/L)	4	12.0	26.0	20.0	6.06
Sulfate, Total (mg/L)	4	19.0	37.0	28.0	8.83
Dissolved Solids, Total (mg/L)	4	157.0	220.0	195.8	27.16
Suspended Solids, Total (mg/L)	4	10.0	60.0	26.3	22.87
Arsenic, Total (mg/L)	4	0.019	0.057	0.034	0.017
Nitrite Nitrate, Total (mg/L)	4	0.005	0.240	0.099	0.102
Nitrogen, Total (mg/L)	4	0.180	0.520	0.340	0.166
Phosphorus, Total (mg/L)	4	0.022	0.087	0.045	0.030

Table B-51: Water quality analyte descriptive statistics at Station 6 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.1	8.7	8.4	0.30
Specific Conductance (µS/cm)	4	330	368	349	16
Temperature, Water (°C)	4	1.8	14.0	7.6	5.0
Turbidity (NTU)	4	0.9	3.7	1.9	1.3
Alkalinity as $CaCO_3$, Total (mg/L)	4	124.0	136.0	129.3	5.74
Bicarbonate as HCO_3, Total (mg/L)	4	151.0	166.0	157.5	7.23
Calcium, Total (mg/L)	4	33.0	42.0	37.5	3.87
Chloride, Total (mg/L)	4	10.0	12.0	11.3	0.96
Magnesium, Dissolved (mg/L)	4	9.0	12.0	10.5	1.29
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	16.0	20.0	18.5	1.91
Sulfate, Total (mg/L)	4	29.0	35.0	32.0	2.94
Dissolved Solids, Total (mg/L)	4	195.0	230.0	211.5	17.60
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.027	0.029	0.028	0.001
Nitrite Nitrate, Total (mg/L)	4	0.130	0.200	0.178	0.033
Nitrite Nitrate, Dissolved (mg/L)	4	0.120	0.200	0.175	0.037
Nitrogen, Total (mg/L)	4	0.360	0.380	0.365	0.010
Phosphorus, Total (mg/L)	4	0.030	0.050	0.043	0.010

Table B-52: Water quality analyte descriptive statistics at Station 6 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.5	8.5	8.0	0.41
Specific Conductance (µS/cm)	4	304	394	349	50
Temperature, Water (°C)	4	1.6	13.5	7.4	5.0
Turbidity (NTU)	4	1.4	4.0	2.6	1.3
Alkalinity as $CaCO_3$, Total (mg/L)	4	110.0	141.0	126.3	17.08
Bicarbonate as HCO_3, Total (mg/L)	4	134.0	173.0	154.0	20.86
Calcium, Total (mg/L)	4	31.0	40.0	35.3	4.92
Chloride, Total (mg/L)	4	9.0	12.0	10.5	1.73
Magnesium, Dissolved (mg/L)	4	8.0	12.0	10.0	2.31
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	15.0	22.0	18.3	3.30
Sulfate, Total (mg/L)	4	25.0	35.0	30.0	5.77
Dissolved Solids, Total (mg/L)	4	171.0	240.0	203.0	33.32
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.025	0.029	0.027	0.002
Cadmium, Total (mg/L)	1	0.000	0.000	0.000	--
Copper, Total (mg/L)	1	0.001	0.001	0.001	--
Iron, Total (mg/L)	1	0.040	0.040	0.040	--
Lead, Total (mg/L)	1	0.001	0.001	0.001	--
Manganese, Total (mg/L)	1	0.030	0.030	0.030	--
Zinc, Total (mg/L)	1	0.005	0.005	0.005	--
Nitrite Nitrate, Total (mg/L)	4	0.050	0.220	0.163	0.078
Nitrite Nitrate, Dissolved (mg/L)	4	0.050	0.210	0.160	0.076
Nitrogen, Total (mg/L)	4	0.330	0.400	0.368	0.038
Phosphorus, Total (mg/L)	4	0.010	0.060	0.038	0.022

Table B-53: Water quality analyte descriptive statistics at Station 6 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.6	8.4	8.1	0.35
Specific Conductance (µS/cm)	4	289	348	322	31
Temperature, Water (°C)	4	2.3	13.4	7.5	4.6
Turbidity (NTU)	4	1.1	7.3	3.3	2.8
Alkalinity as $CaCO_3$, Total (mg/L)	4	105.0	124.0	114.8	8.14
Bicarbonate as HCO_3, Total (mg/L)	4	128.0	152.0	140.3	10.21
Calcium, Total (mg/L)	4	29.0	39.0	34.3	4.57
Chloride, Total (mg/L)	4	8.0	10.0	9.0	1.15
Magnesium, Dissolved (mg/L)	4	8.0	11.0	9.8	1.26
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	15.0	18.0	16.8	1.50
Sulfate, Total (mg/L)	4	18.0	27.0	22.3	4.03
Dissolved Solids, Total (mg/L)	4	169.0	226.0	196.8	23.30
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.023	0.027	0.025	0.002
Nitrite Nitrate, Total (mg/L)	4	0.110	0.290	0.203	0.076
Nitrite Nitrate, Dissolved (mg/L)	4	0.110	0.300	0.208	0.079
Nitrogen, Total (mg/L)	4	0.300	0.500	0.425	0.096
Phosphorus, Total (mg/L)	4	0.020	0.065	0.042	0.018

Table B-54: Water quality analyte descriptive statistics at Station 6 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	5	7.7	8.4	8.0	0.31
Specific Conductance (µS/cm)	5	282	331	309	24
Temperature, Water (°C)	5	1.8	13.8	8.9	5.1
Turbidity (NTU)	5	0.8	3.6	2.3	1.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	113.0	133.0	124.3	9.07
Bicarbonate as HCO_3, Total (mg/L)	4	138.0	162.0	151.3	10.87
Chloride, Total (mg/L)	4	7.0	10.0	8.8	1.50
Sulfate, Total (mg/L)	4	23.0	29.0	27.0	2.71
Dissolved Solids, Total (mg/L)	4	176.0	216.0	199.8	17.71
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.019	0.025	0.023	0.003
Nitrite Nitrate, Total (mg/L)	4	0.080	0.270	0.178	0.081
Nitrite Nitrate, Dissolved (mg/L)	4	0.080	0.270	0.178	0.079
Nitrogen, Total (mg/L)	4	0.300	0.500	0.425	0.096
Phosphorus, Total (mg/L)	4	0.020	0.045	0.034	0.011

Table B-55: Water quality analyte descriptive statistics at Station 6 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	3.5	9.6	6.0	2.4
Dissolved Oxygen (% Sat.)	6	41	85	62	17
pH, (s.u.)	12	7.5	8.2	7.9	0.26
Specific Conductance (µS/cm)	12	245	363	310	44
Temperature, Water (°C)	12	2.6	17.6	8.7	5.5
Turbidity (NTU)	12	0.9	9.5	3.5	2.8
Alkalinity as $CaCO_3$, Total (mg/L)	12	98.0	144.0	123.5	14.84
Bicarbonate as HCO_3, Total (mg/L)	12	120.0	176.0	149.8	17.46
Calcium, Total (mg/L)	12	28.0	41.0	34.3	4.14
Chloride, Total (mg/L)	12	5.0	12.0	8.3	2.53
Magnesium, Dissolved (mg/L)	12	8.0	13.0	10.1	1.56
Potassium, Total (mg/L)	12	3.0	4.0	3.4	0.51
Sodium, Dissolved (mg/L)	12	11.0	21.0	15.9	3.29
Sulfate, Total (mg/L)	12	20.0	38.0	28.8	6.21
Dissolved Solids, Total (mg/L)	12	156.0	241.0	203.1	30.28
Suspended Solids, Total (mg/L)	12	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	12	0.017	0.025	0.021	0.002
Cadmium, Total (mg/L)	12	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	12	0.001	0.005	0.003	0.001
Iron, Total (mg/L)	12	0.015	0.400	0.137	0.132
Lead, Total (mg/L)	12	0.001	0.007	0.002	0.002
Manganese, Total (mg/L)	12	0.010	0.070	0.033	0.018
Zinc, Total (mg/L)	12	0.005	0.005	0.005	0.000
Nitrite Nitrate, Dissolved (mg/L)	12	0.120	0.280	0.205	0.046
Nitrogen, Total (mg/L)	12	0.400	0.700	0.467	0.089
Phosphorus, Total (mg/L)	12	0.023	0.055	0.040	0.011

Table B-56: Water quality analyte descriptive statistics at Station 6 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	3.9	10.4	7.9	2.8
Dissolved Oxygen (% Sat.)	4	43	86	73	20
pH, (s.u.)	4	7.3	8.3	7.9	0.43
Specific Conductance (µS/cm)	4	306	346	319	19
Temperature, Water (°C)	4	1.6	14.3	8.0	5.2
Turbidity (NTU)	4	0.9	3.0	1.9	1.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	123.0	142.0	132.5	7.77
Bicarbonate as HCO_3, Total (mg/L)	4	150.0	173.0	161.0	9.42
Calcium, Total (mg/L)	4	33.0	39.0	36.0	2.58
Chloride, Total (mg/L)	4	8.0	10.0	9.0	0.82
Magnesium, Dissolved (mg/L)	4	10.0	12.0	10.8	0.96
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	16.0	19.0	17.5	1.29
Sulfate, Total (mg/L)	4	27.0	34.0	30.5	3.11
Dissolved Solids, Total (mg/L)	4	174.0	216.0	193.3	19.28
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.021	0.026	0.024	0.002
Nitrite Nitrate, Total (mg/L)	4	0.160	0.260	0.210	0.042
Nitrogen, Total (mg/L)	4	0.390	0.580	0.460	0.083
Phosphorus, Total (mg/L)	4	0.020	0.044	0.032	0.012

Table B-57: Water quality analyte descriptive statistics at Station 6 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	4.1	9.5	7.4	2.4
Dissolved Oxygen (% Sat.)	4	44	83	69	18
pH, (s.u.)	4	7.8	8.4	8.2	0.26
Specific Conductance (µS/cm)	4	322	349	340	12
Temperature, Water (°C)	4	2.8	13.1	7.5	4.3
Turbidity (NTU)	4	1.3	4.8	2.7	1.7
Alkalinity as $CaCO_3$, Total (mg/L)	4	128.0	133.0	131.0	2.16
Bicarbonate as HCO_3, Total (mg/L)	4	151.0	162.0	157.0	5.35
Calcium, Total (mg/L)	4	36.0	40.0	38.0	1.83
Chloride, Total (mg/L)	4	10.0	12.0	11.0	0.82
Magnesium, Dissolved (mg/L)	4	11.0	12.0	11.5	0.58
Potassium, Total (mg/L)	4	3.0	4.0	3.3	0.50
Sodium, Dissolved (mg/L)	4	19.0	21.0	19.8	0.96
Sulfate, Total (mg/L)	4	28.0	33.0	30.8	2.22
Dissolved Solids, Total (mg/L)	4	179.0	211.0	200.3	14.86
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.023	0.030	0.027	0.003
Nitrite Nitrate, Total (mg/L)	4	0.070	0.230	0.145	0.073
Nitrogen, Total (mg/L)	4	0.210	0.400	0.338	0.088
Phosphorus, Total (mg/L)	4	0.031	0.065	0.046	0.015

Table B-58: Water quality analyte descriptive statistics at Station 6 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	3.6	8.6	6.9	2.3
Dissolved Oxygen (% Sat.)	4	41	84	66	18
pH, (s.u.)	4	7.5	8.3	7.9	0.35
Specific Conductance (µS/cm)	4	272	355	315	43
Temperature, Water (°C)	4	2.3	15.8	8.7	5.5
Turbidity (NTU)	4	1.0	7.0	3.1	2.7
Alkalinity as $CaCO_3$, Total (mg/L)	4	105.0	140.0	123.3	16.48
Bicarbonate as HCO_3, Total (mg/L)	4	128.0	171.0	150.3	20.12
Calcium, Total (mg/L)	4	30.0	40.0	35.3	4.57
Chloride, Total (mg/L)	4	8.0	12.0	9.8	2.06
Magnesium, Dissolved (mg/L)	4	8.0	12.0	10.3	2.06
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	15.0	21.0	18.3	3.20
Sulfate, Total (mg/L)	4	20.0	36.0	28.5	7.72
Dissolved Solids, Total (mg/L)	4	165.0	214.0	189.3	21.05
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.026	0.028	0.027	0.001
Nitrite Nitrate, Total (mg/L)	4	0.060	0.210	0.158	0.068
Nitrogen, Total (mg/L)	4	0.300	0.900	0.475	0.287
Phosphorus, Total (mg/L)	4	0.030	0.050	0.040	0.011

Table B-59: Water quality analyte descriptive statistics at Station 6 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	3.3	9.2	6.9	2.6
Dissolved Oxygen (% Sat.)	4	36	83	65	21
pH, (s.u.)	4	7.8	8.4	8.0	0.28
Specific Conductance (µS/cm)	4	316	329	320	6
Temperature, Water (°C)	4	2.4	13.8	8.6	4.7
Turbidity (NTU)	4	1.0	5.8	2.8	2.3
Alkalinity as $CaCO_3$, Total (mg/L)	4	113.0	153.0	132.3	18.10
Bicarbonate as HCO_3, Total (mg/L)	4	137.0	187.0	160.5	22.05
Calcium, Dissolved (mg/L)	4	33.0	39.0	35.8	3.20
Chloride, Total (mg/L)	4	9.0	11.0	9.8	0.96
Magnesium, Dissolved (mg/L)	4	10.0	12.0	10.8	0.96
Potassium, Dissolved (mg/L)	4	3.0	4.0	3.3	0.50
Sodium, Dissolved (mg/L)	4	17.0	21.0	18.8	1.71
Sulfate, Total (mg/L)	4	25.0	34.0	29.0	3.92
Dissolved Solids, Total (mg/L)	4	197.0	222.0	205.0	11.63
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.024	0.027	0.026	0.002
Nitrite Nitrate, Total (mg/L)	4	0.140	0.230	0.198	0.040
Nitrogen, Total (mg/L)	4	0.330	0.400	0.378	0.032
Phosphorus, Total (mg/L)	4	0.019	0.058	0.038	0.016

Table B-60: Water quality analyte descriptive statistics at Station 6 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	3.4	8.3	6.5	2.3
Dissolved Oxygen (% Sat.)	4	39	78	63	17
pH, (s.u.)	4	7.5	8.0	7.7	0.21
Specific Conductance (µS/cm)	4	320	355	335	16
Temperature, Water (°C)	4	2.5	14.4	8.7	4.9
Turbidity (NTU)	4	1.0	6.4	3.0	2.5
Alkalinity as $CaCO_3$, Total (mg/L)	4	125.0	142.0	133.5	7.85
Bicarbonate as HCO_3, Total (mg/L)	4	153.0	169.0	161.8	7.97
Calcium, Dissolved (mg/L)	4	36.0	39.0	37.0	1.41
Chloride, Total (mg/L)	4	10.0	12.0	10.8	0.96
Magnesium, Dissolved (mg/L)	4	10.0	11.0	10.8	0.50
Potassium, Dissolved (mg/L)	4	3.0	4.0	3.3	0.50
Sodium, Dissolved (mg/L)	4	19.0	21.0	19.5	1.00
Sulfate, Total (mg/L)	4	27.0	32.0	29.8	2.63
Dissolved Solids, Total (mg/L)	4	190.0	239.0	212.8	21.41
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.024	0.029	0.026	0.002
Nitrite Nitrate, Total (mg/L)	4	0.040	0.260	0.148	0.090
Nitrogen, Total (mg/L)	4	0.260	0.420	0.318	0.076
Phosphorus, Total (mg/L)	4	0.018	0.041	0.031	0.011

Table B-61: Water quality analyte descriptive statistics at Station 7 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.1	8.9	8.5	0.43
Specific Conductance (µS/cm)	4	345	367	354	10
Temperature, Water (°C)	4	1.5	15.4	8.1	6.2
Turbidity (NTU)	4	0.4	3.5	1.9	1.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	127.0	135.0	130.3	3.40
Bicarbonate as HCO_3, Total (mg/L)	4	155.0	165.0	159.0	4.24
Calcium, Total (mg/L)	4	34.0	42.0	37.8	3.50
Chloride, Total (mg/L)	4	11.0	12.0	11.5	0.58
Magnesium, Dissolved (mg/L)	4	9.0	13.0	10.8	1.71
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	17.0	20.0	19.0	1.41
Sulfate, Total (mg/L)	4	31.0	36.0	33.0	2.45
Dissolved Solids, Total (mg/L)	4	202.0	241.0	221.5	17.37
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.025	0.028	0.027	0.001
Nitrite Nitrate, Total (mg/L)	4	0.060	0.190	0.140	0.059
Nitrite Nitrate, Dissolved (mg/L)	4	0.060	0.190	0.140	0.063
Nitrogen, Total (mg/L)	4	0.330	0.450	0.380	0.050
Phosphorus, Total (mg/L)	4	0.030	0.150	0.070	0.055

Table B-62: Water quality analyte descriptive statistics at Station 7 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.9	8.6	8.2	0.29
Specific Conductance (µS/cm)	4	319	394	358	42
Temperature, Water (°C)	4	1.5	15.9	8.3	5.9
Turbidity (NTU)	4	1.2	4.8	2.7	1.6
Alkalinity as $CaCO_3$, Total (mg/L)	4	117.0	143.0	129.8	14.17
Bicarbonate as HCO_3, Total (mg/L)	4	142.0	174.0	158.0	17.36
Calcium, Total (mg/L)	4	32.0	40.0	36.0	4.08
Chloride, Total (mg/L)	4	10.0	12.0	11.0	1.15
Magnesium, Dissolved (mg/L)	4	9.0	12.0	10.5	1.73
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	16.0	21.0	18.8	2.63
Sulfate, Total (mg/L)	4	27.0	36.0	31.5	4.65
Dissolved Solids, Total (mg/L)	4	181.0	240.0	206.3	29.07
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.024	0.028	0.026	0.002
Cadmium, Total (mg/L)	1	0.000	0.000	0.000	--
Copper, Total (mg/L)	1	0.001	0.001	0.001	--
Iron, Total (mg/L)	1	0.040	0.040	0.040	--
Lead, Total (mg/L)	1	0.001	0.001	0.001	--
Manganese, Total (mg/L)	1	0.010	0.010	0.010	--
Zinc, Total (mg/L)	1	0.005	0.005	0.005	--
Nitrite Nitrate, Total (mg/L)	4	0.025	0.220	0.144	0.084
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.220	0.141	0.084
Nitrogen, Total (mg/L)	4	0.250	0.500	0.395	0.105
Phosphorus, Total (mg/L)	4	0.010	0.060	0.035	0.021

Table B-63: Water quality analyte descriptive statistics at Station 7 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.7	8.6	8.2	0.39
Specific Conductance (µS/cm)	4	295	349	324	27
Temperature, Water (°C)	4	2.2	15.1	7.9	5.5
Turbidity (NTU)	4	1.4	4.6	2.9	1.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	107.0	127.0	118.3	9.07
Bicarbonate as HCO_3, Total (mg/L)	4	130.0	155.0	144.0	11.28
Calcium, Total (mg/L)	4	29.0	39.0	34.3	4.57
Chloride, Total (mg/L)	4	8.0	10.0	8.8	0.96
Magnesium, Dissolved (mg/L)	4	8.0	11.0	9.8	1.26
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	16.0	18.0	16.8	0.96
Sulfate, Total (mg/L)	4	19.0	27.0	22.8	3.50
Dissolved Solids, Total (mg/L)	4	167.0	212.0	194.0	19.10
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.022	0.026	0.024	0.002
Nitrite Nitrate, Total (mg/L)	4	0.080	0.270	0.183	0.078
Nitrite Nitrate, Dissolved (mg/L)	4	0.080	0.260	0.180	0.074
Nitrogen, Total (mg/L)	4	0.300	0.500	0.425	0.096
Phosphorus, Total (mg/L)	4	0.020	0.058	0.041	0.016

Table B-64: Water quality analyte descriptive statistics at Station 7 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.9	8.7	8.3	0.33
Specific Conductance (µS/cm)	4	299	334	320	15
Temperature, Water (°C)	4	1.7	16.0	8.6	5.9
Turbidity (NTU)	4	0.8	5.3	2.5	2.0
Alkalinity as $CaCO_3$, Total (mg/L)	4	119.0	134.0	126.3	6.95
Bicarbonate as HCO_3, Total (mg/L)	4	145.0	164.0	153.5	8.35
Chloride, Total (mg/L)	4	7.0	10.0	8.5	1.29
Sulfate, Total (mg/L)	4	26.0	29.0	28.3	1.50
Dissolved Solids, Total (mg/L)	4	183.0	219.0	202.5	14.80
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.020	0.024	0.022	0.002
Nitrite Nitrate, Total (mg/L)	4	0.020	0.300	0.140	0.119
Nitrite Nitrate, Dissolved (mg/L)	4	0.020	0.300	0.143	0.120
Nitrogen, Total (mg/L)	4	0.200	0.500	0.375	0.126
Phosphorus, Total (mg/L)	4	0.021	0.044	0.036	0.011

Table B-65: Water quality analyte descriptive statistics at Station 7 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	7.2	10.4	8.3	1.2
Dissolved Oxygen (% Sat.)	6	82	95	87	6
pH, (s.u.)	12	8.0	8.5	8.2	0.17
Specific Conductance (µS/cm)	12	261	363	309	42
Temperature, Water (°C)	12	2.2	18.4	9.3	6.1
Turbidity (NTU)	12	1.3	8.1	3.7	2.2
Alkalinity as $CaCO_3$, Total (mg/L)	12	104.0	147.0	123.8	14.98
Bicarbonate as HCO_3, Total (mg/L)	12	127.0	179.0	150.2	16.88
Calcium, Total (mg/L)	12	29.0	41.0	34.6	4.03
Chloride, Total (mg/L)	12	5.0	12.0	8.3	2.49
Magnesium, Dissolved (mg/L)	12	8.0	13.0	10.0	1.60
Potassium, Total (mg/L)	12	3.0	4.0	3.3	0.49
Sodium, Dissolved (mg/L)	12	12.0	21.0	15.6	3.18
Sulfate, Total (mg/L)	12	22.0	39.0	29.1	6.29
Dissolved Solids, Total (mg/L)	12	165.0	230.0	193.3	25.63
Suspended Solids, Total (mg/L)	12	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	12	0.016	0.025	0.021	0.003
Cadmium, Total (mg/L)	12	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	12	0.001	0.003	0.002	0.001
Iron, Total (mg/L)	12	0.030	0.290	0.133	0.095
Lead, Total (mg/L)	12	0.001	0.001	0.001	0.000
Manganese, Total (mg/L)	12	0.010	0.070	0.032	0.019
Zinc, Total (mg/L)	12	0.005	0.005	0.005	0.000
Nitrite Nitrate, Dissolved (mg/L)	12	0.090	0.250	0.187	0.062
Nitrogen, Total (mg/L)	12	0.400	0.700	0.500	0.128
Phosphorus, Total (mg/L)	12	0.022	0.078	0.043	0.015

Table B-66: Water quality analyte descriptive statistics at Station 7 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	5.1	11.0	8.8	2.6
Dissolved Oxygen (% Sat.)	4	57	103	83	19
pH, (s.u.)	4	7.8	8.4	8.1	0.25
Specific Conductance (µS/cm)	4	310	348	323	17
Temperature, Water (°C)	4	1.5	14.9	8.4	5.7
Turbidity (NTU)	4	1.3	4.2	2.8	1.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	119.0	135.0	130.0	7.44
Bicarbonate as HCO_3, Total (mg/L)	4	145.0	162.0	157.5	8.35
Calcium, Total (mg/L)	4	35.0	40.0	37.0	2.16
Chloride, Total (mg/L)	4	9.0	10.0	9.3	0.50
Magnesium, Dissolved (mg/L)	4	10.0	12.0	11.0	0.82
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	16.0	19.0	17.5	1.29
Sulfate, Total (mg/L)	4	28.0	35.0	31.3	3.30
Dissolved Solids, Total (mg/L)	4	188.0	220.0	206.3	15.02
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.020	0.025	0.023	0.002
Nitrite Nitrate, Total (mg/L)	4	0.110	0.260	0.190	0.063
Nitrogen, Total (mg/L)	4	0.410	0.450	0.428	0.017
Phosphorus, Total (mg/L)	4	0.020	0.054	0.037	0.018

Table B-67: Water quality analyte descriptive statistics at Station 7 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	5.1	10.2	8.3	2.3
Dissolved Oxygen (% Sat.)	4	59	97	79	16
pH, (s.u.)	4	7.6	8.6	8.2	0.42
Specific Conductance (µS/cm)	4	323	366	347	18
Temperature, Water (°C)	4	2.4	16.2	8.6	5.9
Turbidity (NTU)	4	1.5	8.5	3.5	3.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	130.0	140.0	134.3	4.35
Bicarbonate as HCO_3, Total (mg/L)	4	152.0	169.0	159.5	8.35
Calcium, Total (mg/L)	4	36.0	41.0	38.5	2.08
Chloride, Total (mg/L)	4	10.0	12.0	11.3	0.96
Magnesium, Dissolved (mg/L)	4	10.0	12.0	11.3	0.96
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	19.0	21.0	20.3	0.96
Sulfate, Total (mg/L)	4	29.0	35.0	32.5	3.00
Dissolved Solids, Total (mg/L)	4	205.0	222.0	213.8	7.68
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.022	0.029	0.026	0.003
Nitrite Nitrate, Total (mg/L)	4	0.050	0.220	0.120	0.072
Nitrogen, Total (mg/L)	4	0.260	0.370	0.325	0.054
Phosphorus, Total (mg/L)	4	0.024	0.053	0.038	0.012

Table B-68: Water quality analyte descriptive statistics at Station 7 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	4.6	9.6	7.8	2.2
Dissolved Oxygen (% Sat.)	4	55	96	74	17
pH, (s.u.)	4	7.6	8.4	8.0	0.33
Specific Conductance (µS/cm)	4	289	362	324	40
Temperature, Water (°C)	4	2.0	17.0	8.4	6.5
Turbidity (NTU)	4	1.3	6.4	3.5	2.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	113.0	143.0	127.3	14.52
Bicarbonate as HCO_3, Total (mg/L)	4	138.0	174.0	154.8	17.50
Calcium, Total (mg/L)	4	31.0	41.0	36.8	4.35
Chloride, Total (mg/L)	4	8.0	12.0	10.0	2.31
Magnesium, Dissolved (mg/L)	4	9.0	13.0	11.0	1.83
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	16.0	22.0	19.0	2.94
Sulfate, Total (mg/L)	4	21.0	37.0	29.8	7.97
Dissolved Solids, Total (mg/L)	4	181.0	212.0	197.3	15.54
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.025	0.028	0.026	0.001
Nitrite Nitrate, Total (mg/L)	4	0.030	0.190	0.128	0.069
Nitrogen, Total (mg/L)	4	0.300	1.000	0.500	0.337
Phosphorus, Total (mg/L)	4	0.031	0.059	0.044	0.014

Table B-69: Water quality analyte descriptive statistics at Station 7 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.1	10.4	8.3	1.8
Dissolved Oxygen (% Sat.)	4	70	90	79	10
pH, (s.u.)	4	7.6	8.7	8.2	0.45
Specific Conductance (µS/cm)	4	320	331	326	5
Temperature, Water (°C)	4	1.9	15.4	8.5	5.6
Turbidity (NTU)	4	1.5	3.1	2.1	0.7
Alkalinity as $CaCO_3$, Total (mg/L)	4	116.0	140.0	127.3	10.05
Bicarbonate as HCO_3, Total (mg/L)	4	142.0	165.0	154.3	9.74
Calcium, Dissolved (mg/L)	4	34.0	42.0	37.8	3.86
Chloride, Total (mg/L)	4	9.0	11.0	9.8	0.96
Magnesium, Dissolved (mg/L)	4	10.0	12.0	11.0	0.82
Potassium, Total (mg/L)	1	3.0	3.0	3.0	--
Potassium, Dissolved (mg/L)	3	3.0	4.0	3.3	0.58
Sodium, Dissolved (mg/L)	4	17.0	21.0	18.8	1.71
Sulfate, Total (mg/L)	4	27.0	35.0	30.3	3.40
Dissolved Solids, Total (mg/L)	4	197.0	221.0	207.5	10.75
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.024	0.027	0.025	0.001
Nitrite Nitrate, Total (mg/L)	4	0.070	0.210	0.158	0.064
Nitrogen, Total (mg/L)	4	0.280	0.400	0.368	0.059
Phosphorus, Total (mg/L)	4	0.015	0.052	0.032	0.015

Table B-70: Water quality analyte descriptive statistics at Station 7 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.7	9.3	8.0	1.5
Dissolved Oxygen (% Sat.)	4	67	92	79	11
pH, (s.u.)	4	8.0	8.3	8.1	0.15
Specific Conductance (µS/cm)	4	329	356	340	12
Temperature, Water (°C)	4	2.8	16.7	9.5	5.7
Turbidity (NTU)	4	1.4	3.9	2.5	1.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	130.0	144.0	136.0	6.68
Bicarbonate as HCO_3, Total (mg/L)	4	158.0	170.0	163.8	5.68
Calcium, Dissolved (mg/L)	4	36.0	39.0	37.0	1.41
Chloride, Total (mg/L)	4	10.0	12.0	10.8	0.96
Magnesium, Dissolved (mg/L)	4	10.0	11.0	10.8	0.50
Potassium, Dissolved (mg/L)	4	3.0	4.0	3.3	0.50
Sodium, Dissolved (mg/L)	4	19.0	21.0	20.0	0.82
Sulfate, Total (mg/L)	4	29.0	33.0	30.8	2.06
Dissolved Solids, Total (mg/L)	4	194.0	244.0	217.5	20.50
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.025	0.026	0.026	0.000
Nitrite Nitrate, Total (mg/L)	4	0.030	0.260	0.133	0.100
Nitrogen, Total (mg/L)	4	0.250	0.420	0.323	0.075
Phosphorus, Total (mg/L)	4	0.020	0.045	0.033	0.011

Table B-71: Water quality analyte descriptive statistics at Station 8 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.2	9.0	8.6	0.43
Specific Conductance (µS/cm)	4	342	356	352	7
Temperature, Water (°C)	4	1.3	17.5	8.9	7.2
Turbidity (NTU)	4	0.8	2.7	1.4	0.9
Alkalinity as $CaCO_3$, Total (mg/L)	4	128.0	133.0	130.3	2.63
Bicarbonate as HCO_3, Total (mg/L)	4	156.0	162.0	158.8	3.20
Calcium, Total (mg/L)	4	34.0	39.0	36.8	2.06
Chloride, Total (mg/L)	4	11.0	12.0	11.3	0.50
Magnesium, Dissolved (mg/L)	4	10.0	12.0	11.0	0.82
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	17.0	20.0	18.5	1.29
Sulfate, Total (mg/L)	4	32.0	36.0	33.3	1.89
Dissolved Solids, Total (mg/L)	4	203.0	232.0	217.0	12.03
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.024	0.028	0.027	0.002
Nitrite Nitrate, Total (mg/L)	4	0.025	0.160	0.106	0.066
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.170	0.106	0.067
Nitrogen, Total (mg/L)	4	0.260	0.400	0.318	0.062
Phosphorus, Total (mg/L)	4	0.020	0.060	0.043	0.017

Table B-72: Water quality analyte descriptive statistics at Station 8 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.2	8.6	8.3	0.19
Specific Conductance (µS/cm)	4	312	400	357	38
Temperature, Water (°C)	4	0.9	18.6	9.3	7.3
Turbidity (NTU)	4	0.9	2.0	1.6	0.5
Alkalinity as $CaCO_3$, Total (mg/L)	4	122.0	190.0	147.8	29.58
Bicarbonate as HCO_3, Total (mg/L)	4	149.0	232.0	180.3	36.22
Calcium, Total (mg/L)	4	33.0	40.0	36.3	3.30
Chloride, Total (mg/L)	4	9.0	12.0	10.5	1.29
Magnesium, Dissolved (mg/L)	4	9.0	12.0	10.3	1.50
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	16.0	21.0	18.5	2.38
Sulfate, Total (mg/L)	4	26.0	37.0	31.8	4.57
Dissolved Solids, Total (mg/L)	4	182.0	226.0	203.8	23.47
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.026	0.028	0.027	0.001
Cadmium, Total (mg/L)	1	0.000	0.000	0.000	--
Copper, Total (mg/L)	1	0.001	0.001	0.001	--
Iron, Total (mg/L)	1	0.015	0.015	0.015	--
Lead, Total (mg/L)	1	0.001	0.001	0.001	--
Manganese, Total (mg/L)	1	0.010	0.010	0.010	--
Zinc, Total (mg/L)	1	0.005	0.005	0.005	--
Nitrite Nitrate, Total (mg/L)	4	0.025	0.200	0.124	0.085
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.200	0.126	0.084
Nitrogen, Total (mg/L)	4	0.190	0.500	0.358	0.130
Phosphorus, Total (mg/L)	4	0.010	0.070	0.035	0.026

Table B-73: Water quality analyte descriptive statistics at Station 8 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.1	8.6	8.3	0.21
Specific Conductance (µS/cm)	4	303	358	329	23
Temperature, Water (°C)	4	1.8	16.9	8.3	6.3
Turbidity (NTU)	4	1.4	2.1	1.7	0.3
Alkalinity as $CaCO_3$, Total (mg/L)	4	112.0	129.0	119.3	7.80
Bicarbonate as HCO_3, Total (mg/L)	4	137.0	156.0	145.5	8.66
Calcium, Total (mg/L)	4	31.0	38.0	34.5	3.51
Chloride, Total (mg/L)	4	8.0	10.0	8.8	0.96
Magnesium, Dissolved (mg/L)	4	9.0	11.0	9.5	1.00
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	15.0	19.0	17.3	1.71
Sulfate, Total (mg/L)	4	21.0	29.0	23.8	3.59
Dissolved Solids, Total (mg/L)	4	172.0	215.0	193.0	17.61
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.022	0.026	0.024	0.002
Zinc, Total (mg/L)	1	0.005	0.005	0.005	--
Nitrite Nitrate, Total (mg/L)	4	0.025	0.240	0.139	0.095
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.240	0.136	0.094
Nitrogen, Total (mg/L)	4	0.200	0.500	0.375	0.126
Phosphorus, Total (mg/L)	4	0.020	0.064	0.042	0.018

Table B-74: Water quality analyte descriptive statistics at Station 8 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.1	8.7	8.4	0.26
Specific Conductance (µS/cm)	4	309	332	319	10
Temperature, Water (°C)	4	1.3	18.0	9.5	6.8
Turbidity (NTU)	4	0.8	2.0	1.5	0.5
Alkalinity as $CaCO_3$, Total (mg/L)	4	122.0	133.0	126.3	5.32
Bicarbonate as HCO_3, Total (mg/L)	4	149.0	158.0	153.3	4.92
Chloride, Total (mg/L)	4	8.0	9.0	8.5	0.58
Sulfate, Total (mg/L)	4	27.0	30.0	28.8	1.50
Dissolved Solids, Total (mg/L)	4	195.0	206.0	198.3	5.25
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.021	0.025	0.022	0.002
Nitrite Nitrate, Total (mg/L)	4	0.005	0.270	0.124	0.120
Nitrite Nitrate, Dissolved (mg/L)	4	0.005	0.260	0.124	0.117
Nitrogen, Total (mg/L)	4	0.200	0.500	0.375	0.126
Phosphorus, Total (mg/L)	4	0.021	0.052	0.036	0.013

Table B-75: Water quality analyte descriptive statistics at Station 8 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	6.3	10.3	7.9	1.4
Dissolved Oxygen (% Sat.)	6	74	96	83	8
pH, (s.u.)	12	8.0	8.5	8.2	0.17
Specific Conductance (µS/cm)	12	266	366	313	37
Temperature, Water (°C)	12	1.0	19.4	9.2	6.8
Turbidity (NTU)	12	1.2	5.7	2.8	1.4
Alkalinity as $CaCO_3$, Total (mg/L)	12	105.0	160.0	128.2	16.98
Bicarbonate as HCO_3, Total (mg/L)	12	128.0	187.0	155.7	19.37
Calcium, Total (mg/L)	12	30.0	41.0	35.0	3.54
Chloride, Total (mg/L)	12	6.0	12.0	8.1	2.15
Magnesium, Dissolved (mg/L)	12	8.0	13.0	10.3	1.42
Potassium, Total (mg/L)	12	3.0	4.0	3.3	0.49
Sodium, Dissolved (mg/L)	12	13.0	20.0	15.5	2.54
Sulfate, Total (mg/L)	12	23.0	40.0	30.2	5.52
Dissolved Solids, Total (mg/L)	12	169.0	245.0	204.1	25.02
Suspended Solids, Total (mg/L)	12	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	12	0.016	0.024	0.020	0.002
Cadmium, Total (mg/L)	12	0.000	0.001	0.000	0.000
Copper, Total (mg/L)	12	0.001	0.005	0.002	0.001
Iron, Total (mg/L)	12	0.030	0.200	0.076	0.051
Lead, Total (mg/L)	12	0.001	0.001	0.001	0.000
Manganese, Total (mg/L)	12	0.010	0.050	0.021	0.015
Zinc, Total (mg/L)	12	0.005	0.005	0.005	0.000
Nitrite Nitrate, Dissolved (mg/L)	12	0.080	0.250	0.166	0.067
Nitrogen, Total (mg/L)	12	0.400	1.600	0.525	0.341
Phosphorus, Total (mg/L)	12	0.021	0.072	0.042	0.016

Table B-76: Water quality analyte descriptive statistics at Station 8 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.9	10.9	9.3	1.7
Dissolved Oxygen (% Sat.)	4	82	99	90	7
pH, (s.u.)	4	8.1	8.4	8.3	0.13
Specific Conductance (µS/cm)	4	293	352	324	26
Temperature, Water (°C)	4	1.3	17.6	9.4	6.8
Turbidity (NTU)	4	1.1	2.0	1.4	0.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	125.0	153.0	138.8	11.44
Bicarbonate as HCO_3, Total (mg/L)	4	153.0	186.0	167.0	13.93
Calcium, Total (mg/L)	4	36.0	38.0	37.3	0.96
Chloride, Total (mg/L)	4	7.0	10.0	8.8	1.26
Magnesium, Dissolved (mg/L)	4	10.0	13.0	11.5	1.29
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	15.0	19.0	17.3	1.71
Sulfate, Total (mg/L)	4	30.0	36.0	32.0	2.83
Dissolved Solids, Total (mg/L)	4	180.0	226.0	201.5	18.93
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.020	0.027	0.023	0.003
Nitrite Nitrate, Total (mg/L)	4	0.050	0.260	0.140	0.090
Nitrogen, Total (mg/L)	4	0.310	0.520	0.400	0.088
Phosphorus, Total (mg/L)	4	0.027	0.100	0.059	0.036

Table B-77: Water quality analyte descriptive statistics at Station 8 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.2	9.8	8.6	1.1
Dissolved Oxygen (% Sat.)	4	77	95	86	8
pH, (s.u.)	4	7.7	8.6	8.3	0.42
Specific Conductance (µS/cm)	4	318	369	348	22
Temperature, Water (°C)	4	2.1	19.9	9.9	7.7
Turbidity (NTU)	4	0.8	1.9	1.5	0.5
Alkalinity as $CaCO_3$, Total (mg/L)	4	128.0	139.0	134.8	4.72
Bicarbonate as HCO_3, Total (mg/L)	4	152.0	165.0	157.5	5.45
Calcium, Total (mg/L)	4	37.0	41.0	38.5	1.73
Chloride, Total (mg/L)	4	10.0	13.0	11.5	1.29
Magnesium, Dissolved (mg/L)	4	11.0	12.0	11.5	0.58
Potassium, Total (mg/L)	4	3.0	4.0	3.3	0.50
Sodium, Dissolved (mg/L)	4	18.0	22.0	20.3	1.71
Sulfate, Total (mg/L)	4	29.0	37.0	33.0	3.65
Dissolved Solids, Total (mg/L)	4	176.0	222.0	201.3	19.17
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.021	0.028	0.026	0.003
Nitrite Nitrate, Total (mg/L)	4	0.005	0.240	0.091	0.110
Nitrogen, Total (mg/L)	4	0.210	0.400	0.308	0.096
Phosphorus, Total (mg/L)	4	0.017	0.071	0.037	0.024

Table B-78: Water quality analyte descriptive statistics at Station 8 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.1	9.9	8.5	1.8
Dissolved Oxygen (% Sat.)	4	75	100	83	12
pH, (s.u.)	4	7.4	8.6	8.1	0.50
Specific Conductance (µS/cm)	4	291	362	331	34
Temperature, Water (°C)	4	1.4	19.4	9.4	7.6
Turbidity (NTU)	4	1.3	3.8	2.3	1.2
Alkalinity as $CaCO_3$, Total (mg/L)	4	117.0	141.0	128.8	13.02
Bicarbonate as HCO_3, Total (mg/L)	4	142.0	172.0	155.5	14.82
Calcium, Total (mg/L)	4	34.0	40.0	37.3	3.20
Chloride, Total (mg/L)	4	8.0	12.0	10.3	2.06
Magnesium, Dissolved (mg/L)	4	10.0	12.0	11.0	1.15
Potassium, Total (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	16.0	22.0	19.3	2.75
Sulfate, Total (mg/L)	4	25.0	39.0	31.3	6.85
Dissolved Solids, Total (mg/L)	4	190.0	220.0	204.0	12.96
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.022	0.028	0.026	0.003
Nitrite Nitrate, Total (mg/L)	4	0.005	0.210	0.101	0.085
Nitrogen, Total (mg/L)	4	0.200	1.000	0.425	0.386
Phosphorus, Total (mg/L)	4	0.028	0.060	0.039	0.014

Table B-79: Water quality analyte descriptive statistics at Station 8 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.8	10.3	8.6	1.2
Dissolved Oxygen (% Sat.)	4	75	96	84	9
pH, (s.u.)	4	8.0	8.6	8.3	0.29
Specific Conductance (µS/cm)	4	313	338	328	12
Temperature, Water (°C)	4	2.1	18.3	9.7	6.7
Turbidity (NTU)	4	1.8	3.9	2.4	1.0
Alkalinity as $CaCO_3$, Total (mg/L)	4	120.0	131.0	126.0	4.55
Bicarbonate as HCO_3, Total (mg/L)	4	136.0	154.0	149.0	8.72
Calcium, Dissolved (mg/L)	4	35.0	41.0	38.0	2.58
Chloride, Total (mg/L)	4	9.0	10.0	9.5	0.58
Magnesium, Dissolved (mg/L)	4	11.0	12.0	11.3	0.50
Potassium, Dissolved (mg/L)	4	3.0	4.0	3.5	0.58
Sodium, Dissolved (mg/L)	4	18.0	21.0	18.8	1.50
Sulfate, Total (mg/L)	4	29.0	36.0	31.3	3.20
Dissolved Solids, Total (mg/L)	4	206.0	223.0	213.8	7.72
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.022	0.028	0.024	0.003
Nitrite Nitrate, Total (mg/L)	4	0.020	0.170	0.098	0.078
Nitrogen, Total (mg/L)	4	0.210	0.400	0.313	0.085
Phosphorus, Total (mg/L)	4	0.013	0.070	0.034	0.027

Table B-80: Water quality analyte descriptive statistics at Station 8 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.3	9.8	8.1	1.5
Dissolved Oxygen (% Sat.)	4	76	89	81	6
pH, (s.u.)	4	8.0	8.4	8.2	0.17
Specific Conductance (µS/cm)	4	326	359	341	15
Temperature, Water (°C)	4	2.1	17.9	10.2	6.5
Turbidity (NTU)	4	0.8	1.7	1.3	0.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	130.0	146.0	136.0	6.93
Bicarbonate as HCO_3, Total (mg/L)	4	159.0	168.0	163.3	3.69
Calcium, Dissolved (mg/L)	4	36.0	39.0	37.5	1.29
Chloride, Total (mg/L)	4	10.0	11.0	10.5	0.58
Magnesium, Dissolved (mg/L)	4	10.0	11.0	10.8	0.50
Potassium, Dissolved (mg/L)	4	3.0	4.0	3.3	0.50
Sodium, Dissolved (mg/L)	4	19.0	20.0	19.5	0.58
Sulfate, Total (mg/L)	4	28.0	34.0	31.3	2.50
Dissolved Solids, Total (mg/L)	4	189.0	238.0	213.5	20.70
Suspended Solids, Total (mg/L)	4	5.0	5.0	5.0	0.00
Arsenic, Total (mg/L)	4	0.025	0.028	0.026	0.001
Nitrite Nitrate, Total (mg/L)	4	0.005	0.230	0.099	0.100
Nitrogen, Total (mg/L)	4	0.190	0.410	0.283	0.099
Phosphorus, Total (mg/L)	4	0.020	0.051	0.035	0.013

Table B-81: Water quality analyte descriptive statistics at Station 9 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.2	9.0	8.5	0.36
Specific Conductance (µS/cm)	4	313	386	358	35
Temperature, Water (°C)	4	-0.3	16.5	7.6	8.9
Turbidity (NTU)	4	2.9	39.3	13.3	17.4
Alkalinity as $CaCO_3$, Total (mg/L)	4	125.0	144.0	135.5	8.66
Bicarbonate as HCO_3, Total (mg/L)	4	152.0	175.0	165.0	10.55
Calcium, Total (mg/L)	4	35.0	42.0	39.0	2.94
Chloride, Total (mg/L)	4	6.0	10.0	8.8	1.89
Magnesium, Dissolved (mg/L)	4	11.0	14.0	12.8	1.26
Potassium, Total (mg/L)	4	2.0	4.0	3.3	0.96
Sodium, Dissolved (mg/L)	4	13.0	20.0	17.8	3.30
Sulfate, Total (mg/L)	4	30.0	46.0	39.5	6.81
Dissolved Solids, Total (mg/L)	4	200.0	238.0	223.5	16.36
Suspended Solids, Total (mg/L)	4	5.0	65.0	21.8	29.02
Arsenic, Total (mg/L)	4	0.012	0.024	0.020	0.005
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.002	0.004	0.003	0.001
Iron, Total (mg/L)	4	0.080	1.600	0.495	0.738
Lead, Total (mg/L)	4	0.001	0.038	0.010	0.019
Manganese, Total (mg/L)	4	0.010	0.050	0.020	0.020
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.025	0.180	0.100	0.087
Nitrite Nitrate, Dissolved (mg/L)	4	0.025	0.190	0.100	0.087
Nitrogen, Total (mg/L)	4	0.280	0.380	0.343	0.048
Phosphorus, Total (mg/L)	4	0.040	0.100	0.063	0.026

Table B-82: Water quality analyte descriptive statistics at Station 9 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.9	8.5	8.3	0.26
Specific Conductance (µS/cm)	4	347	386	366	17
Temperature, Water (°C)	4	-0.1	18.9	8.7	8.2
Turbidity (NTU)	4	3.6	32.2	12.2	13.5
Alkalinity as $CaCO_3$, Total (mg/L)	4	130.0	136.0	133.5	3.00
Bicarbonate as HCO_3, Total (mg/L)	4	156.0	166.0	160.5	4.20
Calcium, Total (mg/L)	4	37.0	38.0	37.3	0.50
Chloride, Total (mg/L)	4	8.0	10.0	8.8	0.96
Magnesium, Dissolved (mg/L)	4	11.0	13.0	12.0	0.82
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	16.0	19.0	17.5	1.29
Sulfate, Total (mg/L)	4	34.0	40.0	36.5	3.00
Dissolved Solids, Total (mg/L)	4	199.0	229.0	210.8	13.33
Suspended Solids, Total (mg/L)	4	5.0	54.0	19.5	23.39
Arsenic, Total (mg/L)	4	0.017	0.024	0.022	0.003
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.002	0.003	0.003	0.001
Iron, Total (mg/L)	4	0.110	1.240	0.450	0.532
Lead, Total (mg/L)	4	0.001	0.003	0.002	0.001
Manganese, Total (mg/L)	4	0.010	0.060	0.025	0.024
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.025	0.250	0.136	0.099
Nitrite Nitrate, Dissolved (mg/L)	4	0.050	0.240	0.140	0.086
Nitrogen, Total (mg/L)	4	0.300	0.500	0.378	0.087
Phosphorus, Total (mg/L)	4	0.030	0.070	0.048	0.017

Table B-83: Water quality analyte descriptive statistics at Station 9 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	7.8	8.7	8.3	0.39
Specific Conductance (µS/cm)	4	333	362	349	12
Temperature, Water (°C)	4	1.4	19.2	8.8	8.2
Turbidity (NTU)	4	2.8	35.4	13.3	15.0
Alkalinity as $CaCO_3$, Total (mg/L)	4	116.0	134.0	126.5	7.59
Bicarbonate as HCO_3, Total (mg/L)	4	141.0	163.0	154.0	9.31
Calcium, Total (mg/L)	4	35.0	43.0	39.8	3.40
Chloride, Total (mg/L)	4	6.0	8.0	7.3	0.96
Magnesium, Dissolved (mg/L)	4	11.0	13.0	11.8	0.96
Potassium, Total (mg/L)	4	2.0	3.0	2.8	0.50
Sodium, Dissolved (mg/L)	4	14.0	18.0	16.5	1.91
Sulfate, Total (mg/L)	4	24.0	32.0	29.3	3.59
Dissolved Solids, Total (mg/L)	4	192.0	231.0	208.3	19.07
Suspended Solids, Total (mg/L)	4	5.0	68.0	23.5	30.12
Arsenic, Total (mg/L)	4	0.015	0.022	0.020	0.003
Cadmium, Total (mg/L)	3	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	3	0.002	0.003	0.002	0.001
Iron, Total (mg/L)	3	0.090	1.440	0.573	0.752
Lead, Total (mg/L)	3	0.001	0.003	0.002	0.001
Manganese, Total (mg/L)	3	0.010	0.060	0.030	0.026
Zinc, Total (mg/L)	3	0.005	0.010	0.007	0.003
Nitrite Nitrate, Total (mg/L)	4	0.030	0.250	0.145	0.107
Nitrite Nitrate, Dissolved (mg/L)	4	0.030	0.320	0.168	0.132
Nitrogen, Total (mg/L)	4	0.300	0.500	0.400	0.082
Phosphorus, Total (mg/L)	4	0.040	0.090	0.055	0.024

Table B-84: Water quality analyte descriptive statistics at Station 9 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.2	8.6	8.4	0.17
Specific Conductance (µS/cm)	4	304	341	329	17
Temperature, Water (°C)	4	1.6	20.2	9.6	8.8
Turbidity (NTU)	4	3.9	81.3	26.3	36.8
Alkalinity as $CaCO_3$, Total (mg/L)	3	135.0	138.0	137.0	1.73
Bicarbonate as HCO_3, Total (mg/L)	3	152.0	168.0	161.7	8.50
Calcium, Total (mg/L)	4	34.0	39.0	37.5	2.38
Chloride, Total (mg/L)	4	5.0	8.0	6.8	1.26
Magnesium, Dissolved (mg/L)	4	11.0	14.0	12.5	1.29
Potassium, Total (mg/L)	4	2.0	3.0	2.8	0.50
Sodium, Dissolved (mg/L)	4	14.0	19.0	16.5	2.08
Sulfate, Total (mg/L)	4	29.0	37.0	33.8	3.40
Dissolved Solids, Total (mg/L)	4	201.0	218.0	211.3	8.30
Suspended Solids, Total (mg/L)	4	5.0	111.0	35.3	50.99
Arsenic, Total (mg/L)	4	0.012	0.019	0.017	0.003
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.003	0.004	0.003	0.001
Iron, Total (mg/L)	4	0.110	2.080	0.638	0.963
Lead, Total (mg/L)	4	0.001	0.001	0.001	0.000
Manganese, Total (mg/L)	4	0.010	0.090	0.035	0.037
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.040	0.230	0.135	0.099
Nitrite Nitrate, Dissolved (mg/L)	4	0.040	0.230	0.138	0.096
Nitrogen, Total (mg/L)	4	0.300	0.500	0.425	0.096
Phosphorus, Total (mg/L)	4	0.032	0.140	0.067	0.050

Table B-85: Water quality analyte descriptive statistics at Station 9 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	6.8	10.8	8.5	1.6
Dissolved Oxygen (% Sat.)	6	83	86	85	1
pH, (s.u.)	12	7.6	8.4	8.2	0.23
Specific Conductance (µS/cm)	12	297	396	339	34
Temperature, Water (°C)	12	-0.2	20.1	8.3	7.3
Turbidity (NTU)	12	4.3	39.3	13.3	11.1
Alkalinity as $CaCO_3$, Total (mg/L)	12	118.0	153.0	133.6	10.80
Bicarbonate as HCO_3, Total (mg/L)	12	144.0	186.0	162.6	13.12
Calcium, Total (mg/L)	12	33.0	43.0	37.7	2.64
Chloride, Total (mg/L)	12	6.0	9.0	7.2	1.19
Magnesium, Dissolved (mg/L)	12	10.0	14.0	12.3	1.36
Potassium, Total (mg/L)	12	3.0	4.0	3.2	0.39
Sodium, Dissolved (mg/L)	12	14.0	22.0	16.3	2.71
Sulfate, Total (mg/L)	12	32.0	57.0	39.5	8.54
Dissolved Solids, Total (mg/L)	12	180.0	262.0	213.0	22.66
Suspended Solids, Total (mg/L)	12	5.0	73.0	22.4	20.94
Arsenic, Total (mg/L)	12	0.013	0.019	0.017	0.002
Cadmium, Total (mg/L)	12	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	12	0.002	0.010	0.004	0.003
Iron, Total (mg/L)	12	0.120	1.500	0.488	0.434
Lead, Total (mg/L)	12	0.001	0.026	0.005	0.007
Manganese, Total (mg/L)	12	0.010	0.060	0.029	0.017
Zinc, Total (mg/L)	12	0.005	0.005	0.005	0.000
Nitrite Nitrate, Dissolved (mg/L)	12	0.060	0.320	0.185	0.094
Nitrogen, Total (mg/L)	12	0.300	0.600	0.467	0.089
Phosphorus, Total (mg/L)	12	0.030	0.087	0.056	0.019

Table B-86: Water quality analyte descriptive statistics at Station 9 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.6	11.9	9.6	2.1
Dissolved Oxygen (% Sat.)	4	84	99	91	7
pH, (s.u.)	4	7.4	8.7	8.2	0.54
Specific Conductance (µS/cm)	4	315	369	348	23
Temperature, Water (°C)	4	0.5	18.1	9.4	8.9
Turbidity (NTU)	4	3.4	13.0	8.5	5.2
Alkalinity as $CaCO_3$, Total (mg/L)	4	144.0	156.0	150.8	5.12
Bicarbonate as HCO_3, Total (mg/L)	4	169.0	187.0	179.3	8.73
Calcium, Total (mg/L)	4	37.0	43.0	40.0	2.45
Chloride, Total (mg/L)	4	7.0	8.0	7.8	0.50
Magnesium, Dissolved (mg/L)	4	13.0	15.0	13.8	0.96
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	16.0	20.0	17.8	2.06
Sulfate, Total (mg/L)	4	38.0	41.0	39.8	1.50
Dissolved Solids, Total (mg/L)	4	193.0	222.0	209.5	12.07
Suspended Solids, Total (mg/L)	4	5.0	20.0	10.5	7.14
Arsenic, Total (mg/L)	4	0.017	0.022	0.019	0.002
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.001	0.003	0.002	0.001
Iron, Total (mg/L)	4	0.080	0.460	0.270	0.179
Lead, Total (mg/L)	4	0.001	0.008	0.002	0.004
Manganese, Total (mg/L)	4	0.015	0.026	0.021	0.005
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.060	0.290	0.158	0.116
Nitrogen, Total (mg/L)	4	0.300	0.430	0.383	0.057
Phosphorus, Total (mg/L)	4	0.023	0.056	0.035	0.014

Table B-87: Water quality analyte descriptive statistics at Station 9 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.5	10.3	8.6	2.0
Dissolved Oxygen (% Sat.)	4	79	84	81	2
pH, (s.u.)	4	7.6	8.8	8.4	0.54
Specific Conductance (µS/cm)	4	333	408	361	35
Temperature, Water (°C)	4	0.6	21.8	9.4	10.4
Turbidity (NTU)	4	3.1	22.2	10.6	8.9
Alkalinity as $CaCO_3$, Total (mg/L)	4	130.0	154.0	141.5	11.79
Bicarbonate as HCO_3, Total (mg/L)	4	152.0	181.0	167.5	12.71
Calcium, Total (mg/L)	4	36.0	44.0	39.3	3.40
Chloride, Total (mg/L)	4	7.0	11.0	9.3	1.71
Magnesium, Dissolved (mg/L)	4	12.0	15.0	13.3	1.50
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	15.0	21.0	18.3	2.75
Sulfate, Total (mg/L)	4	31.0	49.0	38.8	7.59
Dissolved Solids, Total (mg/L)	4	191.0	242.0	219.3	21.06
Suspended Solids, Total (mg/L)	4	5.0	30.0	14.5	12.01
Arsenic, Total (mg/L)	4	0.013	0.023	0.019	0.004
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.001	0.003	0.002	0.001
Iron, Total (mg/L)	4	0.070	0.680	0.318	0.279
Lead, Total (mg/L)	4	0.001	0.005	0.002	0.002
Manganese, Total (mg/L)	4	0.016	0.040	0.024	0.011
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.050	0.240	0.110	0.090
Nitrogen, Total (mg/L)	4	0.100	0.400	0.250	0.129
Phosphorus, Total (mg/L)	4	0.037	0.054	0.046	0.008

Table B-88: Water quality analyte descriptive statistics at Station 9 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.3	10.3	8.6	1.8
Dissolved Oxygen (% Sat.)	4	78	85	81	3
pH, (s.u.)	4	6.8	8.7	8.0	0.82
Specific Conductance (µS/cm)	4	319	386	344	30
Temperature, Water (°C)	4	0.1	20.3	8.9	9.6
Turbidity (NTU)	4	3.9	27.3	11.7	11.0
Alkalinity as $CaCO_3$, Total (mg/L)	4	132.0	146.0	136.0	6.68
Bicarbonate as HCO_3, Total (mg/L)	4	146.0	178.0	161.8	13.07
Calcium, Total (mg/L)	4	37.0	39.0	38.0	0.82
Chloride, Total (mg/L)	4	7.0	10.0	8.8	1.26
Magnesium, Dissolved (mg/L)	4	12.0	14.0	12.8	0.96
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	16.0	21.0	17.8	2.36
Sulfate, Total (mg/L)	4	30.0	52.0	39.0	9.31
Dissolved Solids, Total (mg/L)	4	214.0	261.0	229.0	21.56
Suspended Solids, Total (mg/L)	4	5.0	58.0	21.0	25.21
Arsenic, Total (mg/L)	4	0.019	0.022	0.021	0.002
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.002	0.003	0.003	0.001
Iron, Total (mg/L)	4	0.100	1.100	0.520	0.498
Lead, Total (mg/L)	4	0.001	0.009	0.005	0.004
Manganese, Total (mg/L)	4	0.016	0.055	0.031	0.018
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.010	0.230	0.103	0.102
Nitrogen, Total (mg/L)	4	0.200	0.800	0.425	0.263
Phosphorus, Total (mg/L)	4	0.040	0.064	0.050	0.010

Table B-89: Water quality analyte descriptive statistics at Station 9 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.8	10.4	8.7	1.6
Dissolved Oxygen (% Sat.)	4	79	82	80	1
pH, (s.u.)	4	8.1	8.4	8.3	0.14
Specific Conductance (µS/cm)	4	330	370	351	18
Temperature, Water (°C)	4	0.1	17.7	8.1	8.0
Turbidity (NTU)	4	4.4	20.6	10.4	7.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	135.0	147.0	139.8	5.50
Bicarbonate as HCO_3, Total (mg/L)	4	160.0	172.0	167.3	5.85
Calcium, Dissolved (mg/L)	4	39.0	40.0	39.8	0.50
Chloride, Total (mg/L)	4	7.0	9.0	7.8	0.96
Magnesium, Dissolved (mg/L)	4	12.0	14.0	13.3	0.96
Potassium, Dissolved (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	18.0	21.0	19.0	1.41
Sulfate, Total (mg/L)	4	33.0	45.0	39.3	4.92
Dissolved Solids, Total (mg/L)	4	207.0	235.0	221.5	12.15
Suspended Solids, Total (mg/L)	4	5.0	31.0	16.3	11.00
Arsenic, Total (mg/L)	4	0.014	0.023	0.020	0.004
Cadmium, Total (mg/L)	2	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	2	0.001	0.002	0.001	0.001
Iron, Total (mg/L)	2	0.100	0.240	0.170	0.099
Lead, Total (mg/L)	2	0.001	0.001	0.001	0.000
Manganese, Total (mg/L)	2	0.016	0.019	0.018	0.002
Zinc, Total (mg/L)	2	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.005	0.160	0.104	0.074
Nitrogen, Total (mg/L)	4	0.160	0.400	0.298	0.101
Phosphorus, Total (mg/L)	4	0.025	0.056	0.042	0.013

Table B-90: Water quality analyte descriptive statistics at Station 9 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.1	9.3	7.8	1.3
Dissolved Oxygen (% Sat.)	4	76	84	80	4
pH, (s.u.)	4	8.2	8.4	8.3	0.08
Specific Conductance (µS/cm)	4	341	373	358	13
Temperature, Water (°C)	4	3.7	21.2	11.6	7.7
Turbidity (NTU)	4	4.0	14.9	8.2	5.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	142.0	143.0	142.5	0.58
Bicarbonate as HCO_3, Total (mg/L)	4	165.0	175.0	170.3	4.99
Calcium, Dissolved (mg/L)	4	39.0	41.0	40.0	0.82
Chloride, Total (mg/L)	4	8.0	10.0	9.0	0.82
Magnesium, Dissolved (mg/L)	4	13.0	14.0	13.3	0.50
Potassium, Dissolved (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	18.0	22.0	20.0	1.83
Sulfate, Total (mg/L)	4	34.0	41.0	37.3	2.99
Dissolved Solids, Total (mg/L)	4	206.0	222.0	216.0	7.12
Suspended Solids, Total (mg/L)	4	5.0	28.0	13.3	10.90
Arsenic, Total (mg/L)	4	0.018	0.023	0.021	0.002
Cadmium, Total (mg/L)	3	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	3	0.001	0.002	0.001	0.001
Iron, Total (mg/L)	3	0.090	0.480	0.237	0.212
Lead, Total (mg/L)	3	0.002	0.005	0.003	0.002
Manganese, Total (mg/L)	3	0.018	0.034	0.024	0.009
Zinc, Total (mg/L)	3	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.010	0.180	0.075	0.079
Nitrogen, Total (mg/L)	4	0.190	0.300	0.248	0.061
Phosphorus, Total (mg/L)	4	0.027	0.038	0.034	0.005

Table B-91: Water quality analyte descriptive statistics at Station 10 in 2007.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.3	8.9	8.6	0.32
Specific Conductance (µS/cm)	4	334	419	389	39
Temperature, Water (°C)	4	0.8	16.8	8.3	8.5
Turbidity (NTU)	4	3.5	29.1	11.3	12.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	127.0	147.0	138.0	8.87
Bicarbonate as HCO_3, Total (mg/L)	4	155.0	179.0	168.3	10.56
Calcium, Total (mg/L)	4	38.0	44.0	41.8	2.87
Chloride, Total (mg/L)	4	6.0	10.0	8.8	1.89
Magnesium, Dissolved (mg/L)	4	11.0	15.0	13.8	1.89
Potassium, Total (mg/L)	4	2.0	4.0	3.0	0.82
Sodium, Dissolved (mg/L)	4	13.0	18.0	16.8	2.50
Sulfate, Total (mg/L)	4	37.0	53.0	48.5	7.68
Dissolved Solids, Total (mg/L)	4	220.0	246.0	237.5	11.85
Suspended Solids, Total (mg/L)	4	5.0	31.0	13.0	12.33
Arsenic, Total (mg/L)	4	0.012	0.022	0.018	0.005
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.001	0.003	0.002	0.001
Iron, Total (mg/L)	4	0.080	0.760	0.275	0.324
Lead, Total (mg/L)	4	0.001	0.001	0.001	0.000
Manganese, Total (mg/L)	4	0.010	0.030	0.018	0.010
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.060	0.190	0.128	0.072
Nitrite Nitrate, Dissolved (mg/L)	4	0.060	0.180	0.125	0.064
Nitrogen, Total (mg/L)	4	0.380	0.430	0.405	0.021
Phosphorus, Total (mg/L)	4	0.040	0.060	0.053	0.010

Table B-92: Water quality analyte descriptive statistics at Station 10 in 2008.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.1	8.3	8.3	0.10
Specific Conductance (µS/cm)	4	372	413	392	18
Temperature, Water (°C)	4	1.0	20.0	9.9	8.2
Turbidity (NTU)	4	2.9	26.3	11.0	10.5
Alkalinity as $CaCO_3$, Total (mg/L)	4	135.0	140.0	137.0	2.16
Bicarbonate as HCO_3, Total (mg/L)	4	160.0	171.0	165.3	4.57
Calcium, Total (mg/L)	4	40.0	43.0	40.8	1.50
Chloride, Total (mg/L)	4	8.0	10.0	9.0	0.82
Magnesium, Dissolved (mg/L)	4	13.0	14.0	13.5	0.58
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	17.0	18.0	17.5	0.58
Sulfate, Total (mg/L)	4	41.0	49.0	45.3	3.50
Dissolved Solids, Total (mg/L)	4	208.0	247.0	224.5	16.42
Suspended Solids, Total (mg/L)	4	5.0	31.0	12.8	12.39
Arsenic, Total (mg/L)	4	0.017	0.022	0.020	0.002
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.002	0.004	0.003	0.001
Iron, Total (mg/L)	4	0.080	0.720	0.313	0.283
Lead, Total (mg/L)	4	0.001	0.009	0.003	0.004
Manganese, Total (mg/L)	4	0.010	0.040	0.023	0.013
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.060	0.250	0.148	0.088
Nitrite Nitrate, Dissolved (mg/L)	4	0.070	0.240	0.148	0.081
Nitrogen, Total (mg/L)	4	0.340	0.410	0.388	0.032
Phosphorus, Total (mg/L)	4	0.030	0.070	0.050	0.018

Table B-93: Water quality analyte descriptive statistics at Station 10 in 2009.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.3	8.5	8.4	0.08
Specific Conductance (µS/cm)	4	346	391	376	21
Temperature, Water (°C)	4	2.0	18.3	9.1	7.5
Turbidity (NTU)	4	4.6	26.1	11.6	10.1
Alkalinity as $CaCO_3$, Total (mg/L)	4	131.0	134.0	132.3	1.50
Bicarbonate as HCO_3, Total (mg/L)	4	160.0	163.0	161.3	1.50
Calcium, Total (mg/L)	4	39.0	42.0	40.3	1.50
Chloride, Total (mg/L)	4	6.0	8.0	7.3	0.96
Magnesium, Dissolved (mg/L)	4	12.0	14.0	13.3	0.96
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	14.0	18.0	16.3	1.71
Sulfate, Total (mg/L)	4	29.0	41.0	37.8	5.85
Dissolved Solids, Total (mg/L)	4	212.0	241.0	224.0	14.02
Suspended Solids, Total (mg/L)	4	5.0	32.0	13.0	12.88
Arsenic, Total (mg/L)	4	0.016	0.020	0.018	0.002
Cadmium, Total (mg/L)	3	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	3	0.002	0.003	0.003	0.001
Iron, Total (mg/L)	3	0.130	0.830	0.367	0.401
Lead, Total (mg/L)	3	0.001	0.003	0.002	0.001
Manganese, Total (mg/L)	3	0.010	0.040	0.020	0.017
Zinc, Total (mg/L)	3	0.005	0.010	0.007	0.003
Nitrite Nitrate, Total (mg/L)	4	0.080	0.270	0.165	0.090
Nitrite Nitrate, Dissolved (mg/L)	4	0.080	0.280	0.168	0.094
Nitrogen, Total (mg/L)	4	0.300	0.400	0.350	0.058
Phosphorus, Total (mg/L)	4	0.040	0.060	0.048	0.010

Table B-94: Water quality analyte descriptive statistics at Station 10 in 2010.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
pH, (s.u.)	4	8.3	8.6	8.4	0.14
Specific Conductance (µS/cm)	4	313	375	350	26
Temperature, Water (°C)	4	1.0	20.3	10.1	9.1
Turbidity (NTU)	4	3.1	38.7	13.8	16.8
Alkalinity as $CaCO_3$, Total (mg/L)	4	128.0	167.0	142.8	17.02
Bicarbonate as HCO_3, Total (mg/L)	4	156.0	204.0	173.0	21.21
Calcium, Total (mg/L)	4	36.0	42.0	40.3	2.87
Chloride, Total (mg/L)	4	6.0	9.0	7.3	1.26
Magnesium, Dissolved (mg/L)	4	12.0	14.0	13.5	1.00
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	13.0	17.0	15.5	1.73
Sulfate, Total (mg/L)	4	32.0	49.0	41.8	7.14
Dissolved Solids, Total (mg/L)	4	190.0	243.0	223.5	24.64
Suspended Solids, Total (mg/L)	4	5.0	28.0	12.0	10.92
Arsenic, Total (mg/L)	4	0.012	0.017	0.015	0.002
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.002	0.004	0.003	0.001
Iron, Total (mg/L)	4	0.090	0.930	0.350	0.392
Lead, Total (mg/L)	4	0.001	0.004	0.002	0.002
Manganese, Total (mg/L)	4	0.010	0.040	0.018	0.015
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.070	0.230	0.158	0.080
Nitrite Nitrate, Dissolved (mg/L)	4	0.070	0.240	0.163	0.081
Nitrogen, Total (mg/L)	4	0.300	0.500	0.425	0.096
Phosphorus, Total (mg/L)	4	0.031	0.074	0.047	0.020

Table B-95: Water quality analyte descriptive statistics at Station 10 in 2011.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	6	7.2	10.8	8.9	1.4
Dissolved Oxygen (% Sat.)	6	84	97	89	5
pH, (s.u.)	12	7.9	8.6	8.4	0.21
Specific Conductance (µS/cm)	12	307	412	355	32
Temperature, Water (°C)	12	0.2	20.1	8.7	7.2
Turbidity (NTU)	12	3.7	44.6	14.9	13.9
Alkalinity as $CaCO_3$, Total (mg/L)	12	106.0	155.0	134.3	12.17
Bicarbonate as HCO_3, Total (mg/L)	12	110.0	187.0	160.8	19.42
Calcium, Total (mg/L)	12	34.0	45.0	39.3	2.74
Chloride, Total (mg/L)	12	6.0	9.0	7.2	1.19
Magnesium, Dissolved (mg/L)	12	10.0	15.0	13.2	1.53
Potassium, Total (mg/L)	12	3.0	4.0	3.2	0.39
Sodium, Dissolved (mg/L)	12	13.0	21.0	15.6	2.54
Sulfate, Total (mg/L)	12	36.0	67.0	47.0	9.73
Dissolved Solids, Total (mg/L)	12	188.0	267.0	221.6	21.52
Suspended Solids, Total (mg/L)	12	5.0	74.0	20.6	24.24
Arsenic, Total (mg/L)	12	0.013	0.018	0.016	0.002
Cadmium, Total (mg/L)	12	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	12	0.002	0.005	0.003	0.001
Iron, Total (mg/L)	12	0.110	1.580	0.512	0.526
Lead, Total (mg/L)	12	0.001	0.007	0.002	0.002
Manganese, Total (mg/L)	12	0.010	0.060	0.028	0.019
Zinc, Total (mg/L)	12	0.005	0.005	0.005	0.000
Nitrite Nitrate, Dissolved (mg/L)	12	0.005	0.330	0.191	0.110
Nitrogen, Total (mg/L)	12	0.300	0.800	0.525	0.160
Phosphorus, Total (mg/L)	12	0.023	0.090	0.055	0.021

Table B-96: Water quality analyte descriptive statistics at Station 10 in 2012.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	7.6	11.6	9.5	2.1
Dissolved Oxygen (% Sat.)	4	86	96	90	5
pH, (s.u.)	4	7.8	8.6	8.3	0.36
Specific Conductance (µS/cm)	4	337	401	377	29
Temperature, Water (°C)	4	1.2	19.1	10.1	9.2
Turbidity (NTU)	4	3.9	12.8	7.7	4.2
Alkalinity as $CaCO_3$, Total (mg/L)	4	135.0	159.0	145.3	10.40
Bicarbonate as HCO_3, Total (mg/L)	4	165.0	189.0	172.5	11.36
Calcium, Total (mg/L)	4	39.0	47.0	43.5	3.42
Chloride, Total (mg/L)	4	7.0	9.0	8.0	0.82
Magnesium, Dissolved (mg/L)	4	13.0	17.0	15.0	1.83
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	15.0	19.0	17.3	2.06
Sulfate, Total (mg/L)	4	47.0	56.0	51.0	4.24
Dissolved Solids, Total (mg/L)	4	214.0	263.0	232.3	21.41
Suspended Solids, Total (mg/L)	4	5.0	15.0	8.8	4.79
Arsenic, Total (mg/L)	4	0.016	0.020	0.018	0.002
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.001	0.004	0.002	0.001
Iron, Total (mg/L)	4	0.080	0.360	0.205	0.133
Lead, Total (mg/L)	4	0.001	0.004	0.001	0.002
Manganese, Total (mg/L)	4	0.012	0.029	0.021	0.007
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.060	0.300	0.173	0.120
Nitrogen, Total (mg/L)	4	0.300	0.530	0.408	0.125
Phosphorus, Total (mg/L)	4	0.024	0.058	0.035	0.015

Table B-97: Water quality analyte descriptive statistics at Station 10 in 2013.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	5.8	10.1	8.2	1.9
Dissolved Oxygen (% Sat.)	4	73	84	78	5
pH, (s.u.)	4	7.9	8.4	8.3	0.25
Specific Conductance (µS/cm)	4	353	435	391	39
Temperature, Water (°C)	4	1.9	21.0	10.1	9.5
Turbidity (NTU)	4	3.6	15.2	8.3	5.6
Alkalinity as $CaCO_3$, Total (mg/L)	4	133.0	155.0	145.0	11.66
Bicarbonate as HCO_3, Total (mg/L)	4	155.0	189.0	172.8	14.89
Calcium, Total (mg/L)	4	40.0	50.0	43.5	4.51
Chloride, Total (mg/L)	4	7.0	10.0	9.0	1.41
Magnesium, Dissolved (mg/L)	4	13.0	17.0	14.8	2.06
Potassium, Total (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	14.0	21.0	17.8	2.99
Sulfate, Total (mg/L)	4	37.0	62.0	51.0	11.28
Dissolved Solids, Total (mg/L)	4	215.0	255.0	238.5	16.90
Suspended Solids, Total (mg/L)	4	5.0	16.0	9.0	5.23
Arsenic, Total (mg/L)	4	0.016	0.019	0.018	0.001
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.001	0.002	0.002	0.001
Iron, Total (mg/L)	4	0.090	0.390	0.218	0.147
Lead, Total (mg/L)	4	0.001	0.007	0.004	0.003
Manganese, Total (mg/L)	4	0.014	0.031	0.022	0.009
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.050	0.260	0.150	0.093
Nitrogen, Total (mg/L)	4	0.200	0.500	0.350	0.129
Phosphorus, Total (mg/L)	4	0.038	0.044	0.041	0.003

Table B-98: Water quality analyte descriptive statistics at Station 10 in 2014.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.0	9.9	8.4	1.8
Dissolved Oxygen (% Sat.)	4	74	87	79	6
pH, (s.u.)	4	8.0	8.4	8.2	0.21
Specific Conductance (µS/cm)	4	337	407	368	31
Temperature, Water (°C)	4	1.1	20.5	9.5	9.3
Turbidity (NTU)	4	4.0	27.0	12.0	10.8
Alkalinity as CaCO3, Total (mg/L)	4	133.0	146.0	139.3	5.85
Bicarbonate as HCO3, Total (mg/L)	4	10.0	166.0	126.0	77.36
Calcium, Total (mg/L)	3	40.0	42.0	40.7	1.15
Calcium, Dissolved (mg/L)	1	43.0	43.0	43.0	.
Chloride, Total (mg/L)	4	8.0	178.0	51.0	84.67
Magnesium, Dissolved (mg/L)	4	12.0	16.0	14.0	1.63
Potassium, Total (mg/L)	3	3.0	3.0	3.0	0.00
Potassium, Dissolved (mg/L)	1	3.0	3.0	3.0	.
Sodium, Dissolved (mg/L)	4	16.0	20.0	17.5	1.91
Sulfate, Total (mg/L)	4	35.0	64.0	48.5	11.90
Dissolved Solids, Total (mg/L)	4	209.0	232.0	224.0	10.42
Suspended Solids, Total (mg/L)	4	5.0	41.0	16.8	16.98
Arsenic, Total (mg/L)	4	0.018	0.021	0.020	0.001
Cadmium, Total (mg/L)	4	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	4	0.001	0.002	0.002	0.001
Iron, Total (mg/L)	4	0.080	0.730	0.320	0.301
Lead, Total (mg/L)	4	0.001	0.005	0.002	0.002
Manganese, Total (mg/L)	4	0.014	0.052	0.027	0.018
Zinc, Total (mg/L)	4	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.030	0.250	0.133	0.105
Nitrogen, Total (mg/L)	4	0.200	0.900	0.450	0.311
Phosphorus, Total (mg/L)	4	0.036	0.051	0.042	0.007

Table B-99: Water quality analyte descriptive statistics at Station 10 in 2015.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	6.5	10.2	8.4	1.5
Dissolved Oxygen (% Sat.)	4	76	82	78	3
pH, (s.u.)	4	8.1	8.5	8.4	0.19
Specific Conductance (µS/cm)	4	362	402	380	18
Temperature, Water (°C)	4	1.2	17.6	8.8	7.2
Turbidity (NTU)	4	5.8	17.4	10.1	5.3
Alkalinity as $CaCO_3$, Total (mg/L)	4	131.0	151.0	140.8	8.18
Bicarbonate as HCO_3, Total (mg/L)	4	155.0	178.0	169.0	9.83
Calcium, Dissolved (mg/L)	4	42.0	44.0	43.0	0.82
Chloride, Total (mg/L)	4	7.0	9.0	7.8	0.96
Magnesium, Dissolved (mg/L)	4	14.0	16.0	14.8	0.96
Potassium, Dissolved (mg/L)	4	3.0	3.0	3.0	0.00
Sodium, Dissolved (mg/L)	4	17.0	19.0	18.5	1.00
Sulfate, Total (mg/L)	4	45.0	58.0	51.3	5.38
Dissolved Solids, Total (mg/L)	4	233.0	254.0	240.5	9.47
Suspended Solids, Total (mg/L)	4	5.0	20.0	12.3	6.34
Arsenic, Total (mg/L)	4	0.013	0.022	0.018	0.004
Cadmium, Total (mg/L)	2	0.000	0.000	0.000	0.000
Copper, Total (mg/L)	2	0.001	0.006	0.003	0.004
Iron, Total (mg/L)	2	0.140	0.170	0.155	0.021
Lead, Total (mg/L)	2	0.001	0.004	0.002	0.002
Manganese, Total (mg/L)	2	0.015	0.019	0.017	0.003
Zinc, Total (mg/L)	2	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.070	0.210	0.153	0.059
Nitrogen, Total (mg/L)	4	0.250	0.400	0.338	0.075
Phosphorus, Total (mg/L)	4	0.026	0.047	0.037	0.010

Table B-100: Water quality analyte descriptive statistics at Station 10 in 2016.

Analyte	N	Minimum	Maximum	Mean	Standard Deviation
Dissolved Oxygen (mg/L)	4	5.9	9.0	7.6	1.3
Dissolved Oxygen (% Sat.)	4	74	84	78	5
pH, (s.u.)	4	8.2	8.3	8.2	0.05
Specific Conductance (µS/cm)	4	363	406	385	18
Temperature, Water (°C)	4	4.7	21.6	12.2	7.5
Turbidity (NTU)	4	4.5	16.6	10.0	5.9
Alkalinity as $CaCO_3$, Total (mg/L)	4	146.0	148.0	146.8	0.96
Bicarbonate as HCO_3, Total (mg/L)	4	169.0	179.0	175.8	4.57
Calcium, Dissolved (mg/L)	4	43.0	45.0	43.8	0.96
Chloride, Total (mg/L)	4	8.0	9.0	8.8	0.50
Magnesium, Dissolved (mg/L)	4	14.0	16.0	14.8	0.96
Potassium, Dissolved (mg/L)	4	3.0	4.0	3.3	0.50
Sodium, Dissolved (mg/L)	4	18.0	22.0	19.8	1.71
Sulfate, Total (mg/L)	4	43.0	52.0	48.8	4.27
Dissolved Solids, Total (mg/L)	4	228.0	246.0	237.0	9.31
Suspended Solids, Total (mg/L)	4	5.0	19.0	11.8	7.80
Arsenic, Total (mg/L)	4	0.017	0.020	0.019	0.001
Cadmium, Total (mg/L)	3	0.000	0.001	0.000	0.000
Copper, Total (mg/L)	3	0.001	0.002	0.001	0.001
Iron, Total (mg/L)	3	0.100	0.370	0.203	0.146
Lead, Total (mg/L)	3	0.001	0.010	0.004	0.005
Manganese, Total (mg/L)	3	0.017	0.031	0.023	0.007
Zinc, Total (mg/L)	3	0.005	0.005	0.005	0.000
Nitrite Nitrate, Total (mg/L)	4	0.060	0.210	0.118	0.064
Nitrogen, Total (mg/L)	4	0.200	0.400	0.290	0.084
Phosphorus, Total (mg/L)	4	0.030	0.040	0.035	0.004

Appendix B.2 Correlation Matrices

Table B-101: Kendall's tau correlation matrix of water quality parameters collected at Station 1 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.955*	0.116	0.054	0.085	0.124	-0.105	-0.064	.	.	-0.063	0.198	-0.088	-0.109	0.008	-0.298*
	Significance (2-tailed)	.	0.000	0.276	0.618	0.430	0.362	0.760	0.549	.	.	0.643	0.552	0.433	0.328	0.942	0.015
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Year Quarter	Correlation Coefficient	0.955*	1.000	0.109	0.066	0.096	0.138	-0.105	-0.062	.	.	-0.065	0.198	-0.071	-0.113	0.000	-0.305*
	Significance (2-tailed)	0.000	.	0.320	0.549	0.387	0.330	0.760	0.574	.	.	0.648	0.552	0.543	0.325	1.000	0.016
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Date	Correlation Coefficient	0.116	0.109	1.000	0.148	0.153	-0.044	0.146	0.043	.	.	-0.101	0.229	0.110	-0.003	0.108	-0.118
	Significance (2-tailed)	0.276	0.320	.	0.140	0.126	0.735	0.655	0.669	.	.	0.433	0.469	0.297	0.979	0.282	0.302
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.054	0.066	0.148	1.000	0.965*	0.554*	0.634*	0.712*	.	.	0.701*	0.779*	0.706*	0.575*	0.718*	-0.407*
	Significance (2-tailed)	0.618	0.549	0.140	.	0.000	0.000	0.053	0.000	.	.	0.000	0.014	0.000	0.000	0.000	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.085	0.096	0.153	0.965*	1.000	0.584*	0.634*	0.677*	.	.	0.672*	0.779*	0.673*	0.558*	0.689*	-0.403*
	Significance (2-tailed)	0.430	0.387	0.126	0.000	.	0.000	0.053	0.000	.	.	0.000	0.014	0.000	0.000	0.000	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.124	0.138	-0.044	0.554*	0.584*	1.000	.	0.574*	.	.	0.690*	.	0.638*	0.392*	0.544*	-0.432*
	Significance (2-tailed)	0.362	0.330	0.735	0.000	0.000	.	.	0.000	.	.	0.000	.	0.000	0.003	0.000	0.003
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.105	-0.105	0.146	0.634*	0.634*	.	1.000	0.398	.	.	.	0.564	0.248	0.264	0.497	-0.488
	Significance (2-tailed)	0.760	0.760	0.655	0.053	0.053	.	.	0.230	.	.	.	0.121	0.453	0.442	0.134	0.197
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	-0.064	-0.062	0.043	0.712*	0.677*	0.574*	0.398	1.000	.	.	0.816*	0.793*	0.885*	0.620*	0.821*	-0.291*
	Significance (2-tailed)	0.549	0.574	0.669	0.000	0.000	0.000	0.230	.	.	.	0.000	0.013	0.000	0.000	0.000	0.012
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	-0.063	-0.065	-0.101	0.701*	0.672*	0.690*	.	0.816*	.	.	1.000	.	0.838*	0.625*	0.739*	-0.264*
	Significance (2-tailed)	0.643	0.648	0.433	0.000	0.000	0.000	.	0.000	.	.	.	.	0.000	0.000	0.000	0.070
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	0.198	0.198	0.229	0.779*	0.779*	.	0.564	0.793*	.	.	.	1.000	0.793*	0.594*	0.793*	-0.550
	Significance (2-tailed)	0.552	0.552	0.469	0.014	0.014	.	0.121	0.013	.	.	.	.	0.013	0.073	0.013	0.131
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.088	-0.071	0.110	0.706*	0.673*	0.638*	0.248	0.885*	.	.	0.838*	0.793*	1.000	0.607*	0.782*	-0.266*
	Significance (2-tailed)	0.433	0.543	0.297	0.000	0.000	0.000	0.453	0.000	.	.	0.000	0.013	.	0.000	0.000	0.027
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	-0.109	-0.113	-0.003	0.575*	0.558*	0.392*	0.264	0.620*	.	.	0.625*	0.594*	0.607*	1.000	0.567*	-0.074
	Significance (2-tailed)	0.328	0.325	0.979	0.000	0.000	0.003	0.442	0.000	.	.	0.000	0.073	0.000	.	0.000	0.538
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.008	0.000	0.108	0.718*	0.689*	0.544*	0.497	0.821*	.	.	0.739*	0.793*	0.782*	0.567*	1.000	-0.309*
	Significance (2-tailed)	0.942	1.000	0.282	0.000	0.000	0.000	0.134	0.000	.	.	0.000	0.013	0.000	0.000	.	0.007
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.298*	-0.305*	-0.118	-0.407*	-0.403*	-0.432*	-0.488	-0.291*	.	.	-0.264*	-0.550	-0.266*	-0.074	-0.309*	1.000
	Significance (2-tailed)	0.015	0.016	0.302	0.000	0.000	0.003	0.197	0.012	.	.	0.070	0.131	0.027	0.538	0.007	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	-0.118	-0.115	0.041	0.678*	0.647*	0.502*	0.398	0.840*	.	.	0.766*	0.793*	0.788*	0.586*	0.767*	-0.250*
	Significance (2-tailed)	0.268	0.298	0.683	0.000	0.000	0.000	0.230	0.000	.	.	0.000	0.013	0.000	0.000	0.000	0.029
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.154	-0.221	-0.137	-0.170	-0.184	-0.154	.	-0.046	.	.	-0.068	.	-0.123	-0.031	0.015	0.104
	Significance (2-tailed)	0.511	0.377	0.554	0.469	0.430	0.547	.	0.844	.	.	0.785	.	0.599	0.895	0.948	0.687
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	-0.368*	-0.422*	-0.405*	0.013	0.026	-0.099	.	0.053	.	.	0.000	.	-0.053	0.188	0.039	0.481*
	Significance (2-tailed)	0.085	0.065	0.057	0.951	0.902	0.672	.	0.806	.	.	1.000	.	0.806	0.386	0.854	0.041
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	0.066	0.145	0.065	-0.265	-0.263	-0.371	.	-0.263	.	.	-0.327	.	-0.263	-0.336	-0.261	-0.178
	Significance (2-tailed)	0.789	0.581	0.789	0.284	0.284	0.170	.	0.284	.	.	0.212	.	0.284	0.178	0.285	0.514
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	-0.473*	-0.570*	-0.512*	0.014	0.028	-0.070	.	0.084	.	.	0.092	.	0.028	0.241	0.124	0.490*
	Significance (2-tailed)	0.033	0.016	0.020	0.950	0.900	0.773	.	0.706	.	.	0.695	.	0.900	0.283	0.573	0.045
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.130	-0.130	-0.142	0.256*	0.257*	0.274	-0.054	0.373*	.	.	0.326*	0.303	0.347*	0.405*	0.339*	-0.165
	Significance (2-tailed)	0.337	0.337	0.251	0.039	0.038	0.106	0.877	0.003	.	.	0.056	0.366	0.009	0.002	0.006	0.245
	N	36	36	36	36	36	24	8	36	0	32	24	8	32	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.213	-0.251	0.000	0.438*	0.399*	0.342*	.	0.455*	.	.	0.360*	.	0.445*	0.580*	0.424*	0.073
	Significance (2-tailed)	0.149	0.105	1.000	0.002	0.005	0.045	.	0.001	.	.	0.033	.	0.004	0.000	0.003	0.649
	N	28	28	28	28	28	24	0	28	0	24	24	0	24	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.196*	-0.196*	-0.077	-0.310*	-0.307*	-0.260*	-0.634*	-0.224*	.	.	-0.272*	-0.504	-0.202*	-0.093	-0.185*	0.512*
	Significance (2-tailed)	0.077	0.087	0.456	0.003	0.003	0.053	0.053	0.032	.	.	0.042	0.111	0.063	0.389	0.075	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.143	-0.142	-0.394*	-0.117	-0.132	-0.196	0.000	-0.153	.	.	-0.088	-0.560*	-0.184*	0.015	-0.220*	0.389*
	Significance (2-tailed)	0.185	0.203	0.000	0.250	0.193	0.136	1.000	0.134	.	.	0.502	0.080	0.085	0.886	0.030	0.001
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.144	0.088	-0.022	0.241*	0.247*	0.210	-0.049	0.277*	.	.	0.343*	0.321	0.280*	0.362*	0.272*	-0.263
	Significance (2-tailed)	0.332	0.566	0.877	0.085	0.078	0.272	0.881	0.049	.	.	0.071	0.311	0.047	0.013	0.052	0.104
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	0.174	0.190	-0.534*	-0.322*	-0.328*	0.000	-0.244	-0.353*	.	.	-0.151	-0.779*	-0.443*	-0.245*	-0.335*	-0.189
	Significance (2-tailed)	0.241	0.215	0.000	0.022	0.019	1.000	0.456	0.013	.	.	0.425	0.014	0.002	0.094	0.017	0.243
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
pH, (s.u.)	Correlation Coefficient	0.083	0.095	-0.164	0.069	0.049	0.156	0.146	0.092	.	.	0.272*	-0.413	0.077	-0.003	0.078	-0.166
	Significance (2-tailed)	0.435	0.387	0.100	0.493	0.625	0.227	0.655	0.359	.	.	0.035	0.192	0.466	0.979	0.434	0.146
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	-0.047	-0.040	0.027	0.710*	0.682*	0.609*	0.439	0.882*	.	.	0.785*	0.779*	0.836*	0.604*	0.766*	-0.308*
	Significance (2-tailed)	0.657	0.720	0.783	0.000	0.000	0.000	0.180	0.000	.	.	0.000	0.014	0.000	0.000	0.000	0.007
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Water Temperature (°C)	Correlation Coefficient	0.083	0.103	0.002	-0.306*	-0.299*	-0.313*	0.146	-0.356*	.	.	-0.382*	-0.321	-0.392*	-0.411*	-0.349*	0.150
	Significance (2-tailed)	0.435	0.348	0.986	0.002	0.003	0.015	0.655	0.000	.	.	0.003	0.311	0.000	0.000	0.000	0.189
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.292*	-0.317*	-0.052	-0.270*	-0.292*	-0.337*	-0.439	-0.155	.	.	-0.209	-0.321	-0.142	0.030	-0.164	0.618*
	Significance (2-tailed)	0.006	0.004	0.600	0.007	0.004	0.009	0.180	0.124	.	.	0.104	0.311	0.178	0.774	0.102	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (CFS)	Correlation Coefficient	-0.021	-0.039	-0.051	-0.669*	-0.642*	-0.498*	-0.439	-0.725*	.	.	-0.707*	-0.413	-0.714*	-0.461*	-0.658*	0.417*
	Significance (2-tailed)	0.842	0.727	0.612	0.000	0.000	0.000	0.180	0.000	.	.	0.000	0.192	0.000	0.000	0.000	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (probability)	Correlation Coefficient	-0.021	-0.039	-0.051	-0.669*	-0.642*	-0.498*	-0.439	-0.725*	.	.	-0.707*	-0.413	-0.714*	-0.461*	-0.658*	0.417*
	Significance (2-tailed)	0.842	0.727	0.612	0.000	0.000	0.000	0.180	0.000	.	.	0.000	0.192	0.000	0.000	0.000	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-102: Kendall's tau correlation matrix of water quality parameters collected at Station 1 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	-0.118	.	-0.154	-0.368*	0.066	-0.473*	.	-0.130	-0.213	-0.196*	-0.143	0.144	0.174	0.083	-0.047	0.083	-0.292*	-0.021	-0.021
	Significance (2-tailed)	0.268	.	0.511	0.085	0.789	0.033	.	0.337	0.149	0.077	0.185	0.332	0.241	0.435	0.657	0.435	0.006	0.842	0.842
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Year Quarter	Correlation Coefficient	-0.115	.	-0.221	-0.422*	0.145	-0.570*	.	-0.130	-0.251	-0.196*	-0.142	0.088	0.190	0.095	-0.040	0.103	-0.317*	-0.039	-0.039
	Significance (2-tailed)	0.298	.	0.377	0.065	0.581	0.016	.	0.337	0.105	0.087	0.203	0.566	0.215	0.387	0.720	0.348	0.004	0.727	0.727
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Date	Correlation Coefficient	0.041	.	-0.137	-0.405*	0.065	-0.512*	.	-0.142	0.000	-0.077	-0.394*	-0.022	-0.534*	-0.164	0.027	0.002	-0.052	-0.051	-0.051
	Significance (2-tailed)	0.683	.	0.554	0.057	0.789	0.020	.	0.251	1.000	0.456	0.000	0.877	0.000	0.100	0.783	0.986	0.600	0.612	0.612
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.678*	.	-0.170	0.013	-0.265	0.014	.	0.256*	0.438*	-0.310*	-0.117	0.241*	-0.322*	0.069	0.710*	-0.306*	-0.270*	-0.669*	-0.669*
	Significance (2-tailed)	0.000	.	0.469	0.951	0.284	0.950	.	0.039	0.002	0.003	0.250	0.085	0.022	0.493	0.000	0.002	0.007	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.647*	.	-0.184	0.026	-0.263	0.028	.	0.257*	0.399*	-0.307*	-0.132	0.247*	-0.328*	0.049	0.682*	-0.299*	-0.292*	-0.642*	-0.642*
	Significance (2-tailed)	0.000	.	0.430	0.902	0.284	0.900	.	0.038	0.005	0.003	0.193	0.078	0.019	0.625	0.000	0.003	0.004	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.502*	.	-0.154	-0.099	-0.371	-0.070	.	0.274	0.342*	-0.260*	-0.196	0.210	0.000	0.156	0.609*	-0.313*	-0.337*	-0.498*	-0.498*
	Significance (2-tailed)	0.000	.	0.547	0.672	0.170	0.773	.	0.106	0.045	0.053	0.136	0.272	1.000	0.227	0.000	0.015	0.009	0.000	0.000
	N	36	13	13	13	13	13	13	24	24	36	36	18	18	36	36	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	0.398	.	.	.	.	.	.	-0.054	.	-0.634*	0.000	-0.049	-0.244	0.146	0.439	0.146	-0.439	-0.439	-0.439
	Significance (2-tailed)	0.230	.	.	.	.	.	.	0.877	.	0.053	1.000	0.881	0.456	0.655	0.180	0.655	0.180	0.180	0.180
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	0.840*	.	-0.046	0.053	-0.263	0.084	.	0.373*	0.455*	-0.224*	-0.153	0.277*	-0.353*	0.092	0.882*	-0.356*	-0.155	-0.725*	-0.725*
	Significance (2-tailed)	0.000	.	0.844	0.806	0.284	0.706	.	0.003	0.001	0.032	0.134	0.049	0.013	0.359	0.000	0.000	0.124	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	44	13	13	13	13	13	13	32	24	44	44	26	26	44	44	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	0.766*	.	-0.068	0.000	-0.327	0.092	.	0.326*	0.360*	-0.272*	-0.088	0.343*	-0.151	0.272*	0.785*	-0.382*	-0.209	-0.707*	-0.707*
	Significance (2-tailed)	0.000	.	0.785	1.000	0.212	0.695	.	0.056	0.033	0.042	0.502	0.071	0.425	0.035	0.000	0.003	0.104	0.000	0.000
	N	36	13	13	13	13	13	13	24	24	36	36	18	18	36	36	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	0.793*	.	.	.	.	.	.	0.303	.	-0.504	-0.560*	0.321	-0.779*	-0.413	0.779*	-0.321	-0.321	-0.413	-0.413
	Significance (2-tailed)	0.013	.	.	.	.	.	.	0.366	.	0.111	0.080	0.311	0.014	0.192	0.014	0.311	0.311	0.192	0.192
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.788*	.	-0.123	-0.053	-0.263	0.028	.	0.347*	0.445*	-0.202*	-0.184*	0.280*	-0.443*	0.077	0.836*	-0.392*	-0.142	-0.714*	-0.714*
	Significance (2-tailed)	0.000	.	0.599	0.806	0.284	0.900	.	0.009	0.004	0.063	0.085	0.047	0.002	0.466	0.000	0.000	0.178	0.000	0.000
	N	44	13	13	13	13	13	13	32	24	44	44	26	26	44	44	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	0.586*	.	-0.031	0.188	-0.336	0.241	.	0.405*	0.580*	-0.093	0.015	0.362*	-0.245*	-0.003	0.604*	-0.411*	0.030	-0.461*	-0.461*
	Significance (2-tailed)	0.000	.	0.895	0.386	0.178	0.283	.	0.002	0.000	0.389	0.886	0.013	0.094	0.979	0.000	0.000	0.774	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.767*	.	0.015	0.039	-0.261	0.124	.	0.339*	0.424*	-0.185*	-0.220*	0.272*	-0.335*	0.078	0.766*	-0.349*	-0.164	-0.658*	-0.658*
	Significance (2-tailed)	0.000	.	0.948	0.854	0.285	0.573	.	0.006	0.003	0.075	0.030	0.052	0.017	0.434	0.000	0.000	0.102	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.250*	.	0.104	0.481*	-0.178	0.490*	.	-0.165	0.073	0.512*	0.389*	-0.263	-0.189	-0.166	-0.308*	0.150	0.618*	0.417*	0.417*
	Significance (2-tailed)	0.029	.	0.687	0.041	0.514	0.045	.	0.245	0.649	0.000	0.001	0.104	0.243	0.146	0.007	0.189	0.000	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	.	-0.076	0.065	-0.327	0.124	.	0.281*	0.427*	-0.221*	-0.163	0.161	-0.409*	0.127	0.801*	-0.284*	-0.135	-0.667*	-0.667*
	Significance (2-tailed)	.	.	0.743	0.759	0.181	0.573	.	0.023	0.003	0.033	0.107	0.251	0.004	0.204	0.000	0.004	0.179	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.076	.	1.000	0.265	0.000	0.264	.	.	0.049	0.121	0.095	-0.078	0.545	-0.077	-0.076	0.046	0.277	0.046	0.046
	Significance (2-tailed)	0.743	.	.	0.262	1.000	0.282	.	.	0.840	0.630	0.691	0.837	0.150	0.742	0.743	0.844	0.236	0.844	0.844
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	0.065	.	0.265	1.000	0.067	0.889*	.	.	0.197	0.517*	0.689*	-0.215	0.501	-0.278	0.065	0.118	0.974*	0.039	0.039
	Significance (2-tailed)	0.759	.	0.262	.	0.788	0.000	.	.	0.379	0.024	0.002	0.559	0.173	0.196	0.759	0.581	0.000	0.854	0.854
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	-0.327	.	0.000	0.067	1.000	-0.035	.	.	-0.353	-0.185	-0.068	-0.577	0.577	-0.066	-0.261	0.392	0.066	0.261	0.261
	Significance (2-tailed)	0.181	.	1.000	0.788	.	0.891	.	.	0.173	0.485	0.788	0.143	0.143	0.789	0.285	0.109	0.789	0.285	0.285
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	0.124	.	0.264	0.889*	-0.035	1.000	.	.	0.224	0.438*	0.801*	-0.389	0.389	-0.238	0.097	0.041	0.891*	-0.041	-0.041
	Significance (2-tailed)	0.573	.	0.282	0.000	0.891	.	.	.	0.336	0.065	0.000	0.304	0.304	0.285	0.661	0.851	0.000	0.851	0.851
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	0.281*	.	.	.	.	.	.	1.000	0.868*	0.128	0.055	0.642*	-0.173	-0.299*	0.316*	-0.609*	0.241*	-0.151	-0.151
	Significance (2-tailed)	0.023	.	.	.	.	.	.	.	0.000	0.310	0.657	0.000	0.317	0.015	0.010	0.000	0.051	0.223	0.223
	N	36	1	1	1	1	1	1	36	16	36	36	20	20	36	36	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.427*	.	0.049	0.197	-0.353	0.224	.	0.868*	1.000	0.136	0.035	0.745*	-0.149	-0.272*	0.446*	-0.625*	0.209	-0.352*	-0.352*
	Significance (2-tailed)	0.003	.	0.840	0.379	0.173	0.336	.	0.000	.	0.365	0.808	0.044	0.687	0.056	0.002	0.000	0.142	0.013	0.013
	N	28	13	13	13	13	13	13	16	28	28	28	6	6	28	28	28	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.221*	.	0.121	0.517*	-0.185	0.438*	.	0.128	0.136	1.000	0.212*	0.196	-0.095	-0.286*	-0.262*	-0.085	0.564*	0.367*	0.367*
	Significance (2-tailed)	0.033	.	0.630	0.024	0.485	0.065	.	0.310	0.365	.	0.044	0.169	0.506	0.006	0.011	0.414	0.000	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.163	.	0.095	0.689*	-0.068	0.801*	.	0.055	0.035	0.212*	1.000	-0.141	0.078	-0.025	-0.128	0.068	0.229*	0.099	0.099
	Significance (2-tailed)	0.107	.	0.691	0.002	0.788	0.000	.	0.657	0.808	0.044	.	0.320	0.580	0.803	0.206	0.504	0.024	0.327	0.327
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.161	.	-0.078	-0.215	-0.577	-0.389	.	0.642*	0.745*	0.196	-0.141	1.000	0.015	-0.311*	0.218	-0.846*	0.083	-0.145	-0.145
	Significance (2-tailed)	0.251	.	0.837	0.559	0.143	0.304	.	0.000	0.044	0.169	0.320	.	0.912	0.026	0.118	0.000	0.552	0.300	0.300
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.409*	.	0.545	0.501	0.577	0.389	.	-0.173	-0.149	-0.095	0.078	0.015	1.000	0.275*	-0.392*	0.139	-0.170	0.269*	0.269*
	Significance (2-tailed)	0.004	.	0.150	0.173	0.143	0.304	.	0.317	0.687	0.506	0.580	0.912	.	0.050	0.005	0.321	0.225	0.055	0.055
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
pH, (s.u.)	Correlation Coefficient	0.127	.	-0.077	-0.278	-0.066	-0.238	.	-0.299*	-0.272*	-0.286*	-0.025	-0.311*	0.275*	1.000	0.110	0.285*	-0.421*	-0.199*	-0.199*
	Significance (2-tailed)	0.204	.	0.742	0.196	0.789	0.285	.	0.015	0.056	0.006	0.803	0.026	0.050	.	0.270	0.004	0.000	0.046	0.046
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	0.801*	.	-0.076	0.065	-0.261	0.097	.	0.316*	0.446*	-0.262*	-0.128	0.218	-0.392*	0.110	1.000	-0.320*	-0.198*	-0.767*	-0.767*
	Significance (2-tailed)	0.000	.	0.743	0.759	0.285	0.661	.	0.010	0.002	0.011	0.206	0.118	0.005	0.270	.	0.001	0.048	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Water Temperature (°C)	Correlation Coefficient	-0.284*	.	0.046	0.118	0.392	0.041	.	-0.609*	-0.625*	-0.085	0.068	-0.846*	0.139	0.285*	-0.320*	1.000	-0.079	0.219*	0.219*
	Significance (2-tailed)	0.004	.	0.844	0.581	0.109	0.851	.	0.000	0.000	0.414	0.504	0.000	0.321	0.004	0.001	.	0.429	0.028	0.028
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.135	.	0.277	0.974*	0.066	0.891*	.	0.241*	0.209	0.564*	0.229*	0.083	-0.170	-0.421*	-0.198*	-0.079	1.000	0.381*	0.381*
	Significance (2-tailed)	0.179	.	0.236	0.000	0.789	0.000	.	0.051	0.142	0.000	0.024	0.552	0.225	0.000	0.048	0.429	.	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Flow (CFS)	Correlation Coefficient	-0.667*	.	0.046	0.039	0.261	-0.041	.	-0.151	-0.352*	0.367*	0.099	-0.145	0.269*	-0.199*	-0.767*	0.219*	0.381*	1.000	1.000
	Significance (2-tailed)	0.000	.	0.844	0.854	0.285	0.851	.	0.223	0.013	0.000	0.327	0.300	0.055	0.046	0.000	0.028	0.000	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Flow (probability)	Correlation Coefficient	-0.667*	.	0.046	0.039	0.261	-0.041	.	-0.151	-0.352*	0.367*	0.099	-0.145	0.269*	-0.199*	-0.767*	0.219*	0.381*	1.000	1.000
	Significance (2-tailed)	0.000	.	0.844	0.854	0.285	0.851	.	0.223	0.013	0.000	0.327	0.300	0.055	0.046	0.000	0.028	0.000	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-103: Kendall's tau correlation matrix of water quality parameters collected at Station 2 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.955*	0.116	-0.370*	-0.366*	-0.102	0.396	-0.370*	.	0.072	-0.387*	-0.816*	-0.352*	-0.344*	-0.416*	.
	Significance (2-tailed)	.	0.000	0.276	0.001	0.001	0.459	0.234	0.001	.	0.590	0.005	0.018	0.002	0.002	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Year Quarter	Correlation Coefficient	0.955*	1.000	0.109	-0.369*	-0.361*	-0.130	0.396	-0.383*	.	0.076	-0.404*	-0.816*	-0.368*	-0.368*	-0.436*	.
	Significance (2-tailed)	0.000	.	0.320	0.001	0.001	0.364	0.234	0.001	.	0.585	0.005	0.018	0.002	0.002	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Date	Correlation Coefficient	0.116	0.109	1.000	0.129	0.113	-0.107	0.779*	0.066	.	0.244*	-0.058	-0.378	0.155	0.094	0.059	.
	Significance (2-tailed)	0.276	0.320	.	0.200	0.262	0.413	0.014	0.510	.	0.052	0.656	0.248	0.144	0.376	0.557	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	-0.370*	-0.369*	0.129	1.000	0.967*	0.113	-0.093	0.754*	.	0.065	0.741*	0.722*	0.775*	0.646*	0.700*	.
	Significance (2-tailed)	0.001	0.001	0.200	.	0.000	0.387	0.771	0.000	.	0.607	0.000	0.029	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	-0.366*	-0.361*	0.113	0.967*	1.000	0.113	-0.138	0.735*	.	0.067	0.740*	0.756*	0.752*	0.632*	0.694*	.
	Significance (2-tailed)	0.001	0.001	0.262	0.000	.	0.387	0.664	0.000	.	0.596	0.000	0.021	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	-0.102	-0.130	-0.107	0.113	0.113	1.000	.	0.140	.	0.494*	0.044	.	0.075	0.229*	0.194	.
	Significance (2-tailed)	0.459	0.364	0.413	0.387	0.387	.	.	0.289	.	0.002	0.766	.	0.571	0.096	0.136	.
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	0.396	0.396	0.779*	-0.093	-0.138	.	1.000	-0.238	.	0.939*	.	-0.364	-0.333	-0.354	-0.373	.
	Significance (2-tailed)	0.234	0.234	0.014	0.771	0.664	.	.	0.463	.	0.010	.	0.317	0.304	0.292	0.244	.
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	-0.370*	-0.383*	0.066	0.754*	0.735*	0.140	-0.238	1.000	.	-0.033	0.792*	0.784*	0.900*	0.659*	0.795*	.
	Significance (2-tailed)	0.001	0.001	0.510	0.000	0.000	0.289	0.463	.	.	0.797	0.000	0.019	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.072	0.076	0.244*	0.065	0.067	0.494*	0.939*	-0.033	.	1.000	-0.183	-0.258	-0.043	0.013	-0.006	.
	Significance (2-tailed)	0.590	0.585	0.052	0.607	0.596	0.002	0.010	0.797	.	.	0.244	0.495	0.736	0.922	0.962	.
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	-0.387*	-0.404*	-0.058	0.741*	0.740*	0.044	.	0.792*	.	-0.183	1.000	.	0.804*	0.660*	0.751*	.
	Significance (2-tailed)	0.005	0.005	0.656	0.000	0.000	0.766	.	0.000	.	0.244	.	.	0.000	0.000	0.000	.
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.816*	-0.816*	-0.378	0.722*	0.756*	.	-0.364	0.784*	.	-0.258	.	1.000	0.784*	0.782*	0.674*	.
	Significance (2-tailed)	0.018	0.018	0.248	0.029	0.021	.	0.317	0.019	.	0.495	.	.	0.019	0.025	0.042	.
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.352*	-0.368*	0.155	0.775*	0.752*	0.075	-0.333	0.900*	.	-0.043	0.804*	0.784*	1.000	0.657*	0.784*	.
	Significance (2-tailed)	0.002	0.002	0.144	0.000	0.000	0.571	0.304	0.000	.	0.736	0.000	0.019	.	0.000	0.000	.
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	-0.344*	-0.368*	0.094	0.646*	0.632*	0.229*	-0.354	0.659*	.	0.013	0.660*	0.782*	0.657*	1.000	0.636*	.
	Significance (2-tailed)	0.002	0.002	0.376	0.000	0.000	0.096	0.292	0.000	.	0.922	0.000	0.025	0.000	.	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	-0.416*	-0.436*	0.059	0.700*	0.694*	0.194	-0.373	0.795*	.	-0.006	0.751*	0.674*	0.784*	0.636*	1.000	.
	Significance (2-tailed)	0.000	0.000	0.557	0.000	0.000	0.136	0.244	0.000	.	0.962	0.000	0.042	0.000	0.000	.	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	-0.299*	-0.306*	0.088	0.705*	0.690*	0.049	-0.321	0.871*	.	-0.097	0.797*	0.756*	0.883*	0.581*	0.715*	.
	Significance (2-tailed)	0.005	0.006	0.379	0.000	0.000	0.710	0.311	0.000	.	0.441	0.000	0.021	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	0.000	-0.073	0.000	-0.066	-0.099	-0.364	.	-0.033	.	-0.083	-0.270	.	-0.131	-0.034	-0.131	.
	Significance (2-tailed)	1.000	0.783	1.000	0.789	0.688	0.184	.	0.893	.	0.773	0.317	.	0.593	0.893	0.593	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	-0.336	-0.401*	-0.374*	0.363*	0.406*	-0.083	.	0.270	.	0.136	0.252	.	0.214	0.364	0.160	.
	Significance (2-tailed)	0.122	0.084	0.084	0.095	0.063	0.731	.	0.215	.	0.589	0.287	.	0.323	0.103	0.458	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	-0.214	-0.220	-0.255	0.299	0.272	0.525*	.	0.358	.	0.325	0.301	.	0.368*	0.341	0.396*	.
	Significance (2-tailed)	0.339	0.357	0.252	0.181	0.225	0.034	.	0.111	.	0.213	0.218	.	0.098	0.138	0.075	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.376*	-0.376*	-0.120	0.344*	0.359*	0.101	-0.238	0.327*	.	-0.047	0.276	0.637*	0.269*	0.272*	0.313*	.
	Significance (2-tailed)	0.006	0.006	0.334	0.006	0.004	0.567	0.463	0.010	.	0.767	0.118	0.058	0.047	0.040	0.013	.
	N	36	36	36	36	36	24	8	36	0	32	24	8	32	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.386*	-0.381*	-0.269*	0.539*	0.515*	0.367*	.	0.502*	.	0.181	0.614*	.	0.561*	0.617*	0.559*	.
	Significance (2-tailed)	0.010	0.015	0.061	0.000	0.000	0.032	.	0.001	.	0.331	0.000	.	0.000	0.000	0.000	.
	N	28	28	28	28	28	24	0	28	0	24	24	0	24	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.122	-0.096	0.043	0.145	0.139	-0.210	-0.523	0.116	.	-0.213	0.159	0.490	0.117	-0.040	0.142	.
	Significance (2-tailed)	0.284	0.412	0.685	0.178	0.196	0.133	0.107	0.280	.	0.112	0.257	0.144	0.300	0.722	0.184	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.135	-0.121	-0.131	0.283*	0.275*	0.218	0.327	0.291*	.	0.066	0.357*	0.096	0.273*	0.296*	0.252*	.
	Significance (2-tailed)	0.213	0.281	0.196	0.006	0.007	0.100	0.308	0.005	.	0.607	0.007	0.772	0.011	0.006	0.014	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	-0.088	-0.156	-0.080	0.272*	0.301*	0.021	-0.229	0.238	.	-0.104	0.442*	0.567*	0.269*	0.209	0.294*	.
	Significance (2-tailed)	0.565	0.319	0.575	0.058	0.035	0.918	0.469	0.101	.	0.541	0.027	0.083	0.064	0.167	0.040	.
	N	25	25	25	25	25	17	8	25	0	25	17	8	25	25	25	25
Dissolved Oxygen (% Sat.)	Correlation Coefficient	0.274*	0.266*	-0.651*	-0.552*	-0.526*	-0.501*	0.413	-0.576*	.	-0.197	-0.302	-0.756*	-0.567*	-0.448*	-0.513*	.
	Significance (2-tailed)	0.072	0.089	0.000	0.000	0.000	0.013	0.192	0.000	.	0.248	0.131	0.021	0.000	0.003	0.000	.
	N	25	25	25	25	25	17	8	25	0	25	17	8	25	25	25	25
pH, (s.u.)	Correlation Coefficient	0.310*	0.336*	-0.042	-0.437*	-0.445*	-0.027	-0.046	-0.402*	.	-0.008	-0.518*	-0.472	-0.429*	-0.444*	-0.432*	.
	Significance (2-tailed)	0.004	0.003	0.680	0.000	0.000	0.839	0.885	0.000	.	0.948	0.000	0.149	0.000	0.000	0.000	.
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Specific Conductance (µS/cm)	Correlation Coefficient	-0.321*	-0.338*	0.071	0.702*	0.684*	0.163	-0.321	0.815*	.	0.017	0.654*	0.756*	0.765*	0.566*	0.693*	.
	Significance (2-tailed)	0.003	0.002	0.480	0.000	0.000	0.217	0.311	0.000	.	0.895	0.000	0.021	0.000	0.000	0.000	.
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Water Temperature (°C)	Correlation Coefficient	0.382*	0.404*	0.151	-0.455*	-0.472*	-0.093	0.504	-0.464*	.	0.096	-0.626*	-0.567*	-0.467*	-0.353*	-0.496*	.
	Significance (2-tailed)	0.000	0.000	0.135	0.000	0.000	0.482	0.111	0.000	.	0.449	0.000	0.083	0.000	0.001	0.000	.
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Turbidity (NTU)	Correlation Coefficient	0.432*	0.467*	0.111	-0.117	-0.110	-0.095	0.504	-0.206*	.	0.255*	-0.295*	-0.094	-0.220*	-0.092	-0.234*	.
	Significance (2-tailed)	0.000	0.000	0.278	0.258	0.286	0.480	0.111	0.046	.	0.048	0.028	0.773	0.043	0.396	0.023	.
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Flow (CFS)	Correlation Coefficient	0.001	-0.001	-0.036	-0.130	-0.121	-0.262*	-0.229	-0.222*	.	-0.111	-0.096	-0.189	-0.224*	-0.239*	-0.160	.
	Significance (2-tailed)	0.993	0.993	0.716	0.197	0.230	0.044	0.469	0.028	.	0.378	0.463	0.564	0.035	0.024	0.111	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (probability)	Correlation Coefficient	0.001	-0.001	-0.036	-0.130	-0.121	-0.262*	-0.229	-0.222*	.	-0.111	-0.096	-0.189	-0.224*	-0.239*	-0.160	.
	Significance (2-tailed)	0.993	0.993	0.716	0.197	0.230	0.044	0.469	0.028	.	0.378	0.463	0.564	0.035	0.024	0.111	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-104: Kendall's tau correlation matrix of water quality parameters collected at Station 2 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	-0.299*	.	0.000	-0.336	.	-0.214	.	-0.376*	-0.386*	-0.122	-0.135	-0.088	0.274*	0.310*	-0.321*	0.382*	0.432*	0.001	0.001
	Significance (2-tailed)	0.005	.	1.000	0.122	.	0.339	.	0.006	0.010	0.284	0.213	0.565	0.072	0.004	0.003	0.000	0.000	0.993	0.993
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Year Quarter	Correlation Coefficient	-0.306*	.	-0.073	-0.401*	.	-0.220	.	-0.376*	-0.381*	-0.096	-0.121	-0.156	0.266*	0.336*	-0.338*	0.404*	0.467*	-0.001	-0.001
	Significance (2-tailed)	0.006	.	0.783	0.084	.	0.357	.	0.006	0.015	0.412	0.281	0.319	0.089	0.003	0.002	0.000	0.000	0.993	0.993
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Date	Correlation Coefficient	0.088	.	0.000	-0.374*	.	-0.255	.	-0.120	-0.269*	0.043	-0.131	-0.080	-0.651*	-0.042	0.071	0.151	0.111	-0.036	-0.036
	Significance (2-tailed)	0.379	.	1.000	0.084	.	0.252	.	0.334	0.061	0.685	0.196	0.575	0.000	0.680	0.480	0.135	0.278	0.716	0.716
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.705*	.	-0.066	0.363*	.	0.299	.	0.344*	0.539*	0.145	0.283*	0.272*	-0.552*	-0.437*	0.702*	-0.455*	-0.117	-0.130	-0.130
	Significance (2-tailed)	0.000	.	0.789	0.095	.	0.181	.	0.006	0.000	0.178	0.006	0.058	0.000	0.000	0.000	0.000	0.258	0.197	0.197
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.690*	.	-0.099	0.406*	.	0.272	.	0.359*	0.515*	0.139	0.275*	0.301*	-0.526*	-0.445*	0.684*	-0.472*	-0.110	-0.121	-0.121
	Significance (2-tailed)	0.000	.	0.688	0.063	.	0.225	.	0.004	0.000	0.196	0.007	0.035	0.000	0.000	0.000	0.000	0.286	0.230	0.230
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.049	.	-0.364	-0.083	.	0.525*	.	0.101	0.367*	-0.210	0.218	0.021	-0.501*	-0.027	0.163	-0.093	-0.095	-0.262*	-0.262*
	Significance (2-tailed)	0.710	.	0.184	0.731	.	0.034	.	0.567	0.032	0.133	0.100	0.918	0.013	0.839	0.217	0.482	0.480	0.044	0.044
	N	36	13	13	13	13	13	13	24	24	36	36	17	17	35	35	35	35	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.321	.	.	.	.	.	.	-0.238	.	-0.523	0.327	-0.229	0.413	-0.046	-0.321	0.504	0.504	-0.229	-0.229
	Significance (2-tailed)	0.311	.	.	.	.	.	.	0.463	.	0.107	0.308	0.469	0.192	0.885	0.311	0.111	0.111	0.469	0.469
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	0.871*	.	-0.033	0.270	.	0.358	.	0.327*	0.502*	0.116	0.291*	0.238	-0.576*	-0.402*	0.815*	-0.464*	-0.206*	-0.222*	-0.222*
	Significance (2-tailed)	0.000	.	0.893	0.215	.	0.111	.	0.010	0.001	0.280	0.005	0.101	0.000	0.000	0.000	0.000	0.046	0.028	0.028
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	-0.097	.	-0.083	0.136	.	0.325	.	-0.047	0.181	-0.213	0.066	-0.104	-0.197	-0.008	0.017	0.096	0.255*	-0.111	-0.111
	Significance (2-tailed)	0.441	.	0.773	0.589	.	0.213	.	0.767	0.331	0.112	0.607	0.541	0.248	0.948	0.895	0.449	0.048	0.378	0.378
	N	44	13	13	13	13	13	13	32	24	44	44	25	25	43	43	43	43	44	44
Potassium, Total (mg/L)	Correlation Coefficient	0.797*	.	-0.270	0.252	.	0.301	.	0.276	0.614*	0.159	0.357*	0.442*	-0.302	-0.518*	0.654*	-0.626*	-0.295*	-0.096	-0.096
	Significance (2-tailed)	0.000	.	0.317	0.287	.	0.218	.	0.118	0.000	0.257	0.007	0.027	0.131	0.000	0.000	0.000	0.028	0.463	0.463
	N	36	13	13	13	13	13	13	24	24	36	36	17	17	35	35	35	35	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	0.756*	.	.	.	.	.	.	0.637*	.	0.490	0.096	0.567*	-0.756*	-0.472	0.756*	-0.567*	-0.094	-0.189	-0.189
	Significance (2-tailed)	0.021	.	.	.	.	.	.	0.058	.	0.144	0.772	0.083	0.021	0.149	0.021	0.083	0.773	0.564	0.564
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.883*	.	-0.131	0.214	.	0.368*	.	0.269*	0.561*	0.117	0.273*	0.269*	-0.567*	-0.429*	0.765*	-0.467*	-0.220*	-0.224*	-0.224*
	Significance (2-tailed)	0.000	.	0.593	0.323	.	0.098	.	0.047	0.000	0.300	0.011	0.064	0.000	0.000	0.000	0.000	0.043	0.035	0.035
	N	44	13	13	13	13	13	13	32	24	44	44	25	25	43	43	43	43	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	0.581*	.	-0.034	0.364	.	0.341	.	0.272*	0.617*	-0.040	0.296*	0.209	-0.448*	-0.444*	0.566*	-0.353*	-0.092	-0.239*	-0.239*
	Significance (2-tailed)	0.000	.	0.893	0.103	.	0.138	.	0.040	0.000	0.722	0.006	0.167	0.003	0.000	0.000	0.001	0.396	0.024	0.024
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.715*	.	-0.131	0.160	.	0.396*	.	0.313*	0.559*	0.142	0.252*	0.294*	-0.513*	-0.432*	0.693*	-0.496*	-0.234*	-0.160	-0.160
	Significance (2-tailed)	0.000	.	0.593	0.458	.	0.075	.	0.013	0.000	0.184	0.014	0.040	0.000	0.000	0.000	0.000	0.023	0.111	0.111
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	.	-0.164	0.148	.	0.413*	.	0.345*	0.496*	0.192*	0.249*	0.289*	-0.541*	-0.403*	0.751*	-0.485*	-0.180*	-0.189*	-0.189*
	Significance (2-tailed)	.	.	0.503	0.496	.	0.065	.	0.006	0.001	0.072	0.015	0.044	0.000	0.000	0.000	0.000	0.079	0.059	0.059
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.164	.	1.000	0.408	.	-0.289	.	.	-0.315	-0.503*	-0.133	.	.	-0.113	-0.037	0.260	0.418	0.395	0.395
	Significance (2-tailed)	0.503	.	.	0.105	.	0.268	.	.	0.219	0.071	0.591	.	.	0.663	0.885	0.311	0.109	0.108	0.108
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Iron, Total (mg/L)	Correlation Coefficient	0.148	.	0.408	1.000	.	-0.015	.	.	0.071	-0.205	0.381*	-0.359	0.756*	-0.452*	0.222	-0.222	-0.228	0.054	0.054
	Significance (2-tailed)	0.496	.	0.105	.	.	0.949	.	.	0.752	0.399	0.082	0.405	0.087	0.050	0.329	0.329	0.325	0.804	0.804
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Lead, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Manganese, Total (mg/L)	Correlation Coefficient	0.413*	.	-0.289	-0.015	.	1.000	.	.	0.485*	0.196	0.447*	0.120	-0.252	-0.401*	0.296	-0.296	-0.118	-0.171	-0.171
	Significance (2-tailed)	0.065	.	0.268	0.949	.	.	.	.	0.037	0.436	0.048	0.782	0.568	0.088	0.202	0.202	0.617	0.445	0.445
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	0.345*	.	.	.	.	.	.	1.000	0.987*	0.245*	0.102	0.443*	-0.301*	-0.348*	0.340*	-0.340*	-0.093	-0.086	-0.086
	Significance (2-tailed)	0.006	.	.	.	.	.	.	.	0.000	0.059	0.424	0.011	0.084	0.005	0.006	0.006	0.458	0.493	0.493
	N	36	1	1	1	1	1	1	36	16	36	36	20	20	36	36	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.496*	.	-0.315	0.071	.	0.485*	.	0.987*	1.000	0.208	0.303*	0.000	-0.354	-0.355*	0.411*	-0.380*	-0.233	-0.141	-0.141
	Significance (2-tailed)	0.001	.	0.219	0.752	.	0.037	.	0.000	.	0.194	0.039	1.000	0.420	0.016	0.005	0.009	0.120	0.328	0.328
	N	28	13	13	13	13	13	13	16	28	28	28	5	5	27	27	27	27	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	0.192*	.	-0.503*	-0.205	.	0.196	.	0.245*	0.208	1.000	-0.179*	0.301*	0.028	-0.180*	0.076	-0.205*	-0.193*	0.149	0.149
	Significance (2-tailed)	0.072	.	0.071	0.399	.	0.436	.	0.059	0.194	.	0.098	0.042	0.850	0.095	0.477	0.057	0.076	0.161	0.161
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	0.249*	.	-0.133	0.381*	.	0.447*	.	0.102	0.303*	-0.179*	1.000	0.200	-0.105	-0.178*	0.317*	-0.206*	0.045	-0.150	-0.150
	Significance (2-tailed)	0.015	.	0.591	0.082	.	0.048	.	0.424	0.039	0.098	.	0.167	0.467	0.084	0.002	0.045	0.665	0.139	0.139
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.289*	.	.	-0.359	.	0.120	.	0.443*	0.000	0.301*	0.200	1.000	0.043	-0.397*	0.207	-0.793*	-0.060	0.174	0.174
	Significance (2-tailed)	0.044	.	.	0.405	.	0.782	.	0.011	1.000	0.042	0.167	.	0.761	0.005	0.148	0.000	0.674	0.224	0.224
	N	25	5	5	5	5	5	5	20	5	25	25	25	25	25	25	25	25	25	25
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.541*	.	.	0.756*	.	-0.252	.	-0.301*	-0.354	0.028	-0.105	0.043	1.000	0.308*	-0.618*	0.124	0.117	0.553*	0.553*
	Significance (2-tailed)	0.000	.	.	0.087	.	0.568	.	0.084	0.420	0.850	0.467	0.761	.	0.032	0.000	0.387	0.413	0.000	0.000
	N	25	5	5	5	5	5	5	20	5	25	25	25	25	25	25	25	25	25	25
pH, (s.u.)	Correlation Coefficient	-0.403*	.	-0.113	-0.452*	.	-0.401*	.	-0.348*	-0.355*	-0.180*	-0.178*	-0.397*	0.308*	1.000	-0.335*	0.428*	0.160	-0.007	-0.007
	Significance (2-tailed)	0.000	.	0.663	0.050	.	0.088	.	0.005	0.016	0.095	0.084	0.005	0.032	.	0.001	0.000	0.118	0.941	0.941
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	47	47
Specific Conductance (µS/cm)	Correlation Coefficient	0.751*	.	-0.037	0.222	.	0.296	.	0.340*	0.411*	0.076	0.317*	0.207	-0.618*	-0.335*	1.000	-0.415*	-0.126	-0.269*	-0.269*
	Significance (2-tailed)	0.000	.	0.885	0.329	.	0.202	.	0.006	0.005	0.477	0.002	0.148	0.000	0.001	.	0.000	0.218	0.008	0.008
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	47	47
Water Temperature (°C)	Correlation Coefficient	-0.485*	.	0.260	-0.222	.	-0.296	.	-0.340*	-0.380*	-0.205*	-0.206*	-0.793*	0.124	0.428*	-0.415*	1.000	0.302*	-0.050	-0.050
	Significance (2-tailed)	0.000	.	0.311	0.329	.	0.202	.	0.006	0.009	0.057	0.045	0.000	0.387	0.000	0.000	.	0.003	0.620	0.620
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	47	47
Turbidity (NTU)	Correlation Coefficient	-0.180*	.	0.418	-0.228	.	-0.118	.	-0.093	-0.233	-0.193*	0.045	-0.060	0.117	0.160	-0.126	0.302*	1.000	0.044	0.044
	Significance (2-tailed)	0.079	.	0.109	0.325	.	0.617	.	0.458	0.120	0.076	0.665	0.674	0.413	0.118	0.218	0.003	.	0.666	0.666
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	47	47
Flow (CFS)	Correlation Coefficient	-0.189*	.	0.395	0.054	.	-0.171	.	-0.086	-0.141	0.149	-0.150	0.174	0.553*	-0.007	-0.269*	-0.050	0.044	1.000	1.000
	Significance (2-tailed)	0.059	.	0.108	0.804	.	0.445	.	0.493	0.328	0.161	0.139	0.224	0.000	0.941	0.008	0.620	0.666	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Flow (probability)	Correlation Coefficient	-0.189*	.	0.395	0.054	.	-0.171	.	-0.086	-0.141	0.149	-0.150	0.174	0.553*	-0.007	-0.269*	-0.050	0.044	1.000	1.000
	Significance (2-tailed)	0.059	.	0.108	0.804	.	0.445	.	0.493	0.328	0.161	0.139	0.224	0.000	0.941	0.008	0.620	0.666	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-105: Kendall's tau correlation matrix of water quality parameters collected at Station 3 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.955*	0.116	-0.305*	-0.299*	0.087	0.000	-0.338*	.	0.108	-0.414*	-0.183	-0.314*	-0.245*	-0.379*	-0.157
	Significance (2-tailed)	.	0.000	0.276	0.005	0.005	0.530	1.000	0.002	.	0.419	0.003	0.578	0.005	0.032	0.000	0.205
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Year Quarter	Correlation Coefficient	0.955*	1.000	0.109	-0.312*	-0.307*	0.084	0.000	-0.353*	.	0.087	-0.419*	-0.183	-0.326*	-0.266*	-0.391*	-0.187
	Significance (2-tailed)	0.000	.	0.320	0.005	0.006	0.563	1.000	0.002	.	0.529	0.003	0.578	0.005	0.025	0.000	0.144
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Date	Correlation Coefficient	0.116	0.109	1.000	0.147	0.147	-0.176	0.340	0.018	.	0.311*	0.013	-0.085	0.073	0.004	0.006	-0.024
	Significance (2-tailed)	0.276	0.320	.	0.144	0.144	0.181	0.254	0.859	.	0.013	0.919	0.787	0.491	0.971	0.950	0.834
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	-0.305*	-0.312*	0.147	1.000	0.986*	-0.108	-0.038	0.618*	.	0.276*	0.786*	0.423	0.678*	0.389*	0.589*	-0.086
	Significance (2-tailed)	0.005	0.005	0.144	.	0.000	0.417	0.899	0.000	.	0.029	0.000	0.176	0.000	0.000	0.000	0.463
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	-0.299*	-0.307*	0.147	0.986*	1.000	-0.096	0.000	0.613*	.	0.292*	0.772*	0.387	0.674*	0.392*	0.584*	-0.084
	Significance (2-tailed)	0.005	0.006	0.144	0.000	.	0.470	1.000	0.000	.	0.021	0.000	0.220	0.000	0.000	0.000	0.471
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.087	0.084	-0.176	-0.108	-0.096	1.000	.	-0.152	.	0.368*	-0.145	.	-0.181	0.092	-0.082	0.350*
	Significance (2-tailed)	0.530	0.563	0.181	0.417	0.470	.	.	0.256	.	0.019	0.324	.	0.171	0.515	0.536	0.021
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	0.000	0.000	0.340	-0.038	0.000	.	1.000	-0.577*	.	0.775*	.	-0.716*	-0.616*	-0.250	-0.643*	0.454
	Significance (2-tailed)	1.000	1.000	0.254	0.899	1.000	.	.	0.056	.	0.023	.	0.027	0.041	0.428	0.031	0.182
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	-0.338*	-0.353*	0.018	0.618*	0.613*	-0.152	-0.577*	1.000	.	0.035	0.823*	0.818*	0.887*	0.427*	0.758*	-0.077
	Significance (2-tailed)	0.002	0.002	0.859	0.000	0.000	0.256	0.056	.	.	0.781	0.000	0.010	0.000	0.000	0.000	0.512
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.108	0.087	0.311*	0.276*	0.292*	0.368*	0.775*	0.035	.	1.000	0.183	-0.693*	0.028	0.163	-0.009	0.048
	Significance (2-tailed)	0.419	0.529	0.013	0.029	0.021	0.019	0.023	0.781	.	.	0.241	0.053	0.824	0.226	0.941	0.742
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	-0.414*	-0.419*	0.013	0.786*	0.772*	-0.145	.	0.823*	.	0.183	1.000	.	0.834*	0.443*	0.710*	-0.063
	Significance (2-tailed)	0.003	0.003	0.919	0.000	0.000	0.324	.	0.000	.	0.241	.	.	0.000	0.002	0.000	0.674
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.183	-0.183	-0.085	0.423	0.387	.	-0.716*	0.818*	.	-0.693*	.	1.000	0.861*	0.513	0.761*	-0.507
	Significance (2-tailed)	0.578	0.578	0.787	0.176	0.220	.	0.027	0.010	.	0.053	.	.	0.006	0.122	0.015	0.157
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.314*	-0.326*	0.073	0.678*	0.674*	-0.181	-0.616*	0.887*	.	0.028	0.834*	0.861*	1.000	0.406*	0.732*	-0.105
	Significance (2-tailed)	0.005	0.005	0.491	0.000	0.000	0.171	0.041	0.000	.	0.824	0.000	0.006	.	0.000	0.000	0.389
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	-0.245*	-0.266*	0.004	0.389*	0.392*	0.092	-0.250	0.427*	.	0.163	0.443*	0.513	0.406*	1.000	0.326*	-0.108
	Significance (2-tailed)	0.032	0.025	0.971	0.000	0.000	0.515	0.428	0.000	.	0.226	0.002	0.122	0.000	.	0.002	0.384
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	-0.379*	-0.391*	0.006	0.589*	0.584*	-0.082	-0.643*	0.758*	.	-0.009	0.710*	0.761*	0.732*	0.326*	1.000	0.038
	Significance (2-tailed)	0.000	0.000	0.950	0.000	0.000	0.536	0.031	0.000	.	0.941	0.000	0.015	0.000	0.002	.	0.743
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.157	-0.187	-0.024	-0.086	-0.084	0.350*	0.454	-0.077	.	0.048	-0.063	-0.507	-0.105	-0.108	0.038	1.000
	Significance (2-tailed)	0.205	0.144	0.834	0.463	0.471	0.021	0.182	0.512	.	0.742	0.674	0.157	0.389	0.384	0.743	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	-0.339*	-0.358*	0.006	0.605*	0.594*	-0.196	-0.718*	0.898*	.	-0.032	0.809*	0.845*	0.879*	0.351*	0.739*	-0.099
	Significance (2-tailed)	0.002	0.001	0.950	0.000	0.000	0.137	0.016	0.000	.	0.796	0.000	0.007	0.000	0.001	0.000	0.394
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	0.292	0.255	0.290	-0.077	-0.062	-0.075	.	-0.140	.	-0.234	-0.219	.	-0.168	-0.164	0.000	0.619*
	Significance (2-tailed)	0.202	0.298	0.203	0.737	0.788	0.770	.	0.544	.	0.382	0.367	.	0.461	0.494	1.000	0.018
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	-0.082	-0.091	-0.123	0.151	0.167	0.200	.	0.083	.	-0.278	0.090	.	0.014	0.073	0.165	0.577*
	Significance (2-tailed)	0.707	0.698	0.574	0.491	0.451	0.412	.	0.706	.	0.276	0.698	.	0.950	0.750	0.453	0.021
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	-0.197	-0.327	-0.196	0.197	0.200	-0.120	.	0.233	.	0.083	0.180	.	0.196	0.350	0.197	-0.120
	Significance (2-tailed)	0.422	0.215	0.423	0.422	0.421	0.663	.	0.348	.	0.773	0.491	.	0.423	0.174	0.422	0.671
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	-0.159	-0.241	-0.217	0.179	0.181	0.579*	.	0.101	.	0.151	0.131	.	0.020	0.232	0.060	0.835*
	Significance (2-tailed)	0.504	0.343	0.359	0.452	0.451	0.029	.	0.675	.	0.588	0.605	.	0.934	0.350	0.802	0.002
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.343*	-0.343*	-0.143	0.044	0.054	0.037	-0.160	0.237*	.	-0.200	0.170	0.000	0.107	0.078	0.221*	0.145
	Significance (2-tailed)	0.010	0.010	0.237	0.720	0.659	0.829	0.603	0.055	.	0.196	0.320	1.000	0.412	0.545	0.069	0.299
	N	36	36	36	36	36	24	8	36	0	32	24	8	32	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.397*	-0.426*	0.115	0.317*	0.321*	-0.063	.	0.452*	.	0.026	0.491*	.	0.432*	0.369*	0.428*	0.148
	Significance (2-tailed)	0.006	0.005	0.403	0.022	0.021	0.706	.	0.001	.	0.884	0.003	.	0.004	0.011	0.002	0.353
	N	28	28	28	28	28	24	0	28	0	24	24	0	24	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.204*	-0.217*	-0.029	0.102	0.106	-0.020	-0.115	0.146	.	0.010	0.222	-0.301	0.133	-0.050	0.187*	0.236*
	Significance (2-tailed)	0.066	0.057	0.781	0.332	0.310	0.882	0.702	0.166	.	0.941	0.100	0.341	0.221	0.653	0.073	0.049
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.233*	-0.250*	-0.230*	0.118	0.117	0.325*	0.308	0.155	.	0.059	0.281*	-0.430	0.092	0.164	0.179*	0.568*
	Significance (2-tailed)	0.031	0.025	0.023	0.250	0.254	0.015	0.307	0.132	.	0.644	0.034	0.173	0.388	0.131	0.078	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.044	0.004	0.053	0.354*	0.358*	-0.336*	-0.491*	0.377*	.	-0.038	0.265	0.338	0.404*	0.223	0.321*	-0.158
	Significance (2-tailed)	0.774	0.981	0.709	0.014	0.013	0.091	0.100	0.009	.	0.824	0.188	0.279	0.005	0.148	0.025	0.338
	N	25	25	25	25	25	17	8	25	0	25	17	8	25	25	25	25
Dissolved Oxygen (% Sat.)	Correlation Coefficient	0.051	0.076	0.000	-0.146	-0.156	0.128	-0.038	-0.235	.	-0.101	-0.456*	0.085	-0.269*	-0.056	-0.121	0.085
	Significance (2-tailed)	0.737	0.626	1.000	0.314	0.281	0.522	0.899	0.106	.	0.553	0.024	0.787	0.064	0.718	0.400	0.606
	N	25	25	25	25	25	17	8	25	0	25	17	8	25	25	25	25
pH, (s.u.)	Correlation Coefficient	-0.059	-0.042	-0.158	-0.075	-0.087	0.100	0.154	-0.143	.	-0.174	-0.014	-0.129	-0.133	-0.056	-0.098	-0.079
	Significance (2-tailed)	0.587	0.704	0.119	0.462	0.398	0.458	0.610	0.165	.	0.174	0.915	0.683	0.216	0.605	0.335	0.502
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Specific Conductance (µS/cm)	Correlation Coefficient	-0.365*	-0.363*	0.004	0.619*	0.615*	-0.122	-0.643*	0.866*	.	-0.053	0.786*	0.845*	0.801*	0.417*	0.728*	-0.083
	Significance (2-tailed)	0.001	0.001	0.971	0.000	0.000	0.362	0.031	0.000	.	0.676	0.000	0.007	0.000	0.000	0.000	0.477
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Water Temperature (°C)	Correlation Coefficient	0.185*	0.190*	0.058	-0.356*	-0.359*	0.222*	0.491*	-0.417*	.	0.048	-0.437*	-0.338	-0.434*	-0.217*	-0.391*	0.186
	Significance (2-tailed)	0.086	0.087	0.563	0.000	0.000	0.098	0.100	0.000	.	0.707	0.001	0.279	0.000	0.046	0.000	0.111
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Turbidity (NTU)	Correlation Coefficient	0.041	0.028	0.107	-0.079	-0.070	0.375*	0.643*	-0.099	.	0.201	-0.094	-0.845*	-0.107	-0.096	-0.035	0.585*
	Significance (2-tailed)	0.708	0.805	0.291	0.440	0.497	0.006	0.031	0.339	.	0.117	0.483	0.007	0.319	0.377	0.734	0.000
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Flow (CFS)	Correlation Coefficient	-0.103	-0.208	-0.258	-0.142	-0.142	-0.041	0.447	-0.177	.	-0.043	-0.137	-0.671	-0.214	-0.119	-0.006	0.581*
	Significance (2-tailed)	0.562	0.268	0.123	0.400	0.400	0.856	0.296	0.293	.	0.824	0.528	0.117	0.206	0.511	0.972	0.002
	N	19	19	19	19	19	14	5	19	0	19	14	5	19	19	19	19
Flow (probability)	Correlation Coefficient	-0.103	-0.208	-0.258	-0.142	-0.142	-0.041	0.447	-0.177	.	-0.043	-0.137	-0.671	-0.214	-0.119	-0.006	0.581*
	Significance (2-tailed)	0.562	0.268	0.123	0.400	0.400	0.856	0.296	0.293	.	0.824	0.528	0.117	0.206	0.511	0.972	0.002
	N	19	19	19	19	19	14	5	19	0	19	14	5	19	19	19	19

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-106: Kendall's tau correlation matrix of water quality parameters collected at Station 3 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	-0.339*	.	0.292	-0.082	-0.197	-0.159	.	-0.343*	-0.397*	-0.204*	-0.233*	0.044	0.051	-0.059	-0.365*	0.185*	0.041	-0.103	-0.103
	Significance (2-tailed)	0.002	.	0.202	0.707	0.422	0.504	.	0.010	0.006	0.066	0.031	0.774	0.737	0.587	0.001	0.086	0.708	0.562	0.562
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Year Quarter	Correlation Coefficient	-0.358*	.	0.255	-0.091	-0.327	-0.241	.	-0.343*	-0.426*	-0.217*	-0.250*	0.004	0.076	-0.042	-0.363*	0.190*	0.028	-0.208	-0.208
	Significance (2-tailed)	0.001	.	0.298	0.698	0.215	0.343	.	0.010	0.005	0.057	0.025	0.981	0.626	0.704	0.001	0.087	0.805	0.268	0.268
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Date	Correlation Coefficient	0.006	.	0.290	-0.123	-0.196	-0.217	.	-0.143	0.115	-0.029	-0.230*	0.053	0.000	-0.158	0.004	0.058	0.107	-0.258	-0.258
	Significance (2-tailed)	0.950	.	0.203	0.574	0.423	0.359	.	0.237	0.403	0.781	0.023	0.709	1.000	0.119	0.971	0.563	0.291	0.123	0.123
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.605*	.	-0.077	0.151	0.197	0.179	.	0.044	0.317*	0.102	0.118	0.354*	-0.146	-0.075	0.619*	-0.356*	-0.079	-0.142	-0.142
	Significance (2-tailed)	0.000	.	0.737	0.491	0.422	0.452	.	0.720	0.022	0.332	0.250	0.014	0.314	0.462	0.000	0.000	0.440	0.400	0.400
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.594*	.	-0.062	0.167	0.200	0.181	.	0.054	0.321*	0.106	0.117	0.358*	-0.156	-0.087	0.615*	-0.359*	-0.070	-0.142	-0.142
	Significance (2-tailed)	0.000	.	0.788	0.451	0.421	0.451	.	0.659	0.021	0.310	0.254	0.013	0.281	0.398	0.000	0.000	0.497	0.400	0.400
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Calcium, Total (mg/L)	Correlation Coefficient	-0.196	.	-0.075	0.200	-0.120	0.579*	.	0.037	-0.063	-0.020	0.325*	-0.336*	0.128	0.100	-0.122	0.222*	0.375*	-0.041	-0.041
	Significance (2-tailed)	0.137	.	0.770	0.412	0.663	0.029	.	0.829	0.706	0.882	0.015	0.091	0.522	0.458	0.362	0.098	0.006	0.856	0.856
	N	36	13	13	13	13	13	13	24	24	36	36	17	17	35	35	35	35	14	14
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.718*	.	.	.	.	.	.	-0.160	.	-0.115	0.308	-0.491*	-0.038	0.154	-0.643*	0.491*	0.643*	0.447	0.447
	Significance (2-tailed)	0.016	.	.	.	.	.	.	0.603	.	0.702	0.307	0.100	0.899	0.610	0.031	0.100	0.031	0.296	0.296
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	5	5
Chloride, Total (mg/L)	Correlation Coefficient	0.898*	.	-0.140	0.083	0.233	0.101	.	0.237*	0.452*	0.146	0.155	0.377*	-0.235	-0.143	0.866*	-0.417*	-0.099	-0.177	-0.177
	Significance (2-tailed)	0.000	.	0.544	0.706	0.348	0.675	.	0.055	0.001	0.166	0.132	0.009	0.106	0.165	0.000	0.000	0.339	0.293	0.293
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	-0.032	.	-0.234	-0.278	0.083	0.151	.	-0.200	0.026	0.010	0.059	-0.038	-0.101	-0.174	-0.053	0.048	0.201	-0.043	-0.043
	Significance (2-tailed)	0.796	.	0.382	0.276	0.773	0.588	.	0.196	0.884	0.941	0.644	0.824	0.553	0.174	0.676	0.707	0.117	0.824	0.824
	N	44	13	13	13	13	13	13	32	24	44	44	25	25	43	43	43	43	19	19
Potassium, Total (mg/L)	Correlation Coefficient	0.809*	.	-0.219	0.090	0.180	0.131	.	0.170	0.491*	0.222	0.281*	0.265	-0.456*	-0.014	0.786*	-0.437*	-0.094	-0.137	-0.137
	Significance (2-tailed)	0.000	.	0.367	0.698	0.491	0.605	.	0.320	0.003	0.100	0.034	0.188	0.024	0.915	0.000	0.001	0.483	0.528	0.528
	N	36	13	13	13	13	13	13	24	24	36	36	17	17	35	35	35	35	14	14
Potassium, Dissolved (mg/L)	Correlation Coefficient	0.845*	.	.	.	.	.	.	0.000	.	-0.301	-0.430	0.338	0.085	-0.129	0.845*	-0.338	-0.845*	-0.671	-0.671
	Significance (2-tailed)	0.007	.	.	.	.	.	.	1.000	.	0.341	0.173	0.279	0.787	0.683	0.007	0.279	0.007	0.117	0.117
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	5	5
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.879*	.	-0.168	0.014	0.196	0.020	.	0.107	0.432*	0.133	0.092	0.404*	-0.269*	-0.133	0.801*	-0.434*	-0.107	-0.214	-0.214
	Significance (2-tailed)	0.000	.	0.461	0.950	0.423	0.934	.	0.412	0.004	0.221	0.388	0.005	0.064	0.216	0.000	0.000	0.319	0.206	0.206
	N	44	13	13	13	13	13	13	32	24	44	44	25	25	43	43	43	43	19	19
Sulfate, Total (mg/L)	Correlation Coefficient	0.351*	.	-0.164	0.073	0.350	0.232	.	0.078	0.369*	-0.050	0.164	0.223	-0.056	-0.056	0.417*	-0.217*	-0.096	-0.119	-0.119
	Significance (2-tailed)	0.001	.	0.494	0.750	0.174	0.350	.	0.545	0.011	0.653	0.131	0.148	0.718	0.605	0.000	0.046	0.377	0.511	0.511
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.739*	.	0.000	0.165	0.197	0.060	.	0.221*	0.428*	0.187*	0.179*	0.321*	-0.121	-0.098	0.728*	-0.391*	-0.035	-0.006	-0.006
	Significance (2-tailed)	0.000	.	1.000	0.453	0.422	0.802	.	0.069	0.002	0.073	0.078	0.025	0.400	0.335	0.000	0.000	0.734	0.972	0.972
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.099	.	0.619*	0.577*	-0.120	0.835*	.	0.145	0.148	0.236*	0.568*	-0.158	0.085	-0.079	-0.083	0.186	0.585*	0.581*	0.581*
	Significance (2-tailed)	0.394	.	0.018	0.021	0.671	0.002	.	0.299	0.353	0.049	0.000	0.338	0.606	0.502	0.477	0.111	0.000	0.002	0.002
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	.	-0.168	0.014	0.392	0.020	.	0.260*	0.438*	0.149	0.099	0.413*	-0.219	-0.124	0.798*	-0.415*	-0.156	-0.218	-0.218
	Significance (2-tailed)	.	.	0.461	0.950	0.109	0.934	.	0.033	0.002	0.151	0.332	0.004	0.128	0.222	0.000	0.000	0.127	0.195	0.195
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Cadmium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	8	8
Copper, Total (mg/L)	Correlation Coefficient	-0.168	.	1.000	0.552*	-0.234	0.423	.	.	-0.031	0.337	0.202	0.837*	-0.837*	-0.378	-0.131	0.056	0.653*	0.780*	0.780*
	Significance (2-tailed)	0.461	.	.	0.020	0.382	0.101	.	.	0.893	0.164	0.381	0.052	0.052	0.120	0.587	0.816	0.008	0.011	0.011
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	8	8
Iron, Total (mg/L)	Correlation Coefficient	0.014	.	0.552*	1.000	0.000	0.650*	.	.	0.070	0.105	0.556*	0.224	-0.224	0.066	0.212	0.082	0.451*	0.741*	0.741*
	Significance (2-tailed)	0.950	.	0.020	.	1.000	0.008	.	.	0.753	0.649	0.012	0.602	0.602	0.777	0.358	0.724	0.055	0.012	0.012
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	8	8
Lead, Total (mg/L)	Correlation Coefficient	0.392	.	-0.234	0.000	1.000	-0.151	.	.	0.302	0.072	0.200	.	.	0.337	0.260	-0.037	-0.380	-0.364	-0.364
	Significance (2-tailed)	0.109	.	0.382	1.000	.	0.588	.	.	0.227	0.782	0.421	.	.	0.192	0.311	0.885	0.145	0.272	0.272
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	8	8
Manganese, Total (mg/L)	Correlation Coefficient	0.020	.	0.423	0.650*	-0.151	1.000	.	.	0.121	0.218	0.643*	.	.	0.091	0.000	0.045	0.667*	0.587*	0.587*
	Significance (2-tailed)	0.934	.	0.101	0.008	0.588	.	.	.	0.615	0.387	0.007	.	.	0.715	1.000	0.856	0.008	0.069	0.069
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	8	8
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	8	8
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	0.260*	.	.	.	.	.	.	1.000	0.990*	0.361*	0.357*	0.266	-0.272	-0.220*	0.258*	-0.323*	0.038	0.311	0.311
	Significance (2-tailed)	0.033	.	.	.	.	.	.	.	0.000	0.004	0.004	0.114	0.107	0.070	0.033	0.008	0.752	0.201	0.201
	N	36	1	1	1	1	1	1	36	16	36	36	20	20	36	36	36	36	11	11
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.438*	.	-0.031	0.070	0.302	0.121	.	0.990*	1.000	0.248*	0.185	0.105	-0.105	-0.128	0.446*	-0.210	0.096	0.074	0.074
	Significance (2-tailed)	0.002	.	0.893	0.753	0.227	0.615	.	0.000	.	0.089	0.187	0.801	0.801	0.366	0.002	0.136	0.500	0.802	0.802
	N	28	13	13	13	13	13	13	16	28	28	28	5	5	27	27	27	27	8	8
Nitrogen, Total (mg/L)	Correlation Coefficient	0.149	.	0.337	0.105	0.072	0.218	.	0.361*	0.248*	1.000	0.190*	0.188	-0.148	0.008	0.102	-0.099	0.192*	0.104	0.104
	Significance (2-tailed)	0.151	.	0.164	0.649	0.782	0.387	.	0.004	0.089	.	0.069	0.197	0.312	0.941	0.331	0.345	0.068	0.548	0.548
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Phosphorus, Total (mg/L)	Correlation Coefficient	0.099	.	0.202	0.556*	0.200	0.643*	.	0.357*	0.185	0.190*	1.000	0.027	-0.252*	-0.020	0.193*	-0.047	0.339*	0.533*	0.533*
	Significance (2-tailed)	0.332	.	0.381	0.012	0.421	0.007	.	0.004	0.187	0.069	.	0.851	0.083	0.847	0.060	0.646	0.001	0.002	0.002
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	19	19
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.413*	.	0.837*	0.224	.	.	.	0.266	0.105	0.188	0.027	1.000	-0.281*	-0.415*	0.300*	-0.853*	-0.207	0.341*	0.341*
	Significance (2-tailed)	0.004	.	0.052	0.602	.	.	.	0.114	0.801	0.197	0.851	.	0.050	0.004	0.036	0.000	0.147	0.090	0.090
	N	25	5	5	5	5	5	5	20	5	25	25	25	25	25	25	25	25	14	14
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.219	.	-0.837*	-0.224	.	.	.	-0.272	-0.105	-0.148	-0.252*	-0.281*	1.000	0.342*	-0.234	0.428*	0.040	-0.385*	-0.385*
	Significance (2-tailed)	0.128	.	0.052	0.602	.	.	.	0.107	0.801	0.312	0.083	0.050	.	0.017	0.102	0.003	0.779	0.055	0.055
	N	25	5	5	5	5	5	5	20	5	25	25	25	25	25	25	25	25	14	14
pH, (s.u.)	Correlation Coefficient	-0.124	.	-0.378	0.066	0.337	0.091	.	-0.220*	-0.128	0.008	-0.020	-0.415*	0.342*	1.000	-0.090	0.323*	0.030	-0.571*	-0.571*
	Significance (2-tailed)	0.222	.	0.120	0.777	0.192	0.715	.	0.070	0.366	0.941	0.847	0.004	0.017	.	0.373	0.001	0.769	0.001	0.001
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	18	18
Specific Conductance (µS/cm)	Correlation Coefficient	0.798*	.	-0.131	0.212	0.260	0.000	.	0.258*	0.446*	0.102	0.193*	0.300*	-0.234	-0.090	1.000	-0.378*	-0.063	-0.092	-0.092
	Significance (2-tailed)	0.000	.	0.587	0.358	0.311	1.000	.	0.033	0.002	0.331	0.060	0.036	0.102	0.373	.	0.000	0.533	0.596	0.596
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	18	18
Water Temperature (°C)	Correlation Coefficient	-0.415*	.	0.056	0.082	-0.037	0.045	.	-0.323*	-0.210	-0.099	-0.047	-0.853*	0.428*	0.323*	-0.378*	1.000	0.211*	-0.184	-0.184
	Significance (2-tailed)	0.000	.	0.816	0.724	0.885	0.856	.	0.008	0.136	0.345	0.646	0.000	0.003	0.001	0.000	.	0.037	0.289	0.289
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	18	18
Turbidity (NTU)	Correlation Coefficient	-0.156	.	0.653*	0.451*	-0.380	0.667*	.	0.038	0.096	0.192*	0.339*	-0.207	0.040	0.030	-0.063	0.211*	1.000	0.409*	0.409*
	Significance (2-tailed)	0.127	.	0.008	0.055	0.145	0.008	.	0.752	0.500	0.068	0.001	0.147	0.779	0.769	0.533	0.037	.	0.019	0.019
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	18	18
Flow (CFS)	Correlation Coefficient	-0.218	.	0.780*	0.741*	-0.364	0.587*	.	0.311	0.074	0.104	0.533*	0.341*	-0.385*	-0.571*	-0.092	-0.184	0.409*	1.000	1.000
	Significance (2-tailed)	0.195	.	0.011	0.012	0.272	0.069	.	0.201	0.802	0.548	0.002	0.090	0.055	0.001	0.596	0.289	0.019	.	.
	N	19	8	8	8	8	8	8	11	8	19	19	14	14	18	18	18	18	19	19
Flow (probability)	Correlation Coefficient	-0.218	.	0.780*	0.741*	-0.364	0.587*	.	0.311	0.074	0.104	0.533*	0.341*	-0.385*	-0.571*	-0.092	-0.184	0.409*	1.000	1.000
	Significance (2-tailed)	0.195	.	0.011	0.012	0.272	0.069	.	0.201	0.802	0.548	0.002	0.090	0.055	0.001	0.596	0.289	0.019	.	.
	N	19	8	8	8	8	8	8	11	8	19	19	14	14	18	18	18	18	19	19

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-107: Kendall's tau correlation matrix of water quality parameters collected at Station 4 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.955*	0.116	-0.128	-0.124	0.020	0.120	-0.347*	.	0.039	-0.370*	0.236	-0.344*	-0.096	-0.347*	0.344*
	Significance (2-tailed)	.	0.000	0.276	0.234	0.249	0.877	0.698	0.001	.	0.761	0.008	0.495	0.002	0.393	0.001	0.005
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Year Quarter	Correlation Coefficient	0.955*	1.000	0.109	-0.131	-0.127	0.031	0.120	-0.358*	.	0.038	-0.364*	0.236	-0.360*	-0.107	-0.370*	0.360*
	Significance (2-tailed)	0.000	.	0.320	0.238	0.253	0.818	0.698	0.001	.	0.775	0.012	0.495	0.002	0.356	0.001	0.005
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Date	Correlation Coefficient	0.116	0.109	1.000	0.068	0.050	-0.185	0.148	-0.042	.	0.120	0.013	0.109	0.046	-0.070	-0.024	-0.024
	Significance (2-tailed)	0.276	0.320	.	0.499	0.618	0.134	0.615	0.682	.	0.314	0.918	0.739	0.663	0.505	0.810	0.837
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	-0.128	-0.131	0.068	1.000	0.927*	0.397*	0.148	0.514*	.	0.469*	0.624*	0.436	0.543*	0.591*	0.565*	0.131
	Significance (2-tailed)	0.234	0.238	0.499	.	0.000	0.001	0.615	0.000	.	0.000	0.000	0.182	0.000	0.000	0.000	0.259
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	-0.124	-0.127	0.050	0.927*	1.000	0.415*	0.148	0.482*	.	0.475*	0.622*	0.436	0.519*	0.564*	0.556*	0.161
	Significance (2-tailed)	0.249	0.253	0.618	0.000	.	0.001	0.615	0.000	.	0.000	0.000	0.182	0.000	0.000	0.000	0.167
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.020	0.031	-0.185	0.397*	0.415*	1.000	.	0.088	.	0.638*	0.137	.	0.048	0.404*	0.126	0.062
	Significance (2-tailed)	0.877	0.818	0.134	0.001	0.001	.	.	0.486	.	0.000	0.326	.	0.697	0.002	0.311	0.660
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	0.120	0.120	0.148	0.148	0.148	.	1.000	-0.340	.	0.653*	.	-0.453	-0.340	0.334	-0.222	0.000
	Significance (2-tailed)	0.698	0.698	0.615	0.615	0.615	.	.	0.255	.	0.046	.	0.177	0.255	0.287	0.451	1.000
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	-0.347*	-0.358*	-0.042	0.514*	0.482*	0.088	-0.340	1.000	.	0.226*	0.801*	0.667*	0.869*	0.411*	0.771*	0.132
	Significance (2-tailed)	0.001	0.001	0.682	0.000	0.000	0.486	0.255	.	.	0.064	0.000	0.044	0.000	0.000	0.000	0.263
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.039	0.038	0.120	0.469*	0.475*	0.638*	0.653*	0.226*	.	1.000	0.330*	0.000	0.223*	0.454*	0.282*	0.161
	Significance (2-tailed)	0.761	0.775	0.314	0.000	0.000	0.000	0.046	0.064	.	.	0.028	1.000	0.066	0.000	0.019	0.245
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	-0.370*	-0.364*	0.013	0.624*	0.622*	0.137	.	0.801*	.	0.330*	1.000	.	0.810*	0.508*	0.730*	0.148
	Significance (2-tailed)	0.008	0.012	0.918	0.000	0.000	0.326	.	0.000	.	0.028	.	.	0.000	0.000	0.000	0.326
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	0.236	0.236	0.109	0.436	0.436	.	-0.453	0.667*	.	0.000	.	1.000	0.611*	0.369	0.327	0.218
	Significance (2-tailed)	0.495	0.495	0.739	0.182	0.182	.	0.177	0.044	.	1.000	.	.	0.065	0.293	0.317	0.564
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.344*	-0.360*	0.046	0.543*	0.519*	0.048	-0.340	0.869*	.	0.223*	0.810*	0.611*	1.000	0.415*	0.823*	0.169
	Significance (2-tailed)	0.002	0.002	0.663	0.000	0.000	0.697	0.255	0.000	.	0.066	0.000	0.065	.	0.000	0.000	0.166
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	-0.096	-0.107	-0.070	0.591*	0.564*	0.404*	0.334	0.411*	.	0.454*	0.508*	0.369	0.415*	1.000	0.439*	0.170
	Significance (2-tailed)	0.393	0.356	0.505	0.000	0.000	0.002	0.287	0.000	.	0.000	0.000	0.293	0.000	.	0.000	0.162
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	-0.347*	-0.370*	-0.024	0.565*	0.556*	0.126	-0.222	0.771*	.	0.282*	0.730*	0.327	0.823*	0.439*	1.000	0.121
	Significance (2-tailed)	0.001	0.001	0.810	0.000	0.000	0.311	0.451	0.000	.	0.019	0.000	0.317	0.000	0.000	.	0.297
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	0.344*	0.360*	-0.024	0.131	0.161	0.062	0.000	0.132	.	0.161	0.148	0.218	0.169	0.170	0.121	1.000
	Significance (2-tailed)	0.005	0.005	0.837	0.259	0.167	0.660	1.000	0.263	.	0.245	0.326	0.564	0.166	0.162	0.297	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	-0.393*	-0.414*	0.013	0.304*	0.274*	-0.156	-0.717*	0.724*	.	-0.033	0.671*	0.500	0.724*	0.201*	0.592*	0.062
	Significance (2-tailed)	0.000	0.000	0.901	0.003	0.007	0.206	0.016	0.000	.	0.782	0.000	0.131	0.000	0.058	0.000	0.594
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	0.132	0.145	0.131	-0.263	-0.263	0.111	.	-0.333	.	-0.193	-0.263	.	-0.329	-0.286	-0.327	-0.120
	Significance (2-tailed)	0.592	0.581	0.593	0.284	0.284	0.672	.	0.180	.	0.475	0.326	.	0.181	0.269	0.181	0.671
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.185	-0.279	-0.167	0.118	0.118	-0.321	.	0.289	.	-0.414	0.173	.	0.235	-0.055	0.167	0.000
	Significance (2-tailed)	0.434	0.272	0.478	0.619	0.619	0.203	.	0.226	.	0.110	0.502	.	0.320	0.825	0.478	1.000
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	0.170	0.173	0.208	-0.170	-0.170	-0.676*	.	-0.093	.	-0.429*	-0.254	.	-0.092	-0.327	-0.182	0.526*
	Significance (2-tailed)	0.425	0.445	0.327	0.425	0.425	0.003	.	0.666	.	0.064	0.271	.	0.668	0.143	0.391	0.030
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	0.188	0.224	0.230	-0.188	-0.159	-0.276	.	-0.205	.	-0.475*	-0.182	.	-0.203	-0.236	-0.259	0.132
	Significance (2-tailed)	0.404	0.353	0.305	0.404	0.480	0.249	.	0.367	.	0.054	0.457	.	0.369	0.318	0.249	0.608
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.246*	-0.246*	-0.223*	0.233*	0.211*	0.173	-0.385	0.440*	.	0.162	0.336*	0.504	0.376*	0.290*	0.308*	0.034
	Significance (2-tailed)	0.071	0.071	0.071	0.063	0.090	0.281	0.221	0.001	.	0.284	0.055	0.153	0.005	0.025	0.013	0.811
	N	36	36	36	36	36	24	8	36	0	32	24	8	32	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.290*	-0.334*	-0.046	0.295*	0.294*	0.197	.	0.338*	.	0.394*	0.335*	.	0.330*	0.345*	0.350*	-0.125
	Significance (2-tailed)	0.049	0.031	0.746	0.039	0.039	0.230	.	0.019	.	0.022	0.050	.	0.033	0.020	0.014	0.439
	N	28	28	28	28	28	24	0	28	0	24	24	0	24	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	0.157	0.168	0.054	-0.004	-0.011	-0.126	-0.264	-0.010	.	-0.139	0.100	-0.167	-0.003	-0.107	-0.008	0.057
	Significance (2-tailed)	0.159	0.146	0.605	0.971	0.913	0.333	0.376	0.927	.	0.262	0.472	0.615	0.975	0.334	0.942	0.638
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	0.141	0.133	-0.033	-0.037	-0.051	-0.113	-0.189	0.104	.	-0.145	0.226*	-0.222	0.093	0.014	0.042	0.333*
	Significance (2-tailed)	0.198	0.240	0.747	0.720	0.622	0.371	0.527	0.319	.	0.238	0.094	0.502	0.392	0.899	0.681	0.005
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.037	-0.019	-0.120	0.354*	0.362*	0.324*	0.148	0.191	.	0.412*	0.134	0.218	0.192	0.378*	0.296*	0.205
	Significance (2-tailed)	0.811	0.903	0.400	0.014	0.012	0.088	0.615	0.189	.	0.013	0.508	0.505	0.188	0.012	0.039	0.213
	N	25	25	25	25	25	17	8	25	0	25	17	8	25	25	25	25
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.044	-0.057	-0.407*	-0.172	-0.235	-0.130	0.222	-0.116	.	-0.215	-0.345*	0.000	-0.137	-0.054	-0.081	-0.105
	Significance (2-tailed)	0.774	0.715	0.004	0.233	0.102	0.495	0.451	0.425	.	0.193	0.088	1.000	0.348	0.721	0.574	0.522
	N	25	25	25	25	25	17	8	25	0	25	17	8	25	25	25	25
pH, (s.u.)	Correlation Coefficient	0.067	0.092	-0.117	-0.389*	-0.407*	-0.332*	-0.445	-0.215*	.	-0.559*	-0.226*	-0.218	-0.214*	-0.362*	-0.300*	-0.167
	Significance (2-tailed)	0.536	0.409	0.248	0.000	0.000	0.008	0.132	0.037	.	0.000	0.094	0.505	0.047	0.001	0.003	0.153
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Specific Conductance (µS/cm)	Correlation Coefficient	-0.293*	-0.275*	-0.106	0.584*	0.550*	0.232*	-0.222	0.774*	.	0.288*	0.690*	0.655*	0.718*	0.487*	0.693*	0.191
	Significance (2-tailed)	0.007	0.014	0.292	0.000	0.000	0.064	0.451	0.000	.	0.018	0.000	0.046	0.000	0.000	0.000	0.101
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Water Temperature (°C)	Correlation Coefficient	0.141	0.144	0.032	-0.318*	-0.361*	-0.333*	-0.296	-0.254*	.	-0.534*	-0.277*	-0.218	-0.230*	-0.292*	-0.309*	-0.254*
	Significance (2-tailed)	0.193	0.197	0.748	0.002	0.000	0.008	0.315	0.014	.	0.000	0.040	0.505	0.032	0.006	0.002	0.029
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Turbidity (NTU)	Correlation Coefficient	0.375*	0.377*	0.140	0.048	0.078	-0.085	0.296	-0.079	.	-0.027	-0.037	-0.436	-0.056	0.046	-0.022	0.567*
	Significance (2-tailed)	0.001	0.001	0.166	0.639	0.446	0.496	0.315	0.445	.	0.827	0.782	0.182	0.600	0.669	0.826	0.000
	N	47	47	47	47	47	35	8	47	0	43	35	8	43	47	47	47
Flow (CFS)	Correlation Coefficient	-0.032	-0.052	0.059	-0.130	-0.111	-0.344*	0.667*	-0.067	.	-0.258*	-0.079	-0.655*	-0.057	-0.125	0.006	0.101
	Significance (2-tailed)	0.765	0.639	0.557	0.200	0.270	0.005	0.024	0.509	.	0.031	0.549	0.046	0.591	0.238	0.950	0.383
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (probability)	Correlation Coefficient	-0.032	-0.052	0.059	-0.130	-0.111	-0.344*	0.667*	-0.067	.	-0.258*	-0.079	-0.655*	-0.057	-0.125	0.006	0.101
	Significance (2-tailed)	0.765	0.639	0.557	0.200	0.270	0.005	0.024	0.509	.	0.031	0.549	0.046	0.591	0.238	0.950	0.383
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-108: Kendall's tau correlation matrix of water quality parameters collected at Station 4 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	-0.393*	0.132	-0.185	0.170	.	0.188	.	-0.246*	-0.290*	0.157	0.141	0.037	-0.044	0.067	-0.293*	0.141	0.375*	-0.032	-0.032
	Significance (2-tailed)	0.000	0.592	0.434	0.425	.	0.404	.	0.071	0.049	0.159	0.198	0.811	0.774	0.536	0.007	0.193	0.001	0.765	0.765
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Year Quarter	Correlation Coefficient	-0.414*	0.145	-0.279	0.173	.	0.224	.	-0.246*	-0.334*	0.168	0.133	-0.019	-0.057	0.092	-0.275*	0.144	0.377*	-0.052	-0.052
	Significance (2-tailed)	0.000	0.581	0.272	0.445	.	0.353	.	0.071	0.031	0.146	0.240	0.903	0.715	0.409	0.014	0.197	0.001	0.639	0.639
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Date	Correlation Coefficient	0.013	0.131	-0.167	0.208	.	0.230	.	-0.223*	-0.046	0.054	-0.033	-0.120	-0.407*	-0.117	-0.106	0.032	0.140	0.059	0.059
	Significance (2-tailed)	0.901	0.593	0.478	0.327	.	0.305	.	0.071	0.746	0.605	0.747	0.400	0.004	0.248	0.292	0.748	0.166	0.557	0.557
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.304*	-0.263	0.118	-0.170	.	-0.188	.	0.233*	0.295*	-0.004	-0.037	0.354*	-0.172	-0.389*	0.584*	-0.318*	0.048	-0.130	-0.130
	Significance (2-tailed)	0.003	0.284	0.619	0.425	.	0.404	.	0.063	0.039	0.971	0.720	0.014	0.233	0.000	0.000	0.002	0.639	0.200	0.200
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.274*	-0.263	0.118	-0.170	.	-0.159	.	0.211*	0.294*	-0.011	-0.051	0.362*	-0.235	-0.407*	0.550*	-0.361*	0.078	-0.111	-0.111
	Significance (2-tailed)	0.007	0.284	0.619	0.425	.	0.480	.	0.090	0.039	0.913	0.622	0.012	0.102	0.000	0.000	0.000	0.446	0.270	0.270
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Calcium, Total (mg/L)	Correlation Coefficient	-0.156	0.111	-0.321	-0.676*	.	-0.276	.	0.173	0.197	-0.126	-0.113	0.324*	-0.130	-0.332*	0.232*	-0.333*	-0.085	-0.344*	-0.344*
	Significance (2-tailed)	0.206	0.672	0.203	0.003	.	0.249	.	0.281	0.230	0.333	0.371	0.088	0.495	0.008	0.064	0.008	0.496	0.005	0.005
	N	36	13	13	13	13	13	13	24	24	36	36	17	17	35	35	35	35	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.717*	.	.	.	.	.	.	-0.385	.	-0.264	-0.189	0.148	0.222	-0.445	-0.222	-0.296	0.296	0.667*	0.667*
	Significance (2-tailed)	0.016	.	.	.	.	.	.	0.221	.	0.376	0.527	0.615	0.451	0.132	0.451	0.315	0.315	0.024	0.024
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	0.724*	-0.333	0.289	-0.093	.	-0.205	.	0.440*	0.338*	-0.010	0.104	0.191	-0.116	-0.215*	0.774*	-0.254*	-0.079	-0.067	-0.067
	Significance (2-tailed)	0.000	0.180	0.226	0.666	.	0.367	.	0.001	0.019	0.927	0.319	0.189	0.425	0.037	0.000	0.014	0.445	0.509	0.509
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	-0.033	-0.193	-0.414	-0.429*	.	-0.475*	.	0.162	0.394*	-0.139	-0.145	0.412*	-0.215	-0.559*	0.288*	-0.534*	-0.027	-0.258*	-0.258*
	Significance (2-tailed)	0.782	0.475	0.110	0.064	.	0.054	.	0.284	0.022	0.262	0.238	0.013	0.193	0.000	0.018	0.000	0.827	0.031	0.031
	N	44	13	13	13	13	13	13	32	24	44	44	25	25	43	43	43	43	44	44
Potassium, Total (mg/L)	Correlation Coefficient	0.671*	-0.263	0.173	-0.254	.	-0.182	.	0.336*	0.335*	0.100	0.226*	0.134	-0.345*	-0.226*	0.690*	-0.277*	-0.037	-0.079	-0.079
	Significance (2-tailed)	0.000	0.326	0.502	0.271	.	0.457	.	0.055	0.050	0.472	0.094	0.508	0.088	0.094	0.000	0.040	0.782	0.549	0.549
	N	36	13	13	13	13	13	13	24	24	36	36	17	17	35	35	35	35	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	0.500	.	.	.	.	.	.	0.504	.	-0.167	-0.222	0.218	0.000	-0.218	0.655*	-0.218	-0.436	-0.655*	-0.655*
	Significance (2-tailed)	0.131	.	.	.	.	.	.	0.153	.	0.615	0.502	0.505	1.000	0.505	0.046	0.505	0.182	0.046	0.046
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.724*	-0.329	0.235	-0.092	.	-0.203	.	0.376*	0.330*	-0.003	0.093	0.192	-0.137	-0.214*	0.718*	-0.230*	-0.056	-0.057	-0.057
	Significance (2-tailed)	0.000	0.181	0.320	0.668	.	0.369	.	0.005	0.033	0.975	0.392	0.188	0.348	0.047	0.000	0.032	0.600	0.591	0.591
	N	44	13	13	13	13	13	13	32	24	44	44	25	25	43	43	43	43	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	0.201*	-0.286	-0.055	-0.327	.	-0.236	.	0.290*	0.345*	-0.107	0.014	0.378*	-0.054	-0.362*	0.487*	-0.292*	0.046	-0.125	-0.125
	Significance (2-tailed)	0.058	0.269	0.825	0.143	.	0.318	.	0.025	0.020	0.334	0.899	0.012	0.721	0.001	0.000	0.006	0.669	0.238	0.238
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.592*	-0.327	0.167	-0.182	.	-0.259	.	0.308*	0.350*	-0.008	0.042	0.296*	-0.081	-0.300*	0.693*	-0.309*	-0.022	0.006	0.006
	Significance (2-tailed)	0.000	0.181	0.478	0.391	.	0.249	.	0.013	0.014	0.942	0.681	0.039	0.574	0.003	0.000	0.002	0.826	0.950	0.950
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	0.062	-0.120	0.000	0.526*	.	0.132	.	0.034	-0.125	0.057	0.333*	0.205	-0.105	-0.167	0.191	-0.254*	0.567*	0.101	0.101
	Significance (2-tailed)	0.594	0.671	1.000	0.030	.	0.608	.	0.811	0.439	0.638	0.005	0.213	0.522	0.153	0.101	0.029	0.000	0.383	0.383
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	-0.329	0.286	0.092	.	-0.130	.	0.257*	0.229	0.048	0.136	-0.014	-0.162	0.009	0.536*	-0.051	-0.120	-0.052	-0.052
	Significance (2-tailed)	.	0.181	0.227	0.668	.	0.563	.	0.040	0.106	0.650	0.185	0.925	0.261	0.927	0.000	0.614	0.236	0.606	0.606
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	-0.329	1.000	-0.213	-0.298	.	-0.147	.	.	-0.306	0.386	-0.276	-0.316	0.632	0.408	-0.334	0.408	-0.111	-0.261	-0.261
	Significance (2-tailed)	0.181	.	0.442	0.228	.	0.577	.	.	0.223	0.146	0.277	0.480	0.157	0.111	0.192	0.111	0.664	0.285	0.285
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Copper, Total (mg/L)	Correlation Coefficient	0.286	-0.213	1.000	0.237	.	0.300	.	.	-0.070	-0.217	0.511*	-0.632	-0.316	0.173	-0.019	0.288	0.250	0.033	0.033
	Significance (2-tailed)	0.227	0.442	.	0.319	.	0.235	.	.	0.773	0.395	0.036	0.157	0.480	0.482	0.938	0.241	0.310	0.887	0.887
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Iron, Total (mg/L)	Correlation Coefficient	0.092	-0.298	0.237	1.000	.	0.248	.	.	-0.216	-0.061	0.302	0.000	-0.400	0.154	-0.308	0.031	0.831*	0.546*	0.546*
	Significance (2-tailed)	0.668	0.228	0.319	.	.	0.274	.	.	0.319	0.788	0.169	1.000	0.327	0.491	0.168	0.890	0.000	0.010	0.010
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Lead, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Manganese, Total (mg/L)	Correlation Coefficient	-0.130	-0.147	0.300	0.248	.	1.000	.	.	-0.299	0.187	0.243	-0.120	-0.120	0.152	-0.254	0.186	0.254	0.431*	0.431*
	Significance (2-tailed)	0.563	0.577	0.235	0.274	.	.	.	.	0.193	0.441	0.296	0.782	0.782	0.516	0.279	0.428	0.279	0.054	0.054
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	5	5	12	12	12	12	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	0.257*	.	.	.	.	.	.	1.000	0.989*	0.079	-0.076	0.398*	-0.047	-0.317*	0.392*	-0.350*	-0.235*	-0.149	-0.149
	Significance (2-tailed)	0.040	.	.	.	.	.	.	.	0.000	0.535	0.553	0.022	0.787	0.011	0.002	0.005	0.057	0.229	0.229
	N	36	1	1	1	1	1	1	36	16	36	36	20	20	36	36	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.229	-0.306	-0.070	-0.216	.	-0.299	.	0.989*	1.000	0.041	-0.126	0.949*	0.105	-0.491*	0.276*	-0.459*	-0.200	-0.006	-0.006
	Significance (2-tailed)	0.106	0.223	0.773	0.319	.	0.193	.	0.000	.	0.791	0.390	0.023	0.801	0.001	0.055	0.001	0.166	0.968	0.968
	N	28	13	13	13	13	13	13	16	28	28	28	5	5	27	27	27	27	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	0.048	0.386	-0.217	-0.061	.	0.187	.	0.079	0.041	1.000	0.165	-0.138	-0.219	0.086	0.021	0.139	0.126	-0.154	-0.154
	Significance (2-tailed)	0.650	0.146	0.395	0.788	.	0.441	.	0.535	0.791	.	0.123	0.337	0.128	0.416	0.844	0.188	0.232	0.141	0.141
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	0.136	-0.276	0.511*	0.302	.	0.243	.	-0.076	-0.126	0.165	1.000	-0.345*	-0.257*	0.105	0.075	0.119	0.330*	-0.060	-0.060
	Significance (2-tailed)	0.185	0.277	0.036	0.169	.	0.296	.	0.553	0.390	0.123	.	0.017	0.075	0.310	0.466	0.249	0.001	0.555	0.555
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	-0.014	-0.316	-0.632	0.000	.	-0.120	.	0.398*	0.949*	-0.138	-0.345*	1.000	0.340*	-0.571*	0.120	-0.673*	0.020	0.224	0.224
	Significance (2-tailed)	0.925	0.480	0.157	1.000	.	0.782	.	0.022	0.023	0.337	0.017	.	0.017	0.000	0.400	0.000	0.889	0.118	0.118
	N	25	5	5	5	5	5	5	20	5	25	25	25	25	25	25	25	25	25	25
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.162	0.632	-0.316	-0.400	.	-0.120	.	-0.047	0.105	-0.219	-0.257*	0.340*	1.000	-0.003	-0.220	-0.013	-0.227	0.391*	0.391*
	Significance (2-tailed)	0.261	0.157	0.480	0.327	.	0.782	.	0.787	0.801	0.128	0.075	0.017	.	0.981	0.123	0.926	0.112	0.006	0.006
	N	25	5	5	5	5	5	5	20	5	25	25	25	25	25	25	25	25	25	25
pH, (s.u.)	Correlation Coefficient	0.009	0.408	0.173	0.154	.	0.152	.	-0.317*	-0.491*	0.086	0.105	-0.571*	-0.003	1.000	-0.243*	0.613*	-0.048	-0.028	-0.028
	Significance (2-tailed)	0.927	0.111	0.482	0.491	.	0.516	.	0.011	0.001	0.416	0.310	0.000	0.981	.	0.016	0.000	0.633	0.783	0.783
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	47	47
Specific Conductance (µS/cm)	Correlation Coefficient	0.536*	-0.334	-0.019	-0.308	.	-0.254	.	0.392*	0.276*	0.021	0.075	0.120	-0.220	-0.243*	1.000	-0.249*	0.006	-0.138	-0.138
	Significance (2-tailed)	0.000	0.192	0.938	0.168	.	0.279	.	0.002	0.055	0.844	0.466	0.400	0.123	0.016	.	0.014	0.949	0.172	0.172
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	47	47
Water Temperature (°C)	Correlation Coefficient	-0.051	0.408	0.288	0.031	.	0.186	.	-0.350*	-0.459*	0.139	0.119	-0.673*	-0.013	0.613*	-0.249*	1.000	-0.060	-0.049	-0.049
	Significance (2-tailed)	0.614	0.111	0.241	0.890	.	0.428	.	0.005	0.001	0.188	0.249	0.000	0.926	0.000	0.014	.	0.551	0.627	0.627
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	47	47
Turbidity (NTU)	Correlation Coefficient	-0.120	-0.111	0.250	0.831*	.	0.254	.	-0.235*	-0.200	0.126	0.330*	0.020	-0.227	-0.048	0.006	-0.060	1.000	0.135	0.135
	Significance (2-tailed)	0.236	0.664	0.310	0.000	.	0.279	.	0.057	0.166	0.232	0.001	0.889	0.112	0.633	0.949	0.551	.	0.183	0.183
	N	47	12	12	12	12	12	12	36	27	47	47	25	25	47	47	47	47	47	47
Flow (CFS)	Correlation Coefficient	-0.052	-0.261	0.033	0.546*	.	0.431*	.	-0.149	-0.006	-0.154	-0.060	0.224	0.391*	-0.028	-0.138	-0.049	0.135	1.000	1.000
	Significance (2-tailed)	0.606	0.285	0.887	0.010	.	0.054	.	0.229	0.968	0.141	0.555	0.118	0.006	0.783	0.172	0.627	0.183	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48
Flow (probability)	Correlation Coefficient	-0.052	-0.261	0.033	0.546*	.	0.431*	.	-0.149	-0.006	-0.154	-0.060	0.224	0.391*	-0.028	-0.138	-0.049	0.135	1.000	1.000
	Significance (2-tailed)	0.606	0.285	0.887	0.010	.	0.054	.	0.229	0.968	0.141	0.555	0.118	0.006	0.783	0.172	0.627	0.183	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	25	25	47	47	47	47	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-109: Kendall's tau correlation matrix of water quality parameters collected at Station 5 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.955*	0.116	0.213*	0.213*	0.242*	0.157	-0.032	.	0.222*	-0.079	-0.281	-0.057	0.125	0.088	-0.273*
	Significance (2-tailed)	.	0.000	0.276	0.048	0.048	0.053	0.607	0.770	.	0.061	0.586	0.397	0.619	0.251	0.409	0.014
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Year Quarter	Correlation Coefficient	0.955*	1.000	0.109	0.206*	0.201*	0.226*	0.157	-0.037	.	0.219*	-0.091	-0.281	-0.073	0.116	0.091	-0.265*
	Significance (2-tailed)	0.000	.	0.320	0.064	0.070	0.084	0.607	0.746	.	0.075	0.547	0.397	0.541	0.301	0.413	0.021
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Date	Correlation Coefficient	0.116	0.109	1.000	0.012	-0.013	0.062	-0.109	-0.001	.	0.058	0.082	-0.217	0.119	0.050	-0.053	-0.037
	Significance (2-tailed)	0.276	0.320	.	0.908	0.894	0.604	0.708	0.993	.	0.604	0.549	0.492	0.272	0.624	0.594	0.724
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.213*	0.206*	0.012	1.000	0.923*	0.791*	0.815*	0.340*	.	0.774*	0.566*	0.177	0.377*	0.728*	0.660*	-0.413*
	Significance (2-tailed)	0.048	0.064	0.908	.	0.000	0.000	0.006	0.001	.	0.000	0.000	0.580	0.001	0.000	0.000	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.213*	0.201*	-0.013	0.923*	1.000	0.796*	0.741*	0.363*	.	0.767*	0.556*	0.177	0.403*	0.697*	0.693*	-0.424*
	Significance (2-tailed)	0.048	0.070	0.894	0.000	.	0.000	0.012	0.001	.	0.000	0.000	0.580	0.000	0.000	0.000	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.242*	0.226*	0.062	0.791*	0.796*	1.000	.	0.373*	.	0.845*	0.529*	.	0.460*	0.746*	0.681*	-0.524*
	Significance (2-tailed)	0.053	0.084	0.604	0.000	0.000	.	.	0.002	.	0.000	0.000	.	0.000	0.000	0.000	0.000
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	0.157	0.157	-0.109	0.815*	0.741*	.	1.000	0.113	.	0.981*	.	0.309	0.196	0.847*	0.691*	-0.370
	Significance (2-tailed)	0.607	0.607	0.708	0.006	0.012	.	.	0.704	.	0.001	.	0.333	0.518	0.005	0.018	0.209
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	-0.032	-0.037	-0.001	0.340*	0.363*	0.373*	0.113	1.000	.	0.352*	0.553*	0.765*	0.839*	0.368*	0.479*	-0.365*
	Significance (2-tailed)	0.770	0.746	0.993	0.001	0.001	0.002	0.704	.	.	0.002	0.000	0.018	0.000	0.001	0.000	0.001
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.222*	0.219*	0.058	0.774*	0.767*	0.845*	0.981*	0.352*	.	1.000	0.579*	0.315	0.430*	0.753*	0.705*	-0.554*
	Significance (2-tailed)	0.061	0.075	0.604	0.000	0.000	0.000	0.001	0.002	.	.	0.000	0.330	0.000	0.000	0.000	0.000
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	-0.079	-0.091	0.082	0.566*	0.556*	0.529*	.	0.553*	.	0.579*	1.000	.	0.670*	0.572*	0.603*	-0.325*
	Significance (2-tailed)	0.586	0.547	0.549	0.000	0.000	0.000	.	0.000	.	0.000	.	.	0.000	0.000	0.000	0.022
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.281	-0.281	-0.217	0.177	0.177	.	0.309	0.765*	.	0.315	.	1.000	0.843*	0.413	0.477	-0.662*
	Significance (2-tailed)	0.397	0.397	0.492	0.580	0.580	.	0.333	0.018	.	0.330	.	.	0.011	0.205	0.131	0.038
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.057	-0.073	0.119	0.377*	0.403*	0.460*	0.196	0.839*	.	0.430*	0.670*	0.843*	1.000	0.430*	0.533*	-0.443*
	Significance (2-tailed)	0.619	0.541	0.272	0.001	0.000	0.000	0.518	0.000	.	0.000	0.000	0.011	.	0.000	0.000	0.000
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	0.125	0.116	0.050	0.728*	0.697*	0.746*	0.847*	0.368*	.	0.753*	0.572*	0.413	0.430*	1.000	0.719*	-0.337*
	Significance (2-tailed)	0.251	0.301	0.624	0.000	0.000	0.000	0.005	0.001	.	0.000	0.000	0.205	0.000	.	0.000	0.001
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.088	0.091	-0.053	0.660*	0.693*	0.681*	0.691*	0.479*	.	0.705*	0.603*	0.477	0.533*	0.719*	1.000	-0.348*
	Significance (2-tailed)	0.409	0.413	0.594	0.000	0.000	0.000	0.018	0.000	.	0.000	0.000	0.131	0.000	0.000	.	0.001
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.273*	-0.265*	-0.037	-0.413*	-0.424*	-0.524*	-0.370	-0.365*	.	-0.554*	-0.325*	-0.662*	-0.443*	-0.337*	-0.348*	1.000
	Significance (2-tailed)	0.014	0.021	0.724	0.000	0.000	0.000	0.209	0.001	.	0.000	0.022	0.038	0.000	0.001	0.001	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	-0.201*	-0.230*	0.008	0.022	0.032	-0.012	0.036	0.566*	.	0.022	0.310*	0.737*	0.613*	0.076	0.175*	-0.159
	Significance (2-tailed)	0.063	0.039	0.936	0.831	0.755	0.924	0.901	0.000	.	0.844	0.025	0.020	0.000	0.458	0.084	0.128
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	-0.285	-0.315	-0.260	-0.167	-0.265	-0.344	.	-0.049	.	-0.390	-0.184	.	-0.096	-0.048	-0.260	0.356
	Significance (2-tailed)	0.238	0.224	0.280	0.491	0.277	0.165	.	0.843	.	0.134	0.505	.	0.694	0.844	0.280	0.140
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.279	-0.274	-0.247	-0.671*	-0.597*	-0.609*	.	-0.207	.	-0.618*	-0.625*	.	-0.219	-0.361	-0.277	0.713*
	Significance (2-tailed)	0.225	0.265	0.281	0.004	0.010	0.010	.	0.377	.	0.012	0.017	.	0.344	0.120	0.226	0.002
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	-0.338	-0.316	-0.323	-0.693*	-0.605*	-0.551*	.	-0.133	.	-0.624*	-0.524*	.	-0.144	-0.316	-0.219	0.792*
	Significance (2-tailed)	0.111	0.163	0.126	0.001	0.005	0.011	.	0.537	.	0.006	0.029	.	0.500	0.140	0.299	0.000
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	0.000	-0.058	0.000	-0.637*	-0.677*	-0.582*	.	-0.506*	.	-0.515*	-0.436	.	-0.478*	-0.606*	-0.594*	0.492*
	Significance (2-tailed)	1.000	0.815	1.000	0.007	0.004	0.015	.	0.034	.	0.040	0.101	.	0.042	0.010	0.011	0.035
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	-0.198	-0.152	-0.182	-0.705*	-0.741*	-0.787*	.	-0.485*	.	-0.732*	-0.567*	.	-0.475*	-0.633*	-0.666*	0.731*
	Significance (2-tailed)	0.384	0.533	0.422	0.002	0.001	0.001	.	0.036	.	0.003	0.029	.	0.037	0.006	0.003	0.001
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	-0.071	-0.105	-0.071	-0.502*	-0.506*	-0.541*	.	-0.415*	.	-0.557*	-0.663*	.	-0.407*	-0.457*	-0.449*	0.547*
	Significance (2-tailed)	0.768	0.685	0.768	0.039	0.038	0.029	.	0.092	.	0.032	0.016	.	0.094	0.061	0.062	0.024
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.230*	-0.230*	-0.092	0.448*	0.453*	0.449*	0.473	0.261*	.	0.364*	0.451*	0.130	0.261*	0.405*	0.480*	-0.141
	Significance (2-tailed)	0.077	0.077	0.436	0.000	0.000	0.003	0.105	0.034	.	0.006	0.009	0.680	0.045	0.001	0.000	0.256
	N	36	36	36	36	36	24	8	36	0	32	24	8	32	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.250*	-0.238	-0.059	0.346*	0.415*	0.300*	.	0.446*	.	0.329*	0.439*	.	0.437*	0.428*	0.504*	-0.064
	Significance (2-tailed)	0.077	0.109	0.663	0.011	0.002	0.046	.	0.001	.	0.034	0.011	.	0.004	0.002	0.000	0.644
	N	28	28	28	28	28	24	0	28	0	24	24	0	24	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.203*	-0.186	-0.068	0.024	0.038	0.073	0.000	-0.083	.	-0.018	0.066	-0.177	-0.127	0.129	0.081	0.348*
	Significance (2-tailed)	0.067	0.104	0.512	0.822	0.719	0.553	1.000	0.442	.	0.875	0.645	0.580	0.255	0.224	0.434	0.001
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.424*	-0.417*	-0.163	-0.518*	-0.512*	-0.554*	-0.415	-0.217*	.	-0.560*	-0.390*	-0.225	-0.293*	-0.421*	-0.412*	0.601*
	Significance (2-tailed)	0.000	0.000	0.105	0.000	0.000	0.000	0.164	0.038	.	0.000	0.005	0.487	0.007	0.000	0.000	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.130	0.109	-0.120	0.465*	0.474*	0.460*	0.618*	0.189	.	0.527*	0.396*	0.043	0.213	0.581*	0.492*	-0.217
	Significance (2-tailed)	0.379	0.476	0.390	0.001	0.001	0.009	0.034	0.190	.	0.000	0.043	0.891	0.137	0.000	0.000	0.136
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	0.208	0.232	-0.425*	0.198	0.178	-0.033	0.148	-0.231	.	0.166	-0.017	-0.044	-0.229	0.074	0.087	0.036
	Significance (2-tailed)	0.162	0.129	0.002	0.163	0.208	0.849	0.615	0.109	.	0.268	0.930	0.890	0.110	0.609	0.537	0.804
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
pH, (s.u.)	Correlation Coefficient	0.135	0.147	-0.041	-0.184*	-0.212*	-0.160	-0.400	-0.111	.	-0.170	-0.216	0.130	-0.098	-0.221*	-0.193*	-0.083
	Significance (2-tailed)	0.207	0.182	0.683	0.068	0.035	0.180	0.170	0.287	.	0.127	0.115	0.680	0.365	0.030	0.055	0.426
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	0.117	0.117	-0.113	0.678*	0.669*	0.674*	0.691*	0.486*	.	0.659*	0.552*	0.217	0.468*	0.669*	0.702*	-0.414*
	Significance (2-tailed)	0.272	0.290	0.259	0.000	0.000	0.000	0.018	0.000	.	0.000	0.000	0.492	0.000	0.000	0.000	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Water Temperature (°C)	Correlation Coefficient	0.199*	0.195*	0.106	-0.389*	-0.424*	-0.411*	-0.618*	-0.354*	.	-0.433*	-0.461*	-0.043	-0.313*	-0.412*	-0.509*	0.099
	Significance (2-tailed)	0.062	0.077	0.290	0.000	0.000	0.001	0.034	0.001	.	0.000	0.001	0.891	0.004	0.000	0.000	0.338
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.272*	-0.257*	-0.068	-0.402*	-0.393*	-0.396*	-0.473	-0.358*	.	-0.481*	-0.379*	-0.564*	-0.380*	-0.297*	-0.283*	0.728*
	Significance (2-tailed)	0.011	0.020	0.494	0.000	0.000	0.001	0.105	0.001	.	0.000	0.006	0.074	0.000	0.004	0.005	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (CFS)	Correlation Coefficient	-0.088	-0.098	0.003	-0.181*	-0.184*	-0.232*	-0.182	-0.449*	.	-0.276*	-0.321*	-0.650*	-0.500*	-0.127	-0.210*	0.511*
	Significance (2-tailed)	0.409	0.372	0.979	0.072	0.067	0.051	0.533	0.000	.	0.013	0.019	0.039	0.000	0.212	0.037	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (probability)	Correlation Coefficient	-0.088	-0.098	0.003	-0.181*	-0.184*	-0.232*	-0.182	-0.449*	.	-0.276*	-0.321*	-0.650*	-0.500*	-0.127	-0.210*	0.511*
	Significance (2-tailed)	0.409	0.372	0.979	0.072	0.067	0.051	0.533	0.000	.	0.013	0.019	0.039	0.000	0.212	0.037	0.000
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-110: Kendall's tau correlation matrix of water quality parameters collected at Station 5 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	-0.201*	-0.285	-0.279	-0.338	0.000	-0.198	-0.071	-0.230*	-0.250*	-0.203*	-0.424*	0.130	0.208	0.135	0.117	0.199*	-0.272*	-0.088	-0.088
	Significance (2-tailed)	0.063	0.238	0.225	0.111	1.000	0.384	0.768	0.077	0.077	0.067	0.000	0.379	0.162	0.207	0.272	0.062	0.011	0.409	0.409
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Year Quarter	Correlation Coefficient	-0.230*	-0.315	-0.274	-0.316	-0.058	-0.152	-0.105	-0.230*	-0.238	-0.186	-0.417*	0.109	0.232	0.147	0.117	0.195*	-0.257*	-0.098	-0.098
	Significance (2-tailed)	0.039	0.224	0.265	0.163	0.815	0.533	0.685	0.077	0.109	0.104	0.000	0.476	0.129	0.182	0.290	0.077	0.020	0.372	0.372
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Date	Correlation Coefficient	0.008	-0.260	-0.247	-0.323	0.000	-0.182	-0.071	-0.092	-0.059	-0.068	-0.163	-0.120	-0.425*	-0.041	-0.113	0.106	-0.068	0.003	0.003
	Significance (2-tailed)	0.936	0.280	0.281	0.126	1.000	0.422	0.768	0.436	0.663	0.512	0.105	0.390	0.002	0.683	0.259	0.290	0.494	0.979	0.979
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.022	-0.167	-0.671*	-0.693*	-0.637*	-0.705*	-0.502*	0.448*	0.346*	0.024	-0.518*	0.465*	0.198	-0.184*	0.678*	-0.389*	-0.402*	-0.181*	-0.181*
	Significance (2-tailed)	0.831	0.491	0.004	0.001	0.007	0.002	0.039	0.000	0.011	0.822	0.000	0.001	0.163	0.068	0.000	0.000	0.000	0.072	0.072
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.032	-0.265	-0.597*	-0.605*	-0.677*	-0.741*	-0.506*	0.453*	0.415*	0.038	-0.512*	0.474*	0.178	-0.212*	0.669*	-0.424*	-0.393*	-0.184*	-0.184*
	Significance (2-tailed)	0.755	0.277	0.010	0.005	0.004	0.001	0.038	0.000	0.002	0.719	0.000	0.001	0.208	0.035	0.000	0.000	0.000	0.067	0.067
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	-0.012	-0.344	-0.609*	-0.551*	-0.582*	-0.787*	-0.541*	0.449*	0.300*	0.073	-0.554*	0.460*	-0.033	-0.160	0.674*	-0.411*	-0.396*	-0.232*	-0.232*
	Significance (2-tailed)	0.924	0.165	0.010	0.011	0.015	0.001	0.029	0.003	0.046	0.553	0.000	0.009	0.849	0.180	0.000	0.001	0.001	0.051	0.051
	N	36	13	13	13	13	13	13	24	24	36	36	18	18	36	36	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	0.036	.	.	.	.	.	.	0.473	.	0.000	-0.415	0.618*	0.148	-0.400	0.691*	-0.618*	-0.473	-0.182	-0.182
	Significance (2-tailed)	0.901	.	.	.	.	.	.	0.105	.	1.000	0.164	0.034	0.615	0.170	0.018	0.034	0.105	0.533	0.533
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	0.566*	-0.049	-0.207	-0.133	-0.506*	-0.485*	-0.415*	0.261*	0.446*	-0.083	-0.217*	0.189	-0.231	-0.111	0.486*	-0.354*	-0.358*	-0.449*	-0.449*
	Significance (2-tailed)	0.000	0.843	0.377	0.537	0.034	0.036	0.092	0.034	0.001	0.442	0.038	0.190	0.109	0.287	0.000	0.001	0.001	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.022	-0.390	-0.618*	-0.624*	-0.515*	-0.732*	-0.557*	0.364*	0.329*	-0.018	-0.560*	0.527*	0.166	-0.170	0.659*	-0.433*	-0.481*	-0.276*	-0.276*
	Significance (2-tailed)	0.844	0.134	0.012	0.006	0.040	0.003	0.032	0.006	0.034	0.875	0.000	0.000	0.268	0.127	0.000	0.000	0.000	0.013	0.013
	N	44	13	13	13	13	13	13	32	24	44	44	26	26	44	44	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	0.310*	-0.184	-0.625*	-0.524*	-0.436	-0.567*	-0.663*	0.451*	0.439*	0.066	-0.390*	0.396*	-0.017	-0.216	0.552*	-0.461*	-0.379*	-0.321*	-0.321*
	Significance (2-tailed)	0.025	0.505	0.017	0.029	0.101	0.029	0.016	0.009	0.011	0.645	0.005	0.043	0.930	0.115	0.000	0.001	0.006	0.019	0.019
	N	36	13	13	13	13	13	13	24	24	36	36	18	18	36	36	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	0.737*	.	.	.	.	.	.	0.130	.	-0.177	-0.225	0.043	-0.044	0.130	0.217	-0.043	-0.564*	-0.650*	-0.650*
	Significance (2-tailed)	0.020	.	.	.	.	.	.	0.680	.	0.580	0.487	0.891	0.890	0.680	0.492	0.891	0.074	0.039	0.039
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.613*	-0.096	-0.219	-0.144	-0.478*	-0.475*	-0.407*	0.261*	0.437*	-0.127	-0.293*	0.213	-0.229	-0.098	0.468*	-0.313*	-0.380*	-0.500*	-0.500*
	Significance (2-tailed)	0.000	0.694	0.344	0.500	0.042	0.037	0.094	0.045	0.004	0.255	0.007	0.137	0.110	0.365	0.000	0.004	0.000	0.000	0.000
	N	44	13	13	13	13	13	13	32	24	44	44	26	26	44	44	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	0.076	-0.048	-0.361	-0.316	-0.606*	-0.633*	-0.457*	0.405*	0.428*	0.129	-0.421*	0.581*	0.074	-0.221*	0.669*	-0.412*	-0.297*	-0.127	-0.127
	Significance (2-tailed)	0.458	0.844	0.120	0.140	0.010	0.006	0.061	0.001	0.002	0.224	0.000	0.000	0.609	0.030	0.000	0.000	0.004	0.212	0.212
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.175*	-0.260	-0.277	-0.219	-0.594*	-0.666*	-0.449*	0.480*	0.504*	0.081	-0.412*	0.492*	0.087	-0.193*	0.702*	-0.509*	-0.283*	-0.210*	-0.210*
	Significance (2-tailed)	0.084	0.280	0.226	0.299	0.011	0.003	0.062	0.000	0.000	0.434	0.000	0.000	0.537	0.055	0.000	0.000	0.005	0.037	0.037
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.159	0.356	0.713*	0.792*	0.492*	0.731*	0.547*	-0.141	-0.064	0.348*	0.601*	-0.217	0.036	-0.083	-0.414*	0.099	0.728*	0.511*	0.511*
	Significance (2-tailed)	0.128	0.140	0.002	0.000	0.035	0.001	0.024	0.256	0.644	0.001	0.000	0.136	0.804	0.426	0.000	0.338	0.000	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	0.120	-0.109	-0.013	-0.372	-0.353	-0.263	-0.090	0.149	-0.150	-0.102	0.025	-0.234*	0.028	0.117	-0.088	-0.180*	-0.417*	-0.417*
	Significance (2-tailed)	.	0.622	0.636	0.951	0.113	0.123	0.279	0.452	0.275	0.153	0.314	0.860	0.097	0.783	0.247	0.383	0.075	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	0.120	1.000	0.142	0.166	0.161	0.390	0.391	.	0.144	0.259	0.354	.	.	-0.260	-0.024	-0.118	0.383	0.165	0.165
	Significance (2-tailed)	0.622	.	0.591	0.491	0.548	0.134	0.159	.	0.555	0.311	0.141	.	.	0.280	0.922	0.623	0.115	0.492	0.492
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.109	0.142	1.000	0.837*	0.504*	0.600*	0.653*	.	-0.094	0.169	0.740*	-0.346	0.577	-0.092	-0.401*	0.216	0.718*	0.616*	0.616*
	Significance (2-tailed)	0.636	0.591	.	0.000	0.048	0.015	0.013	.	0.685	0.487	0.001	0.380	0.143	0.686	0.080	0.346	0.002	0.007	0.007
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	-0.013	0.166	0.837*	1.000	0.457*	0.579*	0.547*	.	-0.065	0.170	0.813*	-0.138	0.552	-0.116	-0.323	0.090	0.797*	0.529*	0.529*
	Significance (2-tailed)	0.951	0.491	0.000	.	0.050	0.011	0.024	.	0.759	0.447	0.000	0.702	0.126	0.582	0.126	0.669	0.000	0.012	0.012
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	-0.372	0.161	0.504*	0.457*	1.000	0.680*	0.676*	.	-0.389*	0.153	0.489*	-0.577	0.346	0.105	-0.594*	0.489*	0.425*	0.349	0.349
	Significance (2-tailed)	0.113	0.548	0.048	0.050	.	0.007	0.012	.	0.097	0.535	0.035	0.143	0.380	0.652	0.011	0.035	0.070	0.132	0.132
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	-0.353	0.390	0.600*	0.579*	0.680*	1.000	0.585*	.	-0.276	0.066	0.726*	-0.602	0.775*	0.000	-0.605*	0.363	0.659*	0.454*	0.454*
	Significance (2-tailed)	0.123	0.134	0.015	0.011	0.007	.	0.025	.	0.227	0.782	0.001	0.114	0.042	1.000	0.007	0.108	0.004	0.045	0.045
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	-0.263	0.391	0.653*	0.547*	0.676*	0.585*	1.000	.	-0.191	0.129	0.543*	.	.	-0.071	-0.449*	0.260	0.550*	0.496*	0.496*
	Significance (2-tailed)	0.279	0.159	0.013	0.024	0.012	0.025	.	.	0.431	0.613	0.024	.	.	0.768	0.062	0.280	0.023	0.039	0.039
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.090	.	.	.	.	.	.	1.000	0.987*	0.367*	-0.070	0.628*	-0.016	-0.537*	0.501*	-0.743*	-0.026	0.026	0.026
	Significance (2-tailed)	0.452	.	.	.	.	.	.	.	0.000	0.003	0.557	0.000	0.922	0.000	0.000	0.000	0.827	0.827	0.827
	N	36	1	1	1	1	1	1	36	16	36	36	20	20	36	36	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.149	0.144	-0.094	-0.065	-0.389*	-0.276	-0.191	0.987*	1.000	0.262*	-0.049	0.867*	-0.733*	-0.597*	0.457*	-0.753*	0.030	-0.022	-0.022
	Significance (2-tailed)	0.275	0.555	0.685	0.759	0.097	0.227	0.431	0.000	.	0.066	0.721	0.015	0.039	0.000	0.001	0.000	0.827	0.874	0.874
	N	28	13	13	13	13	13	13	16	28	28	28	6	6	28	28	28	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.150	0.259	0.169	0.170	0.153	0.066	0.129	0.367*	0.262*	1.000	0.327*	0.254*	0.029	-0.285*	0.032	-0.292*	0.321*	0.390*	0.390*
	Significance (2-tailed)	0.153	0.311	0.487	0.447	0.535	0.782	0.613	0.003	0.066	.	0.002	0.076	0.842	0.006	0.760	0.005	0.002	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.102	0.354	0.740*	0.813*	0.489*	0.726*	0.543*	-0.070	-0.049	0.327*	1.000	-0.284*	-0.156	-0.079	-0.368*	0.069	0.587*	0.396*	0.396*
	Significance (2-tailed)	0.314	0.141	0.001	0.000	0.035	0.001	0.024	0.557	0.721	0.002	.	0.044	0.269	0.434	0.000	0.493	0.000	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.025	.	-0.346	-0.138	-0.577	-0.602	.	0.628*	0.867*	0.254*	-0.284*	1.000	0.277*	-0.388*	0.397*	-0.711*	-0.194	0.160	0.160
	Significance (2-tailed)	0.860	.	0.380	0.702	0.143	0.114	.	0.000	0.015	0.076	0.044	.	0.047	0.005	0.004	0.000	0.165	0.252	0.252
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.234*	.	0.577	0.552	0.346	0.775*	.	-0.016	-0.733*	0.029	-0.156	0.277*	1.000	0.127	-0.006	0.012	-0.136	0.151	0.151
	Significance (2-tailed)	0.097	.	0.143	0.126	0.380	0.042	.	0.922	0.039	0.842	0.269	0.047	.	0.366	0.965	0.930	0.332	0.280	0.280
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
pH, (s.u.)	Correlation Coefficient	0.028	-0.260	-0.092	-0.116	0.105	0.000	-0.071	-0.537*	-0.597*	-0.285*	-0.079	-0.388*	0.127	1.000	-0.172*	0.526*	-0.200*	-0.245*	-0.245*
	Significance (2-tailed)	0.783	0.280	0.686	0.582	0.652	1.000	0.768	0.000	0.000	0.006	0.434	0.005	0.366	.	0.086	0.000	0.045	0.014	0.014
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	0.117	-0.024	-0.401*	-0.323	-0.594*	-0.605*	-0.449*	0.501*	0.457*	0.032	-0.368*	0.397*	-0.006	-0.172*	1.000	-0.472*	-0.366*	-0.291*	-0.291*
	Significance (2-tailed)	0.247	0.922	0.080	0.126	0.011	0.007	0.062	0.000	0.001	0.760	0.000	0.004	0.965	0.086	.	0.000	0.000	0.004	0.004
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Water Temperature (°C)	Correlation Coefficient	-0.088	-0.118	0.216	0.090	0.489*	0.363	0.260	-0.743*	-0.753*	-0.292*	0.069	-0.711*	0.012	0.526*	-0.472*	1.000	0.000	-0.028	-0.028
	Significance (2-tailed)	0.383	0.623	0.346	0.669	0.035	0.108	0.280	0.000	0.000	0.005	0.493	0.000	0.930	0.000	0.000	.	1.000	0.776	0.776
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.180*	0.383	0.718*	0.797*	0.425*	0.659*	0.550*	-0.026	0.030	0.321*	0.587*	-0.194	-0.136	-0.200*	-0.366*	0.000	1.000	0.535*	0.535*
	Significance (2-tailed)	0.075	0.115	0.002	0.000	0.070	0.004	0.023	0.827	0.827	0.002	0.000	0.165	0.332	0.045	0.000	1.000	.	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Flow (CFS)	Correlation Coefficient	-0.417*	0.165	0.616*	0.529*	0.349	0.454*	0.496*	0.026	-0.022	0.390*	0.396*	0.160	0.151	-0.245*	-0.291*	-0.028	0.535*	1.000	1.000
	Significance (2-tailed)	0.000	0.492	0.007	0.012	0.132	0.045	0.039	0.827	0.874	0.000	0.000	0.252	0.280	0.014	0.004	0.776	0.000	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Flow (probability)	Correlation Coefficient	-0.417*	0.165	0.616*	0.529*	0.349	0.454*	0.496*	0.026	-0.022	0.390*	0.396*	0.160	0.151	-0.245*	-0.291*	-0.028	0.535*	1.000	1.000
	Significance (2-tailed)	0.000	0.492	0.007	0.012	0.132	0.045	0.039	0.827	0.874	0.000	0.000	0.252	0.280	0.014	0.004	0.776	0.000	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-111: Kendall's tau correlation matrix of water quality parameters collected at Station 6 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.955*	0.116	-0.408*	-0.415*	-0.447*	-0.408	-0.350*	.	-0.415*	-0.499*	-0.236	-0.331*	-0.389*	-0.512*	.
	Significance (2-tailed)	.	0.000	0.276	0.000	0.000	0.000	0.192	0.002	.	0.001	0.001	0.495	0.004	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Year Quarter	Correlation Coefficient	0.955*	1.000	0.109	-0.415*	-0.419*	-0.459*	-0.408	-0.361*	.	-0.424*	-0.529*	-0.236	-0.340*	-0.402*	-0.509*	.
	Significance (2-tailed)	0.000	.	0.320	0.000	0.000	0.000	0.192	0.002	.	0.001	0.001	0.495	0.005	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Date	Correlation Coefficient	0.116	0.109	1.000	0.115	0.088	-0.041	-0.038	-0.013	.	0.081	-0.150	-0.109	0.128	0.014	-0.062	.
	Significance (2-tailed)	0.276	0.320	.	0.255	0.379	0.732	0.899	0.899	.	0.474	0.283	0.739	0.240	0.893	0.539	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	-0.408*	-0.415*	0.115	1.000	0.940*	0.700*	0.643*	0.582*	.	0.705*	0.500*	0.436	0.641*	0.750*	0.606*	.
	Significance (2-tailed)	0.000	0.000	0.255	.	0.000	0.000	0.031	0.000	.	0.000	0.000	0.182	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	-0.415*	-0.419*	0.088	0.940*	1.000	0.716*	0.654*	0.587*	.	0.712*	0.509*	0.444	0.636*	0.754*	0.575*	.
	Significance (2-tailed)	0.000	0.000	0.379	0.000	.	0.000	0.030	0.000	.	0.000	0.000	0.180	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	-0.447*	-0.459*	-0.041	0.700*	0.716*	1.000	.	0.630*	.	0.797*	0.424*	.	0.719*	0.660*	0.639*	.
	Significance (2-tailed)	0.000	0.000	0.732	0.000	0.000	.	.	0.000	.	0.000	0.003	.	0.000	0.000	0.000	.
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.408	-0.408	-0.038	0.643*	0.654*	.	1.000	0.417	.	0.642*	.	0.693*	0.524	0.667*	0.643*	.
	Significance (2-tailed)	0.192	0.192	0.899	0.031	0.030	.	.	0.186	.	0.050	.	0.042	0.101	0.029	0.031	.
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	-0.350*	-0.361*	-0.013	0.582*	0.587*	0.630*	0.417	1.000	.	0.592*	0.495*	0.662*	0.799*	0.668*	0.540*	.
	Significance (2-tailed)	0.002	0.002	0.899	0.000	0.000	0.000	0.186	.	.	0.000	0.001	0.057	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	-0.415*	-0.424*	0.081	0.705*	0.712*	0.797*	0.642*	0.592*	.	1.000	0.473*	0.596	0.714*	0.733*	0.612*	.
	Significance (2-tailed)	0.001	0.001	0.474	0.000	0.000	0.000	0.050	0.000	.	.	0.002	0.100	0.000	0.000	0.000	.
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	-0.499*	-0.529*	-0.150	0.500*	0.509*	0.424*	.	0.495*	.	0.473*	1.000	.	0.484*	0.562*	0.513*	.
	Significance (2-tailed)	0.001	0.001	0.283	0.000	0.000	0.003	.	0.001	.	0.002	.	.	0.001	0.000	0.000	.
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.236	-0.236	-0.109	0.436	0.444	.	0.693*	0.662*	.	0.596	.	1.000	0.756*	0.623*	0.655*	.
	Significance (2-tailed)	0.495	0.495	0.739	0.182	0.180	.	0.042	0.057	.	0.100	.	.	0.032	0.064	0.046	.
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.331*	-0.340*	0.128	0.641*	0.636*	0.719*	0.524	0.799*	.	0.714*	0.484*	0.756*	1.000	0.653*	0.521*	.
	Significance (2-tailed)	0.004	0.005	0.240	0.000	0.000	0.000	0.101	0.000	.	0.000	0.001	0.032	.	0.000	0.000	.
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	-0.389*	-0.402*	0.014	0.750*	0.754*	0.660*	0.667*	0.668*	.	0.733*	0.562*	0.623*	0.653*	1.000	0.629*	.
	Significance (2-tailed)	0.000	0.000	0.893	0.000	0.000	0.000	0.029	0.000	.	0.000	0.000	0.064	0.000	.	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	-0.512*	-0.509*	-0.062	0.606*	0.575*	0.639*	0.643*	0.540*	.	0.612*	0.513*	0.655*	0.521*	0.629*	1.000	.
	Significance (2-tailed)	0.000	0.000	0.539	0.000	0.000	0.000	0.031	0.000	.	0.000	0.000	0.046	0.000	0.000	.	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	-0.077	-0.082	0.020	0.265*	0.267*	0.394*	-0.292	0.536*	.	0.279*	0.132	-0.181	0.461*	0.275*	0.189*	.
	Significance (2-tailed)	0.487	0.475	0.844	0.011	0.011	0.001	0.355	0.000	.	0.018	0.361	0.604	0.000	0.010	0.071	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	-0.296	-0.327	-0.261	0.131	0.000	0.134	.	0.000	.	0.139	-0.267	.	0.000	0.068	0.132	.
	Significance (2-tailed)	0.228	0.215	0.285	0.593	1.000	0.591	.	1.000	.	0.587	0.355	.	1.000	0.787	0.592	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	0.107	0.219	0.151	-0.393*	-0.381*	-0.497*	.	-0.257	.	-0.386	-0.186	.	-0.301	-0.299	-0.261	.
	Significance (2-tailed)	0.644	0.376	0.510	0.087	0.099	0.034	.	0.284	.	0.108	0.492	.	0.205	0.206	0.262	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	0.427*	0.560*	0.411*	-0.517*	-0.507*	-0.558*	.	-0.338	.	-0.676*	-0.433*	.	-0.472*	-0.510*	-0.470*	.
	Significance (2-tailed)	0.048	0.015	0.056	0.016	0.019	0.011	.	0.132	.	0.003	0.084	.	0.033	0.021	0.030	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	0.099	0.044	0.099	-0.059	-0.079	-0.121	.	0.084	.	-0.231	0.161	.	-0.021	0.000	-0.020	.
	Significance (2-tailed)	0.676	0.863	0.677	0.802	0.738	0.615	.	0.734	.	0.351	0.562	.	0.933	1.000	0.933	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	0.269	0.266	0.239	-0.407*	-0.382*	-0.389*	.	-0.314	.	-0.508*	-0.383	.	-0.442*	-0.512*	-0.498*	.
	Significance (2-tailed)	0.229	0.266	0.283	0.067	0.087	0.086	.	0.177	.	0.029	0.141	.	0.054	0.025	0.026	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.107	-0.107	-0.055	-0.235*	-0.223*	-0.375*	-0.462	-0.363*	.	-0.396*	-0.198	-0.611*	-0.483*	-0.323*	-0.249*	.
	Significance (2-tailed)	0.412	0.412	0.642	0.050	0.063	0.015	0.126	0.004	.	0.004	0.265	0.065	0.000	0.008	0.037	.
	N	36	36	36	36	36	24	8	36	0	32	24	8	32	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.037	-0.049	0.145	-0.078	-0.086	-0.114	.	-0.192	.	-0.096	-0.180	.	-0.150	-0.132	-0.114	.
	Significance (2-tailed)	0.794	0.743	0.285	0.565	0.526	0.453	.	0.178	.	0.542	0.309	.	0.336	0.340	0.405	.
	N	28	28	28	28	28	24	0	28	0	24	24	0	24	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	0.097	0.096	-0.076	-0.189*	-0.175*	-0.297*	-0.360	-0.429*	.	-0.265*	-0.254*	-0.462	-0.391*	-0.222*	-0.228*	.
	Significance (2-tailed)	0.387	0.406	0.465	0.074	0.097	0.018	0.244	0.000	.	0.025	0.084	0.175	0.001	0.039	0.031	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	0.311*	0.345*	-0.042	-0.516*	-0.505*	-0.502*	-0.869*	-0.377*	.	-0.527*	-0.363*	-0.655*	-0.432*	-0.472*	-0.548*	.
	Significance (2-tailed)	0.004	0.002	0.675	0.000	0.000	0.000	0.004	0.000	.	0.000	0.011	0.046	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	-0.231	-0.285*	-0.077	0.430*	0.424*	0.548*	0.416	0.168	.	0.433*	0.301	0.327	0.261*	0.400*	0.378*	.
	Significance (2-tailed)	0.120	0.063	0.582	0.002	0.003	0.002	0.164	0.254	.	0.004	0.139	0.317	0.073	0.005	0.007	.
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.104	-0.151	-0.095	0.424*	0.406*	0.466*	0.643*	0.187	.	0.440*	0.181	0.655*	0.281*	0.431*	0.372*	.
	Significance (2-tailed)	0.485	0.323	0.494	0.003	0.004	0.008	0.031	0.202	.	0.003	0.374	0.046	0.054	0.003	0.008	.
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
pH, (s.u.)	Correlation Coefficient	-0.072	-0.062	-0.222*	0.230*	0.208*	0.341*	0.189	0.283*	.	0.298*	0.206	0.546*	0.313*	0.252*	0.312*	.
	Significance (2-tailed)	0.502	0.574	0.027	0.023	0.039	0.005	0.527	0.008	.	0.009	0.144	0.096	0.004	0.014	0.002	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	-0.420*	-0.425*	-0.110	0.593*	0.592*	0.664*	0.340	0.762*	.	0.669*	0.498*	0.546*	0.667*	0.686*	0.605*	.
	Significance (2-tailed)	0.000	0.000	0.270	0.000	0.000	0.000	0.254	0.000	.	0.000	0.000	0.096	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Water Temperature (°C)	Correlation Coefficient	0.503*	0.501*	0.150	-0.435*	-0.454*	-0.590*	-0.265	-0.320*	.	-0.510*	-0.331*	-0.218	-0.324*	-0.391*	-0.489*	.
	Significance (2-tailed)	0.000	0.000	0.133	0.000	0.000	0.000	0.375	0.003	.	0.000	0.018	0.505	0.003	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Turbidity (NTU)	Correlation Coefficient	0.579*	0.633*	0.086	-0.465*	-0.456*	-0.536*	-0.643*	-0.322*	.	-0.503*	-0.359*	-0.655*	-0.363*	-0.405*	-0.471*	.
	Significance (2-tailed)	0.000	0.000	0.388	0.000	0.000	0.000	0.031	0.003	.	0.000	0.011	0.046	0.001	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (CFS)	Correlation Coefficient	-0.143	-0.154	-0.078	-0.034	-0.042	-0.041	0.113	-0.215*	.	-0.062	0.136	0.000	-0.166	-0.012	0.131	.
	Significance (2-tailed)	0.180	0.162	0.434	0.735	0.676	0.732	0.704	0.043	.	0.582	0.330	1.000	0.128	0.908	0.191	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (probability)	Correlation Coefficient	-0.143	-0.154	-0.078	-0.034	-0.042	-0.041	0.113	-0.215*	.	-0.062	0.136	0.000	-0.166	-0.012	0.131	.
	Significance (2-tailed)	0.180	0.162	0.434	0.735	0.676	0.732	0.704	0.043	.	0.582	0.330	1.000	0.128	0.908	0.191	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-112: Kendall's tau correlation matrix of water quality parameters collected at Station 6 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	-0.077	-0.296	0.107	0.427*	0.099	0.269	.	-0.107	-0.037	0.097	0.311*	-0.231	-0.104	-0.072	-0.420*	0.503*	0.579*	-0.143	-0.143
	Significance (2-tailed)	0.487	0.228	0.644	0.048	0.676	0.229	.	0.412	0.794	0.387	0.004	0.120	0.485	0.502	0.000	0.000	0.000	0.180	0.180
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Year Quarter	Correlation Coefficient	-0.082	-0.327	0.219	0.560*	0.044	0.266	.	-0.107	-0.049	0.096	0.345*	-0.285*	-0.151	-0.062	-0.425*	0.501*	0.633*	-0.154	-0.154
	Significance (2-tailed)	0.475	0.215	0.376	0.015	0.863	0.266	.	0.412	0.743	0.406	0.002	0.063	0.323	0.574	0.000	0.000	0.000	0.162	0.162
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Date	Correlation Coefficient	0.020	-0.261	0.151	0.411*	0.099	0.239	.	-0.055	0.145	-0.076	-0.042	-0.077	-0.095	-0.222*	-0.110	0.150	0.086	-0.078	-0.078
	Significance (2-tailed)	0.844	0.285	0.510	0.056	0.677	0.283	.	0.642	0.285	0.465	0.675	0.582	0.494	0.027	0.270	0.133	0.388	0.434	0.434
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.265*	0.131	-0.393*	-0.517*	-0.059	-0.407*	.	-0.235*	-0.078	-0.189*	-0.516*	0.430*	0.424*	0.230*	0.593*	-0.435*	-0.465*	-0.034	-0.034
	Significance (2-tailed)	0.011	0.593	0.087	0.016	0.802	0.067	.	0.050	0.565	0.074	0.000	0.002	0.003	0.023	0.000	0.000	0.000	0.735	0.735
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.267*	0.000	-0.381*	-0.507*	-0.079	-0.382*	.	-0.223*	-0.086	-0.175*	-0.505*	0.424*	0.406*	0.208*	0.592*	-0.454*	-0.456*	-0.042	-0.042
	Significance (2-tailed)	0.011	1.000	0.099	0.019	0.738	0.087	.	0.063	0.526	0.097	0.000	0.003	0.004	0.039	0.000	0.000	0.000	0.676	0.676
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.394*	0.134	-0.497*	-0.558*	-0.121	-0.389*	.	-0.375*	-0.114	-0.297*	-0.502*	0.548*	0.466*	0.341*	0.664*	-0.590*	-0.536*	-0.041	-0.041
	Significance (2-tailed)	0.001	0.591	0.034	0.011	0.615	0.086	.	0.015	0.453	0.018	0.000	0.002	0.008	0.005	0.000	0.000	0.000	0.732	0.732
	N	36	13	13	13	13	13	13	24	24	36	36	18	18	36	36	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.292	.	.	.	.	.	.	-0.462	.	-0.360	-0.869*	0.416	0.643*	0.189	0.340	-0.265	-0.643*	0.113	0.113
	Significance (2-tailed)	0.355	.	.	.	.	.	.	0.126	.	0.244	0.004	0.164	0.031	0.527	0.254	0.375	0.031	0.704	0.704
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	0.536*	0.000	-0.257	-0.338	0.084	-0.314	.	-0.363*	-0.192	-0.429*	-0.377*	0.168	0.187	0.283*	0.762*	-0.320*	-0.322*	-0.215*	-0.215*
	Significance (2-tailed)	0.000	1.000	0.284	0.132	0.734	0.177	.	0.004	0.178	0.000	0.000	0.254	0.202	0.008	0.000	0.003	0.003	0.043	0.043
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.279*	0.139	-0.386	-0.676*	-0.231	-0.508*	.	-0.396*	-0.096	-0.265*	-0.527*	0.433*	0.440*	0.298*	0.669*	-0.510*	-0.503*	-0.062	-0.062
	Significance (2-tailed)	0.018	0.587	0.108	0.003	0.351	0.029	.	0.004	0.542	0.025	0.000	0.004	0.003	0.009	0.000	0.000	0.000	0.582	0.582
	N	44	13	13	13	13	13	13	32	24	44	44	26	26	44	44	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	0.132	-0.267	-0.186	-0.433*	0.161	-0.383	.	-0.198	-0.180	-0.254*	-0.363*	0.301	0.181	0.206	0.498*	-0.331*	-0.359*	0.136	0.136
	Significance (2-tailed)	0.361	0.355	0.492	0.084	0.562	0.141	.	0.265	0.309	0.084	0.011	0.139	0.374	0.144	0.000	0.018	0.011	0.330	0.330
	N	36	13	13	13	13	13	13	24	24	36	36	18	18	36	36	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.181	.	.	.	.	.	.	-0.611*	.	-0.462	-0.655*	0.327	0.655*	0.546*	0.546*	-0.218	-0.655*	0.000	0.000
	Significance (2-tailed)	0.604	.	.	.	.	.	.	0.065	.	0.175	0.046	0.317	0.046	0.096	0.096	0.505	0.046	1.000	1.000
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.461*	0.000	-0.301	-0.472*	-0.021	-0.442*	.	-0.483*	-0.150	-0.391*	-0.432*	0.261*	0.281*	0.313*	0.667*	-0.324*	-0.363*	-0.166	-0.166
	Significance (2-tailed)	0.000	1.000	0.205	0.033	0.933	0.054	.	0.000	0.336	0.001	0.000	0.073	0.054	0.004	0.000	0.003	0.001	0.128	0.128
	N	44	13	13	13	13	13	13	32	24	44	44	26	26	44	44	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	0.275*	0.068	-0.299	-0.510*	0.000	-0.512*	.	-0.323*	-0.132	-0.222*	-0.472*	0.400*	0.431*	0.252*	0.686*	-0.391*	-0.405*	-0.012	-0.012
	Significance (2-tailed)	0.010	0.787	0.206	0.021	1.000	0.025	.	0.008	0.340	0.039	0.000	0.005	0.003	0.014	0.000	0.000	0.000	0.908	0.908
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.189*	0.132	-0.261	-0.470*	-0.020	-0.498*	.	-0.249*	-0.114	-0.228*	-0.548*	0.378*	0.372*	0.312*	0.605*	-0.489*	-0.471*	0.131	0.131
	Significance (2-tailed)	0.071	0.592	0.262	0.030	0.933	0.026	.	0.037	0.405	0.031	0.000	0.007	0.008	0.002	0.000	0.000	0.000	0.191	0.191
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	0.138	-0.575*	-0.532*	-0.270	-0.237	.	-0.299*	-0.230	-0.476*	-0.077	-0.019	-0.032	0.231*	0.408*	-0.144	-0.153	-0.415*	-0.415*
	Significance (2-tailed)	.	0.587	0.016	0.017	0.270	0.303	.	0.016	0.101	0.000	0.466	0.894	0.824	0.027	0.000	0.164	0.144	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	0.138	1.000	-0.116	-0.338	-0.151	0.036	.	.	0.267	-0.198	-0.033	.	.	-0.034	0.131	-0.261	-0.298	0.131	0.131
	Significance (2-tailed)	0.587	.	0.668	0.178	0.588	0.891	.	.	0.283	0.468	0.893	.	.	0.892	0.593	0.285	0.228	0.593	0.593
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.575*	-0.116	1.000	0.516*	0.302	0.265	.	.	-0.123	0.239	0.463*	-0.430	-0.430	-0.142	-0.363	0.363	0.475*	0.333	0.333
	Significance (2-tailed)	0.016	0.668	.	0.028	0.245	0.277	.	.	0.597	0.351	0.047	0.275	0.275	0.548	0.114	0.114	0.041	0.147	0.147
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	-0.532*	-0.338	0.516*	1.000	0.346	0.508*	.	.	-0.243	0.370	0.568*	-0.276	-0.276	-0.262	-0.490*	0.649*	0.940*	0.013	0.013
	Significance (2-tailed)	0.017	0.178	0.028	.	0.152	0.026	.	.	0.264	0.121	0.009	0.444	0.444	0.234	0.023	0.003	0.000	0.951	0.951
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	-0.270	-0.151	0.302	0.346	1.000	0.194	.	.	-0.442*	0.096	0.121	-0.577	-0.577	-0.185	-0.138	0.335	0.300	0.374	0.374
	Significance (2-tailed)	0.270	0.588	0.245	0.152	.	0.439	.	.	0.065	0.717	0.615	0.143	0.143	0.446	0.559	0.156	0.209	0.113	0.113
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	-0.237	0.036	0.265	0.508*	0.194	1.000	.	.	-0.344	0.068	0.559*	-0.414	-0.414	-0.117	-0.351	0.492*	0.498*	-0.098	-0.098
	Significance (2-tailed)	0.303	0.891	0.277	0.026	0.439	.	.	.	0.127	0.783	0.013	0.251	0.251	0.608	0.114	0.027	0.026	0.658	0.658
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.299*	.	.	.	.	.	.	1.000	0.974*	0.507*	0.277*	0.032	-0.118	-0.315*	-0.318*	-0.008	0.016	0.126	0.126
	Significance (2-tailed)	0.016	.	.	.	.	.	.	.	0.000	0.000	0.021	0.845	0.473	0.008	0.007	0.946	0.891	0.286	0.286
	N	36	1	1	1	1	1	1	36	16	36	36	20	20	36	36	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.230	0.267	-0.123	-0.243	-0.442*	-0.344	.	0.974*	1.000	0.541*	0.247*	0.552	0.552	-0.378*	-0.113	-0.129	-0.033	0.065	0.065
	Significance (2-tailed)	0.101	0.283	0.597	0.264	0.065	0.127	.	0.000	.	0.000	0.073	0.126	0.126	0.006	0.405	0.342	0.812	0.635	0.635
	N	28	13	13	13	13	13	13	16	28	28	28	6	6	28	28	28	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.476*	-0.198	0.239	0.370	0.096	0.068	.	0.507*	0.541*	1.000	0.228*	0.102	0.153	-0.166	-0.328*	-0.002	0.159	0.318*	0.318*
	Significance (2-tailed)	0.000	0.468	0.351	0.121	0.717	0.783	.	0.000	0.000	.	0.032	0.477	0.287	0.114	0.002	0.986	0.129	0.002	0.002
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.077	-0.033	0.463*	0.568*	0.121	0.559*	.	0.277*	0.247*	0.228*	1.000	-0.271*	-0.277*	-0.243*	-0.406*	0.311*	0.487*	-0.138	-0.138
	Significance (2-tailed)	0.466	0.893	0.047	0.009	0.615	0.013	.	0.021	0.073	0.032	.	0.055	0.049	0.017	0.000	0.002	0.000	0.173	0.173
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	-0.019	.	-0.430	-0.276	-0.577	-0.414	.	0.032	0.552	0.102	-0.271*	1.000	0.846*	0.320*	0.218	-0.729*	-0.401*	0.126	0.126
	Significance (2-tailed)	0.894	.	0.275	0.444	0.143	0.251	.	0.845	0.126	0.477	0.055	.	0.000	0.022	0.118	0.000	0.004	0.366	0.366
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.032	.	-0.430	-0.276	-0.577	-0.414	.	-0.118	0.552	0.153	-0.277*	0.846*	1.000	0.376*	0.237*	-0.575*	-0.357*	0.132	0.132
	Significance (2-tailed)	0.824	.	0.275	0.444	0.143	0.251	.	0.473	0.126	0.287	0.049	0.000	.	0.007	0.090	0.000	0.011	0.343	0.343
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
pH, (s.u.)	Correlation Coefficient	0.231*	-0.034	-0.142	-0.262	-0.185	-0.117	.	-0.315*	-0.378*	-0.166	-0.243*	0.320*	0.376*	1.000	0.284*	-0.201*	-0.203*	0.029	0.029
	Significance (2-tailed)	0.027	0.892	0.548	0.234	0.446	0.608	.	0.008	0.006	0.114	0.017	0.022	0.007	.	0.005	0.044	0.044	0.769	0.769
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	0.408*	0.131	-0.363	-0.490*	-0.138	-0.351	.	-0.318*	-0.113	-0.328*	-0.406*	0.218	0.237*	0.284*	1.000	-0.418*	-0.383*	-0.082	-0.082
	Significance (2-tailed)	0.000	0.593	0.114	0.023	0.559	0.114	.	0.007	0.405	0.002	0.000	0.118	0.090	0.005	.	0.000	0.000	0.414	0.414
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Water Temperature (°C)	Correlation Coefficient	-0.144	-0.261	0.363	0.649*	0.335	0.492*	.	-0.008	-0.129	-0.002	0.311*	-0.729*	-0.575*	-0.201*	-0.418*	1.000	0.510*	-0.047	-0.047
	Significance (2-tailed)	0.164	0.285	0.114	0.003	0.156	0.027	.	0.946	0.342	0.986	0.002	0.000	0.000	0.044	0.000	.	0.000	0.638	0.638
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.153	-0.298	0.475*	0.940*	0.300	0.498*	.	0.016	-0.033	0.159	0.487*	-0.401*	-0.357*	-0.203*	-0.383*	0.510*	1.000	-0.015	-0.015
	Significance (2-tailed)	0.144	0.228	0.041	0.000	0.209	0.026	.	0.891	0.812	0.129	0.000	0.004	0.011	0.044	0.000	0.000	.	0.880	0.880
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Flow (CFS)	Correlation Coefficient	-0.415*	0.131	0.333	0.013	0.374	-0.098	.	0.126	0.065	0.318*	-0.138	0.126	0.132	0.029	-0.082	-0.047	-0.015	1.000	1.000
	Significance (2-tailed)	0.000	0.593	0.147	0.951	0.113	0.658	.	0.286	0.635	0.002	0.173	0.366	0.343	0.769	0.414	0.638	0.880	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Flow (probability)	Correlation Coefficient	-0.415*	0.131	0.333	0.013	0.374	-0.098	.	0.126	0.065	0.318*	-0.138	0.126	0.132	0.029	-0.082	-0.047	-0.015	1.000	1.000
	Significance (2-tailed)	0.000	0.593	0.147	0.951	0.113	0.658	.	0.286	0.635	0.002	0.173	0.366	0.343	0.769	0.414	0.638	0.880	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-113: Kendall's tau correlation matrix of water quality parameters collected at Station 7 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.955*	0.116	-0.346*	-0.352*	-0.405*	-0.511*	-0.306*	.	-0.299*	-0.419*	-0.447	-0.274*	-0.360*	-0.410*	.
	Significance (2-tailed)	.	0.000	0.276	0.001	0.001	0.001	0.095	0.007	.	0.013	0.004	0.232	0.019	0.001	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Year Quarter	Correlation Coefficient	0.955*	1.000	0.109	-0.354*	-0.359*	-0.431*	-0.511*	-0.322*	.	-0.312*	-0.422*	-0.447	-0.284*	-0.378*	-0.407*	.
	Significance (2-tailed)	0.000	.	0.320	0.001	0.001	0.001	0.095	0.006	.	0.012	0.006	0.232	0.019	0.001	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Date	Correlation Coefficient	0.116	0.109	1.000	0.096	0.069	0.035	-0.182	-0.036	.	0.108	-0.222	-0.276	0.132	0.029	-0.018	.
	Significance (2-tailed)	0.276	0.320	.	0.341	0.493	0.773	0.533	0.731	.	0.339	0.108	0.439	0.231	0.775	0.859	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	-0.346*	-0.354*	0.096	1.000	0.916*	0.723*	0.618*	0.655*	.	0.659*	0.546*	0.690*	0.706*	0.732*	0.634*	.
	Significance (2-tailed)	0.001	0.001	0.341	.	0.000	0.000	0.034	0.000	.	0.000	0.000	0.053	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	-0.352*	-0.359*	0.069	0.916*	1.000	0.719*	0.519*	0.639*	.	0.685*	0.565*	0.414	0.694*	0.732*	0.632*	.
	Significance (2-tailed)	0.001	0.001	0.493	0.000	.	0.000	0.079	0.000	.	0.000	0.000	0.245	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	-0.405*	-0.431*	0.035	0.723*	0.719*	1.000	.	0.610*	.	0.758*	0.438*	.	0.705*	0.663*	0.621*	.
	Significance (2-tailed)	0.001	0.001	0.773	0.000	0.000	.	.	0.000	.	0.000	0.002	.	0.000	0.000	0.000	.
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.511*	-0.511*	-0.182	0.618*	0.519*	.	1.000	0.441	.	0.653*	.	0.707*	0.539*	0.808*	0.473	.
	Significance (2-tailed)	0.095	0.095	0.533	0.034	0.079	.	.	0.152	.	0.041	.	0.051	0.074	0.007	0.105	.
	N	8	8	8	8	8	0	8	8	0	8	1	7	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	-0.306*	-0.322*	-0.036	0.655*	0.639*	0.610*	0.441	1.000	.	0.573*	0.506*	0.690*	0.803*	0.704*	0.622*	.
	Significance (2-tailed)	0.007	0.006	0.731	0.000	0.000	0.000	0.152	.	.	0.000	0.001	0.068	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	-0.299*	-0.312*	0.108	0.659*	0.685*	0.758*	0.653*	0.573*	.	1.000	0.494*	0.592	0.691*	0.682*	0.564*	.
	Significance (2-tailed)	0.013	0.012	0.339	0.000	0.000	0.000	0.041	0.000	.	.	0.001	0.130	0.000	0.000	0.000	.
	N	44	44	44	44	44	36	8	44	0	44	37	7	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	-0.419*	-0.422*	-0.222	0.546*	0.565*	0.438*	.	0.506*	.	0.494*	1.000	.	0.463*	0.590*	0.495*	.
	Significance (2-tailed)	0.004	0.006	0.108	0.000	0.000	0.002	.	0.001	.	0.001	.	.	0.001	0.000	0.000	.
	N	37	37	37	37	37	36	1	37	0	37	37	0	37	37	37	37
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.447	-0.447	-0.276	0.690*	0.414	.	0.707*	0.690*	.	0.592	.	1.000	0.745*	0.745*	0.690*	.
	Significance (2-tailed)	0.232	0.232	0.439	0.053	0.245	.	0.051	0.068	.	0.130	.	.	0.047	0.044	0.053	.
	N	7	7	7	7	7	0	7	7	0	7	0	7	7	7	7	7
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.274*	-0.284*	0.132	0.706*	0.694*	0.705*	0.539*	0.803*	.	0.691*	0.463*	0.745*	1.000	0.649*	0.614*	.
	Significance (2-tailed)	0.019	0.019	0.231	0.000	0.000	0.000	0.074	0.000	.	0.000	0.001	0.047	.	0.000	0.000	.
	N	44	44	44	44	44	36	8	44	0	44	37	7	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	-0.360*	-0.378*	0.029	0.732*	0.732*	0.663*	0.808*	0.704*	.	0.682*	0.590*	0.745*	0.649*	1.000	0.637*	.
	Significance (2-tailed)	0.001	0.001	0.775	0.000	0.000	0.000	0.007	0.000	.	0.000	0.000	0.044	0.000	.	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	-0.410*	-0.407*	-0.018	0.634*	0.632*	0.621*	0.473	0.622*	.	0.564*	0.495*	0.690*	0.614*	0.637*	1.000	.
	Significance (2-tailed)	0.000	0.000	0.859	0.000	0.000	0.000	0.105	0.000	.	0.000	0.000	0.053	0.000	0.000	.	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	-0.055	-0.063	0.039	0.316*	0.331*	0.334*	-0.369	0.554*	.	0.304*	0.281*	-0.307	0.532*	0.307*	0.318*	.
	Significance (2-tailed)	0.621	0.584	0.706	0.003	0.002	0.007	0.234	0.000	.	0.010	0.050	0.417	0.000	0.004	0.002	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	-0.285	-0.315	-0.260	0.307	0.212	0.218	.	0.326	.	0.076	0.066	.	0.204	0.351	0.261	.
	Significance (2-tailed)	0.238	0.224	0.280	0.202	0.377	0.374	.	0.193	.	0.763	0.816	.	0.421	0.161	0.279	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	0.137	0.168	0.182	-0.454*	-0.454*	-0.466*	.	-0.386	.	-0.392	-0.254	.	-0.424*	-0.418*	-0.426*	.
	Significance (2-tailed)	0.553	0.496	0.429	0.048	0.048	0.047	.	0.107	.	0.105	0.347	.	0.079	0.081	0.065	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	0.392*	0.520*	0.416*	-0.546*	-0.546*	-0.720*	.	-0.400*	.	-0.687*	-0.562*	.	-0.547*	-0.566*	-0.431*	.
	Significance (2-tailed)	0.066	0.022	0.050	0.010	0.010	0.001	.	0.069	.	0.002	0.023	.	0.014	0.010	0.043	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	0.258	0.254	0.300	-0.271	-0.300	-0.381*	.	-0.334	.	-0.493*	-0.299	.	-0.431*	-0.334	-0.388*	.
	Significance (2-tailed)	0.251	0.291	0.181	0.226	0.181	0.095	.	0.153	.	0.037	0.255	.	0.067	0.153	0.085	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	0.018	0.018	-0.026	-0.182	-0.136	-0.162	-0.182	-0.240*	.	-0.212	-0.243	-0.690*	-0.367*	-0.225*	-0.217*	.
	Significance (2-tailed)	0.888	0.888	0.827	0.129	0.256	0.291	0.533	0.059	.	0.122	0.160	0.053	0.006	0.065	0.067	.
	N	36	36	36	36	36	24	8	36	0	32	25	7	32	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.029	0.006	0.169	-0.003	-0.005	0.062	.	-0.159	.	0.012	-0.127	.	-0.244	-0.081	-0.082	.
	Significance (2-tailed)	0.841	0.967	0.218	0.984	0.968	0.687	.	0.268	.	0.939	0.478	.	0.121	0.562	0.551	.
	N	28	28	28	28	28	24	0	28	0	24	24	0	24	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	0.130	0.133	-0.125	-0.292*	-0.257*	-0.317*	-0.189	-0.374*	.	-0.347*	-0.176	-0.636*	-0.492*	-0.282*	-0.314*	.
	Significance (2-tailed)	0.243	0.248	0.231	0.005	0.014	0.011	0.527	0.001	.	0.003	0.225	0.079	0.000	0.008	0.003	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	0.316*	0.336*	-0.102	-0.417*	-0.393*	-0.424*	-0.444	-0.328*	.	-0.441*	-0.215	-0.707*	-0.410*	-0.416*	-0.459*	.
	Significance (2-tailed)	0.003	0.003	0.310	0.000	0.000	0.000	0.132	0.002	.	0.000	0.123	0.051	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	-0.304*	-0.341*	-0.077	0.223	0.217	0.335*	0.618*	0.108	.	0.219	0.105	0.552	0.119	0.311*	0.281*	.
	Significance (2-tailed)	0.040	0.026	0.582	0.112	0.122	0.057	0.034	0.460	.	0.144	0.595	0.121	0.410	0.031	0.045	.
	N	26	26	26	26	26	18	8	26	0	26	19	7	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.231	-0.243	-0.231*	0.124	0.062	0.027	0.618*	0.016	.	0.041	0.079	0.690*	0.023	0.164	0.170	.
	Significance (2-tailed)	0.120	0.113	0.098	0.377	0.659	0.879	0.034	0.911	.	0.784	0.690	0.053	0.876	0.256	0.225	.
	N	26	26	26	26	26	18	8	26	0	26	19	7	26	26	26	26
pH, (s.u.)	Correlation Coefficient	-0.168	-0.157	-0.212*	0.225*	0.191*	0.232*	0.036	0.232*	.	0.160	0.287*	0.690*	0.228*	0.230*	0.307*	.
	Significance (2-tailed)	0.117	0.156	0.034	0.026	0.058	0.055	0.901	0.029	.	0.158	0.038	0.053	0.039	0.025	0.002	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	-0.354*	-0.369*	-0.078	0.638*	0.626*	0.620*	0.255	0.779*	.	0.612*	0.533*	0.414	0.696*	0.650*	0.630*	.
	Significance (2-tailed)	0.001	0.001	0.434	0.000	0.000	0.000	0.383	0.000	.	0.000	0.000	0.245	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Water Temperature (°C)	Correlation Coefficient	0.322*	0.338*	0.083	-0.308*	-0.343*	-0.464*	-0.255	-0.159	.	-0.375*	-0.246*	0.000	-0.190*	-0.252*	-0.275*	.
	Significance (2-tailed)	0.003	0.002	0.403	0.002	0.001	0.000	0.383	0.133	.	0.001	0.075	1.000	0.084	0.014	0.006	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Turbidity (NTU)	Correlation Coefficient	0.629*	0.677*	0.116	-0.377*	-0.401*	-0.489*	-0.400	-0.344*	.	-0.416*	-0.343*	-0.414	-0.368*	-0.377*	-0.491*	.
	Significance (2-tailed)	0.000	0.000	0.248	0.000	0.000	0.000	0.170	0.001	.	0.000	0.013	0.245	0.001	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Flow (CFS)	Correlation Coefficient	-0.131	-0.145	-0.068	-0.126	-0.142	-0.127	0.296	-0.260*	.	-0.191*	0.057	0.495	-0.283*	-0.080	-0.092	.
	Significance (2-tailed)	0.221	0.188	0.494	0.213	0.160	0.291	0.315	0.014	.	0.091	0.681	0.171	0.010	0.437	0.360	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48
Flow (probability)	Correlation Coefficient	-0.131	-0.145	-0.068	-0.126	-0.142	-0.127	0.296	-0.260*	.	-0.191*	0.057	0.495	-0.283*	-0.080	-0.092	.
	Significance (2-tailed)	0.221	0.188	0.494	0.213	0.160	0.291	0.315	0.014	.	0.091	0.681	0.171	0.010	0.437	0.360	.
	N	48	48	48	48	48	36	8	48	0	44	37	7	44	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-114: Kendall's tau correlation matrix of water quality parameters collected at Station 7 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	-0.055	-0.285	0.137	0.392*	.	0.258	.	0.018	0.029	0.130	0.316*	-0.304*	-0.231	-0.168	-0.354*	0.322*	0.629*	-0.131	-0.131
	Significance (2-tailed)	0.621	0.238	0.553	0.066	.	0.251	.	0.888	0.841	0.243	0.003	0.040	0.120	0.117	0.001	0.003	0.000	0.221	0.221
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Year Quarter	Correlation Coefficient	-0.063	-0.315	0.168	0.520*	.	0.254	.	0.018	0.006	0.133	0.336*	-0.341*	-0.243	-0.157	-0.369*	0.338*	0.677*	-0.145	-0.145
	Significance (2-tailed)	0.584	0.224	0.496	0.022	.	0.291	.	0.888	0.967	0.248	0.003	0.026	0.113	0.156	0.001	0.002	0.000	0.188	0.188
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Date	Correlation Coefficient	0.039	-0.260	0.182	0.416*	.	0.300	.	-0.026	0.169	-0.125	-0.102	-0.077	-0.231*	-0.212*	-0.078	0.083	0.116	-0.068	-0.068
	Significance (2-tailed)	0.706	0.280	0.429	0.050	.	0.181	.	0.827	0.218	0.231	0.310	0.582	0.098	0.034	0.434	0.403	0.248	0.494	0.494
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.316*	0.307	-0.454*	-0.546*	.	-0.271	.	-0.182	-0.003	-0.292*	-0.417*	0.223	0.124	0.225*	0.638*	-0.308*	-0.377*	-0.126	-0.126
	Significance (2-tailed)	0.003	0.202	0.048	0.010	.	0.226	.	0.129	0.984	0.005	0.000	0.112	0.377	0.026	0.000	0.002	0.000	0.213	0.213
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.331*	0.212	-0.454*	-0.546*	.	-0.300	.	-0.136	-0.005	-0.257*	-0.393*	0.217	0.062	0.191*	0.626*	-0.343*	-0.401*	-0.142	-0.142
	Significance (2-tailed)	0.002	0.377	0.048	0.010	.	0.181	.	0.256	0.968	0.014	0.000	0.122	0.659	0.058	0.000	0.001	0.000	0.160	0.160
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.334*	0.218	-0.466*	-0.720*	.	-0.381*	.	-0.162	0.062	-0.317*	-0.424*	0.335*	0.027	0.232*	0.620*	-0.464*	-0.489*	-0.127	-0.127
	Significance (2-tailed)	0.007	0.374	0.047	0.001	.	0.095	.	0.291	0.687	0.011	0.000	0.057	0.879	0.055	0.000	0.000	0.000	0.291	0.291
	N	36	13	13	13	13	13	13	24	24	36	36	18	18	36	36	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.369	.	.	.	.	.	.	-0.182	.	-0.189	-0.444	0.618*	0.618*	0.036	0.255	-0.255	-0.400	0.296	0.296
	Significance (2-tailed)	0.234	.	.	.	.	.	.	0.533	.	0.527	0.132	0.034	0.034	0.901	0.383	0.383	0.170	0.315	0.315
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	0.554*	0.326	-0.386	-0.400*	.	-0.334	.	-0.240*	-0.159	-0.374*	-0.328*	0.108	0.016	0.232*	0.779*	-0.159	-0.344*	-0.260*	-0.260*
	Significance (2-tailed)	0.000	0.193	0.107	0.069	.	0.153	.	0.059	0.268	0.001	0.002	0.460	0.911	0.029	0.000	0.133	0.001	0.014	0.014
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.304*	0.076	-0.392	-0.687*	.	-0.493*	.	-0.212	0.012	-0.347*	-0.441*	0.219	0.041	0.160	0.612*	-0.375*	-0.416*	-0.191*	-0.191*
	Significance (2-tailed)	0.010	0.763	0.105	0.002	.	0.037	.	0.122	0.939	0.003	0.000	0.144	0.784	0.158	0.000	0.001	0.000	0.091	0.091
	N	44	13	13	13	13	13	13	32	24	44	44	26	26	44	44	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	0.281*	0.066	-0.254	-0.562*	.	-0.299	.	-0.243	-0.127	-0.176	-0.215	0.105	0.079	0.287*	0.533*	-0.246*	-0.343*	0.057	0.057
	Significance (2-tailed)	0.050	0.816	0.347	0.023	.	0.255	.	0.160	0.478	0.225	0.123	0.595	0.690	0.038	0.000	0.075	0.013	0.681	0.681
	N	37	13	13	13	13	13	13	25	24	37	37	19	19	37	37	37	37	37	37
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.307	.	.	.	.	.	.	-0.690*	.	-0.636*	-0.707*	0.552	0.690*	0.690*	0.414	0.000	-0.414	0.495	0.495
	Significance (2-tailed)	0.417	.	.	.	.	.	.	0.053	.	0.079	0.051	0.121	0.053	0.053	0.245	1.000	0.245	0.171	0.171
	N	7	0	0	0	0	0	0	7	0	7	7	7	7	7	7	7	7	7	7
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.532*	0.204	-0.424*	-0.547*	.	-0.431*	.	-0.367*	-0.244	-0.492*	-0.410*	0.119	0.023	0.228*	0.696*	-0.190*	-0.368*	-0.283*	-0.283*
	Significance (2-tailed)	0.000	0.421	0.079	0.014	.	0.067	.	0.006	0.121	0.000	0.000	0.410	0.876	0.039	0.000	0.084	0.001	0.010	0.010
	N	44	13	13	13	13	13	13	32	24	44	44	26	26	44	44	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	0.307*	0.351	-0.418*	-0.566*	.	-0.334	.	-0.225*	-0.081	-0.282*	-0.416*	0.311*	0.164	0.230*	0.650*	-0.252*	-0.377*	-0.080	-0.080
	Significance (2-tailed)	0.004	0.161	0.081	0.010	.	0.153	.	0.065	0.562	0.008	0.000	0.031	0.256	0.025	0.000	0.014	0.000	0.437	0.437
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.318*	0.261	-0.426*	-0.431*	.	-0.388*	.	-0.217*	-0.082	-0.314*	-0.459*	0.281*	0.170	0.307*	0.630*	-0.275*	-0.491*	-0.092	-0.092
	Significance (2-tailed)	0.002	0.279	0.065	0.043	.	0.085	.	0.067	0.551	0.003	0.000	0.045	0.225	0.002	0.000	0.006	0.000	0.360	0.360
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	0.120	-0.463*	-0.490*	.	-0.015	.	-0.286*	-0.158	-0.364*	-0.121	-0.104	-0.278*	0.120	0.487*	-0.007	-0.162	-0.417*	-0.417*
	Significance (2-tailed)	.	0.622	0.047	0.023	.	0.949	.	0.021	0.263	0.001	0.250	0.475	0.055	0.251	0.000	0.943	0.121	0.000	0.000
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	0.120	1.000	-0.390	-0.239	.	-0.210	.	.	0.025	0.055	-0.239	.	.	0.071	0.307	-0.165	-0.261	0.260	0.260
	Significance (2-tailed)	0.622	.	0.141	0.325	.	0.415	.	.	0.921	0.834	0.325	.	.	0.768	0.202	0.492	0.279	0.280	0.280
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.463*	-0.390	1.000	0.399*	.	0.320	.	.	-0.016	-0.248	0.399*	-0.086	0.775*	0.076	-0.545*	0.333	0.381*	0.121	0.121
	Significance (2-tailed)	0.047	0.141	.	0.086	.	0.193	.	.	0.947	0.325	0.086	0.822	0.042	0.742	0.018	0.147	0.099	0.598	0.598
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	-0.490*	-0.239	0.399*	1.000	.	0.376*	.	.	-0.406*	0.243	0.474*	-0.333	0.200	-0.092	-0.571*	0.649*	0.850*	0.182	0.182
	Significance (2-tailed)	0.023	0.325	0.086	.	.	0.097	.	.	0.063	0.293	0.027	0.348	0.573	0.668	0.007	0.002	0.000	0.391	0.391
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	-0.015	-0.210	0.320	0.376*	.	1.000	.	.	0.045	-0.134	0.549*	-0.501	-0.215	-0.172	-0.385*	0.414*	0.546*	-0.128	-0.128
	Significance (2-tailed)	0.949	0.415	0.193	0.097	.	.	.	.	0.847	0.586	0.015	0.173	0.559	0.444	0.085	0.065	0.015	0.566	0.566
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.286*	.	.	.	.	.	.	1.000	0.978*	0.592*	0.354*	0.101	-0.133	-0.298*	-0.277*	-0.389*	0.006	-0.048	-0.048
	Significance (2-tailed)	0.021	.	.	.	.	.	.	.	0.000	0.000	0.003	0.537	0.416	0.012	0.019	0.001	0.956	0.682	0.682
	N	36	1	1	1	1	1	1	36	16	36	36	20	20	36	36	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.158	0.025	-0.016	-0.406*	.	0.045	.	0.978*	1.000	0.325*	0.154	0.552	-0.414	-0.361*	-0.071	-0.440*	-0.036	-0.016	-0.016
	Significance (2-tailed)	0.263	0.921	0.947	0.063	.	0.847	.	0.000	.	0.026	0.265	0.126	0.251	0.009	0.606	0.001	0.796	0.905	0.905
	N	28	13	13	13	13	13	13	16	28	28	28	6	6	28	28	28	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.364*	0.055	-0.248	0.243	.	-0.134	.	0.592*	0.325*	1.000	0.326*	-0.009	-0.060	-0.196*	-0.361*	-0.050	0.185*	0.192*	0.192*
	Significance (2-tailed)	0.001	0.834	0.325	0.293	.	0.586	.	0.000	0.026	.	0.002	0.947	0.673	0.061	0.001	0.633	0.076	0.065	0.065
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.121	-0.239	0.399*	0.474*	.	0.549*	.	0.354*	0.154	0.326*	1.000	-0.342*	-0.317*	-0.308*	-0.380*	0.129	0.383*	-0.137	-0.137
	Significance (2-tailed)	0.250	0.325	0.086	0.027	.	0.015	.	0.003	0.265	0.002	.	0.015	0.024	0.002	0.000	0.200	0.000	0.173	0.173
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	-0.104	.	-0.086	-0.333	.	-0.501	.	0.101	0.552	-0.009	-0.342*	1.000	0.563*	0.234*	0.089	-0.477*	-0.292*	0.228	0.228
	Significance (2-tailed)	0.475	.	0.822	0.348	.	0.173	.	0.537	0.126	0.947	0.015	.	0.000	0.094	0.523	0.001	0.036	0.103	0.103
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.278*	.	0.775*	0.200	.	-0.215	.	-0.133	-0.414	-0.060	-0.317*	0.563*	1.000	0.462*	-0.040	-0.040	-0.077	0.419*	0.419*
	Significance (2-tailed)	0.055	.	0.042	0.573	.	0.559	.	0.416	0.251	0.673	0.024	0.000	.	0.001	0.774	0.774	0.582	0.003	0.003
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
pH, (s.u.)	Correlation Coefficient	0.120	0.071	0.076	-0.092	.	-0.172	.	-0.298*	-0.361*	-0.196*	-0.308*	0.234*	0.462*	1.000	0.244*	0.077	-0.191*	0.142	0.142
	Significance (2-tailed)	0.251	0.768	0.742	0.668	.	0.444	.	0.012	0.009	0.061	0.002	0.094	0.001	.	0.015	0.444	0.057	0.157	0.157
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	0.487*	0.307	-0.545*	-0.571*	.	-0.385*	.	-0.277*	-0.071	-0.361*	-0.380*	0.089	-0.040	0.244*	1.000	-0.225*	-0.427*	-0.193*	-0.193*
	Significance (2-tailed)	0.000	0.202	0.018	0.007	.	0.085	.	0.019	0.606	0.001	0.000	0.523	0.774	0.015	.	0.024	0.000	0.054	0.054
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Water Temperature (°C)	Correlation Coefficient	-0.007	-0.165	0.333	0.649*	.	0.414*	.	-0.389*	-0.440*	-0.050	0.129	-0.477*	-0.040	0.077	-0.225*	1.000	0.390*	0.049	0.049
	Significance (2-tailed)	0.943	0.492	0.147	0.002	.	0.065	.	0.001	0.001	0.633	0.200	0.001	0.774	0.444	0.024	.	0.000	0.625	0.625
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.162	-0.261	0.381*	0.850*	.	0.546*	.	0.006	-0.036	0.185*	0.383*	-0.292*	-0.077	-0.191*	-0.427*	0.390*	1.000	0.067	0.067
	Significance (2-tailed)	0.121	0.279	0.099	0.000	.	0.015	.	0.956	0.796	0.076	0.000	0.036	0.582	0.057	0.000	0.000	.	0.505	0.505
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Flow (CFS)	Correlation Coefficient	-0.417*	0.260	0.121	0.182	.	-0.128	.	-0.048	-0.016	0.192*	-0.137	0.228	0.419*	0.142	-0.193*	0.049	0.067	1.000	1.000
	Significance (2-tailed)	0.000	0.280	0.598	0.391	.	0.566	.	0.682	0.905	0.065	0.173	0.103	0.003	0.157	0.054	0.625	0.505	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48
Flow (probability)	Correlation Coefficient	-0.417*	0.260	0.121	0.182	.	-0.128	.	-0.048	-0.016	0.192*	-0.137	0.228	0.419*	0.142	-0.193*	0.049	0.067	1.000	1.000
	Significance (2-tailed)	0.000	0.280	0.598	0.391	.	0.566	.	0.682	0.905	0.065	0.173	0.103	0.003	0.157	0.054	0.625	0.505	.	.
	N	48	13	13	13	13	13	13	36	28	48	48	26	26	48	48	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-115: Kendall's tau correlation matrix of water quality parameters collected at Station 8 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.955*	0.116	-0.158	-0.153	-0.345*	-0.400	-0.213*	.	-0.278*	-0.395*	-0.527	-0.183	-0.249*	-0.329*	.
	Significance (2-tailed)	.	0.000	0.276	0.144	0.154	0.007	0.195	0.061	.	0.023	0.008	0.127	0.116	0.022	0.002	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Year Quarter	Correlation Coefficient	0.955*	1.000	0.109	-0.176	-0.173	-0.386*	-0.400	-0.228*	.	-0.302*	-0.419*	-0.527	-0.208*	-0.274*	-0.334*	.
	Significance (2-tailed)	0.000	.	0.320	0.113	0.120	0.004	0.195	0.052	.	0.017	0.007	0.127	0.085	0.015	0.003	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Date	Correlation Coefficient	0.116	0.109	1.000	0.044	-0.018	0.101	-0.222	0.003	.	0.143	-0.137	-0.439	0.155	0.050	0.045	.
	Significance (2-tailed)	0.276	0.320	.	0.663	0.859	0.402	0.451	0.978	.	0.211	0.328	0.180	0.156	0.624	0.650	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	-0.158	-0.176	0.044	1.000	0.883*	0.509*	0.415	0.506*	.	0.509*	0.241*	0.248	0.457*	0.561*	0.443*	.
	Significance (2-tailed)	0.144	0.113	0.663	.	0.000	0.000	0.164	0.000	.	0.000	0.089	0.453	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	-0.153	-0.173	-0.018	0.883*	1.000	0.500*	0.154	0.461*	.	0.452*	0.264*	0.000	0.383*	0.510*	0.399*	.
	Significance (2-tailed)	0.154	0.120	0.859	0.000	.	0.000	0.610	0.000	.	0.000	0.061	1.000	0.001	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	-0.345*	-0.386*	0.101	0.509*	0.500*	1.000	.	0.600*	.	0.736*	0.381*	.	0.633*	0.602*	0.488*	.
	Significance (2-tailed)	0.007	0.004	0.402	0.000	0.000	.	.	0.000	.	0.000	0.009	.	0.000	0.000	0.000	.
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.400	-0.400	-0.222	0.415	0.154	.	1.000	0.307	.	0.598*	.	0.760*	0.532*	0.566*	0.519*	.
	Significance (2-tailed)	0.195	0.195	0.451	0.164	0.610	.	.	0.337	.	0.067	.	0.024	0.088	0.058	0.079	.
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	-0.213*	-0.228*	0.003	0.506*	0.461*	0.600*	0.307	1.000	.	0.514*	0.453*	0.000	0.796*	0.636*	0.501*	.
	Significance (2-tailed)	0.061	0.052	0.978	0.000	0.000	0.000	0.337	.	.	0.000	0.002	1.000	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	-0.278*	-0.302*	0.143	0.509*	0.452*	0.736*	0.598*	0.514*	.	1.000	0.450*	0.501	0.570*	0.653*	0.555*	.
	Significance (2-tailed)	0.023	0.017	0.211	0.000	0.000	0.000	0.067	0.000	.	.	0.003	0.172	0.000	0.000	0.000	.
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	-0.395*	-0.419*	-0.137	0.241*	0.264*	0.381*	.	0.453*	.	0.450*	1.000	.	0.352*	0.491*	0.488*	.
	Significance (2-tailed)	0.008	0.007	0.328	0.089	0.061	0.009	.	0.002	.	0.003	.	.	0.016	0.001	0.001	.
	N	36	36	36	36	36	36	0	36	0	36	36	0	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.527	-0.527	-0.439	0.248	0.000	.	0.760*	0.000	.	0.501	.	1.000	0.323	0.497	0.537	.
	Significance (2-tailed)	0.127	0.127	0.180	0.453	1.000	.	0.024	1.000	.	0.172	.	.	0.353	0.134	0.101	.
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.183	-0.208*	0.155	0.457*	0.383*	0.633*	0.532*	0.796*	.	0.570*	0.352*	0.323	1.000	0.557*	0.456*	.
	Significance (2-tailed)	0.116	0.085	0.156	0.000	0.001	0.000	0.088	0.000	.	0.000	0.016	0.353	.	0.000	0.000	.
	N	44	44	44	44	44	36	8	44	0	44	36	8	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	-0.249*	-0.274*	0.050	0.561*	0.510*	0.602*	0.566*	0.636*	.	0.653*	0.491*	0.497	0.557*	1.000	0.601*	.
	Significance (2-tailed)	0.022	0.015	0.624	0.000	0.000	0.000	0.058	0.000	.	0.000	0.001	0.134	0.000	.	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	-0.329*	-0.334*	0.045	0.443*	0.399*	0.488*	0.519*	0.501*	.	0.555*	0.488*	0.537	0.456*	0.601*	1.000	.
	Significance (2-tailed)	0.002	0.003	0.650	0.000	0.000	0.000	0.079	0.000	.	0.000	0.001	0.101	0.000	0.000	.	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	0.113	0.120	0.011	0.292*	0.254*	0.262*	-0.538*	0.526*	.	0.119	0.212	-0.608*	0.465*	0.209*	0.167	.
	Significance (2-tailed)	0.306	0.295	0.914	0.005	0.015	0.037	0.074	0.000	.	0.315	0.146	0.070	0.000	0.048	0.109	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	-0.296	-0.327	-0.261	0.265	0.265	0.034	.	0.036	.	-0.071	-0.228	.	0.035	0.100	0.066	.
	Significance (2-tailed)	0.228	0.215	0.285	0.284	0.284	0.893	.	0.890	.	0.784	0.429	.	0.892	0.687	0.789	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.029	-0.048	0.014	-0.220	-0.235	-0.372	.	-0.224	.	-0.347	-0.243	.	-0.308	-0.207	-0.350	.
	Significance (2-tailed)	0.898	0.842	0.949	0.334	0.302	0.106	.	0.350	.	0.146	0.358	.	0.190	0.366	0.123	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	0.531*	0.587*	0.568*	-0.219	-0.247	-0.278	.	-0.329	.	-0.412*	-0.416	.	-0.460*	-0.262	-0.395*	.
	Significance (2-tailed)	0.015	0.012	0.009	0.318	0.261	0.210	.	0.154	.	0.073	0.102	.	0.042	0.234	0.071	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	0.094	0.052	0.109	0.095	0.126	0.112	.	-0.034	.	-0.017	-0.282	.	-0.066	0.000	0.094	.
	Significance (2-tailed)	0.685	0.834	0.637	0.685	0.588	0.635	.	0.889	.	0.945	0.297	.	0.783	1.000	0.685	.
	N	13	13	13	13	13	13	0	13	0	13	13	0	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	14	14	14	14	14	14	0	14	0	14	14	0	14	14	14	14
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	0.028	0.028	-0.074	-0.262*	-0.143	-0.145	-0.038	-0.349*	.	-0.276*	-0.231	-0.199	-0.466*	-0.372*	-0.346*	.
	Significance (2-tailed)	0.832	0.832	0.530	0.029	0.234	0.349	0.899	0.006	.	0.047	0.192	0.549	0.000	0.002	0.004	.
	N	36	36	36	36	36	24	8	36	0	32	24	8	32	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.083	0.095	0.232*	-0.082	-0.057	-0.142	.	-0.327*	.	-0.175	-0.136	.	-0.401*	-0.261*	-0.160	.
	Significance (2-tailed)	0.560	0.524	0.088	0.551	0.676	0.353	.	0.023	.	0.277	0.442	.	0.010	0.059	0.242	.
	N	28	28	28	28	28	24	0	28	0	24	24	0	24	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	0.130	0.136	-0.104	-0.272*	-0.194*	-0.333*	0.074	-0.522*	.	-0.358*	-0.360*	0.049	-0.525*	-0.328*	-0.380*	.
	Significance (2-tailed)	0.249	0.242	0.320	0.010	0.068	0.009	0.802	0.000	.	0.003	0.015	0.881	0.000	0.002	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	0.280*	0.303*	-0.020	-0.234*	-0.166	-0.316*	-0.264	-0.303*	.	-0.351*	-0.272*	-0.298	-0.344*	-0.343*	-0.330*	.
	Significance (2-tailed)	0.009	0.006	0.845	0.022	0.103	0.009	0.376	0.005	.	0.002	0.054	0.368	0.002	0.001	0.001	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	-0.328*	-0.352*	-0.018	0.252*	0.275*	0.403*	0.222	0.102	.	0.266*	0.206	0.537	0.097	0.240*	0.167	.
	Significance (2-tailed)	0.027	0.022	0.895	0.074	0.052	0.024	0.451	0.487	.	0.080	0.314	0.101	0.503	0.092	0.233	.
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.251*	-0.243	-0.108	0.274*	0.128	0.266	0.148	0.129	.	0.245	0.229	0.439	0.178	0.350*	0.251*	.
	Significance (2-tailed)	0.091	0.113	0.440	0.052	0.365	0.135	0.615	0.382	.	0.107	0.260	0.180	0.220	0.014	0.074	.
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
pH, (s.u.)	Correlation Coefficient	-0.138	-0.136	-0.181*	0.235*	0.162	0.283*	0.000	0.323*	.	0.227*	0.299*	0.146	0.283*	0.309*	0.378*	.
	Significance (2-tailed)	0.198	0.217	0.070	0.020	0.109	0.020	1.000	0.002	.	0.048	0.033	0.655	0.010	0.003	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	-0.236*	-0.249*	-0.067	0.520*	0.470*	0.568*	0.074	0.754*	.	0.498*	0.440*	0.049	0.657*	0.647*	0.566*	.
	Significance (2-tailed)	0.027	0.024	0.499	0.000	0.000	0.000	0.802	0.000	.	0.000	0.002	0.881	0.000	0.000	0.000	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Water Temperature (°C)	Correlation Coefficient	0.331*	0.336*	0.106	-0.124	-0.207*	-0.268*	-0.222	-0.008	.	-0.173	-0.154	-0.146	0.029	-0.042	-0.109	.
	Significance (2-tailed)	0.002	0.002	0.290	0.219	0.040	0.026	0.451	0.942	.	0.130	0.272	0.655	0.791	0.682	0.278	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Turbidity (NTU)	Correlation Coefficient	0.346*	0.348*	0.096	-0.134	-0.150	-0.155	-0.074	-0.239*	.	-0.202*	-0.259*	0.146	-0.204*	-0.153	-0.170*	.
	Significance (2-tailed)	0.001	0.002	0.337	0.187	0.139	0.201	0.802	0.025	.	0.079	0.066	0.655	0.063	0.136	0.093	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (CFS)	Correlation Coefficient	-0.157	-0.168	-0.075	-0.093	-0.072	-0.086	0.222	-0.311*	.	-0.157	-0.050	0.537	-0.311*	-0.076	-0.021	.
	Significance (2-tailed)	0.142	0.127	0.455	0.359	0.477	0.475	0.451	0.003	.	0.169	0.718	0.101	0.005	0.459	0.838	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48
Flow (probability)	Correlation Coefficient	-0.157	-0.168	-0.075	-0.093	-0.072	-0.086	0.222	-0.311*	.	-0.157	-0.050	0.537	-0.311*	-0.076	-0.021	.
	Significance (2-tailed)	0.142	0.127	0.455	0.359	0.477	0.475	0.451	0.003	.	0.169	0.718	0.101	0.005	0.459	0.838	.
	N	48	48	48	48	48	36	8	48	0	44	36	8	44	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-116: Kendall's tau correlation matrix of water quality parameters collected at Station 8 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	0.113	-0.296	-0.029	0.531*	.	0.094	.	0.028	0.083	0.130	0.280*	-0.328*	-0.251*	-0.138	-0.236*	0.331*	0.346*	-0.157	-0.157
	Significance (2-tailed)	0.306	0.228	0.898	0.015	.	0.685	.	0.832	0.560	0.249	0.009	0.027	0.091	0.198	0.027	0.002	0.001	0.142	0.142
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Year Quarter	Correlation Coefficient	0.120	-0.327	-0.048	0.587*	.	0.052	.	0.028	0.095	0.136	0.303*	-0.352*	-0.243	-0.136	-0.249*	0.336*	0.348*	-0.168	-0.168
	Significance (2-tailed)	0.295	0.215	0.842	0.012	.	0.834	.	0.832	0.524	0.242	0.006	0.022	0.113	0.217	0.024	0.002	0.002	0.127	0.127
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Date	Correlation Coefficient	0.011	-0.261	0.014	0.568*	.	0.109	.	-0.074	0.232*	-0.104	-0.020	-0.018	-0.108	-0.181*	-0.067	0.106	0.096	-0.075	-0.075
	Significance (2-tailed)	0.914	0.285	0.949	0.009	.	0.637	.	0.530	0.088	0.320	0.845	0.895	0.440	0.070	0.499	0.290	0.337	0.455	0.455
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.292*	0.265	-0.220	-0.219	.	0.095	.	-0.262*	-0.082	-0.272*	-0.234*	0.252*	0.274*	0.235*	0.520*	-0.124	-0.134	-0.093	-0.093
	Significance (2-tailed)	0.005	0.284	0.334	0.318	.	0.685	.	0.029	0.551	0.010	0.022	0.074	0.052	0.020	0.000	0.219	0.187	0.359	0.359
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.254*	0.265	-0.235	-0.247	.	0.126	.	-0.143	-0.057	-0.194*	-0.166	0.275*	0.128	0.162	0.470*	-0.207*	-0.150	-0.072	-0.072
	Significance (2-tailed)	0.015	0.284	0.302	0.261	.	0.588	.	0.234	0.676	0.068	0.103	0.052	0.365	0.109	0.000	0.040	0.139	0.477	0.477
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.262*	0.034	-0.372	-0.278	.	0.112	.	-0.145	-0.142	-0.333*	-0.316*	0.403*	0.266	0.283*	0.568*	-0.268*	-0.155	-0.086	-0.086
	Significance (2-tailed)	0.037	0.893	0.106	0.210	.	0.635	.	0.349	0.353	0.009	0.009	0.024	0.135	0.020	0.000	0.026	0.201	0.475	0.475
	N	36	13	13	13	13	13	14	24	24	36	36	18	18	36	36	36	36	36	36
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.538*	.	.	.	.	.	.	-0.038	.	0.074	-0.264	0.222	0.148	0.000	0.074	-0.222	-0.074	0.222	0.222
	Significance (2-tailed)	0.074	.	.	.	.	.	.	0.899	.	0.802	0.376	0.451	0.615	1.000	0.802	0.451	0.802	0.451	0.451
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	0.526*	0.036	-0.224	-0.329	.	-0.034	.	-0.349*	-0.327*	-0.522*	-0.303*	0.102	0.129	0.323*	0.754*	-0.008	-0.239*	-0.311*	-0.311*
	Significance (2-tailed)	0.000	0.890	0.350	0.154	.	0.889	.	0.006	0.023	0.000	0.005	0.487	0.382	0.002	0.000	0.942	0.025	0.003	0.003
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.119	-0.071	-0.347	-0.412*	.	-0.017	.	-0.276*	-0.175	-0.358*	-0.351*	0.266*	0.245	0.227*	0.498*	-0.173	-0.202*	-0.157	-0.157
	Significance (2-tailed)	0.315	0.784	0.146	0.073	.	0.945	.	0.047	0.277	0.003	0.002	0.080	0.107	0.048	0.000	0.130	0.079	0.169	0.169
	N	44	13	13	13	13	13	14	32	24	44	44	26	26	44	44	44	44	44	44
Potassium, Total (mg/L)	Correlation Coefficient	0.212	-0.228	-0.243	-0.416	.	-0.282	.	-0.231	-0.136	-0.360*	-0.272*	0.206	0.229	0.299*	0.440*	-0.154	-0.259*	-0.050	-0.050
	Significance (2-tailed)	0.146	0.429	0.358	0.102	.	0.297	.	0.192	0.442	0.015	0.054	0.314	0.260	0.033	0.002	0.272	0.066	0.718	0.718
	N	36	13	13	13	13	13	14	24	24	36	36	18	18	36	36	36	36	36	36
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.608*	.	.	.	.	.	.	-0.199	.	0.049	-0.298	0.537	0.439	0.146	0.049	-0.146	0.146	0.537	0.537
	Significance (2-tailed)	0.070	.	.	.	.	.	.	0.549	.	0.881	0.368	0.101	0.180	0.655	0.881	0.655	0.655	0.101	0.101
	N	8	0	0	0	0	0	0	8	0	8	8	8	8	8	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.465*	0.035	-0.308	-0.460*	.	-0.066	.	-0.466*	-0.401*	-0.525*	-0.344*	0.097	0.178	0.283*	0.657*	0.029	-0.204*	-0.311*	-0.311*
	Significance (2-tailed)	0.000	0.892	0.190	0.042	.	0.783	.	0.000	0.010	0.000	0.002	0.503	0.220	0.010	0.000	0.791	0.063	0.005	0.005
	N	44	13	13	13	13	13	14	32	24	44	44	26	26	44	44	44	44	44	44
Sulfate, Total (mg/L)	Correlation Coefficient	0.209*	0.100	-0.207	-0.262	.	0.000	.	-0.372*	-0.261*	-0.328*	-0.343*	0.240*	0.350*	0.309*	0.647*	-0.042	-0.153	-0.076	-0.076
	Significance (2-tailed)	0.048	0.687	0.366	0.234	.	1.000	.	0.002	0.059	0.002	0.001	0.092	0.014	0.003	0.000	0.682	0.136	0.459	0.459
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.167	0.066	-0.350	-0.395*	.	0.094	.	-0.346*	-0.160	-0.380*	-0.330*	0.167	0.251*	0.378*	0.566*	-0.109	-0.170*	-0.021	-0.021
	Significance (2-tailed)	0.109	0.789	0.123	0.071	.	0.685	.	0.004	0.242	0.000	0.001	0.233	0.074	0.000	0.000	0.278	0.093	0.838	0.838
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	-0.068	-0.629*	-0.364	.	0.305	.	-0.204	-0.240*	-0.322*	-0.077	0.026	-0.048	0.174*	0.404*	0.051	-0.058	-0.446*	-0.446*
	Significance (2-tailed)	.	0.788	0.006	0.102	.	0.196	.	0.100	0.086	0.003	0.462	0.859	0.739	0.094	0.000	0.622	0.579	0.000	0.000
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	-0.068	1.000	0.444*	-0.173	.	0.159	.	.	0.203	-0.126	-0.066	.	.	0.066	0.131	-0.261	-0.329	0.065	0.065
	Significance (2-tailed)	0.788	.	0.094	0.497	.	0.558	.	.	0.419	0.645	0.789	.	.	0.789	0.593	0.285	0.181	0.789	0.789
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Copper, Total (mg/L)	Correlation Coefficient	-0.629*	0.444*	1.000	0.260	.	-0.264	.	.	0.030	0.075	0.029	-0.078	0.545	-0.029	-0.362	0.159	0.058	0.275	0.275
	Significance (2-tailed)	0.006	0.094	.	0.266	.	0.289	.	.	0.897	0.767	0.897	0.837	0.150	0.898	0.108	0.480	0.797	0.222	0.222
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Iron, Total (mg/L)	Correlation Coefficient	-0.364	-0.173	0.260	1.000	.	-0.148	.	.	0.000	0.418*	0.165	0.690*	0.552	-0.123	-0.406*	0.460*	0.804*	0.406*	0.406*
	Significance (2-tailed)	0.102	0.497	0.266	.	.	0.536	.	.	1.000	0.084	0.453	0.056	0.126	0.575	0.062	0.034	0.000	0.062	0.062
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Lead, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Manganese, Total (mg/L)	Correlation Coefficient	0.305	0.159	-0.264	-0.148	.	1.000	.	.	0.177	0.100	0.126	-0.234	-0.701*	-0.094	0.016	0.047	-0.125	-0.233	-0.233
	Significance (2-tailed)	0.196	0.558	0.289	0.536	.	.	.	.	0.454	0.697	0.588	0.537	0.064	0.685	0.946	0.840	0.589	0.312	0.312
	N	13	13	13	13	13	13	13	1	13	13	13	6	6	13	13	13	13	13	13
Zinc, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	14	13	13	13	13	13	14	2	14	14	14	6	6	14	14	14	14	14	14
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.204	.	.	.	.	.	.	1.000	0.983*	0.572*	0.351*	0.257	-0.325*	-0.426*	-0.433*	-0.533*	-0.003	-0.006	-0.006
	Significance (2-tailed)	0.100	.	.	.	.	.	.	.	0.000	0.000	0.003	0.118	0.047	0.000	0.000	0.000	0.978	0.956	0.956
	N	36	1	1	1	1	1	2	36	16	36	36	20	20	36	36	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.240*	0.203	0.030	0.000	.	0.177	.	0.983*	1.000	0.494*	0.405*	0.414	-0.276	-0.459*	-0.286*	-0.402*	0.016	-0.011	-0.011
	Significance (2-tailed)	0.086	0.419	0.897	1.000	.	0.454	.	0.000	.	0.001	0.003	0.251	0.444	0.001	0.036	0.003	0.905	0.937	0.937
	N	28	13	13	13	13	13	14	16	28	28	28	6	6	28	28	28	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.322*	-0.126	0.075	0.418*	.	0.100	.	0.572*	0.494*	1.000	0.394*	0.190	-0.085	-0.404*	-0.478*	-0.213*	0.273*	0.246*	0.246*
	Significance (2-tailed)	0.003	0.645	0.767	0.084	.	0.697	.	0.000	0.001	.	0.000	0.183	0.549	0.000	0.000	0.043	0.010	0.019	0.019
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.077	-0.066	0.029	0.165	.	0.126	.	0.351*	0.405*	0.394*	1.000	-0.009	-0.247*	-0.406*	-0.355*	-0.132	0.139	-0.104	-0.104
	Significance (2-tailed)	0.462	0.789	0.897	0.453	.	0.588	.	0.003	0.003	0.000	.	0.947	0.078	0.000	0.000	0.191	0.170	0.302	0.302
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.026	.	-0.078	0.690*	.	-0.234	.	0.257	0.414	0.190	-0.009	1.000	0.290*	0.022	0.099	-0.616*	0.142	0.127	0.127
	Significance (2-tailed)	0.859	.	0.837	0.056	.	0.537	.	0.118	0.251	0.183	0.947	.	0.038	0.877	0.480	0.000	0.311	0.366	0.366
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.048	.	0.545	0.552	.	-0.701*	.	-0.325*	-0.276	-0.085	-0.247*	0.290*	1.000	0.425*	0.243*	0.095	0.052	0.173	0.173
	Significance (2-tailed)	0.739	.	0.150	0.126	.	0.064	.	0.047	0.444	0.549	0.078	0.038	.	0.002	0.082	0.494	0.708	0.217	0.217
	N	26	6	6	6	6	6	6	20	6	26	26	26	26	26	26	26	26	26	26
pH, (s.u.)	Correlation Coefficient	0.174*	0.066	-0.029	-0.123	.	-0.094	.	-0.426*	-0.459*	-0.404*	-0.406*	0.022	0.425*	1.000	0.375*	0.172*	-0.057	0.069	0.069
	Significance (2-tailed)	0.094	0.789	0.898	0.575	.	0.685	.	0.000	0.001	0.000	0.000	0.877	0.002	.	0.000	0.086	0.569	0.488	0.488
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	0.404*	0.131	-0.362	-0.406*	.	0.016	.	-0.433*	-0.286*	-0.478*	-0.355*	0.099	0.243*	0.375*	1.000	-0.012	-0.225*	-0.167*	-0.167*
	Significance (2-tailed)	0.000	0.593	0.108	0.062	.	0.946	.	0.000	0.036	0.000	0.000	0.480	0.082	0.000	.	0.908	0.025	0.095	0.095
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Water Temperature (°C)	Correlation Coefficient	0.051	-0.261	0.159	0.460*	.	0.047	.	-0.533*	-0.402*	-0.213*	-0.132	-0.616*	0.095	0.172*	-0.012	1.000	0.054	-0.010	-0.010
	Significance (2-tailed)	0.622	0.285	0.480	0.034	.	0.840	.	0.000	0.003	0.043	0.191	0.000	0.494	0.086	0.908	.	0.587	0.922	0.922
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.058	-0.329	0.058	0.804*	.	-0.125	.	-0.003	0.016	0.273*	0.139	0.142	0.052	-0.057	-0.225*	0.054	1.000	0.302*	0.302*
	Significance (2-tailed)	0.579	0.181	0.797	0.000	.	0.589	.	0.978	0.905	0.010	0.170	0.311	0.708	0.569	0.025	0.587	.	0.003	0.003
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Flow (CFS)	Correlation Coefficient	-0.446*	0.065	0.275	0.406*	.	-0.233	.	-0.006	-0.011	0.246*	-0.104	0.127	0.173	0.069	-0.167*	-0.010	0.302*	1.000	1.000
	Significance (2-tailed)	0.000	0.789	0.222	0.062	.	0.312	.	0.956	0.937	0.019	0.302	0.366	0.217	0.488	0.095	0.922	0.003	.	.
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48
Flow (probability)	Correlation Coefficient	-0.446*	0.065	0.275	0.406*	.	-0.233	.	-0.006	-0.011	0.246*	-0.104	0.127	0.173	0.069	-0.167*	-0.010	0.302*	1.000	1.000
	Significance (2-tailed)	0.000	0.789	0.222	0.062	.	0.312	.	0.956	0.937	0.019	0.302	0.366	0.217	0.488	0.095	0.922	0.003	.	.
	N	48	13	13	13	13	13	14	36	28	48	48	26	26	48	48	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-117: Kendall's tau correlation matrix of water quality parameters collected at Station 9 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.951*	0.106	0.047	0.024	-0.025	0.099	-0.114	.	0.066	-0.101	.	-0.087	-0.007	-0.128	-0.186*
	Significance (2-tailed)	.	0.000	0.319	0.667	0.822	0.839	0.766	0.321	.	0.569	0.461	.	0.432	0.949	0.231	0.099
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Year Quarter	Correlation Coefficient	0.951*	1.000	0.109	0.033	0.005	-0.039	0.099	-0.103	.	0.082	-0.115	.	-0.091	-0.015	-0.139	-0.198*
	Significance (2-tailed)	0.000	.	0.320	0.768	0.962	0.760	0.766	0.386	.	0.495	0.421	.	0.430	0.897	0.210	0.090
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Date	Correlation Coefficient	0.106	0.109	1.000	0.245*	0.182*	-0.005	0.138	0.078	.	0.237*	-0.030	.	0.186*	0.144	0.047	-0.037
	Significance (2-tailed)	0.319	0.320	.	0.017	0.075	0.962	0.664	0.466	.	0.030	0.818	.	0.074	0.156	0.644	0.725
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.047	0.033	0.245*	1.000	0.810*	0.442*	-0.428	0.378*	.	0.532*	0.148	.	0.468*	0.441*	0.319*	-0.118
	Significance (2-tailed)	0.667	0.768	0.017	.	0.000	0.000	0.187	0.001	.	0.000	0.266	.	0.000	0.000	0.002	0.274
	N	47	47	47	47	47	39	8	47	0	47	39	8	47	47	47	47
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.024	0.005	0.182*	0.810*	1.000	0.467*	-0.523	0.391*	.	0.431*	0.249*	.	0.463*	0.425*	0.336*	-0.244*
	Significance (2-tailed)	0.822	0.962	0.075	0.000	.	0.000	0.107	0.000	.	0.000	0.061	.	0.000	0.000	0.001	0.023
	N	47	47	47	47	47	39	8	47	0	47	39	8	47	47	47	47
Calcium, Total (mg/L)	Correlation Coefficient	-0.025	-0.039	-0.005	0.442*	0.467*	1.000	.	0.303*	.	0.401*	0.231*	.	0.445*	0.276*	0.300*	-0.249*
	Significance (2-tailed)	0.839	0.760	0.962	0.000	0.000	.	.	0.014	.	0.001	0.089	.	0.000	0.019	0.010	0.041
	N	40	40	40	39	39	40	0	40	0	40	40	0	40	40	40	40
Calcium, Dissolved (mg/L)	Correlation Coefficient	0.099	0.099	0.138	-0.428	-0.523	.	1.000	-0.101	.	-0.223	.	.	-0.354	-0.413	-0.413	0.243
	Significance (2-tailed)	0.766	0.766	0.664	0.187	0.107	.	.	0.763	.	0.524	.	.	0.292	0.192	0.192	0.458
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	-0.114	-0.103	0.078	0.378*	0.391*	0.303*	-0.101	1.000	.	0.401*	0.422*	.	0.693*	0.390*	0.454*	-0.230*
	Significance (2-tailed)	0.321	0.386	0.466	0.001	0.000	0.014	0.763	.	.	0.001	0.003	.	0.000	0.000	0.000	0.044
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.066	0.082	0.237*	0.532*	0.431*	0.401*	-0.223	0.401*	.	1.000	0.442*	.	0.606*	0.678*	0.392*	-0.142
	Significance (2-tailed)	0.569	0.495	0.030	0.000	0.000	0.001	0.524	0.001	.	.	0.002	.	0.000	0.000	0.000	0.219
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Potassium, Total (mg/L)	Correlation Coefficient	-0.101	-0.115	-0.030	0.148	0.249*	0.231*	.	0.422*	.	0.442*	1.000	.	0.485*	0.537*	0.382*	-0.231*
	Significance (2-tailed)	0.461	0.421	0.818	0.266	0.061	0.089	.	0.003	.	0.002	.	.	0.000	0.000	0.003	0.093
	N	40	40	40	39	39	40	0	40	0	40	40	0	40	40	40	40
Potassium, Dissolved (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	8	8	8	8	8	0	8	8	0	8	0	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.087	-0.091	0.186*	0.468*	0.463*	0.445*	-0.354	0.693*	.	0.606*	0.485*	.	1.000	0.523*	0.444*	-0.249*
	Significance (2-tailed)	0.432	0.430	0.074	0.000	0.000	0.000	0.292	0.000	.	0.000	0.000	.	.	0.000	0.000	0.025
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Sulfate, Total (mg/L)	Correlation Coefficient	-0.007	-0.015	0.144	0.441*	0.425*	0.276*	-0.413	0.390*	.	0.678*	0.537*	.	0.523*	1.000	0.450*	-0.202*
	Significance (2-tailed)	0.949	0.897	0.156	0.000	0.000	0.019	0.192	0.000	.	0.000	0.000	.	0.000	.	0.000	0.061
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	-0.128	-0.139	0.047	0.319*	0.336*	0.300*	-0.413	0.454*	.	0.392*	0.382*	.	0.444*	0.450*	1.000	-0.148
	Significance (2-tailed)	0.231	0.210	0.644	0.002	0.001	0.010	0.192	0.000	.	0.000	0.003	.	0.000	0.000	.	0.165
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.186*	-0.198*	-0.037	-0.118	-0.244*	-0.249*	0.243	-0.230*	.	-0.142	-0.231*	.	-0.249*	-0.202*	-0.148	1.000
	Significance (2-tailed)	0.099	0.090	0.725	0.274	0.023	0.041	0.458	0.044	.	0.219	0.093	.	0.025	0.061	0.165	.
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	0.173	0.219*	0.103	0.187*	0.224*	0.178	-0.146	0.567*	.	0.235*	0.252*	.	0.456*	0.229*	0.195*	-0.475*
	Significance (2-tailed)	0.117	0.055	0.320	0.077	0.034	0.137	0.658	0.000	.	0.038	0.061	.	0.000	0.030	0.062	0.000
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	-0.118	-0.161	-0.187	-0.270*	-0.248*	-0.239*	.	-0.136	.	-0.016	-0.015	.	-0.056	0.014	0.025	0.266*
	Significance (2-tailed)	0.375	0.244	0.136	0.035	0.053	0.088	.	0.314	.	0.908	0.924	.	0.670	0.910	0.844	0.047
	N	44	44	44	43	43	39	5	44	0	44	39	5	44	44	44	44
Copper, Total (mg/L)	Correlation Coefficient	0.004	-0.028	-0.258*	-0.262*	-0.288*	-0.235*	0.668	-0.291*	.	-0.229*	-0.072	.	-0.356*	-0.214*	-0.130	0.313*
	Significance (2-tailed)	0.974	0.824	0.026	0.027	0.015	0.074	0.142	0.020	.	0.070	0.626	.	0.003	0.071	0.264	0.011
	N	44	44	44	43	43	39	5	44	0	44	39	5	44	44	44	44
Iron, Total (mg/L)	Correlation Coefficient	-0.170	-0.201*	-0.055	-0.237*	-0.354*	-0.308*	0.359	-0.318*	.	-0.299*	-0.273*	.	-0.351*	-0.263*	-0.244*	0.735*
	Significance (2-tailed)	0.129	0.083	0.599	0.028	0.001	0.009	0.405	0.005	.	0.009	0.040	.	0.001	0.014	0.021	0.000
	N	44	44	44	43	43	39	5	44	0	44	39	5	44	44	44	44
Lead, Total (mg/L)	Correlation Coefficient	-0.113	-0.123	-0.040	-0.282*	-0.306*	-0.231*	-0.267	-0.096	.	-0.113	-0.063	.	-0.096	-0.057	-0.063	0.154
	Significance (2-tailed)	0.345	0.321	0.720	0.014	0.008	0.068	0.557	0.425	.	0.356	0.659	.	0.413	0.620	0.576	0.199
	N	44	44	44	43	43	39	5	44	0	44	39	5	44	44	44	44
Manganese, Total (mg/L)	Correlation Coefficient	-0.017	-0.028	0.081	-0.126	-0.206*	-0.199	0.598	-0.287*	.	-0.224*	-0.322*	.	-0.264*	-0.296*	-0.336*	0.677*
	Significance (2-tailed)	0.884	0.816	0.455	0.257	0.064	0.104	0.166	0.014	.	0.059	0.019	.	0.020	0.008	0.002	0.000
	N	44	44	44	43	43	39	5	44	0	44	39	5	44	44	44	44
Zinc, Total (mg/L)	Correlation Coefficient	-0.054	-0.051	-0.124	-0.219*	-0.218*	0.139	.	-0.191	.	-0.190	-0.380*	.	-0.194	-0.218*	-0.170	0.217
	Significance (2-tailed)	0.689	0.714	0.325	0.090	0.090	0.323	.	0.159	.	0.168	0.017	.	0.142	0.090	0.180	0.107
	N	44	44	44	43	43	39	5	44	0	44	39	5	44	44	44	44
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.056	-0.051	-0.108	-0.040	0.116	0.187	-0.143	-0.057	.	-0.130	0.067	.	0.024	0.045	0.044	-0.584*
	Significance (2-tailed)	0.662	0.692	0.360	0.743	0.339	0.186	0.660	0.654	.	0.315	0.676	.	0.846	0.712	0.712	0.000
	N	36	36	36	35	35	28	8	36	0	36	28	8	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.085	0.094	0.260*	-0.135	-0.035	0.133	.	-0.089	.	-0.018	0.141	.	0.060	0.091	0.129	-0.431*
	Significance (2-tailed)	0.548	0.525	0.055	0.335	0.801	0.347	.	0.541	.	0.902	0.371	.	0.674	0.512	0.341	0.002
	N	28	28	28	27	27	28	0	28	0	28	28	0	28	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	0.026	0.014	-0.176*	-0.245*	-0.097	-0.208*	0.146	-0.378*	.	-0.294*	0.052	.	-0.271*	-0.101	-0.167	-0.177
	Significance (2-tailed)	0.818	0.903	0.094	0.023	0.370	0.090	0.656	0.001	.	0.011	0.705	.	0.014	0.346	0.115	0.114
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	0.125	0.144	-0.217*	-0.421*	-0.417*	-0.277*	0.467	-0.312*	.	-0.424*	-0.272*	.	-0.377*	-0.310*	-0.239*	0.183*
	Significance (2-tailed)	0.242	0.194	0.031	0.000	0.000	0.018	0.145	0.004	.	0.000	0.038	.	0.000	0.003	0.018	0.087
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.050	0.018	-0.089	0.157	0.332*	0.336*	-0.046	-0.081	.	-0.089	.	.	0.045	0.057	-0.050	-0.420*
	Significance (2-tailed)	0.735	0.909	0.523	0.269	0.018	0.060	0.885	0.588	.	0.563	.	.	0.755	0.689	0.724	0.004
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	0.023	0.018	-0.477*	-0.025	-0.071	-0.103	0.046	-0.283*	.	-0.060	.	.	-0.324*	0.032	-0.162	0.156
	Significance (2-tailed)	0.875	0.909	0.001	0.860	0.612	0.565	0.885	0.058	.	0.694	.	.	0.026	0.824	0.250	0.290
	N	26	26	26	26	26	18	8	26	0	26	18	8	26	26	26	26
pH, (s.u.)	Correlation Coefficient	-0.011	-0.016	-0.027	0.029	-0.098	-0.123	-0.138	0.133	.	0.097	0.032	.	0.062	0.010	-0.029	0.233*
	Significance (2-tailed)	0.921	0.883	0.790	0.776	0.339	0.288	0.664	0.216	.	0.373	0.804	.	0.554	0.922	0.776	0.028
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	-0.065	-0.067	-0.037	0.357*	0.335*	0.318*	-0.504	0.633*	.	0.503*	0.393*	.	0.651*	0.476*	0.437*	-0.133
	Significance (2-tailed)	0.538	0.544	0.709	0.000	0.001	0.006	0.111	0.000	.	0.000	0.002	.	0.000	0.000	0.000	0.209
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Water Temperature (°C)	Correlation Coefficient	0.227*	0.227*	0.089	0.025	-0.142	-0.245*	0.046	-0.074	.	0.055	-0.158	.	-0.125	-0.079	-0.188*	0.393*
	Significance (2-tailed)	0.033	0.039	0.374	0.804	0.163	0.034	0.885	0.489	.	0.614	0.222	.	0.233	0.438	0.062	0.000
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.163	-0.181	-0.023	-0.167	-0.292*	-0.298*	0.321	-0.294*	.	-0.184*	-0.242*	.	-0.296*	-0.226*	-0.211*	0.826*
	Significance (2-tailed)	0.126	0.101	0.817	0.102	0.004	0.010	0.311	0.006	.	0.091	0.063	.	0.005	0.026	0.036	0.000
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Flow (CFS)	Correlation Coefficient	-0.150	-0.170	-0.082	-0.294*	-0.287*	-0.253*	0.229	-0.509*	.	-0.435*	-0.232*	.	-0.527*	-0.362*	-0.281*	0.467*
	Significance (2-tailed)	0.158	0.122	0.414	0.004	0.005	0.028	0.469	0.000	.	0.000	0.074	.	0.000	0.000	0.005	0.000
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48
Flow (probability)	Correlation Coefficient	-0.150	-0.170	-0.082	-0.294*	-0.287*	-0.253*	0.229	-0.509*	.	-0.435*	-0.232*	.	-0.527*	-0.362*	-0.281*	0.467*
	Significance (2-tailed)	0.158	0.122	0.414	0.004	0.005	0.028	0.469	0.000	.	0.000	0.074	.	0.000	0.000	0.005	0.000
	N	48	48	48	47	47	40	8	48	0	48	40	8	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-118: Kendall's tau correlation matrix of water quality parameters collected at Station 9 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	0.173	-0.118	0.004	-0.170	-0.113	-0.017	-0.054	-0.056	0.085	0.026	0.125	0.050	0.023	-0.011	-0.065	0.227*	-0.163	-0.150	-0.150
	Significance (2-tailed)	0.117	0.375	0.974	0.129	0.345	0.884	0.689	0.662	0.548	0.818	0.242	0.735	0.875	0.921	0.538	0.033	0.126	0.158	0.158
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Year Quarter	Correlation Coefficient	0.219*	-0.161	-0.028	-0.201*	-0.123	-0.028	-0.051	-0.051	0.094	0.014	0.144	0.018	0.018	-0.016	-0.067	0.227*	-0.181	-0.170	-0.170
	Significance (2-tailed)	0.055	0.244	0.824	0.083	0.321	0.816	0.714	0.692	0.525	0.903	0.194	0.909	0.909	0.883	0.544	0.039	0.101	0.122	0.122
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Date	Correlation Coefficient	0.103	-0.187	-0.258*	-0.055	-0.040	0.081	-0.124	-0.108	0.260*	-0.176*	-0.217*	-0.089	-0.477*	-0.027	-0.037	0.089	-0.023	-0.082	-0.082
	Significance (2-tailed)	0.320	0.136	0.026	0.599	0.720	0.455	0.325	0.360	0.055	0.094	0.031	0.523	0.001	0.790	0.709	0.374	0.817	0.414	0.414
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.187*	-0.270*	-0.262*	-0.237*	-0.282*	-0.126	-0.219*	-0.040	-0.135	-0.245*	-0.421*	0.157	-0.025	0.029	0.357*	0.025	-0.167	-0.294*	-0.294*
	Significance (2-tailed)	0.077	0.035	0.027	0.028	0.014	0.257	0.090	0.743	0.335	0.023	0.000	0.269	0.860	0.776	0.000	0.804	0.102	0.004	0.004
	N	47	43	43	43	43	43	43	35	27	47	47	26	26	47	47	47	47	47	47
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.224*	-0.248*	-0.288*	-0.354*	-0.306*	-0.206*	-0.218*	0.116	-0.035	-0.097	-0.417*	0.332*	-0.071	-0.098	0.335*	-0.142	-0.292*	-0.287*	-0.287*
	Significance (2-tailed)	0.034	0.053	0.015	0.001	0.008	0.064	0.090	0.339	0.801	0.370	0.000	0.018	0.612	0.339	0.001	0.163	0.004	0.005	0.005
	N	47	43	43	43	43	43	43	35	27	47	47	26	26	47	47	47	47	47	47
Calcium, Total (mg/L)	Correlation Coefficient	0.178	-0.239*	-0.235*	-0.308*	-0.231*	-0.199	0.139	0.187	0.133	-0.208*	-0.277*	0.336*	-0.103	-0.123	0.318*	-0.245*	-0.298*	-0.253*	-0.253*
	Significance (2-tailed)	0.137	0.088	0.074	0.009	0.068	0.104	0.323	0.186	0.347	0.090	0.018	0.060	0.565	0.288	0.006	0.034	0.010	0.028	0.028
	N	40	39	39	39	39	39	39	28	28	40	40	18	18	40	40	40	40	40	40
Calcium, Dissolved (mg/L)	Correlation Coefficient	-0.146	.	0.668	0.359	-0.267	0.598	.	-0.143	.	0.146	0.467	-0.046	0.046	-0.138	-0.504	0.046	0.321	0.229	0.229
	Significance (2-tailed)	0.658	.	0.142	0.405	0.557	0.166	.	0.660	.	0.656	0.145	0.885	0.885	0.664	0.111	0.885	0.311	0.469	0.469
	N	8	5	5	5	5	5	5	8	0	8	8	8	8	8	8	8	8	8	8
Chloride, Total (mg/L)	Correlation Coefficient	0.567*	-0.136	-0.291*	-0.318*	-0.096	-0.287*	-0.191	-0.057	-0.089	-0.378*	-0.312*	-0.081	-0.283*	0.133	0.633*	-0.074	-0.294*	-0.509*	-0.509*
	Significance (2-tailed)	0.000	0.314	0.020	0.005	0.425	0.014	0.159	0.654	0.541	0.001	0.004	0.588	0.058	0.216	0.000	0.489	0.006	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.235*	-0.016	-0.229*	-0.299*	-0.113	-0.224*	-0.190	-0.130	-0.018	-0.294*	-0.424*	-0.089	-0.060	0.097	0.503*	0.055	-0.184*	-0.435*	-0.435*
	Significance (2-tailed)	0.038	0.908	0.070	0.009	0.356	0.059	0.168	0.315	0.902	0.011	0.000	0.563	0.694	0.373	0.000	0.614	0.091	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Potassium, Total (mg/L)	Correlation Coefficient	0.252*	-0.015	-0.072	-0.273*	-0.063	-0.322*	-0.380*	0.067	0.141	0.052	-0.272*	.	.	0.032	0.393*	-0.158	-0.242*	-0.232*	-0.232*
	Significance (2-tailed)	0.061	0.924	0.626	0.040	0.659	0.019	0.017	0.676	0.371	0.705	0.038	.	.	0.804	0.002	0.222	0.063	0.074	0.074
	N	40	39	39	39	39	39	39	28	28	40	40	18	18	40	40	40	40	40	40
Potassium, Dissolved (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	8	5	5	5	5	5	5	8	0	8	8	8	8	8	8	8	8	8	8
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.456*	-0.056	-0.356*	-0.351*	-0.096	-0.264*	-0.194	0.024	0.060	-0.271*	-0.377*	0.045	-0.324*	0.062	0.651*	-0.125	-0.296*	-0.527*	-0.527*
	Significance (2-tailed)	0.000	0.670	0.003	0.001	0.413	0.020	0.142	0.846	0.674	0.014	0.000	0.755	0.026	0.554	0.000	0.233	0.005	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Sulfate, Total (mg/L)	Correlation Coefficient	0.229*	0.014	-0.214*	-0.263*	-0.057	-0.296*	-0.218*	0.045	0.091	-0.101	-0.310*	0.057	0.032	0.010	0.476*	-0.079	-0.226*	-0.362*	-0.362*
	Significance (2-tailed)	0.030	0.910	0.071	0.014	0.620	0.008	0.090	0.712	0.512	0.346	0.003	0.689	0.824	0.922	0.000	0.438	0.026	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.195*	0.025	-0.130	-0.244*	-0.063	-0.336*	-0.170	0.044	0.129	-0.167	-0.239*	-0.050	-0.162	-0.029	0.437*	-0.188*	-0.211*	-0.281*	-0.281*
	Significance (2-tailed)	0.062	0.844	0.264	0.021	0.576	0.002	0.180	0.712	0.341	0.115	0.018	0.724	0.250	0.776	0.000	0.062	0.036	0.005	0.005
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.475*	0.266*	0.313*	0.735*	0.154	0.677*	0.217	-0.584*	-0.431*	-0.177	0.183*	-0.420*	0.156	0.233*	-0.133	0.393*	0.826*	0.467*	0.467*
	Significance (2-tailed)	0.000	0.047	0.011	0.000	0.199	0.000	0.107	0.000	0.002	0.114	0.087	0.004	0.290	0.028	0.209	0.000	0.000	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	-0.269*	-0.417*	-0.534*	-0.193*	-0.455*	-0.182	0.112	0.151	-0.176	-0.230*	0.113	-0.397*	0.004	0.368*	-0.120	-0.496*	-0.598*	-0.598*
	Significance (2-tailed)	.	0.039	0.001	0.000	0.098	0.000	0.165	0.362	0.281	0.109	0.027	0.435	0.006	0.971	0.000	0.248	0.000	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	-0.269*	1.000	0.000	0.217*	0.260*	0.215*	-0.033	-0.205	-0.053	0.061	0.256*	.	.	0.011	0.011	-0.025	0.233*	0.159	0.159
	Significance (2-tailed)	0.039	.	1.000	0.086	0.053	0.099	0.827	0.175	0.746	0.646	0.042	.	.	0.933	0.933	0.844	0.063	0.205	0.205
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Copper, Total (mg/L)	Correlation Coefficient	-0.417*	0.000	1.000	0.317*	0.232*	0.138	0.093	-0.220	-0.245	0.132	0.232*	-0.295*	0.286*	0.051	-0.285*	0.193*	0.315*	0.365*	0.365*
	Significance (2-tailed)	0.001	1.000	.	0.007	0.062	0.255	0.505	0.117	0.112	0.283	0.047	0.068	0.077	0.660	0.014	0.096	0.007	0.002	0.002
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Iron, Total (mg/L)	Correlation Coefficient	-0.534*	0.217*	0.317*	1.000	0.202*	0.652*	0.185	-0.379*	-0.275*	-0.027	0.207*	-0.531*	0.325*	0.241*	-0.243*	0.348*	0.853*	0.550*	0.550*
	Significance (2-tailed)	0.000	0.086	0.007	.	0.075	0.000	0.145	0.003	0.049	0.812	0.052	0.000	0.030	0.022	0.021	0.001	0.000	0.000	0.000
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Lead, Total (mg/L)	Correlation Coefficient	-0.193*	0.260*	0.232*	0.202*	1.000	0.102	0.094	-0.233*	-0.134	-0.058	0.088	-0.363*	0.098	0.081	-0.021	0.184	0.179	0.088	0.088
	Significance (2-tailed)	0.098	0.053	0.062	0.075	.	0.382	0.487	0.086	0.383	0.629	0.435	0.022	0.534	0.474	0.850	0.100	0.112	0.436	0.436
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Manganese, Total (mg/L)	Correlation Coefficient	-0.455*	0.215*	0.138	0.652*	0.102	1.000	0.204	-0.396*	-0.177	-0.031	0.309*	-0.380*	0.234	0.168	-0.210*	0.342*	0.662*	0.484*	0.484*
	Significance (2-tailed)	0.000	0.099	0.255	0.000	0.382	.	0.121	0.002	0.238	0.786	0.005	0.013	0.124	0.122	0.053	0.002	0.000	0.000	0.000
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Zinc, Total (mg/L)	Correlation Coefficient	-0.182	-0.033	0.093	0.185	0.094	0.204	1.000	-0.057	-0.117	-0.129	0.195	.	.	-0.089	-0.074	0.055	0.184	0.183	0.183
	Significance (2-tailed)	0.165	0.827	0.505	0.145	0.487	0.121	.	0.704	0.479	0.335	0.124	.	.	0.478	0.555	0.665	0.145	0.145	0.145
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	0.112	-0.205	-0.220	-0.379*	-0.233*	-0.396*	-0.057	1.000	0.940*	0.572*	0.044	0.699*	0.005	-0.378*	-0.060	-0.527*	-0.441*	-0.079	-0.079
	Significance (2-tailed)	0.362	0.175	0.117	0.003	0.086	0.002	0.704	.	0.000	0.000	0.712	0.000	0.974	0.001	0.614	0.000	0.000	0.504	0.504
	N	36	32	32	32	32	32	32	36	16	36	36	20	20	36	36	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.151	-0.053	-0.245	-0.275*	-0.134	-0.177	-0.117	0.940*	1.000	0.451*	-0.033	0.867*	-0.467	-0.581*	-0.030	-0.448*	-0.401*	-0.078	-0.078
	Significance (2-tailed)	0.281	0.746	0.112	0.049	0.383	0.238	0.479	0.000	.	0.002	0.812	0.015	0.188	0.000	0.828	0.001	0.003	0.566	0.566
	N	28	27	27	27	27	27	27	16	28	28	28	6	6	28	28	28	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.176	0.061	0.132	-0.027	-0.058	-0.031	-0.129	0.572*	0.451*	1.000	0.227*	0.388*	0.184	-0.336*	-0.306*	-0.262*	-0.121	0.220*	0.220*
	Significance (2-tailed)	0.109	0.646	0.283	0.812	0.629	0.786	0.335	0.000	0.002	.	0.033	0.008	0.208	0.001	0.004	0.013	0.251	0.037	0.037
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.230*	0.256*	0.232*	0.207*	0.088	0.309*	0.195	0.044	-0.033	0.227*	1.000	0.046	0.170	-0.121	-0.341*	-0.028	0.186*	0.250*	0.250*
	Significance (2-tailed)	0.027	0.042	0.047	0.052	0.435	0.005	0.124	0.712	0.812	0.033	.	0.741	0.225	0.230	0.001	0.783	0.064	0.013	0.013
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.113	.	-0.295*	-0.531*	-0.363*	-0.380*	.	0.699*	0.867*	0.388*	0.046	1.000	-0.003	-0.507*	-0.151	-0.815*	-0.462*	-0.083	-0.083
	Significance (2-tailed)	0.435	.	0.068	0.000	0.022	0.013	.	0.000	0.015	0.008	0.741	.	0.982	0.000	0.280	0.000	0.001	0.552	0.552
	N	26	23	23	23	23	23	23	20	6	26	26	26	26	26	26	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.397*	.	0.286*	0.325*	0.098	0.234	.	0.005	-0.467	0.184	0.170	-0.003	1.000	0.019	-0.157	0.175	0.247*	0.329*	0.329*
	Significance (2-tailed)	0.006	.	0.077	0.030	0.534	0.124	.	0.974	0.188	0.208	0.225	0.982	.	0.895	0.261	0.209	0.078	0.018	0.018
	N	26	23	23	23	23	23	23	20	6	26	26	26	26	26	26	26	26	26	26
pH, (s.u.)	Correlation Coefficient	0.004	0.011	0.051	0.241*	0.081	0.168	-0.089	-0.378*	-0.581*	-0.336*	-0.121	-0.507*	0.019	1.000	0.156	0.501*	0.300*	-0.043	-0.043
	Significance (2-tailed)	0.971	0.933	0.660	0.022	0.474	0.122	0.478	0.001	0.000	0.001	0.230	0.000	0.895	.	0.118	0.000	0.003	0.670	0.670
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	0.368*	0.011	-0.285*	-0.243*	-0.021	-0.210*	-0.074	-0.060	-0.030	-0.306*	-0.341*	-0.151	-0.157	0.156	1.000	-0.005	-0.206*	-0.480*	-0.480*
	Significance (2-tailed)	0.000	0.933	0.014	0.021	0.850	0.053	0.555	0.614	0.828	0.004	0.001	0.280	0.261	0.118	.	0.957	0.039	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Water Temperature (°C)	Correlation Coefficient	-0.120	-0.025	0.193*	0.348*	0.184	0.342*	0.055	-0.527*	-0.448*	-0.262*	-0.028	-0.815*	0.175	0.501*	-0.005	1.000	0.400*	0.099	0.099
	Significance (2-tailed)	0.248	0.844	0.096	0.001	0.100	0.002	0.665	0.000	0.001	0.013	0.783	0.000	0.209	0.000	0.957	.	0.000	0.320	0.320
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.496*	0.233*	0.315*	0.853*	0.179	0.662*	0.184	-0.441*	-0.401*	-0.121	0.186*	-0.462*	0.247*	0.300*	-0.206*	0.400*	1.000	0.480*	0.480*
	Significance (2-tailed)	0.000	0.063	0.007	0.000	0.112	0.000	0.145	0.000	0.003	0.251	0.064	0.001	0.078	0.003	0.039	0.000	.	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Flow (CFS)	Correlation Coefficient	-0.598*	0.159	0.365*	0.550*	0.088	0.484*	0.183	-0.079	-0.078	0.220*	0.250*	-0.083	0.329*	-0.043	-0.480*	0.099	0.480*	1.000	1.000
	Significance (2-tailed)	0.000	0.205	0.002	0.000	0.436	0.000	0.145	0.504	0.566	0.037	0.013	0.552	0.018	0.670	0.000	0.320	0.000	.	.
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Flow (probability)	Correlation Coefficient	-0.598*	0.159	0.365*	0.550*	0.088	0.484*	0.183	-0.079	-0.078	0.220*	0.250*	-0.083	0.329*	-0.043	-0.480*	0.099	0.480*	1.000	1.000
	Significance (2-tailed)	0.000	0.205	0.002	0.000	0.436	0.000	0.145	0.504	0.566	0.037	0.013	0.552	0.018	0.670	0.000	0.320	0.000	.	.
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-119: Kendall's tau correlation matrix of water quality parameters collected at Station 10 from 2007 to 2015.

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Month	Correlation Coefficient	1.000	0.951*	0.106	0.145	0.116	0.163	0.292	-0.111	.	0.151	-0.129	0.194	-0.027	0.045	-0.060	-0.105
	Significance (2-tailed)	.	0.000	0.319	0.179	0.284	0.184	0.338	0.338	.	0.188	0.360	0.549	0.805	0.676	0.574	0.359
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Year Quarter	Correlation Coefficient	0.951*	1.000	0.109	0.152	0.113	0.159	0.292	-0.100	.	0.170	-0.137	0.194	-0.033	0.039	-0.074	-0.123
	Significance (2-tailed)	0.000	.	0.320	0.175	0.311	0.215	0.338	0.406	.	0.152	0.352	0.549	0.774	0.726	0.507	0.299
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Date	Correlation Coefficient	0.106	0.109	1.000	0.227*	0.212*	0.087	0.433	0.045	.	0.228*	-0.022	0.354	0.197*	0.204*	0.111	0.014
	Significance (2-tailed)	0.319	0.320	.	0.025	0.036	0.456	0.132	0.681	.	0.034	0.871	0.245	0.060	0.045	0.270	0.895
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.145	0.152	0.227*	1.000	0.876*	0.485*	0.313	0.462*	.	0.490*	0.144	0.369	0.496*	0.489*	0.479*	-0.151
	Significance (2-tailed)	0.179	0.175	0.025	.	0.000	0.000	0.288	0.000	.	0.000	0.286	0.237	0.000	0.000	0.000	0.167
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.116	0.113	0.212*	0.876*	1.000	0.495*	-0.035	0.461*	.	0.446*	0.144	0.000	0.458*	0.467*	0.513*	-0.233*
	Significance (2-tailed)	0.284	0.311	0.036	0.000	.	0.000	0.906	0.000	.	0.000	0.287	1.000	0.000	0.000	0.000	0.033
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.163	0.159	0.087	0.485*	0.495*	1.000	.	0.380*	.	0.653*	0.110	.	0.500*	0.481*	0.508*	-0.329*
	Significance (2-tailed)	0.184	0.215	0.456	0.000	0.000	.	.	0.003	.	0.000	0.428	.	0.000	0.000	0.000	0.009
	N	39	39	39	39	39	39	0	39	0	39	39	0	39	39	39	39
Calcium, Dissolved (mg/L)	Correlation Coefficient	0.292	0.292	0.433	0.313	-0.035	.	1.000	0.302	.	0.275	.	0.566*	0.149	-0.209	0.033	0.183
	Significance (2-tailed)	0.338	0.338	0.132	0.288	0.906	.	.	0.326	.	0.383	.	0.088	0.625	0.478	0.908	0.544
	N	9	9	9	9	9	0	9	9	0	9	0	9	9	9	9	9
Chloride, Total (mg/L)	Correlation Coefficient	-0.111	-0.100	0.045	0.462*	0.461*	0.380*	0.302	1.000	.	0.415*	0.276*	0.200	0.626*	0.448*	0.515*	-0.152
	Significance (2-tailed)	0.338	0.406	0.681	0.000	0.000	0.003	0.326	.	.	0.000	0.055	0.540	0.000	0.000	0.000	0.193
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.151	0.170	0.228*	0.490*	0.446*	0.653*	0.275	0.415*	.	1.000	0.317*	0.416	0.687*	0.671*	0.516*	-0.253*
	Significance (2-tailed)	0.188	0.152	0.034	0.000	0.000	0.000	0.383	0.000	.	.	0.027	0.214	0.000	0.000	0.000	0.029
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Potassium, Total (mg/L)	Correlation Coefficient	-0.129	-0.137	-0.022	0.144	0.144	0.110	.	0.276*	.	0.317*	1.000	.	0.401*	0.388*	0.205	0.063
	Significance (2-tailed)	0.360	0.352	0.871	0.286	0.287	0.428	.	0.055	.	0.027	.	.	0.004	0.004	0.127	0.661
	N	39	39	39	39	39	39	0	39	0	39	39	0	39	39	39	39
Potassium, Dissolved (mg/L)	Correlation Coefficient	0.194	0.194	0.354	0.369	0.000	.	0.566*	0.200	.	0.416	.	1.000	0.525	0.123	0.354	0.258
	Significance (2-tailed)	0.549	0.549	0.245	0.237	1.000	.	0.088	0.540	.	0.214	.	.	0.104	0.694	0.245	0.418
	N	9	9	9	9	9	0	9	9	0	9	0	9	9	9	9	9
Sodium, Dissolved (mg/L)	Correlation Coefficient	-0.027	-0.033	0.197*	0.496*	0.458*	0.500*	0.149	0.626*	.	0.687*	0.401*	0.525	1.000	0.629*	0.552*	-0.081
	Significance (2-tailed)	0.805	0.774	0.060	0.000	0.000	0.000	0.625	0.000	.	0.000	0.004	0.104	.	0.000	0.000	0.472
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Sulfate, Total (mg/L)	Correlation Coefficient	0.045	0.039	0.204*	0.489*	0.467*	0.481*	-0.209	0.448*	.	0.671*	0.388*	0.123	0.629*	1.000	0.480*	-0.213*
	Significance (2-tailed)	0.676	0.726	0.045	0.000	0.000	0.000	0.478	0.000	.	0.000	0.004	0.694	0.000	.	0.000	0.051
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	-0.060	-0.074	0.111	0.479*	0.513*	0.508*	0.033	0.515*	.	0.516*	0.205	0.354	0.552*	0.480*	1.000	-0.238*
	Significance (2-tailed)	0.574	0.507	0.270	0.000	0.000	0.000	0.908	0.000	.	0.000	0.127	0.245	0.000	0.000	.	0.028
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.105	-0.123	0.014	-0.151	-0.233*	-0.329*	0.183	-0.152	.	-0.253*	0.063	0.258	-0.081	-0.213*	-0.238*	1.000
	Significance (2-tailed)	0.359	0.299	0.895	0.167	0.033	0.009	0.544	0.193	.	0.029	0.661	0.418	0.472	0.051	0.028	.
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48

Parameter	Statistic	Month	Year Quarter	Date	Alkalinity as CaCO3, Total (mg/L)	Bicarbonate as HCO3, Total (mg/L)	Calcium, Total (mg/L)	Calcium, Dissolved (mg/L)	Chloride, Total (mg/L)	Magnesium, Total (mg/L)	Magnesium, Dissolved (mg/L)	Potassium, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Total (mg/L)	Dissolved Solids, Total (mg/L)	Suspended Solids, Total (mg/L)
Arsenic, Total (mg/L)	Correlation Coefficient	0.175	0.214*	0.122	0.339*	0.318*	0.348*	0.212	0.526*	.	0.341*	0.114	-0.063	0.429*	0.268*	0.275*	-0.277*
	Significance (2-tailed)	0.116	0.063	0.243	0.001	0.003	0.004	0.476	0.000	.	0.002	0.414	0.843	0.000	0.012	0.009	0.014
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	0.061	0.067	0.120	-0.070	-0.091	-0.209	0.632	-0.216	.	-0.249*	-0.050	.	-0.199	-0.244*	-0.285*	0.312*
	Significance (2-tailed)	0.648	0.628	0.338	0.581	0.475	0.140	0.157	0.112	.	0.065	0.760	.	0.128	0.055	0.023	0.022
	N	44	44	44	44	44	38	6	44	0	44	38	6	44	44	44	44
Copper, Total (mg/L)	Correlation Coefficient	0.057	0.061	-0.250*	-0.164	-0.187	-0.266*	0.784*	-0.261*	.	-0.326*	0.131	.	-0.290*	-0.309*	-0.307*	0.520*
	Significance (2-tailed)	0.639	0.633	0.030	0.162	0.109	0.042	0.057	0.037	.	0.009	0.385	.	0.016	0.008	0.008	0.000
	N	44	44	44	44	44	38	6	44	0	44	38	6	44	44	44	44
Iron, Total (mg/L)	Correlation Coefficient	-0.031	-0.048	-0.028	-0.261*	-0.337*	-0.399*	0.472	-0.343*	.	-0.377*	-0.081	.	-0.302*	-0.379*	-0.419*	0.748*
	Significance (2-tailed)	0.781	0.682	0.792	0.016	0.002	0.001	0.240	0.003	.	0.001	0.552	.	0.006	0.000	0.000	0.000
	N	44	44	44	44	44	38	6	44	0	44	38	6	44	44	44	44
Lead, Total (mg/L)	Correlation Coefficient	0.057	0.071	0.032	-0.131	-0.103	-0.136	0.756*	-0.088	.	-0.171	-0.022	.	-0.140	-0.240*	-0.109	0.186
	Significance (2-tailed)	0.631	0.565	0.777	0.252	0.366	0.282	0.060	0.471	.	0.157	0.882	.	0.232	0.036	0.334	0.126
	N	44	44	44	44	44	38	6	44	0	44	38	6	44	44	44	44
Manganese, Total (mg/L)	Correlation Coefficient	-0.028	-0.031	0.132	-0.067	-0.137	-0.312*	0.548	-0.088	.	-0.241*	0.014	.	-0.080	-0.187*	-0.267*	0.696*
	Significance (2-tailed)	0.810	0.799	0.226	0.544	0.217	0.012	0.165	0.454	.	0.040	0.923	.	0.481	0.092	0.015	0.000
	N	44	44	44	44	44	38	6	44	0	44	38	6	44	44	44	44
Zinc, Total (mg/L)	Correlation Coefficient	-0.172	-0.181	-0.134	-0.132	-0.116	0.033	.	-0.017	.	-0.105	-0.028	.	0.016	-0.121	0.020	-0.127
	Significance (2-tailed)	0.200	0.193	0.288	0.305	0.364	0.818	.	0.904	.	0.442	0.864	.	0.905	0.344	0.875	0.354
	N	44	44	44	44	44	38	6	44	0	44	38	6	44	44	44	44
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	-0.013	-0.017	-0.036	0.012	0.117	0.163	-0.274	0.009	.	0.083	-0.038	-0.182	0.016	0.115	0.150	-0.584*
	Significance (2-tailed)	0.921	0.898	0.763	0.923	0.337	0.261	0.349	0.944	.	0.519	0.816	0.558	0.900	0.343	0.212	0.000
	N	36	36	36	36	36	27	9	36	0	36	27	9	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	0.068	0.070	0.250*	-0.134	-0.073	0.011	.	-0.167	.	0.097	0.052	.	-0.034	0.162	-0.057	-0.373*
	Significance (2-tailed)	0.631	0.637	0.065	0.330	0.592	0.936	.	0.254	.	0.510	0.743	.	0.809	0.241	0.677	0.010
	N	28	28	28	28	28	28	0	28	0	28	28	0	28	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	0.046	0.032	-0.173	-0.157	-0.059	0.017	-0.557*	-0.140	.	-0.017	0.116	-0.263	-0.165	0.082	-0.083	-0.295*
	Significance (2-tailed)	0.683	0.784	0.103	0.146	0.583	0.891	0.067	0.223	.	0.880	0.409	0.416	0.136	0.448	0.438	0.010
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	0.120	0.137	-0.234*	-0.284*	-0.211*	-0.245*	0.101	-0.129	.	-0.215*	0.037	0.239	-0.203*	-0.183*	-0.190*	0.202*
	Significance (2-tailed)	0.264	0.220	0.021	0.006	0.039	0.037	0.727	0.241	.	0.048	0.781	0.437	0.054	0.076	0.062	0.064
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.037	0.018	-0.169	-0.081	0.062	0.171	-0.367	-0.109	.	-0.088	.	-0.471	-0.094	-0.050	-0.056	-0.475*
	Significance (2-tailed)	0.804	0.909	0.225	0.565	0.659	0.356	0.202	0.467	.	0.555	.	0.121	0.517	0.723	0.691	0.002
	N	26	26	26	26	26	17	9	26	0	26	17	9	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	0.017	0.039	-0.520*	-0.426*	-0.449*	-0.279	-0.300	-0.478*	.	-0.373*	.	-0.354	-0.471*	-0.321*	-0.496*	0.056
	Significance (2-tailed)	0.910	0.800	0.000	0.003	0.001	0.131	0.297	0.001	.	0.013	.	0.245	0.001	0.024	0.000	0.709
	N	26	26	26	26	26	17	9	26	0	26	17	9	26	26	26	26
pH, (s.u.)	Correlation Coefficient	-0.026	-0.043	-0.070	-0.049	-0.104	-0.030	-0.433	-0.164	.	-0.145	-0.009	-0.236	-0.156	-0.116	-0.011	0.216*
	Significance (2-tailed)	0.807	0.699	0.488	0.630	0.310	0.797	0.132	0.134	.	0.180	0.945	0.439	0.139	0.257	0.915	0.045
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	-0.012	-0.004	-0.019	0.453*	0.417*	0.422*	0.167	0.625*	.	0.584*	0.366*	0.354	0.689*	0.559*	0.543*	-0.141
	Significance (2-tailed)	0.913	0.971	0.852	0.000	0.000	0.000	0.562	0.000	.	0.000	0.006	0.245	0.000	0.000	0.000	0.189
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Water Temperature (°C)	Correlation Coefficient	0.236*	0.236*	0.107	0.038	-0.094	-0.169	0.300	-0.104	.	-0.073	-0.095	0.471	-0.068	-0.141	-0.198*	0.438*
	Significance (2-tailed)	0.026	0.032	0.282	0.708	0.354	0.146	0.297	0.337	.	0.497	0.474	0.121	0.513	0.164	0.049	0.000
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.016	-0.033	0.043	-0.168*	-0.243*	-0.380*	0.233	-0.273*	.	-0.270*	-0.040	0.354	-0.159	-0.259*	-0.301*	0.797*
	Significance (2-tailed)	0.878	0.761	0.670	0.099	0.017	0.001	0.417	0.012	.	0.012	0.764	0.245	0.127	0.011	0.003	0.000
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Flow (CFS)	Correlation Coefficient	-0.208*	-0.221*	-0.121	-0.385*	-0.402*	-0.540*	-0.300	-0.488*	.	-0.587*	-0.065	-0.236	-0.512*	-0.483*	-0.434*	0.429*
	Significance (2-tailed)	0.050	0.045	0.227	0.000	0.000	0.000	0.297	0.000	.	0.000	0.627	0.439	0.000	0.000	0.000	0.000
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48
Flow (probability)	Correlation Coefficient	-0.208*	-0.221*	-0.121	-0.385*	-0.402*	-0.540*	-0.300	-0.488*	.	-0.587*	-0.065	-0.236	-0.512*	-0.483*	-0.434*	0.429*
	Significance (2-tailed)	0.050	0.045	0.227	0.000	0.000	0.000	0.297	0.000	.	0.000	0.627	0.439	0.000	0.000	0.000	0.000
	N	48	48	48	48	48	39	9	48	0	48	39	9	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Table B-120: Kendall's tau correlation matrix of water quality parameters collected at Station 10 from 2007 to 2015 (cont.).

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Month	Correlation Coefficient	0.175	0.061	0.057	-0.031	0.057	-0.028	-0.172	-0.013	0.068	0.046	0.120	0.037	0.017	-0.026	-0.012	0.236*	-0.016	-0.208*	-0.208*
	Significance (2-tailed)	0.116	0.648	0.639	0.781	0.631	0.810	0.200	0.921	0.631	0.683	0.264	0.804	0.910	0.807	0.913	0.026	0.878	0.050	0.050
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Year Quarter	Correlation Coefficient	0.214*	0.067	0.061	-0.048	0.071	-0.031	-0.181	-0.017	0.070	0.032	0.137	0.018	0.039	-0.043	-0.004	0.236*	-0.033	-0.221*	-0.221*
	Significance (2-tailed)	0.063	0.628	0.633	0.682	0.565	0.799	0.193	0.898	0.637	0.784	0.220	0.909	0.800	0.699	0.971	0.032	0.761	0.045	0.045
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Date	Correlation Coefficient	0.122	0.120	-0.250*	-0.028	0.032	0.132	-0.134	-0.036	0.250*	-0.173	-0.234*	-0.169	-0.520*	-0.070	-0.019	0.107	0.043	-0.121	-0.121
	Significance (2-tailed)	0.243	0.338	0.030	0.792	0.777	0.226	0.288	0.763	0.065	0.103	0.021	0.225	0.000	0.488	0.852	0.282	0.670	0.227	0.227
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Alkalinity as CaCO3, Total (mg/L)	Correlation Coefficient	0.339*	-0.070	-0.164	-0.261*	-0.131	-0.067	-0.132	0.012	-0.134	-0.157	-0.284*	-0.081	-0.426*	-0.049	0.453*	0.038	-0.168*	-0.385*	-0.385*
	Significance (2-tailed)	0.001	0.581	0.162	0.016	0.252	0.544	0.305	0.923	0.330	0.146	0.006	0.565	0.003	0.630	0.000	0.708	0.099	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Bicarbonate as HCO3, Total (mg/L)	Correlation Coefficient	0.318*	-0.091	-0.187	-0.337*	-0.103	-0.137	-0.116	0.117	-0.073	-0.059	-0.211*	0.062	-0.449*	-0.104	0.417*	-0.094	-0.243*	-0.402*	-0.402*
	Significance (2-tailed)	0.003	0.475	0.109	0.002	0.366	0.217	0.364	0.337	0.592	0.583	0.039	0.659	0.001	0.310	0.000	0.354	0.017	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Calcium, Total (mg/L)	Correlation Coefficient	0.348*	-0.209	-0.266*	-0.399*	-0.136	-0.312*	0.033	0.163	0.011	0.017	-0.245*	0.171	-0.279	-0.030	0.422*	-0.169	-0.380*	-0.540*	-0.540*
	Significance (2-tailed)	0.004	0.140	0.042	0.001	0.282	0.012	0.818	0.261	0.936	0.891	0.037	0.356	0.131	0.797	0.000	0.146	0.001	0.000	0.000
	N	39	38	38	38	38	38	38	27	28	39	39	17	17	39	39	39	39	39	39
Calcium, Dissolved (mg/L)	Correlation Coefficient	0.212	0.632	0.784*	0.472	0.756*	0.548	.	-0.274	.	-0.557*	0.101	-0.367	-0.300	-0.433	0.167	0.300	0.233	-0.300	-0.300
	Significance (2-tailed)	0.476	0.157	0.057	0.240	0.060	0.165	.	0.349	.	0.067	0.727	0.202	0.297	0.132	0.562	0.297	0.417	0.297	0.297
	N	9	6	6	6	6	6	6	9	0	9	9	9	9	9	9	9	9	9	9
Chloride, Total (mg/L)	Correlation Coefficient	0.526*	-0.216	-0.261*	-0.343*	-0.088	-0.088	-0.017	0.009	-0.167	-0.140	-0.129	-0.109	-0.478*	-0.164	0.625*	-0.104	-0.273*	-0.488*	-0.488*
	Significance (2-tailed)	0.000	0.112	0.037	0.003	0.471	0.454	0.904	0.944	0.254	0.223	0.241	0.467	0.001	0.134	0.000	0.337	0.012	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Magnesium, Total (mg/L)	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Significance (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnesium, Dissolved (mg/L)	Correlation Coefficient	0.341*	-0.249*	-0.326*	-0.377*	-0.171	-0.241*	-0.105	0.083	0.097	-0.017	-0.215*	-0.088	-0.373*	-0.145	0.584*	-0.073	-0.270*	-0.587*	-0.587*
	Significance (2-tailed)	0.002	0.065	0.009	0.001	0.157	0.040	0.442	0.519	0.510	0.880	0.048	0.555	0.013	0.180	0.000	0.497	0.012	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Potassium, Total (mg/L)	Correlation Coefficient	0.114	-0.050	0.131	-0.081	-0.022	0.014	-0.028	-0.038	0.052	0.116	0.037	.	.	-0.009	0.366*	-0.095	-0.040	-0.065	-0.065
	Significance (2-tailed)	0.414	0.760	0.385	0.552	0.882	0.923	0.864	0.816	0.743	0.409	0.781	.	.	0.945	0.006	0.474	0.764	0.627	0.627
	N	39	38	38	38	38	38	38	27	28	39	39	17	17	39	39	39	39	39	39
Potassium, Dissolved (mg/L)	Correlation Coefficient	-0.063	.	.	.	.	.	.	-0.182	.	-0.263	0.239	-0.471	-0.354	-0.236	0.354	0.471	0.354	-0.236	-0.236
	Significance (2-tailed)	0.843	.	.	.	.	.	.	0.558	.	0.416	0.437	0.121	0.245	0.439	0.245	0.121	0.245	0.439	0.439
	N	9	6	6	6	6	6	6	9	0	9	9	9	9	9	9	9	9	9	9
Sodium, Dissolved (mg/L)	Correlation Coefficient	0.429*	-0.199	-0.290*	-0.302*	-0.140	-0.080	0.016	0.016	-0.034	-0.165	-0.203*	-0.094	-0.471*	-0.156	0.689*	-0.068	-0.159	-0.512*	-0.512*
	Significance (2-tailed)	0.000	0.128	0.016	0.006	0.232	0.481	0.905	0.900	0.809	0.136	0.054	0.517	0.001	0.139	0.000	0.513	0.127	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Sulfate, Total (mg/L)	Correlation Coefficient	0.268*	-0.244*	-0.309*	-0.379*	-0.240*	-0.187*	-0.121	0.115	0.162	0.082	-0.183*	-0.050	-0.321*	-0.116	0.559*	-0.141	-0.259*	-0.483*	-0.483*
	Significance (2-tailed)	0.012	0.055	0.008	0.000	0.036	0.092	0.344	0.343	0.241	0.448	0.076	0.723	0.024	0.257	0.000	0.164	0.011	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Solids, Total (mg/L)	Correlation Coefficient	0.275*	-0.285*	-0.307*	-0.419*	-0.109	-0.267*	0.020	0.150	-0.057	-0.083	-0.190*	-0.056	-0.496*	-0.011	0.543*	-0.198*	-0.301*	-0.434*	-0.434*
	Significance (2-tailed)	0.009	0.023	0.008	0.000	0.334	0.015	0.875	0.212	0.677	0.438	0.062	0.691	0.000	0.915	0.000	0.049	0.003	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Suspended Solids, Total (mg/L)	Correlation Coefficient	-0.277*	0.312*	0.520*	0.748*	0.186	0.696*	-0.127	-0.584*	-0.373*	-0.295*	0.202*	-0.475*	0.056	0.216*	-0.141	0.438*	0.797*	0.429*	0.429*
	Significance (2-tailed)	0.014	0.022	0.000	0.000	0.126	0.000	0.354	0.000	0.010	0.010	0.064	0.002	0.709	0.045	0.189	0.000	0.000	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48

Parameter	Statistic	Arsenic, Total (mg/L)	Cadmium, Total (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Manganese, Total (mg/L)	Zinc, Total (mg/L)	Nitrite Nitrate, Total (mg/L)	Nitrite Nitrate, Dissolved (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Total (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	pH, (s.u.)	Specific Conductance (µS/cm)	Water Temperature (°C)	Turbidity (NTU)	Flow (CFS)	Flow (probability)
Arsenic, Total (mg/L)	Correlation Coefficient	1.000	-0.156	-0.267*	-0.384*	-0.143	-0.122	0.136	0.123	-0.008	-0.117	-0.086	0.000	-0.386*	-0.151	0.419*	-0.040	-0.279*	-0.547*	-0.547*
	Significance (2-tailed)	.	0.233	0.027	0.001	0.224	0.286	0.302	0.325	0.952	0.290	0.413	1.000	0.008	0.151	0.000	0.699	0.007	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Cadmium, Total (mg/L)	Correlation Coefficient	-0.156	1.000	0.193	0.297*	0.309*	0.347*	-0.048	-0.191	0.146	0.081	0.188	0.000	0.256	-0.072	-0.278*	0.150	0.278*	0.278*	0.278*
	Significance (2-tailed)	0.233	.	0.161	0.019	0.022	0.008	0.752	0.211	0.374	0.544	0.136	1.000	0.145	0.568	0.026	0.229	0.026	0.026	0.026
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Copper, Total (mg/L)	Correlation Coefficient	-0.267*	0.193	1.000	0.448*	0.160	0.253*	0.127	-0.234*	-0.265*	-0.121	0.197*	-0.289*	0.363*	0.253*	-0.175	0.339*	0.420*	0.379*	0.379*
	Significance (2-tailed)	0.027	0.161	.	0.000	0.194	0.035	0.360	0.093	0.084	0.322	0.090	0.078	0.027	0.029	0.128	0.003	0.000	0.001	0.001
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Iron, Total (mg/L)	Correlation Coefficient	-0.384*	0.297*	0.448*	1.000	0.183	0.628*	-0.095	-0.463*	-0.189	-0.275*	0.177*	-0.444*	0.204	0.256*	-0.311*	0.464*	0.853*	0.584*	0.584*
	Significance (2-tailed)	0.001	0.019	0.000	.	0.106	0.000	0.454	0.000	0.174	0.014	0.098	0.003	0.177	0.016	0.003	0.000	0.000	0.000	0.000
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Lead, Total (mg/L)	Correlation Coefficient	-0.143	0.309*	0.160	0.183	1.000	0.225*	-0.072	0.037	0.054	0.004	0.185	-0.098	-0.132	-0.158	-0.174	0.056	0.152	0.192*	0.192*
	Significance (2-tailed)	0.224	0.022	0.194	0.106	.	0.055	0.597	0.788	0.723	0.974	0.104	0.534	0.402	0.163	0.121	0.615	0.176	0.088	0.088
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Manganese, Total (mg/L)	Correlation Coefficient	-0.122	0.347*	0.253*	0.628*	0.225*	1.000	-0.168	-0.501*	-0.196	-0.299*	0.196*	-0.302*	0.052	0.132	-0.174	0.410*	0.670*	0.382*	0.382*
	Significance (2-tailed)	0.286	0.008	0.035	0.000	0.055	.	0.202	0.000	0.192	0.010	0.075	0.047	0.730	0.230	0.110	0.000	0.000	0.000	0.000
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Zinc, Total (mg/L)	Correlation Coefficient	0.136	-0.048	0.127	-0.095	-0.072	-0.168	1.000	0.241	0.191	-0.005	-0.015	.	.	0.140	0.094	-0.104	-0.089	-0.015	-0.015
	Significance (2-tailed)	0.302	0.752	0.360	0.454	0.597	0.202	.	0.115	0.247	0.968	0.906	.	.	0.270	0.454	0.408	0.478	0.906	0.906
	N	44	44	44	44	44	44	44	32	27	44	44	23	23	44	44	44	44	44	44
Nitrite Nitrate, Total (mg/L)	Correlation Coefficient	0.123	-0.191	-0.234*	-0.463*	0.037	-0.501*	0.241	1.000	0.970*	0.617*	0.077	0.620*	0.081	-0.310*	-0.002	-0.494*	-0.481*	-0.141	-0.141
	Significance (2-tailed)	0.325	0.211	0.093	0.000	0.788	0.000	0.115	.	0.000	0.000	0.528	0.000	0.625	0.010	0.989	0.000	0.000	0.239	0.239
	N	36	32	32	32	32	32	32	36	16	36	36	20	20	36	36	36	36	36	36
Nitrite Nitrate, Dissolved (mg/L)	Correlation Coefficient	-0.008	0.146	-0.265*	-0.189	0.054	-0.196	0.191	0.970*	1.000	0.506*	0.074	0.828*	-0.828*	-0.431*	-0.065	-0.459*	-0.263*	-0.070	-0.070
	Significance (2-tailed)	0.952	0.374	0.084	0.174	0.723	0.192	0.247	0.000	.	0.000	0.591	0.022	0.022	0.002	0.634	0.001	0.052	0.606	0.606
	N	28	27	27	27	27	27	27	16	28	28	28	6	6	28	28	28	28	28	28
Nitrogen, Total (mg/L)	Correlation Coefficient	-0.117	0.081	-0.121	-0.275*	0.004	-0.299*	-0.005	0.617*	0.506*	1.000	0.249*	0.553*	0.270*	-0.252*	-0.137	-0.435*	-0.290*	0.003	0.003
	Significance (2-tailed)	0.290	0.544	0.322	0.014	0.974	0.010	0.968	0.000	0.000	.	0.020	0.000	0.065	0.018	0.195	0.000	0.006	0.978	0.978
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Phosphorus, Total (mg/L)	Correlation Coefficient	-0.086	0.188	0.197*	0.177*	0.185	0.196*	-0.015	0.077	0.074	0.249*	1.000	0.068	0.149	-0.094	-0.166*	-0.013	0.191*	0.124	0.124
	Significance (2-tailed)	0.413	0.136	0.090	0.098	0.104	0.075	0.906	0.528	0.591	0.020	.	0.627	0.289	0.354	0.099	0.894	0.059	0.219	0.219
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Dissolved Oxygen (mg/L)	Correlation Coefficient	0.000	0.000	-0.289*	-0.444*	-0.098	-0.302*	.	0.620*	0.828*	0.553*	0.068	1.000	0.206	-0.318*	-0.255*	-0.754*	-0.431*	0.022	0.022
	Significance (2-tailed)	1.000	1.000	0.078	0.003	0.534	0.047	.	0.000	0.022	0.000	0.627	.	0.140	0.023	0.067	0.000	0.002	0.877	0.877
	N	26	23	23	23	23	23	23	20	6	26	26	26	26	26	26	26	26	26	26
Dissolved Oxygen (% Sat.)	Correlation Coefficient	-0.386*	0.256	0.363*	0.204	-0.132	0.052	.	0.081	-0.828*	0.270*	0.149	0.206	1.000	0.262*	-0.446*	0.040	0.105	0.471*	0.471*
	Significance (2-tailed)	0.008	0.145	0.027	0.177	0.402	0.730	.	0.625	0.022	0.065	0.289	0.140	.	0.061	0.001	0.774	0.453	0.001	0.001
	N	26	23	23	23	23	23	23	20	6	26	26	26	26	26	26	26	26	26	26
pH, (s.u.)	Correlation Coefficient	-0.151	-0.072	0.253*	0.256*	-0.158	0.132	0.140	-0.310*	-0.431*	-0.252*	-0.094	-0.318*	0.262*	1.000	-0.063	0.378*	0.256*	0.211*	0.211*
	Significance (2-tailed)	0.151	0.568	0.029	0.016	0.163	0.230	0.270	0.010	0.002	0.018	0.354	0.023	0.061	.	0.528	0.000	0.011	0.036	0.036
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Specific Conductance (µS/cm)	Correlation Coefficient	0.419*	-0.278*	-0.175	-0.311*	-0.174	-0.174	0.094	-0.002	-0.065	-0.137	-0.166*	-0.255*	-0.446*	-0.063	1.000	-0.048	-0.216*	-0.518*	-0.518*
	Significance (2-tailed)	0.000	0.026	0.128	0.003	0.121	0.110	0.454	0.989	0.634	0.195	0.099	0.067	0.001	0.528	.	0.631	0.031	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Water Temperature (°C)	Correlation Coefficient	-0.040	0.150	0.339*	0.464*	0.056	0.410*	-0.104	-0.494*	-0.459*	-0.435*	-0.013	-0.754*	0.040	0.378*	-0.048	1.000	0.512*	0.111	0.111
	Significance (2-tailed)	0.699	0.229	0.003	0.000	0.615	0.000	0.408	0.000	0.001	0.000	0.894	0.000	0.774	0.000	0.631	.	0.000	0.266	0.266
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Turbidity (NTU)	Correlation Coefficient	-0.279*	0.278*	0.420*	0.853*	0.152	0.670*	-0.089	-0.481*	-0.263*	-0.290*	0.191*	-0.431*	0.105	0.256*	-0.216*	0.512*	1.000	0.434*	0.434*
	Significance (2-tailed)	0.007	0.026	0.000	0.000	0.176	0.000	0.478	0.000	0.052	0.006	0.059	0.002	0.453	0.011	0.031	0.000	.	0.000	0.000
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Flow (CFS)	Correlation Coefficient	-0.547*	0.278*	0.379*	0.584*	0.192*	0.382*	-0.015	-0.141	-0.070	0.003	0.124	0.022	0.471*	0.211*	-0.518*	0.111	0.434*	1.000	1.000
	Significance (2-tailed)	0.000	0.026	0.001	0.000	0.088	0.000	0.906	0.239	0.606	0.978	0.219	0.877	0.001	0.036	0.000	0.266	0.000	.	.
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48
Flow (probability)	Correlation Coefficient	-0.547*	0.278*	0.379*	0.584*	0.192*	0.382*	-0.015	-0.141	-0.070	0.003	0.124	0.022	0.471*	0.211*	-0.518*	0.111	0.434*	1.000	1.000
	Significance (2-tailed)	0.000	0.026	0.001	0.000	0.088	0.000	0.906	0.239	0.606	0.978	0.219	0.877	0.001	0.036	0.000	0.266	0.000	.	.
	N	48	44	44	44	44	44	44	36	28	48	48	26	26	48	48	48	48	48	48

*Correlation is significant at the 0.10 level (2-tailed).
Sulfate, Dissolved (mg/L) was not included because N=0 in all years at all stations.

Appendix B.3 Upstream-Downstream Comparisons

Table B-121: Rank comparisons of water quality analytes between Stations 1 and 2 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Alkalinity as CaCO3, Total (mg/L)	1	48	62.86	3,017.50
	2	48	34.14	1,638.50
	Total	96		
Bicarbonate as HCO3, Total (mg/L)	1	48	62.76	3,012.50
	2	48	34.24	1,643.50
	Total	96		
Calcium, Total (mg/L)	1	36	18.67	672.00
	2	36	54.33	1,956.00
	Total	72		
Calcium, Dissolved (mg/L)	1	8	4.50	36.00
	2	8	12.50	100.00
	Total	16		
Chloride, Total (mg/L)	1	48	68.01	3,264.50
	2	48	28.99	1,391.50
	Total	96		
Magnesium, Dissolved (mg/L)	1	44	22.50	990.00
	2	44	66.50	2,926.00
	Total	88		
Potassium, Total (mg/L)	1	36	51.08	1,839.00
	2	36	21.92	789.00
	Total	72		
Potassium, Dissolved (mg/L)	1	8	12.50	100.00
	2	8	4.50	36.00
	Total	16		
Sodium, Dissolved (mg/L)	1	44	61.94	2,725.50
	2	44	27.06	1,190.50
	Total	88		
Sulfate, Total (mg/L)	1	48	63.20	3,033.50
	2	48	33.80	1,622.50
	Total	96		
Dissolved Solids, Total (mg/L)	1	48	67.05	3,218.50
	2	48	29.95	1,437.50
	Total	96		
Suspended Solids, Total (mg/L)	1	48	54.50	2,616.00
	2	48	42.50	2,040.00
	Total	96		
Arsenic, Total (mg/L)	1	48	70.55	3,386.50
	2	48	26.45	1,269.50
	Total	96		
Cadmium, Total (mg/L)	1	13	13.50	175.50
	2	13	13.50	175.50
	Total	26		
Copper, Total (mg/L)	1	13	17.19	223.50
	2	13	9.81	127.50
	Total	26		

Analyte	Station	N	Mean Rank	Sum of Ranks
Iron, Total (mg/L)	1	13	18.19	236.50
	2	13	8.81	114.50
	Total	26		
Lead, Total (mg/L)	1	13	14.00	182.00
	2	13	13.00	169.00
	Total	26		
Manganese, Total (mg/L)	1	13	14.69	191.00
	2	13	12.31	160.00
	Total	26		
Zinc, Total (mg/L)	1	13	13.50	175.50
	2	13	13.50	175.50
	Total	26		
Nitrite Nitrate, Total (mg/L)	1	36	42.57	1,532.50
	2	36	30.43	1,095.50
	Total	72		
Nitrite Nitrate, Dissolved (mg/L)	1	28	34.25	959.00
	2	28	22.75	637.00
	Total	56		
Nitrogen, Total (mg/L)	1	48	41.04	1,970.00
	2	48	55.96	2,686.00
	Total	96		
Phosphorus, Total (mg/L)	1	48	48.61	2,333.50
	2	48	48.39	2,322.50
	Total	96		
Dissolved Oxygen (mg/L)	1	26	21.19	551.00
	2	25	31.00	775.00
	Total	51		
Dissolved Oxygen (% Sat.)	1	26	14.85	386.00
	2	25	37.60	940.00
	Total	51		
pH, (s.u.)	1	48	37.42	1,796.00
	2	47	58.81	2,764.00
	Total	95		
Specific Conductance (µS/cm)	1	48	64.44	3,093.00
	2	47	31.21	1,467.00
	Total	95		
Water Temperature (°C)	1	48	51.64	2,478.50
	2	47	44.29	2,081.50
	Total	95		
Turbidity (NTU)	1	48	65.52	3,145.00
	2	47	30.11	1,415.00
	Total	95		
Flow (CFS)	1	48	29.95	1,437.50
	2	48	67.05	3,218.50
	Total	96		
Flow (probability)	1	48	49.54	2,378.00
	2	48	47.46	2,278.00
	Total	96		

Table B-122: Mann–Whitney *U* test results for water quality analytes at Stations 1 and 2 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Alkalinity as CaCO3, Total (mg/L)	462.500	1,638.500	-5.054	0.000
Bicarbonate as HCO3, Total (mg/L)	467.500	1,643.500	-5.017	0.000
Calcium, Total (mg/L)	6.000	672.000	-7.370	0.000
Calcium, Dissolved (mg/L)	0.000	36.000	-3.478	0.001
Chloride, Total (mg/L)	215.500	1,391.500	-6.865	0.000
Magnesium, Dissolved (mg/L)	0.000	990.000	-9.030	0.000
Potassium, Total (mg/L)	123.000	789.000	-6.014	0.000
Potassium, Dissolved (mg/L)	0.000	36.000	-3.467	0.001
Sodium, Dissolved (mg/L)	200.500	1,190.500	-6.408	0.000
Sulfate, Total (mg/L)	446.500	1,622.500	-5.208	0.000
Dissolved Solids, Total (mg/L)	261.500	1,437.500	-6.526	0.000
Suspended Solids, Total (mg/L)	864.000	2,040.000	-3.673	0.000
Arsenic, Total (mg/L)	93.500	1,269.500	-7.757	0.000
Cadmium, Total (mg/L)	84.500	175.500	0.000	1.000
Copper, Total (mg/L)	36.500	127.500	-2.920	0.004
Iron, Total (mg/L)	23.500	114.500	-3.140	0.002
Lead, Total (mg/L)	78.000	169.000	-1.000	0.317
Manganese, Total (mg/L)	69.000	160.000	-0.815	0.415
Zinc, Total (mg/L)	84.500	175.500	0.000	1.000
Nitrite Nitrate, Total (mg/L)	429.500	1,095.500	-2.490	0.013
Nitrite Nitrate, Dissolved (mg/L)	231.000	637.000	-2.677	0.007
Nitrogen, Total (mg/L)	794.000	1,970.000	-2.665	0.008
Phosphorus, Total (mg/L)	1,146.500	2,322.500	-0.040	0.968
Dissolved Oxygen (mg/L)	200.000	551.000	-2.355	0.019
Dissolved Oxygen (% Sat.)	35.000	386.000	-5.465	0.000
pH, (s.u.)	620.000	1,796.000	-3.782	0.000
Specific Conductance (µS/cm)	339.000	1,467.000	-5.873	0.000
Water Temperature (°C)	953.500	2,081.500	-1.299	0.194
Turbidity (NTU)	287.000	1,415.000	-6.262	0.000
Flow (CFS)	261.500	1,437.500	-6.526	0.000
Flow (probability)	1,102.000	2,278.000	-0.366	0.714

Table B-123: Rank comparisons of water quality analytes between Stations 2 and 3 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Alkalinity as CaCO3, Total (mg/L)	2	48	40.42	1,940.00
	3	48	56.58	2,716.00
	Total	96		
Bicarbonate as HCO3, Total (mg/L)	2	48	40.55	1,946.50
	3	48	56.45	2,709.50
	Total	96		
Calcium, Total (mg/L)	2	36	18.53	667.00
	3	36	54.47	1,961.00
	Total	72		
Calcium, Dissolved (mg/L)	2	8	4.50	36.00
	3	8	12.50	100.00
	Total	16		
Chloride, Total (mg/L)	2	48	62.29	2,990.00
	3	48	34.71	1,666.00
	Total	96		
Magnesium, Dissolved (mg/L)	2	44	22.58	993.50
	3	44	66.42	2,922.50
	Total	88		
Potassium, Total (mg/L)	2	36	45.38	1,633.50
	3	36	27.63	994.50
	Total	72		
Potassium, Dissolved (mg/L)	2	8	12.00	96.00
	3	8	5.00	40.00
	Total	16		
Sodium, Dissolved (mg/L)	2	44	56.92	2,504.50
	3	44	32.08	1,411.50
	Total	88		
Sulfate, Total (mg/L)	2	48	41.10	1,973.00
	3	48	55.90	2,683.00
	Total	96		
Dissolved Solids, Total (mg/L)	2	48	55.97	2,686.50
	3	48	41.03	1,969.50
	Total	96		
Suspended Solids, Total (mg/L)	2	48	44.00	2,112.00
	3	48	53.00	2,544.00
	Total	96		
Arsenic, Total (mg/L)	2	48	64.33	3,088.00
	3	48	32.67	1,568.00
	Total	96		
Cadmium, Total (mg/L)	2	13	13.50	175.50
	3	13	13.50	175.50
	Total	26		
Copper, Total (mg/L)	2	13	10.85	141.00
	3	13	16.15	210.00
	Total	26		

Analyte	Station	N	Mean Rank	Sum of Ranks
Iron, Total (mg/L)	2	13	11.96	155.50
	3	13	15.04	195.50
	Total	26		
Lead, Total (mg/L)	2	13	13.00	169.00
	3	13	14.00	182.00
	Total	26		
Manganese, Total (mg/L)	2	13	15.69	204.00
	3	13	11.31	147.00
	Total	26		
Zinc, Total (mg/L)	2	13	13.50	175.50
	3	13	13.50	175.50
	Total	26		
Nitrite Nitrate, Total (mg/L)	2	36	32.36	1,165.00
	3	36	40.64	1,463.00
	Total	72		
Nitrite Nitrate, Dissolved (mg/L)	2	28	22.73	636.50
	3	28	34.27	959.50
	Total	56		
Nitrogen, Total (mg/L)	2	48	50.24	2,411.50
	3	48	46.76	2,244.50
	Total	96		
Phosphorus, Total (mg/L)	2	48	50.46	2,422.00
	3	48	46.54	2,234.00
	Total	96		
Dissolved Oxygen (mg/L)	2	25	20.60	515.00
	3	25	30.40	760.00
	Total	50		
Dissolved Oxygen (% Sat.)	2	25	21.64	541.00
	3	25	29.36	734.00
	Total	50		
pH, (s.u.)	2	47	40.85	1,920.00
	3	47	54.15	2,545.00
	Total	94		
Specific Conductance (µS/cm)	2	47	51.55	2,423.00
	3	47	43.45	2,042.00
	Total	94		
Water Temperature (°C)	2	47	51.00	2,397.00
	3	47	44.00	2,068.00
	Total	94		
Turbidity (NTU)	2	47	28.69	1,348.50
	3	47	66.31	3,116.50
	Total	94		
Flow (CFS)	2	48	26.98	1,295.00
	3	19	51.74	983.00
	Total	67		
Flow (probability)	2	48	31.33	1,504.00
	3	19	40.74	774.00
	Total	67		

Table B-124: Mann–Whitney *U* test results for water quality analytes at Stations 2 and 3 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Alkalinity as CaCO3, Total (mg/L)	764.000	1,940.000	-2.845	0.004
Bicarbonate as HCO3, Total (mg/L)	770.500	1,946.500	-2.797	0.005
Calcium, Total (mg/L)	1.000	667.000	-7.424	0.000
Calcium, Dissolved (mg/L)	0.000	36.000	-3.422	0.001
Chloride, Total (mg/L)	490.000	1,666.000	-4.856	0.000
Magnesium, Dissolved (mg/L)	3.500	993.500	-8.793	0.000
Potassium, Total (mg/L)	328.500	994.500	-3.778	0.000
Potassium, Dissolved (mg/L)	4.000	40.000	-3.070	0.002
Sodium, Dissolved (mg/L)	421.500	1,411.500	-4.564	0.000
Sulfate, Total (mg/L)	797.000	1,973.000	-2.640	0.008
Dissolved Solids, Total (mg/L)	793.500	1,969.500	-2.627	0.009
Suspended Solids, Total (mg/L)	936.000	2,112.000	-3.130	0.002
Arsenic, Total (mg/L)	392.000	1,568.000	-5.570	0.000
Cadmium, Total (mg/L)	84.500	175.500	0.000	1.000
Copper, Total (mg/L)	50.000	141.000	-2.268	0.023
Iron, Total (mg/L)	64.500	155.500	-1.038	0.299
Lead, Total (mg/L)	78.000	169.000	-1.000	0.317
Manganese, Total (mg/L)	56.000	147.000	-1.628	0.104
Zinc, Total (mg/L)	84.500	175.500	0.000	1.000
Nitrite Nitrate, Total (mg/L)	499.000	1,165.000	-1.702	0.089
Nitrite Nitrate, Dissolved (mg/L)	230.500	636.500	-2.681	0.007
Nitrogen, Total (mg/L)	1,068.500	2,244.500	-0.622	0.534
Phosphorus, Total (mg/L)	1,058.000	2,234.000	-0.690	0.490
Dissolved Oxygen (mg/L)	190.000	515.000	-2.377	0.017
Dissolved Oxygen (% Sat.)	216.000	541.000	-1.873	0.061
pH, (s.u.)	792.000	1,920.000	-2.363	0.018
Specific Conductance (µS/cm)	914.000	2,042.000	-1.441	0.150
Water Temperature (°C)	940.000	2,068.000	-1.244	0.214
Turbidity (NTU)	220.500	1,348.500	-6.687	0.000
Flow (CFS)	119.000	1,295.000	-4.688	0.000
Flow (probability)	328.000	1,504.000	-1.781	0.075

Table B-125: Rank comparisons of water quality analytes between Stations 3 and 4 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Alkalinity as CaCO3, Total (mg/L)	3	48	32.15	1,543.00
	4	48	64.85	3,113.00
	Total	96		
Bicarbonate as HCO3, Total (mg/L)	3	48	33.55	1,610.50
	4	48	63.45	3,045.50
	Total	96		
Calcium, Total (mg/L)	3	36	19.08	687.00
	4	36	53.92	1,941.00
	Total	72		
Calcium, Dissolved (mg/L)	3	8	4.75	38.00
	4	8	12.25	98.00
	Total	16		
Chloride, Total (mg/L)	3	48	53.42	2,564.00
	4	48	43.58	2,092.00
	Total	96		
Magnesium, Dissolved (mg/L)	3	44	24.30	1,069.00
	4	44	64.70	2,847.00
	Total	88		
Potassium, Total (mg/L)	3	36	38.17	1,374.00
	4	36	34.83	1,254.00
	Total	72		
Potassium, Dissolved (mg/L)	3	8	9.25	74.00
	4	8	7.75	62.00
	Total	16		
Sodium, Dissolved (mg/L)	3	44	48.91	2,152.00
	4	44	40.09	1,764.00
	Total	88		
Sulfate, Total (mg/L)	3	48	30.46	1,462.00
	4	48	66.54	3,194.00
	Total	96		
Dissolved Solids, Total (mg/L)	3	48	43.90	2,107.00
	4	48	53.10	2,549.00
	Total	96		
Suspended Solids, Total (mg/L)	3	48	48.15	2,311.00
	4	48	48.85	2,345.00
	Total	96		
Arsenic, Total (mg/L)	3	48	56.53	2,713.50
	4	48	40.47	1,942.50
	Total	96		
Cadmium, Total (mg/L)	3	13	13.00	169.00
	4	13	14.00	182.00
	Total	26		
Copper, Total (mg/L)	3	13	14.54	189.00
	4	13	12.46	162.00
	Total	26		

Analyte	Station	N	Mean Rank	Sum of Ranks
Iron, Total (mg/L)	3	13	10.00	130.00
	4	13	17.00	221.00
	Total	26		
Lead, Total (mg/L)	3	13	14.00	182.00
	4	13	13.00	169.00
	Total	26		
Manganese, Total (mg/L)	3	13	9.50	123.50
	4	13	17.50	227.50
	Total	26		
Zinc, Total (mg/L)	3	13	13.50	175.50
	4	13	13.50	175.50
	Total	26		
Nitrite Nitrate, Total (mg/L)	3	36	38.94	1,402.00
	4	36	34.06	1,226.00
	Total	72		
Nitrite Nitrate, Dissolved (mg/L)	3	28	30.93	866.00
	4	28	26.07	730.00
	Total	56		
Nitrogen, Total (mg/L)	3	48	41.65	1,999.00
	4	48	55.35	2,657.00
	Total	96		
Phosphorus, Total (mg/L)	3	48	44.58	2,140.00
	4	48	52.42	2,516.00
	Total	96		
Dissolved Oxygen (mg/L)	3	25	28.60	715.00
	4	25	22.40	560.00
	Total	50		
Dissolved Oxygen (% Sat.)	3	25	30.48	762.00
	4	25	20.52	513.00
	Total	50		
pH, (s.u.)	3	47	45.00	2,115.00
	4	47	50.00	2,350.00
	Total	94		
Specific Conductance (µS/cm)	3	47	39.49	1,856.00
	4	47	55.51	2,609.00
	Total	94		
Water Temperature (°C)	3	47	43.28	2,034.00
	4	47	51.72	2,431.00
	Total	94		
Turbidity (NTU)	3	47	37.10	1,743.50
	4	47	57.90	2,721.50
	Total	94		
Flow (CFS)	3	19	29.08	552.50
	4	48	35.95	1,725.50
	Total	67		
Flow (probability)	3	19	36.95	702.00
	4	48	32.83	1,576.00
	Total	67		

Table B-126: Mann–Whitney *U* test results for water quality analytes at Stations 3 and 4 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Alkalinity as CaCO3, Total (mg/L)	367.000	1,543.000	-5.756	0.000
Bicarbonate as HCO3, Total (mg/L)	434.500	1,610.500	-5.260	0.000
Calcium, Total (mg/L)	21.000	687.000	-7.141	0.000
Calcium, Dissolved (mg/L)	2.000	38.000	-3.181	0.001
Chloride, Total (mg/L)	916.000	2,092.000	-1.732	0.083
Magnesium, Dissolved (mg/L)	79.000	1,069.000	-7.938	0.000
Potassium, Total (mg/L)	588.000	1,254.000	-0.720	0.472
Potassium, Dissolved (mg/L)	26.000	62.000	-0.732	0.464
Sodium, Dissolved (mg/L)	774.000	1,764.000	-1.620	0.105
Sulfate, Total (mg/L)	286.000	1,462.000	-6.415	0.000
Dissolved Solids, Total (mg/L)	931.000	2,107.000	-1.620	0.105
Suspended Solids, Total (mg/L)	1,135.000	2,311.000	-0.176	0.861
Arsenic, Total (mg/L)	766.500	1,942.500	-2.825	0.005
Cadmium, Total (mg/L)	78.000	169.000	-1.000	0.317
Copper, Total (mg/L)	71.000	162.000	-0.774	0.439
Iron, Total (mg/L)	39.000	130.000	-2.341	0.019
Lead, Total (mg/L)	78.000	169.000	-1.000	0.317
Manganese, Total (mg/L)	32.500	123.500	-2.789	0.005
Zinc, Total (mg/L)	84.500	175.500	0.000	1.000
Nitrite Nitrate, Total (mg/L)	560.000	1,226.000	-1.005	0.315
Nitrite Nitrate, Dissolved (mg/L)	324.000	730.000	-1.126	0.260
Nitrogen, Total (mg/L)	823.000	1,999.000	-2.439	0.015
Phosphorus, Total (mg/L)	964.000	2,140.000	-1.381	0.167
Dissolved Oxygen (mg/L)	235.000	560.000	-1.504	0.133
Dissolved Oxygen (% Sat.)	188.000	513.000	-2.416	0.016
pH, (s.u.)	987.000	2,115.000	-0.889	0.374
Specific Conductance (µS/cm)	728.000	1,856.000	-2.847	0.004
Water Temperature (°C)	906.000	2,034.000	-1.501	0.133
Turbidity (NTU)	615.500	1,743.500	-3.699	0.000
Flow (CFS)	362.500	552.500	-1.301	0.193
Flow (probability)	400.000	1,576.000	-0.779	0.436

Table B-127: Kruskal-Wallis *H* rank results for dissolved oxygen by season at Station 3 from 2011 to 2016.

Analyte	Season	N	Mean Rank
Dissolved Oxygen (mg/L)	Jan-Mar	5	20.0
	Apr-Jun	5	11.0
	Jul-Sep	8	4.5
	Oct-Dec	8	20.0
	Total	26	
Dissolved Oxygen (% Sat.)	Jan-Mar	5	9.3
	Apr-Jun	5	13.4
	Jul-Sep	8	18.2
	Oct-Dec	8	11.4
	Total	26	

Table B-128: Kruskal-Wallis *H* test statistics for dissolved oxygen by season at Station 3 from 2011 to 2016.

Analyte	Chi-Square	df	Asymp. Sig. (2-tailed)
Dissolved Oxygen (mg/L)	21.000	3	0.000
Dissolved Oxygen (% Sat.)	5.179	3	0.159

Table B-129: Kruskal-Wallis *H* rank results for dissolved oxygen by season at Station 4 from 2011 to 2016.

Analyte	Season	N	Mean Rank
Dissolved Oxygen (mg/L)	Jan-Mar	5	21.0
	Apr-Jun	5	10.6
	Jul-Sep	8	5.0
	Oct-Dec	8	19.1
	Total	26	
Dissolved Oxygen (% Sat.)	Jan-Mar	5	14.6
	Apr-Jun	5	13.8
	Jul-Sep	8	13.0
	Oct-Dec	8	13.1
	Total	26	

Table B-130: Kruskal-Wallis *H* test statistics for dissolved oxygen by season at Station 4 from 2011 to 2016.

Analyte	Chi-Square	df	Asymp. Sig. (2-tailed)
Dissolved Oxygen (mg/L)	19.734	3	0.000
Dissolved Oxygen (% Sat.)	0.165	3	0.983

Table B-131: Rank comparisons of water quality analytes between Stations 4 and 5 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Alkalinity as CaCO3, Total (mg/L)	4	48	33.78	1,621.50
	5	48	63.22	3,034.50
	Total	96		
Bicarbonate as HCO3, Total (mg/L)	4	48	33.67	1,616.00
	5	48	63.33	3,040.00
	Total	96		
Calcium, Total (mg/L)	4	36	19.13	688.50
	5	36	53.88	1,939.50
	Total	72		
Calcium, Dissolved (mg/L)	4	8	4.50	36.00
	5	8	12.50	100.00
	Total	16		
Chloride, Total (mg/L)	4	48	67.45	3,237.50
	5	48	29.55	1,418.50
	Total	96		
Magnesium, Dissolved (mg/L)	4	44	24.61	1,083.00
	5	44	64.39	2,833.00
	Total	88		
Potassium, Total (mg/L)	4	36	40.36	1,453.00
	5	36	32.64	1,175.00
	Total	72		
Potassium, Dissolved (mg/L)	4	8	9.63	77.00
	5	8	7.38	59.00
	Total	16		
Sodium, Dissolved (mg/L)	4	44	62.25	2,739.00
	5	44	26.75	1,177.00
	Total	88		
Sulfate, Total (mg/L)	4	48	25.46	1,222.00
	5	48	71.54	3,434.00
	Total	96		
Dissolved Solids, Total (mg/L)	4	48	38.66	1,855.50
	5	48	58.34	2,800.50
	Total	96		
Suspended Solids, Total (mg/L)	4	48	36.05	1,730.50
	5	48	60.95	2,925.50
	Total	96		
Arsenic, Total (mg/L)	4	48	71.52	3,433.00
	5	48	25.48	1,223.00
	Total	96		
Cadmium, Total (mg/L)	4	13	13.00	169.00
	5	13	14.00	182.00
	Total	26		
Copper, Total (mg/L)	4	13	7.54	98.00
	5	13	19.46	253.00
	Total	26		

Analyte	Station	N	Mean Rank	Sum of Ranks
Iron, Total (mg/L)	4	13	9.85	128.00
	5	13	17.15	223.00
	Total	26		
Lead, Total (mg/L)	4	13	11.50	149.50
	5	13	15.50	201.50
	Total	26		
Manganese, Total (mg/L)	4	13	12.31	160.00
	5	13	14.69	191.00
	Total	26		
Zinc, Total (mg/L)	4	13	12.50	162.50
	5	13	14.50	188.50
	Total	26		
Nitrite Nitrate, Total (mg/L)	4	36	25.19	907.00
	5	36	47.81	1,721.00
	Total	72		
Nitrite Nitrate, Dissolved (mg/L)	4	28	19.54	547.00
	5	28	37.46	1,049.00
	Total	56		
Nitrogen, Total (mg/L)	4	48	30.38	1,458.00
	5	48	66.63	3,198.00
	Total	96		
Phosphorus, Total (mg/L)	4	48	44.45	2,133.50
	5	48	52.55	2,522.50
	Total	96		
Dissolved Oxygen (mg/L)	4	25	26.52	663.00
	5	26	25.50	663.00
	Total	51		
Dissolved Oxygen (% Sat.)	4	25	29.32	733.00
	5	26	22.81	593.00
	Total	51		
pH, (s.u.)	4	47	47.68	2,241.00
	5	48	48.31	2,319.00
	Total	95		
Specific Conductance (μS/cm)	4	47	36.94	1,736.00
	5	48	58.83	2,824.00
	Total	95		
Water Temperature (°C)	4	47	49.87	2,344.00
	5	48	46.17	2,216.00
	Total	95		
Turbidity (NTU)	4	47	34.82	1,636.50
	5	48	60.91	2,923.50
	Total	95		
Flow (CFS)	4	48	29.07	1,395.50
	5	48	67.93	3,260.50
	Total	96		
Flow (probability)	4	48	46.42	2,228.00
	5	48	50.58	2,428.00
	Total	96		

Table B-132: Mann–Whitney *U* test results for water quality analytes at Stations 4 and 5 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Alkalinity as CaCO3, Total (mg/L)	445.500	1,621.500	-5.179	0.000
Bicarbonate as HCO3, Total (mg/L)	440.000	1,616.000	-5.218	0.000
Calcium, Total (mg/L)	22.500	688.500	-7.064	0.000
Calcium, Dissolved (mg/L)	0.000	36.000	-3.368	0.001
Chloride, Total (mg/L)	242.500	1,418.500	-6.681	0.000
Magnesium, Dissolved (mg/L)	93.000	1,083.000	-7.431	0.000
Potassium, Total (mg/L)	509.000	1,175.000	-1.719	0.086
Potassium, Dissolved (mg/L)	23.000	59.000	-1.108	0.268
Sodium, Dissolved (mg/L)	187.000	1,177.000	-6.527	0.000
Sulfate, Total (mg/L)	46.000	1,222.000	-8.122	0.000
Dissolved Solids, Total (mg/L)	679.500	1,855.500	-3.463	0.001
Suspended Solids, Total (mg/L)	554.500	1,730.500	-4.776	0.000
Arsenic, Total (mg/L)	47.000	1,223.000	-8.099	0.000
Cadmium, Total (mg/L)	78.000	169.000	-0.601	0.548
Copper, Total (mg/L)	7.000	98.000	-4.127	0.000
Iron, Total (mg/L)	37.000	128.000	-2.438	0.015
Lead, Total (mg/L)	58.500	149.500	-2.123	0.034
Manganese, Total (mg/L)	69.000	160.000	-0.843	0.399
Zinc, Total (mg/L)	71.500	162.500	-1.442	0.149
Nitrite Nitrate, Total (mg/L)	241.000	907.000	-4.606	0.000
Nitrite Nitrate, Dissolved (mg/L)	141.000	547.000	-4.130	0.000
Nitrogen, Total (mg/L)	282.000	1,458.000	-6.416	0.000
Phosphorus, Total (mg/L)	957.500	2,133.500	-1.427	0.153
Dissolved Oxygen (mg/L)	312.000	663.000	-0.245	0.806
Dissolved Oxygen (% Sat.)	242.000	593.000	-1.564	0.118
pH, (s.u.)	1,113.000	2,241.000	-0.112	0.911
Specific Conductance (µS/cm)	608.000	1,736.000	-3.871	0.000
Water Temperature (°C)	1,040.000	2,216.000	-0.655	0.512
Turbidity (NTU)	508.500	1,636.500	-4.612	0.000
Flow (CFS)	219.500	1,395.500	-6.833	0.000
Flow (probability)	1,052.000	2,228.000	-0.733	0.464

Table B-133: Rank comparisons of water quality analytes between Stations 5 and 6 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Alkalinity as CaCO3, Total (mg/L)	5	48	50.60	2,429.00
	6	48	46.40	2,227.00
	Total	96		
Bicarbonate as HCO3, Total (mg/L)	5	48	49.41	2,371.50
	6	48	47.59	2,284.50
	Total	96		
Calcium, Total (mg/L)	5	36	36.86	1,327.00
	6	36	36.14	1,301.00
	Total	72		
Calcium, Dissolved (mg/L)	5	8	7.81	62.50
	6	8	9.19	73.50
	Total	16		
Chloride, Total (mg/L)	5	48	56.50	2,712.00
	6	48	40.50	1,944.00
	Total	96		
Magnesium, Dissolved (mg/L)	5	44	46.39	2,041.00
	6	44	42.61	1,875.00
	Total	88		
Potassium, Total (mg/L)	5	36	41.33	1,488.00
	6	36	31.67	1,140.00
	Total	72		
Potassium, Dissolved (mg/L)	5	8	9.13	73.00
	6	8	7.88	63.00
	Total	16		
Sodium, Dissolved (mg/L)	5	44	51.82	2,280.00
	6	44	37.18	1,636.00
	Total	88		
Sulfate, Total (mg/L)	5	48	50.22	2,410.50
	6	48	46.78	2,245.50
	Total	96		
Dissolved Solids, Total (mg/L)	5	48	51.69	2,481.00
	6	48	45.31	2,175.00
	Total	96		
Suspended Solids, Total (mg/L)	5	48	65.00	3,120.00
	6	48	32.00	1,536.00
	Total	96		
Arsenic, Total (mg/L)	5	48	58.77	2,821.00
	6	48	38.23	1,835.00
	Total	96		
Cadmium, Total (mg/L)	5	13	14.08	183.00
	6	13	12.92	168.00
	Total	26		
Copper, Total (mg/L)	5	13	15.23	198.00
	6	13	11.77	153.00
	Total	26		

Analyte	Station	N	Mean Rank	Sum of Ranks
Iron, Total (mg/L)	5	13	18.38	239.00
	6	13	8.62	112.00
	Total	26		
Lead, Total (mg/L)	5	13	14.08	183.00
	6	13	12.92	168.00
	Total	26		
Manganese, Total (mg/L)	5	13	16.12	209.50
	6	13	10.88	141.50
	Total	26		
Zinc, Total (mg/L)	5	13	14.50	188.50
	6	13	12.50	162.50
	Total	26		
Nitrite Nitrate, Total (mg/L)	5	36	30.03	1,081.00
	6	36	42.97	1,547.00
	Total	72		
Nitrite Nitrate, Dissolved (mg/L)	5	28	22.61	633.00
	6	28	34.39	963.00
	Total	56		
Nitrogen, Total (mg/L)	5	48	44.73	2,147.00
	6	48	52.27	2,509.00
	Total	96		
Phosphorus, Total (mg/L)	5	48	47.32	2,271.50
	6	48	49.68	2,384.50
	Total	96		
Dissolved Oxygen (mg/L)	5	26	31.08	808.00
	6	26	21.92	570.00
	Total	52		
Dissolved Oxygen (% Sat.)	5	26	33.83	879.50
	6	26	19.17	498.50
	Total	52		
pH, (s.u.)	5	48	58.26	2,796.50
	6	48	38.74	1,859.50
	Total	96		
Specific Conductance (µS/cm)	5	48	52.40	2,515.00
	6	48	44.60	2,141.00
	Total	96		
Water Temperature (°C)	5	48	48.15	2,311.00
	6	48	48.85	2,345.00
	Total	96		
Turbidity (NTU)	5	48	69.40	3,331.00
	6	48	27.60	1,325.00
	Total	96		
Flow (CFS)	5	48	47.00	2,256.00
	6	48	50.00	2,400.00
	Total	96		
Flow (probability)	5	48	49.83	2,392.00
	6	48	47.17	2,264.00
	Total	96		

Table B-134: Mann–Whitney *U* test results for water quality analytes at Stations 5 and 6 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Alkalinity as CaCO3, Total (mg/L)	1,051.000	2,227.000	-0.740	0.459
Bicarbonate as HCO3, Total (mg/L)	1,108.500	2,284.500	-0.319	0.750
Calcium, Total (mg/L)	635.000	1,301.000	-0.147	0.883
Calcium, Dissolved (mg/L)	26.500	62.500	-0.583	0.560
Chloride, Total (mg/L)	768.000	1,944.000	-2.834	0.005
Magnesium, Dissolved (mg/L)	885.000	1,875.000	-0.706	0.480
Potassium, Total (mg/L)	474.000	1,140.000	-2.236	0.025
Potassium, Dissolved (mg/L)	27.000	63.000	-0.598	0.550
Sodium, Dissolved (mg/L)	646.000	1,636.000	-2.697	0.007
Sulfate, Total (mg/L)	1,069.500	2,245.500	-0.605	0.545
Dissolved Solids, Total (mg/L)	999.000	2,175.000	-1.121	0.262
Suspended Solids, Total (mg/L)	360.000	1,536.000	-6.852	0.000
Arsenic, Total (mg/L)	659.000	1,835.000	-3.620	0.000
Cadmium, Total (mg/L)	77.000	168.000	-0.693	0.488
Copper, Total (mg/L)	62.000	153.000	-1.239	0.215
Iron, Total (mg/L)	21.000	112.000	-3.260	0.001
Lead, Total (mg/L)	77.000	168.000	-0.493	0.622
Manganese, Total (mg/L)	50.500	141.500	-1.820	0.069
Zinc, Total (mg/L)	71.500	162.500	-1.442	0.149
Nitrite Nitrate, Total (mg/L)	415.000	1,081.000	-2.627	0.009
Nitrite Nitrate, Dissolved (mg/L)	227.000	633.000	-2.706	0.007
Nitrogen, Total (mg/L)	971.000	2,147.000	-1.339	0.181
Phosphorus, Total (mg/L)	1,095.500	2,271.500	-0.414	0.679
Dissolved Oxygen (mg/L)	219.000	570.000	-2.178	0.029
Dissolved Oxygen (% Sat.)	147.500	498.500	-3.487	0.000
pH, (s.u.)	683.500	1,859.500	-3.433	0.001
Specific Conductance (µS/cm)	965.000	2,141.000	-1.370	0.171
Water Temperature (°C)	1,135.000	2,311.000	-0.125	0.901
Turbidity (NTU)	149.000	1,325.000	-7.350	0.000
Flow (CFS)	1,080.000	2,256.000	-0.528	0.598
Flow (probability)	1,088.000	2,264.000	-0.469	0.639

Table B-135: Kruskal-Wallis *H* rank results for dissolved oxygen by season at Station 5 from 2011 to 2016.

Analyte	Season	N	Mean Rank
Dissolved Oxygen (mg/L)	Jan-Mar	5	19.8
	Apr-Jun	5	7.8
	Jul-Sep	8	6.6
	Oct-Dec	8	20.0
	Total	26	
Dissolved Oxygen (% Sat.)	Jan-Mar	5	10.0
	Apr-Jun	5	10.7
	Jul-Sep	8	14.9
	Oct-Dec	8	16.1
	Total	26	

Table B-136: Kruskal-Wallis *H* test statistics for dissolved oxygen by season at Station 5 from 2011 to 2016.

Analyte	Chi-Square	df	Asymp. Sig. (2-tailed)
Dissolved Oxygen (mg/L)	18.411	3	0.000
Dissolved Oxygen (% Sat.)	2.875	3	0.411

Table B-137: Kruskal-Wallis *H* rank results for dissolved oxygen by season at Station 6 from 2011 to 2016.

Analyte	Season	N	Mean Rank
Dissolved Oxygen (mg/L)	Jan-Mar	5	21.4
	Apr-Jun	5	19.2
	Jul-Sep	8	4.5
	Oct-Dec	8	14.0
	Total	26	
Dissolved Oxygen (% Sat.)	Jan-Mar	5	17.4
	Apr-Jun	5	21.8
	Jul-Sep	8	4.5
	Oct-Dec	8	21.4
	Total	26	

Table B-138: Kruskal-Wallis *H* test statistics for dissolved oxygen by season at Station 6 from 2011 to 2016.

Analyte	Chi-Square	df	Asymp. Sig. (2-tailed)
Dissolved Oxygen (mg/L)	19.222	3	0.000
Dissolved Oxygen (% Sat.)	18.524	3	0.000

Table B-139: Rank comparisons of water quality analytes between Stations 6 and 7 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Alkalinity as CaCO3, Total (mg/L)	6	48	47.25	2,268.00
	7	48	49.75	2,388.00
	Total	96		
Bicarbonate as HCO3, Total (mg/L)	6	48	47.49	2,279.50
	7	48	49.51	2,376.50
	Total	96		
Calcium, Total (mg/L)	6	36	35.00	1,260.00
	7	36	38.00	1,368.00
	Total	72		
Calcium, Dissolved (mg/L)	6	8	7.81	62.50
	7	8	9.19	73.50
	Total	16		
Chloride, Total (mg/L)	6	48	47.78	2,293.50
	7	48	49.22	2,362.50
	Total	96		
Magnesium, Dissolved (mg/L)	6	44	43.63	1,919.50
	7	44	45.38	1,996.50
	Total	88		
Potassium, Total (mg/L)	6	36	38.17	1,374.00
	7	37	35.86	1,327.00
	Total	73		
Potassium, Dissolved (mg/L)	6	8	7.88	63.00
	7	7	8.14	57.00
	Total	15		
Sodium, Dissolved (mg/L)	6	44	43.42	1,910.50
	7	44	45.58	2,005.50
	Total	88		
Sulfate, Total (mg/L)	6	48	45.70	2,193.50
	7	48	51.30	2,462.50
	Total	96		
Dissolved Solids, Total (mg/L)	6	48	46.84	2,248.50
	7	48	50.16	2,407.50
	Total	96		
Suspended Solids, Total (mg/L)	6	48	48.50	2,328.00
	7	48	48.50	2,328.00
	Total	96		
Arsenic, Total (mg/L)	6	48	51.02	2,449.00
	7	48	45.98	2,207.00
	Total	96		
Cadmium, Total (mg/L)	6	13	13.00	169.00
	7	13	14.00	182.00
	Total	26		
Copper, Total (mg/L)	6	13	15.85	206.00
	7	13	11.15	145.00
	Total	26		

Analyte	Station	N	Mean Rank	Sum of Ranks
Iron, Total (mg/L)	6	13	12.73	165.50
	7	13	14.27	185.50
	Total	26		
Lead, Total (mg/L)	6	13	15.00	195.00
	7	13	12.00	156.00
	Total	26		
Manganese, Total (mg/L)	6	13	14.46	188.00
	7	13	12.54	163.00
	Total	26		
Zinc, Total (mg/L)	6	13	13.50	175.50
	7	13	13.50	175.50
	Total	26		
Nitrite Nitrate, Total (mg/L)	6	36	40.71	1,465.50
	7	36	32.29	1,162.50
	Total	72		
Nitrite Nitrate, Dissolved (mg/L)	6	28	31.00	868.00
	7	28	26.00	728.00
	Total	56		
Nitrogen, Total (mg/L)	6	48	47.84	2,296.50
	7	48	49.16	2,359.50
	Total	96		
Phosphorus, Total (mg/L)	6	48	47.82	2,295.50
	7	48	49.18	2,360.50
	Total	96		
Dissolved Oxygen (mg/L)	6	26	22.00	572.00
	7	26	31.00	806.00
	Total	52		
Dissolved Oxygen (% Sat.)	6	26	19.88	517.00
	7	26	33.12	861.00
	Total	52		
pH, (s.u.)	6	48	40.45	1,941.50
	7	48	56.55	2,714.50
	Total	96		
Specific Conductance (µS/cm)	6	48	46.41	2,227.50
	7	48	50.59	2,428.50
	Total	96		
Water Temperature (°C)	6	48	47.45	2,277.50
	7	48	49.55	2,378.50
	Total	96		
Turbidity (NTU)	6	48	45.26	2,172.50
	7	48	51.74	2,483.50
	Total	96		
Flow (CFS)	6	48	43.81	2,103.00
	7	48	53.19	2,553.00
	Total	96		
Flow (probability)	6	48	46.98	2,255.00
	7	48	50.02	2,401.00
	Total	96		

Table B-140: Mann–Whitney *U* test results for water quality analytes at Stations 6 and 7 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Alkalinity as CaCO3, Total (mg/L)	1,092.000	2,268.000	-0.440	0.660
Bicarbonate as HCO3, Total (mg/L)	1,103.500	2,279.500	-0.356	0.722
Calcium, Total (mg/L)	594.000	1,260.000	-0.611	0.541
Calcium, Dissolved (mg/L)	26.500	62.500	-0.585	0.559
Chloride, Total (mg/L)	1,117.500	2,293.500	-0.257	0.797
Magnesium, Dissolved (mg/L)	929.500	1,919.500	-0.329	0.742
Potassium, Total (mg/L)	624.000	1,327.000	-0.583	0.560
Potassium, Dissolved (mg/L)	27.000	63.000	-0.151	0.880
Sodium, Dissolved (mg/L)	920.500	1,910.500	-0.400	0.689
Sulfate, Total (mg/L)	1,017.500	2,193.500	-0.988	0.323
Dissolved Solids, Total (mg/L)	1,072.500	2,248.500	-0.583	0.560
Suspended Solids, Total (mg/L)	1,152.000	2,328.000	0.000	1.000
Arsenic, Total (mg/L)	1,031.000	2,207.000	-0.892	0.372
Cadmium, Total (mg/L)	78.000	169.000	-0.601	0.548
Copper, Total (mg/L)	54.000	145.000	-1.669	0.095
Iron, Total (mg/L)	74.500	165.500	-0.515	0.607
Lead, Total (mg/L)	65.000	156.000	-1.802	0.072
Manganese, Total (mg/L)	72.000	163.000	-0.663	0.508
Zinc, Total (mg/L)	84.500	175.500	0.000	1.000
Nitrite Nitrate, Total (mg/L)	496.500	1,162.500	-1.709	0.087
Nitrite Nitrate, Dissolved (mg/L)	322.000	728.000	-1.150	0.250
Nitrogen, Total (mg/L)	1,120.500	2,296.500	-0.234	0.815
Phosphorus, Total (mg/L)	1,119.500	2,295.500	-0.238	0.812
Dissolved Oxygen (mg/L)	221.000	572.000	-2.141	0.032
Dissolved Oxygen (% Sat.)	166.000	517.000	-3.148	0.002
pH, (s.u.)	765.500	1,941.500	-2.833	0.005
Specific Conductance (µS/cm)	1,051.500	2,227.500	-0.736	0.461
Water Temperature (°C)	1,101.500	2,277.500	-0.370	0.711
Turbidity (NTU)	996.500	2,172.500	-1.140	0.254
Flow (CFS)	927.000	2,103.000	-1.649	0.099
Flow (probability)	1,079.000	2,255.000	-0.535	0.593

Table B-141: Rank comparisons of water quality analytes between Stations 7 and 8 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Alkalinity as CaCO3, Total (mg/L)	7	48	46.20	2,217.50
	8	48	50.80	2,438.50
	Total	96		
Bicarbonate as HCO3, Total (mg/L)	7	48	46.80	2,246.50
	8	48	50.20	2,409.50
	Total	96		
Calcium, Total (mg/L)	7	36	36.43	1,311.50
	8	36	36.57	1,316.50
	Total	72		
Calcium, Dissolved (mg/L)	7	8	7.94	63.50
	8	8	9.06	72.50
	Total	16		
Chloride, Total (mg/L)	7	48	50.03	2,401.50
	8	48	46.97	2,254.50
	Total	96		
Magnesium, Dissolved (mg/L)	7	44	43.24	1,902.50
	8	44	45.76	2,013.50
	Total	88		
Potassium, Total (mg/L)	7	37	36.36	1,345.50
	8	36	37.65	1,355.50
	Total	73		
Potassium, Dissolved (mg/L)	7	7	7.64	53.50
	8	8	8.31	66.50
	Total	15		
Sodium, Dissolved (mg/L)	7	44	45.17	1,987.50
	8	44	43.83	1,928.50
	Total	88		
Sulfate, Total (mg/L)	7	48	46.33	2,224.00
	8	48	50.67	2,432.00
	Total	96		
Dissolved Solids, Total (mg/L)	7	48	48.04	2,306.00
	8	48	48.96	2,350.00
	Total	96		
Suspended Solids, Total (mg/L)	7	48	48.50	2,328.00
	8	48	48.50	2,328.00
	Total	96		
Arsenic, Total (mg/L)	7	48	49.30	2,366.50
	8	48	47.70	2,289.50
	Total	96		
Cadmium, Total (mg/L)	7	13	13.92	181.00
	8	13	13.08	170.00
	Total	26		
Copper, Total (mg/L)	7	13	13.50	175.50
	8	13	13.50	175.50
	Total	26		

Analyte	Station	N	Mean Rank	Sum of Ranks
Iron, Total (mg/L)	7	13	15.69	204.00
	8	13	11.31	147.00
	Total	26		
Lead, Total (mg/L)	7	13	13.50	175.50
	8	13	13.50	175.50
	Total	26		
Manganese, Total (mg/L)	7	13	16.08	209.00
	8	13	10.92	142.00
	Total	26		
Zinc, Total (mg/L)	7	13	14.00	182.00
	8	14	14.00	196.00
	Total	27		
Nitrite Nitrate, Total (mg/L)	7	36	40.96	1,474.50
	8	36	32.04	1,153.50
	Total	72		
Nitrite Nitrate, Dissolved (mg/L)	7	28	30.96	867.00
	8	28	26.04	729.00
	Total	56		
Nitrogen, Total (mg/L)	7	48	53.25	2,556.00
	8	48	43.75	2,100.00
	Total	96		
Phosphorus, Total (mg/L)	7	48	49.46	2,374.00
	8	48	47.54	2,282.00
	Total	96		
Dissolved Oxygen (mg/L)	7	26	25.88	673.00
	8	26	27.12	705.00
	Total	52		
Dissolved Oxygen (% Sat.)	7	26	24.88	647.00
	8	26	28.12	731.00
	Total	52		
pH, (s.u.)	7	48	42.99	2,063.50
	8	48	54.01	2,592.50
	Total	96		
Specific Conductance (µS/cm)	7	48	47.49	2,279.50
	8	48	49.51	2,376.50
	Total	96		
Water Temperature (°C)	7	48	47.18	2,264.50
	8	48	49.82	2,391.50
	Total	96		
Turbidity (NTU)	7	48	57.29	2,750.00
	8	48	39.71	1,906.00
	Total	96		
Flow (CFS)	7	48	48.43	2,324.50
	8	48	48.57	2,331.50
	Total	96		
Flow (probability)	7	48	48.91	2,347.50
	8	48	48.09	2,308.50
	Total	96		

Table B-142: Mann–Whitney *U* test results for water quality analytes at Stations 7 and 8 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Alkalinity as CaCO3, Total (mg/L)	1,041.500	2,217.500	-0.810	0.418
Bicarbonate as HCO3, Total (mg/L)	1,070.500	2,246.500	-0.598	0.550
Calcium, Total (mg/L)	645.500	1,311.500	-0.028	0.977
Calcium, Dissolved (mg/L)	27.500	63.500	-0.477	0.633
Chloride, Total (mg/L)	1,078.500	2,254.500	-0.547	0.585
Magnesium, Dissolved (mg/L)	912.500	1,902.500	-0.477	0.634
Potassium, Total (mg/L)	642.500	1,345.500	-0.331	0.741
Potassium, Dissolved (mg/L)	25.500	53.500	-0.354	0.724
Sodium, Dissolved (mg/L)	938.500	1,928.500	-0.248	0.804
Sulfate, Total (mg/L)	1,048.000	2,224.000	-0.764	0.445
Dissolved Solids, Total (mg/L)	1,130.000	2,306.000	-0.161	0.872
Suspended Solids, Total (mg/L)	1,152.000	2,328.000	0.000	1.000
Arsenic, Total (mg/L)	1,113.500	2,289.500	-0.284	0.777
Cadmium, Total (mg/L)	79.000	170.000	-0.508	0.611
Copper, Total (mg/L)	84.500	175.500	0.000	1.000
Iron, Total (mg/L)	56.000	147.000	-1.472	0.141
Lead, Total (mg/L)	84.500	175.500	0.000	1.000
Manganese, Total (mg/L)	51.000	142.000	-1.785	0.074
Zinc, Total (mg/L)	91.000	196.000	0.000	1.000
Nitrite Nitrate, Total (mg/L)	487.500	1,153.500	-1.810	0.070
Nitrite Nitrate, Dissolved (mg/L)	323.000	729.000	-1.133	0.257
Nitrogen, Total (mg/L)	924.000	2,100.000	-1.699	0.089
Phosphorus, Total (mg/L)	1,106.000	2,282.000	-0.337	0.736
Dissolved Oxygen (mg/L)	322.000	673.000	-0.293	0.770
Dissolved Oxygen (% Sat.)	296.000	647.000	-0.769	0.442
pH, (s.u.)	887.500	2,063.500	-1.938	0.053
Specific Conductance (µS/cm)	1,103.500	2,279.500	-0.355	0.722
Water Temperature (°C)	1,088.500	2,264.500	-0.465	0.642
Turbidity (NTU)	730.000	1,906.000	-3.093	0.002
Flow (CFS)	1,148.500	2,324.500	-0.026	0.980
Flow (probability)	1,132.500	2,308.500	-0.143	0.886

Table B-143: Rank comparisons of water quality analytes between Stations 8 and 9 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Alkalinity as CaCO3, Total (mg/L)	8	48	39.98	1,919.00
	9	47	56.19	2,641.00
	Total	95		
Bicarbonate as HCO3, Total (mg/L)	8	48	40.27	1,933.00
	9	47	55.89	2,627.00
	Total	95		
Calcium, Total (mg/L)	8	36	30.78	1,108.00
	9	40	45.45	1,818.00
	Total	76		
Calcium, Dissolved (mg/L)	8	8	5.69	45.50
	9	8	11.31	90.50
	Total	16		
Chloride, Total (mg/L)	8	48	60.32	2,895.50
	9	48	36.68	1,760.50
	Total	96		
Magnesium, Dissolved (mg/L)	8	44	28.75	1,265.00
	9	48	62.77	3,013.00
	Total	92		
Potassium, Total (mg/L)	8	36	43.65	1,571.50
	9	40	33.86	1,354.50
	Total	76		
Potassium, Dissolved (mg/L)	8	8	10.00	80.00
	9	8	7.00	56.00
	Total	16		
Sodium, Dissolved (mg/L)	8	44	48.43	2,131.00
	9	48	44.73	2,147.00
	Total	92		
Sulfate, Total (mg/L)	8	48	32.97	1,582.50
	9	48	64.03	3,073.50
	Total	96		
Dissolved Solids, Total (mg/L)	8	48	41.00	1,968.00
	9	48	56.00	2,688.00
	Total	96		
Suspended Solids, Total (mg/L)	8	48	34.50	1,656.00
	9	48	62.50	3,000.00
	Total	96		
Arsenic, Total (mg/L)	8	48	64.36	3,089.50
	9	48	32.64	1,566.50
	Total	96		
Cadmium, Total (mg/L)	8	13	29.77	387.00
	9	44	28.77	1,266.00
	Total	57		
Copper, Total (mg/L)	8	13	20.38	265.00
	9	44	31.55	1,388.00
	Total	57		

Analyte	Station	N	Mean Rank	Sum of Ranks
Iron, Total (mg/L)	8	13	10.31	134.00
	9	44	34.52	1,519.00
	Total	57		
Lead, Total (mg/L)	8	13	23.00	299.00
	9	44	30.77	1,354.00
	Total	57		
Manganese, Total (mg/L)	8	13	22.69	295.00
	9	44	30.86	1,358.00
	Total	57		
Zinc, Total (mg/L)	8	14	29.00	406.00
	9	44	29.66	1,305.00
	Total	58		
Nitrite Nitrate, Total (mg/L)	8	36	35.69	1,285.00
	9	36	37.31	1,343.00
	Total	72		
Nitrite Nitrate, Dissolved (mg/L)	8	28	27.39	767.00
	9	28	29.61	829.00
	Total	56		
Nitrogen, Total (mg/L)	8	48	47.92	2,300.00
	9	48	49.08	2,356.00
	Total	96		
Phosphorus, Total (mg/L)	8	48	41.28	1,981.50
	9	48	55.72	2,674.50
	Total	96		
Dissolved Oxygen (mg/L)	8	26	26.10	678.50
	9	26	26.90	699.50
	Total	52		
Dissolved Oxygen (% Sat.)	8	26	26.87	698.50
	9	26	26.13	679.50
	Total	52		
pH, (s.u.)	8	48	47.95	2,301.50
	9	48	49.05	2,354.50
	Total	96		
Specific Conductance (µS/cm)	8	48	41.29	1,982.00
	9	48	55.71	2,674.00
	Total	96		
Water Temperature (°C)	8	48	49.86	2,393.50
	9	48	47.14	2,262.50
	Total	96		
Turbidity (NTU)	8	48	25.70	1,233.50
	9	48	71.30	3,422.50
	Total	96		
Flow (CFS)	8	48	42.81	2,055.00
	9	48	54.19	2,601.00
	Total	96		
Flow (probability)	8	48	47.25	2,268.00
	9	48	49.75	2,388.00
	Total	96		

Table B-144: Mann–Whitney *U* test results for water quality analytes at Stations 8 and 9 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Alkalinity as CaCO3, Total (mg/L)	743.000	1,919.000	-2.868	.004
Bicarbonate as HCO3, Total (mg/L)	757.000	1,933.000	-2.763	.006
Calcium, Total (mg/L)	442.000	1,108.000	-2.914	.004
Calcium, Dissolved (mg/L)	9.500	45.500	-2.421	.015
Chloride, Total (mg/L)	584.500	1,760.500	-4.216	.000
Magnesium, Dissolved (mg/L)	275.000	1,265.000	-6.224	.000
Potassium, Total (mg/L)	534.500	1,354.500	-2.607	.009
Potassium, Dissolved (mg/L)	20.000	56.000	-1.861	.063
Sodium, Dissolved (mg/L)	971.000	2,147.000	-0.670	.503
Sulfate, Total (mg/L)	406.500	1,582.500	-5.473	.000
Dissolved Solids, Total (mg/L)	792.000	1,968.000	-2.639	.008
Suspended Solids, Total (mg/L)	480.000	1,656.000	-6.133	.000
Arsenic, Total (mg/L)	390.500	1,566.500	-5.603	.000
Cadmium, Total (mg/L)	276.000	1,266.000	-0.491	.623
Copper, Total (mg/L)	174.000	265.000	-2.226	.026
Iron, Total (mg/L)	43.000	134.000	-4.625	.000
Lead, Total (mg/L)	208.000	299.000	-1.622	.105
Manganese, Total (mg/L)	204.000	295.000	-1.587	.112
Zinc, Total (mg/L)	301.000	406.000	-0.564	.573
Nitrite Nitrate, Total (mg/L)	619.000	1,285.000	-0.327	.744
Nitrite Nitrate, Dissolved (mg/L)	361.000	767.000	-0.509	.611
Nitrogen, Total (mg/L)	1,124.000	2,300.000	-0.209	.835
Phosphorus, Total (mg/L)	805.500	1,981.500	-2.540	.011
Dissolved Oxygen (mg/L)	327.500	678.500	-0.192	.848
Dissolved Oxygen (% Sat.)	328.500	679.500	-0.174	.862
pH, (s.u.)	1,125.500	2,301.500	-0.194	.846
Specific Conductance (µS/cm)	806.000	1,982.000	-2.535	.011
Water Temperature (°C)	1,086.500	2,262.500	-0.480	.631
Turbidity (NTU)	57.500	1,233.500	-8.021	.000
Flow (CFS)	879.000	2,055.000	-2.001	.045
Flow (probability)	1,092.000	2,268.000	-0.440	.660

Table B-145: Rank comparisons of water quality analytes between Stations 9 and 10 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Alkalinity as CaCO3, Total (mg/L)	9	47	44.52	2,092.50
	10	48	51.41	2,467.50
	Total	95		
Bicarbonate as HCO3, Total (mg/L)	9	47	43.86	2,061.50
	10	48	52.05	2,498.50
	Total	95		
Calcium, Total (mg/L)	9	40	30.01	1,200.50
	10	39	50.24	1,959.50
	Total	79		
Calcium, Dissolved (mg/L)	9	8	4.50	36.00
	10	9	13.00	117.00
	Total	17		
Chloride, Total (mg/L)	9	48	47.70	2,289.50
	10	48	49.30	2,366.50
	Total	96		
Magnesium, Dissolved (mg/L)	9	48	37.06	1,779.00
	10	48	59.94	2,877.00
	Total	96		
Potassium, Total (mg/L)	9	40	39.55	1,582.00
	10	39	40.46	1,578.00
	Total	79		
Potassium, Dissolved (mg/L)	9	8	8.50	68.00
	10	9	9.44	85.00
	Total	17		
Sodium, Dissolved (mg/L)	9	48	51.46	2,470.00
	10	48	45.54	2,186.00
	Total	96		
Sulfate, Total (mg/L)	9	48	33.23	1,595.00
	10	48	63.77	3,061.00
	Total	96		
Dissolved Solids, Total (mg/L)	9	48	38.22	1,834.50
	10	48	58.78	2,821.50
	Total	96		
Suspended Solids, Total (mg/L)	9	48	51.46	2,470.00
	10	48	45.54	2,186.00
	Total	96		
Arsenic, Total (mg/L)	9	48	55.72	2,674.50
	10	48	41.28	1,981.50
	Total	96		
Cadmium, Total (mg/L)	9	44	43.51	1,914.50
	10	44	45.49	2,001.50
	Total	88		
Copper, Total (mg/L)	9	44	48.31	2,125.50
	10	44	40.69	1,790.50
	Total	88		

Analyte	Station	N	Mean Rank	Sum of Ranks
Iron, Total (mg/L)	9	44	46.41	2,042.00
	10	44	42.59	1,874.00
	Total	88		
Lead, Total (mg/L)	9	44	44.77	1,970.00
	10	44	44.23	1,946.00
	Total	88		
Manganese, Total (mg/L)	9	44	46.80	2,059.00
	10	44	42.20	1,857.00
	Total	88		
Zinc, Total (mg/L)	9	44	44.50	1,958.00
	10	44	44.50	1,958.00
	Total	88		
Nitrite Nitrate, Total (mg/L)	9	36	32.03	1,153.00
	10	36	40.97	1,475.00
	Total	72		
Nitrite Nitrate, Dissolved (mg/L)	9	28	27.41	767.50
	10	28	29.59	828.50
	Total	56		
Nitrogen, Total (mg/L)	9	48	45.60	2,189.00
	10	48	51.40	2,467.00
	Total	96		
Phosphorus, Total (mg/L)	9	48	50.96	2,446.00
	10	48	46.04	2,210.00
	Total	96		
Dissolved Oxygen (mg/L)	9	26	26.50	689.00
	10	26	26.50	689.00
	Total	52		
Dissolved Oxygen (% Sat.)	9	26	27.12	705.00
	10	26	25.88	673.00
	Total	52		
pH, (s.u.)	9	48	44.92	2,156.00
	10	48	52.08	2,500.00
	Total	96		
Specific Conductance (µS/cm)	9	48	37.42	1,796.00
	10	48	59.58	2,860.00
	Total	96		
Water Temperature (°C)	9	48	46.44	2,229.00
	10	48	50.56	2,427.00
	Total	96		
Turbidity (NTU)	9	48	48.40	2,323.00
	10	48	48.60	2,333.00
	Total	96		
Flow (CFS)	9	48	40.22	1,930.50
	10	48	56.78	2,725.50
	Total	96		
Flow (probability)	9	48	48.27	2,317.00
	10	48	48.73	2,339.00
	Total	96		

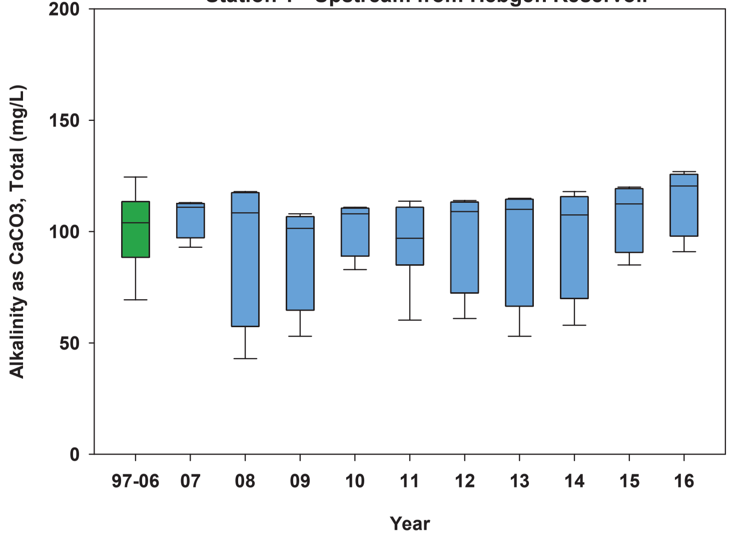
Table B-146: Mann–Whitney *U* test results for water quality analytes at Stations 9 and 10 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Alkalinity as CaCO3, Total (mg/L)	964.500	2,092.500	-1.218	0.223
Bicarbonate as HCO3, Total (mg/L)	933.500	2,061.500	-1.449	0.147
Calcium, Total (mg/L)	380.500	1,200.500	-3.944	0.000
Calcium, Dissolved (mg/L)	0.000	36.000	-3.557	0.000
Chloride, Total (mg/L)	1,113.500	2,289.500	-0.289	0.773
Magnesium, Dissolved (mg/L)	603.000	1,779.000	-4.121	0.000
Potassium, Total (mg/L)	762.000	1,582.000	-0.294	0.769
Potassium, Dissolved (mg/L)	32.000	68.000	-0.943	0.346
Sodium, Dissolved (mg/L)	1,010.000	2,186.000	-1.049	0.294
Sulfate, Total (mg/L)	419.000	1,595.000	-5.377	0.000
Dissolved Solids, Total (mg/L)	658.500	1,834.500	-3.618	0.000
Suspended Solids, Total (mg/L)	1,010.000	2,186.000	-1.088	0.277
Arsenic, Total (mg/L)	805.500	1,981.500	-2.553	0.011
Cadmium, Total (mg/L)	924.500	1,914.500	-0.831	0.406
Copper, Total (mg/L)	800.500	1,790.500	-1.468	0.142
Iron, Total (mg/L)	884.000	1,874.000	-0.702	0.483
Lead, Total (mg/L)	956.000	1,946.000	-0.104	0.917
Manganese, Total (mg/L)	867.000	1,857.000	-0.852	0.394
Zinc, Total (mg/L)	968.000	1,958.000	0.000	1.000
Nitrite Nitrate, Total (mg/L)	487.000	1,153.000	-1.816	0.069
Nitrite Nitrate, Dissolved (mg/L)	361.500	767.500	-0.500	0.617
Nitrogen, Total (mg/L)	1,013.000	2,189.000	-1.038	0.299
Phosphorus, Total (mg/L)	1,034.000	2,210.000	-0.865	0.387
Dissolved Oxygen (mg/L)	338.000	689.000	0.000	1.000
Dissolved Oxygen (% Sat.)	322.000	673.000	-0.293	0.770
pH, (s.u.)	980.000	2,156.000	-1.261	0.207
Specific Conductance (µS/cm)	620.000	1,796.000	-3.898	0.000
Water Temperature (°C)	1,053.000	2,229.000	-0.725	0.468
Turbidity (NTU)	1,147.000	2,323.000	-0.037	0.971
Flow (CFS)	754.500	1,930.500	-2.913	0.004
Flow (probability)	1,141.000	2,317.000	-0.081	0.936

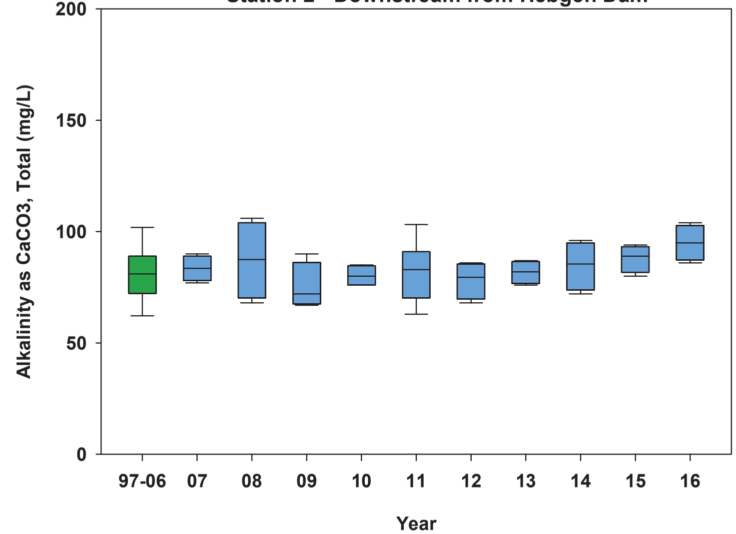
Appendix B.4 Temporal Graphs

Figure B-1: Alkalinity as CaCO3, Total (mg/L) for Stations 1 to 10.

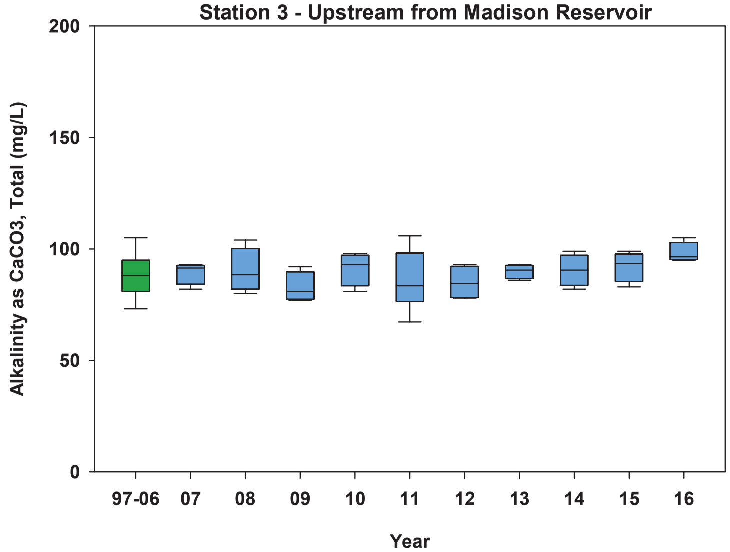
Station 1 - Upstream from Hebgen Reservoir



Station 2 - Downstream from Hebgen Dam



Station 3 - Upstream from Madison Reservoir



Station 4 - Downstream from Madison Dam

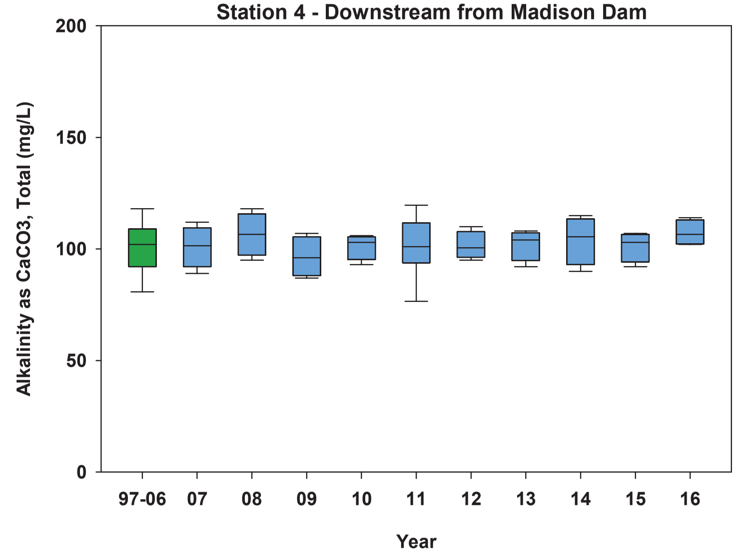


Figure B-1: Alkalinity as CaCO3, Total (mg/L) for Stations 1 to 10 (cont.).

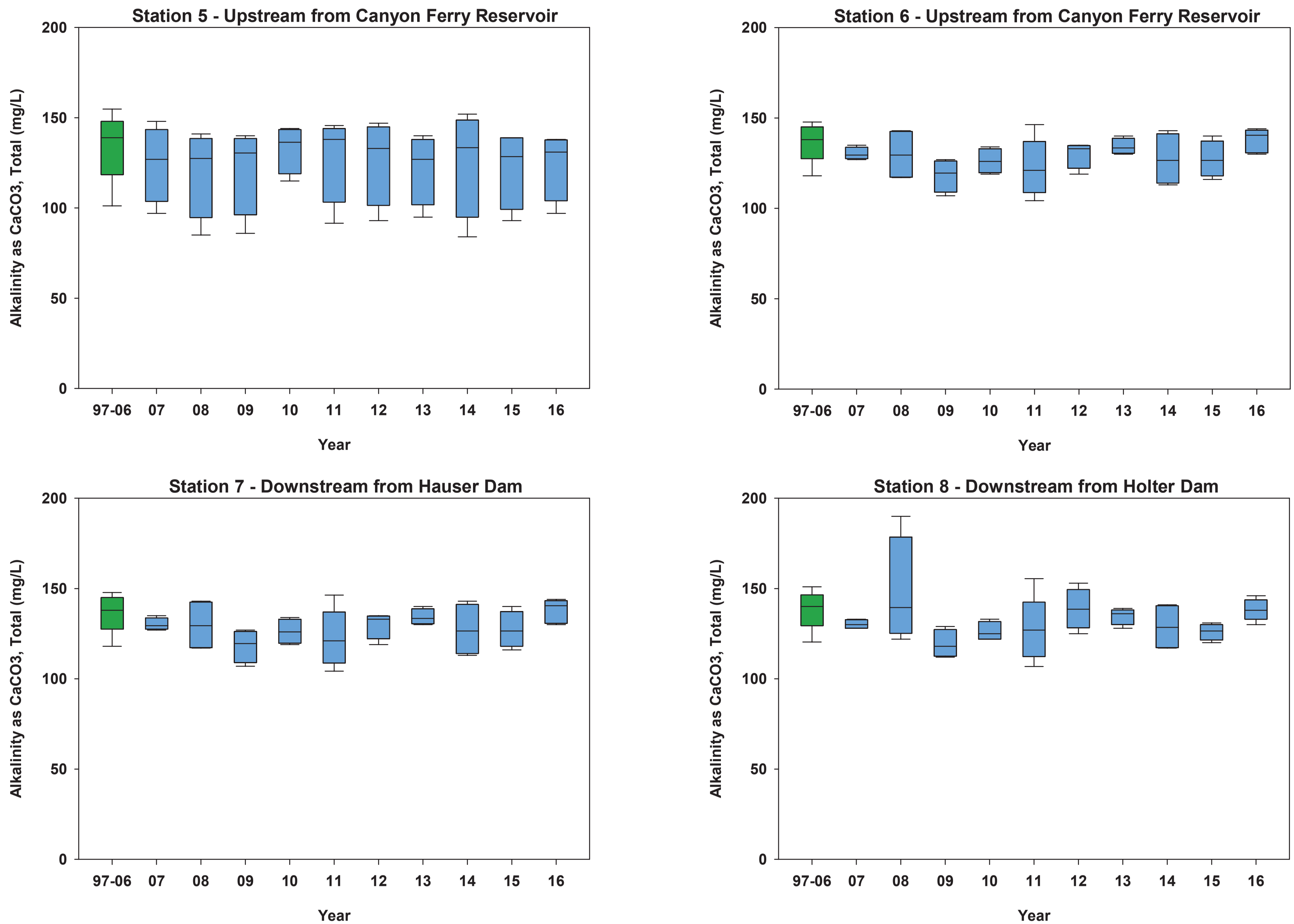
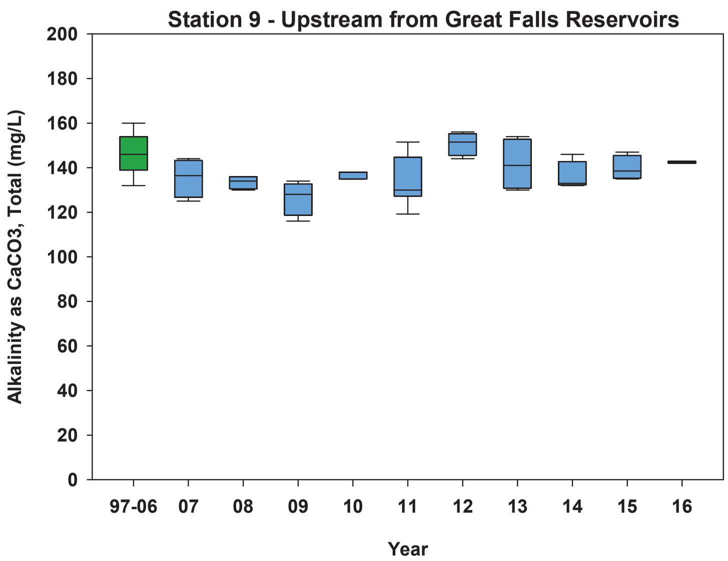


Figure B-1: Alkalinity as CaCO3, Total (mg/L) for Stations 1 to 10 (cont.).



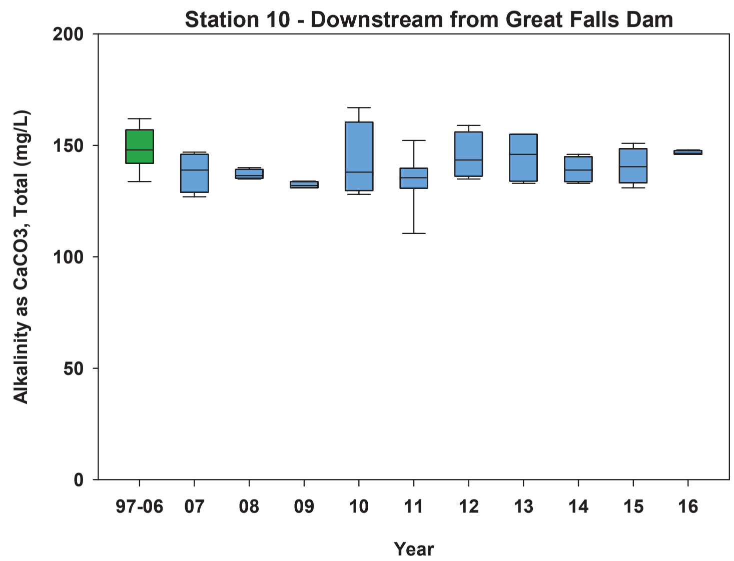
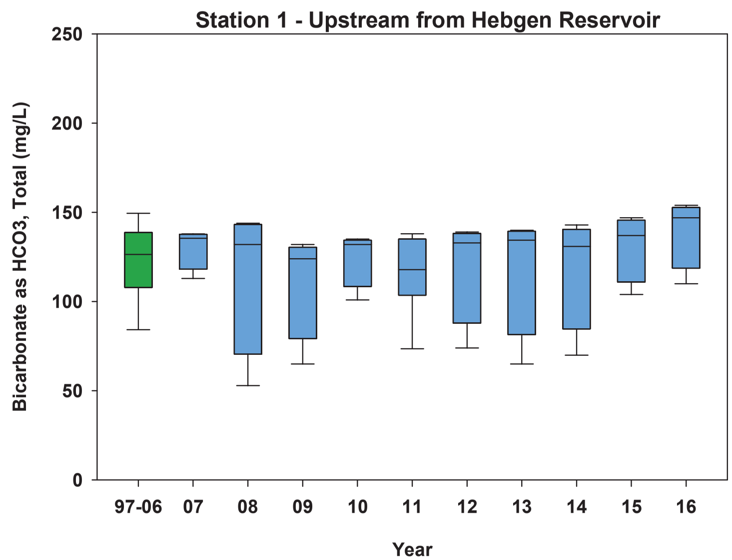
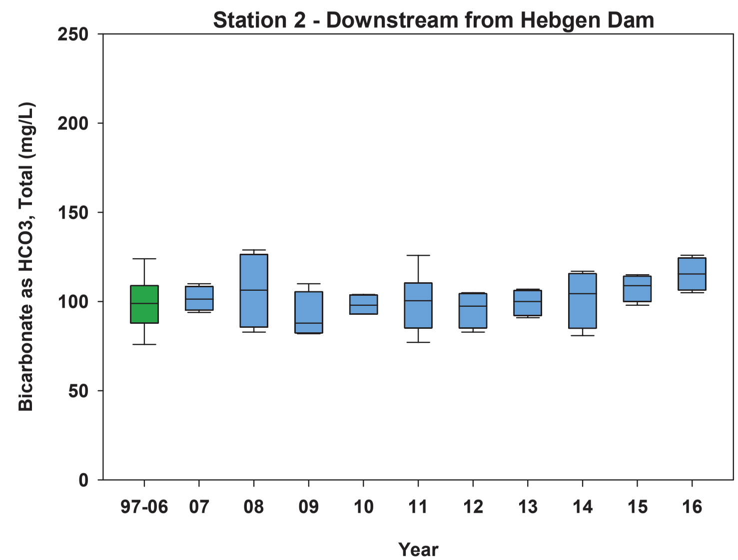
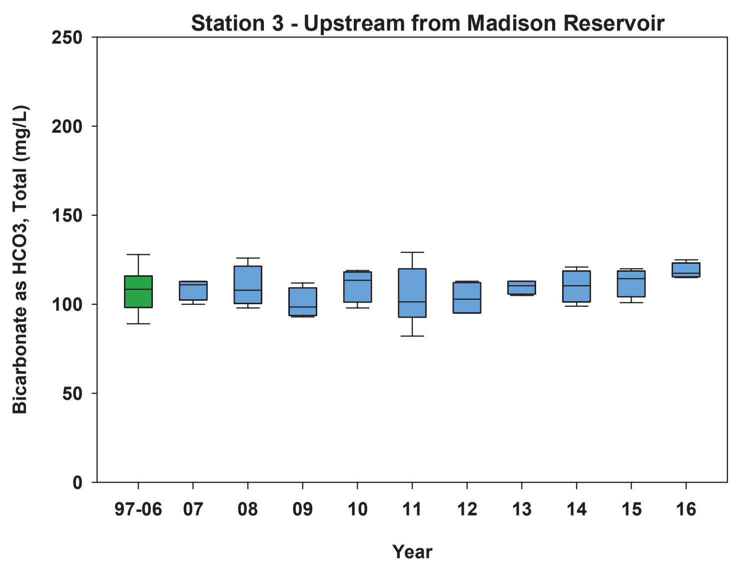


Figure B-2: Bicarbonate as HCO3, Total (mg/L) for Stations 1 to 10.







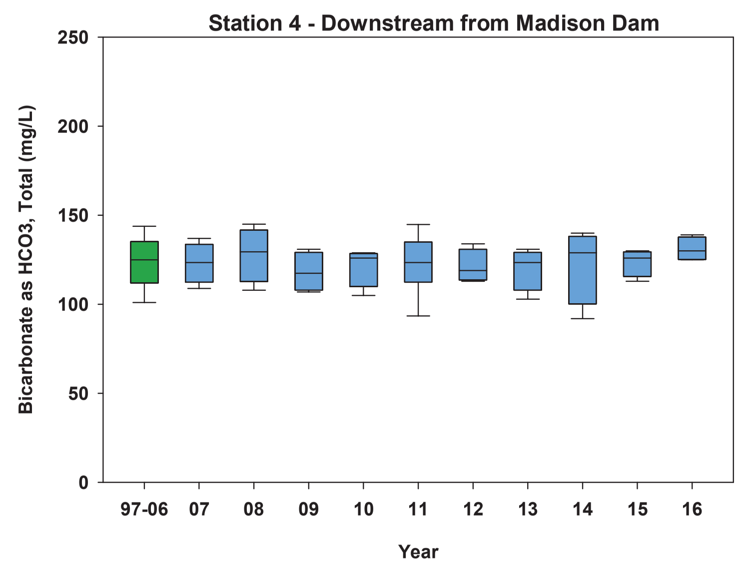
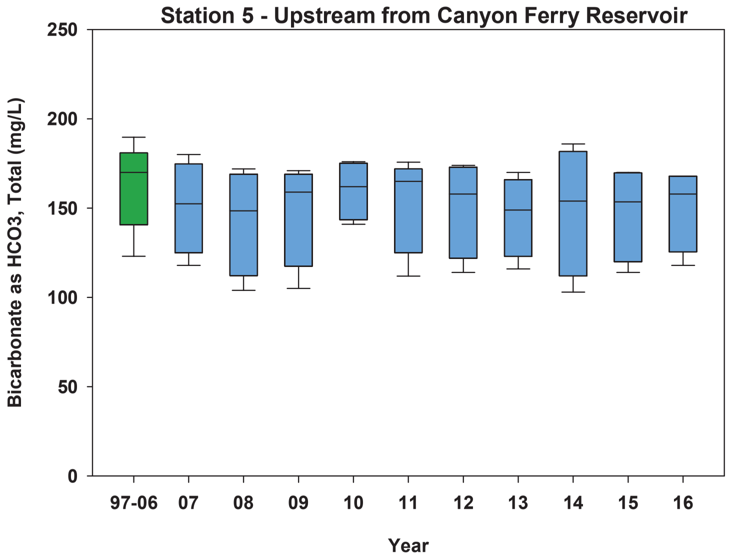
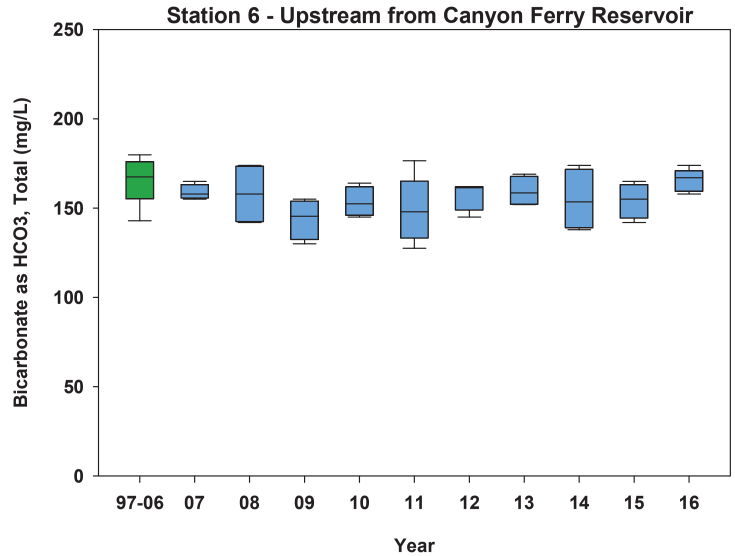
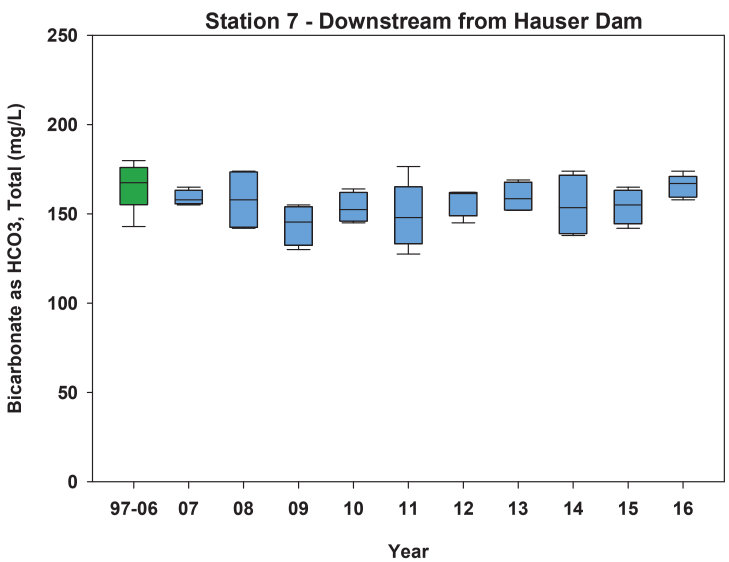


Figure B-2: Bicarbonate as HCO3, Total (mg/L) for Stations 1 to 10 (cont.).







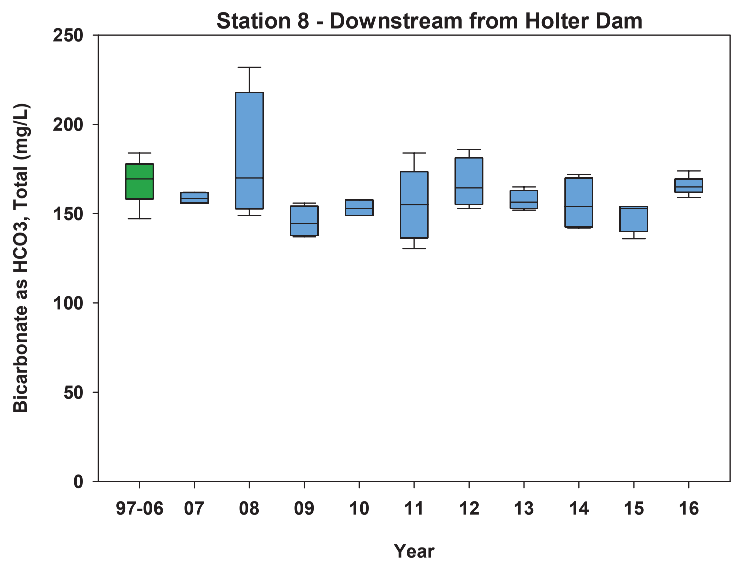
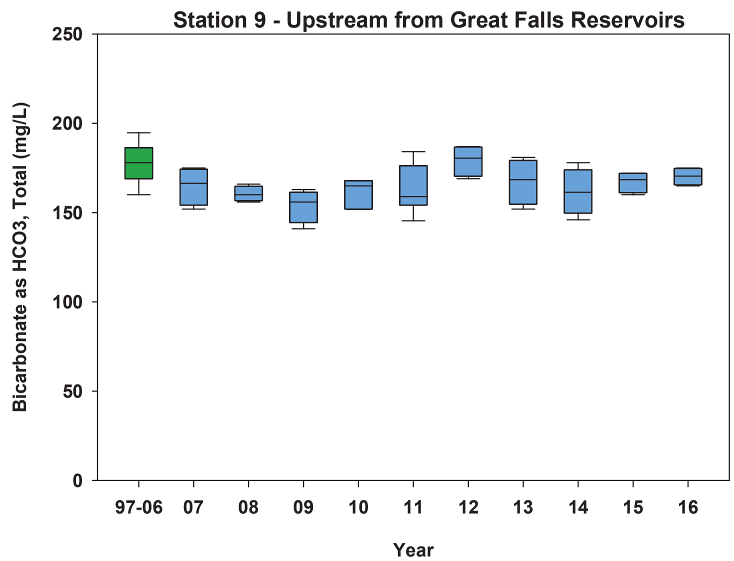


Figure B-2: Bicarbonate as HCO3, Total (mg/L) for Stations 1 to 10 (cont.).



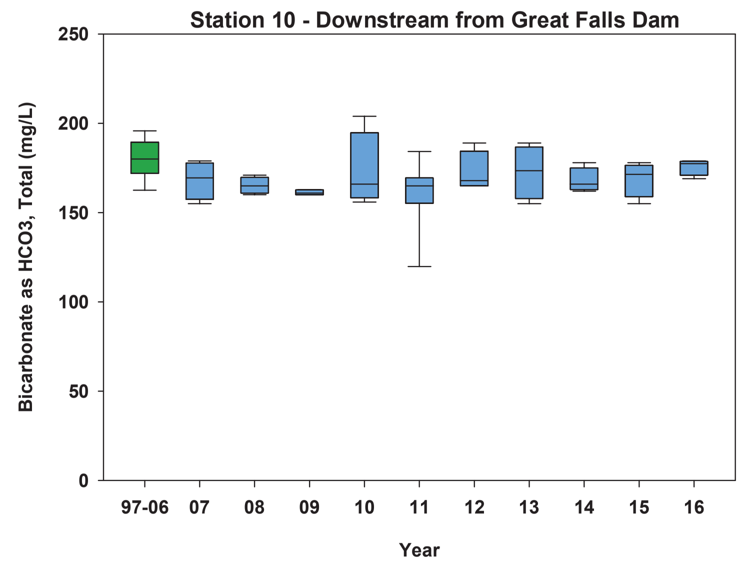
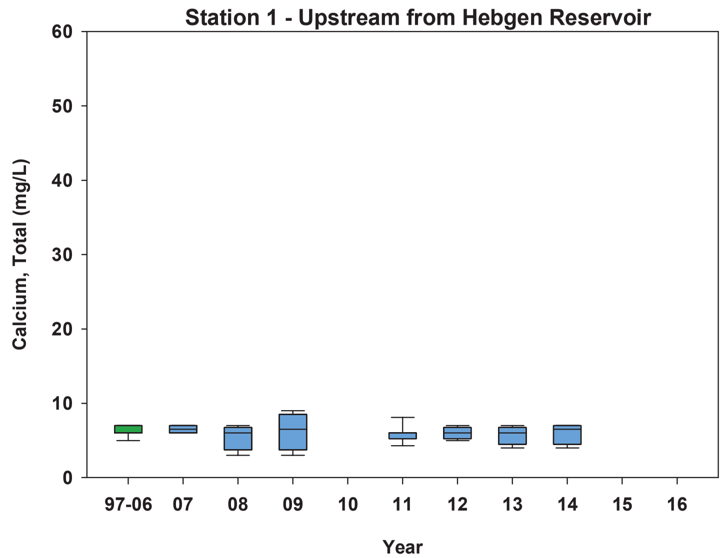
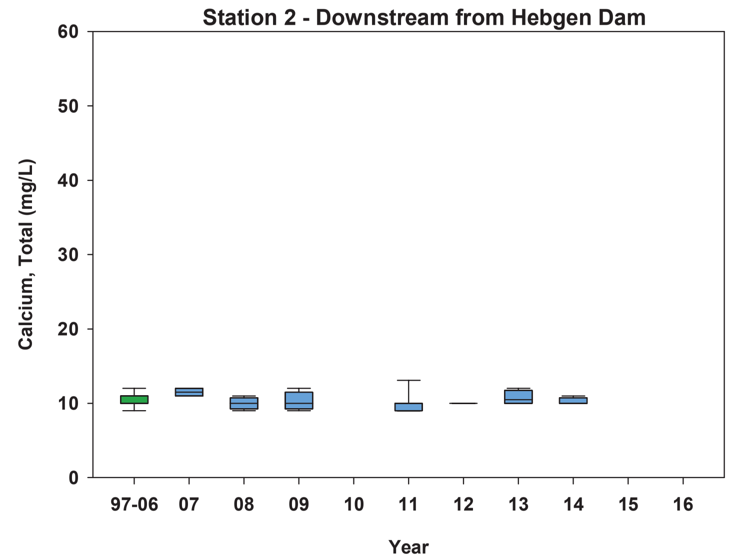
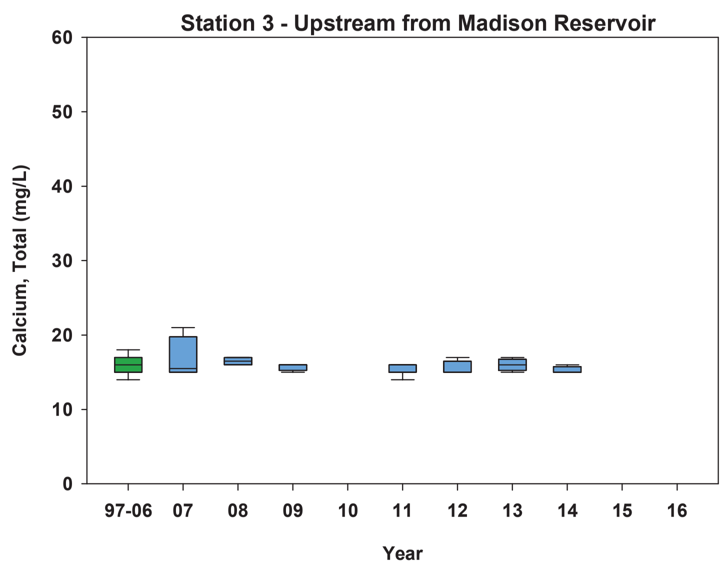


Figure B-3: Calcium, Total (mg/L) for Stations 1 to 10.







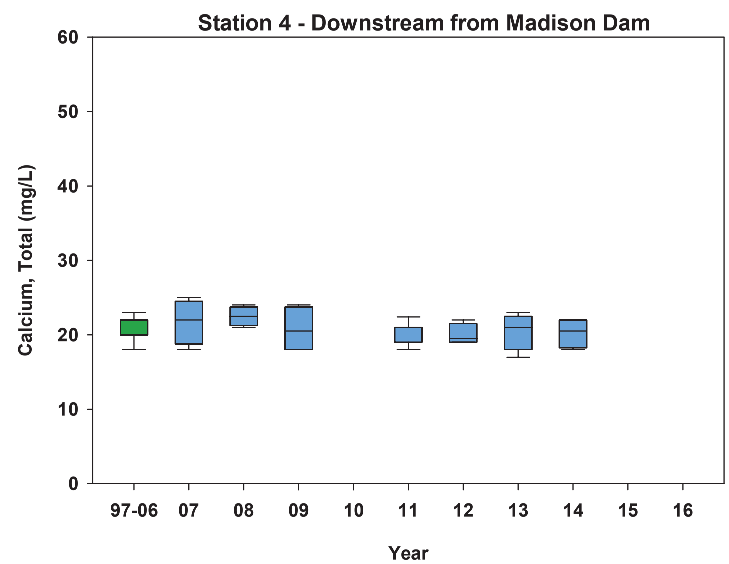
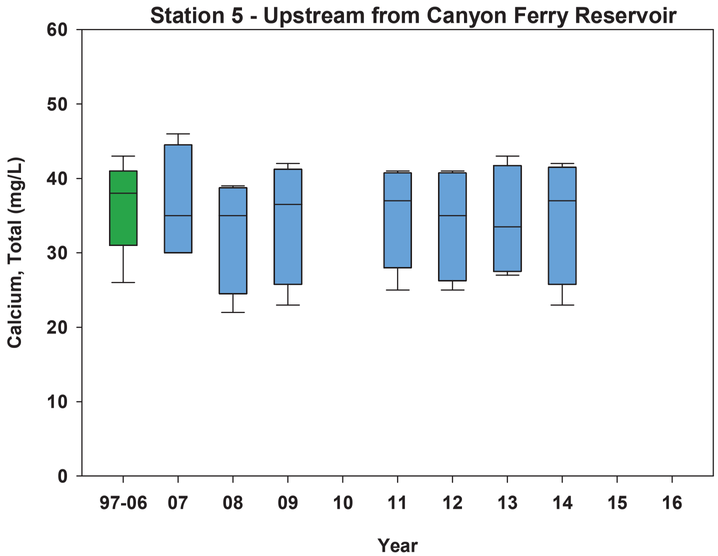
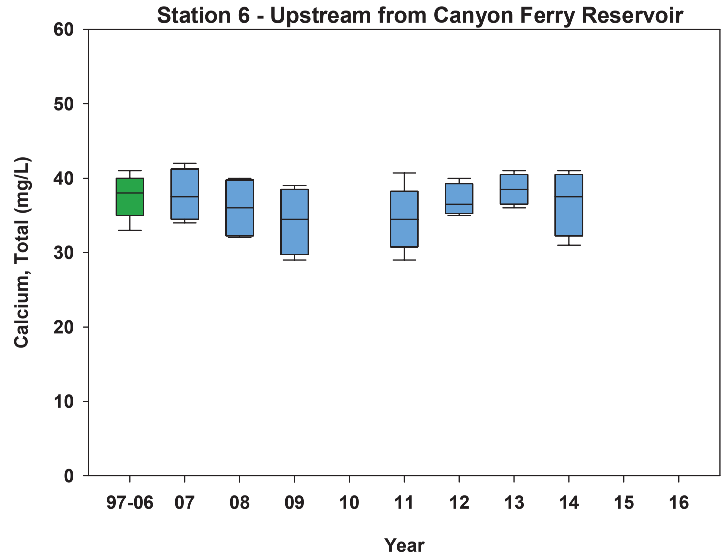
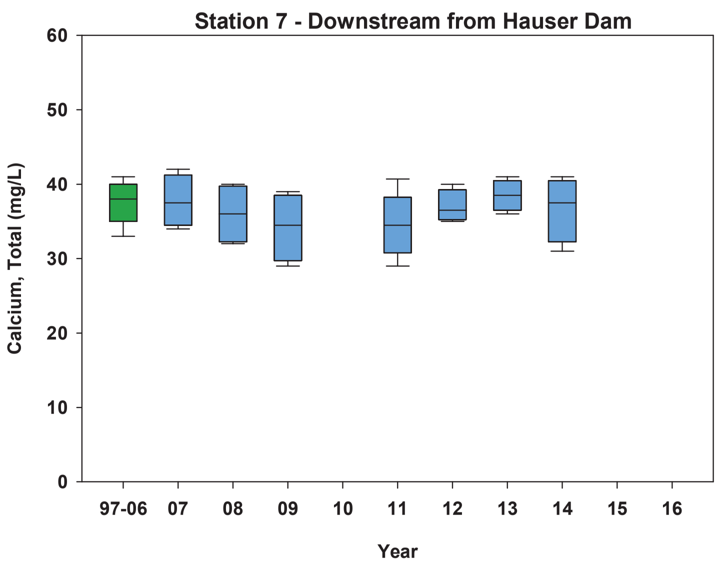


Figure B-3: Calcium, Total (mg/L) for Stations 1 to 10 (cont.).







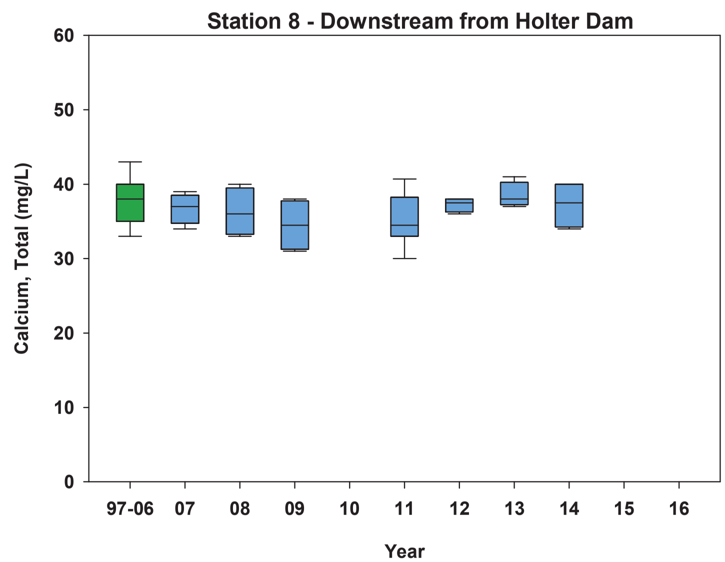
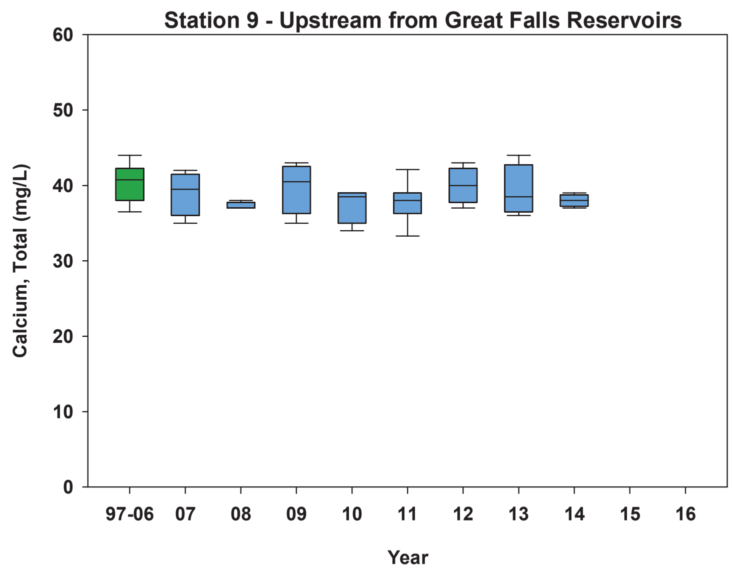


Figure B-3: Calcium, Total (mg/L) for Stations 1 to 10 (cont.).



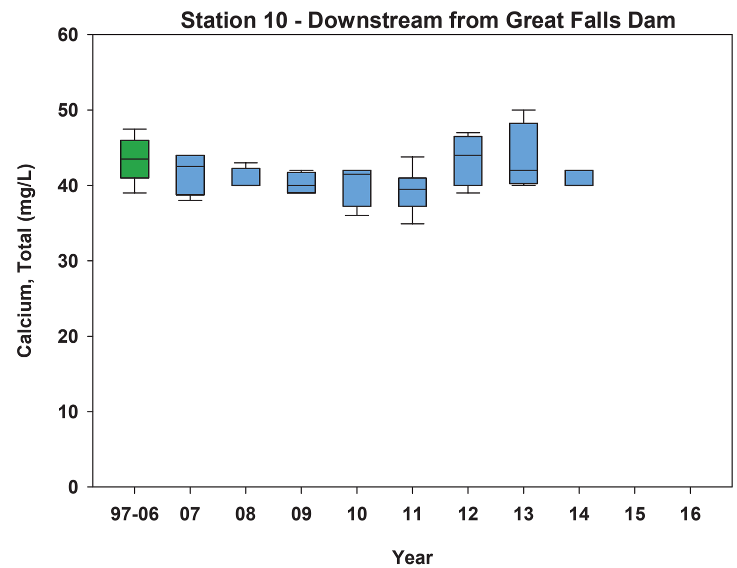


Figure B-4: Calcium, Dissolved (mg/L) for Stations 1 to 10.

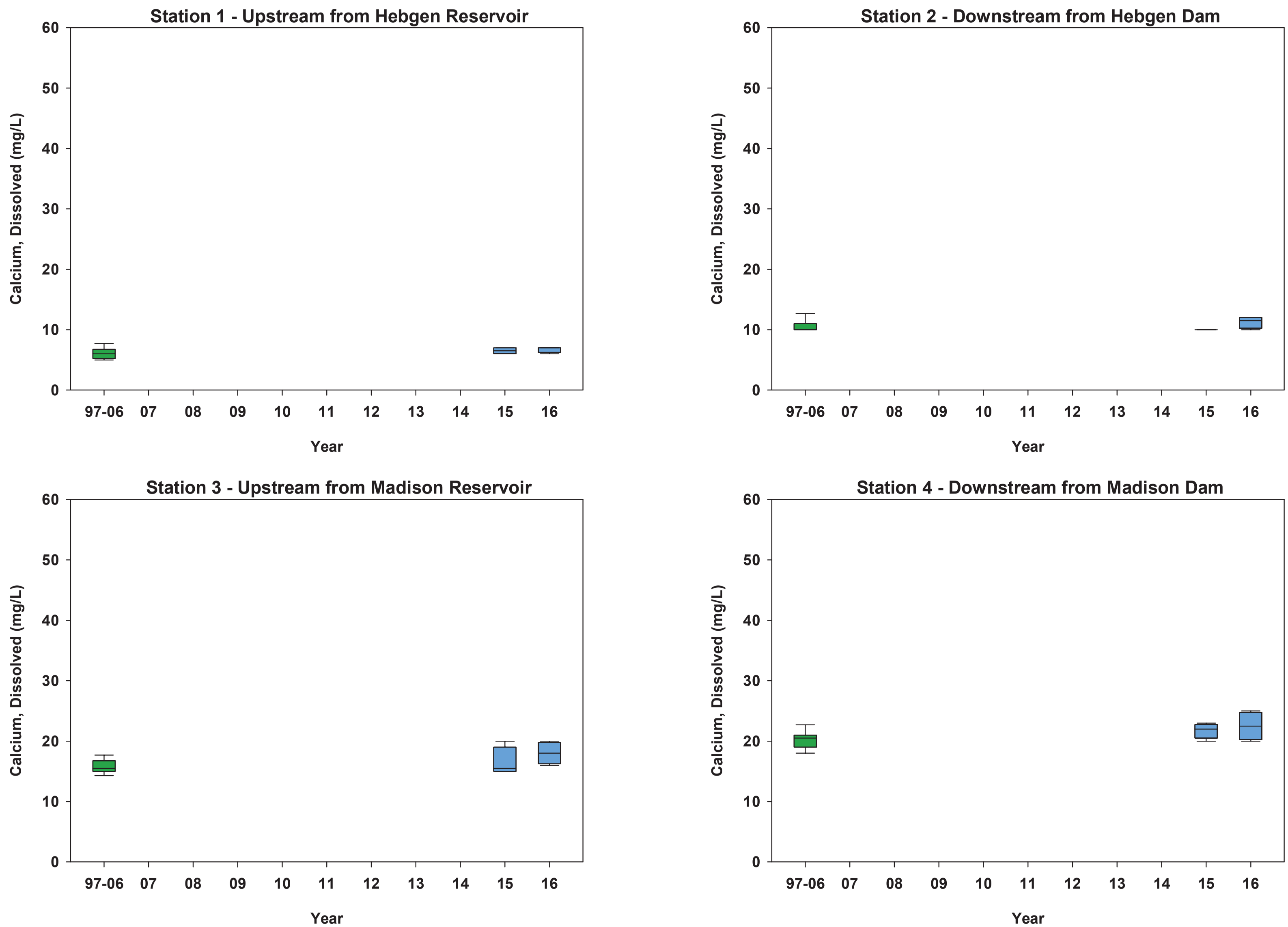
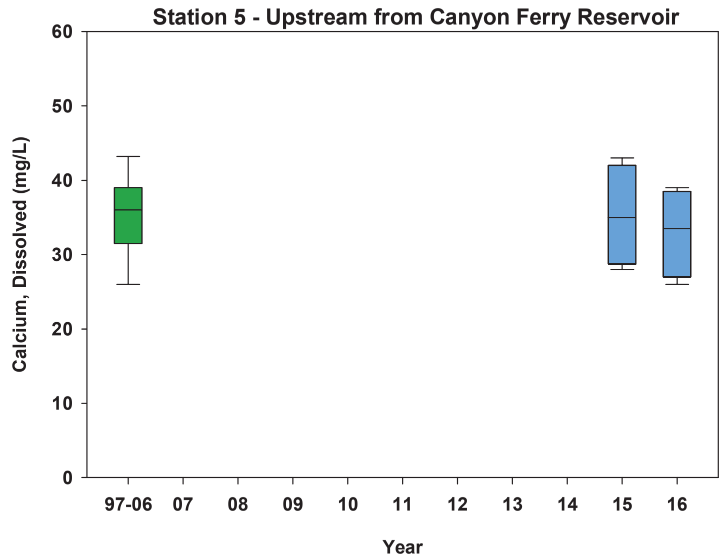
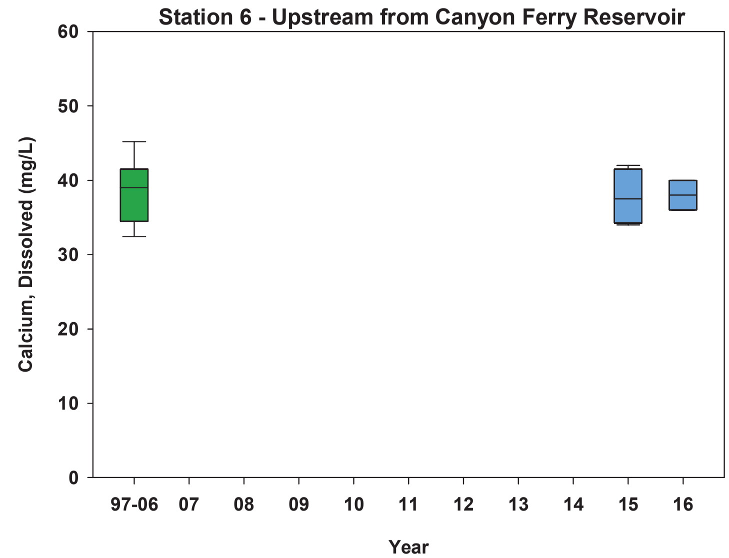
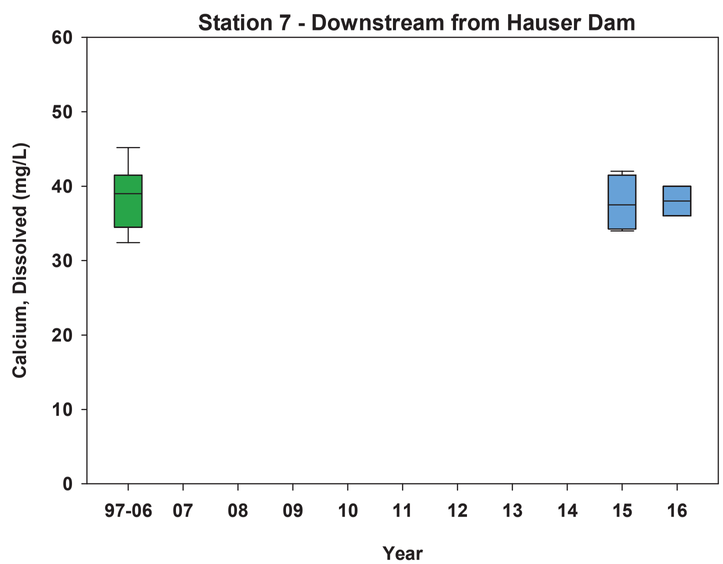


Figure B-4: Calcium, Dissolved (mg/L) for Stations 1 to 10 (cont.).







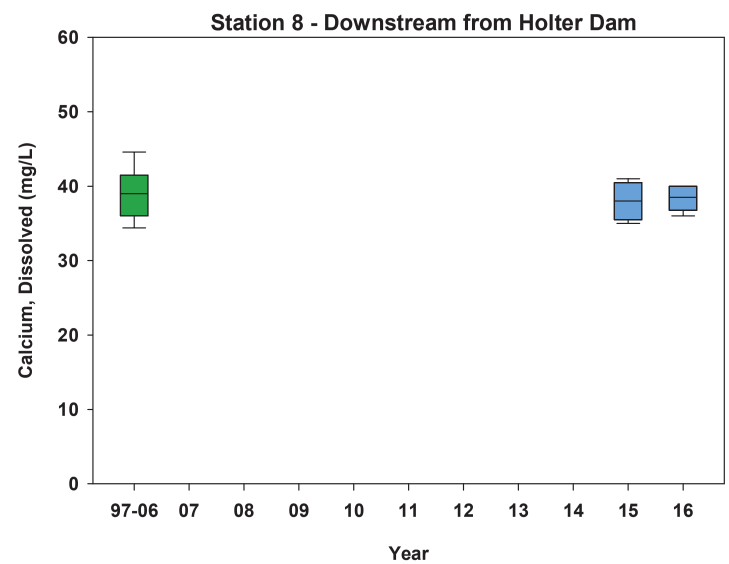
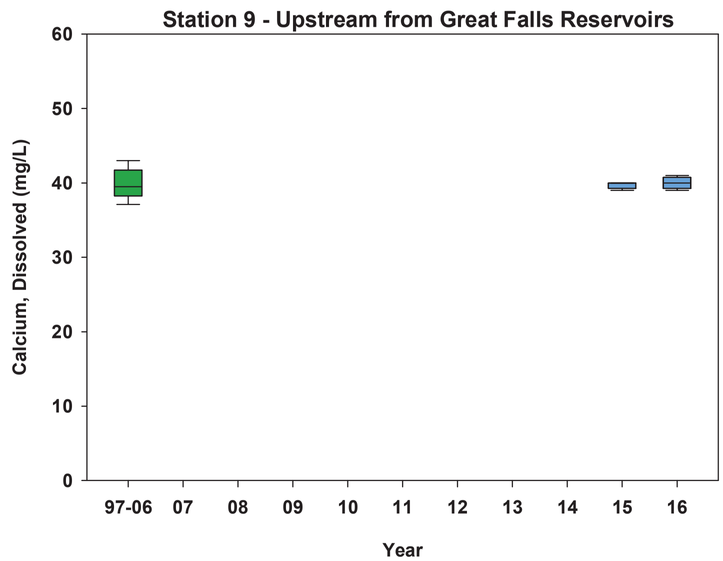


Figure B-4: Calcium, Dissolved (mg/L) for Stations 1 to 10 (cont.).



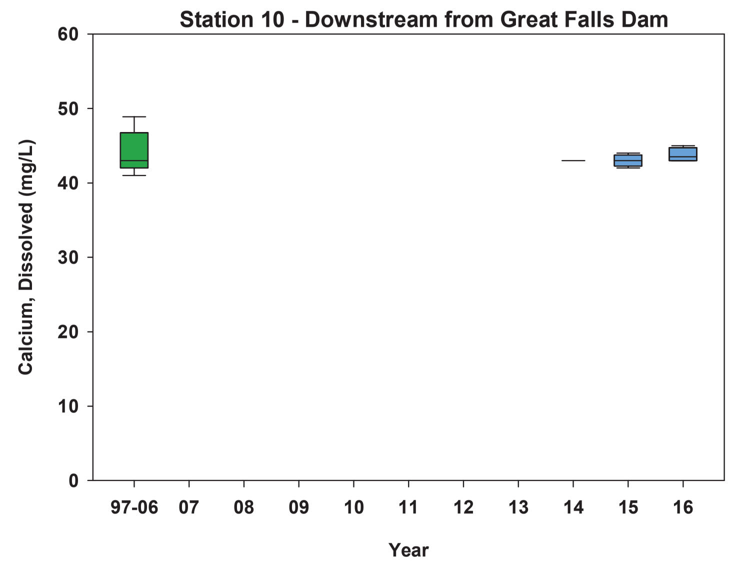
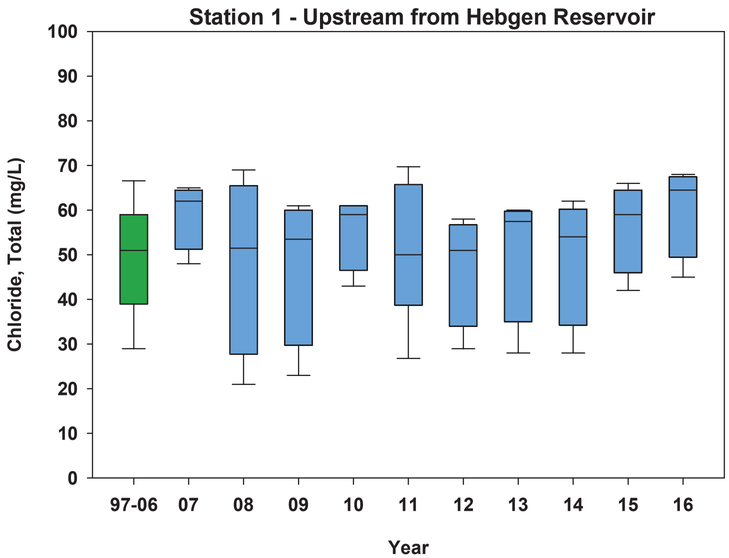
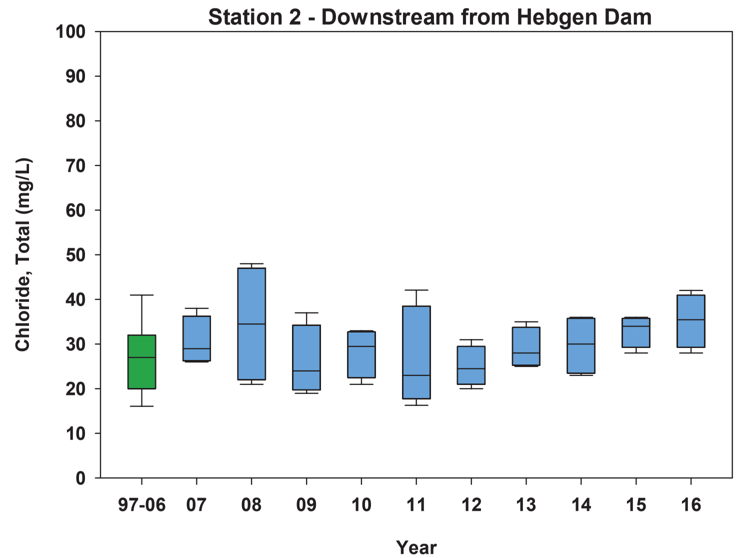
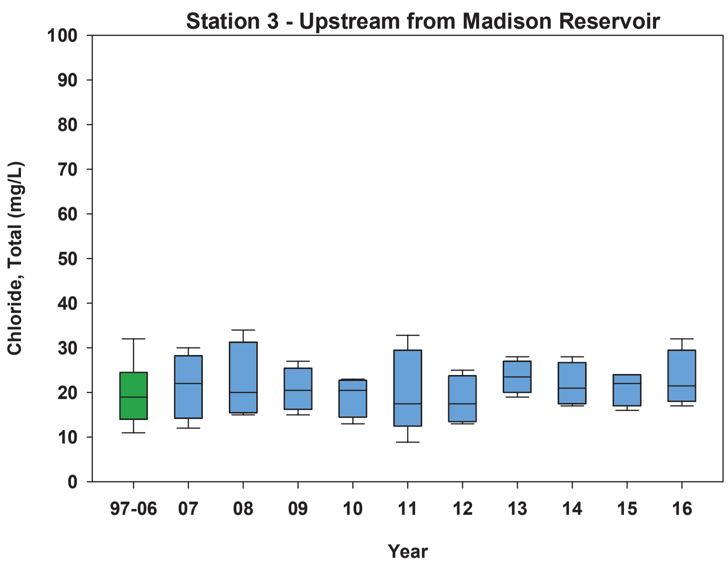


Figure B-5: Chloride, Total (mg/L) for Stations 1 to 10.







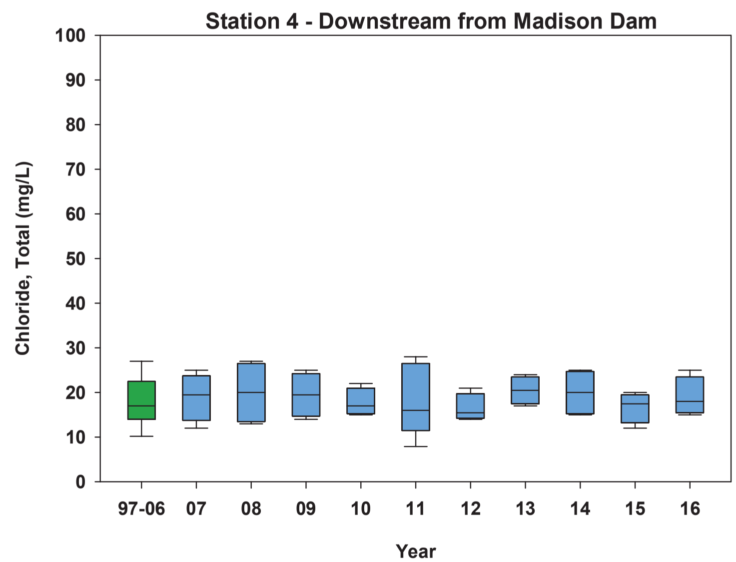


Figure B-5: Chloride, Total (mg/L) for Stations 1 to 10 (cont.).

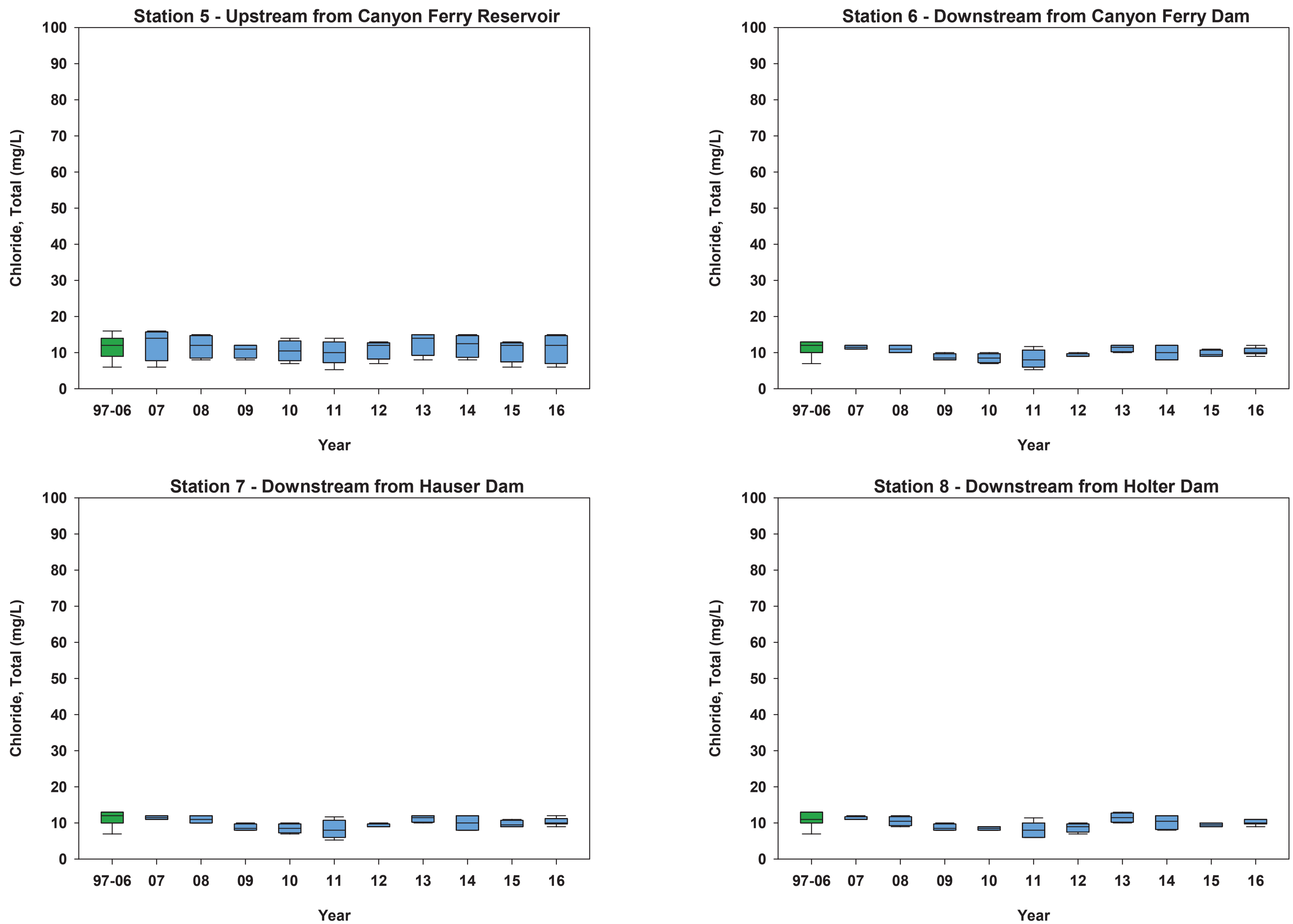
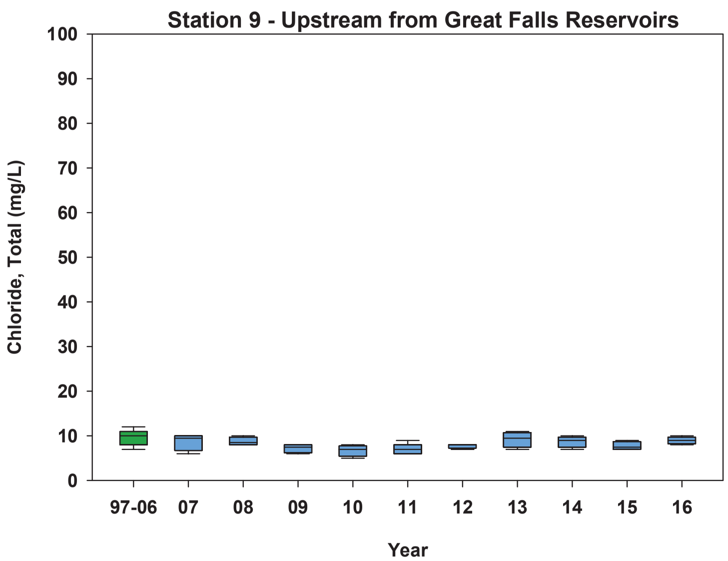


Figure B-5: Chloride, Total (mg/L) for Stations 1 to 10 (cont.).



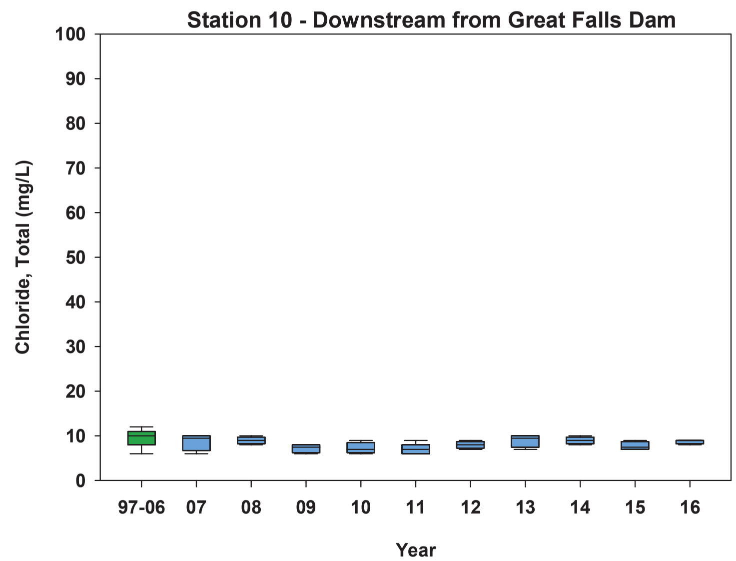
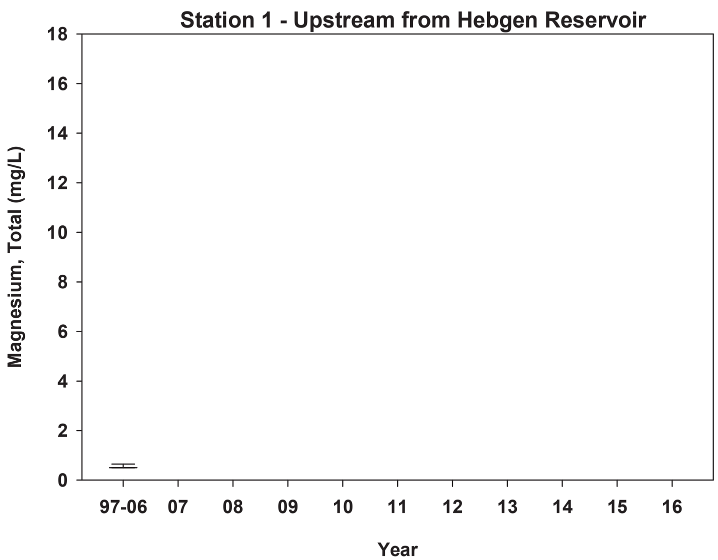
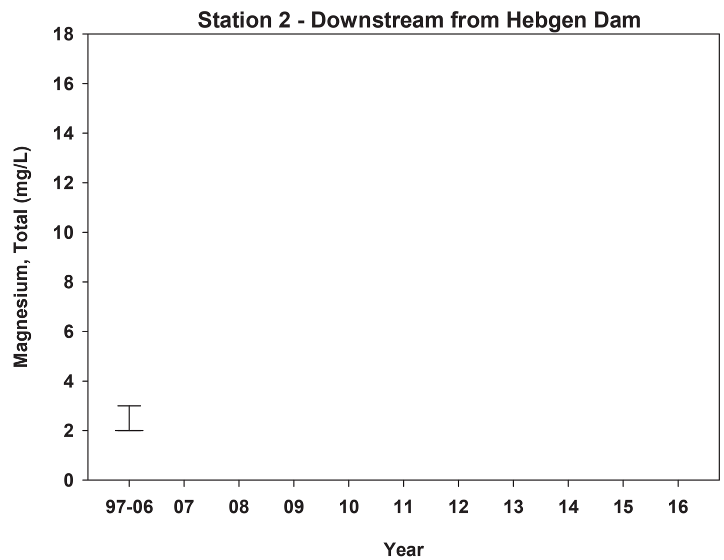
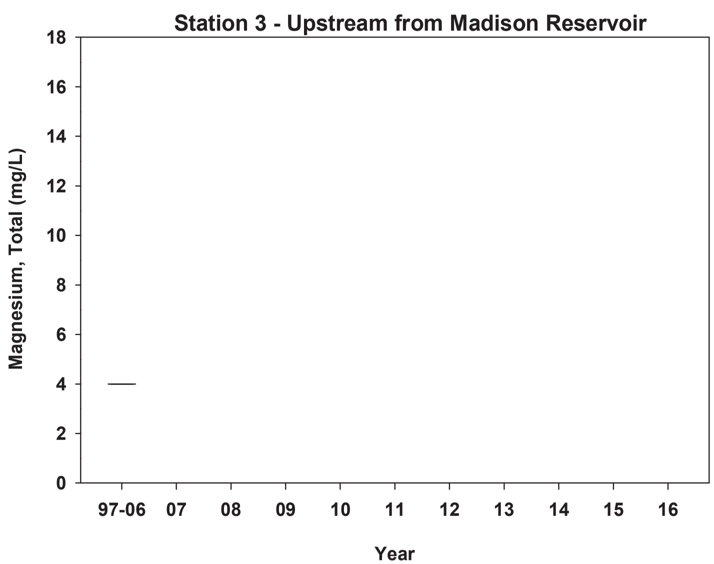


Figure B-6: Magnesium, Total (mg/L) for Stations 1 to 10.







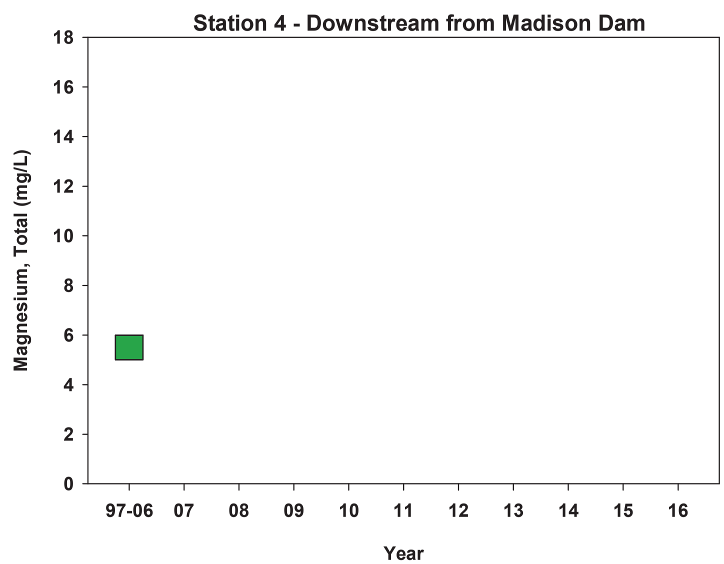
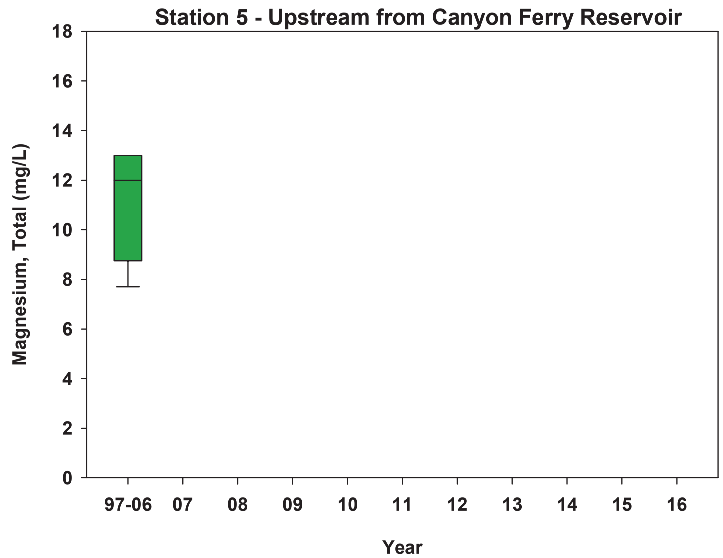
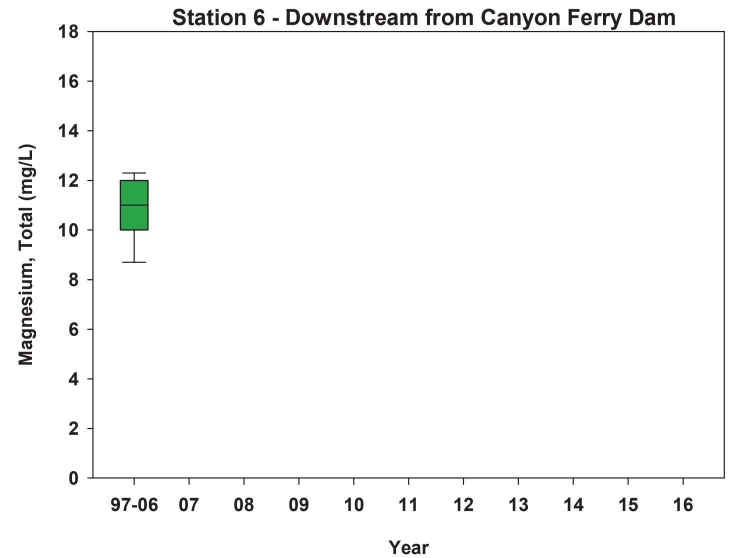
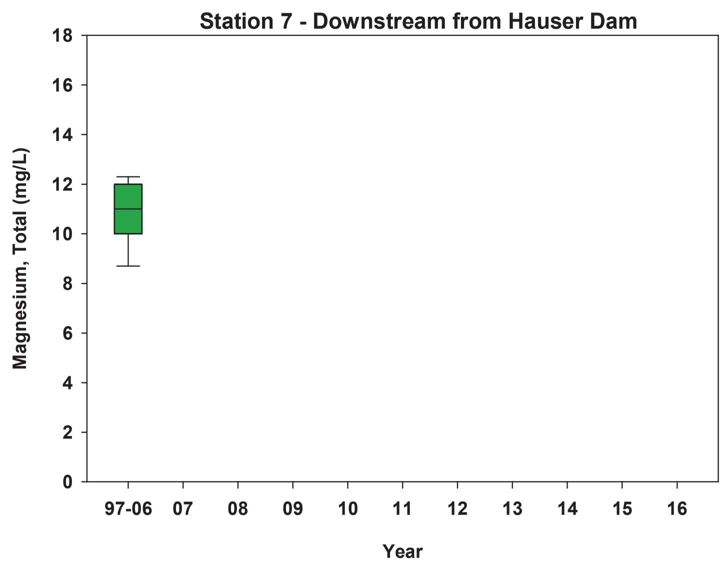


Figure B-6: Magnesium, Total (mg/L) for Stations 1 to 10 (cont.).







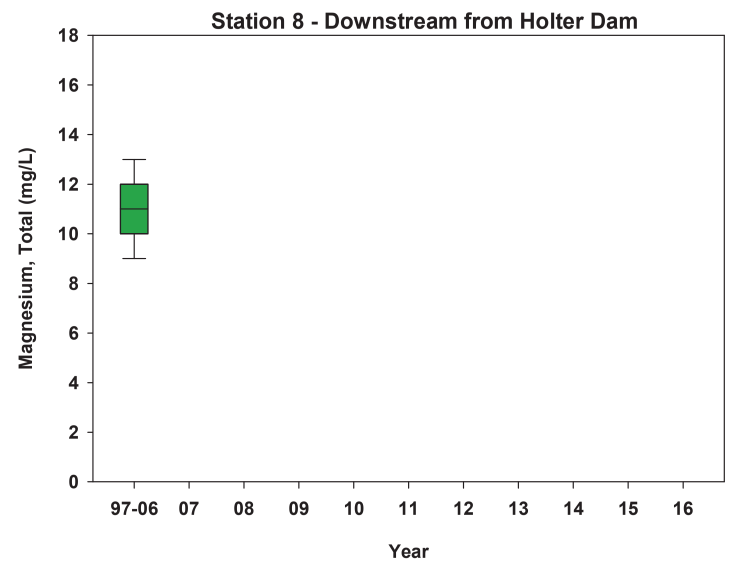
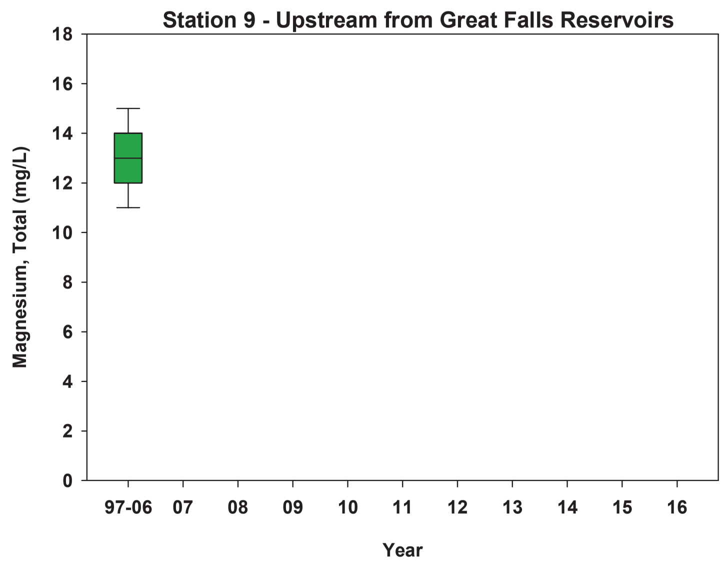


Figure B-6: Magnesium, Total (mg/L) for Stations 1 to 10 (cont.).



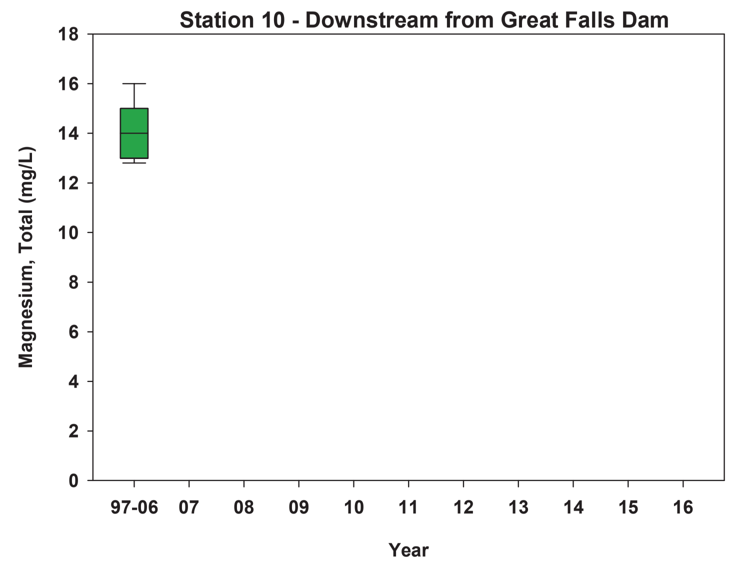
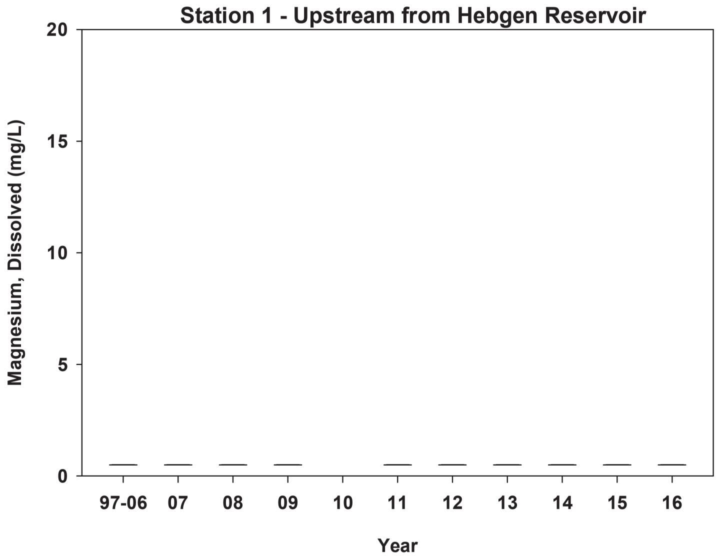
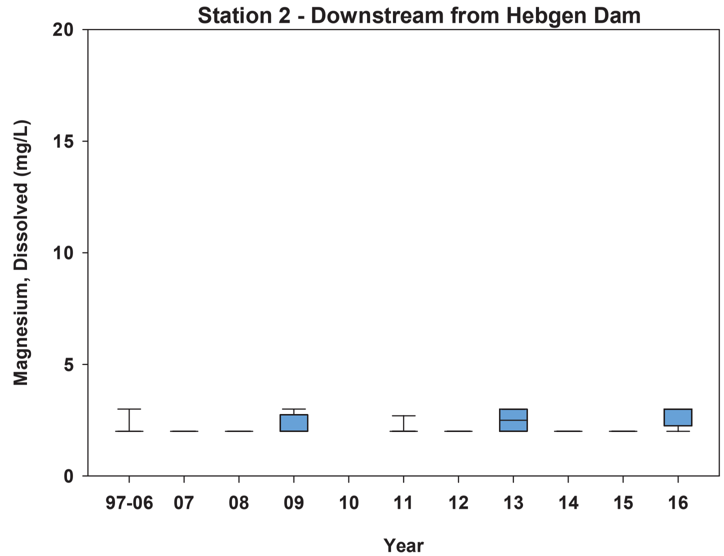
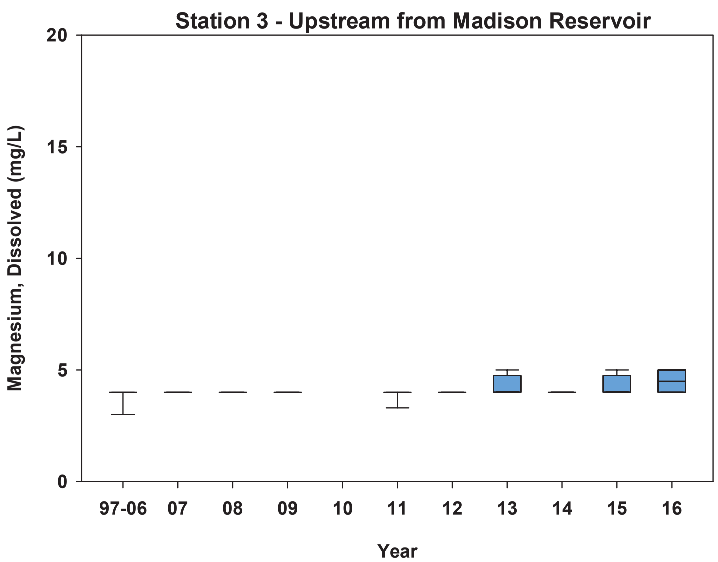


Figure B-7: Magnesium, Dissolved (mg/L) for Stations 1 to 10.







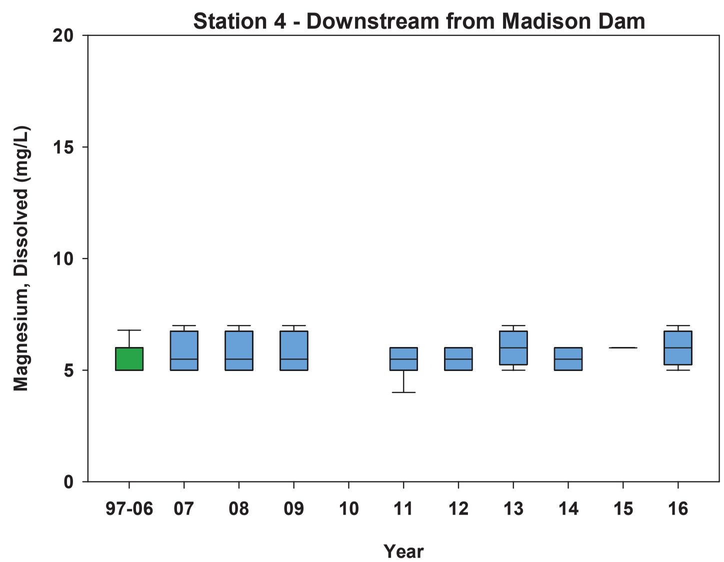
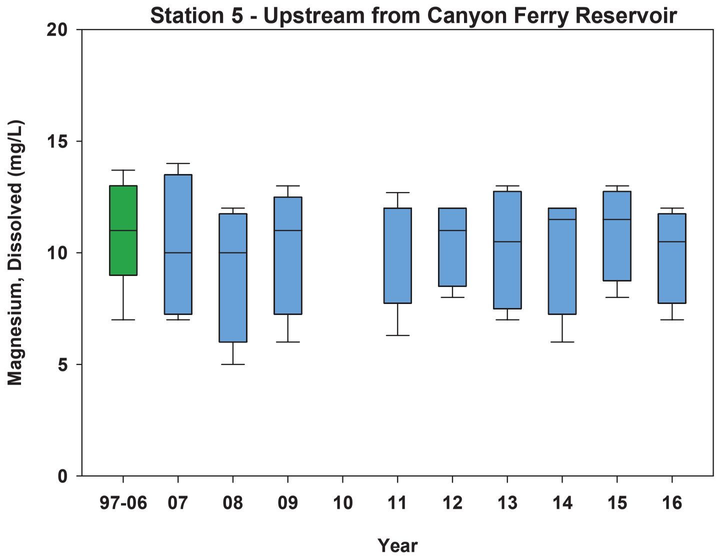
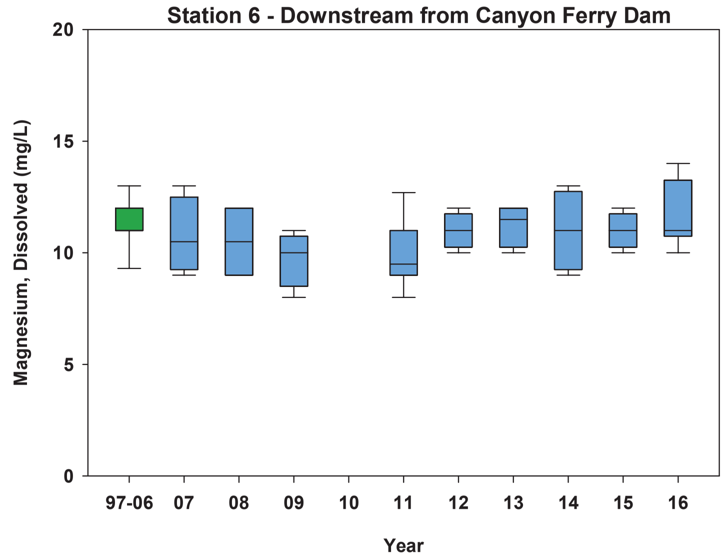
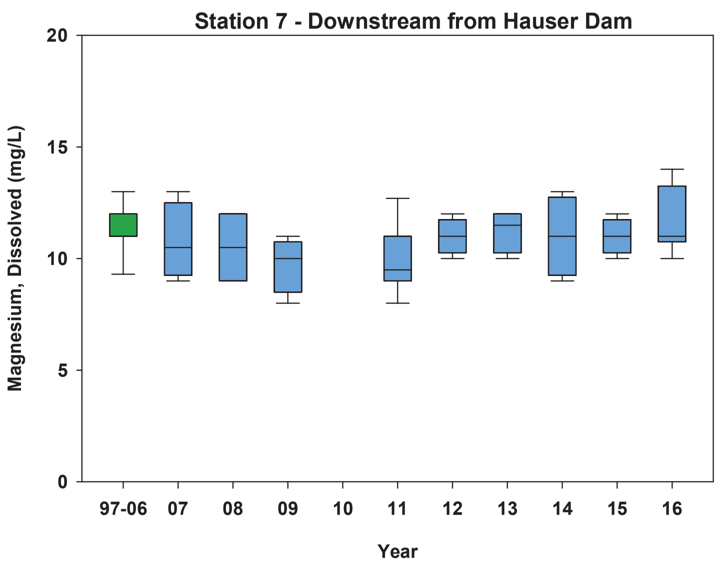


Figure B-7: Magnesium, Dissolved (mg/L) for Stations 1 to 10 (cont.).







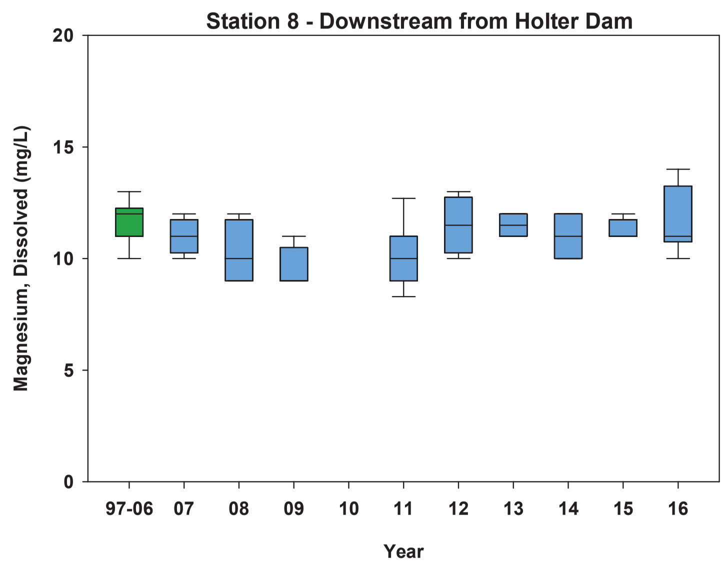
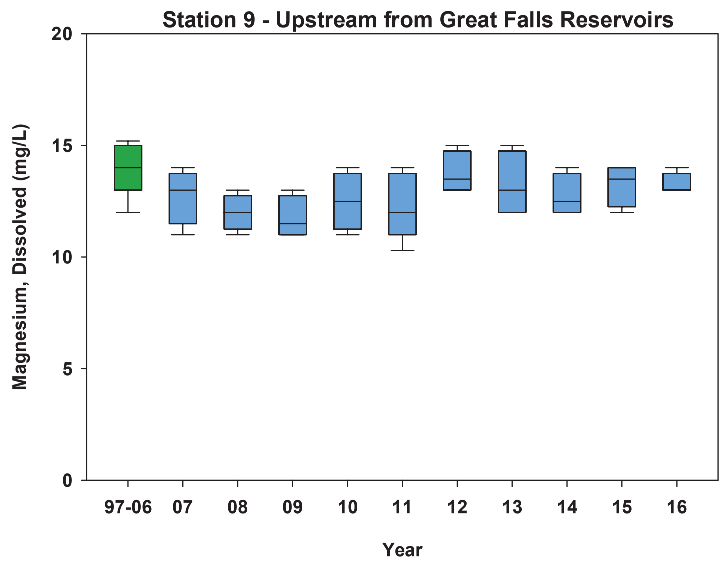


Figure B-7: Magnesium, Dissolved (mg/L) for Stations 1 to 10 (cont.).



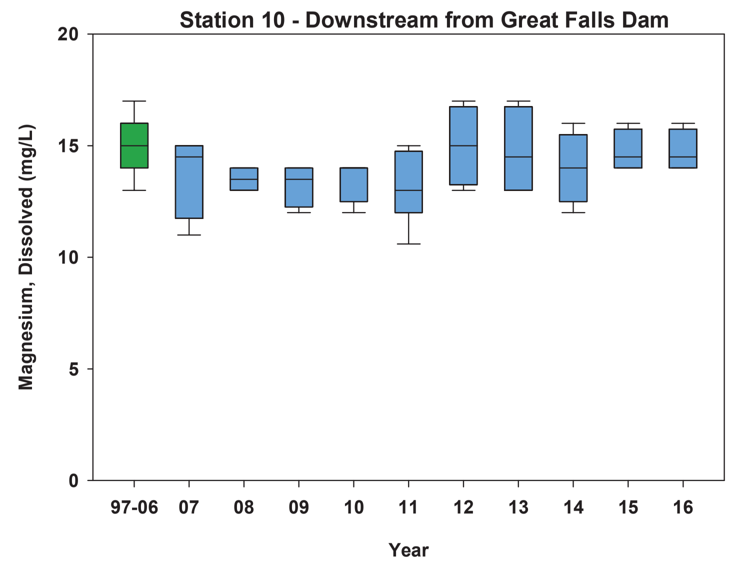


Figure B-8: Potassium, Total (mg/L) for Stations 1 to 10.

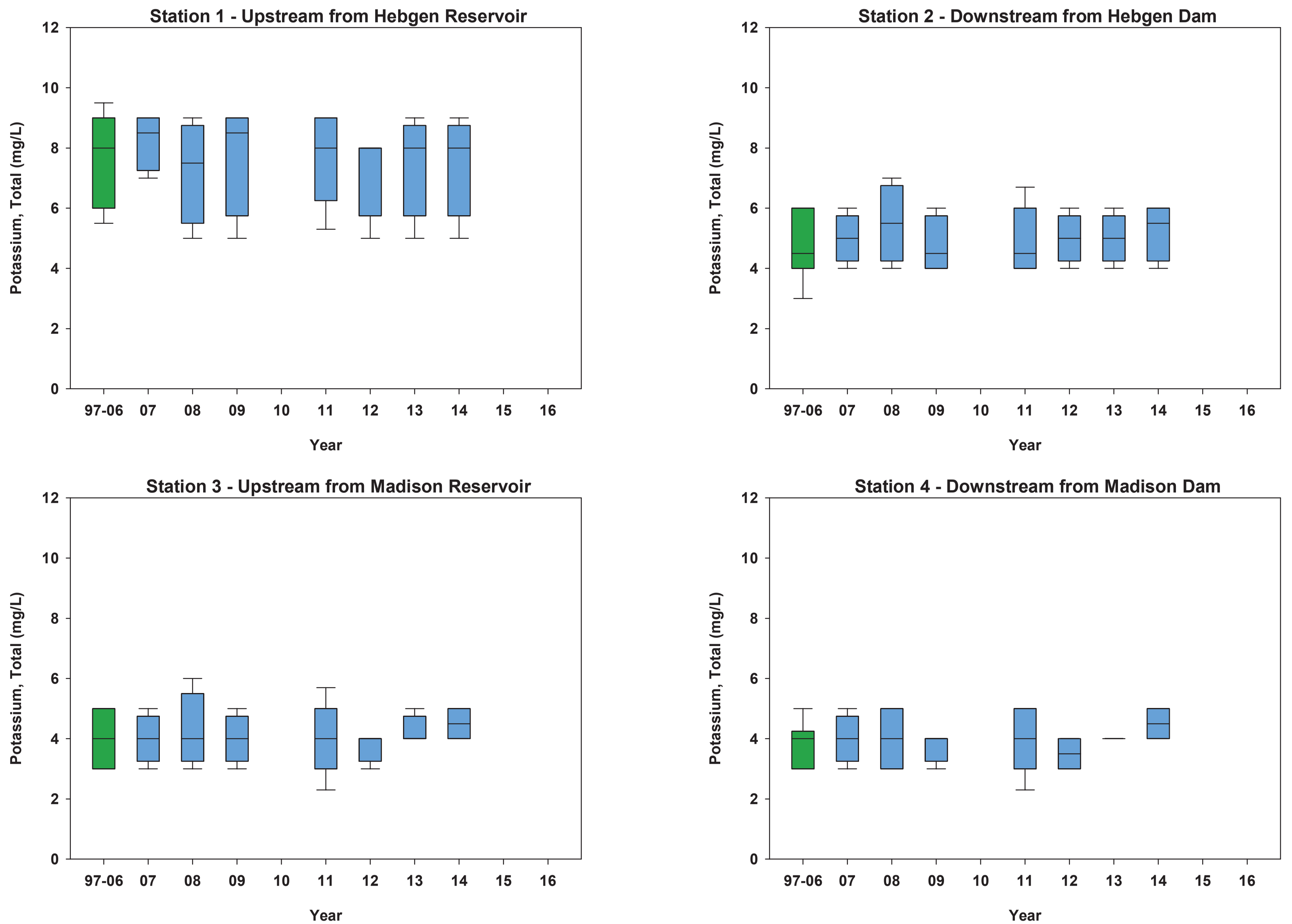


Figure B-8: Potassium, Total (mg/L) for Stations 1 to 10 (cont.).

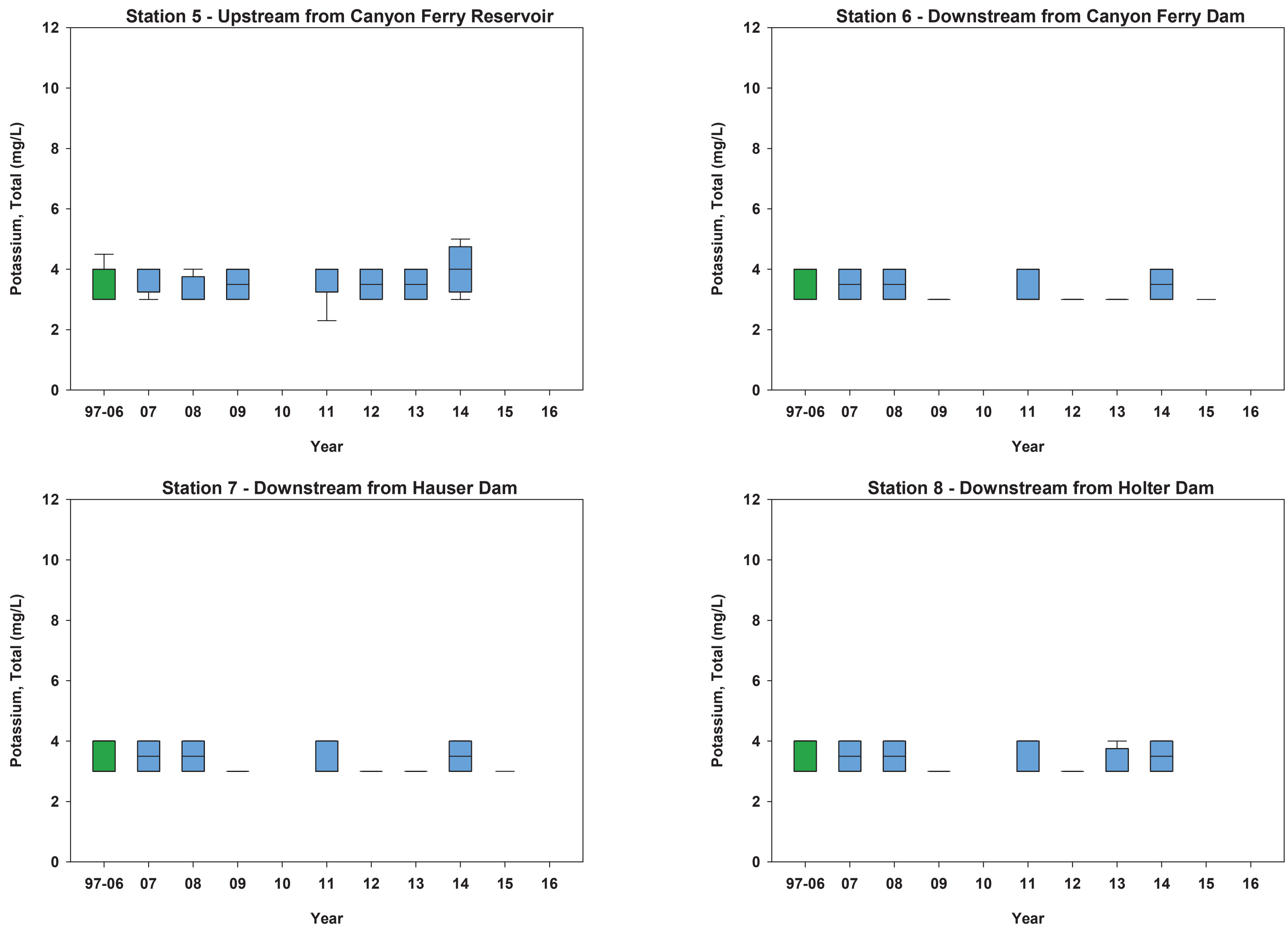
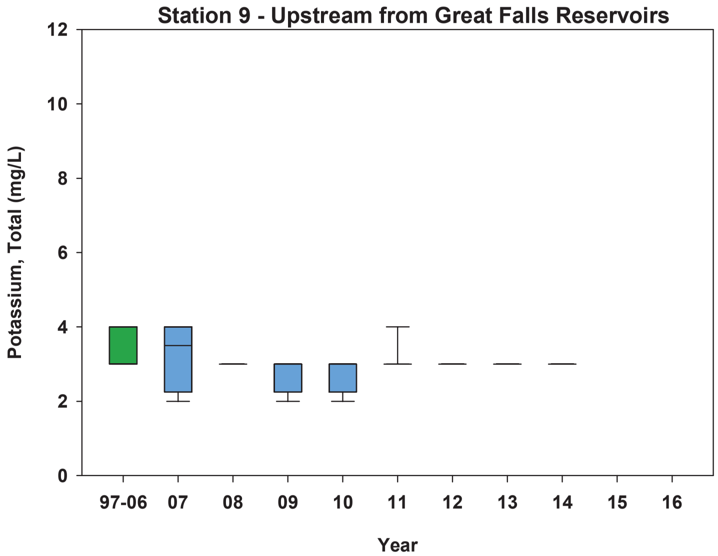


Figure B-8: Potassium, Total (mg/L) for Stations 1 to 10 (cont.).



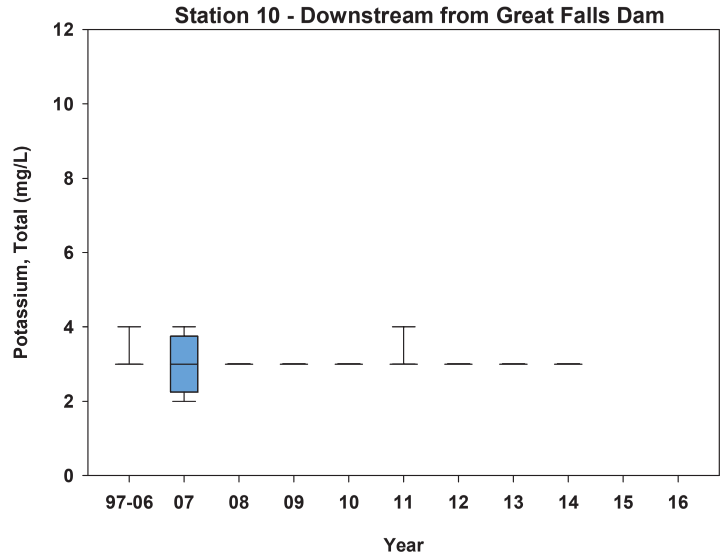


Figure B-9: Potassium, Dissolved (mg/L) for Stations 1 to 10.

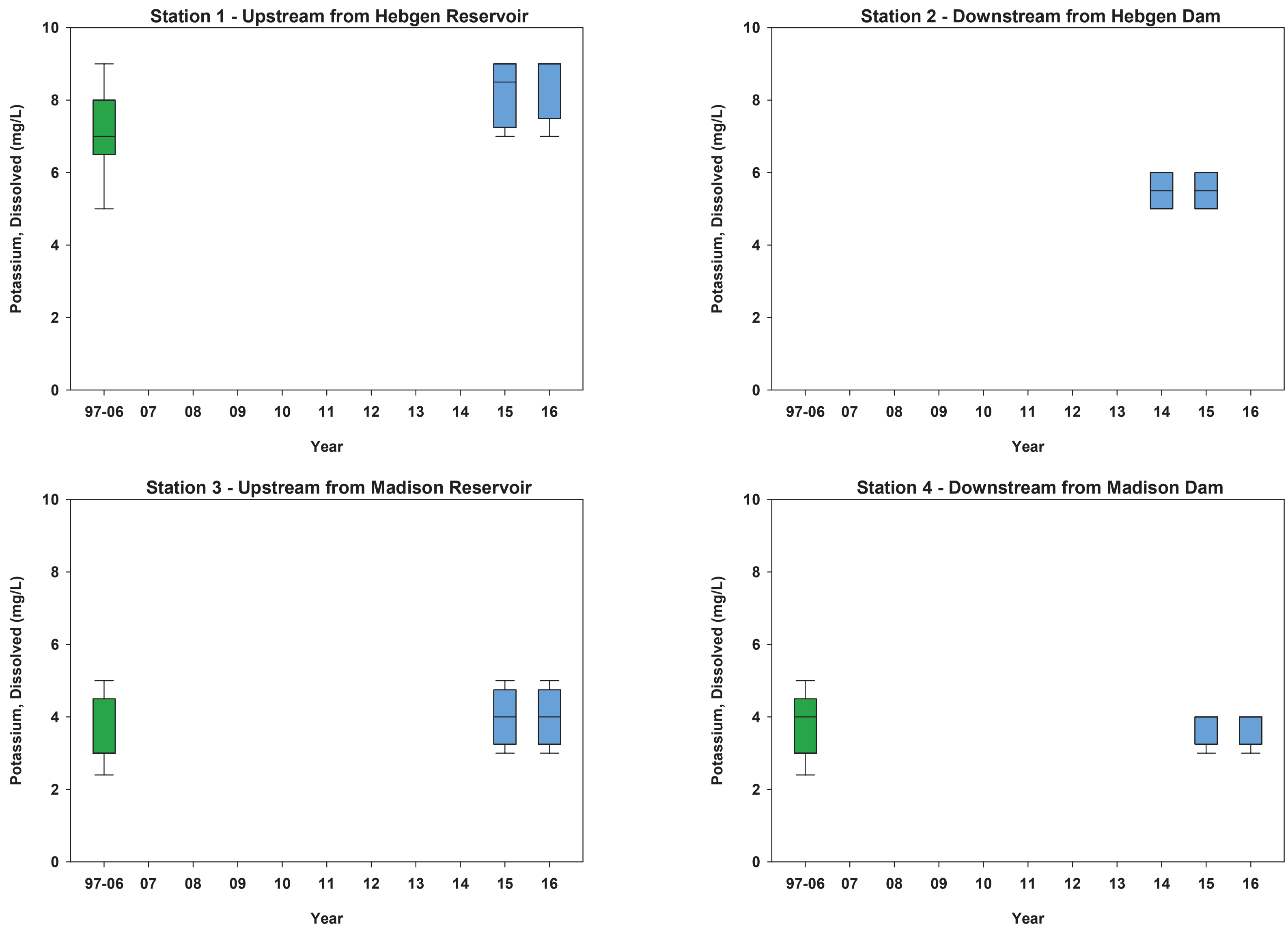


Figure B-9: Potassium, Dissolved (mg/L) for Stations 1 to 10 (cont.).

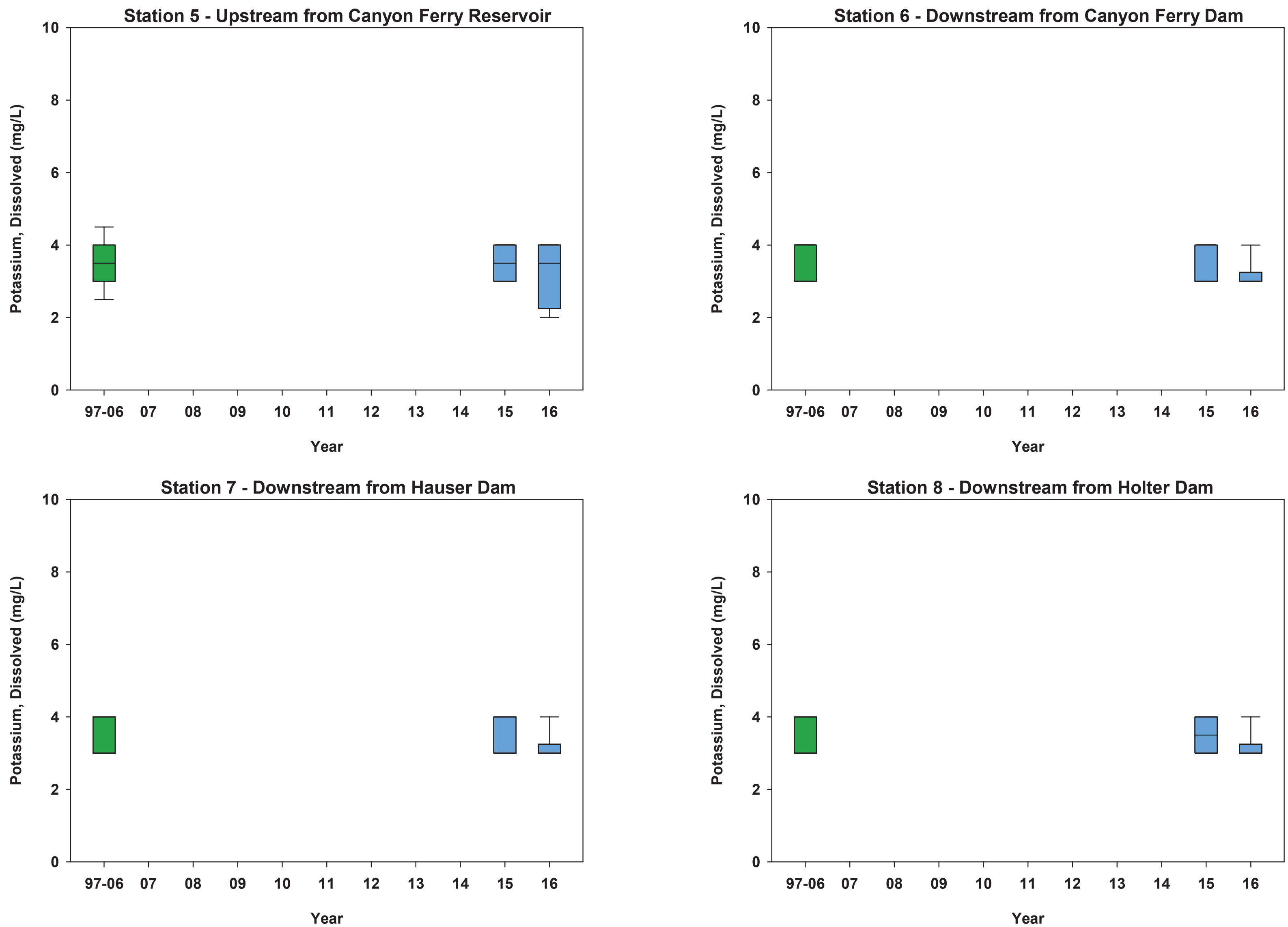
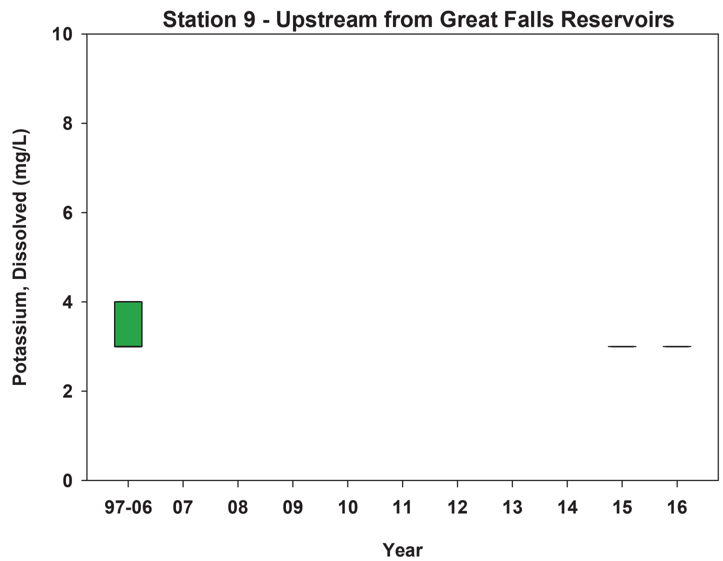


Figure B-9: Potassium, Dissolved (mg/L) for Stations 1 to 10 (cont.).



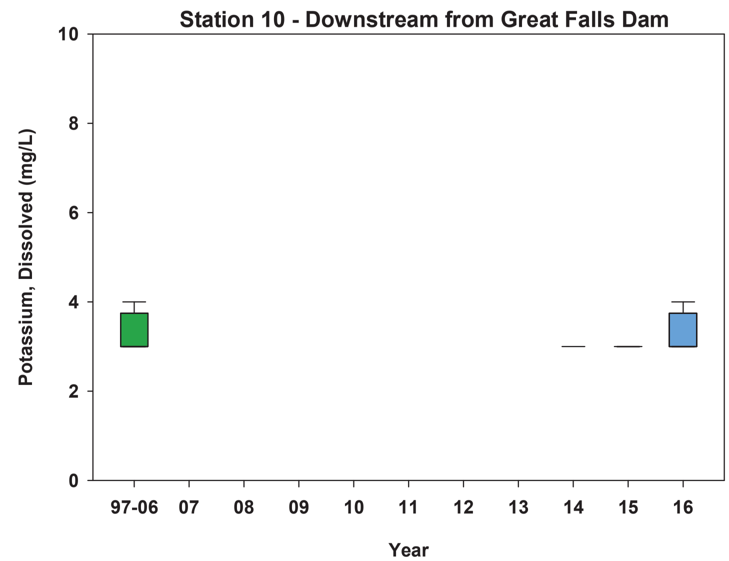


Figure B-10: Sodium, Dissolved (mg/L) for Stations 1 to 10.

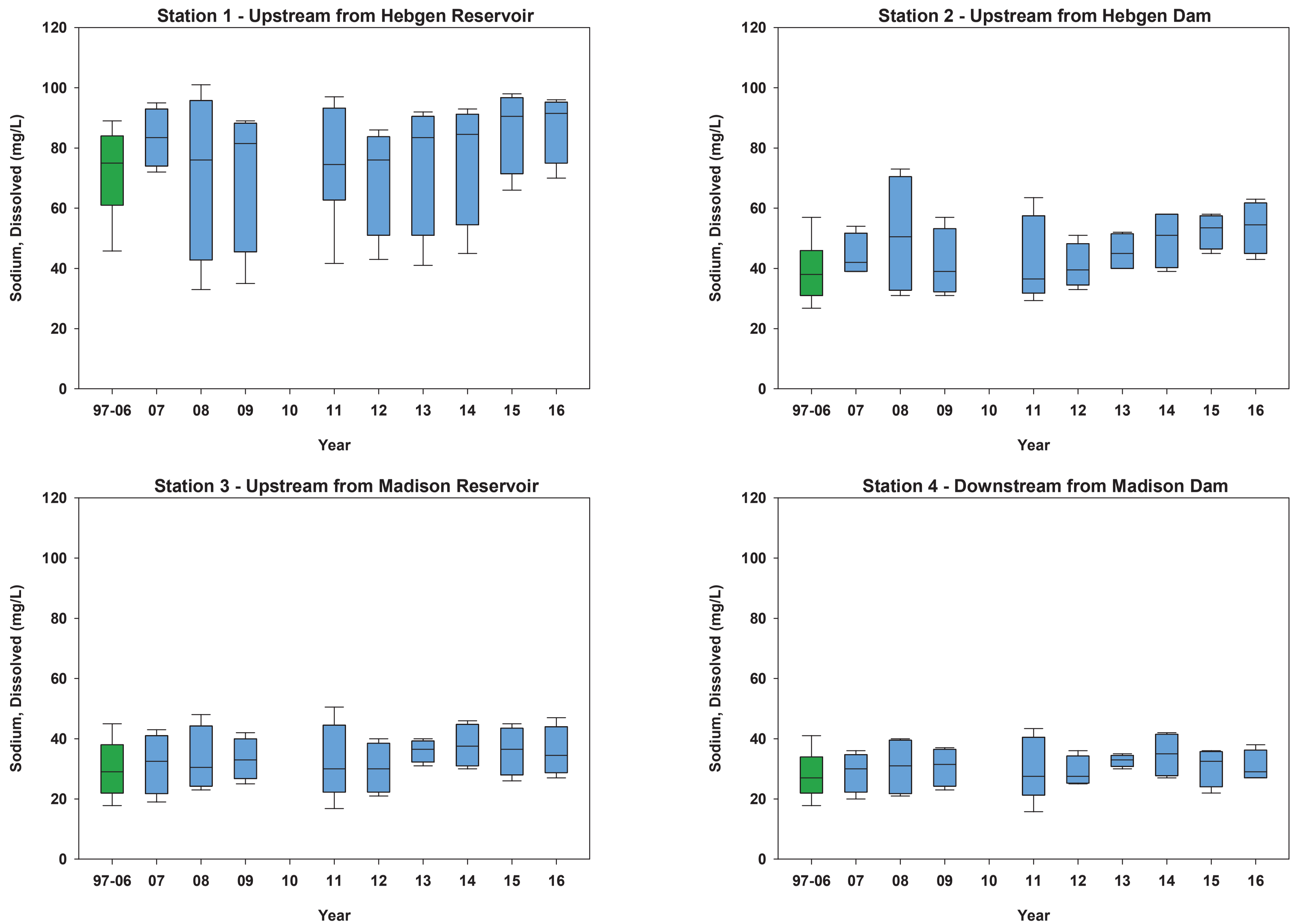


Figure B-10: Sodium, Dissolved (mg/L) for Stations 1 to 10 (cont.).

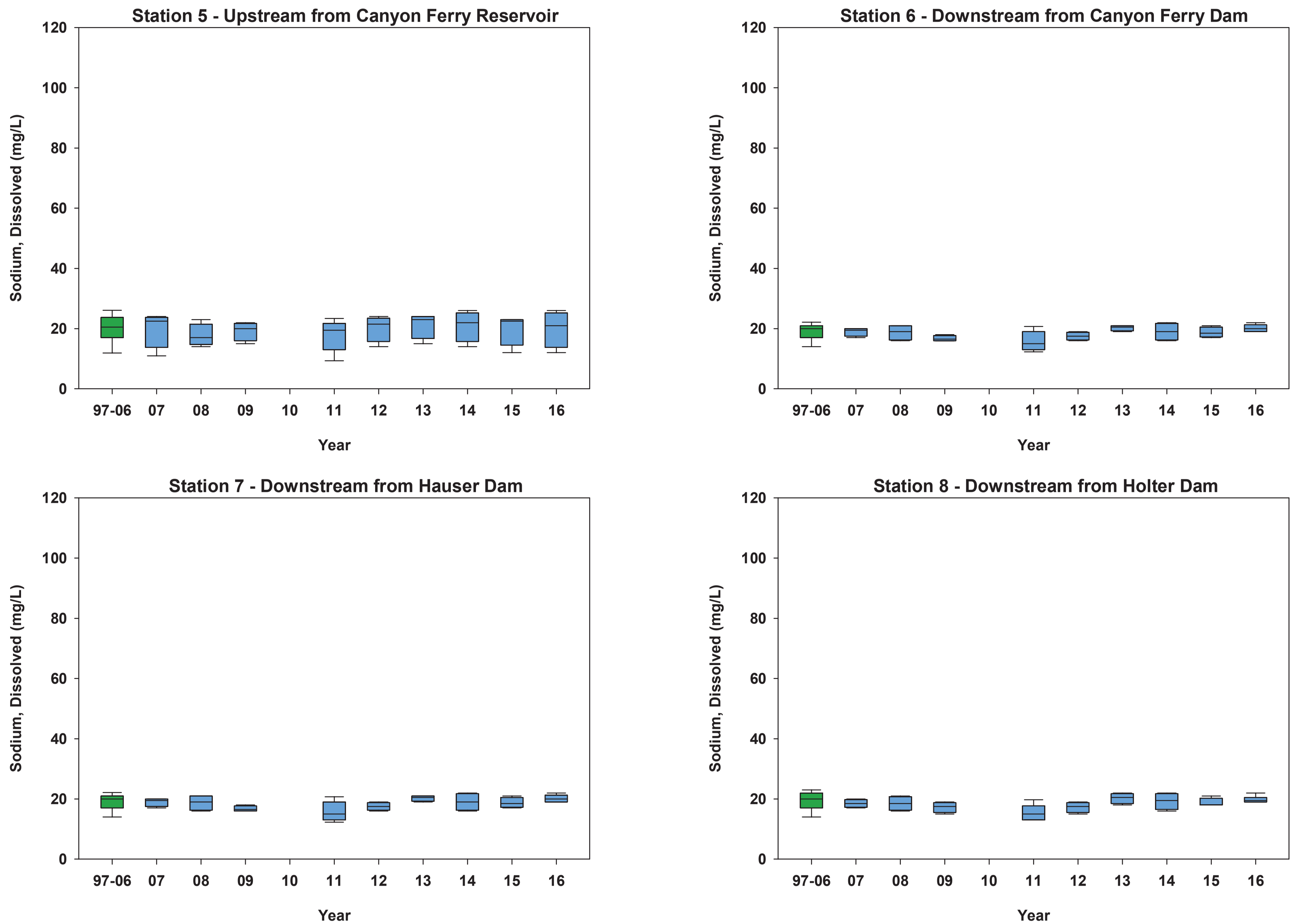
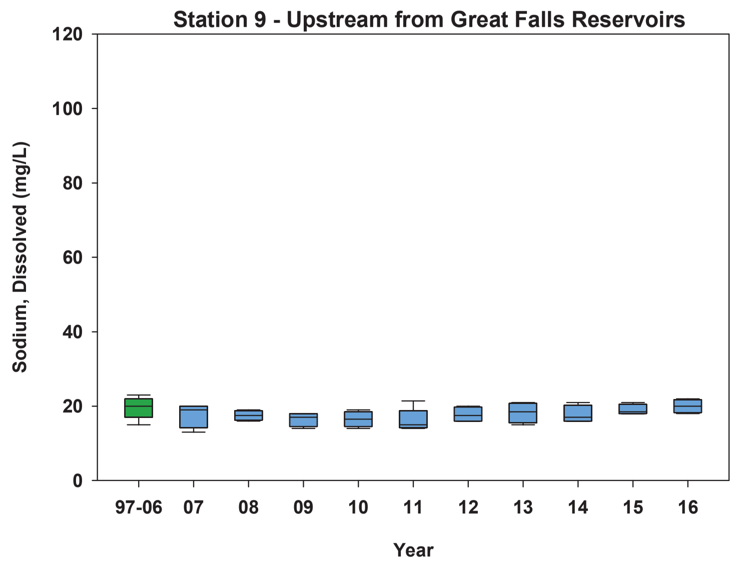


Figure B-10: Sodium, Dissolved (mg/L) for Stations 1 to 10 (cont.).



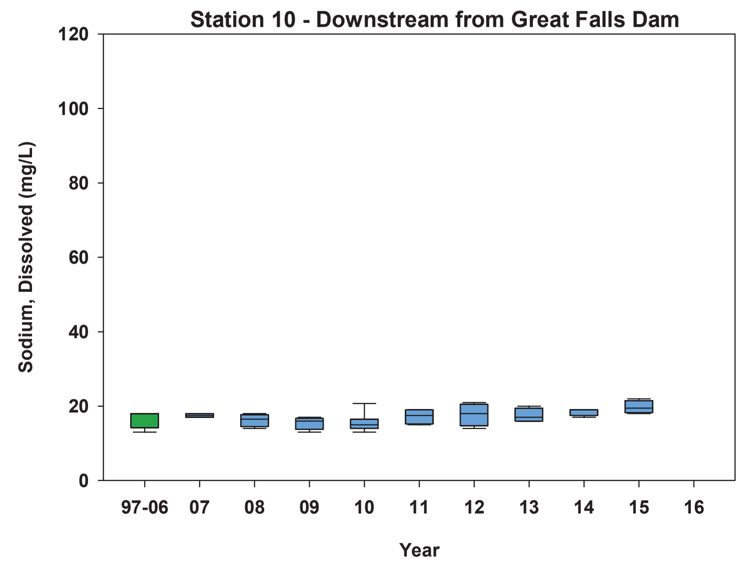
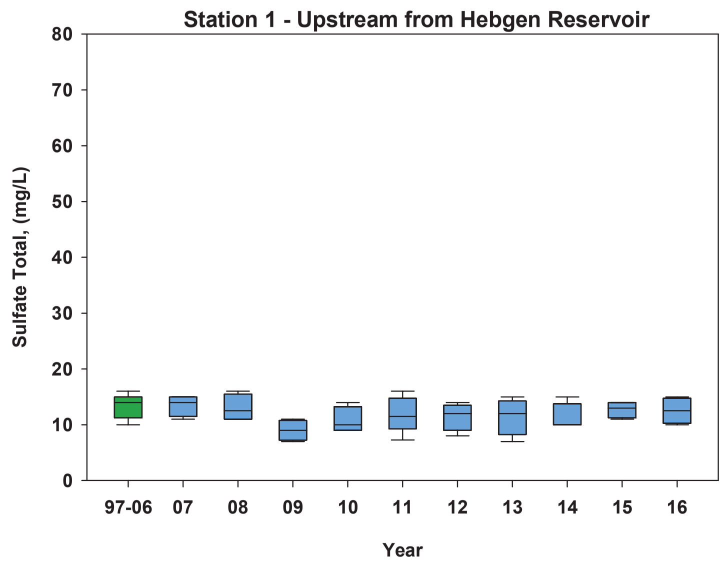
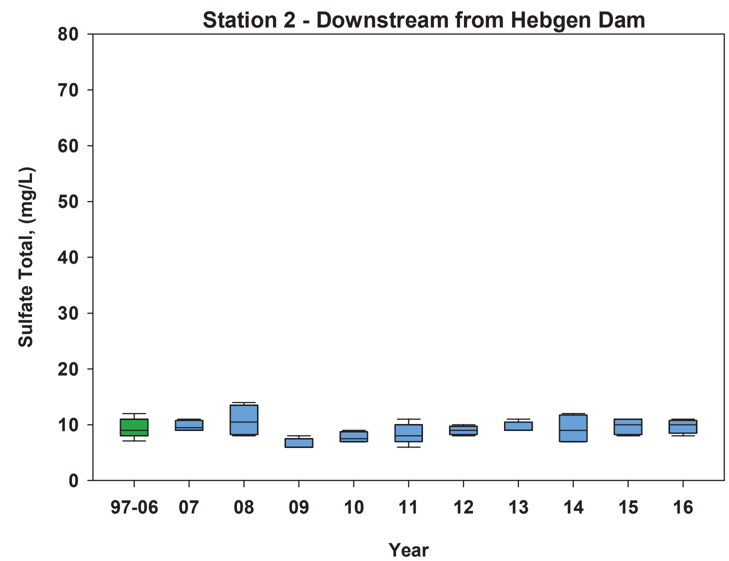
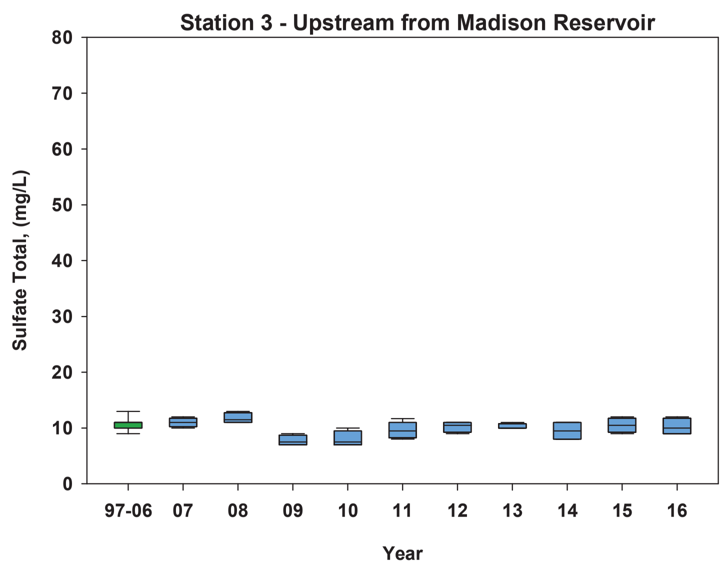


Figure B-11: Sulfate, Total (mg/L) for Stations 1 to 10.







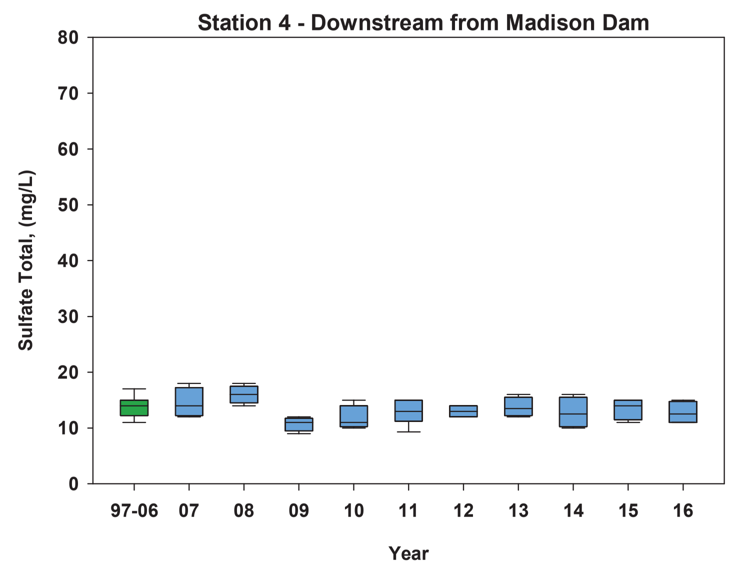


Figure B-11: Sulfate, Total (mg/L) for Stations 1 to 10 (cont.).

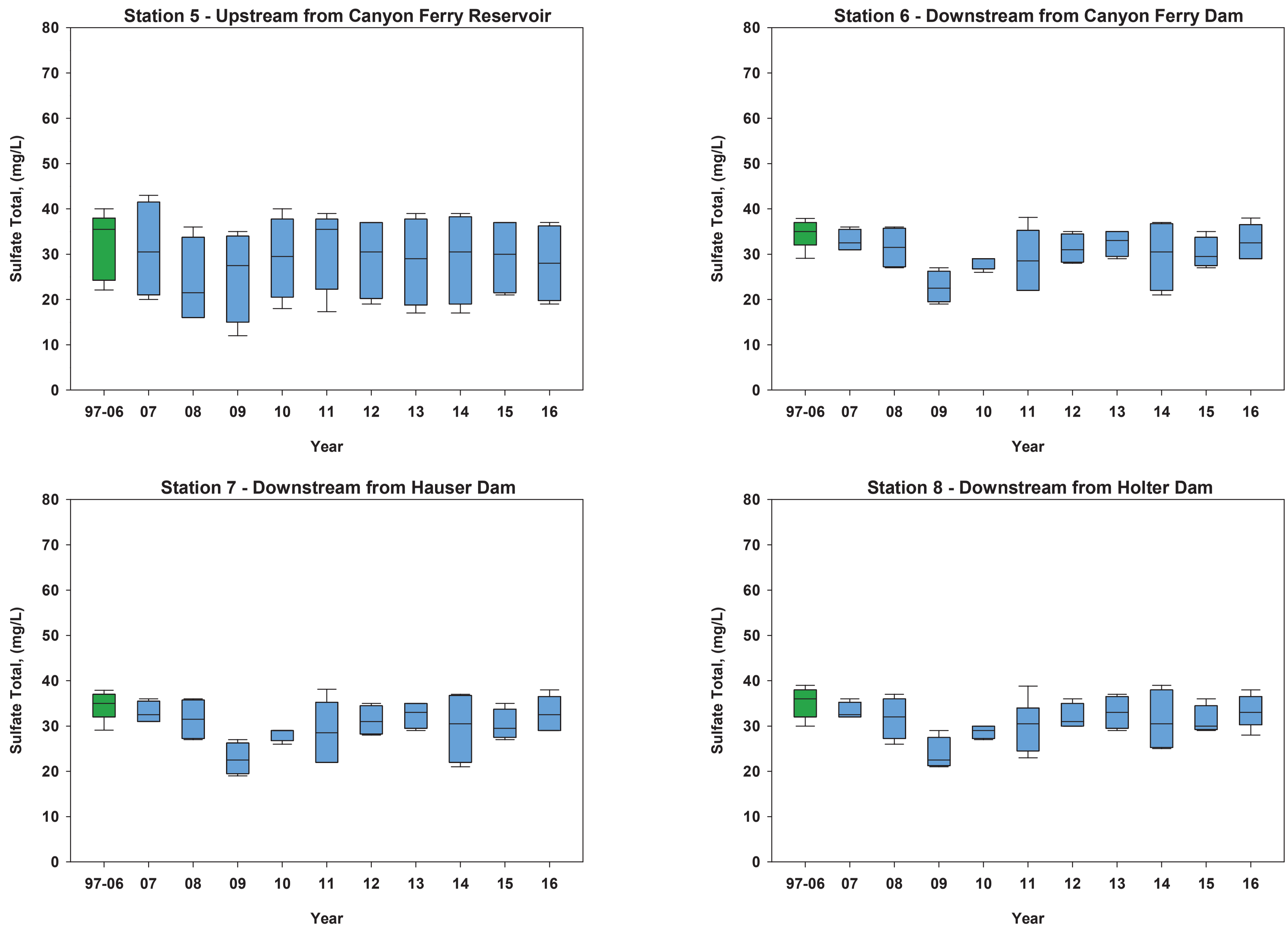
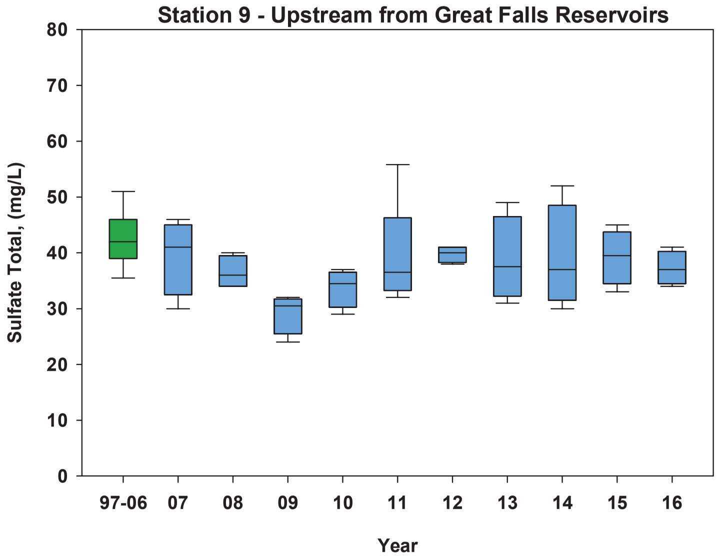


Figure B-11: Sulfate, Total (mg/L) for Stations 1 to 10 (cont.).



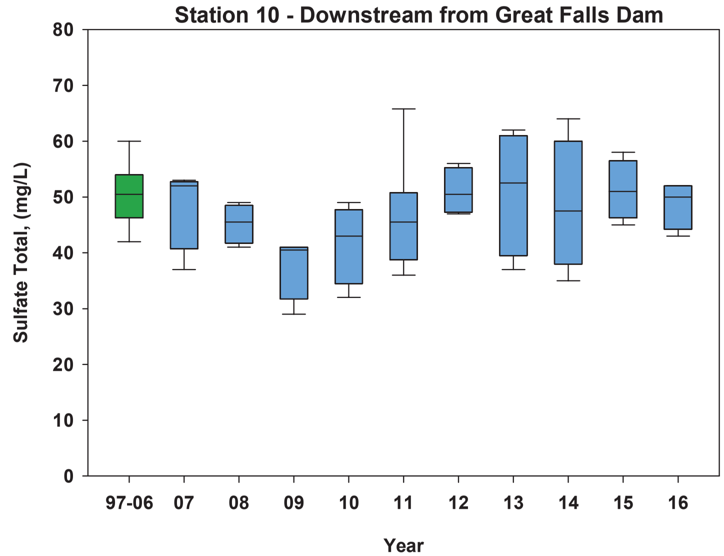


Figure B-12: Sulfate, Dissolved (mg/L) for Stations 1 to 10.

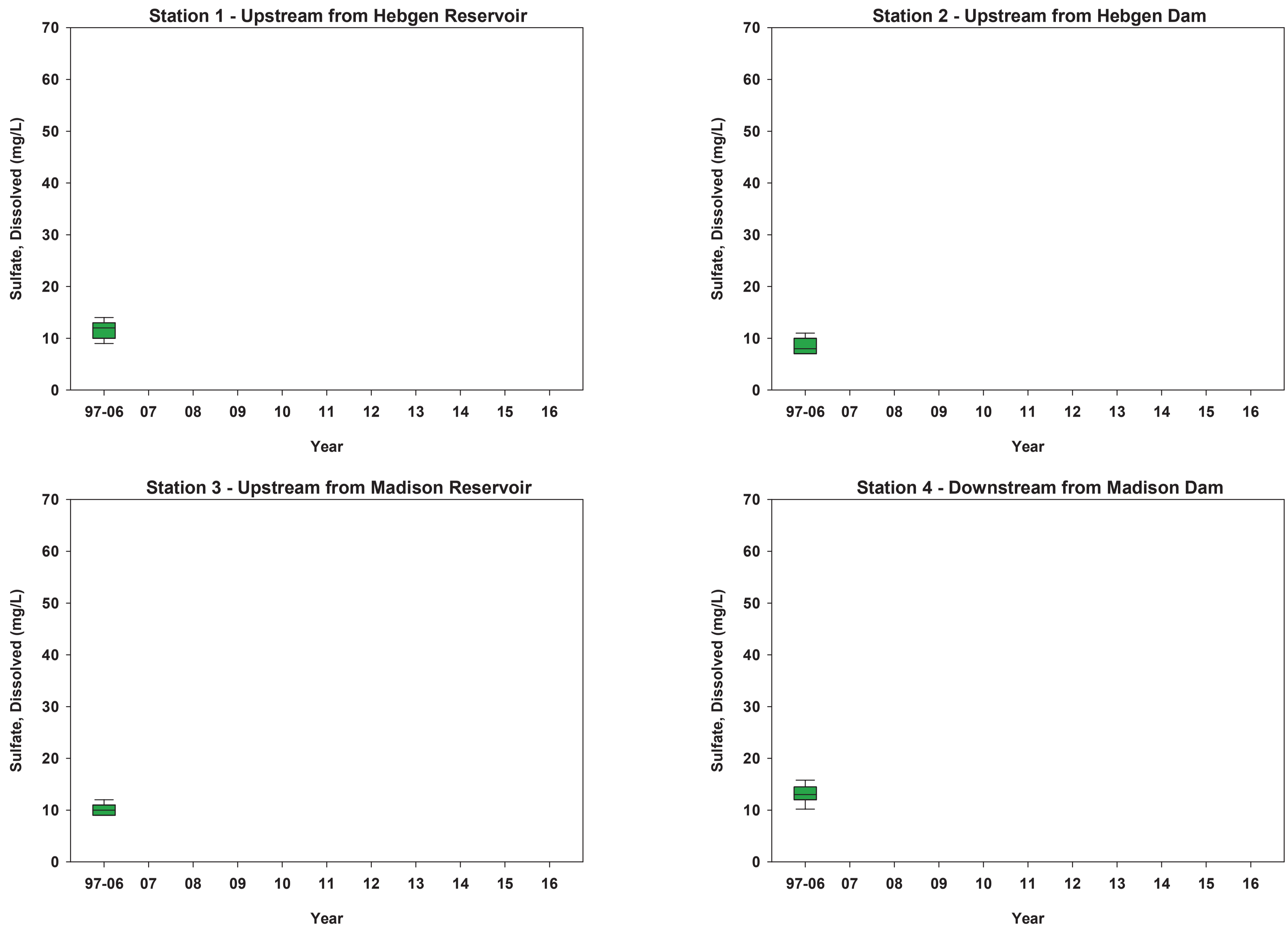


Figure B-12: Sulfate, Dissolved (mg/L) for Stations 1 to 10 (cont.).

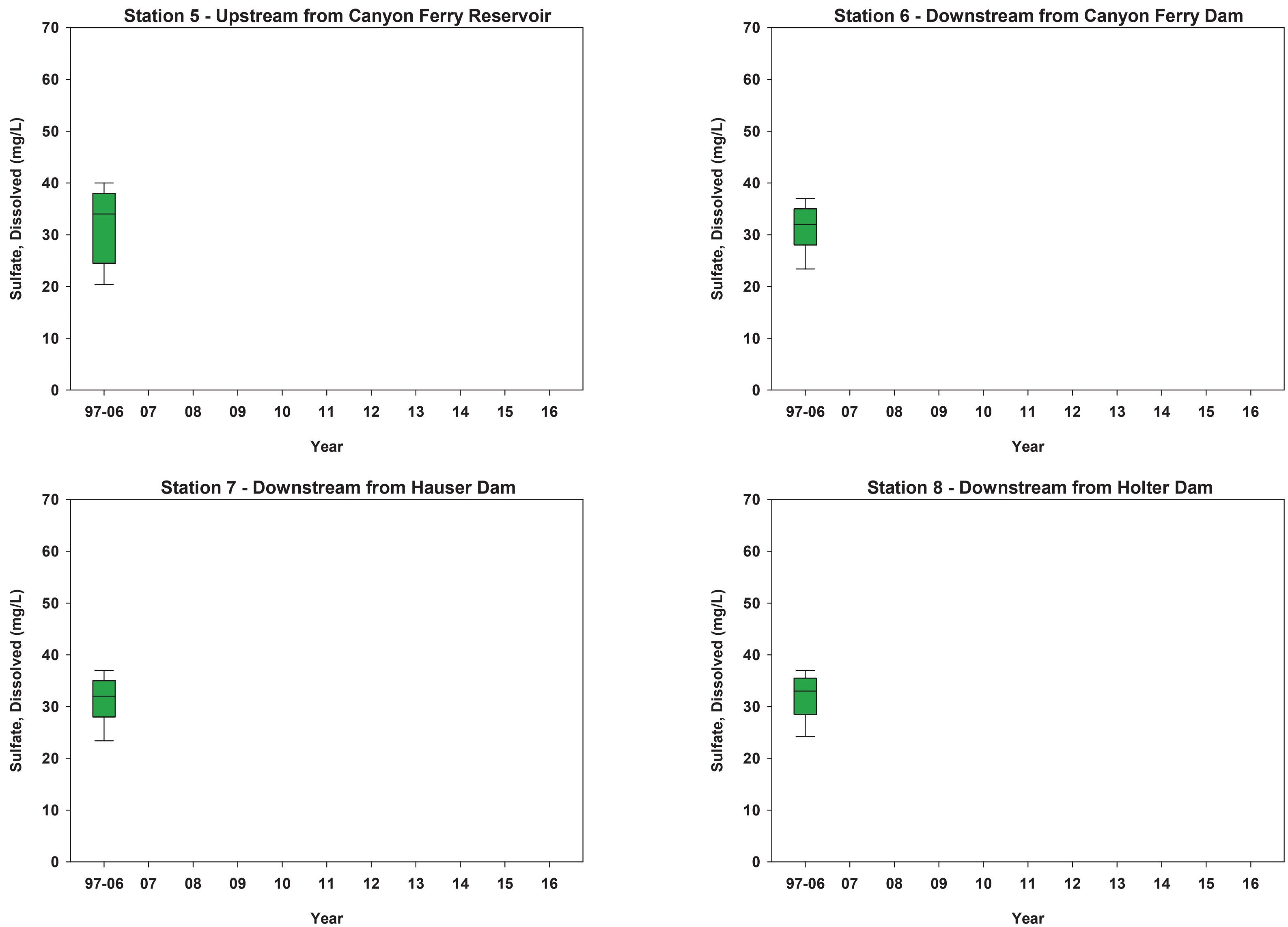
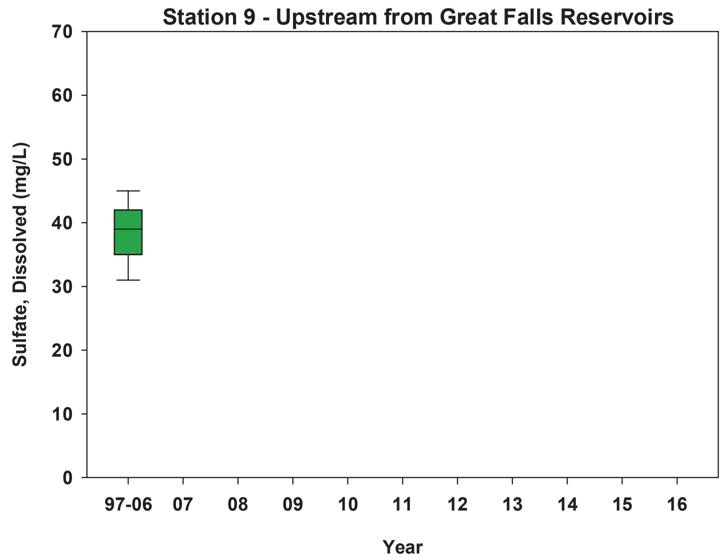


Figure B-12: Sulfate, Dissolved (mg/L) for Stations 1 to 10 (cont.).



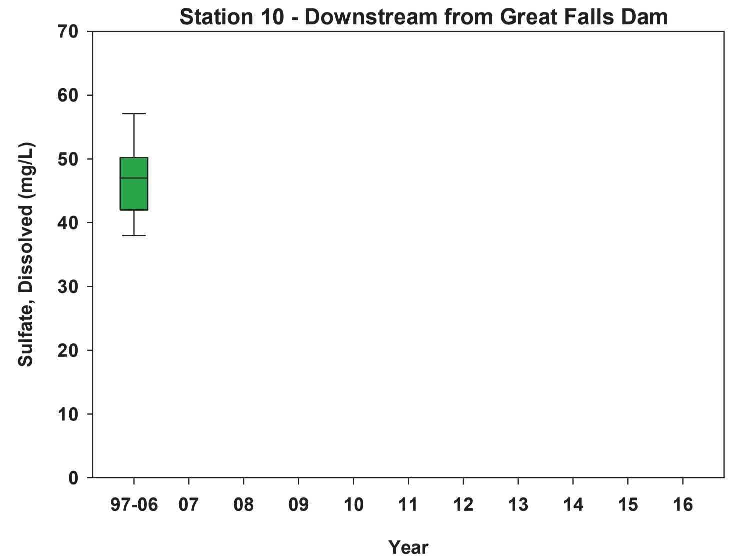
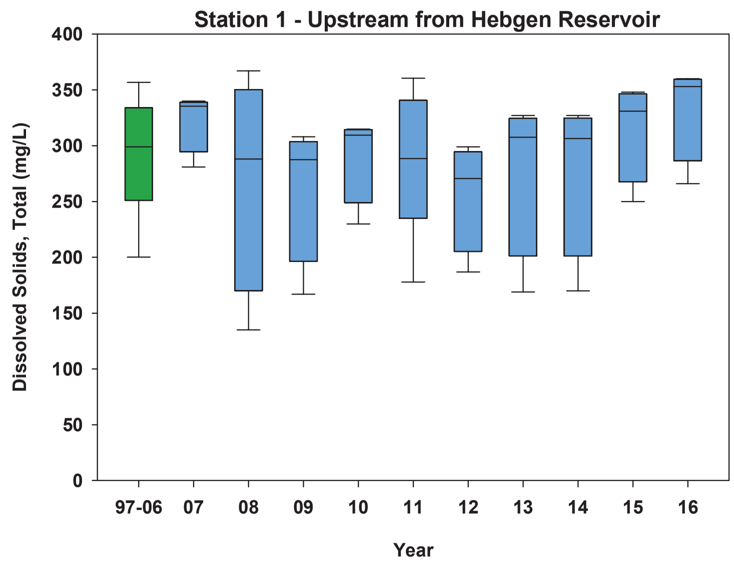
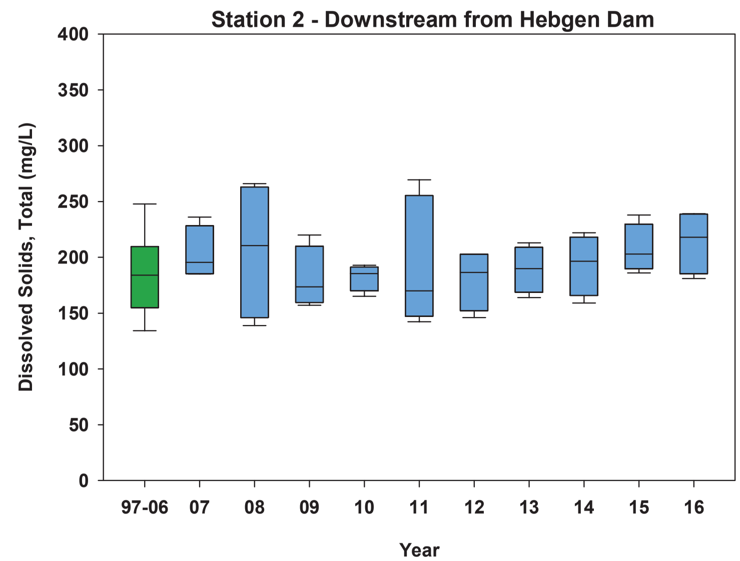
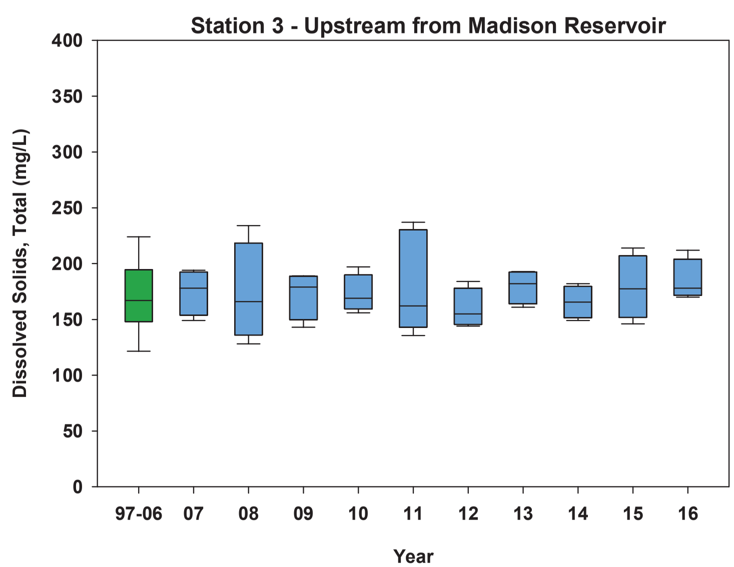


Figure B-13: Dissolved Solids, Total (mg/L) for Stations 1 to 10.







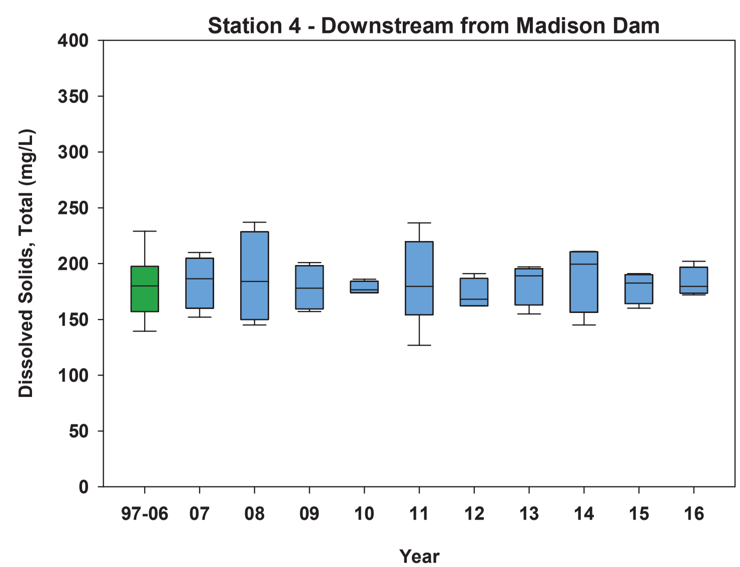


Figure B-13: Dissolved Solids, Total (mg/L) for Stations 1 to 10 (cont.).

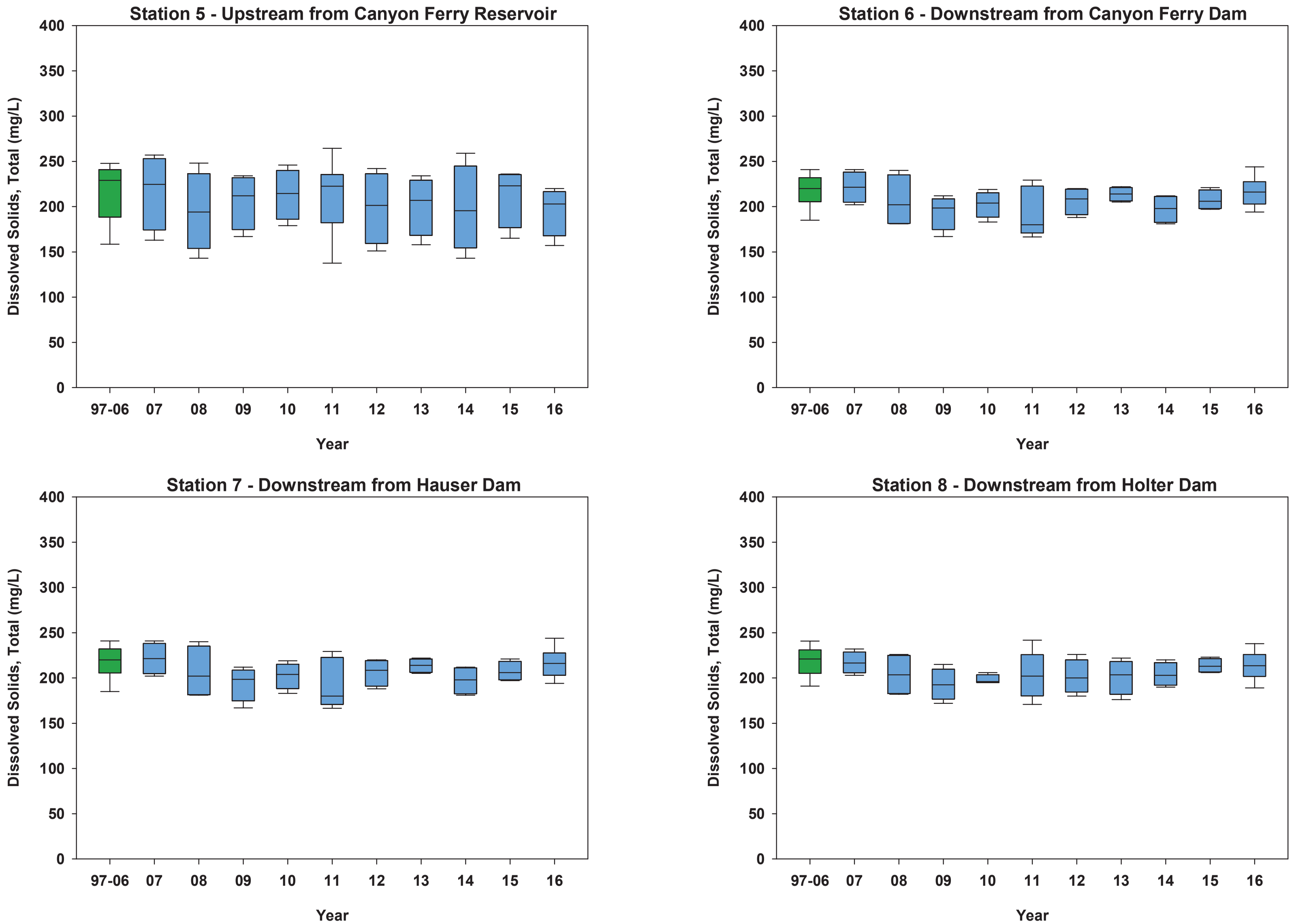
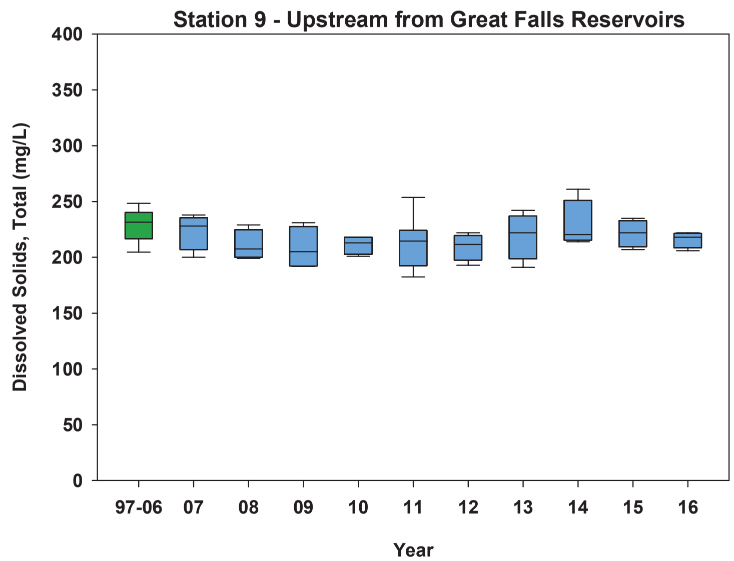


Figure B-13: Dissolved Solids, Total (mg/L) for Stations 1 to 10 (cont.).



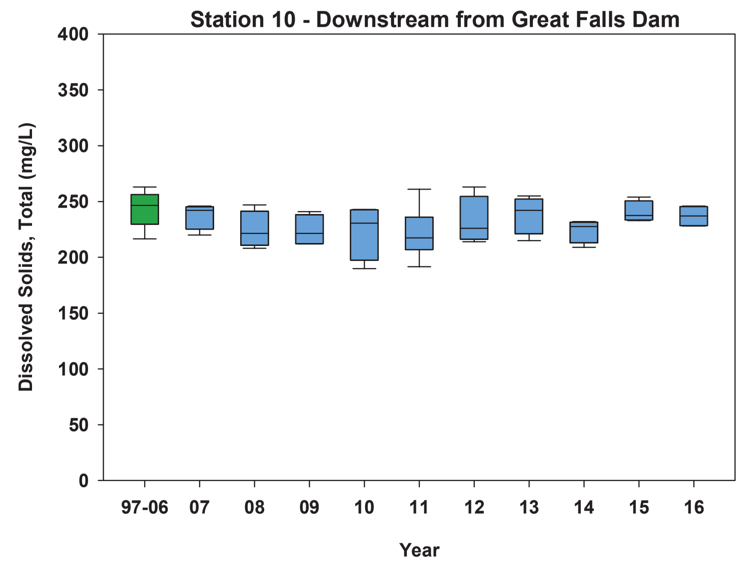


Figure B-14: Suspended Solids Total (mg/L) for Stations 1 to 10.

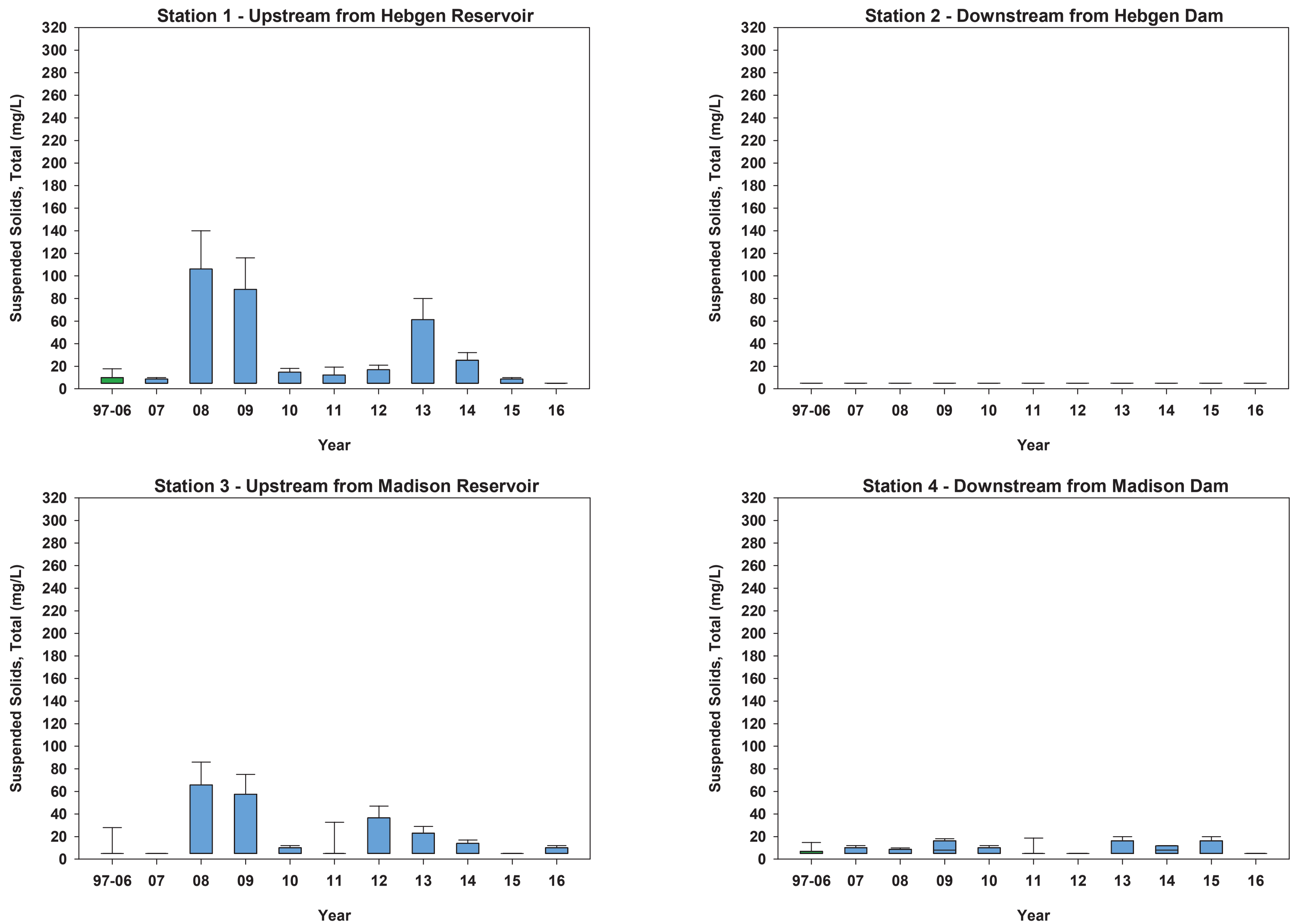
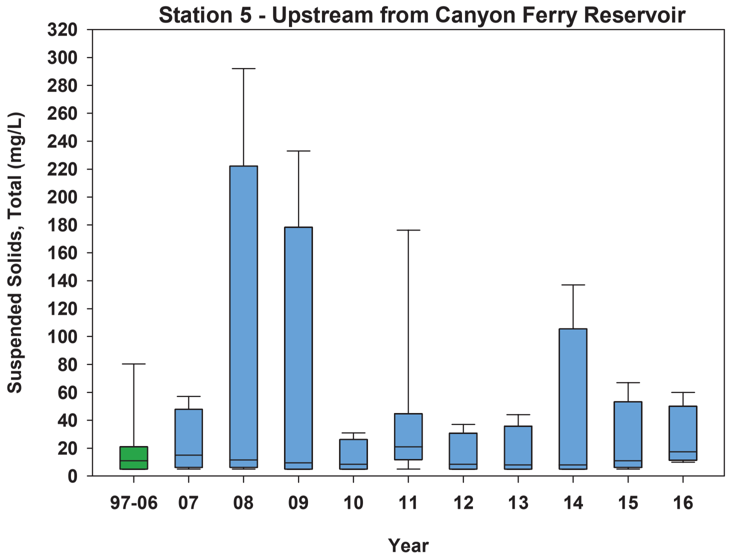
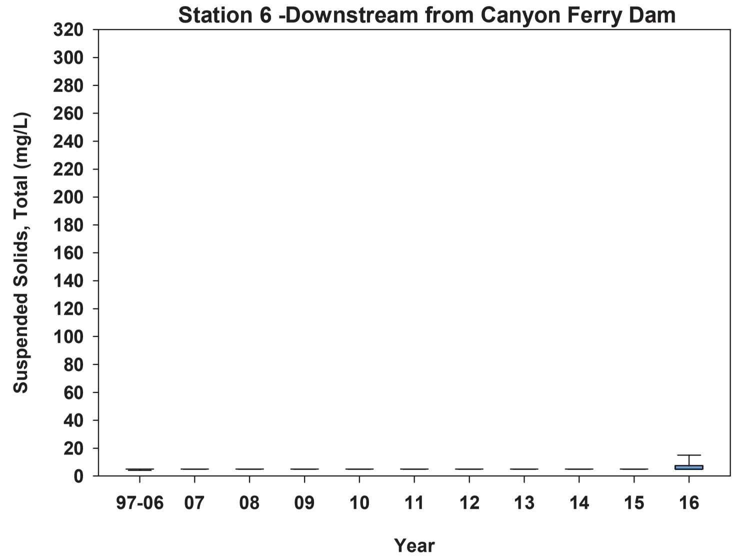
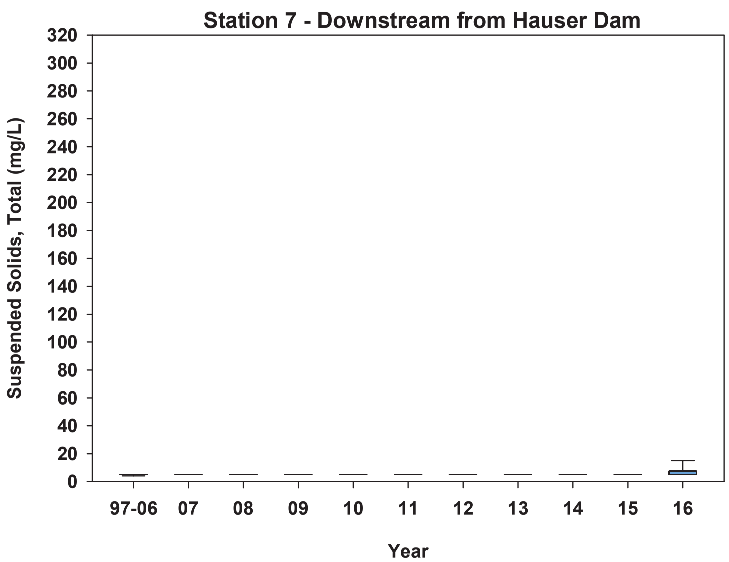


Figure B-14: Suspended Solids Total (mg/L) for Stations 1 to 10 (cont.).







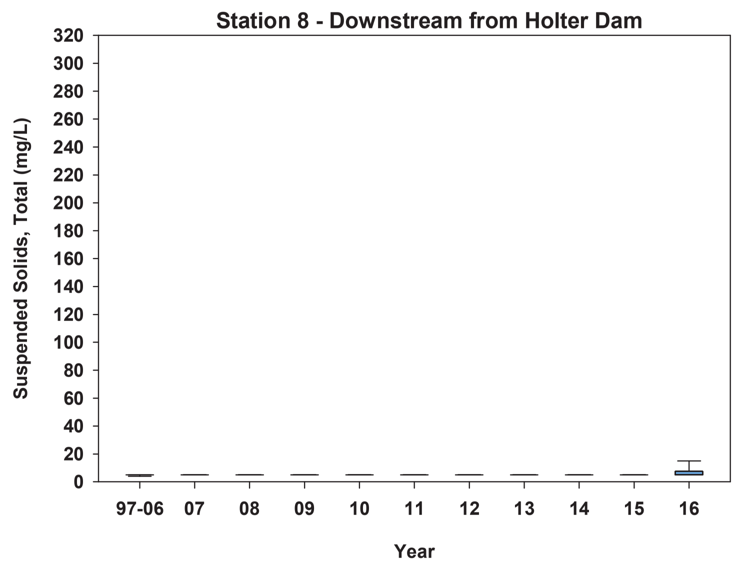
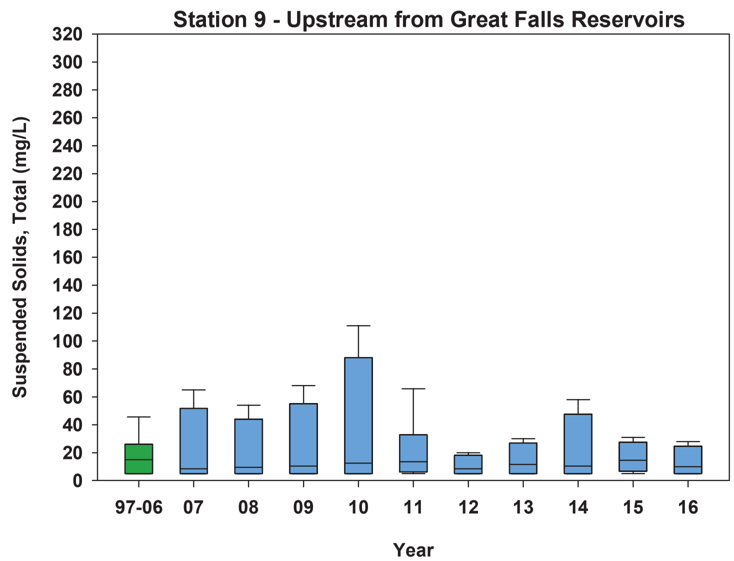


Figure B-14: Suspended Solids Total (mg/L) for Stations 1 to 10 (cont.).



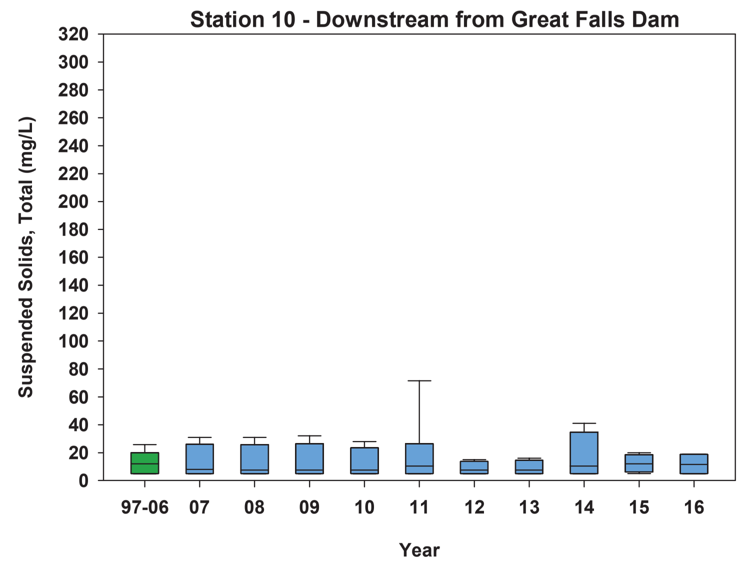


Figure B-15: Arsenic, Total (mg/L) for Stations 1 to 10.

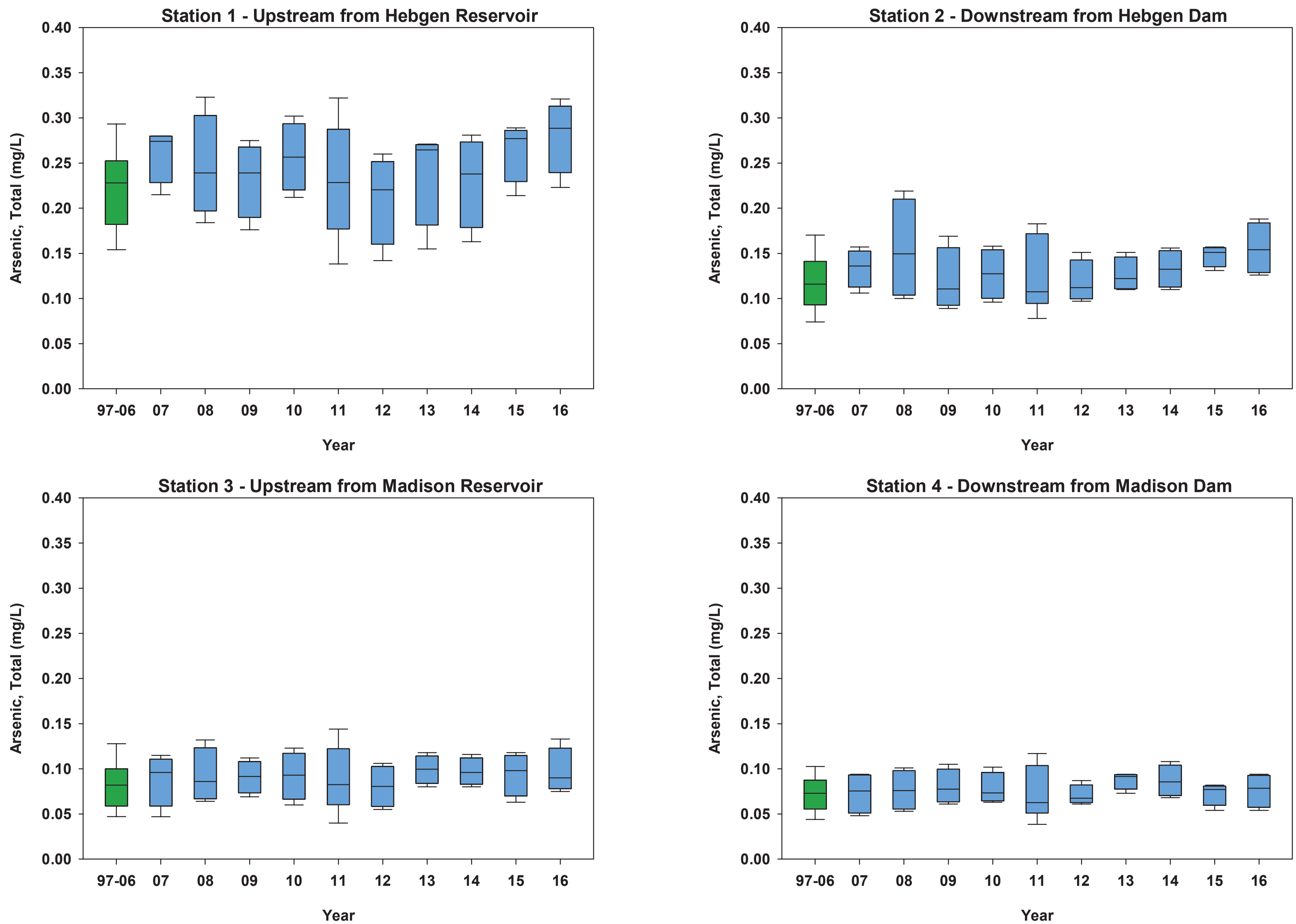
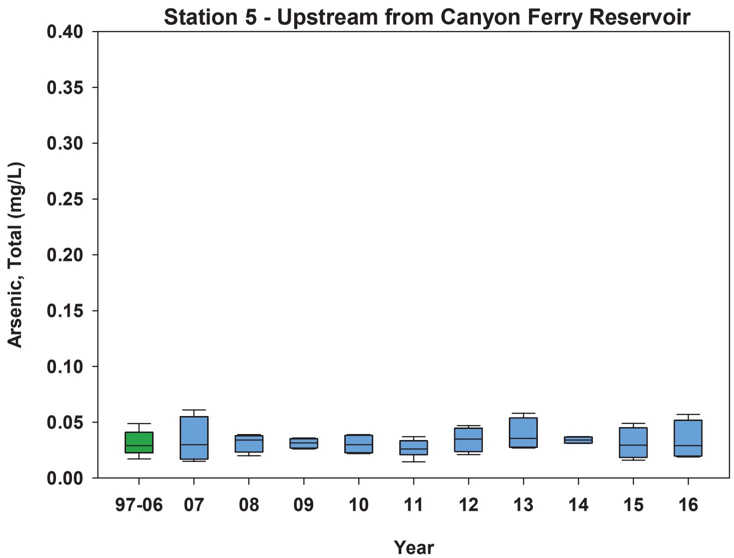
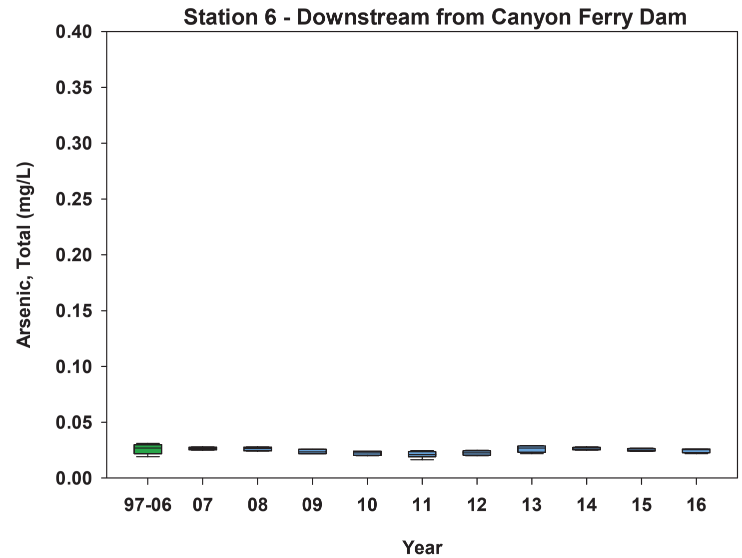
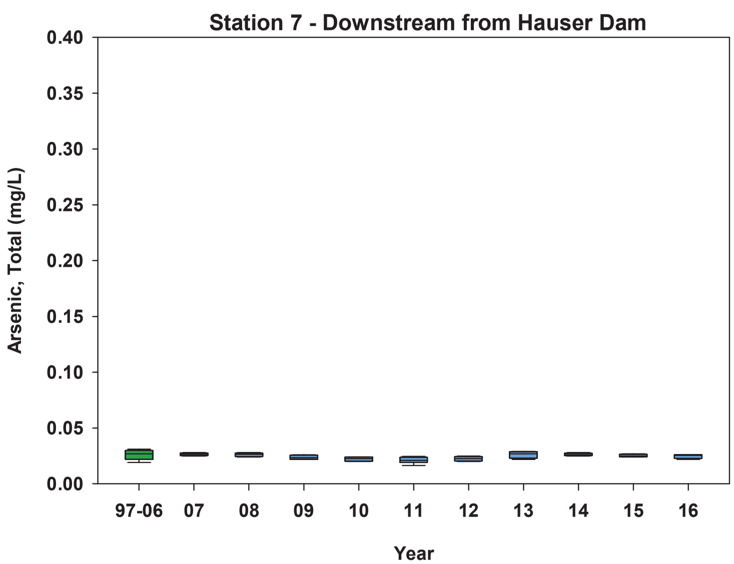


Figure B-15: Arsenic, Total (mg/L) for Stations 1 to 10 (cont.).







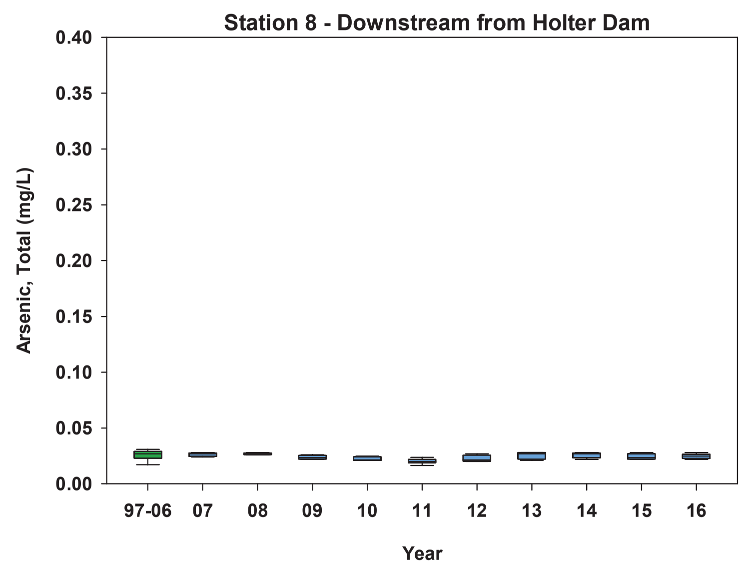
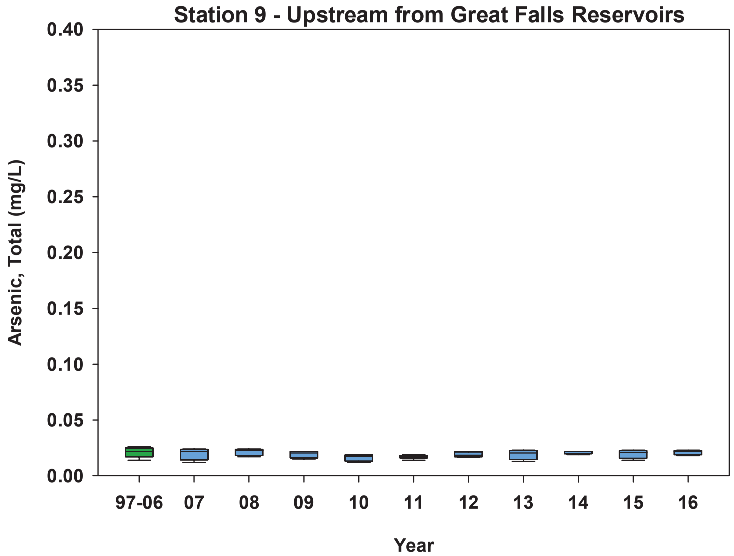


Figure B-15: Arsenic, Total (mg/L) for Stations 1 to 10 (cont.).



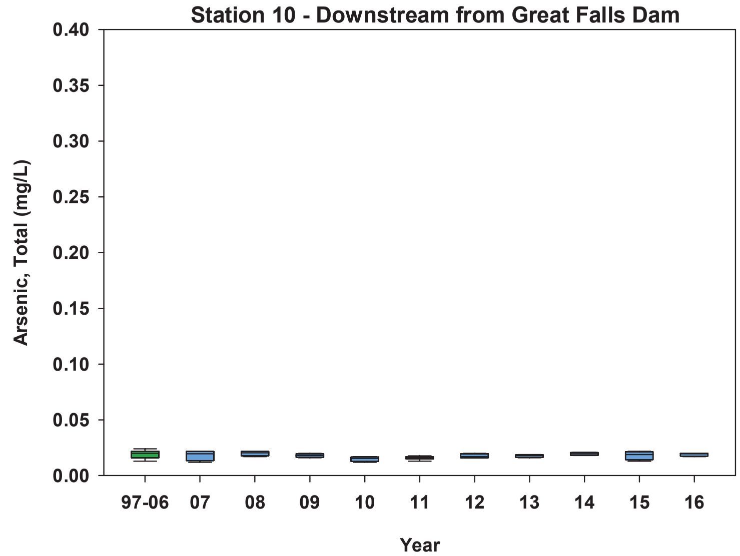


Figure B-16: Cadmium, Total (mg/L) for Stations 1 to 10.

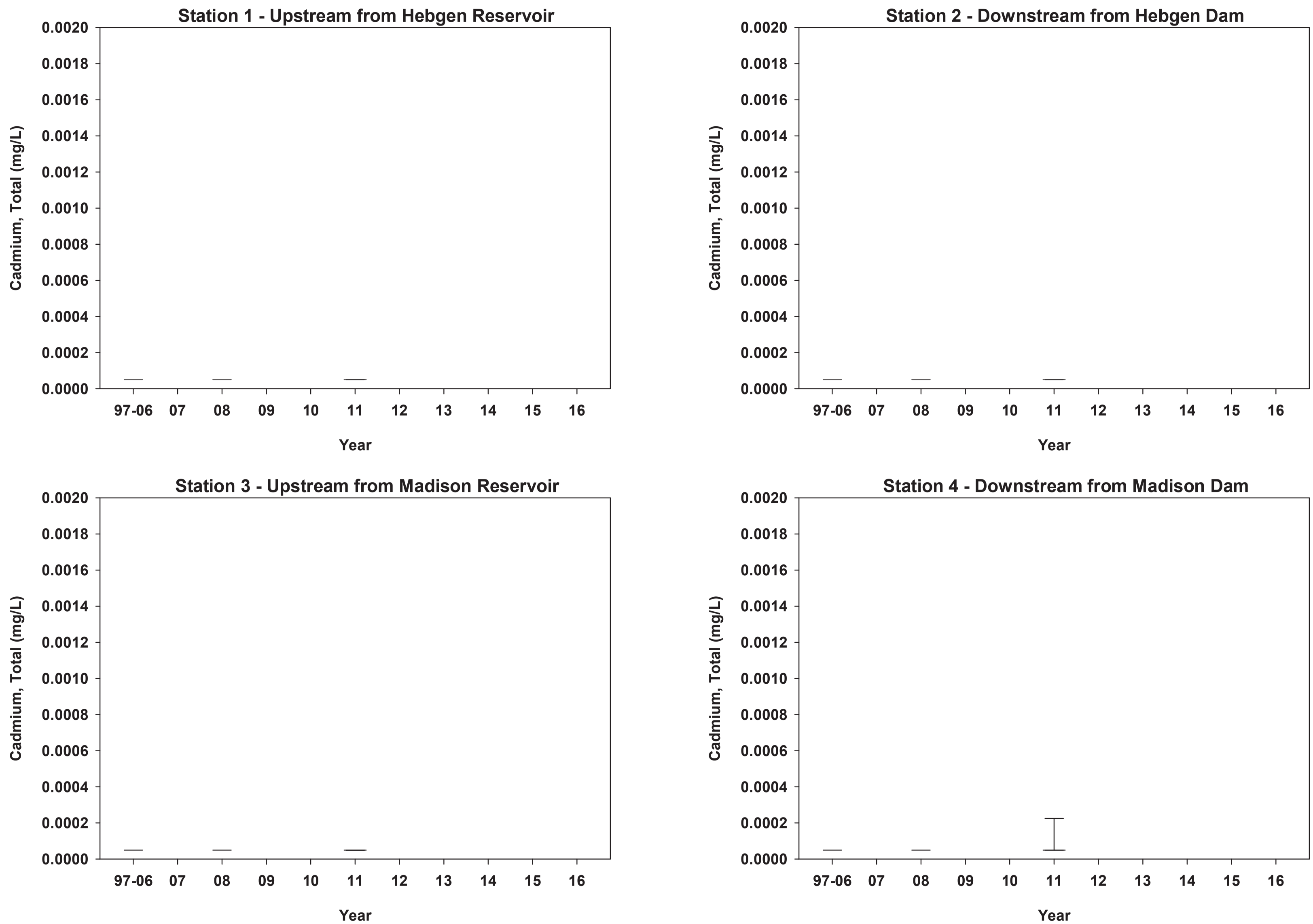
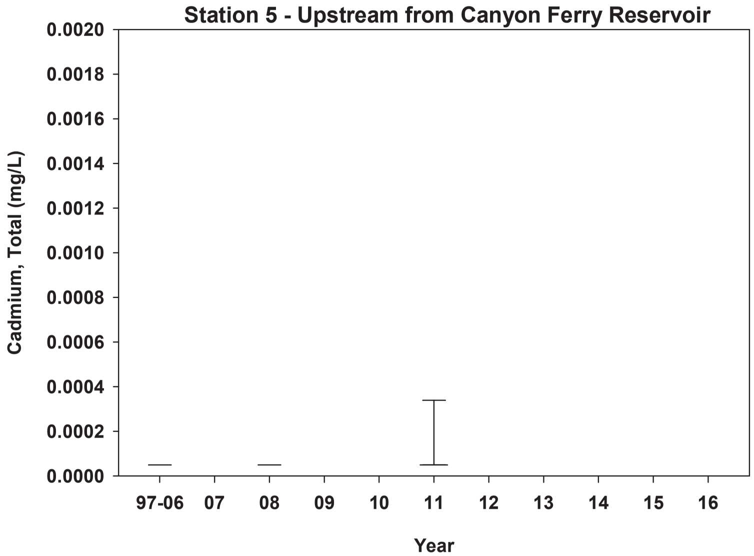
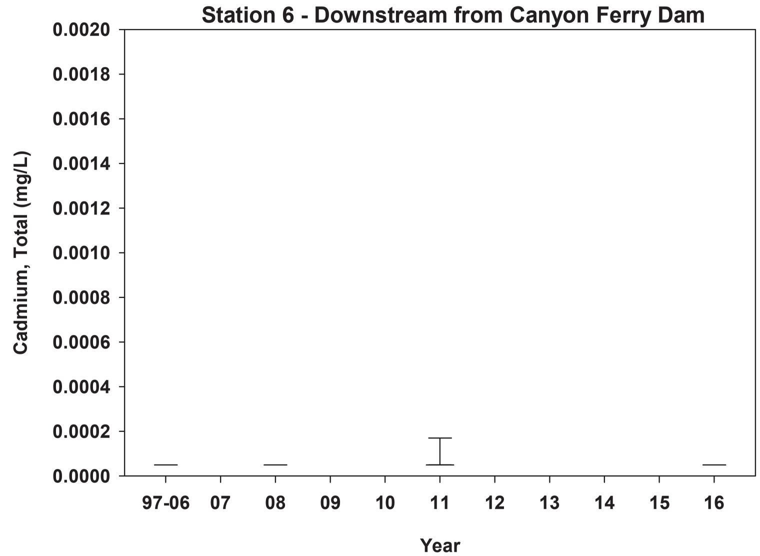
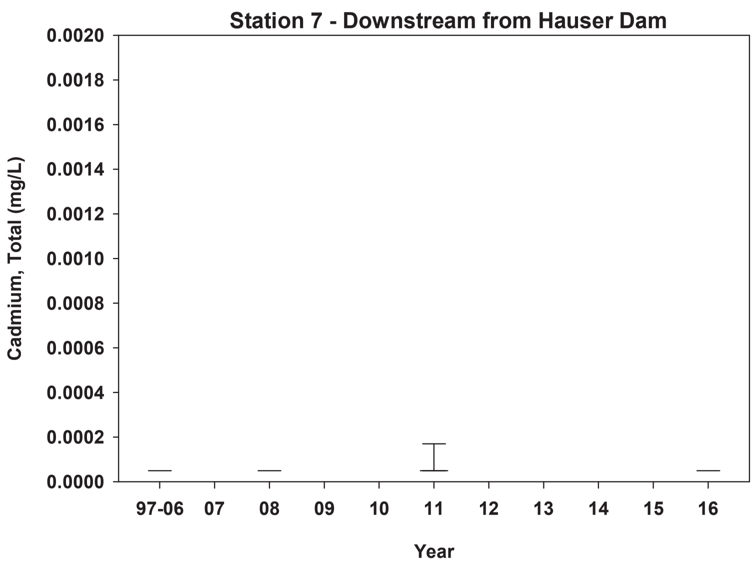


Figure B-16: Cadmium, Total (mg/L) for Stations 1 to 10 (cont.).







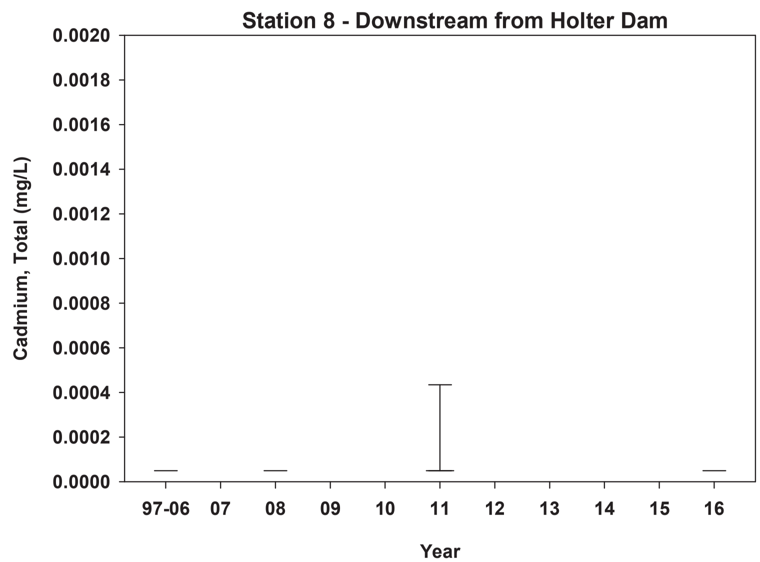
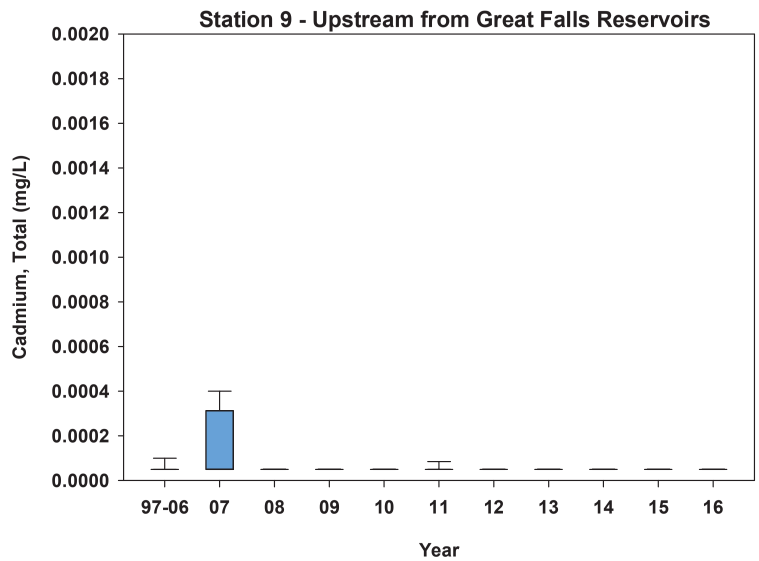


Figure B-16: Cadmium, Total (mg/L) for Stations 1 to 10 (cont.).



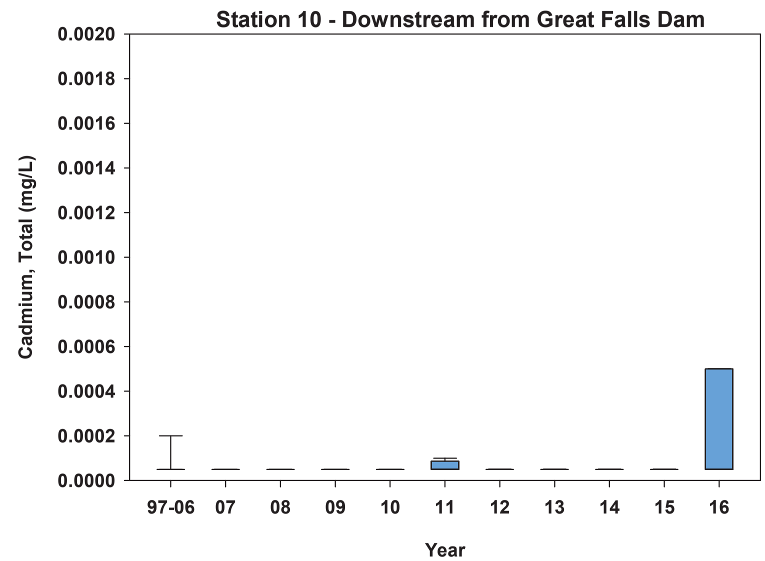
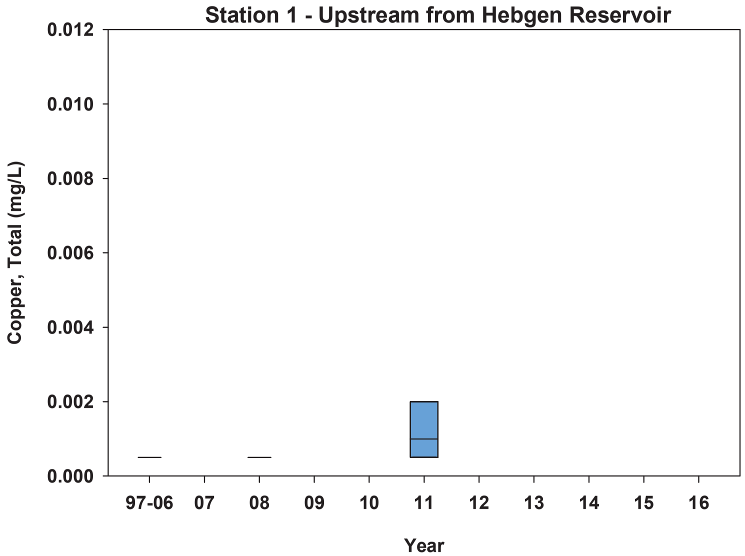
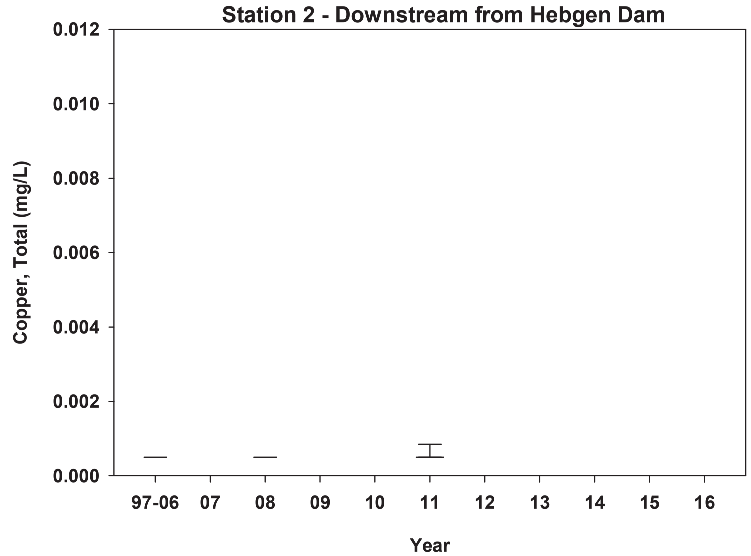
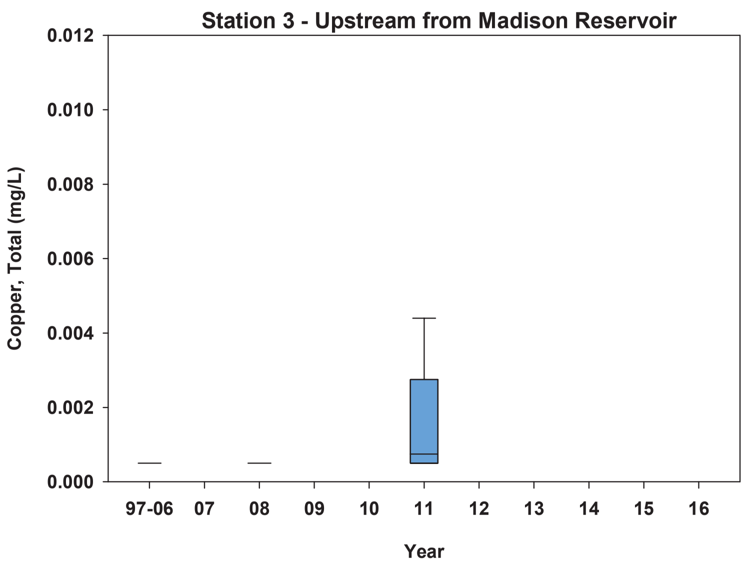


Figure B-17: Copper, Total (mg/L) for Stations 1 to 10.







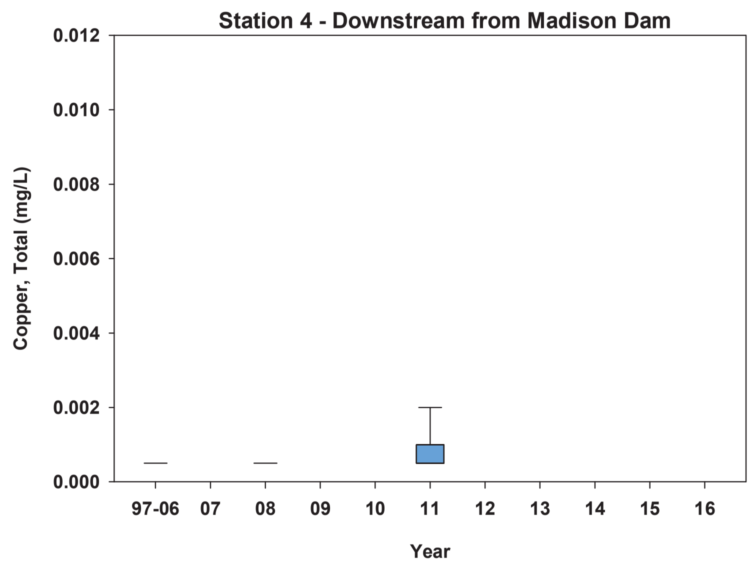


Figure B-17: Copper, Total (mg/L) for Stations 1 to 10 (cont.).

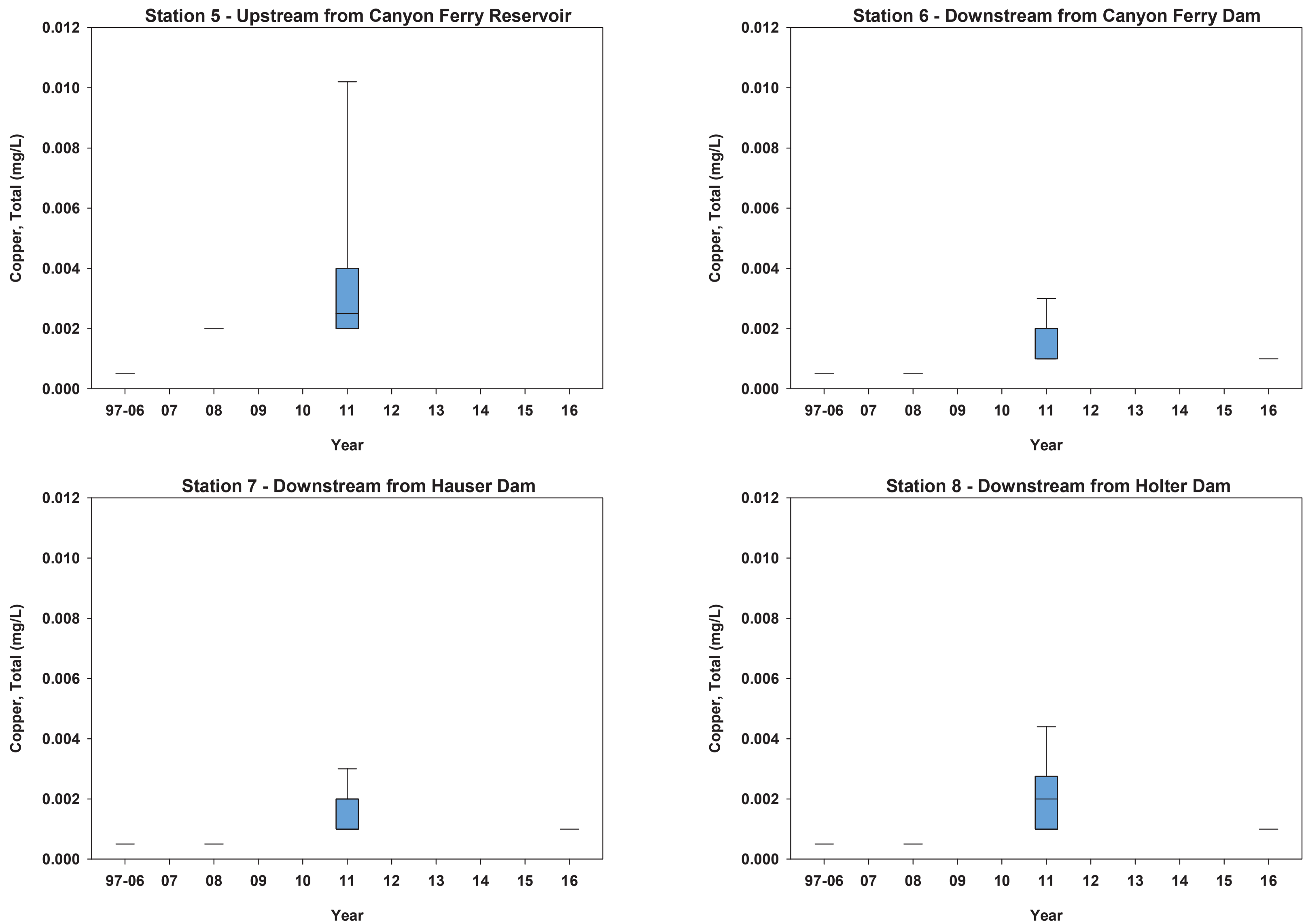
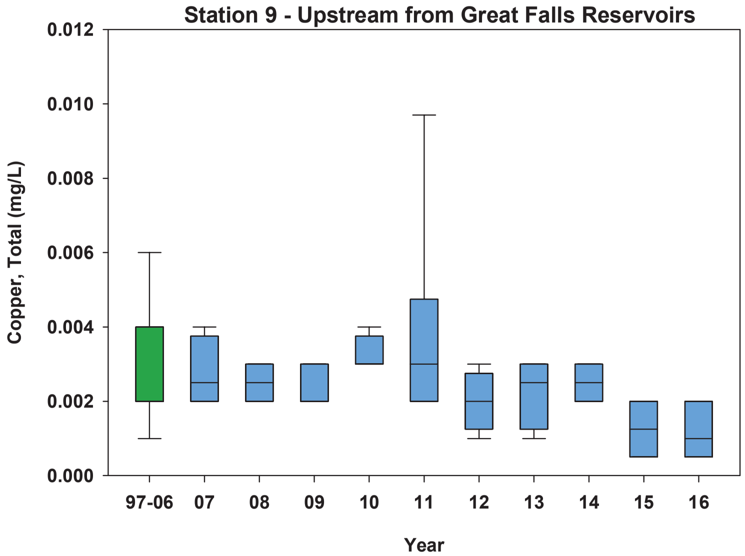


Figure B-17: Copper, Total (mg/L) for Stations 1 to 10 (cont.).



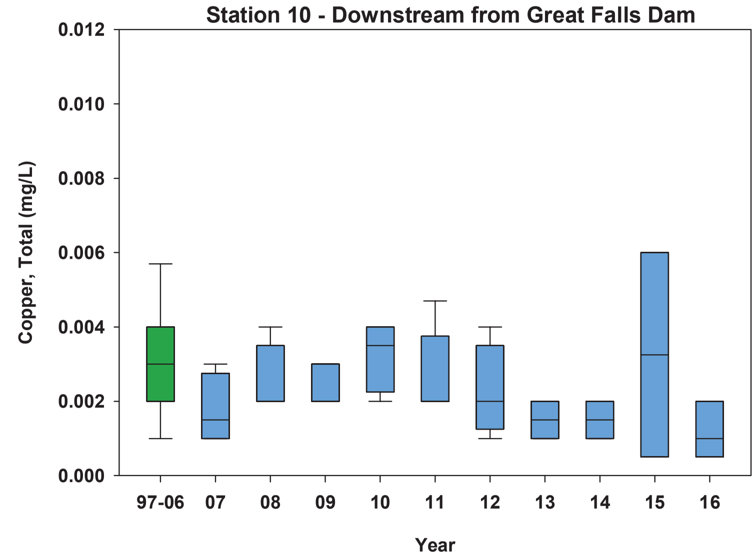
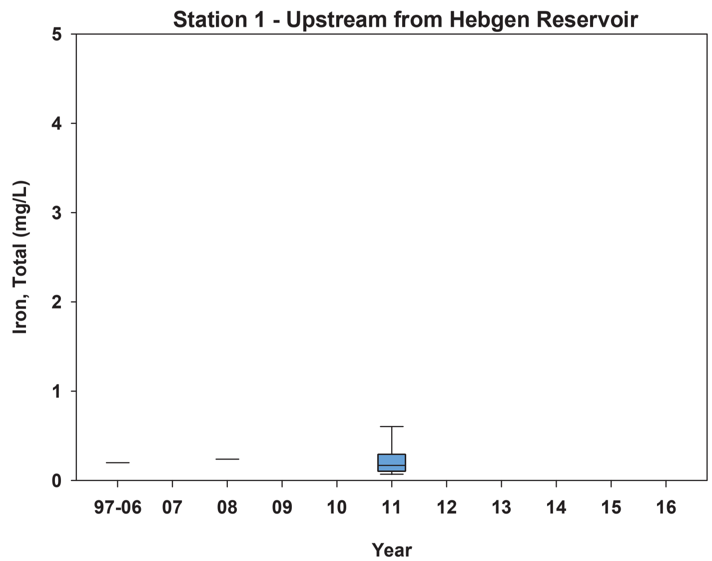
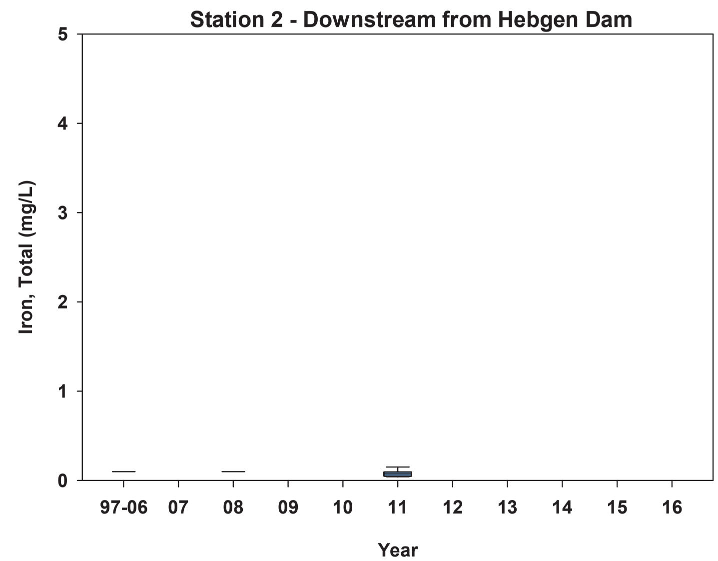
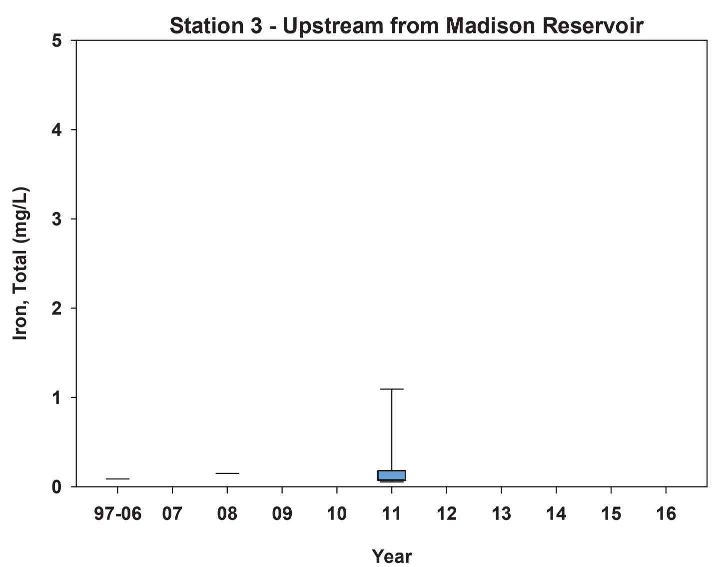


Figure B-18: Iron, Total (mg/L) for Stations 1 to 10.







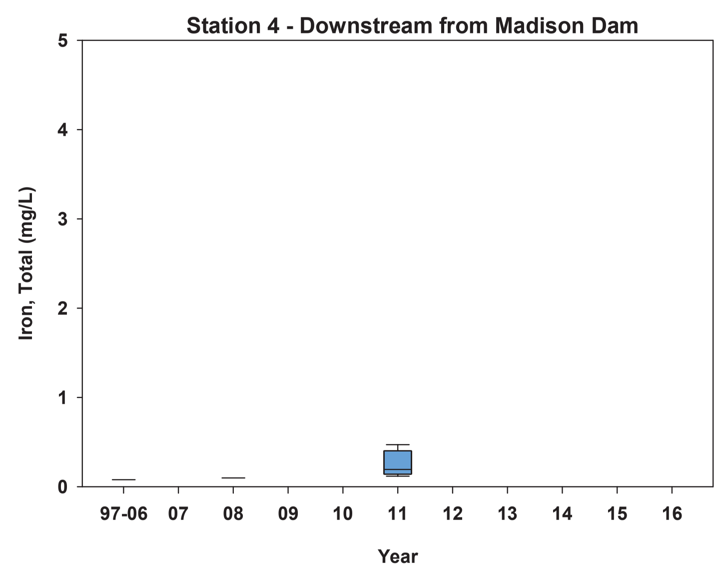


Figure B-18: Iron, Total (mg/L) for Stations 1 to 10 (cont.).

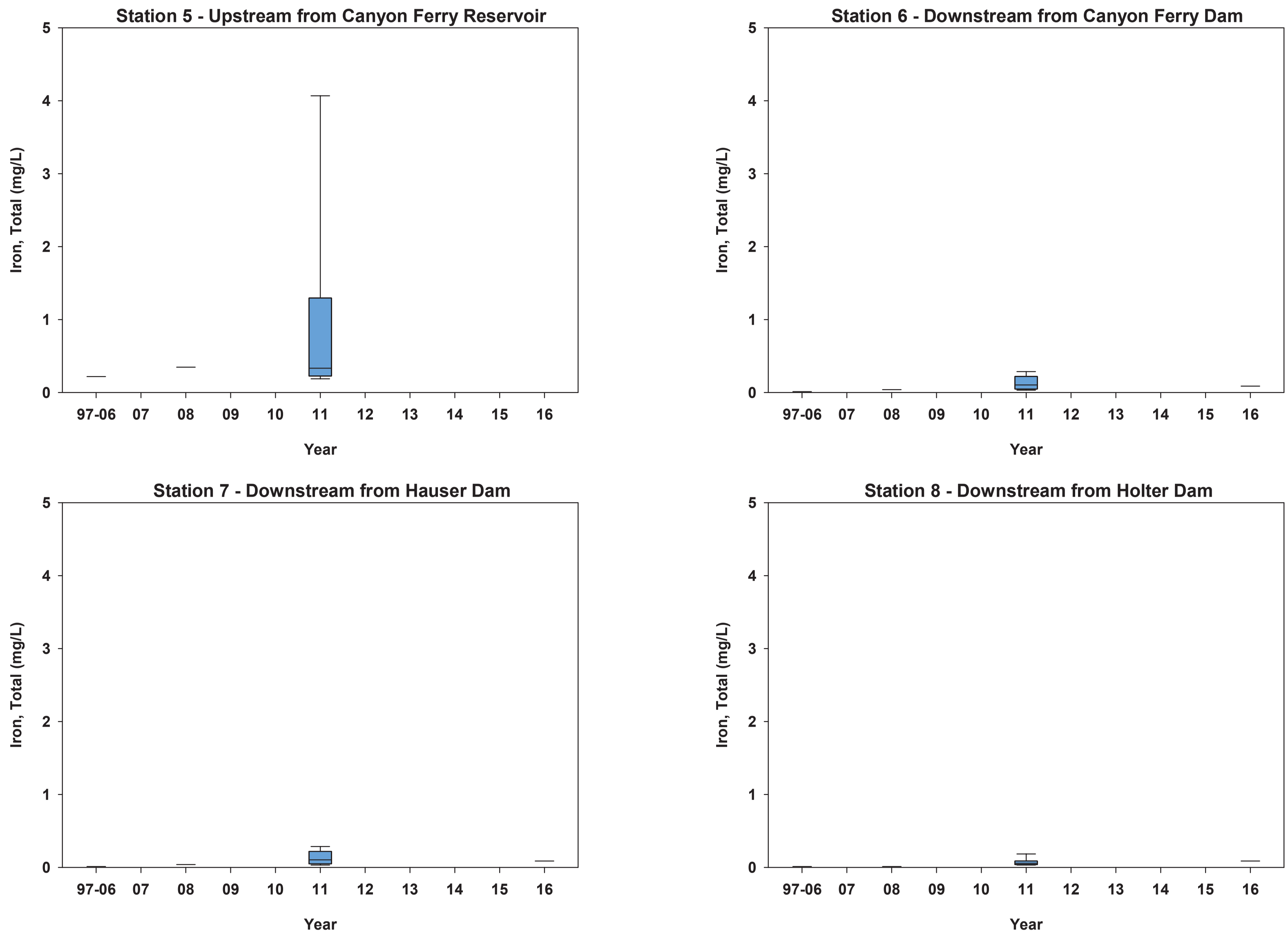
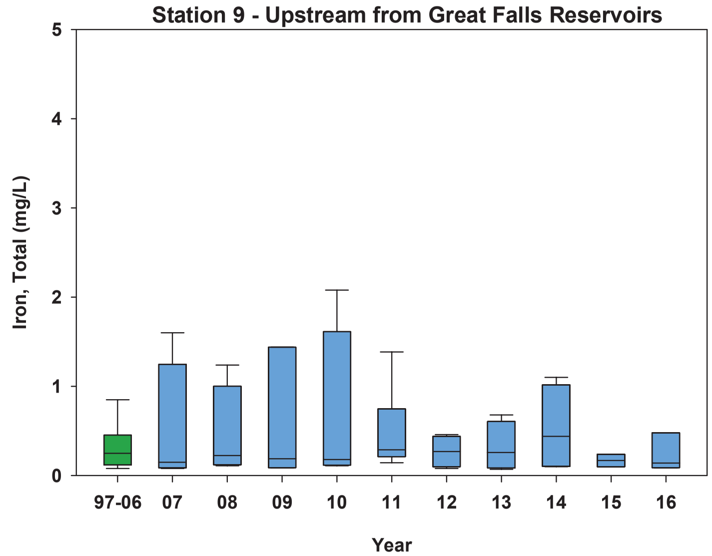


Figure B-18: Iron, Total (mg/L) for Stations 1 to 10 (cont.).



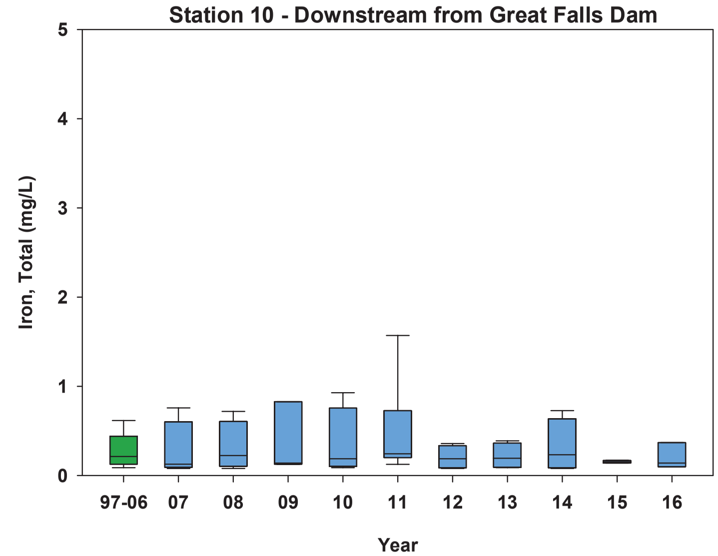


Figure B-19: Lead, Total (mg/L) for Stations 1 to 10.

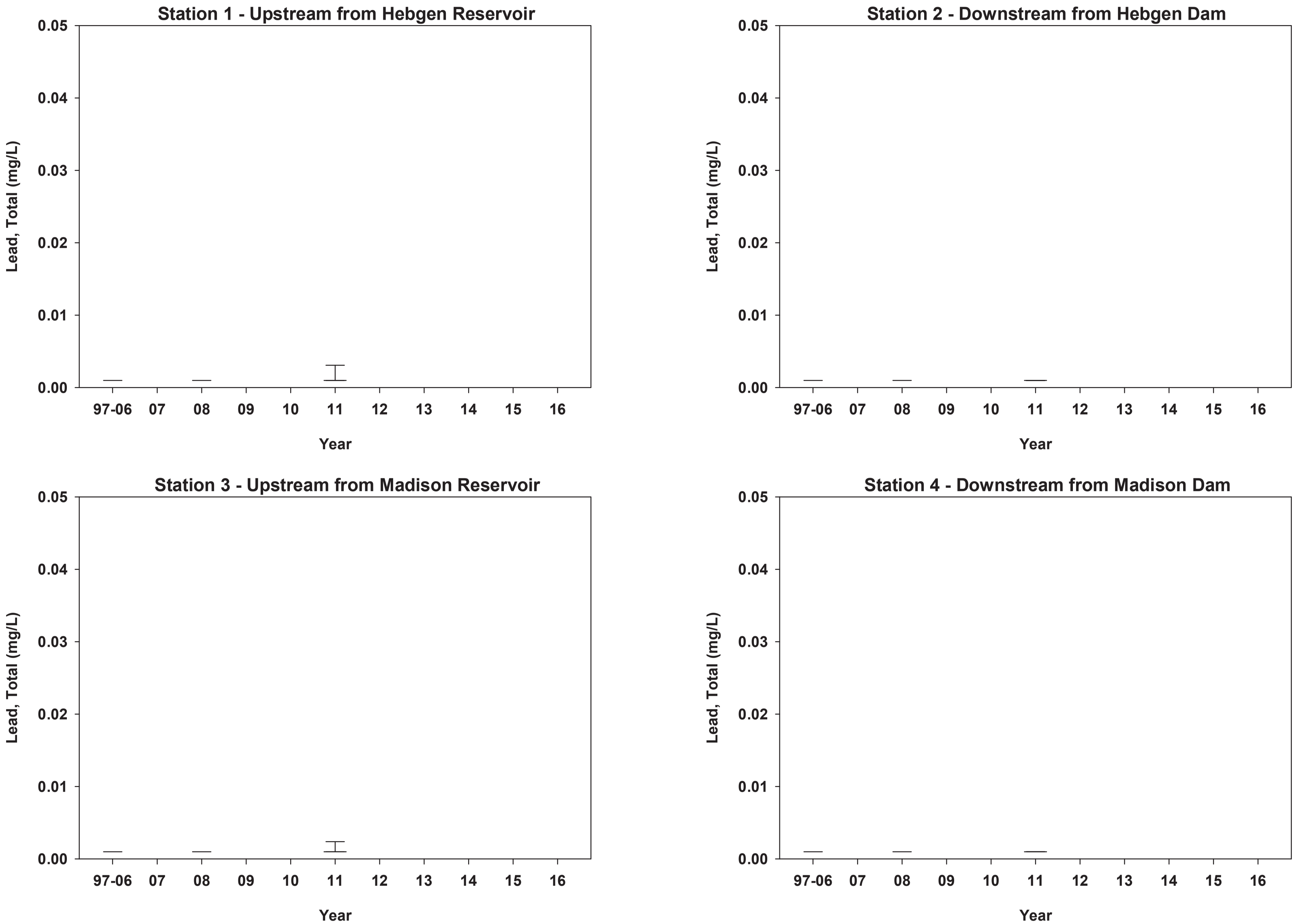


Figure B-19: Lead, Total (mg/L) for Stations 1 to 10 (cont.).

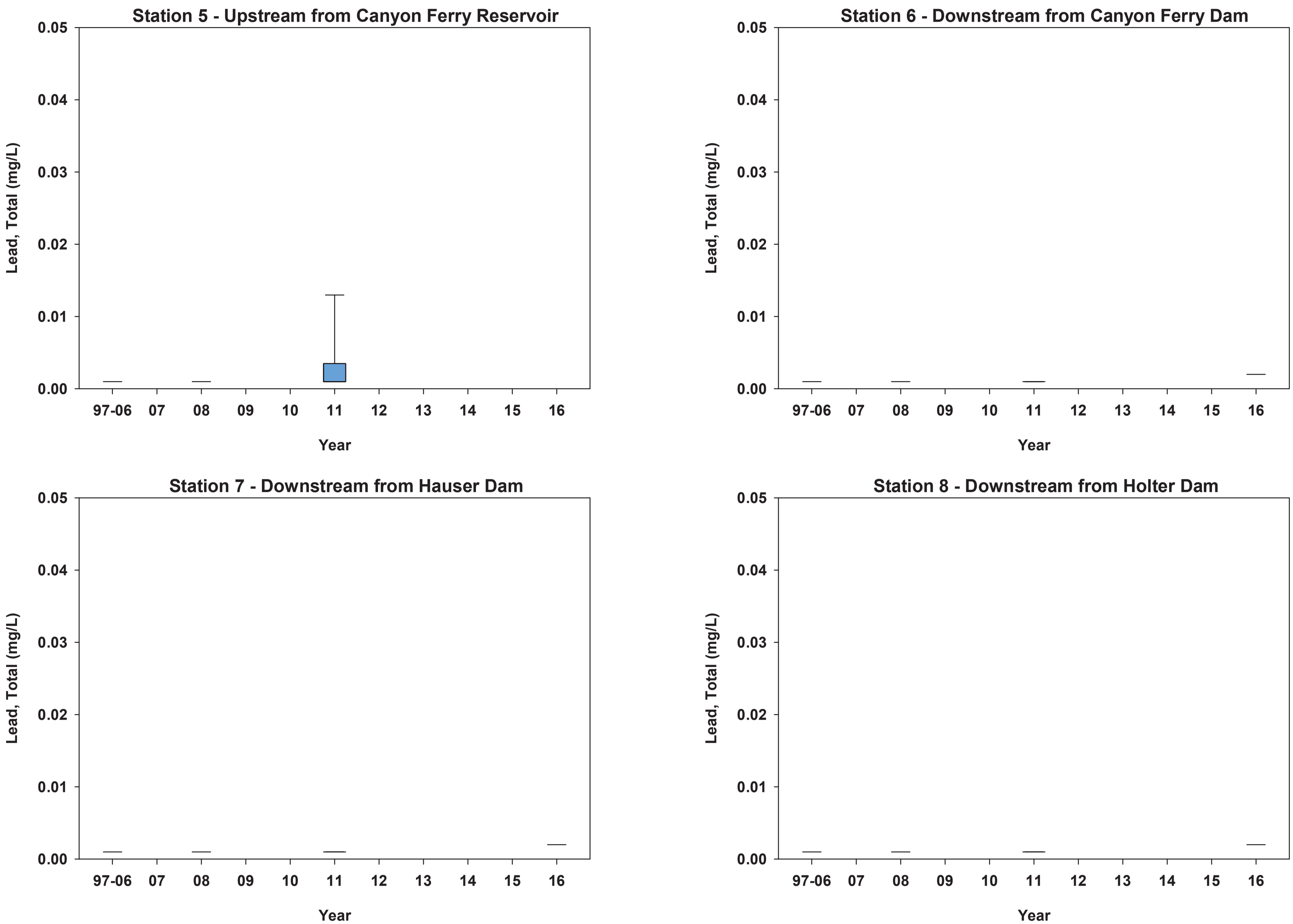
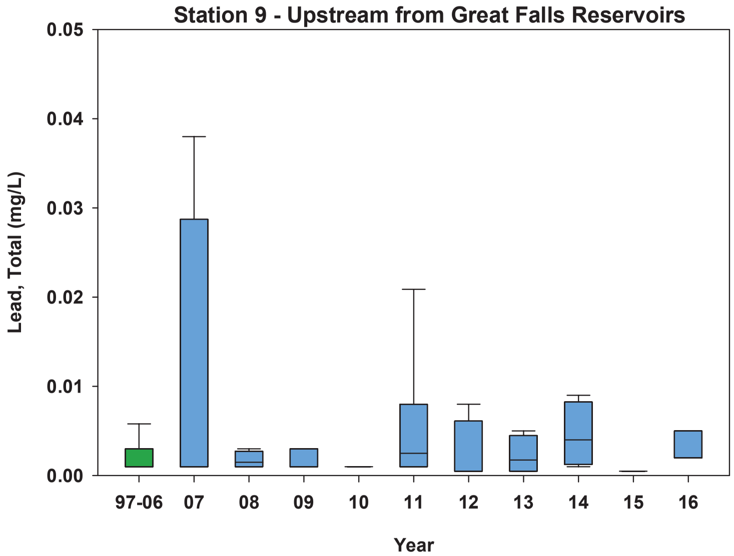


Figure B-19: Lead, Total (mg/L) for Stations 1 to 10 (cont.).



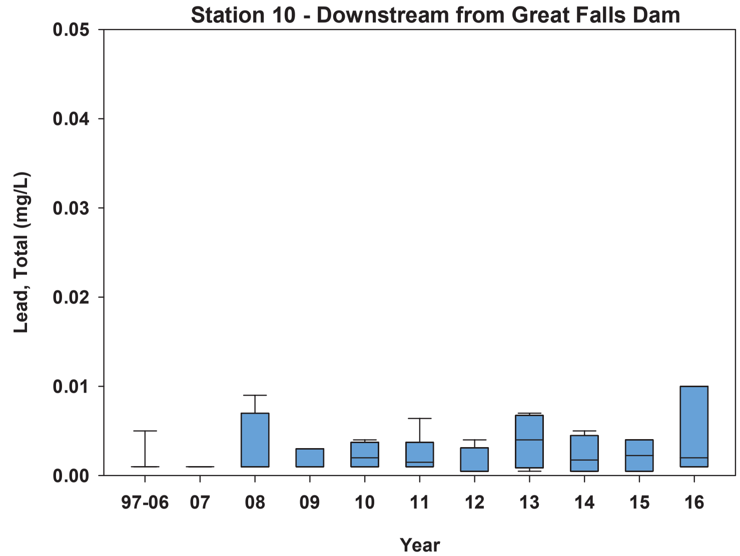


Figure B-20: Manganese, Total (mg/L) for Stations 1 to 10.

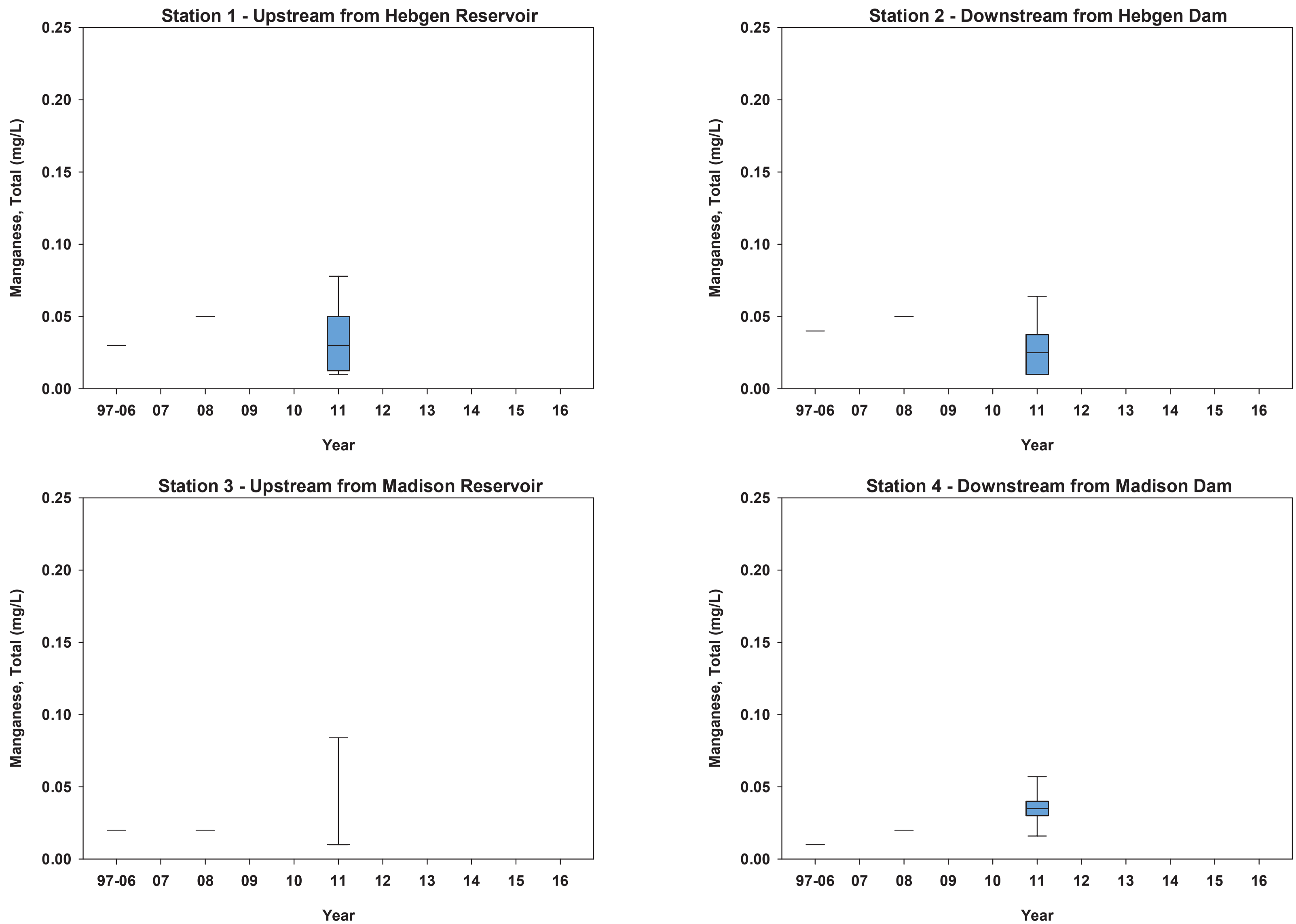


Figure B-20: Manganese, Total (mg/L) for Stations 1 to 10 (cont.).

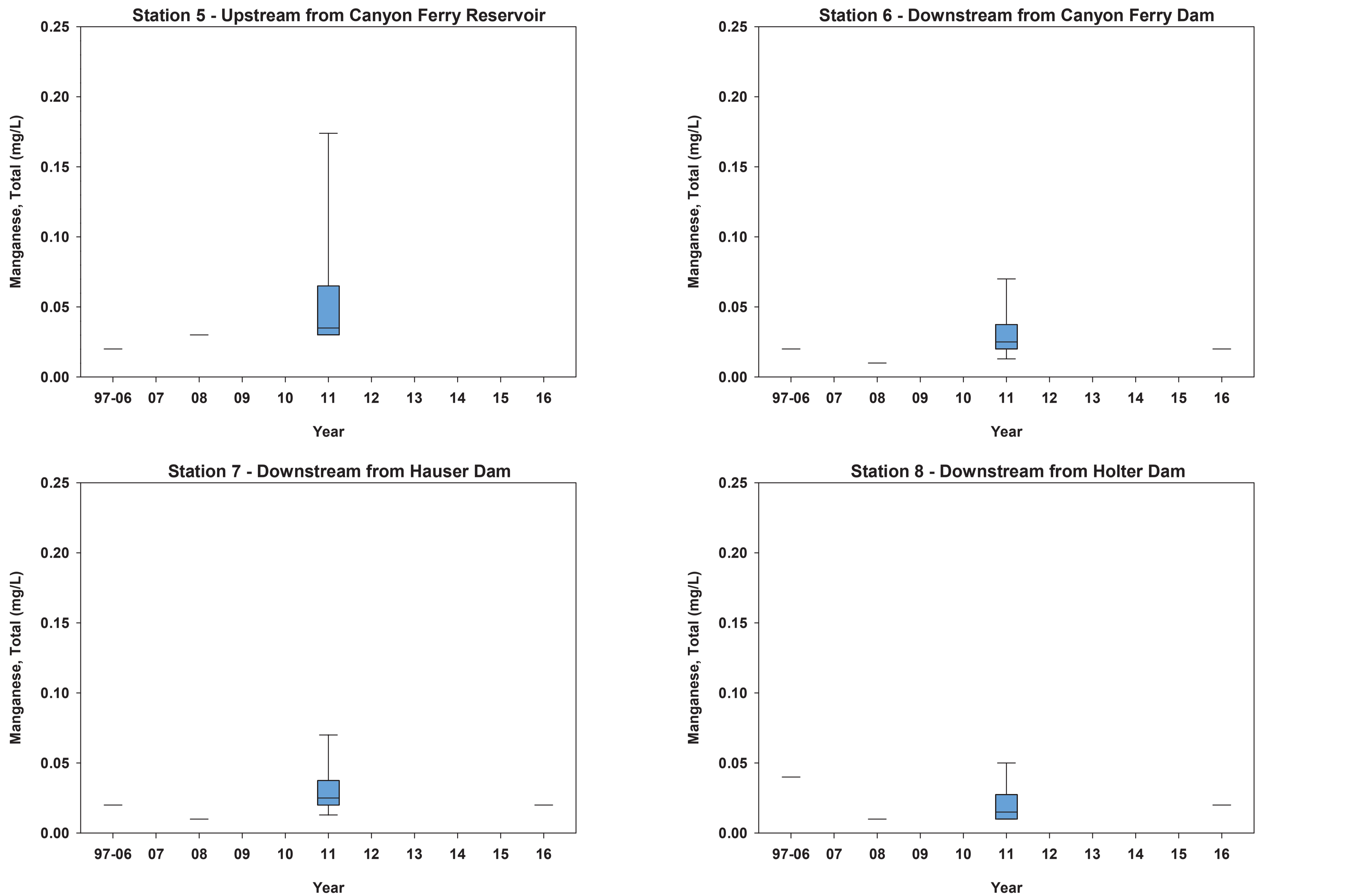
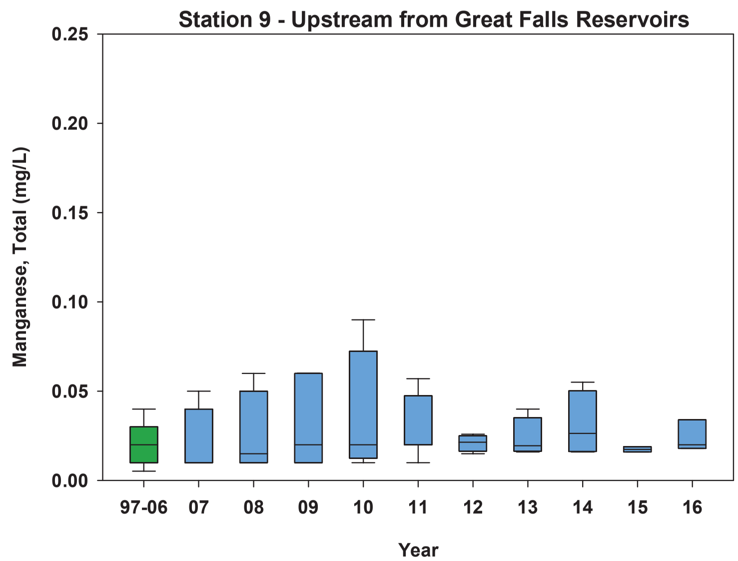


Figure B-20: Manganese, Total (mg/L) for Stations 1 to 10 (cont.).



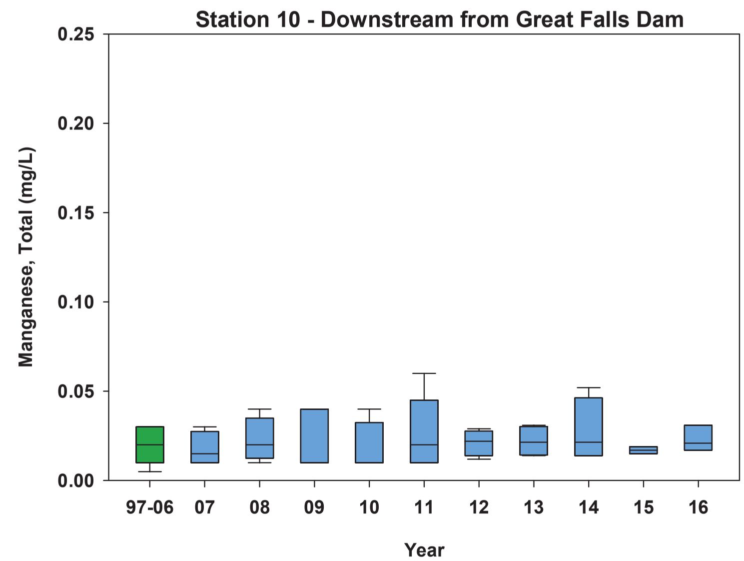
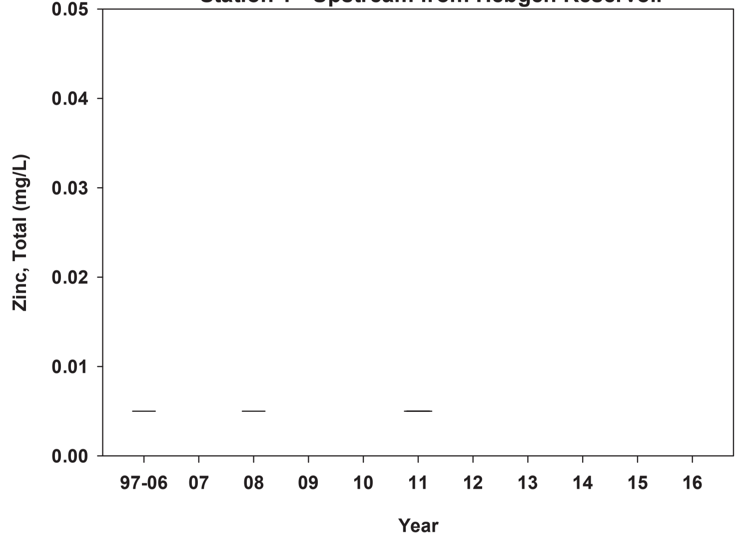
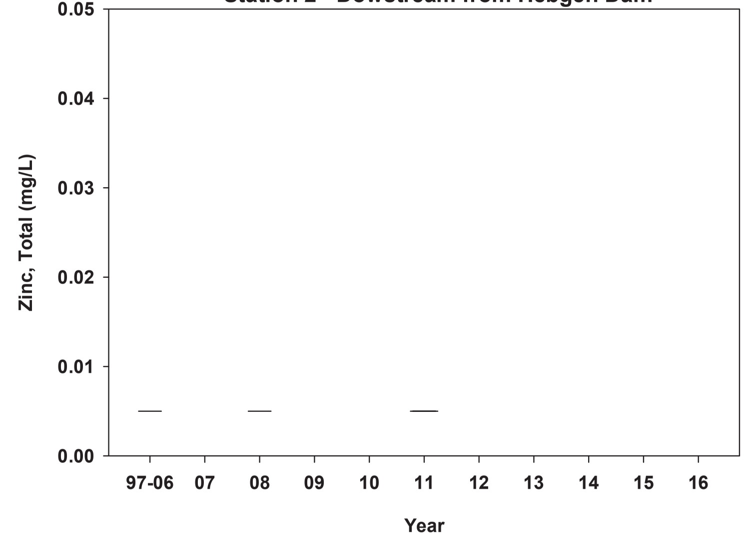
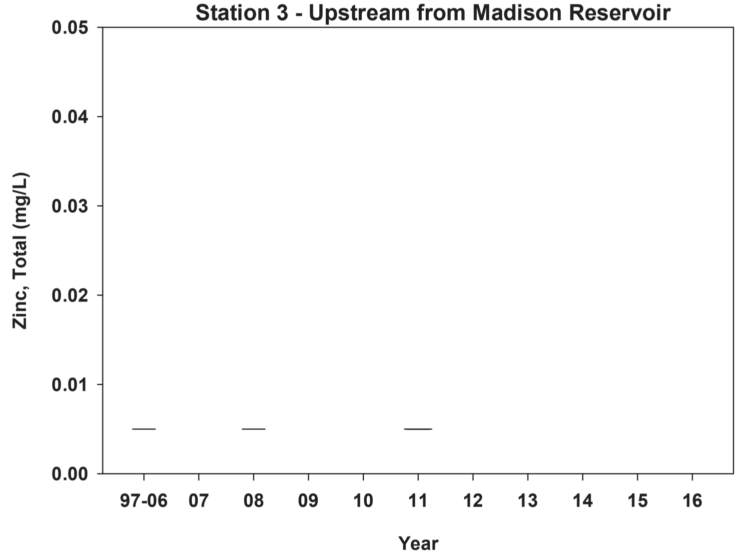


Figure B-21: Zinc, Total (mg/L) for Stations 1 to 10.







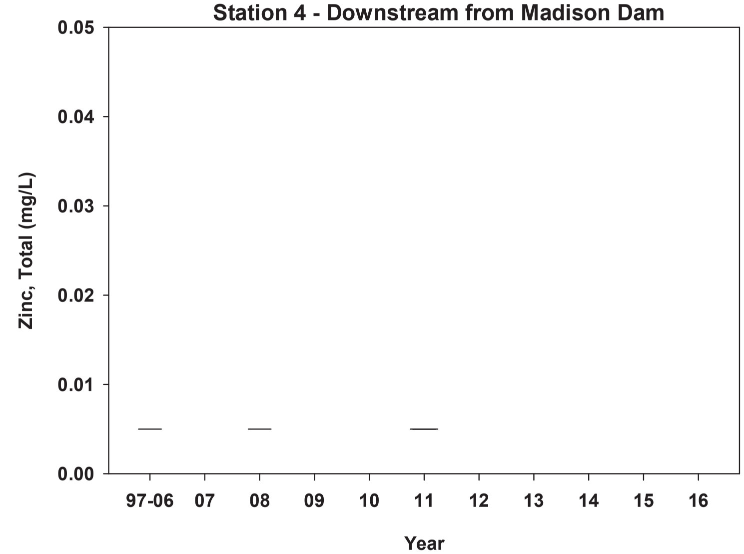


Figure B-21: Zinc, Total (mg/L) for Stations 1 to 10 (cont.).

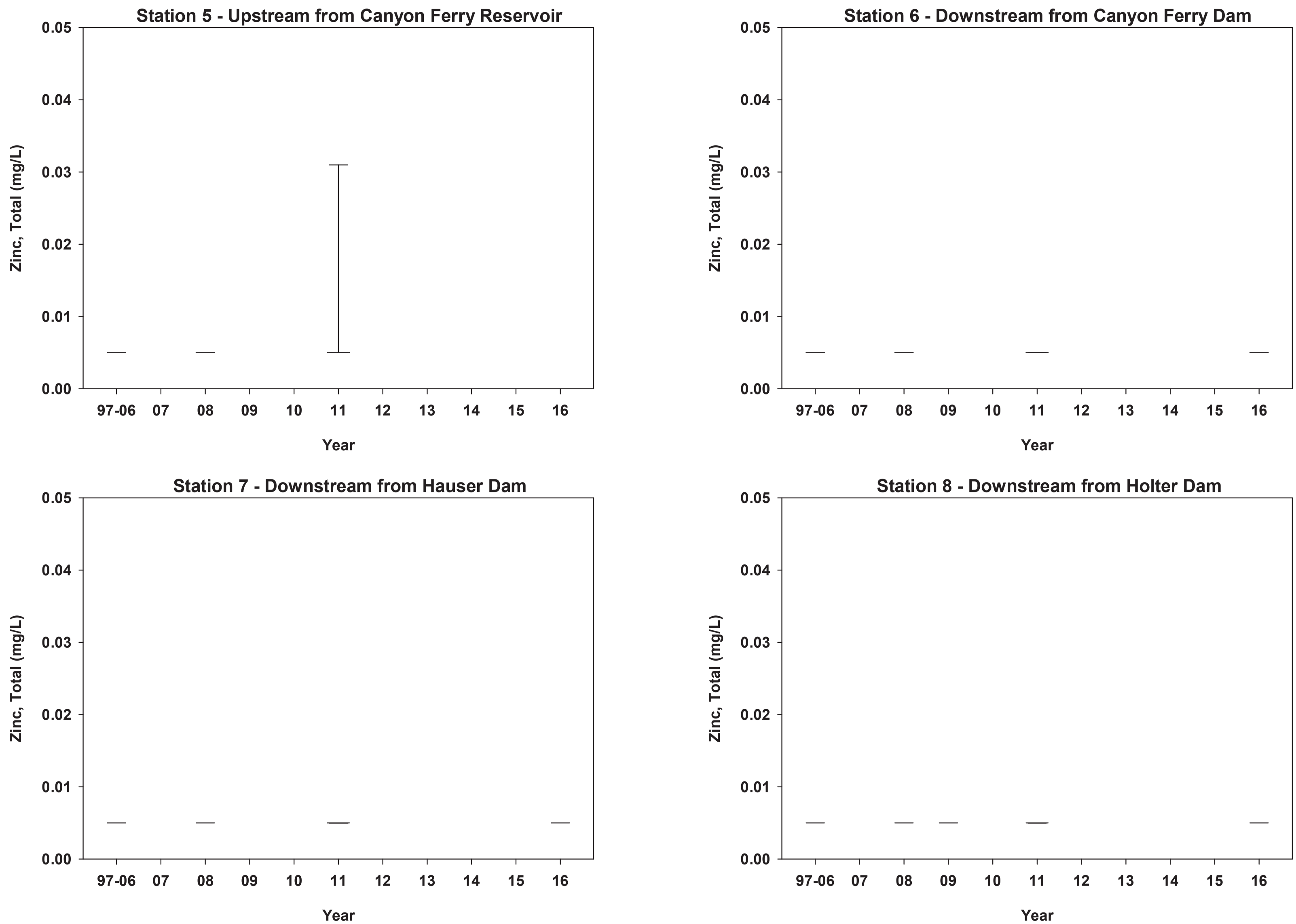
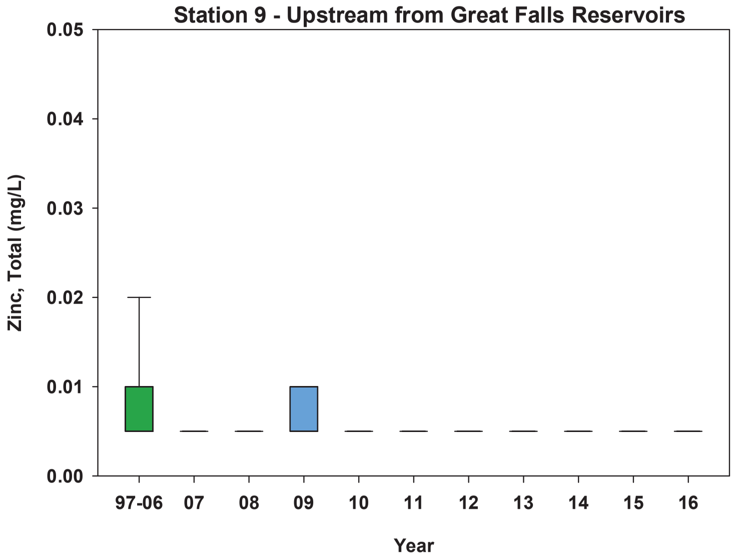


Figure B-21: Zinc, Total (mg/L) for Stations 1 to 10 (cont.).



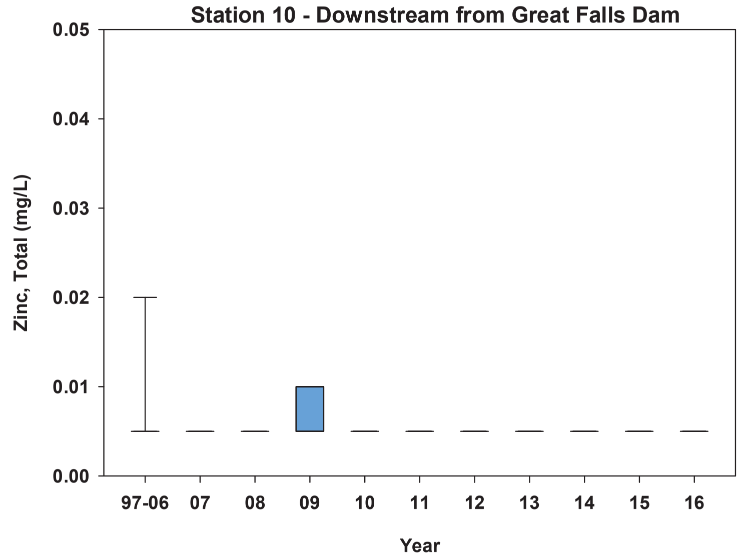
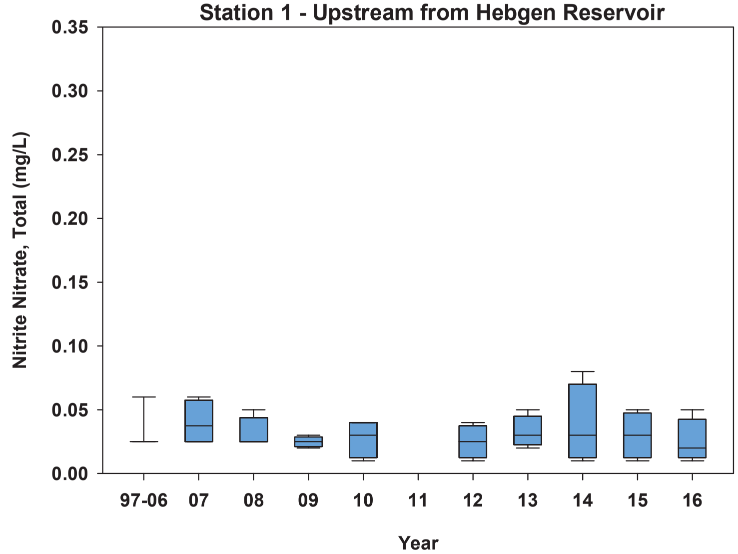
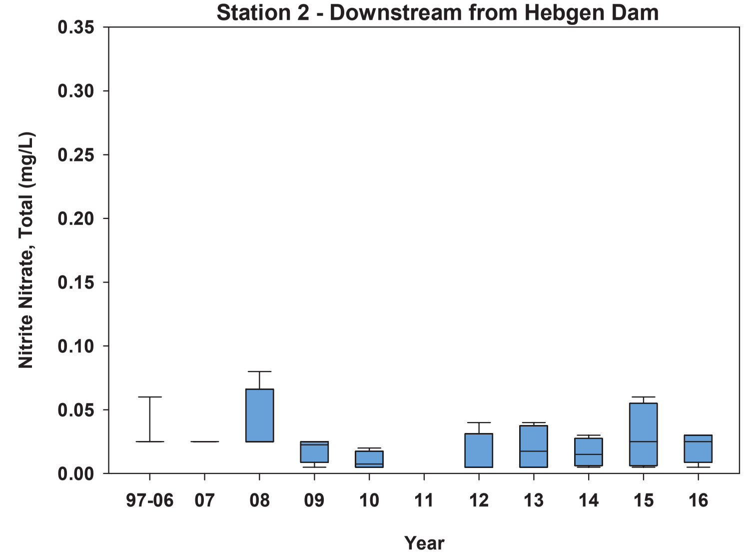


Figure B-22: Nitrite-Nitrate, Total (mg/L) for Stations 1 to 10.

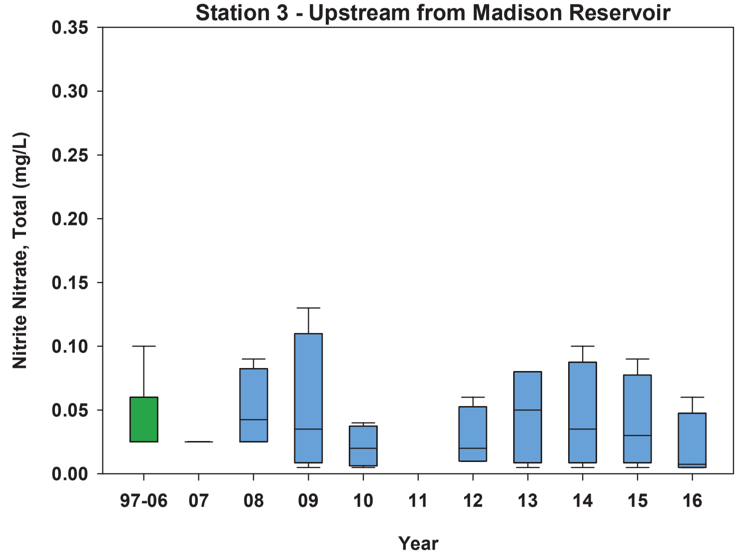
Station 1 - Upstream from Hebgen Reservoir



Station 2 - Downstream from Hebgen Dam



Station 3 - Upstream from Madison Reservoir



Station 4 - Downstream from Madison Dam

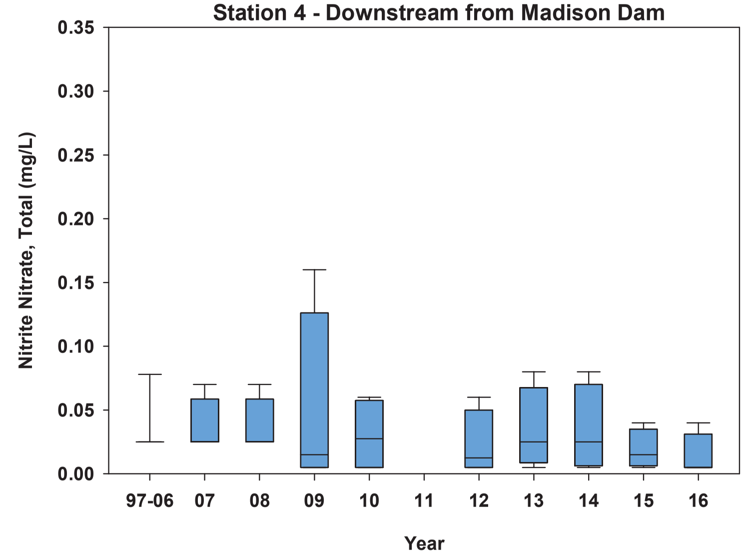
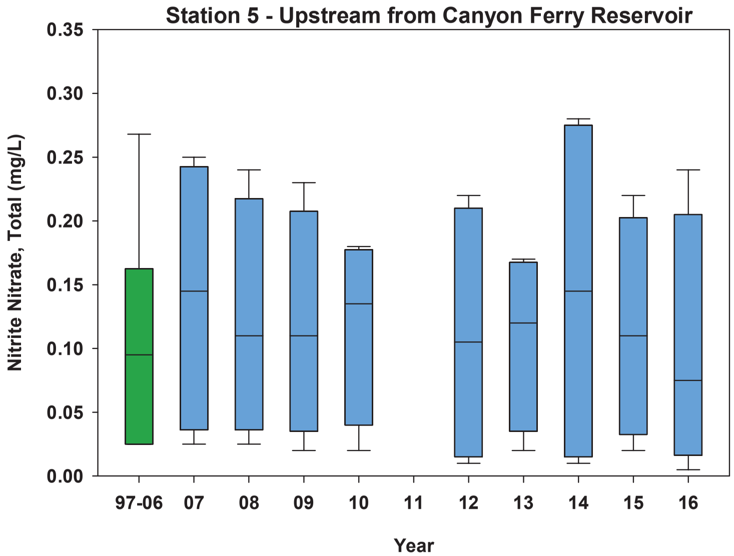
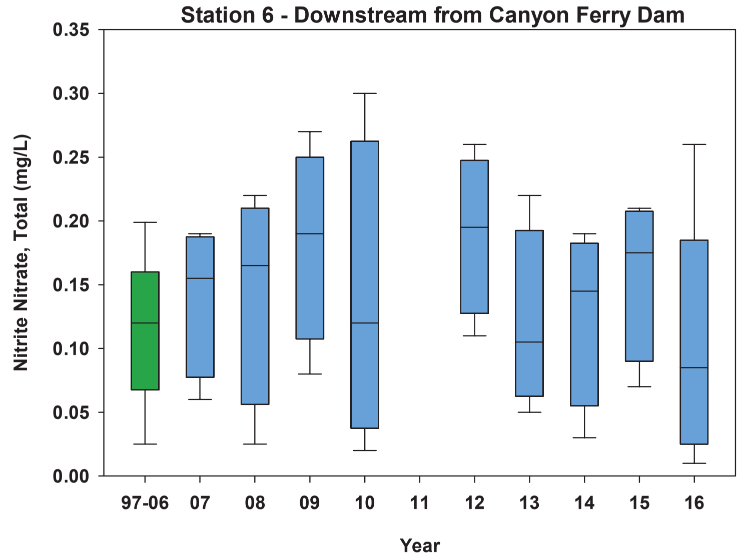
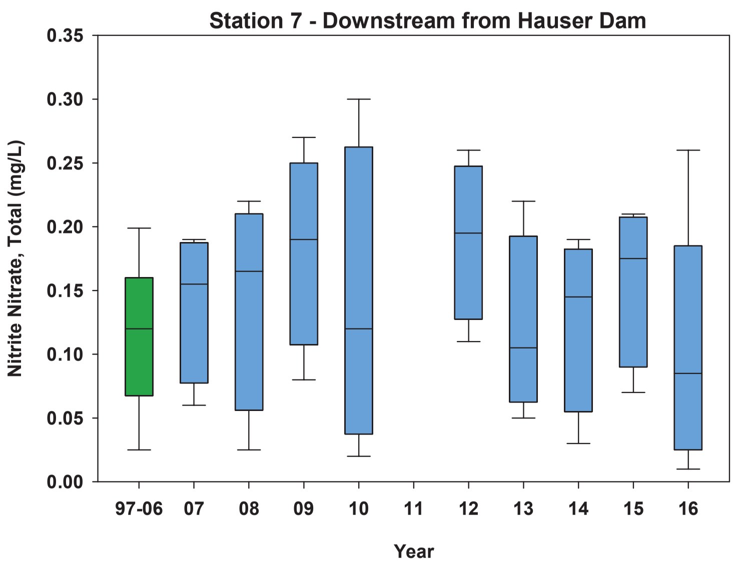


Figure B-22: Nitrite-Nitrate, Total (mg/L) for Stations 1 to 10 (cont.).







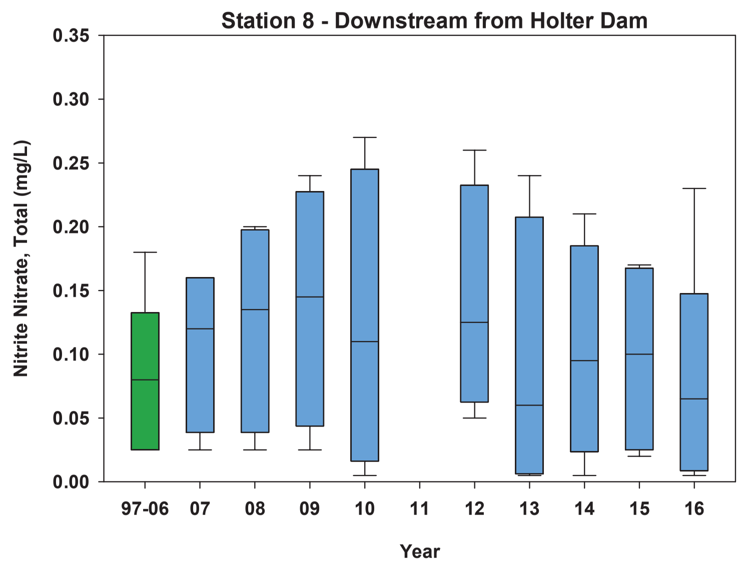


Figure B-22: Nitrite-Nitrate, Total (mg/L) for Stations 1 to 10 (cont.).

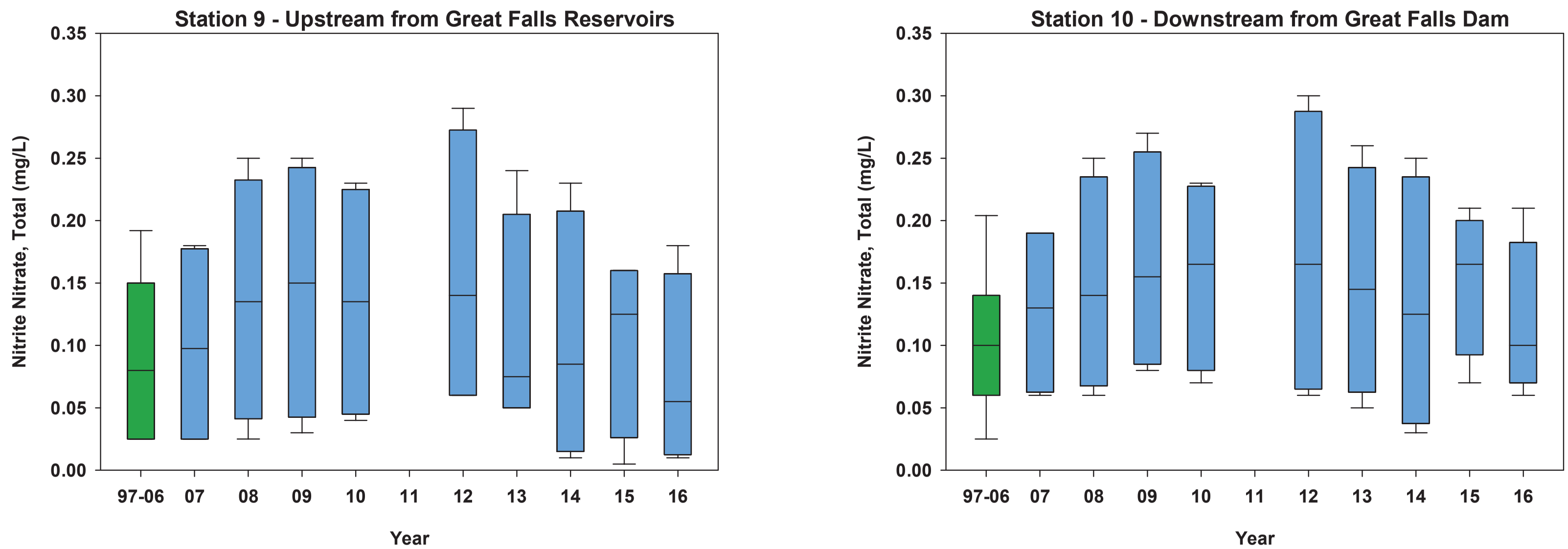


Figure B-23: Nitrite-Nitrate, Dissolved (mg/L) for Stations 1 to 10.

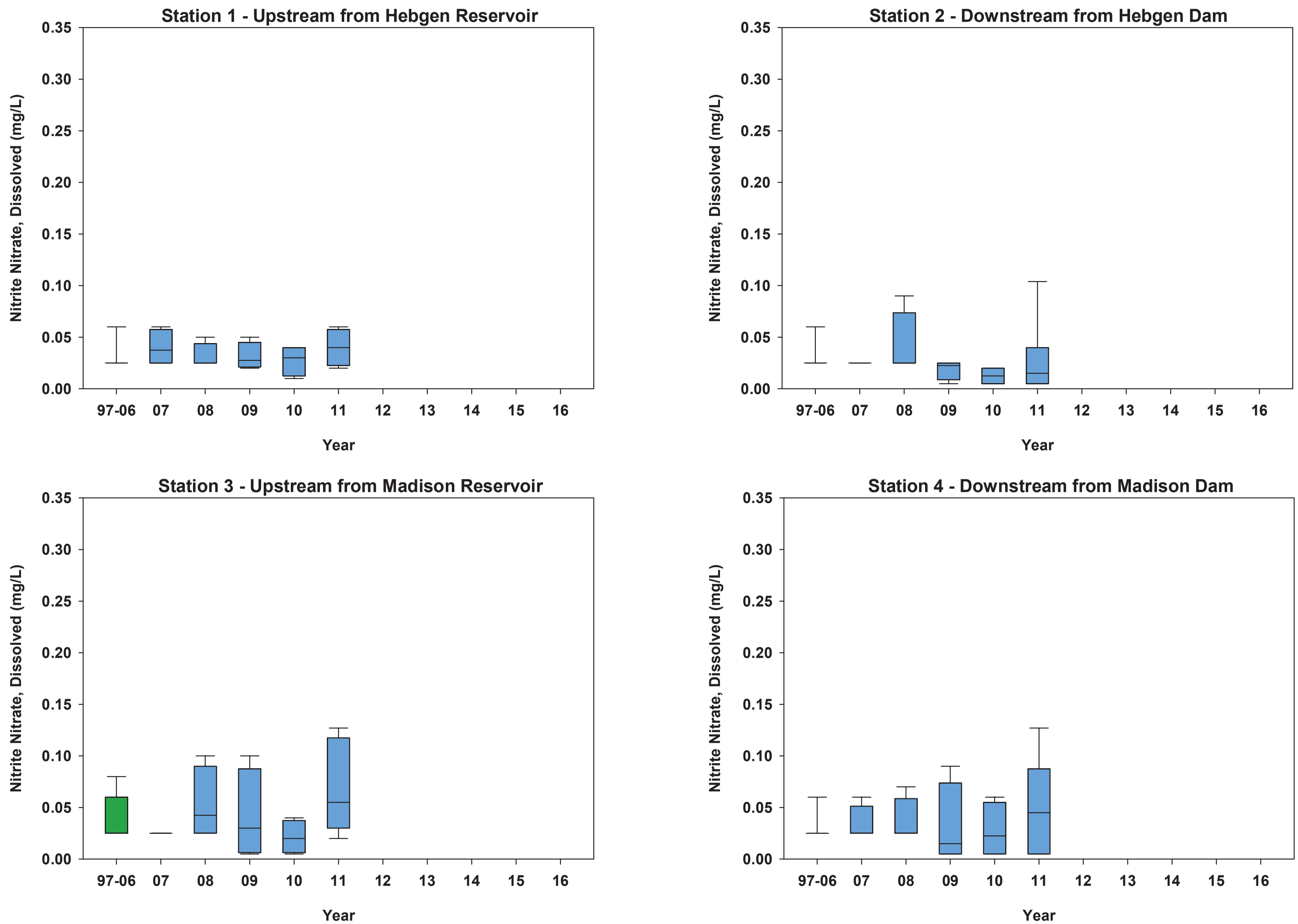
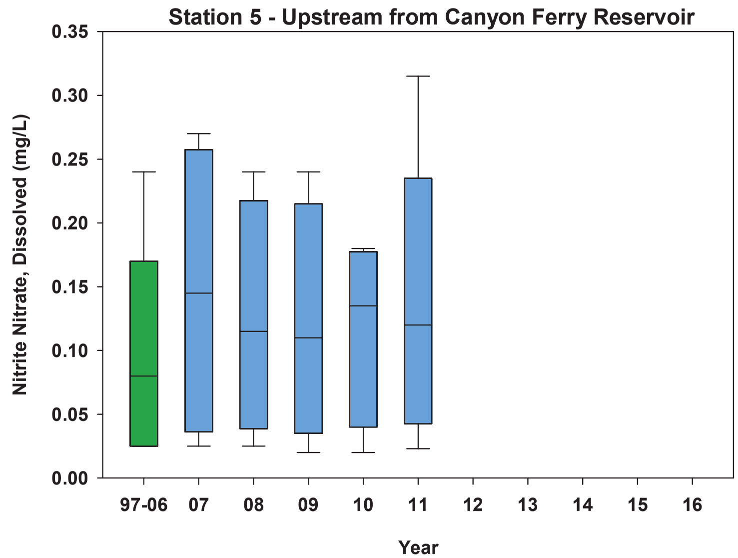
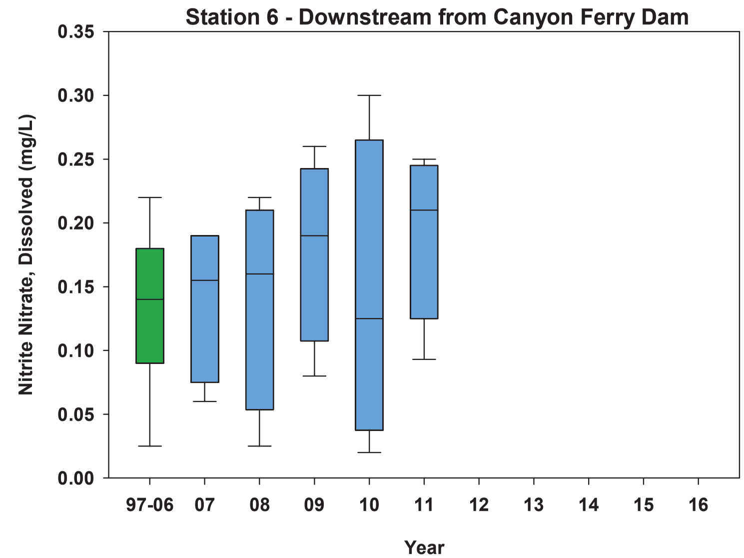
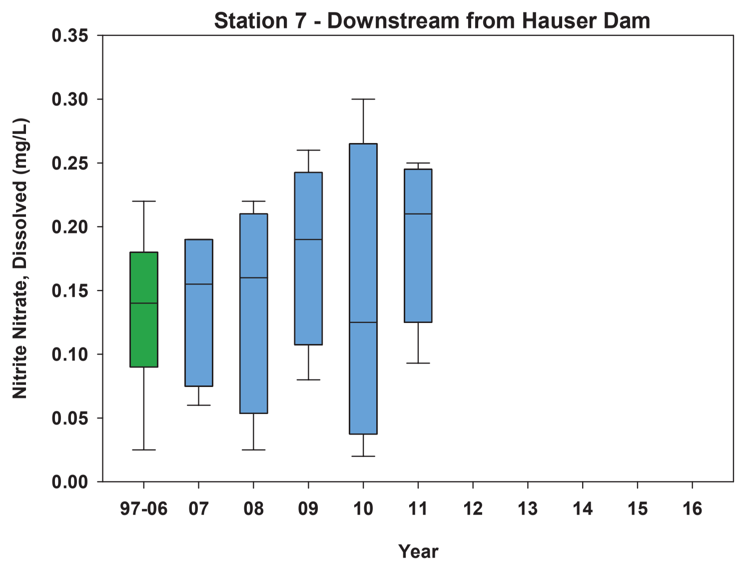


Figure B-23: Nitrite-Nitrate, Dissolved (mg/L) for Stations 1 to 10 (cont.).







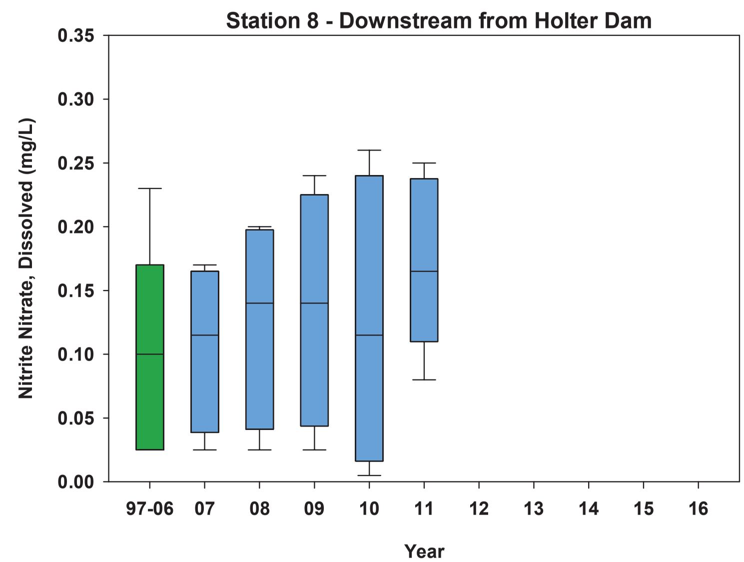
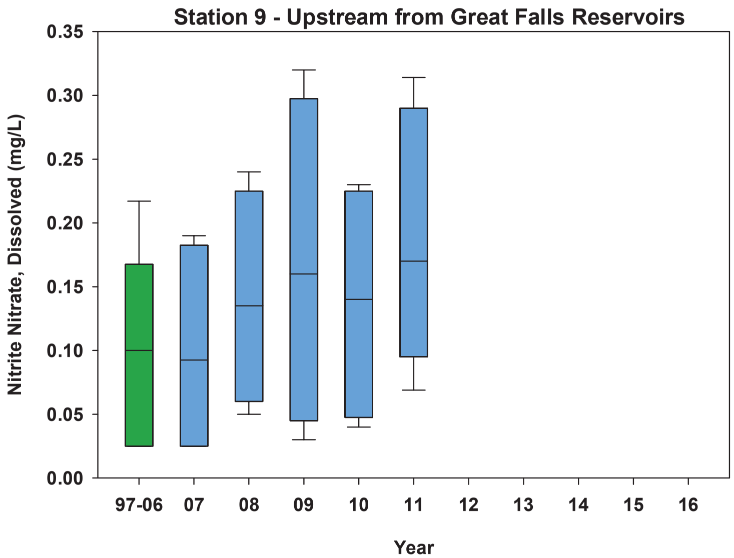


Figure B-23: Nitrite-Nitrate, Dissolved (mg/L) for Stations 1 to 10 (cont.).



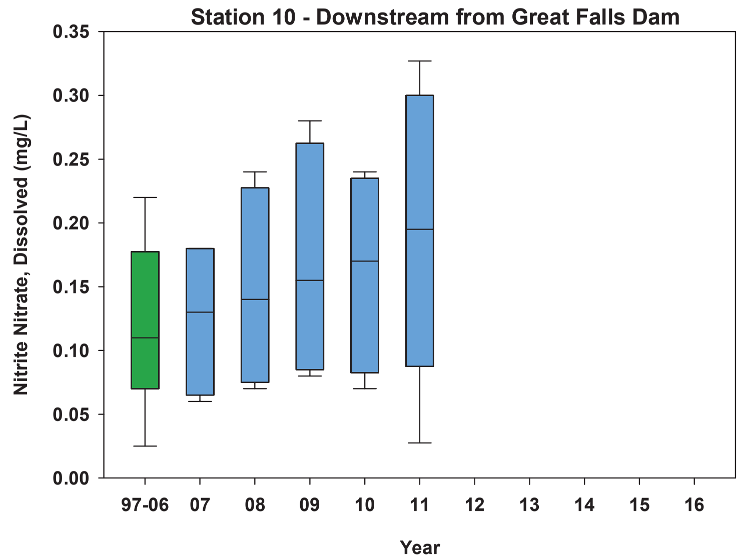
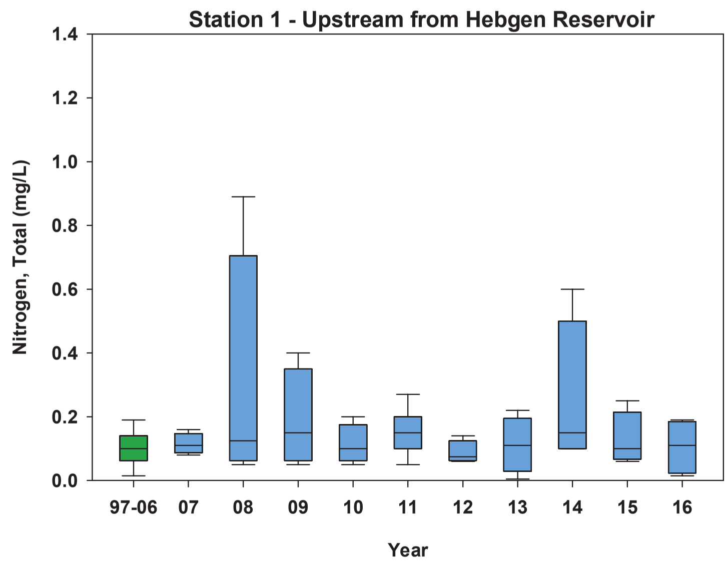
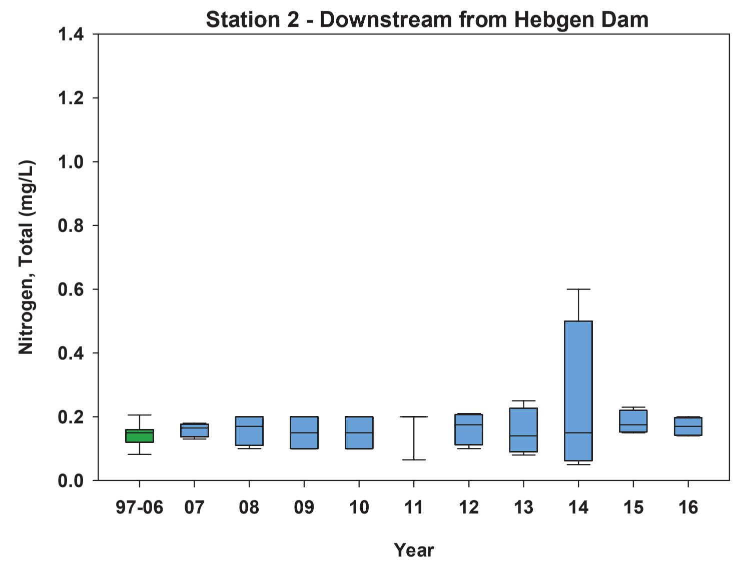
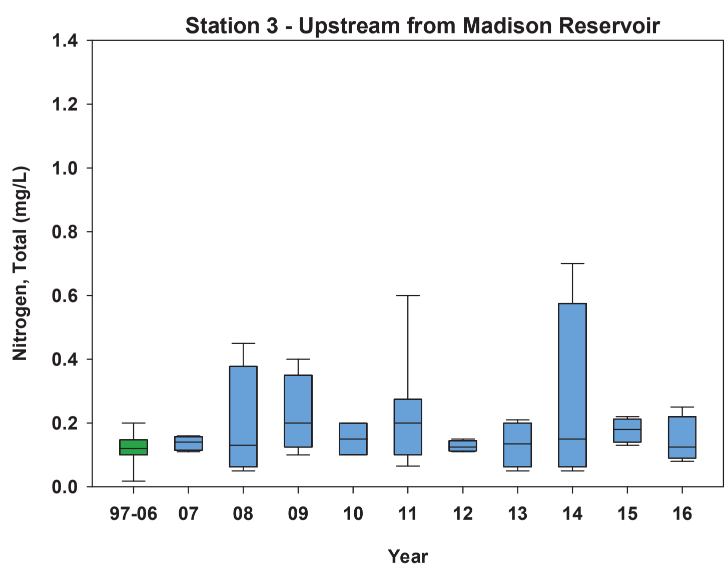


Figure B-24: Nitrogen, Total (mg/L) for Stations 1 to 10.







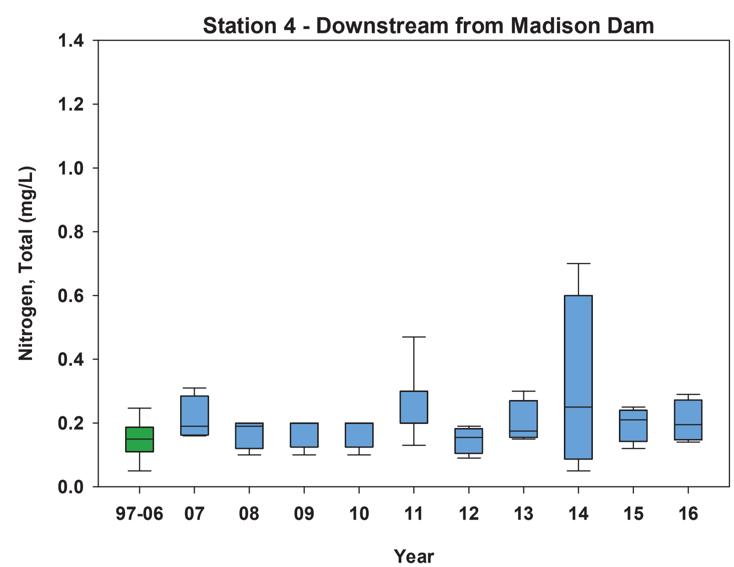
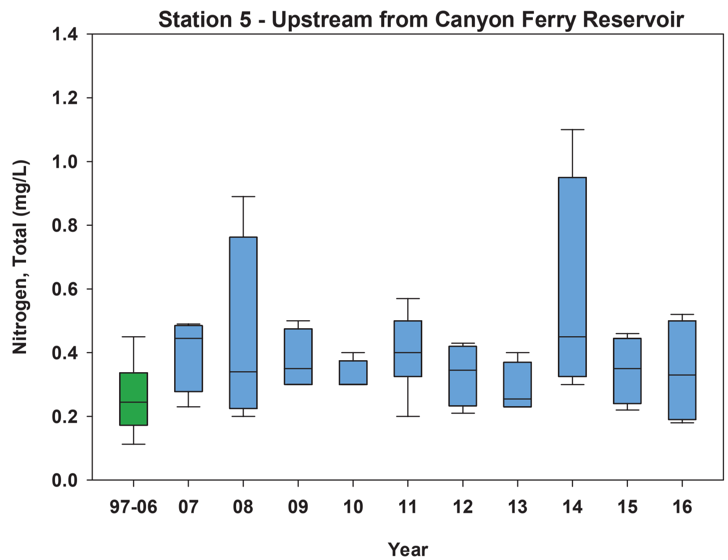
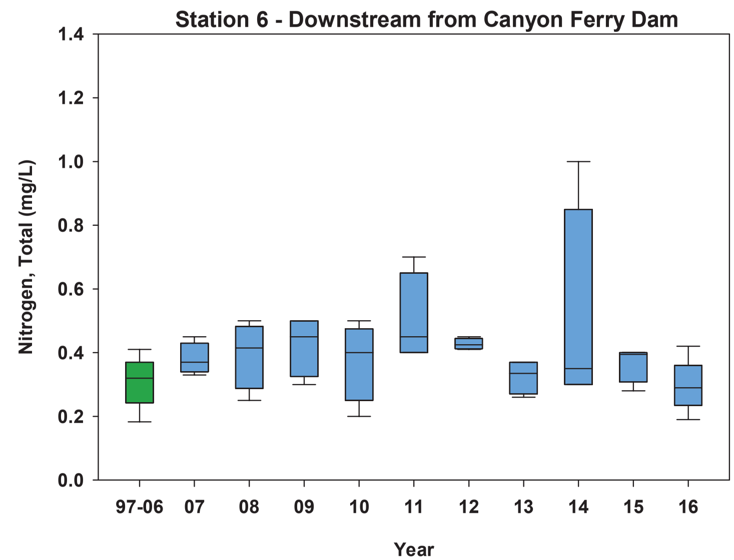
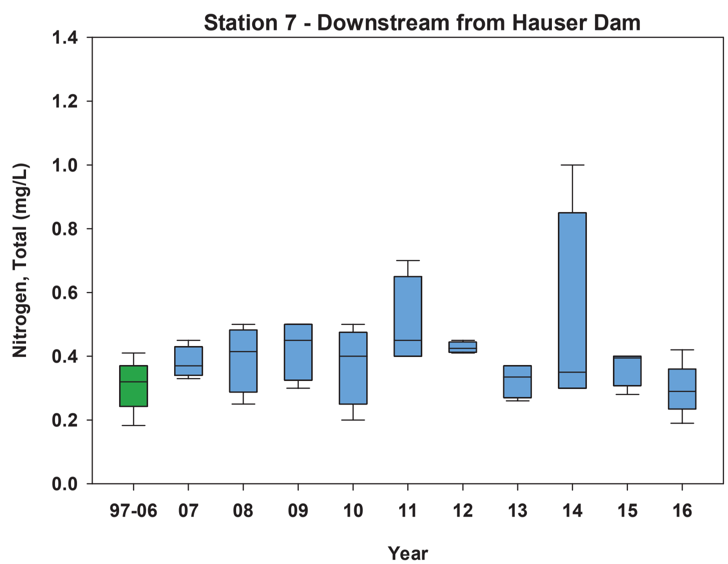


Figure B-24: Nitrogen, Total (mg/L) for Stations 1 to 10 (cont.).







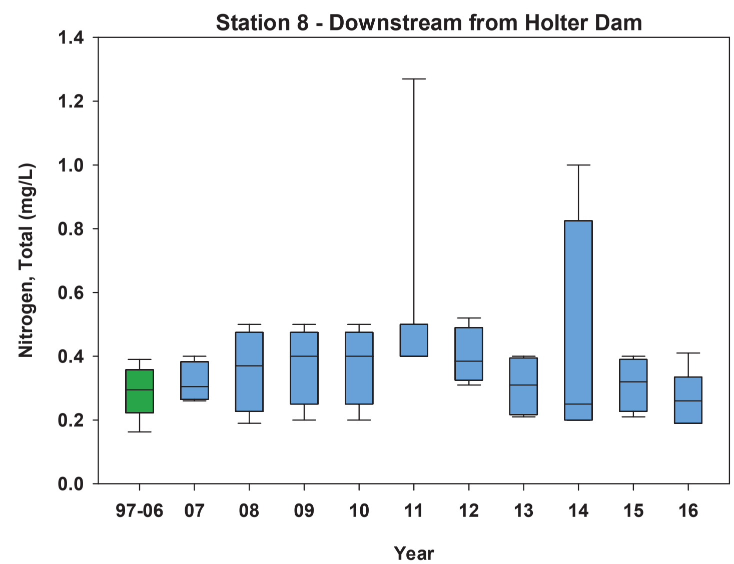
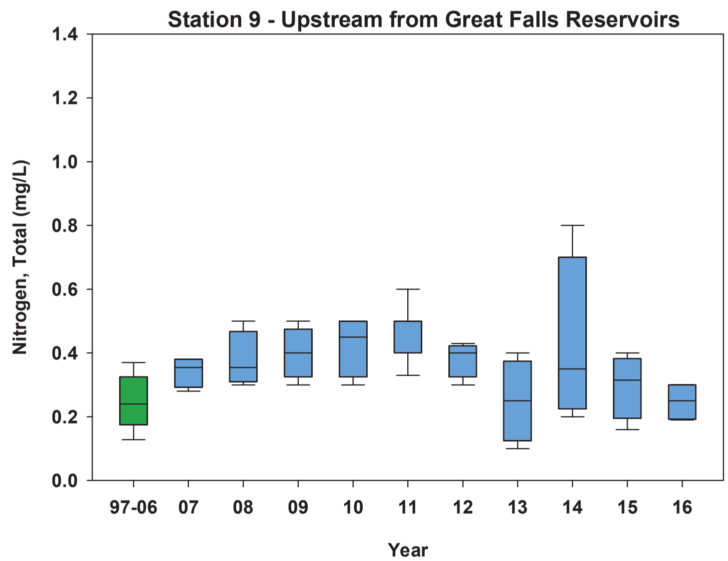


Figure B-24: Nitrogen, Total (mg/L) for Stations 1 to 10 (cont.).



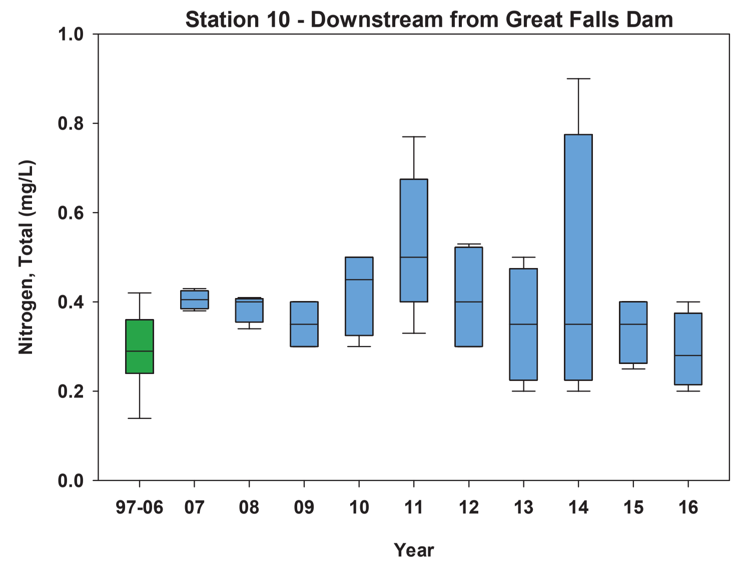


Figure B-25: Phosphorus, Total (mg/L) for Stations 1 to 10.

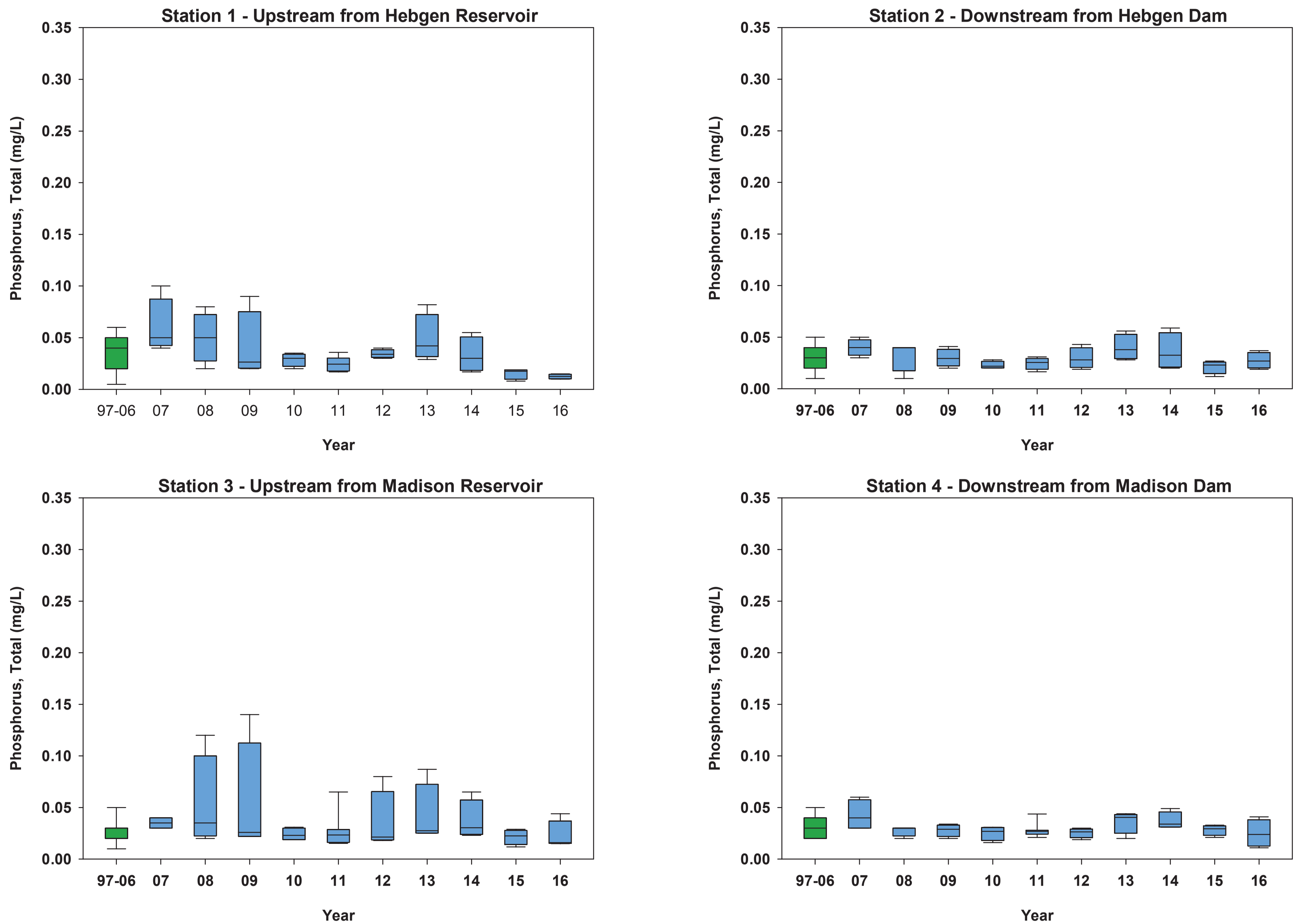


Figure B-25: Phosphorus, Total (mg/L) for Stations 1 to 10 (cont.).

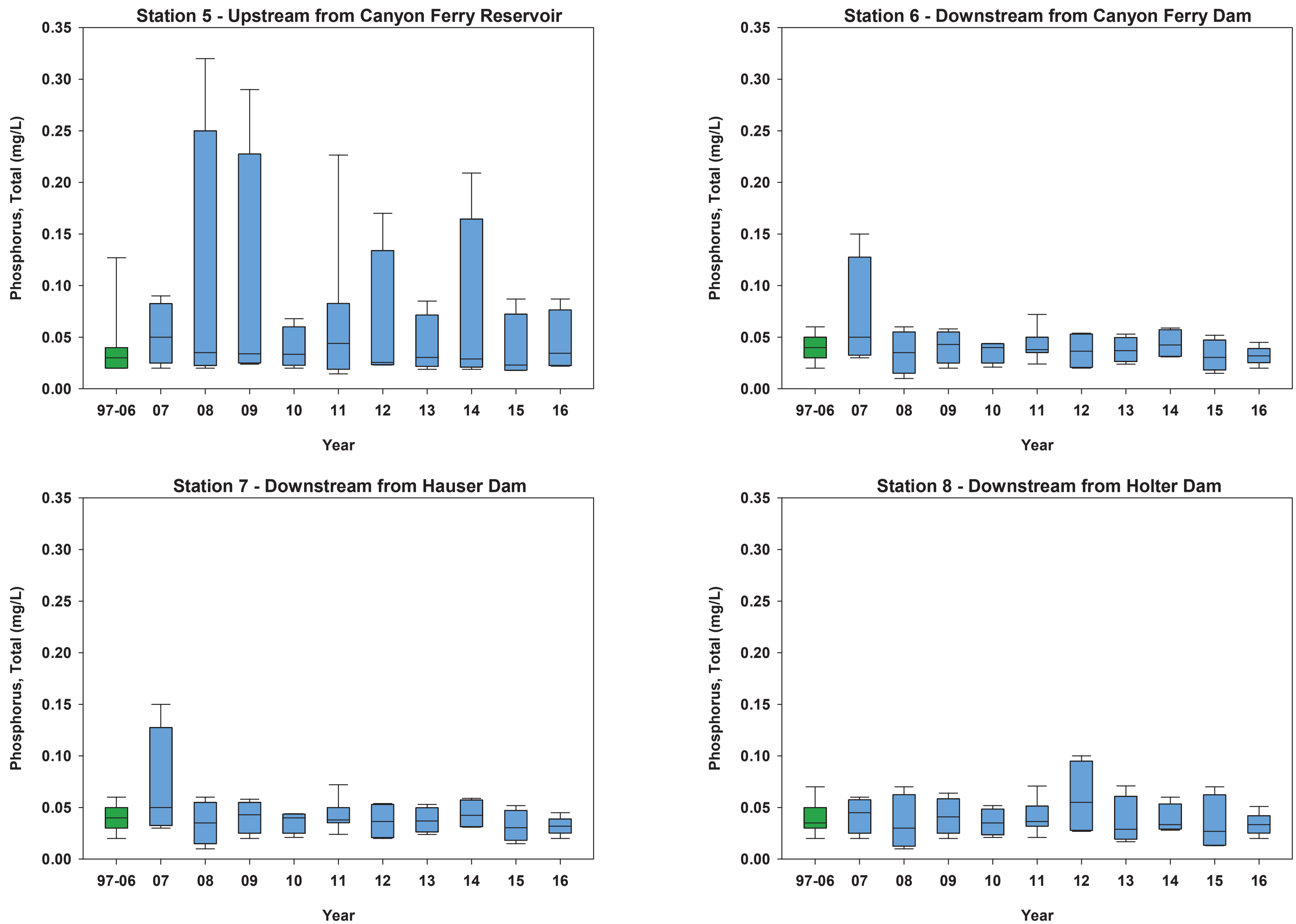
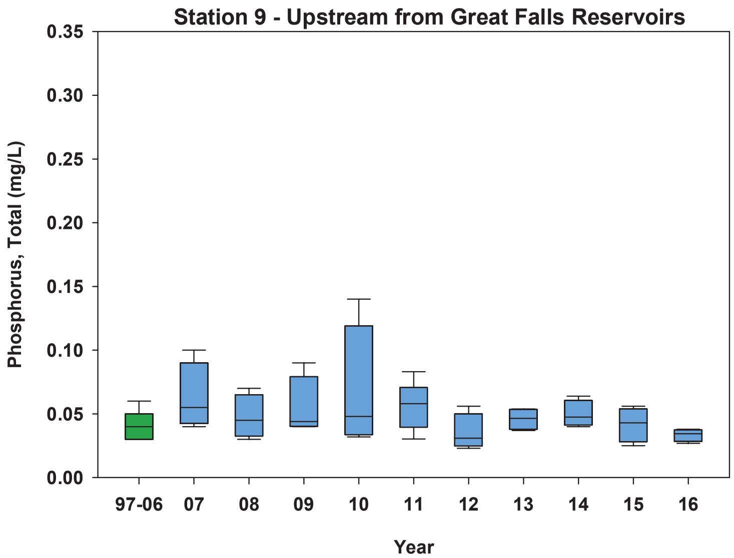


Figure B-25: Phosphorus, Total (mg/L) for Stations 1 to 10 (cont.).



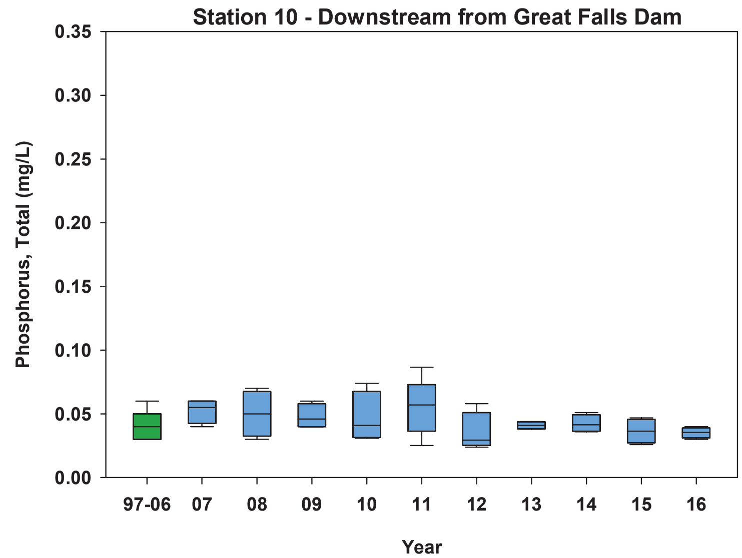


Figure B-26: Dissolved Oxygen (mg/L) for Stations 1 to 10.

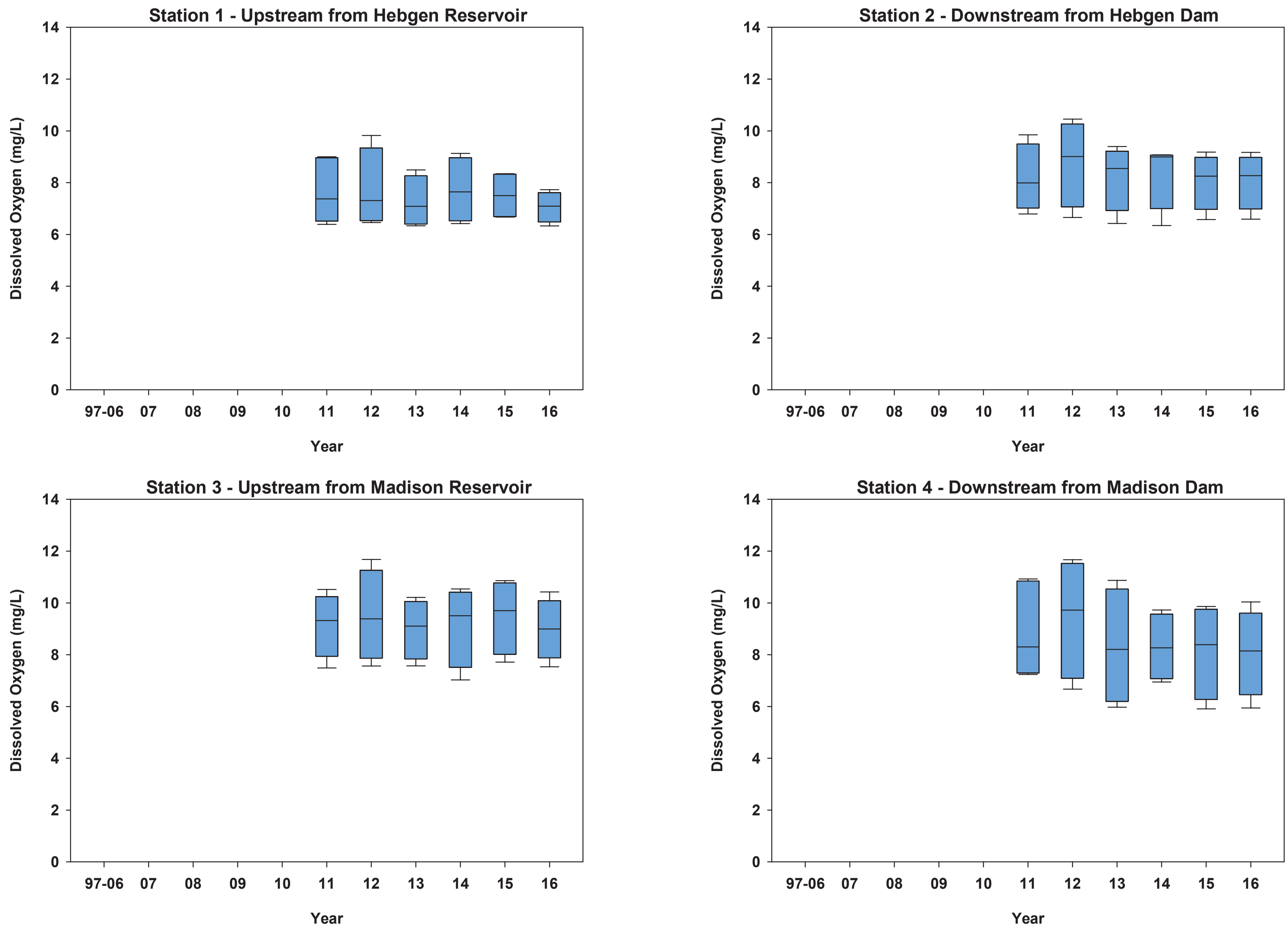
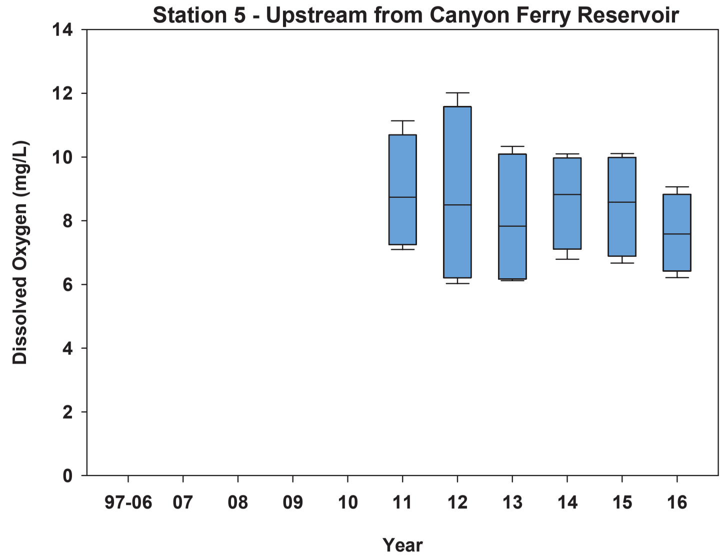
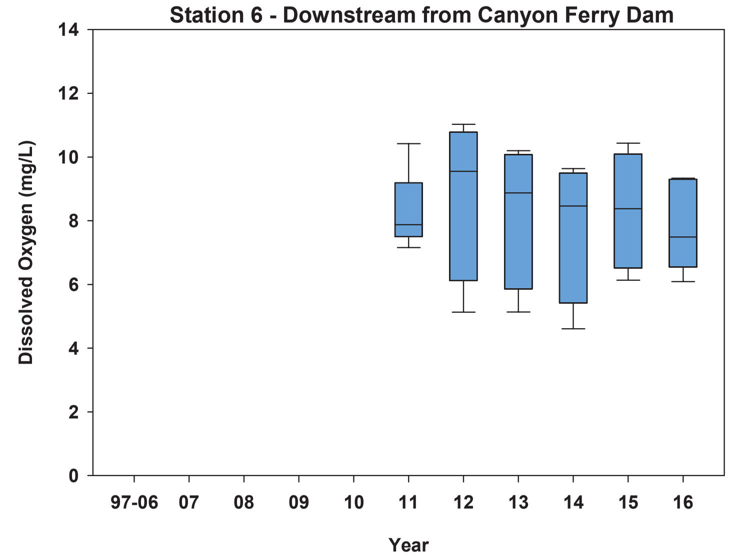
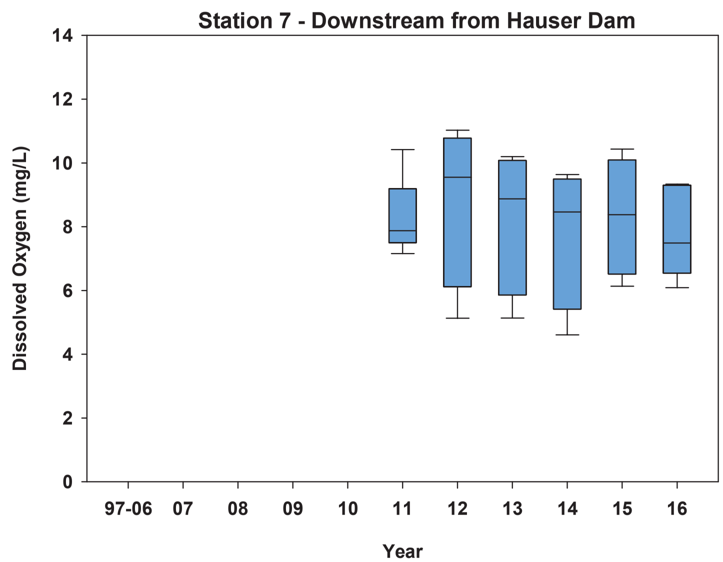


Figure B-26: Dissolved Oxygen (mg/L) for Stations 1 to 10 (cont.).







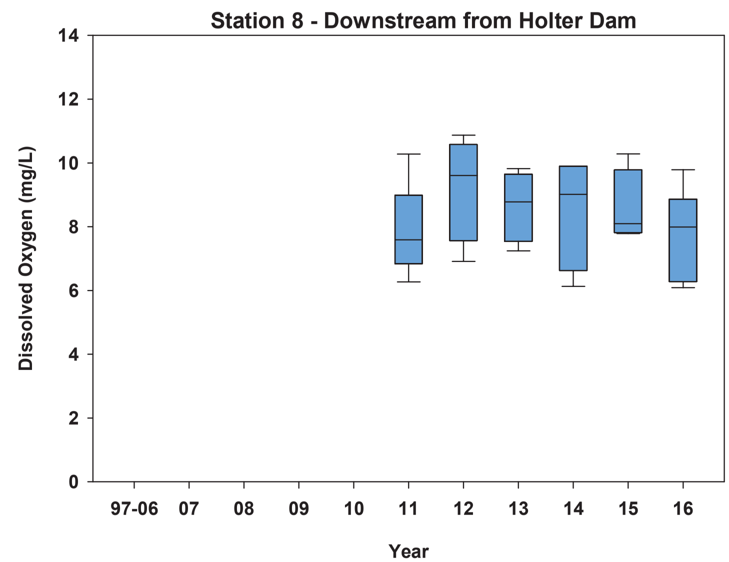
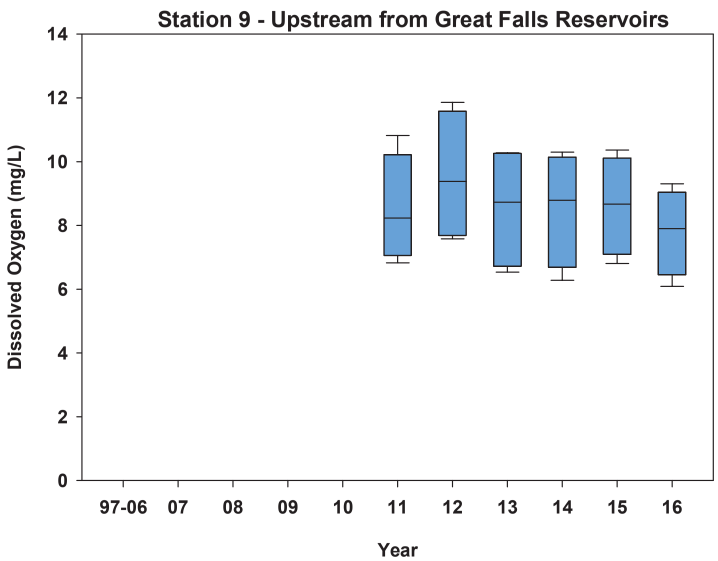


Figure B-26: Dissolved Oxygen (mg/L) for Stations 1 to 10 (cont.).



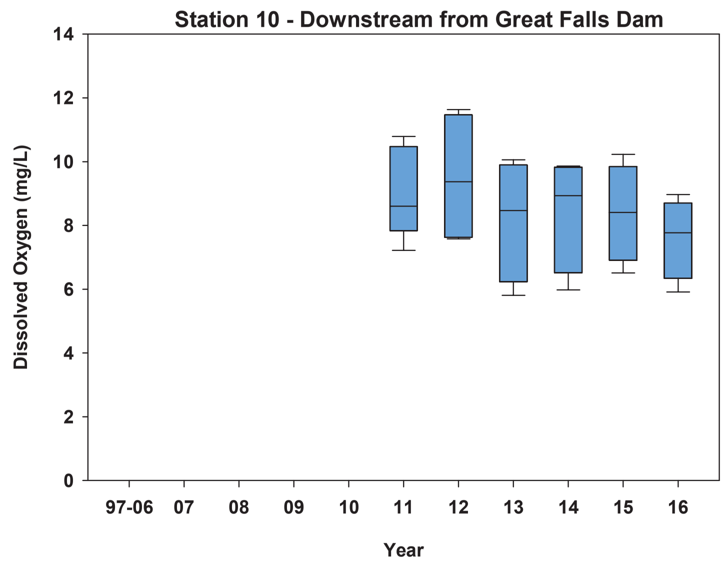


Figure B-27: Dissolved Oxygen (% Sat) for Stations 1 to 10.

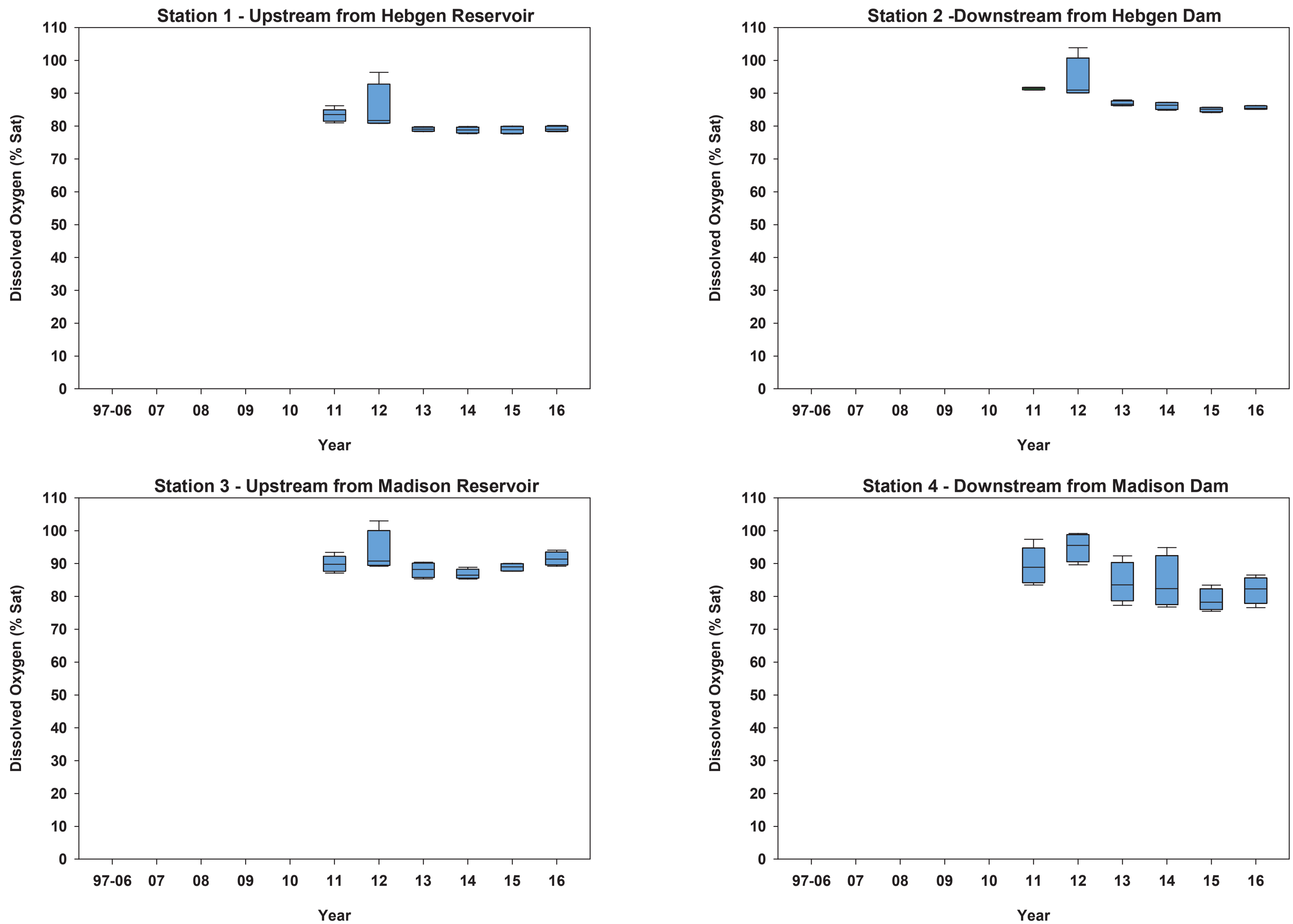
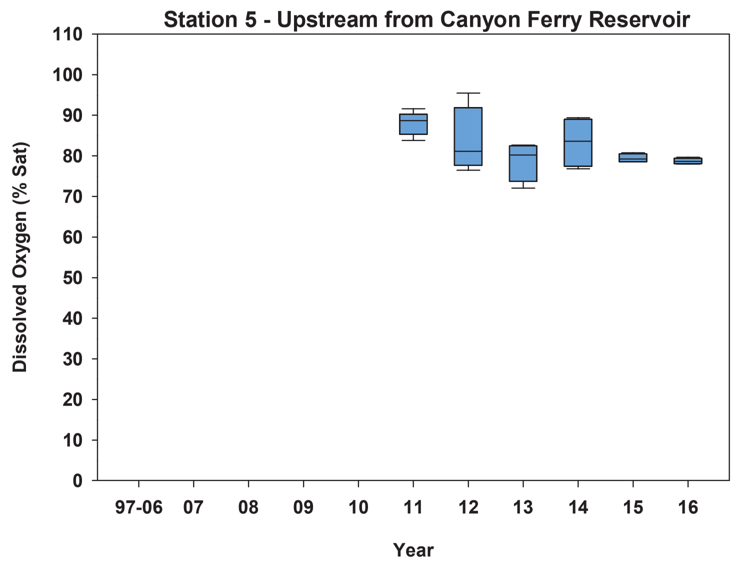
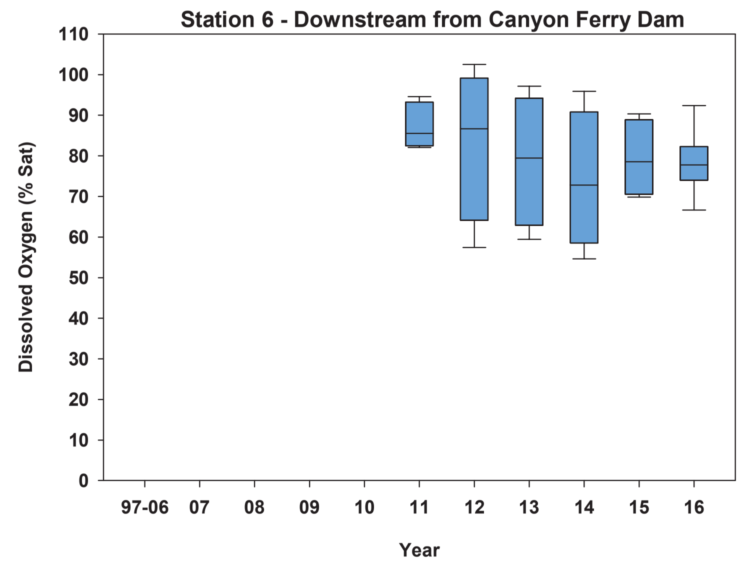
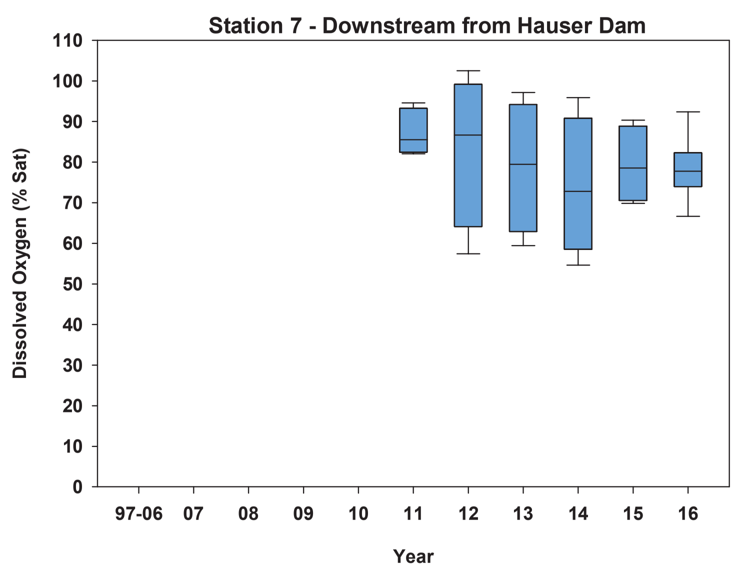


Figure B-27: Dissolved Oxygen (% Sat) for Stations 1 to 10 (cont.).







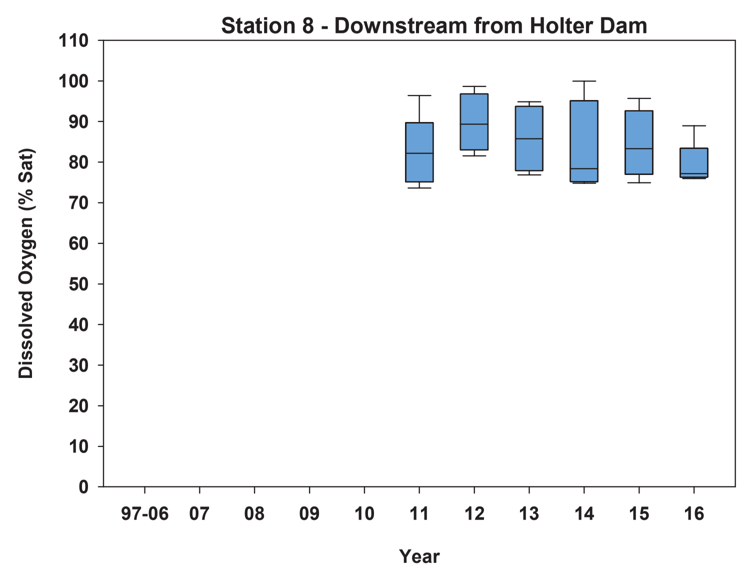
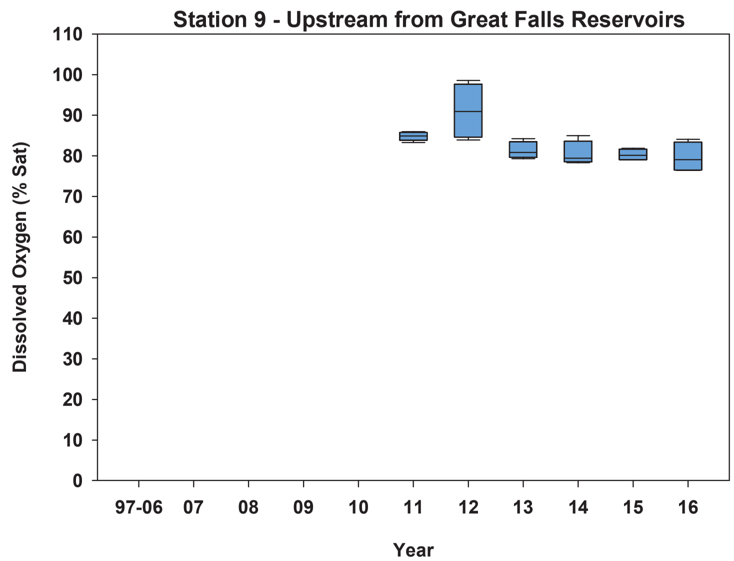


Figure B-27: Dissolved Oxygen (% Sat) for Stations 1 to 10 (cont.).



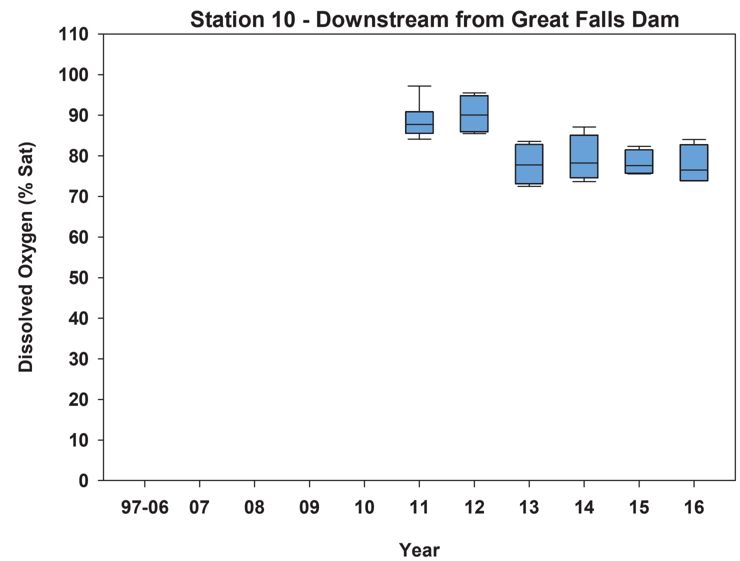
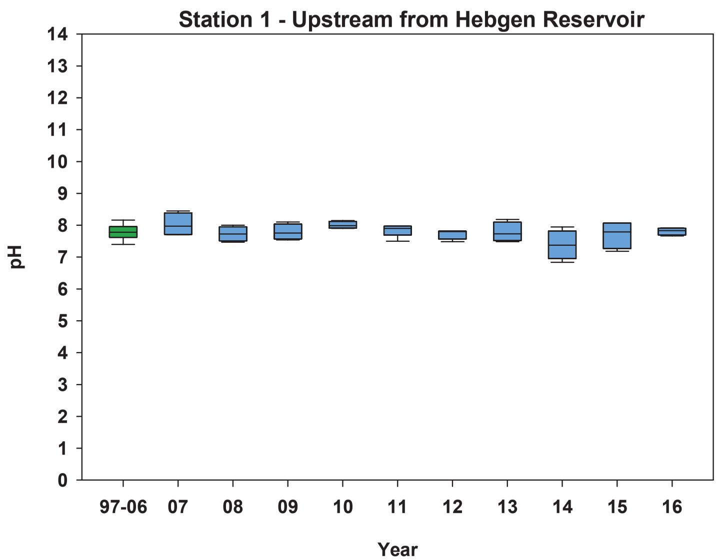
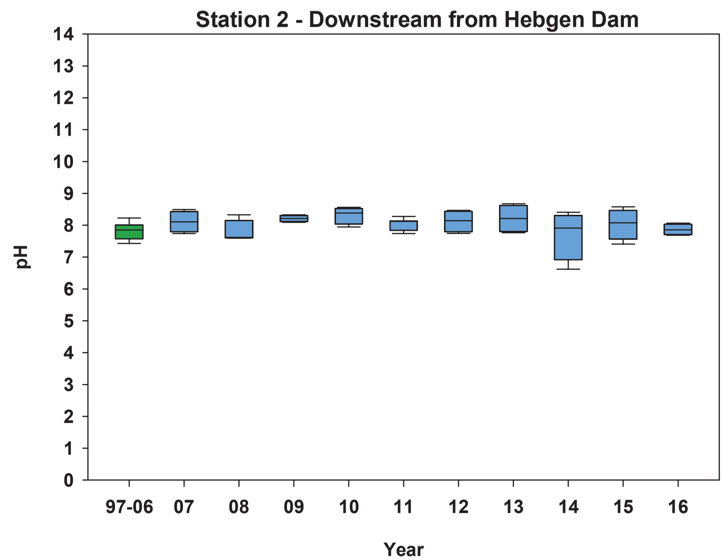
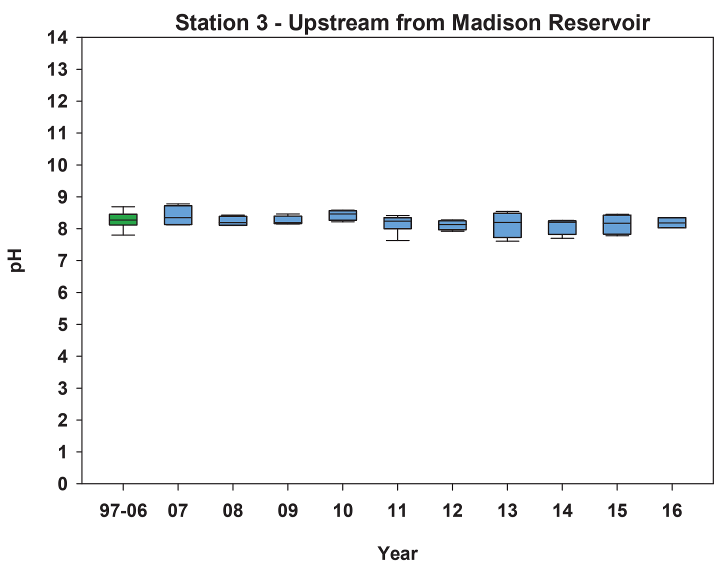


Figure B-28: pH, Taken in field (s.u.) for Stations 1 to 10.







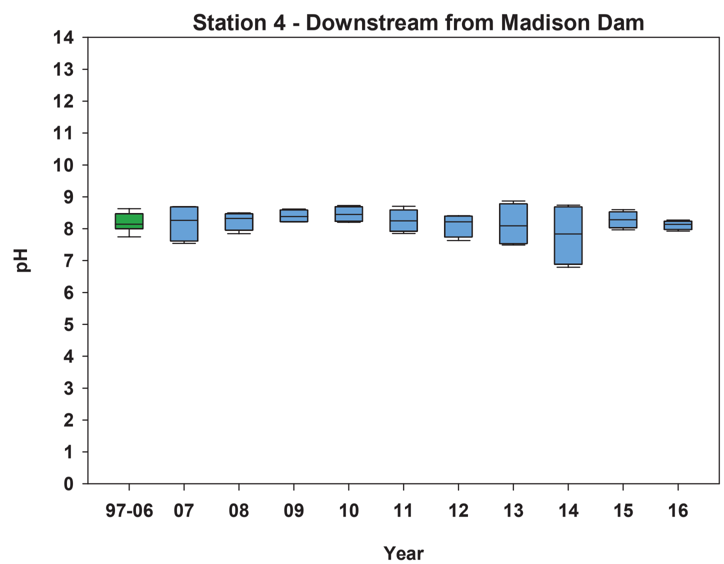
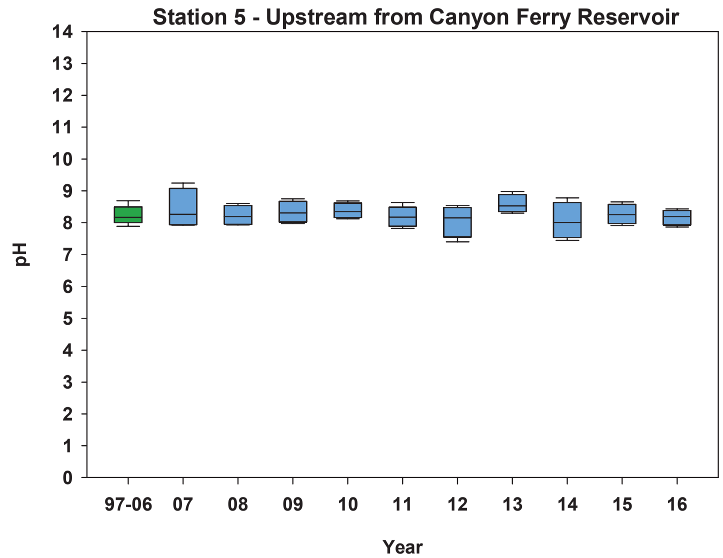
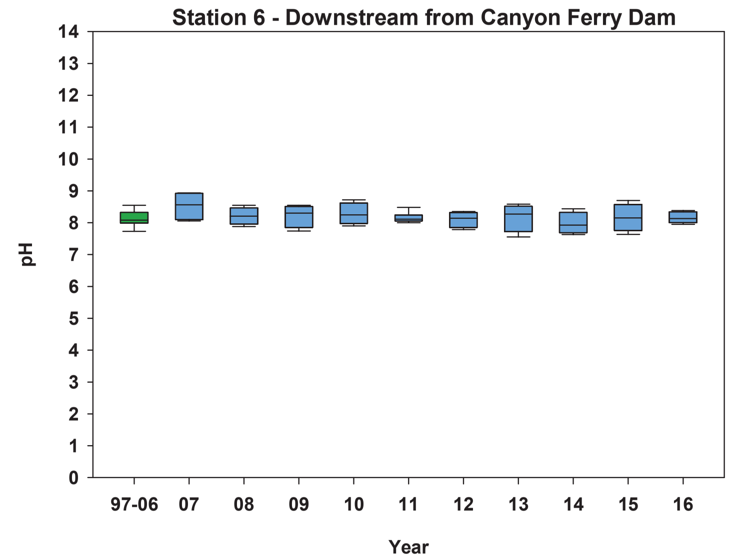
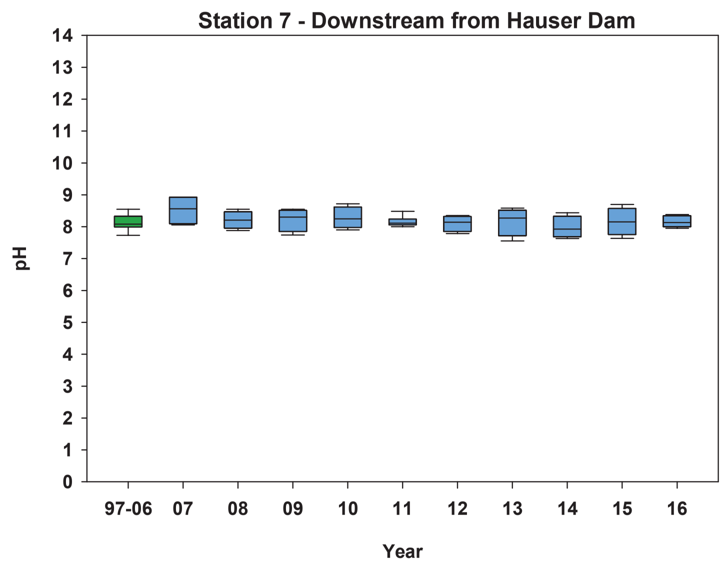


Figure B-28: pH, Taken in field (s.u.) for Stations 1 to 10 (cont.).







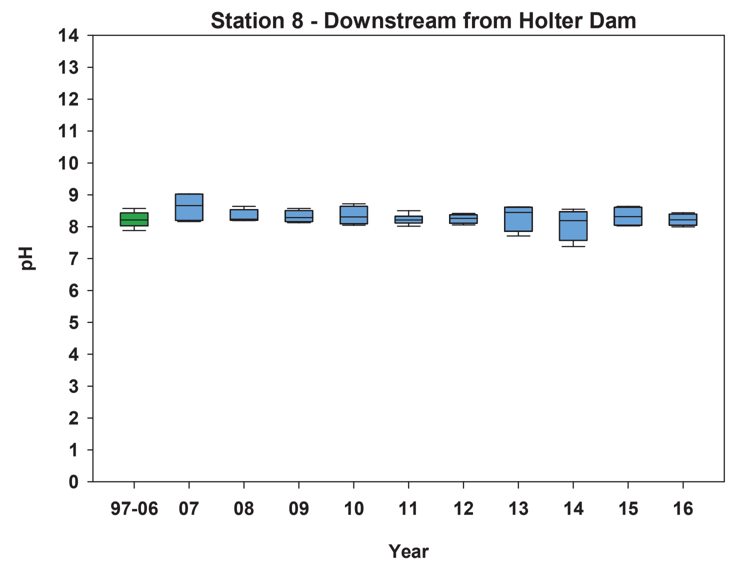
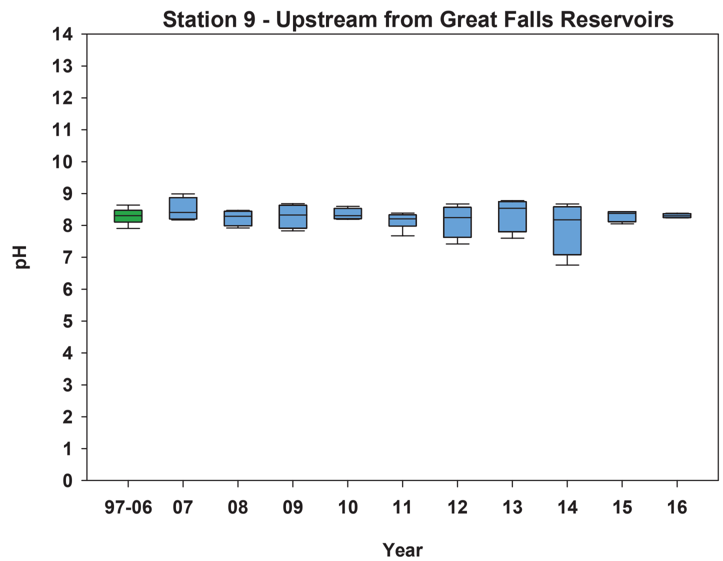


Figure B-28: pH, Taken in field (s.u.) for Stations 1 to 10 (cont.).



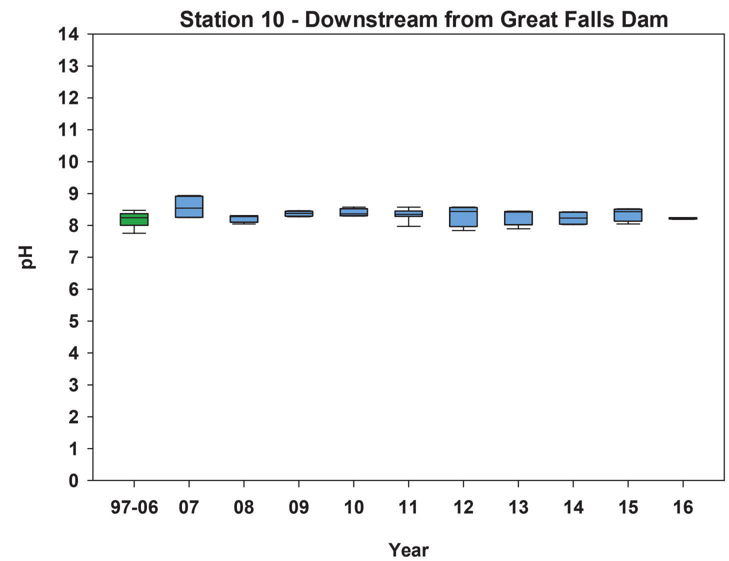
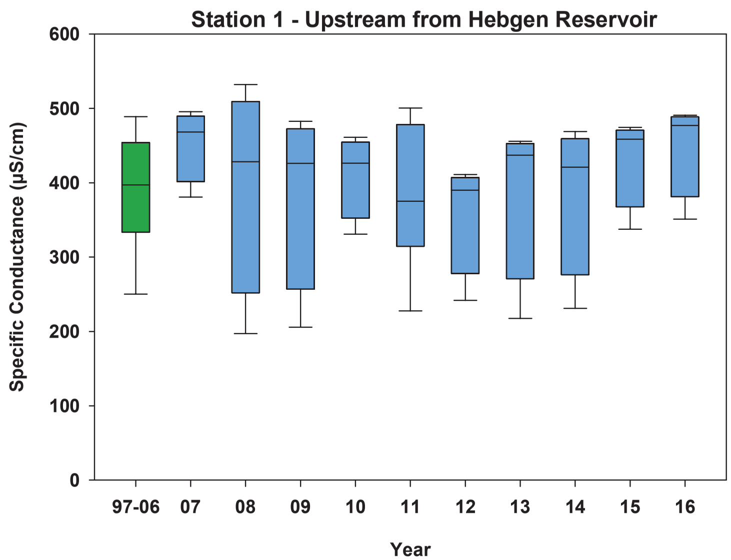
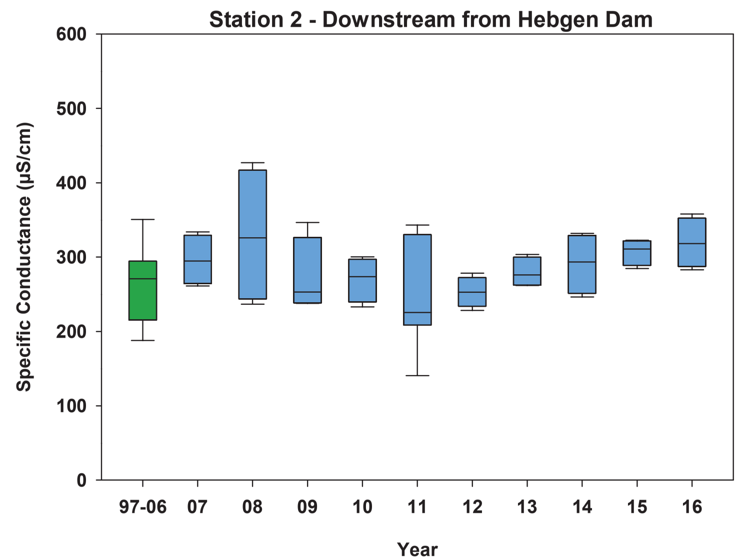
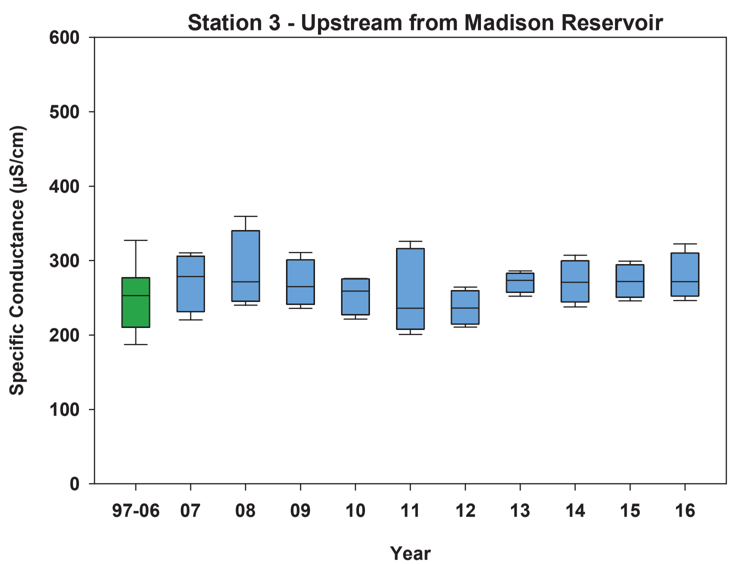


Figure B-29: Specific Conductance (µS/cm) for Stations 1 to 10.







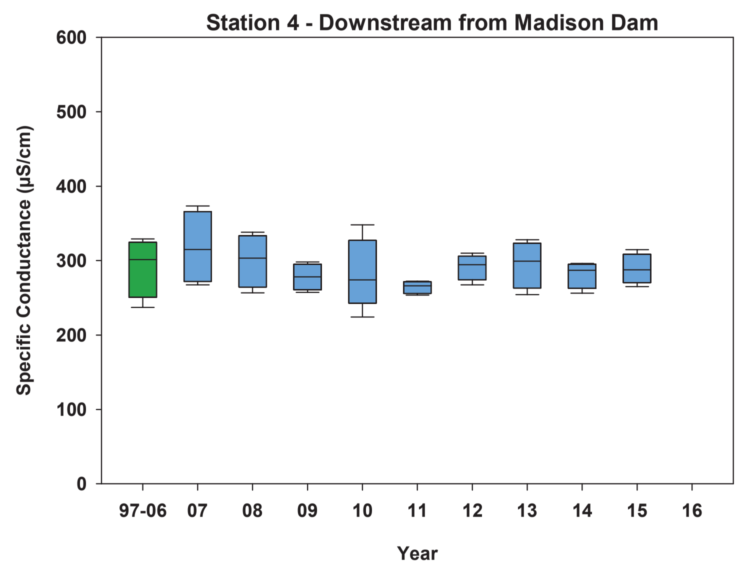


Figure B-29: Specific Conductance (µS/cm) for Stations 1 to 10 (cont.).

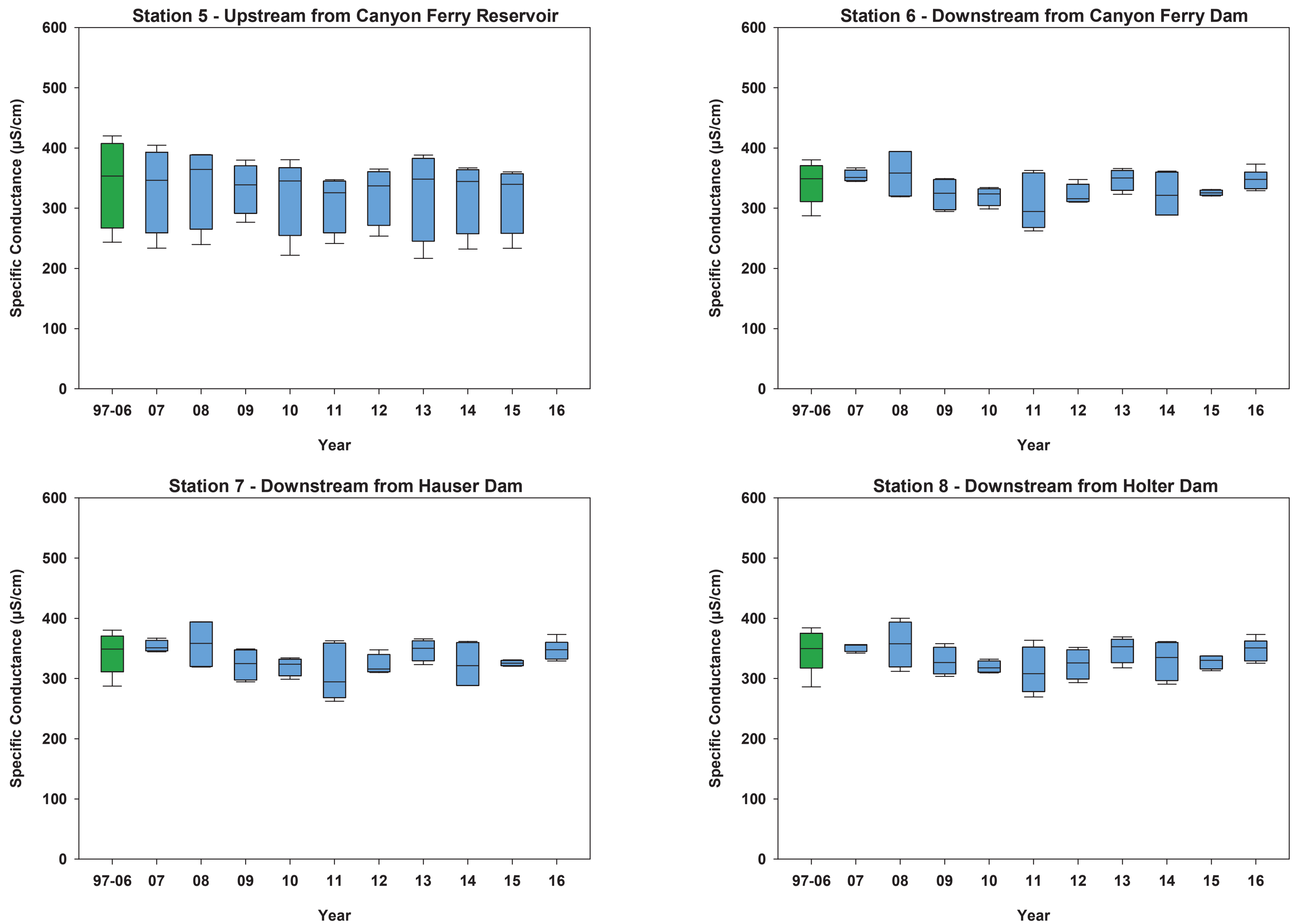
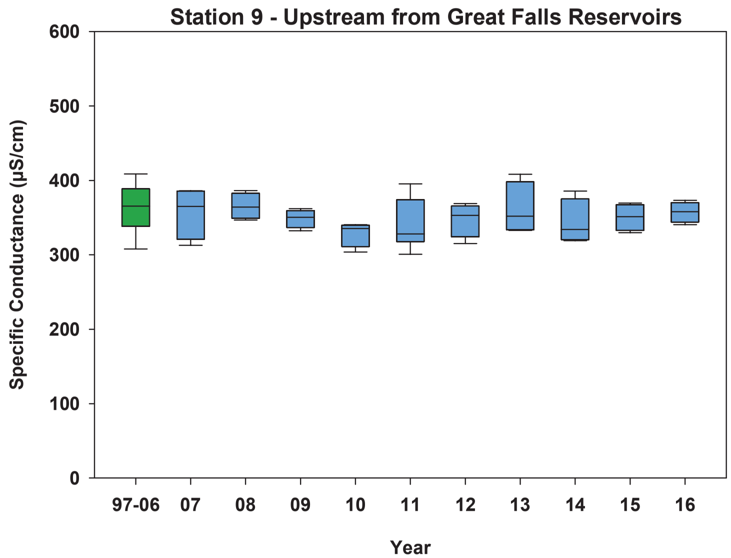


Figure B-29: Specific Conductance (µS/cm) for Stations 1 to 10 (cont.).



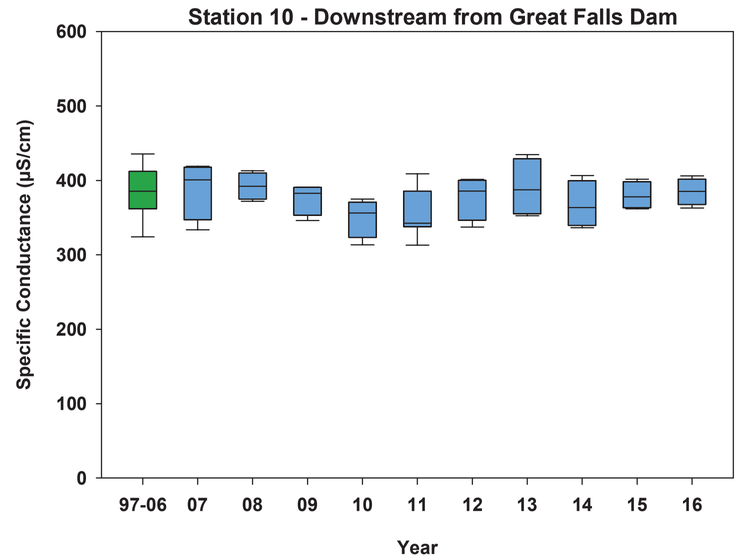


Figure B-30: Temperature, Water (°C) for Stations 1 to 10.

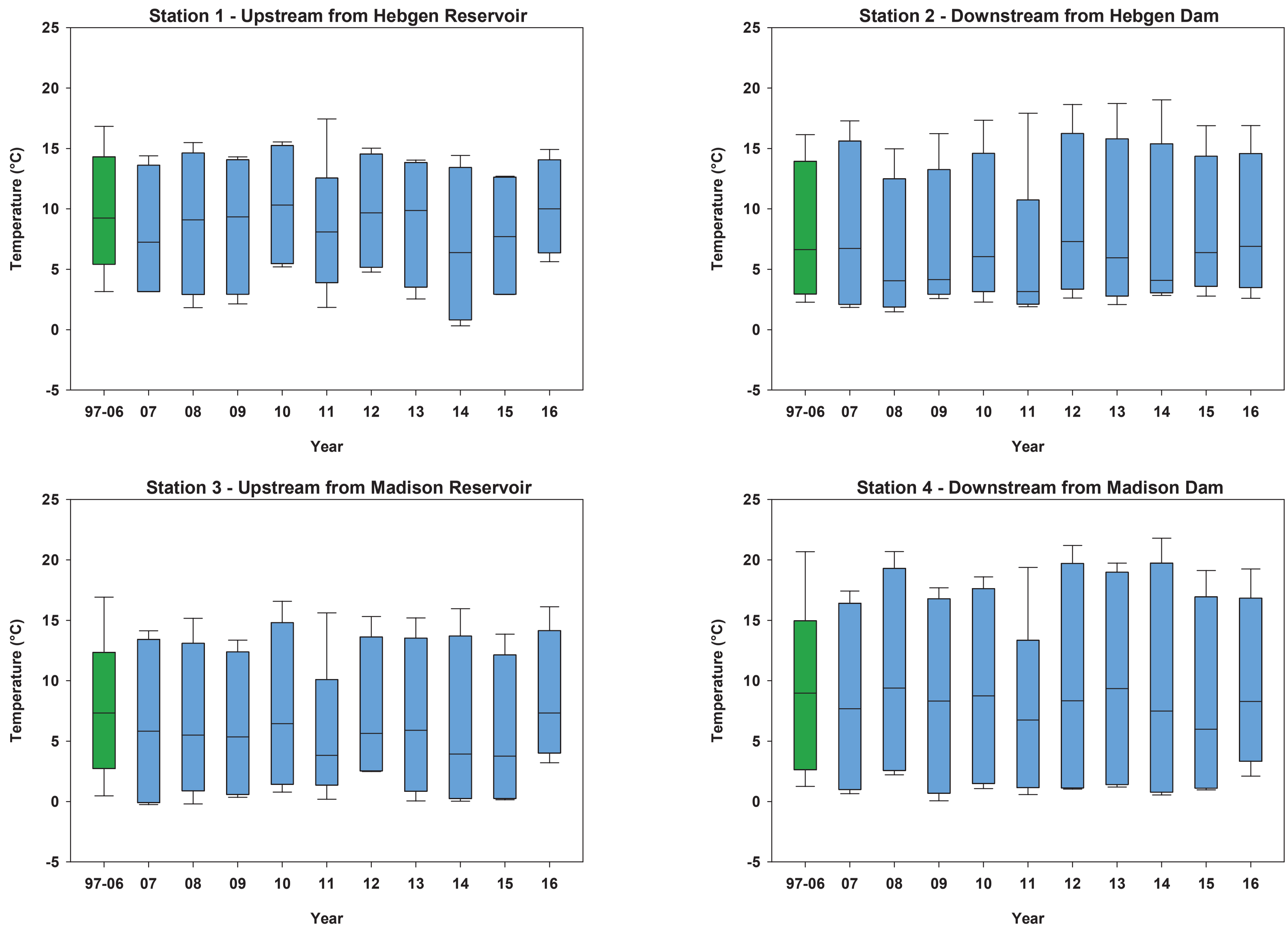
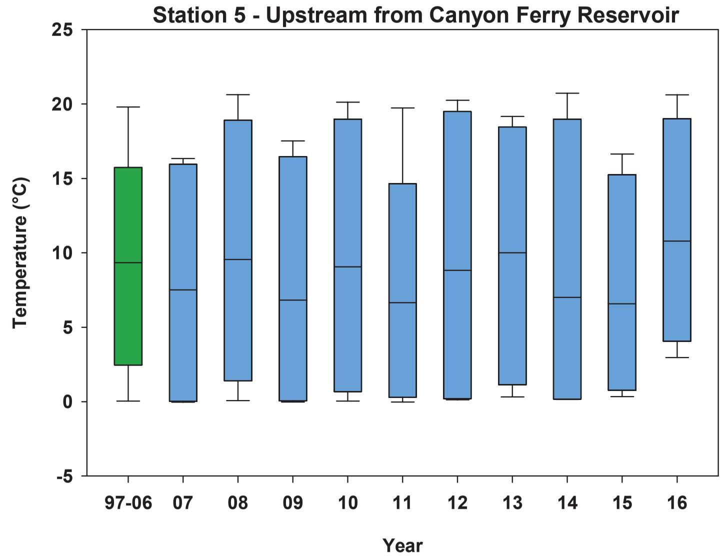
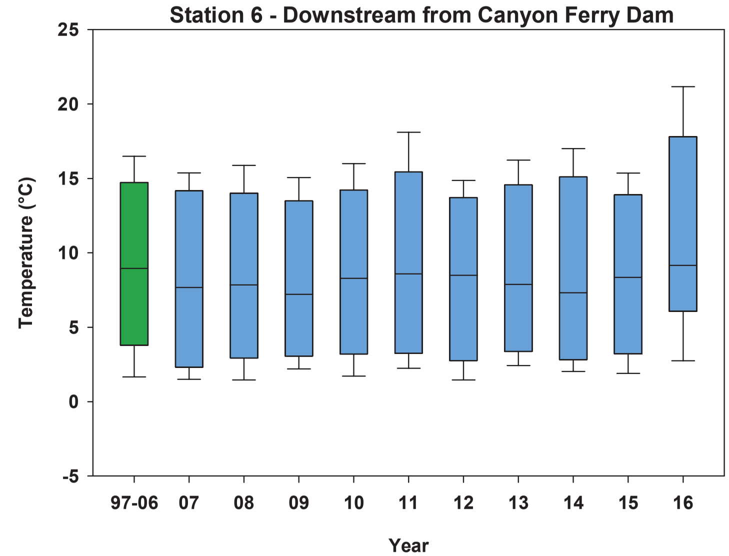
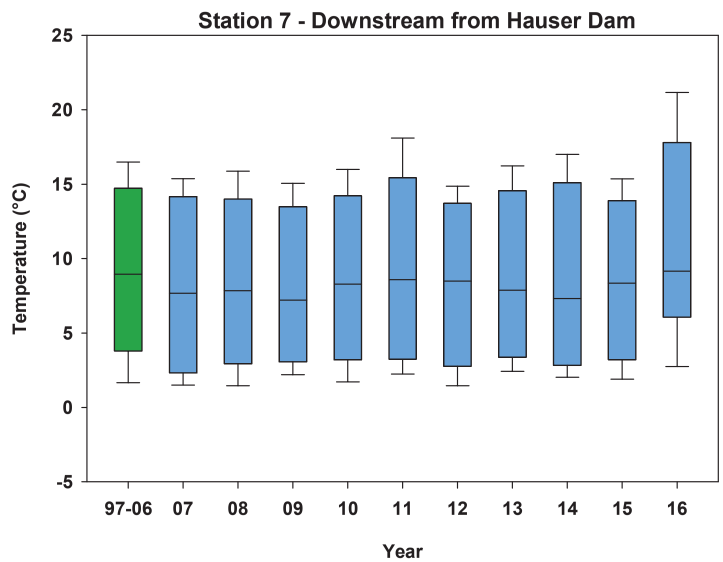


Figure B-30: Temperature, Water (°C) for Stations 1 to 10 (cont.).







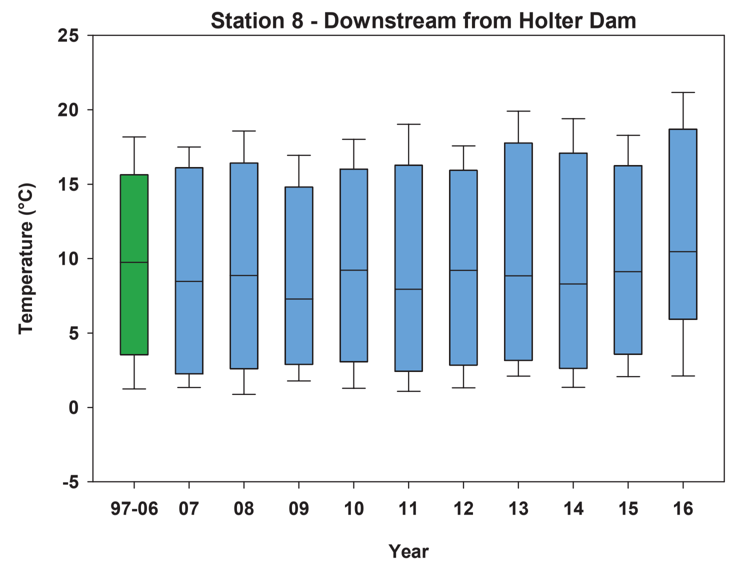
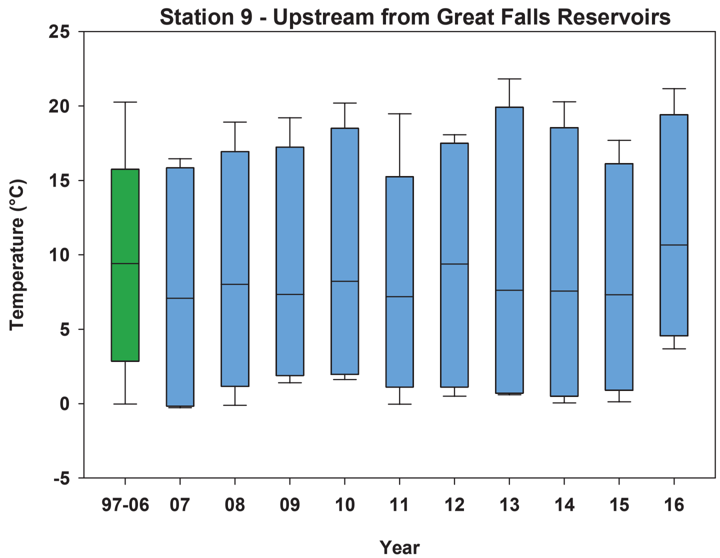


Figure B-30: Temperature, Water (°C) for Stations 1 to 10 (cont.).



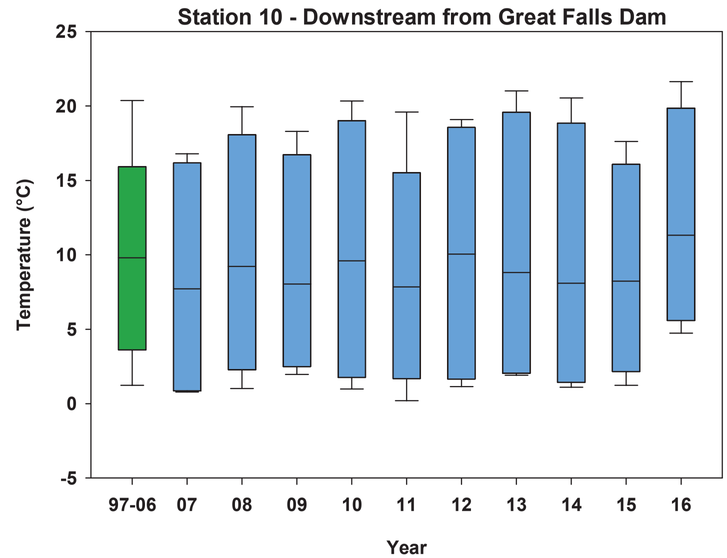


Figure B-31: Turbidity (NTU) for Stations 1 to 10.

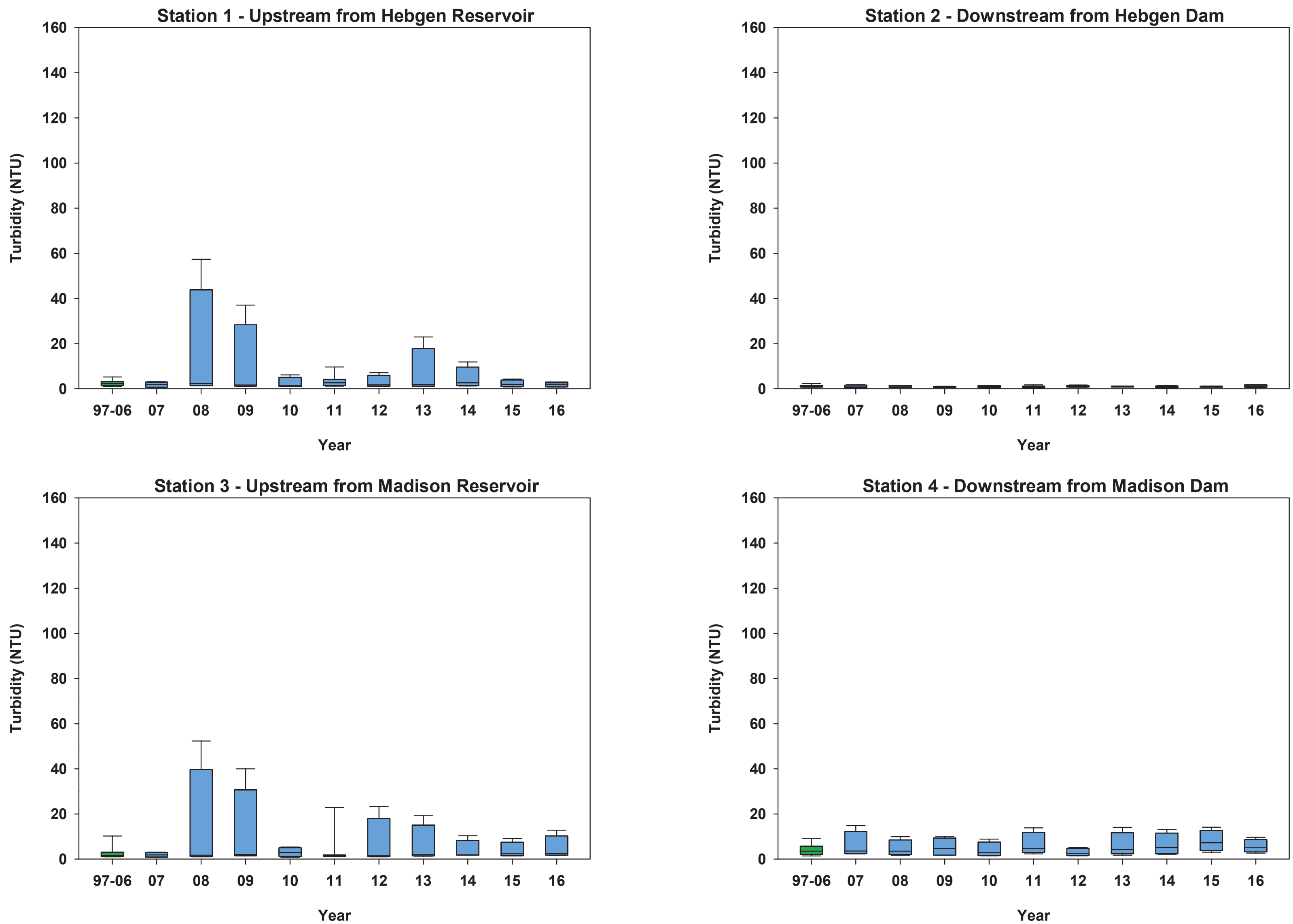


Figure B-31: Turbidity (NTU) for Stations 1 to 10 (cont.).

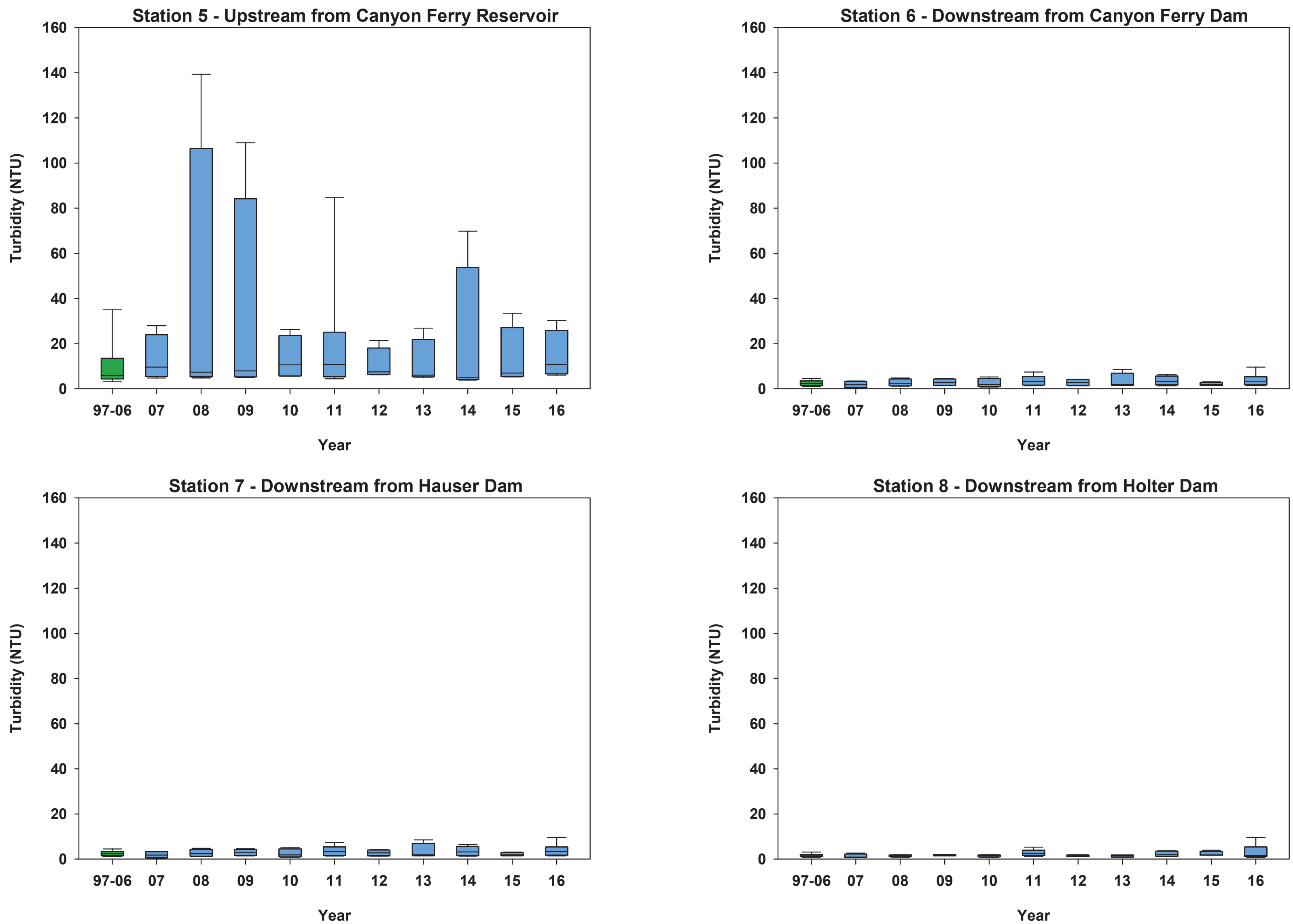
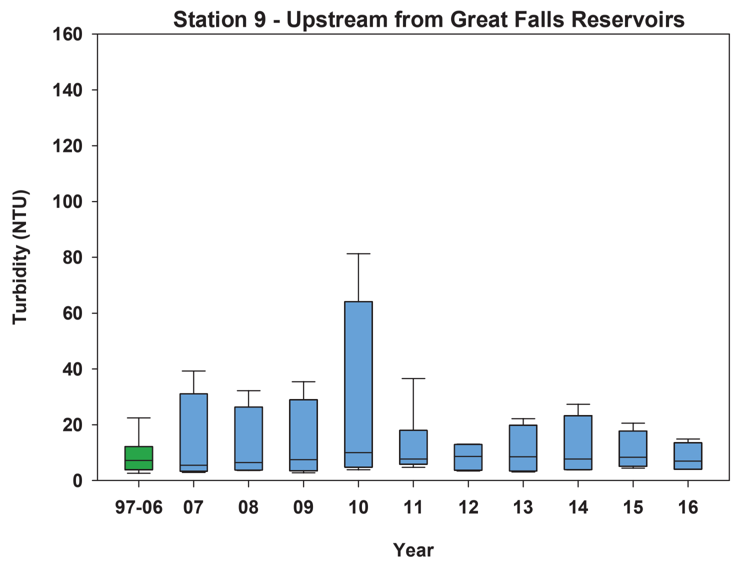
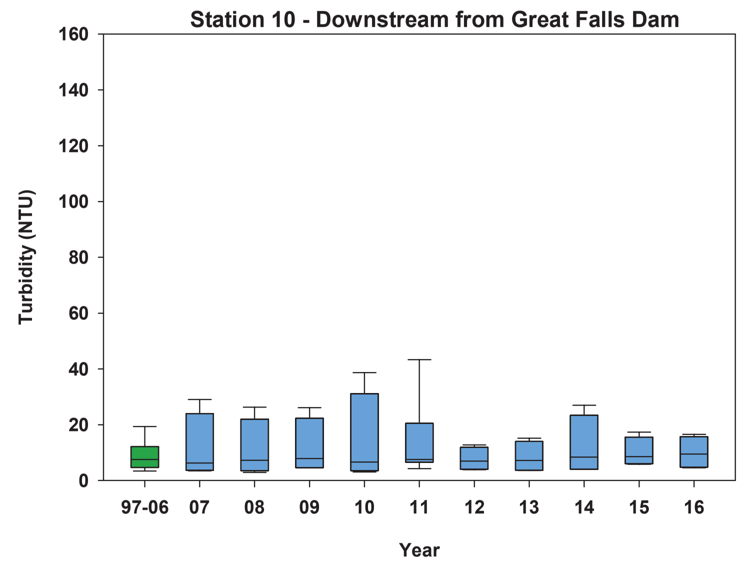


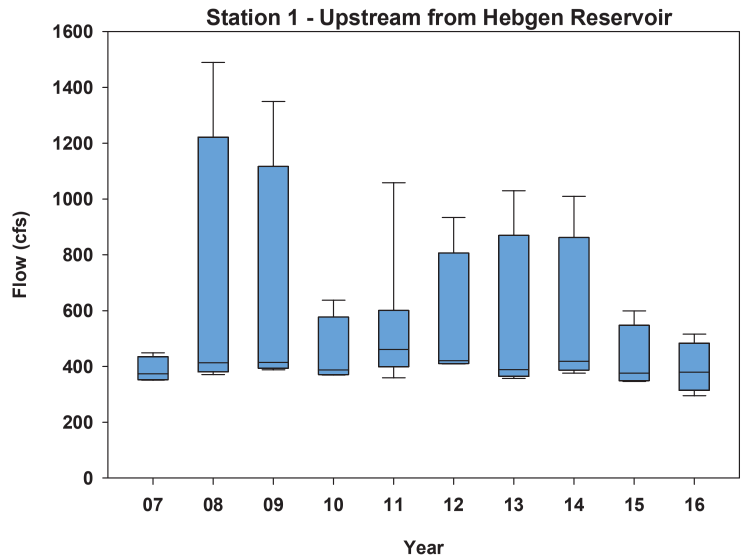
Figure B-31: Turbidity (NTU) for Stations 1 to 10 (cont.).

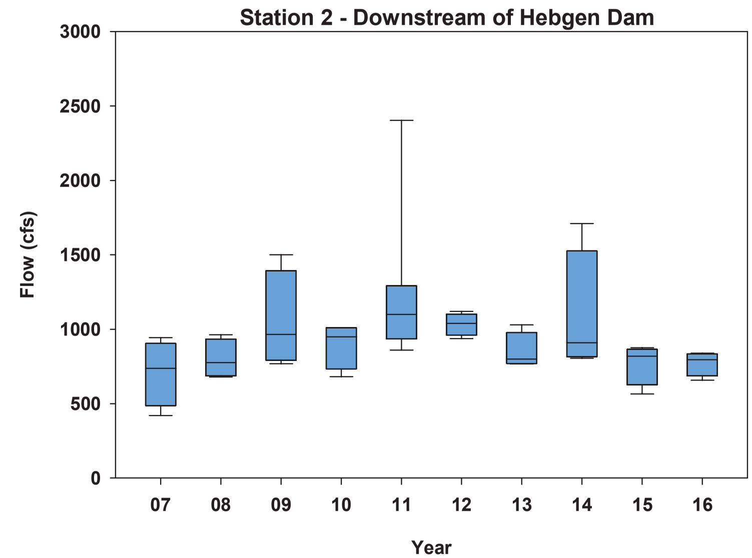


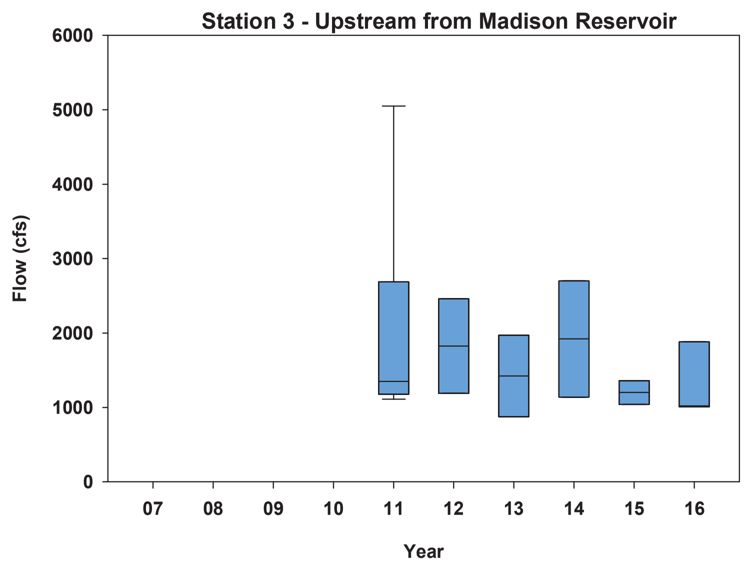


Appendix B.5 Flow-adjusted Temporal Graphs

Figure B-32: Flow (cfs) for Stations 1 to 10.







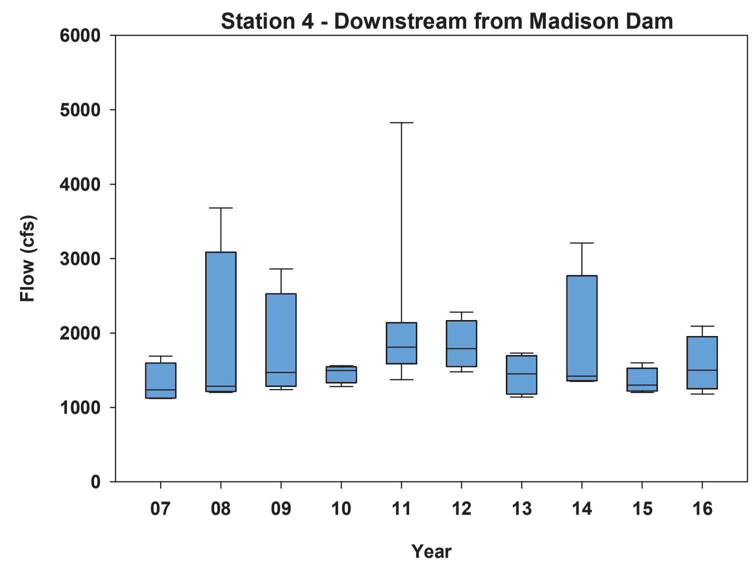
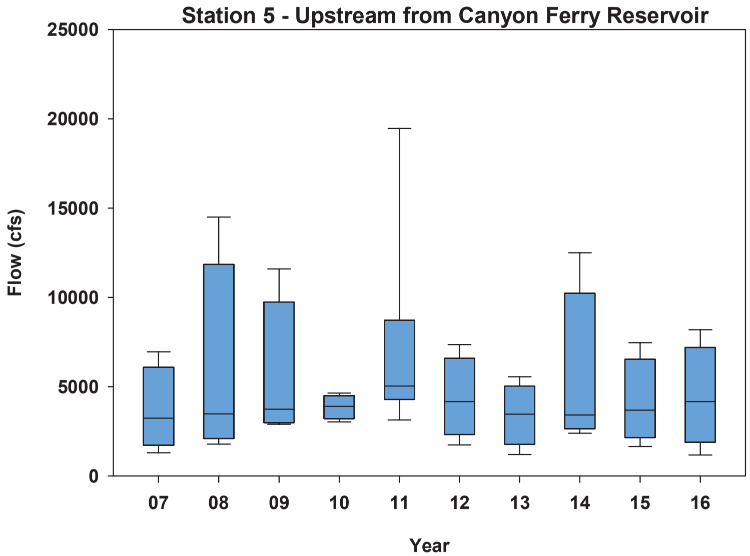
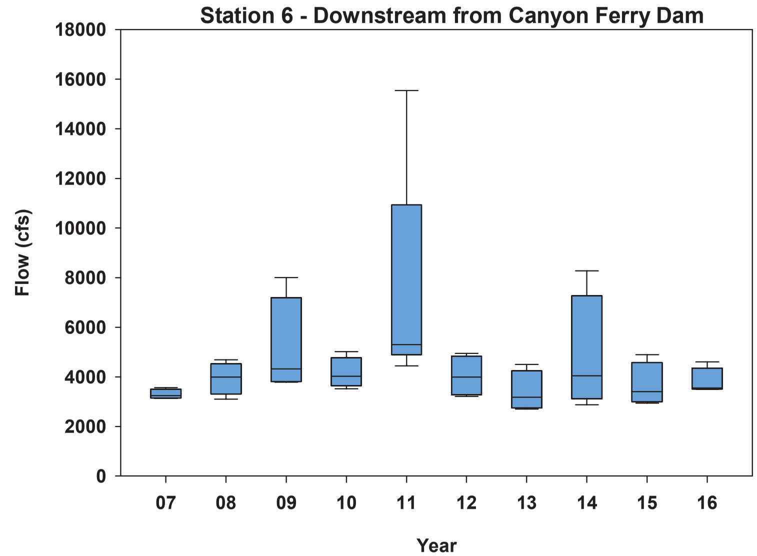
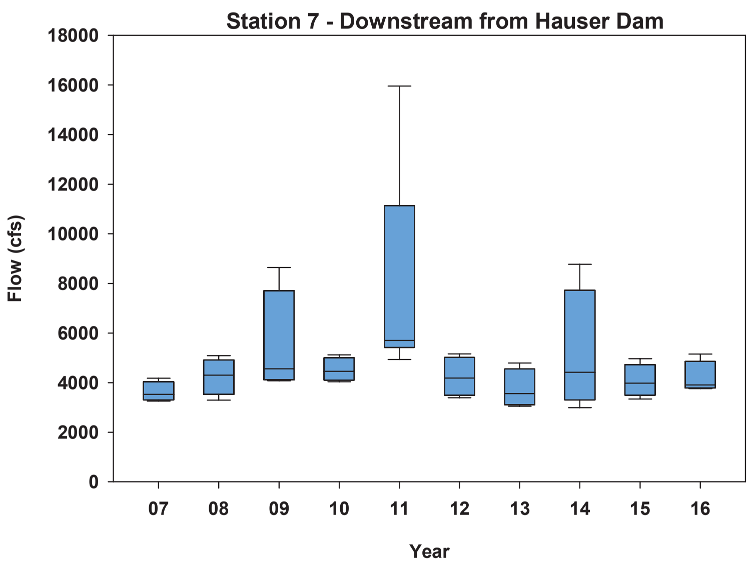


Figure B-32: Flow (cfs) for Stations 1 to 10 (cont.).







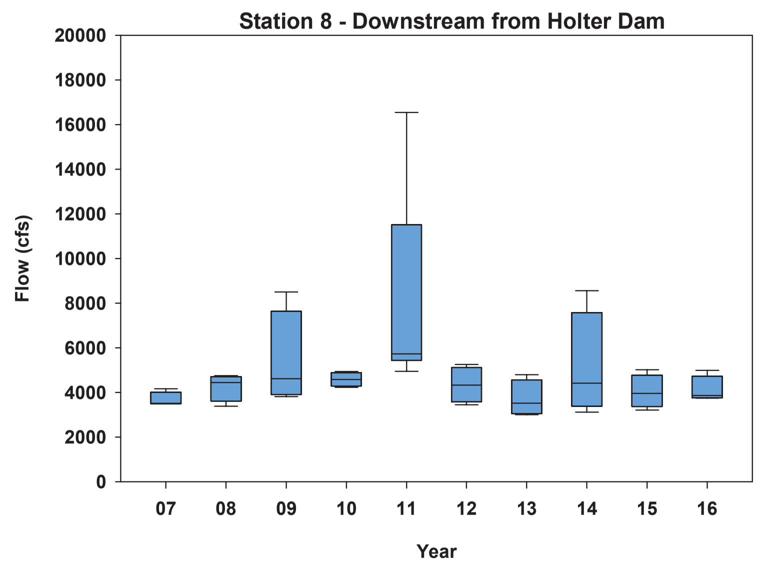
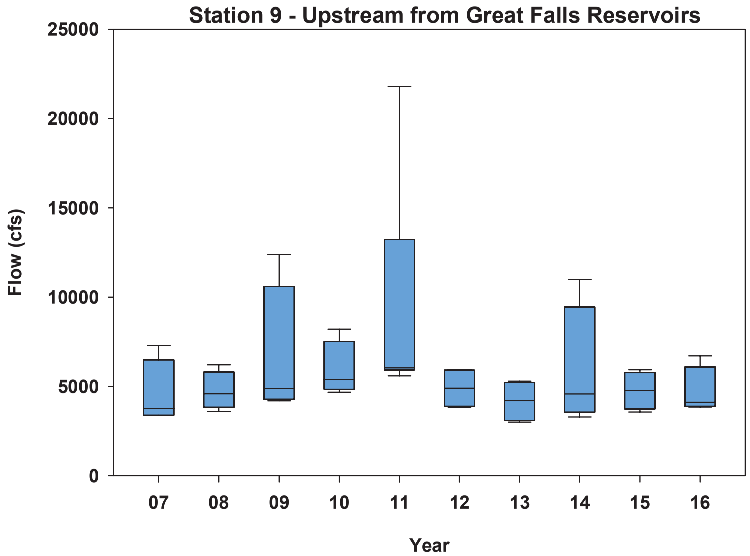


Figure B-32: Flow (cfs) for Stations 1 to 10 (cont.).



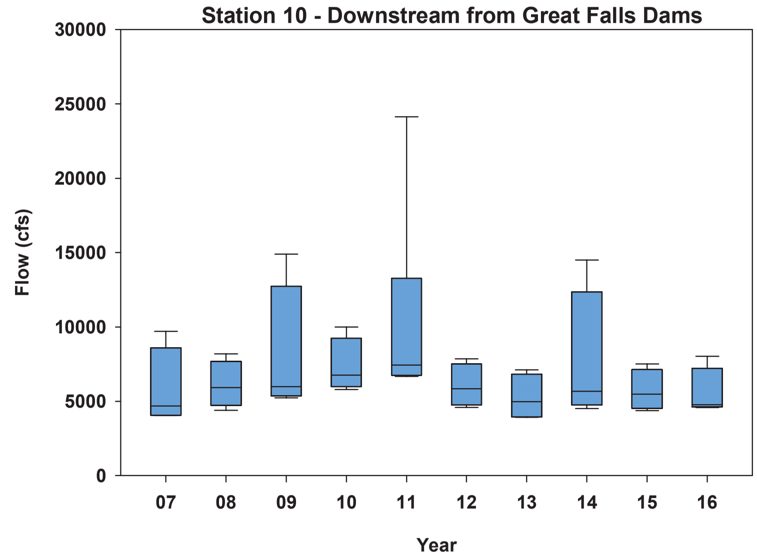
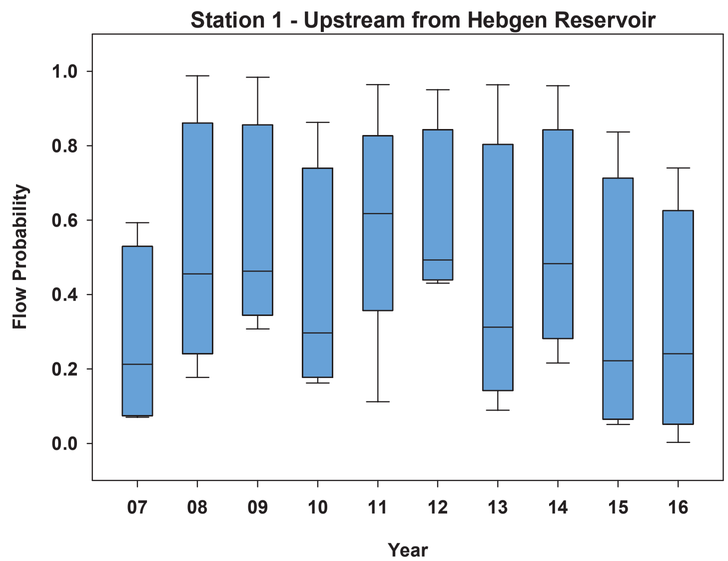
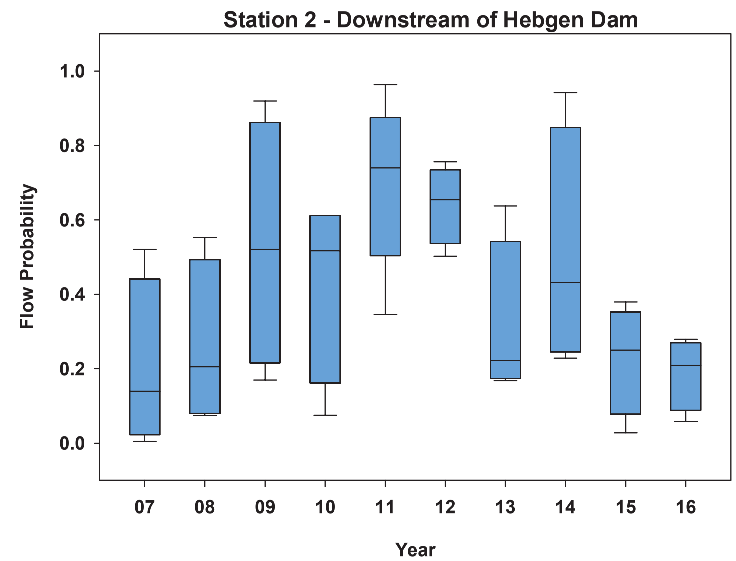
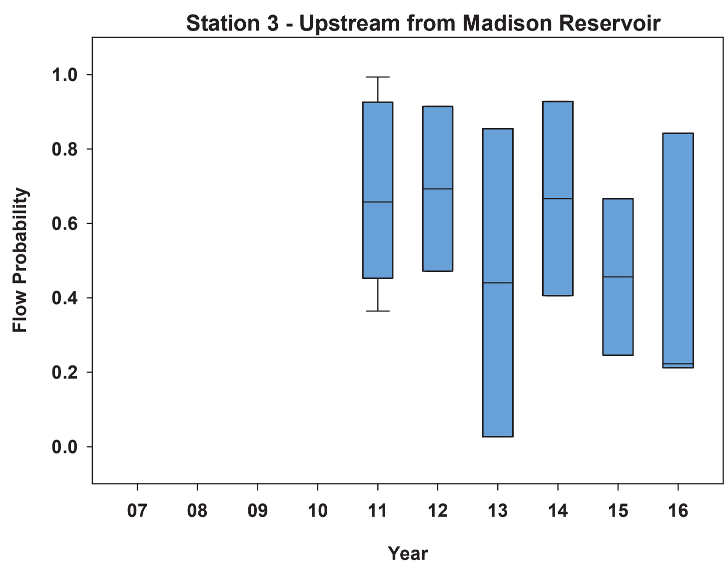


Figure B-33: Flow Probability for Stations 1 to 10.







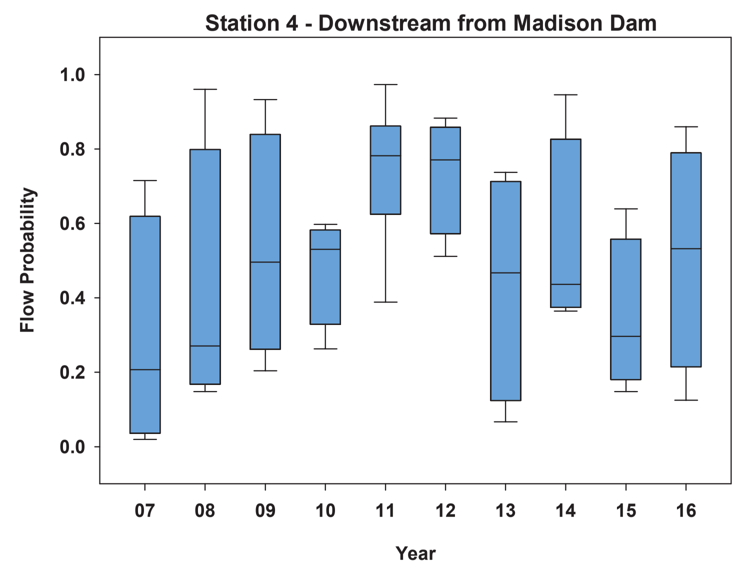


Figure B-33: Flow Probability for Stations 1 to 10 (cont.).

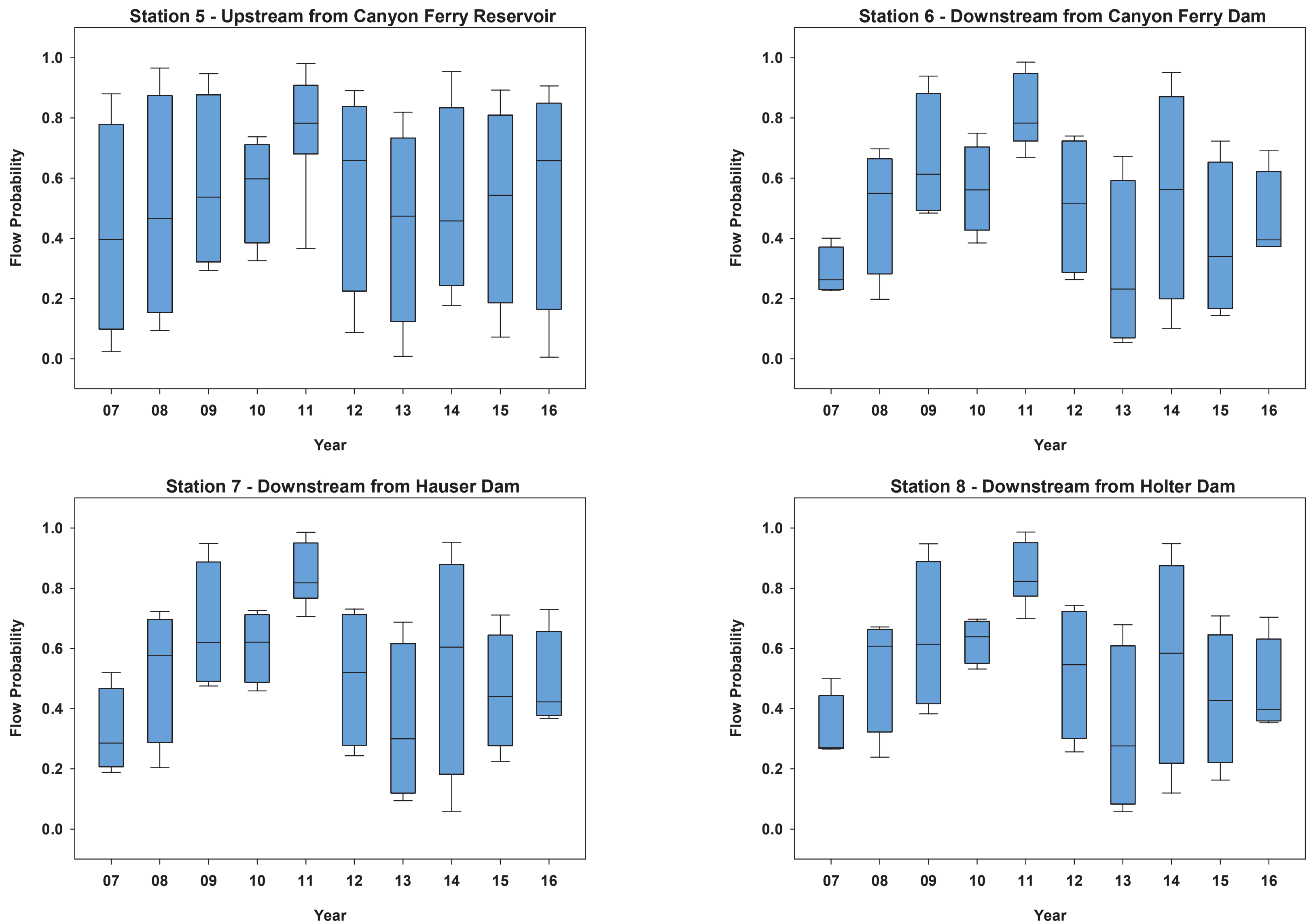
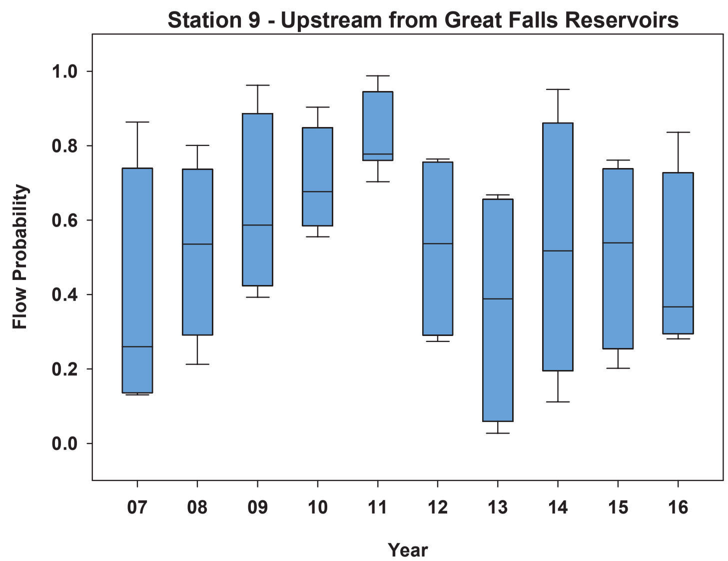


Figure B-33: Flow Probability for Stations 1 to 10 (cont.).



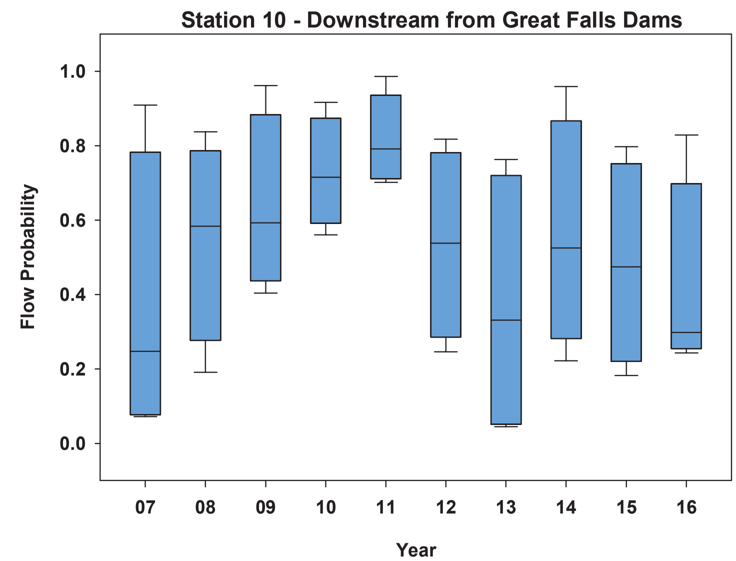


Figure B-34: Specific Conductivity, Flow Adjusted, ln (mg/L) for Stations 1 to 10.

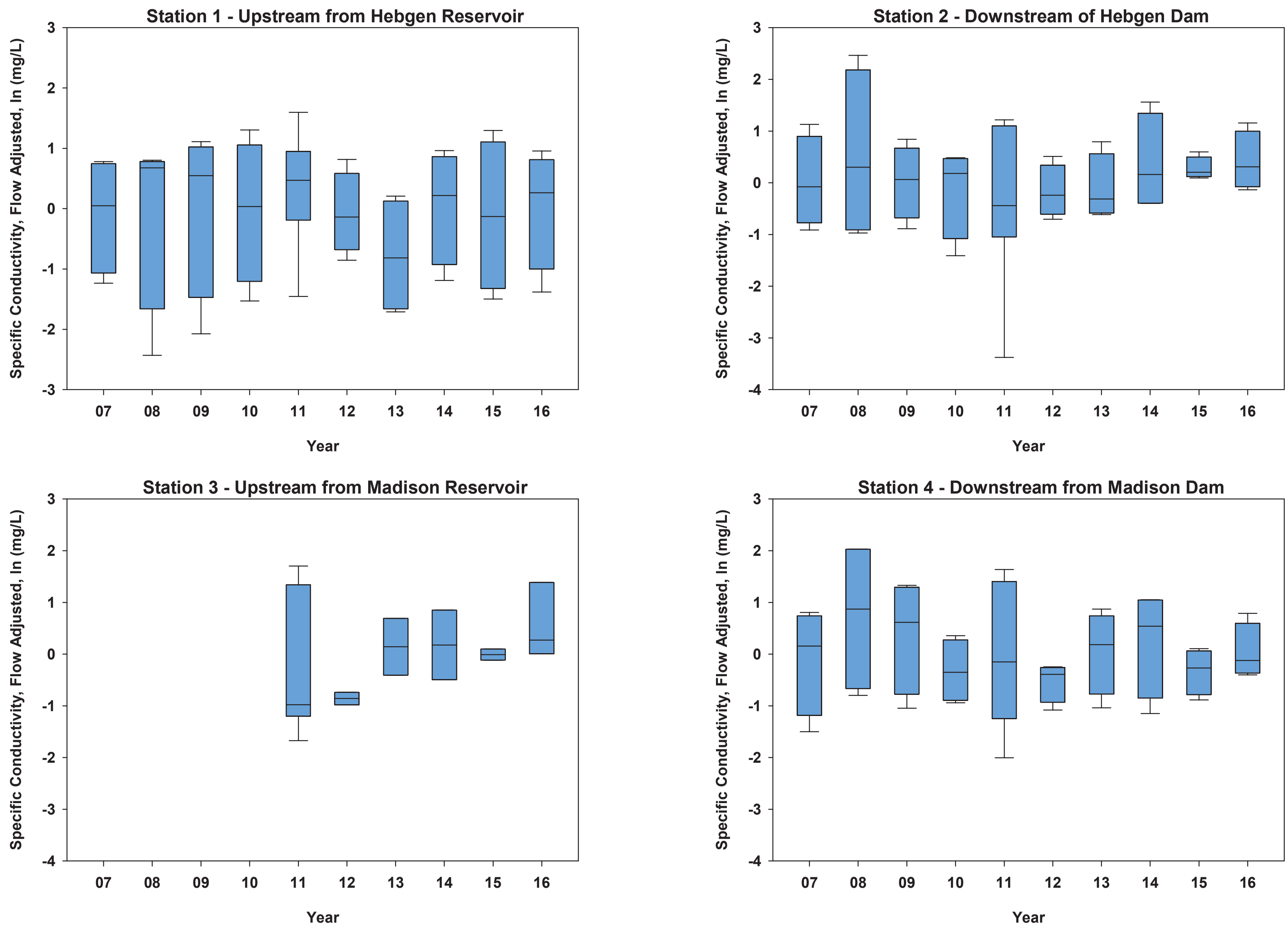
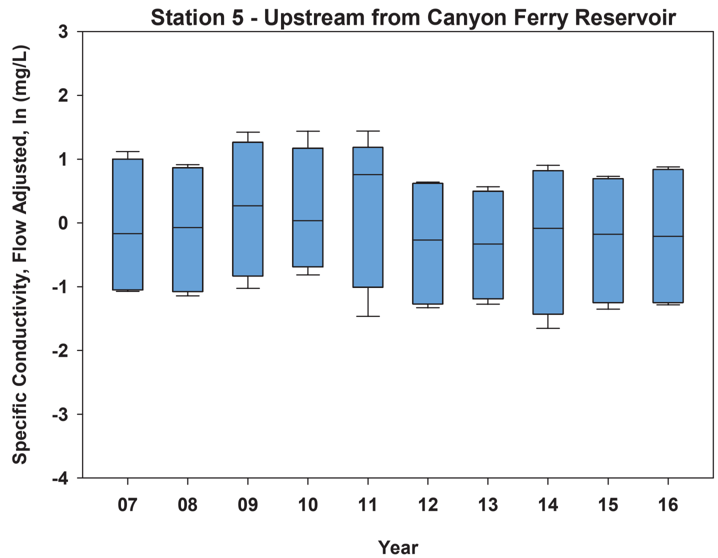
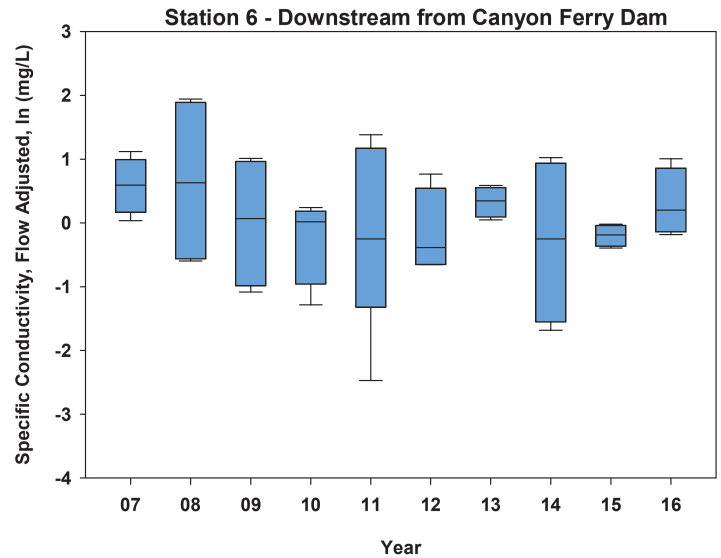
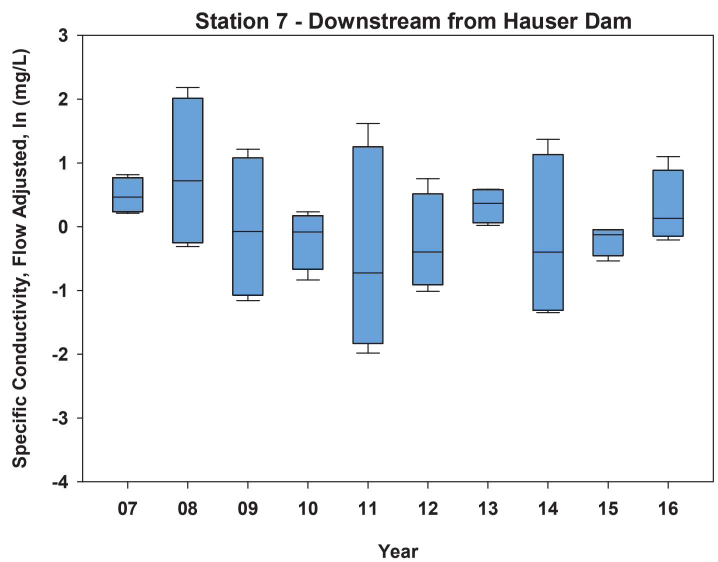


Figure B-34: Specific Conductivity, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).







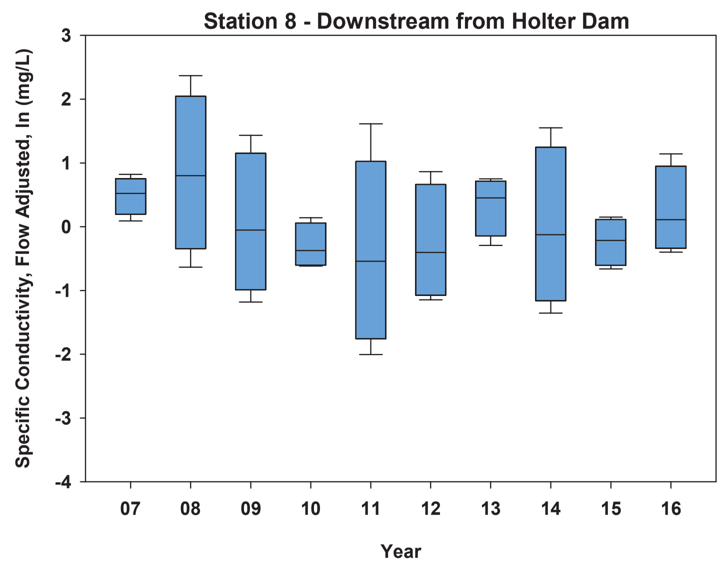
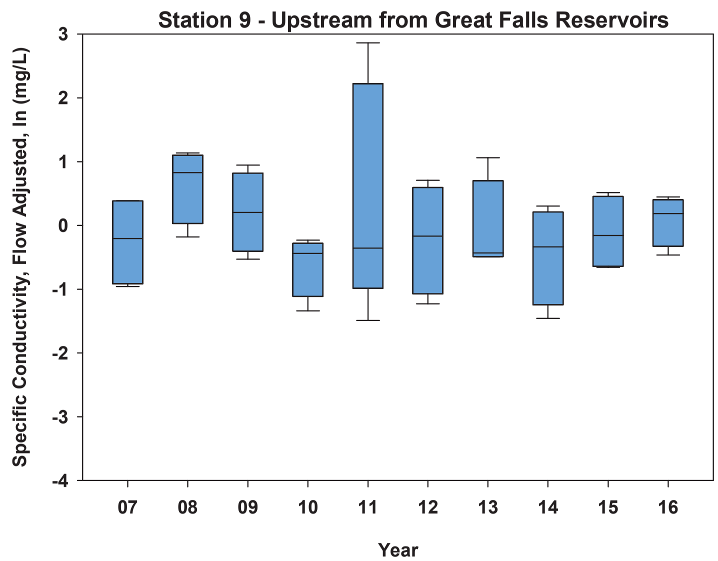


Figure B-34: Specific Conductivity, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).



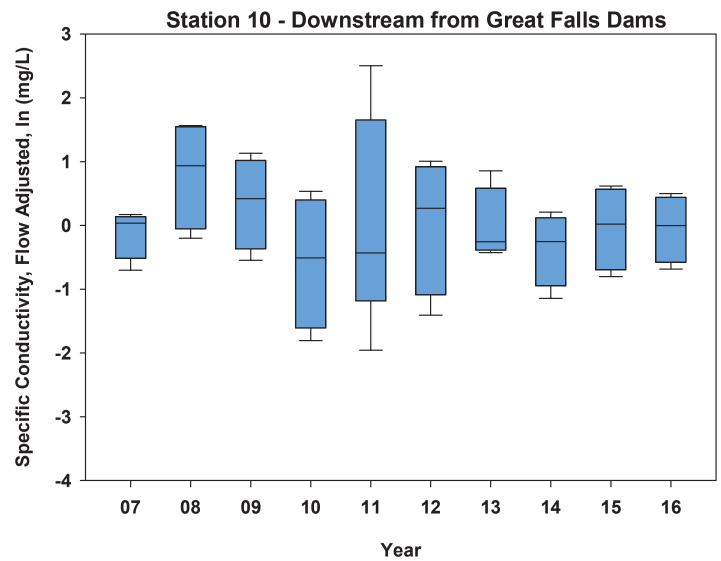


Figure B-35: Calcium, Total, Flow Adjusted, In (mg/L) for Stations 1 to 10.

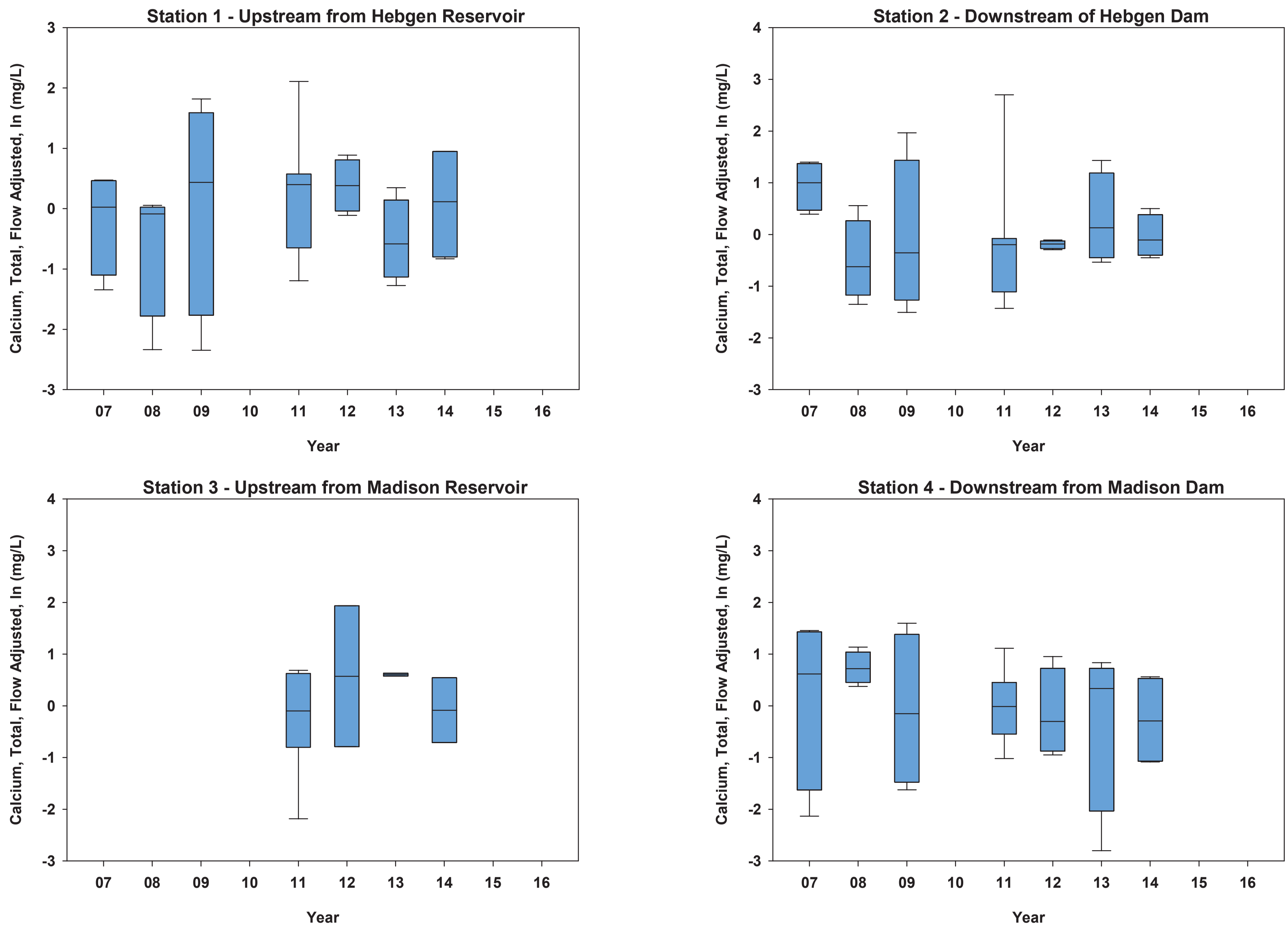
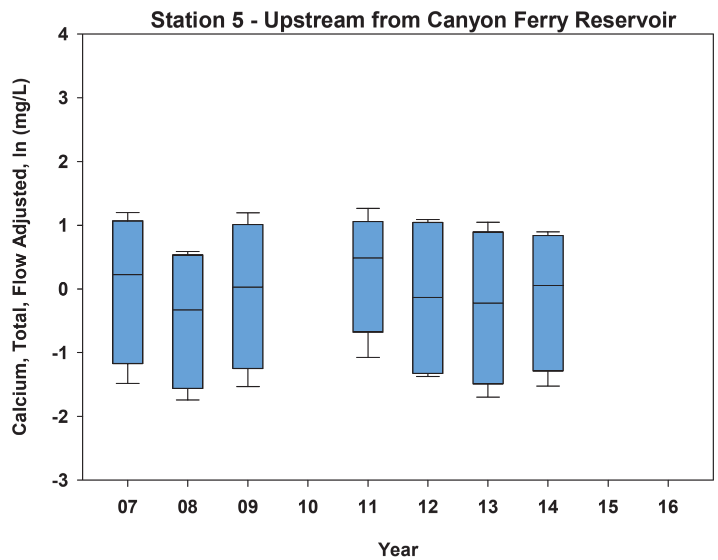
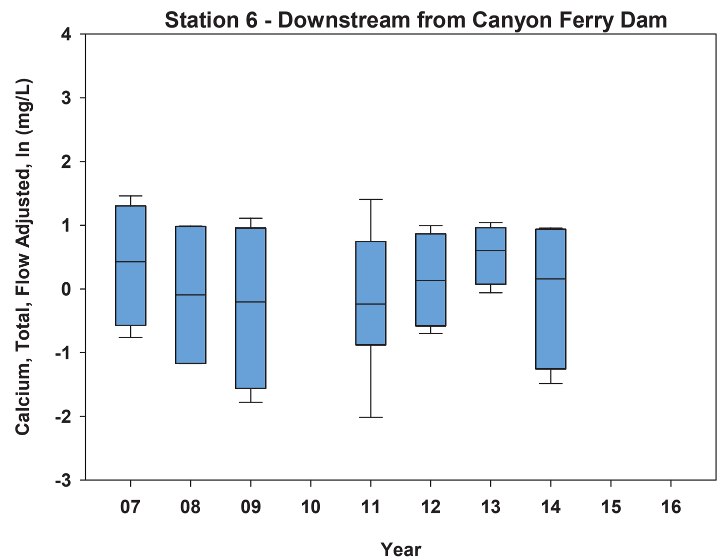
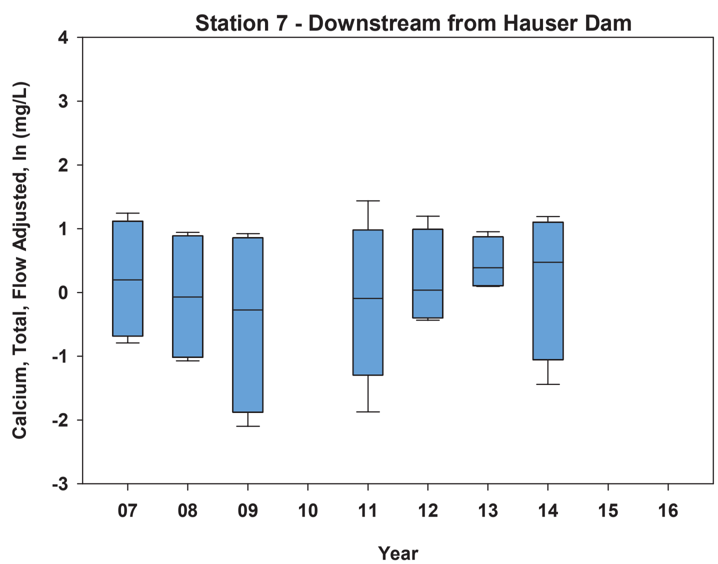


Figure B-35: Calcium, Total, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).







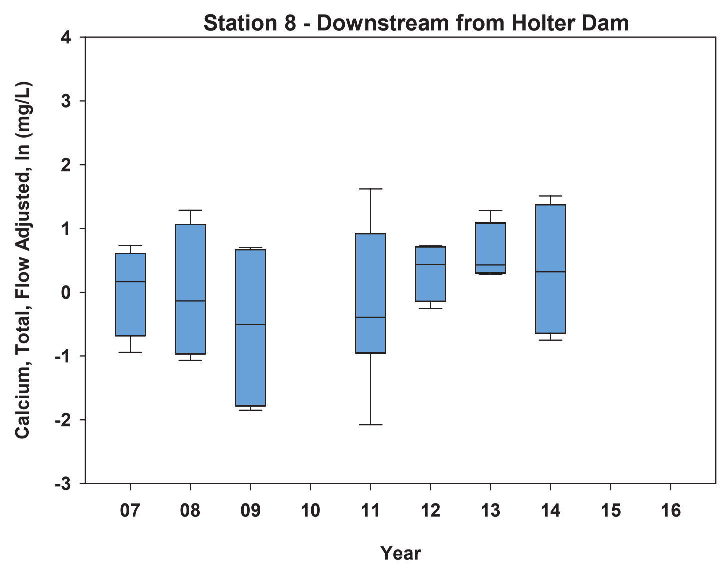
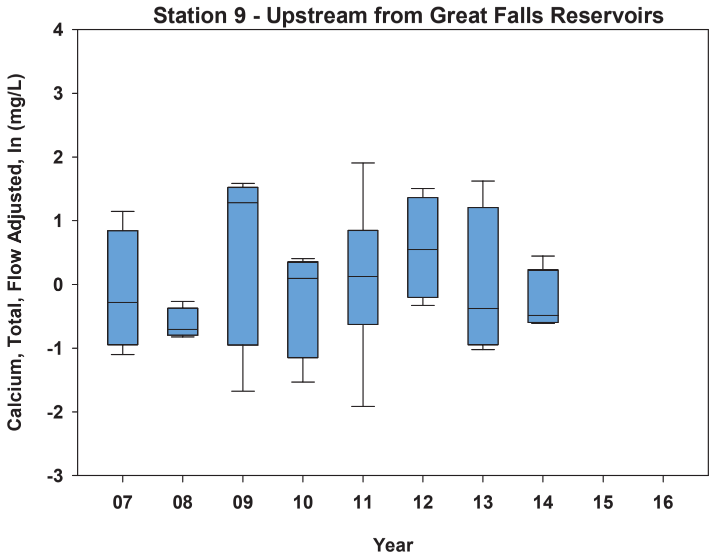


Figure B-35: Calcium, Total, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).



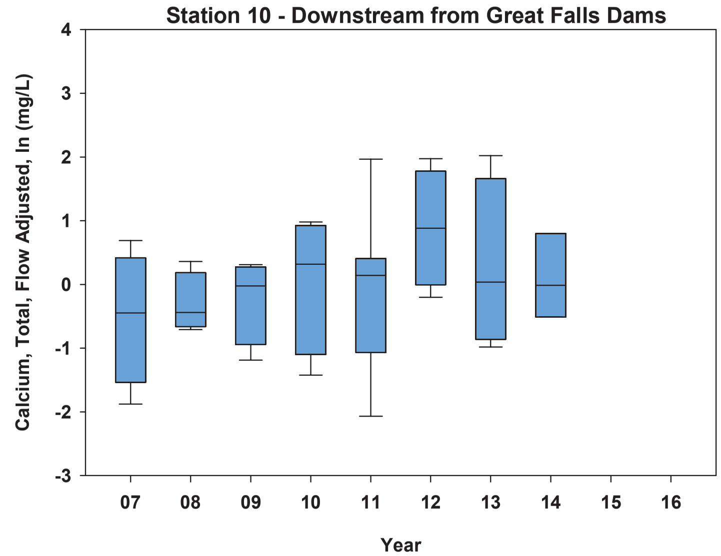


Figure B-36: Chloride, Flow Adjusted, ln (mg/L) for Stations 1 to 10.

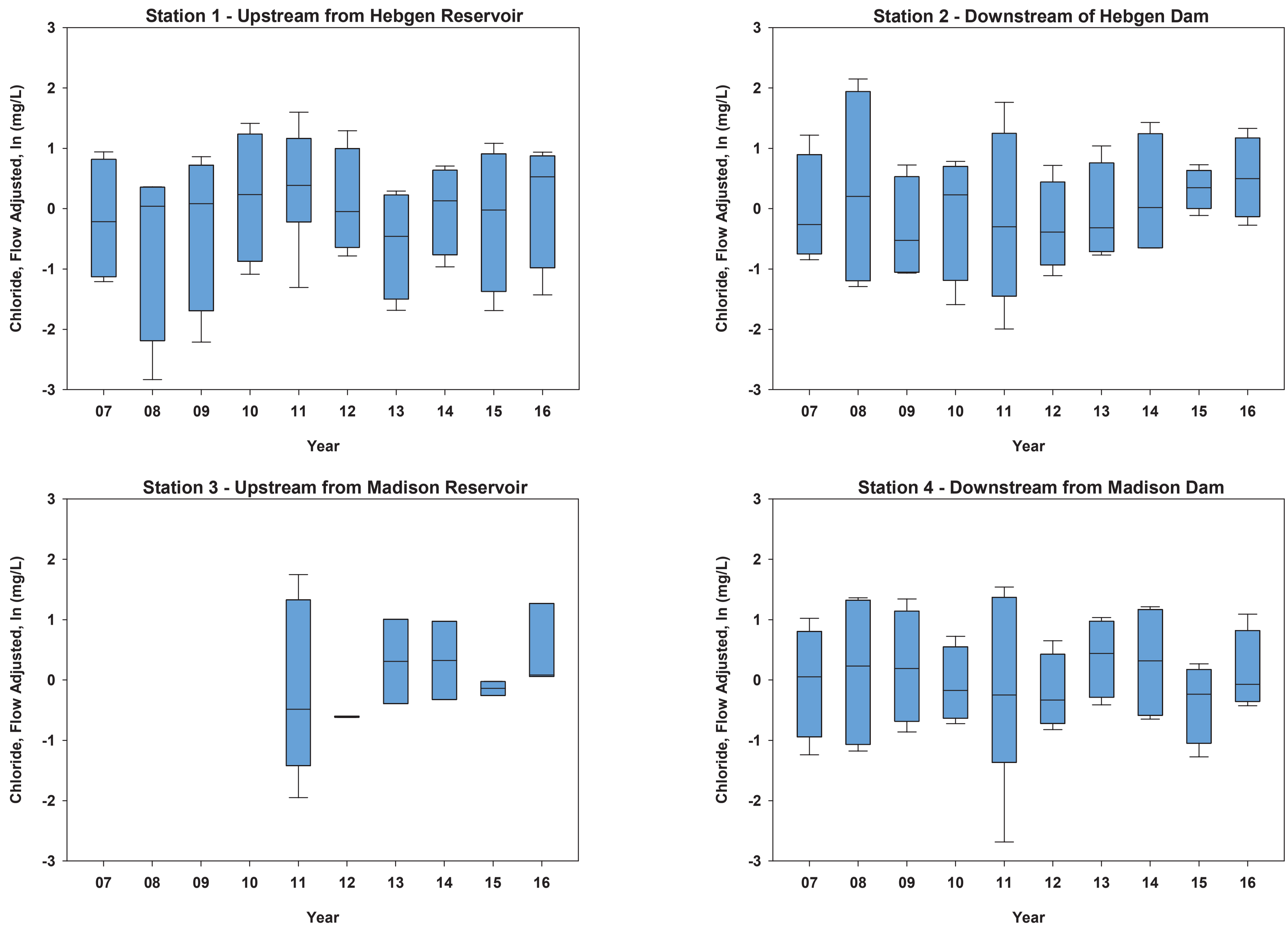


Figure B-36: Chloride, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).

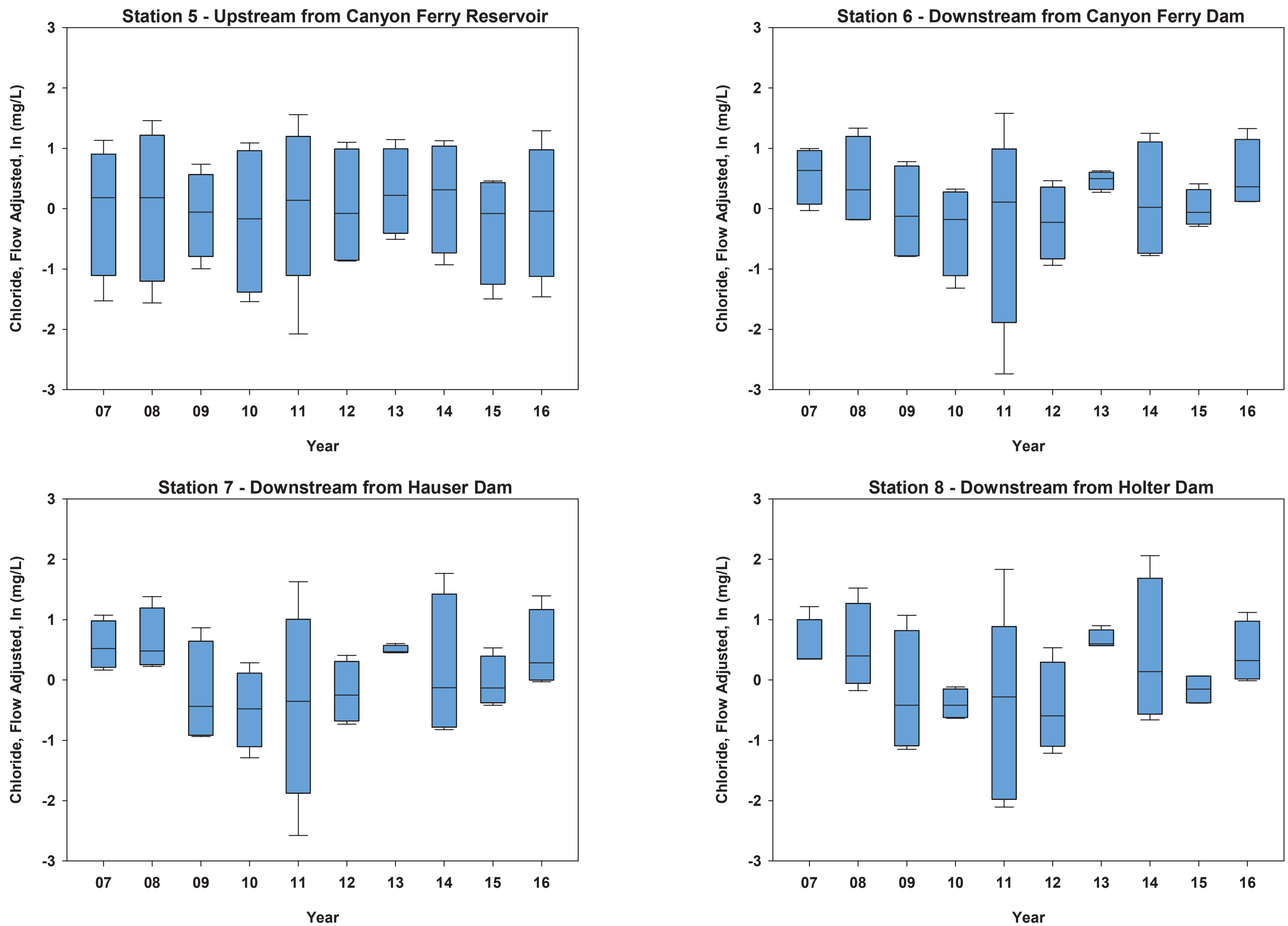
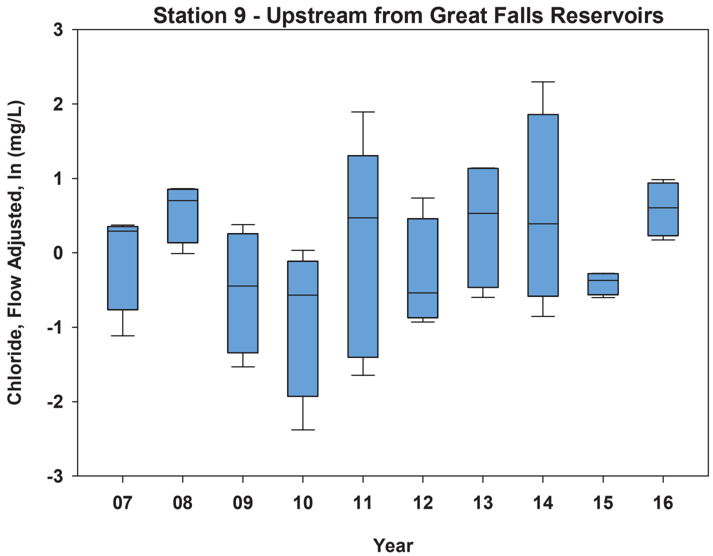


Figure B-36: Chloride, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).



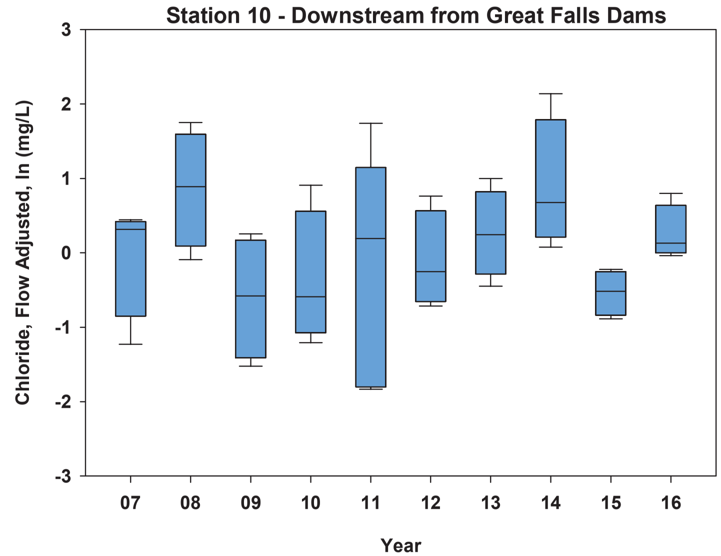


Figure B-37: Sodium, Flow Adjusted, ln (mg/L) for Stations 1 to 10.

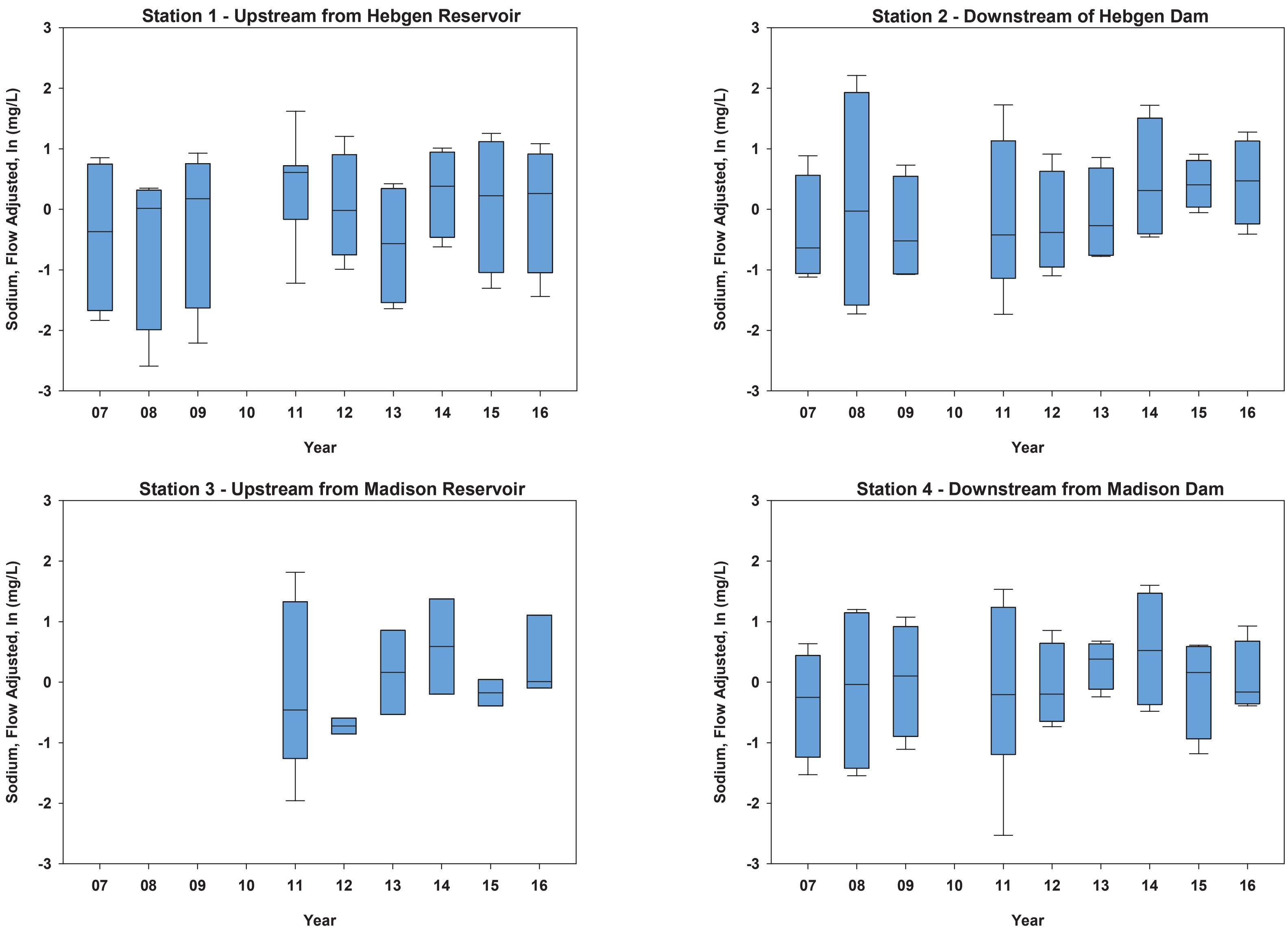
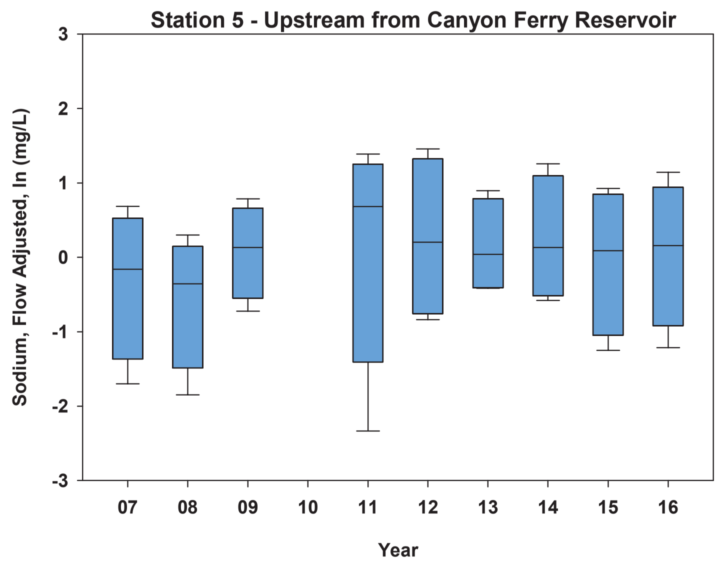
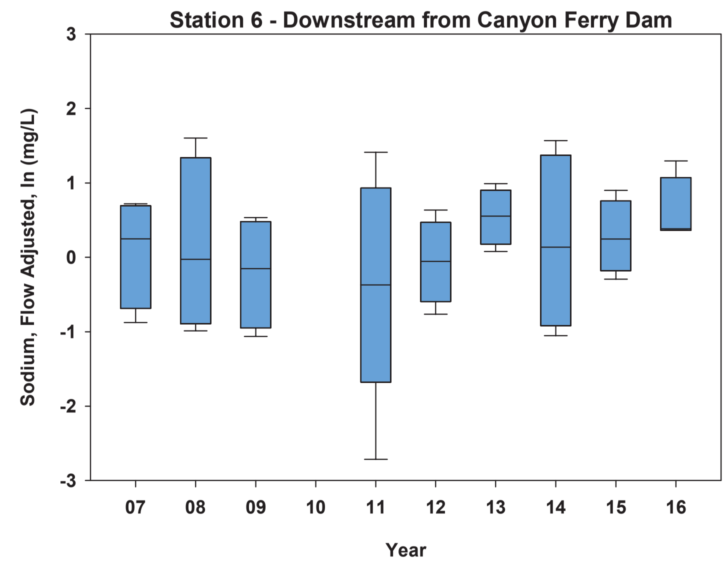
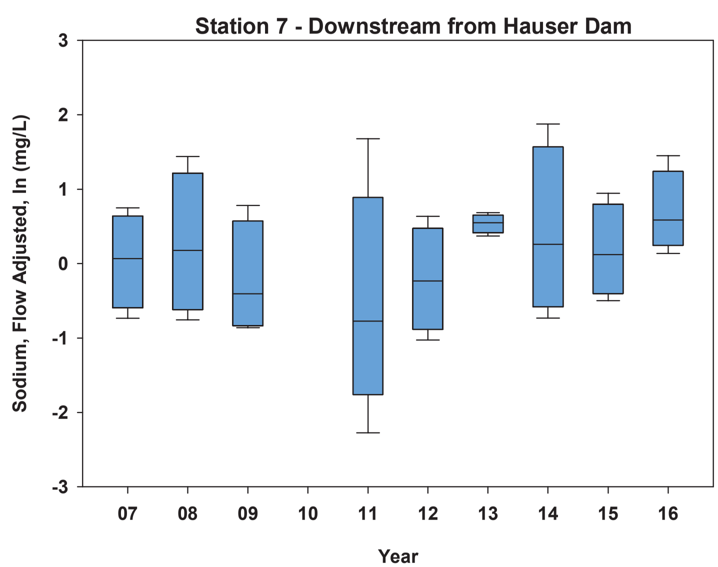


Figure B-37: Sodium, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).







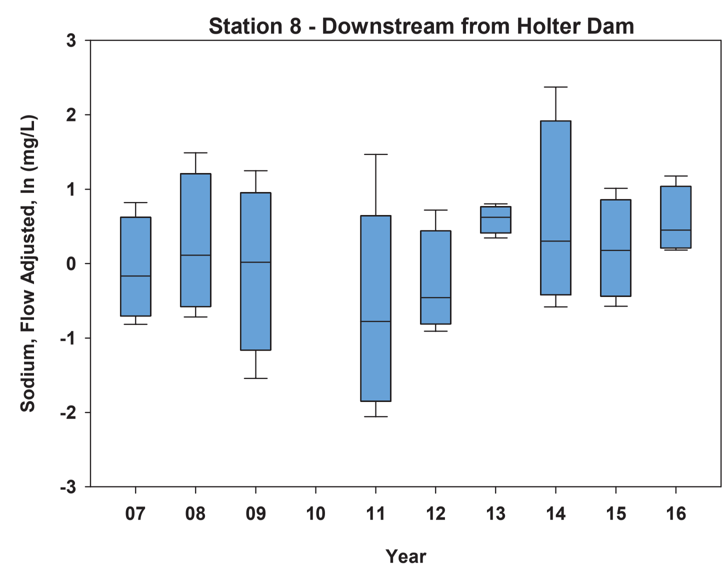
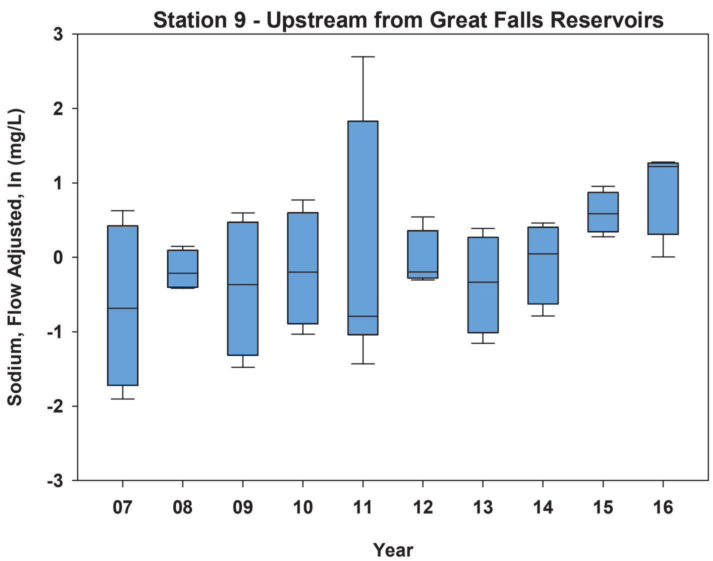


Figure B-37: Sodium, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).



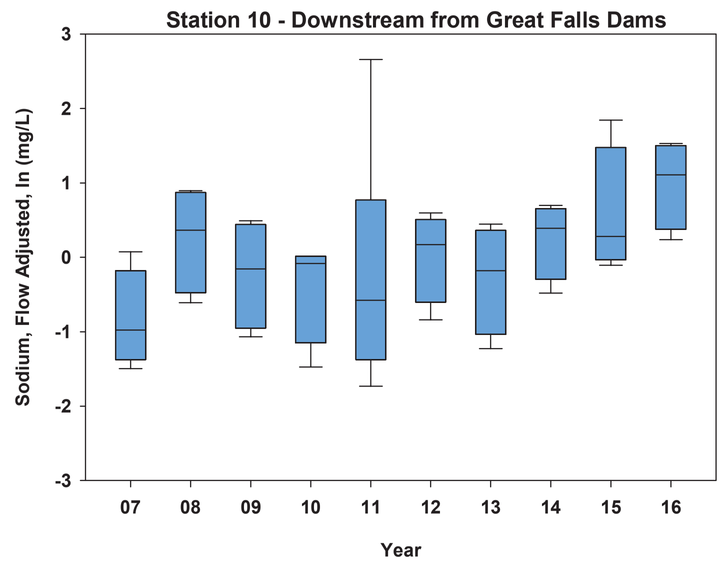


Figure B-38: Arsenic, Total, Flow Adjusted, ln (mg/L) for Stations 1 to 10.

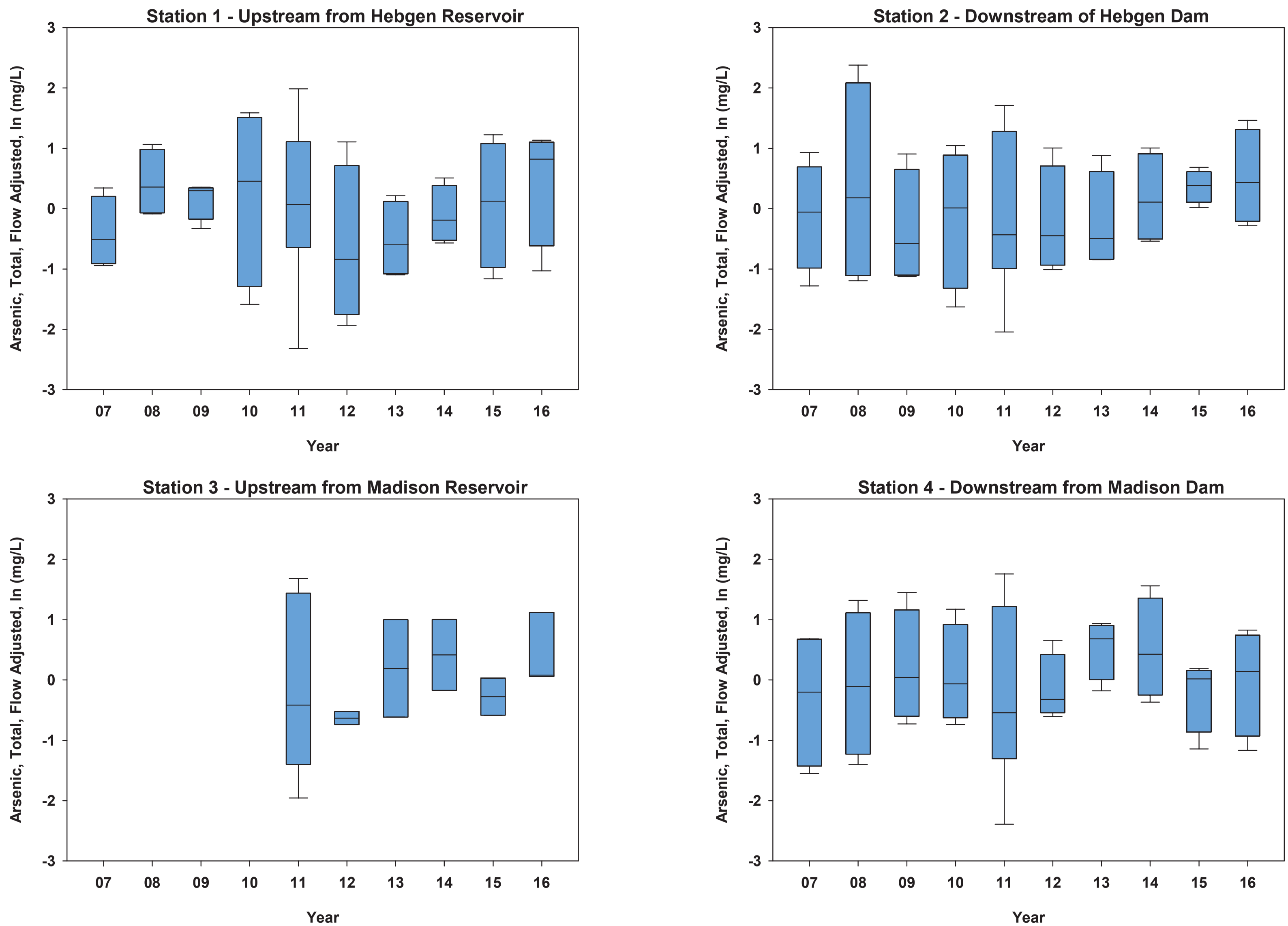
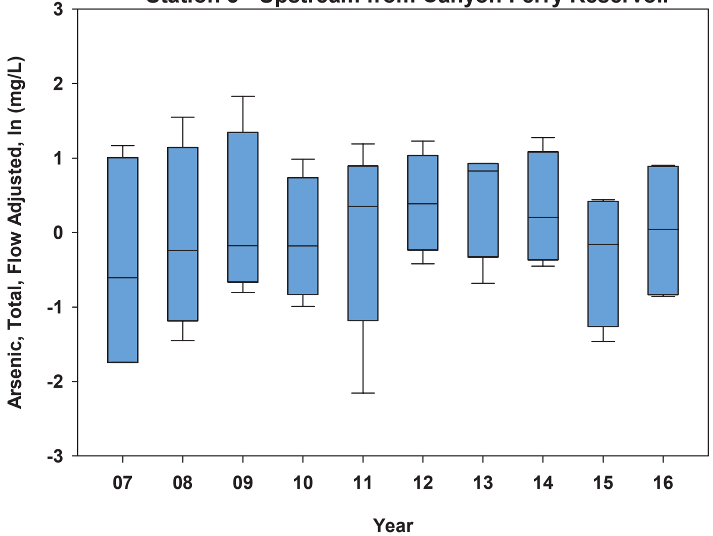
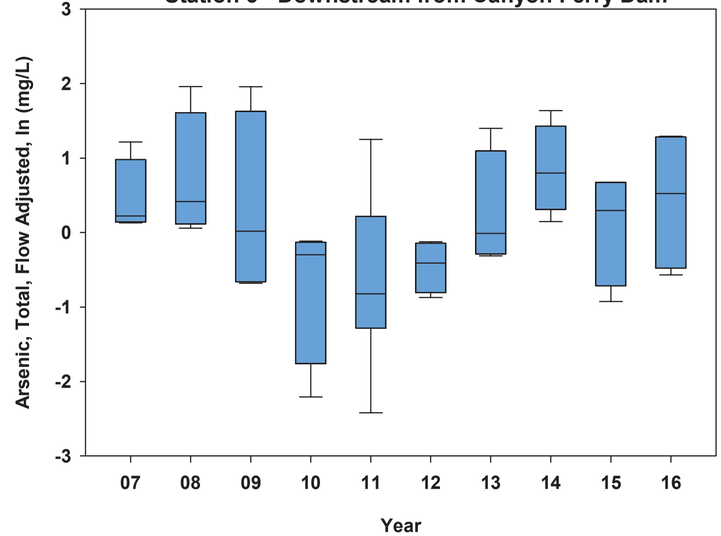


Figure B-38: Arsenic, Total, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).

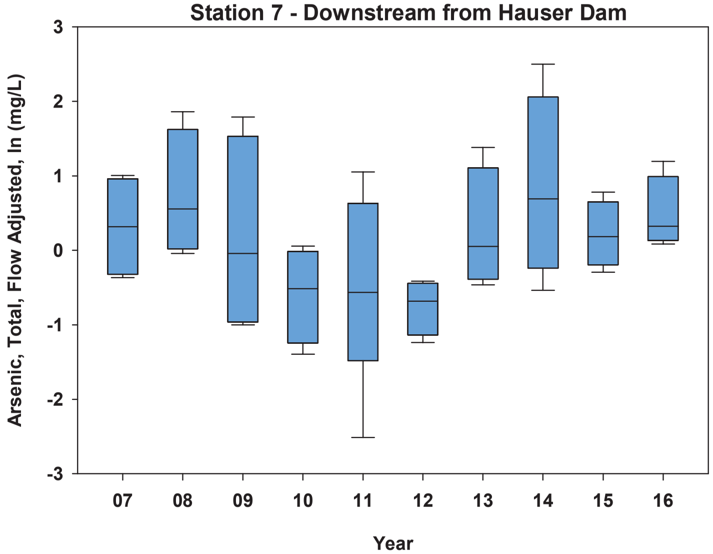
Station 5 - Upstream from Canyon Ferry Reservoir



Station 6 - Downstream from Canyon Ferry Dam



Station 7 - Downstream from Hauser Dam



Station 8 - Downstream from Holter Dam

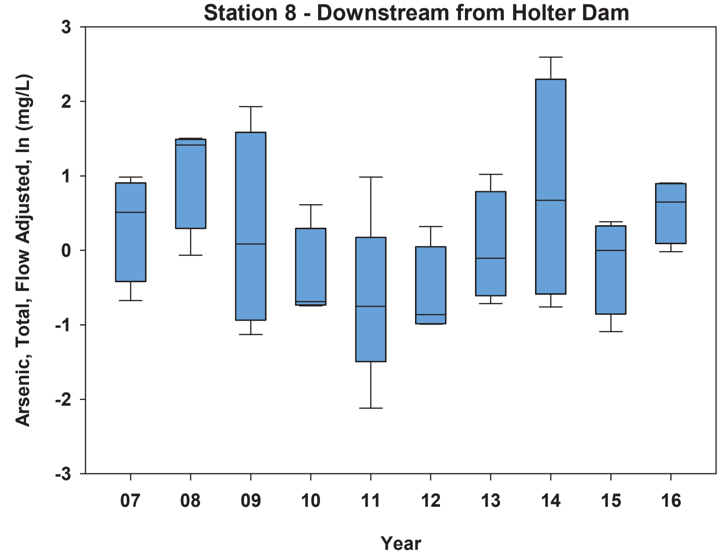
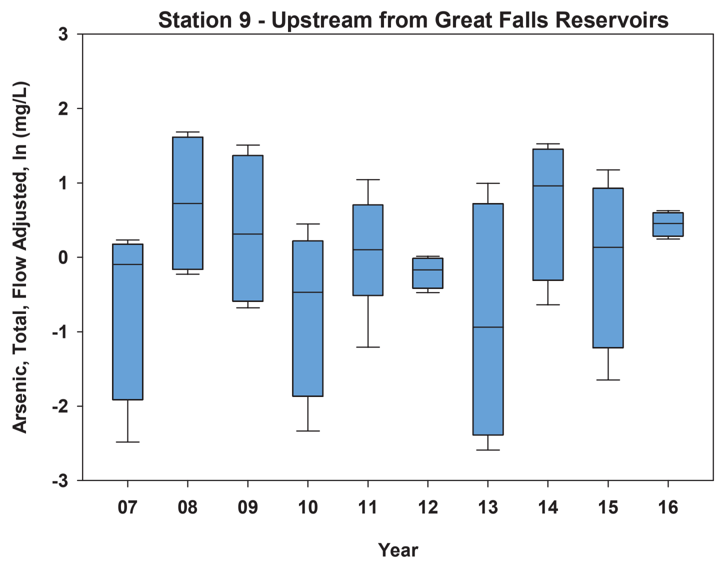
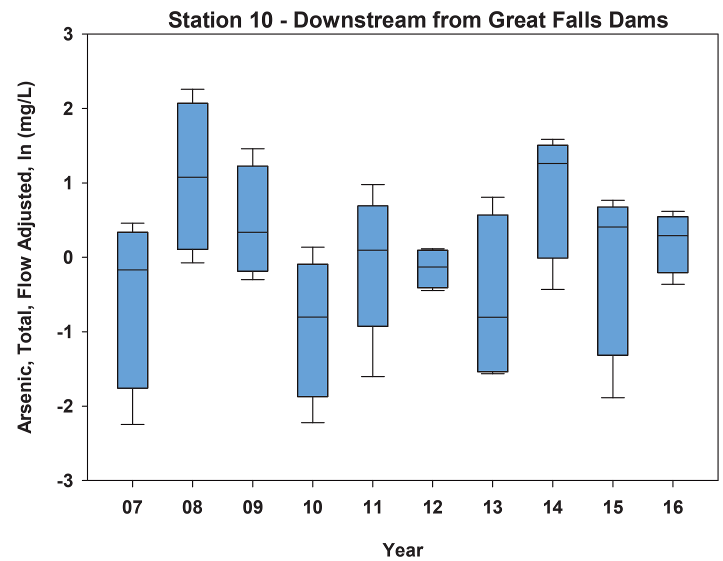


Figure B-38: Arsenic, Total, Flow Adjusted, ln (mg/L) for Stations 1 to 10 (cont.).





Appendix C Chlorophyll-a

Appendix C.1 Descriptive Statistics

Table C-1: Chlorophyll-a (mg/m^2) descriptive statistics of replicate samples in August at Station B-1.

Year	Sample Type	N	Minimum	Maximum	Mean	Standard Deviation
2007	Scrape	10	3.1	41.3	20.4	11.2
	Whole Rock	4	31.0	46.0	37.8	6.2
2008	Scrape	10	11.9	57.5	30.4	15.7
	Whole Rock	4	56.0	105.0	81.0	20.7
2009	Scrape	10	5.0	44.4	18.7	13.4
	Whole Rock	4	44.0	69.0	54.0	11.9
2010	Whole Rock	9	15.8	37.7	30.3	7.3
2011	Scrape	10	0.1	31.4	13.3	11.8
	Whole Rock	6	9.1	39.6	23.4	10.7
2012	Whole Rock	6	27.0	74.6	41.7	17.3
2013	Whole Rock	6	15.6	45.0	27.5	10.3
2014	Whole Rock	6	38.2	100.5	63.9	25.2
2015	Whole Rock	6	0.2	31.3	18.2	10.6
2016	Whole Rock	6	31.0	60.1	47.0	12.7

Table C-2: Chlorophyll-a (mg/m^2) descriptive statistics of replicate samples in August at Station B-2.

Year	Sample Type	N	Minimum	Maximum	Mean	Standard Deviation
2007	Scrape	10	6.3	26.9	13.4	6.2
	Whole Rock	4	11.0	15.0	13.3	1.7
2008	Scrape	10	0.3	18.1	4.0	5.6
	Whole Rock	4	22.0	29.0	24.3	3.3
2009	Scrape	10	2.5	46.3	9.3	13.4
	Whole Rock	4	14.0	33.0	21.0	8.5
2010	Whole Rock	5	7.0	10.3	9.1	1.4
2011	Scrape	10	0.1	14.9	3.0	4.5
	Whole Rock	6	3.3	9.4	5.3	2.3
2012	Whole Rock	6	5.3	21.1	9.1	6.1
2013	Whole Rock	6	9.6	33.7	14.6	9.4
2014	Whole Rock	6	9.6	30.0	18.7	6.7
2015	Whole Rock	6	7.8	14.0	11.0	2.4
2016	Whole Rock	6	15.6	34.1	24.7	7.7

Table C-3: Chlorophyll-a (mg/m^2) descriptive statistics of replicate samples in August at Station B-3.

Year	Sample Type	N	Minimum	Maximum	Mean	Standard Deviation
2007	Scrape	10	11.9	181.3	81.3	60.9
	Whole Rock	4	18.0	77.0	56.0	26.5
2008	Scrape	10	1.9	131.9	62.4	44.8
	Whole Rock	4	42.0	80.0	54.8	17.9
2009	Scrape	10	3.8	52.5	25.8	12.6
	Whole Rock	4	44.0	124.0	88.3	35.4
2010	Whole Rock	9	48.1	77.4	62.7	8.8
2011	Scrape	10	0.1	483.3	93.7	149.2
	Whole Rock	6	36.5	146.8	90.2	47.8
2012	Whole Rock	6	68.5	160.4	115.8	29.7
2013	Whole Rock	6	86.9	152.8	120.5	24.8
2014	Whole Rock	6	140.4	414.0	243.7	92.8
2015	Whole Rock	6	76.4	221.1	160.5	49.1
2016	Whole Rock	6	73.7	130.6	108.9	23.0

Table C-4: Chlorophyll-a (mg/m^2) descriptive statistics of replicate samples in August at Station 4.

Year	Sample Type	N	Minimum	Maximum	Mean	Standard Deviation
2007	Scrape	10	6.9	77.5	34.2	19.7
	Whole Rock	4	22.0	37.0	32.5	7.0
2008	Scrape	10	3.1	212.5	134.5	76.4
	Whole Rock	4	35.0	74.0	50.8	16.5
2009	Scrape	10	15.6	147.5	70.3	45.1
	Whole Rock	4	47.0	111.0	72.8	27.8
2010	Whole Rock	9	28.5	97.1	50.9	20.5
2011	Scrape	10	3.1	147.8	38.3	45.3
	Whole Rock	6	20.0	48.9	29.4	11.4
2012	Whole Rock	6	69.7	135.6	103.2	22.6
2013	Whole Rock	6	54.6	111.2	84.7	22.6
2014	Whole Rock	6	70.9	102.3	84.2	10.3
2015	Whole Rock	6	35.2	115.0	88.3	27.5
2016	Whole Rock	6	0.1	122.4	64.6	40.3

Table C-5: Chlorophyll-a (mg/m^2) descriptive statistics of replicate samples in August at Station B-5.

Year	Sample Type	N	Minimum	Maximum	Mean	Standard Deviation
2007	Scrape	10	114.4	398.8	223.6	107.8
	Whole Rock	4	67.0	188.0	110.0	55.9
2008	Scrape	10	6.3	293.1	97.0	88.9
	Whole Rock	4	65.0	432.0	240.8	151.0
2009	Scrape	10	10.0	132.5	50.6	37.7
	Whole Rock	4	117.0	256.0	196.0	58.8
2010	Whole Rock	9	40.2	220.0	120.5	61.0
2011	Scrape	10	0.1	690.0	165.1	235.6
	Whole Rock	6	28.1	228.6	149.7	74.1
2012	Whole Rock	6	75.9	293.7	191.2	86.9
2013	Whole Rock	6	38.8	220.9	123.1	68.5
2014	Whole Rock	6	133.0	232.7	187.5	39.3
2015	Whole Rock	6	119.8	336.1	192.3	77.5
2016	Whole Rock	6	109.7	279.6	181.7	59.6

Table C-6: Chlorophyll-a (mg/m^2) descriptive statistics of replicate samples in August at Station B-7.

Year	Sample Type	N	Minimum	Maximum	Mean	Standard Deviation
2007	Scrape	10	45.6	100.6	78.6	20.4
	Whole Rock	4	52.0	112.0	89.8	28.0
2008	Scrape	10	3.8	80.6	20.6	25.6
	Whole Rock	4	8.0	76.0	46.5	34.4
2009	Scrape	10	3.8	33.1	14.7	10.7
	Whole Rock	4	50.0	98.0	71.5	22.5
2010	Whole Rock	9	31.5	65.8	47.9	10.9
2011	Scrape	10	9.4	331.0	97.9	98.9
	Whole Rock	6	31.5	184.5	120.2	69.0
2012	Whole Rock	6	52.2	227.4	118.8	61.6
2013	Whole Rock	6	47.6	79.6	57.8	12.5
2014	Whole Rock	6	38.8	87.5	67.7	20.2
2015	Whole Rock	6	64.6	101.7	79.4	12.8
2016	Whole Rock	6	39.8	101.5	70.2	19.7

Table C-7: Chlorophyll-a (mg/m^2) descriptive statistics of replicate samples in August at Station B-8.

Year	Sample Type	N	Minimum	Maximum	Mean	Standard Deviation
2007	Scrape	10	8.8	80.6	32.9	20.8
	Whole Rock	4	63.0	87.0	76.5	10.2
2008	Scrape	10	5.6	240.0	73.5	81.0
	Whole Rock	4	66.0	407.0	234.3	140.3
2009	Scrape	10	14.4	116.3	53.8	30.8
	Whole Rock	4	129.0	230.0	193.0	44.4
2010	Whole Rock	5	52.9	259.0	143.2	85.1
2011	Scrape	10	5.2	117.1	39.2	39.7
	Whole Rock	6	18.5	47.7	34.0	11.8
2012	Whole Rock	6	85.2	163.5	118.7	34.4
2013	Whole Rock	6	44.8	123.7	85.9	34.8
2014	Whole Rock	6	98.3	162.4	117.4	24.4
2015	Whole Rock	6	73.4	173.5	104.8	41.3
2016	Whole Rock	6	91.5	138.8	110.6	20.2

Appendix C.2 Upstream-Downstream Comparisons

Table C-8: Rank comparisons of scrape method chlorophyll-a concentrations between Stations B1 and B2 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B1	40	52.70	2,108.00
B2	40	28.30	1,132.00
Total	80		

Table C-9: Mann–Whitney *U* test results for scrape method chlorophyll-a concentrations at Stations B1 and B2 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	312.000
Wilcoxon W	1,132.000
Z	-4.697
Asymp. Sig. (2-tailed)	.000

Table C-10: Rank comparisons of whole rock method chlorophyll-a concentrations between Stations B1 and B2 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B1	57	76.68	4,370.50
B2	53	32.73	1,734.50
Total	110		

Table C-11: Mann–Whitney *U* test results for whole rock method chlorophyll-a concentrations at Stations B1 and B2 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	303.500
Wilcoxon W	1,734.500
Z	-7.221
Asymp. Sig. (2-tailed)	.000

Table C-12: Rank comparisons of scrape method chlorophyll-a concentrations between Stations B2 and B3 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B2	40	24.56	982.50
B3	40	56.44	2,257.50
Total	80		

Table C-13: Mann–Whitney *U* test results for scrape method chlorophyll-a concentrations at Stations B2 and B3 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	162.500
Wilcoxon W	982.500
Z	-6.135
Asymp. Sig. (2-tailed)	.000

Table C-14: Rank comparisons of whole rock method chlorophyll-a concentrations between Stations B2 and B3 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B2	53	27.29	1,446.50
B3	57	81.73	4,658.50
Total	110		

Table C-15: Mann–Whitney *U* test results for whole rock method chlorophyll-a concentrations at Stations B2 and B3 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	15.500
Wilcoxon W	1,446.500
Z	-8.944
Asymp. Sig. (2-tailed)	.000

Table C-16: Rank comparisons of scrape method chlorophyll-a concentrations between Stations B3 and 4 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B3	40	38.74	1549.50
4	40	42.26	1690.50
Total	80		

Table C-17: Mann–Whitney *U* test results for scrape method chlorophyll-a concentrations at Stations B3 and 4 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	729.500
Wilcoxon W	1,549.500
Z	-.678
Asymp. Sig. (2-tailed)	.498

Table C-18: Rank comparisons of whole rock method chlorophyll-a concentrations between Stations B3 and 4 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B3	57	70.56	4,022.00
4	57	44.44	2,533.00
Total	114		

Table C-19: Mann–Whitney *U* test results for whole rock method chlorophyll-a concentrations at Stations B3 and 4 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	880.000
Wilcoxon W	2,533.000
Z	-4.219
Asymp. Sig. (2-tailed)	.000

Table C-20: Rank comparisons of scrape method chlorophyll-a concentrations between Stations 4 and B5 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
4	40	35.44	1,417.50
B5	40	45.56	1,822.50
Total	80		

Table C-21: Mann–Whitney *U* test results for scrape method chlorophyll-a concentrations at Stations 4 and B5 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	597.500
Wilcoxon W	1,417.500
Z	-1.949
Asymp. Sig. (2-tailed)	.051

Table C-22: Rank comparisons of whole rock method chlorophyll-a concentrations between Stations 4 and B5 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
4	57	35.70	2,035.00
B5	57	79.30	4,520.00
Total	114		

Table C-23: Mann–Whitney *U* test results for whole rock method chlorophyll-a concentrations at Stations 4 and B5 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	382.000
Wilcoxon W	2,035.000
Z	-7.042
Asymp. Sig. (2-tailed)	.000

Table C-24: Rank comparisons of scrape method chlorophyll-a concentrations between Stations B5 and B7 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B5	40	48.91	1,956.50
B7	40	32.09	1,283.50
Total	80		

Table C-25: Mann–Whitney *U* test results for scrape method chlorophyll-a concentrations at Stations B5 and B7 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	463.500
Wilcoxon W	1,283.500
Z	-3.238
Asymp. Sig. (2-tailed)	.001

Table C-26: Rank comparisons of whole rock method chlorophyll-a concentrations between Stations B5 and B7 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B5	57	77.00	4,389.00
B7	57	38.00	2,166.00
Total	114		

Table C-27: Mann–Whitney *U* test results for whole rock method chlorophyll-a concentrations at Stations B5 and B7 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	513.000
Wilcoxon W	2,166.000
Z	-6.299
Asymp. Sig. (2-tailed)	.000

Table C-28: Rank comparisons of scrape method chlorophyll-a concentrations between Stations B7 and B8 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B7	40	39.48	1,579.00
B8	40	41.53	1,661.00
Total	80		

Table C-29: Mann–Whitney *U* test results for scrape method chlorophyll-a concentrations at Stations B7 and B8 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	759.000
Wilcoxon W	1,579.000
Z	-.395
Asymp. Sig. (2-tailed)	.693

Table C-30: Rank comparisons of whole rock method chlorophyll-a concentrations between Stations B7 and B8 from 2007 to 2016.

Station	N	Mean Rank	Sum of Ranks
B7	57	44.57	2,540.50
B8	53	67.25	3,564.50
Total	110		

Table C-31: Mann–Whitney *U* test results for whole rock method chlorophyll-a concentrations at Stations B7 and B8 from 2007 to 2016.

Statistic	Result
Mann-Whitney U	887.500
Wilcoxon W	2,540.500
Z	-3.727
Asymp. Sig. (2-tailed)	.000

Appendix C.3 Temporal Graphs

Figure C-1: Chlorophyll-a (mg/m²) for Biological Stations B1 to B8.

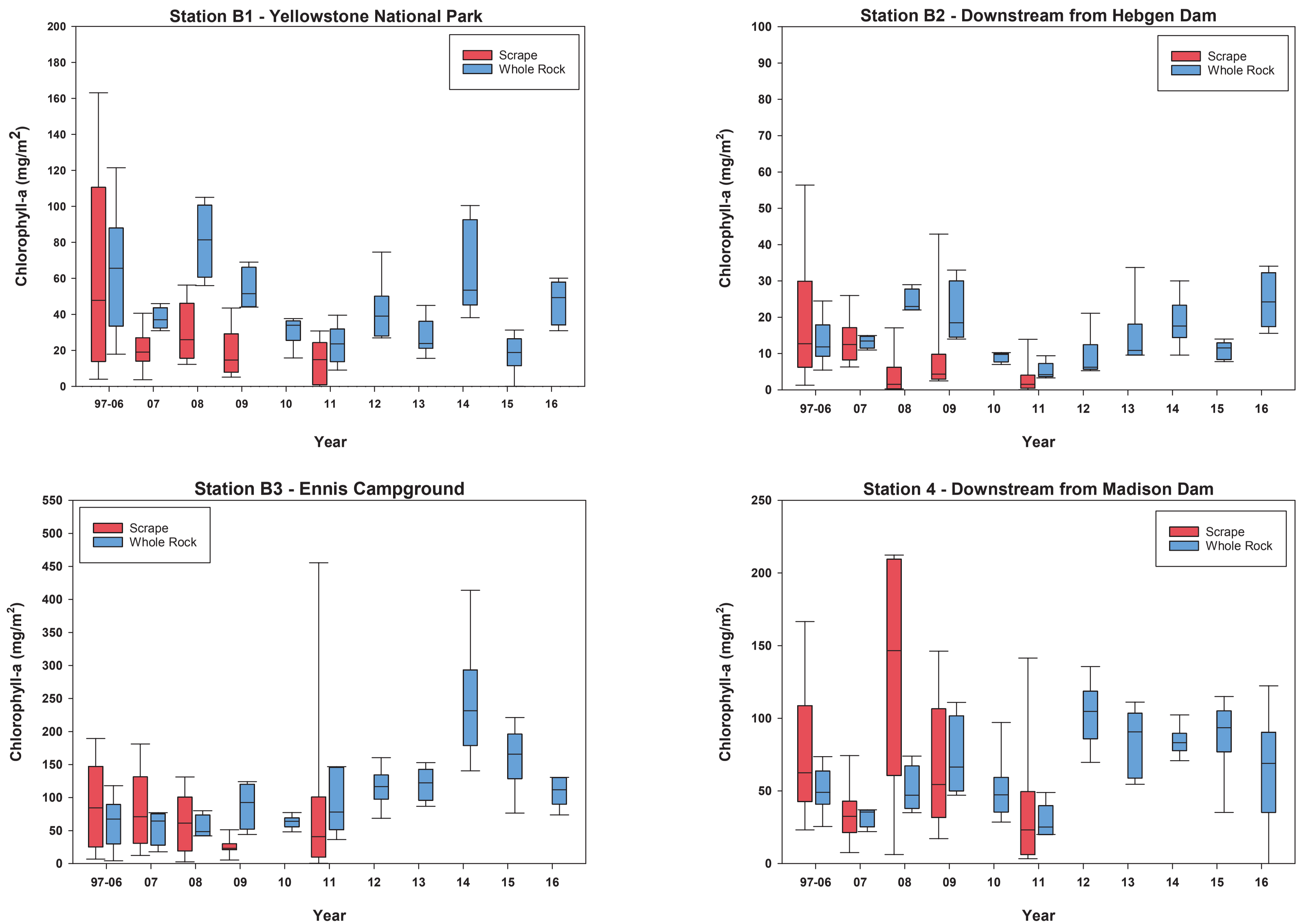
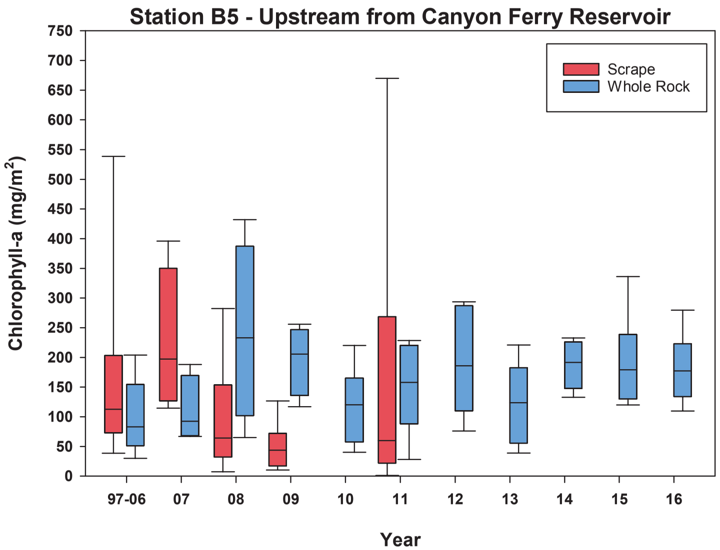
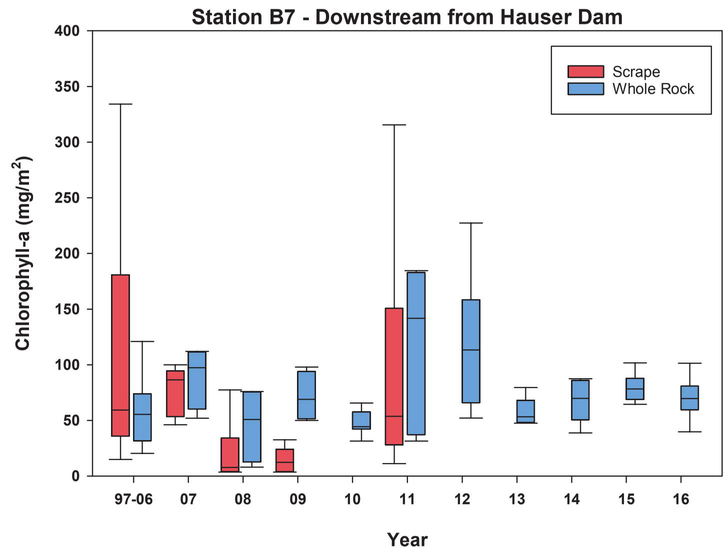
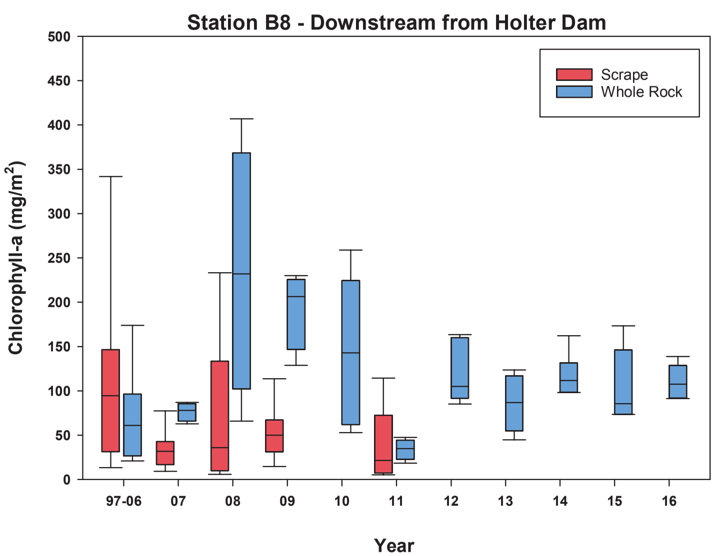


Figure C-1: Chlorophyll-a (mg/m²) for Biological Stations B1 to B8 (cont.).







Appendix D Diatom Metrics

Appendix D.1 Upstream-Downstream Comparisons

Table D-1: Rank comparisons of chlorophyll-a concentrations between Stations B2 and B3 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Shannon Diversity	B2	10	8.10	81.00
	B3	10	12.90	129.00
	Total	20		
Pollution Tolerance Index	B2	10	5.60	56.00
	B3	10	15.40	154.00
	Total	20		
Siltation Index (%)	B2	10	8.40	84.00
	B3	10	12.60	126.00
	Total	20		
Disturbance Index (%)	B2	10	8.90	89.00
	B3	10	12.10	121.00
	Total	20		
Species Richness	B2	10	7.45	74.50
	B3	10	13.55	135.50
	Total	20		
Abundance of Dominant Species (%)	B2	10	13.50	135.00
	B3	10	7.50	75.00
	Total	20		
Abnormal Cells (%)	B2	10	13.05	130.50
	B3	10	7.95	79.50
	Total	20		

Table D-2: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations B2 and B3 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Shannon Diversity	26.000	81.000	-1.814	.070
Pollution Tolerance Index	1.000	56.000	-3.704	.000
Siltation Index (%)	29.000	84.000	-1.587	.112
Disturbance Index (%)	34.000	89.000	-1.210	.226
Species Richness	19.500	74.500	-2.313	.021
Abundance of Dominant Species (%)	20.000	75.000	-2.268	.023
Abnormal Cells (%)	24.500	79.500	-1.950	.051

Table D-3: Rank comparisons of chlorophyll-a concentrations between Stations B3 and 4 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Shannon Diversity	B3	10	6.60	66.00
	4	10	14.40	144.00
	Total	20		
Pollution Tolerance Index	B3	10	10.55	105.50
	4	10	10.45	104.50
	Total	20		
Siltation Index (%)	B3	10	12.20	122.00
	4	10	8.80	88.00
	Total	20		
Disturbance Index (%)	B3	10	14.20	142.00
	4	10	6.80	68.00
	Total	20		
Species Richness	B3	10	6.55	65.50
	4	10	14.45	144.50
	Total	20		
Abundance of Dominant Species (%)	B3	10	13.50	135.00
	4	10	7.50	75.00
	Total	20		
Abnormal Cells (%)	B3	10	12.90	129.00
	4	10	8.10	81.00
	Total	20		

Table D-4: Mann–Whitney U test results for chlorophyll-a concentrations at Stations B3 and 4 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Shannon Diversity	11.000	66.000	-2.948	.003
Pollution Tolerance Index	49.500	104.500	-.038	.970
Siltation Index (%)	33.000	88.000	-1.285	.199
Disturbance Index (%)	13.000	68.000	-2.799	.005
Species Richness	10.500	65.500	-2.995	.003
Abundance of Dominant Species (%)	20.000	75.000	-2.269	.023
Abnormal Cells (%)	26.000	81.000	-1.948	.051

Table D-5: Rank comparisons of chlorophyll-a concentrations between Stations 4 and B5 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Shannon Diversity	4	10	13.00	130.00
	B5	10	8.00	80.00
	Total	20		
Pollution Tolerance Index	4	10	10.10	101.00
	B5	10	10.90	109.00
	Total	20		
Siltation Index (%)	4	10	10.30	103.00
	B5	10	10.70	107.00
	Total	20		
Disturbance Index (%)	4	10	10.00	100.00
	B5	10	11.00	110.00
	Total	20		
Species Richness	4	10	13.10	131.00
	B5	10	7.90	79.00
	Total	20		
Abundance of Dominant Species (%)	4	10	8.70	87.00
	B5	10	12.30	123.00
	Total	20		
Abnormal Cells (%)	4	10	11.50	115.00
	B5	10	9.50	95.00
	Total	20		

Table D-6: Mann–Whitney U test results for chlorophyll-a concentrations at Stations 4 and B5 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Shannon Diversity	25.000	80.000	-1.890	.059
Pollution Tolerance Index	46.000	101.000	-.302	.762
Siltation Index (%)	48.000	103.000	-.151	.880
Disturbance Index (%)	45.000	100.000	-.379	.705
Species Richness	24.000	79.000	-1.971	.049
Abundance of Dominant Species (%)	32.000	87.000	-1.361	.174
Abnormal Cells (%)	40.000	95.000	-1.082	.279

Table D-7: Rank comparisons of chlorophyll-a concentrations between Stations B5 and B7 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Shannon Diversity	B5	10	14.30	143.00
	B7	10	6.70	67.00
	Total	20		
Pollution Tolerance Index	B5	10	7.60	76.00
	B7	10	13.40	134.00
	Total	20		
Siltation Index (%)	B5	10	12.20	122.00
	B7	10	8.80	88.00
	Total	20		
Disturbance Index (%)	B5	10	9.70	97.00
	B7	10	11.30	113.00
	Total	20		
Species Richness	B5	10	15.05	150.50
	B7	10	5.95	59.50
	Total	20		
Abundance of Dominant Species (%)	B5	10	8.30	83.00
	B7	10	12.70	127.00
	Total	20		
Abnormal Cells (%)	B5	10	9.45	94.50
	B7	10	11.55	115.50
	Total	20		

Table D-8: Mann–Whitney U test results for chlorophyll-a concentrations at Stations B5 and B7 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Shannon Diversity	12.000	67.000	-2.873	.004
Pollution Tolerance Index	21.000	76.000	-2.192	.028
Siltation Index (%)	33.000	88.000	-1.285	.199
Disturbance Index (%)	42.000	97.000	-.606	.545
Species Richness	4.500	59.500	-3.446	.001
Abundance of Dominant Species (%)	28.000	83.000	-1.663	.096
Abnormal Cells (%)	39.500	94.500	-1.139	.255

Table D-9: Rank comparisons of chlorophyll-a concentrations between Stations B7 and B8 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Shannon Diversity	B7	10	11.10	111.00
	B8	10	9.90	99.00
	Total	20		
Pollution Tolerance Index	B7	10	12.40	124.00
	B8	10	8.60	86.00
	Total	20		
Siltation Index (%)	B7	10	9.40	94.00
	B8	10	11.60	116.00
	Total	20		
Disturbance Index (%)	B7	10	8.80	88.00
	B8	10	12.20	122.00
	Total	20		
Species Richness	B7	10	10.80	108.00
	B8	10	10.20	102.00
	Total	20		
Abundance of Dominant Species (%)	B7	10	10.40	104.00
	B8	10	10.60	106.00
	Total	20		
Abnormal Cells (%)	B7	10	11.10	111.00
	B8	10	9.90	99.00
	Total	20		

Table D-10: Mann–Whitney U test results for chlorophyll-a concentrations at Stations B7 and B8 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Shannon Diversity	44.000	99.000	-.454	.650
Pollution Tolerance Index	31.000	86.000	-1.436	.151
Siltation Index (%)	39.000	94.000	-.832	.406
Disturbance Index (%)	33.000	88.000	-1.286	.199
Species Richness	47.000	102.000	-.227	.820
Abundance of Dominant Species (%)	49.000	104.000	-.076	.940
Abnormal Cells (%)	44.000	99.000	-.596	.551

Table D-11: Rank comparisons of chlorophyll-a concentrations between Stations B8 and B10 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Shannon Diversity	B8	10	7.40	74.00
	B10	10	13.60	136.00
	Total	20		
Pollution Tolerance Index	B8	10	13.20	132.00
	B10	10	7.80	78.00
	Total	20		
Siltation Index (%)	B8	10	7.40	74.00
	B10	10	13.60	136.00
	Total	20		
Disturbance Index (%)	B8	10	12.95	129.50
	B10	10	8.05	80.50
	Total	20		
Species Richness	B8	10	5.85	58.50
	B10	10	15.15	151.50
	Total	20		
Abundance of Dominant Species (%)	B8	10	11.20	112.00
	B10	10	9.80	98.00
	Total	20		
Abnormal Cells (%)	B8	10	11.05	110.50
	B10	10	9.95	99.50
	Total	20		

Table D-12: Mann–Whitney U test results for chlorophyll-a concentrations at Stations B8 and B1 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Shannon Diversity	19.000	74.000	-2.343	.019
Pollution Tolerance Index	23.000	78.000	-2.041	.041
Siltation Index (%)	19.000	74.000	-2.343	.019
Disturbance Index (%)	25.500	80.500	-1.856	.064
Species Richness	3.500	58.500	-3.519	.000
Abundance of Dominant Species (%)	43.000	98.000	-.529	.597
Abnormal Cells (%)	44.500	99.500	-.669	.503

Appendix D.2 Correlation Matrices

Table D-13: Kendall's tau correlation matrix of diatom metrics collected at Station B-2 from 2007 to 2015.

Metric	Statistic	Date	Mean Chlorophyll-a Replicate Scrape Concentration	Mean Chlorophyll-a Replicate Whole Rock Concentration	Shannon Diversity	Pollution Tolerance Index	Siltation Index (%)	Disturbance Index (%)	Species Richness	Abundance of Dominant Species (%)	Abnormal Cells (%)
Date	Correlation Coefficient	1.000	-0.667	0.067	0.200	-0.156	-0.111	0.467*	0.000	-0.022	-0.114
	Significance (2-tailed)	.	0.174	0.788	0.421	0.531	0.655	0.060	1.000	0.929	0.652
	N	10	4	10	10	10	10	10	10	10	10
Mean Chlorophyll-a Replicate Scrape Concentration	Correlation Coefficient	-0.667	1.000	0.000	-0.333	0.000	1.000	-1.000*	-0.667	0.000	-1.000*
	Significance (2-tailed)	0.174	.	1.000	0.497	1.000	0.000	0.000	0.174	1.000	0.000
	N	4	4	4	4	4	4	4	4	4	4
Mean Chlorophyll-a Replicate Whole Rock Concentration	Correlation Coefficient	0.067	0.000	1.000	-0.200	-0.467*	0.644*	0.067	-0.180	0.022	-0.250
	Significance (2-tailed)	0.788	1.000	.	0.421	0.060	0.009	0.788	0.472	0.929	0.321
	N	10	4	10	10	10	10	10	10	10	10
Shannon Diversity	Correlation Coefficient	0.200	-0.333	-0.200	1.000	0.378	-0.111	0.378	0.539*	-0.644*	0.205
	Significance (2-tailed)	0.421	0.497	0.421	.	0.128	0.655	0.128	0.031	0.009	0.417
	N	10	4	10	10	10	10	10	10	10	10
Pollution Tolerance Index	Correlation Coefficient	-0.156	0.000	-0.467*	0.378	1.000	-0.289	0.111	0.360	-0.378	0.114
	Significance (2-tailed)	0.531	1.000	0.060	0.128	.	0.245	0.655	0.151	0.128	0.652
	N	10	4	10	10	10	10	10	10	10	10
Siltation Index (%)	Correlation Coefficient	-0.111	1.000	0.644*	-0.111	-0.289	1.000	-0.111	-0.180	0.022	-0.341
	Significance (2-tailed)	0.655	0.000	0.009	0.655	0.245	.	0.655	0.472	0.929	0.176
	N	10	4	10	10	10	10	10	10	10	10
Disturbance Index (%)	Correlation Coefficient	0.467*	-1.000*	0.067	0.378	0.111	-0.111	1.000	0.449*	-0.289	0.250
	Significance (2-tailed)	0.060	0.000	0.788	0.128	0.655	0.655	.	0.072	0.245	0.321
	N	10	4	10	10	10	10	10	10	10	10
Species Richness	Correlation Coefficient	0.000	-0.667	-0.180	0.539*	0.360	-0.180	0.449*	1.000	-0.449*	0.644*
	Significance (2-tailed)	1.000	0.174	0.472	0.031	0.151	0.472	0.072	.	0.072	0.011
	N	10	4	10	10	10	10	10	10	10	10
Abundance of Dominant Species (%)	Correlation Coefficient	-0.022	0.000	0.022	-0.644*	-0.378	0.022	-0.289	-0.449*	1.000	-0.114
	Significance (2-tailed)	0.929	1.000	0.929	0.009	0.128	0.929	0.245	0.072	.	0.652
	N	10	4	10	10	10	10	10	10	10	10
Abnormal Cells (%)	Correlation Coefficient	-0.114	-1.000*	-0.250	0.205	0.114	-0.341	0.250	0.644*	-0.114	1.000
	Significance (2-tailed)	0.652	0.000	0.321	0.417	0.652	0.176	0.321	0.011	0.652	.
	N	10	4	10	10	10	10	10	10	10	10

*Correlation is significant at the 0.10 level (2-tailed).

Table D-14: Kendall's tau correlation matrix of diatom metrics collected at Station B-3 from 2007 to 2015.

Metric	Statistic	Date	Mean Chlorophyll-a Replicate Scrape Concentration	Mean Chlorophyll-a Replicate Whole Rock Concentration	Shannon Diversity	Pollution Tolerance Index	Siltation Index (%)	Disturbance Index (%)	Species Richness	Abundance of Dominant Species (%)	Abnormal Cells (%)
Date	Correlation Coefficient	1.000	0.000	0.689*	0.511*	0.333	0.156	0.225	0.471*	-0.200	-0.435*
	Significance (2-tailed)	.	1.000	0.006	0.040	0.180	0.531	0.369	0.067	0.421	0.096
	N	10	4	10	10	10	10	10	10	10	10
Mean Chlorophyll-a Replicate Scrape Concentration	Correlation Coefficient	0.000	1.000	0.333	-0.333	0.333	-1.000*	0.333	-0.548	0.667	0.183
	Significance (2-tailed)	1.000	.	0.497	0.497	0.497	0.000	0.497	0.279	0.174	0.718
	N	4	4	4	4	4	4	4	4	4	4
Mean Chlorophyll-a Replicate Whole Rock Concentration	Correlation Coefficient	0.689*	0.333	1.000	0.644*	0.111	0.200	0.090	0.566*	-0.511*	-0.484*
	Significance (2-tailed)	0.006	0.497	.	0.009	0.655	0.421	0.719	0.028	0.040	0.064
	N	10	4	10	10	10	10	10	10	10	10
Shannon Diversity	Correlation Coefficient	0.511*	-0.333	0.644*	1.000	-0.156	0.467*	0.045	0.849*	-0.600*	-0.387
	Significance (2-tailed)	0.040	0.497	0.009	.	0.531	0.060	0.857	0.001	0.016	0.139
	N	10	4	10	10	10	10	10	10	10	10
Pollution Tolerance Index	Correlation Coefficient	0.333	0.333	0.111	-0.156	1.000	-0.244	-0.090	-0.189	0.111	0.048
	Significance (2-tailed)	0.180	0.497	0.655	0.531	.	0.325	0.719	0.464	0.655	0.853
	N	10	4	10	10	10	10	10	10	10	10
Siltation Index (%)	Correlation Coefficient	0.156	-1.000*	0.200	0.467*	-0.244	1.000	-0.135	0.660*	-0.422*	-0.145
	Significance (2-tailed)	0.531	0.000	0.421	0.060	0.325	.	0.590	0.010	0.089	0.579
	N	10	4	10	10	10	10	10	10	10	10
Disturbance Index (%)	Correlation Coefficient	0.225	0.333	0.090	0.045	-0.090	-0.135	1.000	0.119	0.270	0.122
	Significance (2-tailed)	0.369	0.497	0.719	0.857	0.719	0.590	.	0.646	0.281	0.642
	N	10	4	10	10	10	10	10	10	10	10
Species Richness	Correlation Coefficient	0.471*	-0.548	0.566*	0.849*	-0.189	0.660*	0.119	1.000	-0.471*	-0.385
	Significance (2-tailed)	0.067	0.279	0.028	0.001	0.464	0.010	0.646	.	0.067	0.156
	N	10	4	10	10	10	10	10	10	10	10
Abundance of Dominant Species (%)	Correlation Coefficient	-0.200	0.667	-0.511*	-0.600*	0.111	-0.422*	0.270	-0.471*	1.000	0.387
	Significance (2-tailed)	0.421	0.174	0.040	0.016	0.655	0.089	0.281	0.067	.	0.139
	N	10	4	10	10	10	10	10	10	10	10
Abnormal Cells (%)	Correlation Coefficient	-0.435*	0.183	-0.484*	-0.387	0.048	-0.145	0.122	-0.385	0.387	1.000
	Significance (2-tailed)	0.096	0.718	0.064	0.139	0.853	0.579	0.642	0.156	0.139	.
	N	10	4	10	10	10	10	10	10	10	10

*Correlation is significant at the 0.10 level (2-tailed).

Table D-15: Kendall's tau correlation matrix of diatom metrics collected at Station 4 from 2007 to 2015.

Metric	Statistic	Date	Mean Chlorophyll-a Replicate Scrape Concentration	Mean Chlorophyll-a Replicate Whole Rock Concentration	Shannon Diversity	Pollution Tolerance Index	Siltation Index (%)	Disturbance Index (%)	Species Richness	Abundance of Dominant Species (%)	Abnormal Cells (%)
Date	Correlation Coefficient	1.000	0.000	0.378	0.244	-0.422*	0.511*	0.180	0.180	-0.378	-0.426
	Significance (2-tailed)	.	1.000	0.128	0.325	0.089	0.040	0.472	0.472	0.128	0.119
	N	10	4	10	10	10	10	10	10	10	10
Mean Chlorophyll-a Replicate Scrape Concentration	Correlation Coefficient	0.000	1.000	0.333	0.333	-0.333	0.333	-0.333	0.333	-1.000*	0.183
	Significance (2-tailed)	1.000	.	0.497	0.497	0.497	0.497	0.497	0.497	0.000	0.718
	N	4	4	4	4	4	4	4	4	4	4
Mean Chlorophyll-a Replicate Whole Rock Concentration	Correlation Coefficient	0.378	0.333	1.000	0.689*	-0.600*	0.511*	0.000	0.629*	-0.200	-0.061
	Significance (2-tailed)	0.128	0.497	.	0.006	0.016	0.040	1.000	0.012	0.421	0.824
	N	10	4	10	10	10	10	10	10	10	10
Shannon Diversity	Correlation Coefficient	0.244	0.333	0.689*	1.000	-0.556*	0.556*	0.315	0.854*	-0.244	0.000
	Significance (2-tailed)	0.325	0.497	0.006	.	0.025	0.025	0.209	0.001	0.325	1.000
	N	10	4	10	10	10	10	10	10	10	10
Pollution Tolerance Index	Correlation Coefficient	-0.422*	-0.333	-0.600*	-0.556*	1.000	-0.911*	-0.225	-0.405	0.422*	0.000
	Significance (2-tailed)	0.089	0.497	0.016	0.025	.	0.000	0.369	0.106	0.089	1.000
	N	10	4	10	10	10	10	10	10	10	10
Siltation Index (%)	Correlation Coefficient	0.511*	0.333	0.511*	0.556*	-0.911*	1.000	0.315	0.405	-0.511*	-0.061
	Significance (2-tailed)	0.040	0.497	0.040	0.025	0.000	.	0.209	0.106	0.040	0.824
	N	10	4	10	10	10	10	10	10	10	10
Disturbance Index (%)	Correlation Coefficient	0.180	-0.333	0.000	0.315	-0.225	0.315	1.000	0.295	-0.270	0.000
	Significance (2-tailed)	0.472	0.497	1.000	0.209	0.369	0.209	.	0.241	0.281	1.000
	N	10	4	10	10	10	10	10	10	10	10
Species Richness	Correlation Coefficient	0.180	0.333	0.629*	0.854*	-0.405	0.405	0.295	1.000	-0.135	0.092
	Significance (2-tailed)	0.472	0.497	0.012	0.001	0.106	0.106	0.241	.	0.590	0.738
	N	10	4	10	10	10	10	10	10	10	10
Abundance of Dominant Species (%)	Correlation Coefficient	-0.378	-1.000*	-0.200	-0.244	0.422*	-0.511*	-0.270	-0.135	1.000	0.122
	Significance (2-tailed)	0.128	0.000	0.421	0.325	0.089	0.040	0.281	0.590	.	0.656
	N	10	4	10	10	10	10	10	10	10	10
Abnormal Cells (%)	Correlation Coefficient	-0.426	0.183	-0.061	0.000	0.000	-0.061	0.000	0.092	0.122	1.000
	Significance (2-tailed)	0.119	0.718	0.824	1.000	1.000	0.824	1.000	0.738	0.656	.
	N	10	4	10	10	10	10	10	10	10	10

*Correlation is significant at the 0.10 level (2-tailed).

Table D-16: Kendall's tau correlation matrix of diatom metrics collected at Station B-5 from 2007 to 2015.

Metric	Statistic	Date	Mean Chlorophyll-a Replicate Scrape Concentration	Mean Chlorophyll-a Replicate Whole Rock Concentration	Shannon Diversity	Pollution Tolerance Index	Siltation Index (%)	Disturbance Index (%)	Species Richness	Abundance of Dominant Species (%)	Abnormal Cells (%)
Date	Correlation Coefficient	1.000	-0.333	0.067	0.333	-0.378	0.156	0.322	0.494*	-0.244	-0.447
	Significance (2-tailed)	.	0.497	0.788	0.180	0.128	0.531	0.204	0.048	0.325	0.117
	N	10	4	10	10	10	10	10	10	10	10
Mean Chlorophyll-a Replicate Scrape Concentration	Correlation Coefficient	-0.333	1.000	-0.667	0.333	-0.667	-0.333	0.183	0.333	-0.333	0.707
	Significance (2-tailed)	0.497	.	0.174	0.497	0.174	0.497	0.718	0.497	0.497	0.180
	N	4	4	4	4	4	4	4	4	4	4
Mean Chlorophyll-a Replicate Whole Rock Concentration	Correlation Coefficient	0.067	-0.667	1.000	-0.156	0.289	0.111	-0.046	-0.045	0.333	-0.447
	Significance (2-tailed)	0.788	0.174	.	0.531	0.245	0.655	0.856	0.857	0.180	0.117
	N	10	4	10	10	10	10	10	10	10	10
Shannon Diversity	Correlation Coefficient	0.333	0.333	-0.156	1.000	-0.244	-0.067	0.552*	0.764*	-0.556*	-0.050
	Significance (2-tailed)	0.180	0.497	0.531	.	0.325	0.788	0.029	0.002	0.025	0.862
	N	10	4	10	10	10	10	10	10	10	10
Pollution Tolerance Index	Correlation Coefficient	-0.378	-0.667	0.289	-0.244	1.000	-0.511*	-0.184	-0.315	0.067	-0.348
	Significance (2-tailed)	0.128	0.174	0.245	0.325	.	0.040	0.468	0.209	0.788	0.223
	N	10	4	10	10	10	10	10	10	10	10
Siltation Index (%)	Correlation Coefficient	0.156	-0.333	0.111	-0.067	-0.511*	1.000	-0.092	0.000	0.244	0.050
	Significance (2-tailed)	0.531	0.497	0.655	0.788	0.040	.	0.717	1.000	0.325	0.862
	N	10	4	10	10	10	10	10	10	10	10
Disturbance Index (%)	Correlation Coefficient	0.322	0.183	-0.046	0.552*	-0.184	-0.092	1.000	0.442*	-0.506*	0.154
	Significance (2-tailed)	0.204	0.718	0.856	0.029	0.468	0.717	.	0.083	0.046	0.597
	N	10	4	10	10	10	10	10	10	10	10
Species Richness	Correlation Coefficient	0.494*	0.333	-0.045	0.764*	-0.315	0.000	0.442*	1.000	-0.315	-0.151
	Significance (2-tailed)	0.048	0.497	0.857	0.002	0.209	1.000	0.083	.	0.209	0.600
	N	10	4	10	10	10	10	10	10	10	10
Abundance of Dominant Species (%)	Correlation Coefficient	-0.244	-0.333	0.333	-0.556*	0.067	0.244	-0.506*	-0.315	1.000	-0.149
	Significance (2-tailed)	0.325	0.497	0.180	0.025	0.788	0.325	0.046	0.209	.	0.602
	N	10	4	10	10	10	10	10	10	10	10
Abnormal Cells (%)	Correlation Coefficient	-0.447	0.707	-0.447	-0.050	-0.348	0.050	0.154	-0.151	-0.149	1.000
	Significance (2-tailed)	0.117	0.180	0.117	0.862	0.223	0.862	0.597	0.600	0.602	.
	N	10	4	10	10	10	10	10	10	10	10

*Correlation is significant at the 0.10 level (2-tailed).

Table D-17: Kendall's tau correlation matrix of diatom metrics collected at Station B-7 from 2007 to 2015.

Metric	Statistic	Date	Mean Chlorophyll-a Replicate Scrape Concentration	Mean Chlorophyll-a Replicate Whole Rock Concentration	Shannon Diversity	Pollution Tolerance Index	Siltation Index (%)	Disturbance Index (%)	Species Richness	Abundance of Dominant Species (%)	Abnormal Cells (%)
Date	Correlation Coefficient	1.000	0.000	0.067	-0.067	-0.289	0.467*	0.360	-0.414	-0.467*	-0.715*
	Significance (2-tailed)	.	1.000	0.788	0.788	0.245	0.060	0.151	0.103	0.060	0.010
	N	10	4	10	10	10	10	10	10	10	10
Mean Chlorophyll-a Replicate Scrape Concentration	Correlation Coefficient	0.000	1.000	0.667	-0.333	0.000	0.000	-1.000*	-0.183	-0.333	-0.183
	Significance (2-tailed)	1.000	.	0.174	0.497	1.000	1.000	0.000	0.718	0.497	0.718
	N	4	4	4	4	4	4	4	4	4	4
Mean Chlorophyll-a Replicate Whole Rock Concentration	Correlation Coefficient	0.067	0.667	1.000	0.333	-0.333	0.156	0.045	0.184	-0.244	-0.031
	Significance (2-tailed)	0.788	0.174	.	0.180	0.180	0.531	0.857	0.469	0.325	0.911
	N	10	4	10	10	10	10	10	10	10	10
Shannon Diversity	Correlation Coefficient	-0.067	-0.333	0.333	1.000	-0.378	0.289	0.360	0.644*	-0.467*	0.031
	Significance (2-tailed)	0.788	0.497	0.180	.	0.128	0.245	0.151	0.011	0.060	0.911
	N	10	4	10	10	10	10	10	10	10	10
Pollution Tolerance Index	Correlation Coefficient	-0.289	0.000	-0.333	-0.378	1.000	-0.733*	-0.449*	-0.230	0.556*	0.342
	Significance (2-tailed)	0.245	1.000	0.180	0.128	.	0.003	0.072	0.365	0.025	0.218
	N	10	4	10	10	10	10	10	10	10	10
Siltation Index (%)	Correlation Coefficient	0.467*	0.000	0.156	0.289	-0.733*	1.000	0.270	0.138	-0.556*	-0.528*
	Significance (2-tailed)	0.060	1.000	0.531	0.245	0.003	.	0.281	0.587	0.025	0.057
	N	10	4	10	10	10	10	10	10	10	10
Disturbance Index (%)	Correlation Coefficient	0.360	-1.000*	0.045	0.360	-0.449*	0.270	1.000	0.023	-0.539*	-0.157
	Significance (2-tailed)	0.151	0.000	0.857	0.151	0.072	0.281	.	0.928	0.031	0.574
	N	10	4	10	10	10	10	10	10	10	10
Species Richness	Correlation Coefficient	-0.414	-0.183	0.184	0.644*	-0.230	0.138	0.023	1.000	-0.138	0.354
	Significance (2-tailed)	0.103	0.718	0.469	0.011	0.365	0.587	0.928	.	0.587	0.213
	N	10	4	10	10	10	10	10	10	10	10
Abundance of Dominant Species (%)	Correlation Coefficient	-0.467*	-0.333	-0.244	-0.467*	0.556*	-0.556*	-0.539*	-0.138	1.000	0.466*
	Significance (2-tailed)	0.060	0.497	0.325	0.060	0.025	0.025	0.031	0.587	.	0.093
	N	10	4	10	10	10	10	10	10	10	10
Abnormal Cells (%)	Correlation Coefficient	-0.715*	-0.183	-0.031	0.031	0.342	-0.528*	-0.157	0.354	0.466*	1.000
	Significance (2-tailed)	0.010	0.718	0.911	0.911	0.218	0.057	0.574	0.213	0.093	.
	N	10	4	10	10	10	10	10	10	10	10

*Correlation is significant at the 0.10 level (2-tailed).

Table D-18: Kendall's tau correlation matrix of diatom metrics collected at Station B-8 from 2007 to 2015.

Metric	Statistic	Date	Mean Chlorophyll-a Replicate Scrape Concentration	Mean Chlorophyll-a Replicate Whole Rock Concentration	Shannon Diversity	Pollution Tolerance Index	Siltation Index (%)	Disturbance Index (%)	Species Richness	Abundance of Dominant Species (%)	Abnormal Cells (%)
Date	Correlation Coefficient	1.000	0.000	-0.244	-0.067	0.022	-0.067	0.556*	0.250	0.111	0.108
	Significance (2-tailed)	.	1.000	0.325	0.788	0.929	0.788	0.025	0.321	0.655	0.698
	N	10	4	10	10	10	10	10	10	10	10
Mean Chlorophyll-a Replicate Scrape Concentration	Correlation Coefficient	0.000	1.000	0.667	0.667	0.000	-0.667	0.333	0.000	-1.000*	-0.236
	Significance (2-tailed)	1.000	.	0.174	0.174	1.000	0.174	0.497	1.000	0.000	0.655
	N	4	4	4	4	4	4	4	4	4	4
Mean Chlorophyll-a Replicate Whole Rock Concentration	Correlation Coefficient	-0.244	0.667	1.000	0.200	0.289	-0.333	0.200	-0.159	-0.067	-0.325
	Significance (2-tailed)	0.325	0.174	.	0.421	0.245	0.180	0.421	0.528	0.788	0.244
	N	10	4	10	10	10	10	10	10	10	10
Shannon Diversity	Correlation Coefficient	-0.067	0.667	0.200	1.000	-0.333	0.289	0.111	0.386	-0.600*	-0.036
	Significance (2-tailed)	0.788	0.174	0.421	.	0.180	0.245	0.655	0.125	0.016	0.897
	N	10	4	10	10	10	10	10	10	10	10
Pollution Tolerance Index	Correlation Coefficient	0.022	0.000	0.289	-0.333	1.000	-0.244	0.111	-0.068	0.289	-0.398
	Significance (2-tailed)	0.929	1.000	0.245	0.180	.	0.325	0.655	0.787	0.245	0.154
	N	10	4	10	10	10	10	10	10	10	10
Siltation Index (%)	Correlation Coefficient	-0.067	-0.667	-0.333	0.289	-0.244	1.000	0.022	0.296	0.022	0.036
	Significance (2-tailed)	0.788	0.174	0.180	0.245	0.325	.	0.929	0.241	0.929	0.897
	N	10	4	10	10	10	10	10	10	10	10
Disturbance Index (%)	Correlation Coefficient	0.556*	0.333	0.200	0.111	0.111	0.022	1.000	0.159	0.200	-0.108
	Significance (2-tailed)	0.025	0.497	0.421	0.655	0.655	0.929	.	0.528	0.421	0.698
	N	10	4	10	10	10	10	10	10	10	10
Species Richness	Correlation Coefficient	0.250	0.000	-0.159	0.386	-0.068	0.296	0.159	1.000	-0.068	0.037
	Significance (2-tailed)	0.321	1.000	0.528	0.125	0.787	0.241	0.528	.	0.787	0.896
	N	10	4	10	10	10	10	10	10	10	10
Abundance of Dominant Species (%)	Correlation Coefficient	0.111	-1.000*	-0.067	-0.600*	0.289	0.022	0.200	-0.068	1.000	0.181
	Significance (2-tailed)	0.655	0.000	0.788	0.016	0.245	0.929	0.421	0.787	.	0.517
	N	10	4	10	10	10	10	10	10	10	10
Abnormal Cells (%)	Correlation Coefficient	0.108	-0.236	-0.325	-0.036	-0.398	0.036	-0.108	0.037	0.181	1.000
	Significance (2-tailed)	0.698	0.655	0.244	0.897	0.154	0.897	0.698	0.896	0.517	.
	N	10	4	10	10	10	10	10	10	10	10

*Correlation is significant at the 0.10 level (2-tailed).

Table D-19: Kendall's tau correlation matrix of diatom metrics collected at Station B-10 from 2007 to 2015.

Metric	Statistic	Date	Shannon Diversity	Pollution Tolerance Index	Siltation Index (%)	Disturbance Index (%)	Species Richness	Abundance of Dominant Species (%)	Abnormal Cells (%)
Date	Correlation Coefficient	1.000	0.111	-0.067	0.289	0.552*	-0.156	-0.200	-0.050
	Significance (2-tailed)	.	0.655	0.788	0.245	0.029	0.531	0.421	0.862
	N	10	10	10	10	10	10	10	10
Shannon Diversity	Correlation Coefficient	0.111	1.000	-0.333	0.378	0.184	0.644*	-0.822*	-0.149
	Significance (2-tailed)	0.655	.	0.180	0.128	0.468	0.009	0.001	0.602
	N	10	10	10	10	10	10	10	10
Pollution Tolerance Index	Correlation Coefficient	-0.067	-0.333	1.000	-0.511*	0.046	-0.244	0.333	0.248
	Significance (2-tailed)	0.788	0.180	.	0.040	0.856	0.325	0.180	0.384
	N	10	10	10	10	10	10	10	10
Siltation Index (%)	Correlation Coefficient	0.289	0.378	-0.511*	1.000	0.000	0.111	-0.378	-0.248
	Significance (2-tailed)	0.245	0.128	0.040	.	1.000	0.655	0.128	0.384
	N	10	10	10	10	10	10	10	10
Disturbance Index (%)	Correlation Coefficient	0.552*	0.184	0.046	0.000	1.000	0.184	-0.184	-0.257
	Significance (2-tailed)	0.029	0.468	0.856	1.000	.	0.468	0.468	0.378
	N	10	10	10	10	10	10	10	10
Species Richness	Correlation Coefficient	-0.156	0.644*	-0.244	0.111	0.184	1.000	-0.467*	-0.248
	Significance (2-tailed)	0.531	0.009	0.325	0.655	0.468	.	0.060	0.384
	N	10	10	10	10	10	10	10	10
Abundance of Dominant Species (%)	Correlation Coefficient	-0.200	-0.822*	0.333	-0.378	-0.184	-0.467*	1.000	0.149
	Significance (2-tailed)	0.421	0.001	0.180	0.128	0.468	0.060	.	0.602
	N	10	10	10	10	10	10	10	10
Abnormal Cells (%)	Correlation Coefficient	-0.050	-0.149	0.248	-0.248	-0.257	-0.248	0.149	1.000
	Significance (2-tailed)	0.862	0.602	0.384	0.384	0.378	0.384	0.602	.
	N	10	10	10	10	10	10	10	10

*Correlation is significant at the 0.10 level (2-tailed). Scrape and whole rock chlorophyll-a replicate samples were not collected at Station B-10 in any year.

Appendix D.3 Temporal Graphs

Figure D-1: Shannon-Weaver Diversity Index for Biological Stations B2 to B10.

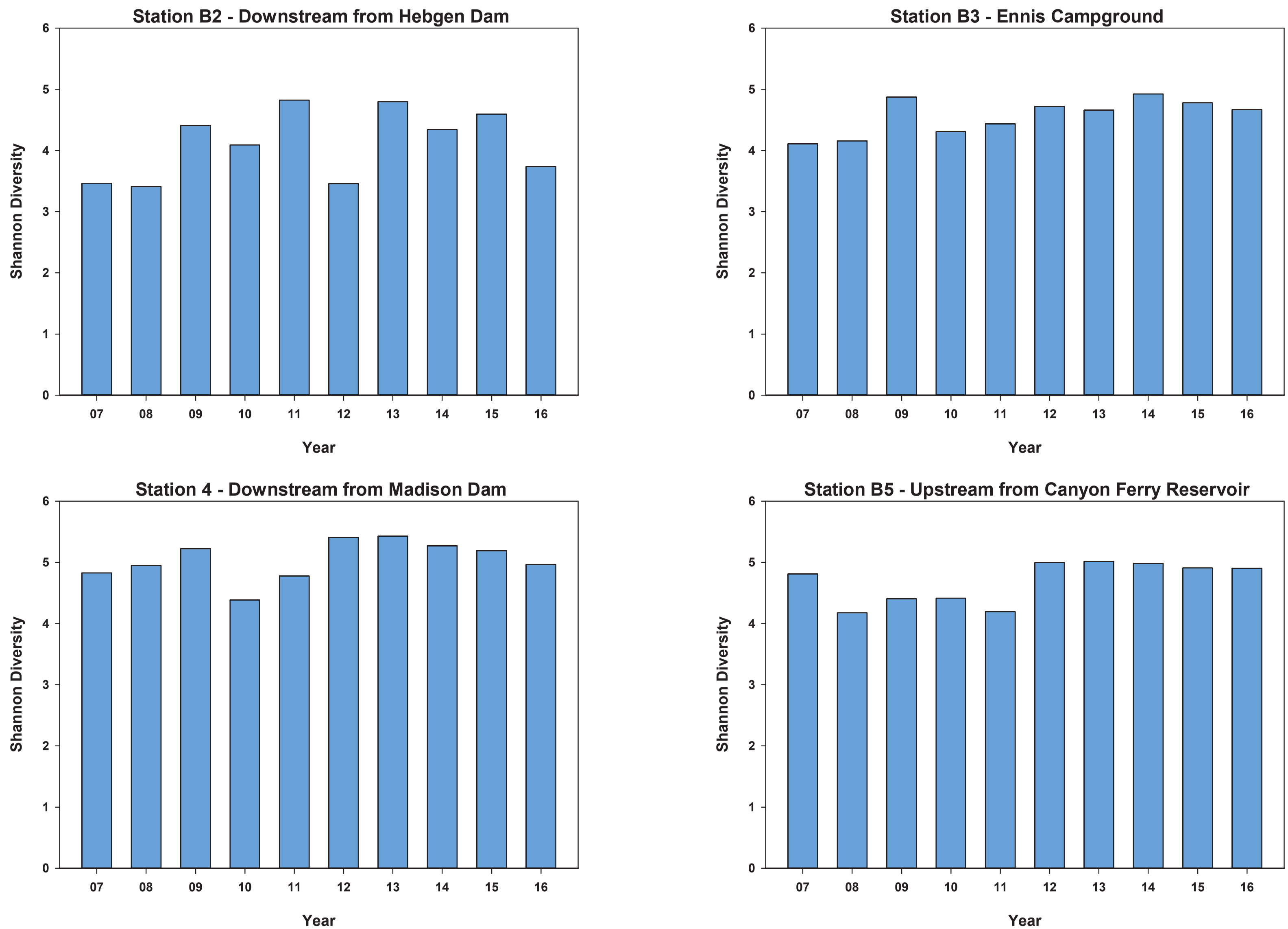
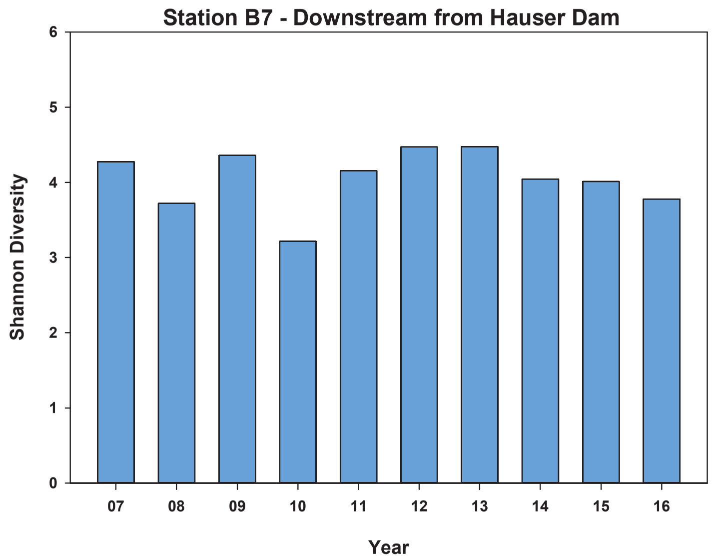
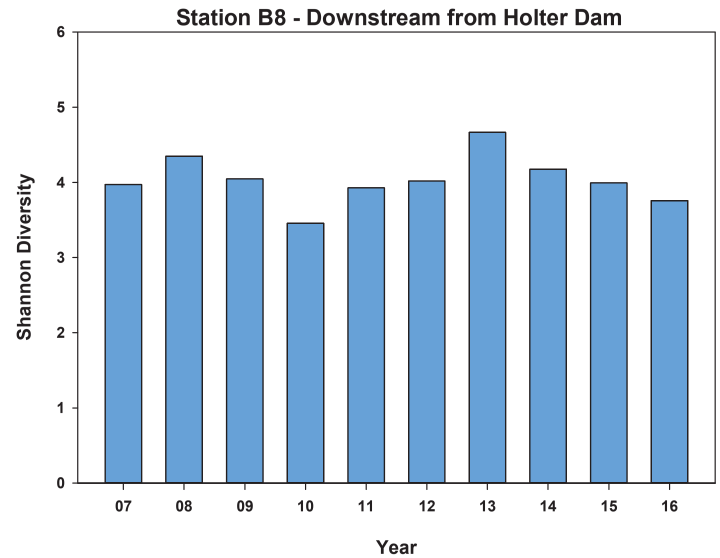


Figure D-1: Shannon-Weaver Diversity Index for Biological Stations B2 to B10 (cont.).





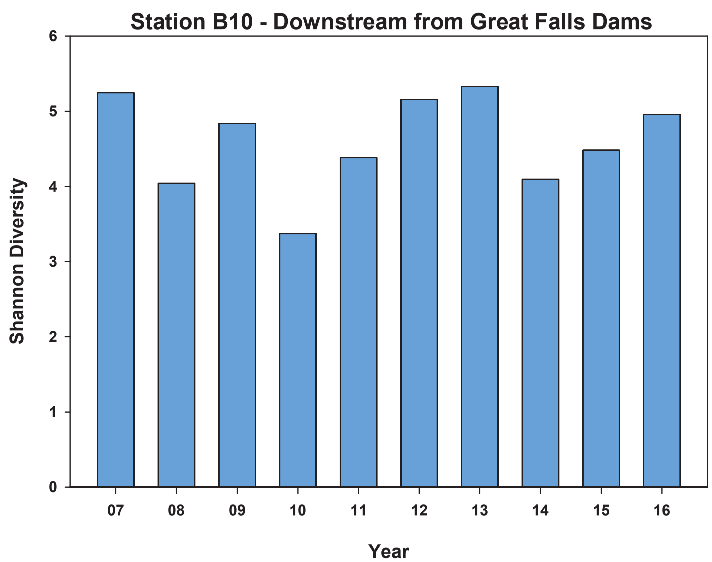


Figure D-2: Pollution Tolerance Index for Biological Stations B2 to B10.

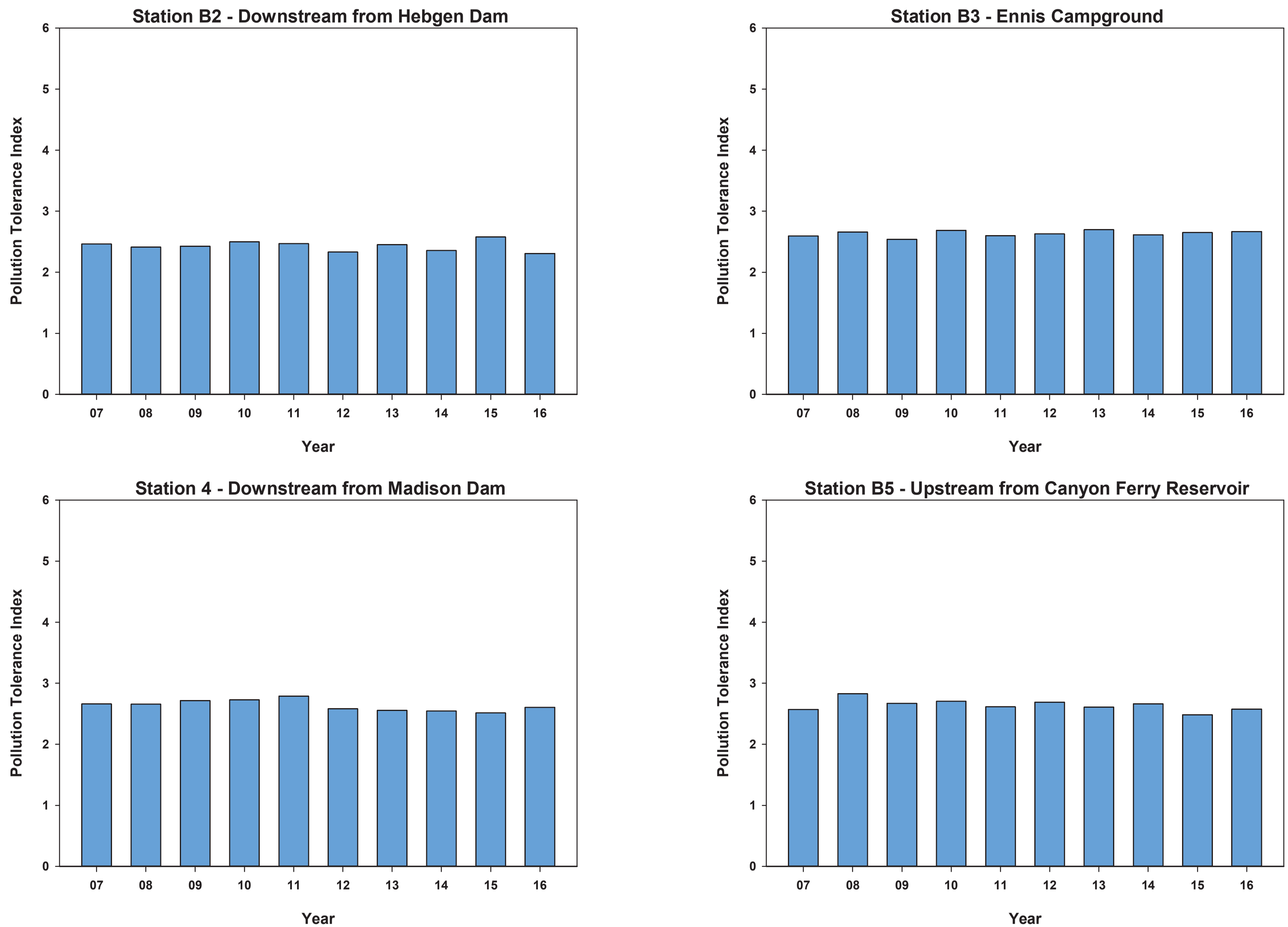
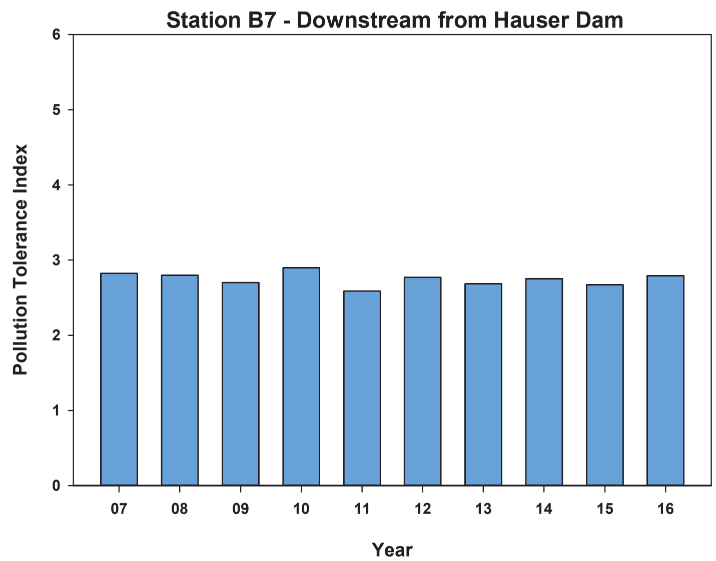
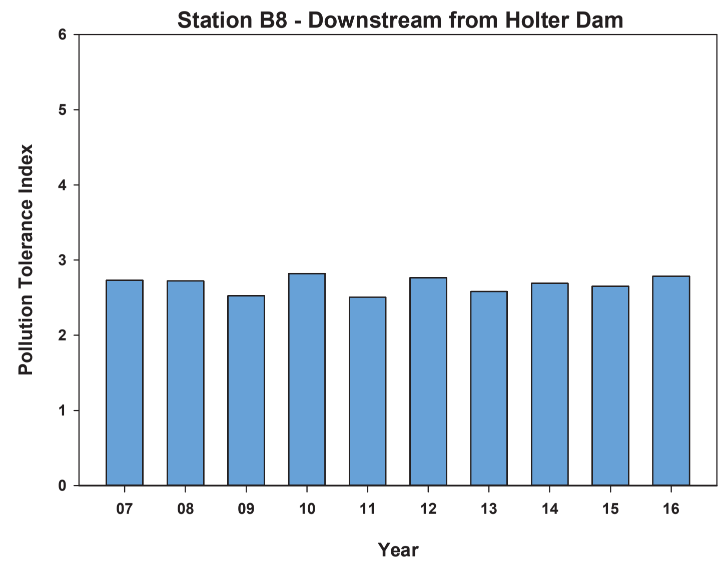


Figure D-2: Pollution Tolerance Index for Biological Stations B2 to B10 (cont.).





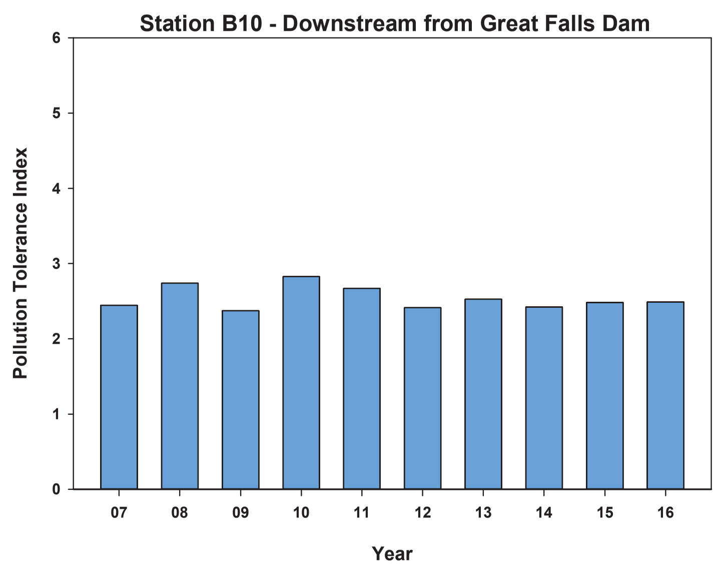


Figure D-3: Siltation Index (%) for Biological Stations B2 to B10.

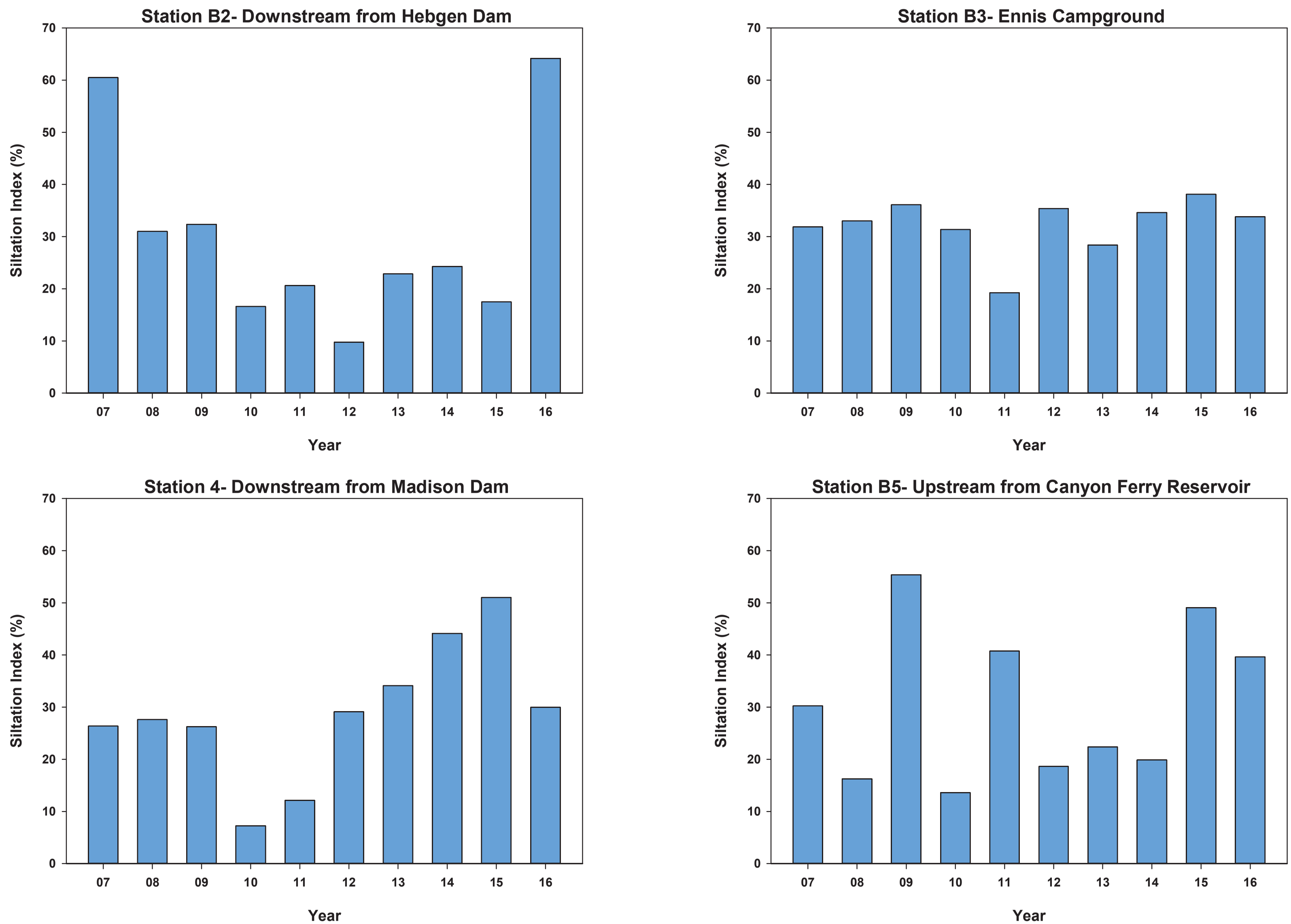
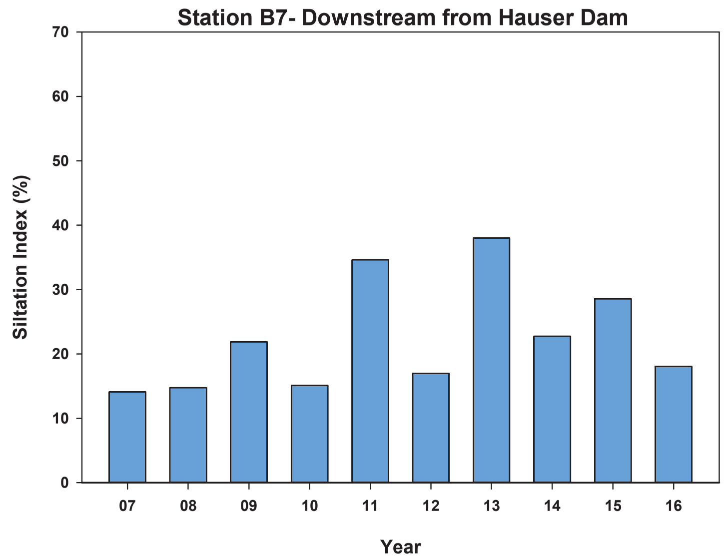
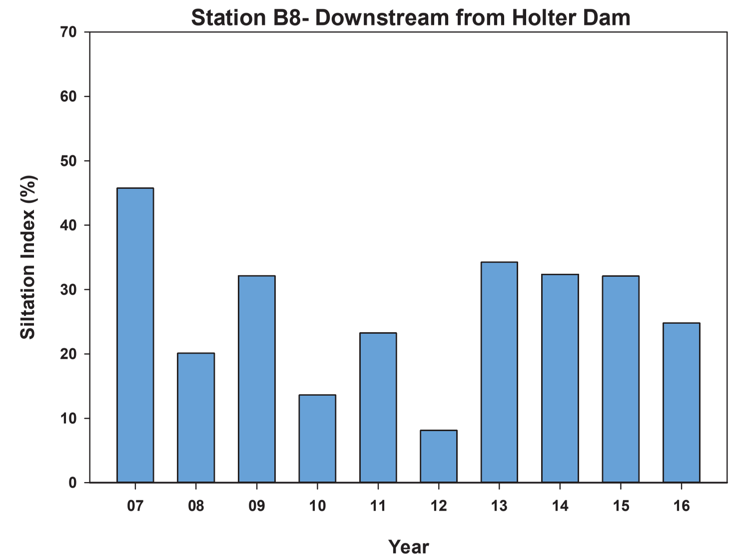


Figure D-3: Siltation Index (%) for Biological Stations B2 to B10 (cont.).





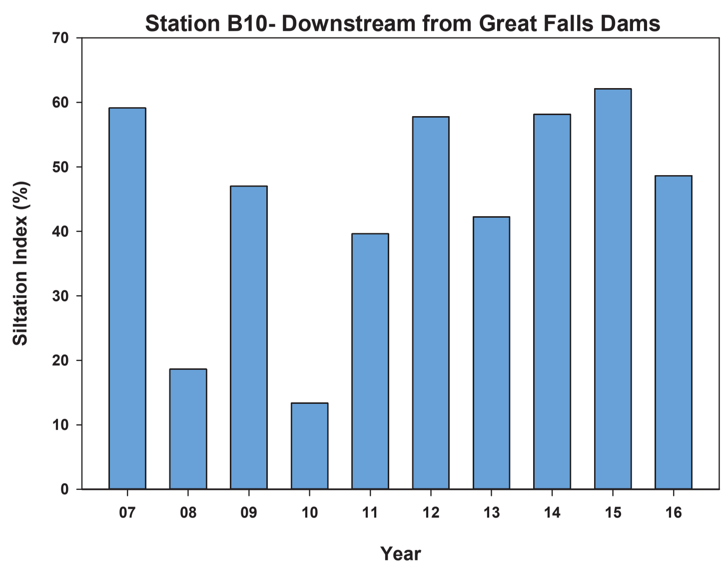


Figure D-4: Disturbance Index (%) for Biological Stations B2 to B10.

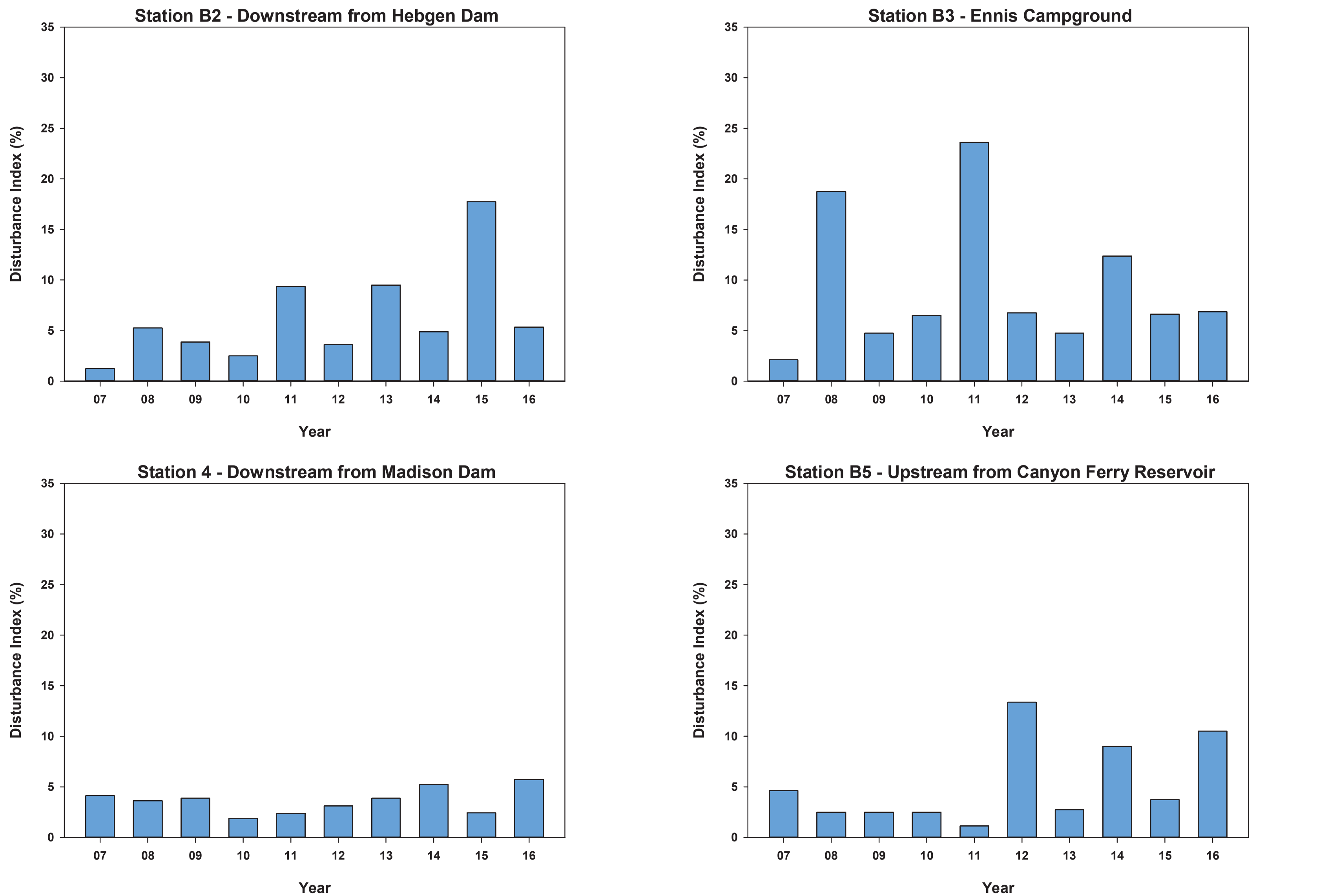
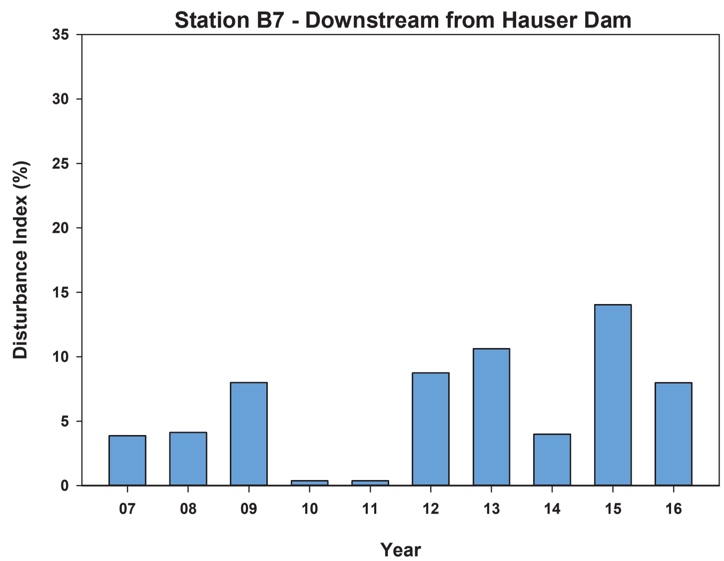
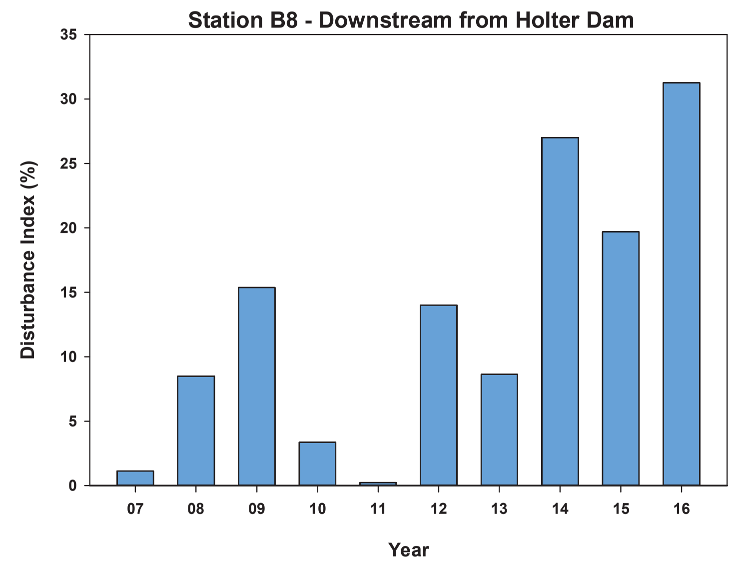


Figure D-4: Disturbance Index (%) for Biological Stations B2 to B10 (cont.).





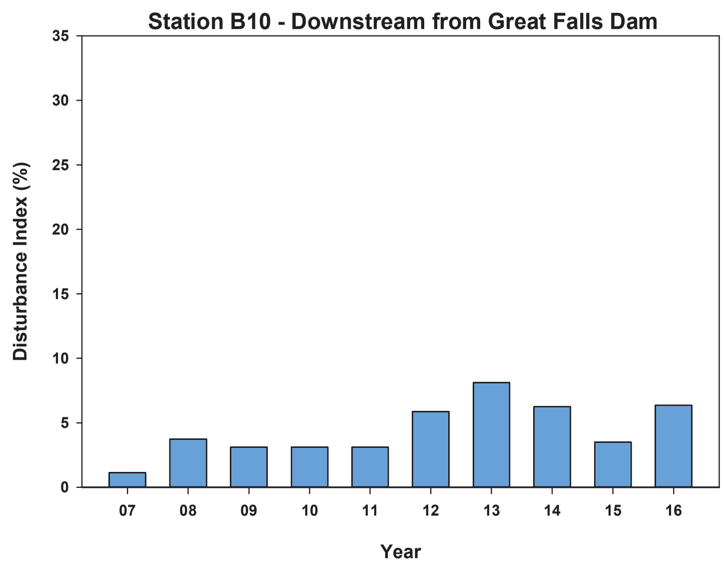


Figure D-5: Species Richness for Biological Stations B2 to B10.

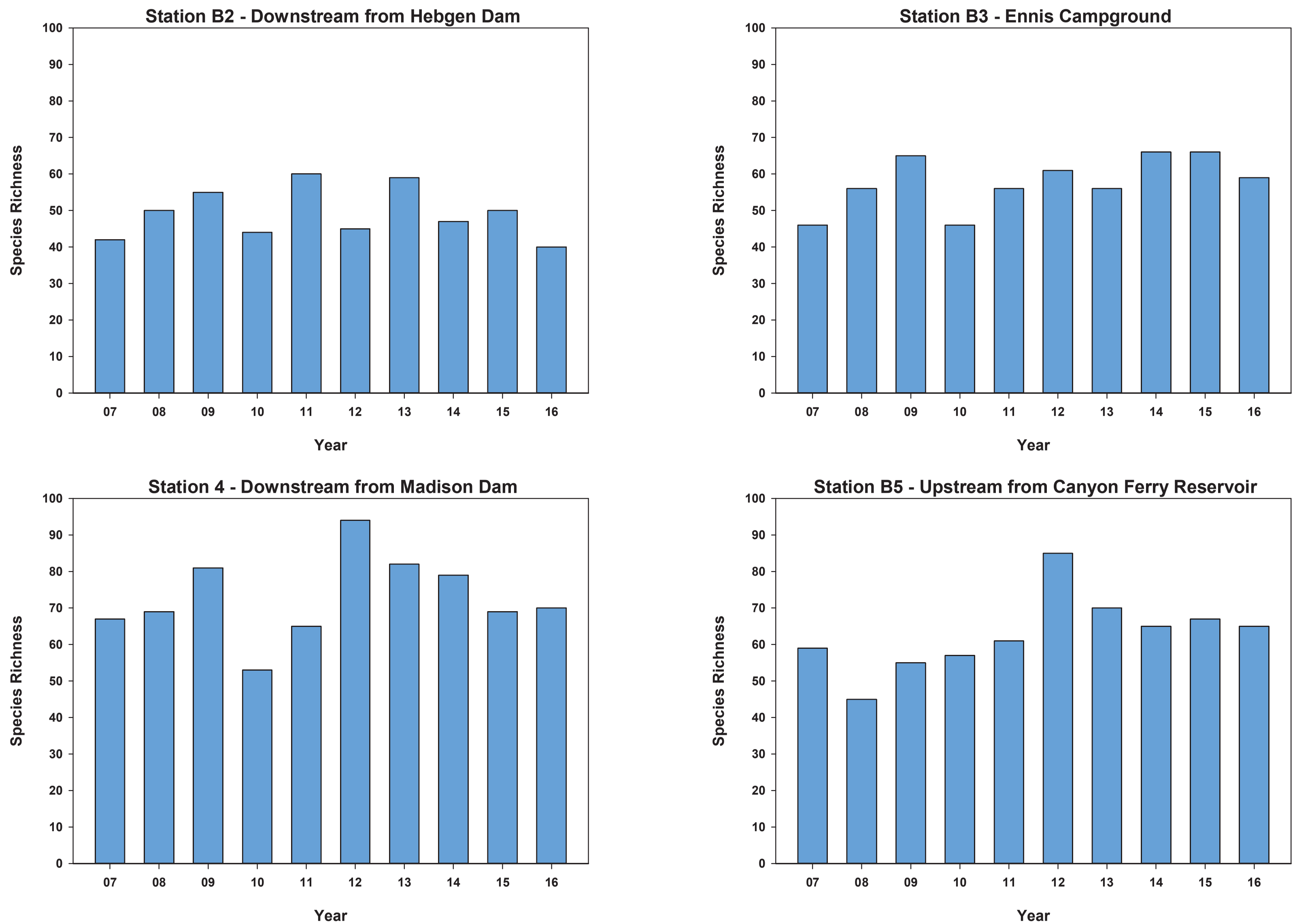
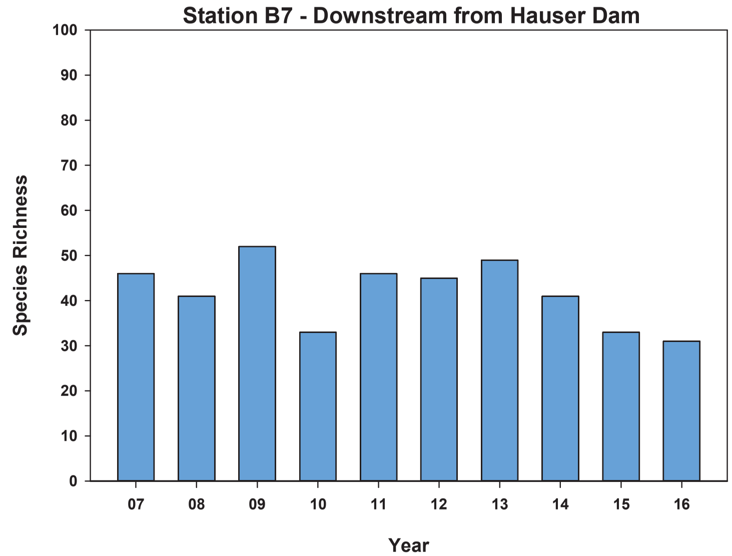
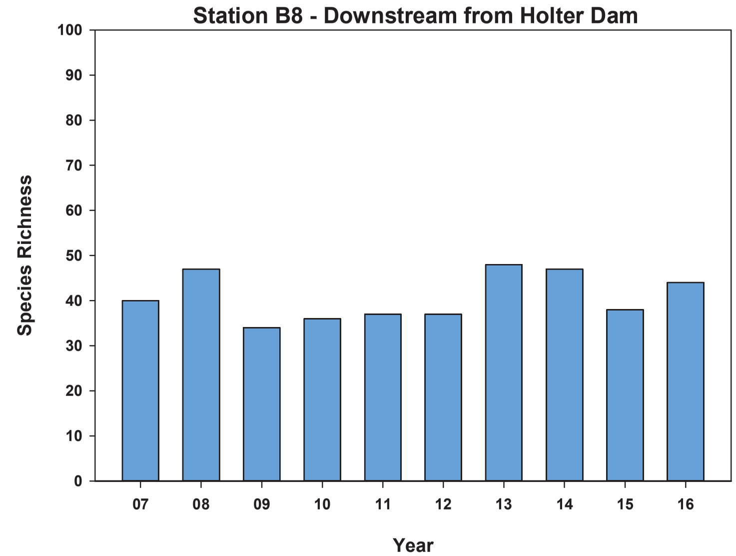


Figure D-5: Species Richness for Biological Stations B2 to B10 (cont.).





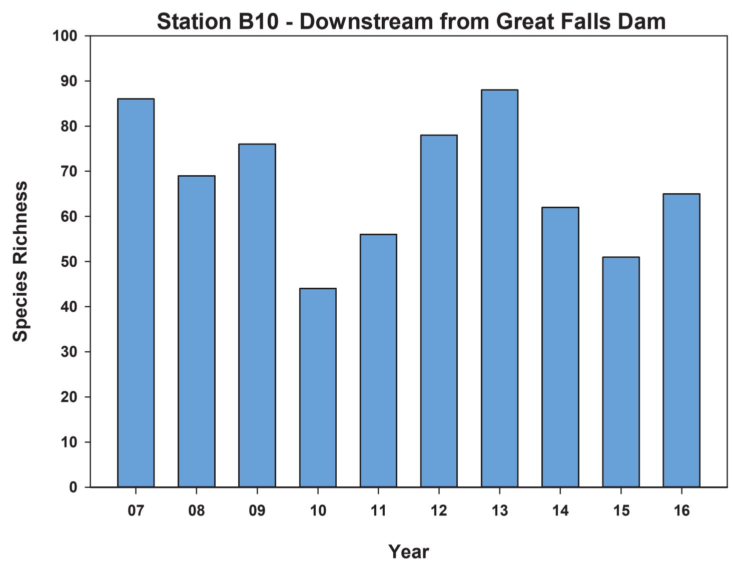


Figure D-6: Abundance of Dominant Species (%) for Biological Stations B2 to B10.

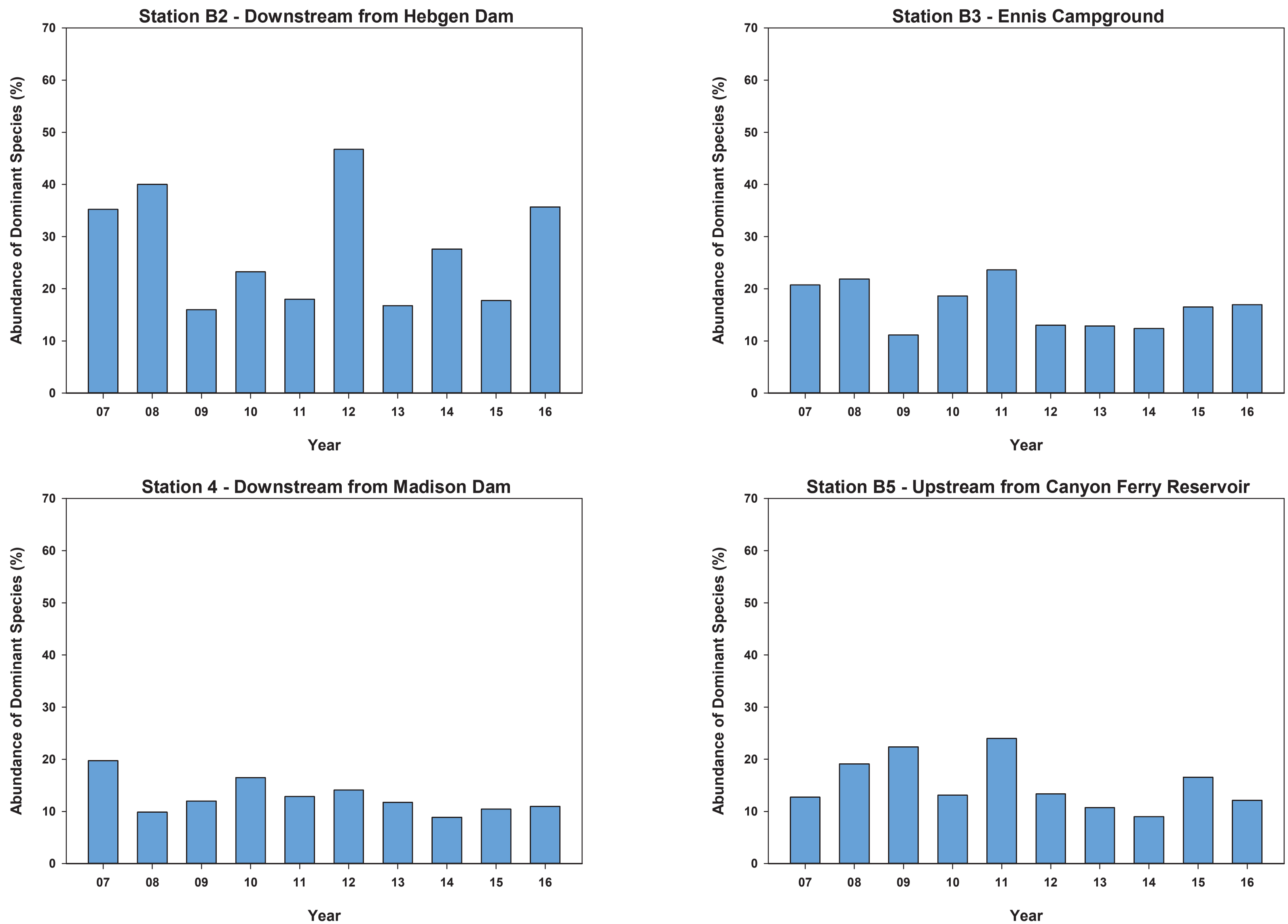
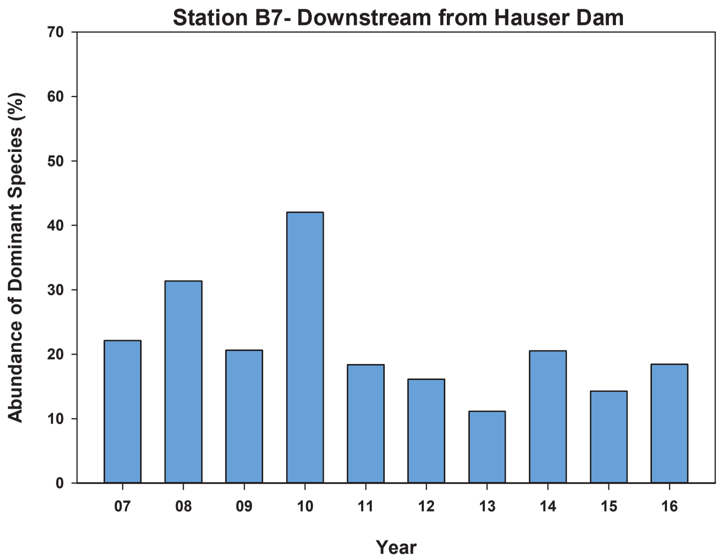
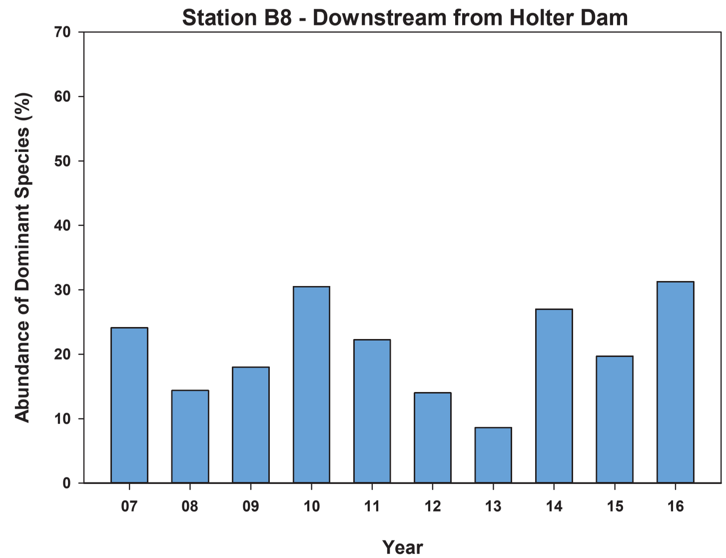


Figure D-6: Abundance of Dominant Species (%) for Biological Stations B2 to B10 (cont.).





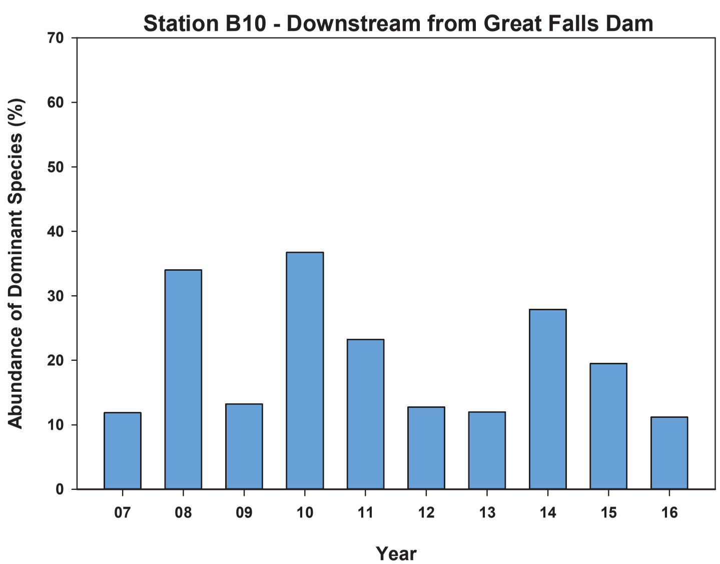
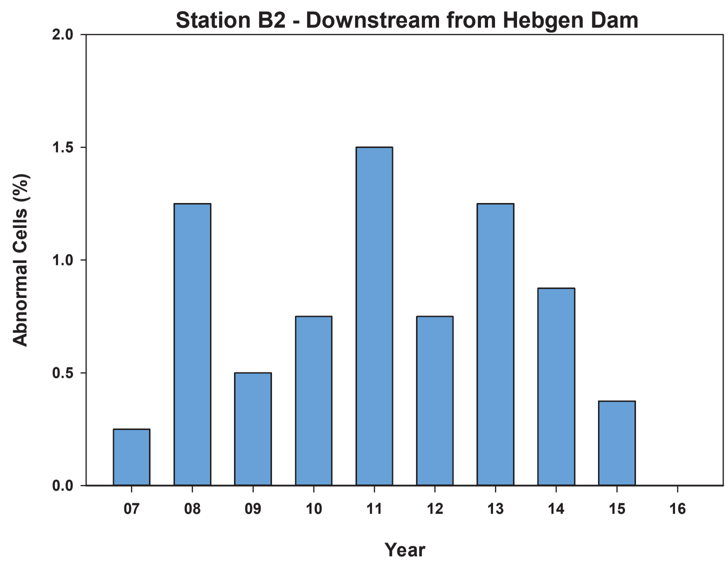
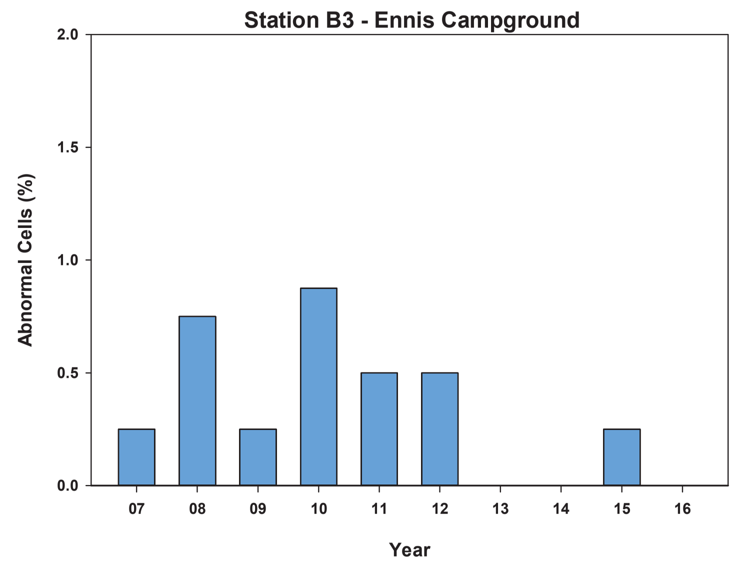
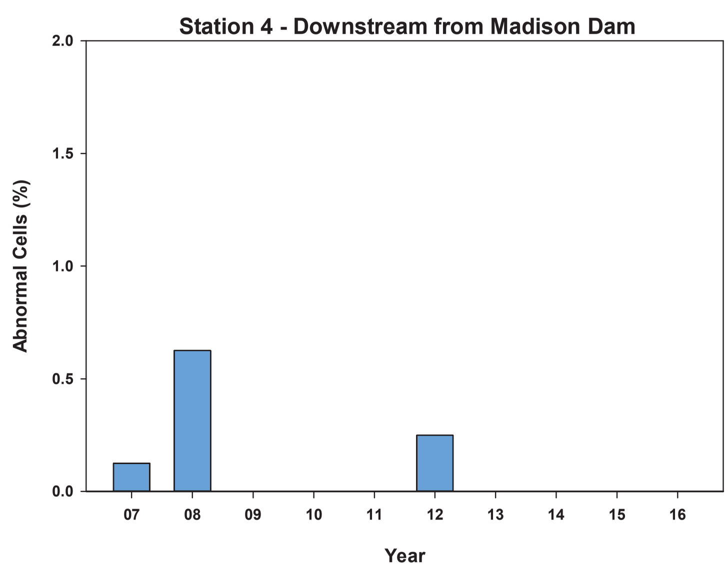


Figure D-7: Abnormal Cells (%) for Biological Stations B2 to B10.







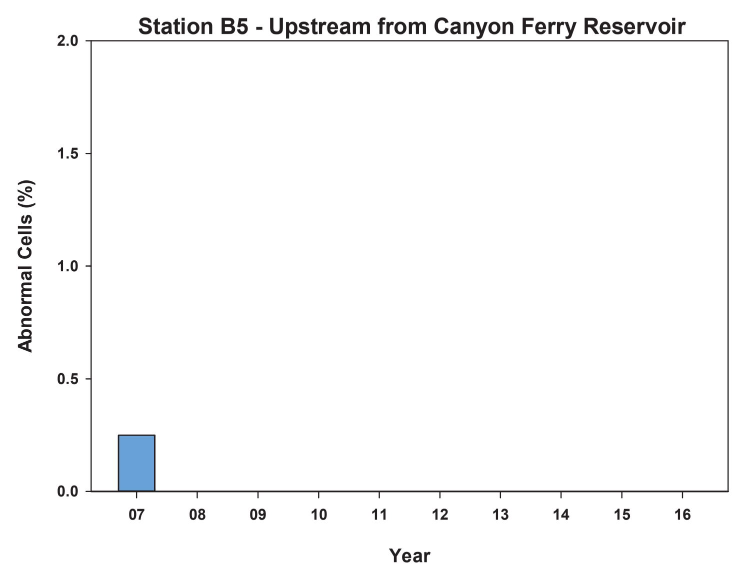
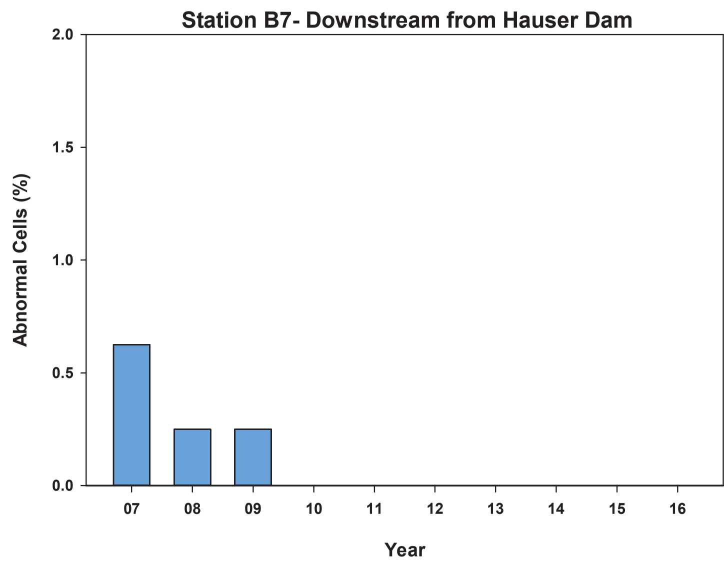
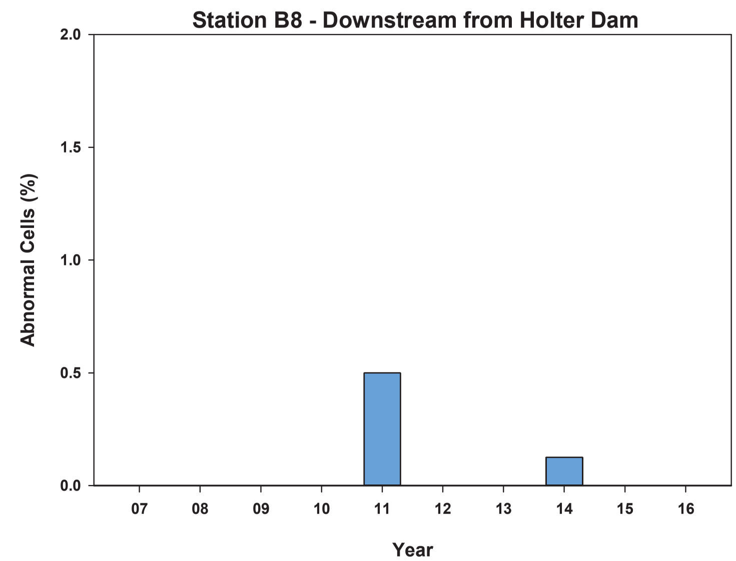
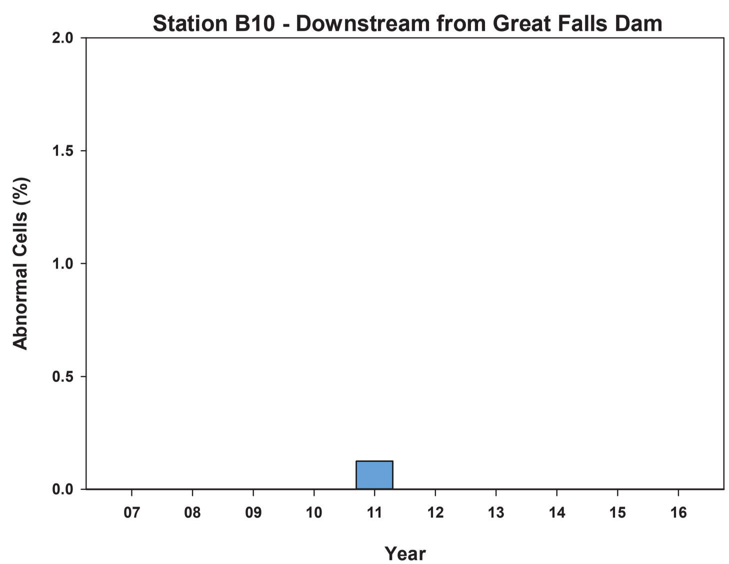


Figure D-7: Abnormal Cells (%) for Biological Stations B2 to B10 (cont.).







Appendix D.4 Biological Integrity Results

Table D-20: Overall biological integrity and impairment ratings in August, 2007 to 2016.

Station	Year	Mountains		Plains	
		Rating	Impairment	Rating	Impairment
B-2	2007	Poor	Severe	Good	Minor
	2008	Good	Minor	Good	Minor
	2009	Good	Minor	Excellent	None
	2010	Good	Minor	Excellent	None
	2011	Good	Minor	Excellent	None
	2012	Good	Minor	Good	Minor
	2013	Good	Minor	Excellent	None
	2014	Good	Minor	Good	Minor
	2015	Good	Minor	Excellent	None
	2016	Poor	Severe	Fair	Moderate
B-3	2007	Good	Minor	Excellent	None
	2008	Good	Minor	Excellent	None
	2009	Good	Minor	Excellent	None
	2010	Good	Minor	Excellent	None
	2011	Good	Minor	Excellent	None
	2012	Good	Minor	Excellent	None
	2013	Good	Minor	Excellent	None
	2014	Good	Minor	Excellent	None
	2015	Good	Minor	Excellent	None
	2016	Good	Minor	Excellent	None
4	2007	Good	Minor	Excellent	None
	2008	Good	Minor	Excellent	None
	2009	Good	Minor	Excellent	None
	2010	Excellent	None	Excellent	None
	2011	Excellent	None	Excellent	None
	2012	Good	Minor	Excellent	None
	2013	Good	Minor	Excellent	None
	2014	Fair	Moderate	Excellent	None
	2015	Fair	Moderate	Good	Minor
	2016	Good	Minor	Excellent	None
B-5	2007	Good	Minor	Excellent	None
	2008	Excellent	None	Excellent	None
	2009	Fair	Moderate	Good	Minor
	2010	Excellent	None	Excellent	None
	2011	Fair	Moderate	Excellent	None
	2012	Excellent	None	Excellent	None
	2013	Good	Minor	Excellent	None
	2014	Excellent	None	Excellent	None
	2015	Fair	Moderate	Excellent	None
	2016	Good	Minor	Excellent	None
B-7	2007	Good	Minor	Excellent	None
	2008	Good	Minor	Good	Minor
	2009	Good	Minor	Excellent	None
	2010	Good	Minor	Good	Minor
	2011	Good	Minor	Excellent	None
	2012	Excellent	None	Excellent	None
	2013	Good	Minor	Excellent	None
	2014	Good	Minor	Excellent	None
	2015	Good	Minor	Good	Minor
	2016	Excellent	None	Good	Minor

Station	Year	Mountains		Plains	
		Rating	Impairment	Rating	Impairment
B-8	2007	Fair	Moderate	Good	Minor
	2008	Good	Minor	Excellent	None
	2009	Good	Minor	Good	Minor
	2010	Good	Minor	Good	Minor
	2011	Good	Minor	Good	Minor
	2012	Excellent	None	Good	Minor
	2013	Good	Minor	Excellent	None
	2014	Good	Minor	Good	Minor
	2015	Good	Minor	Good	Minor
	2016	Good	Minor	Good	Minor
B-10	2007	Fair	Moderate	Good	Minor
	2008	Good	Minor	Good	Minor
	2009	Fair	Moderate	Excellent	None
	2010	Good	Minor	Good	Minor
	2011	Good	Minor	Excellent	None
	2012	Fair	Moderate	Good	Minor
	2013	Fair	Moderate	Excellent	None
	2014	Fair	Moderate	Good	Minor
	2015	Poor	Severe	Good	Minor
	2016	Fair	Moderate	Excellent	None

Appendix E Macroinvertebrate Metrics

Appendix E.1 Upstream-Downstream Comparisons

Table E-1: Rank comparisons of chlorophyll-a concentrations between Stations B1 and B2 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Taxa Richness[a]	B1	9	9.33	84.00
	B2	9	9.67	87.00
	Total	18		
Shannon Diversity[a]	B1	9	9.56	86.00
	B2	9	9.44	85.00
	Total	18		
Biotic Index[a]	B1	9	9.72	87.50
	B2	9	9.28	83.50
	Total	18		
EPT Richness[a]	B1	9	10.50	94.50
	B2	9	8.50	76.50
	Total	18		
Relative Abundance of EPT (%)[a]	B1	9	13.44	121.00
	B2	9	5.56	50.00
	Total	18		
Relative Abundance of Chironomidae (%)[a]	B1	9	7.94	71.50
	B2	9	11.06	99.50
	Total	18		
Community Density (0.25 m^2)[b]	B1	9	7.33	66.00
	B2	9	11.67	105.00
	Total	18		
Multimetric Assessment (Total)[c]	B1	9	12.61	113.50
	B2	9	6.39	57.50
	Total	18		
Multimetric Assessment (% of Possible)[c]	B1	9	12.61	113.50
	B2	9	6.39	57.50
	Total	18		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-2: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations B1 and B2 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	39.000	84.000	-.132	.895
Shannon Diversity[a]	40.000	85.000	-.044	.965
Biotic Index[a]	38.500	83.500	-.177	.860
EPT Richness[a]	31.500	76.500	-.796	.426
Relative Abundance of EPT (%)[a]	5.000	50.000	-3.138	.002
Relative Abundance of Chironomidae (%)[a]	26.500	71.500	-1.243	.214
Community Density (0.25 m^2)[b]	21.000	66.000	-1.722	.085
Multimetric Assessment (Total)[c]	12.500	57.500	-2.505	.012
Multimetric Assessment (% of Possible)[c]	12.500	57.500	-2.505	.012

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-3: Rank comparisons of chlorophyll-a concentrations between Stations B1 and F2 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Taxa Richness[a]	B2	9	9.28	83.50
	F1	9	9.72	87.50
	Total	18		
Shannon Diversity[a]	B2	9	9.67	87.00
	F1	9	9.33	84.00
	Total	18		
Biotic Index[a]	B2	9	5.94	53.50
	F1	9	13.06	117.50
	Total	18		
EPT Richness[a]	B2	9	9.11	82.00
	F1	9	9.89	89.00
	Total	18		
Relative Abundance of EPT (%)[a]	B2	9	13.78	124.00
	F1	9	5.22	47.00
	Total	18		
Relative Abundance of Chironomidae (%)[a]	B2	9	9.61	86.50
	F1	9	9.39	84.50
	Total	18		
Community Density (0.25 m^2)[b]	B2	9	6.33	57.00
	F1	9	12.67	114.00
	Total	18		
Multimetric Assessment (Total)[c]	B2	9	11.06	99.50
	F1	9	7.94	71.50
	Total	18		
Multimetric Assessment (% of Possible)[c]	B2	9	11.06	99.50
	F1	9	7.94	71.50
	Total	18		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-4: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations B1 and F2 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	38.500	83.500	-.177	.860
Shannon Diversity[a]	39.000	84.000	-.133	.894
Biotic Index[a]	8.500	53.500	-2.827	.005
EPT Richness[a]	37.000	82.000	-.310	.757
Relative Abundance of EPT (%)[a]	2.000	47.000	-3.403	.001
Relative Abundance of Chironomidae (%)[a]	39.500	84.500	-.088	.930
Community Density (0.25 m^2)[b]	12.000	57.000	-2.517	.012
Multimetric Assessment (Total)[c]	26.500	71.500	-1.247	.212
Multimetric Assessment (% of Possible)[c]	26.500	71.500	-1.247	.212

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-5: Rank comparisons of chlorophyll-a concentrations between Stations F1 and B3 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Taxa Richness[a]	F1	9	5.89	53.00
	B3	9	13.11	118.00
	Total	18		
Shannon Diversity[a]	F1	9	6.11	55.00
	B3	9	12.89	116.00
	Total	18		
Biotic Index[a]	F1	9	14.00	126.00
	B3	9	5.00	45.00
	Total	18		
EPT Richness[a]	F1	9	5.00	45.00
	B3	9	14.00	126.00
	Total	18		
Relative Abundance of EPT (%)[a]	F1	9	5.00	45.00
	B3	9	14.00	126.00
	Total	18		
Relative Abundance of Chironomidae (%)[a]	F1	9	12.39	111.50
	B3	9	6.61	59.50
	Total	18		
Community Density (0.25 m^2)[b]	F1	9	12.89	116.00
	B3	9	6.11	55.00
	Total	18		
Multimetric Assessment (Total)[c]	F1	9	5.00	45.00
	B3	9	14.00	126.00
	Total	18		
Multimetric Assessment (% of Possible)[c]	F1	9	5.00	45.00
	B3	9	14.00	126.00
	Total	18		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-6: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations F1 and B3 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	8.000	53.000	-2.873	.004
Shannon Diversity[a]	10.000	55.000	-2.709	.007
Biotic Index[a]	.000	45.000	-3.576	.000
EPT Richness[a]	.000	45.000	-3.580	.000
Relative Abundance of EPT (%)[a]	.000	45.000	-3.580	.000
Relative Abundance of Chironomidae (%)[a]	14.500	59.500	-2.304	.021
Community Density (0.25 m^2)[b]	10.000	55.000	-2.693	.007
Multimetric Assessment (Total)[c]	.000	45.000	-3.602	.000
Multimetric Assessment (% of Possible)[c]	.000	45.000	-3.602	.000

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-7: Rank comparisons of chlorophyll-a concentrations between Stations B3 and 4 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Taxa Richness[a]	B3	9	13.89	125.00
	4	9	5.11	46.00
	Total	18		
Shannon Diversity[a]	B3	9	14.00	126.00
	4	9	5.00	45.00
	Total	18		
Biotic Index[a]	B3	9	5.00	45.00
	4	9	14.00	126.00
	Total	18		
EPT Richness[a]	B3	9	14.00	126.00
	4	9	5.00	45.00
	Total	18		
Relative Abundance of EPT (%)[a]	B3	9	13.44	121.00
	4	9	5.56	50.00
	Total	18		
Relative Abundance of Chironomidae (%)[a]	B3	9	5.44	49.00
	4	9	13.56	122.00
	Total	18		
Community Density (0.25 m^2)[b]	B3	9	5.00	45.00
	4	9	14.00	126.00
	Total	18		
Multimetric Assessment (Total)[c]	B3	9	14.00	126.00
	4	9	5.00	45.00
	Total	18		
Multimetric Assessment (% of Possible)[c]	B3	9	14.00	126.00
	4	9	5.00	45.00
	Total	18		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-8: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations B3 and 4 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	1.000	46.000	-3.492	.000
Shannon Diversity[a]	.000	45.000	-3.578	.000
Biotic Index[a]	.000	45.000	-3.576	.000
EPT Richness[a]	.000	45.000	-3.585	.000
Relative Abundance of EPT (%)[a]	5.000	50.000	-3.136	.002
Relative Abundance of Chironomidae (%)[a]	4.000	49.000	-3.243	.001
Community Density (0.25 m^2)[b]	.000	45.000	-3.576	.000
Multimetric Assessment (Total)[c]	.000	45.000	-3.602	.000
Multimetric Assessment (% of Possible)[c]	.000	45.000	-3.602	.000

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-9: Rank comparisons of chlorophyll-a concentrations between Stations 4 and F3 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Taxa Richness[a]	4	9	5.33	48.00
	F3	8	13.13	105.00
	Total	17		
Shannon Diversity[a]	4	9	5.00	45.00
	F3	8	13.50	108.00
	Total	17		
Biotic Index[a]	4	9	12.89	116.00
	F3	8	4.63	37.00
	Total	17		
EPT Richness[a]	4	9	5.00	45.00
	F3	8	13.50	108.00
	Total	17		
Relative Abundance of EPT (%)[a]	4	9	5.33	48.00
	F3	8	13.13	105.00
	Total	17		
Relative Abundance of Chironomidae (%)[a]	4	9	10.39	93.50
	F3	8	7.44	59.50
	Total	17		
Community Density (0.25 m^2)[b]	4	9	13.00	117.00
	F3	8	4.50	36.00
	Total	17		
Multimetric Assessment (Total)[c]	4	9	5.11	46.00
	F3	8	13.38	107.00
	Total	17		
Multimetric Assessment (% of Possible)[c]	4	9	5.11	46.00
	F3	8	13.38	107.00
	Total	17		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-10: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations 4 and F3 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	3.000	48.000	-3.177	.001
Shannon Diversity[a]	.000	45.000	-3.466	.001
Biotic Index[a]	1.000	37.000	-3.368	.001
EPT Richness[a]	.000	45.000	-3.473	.001
Relative Abundance of EPT (%)[a]	3.000	48.000	-3.177	.001
Relative Abundance of Chironomidae (%)[a]	23.500	59.500	-1.207	.228
Community Density (0.25 m^2)[b]	.000	36.000	-3.464	.001
Multimetric Assessment (Total)[c]	1.000	46.000	-3.376	.001
Multimetric Assessment (% of Possible)[c]	1.000	46.000	-3.376	.001

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-11: Rank comparisons of chlorophyll-a concentrations between Stations F3 and F4 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Taxa Richness[a]	F3	8	9.38	75.00
	F4	8	7.63	61.00
	Total	16		
Shannon Diversity[a]	F3	8	8.25	66.00
	F4	8	8.75	70.00
	Total	16		
Biotic Index[a]	F3	8	9.19	73.50
	F4	8	7.81	62.50
	Total	16		
EPT Richness[a]	F3	8	8.31	66.50
	F4	8	8.69	69.50
	Total	16		
Relative Abundance of EPT (%)[a]	F3	8	6.13	49.00
	F4	8	10.88	87.00
	Total	16		
Relative Abundance of Chironomidae (%)[a]	F3	8	10.25	82.00
	F4	8	6.75	54.00
	Total	16		
Community Density (0.25 m^2)[b]	F3	8	5.75	46.00
	F4	8	11.25	90.00
	Total	16		
Multimetric Assessment (Total)[c]	F3	8	7.94	63.50
	F4	8	9.06	72.50
	Total	16		
Multimetric Assessment (% of Possible)[c]	F3	8	7.94	63.50
	F4	8	9.06	72.50
	Total	16		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-12: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations F3 and F4 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	25.000	61.000	-.736	.462
Shannon Diversity[a]	30.000	66.000	-.210	.834
Biotic Index[a]	26.500	62.500	-.578	.563
EPT Richness[a]	30.500	66.500	-.158	.874
Relative Abundance of EPT (%)[a]	13.000	49.000	-2.007	.045
Relative Abundance of Chironomidae (%)[a]	18.000	54.000	-1.481	.139
Community Density (0.25 m^2)[b]	10.000	46.000	-2.310	.021
Multimetric Assessment (Total)[c]	27.500	63.500	-.479	.632
Multimetric Assessment (% of Possible)[c]	27.500	63.500	-.479	.632

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-13: Rank comparisons of chlorophyll-a concentrations between Stations F4 and F5 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
	F4	8	10.75	86.00
Taxa Richness[a]	B5	9	7.44	67.00
	Total	17		
	F4	8	8.63	69.00
Shannon Diversity[a]	B5	9	9.33	84.00
	Total	17		
	F4	8	5.75	46.00
Biotic Index[a]	B5	9	11.89	107.00
	Total	17		
	F4	8	8.38	67.00
EPT Richness[a]	B5	9	9.56	86.00
	Total	17		
	F4	8	8.69	69.50
Relative Abundance of EPT (%)[a]	B5	9	9.28	83.50
	Total	17		
	F4	8	6.63	53.00
Relative Abundance of Chironomidae (%)[a]	B5	9	11.11	100.00
	Total	17		
	F4	8	10.38	83.00
Community Density (0.25 m^2)[b]	B5	9	7.78	70.00
	Total	17		
	F4	8	10.31	82.50
Multimetric Assessment (Total)[c]	B5	9	7.83	70.50
	Total	17		
	F4	8	10.31	82.50
Multimetric Assessment (% of Possible)[c]	B5	9	7.83	70.50
	Total	17		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-14: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations F4 and F5 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	22.000	67.000	-1.348	.178
Shannon Diversity[a]	33.000	69.000	-.289	.772
Biotic Index[a]	10.000	46.000	-2.503	.012
EPT Richness[a]	31.000	67.000	-.482	.630
Relative Abundance of EPT (%)[a]	33.500	69.500	-.241	.809
Relative Abundance of Chironomidae (%)[a]	17.000	53.000	-1.834	.067
Community Density (0.25 m^2)[b]	25.000	70.000	-1.058	.290
Multimetric Assessment (Total)[c]	25.500	70.500	-1.023	.306
Multimetric Assessment (% of Possible)[c]	25.500	70.500	-1.023	.306

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-15: Rank comparisons of chlorophyll-a concentrations between Stations B5 and B7 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Taxa Richness[a]	B5	9	14.00	126.00
	B7	9	5.00	45.00
	Total	18		
Shannon Diversity[a]	B5	9	14.00	126.00
	B7	9	5.00	45.00
	Total	18		
Biotic Index[a]	B5	9	5.22	47.00
	B7	9	13.78	124.00
	Total	18		
EPT Richness[a]	B5	9	14.00	126.00
	B7	9	5.00	45.00
	Total	18		
Relative Abundance of EPT (%)[a]	B5	9	13.94	125.50
	B7	9	5.06	45.50
	Total	18		
Relative Abundance of Chironomidae (%)[a]	B5	9	9.11	82.00
	B7	9	9.89	89.00
	Total	18		
Community Density (0.25 m^2)[b]	B5	9	5.00	45.00
	B7	9	14.00	126.00
	Total	18		
Multimetric Assessment (Total)[c]	B5	9	14.00	126.00
	B7	9	5.00	45.00
	Total	18		
Multimetric Assessment (% of Possible)[c]	B5	9	14.00	126.00
	B7	9	5.00	45.00
	Total	18		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-16: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations B5 and B7 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	.000	45.000	-3.584	.000
Shannon Diversity[a]	.000	45.000	-3.578	.000
Biotic Index[a]	2.000	47.000	-3.400	.001
EPT Richness[a]	.000	45.000	-3.580	.000
Relative Abundance of EPT (%)[a]	.500	45.500	-3.541	.000
Relative Abundance of Chironomidae (%)[a]	37.000	82.000	-.310	.757
Community Density (0.25 m^2)[b]	.000	45.000	-3.576	.000
Multimetric Assessment (Total)[c]	.000	45.000	-3.602	.000
Multimetric Assessment (% of Possible)[c]	.000	45.000	-3.602	.000

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-17: Rank comparisons of chlorophyll-a concentrations between Stations B7 and B10 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Taxa Richness[a]	B7	9	6.61	59.50
	B8	9	12.39	111.50
	Total	18		
Shannon Diversity[a]	B7	9	7.72	69.50
	B8	9	11.28	101.50
	Total	18		
Biotic Index[a]	B7	9	9.72	87.50
	B8	9	9.28	83.50
	Total	18		
EPT Richness[a]	B7	9	6.28	56.50
	B8	9	12.72	114.50
	Total	18		
Relative Abundance of EPT (%)[a]	B7	9	6.56	59.00
	B8	9	12.44	112.00
	Total	18		
Relative Abundance of Chironomidae (%)[a]	B7	9	11.83	106.50
	B8	9	7.17	64.50
	Total	18		
Community Density (0.25 m^2)[b]	B7	9	9.33	84.00
	B8	9	9.67	87.00
	Total	18		
Multimetric Assessment (Total)[c]	B7	9	6.44	58.00
	B8	9	12.56	113.00
	Total	18		
Multimetric Assessment (% of Possible)[c]	B7	9	6.44	58.00
	B8	9	12.56	113.00
	Total	18		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-18: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations B7 and B10 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	14.500	59.500	-2.303	.021
Shannon Diversity[a]	24.500	69.500	-1.414	.157
Biotic Index[a]	38.500	83.500	-.177	.860
EPT Richness[a]	11.500	56.500	-2.567	.010
Relative Abundance of EPT (%)[a]	14.000	59.000	-2.349	.019
Relative Abundance of Chironomidae (%)[a]	19.500	64.500	-1.867	.062
Community Density (0.25 m^2)[b]	39.000	84.000	-.132	.895
Multimetric Assessment (Total)[c]	13.000	58.000	-2.451	.014
Multimetric Assessment (% of Possible)[c]	13.000	58.000	-2.451	.014

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-19: Rank comparisons of chlorophyll-a concentrations between Stations B8 and B10 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
Taxa Richness[a]	B8	9	5.11	46.00
	B10	9	13.89	125.00
	Total	18		
Shannon Diversity[a]	B8	9	6.28	56.50
	B10	9	12.72	114.50
	Total	18		
Biotic Index[a]	B8	9	12.78	115.00
	B10	9	6.22	56.00
	Total	18		
EPT Richness[a]	B8	9	5.00	45.00
	B10	9	14.00	126.00
	Total	18		
Relative Abundance of EPT (%)[a]	B8	9	5.89	53.00
	B10	9	13.11	118.00
	Total	18		
Relative Abundance of Chironomidae (%)[a]	B8	9	7.00	63.00
	B10	9	12.00	108.00
	Total	18		
Community Density (0.25 m^2)[b]	B8	9	13.89	125.00
	B10	9	5.11	46.00
	Total	18		
Multimetric Assessment (Total)[c]	B8	9	5.67	51.00
	B10	9	13.33	120.00
	Total	18		
Multimetric Assessment (% of Possible)[c]	B8	9	5.67	51.00
	B10	9	13.33	120.00
	Total	18		

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Table E-20: Mann–Whitney *U* test results for chlorophyll-a concentrations at Stations B8 and B10 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Taxa Richness[a]	1.000	46.000	-3.497	.000
Shannon Diversity[a]	11.500	56.500	-2.563	.010
Biotic Index[a]	11.000	56.000	-2.605	.009
EPT Richness[a]	.000	45.000	-3.580	.000
Relative Abundance of EPT (%)[a]	8.000	53.000	-2.885	.004
Relative Abundance of Chironomidae (%)[a]	18.000	63.000	-1.989	.047
Community Density (0.25 m^2)[b]	1.000	46.000	-3.488	.000
Multimetric Assessment (Total)[c]	6.000	51.000	-3.069	.002
Multimetric Assessment (% of Possible)[c]	6.000	51.000	-3.069	.002

[a]Subsample of 300
[b]Pooled sample
[c]Metric Score
Note: No for ratio of amphipoda to isopoda at all sites

Appendix E.2 Correlation Matrices

Table E-21: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station B-1 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density ($0.25 m^2$)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	-0.167	-0.333	0.111	-0.254	-0.254	-0.400	0.167	-0.426	-0.426
	Significance (2-tailed)	.	0.532	0.211	0.677	0.345	0.345	0.140	0.532	0.128	0.128
	N	9	9	9	9	9	9	9	9	9	9
Taxa Richness[a]	Correlation Coefficient	-0.167	1.000	0.611*	0.167	0.761*	-0.535*	0.686*	-0.333	0.122	0.122
	Significance (2-tailed)	0.532	.	0.022	0.532	0.005	0.046	0.011	0.211	0.664	0.664
	N	9	9	9	9	9	9	9	9	9	9
Shannon Diversity[a]	Correlation Coefficient	-0.333	0.611*	1.000	0.333	0.592*	-0.310	0.457*	-0.389	0.122	0.122
	Significance (2-tailed)	0.211	0.022	.	0.211	0.028	0.249	0.092	0.144	0.664	0.664
	N	9	9	9	9	9	9	9	9	9	9
Biotic Index[a]	Correlation Coefficient	0.111	0.167	0.333	1.000	-0.085	-0.535*	0.057	-0.389	-0.487*	-0.487*
	Significance (2-tailed)	0.677	0.532	0.211	.	0.753	0.046	0.833	0.144	0.082	0.082
	N	9	9	9	9	9	9	9	9	9	9
EPT Richness[a]	Correlation Coefficient	-0.254	0.761*	0.592*	-0.085	1.000	-0.400	0.551*	-0.310	0.216	0.216
	Significance (2-tailed)	0.345	0.005	0.028	0.753	.	0.140	0.044	0.249	0.445	0.445
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of EPT (%)a	Correlation Coefficient	-0.254	-0.535*	-0.310	-0.535*	-0.400	1.000	-0.203	0.423	0.370	0.370
	Significance (2-tailed)	0.345	0.046	0.249	0.046	0.140	.	0.458	0.116	0.190	0.190
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	-0.400	0.686*	0.457*	0.057	0.551*	-0.203	1.000	-0.286	0.125	0.125
	Significance (2-tailed)	0.140	0.011	0.092	0.833	0.044	0.458	.	0.292	0.661	0.661
	N	9	9	9	9	9	9	9	9	9	9
Community Density ($0.25 m^2$)[b]	Correlation Coefficient	0.167	-0.333	-0.389	-0.389	-0.310	0.423	-0.286	1.000	-0.061	-0.061
	Significance (2-tailed)	0.532	0.211	0.144	0.144	0.249	0.116	0.292	.	0.828	0.828
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (Total)[c]	Correlation Coefficient	-0.426	0.122	0.122	-0.487*	0.216	0.370	0.125	-0.061	1.000	1.000
	Significance (2-tailed)	0.128	0.664	0.664	0.082	0.445	0.190	0.661	0.828	.	.
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	-0.426	0.122	0.122	-0.487*	0.216	0.370	0.125	-0.061	1.000	1.000
	Significance (2-tailed)	0.128	0.664	0.664	0.082	0.445	0.190	0.661	0.828	.	.
	N	9	9	9	9	9	9	9	9	9	9

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-22: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station B-2 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density (0.25 m²)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	-0.667*	-0.444*	0.444*	-0.704*	0.366	-0.648*	-0.056	-0.145	-0.145
	Significance (2-tailed)	.	0.012	0.095	0.095	0.009	0.173	0.016	0.835	0.595	0.595
	N	9	9	9	9	9	9	9	9	9	9
Taxa Richness[a]	Correlation Coefficient	-0.667*	1.000	0.778*	-0.667*	0.930*	-0.366	0.648*	-0.167	0.377	0.377
	Significance (2-tailed)	0.012	.	0.004	0.012	0.001	0.173	0.016	0.532	0.167	0.167
	N	9	9	9	9	9	9	9	9	9	9
Shannon Diversity[a]	Correlation Coefficient	-0.444*	0.778*	1.000	-0.667*	0.761*	-0.366	0.423	-0.389	0.493*	0.493*
	Significance (2-tailed)	0.095	0.004	.	0.012	0.005	0.173	0.116	0.144	0.070	0.070
	N	9	9	9	9	9	9	9	9	9	9
Biotic Index[a]	Correlation Coefficient	0.444*	-0.667*	-0.667*	1.000	-0.761*	0.366	-0.310	0.056	-0.203	-0.203
	Significance (2-tailed)	0.095	0.012	0.012	.	0.005	0.173	0.249	0.835	0.456	0.456
	N	9	9	9	9	9	9	9	9	9	9
EPT Richness[a]	Correlation Coefficient	-0.704*	0.930*	0.761*	-0.761*	1.000	-0.343	0.571*	-0.141	0.353	0.353
	Significance (2-tailed)	0.009	0.001	0.005	0.005	.	0.206	0.035	0.600	0.199	0.199
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of EPT (%)a	Correlation Coefficient	0.366	-0.366	-0.366	0.366	-0.343	1.000	-0.571*	0.028	0.000	0.000
	Significance (2-tailed)	0.173	0.173	0.173	0.173	0.206	.	0.035	0.917	1.000	1.000
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	-0.648*	0.648*	0.423	-0.310	0.571*	-0.571*	1.000	-0.028	0.000	0.000
	Significance (2-tailed)	0.016	0.016	0.116	0.249	0.035	0.035	.	0.917	1.000	1.000
	N	9	9	9	9	9	9	9	9	9	9
Community Density (0.25 m²)[b]	Correlation Coefficient	-0.056	-0.167	-0.389	0.056	-0.141	0.028	-0.028	1.000	-0.319	-0.319
	Significance (2-tailed)	0.835	0.532	0.144	0.835	0.600	0.917	0.917	.	0.242	0.242
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (Total)[c]	Correlation Coefficient	-0.145	0.377	0.493*	-0.203	0.353	0.000	0.000	-0.319	1.000	1.000
	Significance (2-tailed)	0.595	0.167	0.070	0.456	0.199	1.000	1.000	0.242	.	.
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	-0.145	0.377	0.493*	-0.203	0.353	0.000	0.000	-0.319	1.000	1.000
	Significance (2-tailed)	0.595	0.167	0.070	0.456	0.199	1.000	1.000	0.242	.	.
	N	9	9	9	9	9	9	9	9	9	9

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-23: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station F-1 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density (0.25 m^2)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	0.254	0.183	0.167	0.479*	-0.254	0.056	0.556*	0.000	0.000
	Significance (2-tailed)	.	0.345	0.511	0.532	0.075	0.345	0.835	0.037	1.000	1.000
	N	9	9	9	9	9	9	9	9	9	9
Taxa Richness[a]	Correlation Coefficient	0.254	1.000	0.555*	-0.535*	0.686*	0.229	0.648*	0.028	0.435	0.435
	Significance (2-tailed)	0.345	.	0.048	0.046	0.011	0.399	0.016	0.917	0.112	0.112
	N	9	9	9	9	9	9	9	9	9	9
Shannon Diversity[a]	Correlation Coefficient	0.183	0.555*	1.000	-0.487*	0.586*	0.525*	0.365	0.122	0.501*	0.501*
	Significance (2-tailed)	0.511	0.048	.	0.080	0.036	0.061	0.189	0.661	0.077	0.077
	N	9	9	9	9	9	9	9	9	9	9
Biotic Index[a]	Correlation Coefficient	0.167	-0.535*	-0.487*	1.000	-0.366	-0.704*	-0.556*	0.278	-0.114	-0.114
	Significance (2-tailed)	0.532	0.046	0.080	.	0.173	0.009	0.037	0.297	0.673	0.673
	N	9	9	9	9	9	9	9	9	9	9
EPT Richness[a]	Correlation Coefficient	0.479*	0.686*	0.586*	-0.366	1.000	0.171	0.423	0.366	0.261	0.261
	Significance (2-tailed)	0.075	0.011	0.036	0.173	.	0.527	0.116	0.173	0.340	0.340
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of EPT (%)a	Correlation Coefficient	-0.254	0.229	0.525*	-0.704*	0.171	1.000	0.254	-0.366	0.377	0.377
	Significance (2-tailed)	0.345	0.399	0.061	0.009	0.527	.	0.345	0.173	0.168	0.168
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	0.056	0.648*	0.365	-0.556*	0.423	0.254	1.000	-0.167	0.171	0.171
	Significance (2-tailed)	0.835	0.016	0.189	0.037	0.116	0.345	.	0.532	0.527	0.527
	N	9	9	9	9	9	9	9	9	9	9
Community Density (0.25 m^2)[b]	Correlation Coefficient	0.556*	0.028	0.122	0.278	0.366	-0.366	-0.167	1.000	0.114	0.114
	Significance (2-tailed)	0.037	0.917	0.661	0.297	0.173	0.173	0.532	.	0.673	0.673
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (Total)[c]	Correlation Coefficient	0.000	0.435	0.501*	-0.114	0.261	0.377	0.171	0.114	1.000	1.000
	Significance (2-tailed)	1.000	0.112	0.077	0.673	0.340	0.168	0.527	0.673	.	.
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	0.000	0.435	0.501*	-0.114	0.261	0.377	0.171	0.114	1.000	1.000
	Significance (2-tailed)	1.000	0.112	0.077	0.673	0.340	0.168	0.527	0.673	.	.
	N	9	9	9	9	9	9	9	9	9	9

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-24: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station B-3 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density (0.25 m^2)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	-0.366	-0.423	-0.500*	-0.197	0.366	-0.319	0.722*	0.315	0.315
	Significance (2-tailed)	.	0.173	0.116	0.061	0.463	0.173	0.242	0.007	0.268	0.268
	N	9	9	9	9	9	9	9	9	9	9
Taxa Richness[a]	Correlation Coefficient	-0.366	1.000	0.514*	0.085	0.286	-0.457*	0.441	-0.535*	-0.160	-0.160
	Significance (2-tailed)	0.173	.	0.058	0.753	0.292	0.092	0.109	0.046	0.577	0.577
	N	9	9	9	9	9	9	9	9	9	9
Shannon Diversity[a]	Correlation Coefficient	-0.423	0.514*	1.000	0.366	0.629*	-0.571*	-0.029	-0.704*	-0.383	-0.383
	Significance (2-tailed)	0.116	0.058	.	0.173	0.020	0.035	0.915	0.009	0.181	0.181
	N	9	9	9	9	9	9	9	9	9	9
Biotic Index[a]	Correlation Coefficient	-0.500*	0.085	0.366	1.000	0.310	-0.366	-0.087	-0.333	-0.441	-0.441
	Significance (2-tailed)	0.061	0.753	0.173	.	0.249	0.173	0.750	0.211	0.121	0.121
	N	9	9	9	9	9	9	9	9	9	9
EPT Richness[a]	Correlation Coefficient	-0.197	0.286	0.629*	0.310	1.000	-0.371	-0.294	-0.310	0.032	0.032
	Significance (2-tailed)	0.463	0.292	0.020	0.249	.	0.171	0.285	0.249	0.911	0.911
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of EPT (%)a	Correlation Coefficient	0.366	-0.457*	-0.571*	-0.366	-0.371	1.000	-0.118	0.366	0.607*	0.607*
	Significance (2-tailed)	0.173	0.092	0.035	0.173	0.171	.	0.669	0.173	0.034	0.034
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	-0.319	0.441	-0.029	-0.087	-0.294	-0.118	1.000	-0.261	0.000	0.000
	Significance (2-tailed)	0.242	0.109	0.915	0.750	0.285	0.669	.	0.338	1.000	1.000
	N	9	9	9	9	9	9	9	9	9	9
Community Density (0.25 m^2)[b]	Correlation Coefficient	0.722*	-0.535*	-0.704*	-0.333	-0.310	0.366	-0.261	1.000	0.252	0.252
	Significance (2-tailed)	0.007	0.046	0.009	0.211	0.249	0.173	0.338	.	0.375	0.375
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (Total)[c]	Correlation Coefficient	0.315	-0.160	-0.383	-0.441	0.032	0.607*	0.000	0.252	1.000	1.000
	Significance (2-tailed)	0.268	0.577	0.181	0.121	0.911	0.034	1.000	0.375	.	.
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	0.315	-0.160	-0.383	-0.441	0.032	0.607*	0.000	0.252	1.000	1.000
	Significance (2-tailed)	0.268	0.577	0.181	0.121	0.911	0.034	1.000	0.375	.	.
	N	9	9	9	9	9	9	9	9	9	9

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-25: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station 4 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density (0.25 m^2)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	-0.141	0.222	-0.222	0.029	0.500*	0.085	0.167	0.114	0.114
	Significance (2-tailed)	.	0.600	0.404	0.404	0.915	0.061	0.753	0.532	0.673	0.673
	N	9	9	9	9	9	9	9	9	9	9
Taxa Richness[a]	Correlation Coefficient	-0.141	1.000	0.423	0.028	0.588*	0.141	-0.343	-0.366	0.609*	0.609*
	Significance (2-tailed)	0.600	.	0.116	0.917	0.032	0.600	0.206	0.173	0.026	0.026
	N	9	9	9	9	9	9	9	9	9	9
Shannon Diversity[a]	Correlation Coefficient	0.222	0.423	1.000	-0.111	0.087	0.278	0.254	-0.056	0.457*	0.457*
	Significance (2-tailed)	0.404	0.116	.	0.677	0.750	0.297	0.345	0.835	0.092	0.092
	N	9	9	9	9	9	9	9	9	9	9
Biotic Index[a]	Correlation Coefficient	-0.222	0.028	-0.111	1.000	-0.087	-0.500*	-0.254	-0.278	-0.400	-0.400
	Significance (2-tailed)	0.404	0.917	0.677	.	0.750	0.061	0.345	0.297	0.140	0.140
	N	9	9	9	9	9	9	9	9	9	9
EPT Richness[a]	Correlation Coefficient	0.029	0.588*	0.087	-0.087	1.000	0.203	-0.559*	-0.087	0.567*	0.567*
	Significance (2-tailed)	0.915	0.032	0.750	0.750	.	0.456	0.042	0.750	0.041	0.041
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of EPT (%)a	Correlation Coefficient	0.500*	0.141	0.278	-0.500*	0.203	1.000	0.028	0.000	0.400	0.400
	Significance (2-tailed)	0.061	0.600	0.297	0.061	0.456	.	0.917	1.000	0.140	0.140
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	0.085	-0.343	0.254	-0.254	-0.559*	0.028	1.000	0.254	-0.261	-0.261
	Significance (2-tailed)	0.753	0.206	0.345	0.345	0.042	0.917	.	0.345	0.340	0.340
	N	9	9	9	9	9	9	9	9	9	9
Community Density (0.25 m^2)[b]	Correlation Coefficient	0.167	-0.366	-0.056	-0.278	-0.087	0.000	0.254	1.000	-0.171	-0.171
	Significance (2-tailed)	0.532	0.173	0.835	0.297	0.750	1.000	0.345	.	0.527	0.527
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (Total)[c]	Correlation Coefficient	0.114	0.609*	0.457*	-0.400	0.567*	0.400	-0.261	-0.171	1.000	1.000
	Significance (2-tailed)	0.673	0.026	0.092	0.140	0.041	0.140	0.340	0.527	.	.
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	0.114	0.609*	0.457*	-0.400	0.567*	0.400	-0.261	-0.171	1.000	1.000
	Significance (2-tailed)	0.673	0.026	0.092	0.140	0.041	0.140	0.340	0.527	.	.
	N	9	9	9	9	9	9	9	9	9	9

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-26: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station F-3 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density (0.25 m^2)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	0.286	0.182	0.500*	-0.071	-0.691*	0.869*	0.143	-0.519*	-0.519*
	Significance (2-tailed)	.	0.322	0.533	0.083	0.805	0.018	0.004	0.621	0.079	0.079
	N	8	8	8	8	8	8	8	8	8	8
Taxa Richness[a]	Correlation Coefficient	0.286	1.000	0.327	-0.071	0.643*	-0.109	0.340	-0.286	0.148	0.148
	Significance (2-tailed)	0.322	.	0.262	0.805	0.026	0.708	0.254	0.322	0.615	0.615
	N	8	8	8	8	8	8	8	8	8	8
Shannon Diversity[a]	Correlation Coefficient	0.182	0.327	1.000	-0.036	0.473	-0.148	0.308	-0.400	0.038	0.038
	Significance (2-tailed)	0.533	0.262	.	0.901	0.105	0.615	0.307	0.170	0.899	0.899
	N	8	8	8	8	8	8	8	8	8	8
Biotic Index[a]	Correlation Coefficient	0.500*	-0.071	-0.036	1.000	-0.286	-0.837*	0.491*	0.071	-0.964*	-0.964*
	Significance (2-tailed)	0.083	0.805	0.901	.	0.322	0.004	0.100	0.805	0.001	0.001
	N	8	8	8	8	8	8	8	8	8	8
EPT Richness[a]	Correlation Coefficient	-0.071	0.643*	0.473	-0.286	1.000	0.109	0.038	-0.500*	0.371	0.371
	Significance (2-tailed)	0.805	0.026	0.105	0.322	.	0.708	0.899	0.083	0.209	0.209
	N	8	8	8	8	8	8	8	8	8	8
Relative Abundance of EPT (%)a	Correlation Coefficient	-0.691*	-0.109	-0.148	-0.837*	0.109	1.000	-0.693*	-0.036	0.793*	0.793*
	Significance (2-tailed)	0.018	0.708	0.615	0.004	0.708	.	0.022	0.901	0.008	0.008
	N	8	8	8	8	8	8	8	8	8	8
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	0.869*	0.340	0.308	0.491*	0.038	-0.693*	1.000	-0.038	-0.510*	-0.510*
	Significance (2-tailed)	0.004	0.254	0.307	0.100	0.899	0.022	.	0.899	0.095	0.095
	N	8	8	8	8	8	8	8	8	8	8
Community Density (0.25 m^2)[b]	Correlation Coefficient	0.143	-0.286	-0.400	0.071	-0.500*	-0.036	-0.038	1.000	-0.148	-0.148
	Significance (2-tailed)	0.621	0.322	0.170	0.805	0.083	0.901	0.899	.	0.615	0.615
	N	8	8	8	8	8	8	8	8	8	8
Multimetric Assessment, (Total)[c]	Correlation Coefficient	-0.519*	0.148	0.038	-0.964*	0.371	0.793*	-0.510*	-0.148	1.000	1.000
	Significance (2-tailed)	0.079	0.615	0.899	0.001	0.209	0.008	0.095	0.615	.	.
	N	8	8	8	8	8	8	8	8	8	8
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	-0.519*	0.148	0.038	-0.964*	0.371	0.793*	-0.510*	-0.148	1.000	1.000
	Significance (2-tailed)	0.079	0.615	0.899	0.001	0.209	0.008	0.095	0.615	.	.
	N	8	8	8	8	8	8	8	8	8	8

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-27: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station F-4 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density (0.25 m²)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	-0.182	-0.286	0.473	-0.327	0.189	-0.109	0.357	-0.189	-0.189
	Significance (2-tailed)	.	0.533	0.322	0.105	0.262	0.524	0.708	0.216	0.527	0.527
	N	8	8	8	8	8	8	8	8	8	8
Taxa Richness[a]	Correlation Coefficient	-0.182	1.000	0.691*	0.370	0.741*	-0.385	0.074	0.182	0.539*	0.539*
	Significance (2-tailed)	0.533	.	0.018	0.209	0.012	0.200	0.802	0.533	0.074	0.074
	N	8	8	8	8	8	8	8	8	8	8
Shannon Diversity[a]	Correlation Coefficient	-0.286	0.691*	1.000	0.255	0.618*	-0.416	0.109	0.214	0.265	0.265
	Significance (2-tailed)	0.322	0.018	.	0.383	0.034	0.161	0.708	0.458	0.375	0.375
	N	8	8	8	8	8	8	8	8	8	8
Biotic Index[a]	Correlation Coefficient	0.473	0.370	0.255	1.000	0.222	-0.154	-0.148	0.691*	0.000	0.000
	Significance (2-tailed)	0.105	0.209	0.383	.	0.451	0.608	0.615	0.018	1.000	1.000
	N	8	8	8	8	8	8	8	8	8	8
EPT Richness[a]	Correlation Coefficient	-0.327	0.741*	0.618*	0.222	1.000	-0.154	-0.148	0.182	0.616*	0.616*
	Significance (2-tailed)	0.262	0.012	0.034	0.451	.	0.608	0.615	0.533	0.041	0.041
	N	8	8	8	8	8	8	8	8	8	8
Relative Abundance of EPT (%)a	Correlation Coefficient	0.189	-0.385	-0.416	-0.154	-0.154	1.000	-0.731*	0.113	0.160	0.160
	Significance (2-tailed)	0.524	0.200	0.161	0.608	0.608	.	0.015	0.702	0.603	0.603
	N	8	8	8	8	8	8	8	8	8	8
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	-0.109	0.074	0.109	-0.148	-0.148	-0.731*	1.000	-0.400	-0.385	-0.385
	Significance (2-tailed)	0.708	0.802	0.708	0.615	0.615	0.015	.	0.170	0.202	0.202
	N	8	8	8	8	8	8	8	8	8	8
Community Density (0.25 m²)[b]	Correlation Coefficient	0.357	0.182	0.214	0.691*	0.182	0.113	-0.400	1.000	-0.113	-0.113
	Significance (2-tailed)	0.216	0.533	0.458	0.018	0.533	0.702	0.170	.	0.704	0.704
	N	8	8	8	8	8	8	8	8	8	8
Multimetric Assessment, (Total)[c]	Correlation Coefficient	-0.189	0.539*	0.265	0.000	0.616*	0.160	-0.385	-0.113	1.000	1.000
	Significance (2-tailed)	0.527	0.074	0.375	1.000	0.041	0.603	0.202	0.704	.	.
	N	8	8	8	8	8	8	8	8	8	8
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	-0.189	0.539*	0.265	0.000	0.616*	0.160	-0.385	-0.113	1.000	1.000
	Significance (2-tailed)	0.527	0.074	0.375	1.000	0.041	0.603	0.202	0.704	.	.
	N	8	8	8	8	8	8	8	8	8	8

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-28: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station B-5 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density (0.25 m^2)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	-0.278	-0.423	0.444*	-0.254	-0.222	0.333	0.111	-0.286	-0.286
	Significance (2-tailed)	.	0.297	0.116	0.095	0.345	0.404	0.211	0.677	0.292	0.292
	N	9	9	9	9	9	9	9	9	9	9
Taxa Richness[a]	Correlation Coefficient	-0.278	1.000	0.761*	-0.278	0.535*	0.056	-0.167	-0.167	0.400	0.400
	Significance (2-tailed)	0.297	.	0.005	0.297	0.046	0.835	0.532	0.532	0.140	0.140
	N	9	9	9	9	9	9	9	9	9	9
Shannon Diversity[a]	Correlation Coefficient	-0.423	0.761*	1.000	-0.535*	0.514*	0.310	-0.423	-0.028	0.609*	0.609*
	Significance (2-tailed)	0.116	0.005	.	0.046	0.058	0.249	0.116	0.917	0.026	0.026
	N	9	9	9	9	9	9	9	9	9	9
Biotic Index[a]	Correlation Coefficient	0.444*	-0.278	-0.535*	1.000	-0.592*	-0.778*	0.889*	-0.222	-0.857*	-0.857*
	Significance (2-tailed)	0.095	0.297	0.046	.	0.028	0.004	0.001	0.404	0.002	0.002
	N	9	9	9	9	9	9	9	9	9	9
EPT Richness[a]	Correlation Coefficient	-0.254	0.535*	0.514*	-0.592*	1.000	0.479*	-0.479*	0.254	0.667*	0.667*
	Significance (2-tailed)	0.345	0.046	0.058	0.028	.	0.075	0.075	0.345	0.015	0.015
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of EPT (%)a	Correlation Coefficient	-0.222	0.056	0.310	-0.778*	0.479*	1.000	-0.889*	0.444*	0.686*	0.686*
	Significance (2-tailed)	0.404	0.835	0.249	0.004	0.075	.	0.001	0.095	0.011	0.011
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	0.333	-0.167	-0.423	0.889*	-0.479*	-0.889*	1.000	-0.333	-0.743*	-0.743*
	Significance (2-tailed)	0.211	0.532	0.116	0.001	0.075	0.001	.	0.211	0.006	0.006
	N	9	9	9	9	9	9	9	9	9	9
Community Density (0.25 m^2)[b]	Correlation Coefficient	0.111	-0.167	-0.028	-0.222	0.254	0.444*	-0.333	1.000	0.171	0.171
	Significance (2-tailed)	0.677	0.532	0.917	0.404	0.345	0.095	0.211	.	0.527	0.527
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (Total)[c]	Correlation Coefficient	-0.286	0.400	0.609*	-0.857*	0.667*	0.686*	-0.743*	0.171	1.000	1.000
	Significance (2-tailed)	0.292	0.140	0.026	0.002	0.015	0.011	0.006	0.527	.	.
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	-0.286	0.400	0.609*	-0.857*	0.667*	0.686*	-0.743*	0.171	1.000	1.000
	Significance (2-tailed)	0.292	0.140	0.026	0.002	0.015	0.011	0.006	0.527	.	.
	N	9	9	9	9	9	9	9	9	9	9

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-29: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station B-7 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density (0.25 m²)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	-0.319	-0.389	-0.278	0.141	-0.029	-0.551*	0.111	0.000	0.000
	Significance (2-tailed)	.	0.242	0.144	0.297	0.600	0.915	0.043	0.677	1.000	1.000
	N	9	9	9	9	9	9	9	9	9	9
Taxa Richness[a]	Correlation Coefficient	-0.319	1.000	0.957*	-0.319	0.177	0.485*	0.364	-0.493*	0.461	0.461
	Significance (2-tailed)	0.242	.	0.000	0.242	0.521	0.083	0.193	0.070	0.114	0.114
	N	9	9	9	9	9	9	9	9	9	9
Shannon Diversity[a]	Correlation Coefficient	-0.389	0.957*	1.000	-0.222	0.141	0.435	0.377	-0.500*	0.378	0.378
	Significance (2-tailed)	0.144	0.000	.	0.404	0.600	0.110	0.167	0.061	0.183	0.183
	N	9	9	9	9	9	9	9	9	9	9
Biotic Index[a]	Correlation Coefficient	-0.278	-0.319	-0.222	1.000	-0.535*	-0.551*	0.319	0.278	-0.756*	-0.756*
	Significance (2-tailed)	0.297	0.242	0.404	.	0.046	0.043	0.242	0.297	0.008	0.008
	N	9	9	9	9	9	9	9	9	9	9
EPT Richness[a]	Correlation Coefficient	0.141	0.177	0.141	-0.535*	1.000	0.500*	-0.412	-0.028	0.511*	0.511*
	Significance (2-tailed)	0.600	0.521	0.600	0.046	.	0.069	0.134	0.917	0.075	0.075
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of EPT (%)a	Correlation Coefficient	-0.029	0.485*	0.435	-0.551*	0.500*	1.000	0.061	-0.087	0.592*	0.592*
	Significance (2-tailed)	0.915	0.083	0.110	0.043	0.069	.	0.828	0.750	0.042	0.042
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	-0.551*	0.364	0.377	0.319	-0.412	0.061	1.000	-0.261	-0.263	-0.263
	Significance (2-tailed)	0.043	0.193	0.167	0.242	0.134	0.828	.	0.338	0.366	0.366
	N	9	9	9	9	9	9	9	9	9	9
Community Density (0.25 m²)[b]	Correlation Coefficient	0.111	-0.493*	-0.500*	0.278	-0.028	-0.087	-0.261	1.000	-0.189	-0.189
	Significance (2-tailed)	0.677	0.070	0.061	0.297	0.917	0.750	0.338	.	0.506	0.506
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (Total)[c]	Correlation Coefficient	0.000	0.461	0.378	-0.756*	0.511*	0.592*	-0.263	-0.189	1.000	1.000
	Significance (2-tailed)	1.000	0.114	0.183	0.008	0.075	0.042	0.366	0.506	.	.
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	0.000	0.461	0.378	-0.756*	0.511*	0.592*	-0.263	-0.189	1.000	1.000
	Significance (2-tailed)	1.000	0.114	0.183	0.008	0.075	0.042	0.366	0.506	.	.
	N	9	9	9	9	9	9	9	9	9	9

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-30: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station B-8 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density (0.25 m^2)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	-0.535*	-0.761*	0.278	-0.366	-0.535*	-0.028	0.500*	-0.551*	-0.551*
	Significance (2-tailed)	.	0.046	0.005	0.297	0.173	0.046	0.917	0.061	0.044	0.044
	N	9	9	9	9	9	9	9	9	9	9
Taxa Richness[a]	Correlation Coefficient	-0.535*	1.000	0.514*	0.197	0.171	0.229	0.171	-0.592*	0.235	0.235
	Significance (2-tailed)	0.046	.	0.058	0.463	0.527	0.399	0.527	0.028	0.394	0.394
	N	9	9	9	9	9	9	9	9	9	9
Shannon Diversity[a]	Correlation Coefficient	-0.761*	0.514*	1.000	-0.310	0.400	0.571*	0.000	-0.592*	0.530*	0.530*
	Significance (2-tailed)	0.005	0.058	.	0.249	0.140	0.035	1.000	0.028	0.055	0.055
	N	9	9	9	9	9	9	9	9	9	9
Biotic Index[a]	Correlation Coefficient	0.278	0.197	-0.310	1.000	0.028	-0.592*	-0.141	0.000	-0.203	-0.203
	Significance (2-tailed)	0.297	0.463	0.249	.	0.917	0.028	0.600	1.000	0.458	0.458
	N	9	9	9	9	9	9	9	9	9	9
EPT Richness[a]	Correlation Coefficient	-0.366	0.171	0.400	0.028	1.000	0.400	-0.629*	-0.479*	0.500*	0.500*
	Significance (2-tailed)	0.173	0.527	0.140	0.917	.	0.140	0.020	0.075	0.070	0.070
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of EPT (%)a	Correlation Coefficient	-0.535*	0.229	0.571*	-0.592*	0.400	1.000	-0.229	-0.423	0.588*	0.588*
	Significance (2-tailed)	0.046	0.399	0.035	0.028	0.140	.	0.399	0.116	0.033	0.033
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	-0.028	0.171	0.000	-0.141	-0.629*	-0.229	1.000	0.254	-0.353	-0.353
	Significance (2-tailed)	0.917	0.527	1.000	0.600	0.020	0.399	.	0.345	0.201	0.201
	N	9	9	9	9	9	9	9	9	9	9
Community Density (0.25 m^2)[b]	Correlation Coefficient	0.500*	-0.592*	-0.592*	0.000	-0.479*	-0.423	0.254	1.000	-0.551*	-0.551*
	Significance (2-tailed)	0.061	0.028	0.028	1.000	0.075	0.116	0.345	.	0.044	0.044
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (Total)[c]	Correlation Coefficient	-0.551*	0.235	0.530*	-0.203	0.500*	0.588*	-0.353	-0.551*	1.000	1.000
	Significance (2-tailed)	0.044	0.394	0.055	0.458	0.070	0.033	0.201	0.044	.	.
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	-0.551*	0.235	0.530*	-0.203	0.500*	0.588*	-0.353	-0.551*	1.000	1.000
	Significance (2-tailed)	0.044	0.394	0.055	0.458	0.070	0.033	0.201	0.044	.	.
	N	9	9	9	9	9	9	9	9	9	9

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Table E-31: Kendall's tau correlation matrix of macroinvertebrate metrics collected at Station B-10 from 2007 to 2015.

		Date	Taxa Richness[a]	Shannon Diversity[a]	Biotic Index[a]	EPT Richness[a]	Relative Abundance of EPT[a] (%)	Relative Abundance of Chironomidae (%)[a]	Community Density ($0.25\ m^2$)[b]	Multimetric Assessment (Total)[c]	Multimetric Assessment (% of Possible)[c]
Date	Correlation Coefficient	1.000	0.087	0.278	0.000	-0.028	-0.310	0.254	-0.278	0.029	0.029
	Significance (2-tailed)	.	0.750	0.297	1.000	0.917	0.249	0.345	0.297	0.916	0.916
	N	9	9	9	9	9	9	9	9	9	9
Taxa Richness[a]	Correlation Coefficient	0.087	1.000	0.725*	0.261	0.471*	-0.294	0.353	-0.145	0.061	0.061
	Significance (2-tailed)	0.750	.	0.008	0.338	0.087	0.285	0.199	0.595	0.829	0.829
	N	9	9	9	9	9	9	9	9	9	9
Shannon Diversity[a]	Correlation Coefficient	0.278	0.725*	1.000	0.167	0.366	-0.310	0.254	-0.333	0.087	0.087
	Significance (2-tailed)	0.297	0.008	.	0.532	0.173	0.249	0.345	0.211	0.750	0.750
	N	9	9	9	9	9	9	9	9	9	9
Biotic Index[a]	Correlation Coefficient	0.000	0.261	0.167	1.000	-0.254	-0.704*	0.535*	-0.389	-0.667*	-0.667*
	Significance (2-tailed)	1.000	0.338	0.532	.	0.345	0.009	0.046	0.144	0.015	0.015
	N	9	9	9	9	9	9	9	9	9	9
EPT Richness[a]	Correlation Coefficient	-0.028	0.471*	0.366	-0.254	1.000	0.229	-0.114	-0.028	0.559*	0.559*
	Significance (2-tailed)	0.917	0.087	0.173	0.345	.	0.399	0.673	0.917	0.043	0.043
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of EPT (%)a	Correlation Coefficient	-0.310	-0.294	-0.310	-0.704*	0.229	1.000	-0.714*	0.423	0.647*	0.647*
	Significance (2-tailed)	0.249	0.285	0.249	0.009	0.399	.	0.008	0.116	0.019	0.019
	N	9	9	9	9	9	9	9	9	9	9
Relative Abundance of Chironomidae (%)[a]	Correlation Coefficient	0.254	0.353	0.254	0.535*	-0.114	-0.714*	1.000	-0.254	-0.530*	-0.530*
	Significance (2-tailed)	0.345	0.199	0.345	0.046	0.673	0.008	.	0.345	0.055	0.055
	N	9	9	9	9	9	9	9	9	9	9
Community Density ($0.25\ m^2$)[b]	Correlation Coefficient	-0.278	-0.145	-0.333	-0.389	-0.028	0.423	-0.254	1.000	0.203	0.203
	Significance (2-tailed)	0.297	0.595	0.211	0.144	0.917	0.116	0.345	.	0.458	0.458
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (Total)[c]	Correlation Coefficient	0.029	0.061	0.087	-0.667*	0.559*	0.647*	-0.530*	0.203	1.000	1.000
	Significance (2-tailed)	0.916	0.829	0.750	0.015	0.043	0.019	0.055	0.458	.	.
	N	9	9	9	9	9	9	9	9	9	9
Multimetric Assessment, (% of Possible)[c]	Correlation Coefficient	0.029	0.061	0.087	-0.667*	0.559*	0.647*	-0.530*	0.203	1.000	1.000
	Significance (2-tailed)	0.916	0.829	0.750	0.015	0.043	0.019	0.055	0.458	.	.
	N	9	9	9	9	9	9	9	9	9	9

*Correlation is significant at the 0.10 level (2-tailed)
[a]Subsample of 300
[b]Pooled sample; n=0 for Ratio of Amphipoda to Isopoda at all sites
[c]Metric Score
Note: Ratio of amphipoda to isopoda was not included because N=0 in all years at all stations.

Appendix E.3 Temporal Graphs

Figure E-1: Taxa Richness for Biological Stations B1 to B10.

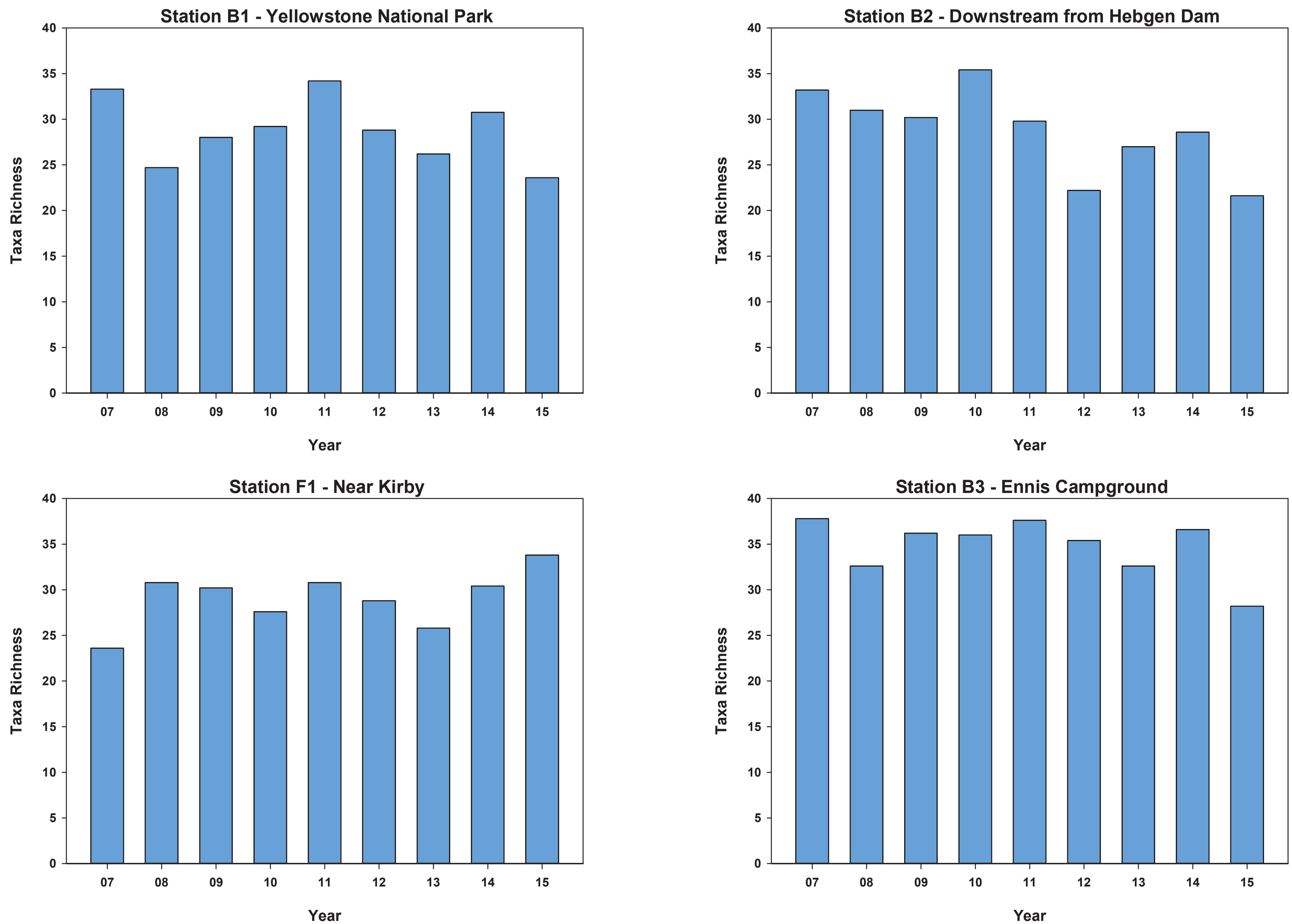
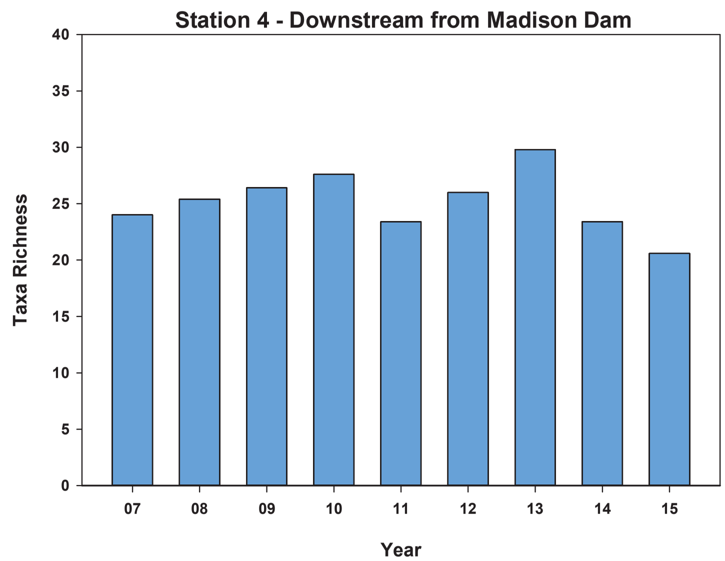
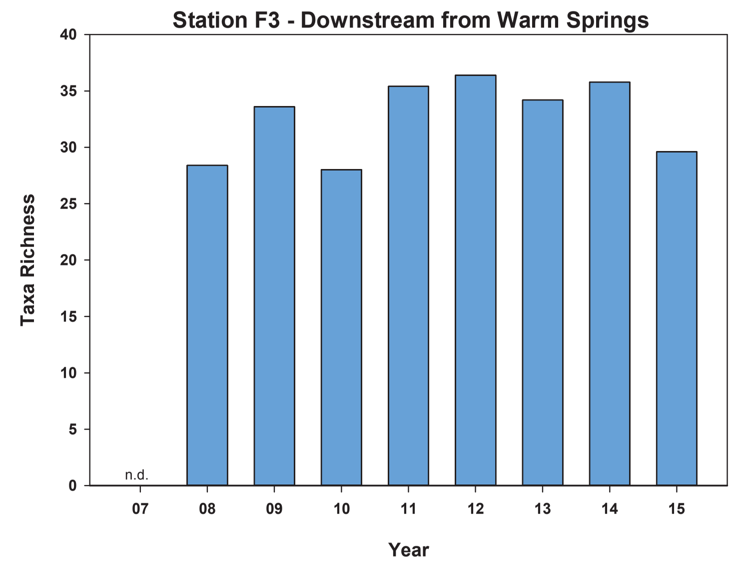
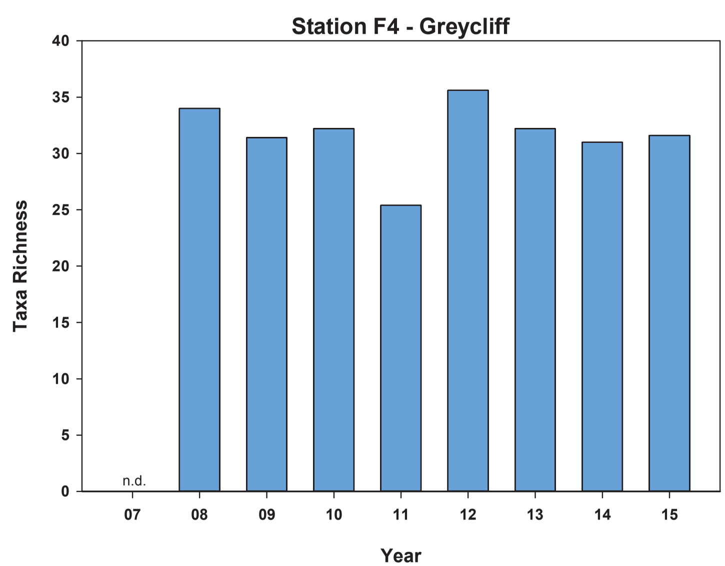


Figure E-1: Taxa Richness for Biological Stations B1 to B10 (cont.).







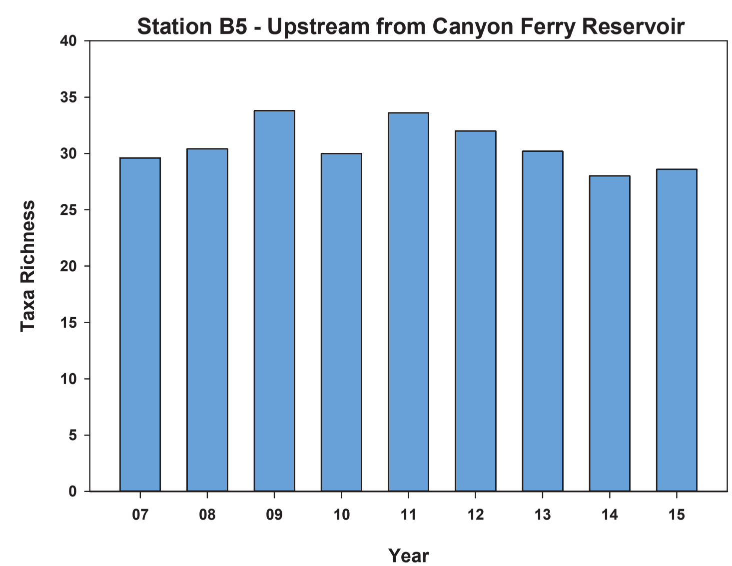
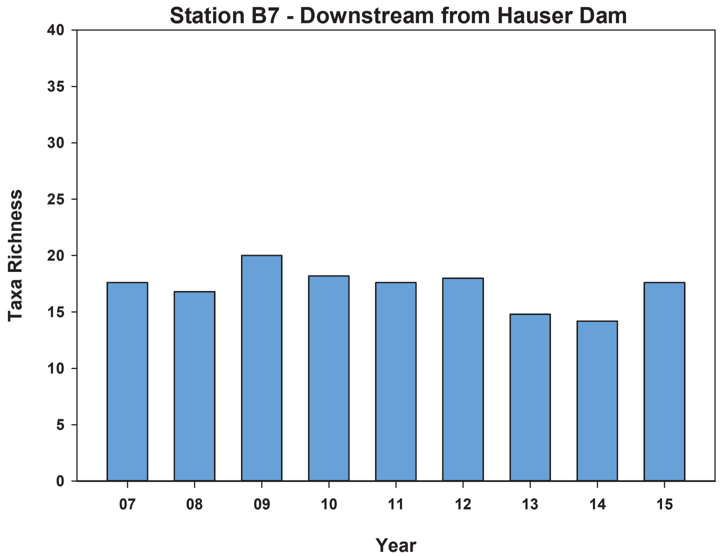
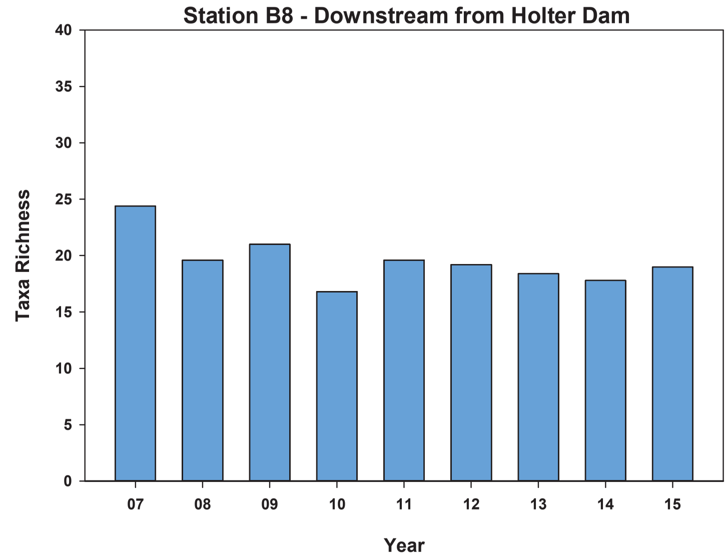


Figure E-1: Taxa Richness for Biological Stations B1 to B10 (cont.).





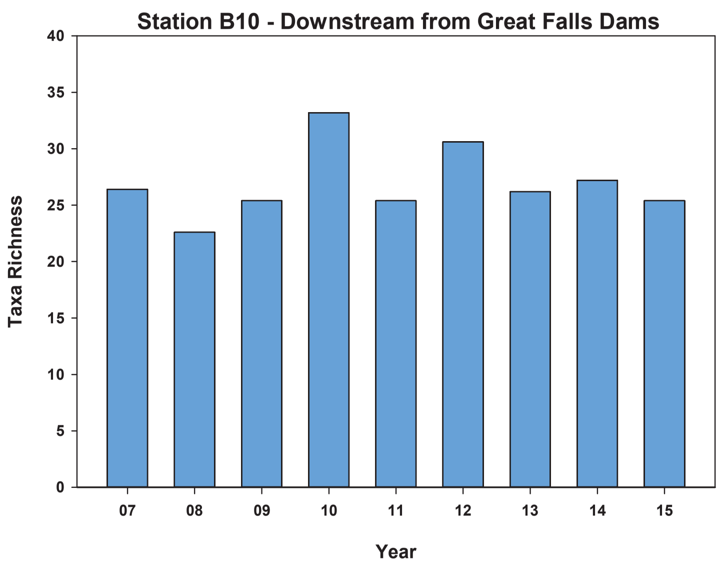
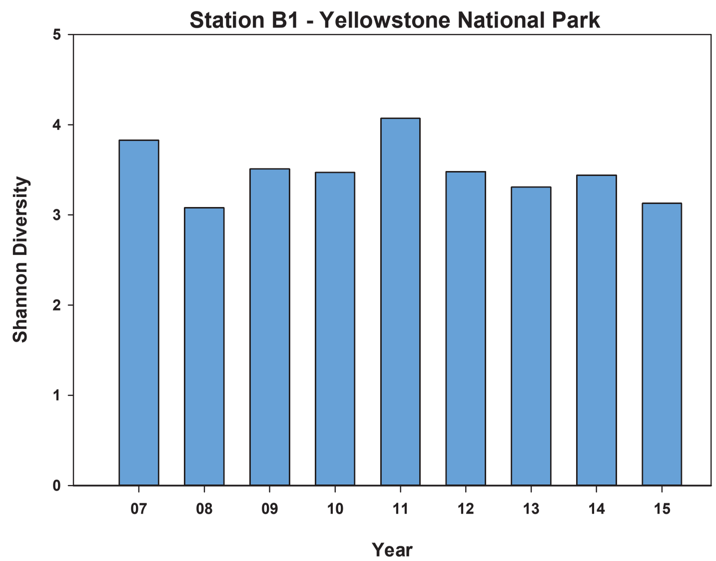
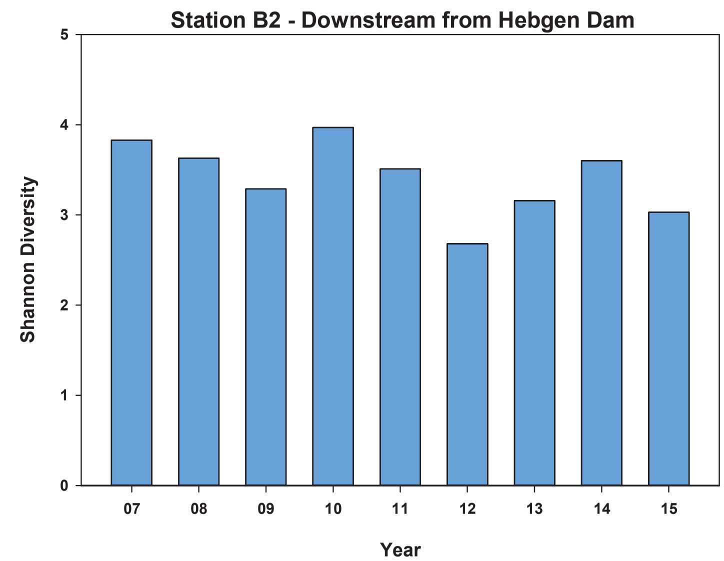
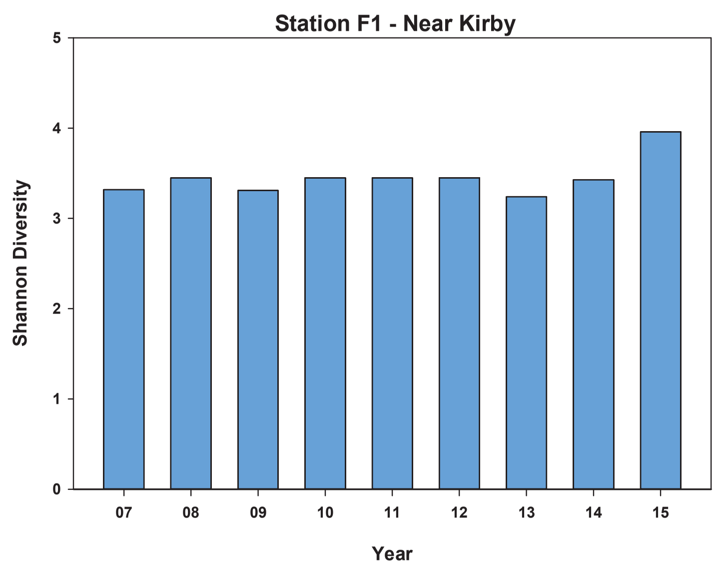


Figure E-2: Shannon Diversity for Biological Stations B1 to B10.







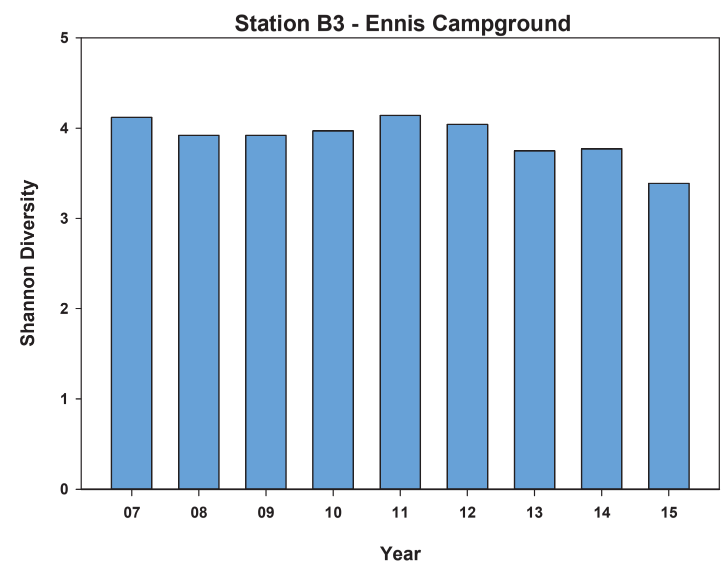


Figure E-2: Shannon Diversity for Biological Stations B1 to B10 (cont.).

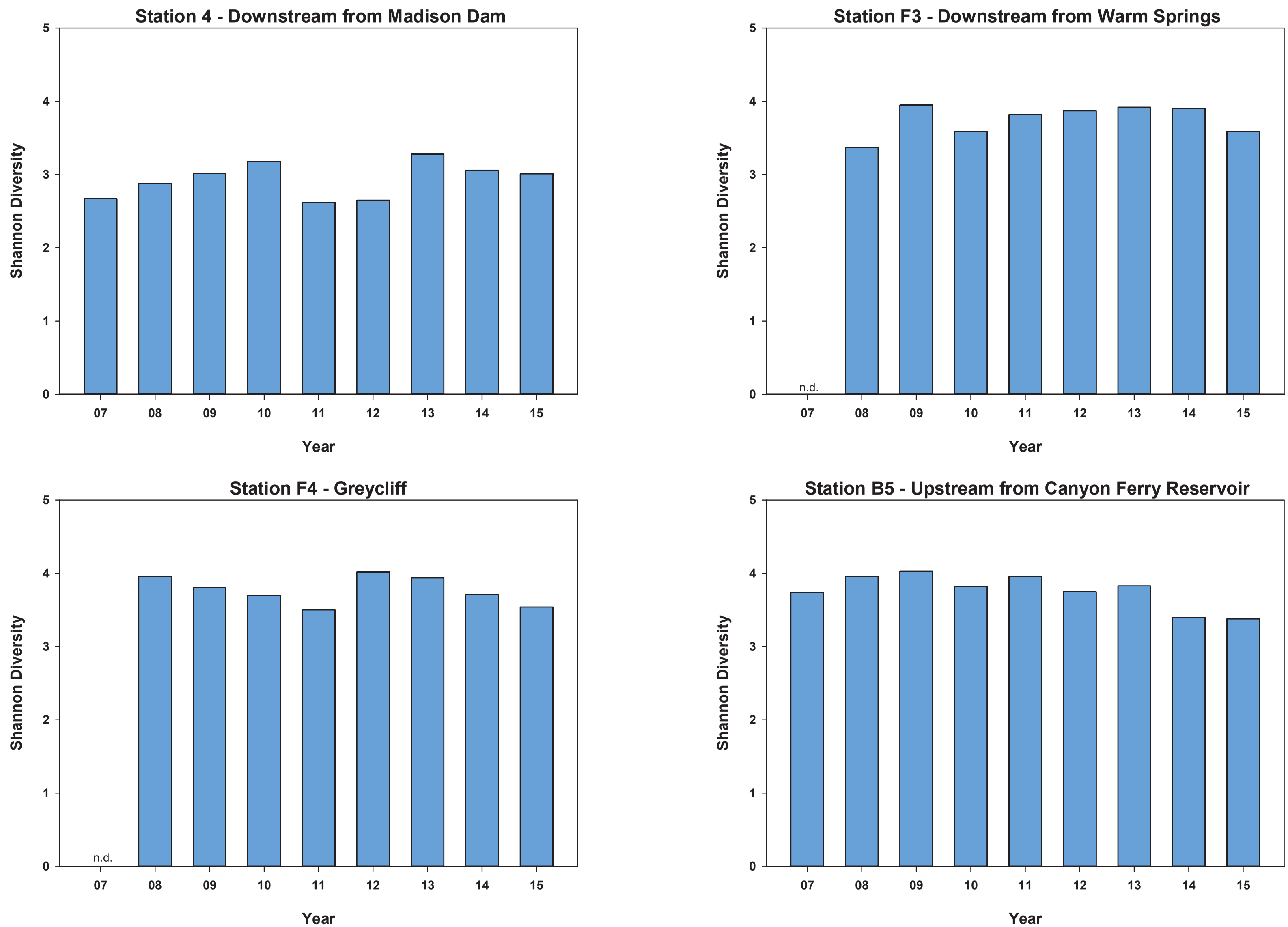
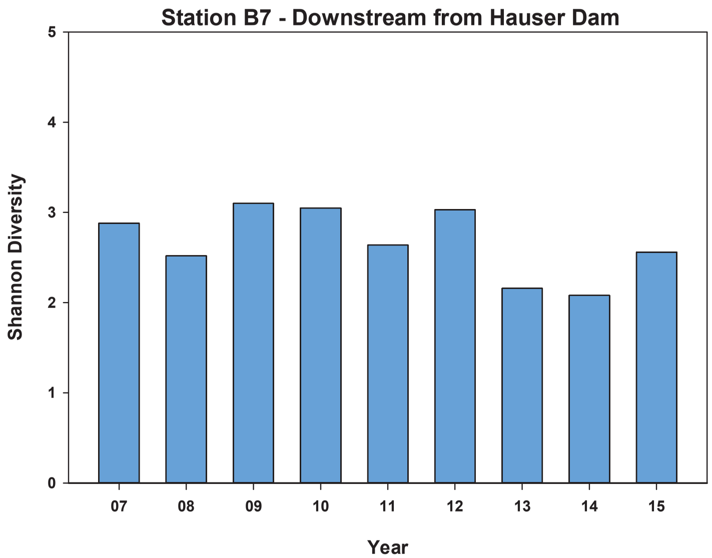
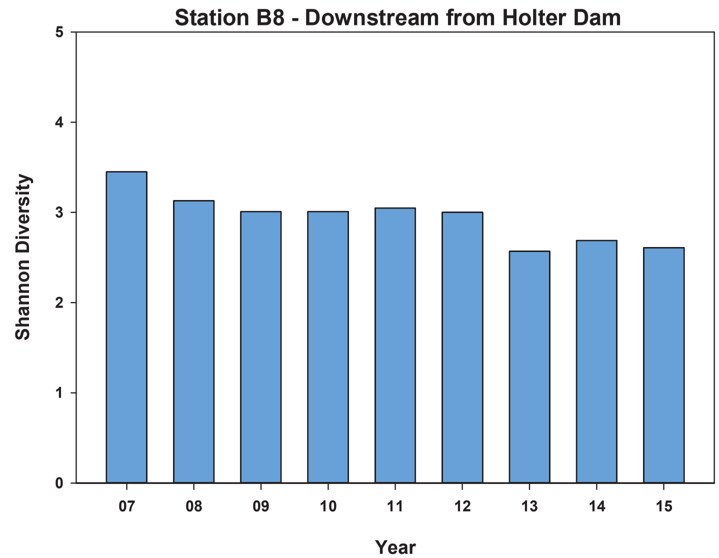


Figure E-2: Shannon Diversity for Biological Stations B1 to B10 (cont.).





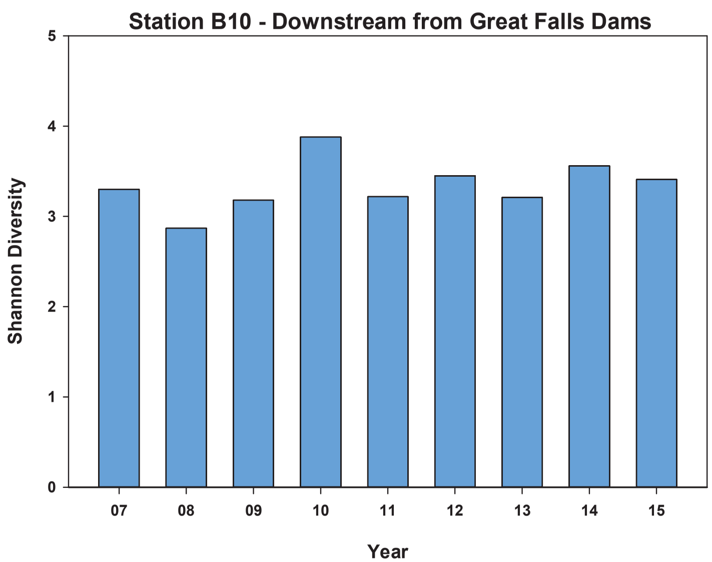


Figure E-3: Biotic Index for Biological Stations B1 to B10.

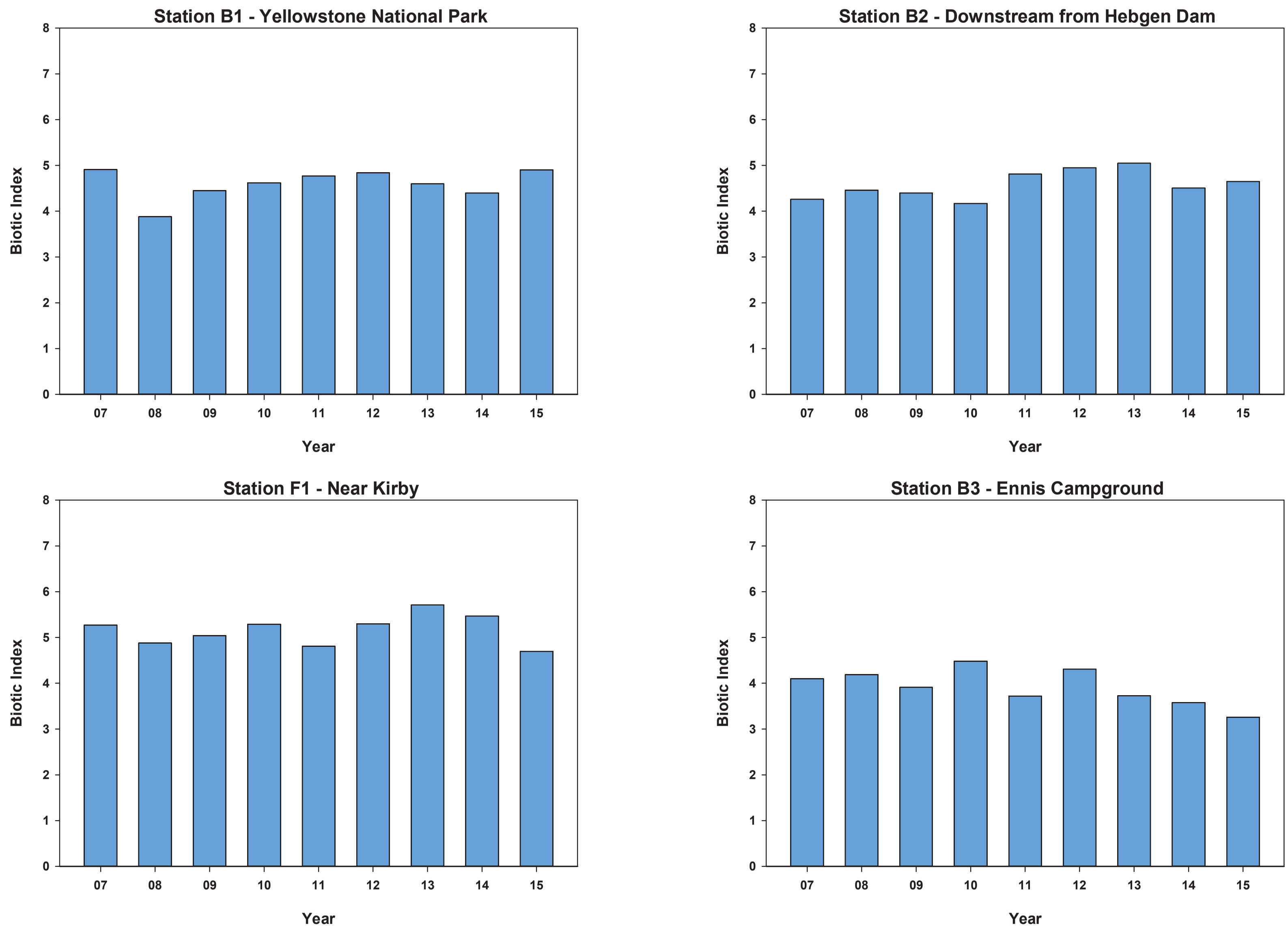
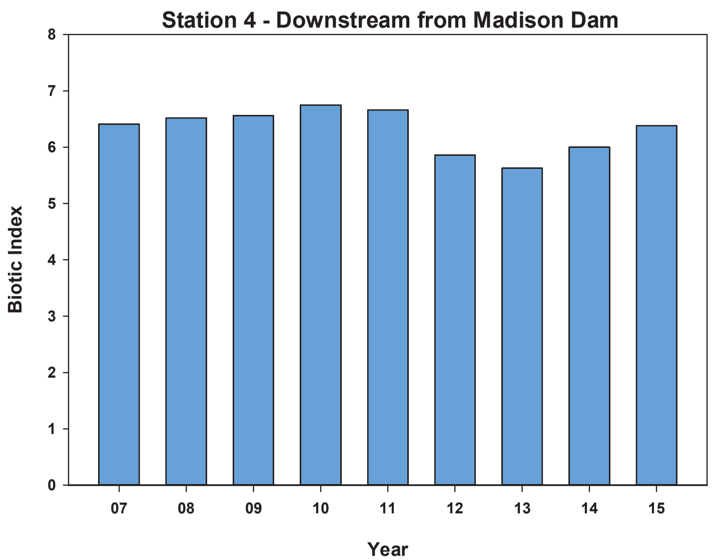
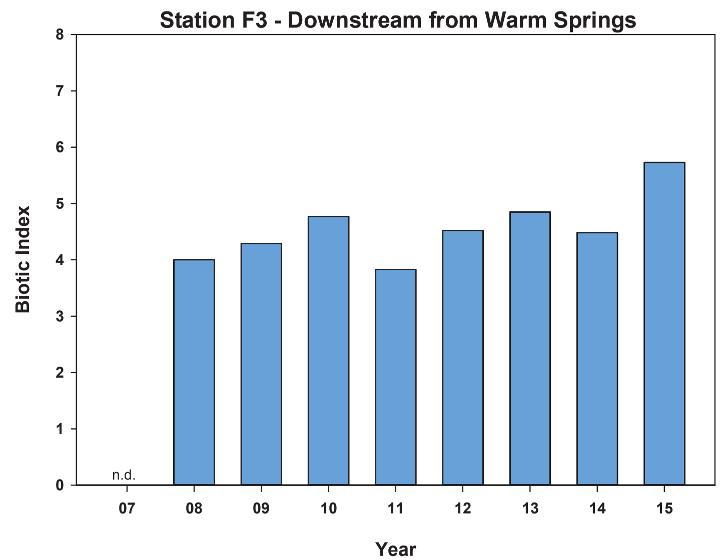
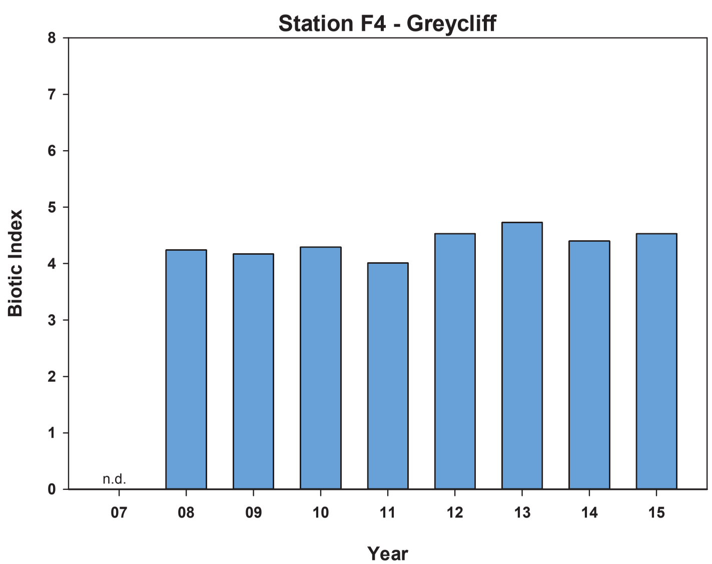


Figure E-3: Biotic Index for Biological Stations B1 to B10 (cont.).







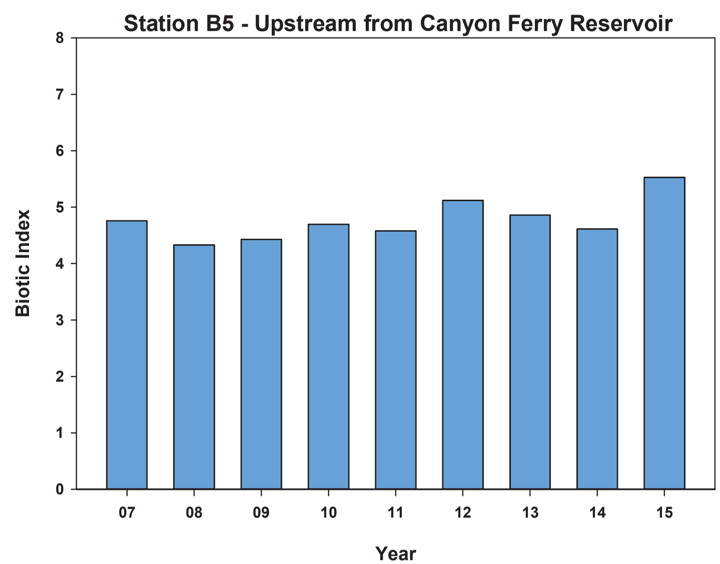
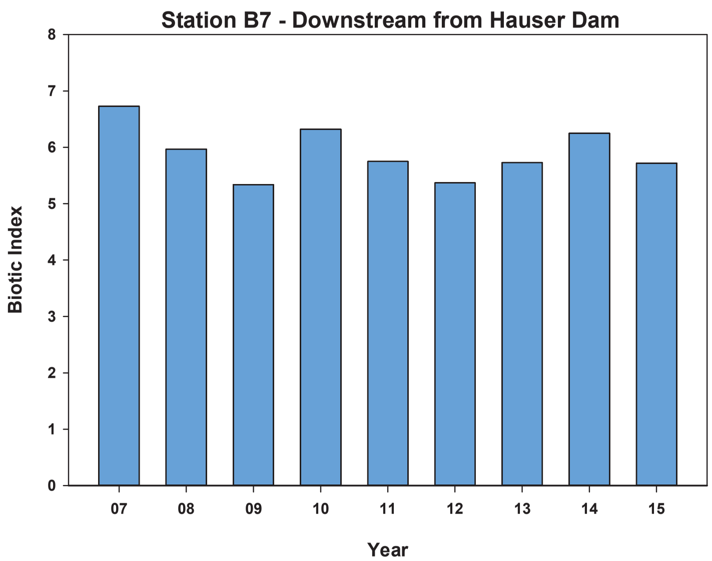
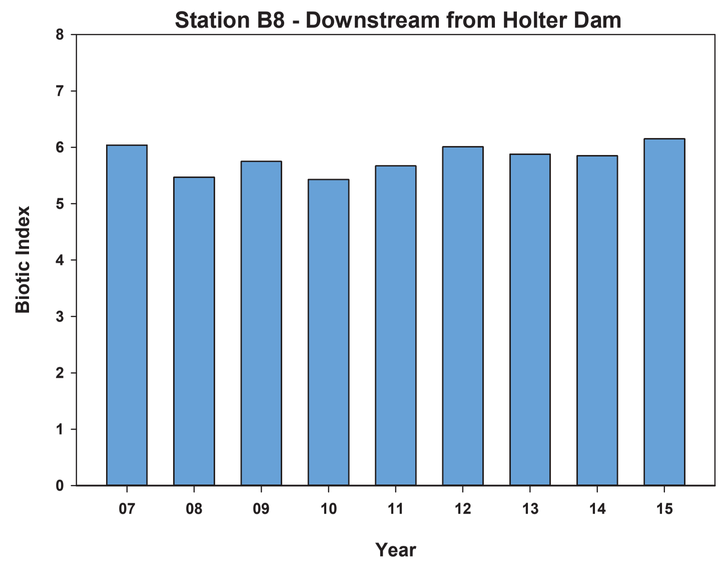


Figure E-3: Biotic Index for Biological Stations B1 to B10 (cont.).





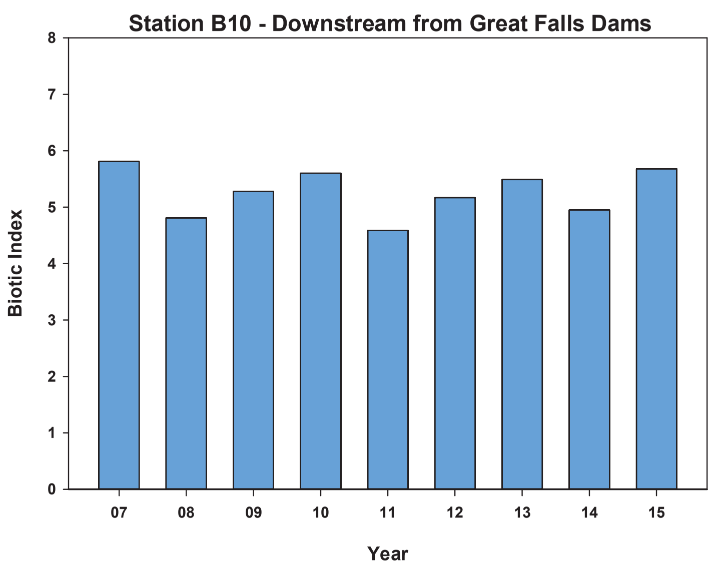


Figure E-4: Relative Abundance of EPT (%) for Biological Stations B1 to B10.

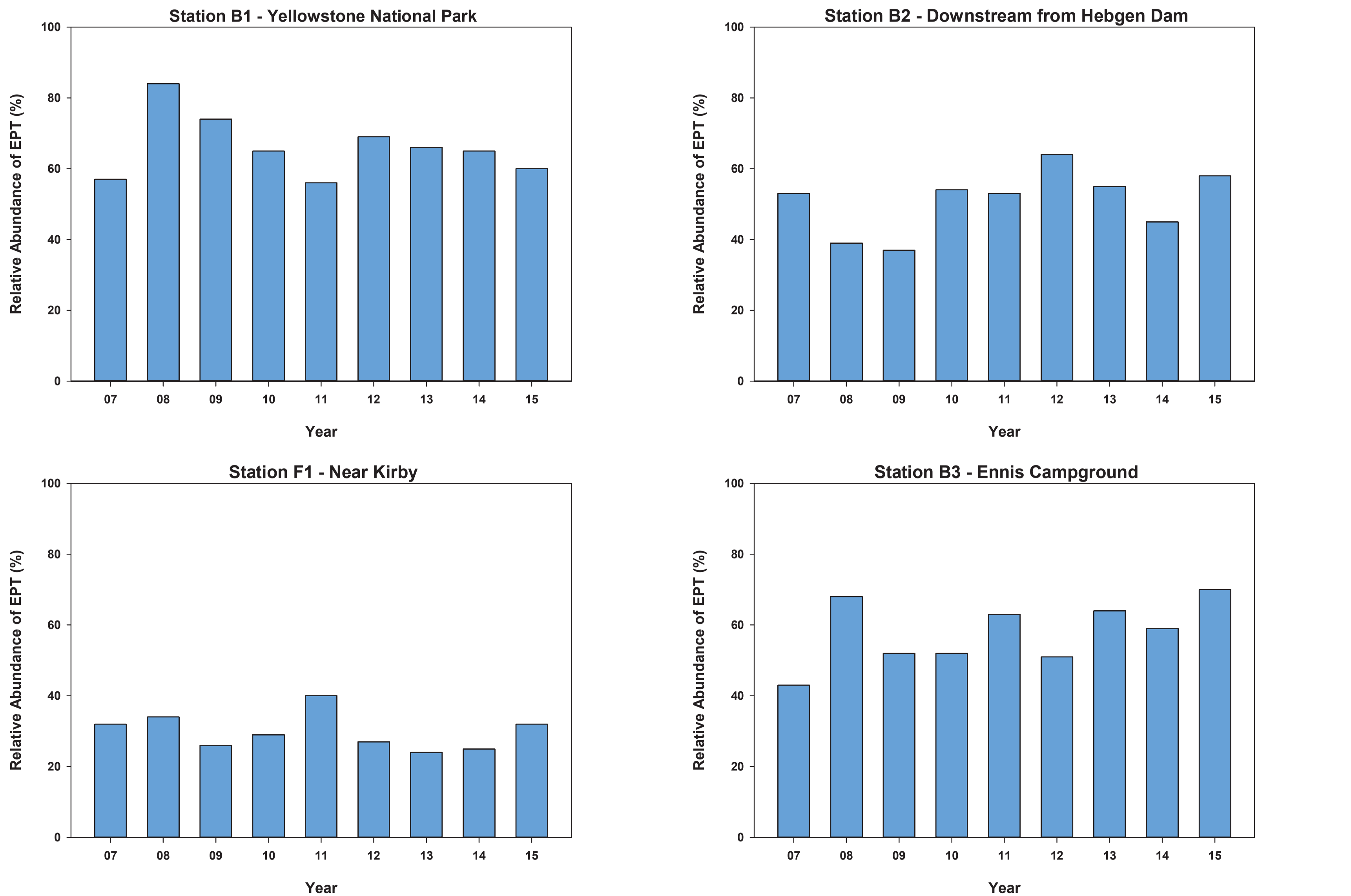
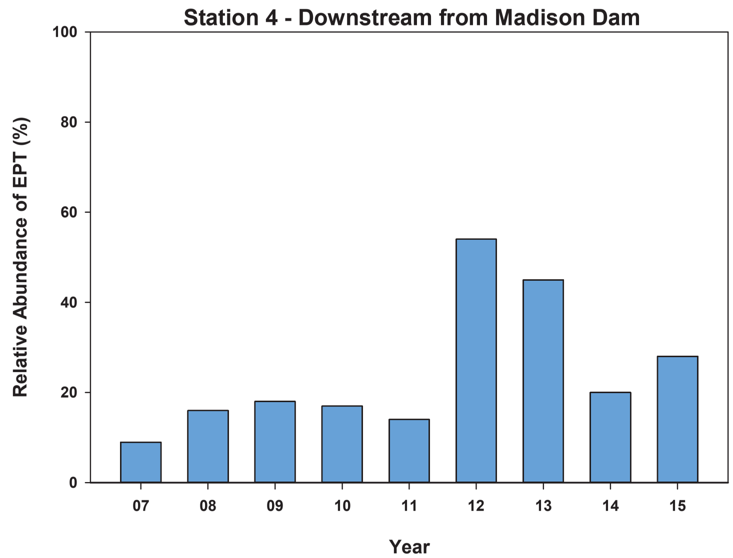
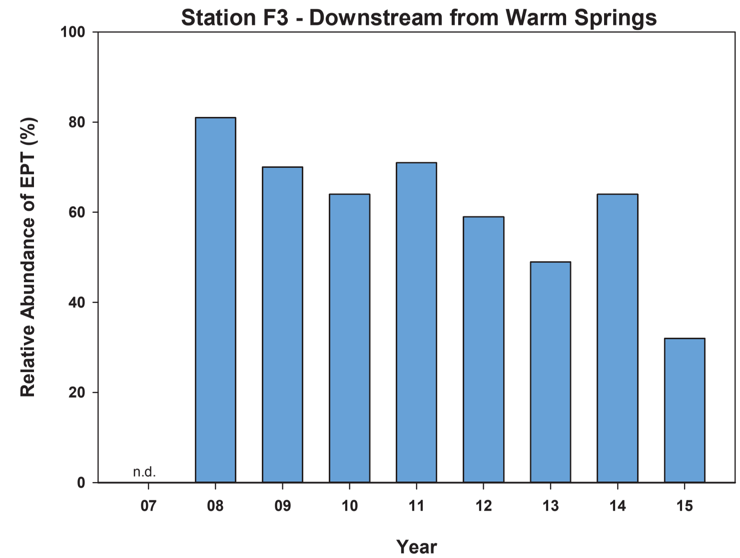
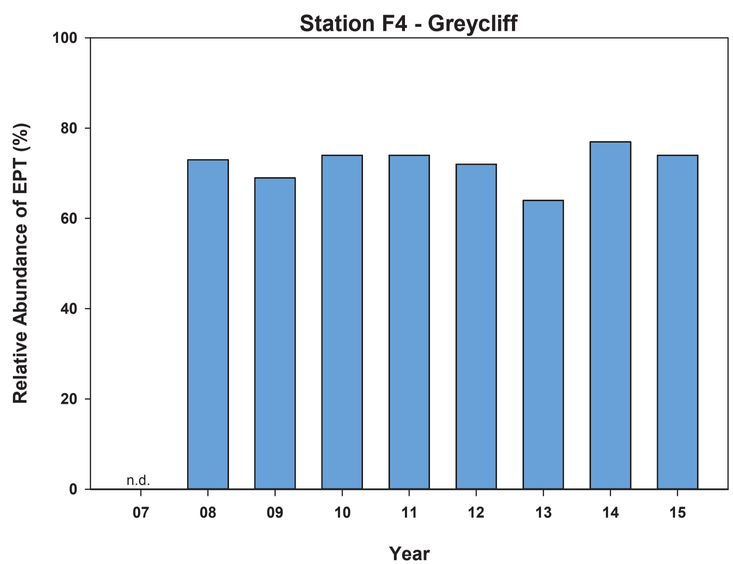


Figure E-4: Relative Abundance of EPT (%) for Biological Stations B1 to B10 (cont.).







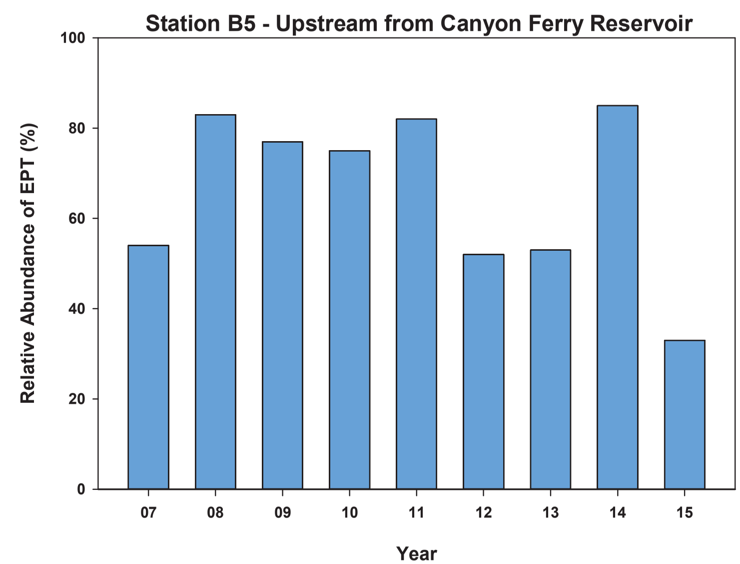
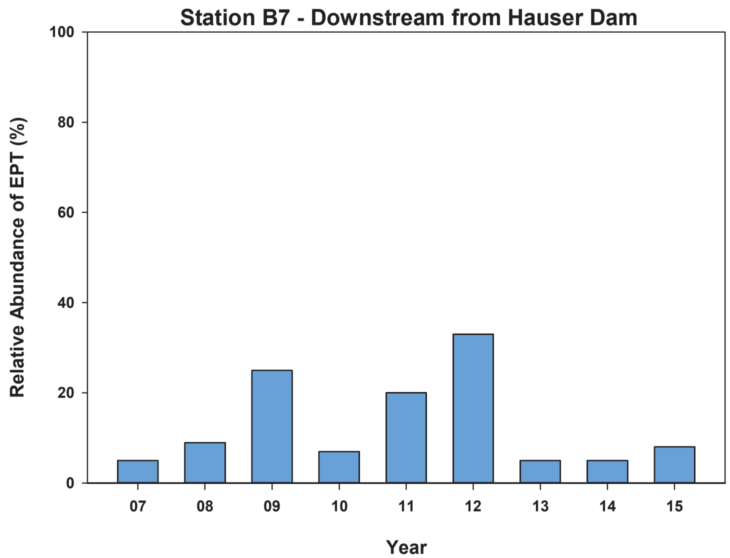
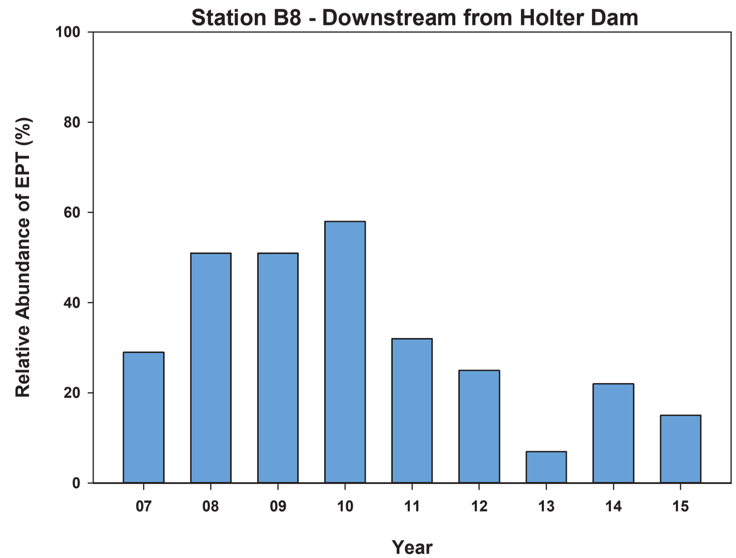


Figure E-4: Relative Abundance of EPT (%) for Biological Stations B1 to B10 (cont.).





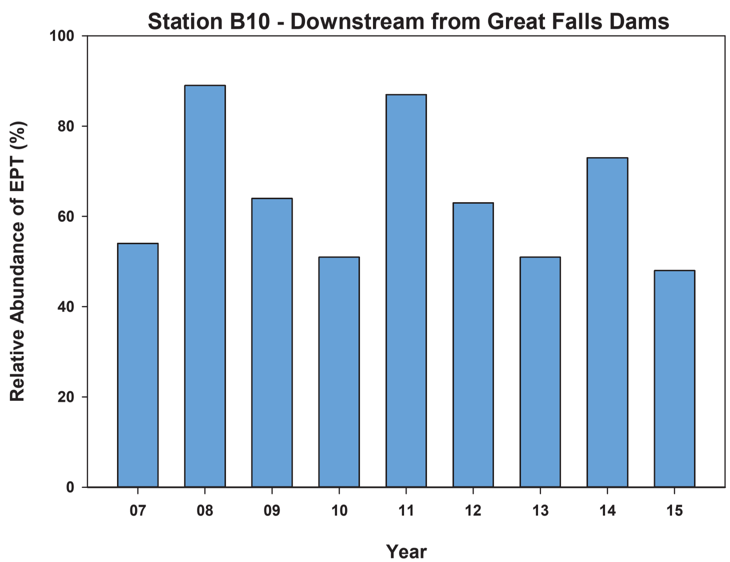
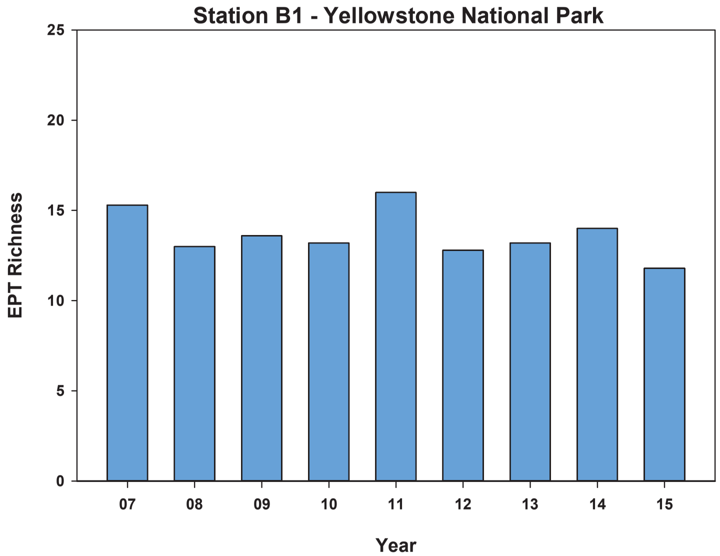
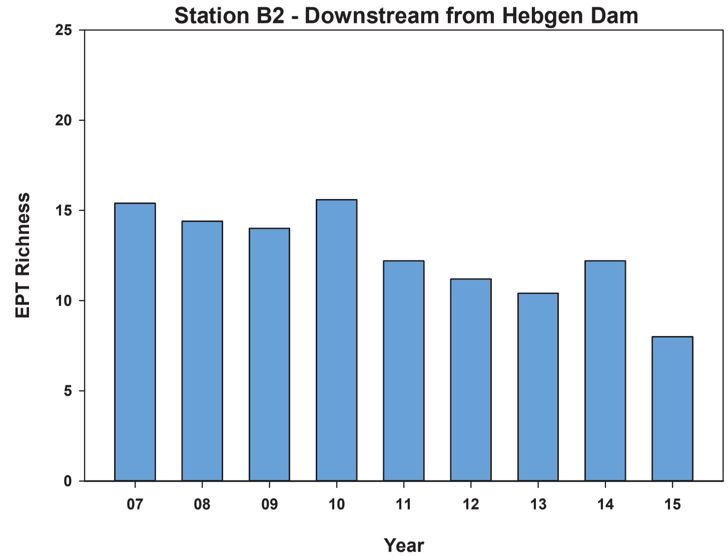
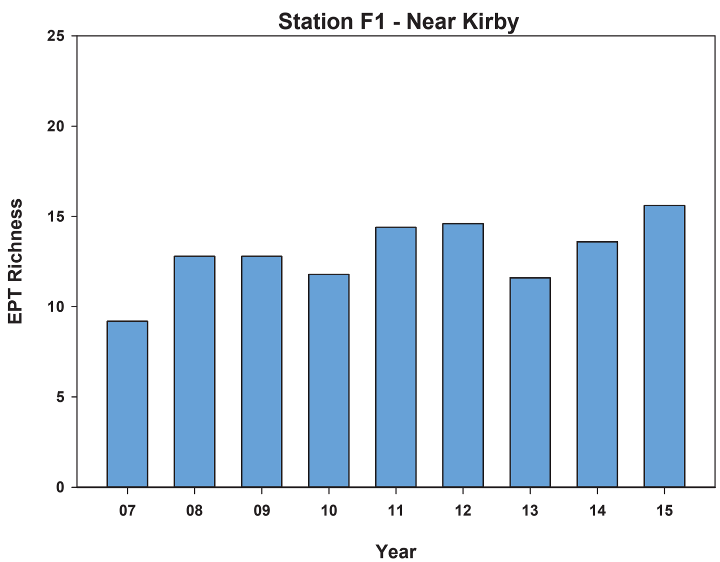


Figure E-5: EPT Richness for Biological Stations B1 to B10.







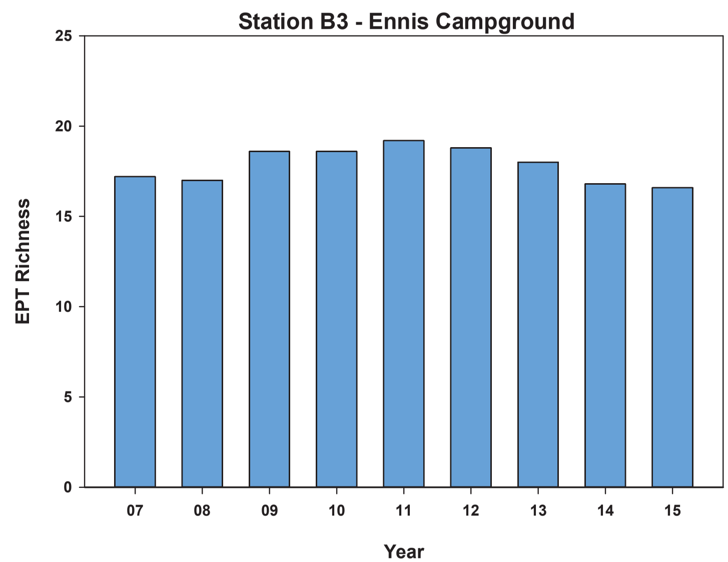


Figure E-5: EPT Richness for Biological Stations B1 to B10 (cont.).

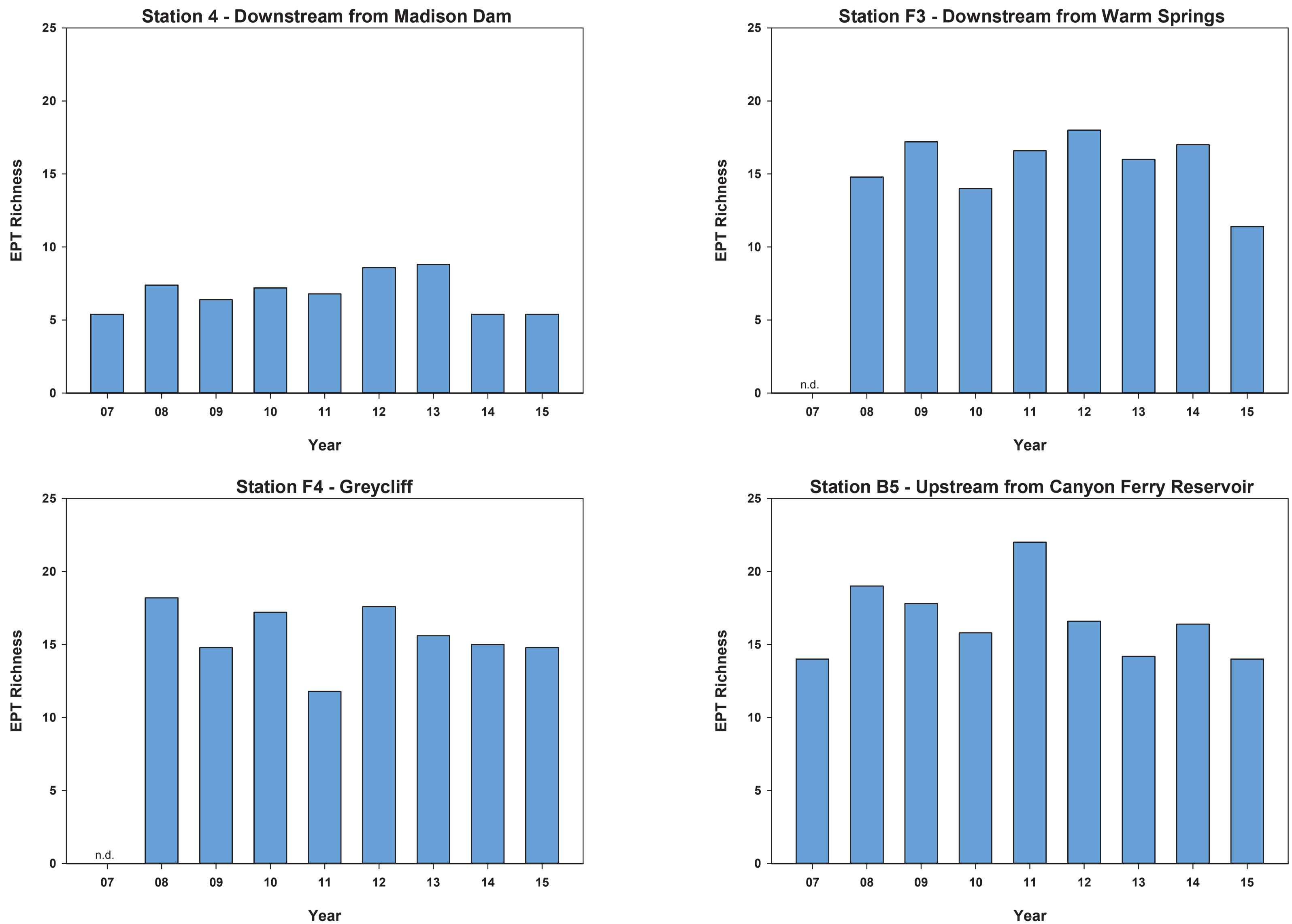
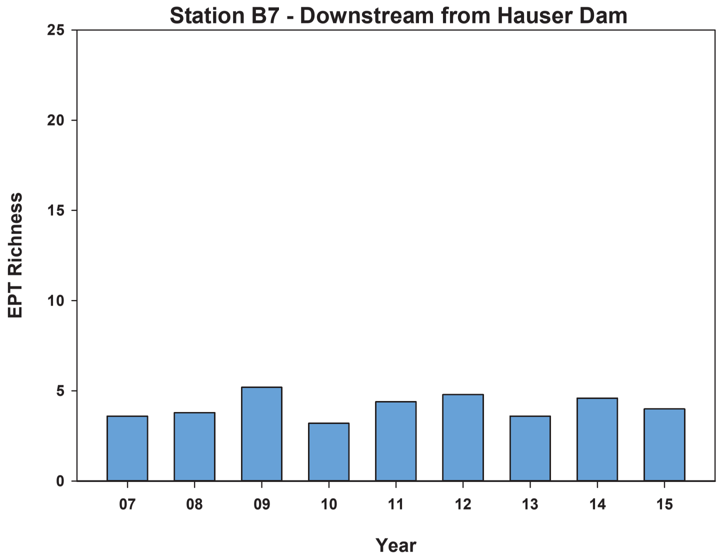
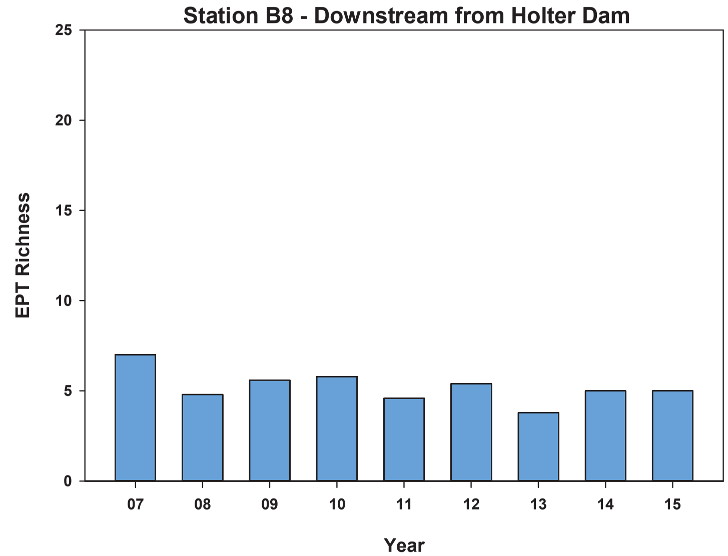


Figure E-5: EPT Richness for Biological Stations B1 to B10 (cont.).





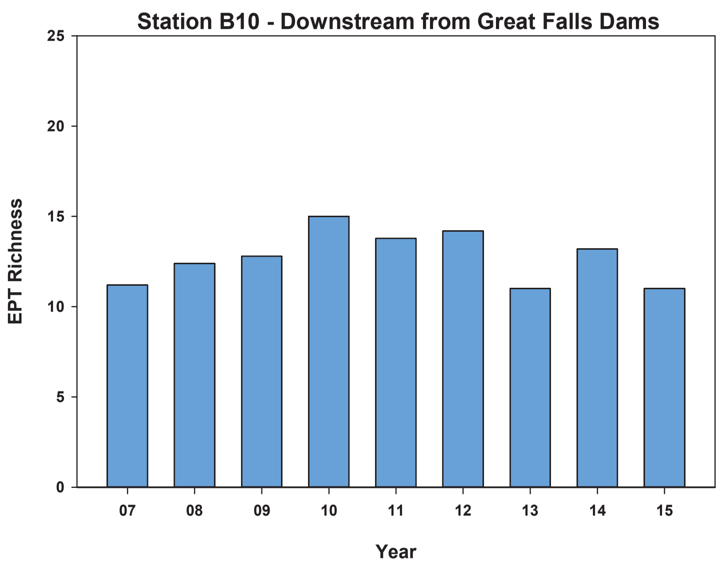


Figure E-6: Relative Abundance of Chironomidae (%) for Biological Stations B1 to B10.

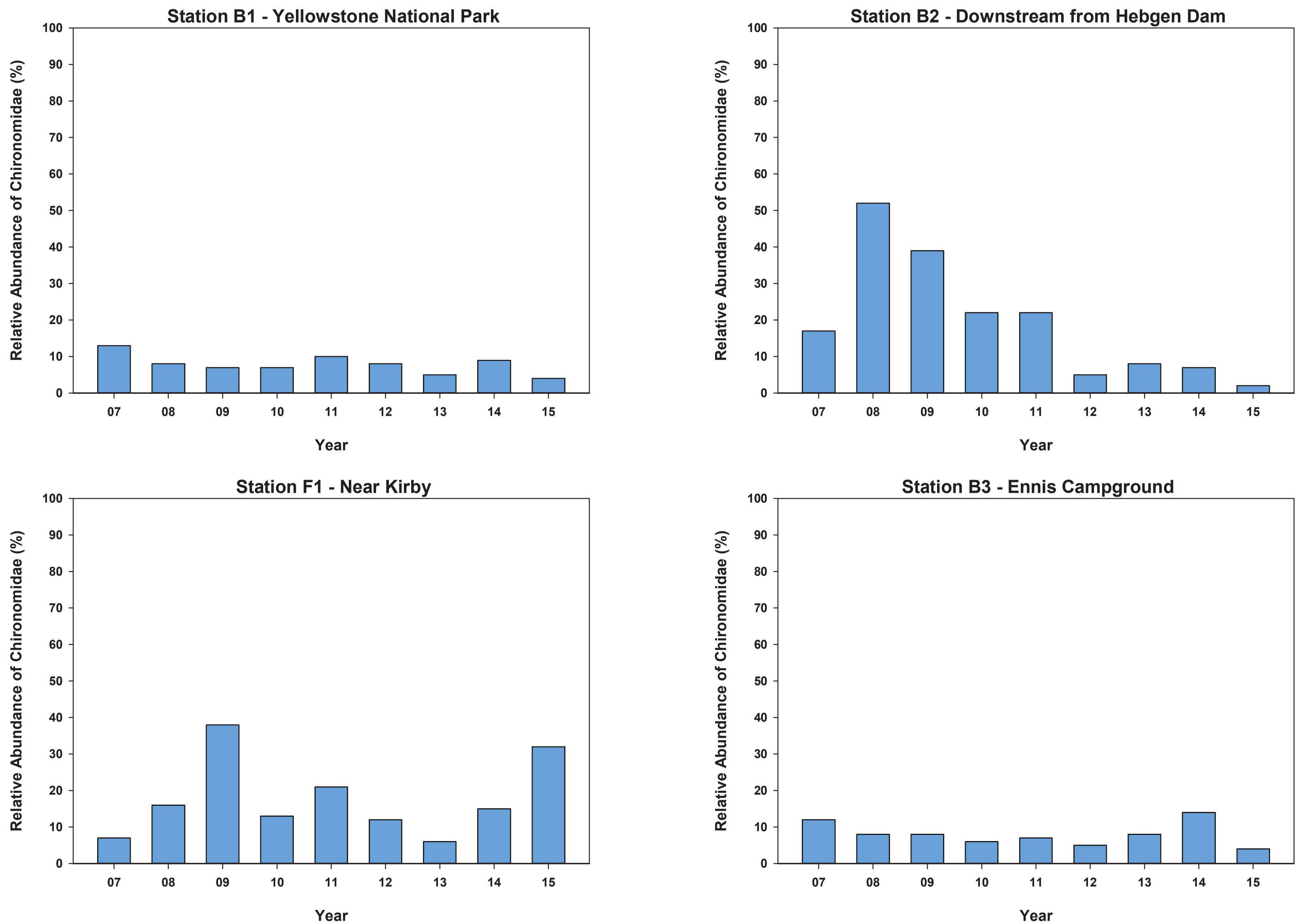


Figure E-6: Relative Abundance of Chironomidae (%) for Biological Stations B1 to B10 (cont.).

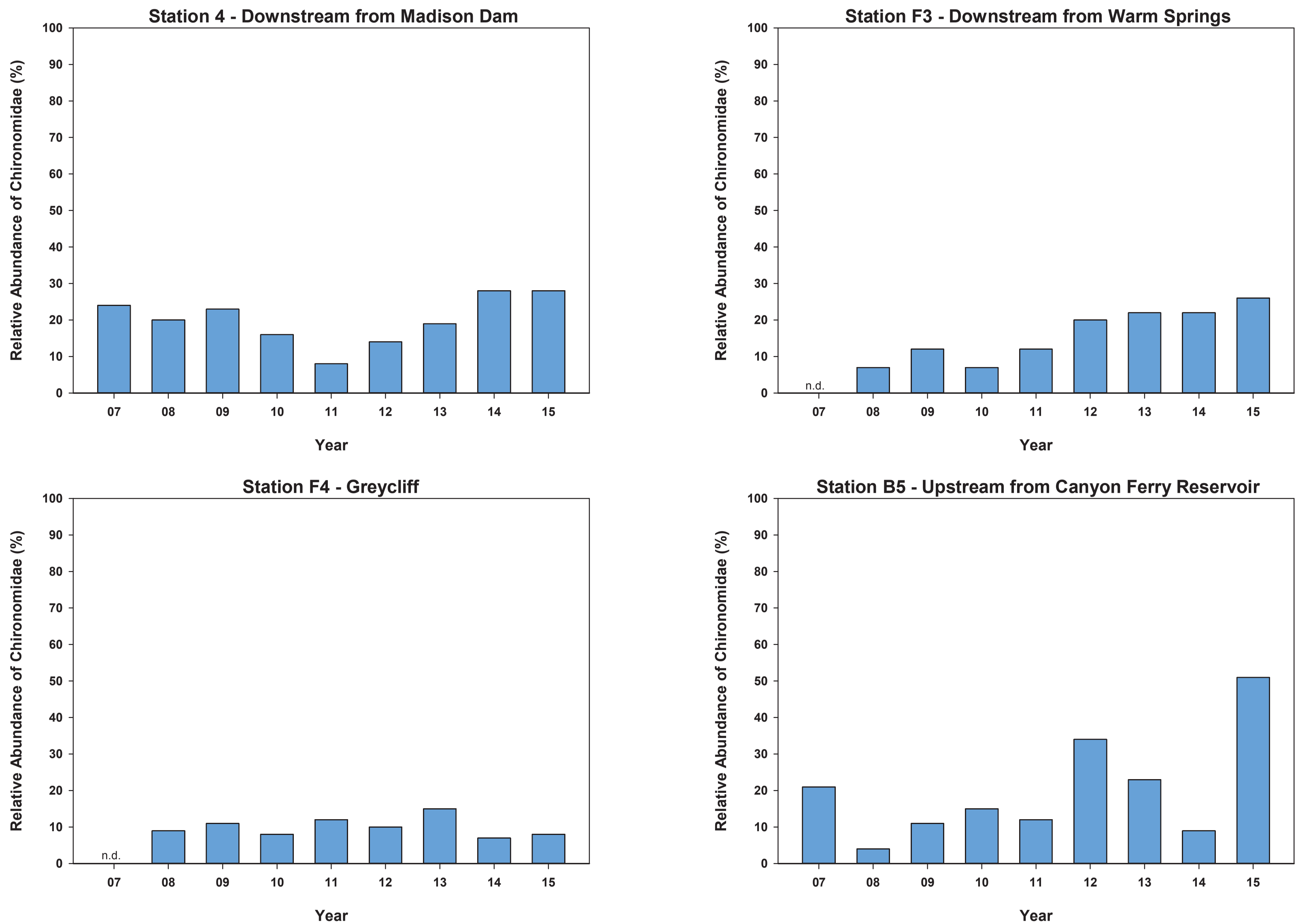
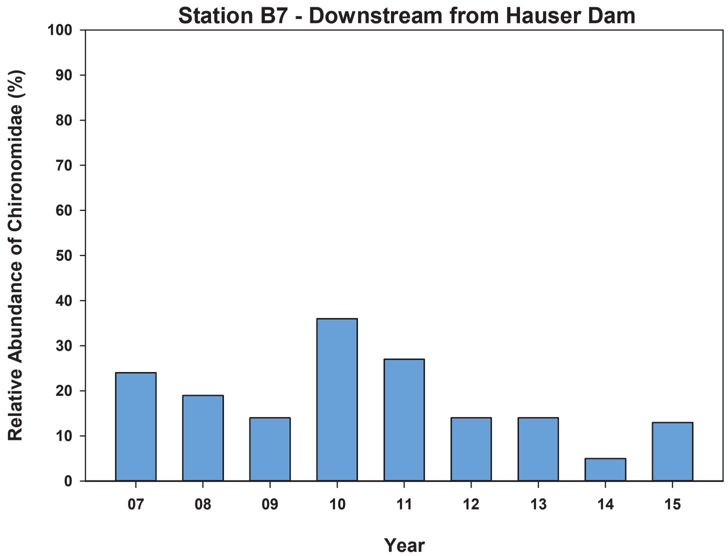
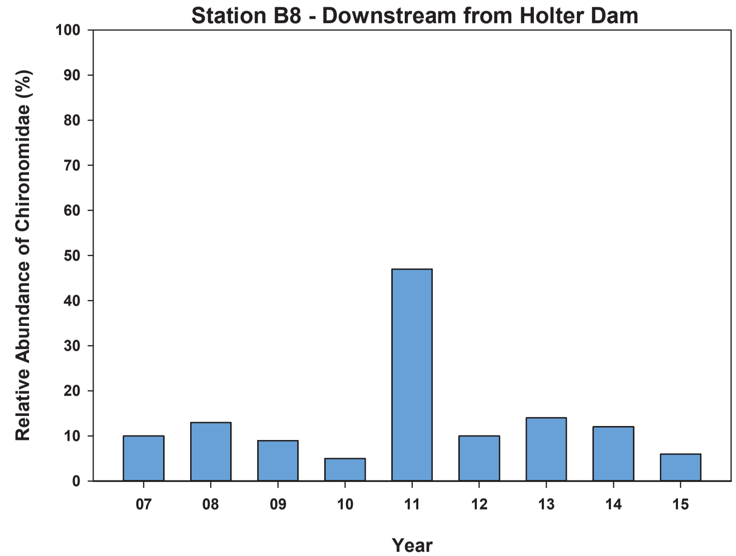


Figure E-6: Relative Abundance of Chironomidae (%) for Biological Stations B1 to B10 (cont.).





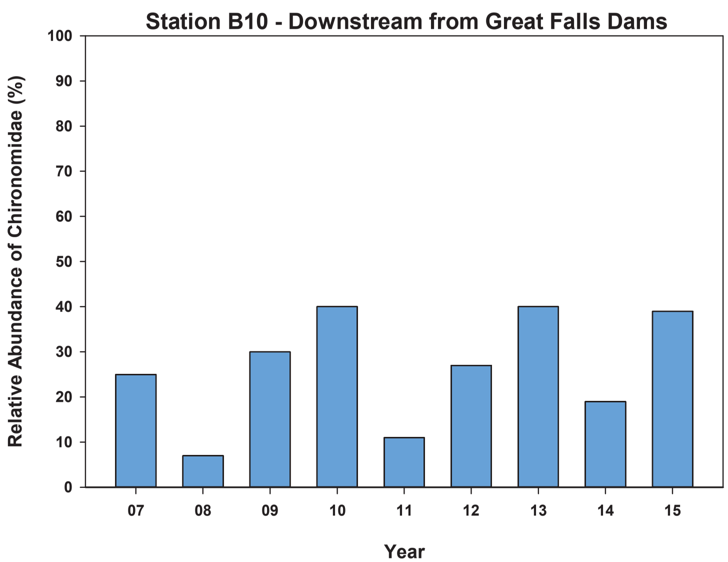


Figure E-7: Community Density ($0.25m^2$) for Biological Stations B1 to B10.

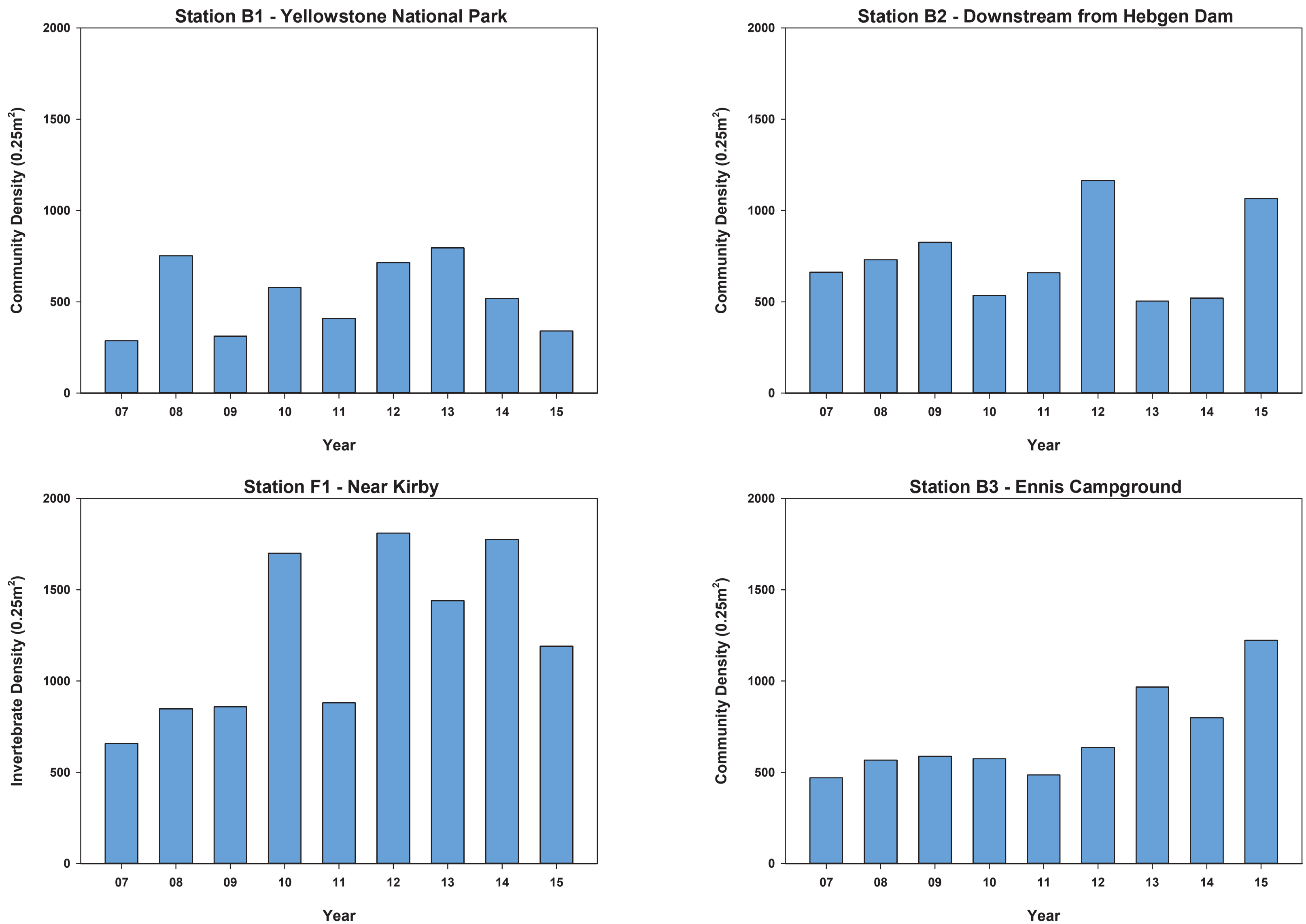
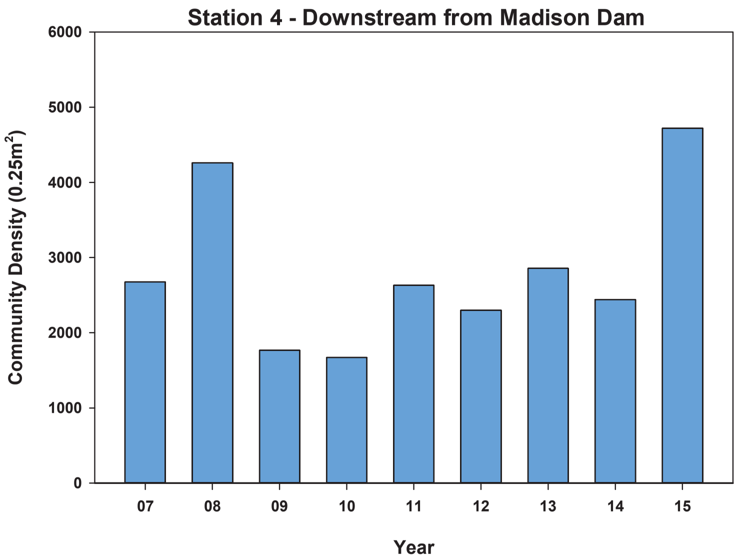
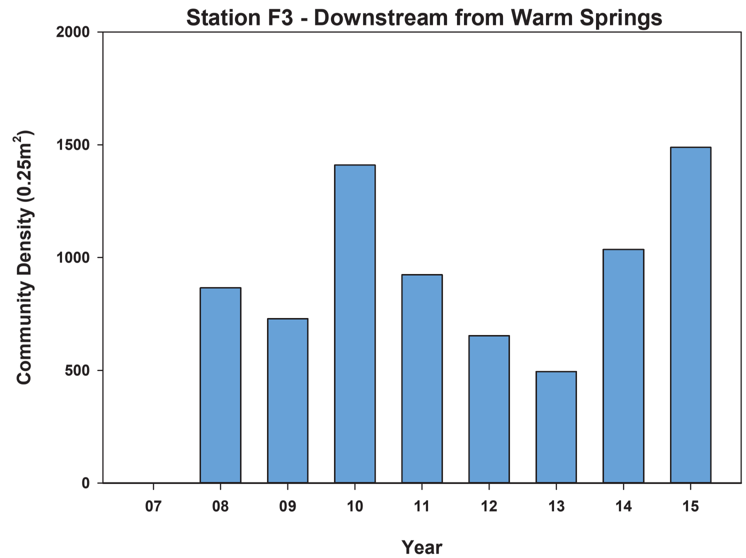
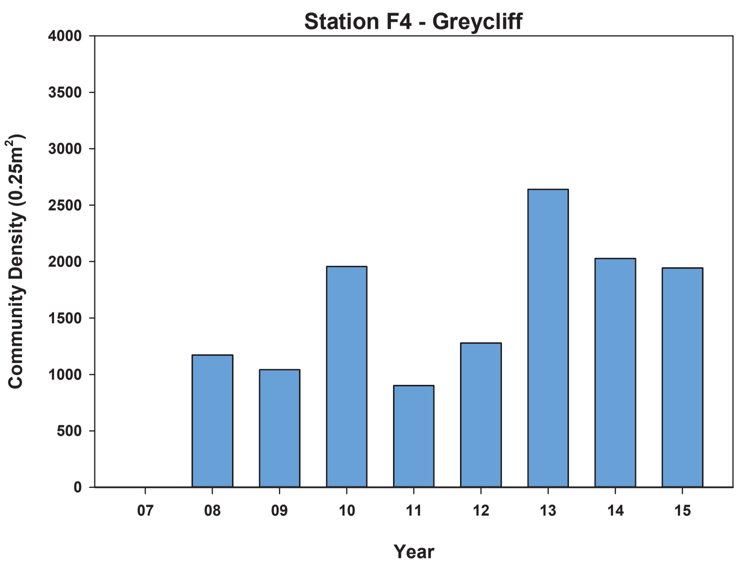


Figure E-7: Community Density (0.25m²) for Biological Stations B1 to B10 (cont.).







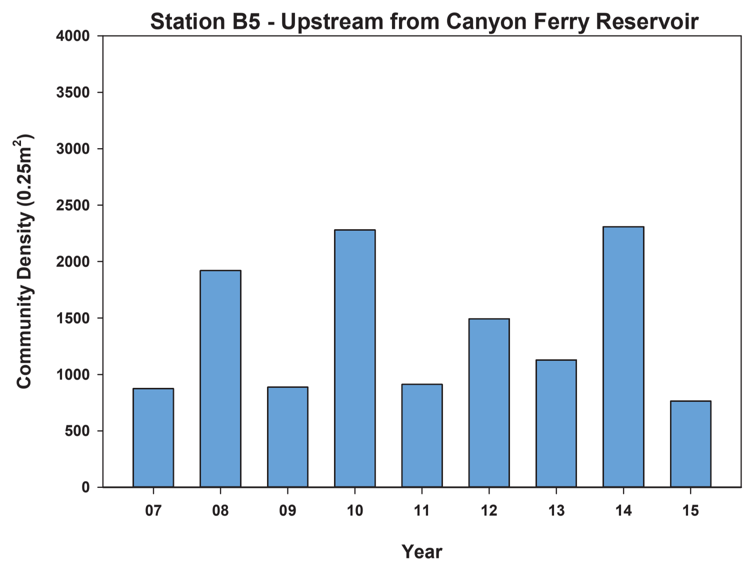
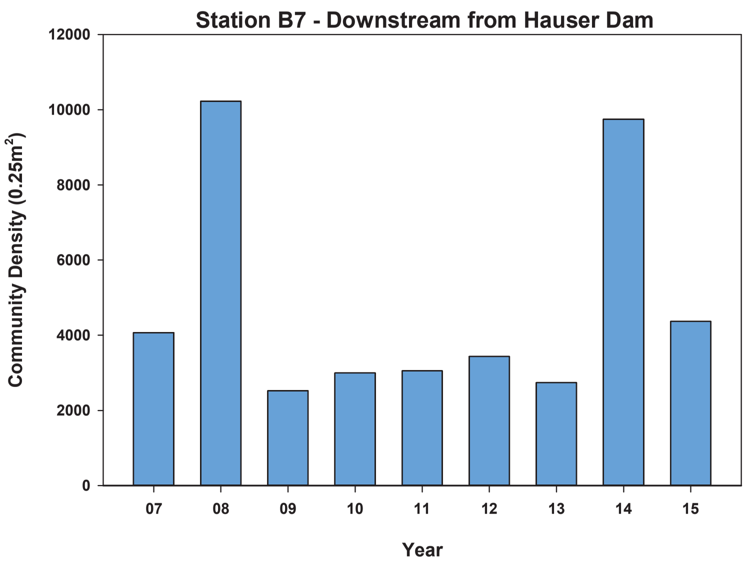
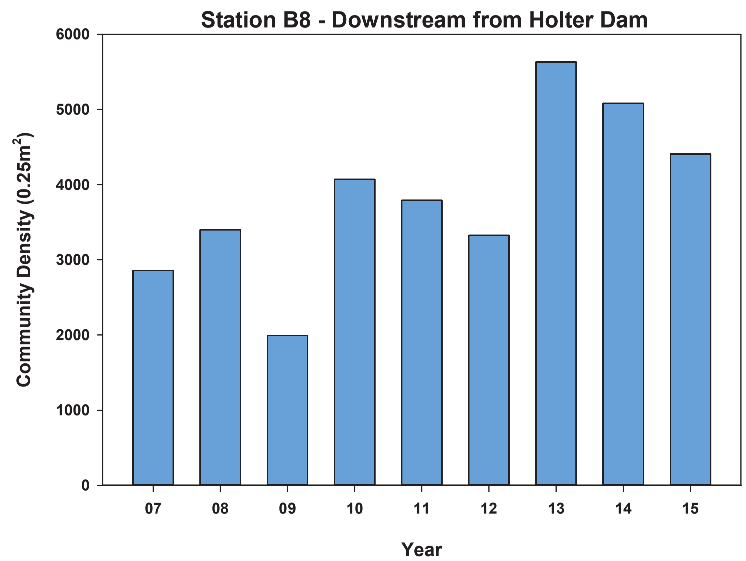
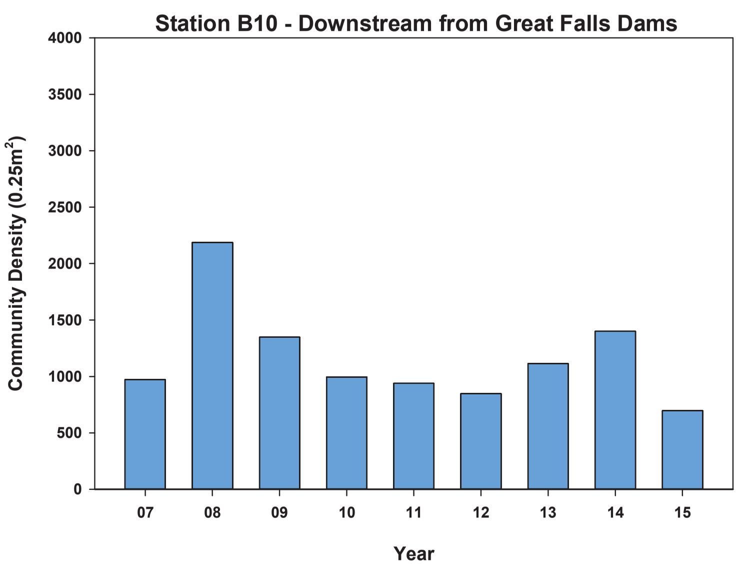


Figure E-7: Community Density (0.25m²) for Biological Stations B1 to B10 (cont.).







Note: This parameter has been scaled individually

Appendix F Fish Tissue Biocontaminants

Appendix F.1 Upstream-Downstream Comparisons

Table F-1: Rank comparisons of Predator fish tissue biocontaminant concentrations between stations B7 and B8 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
PCBs (Aroclor) 1254	B7	6	8.75	52.50
	B8	6	4.25	25.50
	Total	12		
Iron	B7	6	6.42	38.50
	B8	6	6.58	39.50
	Total	12		
Strontium	B7	6	5.25	31.50
	B8	6	7.75	46.50
	Total	12		
Zinc	B7	6	7.50	45.00
	B8	6	5.50	33.00
	Total	12		

Table F-2: Mann–Whitney *U* test results for Predator fish tissue biocontaminant concentrations at stations B7 and B8 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
PCBs (Aroclor) 1254	4.500	25.500	-2.181	.029
Iron	17.500	38.500	-.081	.936
Strontium	10.500	31.500	-1.223	.222
Zinc	12.000	33.000	-.962	.336

Table F-3: Rank comparisons of Bottom fish tissue biocontaminant concentrations between stations B7 and B8 from 2007 to 2016.

Analyte	Station	N	Mean Rank	Sum of Ranks
PCBs (Aroclor) 1254	B7	6	9.33	56.00
	B8	6	3.67	22.00
	Total	12		
Iron	B7	6	4.42	26.50
	B8	6	8.58	51.50
	Total	12		
Strontium	B7	6	7.33	44.00
	B8	6	5.67	34.00
	Total	12		
Zinc	B7	6	6.75	40.50
	B8	6	6.25	37.50
	Total	12		

Table F-4: Mann–Whitney *U* test results for Bottom fish tissue biocontaminant concentrations at stations B7 and B8 from 2007 to 2016.

Analyte	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
PCBs (Aroclor) 1254	1.000	22.000	-2.727	.006
Iron	5.500	26.500	-2.009	.045
Strontium	13.000	34.000	-.802	.423
Zinc	16.500	37.500	-.245	.806