Appendix: Methods, Figures, Resources, and Weight-of-Evidence Tables

A.1 Methods

A.1.1 Predicted Background Conductivity using Random Forest (Olson and Cormier, 2019)

The Natural Background Specific Conductivity (NBSC) model was developed with a national dataset using a random forest modeling approach and enables comparison with measured in-stream conductivity. Geology, soil, vegetation, climate, and other empirically measured data were used as inputs. The NBSC model was designed for streams with natural background specific conductivity (SC) < 2000 microSiemens per centimeter (µS/cm) and, above that level (typical for fresh water), the model's estimates may be less reliable. Data for some parameters that affect background SC were not readily available and were, therefore, not included in the model. These include freshwater and marine interfaces, natural mineral springs, salt deposits that might affect ground water and streams, and other natural sources of salts. In such areas, the model is likely to underestimate SC. Local knowledge is often necessary to assess differences between predicted and measured background SC.

A.1.2 General Modeling Approach

The StreamCat dataset and process were used to develop stream-specific model predictions (Hill et al. 2016) based on watershed averages for each National Hydrography Dataset Plus (NHDPlus) segment in the contiguous United States (McKay et al. 2012). These stream segments drain an average area of 3.1 square kilometers, which characterizes the spatial grain size of this dataset. Natural background SC was not estimated for streams shown as gray lines. The empirical background conductivity model was developed using the following steps:

1. Training and validation datasets of SC observations were developed from minimally altered stream segments.
2. Temporal and spatially specific watershed environments for each observation, including antecedent conditions, were characterized.
3. Observed SC values were related to environmental predictors using a machine learning technique (random forests).
4. Model performance was assessed and validated using multiple observations made at randomly chosen stream segments.

For a detailed description of the steps used to develop the NBSC model, see Olson and Cormier 2019. NHDPlus is available at https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus.

A.1.3 Training and Validation Data

The training and validation datasets consist of minimally disturbed sites. More than 2.4 million SC observations were obtained from the Water Quality Portal (WQP) (U.S. EPA 2016b), state natural resource agencies, the U.S. Geological Survey (USGS) National Water Information System (USGS 2016), and data used in Olson and Hawkins (2012). Data were downloaded from the WQP website using the following query criteria:

- Country–United States.
- Sample Media–Water.
- Characteristics–Conductivity, specific conductivity, specific conductance, calculated/measured ratio.
- Date Range–Observations between January 1, 2001, and December 31, 2015. This time period was chosen so that Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data could be used as predictors in the model (NASA 2019).

- During development, 56 potential explanatory parameters were evaluated. The original source data and final datasets are available for download here. Predicted background conductivity metadata and data are also available on the USEPA GeoPlatform for USEPA users.

Each observation was related to the nearest stream segment in the NHDPlus. Data were limited to one observation per stream segment per month. SC observations with ambiguous locations and repeat measurements along a stream segment in the same month were discarded. Using estimates of anthropocentric stress derived from the StreamCat database (Hill et al. 2016), U.S. EPA selected segments with minimal amounts of human activity based on criteria developed for each Level II ecoregion (Stoddard et al. 2006; Omernik and Griffith 2014). Stream segments were considered as minimally stressed when the associated watershed drainage area had ≤ 0.5 percent impervious surface, up to 5 percent urban, up to 10 percent agriculture, and population densities of 0.8–30 people per square kilometer. Watersheds displaying large residuals during initial model predictions were assessed for evidence of other human activities not represented in StreamCat (e.g., mining, logging, grazing, or oil/gas extraction). Disturbed watersheds with a tidal influence or unusual geologic conditions, such as hot springs, were not removed from the dataset. Some stations with high levels of SC remain in the dataset (e.g., underground mining influenced with no easily accessible evidence). About 5 percent of SC observations in each National Rivers and Stream Assessment (NRSA) region were then randomly selected to form an independent validation dataset. The remaining observational dataset was used for model calibration.

The final training dataset used for modeling had 1,785 stream segments with 11,796 observations, and the validation dataset had 92 segments with 581 observations. The majority of segments had a single observation but ranged up to 165 observations per segment.

A.1.4 Model Validation

The Model Validation view on the Freshwater Explorer shows the predictive performance at reference sites that were used to develop NBSC model. In the wetter and more forested areas, reference sites are more abundant and predictions are more precise. In the central United States, fewer reference sites were available and predictions are more uncertain. In the grass and shrub lands east of the continental divide, measured SC was over-overpredicted by the model by more than 100 µS/cm at 5 percent of stations and underpredicted by more than 100 µS/cm at 3 percent of stations. There are many potential causes for these differences, including data reporting errors and reference site reliability.

Overall, the model explained most of the variation in SC and produced reasonably accurate predictions for both calibration data (mean absolute error (MAE) = 22 µS/cm, Nash-Sutcliffe efficiency = 0.92, and coefficient of determination = 0.92) and external validation data (MAE = 29 µS/cm, Nash-Sutcliffe efficiency = 0.87, and coefficient of determination = 0.87). Values reported as background apply only to streams and have not been validated for lakes or wetlands.

The desert southwest, southern and northern plains, and parts of southern California exhibited the greatest mean SC, likely caused by the calcareous, evaporitic, and marine geologies interacting with high evapotranspiration and low dilution from precipitation in these areas. More details are available in Olson and Cormier (2019).

Table A.1. The final 19 predictor variables used to estimate background specific conductivity
Importance was calculated as the mean increase in error when a predictor is permuted within the model. The higher the value, the greater the importance (Olson and Cormier 2019).

Type	Predictor	Units	Importance
Geology	Calcium oxide rock content	Percentage	83
Geology	Sulfur rock content	Percentage	70
Atmosphere	Ca deposition	Mg/L	65
Soil	Water table depth	cm	59
Vegetation	Grassland	Percentage	53
Soil property	Soil erodibility	K factor	52
Geological	Rock strength	MPa	51
Soil	Clay	Percentage	50
Vegetation	Shrubland	Percentage	49
Vegetation	Conifer	Percentage	46
Vegetation	Mixed forest	Percentage	45
Soil	Soil permeability	cm/hour	42
Precipitation	6-month mean	mm	40
Temperature	2-month prior maximum	ºC	38
Evapotranspiration	12-month mean	mm	37
Temperature	Maximum	ºC	35
Vegetation	Herbaceous wetland	Percentage	32
Precipitation	3-month mean	mm	21
Precipitation	Month prior	mm	15

Notes: ºC = degrees Celsius; cm = centimeters; mg/l = milligrams per liter; mm = millimeters; MPa = megapascal.

A.2 Figures and Tables

A.2.1 Figures

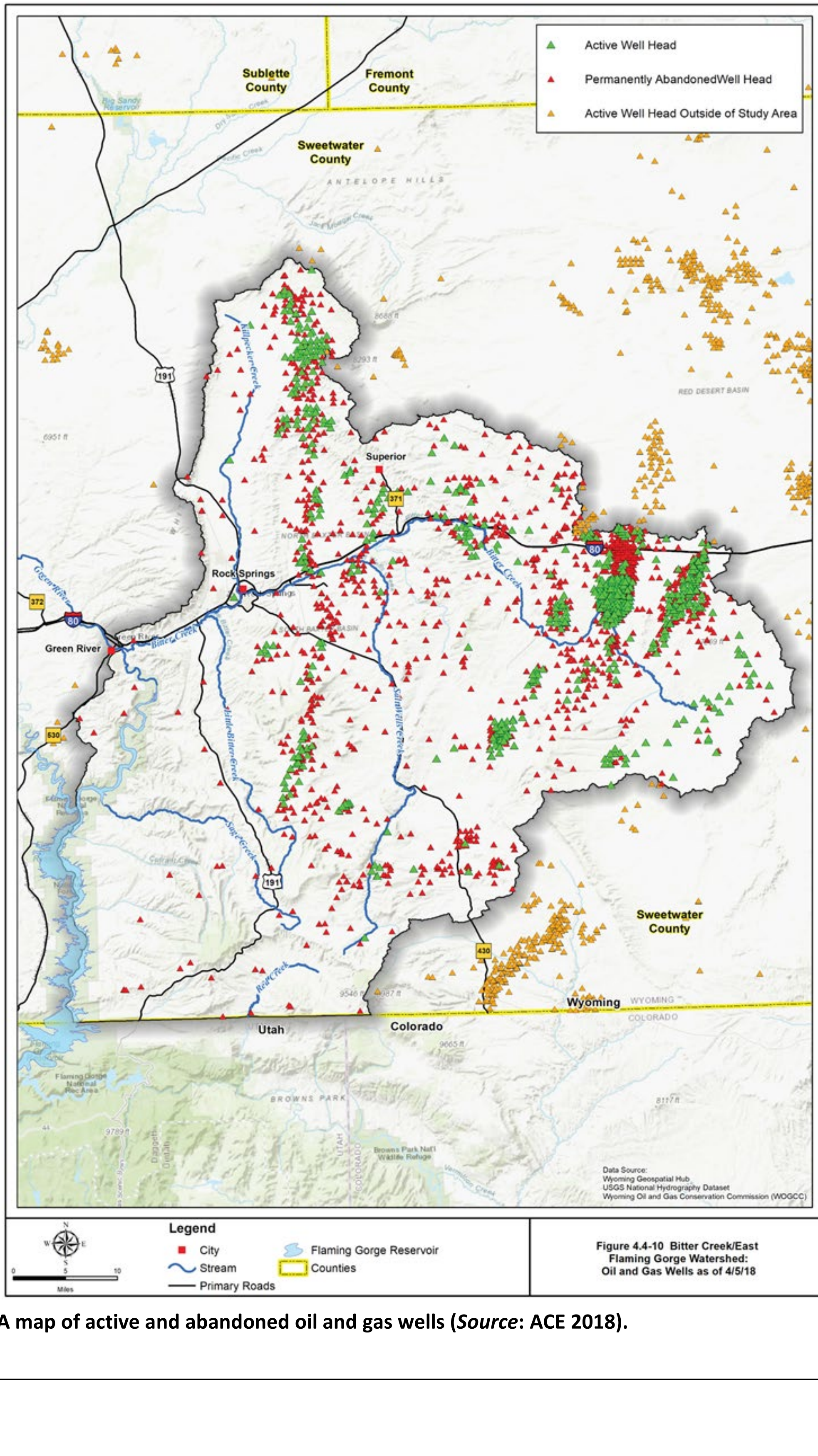


Figure A-1. A map of active and abandoned oil and gas wells (*Source*: ACE 2018).

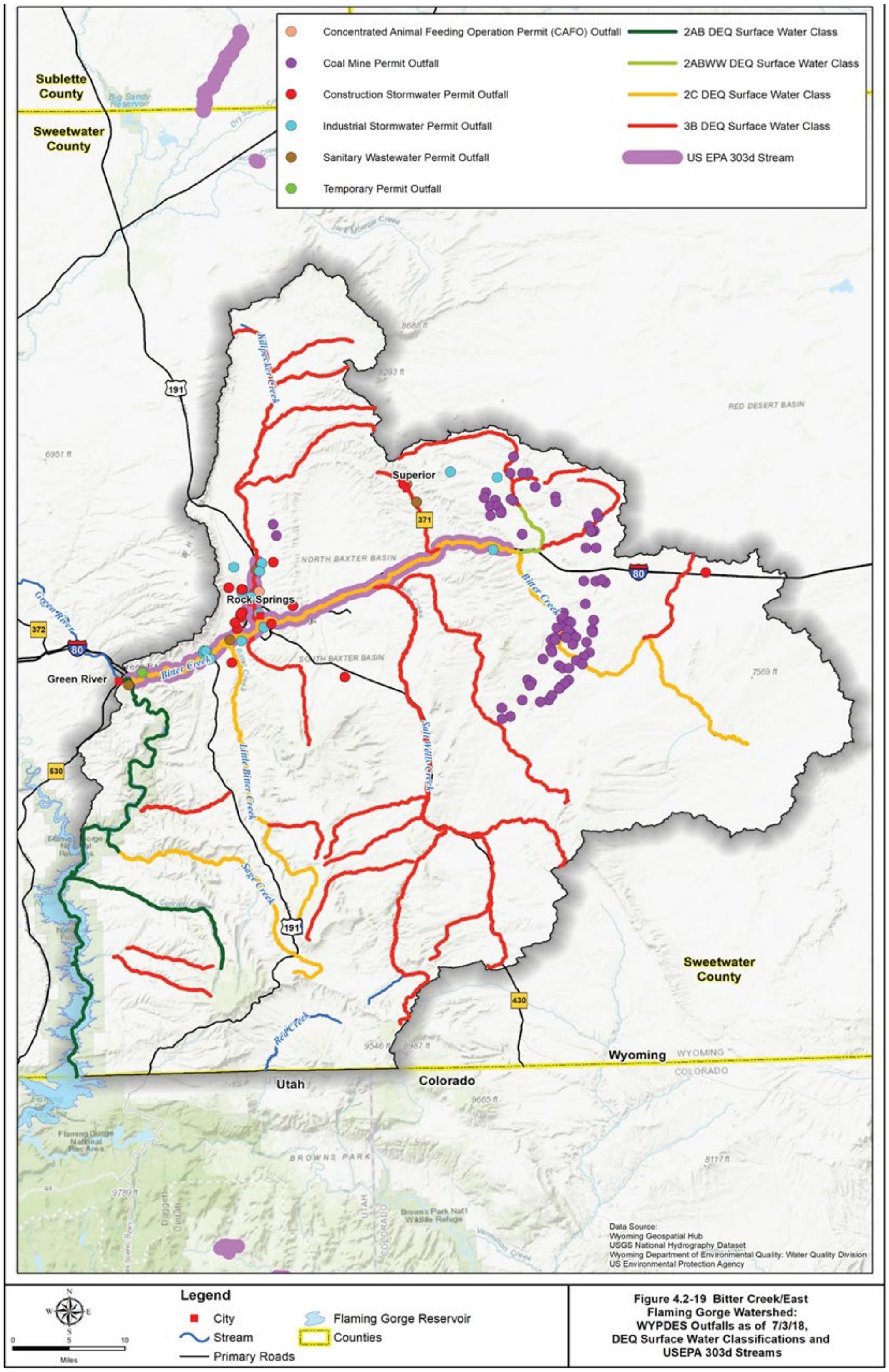


Figure A-2. A map of national pollution discharge permits (*Source*: ACE 2018).

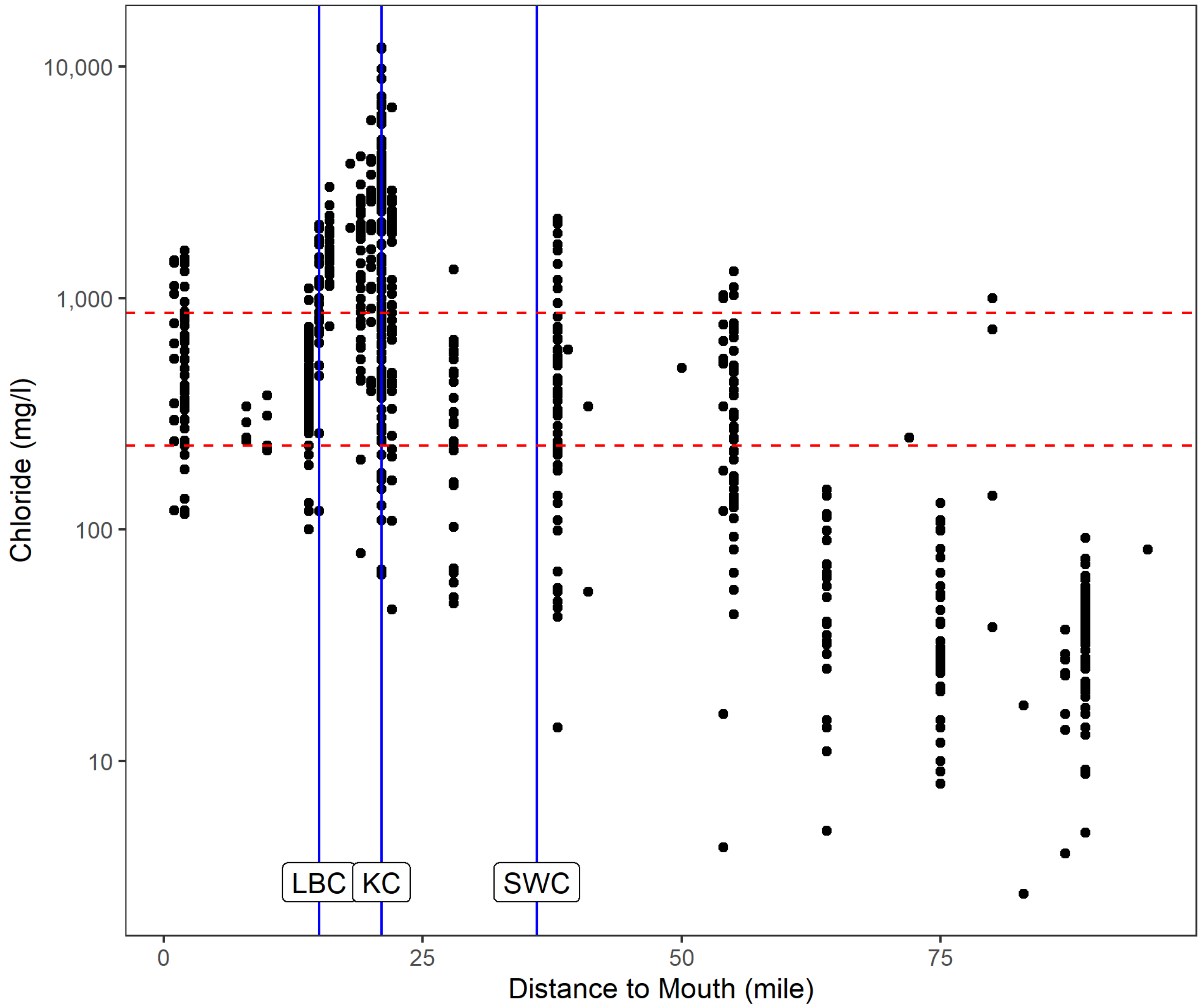


Figure A-3. Bitter Creek chloride profile.
Wyoming Department of Environmental Quality (WDEQ) chronic and acute Cl criteria shown as *horizontal red dashed lines* at 230 mg/l and 860 mg/l, respectively. High levels of chloride at the confluences of Bitter Creek with Salt Wells Creek (SWC) and Killpecker Creek (KC) are indicative of anomalous point sources. The dilution effect of lower Cl levels from Little Bitter Creek (LBC) also are evident. Higher Cl levels near the confluences also suggest a change in background compared to upstream. The sources were not investigated in this study (*Source*: BC_Cl_log10_point).

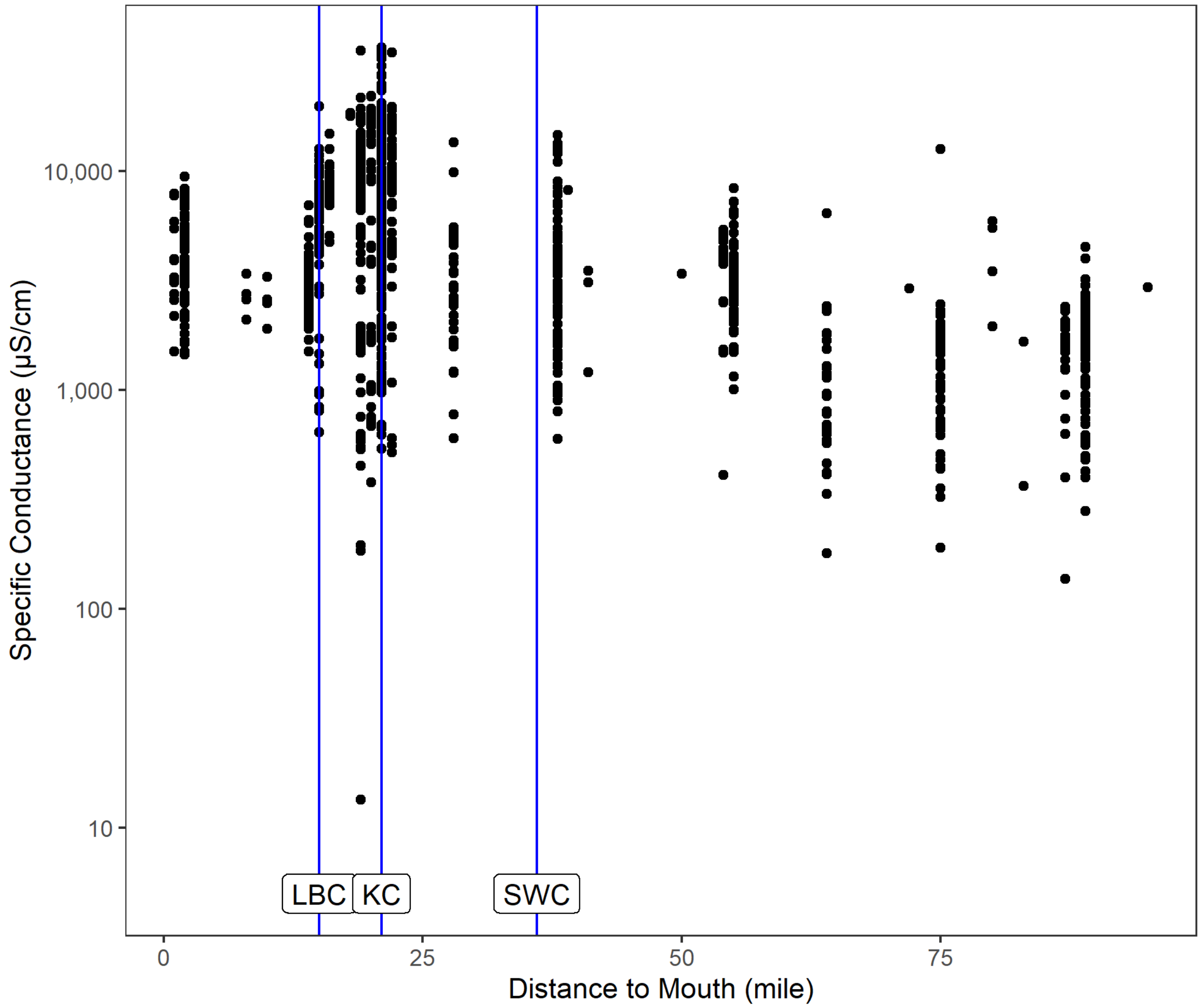


Figure A-4. Bitter Creek specific conductivity (SC) profile.
High levels of SC at the confluences of Bitter Creek with Salt Wells Creek (SWC) and Killpecker Creek (KC) are indicative of anomalous point sources. The dilution effect of lower SC levels from Little Bitter Creek (LBC) are also evident. Higher SC levels near the confluences also suggest a change in background compared to upstream. The sources were not investigated in this study (*Source*: BC_SC_log10_point).

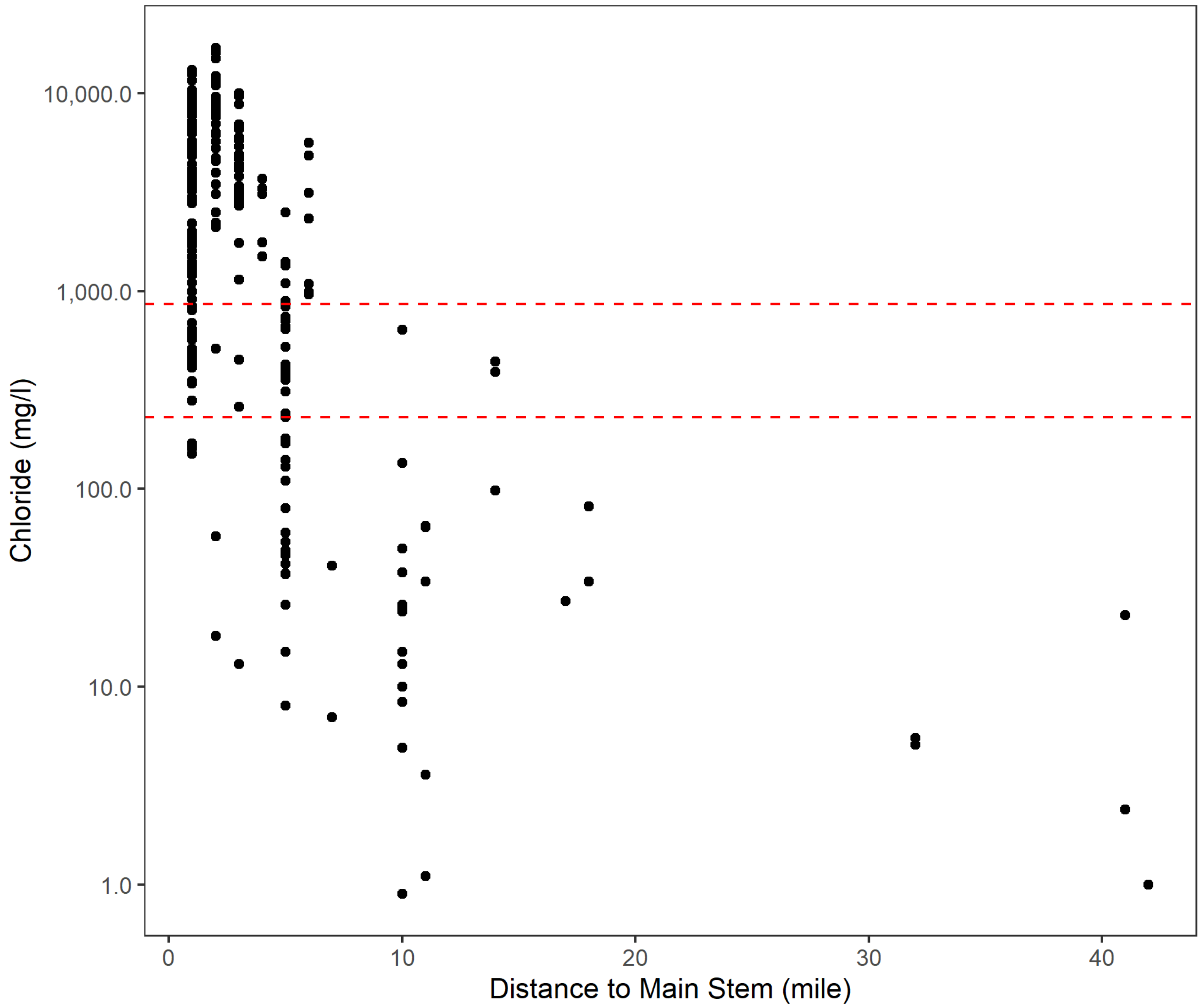


Figure A-5. Killpecker Creek chloride profile.
WDEQ chronic and acute Cl criteria shown as horizontal red dashed lines at 230 mg/l and 860 mg/l, respectively. High levels of chloride below river mile 10 indicates that Killpecker Creek is a source of increased Cl in Bitter Creek. Higher Cl levels near confluence also suggests a change in background compared to upstream. The sources were not investigated in this study (*Source:* KC_Cl_log10_point).

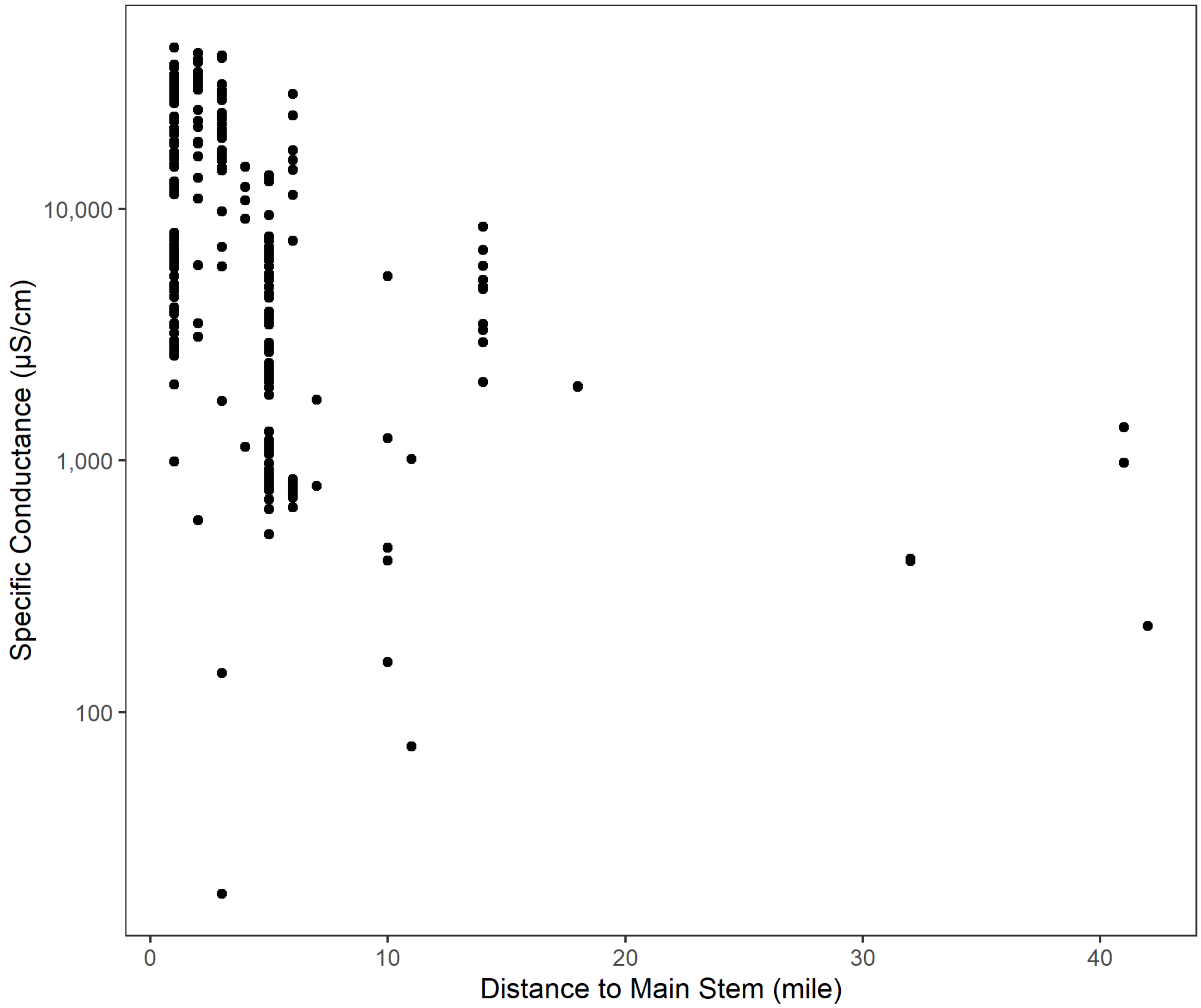


Figure A-6. Killpecker Creek specific conductivity (SC) profile.
High levels of SC below river mile 10 indicates that Killpecker Creek is a source of increased SC in Bitter Creek. Higher SC levels near the confluence also suggests a change in background compared to upstream. The sources were not investigated in this study (*Source:* KC_SC_log10_point).

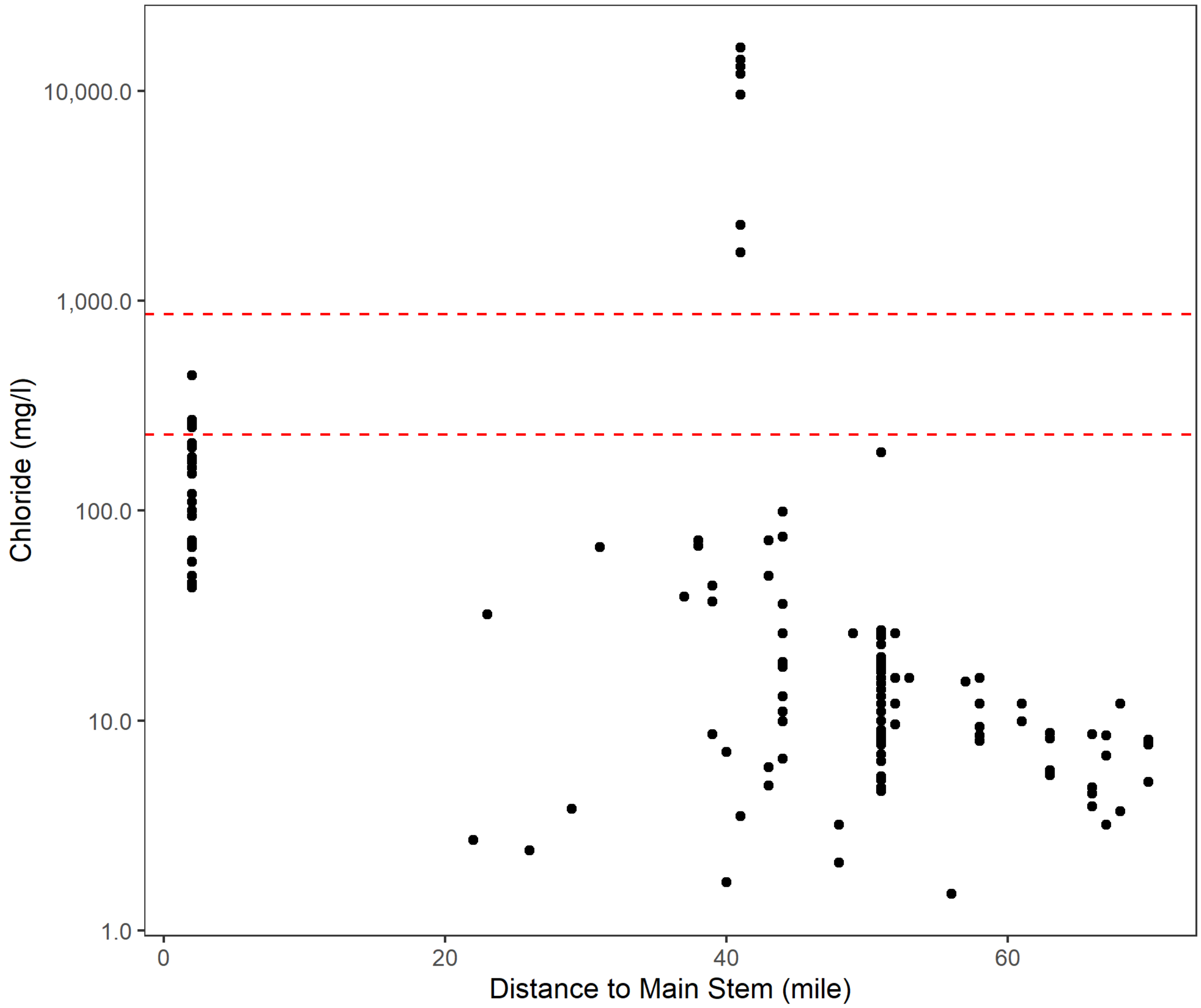


Figure A-7. Salt Wells Creek chloride profile.
WDEQ chronic and acute Cl criteria shown as horizontal red dashed lines at 230 mg/l and 860 mg/l, respectively. High levels of chloride near the confluence with Bitter Creek may be indicative of an anomalous point source. Higher Cl levels near the confluence also suggest a change in background compared to upstream. The sources were not investigated in this study (*Source:* SWC_Cl_log10_point).

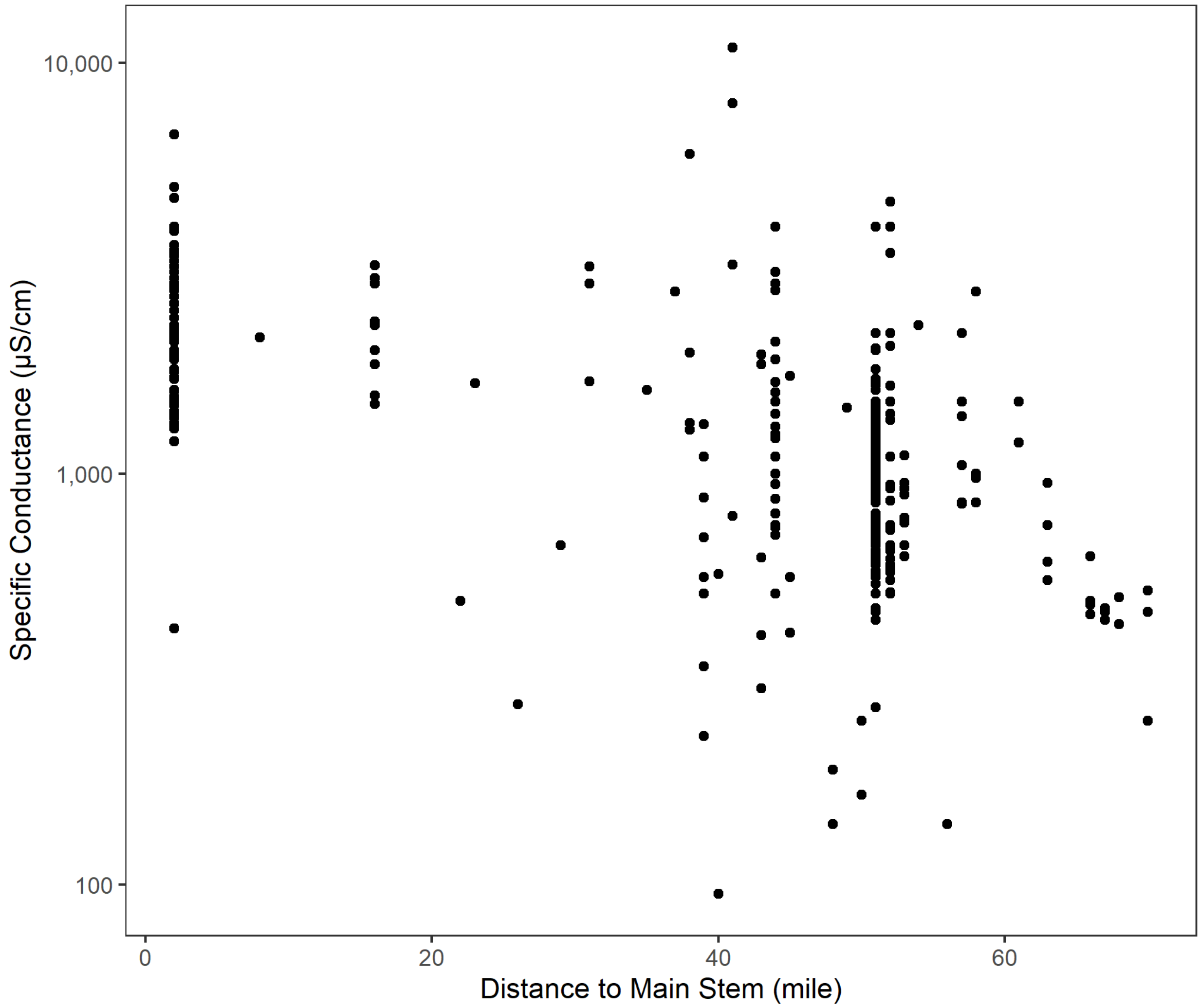


Figure A-8. Salt Wells Creek specific conductivity (SC) profile.
Higher SC levels occur near the confluence of Salt Wells Creek and Bitter Creek compared to upstream. Causes and sources were not investigated in this study. USGS gaging stating 09216565 is first record near mouth (*Source*: SWC_Cl_log10_point).

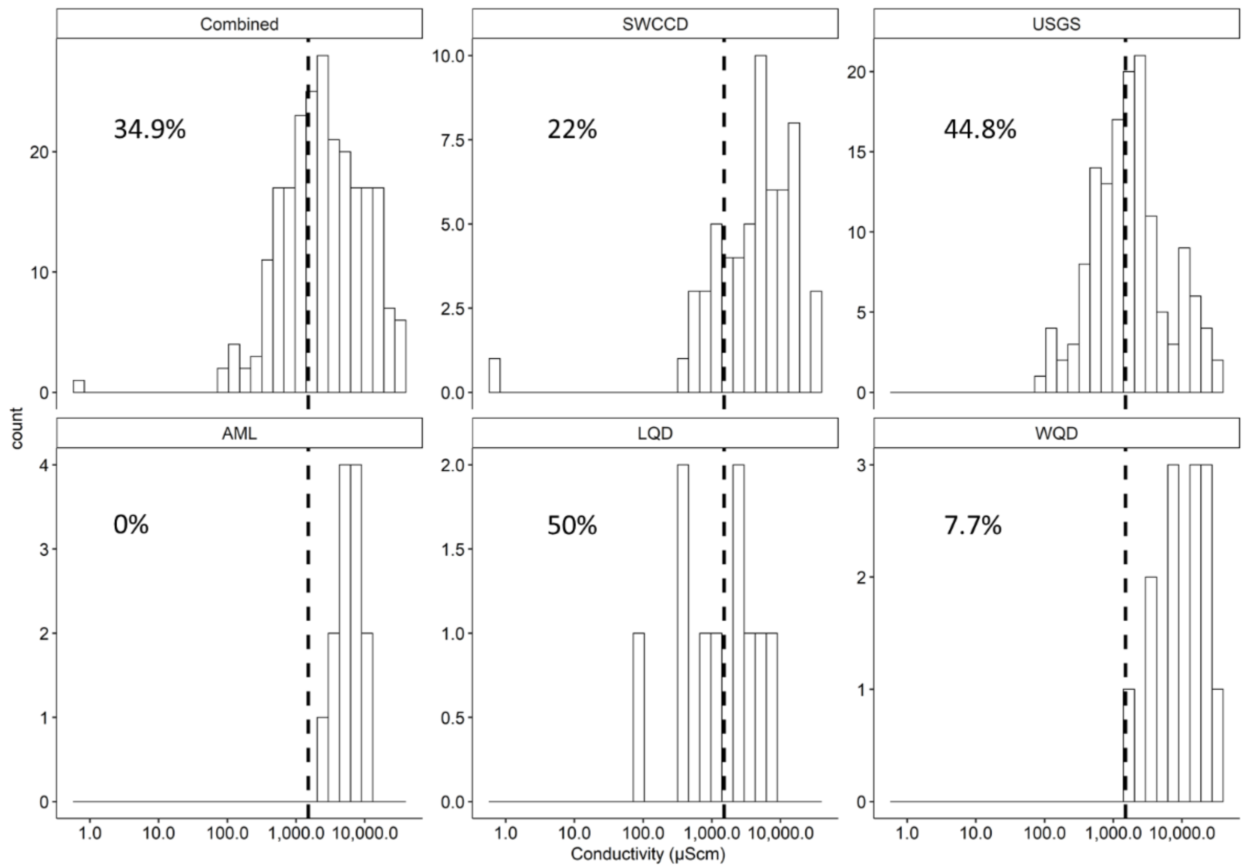


Figure A-9. Specific conductivity sampling stations and distribution (µS/cm).
Station medians were used to reduce bias from multiple samples and were used to estimate percentage of stations < 1500 µS/cm (*vertical dashed line*), which is the upper threshold for fresh water.

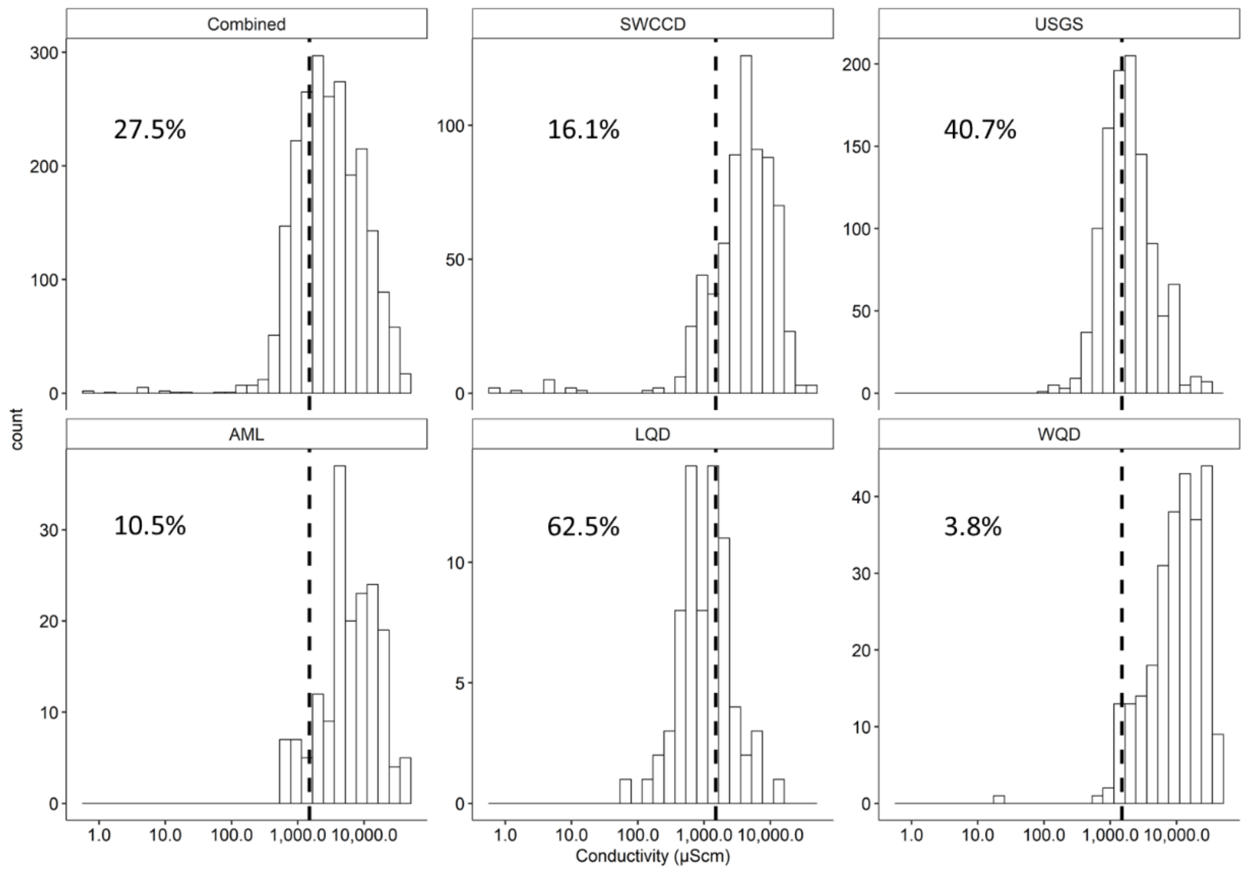


Figure A-10. All specific conductivity sampling stations and distribution (µS/cm), including multiple visits to the same stations, were used to estimate percentage of samples < 1500 µS/cm (*vertical dashed line*).
Note compared with median values (Figure A-9), inclusion of multiple visits decreases the proportion of samples < 1500 except for the dataset from the Land Quality Division (LQD), which is responsible for mining reclamation.

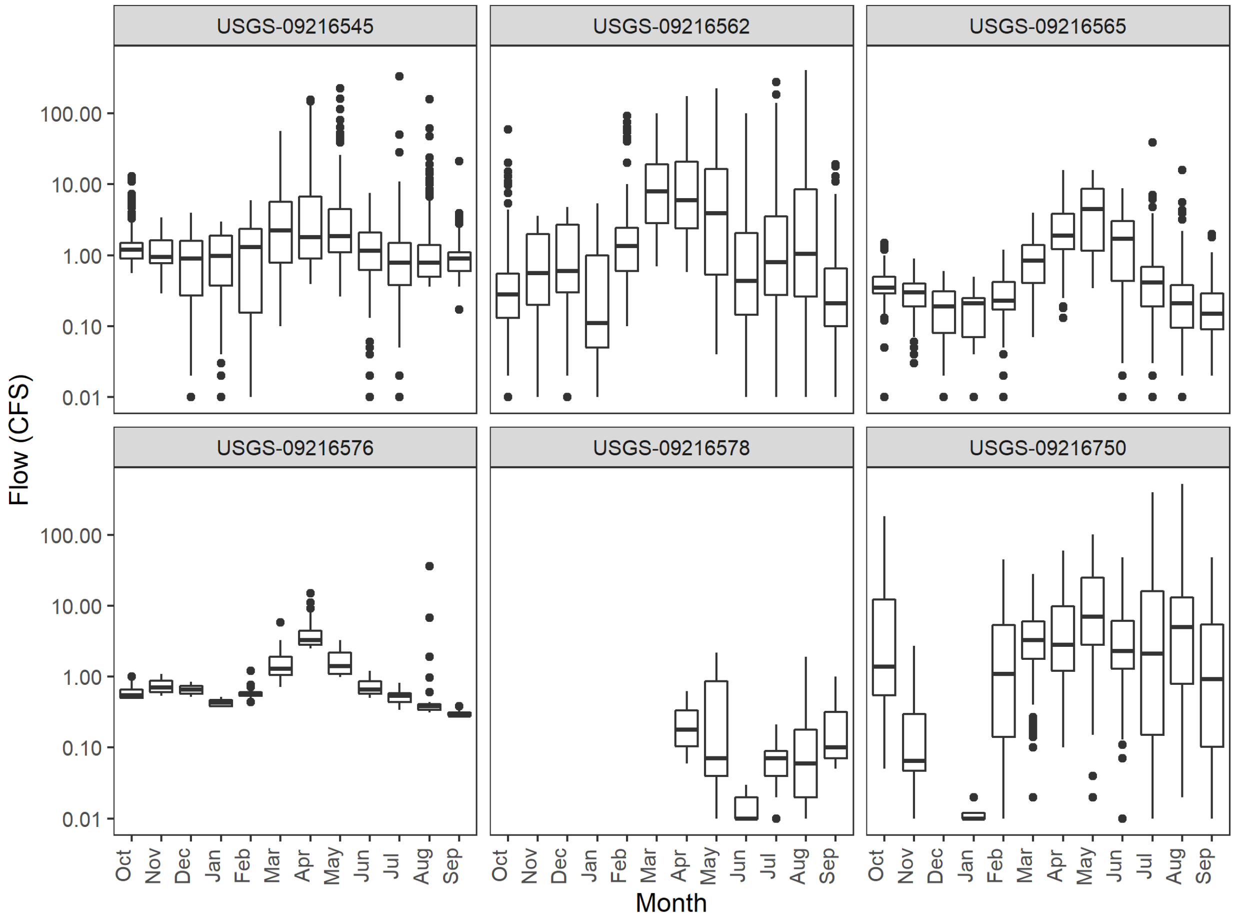


Figure A-11. Example box and whisker plot of stream flow (cfs) for six historical USGS stream gages.
Flow is greater from March to May with high flows indicated by whiskers also occurring in June–October and in February. Low flows occur from July through February except at station USGS-09216578, which was dry part of the year, and lowest flow in June. Flows among gaging stations are not normalized; zeros were removed before analysis.

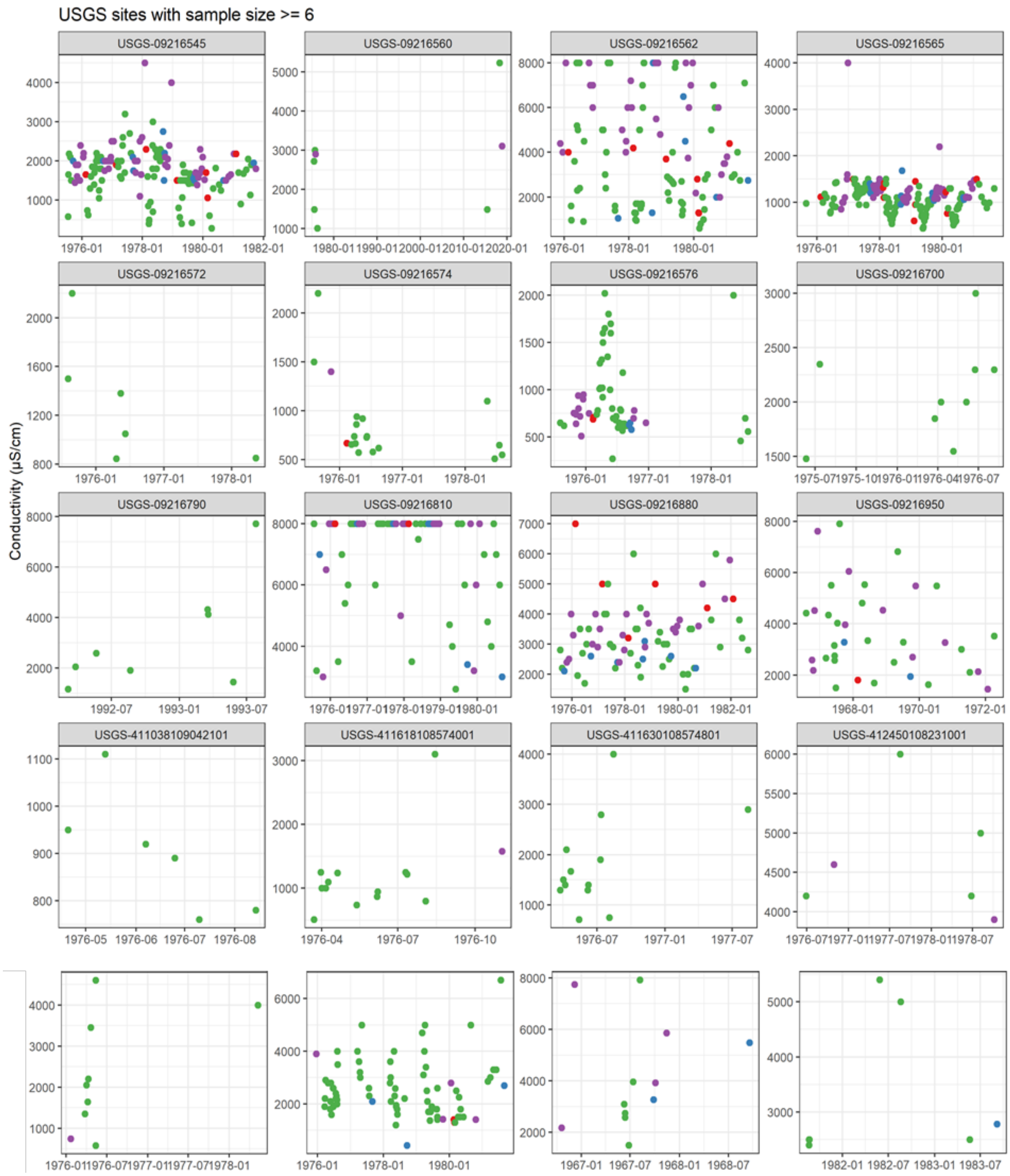
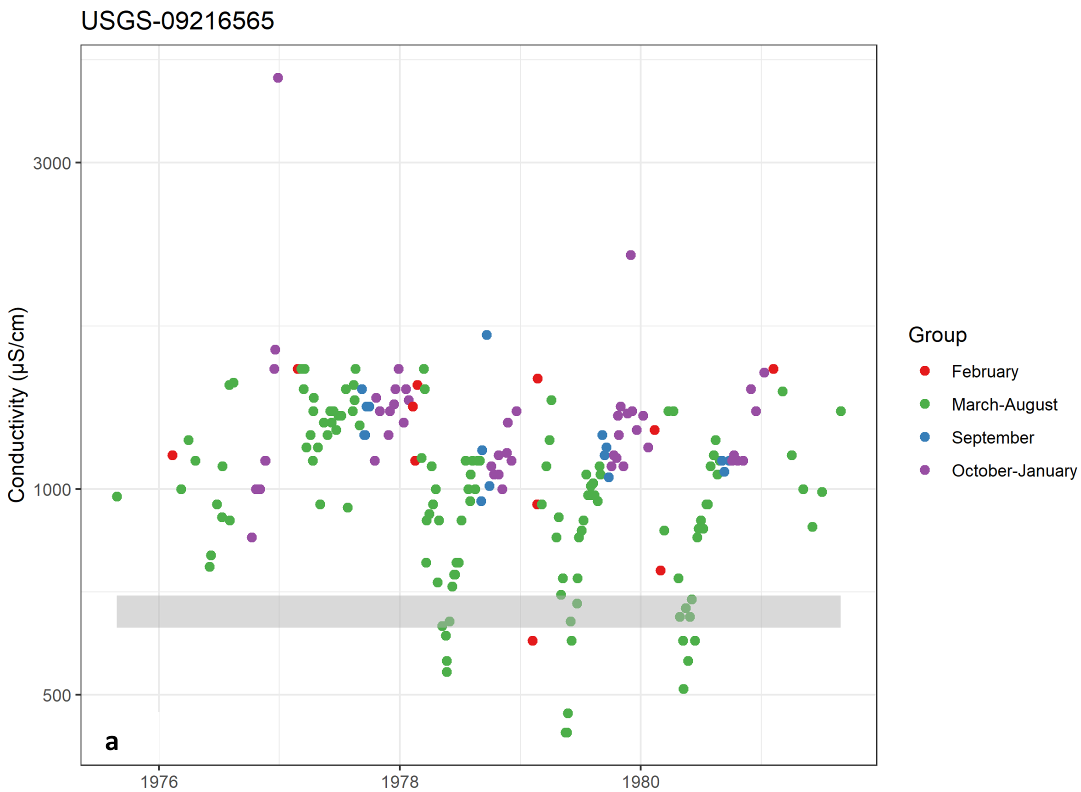
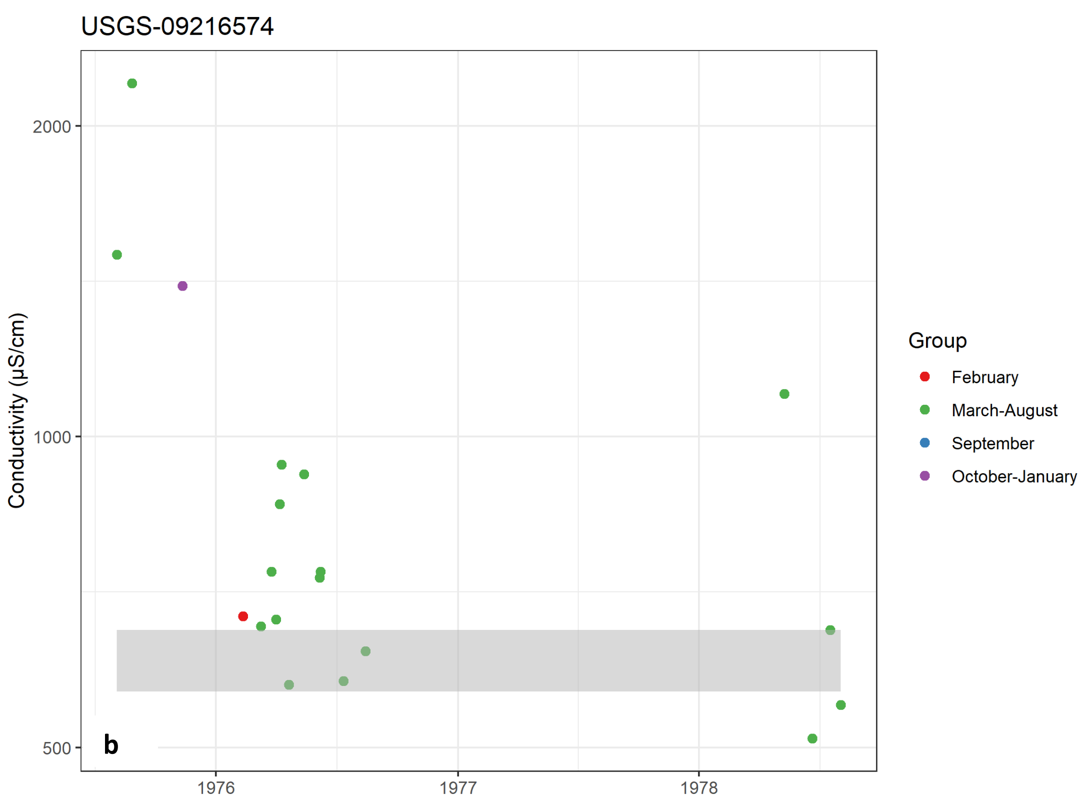
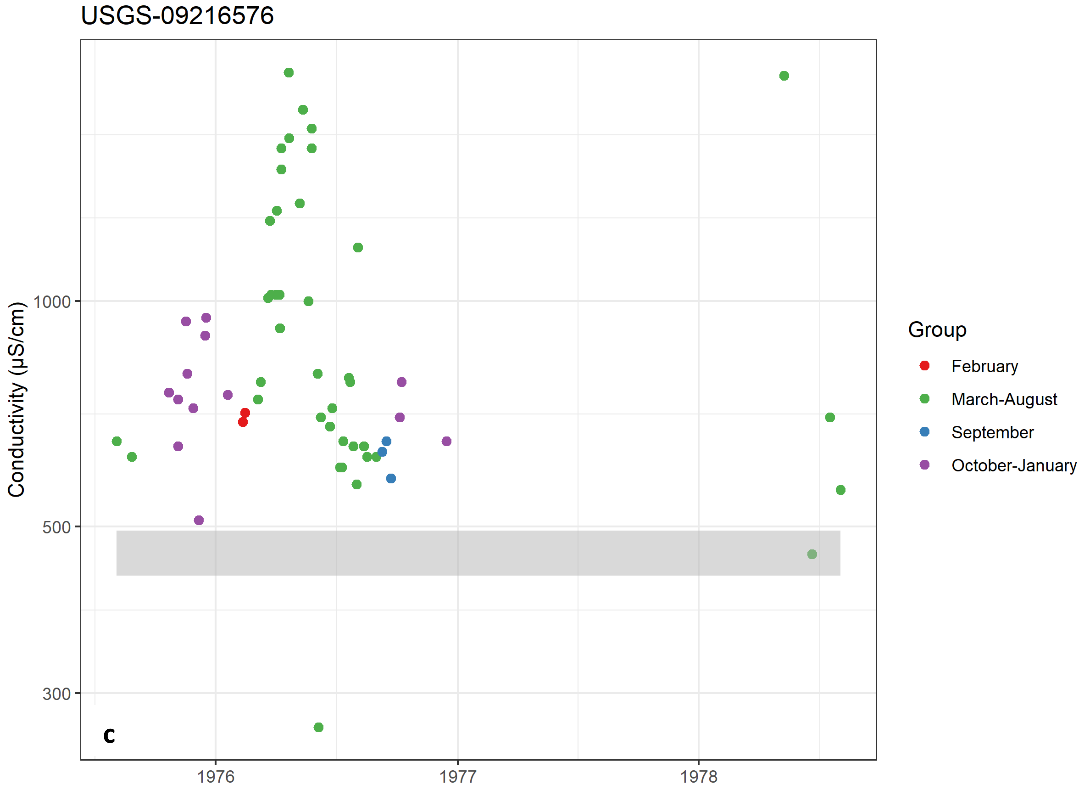


Figure A-12. Examples of USGS stations with more than six observations from non-reference streams. Absence may be due to no sampling occurring during that period rather than lack of flow. Note that the *y*-axis is specific conductivity **(**SC) (µS/cm) and that scale differs among plots. The x-axis is date (year-month). *Circle colors = October-January (violet) February (red), March-August (green), September (blue).*


USGS-09216565
Conductivity (µS/cm)
3000
1000
500
a
1976
1978
1980
Group
February
March-August
September
October-January


USGS-09216574
Conductivity (µS/cm)
2000
1000
500
b
1976
1977
1978
Group
February
March-August
September
October-January



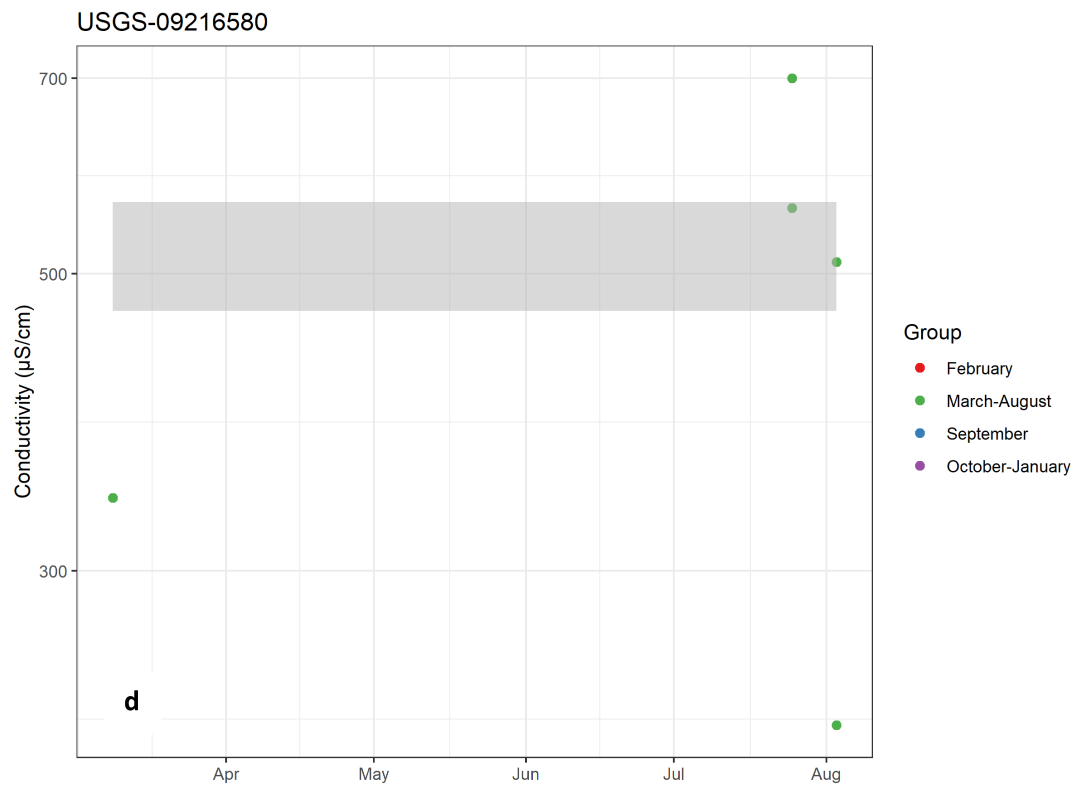


Figure A-13. Examples of minimum and maximum predicted background predicted specific conductivity (SC) (*shaded bar)* vs observed USGS SC (*circles*) from non-reference streams.

Observed SC: October-January (violet) February (red), March-August (green), September (blue). Minimum and maximum predicted SC for 2000-2015 shown as gray bar for comparison because data were not available to run models for 1975–2000. Note that the observed SC sometimes is less than or equal to the predicted background SC, but the average annual SC exceeds the predicted background SC. Absence of observed data may be due to no sampling occurring during that time period rather than lack of flow. *Example a*, USGS station 09216565 at Salt Wells Creek. The predicted annual mean and median for this site were 622.2 µS/cm and 660.9 µS/cm, respectively. The observed geomean was 1046 µS/cm, resulting in a difference between the predicted median and observed geomean of 385 µS/cm. *Example b*, USGS station 09216576 at Gap Creek. The predicted annual mean and median for this site were 472.6 µS/cm and 473 µS/cm, respectively. The observed geomean was 838 µS/cm, resulting in a difference between the predicted median and observed geomean of 365 µS/cm. *Example c*, USGS station 09216574 at Beans Spring Creek at mouth near South Baxter, WY. The predicted annual mean and median for this site were 697 µS/cm and 613 µS/cm, respectively. The observed geomean was 806 µS/cm, resulting in a difference between the predicted median and observed geomean of 193 µS/cm. *Example d*, USGS station 09216580 at Big Flat Draw near Rock Springs, WY in 1976. The predicted annual median for this site were 435 µS/cm. The observed geomean was 546 µS/cm, resulting in a difference between the predicted median and observed geomean of 111 µS/cm.

A.2 Tables

Table A-1. Examples of ions associated with different anthropogenic sources (*Source*: U.S. EPA 2016)

Source	Dominant ion(s)	Reference(s)
Surface coal mining and valley fills associated with mountaintop-removal coal mining	Ca^{2+}, Mg^{2+}, HCO_3^-, SO_4^{2-}	Bryant et al. 2002, Pond et al. 2008, U.S. EPA 2011a, 2011b, Griffith et al. 2012
Runoff and effluents from conventional coal mining and processing	Ca^{2+}, Mg^{2+}, HCO_3^-, SO_4^{2-}	Zielinski et al. 2001, Kennedy et al. 2003, Kimmel and Argent 2010
Deep coal mining	Na^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}	Thomas 2002, Mayhugh and Ziemkiewicz 2005
Combustion effluents	Ca^{2+}, Mg^{2+}, HCO_3^-, SO_4^{2-}	Samarina 2007, Ruhl et al. 2012
Historical industrial sources, such as chlor-alkali plants	Na^+, Cl^-	Echols et al. 2009
Wastewater treatment plants	Na^+, Cl^-, K^+, TKN, SO_4^{2-}	Paul and Meyer 2001, Andersen et al. 2004
Sewage and industrial waste discharges	Na^+, Cl^-, NH_4^+, NO_3^-, PO_4^{3-}	Carey and Migliaccio 2009
Saltwater intrusion	Na^+, Cl^-	Barlow and Reichard 2010, Mulrennan and Woodroffe 1998, Barlow 2003
Produced water from coal bed methane production	Na^+, HCO_3^-, Cl^-	Brinck et al. 2008, Dahm et al. 2011, Jackson and Reddy 2007, National Research Council 2010, Clark et al. 2001, Veil et al. 2004
Produced water from shale gas production (i.e., hydrofracking)	Na^+, Ca^{2+}, Mg^{2+}, Cl^-, HCO_3^-, K^+, SO_4^{2-}, Br^-	Haluszczak et al. 2013, Entrekin et al. 2011, Gregory et al. 2011, Veil et al. 2004

Source	Dominant ion(s)	Reference(s)
Produced water from conventional production of crude oil or natural gas	Na^{+}, Cl^{-}	Meyer et al. 1985, Boelter et al. 1992, Veil et al. 2004
Agricultural runoff, particularly associated with irrigation	Na^{+}, Mg^{+}, NH_4^{+}, Cl^{-}, F^{-}, SO_4^{2-}, PO_4^{3-} Note: Ions may vary by region.	El-Ashry et al. 1985, Leland et al. 2001, Bernot et al. 2006, Lerotholi et al. 2004, Lenat 1984; Bern et al. 2015
Road deicing treatments	Na^{+}, Cl^{-}, Ca^{2+}, Mg^{+}	Forman and Alexander 1998, Kelly et al. 2008, Environment Canada and Health Canada 2001, Evans and Frick 2001, Kaushal et al. 2005
Impervious surfaces and weathering of concrete in urban drainage systems	Ca^{2+}, HCO_3^{-}, Cl^{-}	Kelting et al. 2012, Steffy et al. 2004 Wright et al. 2011, Rose 2007
Dry and wet acid deposition	Ca^{2+}, Mg^{2+}, HCO_3^{-}, SO_4^{2-}	Kaushal et al. 2013

Notes: Br^{-} = bromine; Ca^{2+} = calcium; Cl^{-} = chloride; F^{-} = fluorine; HCO_3^{-} = bicarbonate; K^{+} = potassium; Mg^{2+} = magnesium; Na^{+} = sodium; NH_4^{+} = ammonium; NO_3^{-} = nitrate, PO_4^{3-} = phosphate; SO_4^{2-} = sulfate; TKN = Total Kjeldahl Nitrogen.

Table A-2. Considerations for evaluating suitability of different datasets for estimating background specific conductivity (SC) (green cells are preferred characteristics, yellow cells are not preferred, white cells are intermediate)

Consideration	Influence on estimating background estimate	AML	LQD	WQD	SWCCD	USGS	Combined
Suitability							
Total # of stations	Larger sample sizes are more likely to include some reference stations.	13	10	13	59	143	238
Number of stations with only one sample	May not be representative of the station.	0	4	0	23	82	109
Percentage of stations with > 2 samples	Replicates increase precision and better characterize SC variability	100%	40%	100%	52.54%	30.77%	44.12%
Number of stations with > 100 samples	Biases centiles and means, but useful for seasonal analysis; can use a data reduction to adjust.	0	0	0	0	3	3
Range (µS/cm) median	Indicative of representativeness of watershed and inclusion of stations near background.	603-12640	73-6547	18.98-41563	0.71-39200	95-31000	0.71-39200
Range (µS/cm) with replicates	Indicative of representativeness of watershed and inclusion of stations near background.	2430-12630	73-6620	1497-30636.5	0.82-39200	95-30800	0.82-39200
Within year station range	Percentage of stations with variability > 1500 µS/cm indicative of effluent.	92.31%	20%	92.31%	45.76%	10.49%	28.57%
Percentage of samples with > 1500 µS/cm	Suggests whether dataset measures fresh water or altered water.	100%	50%	92.31%	77.97%	52.45%	63.45%
Skewness[a]	Indicative of representativeness of watershed and inclusion of stations near background. Skew to right indicative of altered water.	-0.04	-0.57	-0.56	-2.42	0.25	-0.77

Consideration	Influence on estimating background estimate	AML	LQD	WQD	SWCCD	USGS	Combined
Kurtosis[b]	Could be representative, non-representative of either tail (e.g., background stations), biased by season.	-0.44	-0.89	-1.04	10.58	-0.28	3.10
Percentage of stations before 1985	Older data may not have complete documentation.	0	0	0	0	93.71%	56.3%
First and last recorded sample year	Longer records are useful for evaluating trends	2012-2018	1981-2017	2017-2019	2004-2016	1958-2018	1958-2019
Span of sampling in years	Different sample periods may represent different weather conditions. Maximum and minimum year.	7	37	3	13	61	62
Total # of years sampled in the dataset		7	37	3	13	45	45
Purpose of data collection	Biases sample towards anthropogenically influenced stations.	AML monitoring.	LQD works to ensure that any land disturbances resulting from mining are minimal and that affected areas are properly restored.	WQD works to keep Wyoming's water clean by monitoring and protecting surface- and ground water in the state.	Bitter Creek total maximum daily load.	A variety of targeted sampling programs.	Includes bias noted in AML, LQD, WQD, and SWCCD.
Spatial distribution	Area that was sampled dictates area that it represents. Broader spatial coverage more likely to capture some reference stations.	Few isolated stations north and east quadrants. None in Salt Wells Creek.	Few isolated stations north and east quadrants. None in Salt Wells Creek.	Few isolated stations north and east quadrants. None in Salt Wells Creek.	Few isolated stations in all quadrants. Few in Salt Wells Creek. Many stations near Rock Springs.	Many stations in all quadrants. Many in Salt Wells Creek. Many stations near Rock Springs.	Reflects spatial distributions of SWCCD and USGS.

Consideration	Influence on estimating background estimate	AML	LQD	WQD	SWCCD	USGS	Combined
Bimodality	Indicates that there are at least two populations (e.g., methods, exposures, seasons, etc.) with potentially different background or interpretations.	No	Yes	No	Yes	No	No
Percentage of stations in tributaries	Fewer likely inputs and, therefore, some may represent background. However, where there are inputs, small streams provide less dilution.	0	80%	0	18.64%	52.45%	39.5%
Absolute change between 10th and 25th centile (µS/cm)	When there are many stations with similar background, the 10th and 25th are similar. Large changes may be caused by false or non-representative low values or bias toward altered stations.	489	169.45	3608.6	943	303.8	512.63
Data quality							
Percentage of repeated values	May indicate data entry error, detection limit, or repeat samples from same location. (Percentage of identified records in raw dataset from the same station, date, time, and having the same values, and calculated percentage).	0	0	1.04%	23.95%	0	7.72%
Percentage negative values	SC cannot be a negative value. This problem did not occur in these datasets.	0	0	0	0	0	0
Percentage of zero values	Zero conductivity is not possible and may indicate no measurement or below detection.	0	0	0	1.24%	0	0.46%

Consideration	Influence on estimating background estimate	AML	LQD	WQD	SWCCD	USGS	Combined
Percentage of values < 10 µS/cm	Values < 10 or even 100 µS/cm are unlikely in any place but especially in Bitter Creek, given the known geology and climate.	0	0	0	2.38%	0	0.88%
Percentage of values > 10,000 µS/cm	Does not represent background, indicative of sampling of altered water. May be data entry error, extremely altered system, or salt spring/terminal inland lake.	36.46%	1.39%	53.95%	16.78%	2.74%	15.97%
Percentage of outliers (values larger than mean plus five times the standard deviation)	Suggests non-representative sampling or data entry errors.	1.1%	1.39%	0	0.41%	1%	0.38%
Summary for Dataset Suitability	AML, LQD, and WQD have 13 or fewer stations and are, therefore, insufficient alone. Of the AML and WQD datasets: more than 90% of stations exceed the freshwater definition of < 1500 µS/cm and would not capture the background for fresh water in the watershed. SWCCD also includes 77.97% stations > 1500 µS/cm. AML, WQD, LQD, and SWCCD are not spatially representative of the watershed whereas the USGS dataset is dispersed across the watershed with about an equal split between mainstem and tributaries. USGS is composed of mostly single samples from over 30 years ago, but it is large and 52% of stations are < 1500 µS/cm. USGS appears to be the most representative dataset of fresh water in the watershed. Combining USGS with other datasets would introduce bias from the other datasets.						
Summary for Data Quality	AML and WQD were represented by many extreme values, which may be data management errors; therefore, a low centile may not reflect background. SWCCD has 23.95% repeated values, which may be indicative of data management problems, and 2.38% values less than 10 µS/cm, which are likely incorrect units and may indicate that there are other undetected errors greater than 10 µS/cm. USGS has some high values, but data management errors were not apparent. The USGS dataset was judged to be more reliable than the other datasets.						

Notes: µS/cm = microSiemens per centimeter; AMD = Abandoned Mine Land Division; N/A= not applicable; SWCCD = Sweetwater County Conservation District; USGS = U.S. Geological Survey; WQD = Water Quality Division.

[a] Skewness coefficient is calculated based on Joanes and Gill (1998). We performed the type III skewness calculation on the data that were log10-transformed. Positive skewness indicates the mean of the data is larger than the median of the data and the data distribution is right-skewed. Negative skewness shows the mean of the data is smaller than the median and the data distribution is left-skewed. If the coefficient is near zero, the mean and the median are similar and the data distribution is symmetrical. Among these agencies, USGS is the only one showing positive skewness, indicating that the USGS dataset contains more values near the background conductivity levels.

[b] Kurtosis coefficient is calculated based on Joanes and Gill (1998). We performed the type III kurtosis calculation on the data that were log10-transformed. Positive kurtosis indicates the data are fat-tailed distribution. Negative kurtosis shows the data are thin-tailed distribution. If the coefficient is near zero, the distribution is similar to a normal distribution with standard tail shape. Among these agencies, USGS's kurtosis coefficient is the closest one to zero, indicating the distribution is similar to a normal distribution.

Table A-3. Considerations and information for estimating background specific conductivity (SC) using the USGS dataset

	Type of evidence	Rationale	Evidence	Inference
A	**Data quality and suitability**			
1	Larger datasets are more reliable.	Large datasets provide more confidence in the evidence derived from them.	The numbers of samples (1,188) and stations (143) in the USGS dataset are suitable to estimate background and can be compared with other smaller datasets. However, many of the records are nearly 50 years old.	Acceptable, but dated.
2	Quality-assured instream chemical measurements are more reliable.	Meter calibration should be performed using appropriate standards. Otherwise, the measurements may be inaccurate.	Meter calibration and other good field and laboratory practices are required by WYDEQ, SWCCD, and USGS standard operating procedures.	Ok.
3	Appropriate reporting units are required.	Units should be reported as SC. Otherwise, direct comparison of the measurements is inappropriate.	Units are reported as SC. Other units and detection limits are not completely known.	No obvious error detected.
4	Comparisons are appropriate if ionic mixtures are similar.	Dissimilar ionic mixtures may indicate different geology and are also suggestive of anthropogenic sources. If the ionic differences are natural, background may vary across the study area.	Samples < 1500 µS/cm are dominated by salts of HCO_3^- plus SO_4^{2-} (Cl^- represents less than 50% of anions on a mass basis). SC is greater than background SC where the ionic mixture is dominated by chloride. However, Na^+ is more often the dominant cation than Ca^{++} or Mg^{++} (**Error! Reference source not found.**, **Error! Reference source not found.**).	Ionic composition varies among samples, so background may also vary across the watershed.
5	Comparisons are more reliable if collection methods and sampling windows are similar.	A similar and shorter sampling window increases the likelihood that similar methods were used. Data should be collected in similar seasons or be normalized for Julian day. Biological sampling methods should be similar. Otherwise, the estimates may not be comparable or are less reliable.	Some records included samples in all seasons, but additional analyses were performed in the present study to consider seasonal background differences. Seasonal low SC was judged to be from March through August and seasonal high SC, October through January. February and September were excluded because they appeared to be transitional based on quantiles and temporal sequence between the high and low SC seasons. Many records are decades old.	Collection period spans more than 43 years. Less reliable.
6	Validation increases reliability.	If more than one dataset is available or another method is available for analysis and they yield similar results, then the results are validated and are less likely to be due to chance alone.	Although small and targeted, it appears that the AML, WQD, and LQD datasets have some less disturbed sites and may be used for comparison but not for validation.	Weak quality of evidence.

	Type of evidence	Rationale	Evidence	Inference
7	Inclusion of likely background sites makes identification of background levels more probable.	Inclusion of headwater (low Strahler order) streams in the sample increases the likelihood that less disturbed background SC is represented, because they tend to have fewer anthropogenic sources. Watersheds with native vegetation are also more likely to have background water quality. The proximity and proportion of point sources, anthropogenically altered subsurface, or land cover near the sampling stations decrease the likelihood that a site represents background. Even if more than 90% of area is in native vegetation, proximity of a sampling station to a point source has a greater effect than the proportion of vegetated area in the catchment (Hopkins et al. 2013).	Samples from Salt Wells Creek are likely to be from less disturbed areas. These areas had more low SC stations than elsewhere in the watershed (**Error! Reference source not found.**).	Fair quality of evidence.
8	Abrupt changes in values at political boundaries makes it likely that differences among areas are not natural.	Abrupt changes in SC at political boundaries suggest that differences in SC are likely due to differences in methods or anthropogenic sources/practices and not natural causes. Such changes do not represent real differences in background and support the argument that SC is not different between two areas.	Targeted sampling especially near Rock Springs is similar to USGS measurements and likely due to conditions near Rock Springs and not due to sampling differences.	Ok.
9	Less disturbed reference site quality independently verified.	Reference sites may not be background. Because identification of reference sites may be subjective, independent verification or comparison to another reference dataset is desirable.	Not assessed, no evidence.	No evidence.
10	Less disturbed reference sites are selected in part based on presence of high biological diversity.	Biological conditions for reference sites are important for verification of reference status.	Not assessed, no evidence.	No evidence.

	Type of evidence	Rationale	Evidence	Inference
11	Less disturbed reference sites have high quality instream and riparian habitat (e.g., RBP score > 140; [Barbour et al. 1999]).	Unless habitat quality is high, sites are unlikely to represent true reference water quality.	Not assessed, no evidence.	No evidence.
12	At less disturbed reference sites, water quality parameters other than SC should reflect minimally affected conditions.	Unless all water quality parameters reflect minimally affected conditions, sites are unlikely to represent background.	Not assessed, no evidence.	No evidence.
13	Reference sites have minimal human disturbance of geological parent material.	Geologic disturbances, such as quarries and road cuts, are likely to raise SC levels. Developed areas are associated with multiple potential sources that affect background.	Not assessed, no evidence.	No evidence.
14	Distribution of background levels: Low SC sites are spatially dispersed in the watershed (in this case example, lowest 35 stations in USGS dataset, < 500 µS/cm).	Low SC stations dispersed throughout the area suggest that background estimates can be applied throughout the watershed.	Low SC stations are spatially dispersed, but less common near Rock Springs (**Error! Reference source not found.**). Background may vary by more than 200 µS/cm in the watershed. Stations from the lowest 10% and 25% are distributed across the watershed.	Site-specific background is likely to be more accurate than watershed-wide background estimate.
B	**Anecdotal information**			
15	Written first-hand accounts.	Early accounts can describe conditions prior to later anthropogenic influences.		
		Journal entries by Major J. Lynde, 1857, December 3rd.	"…took breakfast at the mouth of Bitter Creek... grass very scarce, it has a bitter brackish taste." December 4th: "The water is not fit for man to use, being at least 1/8 salt."	Suggests NaCl ionic mixture in some places: 1857–bitter, brackish, salty; 1863–tastes and acts like seawater.
		Journal entries by A. Howard Cutting, 1863, June 7th; Black Butte Station.	"Sides of the bank crusted." June 8th: Salt Wells "The well water is very salty and tastes and acts, when used for washing, just like seawater... Bitter Creek which runs directly past the well is almost unfit for any purpose. Seems to grow worse the further we travel on it."	

	Type of evidence	Rationale	Evidence	Inference
		Schultz, A.R., 1920. Oil possibilities in and around Baxter basin, in the Rock Springs uplift, Sweetwater County, Wyoming (No. 702). US Government Printing Office.	"In the greater part of the Rock Springs uplift water for drinking and domestic use is somewhat difficult to obtain. The surface water and that, reached by shallow, open wells, or by drilling are both alkaline, and many of the springs contain considerable hydrogen sulphide and mineral matter. So far as ascertained the wells sunk in the alluvium of stream valleys or in the rock to shallow depths are not satisfactory. The water in them is of uncertain quality and very scanty in amount. Most of them yield water that is more alkaline than that of Bitter Creek…. It appears from the records of flowing and other wells at Rock Springs, Superior, Bitter Creek, and other points along the Union Pacific Railroad that water can be obtained in almost any part of the Rock Springs field, outside of Baxter Basin, by drilling to considerable depths. "Water for drinking and domestic use is much more difficult to obtain in Baxter Basin than in the area surrounding the basin. The flow of Bitter Creek within this area is much the same as elsewhere along the stream. The water, however, is not fit for domestic or boiler use and at certain times of the year is not very satisfactory for stock. … Furthermore, the water contains so much alkali that it is not suitable for agriculture. "At the south end of the basin, in the vicinity of Aspen Mountain, where a considerable area of the tablelands is covered by the Bishop conglomerate, a number of springs and small streams occur in the deep, narrow valleys heading on the mountain side. Springs are also found along the contact of the Bishop conglomerate and the underlying formation. The water from these sources is excellent for domestic use and is similar in every respect to that of the area in the vicinity of Little, Miller, and Pine mountains, described above."	Consistent with predicted and measured SC in Little Bitter Creek and South Bitter Creek. In this study, alkaline is assumed to relate to high pH.

	Type of evidence	Rationale	Evidence	Inference
16	Oral first-hand account.	Long-time first-person accounts can provide insight into sources and changes to conditions in the area.	Leonard Hay, 89-year-old lifelong resident of Rock Springs area. Personal Interview prior to release of report in 2003. Stated that there were many mines under the town of Rock Springs. Once the mines closed and the pumping stopped, the mines filled with water and the water table came back up. The mines were refilled to keep them from collapsing. South of town by 84 Lumber, the water table is only 3–3-1/2 feet down and seeps out through the washes. When mines used to pump out the mine water and put it directly into Bitter Creek, the children used to go and collect sulfur water once a month for medical purposes. Elsewhere, water quality has improved for livestock.	c. 1920, high sulfur mineralization from mine seepage. Suggests $NaSO_4$ or $CaSO_4$ ionic mixtures in some places.
C	**Biological evidence**			
17	Background predicted from resident biota.	Historical or recent records of species adapted to the natural SC regime are indicative of background. The XC95 or other species/genus tolerance values can be used to predict background.	Biological data not readily available. Not assessed, no evidence.	No evidence.
D	**Regional and geophysical characteristics**			
18	Climate in the watershed.	Climate affects vegetative cover and precipitation, which could affect background levels.	• Climate is xeric and, therefore, SC is expected to be greater than most of U.S. • More precipitation at higher elevations and in the southwestern part of watershed. Hence, dissolved ions are expected to increase from headwaters to mouth. • Seasonal patterns of stream flow are likely to result in notable variation in background SC during the year.	Climate is expected to affect stream SC.
19	Geology in the watershed.	Geology and soils can affect the background level.	Geology differs across this large watershed but is composed of mostly unweathered sedimentary rock. Rock and soil origins are from freshwater and marine deposits, but unlike areas west of the Green River (e.g., trona deposit area) and northeasterly, not the result of evaporative water bodies.	Ion composition likely to have more Na^+ and Cl^- in parts of the watershed.

	Type of evidence	Rationale	Evidence	Inference
20	Physiography across the watershed.	Physiography can affect the hydrology and interaction time of water and minerals.	Higher elevation buttes have less flow in intermittent streams. There are more springs in the southwestern part of watershed.	More water in the southwest part of watershed is expected to reduce SC in streams than elsewhere in the watershed.
21	Geophysical modeling estimates for the watershed.	Models that predict stream chemistry based on geology, climate, topography, and vegetation are not predicated on altered conditions, so they should estimate background. Some models are available (e.g., Olson and Hawkins 2012; Olson and Cormier 2018).	Annual mean modeled SC within the watershed using data from 2000-2015 ranged between 384 and 1004 µS/cm, with an overall median of 645 µS/cm, 598 µS/cm, and 498 µS/cm for the entire watershed, Bitter Creek, and Killpecker Creek, respectively (**Error! Reference source not found.**). Killpecker, Salt Wells, and Bitter creeks flow more regularly than other streams in the watershed. Among all stations within the predicted background range that are more likely to be representative of natural background, 76% of the observed values were less than the predicted value (**Error! Reference source not found.**). Therefore, the model reasonably predicted background SC, at least for minima.	Median 645 µS/cm (384–1004 µS/cm).
		Modeled ecoregional background should be somewhat similar in the watershed unless it is anthropogenically altered.	The predicted mean base-flow SC for Bitter Creek is 645 µS/cm and 443 µS/cm for the Wyoming Basin Ecoregion (Cormier et al. 2018b). This difference suggests that Bitter Creek may differ from the larger ecoregion due to differences in geology and climate. Forested mountains may have reduced the overall 25th centile measured value for the broader ecoregion and the predicted means. The Bitter Creek watershed has buttes, but few mountains (Cormier et al. 2018b using Olson and Hawkins (2012) model).	443 µS/cm.

	Type of evidence	Rationale	Evidence	Inference
E	**Measured water chemistry**			
22	Minima in watershed.	Low SC is indicative of a minimally affected (natural) condition.	From the USGS dataset, the SC minima during high and low flow are 140 µS/cm and 95 µS/cm, respectively. There are potentially errors with entry or data units for other datasets (e.g., 0.71 µS/cm, 0.82 µS/cm from SWCCD and 18.92 µS/cm from WQD). Minima for chloride during high and low flow are 10 mg/l and 24 mg/l, respectively.	95 µS/cm.
	10^{th} centile of probability sample may be a reasonable estimate of background.	In probability-based samples, the 25^{th} centile is often similar to less disturbed reference or minimally affected sites. When anthropogenic changes are widespread, then 10^{th} centile may be more appropriate.	No probability sample for the watershed.	No evidence.
23	25^{th} centile of probability sample may be a reasonable estimate of less disturbed background.	In probability-based samples, the 25^{th} centile is often similar to reference or minimally affected sites. When anthropogenic changes are widespread, then 10^{th} centile may be more appropriate.	No probability sample for the watershed.	No evidence.
24	The median or 75^{th} centile of minimally affected sites may be a reasonable estimate of background.	Sites with natural vegetation and no or very little recent or historical disturbance should have low SC relative to disturbed areas and be representative of background.	Minimally affected sample stations were not identified, but tributaries and upstream reaches had lower SC and chloride levels consistent with climate inference (Item A-1, above).	No evidence.
25	Similar background compared to ecoregional background or nearby watersheds.	The greater the proportion of stations below the ecoregional level (e.g., for the case example, 397 µS/cm), the more likely that the measured value represents background. (Estimate from Cormier et al. 2018b, flowchart)	Based on a probabilistic U.S. EPA survey of Level III Ecoregion 18, Wyoming Basin, *N* = 37, the 25^{th} centile was 397 µS/cm. Background in Bitter Creek watershed was 411 µS/cm.	397 µS/cm.

	Type of evidence	Rationale	Evidence	Inference
26	In mixed datasets, the 10th or 25th centiles may be reasonable estimates of background.	In a targeted or mixed dataset, centiles are not intended to be representative of the region or watershed overall; they are simply proportions of the dataset. If 10th and 25th are substantially different then sample may not be representative of background and 10th centile is more conservative. Alternatively, a break point analysis may guide selection of a threshold.	The watershed is anthropogenically altered. Also, the difference between the 10th and 25th centiles is > 300 µS/cm suggesting that the 25th centile does not represent background, so the 10th centile was selected (**Error! Reference source not found.**). The 10th centile of the USGS station means is 411.20 µS/cm and the 25th centile is 715 µS/cm, a difference of > 300 µS/cm.	411.20 µS/cm.
27	Sample distribution and minima of targeted datasets.	Programs designed to sample impaired waters may not sample many non-impaired sites and thus may not be representative of background. Inspection of the distribution may suggest a break point for background.	The full datasets, including repeat sampling in WQD, SWCCD, and AML are skewed toward higher SC and are likely to be effluent dominated. However, there are some low values (Table A-6 and Table A-7). Minimum values for LQD and SWCCD may have errors with units (LQD: 73 µS/cm; SWCCD: 0.71 µS/cm; 18.98 WQD). Therefore, 10th centile is shown for LQD and SWCCD.	LQD: 10th 367.30 µS/cm. SWCCD: 10th 756.00 µS/cm.
28	Exceeds freshwater definition of < 1500 µS/cm.	By definition, it is not a background fresh water if it exceeds freshwater limits and is brackish or saline. However, may be natural as in Great Salt Lake.	More than half of stations in the watershed exceed the 1500 µS/cm upper limit for fresh water (Figure A-9 and Figure A-10).	65% of station medians do not meet the definition of fresh water.
29	Historical record.	Trend analysis may indicate that apparent background has changed and that the older record may more accurately reflect the original baseline.	Not analyzed.	No evidence.

Notes: µS/cm = microSiemens per centimeter; NE = no evidence; RBP = Rapid Bioassessment Protocol; SC = specific conductivity; SWCCD = Sweetwater County Conservation District; USGS = U.S. Geological Survey; WYDEQ = Wyoming Department of Environmental Quality; XC = extirpation concentration.

Table A-4. Sub-Data and Combined datasets: Summary annual statistics of observed water quality parameters calculated, including multiple measurements at the same station

agency_cd	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# Stations
AML	SC (µS/cm)	603.00	1477.20	3760.00	6125.00	13622.50	43800.00	9141.00	5989.98	172	13
AML	Cl (mg/l)	48.00	267.50	476.25	1255.00	2930.00	13119.00	2262.46	1204.12	178	13
AML	TSS (mg/l)	1.70	7.10	14.00	28.00	68.75	6000.00	197.91	36.54	162	13
AML	NOx (mg/l)	0.10	0.50	1.00	1.40	2.23	4.70	1.74	1.37	56	11
AML	pH (SU	4.04	7.55	7.86	8.18	8.48	10.57	8.17	8.14	180	13
AML	Temperature (ºC)	0.20	2.20	7.30	12.50	17.50	27.40	12.22	9.42	180	13
LQD	SC (µS/cm)	73.00	401.30	612.50	1059.50	1738.50	12640.00	1559.43	1028.04	72	10
LQD	Cl (mg/l)	0.90	5.00	20.28	75.00	289.75	2190.00	216.72	68.99	240	15
LQD	TSS (mg/l)	60.00	68.00	101.00	186.00	205.00	212.00	154.67	138.10	6	2
LQD	DO (mg/l)	0.03	0.36	6.43	12.55	17.00	20.00	11.03	4.29	8	2
LQD	pH (SU)	6.72	7.37	7.70	8.20	8.48	9.20	8.07	8.05	62	6
LQD	Temperature (ºC)	0.10	1.76	3.80	8.60	15.33	23.70	9.89	6.39	60	6
SWCCD	SC (µS/CM)	0.71	994.40	2145.00	4550.00	8200.00	39200.00	5869.23	3681.50	675	59
SWCCD	Hardness (mg/l)	8.17	242.50	608.93	1539.00	3774.80	9500.00	2296.32	1343.09	256	54
SWCCD	Total alkalinity	41.80	147.54	236.61	311.48	491.80	1065.57	376.84	320.16	259	55
SWCCD	SO4 (mg/l)	30.42	366.00	770.00	2010.00	5200.00	15000.00	3143.70	1793.32	257	54
SWCCD	Cl (mg/l)	2.68	46.87	190.00	690.00	2500.00	17000.00	2500.15	676.09	249	52
SWCCD	SO4_HCO3 (mg/l)	150.42	564.05	1070.00	2420.00	5880.00	15820.00	3600.64	2330.38	257	54
SWCCD	Ca (mg/l)	2.68	40.80	86.34	200.00	372.50	920.00	241.16	162.97	255	55
SWCCD	Mg (mg/l)	0.68	32.50	87.25	268.75	712.50	1940.00	405.16	212.46	256	54
SWCCD	Na (mg/l)	17.00	133.00	360.00	878.50	2675.00	20950.00	2356.71	949.15	254	53
SWCCD	K (mg/l)	0.68	6.00	13.00	23.00	35.75	100.00	27.06	19.64	258	55
SWCCD	TSS (mg/l)	2.40	7.04	14.00	40.50	150.00	5200.00	402.75	59.26	73	21
SWCCD	DO (mg/l)	0.01	2.85	5.20	6.91	8.79	79.00	7.28	5.92	704	62
SWCCD	TP (mg/l)	0.26	0.66	1.70	5.44	5.70	7.90	4.46	2.97	9	9

agency_cd	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# Stations
SWCCD	Fecal	0.50	0.50	0.50	31.75	262.50	24200.00	443.97	21.79	328	18
SWCCD	pH	5.34	7.18	7.77	8.20	8.52	11.30	8.13	8.10	745	66
USGS	SC (µS/CM)	95.00	653.50	1067.50	1755.00	3100.00	31000.00	2809.38	1874.37	1088	143
USGS	Hardness (mg/l)	1.96	20.00	160.00	380.00	740.00	6290.00	628.31	281.61	715	131
USGS	Total alkalinity	26.23	175.41	221.31	270.49	351.43	1172.13	299.27	270.37	422	96
USGS	SO4 (mg/l)	1.40	45.60	260.00	558.00	990.00	9490.00	883.43	411.92	717	132
USGS	Cl (mg/l)	1.00	10.00	26.00	180.00	720.00	8200.00	949.70	158.67	718	132
USGS	SO4_HCO3	51.00	391.20	664.00	973.00	1466.50	7470.00	1317.07	985.39	423	96
USGS	Ca (mg/l)	0.10	1.90	28.00	72.15	120.00	590.00	89.99	43.04	716	132
USGS	Mg (mg/l)	0.01	3.40	21.00	49.00	110.00	1200.00	96.48	38.12	715	132
USGS	Na (mg/l)	1.20	47.60	150.00	427.00	1000.00	18000.00	1559.19	418.66	709	125
USGS	K (mg/l)	0.10	2.16	3.90	8.30	16.00	190.00	14.70	8.24	707	125
USGS	TSS (mg/l)	14.00	41.30	81.25	321.00	984.75	2740.00	659.00	258.86	20	11
USGS	Fe, total (mg/l)	0.03	0.29	0.82	3.20	13.25	220.00	13.91	3.17	204	53
USGS	Fe, dissolved (mg/l)	0.01	0.02	0.04	0.08	0.19	6.10	0.30	0.09	609	109
USGS	Al, total (mg/l)	0.02	0.10	0.30	0.70	5.15	92.00	6.97	1.15	164	44
USGS	Al, dissolved (mg/l)	0.00	0.01	0.01	0.04	0.10	0.37	0.06	0.03	82	25
USGS	DO (mg/l)	0.20	6.20	7.70	9.00	10.70	20.00	9.03	8.14	471	52
USGS	TP (mg/l)	0.01	0.03	0.07	0.19	1.60	16.00	1.56	0.29	450	68
USGS	NOx (mg/l)	0.01	0.02	0.06	0.20	0.45	4.50	0.42	0.17	389	38
USGS	Fecal (cfu)	1.00	50.00	400.00	4600.00	96000.00	1200000.00	115369.89	4639.86	121	3
USGS	pH (SU)	6.10	7.60	8.00	8.30	8.70	10.50	8.38	8.36	759	133
USGS	Temperature (oC)	0.10	2.50	7.00	11.00	17.00	41.00	12.07	9.14	1069	144
WQD	SC (µS/CM)	18.98	2087.15	5650.50	11571.50	19658.75	41563.00	13837.34	9585.12	264	13
WQD	Total alkalinity (mg/l)	139.00	248.20	332.75	434.00	597.75	1127.00	467.62	432.05	272	13
WQD	SO4 (mg/l)	182.00	732.00	1907.50	3494.00	5181.00	15300.00	3748.50	2815.77	272	13

agency_cd	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# Stations
WQD	Cl (mg/l)	10.00	201.60	671.25	1971.00	4218.25	12200.00	2892.97	1373.64	272	13
WQD	SO4_HCO3 (mg/l)	401.60	1059.80	2355.54	3953.72	5792.50	15869.74	4319.00	3440.60	272	13
WQD	Ca (mg/l)	0.50	105.30	172.75	252.00	368.50	599.00	270.97	225.55	272	13
WQD	Mg (mg/l)	9.00	89.10	262.75	548.00	759.25	2100.00	551.25	392.49	272	13
WQD	Na (mg/l)	88.00	332.10	764.75	2057.50	3836.25	10200.00	2715.12	1698.81	272	13
WQD	K (mg/l)	0.50	15.00	28.00	46.00	73.63	145.00	50.57	39.16	270	13
WQD	DO (mg/l)	1.01	6.97	8.73	10.72	13.07	32.55	11.08	10.40	253	13
WQD	pH (SU)	3.02	7.18	7.69	7.96	8.18	9.42	7.85	7.82	264	13
WQD	Temperature (^{o}C)	0.04	1.32	4.62	13.77	19.28	31.10	12.75	7.94	238	13
Combined	SC (µS/CM)	0.71	750.00	1350.00	2900.00	7000.00	43800.00	5440.74	2967.07	2271	238
Combined	Hardness (mg/l)	1.96	49.00	210.00	490.00	1200.00	9500.00	1068.07	425.13	971	185
Combined	Total alkalinity (mg/l)	26.23	177.90	237.70	319.67	453.00	1172.13	368.40	323.60	953	164
Combined	SO4 (mg/l)	1.40	130.00	428.50	927.50	2859.25	15300.00	1975.07	848.81	1246	199
Combined	Cl (mg/l)	0.90	14.00	56.00	409.00	1700.00	17000.00	1536.54	309.83	1657	225
Combined	SO4_HCO3	51.00	510.00	862.63	1669.50	4092.13	15869.74	2791.23	1776.94	952	163
Combined	Ca (mg/l)	0.10	9.22	49.00	110.00	238.00	920.00	160.60	81.27	1243	200
Combined	Mg (mg/l)	0.01	11.00	33.00	99.00	380.50	2100.00	259.57	90.45	1243	199
Combined	Na (mg/l)	1.20	84.20	276.50	610.00	2300.00	20950.00	1977.80	674.44	1235	191
Combined	K (mg/l)	0.10	2.80	6.00	15.00	35.00	190.00	25.12	13.89	1235	193
Combined	TSS (mg/l)	1.70	8.00	15.00	36.00	140.00	6000.00	289.54	50.11	261	47
Combined	Fe, total (mg/l)	0.03	0.29	0.82	3.20	13.25	220.00	13.91	3.17	204	53
Combined	Fe, dissolved (mg/l)	0.01	0.02	0.04	0.08	0.19	6.10	0.30	0.09	609	109
Combined	Al, total (mg/l)	0.02	0.10	0.30	0.70	5.15	92.00	6.97	1.15	164	44
Combined	Al, dissolved (mg/l)	0.00	0.01	0.01	0.04	0.10	0.37	0.06	0.03	82	25
Combined	DO (mg/l)	0.01	4.09	6.39	8.30	10.40	79.00	8.55	7.25	1436	129
Combined	TP (mg/l)	0.01	0.03	0.07	0.19	1.70	16.00	1.62	0.31	459	77

agency_cd	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# Stations
Combined	NOx (mg/l)	0.01	0.02	0.08	0.25	0.70	4.70	0.59	0.22	445	49
Combined	Fecal (cfu)	0.50	0.50	3.00	120.00	800.00	1200000.00	31415.09	92.40	449	21
Combined	pH (SU)	3.02	7.40	7.85	8.20	8.54	11.30	8.19	8.16	2010	231
Combined	Temperature (°C)	0.04	2.00	7.00	11.50	17.40	41.00	12.11	8.85	1547	176

Notes:
Multiple measurements taken the same day were averaged. All-zeros data entries were removed.

Table A-5. Sub-Data and Combined datasets: Summary seasonal statistics of observed water quality parameters calculated, including multiple measurements at the same station

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# of Stations
Spring-Summer	AML	SC (µS/cm)	776.00	3495.00	4254.00	8225.00	13622.50	43800.00	10456.47	7757.43	92	13
Spring-Summer	AML	Cl (mg/l)	48.00	268.80	476.50	1220.00	2600.00	13119.00	2063.47	1129.19	94	13
Spring-Summer	AML	TSS (mg/l)	2.00	9.90	16.00	28.00	49.50	6000.00	294.39	40.28	90	13
Spring-Summer	AML	NOx (mg/l)	0.10	0.40	0.80	1.15	1.50	4.70	1.31	1.04	38	10
Spring-Summer	AML	pH (SU)	4.04	7.70	7.91	8.20	8.52	8.98	8.13	8.11	93	13
Spring-Summer	AML	Temperature (°C)	7.20	9.90	13.20	16.70	19.45	27.40	16.36	15.59	95	13
Spring-Summer	LQD	SC (µS/cm)	73.00	418.60	576.00	940.00	1800.00	12640.00	1665.24	1044.48	49	9
Spring-Summer	LQD	Cl (mg/l)	0.90	5.80	20.00	136.00	331.00	1840.00	244.15	81.75	149	14
Spring-Summer	LQD	TSS (mg/l)	60.00	68.00	101.00	186.00	205.00	212.00	154.67	138.10	6	2
Spring-Summer	LQD	DO (mg/l)	0.03	0.17	0.38	4.45	9.28	11.90	5.21	1.11	4	2
Spring-Summer	LQD	pH (SU)	6.72	7.50	7.80	8.19	8.40	9.20	8.08	8.07	45	6
Spring-Summer	LQD	Temperature (°C)	0.10	2.02	5.45	12.50	16.80	23.70	11.70	8.27	43	6
Spring-Summer	SWCCD	SC (µS/cm)	0.82	1200.00	2722.50	4850.00	8445.00	39200.00	6266.07	4352.79	458	56
Spring-Summer	SWCCD	Hardness (mg/l)	8.17	222.75	685.00	1535.00	3600.00	9500.00	2231.26	1299.30	172	52
Spring-Summer	SWCCD	Total alkalinity (mg/l)	41.80	144.29	243.85	348.36	497.95	983.61	380.41	323.78	174	53
Spring-Summer	SWCCD	SO_4 (mg/l)	30.42	370.00	800.17	2200.00	5000.00	14000.00	3070.59	1797.32	173	52
Spring-Summer	SWCCD	Cl (mg/l)	2.68	53.30	200.00	720.00	2475.00	17000.00	2422.97	678.79	170	52
Spring-Summer	SWCCD	SO_4_HCO_3 (mg/l)	150.42	547.60	1143.42	2650.00	5660.00	14650.00	3531.01	2330.15	173	52
Spring-Summer	SWCCD	Ca (mg/l)	2.68	38.40	86.00	194.00	367.00	920.00	240.23	160.34	173	53
Spring-Summer	SWCCD	Mg (mg/l)	0.68	34.10	87.50	270.00	647.75	1940.00	396.93	206.55	172	52
Spring-Summer	SWCCD	Na (mg/l)	54.02	121.00	375.25	937.00	2525.00	20950.00	2177.84	934.81	172	52
Spring-Summer	SWCCD	K (mg/l)	0.68	6.00	12.00	22.00	34.00	96.00	26.06	18.82	174	53
Spring-Summer	SWCCD	TSS (mg/l)	2.60	9.72	16.00	37.75	300.00	5200.00	551.92	71.44	50	21

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# of Stations
Spring-Summer	SWCCD	DO (mg/l)	0.06	3.54	5.53	7.00	8.80	59.80	7.52	6.32	463	56
Spring-Summer	SWCCD	TP (mg/l)	0.26	0.66	1.70	5.44	5.70	7.90	4.46	2.97	9	9
Spring-Summer	SWCCD	Fecal (cfu)	0.50	0.50	0.50	21.75	150.13	24192.00	279.25	14.60	230	18
Spring-Summer	SWCCD	pH (SU)	5.34	7.31	7.83	8.20	8.55	11.30	8.18	8.15	492	61
Spring-Summer	USGS	SC (µS/cm)	140.00	620.00	950.00	1650.00	2790.00	31000.00	2413.79	1681.15	707	95
Spring-Summer	USGS	Hardness	2.61	14.45	99.00	330.00	722.50	5970.00	549.76	224.80	436	92
Spring-Summer	USGS	Alkalinity (mg/l)	39.34	156.72	213.11	248.36	311.48	1172.13	271.70	245.86	243	58
Spring-Summer	USGS	SO_4 (mg/l)	1.50	28.80	210.00	530.00	975.00	9490.00	836.61	367.49	437	93
Spring-Summer	USGS	Cl (mg/l)	1.00	8.90	27.25	170.00	685.00	8200.00	1019.90	162.29	438	93
Spring-Summer	USGS	$SO_4 + CO_3$ (mg/l)	55.40	356.80	595.00	970.00	1405.00	7470.00	1232.13	916.58	243	58
Spring-Summer	USGS	Ca (mg/l)	0.10	1.50	13.00	61.00	120.00	520.00	80.94	33.70	437	93
Spring-Summer	USGS	Mg (mg/l)	0.10	2.70	15.00	40.00	109.00	1160.00	84.48	30.58	436	93
Spring-Summer	USGS	Na (mg/l)	1.20	48.00	150.00	430.00	1250.00	18000.00	1784.25	446.71	429	85
Spring-Summer	USGS	K (mg/l)	0.10	2.26	3.95	8.30	15.00	150.00	13.85	8.01	427	85
Spring-Summer	USGS	TSS (mg/l)	14.00	58.00	100.50	382.00	1035.00	2120.00	623.07	288.85	15	10
Spring-Summer	USGS	Fe, total (mg/l)	0.04	0.49	1.88	6.35	20.25	220.00	19.42	5.46	140	45
Spring-Summer	USGS	Fe, dissolved (mg/l)	0.01	0.02	0.04	0.09	0.20	4.80	0.31	0.10	358	75
Spring-Summer	USGS	Al, total (mg/l)	0.10	0.20	0.30	1.10	9.93	92.00	9.14	1.60	118	40
Spring-Summer	USGS	Al, dissolved (mg/l)	0.00	0.01	0.01	0.04	0.10	0.37	0.06	0.03	45	21
Spring-Summer	USGS	DO (mg/l)	0.20	6.30	7.50	8.50	10.03	20.00	8.80	8.08	276	40
Spring-Summer	USGS	TP (mg/l)	0.01	0.05	0.11	0.42	2.20	16.00	1.62	0.44	239	34
Spring-Summer	USGS	NOx (mg/l)	0.01	0.02	0.05	0.21	0.43	4.30	0.39	0.16	210	21
Spring-Summer	USGS	Fecal (cfu)	1.00	30.70	250.00	2500.00	41000.00	700000.00	58879.51	2351.41	72	3
Spring-Summer	USGS	pH (SU)	6.10	7.70	8.10	8.40	8.80	10.50	8.48	8.45	470	96
Spring-Summer	USGS	Temperature (^oC)	0.50	5.00	9.50	12.50	18.00	31.00	13.40	10.95	773	108

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# of Stations
Spring-Summer	WQD	SC (µS/cm)	18.98	1889.80	4866.00	10719.00	18160.00	41563.00	13260.95	8735.46	157	13
Spring-Summer	WQD	Total alkalinity (mg/l)	139.00	226.80	315.50	422.00	503.00	1096.00	427.42	396.75	163	13
Spring-Summer	WQD	SO_4 (mg/l)	182.00	607.60	1753.50	3121.00	4855.00	15300.00	3624.68	2620.79	163	13
Spring-Summer	WQD	Cl (mg/l)	10.00	140.60	568.00	1884.00	3960.50	12200.00	2746.63	1229.76	163	13
Spring-Summer	WQD	SO_4 + HCO_3 (mg/l)	401.60	877.06	2166.16	3721.22	5487.18	15869.74	4146.13	3209.93	163	13
Spring-Summer	WQD	Ca (mg/l)	14.00	90.80	165.50	245.00	331.50	544.00	249.80	209.91	163	13
Spring-Summer	WQD	Mg (mg/l)	9.00	85.80	236.50	486.00	710.50	2100.00	532.19	362.32	163	13
Spring-Summer	WQD	Na (mg/l)	114.00	276.20	683.00	1940.00	3595.00	10200.00	2622.45	1579.52	163	13
Spring-Summer	WQD	K (mg/l)	0.50	15.00	25.00	45.00	69.00	145.00	49.00	36.76	161	13
Spring-Summer	WQD	DO (mg/l)	1.01	7.31	8.72	10.80	13.77	30.30	11.42	10.68	152	13
Spring-Summer	WQD	pH (SU)	3.02	7.59	7.87	8.09	8.29	9.42	8.00	7.97	157	13
Spring-Summer	WQD	Temperature (^oC)	0.22	6.14	12.20	17.10	21.36	31.10	16.31	13.46	153	13
Spring-Summer	Combined	SC (µS/cm)	0.82	740.00	1318.50	2820.00	6623.50	43800.00	5264.51	2928.13	1463	186
Spring-Summer	Combined	Hardness (mg/l)	2.61	20.00	170.00	470.00	1100.00	9500.00	1025.45	369.26	608	144
Spring-Summer	Combined	Total alkalinity (mg/l)	39.34	171.60	229.51	303.28	434.43	1172.13	348.07	305.47	580	124
Spring-Summer	Combined	SO_4 (mg/l)	1.50	100.00	400.00	930.00	2700.00	15300.00	1924.50	793.30	773	158
Spring-Summer	Combined	Cl (mg/l)	0.90	13.00	66.25	391.50	1700.00	17000.00	1515.45	309.17	1014	185
Spring-Summer	Combined	SO_4_HCO_3 (mg/l)	55.40	467.40	840.00	1660.00	3932.58	15869.74	2739.36	1723.79	579	123
Spring-Summer	Combined	Ca (mg/l)	0.10	5.62	41.00	110.00	229.50	920.00	152.19	70.27	773	159
Spring-Summer	Combined	Mg (mg/l)	0.10	5.70	27.50	94.00	356.00	2100.00	248.83	78.97	771	158
Spring-Summer	Combined	Na (mg/l)	1.20	84.00	268.25	620.00	2400.00	20950.00	2051.69	690.63	764	150
Spring-Summer	Combined	K (mg/l)	0.10	3.00	6.00	14.00	33.00	150.00	24.06	13.43	762	151
Spring-Summer	Combined	TSS (mg/l)	2.00	10.00	16.00	36.00	180.00	6000.00	399.78	60.54	161	46
Spring-Summer	Combined	Fe, total (mg/l)	0.04	0.49	1.88	6.35	20.25	220.00	19.42	5.46	140	45

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# of Stations
Spring-Summer	Combined	Fe, dissolved (mg/l)	0.01	0.02	0.04	0.09	0.20	4.80	0.31	0.10	358	75
Spring-Summer	Combined	Al, total (mg/l)	0.10	0.20	0.30	1.10	9.93	92.00	9.14	1.60	118	40
Spring-Summer	Combined	Al, dissolved (mg/l)	0.00	0.01	0.01	0.04	0.10	0.37	0.06	0.03	45	21
Spring-Summer	Combined	DO (mg/l)	0.03	4.77	6.52	8.10	10.00	59.80	8.57	7.40	895	111
Spring-Summer	Combined	TP (mg/l)	0.01	0.05	0.12	0.46	2.30	16.00	1.72	0.47	248	43
Spring-Summer	Combined	NOx (mg/l)	0.01	0.02	0.08	0.28	0.63	4.70	0.53	0.21	248	31
Spring-Summer	Combined	Fecal	0.50	0.50	0.50	55.00	375.00	700000.00	14250.18	49.03	302	21
Spring-Summer	Combined	pH (SU)	3.02	7.51	7.93	8.29	8.60	11.30	8.26	8.23	1257	189
Spring-Summer	Combined	Temperature (°C)	0.10	5.00	10.00	14.00	19.00	31.10	14.02	11.51	1064	140
Winter	AML	SC (µS/cm)	1085.00	1689.60	2634.73	6125.00	14997.50	32900.00	9093.41	6051.42	60	13
Winter	AML	Cl (mg/l)	59.00	322.60	601.50	1410.00	3530.00	9610.00	2348.20	1369.37	59	13
Winter	AML	TSS (mg/l)	1.70	5.00	15.50	35.00	107.00	552.00	90.15	38.78	59	13
Winter	AML	NOx (mg/l)	1.10	1.37	1.85	2.30	3.48	4.60	2.64	2.43	18	10
Winter	AML	pH (SU)	6.84	7.53	7.82	8.23	8.61	10.57	8.30	8.27	61	13
Winter	AML	Temperature (°C)	0.20	1.70	6.00	9.50	12.80	17.60	8.95	6.85	61	13
Winter	LQD	SC (µS/cm)	335.00	416.00	660.00	1259.00	1687.00	5380.00	1533.23	1177.84	13	4
Winter	LQD	Cl (mg/l)	3.00	25.00	32.70	54.00	123.00	845.50	124.10	60.26	34	12
Winter	LQD	DO (mg/l)	16.90	16.94	17.00	17.10	17.20	17.30	17.10	17.10	2	2
Winter	LQD	pH (SU)	6.83	7.21	7.96	8.37	8.50	8.90	8.12	8.09	9	2
Winter	LQD	Temperature (°C)	0.10	0.26	2.20	2.50	3.90	5.90	2.79	1.72	9	2
Winter	SWCCD	SC (µS/cm)	13.42	943.20	1449.75	3475.00	6432.50	19850.00	4515.34	2642.20	50	16
Winter	SWCCD	Hardness (mg/l)	216.00	440.20	1120.50	1605.72	3323.50	7261.00	2497.62	1700.35	19	17
Winter	SWCCD	Total alkalinity (mg/l)	139.34	218.03	251.37	295.08	540.98	967.21	405.81	356.89	19	17
Winter	SWCCD	SO4 (mg/l)	310.00	604.00	1200.00	1700.00	5316.71	15000.00	3670.03	2175.69	19	17

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# of Stations
Winter	SWCCD	Cl (mg/l)	16.00	51.50	119.21	510.00	2125.00	15000.17	2320.39	498.24	16	14
Winter	SWCCD	SO4_HCO3 (mg/l)	480.00	960.00	1470.00	2060.00	5725.00	15820.00	4165.12	2749.33	19	17
Winter	SWCCD	Ca (mg/l)	42.00	63.90	130.84	250.00	337.50	600.00	256.46	200.22	18	16
Winter	SWCCD	Mg (mg/l)	27.00	68.40	153.34	256.68	615.00	1400.00	423.28	265.68	19	17
Winter	SWCCD	Na (mg/l)	110.00	183.00	292.50	808.50	3150.00	17000.00	3399.15	1052.35	18	16
Winter	SWCCD	K (mg/l)	2.00	8.30	14.01	22.00	28.01	55.00	23.89	18.04	18	17
Winter	SWCCD	DO (mg/l)	0.21	0.91	2.99	6.01	7.94	14.97	5.82	4.29	59	21
Winter	SWCCD	Fecal (cfu)	0.50	0.50	0.50	0.50	12.50	1510.00	109.50	2.80	20	4
Winter	SWCCD	pH (SU)	6.50	6.97	7.82	8.48	8.80	9.44	8.22	8.18	59	21
Winter	USGS	SC (µS/cm)	95.00	762.50	1215.00	2000.00	3900.00	17300.00	2888.63	2115.75	244	56
Winter	USGS	Hardness (mg/l)	10.00	180.00	277.50	480.00	825.00	6290.00	820.50	501.49	184	66
Winter	USGS	Total alkalinity	26.23	200.82	262.30	320.49	408.20	802.46	349.42	319.98	131	50
Winter	USGS	SO_4 (mg/l)	5.00	102.30	370.00	620.00	1100.00	8790.00	1034.24	539.76	184	66
Winter	USGS	Cl (mg/l)	1.70	9.30	19.00	170.00	670.00	7800.00	657.79	124.37	184	66
Winter	USGS	SO_4_HCO_3 (mg/l)	51.00	401.30	726.00	1017.00	1667.50	6620.00	1436.38	1068.20	132	50
Winter	USGS	Ca (mg/l)	1.50	38.00	54.75	85.50	130.00	590.00	114.00	82.47	184	66
Winter	USGS	Mg (mg/l)	1.00	21.30	34.00	66.00	130.00	1200.00	130.01	67.39	184	66
Winter	USGS	Na (mg/l)	2.70	31.30	110.00	410.00	817.00	18000.00	901.33	315.73	184	66
Winter	USGS	K (mg/l)	0.90	2.10	3.20	7.70	18.00	190.00	16.47	8.45	184	66
Winter	USGS	TSS (mg/l)	17.00	19.70	23.75	30.50	37.25	44.00	30.50	27.35	2	2
Winter	USGS	Fe, total (mg/l)	0.03	0.19	0.47	1.10	3.05	11.20	1.90	0.98	55	12
Winter	USGS	Fe, dissolved (mg/l)	0.01	0.01	0.03	0.06	0.14	6.10	0.27	0.07	166	62
Winter	USGS	Al, total (mg/l)	0.02	0.10	0.20	0.35	1.13	14.00	1.30	0.47	42	10
Winter	USGS	Al, dissolved (mg/l)	0.00	0.01	0.01	0.03	0.10	0.20	0.06	0.03	35	11
Winter	USGS	DO (mg/l)	0.20	5.62	8.55	10.00	11.20	19.20	9.53	8.60	135	28

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# of Stations
Winter	USGS	TP (mg/l)	0.01	0.02	0.05	0.10	0.24	15.00	1.36	0.16	153	48
Winter	USGS	NOx (mg/l)	0.01	0.02	0.07	0.15	0.48	4.10	0.41	0.16	123	26
Winter	USGS	Fecal (cfu)	3.00	330.00	1400.00	46500.00	427500.00	1200000.00	259016.24	18015.70	34	3
Winter	USGS	pH (SU)	6.80	7.40	7.80	8.20	8.50	10.20	8.15	8.13	188	67
Winter	USGS	Temperature (^oC)	0.10	0.55	2.50	6.00	8.63	41.00	6.05	4.09	172	68
Winter	WQD	SC (µS/cm)	1302.00	3161.50	6909.50	11397.00	22116.75	34774.00	14261.08	10656.24	76	13
Winter	WQD	Total alkalinity (mg/l)	212.00	288.00	364.75	537.50	699.00	1127.00	547.15	506.87	76	13
Winter	WQD	SO_4 (mg/l)	394.00	1077.50	2112.50	3795.00	5671.25	9680.00	3873.03	3102.24	76	13
Winter	WQD	Cl (mg/l)	24.00	293.00	774.75	2048.50	4703.75	9730.00	2992.05	1536.17	76	13
Winter	WQD	SO_4_HCO_3 (mg/l)	739.26	1414.72	2592.98	4479.77	6516.10	10862.18	4540.55	3796.99	76	13
Winter	WQD	Ca (mg/l)	0.50	113.00	193.00	309.00	406.25	599.00	303.43	243.62	76	13
Winter	WQD	Mg (mg/l)	31.00	163.50	273.25	565.50	848.13	1500.00	570.33	433.73	76	13
Winter	WQD	Na (mg/l)	233.00	415.50	921.00	2125.00	4490.00	7620.00	2786.04	1875.59	76	13
Winter	WQD	K (mg/l)	4.00	15.50	32.75	44.00	77.50	122.00	52.17	41.96	76	13
Winter	WQD	DO (mg/l)	4.31	7.62	9.13	10.69	11.95	32.55	10.74	10.36	71	13
Winter	WQD	pH (SU)	5.40	6.79	7.30	7.67	7.90	8.65	7.53	7.51	76	13
Winter	WQD	Temperature (^oC)	0.04	0.28	1.19	2.58	6.00	14.30	3.98	2.12	58	13
Winter	Combined	SC (µS/cm)	13.42	992.80	1450.00	3060.00	7392.50	34774.00	5823.86	3244.61	443	102
Winter	Combined	Hardness (mg/l)	10.00	190.00	280.00	510.00	1000.00	7261.00	977.47	562.20	203	83
Winter	Combined	Total alkalinity (mg/l)	26.23	220.90	278.07	358.83	540.98	1127.00	420.66	376.96	226	80
Winter	Combined	SO_4 (mg/l)	5.00	199.20	495.00	940.00	2877.50	15000.00	1987.03	955.68	279	96
Winter	Combined	Cl (mg/l)	1.70	15.24	46.00	458.00	1600.00	15000.17	1431.76	304.29	369	118
Winter	Combined	SO_4_HCO_3 (mg/l)	51.00	553.00	899.00	1619.00	4048.00	15820.00	2704.06	1767.76	227	80
Winter	Combined	Ca (mg/l)	0.50	42.00	70.00	120.00	240.00	600.00	175.01	117.45	278	95

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	N	# of Stations
Winter	Combined	Mg (mg/l)	1.00	26.00	39.65	102.00	423.00	1500.00	269.92	122.87	279	96
Winter	Combined	Na (mg/l)	2.70	76.20	270.00	556.50	1540.00	18000.00	1578.31	555.54	278	95
Winter	Combined	K (mg/l)	0.90	2.30	5.00	16.00	37.75	190.00	26.71	13.75	278	96
Winter	Combined	TSS (mg/l)	1.70	5.00	16.00	35.00	102.00	552.00	88.20	38.34	61	15
Winter	Combined	Fe, total (mg/l)	0.03	0.19	0.47	1.10	3.05	11.20	1.90	0.98	55	12
Winter	Combined	Fe, dissolved (mg/l)	0.01	0.01	0.03	0.06	0.14	6.10	0.27	0.07	166	62
Winter	Combined	Al, total (mg/l)	0.02	0.10	0.20	0.35	1.13	14.00	1.30	0.47	42	10
Winter	Combined	Al, dissolved (mg/l)	0.00	0.01	0.01	0.03	0.10	0.20	0.06	0.03	35	11
Winter	Combined	DO (mg/l)	0.20	4.31	7.31	9.60	11.20	32.55	9.09	7.78	267	64
Winter	Combined	TP (mg/l)	0.01	0.02	0.05	0.10	0.24	15.00	1.36	0.16	153	48
Winter	Combined	NOx (mg/l)	0.01	0.03	0.09	0.20	0.90	4.60	0.69	0.23	141	36
Winter	Combined	Fecal (cfu)	0.50	0.50	4.75	1065.00	113750.00	1200000.00	163124.85	699.88	54	7
Winter	Combined	pH (SU)	5.40	7.20	7.68	8.10	8.50	10.57	8.06	8.03	393	116
Winter	Combined	Temperature (^{o}C)	0.04	0.50	2.19	6.00	9.27	41.00	6.14	3.90	300	96

Notes:
Multiple measurements taken the same day were averaged. All-zeros data entries were removed.

Table A-6. Combined dataset: Summary annual statistics of observed water quality parameters calculated from station medians

agency_cd	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	*N*	# of stations
AML	SC (µS/cm)	2430.00	4086.00	4575.00	5940.00	7130.00	12630.00	6595.00	6017.96	13	13
AML	Cl (mg/l)	73.00	207.40	551.00	1260.00	2768.00	7210.00	1834.62	1037.36	13	13
AML	TSS (mg/l)	10.00	16.70	21.50	27.00	36.00	122.00	33.42	27.67	13	13
AML	NOx (mg/l)	0.90	1.15	1.20	1.50	1.68	2.90	1.64	1.53	11	11
AML	pH (SU)	7.55	7.80	7.99	8.31	8.37	8.65	8.19	8.19	13	13
AML	Temperature (°C)	9.50	10.24	11.20	12.85	13.40	17.60	12.82	12.64	13	13
LQD	SC (µS/cm)	73.00	367.30	536.75	1750.00	3541.25	6620.00	2360.70	1249.50	10	10
LQD	Cl (mg/l)	2.66	4.10	14.40	37.80	148.50	343.00	86.85	35.49	15	15
LQD	TSS (mg/l)	76.00	88.00	106.00	136.00	166.00	196.00	136.00	122.05	2	2
LQD	DO (mg/l)	12.55	12.56	12.58	12.60	12.63	12.65	12.60	12.60	2	2
LQD	pH (SU)	7.60	7.67	7.75	7.97	8.27	9.09	8.11	8.10	6	6
LQD	Temperature (°C)	6.75	7.28	9.26	14.38	15.17	21.20	13.28	12.32	6	6
SWCCD	SC (µS/cm)	0.82	756.00	1699.00	4840.00	10720.00	39200.00	7641.32	3804.61	59	59
SWCCD	Hardness (mg/l)	68.00	165.97	387.77	2104.50	4211.25	7261.00	2413.81	1304.10	54	54
SWCCD	Total alkalinity (mg/l)	114.75	193.17	245.90	364.75	508.20	967.21	407.31	357.22	55	55
SWCCD	SO_4 (mg/l)	120.00	199.18	680.02	2700.00	5300.00	15000.00	3387.45	1800.89	54	54
SWCCD	Cl (mg/l)	7.00	26.03	191.25	938.42	3150.00	16100.00	2923.99	694.99	52	52
SWCCD	SO_4_HCO_3 (mg/l)	300.00	493.00	1262.50	3240.00	5808.75	15820.00	3880.87	2475.40	54	54
SWCCD	Ca (mg/l)	12.84	30.20	65.77	220.00	380.00	720.00	249.01	161.26	55	55
SWCCD	Mg (mg/l)	6.00	22.60	58.75	390.00	747.50	1400.00	429.33	205.32	54	54
SWCCD	Na (mg/l)	51.50	116.00	360.00	1200.00	3300.00	17000.00	2626.55	1062.23	53	53
SWCCD	K (mg/l)	1.00	4.80	13.00	26.00	42.50	96.00	28.50	19.58	55	55
SWCCD	TSS (mg/l)	3.10	11.50	21.00	37.00	82.00	620.00	78.36	38.31	21	21
SWCCD	DO (mg/l)	0.77	3.55	5.27	7.24	8.39	20.30	7.15	6.37	62	62
SWCCD	TP (mg/l)	0.26	0.66	1.70	5.44	5.70	7.90	4.46	2.97	9	9
SWCCD	Fecal (cfu)	0.50	0.50	10.00	47.50	183.75	385.00	100.97	25.93	18	18
SWCCD	pH (SU)	6.72	7.55	7.96	8.21	8.50	9.34	8.21	8.19	66	66
USGS	SC (µS/cm)	95.00	411.20	715.00	1700.00	3240.00	30800.00	3983.41	1746.71	143	143
USGS	Hardness (mg/l)	2.87	18.00	101.00	265.00	565.00	6130.00	510.69	206.25	131	131
USGS	Total alkalinity (mg/l)	26.23	88.52	206.66	258.61	334.43	1172.13	284.91	238.04	96	96
USGS	SO_4 (mg/l)	2.80	17.05	67.38	280.00	710.00	9140.00	620.19	209.82	132	132
USGS	Cl (mg/l)	1.00	3.94	8.58	35.00	270.00	7800.00	814.47	56.31	132	132
USGS	SO_4_HCO_3 (mg/l)	51.00	225.50	359.75	709.50	1126.50	5596.00	901.75	618.41	96	96

agency_cd	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	*N*	# of stations
USGS	Ca (mg/l)	0.10	1.75	17.50	55.70	107.68	520.00	82.07	34.24	132	132
USGS	Mg (mg/l)	0.10	2.71	11.75	31.00	75.38	1180.00	73.03	24.13	132	132
USGS	Na (mg/l)	1.20	10.72	30.00	160.00	610.00	18000.00	1430.73	175.89	125	125
USGS	K (mg/l)	0.10	1.57	2.50	5.80	11.00	190.00	11.23	5.63	125	125
USGS	TSS (mg/l)	14.00	17.00	75.50	140.00	372.00	1290.50	363.05	154.57	11	11
USGS	Fe, total (mg/l)	0.11	0.68	1.90	8.70	15.35	180.00	15.28	5.84	53	53
USGS	Fe, dissolved (mg/l)	0.01	0.01	0.03	0.07	0.16	2.60	0.25	0.08	109	109
USGS	Al, total (mg/l)	0.02	0.11	0.24	0.55	8.30	92.00	7.80	1.10	44	44
USGS	Al, dissolved (mg/l)	0.00	0.00	0.01	0.02	0.09	0.10	0.04	0.02	25	25
USGS	DO (mg/l)	0.20	1.50	7.10	8.80	9.66	12.20	7.71	5.85	52	52
USGS	TP (mg/l)	0.01	0.01	0.03	0.07	0.16	6.00	0.43	0.09	68	68
USGS	NOx (mg/l)	0.01	0.01	0.04	0.10	0.26	0.62	0.16	0.08	38	38
USGS	Fecal (cfu)	180.00	294.00	465.00	750.00	55375.00	110000.00	36976.67	2457.96	3	3
USGS	pH (SU)	6.10	7.20	7.50	8.20	8.60	10.25	8.19	8.14	133	133
USGS	Temperature (°C)	0.50	6.00	8.00	10.25	14.50	41.00	11.34	10.08	144	144
WQD	SC (µS/cm)	1497.00	3018.40	6627.00	13533.25	19019.00	30636.50	13542.10	9787.03	13	13
WQD	Total alkalinity	257.00	283.80	399.00	438.00	458.50	891.00	467.08	440.08	13	13
WQD	SO4 (mg/l)	438.00	858.00	2050.00	4295.00	5587.00	7390.00	3856.27	2945.13	13	13
WQD	Cl (mg/l)	25.00	298.20	643.75	1903.50	4020.00	8340.00	2678.10	1296.37	13	13
WQD	SO_4_HCO_3 (mg/l)	804.10	1156.43	2588.02	5093.65	6112.82	8171.76	4471.63	3611.07	13	13
WQD	Ca (mg/l)	39.00	137.30	199.25	275.00	340.50	471.00	265.02	230.03	13	13
WQD	Mg (mg/l)	33.00	122.30	275.50	601.25	790.00	1200.00	576.79	413.19	13	13
WQD	Na (mg/l)	277.00	442.60	788.50	2060.00	3915.00	6690.00	2580.62	1705.17	13	13
WQD	K (mg/l)	5.00	19.30	31.00	53.50	74.00	118.00	53.58	41.52	13	13
WQD	DO (mg/l)	8.72	8.86	9.47	10.99	11.60	12.83	10.64	10.57	13	13
WQD	pH (SU)	7.71	7.72	7.78	7.96	8.02	8.32	7.94	7.94	13	13
WQD	Temperature (°C)	10.99	11.68	12.17	13.58	15.36	16.39	13.70	13.58	13	13
Combined	SC (µS/cm)	0.82	480.5	993.13	2340.00	6920.00	39200.00	5486.79	2455.53	238	238
Combined	Hardness (mg/l)	2.87	40.00	160.00	380.00	1100.00	7261.00	1066.19	353.32	185	185
Combined	Total alkalinity (mg/l)	26.23	146.72	225.20	284.12	426.23	1172.13	340.40	286.37	164	164
Combined	SO_4 (mg/l)	2.80	23.80	160.00	540.00	1745.00	15000.00	1582.51	446.83	199	199
Combined	Cl (mg/l)	1.00	5.47	15.30	110.17	1263.50	16100.00	1420.12	138.44	225	225
Combined	SO_4_HCO_3 (mg/l)	51.00	277.80	476.75	1047.00	2700.00	15820.00	2173.41	1127.08	163	163
Combined	Ca (mg/l)	0.10	5.60	34.30	80.50	199.44	720.00	139.87	59.35	200	200

agency_cd	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	*N*	# of stations
Combined	Mg (mg/l)	0.10	3.84	20.00	50.00	190.00	1400.00	202.63	51.94	199	199
Combined	Na (mg/l)	1.20	19.00	84.50	391.00	2030.00	18000.00	1840.82	338.14	191	191
Combined	K (mg/l)	0.10	1.72	3.60	9.20	24.00	190.00	19.00	9.19	193	193
Combined	TSS (mg/l)	3.10	15.20	22.25	37.00	106.50	1290.50	135.01	50.99	47	47
Combined	Fe, total (mg/l)	0.11	0.68	1.90	8.70	15.35	180.00	15.28	5.84	53	53
Combined	Fe, dissolved (mg/l)	0.01	0.01	0.03	0.07	0.16	2.60	0.25	0.08	109	109
Combined	Al, Total (mg/l)	0.02	0.11	0.24	0.55	8.30	92.00	7.80	1.10	44	44
Combined	Al, dissolved (mg/l)	0.00	0.00	0.01	0.02	0.09	0.10	0.04	0.02	25	25
Combined	DO (mg/l)	0.20	3.04	6.03	8.25	9.60	20.30	7.81	6.55	129	129
Combined	TP (mg/l)	0.01	0.01	0.04	0.09	0.68	7.90	0.90	0.13	77	77
Combined	NOx (mg/l)	0.01	0.01	0.09	0.16	0.44	2.90	0.49	0.16	49	49
Combined	Fecal (cfu)	0.50	0.50	10.00	68.00	260.00	110000.00	5368.92	49.68	21	21
Combined	pH (SU)	6.10	7.30	7.72	8.20	8.55	10.25	8.18	8.15	231	231
Combined	Temperature (^oC)	0.50	6.00	9.20	11.00	14.97	41.00	11.69	10.55	176	176

Notes:

Table A-7. Subset and Combined dataset: summary seasonal statistics of observed water quality parameters calculated from station medians

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	*N*	# of stations
Spring-Summer	AML	SC (µS/cm)	3470.00	4268.00	5150.00	5940.00	10590.00	24120.00	8871.92	7545.31	13	13
Spring-Summer	AML	Cl (mg/l)	73.00	218.80	551.00	1405.00	1800.00	6260.00	1599.08	968.60	13	13
Spring-Summer	AML	TSS (mg/l)	16.00	16.20	20.50	28.00	38.50	660.00	95.65	39.41	13	13
Spring-Summer	AML	NOx(mg/l)	0.90	0.90	0.95	1.08	1.24	2.40	1.25	1.18	10	10
Spring-Summer	AML	pH (SU)	7.56	7.80	8.05	8.32	8.47	8.98	8.26	8.25	13	13
Spring-Summer	AML	Temperature (ºC)	11.10	13.90	14.90	16.40	19.50	20.60	16.74	16.50	13	13
Spring-Summer	LQD	SC (µS/cm)	73.00	237.80	449.00	861.50	2495.00	6620.00	1991.94	999.57	9	9
Spring-Summer	LQD	Cl (mg/l)	2.00	2.11	8.06	33.18	214.00	489.50	117.11	30.27	14	14
Spring-Summer	LQD	TSS (mg/l)	76.00	88.00	106.00	136.00	166.00	196.00	136.00	122.05	2	2
Spring-Summer	LQD	DO (mg/l)	4.22	4.41	4.71	5.21	5.70	6.20	5.21	5.11	2	2
Spring-Summer	LQD	pH (SU)	7.60	7.67	7.75	8.01	8.29	9.09	8.13	8.11	6	6
Spring-Summer	LQD	Temperature (ºC)	8.60	9.75	11.59	14.38	15.17	21.20	14.11	13.56	6	6
Spring-Summer	SWCCD	SC (µS/cm)	0.82	800.00	1779.63	4915.00	10823.75	39200.00	7719.93	3877.47	56	56
Spring-Summer	SWCCD	Hardness (mg/l)	8.17	153.10	443.26	1640.50	4264.25	6949.00	2301.94	1175.14	52	52
Spring-Summer	SWCCD	Total alkalinity (mg/l)	90.16	150.27	262.30	377.05	491.80	901.64	392.32	344.34	53	53
Spring-Summer	SWCCD	SO_4 (mg/l)	30.42	175.00	770.13	2450.00	4925.00	9000.00	3095.08	1679.19	52	52
Spring-Summer	SWCCD	Cl (mg/l)	2.68	25.58	192.50	1147.50	3000.00	16000.00	2829.46	682.51	52	52
Spring-Summer	SWCCD	SO_4_HCO_3 (mg/l)	150.42	491.00	1302.50	2958.75	5335.00	9815.00	3567.98	2359.01	52	52
Spring-Summer	SWCCD	Ca (mg/l)	2.68	28.60	68.00	200.00	360.00	795.00	246.80	151.71	53	53
Spring-Summer	SWCCD	Mg (mg/l)	0.68	22.20	65.00	300.00	742.50	1300.00	406.76	184.86	52	52
Spring-Summer	SWCCD	Na (mg/l)	54.02	101.00	350.63	1300.00	2575.00	15975.00	2333.64	1007.42	52	52
Spring-Summer	SWCCD	K (mg/l)	0.68	4.40	13.00	24.00	37.50	96.00	27.99	18.58	53	53
Spring-Summer	SWCCD	TSS (mg/l)	3.10	14.00	20.00	36.00	96.00	620.00	96.19	42.25	21	21
Spring-Summer	SWCCD	DO (mg/l)	0.44	3.23	5.10	6.60	8.19	20.30	6.85	5.97	56	56
Spring-Summer	SWCCD	TP (mg/l)	0.26	0.66	1.70	5.44	5.70	7.90	4.46	2.97	9	9
Spring-Summer	SWCCD	Fecal (cfu)	0.50	0.50	0.50	15.00	167.50	300.00	75.08	11.44	18	18
Spring-Summer	SWCCD	pH (SU)	6.83	7.48	7.91	8.23	8.50	9.34	8.19	8.17	61	61
Spring-Summer	USGS	SC (µS/cm)	140.00	404.80	767.50	1680.00	2550.00	31000.00	2746.35	1473.89	95	95
Spring-Summer	USGS	Hardness (mg/l)	3.00	14.11	72.25	207.50	590.00	5970.00	527.42	171.28	92	92
Spring-Summer	USGS	Total alkalinity (mg/l)	39.34	75.08	190.57	237.70	281.76	1172.13	272.46	216.95	58	58
Spring-Summer	USGS	SO_4 (mg/l)	2.60	15.40	63.00	315.00	680.00	9490.00	698.97	213.42	93	93

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	*N*	# of stations
Spring-Summer	USGS	Cl (mg/l)	1.00	5.46	13.00	68.00	600.00	7900.00	1114.26	93.64	93	93
Spring-Summer	USGS	SO_4_HCO_3 (mg/l)	55.40	168.50	319.88	717.50	1116.00	5596.00	953.47	611.02	58	58
Spring-Summer	USGS	Ca (mg/l)	0.10	1.42	8.00	43.00	105.00	520.00	77.17	26.14	93	93
Spring-Summer	USGS	Mg (mg/l)	0.10	1.62	6.90	23.30	85.00	1160.00	79.95	20.31	93	93
Spring-Summer	USGS	Na (mg/l)	1.20	15.80	34.00	310.00	1250.00	18000.00	1964.56	268.22	85	85
Spring-Summer	USGS	K (mg/l)	0.10	1.67	3.60	7.10	12.00	87.20	11.62	6.56	85	85
Spring-Summer	USGS	TSS (mg/l)	14.00	59.00	93.75	200.00	417.50	1320.00	361.70	185.85	10	10
Spring-Summer	USGS	Fe, total (mg/l)	0.12	1.50	4.20	9.75	17.00	180.00	17.74	8.30	45	45
Spring-Summer	USGS	Fe, dissolved (mg/l)	0.01	0.02	0.05	0.09	0.30	2.90	0.35	0.12	75	75
Spring-Summer	USGS	Al, total (mg/l)	0.10	0.20	0.30	0.88	8.65	92.00	8.73	1.49	40	40
Spring-Summer	USGS	Al, dissolved (mg/l)	0.00	0.00	0.01	0.03	0.10	0.10	0.05	0.03	21	21
Spring-Summer	USGS	DO (mg/l)	0.20	1.85	7.10	8.18	9.00	12.20	7.40	5.73	40	40
Spring-Summer	USGS	TP (mg/l)	0.01	0.01	0.05	0.12	0.76	5.15	0.78	0.19	34	34
Spring-Summer	USGS	NOx (mg/l)	0.01	0.01	0.05	0.16	0.30	0.44	0.18	0.10	21	21
Spring-Summer	USGS	Fecal (cfu)	470.00	534.00	630.00	790.00	38645.00	76500.00	25920.00	3051.14	3	3
Spring-Summer	USGS	pH (SU)	6.10	7.20	7.60	8.40	8.70	10.30	8.32	8.27	96	96
Spring-Summer	USGS	Temperature (°C)	2.00	9.43	10.00	11.10	15.00	26.00	12.89	11.99	108	108
Spring-Summer	WQD	SC (µS/cm)	1463.00	2772.60	6783.50	12526.00	18145.50	29770.00	13514.42	9674.59	13	13
Spring-Summer	WQD	Total alkalinity (mg/l)	238.00	276.20	389.00	420.50	438.50	891.00	448.48	422.11	13	13
Spring-Summer	WQD	SO_4 (mg/l)	428.00	855.00	2330.00	4190.00	4978.00	8500.00	3886.90	2942.53	13	13
Spring-Summer	WQD	Cl (mg/l)	25.00	284.80	660.00	1706.50	3966.50	7202.00	2486.81	1202.52	13	13
Spring-Summer	WQD	SO_4_HCO_3 (mg/l)	778.38	1125.16	2819.83	4907.26	5525.78	9837.12	4446.47	3535.89	13	13
Spring-Summer	WQD	Ca (mg/l) (mg/l)	31.00	132.10	203.00	251.50	326.00	384.50	246.38	213.93	13	13
Spring-Summer	WQD	Mg (mg/l)	31.50	121.30	313.50	570.00	717.00	1180.00	557.08	399.98	13	13
Spring-Summer	WQD	Na (mg/l)	271.00	461.00	850.00	1665.00	3490.00	6022.50	2435.00	1636.67	13	13
Spring-Summer	WQD	K (mg/l)	5.00	19.00	28.00	41.00	69.00	79.50	45.58	36.82	13	13
Spring-Summer	WQD	DO (mg/l)	8.58	9.28	10.56	11.53	11.99	12.79	11.11	11.04	13	13
Spring-Summer	WQD	pH (SU)	7.71	7.85	7.98	8.05	8.17	8.32	8.06	8.06	13	13
Spring-Summer	WQD	Temperature (°C)	14.68	15.21	15.83	17.20	18.58	21.23	17.19	17.10	13	13
Spring-Summer	Combined	SC (µS/cm)	0.82	480.00	1002.50	2477.50	6603.75	39200.00	5388.01	2474.36	186	186
Spring-Summer	Combined	Hardness (mg/l)	3.00	18.60	107.50	400.00	1423.75	6949.00	1168.22	343.35	144	144

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	*N*	# of stations
Spring-Summer	Combined	Total alkalinity (mg/l)	39.34	103.28	229.30	283.61	427.80	1172.13	342.15	283.41	124	124
Spring-Summer	Combined	SO_4 (mg/l)	2.60	25.10	165.13	640.00	2475.00	9490.00	1749.86	522.19	158	158
Spring-Summer	Combined	Cl (mg/l)	1.00	7.70	23.50	283.00	1900.00	16000.00	1651.43	211.85	185	185
Spring-Summer	Combined	SO_4_HCO_3	55.40	276.80	525.00	1225.50	3862.71	9837.12	2427.97	1302.16	123	123
Spring-Summer	Combined	Ca (mg/l)	0.10	3.74	25.00	78.00	225.00	795.00	147.55	55.78	159	159
Spring-Summer	Combined	Mg (mg/l)	0.10	2.94	16.25	61.50	312.63	1300.00	226.77	53.69	158	158
Spring-Summer	Combined	Na (mg/l)	1.20	27.75	115.00	555.00	2400.00	18000.00	2133.28	496.36	150	150
Spring-Summer	Combined	K (mg/l)	0.10	1.90	5.05	11.00	29.25	96.00	20.29	10.96	151	151
Spring-Summer	Combined	TSS (mg/l)	3.10	16.00	21.75	39.75	172.38	1320.00	155.49	59.86	46	46
Spring-Summer	Combined	Fe, total	0.12	1.50	4.20	9.75	17.00	180.00	17.74	8.30	45	45
Spring-Summer	Combined	Fe, dissolved	0.01	0.02	0.05	0.09	0.30	2.90	0.35	0.12	75	75
Spring-Summer	Combined	Al, total	0.10	0.20	0.30	0.88	8.65	92.00	8.73	1.49	40	40
Spring-Summer	Combined	Al, dissolved	0.00	0.00	0.01	0.03	0.10	0.10	0.05	0.03	21	21
Spring-Summer	Combined	DO (mg/l)	0.20	3.20	5.98	7.70	9.30	20.30	7.52	6.30	111	111
Spring-Summer	Combined	TP (mg/l)	0.01	0.02	0.07	0.26	2.05	7.90	1.55	0.33	43	43
Spring-Summer	Combined	NOx (mg/l)	0.01	0.01	0.09	0.30	0.93	2.40	0.53	0.22	31	31
Spring-Summer	Combined	Fecal (cfu)	0.50	0.50	0.50	35.00	200.00	76500.00	3767.21	25.40	21	21
Spring-Summer	Combined	pH (SU)	6.10	7.40	7.80	8.26	8.58	10.30	8.25	8.22	189	189
Spring-Summer	Combined	Temperature (°C)	2.00	9.50	10.00	13.50	16.47	26.00	13.70	12.83	140	140
Winter	AML	SC (µS/cm)	2040.0	3955.0	4640.00	6180.00	11588.50	15026.00	7943.88	6811.51	13	13
Winter	AML	Cl (mg/l)	176.00	268.80	417.00	1140.00	3485.00	7515.00	2047.08	1170.92	13	13
Winter	AML	TSS (mg/l)	7.50	19.44	29.50	35.00	85.80	143.00	55.66	42.37	13	13
Winter	AML	NOx (mg/l)	1.80	1.94	1.98	2.50	3.38	3.50	2.64	2.56	10	10
Winter	AML	pH (SU)	7.63	7.82	7.96	8.22	8.32	8.77	8.19	8.19	13	13
Winter	AML	Temperature (°C)	6.50	6.86	7.75	9.35	10.70	12.80	9.19	9.02	13	13
Winter	LQD	SC (µS/cm)	1226.0	1235.9	1250.75	1307.75	2362.38	5380.00	2305.38	1832.02	4	4
Winter	LQD	Cl (mg/l)	3.15	26.25	37.88	49.00	99.38	386.50	90.30	53.37	12	12
Winter	LQD	DO (mg/l)	16.90	16.94	17.00	17.10	17.20	17.30	17.10	17.10	2	2
Winter	LQD	pH (SU)	8.18	8.20	8.23	8.27	8.32	8.37	8.27	8.27	2	2
Winter	LQD	Temperature (°C)	2.40	2.48	2.60	2.80	3.00	3.20	2.80	2.77	2	2
Winter	SWCCD	SC (µS/cm)	13.42	592.50	1676.75	4200.00	6396.25	19850.00	5327.34	2432.22	16	16
Winter	SWCCD	Hardness (mg/l)	216.00	418.40	929.00	1605.72	3435.00	7261.00	2586.45	1742.43	17	17

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	*N*	# of stations
Winter	SWCCD	Total alkalinity (mg/l)	139.34	214.75	237.70	295.08	540.98	967.21	405.34	353.37	17	17
Winter	SWCCD	SO_4 (mg/l)	310.00	548.00	1200.00	1700.00	6000.00	15000.00	3861.21	2247.10	17	17
Winter	SWCCD	Cl (mg/l)	16.00	50.50	101.38	547.50	2775.00	15000.17	2597.58	537.02	14	14
Winter	SWCCD	SO_4_HCO_3 (mg/l)	480.00	1056.0	1450.00	2060.00	6290.00	15820.00	4355.72	2828.16	17	17
Winter	SWCCD	Ca (mg/l)	42.00	58.50	132.51	240.01	355.00	600.00	260.27	201.55	16	16
Winter	SWCCD	Mg (mg/l)	27.00	67.80	140.00	256.68	620.00	1400.00	439.40	272.13	17	17
Winter	SWCCD	Na (mg/l)	110.00	165.00	331.25	868.50	4240.00	17000.00	3756.23	1171.34	16	16
Winter	SWCCD	K (mg/l)	2.00	7.40	13.35	22.00	28.02	55.00	23.94	17.79	17	17
Winter	SWCCD	DO (mg/l)	0.71	1.90	5.83	7.25	9.01	14.97	7.20	5.85	21	21
Winter	SWCCD	Fecal (cfu)	0.50	0.50	0.50	0.50	40.38	160.00	40.38	2.11	4	4
Winter	SWCCD	pH (SU)	6.52	7.21	8.35	8.73	8.85	9.23	8.46	8.43	21	21
Winter	USGS	SC (µS/cm)	95.00	445.00	692.50	1450.00	2905.00	17300.00	2298.62	1419.25	56	56
Winter	USGS	Hardness (mg/l)	10.00	110.00	180.00	348.50	560.00	6290.00	615.18	317.33	66	66
Winter	USGS	Total alkalinity (mg/l)	26.23	186.56	258.61	276.64	365.57	663.93	309.44	282.86	50	50
Winter	USGS	SO_4 (mg/l)	5.00	17.50	90.25	343.50	793.00	8790.00	767.62	241.37	66	66
Winter	USGS	Cl (mg/l)	1.70	3.75	7.45	38.00	518.75	7800.00	980.32	67.38	66	66
Winter	USGS	SO_4_HCO_3 (mg/l)	51.00	263.50	423.75	811.50	1255.25	3966.00	957.19	713.40	50	50
Winter	USGS	Ca (mg/l)	1.50	12.50	39.25	64.50	99.75	533.00	90.67	54.78	66	66
Winter	USGS	Mg (mg/l)	1.00	10.35	21.00	38.80	78.00	1200.00	93.00	39.12	66	66
Winter	USGS	Na (mg/l)	2.70	11.10	33.25	215.00	905.00	18000.00	1434.67	203.84	66	66
Winter	USGS	K (mg/l)	0.90	1.48	2.30	5.20	13.00	190.00	12.40	5.61	66	66
Winter	USGS	TSS (mg/l)	17.00	19.70	23.75	30.50	37.25	44.00	30.50	27.35	2	2
Winter	USGS	Fe, total (mg/l)	0.11	0.19	0.61	0.97	3.34	11.20	2.33	1.12	12	12
Winter	USGS	Fe, dissolved (mg/l)	0.01	0.01	0.03	0.05	0.11	4.40	0.33	0.07	62	62
Winter	USGS	Al, total (mg/l)	0.02	0.09	0.19	0.30	0.34	3.10	0.65	0.29	10	10
Winter	USGS	Al, dissolved (mg/l)	0.00	0.00	0.01	0.03	0.07	0.10	0.04	0.02	11	11
Winter	USGS	DO (mg/l)	0.20	1.07	8.60	9.80	10.80	12.20	8.49	6.14	28	28
Winter	USGS	TP (mg/l)	0.01	0.01	0.03	0.07	0.13	7.15	0.26	0.06	48	48
Winter	USGS	NOx (mg/l)	0.01	0.01	0.06	0.10	0.15	0.69	0.15	0.08	26	26
Winter	USGS	Fecal (cfu)	11.00	528.80	1305.50	2600.00	211300.00	420000.00	140870.33	2290.19	3	3

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	*N*	# of stations
Winter	USGS	pH (SU)	6.80	7.20	7.65	8.20	8.60	10.20	8.19	8.15	67	67
Winter	USGS	Temperature (°C)	0.50	3.70	5.00	7.00	9.50	41.00	7.34	6.15	68	68
Winter	WQD	SC (µS/cm)	1852.0	3505.1	6569.00	13924.50	22835.50	31241.50	14475.04	10678.70	13	13
Winter	WQD	Total alkalinity (mg/l)	265.00	336.60	407.00	610.50	718.00	989.50	578.54	542.82	13	13
Winter	WQD	SO_4 (mg/l)	552.00	1249.0	2067.50	4290.00	5705.00	7155.00	4012.27	3213.76	13	13
Winter	WQD	Cl (mg/l)	28.00	349.70	523.00	1742.50	4790.50	8509.50	2997.96	1440.24	13	13
Winter	WQD	SO_4_HCO_3 (mg/l)	1053.54	1688.24	2588.44	5177.55	6580.96	8037.67	4736.48	3991.35	13	13
Winter	WQD	Ca (mg/l)	58.00	160.00	199.25	339.50	384.50	537.00	312.94	272.94	13	13
Winter	WQD	Mg (mg/l)	38.00	178.20	271.00	596.00	875.00	1195.00	606.73	453.20	13	13
Winter	WQD	Na (mg/l)	351.00	453.00	706.00	2685.00	4550.00	6640.00	2821.04	1874.08	13	13
Winter	WQD	K (mg/l)	6.00	22.80	32.50	49.00	77.00	120.00	55.92	44.94	13	13
Winter	WQD	DO (mg/l)	7.31	9.86	10.17	10.77	11.98	19.47	11.29	11.03	13	13
Winter	WQD	pH (SU)	7.28	7.31	7.36	7.65	7.85	7.99	7.62	7.62	13	13
Winter	WQD	Temperature (°C)	0.37	1.83	2.08	2.52	4.45	8.23	3.52	2.80	13	13
Winter	Combined	SC (µS/cm)	13.42	491.00	1152.50	2722.50	5896.25	31241.50	5045.37	2463.92	102	102
Winter	Combined	Hardness (mg/l)	10.00	112.00	210.00	400.00	932.50	7261.00	1018.94	449.78	83	83
Winter	Combined	Total alkalinity (mg/l)	26.23	204.51	261.48	306.56	439.34	989.50	373.55	329.70	80	80
Winter	Combined	SO_4 (mg/l)	5.00	21.50	167.50	680.00	1825.00	15000.00	1754.82	508.77	96	96
Winter	Combined	Cl (mg/l)	1.70	5.00	18.63	160.50	1579.75	15000.17	1421.49	161.56	118	118
Winter	Combined	SO_4_HCO_3 (mg/l)	51.00	342.48	554.50	1227.50	2411.86	15820.00	2293.51	1264.62	80	80
Winter	Combined	Ca (mg/l)	1.50	19.80	47.00	90.00	206.50	600.00	149.65	84.99	95	95
Winter	Combined	Mg (mg/l)	1.00	12.50	28.50	68.00	226.25	1400.00	223.91	76.85	96	96
Winter	Combined	Na (mg/l)	2.70	23.70	104.50	390.00	2542.50	18000.00	2015.39	370.71	95	95
Winter	Combined	K (mg/l)	0.90	1.80	2.48	8.55	23.50	190.00	20.34	9.12	96	96
Winter	Combined	TSS (mg/l)	7.50	17.52	26.75	35.00	71.33	143.00	52.31	39.97	15	15
Winter	Combined	Fe, Total (mg/l)	0.11	0.19	0.61	0.97	3.34	11.20	2.33	1.12	12	12
Winter	Combined	Fe, dissolved (mg/l)	0.01	0.01	0.03	0.05	0.11	4.40	0.33	0.07	62	62
Winter	Combined	Al, total (mg/l)	0.02	0.09	0.19	0.30	0.34	3.10	0.65	0.29	10	10
Winter	Combined	Al, dissolved (mg/l)	0.00	0.00	0.01	0.03	0.07	0.10	0.04	0.02	11	11
Winter	Combined	DO (mg/l)	0.20	2.48	7.30	9.55	10.83	19.47	8.91	7.03	64	64

Group	Agency	Parameter	Min	Per10	Per25	Per50	Per75	Max	Mean	Geomean	*N*	# of stations
Winter	Combined	TP (mg/l)	0.01	0.01	0.03	0.07	0.13	7.15	0.26	0.06	48	48
Winter	Combined	NOx (mg/l)	0.01	0.01	0.10	0.11	1.84	3.50	0.84	0.21	36	36
Winter	Combined	Fecal (cfu)	0.50	0.50	0.50	11.00	1380.00	420000.0	60396.07	42.25	7	7
Winter	Combined	pH (SU)	6.52	7.24	7.70	8.20	8.60	10.20	8.18	8.15	116	116
Winter	Combined	Temperature (°C)	0.37	2.45	4.43	6.90	9.36	41.00	6.98	5.73	96	96

Notes:
All-zeros data entries were removed.

Table A-8. Stations with up to six observations from reference streams in the NRSA Xeric Ecoregion (*Source*: Olson and Cormier 2019)

COMID	Sample Size	Mean	Minimum	Maximum	Standard Deviation (SD)	Range	Mean_log10	Min_log10	Max_log10	SD_log10	Range_log10
3277409	27	180.96	108.00	233.00	27.80	125.00	2.25	2.03	2.37	0.07	0.33
3380505	12	408.81	229.00	601.00	119.12	372.00	2.59	2.36	2.78	0.14	0.42
3527565	12	1514.00	912.00	1840.00	284.55	928.00	3.17	2.96	3.26	0.09	0.30
3527825	6	905.50	765.00	1328.00	215.83	563.00	2.95	2.88	3.12	0.09	0.24
4930770	17	1458.76	1170.00	1906.00	217.67	736.00	3.16	3.07	3.28	0.06	0.21
4931770	17	624.00	298.00	767.00	119.04	469.00	2.79	2.47	2.88	0.10	0.41
8202233	40	316.25	54.60	520.00	119.73	465.40	2.46	1.74	2.72	0.21	0.98
8915933	45	62.27	34.00	88.00	13.49	54.00	1.78	1.53	1.94	0.10	0.41
10407476	11	68.90	48.00	87.60	14.49	39.60	1.83	1.68	1.94	0.09	0.26
10409540	13	366.01	189.00	464.10	66.56	275.10	2.56	2.28	2.67	0.10	0.39
10409542	17	357.79	324.10	427.90	24.92	103.80	2.55	2.51	2.63	0.03	0.12
10682590	8	71.33	55.00	109.00	16.46	54.00	1.84	1.74	2.04	0.09	0.30
10682632	50	104.36	38.00	176.00	30.94	138.00	2.00	1.58	2.25	0.14	0.67
10696951	20	92.30	62.00	160.00	22.21	98.00	1.95	1.79	2.20	0.10	0.41
10696957	21	128.62	82.00	320.00	48.41	238.00	2.09	1.91	2.51	0.12	0.59
10721930	15	220.00	170.00	300.00	30.71	130.00	2.34	2.23	2.48	0.06	0.25
10722240	17	87.41	76.00	110.00	7.61	34.00	1.94	1.88	2.04	0.04	0.16
10722760	16	98.81	85.00	120.00	10.58	35.00	1.99	1.93	2.08	0.05	0.15
11135648	8	228.75	160.00	280.00	42.24	120.00	2.35	2.20	2.45	0.09	0.24
11177725	6	212.17	163.00	260.00	32.80	97.00	2.32	2.21	2.41	0.07	0.20
11180085	6	84.83	71.00	110.00	15.84	39.00	1.92	1.85	2.04	0.08	0.19
11230228	7	342.71	275.00	375.00	34.38	100.00	2.53	2.44	2.57	0.05	0.13
11230776	11	190.91	163.00	222.00	17.25	59.00	2.28	2.21	2.35	0.04	0.13
11337753	18	321.56	278.00	370.00	16.84	92.00	2.51	2.44	2.57	0.02	0.12
11338023	16	46.81	22.00	57.00	10.88	35.00	1.66	1.34	1.76	0.12	0.41
11338959	14	49.00	33.00	97.00	15.53	64.00	1.67	1.52	1.99	0.11	0.47
11986673	7	1782.86	1610.00	1950.00	104.84	340.00	3.25	3.21	3.29	0.03	0.08
15919739	8	346.60	272.80	438.00	46.81	165.20	2.54	2.44	2.64	0.06	0.21
15919765	10	410.77	202.70	521.00	85.54	318.30	2.60	2.31	2.72	0.11	0.41

COMID	Sample Size	Mean	Minimum	Maximum	Standard Deviation (SD)	Range	Mean_log10	Min_log10	Max_log10	SD_log10	Range_log10
17611425	118	999.22	689.00	1610.00	166.23	921.00	2.99	2.84	3.21	0.07	0.37
17775105	18	557.75	140.00	1096.54	195.54	956.54	2.72	2.15	3.04	0.18	0.89
20716600	6	687.62	615.20	791.00	76.24	175.80	2.84	2.79	2.90	0.05	0.11
20718732	10	1294.80	870.00	1512.00	178.93	642.00	3.11	2.94	3.18	0.07	0.24
20719330	11	784.45	600.00	980.00	116.56	380.00	2.89	2.78	2.99	0.06	0.21
21263965	7	109.54	79.00	190.00	38.57	111.00	2.02	1.90	2.28	0.13	0.38
21263991	8	83.48	61.00	100.00	13.74	39.00	1.92	1.79	2.00	0.07	0.21
21309111	13	192.14	99.90	298.40	77.71	198.50	2.25	2.00	2.47	0.18	0.48
21309129	6	140.77	90.00	191.00	36.98	101.00	2.14	1.95	2.28	0.12	0.33
21397225	8	470.03	230.00	695.00	132.60	465.00	2.65	2.36	2.84	0.14	0.48
21402849	17	494.99	405.00	610.00	54.90	205.00	2.69	2.61	2.79	0.05	0.18
23196654	14	237.14	210.00	270.00	17.29	60.00	2.37	2.32	2.43	0.03	0.11
23288369	39	131.77	76.00	191.00	27.54	115.00	2.11	1.88	2.28	0.10	0.40
Average	17.86	411.11	288.46	542.20	70.14	253.74	2.39	2.22	2.54	0.09	0.32