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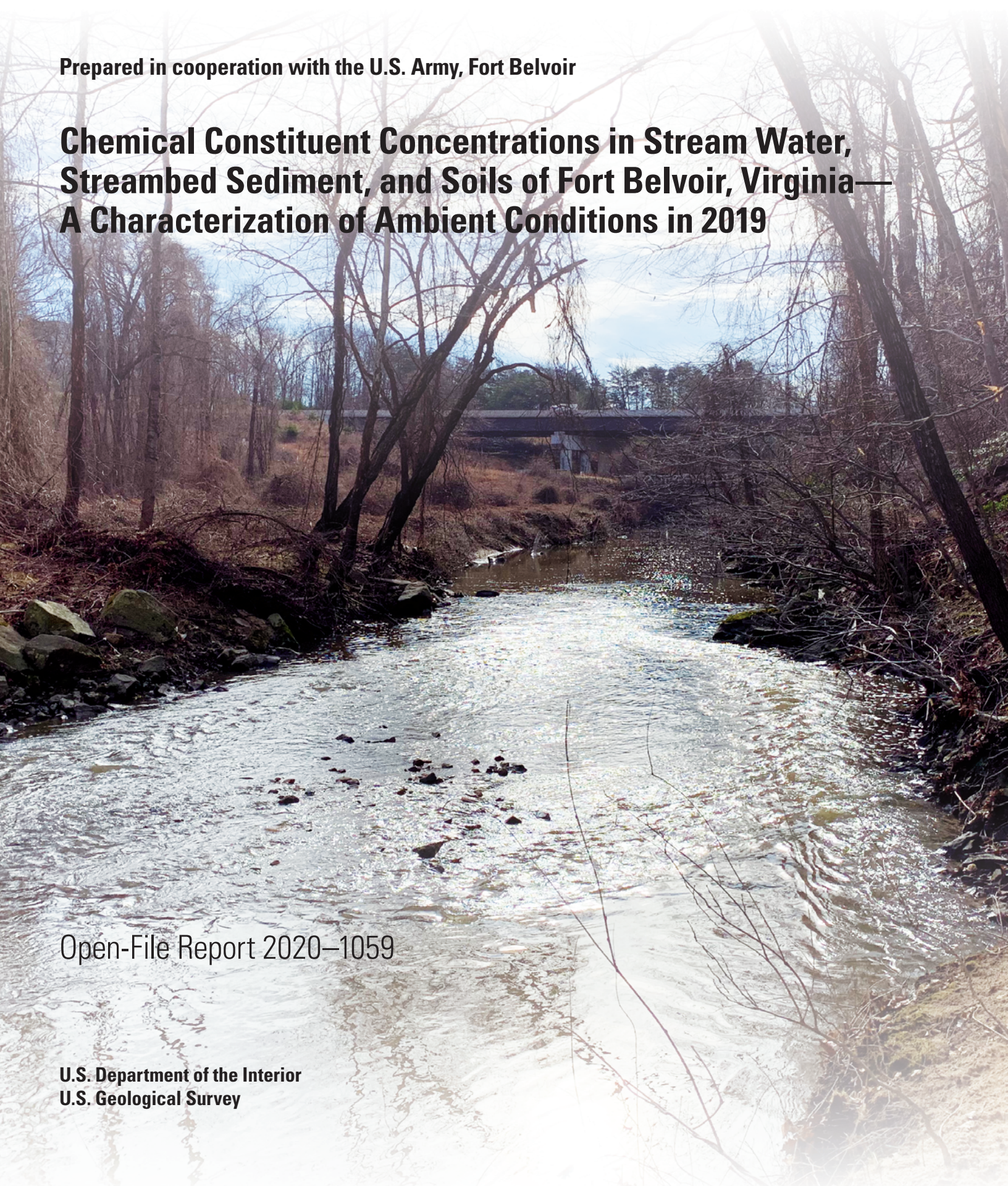
Chemical Constituent Concentrations in Stream Water, Streambed Sediment, and Soils of Fort Belvoir, Virginia—A Characterization of Ambient Conditions in 2019



Open-File Report 2020–1059

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

Cover. Accotink Creek on Fort Belvoir. Photo by Christopher S. Manikas, U.S. Army.

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By Karen C. Rice and Douglas B. Chambers

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DAVID BERNHARDT, Secretary

U.S. Geological Survey
James F. Reilly II, Director

U.S. Geological Survey, Reston, Virginia: 2020

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Contents

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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
	Area	
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8 \times °C) + 32.$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C = (°F - 32) / 1.8.$$

Datum

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

Supplemental Information

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given in either milligrams per liter (mg/L) or micrograms per liter (µg/L).

Concentrations of chemical constituents in streambed sediment and soils are given in micrograms per kilogram (µg/kg).

Abbreviations

Ag	silver
Al	aluminum
Ba	barium
Be	beryllium
Ca	calcium
CN^-	cyanide
Co	cobalt
Cr	chromium
Cu	copper
EPA	U.S. Environmental Protection Agency
FTBL	Fort Belvoir Military Installation
FBNA	Fort Belvoir North Area
Hg	mercury
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
K	potassium
Mg	magnesium
Mn	manganese
Mo	molybdenum
Na	sodium
NFM	National Field Manual
Ni	nickel
Pb	lead
Sb	antimony
Se	selenium
TAL	Target Analyte List
Th	thorium
USGS	U.S. Geological Survey
V	vanadium
Zn	zinc

Chemical Constituent Concentrations in Stream Water, Streambed Sediment, and Soils of Fort Belvoir, Virginia—A Characterization of Ambient Conditions in 2019

By Karen C. Rice and Douglas B. Chambers

Introduction

The U.S. Army Fort Belvoir (FTBL) installation is on the banks of the Potomac River in Fairfax County, northeastern Virginia (fig. 1). The installation was founded by the U.S. Army during World War I. It has been home to a variety of military organizations over the course of its more than 100-year history and currently houses more than 145 mission partners. The installation consists of two noncontiguous units, the Main Post, and a smaller area to the northwest, Fort Belvoir North Area (FTNA). FTBL encompasses 8.91 square miles.

There is concern that activities on FTBL, including a long history of training, operations, and maintenance, may have resulted in contamination of stream water, streambed sediment, and (or) soils. Of particular concern is the U.S. Environmental Protection Agency (EPA) Target Analyte List (TAL; table 1). TAL refers to "the list of inorganic compounds/elements designated for analysis as contained in the version of the EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration in effect as of the date on which the laboratory is performing the analysis" (https://www.nj.gov/dep/srp/guidance/tcl_tal/). Because of the potential for TAL contamination at FTBL, the U.S. Geological Survey (USGS), in cooperation with U.S. Army Fort Belvoir, conducted a survey of FTBL's stream water, streambed sediment, and soils during calendar year 2019.

The terminology "ambient concentrations" is used in this report to represent the concentrations of the TAL and other constituents at the time of sampling. This is in contrast to "background concentrations," a term that "refers to areas in which the concentrations of chemicals have not been elevated by site activities" (Breckenridge and Crockett, 1995). Although some of the samples collected for this project may represent "background concentrations," there is no assurance that they do, so all data collected are described as having "ambient concentrations."

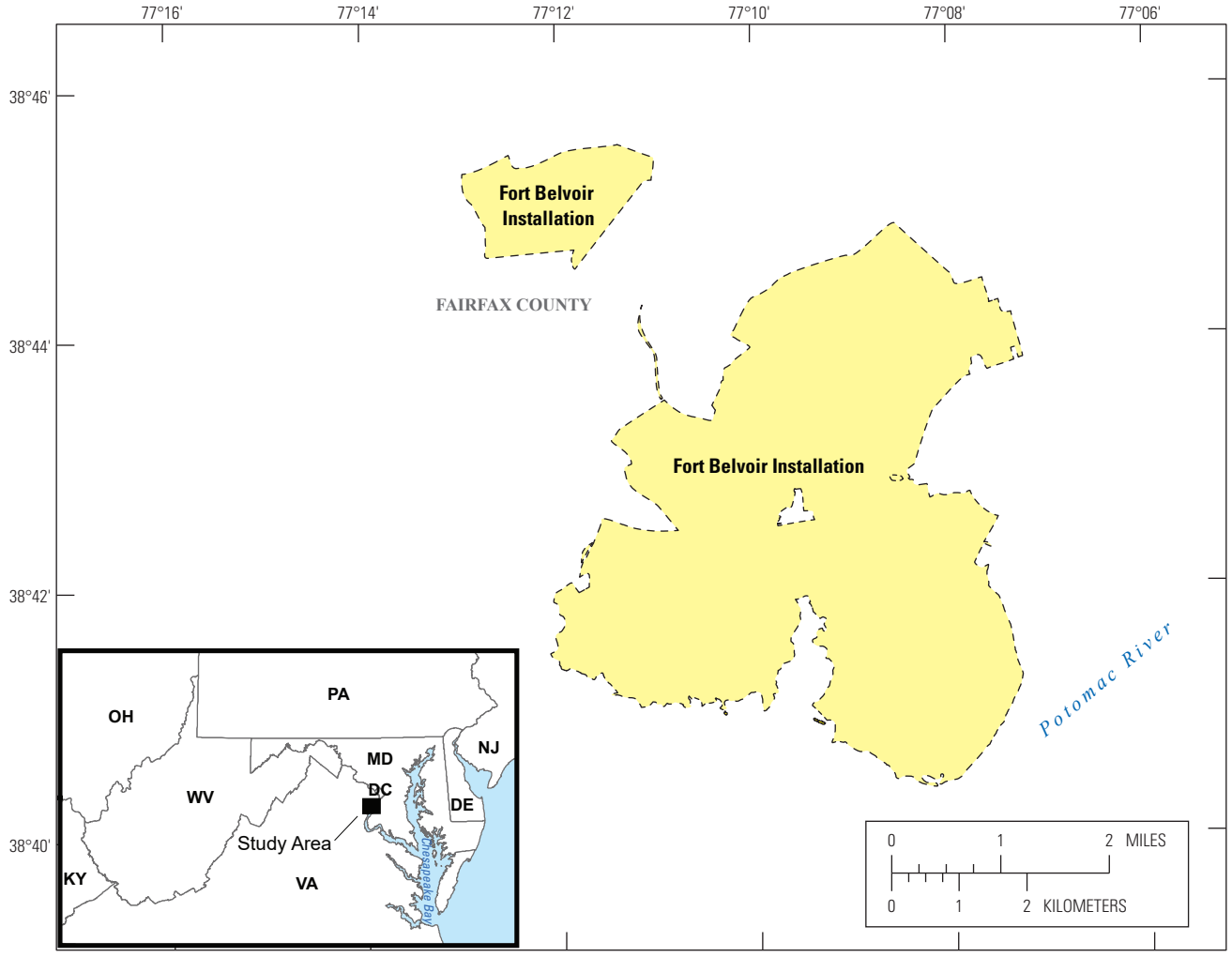
The purpose of the study was to obtain environmental data to characterize ambient concentrations of EPA TAL constituents in stream water, streambed sediment, and soils in FTBL, Virginia. This report describes methods and results of sampling stream water, streambed sediment, and soils during 2019. The purpose of this report is four-fold: (1) to describe the field sampling methods used to collect stream water, streambed sediment, and soils; (2) to describe the laboratory methods used to analyze the samples; (3) to report summaries of the field and laboratory results; and (4) to report the quality assurance and quality control results.

Data Collection and Laboratory Methods

Stream Water

An attempt was made to sample 13 stream-water sites (fig. 2, table 2) four times during the study: February, May, July, and September, 2019. Ten sites are on the FTBL Main Post, and four sites are on the FBNA. Although the target number of samples at each site during the study was four, some of the streams were dry and could not be sampled in May, July, and September. Site 6 (Tributary to Accotink Creek above Poe Road at Accotink, Virginia) was visited twice and sampled once, but owing to safety concerns by FTBL, return to the site by field personnel was prohibited. Site 6 was replaced by Site 14 for the subsequent two sampling trips.

At most sites, stream-water samples were collected at a single station in the stream using a 1-liter Nalgene narrow mouth bottle to collect five vertical samples from the centroid of flow to achieve the needed sample volume for laboratory and field analyses. The vertical samples collected were poured into an 8-liter polyethylene churn splitter for sample processing. For the largest stream sampled, Accotink Creek



Base from USGS The National Map Basemap, 2018.
Virginia state plane coordinate system (north zone), North American Datum of 1983.

Figure 1. Location of Fort Belvoir in northeastern Virginia.

Table 1. Reporting limits for chemical constituents measured in stream-water, streambed-sediment, and soil samples collected as part of the Fort Belvoir ambient conditions survey, 2019.

[This list includes the U.S. Environmental Protection Agency's Target Analyte List (TAL). Constituents in parentheses are not TAL analytes; n.a., not applicable; µg/L, microgram per liter; mg/L, milligram per liter; µg/kg, microgram per kilogram]

Constituent	Sample Matrix					
	Water				Streambed sediment and soil	
	Filtered sample		Unfiltered sample			
	Laboratory reporting limit	Unit	Laboratory reporting lmit	Units	Laboratory reporting limit	Unit
(Hardness)	n.a.	n.a.	5	mg/L	n.a.	n.a.
Aluminum	100	µg/L	50	µg/L	5,000	µg/kg
Antimony	5	µg/L	5	µg/L	1,000	µg/kg
Arsenic	3	µg/L	3	µg/L	2,000	µg/kg
Barium	200	µg/L	50	µg/L	10,000	µg/kg
Beryllium	2	µg/L	2	µg/L	250	µg/kg
Cadmium	2	µg/L	2	µg/L	250	µg/kg
Calcium	1,000	µg/L	2,000	µg/L	50,000	µg/kg
Chromium	20	µg/L	20	µg/L	500	µg/kg
Cobalt	10	µg/L	10	µg/L	1,000	µg/kg
Copper	10	µg/L	10	µg/L	5,000	µg/kg
(Cyanide)	n.a.	n.a.	0.05	mg/L	1	µg/kg
Iron	300	µg/L	400	µg/L	15,000	µg/kg
Lead	2	µg/L	2	µg/L	5,000	µg/kg
Magnesium	1,000	µg/L	500	µg/L	50,000	µg/kg
Manganese	10	µg/L	10	µg/L	1,000	µg/kg
Mercury	0.2	µg/L	0.2	µg/L	10	µg/kg
(Molybdenum)	10	µg/L	10	µg/L	500	µg/kg
Nickel	20	µg/L	20	µg/L	5,000	µg/kg
Potassium	400	µg/L	500	µg/L	20,000	µg/kg
Selenium	10	µg/L	10	µg/L	2,000	µg/kg
Silver	3	µg/L	3	µg/L	1,000	µg/kg
Sodium	1,000	µg/L	500	µg/L	50,000	µg/kg
Thallium	4	µg/L	4	µg/L	2,000	µg/kg
Vanadium	8	µg/L	8	µg/L	2,500	µg/kg
Zinc	100	µg/L	100	µg/L	5,000	µg/kg

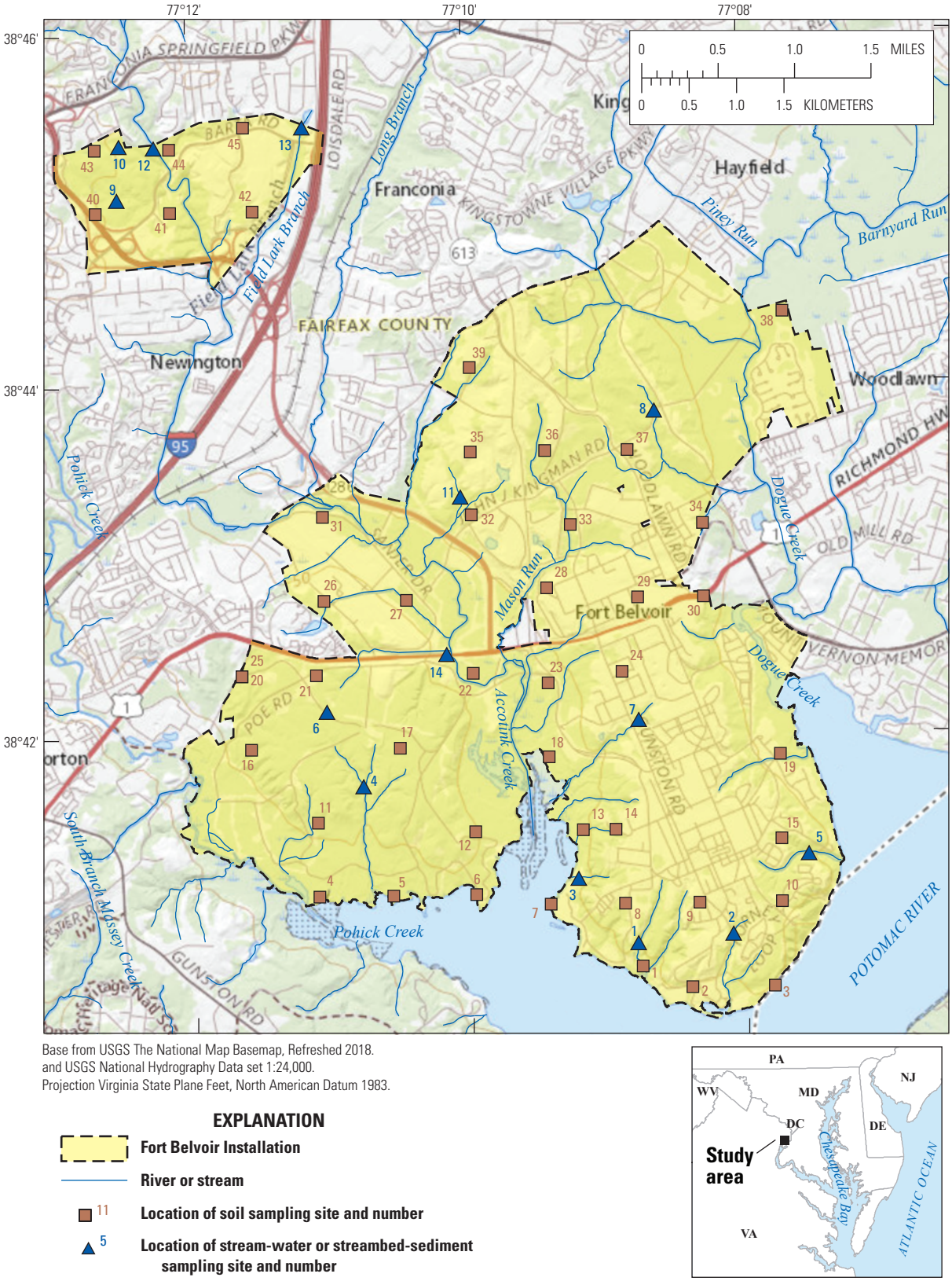


Figure 2. Locations of stream-water, streambed-sediment, and soil sampling sites in Fort Belvoir, Virginia.

Table 2. Description of stream-water sampling sites in Fort Belvoir, Virginia.

[USGS, U.S. Geological Survey; mi², square miles; Trib, tributary; Cr, creek; nr, near; Rd, road; Va, Virginia; R, river; abv., above; Beechwd, Beechwood; Dr, drive; HWY, highway; Br, branch]

Site number	Latitude (decimal degrees)	Longitude (decimal degrees)	Drainage area (mi²)	USGS station identifier	USGS station name
1	38.6802	−77.1465	0.14	0165545630	Trib to Accotink Cr nr Morrow Rd at Accotink, Va.
2	38.6810	−77.1350	0.12	0165545746	Trib to Accotink Cr nr Totten Rd at Accotink, Va.
3	38.6864	−77.1536	0.08	0165517802	Trib to Pohick Cr nr Warren Rd at Accotink, Va.
4	38.6954	−77.1796	0.11	0165545242	Trib to Pohick Cr at Pohick Neck nr Lorton, Va.
5	38.6885	−77.1257	0.17	0165387125	Trib to Potomac R nr Jadwin Rd at Accotink, Va.
6	38.7025	−77.1838	0.05	0165516905	Trib to Accotink Cr abv Poe Rd at Accotink, Va.
7	38.7014	−77.1460	0.12	0165517575	Trib to Accotink Cr abv Gunston Rd at Accotink, Va.
8	38.7307	−77.1437	0.04	0165379148	Trib to Dogue Cr at Kingman Rd at Accotink, Va.
9	38.7512	−77.2084	0.10	0165501562	Trib to Accotink Cr abv Barta Rd nr Newington, Va.
10	38.7563	−77.2081	0.07	01654929	Trib to Accotink Cr nr Beechwd Dr nr Newington, Va.
11	38.7227	−77.1673	0.11	0165516637	Trib to Accotink Cr nr Kingman Rd at Ft Belvoir, Va.
12	38.7561	−77.2039	36.5	01654852	Accotink Cr abv Barta Rd nr Newington, Va.
13	38.7579	−77.1859	0.21	0165505816	Field Lark Br abv Barta Rd nr Newington, Va.
14	38.7078	−77.1692	48.5	01655170	Accotink Cr at HWY 1 at Accotink, Va.

(Sites 12 and 14), the dips were width-integrated from five vertical stations across the stream width. A multi-parameter water-quality sonde (YSI EXO 2) was used to measure water temperature, pH, specific conductance, dissolved oxygen, and turbidity according to procedures described in the USGS National Field Manual (NFM; U.S. Geological Survey, variously dated). Streamflow measurements were made using a Sontek Flow Tracker acoustic doppler velocimeter according to USGS policies and procedures (Turnipseed and Sauer, 2010) to provide hydrologic context for the water-quality data.

Sample processing was conducted in clean environments established inside mobile laboratory vehicles at or near the sample sites. Sample processing included splitting, filtering, preserving, and labeling following procedures described in the NFM. Subsamples were composited and split using a churn splitter to ensure representativeness of the aliquots submitted for the various laboratory analyses. Samples were preserved, packaged, and shipped to the laboratory in accordance with NFM and laboratory guidance. In addition to the environmental samples collected, quality-control samples, including replicates and blanks, were collected and analyzed according to guidance in the NFM and Mueller and others (1997).

Samples were shipped in coolers with ice overnight to RTI Laboratories (Livonia, Mich.), a laboratory certified by the Virginia Environmental Laboratory Accreditation Program (http://rtilab.com/wp-content/uploads/ 2018/06/VADEQ-scope-exp-190614.pdf) working under contract to USGS. Samples were analyzed for 26 constituents, including major and minor ions, trace elements, and hardness (as calcium carbonate), using analytical procedures with detection and reporting limits appropriate for comparison to regulatory criteria (table 1). The 26 constituents listed in table 1 were analyzed for whole-water (unfiltered) and dissolved (filtered; less than 0.45 micron) fractions, except for hardness and cyanide (CN^-), which were reported as total. Hardness (SM 2340C) was analyzed by titration with the reagent EthyleneDiamine-TetraAcetic acid. Whole-water and dissolved elements were analyzed using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS; EPA 200.8) or Inductively Coupled Plasma-Optical Emission Spectrometry (SW 6010D). Mercury (Hg) was analyzed using Cold Vapor Atomic Absorption (EPA 245.1). Cyanide was analyzed using a colorimetric method (SM 4500-CN-E). The reporting level for each analyte is presented in table 1. The reporting level is the concentration at which both false positive risk and false negative risk are minimized; it is often set at two or more times the detection level. The detection level is the concentration at which the chance of a false positive (type II error) is less than or equal to 1 percent. Some constituent concentrations are reported at concentrations less than the reporting level but greater than the detection level. These values have only slightly more uncertainty than those greater than the reporting level and are suitable for all purposes of this study.

Streambed Sediment

Streambed-sediment sampling sites were co-located with 13 stream-water sites, and samples were collected during July 22–24, 2019 (fig. 2; table 2). Streambed-sediment samples were collected to represent longitudinal variability along an approximately 10-foot (ft) sampling reach. Sampling methods are described in the "Bottom Material Samples" chapter of the NFM and Shelton and Capel (1994). Simple grab sampling methods were used, which consisted of scooping up streambed sediment with a plastic scoop and placing it into plastic containers.

Sample processing was conducted in clean environments established inside mobile laboratory vehicles at or near the field sites, following procedures described in the NFM. Samples were preserved, packaged, and shipped in accordance with NFM and laboratory guidance. In addition to the environmental samples, quality-control samples consisting of split samples and concurrent replicate samples were collected and analyzed according to NFM guidance.

Samples were shipped to RTI laboratories for analysis of 25 major and minor ions and trace elements using analytical procedures with detection and reporting limits appropriate for comparison with regulatory criteria. Samples were analyzed by ICP-MS, except for Hg (Cold Vapor Atomic Absorption) and CN^- (colorimetric).

Soils

Soil samples were collected from 45 sites throughout FTBL, with 6 sites in FBNA, April 1–4, 2019 (fig. 2; table 3). Samples were collected using a 1-inch diameter stainless-steel soil probe. A clean polyethylene sheet was placed on the ground next to the targeted site, surface leaf litter was swept away from the targeted site, and the probe was pushed into the ground to a depth of approximately 6 inches (in.) then rotated and pulled to the surface. Using gloved hands, the soil in the probe was gently pushed out of the probe body onto the plastic sheet. The probe was returned to the hole, where the procedure was repeated until the soil core was approximately 36 in. long or until the probe had reached the point of refusal.

Once the entire core from the sampling site was arranged on the plastic sheet, it was examined for differences in color and (or) texture, which would indicate different soil horizons. Two to three samples per core were collected, depending on the soil horizons observed. The first sample was of the topsoil. If additional horizons were evident, a sample from each was collected. If no other horizons were evident, one additional sample was collected below the topsoil. Each soil sample was placed in a glass jar, which was labelled with the location, depth of sample, and date.

After each soil core was collected and sampled, the soil probe was cleaned to avoid cross-site contamination. The probe was wiped of excess soil, sprayed with 1-percent Liquinox solution, scrubbed with a plastic brush, rinsed three times

Table 3. Description of soil-sampling sites in Fort Belvoir, Virginia.

[USGS, U.S. Geological Survey]

Site number	USGS station identifier	Latitude (decimal degrees)	Longitude (decimal degrees)	Date sampled
1	384042077084701	38.67844	−77.14627	4/1/2019
2	384034077082301	38.67613	−77.13969	4/1/2019
3	384035077074801	38.67642	−77.13002	4/1/2019
4	384107077110701	38.68528	−77.18520	4/3/2019
5	384107077103301	38.68528	−77.17576	4/3/2019
6	384106077095601	38.68493	−77.16561	4/3/2019
7	384102077092601	38.68398	−77.15720	4/1/2019
8	384102077085301	38.68387	−77.14796	4/1/2019
9	384102077082001	38.68402	−77.13900	4/1/2019
10	384101077074601	38.68355	−77.12933	4/1/2019
11	384130077110501	38.69154	−77.18481	4/3/2019
12	384129077095901	38.69133	−77.16632	4/3/2019
13	384128077091201	38.69112	−77.15341	4/2/2019
14	384128077085501	38.69100	−77.14854	4/2/2019
15	384123077074501	38.68977	−77.12911	4/1/2019
16	384156077113301	38.69889	−77.19255	4/3/2019
17	384155077103201	38.69868	−77.17543	4/3/2019
18	384154077092701	38.69831	−77.15744	4/2/2019
19	384153077074501	38.69815	−77.12919	4/1/2019
20	384220077081801	38.70614	−77.19380	4/3/2019
21	384222077110401	38.70604	−77.18455	4/3/2019
22	384221077095801	38.70583	−77.16605	4/3/2019
23	384220077092701	38.70543	−77.15739	4/2/2019
24	384223077085201	38.70633	−77.14774	4/1/2019
25	384222077113801	38.70551	−77.19389	4/1/2019
26	384248077110401	38.71328	−77.18442	4/2/2019
27	384246077102601	38.71290	−77.17388	4/2/2019
28	384250077092701	38.71393	−77.15742	4/1/2019
29	384247077084601	38.71315	−77.14614	4/2/2019
30	384246077081701	38.71269	−77.13813	4/2/2019
31	384314077110301	38.72053	−77.18428	4/3/2019
32	384316077095901	38.72101	−77.16648	4/2/2019
33	384313077091401	38.72016	−77.15399	4/1/2019
34	384312077081701	38.72000	−77.13802	4/4/2019
35	384339077095701	38.72748	−77.16584	4/2/2019
36	384339077092601	38.72740	−77.15732	4/4/2019
37	384337077084801	38.72701	−77.14671	4/4/2019
38	384424077074101	38.74014	−77.12811	4/4/2019
39	384405077095601	38.73482	−77.16551	4/2/2019
40	384502077123901	38.75045	−77.21081	4/4/2019
41	384459077120801	38.74973	−77.20226	4/4/2019
42	384501077113301	38.75036	−77.19246	4/4/2019
43	384523077124001	38.75630	−77.21111	4/4/2019
44	384523077120701	38.75649	−77.20184	4/4/2019
45	384530077113401	38.75828	−77.19287	4/4/2019

with tap water, rinsed three times with deionized water, and patted dry with paper towels. Once the probe was thoroughly cleaned, it was placed in a clean plastic bag and transported to the next sampling site.

Upon completion of each day of soil sampling, all samples were shipped overnight to RTI Laboratories for analysis of 25 major and minor ions and trace elements (table 1). Samples were analyzed by ICP-MS, except for Hg (Cold Vapor Atomic Absorption) and CN^- (colorimetric).

Quality Assurance and Quality Control

The purpose of quality assurance (QA) is to demonstrate that valid data have been collected and reported. Quality control (QC) allows the user to have confidence in the data. More specifically, QC monitors the sampling processes, including equipment function and cleanliness, instrument test and calibration, and sample preservation, shipping, and analysis. QC also includes the corrective and preventive actions taken to eliminate causes of unsatisfactory performances.

Quality-assurance samples, including blanks, source-solution blank, equipment blanks, field blanks, and replicates, were prepared and (or) collected and analyzed throughout the project. Blank-water samples are collected to determine the extent to which sampling procedures may contaminate samples, thereby biasing analytical results. Replicate samples are used to determine the variability inherent in the collection and analysis of environmental samples. Together, blank and replicate samples can be used to characterize the accuracy and precision of environmental data. All quality-assurance samples were collected and processed according to protocols described in the USGS National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated).

Blank Samples

A combination of source-solution blanks, equipment blanks, and field blanks was used to identify and quantify potential sources of contamination. A source-solution blank is a sample of the blank water (reagent grade inorganic blank water obtained from the USGS Hydrologic Instrumentation Facility, OneStop # Q378FLD) used to prepare other blank samples. An equipment blank consists of a volume of inorganic blank water that is processed through the sampling equipment in a laboratory environment. A field blank consists of a volume of water processed through the sampling equipment under the same field conditions in which the samples were processed, typically a mobile field laboratory.

Replicate Samples

Comparison of results among replicate samples can provide insight into the sources of variability that are inherent in sample collection, processing, and analysis. Sample-collection protocols for stream water (U.S. Geological Survey, variously dated), stream-bed material (U.S. Geological Survey, variously dated), and soil (Schoeneberger and others, 2012) samples have been developed to produce a sample that is representative of the sampled environment and media. If the appropriate sampling procedures have been used, it is assumed that the media being collected is representative of the sampled environment and that any variability among the main and replicate sample is primarily attributable to sample processing and analysis (Koterba and others, 1995).

Variability for a replicate sample pair was quantified by calculating the relative percent difference (RPD) of the samples. The RPD was calculated using the following formula:

$$(|R_1 - R_2| / (R_1 + R_2 / 2)) \times 100$$

where R_1 is the concentration of the analyte in the first replicate sample, and R_2 is the concentration of the analyte in the second replicate sample. Generally, concentrations in replicate sample pairs differed by small amounts, typically less than 15 percent RPD for constituents in filtered samples and less than 20 percent RPD in unfiltered samples.

Summary of Results

A summary of field characteristics in stream water is shown in table 4. A summary of whole-water chemical constituent concentrations in stream water is shown in table 5. A summary of dissolved chemical constituent concentrations in stream water is shown in table 6. A summary of chemical constituent concentrations in streambed sediment is shown in table 7. A summary of chemical constituent concentrations in soils is shown in table 8. All sample results are available in the companion USGS data release (Rice and Chambers, 2020).

Table 4. Summary of field characteristics in stream water in Fort Belvoir, Virginia.

[N, number of samples; ft³/s, cubic feet per second; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter; fnu, formazin nephelometric unit; n.a., not applicable; HWY, highway]

Characteristic	N	Minimum	Median	Maximum
Site 1: 0165545630 Tributary to Accotink Creek near Morrow Road at Accotink, Virginia				
Streamflow, ft³/s	1	n.a.	0.08	n.a.
Water temperature, °C	1	n.a.	5.7	n.a.
Specific conductance, µS/cm	1	n.a.	180	n.a.
pH, units	1	n.a.	7.0	n.a.
Dissolved oxygen, mg/L	1	n.a.	12	n.a.
Turbidity, fnu	1	n.a.	2.4	n.a.
Site 2: 0165545746 Tributary to Accotink Creek near Totten Road at Accotink, Virginia				
Streamflow, ft³/s	3	0	0.03	0.06
Water temperature, °C	3	6.7	18.1	24.4
Specific conductance, µS/cm	3	187	200	231
pH, units	3	6.3	6.4	6.6
Dissolved oxygen, mg/L	3	4.6	7	11.8
Turbidity, fnu	3	1.6	1.9	5.5
Site 3: 01655517802 Tributary to Pohick Creek near Warren Road at Accotink, Virginia				
Streamflow, ft³/s	4	0.04	0.085	0.18
Water temperature, °C	4	7.9	17.5	20.8
Specific conductance, µS/cm	4	104	118	134
pH, units	4	5.3	5.7	6.2
Dissolved oxygen, mg/L	4	8	8.5	11.7
Turbidity, fnu	4	1.9	2.9	6.5
Site 4: 0165545242 Tributary to Pohick Creek at Pohick Neck near Lorton, Virginia				
Streamflow, ft³/s	4	0.05	0.115	0.61
Water temperature, °C	4	6.4	15.8	21.7
Specific conductance, µS/cm	4	33	37	48
pH, units	4	4.9	5.7	6.4
Dissolved oxygen, mg/L	4	7.5	8.3	11.5
Turbidity, fnu	4	1.1	1.95	5.7
Site 5: 0165387125 Tributary to Potomac River near Jadwin Road at Accotink, Virginia				
Streamflow, ft³/s	4	0.06	0.12	1.9
Water temperature, °C	4	7.2	20.2	25.3
Specific conductance, µS/cm	4	184	210	355
pH, units	4	6.2	6.55	7.3
Dissolved oxygen, mg/L	4	7.2	8.7	12.2
Turbidity, fnu	4	0.3	0.9	7.2
Site 6: 0165516905 Tributary to Accotink Creek above Poe Road at Accotink, Virginia				
Streamflow, ft³/s	1	n.a.	0.07	n.a.
Water temperature, °C	1	n.a.	5.4	n.a.
Specific conductance, µS/cm	1	n.a.	32	n.a.
pH, units	1	n.a.	5.6	n.a.
Dissolved oxygen, mg/L	1	n.a.	10.7	n.a.
Turbidity, fnu	1	n.a.	7.2	n.a.
Site 7: 0165517575 Tributary to Accotink Creek above Gunston Road at Accotink, Virginia				
Streamflow, ft³/s	1	n.a.	0.03	n.a.
Water temperature, °C	1	n.a.	7.6	n.a.
Specific conductance, µS/cm	1	n.a.	519	n.a.
pH, units	1	n.a.	6.8	n.a.
Dissolved oxygen, mg/L	1	n.a.	11.3	n.a.
Turbidity, fnu	1	n.a.	2.1	n.a.
Site 8: 0165379148 Tributary to Dogue Creek at Kingman Road at Accotink, Virginia				
Streamflow, ft³/s	1	n.a.	0.03	n.a.
Water temperature, °C	1	n.a.	6.4	n.a.
Specific conductance, µS/cm	1	n.a.	44	n.a.
pH, units	1	n.a.	5.2	n.a.
Dissolved oxygen, mg/L	1	n.a.	10.2	n.a.
Turbidity, fnu	1	n.a.	2	n.a.
Site 9: 0165501562 Tributary to Accotink Creek above Barta Road near Newington, Virginia				
Streamflow, ft³/s	3	0.01	0.07	0.16
Water temperature, °C	3	5.4	14.6	20.4
Specific conductance, µS/cm	3	85	88	183
pH, units	3	5.8	6.1	6.2
Dissolved oxygen, mg/L	3	7.6	8.9	11.7
Turbidity, fnu	3	2.9	3.2	6.9
Site 10: 01654929 Tributary to Accotink Creek near Beechwood Drive near Newington, Virginia				
Streamflow, ft³/s	3	0.01	0.04	0.11
Water temperature, °C	3	3.5	14.7	20.3
Specific conductance, µS/cm	3	62	70	71
pH, units	3	5.8	6.2	6.2
Dissolved oxygen, mg/L	3	7.8	8.6	12.2
Turbidity, fnu	3	4.1	4.6	5
Site 11: 0165516637 Tributary to Accotink Creek near Kingman Road at Fort Belvoir, Virginia				
Streamflow, ft³/s	3	0	0.02	0.04
Water temperature, °C	3	7.2	14.3	19
Specific conductance, µS/cm	3	69	70	76
pH, units	3	4.8	4.8	5.7
Dissolved oxygen, mg/L	3	6.7	7.8	11.8
Turbidity, fnu	3	3.4	3.8	3.9
Site 12: 01654852 Accotink Creek above Barta Road near Newington, Virginia				
Streamflow, ft³/s	4	2.1	14	42
Water temperature, °C	4	3.7	19.8	26.7
Specific conductance, µS/cm	4	281	304	675
pH, units	4	6.8	7.2	7.2
Dissolved oxygen, mg/L	4	6.5	7.5	12.7
Turbidity, fnu	4	1.2	1.8	27
Site 13: 0165505816 Field Lark Branch above Barta Road near Newington, Virginia				
Streamflow, ft³/s	3	0.04	0.04	0.09
Water temperature, °C	3	7.7	15.9	20.9
Specific conductance, µS/cm	3	128	159	160
pH, units	3	5.9	6	6.2
Dissolved oxygen, mg/L	3	3.5	5.2	10.7
Turbidity, fnu	3	3	3.2	5.8
Site 14: 01655170 Accotink Cr at HWY 1 at Accotink, Virginia				
Streamflow, ft³/s	2	3.6	n.a.	21
Water temperature, °C	2	20.3	n.a.	25.1
Specific conductance, µS/cm	2	284	n.a.	304
pH, units	2	6.7	n.a.	7.5
Dissolved oxygen, mg/L	2	6.9	n.a.	8.8
Turbidity, fnu	2	1.4	n.a.	2.5

Table 5. Summary of whole-water chemical constituent concentrations in stream water in Fort Belvoir, Virginia.

[N, number of samples; concentrations in micrograms per liter, except for cyanide, which is in milligrams per liter; <, less than; n.a., not applicable; HWY, highway]

Constituent	N	Minimum	Median	Maximum
Site 1: 0165545630 Tributary to Accotink Creek near Morrow Road at Accotink, Virginia				
Hardness	1	n.a.	48	n.a.
Aluminum	1	n.a.	81	n.a.
Antimony	1	n.a.	<5.0	n.a.
Arsenic	1	n.a.	<3.0	n.a.
Barium	1	n.a.	43	n.a.
Beryllium	1	n.a.	<2.0	n.a.
Cadmium	1	n.a.	<2.0	n.a.
Calcium	1	n.a.	10,000	n.a.
Chromium	1	n.a.	0.95	n.a.
Cobalt	1	n.a.	<10	n.a.
Copper	1	n.a.	<10	n.a.
Cyanide	1	n.a.	<0.050	n.a.
Iron	1	n.a.	<400	n.a.
Lead	1	n.a.	<2.0	n.a.
Magnesium	1	n.a.	2,600	n.a.
Manganese	1	n.a.	3.8	n.a.
Mercury	1	n.a.	<0.20	n.a.
Molybdenum	1	n.a.	<10	n.a.
Nickel	1	n.a.	<20	n.a.
Potassium	1	n.a.	2,200	n.a.
Selenium	1	n.a.	<10	n.a.
Silver	1	n.a.	<3.0	n.a.
Sodium	1	n.a.	18,000	n.a.
Thallium	1	n.a.	0.36	n.a.
Vanadium	1	n.a.	<8.0	n.a.
Zinc	1	n.a.	<100	n.a.
Site 2: 0165545746 Tributary to Accotink Creek near Totten Road at Accotink, Virginia				
Hardness	3	40	44	48
Aluminum	3	77	110	340
Antimony	3	<5.0	<5.0	<5.0
Arsenic	3	<3.0	<3.0	<3.0
Barium	3	50	60	61
Beryllium	3	<2.0	<2.0	<2.0
Cadmium	3	<2.0	<2.0	<2.0
Calcium	3	9,500	10,000	12,000
Chromium	3	0.67	0.73	0.89
Cobalt	3	2.8	2.9	3.7
Copper	3	1.1	1.8	3.5
Cyanide	3	0.011	<0.050	<0.050
Iron	3	190	250	280
Lead	3	0.55	<2.0	<2.0
Magnesium	3	3,200	3,200	3,400
Manganese	3	31	68	120
Mercury	3	0.09	<0.20	<0.20
Molybdenum	3	<10	<10	<10
Nickel	3	2.8	2.8	<20
Potassium	3	2,300	2,700	2,700
Selenium	3	<10	<10	<10
Silver	3	0.48	<3.0	<3.0
Sodium	3	17,000	22,000	26,000
Thallium	3	0.61	<4.0	<4.0
Vanadium	3	2.9	<8.0	<8.0
Zinc	3	8.8	9.2	13

Constituent	N	Minimum	Median	Maximum
Site 3: 01655517802 Tributary to Pohick Creek near Warren Road at Accotink, Virginia				
Hardness	4	20	22	24
Aluminum	4	120	265	640
Antimony	4	<5.0	<5.0	<5.0
Arsenic	4	<3.0	<3.0	<3.0
Barium	4	110	160	190
Beryllium	4	0.64	<2.0	<2.0
Cadmium	4	<2.0	<2.0	<2.0
Calcium	4	3,500	3,600	4,000
Chromium	4	0.82	0.93	1
Cobalt	4	4.8	5.15	6.2
Copper	4	1.2	1.4	2.9
Cyanide	4	0.008	<0.050	<0.050
Iron	4	530	830	1,000
Lead	4	0.51	0.61	<2.0
Magnesium	4	2,500	2,800	2,900
Manganese	4	31	33	58
Mercury	4	<0.20	<0.20	<0.20
Molybdenum	4	<10	<10	<10
Nickel	4	2.4	7.1	8.4
Potassium	4	3,000	4,350	4,600
Selenium	4	<10	<10	<10
Silver	4	<3.0	<3.0	<3.0
Sodium	4	8,600	10,450	12,000
Thallium	4	0.46	<4.0	<4.0
Vanadium	4	6.3	<8.0	<8.0
Zinc	4	11	16.5	19
Site 4: 0165545242 Tributary to Pohick Creek at Pohick Neck near Lorton, Virginia				
Hardness	4	8	8	12
Aluminum	4	85	140	360
Antimony	4	<5.0	<5.0	<5.0
Arsenic	4	<3.0	<3.0	<3.0
Barium	4	36	38	41
Beryllium	4	0.5	0.75	<2.0
Cadmium	4	<2.0	<2.0	<2.0
Calcium	4	1,200	1,600	3,300
Chromium	4	0.98	2.4	<20
Cobalt	4	0.33	0.56	0.68
Copper	4	1	2.6	<10
Cyanide	4	0.008	<0.050	<0.050
Iron	4	250	380	430
Lead	4	<2.0	<2.0	<2.0
Magnesium	4	730	955	1,700
Manganese	4	30	50	62
Mercury	4	<0.20	<0.20	<0.20
Molybdenum	4	<10	<10	<10
Nickel	4	1.3	1.9	<20
Potassium	4	1,400	1,500	1,700
Selenium	4	<10	<10	<10
Silver	4	<3.0	<3.0	<3.0
Sodium	4	1,700	2,350	2,600
Thallium	4	<4.0	<4.0	<4.0
Vanadium	4	2.8	5.4	<8.0
Zinc	4	5	6.4	<100

Table 5. Summary of whole-water chemical constituent concentrations in stream water in Fort Belvoir, Virginia.—Continued

[N, number of samples; concentrations in micrograms per liter, except for cyanide, which is in milligrams per liter; <, less than; n.a., not applicable; HWY, highway]

Constituent	N	Minimum	Median	Maximum
Site 5: 0165387125 Tributary to Potomac River near Jadwin Road at Accotink, Virginia				
Hardness	4	36	40	88
Aluminum	4	21	60	440
Antimony	4	0.6	<5.0	<5.0
Arsenic	4	<3.0	<3.0	<3.0
Barium	4	53	94	110
Beryllium	4	<2.0	<2.0	<2.0
Cadmium	4	<2.0	<2.0	<2.0
Calcium	4	6,200	7,950	24,000
Chromium	4	0.99	<20	<20
Cobalt	4	0.95	1.5	2.9
Copper	4	1.2	<10	<10
Cyanide	4	0.007	<0.050	<0.050
Iron	4	130	370	<400
Lead	4	0.55	<2.0	<2.0
Magnesium	4	4,000	4,300	6,100
Manganese	4	7.5	16.5	24
Mercury	4	<0.20	<0.20	<0.20
Molybdenum	4	<10	<10	<10
Nickel	4	2.2	4.1	<20
Potassium	4	2,200	3,150	4,500
Selenium	4	<10	<10	<10
Silver	4	<3.0	<3.0	<3.0
Sodium	4	20,000	20,500	35,000
Thallium	4	<4.0	<4.0	<4.0
Vanadium	4	3	4.8	<8.0
Zinc	4	8.4	9.6	<100
Site 6: 0165516905 Tributary to Accotink Creek above Poe Road at Accotink, Virginia				
Hardness	1	n.a.	12	n.a.
Aluminum	1	n.a.	840	n.a.
Antimony	1	n.a.	<5.0	n.a.
Arsenic	1	n.a.	<3.0	n.a.
Barium	1	n.a.	21	n.a.
Beryllium	1	n.a.	<2.0	n.a.
Cadmium	1	n.a.	<2.0	n.a.
Calcium	1	n.a.	2,300	n.a.
Chromium	1	n.a.	0.95	n.a.
Cobalt	1	n.a.	<10	n.a.
Copper	1	n.a.	5.3	n.a.
Cyanide	1	n.a.	<0.050	n.a.
Iron	1	n.a.	540	n.a.
Lead	1	n.a.	1	n.a.
Magnesium	1	n.a.	1,000	n.a.
Manganese	1	n.a.	11	n.a.
Mercury	1	n.a.	<0.20	n.a.
Molybdenum	1	n.a.	<10	n.a.
Nickel	1	n.a.	<20	n.a.
Potassium	1	n.a.	1,300	n.a.
Selenium	1	n.a.	<10	n.a.
Silver	1	n.a.	<3.0	n.a.
Sodium	1	n.a.	1,000	n.a.
Thallium	1	n.a.	<4.0	n.a.
Vanadium	1	n.a.	3.6	n.a.
Zinc	1	n.a.	23	n.a.
Site 7: 0165517575 Tributary to Accotink Creek above Gunston Road at Accotink, Virginia				
Hardness	1	n.a.	64	n.a.
Aluminum	1	n.a.	89	n.a.
Antimony	1	n.a.	<5.0	n.a.
Arsenic	1	n.a.	<3.0	n.a.
Barium	1	n.a.	47	n.a.
Beryllium	1	n.a.	<2.0	n.a.
Cadmium	1	n.a.	<2.0	n.a.
Calcium	1	n.a.	15,000	n.a.
Chromium	1	n.a.	0.88	n.a.
Cobalt	1	n.a.	0.3	n.a.
Copper	1	n.a.	<10	n.a.
Cyanide	1	n.a.	0.014	n.a.
Iron	1	n.a.	<400	n.a.
Lead	1	n.a.	<2.0	n.a.
Magnesium	1	n.a.	4,300	n.a.
Manganese	1	n.a.	16	n.a.
Mercury	1	n.a.	<0.20	n.a.
Molybdenum	1	n.a.	<10	n.a.
Nickel	1	n.a.	<20	n.a.
Potassium	1	n.a.	2,700	n.a.
Selenium	1	n.a.	<10	n.a.
Silver	1	n.a.	<3.0	n.a.
Sodium	1	n.a.	85,000	n.a.
Thallium	1	n.a.	0.43	n.a.
Vanadium	1	n.a.	<8.0	n.a.
Zinc	1	n.a.	8.4	n.a.
Site 8: 0165379148 Tributary to Dogue Creek at Kingman Road at Accotink, Virginia				
Hardness	1	n.a.	8	n.a.
Aluminum	1	n.a.	240	n.a.
Antimony	1	n.a.	<5.0	n.a.
Arsenic	1	n.a.	<3.0	n.a.
Barium	1	n.a.	39	n.a.
Beryllium	1	n.a.	<2.0	n.a.
Cadmium	1	n.a.	<2.0	n.a.
Calcium	1	n.a.	1,200	n.a.
Chromium	1	n.a.	1.4	n.a.
Cobalt	1	n.a.	4.7	n.a.
Copper	1	n.a.	2	n.a.
Cyanide	1	n.a.	<0.050	n.a.
Iron	1	n.a.	420	n.a.
Lead	1	n.a.	<2.0	n.a.
Magnesium	1	n.a.	1,500	n.a.
Manganese	1	n.a.	240	n.a.
Mercury	1	n.a.	<0.20	n.a.
Molybdenum	1	n.a.	<10	n.a.
Nickel	1	n.a.	<20	n.a.
Potassium	1	n.a.	840	n.a.
Selenium	1	n.a.	<10	n.a.
Silver	1	n.a.	<3.0	n.a.
Sodium	1	n.a.	2,700	n.a.
Thallium	1	n.a.	<4.0	n.a.
Vanadium	1	n.a.	<8.0	n.a.
Zinc	1	n.a.	18	n.a.

Table 5. Summary of whole-water chemical constituent concentrations in stream water in Fort Belvoir, Virginia.—Continued

[N, number of samples; concentrations in micrograms per liter, except for cyanide, which is in milligrams per liter; <, less than; n.a., not applicable; HWY, highway]

Constituent	N	Minimum	Median	Maximum
Site 9: 0165501562 Tributary to Accotink Creek above Barta Road near Newington, Virginia				
Hardness	3	16	16	20
Aluminum	3	170	180	330
Antimony	3	0.4	<5.0	<5.0
Arsenic	3	<3.0	<3.0	<3.0
Barium	3	49	55	61
Beryllium	3	0.5	<2.0	<2.0
Cadmium	3	<2.0	<2.0	<2.0
Calcium	3	3,200	3,300	4,100
Chromium	3	0.81	1.2	<20
Cobalt	3	0.96	1.4	2.5
Copper	3	1	<10	<10
Cyanide	3	0.01	<0.050	<0.050
Iron	3	380	1,200	2,000
Lead	3	0.58	<2.0	<2.0
Magnesium	3	1,200	1,200	1,500
Manganese	3	130	240	550
Mercury	3	<0.20	<0.20	<0.20
Molybdenum	3	<10	<10	<10
Nickel	3	<20	<20	<20
Potassium	3	1,200	1,200	1,500
Selenium	3	<10	<10	<10
Silver	3	<3.0	<3.0	<3.0
Sodium	3	9,300	9,600	30,000
Thallium	3	<4.0	<4.0	<4.0
Vanadium	3	2.7	5.1	<8.0
Zinc	3	6.4	11	<100
Site 10: 01654929 Tributary to Accotink Creek near Beechwood Drive near Newington, Virginia				
Hardness	3	16	20	20
Aluminum	3	170	190	390
Antimony	3	0.5	<5.0	<5.0
Arsenic	3	<3.0	<3.0	<3.0
Barium	3	24	25	27
Beryllium	3	<2.0	<2.0	<2.0
Cadmium	3	<2.0	<2.0	<2.0
Calcium	3	2,900	4,000	4,100
Chromium	3	1	<20	<20
Cobalt	3	0.42	0.60	1.1
Copper	3	1.7	<10	<10
Cyanide	3	0.009	<0.050	<0.050
Iron	3	370	780	840
Lead	3	0.52	<2.0	<2.0
Magnesium	3	1,100	1,100	1,100
Manganese	3	49	120	210
Mercury	3	<0.20	<0.20	<0.20
Molybdenum	3	<10	<10	<10
Nickel	3	<20	<20	<20
Potassium	3	980	1,200	1,200
Selenium	3	<10	<10	<10
Silver	3	<3.0	<3.0	<3.0
Sodium	3	6,000	7,000	7,300
Thallium	3	<4.0	<4.0	<4.0
Vanadium	3	3	5.3	<8.0
Zinc	3	5.6	7.2	12

Constituent	N	Minimum	Median	Maximum
Site 11: 0165516637 Tributary to Accotink Creek near Kingman Road at Fort Belvoir, Virginia				
Hardness	3	16	16	20
Aluminum	3	150	210	240
Antimony	3	0.5	<5.0	<5.0
Arsenic	3	<3.0	<3.0	<3.0
Barium	3	73	100	110
Beryllium	3	0.5	0.9	<2.0
Cadmium	3	<2.0	<2.0	<2.0
Calcium	3	2,300	2,300	2,800
Chromium	3	0.92	1.1	<20
Cobalt	3	1.7	2.4	3.4
Copper	3	1.4	<10	<10
Cyanide	3	0.009	<0.050	<0.050
Iron	3	100	130	140
Lead	3	<2.0	<2.0	<2.0
Magnesium	3	1,800	2,000	2,000
Manganese	3	120	150	190
Mercury	3	<0.20	<0.20	<0.20
Molybdenum	3	<10	<10	<10
Nickel	3	2.5	<20	<20
Potassium	3	2,100	2,200	2,400
Selenium	3	<10	<10	<10
Silver	3	<3.0	<3.0	<3.0
Sodium	3	4,600	4,900	5,100
Thallium	3	<4.0	<4.0	<4.0
Vanadium	3	4.2	<8.0	<8.0
Zinc	3	8.7	9.9	14
Site 12: 01654852 Accotink Creek above Barta Road near Newington, Virginia				
Hardness	4	64	78	84
Aluminum	4	35	62	890
Antimony	4	0.5	<5.0	<5.0
Arsenic	4	<3.0	<3.0	<3.0
Barium	4	31	32	40
Beryllium	4	<2.0	<2.0	<2.0
Cadmium	4	<2.0	<2.0	<2.0
Calcium	4	14,000	17,000	19,000
Chromium	4	0.77	1.4	<20
Cobalt	4	0.84	<10	<10
Copper	4	2.1	2.9	<10
Cyanide	4	0.007	<0.050	<0.050
Iron	4	240	410	1,100
Lead	4	1.2	<2.0	<2.0
Magnesium	4	5,600	6,350	7,700
Manganese	4	45	94	140
Mercury	4	<0.20	<0.20	<0.20
Molybdenum	4	2.5	<10	<10
Nickel	4	1.6	<20	<20
Potassium	4	2,100	2,450	2,700
Selenium	4	<10	<10	<10
Silver	4	0.69	<3.0	<3.0
Sodium	4	22,000	24,000	130,000
Thallium	4	0.36	0.38	<4.0
Vanadium	4	<0.80	6.6	<8.0
Zinc	4	18	<100	<100

Table 5. Summary of whole-water chemical constituent concentrations in stream water in Fort Belvoir, Virginia.—Continued

[N, number of samples; concentrations in micrograms per liter, except for cyanide, which is in milligrams per liter; <, less than; n.a., not applicable; HWY, highway]

Constituent	N	Minimum	Median	Maximum
Site 13: 0165505816 Field Lark Branch above Barta Road near Newington, Virginia				
Hardness	3	32	40	52
Aluminum	3	5.7	74	76
Antimony	3	<5.0	<5.0	<5.0
Arsenic	3	<0.3	<3.0	<3.0
Barium	3	9.4	74	97
Beryllium	3	<0.20	<2.0	<2.0
Cadmium	3	<0.20	<2.0	<2.0
Calcium	3	6,700	8,200	8,500
Chromium	3	1.2	<20	<20
Cobalt	3	0.31	1.0	2.1
Copper	3	<1.0	1.1	<10
Cyanide	3	0.007	<0.050	<0.050
Iron	3	410	620	3,200
Lead	3	<0.20	<2.0	<2.0
Magnesium	3	300	3,100	3,200
Manganese	3	86	190	240
Mercury	3	<0.20	<0.20	<0.20
Molybdenum	3	<10	<10	<10
Nickel	3	0.09	<20	<20
Potassium	3	2,200	2,300	2,400
Selenium	3	<1.0	<10	<10
Silver	3	<0.30	0.72	<3.0
Sodium	3	9,800	12,000	12,000
Thallium	3	<0.40	0.45	<4.0
Vanadium	3	<0.80	6.6	<8.0
Zinc	3	1.9	14	26

Constituent	N	Minimum	Median	Maximum
Site 14: 01655170 Accotink Cr at HWY 1 at Accotink, Virginia				
Hardness	2	72	n.a.	72
Aluminum	2	53	n.a.	56
Antimony	2	0.4	n.a.	<5.0
Arsenic	2	<3.0	n.a.	<3.0
Barium	2	40	n.a.	48
Beryllium	2	<2.0	n.a.	<2.0
Cadmium	2	<2.0	n.a.	<2.0
Calcium	2	16,000	n.a.	17,000
Chromium	2	1	n.a.	<20
Cobalt	2	0.31	n.a.	0.48
Copper	2	3.1	n.a.	<10
Cyanide	2	0.007	n.a.	0.007
Iron	2	340	n.a.	350
Lead	2	<0.20	n.a.	<0.20
Magnesium	2	6,300	n.a.	6,400
Manganese	2	52	n.a.	87
Mercury	2	<0.20	n.a.	<0.20
Molybdenum	2	<10	n.a.	<10
Nickel	2	1.7	n.a.	<0.20
Potassium	2	2,700	n.a.	2,700
Selenium	2	<10	n.a.	<10
Silver	2	<3.0	n.a.	<3.0
Sodium	2	25,000	n.a.	25,000
Thallium	2	<4.0	n.a.	<4.0
Vanadium	2	5.3	n.a	6.6
Zinc	2	4.9	n.a.	<100

Table 6. Summary of dissolved chemical constituent concentrations in stream water in Fort Belvoir, Virginia.

[N, number of samples; concentrations in micrograms per liter; n.a., not applicable; <, less than; HWY, highway]

Constituent	N	Minimum	Median	Maximum
Site 1: 0165545630 Tributary to Accotink Creek near Morrow Road at Accotink, Virginia				
Aluminum	1	n.a.	56	n.a.
Antimony	1	n.a.	<5.0	n.a.
Arsenic	1	n.a.	<3.0	n.a.
Barium	1	n.a.	39	n.a.
Beryllium	1	n.a.	<2.0	n.a.
Cadmium	1	n.a.	<2.0	n.a.
Calcium	1	n.a.	11,000	n.a.
Chromium	1	n.a.	<20	n.a.
Cobalt	1	n.a.	<10	n.a.
Copper	1	n.a.	<10	n.a.
Iron	1	n.a.	<300	n.a.
Lead	1	n.a.	<2.0	n.a.
Magnesium	1	n.a.	2,800	n.a.
Manganese	1	n.a.	2.9	n.a.
Mercury	1	n.a.	<0.20	n.a.
Molybdenum	1	n.a.	<10	n.a.
Nickel	1	n.a.	<20	n.a.
Potassium	1	n.a.	2,300	n.a.
Selenium	1	n.a.	<10	n.a.
Silver	1	n.a.	<3.0	n.a.
Sodium	1	n.a.	17,000	n.a.
Thallium	1	n.a.	<4.0	n.a.
Vanadium	1	n.a.	<8.0	n.a.
Zinc	1	n.a.	<100	n.a.
Site 2: 0165545746 Tributary to Accotink Creek near Totten Road at Accotink, Virginia				
Aluminum	3	18	36	45
Antimony	3	0.22	1.3	<5.0
Arsenic	3	0.29	<1.5	<3.0
Barium	3	45	54	61
Beryllium	3	0.06	<1.0	<2.0
Cadmium	3	0.11	<1.0	<2.0
Calcium	3	9,900	11,000	12,000
Chromium	3	<2.0	<10	<20
Cobalt	3	2.7	2.8	3.6
Copper	3	1.2	1.9	2.1
Iron	3	100	<300	<300
Lead	3	0.11	0.26	<2.0
Magnesium	3	2,900	3,200	3,300
Manganese	3	27	65	100
Mercury	3	<0.20	<0.20	<0.20
Molybdenum	3	0.15	<5.0	<10
Nickel	3	1.9	2.6	<20
Potassium	3	2,500	2,800	3,200
Selenium	3	<1.0	<5.0	<10
Silver	3	0.18	<1.5	<3.0
Sodium	3	19,000	21,000	23,000
Thallium	3	0.16	0.2	<4.0
Vanadium	3	0.3	<4.0	<8.0
Zinc	3	5.5	10	13

Constituent	N	Minimum	Median	Maximum
Site 3: 01655517802 Tributary to Pohick Creek near Warren Road at Accotink, Virginia				
Aluminum	4	0.456	0.456	0.456
Antimony	4	0.17	2.4	8
Arsenic	4	0.27	<1.5	<3.0
Barium	4	100	155	180
Beryllium	4	0.22	0.43	<2.0
Cadmium	4	0.11	<1.0	<2.0
Calcium	4	3,200	3,850	4,200
Chromium	4	<2.0	<10	<20
Cobalt	4	4.6	5	5.6
Copper	4	0.95	1.2	1.5
Iron	4	140	210	380
Lead	4	0.098	<1.0	<2.0
Magnesium	4	2,500	2,700	3,200
Manganese	4	26	6.2	6.9
Mercury	4	<0.20	<0.20	<0.20
Molybdenum	4	<1.0	<5.0	<10
Nickel	4	2.7	6.2	6.9
Potassium	4	3,000	4,250	5,200
Selenium	4	<1.0	2	<10
Silver	4	0.15	0.78	<1.5
Sodium	4	8,700	10,500	13,000
Thallium	4	0.05	<2.0	<4.0
Vanadium	4	<0.80	<4.0	<8.0
Zinc	4	15	16.5	19
Site 4: 0165545242 Tributary to Pohick Creek at Pohick Neck near Lorton, Virginia				
Aluminum	4	33	43	92
Antimony	4	0.16	0.54	<5.0
Arsenic	4	0.2	<1.5	<3.0
Barium	4	33	34.5	40
Beryllium	4	0.07	0.42	<2.0
Cadmium	4	<0.20	<1.0	<2.0
Calcium	4	830	1,550	3,500
Chromium	4	0.12	<10	<20
Cobalt	4	0.36	0.50	0.59
Copper	4	1	1.5	<10
Iron	4	130	180	<300
Lead	4	0.078	<1.0	<2.0
Magnesium	4	810	925	1,500
Manganese	4	27	41	54
Mercury	4	<0.20	<0.20	<0.20
Molybdenum	4	<1.0	<5.0	<10
Nickel	4	0.74	0.82	<20
Potassium	4	1,500	1,700	1,900
Selenium	4	0.4	<5.0	<10
Silver	4	0.11	<1.5	<3.0
Sodium	4	1,900	2,250	2,900
Thallium	4	<0.40	<2.0	<4.0
Vanadium	4	0.4	<4.0	<8.0
Zinc	4	2.3	4.65	7.1

Table 6. Summary of dissolved chemical constituent concentrations in stream water in Fort Belvoir, Virginia.—Continued

[N, number of samples; concentrations in micrograms per liter; n.a., not applicable; <, less than; HWY, highway]

Constituent	N	Minimum	Median	Maximum
Site 5: 0165387125 Tributary to Potomac River near Jadwin Road at Accotink, Virginia				
Aluminum	4	38	47	<100
Antimony	4	0.15	1.7	<5.0
Arsenic	4	0.23	<1.5	<3.0
Barium	4	52	83	110
Beryllium	4	0.07	0.37	<2.0
Cadmium	4	0.07	<1.0	<2.0
Calcium	4	6,600	8,000	25,000
Chromium	4	<2.0	<10	<20
Cobalt	4	0.62	1.5	2.8
Copper	4	1.1	1.6	<10
Iron	4	70	<300	<300
Lead	4	0.052	<1.0	<2.0
Magnesium	4	3,400	4,400	6,400
Manganese	4	5.3	14	23
Mercury	4	<0.20	<0.20	<0.20
Molybdenum	4	0.99	<5.0	<10
Nickel	4	1	2.5	4.2
Potassium	4	2,400	3,450	5,141
Selenium	4	<1.0	2.8	<10
Silver	4	0.10	<1.5	<3.0
Sodium	4	19,000	21,000	37,000
Thallium	4	0.06	<2.0	<4.0
Vanadium	4	0.36	<4.0	<8.0
Zinc	4	2.6	7.4	9
Site 6: 0165516905 Tributary to Accotink Creek above Poe Road at Accotink, Virginia				
Aluminum	1	n.a.	290	n.a.
Antimony	1	n.a.	0.64	n.a.
Arsenic	1	n.a.	<3.0	n.a.
Barium	1	n.a.	18	n.a.
Beryllium	1	n.a.	<2.0	n.a.
Cadmium	1	n.a.	<2.0	n.a.
Calcium	1	n.a.	2,500	n.a.
Chromium	1	n.a.	<20	n.a.
Cobalt	1	n.a.	<10	n.a.
Copper	1	n.a.	5.2	n.a.
Iron	1	n.a.	90	n.a.
Lead	1	n.a.	0.68	n.a.
Magnesium	1	n.a.	1,000	n.a.
Manganese	1	n.a.	7.5	n.a.
Mercury	1	n.a.	<0.20	n.a.
Molybdenum	1	n.a.	<10	n.a.
Nickel	1	n.a.	<20	n.a.
Potassium	1	n.a.	1,300	n.a.
Selenium	1	n.a.	<10	n.a.
Silver	1	n.a.	<3.0	n.a.
Sodium	1	n.a.	1,300	n.a.
Thallium	1	n.a.	<4.0	n.a.
Vanadium	1	n.a.	<8.0	n.a.
Zinc	1	n.a.	23	n.a.
Site 7: 0165517575 Tributary to Accotink Creek above Gunston Road at Accotink, Virginia				
Aluminum	1	n.a.	69	n.a.
Antimony	1	n.a.	<5.0	n.a.
Arsenic	1	n.a.	<3.0	n.a.
Barium	1	n.a.	44	n.a.
Beryllium	1	n.a.	<2.0	n.a.
Cadmium	1	n.a.	<2.0	n.a.
Calcium	1	n.a.	16,000	n.a.
Chromium	1	n.a.	<20	n.a.
Cobalt	1	n.a.	<10	n.a.
Copper	1	n.a.	<10	n.a.
Iron	1	n.a.	<300	n.a.
Lead	1	n.a.	<2.0	n.a.
Magnesium	1	n.a.	3,800	n.a.
Manganese	1	n.a.	17	n.a.
Mercury	1	n.a.	<0.20	n.a.
Molybdenum	1	n.a.	1.5	n.a.
Nickel	1	n.a.	<20	n.a.
Potassium	1	n.a.	2,700	n.a.
Selenium	1	n.a.	<10	n.a.
Silver	1	n.a.	<3.0	n.a.
Sodium	1	n.a.	72,000	n.a.
Thallium	1	n.a.	<4.0	n.a.
Vanadium	1	n.a.	<8.0	n.a.
Zinc	1	n.a.	11	n.a.
Site 8: 0165379148 Tributary to Dogue Creek at Kingman Road at Accotink, Virginia				
Aluminum	1	n.a.	150	n.a.
Antimony	1	n.a.	<5.0	n.a.
Arsenic	1	n.a.	<3.0	n.a.
Barium	1	n.a.	38	n.a.
Beryllium	1	n.a.	<2.0	n.a.
Cadmium	1	n.a.	<2.0	n.a.
Calcium	1	n.a.	1,500	n.a.
Chromium	1	n.a.	<20	n.a.
Cobalt	1	n.a.	5.1	n.a.
Copper	1	n.a.	2.4	n.a.
Iron	1	n.a.	230	n.a.
Lead	1	n.a.	<2.0	n.a.
Magnesium	1	n.a.	1,500	n.a.
Manganese	1	n.a.	250	n.a.
Mercury	1	n.a.	<0.20	n.a.
Molybdenum	1	n.a.	<10	n.a.
Nickel	1	n.a.	<20	n.a.
Potassium	1	n.a.	1,100	n.a.
Selenium	1	n.a.	<10	n.a.
Silver	1	n.a.	<3.0	n.a.
Sodium	1	n.a.	2,700	n.a.
Thallium	1	n.a.	<4.0	n.a.
Vanadium	1	n.a.	<8.0	n.a.
Zinc	1	n.a.	22	n.a.

Table 6. Summary of dissolved chemical constituent concentrations in stream water in Fort Belvoir, Virginia.—Continued

[N, number of samples; concentrations in micrograms per liter; n.a., not applicable; <, less than; HWY, highway]

Constituent	N	Minimum	Median	Maximum
Site 9: 0165501562 Tributary to Accotink Creek above Barta Road near Newington, Virginia				
Aluminum	3	32	48	110
Antimony	3	0.24	0.37	<5.0
Arsenic	3	0.64	<1.5	<3.0
Barium	3	44	54	54
Beryllium	3	0.1	<1.0	<2.0
Cadmium	3	<0.20	<1.0	<2.0
Calcium	3	3,100	3,500	3,600
Chromium	3	<2.0	<10	<20
Cobalt	3	0.97	1.5	2.3
Copper	3	0.46	<5.0	<10
Iron	3	280	780	1,100
Lead	3	0.17	<1.0	<2.0
Magnesium	3	880	1,200	1,400
Manganese	3	130	230	510
Mercury	3	<0.20	<0.20	<0.20
Molybdenum	3	<1.0	<5.0	<10
Nickel	3	0.65	0.92	<20
Potassium	3	1,300	1,400	1,500
Selenium	3	<1.0	<5.0	<10
Silver	3	0.31	<1.5	<3.0
Sodium	3	7,800	9,900	27,000
Thallium	3	<0.40	<2.0	<4.0
Vanadium	3	0.35	<4.0	<8.0
Zinc	3	2.8	3.4	12
Site 10: 01654929 Tributary to Accotink Creek near Beechwood Drive near Newington, Virginia				
Aluminum	3	36	42	120
Antimony	3	0.23	0.32	<5.0
Arsenic	3	0.41	<1.5	<3.0
Barium	3	20	22	24
Beryllium	3	<0.20	<1.0	<2.0
Cadmium	3	<0.20	<1.0	<2.0
Calcium	3	3,400	3,900	4,000
Chromium	3	<2.0	<10	<20
Cobalt	3	0.49	0.49	1
Copper	3	1	1.7	<10
Iron	3	120	320	330
Lead	3	0.14	<1.0	<2.0
Magnesium	3	910	1,100	1,200
Manganese	3	45	100	210
Mercury	3	<0.20	<0.20	<0.20
Molybdenum	3	<1.0	<5.0	<10
Nickel	3	0.55	0.71	<20
Potassium	3	1,200	1,200	1,600
Selenium	3	0.4	1.6	<10
Silver	3	0.26	<1.5	<3.0
Sodium	3	6,300	7,300	7,400
Thallium	3	<0.40	<2.0	<4.0
Vanadium	3	0.33	<4.0	<8.0
Zinc	3	3.9	4.5	12

Constituent	N	Minimum	Median	Maximum
Site 11: 0165516637 Tributary to Accotink Creek near Kingman Road at Fort Belvoir, Virginia				
Aluminum	3	42	55	97
Antimony	3	0.2	0.26	<5.0
Arsenic	3	<0.30	<1.5	<3.0
Barium	3	70	110	110
Beryllium	3	0.39	0.48	<2.0
Cadmium	3	0.06	<1.0	<2.0
Calcium	3	2,000	2,400	2,900
Chromium	3	0.1	<10	<20
Cobalt	3	1.7	1.9	3.3
Copper	3	1.1	<5.0	<10
Iron	3	<300	<300	<300
Lead	3	0.064	<1.0	<2.0
Magnesium	3	1,700	1,900	2,100
Manganese	3	110	130	180
Mercury	3	<0.20	<0.20	<0.20
Molybdenum	3	<1.0	<5.0	<10
Nickel	3	2.9	3.5	<20
Potassium	3	2,100	2,300	2,900
Selenium	3	0.3	2	<10
Silver	3	0.20	<1.5	<3.0
Sodium	3	4,300	4,500	5,100
Thallium	3	0.05	<2.0	<4.0
Vanadium	3	<0.80	<4.0	<8.0
Zinc	3	9.5	10	11
Site 12: 01654852 Accotink Creek above Barta Road near Newington, Virginia				
Aluminum	4	27	31	130
Antimony	4	0.29	1.3	<5.0
Arsenic	4	0.74	<1.5	<3.0
Barium	4	29	31	34
Beryllium	4	<0.20	0.42	<2.0
Cadmium	4	<0.20	<1.0	<2.0
Calcium	4	15,000	18,000	21,000
Chromium	4	<2.0	<10	<20
Cobalt	4	0.16	0.57	<5.0
Copper	4	1.4	1.6	2
Iron	4	50	180	270
Lead	4	0.1	<1.0	<2.0
Magnesium	4	4,600	6,850	8,100
Manganese	4	39	83	130
Mercury	4	<0.20	<0.20	<0.20
Molybdenum	4	1	<5.0	<10
Nickel	4	0.64	0.72	<20
Potassium	4	2,200	2,950	3,600
Selenium	4	<1.0	1.95	<10
Silver	4	0.25	<1.5	<3.0
Sodium	4	23,000	26,500	98,000
Thallium	4	<0.40	<2.0	<4.0
Vanadium	4	0.63	<4.0	<8.0
Zinc	4	0.8	10	<50

Table 6. Summary of dissolved chemical constituent concentrations in stream water in Fort Belvoir, Virginia.—Continued

[N, number of samples; concentrations in micrograms per liter; n.a., not applicable; <, less than; HWY, highway]

Constituent	N	Minimum	Median	Maximum
Site 13: 0165505816 Field Lark Branch above Barta Road near Newington, Virginia				
Aluminum	3	23	38	75
Antimony	3	0.28	<2.5	<5.0
Arsenic	3	0.46	<1.5	<3.0
Barium	3	65	92	94
Beryllium	3	<0.20	<1.0	<2.0
Cadmium	3	<0.20	<1.0	<2.0
Calcium	3	7,300	8,100	8,800
Chromium	3	<2.0	<10	<20
Cobalt	3	0.91	2	3.1
Copper	3	0.34	<5.0	<10
Iron	3	380	2,700	3,600
Lead	3	0.073	<1.0	<2.0
Magnesium	3	2,700	3,100	3,200
Manganese	3	77	170	230
Mercury	3	<0.20	<0.20	<0.20
Molybdenum	3	<1.0	<5.0	<10
Nickel	3	1.1	1.3	<20
Potassium	3	2,400	2,400	3,000
Selenium	3	<1.0	1.7	<10
Silver	3	0.25	<1.5	<3.0
Sodium	3	9,700	12,000	13,000
Thallium	3	<0.40	<2.0	<4.0
Vanadium	3	<0.80	<4.0	<8.0
Zinc	3	12	20	26

Constituent	N	Minimum	Median	Maximum
Site 14: 01655170 Accotink Creek at HWY 1 at Accotink, Virginia				
Aluminum	2	21	n.a.	29
Antimony	2	0.37	n.a.	1.1
Arsenic	2	0.51	n.a.	<1.5
Barium	2	38	n.a.	48
Beryllium	2	<0.20	n.a.	0.37
Cadmium	2	<0.20	n.a.	<10
Calcium	2	17,000	n.a.	19,000
Chromium	2	<2.0	n.a.	<10
Cobalt	2	0.28	n.a.	0.32
Copper	2	1.2	n.a.	2.1
Iron	2	100	n.a.	130
Lead	2	0.054	n.a.	<1.0
Magnesium	2	6,500	n.a.	7,200
Manganese	2	45	n.a.	83
Mercury	2	<0.20	n.a.	<0.20
Molybdenum	2	0.8	n.a.	<5.0
Nickel	2	0.68	n.a.	1
Potassium	2	3,300	n.a.	4,100
Selenium	2	0.6	n.a.	3.1
Silver	2	0.18	n.a.	<1.5
Sodium	2	26,000	n.a.	30,000
Thallium	2	<0.40	n.a.	<2.0
Vanadium	2	0.46	n.a.	<4.0
Zinc	2	1.3	n.a.	<50

Table 7. Summary of chemical constituent concentrations in streambed sediment in Fort Belvoir, Virginia.

[Concentrations are in milligrams per kilogram; N, number of analyses; n.a., not applicable; <, less than]

Constituent	N	Minimum	Median	Maximum
Aluminum	13	650	2,600	19,000
Antimony	13	<1.5	<1.90	<2.7
Arsenic	13	2.1	n.a.	<4.9
Barium	13	4.8	15	86
Beryllium	13	0.09	0.2	0.7
Cadmium	13	<0.45	n.a.	<0.6
Calcium	13	73	270	980
Chromium	13	0.63	2.8	15
Cobalt	13	0.2	1.9	8.7
Copper	13	1.4	3	22
Cyanide	13	0.4	n.a.	<1.7
Iron	13	1,200	5,000	61,000
Lead	13	0.3	3.4	15
Magnesium	13	45	200	1,000
Manganese	13	21	77	260
Mercury	13	<0.011	0.022	0.1
Molybdenum	13	<0.8	n.a.	0.3
Nickel	13	0.1	2.4	9.8
Potassium	13	160	270	1,400
Selenium	13	0.456	0.456	0.456
Silver	13	<1.7	n.a.	3.1
Sodium	13	2.8	16.5	96
Thallium	13	<3.3	<3.9	<4.9
Vanadium	13	2.1	6.5	30
Zinc	13	0.3	10	40

Table 8. Summary of chemical constituent concentrations in soils in Fort Belvoir, Virginia.

[Concentrations are in milligrams per kilogram except for moisture content, which is in percent; N, number of analyses]

Constituent	N	Minimum	Median	Maximum
Moisture content	109	6	19	59
Aluminum	119	2,200	13,000	41,000
Antimony	116	0.8	4.45	25
Arsenic	104	1.3	2.6	9.2
Barium	119	18	55	160
Beryllium	106	0.1	0.4	3.5
Cadmium	34	0.1	0.2	5.4
Calcium	119	14	200	49,000
Chromium	119	2.5	16	260
Cobalt	118	0.5	4.2	23
Copper	119	2.2	9.1	61
Cyanide	103	0.1	0.3	1.2
Iron	119	2,100	13,000	71,000
Lead	119	2.4	15	790
Magnesium	119	200	990	4,700
Manganese	119	12	100	2,000
Mercury	17	0.1	0.1	0.7
Molybdenum	14	0.1	0.25	1.5
Nickel	119	2.1	8.7	180
Potassium	119	260	800	2,800
Selenium	119	1	2.8	8.3
Silver	119	0.2	1.1	9.3
Sodium	118	0.3	31	140
Thallium	39	0.6	1	n.a.
Vanadium	119	7.4	28	130
Zinc	119	5.9	26	120

Quality-Assurance Results

Stream-Water Samples

In the source-solution blank, the analytes potassium (K), aluminum (Al), barium (Ba), nickel (Ni), silver (Ag), antimony (Sb), and selenium (Se) were detected at values less than the reporting level (RL) for the analyte but greater than the method detection level (MDL). Equipment blanks were processed in the USGS Richmond, Va., Laboratory and submitted for analysis before each sampling trip. The following constituents were detected in at least one of the equipment blanks: Al, Ag, Ba, beryllium (Be), CN^-, copper (Cu), K, manganese (Mn), molybdenum (Mo), Ni, Sb, Se, thorium (Th), and zinc (Zn). Except for K, all constituents were present in concentrations less than the RL but greater than the MDL. Potassium in filtered water was detected in 3 of 4 equipment blanks, with concentrations ranging from 0.12 to 0.89 mg/L. Only the 0.89 mg/L concentration exceeded the RL. This highest detection of K was less than the lowest environmental concentration, reported at 1.1 mg/L. The potential for contamination when K concentrations are low, however, cannot be discounted. Barium was detected in filtered and unfiltered fractions in 3 of 4 equipment blanks. This persistent contamination was well below any environmental concentration reported and unlikely to affect interpretation of the results. Antimony was present in quantifiable amounts in the filtered fraction in 3 of 4 equipment blanks. Although the detections in blanks were less than the RL, ranging from 0.28 to 1.8 µg/L, they span the range of many environmental results, many of which were less than the RL. Caution needs to be exercised in the interpretation of the low-concentration Ba results.

Field blanks were processed with the following samples: Accotink Creek at Hwy 1 at Accotink, Va., on September 19, 2019; Tributary to Accotink Creek near Kingman Rd at Ft Belvoir, Va., on February 15, 2019; Tributary to Accotink Creek near Kingman Road at Ft Belvoir, Va., on May 23, 2019; and Tributary to Pohick Creek at Pohick Neck near Lorton, Va., on July 24, 2019. The following constituents were present in quantifiable concentrations in at least one field blank: Ag, Al, Ba, Be, calcium (Ca), CN^-, Co, chromium (Cr), Cu, K, magnesium (Mg), Mn, sodium (Na), Ni, Sb, Se, and vanadium (V). All constituents were present in concentrations less than the RL but greater than the MDL. The potential for contamination as indicated by these results led to the cessation of "field cleaning" practices, wherein sampling equipment was cleaned in the field at the end of each sampling day for reuse the following day. Instead, a full set of laboratory-cleaned field equipment, enough to sample all sites without field cleaning and reuse, was prepared for each sampling trip. Concentrations in field blanks of filtered and unfiltered Al, filtered Be, unfiltered Cr, unfiltered Ni, filtered and unfiltered Sb, and filtered Se were greater than the environmental concentrations of these constituents. The lowest concentrations of these constituents may have been affected by contamination. Although Se was detected in the unfiltered fraction of one field blank, it was not detected in any environmental samples.

A concurrent replicate sample was processed at Accotink Creek above Barta Road near Newington, Va., on September 18, 2019. A concurrent replicate consists of two samples collected during the same cross-sectional transit and can indicate variability owing to sampling procedures. All replicate values agreed within 13.3 percent RPD except filtered Al (45.4 RPD), filtered Cu (25 RPD), filtered Mo (17.8 RPD), and filtered Sb (37.8 RPD). All comparisons of constituent pairs that resulted in RPDs greater than 15 were for values between the method detection level and the reporting level, a concentration range in which there is increased uncertainty in analytical results. This analytical uncertainty may have contributed to inherent variability, resulting in increased RPD values.

Streambed-Sediment Samples

Chemical composition of stream-bed sediments is inherently uneven, with concentrations affected by depositional environment, flow, and constituent biogeochemistry. The aim of compositing subsamples is to create a sample representative of the stream reach; yet, some inherent variability between samples is unavoidable. Comparison of replicate samples, however, provides an indication of this variability.

Two replicate sample sets were collected during the stream-bed sediment survey from Tributary to Dogue Creek at Kingman Road at Accotink, Va., on July 23, 2019, and from Tributary to Pohick Creek at Pohick Neck near Lorton, Va., on July 24, 2019. At the Dogue Creek tributary site, the replicate sample pair differed by more than 25 percent RPD for seven constituents: Ba (29.9 RPD), Be (35.3 RPD), Cr (35.3 RPD), Cu (30.8 RPD), Mg (37.4 RPD), lead (Pb; 42.1 RPD), and V (31.0 RPD). At the Pohick Creek tributary site the replicate sample pair differed by more than 25 percent RPD for 10 constituents: Al (35.3 RPD), Ba (36.5 RPD), Ca (31.6 RPD), Cr (44.4 RPD), iron (Fe; 34.5 RPD), Mg (49.9 RPD), Ni (54.5 RPD), Se (66.7 RPD), V (41.5 RPD), and Zn (129 RPD). It appears that the Pohick Creek tributary site was more variable in number of constituents and degree of variability than the Dogue Creek tributary site. Fully understanding the sources of variability would require further study.

Soil Samples

Soil replicate samples were collected at two sites, 53T 80 and 53T 90. These soils samples were further divided into depth intervals, 3 samples at 53T 80 and 2 samples at 53T 90, creating a total of five replicate pairs. The samples differed in variability not only by site, but also by depth interval (table 9). Site 53T 80 was sampled at 0.0 to 0.39 ft, 0.39 to 1.31 ft, and 1.31 to 2.95 ft. In the upper soil horizon, only four constituents differed by more than 25 percent RPD. In the next sampled interval, 19 constituents differed by more than 25 percent RPD, with RPD percentages ranging from 27 to 127. In the

Table 9. Comparison of soil replicate samples collected in Fort Belvoir, Virginia, 2019.

[All concentrations are in milligrams per kilogram; ft, foot; RPD, relative percent difference, <, less than; NC, not calculable; M, constituent presence verified but not quantified; bold, highlighted values indicate concentrations that differ by greater than 25 relative percent difference]

Constituent	Station 53T 80									Station 53T 90					
	Depth interval = 0–0.4 ft			Depth interval = 0.4–1.3 ft			Depth interval = 1.3–3.0 ft			Depth interval = 0–0.5 ft			Depth interval = 0.5–1.0 ft		
	Concentration replicate 1	Concentration replicate 2	RPD	Concentration replicate 1	Concentration replicate 2	RPD	Concentration replicate 1	Concentration replicate 2	RPD	Concentration replicate 1	Concentration replicate 2	RPD	Concentration replicate 1	Concentration replicate 2	RPD
Calcium	130	150	14.3	110	81	**30.4**	34	52	**41.9**	810	810	0.0	690	710	2.9
Magnesium	780	850	8.6	900	1,400	**43.5**	1,200	1,300	8.0	2,300	2,800	19.6	2,300	2,700	16.0
Potassium	630	680	7.6	670	1,200	**56.7**	1,200	1,300	8.0	1,000	1,100	9.5	890	1,000	11.6
Sodium	33	35	5.9	29	47	**47.4**	55	54	1.8	21	25	17.4	25	27	7.7
Aluminum	9,700	11,000	12.6	11,000	20,000	**58.1**	33,000	21,000	**44.4**	16,000	21,000	**27.0**	18,000	20,000	10.5
Barium	50	56	11.3	59	88	**39.5**	57	62	8.4	90	110	20.0	100	100	0.0
Beryllium	0.2	0.3	**40.0**	0.3	0.4	**28.6**	0.3	0.4	**28.6**	1	1.3	**26.1**	1.1	1.1	0.0
Cadmium	<0.5	<0.5	NC	<0.4	<0.4	NC	0.1	<0.5	NC	<0.5	<0.5	NC	<0.4	<0.4	NC
Chromium	13	15	14.3	14	27	**63.4**	35	30	15.4	22	29	**27.5**	24	28	15.4
Cobalt	23	19	19.0	11	4.8	**78.5**	2.8	4.2	40.0	12	16	**28.6**	19	17	11.1
Copper	5.4	6	10.5	4.8	9.6	**66.7**	14	12	15.4	14	18	25.0	15	17	12.5
Iron	9,400	11,000	15.7	10,000	26,000	**88.9**	29,000	24,000	18.9	19,000	26,000	**31.1**	21,000	23,000	9.1
Lead	31	32	3.2	13	12	8.0	13	13	0.0	22	21	4.7	18	16	11.8
Manganese	720	800	10.5	500	110	**127.9**	69	90	**26.4**	650	1,000	**42.4**	1,300	960	**30.1**
Mercury	M	M	NC	M	<0.013	NC	M	<0.012	NC	M	M	NC	M	M	NC
Molybdenum	<1.0	<1.0	NC	<0.8	<0.9	NC	<0.9	<1.0	NC	<1.0	<1.1	NC	<0.9	<0.8	NC
Nickel	6	7.8	**26.1**	6.1	9.2	**40.5**	7.9	11	**32.8**	13	19	**37.5**	21	19	10.0
Silver	0.94	1.1	15.7	0.99	2.1	**71.8**	2.8	2.4	15.4	0.89	1.3	**37.4**	1.1	1.3	16.7
Thallium	<3.9	<4.1	NC	<3.4	<3.5	NC	1.2	1.6	**28.6**	<4.2	1	NC	<3.5	<3.2	NC
Vanadium	24	26	8.0	23	44	**62.7**	58	48	18.9	35	45	25.0	38	44	14.6
Zinc	23	25	8.3	24	36	**40.0**	23	31	**29.6**	56	66	16.4	56	60	6.9
Cyanide	0.3	0.4	**28.6**	0.2	0.2	0.0	0.2	0.3	**40.0**	0.4	0.4	0.0	0.6	0.5	18.2
Antimony	25	20	22.2	12	5.3	**77.5**	3.3	5.1	**42.9**	12	17	**34.5**	19	17	11.1
Arsenic	3	2.7	10.5	2.6	4.9	**61.3**	5.2	5.2	0.0	1.8	2.8	**43.5**	2.1	1.7	21.1
Selenium	2.9	2.2	27.5	3.2	4.2	**27.0**	3.9	3.2	19.7	3.7	5.5	**39.1**	3.9	4.6	16.5

deepest sampled interval, 10 constituents differed by more than 25 percent RPD, ranging from 26.4 to 44.4. Site 53T 90 was more variable in the upper soil horizon, with 11 constituents differing by more than 25 percent RPD, than the lower sampled interval, with only one constituent differing by more than 25 percent RPD. These values indicate that a high degree of variability can be expected in Fort Belvoir soils.

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