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Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, Water Year 2018

Data Report 1144

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

Cover. U.S. Geological Survey streamgage at Spruce Brook near North Scituate, Rhode Island; photograph by the U.S. Geological Survey.

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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
ton, short (2,000 lb)	0.9072	metric ton (t)

Datum

Vertical coordinate information is referenced to North American Vertical Datum of 1988 (NAVD 88).

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

Altitude, as used in this report, refers to distance above the vertical datum.

Supplemental Information

Concentrations of constituents in water are given in either milligrams per liter (mg/L) or colony forming units per 100 milliliters (CFU/100 mL).

Loads of constituents in water are given in kilograms (kg), and daily loads are given in grams per day (g/d), kilograms per day (kg/d), kilograms per year (kg/yr), metric tons per year (t/yr), or million colony forming units per day ($CFU \times 10^6/d$).

Yields are given in grams per day per square mile ($g/d/mi^2$), kilograms per day per square mile ($kg/d/mi^2$), kilograms per year per square mile ($kg/yr/mi^2$), metric tons per year per square mile ($t/yr/mi^2$), or million colony forming units per day per square mile ($CFU \times 10^6/d/mi^2$).

Abbreviations

E. coli	*Escherichia coli*
MOVE.1	Maintenance of Variance Extension type 1
NWIS	National Water Information System
PWSB	Providence Water Supply Board
USGS	U.S. Geological Survey
WY	water year

Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, Water Year 2018

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Abstract

As part of a long-term cooperative program to monitor water quality within the Scituate Reservoir drainage area, the U.S. Geological Survey in cooperation with the Providence Water Supply Board collected streamflow and water-quality data at the Scituate Reservoir and tributaries. Streamflow and concentrations of chloride and sodium estimated from records of specific conductance were used to calculate loads of chloride and sodium during water year 2018 (October 1, 2017, through September 30, 2018) for tributaries to the Scituate Reservoir, Rhode Island. Streamflow was measured or estimated by the U.S. Geological Survey following standard methods at 23 streamgages; 14 of these streamgages are equipped with instrumentation capable of continuously monitoring water level, specific conductance, and water temperature. Water-quality samples were collected by the Providence Water Supply Board at 36 sampling stations, which also include the 14 continuous-record streamgages maintained by the U.S. Geological Survey, during water year 2018 as part of a long-term sampling program; all stations are in the Scituate Reservoir drainage area. Water-quality data collected by the Providence Water Supply Board are summarized by using values of central tendency and are used, in combination with measured (or estimated) streamflows, to calculate loads and yields (loads per unit area) of selected water-quality constituents for water year 2018.

The largest tributary to the reservoir, the Ponaganset River, which was monitored by the U.S. Geological Survey, contributed a mean streamflow of 33 cubic feet per second to the reservoir during water year 2018. For the same period, annual mean streamflows measured (or estimated) for the other monitoring stations in this study ranged from about 0.34 to about 20 cubic feet per second. Together, tributaries equipped with instrumentation capable of continuously monitoring specific conductance transported about 3,100 metric tons of chloride and 1,900 metric tons of sodium to the Scituate Reservoir during water year 2018; annual chloride yields for the tributaries ranged from 18 to 140 metric tons per square mile, and annual sodium yields ranged from 12 to 80 metric tons per square mile.

At the stations where water-quality samples were collected by the Providence Water Supply Board, the medians of the median concentrations were 25.8 milligrams per liter for chloride, 0.001 milligram per liter as nitrogen for nitrite, 0.11 milligram per liter as nitrogen for nitrate, 0.04 milligram per liter as phosphate for orthophosphate, 1,200 colony forming units per 100 milliliters for total coliform bacteria, and 10 colony forming units per 100 milliliters for *Escherichia coli* (*E. coli*). The medians of the median daily loads of chloride, nitrite, nitrate, orthophosphate, total coliform, and *E. coli* bacteria were 220 kilograms per day, 15 grams per day, less than 890 grams per day, 360 grams per day, 93,000 million colony forming units per day, and less than 700 million colony forming units per day, respectively. The medians of the median yields of chloride, nitrite, nitrate, orthophosphate, total coliform, and *E. coli* bacteria were 110 kilograms per day per square mile, 5.5 grams per day per square mile, 250 grams per day per square mile, 210 grams per day per square mile, 36,000 million colony forming units per day per square mile, and 410 million colony forming units per day per square mile, respectively.

Introduction

The Scituate Reservoir is the primary source of drinking water for more than 60 percent of the population of Rhode Island. The Scituate Reservoir drainage area consists of six subbasins and covers an area of about 94 square miles in parts of the towns of Cranston, Foster, Glocester, Johnston, and Scituate, Rhode Island (fig. 1). Information about the water quality of the reservoir and its tributaries is important for management of the water supply and for the protection of human health. The Providence Water Supply Board (PWSB), which is the agency responsible for the management and distribution of the Scituate Reservoir water supply, has been monitoring and assessing water quality in the reservoir and reservoir drainage area for more than 60 years.

Since 1993, the U.S. Geological Survey (USGS) has been cooperating with the PWSB and the Rhode Island Department of Environmental Management to measure streamflow in

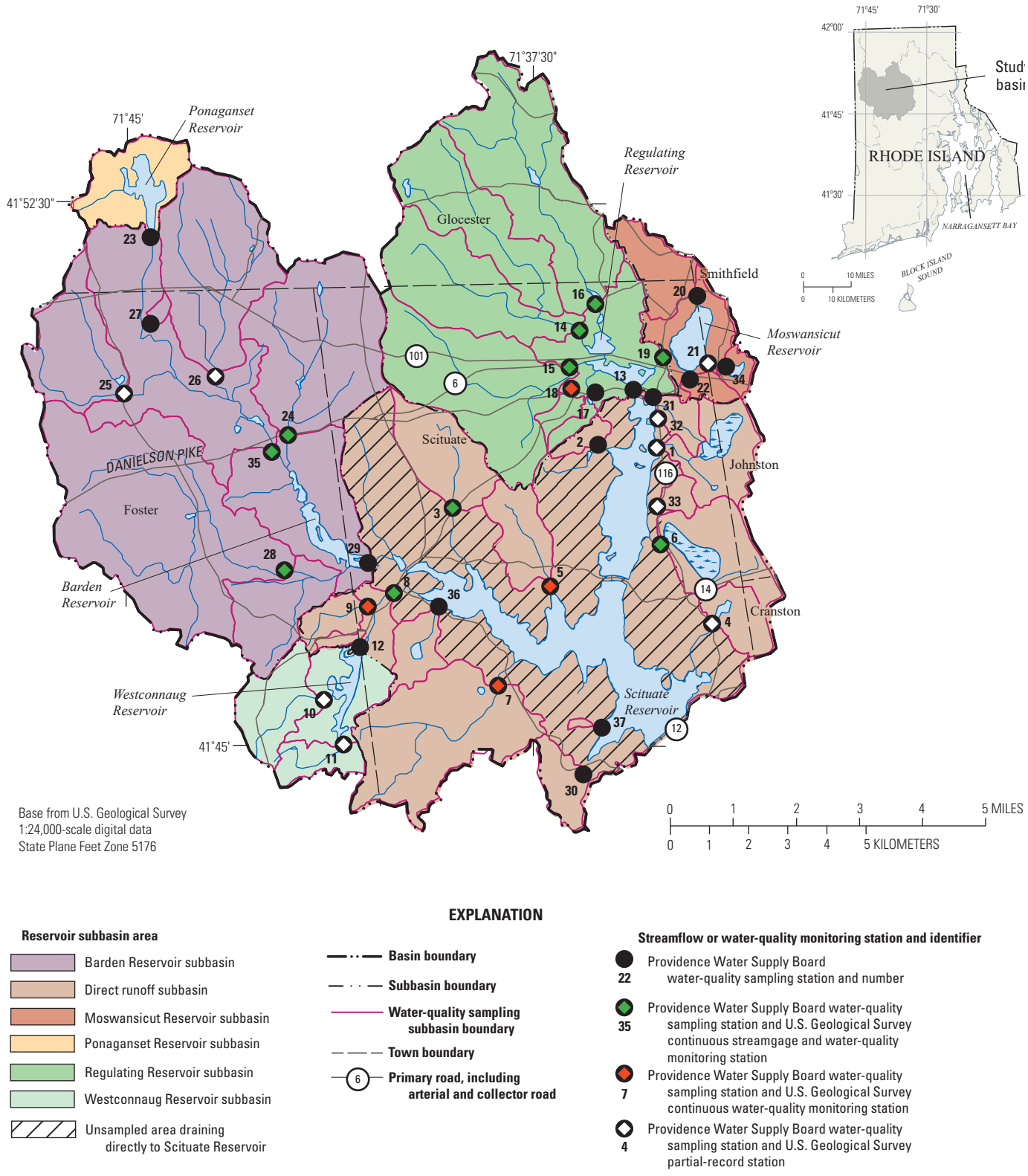

Figure 1. Locations of tributary-reservoir subbasins and stations in the Scituate Reservoir drainage area, Rhode Island, in water year 2018.

tributaries to the Scituate Reservoir. Streamflow has been continuously measured at 10 streamgages in the drainage area (table 1) since 2009 by the USGS. Streamflow also was continuously measured at four streamgages from 2009 to 2014 and periodically measured at nine additional streamgages on tributaries in the drainage area. At the 13 streamgages without continuous flow data, daily mean streamflow has been estimated by using methods developed by the USGS (table 1; Hirsch, 1982). The USGS also has been continuously measuring specific conductance at 14 monitoring stations since 2009 (table 1). Equations that relate specific conductance to concentrations of chloride and sodium in stream water were developed as part of previous cooperative studies of the USGS and the PWSB (Nimiroski and Waldron, 2002; Smith, 2015b, 2018a). These equations, used together with measured (or estimated) streamflows, allow for nearly continuous estimation of chloride and sodium loads to the reservoir.

In 2018, the PWSB regularly, either monthly or quarterly, visited fixed sites on 37 tributaries within the Scituate Reservoir drainage area and collected water-quality samples. Compiled and tabulated streamflow (measured or estimated by the USGS) and water-quality data (collected by the PWSB) have been published in Breault and others (2000), Nimiroski and others (2008), Breault (2010), Breault and Campbell (2010a–d), Breault and Smith (2010), Smith and Breault (2011), and Smith (2013, 2014, 2015a, b, 2016, 2018a–d, 2019a, b, 2021).

This report presents data on streamflow, water quality, and loads and yields of selected constituents for water year (WY)[1] 2018 in the Scituate Reservoir drainage area. These data were collected as part of studies done by the USGS in cooperation with the PWSB and the Rhode Island Department of Environmental Management. A summary of measured and estimated streamflows is presented for the 10 continuous-record and 13 partial-record streamgages in the drainage area. Estimated monthly and annual loads and yields of chloride and sodium are presented for the 14 streamgages at which specific conductance is continuously monitored by the USGS. Summary statistics for water-quality data collected by the PWSB for 36 of the 37 sampling stations (table 1) during WY 2018 also are presented, and these data were used to calculate loads and yields of selected water-quality constituents where flow data were available.

[1]A water year is the period between October 1 and September 30 and is designated by the year in which it ends.

Streamflow Data Collection and Estimation

Streamflow was measured or estimated by the USGS at 23 streamgages (table 1). Measured and estimated streamflows are necessary to estimate water volume and water-quality constituent loads and yields from tributary basins. Stream stage was measured every 10 minutes at most continuous-record streamgages. Streamflow was computed with a stage-discharge relation (known as a rating), which was developed on the basis of periodic manual measurements of streamflow. Daily mean streamflow at a streamgage was calculated by dividing the total volume of water that passed the streamgage each day by 86,400 (the number of seconds in a day). Periodic manual streamflow measurements at partial-record streamgages were used concurrently with continuous-record measurements from streamgages in nearby hydrologically similar drainage areas to estimate a continuous daily record at the partial-record streamgages. Specifically, daily streamflow records for the 13 partial-record sites in the Scituate Reservoir drainage area (table 1) were estimated by using the Maintenance of Variance Extension type 1 (MOVE.1) method, as described by Ries and Friesz (2000) and Smith (2015b); data needed to estimate streamflows at partial-record sites were retrieved from the USGS National Water Information System (NWIS; U.S. Geological Survey, 2020). The upper and lower 90-percent confidence limits for the estimated mean annual streamflows, as described by Tasker and Driver (1988), are listed in table 2. These data indicate that there is a 90-percent chance that the estimated mean annual streamflow is between the upper and lower 90-percent confidence limits.

Continuous-record streamgages were operated and maintained by the USGS during WY 2018 in cooperation with the PWSB (fig. 1; table 1). Streamflow data for these streamgages were collected at 10- or 15-minute intervals (near-real-time streamflow data), were updated at 1-hour intervals on the internet, and are available through the NWIS web interface (U.S. Geological Survey, 2020). Error associated with measured streamflows was generally within about 15 percent as noted in the annual water year summary for each USGS streamgage.

Table 1. Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and specific conductance monitoring in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, to September 30, 2018.

[Alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; mi^2, square mile; QW, water quality; M, monthly; Q, quarterly; Y, yes; N, no; Na, sodium; Cl, chloride; —, none]

PWSB station number	USGS station number	Station name	Drainage area (mi^2)	Frequency of QW sample collection by PWSB	Number of samples collected by PWSB[1]	Daily estimated Na and Cl loads	Streamflow availability	Specific conductance availability
			Barden Reservoir subbasin					
24	01115190	Dolly Cole Brook	4.90	M	11	Y	Continuous	Continuous
25	01115200	Shippee Brook	2.37	Q	2	N	Estimated	None
26	01115185	Windsor Brook	4.33	Q	4	N	Estimated	None
27	011151845	Unnamed tributary to Ponaganset River (unnamed brook B, unnamed brook west of Windsor Brook)	0.10	Q	2	N	None	None
28	01115265	Barden Reservoir (Hemlock Brook)	8.72	M	11	Y	Continuous	Continuous
29	01115271	Ponaganset River (Barden Stream)	33.0	M	11	N	None	None
35	01115187	Ponaganset River	14.0	M	10	Y	Continuous	Continuous
			Direct runoff subbasin					
1	01115180	Brandy Brook	1.57	M	9	N	Estimated	None
2	01115181	Unnamed tributary 2 to Scituate Reservoir (unnamed brook north of Bullhead Brook)	0.22	Q	2	N	None	None
3	01115280	Cork Brook	1.87	M	7	Y	Continuous	Continuous
4	01115400	Kent Brook (Betty Pond Stream)	0.85	M	6	N	Estimated	None
5	01115184	Spruce Brook	1.26	Q	4	Y	Estimated	Continuous
6	01115183	Quonapaug Brook	1.96	M	9	Y	Continuous	Continuous
7	01115297	Wilbur Hollow Brook	4.33	M	8	Y	Estimated	Continuous
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	5.18	M	10	Y	Continuous	Continuous
9	01115275	Bear Tree Brook	0.62	Q	2	Y	Estimated	Continuous
30	01115350	Unnamed tributary 4 to Scituate Reservoir (Coventry Brook, Knight Brook)	0.79	Q	2	N	None	None
31	01115177	Toad Pond	0.03	Q	0	N	None	None
32	01115178	Unnamed tributary 1 to Scituate Reservoir (Pine Swamp Brook)	0.45	Q	2	N	Estimated	None
33	01115182	Unnamed tributary 3 to Scituate Reservoir (Halls Estate Brook)	0.28	Q	2	N	Estimated	None
36	—	Outflow from King Pond	0.76	Q	3	N	None	None
37	—	Fire Tower Stream	0.03	Q	2	N	None	None

Table 1. Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and specific conductance monitoring in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, to September 30, 2018.—Continued

[Alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; mi², square mile; QW, water quality; M, monthly; Q, quarterly; Y, yes; N, no; Na, sodium; Cl, chloride; —, none]

PWSB station number	USGS station number	Station name	Drainage area (mi²)	Frequency of QW sample collection by PWSB	Number of samples collected by PWSB[1]	Daily estimated Na and Cl loads	Streamflow availability	Specific conductance availability
Moswansicut Reservoir subbasin								
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	3.25	M	10	Y	Continuous	Continuous
20	01115160	Unnamed tributary 1 to Moswansicut Reservoir (Blanchard Brook)	1.18	M	9	N	None	None
21	01115165	Unnamed tributary 2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	0.30	Q	2	N	Estimated	None
22	01115167	Moswansicut Reservoir (Moswansicut Stream South)	0.10	M	8	N	None	None
34	01115164	Kimball Stream	0.27	Q	2	N	None	None
Ponaganset Reservoir subbasin								
23	011151843	Ponaganset Reservoir	1.92	M	7	N	None	None
Regulating Reservoir subbasin								
13	01115176	Regulating Reservoir	22.1	M	10	N	None	None
14	01115110	Huntinghouse Brook	6.29	M	5	Y	Continuous	Continuous
15	01115114	Rush Brook	4.70	M	5	Y	Continuous	Continuous
16	01115098	Peeptoad Brook (Harrisdale Brook)	4.97	M	7	Y	Continuous	Continuous
17	01115119	Dexter Pond (Paine Pond)	0.22	Q	3	N	None	None
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	0.28	Q	3	Y	Estimated	Continuous
Westconnaug Reservoir subbasin								
10	01115274	Westconnaug Brook	1.48	M	7	N	Estimated	None
11	01115273	Unnamed tributary to Westconnaug Reservoir (unnamed brook south of Westconnaug Reservoir)	0.72	Q	3	N	Estimated	None
12	011152745	Unnamed tributary to Westconnaug Brook (unnamed brook north of Westconnaug Reservoir)	0.16	Q	3	N	None	None

[1]Not all samples were analyzed for all water-quality properties or constituents.

Table 2. Measured or estimated annual mean streamflow for tributary streams in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.

[Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown on figure 1. USGS, U.S. Geological Survey; ft^3/s, cubic foot per second; $ft^3/s/mi^2$, cubic foot per second per square mile]

PWSB station number	USGS station number	Station name	Annual mean streamflow (ft^3/s)	Upper 90-percent confidence interval (ft^3/s)	Lower 90-percent confidence interval (ft^3/s)	Annual mean streamflow yield ($ft^3/s/mi^2$)
		Barden Reservoir subbasin				
24	01115190	Dolly Cole Brook	9.6	11	8.3	2.0
25	01115200	Shippee Brook	10	33	3.1	4.3
26	01115185	Windsor Brook	13	30	5.9	3.1
28	01115265	Barden Reservoir (Hemlock Brook)	20	24	17	2.3
35	01115187	Ponaganset River	33	37	29	2.4
		Direct runoff subbasin				
1	01115180	Brandy Brook	3.3	6.9	1.5	2.1
3	01115280	Cork Brook	2.7	3.2	2.2	1.4
4	01115400	Kent Brook (Betty Pond Stream)	1.9	8.8	0.43	2.3
5	01115184	Spruce Brook	2.7	6.0	1.2	2.1
6	01115183	Quonapaug Brook	4.4	4.9	3.9	2.3
7	01115297	Wilbur Hollow Brook	9.0	19	4.4	2.1
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	9.5	10	8.7	1.8
9	01115275	Bear Tree Brook	1.7	2.9	1.0	2.7
32	01115178	Unnamed tributary 1 to Scituate Reservoir (Pine Swamp Brook)	0.72	1.4	0.39	1.6
33	01115182	Unnamed tributary 3 to Scituate Reservoir (Halls Estate Brook)	0.34	0.8	0.15	1.2
		Moswansicut Reservoir subbasin				
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	5.8	6.3	5.2	1.8
21	01115165	Unnamed tributary 2 to Moswansicut Reservoir (Blanchard Brook)	0.64	1.4	0.30	2.1
		Regulating Reservoir subbasin				
14	01115110	Huntinghouse Brook	13	15	11	2.0
15	1115114	Rush Brook	8.4	9.7	7.0	1.8
16	01115098	Peeptoad Brook (Harrisdale Brook)	10	12	8.9	2.1
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	0.77	3.4	0.18	2.8
		Westconnaug Reservoir subbasin				
10	01115274	Westconnaug Brook	4.3	10	1.8	2.9

Table 2. Measured or estimated annual mean streamflow for tributary streams in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown on figure 1. USGS, U.S. Geological Survey; ft^3/s, cubic foot per second; $ft^3/s/mi^2$, cubic foot per second per square mile]

PWSB station number	USGS station number	Station name	Annual mean streamflow (ft^3/s)	Upper 90-percent confidence interval (ft^3/s)	Lower 90-percent confidence interval (ft^3/s)	Annual mean streamflow yield ($ft^3/s/mi^2$)
Westconnaug Reservoir subbasin—Continued						
11	01115273	Unnamed tributary to Westconnaug Reservoir (unnamed brook south of Westconnaug Reservoir)	2.4	6.4	0.91	3.3

Water-Quality Data Collection and Analysis

Water-quality data were collected by the USGS and the PWSB. Concentrations of sodium and chloride were estimated by the USGS from continuous records of specific conductance from 14 of the 23 streamgages. Water-quality samples were collected monthly or quarterly at 36 of 37 sampling stations in the Scituate Reservoir drainage area by the PWSB during WY 2018 as part of a long-term sampling program (table 1).

Data Collected by the U.S. Geological Survey

Three or more water-quality samples were collected by the USGS from 14 tributaries equipped with continuous specific conductance monitors in the Scituate Reservoir drainage area (table 1). Samples were collected in the centroid of the streams during the fall, winter, and summer months. Water samples were processed in the USGS New England Water Science Center laboratory in Northborough, Massachusetts, at the conclusion of scheduled sampling. After the processing, the samples were packed in ice and shipped overnight to the USGS National Water Quality Laboratory in Lakewood, Colorado. Analytical results for the USGS water-quality samples are available through the NWIS web interface (U.S. Geological Survey, 2020).

The USGS collected and analyzed continuous-record specific conductance data at 14 streamgages (fig. 1; table 1). Measurements of specific conductance were recorded automatically at 10- or 15-minute intervals at each streamgage. Measurements were made by using an instream probe and standard USGS methods for continuous water-quality monitoring at streams (Wagner and others, 2006). The specific conductance measurement data are available through the NWIS web interface (U.S. Geological Survey, 2020).

Concentrations of chloride and sodium were estimated from continuous measurements of specific conductance by using equations that were developed by the USGS to relate specific conductance to concentrations of chloride and sodium, as follows:

$$C_{Cl}=SPC^{m}\times b \text{ and} \quad (1)$$

$$C_{Na}=SPC^{m}\times b, \quad (2)$$

where

C_{Cl} is the chloride concentration, in milligrams per liter;

C_{Na} is the sodium concentration, in milligrams per liter;

SPC is the specific conductance, in microsiemens per centimeter;

m is the slope from the MOVE.1 analysis (table 3); and

b is the intercept from the MOVE.1 analysis (table 3).

These regression equations were developed by using the MOVE.1 method (also known as the line of organic correlation; Helsel and Hirsch, 2002) on the basis of concurrent measurements of specific conductance (USGS parameter code 90095) along with chloride (USGS parameter code 00940) and sodium (USGS parameter code 00930) concentrations measured in water-quality samples collected by the USGS from tributaries in the Scituate Reservoir drainage area during WY 2000, WY 2005, and WYs 2009–20 (table 3; U.S. Geological Survey, 2020).

MOVE.1 was chosen for regression analysis to maintain variance (Hirsch and Gilroy, 1984). Under some circumstances, specific conductance records were unavailable because a sensor malfunctioned, was affected by debris,

Table 3. Data and regression equation coefficients used to estimate concentrations of chloride and sodium from values of specific conductance for U.S. Geological Survey streamgage stations in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.

[Constituent concentrations and continuous specific conductance available in National Water Information System (U.S. Geological Survey, 2020). Locations of stations are shown in figure 1. U.S. Geological Survey (USGS) parameter codes: specific conductance, 90095; chloride, 00940; sodium, 00930. PWSB, Providence Water Supply Board; <, less than]

PWSB station number	USGS station number	Samples used in analyses		Chloride			Sodium			Amount of specific conductance record unavailable where discharge is greater than zero (percent)
		Sample date range (month/day/year)	Sample count	Slope	Intercept	Standard error of regressions (percent)	Slope	Intercept	Standard error of regressions (percent)	
24	01115190	03/08/2000; 03/29/2005; 01/22/2009 to 01/29/2020	33	1.2568	0.06927	2.3	1.2341	0.04747	4.6	0.1
28	01115265	03/28/2001; 03/30/2005; 01/22/2009 to 01/29/2020	34	1.2272	0.07969	3.4	1.1145	0.08224	5.7	<0.1
35	01115187	03/28/2001; 03/29/2005; 01/22/2009 to 01/14/2020	33	1.0644	0.16539	4.3	1.1690	0.06355	5.4	1.7
3	01115280	03/08/2000; 03/30/2005; 01/22/2009 to 01/14/2020	33	1.2248	0.07611	3.0	1.1018	0.08370	5.0	0.5
5	01115184	03/05/2009 to 01/29/2020	30	1.2604	0.06112	4.0	1.0811	0.08487	4.4	<0.1
6	01115183	03/08/2000; 03/30/2005; 01/22/2009 to 01/28/2020	43	1.1794	0.08455	4.2	1.2057	0.04413	5.9	0.4
7	01115297	03/28/2001; 03/30/2005; 01/22/2009 to 01/14/2020	33	1.0728	0.12410	4.1	0.88661	0.17736	5.8	0.8
8	01115276	01/22/2009 to 01/29/2020	30	1.0995	0.13738	2.9	1.0392	0.11477	3.8	<0.1
9	01115275	03/08/2000; 03/30/2005; 01/22/2009 to 01/29/2020	32	1.0585	0.17773	2.5	1.0720	0.09770	3.4	<0.1
19	01115170	03/08/2000; 03/29/2005; 01/22/2009 to 01/14/2020	39	1.2116	0.07599	2.6	1.2080	0.04599	2.8	<0.1
14	01115110	03/28/2001; 03/29/2005; 01/22/2009 to 01/14/2020	41	1.1225	0.10393	7.1	1.0317	0.09412	7.7	3.2
15	01115114	01/22/2009 to 01/28/2020	47	1.1441	0.11191	2.9	1.0839	0.09260	5.2	0.6
16	01115098	03/28/2001; 03/29/2005; 01/22/2009 to 01/14/2020	34	1.2598	0.05894	4.3	1.0895	0.08335	6.3	<0.1
18	01115120	01/22/2009 to 01/14/2020	26	1.1633	0.09758	2.8	1.1463	0.06160	3.4	<0.1

fouling, or ice, or was not submerged during low flow. In these cases, values of specific conductance were estimated by proportional distribution between recorded values. In general, the period of specific conductance record that was unavailable for each USGS station represents a small fraction of the record period for WY 2018 (table 3).

Data Collected by the Providence Water Supply Board

Water-quality samples were collected by the PWSB at 36 of the 37 fixed stations on tributaries draining to the Scituate Reservoir during WY 2018. Sampling visits typically are conducted monthly at 19 stations and quarterly at another 18 stations (table 1). No quarterly water samples were collected at Toad Pond (PWSB station 31) during WY 2018.

Water-quality samples were not collected during specific weather conditions; instead, a periodic water-quality sampling schedule was followed so that water-quality samples would be representative of various weather conditions. However, sometimes samples could not be collected because tributaries at the sampling stations were dry or frozen. When possible, water-quality samples were collected by dipping the sample bottle into the tributary at the center of flow (Richard Blodgett, PWSB, written commun., 2005). Samples were transported on ice to the PWSB water-quality laboratory at the P.J. Holton Water Purification Plant in Scituate. Water-quality properties and constituent concentrations were measured by using unfiltered water samples. These water-quality properties included pH, alkalinity, color, turbidity, and concentrations of chloride, nitrite, nitrate, orthophosphate, and bacteria (*Escherichia coli* [*E. coli*] and total coliform); these data collected by the PWSB are published in Smith (2021). Analytical methods used for the determination of values or concentrations of pH, color, turbidity, alkalinity, and chloride are documented by Baird and others (2018). Concentrations of nitrite were determined by U.S. Environmental Protection Agency method 353.2 (U.S. Environmental Protection Agency, 1993). Concentrations of nitrate were determined by Standard Method 4500–NO_3 (Holm and others, 2018). Concentrations of orthophosphate were determined by the Hach PhosVer Method (Hach Method 8048; Hach Company, 2000). Standard Method 9223 was used for the determination of concentrations of bacteria (Best and others, 2018).

Water-quality samples were collected by the PWSB during a wide range of flow conditions. The daily mean flow-duration curves for the Hemlock Brook at King Road near Foster (01115265; PWSB station 28) and Windsor Brook at Windsor Road near south Foster (01115185; PWSB station 26) USGS streamgages for WY 2018 are shown in figure 2. The curves represent the percentage of time that each flow duration was equaled or exceeded at the respective stations; the flows at each station on days when water-quality samples were collected are represented by the plotted points superimposed on the curves. At Hemlock Brook, samples were collected at flow durations ranging from the 7.3th percentile to the 93.5th percentile; this range indicates that the water-quality samples collected in WY 2018 represented a wide range of flow conditions during that water year. Samples collected only on a quarterly schedule at Windsor Brook also encompassed a wide range of flow conditions (from the 8.1th percentile to the 88.3th percentile) at this station during WY 2018 (fig. 2).

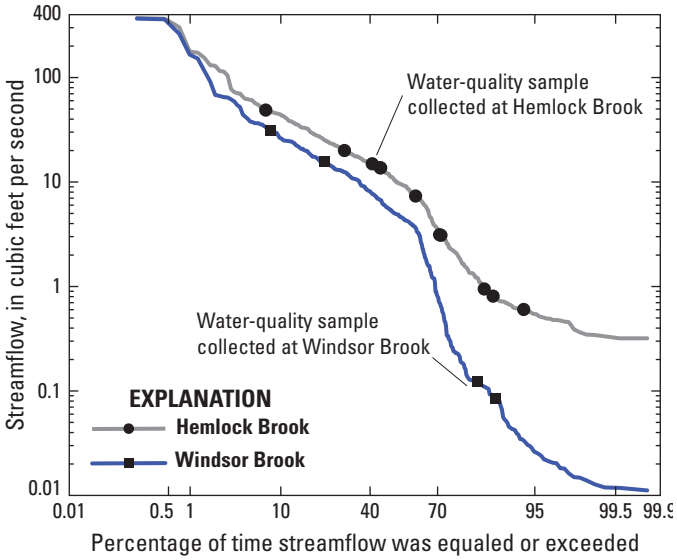

Figure 2. Graph showing flow-duration curves and streamflow on the dates (represented by points) when water-quality samples were collected by the Providence Water Supply Board for the U.S. Geological Survey continuous streamgages on Hemlock Brook at King Road near Foster (01115265) and Windsor Brook at Windsor Road near south Foster, Rhode Island (01115185), for water year 2018. Locations of stations are shown on figure 1.

Estimating Daily, Monthly, and Annual Loads and Yields

Daily, monthly, and annual chloride and sodium loads (in kilograms) were estimated for all streamgages for which continuous-streamflow and specific-conductance data were available for WY 2018. Daily flow-weighted concentrations of chloride and sodium were calculated by multiplying instantaneous flows by concurrent concentrations of chloride and sodium (estimated from measurements of specific conductance) for each day and dividing the sum by the total flow for that day. At the four instrumented monitoring stations, where continuous flow was unavailable (table 1), daily mean concentrations of chloride and sodium were calculated from the daily mean value of specific conductance for each day. The latter method may result in less accurate concentrations because instantaneous measurements of specific conductance may change (decrease or increase) with surface-water runoff; however, the variability of instantaneous measurements of specific conductance at these streamgages was generally small and daily mean values did not differ substantially from daily flow-weighted values estimated during prior water years when instantaneous flow data were available. Daily loads of chloride and sodium were estimated by multiplying daily flow-weighted concentrations of chloride and sodium (in milligrams per liter) by daily discharge (in liters per day). Daily data were summed to estimate monthly or annual loads.

Daily loads of water-quality constituents (in samples collected by the PWSB) were calculated for all sampling dates during WY 2018 (table 4, in back of report) for which periodic- or continuous-streamflow data were available (table 1). These loads were calculated by multiplying constituent concentrations (in milligrams or colony forming units per liter) in single samples by the daily discharge (in liters per day) for the day on which each sample was collected. The flows, which in some cases were estimates, were assumed to be representative of the flow at the time of the sample collection. Loads (in million colony forming units per day, kilograms per day, or grams per day) and yields (in million colony forming units per day per square mile, kilograms per day per square mile, or grams per day per square mile) were calculated for bacteria, chloride, nitrite, nitrate, and orthophosphate. Censored data (concentrations reported as less than method detection limits) were replaced with concentrations equal to one-half the method detection limit.

Streamflow

Monitoring streamflow is a necessary step to measure the volume of water and estimate constituent loads to the Scituate Reservoir. The Ponaganset River is the largest monitored tributary to the Scituate Reservoir. Mean annual streamflow at the streamgage on the Ponaganset River (01115187; PWSB station 35) for the entire period of its operation (mean of the annual mean streamflows for the period of record, WYs 1994–2017) before WY 2018 was about 28 cubic feet per second (ft^3/s; U.S. Geological Survey, 2020). During WY 2018, the annual mean streamflow of 33 ft^3/s was greater (fig. 3) than the long-term median annual streamflows for the period of record. The daily mean streamflow was below the 10th percentile for the daily mean streamflows for the period of record (fig. 3) for parts of October 2017 and May through July 2018; otherwise, the daily mean streamflow often was greater than the median streamflows and for short periods throughout the water year the streamflows exceeded the 90th percentiles of the daily mean streamflows for the period of record. The mean annual streamflow at the Peeptoad Brook streamgage (01115098; PWSB station 16), the other long-term continuous-record streamgage in the Scituate Reservoir drainage area, for the period of record (WYs 1994–2017), before WY 2018 was 10.4 ft^3/s (U.S. Geological Survey, 2020). The annual mean streamflow at the Peeptoad Brook streamgage during WY 2018 was 10.3 ft^3/s, similar to the long-term mean annual streamflow.

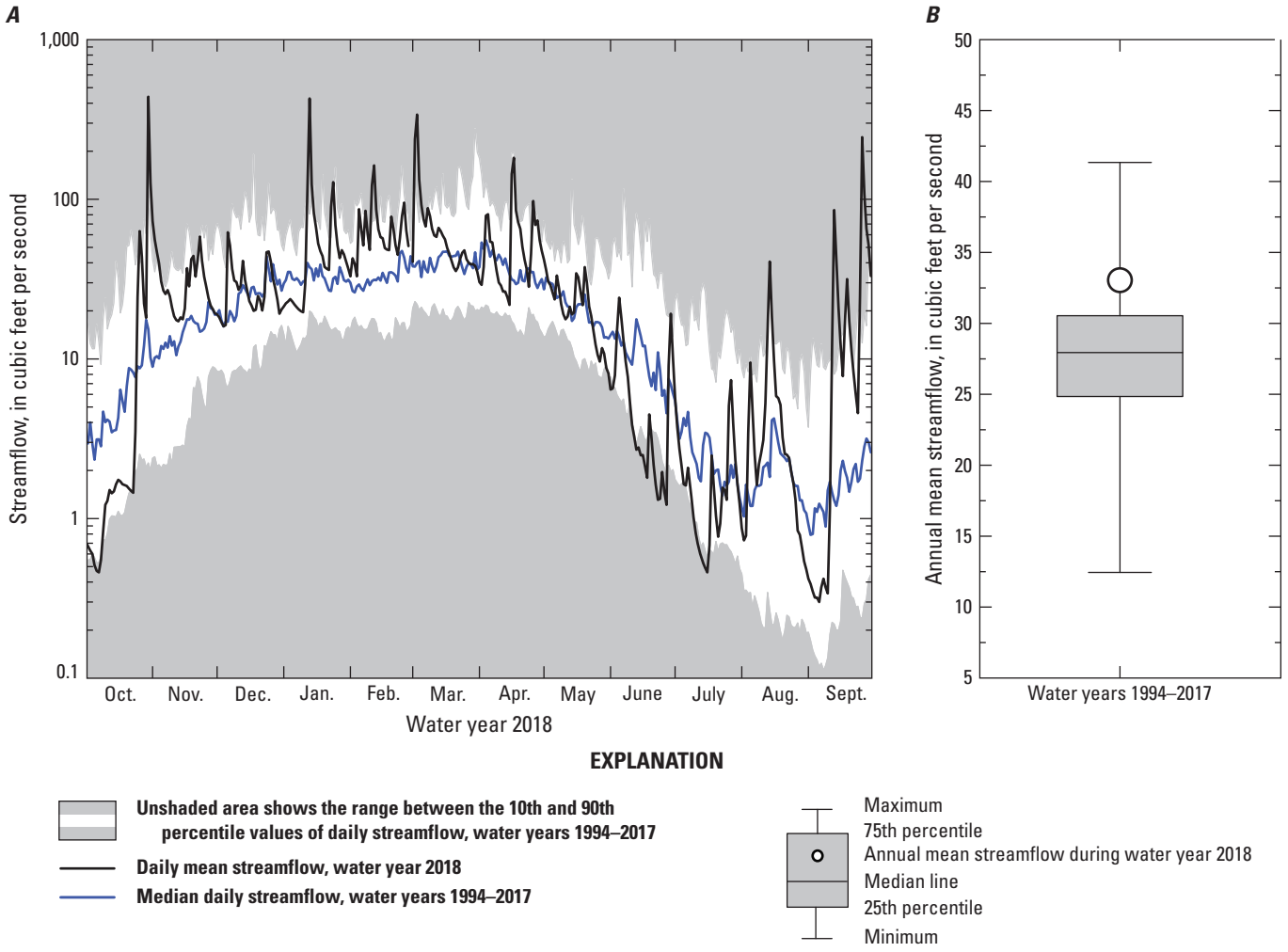

Figure 3. Hydrologic data taken at the U.S. Geological Survey continuous-record streamgage on the Ponaganset river at south Foster (01115187), in the Scituate Reservoir drainage area, Rhode Island; *A*, graph showing measured daily mean streamflow for October 1, 2017, through September 30, 2018, and the 10th percentile, median, and 90th percentile values of daily streamflow for October 1, 1994, through September 30, 2017; and *B*, box plot showing annual mean streamflow during water year 2018 and the distribution of mean annual streamflows for water years 1994–2017. Location of station is shown on figure 1.

Water Quality and Constituent Loads and Yields

Water-quality conditions in the Scituate Reservoir drainage area are described by summary statistics for water-quality properties, constituent concentrations, and estimated constituent loads and yields. Loads and yields measure the rates at which masses of constituents are transferred to the reservoir by tributaries. Tributaries with high flows tend to have high loads because the greater volume of water can carry more of the constituent to the reservoir per unit time than tributaries with low flows. Yield represents the constituent load per unit of drainage area and is calculated by dividing the load estimated for a streamgage by the drainage area for the monitoring station. Yields are useful for comparison among streamgages that have different drainage areas because the basin size and therefore total streamflow volume is normalized. Yields also are useful for examining potential differences among basin properties that may contribute to water quality in the reservoir.

Summary statistics include means and medians. For some purposes, median values are more appropriate because they are less likely to be affected by high or low concentrations (or outliers). Medians are especially important to use for summarizing a relatively limited number of values. In contrast, continuously monitored streamflow and loads of chloride and sodium (estimated from measurements of specific conductance), datasets that include a large number of values, are better summarized in terms of means because large datasets are more resistant to the effects of outliers than small datasets. Mean values also are particularly appropriate for measuring loads because outlier values, which typically represent large flows, are important to include in estimates of constituent masses delivered to receiving waters.

Uncertainties associated with measuring streamflow and specific conductance and with chloride and sodium sample collection, preservation, and analysis produce uncertainties in load and yield estimates. The load and yield estimates presented in the text and tables are the most likely values for chloride and sodium inputs from tributaries or their drainage basins, based on the available data and analysis methods. It may be best to discuss loads and yields in terms of a range within which the true values lie; however, the most likely values of loads and yields are presented for ease of discussion and presentation. The range within which the true values lie depends on the uncertainties in individual measurements of streamflow and concentration, which are difficult to quantify with the available information. The uncertainties associated with streamflow are commonly assumed to affect load and yield calculations more than the errors associated with measuring specific conductance or chemical analysis, and the uncertainties associated with estimated streamflow are greater than those associated with measured streamflow. The most likely values of loads and yields presented in the tables and text are sufficient for planning-level analysis of water quality in tributaries and their drainage basins.

Chloride and Sodium Loads and Yields Estimated from Specific-Conductance Monitoring Data

Chloride and sodium are constituents of special concern in the Scituate Reservoir drainage area; they are major constituents of road salt used for deicing, and several major roadways cross the drainage basin. State Routes 12 and 14 cut across the main body of the reservoir, and Route 116 parallels the eastern limb (fig. 1). Nimiroski and Waldron (2002) indicated that tributaries in basins with State-maintained roads had substantially higher concentrations of chloride and sodium than tributaries in basins with low road density, presumably because of deicing activities. In addition, sodium is a constituent of potential concern for human health; some persons on restricted diets might need to limit intake of sodium.

Estimated monthly mean[2] chloride concentrations in tributaries of the Scituate Reservoir drainage area ranged from 8.1 to 144 milligrams per liter (mg/L), and estimated monthly mean sodium concentrations ranged from 5.6 to 82 mg/L (table 5). The highest monthly mean concentrations of chloride and sodium were estimated to be 144 and 82 mg/L, respectively, at unnamed tributary to Regulating Reservoir (unnamed brook A; 01115120; PWSB station 18) in June 2018. The estimated monthly mean concentrations at most stations were greater during the months of July and August compared with the estimated monthly mean concentrations during the winter months, except concentrations at the station on unnamed brook A, which were greater in June, and at the station on Wilbur Hollow Brook (01115297; PWSB station 7), which also were similar in October. The highest annual mean[3] concentrations of chloride and sodium were estimated to be 60 and 36 mg/L, respectively, at the Moswansicut Reservoir (01115170; PWSB station 19; table 6). The relatively high annual mean concentrations of chloride and sodium at Bear Tree Brook (01115265; PWSB station 9; 51 and 30 mg/L, respectively) are the result of residual chloride and sodium leaching to groundwater from a formerly uncovered salt storage pile (Nimiroski and Waldron, 2002) and comparatively small surface-water flows. Annual mean concentrations of chloride and sodium, ranging from 40 to 57 mg/L and 24 to 33 mg/L, respectively, estimated at the unnamed tributary to the Regulating Reservoir, Rush Brook (01115114; PWSB station 15), and Peeptoad Brook (01115098; PWSB station 16), also were relatively high (table 6). These stations are in the more developed, northeastern part of the Scituate Reservoir drainage area (fig. 1), which also includes the Moswansicut Reservoir.

During WY 2018, the Scituate Reservoir received about 3,100 metric tons (t; about 3,400 short tons) of chloride and 1,900 t (about 2,100 short tons) of sodium from tributaries that are equipped with instrumentation capable of continuously monitoring specific conductance (table 6). The highest chloride and sodium loads in the drainage area during WY 2018 were estimated to be 660 and 410 t, respectively, at the Ponaganset River station (01115187; PWSB station 35; table 6). Monthly estimated chloride and sodium loads were highest in March (table 7), except loads for the station at the Ponaganset River, which were highest in February, and the station at Cork Brook (01115280; PWSB station 3), which were highest in both February and April. From January through April, the sum of the monthly loads of chloride and sodium at each station accounted for between 54 and 80 percent of the annual load at each station and about 63 percent of the annual load for the monitored area in the Scituate Reservoir drainage area. The highest annual chloride and sodium yields were 140 and 80 metric tons per square mile, respectively, measured at unnamed tributary to Regulating Reservoir (unnamed brook A, 01115120; PWSB station 18; table 6). Chloride and sodium yields also were comparatively high at Bear Tree Brook (01115275; PWSB station 9) at 120 and 69 metric tons per square mile, respectively. During WY 2018, estimated annual loads of chloride and sodium at the continuous monitoring stations were greater than the median annual loads for WYs 2009–17 at all stations, and for 4 of the 14 stations, the annual loads were greater than the maximum annual loads for WYs 2009–17 (fig. 4). Estimated annual loads of chloride and sodium for the monitored area in the Scituate Reservoir drainage area during WY 2018 were similar to loads estimated during the previous water year (Smith, 2019a). These estimated annual load values for WYs 2017–18 exceeded prior annual loads since WY 2009 (fig. 5) by 17 to 32 percent.

[2]Monthly mean concentrations were calculated by dividing the total monthly load by the total discharge for the month.

[3]Annual mean concentrations were calculated by dividing the total annual load by the total discharge for the year.

The estimated annual mean yields of chloride and sodium for the drainage areas upstream from the 14 USGS continuous-record streamgages for WY 2018, which represent nearly 66 percent of the Scituate Reservoir drainage area, were 49 and 30 metric tons per year per square mile (t/y/mi^2), respectively. These estimated annual mean yields of chloride and sodium for WY 2018 were similar to yields in WY 2017 (34 and 20 t/y/mi^2, respectively; Smith, 2019a) but higher than those previously estimated since WY 2009 (fig. 5).

Physical and Chemical Properties and Daily Loads and Yields Estimated from Data Collected by the Providence Water Supply Board

Physical and Chemical Properties

Physical and chemical properties, including pH, turbidity, alkalinity, and color, were routinely measured to determine water quality in each of the six subbasins in the Scituate Reservoir drainage area (table 8) by the PWSB. Specifically, pH is a measure of the acidity of the water, color can be an indirect measure of the amount of organic carbon dissolved in the water column, turbidity is an indirect measure of suspended particles, and alkalinity is a measure of the acid-neutralizing capacity of water.

The median pH in tributaries in the Scituate Reservoir drainage area ranged from 5.7 to 6.9; the median of the medians for all stations was 6.3. Median values of color ranged from 15 to 150 platinum cobalt units; the median for all stations was 45 platinum cobalt units. Median values of turbidity ranged from 0.14 to 1.6 nephelometric turbidity units; the median for all stations was 0.61 nephelometric turbidity units. Median alkalinity values in tributaries were low, ranging from 2.7 to 14 mg/L as calcium carbonate ($CaCO_3$); the median for all stations was 4.9 mg/L as $CaCO_3$ (table 8).

Constituent Concentrations and Daily Loads and Yields

Fecal indicator bacteria, chloride, and nutrients such as nitrogen and phosphorus are commonly detected in natural water; at elevated concentrations, these constituents can cause or contribute to water-quality impairments. Fecal indicator bacteria, which are found in the intestines of warm-blooded animals, may indicate impairment from sewage contamination or from livestock or wildlife that defecate in or near the stream margin. Chloride originates in tributary stream water from precipitation, weathering, or human activities such as waste disposal, use of septic systems, and road deicing. Sources of nutrients in tributary stream water include atmospheric deposition, leaching of naturally occurring organic material, discharge of groundwater that is enriched with nutrients from septic-system leachate, and runoff contaminated with fertilizer or animal waste. The ultimate intended use of water in the tributaries is drinking water, which must meet specific water-quality standards. For this reason, the PWSB closely monitors concentrations of these constituents in tributaries. Median concentrations, loads, and yields of water-quality constituents are listed in tables 8 and 9.

Bacteria

Concentrations of total coliform bacteria were detected in water samples collected at all sites (table 8). Uncensored median concentrations of *E. coli* were equal to or greater than 8 colony forming units per 100 milliliters (CFU/100 mL) at 24 of the 36 sampled PWSB stations; however, median concentrations of *E. coli* were censored at different detection limits, all less than 10 CFU/100 mL, at 12 stations. Total coliform bacteria concentrations were greater than *E. coli* concentrations (as expected because total coliform is more inclusive than *E. coli*); the medians of median concentrations for all sites in the drainage area were 1,200 CFU/100 mL for total coliform bacteria and 10 CFU/100 mL for *E. coli* (table 8). Median concentrations of total coliform bacteria were highest at Cork Brook (01115280; PWSB station 3), Wilbur Hollow Brook (01115297; PWSB station 7), and Huntinghouse Brook (01115110; PWSB station 14) at 2,400 CFU/100 mL. Median concentrations of *E. coli* were highest at Quonapaug Brook (01115183; PWSB station 6) at 91 CFU/100 mL. Median concentrations of fecal indicator bacteria were lowest at the Westconnaug Brook (01115276; Westconnaug Reservoir; PWSB station 8).

Median daily loads and yields of total coliform bacteria and *E. coli* varied by about two orders of magnitude; the highest median daily yield of total coliform bacteria at 150,000 million colony forming units per day per square mile (CFU×10^6/d/mi^2) and the highest median daily yield of *E. coli* of 2,400 CFU×10^6/d/mi^2 occurred at the Bear Tree Brook station (01115275; PWSB station 9; table 10). Although relatively high for sampling stations in the Scituate Reservoir subbasin, median daily bacteria yields at Moswansicut Reservoir (01115170; PWSB station 19) were low to moderate for yields of indicator bacteria in sewage-contaminated stream water or stream water affected by stormwater runoff in an urban environment (Breault and others, 2002). The median daily loads of total coliform bacteria for all subbasins in the Scituate Reservoir drainage area ranged from 4,400 to 590,000 million colony forming units per day (CFU×10^6/d), and yields ranged from 12,000 to 150,000 CFU×10^6/d/mi^2; *E. coli* loads ranged from 64 to 5,700 CFU×10^6/d, and yields ranged from 77 to 2,400 CFU×10^6/d/mi^2 (tables 9 and 10).

Table 5. Monthly mean concentrations of chloride and sodium estimated from continuous measurements of specific conductance in the Scituate Reservoir drainage area, Rhode Island, October 1, 2017, through September 30, 2018.

[Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown on figure 1. Monthly mean concentrations were calculated by dividing the monthly load by the total discharge for the month. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; mg/L, milligram per liter; —, not applicable]

PWSB station number	USGS station number	Station name	October		November		December		January		February		March	
			Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)
24	01115190	Dolly Cole Brook	30	19	32	20	35	22	30	18	34	21	31	19
28	01115265	Barden Reservoir (Hemlock Brook)	20	13	24	15	24	15	18	11	22	14	20	12
35	01115187	Ponaganset River	23	15	23	15	23	14	20	12	25	16	21	13
3	01115280	Cork Brook	21	13	39	23	42	25	31	19	43	25	30	18
5	01115184	Spruce Brook	32	18	28	16	27	16	21	13	20	12	20	12
6	01115183	Quonapaug Brook	32	19	40	24	42	25	28	17	35	21	34	20
7	01115297	Wilbur Hollow Brook	13	8.2	11	7.0	11	7.0	8.1	5.6	8.9	6.0	9.0	6.1
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	25	15	23	14	23	14	19	12	19	12	19	12
9	01115275	Bear Tree Brook	50	30	57	34	58	34	49	29	46	27	44	26
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	59	35	60	36	61	36	54	32	56	33	60	35
14	01115110	Huntinghouse Brook	11	7.0	15	8.9	15	9.3	11	6.7	13	8	11	7.0
15	01115114	Regulating Reservoir (Rush Brook)	32	20	47	28	48	29	29	18	39	24	39	23
16	01115098	Peeptoad Brook (Harrisdale Brook)	40	23	45	26	46	26	37	22	41	24	37	22
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	31	18	66	38	72	42	42	24	60	34	60	35
—	—	Mean	30	18	36	22	38	22	28	17	33	20	31	19

Table 5. Monthly mean concentrations of chloride and sodium estimated from continuous measurements of specific conductance in the Scituate Reservoir drainage area, Rhode Island, October 1, 2017, through September 30, 2018.—Continued

[Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown on figure 1. Monthly mean concentrations were calculated by dividing the monthly load by the total discharge for the month. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; mg/L, milligram per liter; —, not applicable]

PWSB station number	USGS station number	Station name	April		May		June		July		August		September	
			Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)
24	01115190	Dolly Cole Brook	31	19	34	21	38	23	43	26	42	26	31	19
28	01115265	Barden Reservoir (Hemlock Brook)	20	12	27	16	34	20	41	24	42	24	22	13
35	01115187	Ponaganset River	22	14	24	15	27	17	28	18	29	19	21	13
3	01115280	Cork Brook	39	23	42	24	44	26	54	31	62	35	39	23
5	01115184	Spruce Brook	21	13	23	14	26	15	34	19	35	20	22	13
6	01115183	Quonapaug Brook	36	22	39	23	43	26	63	38	41	25	31	19
7	01115297	Wilbur Hollow Brook	9.4	6.3	10	6.8	12	7.5	12	7.7	13	8.2	9.8	6.5
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	20	13	23	15	29	18	32	20	33	20	23	15
9	01115275	Bear Tree Brook	49	29	55	33	63	38	75	45	69	41	53	31
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	63	37	68	40	69	41	70	41	70	42	68	40
14	01115110	Huntinghouse Brook	12	7.3	14	8.6	16	9.5	17	10	17	10	13	7.7
15	01115114	Regulating Reservoir (Rush Brook)	42	25	59	35	73	43	91	53	73	43	37	22
16	01115098	Peeptoad Brook (Harrisdale Brook)	41	24	43	25	47	27	49	28	49	28	47	27
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	68	39	85	49	144	82	109	62	67	39	48	28
—	—	Mean	34	20	39	23	48	28	51	30	46	27	33	20

Table 6. Annual mean chloride and sodium concentrations, loads, and yields for sampling stations in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.

[Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown on figure 1. Annual mean concentrations were calculated by dividing the annual load by the total discharge for the year; annual mean yields were calculated by dividing the sum of individual loads by the sum of the drainage area. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; mg/L, milligram per liter; t/yr, metric tons per year; t/yr/mi², metric tons per year per square mile; —, not applicable]

PWSB station number	USGS station number	Station name	Concentration		Load		Yield	
			Cl (mg/L)	Na (mg/L)	Cl (t/yr)	Na (t/yr)	Cl (t/yr/mi²)	Na (t/yr/mi²)
		Barden Reservoir subbasin						
24	01115190	Dolly Cole Brook	32	20	270	170	56	34
28	01115265	Barden Reservoir (Hemlock Brook)	21	13	390	240	45	28
35	01115187	Ponaganset River	22	14	660	410	47	30
		Direct runoff subbasin						
3	01115280	Cork Brook	37	22	88	52	47	28
5	01115184	Spruce Brook	23	14	47	28	37	22
6	01115183	Quonapaug Brook	35	21	140	83	71	42
7	01115297	Wilbur Hollow Brook	10	6.5	76	51	18	12
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	21	14	180	120	35	22
9	01115275	Bear Tree Brook	51	30	72	43	120	69
		Moswansicut Reservoir subbasin						
19	01115170	Moswansicut Reservoir, (Moswansicut Stream North, Moswansicut Pond)	60	36	310	180	96	57
		Regulating Reservoir subbasin						
14	01115110	Huntinghouse Brook	12	7.6	140	86	22	14
15	01115114	Rush Brook	40	24	300	180	63	38
16	01115098	Peeptoad Brook (Harrisdale Brook)	41	24	370	220	75	44
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	57	33	39	23	140	80
		Scituate Reservoir drainage area						
—	—	Mean concentration or yield	33	20	—	—	49	30
—	—	Total load	—	—	3,100	1,900	—	—

Chloride and Sodium

Median chloride concentrations among the PWSB stations ranged from 4.0 to 89.6 mg/L; the highest concentration was measured in the Moswansicut Reservoir subbasin at unnamed tributary #1 to Moswansicut Reservoir (Blanchard Brook; 01115160; PWSB station 20; table 8). The median of median concentrations for all sites in the drainage area was 25.8 mg/L (table 8). Median daily chloride loads and yields estimated from samples collected by the PWSB varied among monitoring stations in the drainage area (tables 9 and 10); the median daily chloride yield for monitored areas within the drainage area was 110 kilograms per day per square mile (kg/d/mi^2). Ponaganset River (01115187; PWSB station 35) had the largest median daily chloride load at 1,900 kilograms per day. The largest median daily chloride yield was determined to be 540 kg/d/mi^2 at Bear Tree Brook (01115275; PSWB station 9; table 10).

Nutrients

Median concentrations of nitrite and nitrate (table 8) were 0.001 and 0.11 mg/L as nitrogen (N), respectively. The highest median concentration of nitrite was 0.006 mg/L as N measured in a sample collected at the Moswansicut Reservoir (01115170; PWSB station 22). The highest median concentration of nitrate (1.53 mg/L as N) also was measured in a sample collected at the Moswansicut Reservoir station. The median concentration of orthophosphate for the entire study area (table 8) was 0.04 mg/L as phosphate (PO_4). The maximum median concentration of orthophosphate was 0.13 mg/L as PO_4 measured in the unnamed brook south of Westconnaug Reservoir (01115273; PWSB station 11).

Median daily nitrite, nitrate, and orthophosphate loads were largest at Ponaganset River (01115187; PWSB station 35) at 80, 3,500, and 3,600 grams per day (g/d), respectively (table 9). The largest median daily yield for nitrite was 41 grams per day per square mile (g/d/mi^2) as N at Bear Tree Brook (01115275; PWSB station 9; table 10); the largest median daily yield for nitrate was 4,800 g/d/mi^2 as N at the unnamed tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir; 01115165; PWSB station 21); and the largest median daily yield for orthophosphate was 860 g/d/mi^2 as PO_4 at Scituate Reservoir (Halls Estate Brook; 01115182; PWSB station 33; table 10). The medians of median daily loads and yields were 15 g/d and 5.5 g/d/mi^2 for nitrite as N, less than 890 g/d and 250 g/d/mi^2 for nitrate as N, and 360 g/d and 210 g/d/mi^2 for orthophosphate as PO_4, respectively.

Table 7. Monthly estimated chloride and sodium loads by sampling station, in the Scituate Reservoir drainage area, Rhode Island, October 1, 2017, through September 30, 2018.

[Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown on figure 1. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; t, metric ton; —, not applicable]

PWSB station number	USGS station number	Station name	October		November		December		January		February		March	
			Cl (t)	Na (t)	Cl (t)	Na (t)	Cl (t)	Na (t)	Cl (t)	Na (t)	Cl (t)	Na (t)	Cl (t)	Na (t)
24	01115190	Dolly Cole Brook	14	8.8	17	10	21	13	41	25	45	27	51	31
28	01115265	Barden Reservoir (Hemlock Brook)	27	17	27	16	28	17	55	34	60	37	65	41
35	01115187	Ponaganset River	44	27	54	34	50	31	91	56	110	70	110	69
3	01115280	Cork Brook	2.9	1.8	2.7	1.6	4.3	2.5	11	6.8	16	9.4	14	8.4
5	01115184	Spruce Brook	2.2	1.3	4.5	2.6	5.7	3.4	5.8	3.5	6.1	3.7	7.0	4.3
6	01115183	Quonapaug Brook	5.6	3.3	8.6	5.2	8.9	5.4	17	10	23	13	25	15
7	01115297	Wilbur Hollow Brook	4.2	2.6	5.2	3.4	5.1	3.4	9.2	6.4	11	7.4	12	8.5
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	7.2	4.5	11	7.1	11	7.0	23	14	28	18	30	19
9	01115275	Bear Tree Brook	2.5	1.5	4.8	2.8	4.8	2.8	9.5	5.6	11	6.6	12	6.8
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	8.7	5.1	18	11	16	9.4	39	23	48	29	65	39
14	01115110	Huntinghouse Brook	5.4	3.4	8.8	5.3	15	9.3	20	12	23	14	27	17
15	01115114	Regulating Reservoir (Rush Brook)	12	7.5	18	11	21	13	35	22	53	32	54	33
16	01115098	Peeptoad Brook (Harrisdale Brook)	17	9.8	19	11	26	15	50	30	63	37	72	43
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	1.5	0.89	1.1	0.64	2.3	1.3	6.1	3.5	5.9	3.4	11	6.5
—	—	Total	150	94	200	120	220	130	150	87	500	310	560	340

Table 7. Monthly estimated chloride and sodium loads by sampling station, in the Scituate Reservoir drainage area, Rhode Island, October 1, 2017, through September 30, 2018.—Continued

[Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown on figure 1. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; t, metric ton; —, not applicable]

PWSB station number	USGS station number	Station name	April		May		June		July		August		September	
			Cl (t)	Na (t)	Cl (t)	Na (t)	Cl (t)	Na (t)	Cl (t)	Na (t)	Cl (t)	Na (t)	Cl (t)	Na (t)
24	01115190	Dolly Cole Brook	43	26	15	9.4	5.5	3.3	2.8	1.7	3.9	2.4	15	9.1
28	01115265	Barden Reservoir (Hemlock Brook)	52	32	24	15	10	5.9	3.8	2.2	9.3	5.4	28	17
35	01115187	Ponaganset River	91	57	42	26	13	8.1	4.1	2.6	11	7.2	42	26
3	01115280	Cork Brook	16	9.4	5.2	3.0	1.8	1.0	0.82	0.46	2.7	1.5	9.9	5.8
5	01115184	Spruce Brook	6.5	3.9	3.8	2.3	1.4	0.85	0.76	0.43	1.3	0.72	2.1	1.3
6	01115183	Quonapaug Brook	20	12	12	7.2	4.1	2.5	0.96	0.58	5.0	3.0	9.0	5.4
7	01115297	Wilbur Hollow Brook	10	6.8	6.8	4.5	2.6	1.7	0.56	0.36	3.4	2.2	5.5	3.7
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	24	15	17	11	9.1	5.7	6.1	3.8	6.2	3.8	9.2	5.8
9	01115275	Bear Tree Brook	9.8	5.8	6.7	4.0	3.4	2.0	2.5	1.5	2.3	1.3	3.5	2.1
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	48	28	30	18	8.6	5.1	2.2	1.3	4.9	2.9	22	13
14	01115110	Huntinghouse Brook	23	14	8.4	5.1	1.8	1.1	0.45	0.27	1.6	0.96	5.9	3.6
15	01115114	Regulating Reservoir (Rush Brook)	52	31	19	11	6.3	3.7	1.1	0.62	4.3	2.5	20	12
16	01115098	Peeptoad Brook (Harrisdale Brook)	61	36	26	15	8.8	5.1	3.6	2.1	6.9	4.0	20	11
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	7.8	4.5	1.4	0.79	0.18	0.10	0.00027	0.00015	0.12	0.071	1.3	0.76
—	—	Total	460	280	220	130	77	46	30	18	63	38	190	120

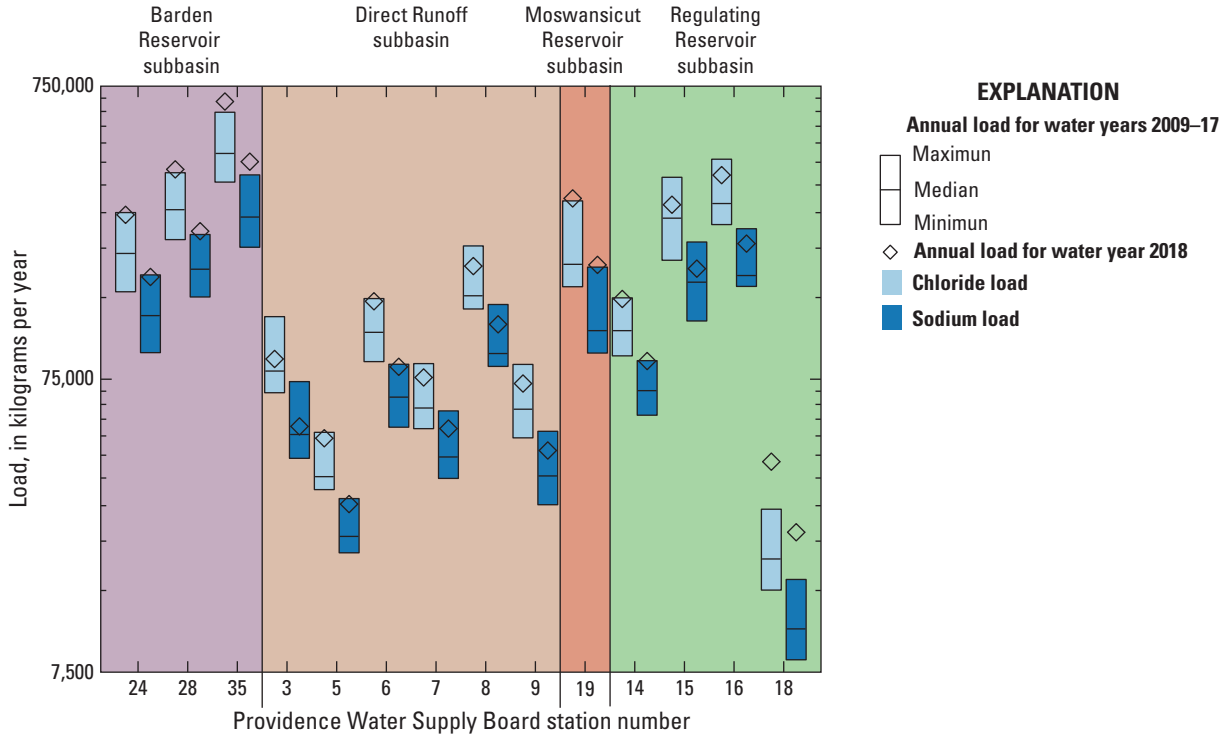

Figure 4. Annual loads of chloride and sodium estimated from streamflow and specific conductance data for water year 2018 and associated minimum, maximum, and median annual loads for water years 2009–17 at 14 Providence Water Supply Board sampling stations in the Scituate Reservoir drainage area, Rhode Island. Locations of continuous water-quality monitoring stations shown on figure 1.

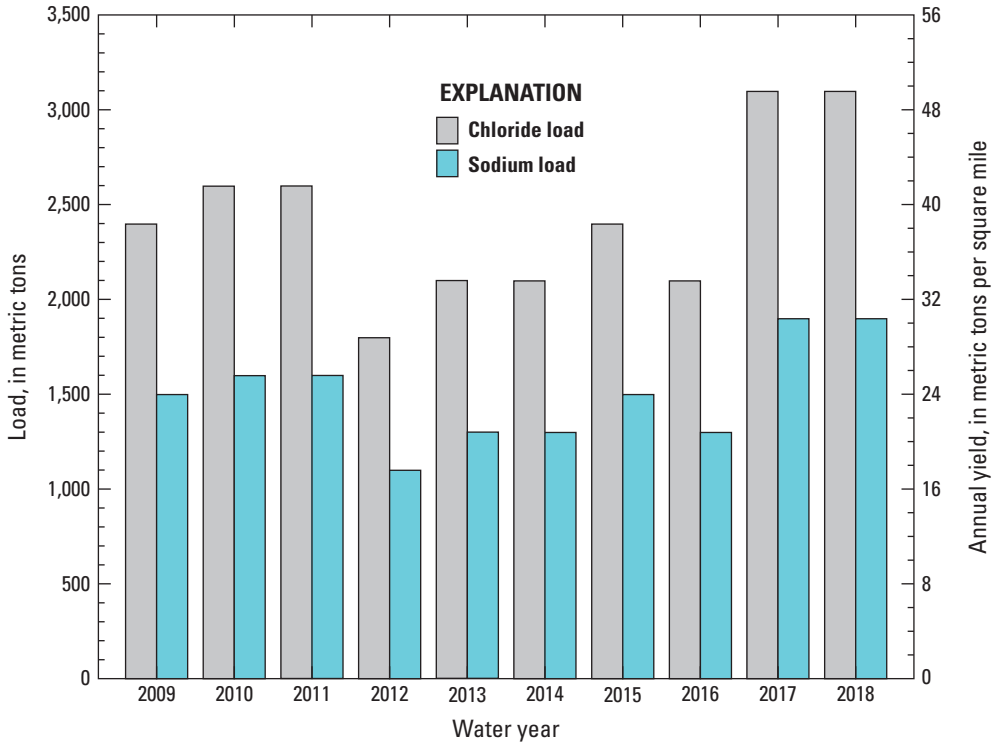

Figure 5. Annual loads and annual yields of chloride and sodium estimated from continuous measurements of flow and specific conductance for water years 2009–18 for the area upstream from 14 Providence Water Supply Board sampling stations in the Scituate Reservoir drainage area, Rhode Island. Locations of continuous water-quality monitoring stations shown on figure 1.

Table 8. Median values for water-quality data collected at Providence Water Supply Board stations in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations are shown on figure 1. USGS, U.S. Geological Survey; PCU, platinum cobalt unit; NTU, nephelometric turbidity unit; CFU/100 mL, colony forming unit per 100 milliliters; *E. coli*, *Escherichia coli*; mg/L, milligram per liter; $CaCO_3$, calcium carbonate; N, nitrogen; PO_4, phosphate; <, less than; —, no data]

PWSB station number	USGS station number	Station name	Properties			Constituents						
			pH	Color (PCU)	Turbidity (NTU)	Total coliform bacteria (CFU/100 mL)	*E. coli* (CFU/100 mL)	Alkalinity (mg/L as $CaCO_3$)	Chloride (mg/L)	Nitrite (mg/L as N)	Nitrate (mg/L as N)	Orthophosphate (mg/L as PO_4)
Barden Reservoir subbasin												
24	01115190	Dolly Cole Brook	6.3	55	0.69	1,600	16	4.6	35.0	0.001	0.1	0.03
25	01115200	Shippee Brook	6.2	23	0.53	1,700	8	5.1	15.1	0.001	0.06	0.03
26	01115185	Windsor Brook	6.5	31	0.32	790	8	4.9	37.0	0.001	[1]<0.10	0.05
27	011151845	Unnamed Tributary to Ponaganset River (unnamed brook B, unnamed brook west of Windsor Brook)	6.2	21	0.32	2,200	13	3.8	15.3	0.001	[1]<0.30	0.09
28	01115265	Barden Reservoir (Hemlock Brook)	6.2	100	0.81	1,300	10	4.4	29.3	0.002	[1]<0.05	0.05
29	01115271	Ponaganset River (Barden Stream)	6.2	50	0.74	350	[1]<10	4.1	23.5	0.001	[1]<0.05	0.03
35	01115187	Ponaganset River	6.3	45	0.64	1,700	15	4.2	25.0	0.001	0.12	0.04
Direct runoff subbasin												
1	01115180	Brandy Brook	6.8	65	1.6	540	10	10	15.9	0.002	0.21	0.06
2	01115181	Unnamed Tributary #2 to Scituate Reservoir (unnamed brook north of Bullhead Brook)	6.3	19	0.31	2200	26	4.6	84.0	0.001	0.40	0.03
3	01115280	Cork Brook	6.5	45	0.34	2,400	10	5.0	49.1	0.001	0.11	0.05
4	01115400	Kent Brook (Betty Pond Stream)	6.5	31	0.52	320	[1]<8	7.6	6.50	0.001	[1]<0.05	0.03
5	01115184	Spruce Brook	6.2	47	0.56	1,200	[1]<5	4.3	24.3	0.002	0.20	0.08
6	01115183	Quonapaug Brook	6.6	100	1.3	1,500	91	11	41.4	0.002	0.21	0.04
7	01115297	Wilbur Hollow Brook	6.3	93	0.91	2,400	44	5.9	10.3	0.002	[1]<0.06	0.04
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	6.3	21	0.43	130	[1]<10	3.8	13.6	0.001	[1]<0.05	0.02
9	01115275	Bear Tree Brook	6.3	58	0.83	740	12	4.8	26.7	0.002	0.23	0.03

Table 8. Median values for water-quality data collected at Providence Water Supply Board stations in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations are shown on figure 1. USGS, U.S. Geological Survey; PCU, platinum cobalt unit; NTU, nephelometric turbidity unit; CFU/100 mL, colony forming unit per 100 milliliters; *E. coli*, *Escherichia coli*; mg/L, milligram per liter; $CaCO_3$, calcium carbonate; N, nitrogen; PO_4, phosphate; <, less than; —, no data]

PWSB station number	USGS station number	Station name	Properties			Constituents						
			pH	Color (PCU)	Turbidity (NTU)	Total coliform bacteria (CFU/100 mL)	*E. coli* (CFU/100 mL)	Alkalinity (mg/L as $CaCO_3$)	Chloride (mg/L)	Nitrite (mg/L as N)	Nitrate (mg/L as N)	Orthophosphate (mg/L as PO_4)
Direct runoff subbasin—Continued												
30	01115350	Unnamed tributary #4 to Scituate Reservoir (Coventry Brook, Knight Brook)	5.9	55	0.56	1,100	24	3.5	23.0	0.001	0.16	0.03
31	01115177	Toad Pond	—	—	—	—	—	—	—	—	—	—
32	01115178	Unnamed tributary #1 to Scituate Reservoir (Pine Swamp Brook)	6.4	63	0.68	1,100	16	5.6	17.2	0.002	0.56	0.08
33	01115182	Unnamed tributary #3 to Scituate Reservoir (Hall's Estate Brook)	6.1	38	0.38	660	[1]<9	4.4	10.8	0.001	0.26	0.08
36	—	Outflow from King Pond	6.3	20	0.30	620	27	3.9	4.0	0.001	[1]<0.05	0.04
37	—	Fire Tower Stream	5.7	21	0.14	460	[1]<4	2.8	6.1	[1]<0.001	[1]<0.05	0.08
Moswansicut Reservoir subbasin												
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	6.9	15	0.61	210	[1]<10	9.3	62.9	0.001	0.08	0.02
20	01115160	Unnamed tributary #1 to Moswansicut Reservoir (Blanchard Brook)	6.2	150	1.00	1,600	10	5.3	89.6	0.002	0.12	0.07
21	01115165	Unnamed tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	6.6	39	0.65	1,400	28	9.4	43.9	0.003	0.59	0.05
22	01115167	Moswansicut Reservoir (Moswansicut Stream South)	6.7	24	0.85	1,800	10	14	87.9	0.006	1.53	0.07
34	01115164	Kimball Stream	6.3	50	0.67	1,700	[1]<5	8.8	31.2	0.003	0.25	0.03

Table 8. Median values for water-quality data collected at Providence Water Supply Board stations in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations are shown on figure 1. USGS, U.S. Geological Survey; PCU, platinum cobalt unit; NTU, nephelometric turbidity unit; CFU/100 mL, colony forming unit per 100 milliliters; *E. coli*, *Escherichia coli*; mg/L, milligram per liter; $CaCO_3$, calcium carbonate; N, nitrogen; PO_4, phosphate; <, less than; —, no data]

PWSB station number	USGS station number	Station name	Properties			Constituents						
			pH	Color (PCU)	Turbidity (NTU)	Total coliform bacteria (CFU/100 mL)	*E. coli* (CFU/100 mL)	Alkalinity (mg/L as $CaCO_3$)	Chloride (mg/L)	Nitrite (mg/L as N)	Nitrate (mg/L as N)	Orthophosphate (mg/L as PO_4)
Ponaganset Reservoir subbasin												
23	011151843	Ponaganset Reservoir	6.0	18	0.48	180	[1]<5	2.7	21	0.001	0.11	0.04
Regulating Reservoir subbasin												
13	01115176	Regulating Reservoir	6.7	36	0.84	340	8	9.0	44.1	0.001	0.07	0.03
14	01115110	Huntinghouse Brook	6.7	42	0.56	2,400	73	7.8	16.7	0.002	0.09	0.04
15	01115114	Rush Brook	6.9	75	0.8	1,500	85	9.8	70.5	0.001	0.09	0.05
16	01115098	Peeptoad Brook (Harrisdale Brook)	6.6	47	1.1	1,200	20	10	46.3	0.002	0.16	0.03
17	01115119	Dexter Pond (Paine Pond)	6.3	60	0.80	1,200	8	7.0	33.5	0.001	0.06	0.06
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	6.4	55	0.54	420	26	8.1	72.5	0.002	0.47	0.08
Westconnaug Reservoir subbasin												
10	01115274	Westconnaug Brook	5.8	25	0.22	2000	[1]<5	2.8	27.0	0.001	[1]<0.05	0.03
11	01115273	Unnamed tributary to Westconnaug Reservoir (unnamed brook south of Westconnaug Reservoir)	5.7	53	0.55	970	[1]<5	4.1	7.00	0.001	[1]<0.05	0.13
12	011152745	Unnamed tributary to Westconnaug Brook (unnamed brook north of Westconnaug Reservoir)	6.2	35	0.60	510	[1]<5	4.6	15.2	0.001	0.058	0.09
Scituate Reservoir drainage area												
—	—	Minimum	5.7	15	0.14	130	[1]<4	2.7	4.0	[1]<0.001	[1]<0.05	0.02
		Median	6.3	45	0.61	1200	10	4.9	25.8	0.001	0.11	0.04
		Maximum	6.9	150	1.6	2,400	91	14	89.6	0.006	1.53	0.13

[1]Values under detection limits were censored.

Table 9. Median daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations are shown on figure 1. USGS, U.S. Geological Survey; CFU×10^6/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; g/d, grams per day; N, nitrogen; PO_4, phosphate; —, not applicable]

PWSB station number	USGS station number	Station name	Total coliform bacteria (CFU×10^6/d)	*E. coli* (CFU×10^6/d)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophosphate (g/d as PO_4)
			Barden Reservoir subbasin					
24	01115190	Dolly Cole Brook	120,000	1,200	590	20	610	660
25	01115200	Shippee Brook	160,000	1,800	410	29	1,600	1,200
26	01115185	Windsor Brook	160,000	500	560	19	[1]500	1,200
28	01115265	Barden Reservoir	160,000	3,300	500	34	[1]510	900
35	01115187	Ponaganset River	590,000	5,700	1,900	80	3,500	3,600
			Direct runoff subbasin					
1	01115180	Brandy Brook	43,000	740	110	15	1,400	370
3	01115280	Cork Brook	44,000	490	140	3.1	420	120
4	01115400	Kent Brook	34,000	[1]230	27	4.0	[1]99	120
5	01115184	Spruce Brook	100,000	[1]190	150	6.9	2,800	360
6	01115183	Quonapaug Brook	110,000	1,300	220	15	1,900	410
7	01115297	Wilbur Hollow Brook	430,000	3,800	250	32	1,200	1,000
8	01115276	Westconnaug Brook	64,000	[1]700	280	22	[1]890	430
9	01115275	Bear Tree Brook	95,000	1,500	340	25	2,900	320
32	01115178	Unnamed tributary #1 to Scituate Reservoir (Pine Swamp Brook)	36,000	500	54	4.8	1,800	230
33	01115182	Unnamed tributary #3 to Scituate Reservoir (Halls Estate Brook)	20,000	240	32	3.1	850	240
			Moswansicut Reservoir subbasin					
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	44,000	[1]250	100	1.6	[1]110	16
21	01115165	Unnamed tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	33,000	610	100	6.1	1,500	120
			Regulating Reservoir subbasin					
14	01115110	Huntinghouse Brook	180,000	3,600	230	16	890	560
15	01115114	Regulating Reservoir (Rush Brook)	64,000	3,100	430	11	660	350
16	01115098	Peeptoad Brook (Harrisdale Brook)	100,000	1,800	720	27	1,600	500
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	4,400	270	140	3.8	490	180
			Westconnaug Reservoir subbasin					
10	01115274	Westconnaug Brook	93,000	[1]180	200	[1]3.6	[1]180	220
11	01115273	Unnamed tributary to Westconnaug Reservoir (unnamed brook south of Westconnaug Reservoir)	13,000	[1]64	33	5.0	[1]120	150

Table 9. Median daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations are shown on figure 1. USGS, U.S. Geological Survey; CFU×10^6/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; g/d, grams per day; N, nitrogen; PO_4, phosphate; —, not applicable]

PWSB station number	USGS station number	Station name	Total coliform bacteria (CFU×10^6/d)	*E. coli* (CFU×10^6/d)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophosphate (g/d as PO_4)
Scituate Reservoir drainage area								
—	—	Minimum	4,400	[1]64	27	1.6	[1]99	16
		Median	93,000	[1]700	220	15	[1]890	360
		Maximum	590,000	5,700	1,900	80	3,500	3,600

[1]The concentrations used to calculate the loads were censored as one-half the method detection limit.

Table 10. Median daily yields of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB). Locations of stations shown on figure 1. USGS, U.S. Geological Survey; CFU×10^6/d/mi^2; millions of colony forming units per day per square mile; *E. coli*, *Escherichia coli*; N, nitrogen; PO_4, phosphate; kg/d/mi^2, kilogram per day per square mile; g/d/mi^2, gram per day per square mile; —, none]

PWSB station number	USGS station number	Station name	Total coliform bacteria (CFU×10^6/mi^2)	*E. coli* (CFU×10^6/mi^2)	Chloride (kg/d/mi^2)	Nitrite (g/d/mi^2 as N)	Nitrate (g/d/mi^2 as N)	Orthophosphate (g/d/mi^2 as PO_4)
			Barden Reservoir subbasin					
24	01115190	Dolly Cole Brook	24,000	240	120	4.1	120	130
25	01115200	Shippee Brook	68,000	740	170	12	660	490
26	01115185	Windsor Brook	36,000	110	130	4.4	[1]120	270
28	01115265	Barden Reservoir	18,000	380	57	3.9	[1]58	100
35	01115187	Ponaganset River	42,000	410	140	5.7	250	250
			Direct runoff subbasin					
1	01115180	Brandy Brook	27,000	470	70	9.6	890	240
3	01115280	Cork Brook	24,000	260	75	1.7	220	64
4	01115400	Kent Brook	39,000	[1]260	31	4.7	[1]120	140
5	01115184	Spruce Brook	80,000	[1]150	120	5.5	2,200	290
6	01115183	Quonapaug Brook	56,000	660	110	7.7	970	210
7	01115297	Wilbur Hollow Brook	98,000	880	58	7.3	270	240
8	01115276	Westconnaug Brook	12,000	[1]140	54	4.2	[1]170	82
9	01115275	Bear Tree Brook	150,000	2,400	540	41	4,700	520
32	01115178	Unnamed tributary #1 to Scituate Reservoir (Pine Swamp Brook)	79,000	1,100	120	11	3,900	510
33	01115182	Unnamed tributary #3 to Scituate Reservoir (Halls Estate Brook)	70,000	860	110	11	3,000	860
			Moswansicut Reservoir subbasin					
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	14,000	[1]77	31	0.49	[1]33	4.9
21	01115165	Unnamed tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	110,000	2,000	350	20	4,800	380
			Regulating Reservoir subbasin					
14	01115110	Huntinghouse Brook	29,000	570	37	2.5	140	89
15	01115114	Regulating Reservoir (Rush Brook)	14,000	660	91	2.3	140	74
16	01115098	Peeptoad Brook (Harrisdale Brook)	20,000	360	140	5.4	320	100
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	16,000	960	500	14	1,800	640
			Westconnaug Reservoir subbasin					
10	01115274	Westconnaug Brook	63,000	[1]120	140	[1]2.4	[1]120	150

Table 10. Median daily yields of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB). Locations of stations shown on figure 1. USGS, U.S. Geological Survey; CFU×10^6/d/mi^2; millions of colony forming units per day per square mile; *E. coli*, *Escherichia coli*; N, nitrogen; PO_4, phosphate; kg/d/mi^2, kilogram per day per square mile; g/d/mi^2, gram per day per square mile; —, none]

PWSB station number	USGS station number	Station name	Total coliform bacteria (CFU×10^6/mi^2)	*E. coli* (CFU×10^6/mi^2)	Chloride (kg/d/mi^2)	Nitrite (g/d/mi^2 as N)	Nitrate (g/d/mi^2 as N)	Orthophosphate (g/d/mi^2 as PO_4)
Westconnaug Reservoir subbasin—Continued								
11	01115273	Unnamed tributary to Westconnaug Reservoir (unnamed brook South of Westconnaug Reservoir)	18,000	[1]89	46	6.9	[1]170	210
Scituate Reservoir drainage area								
—	—	Minimum	12,000	[1]77	31	0.49	33	4.9
		Median	36,000	410	110	5.5	250	210
		Maximum	150,000	2,400	540	41	4,800	860

[1]The concentrations used to calculate the yields were censored as one-half the method detection limit.

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Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations shown on figure 1. USGS, U.S. Geological Survey; ft^3/s, cubic foot per second; $CFU \times 10^6/d$; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; g/d, gram per day; N, nitrogen; PO_4, phosphate; <, less than; >, greater than; —, data not available]

PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophosphate (g/d as PO_4)
Barden Reservoir subbasin										
24	01115190	Dolly Cole Brook	11/03/17	7.9	290,000	14,000	620	38	[1]480	960
			12/01/17	4.5	39,000	1,100	350	11	760	770
			01/22/18	8.9	120,000	1,700	660	22	3,900	660
			02/02/18	11	140,000	520	800	26	3,100	1,000
			03/19/18	13	110,000	[1]780	1,100	31	2,800	940
			04/06/18	21	840,000	8,200	1,900	51	5,000	1,000
			05/04/18	8.1	510,000	[1]490	590	20	[1]490	390
			06/01/18	2.2	260,000	2,000	190	11	610	110
			07/11/18	0.78	58,000	570	73	3.8	250	19
			08/03/18	0.52	36,000	1,200	51	2.6	130	38
			09/07/18	0.46	83,000	2,400	48	2.3	84	91
25	01115200	Shippee Brook	02/20/18	24	320,000	3,500	810	58	3,100	2,300
			07/31/18	0.047	3,300	11	1.8	0.11	6.7	2.3
26	01115185	Windsor Brook	10/20/17	0.12	2,400	30	13	0.30	[1]7.5	18
			02/20/18	31	470,000	1,500	2,400	77	11,000	2,300
			04/30/18	16	310,000	[1]960	1,100	38	[1]960	11,000
			07/31/18	0.086	4600	21	11	0.21	41	4.2

Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations shown on figure 1. USGS, U.S. Geological Survey; ft^3/s, cubic foot per second; $CFU \times 10^6/d$; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; g/d, gram per day; N, nitrogen; PO_4, phosphate; <, less than; >, greater than; —, data not available]

PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophosphate (g/d as PO_4)
Barden Reservoir subbasin—Continued										
28	01115265	Barden Reservoir (Hemlock Brook)	10/10/17	0.95	39,000	950	78	4.6	[1]58	140
			11/14/17	7.3	240,000	36,000	500	36	[1]450	900
			12/12/17	14	99,000	3,300	810	67	1,800	2,700
			02/27/18	49	410,000	7,200	2,600	120	[1]3,000	8,400
			03/30/18	20	1,000,000	3,900	1,300	49	[1]1,200	980
			04/13/18	14	160,000	[1]840	980	34	[1]840	1,000
			05/08/18	15	530,000	9,500	1,000	73	[1]910	1,800
			06/12/18	3.1	38,000	760	240	15	470	380
			07/27/18	3.1	260,000	21,000	300	15	510	150
			08/30/18	0.81	31,000	200	81	9.9	280	79
			09/10/18	0.60	15,000	150	58	4.4	190	29
35	01115187	Ponaganset River	11/03/17	47	2,000,000	110,000	2,600	340	[1]2,900	4,600
			12/01/17	19	730,000	4,700	1,200	47	4,000	6,000
			01/22/18	36	420,000	8,800	2,000	88	18,000	8,800
			02/02/18	43	450,000	2,100	2,500	100	17,000	6,300
			03/19/18	42	360,000	[1]2,600	2,600	100	12,000	3,100
			04/06/18	54	1,600,000	6,700	3,200	130	12,000	4,000
			05/04/18	29	1,900,000	15,000	1,800	71	[1]1,800	1,400
			06/01/18	6.4	880,000	9,600	400	47	2,100	630
			07/11/18	0.77	59,000	370	49	3.7	240	37
			08/03/18	0.78	79,000	1,500	60	3.8	230	150

Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations shown on figure 1. USGS, U.S. Geological Survey; ft^3/s, cubic foot per second; $CFU \times 10^6/d$; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; g/d, gram per day; N, nitrogen; PO_4, phosphate; <, less than; >, greater than; —, data not available]

PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophosphate (g/d as PO_4)
Direct runoff subbasin										
1	01115180	Brandy Brook	10/3/2017	0.22	2,200	[1]27	8.6	0.54	160	32
			12/5/2017	2.3	30,000	[1]280	73	11	1,400	330
			2/6/2018	6.1	43,000	8,000	550	15	6,500	1,800
			3/5/2018	7.8	100,000	3,100	190	57	3,200	2,100
			4/6/2018	5.3	68,000	[1]330	190	26	2,300	920
			5/1/2018	4.5	130,000	[1]270	390	22	1,800	870
			6/5/2018	3.0	90,000	740	110	22	1,300	370
			8/7/2018	0.60	30,000	920	27	1.5	310	44
			9/4/2018	0.13	4,500	1,300	6.5	0.33	85	13
3	01115280	Cork Brook	11/20/17	1.3	37,000	930	140	3.1	350	120
			12/07/17	2.5	44,000	490	240	6.2	620	430
			04/05/18	5.9	97,000	3,000	800	14	1,500	1,600
			05/03/18	2.3	60,000	560	250	5.6	420	110
			06/07/18	0.97	54,000	[1]120	120	2.4	470	170
			07/30/18	0.11	7,400	27	17	0.27	140	13
			08/02/18	0.11	5,200	26	16	0.26	140	10
4	01115400	Kent Brook	12/5/2017	0.67	1,400	[1]82	9.0	1.6	[1]41	16
			1/2/2018	1.0	510	[1]60	19	2.4	[1]60	96
			3/5/2018	5.8	41,000	1,400	85	28	[1]350	570
			4/6/2018	3.0	26,000	180	33	7.3	[1]180	150
			5/1/2018	2.2	240,000	270	37	5.3	[1]130	370
			6/5/2018	1.1	120,000	270	20	2.7	[1]68	27
5	01115184	Spruce Brook	10/17/17	0.20	2,000	[1]12	27	0.48	94	67
			01/16/18	5.4	150,000	[1]330	280	13	5,500	660
			04/17/18	17	550,000	[1]1,100	750	84	8,700	2,500
			07/17/18	0.16	52,000	40	11	0.80	[1]10	40

Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations shown on figure 1. USGS, U.S. Geological Survey; ft^3/s, cubic foot per second; $CFU \times 10^6/d$; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; g/d, gram per day; N, nitrogen; PO_4, phosphate; <, less than; >, greater than; —, data not available]

PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophosphate (g/d as PO_4)
Direct runoff subbasin—Continued										
6	01115183	Quonapaug Brook	11/07/17	2.1	140,000	15,000	220	15	900	150
			12/05/17	2.0	54,000	7,900	200	9.8	1,900	200
			02/06/18	10	270,000	10,000	370	49	5,200	2,900
			03/05/18	12	110,000	[1]750	870	60	8,500	1,800
			04/06/18	5.3	31,000	[1]320	530	13	4,600	640
			05/01/18	7.1	260,000	[1]430	200	35	2,800	520
			06/05/18	2.4	400,000	33,000	260	23	1,200	410
			08/07/18	0.16	39,000	1,300	30	1.2	58	[1]2.0
			09/04/18	0.14	20,000	320	30	1.0	70	10
7	01115297	Wilbur Hollow Brook	11/20/17	8.2	830,000	180,000	260	60	1,500	1,600
			12/07/17	11	320,000	5,900	290	200	2,900	2,500
			02/01/18	11	49,000	1,700	280	28	6,400	1,900
			04/05/18	14	600,000	23,000	350	35	3,900	1,400
			05/03/18	13	1,000,000	[1]820	240	65	[1]820	650
			06/07/18	3.8	530,000	89,000	90	28	[1]230	370
			07/30/18	0.14	5,900	69	5.7	0.69	[1]8.6	10
			08/02/18	0.078	9,900	250	2.7	0.38	[1]4.8	7.6
8	01115276	Westconnaug Brook	11/29/17	5.7	15,000	[1]700	200	14	1,000	140
			12/08/17	7.7	5,600	[1]940	250	19	1,700	380
			01/29/18	16	30,000	1,500	500	38	4,500	1,200
			02/16/18	23	—	—	1,200	56	3,600	3,400
			03/22/18	13	15,000	[1]770	370	31	[1]770	610
			04/20/18	21	64,000	[1]1,300	670	51	[1]1,300	1,500
			05/18/18	9.6	120,000	[1]590	310	24	[1]590	470
			06/15/18	3.2	190,000	[1]390	110	7.8	[1]200	230
			07/23/18	2.6	170,000	[1]320	100	[1]3.2	[1]160	64
			08/20/18	2.5	110,000	[1]310	100	6.2	[1]150	62

Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations shown on figure 1. USGS, U.S. Geological Survey; ft^3/s, cubic foot per second; $CFU \times 10^6/d$; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; g/d, gram per day; N, nitrogen; PO_4, phosphate; <, less than; >, greater than; —, data not available]

PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophosphate (g/d as PO_4)
Direct runoff subbasin—Continued										
9	01115275	Bear Tree Brook	01/16/18	4.0	29,000	780	150	10	1,300	98
			04/17/18	5.6	160,000	2,200	520	41	4,500	550
32	01115178	Unnamed tributary 1 to Scituate Reservoir (Pine Swamp Brook)	01/18/18	1.2	13,000	500	53	2.9	2,200	260
			04/19/18	1.4	58,000	500	54	6.7	1,300	200
33	01115182	Unnamed tributary 3 to Scituate Reservoir (Halls Estate Brook)	01/24/18	1.4	12,000	410	31	3.4	1,300	340
			04/27/18	1.1	27,000	[1]69	33	2.7	390	140
Moswansicut Reservoir subbasin										
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	11/09/17	2.3	1,100	9,700	350	5.7	460	170
			12/11/17	4.2	2,200	5,100	610	21	820	210
			02/12/18	20	11,000	130,000	2,500	100	6,800	1,500
			03/29/18	6.6	[1]400	810	1,000	16	2,600	320
			04/12/18	5.8	[1]360	3,000	920	14	960	710
			05/10/18	5.7	[1]350	3,600	870	14	2,100	140
			06/14/18	1.1	260	46,000	160	2.6	200	26
			07/12/18	0.16	240	16,000	25	0.38	[1]9.5	3.8
			08/09/18	0.24	[1]29	42,000	39	0.58	[1]15	5.8
			09/13/18	6.0	[1]730	180,000	960	15	[1]370	150
21	01115165	Unnamed tributary 2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	02/28/18	1.1	18,000	26	99	7.8	1,800	100
			04/23/18	0.89	47,000	1,200	110	4.4	1,100	130

Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are listed in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations shown on figure 1. USGS, U.S. Geological Survey; ft^3/s, cubic foot per second; $CFU \times 10^6/d$; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; g/d, gram per day; N, nitrogen; PO_4, phosphate; <, less than; >, greater than; —, data not available]

PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophosphate (g/d as PO_4)
Regulating Reservoir subbasin										
14	01115110	Huntinghouse Brook	11/16/17	5.7	180,000	10,000	230	14	1,200	560
			04/13/18	11	160,000	2,700	450	54	3,200	1,300
			05/11/18	6.6	400,000	810	250	16	890	650
			06/08/18	2.0	150,000	3,600	76	10	820	240
			09/14/18	4.2	1,800,000	110,000	200	21	720	210
15	01115114	Rush Brook	10/04/17	0.010	530	9.8	5.3	0.024	[1]0.61	1.5
			11/16/17	4.2	96,000	8,800	650	10	880	520
			04/13/18	5.9	64,000	13,000	1,200	14	1,800	720
			05/11/18	2.9	230,000	2,600	430	14	660	350
			06/08/18	1.5	54,000	3,100	250	11	600	290
16	01115098	Peeptoad Brook (Harrisdale Brook)	11/16/2017	3.70	30,000	1,800	420	9.1	1,500	270
			12/19/2017	5.9	39,000	1,400	680	29	3,000	1,300
			1/19/2018	11	530,000	15,000	1,100	27	8,100	2,400
			4/13/2018	10	92,000	[1]610	1,100	24	4,900	730
			5/11/2018	6.8	320,000	3,500	720	33	1,600	500
			6/8/2018	3.5	100,000	[1]430	390	17	630	170
			9/14/2018	6.5	610,000	43,000	750	32	840	160
18	01115120	Unnamed tributary to Regulating Reservoir (unnamed brook A)	10/31/2017	1.7	800,000	72,000	180	28	[1]100	320
			2/28/2018	0.78	1,600	190	140	3.8	930	130
			4/23/2018	0.43	4,400	270	93	1.0	490	180

Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate in the Scituate Reservoir drainage area, Rhode Island, from October 1, 2017, through September 30, 2018.—Continued

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PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophosphate (g/d as PO_4)
Westconnaug Reservoir subbasin										
10	01115274	Westconnaug Brook	11/14/2017	1.8	93,000	440	120	[1]2.2	[1]110	130
			12/12/2017	3.1	55,000	380	200	7.5	[1]190	450
			2/27/2018	8.1	160,000	400	520	20	[1]500	2,800
			3/30/2018	4.4	220,000	[1]110	300	11	[1]270	540
			4/13/2018	2.8	67,000	[1]170	200	[1]3.4	[1]170	200
			5/8/2018	3.0	190,000	[1]180	200	[1]3.6	[1]180	220
			6/12/2018	0.23	11,000	[1]28	14	[1]0.28	[1]14	17
11	01115273	Unnamed tributary to Westconnaug Reservoir (unnamed brook south of Westconnaug Reservoir)	01/31/18	2.5	12,000	[1]62	44	6.2	500	1,400
			04/24/18	2.0	48,000	[1]120	33	5.0	[1]120	150
			07/24/18	0.08	13,000	64	1.4	0.82	[1]5.1	27

[1]Values were censored and are reported as one-half the method detection limit.

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