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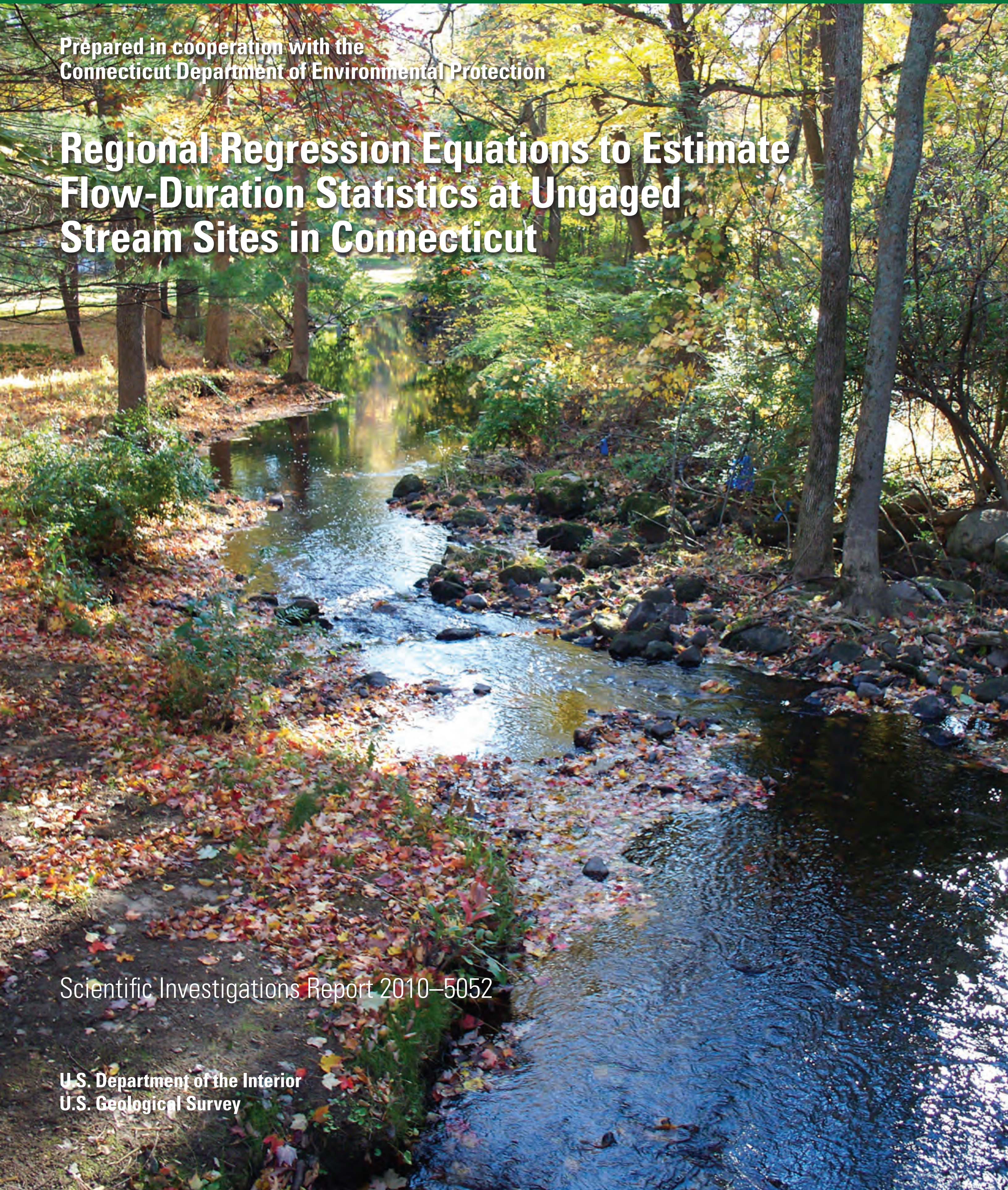

Prepared in cooperation with the
Connecticut Department of Environmental Protection

Regional Regression Equations to Estimate Flow-Duration Statistics at Ungaged Stream Sites in Connecticut

Scientific Investigations Report 2010–5052

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

Cover. Photograph showing Sasco Brook (U.S. Geological Survey station 01208950) from bridge on Hulls Farm Road in Fairfield, CT taken on October 23, 2008. Photograph courtesy of Jason Pollender.

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KEN SALAZAR, Secretary

U.S. Geological Survey
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Conversion Factors and Datum

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.01093	cubic meter per second per square kilometer [(m^3/s)/km^2]

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

°C=(°F-32)/1.8

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

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

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

Regional Regression Equations to Estimate Flow-Duration Statistics at Ungaged Stream Sites in Connecticut

By Elizabeth A. Ahearn

Abstract

Multiple linear regression equations for determining flow-duration statistics were developed to estimate select flow exceedances ranging from 25- to 99-percent for six "bioperiods"—Salmonid Spawning (November), Overwinter (December–February), Habitat Forming (March–April), Clupeid Spawning (May), Resident Spawning (June), and Rearing and Growth (July–October)—in Connecticut. Regression equations also were developed to estimate the 25- and 99-percent flow exceedances without reference to a bioperiod. In total, 32 equations were developed. The predictive equations were based on regression analyses relating flow statistics from streamgages to GIS-determined basin and climatic characteristics for the drainage areas of those streamgages. Thirty-nine streamgages (and an additional 6 short-term streamgages and 28 partial-record sites for the non-bioperiod 99-percent exceedance) in Connecticut and adjacent areas of neighboring States were used in the regression analysis. Weighted least squares regression analysis was used to determine the predictive equations; weights were assigned based on record length. The basin characteristics—drainage area, percentage of area with coarse-grained stratified deposits, percentage of area with wetlands, mean monthly precipitation (November), mean seasonal precipitation (December, January, and February), and mean basin elevation—are used as explanatory variables in the equations.

Standard errors of estimate of the 32 equations ranged from 10.7 to 156 percent with medians of 19.2 and 55.4 percent to predict the 25- and 99-percent exceedances, respectively. Regression equations to estimate high and median flows (25- to 75-percent exceedances) are better predictors (smaller variability of the residual values around the regression line) than the equations to estimate low flows (less than 75-percent exceedance). The Habitat Forming (March–April) bioperiod had the smallest standard errors of estimate, ranging from 10.7 to 20.9 percent. In contrast, the Rearing and Growth (July–October) bioperiod had the largest standard errors, ranging from 30.9 to 156 percent. The adjusted coefficient of determination of the equations ranged from 77.5 to 99.4 percent with medians of 98.5 and 90.6 percent to predict the 25- and 99-percent exceedances, respectively.

Descriptive information on the streamgages used in the regression, measured basin and climatic characteristics, and estimated flow-duration statistics are provided in this report. Flow-duration statistics and the 32 regression equations for estimating flow-duration statistics in Connecticut are stored on the U.S. Geological Survey World Wide Web application "StreamStats" (http://water.usgs.gov/osw/streamstats/index.html). The regression equations developed in this report can be used to produce unbiased estimates of select flow exceedances statewide.

Introduction

The concept that a river has a natural flow regime upon which its ecological integrity depends has been firmly established (Poff and others, 1997). Historically, streamflow standards have been based on a minimum flow regime with no or little natural variability. "*In 2005 the Connecticut legislature passed an act expanding existing environmental flow protection to all streams in the state (previously they covered only stocked streams) and required DEP*[1] *to establish flow regulations to "preserve and protect the natural aquatic life" (State of Connecticut, 2009) and be based, to the maximum extent practicable, on natural variation of flows and water levels while providing for the needs and requirements of public health, flood control, industry, public utilities, water supply, public safety, agriculture, and other lawful uses of such waters."* (Smith, 2009).

In early 2010, the State proposed new streamflow standards to safeguard rivers that support a natural flow regime on which the ecological integrity of the riverine ecosystems depends. These streamflow standards and regulations require the quantification of flow exceedances that are based on biological processes or "bioperiods." Bioperiods are defined by the State of Connecticut as the time of year during which certain biological processes that are dependent on flow occur or are likely to occur (State of Connecticut, 2009). In an effort to provide water managers with the ability to determine flow exceedances that are based on bioperiods at ungaged stream

[1]Connecticut Department of Environmental Protection.

sites in Connecticut, this study was conducted by the U.S. Geological Survey (USGS) in cooperation with the Connecticut Department of Environmental Protection (DEP) and the New England Interstate Water Pollution Control Commission.

To meet future challenges, improved web-based tools are needed to easily obtain streamflow statistics, characteristics of a drainage basin, and other information for planning and management of the water resources. The regression equations developed from this study are included in the USGS StreamStats web-based Geographic Information System (GIS) (Ahearn and others, 2006) to provide users with access to analytical tools and streamflow statistics. StreamStats can be accessed at http://water.usgs.gov/osw/streamstats/index.html and allows users to obtain flow statistics, characteristics of a drainage basin, and other information for user-selected sites on a stream. Using a GIS-based interactive map of Connecticut, the user can 'point and click' on a location and StreamStats will delineate the basin upstream from the selected location and provide flow-duration statistics for the selected location. The user can also 'point and click' on USGS streamgages and receive flow statistics and information about those locations.

Purpose and Scope

This report presents 32 regression equations for predicting flow-duration statistics for select exceedances from 25- to 99-percent. Thirty of these equations are for particular months or seasons, called bioperiods (table 1), and two equations are not associated with any bioperiod. To differentiate the 25- and 99-percent flow exceedances (Q_{25} and Q_{99}) associated with bioperiods from the Q_{25} and Q_{99} that are not based on a particular bioperiod (but on all the data in the streamgage record), the latter are referred to herein as the "non-bioperiod" exceedances. The regression equations were developed using streamflow data collected through September 2007. This report (1) presents estimates of flow-duration statistics for the six bioperiods and the Q_{25} and Q_{99} for non-bioperiods at 41 streamgages; (2) describes methods used to develop the regression equations; and (3) describes the accuracy and limitations of the equations.

Physical Setting

Connecticut encompasses an area of 5,009 mi^2 and can be divided into four physiographic regions: western uplands (northwestern part of the state), eastern uplands (northeastern part of the state), central valley (central part of the state), and coastal lowlands. The western uplands generally have the steepest topography; land-surface elevations range from about 500 to 2,300 ft above NAVD 88 with average slopes of about 11 percent. Land-surface elevations in the eastern uplands range from about 500 to 1,300 ft above NAVD 88 with average slopes of about 8 percent. Topographic relief along the coastal lowlands and central valley generally is low with land-surface elevations ranging from 0 to about 500 ft above NAVD 88 (U.S. Geological Survey, 2006). Average slopes along the coastal lowlands and central valley are less than 7 percent.

The surficial geologic materials of Connecticut, described by Stone and others (1992), are primarily glacial deposits. Unconsolidated glacial deposits of varying thickness blanket the bedrock surface across most of the state. Glacial till is the most widespread surficial deposit and is generally thin (less than 15 ft thick). Till was deposited directly by glacial ice, is a nonsorted material ranging in grain size from clay to large boulders, and covers much of the slopes in the State and upland areas. Stratified deposits occur primarily in valleys and lower, flatter areas both inland and along the coast of Connecticut. These materials were laid down by glacial meltwater in streams and lakes and consist of layers of gravel, sand, silt, and clay. These materials are most widespread in the broad central Connecticut Valley and along the coast. Till, bedrock, and fine-grained stratified deposits (very fine sand, silt, and clay) generally have lower permeability than the coarse-grained stratified deposits (gravel and sand), which generally have high permeability.

Table 1. Bioperiods for which flow-duration statistics and regression equations were developed.

Bioperiod	Months	Typical flow	Significance
Salmonid Spawning	November	Medium	Increased flows needed for spawning migrations and spawning by salmonids (e.g., Atlantic salmon, brook trout).
Overwinter	December–February	Low	Necessary flows for aquatic species, including incubating salmonid eggs, to survive freezing conditions and scour by ice.
Habitat Forming	March–April	High	Maintain natural habitat and connectivity with flood plain, channel formation, and flushing and transport of fine-grained sediment.
Clupeid Spawning	May	Medium	Increased flows needed for spawning migrations and spawning by anadromous clupeids, primarily herring and shad.
Resident Spawning	June	Medium	Flows needed for spawning migrations and spawning by resident fishes (e.g., fallfish, white sucker).
Rearing and Growth	July–October	Low	Flows needed to sustain and grow aquatic life, including resident and anadromous fishes, during metabolically active (i.e., warmer) seasons.

The climate in Connecticut generally is temperate and humid with four distinct seasons. Prevailing westerly winds alternately transport cool, dry, continental-polar, and warm, moist, maritime-tropical air masses into the region, resulting in frequent weather changes. Precipitation is distributed fairly evenly throughout the year and averages about 45 in. annually (based on long-term data from 1920 to 1996 (Miller and others, 2002)). The climate is moderated by maritime influences along coastal regions. Regional differences in topography, elevation, and proximity to the ocean can result in a substantial areal variation in snowfall amounts. Mean snowfall ranges from 30 in. along coastal areas, to 40 in. inland, to 60 in. in the northwestern part of the state (Miller and others, 2002). Average annual temperatures range from 51.7°F in coastal areas (Bridgeport) to 49.9°F in the central valley (Hartford) (Northeast Region Climate Center, 2009).

Land cover in Connecticut is highly mixed, with forests dominating the north, and densely populated urban areas are prominent along the southwestern-coastal and central-valley regions. Most of the land cover in Connecticut can be classified as forested with little urban development or low population density. The National Land Cover Data (NLCD) for the early 1990s, at a 30-m resolution grid for Connecticut, indicates the following categorization of land cover (Multi-Resolution Land Characteristics Consortium, 1992):

- 59 percent is forest (deciduous, evergreen, and mixed forest),
- 12 percent is open space developed and low intensity developed (suburban),
- 5.0 percent is high intensity developed (commercial, industrial, and high population density), and
- 24 percent is one of the following—open water, barren land, shrub, grassland, pasture, wetlands, agriculture, and medium intensity developed.

Previous Studies

Several studies by the USGS that provide estimates of flow-duration statistics in Connecticut have been published, including a series of basin studies (Cervione and others, 1972; Handman and others, 1986; Mazzaferro and others, 1979; Randall and others, 1966; Ryder and others, 1970; Ryder and others, 1981; Thomas and others, 1968; Thomas and others, 1967; Weiss and others, 1982; Wilson and others, 1974). Ahearn (2007) published estimates of flow durations, low-flow frequencies, and monthly median flows for selected streams in Connecticut using data through 2005. That report updated and superseded previously published flow durations, low-flow frequencies, and monthly median flow estimates in Connecticut and was a precursor to the development of regression equations to estimate the flow-duration statistics described in this report. Regional regression techniques to estimate low-flow and flood-flow statistics at ungaged stream sites have been applied in Connecticut (Thomas and Benson, 1970; Cervione and others, 1982; Weiss, 1983; Ahearn, 2004). Studies published by USGS within the last 20 years that regionalized flow-duration statistics in Massachusetts include Archfield and others (2010) and Ries and Friesz (2000).

Data-Set Development

Data from about 100 streamgages with 10 or more years of daily mean flows in Connecticut and in the neighboring states of Rhode Island, Massachusetts, and New York were retrieved from the USGS National Water Inventory System (NWIS) database at http://nwis.waterdata.usgs.gov/usa/nwis/discharge and considered for the regression study (Ahearn, 2007). Subsequently, Connecticut DEP and USGS made a rigorous effort to identify and eliminate any of the streamgages that were impacted by anthropogenic activities (such as flow augmentation, diversions, or water-supply/industrial withdrawals in the upstream drainage basin). After evaluating all available 100 flow records, 41 continuous-record streamgages, 6 short-term streamgages and 28 partial-record sites[2] met the criterion of a natural or near-natural flow regime (table 2 and fig. 1). Of the 41 continuous-record streamgages, 27 are in Connecticut; 10 of these were active in 2007. The 6 short-term streamgages and 28 partial-record sites are located in Connecticut and were available for regionalization of the Q_{99} without reference to a bioperiod. In a companion study that preceded the regression analysis presented in this report, several low-flow statistics, including the Q_{99}, were estimated for the short-term streamgages and partial-record sites (Ahearn, 2007).

Streamgages outside Connecticut were included in the regionalization of flow-duration statistics because of the sparse coverage of long-term streamgages with natural flow conditions within the State. These streamgages are within 15 mi of the State line. Inclusion of more streamgages may provide a more representative sample of the range of physiographic characteristics of Connecticut.

The flow records for the 41 continuous-record streamgages ranged from 10 to 95.2 years with an average of 36.2 years. The flow records for the short-term streamgages and partial-record sites ranged from 3.5 to 19.6 years with an average of 13.1 years. Fourteen continuous-record streamgages had flow records less than 20 years. Twenty or 30 years of flow record would have provided a broader representation of flow variability in the region and would have minimized the influence of unusually wet or dry periods. However, using a longer minimum record length would have decreased the number of available streamgages in the region of the study that already had limited data coverage. The additional streamgages in the regression analysis can

[2]A short-term streamgage has continuous-stage recording equipment with less than 10 years of record. A partial-record site has periodic streamflow measurements and does not have continuous stage-recording equipment.

Table 2. Descriptions of streamgages with 10 or more years of record considered for regionalizing flow durations in Connecticut.

[USGS, U.S. Geological Survey; no., number; mi^2, square miles]

USGS streamgage no.	Streamgage name	State	Latitude (decimal degrees)	Longitude (decimal degrees)	Drainage area (mi^2)	Years of record	Period of record
01111300	Nipmuc River near Harrisville	Rhode Island	41.981	-71.686	16.0	41.6	Mar 1964–Sep 1991, Oct 1993–Sep 2007
01111500	Branch River at Forestdale	Rhode Island	41.996	-71.563	91.2	67.7	[1]Jan 1940–Sep 2007
01115098	Peeptoad Brook at Elmdale Road near Westerly	Rhode Island	41.853	-71.606	4.83	13.3	Jun 1994–Sep 2007
01115187	Ponaganset River at South Foster	Rhode Island	41.819	-71.705	14.4	13.5	Mar 1994–Sep 2007
01117468	Beaver River near Usquepaug	Rhode Island	41.493	-71.628	8.87	32.8	Dec 1974–Sep 2007
01117500	Pawcatuck River at Wood River Junction	Rhode Island	41.445	-71.681	100	66.9	[2]Dec 1940–Sep 2007
01117800	Wood River near Arcadia	Rhode Island	41.574	-71.721	35.2	42.7	Jan 1964–Sep 1981, Oct 1982–Sep 2007
01118000	Wood River at Hope Valley	Rhode Island	41.498	-71.716	72.4	66.6	Mar 1941–Sep 2007
01118300	Pendleton Hill Brook near Clarks Falls	Connecticut	41.475	-71.834	4.02	49.0	Oct 1958–Sep 2007
01120500	Safford Brook near Woodstock Valley	Connecticut	41.926	-72.057	4.15	32.0	Oct 1950–Oct 1981
01121000	Mount Hope River near Warrenville	Connecticut	41.844	-72.169	28.6	67.0	Oct 1940–Sep 2007
01123000	Little River near Hanover	Connecticut	41.672	-72.052	30.0	56.0	Oct 1951–Sep 2007
01125490	Little River at Harrisville	Connecticut	41.928	-71.930	35.8	10.1	Aug 1961–Sep 1971
01126600	Blackwell Brook near Brooklyn	Connecticut	41.765	-71.956	17.0	13.0	Oct 1963–Oct 1976
01126950	Pachaug River at Pachaug	Connecticut	41.585	-71.933	53.0	12.2	Aug 1961–Oct 1973
01176000	Quaboag River at West Brimfield	Massachusetts	42.182	-72.264	150	95.2	Aug 1912–Sep 2007
01187300	Hubbard Brook near West Hartland	Connecticut	42.037	-72.939	19.9	68.0	Oct 1938–Sep 1955, Oct 1956–Sep 2007
01187400	Valley Brook near West Hartland	Connecticut	42.034	-72.930	7.03	32.0	Oct 1940–Sep 1972
01187800	Nepaug River near Nepaug	Connecticut	41.821	-72.970	23.5	52.0	Oct 1921–Sep 1955, Oct 1957–Sep 1972, Oct 1998–Sep 2001
01187850	Clear Brook near Collinsville	Connecticut	41.796	-72.951	0.59	55.0	Oct 1921–Oct 1973, Oct 1998–Sep 2001

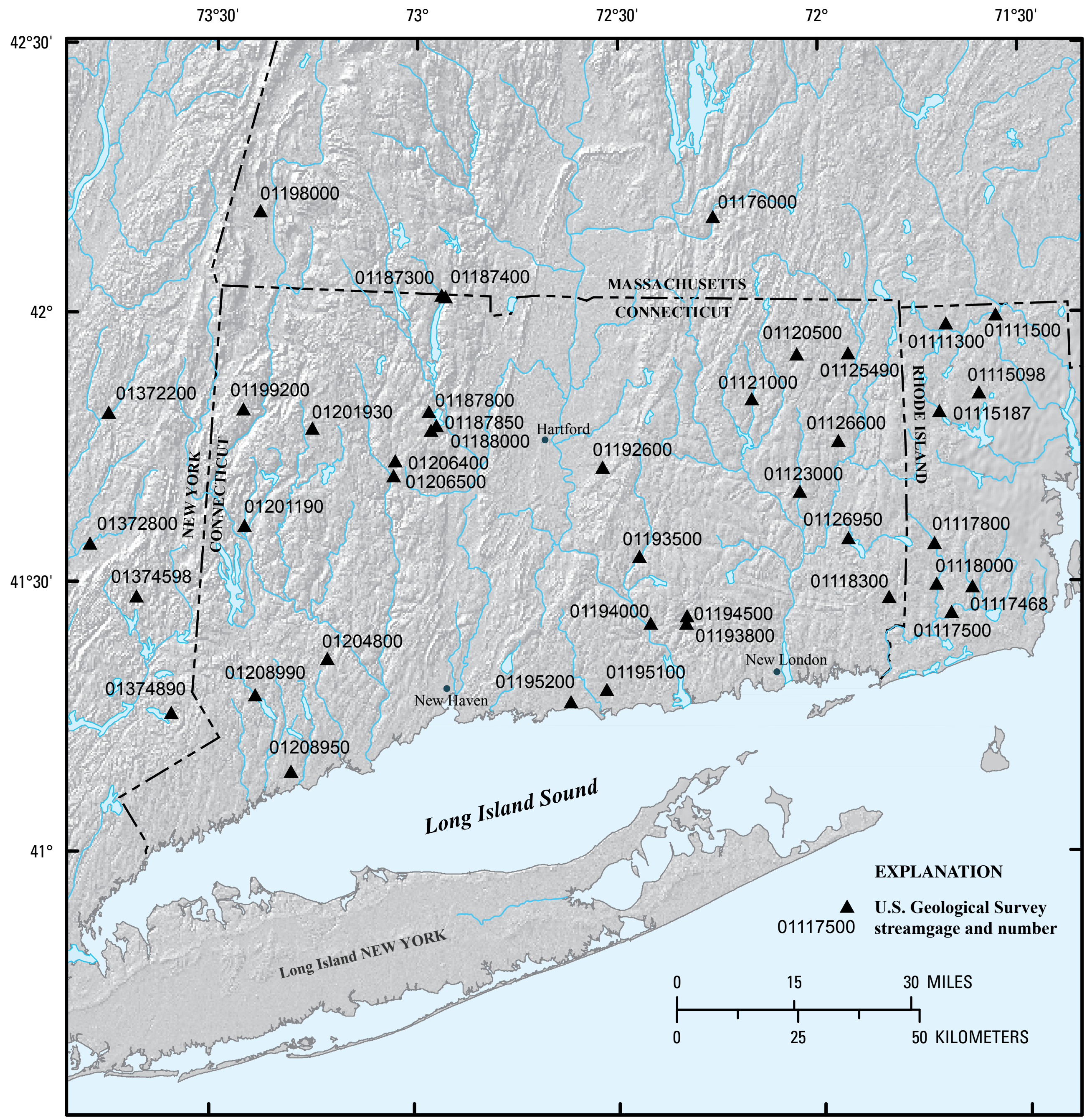
Table 2. Descriptions of streamgages with 10 or more years of record considered for regionalizing flow durations in Connecticut.—Continued

[USGS, U.S. Geological Survey; no., number; mi^2, square miles]

USGS streamgage no.	Streamgage name	State	Latitude (decimal degrees)	Longitude (decimal degrees)	Drainage area (mi^2)	Years of record	Period of record
01188000	Bunnell Brook near Burlington	Connecticut	41.786	-72.965	4.10	76.0	Oct 1931–Sep 2007
01192600	South Branch Salmon Brook at Buckingham	Connecticut	41.718	-72.540	0.94	16.0	Oct 1960–Sep 1976
01193500	Salmon River near East Hampton	Connecticut	41.552	-72.449	100	79.0	Oct 1928–Sep 2007
01193800	Hemlock Valley Brook at Hadlyme	Connecticut	41.428	-72.423	2.62	16.3	Jul 1960–Oct 1976
01194000	Eightmile River at North Lyme	Connecticut	41.442	-72.333	20.1	29.0	Oct 1937–Sep 1966
01194500	East Branch Eightmile River near North Lyme	Connecticut	41.428	-72.334	22.3	50.0	Oct 1937–Sep 1981, Oct 2001–Sep 2007
01195100	Indian River near Clinton	Connecticut	41.306	-72.531	5.68	25.9	Nov 1981–Sep 2007
01195200	Neck River near Madison	Connecticut	41.283	-72.619	6.55	20.2	Sep 1961–Nov 1981
01198000	Green River near Great Barrington	Massachusetts	42.192	-73.391	51.0	22.5	Oct 1951–Sep 1971, Mar 1994–Sep 1996
01199200	Guinea Brook at West Woods Road at Ellsworth	Connecticut	41.824	-73.430	3.50	21.2	Aug 1960–Oct 1981
01201190	West Aspectuck River at Sand Road near New Milford	Connecticut	41.608	-73.425	23.8	10.0	Oct 1962–Sep 1972
01201930	Marshepaug River near Milton	Connecticut	41.790	-73.259	9.24	14.1	Oct 1967–Oct 1981
01204800	Copper Mill Brook near Monroe	Connecticut	41.363	-73.218	2.45	18.0	Oct 1958–Oct 1976
01206400	Leadmine Brook near Harwinton	Connecticut	41.730	-73.053	19.6	13.0	Oct 1960–Oct 1973
01206500	Leadmine Brook near Thomaston	Connecticut	41.702	-73.057	24.3	29.0	Oct 1930–Sep 1959
01208950	Sasco Brook near Southport	Connecticut	41.153	-73.306	7.38	43.0	Oct 1964–Sep 2007
01208990	Saugatuck River near Redding	Connecticut	41.295	-73.395	21.0	43.0	Oct 1964–Sep 2007
01372200	Wappinger Creek near Clinton Corners	New York	41.815	-73.763	92.4	20.0	Jan 1956–Dec 1975
01372800	Fishkill Creek at Hopewell Junction	New York	41.573	-73.807	57.3	28.3	Oct 1957–Dec 1985
01374598	Horse Pound Brook near Lake Carmel	New York	41.476	-73.689	3.94	11.1	Aug 1996–Sep 2007
01374890	Cross River near Cross River	New York	41.260	-73.602	17.1	11.8	Dec 1995–Sep 2007

[1]Flow durations based on data from Oct 1956 through Sep 2007.

[2]Flow durations based on data from Oct 1969 through Sep 2007.



Base from U.S. Geological Survey digital data 1:100,000
2000, Connecticut State Plane projection

Figure 1. Locations of continuous-record streamgages considered for regionalizing flow durations in Connecticut.

result in a set of equations that are more robust. Although an effort was made by Connecticut DEP and USGS to eliminate streamgages with flow records that have been impacted by anthropogenic activities, the possibility exists that some of the flow records, particularly those in neighboring states, were affected by anthropogenic impacts.

Plots of the data revealed some streamgages are outliers; that is, data values from them depart substantially from the rest of the data. For example, Clear Brook (station 01187850), with a drainage area of only 0.59 mi^2, is an outlier. The groundwater drainage area and surface-water drainage area in this basin are not coincident. Also, Marshepaug River (station 01201930), with a drainage area of 9.24 mi^2, is an outlier. The stage-discharge relation is not well defined at this streamgage and consequently is considered less reliable than at the other streamgages. These two outlier streamgages were dropped from the regression analysis, leaving 39 streamgages.

Calculation of Flow-Duration Statistics at Streamgages

Flow durations represent the percentage of time that a given flow, measured over a specified time interval, has been equaled or exceeded during that time interval. For example, a 99-percent flow exceedance (Q_{99}) represents a streamflow that is equaled or exceeded 99 percent of the time. Flow values at or below the Q_{99} indicate extremely low flows. Conversely, a 25-percent flow exceedance (Q_{25}) represents a daily-mean streamflow that is equaled or exceeded 25 percent of the time. Flow values at or above the Q_{25} represent high-flow conditions because 75 percent of all daily mean streamflows in the record are smaller than that flow. Typically, flow durations characterize the range of flows for the period over which data were collected. The streamflow data from the streamgages used in this study are based on periods of record with varying starting and ending years (table 2) with the earliest starting in 1912 and the most recent ending in September 2007.

Flow-duration statistics are computed by sorting the daily mean streamflows for the period of record from the largest value to the smallest value and assigning each streamflow value a rank, starting with 1 for the largest value. The exceedance probabilities are then computed using the Weibull formula for computing plotting position (Helsel and Hirsch, 1992):

$$P = 100 * [M / (n + 1)], \quad (1)$$

where

P = the probability that a given flow will be equaled or exceeded (percentage of time),
M = the ranked position (dimensionless), and
n = the number of events for the period of record (dimensionless).

Flow-duration statistics, in units of cubic feet per second, were derived from historical data through September 2007 (table 3A, at back of this report). The flow exceedances were computed from daily mean flows for the period of record. Seasonal and monthly flow exceedances, representative of the bioperiods, were computed from daily mean flows for the period of record during each of the six bioperiods. For example, the Q_{99} in the Salmonid Spawning bioperiod is calculated using just daily mean flows for every November in the period of record. Similarly, the Q_{99} for the Overwinter bioperiod is calculated using all the daily mean flows for every December, January, and February in the period of record. Flow-duration statistics were computed using a commercial statistics and data-management software package called Spotfire S+® (TIBCO Software Inc., 2008).

To compare flow-duration statistics across basins, the flows were divided by their respective drainage areas (table 3B, at back of this report). The normalized non-bioperiod Q_{99} ranged from 0.0 to 0.90 $ft^3/s/mi^2$; the average value was 0.09 $ft^3/s/mi^2$. For the Rearing and Growth bioperiod (low-flow conditions), the normalized Q_{99} ranged from 0.0 to 0.90 $ft^3/s/mi^2$, the average value was 0.08 $ft^3/s/mi^2$. With the exclusion of Clear Brook, which is a low-flow outlier, the normalized non-bioperiod Q_{99} ranged from 0.0 to 0.33 $ft^3/s/mi^2$, the average value was 0.07 $ft^3/s/mi^2$. For the Rearing and Growth bioperiod, the normalized Q_{99} ranged from 0.0 to 0.30 $ft^3/s/mi^2$, the average value was 0.05 $ft^3/s/mi^2$. During high-flow conditions, the normalized non-bioperiod Q_{25} ranged from 1.56 to 3.56 $ft^3/s/mi^2$; the average value was 2.41 $ft^3/s/mi^2$. For the Habitat Forming bioperiod (high-flow conditions), the normalized Q_{25} ranged from 3.19 to 5.69 $ft^3/s/mi^2$; the average value was 4.26 $ft^3/s/mi^2$. A common time period was not used to derive the normalized flow values, and the differences in flows per square mile between the streamgages are partly attributed to the varying record lengths.

Previously derived flow-duration statistics for the Q_{99} from short-term streamgages and partial-record sites were used in conjunction with the 39 continuous-record streamgages in the regression analysis of the non-bioperiod Q_{99}. In a previous study (Ahearn, 2007), the Q_{99} was derived using the MOVE3 method (Vogel and Stedinger, 1985) for 7 short-term continuous-record and 31 partial-record sites in Connecticut; flow-duration statistics were not computed for the bioperiods. The flow-duration statistics at the short-term continuous-record streamgages and partial-record sites were calculated based on the relation between same-day flows at the short-term streamgages and partial-record sites and concurrent daily mean flows at a nearby continuous-record streamgage with natural flow conditions.

Drainage-Basin Characteristics of the Streamgages

Flow characteristics of streams are directly related to the physical, land-cover, geologic, and climatic features of the basin. Characteristics of the drainage basin were selected for use as potential explanatory variables in the regression analysis based on their theoretical relation to flows, results of previous studies in similar hydrologic regions, and the ability to measure the basin characteristics using digital data sets and GIS technology. Measuring the basin characteristics with GIS technology facilitates automation of the process and solving the regional regression equations in StreamStats.

A GIS database was set up to store the characteristics of the drainage basins measured for the streamgages used in the regression analysis. The name, units of measure, method of measurement, and source of data for each measured basin characteristic are listed in appendix 1. The drainage-basin characteristics considered for use in the Connecticut regression analysis are listed in table 4, and the measured values are in tables 5 (physical, land-cover, and geologic characteristics) and 6 (climate characteristics) (at the back of this report).

Regional Regression Analysis

Multiple linear regression (MLR) analysis was used to develop equations to predict flow-duration statistics at ungaged stream sites in Connecticut. MLR analysis provides a mathematical equation of the relation between a response variable (flow exceedance) and one or more explanatory variables (basin characteristics). After developing such equations, if the explanatory variables are known (can be measured or quantified) at the ungaged locations, the fitted equations can be used to make predictions of the response variables.

Development of Regression Equations

Basic plots and initial regression runs using all the data were used to decide if variable transformations were needed. The plots indicated that a log transformation was needed in order to meet the assumptions of linear regression. Logarithmic (base-10) transformations were made of the flow exceedances (response variable) and basin characteristics (explanatory variables) to linearize the relation between the explanatory variables and the response variables, to stabilize the variance by obtaining equal variance about the regression line, and to improve the spread of the data.

Plots of transformed and untransformed explanatory variables also were examined to eliminate redundant (correlated) explanatory variables in the variable selection process of the regression analysis. The explanatory variables were selected based on their relation to flow and correlation to other basin characteristics using Pearson's correlation coefficient (R). If a moderate correlation (R less than 0.6) existed between two explanatory variables, the two variables were evaluated individually in the variable selection process. Pearson's correlation coefficients were computed for each explanatory variable. If an explanatory variable showed low correlation to flow and high correlation to another explanatory variable with high correlation to flow, it was eliminated from consideration in the study. Several explanatory variables were found to be moderately or highly correlated to other explanatory variables (table 7).

Two automated statistical methods for selecting explanatory variables were used in the regression analysis, "all-possible subsets" and "stepwise selection." Both selection methods determined the statistical contribution of the explanatory variable that was entered into the equation and variables were retained or deleted based on their statistical importance. In "all-possible subsets," all the equations created from all possible combinations of explanatory variables were examined and the coefficient of determination (R^2) was used to check for the best combination of explanatory variables. With this method, each explanatory variable can be included or excluded independently of the other explanatory variables. Efroymson's stepwise-selection method (Efroymson, 1960) is similar to forward selection, which involves testing variables one by one and including them in the equation if they are statistically significant, except that when each new variable is added to the subset, partial correlations are considered to see if any of the variables in the subset should be dropped. When basin characteristics were found to be highly correlated, only one basin characteristic at a time was used in the selection process.

To identify the best combination of explanatory variables, different equations from the regression analysis were compared based on the adj-R^2, Mallow's Cp, PRESS statistics, and SE_r.

- **Adjusted-R-squared** (adj-R^2), also called the adjusted coefficient of determination, is a measure of the percentage of the variation explained by the explanatory variables of the equation and is adjusted for the number of parameters in the equation;

- **Mallow's Cp** statistic is an estimate of the standardized mean square error of prediction. Cp statistic is a compromise between maximizing the explained variance by including all relevant variables and minimizing the standard error by keeping the number of variables as small as possible (Helsel and Hirsch, 1992);

- **Predicted Residual Sum of Squares** (PRESS) statistic is a validation-type estimator of error (Helsel and Hirsch, 1992). PRESS uses n-1 observations to develop the equation, then estimates the value of the observation that was left out. The process is repeated for each observation and the prediction errors are squared and summed;

- **Standard error of estimate** (SE_r, in percent), also referred to as the root-mean-squared error of the residuals, is the standard deviation of observed values about the regression line. It is computed by dividing the unexplained variation or the error sum of squares by its degrees of freedom. In this study, the SE_r is based on one standard deviation.

Table 4. Characteristics of the drainage basins tested for statistical significance in developing regression equations to estimate flow-duration statistics in Connecticut.

[NAVD, North American Vertical Datum of 1988; NLCD, National Land Cover Dataset; NWI, National Wetlands Dataset; PRISM, Parameter-elevation Regressions on Independent Slopes Model (Prism Group, Oregon Climatic Service of Oregon State University); SSURGO, Soil Survey Geographic Database (Natural Resources Conservation Service, 2007)]

Physical characteristics
Drainage area (square miles)
Basin perimeter (miles)
Total river miles (miles)
Maximum basin elevation (feet, NAVD 88)
Mean basin elevation (feet, NAVD 88)
Basin relief (feet)
Mean basin slope (percent)
Latitude of basin centroid (feet)
Longitude of basin centroid (feet)
Gage latitude (decimal degrees)
Gage longitude (decimal degrees)
Total streams in contact with coarse stratified deposits (miles)
Land-cover characteristics (NLCD and NWI)
Deciduous forest (percent)
Evergreen forest (percent)
Mixed forest (percent)
Deciduous and mixed forest (percent)
Developed, open space (percent)
Developed, low intensity (percent)
Developed, open space and low intensity (percent)
Open water (percent)
Impervious area (percent)
Wetlands (percent)
Soil characteristics SSURGO
Soil hydrologic groups A, B, C, and D (dimensionless)
Surficial Geology (Connecticut Surficial Geology Map (Stone and others, 1992))
Percent till and thick till (percent)
Percent coarse stratified deposits (percent)
Percent alluvium deposits (percent)
Precipitation, drainage basin average (PRISM)
Precipitation 1971–2000, Mean annual (inches)
Precipitation 1971–2000, Maximum annual (inches)
Precipitation 1971–2000, Mean monthly salmonid spawning, November (inches)
Precipitation 1971–2000, Mean seasonal overwinter, December–February (inches)
Precipitation 1971–2000, Mean seasonal habitat forming, March–April (inches)
Precipitation 1971–2000, Mean monthly clupeid spawning, May (inches)
Precipitation 1971–2000, Mean monthly resident spawning, June (inches)
Precipitation 1971–2000, Mean seasonal rearing and growth, July–October (inches)
Temperature, drainage basin average (PRISM)
Temperature 1971–2000, Mean annual minimum (degrees Fahrenheit)
Temperature 1971–2000, Mean annual maximum (degrees Fahrenheit)
Temperature 1971–2000, Mean monthly salmonid spawning, November (degrees Fahrenheit)
Temperature 1971–2000, Mean seasonal overwinter, December–February (degrees Fahrenheit)
Temperature 1971–2000, Mean seasonal habitat forming, March–April (degrees Fahrenheit)
Temperature 1971–2000, Mean monthly clupeid spawning, May (degrees Fahrenheit)
Temperature 1971–2000, Mean monthly resident spawning, June (degrees Fahrenheit)
Temperature 1971–2000, Mean seasonal rearing and growth, July–October (degrees Fahrenheit)

Table 7. Pearson's correlation coefficients of basin characteristic and climate characteristics in Connecticut.

[Red italics, basin characteristics used in regression equations; shaded, bold figures are correlations equal to or greater than 0.6]

	Drainage area	Basin perimeter	Total river miles	Maximum basin elevation	*Mean basin elevation*	Basin relief	Mean basin slope	Latitude of basin centroid	Longitude of basin centroid	Gage latitude	Gage longitude	Total streams in contact with coarse stratified deposits	Deciduous forest	Evergreen forest	Mixed forest	Deciduous and mixed forest	Developed, open space	Developed, low intensity	Developed, open space and low intensity
Drainage area	1.0																		
Basin perimeter	**0.9**	1.0																	
Total river miles	**1.0**	**0.9**	1.0																
Maximum basin elevation	0.2	0.2	0.1	1.0															
Mean basin elevation	-0.1	-0.0	-0.1	**0.9**	1.0														
Basin relief	0.4	**0.6**	0.3	**0.8**	0.5	1.0													
Mean basin slope	-0.0	0.1	-0.1	**0.7**	**0.6**	**0.7**	1.0												
Latitude of basin centroid	0.2	0.1	0.2	**-0.6**	-0.5	-0.4	**-0.7**	1.0											
Longitude of basin centroid	0.3	0.3	0.3	**0.6**	**0.6**	0.5	0.2	0.2	1.0										
Gage latitude	0.3	0.2	0.2	**0.6**	**0.7**	0.4	0.2	0.1	**1.0**	1.0									
Gage longitude	0.1	0.0	0.2	**-0.6**	-0.5	-0.5	**-0.7**	**1.0**	0.2	0.2	1.0								
Total streams in contact with coarse-stratified deposits	**0.8**	**0.6**	**0.9**	-0.1	-0.2	0.1	-0.3	0.4	0.2	0.1	0.3	1.0							
Deciduous forest	-0.5	-0.5	-0.5	-0.0	0.1	-0.2	0.3	-0.1	-0.2	-0.2	-0.1	-0.5	1.0						
Evergreen forest	0.3	0.2	0.3	0.1	0.1	0.1	-0.0	0.3	0.4	0.4	0.3	0.4	**-0.6**	1.0					
Mixed forest	0.1	0.1	0.1	0.5	0.5	0.4	0.2	0.0	**0.6**	**0.6**	0.0	-0.0	-0.4	0.3	1.0				
Deciduous and mixed forest	-0.5	-0.5	-0.5	0.3	0.4	0.1	0.4	-0.1	0.1	0.1	-0.1	-0.5	**0.8**	-0.4	0.2	1.0			
Developed, open space	-0.2	-0.3	-0.2	-0.4	-0.3	-0.3	-0.1	-0.3	**-0.6**	**-0.6**	-0.3	-0.2	-0.2	-0.1	-0.3	-0.3	1.0		
Developed, low intensity	-0.0	-0.2	-0.0	-0.4	-0.3	-0.3	-0.3	-0.0	-0.3	-0.2	-0.0	0.1	-0.4	0.1	-0.2	-0.5	**0.6**	1.0	
Developed, open space and low intensity	-0.2	-0.3	-0.2	-0.4	-0.4	-0.4	-0.2	-0.3	-0.5	-0.5	-0.3	-0.1	-0.3	-0.0	-0.3	-0.4	**0.9**	**0.8**	1.0
Open water	0.5	0.4	0.5	0.1	-0.0	0.2	0.0	0.1	0.0	0.0	0.1	0.5	-0.2	0.2	0.0	-0.2	-0.2	-0.2	-0.2
Impervious area	0.0	-0.1	0.1	-0.4	-0.4	-0.3	-0.4	-0.1	-0.3	-0.3	-0.1	0.1	-0.4	0.0	-0.2	-0.5	**0.7**	**0.9**	**0.9**
Wetlands	0.4	0.3	0.4	-0.2	-0.2	-0.1	-0.4	**0.6**	0.1	0.1	**0.6**	**0.7**	-0.2	0.4	-0.1	-0.2	-0.3	-0.1	-0.3
Hydrologic soil type A	0.4	0.3	0.4	0.0	-0.1	0.1	-0.1	0.2	0.2	0.2	0.2	0.5	-0.1	0.3	-0.2	-0.3	-0.2	-0.0	-0.2
Hydrologic soil type B	-0.1	-0.0	-0.1	0.2	0.3	0.1	0.1	-0.1	0.3	0.3	-0.1	-0.2	-0.2	0.2	0.2	-0.1	-0.0	0.2	0.0
Hydrologic soil type C	-0.1	0.0	-0.1	0.5	0.5	0.3	0.1	-0.1	0.5	0.5	-0.0	-0.2	-0.3	0.1	**0.8**	0.2	-0.3	-0.3	-0.3
Hydrologic soil type D	-0.4	-0.3	-0.4	-0.5	-0.4	-0.4	-0.1	-0.1	**-0.7**	**-0.7**	-0.1	-0.3	0.4	-0.5	-0.4	0.2	0.4	0.1	0.3
Hydrologic soil type D and A/D and C/D	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.0	-0.2	**-0.6**	**-0.6**	-0.2	-0.4	0.4	-0.5	-0.3	0.3	0.4	0.1	0.3
Percent till and thick till	-0.4	-0.4	-0.4	0.1	0.3	-0.1	0.2	-0.2	-0.0	-0.1	-0.1	-0.5	0.4	-0.5	0.3	**0.6**	0.1	-0.3	-0.0
Percent coarse stratified deposits	0.3	0.2	0.3	-0.3	-0.4	-0.2	-0.4	0.5	0.1	0.1	0.5	0.5	-0.4	**0.6**	-0.2	-0.5	-0.1	0.4	0.1
Percent alluvium deposits	-0.1	0.1	-0.1	0.2	0.2	0.1	0.2	-0.2	-0.0	-0.0	-0.2	-0.3	0.1	-0.2	-0.1	0.1	-0.2	-0.2	-0.2
Mean annual precipitation	-0.4	-0.4	-0.4	-0.1	0.1	-0.3	-0.1	-0.0	-0.2	-0.2	-0.0	-0.3	0.2	-0.2	0.2	0.3	0.1	0.1	0.1
Maximum annual precipitation	-0.3	-0.3	-0.3	0.0	0.2	-0.1	0.1	-0.2	-0.2	-0.1	-0.2	-0.3	0.1	-0.2	0.3	0.3	0.1	0.1	0.1
Mean monthly precipitation, salmonid spawning (Nov)	-0.2	-0.3	-0.2	**-0.6**	-0.4	**-0.6**	-0.5	**0.6**	-0.2	-0.2	**0.7**	-0.0	0.1	-0.0	0.1	0.2	-0.1	0.1	-0.0
Mean seasonal precipitation, overwinter (Dec–Feb)	-0.2	-0.3	-0.1	**-0.6**	-0.4	**-0.6**	**-0.6**	**0.7**	-0.2	-0.2	**0.7**	0.0	0.1	-0.0	0.1	0.2	-0.2	0.0	-0.1
Mean seasonal precipitation, habitat forming (Mar–Apr)	-0.4	-0.4	-0.3	**-0.6**	-0.4	**-0.6**	-0.5	0.4	-0.4	-0.4	0.4	-0.1	0.2	-0.2	-0.0	0.2	0.1	0.2	0.2
Mean monthly precipitation, clupeid spawning (May)	-0.2	-0.2	-0.3	0.5	**0.6**	0.4	**0.6**	**-0.9**	-0.1	-0.1	**-0.9**	-0.3	0.1	-0.2	0.2	0.2	0.3	0.1	0.3
Mean monthly precipitation, resident spawning (Jun)	-0.2	-0.2	-0.3	**0.6**	**0.7**	0.3	0.5	**-0.8**	0.1	0.1	**-0.8**	-0.4	0.1	-0.2	0.3	0.3	0.2	0.0	0.1
Mean seasonal precipitation, rearing and growth (Jul–Oct)	-0.3	-0.2	-0.3	0.5	**0.6**	0.2	0.5	**-0.6**	0.0	0.1	**-0.6**	-0.5	0.1	-0.1	0.2	0.2	0.1	-0.0	0.1
Mean annual minimum temperature	-0.1	-0.2	-0.1	**-0.8**	**-0.8**	**-0.6**	-0.4	0.1	**-0.8**	**-0.8**	0.1	0.1	0.1	-0.2	**-0.6**	-0.3	**0.6**	0.4	0.5
Mean annual maximum temperature	-0.0	-0.0	-0.0	**-0.7**	**-0.8**	-0.4	-0.3	0.1	**-0.8**	**-0.8**	0.1	0.0	0.1	-0.2	**-0.7**	-0.4	0.5	0.3	0.5
Mean monthly temperature, salmonid spawning (Nov)	-0.0	-0.1	-0.0	**-0.9**	**-0.9**	-0.5	-0.5	0.3	**-0.8**	**-0.8**	0.3	0.1	0.1	-0.1	**-0.7**	-0.4	0.4	0.3	0.5
Mean seasonal temperature, overwinter (Dec–Feb)	-0.1	-0.1	-0.1	-0.5	**-0.6**	-0.3	-0.1	-0.2	**-0.8**	**-0.8**	-0.3	-0.1	-0.0	-0.3	-0.5	-0.3	**0.7**	0.4	**0.7**
Mean seasonal temperature, habitat forming (Mar–Apr)	-0.1	-0.0	-0.1	**-0.6**	**-0.7**	-0.4	-0.2	-0.0	**-0.8**	**-0.8**	-0.0	-0.0	0.1	-0.2	**-0.7**	-0.3	0.5	0.3	0.5
Mean monthly temperature, clupeid spawning (May)	-0.0	0.1	-0.1	-0.2	-0.4	-0.0	0.1	-0.3	-0.5	-0.4	-0.3	-0.2	0.0	-0.1	-0.5	-0.3	0.4	0.2	0.4
Mean monthly temperature, resident spawning (Jun)	0.0	0.1	-0.0	-0.3	-0.5	-0.1	0.0	-0.3	**-0.6**	**-0.6**	-0.3	-0.1	-0.1	-0.1	**-0.6**	-0.4	0.5	0.3	0.5
Mean seasonal temperature, rearing and growth (Jul–Oct)	-0.0	0.0	-0.0	**-0.7**	**-0.8**	-0.3	-0.2	-0.0	**-0.8**	**-0.8**	-0.0	-0.0	0.0	-0.2	**-0.7**	-0.4	0.5	0.3	0.5

Table 7. Pearson's correlation coefficients of basin characteristics and climate characteristics in Connecticut.—Continued

[Red italics, basin characteristics used in regression equations; shaded, bold figures are correlations equal to or greater than 0.6]

Open water	Impervious area	***Wetlands***	Hydrologic soil type A	Hydrologic soil type B	Hydrologic soil type C	Hydrologic soil type D	Hydrologic soil type D and A/D and C/D	Percent till and thick till	***Percent coarse stratified deposits***	Percent alluvium deposits	Mean annual precipitation	Maximum annual precipitation	***Mean monthly precipitation, salmonid spawning (Nov)***	***Mean seasonal precipitation, overwinter (Dec-Feb)***	Mean seasonal precipitation, habitat forming (Mar-Apr)	Mean monthly precipitation, clupeid spawning (May)	Mean monthly precipitation, resident spawning (Jun)	Mean seasonal precipitation, rearing and growth (Jul-Oct)	Mean annual minimum temperature	Mean annual maximum temperature	Mean monthly temperature, salmonid spawing (Nov)	Mean seasonal temperature, overwinter (Dec-Feb)	Mean seasonal temperature, habitat forming (Mar-Apr)	Mean monthly temperature, clupeid spawing (May)	Mean monthly temperature, resident spawning (Jun)	Mean seasonal temperature, rearing and growth, (Jul-Oct)
1.0																										
-0.1	1.0																									
0.5	-0.1	1.0																								
0.4	-0.0	**0.7**	1.0																							
-0.2	0.0	-0.3	-0.5	1.0																						
-0.1	-0.3	-0.2	-0.4	0.4	1.0																					
-0.3	0.2	-0.5	**-0.6**	-0.2	-0.3	1.0																				
-0.3	0.1	-0.5	**-0.7**	-0.2	-0.2	**1.0**	1.0																			
-0.2	-0.2	-0.4	**-0.6**	0.1	0.4	0.4	0.5	1.0																		
0.1	0.3	0.5	0.5	0.0	-0.3	-0.4	-0.4	**-0.9**	1.0																	
-0.2	-0.2	-0.4	**-0.6**	0.4	0.2	0.3	0.3	0.1	-0.3	1.0																
-0.1	0.1	-0.2	-0.4	0.1	0.3	0.3	0.3	0.5	-0.3	0.2	1.0															
-0.0	0.1	-0.3	-0.4	0.1	0.4	0.2	0.3	0.5	-0.3	0.2	**0.9**	1.0														
0.0	0.0	0.2	-0.2	-0.1	0.1	0.3	0.3	0.3	0.1	-0.1	**0.7**	0.5	1.0													
0.0	-0.0	0.3	-0.1	-0.1	0.1	0.2	0.2	0.2	0.1	-0.1	**0.6**	0.5	**1.0**	1.0												
-0.1	0.2	0.1	-0.3	-0.1	0.0	0.4	0.4	0.4	-0.0	-0.0	**0.8**	**0.7**	**0.9**	**0.9**	1.0											
-0.1	0.1	-0.5	-0.3	0.1	0.2	0.2	0.2	0.3	-0.5	0.2	0.3	0.5	-0.3	-0.4	-0.1	1.0										
-0.2	0.0	-0.5	-0.3	0.2	0.4	0.0	0.1	0.4	-0.5	0.2	0.5	**0.6**	-0.2	-0.3	0.0	**0.8**	1.0									
-0.0	-0.0	**-0.6**	-0.4	0.4	0.4	0.0	0.1	0.4	-0.5	0.4	**0.6**	**0.7**	-0.1	-0.2	0.1	**0.7**	**0.8**	1.0								
0.1	0.4	0.1	0.1	-0.4	**-0.6**	0.5	0.4	-0.1	0.1	-0.2	0.1	-0.0	0.3	0.2	0.4	-0.1	-0.3	-0.3	1.0							
0.1	0.4	0.1	0.2	-0.4	**-0.6**	0.4	0.3	-0.3	0.2	-0.1	-0.1	-0.1	0.2	0.2	0.3	-0.2	-0.4	-0.3	**0.9**	1.0						
0.1	0.4	0.2	0.1	-0.4	**-0.6**	0.5	0.4	-0.2	0.3	-0.2	-0.0	-0.1	0.4	0.3	0.4	-0.4	-0.5	-0.4	**0.9**	**1.0**	1.0					
0.0	0.5	-0.1	0.0	-0.4	-0.5	0.5	0.4	-0.0	-0.1	-0.1	0.1	0.1	0.0	-0.0	0.2	0.2	0.0	-0.1	**0.8**	**0.8**	**0.8**	1.0				
0.2	0.4	0.1	0.2	-0.4	**-0.6**	0.4	0.3	-0.2	0.1	-0.1	-0.0	-0.0	0.1	0.1	0.2	-0.1	-0.3	-0.2	**0.9**	**1.0**	**0.9**	**0.8**	1.0			
0.2	0.3	-0.1	0.2	-0.2	-0.4	0.1	0.1	-0.2	-0.0	-0.0	-0.0	-0.0	-0.2	-0.2	-0.1	0.1	0.0	0.2	0.5	**0.7**	**0.6**	**0.7**	**0.8**	1.0		
0.1	0.4	-0.2	0.1	-0.2	-0.4	0.3	0.2	-0.2	-0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.0	0.1	-0.0	0.1	**0.6**	**0.8**	**0.7**	**0.8**	**0.9**	**1.0**	1.0	
0.1	0.4	-0.0	0.1	-0.4	**-0.6**	0.5	0.4	-0.3	0.1	-0.1	-0.1	-0.1	0.1	0.1	0.2	-0.1	-0.3	-0.3	**0.9**	**1.0**	**0.9**	**0.8**	**1.0**	**0.8**	**0.9**	1.0

The equations with a smaller SE_r, Mallow's Cp, and PRESS statistic and higher adj-R^2 were preferred. In addition, the explanatory variables were selected based on (1) statistical significance at the 95-percent confidence level, (2) an analysis of the residuals, and (3) how the explanatory variables might affect flows. Explanatory variables that had a 95-percent probability of effectiveness (probably a good predictor of flow and not due to chance) were classified as significant. If an explanatory variable was significant but had only a small effect on the standard error (arbitrarily chosen as less than a 2-percent change), it was left out of the equation.

An additional criterion in selecting explanatory variables for the final regression equations was to have no more than three variables (basin characteristics). This was done to minimize overfitting the regression equation and to avoid multicollinearity among variables, which makes it difficult to evaluate the relative importance of the individual explanatory variable in the regression equation. Multicollinearity occurs when two (or more) explanatory variables are more highly correlated with each other than they are correlated with the predictor variable. The statistic used to measure the amount of multicollinearity is the variance-inflation factor (VIF) (Montgomery and others, 2001). VIF values express the ratio of the actual variance of the coefficient of the explanatory variable to its variance if it were independent of the explanatory variables (Cavalieri and others, 2000). A VIF value greater than 5–10 generally indicates that multicollinearity is a serious problem in the regression model. The basin characteristics with a VIF value less than five were chosen as the final set of explanatory variables to form the regression equations.

Ordinary least squares (OLS) and weighted least squares (WLS) regression were used for developing the equations and deriving the final coefficients in the equations (Helsel and Hirsch, 1992). In OLS regression, equal weight is given to all streamgages in the analysis regardless of record length. However, the records are not equally reliable; records from a streamgage with 10 years of flow data are not as reliable as records from a streamgage with 50 years of data. The WLS method assigns more weight in the regression to sites with longer records than shorter records, and thus, presumably, the equations are more accurate. In WLS regression, the user-defined weights were computed as the years of record at the streamgage divided by the average number of years (34.6) of record of all of the streamgages. For example, Pendleton Brook (USGS streamgage 01118300) with 49 years of record was assigned a weight of 1.42 (49/34.6), while Indian River (USGS streamgage 01195100) with 26 years of record (23 years less than Pendleton Brook) was assigned a weight of 0.75 (26/34.6).

Short-term and partial-record sites were used in conjunction with continuous-record streamgages in developing the regression equation to estimate the non-bioperiod Q_{99} (table 8, fig. 2). Short-term and partial-record sites are considered less reliable than continuous-record streamgages but were used to increase the number of sites in the analysis. For WLS weighting, short-term and partial-record sites were assigned 0.5 year for each year in which measurements were made. The user-defined weights were based on the assumption that 1 year at a partial-record site is equal to 2 years at a continuous-record site. WLS regression was used to compute the final coefficients in all 32 regression equations.

Assessment of Regression Equations

Methods of assessing the adequacy of the equations included testing each one carefully for violations of the regression assumptions and problems with outliers. The basic assumptions for a regression equation include: (1) the equation adequately describes the relation between the response and explanatory variables, (2) the mean of the residual error is zero, (3) the variance of the residual error is constant, (4) the residual errors are normally distributed, and (5) the residual errors are independent of one another (Helsel and Hirsch, 1992). Examination of the residuals plots indicated no unusual patterns. Overall, the equations appeared to fit the data reasonably well and adequately described the relation between the response and explanatory variables. The p-values from the WLS regression were checked for significance and found to be less than or equal to 0.05, which indicates the probability that the regression coefficient is significant.

Diagnostic checks on the equations included evaluating outliers and influential observations. The presence of outliers is a subtle form of non-normality and influential observations are data that substantially change the fit of the regression line. The influence of an individual observation on the regressions is measured with Cook's D statistic (Helsel and Hirsch, 1992). Cook's D statistic is a measure of the change in the parameter estimates when an observation is deleted from the regression analysis. No influential observations were found with Cook's D statistic; therefore, no individual observation appreciably altered the slope of the regression line.

Final Regression Equations

Final regression equations are listed in table 9, along with the number of stations used in the regression analysis and several performance metrics. The StreamStats variable name and the explanatory variable name used in the final regression equations, along with a definition of the variable and the units of measure, are listed in appendix 2. Six basin characteristics—drainage area, percentage of area with coarse stratified deposits, percentage of the area with wetlands, mean monthly precipitation (November), mean seasonal precipitation (December, January, and February), and mean basin elevation—are used as explanatory variables in the equations. The explanatory variables in the equations were statistically significant at the 95-percent confidence level or better, were not correlated with other explanatory variables, and improved the standard errors by more than 2 percent. The performance metrics used to report the adequacy of the final regression equations included the adj-R^2 in percent and the SE_r in percent (described in "Development of Regression Equations"). The

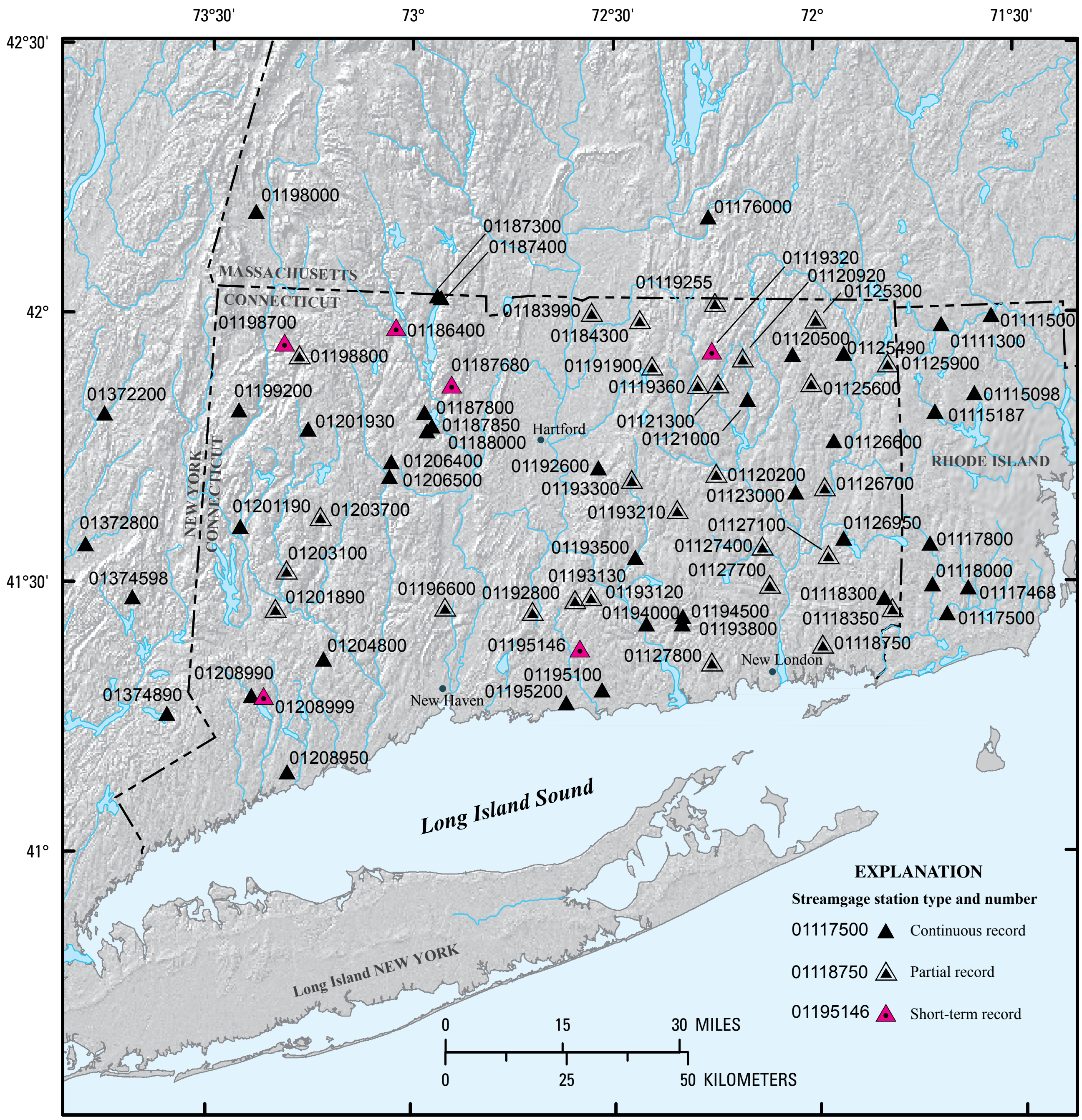


Figure 2. Locations of streamgages and short-term continuous-record and partial-record sites in Connecticut and surrounding states considered for use in developing a regression equation to estimate the non-bioperiod 99-percent flow exceedance (Q_{99}).

Table 8. Descriptions of short-term streamgages and partial-record sites considered for regionalizing flow-duration statistics in Connecticut.

[USGS, U.S. Geological Survey; no., number; mi², square miles; SHT, short-term record; P, partial record; ft³/s, cubic feet per second]

USGS streamgage no.	Streamgage name	Latitude (decimal degrees)	Longitude (decimal degrees)	Drainage area (mi²)	Years of record	Period of record	Type	99-percent flow duration (ft³/s)
01118350	Green Fall River at Clarks Falls	41.455	-71.814	19.8	12.9	Oct 1960–Sep 1973	P	0.92
01118750	Haleys Brook near Old Mystic	41.389	-71.986	4.37	16.5	Feb 1962–Aug 1978	P	0.07
01119255	Delphi Brook near Staffordville	42.023	-72.248	2.59	13.0	Aug 1962–Aug 1975	P	0.08
01119320	Roaring Brook near Stafford Springs	41.934	-72.261	14.6	5.1	Aug 1961–Sep 1966	SHT	0.47
01119360	Conat Brook at West Willington	41.871	-72.291	2.40	15.3	Jun 1963–Sep 1978	P	0.45
01120200	Tenmile River near Willimantic	41.707	-72.247	16.3	11.3	Jun 1962–Sep 1973	P	0.35
01120920	Mount Hope River at Westford	41.920	-72.179	3.16	11.1	Jul 1962–Aug 1973	P	0.11
01121300	Fenton River at East Willington	41.872	-72.241	11.4	14.8	Oct 1960–Jul 1975	P	0.88
01125300	English Neighborhood Brook at North Woodstock	41.991	-71.997	4.66	17.1	Jul 1961–Aug 1978	P	0.01
01125600	Mashamoquet Brook at Abington	41.874	-72.009	11.1	14.0	Jul 1961–Jul 1975	P	0.30
01125900	Cady Brook at East Putnam	41.909	-71.819	8.29	18.0	July 1961–July 1979	P	0.40
01126700	Kitt Brook near Canterbury	41.681	-71.978	11.1	14.1	Jul 1961–Aug 1975	P	0.34
01127100	Broad Brook near Preston City	41.554	-71.970	12.5	12.9	Oct 1960–Jun 1965, Jun 1967–Aug 1975	P	0.51
01127400	Susquetonscut Brook at Yantic	41.571	-72.133	15.7	14.8	Oct 1960–Aug 1975	P	0.56
01127700	Trading Cove Brook near Thamesville	41.501	-72.116	8.46	12.7	Oct 1960–Jun 1973	P	0.41
01127800	Fourmile River near East Lyme	41.357	-72.261	4.30	18.3	Oct 1960–Jan 1979	P	0.10
01183990	Jawbuck Brook near Hazardville	42.007	-72.553	2.16	13.3	Mar 1963–Jun 1976	P	0.35
01184300	Gillette Brook at Somers	41.992	-72.434	3.64	19.6	Sep 1960–Apr 1980	P	0.01
01186400	Sandy Brook at State Highway 8 at Robertsville	41.978	-73.045	34.9	9.0	Oct 1967–Oct 1976	SHT	2.99
01187680	Cherry Brook near Canton Center	41.872	-72.906	8.23	4.9	Oct 1966–Sep 1971	SHT	0.03
01191900	Charter Brook near Crystal Lake	41.906	-72.404	8.51	17.9	Oct 1960–Sep 1978	P	0.40
01192800	Parmalee Brook near Durham	41.452	-72.702	2.79	17.9	Oct 1960–Sep 1978	P	0.25
01193120	Ponset Brook near Higganum	41.479	-72.557	5.72	15.5	Jan 1962–Jul 1977	P	0.20
01193130	Candlewood Hill Brook near Higganum	41.474	-72.596	3.84	12.9	Oct 1960–Sep 1973	P	0.13

Table 8. Descriptions of short-term streamgages and partial-record sites considered for regionalizing flow-duration statistics in Connecticut..—Continued

[USGS, U.S. Geological Survey; no., number; mi², square miles; SHT, short-term record; P, partial record; ft³/s, cubic feet per second]

USGS streamgage no.	Streamgage name	Latitude (decimal degrees)	Longitude (decimal degrees)	Drainage area (mi²)	Years of record	Period of record	Type	99-percent flow duration (ft³/s)
01193210	Raymond Brook near Amston	41.640	-72.343	3.52	9.9	Oct 1960–Jul 1964, Aug 1967–Sep 1973	P	0.02
01193300	Blackledge River near Gilead	41.696	-72.456	6.75	15.0	Sep 1960–Aug 1975, Sep 1978	P	0.17
01195146	Pond Meadow Brook near Killingworth	41.383	-72.589	5.92	8.9	Sep 1984–Aug 1993	SHT	0.02
01196600	Willow Brook near Cheshire	41.460	-72.918	9.34	18.6	Sep 1986–Apr 2005	P	1.97
01198700	Brown Brook at Lower City	41.926	-73.280	5.56	7.9	Sep 1960–Aug 1968	P	0.12
01198800	Hollenbeck River at Huntsville	41.949	-73.321	18.1	3.9	Oct 1970–Sep 1974	SHT	1.21
01201890	Pond Brook near Hawleyville	41.456	-73.335	11.9	12.9	Oct 1962–Sep 1975	P	0.42
01203100	Jacks Brook near Roxbury Falls	41.528	-73.308	7.90	15.0	Sep 1960–Aug 1975, Aug 1978	P	0.33
01203700	Wood Creek near Bethlehem	41.627	-73.226	3.39	17.1	Oct 1960–Nov 1966, Jul 1968–Jul 1979	P	0.12
01208999	Little River at Sanfordtown	41.293	-73.368	5.50	3.5	Mar 1965–Sep 1968	SHT	0.04

Table 9. Summary of regression equations for estimating flow-duration statistics at ungaged stream sites in Connecticut and performance metrics.

[adj-R^2, adjusted coefficient of determination; Q_{25}, 25-percent flow exceedance; Q_{50}, 50-percent flow exceedance; Q_{75}, 75-percent flow exceedance; Q_{80}, 80-percent exceedance; Q_{90}, 90-percent flow exceedance; Q_{95}, 95-percent flow exceedance; Q_{99}, 99-percent flow exceedance; DRNAREA, Drainage area, in square miles; PPTnov, mean monthly precipitation for November, in inches; CRSDFT, percentage of drainage area underlain with coarse stratified deposits; PPTow, mean seasonal precipitation for Dec-Feb, in inches; WETLAND, percentage of drainage area with wetlands; ELEV, mean basin elevation, in feet]

	Regression equation	Number of stations used in analysis	adj-R^2 (percent)	Average percent standard error of estimate (range)
Salmonid Spawning (November)	$Q_{25} = (10^{-0.3513})(DRNAREA^{0.9813})(PPTnov^{1.0465})$	39	98.5	20.9 (23.0 to -18.7)
	$Q_{50} = (10^{-0.8383})(DRNAREA^{0.9761})(PPTnov^{1.3863})$	39	98.2	21.1 (23.2 to -18.8)
	$Q_{75} = (10^{-1.7042})(DRNAREA^{1.0175})(PPTnov^{2.1755})$	39	96.4	27.4 (30.9 to -23.6)
	$Q_{90} = (10^{-3.0117})(DRNAREA^{1.0418})(PPTnov^{3.5009})(CRSDFT^{0.1240})$	39	95.8	36.0 (41.8 to -29.5)
	$Q_{99} = (10^{-4.7478})(DRNAREA^{1.1056})(PPTnov^{5.2826})(CRSDFT^{0.2370})$	39	90.6	55.4 (67.8 to -40.4)
Overwinter (December–February)	$Q_{25} = (10^{-0.5449})(DRNAREA^{1.0092})(PPTow^{1.6126})$	39	97.9	19.2 (21.0 to -17.4)
	$Q_{50} = (10^{-0.9813})(DRNAREA^{1.0204})(PPTow^{1.9523})$	39	97.4	21.4 (23.6 to -19.1)
	$Q_{75} = (10^{-1.4090})(DRNAREA^{1.0328})(PPTow^{2.2826})$	39	97.4	20.7 (22.7 to -18.5)
	$Q_{95} = (10^{-2.0997})(DRNAREA^{1.0425})(PPTow^{2.8578})$	39	96.4	24.9 (27.8 to -21.7)
	$Q_{99} = (10^{-3.3438})(DRNAREA^{1.0733})(PPTow^{4.4479})$	39	96.0	28.4 (32.1 to -24.3)
Habitat Forming (March–April)	$Q_{25} = (10^{0.6225})(DRNAREA^{1.0043})$	39	99.4	11.1 (11.7 to -10.5)
	$Q_{50} = (10^{0.4185})(DRNAREA^{1.0142})$	39	99.4	10.7 (11.2 to -10.1)
	$Q_{75} = (10^{0.1998})(DRNAREA^{1.0074})(CRSDFT^{0.0641})$	39	99.3	12.9 (13.7 to -12.0)
	$Q_{95} = (10^{-0.0583})(DRNAREA^{0.9998})(CRSDFT^{0.1007})$	39	98.4	19.3 (21.1 to -17.4)
	$Q_{99} = (10^{-0.2160})(DRNAREA^{0.9979})(CRSDFT^{0.1138})$	39	98.0	20.9 (22.9 to -18.6)
Clupeid Spawning (May)	$Q_{25} = (10^{0.4126})(DRNAREA^{0.9859})(CRSDFT^{0.0376})$	39	99.0	15.1 (16.2 to -14.0)
	$Q_{50} = (10^{0.1782})(DRNAREA^{0.9932})(CRSDFT^{0.0867})$	39	98.8	17.2 (18.6 to -15.7)
	$Q_{75} = (10^{-0.0217})(DRNAREA^{0.9959})(CRSDFT^{0.1207})$	39	98.4	19.1 (20.8 to -17.2)
	$Q_{95} = (10^{-0.3712})(DRNAREA^{1.0109})(CRSDFT^{0.1999})$	39	96.9	28.1 (31.7 to -24.1)
	$Q_{99} = (10^{-0.6137})(DRNAREA^{1.0322})(CRSDFT^{0.2525})$	39	95.8	36.5 (42.4 to -29.8)
Resident Spawning (June)	$Q_{25} = (10^{0.1626})(DRNAREA^{0.9296})(CRSDFT^{0.0629})(WETLAND^{0.1276})$	39	98.1	21.9 (24.2 to -19.5)
	$Q_{50} = (10^{-0.1910})(DRNAREA^{0.9454})(CRSDFT^{0.1302})(WETLAND^{0.1242})$	39	97.8	24.9 (27.7 to -21.7)
	$Q_{75} = (10^{-0.5148})(DRNAREA^{0.9561})(CRSDFT^{0.1971})(WETLAND^{0.1518})$	39	96.7	31.9 (36.5 to -26.7)
	$Q_{90} = (10^{-0.8412})(DRNAREA^{1.0469})(CRSDFT^{0.2837})$	39	94.5	40.5 (47.7 to -32.3)
	$Q_{99} = (10^{-1.3044})(DRNAREA^{1.1021})(CRSDFT^{0.3671})$	39	90.1	67.3 (84.3 to -45.7)
Rearing and Growth (July–October)	$Q_{25} = (10^{-0.2991})(DRNAREA^{1.0311})(CRSDFT^{0.0962})$	38	96.6	30.9 (35.2 to -26.0)
	$Q_{50} = (10^{-0.7849})(DRNAREA^{1.0784})(CRSDFT^{0.1958})$	38	94.5	40.7 (47.9 to -32.4)
	$Q_{75} = (10^{-1.2209})(DRNAREA^{1.1328})(CRSDFT^{0.2765})$	38	91.9	54.2 (66.1 to -39.8)
	$Q_{80} = (10^{-1.3276})(DRNAREA^{1.1531})(CRSDFT^{0.2915})$	38	90.9	59.2 (72.9 to -42.2)
	$Q_{99} = (10^{-2.4534})(DRNAREA^{1.3776})(CRSDFT^{0.4798})$	36	77.5	156 (203 to -67.0)
Non-bio-period	$Q_{25} = (10^{-0.6903})(DRNAREA^{0.9976})(ELEV^{-0.1146})$	39	99.2	14.5 (15.5 to -13.4)
	$Q_{99} = (10^{-2.0567})(DRNAREA^{1.2141})(CRSDFT^{0.5037})$	72	81.8	111 (145 to -59.1)

metrics indicate how well the equations perform on the sites used in the regression analysis. Theoretically, the equations should perform equally well for ungaged sites as long as the basin characteristics are within the same range as those used to develop the equation. The SE_r measures the difference between the observed value (flow derived from the streamgage record) and the predicted value (flow derived from the regression equation).

In general, the physical processes controlling high flows are related to drainage area and precipitation; the physical processes controlling low flows are related to geologic characteristics as well as drainage area. “Drainage area” was the predominant predictor in all the equations. “Precipitation” was an important predictor in two high-flow bioperiods: Salmonid Spawning (mean monthly precipitation for November) and Overwinter (mean seasonal precipitation for December through February). The inclusion of the precipitation characteristics in the regression models explained an additional 4.2 and 4.9 percent of the variability and improved the standard errors of estimate by 10.3 and 13.8 percent in the Q_{99} for the Salmonid Spawning and Overwinter bioperiods, respectively. The explanatory variable “percentage of area with coarse, stratified deposits” was an important predictor in all the bioperiods, with the exception of Overwinter (December–February); typically, this characteristic was important at the exceedances higher than Q_{75} (low-flow conditions). Drainage basins underlain with a large percent of coarse stratified deposits have larger base flows than drainage basins underlain with glacial till and bedrock (Thomas, 1966). The inclusion of the variable “percentage of area with coarse stratified deposits” in the equations explained an additional 4.7, 7.4, and 6.6 percent of the variability and improved the standard errors of estimate by 11.0, 15.6, and 19.0 percent in the Q_{99} for the Clupeid Spawning, Resident Spawning, and Rearing and Growth bioperiods, respectively. The explanatory variable “percentage of the area with wetlands” was a predictor of flows in the Resident Spawning bioperiod for the Q_{25}-Q_{75} (June high and median flows). This explanatory variable, which showed a positive correlation to flow, may serve as an indicator for other factors such as soil-moisture content and surface storage that cause variation between basins but are difficult to evaluate. During wetter periods (spring), soils are saturated, and infiltration and surface storage are reduced. The explanatory variable “percentage of the area with wetlands” explained an additional 1 percent of the variability and improved the standard error of estimate by 4.4, 2.6, and 2.5 percent in the Q_{25}, Q_{50}, and Q_{75}, respectively.

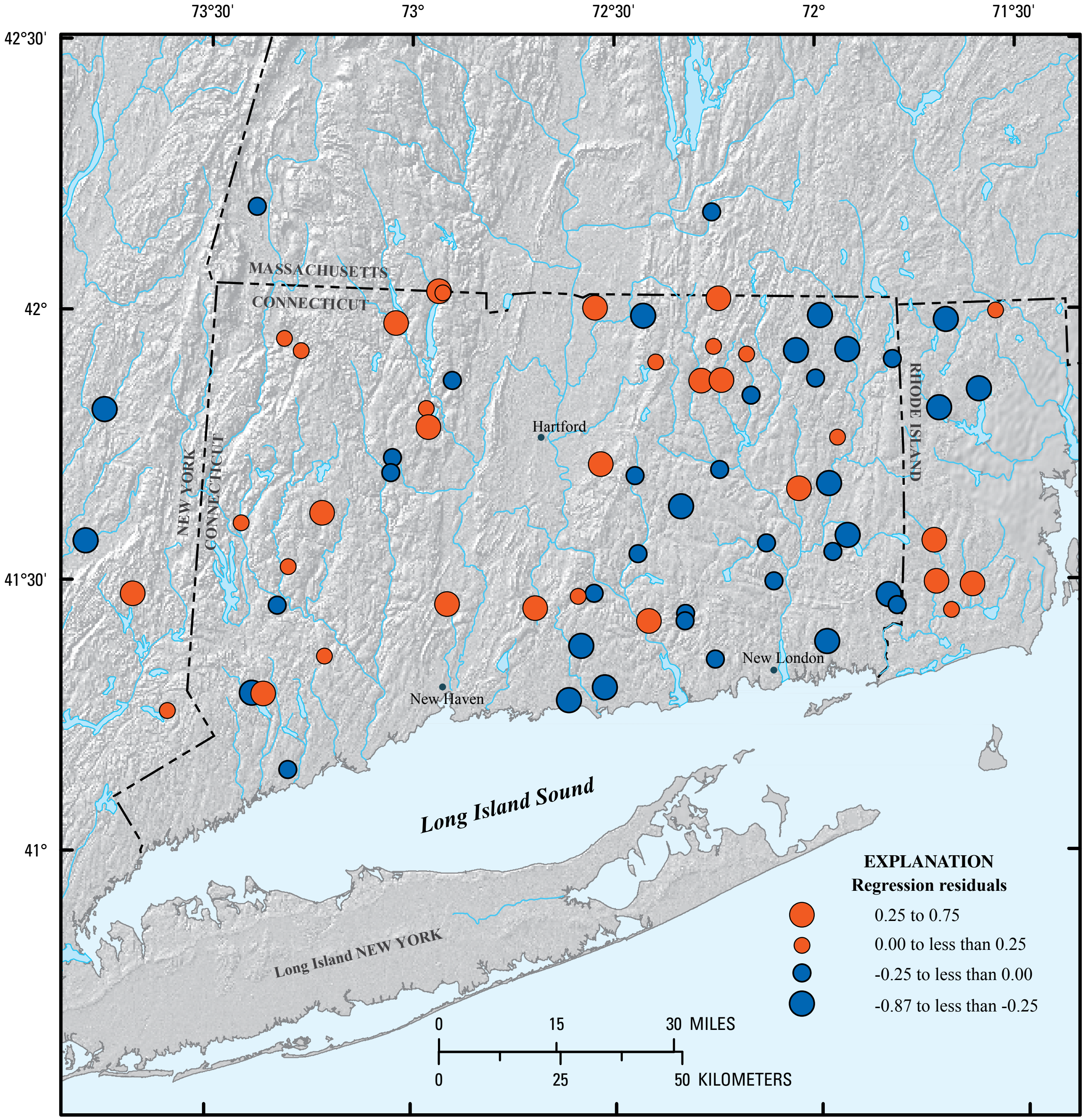
Where possible, the same explanatory variables were used for all flow exceedances in a bioperiod to ensure that the flow estimates decrease with an increase in the exceedance probability. For example, the Q_{99} is less than the Q_{90}, and the Q_{90} is less than the Q_{75}. In several bioperiods, an additional explanatory variable was added to the set of explanatory variables when it improved the standard error of estimate by more than 2 percent. The regression equations were checked to ensure that the flow estimates decrease with an increase in the exceedance probability in cases where an additional explanatory variable was added to the bioperiod.

The proportion of the variability in the flow statistic explained by the explanatory variable (adj-R^2) was greater than 90 percent for all exceedances with two exceptions: equations explained only 77.5 percent of the variability in the Q_{99} for the Rearing and Growth bioperiod and 81.3 percent of the variability in the non-bioperiod Q_{99}. The adj-R^2 of the 32 regression equations ranged from 77.5 to 99.4 percent; the medians were 98.5 and 90.6 percent for the Q_{25} and Q_{99}, respectively. Regression equations for high and median flows (Q_{25}, Q_{50}, and Q_{75}) generally had higher predictive power than regression equations for low flows (Q_{90}, Q_{95}, and Q_{99}). The standard errors of estimate to predict the Q_{25} and Q_{99} had medians of 19.2 and 55.4 percent, respectively. The Habitat Forming (March–April) bioperiod had the smallest standard errors of estimate, ranging from 10.7 to 20.9 percent for the Q_{50} and Q_{99}, respectively. In contrast, the Rearing and Growth (July–Oct) bioperiod had the largest standard errors, ranging from 30.9 to 156 percent for the Q_{25} and Q_{99}, respectively. Table 9 lists the range of standard errors, as well as the average, for each regression equation. In this study, the range is important when the average standard error is large. For example, for the Q_{99} in the Rearing and Growth bioperiod, the average standard error of estimate is 156 percent. If the regression equation resulted in a flow of 10 ft^3/s, the range of flows could be between 3.3 and 30.3 ft^3/s based on the range of the standard error of estimate. Using the average of the standard error of estimate would give a range of flows between -5.6 and 25.6 ft^3/s, which is not possible.

It is difficult to characterize low flows from information available in existing data sets. Subsequently, low flows typically have a large standard error of estimate. High evaporation rates, along with increased use of water by riparian vegetation, are processes that cause low flow but are difficult to capture as explanatory variables. The number of streamgages in the analysis, the number of years of record, the degree of the relation between the explanatory variable and the flow statistic, and the accuracy of the actual measurements all affect the accuracy of the estimates. Increasing any of these factors will improve the estimates. Future improvements in the regression equations for estimating flow durations, particularly low flows, may be made by evaluating different groupings of subsurface geologic characteristics and by incorporating higher spatial-resolution data as they become available.

Limitation of the Regression Equations

Statewide equations were developed because of the limited number of sites available for use in the regression analysis. An analysis of the residuals of the 32 regression equations indicated that no strong regional biases were evident. The residuals for each of the equations were plotted on a map. Several plots that include the variable “percentage of area with coarse stratified deposits” may show a slight regional bias. For example, figure 3 shows that the Q_{99} flows



Base from U.S. Geological Survey digital data 1:100,000
2000, Connecticut State Plane projection

Figure 3. Residuals of the regression equation for the non-bioperiod 99-percent flow exceedance (Q_{99}) for the study area. Several stations considered as outliers or having a Q_{99} value of zero were dropped from the non-bioperiod Q_{99} regression analysis including Clear Brook (01187850), Marshepaug River (01201930), and Guinea Brook (01199200).

in the eastern half of the State tend to be over-predicted and flows in the western half tend to be under-predicted. Regionalization of streamflow characteristics may be improved if there is an increased number of streamgages thus allowing for smaller subregions. The smaller subregions may provide a set of parameters with stronger predictive power. The regression equations developed in this study are not intended to be used at ungaged sites in which the basin characteristics are outside of the range of those used to create the regression equations (tables 5 and 6, at the back of this report). Flow statistics predicted by the equations represent natural flow conditions in Connecticut; effects of dams or other flow alterations are not included in the equations.

Summary

This report documents the development of regression equations with statewide application that can be used for determining flow-duration statistics at ungaged stream sites in Connecticut. Multiple linear regression equations using a weighted least squares (WLS) technique for determining flow-duration statistics were developed to estimate the 25-, 50-, 75- and 99-percent flow exceedances (Q_{25}, Q_{50}, Q_{75}, and Q_{99}) for six bioperiods—Salmonid Spawning (November), Overwinter (December–February), Habitat Forming (March–April), Clupeid Spawning (May), Resident Spawning (June), and Rearing and Growth (July–October)—and one additional low-flow-duration statistic for each bioperiod—the 80-percent exceedance (Q_{80}) for the Rearing and Growth bioperiod; the 90-percent exceedance (Q_{90}) for the Resident Spawning and Salmonid Spawning bioperiods; and the 95-percent exceedance (Q_{95}) for the Overwinter, Habitat Forming, and Clupeid Spawning bioperiods. Regression equations also were developed to estimate the 25- and 99-percent exceedances (Q_{25} and Q_{99}) without reference to a bioperiod.

Streamflow data and GIS-derived basin characteristics from 39 streamgages having 10 or more years of continuous record were used to develop the final equations. The equations were developed using WLS regression analyses with user-defined weights based on the years of streamflow record so that more weight was given in the regression models to sites with longer periods of record. Presumably, this would result in flow statistics that are more accurate. Flow exceedances computed from streamflow data through 2007 were statistically related to the basin characteristics upstream from the streamgages in the regression analysis. The basin characteristics—drainage area, percentage of area with coarse stratified deposits, percentage of the area with wetlands, monthly mean precipitation (November), mean seasonal precipitation (December–February), and mean basin elevation—were used as explanatory variables in the equations. These variables show a positive correlation to the flow for all exceedances.

The regression equations explain greater than 90 percent of the variability in the flow-duration statistics for all exceedances with two exceptions: 77.5 percent of the variability in the Q_{99} for the Rearing and Growth bioperiod and 81.3 percent of the variability in the Q_{99} for the long-term flow conditions. The standard errors of estimates for the 32 regression equations ranged from 10.7 to 156 percent. The Habitat Forming (March–April) bioperiod had the smallest standard errors of estimate, ranging from 10.7 to 20.9 percent for the Q_{50} and Q_{99}, respectively. In contrast, the Rearing and Growth (July–October) bioperiod had the largest standard errors of estimate, ranging from 30.9 to 156 percent for the Q_{25} and Q_{99}, respectively.

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Table 3. Flow-duration statistics for streamgages with at least 10 years of continuous record in Connecticut and neighboring states considered for regression analysis: *A*, Actual streamflow; *B*, Normalized streamflow.

[USGS, U.S. Geological Survey; no. number; mi^2, square miles; Q_{25}, 25-percent flow exceedance; Q_{50}, 50-percent flow exceedance; Q_{75}, 75-percent flow exceedance; Q_{90}, 90-percent flow exceedance; Q_{99}, 99-percent flow exceedance]

***A.* Actual streamflow, in cubic feet per second**

USGS streamgage no.	Streamgage name	State	Drainage area (mi^2)	Non-bioperiod	
				Q_{25}	Q_{99}
01111300	Nipmuc River near Harrisville	Rhode Island	16.0	39.0	0.34
01111500	Branch River at Forestdale	Rhode Island	91.2	228	13.0
01115098	Peeptoad Brook at Elmdale Road near Westerly	Rhode Island	4.83	14.0	0.09
01115187	Ponaganset River at South Foster	Rhode Island	14.4	35.0	0.11
01117468	Beaver River near Usquepaug	Rhode Island	8.87	30.0	2.09
01117500	Pawcatuck River at Wood River Junction	Rhode Island	100	266	28.0
01117800	Wood River near Arcadia	Rhode Island	35.2	103	7.70
01118000	Wood River at Hope Valley	Rhode Island	72.4	210	19.0
01118300	Pendleton Hill Brook near Clarks Falls	Connecticut	4.02	11.0	0.06
01120500	Safford Brook near Woodstock Valley	Connecticut	4.15	8.50	0.02
01121000	Mount Hope River near Warrenville	Connecticut	28.6	66.0	1.00
01123000	Little River near Hanover	Connecticut	30.0	69.0	4.90
01125490	Little River at Harrisville	Connecticut	35.8	56.0	0.60
01126600	Blackwell Brook near Brooklyn	Connecticut	17.0	38.0	0.70
01126950	Pachaug River at Pachaug	Connecticut	53.0	130	0.76
01176000	Quaboag River at West Brimfield	Massachusetts	150	344	16.0
01187300	Hubbard Brook near West Hartland	Connecticut	19.9	43.0	0.56
01187400	Valley Brook near West Hartland	Connecticut	7.03	16.0	0.30
01187800	Nepaug River near Nepaug	Connecticut	23.5	46.0	1.50
01187850	Clear Brook near Collinsville[1]	Connecticut	0.59	2.1	0.53
01188000	Bunnell Brook near Burlington	Connecticut	4.10	9.30	0.65
01192600	South Branch Salmon Brook at Buckingham	Connecticut	0.94	2.00	0.31
01193500	Salmon River near East Hampton	Connecticut	100	238	6.40
01193800	Hemlock Valley Brook at Hadlyme	Connecticut	2.62	6.90	0.20
01194000	Eightmile River at North Plain	Connecticut	20.1	50.0	0.60
01194500	East Branch Eightmile River near North Lyme	Connecticut	22.3	58.0	0.63
01195100	Indian River near Clinton	Connecticut	5.68	13.0	0.08
01195200	Neck River near Madison	Connecticut	6.55	15.0	0.06
01198000	Green River near Great Barrington	Massachusetts	51.0	102	3.30
01199200	Guinea Brook at West Woods Road at Ellsworth	Connecticut	3.50	9.20	[2]0.00
01201190	West Aspectuck River at Sand Road near New Milford	Connecticut	23.8	44.0	0.95
01201930	Marshepaug River near Milton1	Connecticut	9.24	27.0	0.45
01204800	Copper Mill Brook near Monroe	Connecticut	2.45	5.70	0.10
01206400	Leadmine Brook near Harwinton	Connecticut	19.6	45.0	0.60
01206500	Leadmine Brook near Thomaston	Connecticut	24.3	56.0	0.60
01208950	Sasco Brook near Southport	Connecticut	7.38	16.0	0.09
01208990	Saugatuck River near Redding	Connecticut	21.0	51.0	0.35
01372200	Wappinger Creek near Clinton Corners	New York	92.4	160	4.10
01372800	Fishkill Creek at Hopewell Junction	New York	57.2	105	2.00
01374598	Horse Pound Brook near Lake Carmel	New York	3.94	10.0	0.04
01374890	Cross River near Cross River	New York	17.1	44.0	0.46

[1]Site not used in regression.

[2]Zero value not used in regression.

Table 3. Flow-duration statistics for streamgages with at least 10 years of continuous record in Connecticut and neighboring states considered for regression analysis: *A*, Actual streamflow; *B*, Normalized streamflow.—Continued

[USGS, U.S. Geological Survey; no. number; mi^2, square miles; Q_{25}, 25-percent flow exceedance; Q_{50}, 50-percent flow exceedance; Q_{75}, 75-percent flow exceedance; Q_{90}, 90-percent flow exceedance; Q_{99}, 99-percent flow exceedance]

***A* Actual streamflow, in cubic feet per second**

USGS streamgage no.	Salmonid Spawning					USGS streamgage no.	Overwinter				
	Q_{25}	Q_{50}	Q_{75}	Q_{90}	Q_{99}		Q_{25}	Q_{50}	Q_{75}	Q_{95}	Q_{99}
01111300	33.0	17.0	7.90	4.10	0.89	01111300	48.0	30.0	18.0	8.50	4.70
01111500	202	120	75.0	45.0	21.0	01111500	280	176	113	60.0	36.0
01115098	11.0	7.00	2.80	1.04	0.54	01115098	18.0	11.0	6.20	2.30	0.99
01115187	29.0	17.0	8.40	4.20	2.20	01115187	46.0	27.0	16.0	8.40	3.70
01117468	24.0	13.0	7.10	4.40	3.30	01117468	35.0	24.0	15.0	6.90	3.40
01117500	209	118	76.0	55.0	39.0	01117500	344	223	151	79.0	52.0
01117800	81.0	50.0	31.0	17.0	9.50	01117800	128	86.0	55.0	28.0	15.0
01118000	168	94.5	60.0	39.0	22.0	01118000	250	171	114	60.0	35.0
01118300	10.0	5.40	2.90	1.40	0.53	01118300	15.0	9.00	5.40	2.50	1.50
01120500	9.60	4.50	1.70	0.94	0.25	01120500	11.0	5.60	3.20	1.50	0.90
01121000	60.0	29.0	15.0	8.60	2.80	01121000	78.0	46.0	27.0	13.0	8.00
01123000	62.5	34.0	18.0	12.0	5.90	01123000	84.0	52.0	32.0	17.0	11.0
01125490	52.0	25.0	12.5	5.40	2.80	01125490	65.0	36.0	24.0	12.0	9.20
01126600	33.0	15.0	7.80	3.05	0.78	01126600	50.0	29.0	15.0	7.80	5.10
01126950	110	54.5	34.0	10.5	6.00	01126950	156	96.0	67.0	22.0	12.0
01176000	274	142	81.0	46.0	21.0	01176000	360	220	132	60.0	39.0
01187300	47.0	26.0	12.0	6.00	2.60	01187300	44.5	25.0	16.0	7.10	4.20
01187400	14.0	7.10	2.80	1.20	0.55	01187400	14.0	8.60	5.80	2.60	1.70
01187800	38.0	20.0	9.90	5.80	3.10	01187800	45.0	27.0	16.0	7.30	5.00
01187850	1.50	1.10	0.97	0.77	0.61	01187850	1.60	1.20	0.88	0.53	0.40
01188000	9.05	5.30	2.90	1.70	1.00	01188000	9.50	6.00	3.90	2.10	1.30
01192600	1.30	0.88	0.62	0.40	0.31	01192600	1.90	1.20	0.75	0.41	0.31
01193500	200	106	56.0	29.0	16.0	01193500	288	170	103	46.0	26.0
01193800	4.90	2.60	1.70	0.70	0.43	01193800	8.55	5.20	3.10	1.60	1.00
01194000	41.0	21.0	8.20	5.00	2.40	01194000	60.0	37.0	24.0	11.0	5.70
01194500	52.0	28.0	14.0	8.00	4.30	01194500	75.0	44.0	26.0	12.0	7.50
01195100	12.0	6.30	3.10	1.50	0.68	01195100	16.0	9.80	5.90	2.90	1.40
01195200	10.0	5.05	2.30	1.20	0.44	01195200	19.0	11.0	6.10	2.50	1.40
01198000	106	43.5	17.0	7.30	3.20	01198000	100	56.0	37.0	21.0	6.10
01199200	9.00	4.20	1.80	0.48	0.07	01199200	9.70	5.20	2.80	1.20	0.45
01201190	28.0	18.0	8.60	4.20	2.50	01201190	45.0	30.0	19.0	11.0	6.00
01201930	33.0	21.0	7.95	4.85	0.80	01201930	30.0	18.0	6.60	1.90	0.26
01204800	4.40	2.70	1.50	0.85	0.21	01204800	7.10	4.20	2.50	1.20	0.70
01206400	44.0	28.0	15.0	4.00	1.20	01206400	47.0	28.0	21.0	9.90	6.40
01206500	50.0	23.5	10.0	5.90	1.80	01206500	59.0	34.0	19.0	8.00	4.30
01208950	15.0	8.30	3.90	1.60	0.32	01208950	20.0	12.0	7.20	2.70	0.88
01208990	47.0	26.0	14.0	5.40	1.00	01208990	67.0	40.0	23.0	9.70	5.00
01372200	114	62.0	28.0	12.0	5.80	01372200	180	100	60.0	21.0	10.0
01372800	71.0	41.0	15.0	6.70	4.30	01372800	124	76.0	43.0	14.0	6.90
01374598	12.0	6.00	2.40	0.76	0.17	01374598	12.0	7.50	3.95	1.20	0.63
01374890	46.0	25.0	9.90	1.95	1.10	01374890	57.0	33.0	16.5	5.10	2.50

Table 3. Flow-duration statistics for streamgages with at least 10 years of continuous record in Connecticut and neighboring states considered for regression analysis: *A*, Actual streamflow; *B*, Normalized streamflow.—Continued

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***A* Actual streamflow, in cubic feet per second**

USGS streamgage no.	Habitat Forming					USGS streamgage no.	Clupeid Spawning				
	Q_{25}	Q_{50}	Q_{75}	Q_{95}	Q_{99}		Q_{25}	Q_{50}	Q_{75}	Q_{95}	Q_{99}
01111300	69.0	44.0	30.0	17.0	12.0	01111300	43.0	29.0	20.0	11.0	8.00
01111500	395	254	173	101	69.0	01111500	240	162	116	66.0	51.0
01115098	24.0	16.0	11.0	6.80	4.00	01115098	15.0	10.0	6.90	4.40	2.70
01115187	60.0	37.0	24.0	16.0	11.0	01115187	36.0	23.0	15.0	9.60	5.40
01117468	44.0	31.0	23.0	16.0	11.0	01117468	33.0	25.0	19.0	13.0	11.0
01117500	429	307	224	149	114	01117500	319	234	183	133	99.0
01117800	158	112	83.0	55.0	40.0	01117800	110	84.0	62.0	43.0	36.0
01118000	324	234	176	118	87.0	01118000	228	172	132	91.0	72.0
01118300	18.0	12.0	8.30	5.20	3.60	01118300	13.0	8.30	5.70	3.10	2.10
01120500	18.0	10.0	6.10	3.20	2.00	01120500	8.10	4.90	3.20	1.50	0.88
01121000	113	73.0	52.0	30.0	22.0	01121000	72.0	48.0	31.0	16.0	11.0
01123000	113	77.0	55.0	33.0	22.0	01123000	75.0	53.0	38.0	23.0	19.0
01125490	148	90.0	54.0	25.0	20.0	01125490	64.0	41.5	30.0	14.0	7.80
01126600	64.0	43.0	30.0	17.0	12.0	01126600	39.0	28.0	20.0	11.0	5.40
01126950	215	153	106	62.0	46.0	01126950	154	104	77.5	48.0	26.0
01176000	660	445	300	160	110	01176000	412	286	192	114	83.0
01187300	103	55.0	31.0	16.0	10.0	01187300	55.0	30.0	19.0	8.60	5.00
01187400	40.0	23.0	14.0	7.10	5.00	01187400	22.0	14.0	9.30	4.90	2.80
01187800	99.0	60.0	40.0	22.0	16.0	01187800	56.5	37.0	25.0	13.0	9.30
01187850	2.60	2.00	1.40	0.88	0.61	01187850	2.70	2.20	1.70	1.10	0.97
01188000	17.0	11.0	7.40	4.30	3.10	01188000	11.0	7.40	5.30	3.10	2.20
01192600	3.00	2.40	1.70	0.98	0.71	01192600	2.60	2.00	1.40	0.92	0.74
01193500	408	270	189	118	88.0	01193500	272	180	124	73.0	51.0
01193800	11.0	7.60	5.60	3.60	2.80	01193800	9.10	5.80	4.00	2.40	1.60
01194000	86.0	57.0	41.0	26.0	20.0	01194000	54.0	36.0	24.0	15.0	10.0
01194500	100	65.0	45.0	27.0	19.0	01194500	66.0	44.0	29.0	18.0	12.0
01195100	20.0	13.0	8.20	5.40	4.10	01195100	13.0	8.00	5.30	2.60	1.60
01195200	27.0	17.0	12.0	7.15	5.40	01195200	18.0	11.5	7.70	4.30	3.00
01198000	237	140	86.0	44.0	30.0	01198000	128	91.0	65.0	33.0	22.0
01199200	17.0	11.0	6.60	2.80	2.10	01199200	11.0	6.70	4.30	1.70	0.96
01201190	88.0	58.0	39.0	23.0	18.0	01201190	56.0	35.0	24.0	12.0	8.50
01201930	44.0	26.0	12.0	4.00	1.30	01201930	25.0	14.0	8.20	1.90	0.90
01204800	10.0	6.50	4.50	2.90	2.20	01204800	6.30	4.00	2.80	1.40	0.73
01206400	93.0	57.0	39.0	22.0	19.0	01206400	48.0	32.0	24.0	9.80	6.30
01206500	118	68.0	45.0	27.0	16.0	01206500	68.0	41.0	26.0	12.0	9.00
01208950	26.0	16.0	11.0	6.60	4.90	01208950	18.0	11.0	6.60	2.90	1.80
01208990	87.0	52.0	36.0	22.0	15.0	01208990	55.0	34.0	22.0	11.0	6.30
01372200	348	208	136	67.0	52.0	01372200	172	109	74.0	37.0	25.0
01372800	206	136	91.0	45.0	35.0	01372800	113	77.0	53.0	28.0	21.0
01374598	15.0	9.90	6.70	3.50	2.80	01374598	8.90	5.30	3.40	1.70	1.20
01374890	65.0	42.0	30.0	14.0	11.0	01374890	41.0	26.0	16.0	7.30	3.70

Table 3. Flow-duration statistics for streamgages with at least 10 years of continuous record in Connecticut and neighboring states considered for regression analysis: *A*, Actual streamflow; *B*, Normalized streamflow.—Continued

[USGS, U.S. Geological Survey; no. number; mi^2, square miles; Q_{25}, 25-percent flow exceedance; Q_{50}, 50-percent flow exceedance; Q_{75}, 75-percent flow exceedance; Q_{90}, 90-percent flow exceedance; Q_{99}, 99-percent flow exceedance]

***A* Actual streamflow, in cubic feet per second**

USGS streamgage no.	Resident Spawning					USGS streamgage no.	Rearing and Growth				
	Q_{25}	Q_{50}	Q_{75}	Q_{90}	Q_{99}		Q_{25}	Q_{50}	Q_{75}	Q_{95}	Q_{99}
01111300	26.0	12.0	6.90	3.80	1.50	01111300	8.70	3.60	1.60	1.30	0.13
01111500	144	81.5	53.0	37.0	24.0	01111500	75.0	43.0	27.0	24.0	9.10
01115098	10.0	4.65	2.50	1.50	0.70	01115098	2.40	0.99	0.53	0.45	0.03
01115187	23.0	10.0	4.75	2.90	1.10	01115187	7.20	2.50	0.98	0.77	0.04
01117468	26.0	16.0	11.0	8.80	5.90	01117468	10.0	6.60	4.30	3.80	1.80
01117500	236	150	110	86.0	63.0	01117500	113	75.0	52.0	48.0	24.0
01117800	77.0	47.0	33.0	25.0	16.0	01117800	36.0	22.0	14.0	13.0	6.00
01118000	153	100	72.0	55.0	36.0	01118000	75.0	49.0	34.0	31.0	16.0
01118300	7.30	3.80	2.00	1.10	0.50	01118300	2.90	1.20	0.50	0.41	0.03
01120500	3.40	1.90	1.10	0.60	0.15	01120500	1.90	0.70	0.28	0.20	0.01
01121000	40.0	20.0	11.0	6.50	2.90	01121000	17.0	7.90	3.70	3.10	0.67
01123000	45.0	27.0	18.0	13.0	8.30	01123000	22.0	13.0	8.50	7.90	4.40
01125490	37.0	21.0	11.0	6.80	2.35	01125490	12.0	5.90	2.70	2.20	0.50
01126600	25.0	11.0	6.30	3.40	1.40	01126600	8.50	3.80	1.90	1.50	0.60
01126950	106	63.0	37.0	22.0	18.0	01126950	49.0	19.0	11.0	11.0	20.00
01176000	228	132	85.0	58.0	30.0	01176000	122	67.0	40.0	36.0	11.0
01187300	27.0	12.0	6.00	3.40	1.60	01187300	12.0	4.60	2.10	1.90	0.40
01187400	12.0	6.00	3.50	1.80	0.70	01187400	3.50	1.40	0.70	0.60	0.20
01187800	33.0	18.0	10.0	6.95	3.50	01187800	14.0	6.90	3.90	3.30	0.70
01187850	2.40	1.90	1.60	1.20	0.88	01187850	1.70	1.30	1.00	0.97	0.53
01188000	6.60	3.90	2.60	1.80	0.97	01188000	3.70	2.10	1.30	1.20	0.50
01192600	2.10	1.50	1.10	0.74	0.51	01192600	1.20	0.84	0.60	0.55	0.28
01193500	148	82.0	48.0	31.0	16.0	01193500	66.0	31.0	17.0	15.0	4.80
01193800	4.25	2.40	1.30	0.80	0.38	01193800	1.60	0.73	0.38	0.33	0.15
01194000	24.0	14.0	8.00	4.80	2.00	01194000	10.0	4.50	2.30	2.00	0.40
01194500	33.0	18.0	10.0	6.15	2.45	01194500	15.0	6.10	2.90	2.40	0.35
01195100	7.70	3.30	1.30	0.78	0.34	01195100	2.70	1.00	0.45	0.38	0.02
01195200	8.10	4.10	2.50	1.50	0.68	01195200	3.00	1.30	0.50	0.39	0.02
01198000	52.0	32.5	20.0	14.0	9.10	01198000	21.0	11.0	6.10	5.60	2.90
01199200	5.60	2.30	1.10	0.55	0.11	01199200	1.90	0.49	0.16	0.11	20.00
01201190	37.5	16.5	7.50	5.30	3.30	01201190	11.0	4.70	2.60	2.30	0.80
01201930	14.5	7.25	4.60	2.45	1.20	01201930	12.0	4.65	2.80	2.30	0.36
01204800	2.70	1.60	0.85	0.55	0.24	01204800	1.50	0.63	0.31	0.27	0.09
01206400	30.0	16.0	7.80	3.80	1.60	01206400	14.0	4.80	2.00	1.70	0.50
01206500	34.0	16.0	8.20	4.50	2.20	01206500	14.0	5.00	2.00	1.70	0.30
01208950	11.0	4.75	2.30	1.20	0.46	01208950	4.80	1.90	0.72	0.57	0.04
01208990	33.0	15.0	8.30	4.95	2.20	01208990	16.0	6.00	2.30	1.80	0.20
01372200	103	57.0	33.0	22.0	8.80	01372200	50.0	22.0	12.0	10.0	2.80
01372800	78.0	39.0	26.0	16.0	4.40	01372800	36.0	17.0	8.10	6.90	1.20
01374598	8.20	3.40	1.50	0.77	0.48	01374598	2.80	1.00	0.45	0.36	0.01
01374890	34.0	14.0	6.80	3.90	2.00	01374890	16.0	5.10	2.00	1.70	0.29

Table 3. Flow-duration statistics for streamgages with at least 10 years of continuous record in Connecticut and neighboring states considered for regression analysis: *A*, Actual streamflow; *B*, Normalized streamflow.—Continued

[USGS, U.S. Geological Survey; no. number; mi², square miles; Q_{25}, 25-percent flow exceedance; Q_{50}, 50-percent flow exceedance; Q_{75}, 75-percent flow exceedance; Q_{90}, 90-percent flow exceedance; Q_{99}, 99-percent flow exceedance]

***B* Normalized streamflow, in cubic feet per second per square mile**

USGS streamgage no.	Streamgage name	State	Drainage area (mi²)	Non-bioperiod	
				Q_{25}	Q_{99}
01111300	Nipmuc River near Harrisville	Rhode Island	16.0	2.44	0.02
01111500	Branch River at Forestdale	Rhode Island	91.2	2.50	0.14
01115098	Peeptoad Brook at Elmdale Road near Westerly	Rhode Island	4.83	2.90	0.02
01115187	Ponaganset River at South Foster	Rhode Island	14.4	2.43	0.01
01117468	Beaver River near Usquepaug	Rhode Island	8.87	3.38	0.24
01117500	Pawcatuck River at Wood River Junction	Rhode Island	100	2.66	0.28
01117800	Wood River near Arcadia	Rhode Island	35.2	2.93	0.22
01118000	Wood River at Hope Valley	Rhode Island	72.4	2.90	0.26
01118300	Pendleton Hill Brook near Clarks Falls	Connecticut	4.02	2.74	0.01
01120500	Safford Brook near Woodstock Valley	Connecticut	4.15	2.05	0.00
01121000	Mount Hope River near Warrenville	Connecticut	28.6	2.31	0.03
01123000	Little River near Hanover	Connecticut	30.0	2.30	0.16
01125490	Little River at Harrisville	Connecticut	35.8	1.56	0.02
01126600	Blackwell Brook near Brooklyn	Connecticut	17.0	2.24	0.04
01126950	Pachaug River at Pachaug	Connecticut	53.0	2.45	0.01
01176000	Quaboag River at West Brimfield	Massachusetts	150	2.29	0.11
01187300	Hubbard Brook near West Hartland	Connecticut	19.9	2.16	0.03
01187400	Valley Brook near West Hartland	Connecticut	7.03	2.28	0.04
01187800	Nepaug River near Nepaug	Connecticut	23.5	1.96	0.06
01187850	Clear Brook near Collinsville1	Connecticut	0.59	3.56	0.90
01188000	Bunnell Brook near Burlington	Connecticut	4.10	2.27	0.16
01192600	South Branch Salmon Brook at Buckingham	Connecticut	0.94	2.13	0.33
01193500	Salmon River near East Hampton	Connecticut	100	2.38	0.06
01193800	Hemlock Valley Brook at Hadlyme	Connecticut	2.62	2.63	0.08
01194000	Eightmile River at North Plain	Connecticut	20.1	2.49	0.03
01194500	East Branch Eightmile River near North Lyme	Connecticut	22.3	2.60	0.03
01195100	Indian River near Clinton	Connecticut	5.68	2.29	0.01
01195200	Neck River near Madison	Connecticut	6.55	2.29	0.01
01198000	Green River near Great Barrington	Massachusetts	51.0	2.00	0.06
01199200	Guinea Brook at West Woods Road at Ellsworth	Connecticut	3.50	2.63	0.00
01201190	West Aspectuck River at Sand Road near New Milford	Connecticut	23.8	1.85	0.04
01201930	Marshepaug River near Milton1	Connecticut	9.24	2.92	0.05
01204800	Copper Mill Brook near Monroe	Connecticut	2.45	2.33	0.04
01206400	Leadmine Brook near Harwinton	Connecticut	19.6	2.30	0.03
01206500	Leadmine Brook near Thomaston	Connecticut	24.3	2.30	0.02
01208950	Sasco Brook near Southport	Connecticut	7.38	2.17	0.01
01208990	Saugatuck River near Redding	Connecticut	21.0	2.43	0.02
01372200	Wappinger Creek near Clinton Corners	New York	92.4	1.73	0.04
01372800	Fishkill Creek at Hopewell Junction	New York	57.2	1.84	0.03
01374598	Horse Pound Brook near Lake Carmel	New York	3.94	2.54	0.01
01374890	Cross River near Cross River	New York	17.1	2.57	0.03
			Minimum	1.56	0.00
			Maximum	3.56	0.90
			Average	2.41	0.09

Table 3. Flow-duration statistics for streamgages with at least 10 years of continuous record in Connecticut and neighboring states considered for regression analysis: *A*, Actual streamflow; *B*, Normalized streamflow.—Continued

[USGS, U.S. Geological Survey; no. number; mi², square miles; Q_{25}, 25-percent flow exceedance; Q_{50}, 50-percent flow exceedance; Q_{75}, 75-percent flow exceedance; Q_{90}, 90-percent flow exceedance; Q_{99}, 99-percent flow exceedance]

B **Normalized streamflow, in cubic feet per second per square mile**

USGS streamgage no.	Salmonid Spawning					USGS streamgage no.	Overwinter				
	Q_{25}	Q_{50}	Q_{75}	Q_{90}	Q_{99}		Q_{25}	Q_{50}	Q_{75}	Q_{95}	Q_{99}
01111300	2.06	1.06	0.49	0.26	0.06	01111300	3.00	1.88	1.13	0.53	0.29
01111500	2.21	1.32	0.82	0.49	0.23	01111500	3.07	1.93	1.24	0.66	0.39
01115098	2.28	1.45	0.58	0.22	0.11	01115098	3.73	2.28	1.28	0.48	0.20
01115187	2.01	1.18	0.58	0.29	0.15	01115187	3.19	1.88	1.11	0.58	0.26
01117468	2.71	1.47	0.80	0.50	0.37	01117468	3.95	2.71	1.69	0.78	0.38
01117500	2.09	1.18	0.76	0.55	0.39	01117500	3.44	2.23	1.51	0.79	0.52
01117800	2.30	1.42	0.88	0.48	0.27	01117800	3.64	2.44	1.56	0.80	0.43
01118000	2.32	1.31	0.83	0.54	0.30	01118000	3.45	2.36	1.57	0.83	0.48
01118300	2.49	1.34	0.72	0.35	0.13	01118300	3.73	2.24	1.34	0.62	0.37
01120500	2.31	1.08	0.41	0.23	0.06	01120500	2.65	1.35	0.77	0.36	0.22
01121000	2.10	1.01	0.52	0.30	0.10	01121000	2.73	1.61	0.94	0.45	0.28
01123000	2.08	1.13	0.60	0.40	0.20	01123000	2.80	1.73	1.07	0.57	0.37
01125490	1.45	0.70	0.35	0.15	0.08	01125490	1.82	1.01	0.67	0.34	0.26
01126600	1.94	0.88	0.46	0.18	0.05	01126600	2.94	1.71	0.88	0.46	0.30
01126950	2.08	1.03	0.64	0.20	0.11	01126950	2.94	1.81	1.26	0.42	0.23
01176000	1.83	0.95	0.54	0.31	0.14	01176000	2.40	1.47	0.88	0.40	0.26
01187300	2.36	1.31	0.60	0.30	0.13	01187300	2.24	1.26	0.80	0.36	0.21
01187400	1.99	1.01	0.40	0.17	0.08	01187400	1.99	1.22	0.83	0.37	0.24
01187800	1.62	0.85	0.42	0.25	0.13	01187800	1.91	1.15	0.68	0.31	0.21
01187850	2.54	1.86	1.64	1.31	1.03	01187850	2.71	2.03	1.49	0.90	0.68
01188000	2.21	1.29	0.71	0.41	0.24	01188000	2.32	1.46	0.95	0.51	0.32
01192600	1.38	0.94	0.66	0.43	0.33	01192600	2.02	1.28	0.80	0.44	0.33
01193500	2.00	1.06	0.56	0.29	0.16	01193500	2.88	1.70	1.03	0.46	0.26
01193800	1.87	0.99	0.65	0.27	0.16	01193800	3.26	1.98	1.18	0.61	0.38
01194000	2.04	1.04	0.41	0.25	0.12	01194000	2.99	1.84	1.19	0.55	0.28
01194500	2.33	1.26	0.63	0.36	0.19	01194500	3.36	1.97	1.17	0.54	0.34
01195100	2.11	1.11	0.55	0.26	0.12	01195100	2.82	1.73	1.04	0.51	0.25
01195200	1.53	0.77	0.35	0.18	0.07	01195200	2.90	1.68	0.93	0.38	0.21
01198000	2.08	0.85	0.33	0.14	0.06	01198000	1.96	1.10	0.73	0.41	0.12
01199200	2.57	1.20	0.51	0.14	0.02	01199200	2.77	1.49	0.80	0.34	0.13
01201190	1.18	0.76	0.36	0.18	0.11	01201190	1.89	1.26	0.80	0.46	0.25
01201930	3.57	2.27	0.86	0.52	0.09	01201930	3.25	1.95	0.71	0.21	0.03
01204800	1.80	1.10	0.61	0.35	0.09	01204800	2.90	1.71	1.02	0.49	0.29
01206400	2.24	1.43	0.77	0.20	0.06	01206400	2.40	1.43	1.07	0.51	0.33
01206500	2.06	0.97	0.41	0.24	0.07	01206500	2.43	1.40	0.78	0.33	0.18
01208950	2.03	1.12	0.53	0.22	0.04	01208950	2.71	1.63	0.98	0.37	0.12
01208990	2.24	1.24	0.67	0.26	0.05	01208990	3.19	1.90	1.10	0.46	0.24
01372200	1.23	0.67	0.30	0.13	0.06	01372200	1.95	1.08	0.65	0.23	0.11
01372800	1.24	0.72	0.26	0.12	0.08	01372800	2.17	1.33	0.75	0.24	0.12
01374598	3.05	1.52	0.61	0.19	0.04	01374598	3.05	1.90	1.00	0.30	0.16
01374890	2.69	1.46	0.58	0.11	0.06	01374890	3.33	1.93	0.96	0.30	0.15
Minimum	1.18	0.67	0.26	0.11	0.02		1.82	1.01	0.65	0.21	0.03
Maximum	3.57	2.27	1.64	1.31	1.03		3.95	2.71	1.69	0.90	0.68
Average	2.10	1.15	0.59	0.31	0.15		2.80	1.71	1.03	0.48	0.27

Table 3. Flow-duration statistics for streamgages with at least 10 years of continuous record in Connecticut and neighboring states considered for regression analysis: *A*, Actual streamflow; *B*, Normalized streamflow.—Continued

[USGS, U.S. Geological Survey; no. number; mi², square miles; Q_{25}, 25-percent flow exceedance; Q_{50}, 50-percent flow exceedance; Q_{75}, 75-percent flow exceedance; Q_{90}, 90-percent flow exceedance; Q_{99}, 99-percent flow exceedance]

B **Normalized streamflow, in cubic feet per second per square mile**

USGS streamgage no.	Habitat Forming					USGS streamgage no.	Clupeid Spawning				
	Q_{25}	Q_{50}	Q_{75}	Q_{95}	Q_{99}		Q_{25}	Q_{50}	Q_{75}	Q_{95}	Q_{99}
01111300	4.31	2.75	1.88	1.06	0.75	01111300	2.69	1.81	1.25	0.69	0.50
01111500	4.33	2.79	1.90	1.11	0.76	01111500	2.63	1.78	1.27	0.72	0.56
01115098	4.97	3.31	2.28	1.41	0.83	01115098	3.11	2.07	1.43	0.91	0.56
01115187	4.17	2.57	1.67	1.11	0.76	01115187	2.50	1.60	1.04	0.67	0.38
01117468	4.96	3.49	2.59	1.80	1.24	01117468	3.72	2.82	2.14	1.47	1.24
01117500	4.29	3.07	2.24	1.49	1.14	01117500	3.19	2.34	1.83	1.33	0.99
01117800	4.49	3.18	2.36	1.56	1.14	01117800	3.13	2.39	1.76	1.22	1.02
01118000	4.48	3.23	2.43	1.63	1.20	01118000	3.15	2.38	1.82	1.26	0.99
01118300	4.48	2.99	2.06	1.29	0.90	01118300	3.23	2.06	1.42	0.77	0.52
01120500	4.34	2.41	1.47	0.77	0.48	01120500	1.95	1.18	0.77	0.36	0.21
01121000	3.95	2.55	1.82	1.05	0.77	01121000	2.52	1.68	1.08	0.56	0.38
01123000	3.77	2.57	1.83	1.10	0.73	01123000	2.50	1.77	1.27	0.77	0.63
01125490	4.13	2.51	1.51	0.70	0.56	01125490	1.79	1.16	0.84	0.39	0.22
01126600	3.76	2.53	1.76	1.00	0.71	01126600	2.29	1.65	1.18	0.65	0.32
01126950	4.06	2.89	2.00	1.17	0.87	01126950	2.91	1.96	1.46	0.91	0.49
01176000	4.40	2.97	2.00	1.07	0.73	01176000	2.75	1.91	1.28	0.76	0.55
01187300	5.18	2.76	1.56	0.80	0.50	01187300	2.76	1.51	0.95	0.43	0.25
01187400	5.69	3.27	1.99	1.01	0.71	01187400	3.13	1.99	1.32	0.70	0.40
01187800	4.21	2.55	1.70	0.94	0.68	01187800	2.40	1.57	1.06	0.55	0.40
01187850	4.41	3.39	2.37	1.49	1.03	01187850	4.58	3.73	2.88	1.86	1.64
01188000	4.15	2.68	1.80	1.05	0.76	01188000	2.68	1.80	1.29	0.76	0.54
01192600	3.19	2.55	1.81	1.04	0.76	01192600	2.77	2.13	1.49	0.98	0.79
01193500	4.08	2.70	1.89	1.18	0.88	01193500	2.72	1.80	1.24	0.73	0.51
01193800	4.20	2.90	2.14	1.37	1.07	01193800	3.47	2.21	1.53	0.92	0.61
01194000	4.28	2.84	2.04	1.29	1.00	01194000	2.69	1.79	1.19	0.75	0.50
01194500	4.48	2.91	2.02	1.21	0.85	01194500	2.96	1.97	1.30	0.81	0.54
01195100	3.52	2.29	1.44	0.95	0.72	01195100	2.29	1.41	0.93	0.46	0.28
01195200	4.12	2.60	1.83	1.09	0.82	01195200	2.75	1.76	1.18	0.66	0.46
01198000	4.65	2.75	1.69	0.86	0.59	01198000	2.51	1.78	1.27	0.65	0.43
01199200	4.86	3.14	1.89	0.80	0.60	01199200	3.14	1.91	1.23	0.49	0.27
01201190	3.70	2.44	1.64	0.97	0.76	01201190	2.35	1.47	1.01	0.50	0.36
01201930	4.76	2.81	1.30	0.43	0.14	01201930	2.71	1.52	0.89	0.21	0.10
01204800	4.08	2.65	1.84	1.18	0.90	01204800	2.57	1.63	1.14	0.57	0.30
01206400	4.74	2.91	1.99	1.12	0.97	01206400	2.45	1.63	1.22	0.50	0.32
01206500	4.86	2.80	1.85	1.11	0.66	01206500	2.80	1.69	1.07	0.49	0.37
01208950	3.52	2.17	1.49	0.89	0.66	01208950	2.44	1.49	0.89	0.39	0.24
01208990	4.14	2.48	1.71	1.05	0.71	01208990	2.62	1.62	1.05	0.52	0.30
01372200	3.77	2.25	1.47	0.73	0.56	01372200	1.86	1.18	0.80	0.40	0.27
01372800	3.60	2.38	1.59	0.79	0.61	01372800	1.98	1.35	0.93	0.49	0.37
01374598	3.81	2.51	1.70	0.89	0.71	01374598	2.26	1.35	0.86	0.43	0.30
01374890	3.80	2.46	1.75	0.82	0.64	01374890	2.40	1.52	0.94	0.43	0.22
Minimum	3.19	2.17	1.30	0.43	0.14		1.79	1.16	0.77	0.21	0.10
Maximum	5.69	3.49	2.59	1.80	1.24		4.58	3.73	2.88	1.86	1.64
Average	4.26	2.76	1.86	1.08	0.78		2.72	1.81	1.26	0.71	0.50

Table 3. Flow-duration statistics for streamgages with at least 10 years of continuous record in Connecticut and neighboring states considered for regression analysis: *A*, Actual streamflow; *B*, Normalized streamflow.—Continued

[USGS, U.S. Geological Survey; no. number; mi², square miles; Q_{25}, 25-percent flow exceedance; Q_{50}, 50-percent flow exceedance; Q_{75}, 75-percent flow exceedance; Q_{90}, 90-percent flow exceedance; Q_{99}, 99-percent flow exceedance]

***B* Normalized streamflow, in cubic feet per second per square mile**

USGS streamgage no.	Resident Spawning					USGS streamgage no.	Rearing and Growth				
	Q_{25}	Q_{50}	Q_{75}	Q_{90}	Q_{99}		Q_{25}	Q_{50}	Q_{75}	Q_{80}	Q_{99}
01111300	1.63	0.75	0.43	0.24	0.09	01111300	0.54	0.23	0.10	0.08	0.01
01111500	1.58	0.89	0.58	0.41	0.26	01111500	0.82	0.47	0.30	0.26	0.10
01115098	2.07	0.96	0.52	0.31	0.14	01115098	0.50	0.20	0.11	0.09	0.01
01115187	1.60	0.69	0.33	0.20	0.08	01115187	0.50	0.17	0.07	0.05	0.00
01117468	2.93	1.80	1.24	0.99	0.67	01117468	1.13	0.74	0.48	0.43	0.20
01117500	2.36	1.50	1.10	0.86	0.63	01117500	1.13	0.75	0.52	0.48	0.24
01117800	2.19	1.34	0.94	0.71	0.45	01117800	1.02	0.63	0.40	0.37	0.17
01118000	2.11	1.38	0.99	0.76	0.50	01118000	1.04	0.68	0.47	0.43	0.22
01118300	1.82	0.95	0.50	0.27	0.12	01118300	0.72	0.30	0.12	0.10	0.01
01120500	0.82	0.46	0.27	0.14	0.04	01120500	0.46	0.17	0.07	0.05	0.00
01121000	1.40	0.70	0.38	0.23	0.10	01121000	0.59	0.28	0.13	0.11	0.02
01123000	1.50	0.90	0.60	0.43	0.28	01123000	0.73	0.43	0.28	0.26	0.15
01125490	1.03	0.59	0.31	0.19	0.07	01125490	0.34	0.16	0.08	0.06	0.01
01126600	1.47	0.65	0.37	0.20	0.08	01126600	0.50	0.22	0.11	0.09	0.04
01126950	2.00	1.19	0.70	0.42	0.34	01126950	0.92	0.36	0.21	0.21	0.00
01176000	1.52	0.88	0.57	0.39	0.20	01176000	0.81	0.45	0.27	0.24	0.07
01187300	1.36	0.60	0.30	0.17	0.08	01187300	0.60	0.23	0.11	0.10	0.02
01187400	1.71	0.85	0.50	0.26	0.10	01187400	0.50	0.20	0.10	0.09	0.03
01187800	1.40	0.77	0.43	0.30	0.15	01187800	0.60	0.29	0.17	0.14	0.03
01187850	4.07	3.22	2.71	2.03	1.49	01187850	2.88	2.20	1.69	1.64	0.90
01188000	1.61	0.95	0.63	0.44	0.24	01188000	0.90	0.51	0.32	0.29	0.12
01192600	2.23	1.60	1.17	0.79	0.54	01192600	1.28	0.89	0.64	0.59	0.30
01193500	1.48	0.82	0.48	0.31	0.16	01193500	0.66	0.31	0.17	0.15	0.05
01193800	1.62	0.92	0.50	0.31	0.15	01193800	0.61	0.28	0.15	0.13	0.06
01194000	1.19	0.70	0.40	0.24	0.10	01194000	0.50	0.22	0.11	0.10	0.02
01194500	1.48	0.81	0.45	0.28	0.11	01194500	0.67	0.27	0.13	0.11	0.02
01195100	1.36	0.58	0.23	0.14	0.06	01195100	0.48	0.18	0.08	0.07	0.00
01195200	1.24	0.63	0.38	0.23	0.10	01195200	0.46	0.20	0.08	0.06	0.00
01198000	1.02	0.64	0.39	0.27	0.18	01198000	0.41	0.22	0.12	0.11	0.06
01199200	1.60	0.66	0.31	0.16	0.03	01199200	0.54	0.14	0.05	0.03	0.00
01201190	1.58	0.69	0.32	0.22	0.14	01201190	0.46	0.20	0.11	0.10	0.03
01201930	1.57	0.78	0.50	0.27	0.13	01201930	1.30	0.50	0.30	0.25	0.04
01204800	1.10	0.65	0.35	0.22	0.10	01204800	0.61	0.26	0.13	0.11	0.04
01206400	1.53	0.82	0.40	0.19	0.08	01206400	0.71	0.24	0.10	0.09	0.03
01206500	1.40	0.66	0.34	0.19	0.09	01206500	0.58	0.21	0.08	0.07	0.01
01208950	1.49	0.64	0.31	0.16	0.06	01208950	0.65	0.26	0.10	0.08	0.01
01208990	1.57	0.71	0.40	0.24	0.10	01208990	0.76	0.29	0.11	0.09	0.01
01372200	1.11	0.62	0.36	0.24	0.10	01372200	0.54	0.24	0.13	0.11	0.03
01372800	1.36	0.68	0.45	0.28	0.08	01372800	0.63	0.30	0.14	0.12	0.02
01374598	2.08	0.86	0.38	0.20	0.12	01374598	0.71	0.25	0.11	0.09	0.00
01374890	1.99	0.82	0.40	0.23	0.12	01374890	0.94	0.30	0.12	0.10	0.02
Minimum	0.82	0.46	0.23	0.14	0.03		0.34	0.14	0.05	0.03	0.00
Maximum	4.07	3.22	2.71	2.03	1.49		2.88	2.20	1.69	1.64	0.90
Average	1.66	0.91	0.56	0.37	0.21		0.75	0.38	0.22	0.20	0.08

Table 5. Characteristics of the drainage basins used for regionalizing flow-duration statistics in Connecticut: *A*, Continuous streamgages; *B*, Short-term or partial-record streamgages.

[Geographic Information System used to derive all basin characteristics (table 4); USGS, U.S. Geological Survey; no., number; mi², square miles; mi, miles; ft, feet; --, not determined; Q_{99}, 99-percent flow exceedence]

***A* Continuous streamgages used for all flow durations**

USGS continuous streamgage no.	Drainage area (mi²)	Basin perimeter (mi)	Total river miles (mi)	Maximum basin elevation (ft)	Mean basin elevation (ft)	Basin relief (ft)	Mean basin slope (percent)	Latitude of basin centroid (CT state plane ft)	Longitude of basin centroid (CT state plane ft)
01111300	16.32	27.44	38.63	769.69	532.20	425.59	5.44	1,282,922	932,738
01111500	91.22	62.39	201.66	813.25	497.08	615.26	6.41	1,290,774	912,635
01115098	4.83	13.48	11.67	707.78	463.05	394.65	7.00	1,306,577	883,974
01115187	14.36	19.94	35.11	841.96	612.73	490.58	5.15	1,275,302	872,818
01117468	9.50	23.34	27.80	562.01	388.47	383.53	4.21	1,302,743	758,712
01117500	100.13	59.25	290.45	563.19	196.90	514.34	4.14	1,318,057	747,689
01117800	35.31	44.48	95.79	682.78	389.68	559.88	6.10	1,273,313	791,046
01118000	74.53	53.53	215.21	682.78	333.67	615.88	5.77	1,276,820	776,075
01118300	4.00	12.81	12.98	529.92	339.22	373.72	6.79	1,248,957	742,323
01120500	4.17	12.93	11.21	936.06	748.02	400.85	7.66	1,191,997	905,667
01121000	29.00	43.97	99.49	1,257.15	652.28	936.78	7.50	1,157,147	884,863
01123000	30.06	46.83	104.59	792.95	508.21	557.41	7.05	1,190,714	837,547
01125490	36.11	46.63	93.59	938.62	546.00	669.06	7.34	1,207,681	916,057
01126600	17.11	32.35	43.23	771.33	477.75	630.74	7.19	1,206,176	855,508
01126950	52.92	59.10	103.14	656.20	343.66	505.35	5.57	1,243,813	770,826
01176000	149.48	84.71	439.39	1,223.43	810.35	839.76	8.13	1,181,949	1,019,052
01187300	20.66	33.69	39.18	1,643.86	1,286.82	1,048.85	8.70	938,756	954,443
01187400	7.39	19.40	15.58	1,490.12	1,099.08	945.77	14.50	955,253	950,908
01187800	23.77	41.54	57.59	1,186.68	843.48	677.23	10.22	925,452	866,592
01187850	0.56	4.14	0.80	929.86	731.52	410.73	11.71	942,782	849,379
01188000	3.99	12.82	11.20	1,170.01	924.27	435.24	5.93	934,055	843,189
01192600	0.92	5.73	1.78	753.05	466.57	511.61	7.81	1,061,848	823,114
01193500	101.64	81.62	232.70	897.31	488.72	836.09	7.47	1,092,884	789,620
01193800	2.79	12.88	8.18	627.99	354.60	555.41	8.30	1,090,559	726,676
01194000	20.20	29.95	53.38	637.80	406.95	599.84	7.51	1,111,696	740,573
01194500	22.45	41.27	60.79	644.29	365.45	573.33	6.82	1,127,472	735,634
01195100	5.73	19.60	19.98	494.78	236.93	447.47	7.54	1,055,303	681,705
01195200	6.59	25.10	17.15	421.29	167.74	416.70	5.15	1,032,139	677,963
01198000	51.06	53.55	82.86	2,058.04	1,181.24	1,368.96	14.14	812,825	1,020,715
01199200	3.48	12.48	10.58	1,550.07	1,292.07	408.83	9.32	811,218	861,346
01201190	23.85	36.34	52.92	1,421.06	786.92	1,153.48	14.48	818,125	807,974
01201930	9.50	29.87	21.68	1,635.60	1,337.36	550.98	6.96	862,620	868,700
01204800	2.45	8.76	8.25	663.58	490.12	327.82	6.87	872,857	688,797
01206400	19.76	29.70	55.72	1,187.17	900.63	648.79	7.69	916,528	844,459
01206500	24.44	35.88	69.50	1,187.17	873.97	695.47	8.13	916,393	840,680
01208950	7.43	16.90	23.92	397.74	230.11	338.02	5.28	846,137	629,043
01208990	20.67	42.49	53.77	1,001.57	574.21	703.41	11.82	809,886	679,749
01372200	91.05	82.45	193.81	1,398.88	621.61	1,162.17	10.18	741,627	875,346
01372800	57.40	65.74	139.78	1,397.67	656.65	1,174.08	11.41	741,723	787,015
01374598	3.90	14.24	8.06	1,159.35	806.46	586.61	11.37	740,555	742,154
01374890	15.70	28.32	34.49	994.49	592.49	656.50	11.46	776,104	662,551
Range of basin characteristics for continuous-record streamgages only									
Minimum	0.56	4.14	0.80	398	168	328	4.14	--	--
Maximum	149.48	84.71	439.39	2,058	1,337	1,369	14.50	--	--
Average	29.67	34.82	75.55	968	623	638	8.10	--	--

Table 5. Characteristics of the drainage basins used for regionalizing flow-duration statistics in Connecticut: *A*, Continuous streamgages; *B*, Short-term or partial-record streamgages.—Continued

[Geographic Information System used to derive all basin characteristics (table 4); USGS, U.S. Geological Survey; no., number; mi², square miles; mi, miles; ft, feet; --, not determined; Q_{99}, 99-percent flow exceedence]

***A* Continuous streamgages used for all flow durations**

USGS continuous streamgage no.	Latitude of streamgage (decimal degrees)	Longitude of streamgage (decimal degrees)	River miles in contact with sand and gravel (mi)	Deciduous forest (percent)	Evergreen forest (percent)	Mixed forest (percent)	Deciduous and mixed forest (percent)	Developed, open space (percent)	Developed, low intensity (percent)
01111300	41.981	-71.686	18.19	66.3	6.9	4.8	71.1	5.3	1.5
01111500	41.996	-71.563	69.51	59.1	6.4	4.0	63.1	5.2	4.4
01115098	41.853	-71.606	5.81	71.5	1.8	0.9	72.4	4.5	3.3
01115187	41.819	-71.705	10.46	70.5	2.7	0.9	71.5	4.6	1.5
01117468	41.493	-71.628	17.63	66.0	4.3	2.1	68.2	5.9	2.0
01117500	41.445	-71.681	178.76	43.0	7.3	4.7	47.7	5.3	3.6
01117800	41.574	-71.721	43.87	56.9	11.3	4.7	61.7	4.8	1.0
01118000	41.498	-71.716	86.53	55.6	10.6	4.2	59.8	4.9	2.5
01118300	41.475	-71.834	1.24	73.9	0.5	0.1	73.9	4.3	0.4
01120500	41.926	-72.057	0.39	54.8	8.0	10.5	65.3	5.8	0.5
01121000	41.844	-72.169	5.62	60.3	1.9	12.0	72.3	6.0	0.8
01123000	41.672	-72.052	22.33	57.2	2.6	7.1	64.3	5.2	0.7
01125490	41.928	-71.930	11.42	43.9	5.8	8.1	52.0	5.8	1.4
01126600	41.765	-71.956	5.17	59.8	1.6	7.0	66.8	5.5	0.8
01126950	41.585	-71.933	28.26	48.4	10.4	3.4	51.7	3.6	2.1
01176000	42.182	-72.264	133.93	46.1	7.2	6.8	52.9	6.6	2.2
01187300	42.037	-72.939	0.75	51.4	5.7	31.7	83.2	2.6	0.2
01187400	42.034	-72.930	1.37	70.5	7.4	13.7	84.2	2.3	0.1
01187800	41.821	-72.970	4.50	59.5	9.3	7.6	67.1	6.2	1.3
01187850	41.796	-72.951	0.36	61.1	22.9	5.7	66.8	8.7	0.0
01188000	41.786	-72.965	1.87	59.9	2.7	1.9	61.8	7.0	1.8
01192600	41.718	-72.540	0.99	49.1	12.9	5.8	55.0	14.7	11.4
01193500	41.552	-72.449	20.37	56.0	1.6	5.0	61.1	7.8	2.9
01193800	41.428	-72.423	0.94	77.0	0.6	0.3	77.4	7.5	0.3
01194000	41.442	-72.333	6.12	71.4	1.1	4.4	75.8	5.8	0.4
01194500	41.428	-72.334	7.62	68.2	0.4	1.3	69.5	5.6	2.0
01195100	41.306	-72.531	1.70	74.3	0.4	0.3	74.7	9.1	2.2
01195200	41.283	-72.619	2.60	64.3	0.9	0.5	64.8	14.2	4.9
01198000	42.192	-73.391	18.54	57.5	7.9	11.9	69.5	3.5	0.4
01199200	41.824	-73.430	0.11	77.8	0.3	0.3	78.1	4.5	0.1
01201190	41.608	-73.425	4.33	71.9	1.4	0.9	72.8	5.2	0.6
01201930	41.790	-73.259	0.53	51.5	4.0	5.5	57.0	7.3	1.4
01204800	41.363	-73.218	1.76	59.7	1.8	1.8	61.5	9.6	9.9
01206400	41.730	-73.053	5.09	55.6	2.6	8.2	63.8	9.0	5.0
01206500	41.702	-73.057	5.57	57.1	3.0	9.3	66.4	8.2	4.2
01208950	41.153	-73.306	0.31	46.7	2.2	1.5	48.2	30.3	7.2
01208990	41.295	-73.395	9.08	72.7	1.9	0.6	73.3	11.9	0.9
01372200	41.815	-73.763	44.75	50.5	3.3	1.3	51.8	4.3	1.3
01372800	41.573	-73.807	22.74	55.4	3.0	1.7	57.1	6.2	2.6
01374598	41.476	-73.689	0.00	76.5	1.0	0.4	77.0	10.5	1.1
01374890	41.260	-73.602	0.53	61.2	6.3	1.0	62.1	13.1	0.4
Range of basin characteristics for continuous-record streamgages only									
Minimum	--	--	0.00	43.0	0.3	0.1	47.7	2.3	0.0
Maximum	--	--	178.76	77.8	22.9	31.7	84.2	30.3	11.4
Average	--	--	19.55	60.7	4.7	5.0	65.7	7.3	2.2

Table 5. Characteristics of the drainage basins used for regionalizing flow-duration statistics in Connecticut: *A*, Continuous streamgages; *B*, Short-term or partial-record streamgages.—Continued

[Geographic Information System used to derive all basin characteristics (table 4); USGS, U.S. Geological Survey; no., number; mi^2, square miles; mi, miles; ft, feet; --, not determined; Q_{99}, 99-percent flow exceedence]

A **Continuous streamgages used for all flow durations**

USGS continuous streamgage no.	Developed, open space and low intensity (ft)	Open water (percent)	Impervious surface (percent)	Wetlands (percent)	Soil type A (percent)	Soil type B (percent)	Soil type C (percent)	Soil type D (percent)
01111300	6.9	0.2	0.13	9.08	100.0	0.0	0.0	0.0
01111500	9.5	2.6	0.35	9.16	100.0	0.0	0.0	0.0
01115098	7.8	0.5	0.21	10.69	100.0	0.0	0.0	0.0
01115187	6.2	2.8	0.13	15.99	100.0	0.0	0.0	0.0
01117468	7.9	0.5	0.08	12.46	100.0	0.0	0.0	0.0
01117500	9.0	2.9	0.27	18.14	100.0	0.0	0.0	0.0
01117800	5.8	0.9	0.09	13.83	77.4	9.3	7.1	6.2
01118000	7.4	1.9	0.20	16.76	86.7	4.8	3.7	4.7
01118300	4.7	0.0	0.06	4.45	0.0	0.0	0.0	100.0
01120500	6.3	0.1	0.07	1.46	0.0	33.3	41.7	25.0
01121000	6.8	1.5	0.08	1.43	5.0	36.5	34.0	24.5
01123000	6.0	0.4	0.06	3.05	10.8	30.1	39.2	19.9
01125490	7.2	1.2	0.10	3.89	14.2	39.7	28.9	17.2
01126600	6.3	0.4	0.08	2.84	6.4	40.4	30.9	22.3
01126950	5.7	4.7	0.15	7.21	9.2	37.6	12.9	40.3
01176000	8.9	3.2	0.20	9.02	98.3	0.8	0.4	0.5
01187300	2.8	2.1	0.02	5.35	4.2	1.7	79.2	5.0
01187400	2.4	0.1	0.02	2.16	4.7	25.6	11.6	2.3
01187800	7.5	0.1	0.10	1.84	6.9	50.8	21.5	20.8
01187850	8.7	0.0	0.03	0.00	66.7	33.3	0.0	0.0
01188000	8.8	0.3	0.18	1.10	26.1	13.0	34.8	26.1
01192600	26.1	0.0	0.47	0.69	20.0	80.0	0.0	0.0
01193500	10.7	0.9	0.20	1.50	4.2	50.4	20.2	25.3
01193800	7.8	1.3	0.05	0.55	0.0	0.0	0.0	100.0
01194000	6.3	1.4	0.05	1.17	0.0	1.8	0.9	97.3
01194500	7.6	0.5	0.12	1.39	0.0	4.0	2.4	93.7
01195100	11.3	0.2	0.18	0.67	0.0	0.0	0.0	100.0
01195200	19.1	0.2	0.39	1.17	0.0	0.0	0.0	100.0
01198000	3.9	0.7	0.04	2.98	51.1	11.7	27.0	0.0
01199200	4.6	0.6	0.02	3.72	0.0	52.6	5.3	42.1
01201190	5.8	1.9	0.05	2.60	4.6	40.0	20.0	35.4
01201930	8.7	10.6	0.12	2.52	11.3	41.5	35.8	11.3
01204800	19.6	0.4	0.47	0.27	0.0	0.0	0.0	100.0
01206400	14.0	0.8	0.40	1.43	3.2	47.2	33.0	16.7
01206500	12.3	0.7	0.33	1.32	2.2	53.7	30.9	13.2
01208950	37.6	0.0	0.61	0.48	0.0	0.0	0.0	100.0
01208990	12.8	1.3	0.14	1.72	0.0	0.0	0.0	100.0
01372200	5.6	0.8	0.11	3.38	100.0	0.0	0.0	0.0
01372800	8.8	1.9	0.18	3.86	100.0	0.0	0.0	0.0
01374598	11.5	2.0	0.12	2.81	100.0	0.0	0.0	0.0
01374890	13.5	3.6	0.08	5.03	80.7	0.0	0.0	19.3
Range of basin characteristics for continuous-record streamgages only								
Minimum	2.4	0.0	0.02	0.00	0.0	0.0	0.0	0.0
Maximum	37.6	10.6	0.61	18.14	100.0	80.0	79.2	100.0
Average	9.5	1.4	0.16	4.61	36.4	18.0	12.7	31.0

Table 5. Characteristics of the drainage basins used for regionalizing flow-duration statistics in Connecticut: *A*, Continuous streamgages; *B*, Short-term or partial-record streamgages.—Continued

[Geographic Information System used to derive all basin characteristics (table 4); USGS, U.S. Geological Survey; no., number; mi^2, square miles; mi, miles; ft, feet; --, not determined; Q_{99}, 99-percent flow exceedence]

A Continuous streamgages used for all flow durations

USGS continuous streamgage no.	Soil type D, A_D, and C_D	Till (percent)	Coarse stratified deposits (percent)	Alluvium deposits (percent)
01111300	0.0	71.6	26.9	1.3
01111500	0.0	66.7	30.0	0.2
01115098	0.0	76.1	22.9	0.0
01115187	0.0	82.5	14.5	0.0
01117468	0.0	74.0	25.2	0.0
01117500	0.0	48.7	43.8	0.0
01117800	6.2	68.6	26.9	3.0
01118000	4.7	71.1	25.2	1.4
01118300	100.0	85.7	9.0	5.1
01120500	25.0	98.8	0.9	0.3
01121000	24.5	92.0	4.2	2.2
01123000	19.9	78.1	15.3	5.2
01125490	17.2	82.0	11.4	3.5
01126600	22.3	87.5	5.0	3.7
01126950	40.3	63.6	23.2	4.8
01176000	0.5	78.5	20.1	1.3
01187300	15.0	99.7	0.3	0.0
01187400	58.1	90.8	6.3	2.9
01187800	20.8	84.5	8.1	7.2
01187850	0.0	55.1	44.9	0.0
01188000	26.1	68.8	25.4	5.8
01192600	0.0	44.9	55.1	0.0
01193500	25.3	84.8	8.2	4.4
01193800	100.0	93.0	4.7	2.3
01194000	97.3	89.2	6.6	2.5
01194500	93.7	88.3	8.3	2.9
01195100	100.0	90.9	7.3	1.9
01195200	100.0	79.3	14.3	4.0
01198000	10.3	78.9	11.3	3.4
01199200	42.1	93.5	1.6	4.8
01201190	35.4	88.2	2.7	4.1
01201930	11.3	84.1	1.3	4.5
01204800	100.0	87.4	9.8	2.6
01206400	16.7	91.3	4.1	3.7
01206500	13.2	91.8	3.9	3.4
01208950	100.0	97.6	1.7	0.7
01208990	100.0	84.7	9.8	4.5
01372200	0.0	47.5	17.7	2.2
01372800	0.0	53.8	14.8	2.4
01374598	0.0	85.7	0.0	0.0
01374890	19.3	83.9	1.9	0.9
Range of basin characteristics for continuous-record streamgages only				
Minimum	0.0	44.9	0.0	0.0
Maximum	100.0	99.7	55.1	7.2
Average	32.8	79.6	14.0	2.5

Table 5. Characteristics of the drainage basins used for regionalizing flow-duration statistics in Connecticut: *A*, Continuous streamgages; *B*, Short-term or partial-record streamgages.—Continued

[Geographic Information System used to derive all basin characteristics (table 4); USGS, U.S. Geological Survey; no., number; mi^2, square miles; mi, miles; ft, feet; --, not determined; Q_{99}, 99-percent flow exceedence]

***B* Short-term or partial-record streamgages; used with continuous-record streamgages only for Q_{99}**

USGS short-term or partial-record streamgage no.	Drainage area (mi^2)	Basin perimeter (mi)	Total river miles (mi)	Maximum basin elevation (ft)	Mean basin elevation (ft)	Basin relief (ft)	Mean basin slope (percent)	Latitude of basin centroid (CT state plane ft)	Longitude of basin centroid (CT state plane ft)
01118350	19.25	34.00	71.33	530	285	461	7.0	1,251,142	740,216
01118750	4.41	15.42	12.04	350	239	253	5.1	1,204,274	709,388
01119255	2.57	9.58	7.90	1,204	1,006	434	10.9	1,140,243	937,992
01119320	15.13	28.94	43.92	1,304	909	708	8.7	1,140,846	916,506
01119360	2.13	9.80	8.64	960	653	450	7.0	1,128,898	884,213
01120200	16.29	29.24	32.24	726	492	484	6.2	1,127,838	809,059
01120920	3.44	13.28	10.48	1,257	914	588	8.8	1,153,136	905,198
01121300	10.93	24.06	34.32	1,204	768	763	8.5	1,143,424	894,975
01125300	4.46	14.11	11.42	876	673	492	7.7	1,197,966	924,512
01125600	11.02	28.41	26.20	890	685	407	7.3	1,197,595	887,264
01125900	8.29	21.83	24.05	836	648	417	6.5	1,262,431	885,894
01126700	10.66	26.45	36.05	662	388	491	6.1	1,203,871	825,347
01127100	12.30	29.31	33.77	535	290	419	6.4	1,223,431	753,552
01127400	15.27	35.10	44.62	671	368	558	7.9	1,153,856	791,794
01127700	8.91	25.22	27.09	518	294	468	8.4	1,162,583	749,714
01127800	4.38	17.75	10.53	427	216	348	8.0	1,133,911	702,460
01183990	2.04	12.77	5.74	239	194	102	3.7	1,058,147	936,493
01184300	3.66	12.08	8.68	1,114	677	835	12.9	1,091,888	927,606
01186400	35.56	52.07	74.11	1,812	1,360	1,243	10.4	896,972	936,358
01187680	8.14	20.98	23.64	1,215	897	774	11.4	959,039	893,427
01191900	8.47	16.83	21.07	1,050	723	507	7.8	1,094,204	900,328
01192800	2.90	12.15	7.81	733	396	524	10.3	1,009,014	720,159
01193120	5.63	16.89	14.79	681	489	539	8.2	1,048,948	725,974
01193130	3.71	11.97	12.71	727	479	523	9.4	1,038,605	729,826
01193210	3.66	12.64	8.19	784	583	395	6.3	1,109,630	801,910
01193300	6.78	18.24	16.66	897	657	421	7.0	1,081,517	827,909
01195146	6.24	19.25	16.97	662	491	354	5.5	1,047,945	709,447
01196600	9.40	24.28	21.19	873	346	760	8.9	949,946	735,484
01198700	5.55	16.00	15.06	1,747	1,414	975	13.0	864,070	901,264
01198800	19.02	38.60	51.18	1,747	1,254	1,089	14.4	858,794	892,784
01201890	11.86	22.00	37.40	825	513	577	8.4	834,407	717,297
01203100	7.82	18.30	13.43	1,044	687	752	9.8	853,226	761,022
01203700	3.40	12.05	7.31	1,138	904	578	11.0	864,778	797,037
01208999	5.52	15.71	14.67	851	633	476	8.6	829,355	678,368
Range of basin characteristics for all streamgages									
Minimum	0.56	4.14	0.80	239	168	102	3.7	--	--
Maximum	149.48	84.71	439.39	2,058	1,414	1,369	14.5	--	--
Average	20.20	28.57	52.04	944	628	604	8.3	--	--

Table 5. Characteristics of the drainage basins used for regionalizing flow-duration statistics in Connecticut: *A*, Continuous streamgages; *B*, Short-term or partial-record streamgages.—Continued

[Geographic Information System used to derive all basin characteristics (table 4); USGS, U.S. Geological Survey; no., number; mi², square miles; mi, miles; ft, feet; --, not determined; Q_{99}, 99-percent flow exceedence]

B **Short-term or partial-record streamgages; used with continuous-record streamgages only for Q_{99}**

USGS short-term or partial-record streamgage no.	Latitude of streamgage (decimal degrees)	Longitude of streamgage (decimal degrees)	River miles in contact with sand and gravel (mi)	Deciduous forest (percent)	Evergreen forest (percent)	Mixed forest (percent)	Deciduous and mixed forest (percent)	Developed, open space (percent)	Developed, low intensity (percent)
01118350	41.455	-71.814	14.88	73.0	1.5	0.2	73.2	3.4	0.6
01118750	41.389	-71.986	1.52	64.7	0.6	0.0	64.7	5.8	2.5
01119255	42.023	-72.248	0.47	73.6	1.8	10.3	83.9	6.3	0.6
01119320	41.934	-72.261	0.83	56.3	7.8	18.9	75.2	4.6	0.2
01119360	41.871	-72.291	0.80	44.5	1.9	21.2	65.7	7.2	0.8
01120200	41.707	-72.247	1.89	64.2	0.5	2.9	67.1	4.4	1.3
01120920	41.920	-72.179	0.34	62.9	2.5	6.1	68.9	10.1	0.9
01121300	41.872	-72.241	2.44	70.7	1.5	10.3	80.9	5.0	0.8
01125300	41.991	-71.997	0.36	56.5	4.2	10.7	67.3	5.9	0.4
01125600	41.874	-72.009	3.41	66.7	1.6	5.7	72.4	4.9	0.3
01125900	41.909	-71.819	9.41	58.8	9.4	10.2	68.9	3.2	1.4
01126700	41.681	-71.978	14.00	56.2	0.6	5.0	61.2	4.5	0.8
01127100	41.554	-71.970	9.93	52.9	0.7	0.2	53.2	2.8	0.9
01127400	41.571	-72.133	8.17	50.6	0.7	3.2	53.8	4.3	1.5
01127700	41.501	-72.116	4.89	75.1	0.5	1.1	76.2	5.2	3.2
01127800	41.357	-72.261	1.11	78.3	0.2	0.1	78.4	2.6	1.0
01183990	42.007	-72.553	1.59	25.2	5.5	1.2	26.4	15.4	14.8
01184300	41.992	-72.434	0.77	73.0	3.6	4.6	77.6	6.4	1.3
01186400	41.978	-73.045	5.92	54.6	5.8	23.7	78.3	4.2	0.2
01187680	41.872	-72.906	0.00	76.4	3.1	4.0	80.4	5.5	0.6
01191900	41.906	-72.404	0.96	57.9	4.3	7.3	65.2	6.2	1.5
01192800	41.452	-72.702	0.62	58.3	1.2	1.7	60.0	6.7	7.1
01193120	41.479	-72.557	4.74	77.6	0.8	1.9	79.5	6.7	1.8
01193130	41.474	-72.596	2.24	81.7	0.8	5.0	86.8	5.8	0.6
01193210	41.640	-72.343	0.20	58.2	0.2	0.6	58.8	6.5	2.8
01193300	41.696	-72.456	0.63	65.5	0.4	2.9	68.4	5.6	2.6
01195146	41.383	-72.589	2.47	72.3	0.4	0.6	72.9	8.0	0.8
01196600	41.460	-72.918	8.48	54.1	1.0	0.6	54.7	15.4	15.3
01198700	41.926	-73.280	0.04	70.3	7.3	12.7	83.1	1.0	0.0
01198800	41.949	-73.321	2.87	68.8	8.4	10.1	78.9	2.9	0.2
01201890	41.456	-73.335	3.65	59.2	1.1	1.0	60.2	10.5	7.3
01203100	41.528	-73.308	0.54	67.0	0.7	1.5	68.5	7.4	0.7
01203700	41.627	-73.226	0.08	76.0	0.7	0.2	76.2	5.9	0.2
01208999	41.293	-73.368	0.77	76.7	1.2	0.2	76.9	8.0	0.9
Range of basin characteristics for all streamgages									
Minimum	--	--	0.00	25.2	0.2	0.0	26.4	1.0	0.0
Maximum	--	--	178.76	81.7	22.9	31.7	86.8	30.3	15.3
Average	--	--	12.17	62.2	3.7	5.2	67.4	6.8	2.2

Table 5. Characteristics of the drainage basins used for regionalizing flow-duration statistics in Connecticut: *A*, Continuous streamgages; *B*, Short-term or partial-record streamgages.—Continued

[Geographic Information System used to derive all basin characteristics (table 4); USGS, U.S. Geological Survey; no., number; mi², square miles; mi, miles; ft, feet; --, not determined; Q_{99}, 99-percent flow exceedence]

***B* Short-term or partial-record streamgages; used with continuous-record streamgages only for Q_{99}**

USGS short-term or partial-record streamgage no.	Developed, open space and low intensity (ft)	Open water (percent)	Impervious surface (percent)	Wetlands (percent)	Soil Type A (percent)	Soil type B (percent)	Soil type C (percent)	Soil type D (percent)
01118350	4.0	1.3	0.06	6.7	0.0	0.4	0.0	99.6
01118750	8.3	0.0	0.25	1.2	0.0	0.0	0.0	100.0
01119255	6.9	0.3	0.06	2.7	0.0	18.8	43.7	31.3
01119320	4.8	1.4	0.03	1.3	2.5	49.4	11.1	37.0
01119360	8.0	0.9	0.08	2.8	0.0	63.6	0.0	36.4
01120200	5.7	0.8	0.09	1.3	3.3	35.6	37.8	23.3
01120920	11.0	4.5	0.15	1.4	14.9	25.5	40.4	19.1
01121300	5.8	1.3	0.09	1.7	3.2	37.0	40.3	19.5
01125300	6.2	0.0	0.05	3.2	0.0	50.0	28.1	21.9
01125600	5.2	1.2	0.04	4.5	6.3	27.0	46.0	20.6
01125900	4.6	1.0	0.10	16.7	75.0	22.7	2.3	0.0
01126700	5.3	0.4	0.07	4.3	10.3	46.6	25.9	17.2
01127100	3.7	0.0	0.07	2.3	1.4	15.7	7.1	75.7
01127400	5.8	0.1	0.12	0.8	2.3	32.6	50.0	15.1
01127700	8.3	0.5	0.25	0.4	0.0	6.0	6.0	88.0
01127800	3.6	1.2	0.06	1.9	0.0	0.0	0.0	100.0
01183990	30.3	2.1	1.53	4.1	36.4	36.4	0.0	27.3
01184300	7.7	1.1	0.09	0.5	0.0	38.1	19.0	42.9
01186400	4.5	2.0	0.04	5.3	1.0	29.2	33.2	31.7
01187680	6.1	0.4	0.06	0.4	0.0	71.1	20.0	8.9
01191900	7.7	0.1	0.10	0.8	4.3	61.7	10.6	23.4
01192800	13.8	0.2	0.28	0.2	0.0	0.0	0.0	100.0
01193120	8.5	0.0	0.15	0.7	0.0	0.0	0.0	100.0
01193130	6.4	0.0	0.06	0.2	0.0	0.0	0.0	100.0
01193210	9.3	0.9	0.23	1.2	0.0	25.5	56.9	17.6
01193300	8.2	0.5	0.13	2.5	2.1	43.6	24.5	29.8
01195146	8.7	1.2	0.09	3.1	0.0	0.0	0.0	100.0
01196600	30.7	0.1	0.99	0.6	0.0	0.0	0.0	100.0
01198700	1.0	1.0	0.00	2.4	1.2	53.7	1.2	43.9
01198800	3.1	0.4	0.03	1.5	2.8	54.2	14.0	29.0
01201890	17.9	1.9	0.52	0.7	0.0	0.0	0.0	100.0
01203100	8.2	0.1	0.09	0.5	0.0	25.0	11.4	63.6
01203700	6.1	0.6	0.05	0.5	0.0	59.6	25.5	14.9
01208999	8.9	0.4	0.10	0.2	0.0	0.0	0.0	100.0
Range of basin characteristics for all streamgages								
Minimum	1.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0
Maximum	37.6	10.6	1.53	18.1	100	80.0	79.2	100.0
Average	9.0	1.1	0.08	3.6	23.0	22.6	15.0	40.2

Table 5. Characteristics of the drainage basins used for regionalizing flow-duration statistics in Connecticut: *A*, Continuous streamgages; *B*, Short-term or partial-record streamgages.—Continued

[Geographic Information System used to derive all basin characteristics (table 4); USGS, U.S. Geological Survey; no., number; mi², square miles; mi, miles; ft, feet; --, not determined; Q_{99}, 99-percent flow exceedence]

B Short-term or partial-record streamgages; used with continuous-record streamgages only for Q_{99}

USGS short-term or partial-record streamgage no.	Soil type D, A_D, and C_D	Till (percent)	Coarse stratified deposits (percent)	Alluvium deposits (percent)
01118350	99.6	83.2	10.6	3.7
01118750	100.0	82.8	9.6	5.3
01119255	37.5	94.9	1.5	3.7
01119320	37.0	93.5	1.5	3.5
01119360	36.4	78.2	19.5	1.5
01120200	23.3	91.3	2.6	4.4
01120920	19.1	89.6	4.3	1.5
01121300	19.5	92.3	3.9	2.5
01125300	21.9	93.3	0.8	5.4
01125600	20.6	87.5	7.4	4.2
01125900	0.0	74.4	23.6	1.2
01126700	17.2	74.6	22.1	2.9
01127100	75.7	81.7	15.8	2.3
01127400	15.1	79.6	13.2	7.1
01127700	88.0	84.2	8.8	4.1
01127800	100.0	87.5	6.3	2.1
01183990	27.3	0.8	46.0	2.4
01184300	42.9	90.8	6.2	1.9
01186400	36.6	92.7	2.5	3.2
01187680	8.9	97.4	0.0	2.6
01191900	23.4	90.1	5.9	4.0
01192800	100.0	86.0	8.9	5.1
01193120	100.0	79.3	13.3	0.6
01193130	100.0	94.9	5.1	0.0
01193210	17.6	98.2	0.7	0.5
01193300	29.8	91.7	3.9	3.9
01195146	100.0	90.4	5.3	2.4
01196600	100.0	56.1	39.2	4.6
01198700	43.9	92.6	2.6	3.7
01198800	29.0	89.4	4.7	5.5
01201890	100.0	85.8	8.0	4.4
01203100	63.6	93.0	3.9	2.9
01203700	14.9	93.3	1.6	4.5
01208999	100.0	97.5	1.3	0.6
Range of basin characteristics for all streamgages				
Minimum	0.0	1.8	0.0	0.0
Maximum	100.0	99.7	55.1	7.2
Average	41.4	81.7	12.2	2.8

Table 6. Climate characteristics used for regionalizing flow-duration statistics in Connecticut.

[Climate characteristics are basinwide averages for the streamgages. USGS, U.S. Geological Survey; no., number; Precip, precipitation, in inches; Temp, temperature, in degrees Fahrenheit]

USGS streamgage no.[1]	Precipitation		Temperature		Salmonid Spawning		Overwinter	
	Mean annual	Maximum annual	Mean annual minmum	Mean annual maxmum	Precip	Temp	Precip	Temp
01111300	49.4	50.2	37.23	58.42	4.58	50.2	4.04	36.4
01111500	50.2	52.2	37.99	58.77	4.68	50.6	4.14	37.0
01115098	50.5	50.9	38.76	58.93	4.73	50.8	4.20	37.6
01115187	52.0	52.2	38.36	58.51	4.88	50.4	4.40	37.1
01117468	50.1	50.5	38.97	58.57	4.85	51.0	4.25	37.8
01117500	50.4	51.2	40.31	58.87	4.90	51.6	4.27	38.6
01117800	49.6	49.9	38.06	59.23	4.61	51.1	4.09	37.7
01118000	49.7	50.3	38.45	59.26	4.65	51.2	4.12	37.8
01118300	50.1	50.2	39.57	59.09	4.67	51.2	4.16	37.6
01120500	50.8	51.0	36.85	57.18	4.63	48.5	4.05	34.6
01121000	50.5	51.1	36.91	57.61	4.56	49.0	3.99	35.2
01123000	51.0	51.5	37.31	58.40	4.73	49.9	4.14	36.0
01125490	50.9	51.3	36.75	58.10	4.67	49.6	4.08	35.7
01126600	50.8	51.0	37.14	58.47	4.76	50.0	4.16	36.1
01126950	49.6	50.6	38.44	59.53	4.58	51.4	4.06	37.9
01176000	48.4	49.6	35.70	56.79	4.26	47.8	3.70	33.9
01187300	53.1	54.3	33.80	55.07	4.71	46.0	4.12	32.0
01187400	52.3	53.4	34.03	55.94	4.63	46.9	4.08	32.9
01187800	53.7	54.0	35.64	57.23	4.57	48.6	4.06	34.4
01188000	53.3	53.6	35.44	56.97	4.55	48.5	4.00	34.4
01192600	49.2	50.1	37.55	58.60	4.39	49.8	3.78	35.9
01193500	51.5	52.4	37.81	58.72	4.66	50.3	4.04	36.5
01193800	52.4	52.7	38.28	58.80	4.93	50.5	4.28	36.8
01194000	51.7	52.1	37.79	58.68	4.81	50.5	4.17	36.7
01194500	51.6	51.8	37.90	58.97	4.84	50.8	4.19	37.1
01195100	50.3	51.5	39.69	59.61	4.68	51.9	4.04	38.3
01195200	49.8	51.1	40.53	59.86	4.55	52.1	3.97	52.6
01198000	47.7	49.6	34.07	55.63	3.97	46.3	3.31	26.5
01199200	48.4	49.2	36.20	55.92	3.96	46.8	3.47	29.7
01201190	49.9	51.2	37.06	58.18	4.22	49.3	3.57	38.8
01204800	53.9	54.1	41.10	60.14	4.83	51.7	4.11	50.1
01206400	52.9	53.9	35.51	57.11	4.53	48.4	4.00	34.2
01206500	52.8	53.9	35.62	57.27	4.53	48.5	3.98	34.8
01208950	50.2	51.1	41.98	60.58	4.38	52.5	3.76	53.7
01208990	52.7	53.1	40.81	60.22	4.57	51.5	3.90	48.3
01372200	44.8	47.4	36.02	59.01	3.48	49.7	3.19	40.7
01372800	48.7	51.2	37.69	59.34	4.01	50.1	3.54	42.4
01374598	50.7	50.9	37.99	59.04	4.21	49.8	3.78	41.6
01374890	52.2	53.0	41.30	60.47	4.57	51.5	3.83	48.8
Minimum	44.8	47.4	33.80	55.07	3.48	46.0	3.19	26.5
Maximum	53.9	54.3	41.98	60.58	4.93	52.5	4.40	53.7
Average	50.7	51.5	37.71	58.39	4.55	49.9	3.98	38.1

[1]Clear Brook (01187850) and Marshepaug River (01201930) are not included in this data set.

Table 6. Climate characteristics used for regionalizing flow-duration statistics in Connecticut.—Continued

[Climate characteristics are basinwide averages for the streamgages. USGS, U.S. Geological Survey; no., number; Precip, precipitation, in inches; Temp, temperature, in degrees Fahrenheit]

USGS streamgage no.[1]	Habitat Forming		Clupeid Spawning		Resident Spawning		Rearing and Growth	
	Precip	Temp	Precip	Temp	Precip	Temp	Precip	Temp
01111300	4.33	51.0	3.75	68.6	3.80	76.7	4.12	73.8
01111500	4.44	51.7	3.78	68.8	3.82	76.7	4.14	73.8
01115098	4.50	52.0	3.80	68.8	3.79	76.4	4.12	73.5
01115187	4.70	51.8	3.83	68.7	3.92	76.1	4.19	73.2
01117468	4.59	51.2	3.96	67.0	3.79	75.5	3.95	73.7
01117500	4.64	51.1	3.99	66.6	3.82	75.2	3.91	73.8
01117800	4.31	52.2	3.79	68.9	3.65	76.7	4.16	74.0
01118000	4.37	52.1	3.83	68.6	3.68	76.6	4.11	74.2
01118300	4.43	51.6	3.90	67.9	3.71	76.4	4.11	74.4
01120500	4.39	49.5	3.96	67.7	4.08	75.9	4.31	72.4
01121000	4.34	50.1	3.98	68.0	4.05	76.1	4.33	73.0
01123000	4.45	50.9	3.96	68.5	3.89	76.8	4.27	73.8
01125490	4.41	50.7	3.92	68.6	3.99	76.8	4.31	73.6
01126600	4.47	51.0	3.91	68.8	3.87	76.9	4.20	74.0
01126950	4.24	52.3	3.79	68.9	3.61	77.1	4.23	74.6
01176000	4.06	49.2	4.07	67.4	3.99	75.8	4.22	72.4
01187300	4.44	47.8	4.85	66.1	4.47	74.0	4.46	70.7
01187400	4.36	48.6	4.74	67.0	4.41	74.9	4.39	71.6
01187800	4.54	50.3	4.66	68.1	4.42	76.1	4.69	72.6
01188000	4.51	50.2	4.65	68.0	4.39	76.0	4.68	72.5
01192600	4.20	51.0	4.21	68.6	3.93	76.9	4.29	73.8
01193500	4.46	51.4	4.18	68.6	4.05	77.0	4.39	74.0
01193800	4.63	51.5	4.24	67.8	3.91	76.0	4.30	73.9
01194000	4.54	51.5	4.19	67.9	3.96	76.2	4.29	74.0
01194500	4.55	51.7	4.17	68.1	3.95	76.5	4.25	74.3
01195100	4.49	52.1	4.12	68.2	3.96	76.6	4.12	74.8
01195200	4.45	52.2	4.15	68.2	3.93	76.8	4.11	75.0
01198000	3.91	48.3	4.81	66.9	4.01	75.1	4.29	71.4
01199200	3.95	49.0	4.53	66.7	4.21	74.6	4.35	71.3
01201190	4.21	51.4	4.56	68.8	4.10	76.6	4.50	73.5
01204800	4.91	53.3	4.86	69.7	4.39	78.2	4.43	75.3
01206400	4.49	50.1	4.63	67.9	4.32	75.9	4.64	72.3
01206500	4.48	50.2	4.62	68.0	4.31	76.0	4.63	72.5
01208950	4.44	53.3	4.69	69.4	4.06	78.2	4.23	75.7
01208990	4.52	53.4	4.86	70.3	4.30	78.6	4.56	75.3
01372200	3.56	51.9	4.36	69.7	3.99	78.0	4.04	74.7
01372800	3.98	52.5	4.46	70.1	4.25	77.9	4.35	74.9
01374598	4.12	52.4	4.45	69.8	4.39	77.3	4.52	74.6
01374890	4.46	53.7	4.96	70.9	4.20	78.9	4.55	75.5
Minimum	3.56	47.8	3.75	66.1	3.61	74.0	3.91	70.7
Maximum	4.91	53.7	4.96	70.9	4.47	78.9	4.69	75.7
Average	4.38	51.2	4.26	68.4	4.04	76.5	4.30	73.7

Appendix 1. Basin characteristics considered for use in regression analysis (includes units, method or procedure, and source data).

[Red italics, basin characteristics used in regression equations]

Variable name	Units	Method	Source data
Drainage area	square miles	StreamStats and ArcGIS 9.3 ArcToolbox - calculate field	U.S. Geological Survey, 2006, National Elevation Dataset: accessed on June 25, 2009, at http://ned.usgs.gov. Watershed Boundary Dataset drainage boundaries (http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/, accessed June 25, 2009)
Basin perimeter	miles	ArcGIS 9.3 ArcToolbox - calculate field	
Total river miles	miles	ArcGIS 9.3 ArcToolbox - calculate field	U.S. Geological Survey, 2009, National Hydrography Dataset: accessed on June 25, 2009, at http://nhd.usgs.gov.
Maximum basin elevation; ***Mean basin elevation***	feet	ArcGIS 9.3 ArcToolbox - spatial analyst tools	U.S. Geological Survey, 2006, National Elevation Dataset: accessed on June 25, 2009, at http://ned.usgs.gov.
Basin relief	feet	Maximum basin elevation minus minimum basin elevation ("Minimum basin elevation" from same method and source data as maximum and mean basin elevation)	U.S. Geological Survey, 2006, National Elevation Dataset: accessed on June 25, 2009, at http://ned.usgs.gov.
Mean basin slope	percent	ArcGIS 9.3 ArcToolbox - spatial analyst tools	U.S. Geological Survey, 2009, National Hydrography Dataset: accessed on June 25, 2009, at http://nhd.usgs.gov. National Elevation slope grid, 30-meter resolution (http://ned.usgs.gov/), accessed June 25, 2009
Latitude of basin centroid; Longitude of basin centroid	feet	divide by 100,000; ArcGIS 9.3 ArcToolbox - zonal geometry tool	
Gage latitude; Gage longitude	decimal degrees		USGS NWIS database, accessed June 25, 2009
Total streams in contact with coarse stratified deposits	miles	ArcGIS 9.3 ArcToolbox - spatial analyst tools	
Deciduous forest; Evergreen forest; and Mixed forest	percent	(Sum of area of the land cover classification/drainage area)*100; land cover classifications (41-deciduous, 42-evergreen, and 43-mixed) are defined at http://www.mrlc.gov/nlcd_definitions.asp	Multi-Resolution Land Characteristics Consortium, 1992, National Land-Cover Dataset 1992: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp. Multi-Resolution Land Characteristics Consortium, 2001, National Land-Cover Dataset 2001: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp.
Deciduous and mixed forest	percent	(Sum of areas of two land cover classification/drainage area)*100; land cover classifications (41-deciduous forest, 43-mixed forest) are defined at http://www.mrlc.gov/nlcd_definitions.asp	Multi-Resolution Land Characteristics Consortium, 1992, National Land-Cover Dataset 1992: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp. Multi-Resolution Land Characteristics Consortium, 2001, National Land-Cover Dataset 2001: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp.

Appendix 1. Basin characteristics considered for use in regression analysis (includes units, method or procedure, and source data).—Continued

[Red italics, basin characteristics used in regression equations]

Variable name	Units	Method	Source data
Developed, open space; Developed, low intensity	percent	(Sum of area of land cover classification/drainage area)*100; land cover classifications (21-developed, open space; 22-developed-low intensity) are defined at http://www.mrlc.gov/nlcd_definitions.asp	Multi-Resolution Land Characteristics Consortium, 1992, National Land-Cover Dataset 1992: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp. Multi-Resolution Land Characteristics Consortium, 2001, National Land-Cover Dataset 2001: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp.
Developed, open space and low intensity	percent	(Sum of areas of land cover classifications 21 and 22/drainage area)*100; land cover classifications (21-developed, open space; 22-developed, low intensity) are defined at http://www.mrlc.gov/nlcd_definitions.asp	Multi-Resolution Land Characteristics Consortium, 1992, National Land-Cover Dataset 1992: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp. Multi-Resolution Land Characteristics Consortium, 2001, National Land-Cover Dataset 2001: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp.
Open water; Impervious area	percent	(Sum of area of land cover classification/drainage area)*100; land cover classifications (11-open water, impervious) are defined at http://www.mrlc.gov/nlcd_definitions.asp	Multi-Resolution Land Characteristics Consortium, 1992, National Land-Cover Dataset 1992: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp. Multi-Resolution Land Characteristics Consortium, 2001, National Land-Cover Dataset 2001: accessed on June 25, 2009, at http://www.mrlc.gov/mric2k_nlcd.asp.
Wetlands	percent	(Sum of area /drainage area)*100	U.S. Fish and Wildlife Service, 2009, National Wetlands Inventory: Branch of Resource and Mapping Support, accessed on August 5, 2009, at http://www.fws.gov/wetlands/.
Soil hydrologic group A, B, C, and D[1]	percent	(Area of type soil/drainage area)*100, type A is high infiltration rate soils, type D is low infiltration rate soils	Natural Resources Conservation Service, 2009a, Soil Data Mart: U.S. Department of Agriculture, accessed on April 20, 2009, at http://soildatamart.nrcs.usda.gov.
Percent till and thick till	percent	(Area of till and thick till/drainage area)*100	Connecticut: Stone, J.R., Schafer, J.P., London, E.H., and Thompson, W.B., Compilation sheets at 1:24,000 scale *for* Stone, J.R., Schafer, J.P., London, E.H., and Thompson, W.B., 1992, Surficial materials map of Connecticut: U.S. Geological Survey Special Map, 2 sheets, scale 1:125,000, accessed on April 20, 2009, at http://www.ct.gov/dep/cwp/view.asp?a=2698&q=322898&depNav_GID=1707#Geology. New York: New York State Geological Survey, Surficial Geology, New York State Museum Technology Center, http://www.nysm.nysed.gov/gis.html, accessed on April 20, 2009 Rhode Island: Glacial Deposits, Rhode Island Geographic Information System, http://www.edc.uri.edu/rigis/data/data.aspx?ISO=geoscientificInformation, accessed on April 20, 2009. Massachusetts: MassGIS, Surficial Geology (1:24,000), accessed on April 20, 2009.

Appendix 1. Basin characteristics considered for use in regression analysis (includes units, method or procedure, and source data).—Continued

[Red italics, basin characteristics used in regression equations]

Variable name	Units	Method	Source data
Percent coarse stratified deposits (percent)	percent	(Area of coarse stratified deposits /drainage area)*100; glacial meltwater deposits (stratified) consists of coarse deposits and stacked coarse deposits	Connecticut: Stone, J.R., Schafer, J.P., London, E.H., and Thompson, W.B., Compilation sheets at 1:24,000 scale *for* Stone, J.R., Schafer, J.P., London, E.H., and Thompson, W.B., 1992, Surficial materials map of Connecticut: U.S. Geological Survey Special Map, 2 sheets, scale 1:125,000, accessed on April 20, 2009, at http://www.ct.gov/dep/cwp/view.asp?a=2698&q=322898&depNav_GID=1707#Geology. New York: New York State Geological Survey, Surficial Geology, New York State Museum Technology Center, http://www.nysm.nysed.gov/gis.html, accessed on April 20, 2009 Rhode Island: Glacial Deposits, Rhode Island Geographic Information System, http://www.edc.uri.edu/rigis/data/data.aspx?ISO=geoscientificInformation, accessed on April 20, 2009. Massachusetts: MassGIS, Surficial Geology (1:24,000), accessed on April 20, 2009.
Percent alluvium deposits	percent	(Area of postglacial deposits/drainage area)*100; postglacial deposits consists of floodplain alluvium and swamp deposits	Connecticut: Stone, J.R., Schafer, J.P., London, E.H., and Thompson, W.B., Compilation sheets at 1:24,000 scale *for* Stone, J.R., Schafer, J.P., London, E.H., and Thompson, W.B., 1992, Surficial materials map of Connecticut: U.S. Geological Survey Special Map, 2 sheets, scale 1:125,000, accessed on April 20, 2009, at http://www.ct.gov/dep/cwp/view.asp?a=2698&q=322898&depNav_GID=1707#Geology. New York: New York State Geological Survey, Surficial Geology, New York State Museum Technology Center, http://www.nysm.nysed.gov/gis.html, accessed on April 20, 2009 Rhode Island: Glacial Deposits, Rhode Island Geographic Information System, http://www.edc.uri.edu/rigis/data/data.aspx?ISO=geoscientificInformation, accessed on April 20, 2009. Massachusetts: MassGIS, Surficial Geology (1:24,000), accessed on April 20, 2009.
Precipitation 1971–2000, Mean annual	inches	Averaged over the basin surface area minus 40 estimated using ArcInfo Grid	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Precipitation 1971–2000, Maximum annual	inches	Averaged over the basin surface area minus 40 estimated using ArcInfo Grid	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Precipitation 1971–2000, November, Mean monthly	inches	Averaged over the basin surface area estimated using ArcInfo Grid	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.

Appendix 1. Basin characteristics considered for use in regression analysis (includes units, method or procedure, and source data).—Continued

[Red italics, basin characteristics used in regression equations]

Variable name	Units	Method	Source data
Precipitation 1971–2000, December–February, Mean seasonal	inches	Averaged over the basin surface area estimated using ArcInfo Grid as sum of monthly averages of December, January, and February divided by 3	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Precipitation 1971–2000, March–April, Mean seasonal	inches	Averaged over the basin surface area estimated using ArcInfo Grid as sum of monthly averages of March and April divided by 2	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Precipitation 1971–2000, June, Mean monthly	inches	Averaged over the basin surface area estimated using ArcInfo Grid	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Precipitation 1971–2000, July–Oct, Mean seasonal	inches	Averaged over the basin surface area estimated using ArcInfo Grid as sum of monthly averages of July, August, September, and October divided by 4	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Temperature 1971–2000, Mean annual	degrees Fahrenheit	Averaged over the basin surface area minus 50 estimated using ArcInfo Grid	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Temperature 1971–2000, Maximum annual	degrees Fahrenheit	Averaged over the basin surface area minus 50 estimated using ArcInfo Grid	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Temperature 1971–2000, November, Mean monthly	degrees Fahrenheit	Averaged over the basin surface area estimated using ArcInfo Grid	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Temperature 1971–2000, December–February, Mean seasonal	degrees Fahrenheit	Averaged over the basin surface area estimated using ArcInfo Grid as sum of monthly averages of December, January, and February divided by 3	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Temperature 1971–2000, March–April, Mean seasonal	degrees Fahrenheit	Averaged over the basin surface area estimated using ArcInfo Grid as sum of monthly averages of March and April divided by 2	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Temperature 1971–2000, June, Mean monthly	degrees Fahrenheit	Averaged over the basin surface area estimated using ArcInfo Grid	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.
Temperature 1971–2000, July–Oct, Mean seasonal	degrees Fahrenheit	Averaged over the basin surface area estimated using ArcInfo Grid as sum of monthly averages of July, August, September, and October divided by 4	Prism Climate Group, 2009, Precipitation: Corvallis, Oreg., Oregon State University, accessed on August 5, 2009, at http://www.prism.oregonstate.edu/.

[1]Massachusetts, New York, and Rhode Island geology and soils data from abutting states.

Appendix 2. Predictor and explanatory variable names used in StreamStats (includes units, method, and source data).

[Method and source of data are in Appendix 1]

Predictor variable	Variable name shown in equation in Table 9	StreamStats/National Streamflow Statistic name	Definition	Units
Salmonid Spawning (November)				
25-percent flow duration	Q25	NOVD25	November streamflow exceeded 25 percent of the time	cubic feet per second
50-percent flow duration	Q50	NOVD50	November streamflow exceeded 50 percent of the time	cubic feet per second
75-percent flow duration	Q75	NOVD75	November streamflow exceeded 75 percent of the time	cubic feet per second
90-percent flow duration	Q90	NOVD90	November streamflow exceeded 90 percent of the time	cubic feet per second
99-percent flow duration	Q99	NOVD99	November streamflow exceeded 99 percent of the time	cubic feet per second
Overwinter (December, January, and February)				
25-percent flow duration	Q25	D25_12_02	December through February streamflow exceeded 25 percent of time	cubic feet per second
50-percent flow duration	Q50	D50_12_02	December through February streamflow exceeded 50 percent of time	cubic feet per second
75-percent flow duration	Q75	D75_12_02	December through February streamflow exceeded 75 percent of time	cubic feet per second
95-percent flow duration	Q95	D95_12_02	December through February streamflow exceeded 95 percent of time	cubic feet per second
99-percent flow duration	Q99	D99_12_02	December through February streamflow exceeded 99 percent of time	cubic feet per second
Habitat Forming (March–April)				
25-percent flow duration	Q25	D25_03_04	March through April streamflow exceeded 25 percent of time	cubic feet per second
50-percent flow duration	Q50	D50_03_04	March through April streamflow exceeded 50 percent of time	cubic feet per second
75-percent flow duration	Q75	D75_03_04	March through April streamflow exceeded 75 percent of time	cubic feet per second
95-percent flow duration	Q95	D95_03_04	March through April streamflow exceeded 95 percent of time	cubic feet per second
99-percent flow duration	Q99	D99_03_04	March through April streamflow exceeded 99 percent of time	cubic feet per second
Clupeid Spawning (May)				
25-percent flow duration	Q25	MAYD25	November streamflow exceeded 25 percent of the time	cubic feet per second
50-percent flow duration	Q50	MAYD50	November streamflow exceeded 50 percent of the time	cubic feet per second
75-percent flow duration	Q75	MAYD75	November streamflow exceeded 75 percent of the time	cubic feet per second
95-percent flow duration	Q95	MAYD95	November streamflow exceeded 90 percent of the time	cubic feet per second
99-percent flow duration	Q99	MAYD99	November streamflow exceeded 99 percent of the time	cubic feet per second
Resident Spawning (June)				
25-percent flow duration	Q25	JUND25	June streamflow exceeded 25 percent of the time	cubic feet per second
50-percent flow duration	Q50	JUND50	June streamflow exceeded 50 percent of the time	cubic feet per second
75-percent flow duration	Q75	JUND75	June streamflow exceeded 75 percent of the time	cubic feet per second
90-percent flow duration	Q90	JUND90	June streamflow exceeded 90 percent of the time	cubic feet per second
99-percent flow duration	Q99	JUND99	June streamflow exceeded 99 percent of the time	cubic feet per second
Rearing through Growth (July, August, September, through October)				
25-percent flow duration	Q25	D25_07_10	July through October streamflow exceeded 25 percent of time	cubic feet per second
50-percent flow duration	Q50	D50_07_10	July through October streamflow exceeded 50 percent of time	cubic feet per second
75-percent flow duration	Q75	D75_07_10	July through October streamflow exceeded 25 percent of time	cubic feet per second
80-percent flow duration	Q80	D80_07_10	July through October streamflow exceeded 25 percent of time	cubic feet per second
99-percent flow duration	Q99	D99_07_10	July through October streamflow exceeded 25 percent of time	cubic feet per second
Non-bioperiod				
25-percent flow duration	Q25	D25	Streamflow exceeded 25 percent of time	cubic feet per second
99-percent flow duration	Q99	D99	Streamflow exceeded 99 percent of time	cubic feet per second

Appendix 2. Predictor and explanatory variable names used in StreamStats (includes units, method, and source data). —Continued

[Method and source of data are in Appendix 1]

Explanatory variable	Variable name shown in equation in Table 9	StreamStats/National Streamflow Statistic name	Definition	Units
Drainage area	DRNAREA	DNRAREA	Area that drains to a point on a steram	square miles
Mean basin elevation	ELEV	ELEV	Mean basin elevation	feet
Wetlands	WETLAND	WETLAND	Percentage of wetlands	percent
Percent coarse stratified deposits	CRSDFT	CRSDFT	Percentage of area of coarse stratified deposits	percent
Precipitation 1971–2000, November, mean monthly	PPTnov	NOVAVPRE	Average monthly precipitation for November for the climatological period 1971–2000	inches
Precipitation 1971–2000, December–February, mean seasonal	PPTow	PRCWINTER	Average of the three 30-year average monthly precipitation values (December, January, and February) for the climatological period 1971–2000	inches

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