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Nutrient Enrichment, Phytoplankton Algal Growth, and Estimated Rates of Instream Metabolic Processes in the Quinebaug River Basin, Connecticut, 2000–2001

Scientific Investigations Report 2004-5227

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Cover.—Photograph showing the Quinebaug River at the outlet of West Thompson Lake, August 2003. (Photograph by Jonathan Morrison, U.S. Geological Survey.)

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Contents

Figures

Tables

Conversion Factors, Vertical Datum, and Abbreviations

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Area	
square mile (mi^2)	2.590	square kilometer
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
cubic foot per second per square mile ($ft^3/s/mi^2$)	0.01093	cubic meter per second per square kilometer

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:
°F = (1.8 × °C) + 32

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 1927 (NAD 27).

Concentration of chemical constituents is given in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Primary productivity is expressed as a rate of change in either a positive (increasing) or negative (decreasing) direction in grams of oxygen per cubic meter per hour (g $O_2/m^3/hr$).

Phytoplankton density is given in algal cells per milliliter (c/mL).

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Abstract

A consistent and pervasive pattern of nutrient enrichment was substantiated by water-quality sampling in the Quinebaug River and its tributaries in eastern Connecticut during water years 2000 and 2001. Median total nitrogen and total phosphorus concentrations exceeded the U.S. Environmental Protection Agency's recently recommended regional ambient water-quality criteria for streams (0.71 and 0.031 milligrams per liter, respectively). Maximum total phosphorus concentrations exceeded 0.1 milligrams per liter at nearly half the sampled locations in the Quinebaug River Basin. Elevated total nitrogen and total phosphorus concentrations were measured at all stations on the mainstem of the Quinebaug River, the French River, and the Little River. Nutrient enrichment was related to municipal wastewater point sources at the sites on the mainstem of the Quinebaug River and French River, and to agricultural nonpoint nutrient sources in the Little River Basin.

Nutrient enrichment and favorable physical factors have resulted in excessive, nuisance algal blooms during summer months, particularly in the numerous impoundments in the Quinebaug River system. Phytoplankton algal density as high as 85,000 cells per milliliter was measured during such nuisance blooms in water years 2000 and 2001. Different hydrologic conditions during the summers of 2000 and 2001 produced very different seston algal populations. Larger amounts of precipitation sustained higher streamflows in the summer of 2000 (than in 2001), which resulted in lower total algal abundance and inhibited the typical algal succession from diatoms to cyanobacteria. Despite this, nearly half of all seston chlorophyll-a concentrations measured during this study exceeded the recommended regional ambient stream-water-quality criterion (3.75 micrograms per liter), and seston chlorophyll-a concentrations as large as 42 micrograms per liter were observed in wastewater-receiving reaches of the Quinebaug River.

Estimates of primary productivity and respiration obtained from diel dissolved oxygen monitoring and from light- and dark-bottle dissolved oxygen measurements demonstrated that instream metabolic processes are consistent with a seston-algae dominant system. The highest estimated maximum primary productivity rate was 1.72 grams of oxygen per cubic meter per hour at the Quinebaug River at Jewett City during September 2001. The observed extremes in diel dissolved oxygen concentrations (less than 5 milligrams per liter) and pH (greater than 9) may periodically stress aquatic organisms in the Quinebaug River Basin.

Introduction

Phosphorus and nitrogen are essential nutrients for plant growth; however, excessive concentrations of both nutrients have been reported historically at water-quality monitoring stations in the Quinebaug River Basin that are operated cooperatively by the Connecticut Department of Environmental Protection (CTDEP) and the U.S. Geological Survey (USGS). Nitrogen availability rarely limits aquatic plant growth in freshwater, whereas phosphorus concentrations in natural or near-natural streams are generally low enough to limit plant growth. Excessive phosphorus concentrations in freshwater promote growth of aquatic algae and eutrophic conditions (Hem, 1985; Litke, 1999). National criteria have not been established for concentrations of phosphorus compounds in streams; however, to control eutrophication, the U.S. Environmental Protection Agency (USEPA) (1986) has recommended that total phosphorus not exceed 0.05 mg/L (milligrams per liter) in a stream at a point where it enters a lake or reservoir and not exceed 0.1 mg/L in flowing waters. More recently, the USEPA has presented a national strategy to develop regional nutrient criteria (U.S. Environmental Protection Agency, 1998) and has recommended an ambient water-quality criterion of 0.031 mg/L of total phosphorus as the aggregate reference condition for rivers and streams in the Eastern Coastal Plain ecogregion, which includes Connecticut (U.S. Environmental Protection Agency, 2000a).

Municipal wastewater containing high levels of phosphorus and nitrogen is discharged to the Quinebaug River and its tributaries (Medalie, 1996; Trench, 2000) at numerous locations in Connecticut and Massachusetts (fig. 1). Municipal wastewater return flows constituted approximately 1.3 to 2.4 percent of the annual mean streamflow of the Quinebaug River (measured at USGS streamflow-gaging stations at Quinebaug and at Jewett City, Connecticut) in the early to mid-1990's (Trench, 2000). Improvements in wastewater treatment and the decline in the manufacture and use of detergents containing phosphorus probably have contributed to the significant decline in total phosphorus concentrations observed in many Connecticut streams, including the Quinebaug River, from the 1970's to the 1990's (Trench, 1996; 2000; Colombo and Trench, 2002). Litke (1999) reported that total phosphorus concentrations in municipal wastewater have declined nationally from about 11 mg/L during the height of phosphate detergent use in the 1970's to about 5 mg/L in the late 1990's. Despite the improvements in wastewater treatment and significant long-term downward trends in

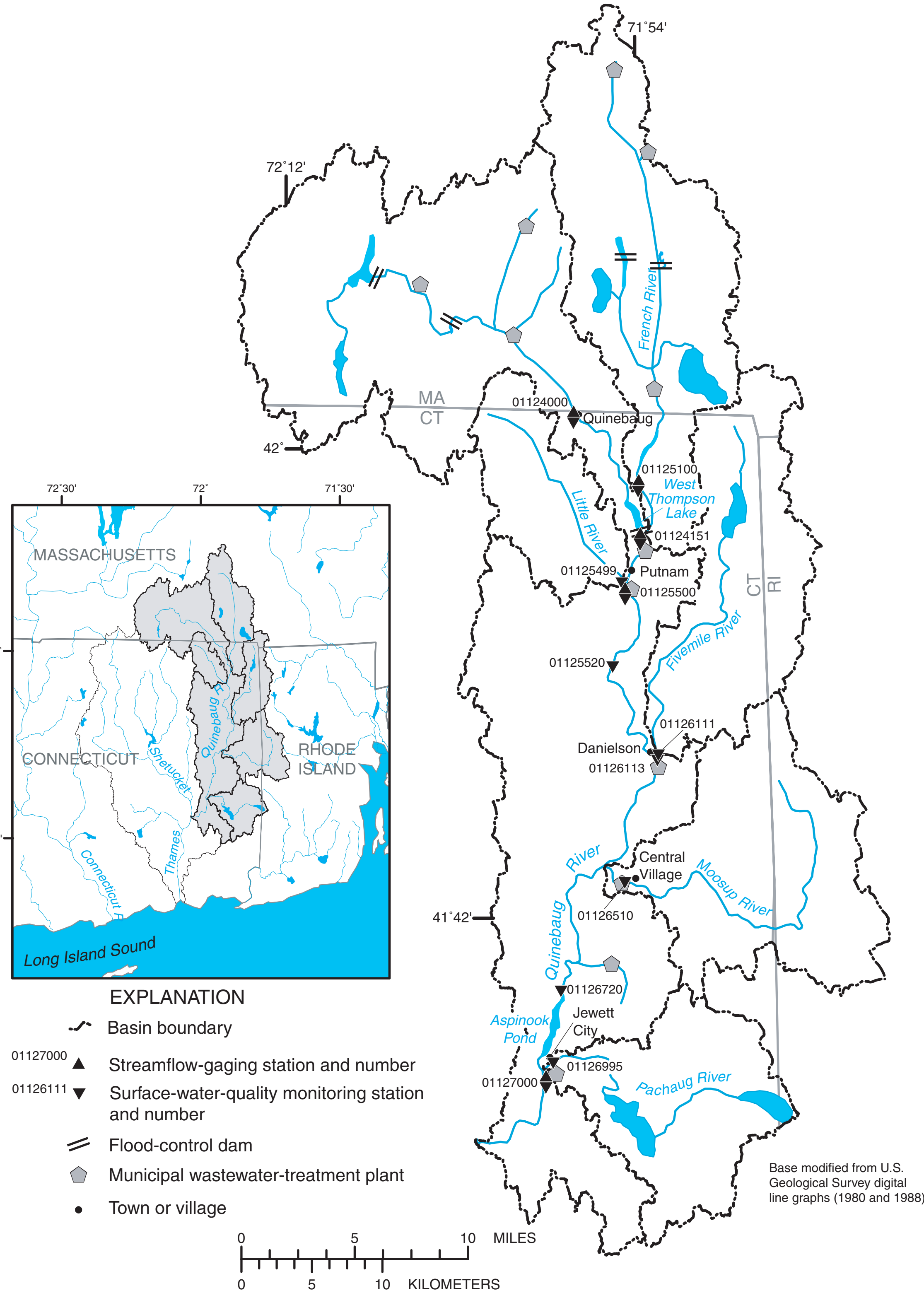


Figure 1. Locations of U.S. Geological Survey stations, flood-control dams, and municipal wastewater-treatment plants in the Quinebaug River Basin, Connecticut.

phosphorus concentrations in the Quinebaug River, current concentrations of total phosphorus are substantially higher than those that would be found under natural or near-natural conditions in Connecticut. Total phosphorus concentrations in excess of 0.1 mg/L are still measured along many reaches of the Quinebaug River and some of its tributaries (Morrison and others, 2003), and eutrophic conditions with nuisance algal blooms have been observed during summer and fall months in several impoundments and slackwater reaches of the Quinebaug River and its tributaries (fig. 2).

Several impoundments and stream reaches in the Quinebaug River Basin have been listed repeatedly as not meeting standards of the Federal Clean Water Act because of elevated nutrient and chlorophyll-a concentrations, excessive algal growth, and persistent organic enrichment causing high levels of biochemical oxygen demand and low levels of dissolved oxygen (Connecticut Department of Environmental Protection, 1994; 1998a; 2002). Furthermore, the affected impoundments and river reaches of the Quinebaug River and its tributaries may store and release nutrients and algae and serve as “point sources” for downstream stream reaches under some conditions. High levels of biochemical oxygen demand in the upper reaches of the Thames River Estuary have been attributed to downstream transport of high concentrations of nutrients and algae originating in the Quinebaug River Basin (T. Nelson, Connecticut Department of Environmental Protection, written commun., 1998).

Figure 2. Summer algal bloom on the French River in Connecticut, August 20, 2002. (Photograph by S. Lyle Phipps, USGS.)

Algae are single-celled plants that contain chlorophyll and carry out photosynthesis. Nutrient enrichment can promote excessive growth of two types of algae: (1) phytoplankton, algae suspended in lakes and reservoirs and sometimes in slow-flowing rivers and streams, and (2) periphyton, algae attached to some submerged substrate. Seston refers to the algae transported in the river or stream and includes both the suspended phytoplankton plus any periphyton that have been dislodged. Algae decompose when they die, consuming oxygen in the water and contributing to a condition called hypoxia. Hypoxia occurs when dissolved oxygen levels are depleted to such a degree that the viability of aquatic life is affected. Low concentrations of dissolved oxygen in the Thames River have been reported by the CTDEP during summer and fall periods coinciding with or following periods of observed high concentrations of nutrients and nuisance algae blooms in the Quinebaug River Basin (E. Pizzuto, Connecticut Department of Environmental Protection, oral commun., 2001).

The diurnal metabolic cycle of aquatic plants and animals can produce fluctuations in nutrient concentrations and affect water-quality conditions, as measured by parameters such as specific conductance, pH, dissolved oxygen, and carbon dioxide. During the day, photosynthetic activity of aquatic plants, including algae, removes carbon dioxide and releases oxygen to the stream. At night, photosynthesis ceases while aquatic plants and animals continue to respire and consume oxygen. Continuous water-quality monitoring records for water temperature, pH, specific conductance, and dissolved oxygen collected in the Quinebaug River during 2000 and 2001 show that pH and dissolved oxygen levels vary on a diurnal basis. The cause of this diel activity is believed to be associated with excess algal plant growth due to nutrient enrichment.

Understanding where, when, and how elevated nutrient concentrations affect the rate of primary productivity in the Quinebaug River Basin may facilitate decisions by water-resource managers on how best to manage the water resources to minimize nuisance algal blooms. This may involve lowering maximum productivity rates and decreasing the length of time during which the blooms occur. As part of the continuing effort to understand and improve water quality in Connecticut, the CTDEP and the USGS began a cooperative multi-part study in 2000 to (1) characterize the relation between nutrient enrichment and excessive algal productivity in the Quinebaug River Basin, (2) analyze long-term trends for total phosphorus in the Quinebaug River Basin and evaluate optimal sampling designs for monitoring future trends, (3) review the current level of understanding of nutrient-related water-quality problems in the Thames River Basin, and (4) develop a science plan to direct water-quality investigations needed to manage and restore aquatic resources. Results from the first objective of the study, relating to nutrient concentrations in the Quinebaug River Basin and the effects of nutrient enrichment on algal growth, are reported here.

Purpose and Scope

This report presents information on nutrient concentrations in the Quinebaug River and several tributaries in eastern Connecticut during water years[1] 2000 and 2001 (October 1999 through September 2001) and relates the location and timing of elevated nutrient concentrations to the occurrence of elevated seston chlorophyll-a concentrations and pronounced increases in seston algal populations. The report also provides estimated rates of primary productivity and respiration of seston algal communities using both diel curves of dissolved oxygen concentrations measured at continuous water-quality monitors and in light- and dark-bottle samples. On the basis of the primary productivity and respiration rates determined from the light- and dark-bottle method, this report also characterizes parts of the main stem and tributary rivers as either seston- or periphyton-dominated systems.

Description of the Study Area

The Quinebaug River drains 740 mi^2 (square miles) in eastern Connecticut, western Rhode Island, and south-central Massachusetts and is a major tributary to the Shetucket River, which flows into the Thames River Estuary at the eastern end of Long Island Sound (fig. 1). The principal tributaries of the Quinebaug River, listed from north to south, are the French, Little, Fivemile, Moosup, and Pachaug Rivers. The Quinebaug River and some of its tributaries were used at numerous locations in the basin for industrial water power to supply 18th- and 19th-century mills. Numerous dams and associated structures were located throughout the watershed and many of these remain, some still producing hydroelectric power. Additional dams were constructed by the U.S. Army Corps of Engineers for flood control following widespread floods in 1938 and 1955. With numerous impoundments along the main stem and its tributaries (fig. 1), streamflow in the Quinebaug River is highly regulated.

Land use in the Quinebaug River Basin is primarily forest (68 percent) and agriculture (12 percent). Scattered small urban areas are mostly along the main stem and upper tributaries where villages and towns were built around an economy dominated by textile mill works. Urban land use encompasses about 8 percent of the watershed including the historic small urban centers and newer suburban developments that are more often found in upland areas. The remaining area includes water or wetlands and other minor land uses. The current and historic land-use patterns have affected various segments of the basin with point- and nonpoint-source pollution from municipal and industrial wastewater discharges, urban runoff, and agricultural practices.

Data Collection and Analysis

Water-quality and biological samples were collected at 12 USGS stations during water years 2000 and 2001. The stations sampled included seven sites along the main stem of the Quinebaug River and five sites on tributaries to the Quinebaug River. The distribution, type, and period of record for the data used in this report are summarized in table 1.

[1]A water year is defined as the 12-month period October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 2001 is called the 2001 water year.

Table 1. Sampling sites and types of data collected in the Quinebaug River Basin, Connecticut, water years 2000 and 2001.

[CM, continuous water-quality monitoring for dissolved oxygen, pH, specific conductance, and water temperature; TN, total nitrogen; TP, total phosphorus; TOC, total organic carbon; CHLa, chlorophyll-a; PA, phytoplankton analysis; LD, light- and dark-bottle productivity]

U.S. Geological Survey station		Type of data collected and number of days of data or number of samples						
Number	Name	CM	TN	TP	TOC	CHLa	PA	LD
01124000	Quinebaug River at Quinebaug, Conn.	0	34	34	22	19	6	0
01124151	Quinebaug River at West Thompson, Conn.	243	27	27	8	19	6	1
01125100	French River near North Grosvenordale, Conn.	0	34	34	21	18	6	1
01125499	Little River at Putnam, Conn.	0	20	20	5	18	6	1
01125500	Quinebaug River at Putnam, Conn.	0	37	37	6	18	6	1
01125520	Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.	300	33	33	18	18	7	1
01126111	Fivemile River at Danielson, Conn.	0	18	18	4	18	6	0
01126113	Quinebaug River at Danielson, Conn.	0	18	18	4	18	7	1
01126510	Moosup River at Plainfield, Conn.	0	18	18	4	18	6	1
01126720	Quinebaug River near Packer, Conn.	217	20	20	6	18	7	1
01126995	Pachaug River at Jewett City, Conn.	0	18	18	5	17	7	1
01127000	Quinebaug River at Jewett City, Conn.	305	32	32	20	17	7	1

Water-Quality and Biological Samples

At most stations, water-quality samples were collected from October 1999 through September 2001 (fig. 3) to characterize the areal and temporal distribution of nutrient concentrations and loads in various reaches of the Quinebaug River Basin. Total nitrogen was determined as the sum of analytically determined dissolved nitrite-plus-nitrate nitrogen and total ammonia-plus-organic nitrogen concentrations. Total phosphorus was analytically determined by a Kjeldahl digestion method. Nutrient samples were collected year-round at most sites, although the sampling frequency increased from monthly during the fall and winter to biweekly during the spring and summer (fig. 3). Also, sampling was begun in the fall of 1999 at 5 of the sites but not until the spring of 2000 at 7 others; consequently, the number of total nitrogen and total phosphorus samples ranged from as few as 18 to as many as 37 among the 12 stations (table 1).

Biological data collection included seston samples for phytoplankton enumeration and identification, and determination of chlorophyll-a concentrations. Biological data were collected only during the growing seasons of 2000 and 2001 (fig. 3). Limited phytoplankton sampling was conducted to document the number and identification of seston algae in the Quinebaug River and tributaries at selected dates before, during, and (or) after observed nuisance algal blooms. Generally, six or seven phytoplankton samples were collected in May, July, and (or) September 2000 and June, August, and September 2001 at each of the 12 sites sampled (table 1). Chlorophyll-a samples were collected with all phytoplankton samples and with most biweekly summer water-quality samples to estimate algal enrichment at the sampling sites when phytoplankton samples were not collected (fig. 3). Between 17 and 19 seston chlorophyll-a samples were collected at each station during this study (table 1). Total organic carbon (TOC) samples can be used as an indirect indicator of algal enrichment, but other sources of organic carbon (industrial and municipal wastewater effluents) are likely contributors to elevated TOC concentrations in waste-receiving streams. TOC samples were collected at all 12 sites; however, only 4 of the sites in the Quinebaug River Basin were sampled frequently for TOC (table 1).

In addition to the water-quality and biological sampling described above, treated effluent wastewater samples were collected during the summer of 2001 at four municipal wastewater-treatment plants to characterize the nutrient content of wastewater that is discharged to the Quinebaug River. Ten samples were collected from the outfall of each plant and analyzed for the same nutrient constituents as the surface-water samples.

All water-quality samples, seston chlorophyll-a, and phytoplankton samples were collected in accordance with USGS approved methods and protocols (Britton and Greeson, 1989; Ward and Harr, 1990; Shelton, 1994; Wilde and Radtke, 1998; and, Moulton and others, 2002). Water-quality (and effluent) samples were processed (filtered and preserved as appropriate), chilled, and shipped for analysis at the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado. The NWQL performed all analyses for nutrients, carbon, and chlorophyll-a included in this report; analytical methods used by the NWQL are described in USGS reports (Wershaw and others, 1987; Britton and Greeson, 1989; Fishman and Friedman, 1989; Patton and Truitt, 1992; Brenton and Arnett, 1993; and Fishman, 1993). Samples obtained for seston (phytoplankton) analyses were collected generally on the same day as water-quality samples and were chilled and delivered to the CTDEP laboratory in Hartford, Connecticut. Phytoplankton enumeration (Sedgwick-Rafter cell counts) and identification were conducted in accordance with protocols described by the American Public Health Association (1992).

Continuous Water-Quality Monitors

Continuous water-quality monitors were deployed at four sites in the Quinebaug River to collect dissolved oxygen concentration, pH, water temperature, and specific conductance data at 15-minute intervals. Daily maximum and minimum values are reported in appendixes 1 to 4. The monitors were intended to collect data throughout the period of each water year when solar insolation is greatest and most aquatic plant growth occurs (generally May through September). Additionally, in the first year of the study, continuous data also were collected during the period of declining solar insolation during fall and early winter (October to December). Installation, maintenance, calibration, cleaning, and record computation were done in accordance with USGS guidelines and standard procedures (Wagner and others, 2000). Some record was lost at each station, however, because of operational problems including battery, probe fouling, and instrument failures; hence, the number of days with continuous monitor data ranged from 217 for station 01126720 (appendix 3) to 305 at station 0112700 (appendix 4). Dissolved oxygen data were the most problematic of the continuous-monitor measurements, and the number of days with complete daily dissolved oxygen record varied from 102 to 185 days at the four sites in water year 2000. Operational problems also severely limited data collection at two sites in 2001 such that only 40 days of dissolved oxygen data were collected at station 01126720 (appendix 3), and just 6 days of data were recorded at station 01124151(appendix 1).

Light- and Dark-Bottle Measurements

Standard light- and dark-bottle metabolic-rate measurements (Britton and Greeson, 1989; American Public Health Service, 1992) were conducted one time at each of 10 stations in water year 2001, including 6 sites on the main stem of the Quinebaug River and 4 tributary sites (table 1). Two sets of three light-transmitting and three darkened bottles were used for the experiment. The bottles were 1-pint, glass, milk bottles (used primarily for USGS sediment collection) with plastic, snap-on caps. The light bottles were clear with no labels; conversely, the dark bottles were completely wrapped with black vinyl tape.

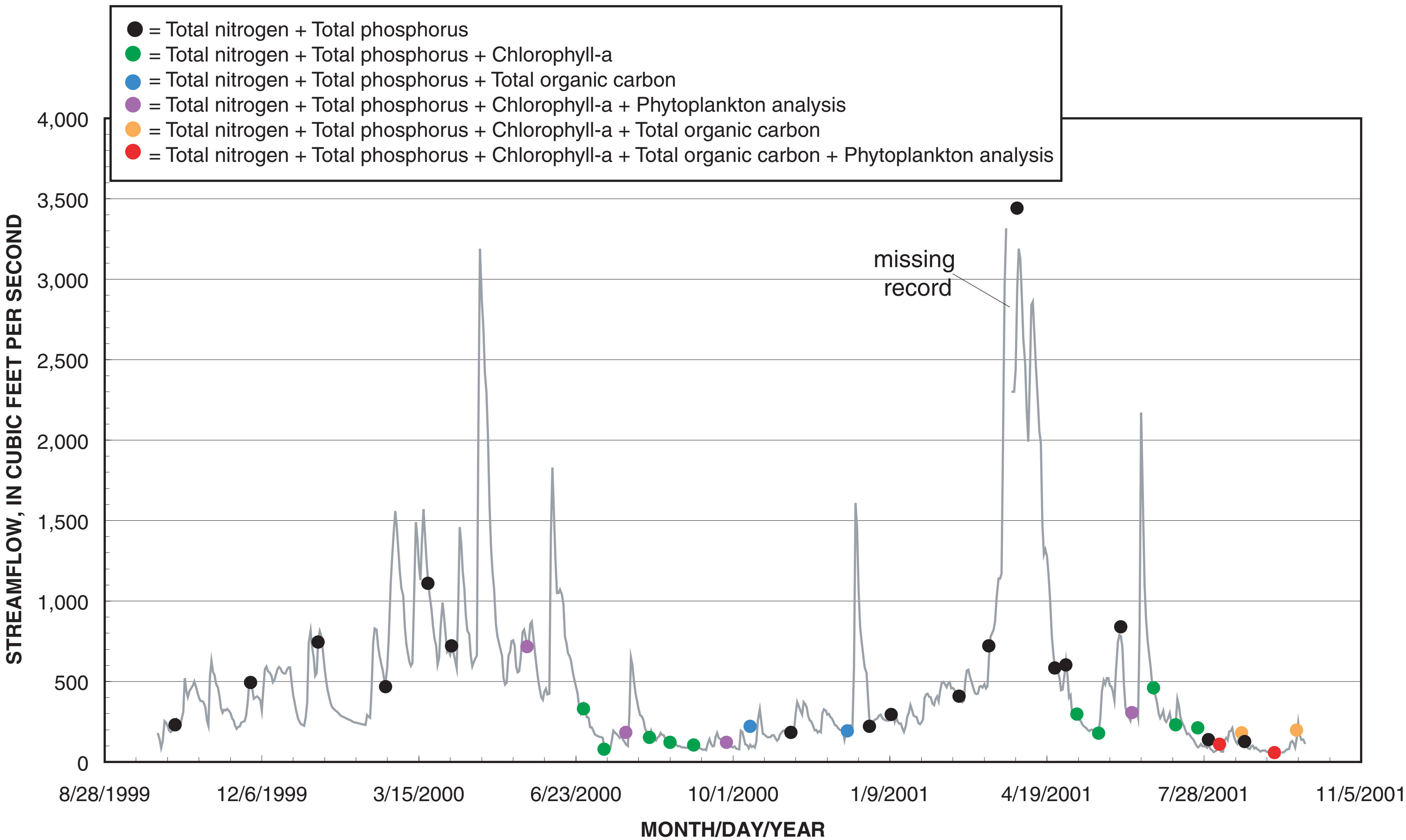


Figure 3. Streamflow at U.S. Geological Survey station 01125500, Quinebaug River at Putnam, Connecticut, indicating dates and flow conditions when water samples were collected, October 1999 through September 2001. [Dots represent instantaneous streamflow at time of sample collection.]

The light- and dark-bottle experiments were conducted during the photoperiod (sunlight part of the day) in the euphotic zone (part of the aquatic environment with sufficient light for photosynthesis) of the Quinebaug River and its tributaries. The bottles were filled with unfiltered river water, sealed, and placed at a location within the euphotic zone on the riverbed for several hours. The dissolved oxygen in the river was measured and recorded initially when the bottles were filled. The euphotic zone was measured at several sites and was determined to extend to the river bottom during low- flow periods when the light- and dark-bottle productivity measurements were made. After a measured time interval of approximately 1 to 2 hours, the bottles were retrieved from the river, and a dissolved oxygen measurement was taken using a dissolved oxygen meter immediately upon opening each bottle. The measured values for each set of three light and three dark bottles for each site were averaged for one light-bottle value and one dark-bottle value.

Nutrient Enrichment in the Quinebaug River Basin

Water-quality samples collected during water years 2000 and 2001 substantiate the consistent and pervasive occurrence of elevated concentrations of total nitrogen and total phosphorus in wastewater-receiving parts of the Quinebaug River Basin. Runoff from agricultural lands also caused elevated nutrient concentrations in some parts of the basin. The following sections describe the extent of nutrient enrichment observed during this study in various parts of the Quinebaug Basin.

Total Nitrogen

Elevated concentrations of total nitrogen were measured throughout the Quinebaug River Basin in water years 2000 and 2001. Median total nitrogen concentrations in water samples from 9 of the 12 stations sampled for this study (fig. 4) equaled or exceeded the USEPA's proposed regional total nitrogen ambient water quality criterion of 0.71 mg/L (U.S. Environmental Protection Agency, 2000a). The maximum total nitrogen concentrations measured at the same nine stations during this study ranged from 1.2 to 4.8 mg/L. The nine stations with elevated total nitrogen concentrations included all seven Quinebaug River mainstem stations and stations on two tributaries, the French River and Little River (fig. 4). The largest median total nitrogen concentration (1.5 mg/L) and the highest total nitrogen concentration (4.8 mg/L) in the basin observed during this study were in water samples from the French River near North Grosvenordale, Connecticut (USGS station 01125100). Several municipal wastewater-treatment plants discharge nutrient-enriched wastewater to the Quinebaug River and the French River upstream from the locations sampled for this study. Total nitrogen concentrations in the effluent samples collected at four of these wastewater-treatment plants during the summer of 2001 ranged from 1.5 to 25 mg/L, and median total nitrogen concentration for each plant were 4.3, 9.2, 11.5 and 13.5 mg/L. The Little River at Putnam, Connecticut (USGS station 01125499) does not receive wastewater discharges but this drainage basin contains substantially more agricultural land (24 percent) than other tributary streams or reaches of the Quinebaug River. The three tributary streams with the smallest total nitrogen concentrations—the Fivemile, Moosup, and Pachaug Rivers—do not receive wastewater discharges upstream from the sampled locations and contain less than 10 percent agricultural land.

Nutrient concentrations vary with variations in streamflow, as do most water-quality constituents. The nature of the relation between concentration and streamflow can provide an indication of the types of nutrient inputs upstream (Mueller and others, 1995). If the principal source of nitrogen is atmospheric fallout and leaching of forested and undeveloped areas, generally low concentrations persist over a broad range of streamflow conditions because no substantial dilution takes place. With a point source of nitrogen such as a wastewater-treatment plant, however, the effluent nitrogen concentration is added to the stream at a relatively stable rate on a day-to-day basis and in-stream concentrations increase as streamflow declines. Conversely, concentration decreases sharply as the volume of streamflow rises and dilution takes place. This pattern can be seen in a plot of total nitrogen and streamflow (fig. 5) for the French River near North Grosvenordale, Connecticut (USGS station 01125100). The total nitrogen concentrations decline exponentially as streamflow increases at this station, which receives effluent discharged from a municipal wastewater-treatment plant several miles upstream.

Total Phosphorus

The distribution of stations with elevated total phosphorus concentrations in the Quinebaug River Basin during water years 2000 and 2001(fig. 6) is similar to total nitrogen. Median total phosphorus concentrations equaled or exceeded the USEPA's proposed regional total phosphorus ambient water-quality criterion of 0.031 mg/L (U.S. Environmental Protection Agency, 2000a) in water samples from the same nine stations that showed elevated total nitrogen concentrations (fig. 4). The maximum total phosphorus concentrations observed at these nine stations during the study ranged from 0.07 to 0.18 mg/L. Whereas the highest total nitrogen concentrations were measured in the French River near North Grosvenordale, Connecticut (USGS station 01125100), the largest median (0.065 mg/L) and maximum (0.181 mg/L) total phosphorus levels were measured at the Quinebaug River at Cotton Bridge Road near Pomfret Landing, Connecticut (USGS station 01125520).

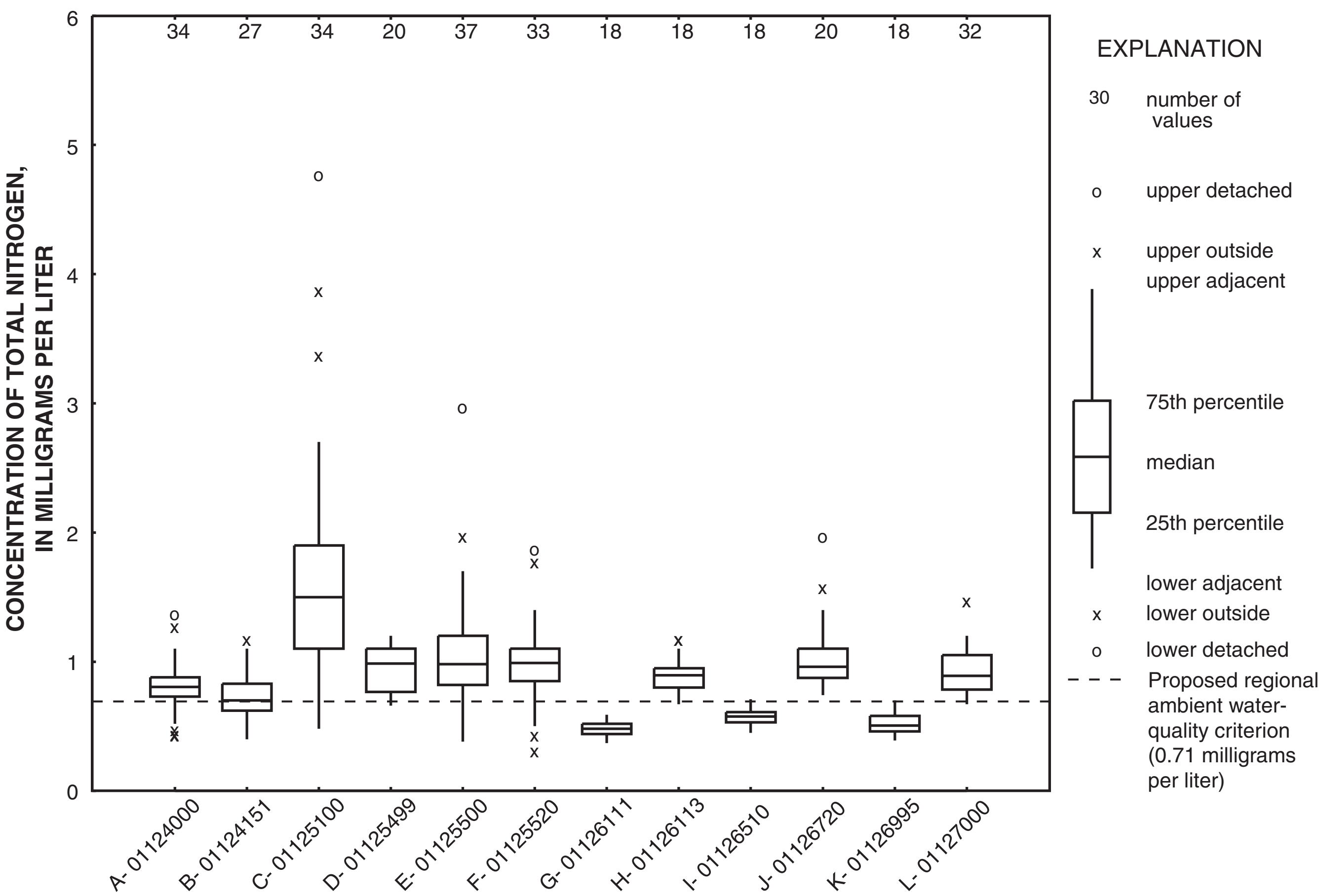
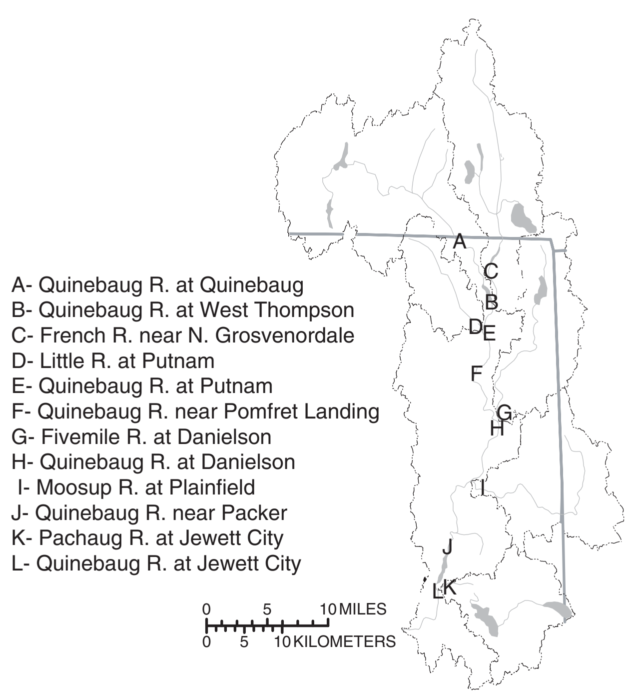
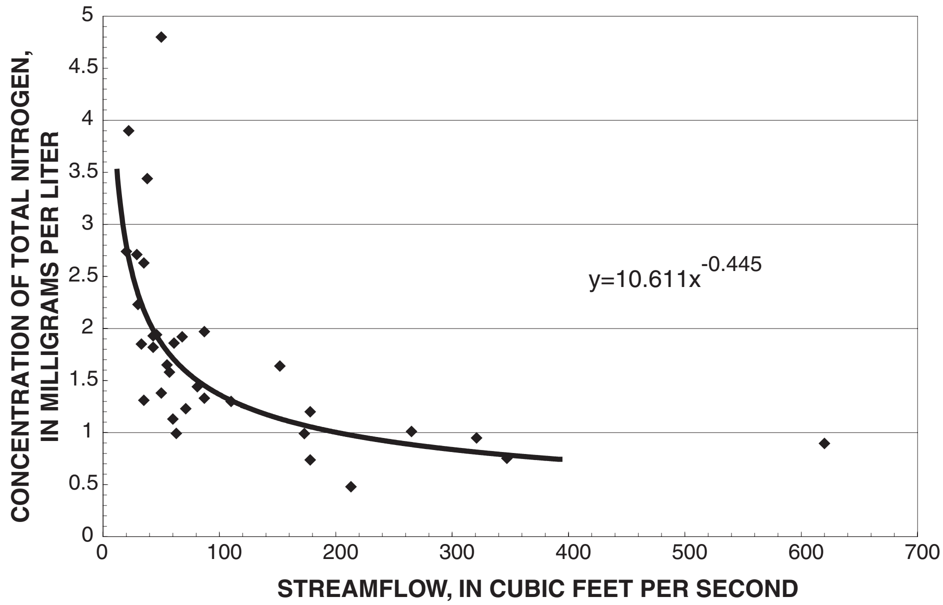


Figure 4. Concentration of total nitrogen at water-quality stations in the Quinebaug River Basin, October 1999 through September 2001.



Lettered stations on this map refer to stations in boxplots above (fig. 4) and right (fig. 6).

Figure 5. Relation between concentration of total nitrogen and streamflow for dates sampled during water years 2000 and 2001 at U.S. Geological Survey station 01125100, French River near North Grosvenordale, Connecticut.



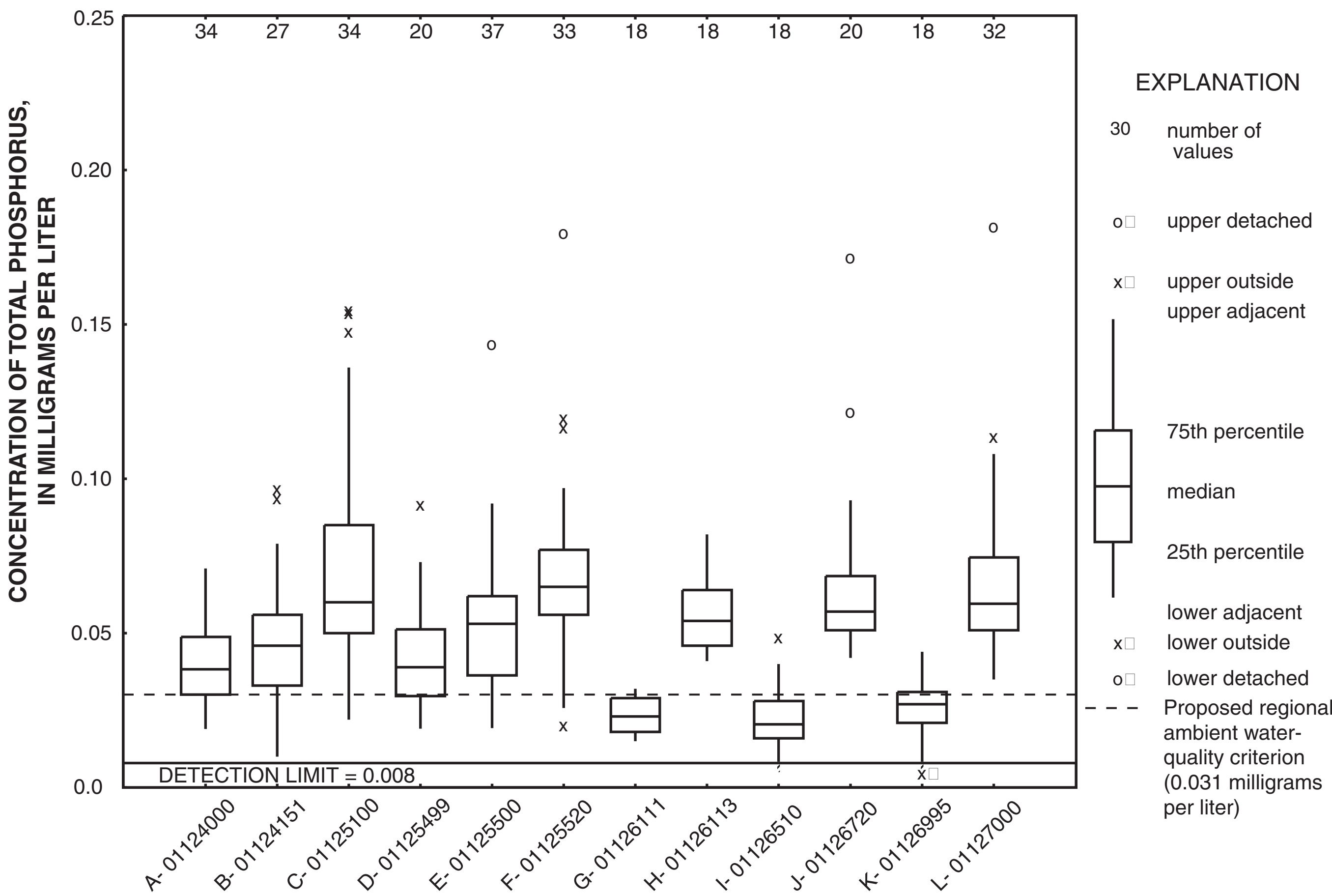


Figure 6. Concentrations of total phosphorus at water-quality stations in the Quinebaug River Basin, October 1999 through September 2001.

Overall, 78 percent of all total phosphorus samples in the Quinebaug River Basin collected during the study equaled or exceeded the 0.031-mg/L proposed regional ambient water-quality criterion. As with total nitrogen, the geographic distribution of the water-quality stations with elevated total phosphorus concentrations reflects the distribution of point and nonpoint sources. The cumulative distribution curve of total phosphorus concentrations for the three tributary streams without wastewater or substantial agricultural phosphorus sources—the Fivemile, Moosup and Pachaug Rivers—plots significantly ($p<0.0001$ for a Kruskal-Wallis rank sum test) to the left of other Quinebaug River Basin stations (fig. 7). Collectively, about 85 percent of the total phosphorus concentrations in water samples from these three stations were less than 0.031 mg/L, and none of the samples from these stations had concentrations exceeding 0.1 mg/L. Nonpoint sources of phosphorus in the Little River Basin resulted in fewer samples that would meet the proposed regional ambient water-quality criterion of 0.031 mg/L; only about 30 percent of the samples from USGS station 01125499 had total phosphorus concentrations less than 0.031 mg/L (fig. 7). In water samples from stations on the mainstem of the Quinebaug River and the French River near North Grosvenordale, total phosphorus concentrations seldom were less than 0.031 mg/L; fewer than 10 percent of the samples collected during this study at the French River and mainstem Quinebaug River stations would meet the proposed criterion. Although a variety of point and nonpoint phosphorus sources may contribute to the elevated total phosphorus concentrations at these stations, municipal wastewater-treatment plants are the most probable sources of total phosphorus concentrations that exceeded 0.1 mg/L in nearly 10 percent of the samples. Total phosphorus concentrations measured in effluent samples from four municipal wastewater-treatment plants that discharge to the Quinebaug River ranged from 0.242 to 4.03 mg/L; the median effluent total phosphorus concentrations from the individual wastewater-treatment plants were 0.55, 1.97, 3.0 and 3.34 mg/L.

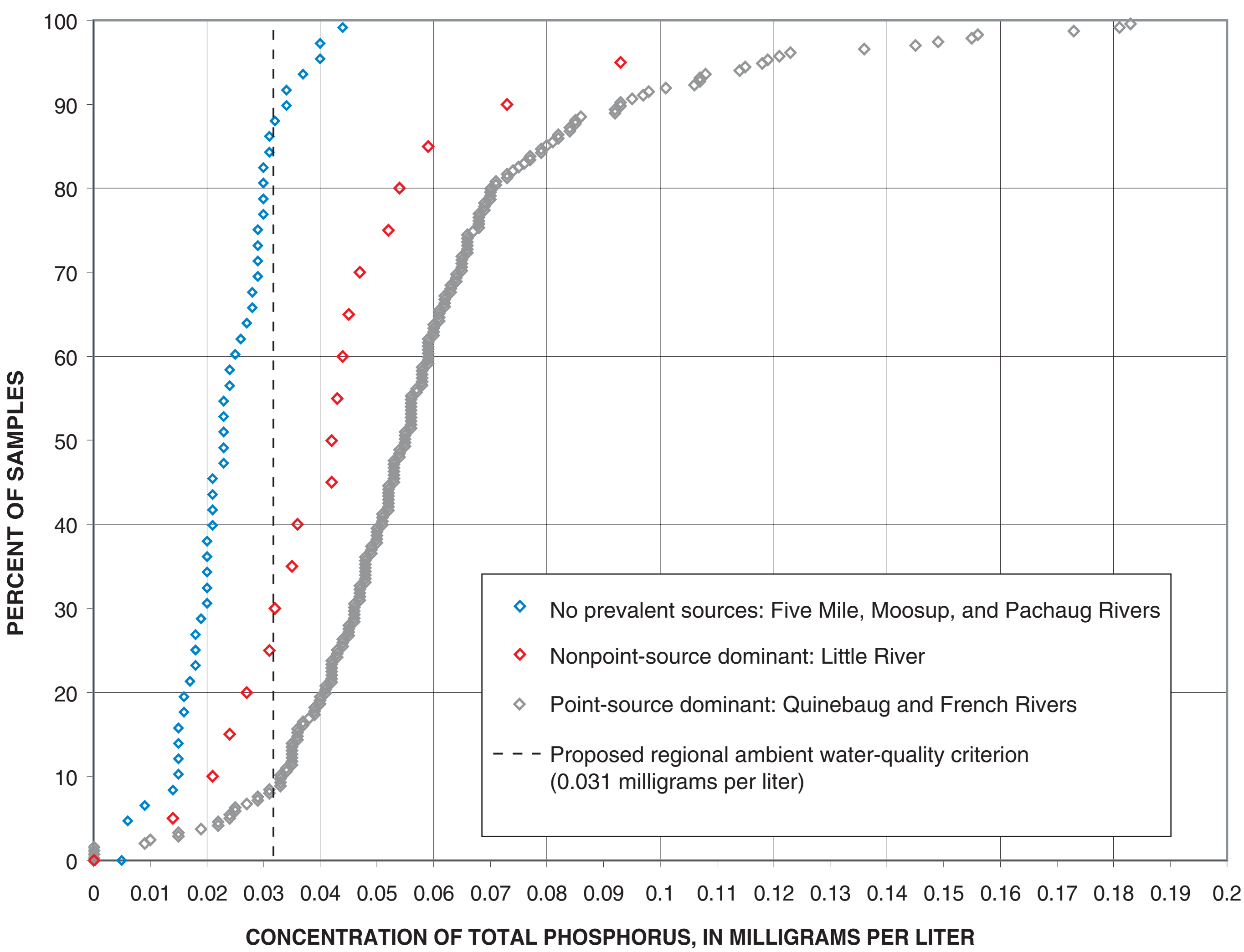


Figure 7. Cumulative distribution of total phosphorus concentrations in water samples collected during water years 2000 and 2001 from stations in the Quinebaug River Basin in relation to probable phosphorus sources.

Correlation Between Total Nitrogen and Total Phosphorus

Generally, the correlation is relatively poor between total nitrogen and total phosphorus concentrations (fig. 8) in the Quinebaug River Basin (r= 0.52); this reflects the differences in their sources as well as their transport mechanisms. For the tributary streams with no prevalent nutrient sources, total nitrogen is relatively constant at about 0.5 mg/L, whereas total phosphorus ranges from less than 0.01 to 0.05 mg/L (fig. 8). For the Little River, which is affected by agricultural nonpoint sources, total nitrogen concentrations vary only a little above or below the 1.0-mg/L level, whereas total phosphorus concentrations extend nearly an order of magnitude from near zero to almost 0.1 mg/L (fig. 8). It is only in the reaches of the Quinebaug and French Rivers affected by wastewater-treatment plant point sources that total nitrogen concentrations increase proportionally with total phosphorus concentrations in some samples. A number of factors probably account for the weak total nitrogen: total phosphorus correlation; these include the composition of fertilizers used on agricultural and residential land, with formulations that often contain 10 to 50 times more nitrogen than phosphorus; the seasonal removal of phosphorus from some municipal wastewater effluents; differential aquatic attenuation processes; and the fact that nitrogen species are transported mostly in a dissolved state whereas phosphorus species tend to adsorb to sediment particles.

Effect of Nutrient Enrichment on Phytoplankton Algal Growth

Low streamflow velocities, warm temperatures, and long hours of daylight all act together to promote algal growth in areas where concentrations of nutrients are elevated during summer and early fall. These conditions favor phytoplankton rather than periphyton dominance. Summer and fall algal blooms that produce turbid, deep-green discolored water (see fig. 2) have been observed at a number of locations on slow-moving and impounded reaches of the Quinebaug, French, and Little Rivers for more than 20 years (Connecticut Department of Environmental Protection, 1978; Kulp, 1991; Healy and Kulp, 1995). Although a variety of phytoplankton have been identified in recent efforts to characterize the algal community (Connecticut Department of Environmental Protection, 1998b), blue-green algae were the predominant contributors to the phytoplankton biomass during periods of nuisance algal growth observed in the Quinebaug River Basin.

Algal biomass is the amount of algae in a water body at a given time. Two methods were used during this study to measure seston algal biomass: microscopic counts of phytoplankton cells and determinations of chlorophyll-a concentrations.

Phytoplankton Density

Phytoplankton samples were collected three to four times during the summer of 2000 and three times during the summer of 2001 at 12 stations (table 2) for microscopic examination. The results of algal identification and enumeration are reported by taxa in appendix 5, and the observed phytoplankton densities are summarized in table 2. Measured phytoplankton density ranged from 0 algal c/mL (cells per milliliter) in samples from four stations (at least once during the study), including two on the main stem of the Quinebaug River plus two tributaries, to an observed maximum of 85,000 algal c/mL at the Quinebaug River near Packer, Connecticut in September 2001. Phytoplankton densities exceeding 10,000 algal c/mL were observed in 16 percent (12 of the 77 samples) of the phytoplankton samples collected over the two summers. Eight of the 10 highest phytoplankton densities were measured during August and September 2001 at stations on impounded or slow-moving reaches of the Quinebaug River; the stations with high phytoplankton density were among the nine stations with median total phosphorus concentrations greater than 0.031 mg/L (fig. 6). Generally, algal densities were lower, showed a less consistent pattern of increasing over the summer, and peaked earlier during the summer of 2000 than in 2001.

The different patterns of algal growth and the generally lower densities observed during the summer of 2000 compared to the summer of 2001 may relate to differences in precipitation and the consequence of that precipitation—higher sustained streamflow in 2000 than 2001 (fig.9). Annual precipitation at the National Oceanic and Atmospheric Administration (NOAA) climatological station at Worcester, Mass. for the year 2000 (44.14 in.) was slightly below average (44.75 in.), but the 32.32 in. recorded for the year 2001 was substantially (15.43 in.) below average. Although annual precipitation totals were below average in both 2000 and 2001, precipitation recorded during the summer months of both years was greater than normal. Streamflow in the summer of 2000 was consistently higher than in the summer of 2001, particularly for May and June, and higher even than median streamflow for the period of record (fig. 9). Comparatively, the average mean daily streamflow of the Quinebaug River at Putnam, Conn. (fig. 10) for the 153 days from May 1 through September 30, 2000 was 379 ft^3/s; whereas average mean daily streamflow was 255 ft^3/s for the same period in 2001. Additionally, only two or three brief periods of relatively elevated streamflow occurred during the summer of 2001, and these periods were both of short duration and before mid-July (fig. 10). Cool, wet periods with elevated streamflow were more pervasive during the summer of 2000, including a 2-week period in late July and early August 2000 (fig. 10) that is likely to have flushed the standing crop of algae from impoundments; the elevated streamflow likely diluted nutrient concentrations and carried more turbid waters that would limit solar insolation and subsequently hinder algal growth.

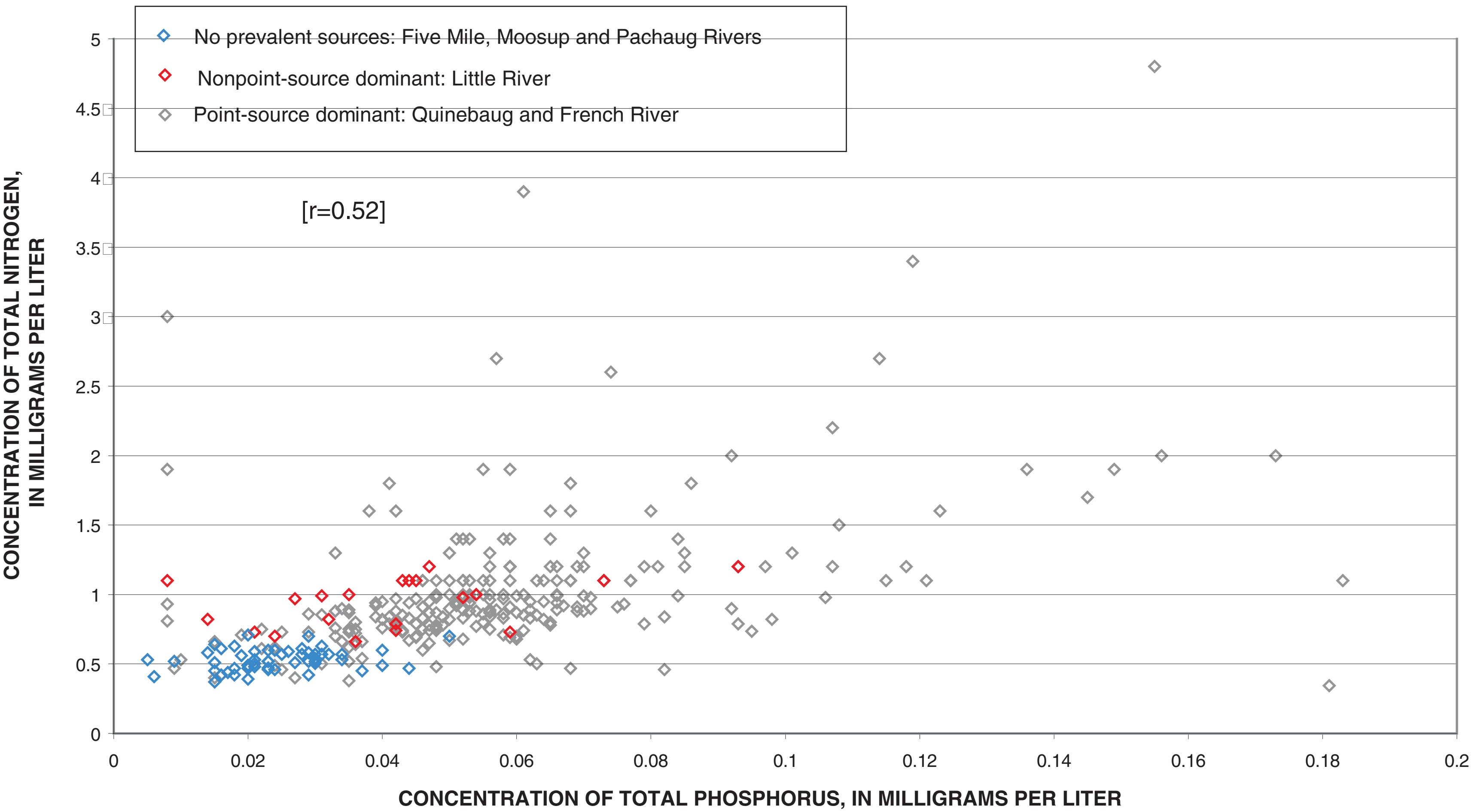


Figure 8. Concentration of total nitrogen plotted against concentration of total phosphorus in water samples collected during water years 2000 and 2001 from stations in the Quinebaug River Basin, Connecticut, in relation to probable nutrient sources.

Table 2. Phytoplankton density at sampling locations in the Quinebaug River Basin, Connecticut, water years 2000 and 2001.

[Phytoplankton enumeration performed by Connecticut Department of Environmental Protection (DEP) using Sedgwick-Rafter cell counts as described by American Public Health Administration, 1992; values are rounded; c/mL, cells per milliliter; --, not sampled

U.S. Geological Survey station		Phytoplankton density (algal c/mL) on sample-collection dates						
Number	Name	May 22 - 25, 2000	July 24 - 27, 2000	August 23 - 25, 2000	Sept. 26 - 29, 2000	June 11 - 15, 2001	August 6 - 10, 2001	Sept. 10 - 14, 2001
01124000	Quinebaug River at Quinebaug, Conn.	140	70	--	0	280	70	140
01124151	Quinebaug River at West Thompson, Conn.	910	4,400	--	4,000	1,600	18,000	22,000
01125100	French River near North Grosvenordale, Conn.	560	2,100	--	9,000	630	1,100	9,500
01125499	Little River at Putnam, Conn.	630	62,000	--	1,500	2,500	840	560
01125500	Quinebaug River at Putnam, Conn.	1,200	4,000	--	3,800	1,500	1,900	18,000
01125520	Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.	0	12,000	560	1,200	1,600	2,200	25,000
01126111	Fivemile River at Danielson, Conn.	70	560	0	0	--	70	0
01126113	Quinebaug River at Danielson, Conn.	910	1,900	140	47,000	1,600	2,900	77,000
01126510	Moosup River at Plainfield, Conn.	490	0	140	70	--	140	0
01126720	Quinebaug River near Packer, Conn.	490	910	210	980	1,500	15,000	85,000
01126995	Pachaug River at Jewett City, Conn.	280	4,000	210	140	2,000	9,800	2,300
01127000	Quinebaug River at Jewett City, Conn.	980	4,900	1,800	1,800	3,400	21,000	59,000

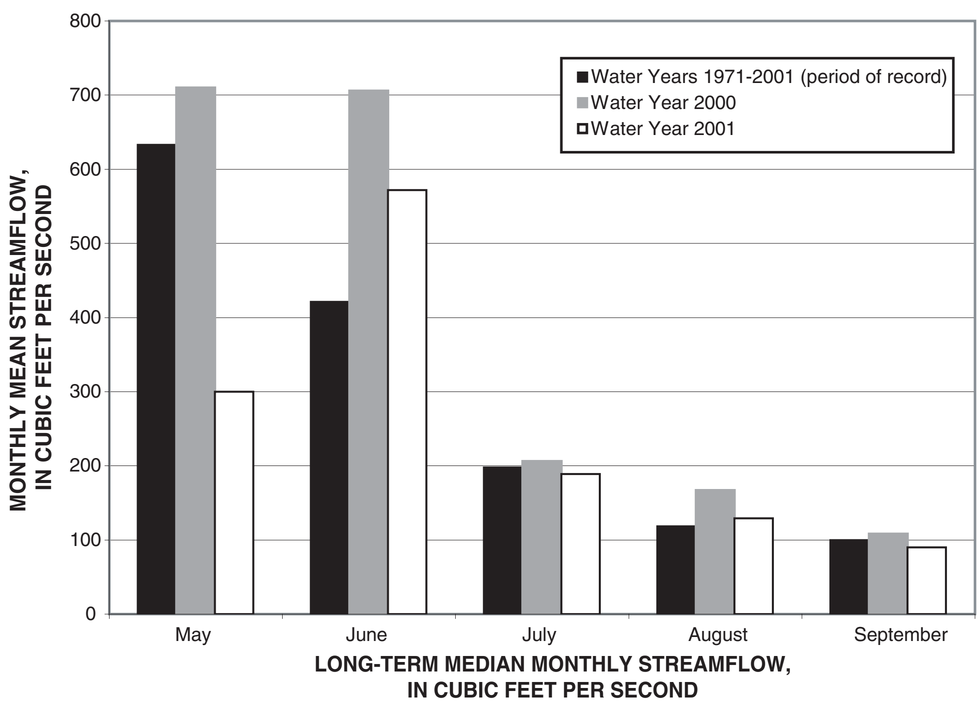


Figure 9. Long-term median monthly streamflow plotted against monthly mean streamflow during the growing seasons of water years 2000 and 2001 for U.S. Geological Survey station 01125500, Quinebaug River at Putnam, Connecticut.

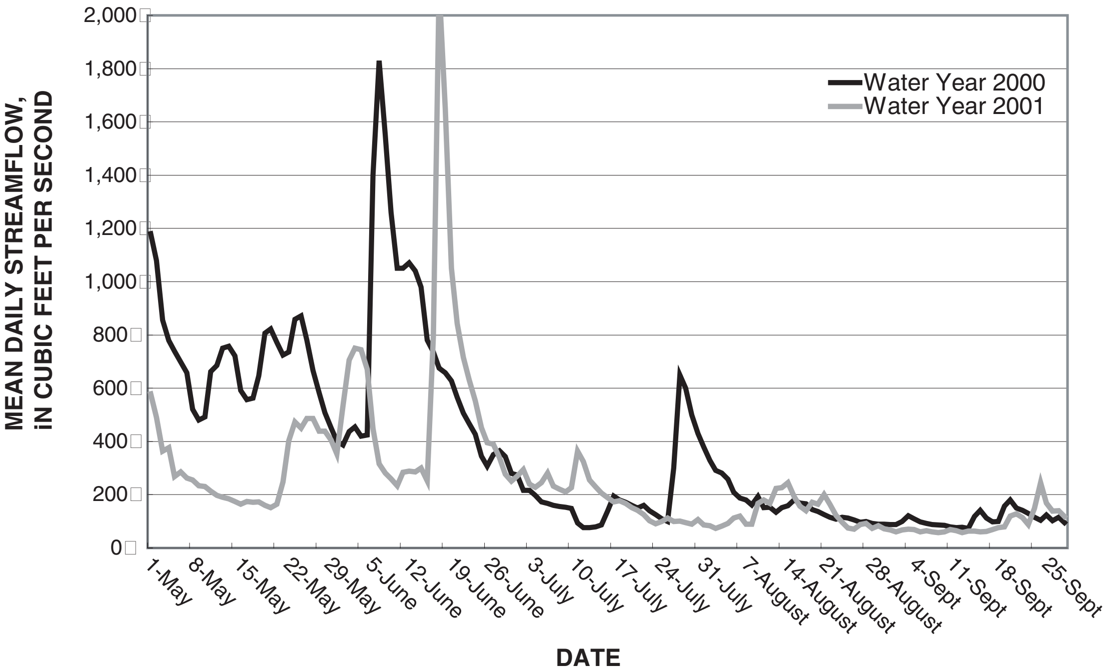


Figure 10. Mean daily streamflow during the growing seasons of water years 2000 and 2001 for U.S. Geological Survey station 01125500, Quinebaug River at Putnam, Connecticut.

Algal Community Succession

Algae have life cycles that span hours to days and integrate water quality over a relatively short period of time. As physical, chemical, and biological conditions in a stream change over time, some species of algae compete better for available resources or can tolerate the changing conditions. Consequently, as time passes during the growing season, a succession of various types of algae is typical (Wetzel, 1983). Generally, the succession may begin with diatoms as the dominant or only species present from winter into early spring. Then in late spring, with warmer water, more daylight, and potentially greater nutrient availability, green algae appear, and ultimately, in eutrophic streams, cyanobacteria (blue-green algae) take precedence. Although this pattern of algal succession probably occurs to some degree every summer, perturbations in the physical environment (storms, extended cool and wet periods, and regulation in streamflow) can disrupt its timing and sequence. Other factors, such as the establishment of a herbivore zooplankton population, or events that limit nutrient availability (lack of agricultural runoff and potential disruptions or elimination of nutrient-bearing point-source discharges), could preclude the establishment and (or) full development of successive algal communities.

A comparison of the algal community and abundance data from the station on the Quinebaug River at West Thompson, Connecticut (USGS station 01124151) demonstrates the differences observed in algal populations in the Quinebaug River between the summers of 2000 and 2001 (fig. 11). In May 2000, total algal abundance at West Thompson was less than 1,000 algal c/mL and consisted entirely of diatoms (Bacillariophyceae). This site was not sampled in June 2000 for phytoplankton analysis, but in July, even after wet weather in spring and early summer, the exclusive diatom community had essentially been replaced by a more abundant community of green algae (Chlorophyceae) and blue-green algae/cyanobacteria (Cyanophyceae) with a small number of dinoflagellates (Dinophyceae) present. In late September 2000, diatom populations were reestablished, replacing the green algae, and the cyanobacteria were in decline. For the most part, truly nuisance algal biomass concentrations causing deep green coloration or floating algal mats were not observed at West Thompson or most other stations in the basin in 2000. During the summer of 2001, however, warm dry weather and lower streamflows, in conjunction with high nutrient concentrations, produced algal blooms with stream discoloration similar to events previously observed at this site. In June 2001, cyanobacteria already dominated the seston algal community, and, with continued favorable growing conditions, populations of blue-green algae expanded exponentially to more than 13,000 algal c/mL in August and nearly 19,000 algal c/mL in September (fig. 11, appendix 5). Green algae, as well as diatom populations all expanded in August 2001 at this site and subsequently declined in September. Similar patterns of algal succession were observed at most of the main stem stations during 2001, whereas the tributaries, in particular the Fivemile and Moosup Rivers, saw little or no succession to green and blue-green algae.

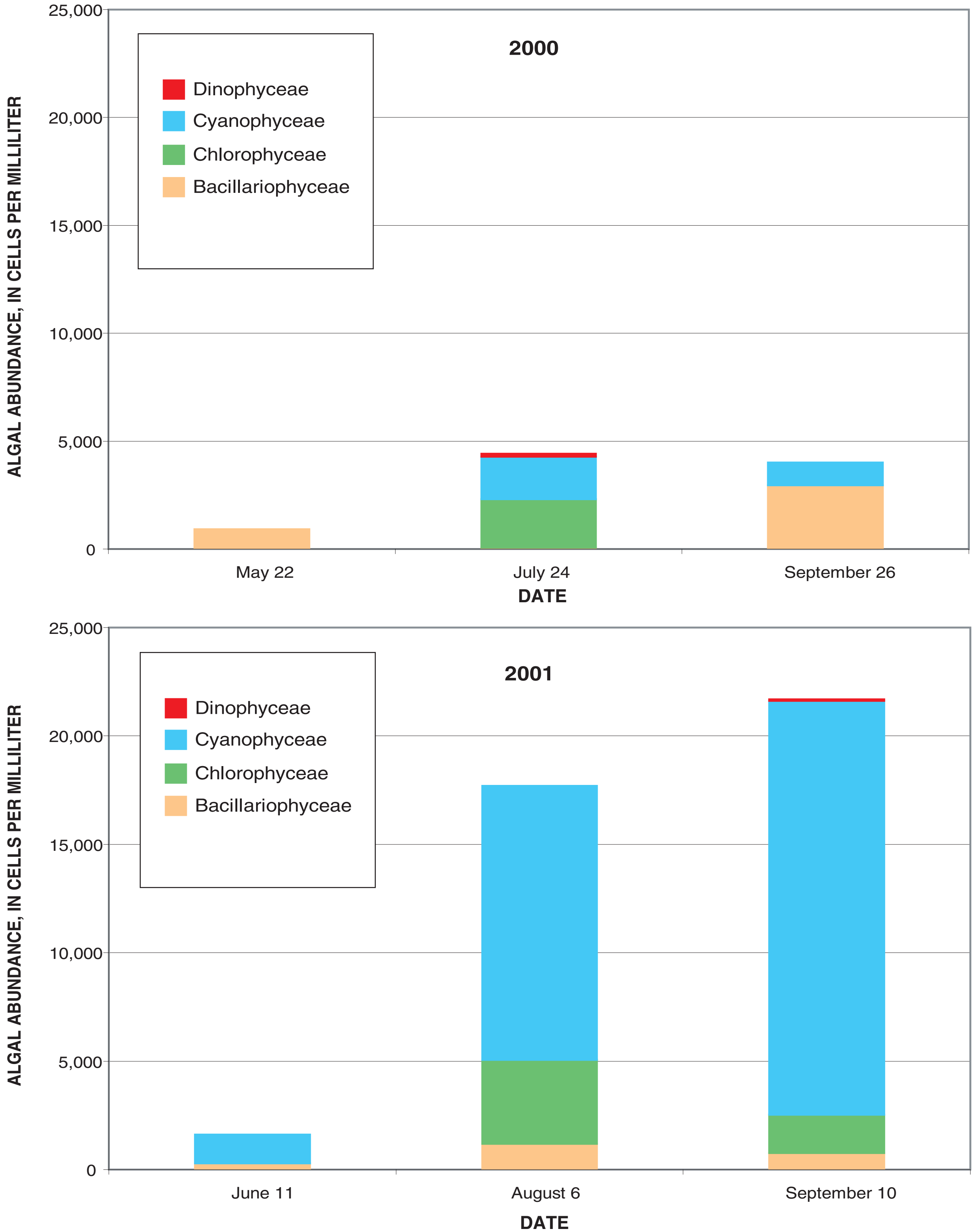


Figure 11. Seston algal communities in the Quinebaug River at West Thompson, Connecticut, during the summers of 2000 and 2001.

Chlorophyll-a

Chlorophyll-a is a green pigment that is common to all phytoplankton and is the principal photosynthetic pigment responsible for a plant's ability to convert sunlight into the chemical energy needed to fix carbon dioxide into cell biomass. Chlorophyll-a concentrations are widely used to estimate phytoplankton biomass because a comprehensive microscopic enumeration of the dozens of species of algae that may be present in the water column is often tedious, time consuming, and may be prohibitively costly or impractical. Chlorophyll-a concentrations measured in samples from the Quinebaug River Basin during water years 2000 and 2001 generally increased proportionally with algal abundance (fig. 12). Chlorophyll-a concentrations are low in clean, natural waters and, similarly, can be low in flowing surface-water bodies that are nutrient-enriched, because even slow-moving streams may disperse phytoplankton before high algal biomass develops. Further, seston chlorophyll-a concentrations are limited in most deep, slow-moving rivers to approximately 10 µg/L (micrograms per liter) by light attenuation (U.S. Environmental Protection Agency, 2000b). Under conditions that promote the rapid and expansive growth of algal populations in shallow waters, however, chlorophyll-a concentrations can attain levels of 70 to 125 µg/L (U.S. Environmental Protection Agency, 2000b). The USEPA's recommended regional ambient water-quality criterion for chlorophyll-a is 3.75 µg/L to protect aquatic resources (U.S. Environmental Protection Agency, 2000a)[2].

Chlorophyll-a concentrations in water samples from the Quinebaug River Basin during this study ranged from 0.2 to 42 µg/L. Concentrations were highest in samples from the wastewater-receiving parts of the system—the French and Quinebaug Rivers—and were lowest in samples from the unimpaired tributaries—the Fivemile, Moosup, and Pachaug Rivers (fig. 13). Nearly half (49 percent) of all chlorophyll-a concentrations exceeded the USEPA's 3.75-µg/L recommended regional water-quality criterion, but chlorophyll-a (and consequently algal biomass) levels above the 3.75-µg/L threshold most often were present (62 percent) in samples from the French and Quinebaug Rivers. Of note, however, was that the distribution of chlorophyll-a concentrations in samples from the Little River at Putnam, Connecticut (USGS station 01125499) was clearly comparable to the wastewater-receiving main stem stations of the French and Quinebaug Rivers (fig. 13). Runoff of agricultural fertilizers and animal wastes into the 39-mi^2 Little River drainage basin appears to affect algal responses in a manner comparable to those of wastewater discharges in the larger streams.

[2]The USEPA's chlorophyll-a recommended regional ambient water-quality criterion is based upon chlorophyll-a determinations using the spectrophotometric method (U.S. Environmental Protection Agency, 2000a, p. 14). Sorenson and others (1999, p. 23) have reported that chlorophyll-a concentrations determined by the NWQL using High Performance Liquid Chromatography (HPLC) were slightly less than half of those determined by the fluorometric method. Chlorophyll-a concentrations were determined for this study by the NWQL using HPLC and as such may be negatively biased with respect to chlorophyll-a concentration determined by USEPA methods.

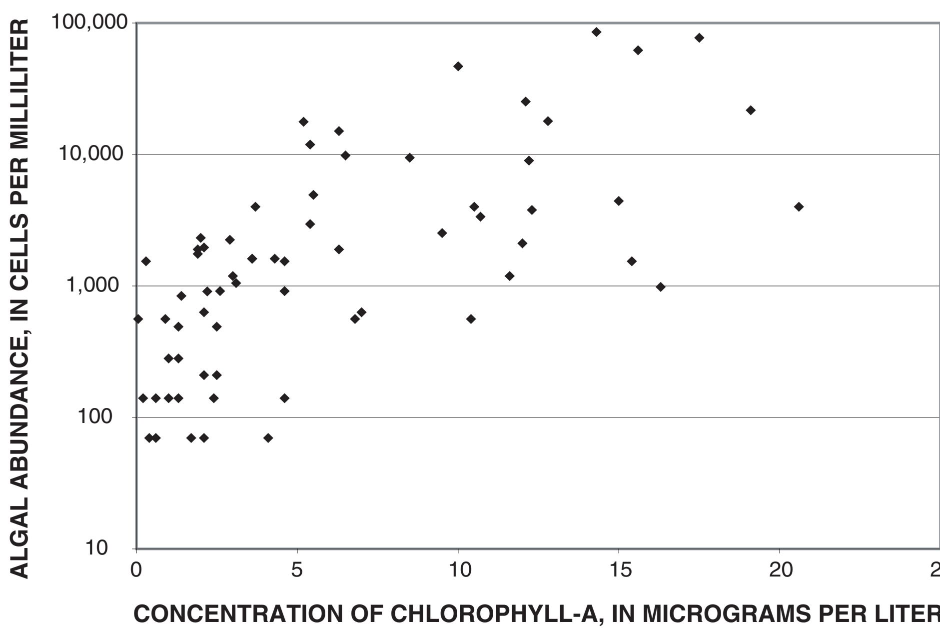


Figure 12. Relation of concentration of seston chlorophyll-a to phytoplankton algal abundance in the Quinebaug River Basin, Connecticut, October 1999 through September 2001.

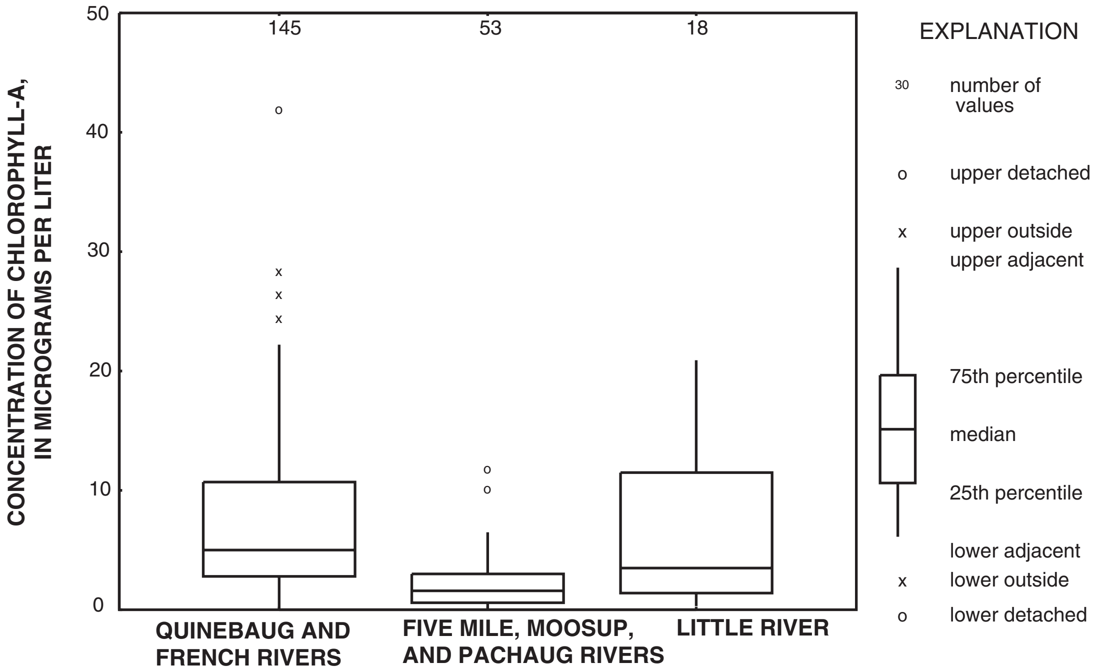


Figure 13. Concentrations of chlorophyll-a in the Quinebaug River and tributary streams, Connecticut, October 1999 through September 2001.

Estimated Rates of Instream Metabolic Processes

Temporal and spatial variations in rates of instream metabolic processes, primary productivity and respiration, were quantified and evaluated at locations in the Quinebaug River Basin using two methods: (1) interpolations from dissolved oxygen data from continuous monitors at four sites during 2000 and 2001 and (2) observed differences in dissolved oxygen concentrations in paired light- and dark-bottle measurements made during the summer of 2001.

Rates Determined from Continuous Water-Quality Monitor Data

Data from the continuous water-quality monitors can be used to estimate rates of primary productivity and respiration in streams (Sorenson and others, 1999; Peterson and others 2001). Both dissolved oxygen and pH may exhibit diel variation as a result of primary production and respiration of algal communities. Generally, dissolved oxygen and pH increase sharply during daylight hours as algae use energy from sunlight to take in nutrients and carbon dioxide and release oxygen. At night, photosynthesis ceases, and dissolved oxygen and pH decrease as aquatic plants and animals continue to respire. The rate of primary productivity and respiration can be calculated from the slope of the diel curve, which is a plot of the change in dissolved oxygen over time (Peterson and others, 2001). The process can be expressed as a rate of change in either a positive (increasing) or negative (decreasing) direction in grams of oxygen per cubic meter per hour (g O_2/m^3/hr). The linear portion of the positive slope of the diel curve is taken as the maximum estimated rate of productivity and termed P_{max}; the linear portion of the negative slope of the diel curve is the maximum estimated rate of respiration or R_{max} (fig. 14).

Rates of stream productivity and respiration were calculated for the four main stem sites with a continuous water-quality monitor (see table 1) for all days with complete or nearly complete dissolved oxygen data, and without large changes in streamflow that often disrupted the dissolved oxygen concentration plot. First, the recorded 15-minute continuous-monitor dissolved oxygen data for each site were used to generate diel curves (fig. 14). Then the linear periods of rapidly changing dissolved oxygen concentrations were determined. For example, the rapid rates of dissolved oxygen change between 9:00 a.m. and 3:00 p.m. and between 7:00 p.m. and midnight on July 21, 2001 at the Quinebaug River at Cotton Bridge Road near Pomfret Landing, Connecticut (USGS station 01125520) were linear. Productivity estimates were determined by calculating the slope of the dissolved oxygen (DO) concentrations between 9:00 a.m. and 3:00 p.m.:

Stream Productivity (P_{max}) = 3:00 p.m. DO – 9:00 a.m. DO/6 hours
= (11.3 mg/L- 7.5mg/L)/6 hours
= 0.63 mg O_2/L/hr (which is equivalent to 0.63 g O_2/m^3/hr).

Similarly, respiration estimates were determined by calculating the DO slope between 7:00 p.m.and midnight:

Stream Respiration (R_{max}) = - [7:00 p.m. DO – Midnight DO]/5 hours
= - [(10.6 mg/L - 7.8 mg/L)/5 hours]
= - 0.56 g O_2/m^3/hr

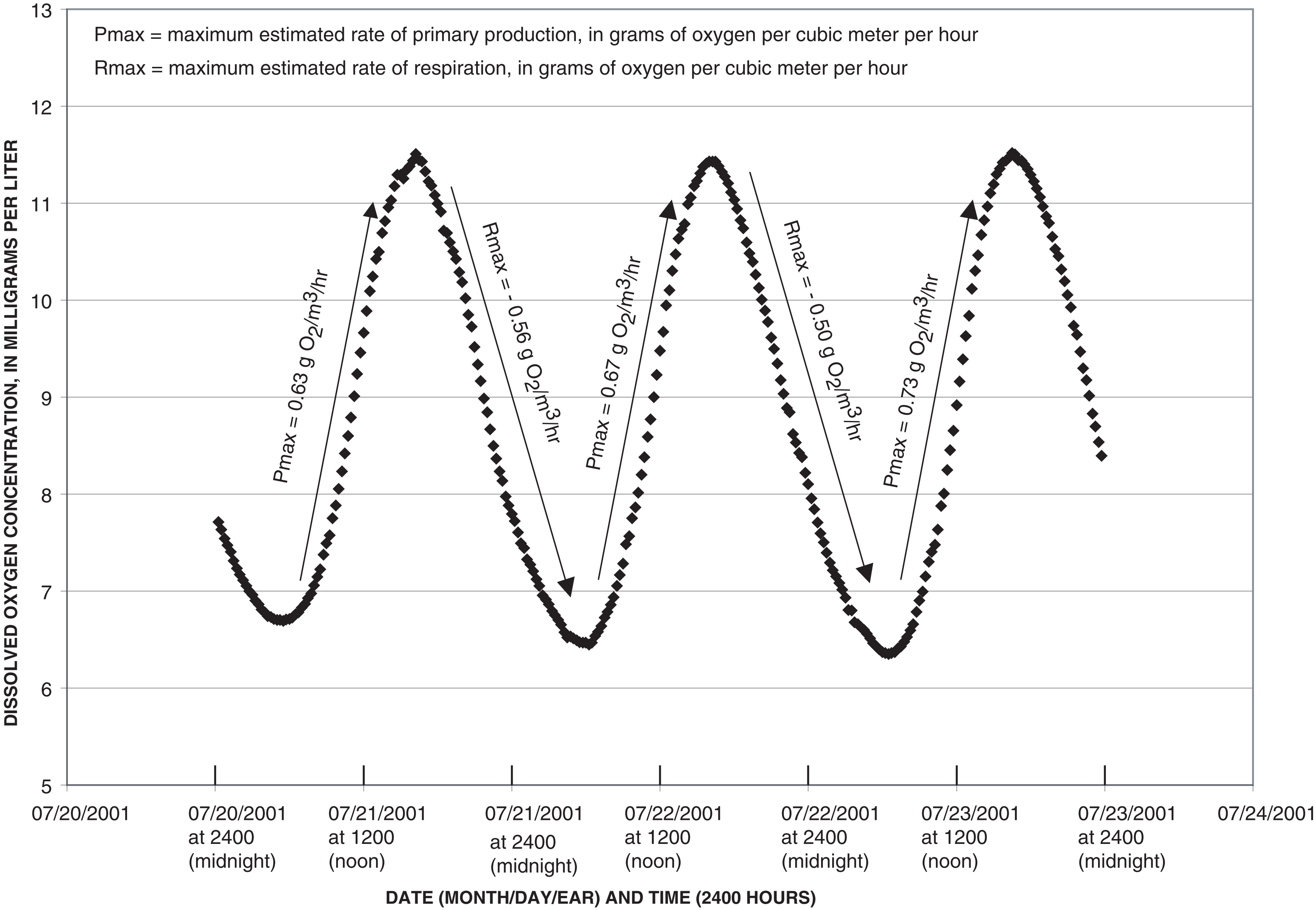


Figure 14. Determination of the maximum estimated rate of primary productivity and respiration from continuous monitor dissolved oxygen data at U.S. Geological Survey station 01125520, Quinebaug River at Cotton Bridge Road near Pomfret Landing, Connecticut.

Similar curves were determined for each site and each date for which sufficient, undisturbed dissolved oxygen data were recorded to allow an estimate of stream metabolic rate to be computed; however, continuous-monitor-based estimates of P_{max} and R_{max} do not account for losses or gains due to oxygen diffusion that is a function of water temperature and barometric pressure (Odum, 1956) or accrual of surface and ground water (Britton and Greeson, 1989).

Primary productivity and respiration estimates based on the dissolved oxygen data (appendixes 1 to 4) from the continuous water-quality monitors represent seasonal trends in the duration of daylight, as well as short-term changes in flow conditions and various weather patterns throughout the growing season. Phytoplankton growth, as well as other aquatic plant growth, favors stagnant, shallow, nutrient-rich streams; thus for any given stream location, metabolic rates generally are inversely related to streamflow (fig. 15A). Consequently, estimated stream metabolic rates in the Quinebaug River often vary considerably from day to day, even for the same station (fig. 15B). Some areal and seasonal patterns are evident, however, that probably reflect differences in both anthropogenic and natural factors.

The Quinebaug River at Jewett City showed the highest daily maximum productivity rate (1.72 g O_2/m^3/hr) measured in the study as well as the highest median productivity and respiration rates for the four measured sites (table 3). This station is located on the Quinebaug River below the outflow from the Aspinook Pond impoundment, a eutrophic, largely stagnant reach of the lower part of the Quinebaug River. A hydroelectric-power plant taps the Quinebaug River at this location, and the regulation of streamflow with a daily pattern of water released from storage to pass through turbine generators causes rapid changes in dissolved oxygen concentrations (fig. 16). The continuous water-quality monitor data at this site show a pattern of generally sharp rises in dissolved oxygen as aerated water passing through the turbines reaches the monitor, then a decline as the hydroelectric release passes by and backwater formed behind the release reaches the monitor superimposed on the daily fluctuations. These perturbations in dissolved oxygen confound the estimation of instream metabolic processes at this site for those days when the hydroelectric plant was in operation. During this study, the plant operated essentially all of the 2000 growing season and all but 26 days in late summer of 2001 when streamflow conditions were too low to allow hydroelectric-power generation. It was on several days during this period in 2001 that primary productivity in the diminished streamflow of the Quinebaug River exceeded the maximum productivity rates estimated for the other three sites by a factor of 1.4 to 7.2 times.

Table 3. Primary productivity and respiration estimated from continuous monitors at sampling locations in the Quinebaug River Basin, Connecticut, water years 2000 and 2001.

[Values for primary productivity and respiration expressed as a rate of change in either a positive (increasing) or negative (decreasing) direction in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) for lowest, highest, or median values]

U.S. Geological Survey station		Number of days that stream metabolic rates could be determined		Productivity			Respiration		
Number	Name	2000	2001	Pmax lowest	Pmax highest	Pmax median	Rmax lowest	Rmax highest	Rmax median
01124151	Quinebaug River at West Thompson, Conn.	89	0	0.01	0.24	0.04	-0.01	-0.22	-0.05
01125520	Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.	122	79	.01	.92	.44	-.01	-.30	-.10
01126720	Quinebaug River near Packer, Conn.	105	38	.02	.45	.11	-.01	-.83	-.42
01127000	Quinebaug River at Jewett City, Conn.	0	26	.43	1.72	.70	-.36	-.796	-.49

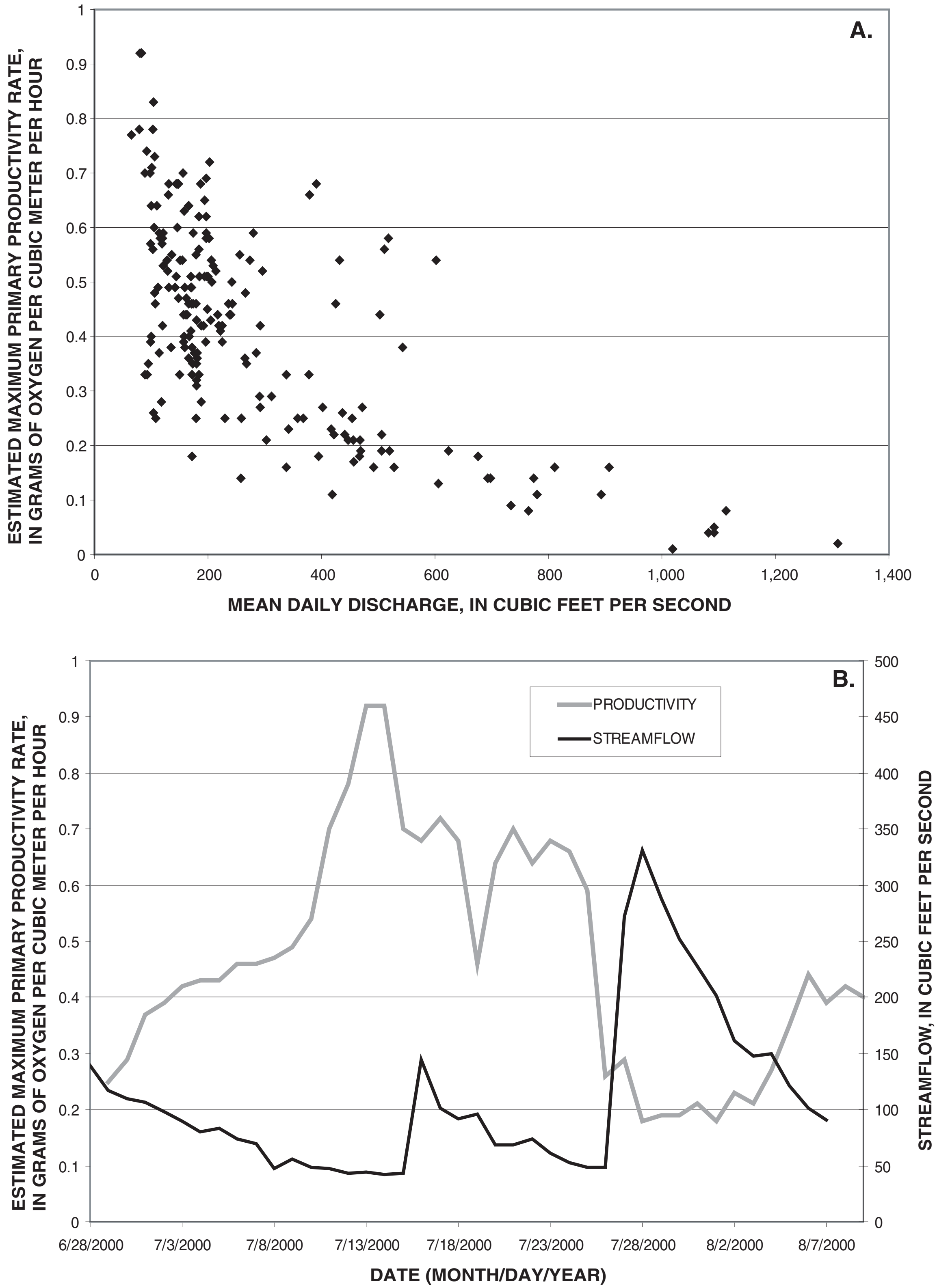


Figure 15. Estimated maximum primary productivity and streamflow of the Quinebaug River at U.S. Geological Survey station 01125520, Cotton Bridge Road near Pomfret Landing, Connecticut. A. Variability with discharge. B. Variability with time.

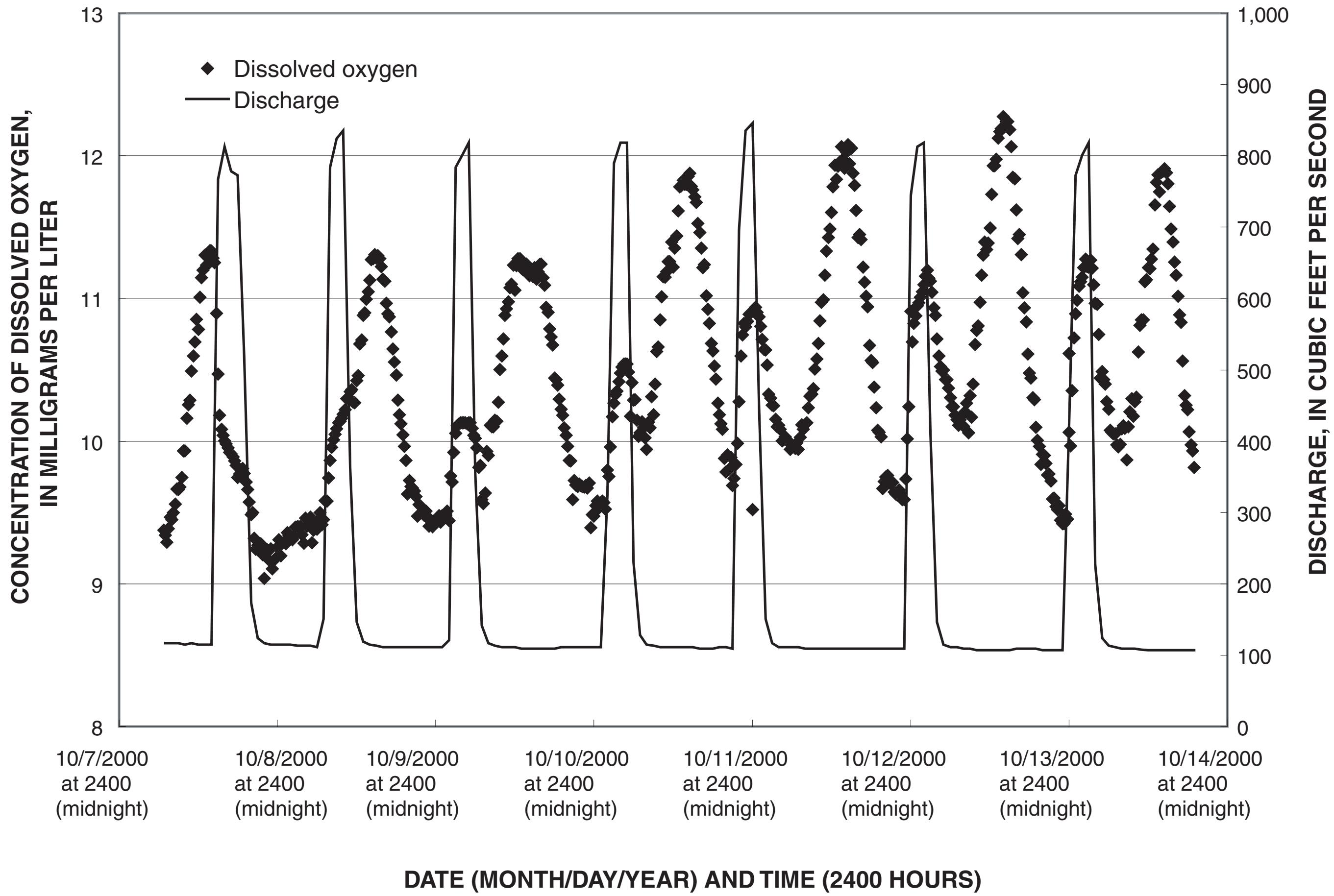


Figure 16. Effects of streamflow regulation on concentrations of dissolved oxygen at U.S. Geological Survey station 01127000, Quinebaug River at Jewett City, Connecticut.

Ideally, a balance to a slight net gain between photosynthetic primary productivity and respiration is desired (to provide food for aquatic herbivores) with organic materials being decomposed by respiratory activity at about the same rate as they are produced through photosynthesis. The ratio of P_{max} to R_{max} is therefore, an indication of metabolic balance in the stream. When P_{max} greatly exceeds R_{max}, algal biomass is accumulating faster than it can be consumed or decomposed, ultimately leading to an imbalance that may be exported downstream, potentially disturbing the metabolic balance of the receiving stream reach (Stumm and Morgan, 1981, p. 701). Plots of the P_{max} to R_{max} ratio from the continuous-monitor-derived metabolic rates (fig. 17) indicate that there is a tendency toward excess productivity at the four sites monitored on the Quinebaug River during water years 2000 and 2001. About 60 percent of the time when both a productivity rate and a respiration rate were determined on the same day at any station, the P_{max} to R_{max} ratio exceeded 1.0. Productivity rates as much as 11 times greater than respiration rates were determined during some of the most productive periods monitored.

Rates Determined from Light- and Dark-Bottle Measurements

An alternative method to measure in-stream metabolic rates—the light-dark bottle experiments—was used to help evaluate the estimates produced from continuous-monitor data and to provide rate estimates at locations in the basin that were not monitored. Estimates of primary productivity and respiration were calculated from the measured difference between initial and final dissolved oxygen (DO) concentrations within each light and dark bottle after a known incubation time in the euphotic zone in the river (American Public Health Association and others, 1992).

Primary productivity = light bottle DO – initial DO/incubation period

Respiration = initial DO – dark bottle DO/incubation period

Primary productivity and respiration rates from the light- and dark-bottle measurements conducted in the Quinebaug River Basin during the summer of 2001 are shown in table 4.

At 6 of the 10 sites sampled, the light bottles had measurable increases of dissolved oxygen over the duration of the experiment allowing for quantification of primary production within the bottle. Conversely, at most sites, the dark bottles had a loss of oxygen as respiration continued in the absence of light. Results for several sites, however, were anomalous: a loss of oxygen in the light bottles occurred at the Little River, the Moosup River, and the Quinebaug River at Jewett City locations. No measurable dissolved oxygen loss occurred in the dark bottles from the French River and Quinebaug River at West Thompson, Connecticut, and no measurable change in dissolved oxygen was observed in either bottle at the Pachaug River location. Oxygen losses in the light bottles may be attributed to chemical oxygen demand and microbial activity that can occur when sample times exceed a few hours (Vollenweider, 1974; Hall and Moll, 1975). These anomalous dissolved oxygen measurements occurred principally in the tributaries, which are generally less nutrient-enriched, and may indicate that a significant seston algal population was not present or was not the dominant primary producer at that time. Periphyton (attached algae) and macrophyte growth have been observed at some of these sites and may be the principal crop in the tributary streams. Riskin and others (2003) have reported median periphyton chlorophyll-a concentrations of 5.4 milligrams per square meter from unimpaired reference streams in eastern Massachusetts that are similar to the Quinebaug tributaries.

The primary productivity and respiration rates in the light and dark bottles were variable throughout the basin (table 4). The highest productivity rate (0.49 g $O_2/m^3/hr$) was measured in the Quinebaug River at West Thompson. At three locations in the basin, the light- and dark-bottle data demonstrated negative primary productivity rates, indicating that oxygen consumption was substantially greater than oxygen production at these sites. These conditions may represent high biochemical oxygen demand in the stream that can exist downstream from wastewater-effluent discharges, but two of the sites (the Little River and Moosup River) are not waste-receiving streams. A comparison of the metabolic rates determined from the continuous-monitor data could only be accomplished at one location, the Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn. P_{max} and R_{max} rates from the continuous monitor dissolved oxygen data on July 24, 2001 were about twice the values obtained from the light- and dark-bottle measurements. The differences may be an artifact of comparing essentially instantaneous rates (determined from the light and dark bottles) for exclusively phytoplankton populations to time-averaged rates of primary production and respiration in the Quinebaug River aquatic community at large. It can be inferred, however, that about half the productivity in the Quinebaug River at this location was attributable to periphyton and macrophytes.

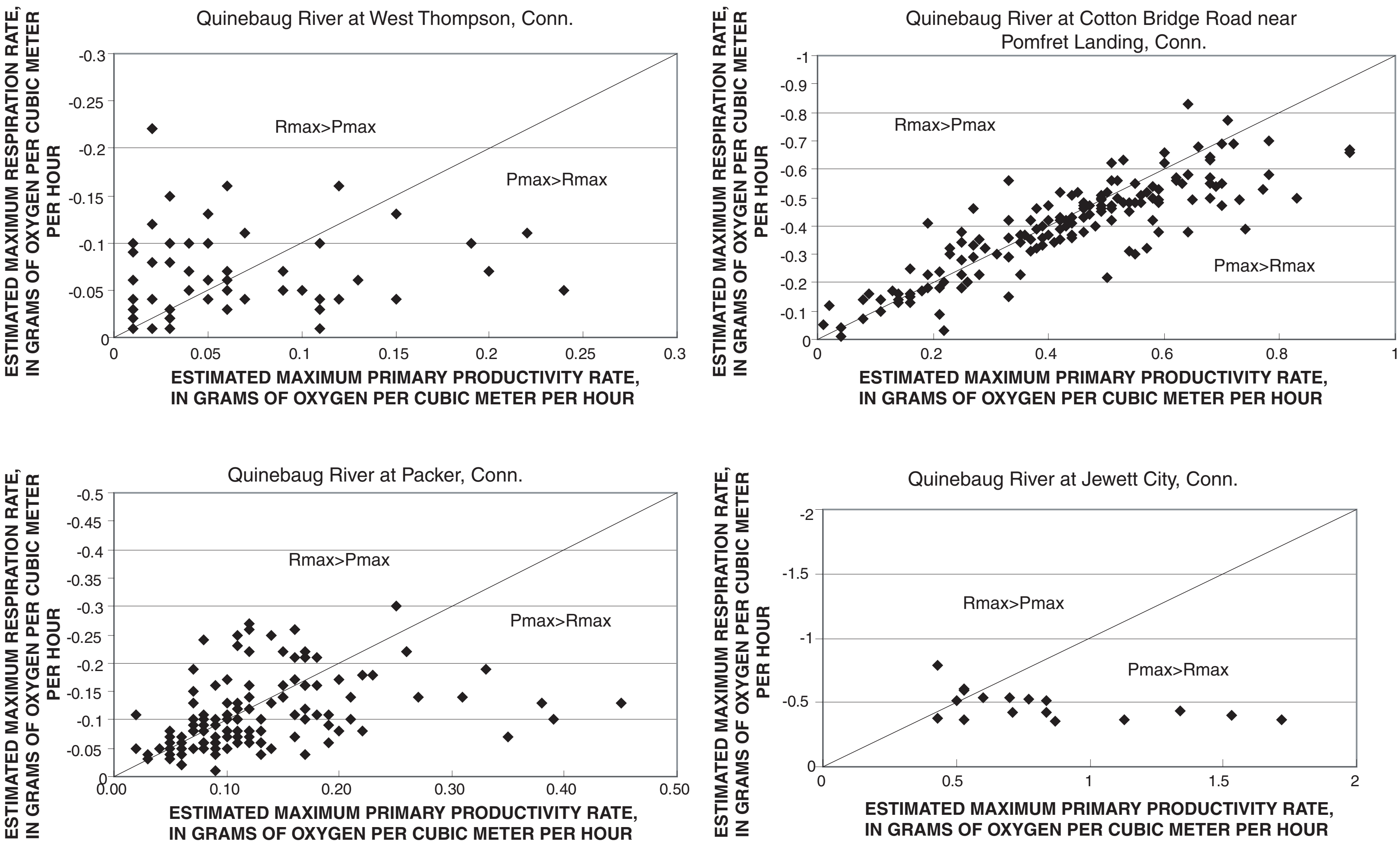


Figure 17. Ratio of estimated maximum primary productivity rate (Pmax) to estimated maximum respiration rate (Rmax) during water years 2000 and 2001 at four stations in the Quinebaug River Basin, Connecticut.

Table 4. Primary productivity and respiration estimated from light and dark bottles at sampling locations in the Quinebaug River Basin, Connecticut, water year 2001.

[Values for primary productivity and respiration expressed as a rate of change in either a positive (increasing) or negative (decreasing) direction in grams of oxygen per cubic meter per hour (g O_2/m^3/hr); --, not sampled

U.S. Geological Survey station		Date	Time (duration, in hours)	Primary productivity	Respiration
Number	Name				
01124000	Quinebaug River at Quinebaug, Conn.	--	--	--	--
01124151	Quinebaug River at West Thompson, Conn.	07/23/2001	1.92	0.49	0
01125100	French River near North Grosvenordale, Conn.	07/23/2001	1.20	.36	0
01125499	Little River at Putnam, Conn.	08/20/2001	4.50	-.01	-.10
01125500	Quinebaug River at Putnam, Conn.	07/24/2001	1.17	.40	-.31
01125520	Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.	07/24/2001	1.23	.32	-.16
01126111	Fivemile River at Danielson, Conn.	--	--	--	--
01126113	Quinebaug River at Danielson, Conn.	08/08/2001	1.50	.33	-.04
01126510	Moosup River at Plainfield, Conn.	08/09/2001	1.33	-.30	-.60
01126720	Quinebaug River near Packer, Conn.	07/24/2001	1.35	.37	-.52
01126995	Pachaug River at Jewett City, Conn.	09/13/2001	1.5	0	0
01127000	Quinebaug River at Jewett City, Conn.	07/27/2001	3.50	-.33	-.50

Phytoplankton dominance in the Quinebaug River is supported by the light- and dark-bottle data collected throughout the Quinebaug River Basin. Substantially increased concentrations of dissolved oxygen in the light bottles in the known absence of periphyton can be attributed only to seston productivity. Measurable loss of oxygen in the dark bottles (in the absence of other biota) indicates seston algal metabolism and/or other biochemical oxygen demand.

The daily primary cycle of productivity and respiration in the river also caused daily variability in pH. As dissolved oxygen increases throughout the day during primary production by algae, pH values also increase as carbon dioxide is removed from the water (Stumm and Morgan, 1981, p. 195). Daily maximum pH values exceeding 9.0 (and ranging as high as 9.8) have been measured on 44 days during this study. Conversely, during night time hours pH values return to daily minima as carbon dioxide is produced and dissolved oxygen consumed. Generally, pH values recorded at the four continuously monitored stations seldom dropped much below 6.7 as the moderate alkalinity of the waters provided a natural buffering capacity. The lowest measured pH was 6.1 at the Quinebaug River at West Thompson on May 18, 2001. Dissolved oxygen concentrations less than 5 mg/L, and as low as 2.5 mg/L, however, were recorded on 34 days during the monitoring period. Extreme values of both pH and dissolved oxygen concentration may periodically be stressors on the aquatic health of the Quinebaug River Basin.

Summary and Conclusions

As part of the continuing effort to understand and improve water quality in Connecticut, the Connecticut Department of Environmental Protection and the U.S. Geological Survey began a cooperative study in 2002 to characterize the relation between nutrient enrichment and excessive algal productivity in the Quinebaug River Basin. Understanding where, when, and how elevated nutrient concentrations affect the rate of primary productivity in the Quinebaug River Basin may facilitate decisions by water-resource managers on how best to manage the water resources to minimize nuisance algal blooms. This may involve lowering maximum productivity rates and decreasing the length of time during which the blooms occur.

Water-quality samples collected in the Quinebaug River Basin during water years 2000 and 2001 substantiate a historically consistent and pervasive distribution of elevated total nitrogen and total phosphorus concentrations. Median total nitrogen concentrations equalled or exceeded the U.S. Environmental Protection Agency (USEPA) proposed regional total nitrogen ambient water-quality criterion of 0.71 milligrams per liter (mg/L), and maximum total nitrogen concentrations exceeded 1.0 mg/L in water samples from 9 of the 12 stations in the basin sampled for this study. Median total phosphorus concentrations also equalled or exceeded the USEPA's proposed regional total phosphorus ambient water-quality criterion of 0.031 mg/L in water samples from the same stations in the basin that demonstrated elevated total nitrogen concentrations. Maximum total phosphorus concentrations exceeded 0.1 mg/L at five of these stations. The elevated total nitrogen and total phosphorus concentrations were evident at all Quinebaug River main-stem stations and at stations on two tributaries, the French River and Little River. The elevated concentrations at main-stem and French River stations are the result of municipal wastewater-treatment plants that discharge nitrogen- (and phosphorus-) enriched wastewater to the Quinebaug River and the French River upstream from the stations sampled. The elevated concentrations at the station on the Little River reflect the contribution of nonpoint sources of nutrients from the Little River drainage area, which contains 24 percent agricultural land.

Poor correlation between total nitrogen and total phosphorus concentrations in the Quinebaug River Basin (r= 0.52) reflects differences in their sources as well as their transport mechanisms. A number of factors contribute to the weak total nitrogen:total phosphorus correlation, including the composition of fertilizers used on agricultural and residential land with formulations that often contain 10 to 50 times more nitrogen than phosphorus, the seasonal removal of phosphorus from some municipal wastewater effluents, differential aquatic attenuation processes, and the fact that nitrogen species largely are transported in a dissolved state whereas phosphorus species tend to adsorb to sediment particles.

Low streamflow, warm temperatures, and long hours of daylight all act together to promote algal growth in areas where concentrations of nutrients are elevated during summer and early fall. Measured phytoplankton densities ranged from 0 algal c/mL (cells per milliliter) in samples from four stations (at least once during the study), including two on the main stem of the Quinebaug River plus two tributaries, to an observed maximum of 85,000 algal c/mL at the Quinebaug River near Packer, Connecticut, in September 2001. Phytoplankton densities exceeding 10,000 algal c/mL were observed in 16 percent (12 of 77) of the phytoplankton samples collected over the two summers, most often during August and September 2001 at impounded or slow-moving reaches of the Quinebaug River. Generally, observed algal densities were lower during summer 2000 than in 2001. Streamflow in the summer of 2000 was consistently higher than in the summer of 2001, including a 2-week period in early August 2000 that likely would have flushed the standing crop of algae from impoundments, diluted nutrient concentrations, and carried more turbid waters that would hinder algal growth.

Chlorophyll-a concentration provides a reasonable estimate of algal biomass; concentrations in water samples from the Quinebaug River Basin during this study ranged from 0.2 to 42 μg/L (micrograms per liter) and were highest in samples from the waste-receiving parts of the system—the French and Quinebaug Rivers—and were lowest in samples from the unimpaired tributaries—the Fivemile, Moosup, and Pachaug Rivers. Nearly half (49 percent) of all chlorophyll-a concentrations exceeded the USEPA's 3.75-μg/L recommended regional water-quality criterion, but chlorophyll-a (and consequently, algal biomass) levels elevated above the 3.75-μg/L threshold were most often present (62 percent) in samples from the French and Quinebaug Rivers.

Two methods were used to estimate rates of primary productivity and respiration of algae in the Quinebaug River Basin. Dissolved oxygen concentrations from continuous water-quality monitor data were used to calculate rates of primary production (P_{max}) and respiration (R_{max}). Estimated maximum primary productivity and respiration rates, calculated as the difference between the minima and maxima over rapidly changing linear portions of the diel curves, were as high as 1.72 g O_2/m^3/hr (grams of oxygen per cubic meter per hour) for the Quinebaug River at Jewett City, Connecticut. A diel dissolved oxygen change of 5.9 mg/L was also measured at this location on the same day, September 20, 2001, during a period of low streamflow. Productivity rates were greater than respiration rates about 60 percent of the time, suggesting that excessive algal production upstream can be exported to downstream locations, affecting downstream indicators of eutrophication and organic enrichment. The primary productivity and respiration calculated from dissolved oxygen data from continuous water-quality monitors demonstrated considerable seasonal and flow-related variability, but also varied substantially on consecutive days.

Primary productivity and respiration rate estimates also were determined based on the light- and dark-bottle dissolved oxygen method. These rates, calculated as the difference between initial and final dissolved oxygen concentrations in the closed light and dark bottles after a known incubation time in the euphotic zone in the river, clearly indicated that most of the primary production in the Quinebaug River Basin occurs in the waste-receiving reaches of the main stem of the Quinebaug River and the French River. The highest metabolic rates, P_{max} 0.49 g O_2/m^3/hr at West Thompson and R_{max} –0.52 g O_2/m^3/hr at Packer, were recorded in the main stem Quinebaug River near impoundments. The light- and dark-bottle results also indicated the dominance of seston algae in the main stem Quinebaug River and French River, and the absence of seston algae and consequentially the more important role of periphyton and macrophytes on metabolic rates in the tributaries.

Changes in water quality as a result of primary productivity and respiration in the river were observed. Values of pH exceeded 9.0 standard units on several occasions during peak algal blooms. The diel effects of photosynthesis also include decreases in dissolved oxygen concentration below 5 mg/L (milligrams per liter) during respiration. The extreme values of both pH and dissolved oxygen concentration may periodically be stressors on the aquatic health of streams in the Quinebaug River Basin.

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Appendixes 1 - 5

Appendix 1 - 4. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at:

1. Station 01124151, Quinebaug River at West Thompson, Conn.
2. Station 01125520, Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.
3. Station 01126720, Quinebaug River near Packer, Conn.
4. Station 01127000, Quinebaug River at Jewett City, Conn.

Appendix 5. Seston algal abundance by taxa in water samples collected from the Quinebaug River Basin, Connecticut, water years 2000 and 2001

Appendix 1

Appendix 1. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01124151, Quinebaug River at West Thompson, Conn.

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
05-11-00	10.3	9.9	10.1	nd	nd	7.1	--	140	133	--	--	18.0	--
05-12-00	10.8	9.9	10.5	nd	nd	6.9	6.8	141	137	140	18.0	16.0	16.5
05-13-00	10.8	10.7	10.8	nd	nd	6.9	6.9	143	141	142	16.5	16.0	16.0
05-14-00	10.9	10.8	10.8	nd	nd	7.1	6.9	143	138	141	17.5	16.0	16.5
05-15-00	10.9	10.8	10.9	nd	nd	7.0	6.9	138	136	137	17.0	16.5	17.0
05-16-00	10.9	10.5	10.7	nd	nd	7.0	6.9	140	138	139	17.5	16.0	17.0
05-17-00	10.8	10.5	10.6	nd	nd	7.0	6.8	141	139	139	17.0	16.0	16.5
05-18-00	10.6	10.4	10.5	nd	nd	7.0	6.9	144	141	142	17.5	16.5	17.0
05-19-00	10.7	10.4	10.5	nd	nd	7.0	6.9	143	135	139	17.5	16.0	16.5
05-20-00	11.1	10.6	10.8	nd	nd	6.9	6.8	136	129	132	16.0	14.5	15.5
05-21-00	11.2	10.3	11.1	nd	nd	6.9	6.8	130	128	128	14.5	14.0	14.5
05-22-00	11.3	10.4	11.2	nd	nd	6.9	6.8	131	129	130	14.0	14.0	14.0
05-23-00	11.3	11.0	11.1	nd	nd	6.9	6.8	129	128	129	14.5	14.0	14.0
05-24-00	11.0	10.7	10.9	nd	nd	7.0	6.9	129	124	127	16.5	14.5	15.0
05-25-00	10.7	10.5	10.6	nd	nd	7.0	6.9	125	122	124	17.5	15.5	16.5
05-26-00	10.6	10.4	10.5	nd	nd	7.0	6.9	124	122	123	18.0	16.5	17.5
05-27-00	10.4	10.2	10.3	nd	nd	7.1	6.9	125	123	124	18.5	17.5	18.0
05-28-00	10.3	10.0	10.2	nd	nd	7.0	6.9	125	124	124	18.5	18.0	18.0
05-29-00	10.2	10.0	10.1	nd	nd	7.0	6.9	128	125	126	18.0	17.0	17.5
05.30-00	10.2	9.9	10.0	nd	nd	6.9	6.8	131	127	129	17.0	16.5	17.0
05-31-00	9.9	9.6	9.8	nd	nd	6.9	6.8	134	131	132	17.5	16.5	16.5
06-01-00	9.9	--	--	nd	nd	6.9	--	--	133	--	--	--	--
06-16-00	--	9.1	--	nd	nd	6.9	--	121	--	--	19.0	--	--
06-17-00	9.1	8.8	9.0	nd	nd	7.1	6.9	119	117	118	22.5	19.0	20.5
06-18-00	8.8	8.7	8.8	nd	nd	7.0	6.9	118	116	117	22.5	22.0	22.0
06-19-00	8.8	8.6	8.7	nd	nd	6.9	6.8	120	117	119	22.0	21.0	21.5
06-20-00	9.0	8.7	8.8	nd	nd	7.0	6.8	124	119	120	23.0	20.5	21.5
06-21-00	8.8	8.4	8.6	nd	nd	6.9	6.7	124	121	123	22.0	20.5	21.5
06-22-00	8.7	8.4	8.6	nd	nd	7.0	6.9	125	121	123	22.5	21.5	22.0
06-23-00	8.9	8.5	8.7	nd	nd	7.4	6.9	127	124	125	24.5	22.5	23.5
06-24-00	8.6	8.2	8.5	nd	nd	7.2	6.9	128	125	127	24.0	22.5	23.5
06-25-00	8.5	7.6	8.1	nd	nd	7.0	6.8	129	127	128	23.5	22.5	23.0
06-26-00	8.4	7.9	8.2	nd	nd	7.2	6.9	132	128	129	24.5	23.5	24.0
06-27-00	8.3	7.3	8.1	nd	nd	9.0	6.9	138	128	132	25.5	24.0	24.5
06-28-00	8.3	7.8	8.1	nd	nd	7.9	7.1	137	135	136	26.9	24.5	25.0
06-29-00	8.0	7.4	7.8	nd	nd	7.3	6.8	137	135	136	25.0	24.0	24.5
06-30-00	8.5	7.5	8.1	0.03	-0.15	8.0	6.8	137	135	136	25.5	24.0	24.5
07-01-00	8.1	7.4	7.8	.02	-.21	7.4	6.9	139	135	136	26.0	24.5	25.0
07-02-00	7.9	7.1	7.5	.02	-.12	7.0	6.8	140	136	138	25.0	24.0	24.5
07-03-00	7.9	7.1	7.5	.01	-.09	7.0	6.8	143	137	140	24.5	24.0	24.5
07-04-00	7.4	7.4	7.6	.03	-.10	7.0	6.8	142	140	141	25.5	24.0	24.5
07-05-00	8.1	7.3	7.7	.06	-.06	7.2	6.8	143	138	141	26.5	24.5	25.5
07-06-00	8.1	7.5	7.7	.05	-.13	7.2	6.9	145	140	142	26.5	25.0	25.5

Appendix 1. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01124151, Quinebaug River at West Thompson, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
07-07-00	8.6	7.6	8.1	.0	-.11	7.8	6.8	146	141	145	26.0	25.0	25.5
07-08-00	8.7	8.2	8.5	.01	-.03	7.6	7.2	148	142	146	25.0	24.0	24.5
07-09-00	8.4	7.8	8.2	nd	-.03	7.3	6.8	155	144	148	24.0	22.5	23.5
07-10-00	8.3	7.7	8.0	.09	-.07	7.6	6.8	151	115	133	24.5	23.0	23.5
07-11-00	8.8	7.8	8.4	.04	-.10	8.7	7.1	117	116	116	25.5	23.5	24.5
07-12-00	9.0	8.2	8.6	.02	-.22	8.9	7.4	120	116	118	26.0	24.0	25.0
07-13-00	8.2	7.5	7.9	.04	nd	7.9	7.0	121	117	119	25.0	23.5	24.0
07-14-00	8.2	7.2	7.6	nd	nd	7.2	6.9	123	120	121	24.5	23.5	23.5
07-15-00	8.3	7.4	7.8	.10	nd	7.8	7.0	122	115	121	24.0	23.5	24.0
07-16-00	8.6	7.7	8.2	nd	-.16	8.4	7.2	154	118	123	24.5	23.5	24.0
07-17-00	8.7	8.2	8.4	nd	nd	8.9	7.4	161	153	157	25.0	24.0	24.5
07-18-00	8.7	8.1	8.3	nd	nd	8.9	7.2	162	159	161	25.0	24.0	24.5
07-19-00	9.1	8.7	8.9	nd	nd	9.2	8.8	163	161	162	24.5	24.0	24.5
07-20-00	10.0	8.4	8.9	nd	nd	9.3	7.0	179	161	171	25.0	23.5	24.0
07-21-00	8.5	8.1	8.3	.22	-.08	8.6	7.1	182	177	180	24.0	22.5	23.0
07-22-00	8.9	8.1	8.5	.11	-.23	9.2	7.1	181	178	179	25.0	23.0	24.0
07-23-00	9.6	8.3	8.8	.10	-.13	9.5	8.5	185	179	181	25.5	23.5	24.5
07-24-00	8.6	7.8	8.3	.15	-.16	9.1	7.7	180	177	179	25.0	23.5	24.5
07-25-00	9.4	7.8	8.5	.12	-.16	9.2	8.0	180	177	178	24.5	23.5	24.0
07-26-00	9.8	8.8	9.3	.07	-.13	9.3	8.9	180	177	179	23.5	23.0	23.5
07-27-00	9.4	8.9	9.2	.06	nd	9.1	7.9	178	173	174	23.0	22.0	22.5
07-28-00	9.3	9.0	9.2	.19	-.11	7.9	7.0	173	163	170	22.0	20.5	21.5
07-29-00	9.3	9.1	9.2	.17	-.16	7.0	6.8	164	159	161	21.0	20.0	20.5
07-30-00	9.3	9.1	9.2	.13	-.10	7.2	6.8	163	158	160	21.5	20.5	21.0
07-31-00	9.2	9.0	9.1	.09	-.06	7.2	6.9	162	153	158	21.5	21.0	21.5
08-01-00	9.0	8.8	9.0	.08	-.10	7.0	6.8	156	150	152	21.5	21.0	21.0
08-02-00	9.1	8.7	8.8	.10	-.17	7.1	6.7	152	139	144	21.0	20.5	21.0
08-03-00	8.7	8.5	8.6	nd	nd	6.9	6.8	141	139	140	22.0	20.5	21.0
08-04-00	8.8	8.4	8.6	nd	nd	8.2	6.9	141	140	140	24.5	22.0	23.0
08-05-00	8.5	8.1	8.4	nd	nd	8.2	7.0	141	140	141	25.0	23.0	24.0
08-06-00	8.3	7.8	8.1	nd	nd	7.1	6.8	144	141	142	23.5	22.5	23.0
08-07-00	8.0	7.7	7.9	.05	-.06	7.0	6.8	145	143	144	24.0	22.5	23.0
08-08-00	8.3	7.7	8.0	nd	-.12	8.6	6.9	147	144	145	26.0	23.5	24.5
08-09-00	8.0	7.6	8.9	nd	-.04	7.3	6.9	150	146	148	25.0	24.0	24.5
08-15-00	8.9	--	--	nd	-.04	8.4	--	159	--	--	23.0	--	--
08-16-00	8.4	8.1	8.2	.02	-.04	7.4	7.0	165	158	162	22.5	21.5	22.0
08-17-00	8.7	8.3	8.5	.05	-.04	8.1	7.1	165	161	162	22.5	21.5	22.0
08-18-00	8.8	8.5	8.7	nd	-.08	7.5	7.2	167	164	165	22.0	21.5	21.5
08-19-00	8.8	8.2	8.6	nd	nd	8.4	7.1	169	166	167	23.0	21.0	22.0
08-20-00	9.0	8.0	8.7	nd	nd	8.7	7.3	170	168	169	22.5	21.5	22.0
08-21-00	9.3	8.9	9.1	nd	-.03	8.9	7.7	171	169	170	22.5	21.0	22.0
08-22-00	9.1	8.4	8.9	nd	-.10	8.5	7.3	173	170	171	22.0	21.0	21.5
08-23-00	8.6	8.3	8.5	nd	nd	7.3	7.0	173	171	172	21.0	20.5	20.5

Appendix 1. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01124151, Quinebaug River at West Thompson, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; μS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (μS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
08-24-00	8.9	8.4	8.6	.03	-.01	8.9	7.1	172	171	171	23.0	20.5	21.5
08-25-00	8.7	8.2	8.4	.01	-.04	9.2	7.4	173	171	172	23.5	21.0	22.0
08-26-00	8.4	8.0	8.2	.04	nd	8.5	7.3	172	170	171	22.5	21.0	21.5
08-27-00	8.5	8.0	8.2	nd	-.06	8.9	7.8	171	169	170	22.5	21.5	22.0
08-28-00	8.6	7.9	8.2	.11	-.03	9.2	8.4	172	170	171	23.0	22.0	22.5
08-29-00	10.6	7.9	9.2	nd	nd	8.9	7.2	173	170	172	22.5	22.0	22.0
08-30-00	11.4	10.0	10.7	nd	nd	9.0	7.5	174	173	173	23.0	22.0	22.0
08-31-00	11.2	9.7	10.2	nd	nd	8.8	7.1	176	173	174	23.0	22.0	22.5
09-01-00	10.4	9.4	9.9	nd	nd	8.0	7.3	176	175	175	23.0	22.5	23.0
09-02-00	10.2	9.3	9.7	.06	-.16	8.1	7.2	177	175	176	24.0	23.0	23.5
09-03-00	10.0	9.0	9.4	nd	-.03	8.0	6.9	179	175	177	24.0	23.0	23.5
09-04-00	11.1	8.8	9.8	nd	-.11	8.9	6.9	179	178	179	25.0	23.0	24.0
09-05-00	11.4	10.7	11.1	.15	-.13	9.0	8.4	179	177	178	24.0	22.5	23.5
09-06-00	11.6	10.3	11.0	.11	-.10	8.8	7.8	178	176	177	23.0	21.5	22.0
09-07-00	10.9	9.6	10.3	.05	-.10	7.9	7.1	179	176	177	21.5	20.0	21.0
09-08-00	10.7	8.8	10.2	.22	-.11	7.7	7.0	180	177	178	20.5	20.0	20.5
09-09-00	11.3	8.9	10.5	.15	-.04	8.9	7.2	181	178	179	22.0	20.0	21.0
09-10-00	10.9	8.6	10.1	nd	-.08	8.8	7.9	183	179	181	22.5	21.0	21.5
09-11-00	10.5	9.4	9.9	nd	nd	8.3	7.0	186	181	183	21.5	20.5	21.0
09-12-00	10.1	8.2	9.3	nd	nd	8.1	6.9	187	182	184	21.5	21.0	21.0
09-13-00	10.6	7.9	9.5	.15	nd	9.1	6.8	186	182	184	23.5	21.0	22.5
09-14-00	9.8	8.6	9.2	nd	nd	8.8	7.7	187	184	185	22.5	21.5	22.0
09-15-00	9.8	8.6	9.1	nd	nd	9.0	8.0	186	181	183	22.0	21.5	21.5
09-16-00	10.1	8.9	9.7	.11	-.04	9.2	8.7	186	182	184	21.5	21.0	21.5
09-17-00	9.7	9.1	9.4	nd	nd	9.0	8.8	186	182	184	21.0	20.0	20.5
09-18-00	9.6	8.6	9.0	nd	nd	9.0	8.2	188	182	185	20.5	19.5	20.0
09-19-00	9.4	8.2	8.7	.20	-.07	--	7.9	187	173	180	19.5	19.0	19.5
09-20-00	9.6	8.6	9.1	nd	nd	--	--	183	176	178	22.0	19.5	20.5
09-21-00	9.2	8.6	8.9	nd	-.01	--	--	179	176	178	21.5	20.0	20.5
09-22-00	9.8	9.1	9.4	.10	nd	--	9.4	182	178	180	21.0	20.5	20.5
09-23-00	9.8	9.1	9.4	.24	-.05	9.5	9.0	180	178	179	20.5	19.5	20.0
09-24-00	9.4	8.9	9.2	.04	-.07	9.4	8.8	180	178	179	20.0	19.5	19.5
09-25-00	10.0	9.2	9.6	.13	-.06	9.5	9.0	180	178	179	19.5	19.0	19.0
09-26-00	10.1	9.7	9.9	.05	nd	9.4	9.2	180	177	178	19.0	17.5	18.0
09-27-00	10.1	9.2	9.8	nd	-.08	9.4	8.7	180	177	178	17.5	16.5	17.0
09-28-00	10.6	9.2	10.0	.01	-.10	9.5	8.4	181	179	180	17.0	16.0	16.5
09-29-00	10.7	9.8	10.2	nd	-.03	9.5	9.2	182	179	181	16.5	15.5	16.0
09-30-00	10.7	10.1	10.4	nd	-.04	9.3	8.6	187	181	183	15.5	15.0	15.0
10-01-00	11.0	10.2	10.5	nd	-.06	9.2	8.7	187	185	185	15.0	14.5	15.0
10-02-00	11.4	10.5	10.8	.19	-.10	9.5	8.8	187	185	186	16.5	15.0	15.5
10-03-00	11.3	10.4	10.8	nd	-.11	9.7	9.0	188	186	187	16.5	15.5	16.0
10-04-00	11.0	10.2	10.5	nd	nd	9.5	8.3	186	174	179	16.5	15.5	16.0
10-05-00	11.3	10.3	10.9	.12	-.04	9.5	9.0	174	169	173	16.5	16.0	16.0

Appendix 1. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01124151, Quinebaug River at West Thompson, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; μS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (μS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
10-06-00	11.6	10.6	11.1	.10	-.05	9.5	9.2	172	168	170	16.0	16.0	16.0
10-07-00	11.6	11.0	11.3	.09	-.05	9.4	9.1	172	168	170	16.0	15.5	16.0
10-08-00	11.7	11.1	11.3	.06	-.07	9.4	9.1	173	168	171	15.5	15.0	15.5
10-09-00	11.6	10.9	11.2	.07	-.04	9.3	8.4	178	169	173	15.0	13.0	14.0
10-10-00	11.9	8.7	10.8	nd	-.05	8.4	7.9	189	178	185	13.0	7.0	12.5
10-11-00	11.2	10.8	11.0	.03	-.03	8.4	7.7	192	189	191	12.5	12.0	12.0
10-12-00	11.4	10.6	11.0	.02	-.08	8.1	7.6	198	192	196	12.5	11.5	12.0
10-13-00	11.4	10.6	11.0	.01	-.06	8.2	7.5	200	197	199	12.5	11.5	12.0
10-14-00	11.1	10.5	10.8	nd	-.07	7.7	7.3	203	200	201	12.5	12.0	12.5
10-15-00	11.2	10.5	10.8	nd	nd	8.1	7.4	203	202	203	14.0	12.5	13.0
10-16-00	11.6	10.3	11.0	nd	nd	8.3	7.6	205	202	204	14.0	13.0	13.5
10-17-00	11.3	10.2	10.8	nd	-.03	8.2	7.6	207	205	206	15.0	12.5	13.0
10-18-00	10.4	10.0	10.2	nd	nd	7.6	7.3	207	206	207	13.0	12.5	12.5
10-19-00	11.7	9.5	10.1	.02	nd	7.4	5.9	210	207	209	15.0	6.5	12.0
10-20-00	10.1	9.8	9.9	.03	nd	7.3	7.2	210	208	209	13.0	12.0	12.5
10-21-00	9.9	9.6	9.7	.03	nd	7.3	7.1	209	207	207	13.0	12.0	12.5
10-22-00	10.2	9.6	10.0	nd	nd	7.3	7.2	207	206	207	13.0	12.5	13.0
10-23-00	10.3	10.0	10.1	nd	nd	7.3	7.2	207	205	206	12.5	12.0	12.0
10-24-00	10.3	9.9	10.1	nd	-.02	7.3	7.2	206	204	205	12.0	11.5	12.0
10-25-00	10.6	--	--	nd	nd	7.4	7.2	205	204	205	13.0	11.5	12.0
10-26-00	10.4	7.0	9.1	nd	nd	7.5	7.2	208	197	203	12.5	12.0	12.0
10-27-00	7.5	6.1	6.7	nd	nd	7.6	7.2	204	203	203	12.5	12.0	12.5
10-28-00	9.5	7.4	8.7	nd	nd	7.7	7.3	203	202	203	13.0	11.5	12.5
10-29-00	9.2	8.2	8.6	nd	nd	7.5	7.3	203	201	202	11.5	9.5	10.5
10-30-00	9.3	8.0	8.8	nd	nd	7.4	7.3	202	201	202	9.5	8.0	9.0
10-31-00	12.4	8.3	10.2	nd	nd	7.7	7.3	202	198	200	9.0	7.5	8.0
11-01-00	11.7	11.5	11.6	nd	nd	7.7	7.5	198	197	198	8.0	7.5	7.5
11-02-00	11.7	11.6	11.6	nd	nd	7.8	7.6	198	196	197	8.5	7.5	8.0
11-03-00	11.8	11.6	11.6	nd	nd	8.0	7.7	197	194	196	9.0	8.0	8.5
11-04-00	11.7	11.5	11.6	nd	nd	7.8	7.6	195	192	194	9.0	8.5	8.5
11-05-00	11.6	11.5	11.6	nd	-.01	7.7	7.6	193	190	192	8.5	8.5	8.5
11-06-00	11.7	11.6	11.7	nd	-.01	7.7	7.5	190	185	188	8.5	8.0	8.5
11-07-00	11.8	11.6	11.7	nd	nd	7.7	7.5	185	181	183	9.0	8.0	8.5
11-08-00	11.8	11.7	11.7	nd	nd	7.9	7.5	182	178	181	9.0	8.5	9.0
11-09-00	11.9	11.7	11.7	nd	nd	8.1	7.6	179	174	177	9.5	8.5	9.0
11-10-00	11.7	11.6	11.7	nd	nd	7.6	7.5	175	168	172	9.0	9.0	9.0
11-11-00	11.7	11.6	11.6	nd	-.02	7.5	7.3	168	157	162	9.5	9.0	9.0
11-12-00	11.6	11.5	11.6	nd	nd	7.4	7.3	158	152	156	9.5	9.0	9.5
11-13-00	11.7	11.6	11.7	nd	nd	7.4	7.3	160	156	157	9.0	9.0	9.0
11-14-00	11.6	11.4	11.5	nd	nd	7.3	7.2	158	154	156	9.0	9.0	9.0
11-15-00	11.9	11.5	11.7	nd	-.01	7.3	7.2	157	154	156	9.0	8.0	8.5
11-16-00	12.1	11.9	12.0	nd	-.01	7.3	7.3	160	157	158	8.0	8.0	8.0
11-17-00	12.1	11.2	11.6	nd	nd	7.3	7.3	158	156	158	8.0	7.5	8.0

Appendix 1. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01124151, Quinebaug River at West Thompson, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
11-18-00	11.5	11.3	11.5	nd	nd	7.3	7.3	158	155	157	7.5	7.0	7.0
11-19-00	11.6	11.4	11.6	nd	-.02	7.3	7.2	156	154	154	7.0	6.5	7.0
11-20-00	11.8	11.6	11.7	nd	nd	7.3	7.2	154	153	153	6.5	6.0	6.0
11-21-00	11.8	11.6	11.8	nd	nd	7.4	7.2	153	153	153	6.0	5.5	6.0
11-22-00	12.2	11.8	12.0	nd	nd	7.4	7.3	153	152	152	5.5	4.0	4.5
11-23-00	12.7	12.2	12.5	nd	nd	7.3	7.3	153	152	153	4.0	3.0	3.5
11-24-00	12.9	12.7	12.8	nd	nd	7.3	7.3	154	153	154	3.0	2.5	2.5
11-25-00	13.0	12.8	12.9	nd	nd	7.3	7.3	156	154	155	3.0	3.0	3.0
11-26-00	12.8	12.5	12.7	nd	nd	7.3	7.3	156	153	155	3.0	3.0	3.0
11-27-00	13.0	12.6	12.9	nd	nd	7.3	7.2	158	155	156	3.0	3.0	3.0
11-28-00	13.2	12.9	13.0	nd	nd	7.3	7.2	159	156	158	3.5	3.0	3.0
11-29-00	13.1	12.7	12.9	nd	nd	7.2	7.1	159	156	157	4.0	3.0	3.5
11-30-00	12.8	12.6	12.7	nd	nd	7.2	7.1	162	155	158	3.5	3.5	3.5
12-01-00	12.9	12.7	12.8	nd	nd	7.1	7.1	171	158	167	3.5	3.0	3.5
12-02-00	13.2	12.9	13.0	nd	nd	7.1	7.1	181	170	176	3.0	2.5	3.0
12-03-00	13.2	13.1	13.2	nd	nd	7.1	7.1	191	181	188	2.5	2.0	2.5
12-04-00	13.1	13.0	13.1	nd	nd	7.2	7.1	194	190	193	3.0	2.5	3.0
12-05-00	13.0	--	--	nd	nd	--	7.1	--	193	--	--	3.0	--
05-03-01	12.2	10.8	12.3	nd	nd	7.6	--	172	--	--	17.5	--	--
05-04-01	12.5	10.0	11.0	nd	nd	7.9	6.8	178	170	173	21.0	17.0	19.0
05-05-01	11.0	10.0	10.4	nd	nd	7.8	7.0	190	173	184	21.5	19.0	20.5
05-06-01	11.3	10.7	10.9	nd	nd	7.7	6.9	191	187	190	20.0	19.0	19.5
05-07-01	12.5	11.2	12.1	nd	nd	7.2	6.7	205	191	196	19.0	17.0	17.5
05-08-01	12.7	12.4	12.5	nd	nd	7.2	6.7	208	197	202	17.0	16.5	16.5
05-09-01	12.5	12.2	--	nd	nd	7.6	6.6	207	201	203	18.0	16.5	17.0
05-10-01	--	11.8	--	nd	nd	8.0	6.7	209	204	206	20.5	17.0	19.0
05-11-01	--	--	--	nd	nd	7.7	6.7	209	206	208	20.5	18.5	19.5
05-12-01	--	--	--	nd	nd	7.0	6.5	214	208	211	21.0	18.5	19.5
05-13-01	--	--	--	nd	nd	7.2	7.0	216	213	215	21.0	20.0	2.05
05-14-01	--	--	--	nd	nd	7.2	6.8	217	215	216	20.5	19.0	19.5
05-15-01	--	--	--	nd	nd	7.0	6.8	218	216	217	19.0	17.0	18.0
05-16-01	--	--	--	nd	nd	6.9	6.8	218	217	218	17.0	16.0	16.5
05-17-01	--	--	--	nd	nd	6.8	6.6	222	218	219	16.0	15.5	16.0
05-18-01	--	--	--	nd	nd	6.8	6.1	227	219	223	15.5	15.0	15.0
05-19-01	--	--	--	nd	nd	7.0	6.7	222	220	221	17.5	15.0	16.0
05-20-01	--	--	--	nd	nd	6.8	6.6	222	220	221	17.0	16.0	16.5
05-21-01	--	--	--	nd	nd	6.8	6.5	222	220	221	17.5	16.0	16.5
05-22-01	--	--	--	nd	nd	6.8	6.6	221	220	220	18.0	17.0	18.0
05-23-01	--	--	--	nd	nd	6.7	6.4	221	218	219	18.0	17.0	17.5
05-24-01	--	--	--	nd	nd	6.7	6.5	218	214	216	17.0	16.5	16.5
05-25-01	--	--	--	nd	nd	6.7	6.5	215	197	210	17.0	15.5	16.0
05-26-01	--	--	--	nd	nd	6.7	6.5	204	195	200	16.5	15.5	16.0
05-27-01	--	--	--	nd	nd	6.7	6.5	200	191	196	17.5	16.0	16.5

Appendix 1. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01124151, Quinebaug River at West Thompson, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour ($g\ O_2/m^3/hr$) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
05-28-01	--	--	--	nd	nd	6.5	6.4	191	178	183	17.5	16.5	17.0
05-29-01	--	--	--	nd	nd	6.6	6.4	184	173	179	18.0	17.0	17.5
05-30-01	--	--	--	nd	nd	6.7	6.4	177	173	175	18.5	17.5	18.0
05-31-01	--	--	--	nd	nd	6.7	6.5	181	173	175	17.5	17.0	17.0
06-01-01	--	--	--	nd	nd	6.6	6.4	200	179	184	17.0	16.0	16.5
06-02-01	--	--	--	nd	nd	6.6	6.4	196	186	189	17.0	16.5	16.5
06-03-01	--	--	--	nd	nd	6.5	6.4	192	170	181	17.5	16.5	17.0
06-04-01	--	--	--	nd	nd	6.7	6.4	178	169	173	18.0	17.0	17.5
06-05-01	--	--	--	nd	nd	6.6	6.4	171	169	170	19.0	17.5	18.0
06-06-01	--	--	--	nd	nd	6.6	6.4	171	169	171	19.5	18.0	18.5
06-07-01	--	--	--	nd	nd	6.6	6.3	176	167	172	20.0	18.5	19.0
06-08-01	--	--	--	nd	nd	6.7	6.4	176	170	173	21.5	18.0	19.5
06-09-01	--	--	--	nd	nd	6.6	6.3	174	168	171	20.5	19.0	19.5
06-21-01	--	--	--	nd	nd	6.8	--	--	155	--	25.0	24.0	--
06-22-01	--	--	--	nd	nd	6.6	6.4	155	148	151	24.0	22.5	23.0
06-23-01	--	--	--	nd	nd	6.6	6.4	150	148	149	23.0	22.0	22.5
06-24-01	--	--	--	nd	nd	6.7	6.5	150	148	149	23.5	23.0	23.5
06-25-01	--	--	--	nd	nd	6.7	6.5	150	148	149	24.0	23.0	23.5
06-26-01	--	--	--	nd	nd	6.6	6.4	152	149	150	23.5	23.0	23.0
06-27-01	--	--	--	nd	nd	7.0	6.4	157	150	152	26.5	23.0	24.5
06-28-01	--	--	--	nd	nd	7.1	6.4	163	155	157	27.5	24.0	26.0
06-29-01	--	--	--	nd	nd	6.8	6.4	165	158	161	26.5	24.5	25.5
06-30-01	--	--	--	nd	nd	6.8	6.5	166	160	162	26.5	24.5	25.0
07-01-01	--	--	--	nd	nd	6.8	6.5	175	161	165	26.0	24.5	25.5
07-02-01	--	--	--	nd	nd	7.0	6.7	174	166	169	26.0	24.5	25.0
07-03-01	--	--	--	nd	nd	6.9	6.6	194	173	180	24.5	23.5	24.0
07-04-01	--	--	--	nd	nd	6.8	6.6	200	184	188	23.5	23.0	23.0
07-05-01	--	--	--	nd	nd	--	6.6	--	184	--	23.5	--	--

Appendix 2

Appendix 2. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01125520, Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
05-23-00	--	10.3	--	nd	nd	--	--	141	--	--	15.5	--	--
05-24-00	10.9	10.0	10.5	0.08	-0.14	6.9	6.8	141	134	138	16.0	14.0	15.0
05-25-00	10.6	9.6	10.1	.11	-.14	7.0	6.8	139	134	136	18.0	15.5	16.5
05-26-00	10.6	9.5	10.0	.16	-.16	7.0	6.8	134	131	133	18.5	16.5	17.5
05-27-00	10.4	9.2	9.8	.16	-.15	7.0	6.7	136	132	134	19.0	17.0	18.0
05-28-00	10.2	9.2	9.6	.14	-.13	6.9	6.7	138	135	136	18.0	17.0	17.5
05-29-00	10.4	9.3	9.8	.13	-.17	6.9	6.7	139	136	138	18.0	16.5	17.0
05.30-00	10.8	9.3	9.9	.16	-.25	6.9	6.7	142	137	140	18.0	16.0	16.5
05-31-00	10.8	8.6	9.8	.19	-.41	6.9	6.6	147	138	141	19.5	15.5	17.0
06-01-00	10.7	8.3	9.5	.23	-.32	7.2	6.6	147	140	143	21.0	16.5	18.5
06-02-00	10.1	7.4	8.8	.27	-.46	7.6	6.6	147	141	145	23.0	19.0	20.5
06-03-00	9.8	7.2	8.4	.25	-.34	7.3	6.6	152	141	146	22.5	19.5	21.0
06-04-00	9.5	7.4	8.3	.27	-.29	7.6	6.7	152	146	149	23.0	19.5	21.0
06-05-00	9.1	7.5	8.1	.26	-.20	7.2	6.7	157	151	154	20.5	19.5	20.0
06-06-00	8.3	7.5	8.0	.22	-.03	6.9	6.7	154	145	152	19.5	16.5	18.0
06-07-00	9.1	8.2	8.7	nd	-.04	7.0	6.7	145	130	137	17.0	15.0	16.0
06-08-00	9.0	8.6	8.8	nd	-.04	6.9	6.8	130	125	127	16.5	15.0	15.5
06-09-00	10.8	8.5	9.3	.02	-.12	6.9	6.7	126	121	123	17.5	16.0	16.5
06-10-00	10.1	9.2	9.8	.05	nd	7.0	6.8	121	118	119	20.0	17.5	18.5
06-11-00	9.4	8.8	9.1	.04	-.01	7.0	6.8	118	112	116	21.5	19.5	20.5
06-12-00	9.2	8.8	9.1	.08	-.07	6.9	6.8	118	114	116	20.5	18.0	19.0
06-13-00	9.6	9.1	9.3	.04	-.04	7.0	6.9	122	115	117	18.5	17.5	18.0
06-14-00	9.4	9.1	9.2	.01	-.05	6.9	6.9	129	122	126	17.5	17.0	17.0
06-15-00	9.1	8.8	9.0	nd	nd	6.9	6.9	130	126	128	17.0	16.5	17.0
06-16-00	--	--	--	nd	nd	6.9	6.7	137	128	131	20.5	17.0	18.5
06-17-00	--	--	--	nd	nd	7.0	6.8	133	129	131	22.5	19.0	20.5
06-18-00	--	--	--	nd	nd	7.0	6.8	134	131	132	22.0	21.0	21.5
06-19-00	--	--	--	nd	nd	7.0	6.8	135	132	133	21.5	20.5	21.0
06-20-00	--	--	--	nd	nd	7.1	6.8	136	133	135	22.5	20.0	21.0
06-21-00	--	--	--	nd	nd	7.1	6.8	139	134	136	23.0	20.5	21.5
06-22-00	--	--	--	nd	nd	7.2	6.8	143	137	140	23.5	21.0	22.0
06-23-00	--	--	--	nd	nd	7.2	6.8	149	142	145	24.0	21.5	22.5
06-24-00	--	--	--	nd	nd	7.5	6.8	151	144	146	25.0	21.5	23.5
06-25-00	--	--	--	nd	nd	7.4	6.8	152	147	149	25.5	22.0	23.5
06-26-00	--	--	--	nd	nd	7.4	6.8	157	149	154	25.0	22.5	23.5
06-27-00	--	--	--	nd	nd	7.8	6.8	155	147	152	26.5	23.0	24.5
06-28-00	9.8	--	--	nd	-.38	7.9	6.8	150	143	146	26.0	23.0	24.0
06-29-00	9.6	7.0	8.1	.25	-.38	7.6	6.8	150	142	146	24.5	23.0	23.5
06-30-00	9.8	7.4	8.4	.29	-.32	7.7	6.8	158	147	151	25.5	22.0	23.5
07-01-00	9.7	7.2	8.3	.37	-.35	7.9	6.8	157	147	152	26.0	21.5	23.5
07-02-00	10.1	7.1	8.3	.39	-.04	7.9	6.8	157	151	153	26.5	22.0	24.0
07-03-00	10.2	7.0	8.4	.42	-.39	8.1	6.8	167	154	158	25.5	22.5	24.0
07-04-00	10.1	6.8	8.2	.43	-.40	8.0	6.8	170	160	164	26.0	23.0	24.5
07-05-00	9.9	6.7	8.2	.43	-.42	7.9	6.8	179	163	168	26.5	23.0	24.5
07-06-00	10.2	6.7	8.3	.46	-.43	8.0	6.8	180	164	171	26.0	21.5	24.0
07-07-00	10.2	6.7	8.3	.46	-.38	8.0	6.8	182	165	172	25.0	21.5	23.5

Appendix 2. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01125520, Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
07-08-00	10.5	6.9	8.5	.47	-.44	8.2	6.8	182	166	173	24.5	20.0	22.5
07-09-00	10.7	6.9	8.6	.49	-.47	8.3	6.8	175	165	169	24.0	20.5	22.5
07-10-00	10.9	6.7	8.6	.54	-.48	8.6	6.8	181	167	172	25.5	22.0	23.5
07-11-00	12.0	6.6	9.2	.70	-.47	8.7	6.8	189	175	179	25.0	21.0	23.0
07-12-00	13.2	7.0	9.9	.78	-.58	8.8	6.8	201	183	193	24.5	20.5	23.0
07-13-00	13.7	7.0	10.2	.92	-.67	9.0	6.9	202	183	194	24.5	21.5	23.0
07-14-00	13.7	6.1	10.2	.92	-.66	9.1	6.9	203	188	196	25.0	22.0	23.5
07-15-00	12.1	6.7	9.4	.70	-.55	8.7	7.0	207	186	198	25.0	22.0	23.0
07-16-00	11.9	6.7	9.0	.68	-.63	8.5	6.8	189	162	175	25.5	21.5	23.0
07-17-00	11.9	6.0	8.8	.72	-.69	8.8	6.8	205	185	193	25.5	22.0	24.0
07-18-00	11.8	6.7	8.9	.68	-.64	8.8	6.9	203	179	190	26.0	22.5	24.5
07-19-00	10.8	6.6	8.7	.46	-.48	8.3	6.9	202	182	192	24.5	21.5	22.5
07-20-00	12.1	7.2	9.3	.64	-.58	8.8	6.9	205	186	194	25.0	20.5	22.5
07-21-00	12.2	6.7	9.3	.70	-.69	8.9	6.9	206	186	196	24.5	20.5	22.5
07-22-00	11.9	5.8	9.2	.64	-.58	8.6	6.8	207	169	184	25.5	21.5	23.5
07-23-00	11.9	6.8	9.1	.68	-.57	8.6	6.9	209	191	200	25.0	20.5	23.0
07-24-00	12.1	6.3	9.1	.66	-.68	8.7	6.9	236	196	207	24.5	21.0	23.0
07-25-00	11.0	5.7	8.6	.59	-.38	8.1	6.9	240	198	216	24.5	22.0	22.5
07-26-00	8.9	6.4	7.7	.26	-.20	7.3	6.9	230	196	213	22.5	20.5	21.0
07-27-00	9.7	6.9	8.3	.29	-.32	7.3	6.9	216	176	195	20.5	19.5	20.0
07-28-00	9.9	8.2	9.0	.18	-.17	7.8	7.1	192	181	188	22.0	20.5	21.0
07-29-00	9.5	8.4	8.9	.19	-.18	7.4	7.1	191	169	179	21.5	20.5	21.p
07-30-00	9.8	8.3	9.0	.19	-.23	7.4	7.0	169	165	167	21.5	20.0	20.5
07-31-00	9.2	8.2	8.6	.21	-.09	7.2	6.9	165	159	163	21.0	20.5	21.0
08-01-00	9.6	8.4	8.9	.18	-.17	7.2	6.9	166	158	161	21.0	20.0	20.5
08-02-00	10.0	8.2	8.8	.23	-.30	7.4	6.9	167	154	160	22.5	20.5	21.0
08-03-00	9.5	7.9	8.6	.21	-.24	7.2	6.8	165	154	160	22.5	21.0	22.0
08-04-00	9.9	7.8	8.6	.27	-.33	7.6	6.8	165	156	162	24.5	21.0	22.5
08-05-00	10.0	7.4	8.4	.35	-.37	7.8	6.8	164	156	161	25.5	22.0	23.5
08-06-00	10.1	7.2	8.4	.44	-.36	7.7	6.8	163	156	160	24.0	21.5	23.0
08-07-00	9.5	7.0	8.0	.39	-.33	7.4	6.7	166	158	163	25.5	22.0	23.5
08-08-00	9.9	6.8	8.1	.42	-.42	7.7	6.7	169	160	165	26.5	22.5	24.5
08-09-00	9.8	6.5	7.8	.40	-.42	7.7	6.7	170	162	166	26.0	23.0	24.5
08-10-00	--	6.5	--	nd	-.38	--	--	--	--	--	--	23.5	--
08-15-00	9.9	--	--	.28	-.35	7.9	--	--	166	--	22.0	--	--
08-16-00	9.4	6.9	8.0	.37	-.42	7.2	6.7	179	161	170	22.5	20.5	21.5
08-17-00	10.1	7.2	8.5	.35	-.23	7.5	6.8	192	170	177	23.0	19.5	21.0
08-18-00	10.0	7.1	8.4	.33	-.42	7.3	6.8	192	169	180	21.5	19.0	20.0
08-19-00	10.3	7.2	8.4	.49	-.45	7.7	6.8	190	171	179	23.0	19.5	21.0
08-20-00	10.6	6.9	8.6	.49	-.51	7.7	6.7	189	174	180	22.5	18.5	20.5
08-21-00	11.0	7.0	8.8	.53	-.63	7.9	6.7	197	176	183	22.5	18.0	20.0
08-22-00	11.5	7.0	8.9	.49	-.46	8.1	6.7	197	179	188	22.5	18.5	20.5
08-23-00	10.9	6.9	8.6	.58	-.50	7.7	6.7	199	183	190	22.0	19.0	20.5
08-24-00	10.9	6.8	8.6	.58	-.54	8.0	6.7	207	184	194	23.0	19.0	21.0
08-25-00	11.3	6.8	8.6	.44	-.36	8.1	6.8	210	187	198	23.0	19.5	21.5
08-26-00	11.4	5.5	8.5	.64	-.83	8.4	6.8	212	187	198	24.0	19.5	22.0

Appendix 2. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01125520, Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
08-27-00	11.9	5.4	8.1	.71	-.77	8.6	6.8	203	189	197	24.0	20.5	22.5
08-28-00	11.2	4.8	8.0	.83	-.50	8.2	6.8	208	190	199	23.5	21.5	22.5
08-29-00	--	6.2	--	nd	nd	8.6	6.8	212	190	201	23.5	20.0	22.0
08-30-00	--	--	--	nd	nd	8.1	6.8	210	193	203	22.5	20.0	21.5
08-31-00	--	--	--	nd	nd	8.5	6.8	216	196	207	24.5	21.5	23.0
09-01-00	--	--	--	nd	nd	8.0	6.8	218	200	210	24.5	23.0	24.0
09-02-00	--	--	--	nd	nd	7.6	6.8	220	200	211	24.5	23.0	23.5
09-03-00	--	--	--	nd	nd	8.2	6.8	215	201	209	24.0	21.5	22.5
09-04-00	--	--	--	nd	nd	7.8	6.8	212	195	200	24.5	23.0	23.5
09-05-00	--	--	--	nd	nd	8.3	6.9	206	190	198	23.0	19.0	20.5
09-06-00	--	--	--	nd	nd	8.5	6.9	211	195	204	20.5	17.5	19.0
09-07-00	--	--	--	nd	nd	8.8	6.9	212	197	205	20.5	17.5	19.0
09-08-00	--	--	--	nd	nd	8.9	7.0	218	201	210	21.0	18.0	19.5
09-09-00	--	--	--	nd	nd	8.6	7.0	225	205	215	21.5	20.0	21.0
09-10-00	--	--	--	nd	nd	8.6	6.9	219	205	213	22.5	20.0	21.5
09-11-00	--	--	--	nd	nd	8.8	7.0	218	206	214	22.5	20.5	21.5
09-12-00	--	--	--	nd	nd	8.7	7.0	227	208	219	22.5	20.5	21.5
09-13-00	--	--	--	nd	nd	8.5	7.0	226	205	217	23.5	22.0	22.5
09-14-00	--	--	--	nd	nd	8.3	6.9	232	211	222	22.5	19.5	21.0
09-15-00	--	--	--	nd	nd	7.8	7.0	236	182	211	21.0	19.5	20.5
09-16-00	--	--	--	nd	nd	8.2	7.0	221	196	204	20.5	18.0	19.0
09-17-00	--	--	--	nd	nd	8.4	7.0	221	194	210	19.5	16.0	18.0
09-18-00	--	--	--	nd	nd	--	--	214	--	--	--	16.5	--
09-19-00	--	--	--	nd	nd	8.1	--	--	204	--	20.0	--	--
09-20-00	--	--	--	nd	nd	8.4	6.8	223	181	202	22.5	19.5	20.5
09-21-00	--	--	--	nd	nd	8.4	6.8	219	197	208	21.5	19.0	20.5
09-22-00	11.0	--	--	nd	-.55	8.3	6.9	221	191	205	20.5	17.5	19.0
09-23-00	10.5	6.7	8.4	.47	-.47	8.0	6.8	221	193	208	19.0	16.5	18.0
09-24-00	9.6	6.3	7.8	.38	-.39	7.7	6.8	223	207	214	19.5	18.5	19.0
09-25-00	10.8	6.4	8.3	.59	-.49	8.0	6.9	235	209	219	19.0	16.5	17.5
09-26-00	9.1	6.6	7.9	.25	-.18	7.4	6.9	238	210	223	17.5	15.0	16.0
09-27-00	10.9	7.1	8.8	.52	-.56	8.0	6.9	231	213	222	17.5	14.0	15.5
09-28-00	11.4	7.2	9.1	.48	-.46	8.3	6.9	226	203	213	17.0	14.5	15.5
09-29-00	11.4	7.6	9.4	.42	-.52	7.8	6.9	226	208	217	15.5	12.0	13.5
09-30-00	11.3	7.9	9.5	.39	-.36	7.8	6.9	226	204	212	14.5	11.5	13.5
10-01-00	11.4	7.2	9.4	.40	-.47	7.9	6.9	225	206	216	16.0	13.0	14.5
10-02-00	11.5	6.9	9.1	.46	-.46	8.0	6.9	219	202	212	16.5	14.5	15.5
10-03-00	11.3	6.8	8.7	.33	-.56	8.0	6.9	232	207	219	17.0	15.0	16.0
10-04-00	11.9	6.3	9.0	.74	-.39	8.0	6.9	233	214	225	16.5	14.5	15.5
10-05-00	11.0	7.7	9.0	.33	-.15	7.7	6.9	238	211	226	16.5	15.0	15.5
10-06-00	11.0	7.6	8.8	.50	-.22	7.3	6.8	234	213	224	15.5	14.5	15.0
10-07-00	11.9	8.4	9.8	.45	-.52	8.0	6.9	220	197	206	16.0	14.0	15.0
10-08-00	11.8	8.1	9.8	.44	-.41	7.9	6.9	216	198	204	15.0	13.0	14.0
10-09-00	11.8	7.5	9.6	.57	-.32	7.5	6.8	219	201	208	14.5	11.5	12.5
10-10-00	11.9	8.9	10.4	.37	-.31	7.4	6.9	232	219	225	12.0	10.5	11.0
10-11-00	12.0	8.7	10.2	.35	nd	7.3	6.9	240	222	232	12.5	10.0	11.5

Appendix 2. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01125520, Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
10-12-00	--	--	--	nd	nd	7.4	6.9	249	231	243	13.0	10.0	11.5
10-13-00	--	--	--	nd	nd	7.3	6.9	252	244	248	13.0	10.0	11.5
10-14-00	--	--	--	nd	nd	7.6	6.9	266	243	254	14.5	11.5	13.0
10-15-00	--	--	--	nd	nd	7.8	6.8	251	234	240	14.5	12.5	13.5
10-16-00	--	--	--	nd	nd	7.7	6.9	251	236	243	14.5	11.5	13.0
10-17-00	--	--	--	nd	nd	8.1	7.0	251	226	234	13.5	11.5	12.5
10-18-00	9.9	9.1	9.4	.16	-.13	7.3	7.1	233	220	226	12.5	12.5	12.5
10-19-00	10.9	9.0	9.7	.25	-.23	7.4	7.0	220	212	217	13.5	12.0	12.5
10-20-00	11.3	8.9	9.9	.33	-.36	7.3	6.9	219	205	212	13.0	10.5	11.5
10-21-00	11.3	9.0	9.9	.35	-.34	7.4	6.9	211	188	196	14.0	11.0	12.5
10-22-00	11.6	8.7	10.0	.41	-.34	7.4	6.8	193	180	186	13.5	11.0	12.0
10-23-00	12.3	9.3	10.5	.40	-.37	7.4	6.8	189	175	182	12.0	9.5	11.0
10-24-00	12.5	9.5	10.8	.38	-.46	7.5	6.8	185	171	178	12.5	9.5	11.0
10-25-00	12.6	9.5	10.7	.44	-.43	7.5	6.8	184	170	177	13.0	10.0	11.5
10-26-00	12.8	9.2	10.7	.49	-.50	7.8	6.8	182	167	174	13.5	11.0	12.5
10-27-00	12.9	9.3	10.6	.51	-.46	7.9	6.8	184	170	176	13.5	12.0	12.5
10-28-00	12.7	9.2	10.6	.54	-.31	7.9	6.8	189	173	180	13.0	10.5	12.0
10-29-00	13.9	10.0	11.7	.55	-.30	7.9	6.8	189	179	184	10.5	8.0	9.0
10-30-00	14.5	10.8	12.4	.51	-.47	7.9	6.8	196	180	188	8.5	7.0	7.5
10-31-00	13.0	10.9	11.8	.38	-.32	7.6	6.9	198	183	190	8.5	7.5	8.0
11-01-00	14.0	10.6	11.9	.56	-.48	8.4	7.0	198	182	190	9.0	7.5	8.0
11-02-00	13.8	10.5	11.8	.58	-.50	8.3	7.1	200	185	192	10.0	7.5	8.5
11-03-00	14.0	10.3	11.6	.69	-.53	8.5	7.1	201	187	194	9.5	8.0	8.5
11-04-00	13.6	10.1	11.5	.59	-.53	8.3	7.1	198	187	193	10.0	8.0	9.0
11-05-00	12.9	10.0	11.2	.51	-.42	7.8	7.1	197	186	191	9.5	8.5	8.9
11-06-00	13.8	10.3	11.6	.65	-.49	8.4	7.0	197	185	191	9.0	7.5	8.0
11-07-00	14.0	10.1	11.6	.51	-.62	8.3	7.1	198	185	192	9.5	7.0	8.0
11-08-00	14.2	9.8	11.6	.51	-.62	8.5	7.1	198	184	191	9.5	7.5	8.5
11-09-00	--	--	--	nd	nd	8.5	7.1	198	184	192	10.0	8.0	9.0
11-10-00	--	--	--	nd	nd	7.4	7.1	197	167	181	10.0	9.5	9.5
11-11-00	--	--	--	nd	nd	7.3	7.1	178	169	174	9.5	9.0	9.5
11-12-00	---	--	--	nd	nd	7.6	7.1	171	164	166	10.0	9.0	9.5
11-13-00	--	--	--	nd	nd	7.3	7.1	178	161	167	9.5	9.0	9.0
11-14-00	--	--	--	nd	nd	7.2	7.1	183	166	174	9.5	9.0	9.0
11-15-00	--	--	--	nd	nd	7.5	7.1	181	161	170	9.0	8.0	8.5
11-16-00	--	--	--	nd	nd	7.4	6.9	173	160	167	8.5	7.5	7.5
11-17-00	--	--	--	nd	nd	7.4	6.9	173	161	168	8.5	7.5	8.0
11-18-00	--	--	--	nd	nd	7.4	6.9	178	162	169	7.5	6.0	6.5
11-19-00	---	--	--	nd	nd	7.5	6.9	173	162	168	7.0	5.5	6.5
11-20-00	--	--	--	nd	nd	7.4	6.9	177	163	170	6.0	5.0	5.5
11-21-00	--	--	--	nd	nd	7.4	6.9	179	166	173	5.5	4.0	5.0
11-22-00	--	--	--	nd	nd	7.4	6.9	185	169	177	5.0	3.5	4.0
11-23-00	--	--	--	nd	nd	7.4	7.0	185	171	177	3.5	2.5	3.0
11-24-00	--	--	--	nd	nd	7.3	6.9	182	173	177	2.5	1.0	1.5
11-25-00	--	--	--	nd	nd	7.2	6.8	184	177	181	2.0	0.5	1.0
11-26-00	---	--	--	nd	nd	7.0	6.9	188	169	180	3.5	1.5	2.5

Appendix 2. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01125520, Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
11-27-00	--	--	--	nd	nd	7.3	6.9	193	176	183	4.5	3.5	4.0
11-28-00	--	--	--	nd	nd	7.3	6.9	186	171	178	4.5	3.5	4.0
11-29-00	--	--	--	nd	nd	7.3	6.9	185	173	179	4.5	3.0	4.0
11-30-00	--	--	--	nd	nd	7.2	6.8	190	171	180	4.0	3.5	3.5
04-26-01	11.8	9.4	10.4	.38	nd	8.3	7.2	180	176	178	16.5	13..5	15.0
04-27-01	11.9	9.2	10.4	.44	nd	8.4	7.3	182	177	179	16.5	13.5	15.0
04-28-01	12.4	9.2	10.6	.46	nd	8.7	7.2	180	176	177	17.0	14.0	15.0
04-29-01	12.8	9.4	10.9	.54	nd	9.3	7.2	185	176	180	16.5	12.5	14.0
04-30-01	12.8	9.4	10.8	.58	nd	9.4	7.3	195	185	188	16.5	12.5	14.5
05-01-01	12.1	8.9	10.4	.54	nd	9.3	7.2	195	186	192	18.0	14.5	16.0
05-02-01	12.2	8.4	10.2	.56	nd	9.5	7.2	213	189	200	19.5	15.5	17.5
05-03-01	12.8	7.8	10.1	.66	nd	9.8	7.0	207	185	197	21.5	17.0	19.0
05-04-01	12.2	7.5	9.6	.68	nd	9.7	7.0	204	188	196	22.5	18.5	20.5
05-05-01	11.9	7.2	9.3	.59	nd	9.2	7.0	204	188	195	21.0	18.5	20.0
05-06-01	11.7	7.6	9.4	.52	nd	8.8	7.0	204	188	195	20.0	16.5	18.0
05-07-01	11.9	7.8	9.7	.54	nd	8.6	7.1	210	197	203	19.5	14.5	17.0
05-08-01	12.0	8.2	9.8	.48	nd	8.2	7.0	223	200	210	19.5	14.5	16.5
05-09-01	11.7	8.1	9.6	.46	nd	7.9	6.9	224	210	217	20.0	15.0	17.5
05-10-01	11.3	7.6	9.2	.44	nd	7.8	6.9	224	205	214	21.0	16.0	18.5
05-11-01	11.1	7.4	9.0	.41	nd	7.8	6.9	230	211	219	22.5	17.0	19.5
05-12-01	11.0	7.2	8.7	.54	nd	8.0	6.9	235	219	227	23.0	18.0	20.5
05-13-01	10.9	7.1	8.8	.51	nd	7.7	6.8	230	215	222	21.0	18.0	19.5
05-14-01	10.7	7.7	9.2	.42	nd	7.6	6.9	234	218	225	19.5	16.5	18.0
05-15-01	11.2	8.0	9.5	.37	nd	7.7	6.9	238	220	228	17.5	15.5	16.5
05-16-01	10.8	8.4	9.6	.33	nd	7.3	6.9	239	222	230	16.0	14.5	15.0
05-17-01	11.7	8.7	10.1	.36	nd	7.6	6.9	239	223	232	16.5	14.0	15.0
05-18-01	10.8	8.8	9.7	.25	nd	7.3	6.9	239	224	231	15.5	14.5	15.0
05-19-01	11.1	8.7	9.9	.32	nd	7.5	6.9	239	225	232	19.0	14.0	16.5
05-20-01	11.3	8.4	9.6	.36	nd	7.6	6.8	237	225	232	20.5	15.0	16.0
05-21-01	11.0	8.0	9.4	.39	nd	7.6	6.8	258	229	239	18.0	15.5	16.5
05-22-01	9.4	7.9	8.6	.18	nd	7.1	6.8	250	225	236	18.0	16.0	16.5
05-23-01	9.5	8.4	9.0	.14	nd	7.1	6.9	238	224	232	16.0	15.5	16.0
05-24-01	10.1	9.0	9.6	.11	nd	7.3	7.0	235	211	225	16.0	15.0	15.5
05-25-01	10.7	9.4	10.0	.16	nd	7.5	7.1	227	211	219	17.0	15.0	16.0
05-26-01	10.8	9.2	9.9	.21	nd	7.5	7.0	221	205	211	18.0	15.5	16.5
05-27-01	10.2	9.1	9.5	.19	nd	7.3	6.9	209	199	204	18.0	16.0	17.0
05-28-01	10.2	9.0	9.5	.22	nd	7.3	7.0	207	197	201	18.5	16.5	17.5
05-29-01	10.2	8.8	9.5	.17	nd	7.3	6.9	205	191	198	19.0	16.0	17.5
05-30-01	10.3	8.8	9.5	.21	-.18	7.4	6.9	204	188	197	19.0	16.5	17.5
05-31-01	10.6	9.1	9.8	.22	-.20	7.4	6.9	202	191	197	18.5	15.5	17.0
06-01-01	10.9	8.8	9.9	.25	-.28	7.6	6.9	207	193	200	19.5	15.0	17.0
06-02-01	9.9	8.8	9.5	nd	-.08	7.1	6.8	203	180	191	17.5	16.0	16.5
06-03-01	10.1	9.2	9.6	.09	-.16	7.2	6.9	189	182	187	18.5	17.0	17.5
06-04-01	10.1	9.3	9.7	.11	-.10	7.2	6.9	193	181	187	18.0	16.5	17.5
06-05-01	10.2	9.1	9.7	.14	-.14	7.2	6.9	194	183	189	19.5	16.5	18.0
06-06-01	9.9	8.9	9.5	.14	-.16	7.1	6.8	194	186	189	20.0	18.0	19.0

Appendix 2. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01125520, Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour ($g\ O_2/m^3/hr$) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
06-07-01	--	--	--	.18	nd	--	--	--	185	--	--	--	--
07-05-01	10.4	--	--	nd	-.46	--	--	233	--	--	--	--	--
07-06-01	10.2	7.2	8.6	.42	-.35	8.0	6.8	215	197	206	24.0	21.5	22.5
07-07-01	11.2	7.5	9.1	.50	-.52	8.5	6.8	207	191	199	24.5	20.5	22.5
07-08-01	9.0	7.1	8.0	.25	-.18	7.0	6.8	208	194	201	22.5	21.0	21.5
07-09-01	10.5	7.5	8.7	.42	-.43	7.8	6.8	214	193	204	25.5	20.5	23.0
07-10-01	10.4	6.9	8.3	.46	-.47	7.9	6.8	212	179	204	26.5	21.5	24.0
07-11-01	9.6	6.9	8.1	.33	-.29	7.6	6.7	199	178	189	24.5	21.5	22.5
07-12-01	10.0	7.5	8.5	.33	-.29	7.7	6.8	210	193	200	24.0	21.0	22.5
07-13-01	10.2	7.5	8.7	.36	-.37	7.9	6.8	208	190	200	24.0	20.0	22.0
07-14-01	10.4	7.4	8.7	.44	-.37	7.8	6.8	202	189	196	23.5	20.0	21.5
07-15-01	11.1	7.2	8.9	.52	-.50	8.4	6.8	203	190	196	24.5	20.0	22.5
07-16-01	11.6	7.0	8.9	.62	-.57	8.7	6.8	215	194	203	25.5	20.5	23.0
07-17-01	9.8	6.7	8.1	.31	-.30	7.4	6.8	220	198	208	23.5	21.5	22.0
07-18-01	11.5	7.2	9.1	.62	-.56	8.4	6.8	221	199	210	25.5	21.0	23.0
07-19-01	11.1	6.8	8.7	.59	-.48	8.2	6.7	224	203	213	24.0	21.5	22.5
07-20-01	11.5	7.0	9.0	.63	-.55	8.2	6.6	227	205	215	25.5	20.0	22.5
07-21-01	11.5	6.7	8.8	.63	-.56	8.3	6.6	226	208	216	26.0	20.5	23.5
07-22-01	11.4	6.4	8.7	.67	-.50	8.2	6.6	226	211	218	26.0	21.5	24.0
07-23-01	11.5	6.3	8.7	.73	-.49	8.4	6.6	238	217	226	26.0	21.5	24.0
07-24-01	11.0	6.0	8.4	.77	-.53	8.3	6.5	245	218	233	27.0	23.0	25.5
07-25-01	11.0	5.4	8.1	.78	-.70	8.2	6.6	252	227	240	28.5	24.5	26.5
07-26-01	8.1	5.1	6.7	.28	-.23	7.3	6.6	257	223	237	28.0	22.5	24.5
07-27-01	10.4	6.5	8.2	.56	-.51	7.5	6.7	254	227	239	24.0	20.0	22.0
07-28-01	10.8	5.0	8.4	.60	-.62	7.9	6.8	261	220	232	24.0	20.0	22.5
07-29-01	10.8	6.2	8.4	.57	-.52	8.1	6.8	260	222	231	24.0	21.0	22.5
07-30-01	--	6.1	--	.55	-.48	8.0	6.8	242	--	--	--	--	--
08-15-01	11.1	--	--	.58	-.42	8.6	--	213	189	198	--	--	--
08-16-01	11.0	7.2	8.9	.44	-.51	8.4	7.4	243	199	215	25.5	21.5	23.5
08-17-01	10.7	7.0	8.7	.60	-.66	8.1	7.3	259	206	229	24.5	21.5	23.0
08-18-01	10.9	6.2	8.5	.55	-.55	8.1	7.3	259	212	233	25.0	22.0	23.5
08-19-01	10.9	6.8	8.5	.46	-.43	8.4	7.2	249	214	231	25.5	22.0	24.0
08-20-01	9.8	6.8	7.9	.53	-.48	7.7	7.2	271	217	236	24.5	23.0	24.0
08-21-01	10.4	6.7	8.2	.49	-.49	8.2	7.2	251	211	230	26.0	23.0	24.5
08-22-01	10.3	6.8	8.3	.60	-.62	8.0	7.1	242	206	225	26.5	22.0	24.0
08-23-01	10.5	6.7	8.4	.54	-.45	7.9	7.1	247	209	226	24.5	22.0	23.5
08-24-01	10.5	6.0	8.3	.64	-.38	7.8	7.0	247	220	232	25.0	22.5	24.0
08-25-01	10.5	6.6	8.4	nd	nd	7.6	7.1	255	225	242	24.0	21.0	23.0
08-26-01	11.3	5.7	8.7	nd	nd	8.1	7.1	252	221	232	24.5	21.5	23.0
08-27-01	10.3	6.6	8.2	nd	nd	7.6	7.0	263	225	243	23.5	22.0	23.0
08-28-01	10.6	6.3	8.3	nd	nd	7.7	6.9	262	224	235	25.5	22.5	24.0
08-29-01	10.3	4.1	7.0	nd	nd	7.4	7.0	268	234	254	24.5	22.0	23.5
08-30-01	11.0	6.3	8.6	nd	nd	7.9	7.0	274	226	247	24.5	21.0	23.0
08-31-01	10.7	5.5	8.3	nd	nd	7.6	7.0	255	231	247	24.5	22.5	23.5
09-01-01	10.2	3.9	7.2	nd	nd	7.5	7.0	269	233	248	25.0	23.0	24.0
09-02-01	10.4	4.8	7.8	nd	nd	7.6	7.0	258	236	248	23.0	19.5	21.0

Appendix 2. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01125520, Quinebaug River at Cotton Bridge Road near Pomfret Landing, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
09-03-01	10.8	4.3	7.7	nd	nd	7.8	7.0	262	239	252	22.0	19.0	20.5
09-04-01	10.1	4.0	7.3	nd	nd	7.8	7.0	267	237	253	21.5	18.5	20.0
09-05-01	9.8	3.9	7.6	nd	nd	7.8	6.9	277	246	263	21.5	19.5	20.5
09-06-01	10.0	6.4	8.1	nd	nd	7.8	6.9	288	248	268	20.5	18.0	19.5
09-07-01	9.9	6.8	8.3	nd	nd	7.8	6.9	284	251	269	21.5	18.5	20.0
09-08-01	10.1	6.4	8.2	nd	nd	8.2	6.9	289	250	270	22.5	20.0	21.0
09-09-01	10.0	6.5	8.3	nd	nd	8.4	7.0	274	251	265	23.5	21.0	22.5
09-10-01	9.7	6.2	8.0	nd	nd	8.3	7.0	277	253	268	24.5	22.0	23.5
09-11-01	9.9	5.8	7.8	nd	nd	8.4	6.9	295	261	279	24.0	22.0	23.0
09-12-01	10.1	6.0	8.1	nd	nd	8.2	7.0	291	259	277	22.0	19.5	21.0
09-13-01	10.0	6.5	8.2	nd	nd	8.0	7.1	293	259	279	22.0	19.0	20.5
09-14-01	9.5	6.6	7.8	nd	nd	7.9	6.9	287	247	268	21.5	17.5	19.5
09-15-01	10.4	7.2	8.5	nd	nd	7.7	7.0	275	248	265	18.0	15.5	17.0
09-16-01	10.1	7.5	8.8	nd	nd	7.6	7.1	294	258	280	18.5	16.0	17.5
09-17-01	10.3	7.5	8.7	nd	nd	7.8	7.1	286	261	277	18.5	16.5	17.5
09-18-01	10.6	6.5	8.6	nd	nd	8.1	7.0	311	267	292	19.0	17.0	18.0
09-19-01	10.4	7.0	8.6	nd	nd	8.0	7.2	303	266	285	19.5	18.0	19.0
09-20-01	9.9	6.8	8.4	nd	nd	7.8	7.2	297	265	283	19.0	18.0	18.5
09-21-01	--	6.7	--	nd	nd	7.5	7.0	292	238	266	19.5	18.5	19.0
09-22-01	--	--	--	nd	nd	8.1	7.0	304	262	277	21.5	19.0	20.5
09-23-01	--	--	--	nd	nd	8.1	6.9	304	262	283	22.0	19.5	21.0
09-24-01	--	--	--	nd	nd	7.7	6.9	284	255	271	21.5	20.0	20.5
09-25-01	--	--	--	nd	nd	7.4	7.0	290	247	268	21.5	20.5	21.0
09-26-01	--	--	--	nd	nd	--	--	265	--	--	--	--	--

Appendix 3

Appendix 3. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01126720, Quinebaug River near Packer, Conn.

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
06-16-00	9.2	--	--	nd	-0.11	6.7	--	119	--	--	20.0	--	--
06-17-00	8.6	7.9	8.2	0.10	-.11	6.8	6.5	122	117	119	22.5	19.5	21.0
06-18-00	8.2	7.6	7.9	.11	-.06	6.7	6.6	122	120	121	22.0	21.0	21.5
06-19-00	8.3	7.6	7.9	.09	-.06	6.8	6.6	123	120	121	21.0	20.5	20.5
06-20-00	8.7	7.8	8.2	.12	-.07	6.9	6.6	125	120	123	22.0	20.0	21.0
06-21-00	8.6	7.6	8.0	.12	-.12	6.9	6.6	126	123	125	22.0	20.5	21.5
06-22-00	8.4	7.4	7.9	.11	-.13	7.0	6.7	130	125	127	23.0	21.5	22.0
06-23-00	8.5	7.2	7.8	.14	-.14	7.1	6.8	135	128	131	23.5	21.5	22.5
06-24-00	8.7	7.2	7.8	.18	-.16	7.2	6.8	137	132	135	23.5	22.0	23.0
06-25-00	8.8	7.2	8.0	.16	-.17	7.3	6.8	140	135	138	24.5	22.5	23.5
06-26-00	8.7	7.0	7.7	.32	nd	7.3	6.9	145	137	142	24.5	23.5	24.0
06-27-00	8.4	7.2	7.8	nd	-.04	7.2	7.0	147	138	142	25.0	24.5	25.0
06-28-00	8.9	6.7	7.7	nd	nd	7.5	6.8	148	142	144	25.0	23.5	24.5
06-29-00	8.9	6.9	7.9	nd	nd	7.5	6.9	146	135	142	25.0	23.0	24.0
06-30-00	10.3	7.5	8.9	.33	-.19	8.5	6.9	141	134	138	23.5	22.5	23.0
07-01-00	10.1	7.5	9.2	.26	-.22	8.3	7.1	144	135	138	23.5	22.5	23.0
07-02-00	9.7	7.8	8.7	.31	-.14	8.0	7.1	150	137	143	24.0	23.0	23.5
07-03-00	9.3	7.6	8.6	.07	-.15	7.6	7.2	153	141	146	24.5	23.5	24.0
07-04-00	8.8	7.3	8.0	nd	nd	7.4	7.0	152	143	147	25.0	24.0	24.5
07-05-00	9.8	7.5	8.2	nd	nd	7.7	6.8	153	136	143	25.5	24.5	25.0
07-06-00	9.2	7.7	8.3	nd	nd	7.2	6.9	145	138	141	25.5	24.0	24.5
07-07-00	9.1	7.8	8.5	nd	nd	7.2	6.8	145	143	144	24.5	23.5	24.0
07-08-00	9.1	8.0	8.5	nd	nd	7.1	6.9	151	144	147	23.5	22.0	22.5
07-09-00	9.5	8.1	8.9	nd	nd	7.2	6.9	153	150	152	22.0	21.5	22.0
07-10-00	9.5	8.5	9.0	nd	nd	7.3	6.9	155	153	154	23.5	22.0	22.5
07-11-00	9.7	8.5	9.1	nd	nd	7.5	7.1	162	154	158	24.0	23.5	23.5
07-12-00	10.7	8.8	9.6	nd	nd	8.2	7.0	164	158	162	24.5	23.5	24.0
07-13-00	11.2	7.9	9.8	.17	-.16	8.2	6.9	163	158	160	24.0	23.0	23.5
07-14-00	12.2	9.4	10.7	.35	-.07	8.7	7.2	163	156	159	24.5	23.0	23.5
07-15-00	11.2	8.9	10.0	nd	nd	8.8	7.7	165	157	161	24.5	23.5	24.0
07-16-00	9.5	8.1	8.8	nd	-.16	8.4	7.3	161	148	158	23.5	22.5	23.0
07-17-00	9.0	7.3	8.0	nd	nd	7.4	7.0	148	140	144	24.5	23.5	23.5
07-18-00	8.7	7.8	8.2	nd	nd	7.3	7.1	152	142	147	25.0	24.	24.5
07-19-00	9.6	7.0	7.8	nd	nd	7.3	6.9	157	142	147	24.5	22.0	23.5
07-20-00	9.9	7.5	8.6	nd	nd	7.8	7.0	165	156	161	22.0	21.0	21.5
07-21-00	10.9	9.9	10.3	.22	-.08	8.7	7.5	174	162	166	23.0	22.0	22.5
07-22-00	10.7	9.7	10.4	.11	-.23	8.6	7.8	174	165	169	24.5	22.5	23.0
07-23-00	10.6	8.7	9.5	.10	-.13	8.6	7.9	172	157	166	24.0	23.0	23.5
07-24-00	9.7	8.7	9.4	.15	-.16	8.5	7.5	157	144	147	23.5	22.5	23.0
07-25-00	9.2	7.7	8.6	.12	-.16	7.6	7.1	148	141	143	23.0	22.0	23.0
07-26-00	8.1	7.4	7.7	.07	-.13	7.1	6.9	163	148	159	22.0	21.0	21.5
07-27-00	7.9	7.1	7.5	.06	nd	7.0	6.8	169	161	164	21.0	20.0	20.5
07-28-00	9.2	7.8	8.6	.19	-.11	7.2	7.0	171	160	167	20.5	19.5	20.0
07-29-00	9.9	8.4	9.1	.17	-.16	7.5	7.0	168	158	164	21.5	20.5	21.0
07-30-00	9.6	8.3	8.9	.13	-.13	7.4	7.1	173	158	167	21.5	21.0	21.0
07-31-00	9.4	8.3	8.7	.09	-.06	7.3	7.0	158	142	152	21.5	20.5	21.0

Appendix 3. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01126720, Quinebaug River near Packer, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour ($g\ O_2/m^3/hr$) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
08-01-00	9.3	8.5	8.8	.08	-.10	7.1	7.0	142	136	139	20.5	20.0	20.5
08-02-00	9.5	8.5	8.9	.10	-.17	7.1	6.9	140	136	138	21.5	20.5	21.0
08-03-00	--	8.2	--	nd	nd	7.1	6.9	--	136	--	--	21.5	--
08-04-00	--	7.4	--	nd	nd	--	6.3	141	--	--	23.5	--	--
08-05-00	8.6	7.2	7.8	nd	nd	7.1	6.8	145	138	142	24.0	23.0	23.5
08-06-00	8.4	7.2	7.7	nd	nd	7.0	6.8	148	142	144	24.0	23.0	23.0
08-07-00	8.6	7.3	7.9	nd	nd	7.0	6.9	148	145	146	23.5	22.5	23.0
08-08-00	8.1	7.5	7.8	nd	nd	7.0	6.9	150	147	148	25.0	23.5	24.0
08-09-00	8.5	5.2	7.8	nd	nd	7.1	6.9	152	149	150	25.0	25.0	25.0
08-10-00	8.2	5.2	7.8	nd	nd	7.1	6.9	154	149	151	26.0	24.5	25.0
08-11-00	8.4	6.6	7.7	nd	nd	7.2	7.0	154	148	150	26.0	25.0	25.5
08-12-00	8.5	6.8	7.9	nd	nd	7.2	6.9	149	142	146	25.0	24.0	24.5
08-13-00	8.3	7.3	7.9	nd	nd	7.0	6.9	144	141	142	24.0	21.5	22.5
08-14-00	8.7	7.6	8.3	nd	nd	7.0	6.9	149	144	147	21.5	20.5	21.0
08-15-00	9.6	6.9	8.2	nd	nd	7.0	6.7	155	148	152	21.0	20.0	20.5
08-16-00	9.0	7.9	8.5	nd	nd	7.0	6.8	155	152	153	21.0	21.0	21.0
08-17-00	8.8	8.0	8.4	nd	nd	7.0	6.8	154	147	150	21.5	20.5	21.0
08-18-00	9.1	8.1	8.6	nd	nd	7.0	6.8	148	142	145	21.0	20.0	20.5
08-19-00	9.0	8.3	8.6	nd	nd	7.0	6.8	145	140	141	20.5	19.0	20.0
08-20-00	9.3	8.5	8.9	nd	nd	7.1	6.9	155	145	149	21.0	20.0	20.5
08-21-00	9.5	8.2	9.2	nd	nd	7.1	7.0	155	152	153	20.5	20.0	20.0
08-22-00	9.7	8.8	9.3	.08	-.08	7.1	6.9	159	154	156	20.5	20.0	20.0
08-23-00	9.7	8.9	9.3	.21	-.10	7.2	6.9	164	155	159	21.0	20.0	20.5
08-24-00	9.4	8.8	9.1	.10	-.07	7.1	7.0	161	159	160	21.0	20.0	20.5
08-25-00	9.7	8.7	9.2	.07	-.19	7.2	7.0	165	158	161	22.5	20.5	21.5
08-26-00	9.4	8.6	8.9	.08	-.09	7.2	7.0	163	157	159	23.0	21.5	22.0
08-27-00	9.6	8.6	9.0	.12	-.08	7.2	6.9	166	159	161	23.0	22.0	22.5
08-28-00	9.1	7.0	8.5	nd	nd	7.2	6.8	169	166	167	23.0	22.5	22.5
08-29-00	9.5	8.0	8.7	.12	-.14	7.3	6.7	176	167	171	23.0	22.0	22.0
08-30-00	9.5	8.4	9.0	.08	-.24	7.3	7.1	177	170	173	23.0	22.0	22.0
08-31-00	9.4	8.2	8.8	.11	-.10	7.1	7.0	177	146	160	22.5	21.5	22.0
09-01-00	9.1	8.2	8.6	.06	nd	7.1	6.9	161	146	153	24.0	22.5	23.0
09-02-00	8.7	7.6	8.0	nd	nd	7.1	6.9	173	161	167	24.5	24.0	24.0
09-03-00	8.2	7.2	7.6	nd	nd	7.0	6.9	177	169	174	24.0	23.5	24.0
09-04-00	8.7	7.0	7.6	nd	-.12	7.2	6.9	177	171	174	23.5	23.0	23.5
09-05-00	8.8	7.8	8.4	.13	-.06	7.3	7.1	182	174	176	23.5	22.0	23.0
09-06-00	9.8	8.2	8.7	.11	-.07	7.3	7.1	185	181	183	22.0	20.0	20.5
09-07-00	10.2	9.2	9.7	.19	-.06	7.3	7.1	186	185	185	20.0	18.5	19.5
09-08-00	10.5	9.7	10.1	.19	-.09	7.3	7.2	187	183	185	19.5	18.5	19.0
09-09-00	10.3	9.7	9.9	nd	nd	7.3	7.2	186	184	184	20.0	19.5	19.5
09-10-00	10.0	8.2	9.5	nd	-.08	7.3	7.1	186	183	185	21.0	20.0	20.5
09-11-00	10.1	9.1	9.6	.13	-.08	7.5	7.2	190	177	184	22.0	21.0	21.5
09-12-00	11.6	9.3	10.3	.39	-.10	8.2	7.4	188	184	186	22.5	21.5	22.0
09-13-00	11.5	9.7	10.6	nd	nd	8.4	7.9	188	186	186	22.5	22.0	22.5
09-14-00	12.8	9.3	11.7	.45	-.13	8.9	8.4	192	187	190	22.5	22.0	22.0
09-15-00	11.8	7.9	10.3	.14	-.25	8.7	7.4	190	173	184	22.5	21.0	21.5

Appendix 3. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01126720, Quinebaug River near Packer, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour ($g\ O_2/m^3/hr$) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
09-16-00	9.9	8.8	9.3	.11	nd	7.4	7.1	189	169	180	21.0	19.0	19.5
09-17-00	10.7	9.9	10.2	.14	-.05	7.7	7.3	169	167	168	19.0	18.0	18.5
09-18-00	11.4	8.0	10.5	.16	-.11	7.8	7.2	171	163	168	18.5	17.5	18.0
09-19-00	10.9	9.6	10.3	.11	-.10	7.5	7.2	163	155	158	19.0	18.0	18.5
09-20-00	10.4	9.4	9.8	nd	-.23	7.6	7.1	172	158	166	20.5	18.5	19.5
09-21-00	10.4	8.3	9.2	.27	-.14	7.6	7.1	163	154	157	20.5	20.0	20.5
09-22-00	9.9	8.9	9.5	.12	nd	7.5	7.2	158	150	155	20.5	19.0	19.5
09-23-00	10.0	9.3	9.8	nd	nd	7.4	7.1	159	148	151	19.0	18.0	18.0
09-24-00	9.8	8.9	9.4	nd	-.13	7.2	7.0	164	159	162	18.0	18.0	18.0
09-25-00	10.7	8.8	9.6	.27	-.14	7.6	7.0	170	164	167	18.5	17.5	18.0
09-26-00	10.6	9.4	10.0	.12	nd	7.4	7.1	170	163	167	17.5	16.0	17.0
09-27-00	10.7	9.2	9.8	nd	nd	7.3	7.0	171	166	168	16.0	15.0	15.0
09-28-00	11.0	10.2	10.5	nd	-.13	7.4	7.1	171	168	169	15.5	15.0	15.5
09-29-00	11.6	9.7	10.8	.27	-.14	7.6	7.1	175	170	173	15.0	14.0	14.5
09-30-00	11.6	10.3	10.9	.12	nd	7.3	7.0	178	173	175	14.0	13.0	13.5
10-01-00	11.6	10.6	11.1	nd	nd	7.3	7.0	180	174	186	14.0	13.0	13.5
10-02-00	11.6	10.4	11.0	nd	-.13	7.5	7.0	178	172	176	15.0	13.5	14.5
10-03-00	10.8	9.9	10.3	.27	-.14	7.0	6.7	183	173	181	16.0	15.0	15.5
10-04-00	10.7	10.0	10.4	.12	nd	6.9	6.8	185	179	182	16.5	15.5	16.0
10-05-00	10.7	9.6	10.1	nd	nd	6.9	6.8	185	181	182	16.0	14.0	15.5
10-06-00	9.6	8.7	9.0	nd	-.13	6.9	6.8	188	182	185	15.5	15.0	15.0
10-07-00	10.2	8.9	9.4	.27	-.14	7.2	6.8	193	178	185	15.5	14.5	15.0
10-08-00	10.6	9.4	9.9	.12	nd	7.2	7.0	203	193	198	15.0	13.5	14.0
10-09-00	10.6	9.9	10.3	nd	nd	7.2	7.0	198	195	197	14.0	12.0	12.5
10-10-00	10.9	10.4	10.7	.12	-.08	7.0	6.9	195	185	189	12.0	10.5	11.0
10-11-00	11.4	10.7	11.0	.12	-.06	7.1	6.9	188	182	186	11.5	10.5	11.0
10-12-00	11.3	10.7	10.9	.02	-.11	7.0	6.9	187	179	181	11.5	10.5	11.0
10-13-00	10.8	10.2	10.5	.07	-.09	7.0	6.9	189	185	186	12.0	11.0	11.5
10-14-00	10.7	10.0	10.3	.11	-.12	7.0	6.9	197	187	190	13.0	12.0	12.5
10-15-00	10.4	9.6	10.0	.08	-.11	7.0	6.9	200	195	197	14.0	13.0	13.5
10-16-00	10.4	9.1	9.7	nd	-.04	7.1	6.9	204	198	200	14.0	13.0	13.5
10-17-00	10.3	8.7	9.3	.17	-.10	7.1	6.8	206	204	206	13.0	12.5	12.5
10-18-00	10.3	9.3	9.7	nd	-.07	7.1	6.9	222	206	216	13.0	12.5	12.5
10-19-00	10.3	9.0	9.6	.21	-.14	7.2	6.9	222	212	218	13.0	12.0	12.5
10-20-00	10.3	9.2	9.8	.16	-.07	7.1	6.9	212	196	202	13.0	11.5	12.0
10-21-00	10.4	9.5	10.0	.10	-.08	7.0	6.8	196	186	190	13.0	11.5	12.0
10-22-00	10.2	9.3	9.8	.13	-.04	7.0	6.8	191	185	187	13.0	12.0	12.5
10-23-00	10.6	9.7	10.0	.09	-.05	6.9	6.8	196	181	183	12.5	10.5	11.0
10-24-00	10.8	10.2	10.4	.06	-.06	6.9	6.9	183	171	177	11.5	10.0	11.0
10-25-00	10.7	10.0	10.3	.09	-.06	7.0	6.9	173	166	170	12.0	10.5	11.5
10-26-00	10.6	9.8	10.2	.05	-.08	7.0	6.9	170	165	167	13.0	11.5	12.0
10-27-00	10.5	9.6	9.0	.09	-.04	7.0	6.8	167	162	165	13.0	12.5	13.0
10-28-00	10.0	9.4	9.8	.08	-.06	7.0	6.9	165	160	163	13.0	12.0	12.5
10-29-00	10.7	9.7	10.0	nd	nd	6.9	6.8	165	160	162	12.0	8.5	10.0
10-30-00	11.4	10.7	11.0	.03	-.03	6.9	6.9	164	160	163	8.5	7.5	7.5
10-31-00	11.6	11.2	11.4	.05	-.03	6.9	6.8	167	160	164	8.0	7.5	7.5

Appendix 3. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01126720, Quinebaug River near Packer, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
11-01-00	11.6	10.4	11.0	nd	nd	6.9	6.8	165	160	162	8.5	8.0	8.0
11-02-00	10.6	10.2	10.5	nd	nd	6.9	6.8	164	161	163	9.0	8.0	8.5
11-03-00	10.4	10.1	10.3	nd	nd	6.9	6.8	166	160	163	8.0	8.5	9.0
11-04-00	10.5	10.1	10.3	nd	nd	6.9	6.8	170	162	167	9.5	9.0	9.5
11-05-00	10.4	9.9	10.2	nd	nd	6.9	6.8	171	164	169	9.5	9.0	9.5
11-06-00	10.4	9.9	10.2	.06	-.02	6.9	6.8	172	168	170	8.0	8.5	9.0
11-07-00	10.9	10.2	10.6	.06	-.07	6.9	6.8	169	167	169	8.5	8.0	8.5
11-08-00	10.9	10.4	10.7	nd	-.04	6.9	6.8	171	167	169	8.5	8.0	8.5
11-09-00	11.1	10.5	10.8	nd	-.09	6.9	6.8	171	167	169	9.0	8.5	8.5
11-10-00	10.8	9.2	10.2	.08	-.06	6.9	6.6	172	161	169	9.5	9.0	9.5
11-11-00	10.0	9.4	9.6	.03	-.04	6.7	6.6	166	149	159	9.5	9.5	9.5
11-12-00	10.4	9.7	9.9	.10	-.05	6.7	6.6	149	139	142	10.0	9.5	9.5
11-13-00	10.4	9.8	10.1	.08	-.06	6.7	6.6	145	142	144	9.5	9.0	9.5
11-14-00	10.3	9.9	10.1	.07	-.05	6.6	6.6	145	142	144	9.0	9.0	9.0
11-15-00	10.7	9.9	10.2	.08	-.05	6.7	6.6	145	140	143	9.0	8.0	8.5
11-16-00	11.4	10.4	10.8	nd	nd	6.8	6.6	146	139	142	8.0	7.5	7.5
11-17-00	11.4	10.8	11.0	nd	-.09	6.9	6.8	147	136	142	8.0	7.5	7.5
11-18-00	11.6	10.9	11.1	.08	-.06	6.9	6.8	150	140	145	8.0	6.5	7.0
11-19-00	11.9	11.4	11.6	.03	-.04	6.8	6.8	150	143	146	6.5	6.0	6.0
11-20-00	12.2	11.8	12.0	nd	nd	6.9	6.8	149	142	146	6.0	5.0	5.5
11-21-00	12.4	12.0	12.2	nd	nd	6.8	6.8	151	144	148	5.0	4.5	4.5
11-22-00	12.6	12.3	12.5	nd	nd	6.8	6.8	151	148	150	4.5	3.5	4.0
11-23-00	13.2	12.5	13.0	nd	nd	6.8	6.8	154	148	152	3.5	2.0	2.5
11-24-00	13.7	13.2	13.6	nd	nd	6.8	6.8	156	149	154	2.0	1.0	1.5
11-25-00	14.3	13.7	14.1	nd	nd	6.8	6.8	156	155	155	1.0	.5	1.0
11-26-00	14.5	13.9	14.3	nd	nd	6.8	6.8	156	152	154	2.0	.5	1.0
11-27-00	13.9	12.9	13.3	nd	nd	6.8	6.7	153	138	147	3.5	2.0	3.0
11-28-00	13.2	12.6	12.8	nd	nd	6.8	6.7	143	134	137	4.5	3.5	4.0
11-29-00	12.9	12.4	12.6	nd	nd	6.8	6.7	144	138	141	4.5	4.0	4.5
11-30-00	12.9	12.4	12.6	nd	nd	6.8	6.8	149	139	144	4.5	4.0	4.0
12-01-00	13.3	12.7	12.9	nd	nd	6.8	6.7	149	140	145	4.0	3.0	3.5
12-02-00	13.8	13.2	13.4	nd	nd	6.8	6.7	150	139	145	3.0	2.0	2.5
12-03-00	14.5	13.8	14.0	nd	nd	6.8	6.7	154	142	149	2.0	1.0	1.0
12-04-00	14.7	14.4	14.5	nd	nd	6.7	6.7	156	150	152	1.0	.5	.5
12-05-00	14.8	14.5	14.6	nd	nd	6.7	6.7	158	155	156	.5	.0	.5
12-06-00	14.6	14.3	14.5	nd	nd	6.8	6.7	--	158	--	.5	.5	.5
05-03-01	10.2	--	--	.17	-.21	7.4	7.0	167	161	--	20.5	--	--
05-04-01	10.0	8.2	9.1	.25	-.30	7.4	7.0	169	156	164	21.5	19.5	20.5
05-05-01	9.8	7.7	8.6	.22	-.18	7.4	6.9	170	160	167	21.5	20.0	20.5
05-06-01	10.5	8.3	9.2	.17	-.22	7.4	7.1	166	161	164	20.0	18.0	18.5
05-07-01	11.0	8.8	9.8	.18	-.21	7.4	7.1	166	161	163	18.0	16.0	16.5
05-08-01	11.0	9.1	10.0	.15	-.22	7.4	7.1	168	161	164	17.0	15.5	16.5
05-09-01	10.9	9.0	9.9	.16	-.26	7.4	7.1	171	165	167	18.0	16.0	17.0
05-10-01	10.8	8.5	9.6	.11	-.25	7.4	7.0	172	164	168	19.0	17.5	18.0
05-11-01	10.6	8.4	9.3	.12	-.26	7.3	7.0	177	170	173	19.5	18.5	19.0
05-12-01	10.3	8.3	9.2	.12	-.22	7.3	7.1	184	167	175	21.0	19.5	20.0

Appendix 3. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01126720, Quinebaug River near Packer, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
05-13-01	9.9	7.9	8.8	.17	-.12	7.3	7.0	177	167	173	21.0	19.5	20.5
05-14-01	10.2	8.4	9.5	.12	-.27	7.4	7.2	192	173	178	19.5	17.5	18.5
05-15-01	10.3	7.9	9.4	.09	nd	7.4	7.2	196	182	188	17.5	16.0	17.0
05-16-01	10.3	9.2	9.8	nd	nd	7.3	6.9	184	173	180	16.0	14.5	15.5
05-17-01	10.9	8.5	9.9	.06	nd	7.3	7.1	194	172	182	15.0	14.0	14.5
05-18-01	11.0	9.5	10.2	nd	nd	7.3	7.0	190	182	187	15.0	14.5	15.0
05-19-01	11.0	9.7	10.3	.10	-.11	7.3	7.1	189	174	183	17.0	14.5	15.5
05-20-01	11.0	9.8	10.4	nd	-.23	7.3	7.2	194	177	183	18.0	17.0	17.5
05-21-01	10.8	9.5	10.0	nd	nd	7.4	7.1	201	177	190	18.5	17.5	18.0
05-22-01	10.1	7.9	9.1	nd	nd	7.2	6.8	193	175	179	18.0	17.0	17.5
05-23-01	8.6	7.8	8.1	.09	-.01	6.9	6.8	195	162	181	17.0	16.0	16.5
05-24-01	9.2	8.4	8.8	.06	-.02	6.9	6.8	183	143	155	16.0	15.0	15.5
05-25-01	9.6	9.1	9.3	.05	-.06	6.9	6.8	147	135	141	15.5	14.5	15.0
05-26-01	9.8	9.1	9.5	.11	-.12	7.0	6.8	159	140	149	17.0	15.0	16.0
05-27-01	9.3	8.7	9.0	.10	-.08	7.0	6.8	151	133	146	18.0	16.5	17.0
05-28-01	9.0	8.5	8.8	.06	-.05	6.8	6.7	149	132	142	18.0	17.0	17.5
05-29-01	9.3	8.3	8.9	.09	-.09	6.9	6.7	148	138	145	18.0	16.5	17.5
05-30-01	9.4	8.5	8.9	.09	-.09	6.9	6.7	152	141	145	18.0	16.5	17.5
05-31-01	10.0	8.6	9.3	.14	-.13	7.0	6.8	157	147	149	17.5	15.5	16.5
06-01-01	10.4	8.8	9.6	.16	-.21	7.1	6.8	161	148	153	18.0	15.5	17.0
06-02-01	9.9	8.6	9.0	.06	-.04	7.0	6.7	162	124	142	18.0	16.5	17.0
06-03-01	9.2	8.9	9.1	.02	-.05	6.7	6.7	131	106	115	17.5	16.0	17.0
06-04-01	9.2	8.8	9.0	.05	-.05	6.8	6.7	132	113	123	18.0	17.0	17.5
06-05-01	9.4	8.9	9.1	.07	.08	6.8	6.7	143	130	137	19.0	17.0	18.0
06-06-01	9.2	8.6	8.9	.08	-.08	6.8	6.7	155	142	147	20.0	18.0	19.0
06-07-01	9.1	8.4	8.8	.08	-.09	6.8	6.7	147	142	145	20.5	18.0	19.0
06-08-01	8.7	8.0	8.4	.07	nd	6.9	6.7	149	141	145	21.0	19.0	20.0
06-09-01	--	--	--	nd	nd	--	--	--	--	--	--	--	--
06-21-01	--	--	--	nd	nd	--	--	--	--	--	--	--	--
06-22-01	8.1	--	--	.04	-.05	6.7	--	128	--	--	22.5	--	--
06-23-01	8.0	7.6	7.8	.05	-.07	6.8	6.7	131	124	128	23.0	21.5	22.5
06-24-01	7.7	7.3	7.5	.05	-.04	6.8	6.7	131	128	129	23.0	22.5	22.5
06-25-01	8.0	7.4	7.7	.07	-.08	6.8	6.7	135	131	132	24.0	22.0	23.0
06-26-01	7.8	7.2	7.5	.09	-.07	6.8	6.7	142	131	136	25.0	22.5	24.0
06-27-01	--	6.9	--	nd	nd	--	--	--	--	--	--	23.5	--

Appendix 4

Appendix 4. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01127000, Quinebaug River at Jewett City, Conn.

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
06-02-00	--	--	--	nd	nd	--	--	--	--	--	26.5	--	--
06-03-00	--	--	--	nd	nd	7.1	6.7	114	107	111	22.5	20.5	21.5
06-04-00	--	--	--	nd	nd	6.9	6.6	111	107	109	21.5	20.5	21.0
06-05-00	--	--	--	nd	nd	7.0	6.6	111	106	109	21.5	20.5	21.0
06-06-00	---	--	--	nd	nd	6.7	6.6	115	108	111	20.5	18.0	19.0
06-07-00	--	--	--	nd	nd	6.8	6.7	114	96	108	18.0	16.0	16.5
06-08-00	--	--	--	nd	nd	6.7	6.7	100	93	97	16.5	15.5	16.0
06-09-00	--	--	--	nd	nd	6.8	6.7	101	98	99	18.0	16.5	17.0
06-10-00	--	--	--	nd	nd	6.7	6.7	101	99	100	20.0	18.0	19.0
06-11-00	--	--	--	nd	nd	6.7	6.6	100	95	98	22.0	20.0	21.0
06-12-00	---	--	--	nd	nd	6.7	6.6	98	94	97	21.5	19.0	20.5
06-13-00	--	--	--	nd	nd	6.7	6.6	96	94	95	19.0	18.0	18.5
06-14-00	--	--	--	nd	nd	6.7	6.6	98	94	95	18.0	18.0	18.0
06-15-00	--	--	--	nd	nd	6.6	6.6	103	97	100	18.0	17.5	17.5
06-16-00	9.2	8.9	9.1	nd	nd	6.6	6.3	105	101	103	19.5	17.5	18.0
06-17-00	9.3	8.7	9.0	nd	nd	6.7	6.5	106	102	104	22.0	19.5	20.5
06-18-00	9.0	8.2	8.6	nd	nd	6.7	6.6	108	104	107	22.5	21.5	22.0
06-19-00	8.7	8.2	8.4	nd	nd	6.7	6.6	110	106	108	21.5	21.0	21.5
06-20-00	9.0	8.2	8.5	nd	nd	6.8	6.6	112	108	110	22.5	20.5	21.5
06-21-00	9.0	8.1	8.6	nd	nd	6.8	6.6	114	110	112	22.0	21.0	21.5
06-22-00	8.7	8.1	8.4	nd	nd	6.8	6.7	116	113	115	22.5	21.5	22.0
06-23-00	9.3	7.9	8.5	nd	nd	7.1	6.7	118	114	116	24.5	22.0	23.0
06-24-00	9.0	7.7	8.2	nd	nd	7.0	6.6	123	117	120	24.0	22.5	23.0
06-25-00	8.8	6.8	8.1	nd	nd	7.0	6.4	131	113	124	24.5	23.0	23.5
06-26-00	9.1	6.8	8.0	nd	nd	6.9	6.5	135	117	127	26.0	24.0	24.5
06-27-00	8.7	6.6	8.1	nd	nd	7.3	6.7	130	121	125	25.5	24.0	25.0
06-28-00	8.9	6.4	8.0	nd	nd	7.3	6.8	126	108	122	27.5	24.5	25.0
06-29-00	8.1	7.3	7.7	nd	nd	7.0	6.8	135	124	129	25.0	24.5	24.5
06-30-00	9.1	7.4	8.3	nd	nd	7.5	6.6	135	107	127	25.0	23.5	24.0
07-01-00	10.1	6.6	8.4	nd	nd	8.5	6.5	130	113	122	25.5	22.5	24.0
07-02-00	9.6	5.2	8.4	nd	nd	8.1	6.7	131	114	123	26.0	22.5	23.5
07-03-00	9.5	5.3	8.2	nd	nd	7.9	6.7	129	113	123	26.0	22.5	24.0
07-04-00	9.2	6.3	7.7	nd	nd	8.0	6.7	133	116	125	26.5	23.5	24.5
07-05-00	10.3	5.5	8.1	nd	nd	8.5	6.8	138	119	129	27.0	24.0	25.5
07-06-00	9.1	6.4	7.9	nd	nd	7.6	6.7	137	123	132	28.0	24.0	25.5
07-07-00	9.9	6.5	8.1	nd	nd	8.4	6.7	140	128	134	26.5	23.0	24.5
07-08-00	9.3	6.3	7.6	nd	nd	7.6	6.7	141	132	137	25.5	22.0	23.5
07-09-00	9.0	6.0	7.4	nd	nd	7.2	6.6	149	133	144	25.0	22.5	23.5
07-10-00	8.9	6.2	7.5	nd	nd	7.2	6.6	148	139	143	25.5	22.5	23.5
07-11-00	9.5	5.8	7.4	nd	nd	8.1	6.6	150	139	144	25.5	22.0	23.5
07-12-00	9.2	5.6	7.1	nd	nd	7.9	6.7	153	141	147	26.0	22.0	24.0
07-13-00	8.8	5.4	6.9	nd	nd	7.5	6.7	153	144	148	26.5	22.5	24.0
07-14-00	--	--	--	nd	nd	--	6.7	--	145	--	30.0	21.5	24.0
07-15-00	--	--	--	nd	nd	--	--	155	--	--	24.5	21.5	23.0
07-16-00	--	--	--	nd	nd	--	--	--	70	--	25.0	19.5	23.0
07-17-00	--	--	--	nd	nd	--	--	153	--	--	28.0	21.5	24.5

Appendix 4. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01127000, Quinebaug River at Jewett City, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
07-18-00	--	--	--	nd	nd	--	--	--	65	--	26.0	23.0	24.5
07-19-00	--	--	--	nd	nd	--	--	--	--	--	24.5	22.0	23.5
07-20-00	--	--	--	nd	nd	--	--	--	--	--	25.0	21.5	23.0
07-21-00	9.9	--	--	nd	nd	6.9	--	151	138	145	--	21.0	--
07-22-00	11.3	7.1	9.5	nd	nd	7.1	6.4	156	143	149	25.5	22.5	23.5
07-23-00	14.1	8.5	10.8	nd	nd	8.4	6.5	160	147	154	25.0	22.0	23.5
07-24-00	14.4	8.9	12.3	nd	nd	8.9	6.8	164	151	157	26.0	23.0	24.0
07-25-00	14.6	10.4	12.6	nd	nd	8.9	7.1	164	156	161	24.0	22.5	23.0
07-26-00	14.1	9.9	11.5	nd	nd	8.5	7.0	165	142	154	23.5	22.0	22.5
07-27-00	12.4	9.6	10.9	nd	nd	7.3	6.6	153	117	137	22.5	21.5	22.0
07-28-00	11.1	9.7	10.4	nd	nd	6.7	6.6	155	121	142	22.0	21.0	21.5
07-29-00	11.4	10.0	10.9	nd	nd	6.7	6.6	159	153	156	21.0	20.5	20.5
07-30-00	12.8	11.3	12.0	nd	nd	7.1	6.7	160	140	154	22.0	21.0	21.5
07-31-00	11.8	11.2	11.5	nd	nd	6.9	6.7	142	124	132	21.5	21.5	21.5
08-01-00	11.3	10.8	11.1	nd	nd	6.7	6.6	130	120	124	21.5	21.0	21.0
08-02-00	11.4	10.2	10.7	nd	nd	6.7	6.5	127	102	117	22.0	21.0	21.5
08-03-00	10.6	9.8	10.2	nd	nd	6.7	6.5	121	93	116	23.0	21.5	22.0
08-04-00	10.4	8.6	9.6	nd	nd	6.9	6.3	119	92	114	24.0	22.5	23.0
08-05-00	9.2	7.4	8.3	nd	nd	7.0	6.5	129	95	114	25.0	22.5	23.5
08-06-00	--	--	--	nd	nd	6.8	6.5	129	104	117	24.5	23.0	23.5
08-07-00	--	--	--	nd	nd	6.8	6.3	133	101	118	24.5	23.0	23.5
08-08-00	--	--	--	nd	nd	6.9	6.5	131	105	117	26.5	23.5	24.5
08-09-00	--	--	--	nd	nd	6.9	6.6	137	113	125	26.0	24.0	24.5
08-10-00	--	--	--	nd	nd	7.8	6.5	134	90	114	27.0	24.0	25.5
08-11-00	--	--	--	nd	nd	7.1	6.6	134	106	121	27.5	25.0	26.0
08-12-00	--	--	--	nd	nd	7.2	6.6	138	113	123	25.5	23.5	24.5
08-13-00	--	--	--	nd	nd	6.9	6.6	140	114	126	24.0	22.5	23.5
08-14-00	--	--	--	nd	nd	6.8	6.7	139	116	129	23.0	22.0	22.5
08-15-00	--	--	--	nd	nd	6.9	6.6	136	116	124	23.0	21.5	22.0
08-16-00	9.4	8.1	--	nd	nd	7.0	6.5	136	95	114	24.0	21.5	22.5
08-17-00	9.6	7.6	8.8	nd	nd	7.3	6.9	138	113	127	22.5	20.5	21.5
08-18-00	11.4	7.5	8.3	nd	nd	7.2	6.9	143	119	133	21.5	20.5	21.0
08-19-00	--	--	--	nd	nd	7.4	6.9	145	128	137	22.5	20.0	21.5
08-20-00	--	--	--	nd	nd	7.4	6.8	142	127	136	24.0	20.5	21.5
08-21-00	--	--	--	nd	nd	7.8	6.8	141	125	136	23.5	19.0	21.0
08-22-00	--	--	--	nd	nd	7.5	6.8	144	131	138	22.5	19.5	21.0
08-23-00	--	--	--	nd	nd	7.3	6.6	146	134	140	21.5	19.0	20.0
08-24-00	--	--	--	nd	nd	7.3	6.6	145	132	140	24.5	20.0	21.5
08-25-00	--	--	--	nd	nd	8.0	6.7	152	135	144	25.5	20.5	22.5
08-26-00	--	--	--	nd	nd	7.8	6.6	153	138	146	24.5	21.0	22.0
08-27-00	--	--	--	nd	nd	7.8	6.6	157	140	149	24.0	20.5	21.5
08-28-00	--	--	--	nd	nd	7.3	6.5	153	143	147	24.5	22.0	23.0
08-29-00	--	--	--	nd	nd	8.3	6.6	158	145	149	26.0	22.0	23.0
08-30-00	10.3	--	--	nd	nd	8.0	6.5	161	145	155	24.0	21.5	22.5
08-31-00	11.0	4.1	8.1	nd	nd	7.6	6.8	166	147	158	24.5	22.5	23.0
09-01-00	11.2	5.8	8.2	nd	nd	7.4	6.7	169	153	160	25.5	22.5	23.0

Appendix 4. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01127000, Quinebaug River at Jewett City, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour ($g\ O_2/m^3/hr$) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
09-02-00	10.0	4.4	7.6	nd	nd	7.1	6.6	162	111	142	24.5	23.0	24.0
09-03-00	10.4	4.6	8.6	nd	nd	7.5	6.6	132	109	125	24.5	23.0	24.0
09-04-00	10.7	4.4	8.9	nd	nd	7.6	6.8	133	124	128	25.5	23.5	24.0
09-05-00	12.1	6.1	10.1	nd	nd	7.8	6.8	153	124	134	23.5	21.0	22.5
09-06-00	12.4	8.7	10.6	nd	nd	7.2	6.7	152	118	130	24.0	20.0	21.5
09-07-00	12.8	9.1	10.6	nd	nd	7.4	6.8	140	123	133	23.0	19.5	21.0
09-08-00	13.0	8.9	10.7	nd	nd	7.4	6.8	159	131	146	23.0	19.5	21.0
09-09-00	12.8	7.3	10.0	nd	nd	7.3	6.7	151	130	142	22.5	20.0	21.0
09-10-00	12.2	7.5	10.5	nd	nd	7.3	6.7	155	117	129	24.5	21.0	22.0
09-11-00	12.3	7.4	10.5	nd	nd	7.4	6.8	157	113	126	24.0	21.0	22.0
09-12-00	11.8	8.5	10.1	nd	nd	7.3	6.8	142	115	125	24.0	21.5	22.5
09-13-00	11.6	8.4	9.6	nd	nd	7.3	6.7	139	115	127	24.5	22.0	23.0
09-14-00	11.8	8.3	10.2	nd	nd	7.7	6.8	161	125	139	25.0	21.5	22.5
09-15-00	11.3	5.7	9.2	nd	nd	7.7	6.6	144	99	124	22.5	21.5	22.0
09-16-00	11.0	8.9	10.2	nd	nd	7.8	6.7	147	98	127	22.5	21.0	21.5
09-17-00	11.2	8.5	9.6	nd	nd	7.9	6.8	148	101	117	21.5	19.5	20.0
09-18-00	10.8	7.2	9.1	nd	nd	8.2	6.7	149	104	119	21.0	19.0	20.0
09-19-00	10.1	6.8	8.1	nd	nd	8.2	6.7	151	111	127	20.5	19.5	20.0
09-20-00	--	--	--	nd	nd	9.0	6.7	145	105	124	22.0	20.0	21.0
09-21-00	--	--	--	nd	nd	8.9	7.0	142	110	128	21.0	20.0	20.5
09-22-00	--	--	--	nd	nd	8.0	7.0	143	105	126	22.0	19.5	20.5
09-23-00	--	--	--	nd	nd	7.7	6.9	141	111	122	20.0	19.0	19.5
09-24-00	--	--	--	nd	nd	7.4	6.9	140	112	122	20.5	19.0	19.5
09-25-00	--	--	--	nd	nd	7.7	7.0	141	115	124	20.0	18.0	19.0
09-26-00	--	--	--	nd	nd	7.7	7.0	140	119	130	18.5	17.0	17.5
09-27-00	--	--	--	nd	nd	7.7	6.9	149	119	132	19.5	16.0	17.0
09-28-00	--	--	--	nd	nd	8.6	6.9	149	124	135	17.5	15.5	16.5
09-29-00	--	--	--	nd	nd	8.1	7.0	154	128	139	18.0	14.5	16.0
09-30-00	--	--	--	nd	nd	8.1	7.0	155	132	142	18.5	14.5	15.5
10-01-00	14.2	10.6	12.7	nd	nd	8.0	7.0	153	134	144	18.0	14.0	15.5
10-02-00	14.7	10.2	12.3	nd	nd	8.7	7.0	164	137	152	16.0	14.5	15.5
10-03-00	12.7	9.6	11.4	nd	nd	7.8	6.9	164	144	154	18.5	15.0	16.0
10-04-00	11.8	8.3	10.4	nd	nd	7.4	6.8	166	144	155	18.0	15.0	16.0
10-05-00	11.1	8.4	9.8	nd	nd	7.1	6.8	166	144	153	16.5	14.5	16.0
10-06-00	11.3	9.1	10.2	nd	nd	7.2	6.9	164	139	151	17.0	16.0	16.5
10-07-00	11.3	9.1	10.1	nd	nd	7.1	6.8	166	134	157	16.5	15.0	15.5
10-08-00	11.3	9.0	9.9	nd	nd	7.1	6.7	170	145	160	17.0	14.0	15.0
10-09-00	11.3	9.2	10.0	nd	nd	7.0	6.7	171	148	158	14.0	12.5	13.5
10-10-00	11.3	9.4	10.3	nd	nd	7.1	6.8	173	152	166	13.5	12.0	12.5
10-11-00	11.9	9.5	10.6	nd	nd	7.3	6.9	183	161	173	15.0	12.0	13.0
10-12-00	12.1	9.6	10.6	nd	nd	7.4	6.9	182	165	172	15.0	11.0	12.5
10-13-00	12.3	9.4	10.7	nd	nd	7.5	7.0	180	161	172	15.0	11.0	12.5
10-14-00	11.9	8.9	10.5	nd	nd	7.6	6.9	177	161	168	16.0	12.0	13.5
10-15-00	11.9	8.7	10.4	nd	nd	7.6	6.9	174	157	166	15.5	12.5	14.0
10-16-00	10.7	8.2	9.7	nd	nd	7.3	6.9	178	143	166	14.0	12.5	13.5
10-17-00	10.9	7.9	9.6	nd	nd	7.3	6.8	175	123	168	13.5	12.0	13.0

Appendix 4. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01127000, Quinebaug River at Jewett City, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
10-18-00	10.2	7.6	9.2	nd	nd	7.1	6.7	182	143	176	13.5	12.5	13.0
10-19-00	10.1	8.1	9.4	nd	nd	7.1	6.8	196	139	184	14.0	12.5	13.0
10-20-00	10.8	8.7	9.6	nd	nd	7.1	6.8	201	173	190	15.0	11.5	13.0
10-21-00	11.1	8.5	9.8	nd	nd	7.2	6.8	202	173	188	15.0	12.0	12.5
10-22-00	11.3	8.7	9.8	nd	nd	7.3	6.8	191	133	176	14.5	12.0	13.0
10-23-00	11.1	8.7	9.9	nd	nd	7.2	6.7	182	124	171	13.0	10.5	12.0
10-24-00	11.0	8.7	9.8	nd	nd	7.1	6.8	182	135	169	12.5	10.5	12.0
10-25-00	12.0	8.9	10.3	nd	nd	7.3	6.8	176	155	167	15.0	11.5	12.5
10-26-00	11.9	9.0	10.2	nd	nd	7.3	6.8	171	153	163	14.5	12.0	12.5
10-27-00	11.6	8.4	10.1	nd	nd	7.2	6.7	164	124	157	14.0	12.0	13.0
10-28-00	10.8	9.2	9.9	nd	nd	7.1	6.8	138	94	117	14.0	11.5	13.0
10-29-00	11.1	9.8	10.5	nd	nd	7.1	6.8	137	88	113	12.0	10.0	11.0
10-30-00	11.6	10.3	10.9	nd	nd	7.1	6.8	134	91	112	10.5	9.5	10.0
10-31-00	11.9	10.6	11.2	nd	nd	7.0	6.8	129	86	106	9.5	9.0	9.5
11-01-00	12.4	10.7	11.5	nd	nd	--	6.7	99	85	90	11.0	8.5	9.5
11-02-00	12.2	11.2	11.6	nd	nd	7.0	6.6	140	80	98	11.0	8.5	9.5
11-03-00	12.2	11.2	11.6	nd	nd	7.1	6.7	130	91	104	10.0	9.0	9.5
11-04-00	12.2	11.1	11.7	nd	nd	7.0	6.7	130	85	113	11.0	9.0	9.5
11-05-00	12.0	10.8	11.3	nd	nd	6.9	6.6	132	84	111	9.5	9.0	9.5
11-06-00	12.1	11.1	11.6	nd	nd	7.0	6.6	134	92	106	9.5	8.5	9.0
11-07-00	12.6	11.4	11.9	nd	nd	7.0	6.7	149	93	110	10.0	8.5	9.0
11-08-00	12.7	11.3	11.8	nd	nd	7.1	6.7	138	95	108	10.0	8.5	9.0
11-09-00	12.8	11.4	12.0	nd	nd	7.0	6.7	142	97	120	10.5	8.5	9.5
11-10-00	12.1	11.1	11.6	nd	nd	7.0	6.7	138	100	120	9.5	9.5	9.5
11-11-00	12.1	11.4	11.8	nd	nd	7.0	6.9	149	135	140	9.5	9.0	9.5
11-12-00	11.8	11.1	11.4	nd	nd	7.0	6.8	158	143	149	10.5	9.5	10.0
11-13-00	11.5	10.5	11.1	nd	nd	6.8	6.7	144	105	131	9.5	9.5	9.5
11-14-00	11.6	10.9	11.3	nd	nd	6.8	6.6	153	107	135	10.0	9.0	9.5
11-15-00	11.9	9.5	11.4	nd	nd	6.9	6.6	155	120	142	9.0	8.5	9.0
11-16-00	12.1	10.8	11.4	nd	nd	--	--	150	131	138	8.5	8.0	8.5
11-17-00	11.4	9.9	11.0	nd	nd	--	--	140	128	138	8.5	7.5	8.0
11-18-00	11.8	9.7	11.0	nd	nd	--	--	144	133	140	7.5	6.5	7.0
11-19-00	12.5	9.8	11.4	nd	nd	--	--	146	134	141	8.5	6.5	7.0
11-20-00	11.9	10.1	11.2	nd	nd	--	--	146	137	143	6.5	5.5	6.0
11-21-00	13.2	11.1	11.9	nd	nd	--	--	150	139	145	7.5	5.0	5.5
11-22-00	13.0	11.1	11.9	nd	nd	--	--	149	140	146	5.0	3.5	4.5
11-23-00	14.0	11.5	12.4	nd	nd	--	--	147	141	145	6.0	3.0	4.0
11-24-00	13.6	11.4	12.4	nd	nd	--	--	149	140	145	4.5	2.5	3.0
11-25-00	14.3	11.5	12.8	nd	nd	--	--	150	144	148	4.0	2.5	3.0
11-26-00	13.0	10.4	11.9	nd	nd	--	--	155	139	145	3.5	2.5	3.0
11-27-00	13.4	9.9	12.8	nd	nd	---	--	144	128	141	3.5	2.0	2.5
11-28-00	13.2	12.4	12.9	nd	nd	--	--	141	132	137	4.0	2.5	3.0
11-29-00	12.9	11.7	12.5	nd	nd	--	--	133	119	129	4.5	4.0	4.0
11-30-00	12.7	11.9	12.4	nd	nd	--	--	130	115	126	4.5	4.5	4.5
12-01-00	13.0	11.8	12.5	nd	nd	--	--	132	116	128	4.5	4.0	4.0
12-02-00	13.0	12.2	12.6	nd	nd	--	--	135	117	131	4.0	3.0	3.5

Appendix 4. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01127000, Quinebaug River at Jewett City, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour ($g\ O_2/m^3/hr$) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
12-03-00	14.0	12.5	13.0	nd	nd	--	--	134	115	130	4.0	2.5	2.5
12-04-00	13.6	12.3	13.1	nd	nd	--	--	136	115	129	4.0	2.0	2.5
12-05-00	13.8	12.4	13.2	nd	nd	--	--	140	120	132	3.0	2.0	2.5
12-06-00	14.3	12.6	13.5	nd	nd	--	--	144	117	132	2.5	1.5	2.0
12-07-00	14.0	12.8	13.4	nd	nd	--	--	143	120	132	3.0	1.5	2.0
12-08-00	14.0	12.9	13.6	nd	nd	--	--	--	121	137	2.5	1.5	2.0
04-25-01	--	--	--	nd	nd	--	--	--	--	--	17.0	--	--
04-26-01	8.5	7.5	8.0	nd	nd	7.2	7.1	130	138	129	16.5	15.0	15.5
04-27-01	9.8	6.9	8.0	nd	nd	7.2	7.1	133	127	131	16.0	14.0	15.0
04-28-01	9.4	7.2	8.1	nd	nd	7.3	7.1	134	131	132	16.0	14.5	15.0
04-29-01	8.6	6.7	7.8	nd	nd	7.3	7.2	135	132	134	16.0	14.5	15.0
04-30-01	9.1	7.5	8.1	nd	nd	7.3	7.1	135	131	134	16.0	14.0	15.0
05-01-01	9.2	7.6	8.3	nd	nd	7.2	7.1	137	131	134	16.5	15.0	16.0
05-02-01	8.5	7.0	7.6	nd	nd	7.3	7.1	142	137	139	19.0	16.5	17.5
05-03-01	8.0	6.4	7.1	nd	nd	7.3	7.2	--	--	--	20.0	18.0	18.5
05-04-01	9.8	6.2	7.6	nd	nd	7.2	6.7	--	--	--	22.0	19.0	20.0
05-05-01	--	--	--	nd	nd	--	--	--	--	--	22.5	19.0	21.0
05-19-01	--	8.8	--	nd	nd	--	--	--	--	--	--	17.0	--
05-20-01	11.4	8.6	9.8	nd	nd	7.5	6.6	174	147	163	19.5	16.0	17.0
05-21-01	11.2	8.4	9.8	nd	nd	7.4	6.7	173	148	164	19.0	15.5	17.5
05-22-01	10.6	7.7	9.3	nd	nd	7.2	6.7	168	133	156	18.0	17.5	18.0
05-23-01	10.0	8.1	9.3	nd	nd	7.0	6.7	163	121	148	17.5	17.0	17.5
05-24-01	9.4	8.8	9.1	nd	nd	6.8	6.8	149	139	145	17.0	16.0	16.5
05-25-01	10.0	9.4	9.8	nd	nd	6.9	6.8	139	120	127	16.5	15.5	16.0
05-26-01	10.2	9.9	10.0	nd	nd	6.9	6.8	120	112	118	17.0	16.0	16.5
05-27-01	10.4	9.0	10.1	nd	nd	6.9	6.8	120	110	115	18.0	16.5	17.5
05-28-01	10.0	9.7	9.9	nd	nd	6.9	6.8	123	109	114	18.5	18.0	18.0
05-29-01	10.0	9.7	9.8	nd	nd	6.8	6.8	115	107	111	18.5	17.5	18.0
05-30-01	10.5	9.8	10.1	nd	nd	7.0	6.8	120	111	117	19.0	18.0	18.5
05-31-01	10.8	9.8	10.3	nd	nd	7.0	6.8	125	118	181	18.0	17.0	17.5
06-01-01	10.8	7.7	10.3	nd	nd	7.0	6.6	131	106	125	19.0	17.0	17.5
06-02-01	10.9	10.0	10.6	nd	nd	7.0	6.9	131	112	123	18.0	17.5	18.0
06-03-01	10.5	10.1	10.3	nd	nd	6.9	6.8	127	102	113	18.0	17.5	17.5
06-04-01	10.3	10.1	10.2	nd	nd	6.8	6.7	106	99	103	19.0	18.0	18.5
06-05-01	10.5	10.2	10.3	nd	nd	6.8	6.7	115	105	111	19.0	18.0	18.5
06-06-01	10.7	9.4	10.2	nd	nd	6.9	6.7	127	114	119	20.0	18.5	19.5
06-07-01	10.5	8.9	10.1	nd	nd	6.9	6.8	127	120	124	21.5	19.0	20.0
06-08-01	10.7	6.0	9.9	nd	nd	7.1	6.6	128	111	123	22.0	19.5	20.5
06-09-01	--	--	--	nd	nd	7.0	6.7	--	--	--	--	--	--
06-10-01	--	--	--	nd	nd	7.1	6.7	--	--	--	--	--	--
06-11-01	--	--	--	nd	nd	6.9	6.7	--	--	--	--	--	--
06-12-01	--	--	--	nd	nd	7.0	6.7	--	--	--	--	--	--
06-13-01	--	--	--	nd	nd	6.9	6.8	--	--	--	--	--	--
06-14-01	--	--	--	nd	nd	7.0	6.8	--	--	--	--	--	--
06-15-01	--	--	--	nd	nd	7.0	6.7	--	--	--	--	--	--
06-16-01	--	--	--	nd	nd	7.0	6.7	--	--	--	--	--	--

Appendix 4. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01127000, Quinebaug River at Jewett City, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
06-17-01	--	--	--	nd	nd	6.9	6.7	--	--	--	--	--	--
06-18-01	--	--	--	nd	nd	6.8	6.6	--	--	--	--	--	--
06-19-01	--	--	--	nd	nd	6.7	6.6	--	--	--	--	--	--
06-20-01	--	--	--	nd	nd	6.8	6.6	--	--	--	--	--	--
06-21-01	--	--	--	nd	nd	6.7	6.7	--	--	--	--	--	--
07-06-01	9.2	--	--	nd	nd	--	6.8	--	--	--	25.0	--	--
07-07-01	8.6	5.8	7.5	nd	nd	7.2	6.9	139	114	129	24.0	22.0	23.0
07-08-01	8.3	5.0	6.8	nd	nd	7.1	6.9	142	116	134	23.0	22.0	22.5
07-09-01	8.9	4.7	7.0	nd	nd	7.3	6.8	143	118	136	24.0	22.0	23.0
07-10-01	9.0	5.1	7.3	nd	nd	7.3	6.8	143	114	135	24.0	22.0	23.0
07-11-01	9.7	5.3	7.6	nd	nd	8.0	6.9	143	122	139	25.0	23.0	24.0
07-12-01	8.7	4.4	7.7	nd	nd	7.3	6.9	145	114	139	24.5	22.5	23.5
07-13-01	8.7	5.0	7.6	nd	nd	7.3	6.9	146	113	137	24.5	22.0	23.0
07-14-01	9.2	5.4	7.4	nd	nd	7.5	6.8	145	117	134	24.5	21.5	23.0
07-15-01	9.7	5.2	7.6	nd	nd	7.9	6.8	148	122	136	25.5	21.5	23.0
07-16-01	9.6	5.1	6.9	nd	nd	7.6	6.8	149	124	139	25.5	22.0	23.5
07-17-01	8.9	4.7	6.6	nd	nd	7.4	6.7	151	127	142	23.5	22.5	23.0
07-18-01	10.0	4.8	7.9	nd	nd	7.8	6.8	152	120	139	26.0	22.5	23.5
07-19-01	9.9	5.5	8.2	nd	nd	7.6	6.8	154	129	141	25.5	22.5	23.5
07-20-01	11.2	5.3	7.7	nd	nd	8.4	6.8	154	132	145	25.5	21.5	23.5
07-21-01	10.2	6.5	8.6	nd	nd	8.4	6.9	160	138	148	27.0	22.0	23.5
07-22-01	11.4	5.3	8.2	nd	nd	8.9	6.8	160	141	150	26.0	21.5	23.5
07-23-01	10.8	6.4	8.7	nd	nd	9.0	6.9	160	142	151	27.5	22.5	24.5
07-24-01	10.5	6.9	9.0	nd	nd	9.1	7.1	163	147	155	28.0	23.5	25.5
07-25-01	10.2	6.8	8.5	nd	nd	9.4	7.2	167	149	157	29.0	24.5	26.5
07-26-01	10.0	6.1	7.7	nd	nd	9.5	7.2	165	129	146	26.0	24.5	25.5
07-27-01	9.8	6.8	7.8	nd	nd	9.3	7.1	163	126	137	27.0	23.0	25.0
07-28-01	8.9	6.5	7.5	nd	nd	8.7	6.9	165	129	142	26.5	23.0	24.0
07-29-01	8.9	6.2	7.3	nd	nd	7.5	6.9	170	135	144	26.0	22.5	23.5
07-30-01	9.0	5.8	7.3	nd	nd	7.6	6.8	170	141	150	27.0	22.0	24.0
07-31-01	9.2	5.5	7.1	nd	nd	8.3	6.9	175	147	156	26.0	22.0	24.0
08-01-01	8.6	5.8	7.0	nd	nd	7.8	6.8	183	155	163	28.0	22.0	24.0
08-02-01	--	5.6	--	nd	nd	--	6.9	--	158	--	--	23.0	--
08-15-01	8.9	--	--	nd	nd	7.1	6.8	141	109	127	24.5	23.0	--
08-16-01	9.1	4.5	7.2	nd	nd	7.1	6.7	138	110	128	25.5	23.0	23.5
08-17-01	8.8	4.1	7.3	nd	nd	7.1	6.7	132	112	123	25.5	23.0	24.0
08-18-01	9.2	3.5	6.7	nd	nd	7.3	6.6	134	118	126	26.0	23.5	24.5
08-19-01	8.8	5.0	7.2	nd	nd	7.1	6.7	143	124	132	26.5	23.5	24.5
08-20-01	9.1	4.1	6.6	nd	nd	7.4	6.7	144	96	132	25.5	24.0	24.5
08-21-01	9.0	5.1	7.1	nd	nd	7.4	6.8	136	96	115	26.0	24.5	25.0
08-22-01	8.8	5.5	7.2	nd	nd	7.4	6.8	142	98	119	26.5	24.5	25.0
08-23-01	8.3	5.3	7.0	nd	nd	7.2	6.8	147	105	122	26.5	24.5	25.0
08-24-01	9.6	4.3	6.6	nd	nd	8.2	6.7	148	106	124	26.5	24.5	25.0
08-25-01	8.6	5.0	6.6	nd	nd	7.3	6.6	152	117	128	27.0	23.5	25.0
08-26-01	8.0	4.5	6.5	nd	nd	7.1	6.6	157	123	135	26.5	23.0	24.5
08-27-01	8.1	3.0	5.9	nd	nd	7.1	6.6	165	130	144	25.5	23.0	24.0

Appendix 4. Continuous water-quality monitor data and estimated maximum rates of instream metabolic processes at station 01127000, Quinebaug River at Jewett City, Conn.—Continued

[mg/L, milligrams per liter; P_{max} (maximum rate of productivity) and R_{max} (maximum rate of respiration) in grams of oxygen per cubic meter per hour (g O_2/m^3/hr) estimated from diel changes in dissolved oxygen concentrations; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, data not available due to partial record; nd, not determined due to equipment malfunction or changes in dissolved oxygen concentration that result from rapid changes in streamflow]

Date	Dissolved oxygen (mg/L)			Productivity/ respiration		pH (standard units)		Specific conductance (µS/cm)			Water temperature (degrees Celsius)		
	Max	Min	Mean	Pmax	Rmax	Max	Min	Max	Min	Mean	Max	Min	Mean
08-28-01	8.2	2.8	5.8	nd	nd	7.3	6.7	155	136	145	27.0	24.0	25.0
08-29-01	8.0	5.5	6.8	nd	nd	7.4	6.9	159	149	153	27.0	23.5	25.0
08-30-01	8.3	5.1	6.8	nd	nd	7.5	6.9	168	154	159	26.5	23.5	24.5
08-31-01	8.2	4.3	6.3	nd	nd	7.2	6.8	177	163	166	26.0	23.5	24.5
09-01-01	8.2	2.5	5.5	0.60	-0.54	7.2	6.7	175	161	167	26.5	23.5	24.5
09-02-01	8.6	3.6	6.4	1.34	-.44	7.6	6.7	173	160	167	26.0	22.0	23.5
09-03-01	8.2	4.7	6.3	.87	.36	7.2	6.7	169	163	166	25.5	21.5	23.0
09-04-01	8.5	3.6	6.4	.53	-.59	7.4	6.7	174	162	168	24.5	21.0	22.5
09-05-01	9.6	4.1	6.8	.43	-.38	7.7	6.7	177	164	169	25.0	21.0	22.5
09-06-01	10.0	5.9	7.7	nd	-.49	7.9	7.0	180	157	171	25.5	20.5	22.0
09-07-01	9.6	5.9	7.8	.70	-.54	7.6	7.0	186	174	178	24.5	20.5	22.0
09-08-01	9.7	5.6	7.4	.50	-.51	7.7	6.9	188	180	183	24.5	20.5	22.0
09-09-01	9.5	5.2	7.3	.68	nd	7.6	6.9	197	180	187	25.0	21.0	22.5
09-10-01	9.5	5.4	7.2	.53	-.37	7.6	6.9	193	183	188	25.0	21.5	23.0
09-11-01	10.6	5.6	7.8	1.13	-.37	9.2	6.9	192	178	183	26.0	22.0	23.5
09-12-01	10.8	5.5	8.1	.43	-.79	9.4	7.4	193	184	187	26.0	21.5	23.0
09-13-01	10.1	5.4	7.8	.71	-.42	9.1	7.5	195	187	190	25.5	21.0	23.0
09-14-01	9.0	4.0	7.5	.84	-.42	8.6	7.3	194	183	187	22.0	20.0	21.0
09-15-01	10.6	6.1	8.3	nd	-.54	8.8	7.1	195	185	189	23.0	19.0	20.5
09-16-01	10.4	6.3	8.2	.77	-.53	8.4	7.2	202	191	194	23.5	19.0	20.5
09-17-01	10.9	5.5	8.1	1.53	-.40	8.3	7.1	197	194	195	23.0	18.5	20.0
09-18-01	11.3	6.0	8.6	.84	-.52	8.3	7.1	198	193	195	23.5	18.5	20.5
09-19-01	11.0	5.7	8.1	.53	-.61	8.9	7.0	206	195	198	23.5	19.0	20.5
09-20-01	9.8	3.9	7.3	1.72	-.37	7.7	6.9	211	196	202	21.0	19.0	20.0
09-21-01	8.8	5.9	7.3	nd	nd	7.3	6.9	209	168	186	21.0	19.5	20.0
09-22-01	9.7	6.8	8.1	nd	nd	7.9	7.1	175	167	171	22.0	20.0	20.5
09-23-01	9.8	7.2	8.3	nd	nd	8.8	7.3	171	160	168	23.5	20.5	21.5
09-24-01	10.1	4.7	7.8	nd	nd	8.6	7.0	203	162	175	22.0	21.0	21.0
09-25-01	9.1	4.6	6.6	nd	nd	7.4	6.9	183	162	171	--	--	--

Appendix 5

Appendix 5. Seston algal abundance by taxa in water samples collected from the Quinebaug River Basin, Connecticut, water years 2000 and 2001.

[Algal identification and enumeration of all samples was performed by Connecticut Department of Environmental Protection using Sedgwick-Rafter cell count as per American Public Health Association, 1992; numbers may not add to totals because of independent rounding. Bacillariophyceae, centric, pennate, and other diatoms; Chlorophyceae, flagellated, filamentous and non-filamentous green algae; Chrysophyceae, gold, brown, and gold-brown pigmented algae; Cyanophyceae, filamentous and non-filamentous blue-green algae (currently considered to be bacteria due to lack of a distinct cellular nucleus); Dinophyceae, dinoflagellates]

Station name	Date	Taxon and density (algal cells per milliliter), rounded					
		Bacillariophyceae	Chlorophyceae	Chrysophyceae	Cyanophyceae	Dinophyceae	Total algal count
Quinebaug River at Quinebaug, Conn.	05/22/2000	140	0	0	0	0	140
	07/24/2000	70	0	0	0	0	70
	09/26/2000	0	0	0	0	0	0
	06/11/2001	70	0	0	210	0	280
	08/6/2001	70	0	0	0	0	70
	09/10/2001	140	0	0	0	0	140
Quinebaug River at West Thompson, Conn.	05/22/2000	910	0	0	0	0	910
	07/24/2000	70	2,200	0	2,000	140	4,400
	09/26/2000	2,900	0	0	1,100	0	4,000
	06/11/2001	280	0	0	1,300	0	1,600
	08/06/2001	1,200	3,900	0	13,000	0	18,000
	09/10/2001	770	1,800	0	19,000	70	22,000
French River near North Grosvenordale, Conn.	05/22/2000	490	0	0	70	0	560
	07/24/2000	210	1,900	0	0	0	2,100
	09/26/2000	7,700	840	0	420	0	9,000
	06/11/2001	0	0	0	630	0	630
	08/06/2001	350	210	0	420	70	1,100
	09/10/2001	280	1,200	0	8,000	0	9,500
Little River at Putnam, Conn.	05/23/2000	630	0	0	0	0	630
	07/25/2000	420	0	0	61,000	70	62,000
	09/26/2000	0	1,200	350	0	0	1,500
	06/12/2001	1,300	140	0	1,100	0	2,500
	080/6/2001	840	0	0	0	0	840
	09/11/2001	140	210	0	210	0	560
Quinebaug River at Putnam, Conn.	05/23/2000	630	560	0	0	0	1,200
	07/25/2000	140	1,300	0	2,500	0	4,000
	09/27/2000	2,500	1,300	0	0	0	3,800
	06/12/2001	210	420	0	910	0	1,500
	08/07/2001	350	70	0	1,500	0	1,900
	09/11/2001	280	2,500	0	15,000	70	18,000

Appendix 5. Seston algal abundance by taxa in water samples collected from the Quinebaug River Basin, Connecticut, water years 2000 and 2001.—Continued

[Algal identification and enumeration of all samples was performed by Connecticut Department of Environmental Protection using Sedgwick-Rafter cell count as per American Public Health Association, 1992; numbers may not add to totals because of independent rounding. Bacillariophyceae, centric, pennate, and other diatoms; Chlorophyceae, flagellated, filamentous and non-filamentous green algae; Chrysophyceae, gold, brown, and gold-brown pigmented algae; Cyanophyceae, filamentous and non-filamentous blue-green algae (currently considered to be bacteria due to lack of a distinct cellular nucleus); Dinophyceae, dinoflagellates]

Station name	Date	Taxon and density (algal cells per milliliter), rounded					
		Bacillariophyceae	Chlorophyceae	Chrysophyceae	Cyanophyceae	Dinophyceae	Total algal count
Quinebaug River at Cotton Bridge Rd. near Pomfret Landing, Conn.	05/23/2000	0	0	0	0	0	0
	07/26/2000	280	3,200	0	8,400	0	12,000
	08/23/2000	560	0	0	0	0	560
	09/27/2000	700	420	0	70	0	1,200
	06/12/2001	700	70	0	840	0	1,600
	08/07/2001	140	70	0	2,000	0	2,200
	09/12/2001	210	1,200	0	24,000	0	25,000
Five Mile River at Danielson, Conn.	05/24/2000	70	0	0	0	0	70
	07/26/2000	0	560	0	0	0	560
	08/23/2000	0	0	0	0	0	0
	09/28/2000	0	0	0	0	0	0
	08/08/2001	0	0	0	70	0	70
	09/12/2001	0	0	0	0	0	0
Quinebaug River at Danielson, Conn.	05/24/2000	630	280	0	0	0	910
	07/26/2000	560	1,300	0	0	0	1,900
	08/23/2000	70	70	0	0	0	140
	09/28/2000	0	70	0	47,000	0	47,000
	06/13/2001	420	0	70	1,100	0	1,600
	08/08/2001	350	70	0	2,500	0	2,900
	09/12/2001	1,100	5,200	0	71,000	0	77,000
Moosup River at Plainfield, Conn.	05/24/2000	490	0	0	0	0	490
	07/26/2000	0	0	0	0	0	0
	08/24/2000	140	0	0	0	0	140
	09/28/2000	70	0	0	0	0	70
	08/09/2001	140	0	0	0	0	140
	09/13/2001	0	0	0	0	0	0

Appendix 5. Seston algal abundance by taxa in water samples collected from the Quinebaug River Basin, Connecticut, water years 2000 and 2001.—Continued

[Algal identification and enumeration of all samples was performed by Connecticut Department of Environmental Protection using Sedgwick-Rafter cell count as per American Public Health Association, 1992; numbers may not add to totals because of independent rounding. Bacillariophyceae, centric, pennate, and other diatoms; Chlorophyceae, flagellated, filamentous and non-filamentous green algae; Chrysophyceae, gold, brown, and gold-brown pigmented algae; Cyanophyceae, filamentous and non-filamentous blue-green algae (currently considered to be bacteria due to lack of a distinct cellular nucleus); Dinophyceae, dinoflagellates]

Station name	Date	Taxon and density (algal cells per milliliter), rounded					
		Bacillariophyceae	Chlorophyceae	Chrysophyceae	Cyanophyceae	Dinophyceae	Total algal count
Quinebaug River at Butts Bridge Rd. near Clayville, Conn.	05/25/2000	420	0	70	0	0	490
	07/27/2000	0	910	0	0	0	910
	08/24/2000	140	70	0	0	0	210
	09/29/2000	700	280	0	0	0	980
	06/14/2001	770	0	0	770	0	1,500
	08/09/2001	0	6,200	0	8,900	0	15,000
	09/13/2001	70	490	0	85,000	0	85,000
Pachaug River at Jewett City, Conn.	05/25/2000	0	280	0	0	0	280
	07/27/2000	1,500	0	0	2,500	0	4,000
	08/25/2000	70	0	0	0	140	210
	09/29/2000	0	0	70	70	0	140
	06/14/2001	560	420	140	840	0	2,000
	08/09/2001	910	140	0	8,800	0	9,800
	09/13/2001	70	0	0	2,200	0	2,300
Quinebaug River at Jewett City, Conn.	05/25/2000	700	280	0	0	0	980
	07/27/2000	1,600	2,700	0	560	0	4,900
	08/25/2000	1,800	0	0	0	0	1,800
	09/28/2000	1,100	420	0	280	0	1,800
	06/15/2001	1,200	280	0	1,900	0	3,400
	08/10/2001	2,100	140	0	19,000	0	21,000
	09/14/2001	1,900	420	0	56,000	0	59,000