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Fox River Streamflow Assessment Model: 1999 Update to the Hydrologic Analysis

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H. Vernon Knapp and Michael W. Myers

Prepared for the
Illinois Department of Natural Resources
Office of Water Resources

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Illinois State water Survey
Watershed Science Section
Champaign, Illinois

A Division of the Illinois Department of Natural Resources

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Contents

Introduction

The proper management of surface water resources in a watershed requires an understanding of both the expected streamflow characteristics within a river basin and the effects of various potential water-use practices on those flow characteristics. In many circumstances, potential conflicts exist between the uses of streams for domestic, industrial, and agricultural water supplies and the natural functions of the streams, which include providing habitat for aquatic and terrestrial biota. Sufficient information to evaluate these potential conflicts and other water resource questions is seldom available in a useful form.

The Illinois Streamflow Assessment Model (ILSAM) was developed to provide needed streamflow information to watershed managers and planners. This specialized software program was developed for use on a personal computer to provide estimates of the long-term expected magnitude of streamflow at various frequencies for any stream location along a major stream in a watershed. The effects of potential or hypothetical water resource projects on the quantity of water in streams also can be examined using options available in the model. For the purposes of this model, major streams are considered to be those having upstream contributing drainage areas that exceed 10 square miles in size.

To date, the sets of hydrologic data used by the model have been developed for four major watersheds in Illinois: the Sangamon, Fox, Kaskaskia, and Kankakee River Basins. Hydrologic data sets also are currently being developed for the Little Wabash and Rock River Basins.

The purpose of this study was to update ILSAM for the Fox River Basin, a model originally developed in 1988. Over time, climate variability and changes in human factors, such as land and water use, and water resource projects, can greatly affect the quantity and distribution (both in space and time) of surface waters in a river basin. For this reason, the data sets used by ILSAM were designed to be updated periodically, perhaps every 5 to 15 years. The frequency of and need for updates are governed by the rate at which streamflow conditions in the watershed change over time. The model update for the Fox River Basin addresses four areas that influence the flow frequencies and their estimation:

- Increases in population, overall water use, and the resulting effluent discharges.
- A new public water supply withdrawal from the Fox River and increases in magnitude of existing withdrawals.
- General increases in streamflow magnitude caused by climatic variability and the overall increase in average precipitation.
- Adoption of improved regional equations from which to estimate flow at ungaged sites.

Background Information

There are more than 900 miles of rivers and major streams in the Fox River Basin. Because it is not feasible to monitor the flows in all the streams in a basin, gaging stations have been established at selected locations to measure the amount and distribution of water passing the station. The data collected at these gaging stations often may be used to estimate flow at other parts of the watershed by applying hydrologic principles. The hydrologic principles often are represented in the form of regional regression equations. These equations are developed using a statistical analysis of streamgage records within a geographic region with watershed characteristics that are similar to the site of interest. However, numerous factors must be considered in such an analysis, including human alterations to streamflows and the period of record for which streamflow records are available at the various gages being evaluated.

For purposes of analysis, the flow in a stream can be separated into two components: the unaltered or "virgin" flow conditions influenced primarily by weather and climate phenomena as well as the topography, hydrogeology and prevailing land use, and well-defined, quantifiable modifications to the flow conditions by human activity. The estimated virgin flow does not identify the pristine condition of the stream. There has been no attempt to represent the natural flow conditions such as what existed prior to European settlement and the development of the current drainage systems in the mid- and late-1800s. These drainage modifications and other extensive modifications to the natural landscape precede the establishment of streamflow gages in the state, for which measurements were begun in the early 1900s.

The human modifications to the flow conditions that are examined in the analysis include direct additions to or subtractions from the flow in the stream, such as from effluent discharges or water supply withdrawals, and changes in the temporal response of flow from the watershed, such as might be caused by a reservoir and other changes in the water stored within the watershed. Several different methodologies have been established in previous studies (Knapp et al., 1985; Knapp, 1988, 1990, 1992) to quantify the magnitude of the impact of these flow modifications on present and future flow conditions, as well as to evaluate the historical flow record to identify the expected character of the virgin flow condition.

As mentioned previously, there has been no attempt to identify the human modification to flow caused by major land-use changes. The Fox River watershed is experiencing urban development, but as yet there is no analyses from which to produce a consistent, deterministic estimate of the urban impact on the full range of flow conditions, particularly for smaller urban streams. Though the effects of urbanization on medium flows and the total volume of streamflow are often difficult to detect, there can be noticeable increases to low flows and flooding. But for larger streams such as the Fox River, the urban impact on flooding may not be as apparent because urbanization tends to produce progressively less impact on flood peaks as the size of the watershed increases (IDNR, 1999).

The climatic window during which streamflow records are available also influences the predicted long-term characteristics of streamflow. Streamflow varies considerably over time, not only displaying day-to-day fluctuations as influenced by weather phenomena, but also by climatic variations that may cause streamflows to remain above or below the long-term expected condition for several decades. Thus, to maintain consistency in the estimate of their long-term streamflow conditions, it is useful to compare and evaluate flows measured at different locations during a common period of record. The ability to detect the impact of human modifications to the streamflow using gaging records also may be limited to some degree because there have been coincident trends in precipitation and other climate factors. In many cases, climate variability can mask all or part of the impacts of less obtrusive human modifications to river flows, especially if the magnitude of the modification is comparatively small.

Complete description of the methods used to determine the streamflow characteristics for ILSAM have been presented in several earlier reports (Knapp, 1988, 1990, 1992). Knapp (1988) describes the Fox River Basin and the factors that influence its streamflow conditions. This current report focuses on changes in the data and model structure used to update the Fox River Basin model, as compared to the 1988 study. These model and data changes are categorized as follows:

- Changes in the database of flow modifications, which characterize the impacts of effluent discharges and surface water withdrawals in the basin.
- Changes in the expected long-term frequency of flow for virgin conditions at gaging stations, as influenced by climate variability. For this study, differences in climate conditions have been assumed to be part of natural climatic variability.
- Improvements in the estimated streamflow conditions at gaging station sites where previous data had been lacking.

Streamflow Information Produced by ILSAM

The ILSAM produces information on 154 selected streamflow parameters, including flow duration relationships (flow versus probability of exceedence) and low flows for various durations and expected recurrence intervals. All flows are given in units of cubic feet per second (cfs). The 154 flow parameters will be described in detail. For gaging locations, these flow parameters are computed using daily flow records, which are average flow rates estimated for each day within the gage's period of record.

Average Flow Values

Parameters: Average annual flow (Q_{mean}) and average monthly flows

Annual Flow-Duration Values

Description: The 2 percent flow (Q_2), for example, is the daily streamflow rate that is exceeded on 2 percent of the days. The 1 percent flow (Q_1) is necessarily a higher flow rate because it is exceeded less frequently.

Parameters: Q_1, Q_2, Q_5, Q_{10}, Q_{15}, Q_{25}, Q_{40}, Q_{50}, Q_{60}, Q_{75}, Q_{85}, Q_{90}, Q_{95}, Q_{98}, and Q_{99}

Monthly Flow-Duration Values

Description: Monthly flow duration values are defined in the same manner as the annual flow-duration values, except they are determined using only those daily discharges that fall within a certain month of the year.

Parameters for each calendar month: Q_2, Q_{10}, Q_{25}, Q_{50}, Q_{75}, Q_{90}, and Q_{98}.

Low Flows

Description: Each low-flow parameter is defined by a duration in consecutive days and a recurrence interval in years. A 7-day low flow for a given year is the lowest average flow that occurred within a 7-consecutive-day period during that year. The 7-day, 10-year low flow is the 7-day low flow that is on average exceeded 9 years out of 10. Thus, the 7-day low flow is expected to be equal to or smaller than the $Q_{7,10}$ an average of once every 10 years. A 2-year low flow is the value expected to occur during an "average" year.

Low Flow Durations: 1, 7, 15, 31, 61, and 91 days

Recurrence Intervals: 2, 10, 25, and 50 years

Drought Flows

Description: Drought flows are similar to low flows, except that the duration of the period is longer and is defined in months instead of days, and the average low flows are developed from monthly records. Drought durations are usually not defined on an annual basis, because a drought period typically encompasses multiple years.

Drought Flow Durations: 6, 9, 12, 18, 30, and 54 months

Recurrence Intervals: 10, 25, and 50 years

Database Used by ILSAM

The ILSAM uses four basic sets of data for computing streamflow characteristics in a watershed.

- Estimates of the 154 flow parameters at gaging stations within the watershed, as well as at other stream locations that have well-defined flow characteristics, such as downstream of reservoirs. Basic streamflow frequency data are listed in appendix A.
- A data set of all flow modifiers in the watershed (withdrawals, diversions, and effluent discharges), including the estimated impact of that modification on each of the 154 flow parameters produced by the model. Basic flow data for these modifications are listed in appendix B.

- A table of watershed characteristics for 609 locations in the basin, including stream mileage, drainage area, soils information, and the location of gaging stations, water-use projects, reservoirs, and other points of interest in the basin. Stream network data are listed in appendix C.
- The set of regional regression equations used to estimate the virgin flow conditions for each of the 154 flow conditions for ungaged sites in the watershed. These equations are presented in appendix D.

In addition to these four basic sets of data, three supplemental data sets provide stream codes that help to identify each stream in the watershed, an index of the stream network in the watershed (which helps the model identify all downstream locations impacted by a flow modification), and basic data on the size of each major reservoir in the watershed. All data sets have been imported into a Microsoft Access database, which will be accessed by a Windows version of ILSAM currently under development.

Changes in Human Modifications to Streamflows

Effluent Discharges to Streams

Monthly discharge data were obtained from the Illinois Environmental Protection Agency (IEPA) for all sanitary effluents in the Fox River Basin having an average discharge greater than 100,000 gallons per day. The frequency of daily discharges for these effluents was estimated using methods described by Knapp (1988, 1990, and 1992). Estimates of low flow discharges were compared to the analytical results of Singh and Ramamurthy (1993) to maintain consistency with that report.

Table 1 lists 50 of the largest sources of effluent discharge in the Fox River Basin. Discharge frequency data for these 50 discharges are used by the Fox River ILSAM. The full set of frequency data computed for these discharges and used by the model is listed in appendix B. Sixteen of these discharge locations, identified in table 1 by italics, have been added since the 1988 version of the Fox River model. Many of these additional discharges are smaller municipal facilities or industrial discharges that were not included in the 1988 model, although there are several new discharges. The two largest discharges in the watershed, the Fox Metro Water Reclamation District (WRD) and the Fox River WRD are the same discharges previously identified in the 1988 model as the Aurora and Elgin municipal discharges, respectively. Five discharge facilities in the basin have been discontinued over the last 10 years as a result of either closure of an industry or the transfer of wastewaters to a larger nearby facility. In addition to these 50 facilities, the Fox River Basin contains a number of smaller effluent discharges that are not considered in the model.

Table 2 lists the amount of wastewater discharged by the largest wastewater treatment facilities in the basin, as estimated for use in the 1988 and 1999 versions of the Fox River ILSAM, and represents 1985 and 1997 flow conditions, respectively. Also shown is an estimate of the total amount of wastewater discharged from the 50 largest facilities in the basin, as identified in table 1. The total amount of the wastewater discharged has increased approximately 16 percent in the past 12 years, with a 10 percent increase in low flow discharge. Facilities that have experienced the largest growth rate in wastewater effluent are the McHenry, Batavia, and Crystal Lake treatment plants. The Fox Metro WRD has experienced the greatest overall growth.

Surface Water Withdrawals

There are three major surface water withdrawals in the watershed, all of which withdraw from the Fox River: Aurora, Elgin, and Fermi National Accelerator Laboratory (FermiLab). The Aurora and Elgin withdrawals are for public water supply use; the FermiLab withdrawal is primarily used for a cooling water supply. Aurora and Elgin, the two largest water supplies in the watershed, began withdrawing from the Fox River for their public water supply in 1993 and 1983, respectively. The Fox River provides for more than 90 percent of the water supply for Elgin, and roughly 63 percent for Aurora.

Table 1. Major Effluent Discharges in the Fox River Basin and Average Annual Discharge as Estimated for 1997 Conditions

Facility name	*Annual discharge (cfs)*	*Facility name*	*Annual discharge (cfs)*
Algonquin STP	2.80	*Hinckley STP*	0.36
Antioch WWTP	1.50	*Intermatic, Inc.*	0.93
Barrington WWTP	4.20	Island Lake SD WWTP	1.50
Batavia WWTP	4.70	*Lake Barrington Assoc.*	0.67
Baxter Heathcare	0.52	Lake in the Hills SD STP	3.00
Carpentersville-Kimball Hill	0.17	McHenry Central STP	3.50
Carpentersville STP	4.00	*McHenry South STP*	0.72
Cary WWTP	2.20	*Modine Mfg.-McHenry*	0.36
Citizens Util-Valley Water Co.	0.45	*Mooseheart*	0.16
Crystal Lake STP #2	5.40	Morton International	2.40
Crystal Lake STP #3	0.68	Paw Paw STP	0.16
Dial Corporation	0.50	Plano STP	0.98
Earlville STP	0.42	*Quaker Oats-Barrington*	0.58
East Dundee WWTP	0.83	Richmond STP	0.35
Elburn STP	0.72	Sandwich STP	1.00
Ferson Creek Utilities, Inc.	0.17	*Shabbona STP*	0.16
Fox Lake STP	10.30	*Sheridan STP*	0.38
Fox Lake Tall Oaks STP	0.13	Somonauk STP	0.29
Fox Metro WRD(1)	44.40	St. Charles STP	7.50
Fox River Grove WWTP	1.10	*Sugar Grove STP*	0.78
Fox River WRD North STP(2)	7.40	*TC Industries*	0.18
Fox River WRD South STP(2)	21.30	Waterman STP	0.23
Fox River WRD West STP(2)	1.30	Wauconda WWTP	1.50
Geneva STP	4.10	Woodstock North STP	3.80
Hebron STP	0.13	Yorkville-Bristol STP	1.60

Notes: Locations added since the 1988 Fox River ILSAM appear in italic type.

(1)at Aurora

(2)at Elgin

SD = Sanitary District

STP = Sanitary Treatment Plant

WRD = Water Reclamation District

WWTP = Waste Water Treatment Plant

Table 3 shows the trend in water use and the source of water for these two systems over the past 15 years, and it provides a forecast of water use for the year 2010. During 1985-1996; the total amount of water use for Aurora and Elgin has grown by 48 and 30 percent, respectively.

Table 2. Comparison of 1985 and 1997 Discharges for the Largest Wastewater Effluents in the Fox River Basin

Location	*Avg. discharge (cfs)*		*$Q_{7,10}$ discharge(cfs)*	
	1985	*1997*	*1985*	*1997*
Fox Metro WRD (Aurora)	37.9	44.4	26.6	30.6
Fox River WRD (Elgin)	27.0	30.0	20.9	19.9
Fox Lake Regional	8.4	10.3	5.4	6.2
St. Charles	6.3	7.5	4.6	4.9
Crystal Lake	5.2	6.9	3.4	4.0
Batavia	3.5	4.7	1.9	2.8
McHenry	3.0	4.2	1.9	2.7
Barrington	4.3	4.2	2.6	2.5
Geneva	3.6	4.1	2.3	2.5
Carpentersville	4.3	4.0	2.3	2.4
Woodstock	3.2	3.8	1.8	2.3
Total for the 50 largest facilities	131.4	152.5	90.2	99.0

Note: WRD = Water Reclamation District

Table 3. Water Use for Aurora and Elgin

	Aurora water use (mgd)		*Elgin water use (mgd)*	
Year	*Fox River*	*Groundwater*	*Fox River*	*Groundwater*
1985	0.00	10.50	8.10	1.43
1993*	6.70	6.75	10.69	0.95
1996	9.62	5.63	11.58	1.11
1998	-----	-------	12.61	0.57
2010 forecast*	11.98	6.75	14.13	0.95

Note: *Values are from Singh et al. (1995).

Dams and Reservoirs

There are 15 dams on the Fox River in Illinois. All of these dams are low-channel dams, and 14 of them have minimal storage and little impact on flow conditions in the river. The exception is Stratton Dam (formerly called McHenry Dam), which partially controls the outflow from the Fox Chain of Lakes near the Illinois-Wisconsin border. The impact of Stratton Dam on the downstream flow frequencies in the Fox River was originally estimated by Knapp (1988) using a reservoir routing model and the modified Puls routing method. This analysis estimated that the existence (or structure) and operation of Stratton Dam caused a 6-8 percent increase in high flows by reducing the amount of storage available to detain floodwaters above the dam. Since the development of the 1988 Fox River ILSAM, a more sophisticated unsteady flow routing model has been developed for the Fox Chain of Lakes system (Knapp and Ortel, 1992). The unsteady flow routing indicates that the structure and operation of the dam has little impact on the discharges from the dam under extreme flood events and increases discharges during moderate flooding by less than 5 percent. The operation of Stratton Dam also has a tendency to reduce moderate low flows by 10-15 percent, but it increases extreme low flows by maintaining a minimum flow release of roughly 94 cfs.

Four additional reservoirs in the Fox River Basin are accounted for in both the 1988 and 1999 versions of the Fox River ILSAM: Wonder Lake, Lake Holiday, Lake Shabbona, and Crystal Lake. The Fox River Basin has many other smaller reservoirs on minor streams that have minimal impact on the flows in the major streams of the watershed and, therefore, are not included in the model.

The algorithms developed for estimating the impact of reservoirs have been described by Knapp (1988, 1990). These algorithms were used to produce new estimates of flows downstream of the four lakes listed above. Each of these lakes is of moderate size and produces only minor impacts on the flow downstream of the reservoir. The modifications to downstream flows caused by these lakes are mostly related to extreme flow conditions, i.e., flooding and very low flows. In most instances, the 1999 estimates of reservoir outflow at these lakes are very similar to that given by the 1988 model. However, the high flow estimates from Wonder Lake have been increased based on the flow records from the streamgage located downstream of this lake from 1994-1997.

The reservoir algorithms are used in ILSAM to estimate flows resulting from uncontrolled outflow over reservoir spillways. For this reason they are not applicable to Stratton Dam, at which daily operational changes in gate settings alter the inflow-outflow relationship at the dam.

Updates to Flow Frequency Estimates at Gaged Sites

The analysis of streamgaging records attempts to separate the observed flow into two components: the unaltered or virgin flow conditions, and modifications to the flow conditions by human activity. Present flow conditions are defined as the virgin flow conditions as changed by the present-day level of flow modifications, which is often different than the level of modification displayed in the gaging record. Present flow conditions, and their associated flow modifications, normally are considered to be transitory in nature. For example, any time there is a change in the amount of an effluent discharge or surface water withdrawal, the estimated present flow condition will change.

In previous analyses, virgin flow conditions were assumed to be relatively stable over time. However, as will be demonstrated in the following comparisons, much of the estimated differences in high and medium flow frequencies in the Fox River Basin since 1988 appear to be induced by climatic variability. The magnitude of these high and medium flow differences are considerably greater than that attributed to changes in the human impacts on streamflow. There is a heated debate within the scientific community as to whether observed changes in climatic conditions are a result of "real" climate changes or are part of the normal variability of climate. Until a quantifiable estimate of real climate change can be established, streamflow frequency estimates developed for ILSAM are based on the assumption that the observed differences in the climatic record are part of normal climate variability.

Over time, the estimated frequency of virgin flow conditions at a gaged site can change from two factors: climatic variability can change the expected long-term frequency of flow for virgin conditions at gaging stations, or new or additional streamflow data can improve the estimate of long-term flow conditions, in which the data were previously lacking.

Gaging Stations

The U.S. Geological Survey (USGS) has operated continuously recording streamgaging stations at 12 locations in the Illinois portion of the Fox River Basin. These locations are listed in table 4. Also listed are two stations in Wisconsin, at Wilmot and near New Munster, which are located on the Fox River directly upstream of the Illinois-Wisconsin state line. Nine gages are currently active. At the time of the analysis used in this report, only those streamgage records through 1997 were published.

Representative Period for Long-Term Conditions

The years included in a streamgage record have a significant impact on the estimation of flow frequency at that gage. A primary consideration in the development of flow estimates for ILSAM is that a consistent relationship be maintained between different locations. For this reason, it is necessary to define a base period, representative of long-term flow conditions, to which frequency estimates could be related.

Table 4. USGS Continuous Discharge Records for the Fox River Basin

USGS ID	*Station name*	*Drainage area (mi²)*	*RL* (years)*	*Period of record*
05545750	Fox River near New Munster, WI	811.	5	1993-present
05546500	Fox River at Wilmot, WI	868.	54	1939-1993
05547755	Squaw Creek at Round Lake	17.2	9	1989-present
05548105	Nippersink Creek above Wonder Lake	84.5	3	1994-1997
05548 110	Nippersink Creek below Wonder Lake	97.3	3	1994-1997
05548280	Nippersink Creek near Spring Grove	192.	32	1966-present
05549000	Boone Creek near McHenry	15.5	34	1948-1982
05549850	Flint Creek near Fox River Grove	37.0	6	1990-1996
05550000	Fox River at Algonquin	1403.	83	1915-present
05550500	Poplar Creek at Elgin	35.2	48	1951-present
0555 1000	Fox River at South Elgin	1556.	9	1989-present
0555 1200	Ferson Creek near St. Charles	51.7	38	1960-present
05551700	Blackberry Creek near Yorkville	70.2	38	1960-present
05552500	Fox River at Dayton	2642.	73	1925-present

Note: *RL = record length

Considerations include both finding a period that includes a representative number of dry and wet hydrologic conditions, and finding a period for which many stations have complete records. For the 1988 study, the base period for computing streamflow frequencies was 1942-1985 for locations on the Fox River and 1951-1985 for all tributary streams. For the updated model version, a common base period of 1948-1997 was chosen for all locations, providing for a consistent estimate of long-term conditions throughout the watershed. The selection of 1948 as the beginning year of the base period also is consistent with the hydrologic analyses conducted for all other ILSAM model applications (Knapp, 1990, 1992, and 1999).

Many streamgaging stations, particularly those on smaller streams, have periods of record that are shorter than the base period of 1948-1997. To provide consistency throughout the basin, it is necessary to adjust the flow frequencies observed at these gages to more accurately reflect the base period of long-term flow conditions. The procedure for making this adjustment was described by Knapp (1988).

Differences in the Long-Term Observed Flow Records

Only four gages in the watershed have a period of record that spans most of the base period used to establish long-term frequencies: Fox River at Wilmot, Algonquin, and Dayton, and Poplar Creek at Elgin. Streamflow records at these gages were examined to estimate the general changes in the long-term flow conditions in the Fox

River watershed since the original estimate associated with the 1988 model. The Poplar Creek watershed does not have any major water resource modifications, thus it is considered to have flows that are close to the virgin condition, even though the watershed has experienced urbanization. The Fox River gages are noticeably impacted by upstream water uses, particularly by effluent discharges. Thus as water use in the watershed increases over time, low flows can be expected to increase, even if climatic conditions are stationary.

Table 5 shows the flow frequencies as computed with the long-term gaging records for three different periods of record, 1942-1985, 1942-1997, and 1948-1997. Because the flow record on Poplar Creek began in 1951, frequencies are computed for only two periods, 1951-1985 and 1951-1997. During the period 1942-1948, the climatic conditions in the watershed favored below average flows. Conversely, during 1986-1997, the watershed experienced flows that were above the long-term condition. The flow frequency estimates for the 1948-1997 records on the Fox River gages are roughly 4 percent higher than the estimates for 1942-1997; however, the low flows show as much as a 10 percent increase. Two factors have caused the low flow conditions on the Fox River to increase over time: the changes in low flow operations at Stratton Dam, and increases in wastewater effluents from communities along the Fox River.

Table 5. Comparison of Flow Frequencies at Long-Term Streamgages for Different Periods of Record

Period of record	*Flow frequency parameter*							
	Q_{mean}	Q_1	Q_{10}	Q_{50}	Q_{75}	Q_{90}	Q_{98}	$Q_{7,10}$
Fox River at Wilmot New Munster								
1942-1985	543	2800	1260	337	180	117	78	67
1942-1997	568	2900	1280	366	196	124	81	67
1948-1997	587	2930	1312	381	205	130	84	69
Fox River at Algonquin								
1942-1985	895	4200	2080	586	308	186	92	50
1942-1997	936	4270	2100	638	322	201	100	51
1948-1997	967	4339	2150	668	352	215	113	87
Poplar Creek at Elgin								
1951-1985	24.4	212	62	9.1	2.8	1.0	0.45	0.20
1951-1997	26.1	227	64	10.0	3.3	1.2	0.45	0.31
Fox River at Dayton								
1942-1985	1875	9353	4280	1200	608	393	236	175
1942-1997	1958	9600	4400	1300	660	419	250	200
1948-1997	2017	9800	4480	1330	688	438	272	224

Differences in the Long-Term Estimates of Virgin Flow

Table 6 shows the estimates of the virgin flow conditions for the Fox River gages for the same periods of record as given in table 5. The differences in the virgin flow estimates in table 6 mainly can be attributed to the impact of climatic variability. The 1942-1985 virgin flow estimates are the same as used in the 1988 version of the Fox River ILSAM; the 1948-1997 estimates are those used in the present study.

Average Flows

The Fox River has experienced an increase in average flows over the 12-year period 1986-1997. A comparison of the 1942-1985 and 1942-1997 virgin flow estimates, as given in table 6, shows a 4-5 percent increase in the long-term estimate of average flow. There is an additional 3-4 percent increase in the long-term estimate of average flow if the period 1942-1947 is not used, as is the case with the 1948-1997 estimate.

High Flows

Between 1942-1985 and 1942-1997 there has been a 4-6 percent increase in the magnitude of moderate flooding conditions, as represented by Q_1, the 1 percent flow duration (the flow that has a 1 percent probability of being exceeded on any particular day). This is roughly the same as the coincident increase in average flow conditions. Elimination of the years 1942-1947 produces an additional 2 percent increase in the estimated long-term high flow conditions.

Table 6. Comparison of Long-Term Virgin Flow Estimates on the Fox River

Period of record	*Flow frequency parameter*							
	Q_{mean}	Q_1	Q_{10}	Q_{50}	Q_{75}	Q_{90}	Q_{98}	$Q_{7,10}$
Fox River at Wilmot								
1942-1985	516	2720	1174	315	168	108	71	60
1942-1997	536	2820	1226	340	180	114	71	60
1948-1997	554	2870	1260	350	185	118	72	58
Fox River at Algonquin								
1942-1985	838	3860	1955	557	294	187	119	102
1942-1997	870	4000	1995	588	304	188	114	102
1948-1997	895	4070	2045	613	307	188	113	100
Fox River at Dayton								
1942-1985	1743	8725	3981	1104	539	355	220	195
1942-1997	1848	9235	4120	1175	561	370	217	195
1948-1997	1929	9490	4255	1180	576	379	230	195

Medium Flows

Medium flows are represented by the 50 and 75 percent flow duration. The Fox River gaging stations listed in table 6 generally show a 6-8 percent increase in medium flows between the 1942-1985 and 1942-1997 periods, which is larger than the coincident increase in average flow. The medium flows for the 1948-1997 period are generally less than 3 percent higher than those for 1942-1997.

Low Flows

There is relatively little difference between the different periods of record in the estimate of virgin low flows. As mentioned earlier, most of the changes in low flows in the Fox River have come as a result of changes in the operation of Stratton Dam, water use, and effluent discharges.

Update to the Virgin and Present Flow Conditions

The flow frequencies at each short-term gage were estimated using the available flow record. These flow frequencies were adjusted using the procedures given by Knapp (1988) to reflect the long-term virgin conditions associated with the 1948-1998 base period. The impacts of flow modifications (specifically effluent discharges, withdrawals, and reservoirs located in the watershed upstream of each gage) were computed and added to the virgin flow to estimate the present flow conditions. The flow frequency results of these analyses are presented in appendix A. Most of the short-term gages in the Fox River watershed, such as those gages on Boone Creek, Ferson Creek, and Blackberry Creek, are either not impacted or are minimally impacted by modifications such as effluent discharges.

The gages listed in table 4 with less than 10 years of record did not have a record long enough from which to accurately estimate long-term flow conditions. The ILSAM uses the regional flow equations, discussed in the following sections, to estimate the long-term flow conditions at these gage locations.

Table 7 compares the estimated 1999 present flow conditions with the 1988 estimates for several gages. Also shown is the estimate of flow conditions at one ungaged site, the Fox River immediately upstream of the Fox Metro WRD discharge. The most significant changes between the 1988 and 1999 present flow conditions are provided by the changes to the virgin conditions, as impacted by climatic variability. This is particularly noticeable for average, medium, and high flows at the main stem Fox River locations. As discussed earlier, the increases in the estimated virgin conditions on the Fox River are caused primarily by the addition of the 1986-1997 record, which was a relatively wet period, but also are impacted by the subtraction of the 1942-1948 record, which was a relatively dry period.

Table 7. Comparison of the 1985 and 1999 Estimates of Present Flow Conditions

Period of record	*Flow frequency parameter*							
	Q_{mean}	Q_1	Q_{10}	Q_{50}	Q_{75}	Q_{90}	Q_{98}	$Q_{7,10}$
Fox River at Wilmot								
1988 model	544	2820	1230	336	185	125	85	73
1999 model	588	2930	1312	381	210	138	92	73
Fox River at Algonquin								
1988 model	897	4260	2060	537	294	187	119	115
1999 model	967	4340	2150	688	352	208	118	115
Fox River at South Elgin								
1988 model	1032	4715	2345	661	357	232	163	157
1999 model	1122	5098	2368	776	435	273	154	142
Fox River upstream of Fox Metro WRD*								
1988 model	1179	5382	2654	750	398	264	185	180
1999 model	1268	5923	2624	855	482	305	167	151
Fox River at Dayton								
1988 model	1886	9205	4188	1167	615	416	291	277
1999 model	2081	9860	4462	1314	689	458	283	251
Blackberry Creek near Yorkville								
1988 model	47.0	363	101	25	12.4	7.1	4.0	3.4
1999 model	50.4	390	113	29	14.7	8.6	5.2	4.4
Nippersink Creek near Spring Grove								
1988 model	141	827	291	90	55	35	19	15.5
1999 model	146	896	314	96	56	36	20	16.6
Ferson Creek near St. Charles								
1988 model	36.2	275	82	17	6.2	1.8	0.48	0.36
1999 model	38.2	337	88	19	7.6	2.3	0.6	0.45
Poplar Creek at Elgin								
1988 model	23.5	206	60	8.6	2.6	0.96	0.41	0.22
1999 model	26.1	227	64	10	3.3	1.2	0.45	0.27

Note: * The Fox Metro Water Reclamation District (WRD) treatment plant is located south of Montgomery.

Low Flows on the Fox River

The impacts of the Elgin and Aurora public water supply withdrawals have caused a sizable reduction in the estimated low flows in the Fox River since the 1988 version of ILSAM. This reduction has been offset somewhat by the continued growth in the volume of water discharged into the river by wastewater treatment facilities. As a result, the magnitude of low flows downstream of the Elgin withdrawal are roughly 15 cfs lower than in the 1988 model, and the low flows downstream of the Aurora withdrawal are roughly 30 cfs lower.

In the preparation of the 7-day, 10-year low flow maps ($Q_{7,10}$) for the Fox River, Singh and Ramamurthy (1993) estimated that Elgin and Aurora would cease withdrawals from the river during extreme low flow conditions because of potential taste and odor problems. However, following discussions with these water supplies, it is now believed that these withdrawals may continue during droughts. This condition could change in the future, however, as minimum instream flow needs of the Fox River are considered. The present flow conditions given in this report are based on the condition that withdrawals will continue at all times. The $Q_{7,10}$ flows in this report compare reasonably well with similar estimates from Singh et al. (1995), although the ILSAM analysis suggests higher low flows on the downstream portion of the Fox River, such as that at Dayton.

The volume of low flow available for the dilution of wastewater effluents into the river has been a major concern for the Fox River. In the Kane County area, it is estimated that over one-third of the flow in the Fox River during extreme low flows was at some point discharged from an upstream wastewater treatment facility. One common method for analyzing the ability of a stream to assimilate treated wastewaters is the use of the 5:1 dilution ratio, in which the flow in the stream above a treatment plant at $Q_{7,10}$ condition is expected to be at least five times greater than the amount of the effluent discharge. Because other, more technical, standards exist for analyzing a stream’s assimilative capacity, it is not essential that all plants meet the 5:1 ratio. However, the ratio is used here to provide a general idea of the volume of effluent in the river.

The two largest treatment facilities in the basin are the Fox River WRD and the Fox Metro WRD, at Elgin and Aurora, respectively. The analysis of discharge data from the Fox Metro WRD indicates that the effluent discharge from this facility is greater than 31 cfs during the $Q_{7,10}$ conditions. The $Q_{7,10}$ of the Fox River upstream of this location is estimated to be 151 cfs. Thus, the ratio between the effluent and the receiving waters during the $Q_{7,10}$ is expected to be 4.87:1. For the Fox River WRD, the ratio between the receiving waters and the total amount of effluent is roughly 6:1. However, the Fox River WRD has three treatment facilities, and the lowest ratio at any one facility is 9:1.

Updates to Flow Frequency Estimates at Ungaged Sites

The ILSAM estimates flow conditions at ungaged sites through the use of two types of information: a set of regional equations to estimate virgin flow conditions at the ungaged site, and data on the magnitude of flow modifications located upstream of the site.

Regional equations used to estimate virgin flow conditions are based on a regression analysis of streamgage records within geographic regions that are expected to have similar streamflow characteristics. These geographic regions are often based on the physiographic character of the watershed. The two major physiographic regions of the Fox River Basin are the Bloomington Ridged Till Plain, situated in the southern portion of the basin, and the Wheaton Morainal Country, which covers the northern portion. Flow conditions in these two regions were represented by one set of equations in the 1988 version of the Fox River ILSAM. More recent analysis, particularly that associated with the development of the Kankakee River ILSAM (Knapp, 1992) produced two sets of equations, one for use in the Bloomington Ridged Plain and one for use in watersheds underlain by coarse, sandy sub-strata.

Regional equations developed in the ILSAM studies have used an approach in which three watershed characteristics are used in the regional equations: drainage area, soil permeability, and average annual net precipitation (precipitation minus evapo-transpiration). A database of these watershed characteristic was developed for more than 600 stream locations in the Fox River Basin during the development of the 1988 version of the Fox River ILSAM. To update the model to 1999 conditions, it was necessary to update the values of one of these characteristics, the estimate of net precipitation for each watershed.

Applicability of Virgin Flow Equations

Appendix D lists the equations developed for the Bloomington Ridged Till Plain and the Wheaton Morainal Country for each of the 154 flow parameters used in ILSAM. These flow equations were developed using long-term streamflow data from the 1948-1988 period. Also shown in appendix D is a coefficient of error, ce, associated with these equations. The coefficient of error was computed as follows. For each gaging station, the equation error is computed as the difference between the observed flow parameter and the virgin flow estimate; it is then divided by the observed mean flow at the gage:

$$\text{Equation error at each station} = (Q_{est} - Q_{obs})/Q_{mean}$$

All values on the right-hand side of this equation are in cfs, and the defined equation error has no dimension. Division by the mean flow at the station provides for a better comparison of the errors between gages in small and large watersheds. The coefficient of error for a particular flow parameter, ce, is then computed as the standard deviation of computed error values at all stations included in the development of the regional flow equations. To compute the expected error of a particular flow parameter at a selected station, in cfs, the coefficient of error should be multiplied by the mean flow rate in cfs at the location of interest. The standard error of estimate of the regional equations for most flow parameters is generally in the range of 5-10 percent.

Even though the regional flow equations in appendix D were created for use with other river basins, streamflow data from the Fox River Basin were used in their development. The applicability of these equations to the Fox River Basin was verified using the existing gaging records from the basin. A second concern was whether these equations should be updated using streamflow data from the 1948-1997 period. This concern is addressed in the following paragraphs.

With the regional flow equations, the average flow for an ungaged watershed is computed from the net precipitation for that watershed, a parameter included in the NETWORK database. Therefore, as the average streamflow for a region changes over time, that increase can be accounted for by changing the estimated net precipitation in the database by a proportional amount. The regional equations of the 154 flow parameters, presented in appendix D, all use the average flow as the primary scaling factor in the equations. Thus, if the average flow is increased by 10 percent, the values of all flow parameters also would be expected to increase by 10 percent.

A flow duration analysis was developed for 16 long-term gaging records that had been used to compute the regional flow equations given in appendix D. This complete analysis was presented by Knapp (1999). Flow durations in this analysis were computed for two periods of record, 1948-1988 and 1948-1997. Most gaging stations used in the analysis have experienced an increase in both the average flow rate and the flows throughout the range of the flow duration curve. The mean increase in average flow for all gages was approximately 5 percent. The mean change in other flow duration values varied from 2 percent up to 8 percent, but for most parameters had a value close to 5 percent. The analysis concluded that the use of the regional equations given in appendix D produced generally acceptable estimates of 1948-1997 conditions, but for some parameters these equations may produce a bias toward overestimating or underestimating flow by as much as 3 percent.

A possible 3 percent error related to the bias is generally small compared to that related to the error in the regional equations, which is generally in the range of 5-10 percent. The error also is generally small compared to the flow measurement error at individual stations, which is in the range of 5-15 percent. For this reason, a potential bias of 3 percent is not statistically significant nor is it likely to be significant when dealing with most operational issues in water resources. Therefore, it was not deemed necessary to update the equations given in appendix D at this time. A future update of the equations may be required if the long-term flow conditions in the basin continue to migrate.

Uncertainties of Flow Estimation

Every step in the computation of flow conditions includes some amount of uncertainty, which is normal and expected. Measurement error in streamgaging, and the resulting estimate of daily flows, is generally considered to be in the range of 5-15 percent, depending on the quality of the gaging location. Additional uncertainties are associated in the processing of hydrologic information for the model, including the flow frequency adjustments for period of record, errors in estimating infrequent events such as low flows, the separation of the gaging record into virgin flow conditions and the impact of flow modifications, and the algorithms that estimate downstream impacts of the various types of flow modifications. Only the error in the regional flow equations, given in appendix D, is readily quantifiable and generally applicable to all locations within the basin. The equation error is generally in the range of 5-10 percent, but can be larger for extreme low flow conditions. The estimated error in developing these regional equations also encompasses many of the other errors listed here; however, it is not to be taken as a comprehensive error for the entire process of flow estimation. The flow estimation error is expected to be less for larger streams with several long-term gaging records, such as the Fox River.

Within the range of the normal uncertainty in the absolute flow values, ILSAM maintains sound relative differences between the estimated virgin and present flow conditions, as well as between flows at different locations on the same stream. In other words, the relative increase or decrease to a flow parameter between two locations on the same stream, whether caused by natural inflow or human modification, can be taken as a reliable assessment of the expected difference in flow conditions.

Conclusions

The streamflow statistics presented in this report are updates of the statistics presented in the initial version of the Fox River Basin Streamflow Assessment Model (Knapp, 1988). As has been demonstrated, some of the flow statistics have changed moderately over time as a result of climate variability, new information from additional streamgaging, and the changes in the modifications to flows caused by water use practices. The variability in climatic conditions appears to cause noticeable fluctuations in the expected unaltered, or virgin flow condition, most notably for medium and high flows. Thus a previous assumption, that long-term virgin streamflow conditions in the future were expected to be similar to those of the past, has been demonstrated to be incorrect. Human modifications have also altered the magnitude of streamflows, particularly from the increase in water use withdrawals from and discharges to the stream, all associated with the increasing population within the basin. The impacts of these water uses are most evident on the Fox River during low flow conditions. A consistent deterministic estimate of the impacts of urbanization on streamflow frequency is not available and thus will need further study for future use in ILSAM. The estimated virgin flows are based on the prevailing land use and do not represent pristine flow conditions.

The proper prediction of expected flow conditions in the future will need additional periodic review and updating, such as this report provides, and will depend upon the continued procurement of flow data from streamgaging, particularly from gages that are located to provide the most useful information on regional hydrology.

This study has produced data sets of hydrologic information, which are developed for use with a new Windows-based version of ILSAM currently being developed. The basic data used by ILSAM are included in the appendices.

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Any opinions, findings, and conclusion or recommendations expressed in this report are those of the authors and do not necessarily reflect those of the Office of Water Resources or the State Water Survey.

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Appendix A. Control Points: Location and Estimated 1997 Flow Conditions

Control point location	Flow condition	Stream code	Mile
1) Fox River at Wilmot, WI	Virgin	V	116.6
2) Fox River at Wilmot, WI	Present	V	116.6
3) Chain of Lakes outlet near Johnsburg	Virgin	V	104.5
4) Chain of Lakes outlet near Johnsburg	Present	V	104.5
5) Fox River at Stratton Dam	Virgin	V	97.8
6) Fox River at Stratton Dam	Present	V	97.8
7) Fox River at Algonquin	Virgin	V	81.6
8) Fox River at Algonquin	Present	V	81.6
9) Upstream of Elgin PWS withdrawal	Virgin	V	72.4
10) Upstream of Elgin PWS withdrawal	Present	V	72.4
11) Fox River at South Elgin	Virgin	V	67.3
12) Fox River at South Elgin	Present	V	67.3
13) Fox River at Geneva	Virgin	V	57.9
14) Fox River at Geneva	Present	V	57.9
15) Upstream of Aurora PWS withdrawal	Virgin	V	50.0
15) Upstream of Aurora PWS withdrawal	Present	V	50.0
17) Fox River at Fox Metro WRD	Virgin	V	44.5
18) Fox River at Fox Metro WRD	Present	V	44.5
19) Fox River at Dayton	Virgin	V	5.4
20) Fox River at Dayton	Present	V	5.4
21) Poplar Creek at Elgin	Virgin/Present	VP	2.3
22) Indian Creek at Lake Shabbona	Virgin	VC	41.2
23) Indian Creek at Lake Shabbona	Present	VC	41.2
24) Blackberry Creek near Yorkville	Virgin	VI	3.3
25) Blackberry Creek near Yorkville	Present	VI	3.3
26) Ferson Creek near St. Charles	Virgin/Present	VN	2.2
27) Boone Creek near McHenry	Virgin/Present	VW	4.8
28) Crystal Lake outlet	Virgin	VS	7.5
29) Crystal Lake outlet	Present	VS	7.5
30) Nippersink Creek at Wonder Lake	Virgin	VX	16.7
31) Nippersink Creek at Wonder Lake	Present	VX	16.7
32) Nippersink Creek at Spring Grove	Virgin	VX	7.0
33) Nippersink Creek at Spring Grove	Present	VX	7.0
34) Somonauk Creek at Lake Holiday	Virgin	VF	9.3
35) Somonauk Creek at Lake Holiday	Present	VF	9.3

Notes:

Stream codes are as listed in appendix C
PWS - Public Water Supply
WRD - Water Reclamation District

Appendix A. Continued

Flow type	Location									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Q_{01}	2870	2930	3580	3800	3700	3950	4070	4340	4356	4651
Q_{02}	2340	2400	2975	3185	3085	3320	3425	3680	3681	3959
Q_{05}	1680	1738	2255	2370	2345	2485	2625	2780	2745	2920
Q_{10}	1260	1312	1730	1800	1810	1900	2045	2150	2113	2237
Q_{15}	1000	1047	1409	1472	1475	1558	1663	1760	1726	1841
Q_{25}	703	743	1007	1043	1050	1105	1192	1260	1243	1328
Q_{40}	457	491	675	704	702	748	796	855	836	911
Q_{50}	350	381	516	542	539	582	613	668	648	719
Q_{60}	272	300	390	414	408	448	469	521	499	567
Q_{75}	185	210	258	277	268	302	307	352	334	394
Q_{85}	140	162	190	200	198	223	224	260	247	297
Q_{90}	118	138	159	155	166	176	188	208	209	242
Q_{95}	91	110	123	108	129	127	144	152	160	181
Q_{98}	72	92	98	82	103	99	113	118	123	140
Q_{99}	62	80	84	78	89	94	97	110	105	129
Q_{mean}	554	588	747	789	784	843	895	967	947	1035
Low Flows										
$Q_{1,2}$	96	114	129	123	141	145	184	196	197	219
$Q_{1,10}$	49	64	82	77	85	89	92	103	98	118
$Q_{1,25}$	42	55	59	73	62	85	67	97	71	110
$Q_{1,50}$	36	48	44	72	46	83	50	94	54	107
$Q_{7,2}$	109	125	133	124	147	152	193	208	210	237
$Q_{7,10}$	58	73	82	78	87	94	100	115	108	133
$Q_{7,25}$	48	61	61	74	64	88	72	104	79	122
$Q_{7,50}$	40	53	46	73	48	85	52	97	59	114
$Q_{15,2}$	117	134	150	143	168	175	216	233	233	263
$Q_{15,10}$	67	82	86	79	92	96	110	122	118	141
$Q_{15,25}$	56	69	66	75	69	89	76	104	84	122
$Q_{15,50}$	45	58	50	74	52	86	55	97	62	115
$Q_{31,2}$	129	147	168	165	187	198	236	257	255	290
$Q_{31,10}$	81	97	95	84	101	102	122	132	129	150
$Q_{31,25}$	59	73	71	76	74	90	81	105	91	126
$Q_{31,50}$	48	62	55	75	57	87	58	96	66	114
$Q_{61,2}$	160	180	195	205	212	237	261	297	282	332
$Q_{61,10}$	85	101	106	92	112	110	136	143	142	161
$Q_{61,25}$	65	79	79	79	83	94	93	112	106	136
$Q_{61,50}$	54	68	61	76	64	90	68	102	79	123
$Q_{91,2}$	183	204	249	267	264	297	304	348	329	387
$Q_{91,10}$	95	112	122	107	126	124	146	154	156	176
$Q_{91,25}$	72	87	88	89	92	105	103	125	117	150
$Q_{91,50}$	58	73	69	75	72	90	81	108	93	131

Appendix A. Continued

Flow type	Location (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Drought Flows										
$Q_{6,10}$	140	158	161	182	169	204	188	234	210	270
$Q_{6,25}$	98	114	129	145	136	166	152	192	173	226
$Q_{6,50}$	88	104	116	132	115	144	141	180	160	211
$Q_{9,10}$	160	181	199	220	213	249	253	300	274	335
$Q_{9,25}$	116	132	146	165	154	188	173	218	195	254
$Q_{9,50}$	101	117	128	146	135	167	151	194	172	229
$Q_{12,10}$	244	271	299	332	312	361	357	418	379	456
$Q_{12,25}$	175	187	213	247	222	272	251	313	280	357
$Q_{12,50}$	137	158	195	228	202	250	223	282	250	323
$Q_{18,10}$	282	310	359	402	367	427	392	464	422	510
$Q_{18,25}$	179	203	221	260	231	286	264	331	296	378
$Q_{18,50}$	153	175	201	240	208	262	231	296	258	338
$Q_{30,10}$	346	377	458	501	498	558	617	690	650	739
$Q_{30,25}$	235	263	293	336	304	364	338	410	374	462
$Q_{30,50}$	181	205	211	254	220	279	249	320	277	363
$Q_{54,10}$	490	525	707	749	732	792	807	880	853	943
$Q_{54,25}$	348	379	429	472	455	515	533	605	576	664
$Q_{54,50}$	258	286	326	369	350	410	422	494	463	551
January										
Q_{02}	1520	1578	2020	2135	2110	2250	2345	2505	2549	2732
Q_{10}	852	896	1381	1642	1447	1729	1434	1731	1497	1813
Q_{25}	440	474	777	810	808	859	910	974	952	1033
Q_{50}	272	300	442	473	462	510	525	585	555	631
Q_{75}	177	201	263	287	275	314	315	365	342	407
Q_{90}	113	134	178	183	186	205	211	240	234	276
Q_{98}	75	93	136	131	142	149	159	175	166	194
Q_{mean}	390	423	609	643	635	687	717	782	759	841
February										
Q_{02}	2125	2185	2340	2514	2450	2650	2740	2960	2972	3216
Q_{10}	1067	1114	1461	1523	1527	1610	1716	1814	1787	1904
Q_{25}	621	660	919	965	960	1025	1081	1160	1132	1229
Q_{50}	319	350	475	507	497	546	566	628	602	680
Q_{75}	189	215	314	336	328	366	376	426	404	468
Q_{90}	125	147	190	200	198	223	224	260	252	302
Q_{98}	96	115	146	142	152	161	171	190	191	223
Q_{mean}	494	530	698	739	726	786	810	883	854	945
March										
Q_{02}	3570	3640	3570	3803	3700	3960	4080	4360	4197	4502
Q_{10}	2400	2460	2650	2848	2760	2980	3085	3320	3297	3552
Q_{25}	1495	1550	1763	1948	1845	2050	2080	2300	2205	2443
Q_{50}	831	874	1038	1087	1083	1150	1220	1300	1309	1406
Q_{75}	456	491	619	659	645	702	723	792	778	863
Q_{90}	266	294	324	347	338	377	387	438	426	492
Q_{98}	162	186	175	191	183	213	208	249	245	299
Q_{mean}	1095	1145	1471	1527	1495	1570	1563	1652	1681	1788

Appendix A. Continued

Flow type	Location (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
April										
Q_{02}	3580	3650	4670	4853	4810	5020	5220	5450	5481	5736
Q_{10}	2080	2140	2880	3103	2990	3235	3310	3570	3501	3781
Q_{25}	1395	1450	2050	2145	2140	2255	2410	2540	2506	2655
Q_{50}	895	939	1278	1334	1335	1410	1501	1590	1585	1692
Q_{75}	561	599	723	757	753	804	851	915	906	986
Q_{90}	350	381	422	453	441	489	501	561	549	625
Q_{98}	192	218	244	266	255	292	292	340	334	396
Q_{mean}	1110	1160	1504	1565	1575	1655	1785	1879	1888	2000
May										
Q_{02}	2315	2375	3620	3853	3735	3995	4065	4345	4332	4637
Q_{10}	1400	1455	1998	2092	2085	2200	2340	2470	2428	2577
Q_{25}	871	916	1325	1389	1385	1468	1553	1650	1626	1740
Q_{50}	538	575	763	797	794	846	895	960	955	1037
Q_{75}	347	378	444	473	465	511	532	590	571	645
Q_{90}	211	237	273	296	285	324	326	377	360	426
Q_{98}	117	138	158	155	165	177	186	209	211	248
Q_{mean}	697	737	1023	1069	1061	1126	1177	1255	1246	1341
June										
Q_{02}	1775	1835	2550	2703	2655	2835	2955	3155	3254	3478
Q_{10}	1070	1120	1618	1687	1695	1785	1915	2020	1980	2104
Q_{25}	593	631	917	960	956	1018	1074	1150	1128	1222
Q_{50}	320	351	457	489	479	528	547	609	601	679
Q_{75}	197	223	253	274	264	302	302	352	340	406
Q_{90}	130	152	170	163	177	186	199	220	227	263
Q_{98}	96	115	118	101	124	121	137	145	161	183
Q_{mean}	480	516	700	743	728	788	812	885	875	964
July										
Q_{02}	1605	1660	2100	2197	2190	2310	2455	2595	2525	2686
Q_{10}	929	974	1206	1371	1258	1442	1413	1611	1416	1632
Q_{25}	471	506	667	689	694	734	783	836	809	878
Q_{50}	232	259	328	340	339	368	387	428	419	475
Q_{75}	142	165	190	200	198	223	224	260	250	301
Q_{90}	98	118	134	122	140	143	154	168	176	204
Q_{98}	52	70	73	77	77	94	74	101	92	132
Q_{mean}	379	411	510	547	535	588	610	675	639	720
August										
Q_{02}	1350	1405	1485	1548	1555	1640	1753	1854	1643	1765
Q_{10}	701	741	931	978	970	1035	1093	1171	1139	1234
Q_{25}	397	430	531	568	555	609	629	695	665	746
Q_{50}	217	244	297	321	310	349	356	406	383	448
Q_{75}	138	158	175	182	183	205	207	240	227	274
Q_{90}	90	109	129	118	135	138	149	162	165	191
Q_{98}	49	67	60	78	54	94	58	97	73	123
Q_{mean}	328	357	416	448	435	482	493	551	517	590

Appendix A. Continued

Flow type	Location									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
September										
Q_{02}	1520	1575	1968	2057	2055	2165	2315	2440	2446	2590
Q_{10}	765	806	1023	1080	1068	1142	1204	1290	1292	1394
Q_{25}	347	379	449	482	470	518	538	597	577	651
Q_{50}	208	232	246	267	257	293	295	342	320	381
Q_{75}	125	147	169	162	176	183	200	217	217	247
Q_{90}	81	99	104	87	109	105	120	126	135	153
Q_{98}	54	72	62	80	65	94	59	96	72	120
Q_{mean}	321	352	422	450	441	484	507	561	536	605
October										
Q_{02}	1688	1746	2315	2429	2410	2545	2700	2850	2773	2942
Q_{10}	815	858	1120	1170	1170	1238	1320	1401	1395	1493
Q_{25}	465	500	609	659	642	708	732	810	783	877
Q_{50}	236	264	337	361	352	391	405	455	425	488
Q_{75}	145	168	189	200	197	222	224	259	243	291
Q_{90}	87	106	113	95	118	112	131	134	148	163
Q_{98}	65	83	82	81	85	94	79	96	91	118
Q_{mean}	379	411	505	543	529	582	604	668	649	727
November										
Q_{02}	1528	1578	1973	2061	2060	2170	2320	2445	2385	2530
Q_{10}	1022	1070	1437	1504	1505	1590	1702	1800	1759	1874
Q_{25}	662	702	1007	1055	1050	1115	1183	1260	1221	1314
Q_{50}	358	390	586	621	612	662	696	757	717	793
Q_{75}	188	214	300	325	314	353	361	411	381	445
Q_{90}	122	144	177	183	185	204	211	240	231	272
Q_{98}	83	102	118	102	123	118	138	141	154	167
Q_{mean}	479	514	716	759	745	805	833	905	867	955
December										
Q_{02}	1660	1717	2140	2240	2225	2350	2470	2615	2580	2748
Q_{10}	953	999	1338	1398	1400	1479	1578	1671	1568	1679
Q_{25}	571	631	972	1020	1014	1079	1142	1220	1171	1265
Q_{50}	336	368	636	668	663	711	753	813	779	854
Q_{75}	177	202	316	342	330	371	378	430	392	458
Q_{90}	115	136	192	204	201	226	229	264	246	294
Q_{98}	84	102	147	146	153	164	173	193	187	218
Q_{mean}	454	489	720	760	750	808	841	912	870	958

Appendix A. Continued

Flow type	Location									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Q_{01}	4777	5098	5264	5596	5489	5830	5592	5987	9490	9860
Q_{02}	4065	4365	4508	4819	4717	5037	4829	5197	7825	8183
Q_{05}	2937	3131	3167	3371	3280	3491	3347	3602	5665	5926
Q_{10}	2227	2368	2364	2513	2432	2588	2479	2675	4255	4462
Q_{15}	1824	1954	1935	2073	1990	2134	2030	2212	3440	3632
Q_{25}	1318	1417	1395	1502	1433	1546	1462	1611	2395	2553
Q_{40}	890	977	941	1035	965	1064	985	1117	1514	1655
Q_{50}	694	776	736	825	755	849	772	898	1180	1314
Q_{60}	538	616	571	655	586	674	600	719	885	1012
Q_{75}	367	435	392	467	403	482	414	522	576	689
Q_{85}	275	333	297	360	306	- 373	316	409	447	546
Q_{90}	233	273	251	297	259	308	267	342	379	458
Q_{95}	183	209	199	231	195	230	213	272	305	368
Q_{98}	145	165	157	182	146	174	168	217	235	288
Q_{99}	125	151	136	166	123	155	145	197	207	262
Q_{mean}	1021	1122	1098	1206	1138	1251	1165	1312	1929	2081
Low Flows										
$Q_{1,2}$	211	234	218	246	220	250	225	273	242	293
$Q_{1,10}$	114	132	120	143	109	133	126	165	153	194
$Q_{1,25}$	84	121	88	129	77	119	93	149	107	166
$Q_{1,50}$	65	116	68	124	59	116	72	143	82	155
$Q_{7,2}$	228	262	240	280	245	288	251	320	308	381
$Q_{7,10}$	129	156	139	172	124	159	149	203	208	264
$Q_{7,25}$	95	138	103	151	93	143	110	179	153	224
$Q_{7,50}$	73	129	80	141	71	134	87	168	125	210
$Q_{15,2}$	252	289	264	306	269	314	275	346	330	406
$Q_{15,10}$	142	167	154	184	135	168	165	217	232	289
$Q_{15,25}$	102	142	111	156	100	147	120	185	170	238
$Q_{15,50}$	79	133	88	146	78	138	96	175	143	226
$Q_{31,2}$	277	319	292	339	298	349	305	382	382	464
$Q_{31,10}$	155	180	168	198	147	179	179	233	244	302
$Q_{31,25}$	110	146	120	161	111	154	130	192	185	250
$Q_{31,50}$	85	134	94	149	82	139	103	178	154	232
$Q_{61,2}$	307	365	324	388	331	399	339	434	419	519
$Q_{61,10}$	172	195	185	214	159	191	197	251	265	323
$Q_{61,25}$	125	158	138	175	126	166	149	208	215	279
$Q_{61,50}$	99	146	111	163	100	155	122	195	190	267
$Q_{91,2}$	358	425	378	452	387	465	396	503	499	610
$Q_{91,10}$	184	210	198	230	179	215	211	270	282	345
$Q_{91,25}$	140	177	155	197	146	191	168	234	250	320
$Q_{91,50}$	117	159	132	178	119	168	145	214	231	305

Appendix A. Continued

Flow type	Location									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Drought Flows										
$Q_{6,10}$	236	304	256	329	264	341	273	377	387	496
$Q_{6,25}$	197	256	215	280	223	291	231	325	340	438
$Q_{6,50}$	182	239	199	261	206	271	214	303	316	410
$Q_{9,10}$	299	369	317	395	325	407	334	445	460	575
$Q_{9,25}$	221	289	242	316	251	329	261	366	417	527
$Q_{9,50}$	198	262	219	289	228	302	237	337	391	496
$Q_{12,10}$	409	496	434	529	446	546	457	588	722	857
$Q_{12,25}$	317	403	349	442	363	461	376	503	602	734
$Q_{12,50}$	284	365	313	401	326	418	338	458	570	695
$Q_{18,10}$	463	562	501	608	519	631	533	678	877	1026
$Q_{18,25}$	337	429	373	473	390	494	403	538	666	805
$Q_{18,50}$	294	383	326	422	341	441	353	483	634	767
$Q_{30,10}$	694	796	737	847	757	872	772	921	1137	1290
$Q_{30,25}$	422	521	466	572	486	597	502	644	823	970
$Q_{30,50}$	314	411	348	451	364	471	377	515	709	852
$Q_{54,10}$	918	1022	983	1095	1013	1131	1035	1188	1579	1736
$Q_{54,25}$	635	734	691	798	717	829	737	882	1224	1373
$Q_{54,50}$	518	616	570	676	594	705	613	755	1033	1180
January										
Q_{02}	2864	3071	3242	3459	3420	3646	3505	3781	5700	5972
Q_{10}	1601	1934	1722	2064	1782	2131	1824	2213	3345	3740
Q_{25}	1010	1104	1066	1168	1092	1200	1114	1257	1663	1815
Q_{50}	594	681	627	721	642	741	656	787	971	1110
Q_{75}	375	448	400	479	411	494	421	533	562	680
Q_{90}	262	310	282	337	291	349	300	383	406	494
Q_{98}	171	204	169	207	167	208	168	231	238	305
Q_{mean}	819	914	880	983	908	1017	929	1072	1443	1593
February										
Q_{02}	3344	3614	3805	4085	4025	4314	4132	4473	7330	7654
Q_{10}	1911	2046	2067	2211	2145	2297	2195	2388	4145	4347
Q_{25}	1211	1323	1298	1418	1341	1467	1373	1537	2485	2658
Q_{50}	652	743	699	797	721	824	740	877	1249	1393
Q_{75}	437	512	463	545	474	561	486	602	665	786
Q_{90}	287	345	315	380	327	396	339	435	508	609
Q_{98}	214	252	231	275	238	286	246	318	348	424
Q_{mean}	922	1026	996	1108	1032	1150	1057	1211	1842	2002
March										
Q_{02}	4350	4681	4511	4854	4676	5029	4878	5285	10900	11288
Q_{10}	3602	3876	3936	4220	4093	4385	4186	4521	6570	6913
Q_{25}	2387	2641	2583	2846	2677	2947	2740	3048	4570	4887
Q_{50}	1434	1545	1563	1681	1624	1748	1668	1827	2875	3043
Q_{75}	851	947	920	1023	952	1060	977	1117	1552	1700
Q_{90}	475	552	518	602	537	626	554	674	892	1018
Q_{98}	291	353	332	400	351	422	367	466	713	818
Q_{mean}	1847	1968	2021	2151	2103	2239	2155	2328	3470	3548

Appendix A. Continued

Flow type	Location									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
April										
Q_{02}	5861	6142	6297	6589	6495	6797	6582	6937	11100	11439
Q_{10}	3785	4084	4106	4415	4259	4576	4349	4709	6945	7313
Q_{25}	2656	2822	2827	3001	2911	3092	2968	3189	4940	5171
Q_{50}	1707	1828	1836	1965	1898	2033	1943	2114	3335	3514
Q_{75}	980	1072	1052	1152	1086	1191	1113	1251	1809	1955
Q_{90}	614	701	675	768	703	801	726	856	1291	1428
Q_{98}	389	459	439	515	462	542	481	588	894	1008
Q_{mean}	2038	2165	2201	2336	2279	2420	2330	2508	3794	3978
May										
Q_{02}	4749	5080	5245	5587	5485	5837	5618	6023	9880	10268
Q_{10}	2574	2741	2750	2927	2838	3023	2896	3122	5110	5345
Q_{25}	1736	1866	1858	1995	1918	2061	1962	2141	3460	3652
Q_{50}	1040	1134	1124	1227	1165	1273	1196	1339	2110	2260
Q_{75}	624	710	674	767	698	796	718	848	1269	1406
Q_{90}	404	481	443	527	461	550	478	598	879	1005
Q_{98}	244	289	272	323	285	340	297	379	563	651
Q_{mean}	1347	1456	1457	1574	1510	1633	1547	1706	2690	2855
June										
Q_{02}	3695	3946	4208	4470	4447	4720	4563	4888	8830	9138
Q_{10}	2100	2243	2257	2409	2339	2498	2393	2594	4315	5025
Q_{25}	1212	1320	1304	1420	1350	1472	1385	1544	2665	2835
Q_{50}	675	765	748	846	783	886	810	946	1569	1713
Q_{75}	390	466	436	519	457	545	475	595	910	1036
Q_{90}	262	308	292	344	305	362	318	404	561	652
Q_{98}	190	220	214	250	224	264	234	301	392	463
Q_{mean}	966	1067	1064	1173	1111	1226	1143	1291	2074	2227
July										
Q_{02}	2662	2845	2854	3047	2952	3153	3007	3254	5450	5692
Q_{10}	1438	1669	1475	1715	1498	1744	1519	1803	2785	3078
Q_{25}	847	929	885	975	904	1000	923	1052	1570	1708
Q_{50}	460	528	497	572	514	594	530	642	916	1035
Q_{75}	283	343	309	376	321	392	332	433	540	646
Q_{90}	203	238	224	266	233	279	242	316	389	467
Q_{98}	114	159	131	181	138	192	146	223	267	349
Q_{mean}	682	773	726	824	747	850	764	898	1299	1439
August										
Q_{02}	1543	1684	1485	1635	1472	1629	1476	1677	3480	3682
Q_{10}	1206	1314	1273	1390	1306	1429	1333	1491	2210	2375
Q_{25}	710	802	749	849	767	872	783	919	1117	1261
Q_{50}	416	489	441	521	452	536	463	576	618	738
Q_{75}	251	305	268	329	275	340	284	376	399	496
Q_{90}	183	216	197	235	203	244	209	276	297	368
Q_{98}	90	144	103	162	108	170	114	197	202	289
Q_{mean}	550	631	578	667	592	685	604	727	923	1051

Appendix A. Continued

Flow type	Location									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
September										
Q_{02}	2632	2792	2837	3007	2931	3108	2977	3194	5565	5787
Q_{10}	1410	1523	1524	1646	1577	1704	1614	1774	2510	2676
Q_{25}	626	709	667	757	686	780	701	825	969	1099
Q_{50}	350	419	373	448	383	462	393	499	536	647
Q_{75}	237	273	250	292	255	301	262	333	331	407
Q_{90}	152	176	164	194	169	202	175	232	238	299
Q_{98}	88	137	99	153	104	160	109	184	180	259
Q_{mean}	572	649	601	685	613	702	623	740	993	1114
October										
Q_{02}	2889	3076	3021	3217	3086	3289	3133	3377	4770	5022
Q_{10}	1499	1609	1601	1719	1649	1773	1685	1842	2595	2761
Q_{25}	847	950	901	1012	925	1041	944	1091	1478	1631
Q_{50}	445	517	456	534	459	541	465	575	580	695
Q_{75}	264	319	278	338	283	347	290	379	343	437
Q_{90}	168	187	182	207	188	216	194	245	267	321
Q_{98}	104	132	112	145	115	150	120	173	161	218
Q_{mean}	707	794	758	852	781	879	799	926	1118	1250
November										
Q_{02}	2497	2661	2637	2810	2705	2886	2746	2969	4195	4423
Q_{10}	1837	1966	1912	2049	1947	2090	1974	2152	2590	2774
Q_{25}	1268	1373	1307	1418	1324	1440	1339	1487	1539	1694
Q_{50}	739	824	750	842	754	850	760	885	852	983
Q_{75}	403	474	417	494	422	503	429	536	480	593
Q_{90}	254	301	270	322	276	332	284	363	350	434
Q_{98}	172	187	184	205	189	212	195	238	267	312
Q_{mean}	911	1010	948	1054	964	1075	978	1121	1182	1331
December										
Q_{02}	2769	2960	3014	3216	3132	3343	3186	3445	4905	5167
Q_{10}	1572	1699	1591	1726	1603	1744	1613	1792	2280	2465
Q_{25}	1210	1316	1245	1359	1261	1380	1276	1428	1605	1765
Q_{50}	809	894	828	921	836	933	845	973	859	993
Q_{75}	404	478	406	486	405	489	408	519	476	593
Q_{90}	265	318	276	336	280	344	287	375	323	415
Q_{98}	203	238	213	253	217	259	222	286	261	328
Q_{mean}	910	1011	948	1057	965	1080	978	1127	1217	1372

Appendix A. Continued

Flow type	Location							
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
Q_{01}	227	141	756	389	390	337	55	29.7
Q_{02}	168	99	454	280	281	229	43	22.1
Q_{05}	104	55	261	169	170	136	29.5	13.6
Q_{10}	64	32	167	112	113	88	22.5	9.1
Q_{15}	47	22.8	124	86	87	66	18.8	7.1
Q_{25}	29.0	13.2	81	57	58	42	14.7	5.0
Q_{40}	15.0	6.7	51	37	38	26.0	11.3	3.7
Q_{50}	10.0	4.2	39	28.0	28.8	19.0	9.8	3.1
Q_{60}	6.6	2.4	29.8	21.0	21.7	14.0	8.8	2.6
Q_{75}	3.3	0.86	20.6	14.0	14.7	7.6	7.3	2.0
Q_{85}	1.8	0.4	16.3	9.8	10.5	3.9	6.0	1.7
Q_{90}	1.2	0.26	13.6	8.0	8.7	2.3	5.6	1.5
Q_{95}	0.8	0.16	10.7	5.8	6.4	1.2	5.1	1.31
Q_{98}	0.45	0.09	8.3	4.6	5.2	0.6	4.6	1.13
Q_{99}	0.35	0.05	7.1	3.9	4.4	0.4	4.2	1.04
Q_{mean}	26.1	13.8	74.9	49.6	50.4	36.2	13.1	4.73
Low Flows								
$Q_{1,2}$	0.6	0.2	9.1	7.6	8.1	2.6	5.0	1.48
$Q_{1,10}$	0.2	0.02	6.1	3.5	4.0	0.3	3.5	0.95
$Q_{1,25}$	0.12	0.0	4.9	2.3	2.8	0.13	3.3	0.81
$Q_{1,50}$	0.08	0.0	4.5	2.0	2.5	0.1	3.2	0.76
$Q_{7,2}$	0.8	0.26	10.9	8.6	9.2	3.2	5.3	1.53
$Q_{7,10}$	0.27	0.04	7.1	3.9	4.4	0.45	3.7	1.02
$Q_{7,25}$	0.15	0.0	5.8	2.5	3.0	0.22	3.5	0.88
$Q_{7,50}$	0.1	0.0	5.2	2.2	2.7	0.15	3.4	0.83
$Q_{15,2}$	1.25	0.32	12.8	9.5	10.2	4.0	5.6	1.59
$Q_{15,10}$	0.4	0.07	8.1	4.4	5.0	0.65	4.0	1.07
$Q_{15,25}$	0.21	0.01	6.8	2.8	3.3	0.35	3.7	0.95
$Q_{15,50}$	0.14	0.0	6.2	2.5	3.0	0.23	3.6	0.9
$Q_{31,2}$	2.0	0.42	14.1	10.6	11.3	5.3	6.0	1.66
$Q_{31,10}$	0.52	0.11	9.0	5.0	5.6	1.0	4.4	1.16
$Q_{31,25}$	0.28	0.06	7.6	3.5	4.0	0.6	4.1	1.02
$Q_{31,50}$	0.2	0.01	6.7	3.1	3.6	0.5	4.0	0.96
$Q_{61,2}$	3.0	0.59	16.2	12.8	13.5	7.0	6.6	1.79
$Q_{61,10}$	0.85	0.16	10.1	6.0	6.6	1.6	4.6	1.27
$Q_{61,25}$	0.48	0.08	8.9	4.6	5.2	1.15	4.3	1.1
$Q_{61,50}$	0.35	0.04	8.0	4.1	4.6	1.0	4.2	1.02
$Q_{91,2}$	3.4	0.85	19.3	15.5	16.2	11.0	7.2	2.04
$Q_{91,10}$	0.95	0.19	11.1	7.3	7.9	2.3	4.9	1.35
$Q_{91,25}$	0.55	0.11	9.7	5.5	6.1	1.6	4.7	1.18
$Q_{91,50}$	0.4	0.06	8.9	5.2	5.8	1.4	4.6	1.1

Appendix A. Continued

Flow type	Location							
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
Drought Flows								
$Q_{6,10}$	1.5	0.36	14.8	10.0	10.7	5.0	5.6	1.59
$Q_{6,25}$	0.8	0.19	13.2	7.2	7.8	3.0	5.0	1.46
$Q_{6,50}$	0.6	0.13	12.1	6.4	7.0	2.5	4.7	1.35
$Q_{9,10}$	5.2	1.3	19.8	16.0	16.7	8.5	6.4	2.03
$Q_{9,25}$	2.2	0.72	16.3	11.0	11.7	4.5	5.5	1.71
$Q_{9,50}$	1.4	0.51	14.6	9.5	10.2	3.3	5.2	1.55
$Q_{12,10}$	9.2	3.5	28.2	22.0	22.8	13.0	7.7	2.7
$Q_{12,25}$	5.4	2.1	21.8	14.7	15.4	7.6	6.8	2.2
$Q_{12,50}$	4.2	1.45	19.0	12.8	13.5	6.4	6.5	2.0
$Q_{18,10}$	12.0	4.4	36.9	26.0	26.8	18.0	8.0	3.1
$Q_{18,25}$	5.2	2.4	24.1	16.0	16.7	8.6	7.0	2.5
$Q_{18,50}$	3.6	1.77	20.3	13.6	14.3	7.0	6.6	2.0
$Q_{30,10}$	17.0	8.2	50	36	37	26.0	10.3	3.7
$Q_{3o,25}$	10.5	4.2	32.8	21.8	22.6	12.0	8.0	3.0
$Q_{30,50}$	7.2	3.2	26.8	17.9	18.6	9.5	7.3	2.3
$Q_{54,10}$	25.5	11.7	64	46	47	37	12.1	4.5
$Q_{54,25}$	14.5	6.8	42	32	33	21.0	9.0	3.4
$Q_{54,50}$	11.5	5.0	34.3	27	27.8	17.0	8.2	3.0
January								
Q_{02}	168	99	685	249	250	224	40	23.4
Q_{10}	49	24.2	574	90	91	61	17.2	9.6
Q_{25}	20.0	8.6	166	43	44	33	11.8	5.2
Q_{50}	7.4	3.1	42	24.0	24.8	18.0	9.0	3.4
Q_{75}	3.1	0.72	22.4	15.0	15.7	10.4	6.9	2.4
Q_{90}	1.1	0.17	16.7	9.2	9.9	4.4	5.5	1.68
Q_{98}	0.7	0.04	8.9	4.1	4.7	1.8	4.5	1.3
Q_{mean}	21.0	10.9	104	40	41	30.5	11.2	5.0
February								
Q_{02}	188	114	732	334	335	272	58	27.2
Q_{10}	62	36	308	102	103	88	23.0	11.8
Q_{25}	28.0	15.6	155	63	64	49	14.6	6.6
Q_{50}	10.0	5.3	52	29.0	29.8	20.0	9.6	3.9
Q_{75}	4.4	1.68	26.6	16.0	16.7	10.7	7.1	2.7
Q_{90}	1.2	0.26	16.1	10.5	11.2	5.6	5.4	1.88
Q_{98}	0.7	0.1	11.0	5.1	5.7	2.7	4.4	1.38
Q_{mean}	26.6	15.6	128	51	52	41	13.9	5.9
March								
Q_{02}	262	133	627	383	384	348	60	33.7
Q_{10}	109	56	244	173	174	144	34	16.0
Q_{25}	59	27.3	137	94	95	75	21.6	9.6
Q_{50}	30	12.9	77	58	59	46	14.1	6.0
Q_{75}	14.0	5.4	47	36	37	27.0	10.3	4.0
Q_{90}	6.2	2.5	28.6	23.0	23.7	16.3	8.1	3.1
Q_{98}	1.8	0.62	16.6	14.1	14.8	9.0	6.7	2.2
Q_{mean}	49	24.6	125	88	89	67	19.0	8.5

Appendix A. Continued

Flow type	Location							
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
April								
Q_{02}	254	135	1218	358	359	304	60	30.3
Q_{10}	113	58	360	181	182	132	32	16.1
Q_{25}	61	31	178	108	109	81	23.0	9.6
Q_{50}	34	16.4	89	66	67	49	16.4	6.1
Q_{75}	17.0	8.3	55	37	38	30	11.7	4.1
Q_{90}	10.0	4.1	36	25.0	25.8	19.0	9.5	3.1
Q_{98}	3.6	1.26	22.1	16.0	16.7	10.9	8.4	2.4
Q_{mean}	52	27.4	153	89	90	68	20.1	8.2
May								
Q_{02}	168	115	1102	367	368	256	43	22.9
Q_{10}	78	39	279	152	153	107	25.6	10.2
Q_{25}	42	19.3	128	85	86	62	17.0	6.0
Q_{50}	19.0	10.2	66	48	49	33	12.2	4.2
Q_{75}	9.8	5.6	39	29.0	29.8	18.2	9.3	3.1
Q_{90}	5.3	3.3	27.6	20.0	20.8	10.0	7.7	2.5
Q_{98}	2.4	1.39	16.8	16.0	16.7	5.9	5.9	1.9
Q_{mean}	34.5	19.7	128	77	78	50	15.3	5.8
June								
Q_{02}	178	130	1334	351	352	320	43	24.2
Q_{10}	66	39	266	135	136	96	23.8	7.4
Q_{25}	27.0	16.1	116	67	68	45	15.3	4.4
Q_{50}	10.0	6.9	53	37	38	23.0	10.3	3.2
Q_{75}	3.9	3.3	30.1	22.0	22.8	9.7	7.4	2.5
Q_{90}	1.8	1.78	17.2	14.0	14.7	4.8	5.7	2.0
Q_{98}	0.8	0.71	10.6	10.0	10.7	1.7	4.7	1.5
Q_{mean}	26.8	18.6	119	64	65	44	13.7	4.9
July								
Q_{02}	114	76	366	230	231	144	35	12.3
Q_{10}	34	19.1	109	73	74	45	18.9	3.9
Q_{25}	15.0	7.7	57	40	41	24.0	13.6	2.9
Q_{50}	5.5	3.0	32	25.0	25.8	14.0	9.3	2.3
Q_{75}	2.4	1.21	19.7	14.0	14.7	5.7	7.1	1.9
Q_{90}	1.0	0.51	12.6	9.3	10.0	2.3	5.5	1.5
Q_{98}	0.4	0.19	8.2	6.1	6.7	0.6	4.4	1.18
Q_{mean}	15.8	9.9	64	48	49	24.2	11.9	3.1
August								
Q_{02}	131	57	243	150	151	186	29.5	4.3
Q_{10}	30	9.1	66	55	56	51	16.9	3.1
Q_{25}	10.0	2.8	37	30	31	22.0	11.2	2.5
Q_{50}	4.1	1.01	24.3	17.0	17.7	9.5	7.9	2.0
Q_{75}	1.9	0.44	15.9	10.0	10.7	4.3	5.8	1.56
Q_{90}	1.0	0.23	10.7	7.4	8.1	1.6	5.0	1.21
Q_{98}	0.5	0.1	7.5	4.4	5.0	0.4	4.2	1.0
Q_{mean}	15.8	5.8	42	26.5	27.2	23.4	10.0	2.25

Appendix A. Continued

Flow type	Location							
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
September								
Q_{02}	112	53	354	191	192	179	39	11.4
Q_{10}	34	8.8	74	79	80	57	17.1	3.9
Q_{25}	9.8	1.78	35	31	32	21.0	10.2	2.3
Q_{50}	3.4	0.6	23.2	16.0	16.7	8.2	7.4	1.8
Q_{75}	1.3	0.22	15.3	9.1	9.8	3.9	5.7	1.45
Q_{90}	0.6	0.09	9.8	5.9	6.5	1.3	4.9	1.19
Q_{98}	0.2	0.01	6.6	4.0	4.5	0.4	4.1	0.97
Q_{mean}	13.2	5.4	52	33	33.7	25.2	10.0	2.55
October								
Q_{02}	89	50	230	138	139	134	27.2	11.0
Q_{10}	36	12.4	95	64	65	46	15.3	4.9
Q_{25}	12.0	3.6	40	36	37	24.0	10.4	3.3
Q_{50}	3.6	0.7	24.3	19.0	19.7	13.0	8.0	2.2
Q_{75}	1.4	0.24	16.4	11.0	11.7	5.2	6.1	1.66
Q_{90}	0.8	0.12	10.5	6.7	7.3	1.9	5.3	1.36
Q_{98}	0.4	0.04	8.5	4.3	4.8	0.6	4.6	1.03
Q_{mean}	13.0	5.8	47	28.0	28.7	19.9	9.6	3.1
November								
Q_{02}	118	51	253	171	172	165	26.1	13.3
Q_{10}	54	16.6	113	88	89	77	17.5	7.1
Q_{25}	28.0	6.0	62	53	54	45	12.8	4.2
Q_{50}	8.8	1.41	33	25.0	25.7	24.0	9.4	2.7
Q_{75}	2.5	0.34	22.7	14.0	14.7	9.7	7.2	2.0
Q_{90}	1.0	0.14	13.8	9.4	10.0	2.8	5.8	1.56
Q_{98}	0.3	0.04	10.0	4.4	4.9	0.8	5.0	1.17
Q_{mean}	22.0	6.0	55	39	39.8	30	11.1	3.8
December								
Q_{02}	136	81	880	238	239	179	30	19.5
Q_{10}	52	23.8	159	96	97	72	18.0	8.9
Q_{25}	27.0	9.4	77	55	56	43	13.1	5.7
Q_{50}	13.0	2.8	44	32	33	14.5	9.5	3.7
Q_{75}	4.0	0.55	25.5	19.0	19.7	14.0	7.3	2.4
Q_{90}	1.0	0.14	15.6	9.5	10.1	4.2	5.9	1.65
Q_{98}	0.5	0.03	9.3	3.6	4.2	1.8	4.7	1.31
Q_{mean}	23.9	10.15	82	45	45.8	35	11.6	5.1

Appendix A. Continued

Flow type	Location						
	(29)	(30)	(31)	(32)	(33)	(34)	(35)
Q_{01}	26.7	750	679	965	29.7	467	468
Q_{02}	20.4	449	411	680	22.1	329	330
Q_{05}	13.4	256	255	437	13.6	186	187
Q_{10}	9.3	163	173	302	9.1	111	112
Q_{15}	7.4	119	131	236	7.1	79	79
Q_{25}	5.3	77	88	163	5.0	47	47
Q_{40}	3.8	47	55	109	3.7	24.4	24.7
Q_{50}	3.2	35.3	42	88	3.1	15.7	16
Q_{60}	2.6	26.2	31.9	70	2.6	9.6	9.8
Q_{75}	2.1	17.3	21.3	51	2.0	4.1	4.3
Q_{85}	1.7	13.1	16.3	40	1.7	2.3	2.5
Q_{90}	1.4	10.6	13.6	32	1.5	1.7	1.9
Q_{95}	1.08	7.9	10.2	23.7	1.31	1.23	1.4
Q_{98}	0.83	5.8	6.2	18.7	1.13	0.89	1.03
Q_{99}	0.72	4.8	4.6	16.2	1.04	0.7	0.81
Q_{mean}	4.7	71.1	74.8	140.9	4.73	47.7	47.9
Low Flows							
$Q_{1,2}$	1.13	6.9	6.1	23.4	1.48	1.4	1.5
$Q_{1,10}$	0.6	4.2	3.1	15.1	0.95	0.52	0.58
$Q_{1,25}$	0.46	3.1	1.9	11.5	0.81	0.35	0.4
$Q_{1,50}$	0.41	2.7	1.5	10.2	0.76	0.16	0.21
$Q_{7,2}$	1.18	7.9	7.9	25.7	1.53	1.68	1.87
$Q_{7,10}$	0.67	4.7	4.1	16.4	1.02	0.65	0.76
$Q_{7,25}$	0.53	3.6	2.8	12.7	0.88	0.42	0.52
$Q_{7,50}$	0.48	3	2.2	10.7	0.83	0.22	0.32
$Q_{15,2}$	1.24	9.8	9.7	32	1.59	2.0	2.2
$Q_{15,10}$	0.72	5.7	5.1	19.4	1.07	0.8	0.92
$Q_{15,25}$	0.6	4.6	3.8	16	0.95	0.52	0.63
$Q_{15,50}$	0.55	4.0	3.2	14.1	0.9	0.34	0.45
$Q_{31,2}$	1.31	11.1	11	36	1.66	2.4	2.6
$Q_{31,10}$	0.81	6.4	5.9	21.8	1.16	1.0	1.14
$Q_{31,25}$	0.67	5.3	4.6	18.3	1.02	0.71	0.82
$Q_{31,50}$	0.61	4.4	3.7	15.3	0.96	0.47	0.58
$Q_{61,2}$	1.44	13	13.1	42	1.79	3.1	3.3
Q_{6110}	0.92	7.4	7.0	24.7	1.27	1.2	1.35
$Q_{61,25}$	0.75	6.4	5.9	21.8	1.1	0.83	0.95
$Q_{61,50}$	0.67	5.7	5.0	19.5	1.02	0.6	0.72
$Q_{91,2}$	1.7	16	16.3	50	2.04	4.1	4.3
$Q_{91,10}$	1.0	8.3	8.0	27.7	1.35	1.37	1.54
$Q_{91,25}$	0.83	7.2	6.7	24.3	1.18	0.96	1.1
$Q_{91,50}$	0.75	6.4	5.9	21.8	1.1	0.71	0.84

Appendix A. Continued

Flow type	Location						
	(29)	(30)	(31)	(32)	(33)	(34)	(35)
Drought Flows							
$Q_{6,10}$	1.24	11.7	11.7	38	1.59	2.1	2.3
$Q_{6,25}$	1.11	10.2	10.1	34	1.46	1.4	1.59
$Q_{6,50}$	1.0	9.3	9.0	31.3	1.35	1.14	1.31
$Q_{9,10}$	1.68	16.4	16.7	46	2.03	5.2	5.5
$Q_{9,25}$	1.36	13	13.2	40	1.71	3.2	3.5
$Q_{12,10}$	1.2	11.5	11.5	36	1.55	2.4	2.7
$Q_{12,10}$	2.3	24.6	25.1	61	2.7	12.8	13.1
$Q_{12,25}$	1.9	18.4	18.6	51	2.2	7.8	8.1
$Q_{12,50}$	1.6	15.7	15.8	45	2.0	5.7	6.0
$Q_{18,10}$	2.7	33.2	33.8	75	3.1	15.8	16
$Q_{18,25}$	2.1	20.6	20.9	53	2.5	8.8	9.1
$Q_{18,50}$	1.6	17	17	47	2.0	6.8	7.0
$Q_{30,10}$	3.4	46	46.8	97	3.7	28.5	28.7
$Q_{3o,25}$	2.6	29.2	29.5	66	3.0	15.1	15.4
$Q_{30,50}$	2.0	23.3	23.4	57	2.3	11.7	11.9
$Q_{54,10}$	4.1	60	60.8	128	4.5	40.5	40.8
$Q_{54,25}$	3.0	39	38.7	88	3.4	24.1	24.4
$Q_{54,50}$	2.6	30.6	30.9	72	3.0	17.7	18
January							
Q_{02}	22.3	679	656	501	23.4	326	327
Q_{10}	9.6	569	574	203	9.6	81	81
Q_{25}	5.3	162	169	125	5.2	29.6	29.9
Q_{50}	-	3.5.	39	45	83	3.4	11.5
Q_{75}	2.3	19.1	21.8	57	2.4	3.4	3.6
Q_{90}	1.67	13.7	16.6	43	1.68	1.3	1.5
Q_{98}	1.29	6.3	8.8	18.5	1.3	0.7	0.89
Q_{mean}	5.3	100	104	120	5.0	37	37.3
February							
Q_{02}	25	726	675	831	27.2	377	378
Q_{10}	11.8	303	308	285	11.8	121	122
Q_{25}	6.7	151	158	151	6.6	52	53
Q_{50}	4.0	49	55	89	3.9	18.7	19
Q_{75}	2.7	23.2	25.7	60	2.7	6.5	6.8
Q_{90}	1.89	12.9	16.4	39	1.88	1.8	2.0
Q_{98}	1.39	8.1	11.3	23.7	1.38	1.1	1.2
Q_{mean}	6.0	124	127	157	5.9	52.6	52.9
March							
Q_{02}	31.4	621	570	1083	33.7	446	447
Q_{10}	16	239	244	508	16	194	194
Q_{25}	9.8	132	141	305	9.6	97	97
Q_{50}	6.2	73	81	175	6.0	47	47
Q_{75}	4.1	43	48	107	4.0	19.9	20.2
Q_{90}	3.1	25	29.7	65	3.1	9.6	9.8
Q_{98}	2.2	13.4	17.5	39	2.2	3.1	3.3
Q_{mean}	8.4	121	123	260	8.5	86	86

Appendix A. Continued

Flow type	Location						
	(29)	(30)	(31)	(32)	(33)	(34)	(35)
April							
Q_{02}	28.1	1213	1161	1060	30.3	448	449
Q_{10}	16.2	356	361	503	16.1	195	195
Q_{25}	9.9	174	184	314	9.6	108	108
Q_{50}	6.2	85	93	184	6.1	58	58
Q_{75}	4.2	51	58	121	4.1	30	30
Q_{90}	3.1	32	37	80	3.1	15.1	15.4
Q_{98}	2.4	18.8	21.5	54	2.4	5.4	5.6
Q_{mean}	8.1	148	152	263	8.2	94	94
May							
Q_{02}	20,6	1096	i 045	719	22,9	376	376
Q_{10}	10,2	275	280	340	10.2	133	133
Q_{25}	6.2	124	135	206	6.0	66	67
Q_{50}	4.3	62	69	122	4.2	36	36
Q_{75}	3.2	35	41	74	3.1	20	20.3
Q_{90}	2.5	24	26.2	54	2.5	12.1	12.4
Q_{98}	1.9	13.6	16.8	33	1,9	5.3	5,5
Q_{mean}	5.4	124	128	178	5.8	67	67
June							
Q_{02}	21.9	1328	1277	639	24.2	422	422
Q_{10}	7.5	261	269	306	7.4	131	131
Q_{25}	4.7	112	123	174	4.4	55	56
Q_{50}	3.2	49	56	96	3.2	24.2	24.5
Q_{75}	2.2	26.5	29.3	60	2.5	12.1	12.4
Q_{90}	1.62	13.7	13	36	2.0	6.7	7.0
Q_{98}	1.21	7.4	7.8	21.4	1.5	3.1	3.3
Q_{mean}	4.3	115	119	154	4.9	62	62
July							
Q_{02}	11.2	360	337	531	12.3	251	251
Q_{10}	4.1	105	115	190	3,9	66	66
Q_{25}	3.1	53	63	110	2.9	27.3	27.6
Q_{50}	2.2	28,3	34	66	2.3	11.1	11.3
Q_{75}	1.61	16.3	18.6	44	1.9	4.9	5.2
Q_{90}	1.14	9.4	9.0	29.2	1.5	2.4	2.7
Q_{98}	0.85	5.4	5.4	17	1.18	1.1	1.3
Q_{mean}	2.6	60	64.3	111	3.1	33.9	34.2
August							
Q_{02}	3.8	238	229	380	4.3	189	189
Q_{10}	3.2	62	69	158	3.1	34	34
Q_{25}	2.6	33	41	91	2.5	11.2	11.5
Q_{50}	1,8	21	25.7	61	2.0	4.6	4.9
Q_{75}	1.26	12.7	14	40	1.56	2.3	2.5
Q_{90}	0.85	7.8	7.3	25.4	1.21	1.4	1,6
Q_{98}	0.67	5.0	4.7	16.4	1.0	0.8	0.9
Q_{mean}	1.9	39	42.5	90.2	2,25	20.6	20.8

Appendix A. Continued

Flow type	Location						
	(29)	(30)	(31)	(32)	(33)	(34)	(35)
September							
Q_{02}	11.1	350	348	599	11.4	179	179
Q_{10}	3.9	71	75	191	3.9	33	33
Q_{25}	2.4	32	37	95	2.3	7.9	8.2
Q_{50}	1.8	20	23.5	62	1.8	3.3	3.5
Q_{75}	1.2	12.3	15	38	1.45	1.6	1.8
Q_{90}	0.93	6.9	8.6	21.3	1.19	0.9	1.1
Q_{98}	0.69	4.3	4.7	13.8	0.97	0.5	0.6
Q_{mean}	2.4	49	51.5	120	2.55	19.3	19.5
October							
Q_{02}	11	225	230	406	11	169	170
Q_{10}	4.9	91	96	222	4.9	44	45
Q_{25}	3.3	36	42	102	3.3	14.4	14.6
Q_{50}	2.2	21.1	24.6	65	2.2	3.7	3.9
Q_{75}	1.6	13.4	16.7	42	1.66	1.7	1.9
Q_{90}	1.1	7.8	10	23.8	1.36	1.1	1.3
Q_{98}	0.78	6.3	7.5	20	1.03	0.7	0.8
Q_{mean}	3.0	44	46.8	106	3.1	20.9	21.1
November							
Q_{02}	13.1	248	247	399	13.3	170	170
Q_{10}	7.1	109	114	253	7.1	59	59
Q_{25}	4.3	58	63	160	4.2	22.7	23
Q_{50}	2.7	30	33.6	91	2.7	6.7	6.9
Q_{75}	2.0	19.6	23	62	2.0	2.3	2.5
Q_{90}	1.49	10.9	13.8	34	1.56	1.4	1.6
Q_{98}	1.03	7.7	10	23.9	1.17	0.8	1.0
Q_{mean}	3.9	51	54.7	128	3.8	21.7	22
December							
Q_{02}	19	875	866	519	19.5	266	267
Q_{10}	8.9	155	159	273	8.9	81	81
Q_{25}	5.7	73	79	163	5.7	33	33
Q_{50}	3.8	41	46	112	3.7	11	11.3
Q_{75}	2.4	22.3	24.9	70	2.4	2.9	3.1
Q_{90}	1.65	12.7	15.6	40	1.65	1.3	1.5
Q_{98}	1.31	6.8	9.3	20.6	1.31	0.7	0.9
Q_{mean}	5.3	78	81	151	5.1	34.9	35.2

Note: Streamflow values published by the U.S. Geological Survey ordinarily have 3 significant digits for values greater than and equal to 100 cfs, and 2 significant digits for values less than 100 cfs. Additional significant digits have been added to some streamflow frequency estimates in this appendix when used by ILSAM to estimate relative differences in flow values, either between virgin and present flow conditions, or between flows at two different locations. The additional digits do not indicate an improvement in the accuracy of the streamflow estimates.

Appendix B. Withdrawals and Effluent Discharges: Location and Estimated 1997 Flow Conditions

Facility	Stream name	Code	Mile
1) Algonquin STP	Fox River	V	80.60
2) Antioch WWTP	Sequoit Creek	VZ	1.40
3) Barrington WWTP	Flint Creek Tributary	VUP	0.50
4) Batavia WWTP	Fox River	V	54.80
5) Baxter Healthcare-Round Lake	Squaw Creek Tributary	VYH	2.20
6) Carpentersville-Kimball Hill	Fox River	V	78.50
7) Carpentersville STP	Fox River	V	76.60
8) Cary WWTP	Cary Creek	VT1	0.90
9) Valley Water Company	Fox River	V	44.00
10) Crystal Lake STP #2	Crystal Creek	VS	6.10
11) Crystal Lake STP #3	Sleepy Hollow Creek	VV4	3.40
12) Dial Corporation	Fox River Tributary	VJ3	1.40
13) Earlville STP	Indian Creek	VC	22.61
14) East Dundee WWTP	Fox River	V	74.90
15) Elburn STP	Welch Creek	VHJ	16.00
16) Ferson Creek Utilities, Inc.	Ferson Creek	VN	12.00
17) Fox Lake STP	Fox River	V	104.40
18) Fox Lake Tall Oaks STP	Fox River	V	106.80
19) Fox Metro WRD	Fox River	V	44.50
20) Fox River Grove WWTP	Spring Creek	VT	0.60
21) Fox River WRD North STP	Fox River	V	71.60
22) Fox River WRD South STP	Fox River	V	69.10
23) Fox River WRD West STP	Fox River	V	68.81
24) Geneva STP	Fox River	V	57.30
25) Hebron STP	DeYoung Creek	VXHV	0.50
26) Hinckley STP	Little Rock Creek	VHA	18.40
27) Intermatic, Inc.	Nippersink Creek	VX	7.80
28) Island Lake SD WWTP	Cotton Creek	VV	1.70
29) Lake Barrington Home Assoc.	Fox River	V	82.40
30) Lake in the Hills SD STP	Crystal Creek	VS	2.50
31) McHenry Central STP	Fox River	V	100.10
32) McHenry South STP	Fox River	V	98.90
33) Modine Mfg.-McHenry	Dutch Creek Tributary	VW4J	1.70
34) Mooseheart Board of Governors	Fox River	V	52.99
35) Morton International Ringwood	Dutch Creek Tributary	VW4J	1.80
36) Paw Paw STP	Paw Paw Creek	VCN	8.70
37) Piano STP	Big Rock Creek	VH	1.20
38) Quaker Oats-Barrington	Flint Creek	VU	9.90
39) Richmond STP	North Branch Nippersink	VXH	5.70
40) Sandwich STP	Little Rock Creek Tributary	VHAD	1.60
41) Shabbona STP	Indian Creek	VC	42.30
42) Sheridan STP	Fox River	V	19.10
43) Somonauk STP	Somonauk Creek Tributary	VFH	1.40
44) St. Charles STP	Fox River	V	58.70
45) Sugar Grove STP	Blackberry Creek	VI	17.50
46) TC Industries, Crystal Lake	Sleepy Hollow Creek	VV4	4.00
47) Waterman STP	Somonauk Creek Tributary	VFU	1.80
48) Wauconda WWTP	Slocum Lake Outlet	VU3	4.80
49) Woodstock North STP	Silver Creek	VXP	5.80
50) Yorkville-Bristol SD STP	Fox River	V	35.61
51) Elgin water supply withdrawal	Fox River	V	72.30
52) Aurora water supply withdrawal	Fox River	V	49.90
53) Fermilab water supply withdrawal	Fox River	V	54.70

Notes:

Stream codes are as listed in appendix C, SD - Sanitary District, STP - Sanitary Treatment Plant
WRD - Water Reclamation District, WWTP - Waste Water Treatment Plant

Appendix B. Continued

Flow type	Location									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Q_{01}	4.81	2.85	6.61	7.39	0.92	0.27	6.29	2.64	0.66	7.95
Q_{02}	4.35	2.55	6.06	6.78	0.83	0.25	5.77	2.54	0.61	7.37
Q_{05}	3.82	2.19	5.43	6.07	0.72	0.22	5.17	2.42	0.56	6.70
Q_{10}	3.48	1.96	5.02	5.61	0.66	0.20	4.78	2.35	0.52	6.27
Q_{15}	3.25	1.81	4.74	5.31	0.61	0.19	4.52	2.30	0.50	5.98
Q_{25}	3.03	1.65	4.47	5.00	0.57	0.18	4.26	2.25	0.47	5.69
Q_{40}	2.80	1.50	4.20	4.70	0.52	0.17	4.00	2.20	0.45	5.40
Q_{50}	2.69	1.42	4.06	4.55	0.50	0.16	3.87	2.18	0.44	5.26
Q_{60}	2.57	1.35	3.93	4.40	0.47	0.16	3.74	2.15	0.43	5.11
Q_{75}	2.35	1.19	3.66	4.09	0.43	0.15	3.48	2.10	0.40	4.82
Q_{85}	2.19	1.09	3.47	3.89	0.40	0.14	3.31	2.07	0.39	4.63
Q_{90}	2.04	0.99	3.29	3.68	0.37	0.13	3.14	2.03	0.37	4.44
Q_{95}	1.89	0.89	3.11	3.48	0.34	0.12	2.96	2.00	0.35	4.24
Q_{98}	1.63	0.71	2.79	3.12	0.28	0.11	2.66	1.94	0.33	3.91
Q_{99}	1.40	0.56	2.52	2.82	0.24	0.10	2.40	1.89	0.30	3.62
Q_{mean}	2.80	1.50	4.20	4.70	0.52	0.17	4.00	2.20	0.45	5.40
Low Flows										
$Q_{1,2}$	1.32	0.50	2.43	2.72	0.22	0.10	2.31	1.88	0.29	3.52
$Q_{,1.10}$	0.98	0.27	2.02	2.26	0.16	0.08	1.92	1.80	0.26	3.09
$Q_{1,25}$	0.95	0.25	1.98	2.21	0.15	0.08	1.88	1.79	0.25	3.04
$Q_{1,50}$	0.95	0.25	1.98	2.21	0.15	0.08	1.88	1.79	0.25	3.04
$Q_{7,2}$	2.01	0.96	3.25	3.63	0.36	0.13	3.09	2.03	0.37	4.39
$Q_{7,10}$	1.40	0.56	2.52	2.82	0.24	0.10	2.40	1.89	0.30	3.62
$Q_{7,25}$	1.32	0.50	2.43	2.72	0.22	0.10	2.31	1.88	0.29	3.52
$Q_{7,50}$	1.32	0.50	2.43	2.72	0.22	0.10	2.31	1.88	0.29	3.52
$Q_{15,2}$	2.04	0.99	3.29	3.68	0.37	0.13	3.14	2.03	0.37	4.44
$Q_{15,10}$	1.51	0.63	2.66	2.97	0.26	0.11	2.53	1.92	0.31	3.76
$Q_{15,25}$	1.36	0.53	2.47	2.77	0.23	0.10	2.36	1.88	0.30	3.57
$Q_{15,50}$	1.36	0.53	2.47	2.77	0.23	0.10	2.36	1.88	0.30	3.57
$Q_{31,2}$	2.12	1.04	3.38	3.79	0.38	0.14	3.22	2.05	0.38	4.53
$Q_{31,10}$	1.63	0.71	2.79	3.12	0.28	0.11	2.66	1.94	0.33	3.91
$Q_{31,25}$	1.40	0.56	2.52	2.82	0.24	0.10	2.40	1.89	0.30	3.62
$Q_{31,50}$	1.36	0.53	2.47	2.77	0.23	0.10	2.36	1.88	0.30	3.57
$Q_{61,2}$	2.23	1.12	3.52	3.94	0.41	0.14	3.35	2.08	0.39	4.68
$Q_{61,10}$	1.74	0.78	2.93	3.28	0.31	0.12	2.79	1.97	0.34	4.05
$Q_{61,25}$	1.51	0.63	2.66	2.97	0.26	0.11	2.53	1.92	0.31	3.76
$Q_{61,50}$	1.44	0.58	2.57	2.87	0.25	0.10	2.44	1.90	0.31	3.67
$Q_{91,2}$	2.35	1.19	3.66	4.09	0.43	0.15	3.48	2.10	0.40	4.82
$Q_{91,10}$	1.89	0.89	3.11	3.48	0.34	0.12	2.96	2.00	0.35	4.24
$Q_{91,25}$	1.63	0.71	2.79	3.12	0.28	0.11	2.66	1.94	0.33	3.91
$Q_{91,50}$	1.59	0.68	2.75	3.07	0.28	0.11	2.62	1.93	0.32	3.86

Appendix B. Continued

Flow type	Location									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Drought Flows										
$Q_{6,IO}$	2.19	1.09	3.47	3.89	0.40	0.14	3.31	2.07	0.39	4.63
$Q_{6,25}$	2.01	0.96	3.25	3.63	0.36	0.13	3.09	2.03	0.37	4.39
$Q_{6,50}$	1.89	0.89	3.11	3.48	0.34	0.12	2.96	2.00	0.35	4.24
$Q_{9,10}$	2.40	1.23	3.72	4.17	0.44	0.15	3.55	2.11	0.41	4.89
$Q_{9,25}$	2.27	1.14	3.56	3.99	0.41	0.14	3.39	2.08	0.39	4.73
$Q_{9,50}$	2.16	1.07	3.43	3.84	0.39	0.14	3.26	2.06	0.38	4.58
$Q_{12,10}$	2.61	1.37	3.97	4.45	0.48	0.16	3.78	2.16	0.43	5.16
$Q_{12,25}$	2.46	1.27	3.79	4.24	0.45	0.15	3.61	2.13	0.41	4.97
$Q_{12,50}$	2.31	1.17	3.61	4.04	0.42	0.15	3.44	2.09	0.40	4.77
$Q_{18,10}$	2.72	1.45	4.11	4.60	0.50	0.17	3.91	2.18	0.44	5.30
$Q_{18,25}$	2.54	1.32	3.88	4.34	0.47	0.16	3.70	2.14	0.42	5.06
$Q_{l8,50}$	2.40	1.23	3.72	4.17	0.44	0.15	3.55	2.11	0.41	4.89
$Q_{3O,10}$	2.84	1.53	4.25	4.75	0.53	0.17	4.04	2.21	0.45	5.45
$Q_{30,25}$	2.65	1.40	4.02	4.50	0.49	0.16	3.83	2.17	0.43	5.21
$Q_{30,50}$	2.54	1.32	3.88	4.34	0.47	0.16	3.70	2.14	0.42	5.06
$Q_{54,10}$	2.99	1.63	4.43	4.95	0.56	0.18	4.22	2.24	0.47	5.64
$Q_{54,25}$	2.72	1.45	4.11	4.60	0.50	0.17	3.91	2.18	0.44	5.30
$Q_{54,50}$	2.65	1.40	4.02	4.50	0.49	0.16	3.83	2.17	0.43	5.21
January										
Q_{02}	4.46	2.62	6.20	6.94	0.85	0.25	5.90	2.57	0.63	7.52
Q_{10}	3.48	1.96	5.02	5.61	0.66	0.20	4.78	2.35	0.52	6.27
Q_{25}	3.03	1.65	4.47	5.00	0.57	0.18	4.26	2.25	0.47	5.69
Q_{50}	2.69	1.42	4.06	4.55	0.50	0.16	3.87	2.18	0.44	5.26
Q_{75}	2.35	1.19	3.66	4.09	0.43	0.15	3.48	2.10	0.40	4.82
Q_{90}	2.02	0.98	3.27	3.66	0.36	0.13	3.11	2.03	0.37	4.41
Q_{98}	1.74	0.78	2.93	3.28	0.31	0.12	2.79	1.97	0.34	4.05
Q_{mean}	2.95	1.60	4.38	4.90	0.55	0.18	4.17	2.23	0.47	5.59
February										
Q_{02}	4.65	2.75	6.42	7.19	0.89	0.26	6.12	2.61	0.65	7.76
Q_{l0}	3.63	2.06	5.20	5.82	0.69	0.21	4.95	2.38	0.54	6.46
Q_{25}	3.22	1.78	4.70	5.26	0.60	0.19	4.48	2.29	0.49	5.93
Q_{50}	2.80	1.50	4.20	4.70	0.52	0.17	4.00	2.20	0.45	5.40
Q_{75}	2.46	1.27	3.79	4.24	0.45	0.15	3.61	2.13	0.41	4.97
Q_{90}	2.23	1.12	3.52	3.94	0.41	0.14	3.35	2.08	0.39	4.68
Q_{98}	1.97	0.94	3.20	3.58	0.35	0.13	3.05	2.02	0.36	4.34
Q_{mean}	3.07	1.68	4.53	5.07	0.57	0.18	4.31	2.26	0.48	5.75
March										
Q_{02}	4.81	2.85	6.61	7.39	0.92	0.27	6.29	2.64	0.66	7.95
Q_{l0}	3.82	2.19	5.43	6.07	0.72	0.22	5.17	2.42	0.56	6.70
Q_{25}	3.37	1.88	4.88	5.46	0.63	0.20	4.65	2.32	0.51	6.12
Q_{50}	3.03	1.65	4.47	5.00	0.57	0.18	4.26	2.25	0.47	5.69
Q_{75}	2.72	1.45	4.11	4.60	0.50	0.17	3.91	2.18	0.44	5.30
Q_{90}	2.57	1.35	3.93	4.40	0.47	0.16	3.74	2.15	0.43	5.11
Q_{98}	2.19	1.09	3.47	3.89	0.40	0.14	3.31	2.07	0.39	4.63
Q_{mean}	3.17	1.75	4.64	5.20	0.59	0.19	4.42	2.28	0.49	5.87

Appendix B. Continued

Flow type	Location									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
April										
Q_{02}	4.81	2.85	6.61	7.39	0.92	0.27	6.29	2.64	0.66	7.95
Q_{10}	3.82	2.19	5.43	6.07	0.72	0.22	5.17	2.42	0.56	6.70
Q_{25}	3.44	1.93	4.97	5.56	0.65	0.20	4.74	2.34	0.52	6.22
Q_{50}	3.10	1.70	4.56	5.11	0.58	0.19	4.35	2.27	0.48	5.79
Q_{75}	2.80	1.50	4.20	4.70	0.52	0.17	4.00	2.20	0.45	5.40
Q_{90}	2.65	1.40	4.02	4.50	0.49	0.16	3.83	2.17	0.43	5.21
Q_{98}	2.27	1.14	3.56	3.99	0.41	0.14	3.39	2.08	0.39	4.73
Q_{mean}	3.17	1.75	4.65	5.20	0.60	0.19	4.43	2.28	0.49	5.88
May										
Q_{02}	4.81	2.85	6.61	7.39	0.92	0.27	6.29	2.64	0.66	7.95
Q_{10}	3.63	2.06	5.20	5.82	0.69	0.21	4.95	2.38	0.54	6.46
Q_{25}	3.17	1.75	4.64	5.19	0.59	0.19	4.42	2.28	0.49	5.87
Q_{50}	2.91	1.58	4.34	4.85	0.54	0.18	4.13	2.22	0.46	5.54
Q_{75}	2.72	1.45	4.11	4.60	0.50	0.17	3.91	2.18	0.44	5.30
Q_{90}	2.61	1.37	3.97	4.45	0.48	0.16	3.78	2.16	0.43	5.16
Q_{98}	2.23	1.12	3.52	3.94	0.41	0.14	3.35	2.08	0.39	4.68
Q_{mean}	3.06	1.68	4.52	5.06	0.57	0.18	4.30	2.26	0.48	5.74
June										
Q_{02}	4.81	2.85	6.61	7.39	0.92	0.27	6.29	2.64	0.66	7.95
Q_{10}	3.63	2.06	5.20	5.82	0.69	0.21	4.95	2.38	0.54	6.46
Q_{25}	3.14	1.73	4.61	5.16	0.59	0.19	4.39	2.27	0.49	5.83
Q_{50}	2.80	1.50	4.20	4.70	0.52	0.17	4.00	2.20	0.45	5.40
Q_{75}	2.65	1.40	4.02	4.50	0.49	0.16	3.83	2.17	0.43	5.21
Q_{90}	2.50	1.30	3.84	4.29	0.46	0.15	3.65	2.13	0.42	5.01
Q_{98}	2.19	1.09	3.47	3.89	0.40	0.14	3.31	2.07	0.39	4.63
Q_{mean}	2.83	1.52	4.24	4.75	0.53	0.17	4.04	2.21	0.45	5.44
July										
Q_{02}	4.09	2.37	5.74	6.43	0.78	0.23	5.47	2.48	0.59	7.04
Q_{10}	3.25	1.81	4.74	5.31	0.61	0.19	4.52	2.30	0.50	5.98
Q_{25}	2.88	1.55	4.29	4.80	0.54	0.17	4.09	2.22	0.46	5.50
Q_{50}	2.69	1.42	4.06	4.55	0.50	0.16	3.87	2.18	0.44	5.26
Q_{75}	2.42	1.24	3.75	4.19	0.44	0.15	3.57	2.12	0.41	4.92
Q_{90}	2.23	1.12	3.52	3.94	0.41	0.14	3.35	2.08	0.39	4.68
Q_{98}	1.89	0.89	3.11	3.48	0.34	0.12	2.96	2.00	0.35	4.24
Q_{mean}	2.61	1.37	3.97	4.45	0.48	0.16	3.78	2.16	0.43	5.16
August										
Q_{02}	3.82	2.19	5.43	6.07	0.72	0.22	5.17	2.42	0.56	6.70
Q_{10}	2.99	1.63	4.43	4.95	0.56	0.18	4.22	2.24	0.47	5.64
Q_{25}	2.65	1.40	4.02	4.50	0.49	0.16	3.83	2.17	0.43	5.21
Q_{50}	2.40	1.23	3.72	4.17	0.44	0.15	3.55	2.11	0.41	4.89
Q_{75}	2.23	1.12	3.52	3.94	0.41	0.14	3.35	2.08	0.39	4.68
Q_{90}	2.02	0.98	3.27	3.66	0.36	0.13	3.11	2.03	0.37	4.41
Q_{98}	1.63	0.71	2.79	3.12	0.28	0.11	2.66	1.94	0.33	3.91
Q_{mean}	2.42	1.24	3.75	4.19	0.44	0.15	3.57	2.12	0.41	4.92

Appendix B. Continued

Flow type	Location									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
September										
Q_{02}	3.48	1.96	5.02	5.61	0.66	0.20	4.78	2.35	0.52	6.27
Q_{10}	2.76	1.47	4.15	4.65	0.51	0.17	3.96	2.19	0.45	5.35
Q_{25}	2.42	1.24	3.75	4.19	0.44	0.15	3.57	2.12	0.41	4.92
Q_{50}	2.23	1.12	3.52	3.94	0.41	0.14	3.35	2.08	0.39	4.68
Q_{75}	2.04	0.99	3.29	3.68	0.37	0.13	3.14	2.03	0.37	4.44
Q_{90}	1.89	0.89	3.11	3.48	0.34	0.12	2.96	2.00	0.35	4.24
Q_{98}	1.40	0.56	2.52	2.82	0.24	0.10	2.40	1.89	0.30	3.62
Q_{mean}	2.34	1.19	3.65	4.08	0.43	0.15	3.47	2.10	0.40	4.81
October										
Q_{02}	3.59	2.04	5.15	5.77	0.68	0.21	4.91	2.37	0.53	6.41
Q_{10}	2.91	1.58	4.34	4.85	0.54	0.18	4.13	2.22	0.46	5.54
Q_{25}	2.57	1.35	3.93	4.40	0.47	0.16	3.74	2.15	0.43	5.11
Q_{50}	2.23	1.12	3.52	3.94	0.41	0.14	3.35	2.08	0.39	4.68
Q_{75}	2.02	0.98	3.27	3.66	0.36	0.13	3.11	2.03	0.37	4.41
Q_{90}	1.74	0.78	2.93	3.28	0.31	0.12	2.79	1.97	0.34	4.05
Q_{98}	1.32	0.50	2.43	2.72	0.22	0.10	2.31	1.88	0.29	3.52
Q_{mean}	2.33	1.18	3.64	4.07	0.43	0.15	3.46	2.10	0.40	4.80
November										
Q_{02}	3.75	2.14	5.34	5.97	0.71	0.22	5.08	2.41	0.55	6.60
Q_{10}	3.03	1.65	4.47	5.00	0.57	0.18	4.26	2.25	0.47	5.69
Q_{25}	2.72	1.45	4.11	4.60	0.50	0.17	3.91	2.18	0.44	5.30
Q_{50}	2.40	1.23	3.72	4.17	0.44	0.15	3.55	2.11	0.41	4.89
Q_{75}	2.16	1.07	3.43	3.84	0.39	0.14	3.26	2.06	0.38	4.58
Q_{90}	1.89	0.89	3.11	3.48	0.34	0.12	2.96	2.00	0.35	4.24
Q_{98}	1.40	0.56	2.52	2.82	0.24	0.10	2.40	1.89	0.30	3.62
Q_{mean}	2.69	1.42	4.06	4.55	0.50	0.16	3.87	2.18	0.44	5.26
December										
Q_{02}	4.35	2.55	6.06	6.78	0.83	0.25	5.77	2.54	0.61	7.37
Q_{10}	3.25	1.81	4.74	5.31	0.61	0.19	4.52	2.30	0.50	5.98
Q_{25}	2.80	1.50	4.20	4.70	0.52	0.17	4.00	2.20	0.45	5.40
Q_{50}	2.54	1.32	3.88	4.34	0.47	0.16	3.70	2.14	0.42	5.06
Q_{75}	2.23	1.12	3.52	3.94	0.41	0.14	3.35	2.08	0.39	4.68
Q_{90}	1.97	0.94	3.20	3.58	0.35	0.13	3.05	2.02	0.36	4.34
Q_{98}	1.59	0.68	2.75	3.07	0.28	0.11	2.62	1.93	0.32	3.86
Q_{mean}	2.94	1.60	4.37	4.89	0.55	0.18	4.16	2.23	0.47	5.58

Appendix B. Continued

Flow type	Location									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Q_{01}	1.11	0.96	0.73	1.34	1.27	0.33	16.20	0.17	64.12	1.65
Q_{02}	1.01	0.85	0.66	1.23	1.14	0.29	14.87	0.16	59.65	1.53
Q_{05}	0.90	0.73	0.58	1.09	1.00	0.25	13.31	0.15	54.44	1.38
Q_{10}	0.83	0.66	0.53	1.00	0.91	0.22	12.30	0.14	51.10	1.29
Q_{15}	0.78	0.60	0.49	0.95	0.84	0.21	11.64	0.14	48.86	1.22
Q_{25}	0.73	0.55	0.46	0.89	0.78	0.19	10.97	0.13	46.63	1.16
Q_{40}	0.68	0.50	0.42	0.83	0.72	0.17	10.30	0.13	44.40	1.10
Q_{50}	0.66	0.47	0.40	0.80	0.69	0.16	9.97	0.13	43.28	1.07
Q_{60}	0.63	0.45	0.38	0.77	0.66	0.15	9.63	0.13	42.17	1.04
Q_{75}	0.58	0.40	0.35	0.71	0.60	0.13	8.96	0.12	39.94	0.98
Q_{85}	0.55	0.36	0.33	0.68	0.55	0.12	8.52	0.12	38.45	0.93
Q_{90}	0.52	0.33	0.30	0.64	0.51	0.11	8.07	0.11	36.96	0.89
Q_{95}	0.49	0.29	0.28	0.60	0.47	0.10	7.63	0.11	35.47	0.85
Q_{98}	0.43	0.23	0.24	0.53	0.40	0.08	6.85	0.10	32.87	0.78
Q_{99}	0.38	0.18	0.20	0.47	0.34	0.06	6.18	0.10	30.64	0.72
Q_{mean}	0.68	0.50	0.42	0.83	0.72	0.17	10.30	0.13	44.40	1.10
Low Flows										
$Q_{1,2}$	0.36	0.16	0.19	0.45	0.32	0.05	5.96	0.10	29.89	0.69
$Q_{1,10}$	0.29	0.08	0.14	0.37	0.22	0.03	4.96	0.09	26.54	0.60
$Q_{1,25}$	0.28	0.08	0.13	0.36	0.21	0.02	4.84	0.09	26.17	0.59
$Q_{1,50}$	0.28	0.08	0.13	0.36	0.21	0.02	4.84	0.09	26.17	0.59
$Q_{7,2}$	0.51	0.32	0.30	0.63	0.50	0.11	7.96	0.11	36.59	0.88
$Q_{7,10}$	0.38	0.18	0.20	0.47	0.34	0.06	6.18	0.10	30.64	0.72
$Q_{7,25}$	0.36	0.16	0.19	0.45	0.32	0.05	5.96	0.10	29.89	0.69
$Q_{7,50}$	0.36	0.16	0.19	0.45	0.32	0.05	5.96	0.10	29.89	0.69
$Q_{15,2}$	0.52	0.33	0.30	0.64	0.51	0.11	8.07	0.11	36.96	0.89
$Q_{15,10}$	0.41	0.21	0.22	0.50	0.37	0.07	6.51	0.10	31.75	0.75
$Q_{15,25}$	0.37	0.17	0.20	0.46	0.33	0.06	6.07	0.10	30.26	0.70
$Q_{15,50}$	0.37	0.17	0.20	0.46	0.33	0.06	6.07	0.10	30.26	0.70
$Q_{31,2}$	0.53	0.34	0.31	0.66	0.53	0.12	8.30	0.12	37.70	0.91
$Q_{31,10}$	0.43	0.23	0.24	0.53	0.40	0.08	6.85	0.10	32.87	0.78
$Q_{31,25}$	0.38	0.18	0.20	0.47	0.34	0.06	6.18	0.10	30.64	0.72
$Q_{31,50}$	0.37	0.17	0.20	0.46	0.33	0.06	6.07	0.10	30.26	0.70
$Q_{61,2}$	0.56	0.37	0.33	0.69	0.57	0.13	8.63	0.12	38.82	0.94
$Q_{61,10}$	0.45	0.26	0.25	0.56	0.43	0.09	7.18	0.11	33.98	0.81
$Q_{61.25}$	0.41	0.21	0.22	0.50	0.37	0.07	6.51	0.10	31.75	0.75
$Q_{61,50}$	0.39	0.19	0.21	0.48	0.35	0.06	6.29	0.10	31.01	0.73
$Q_{91,2}$	0.58	0.40	0.35	0.71	0.60	0.13	8.96	0.12	39.94	0.98
$Q_{91,10}$	0.49	0.29	0.28	0.60	0.47	0.10	7.63	0.11	35.47	0.85
$Q_{91,25}$	0.43	0.23	0.24	0.53	0.40	0.08	6.85	0.10	32.87	0.78
$Q_{91,50}$	0.42	0.22	0.23	0.52	0.39	0.07	6.74	0.10	32.50	0.77

Appendix B. Continued

Flow type	Location									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Drought Flows										
$Q_{6,10}$	0.55	0.36	0.33	0.68	0.55	0.12	8.52	0.12	38.45	0.93
$Q_{6,25}$	0.51	0.32	0.30	0.63	0.50	0.11	7.96	0.11	36.59	0.88
$Q_{6,50}$	0.49	0.29	0.28	0.60	0.47	0.10	7.63	0.11	35.47	0.85
$Q_{9,10}$	0.60	0.41	0.36	0.73	0.61	0.14	9.13	0.12	40.49	0.99
$Q_{9,25}$	0.57	0.38	0.34	0.69	0.58	0.13	8.74	0.12	39.19	0.95
$Q_{9,50}$	0.54	0.35	0.32	0.67	0.54	0.12	8.41	0.12	38.08	0.92
$Q_{12,10}$	0.64	0.46	0.39	0.78	0.67	0.16	9.74	0.13	42.54	1.05
$Q_{12,25}$	0.61	0.42	0.37	0.74	0.63	0.14	9.30	0.12	41.05	1.01
$Q_{12,50}$	0.57	0.39	0.34	0.70	0.59	0.13	8.85	0.12	39.56	0.96
$Q_{18,10}$	0.66	0.48	0.41	0.81	0.70	0.16	10.08	0.13	43.66	1.08
$Q_{18,25}$	0.62	0.44	0.38	0.76	0.65	0.15	9.52	0.12	41.80	1.03
$Q_{18,50}$	0.60	0.41	0.36	0.73	0.61	0.14	9.13	0.12	40.49	0.99
$Q_{30,10}$	0.69	0.51	0.43	0.84	0.73	0.17	10.41	0.13	44.77	1.11
$Q_{30,25}$	0.65	0.47	0.40	0.79	0.68	0.16	9.85	0.13	42.91	1.06
$Q_{30,50}$	0.62	0.44	0.38	0.76	0.65	0.15	9.52	0.12	41.80	1.03
$Q_{54,10}$	0.72	0.54	0.45	0.88	0.77	0.18	10.86	0.13	46.26	1.15
$Q_{54,25}$	0.66	0.48	0.41	0.81	0.70	0.16	10.08	0.13	43.66	1.08
$Q_{54,50}$	0.65	0.47	0.40	0.79	0.68	0.16	9.85	0.13	42.91	1.06
January										
Q_{02}	1.04	0.88	0.68	1.25	1.17	0.30	15.20	0.17	60.77	1.56
Q_{10}	0.83	0.66	0.53	1.00	0.91	0.22	12.30	0.14	51.10	1.29
Q_{25}	0.73	0.55	0.46	0.89	0.78	0.19	10.97	0.13	46.63	1.16
Q_{50}	0.66	0.47	0.40	0.80	0.69	0.16	9.97	0.13	43.28	1.07
Q_{75}	0.58	0.40	0.35	0.71	0.60	0.13	8.96	0.12	39.94	0.98
Q_{90}	0.51	0.32	0.30	0.63	0.51	0.11	8.02	0.11	36.77	0.89
Q_{98}	0.45	0.26	0.25	0.56	0.43	0.09	7.18	0.11	33.98	0.81
Q_{mean}	0.71	0.53	0.44	0.87	0.76	0.18	10.75	0.13	45.89	1.14
February										
Q_{02}	1.08	0.92	0.71	1.30	1.23	0.32	15.76	0.17	62.63	1.61
Q_{10}	0.86	0.69	0.55	1.04	0.95	0.24	12.75	0.15	52.58	1.33
Q_{25}	0.77	0.60	0.48	0.94	0.83	0.20	11.52	0.14	48.49	1.21
Q_{50}	0.68	0.50	0.42	0.83	0.72	0.17	10.30	0.13	44.40	1.10
Q_{75}	0.61	0.42	0.37	0.74	0.63	0.14	9.30	0.12	41.05	1.01
Q_{90}	0.56	0.37	0.33	0.69	0.57	0.13	8.63	0.12	38.82	0.94
Q_{98}	0.50	0.31	0.29	0.62	0.49	0.10	7.85	0.11	36.22	0.87
Q_{mean}	0.74	0.56	0.46	0.90	0.79	0.19	11.10	0.14	47.08	1.17
March										
Q_{02}	1.11	0.96	0.73	1.34	1.27	0.33	16.20	0.17	64.12	1.65
Q_{10}	0.90	0.73	0.58	1.09	1.00	0.25	13.31	0.15	54.44	1.38
Q_{25}	0.80	0.63	0.51	0.97	0.87	0.21	11.97	0.14	49.98	1.26
Q_{50}	0.73	0.55	0.46	0.89	0.78	0.19	10.97	0.13	46.63	1.16
Q_{75}	0.66	0.48	0.41	0.81	0.70	0.16	10.08	0.13	43.66	1.08
Q_{90}	0.63	0.45	0.38	0.77	0.66	0.15	9.63	0.13	42.17	1.04
Q_{98}	0.55	0.36	0.33	0.68	0.55	0.12	8.52	0.12	38.45	0.93
Q_{mean}	0.76	0.58	0.48	0.92	0.82	0.20	11.39	0.14	48.05	1.20

Appendix B. Continued

Flow type	Location									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
April										
Q_{02}	1.11	0.96	0.73	1.34	1.27	0.33	16.20	0.17	64.12	1.65
Q_{10}	0.90	0.73	0.58	1.09	1.00	0.25	13.31	0.15	54.44	1.38
Q_{25}	0.82	0.65	0.52	0.99	0.90	0.22	12.19	0.14	50.72	1.28
Q_{50}	0.74	0.57	0.47	0.91	0.80	0.19	11.19	0.14	47.38	1.18
Q_{75}	0.68	0.50	0.42	0.83	0.72	0.17	10.30	0.13	44.40	1.10
Q_{90}	0.65	0.47	0.40	0.79	0.68	0.16	9.85	0.13	42.91	1.06
Q_{98}	0.57	0.38	0.34	0.69	0.58	0.13	8.74	0.12	39.19	0.95
Q_{mean}	0.76	0.59	0.48	0.93	0.82	0.20	11.40	0.14	48.08	1.20
May										
Q_{02}	1.11	0.96	0.73	1.34	1.27	0.33	16.20	0.17	64.12	1.65
Q_{10}	0.86	0.69	0.55	1.04	0.95	0.24	12.75	0.15	52.58	1.33
Q_{25}	0.76	0.58	0.48	0.92	0.82	0.20	11.38	0.14	48.01	1.20
Q_{50}	0.70	0.53	0.44	0.86	0.75	0.18	10.63	0.13	45.52	1.13
Q_{75}	0.66	0.48	0.41	0.81	0.70	0.16	10.08	0.13	43.66	1.08
Q_{90}	0.64	0.46	0.39	0.78	0.67	0.16	9.74	0.13	42.54	1.05
Q_{98}	0.56	0.37	0.33	0.69	0.57	0.13	8.63	0.12	38.82	0.94
Q_{mean}	0.74	0.56	0.46	0.90	0.79	0.19	11.08	0.14	47.00	1.17
June										
Q_{02}	1.11	0.96	0.73	1.34	1.27	0.33	16.20	0.17	64.12	1.65
Q_{10}	0.86	0.69	0.55	1.04	0.95	0.24	12.75	0.15	52.58	1.33
Q_{25}	0.75	0.58	0.47	0.92	0.81	0.20	11.30	0.14	47.75	1.19
Q_{50}	0.68	0.50	0.42	0.83	0.72	0.17	10.30	0.13	44.40	1.10
Q_{75}	0.65	0.47	0.40	0.79	0.68	0.16	9.85	0.13	42.91	1.06
Q_{90}	0.62	0.43	0.37	0.75	0.64	0.15	9.41	0.12	41.42	1.02
Q_{98}	0.55	0.36	0.33	0.68	0.55	0.12	8.52	0.12	38.45	0.93
Q_{mean}	0.69	0.51	0.43	0.84	0.73	0.17	10.40	0.13	44.73	1.11
July										
Q_{02}	0.95	0.79	0.62	1.16	1.07	0.27	14.09	0.16	57.05	1.45
Q_{10}	0.78	0.60	0.49	0.95	0.84	0.21	11.64	0.14	48.86	1.22
Q_{25}	0.70	0.52	0.43	0.85	0.74	0.18	10.52	0.13	45.14	1.12
Q_{50}	0.66	0.47	0.40	0.80	0.69	0.16	9.97	0.13	43.28	1.07
Q_{75}	0.60	0.41	0.36	0.73	0.62	0.14	9.19	0.12	40.68	1.00
Q_{90}	0.56	0.37	0.33	0.69	0.57	0.13	8.63	0.12	38.82	0.94
Q_{98}	0.49	0.29	0.28	0.60	0.47	0.10	7.63	0.11	35.47	0.85
Q_{mean}	0.64	0.46	0.39	0.78	0.67	0.16	9.74	0.13	42.54	1.05
August										
Q_{02}	0.90	0.73	0.58	1.09	1.00	0.25	13.31	0.15	54.44	1.38
Q_{10}	0.72	0.54	0.45	0.88	0.77	0.18	10.86	0.13	46.26	1.15
Q_{25}	0.65	0.47	0.40	0.79	0.68	0.16	9.85	0.13	42.91	1.06
Q_{50}	0.60	0.41	0.36	0.73	0.61	0.14	9.13	0.12	40.49	0.99
Q_{75}	0.56	0.37	0.33	0.69	0.57	0.13	8.63	0.12	38.82	0.94
Q_{90}	0.51	0.32	0.30	0.63	0.51	0.11	8.02	0.11	36.77	0.89
Q_{98}	0.43	0.23	0.24	0.53	0.40	0.08	6.85	0.10	32.87	0.78
Q_{mean}	0.60	0.41	0.36	0.73	0.62	0.14	9.19	0.12	40.68	1.00

Appendix B. Continued

Flow type	Location									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
September										
Q_{02}	0.83	0.66	0.53	1.00	0.91	0.22	12.30	0.14	51.10	1.29
Q_{10}	0.67	0.49	0.41	0.82	0.71	0.17	10.19	0.13	44.03	1.09
Q_{25}	0.60	0.41	0.36	0.73	0.62	0.14	9.19	0.12	40.68	1.00
Q_{50}	0.56	0.37	0.33	0.69	0.57	0.13	8.63	0.12	38.82	0.94
Q_{75}	0.52	0.33	0.30	0.64	0.51	0.11	8.07	0.11	36.96	0.89
Q_{90}	0.49	0.29	0.28	0.60	0.47	0.10	7.63	0.11	35.47	0.85
Q_{98}	0.38	0.18	0.20	0.47	0.34	0.06	6.18	0.10	30.64	0.72
Q_{mean}	0.58	0.39	0.35	0.71	0.59	0.13	8.94	0.12	39.86	0.97
October										
Q_{02}	0.85	0.68	0.54	1.03	0.94	0.23	12.64	0.15	52.21	1.32
Q_{10}	0.70	0.53	0.44	0.86	0.75	0.18	10.63	0.13	45.52	1.13
Q_{25}	0.63	0.45	0.38	0.77	0.66	0.15	9.63	0.13	42.17	1.04
Q_{50}	0.56	0.37	0.33	0.69	0.57	0.13	8.63	0.12	38.82	0.94
Q_{75}	0.51	0.32	0.30	0.63	0.51	0.11	8.02	0.11	36.77	0.89
Q_{90}	0.45	0.26	0.25	0.56	0.43	0.09	7.18	0.11	33.98	0.81
Q_{98}	0.36	0.16	0.19	0.45	0.32	0.05	5.96	0.10	29.89	0.69
Q_{mean}	0.58	0.39	0.35	0.71	0.59	0.13	8.92	0.12	39.79	0.97
November										
Q_{02}	0.88	0.72	0.57	1.07	0.98	0.24	13.08	0.15	53.70	1.36
Q_{10}	0.73	0.55	0.46	0.89	0.78	0.19	10.97	0.13	46.63	1.16
Q_{25}	0.66	0.48	0.41	0.81	0.70	0.16	10.08	0.13	43.66	1.08
Q_{50}	0.60	0.41	0.36	0.73	0.61	0.14	9.13	0.12	40.49	0.99
Q_{75}	0.54	0.35	0.32	0.67	0.54	0.12	8.41	0.12	38.08	0.92
Q_{90}	0.49	0.29	0.28	0.60	0.47	0.10	7.63	0.11	35.47	0.85
Q_{98}	0.38	0.18	0.20	0.47	0.34	0.06	6.18	0.10	30.64	0.72
Q_{mean}	0.66	0.47	0.40	0.80	0.69	0.16	9.97	0.13	43.28	1.07
December										
Q_{02}	1.01	0.85	0.66	1.23	1.14	0.29	14.87	0.16	59.65	1.53
Q_{10}	0.78	0.60	0.49	0.95	0.84	0.21	11.64	0.14	48.86	1.22
Q_{25}	0.68	0.50	0.42	0.83	0.72	0.17	10.30	0.13	44.40	1.10
Q_{50}	0.62	0.44	0.38	0.76	0.65	0.15	9.52	0.12	41.80	1.03
Q_{75}	0.56	0.37	0.33	0.69	0.57	0.13	8.63	0.12	38.82	0.94
Q_{90}	0.50	0.31	0.29	0.62	0.49	0.10	7.85	0.11	36.22	0.87
Q_{98}	0.42	0.22	0.23	0.52	0.39	0.07	6.74	0.10	32.50	0.77
Q_{mean}	0.71	0.53	0.44	0.87	0.76	0.18	10.72	0.13	45.81	1.14

Appendix B. Continued

Flow type	Location									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Q_{01}	10.79	31.67	2.04	6.39	0.25	0.58	1.40	1.93	1.05	3.86
Q_{02}	10.02	29.32	1.88	5.87	0.22	0.53	1.29	1.83	0.97	3.66
Q_{05}	9.13	26.58	1.68	5.27	0.19	0.47	1.17	1.72	0.87	3.44
Q_{10}	8.55	24.82	1.55	4.88	0.17	0.43	1.09	1.65	0.80	3.29
Q_{15}	8.17	23.65	1.47	4.62	0.16	0.41	1.04	1.60	0.76	3.19
Q_{25}	7.78	22.47	1.38	4.36	0.14	0.38	0.98	1.55	0.71	3.10
Q_{40}	7.40	21.30	1.30	4.10	0.13	0.36	0.93	1.50	0.67	3.00
Q_{50}	7.21	20.71	1.26	3.97	0.12	0.35	0.90	1.48	0.65	2.95
Q_{60}	7.02	20.13	1.22	3.84	0.12	0.34	0.88	1.45	0.63	2.90
Q_{75}	6.63	18.95	1.13	3.58	0.10	0.31	0.82	1.40	0.58	2.81
Q_{85}	6.38	18.17	1.08	3.41	0.10	0.29	0.79	1.37	0.55	2.74
Q_{90}	6.12	17.39	1.02	3.24	0.09	0.28	0.75	1.34	0.53	2.68
Q_{95}	5.86	16.60	0.96	3.06	0.08	0.26	0.72	1.31	0.50	2.61
Q_{98}	5.42	15.23	0.86	2.76	0.06	0.23	0.66	1.25	0.45	2.50
Q_{99}	5.03	14.06	0.78	2.50	0.05	0.21	0.60	1.20	0.40	2.40
Q_{mean}	7.40	21.30	1.30	4.10	0.13	0.36	0.93	1.50	0.67	3.00
Low Flows										
$Q_{1,2}$	4.90	13.67	0.75	2.41	0.05	0.20	0.59	1.18	0.39	2.37
$Q_{1,10}$	4.33	11.90	0.63	2.03	0.03	0.16	0.51	1.11	0.32	2.22
$Q_{1,25}$	4.26	11.71	0.61	1.98	0.02	0.16	0.50	1.10	0.32	2.21
$Q_{1,50}$	4.26	11.71	0.61	1.98	0.02	0.16	0.50	1.10	0.32	2.21
$Q_{7,2}$	6.06	17.19	1.00	3.19	0.08	0.27	0.75	1.33	0.52	2.66
$Q_{7,10}$	5.03	14.06	0.78	2.50	0.05	0.21	0.60	1.20	0.40	2.40
$Q_{7,25}$	4.90	13.67	0.75	2.41	0.05	0.20	0.59	1.18	0.39	2.37
$Q_{7,50}$	4.90	13.67	0.75	2.41	0.05	0.20	0.59	1.18	0.39	2.37
$Q_{15,2}$	6.12	17.39	1.02	3.24	0.09	0.28	0.75	1.34	0.53	2.68
$Q_{15,10}$	5.22	14.65	0.82	2.63	0.06	0.22	0.63	1.22	0.42	2.45
$Q_{l5,25}$	4.97	13.86	0.77	2.46	0.05	0.20	0.60	1.19	0.39	2.38
$Q_{15,50}$	4.97	13.86	0.77	2.46	0.05	0.20	0.60	1.19	0.39	2.38
$Q_{31,2}$	6.25	17.78	1.05	3.32	0.09	0.29	0.77	1.35	0.54	2.71
$Q_{31,10}$	5.42	15.23	0.86	2.76	0.06	0.23	0.66	1.25	0.45	2.50
$Q_{31,25}$	5.03	14.06	0.78	2.50	0.05	0.21	0.60	1.20	0.40	2.40
$Q_{31,50}$	4.97	13.86	0.77	2.46	0.05	0.20	0.60	1.19	0.39	2.38
$Q_{61,2}$	6.44	18.36	1.09	3.45	0.10	0.30	0.80	1.38	0.56	2.76
$Q_{61,10}$	5.61	15.82	0.91	2.89	0.07	0.25	0.68	1.27	0.47	2.55
$Q_{61,25}$	5.22	14.65	0.82	2.63	0.06	0.22	0.63	1.22	0.42	2.45
$Q_{61,50}$	5.10	14.25	0.79	2.54	0.05	0.21	0.61	1.21	0.41	2.42
$Q_{91,2}$	6.63	18.95	1.13	3.58	0.10	0.31	0.82	1.40	0.58	2.81
$Q_{91,10}$	5.86	16.60	0.96	3.06	0.08	0.26	0.72	1.31	0.50	2.61
$Q_{91,25}$	5.42	15.23	0.86	2.76	0.06	0.23	0.66	1.25	0.45	2.50
$Q_{91,50}$	5.35	15.04	0.85	2.72	0.06	0.23	0.65	1.24	0.44	2.48

Appendix B. Continued

Flow type	Location									
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Drought Flows										
$Q_{6,10}$	6.38	18.17	1.08	3.41	0.10	0.29	0.79	1.37	0.55	2.74
$Q_{6,25}$	6.06	17.19	1.00	3.19	0.08	0.27	0.75	1.33	0.52	2.66
$Q_{6,50}$	5.86	16.60	0.96	3.06	0.08	0.26	0.72	1.31	0.50	2.61
$Q_{9,10}$	6.73	19.24	1.15	3.65	0.11	0.32	0.84	1.41	0.59	2.83
$Q_{9,25}$	6.50	18.56	1.10	3.49	0.10	0.30	0.81	1.39	0.57	2.77
$Q_{9,50}$	6.31	17.97	1.06	3.37	0.09	0.29	0.78	1.36	0.55	2.72
$Q_{12,10}$	7.08	20.32	1.23	3.88	0.12	0.34	0.89	1.46	0.63	2.92
$Q_{12,25}$	6.82	19.54	1.17	3.71	0.11	0.32	0.85	1.43	0.60	2.85
$Q_{12,50}$	6.57	18.76	1.12	3.54	0.10	0.31	0.82	1.39	0.58	2.79
$Q_{18,10}$	7.27	20.91	1.27	4.01	0.13	0.35	0.91	1.48	0.66	2.97
$Q_{18,25}$	6.95	19.93	1.20	3.80	0.11	0.33	0.87	1.44	0.62	2.89
$Q_{18,50}$	6.73	19.24	1.15	3.65	0. 11	0.32	0.84	1.41	0.59	2.83
$Q_{30,10}$	7.46	21.50	1.31	4.14	0.13	0.36	0.94	1.51	0.68	3.02
$Q_{30,25}$	7.14	20.52	1.24	3.93	0.12	0.34	0.89	1.47	0.64	2.94
$Q_{30,50}$	6.95	19.93	1.20	3.80	0.11	0.33	0.87	1.44	0.62	2.89
$Q_{54,10}$	7.72	22.28	1.37	4.32	0.14	0.38	0.97	1.54	0.71	3.08
$Q_{54,25}$	7.27	20.91	1.27	4.01	0.13	0.35	0.91	1.48	0.66	2.97
$Q_{54,50}$	7.14	20.52	1.24	3.93	0.12	0.34	0.89	1.47	0.64	2.94
January										
Q_{02}	10.22	29.91	1.92	6.00	0.23	0.54	1.32	1.86	0.99	3.71
Q_{10}	8.55	24.82	1.55	4.88	0.17	0.43	1.09	1.65	0.80	3.29
Q_{25}	7.78	22.47	1.38	4.36	0.14	0.38	0.98	1.55	0.71	3.10
Q_{50}	7.21	20.71	1.26	3.97	0.12	0.35	0.90	1.48	0.65	2.95
Q_{75}	6.63	18.95	1.13	3.58	0.10	0.31	0.82	1.40	0.58	2.81
Q_{90}	6.09	17.29	1.01	3.21	0.09	0.28	0.75	1.33	0.52	2.67
Q_{98}	5.61	15.82	0.91	2.89	0.07	0.25	0.68	1.27	0.47	2.55
Q_{mean}	7.66	22.08	1.36	4.27	0.14	0.38	0.97	1.53	0.70	3.06
February										
Q_{02}	10.54	30.89	1.99	6.22	0.24	0.56	1.36	1.90	1.02	3.79
Q_{10}	8.81	25.61	1.61	5.05	0.18	0.45	1.12	1.68	0.83	3.36
Q_{25}	8.10	23.45	1.45	4.58	0.15	0.40	1.03	1.59	0.75	3.18
Q_{50}	7.40	21.30	1.30	4.10	0.13	0.36	0.93	1.50	0.67	3.00
Q_{75}	6.82	19.54	1.17	3.71	0.11	0.32	0.85	1.43	0.60	2.85
Q_{90}	6.44	18.36	1.09	3.45	0.10	0.30	0.80	1.38	0.56	2.76
Q_{98}	5.99	16.99	0.99	3.15	0.08	0.27	0.74	1.32	0.51	2.64
Q_{mean}	7.86	22.71	1.40	4.41	0.15	0.39	0.99	1.56	0.72	3.12
March										
Q_{02}	10.79	31.67	2.04	6.39	0.25	0.58	1.40	1.93	1.05	3.86
Q_{10}	9.13	26.58	1.68	5.27	0.19	0.47	1.17	1.72	0.87	3.44
Q_{25}	8.36	24.24	1.51	4.75	0.16	0.42	1.06	1.62	0.78	3.24
Q_{50}	7.78	22.47	1.38	4.36	0.14	0.38	0.98	1.55	0.71	3.10
Q_{75}	7.27	20.91	1.27	4.01	0.13	0.35	0.91	1.48	0.66	2.97
Q_{90}	7.02	20.13	1.22	3.84	0.12	0.34	0.88	1.45	0.63	2.90
Q_{98}	6.38	18.17	1.08	3.41	0.10	0.29	0.79	1.37	0.55	2.74
Q_{mean}	8.03	23.22	1.44	4.52	0. 15	0.40	1.02	1.58	0.74	3.16

Appendix B. Continued

Flow type	Location									
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
April										
Q_{02}	10.79	31.67	2.04	6.39	0.25	0.58	1.40	1.93	1.05	3.86
Q_{10}	9.13	26.58	1.68	5.27	0.19	0.47	1.17	1.72	0.87	3.44
Q_{25}	8.49	24.63	1.54	4.83	0.17	0.43	1.08	1.64	0.79	3.28
Q_{50}	7.91	22.87	1.41	4.45	0.15	0.39	1.00	1.56	0.73	3.13
Q_{75}	7.40	21.30	1.30	4.10	0.13	0.36	0.93	1.50	0.67	3.00
Q_{90}	7.14	20.52	1.24	3.93	0.12	0.34	0.89	1.47	0.64	2.94
Q_{98}	6.50	18.56	1.10	3.49	0.10	0.30	0.81	1.39	0.57	2.77
Q_{mean}	8.03	23.24	1.44	4.53	0.15	0.40	1.02	1.58	0.74	3.16
May										
Q_{02}	10.79	31.67	2.04	6.39	0.25	0.58	1.40	1.93	1.05	3.86
Q_{10}	8.81	25.61	1.61	5.05	0.18	0.45	1.12	1.68	0.83	3.36
Q_{25}	8.02	23.20	1.44	4.52	0.15	0.40	1.02	1.58	0.74	3.16
Q_{50}	7.59	21.89	1.34	4.23	0.14	0.37	0.96	1.52	0.69	3.05
Q_{75}	7.27	20.91	1.27	4.01	0.13	0.35	0.91	1.48	0.66	2.97
Q_{90}	7.08	20.32	1.23	3.88	0.12	0.34	0.89	1.46	0.63	2.92
Q_{98}	6.44	18.36	1.09	3.45	0.10	0.30	0.80	1.38	0.56	2.76
Q_{mean}	7.85	22.67	1.40	4.40	0.15	0.39	0.99	1.56	0.72	3.11
June										
Q_{02}	10.79	31.67	2.04	6.39	0.25	0.58	1.40	1.93	1.05	3.86
Q_{10}	8.81	25.61	1.61	5.05	0.18	0.45	1.12	1.68	0.83	3.36
Q_{25}	7.98	23.06	1.43	4.49	0.15	0.40	1.01	1.57	0.74	3.15
Q_{50}	7.40	21.30	1.30	4.10	0.13	0.36	0.93	1.50	0.67	3.00
Q_{75}	7.14	20.52	1.24	3.93	0.12	0.34	0.89	1.47	0.64	2.94
Q_{90}	6.89	19.73	1.19	3.75	0.11	0.33	0.86	1.44	0.61	2.87
Q_{98}	6.38	18.17	1.08	3.41	0.10	0.29	0.79	1.37	0.55	2.74
Q_{mean}	7.46	21.48	1.31	4.14	0.13	0.36	0.94	1.51	0.68	3.01
July										
Q_{02}	9.58	27.95	1.78	5.57	0.20	0.50	1.23	1.78	0.92	3.55
Q_{10}	8.17	23.65	1.47	4.62	0.16	0.41	1.04	1.60	0.76	3.19
Q_{25}	7.53	21.69	1.33	4.19	0.13	0.37	0.95	1.52	0.68	3.03
Q_{50}	7.21	20.71	1.26	3.97	0.12	0.35	0.90	1.48	0.65	2.95
Q_{75}	6.76	19.34	1.16	3.67	0.11	0.32	0.84	1.42	0.60	2.84
Q_{90}	6.44	18.36	1.09	3.45	0.10	0.30	0.80	1.38	0.56	2.76
Q_{98}	5.86	16.60	0.96	3.06	0.08	0.26	0.72	1.31	0.50	2.61
Q_{mean}	7.08	20.32	1.23	3.88	0.12	0.34	0.89	1.46	0.63	2.92
August										
Q_{02}	9.13	26.58	1.68	5.27	0.19	0.47	1.17	1.72	0.87	3.44
Q_{10}	7.72	22.28	1.37	4.32	0.14	0.38	0.97	1.54	0.71	3.08
Q_{25}	7.14	20.52	1.24	3.93	0.12	0.34	0.89	1.47	0.64	2.94
Q_{50}	6.73	19.24	1.15	3.65	0.11	0.32	0.84	1.41	0.59	2.83
Q_{75}	6.44	18.36	1.09	3.45	0.10	0.30	0.80	1.38	0.56	2.76
Q_{90}	6.09	17.29	1.01	3.21	0.09	0.28	0.75	1.33	0.52	2.67
Q_{98}	5.42	15.23	0.86	2.76	0.06	0.23	0.66	1.25	0.45	2.50
Q_{mean}	6.76	19.34	1.16	3.67	0.11	0.32	0.84	1.42	0.60	2.84

Appendix B. Continued

Flow type	Location									
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
September										
Q_{02}	8.55	24.82	1.55	4.88	0.17	0.43	1.09	1.65	0.80	3.29
Q_{10}	7.34	21.10	1.29	4.06	0.13	0.36	0.92	1.49	0.66	2.98
Q_{25}	6.76	19.34	1.16	3.67	0.11	0.32	0.84	1.42	0.60	2.84
Q_{50}	6.44	18.36	1.09	3.45	0.10	0.30	0.80	1.38	0.56	2.76
Q_{75}	6.12	17.39	1.02	3.24	0.09	0.28	0.75	1.34	0.53	2.68
Q_{90}	5.86	16.60	0.96	3.06	0.08	0.26	0.72	1.31	0.50	2.61
Q_{98}	5.03	14.06	0.78	2.50	0.05	0.21	0.60	1.20	0.40	2.40
Q_{mean}	6.62	18.91	1.13	3.57	0.10	0.31	0.82	1.40	0.58	2.80
October										
Q_{02}	8.74	25.41	1.60	5.01	0.18	0.45	1.11	1.67	0.82	3.34
Q_{10}	7.59	21.89	1.34	4.23	0.14	0.37	0.96	1.52	0.69	3.05
Q_{25}	7.02	20.13	1.22	3.84	0.12	0.34	0.88	1.45	0.63	2.90
Q_{50}	6.44	18.36	1.09	3.45	0.10	0.30	0.80	1.38	0.56	2.76
Q_{75}	6.09	17.29	1.01	3.21	0.09	0.28	0.75	1.33	0.52	2.67
Q_{90}	5.61	15.82	0.91	2.89	0.07	0.25	0.68	1.27	0.47	2.55
Q_{98}	4.90	13.67	0.75	2.41	0.05	0.20	0.59	1.18	0.39	2.37
Q_{mean}	6.61	18.87	1.13	3.56	0.10	0.31	0.82	1.40	0.58	2.80
November										
Q_{02}	9.00	26.19	1.65	5.18	0.18	0.46	1.15	1.70	0.85	3.41
Q_{10}	7.78	22.47	1.38	4.36	0.14	0.38	0.98	1.55	0.71	3.10
Q_{25}	7.27	20.91	1.27	4.01	0.13	0.35	0.91	1.48	0.66	2.97
Q_{50}	6.73	19.24	1.15	3.65	0.11	0.32	0.84	1.41	0.59	2.83
Q_{75}	6.31	17.97	1.06	3.37	0.09	0.29	0.78	1.36	0.55	2.72
Q_{90}	5.86	16.60	0.96	3.06	0.08	0.26	0.72	1.31	0.50	2.61
Q_{98}	5.03	14.06	0.78	2.50	0.05	0.21	0.60	1.20	0.40	2.40
Q_{mean}	7.21	20.71	1.26	3.97	0.12	0.35	0.90	1.48	0.65	2.95
December										
Q_{02}	10.02	29.32	1.88	5.87	0.22	0.53	1.29	1.83	0.97	3.66
Q_{10}	8.17	23.65	1.47	4.62	0.16	0.41	1.04	1.60	0.76	3.19
Q_{25}	7.40	21.30	1.30	4.10	0.13	0.36	0.93	1.50	0.67	3.00
Q_{50}	6.95	19.93	1.20	3.80	0.11	0.33	0.87	1.44	0.62	2.89
Q_{75}	6.44	18.36	1.09	3.45	0.10	0.30	0.80	1.38	0.56	2.76
Q_{90}	5.99	16.99	0.99	3.15	0.08	0.27	0.74	1.32	0.51	2.64
Q_{98}	5.35	15.04	0.85	2.72	0.06	0.23	0.65	1.24	0.44	2.48
Q_{mean}	7.64	22.04	1.35	4.26	0.14	0.38	0.96	1.53	0.70	3.06

Appendix B. Continued

Flow type	Location									
	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
Q_{01}	4.95	1.45	0.66	0.24	3.53	0.35	1.32	1.27	0.57	1.47
Q_{02}	4.62	1.29	0.59	0.23	3.28	0.30	1.24	1.11	0.52	1.37
Q_{05}	4.24	1.09	0.51	0.20	2.98	0.25	1.15	0.93	0.46	1.24
Q_{10}	3.99	0.97	0.46	0.19	2.79	0.22	1.09	0.81	0.42	1.16
Q_{15}	3.83	0.89	0.43	0.18	2.66	0.20	1.06	0.74	0.40	1.11
Q_{25}	3.66	0.80	0.39	0.17	2.53	0.18	1.02	0.66	0.37	1.05
Q_{40}	3.50	0.72	0.36	0.16	2.40	0.16	0.98	0.58	0.35	1.00
Q_{50}	3.42	0.68	0.34	0.16	2.34	0.15	0.96	0.54	0.34	0.97
Q_{60}	3.34	0.64	0.33	0.15	2.27	0.14	0.94	0.50	0.33	0.95
Q_{75}	3.17	0.55	0.29	0.14	2.14	0.12	0.90	0.42	0.30	0.89
Q_{85}	3.06	0.50	0.27	0.13	2.06	0.10	0.88	0.37	0.28	0.86
Q_{90}	2.95	0.44	0.25	0.13	1.97	0.09	0.85	0.32	0.27	0.82
Q_{95}	2.84	0.39	0.22	0.12	1.89	0.08	0.83	0.27	0.25	0.79
Q_{98}	2.65	0.29	0.19	0.11	1.74	0.05	0.78	0.18	0.22	0.72
Q_{99}	2.49	0.21	0.15	0.10	1.61	0.03	0.74	0.10	0.20	0.67
Q_{mean}	3.50	0.72	0.36	0.16	2.40	0.16	0.98	0.58	0.35	1.00
Low Flows										
$Q_{1,2}$	2.43	0.18	0.14	0.10	1.57	0.02	0.73	0.07	0.19	0.65
$Q_{1,10}$	2.18	0.06	0.09	0.08	1.37	0.00	0.67	0.00	0.15	0.57
$Q_{1,25}$	2.16	0.04	0.08	0.08	1.35	0.00	0.67	0.00	0.15	0.56
$Q_{1,50}$	2.16	0.04	0.08	0.08	1.35	0.00	0.67	0.00	0.15	0.56
$Q_{7,2}$	2.92	0.43	0.24	0.13	1.95	0.09	0.85	0.31	0.26	0.81
$Q_{7,10}$	2.49	0.21	0.15	0.10	1.61	0.03	0.74	0.10	0.20	0.67
$Q_{7,25}$	2.43	0.18	0.14	0.10	1.57	0.02	0.73	0.07	0.19	0.65
$Q_{7,50}$	2.43	0.18	0.14	0.10	1.57	0.02	0.73	0.07	0.19	0.65
$Q_{15,2}$	2.95	0.44	0.25	0.13	1.97	0.09	0.85	0.32	0.27	0.82
$Q_{15,10}$	2.57	0.25	0.17	0.11	1.67	0.04	0.76	0.14	0.21	0.70
$Q_{15,25}$	2.46	0.19	0.15	0.10	1.59	0.03	0.74	0.09	0.20	0.66
$Q_{15,50}$	2.46	0.19	0.15	0.10	1.59	0.03	0.74	0.09	0.20	0.66
$Q_{31,2}$	3.01	0.47	0.26	0.13	2.01	0.10	0.87	0.35	0.28	0.84
$Q_{31,10}$	2.65	0.29	0.19	0.11	1.74	0.05	0.78	0.18	0.22	0.72
$Q_{31,25}$	2.49	0.21	0.15	0.10	1.61	0.03	0.74	0.10	0.20	0.67
$Q_{31,50}$	2.46	0.19	0.15	0.10	1.59	0.03	0.74	0.09	0.20	0.66
$Q_{61,2}$	3.09	0.51	0.28	0.14	2.08	0.11	0.88	0.38	0.29	0.87
$Q_{61,10}$	2.73	0.33	0.20	0.12	1.80	0.06	0.80	0.22	0.24	0.75
$Q_{61,25}$	2.57	0.25	0.17	0.11	1.67	0.04	0.76	0.14	0.21	0.70
$Q_{61,50}$	2.51	0.22	0.16	0.10	1.63	0.03	0.75	0.11	0.20	0.68
$Q_{91,2}$	3.17	0.55	0.29	0.14	2.14	0.12	0.90	0.42	0.30	0.89
$Q_{91,10}$	2.84	0.39	0.22	0.12	1.89	0.08	0.83	0.27	0.25	0.79
$Q_{91,25}$	2.65	0.29	0.19	0.11	1.74	0.05	0.78	0.18	0.22	0.72
$Q_{91,50}$	2.62	0.28	0.18	0.11	1.72	0.05	0.78	0.16	0.22	0.71

Appendix B. Continued

Flow type	Location									
	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
Drought Flows										
$Q_{6,10}$	3.06	0.50	0.27	0.13	2.06	0.10	0.88	0.37	0.28	0.86
$Q_{6,25}$	2.92	0.43	0.24	0.13	1.95	0.09	0.85	0.31	0.26	0.81
$Q_{6,50}$	2.84	0.39	0.22	0.12	1.89	0.08	0.83	0.27	0.25	0.79
$Q_{9,10}$	3.21	0.57	0.30	0.14	2.18	0.12	0.91	0.44	0.31	0.91
$Q_{9,25}$	3.12	0.53	0.28	0.14	2.10	0.11	0.89	0.40	0.29	0.88
$Q_{9,50}$	3.03	0.49	0.26	0.13	2.04	0.10	0.87	0.36	0.28	0.85
$Q_{12,10}$	3.36	0.65	0.33	0.15	2.29	0.14	0.95	0.51	0.33	0.96
$Q_{12,25}$	3.25	0.60	0.31	0.15	2.21	0.13	0.92	0.46	0.31	0.92
$Q_{12,50}$	3.14	0.54	0.29	0.14	2.12	0.11	0.90	0.41	0.30	0.88
$Q_{18,10}$	3.45	0.69	0.35	0.16	2.36	0.15	0.97	0.55	0.34	0.98
$Q_{18,25}$	3.31	0.62	0.32	0.15	2.25	0.14	0.94	0.49	0.32	0.94
$Q_{18,50}$	3.21	0.57	0.30	0.14	2.18	0.12	0.91	0.44	0.31	0.91
$Q_{30,10}$	3.53	0.73	0.37	0.16	2.42	0.16	0.99	0.59	0.35	1.01
$Q_{30,25}$	3.39	0.66	0.34	0.15	2.31	0.15	0.95	0.53	0.33	0.96
$Q_{30,50}$	3.31	0.62	0.32	0.15	2.25	0.14	0.94	0.49	0.32	0.94
$Q_{54,10}$	3.64	0.79	0.39	0.17	2.51	0.18	1.01	0.65	0.37	1.04
$Q_{54,25}$	3.45	0.69	0.35	0.16	2.36	0.15	0.97	0.55	0.34	0.98
$Q_{54,50}$	3.39	0.66	0.34	0.15	2.31	0.15	0.95	0.53	0.33	0.96
January										
Q_{02}	4.71	1.33	0.61	0.23	3.34	0.31	1.26	1.15	0.53	1.39
Q_{10}	3.99	0.97	0.46	0.19	2.79	0.22	1.09	0.81	0.42	1.16
Q_{25}	3.66	0.80	0.39	0.17	2.53	0.18	1.02	0.66	0.37	1.05
Q_{50}	3.42	0.68	0.34	0.16	2.34	0.15	0.96	0.54	0.34	0.97
Q_{75}	3.17	0.55	0.29	0.14	2.14	0.12	0.90	0.42	0.30	0.89
Q_{90}	2.94	0.44	0.24	0.13	1.96	0.09	0.85	0.31	0.27	0.82
Q_{98}	2.73	0.33	0.20	0.12	1.80	0.06	0.80	0.22	0.24	0.75
Q_{mean}	3.61	0.78	0.38	0.17	2.49	0.17	1.01	0.63	0.37	1.04
February										
Q_{02}	4.84	1.40	0.64	0.24	3.45	0.33	1.29	1.22	0.55	1.44
Q_{10}	4.10	1.02	0.48	0.20	2.87	0.24	1.12	0.87	0.44	1.20
Q_{25}	3.80	0.87	0.42	0.18	2.64	0.20	1.05	0.72	0.39	1.10
Q_{50}	3.50	0.72	0.36	0.16	2.40	0.16	0.98	0.58	0.35	1.00
Q_{75}	3.25	0.60	0.31	0.15	2.21	0.13	0.92	0.46	0.31	0.92
Q_{90}	3.09	0.51	0.28	0.14	2.08	0.11	0.88	0.38	0.29	0.87
Q_{98}	2.90	0.42	0.24	0.12	1.93	0.08	0.84	0.29	0.26	0.80
Q_{mean}	3.70	0.82	0.40	0.17	2.55	0.19	1.03	0.67	0.38	1.06
March										
Q_{02}	4.95	1.45	0.66	0.24	3.53	0.35	1.32	1.27	0.57	1.47
Q_{10}	4.24	1.09	0.51	0.20	2.98	0.25	1.15	0.93	0.46	1.24
Q_{25}	3.91	0.93	0.44	0.18	2.72	0.21	1.08	0.78	0.41	1.13
Q_{50}	3.66	0.80	0.39	0.17	2.53	0.18	1.02	0.66	0.37	1.05
Q_{75}	3.45	0.69	0.35	0.16	2.36	0.15	0.97	0.55	0.34	0.98
Q_{90}	3.34	0.64	0.33	0.15	2.27	0.14	0.94	0.50	0.33	0.95
Q_{98}	3.06	0.50	0.27	0.13	2.06	0.10	0.88	0.37	0.28	0.86
Q_{mean}	3.77	0.86	0.42	0.18	2.61	0.19	1.04	0.71	0.39	1.09

Appendix B. Continued

Flow type	Location									
	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
April										
Q_{02}	4.95	1.45	0.66	0.24	3.53	0.35	1.32	1.27	0.57	1.47
Q_{10}	4.24	1.09	0.51	0.20	2.98	0.25	1.15	0.93	0.46	1.24
Q_{25}	3.97	0.95	0.46	0.19	2.76	0.22	1.09	0.80	0.42	1.15
Q_{50}	3.72	0.83	0.41	0.17	2.57	0.19	1.03	0.68	0.38	1.07
Q_{75}	3.50	0.72	0.36	0.16	2.40	0.16	0.98	0.58	0.35	1.00
Q_{90}	3.39	0.66	0.34	0.15	2.31	0.15	0.95	0.53	0.33	0.96
Q_{98}	3.12	0.53	0.28	0.14	2.10	0.11	0.89	0.40	0.29	0.88
Q_{mean}	3.77	0.86	0.42	0.18	2.61	0.19	1.04	0.71	0.39	1.09
May										
Q_{02}	4.95	1.45	0.66	0.24	3.53	0.35	1.32	1.27	0.57	1.47
Q_{10}	4.10	1.02	0.48	0.20	2.87	0.24	1.12	0.87	0.44	1.20
Q_{25}	3.77	0.85	0.41	0.18	2.61	0.19	1.04	0.71	0.39	1.09
Q_{50}	3.58	0.76	0.38	0.16	2.46	0.17	1.00	0.62	0.36	1.03
Q_{75}	3.45	0.69	0.35	0.16	2.36	0.15	0.97	0.55	0.34	0.98
Q_{90}	3.36	0.65	0.33	0.15	2.29	0.14	0.95	0.51	0.33	0.96
Q_{98}	3.09	0.51	0.28	0.14	2.08	0.11	0.88	0.38	0.29	0.87
Q_{mean}	3.69	0.82	0.40	0.17	2.55	0.18	1.02	0.67	0.38	1.06
June										
Q_{02}	4.95	1.45	0.66	0.24	3.53	0.35	1.32	1.27	0.57	1.47
Q_{10}	4.10	1.02	0.48	0.20	2.87	0.24	1.12	0.87	0.44	1.20
Q_{25}	3.75	0.84	0.41	0.17	2.59	0.19	1.04	0.70	0.39	1.08
Q_{50}	3.50	0.72	0.36	0.16	2.40	0.16	0.98	0.58	0.35	1.00
Q_{75}	3.39	0.66	0.34	0.15	2.31	0.15	0.95	0.53	0.33	0.96
Q_{90}	3.28	0.61	0.31	0.15	2.23	0.13	0.93	0.48	0.32	0.93
Q_{98}	3.06	0.50	0.27	0.13	2.06	0.10	0.88	0.37	0.28	0.86
Q_{mean}	3.52	0.73	0.37	0.16	2.42	0.16	0.99	0.59	0.35	1.01
July										
Q_{02}	4.43	1.19	0.55	0.21	3.13	0.28	1.20	1.02	0.49	1.30
Q_{10}	3.83	0.89	0.43	0.18	2.66	0.20	1.06	0.74	0.40	1.11
Q_{25}	3.55	0.75	0.37	0.16	2.44	0.17	0.99	0.61	0.36	1.02
Q_{50}	3.42	0.68	0.34	0.16	2.34	0.15	0.96	0.54	0.34	0.97
Q_{75}	3.23	0.58	0.30	0.14	2.19	0.12	0.92	0.45	0.31	0.91
Q_{90}	3.09	0.51	0.28	0.14	2.08	0.11	0.88	0.38	0.29	0.87
Q_{98}	2.84	0.39	0.22	0.12	1.89	0.08	0.83	0.27	0.25	0.79
Q_{mean}	3.36	0.65	0.33	0.15	2.29	0.14	0.95	0.51	0.33	0.96
August										
Q_{02}	4.24	1.09	0.51	0.20	2.98	0.25	1.15	0.93	0.46	1.24
Q_{10}	3.64	0.79	0.39	0.17	2.51	0.18	1.01	0.65	0.37	1.04
Q_{25}	3.39	0.66	0.34	0.15	2.31	0.15	0.95	0.53	0.33	0.96
Q_{50}	3.21	0.57	0.30	0.14	2.18	0.12	0.91	0.44	0.31	0.91
Q_{75}	3.09	0.51	0.28	0.14	2.08	0.11	0.88	0.38	0.29	0.87
Q_{90}	2.94	0.44	0.24	0.13	1.96	0.09	0.85	0.31	0.27	0.82
Q_{98}	2.65	0.29	0.19	0.11	1.74	0.05	0.78	0.18	0.22	0.72
Q_{mean}	3.23	0.58	0.30	0.14	2.19	0.12	0.92	0.45	0.31	0.91

Appendix B. Continued

Flow type	Location									
	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
September										
Q_{02}	3.99	0.97	0.46	0.19	2.79	0.22	1.09	0.81	0.42	1.16
Q_{10}	3.47	0.71	0.35	0.16	2.38	0.16	0.97	0.57	0.35	0.99
Q_{25}	3.23	0.58	0.30	0.14	2.19	0.12	0.92	0.45	0.31	0.91
Q_{50}	3.09	0.51	0.28	0.14	2.08	0.11	0.88	0.38	0.29	0.87
Q_{75}	2.95	0.44	0.25	0.13	1.97	0.09	0.85	0.32	0.27	0.82
Q_{90}	2.84	0.39	0.22	0.12	1.89	0.08	0.83	0.27	0.25	0.79
Q_{98}	2.49	0.21	0.15	0.10	1.61	0.03	0.74	0.10	0.20	0.67
Q_{mean}	3.17	0.55	0.29	0.14	2.14	0.12	0.90	0.42	0.30	0.89
October										
Q_{02}	4.08	1.01	0.48	0.19	2.85	0.23	1.11	0.85	0.44	1.19
Q_{10}	3.58	0.76	0.38	0.16	2.46	0.17	1.00	0.62	0.36	1.03
Q_{25}	3.34	0.64	0.33	0.15	2.27	0.14	0.94	0.50	0.33	0.95
Q_{50}	3.09	0.51	0.28	0.14	2.08	0.11	0.88	0.38	0.29	0.87
Q_{75}	2.94	0.44	0.24	0.13	1.96	0.09	0.85	0.31	0.27	0.82
Q_{90}	2.73	0.33	0.20	0.12	1.80	0.06	0.80	0.22	0.24	0.75
Q_{98}	2.43	0.18	0.14	0.10	1.57	0.02	0.73	0.07	0.19	0.65
Q_{mean}	3.16	0.55	0.29	0.14	2.13	0.12	0.90	0.42	0.30	0.89
November										
Q_{02}	4.19	1.07	0.50	0.20	2.94	0.25	1.14	0.91	0.45	1.22
Q_{10}	3.66	0.80	0.39	0.17	2.53	0.18	1.02	0.66	0.37	1.05
Q_{25}	3.45	0.69	0.35	0.16	2.36	0.15	0.97	0.55	0.34	0.98
Q_{50}	3.21	0.57	0.30	0.14	2.18	0.12	0.91	0.44	0.31	0.91
Q_{75}	3.03	0.49	0.26	0.13	2.04	0.10	0.87	0.36	0.28	0.85
Q_{90}	2.84	0.39	0.22	0.12	1.89	0.08	0.83	0.27	0.25	0.79
Q_{98}	2.49	0.21	0.15	0.10	1.61	0.03	0.74	0.10	0.20	0.67
Q_{mean}	3.42	0.68	0.34	0.16	2.34	0.15	0.96	0.54	0.34	0.97
December										
Q_{02}	4.62	1.29	0.59	0.23	3.28	0.30	1.24	1.11	0.52	1.37
Q_{10}	3.83	0.89	0.43	0.18	2.66	0.20	1.06	0.74	0.40	1.11
Q_{25}	3.50	0.72	0.36	0.16	2.40	0.16	0.98	0.58	0.35	1.00
Q_{50}	3.31	0.62	0.32	0.15	2.25	0.14	0.94	0.49	0.32	0.94
Q_{75}	3.09	0.51	0.28	0.14	2.08	0.11	0.88	0.38	0.29	0.87
Q_{90}	2.90	0.42	0.24	0.12	1.93	0.08	0.84	0.29	0.26	0.80
Q_{98}	2.62	0.28	0.18	0.11	1.72	0.05	0.78	0.16	0.22	0.71
Q_{mean}	3.60	0.77	0.38	0.17	2.48	0.17	1.00	0.63	0.37	1.03

Appendix B. Continued

Flow type	Location		
	(51)	(52)	(53)
Q_{01}	-18	-15	-1.1
Q_{02}	-18	-15	-1.1
Q_{05}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{15}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{40}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{60}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{85}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{95}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{99}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
Low Flows			
$Q_{1,2}$	-18	-15	-1.1
$Q_{1,10}$	-18	-15	-1.1
$Q_{1,25}$	-18	-15	-1.1
$Q_{1,50}$	-18	-15	-1.1
$Q_{7,2}$	-18	-15	-1.1
$Q_{7,10}$	-18	-15	-1.1
$Q_{7,25}$	-18	-15	-1.1
$Q_{7,50}$	-18	-15	-1.1
$Q_{15,2}$	-18	-15	-1.1
$Q_{15,10}$	-18	-15	-1.1
$Q_{15,25}$	-18	-15	-1.1
$Q_{15,50}$	-18	-15	-1.1
$Q_{31,2}$	-18	-15	-1.1
$Q_{31,10}$	-18	-15	-1.1
$Q_{31,25}$	-18	-15	-1.1
$Q_{31,50}$	-18	-15	-1.1
$Q_{61,2}$	-18	-15	-1.1
$Q_{61,10}$	-18	-15	-1.1
$Q_{61,25}$	-18	-15	-1.1
$Q_{61,50}$	-18	-15	-1.1
$Q_{91,2}$	-18	-15	-1.1
$Q_{91,10}$	-18	-15	-1.1
$Q_{91,25}$	-18	-15	-1.1
$Q_{91,50}$	-18	-15	-1.1

Appendix B. Continued

Flow type	Location									
	(41)	(42)	(44)	(44)	(45)	(46)	(47)	(48)	(49)	(50)
Drought Flows										
$Q_{8,10}$	0.10	0.33	0.21	6.36	0.68	0.15	0.17	1.20	3.16	1.43
$Q_{6,25}$	0.08	0.32	0.19	6.01	0.64	0.14	0.15	1.10	2.96	1.37
$Q_{6,50}$	0.07	0.31	0.17	5.80	0.62	0.13	0.14	1.04	2.84	1.34
$Q_{9,10}$	0.12	0.35	0.24	6.76	0.71	0.16	0.19	1.30	3.38	1.49
$Q_{9,25}$	0.11	0.34	0.22	6.51	0.69	0.15	0.18	1.23	3.24	1.45
$Q_{9,50}$	0.10	0.33	0.21	6.29	0.67	0.15	0.17	1.18	3.12	1.42
$Q_{12,10}$	0.14	0.37	0.27	7.15	0.75	0.17	0.21	1.40	3.60	1.55
$Q_{12,25}$	0.13	0.35	0.25	6.86	0.72	0.16	0.20	1.33	3.44	1.50
$Q_{12,50}$	0.11	0.34	0.23	6.58	0.70	0.16	0.18	1.25	3.28	1.46
$Q_{18,10}$	0.15	0.37	0.28	7.36	0.77	0.18	0.22	1.46	3.72	1.58
$Q_{18,25}$	0.13	0.36	0.26	7.00	0.73	0.17	0.20	1.37	3.52	1.52
$Q_{18.50}$	0.12	0.35	0.24	6.76	0.71	0.16	0.19	1.30	3.38	1.49
$Q_{30,10}$	0.16	0.38	0.29	7.57	0.79	0.18	0.23	1.52	3.84	1.61
$Q_{30,25}$	0.14	0.37	0.27	7.22	0.75	0.17	0.21	1.42	3.64	1.56
$Q_{30,50}$	0.13	0.36	0.26	7.00	0.73	0.17	0.20	1.37	3.52	1.52
$Q_{54,10}$	0.18	0.39	0.31	7.85	0.81	0.19	0.25	1.60	4.00	1.65
$Q_{54,25}$	0.15	0.37	0.28	7.36	0.77	0.18	0.22	1.46	3.72	1.58
$Q_{54,50}$	0.14	0.37	0.27	7.22	0.75	0.17	0.21	1.42	3.64	1.56
January										
Q_{02}	0.33	0.51	0.50	10.62	1.07	0.26	0.40	2.34	5.56	2.08
Q_{10}	0.23	0.43	0.38	8.78	0.90	0.21	0.30	1.84	4.52	1.79
Q_{25}	0.18	0.40	0.32	7.93	0.82	0.19	0.25	1.61	4.04	1.66
Q_{50}	0.15	0.37	0.28	7.29	0.76	0.17	0.22	1.44	3.68	1.57
Q_{75}	0.11	0.34	0.23	6.65	0.70	0.16	0.18	1.27	3.32	1.47
Q_{90}	0.08	0.32	0.19	6.05	0.65	0.14	0.15	1.11	2.98	1.38
Q_{98}	0.05	0.30	0.15	5.51	0.60	0.13	0.12	0.97	2.68	1.30
Q_{mean}	0.18	0.39	0.31	7.78	0.81	0.19	0.25	1.58	3.96	1.64
February										
Q_{02}	0.34	0.53	0.53	10.98	1.10	0.27	0.42	2.43	5.76	2.13
Q_{10}	0.24	0.45	0.40	9.06	0.92	0.22	0.31	1.92	4.68	1.84
Q_{25}	0.20	0.41	0.34	8.28	0.85	0.20	0.27	1.71	4.24	1.72
Q_{50}	0.16	0.38	0.29	7.50	0.78	0.18	0.23	1.50	3.80	1.60
Q_{75}	0.13	0.35	0.25	6.86	0.72	0.16	0.20	1.33	3.44	1.50
Q_{90}	0.10	0.34	0.22	6.44	0.68	0.15	0.17	1.21	3.20	1.44
Q_{98}	0.08	0.31	0.18	5.94	0.64	0.14	0.15	1.08	2.92	1.36
Q_{mean}	0.19	0.40	0.32	8.01	0.83	0.19	0.26	1.64	4.09	1.68
March										
Q_{02}	0.36	0.54	0.55	11.26	1.13	0.28	0.43	2.51	5.92	2.17
Q_{10}	0.26	0.46	0.42	9.42	0.96	0.23	0.33	2.01	4.88	1.89
Q_{25}	0.22	0.42	0.36	8.56	0.88	0.21	0.29	1.79	4.40	1.76
Q_{50}	0.18	0.40	0.32	7.93	0.82	0.19	0.25	1.61	4.04	1.66
Q_{75}	0.15	0.37	0.28	7.36	0.77	0.18	0.22	1.46	3.72	1.58
Q_{90}	0.14	0.36	0.26	7.07	0.74	0.17	0.21	1.39	3.56	1.54
Q_{98}	0.10	0.33	0.21	6.36	0.68	0.15	0.17	1.20	3.16	1.43
Q_{mean}	0.20	0.41	0.34	8.20	0.84	0.20	0.27	1.69	4.19	1.71

Appendix B. Continued

Flow type	Location									
	(41)	(42)	(44)	(44)	(45)	(46)	(47)	(48)	(49)	(50)
April										
Q_{02}	0.36	0.54	0.55	11.26	1.13	0.28	0.43	2.51	5.92	2.17
Q_{10}	0.26	0.46	0.42	9.42	0.96	0.23	0.33	2.01	4.88	1.89
Q_{25}	0.22	0.43	0.37	8.71	0.89	0.21	0.29	1.82	4.48	1.78
Q_{50}	0.19	0.40	0.33	8.07	0.83	0.20	0.26	1.65	4.12	1.69
Q_{75}	0.16	0.38	0.29	7.50	0.78	0.18	0.23	1.50	3.80	1.60
Q_{90}	0.14	0.37	0.27	7.22	0.75	0.17	0.21	1.42	3.64	1.56
Q_{98}	0.11	0.34	0.22	6.51	0.69	0.15	0.18	1.23	3.24	1.45
Q_{mean}	0.20	0.41	0.34	8.20	0.84	0.20	0.27	1.69	4.20	1.71
May										
Q_{02}	0.36	0.54	0.55	11.26	1.13	0.28	0.43	2.51	5.92	2.17
Q_{10}	0.24	0.45	0.40	9.06	0.92	0.22	0.31	1.92	4.68	1.84
Q_{25}	0.20	0.41	0.34	8.19	0.84	0.20	0.27	1.68	4.19	1.70
Q_{50}	0.17	0.39	0.30	7.71	0.80	0.19	0.24	1.56	3.92	1.63
Q_{75}	0.15	0.37	0.28	7.36	0.77	0.18	0.22	1.46	3.72	1.58
Q_{90}	0.14	0.37	0.27	7.15	0.75	0.17	0.21	1.40	3.60	1.55
Q_{98}	0.10	0.34	0.22	6.44	0.68	0.15	0.17	1.21	3.20	1.44
Q_{mean}	0.19	0.40	0.32	8.00	0.83	0.19	0.26	1.63	4.08	1.68
June										
Q_{02}	0.36	0.54	0.55	11.26	1.13	0.28	0.43	2.51	5.92	2.17
Q_{10}	0.24	0.45	0.40	9.06	0.92	0.22	0.31	1.92	4.68	1.84
Q_{25}	0.19	0.41	0.33	8.14	0.84	0.20	0.26	1.67	4.16	1.70
Q_{50}	0.16	0.38	0.29	7.50	0.78	0.18	0.23	1.50	3.80	1.60
Q_{75}	0.14	0.37	0.27	7.22	0.75	0.17	0.21	1.42	3.64	1.56
Q_{90}	0.13	0.36	0.25	6.93	0.73	0.16	0.20	1.35	3.48	1.51
Q_{98}	0.10	0.33	0.21	6.36	0.68	0.15	0.17	1.20	3.16	1.43
Q_{mean}	0.16	0.38	0.29	7.56	0.79	0.18	0.23	1.52	3.84	1.61
July										
Q_{02}	0.29	0.48	0.46	9.91	1.00	0.24	0.36	2.15	5.16	1.97
Q_{10}	0.21	0.42	0.35	8.35	0.86	0.20	0.28	1.73	4.28	1.73
Q_{25}	0.17	0.39	0.30	7.64	0.79	0.18	0.24	1.54	3.88	1.62
Q_{50}	0.15	0.37	0.28	7.29	0.76	0.17	0.22	1.44	3.68	1.57
Q_{75}	0.12	0.35	0.24	6.79	0.71	0.16	0.19	1.31	3.40	1.49
Q_{90}	0.10	0.34	0.22	6.44	0.68	0.15	0.17	1.21	3.20	1.44
Q_{98}	0.07	0.31	0.17	5.80	0.62	0.13	0.14	1.04	2.84	1.34
Q_{mean}	0.14	0.37	0.27	7.15	0.75	0.17	0.21	1.40	3.60	1.55
August										
Q_{02}	0.26	0.46	0.42	9.42	0.96	0.23	0.33	2.01	4.88	1.89
Q_{10}	0.18	0.39	0.31	7.85	0.81	0.19	0.25	1.60	4.00	1.65
Q_{25}	0.14	0.37	0.27	7.22	0.75	0.17	0.21	1.42	3.64	1.56
Q_{50}	0.12	0.35	0.24	6.76	0.71	0.16	0.19	1.30	3.38	1.49
Q_{75}	0.10	0.34	0.22	6.44	0.68	0.15	0.17	1.21	3.20	1.44
Q_{90}	0.08	0.32	0.19	6.05	0.65	0.14	0.15	1.11	2.98	1.38
Q_{98}	0.04	0.29	0.14	5.30	0.58	0.12	0.11	0.91	2.56	1.26
Q_{mean}	0.12	0.35	0.24	6.79	0.71	0.16	0.19	1.31	3.40	1.49

Appendix B. Continued

Flow type	Location									
	(41)	(42)	(44)	(44)	(45)	(46)	(47)	(48)	(49)	(50)
September										
Q_{02}	0.23	0.43	0.38	8.78	0.90	0.21	0.30	1.84	4.52	1.79
Q_{l0}	0.16	0.38	0.29	7.43	0.77	0.18	0.23	1.48	3.76	1.59
Q_{25}	0.12	0.35	0.24	6.79	0.71	0.16	0.19	1.31	3.40	1.49
Q_{50}	0.10	0.34	0.22	6.44	0.68	0.15	0.17	1.21	3.20	1.44
Q_{75}	0.08	0.32	0.19	6.08	0.65	0.14	0.15	1.12	3.00	1.38
Q_{90}	0.07	0.31	0.17	5.80	0.62	0.13	0.14	1.04	2.84	1.34
Q_{98}	0.02	0.27	0.11	4.88	0.54	0.11	0.09	0.80	2.32	1.20
Q_{mean}	0.11	0.34	0.23	6.63	0.70	0. 16	0. 18	1.27	3.31	1.47
October										
Q_{02}	0.24	0.44	0.39	8.99	0.92	0.22	0.31	1.90	4.64	1.83
Q_{l0}	0.17	0.39	0.30	7.71	0.80	0.19	0.24	1.56	3.92	1.63
Q_{25}	0.14	0.36	0.26	7.07	0.74	0.17	0.21	1.39	3.56	1.54
Q_{50}	0.10	0.34	0.22	6.44	0.68	0.15	0.17	1.21	3.20	1.44
Q_{75}	0.08	0.32	0.19	6.05	0.65	0.14	0.15	1.11	2.98	1.38
Q_{90}	0.05	0.30	0.15	5.51	0.60	0.13	0.12	0.97	2.68	1.30
Q_{98}	0.01	0.26	0.10	4.73	0.53	0.11	0.08	0.76	2.24	1.18
Q_{mean}	0.11	0.34	0.23	6.62	0.70	0. 16	0. 18	1.26	3.30	1.47
November										
Q_{02}	0.25	0.45	0.41	9.27	0.94	0.23	0.32	1.98	4.80	1.87
Q_{l0}	0.18	0.40	0.32	7.93	0.82	0.19	0.25	1.61	4.04	1.66
Q_{25}	0.15	0.37	0.28	7.36	0.77	0.18	0.22	1.46	3.72	1.58
Q_{50}	0.12	0.35	0.24	6.76	0.71	0.16	0.19	1.30	3.38	1.49
Q_{75}	0.10	0.33	0.21	6.29	0.67	0.15	0.17	1.18	3.12	1.42
Q_{90}	0.07	0.31	0.17	5.80	0.62	0.13	0.14	1.04	2.84	1.34
Q_{98}	0.02	0.27	0.11	4.88	0.54	0.11	0.09	0.80	2.32	1.20
Q_{mean}	0.15	0.37	0.28	7.29	0.76	0. 17	0.22	1.44	3.68	1.57
December										
Q_{02}	0.31	0.50	0.49	10.41	1.05	0.26	0.39	2.28	5.44	2.04
Q_{l0}	0.21	0.42	0.35	8.35	0.86	0.20	0.28	1.73	4.28	1.73
Q_{25}	0.16	0.38	0.29	7.50	0.78	0.18	0.23	1.50	3.80	1.60
Q_{50}	0.13	0.36	0.26	7.00	0.73	0. 17	0.20	1.37	3.52	1.52
Q_{75}	0.10	0.34	0.22	6.44	0.68	0.15	0.17	1.21	3.20	1.44
Q_{90}	0.08	0.31	0.18	5.94	0.64	0.14	0.15	1.08	2.92	1.36
Q_{98}	0.04	0.28	0.13	5.23	0.57	0.12	0.11	0.89	2.52	1.25
Q_{mean}	0.17	0.39	0.31	7.77	0.80	0.19	0.24	1.57	3.95	1.64

Appendix B. Continued

Flow type	Location		
	(51)	(52)	(53)
Q_{01}	-18	-15	-1.1
Q_{02}	-18	-15	-1.1
Q_{05}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{15}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{40}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{60}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{85}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{95}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{99}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
Low Flows			
$Q_{1,2}$	-18	-15	-1.1
$Q_{1,10}$	-18	-15	-1.1
$Q_{1,25}$	-18	-15	-1.1
$Q_{1,50}$	-18	-15	-1.1
$Q_{7,2}$	-18	-15	-1.1
$Q_{7,10}$	-18	-15	-1.1
$Q_{7,25}$	-18	-15	-1.1
$Q_{7,50}$	-18	-15	-1.1
$Q_{15,2}$	-18	-15	-1.1
$Q_{15,10}$	-18	-15	-1.1
$Q_{15,25}$	-18	-15	-1.1
$Q_{15,50}$	-18	-15	-1.1
$Q_{31,2}$	-18	-15	-1.1
$Q_{31,10}$	-18	-15	-1.1
$Q_{31,25}$	-18	-15	-1.1
$Q_{31,50}$	-18	-15	-1.1
$Q_{61,2}$	-18	-15	-1.1
$Q_{61,10}$	-18	-15	-1.1
$Q_{61,25}$	-18	-15	-1.1
$Q_{61,50}$	-18	-15	-1.1
$Q_{91,2}$	-18	-15	-1.1
$Q_{91,10}$	-18	-15	-1.1
$Q_{91,25}$	-18	-15	-1.1
$Q_{91,50}$	-18	-15	-1.1

Appendix B. Continued

Flow type	Location		
	(51)	(52)	(53)
Drought Flows			
$Q_{6,10}$	-18	-15	-1.1
$Q_{6,25}$	-18	-15	-1.1
$Q_{6,50}$	-18	-15	-1.1
$Q_{9,10}$	-18	-15	-1.1
$Q_{9,25}$	-18	-15	-1.1
$Q_{9,50}$	-18	-15	-1.1
$Q_{12,10}$	-18	-15	-1.1
$Q_{12,25}$	-18	-15	-1.1
$Q_{12,50}$	-18	-15	-1.1
$Q_{18,10}$	-18	-15	-1.1
$Q_{18,25}$	-18	-15	-1.1
$Q_{18,50}$	-18	-15	-1.1
$Q_{30,10}$	-18	-15	-1.1
$Q_{30,25}$	-18	-15	-1.1
$Q_{30,50}$	-18	-15	-1.1
$Q_{54,10}$	-18	-15	-1.1
$Q_{54,25}$	-18	-15	-1.1
$Q_{54,50}$	-18	-15	-1.1
January			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
February			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
March			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1

Appendix B. Continued

Flow type	Location		
	(51)	(52)	(53)
April			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
May			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
June			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
July			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
August			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1

Appendix B. Continued

Flow type	Location		
	(51)	(52)	(53)
September			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
October			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
November			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1
December			
Q_{02}	-18	-15	-1.1
Q_{10}	-18	-15	-1.1
Q_{25}	-18	-15	-1.1
Q_{50}	-18	-15	-1.1
Q_{75}	-18	-15	-1.1
Q_{90}	-18	-15	-1.1
Q_{98}	-18	-15	-1.1
Q_{mean}	-18	-15	-1.1

Appendix C. NETWORK File Describing the Location of Streams, Control Points, Withdrawals, and Discharges in the Fox River Basin

List of Stream Names and Associated Stream Codes

Stream name	Code	Stream name	Code
Battle Creek	VHMO	Mission Creek	VE
Big Rock Creek	VH	Morgan Creek	VI3
Blackberry Creek	VI	Nippersink Creek	VX
Boone Creek	VW	Nippersink Creek Tributary	VXV
Brewster Creek	VO	North Branch Nippersink Creek	VXH
Brumbach Creek	VD	Norton Creek	VN3
Buck Branch	VFK	Otter Creek	VNL
Buck Creek	VB	Paw Paw Run	VCN
Buck Creek Tributary	VBP	Pingree Creek	VQR
Cary Creek	VT1	Poplar Creek	VP
Cotton Creek	VV	Poplar Creek Tributary	VPH
Crooked Leg Creek	VCB	Rob Roy Creek	VH2
Crystal Creek	VS	Roods Creek	VF1
DeYoung Creek	VXHV	Sequoit Creek	VZ
Dutch Creek	VW4	Silver Creek	VXP
Dutch Creek Tributary	VW4J	Silver Creek Tributary	VXPL
Eagle Creek	VYE	Sleepy Hollow Creek	VV4
East Branch Poplar Creek	VPQ	Slocum Lake Outlet	VU3
Elizabeth Lake Drain	VXHG	Slough Creek	VXPD
Ferson Creek	VN	Somonauk Creek	VF
Flint Creek	VU	Somonauk Creek Tributary	VFH
Flint Creek Tributary	VUE	Somonauk Creek Tributary	VFU
Flint Creek Tributary	VUP	Spring Creek	VT
Fox River	V	Squaw Creek	VY
Fox River Tributary	VJ3	Squaw Creek Tributary	VYF
Hollenback Creek	VG7	Squaw Creek Tributary	VYH
Indian Creek	VC	Stony Creek	VNLK
Indian Creek	VK	Sutphens Run	VCL
Indian Creek Tributary	VCM	Tyler Creek	VQ
Jelkes Creek	VQ5	Vander Karr Creek	VXO
Lake Run	VIN	Waubansee Creek	VJ
Little Indian Creek	VCF	Welch Creek	VHJ
Little Rock Creek	VHA	Welch Creek Tributary	VHJD
Little Rock Creek Tributary	VHAL	West Branch Big Rock Creek	VHM
Little Rock Creek Tributary	VHAD	Woods Creek	VSE
Mill Creek	VL	Youngs Creek	VHT

Note: Each stream has a unique code. Along the course of a stream it is possible for the stream name to change, but the stream code will not change. To differentiate between two streams that share the same name, use the location descriptions presented in the remainder of this appendix.

Appendix C. Continued

Watershed Characteristics at Locations of Interest in the Fox River Basin

DA(u) = Drainage area upstream of location (sq mi)
DA(d) = Drainage area downstream of location (sq mi)
K = Average subsoil permeability (inches/hr)
P-ET = Net excess precipitation for the watershed (inches), defined as average annual precipitation (P) minus evapotranspiration (ET)

ID = 0 Basic watershed information
= 1 Tributary inflow
= 2 Effluent discharge
= 3 Water supply withdrawal
= 6 Control point (full set of flow information)
= 9 Reservoir

Region = 1 Wheaton Morainal Country/areas of sandy strata
= 2 Bloomington Ridged Plain

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Fox River	116.60	868.0	868.0	3.74	8.70	6	1	USGS Gage 05546500 at Wilmot, WI
(V)	109.50	894.0	894.0	3.74	8.72	1	1	at Sequoit Creek (VZ)
	107.51	931.5	931.5	3.76	8.75	0	1	
	107.50	931.5	978.0	3.68	8.78	1	1	at Squaw Creek (VY)
	106.80	981.1	981.1	3.68	8.78	2	1	Fox Lake Tall Oaks STP
	106.30	981.1	1184.6	3.96	8.91	1	1	at Nippersink Creek (VX)
	104.50	1201.0	1201.0	4.00	8.92	6	1	Chain of Lakes outlet near Johnsburg
	104.40	1201.0	1201.0	4.00	8.92	2	1	Fox Lake Regional STP
	103.00	1204.0	1204.0	4.00	8.92	0	1	USGS Gage 05548500 at Johnsburg
	102.50	1204.1	1216.8	4.02	8.92	1	1	at Dutch Creek (VW4)
	100.31	1219.4	1219.4	4.03	8.93	0	1	
	100.30	1219.4	1242.7	4.10	8.94	1	1	at Boone Creek (VW)
	100.10	1242.8	1242.8	4.10	8.94	2	1	McHenry STP
	98.90	1244.3	1244.3	4.11	8.94	2	1	McHenry South STP
	97.80	1249.0	1249.0	4.12	8.94	6	1	Stratton Dam
	96.91	1254.0	1254.0	4.14	8.94	0	1	
	96.90	1254.0	1269.0	4.17	8.95	1	1	at Sleepy Hollow Creek (VV4)
	94.31	1276.7	1276.7	4.20	8.96	0	1	
	94.30	1276.7	1289.1	4.19	8.97	1	1	at Mutton Creek(VV)
	90.81	1302.7	1302.7	4.23	8.98	0	1	
	90.80	1302.7	1313.2	4.19	8.98	1	1	at Slocum Lake Outlet (VU3)
	89.41	1320.0	1320.0	4.22	8.99	0	1	
	89.40	1320.0	1356.8	4.18	9.01	1	1	at Flint Creek (VU)
	85.50	1362.7	1366.0	4.21	9.01	1	1	at Cary Creek (VT1)
	85.30	1366.0	1391.8	4.18	9.03	1	1	at Spring Creek (VT)
	81.60	1399.0	1399.0	4.20	9.05	6	1	USGS Gage 05550000 at Algonquin
	81.59	1399.0	1427.2	4.25	9.05	1	1	at Crystal Creek (VS)
	80.60	1431.5	1431.5	4.26	9.05	2	1	Algonquin STP
	78.50	1436.3	1436.3	4.26	9.06	2	1	Carpentersville-Kimball Hill WTP
	76.60	1444.7	1444.7	4.27	9.06	2	1	Carpentersville STP
	74.90	1451.0	1451.0	4.27	9.06	2	1	East Dundee WWTP
	74.60	1451.6	1458.4	4.27	9.07	1	1	at Jelkes Creek (VQ5)
	73.20	1462.3	1462.3	4.27	9.07	0	1	Interstate Hwy. 90
	72.40	1464.0	1464.0	4.27	9.07	6	1	Upstream of Elgin withdrawal
	72.30	1464.0	1464.0	4.27	9.07	3	1	Elgin Water Supply Withdrawal

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Fox River	72.20	1464.0	1504.0	4.28	9.09	1	1	at Tyler Creek (VQ)
	71.60	1504.3	1504.3	4.28	9.09	2	1	Elgin (north) STP
	69.10	1507.7	1507.7	4.28	9.09	2	1	Elgin (south) STP
	68.81	1507.8	1507.8	4.28	9.09	2	1	Elgin (west) STP
	68.80	1507.8	1552.1	4.28	9.12	1	1	at Poplar Creek (VP)
	67.30	1555.0	1555.0	4.28	9.12	6	1	USGS Gage 05551000 at South Elgin
	65.91	1557.5	1557.5	4.28	9.12	0	1	
	65.90	1557.5	1573.0	4.29	9.13	1	1	at Brewster Creek (VO)
	62.41	1577.5	1577.5	4.29	9.13	0	1	
	62.40	1577.5	1589.6	4.27	9.14	1	1	at Norton Creek (VN3)
	60.91	1590.5	1590.5	4.27	9.14	0	1	
	60.90	1590.5	1644.6	4.17	9.16	1	1	at Ferson Creek(VN)
	59.90	1646.0	1646.0	4.17	9.17	0	1	St. Charles Dam
	58.70	1646.8	1650.5	4.17	9.17	2	1	St. Charles STP
	57.90	1652.0	1652.0	4.17	9.17	6	1	DOWR Gage at Geneva
	57.30	1652.5	1652.5	4.17	9.17	2	1	Geneva STP
	54.80	1657.9	1657.9	4.17	9.17	2	1	Batavia STP
	54.70	1658.0	1658.0	4.17	9.17	3	1	Fermilab water supply withdrawal
	53.00	1662.7	1693.6	4.11	9.19	1	1	at Mill Creek (VL)
	52.99	1693.6	1693.6	4.11	9.19	2	1	Mooseheart treatment plant
	50.00	1698.7	1698.7	4.11	9.19	6	1	Upstream of Aurora withdrawal
	49.90	1698.7	1698.7	4.11	9.19	3	1	Aurora water supply withdrawal
	49.30	1701.6	1701.6	4.11	9.19	0	1	Illinois Avenue in Aurora
	49.00	1701.8	1716.5	4.12	9.20	1	1	at Indian Creek (VK)
	45.90	1726.5	1726.5	4.12	9.20	0	1	at Montgomery
	44.80	1726.0	1729.0	4.12	9.21	1	1	Fox River tributary (VJ3)
	44.50	1729.0	1729.0	4.12	9.21	6	1	Fox Metro WRD (Aurora) treatment plant
	44.00	1729.4	1729.4	4.12	9.21	2	1	Citizens Utility-Valley Water discharge
	42.71	1733.7	1733.7	4.12	9.21	0	1	
	42.70	1733.7	1763.1	4.11	9.22	1	1	at Waubansee Creek (VJ)
	42.40	1763.1	1763.1	4.11	9.22	2	1	Oswego STP
	37.81	1766.0	1766.0	4.11	9.22	0	1	
	37.80	1766.0	1783.0	4.08	9.24	1	1	at Morgan Creek (VI3)
	35.90	1788.7	1788.7	4.08	9.24	0	1	IL Rte. 47 at Yorkville
	35.61	1789.0	1789.0	4.08	9.24	2	1	Yorkville-Bristol treatment plant
	35.60	1789.0	1864.0	4.00	9.27	1	1	at Blackberry Creek (VI)
	31.31	1873.0	1873.0	4.00	9.27	0	1	
	31.30	1873.0	1892.6	3.98	9.28	1	1	at Rob Roy Creek (VH2)
	31.01	1900.3	1900.3	3.98	9.29	0	1	
	31.00	1900.3	2092.7	3.75	9.37	1	1	at Big Rock Creek (VH)
	29.51	2094.3	2094.3	3.75	9.37	0	1	
	29.50	2094.3	2109.6	3.73	9.38	1	1	at Hollenback Creek (VG7)
	25.41	2126.5	2126.5	3.73	9.38	0	1	
	25.40	2126.5	2132.0	3.73	9.39	0	1	
	21.01	2134.0	2134.0	3.73	9.39	0	1	
	21.00	2134.0	2150.0	3.72	9.39	1	1	at Roods Creek (VF1)
	20.11	2160.9	2160.9	3.72	9.39	0	1	
	20.10	2160.9	2243.9	3.62	9.42	1	1	at Somonauk Creek (VF)
	19.10	2247.4	2247.4	3.62	9.42	2	1	Sheridan treatment plant
	19.00	2247.4	2250.1	3.62	9.42	0	1	at Sheridan
	15.81	2257.2	2257.2	3.62	9.42	0	1	
	15.80	2257.2	2272.4	3.59	9.43	1	1	at Mission Creek (VE)
	13.01	2285.1	2285.1	3.57	9.43	0	1	
	13.00	2285.1	2296.8	3.55	9.43	1	1	at Brumbach Creek (VD)
	9.41	2304.4	2304.4	3.54	9.44	0	1	
	9.40	2304.4	2568.8	3.29	9.49	1	1	at Indian Creek (VC)

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Fox River	8.51	2572.0	2572.0	3.29	9.50	0	1	
	8.50	2572.0	2612.9	3.25	9.50	1	1	at Buck Creek (VB)
	5.40	2630.8	2630.8	3.23	9.50	6	1	USGS Gage 05552500 at Dayton
	0.00	2647.7	2647.7	3.21	9.51	0	1	at mouth at Ottawa
BuckCreek (VB)	16.40	0.0	0.0	0.87	9.90	0	2	
	11.90	6.5	6.5	0.87	9.90	0	2	
	10.40	11.7	11.7	0.87	9.90	0	2	
	9.10	16.3	16.3	0.87	9.90	0	2	
	8.61	17.3	17.3	0.87	9.90	0	2	
	8.60	17.3	29.7	0.97	9.90	1	2	at Buck Creek tributary (VBP)
	5.90	30.2	30.2	0.97	9.90	0	2	IL Rte. 23
	4.52	36.3	36.3	0.94	9.90	0	2	
	4.10	38.0	38.0	0.94	9.90	0	2	
	2.90	40.1	40.1	0.93	9.90	0	2	
	0.00	40.9	40.9	0.93	9.90	0	2	
Buck Creek Tributary (VBP)	14.00	0.0	0.0	1.11	9.90	0	2	
	6.90	2.7	2.7	1.11	9.90	0	2	
	5.78	5.6	5.6	1.11	9.90	0	2	
	3.84	8.5	8.5	1.11	9.90	0	2	
	1.52	12.1	12.1	1.11	9.90	0	2	
	0.63	13.1	13.1	1.11	9.90	0	2	
	0.00	13.4	13.4	1.11	9.90	0	2	
Indian Creek (VC)	53.19	0.0	0.0	0.81	10.00	0	2	
	52.70	2.1	2.1	0.81	10.00	0	2	
	46.10	7.6	7.6	0.81	10.00	0	2	
	44.00	11.8	13.7	0.81	10.00	0	2	
	42.30	17.6	17.6	0.83	10.00	2	2	Shabbona STP
	41.20	18.8	18.8	0.81	10.00	9	2	Lake Shabbona
	37.60	26.0	26.0	0.84	10.00	0	2	Sleepy Hollow Road
	36.00	31.8	31.8	0.86	10.00	0	2	Chicago Road
	32.90	36.6	36.6	0.87	10.00	0	2	Suydam Road
	26.81	47.6	47.6	1.00	10.00	0	2	
	26.80	47.6	59.8	1.06	10.00	1	2	at Paw Paw Run (VCN)
	24.21	68.1	68.1	1.11	10.00	0	2	
	24.20	68.1	86.0	1.13	10.00	1	2	Indian Creek tributary (VCM)
	22.61	87.9	87.9	1.13	10.00	2	2	Earlville STP
	22.60	87.9	115.6	1.19	10.00	1	2	at Sutphens Run (VCL)
	15.70	125.6	125.6	1.20	10.00	0	2	
	9.41	138.1	138.1	1.21	10.00	0	2	
	9.40	138.1	225.3	1.22	10.00	1	2	at Little Indian Creek (VCF)
	4.40	231.5	231.5	1.23	10.00	0	2	
	1.51	234.1	234.1	1.23	10.00	0	2	
	1.50	234.1	263.3	1.19	10.00	1	2	at Crooked Leg Creek (VCB)
	0.00	264.4	264.4	1.19	10.00	0	2	at mouth near Wedron
Crooked Leg Creek (VCB)	18.81	0.0	0.0	0.80	10.00	0	2	
	16.50	5.7	5.7	0.80	10.00	0	2	
	13.00	8.9	8.9	0.80	10.00	0	2	
	12.24	10.6	10.6	0.80	10.00	0	2	
	9.90	15.8	15.8	0.80	10.00	0	2	US Hwy. 23
	7.50	17.8	17.8	0.80	10.00	0	2	
	6.50	18.7	18.7	0.80	10.00	0	2	
	5.20	21.0	21.0	0.80	10.00	0	2	US Hwy. 52
	3.10	24.8	24.8	0.80	10.00	0	2	
	0.00	28.7	28.7	0.80	10.00	0	2	

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Little Indian	34.70	0.0	0.0	0.81	10.00	0	2	
Creek (VCF)	32.30	3.4	3.4	0.81	10.00	0	2	Duffy Road
	28.90	8.1	8.1	0.81	10.00	0	2	Leland Road
	27.40	10.9	10.9	0.81	10.00	0	2	Watson Road
	24.30	16.6	26.5	0.81	10.00	0	2	
	20.70	31.1	31.1	1.05	10.00	0	2	Suydam Road
	18.70	37.9	37.9	1.21	10.00	0	2	Sanderson Road
	17.00	40.6	40.6	1.23	10.00	0	2	Dekalb-LaSalle County Line
	15.60	42.8	42.8	1.24	10.00	0	2	Leland Road
	14.03	43.7	43.7	1.23	10.00	0	2	
	14.02	43.7	51.2	1.27	10.00	0	2	
	12.10	55.0	55.0	1.26	10.00	0	2	
	8.81	64.7	64.7	1.24	10.00	0	2	
	8.80	64.7	73.6	1.22	10.00	0	2	
	6.40	79.8	79.8	1.23	10.00	0	2	
	4.10	82.6	82.6	1.24	10.00	0	2	
	0.00	87.3	87.3	1.24	10.00	0	2	at mouth near Sheridan
Sutphens Run	15.30	0.0	0.0	1.35	10.00	0	2	
(VCL)	12.50	3.8	3.8	1.35	10.00	0	2	
	10.90	7.1	7.1	1.35	10.00	0	2	Lee-LaSalle County Line
	9.57	9.2	9.2	1.35	10.00	0	2	
	7.30	12.8	18.1	1.35	10.00	0	2	
	5.40	19.1	19.1	1.36	10.00	0	2	Burlington Northern RR
	1.90	26.6	26.6	1.39	10.00	0	2	Chicago and Northwestern RR
	0.00	27.7	27.7	1.39	10.00	0	2	
Indian Creek	8.40	0.0	0.0	1.20	10.00	0	2	
Tributary (VCM)	5.60	2.9	2.9	1.20	10.00	0	2	
	3.30	4.8	4.8	1.20	10.00	0	2	Lee-DeKalb County Line
	0.81	10.2	10.2	1.20	10.00	0	2	
	0.80	10.2	17.7	1.20	10.00	0	2	Earlville Road
	0.00	18.0	18.0	1.20	10.00	0	2	
Paw Paw Run	11.10	0.0	0.0	1.31	10.00	0	2	
(VCN)	8.70	2.4	2.4	1.31	10.00	2	2	Paw Paw STP
	5.70	4.5	4.5	1.31	10.00	0	2	Lee-DeKalb County Line
	3.00	9.2	9.2	1.31	10.00	0	2	Chicago and Northwestern RR
	1.00	10.9	10.9	1.31	10.00	0	2	DeKalb-LaSalle County Line
	0.00	12.2	12.2	1.31	10.00	0	2	
Brumbach Creek	9.00	0.0	0.0	0.25	10.00	0	2	
(VD)	8.81	0.2	0.2	0.25	10.00	0	2	
	6.34	4.2	4.2	0.25	10.00	0	2	
	3.60	6.6	6.6	0.25	10.00	0	2	IL Rte. 71
	1.70	9.4	9.4	0.25	10.00	0	2	
	0.60	10.2	10.2	0.25	10.00	0	2	
	0.00	11.7	11.7	0.25	10.00	0	2	
Mission Creek	8.70	0.0	0.0	0.97	10.00	0	2	
(VE)	6.60	2.2	2.2	0.97	10.00	0	2	US Hwy. 52
	3.70	5.7	5.7	0.97	10.00	0	2	
	1.10	8.7	8.7	0.97	10.00	0	2	IL Rte. 71
	0.00	15.2	15.2	0.97	10.00	0	2	

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Somonauk Creek	35.00	0.0	0.0	0.82	10.10	0	2	
(VF)	30.20	8.9	8.9	0.82	10.10	0	2	Crego Road
	29.10	12.5	14.1	0.82	10.10	1	2	at Somonauk Creek tributary (VFU)
	25.30	22.3	32.0	0.82	10.10	0	2	
	20.40	26.4	37.7	0.89	10.10	0	2	Somonauk Road
	14.01	43.3	43.3	1.02	10.10	0	2	
	14.00	43.3	55.8	1.03	10.10	1	2	at Buck Branch (VFK)
	10.50	59.8	62.8	1.04	10.10	1	2	at Somonauk Creek tributary (VFH)
	9.30	64.0	64.0	1.04	10.10	9	2	Lake Holiday
	5.30	64.9	64.9	1.05	10.10	0	2	
	4.71	73.1	73.1	1.12	10.10	0	2	
	0.00	83.0	83.0	1.18	10.10	0	2	at mouth near Sheridan
Somonauk Creek	1.40	1.9	1.9	1.60	10.10	2	2	Somonauk STP
Tributary (VFH)	0.00	3.0	3.0	1.60	10.10	0	2	
Buck Branch	6.10	0.0	0.0	1.05	10.10	0	2	
(VFK)	3.70	6.7	6.7	1.05	10.10	0	2	Pine Road
	2.50	9.0	9.0	1.05	10.10	0	2	Suydam Road
	0.90	12.1	12.1	1.05	10.10	0	2	Somonauk Road
	0.00	12.5	12.5	1.05	10.10	0	2	
Somonauk Creek	1.80	0.9	0.9	0.82	10.10	2	2	Waterman STP
Tributary (VFU)	0.00	1.6	1.6	0.82	10.10	0	2	
Roods Creek	12.30	0.0	0.0	2.89	10.10	0	2	
(VF1)	9.80	1.4	1.4	2.89	10.10	0	2	Roods Road
	7.40	5.7	5.7	2.89	10.10	0	2	US Hwy. 52
	4.40	11.9	11.9	2.89	10.10	0	2	IL Rte. 71
	0.90	14.8	14.8	2.89	10.10	0	2	Burlington Northern RR
	0.00	15.9	15.9	2.89	10.10	0	2	
Hollenback Creek	8.20	0.0	0.0	2.21	10.10	0	2	
(VG7)	5.00	5.7	5.7	2.21	10.10	0	2	Walker Road
	4.20	8.0	8.0	2.21	10.10	0	2	IL Rte. 71
	3.00	11.3	11.3	2.21	10.10	0	2	
	1.70	13.5	13.5	2.21	10.10	0	2	Fox River Road
	0.00	15.3	15.3	2.21	10.10	0	2	
Big Rock Creek	30.20	0.0	0.0	1.14	10.20	0	2	
(VH)	26.90	5.7	5.7	1.14	10.20	0	2	Harter Road
	25.70	6.9	6.9	1.14	10.20	0	2	Perry Road
	24.10	9.1	9.1	1.14	10.20	0	2	Owens Road
	21.71	11.2	11.2	1.14	10.20	0	2	
	21.70	11.4	22.9	1.10	10.20	1	2	at Youngs Creek (VHT)
	19.80	26.9	26.9	1.14	10.20	0	2	Kane-DeKalb County Line
	15.70	32.6	32.6	1.17	10.20	0	2	US Hwy. 630
	13.81	33.1	33.1	1.18	10.20	0	2	
	13.80	33.1	60.9	1.04	10.20	1	2	at West Branch Big Rock Creek (VHM)
	12.90	62.0	62.0	1.05	10.20	0	2	Price Road
	10.31	64.4	64.4	1.07	10.20	0	2	
	10.30	64.4	102.7	1.52	10.20	1	2	at Welch Creek (VHJ)
	8.00	108.2	108.2	1.60	10.20	0	2	Kendall-Kane County Line
	7.40	109.6	109.6	1.62	10.20	0	2	
	3.00	114.9	114.9	1.69	10.20	0	2	Main St.
	1.20	115.7	115.7	1.70	10.20	2	2	Plano STP
	0.11	117.9	117.9	1.73	10.20	0	2	
	0.10	117.9	192.4	1.48	10.20	1	2	at Little Rock Creek (VHA)
	0.00	192.4	192.4	1.48	10.20	0	2	at mouth near Plano

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Little Rock	30.80	0.0	0.0	0.80	10.20	0	2	
Creek (VHA)	27.10	5.6	5.6	0.80	10.20	0	2	McGirr Road
	24.00	7.6	14.4	0.80	10.20	0	2	
	23.40	14.5	18.9	0.80	10.20	0	2	
	18.40	24.3	24.3	0.80	10.20	2	2	Hinckley STP
	13.40	29.2	40.1	0.80	10.20	1	2	at Little Rock Creek tributary (VHAL)
	9.50	51.2	51.2	0.87	10.20	0	2	Miller Road
	4.10	58.6	66.2	0.93	10.20	0	2	
	3.20	66.5	71.4	1.03	10.20	1	2	at Little Rock Creek tributary (VHAD)
	0.00	74.5	74.5	1.09	10.20	0	2	
Little Rock Creek	1.60	3.0	3.0	2.46	10.20	2	2	Sandwich STP
Tributary (VHAD)	0.00	4.9	4.9	2.46	10.20	0	2	
Little Rock Creek	6.60	0.0	0.0	1.09	10.20	0	2	
Creek Tributary	3.30	6.3	6.3	1.09	10.20	0	2	Somonauk Road
(VHAL)	1.00	10.5	10.5	1.09	10.20	0	2	East Sandwich Road
	0.00	10.9	10.9	1.09	10.20	0	2	
Welch Creek	17.40	0.0	0.0	3.70	10.20	0	1	
(VHJ)	16.00	2.1	2.1'	3.70	10.20	2	1	Elburn STP
	14.50	3.8	3.8	3.70	10.20	0	1	
	12.00	10.0	10.0	3.70	10.20	0	1	Dauberman Road at Kaneville
	10.90	12.0	12.0	3.42	10.20	0	1	
	7.10	15.6	15.6	3.10	10.20	0	1	Scott Road
	4.90	19.3	19.3	2.90	10.20	0	1	Dauberman Road
	3.20	22.1	22.1	2.79	10.20	0	1	Grannart Road near Big Rock
	2.21	22.4	22.4	2.78	10.20	0	1	
	2.20	22.4	36.8	2.24	10.20	1	1	At Unnamed tributary (VHJD)
	0.00	38.3	38.3	2.28	10.20	0	1	at mouth near Plano
Welch Creek	7.10	0.0	0.0	1.39	10.20	0	2	
Tributary (VHJD)	4.20	5.5	5.5	1.39	10.20	0	2	Scoff Road
	2.90	7.7	7.7	1.39	10.20	0	2	Wheeler Road
	1.50	10.2	10.2	1.39	10.20	0	2	Grannart Road
	0.00	14.4	14.4	1.39	10.20	0	2	
West Branch Big	13.90	0.0	0.0	0.87	10.20	0	2	
Rock Creek	10.90	3.9	3.9	0.87	10.20	0	2	McGirr Road
(VHM)	7.51	8.4	8.4	0.87	10.20	0	2	
	7.50	8.4	23.2	0.89	10.20	1	2	at Battle Creek (VHMO)
	7.00	23.6	23.6	0.89	10.20	0	2	Phillips Road
	5.60	24.8	24.8	0.89	10.20	0	2	Pritchard Road at Hinckley
	4.10	25.4	25.4	0.89	10.20	0	2	Kane-DeKalb County Line
	2.60	25.8	25.8	0.89	10.20	0	2	US Hwy. 30 (west of Big Rock)
	0.80	26.6	26.6	0.89	10.20	0	2	
	0.00	27.8	27.8	0.89	10.20	0	2	at mouth near Big Rock
Battle Creek	10.00	0.0	0.0	0.90	10.20	0	2	
(VHMO)	7.40	3.4	3.4	0.90	10.20	0	2	Harter Road
	5.90	9.9	9.9	0.90	10.20	0	2	
	3.30	12.6	12.6	0.90	10.20	0	2	McGirr Road
	0.00	14.8	14.8	0.90	10.20	0	2	

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Youngs Creek	8.30	0.0	0.0	1.08	10.20	0	2	
(VHT)	6.70	2.6	2.6	1.08	10.20	0	2	
	4.40	4.5	4.5	1.08	10.20	0	2	DeKalb-Kane County Line Road
	2.20	8.3	8.3	1.08	10.20	0	2	Owens Road (county line)
	0.40	11.0	11.0	1.08	10.20	0	2	
	0.00	19.8	19.8	1.08	10.20	0	2	at mouth near Kaneville
Rob Roy Creek	10.30	0.0	0.0	2.18	10.20	0	2	
(VH2)	7.80	7.2	7.2	2.18	10.20	0	2	Galena Road
	5.40	13.1	13.1	2.18	10.20	0	2	C.B.&Q. RR
	5.00	14.1	14.1	2.18	10.20	0	2	Faxon Road
	3.00	17.0	17.0	2.18	10.20	0	2	Schaefer Road
	0.00	19.6	19.6	2.18	10.20	0	2	
Blackberry	34.60	0.0	0.0	1.16	10.10	0	2	
Creek (VI)	31.90	3.5	3.5	1.16	10.10	0	2	Pouley Road
	27.90	6.0	6.0	1.16	10.10	0	2	
	25.40	9.2	9.2	1.67	10.10	0	2	Main Street
	22.60	18.7	18.7	2.14	10.10	0	2	Scott Road
	21.90	21.1	21.1	2.20	10.10	0	2	IL Rte. 47
	19.80	25.2	25.2	2.04	10.10	0	2	Ka-De-Ka Road
	17.50	27.3	27.3	1.99	10.10	2	2	Sugar Grove treatment plant
	17.01	30.7	30.7	1.89	10.10	0	2	
	17.00	30.7	44.3	1.81	10.10	1	2	at Lake Run (VIN)
	15.50	45.4	51.2	2.15	10.10	0	2	at East Run
	13.00	54.9	58.4	2.58	10.10	0	2	
	11.30	60.2	60.2	2.67	10.10	0	2	Kendall-Kane County Line Road
	7.40	64.0	64.0	2.84	10.10	0	2	
	3.30	70.2	70.2	3.11	10.10	5	2	USGS Gage 05551700 near Yorkville
	1.80	71.7	71.7	3.17	10.10	0	2'	US Hwy. 34
	0.00	72.9	72.9	3.22	10.10	0	2	at mouth at Yorkville
Lake Run	7.30	0.0	0.0	0.98	10.10	0	2	
(VIN)	6.00	2.1	2.1	0.98	10.10	0	2	Bliss Road (west of Batavia)
	3.98	8.8	8.8	0.98	10.10	0	2	
	3.30	11.0	11.0	0.98	10.10	0	2	Tanner Road
	2.00	12.5	12.5	0.98	10.10	0	2	East-West Tollway
	0.00	13.6	13.6	0.98	10.10	0	2	at mouth near Sugar Grove
Morgan Creek	8.60	0.0	0.0	1.45	10.10	0	2	
(VI3)	6.70	1.2	1.2	1.45	10.10	0	2	
	4.60	4.2	4.2	1.45	10.10	0	2	
	2.90	9.3	15.7	1.45	10.10	0	2	
	1.00	17.4	17.4	1.45	10.10	0	2	IL Rte. 71
	0.00	17.7	17.7	1.45	10.10	0	2	
Waubansee	12.60	0.0	0.0	2.84	10.10	0	1	
Creek (VJ)	10.50	1.8	1.8	2.84	10.10	0	1	IL Rte. 65
	9.30	3.9	3.9	2.84	10.10	0	1	E.J. & E. RR
	7.20	14.3	14.3	2.84	10.10	0	1	Kane-DuPage County Line
	5.50	17.2	17.2	2.84	10.10	0	1	E.J. & E. RR
	3.40	20.3	20.3	2.67	10.10	0	1	
	1.20	28.8	28.8	2.39	10.10	0	1	IL Rte. 71 near Oswego
	0.30	28.9	28.9	2.39	10.10	0	1	IL Rte. 25
	0.00	29.4	29.4	2.38	10.10	0	1	at mouth at Oswego
Fox River	1.40	2.3	2.3	4.63	10.10	2	1	Dial Corporation discharge
Tributary (VJ3)	0.00	2.8	2.8	4.63	10.10	0	1	

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Indian Creek	9.10	0.0	0.0	4.63	10.00	0	1	
(VK)	5.70	3.1	3.1	4.63	10.00	0	1	
	2.90	8.9	8.9	4.63	10.00	0	1	Reckinger Road
	1.10	14.2	14.2	4.63	10.00	0	1	Ohio Street in Aurora
	0.50	14.5	14.5	4.63	10.00	0	1	High Sreet in Aurora
	0.00	14.7	14.7	4.63	10.00	0	1	
Mill Creek	16.30	0.0	0.0	1.16	10.00	0	2	
(VL)	13.20	3.6	3.6	1.16	10.00	0	2	Brown Road
	10.20	8.0	8.0	1.16	10.00	0	2	US Alt Hwy. 30 near Wasco
	7.20	14.7	14.7	1.00	10.00	0	2	Keslinger Road
	5.40	19.8	19.8	0.94	10.00	0	2	Kaneville Road
	4.10	23.5	23.5	0.92	10.00	0	2	Wenmoth Road
	1.00	30.4	30.4	0.89	10.00	0	2	at Mooseheart Lake
	0.20	30.8	30.8	0.89	10.00	0	2	IL Rte. 31
	0.00	30.9	30.9	0.89	10.00	0	2	at mouth near Mooseheart
Ferson Creek	15.20	0.0	0.0	1.17	10.00	0	2	
(VN)	12.00	4.8	4.8	1.17	10.00	2	2	Ferson Creek Utility
	10.40	6.1	6.1	1.17	10.00	0	2	Burlington Road at Wasco
	8.74	8.4	8.4	1.17	10.00	0	2	
	6.51	11.4	11.4	1.26	10.00	0	2	
	6.50	11.4	45.5	2.15	10.00	1	2	at Otter Creek (VNL)
	4.40	47.9	47.9	2.11	10.00	0	2	
	2.20	53.1	53.1	2.06	10.00	6	2	USGS Gage 05551200 near St. Charles
	0.20	54.1	54.1	2.04	10.00	0	2	IL Rte. 31
	0.00	54.1	54.1	2.04	10.00	0	2	at mouth at St. Charles
Otter Creek	7.20	0.0	0.0	4.28	10.00	0	1	
(VNL)	4.40	2.5	2.5	4.28	10.00	0	1	
	3.81	4.7	4.7	4.28	10.00	0	1	
	3.80	4.7	11.9	2.88	10.00	0	1	at Fitchie Creek
	2.71	13.9	13.9	2.58	10.00	0	1	
	2.70	13.9	25.4	1.74	10.00	1	1	at Stony Creek (VNLK)
	1.00	28.9	28.9	1.68	10.00	0	1	Silver Glen Road
	0.00	34.1	34.1	1.52	10.00	0	1	
Stony Creek	6.00	0.0	0.0	1.06	10.00	0	2	
(VNLK)	3.40	5.0	5.0	1.06	10.00	0	2	
	1.20	10.8	11.1	1.06	10.00	0	2	at Bowes Creek
	0.60	11.6	11.6	1.06	10.00	0	2	Stevens Road
	0.00	11.7	11.7	1.06	10.00	0	2	
Norton Creek	5.30	0.0	0.0	1.14	10.00	0	2	
(VN3)	2.60	7.4	7.4	1.14	10.00	0	2	Dunham Road near Wayne
	0.50	11.5	11.5	1.14	10.00	0	2	IL Rte. 25
	0.00	12.1	12.1	1.14	10.00	0	2	at mouth near St Charles
Brewster Creek	6.80	0.0	0.0	6.53	10.00	0	1	
(VO)	4.20	4.9	4.9	6.53	10.00	0	1	Illinois Central RR
	2.00	7.0	7.0	6.53	10.00	0	1	Kane-DuPage County Line
	0.80	12.0	12.0	6.53	10.00	0	1	IL Rte. 25
	0.00	15.5	15.5	6.53	10.00	0	1	at mouth near South Elgin

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Poplar Creek	17.70	0.0	0.0	1.17	9.90	0	2	
(VP)	14.80	3.3	3.3	1.17	9.90	0	2	IL Rte. 62 near Barrington
	11.80	7.8	7.8	1.17	9.90	0	2	IL Rte. 72 near Bartlett
	10.71	8.2	8.2	1.17	9.90	0	2	
	10.70	8.2	13.3	1.17	9.90	1	2	at East Branch Poplar Creek (VPQ)
	10.10	16.6	16.6	1.49	9.90	0	2	IL Rte. 58
	7.50	21.8	21.8	1.80	9.90	0	2	IL Rte. 58
	4.91	26.1	26.1	2.14	9.90	0	2	
	4.90	26.1	33.2	2.14	9.90	1	2	at Poplar Creek tributary (VPH)
	4.40	34.4	34.4	2.16	9.90	0	2	
	2.30	35.5	35.5	2.18	9.90	5	2	USGS Gage 05550500 at Elgin
	1.00	43.4	43.4	3.57	9.90	0	2	Kane-Cook County Line
	0.00	44.3	44.3	3.69	9.90	0	2	at mouth at Elgin
Poplar Creek	6.48	0.0	0.0	6.98	9.90	0	1	
Tributary (VPH)	1.30	6.0	6.0	6.98	9.90	0	1	
	0.00	7.2	7.2	6.98	9.90	0	1	
East Branch	5.07	0.0	0.0	0.74	9.90	0	2	
Poplar Creek	2.70	3.7	3.7	0.74	9.90	0	2	
(VPQ)	0.00	5.1	5.1	0.74	9.90	0	2	
Tyler Creek	17.70	0.0	0.0	4.00	9.90	0	1	
(VQ)	15.50	5.2	5.2	4.00	9.90	0	1	IL Rte. 72 at Starks
	11.61	10.1	10.1	4.00	9.90	0	1	
	11.60	10.1	21.5	3.94	9.90	1	1	at Pingree Creek (VQR)
	9.00	28.0	28.0	4.17	9.90	0	1	Chicago & Northwestern RR
	7.90	30.7	30.7	4.24	9.90	0	1	Big Timber Road
	6.80	32.2	32.2	4.27	9.90	0	1	
	5.60	33.8	33.8	4.30	9.90	0	1	Randall Road
	3.00	36.9	36.9	4.36	9.90	0	1	
	1.60	38.4	38.4	4.38	9.90	0	1	Big Timber Road at Elgin
	0.00	40.0	40.0	4.40	9.90	0	1	at mouth at Elgin
Pingree Creek	9.00	0.0	0.0	3.89	9.90	0	1	
(VQR)	6.40	1.9	1.9	3.89	9.90	0	1	Illinois Central RR
	2.70	8.4	8.4	3.89	9.90	0	1	US Hwy. 20
	1.40	10.0	10.0	3.89	9.90	0	1	Highland Ave
	0.00	11.4	11.4	3.89	9.90	0	1	
Jelkes Creek	6.30	0.0	0.0	5.20	9.90	0	1	
(VQ5)	3.80	2.9	2.9	5.20	9.90	0	1	Sleepy Hollow Road
	0.50	6.5	6.5	5.20	9.90	0	1	IL Rte. 31
	0.00	6.8	6.8	5.20	9.90	0	1	at mouth near West Dundee
Crystal Creek	8.85	0.0	0.0	6.63	9.80	0	1	
(VS)	7.50	5.8	5.8	6.63	9.80	9	1	Crystal Lake outlet
	6.10	8.4	8.4	6.63	9.80	2	1	Crystal Lake STP
	2.50	9.5	9.5	6.63	9.80	2	1	Lake in the Hills treatment plant
	2.10	10.4	10.4	6.63	9.80	0	1	Cedar Street
	1.40	11.4	11.4	6.63	9.80	0	1	Algonquin Road
	1.30	11.4	20.4	6.63	9.80	1	1	at Woods Creek (VSE)
	0.00	27.2	27.2	6.63	9.80	0	1	at mouth near Algonquin

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Woods Creek	3.68	0.0	0.0	6.63	9.80	0	1	
(VSE)	3.30	3.4	3.4	6.63	9.80	0	1	
	1.70	8.3	8.3	6.63	9.80	0	1	
	0.40	8.9	8.9	6.63	9.80	0	1	
	0.00	9.0	9.0	6.63	9.80	0	1	
Spring Creek	12.90	0.0	0.0	3.01	9.80	0	1	
(VT)	10.10	5.2	5.2	3.01	9.80	0	1	Penny Road
	9.30	5.3	5.3	3.01	9.80	0	1	
	8.00	8.2	8.2	3.01	9.80	0	1	IL Rte. 62
	5.70	17.7	17.7	2.80	9.80	0	1	Donlea Road
	4.60	20.7	20.7	2.78	9.80	0	1	McHenry-Cook County Line
	0.60	24.8	24.8	2.75	9.80	2	1	Fox River Grove treatment plant
	0.00	25.8	25.8	2.75	9.80	0	1	at mouth near Fox River Grove
Cary Creek	0.90	3.0	3.0	6.63	9.80	2	1	Cary STP
(VT1)	0.00	3.3	3.3	6.63	9.80	0	1	
Flint Creek	15.58	0.0	0.0	2.76	9.80	0	1	
(VU)	15.00	0.7	0.7	2.76	9.80	0	1	
	12.10	3.4	3.4	2.76	9.80	0	1	IL Rte. 59
	9.90	4.4	4.4	2.76	9.80	2	1	Quaker Oats Company discharge
	9.30	5.6	13.3	2.76	9.80	1	1	at Flint Creek tributary (VUP)
	5.10	19.8	19.8	2.76	9.80	0	1	Cuba Road (at Cuba)
	4.70	20.4	20.4	2.76	9.80	0	1	US Hwy. 14
	2.30	23.9	35.3	2.76	9.80	1	1	at Flint Creek tributary (VUE)
	1.10	36.0	36.0	2.76	9.80	0	1	Kelsey Road
	0.70	36.2	36.2	2.76	9.80	2	1	Lake Barrington Home Assoc. WTP
	0.00	36.8	36.8	2.76	9.80	0	1	at mouth near Fox River Grove
Flint Creek	6.50	0.0	0.0	2.36	9.80	0	1	
Tributary (VUE)	4.10	5.6	5.6	2.36	9.80	0	1	
	1.50	8.3	8.3	2.36	9.80	0	1	IL Rte. 59
	1.32	8.6	8.6	2.36	9.80	0	1	
	0.30	10.8	10.8	2.36	9.80	0	1	
	0.00	11.4	11.4	2.36	9.80	0	1	at mouth near North Barrington
Flint Creek	2.00	5.7	5.7	2.76	9.80	0	1	
Tributary (VUP)	0.50	7.5	7.5	2.76	9.80	2	1	Barrington STP
	0.00	7.7	7.7	2.76	9.80	0	1	
Slocum Lake	9.20	0.0	0.0	1.30	9.80	0	2	
Outlet (VU3)	4.80	4.9	4.9	1.30	9.80	2	2	Wauconda STP
	2.00	8.8	8.8	1.30	9.80	0	2	
	0.00	11.5	11.5	1.30	9.80	0	2	
Cotton Creek	7.85	0.0	0.0	2.56	9.80	0	1	
(VV)	6.50	3.9	3.9	2.56	9.80	0	1	Garland Road
	3.50	9.0	9.0	2.56	9.80	0	1	Darrell Road at Island Lake
	2.79	10.4	10.4	2.56	9.80	0	1	
	2.60	10.9	10.9	2.56	9.80	0	1	
	1.70	11.3	11.3	2.56	9.80	2	1	Island Lake STP
	0.00	12.4	12.4	2.56	9.80	0	1	

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Sleepy Hollow	8.00	0.0	0.0	7.28	9.60	0	1	
Creek (VV4)	5.20	3.1	3.1	7.28	9.60	0	1	Pleasant Hill Road
	4.60	7.5	7.5	7.28	9.60	0	1	Bay Road
	4.00	9.0	9.0	7.28	9.60	2	1	TC Industries discharge
	3.80	9.1	9.1	7.28	9.60	0	1	IL Rte. 31
	3.40	9.2	10.8	7.28	9.60	2	1	Crystal Lake STP #3 tributary inflow
	2.80	12.2	12.2	7.28	9.60	0	1	Thunderbird Lake Dam
	1.40	13.8	13.8	7.28	9.60	0	1	Barreville Road
	0.00	15.0	15.0	7.28	9.60	0	1	at mouth near Burtons Grove
Boone Creek	12.40	0.0	0.0	7.92	9.60	0	1	
(VW)	9.70	4.5	4.5	7.92	9.60	0	1	
	9.00	5.8	5.8	7.92	9.60	0	1	Valley Hill Road
	7.30	8.9	8.9	7.92	9.60	0	1	
	6.89	9.9	9.9	7.92	9.60	0	1	
	5.42	13.4	13.4	7.92	9.60	0	1	
	4.80	14.9	14.9	7.92	9.60	5	1	USGS Gage 05549000 near McHenry
	3.38	17.9	17.9	7.68	9.60	0	1	
	1.30	22.3	22.3	7.36	9.60	0	1	IL Rte. 120 at McHenry
	0.00	23.3	23.3	7.28	9.60	0	1	at mouth at McHenry
Dutch Creek	4.80	0.0	0.0	5.95	9.60	0	1	
(VW4)	1.81	3.5	3.5	5.95	9.60	0	1	
	1.80	3.5	6.4	5.95	9.60	1	1	at Dutch Creek tributary (VW4J)
	0.80	7.9	7.9	5.95	9.60	0	1	
	0.00	12.7	12.7	5.95	9.60	0	1	
Dutch Creek	1.80	0.6	0.6	5.95	9.60	2	1	Morton Chemical industrial discharge
Tributary (VW4J)	1.70	0.6	0.6	5.95	9.60	2	1	Modine Manufacturing industrial discharge
	0.00	2.9	2.9	5.95	9.60	0	1	
Nippersink	38.00	0.0	0.0	2.13	9.60	0	1	
Creek (VX)	36.40	2.5	2.5	2.13	9.60	0	1	
	31.01	8.0	8.0	2.13	9.60	0	1	
	31.00	8.0	18.4	2.34	9.60	1	1	at Nippersink Creek tributary (VXV)
	30.70	19.3	19.3	2.34	9.60	0	1	IL Rte. 173 near Alden
	27.50	21.7	21.7	2.34	9.60	0	1	Johnson Road near Hebron
	24.50	24.7	24.7	2.34	9.60	0	1	IL Rte. 47
	22.21	28.3	28.3	2.27	9.60	0	1	
	22.20	28.3	65.1	2.71	9.60	1	1	at Newman Creek (VXP)
	22.01	65.1	65.1	2.71	9.60	0	1	
	22.00	65.1	79.9	2.81	9.60	1	1	at Vander Karr Creek (VXO)
	19.30	84.1	84.1	2.93	9.60	0	1	Thompson Road
	16.70	95.7	95.7	3.25	9.60	9	1	Wonder Lake
	10.30	115.7	15.7	3.67	9.60	0	1	Richmond Road
	9.71	116.3	16.3	3.68	9.60	0	1	
	9.70	116.3	84.6	4.93	9.52	1	1	at North Branch Nippersink Creek (VXH)
	7.80	186.7	86.7	5.02	9.52	2	1	Intermatic, Inc.
	7.01	191.3	91:.3	5.07	9.52	0	1	
	7.00	191.3	91.3	5.07	9.52	4	1	USGS Gage 05548280 near Spring Grove
	2.70	201.8	01.8	5.26	9.52	0	1	
	0.00	203.5	03.5	5.28	9.52	0	1	at mouth at Fox Lake

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
North Branch	20.10	0.0	0.0	7.20	9.40	0	1	
Nippersink Creek	16.51	6.1	6.1	7.20	9.40	0	1	
(VXH)	16.50	6.1	11.7	7.20	9.40	1	1	at DeYoung Creek (VXHV)
	14.70	13.6	13.6	7.20	9.40	0	1	Wisconsin County Road B
	12.20	16.2	27.3	7.20	9.40	0	1	at West Branch
	10.50	30.0	42.7	7.20	9.40	0	1	
	9.00	43.9	43.9	7.20	9.40	0	1	Genoa City
	8.60	44.3	44.3	7.20	9.40	0	1	Illinois-Wisconsin State Line
	5.70	51.7	51.7	7.22	9.40	2	1	Richmond STP
	5.01	51.8	51.8	7.22	9.40	0	1	
	5.00	51.8	64.6	7.06	9.40	1	1	at Elizabeth Lake Drain (VXHG)
	4.30	65.8	65.8	7.06	9.40	0	1	Hill Road
	2.40	67.3	67.3	7.06	9.40	0	1	US Hwy. 12
	0.00	68.3	68.3	7.06	9.40	0	1	at mouth near Solon Mills
Elizabeth Lake	5.40	0.0	0.0	6.42	9.40	0	1	
Drain (VXHG)	2.30	8.5	8.5	6.42	9.40	0	1	Illinois-Wisconsin State Line
	1.90	9.7	9.7	6.42	9.40	0	1	Elizabeth Lake
	0.90	12.4	12.4	6.42	9.40	0	1	IL Rte. 173
	0.00	12.8	12.8	6.42	9.40	0	1	at mouth near Richmond
DeYoung Creek	3.30	0.0	0.0	4.08	9.40	0	1	
(VXHV)	1.70	1.5	1.5	4.08	9.40	0	1	IL Rte. 170 at Hebron
	0.50	5.5	5.5	4.08	9.40	2	1	Hebron STP
	0.00	5.6	5.6	4.08	9.40	0	1	
Vander Karr	6.20	0.0	0.0	3.25	9.60	0	1	
Creek	3.70	4.0	4.0	3.25	9.60	0	1	Stewart Street
(VXO)	2.85	9.3	9.3	3.25	9.60	0	1	
	2.50	11.4	11.4	3.25	9.60	0	1	Vander Karr Road
	0.20	14.8	14.8	3.25	9.60	0	1	Allendale Road
	0.00	14.8	14.8	3.25	9.60	0	1	
Silver Creek	9.80	0.0	0.0	4.06	9.60	0	1	
(VXP)	7.30	2.7	5.4	4.06	9.60	0	1	
	5.80	9.0	9.0	4.06	9.60	2	1	Woodstock North treatment plant
	5.00	9.3	12.2	4.06	9.60	1	1	
	4.00	15.4	15.4	4.06	9.60	0	1	Alden Road
	1.21	18.0	18.0	4.06	9.60	0	1	
	1.20	18.0	36.4	3.03	9.60	1	1	at Slough Creek (VXPD)
	0.00	36.8	36.8	3.04	9.60	0	1	at mouth near Greenwood
Slough Creek	8.20	0.0	0.0	2.02	9.60	0	1	
(VXPD)	6.20	3.6	3.6	2.02	9.60	0	1	Nelson Road
	5.10	7.6	7.6	2.02	9.60	0	1	Rose Farm Road
	3.60	8.4	8.4	2.02	9.60	0	1	Alden Road
	2.86	11.0	11.0	2.02	9.60	0	1	
	0.90	17.8	17.8	2.02	9.60	0	1	IL Rte. 47
	0.00	18.4	18.4	2.02	9.60	0	1	
Silver Creek	2.20	0.2	0.2	4.06	8.80	0	1	
Tributary (VXPL)	0.00	2.9	2.9	4.06	8.80	0	1	
Nippersink	6.90	0.0	0.0	2.51	9.60	0	1	
Creek	5.50	3.7	3.7	2.51	9.60	0	1	Ferris Road
Tributary (VXV)	2.80	3.1	3.1	2.51	9.60	0	1	Alden Road at Alden
	0.00	10.6	10.6	2.51	9.60	0	1	at mouth at Alden

Appendix C. Continued

Stream (code)	Mileage	DA(u)	DA(d)	K	P-ET	ID	Region	Location description
Squaw Creek	15.30	0.0	0.0	2.45	9.40	0	1	
(VY)	11.40	7.5	7.5	2.45	9.40	0	1	IL Rte. 60 at Fremont Center
	9.50	12.6	12.6	2.45	9.40	0	1	
	8.20	16.1	16.1	2.45	9.40	0	1	IL Rte. 120 at Round Lake Park
	4.70	18.5	18.5	2.45	9.40	0	1	
	4.50	18.5	21.7	2.38	9.40	1	1	tributary - Baxter Healthcare discharge
	3.20	23.7	30.9	2.25	9.40	1	1	at Squaw Creek tributary (VYF)
	2.70	31.5	35.6	2.23	9.40	1	1	at Eagle Creek (VYE)
	1.40	37.8	37.8	2.23	9.40	0	1	Rollins Road at Fox Lake
	1.20	38.0	45.7	2.23	9.40	0	1	Fish Lake Drain confluence
	0.00	46.5	46.5	2.20	9.40	0	1	at mouth at Fox Lake
Eagle Creek	4.80	0.0	0.0	2.09	9.40	0	1	
(VYE)	3.30	1.3	1.3	2.09	9.40	0	1	
	0.00	4.1	4.1	2.09	9.40	0	1	at mouth at Long Lake
Squaw Creek	4.60	0.0	0.0	2.09	9.40	0	1	
Tributary (VYF)	2.70	4.5	4.5	2.09	9.40	0	1	
	1.50	5.2	5.2	2.09	9.40	0	1	
	0.00	7.2	7.2	2.09	9.40	0	1	
Squaw Creek	2.20	1.5	1.5	2.09	9.40	2	1	Baxter Healthcare discharge
Tributary (VYH)	0.00	3.2	3.2	2.09	9.40	0	1	
Sequoit Creek	7.50	0.0	0.0	2.13	9.40	0	1	
(VZ)	5.00	5.2	5.2	2.13	9.40	0	1	Grass Lake Road
	3.10	10.4	10.4	2.13	9.40	0	1	
	1.40	12.8	12.8	2.13	9.40	2	1	Antioch STP
	0.90	13.4	13.4	2.13	9.40	0	1	Tiffany Road
	0.00	13.7	13.7	2.13	9.40	0	1	at mouth at IL Rte. 173

Appendix D. Coefficients for Virgin Flow Equations

The mean flow for a stream location (Q_{mean}) is computed as: Q_{mean} = 0.0738 DA (P-ET), where the drainage area (DA) and net excess precipitation (P-ET) are included in the NETWORK file, listed in appendix C.

The flow values for the remaining flow parameters, designated by Q_x, are computed using the following equation:

$$Q_x = \min \{ Q_{mean} [a + b\ DA + c\ K] - 0.05, 0\}$$

where K is the average soil permeability for the watershed, also included in the NETWORK file (see appendix C), and the coefficients a, b, and c are defined in the following table.

Flow type	*Data set 1, for use in areas with sandy strata*				*Data set 2, for use in the Bloomington Ridged Plain*			
	(a)	(b)	(c)	Error (c_e)	(a)	(b)	(c)	Error (c_e)
Q_{01}	10.554910	-0.0035700	-0.648740	1.3163	11.373080	-0.0011800	-1.445050	0.8389
Q_{02}	7.621187	-0.0017000	-0.448960	0.8605	7.788779	-0.0007400	-0.804580	0.4752
Q_{05}	4.313487	0.0000982	-0.219410	0.4202	4.217719	0.0000246	-0.297770	0.2523
Q_{10}	2.496603	0.0006040	-0.089380	0.2063	2.408664	0.0002660	-0.085570	0.1349
Q_{15}	1.701809	0.0004770	-0.031770	0.1590	1.635997	0.0002180	0.008032	0.0927
Q_{25}	0.945960	0.0002930	0.017731	0.1269	0.906904'	0.0001790	0.057598	0.0645
Q_{40}	0.477278	0.0001180	0.044701	0.1012	0.423646	0.0001020	0.078911	0.0577
Q_{50}	0.304856	0.0000791	0.051749	0.0849	0.230940	0.0000731	0.090849	0.0495
Q_{60}	0.179565	0.0000302	0.055214	0.0531	0.099315	0.0000437	0.095504	0.0398
Q_{75}	0.066637	-0.0000460	0.055645	0.0437	-0.006340	0.0000114	0.088305	0.0224
Q_{85}	0.024087	-0.0000410	0.050787	0.0376	-0.025320	0.0000112	0.071292	0.0140
Q_{90}	0.005731	-0.0000320	0.047982	0.0320	-0.027050	0.0000104	0.061116	0.0118
Q_{95}	-0.007410	-0.0000280	0.044019	0.0290	-0.026610	0.0000075	0.050945	0.0092
Q_{98}	-0.014880	-0.0000200	0.039612	0.0275	-0.024100	0.0000046	0.041830	0.0074
Q_{99}	-0.021180	-0.0000098	0.037485	0.0252	-0.022820	0.0000037	0.036853	0.0065
Low Flows								
$Q_{1,2}$	-0.012000	-0.0000150	0.050000	0.0447	-0.024230	0.0000055	0.052233	0.0110
$Q_{1,10}$	-0.017000	-0.0000150	0.034000	0.0413	-0.019930	0.0000043	0.030450	0.0056
$Q_{1,25}$	-0.019000	-0.0000080	0.030000	0.0427	-0.017740	0.0000034	0.024968	0.0045
$Q_{1,50}$	-0.022000	-0.0000050	0.029000	0.0432	-0.015690	0.0000044	0.019100	0.0038
$Q_{7,2}$	-0.007000	-0.0000200	0.051000	0.0485	-0.025110	0.0000039	0.058737	0.0121
$Q_{7,10}$	-0.015000	-0.0000200	0.036000	0.0449	-0.022630	0.0000042	0.035682	0.0065
$Q_{7,25}$	-0.018000	-0.0000120	0.032000	0.0482	-0.019670	0.0000044	0.028100	0.0048
$Q_{7,50}$	-0.021000	-0.0000070	0.030981	0.0494	-0.017120	0.0000052	0.021500	0.0038
$Q_{15,2}$	-0.002000	-0.0000250	0.052000	0.0511	-0.026190	0.0000034	0.065619	0.0128
$Q_{15,10}$	-0.013000	-0,0000250	0.037437	0.0466	-0.024160	0.0000039	0.040200	0.0078
$Q_{15,25}$	-0.016000	-0.0000180	0.033946	0.0495	-0.020500	0.0000038	0.031000	0.0058
$Q_{15,50}$	-0.019000	-0.0000130	0.032731	0.0517	-0.018200	0.0000044	0.025000	0.0042
$Q_{31,2}$	0.006000	-0.0000300	0.053000	0.0525	-0.025650	0.0000001	0.073262	0.0142
$Q_{31,10}$	-0.011000	-0.0000300	0.039752	0.0479	-0.024200	0.0000025	0.044337	0.0087
$Q_{31,25}$	-0.014000	-0.0000230	0.036000	0.0510	-0.020700	0.0000026	0.035063	0.0067
$Q_{31,50}$	-0.017000	-0.0000180	0.034500	0.0535	-0.018400	0.0000035	0.028000	0.0047
$Q_{61,2}$	0.020000	-0.0000500	0.055000	0.0504	-0.022730	0.0000002	0.085028	0.0175
$Q_{61.10}$	-0.009000	-0.0000350	0.042932	0.0481	-0.024360	0.0000030	0.048514	0.0090
$Q_{61,25}$	-0.012000	-0.0000280	0.038000	0.0509	-0.021570	0.0000027	0.038344	0.0072
$Q_{61,50}$	-0.015000	-0.0000230	0.036000	0.0531	-0.018520	0.0000035	0.030719	0.0054
$Q_{91,2}$	0.040000	-0.0000600	0.060000	0.0565	-0.012240	-0.0000064	0.095759	0.0202
$Q_{91,10}$	-0.005000	-0.0000400	0.045000	0.0466	-0.026870	0.0000054	0.054067	0.0102
$Q_{91,25}$	-0.008000	-0.0000350	0.040000	0.0512	-0.023090	0.0000043	0.042206	0.0077
$Q_{91,50}$	-0.012000	-0.0000300	0.038000	0.0542	-0.018360	0.0000043	0.032794	0.0060

Appendix D. Continued

Flow type	*Data set 1*				*Data set 2*			
	(a)	(b)	(c)	Error (c_e)	(a)	(b)	(c)	Error (c_e)
Drought Flows								
$Q_{6,10}$	0.005000	-0.0000400	0.051000	0.0477	-0.020250	0.0000126	0.061397	0.0269
$Q_{6,25}$	-0.002000	-0.0000350	0.048000	0.0494	-0.025780	0.0000134	0.053184	0.0199
$Q_{6,50}$	-0.006000	-0.0000250	0.045000	0.0522	-0.027080	0.0000112	0.049294	0.0170
$Q_{9,10}$	0.130000	-0.0000200	0.046000	0.0481	0.056450	0.0000430	0.049126	0.0692
$Q_{9,25}$	0.070000	-0.0000100	0.045000	0.0407	0.010527	0.0000042	0.055739	0.0392
$Q_{9,50}$	0.030000	-0.0000050	0.046000	0.0429	-0.002770	-0.0000013	0.052993	0.0280
$Q_{12,10}$	0.337008	0.0000654	0.034453	0.0461	0.214412	0.0000233	0.051174	0.1559
$Q_{12,25}$	0.217173	-0.0000520	0.039355	0.0376	0.098817	-0.0000210	0.064969	0.0945
$Q_{12,50}$	0.154615	-0.0000150	0.039858	0.0510	0.058534	-0.0000370	0.062428	0.0674
$Q_{18,10}$	0.481288	0.0000127	0.026008	0.0496	0.302353	0.0000773	0.023239	0.1973
$Q_{18,25}$	0.304443	-0.0000700	0.033136	0.0411	0.136027	0.0000199	0.047060	0.1129
$Q_{18,50}$	0.171379	0.0000162	0.038849	0.0616	0.085953	-0.0000180	0.056233	0.0858
$Q_{30,10}$	0.674268	-0.0000210	0.017591	0.0518	0.577792	0.0000312	0.016966	0.3370
$Q_{30,25}$	0.412472	-0.0000760	0.032603	0.0460	0.288214	0.0000740	0.023831	0.1933
$Q_{30,50}$	0.243558	0.0000605	0.038703	0.0630	0.204693	-0.0000200	0.040279	0.1382
$Q_{54,10}$	0.903503	-0.0000610	0.006880	0.0569	0.821054	-0.0000035	0.027199	0.4707
$Q_{54,25}$	0.532042	-0.0000180	0.028550	0.0534	0.465373	0.0000271	0.038042	0.2908
$Q_{54,50}$	0.446283	-0.0000540	0.028590	0.0730	0.324378	-0.0000061	0.046099	0.2116
January								
Q_{02}	8.461549	-0.0020100	-0.535240	1.3314	8.256238	0.0002820	-1.381390	1.2030
Q_{10}	2.508796	0.0004710	-0.073030	0.4344	2.064314	0.0011100	.-0.420500	0.3917
Q_{25}	0.926433	0.0000709	0.026720	0.1577	0.728722	0.0005970	-0.140090	0.1719
Q_{50}	0.372278	0.0000601	0.051337	0.1123	0.220107	0.0002320	0.006675	0.0760
Q_{75}	0.135356	-0.0000660	0.055242	0.0583	0.005306	0.0000419	0.061177	0.0191
Q_{90}	0.020667	-0.0000620	0.051453	0.0456	-0.027210	0.0000128	0.052691	0.0106
Q_{98}	0.001205	-0.0000880	0.042394	0.0497	-0.028040	0.0000083	0.042319	0.0085
Q_{mean}	1.049283	-0.0000470	0.000996	0.1119	0.888421	0.0003100	-0.126030	0.1175
February								
Q_{02}	10.244680	-0.0018100	-0.683430	1.3079	9.284479	-0.0007400	-1.280140	1.0674
Q_{10}	3.593165	0.0005400	-0.167650	0.4135	2.989105	0.0008410	-0.482250	0.4091
Q_{25}	1.478149	0.0003890	-0.014800	0.1645	1.279789	0.0005000	-0.203440	0.2485
Q_{50}	0.558261	0.0001350	0.041151	0.1272	0.399664	0.0002390	-0.020310	0.1236
Q_{75}	0.206311	-0.0000300	0.056921	0.0876	0.093291	0.0000907	0.037001	0.0479
Q_{90}	0.064490	-0.0000720	0.051278	0.0467	-0.025330	0.0000489	0.057587	0.0139
Q_{98}	0.009268	-0.0000610	0.043814	0.0520	-0.029870	0.0000156	0.049982	0.0098
Q_{mean}	1.439258	0.0001160	-0.028530	0.1073	1.258718	0.0002290	-0.162870	0.1879
March								
Q_{02}	10.312500	-0.0049400	-0.487570	1.4102	10.194180	-0.0014800	-0.719630	1.3390
Q_{10}	4.682353	-0.0010200	-0.197970	0.5283	3.940799	-0.0003400	0.137838	0.5570
Q_{25}	2.389201	-0.0000140	-0.055870	0.2445	1.792988	0.0002440	0.212393	0.2611
Q_{50}	1.169233	0.0000423	0.014644	0.1242	0.803663	0.0001620	0.156120	0.1055
Q_{75}	0.570738	-0.0000410	0.043005	0.0972	0.316486	0.0001730	0.086546	0.0721
Q_{90}	0.295692	-0.0000280	0.054419	0.0942	0.122431	0.0000955	0.070082	0.0501
Q_{98}	0.087426	0.0000114	0.057228	0.0419	-0.009690	0.0000468	0.070258	0.0270
Q_{mean}	2.045213	-0.0003900	-0.039870	0.1819	1.722511	-0.0000300	0.070402	0.1702

Appendix D. Continued

Flow type	*Data set 1*				*Data set 2*			
	(a)	(b)	(c)	Error (c_e)	(a)	(b)	(c)	Error (c_e)
April								
Q_{02}	10.429970	-0.0038200	-0.611370	1.1391	11.217380	0.0011420	-1.823100	1.2877
Q_{10}	4.918234	-0.0006200	-0.231470	0.5386	4.575437	0.0008530	-0.530060	0.6603
Q_{25}	2.539360	0.0004530	-0.077890	0.2826	2.352647	0.0005480	-0.122270	0.2950
Q_{50}	1.202432	0.0002760	0.011023	0.1606	1.121761	0.0001910	0.076074	0.1683
Q_{75}	0.581255	0.0000760	0.042065	0.1116	0.515019	0.0000397	0.107929	0.0849
Q_{90}	0.319224	0.0000485	0.050315	0.0643	0.230835	0.0000814	0.078383	0.0613
Q_{98}	0.165626	-0.0000110	0.053701	0.0623	0.033722	0.0000406	0.074163	0.0402
Q_{mean}	2.105230	-0.0000830	-0.055770	0.1593	2.075321	0.0002480	-0.122090	0.2123
May								
Q_{02}	8.150895	-0.0007600	-0.504910	0.7884	9.592962	-0.0004700	-1.623350	1.4765
Q_{10}	3.016309	0.0006550	-0.132350	0.2304	3.183883	0.0009280	-0.438810	0.3242
Q_{25}	1.330978	0.0004760	-0.011430	0.1582	1.475056	0.0006100	-0.118080	0.1741
Q_{50}	0.644321	0.0001960	0.035650	0.0991	0.739528	0.0002710	-0.006600	0.1025
Q_{75}	0.341718	0.0001550	0.047929	0.0858	0.386462	0.0001480	0.022807	0.0633
Q_{90}	0.207107	0.0000862	0.049379	0.0670	0.222348	0.0000858	0.025465	0.0364
Q_{98}	0.090345	0.0000533	0.046449	0.0490	0.078393	0.0000291	0.030314	0.0375
Q_{mean}	1.356728	0.0001550	-0.020530	0.1028	1.556877	0.0002610	-0.169390	0.0986
June								
Q_{02}	9.174983	-0.0030300	-0.616350	1.5822	10.915300	-0.0016100	-1.895610	1.7579
Q_{10}	2.488109	0.0011330	-0.142570	0.3987	3.167954	0.0004850	-0.432610	0.4487
Q_{25}	0.904021	0.0005510	0.003690	0.1264	1.251336	0.0004160	-0.114550	0.1973
Q_{50}	0.396318	0.0001480	0.043950	0.0995	0.497747	0.0001830	-0.000250	0.0986
Q_{75}	0.209118	0.0000583	0.048963	0.0625	0.222524	0.0001010	0.024847	0.0590
Q_{90}	0.108681	0.0000030	0.048527	0.0625	0.102360	0.0000482	0.035293	0.0420
Q_{98}	0.035000	-0.0000400	0.045000	0.0492	0.018023	0.0000220	0.045060	0.0275
Q_{mean}	1.191798	0.0000149	-0.024700	0.1434	1.476773	0.0000147	-0.167980	0.2120
July								
Q_{02}	4.627779	0.0006430	-0.308660	0.8249	5.959371	-0.0009000	-0.614200	0.9058
Q_{10}	0.972208	0.0011590	-0.023070	0.1652	1.419172	0.0003270	-0.059250	0.2643
Q_{25}	0.352010	0.0004040	0.037984	0.0935	0.532244	0.0002300	0.024553	0.1362
Q_{50}	0.154378	0.0001020	0.052086	0.0852	0.185234	0.0001380	0.037420	0.0683
Q_{75}	0.073861	-0.0000062	0.049859	0.0593	0.052863	0.0000588	0.045725	0.0368
Q_{90}	0.022000	-0.0000200	0.046000	0.0516	0.004029	0.0000224	0.044747	0.0205
Q_{98}	-0.007000	-0.0000100	0.040000	0.0485	-0.008580	0.0000132	0.031476	0.0106
Q_{mean}	0.547034	0.0001850	0.015988	0.0902	0.731141	0.0000116	-0.019210	0.0948
August								
Q_{02}	1.673471	0.0031510	-0.116840	0.6770	4.395971	-0.0009900	-0.355850	0.9775
Q_{10}	0.389734	0.0003570	0.041331	0.1334	0.515885	0.0000056	0.180363	0.1606
Q_{25}	0.156511	0.0000096	0.055721	0.0615	0.085608	0.0000401	0.142585	0.0642
Q_{50}	0.066876	-0.0000550	0.054160	0.0610	0.003665	0.0000234	0.089638	0.0340
Q_{75}	0.011000	-0.0000150	0.049000	0.0577	-0.012620	0.0000109	0.058857	0.0180
Q_{90}	-0.011000	-0.0000080	0.041500	0.0516	-0.015160	0.0000069	0.043720	0.0115
Q_{98}	-0.022000	-0.0000070	0.036500	0.0478	-0.014440	0.0000040	0.030773	0.0068
Q_{mean}	0.228033	0.0000985	0.038155	0.0728	0.371711	-0.0000740	0.062424	0.0830

Appendix D. Concluded

Flow type	Data set 1				Data set 2			
	(a)	(b)	(c)	Error (c_e)	(a)	(b)	(c)	Error (c_e)
September								
Q_{02}	3.792630	-0.0015200	-0.210990	0.8451	4.060000	-0.0008500	-0.245000	1.5610
Q_{10}	0.572209	-0.0002800	0.038158	0.1534	0.445846	-0.0000370	0.236173	0.3236
Q_{25}	0.120004	-0.0001000	0.057289	0.0635	0.010761	0.0000195	0.149305	0.0712
Q_{50}	0.020000	-0.0000400	0.056000	0.0594	-0.035390	0.0000034	0.101760	0.0247
Q_{75}	-0.005000	-0.0000250	0.048000	0.0542	-0.030590	0.0000079	0.061490	0.0127
Q_{90}	-0.012000	-0.0000230	0.041000	0.0543	-0.024850	0.0000055	0.042832	0.0084
Q_{98}	-0.023000	-0.0000080	0.035716	0.0488	-0.019450	0.0000040	0.029154	0.0061
Q_{mean}	0.320270	-0.0002200	0.033986	0.0500	0.330553	-0.0000940	0.077429	0.1099
October								
Q_{02}	2.695502	0.0005040	-0.058880	0.8500	3.749512	-0.0009800	-0.134930	0.8482
Q_{10}	0.810084	-0.0000160	0.0337.51	0.1765	0.766785	0.0000512	0.156244	0.2924
Q_{25}	0.271568	-0.0002300	0.063712	0.1118	0.112101	0.0000029	0.182602	0.1447
Q_{50}	0.064483	-0.0001300	0.061197	0.0600	-0.032320	-0.0000021	0.106540	0.0267
Q_{75}	0.005000	-0.0000500	0.053106	0.0595	-0.034640	0.0000066	0.068646	0.0124
Q_{90}	-0.010000	-0.0000300	0.045966	0.0537	-0.029570	0.0000014	0.051620	0.0087
Q_{98}	-0.025000	-0.0000080	0.038000	0.0578	-0.024610	0.0000009	0.038254	0.0069
Q_{mean}	0.353925	-0.0001600	0.045747	0.1062	0.360370	-0.0000940	0.081682	0.1237
November								
Q_{02}	3.989761	0.0000940	-0.180440	0.8126	3.912397	-0.0007100	-0.300110	0.6226
Q_{10}	1.328579	-0.0000670	0.025014	0.2334	1.097621	0.0000194	0. 125676	0.3098
Q_{25}	0.511781	-0.0001400	0.058340	0.1213	0.276369	-0.0000070	0.193159	0.1791
Q_{50}	0.166203	-0.0001700	0.061810	0.0728	-0.018760	0.0000042	0.153421	0.0523
Q_{75}	0.047532	-0.0000970	0.057596	0.0574	-0.047060	0.0000175	0.092118	0.0175
Q_{90}	0.005000	-0.0000600	0.050000	0.0518	-0.042390	0.0000111	0.069137	0.0130
Q_{98}	-0.014000	-0.0000250	0.040500	0.0543	-0.034620	0.0000073	0.050684	0.0104
Q_{mean}	0.542369	-0.0001400	0.039341	0.1012	0.350713	-0.0000048	0.101021	0.1065
December								
Q_{02}	7.120896	-0.0010000	-0.455650	1.1606	6.806380	-0.0001400	-1.168730	1.1576
Q_{10}	2.489002	0.0005730	-0.092590	0.2761	1.794654	-0.0000051	-0.098070	0.3902
Q_{25}	0.995378	0.0000409	0.029858	0.1579	0.629568	-0.0000150	0.060414	0.1730
Q_{50}	0.406591	-0.0001600	0.058074	0.1091	0.123610	0.0000055	0.103285	0.0990
Q_{75}	0.114075	-0.0001600	0.060724	0.0719	-0.021920	0.0000081	0.080068	0.0199
Q_{90}	0.003000	-0.0000400	0.053168	0.0680	-0.032410	0.0000141	0.056926	0.0106
Q_{98}	-0.018000	-0.0000250	0.045785	0.0670	-0.030510	0.0000111	0.044116	0.0085
Q_{mean}	1.040118	-0.0001300	0.004070	0.0717	0.742898	-0.0000230	-0.009110	0.1270

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