UNCERTAINTIES IN RECORDS OF ANNUAL MEAN DISCHARGE IN MAINE

by Richard A. Fontaine

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EXPLANATION OF SYMBOLS USED IN THIS REPORT

q - Spectral density of a random variable.

r - Variance of measurement error.

R^2 - Correlation coefficient.

t - Time.

β - Inverse of the correlation-time constant of a first order Markovian process.

$\Gamma(\Delta)$ - Autocovariance of discharge rates separated by a time interval Δ .

Δ - Lag time of an autocovariance function.

$e^{-\beta}$ - One day serial correlation coefficient.

σ_z^2 - Variance of the differences between measured and rated discharge.

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ABSTRACT

This report documents the results of rating analyses based on linear multiple regression for ice-covered periods of flow at 33 stations on selected rivers in Maine. The report also presents functions relating uncertainties in records to the number of discharge measurements made at 54 stations. The application is unusual in that it includes analysis of the uncertainty of discharge affected by backwater from ice. Total uncertainty consists of errors incurred during both streamflow measurement and data processing. An average of 46.8 percent of the total variance for the 21 stations not affected by backwater was due to measurement variance and 53.2 percent was due to process variance. Data from the remaining 33 stations were classified as either summer period or winter period. Among the summer-period stations, an average of 49.3 percent of the total variance was due to measurement variance and 50.7 percent was due to process variance. Among the winter-period stations, an average of 25.2 percent of the total variance was due to measurement variance and 74.8 percent was due to process variance.

Results of the seasonal division of average variance suggest that the process and measurement variances are essentially equal during open-water periods and that process variance is considerably greater than the measurement variance during backwater periods. The errors in winter discharge records significantly increased average uncertainty in the records of annual mean discharge.

INTRODUCTION

In recent years, stream-gaging programs have come under increased scrutiny in terms of accuracy requirements and economic limitations. These considerations prompted the use of techniques developed by Moss and Gilroy (1980) to assess the cost effectiveness of stream-gaging operations in the Lower Colorado River basin. The purpose of the Moss and Gilroy technique was to devise strategies for operating networks of gages that would minimize the total uncertainty or error in the estimation of streamflow in the system within given economic constraints.

The streamflow characteristic that served as the basis of the Moss and Gilroy technique was annual mean discharge. The uncertainty or error in the estimation of annual discharges serves in this study as an inverse surrogate for the economic worth of the data. This uncertainty is a function of the frequency of visits made to a station to service the recording equipment and to make discharge measurements. The approach that was developed by Moss and Gilroy to investigate uncertainty utilized Kalman filter theory. The costs of operating gaging stations are easily computed; those for the Maine network are documented by Fontaine (1982).

The purpose of this study was to document an application of the Moss and Gilroy technique to a region in which stream-gaging problems and practices differ from those in the Lower Colorado River basin. To do this, the uncertainties in the records of discharge at 54 gages, 33 of which experience backwater from ice, were analyzed. Locations of sites analyzed are shown in figure 1; site names are listed in table 1.

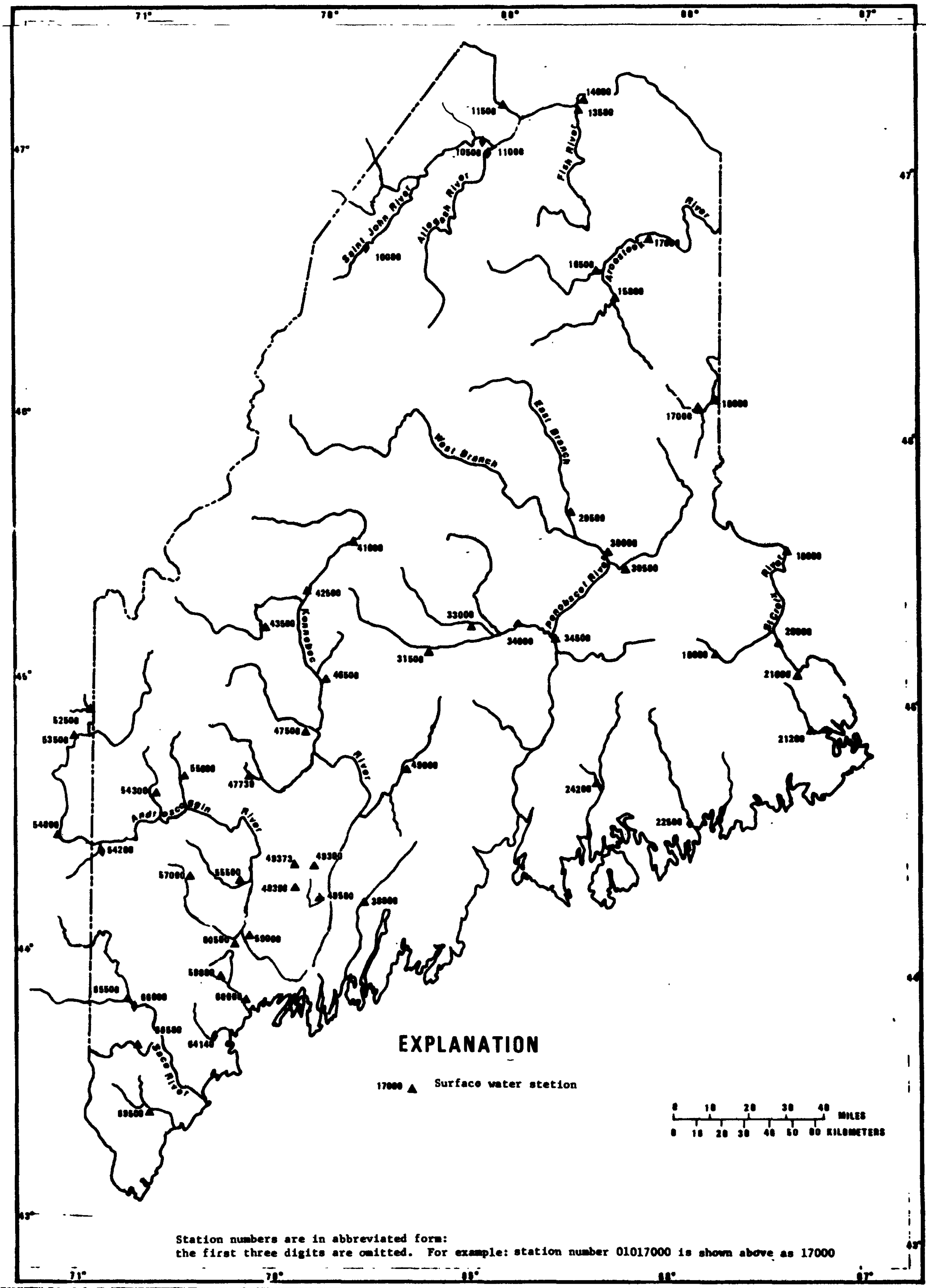


Figure 1. Map showing location of stations

Table 1.--Gaging stations used in this study

Station No.	Station Name
01010000	St. John River at Ninemile Bridge, Maine
01010500	St. John River at Dickey, Maine
01011000	Allagash River near Allagash, Maine
01011500	St. Francis River at outlet of Glasier Lake, near Connors, New Brunswick
01013500	Fish River near Fort Kent, Maine
01014000	St. John River below Fish River at Fort Kent, Maine
10158000	Aroostook River near Masardis, Maine
01016500	Machias River near Ashland, Maine
01017000	Aroostook River at Washburn, Maine
01017900	Marley Brook near Ludlow, Maine
01018000	Meduxnekeag River near Houlton, Maine
01018500	St. Croix River at Vanceboro, Maine
01019000	Grand Lake Stream at Grand Lake Stream, Maine
01020000	St. Croix River near Baileyville, Maine
01021000	St. Croix River at Baring, Maine
01021200	Dennys River at Dennysville, Maine
01022500	Narraguagus River at Cherryfield, Maine
01024200	Garland Brook near Mariaville, Maine
01029500	East Branch Penobscot River at Grindstone, Maine
01030000	Penobscot River near Mattawamkeag, Maine
01030500	Mattawamkeag River near Mattawamkeag, Maine
01031500	Piscataquis River near Dover-Foxcroft, Maine
01033000	Sebec River at Sebec, Maine
01034000	Piscataquis River at Medford, Maine
01034500	Penobscot River at West Enfield, Maine
01038000	Sheepscot River at North Whitefield, Maine
01041000	Kennebec River at Moosehead, Maine
01042500	Kennebec River at The Forks, Maine
01043500	Dead River near Dead River, Maine
01046500	Kennebec River at Bingham, Maine
01047000	Carrabassett River near North Anson, Maine
01047730	Wilson Stream at East Wilton, Maine
01049000	Sebasticook River near Pittsfield, Maine
01049300	North Branch Tanning Brook near Manchester, Maine
01049373	Mill Stream at Winthrop, Maine
01049396	Jock Stream at South Monmouth, Maine
01049500	Cobbosseecontee Stream at Gardiner, Maine
01052500	Diamond River near Wentworth Location, New Hampshire
01053500	Androscoggin River at Errol, New Hampshire
01054000	Androscoggin River near Gorham, New Hampshire
01054200	Wild River at Gilead, Maine
01054300	Ellis River at South Andover, Maine
01055000	Swift River near Roxbury, Maine
01055500	Nezinscot River at Turner Center, Maine
01057000	Little Androscoggin River near South Paris, Maine

Table 1.--Gaging stations used in this study -cont.

Station No.	Station Name
01058500	Little Androscoggin River near Auburn, Maine
01059000	Androscoggin River near Auburn, Maine
01059800	Collyer Brook near Gray, Maine
01060000	Royal River at Yarmouth, Maine
01064140	Presumpscot River near West Falmouth, Maine
01065500	Ossipee River at Cornish, Maine
01066000	Saco River at Cornish, Maine
01066500	Little Ossipee River near South Limington, Maine
01069500	Mousam River near West Kennebunk, Maine

General Approach

The Kalman filter theory, which was used to determine uncertainty functions, is complex and a thorough discussion is beyond the scope of this report. The theoretical background and an application are described by Moss and Gilroy (1980); the computer programs to execute these procedures are documented by Gilroy (1982). However, a brief review of the process is included to provide introductory information.

The Kalman filter used in this study assumes that the differences between the true and the rated instantaneous discharges can be described by a continuous first-order Markovian process that has an underlying Gauissan (normal) probability distribution with a mean value of zero and is referred to as the process variance ($q/2\beta$). An unbiased long-term discharge rating that exhibits this zero mean characteristic of the residuals must be available for each site to satisfy these assumptions. Once this rating has been obtained, a sequence of residuals, the discharge measurement minus the rated value (σ_z^2), can be tabulated. If there were no measurement errors, this residual series would yield an estimate of the process variance, $q/2\beta$, or the difference between the true and rated discharge. Measurement errors must be considered and are dealt with by means of the general equation for total error:

$$\sigma_z^2 = q/2\beta + r \qquad (1)$$

in which r represents the variance of the measurement errors.

To use the Kalman-filter, three parameters (1) r, the variance of the discharge-measurement errors, (2) $e^{-\beta}$, the one day autocorrelation of the Markovian structure of the difference between computed and actual instantaneous discharge rate, and (3) $q/2\beta$, the variance of the Markovian process, must be determined at each streamgage.

The variance of the discharge-measurement errors, r, can be initially estimated from the factors considered by Carter and Anderson (1963) and from standard stream-gaging practice as documented by Buchanan and Somers (1969). Moss and Gilroy (1980) assumed that r can be considered a constant percentage of the measured flow.

An initial estimate of the process variance, $q/2\beta$, can be obtained by manipulating equation (1) to yield the following:

$$q/2\beta = \sigma_Z^{\,2} - r \qquad (2)$$

Use of the Kalman filter requires that the magnitudes of q and β be defined individually. The autocovariance function

$$\Gamma(\Delta) = (q/2\beta)\, e^{-\beta\Delta} \qquad (3)$$

of a lag one autoregressive process is fit to the sample autocovariance function of the residuals from the rating by using a weighted nonlinear least squares estimating procedure taken from the Statistical Analysis System (SAS 1979). The procedure gives estimates of $q/2\beta$ and $e^{-\beta}$. The parameters thus obtained, the process variance, $q/2\beta$ and the one day serial correlations coefficient, $e^{-\beta}$, determine the uncertainty function. The uncertainty function is the variance of the mean discharge for a specified time period as a function of the number of discharge measurements made in that period.

Approach Used in Maine

The approach developed by Moss and Gilroy (1980) has been applied in the lower Colorado River basin, where the stations investigated do not experience backwater caused by ice, as is common in Maine. The backwater conditions in Maine required a slightly different approach to determine uncertainty or error functions.

The preceeding discussion indicated that the first requirement was a stable or long-term rating from which measurement residuals have a mean variance of zero. The winter backwater conditions in Maine make this result unobtainable when a yearly period is used for analysis. To obtain an analysis of the annual mean discharge, the year must be divided into periods during which stable ratings can be developed, the combined effects of which can be used to simulate an annual cycle. For stations affected by backwater this can be accomplished by dividing the year into a backwater period and an open-water period. The analysis periods for each station were determined by computing long-term average duration of backwater and open-water periods from available stream-gage information in consultation with experienced hydrologists. The duration of backwater and open-water periods for each station are tabulated in the Appendix. In this report, the backwater period is referred to as the winter period and the open-water period as the summer period.

Analysis of the open-water period was simplified by the fact that ratings in Maine are based primarily on ledge or bedrock controls and therefore are not subjected to the frequent rating shifts that occur in many parts of the United States. The requirement of a mean residual of zero is easily obtainable at these stations. However, infrequent shifting means that rating curve verification typically requires an average of only three discharge measurements annually. This limited amount of data in turn subjects the nonlinear curve fitting techniques used in uncertainty function determination to large errors. Another drawback of the limited number of discharge measurements is the inability to apply proper verification to the Kalman filter parameters as outlined by Moss and Gilroy (1980). Ideally, the number of measurements should be sufficient for a split-sample approach in which the calibration is done with part of the measurements and verification is done with the rest as described by Burkham and Dawdy (1968).

The winter season presented similar computation problems. Owing to the dangerous and expensive nature of discharge measurements made through the ice (ice measurements), only two or three measurements are made at each site during a typical winter. Therefore, few data points are available for use in the nonlinear curve fitting techniques and verification schemes are thus inappropriate.

The greatest problem, however, is determination of the rating curve for the period of ice cover. The technique used in this study for rating determination was to list available correlative data gathered at the gage in question, data from other regionally similar gages, and data from nearby weather stations. A winter rating was then established for each ice-affected station using multiple linear stepwise regression techniques to fit the dependent variable (measured discharge at the station), to a list of correlative (independent) variables. The correlative data from the gage in question were measured stage and indicated flow (from open-water rating). The correlative weather data were maximum and minimum daily temperatures, total daily precipitation, previous day's precipitation, average monthly maximum and minimum temperatures, and heating degree days for the month. The correlative streamflow data from nearby stations in hydrologically similar basins consisted of the concurrent indicated daily discharge. The indicated daily discharge was based on measured stage and the open-water rating. Measurement errors were assumed to be a uniform percentage and are considered to be 2 percent for open-water measurements and 10 percent for ice measurements.

RESULTS

Data generated in this study are presented station-by-station in the Appendix and include results of winter rating analysis as well as the uncertainty functions for both the open-water and backwater periods and their related parameters. An example of uncertainty functions for winter and summer periods are presented as figures 2 and 3. The remainder of the results are tabulated in the Appendix; significant results are summarized in table 2.

In table 2 the result listed in column H (total standard error for the year) represents the combined effects of both the summer and winter periods. The standard errors of the individual periods listed in column G were combined as follows:

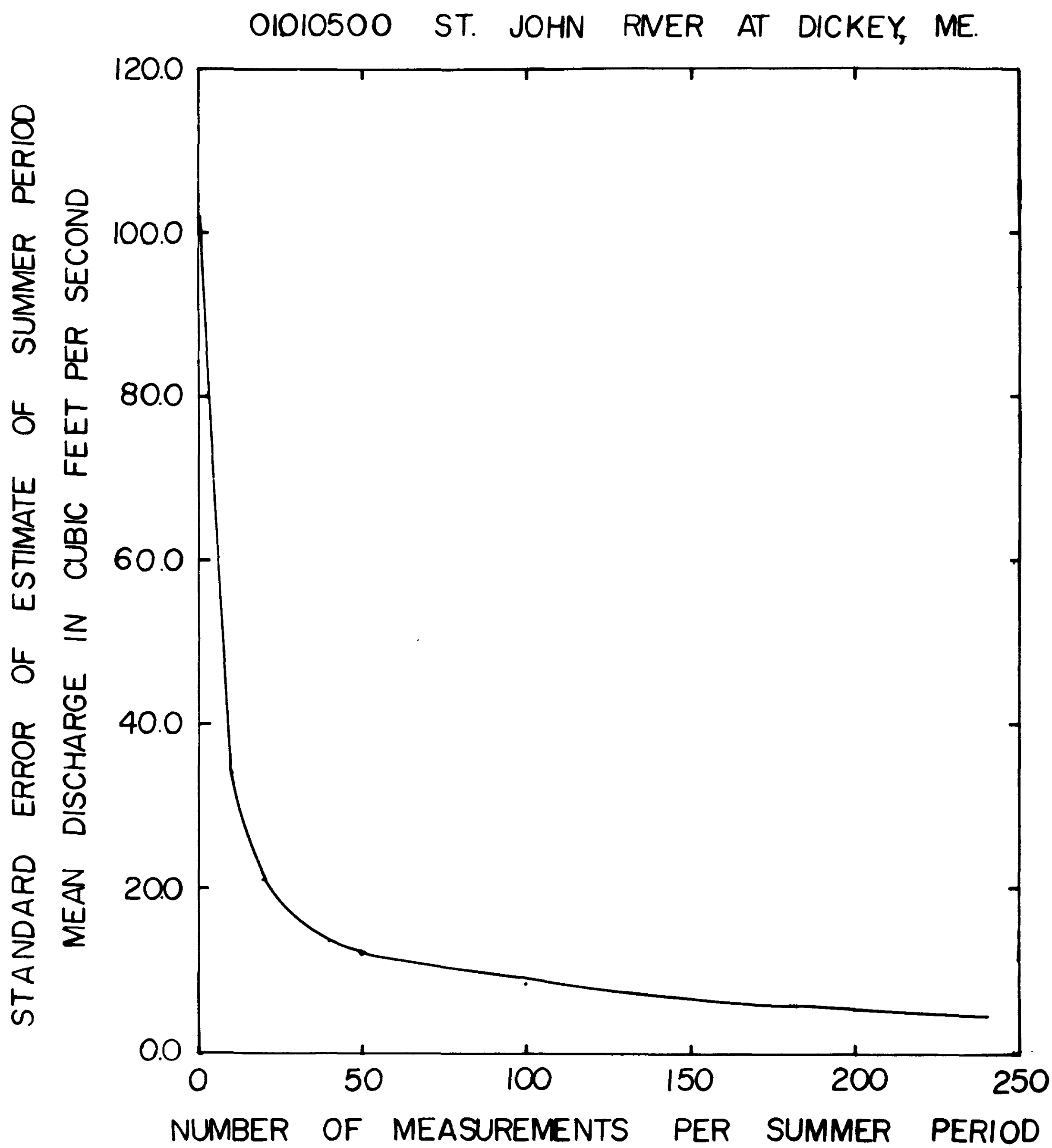
$$\mathrm{Var}\,(\bar{q}A) = \left(\frac{Ns}{N}\right)^2 \mathrm{Var}(\bar{q}s) + \left(\frac{Nw}{N}\right)^2 \mathrm{Var}\,(\bar{q}w) \qquad (4)$$

where:
- $\mathrm{Var}\,(\bar{q}A)$ is the variance of the annual mean
- $\mathrm{Var}\,(\bar{q}s)$ is the variance of the summer period
- $\mathrm{Var}\,(\bar{q}w)$ is the variance of the winter period
- N is the number of days in year
- Ns is the number of days in summer period
- Nw is the number of days in winter period

The standard error for the entire year is then simply the square root of $\mathrm{Var}(\bar{q}A)$. The result given in column J (percent error in annual mean with no measurements) is then determined as follows:

$$\text{percent error} = \frac{\left(\mathrm{Var}(\bar{q}A)\right)^{1/2}}{qa} \times 100 \qquad (5)$$

where: qa is the annual mean discharge.



2. Graph showing summer-period standard error of estimate for mean discharge St. John River at Dickey.

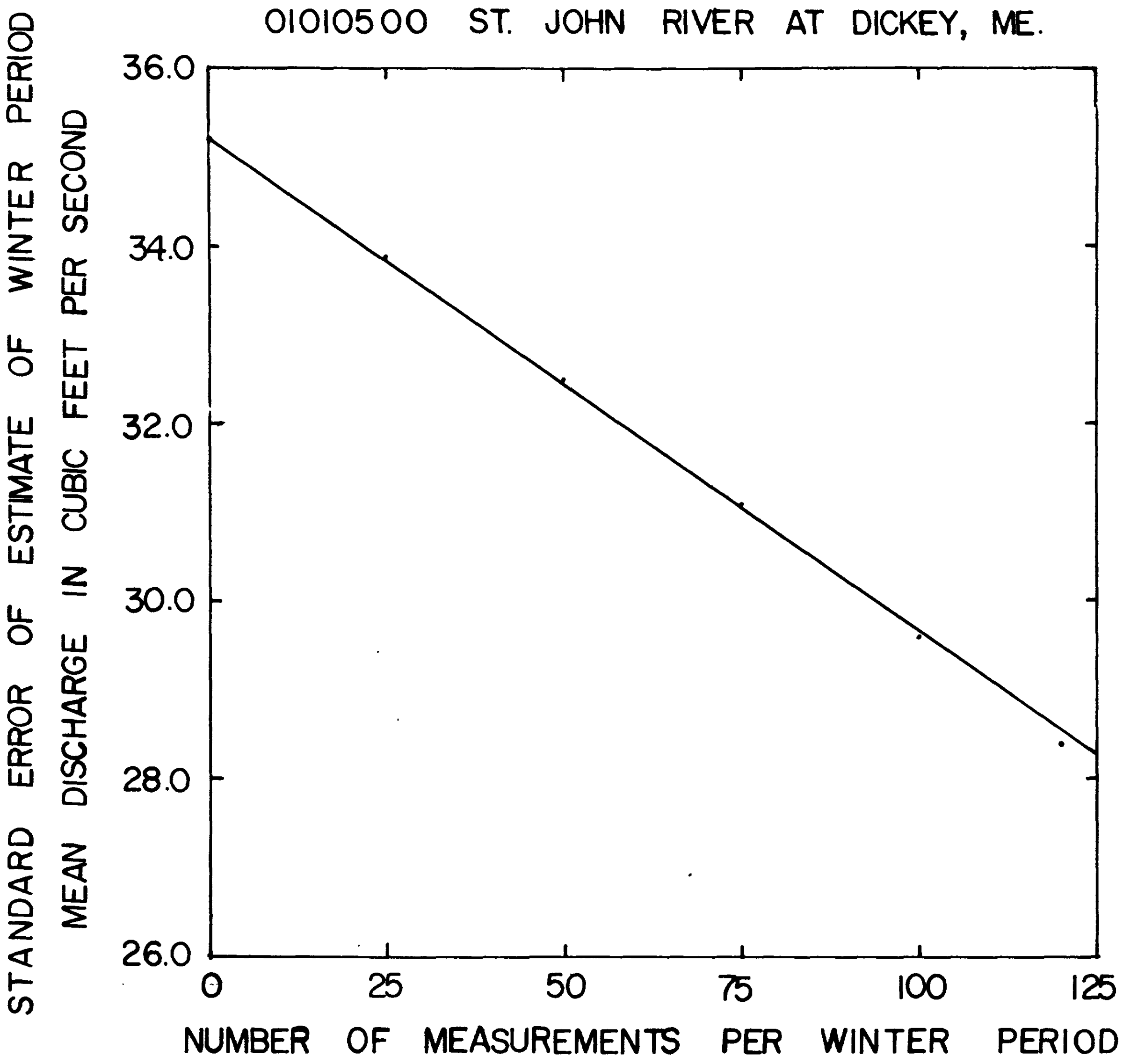


Figure 3. Graph showing winter-period standard error of estimate for mean discharge St. John River at Dickey.

Table 2 - Summary of significant results

Station Number	Period of Analysis	Variance measurement	Percent process	e-β	Winter rating R^2	Standard error of period mean with no measurements (ft^3/s)	Total standard error for annual mean with no measurements (ft^3/s)	Average annual mean discharge (ft^3/s)	Percent error in average with no measure ments
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
01010000	summer	99.96	0.04	.789	--	0.38	3.6	2,297	0.2
	winter	37.5	62.5	.010	.950	11.0			
01010500	summer	10.5	89.5	.965	--	102	69.2	4,709	1.5
	winter	16.8	83.2	.010	.894	35.2			
01011000	summer	44.9	55.1	.973	--	70.1	55.3	1,917	2.9
	winter	26.7	73.3	.946	.900	88.7			
01011500	all year	65.0	35.0	.010	--	1.06	1.06	883	0.1
01013500	summer	23.3	76.7	.010	--	4.90	3.69	1,398	0.3
	winter	42.3	57.7	.010	.888	5.10			
01014000	summer	99.8	0.2	.823	--	3.4	16.3	9,647	0.2
	winter	26.9	73.1	.010	.915	48.7			
01015800	summer	54.2	45.8	.010	--	4.2	14.1	1,502	0.9
	winter	26.6	73.4	.801	.907	41.7			
01016500	summer	89.5	10.5	.842	--	3.3	2.46	569	0.4
	winter	24.7	75.3	.010	.912	3.3			
01017000	summer	66.3	33.7	.867	--	27.1	45.2	2,643	1.7
	winter	42.6	57.4	.985	.900	125			
01017900	summer	97.0	3.0	.792	--	.006	0.005	2.82	0.2
	winter	99.9	0.1	.792	.997	.008			
01018000	summer	97.8	2.2	.792	--	.416	4.25	295	1.4
	winter	36.7	63.3	.937	.927	12.8			
01018500	all year	11.7	88.3	.749	--	6.42	6.42	717	0.9
01019000	all year	71.4	28.6	.942	--	2.05	2.05	396	0.5
01020000	all year	40.3	59.7	.211	--	3.39	3.39	2,334	0.1
01021000	all year	45.7	54.3	.958	--	38.1	38.1	2,716	1.4
01021200	all year	97.7	2.3	.010	--	.040	.040	194	.02

Table 2 - Summary of significant results cont.

Station Number	Period of Analysis	Variance measure-ment	Percent process	e-β	Winter rating R^2	Standard error of period mean with no measurements (ft³/s)	Total standard error for annual mean with no measurements (ft³/s)	Average annual mean discharge (ft³/s)	Percent error in average with no measure ments
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
01022500	summer	64.9	35.1	.973	--	6.69	5.04	499	1.0
	winter	99.6	0.4	.792	.974	.655			
01024200	summer	5.2	94.8	.903	--	.958	.789	22.3	3.5
	winter	25.1	74.9	.977	.962	1.29			
01029500	summer	90.0	10.0	.990	--	10.7	8.46	1,940	0.4
	winter	36.1	63.9	.010	.845	12.7			
01030000	summer	5.0	95.0	.920	--	305.	287.	5,762	5.0
	winter	19.5	80.5	.979	.984	540.			
01030500	summer	43.1	56.9	.010	--	2.14	8.77	2,481	0.4
	winter	29.6	70.4	.010	.936	30.3			
01031500	summer	99.8	0.2	.813	--	.23	18.5	602	3.1
	winter	39.0	61.0	.954	.960	64.9			
01033000	all year	34.7	65.3	.869	--	8.74	8.74	632	1.4
01034000	summer	64.2	35.8	.954	--	21.2	15.2	2,355	0.6
	winter	99.94	.06	.648	.969	.61			
01034500	summer	43.6	56.4	.010	--	29.2	20.9	11,860	0.2
	winter	100.	0.0	.792	.970	.56			
01038000	summer	17.4	82.6	.888	--	4.10	3.48	248	1.4
	winter	87.0	23.0	.990	.971	5.84			
01041000	all year	74.8	25.2	.787	--	6.80	6.80	1.951	0.3
01042500	all year	31.8	68.2	.903	--	44.5	44.5	2,601	1.7
01043500	all year	38.4	61.6	.442	--	2.08	2.08	860	0.2
01046500	all year	53.3	46.7	.749	--	34.4	34.4	4,433	0.8
01047000	summer	47.3	52.7	.983	--	25.0	17.9	718	2.5
	winter	38.3	61.7	.010	.954	5.1			
01047730	summer	99.4	0.6	.863	--	.114	.086	56.9	0.2
	winter	100.	0.0	.750	.993	.032			

Table 2 - Summary of significant results cont.

Station Number	Period of Analysis	Variance measure-ment	Percent process	$e^{-\beta}$	Winter rating R^2	Standard error of period mean with no measurements (ft^3/s)	Total standard error for annual mean with no measurements (ft^3/s)	Average annual mean discharge (ft^3/s)	Percent error in average with no measure ments
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
0104900	summer winter	59.5 15.7	40.5 84.3	.724 .981	-- .958	4.61 85.6	14.4	958	1.5
01049300	all year	11.8	88.2	.713	--	.071	.071	2.07	3.4
01049373	all year	12.9	87.1	.219	--	.192	.192	39.6	0.5
01049396	all year	6.4	93.6	.885	--	.117	.117	19.4	0.9
01049500	all year	27.3	72.7	.261	--	1.91	1.91	342	0.6
01052500	summer winter	29.8 11.3	70.2 88.7	.010 .010	-- .765	1.33 4.05	1.50	348	0.4
01053500	all year	86.6	13.4	.985	--	11.8	11.8	1,903	0.6
01054000	all year	33.0	67.0	.010	--	2.03	2.03	2,462	0.1
01054200	summer winter	13.7 24.0	86.3 76.0	.010 .919	-- .821	1.22 6.05	1.93	179	1.1
01054300	summer winter	14.1 28.2	85.9 71.8	.935 .953	-- .908	9.09 16.2	7.97	250	3.2
01055000	summer winter	7.1 95.6	92.9 4.4	.177 .990	-- .936	4.23 1.93	3.07	198	1.6
01055500	summer winter	16.9 26.5	83.1 73.5	.940 .968	-- .935	10.3 34.2	11.5	305	3.8
01057000	all year	77.9	22.1	.994	--	3.33	3.33	139	2.4
01058500	summer winter	48.8 97.0	51.2 3.0	.134 .985	-- .989	1.11 3.73	1.11	572	0.2
01059000	all year	100.	0.0	.792	--	.259	.259	6,137	0.0
01059800	summer winter	3.2 64.8	96.8 35.2	.657 .010	-- .937	.531 .145	.437	27.8	1.6
01060000	summer winter	42.6 46.5	57.4 53.5	.010 .914	-- .848	.803 7.12	1.12	276	0.4

Table 2 - Summary of significant results cont.

Station Number	Period of Analysis	Variance measure-ment	Percent process	e-β	Winter rating R^2	Standard error of period mean with no measurements (ft^3/s)	Total standard error for annual mean with no measurements (ft^3/s)	Average annual mean discharge (ft^3/s)	Percent error in average with no measure ments
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
01064140	all year	35.7	64.3	.707	--	6.11	6.11	658	0.9
01065500	summer	77.2	22.8	.896	--	4.10	3.71	876	0.4
	winter	94.9	5.1	.925	.959	8.3			
01066000	summer	56.9	43.1	.955	--	22.5	21.8	2,706	0.8
	winter	92.5	7.5	.990	.974	55.6			
01066500	summer	47.3	52.7	.010	--	.573	.492	292	0.2
	winter	52.9	47.1	.010	.921	.657			
01069500	all year	26.7	73.3	.858	--	2.14	2.14	180	1.2

CONCLUSIONS

Inspection of table 2 and the station-by-station results in the Appendix reveals several facts concerning annual mean discharge records in Maine.

The technique used to determine winter backwater rating curves proved to be acceptable. The multiple linear regression analyses resulted in rating equations with coefficient of determination (R^2) greater than 0.900 for 27 of the 33 stations. The 33 winter backwater rating curves used a variety of the independent variables. No pattern was evident in the variables found statistically significant for the regression equations.

Total variance, or the squared difference between the true discharge and the computed discharge, as noted in equation (1) consists of two components -- measurement variance and process variance. Of interest in the results of this report is the division of variance between the components, or, in essence, what part of the variance is the result of errors generated by techniques of flow measurement and what part is the result of the process of flow computation.

An average of 46.8 percent of the total variance for the 21 stations not affected by backwater was due to measurement variance and 53.2 percent was due to process variance. Data from the remaining 33 stations were classified as either summer or winter period. Among the summer-period stations, an average of 49.3 percent of the total variance was due to measurement vaiance and 50.7 percent was due to process variance. Among the winter-period stations, an average of 25.2 percent of the total variance was due to measurement variance and 74.8 percent was due to process variance.

Results of the seasonal divisions of average variance suggest that the process and measurement variances are essentially equal during open-water periods and that process variance is considerably greater than the measurement variance during backwater periods.

Percent error in the average annual mean discharge for stations in Maine, when no discharge measurements are made, are summarized in column J of table 2. The average error for the 21 stations that had open water during the entire year was 0.9 percent. The remaining 33 stations had a slightly higher average error of 1.3 percent. The error associated with the winter period was the prime reason for the difference. The magnitude of errors in average annual mean discharge further demonstrates the stability of rating curves for gaging stations in Maine.

The accuracy of results found in this report must be reviewed with care. The limited data upon which the uncertainty functions were based prevented the use of proper verification techniques.

REFERENCES

Buchanan, T. J., and Somers, W. P., 1969, Discharge measurements at gaging stations: U.S. Geological Survey Techniques of Water Resources Investigations, Book 3, Chap. A8, 65 p.

Burkham, D. E., and Dawdy, D. R., 1968, Error analysis of streamflow data for an alluvial stream: U.S. Geological Survey Professional Paper 655-C, 13 p.

Carter, R. W., and Anderson, I. E., 1963, Accuracy of current meter measurements; Proceedings of the American Society of Civil Engineers, ASCE, vol. 89, no. HY4, pp. 105-115.

Fontaine, R. A., 1982, Cost effective stream-gaging strategies for Maine: U.S. Geologcial Survey Open-File Report 82-507, 43 p.

Gilroy, E. J., 1982, Computer procedures for determining cost effective streamgaging strategies unpublished data on file in Surface Water Branch, U.S. Geological Survey, Reston, Va.

Moss, M. E., and Gilroy, E. J., 1980, Cost effective streamgaging strategies for the Lower Colorado River basin; the Blythe Field Office operations: U.S. Geological Survey Open-File Report 80-1048, 112 p.

SAS users guide, 1979 edition, Statistical Analysis System, Cary, North Carolina, 494 p.

APPENDIX

A summary of the uncertainty analyses data is presented for each station in the order presented in table 1. Data include the multiple linear winter rating function with the associated coefficient of determination (R^2). Also included are the measurement variance, process variance and one-day serial correlations coefficient for the winter and summer periods. A listing of the standard error of estimate of annual mean winter and summer discharges for various measurement frequencies is shown for each station.

01010000 St. John River at Ninemile Bridge, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 22 discharge measurements made during water years 1974-81. The average variance of measurements errors is estimated to be 9,620 cubic feet per second squared $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 4 $(ft^3/s)^2$ and a one-day serial correlations coefficient ($e^{-\beta}$) of 0.789. The relationship of the square root of the variance or the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 21 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -1617.98 + 28.50\ (\text{MAXTEMP}) + 0.20\ (\text{ALLAGASH}) + 3.71\ (\text{FRANCIS}) \qquad (4)$$

where MAXTEMP is the maximum daily temperature,
ALLAGASH is the indicated discharge at station 01011000,
FRANCIS is the indicated discharge at station 01011500.

This relationship had an R-square, or ratio of the sum of squares for the model divided by the sum of squares for the corrected total, of 0.950.

The average variance of measurement errors is estimated to be 20,356 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 33,923 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1950-80, is 2,297 ft^3/s.

St. John River at Ninemile Bridge. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (121 days)	summer period (244 days)
0	11.0	.38
5	11.0	.38
10	10.9	.38
15	10.8	.38
20	10.8	.38
25	10.7	.38
30	10.6	.38
35	10.6	.38
40	10.5	.38
45	10.5	.38
50	10.4	.38
60	10.3	.38
70	10.1	.38
80	10.0	.38
90	9.9	.38
100	9.7	.38
120	9.4	.38
140	--	.38
160	--	.38
180	--	.38
200	--	.38
220	--	.38
240	--	.38

01010500 St. John River at Dickey, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 22 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 50,844 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 5,990 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.965. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in figure 2. This relationship is presented graphically to demonstrate the effect of an $e^{-\beta}$ of close to one, demonstrating that, the larger the coefficient the sharper the descent of the uncertainty function.

The winter rating analysis was based on 26 discharge measurements made during water years 1971-81. The resulting rating curve is

$$q_r = -1661.95 + 21.08(\mathrm{MINTEMP}) + 4.49(\mathrm{FRANCIS}) + 0.20(\mathrm{FTKENT}) \qquad (5)$$

where MINTEMP is the minimum daily temperature,
FRANCIS is the indicated discharge at station 01011500,
FTKENT is the indicated discharge at station 01014000.

This relationship had an R-square of 0.894.

The average variance of measurement errors is estimated to be 69,825 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 346,226 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in figure 3. This relationship is presented graphically to demonstrate the effect of an $e^{-\beta}$ of close of zero. As demonstrated, the smaller the coefficient, the more gradual the descent of the uncertainty function.

The average discharge for the period of record, water years 1947-80, is 4,709 ft^3/s.

01011000 Allagash River near Allagash, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 24 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 15,716 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 19,278 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.973. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 31 discharge measurements made during water years 1971-81. The resulting rating curve is

$$q_r = -6383.94 + 2699.26(\mathrm{INDSTAGE}) + 1.89(\mathrm{INDQ}) + 12.55(\mathrm{MEANTEMP}) \qquad (6)$$

where INDSTAGE is the indicated gage height,
INDQ is the indicated discharge based on the summer rating,
MEANTEMP is the mean daily temperature.

This relationship had an R-square of 0.900.

The average variance of measurement errors is estimated to be 11,322 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 31,020 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.946. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1932-80, is 1,917 ft^3/s.

Allagash River near Allagash. Standard error of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (121 days)	summer period (244 days)
0	88.7	70.1
5	49.3	46.3
10	34.7	35.6
15	28.1	29.9
20	24.2	26.4
25	21.6	23.8
30	19.7	21.9
35	18.2	20.4
40	17.0	19.1
45	16.0	18.1
50	15.1	17.2
60	13.8	15.8
70	12.8	14.6
80	11.9	13.7
90	11.2	13.0
100	10.7	12.3
120	9.72	11.3
140	--	10.5
160	--	9.79
180	--	9.24
200	--	8.77
220	--	8.37
240	--	8.02

01011500 St. Francis River at Outlet of Glasier Lake, near Connors, New Brunswick, Canada

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 16 discharge measurements made during water years 1977-81. The average variance of measurement errors is estimated to be 1,474 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 940 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1951-80, is 883 ft^3/s.

St. Francis River near Connors, New Brunswick.
Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	1.06
5	1.06
10	1.06
15	1.05
20	1.05
25	1.05
30	1.05
35	1.05
40	1.05
50	1.05
60	1.04
70	1.04
80	1.04
90	1.04
100	1.04
120	1.03
140	1.03
160	1.02
180	1.02
200	1.01
250	1.00
300	.989
350	.978

01013500 Fish River near Fort Kent, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 25 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 4,092 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 13,445 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 26 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -138.91 + 0.18(INDQ) + 2.01(FRANCIS) \quad (7)$$

where INDQ is the indicated discharge based on the summer rating
FRANCIS is the indicated discharge at station 01011500.

This relationship had an R-square of 0.888.

The average variance of measurement errors is estimated to be 5,270 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 7,193 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1904-08, and 1930-80, is 1,398 ft^3/s.

Fish River near Fort Kent. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (121 days)	summer period (244 days)
0	5.08	4.89
5	5.05	4.87
10	5.03	4.86
15	5.00	4.84
20	4.97	4.82
25	4.95	4.81
30	4.92	4.79
35	4.89	4.77
40	4.86	4.76
45	4.84	4.74
50	4.81	4.72
60	4.75	4.69
70	4.70	4.65
80	4.64	4.62
90	4.58	4.58
100	4.52	4.55
120	4.41	4.47
140	--	4.40
160	--	4.33
180	--	4.25
200	--	4.17
220	--	4.10
240	--	4.02

01014000 St. John River below Fish River, at Fort Kent, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 28 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 129,376 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 280 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.823. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 31 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -4721.81 + 2261.70(\text{INDSTAGE}) + 1.09(\text{INDQ}) + 7.62(\text{FRANCIS}) \qquad (8)$$

where INDSTAGE is the indicated gage height,
INDQ is the indicated discharge based on the summer rating
FRANCIS is the indicated discharge at station 01011500.

This relationship had an R-square of 0.915.

The average variance of measurement errors is estimated to be 244,026 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 662,236 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1926-80, is 9,647 ft^3/s.

St. John River below Fish River at Fort Kent. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (121 days)	summer period (244 days)
0	48.7	3.40
5	48.4	3.40
10	48.1	3.39
15	47.8	3.39
20	47.4	3.39
25	47.1	3.39
30	46.8	3.39
35	46.5	3.39
40	46.1	3.39
45	45.8	3.39
50	45.4	3.39
60	44.7	3.39
70	44.0	3.38
80	43.3	3.38
90	42.6	3.38
100	41.9	3.38
120	40.5	3.38
140	--	3.37
160	--	3.37
180	--	3.37
200	--	3.37
220	--	3.36
240	--	3.36

01015800 Aroostook River near Masardis, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 24 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 11,911 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 10.081 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 32 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -202.54 + 379.86(\text{TOTPREC}) - 0.13(\text{WASHBURN}) + 1.17(\text{FRANCIS}) + 0.57\ (\text{INDQ}) \qquad (9)$$

where TOTPREC is the total precipitation for the day in question,
WASHBURN is the indicated discharge at station 01017000,
FRANCIS is the indicated discharge at station 01011500,
INDQ is the indicated discharge based on the summer rating.

This relationship had an R-square of 0.900.

The average variance of measurement errors is estimated to be 8,779 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 24,227 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.801. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that time is given in the following table.

The average discharge for the period of record, water years 1957-80, is 1,502 ft^3/s.

Aroostook River near Masardis. Standard error of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (121 days)	summer period (244 days)
0	41.7	4.23
5	36.0	4.23
10	30.0	4.22
15	25.5	4.21
20	22.3	4.20
25	20.0	4.19
30	18.2	4.18
35	16.8	4.17
40	15.6	4.17
45	14.7	4.16
50	13.9	4.15
60	12.6	4.13
70	11.6	4.11
80	10.8	4.09
90	10.2	4.08
100	9.63	4.06
120	8.76	4.02
140	--	3.98
160	--	3.95
180	--	3.91
200	--	3.88
220	--	3.84
240	--	3.80

01016500 Machias River near Ashland, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 27 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 2,020 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 238 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.842. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 34 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -202.51 - 262.45(\text{INDSTAGE}) + 0.41(\text{INDQ}) + 0.55(\text{FRANCIS}) \qquad (10)$$

where INDSTAGE is the indicated gage height at the station,
INDQ is the indicated discharge based on the summer rating,
FRANCIS is the indicated discharge at station 01011500.

This relationship had an R-square of 0.912.

The average variance of measurement errors is estimated to be 1,028 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 3,126 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter period mean discharge as a function of number of discharge measurements during that time is given in the following table.

The average discharge for the period of record, water years 1951-80, is 569 ft^3/s.

Machias River near Ashland. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (121 days)	summer period (244 days)
0	3.35	3.33
5	3.33	3.29
10	3.30	3.25
15	3.28	3.21
20	3.26	3.17
25	3.23	3.13
30	3.21	3.09
35	3.19	3.05
40	3.16	3.02
45	3.14	2.98
50	3.11	2.95
60	3.06	2.89
70	3.02	2.83
80	2.97	2.78
90	2.91	2.72
100	2.86	2.67
120	2.76	2.58
140	--	2.50
160	--	2.43
180	--	2.36
200	--	2.30
220	--	2.24
240	--	2.18

<u>01017000 Aroostook River at Washburn, Maine</u>

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 27 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 25,856 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 13,154 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.867. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in .

The winter rating analysis was based on 26 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -172.11 + 0.26(\text{MASARDIS}) + 0.58\ (\text{ASHLAND}) \qquad (11)$$

where MASARDIS is the indicated discharge at station 01015800
AHSLAND is the indicated discharge at station 01016500.

This relationship had an R-square of 0.900.

The average variance of measurement errors is estimated to be 19,676 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 26,521 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.985. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that time is given in the following table.

The average discharge for the period of record, water years 1930-80, is 2,643 ft^3/s.

Aroostook River at Washburn. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (121 days)	Standard error of estimate of period mean in ft^3/s summer period (244 days)
0	125.	27.1
5	54.6	25.8
10	40.6	24.5
15	33.8	23.2
20	29.7	22.1
25	26.7	21.1
30	24.5	20.3
35	22.8	19.5
40	21.4	18.8
45	20.2	18.2
50	19.2	17.7
60	17.6	16.7
70	16.4	15.8
80	15.3	15.1
90	14.5	14.5
100	13.8	13.9
120	12.6	13.0
140	--	12.2
160	--	11.6
180	--	11.0
200	--	10.5
220	--	10.1
240	--	9.72

01017900 Marley Brook near Ludlow, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 28 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 0.032 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 0.001 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.792. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 9 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -.066 + 0.825(INDQ) \qquad (12)$$

where INDQ is the indicated discharge based on the summer rating.

This relationship had an R-square of 0.997.

The average variance of measurement errors is estimated to be 0.008 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 0.001 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.792. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1963-80, is 2.82 ft^3/s.

Marley Brook near Ludlow. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (121 days)	summer period (244 days)
0	.008	.006
5	.008	.006
10	.008	.006
15	.008	.006
20	.008	.006
25	.008	.006
30	.008	.006
35	.008	.006
40	.008	.006
45	.008	.006
50	.008	.006
60	.008	.006
70	.008	.006
80	.008	.006
90	.008	.006
100	.008	.006
120	.008	.006
140	--	.005
160	--	.005
180	--	.005
200	--	.005
220	--	.005
240	--	.005

01018000 Meduxnekeag River near Houlton, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 121 days a year and is relevant for the remaining 244 days.

The summer uncertainty analysis was based on 27 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 220 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 5.0 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.792. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 31 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -547.18 + 181.41(\mathrm{INDSTAGE}) + 1.99(\mathrm{MAXTEMP}) \qquad (13)$$

where INDSTAGE is the indicated gage height
MAXTEMP is the maximum daily temperature.

This relationship had an R-square of 0.927.

The average variance of measurement errors is estimated to be 430 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 744 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.937. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1940-80, is 295 ft^3/s.

Meduxnekeag River near Houlton. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (121 days)	summer period (244 days)
0	12.8	.416
5	8.33	.415
10	6.23	.414
15	5.17	.413
20	4.51	.412
25	4.05	.411
30	3.71	.411
35	3.44	.410
40	3.23	.409
45	3.05	.408
50	2.89	.407
60	2.64	.406
70	2.45	.404
80	2.30	.403
90	2.17	.401
100	2.06	.400
120	1.88	.397
140	--	.394
160	--	.392
180	--	.389
200	--	.386
220	--	.384
240	--	.381

01018500 St. Croix River at Vanceboro, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 23 discharge measurements made during water years 1976-81. The average variance of measurement errors is estimated to be 290 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 2,196 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.749. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1928-80, is 717 ft^3/s.

St. Croix River at Vanceboro. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	6.42
5	6.17
10	5.88
15	5.58
20	5.27
25	4.96
30	4.66
35	4.39
40	4.13
45	3.90
50	3.69
60	3.32
70	3.02
80	2.78
90	2.57
100	2.40
120	2.12
140	1.91
160	1.75
180	1.62
200	1.51
250	1.30
300	1.16
350	1.05

01019000 Grand Lake Stream at Grand Lake Stream, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 24 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 120 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 47.9 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.942. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1928-80, is 396 ft^3/s.

Grand Lake Stream at Grand Lake Stream. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	2.05
5	1.92
10	1.79
15	1.68
20	1.59
25	1.51
30	1.44
35	1.38
40	1.33
45	1.28
50	1.24
60	1.17
70	1.11
80	1.05
90	1.01
100	.967
120	.899
140	.844
160	.798
180	.758
200	.724
250	.656
300	.604
350	.563

01020000 St. Croix River near Baileyville, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 24 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 2,210 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 3,273 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.211. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, 1919-80 water years, is 2,334 ft^3/s.

St. Croix River near Baileyville. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	3.39
5	3.38
10	3.36
15	3.34
20	3.32
25	3.30
30	3.28
35	3.27
40	3.25
45	3.23
50	3.21
60	3.17
70	3.13
80	3.10
90	3.06
100	3.02
120	2.94
140	2.86
160	2.79
180	2.72
200	2.65
250	2.49
300	2.35
350	2.23

01021000 St. Croix River at Baring, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 27 discharge measurements made during water years 1977-81. The average variance of measurement errors is estimated to be 10,241 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 12,160 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.958. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1959-80, is 2,716 ft^3/s.

St. Croix River at Baring. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	38.1
5	31.6
10	26.2
15	22.8
20	20.3
25	18.6
30	17.2
35	16.0
40	15.1
45	14.3
50	13.7
60	12.6
70	11.7
80	11.0
90	10.4
100	9.87
120	9.04
140	8.40
160	7.87
180	7.43
200	7.06
250	6.33
300	5.79
350	5.36

01021200 Dennys River at Dennysville, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 24 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 56.2 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 1.33 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1956-80, is 194 ft^3/s.

Dennys River at Dennysville. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	.040
5	.040
10	.040
15	.040
20	.040
25	.040
30	.040
35	.040
40	.040
45	.040
50	.040
60	.040
70	.040
80	.040
90	.040
100	.040
120	.040
140	.040
160	.040
180	.040
200	.040
250	.040
300	.040
350	.040

01022500 Narraguagus River at Cherryfield, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 90 days a year and is relevant for the remaining 275 days.

The summer uncertainty analysis was based on 24 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 358 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 194 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.973. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 16 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = 10.21 + 0.59(\text{DOVER}) + 4.64(\text{GARLAND}) \qquad (14)$$

where DOVER is the indicated discharge at station number 01031500
GARLAND is the indicated discharge at station number 01024200.

This relationship had an R-square of 0.974.

The average variance of measurement errors is estimated to be 1,250 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 4.73 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.792. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1948-80, is 499 ft^3/s.

Narraguagus River at Cherryfield. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (90 days)	summer period (275 days)
0	.655	6.69
5	.655	5.33
10	.654	4.48
15	.654	3.94
20	.653	3.56
25	.652	3.28
30	.652	3.05
35	.651	2.87
40	.651	2.71
45	.650	2.58
50	.650	2.47
60	.649	2.28
70	.647	2.13
80	.646	2.00
90	.645	1.90
100	--	1.81
120	--	1.66
140	--	1.55
160	--	1.45
180	--	1.37
200	--	1.30
220	--	1.25
240	--	1.19
260	--	1.15

01024200 Garland Brook near Mariaville, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 90 days a year and is relevant for the remaining 275 days.

The summer uncertainty analysis was based on 27 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 0.734 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 13.4 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.903. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 12 discharge measurements made during water years 1972-81. The resulting rating curve is:

$$q_r = -42.53 + 15.55(\mathrm{INDSTAGE}) + 0.01(\mathrm{NWHITE}) \qquad (15)$$

where INDSTAGE is the indicated gage height
NWHITE is the indicated discharge at station number 01038000.

This relationship had an R-square of 0.962.

The average variance of measurement errors is estimated to be 1.00 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 2.98 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.977. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1964-80, is 22.3 ft^3/s.

Garland Brook near Mariaville. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (90 days)	summer period (275 days)
0	1.29	.958
5	.440	.794
10	.311	.614
15	.254	.484
20	.221	.395
25	.197	.334
30	.180	.290
35	.167	.257
40	.156	.232
45	.148	.211
50	.140	.194
60	.128	.169
70	.119	.150
80	.111	.136
90	.105	.125
100	--	.115
120	--	.102
140	--	.091
160	--	.083
180	--	.077
200	--	.072
220	--	.068
240	--	.064
260	--	.061

01029500 East Branch Penobscot River at Grindstone, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 24 discharge measurements made during water years 1973-81. The average variance of measurement errors is estimated to be 2,084 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 231 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.990. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 27 discharge measurements made during water years 1972-81. The resulting rating curve is:

$$q_r = -777.82 + 15.84(MAXTEMP) + 0.08(MATT) + 0.30(PMATT) \quad (16)$$

where MAXTEMP is the maximum daily temperature
MATT is the indicated discharge at station number 01030500
PMATT is the indicated discharge at station number 01030000.

This relationship had an R-square of 0.845.

The average variance of measurement errors is estimated to be 21,967 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 38,839 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1902-80, is 1,940 ft^3/s.

East Branch Penobscot River at Grindstone. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (104 days)	summer period (261 days)
0	12.7	10.7
5	12.6	9.28
10	12.6	8.34
15	12.5	7.65
20	12.4	7.12
25	12.3	6.69
30	12.2	6.33
35	12.1	6.02
40	12.0	5.76
45	11.9	5.53
50	11.8	5.32
60	11.7	4.98
70	11.5	4.69
80	11.3	4.45
90	11.1	4.24
100	10.9	4.06
120	--	3.77
140	--	3.53
160	--	3.33
180	--	3.16
200	--	3.01
220	--	2.89
240	--	2.77
260	--	2.67

01030000 Penobscot River near Mattawamkeag, Maine

The stage-discharge relation for this station is affected by backwater caused by aquatic growth in the channel an average of 152 days a year and is relevant for the remaining 213 days.

The open-water uncertainty analysis was based on 17 discharge measurements made during water years 1972-81. The average variance of measurement errors is estimated to be 46,325 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 873,987 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.920. The relationship of the standard error of estimate of the open-water period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 35 discharge measurements made during water years 1972-81. The resulting rating curve is:

$$q_r = -18,351.75 + 4,544.12(\text{INDSTAGE}) \qquad (17)$$

where INDSTAGE is the indicated gage height.

This relationship had an R-square of 0.984.

The average variance of measurement errors is estimated to be 162,208 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 670,870 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.979. The standard error of estimate of the backwater period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1940-80, is 5,762 ft^3/s.

Penobscot River near Mattawamkeag. Standard error of estimate of annual mean open-water and backwater discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	backwater period (152 days)	open-water period (213 days)
0	540	305
5	196	220
10	133	150
15	107	111
20	91.9	89.1
25	81.8	74.7
30	74.4	64.7
35	68.7	57.4
40	64.2	51.7
45	60.4	47.3
50	57.3	43.7
60	52.2	38.2
70	48.2	34.2
80	45.1	31.1
90	42.5	28.7
100	40.3	26.7
120	36.7	23.7
140	34.0	21.4
160	--	19.7
180	--	18.3
200	--	17.2

01030500 Mattawamkeag River near Mattawamkeag, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 24 discharge measurements made during water years1974-81. The average variance of measurement errors is estimated to be 2,089 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 2,760 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 19 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -56.42 + 1.79(\text{HOULTON}) + 0.73(\text{PITTS}) \tag{18}$$

where HOULTON is the indicated discharge at station number 01018000
PITTS is the indicated discharge at station number 01049000.

This relationship had an R-square of 0.936.

The average variance of measurement errors is estimated to be 92,986 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 220,797 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1934-80, is 2,481 ft^3/s.

Mattawamkeag River near Mattawamkeag. Standard error of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (104 days)	summer period (261 days)
0	30.3	2.14
5	30.1	2.14
10	29.9	2.13
15	29.7	2.13
20	29.2	2.12
25	29.0	2.12
30	28.8	2.11
35	28.5	2.11
40	28.3	2.10
45	28.0	2.10
50	27.5	2.09
60	27.1	2.08
70	26.6	2.07
80	26.1	2.06
90	25.6	2.05
100	--	2.04
120	--	2.02
140	--	2.00
160	--	1.97
180	--	1.95
200	--	1.93
220	--	1.91
240	--	1.88
260	--	1.86

01031500 Piscataquis River near Dover-Foxcroft, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 26 discharge measurements made during water years 1977-81. The average variance of measurement errors is estimated to be 702 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 1.50 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.813. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 38 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -20.92 + 0.51(INDQ) + 31.82(ANTPREC) \qquad (19)$$

where INDQ is the indicated discharge based on the summer rating
ANTPREC is the total precipitation that fell on the previous day.

This relationship had an R-square of 0.960.

The average variance of measurement errors is estimated to be 8,267 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 12,955 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.954. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1902-80, is 602 ft^3/s.

Piscataquis River near Dover-Foxcroft. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (104 days)	summer period (261 days)
0	64.9	.233
5	36.5	.233
10	27.0	.233
15	22.4	.233
20	19.6	.233
25	17.6	.233
30	16.1	.233
35	15.0	.233
40	14.1	.233
45	13.3	.233
50	12.6	.233
60	11.5	.233
70	10.7	.232
80	10.0	.232
90	9.46	.232
100	8.98	.232
120	--	.232
140	--	.232
160	--	.232
180	--	.232
200	--	.231
220	--	.231
240	--	.231
260	--	.231

01033000 Sebec River at Sebec, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 27 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 1,060 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 1,996 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.869. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1925-80, is 632 ft^3/s.

Sebec River at Sebec. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	8.74
5	8.21
10	7.59
15	6.99
20	6.45
25	5.99
30	5.60
35	5.27
40	4.98
45	4.73
50	4.51
60	4.15
70	3.86
80	3.62
90	3.42
100	3.25
120	2.97
140	2.75
160	2.57
180	2.43
200	2.30
250	2.06
300	1.88
350	1.74

01034000 Piscataquis River at Medford, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 22 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 5,389 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 3,005 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.954. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 20 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = 20.33 + 11.15(MINTEMP) + 0.19(MATT) + 1.92(SEBEC) \qquad (20)$$

where MINTEMP is the daily temperature
MATT is the indicated discharge at station number 01030500
SEBEC is the indicated discharge at station number 01033000.

This relationship had an R-square of 0.969.

The average variance of measurement errors is estimated to be 14,720 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 8.5 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.648. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1924-80, is 2,355 ft^3/s.

Table 25.--Standard error of estimate of annual mean winter and summer discharge for the Piscataquis River at Medford.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (104 days)	summer period (261 days)
0	.607	21.2
5	.607	18.2
10	.607	15.9
15	.607	14.3
20	.607	13.1
25	.607	12.1
30	.607	11.4
35	.607	10.7
40	.607	10.2
45	.607	9.73
50	.607	9.32
60	.606	8.64
70	.606	8.10
80	.606	7.64
90	.606	7.25
100	.606	6.92
120	--	6.37
140	--	5.94
160	--	5.58
180	--	5.28
200	--	5.03
220	--	4.81
240	--	4.61
260	--	4.44

01034500 Penobscot River at West Enfield, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 24 discharge measurements made during water years 1976-81. The average variance of measurement errors is estimated to be 396,167 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 511,496 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 23 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -1243.34 + 0.14(\text{INDQ}) + 54.84(\text{MONTHMAX}) + 0.621(\text{SUNKHAZE}) \tag{21}$$

where INDQ is the indicated discharge based on the summer rating
MONTHMAX is the average of the daily maximum temperatures in the month
SUNKHAZE is the furnished discharge from the Sunkhaze dam.

This relationship had an R-square of 0.970.

The average variance of measurement errors is estimated to be 774,330 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 4.0 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.792. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1902-80, is 11,860 ft^3/s.

Table 26.--Standard error of estimate of annual mean winter and summer discharge for the Penobscot River at West Enfield.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (104 days)	summer period (261 days)
0	.562	29.2
5	.562	29.1
10	.562	29.0
15	.562	29.0
20	.562	28.9
25	.562	28.8
30	.562	28.8
35	.562	28.7
40	.562	28.6
45	.562	28.5
50	.562	28.5
60	.562	28.3
70	.562	28.2
80	.562	28.1
90	.562	27.9
100	.562	27.8
120	--	27.5
140	--	27.2
160	--	26.9
180	--	26.6
200	--	26.3
220	--	26.0
240	--	25.7
260	--	25.4

01038000 Sheepscot River at North Whitefield, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 73 days a year and is relevant for the remaining 292 days.

The summer uncertainty analysis was based on 29 discharge measurements made during water years 1976-81. The average variance of measurement errors is estimated to be 63.8 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 300 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.888. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 13 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = 60.38 + 1.30(\text{SPARIS}) \qquad (22)$$

where SPARIS is the indicated discharge at station number 01057000.

This relationship had an R-square of 0.971.

The average variance of measurement errors is estimated to be 288 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 42.9 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.990. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1939-80, is 248 ft^3/s.

Table 27.--Standard error of estimate of annual mean winter and summer discharge for the Sheepscot River at North Whitefield.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (73 days)	summer period (292 days)
0	5.84	4.10
5	4.11	3.62
10	3.46	3.07
15	3.07	2.61
20	2.80	2.26
25	2.59	2.00
30	2.43	1.80
35	2.30	1.64
40	2.19	1.51
45	2.09	1.41
50	2.01	1.32
60	1.87	1.19
70	1.76	1.08
80	--	.999
90	--	.933
100	--	.878
120	--	.791
140	--	.724
160	--	.672
180	--	.630
200	--	.594
220	--	.564
240	--	.538
260	--	.516
280	--	.496

01041000 Kennebec River at Moosehead, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 26 discharge measurements made during water years 1972-81. The average variance of measurement errors is estimated to be 6,071 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 2,046 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.787. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1920-80, is 1,951 ft^3/s.

Kennebec River at Moosehead. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	6.80
5	6.71
10	6.61
15	6.51
20	6.41
25	6.31
30	6.21
35	6.12
40	6.02
45	5.94
50	5.85
60	5.70
70	5.55
80	5.41
90	5.29
100	5.17
120	4.96
140	4.77
160	4.60
180	4.45
200	4.31
250	4.01
300	3.77
350	3.57

01042500 Kennebec River at The Forks, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 29 discharge measurements made during water years 1972-81. The average variance of measurement errors is estimated to be 17,674 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 37,842 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.903. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1902-80, is 2,601 ft^3/s.

Kennebec River at The Forks. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	44.5
5	40.5
10	36.0
15	32.0
20	28.8
25	26.3
30	24.3
35	22.6
40	21.2
45	20.0
50	19.0
60	17.4
70	16.1
80	15.0
90	14.2
100	13.4
120	12.3
140	11.3
160	10.6
180	9.98
200	9.47
250	8.46
300	7.71
350	7.14

01043500 Dead River at Dead River, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 27 discharge measurements made during water years 1973-81. The average variance of measurement errors is estimated to be 405 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 649 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.442. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1940-80, is 860 ft^3/s.

Dead River at Dead River. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	2.08
5	2.06
10	2.04
15	2.02
20	2.00
25	1.97
30	1.95
35	1.93
40	1.90
45	1.88
50	1.86
60	1.81
70	1.76
80	1.72
90	1.67
100	1.63
120	1.55
140	1.48
160	1.42
180	1.36
200	1.30
250	1.19
300	1.10
350	1.03

01046500 Kennebec River at Bingham, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 21 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 71,685 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 62,891 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.749. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1908-09, and 1931-80, is 4,433 ft^3/s.

Kennebec River at Bingham. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	34.4
5	33.7
10	32.9
15	32.1
20	31.2
25	30.4
30	29.6
35	28.9
40	28.2
45	27.5
50	26.8
60	25.6
70	24.6
80	23.6
90	22.8
100	22.0
120	20.7
140	19.6
160	18.6
180	17.8
200	17.0
250	15.5
300	14.4
350	13.4

01047000 Carrabassett River near North Anson, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 27 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 1,614 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 1,797 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.983. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 26 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -8.91 + 4.95(SPARIS) - 0.34(ROYAL) \tag{23}$$

where SPARIS is the indicated discharge at station number 01057000
ROYAL is the indicated discharge at station number 01060000.

This relationship had an R-square of 0.954.

The average variance of measurement errors is estimated to be 3,865 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 6,221 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1902-06, and 1926-80, is 718 ft^3/s.

Carrabassett River at North Anson. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (104 days)	summer period (261 days)
0	5.09	25.0
5	5.06	15.0
10	5.03	11.4
15	5.00	9.58
20	4.96	8.43
25	4.93	7.61
30	4.89	7.00
35	4.86	6.51
40	4.82	6.12
45	4.79	5.79
50	4.75	5.50
60	4.69	5.04
70	4.61	4.68
80	4.54	4.39
90	4.47	4.15
100	4.40	3.94
120	--	3.61
140	--	3.35
160	--	3.13
180	--	2.96
200	--	2.81
220	--	2.68
240	--	2.57
260	--	2.47

01047730 Wilson Stream at East Wilton, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 90 days a year and is relevant for the remaining 275 days.

The summer uncertainty analysis was based on 29 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 50.9 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 0.27 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.863. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 11 discharge measurements made during water years 1977-81. The resulting rating curve is:

$$q_r = -1.57 + 0.10(\text{DOVER}) \qquad (24)$$

where DOVER is the indicated discharge at station number 01031500.

This relationship had an R-square of 0.993.

The average variance of measurement errors is estimated to be 316 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 0.014 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.750. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the 1980 water year is 56.9 ft^3/s.

Wilson Stream at East Wilton. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (90 days)	summer period (275 days)
0	.032	.114
5	.032	.114
10	.032	.114
15	.032	.114
20	.032	.114
25	.032	.114
30	.032	.114
35	.032	.114
40	.032	.114
45	.032	.114
50	.032	.114
60	.032	.114
70	.032	.113
80	.032	.113
90	.032	.113
100	--	.113
120	--	.113
140	--	.112
160	--	.112
180	--	.112
200	--	.112
220	--	.111
240	--	.111
260	--	.111

01049000 Sebasticook River near Pittsfield, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 59 days a year and is relevant for the remaining 306 days.

The summer uncertainty analysis was based on 28 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 1,560 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 1,062 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.724. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 11 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -316.73 + 0.41(INDQ) + 7.95(SPARIS) \quad (25)$$

where INDQ is the indicated discharge based on the summer rating
SPARIS is the indicated discharge at station number 01057000.

This relationship had an R-square of 0.958.

The average variance of measurement errors is estimated to be 1,925 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 10,330 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.981. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1930-80, is 958 ft^3/s.

Sebasticook River near Pittsfield. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (59 days)	summer period (306 days)
0	85.6	4.61
5	19.7	4.53
10	13.8	4.43
15	11.2	4.33
20	9.71	4.23
25	8.69	4.13
30	7.93	4.03
35	7.34	3.94
40	6.87	3.85
45	6.48	3.77
50	6.14	3.69
60	--	3.54
70	--	3.41
80	--	3.29
90	--	3.18
100	--	3.09
120	--	2.91
140	--	2.77
160	--	2.64
180	--	2.53
200	--	2.43
220	--	2.35
240	--	2.27
260	--	2.20
280	--	2.13

01049300 North Branch Tanning Brook near Manchester, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 25 discharge measurements made during water years 1976-81. The average variance of measurement errors is estimated to be 0.042 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 0.315 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.713. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1964-80, is 2.07 ft^3/s.

North Branch Tanning Brook near Manchester. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	.071
5	.069
10	.066
15	.063
20	.060
25	.057
30	.055
35	.052
40	.049
45	.047
50	.044
60	.040
70	.037
80	.034
90	.032
100	.029
120	.026
140	.024
160	.022
180	.020
200	.019
250	.016
300	.014
350	.013

01049373 Mill Stream at Winthrop, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 28 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 1.53 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 10.3 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.219. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the 1980 water year is 39.6 ft^3/s.

Mill Stream at Winthrop. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	.192
5	.191
10	.190
15	.188
20	.187
25	.185
30	.183
35	.182
40	.180
45	.178
50	.177
60	.174
70	.170
80	.167
90	.163
100	.160
120	.153
140	.146
160	.139
180	.133
200	.127
250	.114
300	.104
350	.095

01049396 Jock Stream at South Monmouth, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 18 discharge measurements made during water years 1978-81. The average variance of measurement errors is estimated to be 10.5 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 0.714 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.885. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the 1980 water year is 19.4 ft^3/s.

Jock Stream at South Monmouth. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	.177
5	.176
10	.174
15	.173
20	.172
25	.171
30	.169
35	.168
40	.167
45	.166
50	.165
60	.163
70	.161
80	.159
90	.157
100	.155
120	.152
140	.148
160	.145
180	.142
200	.140
250	.134
300	.128
350	.123

01049500 Cobbosseecontee Stream at Gardiner, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 27 discharge measurements made during water years 1976-81. The average variance of measurement errors is estimated to be 338 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 901 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.261. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1891-64, and 1977-80, is 342 ft^3/s.

Cobbosseecontee Stream at Gardiner. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	1.91
5	1.90
10	1.89
15	1.87
20	1.86
25	1.84
30	1.83
35	1.81
40	1.80
45	1.78
50	1.77
60	1.74
70	1.71
80	1.67
90	1.64
100	1.61
120	1.55
140	1.49
160	1.43
180	1.38
200	1.33
250	1.18
300	1.12
350	1.04

01052500 Diamond River near Wentworth Location, New Hampshire

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 28 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 449 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 1,057 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 24 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -1{,}569.85 + 0.22(\mathrm{INDQ}) + 26.33(\mathrm{MONTHMAX}) + .626(\mathrm{DEGDAY}) \tag{26}$$

where INDQ is the indicated discharge based on the summer rating,
MONTHMAX is the average of the maximum daily temperatures for the month in question
DEGDAY is the total heating degree days for the month in question.

This relationship had an R-square of 0.765.

The average variance of measurement errors is estimated to be 499 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 3,935 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1941-80, is 348 ft^3/s.

Diamond River near Wentworth Location. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (104 days)	summer period (261 days)
0	4.05	1.33
5	4.01	1.32
10	3.98	1.32
15	3.94	1.31
20	3.90	1.31
25	3.86	1.31
30	3.82	1.30
35	3.78	1.30
40	3.74	1.29
45	3.70	1.29
50	3.66	1.29
60	3.57	1.28
70	3.49	1.27
80	3.40	1.26
90	3.32	1.25
100	3.23	1.25
120	--	1.23
140	--	1.21
160	--	1.20
180	--	1.18
200	--	1.16
220	--	1.14
240	--	1.13
260	--	1.11

01053500 Androscoggin River at Errol, New Hampshire

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 28 discharge measurements made during water years 1972-81. The average variance of measurement errors is estimated to be 3,024 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 466 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.985. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1905-80, is 1,903 ft^3/s.

Androscoggin River ar Errol. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	11.8
5	10.6
10	9.65
15	8.94
20	8.38
25	7.91
30	7.51
35	7.17
40	6.87
45	6.61
50	6.37
60	5.97
70	5.64
80	5.36
90	5.11
100	4.90
120	4.54
140	4.26
160	4.02
180	3.82
200	3.64
250	3.29
300	3.03
350	2.82

01054000 Androscoggin River at Gorham, New Hampshire

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 28 discharge measurements made during water years 1972-81. The average variance of measurement errors is estimated to be 7,034 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 3,470 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1913-80, is 2,462 ft^3/s.

Androscoggin River at Gorham. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	2.03
5	2.03
10	2.03
15	2.03
20	2.02
25	2.02
30	2.02
35	2.02
40	2.02
45	2.01
50	2.01
60	2.01
70	2.00
80	2.00
90	2.00
100	1.99
120	1.98
140	1.97
160	1.97
180	1.96
200	1.95
250	1.93
300	1.91
350	1.89

01054200 Wild River at Gilead, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 23 discharge measurements made during water years 1978-81. The average variance of measurement errors is estimated to be 143 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 901 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 23 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = 26.12 + 0.38(\text{SPARIS}) + 0.17(\text{ROXBURY}) \quad (27)$$

where SPARIS is the indicated discharge at station number 01057000
ROXBURY is the indicated discharge at station number 01055000.

This relationship had an R-square of 0.821.

The average variance of measurement errors is estimated to be 57.4 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 182 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.919. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1964-80, is 179 ft^3/s.

Wild River at Gilead. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (104 days)	summer period (261 days)
0	6.05	1.22
5	3.68	1.22
10	2.58	1.22
15	2.07	1.21
20	1.78	1.21
25	1.58	1.20
30	1.43	1.20
35	1.32	1.19
40	1.23	1.19
45	1.15	1.18
50	1.09	1.18
60	.994	1.17
70	.918	1.16
80	.857	1.15
90	.807	1.14
100	.765	1.13
120	--	1.11
140	--	1.09
160	--	1.08
180	--	1.05
200	--	1.03
220	--	1.01
240	--	.994
260	--	.974

01054300 Ellis River at South Andover, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 25 discharge measurements made during water years 1977-81. The average variance of measurement errors is estimated to be 126 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 768 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.935. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 28 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -7.58 + 0.47(INDQ) + 0.07(DIAMOND) \qquad (28)$$

where INDQ is the indicated discharge based on the summer rating
DIAMOND is the indicated discharge at station number 01052500.

This relationship had an R-square of 0.908.

The average variance of measurement errors is estimated to be 321 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 818 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.953. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1963-80, is 250 ft^3/s.

Ellis River at South Andover. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (104 days)	summer period (261 days)
0	16.2	9.09
5	8.08	6.80
10	5.71	4.91
15	4.64	3.85
20	4.01	3.20
25	3.59	2.78
30	3.27	2.47
35	3.03	2.25
40	2.83	2.07
45	2.67	1.92
50	2.53	1.80
60	2.31	1.62
70	2.14	1.48
80	2.00	1.37
90	1.88	1.28
100	1.79	1.20
120	--	1.09
140	--	.998
160	--	.928
180	--	.871
200	--	.823
220	--	.782
240	--	.747
260	--	.716

01055000 Swift River near Roxbury, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 104 days a year and is relevant for the remaining 261 days.

The summer uncertainty analysis was based on 31 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 311 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 4,051 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.177. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 19 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -24.56 + 32.26(\text{INDSTAGE}) + 16.01(\text{ANTPREC}) + 0.18(\text{ELLIS}) \tag{29}$$

where INDSTAGE is the indicated gage height,
ANTPREC is the previous day's total precipitation
ELLIS is the indicated discharge at station 01054300.

This relationship had an R-square of 0.936.

The average variance of measurement errors is estimated to be 113 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 5.14 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.990. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1929-80, is 198 ft^3/s.

Swift River near Roxbury. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (104 days)	summer period (261 days)
0	1.93	4.23
5	1.72	4.19
10	1.57	4.15
15	1.46	4.10
20	1.38	4.06
25	1.31	4.01
30	1.25	3.96
35	1.20	3.92
40	1.15	3.87
45	1.11	3.82
50	1.08	3.77
60	1.02	3.68
70	.967	3.57
80	.924	3.47
90	.886	3.37
100	.853	3.27
120	--	3.08
140	--	2.89
160	--	2.72
180	--	2.56
200	--	2.41
220	--	2.28
240	--	2.16
260	--	2.05

Nezinscot River at Turner Center. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (90 days)	summer period (275 days)
0	34.2	10.3
5	13.5	7.74
10	9.49	5.65
15	7.74	4.48
20	6.70	3.77
25	6.00	3.29
30	5.48	2.95
35	5.07	2.69
40	4.74	2.48
45	4.47	2.32
50	4.24	2.18
60	3.88	1.96
70	3.59	1.80
80	3.36	1.67
90	3.17	1.56
100	--	1.47
120	--	1.34
140	--	1.23
160	--	1.14
180	--	1.08
200	--	1.02
220	--	.967
240	--	.924
260	--	.886

01057000 Little Androscoggin River near South Paris, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 29 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 72.4 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 20.5 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.994. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1932-80, is 139 ft^3/s.

Little Androscoggin River near South Paris. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	3.33
5	2.42
10	2.00
15	1.75
20	1.58
25	1.45
30	1.35
35	1.27
40	1.20
45	1.14
50	1.09
60	1.01
70	.943
80	.889
90	.843
100	.803
120	.738
140	.687
160	.646
180	.611
200	.581
250	.522
300	.478
350	.444

01055500 Nezinscot River at Turner Center, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 90 days a year and is relevant for the remaining 275 days.

The summer uncertainty analysis was based on 26 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 196 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 964 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.940. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 25 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = 345.0 - 226.88(\mathrm{INDSTAGE}) + 0.77(\mathrm{INDQ}) - 290.90(\mathrm{ANTPREC}) + 0.28(\mathrm{NWHITE}) \qquad (30)$$

where INDSTAGE is the indicated gage height
INDQ is the indicated discharge based on the summer rating
ANTPREC is the previous day's total precipitation
NWHITE is the indicated discharge at station 01038000.

This relationship had an R-square of 0.935.

The average variance of measurement errors is estimated to be 915 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 2,533 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.968. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1941-80, is 305 ft^3/s.

01058500 Little Androscoggin River near Auburn, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 59 days a year and is relevant for the remaining 306 days.

The summer uncertainty analysis was based on 29 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 364 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 382 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.134. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 10 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = 43.65 + 1.08(INDQ) - 0.70(ELLIS) \qquad (31)$$

where INDQ is the indicated discharge based on the summer rating
Ellis is the indicated discharge at station 01054300.

This relationship had an R-square of 0.989.

The average variance of measurement errors is estimated to be 605 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 18.4 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.985. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1941-80, is 572 ft^3/s.

Little Androscoggin River near Auburn. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (59 days)	summer period (306 days)
0	3.73	1.11
5	3.40	1.11
10	3.16	1.10
15	2.98	1.10
20	2.83	1.10
25	2.70	1.09
30	2.59	1.09
35	2.50	1.08
40	2.42	1.08
45	2.35	1.07
50	2.28	1.07
60	--	1.06
70	--	1.05
80	--	1.04
90	--	1.03
100	--	1.02
120	--	.997
140	--	.977
160	--	.958
180	--	.939
200	--	.920
250	--	.877
300	--	.838

01059000 Androscoggin River near Auburn, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 21 discharge measurements made during water years 1973-81. The average variance of measurement errors is estimated to be 19,580 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 2.90 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.792. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1929-80, is 6,137 ft^3/s.

Androscoggin River near Auburn. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	.259
5	.259
10	.259
15	.259
20	.259
25	.259
30	.259
35	.259
40	.259
45	.259
50	.259
60	.259
70	.259
80	.259
90	.259
100	.259
120	.259
140	.259
160	.259
180	.259
200	.259
250	.259
300	.259
350	.259

01059800 Collyer Brook near Gray, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 65 days a year and is relevant for the remaining 300 days.

The summer uncertainty analysis was based on 24 discharge measurements made during water years 1977-81. The average variance of measurement errors is estimated to be .586 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 17.9 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.657. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 21 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = 10.29 - 9.65(TOTPREC) + 0.07(SPARIS) + 0.01(TURNER) \quad (32)$$

where TOTPREC is the total precipitation for that given day, SPARIS is the indicated discharge at station number 01057000 TURNER is the indicated discharge at station number 01055500.

This relationship had an R-square of 0.937.

The average variance of measurement errors is estimated to be 5.90 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 3.12 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1965-80, is 27.8 ft^3/s.

Collyer Brook near Gray. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (65 days)	summer period (300 days)
0	.145	.531
5	.144	.513
10	.144	.491
15	.143	.468
20	.142	.444
25	.141	.420
30	.140	.340
35	.139	.373
40	.138	.352
45	.137	.331
50	.137	.312
60	.135	.279
70	--	.252
80	--	.228
90	--	.209
100	--	.192
120	--	.166
140	--	.146
160	--	.131
180	--	.119
200	--	.106
250	--	.090
300	--	.077

01060000 Royal River at Yarmouth, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 45 days a year and is relevant for the remaining 320 days.

The summer uncertainty analysis was based on 27 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 352 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 475 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 16 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = -43.56 + 52.46(\text{INDSTAGE}) + 1.77(\text{MONTHMIN}) + 0.15(\text{LAUBURN}) \tag{33}$$

where INDSTAGE is the indicated gage height
MONTHMIN is the average of daily minimum temperatures for the month
LAUBURN is the indicated discharge at station number 01058500.

This relationship had an R-square of 0.848.

The average variance of measurement errors is estimated to be 118 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 136 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.914. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1950-80, is 276 ft^3/s.

Royal River at Yarmouth. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (45 days)	summer period (320 days)
0	7.12	.803
5	4.10	.801
10	3.11	.800
15	2.60	.798
20	2.29	.797
25	2.07	.795
30	1.90	.794
35	1.77	.792
40	1.66	.790
45	1.57	.789
50	--	.787
60	--	.784
70	--	.781
80	--	.778
90	--	.774
100	--	.771
120	--	.765
140	--	.758
160	--	.751
180	--	.745
200	--	.738
250	--	.721
300	--	.704

01064140 Presumpscot River near West Falmouth, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 22 discharge measurements made during water years 1977-81. The average variance of measurement errors is estimated to be 1,325 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 2,382 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.707. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the 1980 water year is 658 $(ft^3/s)^2$.

Presumpscot River near West Falmouth. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	6.11
5	5.97
10	5.81
15	5.64
20	5.47
25	5.30
30	5.13
35	4.96
40	4.80
45	4.65
50	4.51
60	4.25
70	4.02
80	3.82
90	3.65
100	3.49
120	3.23
140	3.01
160	2.83
180	2.68
200	2.55
250	2.29
300	2.09
350	1.94

01065500 Ossipee River at Cornish, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 90 days a year and is relevant for the remaining 275 days.

The summer uncertainty analysis was based on 28 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 889 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 262 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.896. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 22 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = 51.59 + 1.04(\text{EOSSIPEE}) + 0.33(\text{LOSSIPEE}) \quad (34)$$

where EOSSIPEE is the indicated discharge at station number 01065000
LOSSIPEE is the indicated discharge at station number 01066500.

This relationship had an R-square of 0.959.

The average variance of measurement errors is estimated to be 5,259 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 282 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.925. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1916-80, is 876 ft^3/s.

Ossipee River at Cornish. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s winter period (90 days)	summer period (275 days)
0	8.30	4.10
5	8.03	3.95
10	7.78	3.79
15	7.55	3.65
20	7.34	3.52
25	7.15	3.40
30	6.97	3.29
35	6.81	3.20
40	6.66	3.11
45	6.51	3.03
50	6.38	2.95
60	6.14	2.81
70	5.92	2.70
80	5.72	2.59
90	5.55	2.50
100	--	2.41
120	--	2.27
140	--	2.15
160	--	2.04
180	--	1.95
200	--	1.87
220	--	1.80
240	--	1.74
260	--	1.68

01066000 Saco River at Cornish, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 90 days a year and is relevant for the remaining 275 days.

The summer uncertainty analysis was based on 25 discharge measurements made during water years 1975-81. The average variance of measurement errors is estimated to be 4,594 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 3,485 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.955. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 23 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = 13.57 + 3.74(\text{EOSSIPEE}) \qquad (35)$$

where EOSSIPEE is the indicated discharge at station number 01065000.

This relationship had an R-square of 0.974.

The average variance of measurement errors is estimated to be 50,582 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 4,083 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.990. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1916-80, is 2,706 ft^3/s.

Saco River at Cornish. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (90 days)	summer period (275 days)
0	55.6	22.5
5	45.2	18.8
10	39.7	16.0
15	36.1	14.1
20	33.4	12.8
25	31.3	11.8
30	29.6	11.0
35	28.2	10.3
40	26.9	9.74
45	25.9	9.27
50	24.9	8.86
60	23.4	8.18
70	22.1	7.64
80	21.0	7.19
90	20.0	6.82
100	--	6.49
120	--	5.97
140	--	5.55
160	--	5.21
180	--	4.92
200	--	4.68
220	--	4.47
240	--	4.29
260	--	4.13

01066500 Little Ossipee River near South Limington, Maine

The stage-discharge relation for this station is affected by winter backwater conditions an average of 59 days a year and is relevant for the remaining 306 days.

The summer uncertainty analysis was based on 29 discharge measurements made during water years 1973-81. The average variance of measurement errors is estimated to be 207 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 231 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The relationship of the standard error of estimate of the summer-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The winter rating analysis was based on 11 discharge measurements made during water years 1971-81. The resulting rating curve is:

$$q_r = - 41.5 + 57.62(\mathrm{INDSTAGE}) + 4.28(\mathrm{MONTHMIN}) \qquad (36)$$

where INDSTAGE is the indicated gage height
MONTHMIN is the average of daily minimum temperatures for the month.

This relationship had an R-square of 0.921.

The average variance of measurement errors is estimated to be 66.1 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 58.8 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.010. The standard error of estimate of the winter-period mean discharge as a function of number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1940-80, is 292 ft^3/s.

Little Ossipee River near South Limington. Standard error of estimate of annual mean winter and summer discharge.

Number of measurements in period	Standard error of estimate of period mean in ft^3/s	
	winter period (59 days)	summer period (306 days)
0	.657	.573
5	.652	.572
10	.646	.571
15	.640	.569
20	.634	.568
25	.628	.567
30	.622	.566
35	.616	.565
40	.610	.565
45	.604	.564
50	.598	.563
60	--	.562
70	--	.560
80	--	.557
90	--	.555
100	--	.553
120	--	.551
140	--	.546
160	--	.542
180	--	.537
200	--	.533
220	--	.528
240	--	.516
260	--	.505

01069500 Mousam River near West Kennebunk, Maine

The stage-discharge relation for this station is typically not affected by winter backwater conditions and the rating curve is relevant for the entire year.

The uncertainty analysis was based on 26 discharge measurements made during water years 1974-81. The average variance of measurement errors is estimated to be 47.3 $(ft^3/s)^2$. The fit of the autocovariance function yielded a process variance of 130 $(ft^3/s)^2$ and an $e^{-\beta}$ of 0.858. The relationship of the standard error of estimate of the annual mean discharge as a function of the number of discharge measurements during that period is given in the following table.

The average discharge for the period of record, water years 1940-80, is 180 ft^3/s.

Mousam River near West Kennebunk. Standard error of estimate of annual mean discharge.

Number of measurements in year	Standard error of estimate of annual mean in ft^3/s
0	2.14
5	2.00
10	1.85
15	1.69
20	1.55
25	1.43
30	1.32
35	1.24
40	1.16
45	1.10
50	1.04
60	.947
70	.873
80	.814
90	.765
100	.723
120	.657
140	.605
160	.564
180	.530
200	.501
250	.446
300	.406
350	.374