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LOW FLOW FREQUENCY ANALYSIS PACKAGE

LFA

(User Manual for Version 1 - DEC PRO Series)

by

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The Inland Waters Directorate makes no warranty, expressed or implied, as to the performance of this program. Users are expected to make the final evaluation as to the applicability and correctness of this program in their own set of circumstances, and they are responsible for the correct working of the software and hardware used and the design that results.

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Abstract

The LFA software package estimates the frequency of occurrence of selected low flows, based upon streamflow records at one or more gauging sites. It allows water resource engineers and scientists to evaluate low flows for the design of water supply, wastewater disposal, navigation, fish habitat management, and irrigation facilities. The program employs historical streamflow and water level data from the Water Resources Branch databank (HYDAT), and was originally developed for reviewing data from hydrometric sites, conducting surface water studies and assessments, and for network planning and evaluation purposes. It is made available to other agencies and individuals who may find it useful for similar engineering purposes.

The program methodology is based on the Gumbel III (GIII) distribution. For the unusual occurrence where the GIII cannot provide results, the three-parameter lognormal (3LN) distribution is employed.

This document is only intended as a user manual and does not describe the details of the analytical procedures involved. The software is a combination of the data management, nonparametric testing, and graphical displays of the Consolidated Frequency Analysis Package and the computations of the low flow regime as performed by the program LOFLOW. This facilitates testing and data review prior to performing the frequency analysis. In addition, the package allows the display of tabular and graphical output of up to five different gauging stations or drought flows for up to five different durations at the same time.

This version of the Low Flow Frequency Analysis (LFA) package is designed to run on DEC PRO 350 and 380 microcomputers with PRO/Tool Kit FORTRAN-77 (programming tools and libraries). The Graphics Module with Extended Bitmap Option is required for the interactive generation of polychrome plots and graphs.

For technical details regarding the methodologies, users are referred to the following companion publications:

- 1) Condie, R. and Cheng, L.C. 1982. Low Flow Frequency Analysis, Program LOFLOW, Inland Waters Directorate, Environment Canada.
- 2) Pilon, P.J., Condie, R., and Harvey, K.D. 1985. Consolidated Frequency Analysis Package, CFA, User Manual for Version 1 - DEC PRO Series, Inland Waters Directorate.

Résumé

Le progiciel LFA permet d'évaluer la fréquence des débits d'étiage dans des zones choisies, d'après les dossiers sur les débits établis à une ou plusieurs stations de jaugeage. Il permet, en outre, aux ingénieurs et aux chercheurs intéressés aux ressources en eau, d'évaluer les faibles débits en vue de la conception des réservoirs pour l'approvisionnement en eau, le déversement des eaux usées, la navigation, la gestion de l'habitat du poisson, et l'irrigation. Le programme utilise des données déjà établies sur les niveaux d'eau et les débits préparées par la Banque de données de la Direction des ressources en eau (HYDAT), et a tout d'abord été mis en place pour permettre de revoir les données recueillies dans les stations hydrométriques, d'effectuer des études et des évaluations sur le plan des eaux de surface, et enfin, de servir à des fins de planification et d'évaluation du réseau. Il est mis à la disposition des autres agences et particuliers qui peuvent le trouver utile pour d'autres projets en génie.

Les méthodes du programme sont basées sur la distribution de Gumbel III (GIII). On se sert toutefois de la distribution logarithmique normale à trois paramètres (3LN) dans les cas exceptionnels où la GIII ne peut fournir de résultats.

Le présent document vise à servir de guide d'utilisation et non de documentation sur les méthodes d'analyse pertinentes. Le progiciel regroupe la gestion des données, la mise à l'essai sans paramètre, des images graphiques du progiciel d'analyse synthétisée des fréquences ainsi que les calculs du régime de fréquence des débits d'étiage effectués grâce au programme LOFLOW. Ceci facilite la revue des mises à l'essai et des données avant la réalisation de l'analyse de fréquence. En outre, il permet de présenter sur écran, sous forme de tableaux et de graphiques, des résultats concernant jusqu'à cinq stations de jaugeage différentes ou encore des débits en temps de sécheresse pouvant toucher jusqu'à cinq différentes durées en même temps.

Cette version du progiciel a été conçue pour être exécutée sur des micro-ordinateurs 350 et 380 DEC PRO dotés d'un "PRO/Tool Kit" de langage FORTRAN-77 (outils de programmation et bibliothèques)". Le Graphics Module with Extended Bitmap Option (module de visualisation graphique doté de trois plans de bits) est requis pour produire des tracés et graphiques polychromes de façon interactive.

Pour obtenir plus de précisions techniques au sujet des méthodes employées, les utilisateurs sont priés de se reporter aux publications suivantes, disponibles uniquement en anglais :

- 1) Condie, R. et L.C. Cheng, 1982. Low Flow Frequency Analysis, Program LOFLOW, Direction générale des eaux intérieures, Environnement Canada.
- 2) Pilon, P.J., R. Condie et K.D. Harvey, 1985. Consolidated Frequency Analysis Package, CFA, User Manual for Version 1 - DEC PRO Series, Direction générale des eaux intérieures.

1. INTRODUCTION

The Low Flow Frequency Analysis (LFA) Package is a combination of the data management, nonparametric testing, and graphical displays of the Consolidated Frequency Analysis (CFA) Package (Pilon et al., 1985) with the computations of the low flow frequency regime as presented by Condie and Cheng (1982) and Condie (1986). This combination allows the user to: easily enter data for analysis; modify data sets so as to add, delete, or modify all stored information; save modified data sets for future use; perform nonparametric tests for homogeneity, trend, independence and randomness; and determine the low flow frequency regime using the Gumbel III, sometimes known as the Weibull, distribution or the three-parameter lognormal distribution. The LFA Package also is comprised of a "Composite Results" feature which permits the listing of the statistics, parameters, and frequency regimes for up to five stations in two tables. A composite graphical display of the frequency regimes is included so as to enhance the output capabilities of the analytical techniques.

This document is intended to provide an overview of the operation of the LFA Package on the DEC PRO microcomputer and the characteristics of the data files containing the low flow data. For information regarding the frequency analysis techniques and their limitations, the reader is referred to Condie and Cheng (1982) and Condie (1986). These references are the documentation for the program LOFLOW

and its supplement, which form the basis of the frequency techniques in the LFA Package. Nonparametric testing and graphical screening procedures as well as data management features, with the exception of historic information, are as presented in the CFA Package (Pilon et al., 1985). The techniques described in these references will not be repeated herein. An example of single-site and composite output are provided.

2. OVERVIEW OF LFA PACKAGE

Figure 1 shows a schematic of the LFA Package. This figure illustrates the different features of the package and their interaction with required data sets. The main menu, shown in Figure 2, is the focal point from which the user can select the various tasks to be performed. Once the main menu is displayed on the CRT, the user should select option 1), Data Entry, prior to proceeding with options 2 to 5, inclusive. Option 6), Data Set Directory, can be selected at any time in order to obtain a listing of all the station numbers and names having low flow data contained in a user-specified mass storage device. Provided a single-station low flow frequency analysis has been performed on one or more sites, then option 8), Composite Results, can be used. Note that when performing option 7), Frequency Analysis, an initialized disk must be inserted in the lower drive -- DISKETTE2. Once single-site frequency analysis results have been stored on the lower drive, they then can be retrieved by use of option 8.

2.1 Program Documentation

Low flow data are stored in a data set compatible with that of CFA. The data set is entitled "H22FLOODS.DAT". When option 7), Frequency Analysis, is activated, the package looks for a disk in the second drive and, in particular, a second data set entitled "H25FLOODS.DAT". The package stores all pertinent information regarding the frequency analysis of the station on this second data set so that

composite outputs can be created at a later date. That is, when a composite table or graph is requested for certain sites, appropriate information must be contained on the "H25FLOODS.DAT" file. When performing option 7 and if no "H25FLOODS.DAT" file is on the disk in the second drive, the package will create a "H25FLOODS.DAT" file and store in it the necessary information.

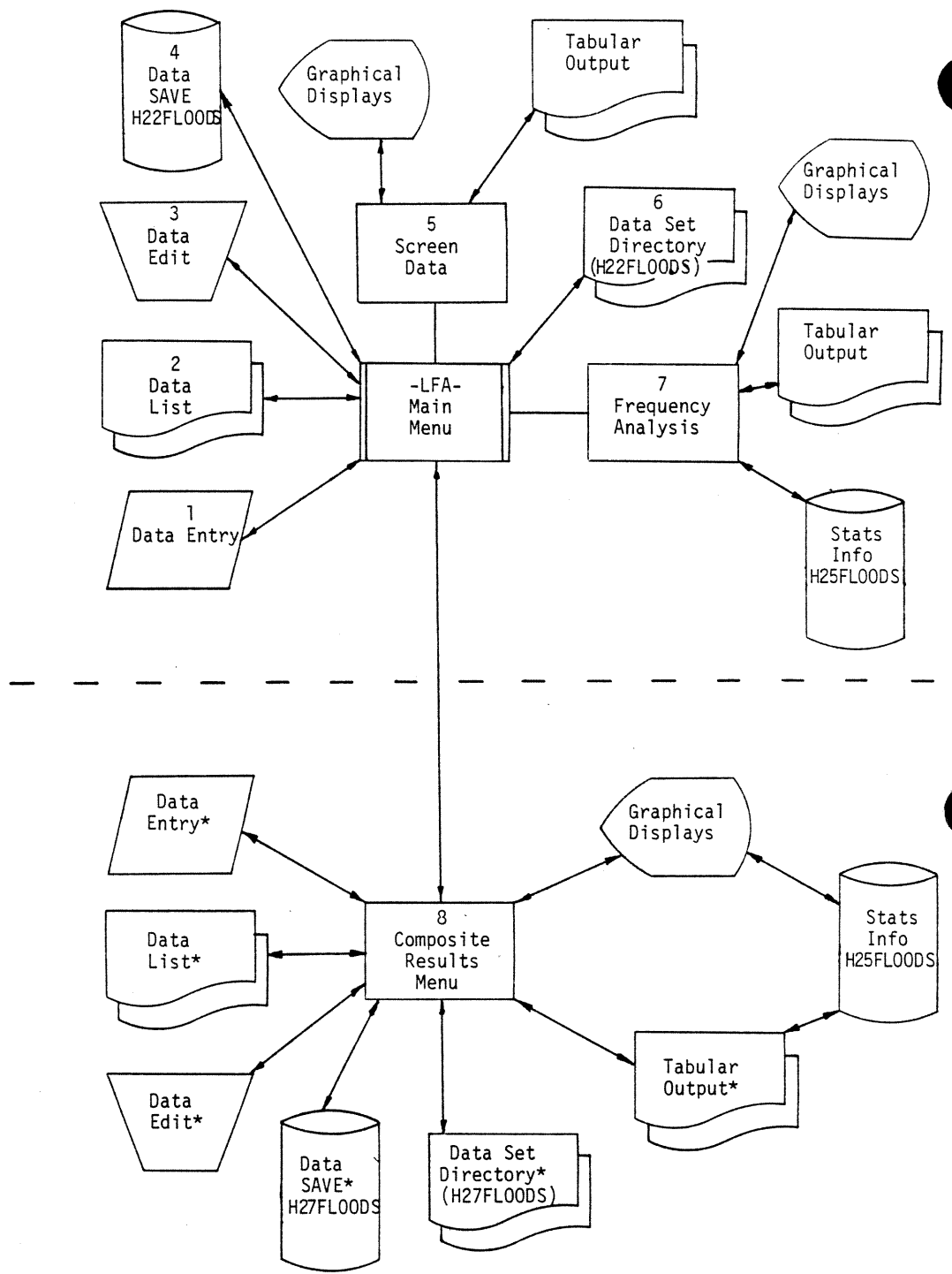
The package accesses the two mentioned data sets based on a 10 character, alphanumeric sequence. The first seven characters are usually comprised of the Water Survey of Canada (WSC) station number (e.g. 01AK001); the eighth character refers to the version number of the data for the station, is user-specified and can vary from 0 to 9; and the two last digits refer to the n-day duration of the low flow data (e.g. 14). The version number allows the user to save more than one data set for the same station and duration. This could be used if a split sample analysis is being performed, for example. One time period could be stored in one version, the second in another, the total sample in another, etc.

Figure 3 shows the menu for option 8), "Composite Results". This option permits the user to generate tabular and graphical output for one to five stations provided that all the sites, with their appropriate version and duration, are included on data set "H25FLOODS.DAT". The Composite Results Menu allows the user to enter, list, edit, and save information regarding the composite request. That is, the number of sites, their WSC station numbers, their versions, and their durations

must be entered via option 1 prior to performing options 6 and/or 7. This information can be saved for future retrieval using option 4. The information can be modified using option 3. Information management features of this menu are analogous to those of the Main Menu of LFA. The information is stored on a data set entitled "H27FLOODS.DAT" residing on the second disk drive. The package will create this data set on an initialized disk when performing option 4, if the data set does not previously exist on the device.

2.2 Data File Characteristics

The data files are accessed by the LFA Package. They are H22FLOODS.DAT, H25FLOODS.DAT, and H27FLOODS.DAT. Table 1 describes the variables contained in a record of H22FLOODS.DAT. Table 2 describes the contents of a record of H25FLOODS.DAT, while Table 3 describes a record of H27FLOODS.DAT.



*: Composite Results

Figure 1. Schematic of LFA Package

*** LOW FLOW FREQUENCY ANALYSIS PACKAGE - VERSION 1.0 ***

MAIN MENU - SELECT ONE OF THE FOLLOWING:

0 - STOP THE PROGRAM (default)

1 - DATA ENTRY

2 - DATA LIST

3 - DATA EDIT

4 - DATA SAVE

5 - SCREEN DATA

6 - DATA SET DIRECTORY

7 - FREQUENCY ANALYSIS

8 - COMPOSITE RESULTS

ENTER ONE INTEGER VALUE AND PRESS <RETURN>:

Figure 2. Main Menu of LFA

*** LOW FLOW FREQUENCY ANALYSIS PACKAGE ***

COMPOSITE RESULTS MENU - SELECT ONE OF THE FOLLOWING:

0 - RETURN TO MAIN MENU OF LOFLOW (default)

1 - COMPOSITE RESULTS DATA ENTRY

2 - COMPOSITE RESULTS DATA LIST

3 - COMPOSITE RESULTS DATA EDIT

4 - COMPOSITE RESULTS DATA SAVE

5 - COMPOSITE RESULTS DATA SET DIRECTORY

6 - TABULAR COMPOSITE RESULTS

7 - GRAPHICAL COMPOSITE RESULTS

ENTER ONE INTEGER VALUE AND PRESS <RETURN>:

Figure 3. Composite Results Menu of LFA

Table 1. Description of Contents of Records Contained in H22FLOODS.DAT

Variables in each record:

1 st variable	Station key (< = 10 characters). This key is made up of the station number (< = 7 characters) plus the version number (1 character) plus a value for the number of days for which each low flow mean was computed (< = 2 characters).
2 nd variable	Station name (< = 50 characters).
3 rd variable	Drainage area.
4 th variable	Number of observations.
5 th variable	An integer variable which is not used. This variable is included so that the format of this data file will be compatible with the format of data files used with the CFA package.
6 th variable	The date on which the water season starts.
7 th variable	The data on which the water season ends.
8 th variable	Up to 150 values for the year in which each observation was recorded.
.	.
157 th variable	.
158 th variable	Up to 150 values for the month in which each observation was recorded.
.	.
307 th variable	.
308 th variable	Up to 150n-day mean observations.
.	.
457 th variable	.

Table 2. Description of Contents of Records Contained in H25FLOODS.DAT.

Variables in each record:

1 st variable	Station key (< = 10 characters). This key is made up of the station number (< = 7 characters) plus the version number (1 character) plus a value for the number of days for which each low flow mean was computed (< = 2 characters).
2 nd variable	Station name (< = 50 characters).
3 rd variable	No. of drought estimates stored in the next 1 to 25 variables.
4 th variable	Drought estimates for each return period.
.	.
28 th variable	.
29 th variable	Return period of zero flow.
30 th variable	The distribution type: = 1 then it is Gumbel III = 2 then it is Three Parameter Log-Normal
31 st variable	The solution type: = 1 parameters by maximum likelihood = 2 parameters by smallest observed drought = 3 parameters by moments
32 nd variable	Overall mean of the observations.
33 rd variable	Standard deviation.
34 th variable	Coefficient of skewness.
35 th variable	Coefficient of variation.
36 th variable	Number of observations.
37 th variable	Overall minimum value of the observations.
38 th variable	"A" parameter.
39 th variable	"E(M)" parameter.
40 th variable	"U(S)" parameter.
41 st variable	Up to 150 n-day mean observations.
.	.
190 th variable	.

Table 3. Description of Contents of Records Contained in H27FLOODS.DAT.

Variables in each record:

1 st variable	User supplied name for the composite analysis run (< = 10 characters).
2 nd variable	No. of stations to be used in the composite analysis.
3 rd variable	Up to 5 station keys representing each single station analysis result to be included in the composite analysis (< = 10 characters per station).
4 th variable	
5 th variable	
6 th variable	
7 th variable	
8 th variable	The plotting style for the composite plot: = 1 Plot symbols only. = 2 Plot lines only. = 3 Plot symbols and solid lines.

3. EXAMPLE OF SINGLE-SITE ANALYSIS -

MEDUXNEKEAG RIVER NEAR BELLEVILLE, WSC NO. 01AJ003

The single-site low flow frequency analysis output presented in this chapter is obtained by selection of option 7) "Frequency Analysis" from the Main Menu (Figure 2). Tabular and graphical output is as performed by Condie and Cheng (1982).

Tables 4 and 5 and Figure 4 give the package's output for the low flow frequency analysis of the ten-day minimum flows on the Meduxnekeag River near Belleville, WSC No. 01AJ003. Table 4 lists the data in the first three columns by starting month, year of occurrence, and the ten-day mean flow. Column four represents sorted flows in ascending order of magnitude, while column five shows their assigned rank starting with rank 1 for the lowest. The last two columns give, respectively, the empirical probabilities and return periods of non-exceedence computed from the Cunnane (1978) formula. Table 5 identifies the station and gives best estimates of the population mean, standard deviation, skewness, and coefficient of variation. The sample size, sample minimum, parameter estimation technique, estimated parameters, and the tabular low flow frequency regime are also listed. Figure 4 shows a graphical representation of the frequency regime and the data. Note that no measure of accuracy regarding the estimated low flow is given. The accuracy of the estimate of a quantile is dependent on the level of the quantile, the number of observations, the quality of the data, and the choice of the distribution and its parameters and the method by which they were estimated.

The ten-day minimum flows are defined for each twelve-month period from May 1 to April 30 throughout the period of analysis. Careful selection of the water year, rather than use of the calendar year, is performed to lessen the possibility of dependence occurring in the data series. Prior to performing a frequency analysis, a close scrutiny of the data with respect to the basic assumptions of frequency analysis is warranted. Selection of option 5) "Screen Data" from the Main Menu (Figure 2), is intended to assist in the analysis of the adequacy of the data. Graphical and tabular output of this menu item are described by Pilon et al. (1985), thus they will not be discussed herein.

Table 4. Output of LFA listing the station's ten-day low flow, its start month and year of occurrence, the ten-day low flows ranked in ascending order of magnitude, their probability of non-exceedence and return period as obtained from the Cunnane formula for the Meduxnekeag River near Belleville - 01AJ003.

01AJ003 MEDUXNEKEAG RIVER NEAR BELLEVILLE
 10 DAY LOW FLOW MEAN DISCH. IN PERIOD MAY 1 TO APR 30

STARTING MONTH	YEAR	10 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
					(%)	(YEARS)
1	1971	5.6100	0.6241	1	3.70	27.00
10	1971	0.6241	0.6242	2	9.88	10.13
9	1972	1.0767	0.6376	3	16.05	6.23
9	1973	1.8490	1.0767	4	22.22	4.50
8	1974	2.4780	1.0808	5	28.40	3.52
8	1975	0.6242	1.3120	6	34.57	2.89
2	1977	2.3850	1.6620	7	40.74	2.45
9	1977	3.5610	1.8490	8	46.91	2.13
8	1978	0.6376	1.9300	9	53.09	1.88
2	1980	1.9300	2.1180	10	59.26	1.69
9	1980	2.5930	2.1480	11	65.43	1.53
9	1981	2.1180	2.3850	12	71.60	1.40
7	1982	1.0808	2.4780	13	77.78	1.29
9	1983	2.1480	2.5930	14	83.95	1.19
9	1984	1.6620	3.5610	15	90.12	1.11
9	1985	1.3120	5.6100	16	96.30	1.04

Table 5. Output of LFA listing the summary statistics of the sample, the solution method, the estimated parameters of the distribution, and the tabular ten-day low flow frequency regime of the Meduxnekeag River near Belleville (01AJ003) for the Gumbel III distribution.

01AJ003 MEDUXNEKEAG RIVER NEAR BELLEVILLE
10 DAY LOW FLOW MEAN DISCH. IN PERIOD MAY 1 TO APR 30
MEAN= 1.98 S.D.= 1.2697 SKEW= 1.5994 C.V.= 0.6411
GUMBEL III DISTRIBUTION - PARAMETERS BY SMALLEST OBSERVED DROUGHT
N= 16 XMIN= 0.624 A= 1.18742 E= 0.4787 U= 2.0710

<u>RETURN PERIOD (YRS)</u>	<u>DROUGHT ESTIMATE</u>
1.005	6.968
1.010	6.251
1.110	3.703
1.250	2.856
2.000	1.648
5.000	0.9289
10.000	0.7180
20.000	0.6092
50.000	0.5382
100.000	0.5118
200.000	0.4971
500.000	0.4872

01AJ003 MEDUXNEKEAG RIVER NEAR BELLEVILLE
LOW FLOW FREQUENCY ANALYSIS - GUMBEL III DISTRIBUTION
10 DAY MEAN LOW - PARAMETERS BY SMALLEST OBSERVED DROUGHT

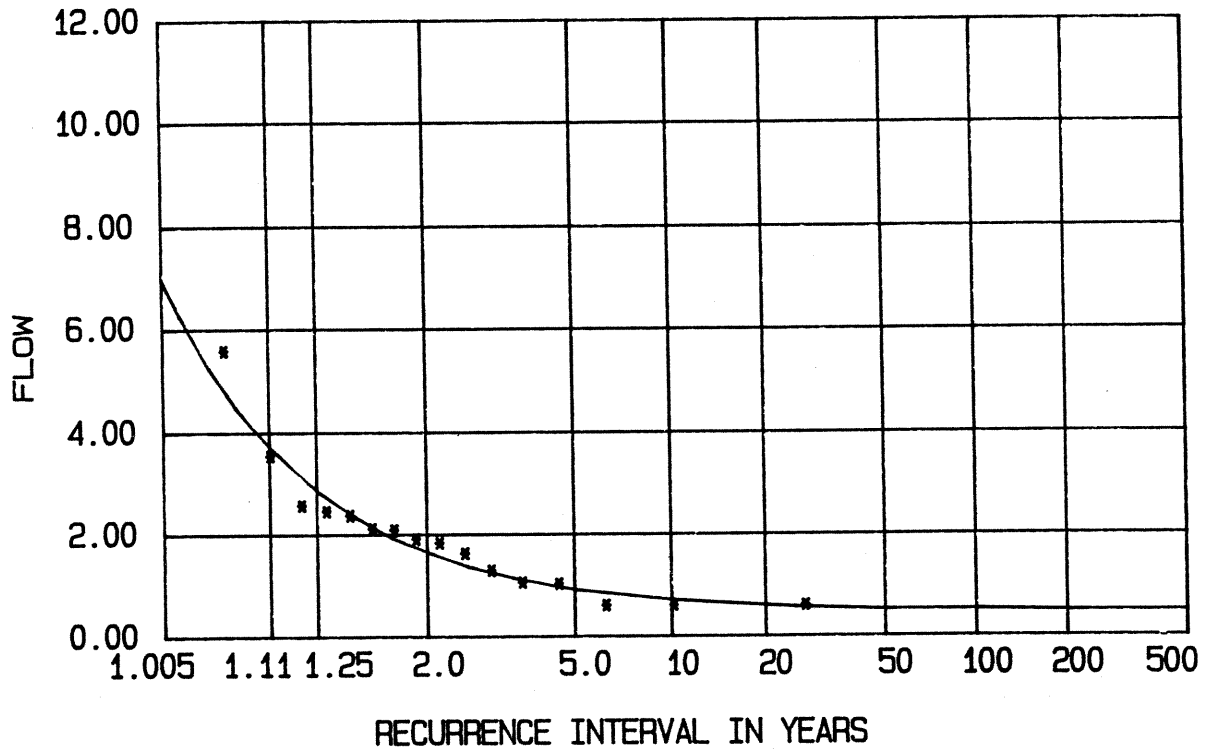


Figure 4. Output of LFA showing the ten-day low flow frequency plot based on the Gumbel III distribution for the Meduxnekeag River near Belleville - 01AJ003.

4. EXAMPLE OF COMPOSITE OUTPUT

It is evident from the Composite Results Menu of LFA (Figure 3), that the composite output is available in both tabular (option 6) and graphical (option 7) form. Output can consist of one to five single-site analyses, inclusive.

Tabular output is broken into two tables. Tables 6 and 7 list the tabular output for the ten-day low flow analyses of five sites. The sites are:

- 1) Meduxnekeag River near Belleville (01AJ003);
- 2) Big Presque Isle Stream at Tracey Mills (01AJ004);
- 3) Shogomoc Stream near Trans Canada Highway (01AK001);
- 4) Nockawic River near Temperance Vale (01AK007); and
- 5) Nashwaak River at Durham Bridge (01AL002).

Table 6 lists the summary statistics, the number of observations, the minimum observed flow, and the estimated parameters of the distribution. Note that the distribution is also given. At all five sites, the parameters of the Gumbel III (GIII) distribution were successfully obtained. The parameters of the GIII are given as A, E, and U. For more information regarding the GIII, please consult Condie and Cheng (1982). Occasionally, parameters of the GIII may not be obtained. The three-parameter lognormal (3LN) distribution is then used in lieu of the GIII. Parameters of the 3LN are given as A, (M), and (S) in

Table 6. Condie (1986) may be consulted regarding the application of the 3LN under such circumstances.

Table 7 represents the second portion of the tabular output of the Composite Results Menu. It comprises the low flow frequency regime for each of the analyses.

Figure 5 shows a composite plot of the five sites' ten-day low flow frequency analyses. The graph indicates the site, its version number, and its duration. The symbol representing the data is located beneath the site descriptor. For example, an "*" is used to represent the data of WSC No. 01AJ003, version 0, having a ten-day duration.

The package has the ability to give a plot of: 1) both the symbols and the cumulative density function (cdf); 2) the symbols only; or 3) the cdf's only.

Note that the version and duration are given in the titling of the graphical output, as a composite graphical display may comprise one site with various low flow durations, or one site with different sampling periods but the same duration, or different sites with the same duration, etc. Thus, the package has some flexibility when attempting to display temporal and spatial variability of low flows. It is, therefore, a useful tool in performing regional as well as single-site low flow frequency analyses.

Table 6. First portion of composite tabular output of LFA listing the WSC No., the station's name, the data set's version number, the duration of the low flows, the summary statistics, the number of observations, the minimum observed flow of each data set, the estimated parameters of the distribution, and the distribution used to obtain the low flow frequency regime.

*** COMPOSITE RESULTS TABLE (1) ***

	<u>STATION</u>	<u>STATION NAME</u>	<u>VERSION</u>	<u>N-DAY MEAN</u>	
(1)	01AJ003	MEDUXNEKEAG RIVER NEAR BELLEVILLE	0	10 day	
(2)	01AJ004	BIG PRESQUE ISLE STREAM AT TRACEY MILLS	0	10 day	
(3)	01AK001	SHOGOMOC STREAM NEAR TRANS CANADA HIGHWAY	0	10 day	
(4)	01AK007	NACKAWIC RIVER NEAR TEMPERANCE VALE	0	10 day	
(5)	01AL002	NASHWAAK RIVER AT DURHAM BRIDGE	0	10 day	
	(1)	(2)	(3)	(4)	(5)
MEAN	1.9806	1.1632	0.4902	0.1835	5.1447
S.D.	1.2697	0.5680	0.3305	0.1565	1.5396
C.S.	1.5994	0.6039	0.5885	1.6698	-0.2219
C.V.	0.6411	0.4884	0.6742	0.8527	0.2993
N	16	16	16	16	16
MIN.	0.6241	0.2823	0.0692	0.0273	2.9950
A	1.1874	1.8561	1.5712	1.0828	1.8828
E(M)	0.4787	0.1708	-0.0178	0.0142	2.3553
U(S)	2.0710	1.2866	0.5478	0.1887	5.4978
	GIII	GIII	GIII	GIII	GIII

Table 7. Second and final portion of composite tabular output of LFA listing the tabular n-day low flow frequency regime for the sites and the return period of zero flow.

*** COMPOSITE RESULTS TABLE (2) ***

	(1)	(2)	(3)	(4)	(5)
RETURN PERIOD (YRS)	01AJ003	01AJ004	01AK001	01AK007	01AL002
	10 day DROUGHT ESTIMATE	10 day DROUGHT ESTIMATE	10 day DROUGHT ESTIMATE	10 day DROUGHT ESTIMATE	10 day DROUGHT ESTIMATE
1.005	6.968	2.912	1.618	0.8290	9.978
1.010	6.251	2.714	1.479	0.7308	0.435
1.110	3.703	1.923	0.9462	0.3926	7.259
1.250	2.856	1.613	0.7478	0.2851	6.401
2.000	1.648	1.087	0.4301	0.1386	4.942
5.000	0.9289	0.6681	0.1999	0.0579	3.772
10.000	0.7180	0.5028	0.1173	0.0361	3.306
20.000	0.6092	0.3961	0.0676	0.0255	3.004
50.000	0.5382	0.3072	0.0294	0.0190	2.751
100.000	0.5118	0.2644	0.0125	0.0167	2.628
200.000	0.4971	0.2352	0.0017	0.0155	2.544
500.000	0.4872	0.2101		0.0148	2.471
R.P. Zero Q	_____	_____	230	_____	_____

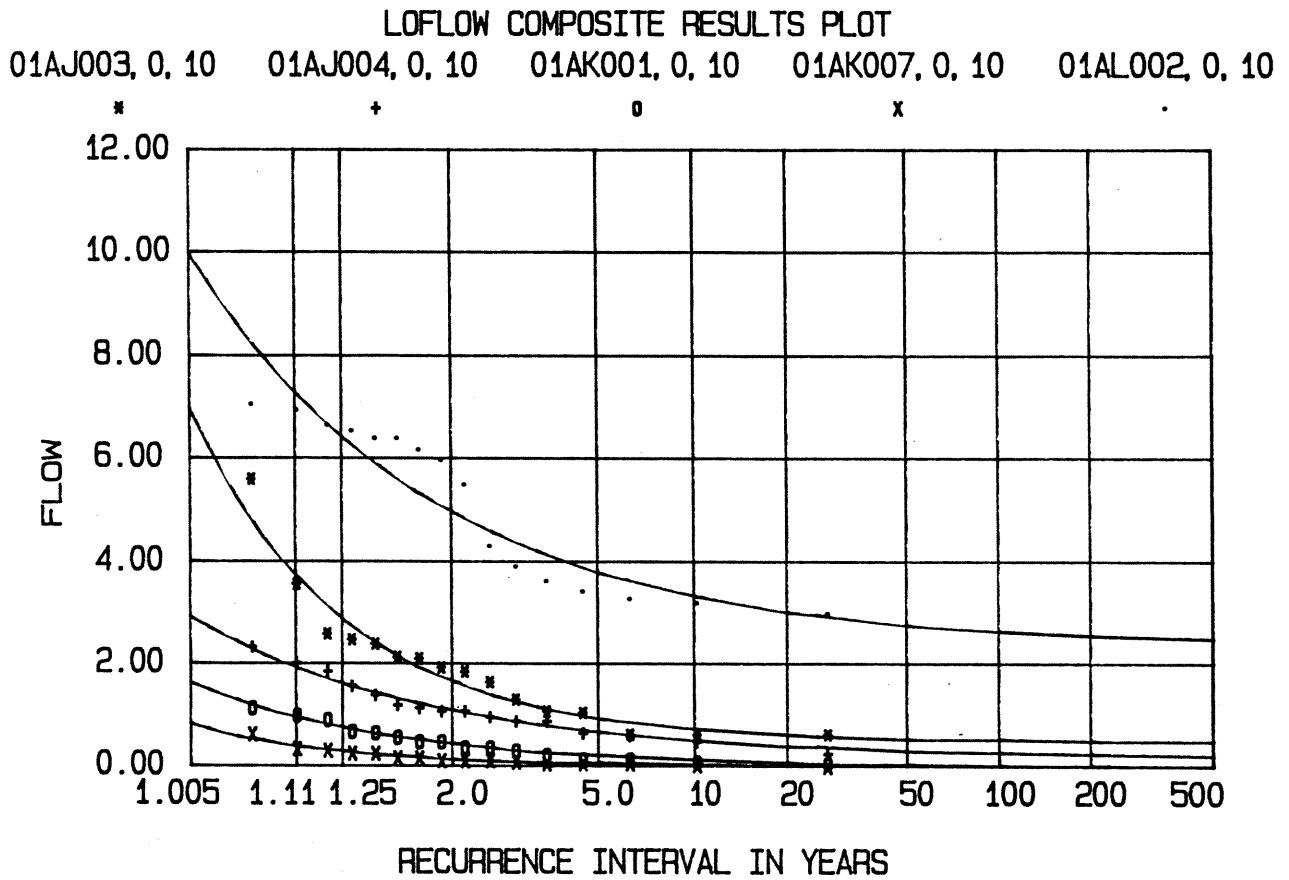


Figure 5. Composite graphical output of LFA showing the ten-day low flow frequency plots for the WSC Nos. 01AJ003, 01AJ004, 01AK001, 01AK007, and 01AL002.

5. REFERENCES

1. Condie, R. and Cheng, L.C. 1982. Low Flow Frequency Analysis, Program LOFLOW. Inland Waters Directorate, Environment Canada.
2. Condie, R. 1986. Program LOFLOW Supplement. Inland Waters Directorate, Environment Canada.
3. Cunnane, C. 1978. Unbiased Plotting Positions - A Review, Journal of Hydrology. Vol. 37. pp. 205-222.
4. Pilon, P.J., Condie, R., and Harvey, K.D. 1985. Consolidated Frequency Analysis Package, CFA, User Manual for Version 1 - DEC PRO Series. Inland Waters Directorate, Environment Canada.

Appendix

A. Program Summary

Program Language: Digital Equipment Corporation (DEC) 300 series
FORTRAN 77.

Computer: DEC PRO 350 and 380 microcomputers.

Available From: Hydrology Division, Water Resources Branch,
Environment Canada.

Purpose/Technique: To provide a user-friendly interactive package to:

- 1) enter low flow data into the program;
- 2) list contents of stored data sets;
- 3) edit existing data sets;
- 4) save entered or edited data by placing it into permanent storage;
- 5) perform nonparametric tests and plot data;
- 6) obtain a list of all the stations' numbers and names that are permanently in storage;
- 7) compute the low flow frequency regime using the Gumbel III or three-parameter lognormal distribution;
- 8) obtain a list of the low flow frequency regime of up to five stations; and
- 9) obtain a frequency plot containing up to five stations.

Input: The sample series of low flow data is input to the program via the keyboard and/or mass storage transfer of files.

Output: The CRT/monitor is the usual mode of display. Hard copies may be obtained using a LA100 (DEC) printer and a LVP16 (DEC) plotter, or compatible equipment.

Output includes:

- i) the ranked input series of low flows and their empirical probabilities;
- ii) estimates of population statistics and the distribution's parameters and their solution technique;
- iii) low flows for preselected return periods; and
- iv) optional plots of frequency curves and nonparametric display of data.

Comments: The authors would very much appreciate hearing from users who find any difficulties with the package.

The number of observations in a data set cannot exceed 150.

B. Sommaire du programme

Langage du programme : Digital Equipment Corporation (DEC), série 300,
FORTRAN 77.

Ordinateur : Micro-ordinateurs DEC PRO 350 et 380.

Fournisseur : Division de l'hydrologie, Direction des
ressources en eau, Environnement Canada.

But/Technique : Fournir un progiciel interactif à la portée de
l'utilisateur pour :

- 1) l'entrée de données relatives à l'écoulement
en période d'étiage.
- 2) le listage de fichiers de données enregistrés.
- 3) la révision de fichiers existants.
- 4) la préservation de fichiers entrés ou révisés
en les introduisant dans la mémoire
permanente.
- 5) la réalisation de tests non paramétriques et
le traçage de courbes.
- 6) l'obtention de la liste de tous les numéros
et noms des stations enregistrés dans la
mémoire permanente.

- 7) le calcul de la fréquence des étiages en utilisant la distribution de Gumbel III ou la distribution logarithmique normale à trois paramètres.
- 8) le listage de la fréquence des étiages jusqu'à cinq stations.
- 9) l'obtention du traçage des courbes de fréquences jusqu'à cinq stations.

Entrée :

La série d'événements des étiages peut être introduite par clavier ou par transfert des fichiers de données enregistrés dans la mémoire de grande capacité.

Sortie :

L'écran cathodique est le mode usuel d'affichage. Les sorties d'ordinateur peuvent être obtenues en utilisant une imprimante LA100 (DEC) et un traçeur de courbes LVP16 (DEC) ou à l'aide de tout autre équipement compatible.

Les sorties comprennent :

- i) le classement des données d'étiages et leurs probabilités empiriques.

- ii) des estimations statistiques de l'échantillonnage, le type de distribution et ses paramètres (incluant la technique de solution).
- iii) les étiages pour des périodes de récurrence déterminées d'avance.
- iv) des tracés facultatifs des courbes de fréquence et l'affichage de résultats de tests non paramétriques.

Observations :

Les utilisateurs qui épouvent des difficultés avec le progiciel sont invités à les signaler à la Division de l'hydrologie.

Le fichier de données ne peut contenir plus de 150 observations.

