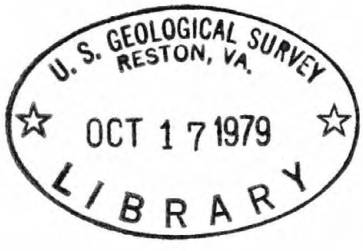
WATSTORE user's guide

National Water Data Storage and Retrieval System

U.S. GEOLOGICAL SURVEY



Open-File Report 79—1336—I

by W.D. Lepkin, M.M. DeLapp, W.H. Kirby, and T.A. Wilson

Sections A and B were prepared under Contract Nos. 14-0001-16535 and 14-0001-15302 by CACI, Inc.-Fed., Herndon, Va.

Volume 4

Chapter I INSTRUCTIONS FOR PEAK FLOW FILE

UNITED STATES DEPARTMENT OF THE INTERIOR

CECIL D. ANDRUS, Secretary

GEOLOGICAL SURVEY

H. William Menard

For additional information write to:

Chief Hydrologist
U.S. Geological Survey
437 National Center
Reston, Virginia 22092

1979

Volume 4

Chapter I. Instructions for Peak Flow File

A. Peak Flow File Input and Update (Program J979)

B. Peak Flow File Retrieval (Program J980)

C. Annual Flood Frequency Analysis Using U.S. Water Resources Council Guidelines (Program J407)

D. Peak Flow Tables (Program A534)

CHAPTER I. INSTRUCTIONS FOR PEAK FLOW FILE

Section A. Peak Flow File Input and Update (Program J979)

Prepared by:

Wayne D. Lepkin
Mary M. DeLapp
CACI, Inc.-Federal

August 1979

CONTENTS

ILLUSTRATIONS

TABLES

I.A. PEAK FLOW FILE INPUT AND UPDATE (PROGRAM J979)

A.1. Introduction

The Peak Flow File Input and Update Program (program J979) allows users to:

- enter new records into the Peak Flow File
- change or correct information in a currently existing record
- delete one or more records
- list the contents of one or more records
- correct the data identifiers
- place record in the transaction data base

The Peak Flow File is always used in conjunction with the Station Header File, which contains fixed identification items for all sites represented in the WATSTORE data files. Data will not be stored in or retrieved from the Peak Flow File unless the Station Header File contains header entries for the stations to be processed. This restriction ensures that all data are associated with a properly identified station.

The Peak Flow File Input and Update Program operates in conjunction with the Peak Flow Transaction File. This transaction file provides for simultaneous backup of all the entries and/or update records in the Peak Flow File which have occurred since the last backup of the Peak Flow File. For every such input or update to the Peak Flow File, a duplicate record is input into the Peak Flow Transaction File after expansion of the record to a fixed block length equal to the maximum record size. If a record cannot be successfully written to this Peak Flow Transaction File, further processing of the Peak Flow File is terminated until the necessary maintenance is performed. This ensures that all information in the Peak Flow File is properly backed up.

For information on entering and updating data in the Station Header File refer to Volume 1, Chapter III, Section A, entitled "Entering and Updating Data Stored in the Station Header File. " The job control language for program J979 has been cataloged under procedure name PKINPUT. Symbolic parameters are available within the cataloged procedure for specifying an agency code, an update password, and other values.

For each item to be stored in the Peak Flow File the agency code, station identification number, and date must be provided. This information, in addition to the data to be added to the file, is entered via the EXECute card (agency code) and on data cards. Also, in any given execution of

the program, data may be entered from a tape or disk in the standard Peak Flow File record format (see sec.B.4.b. for format description) with or without data cards.

Program J979 was written in PL/I for the IBM 360 and 370 computer series of the USGS by Wayne D. Lepkin and Richard H. Burnett of CACI, Inc., Reston, Virginia.

A.2. Peak Flow File Organization

The Peak Flow File is a collection of instantaneous maximum (peak) stream discharge data and associated gage height measurements made at streams throughout the Nation. The file is online, so that the data it contains are immediately available. The Peak Flow File is organized by agency, water-measurement site or station, and water year. The file contains one or more records for each station, one record per water year. A water year is defined as a 12-month period beginning October 1 and ending September 30, bearing the number of the year in which it ends (i.e., the 1977 water year ended September 30, 1977).

A single record contains an annual peak discharge (also called peak flow), and an associated gage height (also called stage), for the water year. If some other peak gage height measurement at any time during the water year is greater than the gage height associated with the peak discharge, then the maximum such gage height is also stored in the record. In addition, a record may contain up to 30 "partial duration peaks" (that is, peak discharges above a base discharge but less than the annual maximum peak discharge for the year) and their associated gage heights. The dates when all measurements were made are also kept in the file, but time of day is not stored.

In the event that a peak discharge has been measured but the year is unknown or is not exact (i.e., a high water mark due to a flood which occurred prior to recorded measurements at a station), the water year is to be estimated and the record is given a qualification code as indication of its imprecise nature.

All records in the Peak Flow File are stored in ascending order by record access key. The record access key consists of the three identifiers in the order listed below:

1.	Agency Code	See WATSTORE User's Guide, Appendix A.
2.	Station Identification Number	See Volume 1, chapter II, section B, for a discussion of station identification numbers.

3. Water Year — The 12-month period, October 1 through September 30, designated by the year in which the 12-month period ends.

In addition to the record access keys, the following important data elements are stored in the Peak Flow File:

Data Element	Description
Peak Flow	The maximum discharge value for the year.
Gage Height	Gage Height for the maximum discharge.
Gage Height Qualification Codes	See section A.4.b.(1).(c). for list of codes.
Peak Flow Qualification Codes	See section A.4.b.(1).(c). for list of codes.
Retrieval Security Flag	If flag is set, password must be supplied.
Day of Peak Flow	The day maximum discharge occurred.
Month of Peak Flow	The month maximum discharge occurred.
Number of Partial Duration Peaks	The number of partial peak flows stored in the record.
Create Date	The date the record was created.
Process Date	The date the record was last modified.
District Code	The code of the district responsible for the data.
Highest Since Year	The peak discharge reported is the highest since this year.
Annual Peak Stage	Maximum stage for the water year.
Peak Stage Month	Month peak stage occurred.
Peak Stage Day	Day peak stage occurred.
Peak Stage Qualification Code	See section A.4.b.(1).(c). for list of codes.
Partial Duration Peak Discharge(s)	Each peak discharge less than annual maximum peak discharge but higher than base discharge in Station Header File.
Partial Duration Peak Month(s)	Month each partial duration peak discharge occurred.
Partial Duration Peak Day(s)	Day each partial duration peak discharge occurred.
Partial Duration Peak Stage(s)	Each peak stage less than annual maximum stage.
Partial Duration Peak Stage Qualification Codes	See section A.4.b.(1).(d). for list of codes.
Partial Duration Peak Discharge Qualification Codes	See section A.4.b.(1).(d). for list of codes.

Each site for which data are stored in the Peak Flow File must have an entry in the Station Header File. In addition to the mandatory items, a base discharge value and the gage datum should be stored in the Station Header File.

A.3. Data Security

Program J979 allows for protection against unauthorized updates or retrievals of peak flow records. The data security features are optional and should be utilized only when there is a need to prevent others from accessing specific data records. If an update/retrieval password has been stored in a station header record, a peak flow record for any year for that station cannot be created or updated unless the user supplies a matching password. Personnel are encouraged to assign the same password to all stations in their jurisdiction when password protection is needed. If the user-supplied password does not match the update/ retrieval password in the station header record, the input for that station will not be processed and an error message will be printed. A user-supplied password need not be specified if an update/retrieval password is not stored in the station header record.

Peak flow records for the current water year that may be considered provisional also may be protected against unauthorized retrievals if: (1) both an update/retrieval password and a retrieval only password have been stored in the station header record and (2) the security flag in the peak flow record has been set "on". Only records for the current water year may be so protected.

Data that were submitted from card input may be protected against unauthorized retrieval at the time of initial entry or at a later time during an update operation. A detailed discussion of the steps required to request retrieval protection is given in section A.3.b. The retrieval of peak flow records is discussed in section B of this chapter.

Input data in the standard peak flow record format (see sec. A.6) from tape or disk cannot be protected against unauthorized retrievals until after the data are stored. During an update of these records, the security retrieval flag may be set "on" during execution of the input procedure (PKINPUT). A complete discussion of data security is contained in Volume 1, chapter II, section C.

A.3.a. Symbolic Parameter (PASSWRD)

The symbolic parameter PASSWRD within the cataloged procedure PKINPUT is available for specifying an update/retrieval password. A symbolic parameter is a key word coded on a procedure execution card that provides a method of passing variable job control information, in this case the password, to the procedure. The password is specified on the job control language (JCL) EXECute card (see V. 1, chap. II, sec. A) as shown below:

```
// EXEC PKINPUT,PASSWRD=your password
```

where "your password" is the user-supplied password.

The password specified by means of the symbolic parameter PASSWRD remains in effect throughout the execution of the cataloged procedure PKINPUT, except when it has been temporarily superseded by a password submitted by means of a password/agency identification card.

A.3.b. Password/Agency Identification Card (Z Card)

The password/agency identification card (Z card), which is optional, is shown in figure 1. When used, it immediately precedes either a peak flow code card (2 card) or a special program option card (6 card). The Z card may be used to:

- supply a password for a station that is to be individually password protected
- request the protection of data against unauthorized retrievals
- separate and identify the data by agency (see sec. A.4.a.(1).
- update the agency code in the peak flow records (see sec. A.4.c.)

A Z card indicates that one or more of the above options are to be applied to the data which are identified by the succeeding peak flow card or special program option card. The password coded on the Z card will override the password submitted by means of the symbolic parameter only for records identified by the card that immediately follows the Z card.

When entering data into the file, only the update/retrieval password is coded on a Z card. The retrieval only password does not apply.

To password protect current water year data from unauthorized retrieval, code columns 25-28 of the Z card with FLAG. This will set the security retrieval flag stored in the peak flow data record to "on." If columns 25-28 are coded with NULL, the retrieval flag already set to "on" will be set "off". If no password/agency identification card is present, or if columns 25-28 are left blank, the security retrieval flag will remain unchanged for all data records being updated and set "off" for initial entry. Security retrieval flags cannot be set "on" or "off" for any data identified by a special program option card, i.e., columns 25-28 of a Z card are ignored when a special program option card follows.

The password/agency identification card format follows:

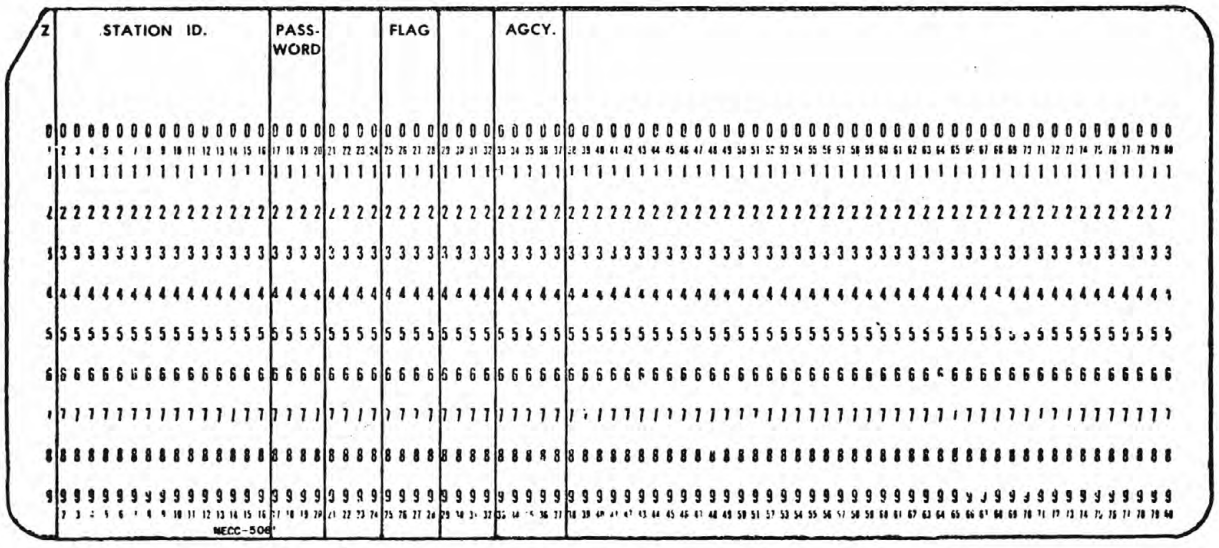


Figure 1. Password/agency identification card (Z card)

Col. 1 Enter a Z.

Col. 2-16 Station identification number.

Col. 17-20 Code the update/retrieval password.

Col. 21-24 Blank.

Col. 25-28 Code the word FLAG if the security retrieval flag is to be set "on". Code the word NULL if an existing security retrieval flag is to be set "off". If this field is left blank, security retrieval is set "off" on initial entry and is unchanged during update. This field is applicable only when the peak flow code card (type 2) follows the Z card.

Col. 29-32 Blank.

Col. 33-37 Agency code -- code this field with the agency code that identifies the record in the Peak Flow File (see sec. A.4.a.(1)).

Col. 38-80 Blank.

A.4. Program Operations

Five program operations are available when using card input. Table 1 summarizes the operations and lists the corresponding code to request each operation. The last column in the table indicates the card types available for each operation. The operation code is specified by means of the peak flow code card.

Table 1. Summary of operations and corresponding codes

CODE	OPERATION	CARD TYPES
'ENT'	Initially enter peak flow information or update peak flow information.	Z, 2, 3, 4
'CID'	Change or correct the record access key identifiers (agency or station identification) with which the peak flow data are stored.	Z, 2, 6
'DEL'	Delete one or more peak flow records for a station.	Z, 2
'PRT'	Print out one or more records for a station in table format.	Z, 2
'YER'	Change or correct the water year.	Z, 2

The card formats as they apply to each operation are described in sections A.4.a through A.4.f.

A.4.a. Data Identification

Peak flow records are uniquely identified by three items: agency code, station identification number, and water year. The agency code can be specified in two ways: as a parameter on the EXECute card, and on a Z card. The remaining two identifiers are specified on the peak flow code card.

A.4.a.(1). Agency Identification

The agency responsible for the data stored in the Peak Flow File is identified by a code consisting of 3 to 5 alphanumeric characters. Each record in the Peak Flow File must be identified by an agency code. The use of an agency code in processing peak flow data is MANDATORY. A data record not identified by agency will result in an error message, and the data will be ignored. The agency code may be specified by means of the symbolic parameter AGENCY or the password/agency identification card.

A list of agency codes may be obtained by executing a procedure described in Appendix A, or from the NAWDEX publication "Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey", Open-File Report 79-331.

A.4.a.(1).(a). Symbolic Parameter (AGENCY)

AGENCY is the symbolic parameter within the cataloged procedure PKINPUT for specifying the agency code on the EXEC card.

```
// EXEC PKINPUT,AGENCY=agency code
```

where "agency code" is the agency code to be stored with the data upon initial entry, or the agency code identifying the data for update.

The agency code specified by means of the symbolic parameter AGENCY remains in effect for all input data except when temporarily superseded by an agency code submitted by means of the password/agency identification card. The agency code submitted by means of the password/agency identification card will be in effect only for the peak flow record defined on the succeeding peak flow code card or special program option card.

A.4.a.(1).(b). Password/Agency Identification Card (Z Card)

The Z card, which is optional, is used to supply passwords and identify data by agency. When required, it immediately precedes either a peak flow code card or a special program option card. The agency code on the Z card will supersede the agency code submitted by means of the symbolic parameter only for records identified by the card that follows the Z card. The Z card format is described in section A.3.b.

A.4.a.(2). Site and Water Year Identification

The two other identifiers of a peak flow record, the station identification number and the date, are specified on the peak flow code card (fig. 2) or the special program option card (fig. 3). The formats of these two cards are given below.

A.4.a.(2).(a). Peak Flow Code Card (2 Card)

The peak flow code card (2 card) is required to identify the data to be entered or updated in the Peak Flow File and to specify the operation. The peak flow code card is described below.

Col. 1	Enter a 2.
Col. 2-16	Station identification number.
Col. 17-38	Blank.
Col. 39-42	Beginning calendar year of the period of record to be processed (operation codes DEL and PRT). If operation code is YER or CID, code this field with the water year to be corrected. If operation code is ENT, leave this field blank.
Col. 43-44	Beginning month -- a two-digit number which represents the beginning month of the period of record to be processed (e.g., 01 for January, 12 for December). If the operation code is CID, YER, or ENT, then leave this field blank.
Col. 45-46	Blank.
Col. 47-50	Ending calendar year of the period of record to be processed (operation codes DEL and PRT). If operation code is YER or CID, code this field with the correct water year. If operation code is ENT, then leave this field blank.

Col. 51-52 Ending month -- a two-digit number which represents the ending month of the period of record to be processed. If the operation code is CID, YER, or ENT, then leave this field blank.

Col. 53-54 Blank.

Col. 55-57 Operation Code -- detailed instructions are given in succeeding sections.

ENT - data entry and/or update
CID - change record key identifiers
DEL - delete one or more records
PRT - print one or more records
YER - change water year

Col. 58-64 Blank.

Col. 65 If a P is coded in this column, a listing of the record(s) for the station identified on this card will be printed.

Col. 66-80 Blank.

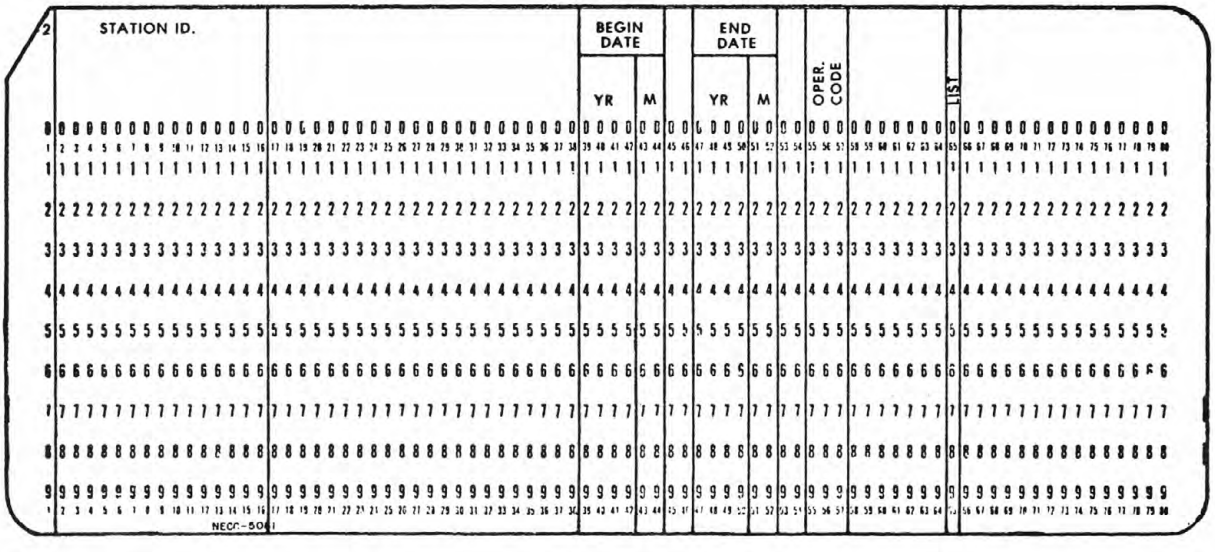


Figure 2. Peak flow code card (2 card)

A.4.a.(2).(b). Special Program Option Card (6 Card)

The special program option card (6 card) is used to identify data record(s) for which the record access key is to be corrected. This card is used only for the CID operation. Records identified by "6" cards must reside in the Peak Flow File. The special program option card is described below.

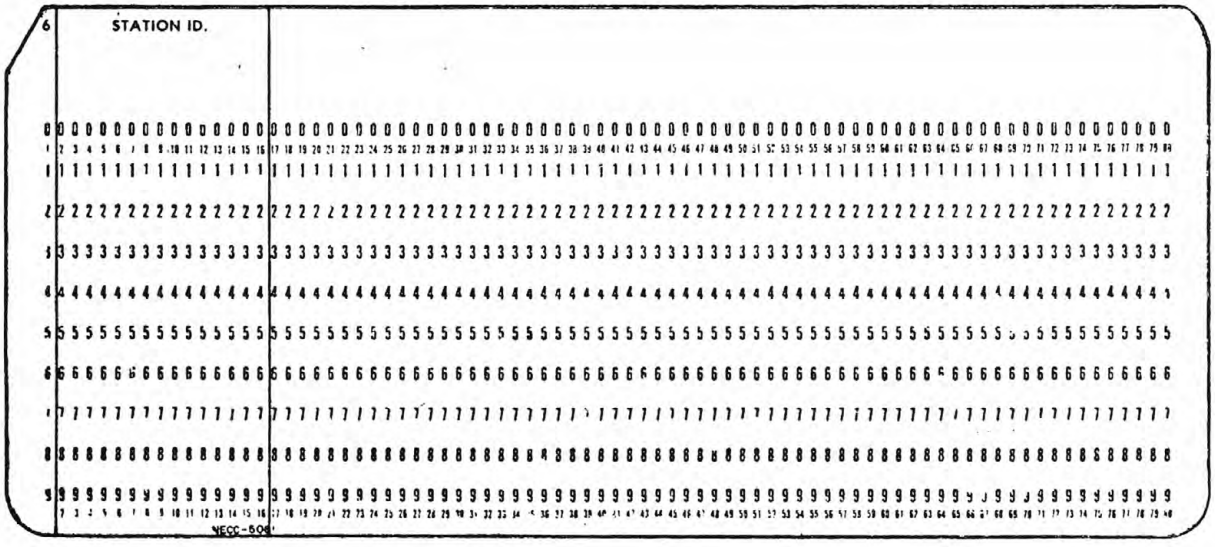


Figure 3. Special program option card (6 card)

Col. 1	Enter a 6.
Col. 2-16	Station Identification Number -- code this field with the current station ID of the record(s) to be changed.
Col. 17-80	Blank.

A.4.b. Data Entry (ENT)

The operation code ENT is used for entry of peak flow data from cards, to be stored in the Peak Flow File. The agency code is supplied on the EXEC card or on the password/agency identification card (Z card), and the remaining two record identifiers (station ID and water year) on the peak flow code card (2 card) and data cards, (type 3 or 4 card), respectively. The water year is determined from the calendar year and month specified on the type 3 or 4 data cards. The peak flow data are also entered on card types 3 and 4. A type 3 card is used for annual peak discharge and annual maximum gage height data, whereas a type 4 card is used for partial duration peak discharge data (peaks above a base).

With this operation, initial entry of data causes creation of a new record; data already existing in a record can be modified or deleted. If a new record is to be created, a type 3 card must be supplied; in other cases, it is optional. Type 4 cards are always optional. Type 2 cards are always mandatory.

A.4.b.(1). Preparation of Input

Four card formats are available for input by operation ENT. These are as follows:

a. password/agency identification card (Z card), optional
b. peak flow code card (2 card), mandatory
c. peak flow data card (3 card), optional
d. partial duration peak flow data card (4 card), optional

A.4.b.(1).(a). Password/Agency Identification Card (Z Card)

The Z card is used when it is necessary to override the update/retrieval password and(or) the agency code specified on the EXECute card. It may also be used to set the security retrieval flag to "on" or off" (see sec. A.3.b.).

The format of the Z card used in an ENT operation is described below.

Col. 1	Enter a Z.
Col. 2-16	Station identification number.
Col. 17-20	Update/retrieval password is coded to temporarily override the PASSWRD symbolic JCL parameter.
Col. 21-24	Blank.
Col. 25-28	Security retrieval flag. Code: FLAG -- set flag "on". NULL -- set flag "off". If this field is left blank, the flag is set "off" on initial entry and unchanged during update.
Col. 29-32	Blank.
Col. 33-37	Agency code is coded to temporarily override the AGENCY symbolic JCL parameter.
Col. 38-80	Blank.

A.4.b.(1).(b). Peak Flow Code Card (2 Card)

The type 2 card is required to identify the data to be entered or updated in the Peak Flow File. The format of the 2 card as it applies to the ENT operation is described below.

Col. 1	Enter a 2.
Col. 2-16	Station identification number.
Col. 17-54	Blank.
Col. 55-57	Operation code -- enter ENT.

Col. 58-64 Blank.

Col. 65 Peak flow record listing -- code P if desired, otherwise leave blank.

Col. 66-80 Blank.

A.4.b.(1).(c). Peak Flow Data Card (3 Card)

The type 3 peak flow data card (fig. 4) is required for entering, updating, or deleting annual peak discharge or annual peak gage height data. The type 3 card can be used only when the operation code ENT is specified on the type 2 card.

If the record identified by the station ID on the preceding type 2 card and the date on the type 3 card does not currently exist, a record will be created and updated with the data entered on the type 3 card. For initial entry, the minimum requirement for a record to be created includes entry of either an annual peak discharge, an annual peak stage, or a maximum annual stage. The remaining fields are optional.

If the record specified does currently exist, the values on the 3 card will replace the values in the record. A value in the record may be deleted (that is, given a null value, rather than being replaced with a new value) by placing a string of 9's in the field; details are given below.

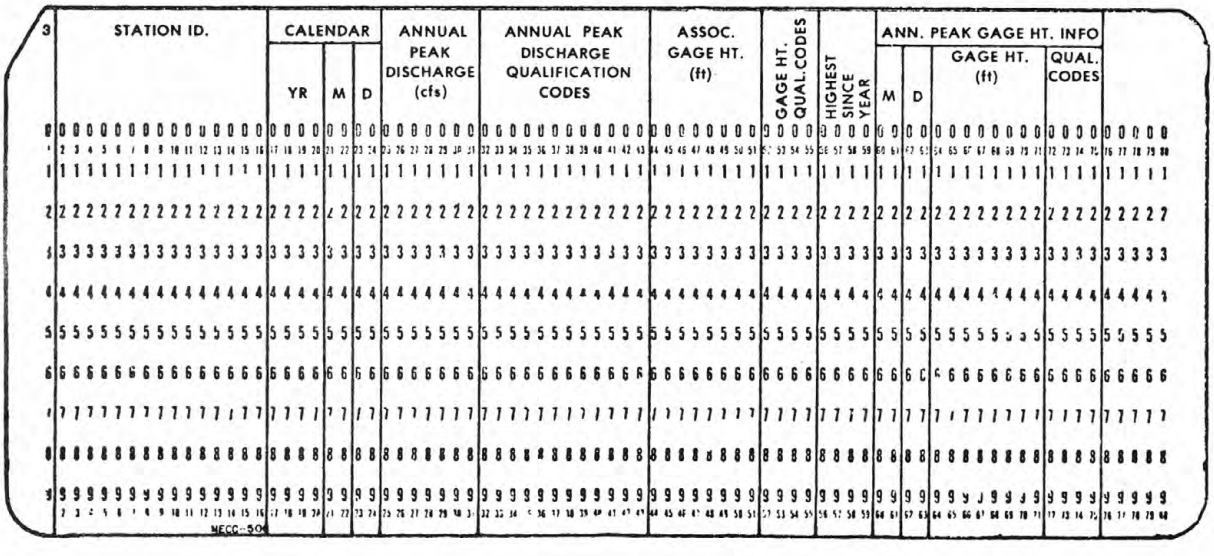


Figure 4. Peak flow data card (3 card).

Col. 1	Enter a 3.
Col. 2-16	Station identification number; same as on type 2 card.
Col. 17-20	Calendar year -- a four-digit number representing the actual calendar year of the annual peak discharge; if columns 21-22 are blank, assume this is a water year.
Col. 21-22	Month -- a two-digit number representing the month the annual peak discharge occurred. For example, March is coded as 03. Leave blank if not known. Enter 99 to delete.
Col. 23-24	Day -- a two-digit number in the range 01-31 representing the day of the month the annual peak discharge occurred. Leave blank if not known. Enter 99 to delete.
Col. 25-31	Annual Peak Discharge in cfs -- the value is punched with a decimal point, and significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. Blank fields will be interpreted as no data available (initial entry) or no modifications necessary (updates). The data value may be punched anywhere in the seven-column field (e.g., bb19.2b, where b=blank). There must be no alphabetic characters or embedded blanks within the data values. The decimal point is punched only when a fractional portion is to be reported . A field of 999999 will be interpreted as a deletion code on an update.
Col. 32-43	Annual peak discharge qualification codes -- This field contains one-column fields in which from none to 12 qualification codes can be punched. There are a total of 12 single-character codes presently available. Certain combinations of codes are invalid as shown below.

Col. 32-43 (continued)

The codes may be punched in any of the fields, in any order (e.g., bb2A5bbbbbbb, where b=blank). If a code appears in any of the fields, it will be placed in the record. If a code is to be deleted from a record, it must be preceded by an asterisk (*) (e.g., b2*A5bbbbbbb, in which codes 2 and 5 will be added, and code A deleted).

Peak Discharge Qualification Codes

1	discharge is a maximum daily average
2	discharge is an estimate
3	discharge affected by dam failure
4	discharge less than indicated value, which is minimum recordable discharge at this site*
5	discharge affected to unknown degree by regulation or diversion**
6	discharge affected by regulation or diversion**
7	discharge is an historic peak***
8	discharge actually greater than indicated value
9	discharge due to snowmelt, hurricane, ice-jam or debris dam breakup
A	year of occurrence is unknown or not exact
B	month or day of occurrence is unknown or not exact
C	all or part of the record affected by urbanization

*Code 4 cannot occur simultaneously with codes 1, 2, 3, 7, or 8.

**Codes 5 and 6 cannot occur simultaneously.

***Code 7 should indicate that historic peak occurred before or after the systematic record, or during a break in the systematic record.

Col. 44-51 Gage height associated with annual peak discharge -- the value is punched with a decimal point, and significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. Blank fields will be interpreted as no data available (initial entry) or no modifications necessary (updates). The data value may be punched anywhere in the field (e.g., bb19.20b, where b=blank). There must be no alphabetic characters or embedded blanks within the data values. The decimal point is punched only when a fractional portion is to be reported. A field of 999999 will be interpreted as a deletion code.

Col. 52-55 Gage height qualification codes -- four one-column fields in which none to 4 qualification codes can be punched. There are a total of five single-character codes presently available. The valid codes and their meanings are given below. The codes may be punched in any of the fields, in any order (e.g., b32b, where b=blank). If a code is to be deleted from a record in an update, it must be preceded by an asterisk (*) (e.g., bb*2, in which code 2 will be deleted).

Gage Height Qualification Codes

1 gage height affected by backwater
2 gage height not the maximum for the year
3 gage height at different site and/or datum
4 gage height below minimum recordable elevation
5 gage height is an estimate

If code 2 is given here, then a date and data entries should be made for the maximum annual gage height (cols. 60-75).

Col. 56-59 "Highest since" year -- a four-digit number representing the calendar year after which the given peak discharge is known to be the highest. Code 9999 to delete value. A blank indicates no year to be entered or no change.

Col. 60-75 Annual peak gage height information. These columns contain four fields for the annual peak gage height, to be coded if the maximum gage height for the water year is not that associated with the maximum discharge. If the gage height reported in columns 44-51 is the maximum for the water year, columns 60-75 are to be left blank. The fields are coded as follows:

Col. 60-61 Month -- a two-digit number representing the month in which the annual peak gage height occurred. While this month may not be in the same calendar year as the annual peak discharge, i.e., the year specified in columns 17-20, it is assumed that it is in the same water year.

Col. 62-63 Day -- a two-digit number representing the day of the month the annual peak gage height occurred.

Col. 64-71 Annual peak gage height -- the value is punched with a decimal point, and significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. Blank fields are interpreted as no data available (initial entry) or no modifications necessary (updates). The data value may be punched anywhere in the eight-column field (e.g., bb19.20b, where b=blank). There must be no alphabetic characters or embedded blanks within the data values. The decimal point is punched only when a fractional portion is to be reported. A field of 999999 will be be interpreted as a deletion code.

Col. 72-75 Annual peak gage height qualification codes -- four one-column fields in which none to 3 qualification codes can be punched. Only three codes have a meaning for the annual peak gage height (see below). If codes 2 or 4 are entered, as allowed for the other gage height entries, a warning message will be issued. The codes may be punched in any column (e.g., bblb, where b=blank). If a code is to be deleted from the record in an update, it must be preceded by an asterisk (*). (e.g., *lbb, in which code 1 will be deleted).

Codes:

1 gage height due to backwater
3 gage height at different site and/or datum
5 gage height is an estimate

Col. 76-80 Blank

A.4.b.(1).(d). Partial Duration Peak Flow Data Card (4 Card)

The type 4 peak flow data card is required for entering, updating, or deleting partial duration peak discharge data (data above a base and less than an annual maximum). The type 4 card (see fig. 5) can be used only when the operation code ENT is specified on the peak flow code card.

In order to add partial duration peak data to a record, the record must either already exist or be in the process of being created, the latter case requiring that a type 3 card also be supplied. If the record is being created, then each type 4 card causes a partial duration peak entry to be added to the record. If the record already exists, each type 4 card either causes a partial duration peak entry to be added or causes one to be updated. If the month and day match those of a partial duration peak entry already in the record, then an update is made to that entry, otherwise a new entry is added to the record. No more than one partial duration peak per day can be stored; however, there can be one partial duration peak and one annual peak stored for the same day.

For a partial duration peak entry to be added to a record, a value for the partial duration peak discharge or the partial duration peak gage height must be coded. To delete a partial peak entry from a record, both the partial peak discharge and the gage height values must be deleted. The qualification codes are automatically deleted.

Each peak flow record can contain a maximum of 30 partial duration peak entries. Therefore, up to 30 type 4 cards may be supplied following a type 2 or type 3 card.

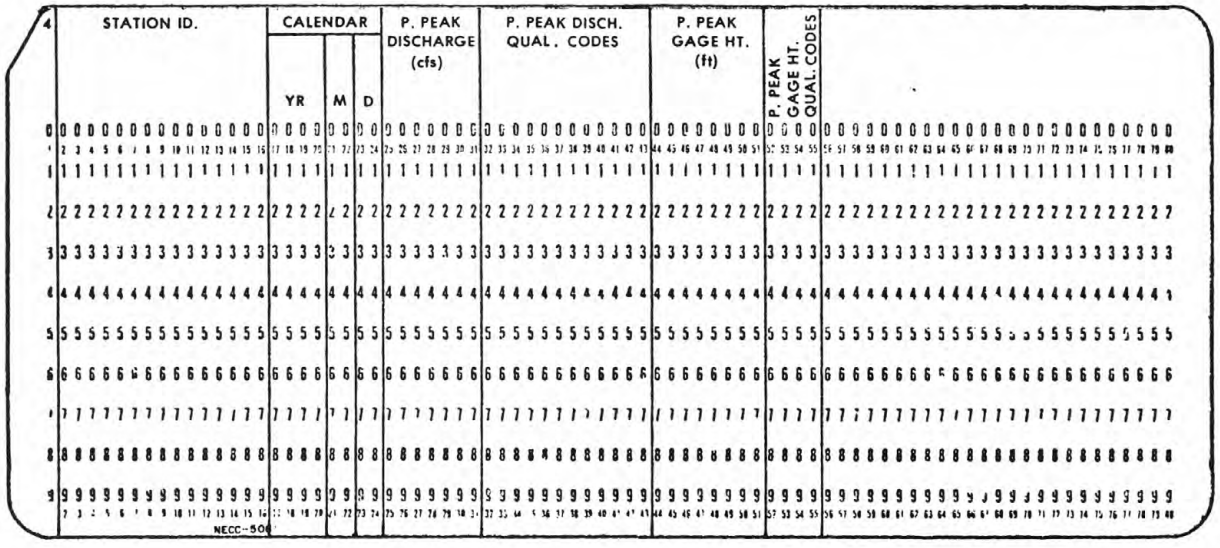


Figure 5. Partial duration peak flow data card (4 card)

Col. 1 Enter a 4.

Col. 2-16 Station identification number -- same as on type 2 card.

Col. 17-20 Calendar year -- a four-digit number representing the actual calendar year of the data on the card. This entry may or may not be the same as on the preceding type 3 card if one is present, but the month and year must have occurred in the same water year as the peak discharge.

Col. 21-22 Month of partial duration peak -- a two-digit number representing the month in which the partial duration peak occurred. Leave blank if not known. Enter 99 to delete.

Col. 23-24 Day of partial duration peak -- a two-digit number representing the day of the month the partial duration peak occurred. Leave blank if not known. Enter 99 to delete.

Col. 25-31 Partial duration peak discharge -- the value is punched with a decimal point, and significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. Blank fields will be interpreted as no data available (initial entry) or no modifications necessary (updates). The data value may be punched anywhere in the seven-column field (e.g., bb19.2b, where b=blank). There must be no alphabetic characters or embedded blanks within the data values. The decimal point is punched only when a fractional portion is to be reported. A field of 999999 will be interpreted as a deletion code.

Col. 32-43 Partial duration peak discharge qualification code -- 12 one-column fields in which none to 12 qualification codes can be punched. There are a total of 12 single-character codes presently available. The valid codes and their meanings are listed in section A.4.b.(1).(c). The codes may be punched in any of the columns, in any order (e.g., bb2A5bbbbbbb, where b=blank). If a code is to be deleted from a record in an update it must be preceded by an asterisk (*) (e.g., b2*A5bbbbbbb, in which codes 2 and 5 will be added, and code A deleted).

Col. 44-51 Partial duration peak gage height -- the value is punched with a decimal point, and significant digits where needed to the right of the decimal point. Whole numbers need no decimal point. Blank fields will be

interpreted as no data available (initial entry) or no modifications necessary (updates). The data value may be punched anywhere in the eight-column field (e.g., bb19.20b, where b=blank). There must be no alphabetic characters or embedded blanks within the data values. The decimal point is punched only when a fractional portion is to be reported. A field of 999999 will be interpreted as a deletion code on an update.

Col. 52-55 Partial duration peak gage height qualification codes -- four one-column fields in which up to four qualification codes can be punched. At present, only codes 1, 3, 4, and 5 have been assigned (see below). The codes may be punched in any of the columns (e.g., b31b, where b=blank). If a code is to be deleted from the record in an update, it must be preceded by an asterisk (*) (e.g., b*1b, in which code 1 will be deleted).

Codes:

1 gage height due to backwater
3 gage height at different site and/or datum
4 gage height below bottom of gage
5 gage height is an estimate

Col. 56-80 Blank.

A.4.b.(1).(e). Order of Input Cards

The following four card types are used with the ENT operation.

a. password/agency identification card (Z card)
b. peak flow code card (2 card)
c. peak flow data card (3 card)
d. partial peak flow data card (4 card)

A type 2 card, which contains the operation code ENT, is always required. If the optional Z card is to be included, it must precede the 2 card.

At least one 3 card or one 4 card must be included. If both types 3 and 4 cards are given, the 3 card must follow the 2 card and precede the 4 card(s). The type 4 cards may appear in any order. The input data will be sorted by the program so that partial peak data appear in chronological order in the peak flow record. Information for up to 30 partial peaks may be stored in each record (each water year); therefore up to 30 type 4 cards may be supplied following a type 2 card.

A.4.b.(2). Sample Input and Output

A sample card deck setup for one water year of data at one station, using only the ENT operation is shown in figure 6. Cards beginning with a slash are job control language (JCL) cards. A sample printout produced from these cards is shown in figure 7.

A.4.c. Change Record Identifiers (CID)

The operation code CID indicates that records in the file are to have one or more of their record identifiers changed. The three record identifiers are the agency code, the station identification number, and the water year. Only the agency code and the station identification number may be changed using the CID operation. Water year is changed by the YER operation.

The new or corrected station identification number must be specified on the peak flow code card (type 2) along with the operation code CID and the water year or range of years of the record to be corrected. If all records for that station are to be corrected, no water year is specified. The current station ID number must appear on the special program option card (type 6). If the agency code is to be corrected, the new agency code must be specified on a Z card preceding the peak flow code card, and the current agency code must be specified on a Z card preceding the special program option card (6 card).

```
Col. 1     Col. 12          Col. 28              Col. 48  Col. 55   Col. 65

.          .                .                    .        .         .
/*  (relay card)
//  (job   card)
/*PROCLIB  WRD.PROCLIB
//S1 EXEC PKINPUT,AGENCY=agency,PASSWRD=password (if required)
//PKIN.SYSIN DD *
2       08056500                                          ENT       P
3       0805650019760419   3400                 6.95
4       0805650019760523   1500                 4.80
4       0805650019760526   2180                 5.62
4       0805650019760530   1440                 4.72
4       0805650019760831   1380                 4.65
/*
//
$$$
```

Figure 6. Sample input for ENT operation

********** ALL MESSAGES FOR PEAKFLOW CARD SET NO. 1 (ERROR AND UPDATE MESSAGES)**********

INPUT DATA FOR STATION: 08056500 PEAK_FLOW_CARD SET NO. 1

TYPE3 DATA											TYPE4 DATA						
CAL. YEAR	MO	DAY	ANNUAL PEAK DISCHARGE	ANNUAL DISCHARGE CODE	PEAK STAGE	PEAK STAGE CODE	YEAR SINCE	MO	DAY	ANNUAL PEAK STAGE	ANNUAL STAGE CODE	MO	DAY	PARTIAL PEAK DISCHGE	PART. DISC. CODE	PARTIAL PEAK STAGE	PARTIAL STAGE CODE	YEAR	CRD NO.
1976	04	19	3400		6.95							05	23	1500		4.80		1976	1
												05	26	2180		5.62		1976	2
												05	30	1440		4.72		1976	3
												08	31	1380		4.65		1976	4

PEAK_FLOW_CARD SET NO. 1
STATION 08056500

AGENCY: USGS
DISTRICT: 48

WATER YEAR	DATE	PEAK DISCHARGE (CFS)	DISCHARGE CODES	GAGE HEIGHT (FT)	GAGE HT CODES	HIGHEST SINCE	MAX GAGE HEIGHT (FT)	DATE	GAGE HT CODES	NUMBER OF PARTIAL PEAKS
1976	04/19/76	3400.00		6.95						4
	05/23/76	1500.00		4.80						
	05/26/76	2180.00		5.62						
	05/30/76	1440.00		4.72						
	08/31/76	1380.00		4.65						

Figure 7. Sample output for ENT operation.

A.4.c.(1). Preparation of Input

The three card types available for use with operation code CID are:

a. password/agency identification card (Z card), optional
b. peak flow code card (2 card), mandatory
c. special program option card (6 card), mandatory

A.4.c.(1).(a). Password/Agency Identification Card (Z Card)

The password/agency identification card is optional. It may be required to:

i) supersede the password submitted by the symbolic parameter

ii) supersede the agency code submitted by the symbolic parameter

iii) correct the agency code in the Peak Flow File

If the agency code is to be corrected, the correct agency code is specified in columns 33-37 of the Z card preceding the peak flow code card, and the current agency code is specified in columns 33-37 of the Z card preceding the special program option card. The password, if required, must be an update/retrieval password whether the Z card precedes a 2 card or a 6 card. A brief description of the Z card follows:

Col. 1	Enter a Z.
Col. 2-16	Station identification number.
Col. 17-20	Update/retrieval password (if required).
Col. 21-24	Blank.
Col. 25-28	Security retrieval flag -- applicable only if Z card precedes a 2 card. If left blank, flag is set "off". Code: FLAG--set flag "on". NULL--set flag "off".

Col. 29-32 Blank.

Col. 33-37 Agency code (if required).

Col. 38-80 Blank.

A.4.c.(1).(b). Peak Flow Code Card (2 Card)

The correct record identifiers (except the agency code) are coded on the peak flow code card. A station ID number must always be given. The 2 card is the first card except when preceded by a Z card. Refer to Section A.4.a.(2).(a) for a general description of the peak flow code card. A description of the 2 card as it applies to the CID operation follows:

Col. 1 Enter a 2.

Col. 2-16 Correct station identification number.

Col. 17-38 Blank.

Col. 39-42 Water Year 1 (beginning water year) if required, otherwise blank.

Col. 43-46 Blank.

Col. 47-50 Water Year 2 (ending water year) if required, otherwise blank. An entry is needed in this field only if a range of water years is to be defined.

Col. 51-54 Blank.

Col. 55-57 Operation code -- enter CID.

Col. 58-64 Blank.

Col. 65 Peak flow record listing -- code P if desired, otherwise leave blank.

Col. 66-80 Blank.

A.4.c.(1).(c). Special Program Option Card (6 Card)

The incorrect record identifiers (except the agency code) are coded on the peak flow code card. The 6 card follows the 2 card. If required, a Z card may precede the 6 card. Refer to Section A.4.a.(2).(b) for a detailed description of the special program option card. A description of the 6 card as it applies to the CID operation follows:

Col. 1	Enter a 6.
Col. 2-16	Incorrect station identification number (the number to be changed).
Col. 17-80	Blank.

A.4.c.(2). Options

The change to be executed by the CID operation is controlled by the content of the input cards. The two possible options are to change agency code or station identification number. Generally, the four control cards are submitted in the following order:

- Z card (mandatory only for agency code change)
- 2 card (mandatory for all options)
- Z card (mandatory only for agency code change)
- 6 card (mandatory for all options)

The Z card (password/agency identification card) is required for the agency change option and in all other cases where the agency and/or passwords are not identified on the EXECute card. The site identification contained on the 2 card and preceding Z card must correspond to an entry in the Station Header File. If that entry contains an update/retrieval password, then the user must also submit a matching password. The site identification contained on the 6 card and preceding Z card need not correspond to an existing entry in the Station Header File. However, if there is a corresponding entry in the Header File, and if an update/retrieval password has been stored in that entry, the user must submit a matching password.

The two change options are described below.

A.4.c.(2).(a). Change of Agency Code

There must be an entry in the Station Header File that corresponds to the new agency code and current station identification number. Four cards are needed to change the agency code:

i) a Z card, containing the new or corrected agency code, and if needed, a password code to supersede the password supplied on the EXECute card. A password is required if an update/retrieval password has been entered into the Station Header File for the site identified by this card.

ii) a peak flow code card (2 card), containing the operation code CID and the station ID number.

iii) a second Z card, containing the agency code currently used to identify the record. A password is required if an update/retrieval password has been entered into the Station Header File for the site identified by this card

iv) a special program option card (6 card) containing the current station identification number.

The second card, the peak flow code card (2 card), may optionally contain one or two water year entries. If only one water year is given, the agency code will be changed only in the record for that water year. If two water year entries are given, the agency code will be changed in the records for all years within the range defined by the two water years, inclusive. If no water year entries are made on the peak flow code card,then the agency code will be changed in all records for the station. There need not be an entry in the Station Header File for the site identified by the second Z card, in which case password checking for this site will be bypassed. Password checking will always be in effect for the site identified by the first Z card.

Example: The agency code is to be changed from 'USGS' to 'NEWAG' for all records for station ' 12345678'. The password specified on the EXECute card is not the same as the one required here, so passwords must be specified on the Z cards. The password for agency USGS and station ID 12345678 is 'PSW1'; for agency NEWAG and station ID 12345678 it is 'PSW2'. The formats of the four cards are:

```
         1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345

Z        12345678PSW2           NEWAG
2        12345678                                        CID
Z        12345678PSW1           USGS
6        12345678
```

A.4.c.(2).(b). Change of Station ID Number

There must be an entry in the Station Header File that corresponds to the current agency code and new station identification number. If the agency code and password are given on the EXECute card, only two cards are needed to change a station identification number:

i) a peak flow code card (2 card), containing the operation code CID and the new or corrected station ID number

ii) a special program option card (6 card), containing the station ID number currently in the record

The first card, the peak flow code card, may optionally contain one or two water year entries. If only one water year is given, the station ID number will be changed only in the record for that water year. If two water year entries are given, the station ID number will be changed in the records for all years within the range defined by the two water years, inclusive. If no water year entries are made on the peak flow code card, then the station ID number will be changed in the records for all water years.

A Z card preceding either or both cards will be required, if the agency code or password(s) given on the EXECute card do not correspond to the identification and security of the two sites. There need not be an entry in the Station Header File for the site identified by the special program option card, in which case password checking for this site will be bypassed. Password checking will always be in effect for the site identified by the peak flow code card.

Example: The station ID number is to be changed from ' 12345678' to ' 55555555' for a group of records from water year 1950 to water year 1960, inclusive. The agency code and password specified on the EXECute card do correspond to those for both stations IDs, so no Z cards are necessary. The formats of the two cards are:

```
          1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345

2       55555555                        1950    1960    CID
6       12345678
```

A.4.c.(3). Sample Input and Output

A sample card deck setup to change a station ID number from 01605602 to 01605600 for five water years using the CID operation code is shown in figure 8. A sample printout produced from these cards is shown in figure 9.

A.4.d. Record Deletion (DEL)

The operation code DEL indicates that one or more records for a station are to be deleted from the Peak Flow File. Only the peak flow code card (type 2) is required for this operation. The password/agency identification card is optional.

The station ID number and the operation code DEL are specified on the peak flow code card. Optionally, one or a range of years may be specified on the peak flow code card. If only a begin date is specified, then only the record for that year is deleted. If two dates are specified, then all records within the range defined by the two dates will be deleted. If no dates are given, then all records for the station will be deleted.

```
Col. 1     Col. 12                    Col. 39  Col. 47  Col. 55  Col. 65

.          .                          .        .        .        .
/*   (relay card)
//   (job card)
/*PROCLIB  WRD.PROCLIB
//S1 EXEC PKINPUT,AGENCY=agency,PASSWRD=password (if required)
//PKIN.SYSIN DD *
2       01605600                      1966     1970     CID      P
6       01605602
/*
//
$$$
```

Figure 8. Sample input for CID operation

```
************* ALL MESSAGES FOR PEAKFLOW CARD SET NO.  1 (ERROR AND UPDATE MESSAGES)************
-------------------------------------------------------------------------------------------------
THE KEY WAS CHANGED FROM USGS          01605602  1966 TO USGS          01605600  1966
THE KEY WAS CHANGED FROM USGS          01605602  1967 TO USGS          01605600  1967
THE KEY WAS CHANGED FROM USGS          01605602  1968 TO USGS          01605600  1968
THE KEY WAS CHANGED FROM USGS          01605602  1969 TO USGS          01605600  1969
THE KEY WAS CHANGED FROM USGS          01605602  1970 TO USGS          01605600  1970
PU009    THE DATA THAT WAS IDENTIFIED DOES NOT EXIST --IF OPERATION IS ENT, A NEW RECORD WILL TRY TO BE ADDED
             RECORD KEY INFO:  AGENCY =        STATION =        01605600  WY = 1966
```

Figure 9. Sample output for CID operation.

A.4.d.(1). Preparation of Input

The two card types available for use with operation code DEL are:

- password/agency identification card (Z card), optional
- peak flow code card (2 card), mandatory

A.4.d.(1).(a). Password/Agency Identification Card (Z Card)

The password/agency identification card must precede the peak flow code card if needed to supercede the agency or password coded on the EXEC card. Refer to section A.4.a.(1) for a detailed description. A brief description of the Z card follows:

Col. 1	Enter a Z.
Col. 2-16	Station identification number.
Col. 17-20	Update/retrieval password (if required).
Col. 21-32	Blank.
Col. 33-37	Agency code (if required).
Col. 38-80	Blank.

A.4.d.(1).(b). Peak Flow Code Card (2 Card)

The station ID number must always be given on the peak flow code card. The 2 card is the only card required except when the Z card is needed to identify the agency and/or passwords. Refer to section A.4.a.(2).(a) for a general description of the peak flow code card. A description of the 2 card as it applies to the DEL operation follows:

Col. 1	Enter a 2.
Col. 2-16	Station identification number.
Col. 17-38	Blank.
Col. 39-42	Calendar year 1 (beginning calendar year) if required, otherwise blank.

Col. 43-44	Month -- beginning month if required, otherwise blank. (If left blank, assumes year in cols. 39-42 is a water year.)
Col. 45-46	Blank.
Col. 47-50	Calendar year 2 (ending calendar year) if required, otherwise blank. An entry is made in this field only if a range of dates is to be deleted.
Col. 51-52	Month -- ending month if required, otherwise blank. (If left blank, assumes year in cols. 47-50 is a water year.)
Col. 53-54	Blank.
Col. 55-57	Operation code -- enter DEL.
Col. 58-64	Blank.
Col. 65	Peak flow record listing -- code P if listings of deleted records are desired, otherwise leave blank.
Col. 66-80	Blank.

A.4.d.(2). Sample Input and Output

A sample card deck setup for deleting water years 1900-1970 for one station (no listing of deleted records requested) using the DEL operation code is shown in figure 10. A sample printout produced from these cards is shown in figure 11.

A.4.e. Record Print (PRT)

The operation code PRT indicates that one or more records for a station are to be printed in a peak flow record listing format (see fig. 12, listing for one station). Peak flow records can be listed during any of the other three operations. This operation is provided in case only record listing is desired. Only the peak flow code card type-2 is required for this operation. The password/agency identification card is optional.

The station ID number and the operation code PRT are specified on the peak flow code card. Also, a P is placed in column 65 of

```
Col 1.      Col. 12                          Col. 39  Col. 47  Col. 55

.           .                                .        .        .
/*  (relay card)
//  (Job card)
/*PROCLIB  WRD.PROCLIB
//S1 EXEC PKINPUT,AGENCY=agency,PASSWRD=password (if required)
//PKIN.SYSIN DD *
2       03114651                           189910   197009   DEL
/*
//
$$$
```

Figure 10. Sample input for DEL operation

```
********** ALL MESSAGES FOR PEAKFLOW CARD SET NO.  1 (ERROR AND UPDATE MESSAGES)**********
-------------------------------------------------------------------------------------------
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1900
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1901
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1902
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1903
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1904
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1905
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1906
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1907
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1908
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1909
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1910
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1911
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1912
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1913
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1914
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1915
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1916
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1917
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1918
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1919
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1920
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1921
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1922
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1923
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1924
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1925
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1926
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1927
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1928
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1929
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1930
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1931
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1932
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1933
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1934
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1935
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1936
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1937
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1938
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1939
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1940
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1941
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1942
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1943
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1944
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1945
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1946
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1947
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1948
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1949
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1950
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1951
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1952
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1953
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1954
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1955
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1956
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1957
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1958
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1959
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1960
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1961
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1962
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1963
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1964
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1965
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1966
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1967
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1968
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1969
THE FOLLOWING RECORD WAS DELETED  USGS          03114651   1970
```

Figure 11. Sample output for DEL operation

PEAK_FLOW_CARD SET NO. 1
STATION 08056500

AGENCY: USGS
DISTRICT: 48

WATER YEAR	DATE	PEAK DISCHARGE (CFS)	DISCHARGE CODES	GAGE HEIGHT (FT)	GAGE HT CODES	HIGHEST SINCE	MAX GAGE HEIGHT (FT)	DATE	GAGE HT CODES	NUMBER OF PARTIAL PEAKS
1947	08/27/47	3350.00		6.80						0
1948	05/11/48	1630.00		4.68						0
1949	05/13/49	2300.00		6.15						0
1950	05/01/50	2060.00		5.29						0
1951	09/12/51	1700.00		4.82						0
1952	05/17/52	2220.00		5.47						0
1953	04/23/53	910.00		3.54						0
1954	04/12/54	2380.00		6.40						0
1955	06/18/55	852.00		3.44						0
1956	05/01/56	1740.00		4.84						0
1957	04/25/57	3850.00		7.30						0
1958	04/26/58	3070.00		6.54						0
1959	02/14/59	1460.00		4.47						0
1960	10/01/59	4650.00		8.10						0
1961	10/13/60	1240.00		4.08						0
1962	07/27/62	4540.00		7.96						0
1963	04/28/63	4290.00		7.77						0
1964	09/21/64	3240.00		6.79						0
1965	05/10/65	4520.00		7.97						0
1966	04/23/66	12200		10.54		1903				0
1967	04/21/67	1790.00		5.14						0
1968	05/13/68	3220.00		6.77						0
1969	05/06/69	8840.00		9.96						0
1970	10/12/69	3130.00		6.68						0
1971	08/14/71	2400.00		5.87						0
1972	10/19/71	3590.00		7.14						0
1973	05/03/73	4160.00		7.67						0
1974	05/05/74	3160.00		6.71						0
1975	10/31/74	2440.00		5.92						0
1976	04/19/76	3400.00		6.95						4
	05/23/76	1500.00		4.80						
	05/25/76	2180.00		5.62						
	05/30/76	1440.00		4.72						
	08/31/76	1380.00		4.65						
1977	03/27/77	4000.00		7.51						0

Figure 12. Sample output for PRT operation.

the 2 card indicating that the record listing is desired (this is the same procedure for requesting record listings as used for the other operations). Optionally, one or two dates may be specified on the peak flow code card. If a single date is specified, then only the record for that year is printed. If two dates are specified, all records for the station between these dates will be printed. If no dates are given, all records for the station will be printed.

A.4.e.(1). Preparation of Input

The two card types available for use with operation code PRT are:

- password/agency identification card (Z card), optional
- peak flow code card (2 card), mandatory

A.4.e.(1).(a). Password/Agency Identification Card (Z Card)

The password/agency identification card must precede the peak flow code card if needed to supercede the agency or password specified on the EXEC card. Refer to section A.4.a.(1) for a detailed description. A brief description of the Z card follows:

Col. 1	Enter a Z.
Col. 2-16	Station identification number
Col. 17-20	Update/retrieval password (if required).
Col. 21-24	Blank.
Col. 25-28	Security retrieval flag. -- Code: FLAG - set flag "on" NULL - set flag "off" If this field is left blank, the flag is set "off" on initial entry and unchanged during update.

Col. 29-32 Blank.

Col. 33-37 Agency code (if required).

Col. 38-80 Blank.

A.4.e.(1).(b). Peak Flow Code Card (2 Card)

The station ID number must always be given on the peak flow code card. The 2 card is the only card used except when a Z card is needed to identify the agency and/or password. Refer to section A.4.a.(2).(a) for a general description of the peak flow code card. A description of the 2 card as it applies to the PRT operation follows:

Col. 1 Enter a 2.

Col. 2-16 Station identification number.

Col. 17-38 Blank.

Col. 39-42 Calendar year 1 (beginning year) if required. If this entry is left blank, the printing will begin with the earliest record (chronologically) available for the site.

Col. 43-44 Month -- beginning month if required, otherwise blank. (If left blank, assumes year in cols. 39-42 is a water year.)

Col. 45-46 Blank.

Col. 47-50 Calendar year 2 (ending year) if required, otherwise blank. Code this entry if a range of water years is to be listed.

Col. 51-52 Month -- ending month if required, otherwise blank. (If left blank, assumes year in cols. 47-50 is a water year.)

Col. 53-54 Blank.

Col. 55-57 Operation code -- enter PRT.

Col. 58-64 Blank.

Col. 65 Peak flow record listing -- code P.

Col. 66-80 Blank.

A.4.f. Update Water Year (YER)

The operation code YER indicates that a record in the file has been stored with an incorrect water year which is to be corrected.

If the agency code and password are specified on the EXECute card, only one card is needed to perform this function: the peak flow code card, containing the operation code YER, the station ID number, and the current water year and the new or corrected water year.

Note that in this case only a single water year can be placed on the peak flow code card, that is, the water year can be changed for only a single record at a time, rather than for a range of records or all records for a station.

If required, a Z card may be added preceding the 2 card, in order to supersede the agency and/or password code specified on the EXECute card.

Example: A record was mistakenly entered as water year 1878 when the intended year was 1978 so a correction will be made. The station ID is ' 12345678'. The agency code and password on the EXECute card are the same as those required here, but the security retrieval flag is to be set "on" in the record, so a Z card is needed preceding the peak flow code card. (Note that only a record for the current water year, '1978' at the time of this writing, can have the flag set "on".) In addition, a listing of the contents of the record is desired. The card formats are:

```
         1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345

Z        12345678          FLAG
2        12345678                             1878     1978     CID        P
```

A.4.f.(1). Preparation of Input

The two cards available for use when updating the water years are:

(1) Password/agency identification card (optional)
(2) Peak flow code card (mandatory)

A.4.f.(1).(a). Password/Agency Identification Card (Z Card)

If needed, the password/agency identification card must precede the peak flow code card. A brief description of the Z card follows:

Col. 1	Enter a Z.
Col. 2-16	Station identification number.
Col. 17-20	Update/retrieval password (if required).
Col. 21-24	Blank.
Col. 25-28	Security retrieval flag -- applicable only if Z card precedes a 2 card. If left blank, flag is set "off". FLAG -- set flag "on". NULL -- set flag "off".
Col. 29-32	Blank.
Col. 33-37	Agency code.
Col. 38-80	Blank.

A.4.f.(1).(b). Peak Flow Code Card (2 Card)

The primary identifiers, the current water year, and the operation code YER are coded on this card. A description of the 2 card as it applies to the YER operation follows:

Col. 1	Enter a 2.
Col. 2-16	Station identification number.
Col. 17-38	Blank.

Col. 39-42	Incorrect water year as stored in file.
Col. 43-46	Blank.
Col. 47-50	Correct water year to be stored in file.
Col. 51-54	Blank.
Col. 55-57	Operation Code -- enter YER.
Col. 58-64	Blank.
Col. 65	Peak flow record dump -- if required enter P, otherwise leave blank.
Col. 66-80	Blank.

A.5. Multiple Operations

Any number of operations may be submitted for a given execution of the cataloged procedure PKINPUT. Each 2 card indicates the beginning of an operation.

The input data cards must be organized in accordance with the following rules:

a) When a password/agency card (Z card) is required, it must precede the peak flow code card (2 card) or the special program option card (6 card) to which it applies.

b) The first card for each operation must be a 2 card except when a Z card precedes the 2 card.

c) Peak flow data cards (3 and 4 cards) are used only when the operation code on the preceding 2 card is ENT.

d) Special program option cards (6 card) are used only when the operation code on the preceding 2 card is CID.

A special deck setup using multiple operations in the same job step is shown in figure 13.

A.6. Standard Peak Flow Record Format Input

In any given job step, data may be entered from a tape or disk in the standard peak flow record format (see sec. B.4.b for format description) with or without card input. The records found on the input file used for this purpose will first be transferred to the Peak Flow File; the card input will then be processed. If a record on the input file has the same record identifiers as a record which already exists on the Peak Flow File, the input record will replace the existing record. A message will be printed for every record inserted or replaced in the Peak Flow File. The cataloged procedure PKINPUT has been written for entering data into the Peak Flow File (see Section A.8).

```
Col. 1                          Col. 33                 Col. 55

.                               .                       .
//xxxxxxxx JOB(----)
/*PROCLIB  WRD.PROCLIB
//S1 EXEC PKINPUT
//SYSIN DD *
Z               PSWR            USGS
2       01014000                        197208  197609  DEL     P
2       08056500                                        ENT     P
3       0805650019470827  3350                  6.8
3       0805650019480511  1630                  4.68
Z               PSWR            NEWAG
2       01010000                        196008  196509  CID     P
Z               PSWR            USGS
6       01010000
2       08056500                                        ENT     P
3       0805650019710814  2400                  5.87
4       0805650019710527  2360                  5.82
/*
//
```

*Note: Add AGENCY=agency,PASSWRD=password to EXEC card if required.

Figure 13. Sample input for multiple operations

A.7. Output

The primary output from program J979 consists of peak flow records stored in the Peak Flow File that are the result of entering or updating data. An entry is automatically made into the Peak Flow Transaction File for every entry to and update of the Peak Flow File. This record is a duplicate of the Peak Flow File record with the exception that it is expanded to a fixed block length equal to the maximum length of a peak flow record that contains all thirty partial peaks as well as an annual peak. Three other types of output may also be produced:

- a peak flow record table displaying the contents of the new or updated record(s)
- a display of the data on each input card
- diagnostic messages

These output types are discussed below.

A.7.a. Peak Flow Record Table

A peak flow record table as shown in figure 12 may be requested by coding column 65 of the peak flow code card (2 card) with a P. Each record defined by the 2 card will be printed after processing. These records are placed in a separate print file specifically for this purpose. The file is printed in its entirety following printing of the print file that contains diagnostic messages and input data displays (discussed in the following sections).

A.7.b. Input Data Display

For every peak flow code card (type 2) in the input, the printout shows the data that were found on the card and on any other cards associated with the code card, such as peak flow data cards (types 3 and 4). A string of F's (FFFFF) on the printout indicates a fatal error. Execution of the program is terminated if this occurs. In certain cases a string of W's (WWWWWW) is printed beneath one or more data items, indicating a warning; execution will continue, however. In all cases, diagnostic messages (discussed below) are also produced explaining the errors or warnings. These diagnostics precede the display(s) discussed in this section.

A.7.c. Diagnostic Messages

Diagnostic messages are printed to show the status of the processing by program J979. The diagnostic messages are identified by PUxxx, where PU (Peak flow Update) is a unique abbreviation for program J979 and xxx is a three-digit sequence number. All diagnostic messages printed by program number J979 are sequentially listed below. The content of the card on which an error was detected will generally be printed following the error message(s) for that card.

PU001 STATION NOT ON HEADER FILE -- PROCESSING FOR THIS STATION TERMINATED

Check card for error and resubmit if there was an error on card. If no card error, make update or correction to Station Header File.

PU002 MANDATORY ENTRIES MISSING FROM STATION HEADER FILE

XXX ETC.XXX=1
XXX ETC.XXX=2
XXX ETC.XXX=3
XXX ETC.XXX=4
XXX ETC.XXX=5
XXX ETC.XXX=6

Station Header File record was found, and from 1 to 6 of the mandatory entries were missing. Check card for error and resubmit if there was an error on card. If no card error, make update or correction to Station Header File.

PU003 PASSWORD SECURITY VIOLATION -- DATA NOT PROCESSED

Check Z card for error and resubmit if password was incorrectly coded. If no card error, contact ADP Unit in Reston, Virginia.

PU004 AGENCY CODE MISSING -- DATA FOR THIS STATION NOT PROCESSED

Check Z card for error in the agency code and resubmit if the agency code was missing or coded incorrectly. If no card error, contact ADP Unit.

PU005 IMPROPER OR MISSING STATION IDENTIFIER

Check card for error and resubmit card with proper station ID.

PU006 FLAG REQUEST -- RETRIEVAL/ONLY PASSWORD NOT IN HDR FILE -- REQUEST IGNORED

A request was made to set the security retrieval flag "on" but the retrieval/only password was not in the Station Header File. Enter retrieval/only password into the Station Header File and resubmit.

PU007 STATION NOT PROCESSED -- INVALID RETURN FROM HEADER FILE

Call ADP Unit in Reston, Virginia, and inform them of this message and the return code number printed below the message.

PU008 AN EXISTING RECORD IN THE PEAK FLOW FILE HAS BEEN REPLACED

Occurs when adding records from the standard peak flow record format input file, in the CID operation or in the ENT operation. If a record is being added and it already exists in the Peak Flow File then the old record is over-written.

PU009 THE DATA THAT WAS IDENTIFIED DOES NOT EXIST -- IF OPERATION IS ENT, A NEW RECORD WILL TRY TO BE ADDED

Check the identifiers on the Z and 2 cards. The agency, station identifier, or water year may have been coded incorrectly. If a new record is to be added, printing of this message is normal.

PU010 THERE IS NOT ENOUGH SPACE IN THE PEAK FLOW FILE TO ADD NEW RECORDS

Please contact ADP Unit.

PU011 WRONG STATION NUMBER -- CARD IGNORED

Station ID submitted on 3 card did not match Station ID on 2 card. Make necessary changes and resubmit.

PU012 ONE OF THE IDENTIFICATION COMPONENTS ON THE CODE CARD CONTAINS ILLEGAL CHARACTERS -- PROCESSING FOR THIS STATION TERMINATED

Either the site identifier or the water year were coded incorrectly on the type 2 card. Correct data and resubmit.

PU013 INVALID OPERATION ON THE CODE CARD (TYPE 2) -- DATA NOT PROCESSED

The Operation field on the type 2 card has an entry other than CID, DEL, ENT, PRT, OR YER. Correct error and resubmit.

PU014 THE BEGIN YEAR IN THE RANGE IS GREATER THAN THE END -- DATA NOT PROCESSED

The water years specified on the type 2 card are coded incorrectly. Water year 1 must be less than or equal to water year 2 or a fatal error results. Correct years and resubmit.

PU015 BEGIN YEAR HAS INVALID ENTRY -- DATA NOT PROCESSED

The first water year specified on the type 2 card is less than 1750 or greater than the current year. Either results in a fatal error causing processing to be stopped. Correct data and resubmit.

PU016 END YEAR HAS INVALID ENTRY -- DATA NOT PROCESSED

The second water year specified on the type 2 card is less than 1750 or greater than the current year. Either case results in a fatal error causing processing for that site to be stopped. Correct data and resubmit.

PU019 THE CALENDAR YEAR ENTRY ON THE TYPE 4 CARD CONTAINS ILLEGAL CHARACTERS. CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The type 4 card contains an entry other than numeric digits in the calendar year field. Correct the illegal characters and resubmit.

PU020 THE CALENDAR YEAR ENTRY ON THE TYPE 4 CARD IS GREATER THAN THE CURRENT YEAR. CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The type 4 card contains a numeric field in the calendar year position that is greater than the current year, causing processing to stop for the station. Correct year and resubmit.

PU021 THE CALENDAR YEAR ENTRY ON THE TYPE 4 CARD IS LESS THAN 1750 CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The type 4 card contains a numeric field in the calendar year position that is less than 1750. Correct year and resubmit.

PU022 **WARNING** THE PARTIAL DURATION MONTH NUMBER IS MISSING FROM THE TYPE 4 CARD. CARD NO.____

The month number for the partial duration peak on the type 4 card was left blank. Processing will continue as it is not mandatory for a month value to be input.

PU023 THE PARTIAL DURATION MONTH NUMBER WAS CODED INCORRECTLY. CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The month number entered for the partial duration peak on the type 4 card contains non-numeric characters causing processing of data for the station to stop. Correct the data and resubmit.

PU024 **WARNING** THE PARTIAL DURATION DAY NUMBER IS MISSING FROM THE TYPE 4 CARD. CARD NO.____

The day for the partial duration peak on the type 4 card was left blank. Processing will continue as it is not mandatory for a day value to be input.

PU025 THE PARTIAL DURATION PEAK DAY NUMBER WAS CODED INCORRECTLY.
CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The day number specified for the partial duration peak on the type 4 card contains non-numeric values causing processing of data for the station to stop. Correct the data and resubmit.

PU026 THE PARTIAL DURATION PEAK DISCHARGE CONTAINS ILLEGAL CHARACTERS.
CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The partial duration peak discharge field on the type 4 card contains characters that are non-numeric causing processing for the station to stop. Correct data and resubmit.

PU027 **WARNING** THE PARTIAL DURATION PEAK DISCHARGE WAS NOT REPORTED.
CARD NO.____

The partial duration peak discharge field on the type 4 is blank. The value that now exists in the Peak Flow File will remain unchanged. If it is a new record, then a null value is input to the record. Processing continues.

PU028 THE PARTIAL DURATION PEAK STAGE CONTAINS ILLEGAL CHARACTERS.
CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The partial duration peak stage field on the type 4 card contains characters that are non-numeric causing processing for the station to stop. Correct data and resubmit.

PU029 **WARNING** THE PARTIAL DURATION PEAK STAGE WAS NOT REPORTED.
CARD NO.____

The partial duration peak stage field on the type 4 card is blank. The value that now exists in the Peak Flow File will remain unchanged. If it is a new record, then a null value is input to the record and processing continues.

PU030 **WARNING** A QUALIFICATION CODE WAS NOT REPORTED FOR PARTIAL DURATION PEAK DISCHARGE. CARD NO.____

The partial duration peak discharge code on the type 4 card is blank. The value that now exists in the Peak Flow File will not be changed. If it is a new record, then the code position in the record remains empty and processing continues.

PU031 **WARNING** A QUALIFICATION CODE WAS NOT REPORTED FOR PARTIAL DURATION PEAK STAGE. CARD NO.____

The partial duration peak stage qualification code on the type 4 card is blank. The value that now exists in the Peak Flow File will not be changed. If it is a new record, then the code position in the record remains empty and processing continues.

PU033 THE CALENDAR YEAR ENTRY ON THE TYPE 3 CARD CONTAINS AN ILLEGAL CHARACTER -- PROCESSING FOR THIS STATION TERMINATED

The type 3 card contains an entry other than numeric digits in the calendar year field. Correct the illegal characters and resubmit.

PU034 THE CALENDAR YEAR ENTRY ON THE TYPE 3 CARD IS GREATER THAN THE CURRENT YEAR -- PROCESSING FOR THIS STATION TERMINATED

The type 3 card contains a numeric field in the calendar year position that is greater than the current year causing processing to stop. Correct data and resubmit.

PU035 THE CALENDAR YEAR ENTRY ON THE TYPE 3 CARD IS LESS THAN 1750 -- PROCESSING FOR THIS STATION TERMINATED

The type 3 card contains a numeric field in the calendar year position that is less than 1750 causing processing to stop. Correct data and resubmit.

PU036 **WARNING** THE MONTH NUMBER IS MISSING FROM THE TYPE 3 CARD FOR ANNUAL PEAK DISCHARGE.

The month for the Annual Peak Discharge on the type 3 card was left blank. The month is not mandatory so processing continues.

PU037 THE ANNUAL PEAK DISCHARGE MONTH NUMBER WAS CODED INCORRECTLY -- PROCESSING FOR THIS STATION TERMINATED.

The month number entered for the Annual Peak Discharge on the type 3 card contains non-numeric characters causing processing to stop. Correct data and resubmit.

PU038 **WARNING** THE DAY NUMBER IS MISSING FROM THE TYPE 3 CARD FOR ANNUAL PEAK DISCHARGE.

The day for the Annual Peak Discharge on the type 3 card was left blank. The day is not a mandatory entry so processing continues.

PU039 THE ANNUAL PEAK DISCHARGE DAY NUMBER WAS CODED INCORRECTLY -- PROCESSING FOR THIS STATION TERMINATED

The day specified for the Annual Peak Discharge on the type 3 card contains non-numeric values causing processing to stop. Correct data and resubmit.

PU040 **WARNING** THE MONTH NUMBER IS MISSING FROM THE TYPE 3 CARD FOR ANNUAL PEAK STAGE

The month for the Annual Peak Stage on the type 3 card was left blank. This entry is not mandatory so processing continues.

PU041 THE ANNUAL PEAK STAGE MONTH NUMBER WAS CODED INCORRECTLY -- PROCESSING FOR THIS STATION TERMINATED

The month number entered for the Annual Peak Stage on the type 3 card contains non-numeric characters causing processing to stop. Correct data and resubmit.

PU042 **WARNING** THE DAY NUMBER IS MISSING FROM THE TYPE 3 CARD FOR ANNUAL PEAK STAGE

The day for the Annual Peak Stage on the type 3 card was left blank. This entry is not mandatory so processing continues.

PU043 THE ANNUAL PEAK STAGE DAY NUMBER WAS CODED INCORRECTLY -- PROCESSING FOR THIS STATION TERMINATED

The day specified for the Annual Peak Stage on the type 3 card contains characters that are non-numeric causing processing to stop. Correct data and resubmit.

PU044 THE ANNUAL PEAK DISCHARGE CONTAINS AN ILLEGAL CHARACTER -- PROCESSING FOR THIS STATION TERMINATED

The annual peak discharge field on the type 3 card contains characters that are non-numeric causing processing to stop. Correct data and resubmit.

PU045 **WARNING** THE ANNUAL PEAK DISCHARGE WAS NOT REPORTED

The Annual Peak Discharge value on the type 3 card is blank. The value that now exists in the Peak Flow File will remain unchanged. If adding a new record, a null value is put into the record and processing continues.

PU046 **WARNING** A QUALIFICATION CODE WAS NOT REPORTED FOR ANNUAL PEAK DISCHARGE

The Annual Peak Discharge code on the type 3 card is blank. The value that now exists in the Peak Flow File will not be changed. If the record is new, the code remains empty and processing continues.

PU047 THE PEAK STAGE CONTAINS AN ILLEGAL CHARACTER -- PROCESSING FOR THIS STATION TERMINATED

The Peak Stage field on the type 3 card contains characters that are non-numeric causing processing to stop. Correct the data entry card and resubmit.

PU048 **WARNING** THE PEAK STAGE WAS NOT REPORTED

The Peak Stage value on the type 3 card is blank. The value that now exists in the Peak Flow File will remain unchanged. If the record is new, a null value is used to fill the position in the record and processing continues.

PU049 **WARNING** A QUALIFICATION CODE WAS NOT REPORTED FOR PEAK STAGE

The Peak Stage code on the type 3 card is blank. The value that now exists in the Peak Flow File will not be changed. If the record is new, the code remains empty and processing continues.

PU050 THE ANNUAL PEAK STAGE CONTAINS AN ILLEGAL CHARACTER -- PROCESSING FOR THIS STATION TERMINATED

The Annual Peak Stage field on the type 3 card contains characters that are non-numeric causing processing to stop. Correct the data entry and resubmit.

PU051 **WARNING** THE ANNUAL PEAK STAGE WAS NOT REPORTED

The Annual Peak Stage value on the type 3 card is blank. The value that now exists in the Peak Flow File will remain unchanged. If the record is new, a null value is used to fill the position in the record and processing continues.

PU052 **WARNING** A QUALIFICATION CODE WAS NOT REPORTED FOR ANNUAL PEAK STAGE

The Annual Peak Stage code on the type 3 is blank. The value that now exists in the Peak Flow File will not be changed. If the record is new, the code remains empty and processing continues.

PU053 THE "YEAR SINCE" ENTRY ON THE TYPE 3 CARD CONTAINS AN ILLEGAL CHARACTER -- PROCESSING FOR THIS STATION TERMINATED

The type 3 card contains an entry other than numeric digits in the "year since" field causing processing to stop. Correct the data and resubmit.

PU054 THE "YEAR SINCE" ENTRY ON THE TYPE 3 CARD IS GREATER THAN THE CURRENT YEAR -- PROCESSING FOR THIS STATION TERMINATED

The type 3 card contains a numeric field in the "year since" position that is greater than the current year causing processing to stop. Correct the data field and resubmit.

PU055 THE "YEAR SINCE" ENTRY ON THE TYPE 3 CARD IS LESS THAN 1750 -- PROCESSING FOR THIS STATION TERMINATED

The type 3 card contains a numeric field in the "year since" position that is less than 1750 causing processing to stop. Correct the data field and resubmit.

PU056 PARTIAL DURATION PEAK STAGE IS GREATER THAN ANNUAL PEAK STAGE. CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The Annual Peak Stage field on the type 3 card is less than the Partial Duration Peak Stage field on the type 4 card causing processing to stop. Adjust the data fields and resubmit.

PU057 PARTIAL DURATION PEAK DISCHARGE IS GREATER THAN ANN. PEAK DISC. CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The Annual Peak Discharge field on the type 3 card is less than the Partial Duration Peak Discharge on the type 4 card causing processing to stop. Adjust the data fields and resubmit.

PU058 THE ANN. DISCHARGE QUALIFICATION CODE HAS A 4 CODE AND EITHER A 1, 2, 3, 7, or 8 CODE -- PROCESSING FOR THIS STATION TERMINATED

The Annual Discharge qualification code on the type 3 card contains a code of 4 and one of the following: 1, 2, 3, 7, or 8. A 4 code cannot appear with these codes, causing processing of data to stop. Check the code, adjust the data and resubmit.

PU059 THE ANN. DISCH. QUALIFICATION CODE HAS BOTH A 5 AND A 6 POSITION FILLED -- PROCESSING FOR THIS STATION TERMINATED

The Annual Discharge Code on the type 3 card contains a code of both 5 and 6. A 5 and 6 cannot appear together causing processing of data to stop. Check the code, adjust the data and resubmit.

PU060 THE PARTIAL DISCHARGE QUAL. CODE HAS A 4 CODE AND EITHER 1, 2, 3, 7, or 8 CODE. CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The Partial Duration Peak Discharge Code on the type 4 card contains a code of 4 and at least one of the following: 1, 2, 3, 7, or 8. A 4 code cannot appear with these codes causing processing of data to stop. Check the code, adjust the data and resubmit.

PU061 THE PARTIAL DISCHARGE QUAL. CODE HAS BOTH A 5 AND A 6 POSITION FILLED. CARD NO.____ -- PROCESSING FOR THIS STATION TERMINATED

The Partial Duration Peak Discharge Code on the type 4 card contains a code of both 5 and 6. A 5 and 6 cannot appear together, causing processing of data to stop. Check the code, adjust the data and resubmit.

PU062 **WARNING** PEAK STAGE CODE=3

The type 3 card contains a Peak Stage field and also a Peak Stage Qualification code equal to 3. Processing will continue.

PU063 **WARNING** MULTIPLE PEAK STAGE CODES

The type 3 card contains a Peak Stage Qualification code with multiple entries. Processing will continue.

PU064 **WARNING** THE PEAK STAGE IS A NEGATIVE NUMBER

The type 3 card contains a negative Peak Stage field. Processing will continue. Check the data, make corrections and resubmit.

PU065 PEAK STAGE CODE OF 2 AND NO INPUT OF ANNUAL STAGE DATA OR ANNUAL STAGE DATE -- PROCESSING FOR THIS STATION TERMINATED

The type 3 card contains a Peak Stage Qualification code equal to 2 and the Type 3 card does not contain any Annual Peak Stage data or date. This causes the processing to stop. Check the Gage Code to make sure it is supposed to be 2. If so, Annual Data must be input also.

PU066 **WARNING** ANNUAL DISCHARGE QUALIFIER CODE OF 4 PLUS A PEAK STAGE WAS INPUT

The type 3 card contains an annual discharge qualification code of 4 plus a peak stage value. Processing continues.

PU067 **WARNING** ANNUAL DISCHARGE QUAL. CODE IS EQUAL TO 2 OR 8 AND A PEAK STAGE WAS ALSO INPUT

The type 3 card contains a Peak Stage and also an Annual Discharge Qualification code of 2 or 8. Processing continues.

PU068 INCOMING ANNUAL DISCHARGE CODE OF 6 IS TO BE COMBINED WITH AN EXISTING ANNUAL DISCHARGE CODE OF 5 -- PROCESSING FOR THIS STATION TERMINATED

The Annual Discharge code currently contains a 5 code. The incoming discharge code contains a 6 and no delete for the existing 5 code. A 5 and 6 cannot exist together so processing is stopped.

PU069 INCOMING ANNUAL DISCHARGE CODE 5 IS TO BE COMBINED WITH AN EXISTING ANNUAL DISCHARGE CODE OF 6 -- PROCESSING FOR THIS STATION TERMINATED

The Annual Discharge code currently contains a 6 code. The incoming discharge code contains a 5 code and no delete for the existing code. A 5 and 6 cannot exist together, so processing is stopped.

PU070 INCOMING ANNUAL DISC. CODE OF 1, 2, 3, 7, or 8 IS TO BE COMBINED WITH AN EXISTING DISC. CODE OF 4 -- PROCESSING FOR THIS STATION TERMINATED

The Annual Discharge code currently contains a 4 code. The incoming discharge code contains one of the following codes: 1, 2, 3, 7, or 8 and no delete for the 4 code. A 4 cannot exist with any of the codes so processing stops.

PU071 INCOMING ANNUAL DISC. CODE OF 4 IS TO BE COMBINED WITH AN EXISTING DISC. CODE OF 1, 2, 3, 7, or 8 -- PROCESSING TERMINATED

The Annual Discharge code currently contains one of the following codes 1, 2, 3, 7, or 8. The incoming discharge code contains a 4 code and no delete for the already existing codes. A 4 code cannot exist with any of the codes so processing stops.

PU072 **WARNING** INCOMING DATA COMBINED WITH EXISTING DATA WILL YIELD MULTIPLE CODES FOR THE PEAK STAGE CODE

The existing Peak Stage code has a position filled. The incoming Peak Stage Qualification code has more positions to be filled resulting in multiple codes. Processing continues.

PU073 THE PARTIAL DURATION PEAK STAGE DATA IS GREATER THAN THE EXISTING ANNUAL PEAK STAGE. CARD NO.____ -- PROCESSING TERMINATED

The Partial Duration Peak Stage data input on the type 4 card is greater than the existing Annual Peak Stage value, causing processing to stop. Adjust incoming data and resubmit or update the Annual Peak Stage.

PU074 PARTIAL DURATION PEAK STAGE DATA CANNOT BE ADDED BECAUSE THERE IS NO ANN. PEAK STAGE TO COMPARE IT TO. CARD NO.____ -- PROCESSING OF THIS STATION TERMINATED

There is no Annual Peak Stage that now exists in the Peak Flow File. Until one is added to the record, no partial peak stages may be added.

PU075 THE EXISTING ANN. DISCHARGE DATA IS LESS THAT THE PARTIAL DURATION DISC. BEING INPUT. CARD NO.____ -- PROCESSING TERMINATED

The Partial Duration Peak Discharge on the type 4 card is greater than the already existing Annual Peak Discharge value. Processing is stopped; either the Annual Peak should be updated to reflect the larger Partial Duration Peak Discharge or the Partial Duration Peak Discharge is in error.

PU076 INCOMING PARTIAL DISC. CODE OF 6 IS TO BE COMBINED WITH AN EXISTING PARTIAL DISC. CODE OF 5. CARD NO.____ -- PROCESSING TERMINATED

The Partial Duration Peak Discharge Code currently contains a 5 code. The incoming Partial Duration Peak Discharge Code contains a 6 and no delete for the existing 5 code. A 5 and 6 cannot exist together so processing stops.

PU077 INCOMING PARTIAL DISC. CODE OF 5 IS TO BE COMBINED WITH AN EXISTING PARTIAL DISC. CODE OF 6. CARD NO.____ -- PROCESSING TERMINATED

The Partial Duration Peak Discharge code currently contains a 6 code. The incoming Partial Duration Peak Discharge code contains a 5 code and no delete for the existing 6 code. A 5 and 6 cannot exist together so processing stops.

PU078 INCOMING PARTIAL DISC. CODE 1, 2, 3, 7, or 8 IS TO BE COMBINED WITH AN EXISTING PARTIAL DISC. CODE OF 4. CARD NO.____ -- PROCESSING TERMINATED

The Partial Duration Peak Discharge code currently contains a 4 code. The incoming Partial Duration Peak Discharge Code contains one of the following codes: 1, 2, 3, 7, or 8 and no delete for the 4 code. A 4 code cannot exist with these so processing stops.

PU079 INCOMING PARTIAL DISC. CODE OF 4 IS TO BE COMBINED WITH AN EXISTING PARTIAL DISC. CODE OF 1, 2, 3, 7, or 8. CARD NO.____ -- PROCESSING TERMINATED

The Partial Duration Peak Discharge code currently contains one of the following codes: 1, 2, 3, 7, or 8. The incoming Partial Duration Peak Discharge code contains a 4 code and no delete for the already existing codes. A 4 code cannot exist with these codes so processing stops.

PU080 A NEW PARTIAL RECORD IS TO BE ADDED AND THERE IS NO PARTIAL PEAK DISC. OR STAGE DATA ON THE TYPE 4 CARD. CARD NO.____ -- PROCESSING TERMINATED

A partial peak is to be added to the file and there is no partial peak data to add. A probable cause is an incorrect date on the Type 4 card with an attempt to update an already existing record.

PU081 **WARNING** AN ANNUAL DISC. CODE OF 4 ALREADY EXISTS AND A PEAK STAGE VALUE IS TO BE ADDED

The existing record contains an annual discharge code of 4 and the incoming card contains a Peak Stage value and no delete for the annual discharge code of 4. Processing continues.

PU082 **WARNING** A PEAK STAGE ALREADY EXISTS IN THE PEAK FLOW RECORD AND AN ANNUAL DISC. CODE OF 4 IS TO BE ADDED

The existing record contains a Peak Stage value and the incoming type 4 card contains an annual discharge code of 4. Processing continues.

PU083 **WARNING** AN ANN. DISCHARGE CODE OF 2 OR B ALREADY EXISTS AND A A PEAK STAGE VALUE IS TO BE ADDED

The existing record contains an annual discharge code of 2 or B and the incoming type 4 card contains a Peak Stage value and no delete for the annual discharge code of 2 or B.

PU084 **WARNING** A PEAK STAGE VALUE ALREADY EXISTS IN THE PEAK FLOW RECORD AND AN ANN. DISC. CODE OF 2 OR B TO BE ADDED

The existing record contains a Peak Stage value and the incoming type 4 card contains an annual discharge code of 2 or B and no value to set the Peak Stage to a "null" value. Processing continues.

PU085 ONE OF THE IDENTIFICATION COMPONENTS ON THE 6 CARD CONTAINS AN ILLEGAL CHARACTER -- PROCESSING TERMINATED

Either the site or the water year has non-numeric characters in their respective position on the 6 card for the CID operation. Processing for that station is terminated. Correct and resubmit.

PU089 A NEW RECORD IS TO BE ADDED BUT THERE IS NO DATA ON THE TYPE 3 CARD

Check the agency code, site ID, and year as a new record is to be added but input data are missing. More than likely, an update is to be made and the data have been mispunched. If attempts are being made to add, there must be one of the following input: discharge, gage height, or peak stage.

PU090 THE FOLLOWING STATION WAS ADDED TO THE PEAK FLOW FILE FROM A TAPE OR A DISK agency station year

This message occurs for each record added to the Peak Flow File from the tape or disk at the beginning of the program.

PU091 THE PARTIAL DURATION PEAK DISCHARGE CONTAINS A VALUE LESS THAN THE HEADER BASE VALUE. CARD NO. m -- PROCESS TERMINATED.

Verify Partial Peak Discharge value. If in error, correct and resubmit. If not in error, change base value in Station Header File.

PU092 **WARNING** ANNUAL PEAK GAGE HEIGHT HAS BEEN GIVEN QUALIFICATION CODE OF 2 AND/OR 4, INCONSISTENT WITH DEFINITION OF ANNUAL PEAK GAGE HEIGHT. CHECK DATA AND CODES. PROCESSING CONTINUES.

PU093 RECORD NOT WRITTEN IN THE PEAK FLOW TRANSACTION FILE. TRANSACTION FILE IS FULL TO CAPACITY. ALL INPUT/UPDATE OF PEAK FLOW DATA BASE IS TERMINATED. (NOTIFY ADP UNIT).

PU094 RECORD NOT WRITTEN IN THE PEAK FLOW TRANSACTION FILE. UNCORRECTABLE TRANSMISSION ERROR IN TRANSACTION DATA SET. (NOTIFY ADP UNIT)

PU095 RECORD NOT WRITTEN IN THE PEAK FLOW TRANSACTION FILE. KEY SPECIFIED CAN NOT BE FOUND. (NOTIFY ADP UNIT).

PU096 RECORD NOT WRITTEN IN THE PEAK FLOW TRANSACTION FILE. ATTEMPT WAS MADE TO WRITE INTO A REGION ALREADY CONTAINING A RECORD. (NOTIFY ADP UNIT).

PU097 RECORD NOT WRITTEN IN THE PEAK FLOW TRANSACTION FILE. VALUE SPECIFIED IN KEY FROM OPTION DURING SEQUENTIAL CREATION OF REGIONAL DATA SET IS LESS THAN VALUE OF PREVIOUSLY SPECIFIED REGION NUMBER. (NOTIFY ADP UNIT).

PU098 RECORD NOT WRITTEN TO PEAK FLOW TRANSACTION FILE. KEY CONVERSION ERROR HAS OCCURRED. (NOTIFY ADP UNIT).

PU099 RECORD NOT WRITTEN TO THE PEAK FLOW TRANSACTION FILE. KEY SPECIFIED IS INVALID. (NOTIFY ADP UNIT).

PU100 RECORD NOT WRITTEN TO THE PEAK FLOW TRANSACTION FILE. NO SPACE AVAILABLE IN TRANSACTION DATA FILE TO ADD RECORD. (NOTIFY ADP UNIT).

A.8. Cataloged JCL Procedure

A cataloged procedure for entering and updating data in the Peak Flow File (program J979) has been stored in the WATSTORE procedure library. The procedure name is PKINPUT and the procedure may be executed by using the following cards:

```
Column 1   Column 12

.          .
//xxxxxxxx JOB  (-----)
/*PROCLIB  WRD.PROCLIB
//  EXEC  PKINPUT,AGENCY=agency,PASSWRD=password
//PKIN.SYSIN  DD  *
      .
      .
Data cards for program J979
      .
      .
/*
//
```

where "agency" is the agency code indicating the agency responsible for the data and "password" is the password required to access data that have been password protected for updating. If the data have not been password protected, a password is not required.

If the execution time coded in the procedure (2 minutes) is not sufficient, the time may be changed by coding TIME1=time on the execute card as shown below:

```
//  EXEC  PKINPUT,TIME1=time
```

The value "time" is in minutes. The parameters AGENCY, PASSWRD, and TIME1 can appear in any order.

If a file of peak flow records in the standard format is to be processed prior to processing of the SYSIN cards (see sec. A.6), NAME1='data-set-name' should be coded as a parameter on the EXECute card. It is assumed that the data set 'data-set-name' is a cataloged data set. If the data set resides on magnetic tape, the parameters UNIT1=unit and VOL1=volume must also be coded on the EXECute card. The parameters FILE1 and LB1 are available for use in case the file is not the first data set on the tape or if the tape labels are not standard.

A complete list of parameters that may be used with procedure PKINPUT, and their default values, follows:

Parameter	Description
AGENCY	The agency which is responsible for the data. Code AGENCY=agency.
PASSWRD	The Update/Retrieval Password required for password protected data. Code PASSWRD=password.
REG	The region size for execution of program J979. The default is REG=360K.
TIME1	The time to be allowed for execution of program J979. The default is TIME1=3 minutes.
NAME1	The data set containing the peak flow records in standard format to be processed prior to the SYSIN cards. Code NAME1=data-set-name. The default is NAME1=NULLFILE
UNIT1	Device type for data set of standard peak flow records. The default is null.
VOL1	Volume serial number of the magnetic tape which contains the data set of standard peak flow records, or of the direct access volume if the data set is on such a volume but is not catalogued. Code VOL1=xxxxxx. The default is null.
FILE1	The sequence number which specifies the relative position on a magnetic tape of the input data set of standard format peak flow records. The default is FILE1=1.
LB1	The label type subparameter which tells the system what type of label is associated with the magnetic tape data set in the standard peak flow record. The default is LB1=SL.

CHAPTER I. INSTRUCTIONS FOR PEAK FLOW FILE

Section B. Peak Flow File Retrieval (Program J980)

Prepared by:

Wayne D. Lepkin and Mary M. DeLapp
CACI, Inc.

August 1979

CONTENTS

ILLUSTRATIONS

B.1 Introduction

Peak Flow File Retrieval (program J980) permits the retrieval of data from the WATSTORE Peak Flow File. The data may be retrieved in any of five formats:

- in a computer printout
- on punched cards
- in the standard peak flow record format (station header record followed by peak flow data records) on a magnetic device
- in a vector format, for use as input to application programs
- in a publication table format, for use as input to the tabling program (A534)

The Peak Flow File is always used in conjunction with the Station Header File, which contains fixed identification items for all sites represented in the WATSTORE data files. Data will not be retrieved from the Peak Flow File unless the Station Header File contains header entries for the stations to be processed. This restriction ensures that all data are associated with a properly identified station. For information on entering and updating data in the Station Header File, refer to Volume 1, Chapter III, Section A, entitled "Entering and Updating Data Stored in the Station Header File."

For each item to be retrieved from the Peak Flow File the agency code, station identification number, and date must be provided. The retrieval specifications, entered by means of data control cards, are processed first by the preprocessor program G745. That program creates a subfile of required station header records. After execution of the preprocessor, program J980 is invoked. Program J980 retrieves peak flow records from the Peak Flow File if the records satisfy the specifications on the retrieval cards and have a corresponding station header record in the subfile created by program G745. Only records for stations represented in the Station Header File, and thus in the subfile passed to program J980, can be retrieved. In addition, editing can be performed on the retrieved records; the editing affects only the output records, not the records stored in the Peak Flow File.

In order to simplify the retrieval of data from the Peak Flow File, the job control language (JCL) for program J980, including the associated program G745, has been cataloged in a procedure called PEAKRET. Symbolic parameters are available within the cataloged procedure for specifying an agency code, a password, and other values.

Program J980 was written in PL/I for the IBM 360 and 370 computer series. It was written for the USGS by Gary E. Jones and Mary M. DeLapp, of CACI, Inc.-Federal, of Herndon, Virginia.

B.2 Peak Flow File Organization

The Peak Flow File is a general purpose file which contains a collection of peak discharge and associated gage-height data for stream sites throughout the nation. The file is online, so that the data it contains are immediately available. The Peak Flow File is organized by streamflow measurement site or station, agency code, and water year. The file contains one or more records for each station, one record per water year. A water year is defined as a twelve-month period beginning October 1 and ending September 30 and bears the number of the year in which it ends.

A single record contains the peak discharge (also called peak flow), and associated gage height (also called stage), for a water year. If a gage height recorded at any time during the water year is greater than the gage height associated with the peak discharge, the maximum such gage height is also stored in the record. In addition, a record may contain up to 30 partial duration peaks (that is, peaks above a base discharge but less than the maximum peak for the year) and their associated gage heights. The dates of all peak values are kept in the file.

Records are stored in ascending order by record access key (see v. 1, chap. II, sec. E). The record access key consists of three identifiers in the order listed below:

• Agency Code	See appendix A for a list of agency codes.
• Station Identification Number	See volume 1, chapter II, section B, for a discussion of station identification numbers.
• Water Year	The 12-month period, October 1 through September 30, designated by the calendar year in which the 12-month period ends.

B.3. Retrieval Specifications

Retrieval specifications define the peak flow data that are to be retrieved by program J980. There are two basic types of specifications:

- those used by the preprocessor program to select the stations whose records are to be examined by the retrieval program; and
- those used by the retrieval program to extract or modify data from within the records selected by the preprocessor.

The first type of specification above is mandatory; the preprocessor must be informed which stations are to be eligible for retrieval. A station must be represented in the header file in order to be retrieved. The second type of specification is optional; if none is given, the default specifications apply (all peak discharges for the eligible stations are retrieved). In addition, there is a third type of specification that is used by any application program which might be executed following the retrieval. Although such specifications are recognized by the preprocessor and retrieval programs, they are not used by those programs, but are simply passed unchanged to the application program.

There are five basic types of input cards which contain the specifications:

- master control card
- application program control card
- peak flow data retrieval cards
- password/agency identification card
- station or site selection cards

A group of these cards makes up a single retrieval.

The first and last of these are mandatory; the master control card delineates the retrieval, while the station selection cards are used by the preprocessor to determine the stations that are to be eligible for retrieval. The remaining types of cards are optional. Cards included for a given retrieval must appear in the above order.

B.3.a. Required Specifications

Two specifications are required for each retrieval, an agency code and a station selection method.

B.3.a.(1). Agency Code

The agency code for each retrieval is furnished either by a symbolic parameter within the cataloged procedure (see sec. B.5) or by password/agency identification cards (see sec. B.3.c.(5)). An agency specified on a password/agency identification card for a given station will supersede the agency specified by a symbolic parameter for that station only. If data for all agencies are required, use the code "ALLAG" either in the symbolic parameter or in the proper field on the password/agency identification card.

B.3.a.(2). Station Selection Method

Stations to be eligible for retrieval may be specified in three ways:

- by listing individual station identification numbers (I cards)
- by a range of station identification numbers described by a beginning and an ending station number (S cards)
- by geographic area using vertices of latitude and longitude which describe a polygon (V cards)

Data for any number of individual stations may be requested. The second and third methods above may be mixed in a retrieval, but the first method cannot be mixed with either of the other two. Note that a retrieval using more than one station selection method (a range and a polygon) may result in the same stations being selected twice, thereby causing duplication in the data retrieval; however, duplicate stations in a given retrieval are ignored if a sort on station ID is performed after program G745 such that duplicate records are adjacent to each other. However, the same station may be processed again by some other retrieval. All polygon specifications in a given retrieval must contain the same number of vertices. The type of station selection desired is indicated by coding the station selection cards. Card formats and a detailed discussion of station selection appear in sections on the following pages.

B.3.b. Data Security

A security retrieval flag is stored in each record of the Peak Flow File to protect against unauthorized retrieval. The flag is examined only if retrieval is requested for a record of the current water year; retrieval for previous water years is unrestricted. In the case of a current water year, the flag is tested to see if password checking is required. If required, the user-supplied password will be checked against the two passwords stored in the Station Header File. If it matches either password, the data are retrieved; if not, a diagnostic message is printed indicating the sites for which data could not be retrieved. A password is specified by means of the symbolic parameter PASSWRD within the cataloged procedure, or by means of the password/agency identification card (Z card). Refer to volume 1, chapter II, section C for a detailed discussion of data security.

B.3.c. Retrieval Control Cards

Several types of control cards are available for retrieval specifications. The formats and coding instructions for those listed immediately below are described fully in volume 1, chapter III, section B.2, so they are not discussed here. Proper order of the cards is discussed in a later section.

- Station header criteria
  --locator control card -- L card
  --additional identifier control card -- A card
  --retrieval control card -- K card
  --extended retrieval control card -- E card
  --station name control card -- N card

- Site selection cards
  --station range card -- S card
  --polygon retrieval card -- V card

The other 10 types of control cards, listed below, are described fully in the following sections.

- master control card -- M card

- application control card -- X card

- General data retrieval specifications
  --qualification codes card -- Q card
  --parameter code list card -- R card
  --station identification card -- I card
  --control values card -- C card

- Site dependent data retrieval specifications
  --peak flow code card -- 2 card
  --peak flow data card -- 3 card
  --partial peak flow data card -- 4 card
  --(types I and C can also contain site dependent retrieval specifications)

- password/agency identification card -- Z card

The station identification card (I card) also acts as a site selection card if no types S or V cards are used. In this case, an I card must be supplied for every station to be retrieved. This is discussed more fully in the later section on card organization (B.3.d.(1)).

B.3.c.(1). Master Control Card (M Card)

The master control card (fig. 1) is required for each retrieval and must be the first card of each retrieval set. In addition to its use as a separator, it is also used to specify the number of vertices of a polygon retrieval, a range of water years to which the retrieval is to be limited, and the desired output format(s). The format for the master control card is described below:

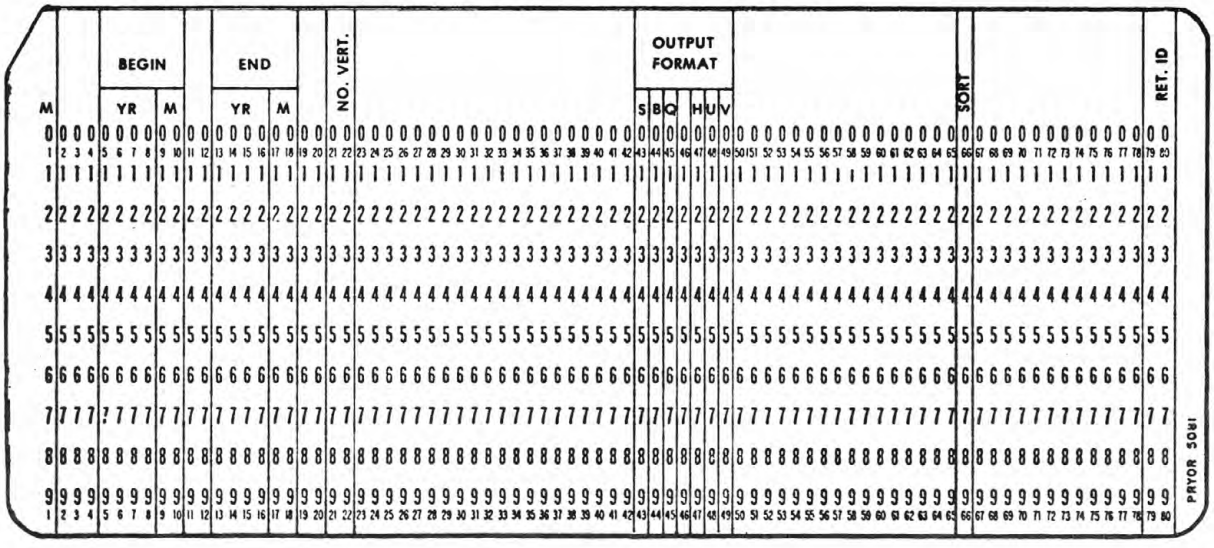


Figure 1. Master control card (M card)

Col. 1	Enter an M.
Col. 2-4	Blank.
Col. 5-8	Beginning calendar year. This field is coded with a four-digit number which represents the first calendar year of period requested (e.g., '1971'). If this field is left blank, columns 9-10 should be left blank and the earliest year of record in the Peak Flow File will be made available for retrieval. If this field is coded and columns 9-10 are blank, this is assumed to be a water year.
Col. 9-10	Beginning month. This field is coded with a two-digit number which represents the first month of the period requested (e.g., code '01' for January, '12' for December).
Col. 11-12	Blank.
Col. 13-16	Ending calendar year. This field is coded with a four-digit number which represents the last calendar year of period requested. If this field is left blank, then columns 17-18 should be left blank and the latest year of record will be made available for retrieval. If the beginning year (cols. 5-8) also is left blank, then the entire period of record in the Peak Flow File will be made available for retrieval. If this field is coded and columns 17-18 are blank, water year is assumed.
Col. 17-18	Ending month. Code this field with a two-digit number which represents the last month of the period requested.
Col. 19-20	Blank.
Col. 21-22	Number of vertices (minimum of 3) to be considered if a polygon is included in the retrieval (refer to v. 1, chap. III, sec. B.2.j.(3), otherwise blank.

Col. 23-42 Blank.

Col. 43-49 Output formats, coded as follows:

Col. 43 Standard record format. Code an S in this field if output in this format is desired (see sec. B.4.b). This format is the default if no output format is specified in columns 43-49, unless an X card specifying application program J407 is detected. For program J407 the default is vector format.

Col. 44 Printout format. For vector format (col. 49), code a B if the brief printout format is desired, or an L if the long printout format is desired (see sec. B.4.g). L is the default. Code an N to suppress all tabular data printout during retrieval.

Col. 45 Publication table format. Code a Q (to obtain annual peaks) or a P (to obtain all peaks above the base) in this field if output is desired in a format suitable for use with the publication tabling program. The choice of Q or P determines which set of edit instructions will be used for the X cards (see sec. B.3.c.(2).(b).).

Col. 46 Blank.

Col. 47 Update format header records. Code an H to specify that cards containing station header information be included with cards containing peak flow data in the input/update format, otherwise leave blank. This field is disregarded unless a U is coded in the next field.

Col. 48 Input/update format. Code a U in this field to specify that cards containing peak flow data be punched (see sec. B.4.c), otherwise leave blank. These cards are punched in a format suitable for use as input to the Peak Flow Input and Update Program, J979.

Col. 49 — Vector format. Code a V in this field to specify output in vector format, otherwise leave blank. If an X card specifying application program J407 is detected, then this format output is produced by default, otherwise the standard record format is the default. See section B.4.a for a description of vector format output.

Col. 50-65 — Blank.

Col. 66 — Code X in this field to cause a sort on station ID of the records for a given retrieval.

Col. 67-78 — Blank.

Col. 79-80 — User defined retrieval identifier. Code any alphanumeric characters. This is an optional field.

B.3.c.(2). Application Control Card (X Card)

The application control card (fig. 2) identifies the application program that will process the retrieved data and contains information used by that application program. If an application control card(s) is required, it must immediately follow the master control card. An application control card indicates that another procedure will be executed following the retrieval. Up to 30 X cards are permitted. The format for the application control card is:

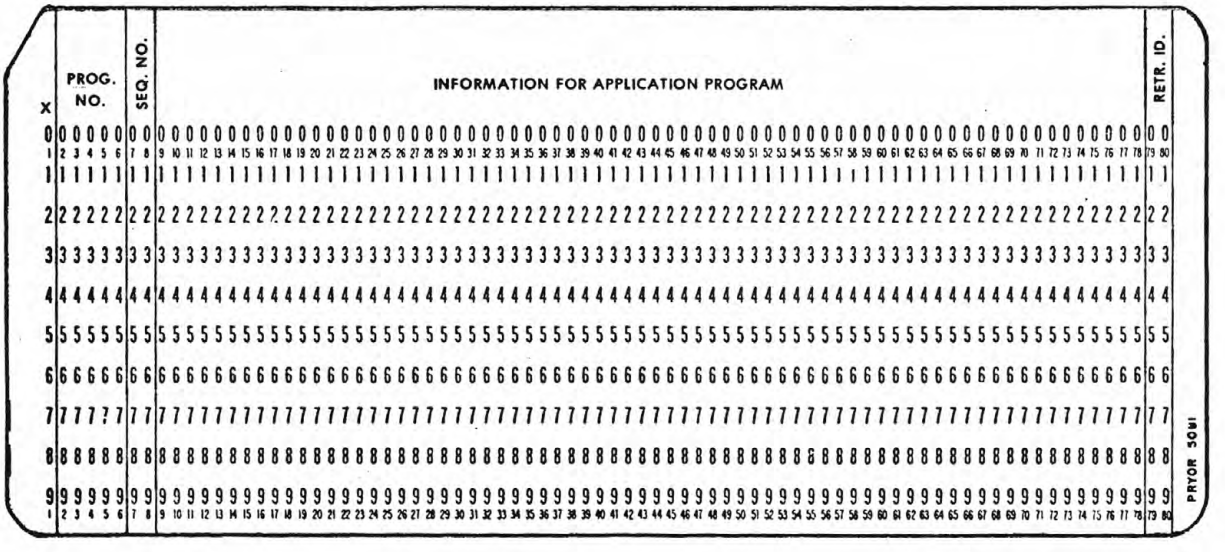


Figure 2. Application control card (X card)

Col. 1	Enter an X.
Col. 2-6	Program number of the application program, left justified.
Col. 7-8	Optional sequence number to be processed by the application program.
Col. 9-78	Other information for the application program.
Col. 79-80	Retrieval identifier matching the one in columns 79-80 of the preceding master control card.

The coding of the X card is explained in more detail in the instructions for each application program.

B.3.c.(3). General Data Retrieval Specifications

The general data retrieval control cards are used to specify further retrieval criteria to be applied to all stations within the retrieval (i.e., associated with a single master control card). There are four card types:

- qualification codes card -- Q card
- parameter code list card -- R card
- station identification card -- I card
- control values card -- C card

These cards must appear following the master control card for the retrieval, and must follow the application control cards if any are present. They may be followed by site dependent data retrieval cards, to be discussed in the next section. All four card types are optional.

While card types Q and R always apply to all stations in the retrieval, types I and C may also be used to specify retrieval criteria for individual stations. The varying uses of these two card types will be discussed in the sections describing each card.

B.3.c.(3).(a). Qualification Codes Card (Q card) (Boolean Expressions)

The qualification codes card specifies checking of qualification codes to be performed during retrieval. Both peak discharge and gage height qualification codes can be checked (see sec. B.6).

Because there can be up to 16 codes associated with a discharge value and up to 8 codes for a gage height value, some method is needed to express the combination of codes that the user wishes to be present or absent from a record in order for that record to be retrieved. Boolean logic is used for this purpose. Expressions consisting of qualification codes combined by the Boolean operators signify the user's desires.

A Boolean expression is made up of operands and operators. Here, the operands are qualification codes. Any operand has one of two values, either "true" or "false". Here, a value of "true" corresponds to the presence of the condition code in a record, while a value of "false" corresponds to the absence of the code from the record. There are three Boolean operators: the NOT, signified by a "¬"; the AND, signified by a "∧"; and the OR, signified by a "∨". These are discussed in turn below. An expression can always be reduced to a value of "true" or "false", according to the values of the operands and how they are combined by the operators. If an expression consists solely of a single operand, then the value of the expression depends entirely upon the value of the operand. If the operand is true, the expression is true; if the operand is false, the expression is false.

i. The NOT ("¬")

The NOT operator "inverts" the value of an operand. If "x" is true, then "¬x" is false; if "x" is false, then "¬x" is true. The NOT operator can also be applied to an entire expression. If "expression" is true, then "¬ expression" is false, etc. This relationship can be graphically expressed in a "truth table", as follows:

Let "x" be a Boolean expression (which may consist solely of a single operand). Then for the given value of "x" in the left column of the truth table, the value of "¬x" is opposite it in the right column.

x	¬x
false	true
true	false

ii. The AND ("∧")

The AND operator combines two operands (or expressions), as follows: if both operands are true, then the result is true, otherwise the result is false. The truth table for this operation is:

x	y	x ∧ y
false	false	false
false	true	false
true	false	false
true	true	true

Note that with two operands there are four possible combinations of values, hence four lines in the truth table.

iii. The OR ("∨")

The OR operator combines two operands (or expressions), as follows: if either operand is true, or both are true, then the result is true, otherwise the result is false. The truth table for this operation is:

x	y	x ∨ y
false	false	false
false	true	true
true	false	true
true	true	true

An expression can consist of combinations of operands and operators. For example, the truth table for the expression "x∧¬y" would be:

x	y	¬y	x∧¬y
false	false	true	false
false	true	false	false
true	false	true	true
true	true	false	false

This table shows the two operations that are performed to determine the value of the expression "$x \wedge \neg y$" for each of the four possible value combinations of x and y. The left-hand column contains the four combinations. The first operation performed is to "NOT" y; across from each value of y is the value of $\neg y$, in the middle column. The second operation is to "AND" x and $\neg y$. The results of that operation are in the right-hand column.

For another example, let us evaluate the expression "$(x \vee y) \wedge \neg (a \vee b)$". Note that parentheses, which are evaluated first, can be used to make the meaning of the expression unambiguous. To save space, let F stand for false and T for true.

x	y	a	b	$x \vee y$	$a \vee b$	$\neg(a \vee b)$	$(x \vee y) \wedge \neg(a \vee b)$
F	F	F	F	F	F	T	F
F	F	F	T	F	T	F	F
F	F	T	F	F	T	F	F
F	F	T	T	F	T	F	F
F	T	F	F	T	F	T	T
F	T	F	T	T	T	F	F
F	T	T	F	T	T	F	F
F	T	T	T	T	T	F	F
T	F	F	F	T	F	T	T
T	F	F	T	T	T	F	F
T	F	T	F	T	T	F	F
T	F	T	T	T	T	F	F
T	T	F	F	T	F	T	T
T	T	F	T	T	T	F	F
T	T	T	F	T	T	F	F
T	T	T	T	T	T	F	F

Of the 16 possible combinations of values for the four operands x, y, a, and b, the value of the expression is "true" for only three of them. We can better understand intuitively why this is so by looking at what the expression says in words. The value of the expression is true whenever x or y is true and "NOT" a or b is true. Let us examine the first of the three true cases to see that this is so.

In the first case, the fifth line of the last truth table, "$x \vee y$" is true because y is true. "$a \vee b$" is false since both a and b are false, so "$\neg(a \vee b)$" is true. The complete expression thus boils down to "true $\wedge$ true" which equals "true". A similar analysis can be performed for each of the other cases.

Of course, it is not necessary to prepare a truth table everytime Boolean logic is used; besides, the tables get very large as operands are added. We have used truth tables here merely to illustrate the meaning and reduction of expressions.

Let us now relate the preceding discussion to specification of peak flow qualification codes. We desire to specify which qualification codes from the tables in sec. B.6 should be present in a record, and which codes should be absent from the record, in order that the record be retrieved. For example, suppose that we wish a record to be retrieved if (and only if) qualification codes 1 and 2 are present, and if codes 3 or 4 are present, but not if codes 5 or 6 (or both) are present. If we let each code be an operand in a Boolean expression, we have $[(1 \wedge 2) \wedge (3 \vee 4) \wedge \neg(5 \vee 6)]$. If the value of this expression is true, which depends upon the presence or absence of the various qualification codes, then the record should be retrieved.

Another example: suppose we wish the record to be retrieved if (and only if) codes 1 or 2 or 3 are present, and if code 4 is present or code 5 is not present. The expression is $[(1 \vee 2 \vee 3) \wedge (4 \vee \neg 5)]$.

Another example: suppose we wish the record to be retrieved if (and only if) code 1 is not present, and either code 2 is not present or code 3 is not present. We have $[\neg 1 \wedge (\neg 2 \vee \neg 3)]$.

Note that in these examples we have parenthesized "sub-expressions" separated by $\wedge$ signs, that each sub-expression can consist of one or more qualification codes separated by $\vee$ signs, and that $\neg$ signs can appear preceding any condition code or sub-expression. This is the key to punching an expression onto qualification codes cards.

The user must determine the expression which describes his wishes regarding the retrieval codes necessary for a record to be retrieved. Then, the qualification code cards are punched, according to the following rules:

i. Each "sub-expression" appears on a single card. There can be from one to five peak discharge qualification codes on each card. Any code can have a "NOT" applied to it if desired. The codes are "ORed" together to determine the resultant value of the sub-expression; "NOTing" of the appropriate codes is performed before they are "ORed" together. A "NOT" may be applied to the entire sub-expression.

ii. From one to five cards can be included. The resultant values of the sub-expressions on the cards are "ANDed" together to form a result for the entire expression. If the result is "true", then the record is retrieved (unless some other criteria indicate that it not be).

iii. Each card also has space for one to three gage height qualification codes. These are handled in exactly the same manner as the discharge codes, except of course that they refer to the gage height codes in the record. Any code can have a "NOT" applied, and the codes are "ORed" together to form a resultant value for the card, which can itself have a "NOT" applied.

iv. Since the gage height codes appear on the same card(s) as the peak discharge codes, there can be one to five sub-expressions relating to gage height codes, one per card. These are "ANDed" together to form a result. If this result and the result for the peak discharge qualification codes are <u>both</u> "true", then the record is retrieved (unless some other criteria indicate that it not be).

v. Although qualification codes for both the discharge and the gage height appear on the same card(s), the codes which happen to appear on a given card have no relationship to each other.

vi. Only codes which appear on the qualification codes card(s) will be examined in the peak flow records. The presence or absence in a record of codes that do not appear on the card(s) does not affect retrieval.

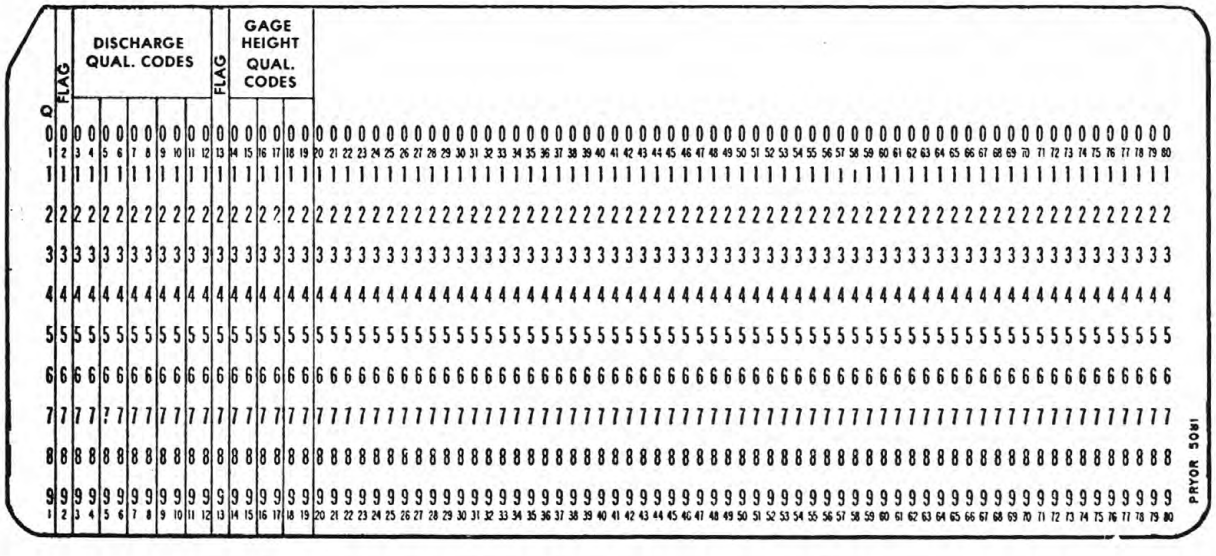


Figure 3. Qualification codes card (Q card)

The format for the qualification codes card is as follows:

Col. 1	Enter a Q.
Col. 2	Discharge "NOT" flag. Code a blank, a '+', or a '-'. Blank and '+' are equivalent. A '-' indicates that the Boolean "NOT" is to apply to the logical result of "ORing" together the discharge qualification codes in the succeeding five fields.
Col. 3-12	Discharge qualification codes. There are five fields of 2 columns each. The second column of each field contains a peak discharge qualification code, or is left blank. The first column of each field contains a blank, a '+', or a '-'. A blank and a '+' are equivalent. A '-' indicates that the Boolean 'NOT' of the succeeding qualification code is to be used.
Col. 13	Gage height "NOT" flag. Code a blank, a '+', or a '-'. A blank and a '+' are equivalent. A '-' indicates that the Boolean "NOT" is to apply to the logical result of "ORing" together the gage height qualification codes in the succeeding three fields.
Col. 14-19	Gage height qualification codes. There are three fields of 2 columns each. The second column of each field contains a gage height qualification code, or is left blank. The first column of each field contains a blank, a '+', or a '-'. A blank and a '+' are equivalent. A '-' indicates that the Boolean 'NOT' of the succeeding qualification code is to be used.
Col. 20-80	Blank.

Example: In a previous example, we wished a record to be retrieved if any one of qualification codes 1 or 2 or 3 are present, and if code 4 is present or code 5 is not present. The Boolean expression was $[(1 \vee 2 \vee 3) \wedge (4 \vee \neg 5)]$.

We have two "sub-expressions" separated by a $\wedge$, therefore we need two Q cards. The formats of the two cards are:

```
                        1         2
column:   12345678901234567890

card 1:   Q  1 2 3
card 2:   Q  4-5
```

On the first card, the values of codes 1, 2, and 3 are "ORed" together. On the second card, the value of code 4 and the "NOTed" value of code 5 are "ORed" together. The results from both cards are "ANDed" together.

This process is repeated with the codes for each peak flow record. If the final result for each record is "true", then the record is eligible for retrieval. If the result is "false", then the record is eliminated from further consideration.

B.3.c.(3).(b). Alpha-Parameter Code List Card (R Card)

The alpha-parameter code list card specifies the names of the data values which are to be included in retrieval output in the vector format, described later. Only vector format output is affected by this card. The card specifies which of the four types of data in a record are to be output.

The four 5-character alpha-parameter codes which correspond to four data items are:

- PEAKQ - annual peak discharge (default)
- PEAKG - annual gage height
- PARTQ - partial duration peak discharge
- PARTG - gage height associated with partial duration peak

Any or all of these codes can appear on the R card, in any one of the nine valid combinations as shown below. The codes indicate the data types that are to appear in the vector format output. Only those types indicated on this card, if present, will appear in output. If codes PEAKQ and PEAKG both appear, then the gage height used in the output will be the one associated with the peak discharge. If code PEAKG appears without code PEAKQ, then the maximum annual gage height will be used if one exists.

The nine valid parameter combinations are shown below. An 'X' indicates the presence of a parameter on the card, a '-' indicates its absence:

PEAKQ	PEAKG	PARTQ*	PARTG*	
X	-	X	-	OK
-	-	-	-	invalid
-	-	-	X	OK
-	-	X	-	OK
-	-	X	X	OK
-	X	-	-	OK
-	X	-	X	OK
-	X	X	-	invalid
-	X	X	X	invalid
X	-	-	-	OK
X	-	-	X	invalid
X	-	X	X	invalid
X	X	-	-	OK
X	X	-	X	invalid
X	X	X	-	invalid
X	X	X	X	OK

*These options will produce only partial duration peaks below the annual maximum and/or their associated gage heights. If the full "partial duration series" is desired, PEAKQ and PARTQ and/or PEAKG and PARTG must both appear. To get a true partial duration series, a C card specifying exclusion of annual peaks below the partial duration base must be supplied.

If an alpha-parameter code list card is not found for a retrieval, the default is used, which is that only values for annual peak discharges appear in the output. If a card is supplied, the code PEAKQ must appear somewhere on the card if those values are desired.

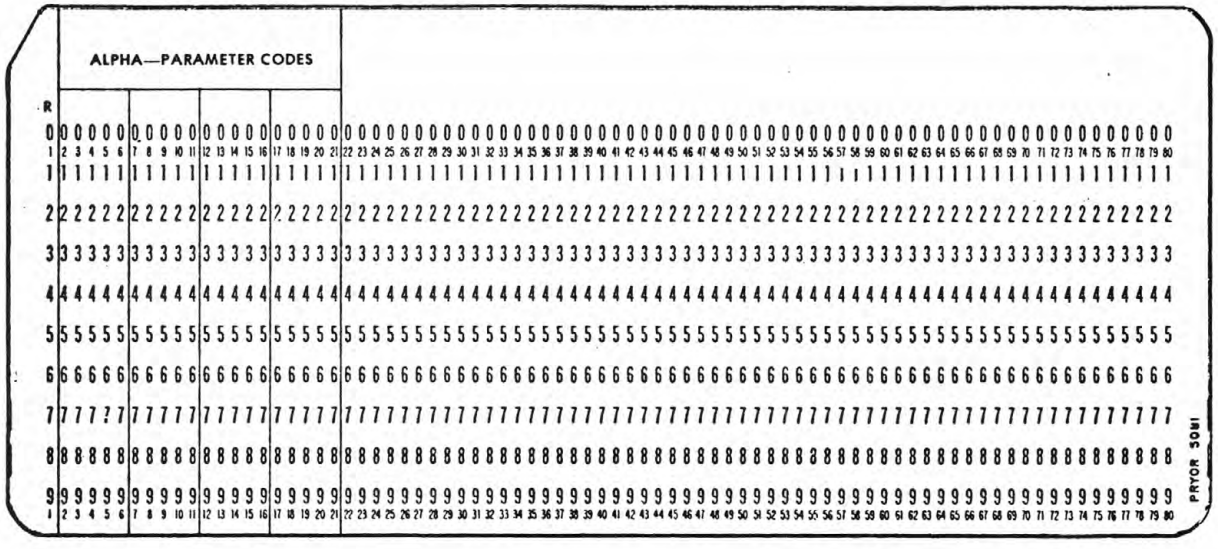


Figure 4. Alpha-parameter code list card (R card)

The format for the alpha-parameter code list card is:

Col. 1	Enter an R.
Col. 2-6 7-11 12-16 17-21	Four 5-column code fields -- code the appropriate parameters in any of the fields, and leave any unused fields blank.
Col. 22-80	Blank.

Note that this card has no effect upon the content of output in formats other than vector format. Only one card can appear for a given retrieval.

B.3.c.(3).(c). Station Identification Card (I Card)

The station identification card (fig. 5) is used as a separator to identify stations for which succeeding retrieval control cards apply, and contains auxiliary data to be passed to application programs along with the retrieved data. Station ID cards are mandatory in some cases depending upon whether or not site selection cards (card types S and V) are used, and upon the control cards to follow; this is discussed in succeeding sections.

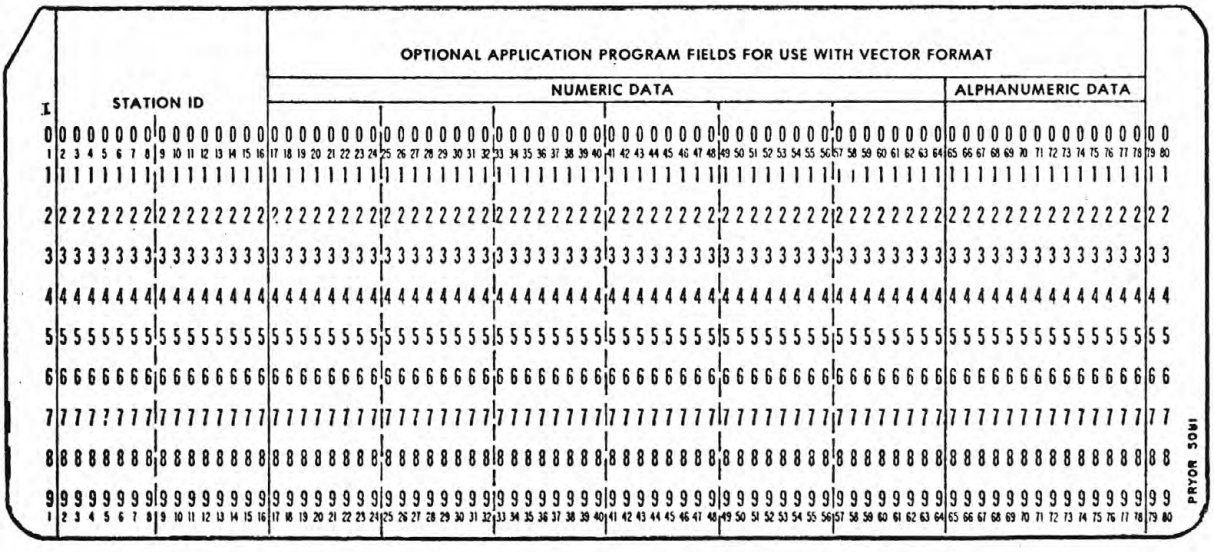


Figure 5. Station identification card (I card)

The format of the station identification card is:

Col. 1	Enter an I.
Col. 2-16	Station identification number. This field is optional depending upon whether the card applies to one station or to more than one. If it applies to one station, code the station ID in this field. If it applies to more than one, leave this field blank; only one I card with blank field is permitted.
Col. 17-24 25-32 33-40 41-48 49-56 57-64	Six 8-column fields, whose numeric contents are passed to one or more application programs by way of vector format output. The fields are blank unless they are coded as part of an application program.
Col. 65-78	Field for alphanumeric data, to be passed to one or more application programs by way of vector format output. The field is blank unless it is coded as part of an application program.
Col. 79-80	Blank.

When the station ID card is used without a station ID number appearing in columns 2-16 (only one I card allowed per retrieval), the contents on the card that are dependent on the application program will apply to all stations in the retrieval. In addition, if a control values card (C card, see following section) appears immediately after such an I card, then the specifications on it will also apply to all stations in the retrieval. The I card, and the succeeding C card if one is present, must follow the M card. If any X, Q, or R cards are present, the I (and C) card(s) must follow immediately after those cards.

When the station ID card does contain a station ID number in columns 2-16, the contents of the card will apply only to that station. The only limit on the number of I cards with the station ID is the processing time as set via symbolic parameter on the cataloged JCL. Other such site dependent control cards can follow the I card; this situation is discussed in a later section.

B.3.c.(3).(e). Control Values Card (C Card)

The control values card (fig. 6) is used to define a range of values for the peak discharge or gage height. If a given discharge or gage height does not fall within the specified range, it is not included in the retrieval.

Four parameter codes are used to identify the data to which a range applies. The same codes are used as on the alpha-parameter code list card (type R), PEAKQ, PEAKG, PARTQ, and PARTG. Three options are available for coding a range of values:

i. Code both the maximum and minimum fields -- This defines an inclusive range of values that will allow for the retrieval of only those peak flow records that contain data within the specified range.

ii. Code only the maximum value -- Peak flow records containing a data value less than or equal to the maximum value will be retrieved. All other records will be rejected.

iii. Code only the minimum value -- Peak flow records containing a value greater than or equal to the minimum value will be retrieved. All other records will be rejected.

For all control fields, a decimal point must be entered if a fractional portion of a value is coded. The control values may be entered anywhere within the specified input fields.

Three sets of parameter codes and range limits will fit on a single C card. Since there are four parameter codes, a second card may be needed. The sets for the four parameter codes may be placed anywhere on the two cards, but no more than two cards may be given for any retrieval. The format is shown below.

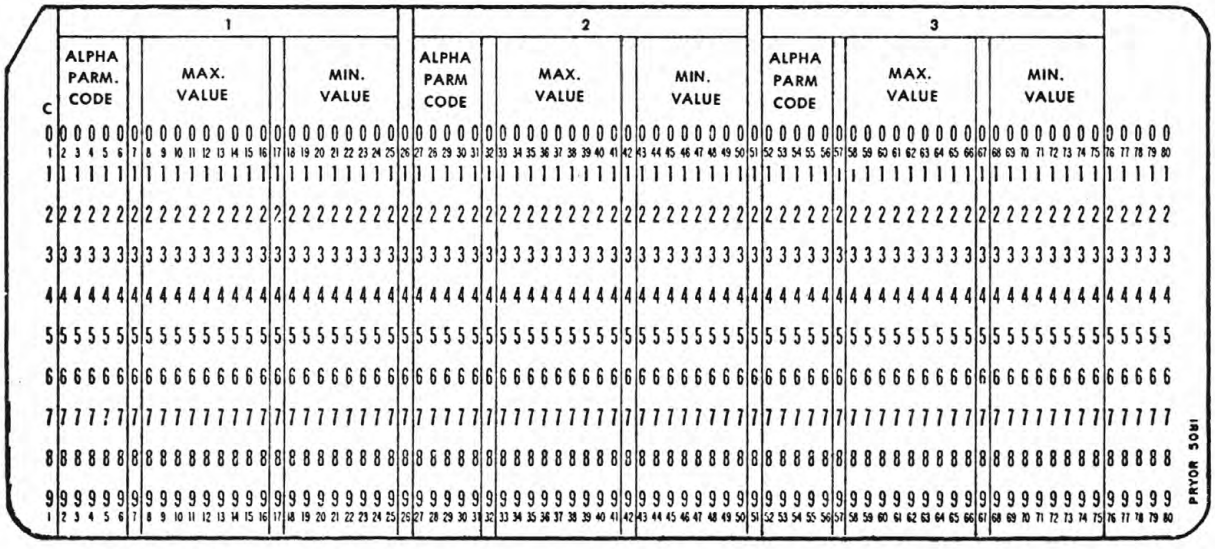


Figure 6. Control values card (C card)

Col. 1	Enter a C.
Col. 2-6 27-31 52-56	The 5-character parameter code for which a range is to be given.
Col. 7, 32, 57	Always blank.
Col. 8-16 33-41 58-66	Maximum value for each corresponding parameter code.

Col. 17, 42, 67 Always blank.

Col. 18-25, 43-50, 68-75 Minimum value for each corresponding parameter code.

Col. 26, 51, 76-80 Always blank.

If the control values card(s) appear before any station ID cards which contain station ID numbers, the ranges apply to records for all stations within the retrieval. Control values cards may appear along with station ID cards which do contain station ID numbers, in which case the range(s) apply only to records for that station. The placement of the C card for these differing uses is discussed in a later section.

B.3.c.(4). Site Dependent Data Retrieval Specifications

The site dependent data retrieval control cards are used to specify further retrieval criteria to be applied to records for a specific site. There are five card types:

- station identification card -- I card
- control values card -- C card
- peak flow code card -- 2 card
- peak flow data card -- 3 card
- partial peak flow data card -- 4 card

The formats of card types I and C have been discussed in the preceding sections, since they are used for general data retrieval specifications, as well as for site dependent data retrieval specifications.

A type I card must be present if any of the other types of site dependent cards are to be supplied. It is the I card that identifies the station to which the other cards apply.

All of these cards are optional. If they are supplied for a given retrieval, they must follow the general data retrieval specification cards. The order of the control cards is discussed in section B.3.d.

Formats of card types 2, 3, and 4 are discussed in the following sections.

B.3.c.(4).(a). Peak Flow Code Card (2 Card)

The peak flow code card (fig. 7) is used to specify a water year. If a given discharge or gage height occurred in the specified water year, it is forced to be retrieved or not to be retrieved, depending upon an operation code. The card contains an operation code and a water year. The card format follows:

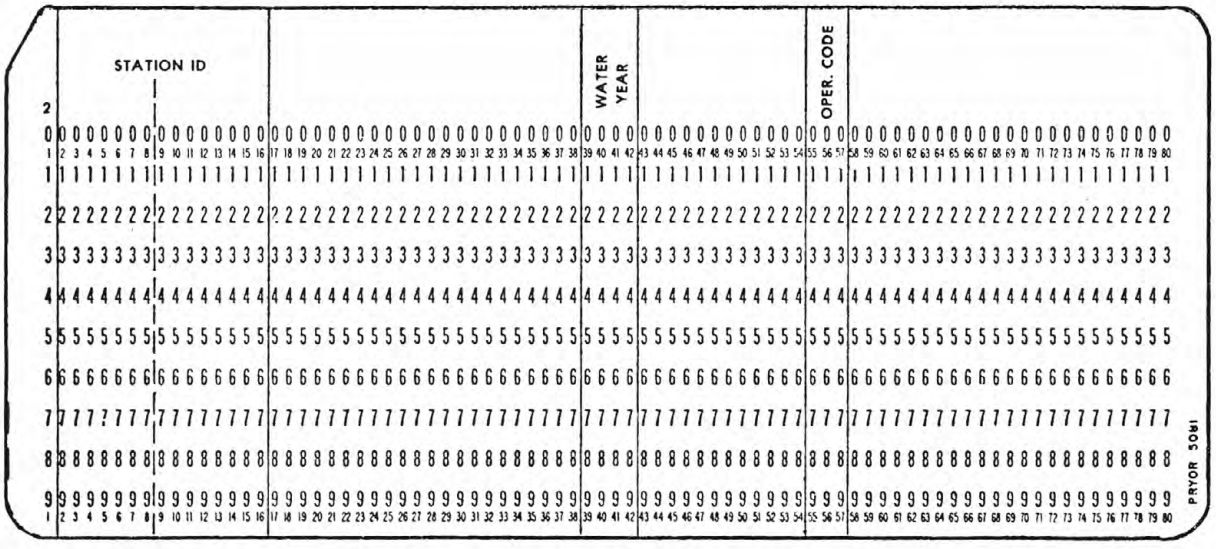


Figure 7. Peak flow code card (2 card)

Col. 1	Enter a 2.
Col. 2-16	Station identification number. Same as on associated I card.
Col. 17-38	Blank.
Col. 39-42	Water year. Enter the 4-digit water year for which data are forced to be retrieved or forced not to be retrieved.
Col. 43-54	Blank.

Col. 55-57 Operation code. Code one of two 3-character operation codes to indicate whether or not retrieval is desired for this water year. The codes are:

Code	Meaning
+++	force retrieval
---	force nonretrieval

Col. 58-80 Blank.

Up to 10 peak flow code cards can be supplied for each I card.

B.3.c.(4).(b). Peak Flow Data Card (3 Card)

The type 3 peak flow data card (fig. 8) and the similar type 4 card discussed in the next section allow for replacement of data values during retrieval. Values can be given for the discharge and/or gage height. The values are used only for retrieval; data in the Peak Flow File are not altered.

The type 3 card contains data for the annual peak discharge and maximum annual gage height. One or two dates must also be supplied. The format of the type 3 card is as follows:

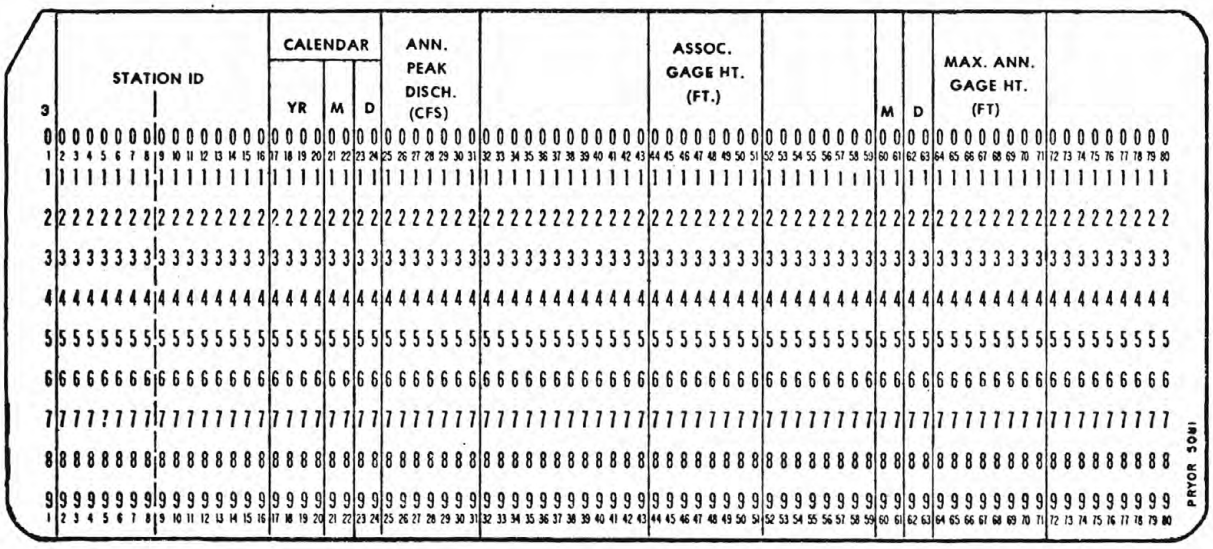


Figure 8. Peak flow data card (3 card)

Col. 1	Enter a 3.
Col. 2-16	Station identification number. Same as on I card.
Col. 17-20	Calendar year. If the next two fields (month and day) are left blank, then the content of this field is taken as a water year; if data currently exist in the Peak Flow File for that water year, the values for the discharge and/or gage height on this card replace that data for the retrieval, otherwise the data on the card are added to the retrieval. If a date is supplied (year, month, day) that does not match the date of a maximum annual value in the Peak Flow File, a message is ouput indicating the date discrepancy.
Col. 21-22	Month of peak discharge. Code a 2-digit number (in the range 01-12) representing the month in which the peak discharge occurred, or leave blank (see description of the preceding field). If a value is coded in this field, the next field must also contain a value.
Col. 23-24	Day of peak discharge. Code a 2-digit number (in the range 01-31) representing the day of the month in which the peak discharge occurred, or leave blank (see description of the year field in columns 17-20). If a value is coded in this field, the preceding field must also contain a value.
Col. 25-31	Peak discharge. This value is added to the retrieval, or replaces a value from a record that otherwise would be included in the retrieval, depending upon the contents of the date fields (previously discussed). The value is punched with a decimal point, and significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. A blank field indicates that no replacement is desired for the discharge.

The data value may be punched anywhere in the 7-column field (e.g., bb19.2b, where b=blank). There must be no alphabetic characters or embedded blanks within the data value. If a replacement value is 999999, the original value is deleted from the retrieval, rather than any replacement being made.

Col. 32-43 Blank.

Col. 44-51 Gage height. This value is added to the retrieval, or replaces a value from a record that otherwise would be included in the retrieval, depending upon the contents of the date fields (previously discussed). The value is punched with a decimal point, and significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. A blank field indicates that no replacement is desired for the gage height. The data value may be punched anywhere in the 8-column field (e.g., bb19.20b, where b=blank). There must be no alphabetic characters or embedded blanks within the data value. If a replacement value is 9999.999, the original value is deleted from the retrieval, rather than any replacement being made.

Col. 52-59 Blank.

Col. 60-61 Month of maximum annual gage height. Code a 2-digit number (in the range 01-12) representing the month in which the maximum annual gage height occurred, or leave blank. If a number is supplied here, then one must also be supplied in the next field, the day. If the month and day exactly match those of the maximum annual gage height in the peak flow record, then the gage height value on the card will replace the value in the record for purposes of the retrieval; if the dates do not match, then replacement is made and a message output indicating the discrepancy. If there is currently no maximum annual gage height in the record, the data will be added to the retrieval. If this field is left blank (in which case the day field must also be left blank), then the gage height value on the card is added to the retrieval.

Col. 62-63 Day of maximum annual gage height. Code a 2-digit number (in the range 01-31) representing the day of the month in which the maximum annual gage height occurred, or leave blank (see description of the preceding field). If a value is coded in this field, the preceding field must also contain a value.

Col. 64-71 Maximum annual gage height. This value is added to the retrieval, or replaces a value from a record that otherwise would be included in the retrieval depending upon the contents of the date fields (previously discussed). The value is punched with a decimal point, and significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. A blank field indicates that no replacement or update is desired for the gage height. The data value may be punched anywhere in the 8-column field (e.g., bb19.20b, where b=blank). There must be no alphabetic characters or embedded blanks within the data value. If a replacement value is 9999.999, then the original value is deleted from the retrieval rather than any replacement being made.

Col. 72-80 Blank.

Up to 10 type 3 and 4 cards, in any combination, can be supplied for each I card.

B.3.c.(4).(c). Partial Duration Peak Flow Data Card (4 Card)

The partial duration peak flow data card (fig. 9) is used for updating or replacement during retrieval of partial peak discharge and gage height values. The values supplied on the card are used only for retrieval; data in the Peak Flow File are not altered. A date may also be supplied on the card. The card format follows:

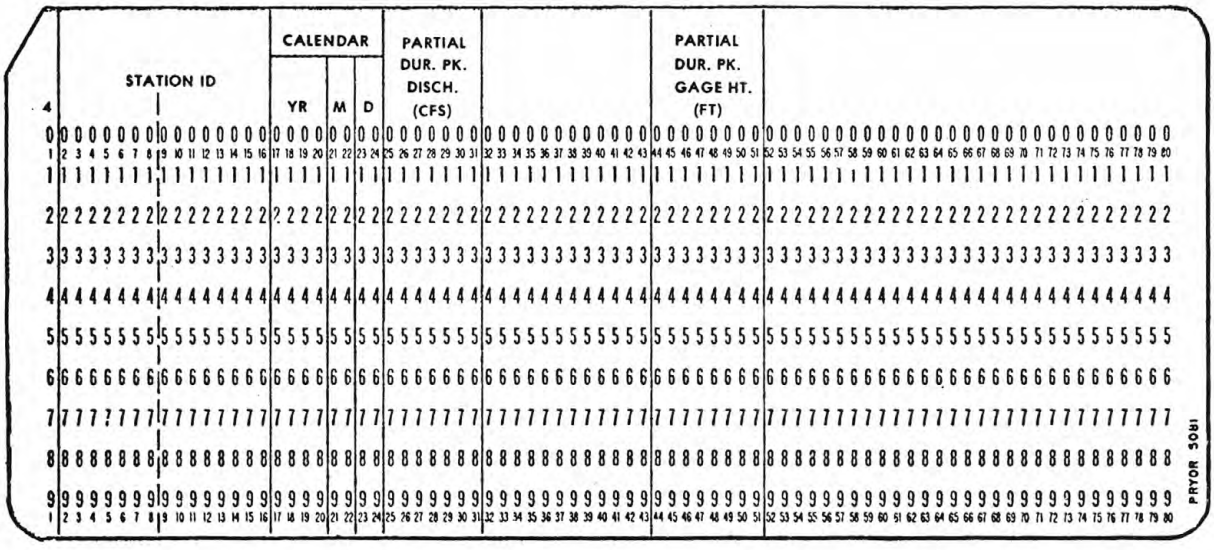


Figure 9. Partial duration peak flow data card (4 card)

Col. 1 Enter a 4.

Col. 2-16 Station identification number. Same as on I card.

Col. 17-20 Calendar year. If the next two fields (month and day) are left blank, the content of this field is taken as a water year; if data currently exist in the Peak Flow File for that water year, then the values for the discharge and/or gage height on this card replace that data for the retrieval, otherwise the data on the card are added to the retrieval. If the month and day fields are supplied, then a calendar date is assumed.

If the date (month, day, and year) exactly matches the date of some data in the Peak Flow File, then the discharge and/or gage height on this card replace that data for the retrieval, otherwise the data on the card are added to the retrieval, subject to the limitation of a maximum of 30 partial peaks for water year. An attempt to include more than 30 partial duration peaks will produce a message.

Col. 21-22 Month of partial duration peak discharge. Code a 2-digit number (in the range 01-12) representing the month in which the partial duration peak discharge occurred, or leave blank (see description of the preceding field). If a value is coded in this field, the next field must also contain a value.

Col. 23-24 Day of partial duration peak discharge. Code a 2-digit number (in the range 01-31) representing the day of the month in which the partial peak discharge occurred, or leave blank (see description of the year field in columns 17-20). If a value is coded in this field, the preceding field must also contain a value.

Col. 25-31 Partial duration peak discharge. This value is added to the retrieval, or replaces a value from a record that otherwise would be included in the retrieval, depending upon the contents of the date field (previously discussed). The value is punched with a decimal point, and significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. A blank field indicates that no replacement is desired for the discharge. The data value may be punched anywhere in the 7-column field (e.g., bb19.2b, where b=blank). There must be no alphabetic characters or embedded blanks within the data value. If a replacement value is 999999, then the original value is deleted from the retrieval, rather than any replacement being made.

Col. 32-43 Blank.

Col. 44-51 Partial duration peak gage height. This value is added to the retrieval, or replaces a value from a record that otherwise would be included in the retrieval, depending upon the contents of the date fields (previously discussed). The value is punched with a decimal point, and significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. A blank field indicates that no replacement is desired for the gage height. The data value may be punched anywhere in the 8-column field (e.g., bb19.20b, where b=blank). There must be no alphabetic characters or embedded blanks within the data value. If a replacement value is 9999.999, then the original value is deleted from the retrieval, rather than any replacement being made.

Col. 52-80 Blank.

Up to 10 type 3 and 4 cards, in any combination, can be supplied for each I card.

B.3.c.(5). Password/Agency Identification Card (Z Card)

The password/agency identification card (fig. 10) is used to:

- identify the agency that is associated with a collection site, and
- supply one of the two passwords stored in the station header record in the event the security retrieval flag stored in the peak flow record indicates password checking is required.

When used, the password/agency identification card (Z card) must be positioned in the card deck immediately ahead of a site selection card (S or V card) or in front of a station ID card (I card). If an I card appears for a station, and a Z card is required for that station, it must immediately precede the I card. If an I card does not appear for a station needing a Z card, which implies that the station is defined by some

S card or set of V cards, then the Z card must immediately precede the S or V card(s). The Z card will apply to all stations in that retrieval (that is, defined by S or V card(s)) which do not have their own I cards. Card organization is discussed further in the next section.

If a site is not affected by any Z card, the agency code and password for that site will be taken from the AGENCY and PASSWRD symbolic parameters, if both parameters were coded on the EXEC card (see v. 1, chap. II, sec. A). When the Z card is used, the association with site selection cards is as follows:

- station range card -- one Z card preceding each S card
- polygon vertex cards (V cards) -- from one to five Z cards (up to five agencies, but only one password) preceding each set of V cards (each V card contains one or two latitude-longitude identifiers) that define a polygon. (Polygon retrieval is discussed in v. 1, chap. III, sec. B.2.j.)
- no site selection cards (only I cards) -- one Z card preceding each I card

The format of the Z card as it applies to the retrieval of peak flow records follows:

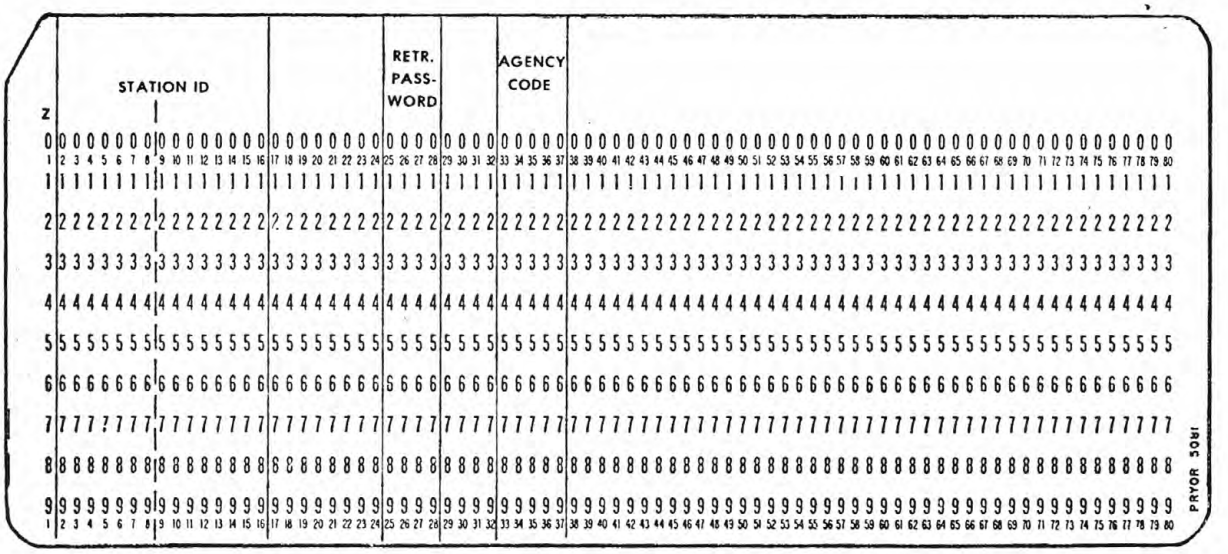


Figure 10. Password/agency identification card (Z card)

Col. 1	Enter a Z.
Col. 2-16	Station identification number. This field is left blank when the Z card precedes an S card or a set of V cards.
Col. 17-24	Blank.
Col. 25-28	Retrieval password. Used for password checking, if the security retrieval flag in the peak flow record indicates checking is required for the sites defined on the site selection or I card immediately following the Z card.
Col. 29-32	Blank.
Col. 33-37	Agency code. If required, enter the agency code which is to be associated with the sites defined on the site selection or I card immediately following the Z card.
Col. 38-80	Blank.

The password/agency identification card is optional, and is used only when the password or agency for a station is different from the one specified on the EXEC card.

B.3.d. Organization of Control Cards

There are two major types of retrievals, which are differentiated by the way in which the sites to be retrieved are specified:

- by individual station number, through the use of I cards
- by groups of sites, through the use of S or V site selection cards

A third type of retrieval consists of a combination of these two major types, in which stations are retrieved in groups, but where additional retrieval criteria can be given for individual stations.

The control cards that are required for a retrieval (a "retrieval" is a group of cards which begins with a master control card, type M) vary depending upon the type of retrieval. Card organization for the three types is described below, followed by a discussion concerning the order that retrieval specifications are evaluated.

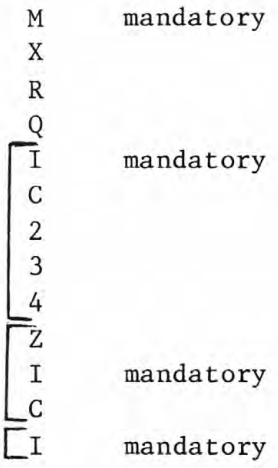
B.3.d.(1). Retrieval by Station Number

In this type of retrieval, a station identification card (I card) must be specified for every station that is to be retrieved. At least one I card, then, is mandatory for each retrieval in addition to the M card which signals the beginning of the retrieval.

Each I card separates the group of cards for a single retrieval into sets, one set for each station. The I card must contain the station identification number in columns 2-16. Any I card can be preceded by a Z card, containing an agency code and/or a retrieval password. Any I card can be followed by any combination of C, 2, 3, and 4 cards, containing additional retrieval criteria for the station. The cards can appear in any order, and every 2, 3, or 4 card must contain in columns 2-16 the station ID number, the same as on the preceding I card. The I cards, and their associated retrieval cards, can appear in the retrieval group (following the M card) in any order. The retrieval output will appear in the same order. In this case, do not request a sort of station header records on the M card as this will reorder only the header file and not the control cards.

A retrieval group may also contain cards following the M card, but preceding the I card sets. These are the X, Q, and R cards. The specifications on these cards will apply to all stations in the retrieval. If one or more type X (application program control) cards are used, they must immediately follow the master control card. If one or more type Q or R (general data retrieval) cards are used, they must follow any X cards, or the master control card if no X cards are present. If both Q and R cards are used, all Q cards needed must appear either before or after the single R card permitted.

Example:



In this example three stations are to be retrieved. Additional retrieval criteria are specified for the first station on C, 2, 3, and 4 cards, and for the second station on a C card. Also, a Z card is included for the second station (note that it immediately precedes the I card for the station). An X, an R, and a Q card are also supplied; the specifications thereon apply to all three stations.

B.3.d.(2). Retrieval by Station Group

In this type of retrieval, the stations to be retrieved are identified through the use of S and V site selection cards. S cards permit selection of a group of stations by specification of a range of station identification numbers. V cards permit specification of a geographical area enclosed by a polygon; all stations within the polygon are selected. At least one S or one set of V cards is mandatory for each retrieval in addition to the M card which signals the beginning of the retrieval. (See v. 1, chap. III, sec. B.2. for detailed descriptions of the S and V cards.)

Any combination of S cards or sets of V cards (one set per polygon) can be given, resulting in many groups of selected stations. Although stations will be in order by station ID number within each group, the stations together are likely to be out of order. Moreover, a station may be selected by more than one group, causing duplications. Optionally, the stations for a retrieval

may be sorted (at station header level) before being passed to the retrieval routines. Stations appearing more than once will thus appear together making identification of the duplication possible. Such stations will be treated by the retrieval routines as if they appear only once; that is, any duplication will not be reflected in the output. (See v. 1, chap. III, sec. B.2. for a description of the sort option.)

As in the case of retrieval by station number, retrieval cards can be included which apply to all stations in the retrieval. These cards must appear between the master control card, which begins the retrieval and the S and/or V site selection cards, which come at the very end of each retrieval group. The cards which may be used are the X, Q, R, C, and I cards. The X, Q, and R cards are used in the same way as in retrieval by station number, above. If one or more type X (application program control) cards are used, they must immediately follow the master control card. If one or more type Q or R (general data retrieval) cards are used, they must follow any X cards, or the master control card if no X cards are present. If both type Q and R cards are used, and more than one Q cards are needed, they must all appear either before or after the single R card permitted.

The C and I cards, when used here, apply to <u>all</u> stations in the retrieval, rather than to a single station which was the case in retrieval by station number. Columns 2-16 of the I card, which otherwise contain a station ID number, must be left blank. (The C card has no field reserved for a station ID number.) In this case, the I card is used solely to pass auxiliary data to an application program. Such data, as contained on the I card, is passed identically for every station in the retrieval. Only a single card may be used per retrieval.

The C card is used in the same manner in this case as in retrieval by station number, to define a range of values for the discharge or gage height, except that the range(s) apply to all stations in the retrieval. One or two cards, as needed, are permitted per retrieval.

If one or more type I or C cards are used, they must follow any Q or R cards, or any X cards if no Q or R cards are present, or the master control card if no X cards are present. If both type I and C cards are used, and two C cards are needed, they must both appear either before or after the single I card permitted.

Example:

```
M     mandatory
X
R     the options on the cards
C     apply to all sites retrieved
I
S
S
V     at least one S or one set
V     of V cards is mandatory
V
```

B.3.d.(3). Retrieval by Station Group, with Additional Retrieval Criteria for Individual Stations

In this type of retrieval, the stations to be retrieved are identified through the use of S and V site selection cards, as in the preceding section, but in addition, station identification cards (I cards) and other data retrieval specification cards can be included which apply to individual stations.

The S and V cards are used in exactly the same manner as discussed in Section B.3.d.(2). Similarly, card types X, Q, R, C, and I may also be included, following the master control card (type M), to apply to all stations in the retrieval. Card order must also be the same as that discussed above.

However, data retrieval specification cards (types I, C, 2, 3, and 4) may be included for individual stations. Such specifications on I and C cards can be used to override, for certain stations, the contents of I or C cards discussed in the preceding paragraph. Specifications on 2, 3, and 4 cards must be supplied in this manner; it is impossible to supply 2, 3, or 4 cards that apply to all stations in a retrieval.

The I cards, then, separate groups of I, C, 2, 3, or 4 cards which contain retrieval specifications for individual stations. Columns 2-16 on each I card must contain the station ID number. The C, 2, 3, and 4 cards which may follow an I card may appear in any order following that card. However, the groups of cards, each delineated by an I card, must appear in ascending order by station ID number.

Each retrieval must begin with a master control (type M) card. If any X, Q, or R cards are used, they must appear next. X (application program control) cards must immediately follow the master control card. Q and R (general data retrieval) cards can appear next in any order, except that if more than one Q cards are used they must appear together. If any types I or C cards are used which apply to all stations in the retrieval they appear next in any order, except that if two C cards are used they must appear together.

The groups of cards which contain retrieval specifications for individual stations (i.e., I, C, 2, 3, and 4 cards) appear next. The groups are separated by the I cards, and each I card must contain the station ID number in columns 2-16. The groups must appear in ascending order by station ID number. The C, 2, 3, and 4 cards can appear in any order within a group. Card types 2, 3, and 4 must also contain the station ID number in columns 2-16 (type C has no field reserved for the ID number).

Finally, the S and V cards appear at the end of the retrieval. Any combination of S cards or sets of V cards can be given, as described in the preceding section.

If needed, a password/agency identification card (Z card) may be included preceding any I or S card or set of V cards. A card would be necessary whenever the agency or password for a station is different from the one specified on the EXECute card. If all stations defined by an S card or set of V cards have the same agency or password (whichever is needed) then only a single Z card is required, preceding the S card or set of V cards. Otherwise, a Z card must precede the I card for each affected station. This is the only exception to the rule that groups of retrieval cards for individual stations always begin with I cards, since in this case the Z card begins the group. Note that passwords may be necessary only when retrieving from a record for the current water year.

Example:

```
M    mandatory
X
R    the options on these cards
Q    apply to all sites in the
I    retrieval
C
I    retrieval specifications for an individual
C    station, which override specs on the preceding cards
I
2
3    an individual station
4
4
Z    an individual station, for which specifications
I    on the Z card override those on the EXECute
2    card and on the Z card below
I    individual station
I    individual station
Z    site selection cards:  at least one S or one
S    set of V cards is mandatory; the Z card
V    applies to all stations (unless overridden)
V    and overrides specs on the EXECute card
```

B.3.d.(4). Order of Specification Evaluation

There are a large number of retrieval criteria that can apply to any given peak flow record, depending upon which specifications are given by the user. Some of these criteria might be contradictory, in that one card might specify that a certain record be retrieved, while another card specifies that it not be.

The following rules are used to determine whether or not a given record is retrieved:

1. Within a retrieval, evaluation is performed station by station, and record by record within each station. The only stations examined are those passed by the preprocessor program G745, which uses the site selection cards, types I, S, and V, to select the stations.

2. For each station, examination of records is limited to those which fall within the date range specified on the master control card (type M). If no range was specified, all records for the station are examined. Records are examined in chronological order.

3. For each record, the retrieval specifications are passed through in the order that the cards appear in the retrieval. Although certain restrictions are imposed concerning the relative placement of retrieval control cards (as discussed above), the user does have some flexibility with regard to card order.

4. If, when a retrieval specification is applied to a record, it is determined that the record contents should not be retrieved, then that record is eliminated from further consideration for that retrieval. If the record does meet the specification, it is eligible for continued examination with regard to the remaining specifications.

5. If after all specifications have been applied (in order) to a record, the record has met all criteria, then it will be added to the retrieval.

B.3.e. Restrictions

The following restrictions apply to program J980:

1. For each execution of the cataloged procedure (see sec. B.5), the number of retrievals is governed only by the space allocated to the output file.

2. Each retrieval must begin with a master control card (fig. 1).

3. Only station identification numbers can be used on station ID cards (fig. 5) or on a station range card (type S); station locators may be used only in polygon retrievals (type V).

4. Station ID cards, and groups of retrieval specifications (which begin with such cards), must appear in a retrieval in ascending order by agency code and station ID number.

5. If a retrieval is by station group, it must end with a station range or polygon retrieval card.

B.4. Output

The output produced by program J980 is as follows:

- retrieval output in vector format
- retrieval output in standard format
- retrieval output in input/update format
- retrieval output in publication table format
- file of X and C records
- printed output

Certain of these formats will be produced only if requested by the user. The different types of output are discussed in detail below.

B.4.a. Vector Format

Vector format is intended as one output method to pass retrieved data to application programs. This output is not produced by default, however (standard format is the default), unless one or more application program control cards (X cards) for program J407 are detected by the program. In this case, vector format output is produced by default, and standard format output is not produced unless specifically requested.

Vector format output is requested for a retrieval by coding a V in column 49 of the master control card. The output consists of two logical records for each station retrieved. The first record contains station identification information from the preprocessor subfile of station header records, and counts of the items contained in the succeeding record. The second record contains the retrieved discharges and/or gage heights (depending upon the retrieval specifications), along with corresponding water years, dates, qualification codes, etc.

The first record for each station is of fixed length; the length (LRECL) is 170 bytes. The second record is of varying length depending upon whether discharges or gage heights or both are retrieved (as specified on the alpha-parameter code list card (R card)) and upon the number of each. The maximum size of the record is 5504 bytes; a record that size can contain 250 discharges and gage heights.

This file is normally put on magnetic disk, for use immediately afterward by an application program. The catalogued procedure includes a DD card for the file (DDNAME=VECTOR). See section B.5 for more details.

The formats of the two records are as follows:

ID RECORD:

Byte Position	Data Type	Identifier
1-2	CHAR(2)	Reserved.
3-4	CHAR(2)	State code (app. B).
5-9	CHAR(5)	Agency code (app. A).
10-24	CHAR(15)	Station identification number.
25-26	CHAR(2)	One of three parameter code combinations, indicating which values are contained in the data record -- Db only discharges bG only gage heights DG both where b=blank.
27	CHAR(1)	Parameter code for values in data record -- A only annual peak discharges and/or gage heights P partial duration peak discharges and/or gage heights B both annual and partial data i.e., the full "partial duration series"
28	CHAR(1)	Reserved.

29-32	FLOAT DECIMAL(6)	Missing value code. The value used in the data record for a discharge or gage height to indicate that the actual value is missing from the record; the current value used is 999999.
33-36	FIXED BINARY(31)	Number of sets of observations (N) in the data record. A set consists of a water year, date, and either or both a discharge and gage height with associated qualification codes.
37-44	(2)*FIXED BINARY(31)	Padding -- set to zero.
45-68	(6)*FLOAT DECIMAL(6)	Auxiliary numeric data from the I card.
69-82	CHAR(14)	Auxiliary alpha data.
83-84	CHAR(2)	District code.
85-87	CHAR(3)	County code.
88	CHAR(1)	Blank.
89-136	CHAR(48)	Station name.
137-140	FLOAT DECIMAL(6)	Drainage area.
141-144	FLOAT DECIMAL(6)	Contributing drainage area.
145-148	FLOAT DECIMAL(6)	Gage base discharge.
149-152	FLOAT DECIMAL(6)	Gage datum (in 1/100 ft. above MSL).
153-156	FIXED BINARY(31)	Hydrologic unit code.
157-158	FIXED BINARY(15)	Retrieval sequence number from columns 79-80 of the master control card.
159-160	CHAR(2)	Blank.

161-164	FLOAT DECIMAL(6)	Station latitude (in degrees and fractions of degree).
165-168	FLOAT DECIMAL(6)	Station longitude (in degrees and fractions of degree).
169-170	CHAR(2)	Station locator sequence number.

DATA RECORD:

The data record contains N sets of observations where N is a number specified in the ID record. Each set consists of a water year, date of observation, and either or both a discharge and gage height with associated qualification codes. Rather than each set appearing together, with one set after another in the record, all N water years appear together, followed by all N dates of observation, etc. This organization is used for ease of reading by FORTRAN application programs.

The order and formats of the values follow:

	(N)*FIXED BINARY(31)	water year
	(N)*FIXED BINARY(31)	date (format yyyymmdd)
A	(N)* FLOAT DECIMAL(6)	discharge
A	(N*16)*BIT(1)	discharge qualification codes -- there are 16 codes, 0-F. If code 0 is present for this discharge, the first bit is set on ('1'B) otherwise it is set off ('0'B). Similarly, if code 1 is present the next bit is turned on, otherwise off, and so forth.
A	(N)*FIXED BINARY(15)	"highest since" year
B	(N)*FLOAT DECIMAL(6)	gage height
B	(N*16)*BIT(1)	gage height qualification codes -- there are 8 codes, left justified in the field of 16 bits

A: these fields are included only if discharges are requested
B: these fields are included only if gage heights are requested

B.4.b. Standard Format

Standard format output (station header and data records) is the default, unless one or more application program control cards (X cards) for program J407 are detected by the program, in which case vector format output is the default. Standard format output may be specifically requested by coding an 'S' in column 43 of the master control card.

The output consists of a sequential file of station header records from preprocessor subfile and peak flow records copied directly from the peak flow file. The station header record for a given station is followed by all peak flow data records for that station. If a discharge or gage height has been chosen for retrieval, then the entire record in which it is contained is written to this output file. Any editing or updating specified by retrieval control cards is not performed for this output file.

This file would likely be put to tape or disk for later use. The catalogued procedure contains a DD card for the file (DDNAME=Standard). See Section B.5 for more details.

The format of the station header record is given in WATSTORE, Volume 1, Section III.A.4. The format of the standard peak flow data record is shown below. The header record is fixed length, 152 bytes, and the data record is variable length. This length is dependent upon the presence or absence of a maximum annual gage height (that is, a value distinct from, and greater than, the gage height, associated with the peak discharge). It is also dependent upon the number of partial duration peak entries, of which 0 to 30 partial peaks can be stored. The maximum data record size is 560 bytes.

Byte Position	Data Type	Identifier
1-2	CHAR(2)	Reserved.
3-7	CHAR(5)	Agency code (app. A).
8-22	CHAR(15)	Station identification number.
23-24	FIXED BINARY(15)	Four-digit water year number.
25-28	FLOAT DECIMAL(6)	Peak flow. The maximum discharge for the water year. A value of 999999 indicates that the peak flow was not stored.

29-32	FIXED DECIMAL(7,3)	Gage height. Corresponding gage height for the maximum discharge. A value of 9999.999 indicates that no value has been stored.
33	BIT(8)	Gage height qualification codes. See section B.6.
34-35	BIT(16)	Peak flow qualification codes. Codes for the maximum discharge for the water year. See section B.6.
36	CHAR(1)	Retrieval security flag. If this byte is set to '1', the record cannot be retrieved unless the user-supplied password matches one of the passwords stored in the station header file. Only records for the current water year can be so secured.
37-38	CHAR(2)	Day of peak flow. Two-digit day number (01-31) within the month.
39-40	CHAR(2)	Month of peak flow. Two-digit month number (01-12).
41-42	FIXED BINARY(15)	Number of annual peak stages. Equals 0 if the stage (gage height) associated with the maximum discharge is the maximum stage for the water year, or equals 1 if a separate entry for annual peak stage is required.
43-44	FIXED BINARY(15)	Number of partial duration peaks. Varies from 0 to 30.
45-48	FIXED BINARY(31)	Reserved.
49-52	FIXED BINARY(31)	Create date. Date the record was created, in format yymmdd.
53-56	FIXED BINARY(31)	Process date. Date the record was last modified, in format-yymmdd.

57-58	CHAR(2)	District code. The district responsible for the site.
59-60	FIXED BINARY(15)	"Highest since" year. The annual peak discharge reported in this record is the highest known discharge since the year recorded in this field.
61-68	CHAR(8)	Reserved.

If an entry for the annual peak stage is required, that is, if the "number of annual peak stages" equals 1 rather than 0, the following 12 bytes will appear next in the record:

1-4	FIXED DECIMAL(7,3)	Annual peak stage.
5-6	CHAR(2)	Two-digit month number.
7-8	CHAR(2)	Two-digit day number.
9	BIT(8)	Qualification codes.
10-12	CHAR(3)	Reserved.

If partial duration peaks are contained in the record, that is, if the "number of partial peaks" is greater than zero, the following 16 bytes will appear next for each partial duration peak, one after the other, in chronological order:

1-2	CHAR(2)	Two-digit month number.
3-4	CHAR(2)	Two-digit day number.
5-8	FLOAT DECIMAL(6)	Partial duration peak discharge. a discharge above base, but less than the maximum annual peak.
9-12	FIXED DECIMAL(7,3)	Partial duration peak stage. The gage height corresponding to the preceding partial peak.
13	BIT(8)	Stage qualification codes.
14-15	BIT(16)	Discharge qualification codes.
16	CHAR(1)	Reserved.

B.4.c. Input/Update Format

Input/update format output may be requested by coding a U in column 48 of the master control card. The output consists of a file of card images in the format accepted for input by the Peak Flow File Input and Update Program (J979). As with standard format, output is written to this file whenever a discharge or gage height in a peak flow record has been selected for retrieval. The entire peak flow record is written to the output file. Editing or updating specified by retrieval control cards is not performed on the output records.

For each peak flow record, four card types will appear in the output: the Z card, only if the agency changes, the type 2 peak flow code card, the type 3 peak flow data card, and, if the record contains partial peak information, one or more type 4 partial peak flow data cards. These cards are described in the user instructions for the input and update program, section A of this chapter.

In addition, by coding an H in column 47 of the master control card, the user can specify that station header cards types H and N (see V.1, chap. III, sec. A), are to be included in the output. The station header cards will precede all peak flow cards for a station.

This file is normally punched onto cards. The cataloged procedure has been set up accordingly (see sec. B.5). The file name is PUNCH.

B.4.d. Publication Table Format

The publication table peak flow data format is used to retrieve output suitable for use by the tabling program, A534. The values supplied in this record are a combination of data from both the Peak Flow File and the Station Header File.

Following is the data format as modified for the new peak record.

FIELD	DATA TYPE	BYTE POS
RESERVED	CH(1)	1
STATION_ID	CH(15)	2-16
YEAR_NO	CH(4)	17-20

FIELD	DATA TYPE	BYTE POS
MONTH_NO	CH(2)	21-22
DAT_NO	CH(2)	23-24
HIGH_YEAR_DATE	CH(4)	25-28
RESERVED	CH(4)	29-32
TIME	CH(4)	33-36
GAGE_HEIGHT_CODE	BIT(8)	37
COUNTY_CODE	CH(3)	38-40
STATE_CODE	CH(2)	41-42
DISTRICT	CH(2)	43-44
BASE_DISCHARGE	FLOAT DEC(6)	45-48
RESERVED	CH(4)	49-52
STATLOC_LAT	CH(6)	53-58
STATLOC_LONG	CH(7)	59-65
STATLOC_SEQNO	CH(2)	66-67
AGENCY_CODE	CH(5)	68-72
HYDROLOGIC_UNIT	FIXED BIN(31)	73-76
SITE_SEQUENCE	FIXED BIN(31)	77-80
RET_SEQ_NO	FIXED BIN(15)	81-82
DISCHARGE_CODE	BIT(16)	83-84
STATION_NAME	CH(48)	85-132

FIELD	DATA TYPE	BYTE POS
NO_DETERMINATIONS	FIXED BIN(31)	133-136
DATA_ARRAY	CH(1)	137
PARM_CODE	FIXED BIN(31)	(1)-(4)
VALUE	FLOAT(6)	(5)-(8)
REMARK_CODE	CH(1)	(9)
RESERVED	CH(3)	(10)-(12)

The following are the fields that will be retrieved from both the Station Header File and the Peak Flow File to be output to the putlication table record format.

I. Peak Flow File

FIELD	COLUMNS
STATION_ID	8-22
WATER_YEAR	23-24
ANNUAL_PEAK_FLOW	25-28
GAGE_HEIGHT	29-32
GAGE_HEIGHT_QUALIFYING_CODE	33
QUALIFYING_CODES	34-35
DAY_ANNUAL_PEAK_FLOW	37-38
MONTH_ANNUAL_PEAK_FLOW	39-40
HIGHEST_SINCE	59-60

II. Station Header File

FIELD	COLUMNS
HEADER_AGENCY	3-7
HDR_LAT	23-28
HDR_LONG	29-35
HDR_SEQ#	36-37
HDR_STATE	38-39
HDR_DISTRICT	40-41
HDR_COUNTY	42-44
HDR_NAME	53-100
HDR_HYDROL	121-124
HDR_DRAINAGE	125-128
HDR_CONTRIBUTING	129-132
HDR_dATUM	133-136
HDR_RETR_SEQ#	143-144
SITE_SEQ	145-148
HDR_BASE_LEVEL	149-152

B.4.e. X and C Record Control File Output

Application control cards (X cards) are used to pass information to an application program that is executed using the data retrieved from the Peak Flow File. The contents of X cards are ignored by the station header retrieval program and by the peak flow retrieval program, except that the latter program separates the X cards from the other retrieval specifications and reformats their contents. The reformatted X records are in a standard format, used by a number of WATSTORE file systems.

Output of X records need not be specifically requested. If the retrieval program detects any X cards, the reformatted output is automatically produced. The data are output to a disk control file.

After the X record, containing the X cards for a given retrieval, there follows one or more C records in the control file.

The C records in the control file are generated by the retrieval program. They contain identifying information as well as values for various statistical computations based upon the data successfully retrieved. There will be one C record in the control file per station header record in the data file. The format of the C record will vary depending upon the user's choice of output format. Publication table format receives a slightly different C record from the standard C record of all other output formats and only one C record is allowed per retrieval. The two types of C records are given below.

The following is the format for the standard C record:

Byte Position	Data Type	Identifier
1	CHAR(1)	Record type
2	CHAR(1)	Reserved
3-4	FIXED BIN(15)	Retrieval sequence number
5-6	FIXED BIN(15)	Number of records retrieved
7-10	CHAR(4)	Begin year
11-12	CHAR(2)	Begin month
13-14	CHAR(2)	Begin day
15-18	CHAR(2)	End year
19-20	CHAR(2)	End month
21-22	CHAR(2)	End day
23-34	CHAR(12)	Reserved
35-36	CHAR(2)	State name

37-41	CHAR(5)	Agency code
42-56	CHAR(15)	Station Identification
57-60	FLOAT(6)	X Sec
61-64	FLOAT(6)	Depth
65-68	FIXED BIN(31)	Number of parms
	PARAMETER LIST (repeated for each parameter)	
(1)-(4)	FIXED BIN(31)	Parm code
(5)-(6)	FIXED BIN(15)	Stat code
(7)-(8)	FIXED BIN(15)	Add Code
(9)-(12)	FLOAT(6)	Sec high
(13)-(16)	FLOAT(6)	Sec low

The following is the format for the publication table C record:

Byte Position	Data Type	Identifier
1	CHAR(1)	Record type
2	CHAR(1)	Reserved
3-4	FIXED BIN(15)	Retrieval sequence mumber
5-6	FIXED BIN(15)	Number of records written
7-12	CHAR(6)	Begin year and begin month
13-18	CHAR(6)	End year and end month
19-28	CHAR(10)	Reserved
29-32	FIXED BIN(31)	Number of parameters

PARAMETER LIST (repeated for each parameter)

33-36	FIXED BIN(31)	Parameter code
37-44	CHAR(8)	Reserved

B.4.f. Printed Output

There are three types of printed output produced by program J980:

- "brief print" format available only with vector format retrieval for a station
- "long print" retrieval format
- diagnostic messages

Long print is simply an expansion of brief print format. The brief print format consists of a page header for each station with identifying information for the station, and a listing of the discharge and/or gage height values put to the vector file. The long print format consists of the above items, plus a complete listing of the peak flow data for the station. A sample long print listing is given in figure 11.

B.4.g. Diagnostic Messages

The diagnostic messages are printed to aid in determining the status of processing and the action required to correct errors. Diagnostic messages printed by program number G745, the station header retrieval program, can be identified by the code HRxxx preceding each message, where HR is a unique abbreviation for program G745 and xxx is a sequence number. The diagnostic messages printed by program G745 are listed sequentially in volume 1, chapter III, section B.

Diagnostic messages printed by program J980 can be identified by the code PRxxx preceding each message, where PR is a unique abbreviation for program J980 and xxx is a sequence number. The following diagnostic messages printed by program J980 are listed sequentially.

STATION 08056500 TURTLE CREEK AT DALLAS, TEX.

AGENCY: USGS
STATE: 48
COUNTY: 113
DISTRICT: 48

STATION LOCATOR
LAT. LONG.
324826 0964808

DRAINAGE AREA: 7.98 SQ MI
CONTRIBUTING DRAINAGE AREA: SQ MI
GAGE DATUM: 428.13 (NGVD)
BASE DISCHARGE: 1200.00 CFS

WATER YEAR	DATE	PEAK DISCHARGE (CFS)	DISCHARGE CODES	GAGE HEIGHT (FT)	GAGE HT CODES	HIGHEST SINCE	MAX GAGE HEIGHT (FT)	DATE	GAGE HT CODES	NUMBER OF PARTIAL PEAKS
1947	08/27/47	3350.00		6.80						0
1948	05/11/48	1630.00		4.68						0
1949	05/18/49	2800.00		6.15						0
1950	05/01/50	2060.00		5.29						0
1951	09/12/51	1700.00		4.82						0
1952	05/17/52	2220.00		5.47						0
1953	04/23/53	910.00		3.54						0
1954	04/12/54	2980.00		6.40						0
1955	06/18/55	852.00		3.44						0
1956	05/01/56	1740.00		4.84						0
1957	04/26/57	3850.00		7.30						0
1958	04/26/58	3070.00		6.54						0
1959	02/14/59	1460.00		4.47						0
1960	10/01/59	4650.00		8.10						0
1961	10/13/60	1240.00		4.08						0
1962	07/27/62	4640.00		7.96						0
1963	04/28/63	4290.00		7.77						0
1964	09/21/64	3240.00		6.79						0
1965	05/10/65	4520.00		7.97						0
1966	04/28/66	12200.00		10.54		1903				0
1967	04/21/67	1790.00		5.14						0
1968	05/13/68	3220.00		6.77						0
1969	05/06/69	8840.00		9.96						0
1970	10/12/69	3130.00		6.68						0
1971	08/14/71	2400.00		5.87						3
	05/27/71	2360.00		5.82						
	07/28/71	1360.00		4.61						
	08/24/71	1640.00		4.96						
1972	10/19/71	3590.00		7.14						2
	10/03/71	3000.00		6.55						
	10/18/71	1980.00		5.38						
1973	06/03/73	4160.00		7.67						8
	10/21/72	1390.00		4.64						
	03/10/73	2500.00		5.99						
	04/24/73	2740.00		6.25						
	05/11/73	3300.00		6.85						
	06/03/73	3230.00		6.78						
	06/19/73	1920.00		5.31						
	07/07/73	1330.00		4.57						
	07/15/73	1430.00		4.68						
1974	05/05/74	3160.00		6.71						11
	10/11/73	2940.00		6.47						
	10/30/73	2160.00		5.60						
	11/24/73	1360.00		4.62						
	06/07/74	2320.00		5.79						
	06/07/74	1880.00		5.26						
	06/09/74	1580.00		4.89						
	08/12/74	2690.00		6.20						
	09/12/74	2310.00		5.77						
	09/16/74	2730.00		6.25						
	09/17/74	2160.00		5.60						
	09/20/74	1860.00		5.24						
1975	10/31/74	2440.00		5.92						7
	10/28/74	1320.00		4.57						
	02/01/75	1610.00		4.93						
	04/08/75	1990.00		5.40						
	05/02/75	1430.00		4.71						
	05/29/75	1960.00		5.36						
	06/09/75	1630.00		4.95						
	07/25/75	1250.00		4.42						
1976	04/19/76	3400.00		6.95						4
	05/23/76	1500.00		4.80						
	05/26/76	2180.00		5.62						
	05/30/76	1440.00		4.72						
	08/31/76	1380.00		4.65						
1977	03/27/77	4000.00		7.51						0

Figure 11. Sample "long print" output listing.

PR000 END OF PEAK FLOW FILE, NO MORE DATA FOR THIS RETRIEVAL

PR001 IMPROPER AGENCY ON EXEC CARD - PROCESSING TERMINATED

PR002 RETRIEVAL CARDS NOT SUPPLIED - PROCESSING TERMINATED

PR003 RETRIEVAL REQUEST ERROR - PROCESSING TERMINATED

PR004 M CARD NOT FIRST CARD - SKIPPING TO FIRST M CARD

PR005 STATION HEADER FILE NOT PRESENT - PROCESSING TERMINATED

PR006 BEGIN STATION ID IS GREATER THAN END STATION ID ON RANGE REQUEST

PR008 STATION HEADER ERROR FOR THIS REQUEST

PR009 OUTPUT FORMAT REQUEST CONFLICTS WITH PUBLICATION-FORMAT REQUEST

PR010 BRIEF PRINT FORMAT AVAILABLE ONLY WITH VECTOR FORMAT OUTPUT

PR021 INVALID ENTRY ON M-CARD FOR PUBLICATION-FORMAT REQUEST CODE

PR022 PUBLICATION COL 10 ON X-CARD IS 1 - INVALID FOR Q TYPE RETRIEVAL

PR031 STATION ID ON 2, 3, or 4-CARD IS BLANK

PR032 STATION ID on 2, 3, or 4-CARD DIFFERS FROM I-CARD ID

PR033 INVALID OPERATION ON 2-CARD

PR034 TOO MANY 2-CARDS HAVE BEEN SUBMITTED

PR035 2-CARD IGNORED

PR036 TOO MANY 3 AND 4-CARDS HAVE BEEN SUBMITTED

PR037 A 3 OR 4-CARD HAS BEEN IGNORED

PR041 DUPLICATE PARAMETER CODES SUBMTTED ON C CARD

PR042 INVALID PARAMETER CODE SUBMITTED ON C CARD

PR043 TOO MANY PARAMETERS SUBMITTED ON C CARD

PR045 INVALID PARAMETER ON THE R-CARD

PR046 INVALID COMBINATION OF PARAMETER ON THE R-CARD

PR053 PEAK FLOW DATA NOT FOUND FOR STATION NO.

PR061 PEAK FLOW DATA NOT FOUND FOR THIS RETRIEVAL REQUEST

PR071 PROCESSING OF THIS REQUEST BYPASSED DUE TO REQUEST ERRORS.

PR072 TWO Z CARDS SUBMITTED - PROCESSING FOR THIS REQUEST BYPASSED.

PR075 OPERATION SYMBOL ON Q-CARD IS OTHER THAN BLANK, - OR +

PR076 INVALID QUALIFICATION CODE ON A Q-CARD

PR081 TOO MANY X CARDS SUBMITTED - EXTRAS IGNORED

PR082 TOO MANY Q CARDS SUBMITTED

PR083 TOO MANY R CARDS SUBMITTED

PR084 TOO MANY I CARDS WITH BLK FIELDS SUBMITTED - EXTRA CARDS IGNORED

PR085 TOO MANY C CARDS SUBMITTED

PR086 ERROR ON C CARD

PR087 CARD IGNORED BY PGM. J980 - PROBABLY USED BY PREPROCESSOR

PR091 INVALID BEGIN YEAR - PROCESSING FOR THIS REQUEST BYPASSED

PR092 INVALID BEGIN MONTH - PROCESSING FOR THIS REQUEST BYPASSED

PR094 INVALID END YEAR - PROCESSING FOR THIS REQUEST BYPASSED

PR095 INVALID END MONTH - PROCESSING FOR THIS REQUEST BYPASSED

PR099 BEGIN YEAR AFTER END YEAR - PROCESSING FOR THIS REQUEST BYPASSED

B.5. Cataloged JCL Procedure

A cataloged procedure to facilitate the use of program J980 has been stored in the WATSTORE procedure library. The procedure name is PEAKRET and the procedure may be executed by using the following cards:

```
Column 1    Column 12

.           .
//xxxxxxxx  JOB (-----)
/*PROCLIB   WRD.PROCLIB
//S1 EXEC    PEAKRET,AGENCY=agency,PASSWRD=password
//HDR.SYSIN  DD *
   .
   .
Data cards for program J980
   .
   .
/*
//
```

where "agency" is the agency code indicating the agency responsible for the data and "password" is the password required to access data that have been password protected. If the data have not been password protected, a password is not required. If the execution time coded in the procedure is not sufficient, time may be increased by coding TIME1=time on the execute card as shown below:

```
// EXEC PEAKRET,TIME1=time
```

The parameters AGENCY, PASSWRD, and TIME1 can appear in any order.

B.6. Qualification Codes

Peak Flow Qualification Codes

1	Discharge is a maximum daily average
2	Discharge is an estimate

3	Discharge affected by dam failure
4	Discharge less than indicated value, which is minimum recordable discharge at this site
5	Discharge affected to unknown degree by regulation or diversion
6	Discharge affected by regulation or diversion
7	Discharge is an historic peak
8	Discharge actually greater than indicated value
9	Discharge due to snowmelt, hurricane, ice-jam or debris dam breakup
A	Year of occurrence is unknown or not exact
B	Month or day of occurrence is unknown or not exact
C	All or part of the record affected by urbanization

Gage Height Qualification Codes

1	Gage height affected by backwater
2	Gage height not the maximum for the year
3	Gage height at different site and/or datum
4	Gage height below minimum recordable elevation
5	Gage height is an estimate

Application Qualification Codes for Annual Peak Gage Heights

1	Gage height due to backwater
3	Station at different site and/or datum
5	Gage height is an estimate

B.7 Parameter Codes

The following are the parameter codes required when creating the peak tables publication format records.

FIELD	SOURCE FILE	PARAMETER CODE
Discharge, CFS (annual)	Peak Flow File	00060
Discharges, CFS (above base)	Peak Flow File	00060
Codes (peak Q)	Peak Flow File	-21
Highest since data	Peak Flow File	-22

Gage hts peak Q and/or above base	Peak Flow File	00065
Codes (gage ht)	Peak Flow File	-23
Base discharge	Station Header File	-24
Drainage area	Station Header File	81024
Contr drainage area	Station Header File	81025
Gage datum	Station Header File	72020

Negative values are assigned to fields that do not contain valid EPA parameter codes.

Various parameter codes will be written to the peak tables publication backfile record depending on the type of record requested. The three record types and their associated parameter codes follow:

RECORD TYPE	PARAMETER CODES
Annual peak Q record type	00065,-23,00060,-21,-22
Peaks above base record type	00065,-23,00060,-21
Annual maximum gage height record type	00065,-23

The information identified with a positive parameter code is moved to the variable length data array beginning in column 137 of the peak tables publication backfile record. Information identified with a negative parameter is moved to fixed fields in the first part of the record.

The parameter codes associated with the various record types, as indicated in the preceding table, will be moved to the output record and written to the file in the order specified.

CHAPTER I. INSTRUCTIONS FOR PEAK FLOW FILE

Section C. Annual Flood Frequency Analysis Using U.S. Water Resources Council Guidelines (Program J407)

Prepared by:

William H. Kirby

August 1979

CONTENTS

ILLUSTRATIONS

I.C. ANNUAL FLOOD FREQUENCY ANALYSIS USING U.S. WATER RESOURCES COUNCIL GUIDELINES (PROGRAM J407)

C.1. Introduction

Program J407 is used for statistical flood-frequency analysis of annual peak flow records using U.S. Water Resources Council (WRC) guidelines (1977). The principles of computation presented in the guidelines are reviewed in section C.4. for easy reference. Program J407 produces tables and plots of the estimated flood-frequency curves. In addition, it produces supplementary information including expected-probability frequency curves, confidence limits, and listings of the probability plotting positions of the observed peaks. A summary punch card format suitable for use as input to the USGS streamflow/basin characteristics file can be optionally produced.

Flood frequency analysis using the WRC guidelines includes calculation of a log-Pearson Type III frequency curve based on the mean, standard deviation, and skewness of the logarithms of the recorded annual peak flows. The basic calculations are followed by adjustments for zero flows, peaks below a gage base, low outliers, historic information, and regional skew information.

The calculations are performed on annual peak flow records retrieved from the USGS Peak Flow File. Auxiliary inputs of historic information, regional skew information, and program control options are specified on input data cards.

Program J407 is invoked by the cataloged Job Control Language (JCL) procedure PKWRCA--Peak Flow File WRC Annual Flood Frequency Analysis (sec. C.2.f.). This procedure performs only flood frequency analyses; it is preceded by a separate job step that uses the Peak Flow File retrieval program (J980) to retrieve the necessary records and merge them with any user-supplied auxiliary inputs. The procedure can also run independently of the retrieval program by specifying additional parameters (RETR and REGION) on the job execution (EXEC) card and by supplying the necessary peak flow records and auxiliary data on punched input cards.

Program J407 was written for the IBM System/370 using FORTRAN IV programming language by William H. Kirby, USGS, Reston, Va.

C.2. Preparation of Input

Program J407 requires three types of input data: annual peak flow records, flood frequency program control data, and auxiliary flood-frequency information. The annual peak flow records ordinarily are retrieved from the USGS online Peak Flow File whereas the program control data and auxiliary information are supplied by the user on input cards. The peak file retrieval program (J980) retrieves the records and merges them with the user-supplied control and auxiliary information. Full instructions for use of the retrieval program are given in section B. The following sections explain how to prepare program control and auxiliary information for preprocessing and transmittal to program J407 by the retrieval program.

Program J407 also can analyze peak flow records in a card or card-image format. In this way, records not in the Peak Flow File can be analyzed if necessary. Instructions for card-input operation are given in section C.2.k.

C.2.a. Peak Flow Record Retrieval

The annual peak flow records to be analyzed are retrieved from the online Peak Flow File. These records contain both systematic-record peaks, including some high outliers with associated historic information, and historic peaks. Program J407 automatically identifies historic peaks and separates them from the systematic record.

The records to be retrieved are specified by station identification cards or site selection cards in the retrieval program. In addition, temporary modifications to the retrieved record can be made for purposes of analysis without affecting the record stored in the file. Full instructions for these operations are given in the retrieval program instructions in section B. The retrieval program recognizes retrieval requests for program J407 and automatically ensures that annual peak discharge records are output in the proper format.

C.2.b. Program Control Options

Several program J407 control options are available for controlling the quantity and format of program output and for specifying minor variations in the computational procedure. Options are specified by means of option codes which are listed below. Default options are applicable and are underlined in the list. If a nondefault program option is specified, it remains in effect until reset by another explicit option specification. The available program control options are as follows:

(Default options are underlined)

PLOT - Log-probability plots of the frequency curves and data are to be produced.

NPLT - No plots are to be produced. If plots are not required, this option will save significant computer time and printout volume.

BCPU - Summary results are to be punched in a format suitable for input to the U.S. Geological Survey streamflow/basin characteristics file or for use by other programs.

NOBC - No streamflow/basin characteristics summary is to be punched.

LGPT - Long format of printout, in which the input peak data are listed.

BFPT - Brief printout, in which printing of input peaks and probability plotting positions is suppressed.

DBGA - Causes printing of the logarithmic statistics of the above-flood-base peaks. This information is useful only for debugging; all information useful in assessing flood risk is contained in the default printout.

DBUG - Causes voluminous debugging output to be printed as it is computed. This information is useful only for debugging; all information useful in assessing flood risk is contained in the default printout.

NODB - No debugging output is produced.

PPOS - Probability plotting positions of the input peaks are printed. This option is overridden by BFPT.

NOPP - Probability plotting positions are not to be printed.

RSK1,RSK2 - The skew coefficient of the final WRC frequency curve is to be rounded off to one (RSK1) or two (RSK2) decimal places.

NORS - The skew coefficient is not to be rounded off; all significant figures are to be retained.

EXPR - The expected probability frequency curve is to be computed.

NOEX - The expected probability curve is not to be computed. This option will save significant computer time if the expected-probability curve will not be used.

CLIM - Confidence limits based on the WRC frequency curve are to be computed.

NOCL - Confidence limits are not to be computed.

In addition to the above options, a job-title option is available, which allows the user to specify job identification information (40 characters) to be printed in the output page headings. If specified anywhere after the beginning of the job, it also causes the end-of-job message to be printed and the run-sequence numbers and work counts to be reinitialized in preparation for a new job.

C.2.c Program Control Cards (X Cards)

Program J407 control cards (X cards) are used to specify non-standard program options and job titles. In addition, they serve as requests to program J407 to process the retrieved data with which they are associated. Unless at least one J407 program control card appears in each retrieval group, J407 will skip over that group. The program control cards must be placed immediately after the master control card (M card) for each retrieval group in the retrieval program. Only one set of J407 program control cards may be used in one retrieval group. The formats of the program control cards follow.

C.2.c.(1) Job Title Card (X-$JOB Card)

This card specifies up to a 40-character job title to be printed in the upper right-hand corner of each output page. If no title is specified for a retrieval group, blanks will be printed. Only one of these cards may be used in each retrieval group. The format of the job title card is given in fig. 1.

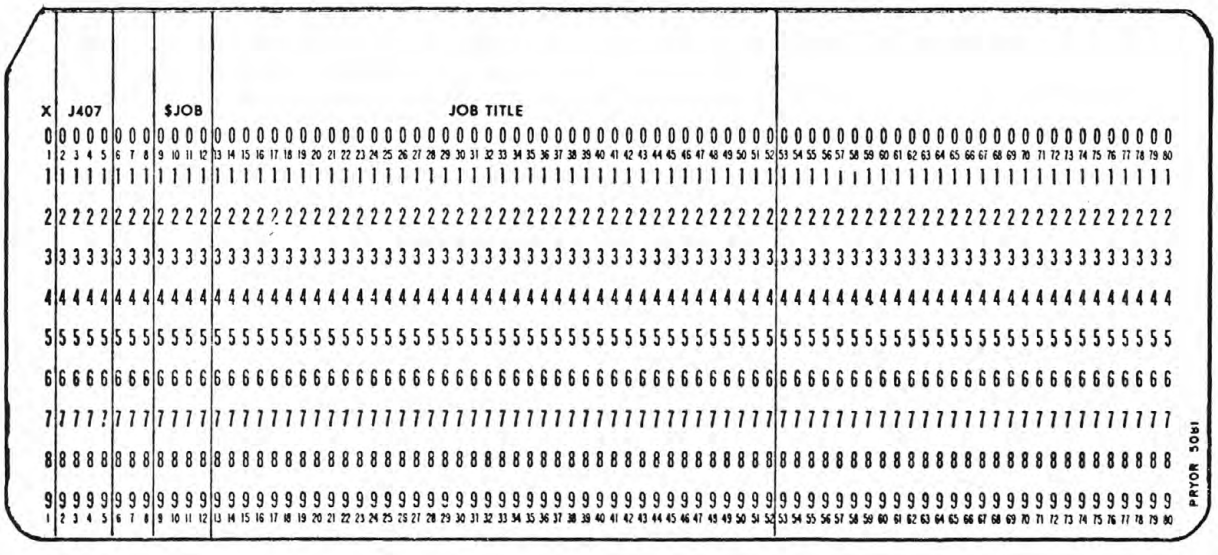


Figure 1. Job title card (X-$JOB card)

Columns	Contents
1	Always X.
2-5	Always J407.
6-8	Blank.
9-12	Always $JOB.
13-52	Any desired job identification information up to 40 characters long. This field may be left blank.
53-80	Blank.

C.2.c.(2) Program Option Card (X-$OPT Card)

This card specifies the nonstandard options. The available options were listed in section C.2.b. Any options selected will remain in effect throughout a retrieval (and any subsequent retrievals) until reset on another X-$OPT card in another retrieval. Up to three options may appear on each card; as many cards as needed may be used. The format of the program option card is given in figure 2.

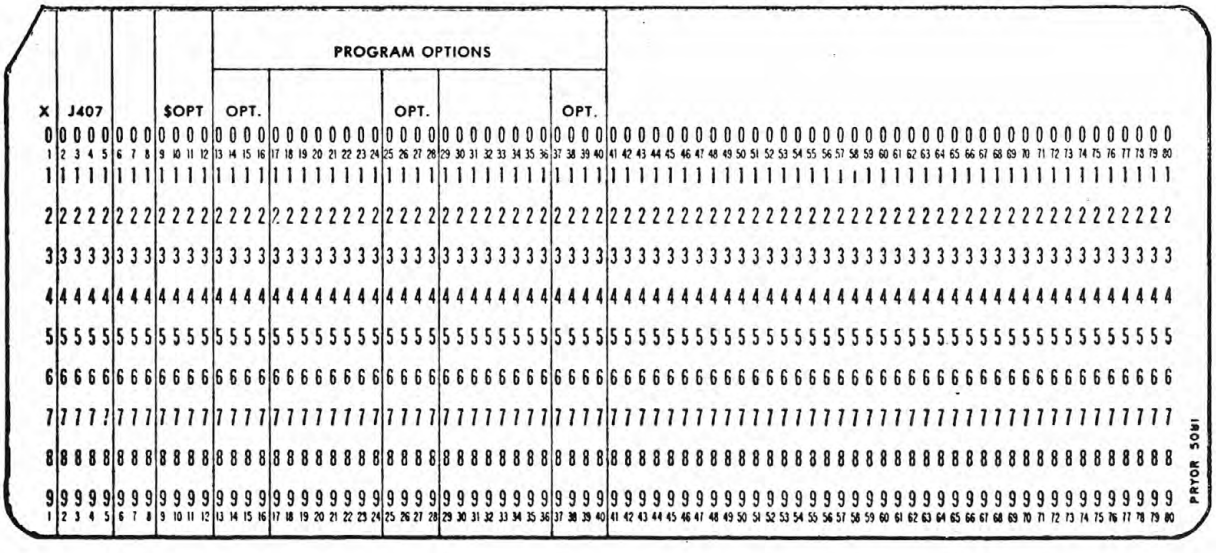


Figure 2. Program option card (X-$OPT card)

Columns	Contents
1	Always X.
2-5	Always J407.
6-8	Blank.
9-12	Always $OPT.
13-16, 25-28, 37-40	Three 4-column control option fields. One option may appear in each field. Blank fields are ignored.
17-14, 29-36, 41-80	Blank.

C.2.d. Auxiliary Flood Frequency Information

Certain auxiliary information in addition to the peak flow records is required for the WRC flood frequency analysis. This information usually can be determined automatically by program J407, or standard default values can be used, but occasionally it has to be specified by the user. The station identification card (I card) is used for this purpose. The data elements that can be specified as auxiliary flood-frequency information are listed below. Unless otherwise noted, the hydrologic and statistical significance of these data elements is explained in the "Principles of Computation" section (sec. C.4).

- Generalized skew coefficient
- Historic period
- Historic record threshold discharge
- User-specified low-outlier criterion
- Gage base discharge
- Skew-selection option
- Historic peak input option
- Known regulation/urbanization input option
- Beginning and ending years of the period to be analyzed, if different from the period retrieved.

C.2.e Station Identification Card (I-Card)

The station identification card (fig. 3) is used to associate user-supplied auxiliary flood frequency information with peak flow data retrieved from the file. An I card may be specified for each station in the retrieval program. In addition, an I card with a blank station identifier field may be used to supply auxiliary information to any retrieved stations not matched by an I card. Finally, an I card for a specific station will serve as a data retrieval request for that station in the absence of any other retrieval request for that station. Complete instructions for the placement and usage of the I card are given in the retrieval instructions in section B. The format of the I card as required for program J407 follows.

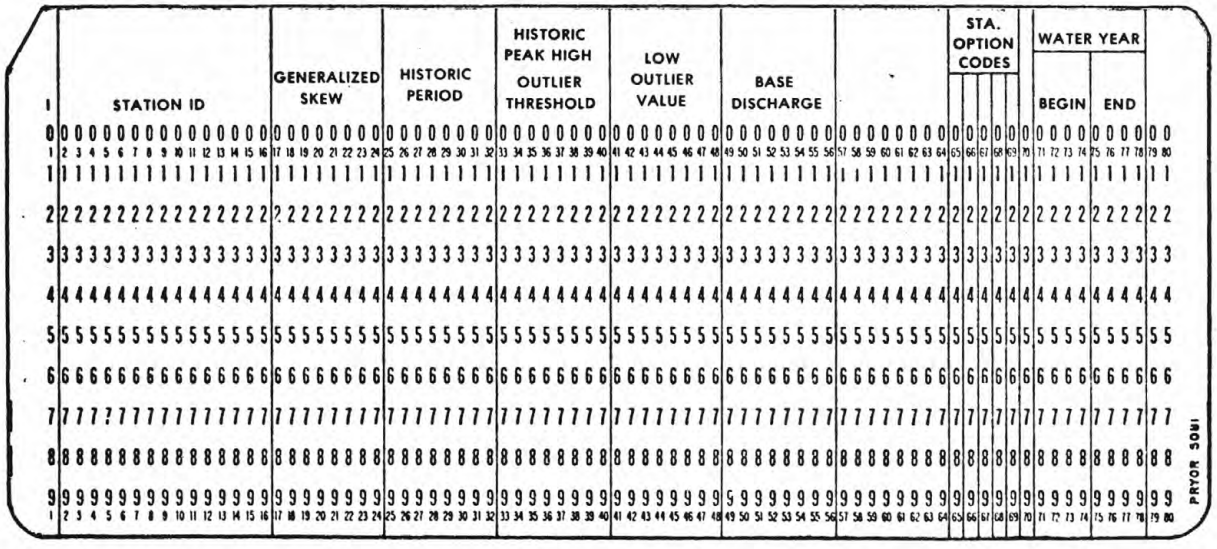


Figure 3. Station identification card (I card)

Columns	Contents
1	Always I.
2-16	Station identification number, right justified. This field may be left blank on the first I card of a retrieval, in which case the auxiliary data specified will be applied to all stations without matching I cards.

Columns	Contents
17-24	Generalized skew. If not specified, the generalized skew will be read by the computer based on gage latitude and longitude. Skew values are the generalized values given on the skew map accompanying the WRC guidelines. (Refer to sec. C.4.e for explanation of generalized skew.)
25-32	Historic period. A positive value must be supplied in order for the historic adjustment to be applied. The historic period contains the systematic record period as a subset.
33-40	Historic-peak-high-outlier threshold. Used only in conjunction with the historic period; the discharge is used, when necessary, to identify the peaks to which the historic adjustment must be applied. This should not be specified unless one of the following conditions exists: • A systematic peak is to be treated as a high outlier and there are no historic peaks smaller than the systematic peak, in which case the threshold should be set just below the high outlier. • Historic peaks exist that may have been exceeded by unrecorded peaks in the historic period, in which case the threshold should be set at a level above which the historic record is known to be complete. (The below-threshold historic peaks will be ignored.)
41-48	User-specified low-outlier criterion. This criterion, if a positive number, will override the WRC-computed low outlier threshold. A blank, negative value, or zero will be ignored.
49-56	Gage base discharge. This discharge, if a positive number, will supersede the gage base inferred from the "less than" qualification codes of the input peak flow records. A blank, negative value, or zero will be ignored.
57-64	Blank.

Columns	Contents
65-69	Station-option codes selected from the following list. The codes may be in any order or combination and may be punched in any available column. In case of conflict, the rightmost code is used. The available options are: S - Station-skew option. Causes the station skew, after historic and outlier adjustments, rather than the WRC weighted skew, to be used for the final frequency curves. G - Generalized-skew option. Causes the generalized skew, rather than the WRC weighted skew, to be used for the final frequency curve. K - Known regulation/urbanization input option. Allows peaks with the known regulation or urbanization codes (code 6 or C, program J407 value K) to be included in the statistical analysis. H - Historic peak input option. Allows all historic peaks to be used, whether or not they exceed the user-specified high-outlier historic-peak threshold. The program will print a warning message if it finds any below-threshold historic peaks and will lower the threshold to include them.
70	Blank.
71-74	Begin Year: first water year of record to be included in the statistical analysis; earlier years will be ignored. This value must be either blank or a four-digit number. If blank or less than the first year of the input record, no years will be dropped from the beginning of the record.

Column	Content
75-78	End year: last water year of record to be included in the statistical analysis; later years will be ignored. This value must be either blank or a four-digit number. If blank or greater than the last year of the input record, no years will be dropped from the end of the record.
79-80	Blank.

Figure 4 is a sample listing of the input cards necessary to run program J407.

```
         1         2         3         4
1234567890123456789012345678901234567890123456
M
XJ407    $JOB  INPUT - OUTPUT  EXAMPLE
XJ407    $OPTBCPU
I        01091500          100.
```

Figure 4. Sample listing of program input cards

C.2.f. Cataloged JCL Procedure

Program J407 is executed using the cataloged procedure PKWRCA--Peak Flow File WRC Annual Flood Frequency Analysis--following cataloged procedure PEAKRET (described in section B). Both procedures are stored in the WATSTORE system library, WRD.PROCLIB. Before procedure PKWRCA is used, the Peak Flow File retrieval program must be executed to retrieve the peak flow records and merge them with any program control options and auxiliary flood-frequency information. All input cards, specifically M, X, and I cards, are input to the retrieval program. The retrieval program processses these cards and produces two temporary output data sets, which contain all the control information and data used by program J407. These data sets are retrieved automatically by procedure PKWRCA.

C.2.g. Sample Job Setup

The general form of a deck setup to run program J407 using the cataloged procedure is shown below. The job includes retrieval of data from the Peak Flow File, processing of this data by program J407, and storage of punched card formatted summary data in a temporary data set for use by another program in the same job.

```
//xxxxxxxx JOB (----)
/*PROCLIB  WRD.PROCLIB
//S1  EXEC PEAKRET,AGENCY=agency
//HDR.SYSIN  DD *
         .
         .
         .
   Retrieval control cards including
   application control (X) cards for
   J407.  If more than one retrieval
   set is specified an X card must be
   supplied for each set to be
   processed by J407.
         .
         .
         .
/*
//S2       EXEC  PKWRCA
         .
         .
         .
/*
//S3       EXEC  ...  1/
// ...     DD    DSN=&&BCCARDS,DISP=(OLD,PASS)
         .
         .
         .
/*
//
$$$
```

Represents use of another computer program and the temporary punched card formatted work file.

Procedure PKWRCA provides various facilities for storing the card-image summary records produced by the BCPU option. The default option, illustrated above, creates a temporary data set named &&BCCARDS that can be used in a later step of the same job. This data set can hold the output for up to 4000 stations; any unused storage space is released.

C.2.h. Saved Data Set

To save a data set for use in a later job, a permanent data set may be created in the computer public online storage system as follows:

```
//  EXEC PKWRCA,BCDS='userid.data.set.name',BCU=ONLINE
```

in which the BCDS parameter assigns a name to the data set in accordance with the standard naming conventions. (Use of the public storage system requires prior registration with the U.S. Geological Survey Computer Center Division and use of the assigned user-identification symbol userid.) The data set will be cataloged, so it can be referenced in a later job by means of a DD statement of the following form:

```
//ddname  DD  DSN=userid.data.set.name,DISP=SHR
```

The data may be added to a preexisting data set by specifying the BCDS and BCDISP paramters and, if necessary, the BCU and BCVOL parameters, as follows:

```
//EXEC  PKWRCA,BCDS='data.set.name',BCDISP=MOD,BCU=3330,BCVOL=packno
```

in which BCU and BCVOL specify the unit type and volume serial number (used only if the data set is not cataloged) of the storage device. To reuse the data set, over-writing any data previously stored, replace BCDISP=MOD by BCDISP=OLD.

Finally, users having access to a card punch or similar device may get their output punched by specifying the parameter BCOUT=SYSOUT, as follows:

```
//  EXEC  PKWRCA,BCOUT=SYSOUT
```

The card images can be printed, rather than punched, by specifying the additional parameter SYSOUT=A, as follows:

```
//  EXEC  PKWRCA,BCOUT=SYSOUT,SYSOUT=A
```

C.2.i. Execution Time and Output Volume

Program J407 uses 1.0 to 2.0 CPU seconds (IBM 370/155) per station record analyzed. The 2-second estimate is an upper bound for very long records; a station with 40 years of record takes about 1.25 sec. The default run time of 1 minute is adequate for 30-40 stations. Much of the time is spent in preparing and printing the probability plot and the time can be reduced by 1) bypassing the plot, 2) not applying the expected-probability adjustment, and 3) not printing the input peaks and their probability plotting positions.

The program produces about 60 printed lines in tables and messages per station processed, plus another 60 lines per station for probability plots, plus 1 line per station-year of record when the input peaks and probability plotting positions are printed. The printed output from the retrieval program will add another line per station year if not suppressed. Thus an allowance of 2000 printed lines is sufficient for somewhat under 10 stations. Punched output, if requested, is 3 cards per station processed.

C.2.j. Example Job Decks

The example job decks shown in figure 5 illustrate typical usage of program J407. The first deck is the one used to obtain the sample output presented later in figure 6.

In the second deck, a group of stations is processed using tabulated values of generalized skew and no historic information. The card-image summary is saved in a permanent data set. After inspecting the results of this run, the analyst decides to treat the lowest peak at one station as a low outlier and to supply historic information for another station; the remaining results are satisfactory as they are. The historic information is obtained from the "highest since" column of the retrieval listing.

The third deck reruns the two stations, adding the summary records to the end of the data set created in the first run.

The fourth deck illustrates how the resulting data set could be used to update a file similar to the U.S. Geological Survey streamflow/basin characteristics file; the second set of summary records for the rerun stations supersedes the first set.

SAMPLE JOBS -- PKWRCA/J407

```
/*RELAY  PUNCH RE#
//........ JOB (.........)
/*PROCLIB  WRD.PROCLIB
//     EXEC     PEAKRET,AGENCY=USGS
//HDR.SYSIN  DD  *
M
XJ407   $JOB  INPUT - OUTPUT  EXAMPLE
XJ407   $OPTBCPU
I       01091500          100.
//     EXEC     PKWRCA
//     EXEC     FORTRUN,PROG=MYPRINT,ULIB='MYOWN.LOADLIB'
//SYSIN  DD   DSN=&&BCCARDS,DISP=SHR
//
$$$


/*RELAY  PUNCH RE#
//........ JOB (.........)
/*PROCLIB  WRD.PROCLIB
//     EXEC     PEAKRET,AGENCY=USGS
//HDR.SYSIN  DD  *
M
XJ407   $JOB  EXAMPLE 1 - RUN STATION RANGE
XJ407   $OPTBCPU
S       02482500       02483000
//  EXEC  PKWRCA,BCDS='USERID.BCPUNCH.DATA',BCU=ONLINE
//
/$$$


/*RELAY  PUNCH RE#
//........ JOB (.........)
/*PROCLIB  WRD.PROCLIB
//     EXEC     PEAKRET,AGENCY=USGS
//HDR.SYSIN  DD  *
M
XJ407   $JOB  EXAMPLE 2 - RERUN SELECTED STATIONS
XJ407   $OPTBCPU
I       02482550          105.
I       02482900                              11.0
//  EXEC  PKWRCA,BCDS='USERID.BCPUNCH.DATA',BCDISP=MOD
//
/$$$


/*RELAY  PUNCH RE#
//........ JOB (.........)
//     EXEC     FORTRUN,PROG=MYFILEUP,ULIB='MYOWN.LOADLIB'
//FT11F001 DD  DSN=MYOWN.BCFILE,DISP=MOD
//SYSIN  DD  DSN=USERID.BCPUNCH.DATA,DISP=SHR
//*  REMOVE THE DATA SET AFTER SUCCESSFUL USE
//*  ELSE RETAIN FOR ANOTHER TRY
//     EXEC     PGM=IEFBR14,COND=(0,LT)
//DDD  DD      DSN=USERID.BCPUNCH.DATA,DISP=(OLD,DELETE)
//
/$$$
```

Figure 5. Sample listings of job decks

C.2.k. Stand-alone Operation

Program J407 can process annual peak flow data not stored in the online Peak Flow File; the data are made available to program J407 through a special card-image format. The program options and principles of computation are the same as in the retrieval mode of operation explained herein with minor differences in the input requirements. The main difference is that the user has to select each systematic and historic peak to be analyzed and has to supply all auxiliary data such as generalized skew and gage base discharge. The following paragraphs describe the deck setup and card formats used for stand-alone operation; the definitions of the various options and data elements are the same as for the retrieval mode of operation.

The parameters defining the output data set (basin-characteristics card) are used the same way as in the retrieval operation mode. Similarly, the estimates for computer time and printed and punched ouput volumes would be the same as in the retrieval operation mode.

C.2.k.(1) Program Control Cards

The program control cards used in the stand-alone mode have the same functions and similar formats as those used in the retrieval mode. In contrast to the retrieval mode, the control cards can be omitted entirely if none of the default options have to be overridden (see sec. C.2.b). The alternate format of the job title card follows:

Job Title Card ($JOB Card)

Columns	Contents
1-4	Always $JOB.
5-12	Blank.
13-52	User-specified job-identification information, 40 characters maximum.
53-80	Blank.

The alternate format of the program option card follows:

Program Option Card ($OPT Card)

Columns	Contents
1-4	Always $OPT.
5-12	Blank.
13-16,25-28,37-40	Three 4-column fields for program control options.
41-80	Blank.

C.2.k.(2) Station Record Cards

The station record cards are used to enter the systematic and historic annual peak flow records and to supply necessary auxiliary information. To code these cards, the user must perform much the same work done automatically by the program in the retrieval operation mode. The record for each station consists of a station name card, followed by one or more systematic-record data cards, followed by an optional historic/outlier data card. The formats of the station record and systematic record data cards are described below.

Station Name Card

Columns	Contents
1-52	Station name, beginning with an alphabetic character in column 1. If desired, the beginning and ending years of record may be noted in the field.
53-57	Gage base discharge. If blank, a value of 0.0 will be used.
58-62	Generalized skew. Usual procedure is to enter the value read from the generalized skew map accompanying the WRC guidelines based on station location. If left blank, a value of 0.0 will be used.
63-67	Station-option codes from the following list. The codes may be punched in any available columns in this field.

Columns	Contents
63-67 (cont.)	G - use the generalized skew, rather than the WRC-recommended (weighted) skew as the skew of the final frequency curve. S - use the station skew, rather than the WRC-recommended (weighted) skew as the skew of the final frequency curve. H - read historic and outlier information from a historic/outlier data card following the systematic-record data cards.
68-70	Number of annual peak discharges specified on subsequent systematic-record data cards, right justified.
71-78	Station identification code. For U.S. Geological Survey stations, the 8-digit downstream-order station number.
79-80	Peak description code. Arbitrary 2-character symbol.

Systematic Record Data Card

Columns	Contents
1-70	Annual peak discharges in the systematic record, entered in ten 7-column fields per card on as many cards as needed. All 10 fields must be coded (except on the last card for the station). Peaks below the gage base must be entered, although they may be entered as zeroes or blanks. Blank fields are evaluated as 0.0. Fields containing -888888 or -999999 are interpreted as unknown discharges to be printed; other negative values are skipped over (and the systematic peak count reduced) without comment.
71-78	Station identification code; identical to that on the station name card.
79-80	Peak description code; identical to that on the station name card.

Historic/Outlier Data Card

This card is used only if the historic data option is specified on the station name card.

Columns	Content
1-7	User-specified low outlier criterion to override the WRC-computed criterion. To set the criterion, a positive number must be specified; nonpositive values are ignored. Blanks are interpreted as zeroes. A plus or minus sign may appear in column 1; it is interpreted in the usual way as part of the number.
8-14	High outlier criterion. To set the criterion, specify a positive number; a blank, zero, or negative values are ignored. If historic peaks are being entered, this field should be blank unless certain systematic peaks smaller than the smallest historic peak are to be treated as high outliers.
15-21	Historic period, in years.
22-28	Number of historic peaks (maximum of 16).
29-70	Historic peak discharges (first six or fewer) in up to six 7-column fields. If more than six historic peaks are to be used, enter the remainder (up to 10 more, for a total of 16) in the systematic-record format (ten 7-column fields) on the next card.
71-78	Station identifier code; identical to that on the station name card, or may be left blank.
79-80	Peak description code; identical to that on the station name card, or may be left blank.

C.2.k.(3) Cataloged JCL Procedure for Stand-alone Operation

The stand-alone operation mode of J407 is invoked by cataloged procedure PKWRCA with the additional parameters RETR and REGION coded on the EXEC statement. A typical deck setup follows:

```
Col. 1      Col. 12

.           .
//xxxxxxxx JOB (----)
//S1        EXEC PKWRCA,RETR=DUMMY,REGION=136K
//SYSIN     DD   *
     program control cards (optional)
     station record cards (one or more stations)
           .
           .
           .
     additional sets of program control cards and station record
     cards, as desired
/*
//
```

C.3. Program Output

Program J407 prints tables of the WRC-estimated log-Pearson Type III flood frequency curve and of the supplementary systematic-record and expected-probability curves and confidence limits. These results are supported by listings of the input peak flows and user-supplied auxiliary information. The program also produces a printed probability plot of the estimated frequency curve and the observed peak flows. The empirical probability plotting positions of the observed peaks also are printed. Sample printed results are given in figure 6. The program also can write a summary of the results in a punch-card format (see sec. C.3.g.).

The statistical and hydrologic significance of the various output data elements is explained in section C.4. "Principles of Computation".

PGM J407 VER 3.1
(REV 06/22/79)

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
FOLLOWING WRC GUIDELINES BULL. 17-A.

INPUT - OUTPUT EXAMPLE
RUN-DATE 7/ 3/79 AT 1207 SEQ 1.0001

OPTIONS IN EFFECT -- PLOT RCPU LGPT NODB PPOS NORS EXPR CLIM

STATION - 01091500/USGS PISCATAQUOG RIVER NEAR GOFFSTOWN, NH 1936-1977 * HISTORIC * 01091500/USGS

I N P U T D A T A S U M M A R Y

-- YEARS OF RECORD -- SYSTEMATIC	HISTORIC	HISTORIC PEAKS	GENERALIZED SKEW	SKEW OPTION	GAGE BASE DISCHARGE	USER-SET OUTLIER CRITERIA HIGH OUTLIER	LOW OUTLIER
38	100	2	0.577	WRC WEIGHTED	0.0	--	--

********* NOTICE -- PRELIMINARY MACHINE COMPUTATIONS. *********
********* USER RESPONSIBLE FOR ASSESSMENT AND INTERPRETATION. *********

**WCF109W-PEAKS WITH MISSING-DISCHARGE CODES WERE BYPASSED. 16
**WCF113W-NUMBER OF SYSTEMATIC PEAKS HAS BEEN REDUCED TO NSYS = 22
WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE. 0.0
WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION. 1106.1
WCF165I-HIGH OUTLIERS AND HISTORIC PEAKS ABOVE HHBASE. 0 2 19899.9
WCF002J-CALCS COMPLETED. RETURN CODE = 2

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE DISCHARGE	FLOOD BASE EXCEEDANCE PROBABILITY	LOGARITHMIC MEAN	LOGARITHMIC STANDARD DEVIATION	LOGARITHMIC SKEW
SYSTEMATIC RECORD	0.0	1.0000	3.5379	0.2206	-0.520
W R C ESTIMATE	0.0	1.0000	3.5536	0.2410	0.157

ANNUAL FREQUENCY CURVE ORDINATES -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	W R C ESTIMATE	SYSTEMATIC RECORD	'EXPECTED-PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR W R C ESTIMATES LOWER	UPPER
0.9950	929.3	729.4	795.8	557.8	1285.7
0.9900	1048.8	875.6	929.6	653.2	1422.2
0.9500	1472.7	1397.8	1388.2	1012.1	1896.1
0.9000	1774.1	1761.0	1696.6	1281.4	2229.9
0.8000	2234.0	2290.7	2182.6	1703.9	2744.9
0.5000	3526.1	3605.5	3526.1	2880.2	4308.1
0.2000	5680.4	5332.7	5829.9	4626.0	7433.9
0.1000	7349.1	6391.2	7741.7	5833.9	10223.2
0.0400	9733.4	7621.8	10600.6	7436.9	14622.4
0.0200	11711.6	8463.6	13275.5	8694.6	18575.3
0.0100	13864.8	9246.0	16204.7	10009.9	23144.8
0.0050	16212.5	9978.3	19935.0	11394.1	28407.8
0.0020	19646.3	10880.2	26087.5	13344.6	36573.3

Figure 6. Sample printed output from program J407.

PGM J407 VER 3.1
(REV 06/22/79)

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
FOLLOWING WRC GUIDELINES BULL. 17-A.

INPUT - OUTPUT EXAMPLE
RUN-DATE 7/ 3/79 AT 1207 SEQ 1.0001

STATION - 01091500/USGS PISCATAQUOG RIVER NEAR GOFFSTOWN, NH 1936-1977 * HISTORIC * 01091500/USGS

********* NOTICE -- PRELIMINARY MACHINE COMPUTATIONS. *********
********* USER RESPONSIBLE FOR ASSESSMENT AND INTERPRETATION. *********

INPUT DATA LISTING

WATER YEAR	DISCHARGE	CODES
-1936	19900.0	H
-1938	21900.0	H
1940	4920.0	
1941	1780.0	
1942	6760.0	
1943	1920.0	
1944	6530.0	
1945	3170.0	
1946	2800.0	
1947	2040.0	
1948	4650.0	
1949	1480.0	
1950	2430.0	
1951	4120.0	
1952	5340.0	
1953	5170.0	
1954	4280.0	
1955	2350.0	
1956	3800.0	
1957	1210.0	
1958	3540.0	
1959	4860.0	
1960	6840.0	
1961	-2510.0	K
1962	-4320.0	K
1963	-3880.0	K
1964	-2150.0	K
1965	-1040.0	K
1966	-1610.0	K
1967	-3090.0	K
1968	-3180.0	K
1969	-3660.0	K
1970	-4310.0	K
1971	-2040.0	K
1972	-2730.0	K
1973	-3790.0	K
1974	-3850.0	K
1975	-4220.0	K
1976	-2040.0	K
1977	4910.0	

EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	W R C ESTIMATE
-1938	21900.0	--	0.0099
-1936	19900.0	--	0.0198
1960	6840.0	0.0435	0.0468
1942	6760.0	0.0870	0.0909
1944	6530.0	0.1304	0.1350
1952	5340.0	0.1739	0.1791
1953	5170.0	0.2174	0.2232
1940	4920.0	0.2609	0.2673
1977	4910.0	0.3043	0.3114
1959	4860.0	0.3478	0.3555
1948	4650.0	0.3913	0.3996
1954	4280.0	0.4348	0.4437
1951	4120.0	0.4783	0.4878
1956	3800.0	0.5217	0.5320
1958	3540.0	0.5652	0.5761
1945	3170.0	0.6087	0.6202
1946	2800.0	0.6522	0.6643
1950	2430.0	0.6957	0.7084
1955	2350.0	0.7391	0.7525
1947	2040.0	0.7826	0.7966
1943	1920.0	0.8261	0.8407
1941	1780.0	0.8696	0.8848
1949	1480.0	0.9130	0.9289
1957	1210.0	0.9565	0.9730
1965	-1040.0	--	--
1966	-1610.0	--	--
1971	-2040.0	--	--
1976	-2040.0	--	--
1964	-2150.0	--	--
1961	-2510.0	--	--
1972	-2730.0	--	--
1967	-3090.0	--	--
1968	-3180.0	--	--
1969	-3660.0	--	--
1973	-3790.0	--	--
1974	-3850.0	--	--
1963	-3880.0	--	--
1975	-4220.0	--	--
1970	-4310.0	--	--
1962	-4320.0	--	--

Figure 6. Sample printed output from program J407 (continued).

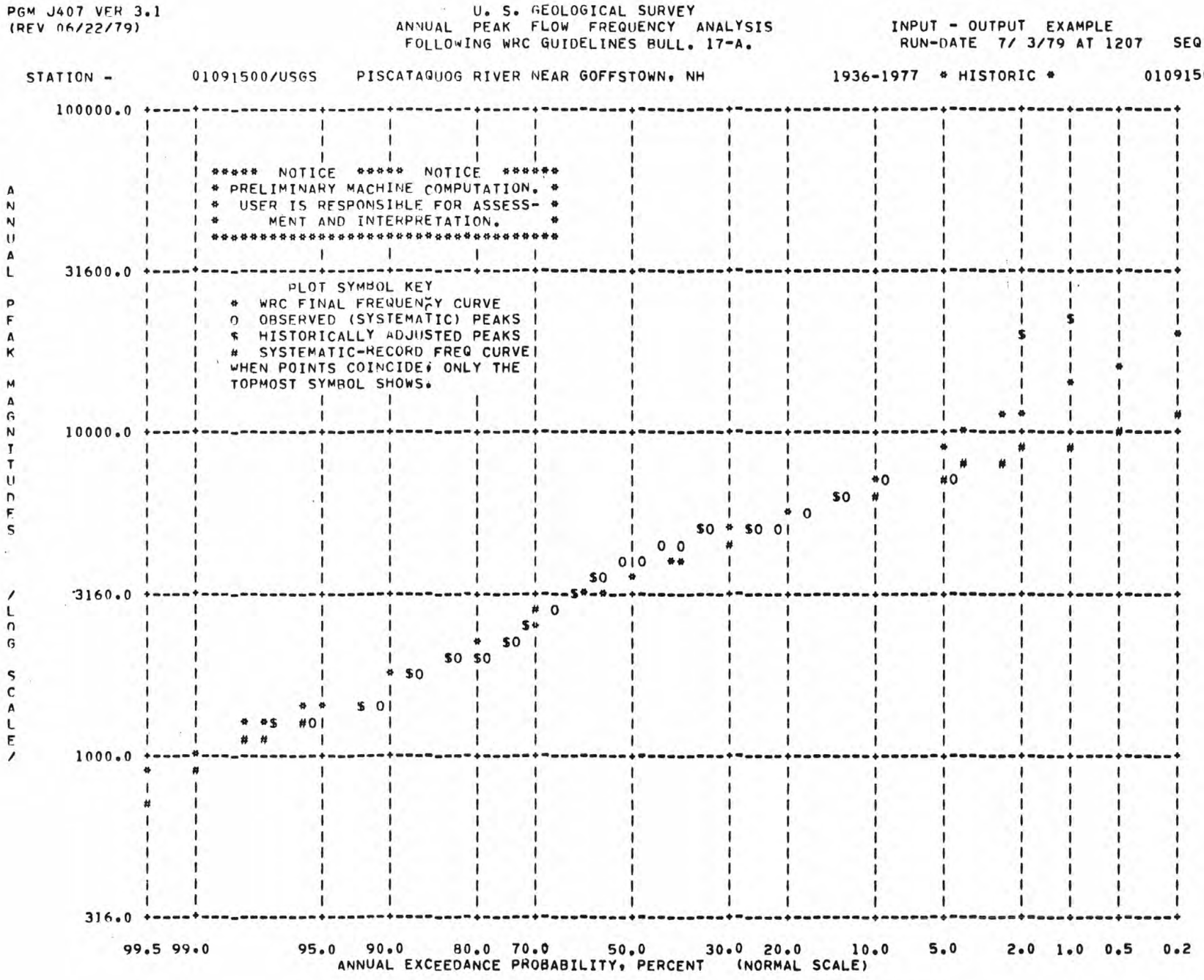


Figure 6. Sample printed output from program J407 (continued).

C.3.a. Station and Program-Run Information

The following information is printed at the top of each computer printout page to identify the station and the program run:

- Version number and last revision date of the program and the current edition mumber of WRC guidelines.
- A user-supplied job title (optional), computer run date and time, and a run sequence number, all in the upper right corner. The run sequence number is provided for convenience in thumbing through multistation printouts.
- The station identifier and agency code, the station name, and the first and last years of record analyzed. When historic information is present, a notation follows the years of record.
- A list of program options appears only on the first page for each station. The meaning of each option was explained in an earlier section on program control options.

C.3.b. Input Data Summary

A summary of the input data is printed for each station. The summary includes:

- Number of years of systematic record, which equals the number of systematic annual peaks. The user is responsible for finding and investigating any gaps in the systematic record and filling them in, if appropriate.
- Number of years of historic record. The historic record period contains the entire systematic record plus one or more years from before, after, or during gaps in the systematic record. A value of zero means that no historic period has been specified and that no historic adjustment has been performed.
- Number of historic peaks. The historic peaks have been isolated and made available to the program separately from the systematic record. This count does not include any high outliers.

- Generalized skew and skew option. The generalized skew is estimated skew based on experience at nearby stations. It is used to improve the reliability of the skewness computed from the station data. Unless otherwise specified by the user, this value is selected on the basis of gage latitude and longitude using the generalized skew given in the WRC guidelines (the map is stored in the computer in digitized form). The normal skew option is to use the WRC-recommended weighted average of station and generalized skews to compute the final WRC frequency curve. Alternatively, this field may indicate that either the station skew or the generalized skew has been adopted for the final curve.

- Gage base discharge. This is a lower limit of observation at the station. Annual peaks below this limit cannot be measured although the fact that they are below this limit can be observed. Unless set by the user at a value greater than zero, the gage base automatically is set equal to the largest input peak having a "less than" qualification code (or to zero if there is no such input peak).

- User-set outlier criteria. The low-outlier criterion, if set by the user, overrides the standard WRC outlier criterion. The high-outlier criterion, if set, isolates and identifies one or more high outliers in the systematic record. If the high-outlier criterion is not specified, the program automatically gives the proper historic treatment to any systematic peaks exceeding the smallest historic peak.

C.3.c. Description of Error and Advisory Messages

Program J407 checks for various errors and questionable conditions during both the data-input and computational phases. When such conditions are detected, the program prints a message and attempts to continue the computations. When severe errors are found, the program abandons the computations with the current station and attempts to resume computations at the next input station.

Program J407's messages generally are of the form

*** iiinnn - message text data values

in which the number of asterisks indicates the severity of the condition, the identifier iii identifies the general part of the program producing the message, and the number nnn (which is absent from some messages) usually identifies the specific message. Identifiers beginning with PKF and INP refer to data-input processing, whereas WCF refers to the flood-frequency computations. The message text is a brief description of the condition detected and the data values are the numerical values of variables referred to in the message text.

A listing of error and advisory messages produced by program J407 is given in section C.3.h. A few routine messages appear frequently, and they deserve special mention.

MESSAGES WCF133 and WCF134 report the presence or absence of peaks below the gage base. The gage base discharge and number of peaks below the base, if any, are printed.

MESSAGES WCF165 and WCF163 report the presence or absence of historic information. If historic information is present, the numbers of high outliers and historic peaks and the high-outlier-historic threshold discharge are printed.

MESSAGES WCF198 and WCF195 report the presence or absence of low outliers. The low outlier threshold and the number of peaks below it are printed.

MESSAGES WCF109 and WCF113 report that certain peaks in the input record had discharge-qualification codes that prevented their being treated as part of the systematic record. The number of peaks bypassed for this reason and the corrected number of systematic peaks are printed. This message calls attention to historic peaks, peaks with undefined discharge values, and similar conditions requiring knowledgeable hydrologic interpretation. See also the description of the input data listing, below.

A disclaimer printed on each page indicates that the computer can do only arithmetic and the analyst must interpret the outcome of the flood-frequency analysis. At the end of the job, the program prints a summary of the number of stations processed successfully, the number of stations that could not be processed because of errors in calculation, the number of stations or groups of stations that could not be read on input, and the total number of station-years processed.

C.3.d. Frequency Curve Tabulations

The WRC-estimated and systematic-record frequency curves are defined by five parameters (explained in section C.4., "Principles of Computation"). They are: 1) flood base, Q_o, 2) flood base exceedance probability $\tilde{P}_o$, 3) log-mean $\hat{M}$, 4) log-standard deviation $\hat{S}$, and 5) the skew coefficient.

The flood base, Q_o, is the lower limit of discharge for which the frequency curve is defined. It is the gage base discharge (or zero) unless low outliers are detected, in which case the flood base of the WRC curve is set at the low-outlier criterion. The flood base exceedance probability, $\tilde{P}_o$, is the fraction of all peaks above the flood base. (The point Q_o, $\tilde{P}_o$ in general does not lie exactly on the frequency curve.) The logarithmic mean and standard deviation are the "synthetic" values $\hat{M}$ and $\hat{S}$ that reflect the conditional probability adjustment (if one was performed); they reflect the presence of any peaks below the flood base. The mean and standard deviation of the above-base peaks are not printed because they give a biased picture that conflicts with the tabulated curve; a special program option can be used to print them if desired. The WRC-estimated and systematic-record frequency curves both have the log-Pearson Type III shape; they can be reconstructed using the tabulated logarithmic mean, standard deviation, and skew and the standard Pearson Type III tables.

The WRC-estimated frequency curve is the principal output of this program. The other curves are provided for use in assessing and interpreting the WRC curve. The systematic-record frequency curve is the preliminary estimate from which the WRC curve is derived by means of historic, outlier, and generalized-skew adjustments. The expected-probability curve is a refinement of the WRC curve that attempts to provide an unbiased estimate of the p-probability flood. This curve is more variable than the WRC curve, yielding larger estimates than the WRC curve for floods above the median and smaller estimates for floods below the median. The confidence limits are the estimated upper and lower bounds on the population p-probability floods. Although the limit computed from any given sample may fail to bound the population value, the limits computed from the stated proportion of a large number of samples will in fact be correct bounds. The confidence limits tabulated are one-side limits with the stated confidence level.

C.3.e. Input Data Listing and Probability Plotting Positions

A listing of the input data water years, discharges, and selected discharge qualification codes is printed. This listing supplements any listing produced by the peak file retrieval program and documents Program J407 treatment of qualified-discharge peaks. In addition, the probability plotting positions of the observed peaks, before and after any WRC adjustments, are provided to supplement Program J407 line-printer probability plots. These listings may be suppressed, if desired, to reduce the volume of printout.

Program J407 uses the following conventions in listing the input data:

- Peaks with certain discharge qualification codes are printed with mnemonic codes as follows:

Peak file Code	J407 Code	Meaning
3	D	Dam failure or nonrecurrent flow anomaly
8	G	Actual discharge was greater than stated value
3 + 8	X	Both of the above
7	H	Historic peak
6 or C	K	Discharge was subject to regulation or urbanization
4	L	Actual discharge was less than stated value

- Peaks with undefined discharge values are printed as -999999 and are excluded from the statistical analysis.

- Peaks with the J407 qualification code L (code 4, discharge less than stated value) are used to determine the gage base discharge. The base is set equal to the largest of the L-coded peaks, unless otherwise specified by the user.

- Peaks coded with D, G, or X (codes 3 and 8, dam failures and actual discharges exceeding recorded values) are given negative signs, which causes them to be excluded from the statistical analysis. Dam failures are excluded because they are assumed to be irregular and nonrecurrent events, unrepresentative of future flood risk. Peaks with actual discharges exceeding the stated values are excluded because the stated values may grossly misrepresent the actual discharges.

- Peaks coded with K (regulation or urbanization, code 6 or C) are given a minus sign and excluded from the statistical analysis because they are presumed to be drawn from a different population than the unregulated or unurbanized peaks. A mixed-population analysis might be required for stations with significant mixtures of regulated/unregulated (or urbanized/unurbanized) peaks. An option is available to allow K-coded peaks to be included in the analysis.

- Peaks coded with H (historic, code 7) are given a minus sign and are excluded from the analysis unless a historic period has been specified by the user. If a historic period has been specified, the water year in which the peak occurred is given a minus sign and the peak is printed at the beginning of the input data listing. There is one exception to this rule: if a high-outlier threshold has been set by the user (and station-option H has not been set), any historic peak lying below the threshold will be given a minus sign and excluded from the statistical analysis.

Any peak that has been assigned a negative sign by program J407 will cause messages WCF109 and WCF113 to appear and will be dropped from the statistical analysis.

Probability plotting positions are reported for both the systematic record (before WRC adjustments) and the WRC-estimated record. The two sets of plotting positions are identical unless historic information is present. The low-outlier and generalized-skew adjustments do not affect the plotting positions. Plotting positions are computed for low outliers, if any, but not for peaks below the gage base or zeroes, because those peaks cannot be plotted.

C.3.f. Log-Probability Plot

The computed frequency curves and observed samples can be plotted on log-probability coordinates as part of the printed output. The resolution of this plot is believed to be commensurate with the accuracy of the data plotted. The plot scale is adjusted automatically to fit on one page. The interval between grid lines on the discharge axis may be either a full log cycle or half a log cycle; in the latter case, the scale annotations of the half-cycle grid lines will be 31.6, 316., 3160., etc. Four curves are plotted, as shown in the annotation on the plot. The plotting mechanism is limited to printing only one symbol in any print-position, so only the last-plotted symbol can be shown when two or more curves cross. For example, if any of the observed data points appear to be missing from the plot, they probably are hidden under other observed data points or under the final WRC frequency curve. The probability plot is optional and may be suppressed by a program option for a significant saving in computer time and print volume.

C.3.g. Punched Output

A summary of the main results of the WRC analysis can be written in a punched-card format suitable for input to the USGS streamflow/basin characteristics file or for use by other computer programs. This output is optional and must be requested by the user. It may be directed to actual punched cards, to a printer, or to a data set on disk (or tape). A sample of this output is shown in figure 7, and is written in the following format:

Columns	Contents
1	Always contains a numeral 2.
2-16	Station identification number.
17-76	Six 10-column fields containing successive 3-digit integer parameter codes, and 7-digit real parameter values.
77-80	Blank.

Three cards are punched per station.

The assignment of parameters to fields is as follows:

```
&BCCARDS -  INPUT-OUTPUT EXAMPLE

COLUMN NO        10        20        30        40        50        60        70        80
LINE NO 123456789.123456789.123456789.123456789.123456789.123456789.123456789.123456789.1

   1.. 2       01091500 75   2230 76   3530 77   5680 78   7350 79   9730 80  11700
   2.. 2       01091500 81  13900 82  16200 83  3.538 84  0.221 85 -0.520178  19600
   3.. 2       01091500179  0.157180  3.554181  0.241196     22197     100
```

Figure 7. Sample listing of card format summary output (in streamflow/ basin characteristics file input format)

Card No.	Field No.	Parameter Code	Parameter Description
1	1-6	75-80	WRC-estimated discharges having annual exceedance probabilities of 0.80, 0.50, 0.20, 0.10, 0.04, 0.02.
2	1-2	81-82	WRC-estimated discharges having annual exceedance probabilities of 0.01, 0.005.
	3-5	83-85	Systematic-record logarithmic mean, standard deviation, and skew.
	6	178	WRC-estimated discharge having annual exceedance probability of 0.002.
3	1	179	WRC-estimated logarithmic skew coefficient.
	2-3	180-181	WRC-estimated logarithmic mean and standard deviation.
	4	196	Number of years of systematic record.
	5	197	Length of historic period, if specified by user.

The frequency curve parameters punched are the same ones printed in the frequency curve tabulations, rounded off to three significant figures.

C.3.h. Diagnostic Messages

J407 produces diagnostic messages when real or potential errors are detected. These messages are listed and are briefly explained below. Most of the messages have the following general format:

***iiinnns - text data

in which:

*** represents a variable number, possibly zero, of asterisks, to call attention to the message

iii identifies the general part of the program producing the message, as follows:

INP - input processing

PKF - reading the peak flow file retrieval records or the log-Pearson cards

WCF - flood frequency calculations following WRC Guidelines

nnn is a message number. The messages are listed below approximately in alphabetic and numerical order by identifier and number

s is a severity indicator. E means error, W means warning, I and J mean routine information, and L means listing of data or results

text is the text of the message

data is a list of number or words generally in the same order as items mentioned in the text

J407 Messages

FRQPLT WILL DROP POINTS BELOW PLOT BASE.

One or more points on the computed or empirical frequency curves fall below the lower boundary of the plot. These points will not be plotted.

IHOxxx These messages are produced by IBM FORTRAN Library routines. They should not occur; report them to WATSTORE user assistance.

INP112E GEN SKEW OUT OF RANGE station-ident gs

Input generalized skew gs has absolute value greater than 2.5. Probable error in input data. The station is rejected and the next input data set is sought, unless this message is followed by INP119E.

INP119E ATTEMPTED FIXUP -- NEW GEN SKEW = gs

This message follows INP112 if it seems possible that the input generalized skew has a misplaced decimal point. The value gs is assumed to be the intended input skew.

INP104 STA HAS INVALID AUX DATA CODE. station-ident code

COLUMNS 63-67 (Code) of the station name card contain characters not accepted by J407. The station is rejected.

INP923 STA HAS INVALID PEAK COUNTS NHIST, NSYS station-ident nhist nsys

Either the number of historic peaks (nhist) or the number of systematic peaks (nsys) was less than zero or their sum was less than or equal to zero. Probable cause -- invalid input peak counts or input cards out of order. The station is rejected.

INP971 END OF INPUT/CMD STREAM.

The end of the input data has been reached. This marks the normal end of the job.

INPD11W UNDEFINED CONTROL CARD FLUSHED. card

A control card of undefined type has been encountered. The first 52 characters of the card are printed. The card type ($JOB, $OPT) will appear in columns 1-4 and the XJ407 field in columns 5-9. Probable cause - misspelled card type or station name card with no systematic record (zero in cols 68-70). The card is ignored.

INPD18W UNDEFINED OPTIONS IGNORED. n card

A control card has been recognized and processed, but it contains one or more (n) undefined option fields. The card image is printed. The card type ($JOB, $OPT) will appear in columns 1-4 and the XJ407 field in columns 5-9. Probable cause - misspelled or misaligned options. The options that were correctly specified are in effect.

INPF13 - INVALID PLOT CARD IGNORED. card

A "plot card" of the type formerly used by J407 and other programs has been prepared incorrectly. Replace it by $JOB and $OPTION cards of the current type.

INPUT3 HISTORIC PEAKS OVERFLOWED - nhp i sta-id

The number of historic peaks (nhp) retrieved from stations (sta-id) exceeds the capacity of program J407. Probable system error; notify WATSTORE user assistance.

INPUT3 INVALID BEGIN OR END YEAR FROM I-CARD 'years' sta-id

The begin-year or end-year field on the I-card for the station (sta-id) contains illegal decimal characters; these fields are displayed between single quotes (years). Probable user error.

INPUT3 INVALID STATION OPTIONS FROM I-CARD = 'options' sta-id

Probable user error. The options specified are displayed between single quotes. Check for invalid station options on the I card for the station (sta-id) printed.

INPUT3 PEAK COUNT EXCEEDS STORAGE CAPACITY n sta-id

The number of peaks (n) retrieved from station (sta-id) exceeds the storage capacity of program J407. Probable system error; notify WATSTORE user assistance.

INPUT3 REQUESTED YEARS NOT IN RECORD - beg-yr end-yr first-yr last-yr sta-id

Probable user error. The years requested on the I-card (beg-yr, end-yr) do not overlap the years available in the record (first-yr, last yr) at the station (sta-id).

PKF Messages (Peak File Card Reader)

PKF000L card image

A listing of input data cards produced when the PKF reader is in print mode. (When J407 is in DBUG mode.)

PKF001E ILLEGAL DECIMAL CHARS ON STA-NAME CARD, n

One or more (n) non-numeric characters have been found in one of the numeric fields of the station name card. See also message PKF011E.

PKF002E INVALID STATION NAME.

The station name does not begin with an alphabetic character or dollar sign or asterisk. See message PKF011E.

PKF003E ITEM COUNT NQ OUT OF BOUNDS. nq

Columns 68-70 of the station name card contain a number nq which is less than zero or greater than the maximum number of peaks that can be stored in the program. Probable cause -- item count not right-justified on column 70. See also message PKF011E.

PKF004E ILLEGAL DECIMAL CHARACTERS ON I-TH Q-DATA CARD. n i station-ident

One or more (n) non-numeric characters have been detected in columns 1-70 of the i-th systematic record data card for the station identified. See also message PKF011E.

PKF005E ID-FIELDS MISMATCH I-TH Q-DATA CARD. i station-id

Columns 71-80 of the i-th systematic record data card do not agree with columns 71-80 of the station name card (station id). The offending systematic record data card is printed immediately above or below this message. See also message PKF011E.

PKF006E DATA ENDED BEFORE I-TH Q-DATA CARD. i station-ident.

The end of the input data set was encountered while attempting to read the i-th systematic record data card for the indicated station. Probable cause: invalid item count or lost input cards. The reader cannot recover from this error. It returns the available data and an error indicator to the calling program.

PKF008W IGNORED FLDS J-10 I-TH Q-DATA CARD. j i station-ident.

Warning only. The item count on the station name card indicated that the j-th through 10-th fields of the i-th systematic record data card contained no data, but these fields were not blank. The item count may be incorrect or the cards may be out of order. The number of data items indicated by the item count is returned to the calling program; the excess information is ignored.

PK011E An error in the input data has been detected, as explained in the preceding PKFxxx messages. The card on which the error was found is displayed in message PKF000L or PKF015E. The probable cause of all these errors is invalid item counts on the station name card or cards out of order in the input deck. The reader begins searching for the next valid station name card.

PKF015E card image.

Listing of input cards on which errors were detected, as explained by preceding messages. See also message PKF011E.

PKF203E HIST PEAK COUNT OUT OF BOUNDS. n station-ident

The historic peak count in the historic/outlier data card is less than zero or greater than the maximum allowable number of historic peaks. See also message PKF211E.

PKF204E ILLEGAL DECIMAL CHARS ON THE I-TH H-DATA CARD. n i station-ident.

One or more (n) non-numeric characters have been detected in columns 1-70 of the i-th historic/outlier data card of the station identified. See also message PKF211E.

PKF205E ID-FIELD MISMATCH I-TH H-DATA CARD i station-ident.

Columns 71-78 of the i-th historic/outlier data card conflict with the corresponding columns on the station name card for the station identified. The offending historic/outlier card is printed immediately above or below this message. See also message PKF211E.

PKF206E DATA ENDED BEFORE I-TH H-DATA CARD i station-ident.

The end of the input data set was encountered while attempting to read the i-th historic/outlier data card for the station identified. See also message PKF211E.

PKF211E HISTORIC DATA RETRIEVAL FAILED.

An error in the historic/outlier data has been detected, as explained in preceding messages. The card in which the error was found is displayed by message PKF0001 or PKF015E. The probable cause of all these errors is incorrect counting of historic peaks, incorrect placement of data on the cards, or cards out of order. The reader passes the available data and an error indicator back to the calling program. (J407 rejects the station and searches for the next station.)

PKFQV3 ERROR-END OF VECTOR FILE.

PKFQV3 ERROR-FILES SCRAMBLED.

PKFQV3 ERROR-UNKNOWN CONTROL RECORD.

All three messages mean that the data sets received from the peak file retrieval program do not conform to the expected format. Check the retrieval program and JCL listings for error messages before calling WATSTORE user assistance.

WCF001J FLOOD FREQUENCY, WRC BULL. 17. VER n.n(dddddd).

Unedited machine computations. User is responsble for interpretation and use.
n.n (dddddd) = version number and date of last revision.
Normal beginning-of-job message, if requested.

WCF002J CALCS COMPLETED. RETURN CODE = n

Normal end-of-job message. Return codes: 0 = no error detected. 1 = non-standard data accepted, 2 = warning -- calculations completed, but results may be incorrect.

WCF003E CALCS ABORTED. RETURN CODE = 3.

WCF ... Routines were unable to complete the calculations for reasons explained in previous messages.

WCF101L INPUT PARAMETERS - GENSKU OPT GAGEB QLWOUT QHIOUT NHIST HISTPD
xxx xxx xxx xxx xxx xxx xxx

Routine listing of input data, if requested.

WCF102E INVALID INPUT PEAK COUNTS. NPK,NHIST = nnn nnn

Either the number of historic peaks (NHIST) is negative or the total number of input peaks is less than NHIST. Probable error in counting input peaks.

WCF103L INPUT PEAKS, HISTORIC FIRST. TOTAL NO. = nnn

Routine listing of input data, if requested.

WCF104L INPUT LOG PKS, HISTORIC FIRST. TOTAL NO. = nnn

Routine listing of input data, if requested.

WCF1071 ACCEPTED GENSKEW OUTSIDE MAP LIMITS GS m1 m2

Input generalized skew GS was outside range of values (m1, m2) set at program installation time. (Limits of WRC skew map.)

WCF109W PEAKS WITH MISSING-DISCHARGE CODES WERE BYPASSED. nnn

nnn negative input peaks were found. These are assumed to be codes for unknown discharges. These peaks are ignored in the computations, but large negative values are stored in corresponding locations in output logarithm vector. If the input has any unknown discharges coded as negative values, ensure that these peaks legitimately can be ignored. Otherwise, incorrect input peak counts may cause this message. Warning only -- analysis continues.

WCF111E HISTORIC PEAK HAD MISSING-DISCHARGE CODE.

One of the historic peaks was negative. Probable error in input data value or count.

WCF113W NUMBER SYSTEMATIC PEAKS HAS BEEN REDUCED TO NSYS - nnn

Missing-discharge peaks were noted and have been omitted from the sample (WCF109). The correct sample size for analysis is nnn.

WCF117E NO DATA IN SYST RECORD. NSYS NPK NHIST NMISS
xxx xx xxx xxx

There is no systematic record at this station. Possible error in input data or input peak count. NPK = total number of input peaks. Others as in list of variables.

WCF118W SYSTEMATIC RECORD SHORTER THAN WRC SPEC. nnn

Systematic record length nnn is less than that specified in WRC BULL 17. Analysis proceeds, but sample size may be too small for reliable conclusions.

WCF1331 SYST PEAKS BELOW GAGE BASE WERE NOTED. nnn bbb

nnn = number of below-gage-base peaks. bbb = gage-base-discharge.

WCF1341 NO SYST PEAKS WERE BELOW GAGE BASE. bbb

WCF141E SAMPLE SIZE TOO SMALL TO CALC STATS. 111 nnn
NSYS,NBGB,NLWOUT,NHIOUT,NHISTN,HISTPN
xxx xx xx xx xx xx

Either the systematic or the WRC-adjusted record is too short for calculation of mean, variance, and skew (less than 3 items). Probable cause -- insufficient record length or excessively high gage base or user low-outlier criterion.
111 = either SYS (systematic) or WRC. nnn = effective sample size. Others as in list of variables.

WCF143E NEGATIVE VARIANCE OF LOGS. 111 vvv
111 = either SYS (systematic) or WRC. vvv = the computed variance (should be near zero). Probable cause -- roundoff error in computing near-zero variance when all input peaks are (nearly) equal.

WCF1511 WRC WEIGHTED SKEW REPLACED BY USER OPTION. www uuu

WRC weighted skew calculation (www) has been superseded by user-specified skew uuu.

WCF153E INCOMPLETE HISTORIC INFO. HI-OUT BASE NHIST HIST.PERIOD
xxxxx xx xxxxx

Probable user error -- historic period and either high-outlier criterion or one or more historic peaks must be specified, if historic adjustment is desired.

WCF157W USER HIGH-OUTLIER CRIT LOWERED TO MIN HIST PK. uuu hhh

Probable user error -- if historic peaks are given. The high-outlier base need not be set unless peaks smaller than the smallest historic peak are to be treated as high outliers. uuu=user high-outlier criterion. hhh=minimum historic peak.

WCF159E HIGH-OUT/HIST-PK BASE BELOW LOW-OUT/GAGE BASE. hhh 111

Probable user error--perhaps the high-outlier and low-outlier or gage-base data have been entered in the wrong order. hhh=high-outlier or historic base. 111=low-outlier or gage base.

WCF160E INTERNAL PROGRAM LOGIC ERROR DHH. xxx xxx

This should not occur. Contact W. Kirby, U.S. Geological Survey, WRD-NR Stop 430, Reston, Va, 22092. Phone (703) 860-6947.

WCF163I NO HIGH OUTLIERS OR HISTORIC PEAKS NOTED.

WCF164W USER-HI-OUT CRIT EXCEEDS MAX SYS PK. uuu sss

No peaks meet the stated high-outlier criterion uuu. Max systematic peak is sss. Probable user error - high outlier criterion need be specified only if one or more systematic peaks are to be treated as high outliers.

WCF165I HIGH OUTLIERS AND HISTORIC PKS ABOVE HHBASE. nho nhp hhb
Historic adjustment was applied. nho = number high outliers noted nhp = number historic peaks, hhb = high outlier/historic base flow.

WCF167E HIST PERIOD NO LONGER THAN SYS+HIST PEAKS. hhh nnn

Stated historic period hhh is no longer than actual count of observed peaks nnn. Probable user error - if both hhh and nnn are correct, there is no point in doing the historic adjustment.

WCF169I ACCEPTED HISTORIC PERIOD GTR THAN T hhh ttt

The historic period hhh may be longer than can be justified under the WRC criteria for historic information. T = 5*systematic record+ up to max of 300 yrs.

WCF171W NUMBER HI-OUT + HIST PKS EXCEEDS 10PCT OF SYS.PKS. nho nhp

Excessive numbers of historic peaks nhp and high outliers nho suggest that historic base may be set too low to ensure that every peak exceeding it has been recorded.

WCF191I USER LOW-OUTLIER CRITERION REPLACES WRC. uuu www

uuu = user low-outlier criterion, www = WRC low-outlier criterion.

WCF193E LOW OUTLIER CRITERION EXCEEDS HIGH-HIST lll hhh

Probable user error--perhaps the high-outlier and low-outlier or gage-base data have been entered in the wrong order. hhh = high-outlier or historic base. lll = low-outlier or gage base.

WCF195I NO LOW OUTLIERS DETECTED BELOW CRITERION xxxxx

No peaks above the gage base were below the low-outlier criterion. xxxxx = low outlier criterion adopted (user or WRC).

WCF197E INTERNAL PROGRAM LOGIC ERROR DLO. xxx xxx xxx

This should not occur. Contact W. Kirby, U.S. Geological Survey, WRD-NR Stop 430, Reston, Va, 22092. Phone (703) 860-6947.

WCF198I LOW OUTLIERS BELOW FLOOD BASE WERE DROPPED. nnn bbb

Peaks above the gage base and below the low-outlier criterion were noted. The flood base of the WRC frequency curve has been set at the low-outlier criterion. nnn = number of low outliers dropped. bbb = WRC flood base.

WCF199W NUMBER OF PEAKS BELOW FLOOD BASE EXCEEDS WRC SPEC. nbb bbb MAXNBB

WRC Bull 17 specifies a maximum number of peaks that may fall below the flood base for this length of systematic record. The actual number nbb of below-base peaks exceeds this limit (MAXNBB). The flood base = bbb. Warning - the calculation proceeds but the results may be unreliable.

WCF213E COND PROB ADJUST FAILED - EXCESSIVE 111 PROB BELOW BASE. ppp

The conditional probability adjustment described in appendix 4 of WRC Bull 17 cannot be performed when ppp fraction of the peaks are below the flood base. 111 = (SYS for systematic rec freq curve, in which case flood base = gage base) or WRC.

WCF215E SKEW OUT OF TABLE RANGE. 111 skw ask

One or more of the skews to be used in constructing the Pearson Type III curve for either the systematic or WRC record is out of the range of the WRC Pearson Type III table (+ or - 9.0). 111 = either SYS or WRC. SKW = skew of final freq curve. ask = station (computed) skew of above-base peaks.

WCF217L FREQ CURVE PARMS(PASGASG) 111 xxx xxxxx xxxxx xxxxx
xxxxx xxxxx xxxxx

Routine report of frequency curve parameters for curve 111 (SYS or WRC). Parameters are -- prob of exceeding base, mean and standard deviation (unconditional -- after a conditional probability adjustment, if P (BASE) is less than 1.0), skew or freq curve mean, std dev , skew of above-base peaks (before cond prob adj).

WCF219J FREQ CURVE ORDINATES 111 2-YR (.50) 10-YR (.10) 100-YR (.01)
xxxxxxx xxxxxxx xxxxxxx

Routine report of frequency curve ordinates at 2-yr, 10-yr, and 100-yr levels for 111 (SYS or WRC) frequency curve.

WCF233W EXPECTED PROB OUT OF RANGE AT TAB PROB xxxxx yyyyy

Expected-probability calculation called for table lookup at probability xxxxx beyond the limits of the computed WRC frequency curve. This message normally occurs several times when sample size is less than about 10 years and tabular probability yyyyy is less than about 0.10.

WCF237E INTERNAL PROGRAM ERROR - TDTRI. n xxxxx yyyyy

This should not occur. Contact W. Kirby, U.S. Geological Survey, WRD-NR Stop 430, Reston, Va, 22092. Phone (703)860-6947.

WCF238J FREQ CURVE WRC-EXPECT-PROB xxxxxxx xxxxxxx xxxxxxx

Routine report of 'expected-probability' frequency curve ordinates at 2-, 10-, and 100-yr levels. 'Expected-probability' curve is based on WRC frequency curve.

WCF239J FREQ CURVE CONF LIMS WRC xx.x xxxxxxx xxxxxxx xxxxxxx
xxxxxxx xxxxxxx xxxxxxx

Upper and lower confidence limits for WRC frequency curve ordinates reported in WCF219. xx.x = one-sided confidence level.

C.4. Principles of Computation

Program J407 performs statistical flood-frequency analyses of annual peak flows following procedures recommended by the U.S. Water Resources Council (WRC) (1977). The WRC guidelines contain a complete and definitive description of the recommended procedures. This section is provided to document implementation of the guidelines in program J407. Although this information is not needed to run the program, it may help to answer any questions about the interpretation or use of the calculated results.

In broadest outline, the WRC procedure characterizes flood occurrence at a single site as a sequence of annual peak flow events or trials. The magnitudes of the annual events are assumed to be independent random variables following log-Pearson Type III probability distribution; that is, the logarithms of the peak flows follow a Pearson Type III distribution. This distribution defines the probability that any single annual peak will exceed a specified discharge. Given this annual probability, other probabilities, such as the probability that a future design period will be free of exceedances, can be calculated by standard methods. (For an example, see appendix 10 of the guidelines.) By considering only annual events, the WRC guidelines reduce the flood-frequency problem to the problem of estimating the log-Pearson annual-probability curve using the record of annual peak flows at the site. This estimated curve is what program J407 computes.

C.4.a. Peak flow records

The recorded data fall into two classes: systematic and historic. The systematic record includes all annual peaks observed in the course of one or more systematic gaging programs at the site. In a systematic gaging program, the annual peak is observed (or estimated) for each and every year of the program. If the peak should be too large or too small to measure, an estimate or lower bound or upper bound on its magnitude nonetheless may be recorded; this peak is identified in the Peak Flow File with an appropriate qualification code. Several systematic records at one site can be combined, provided that the hydrologic conditions during the several record periods are comparable. The gaps between distinct systematic record periods can be ignored, provided that the lack of record in the interim was unrelated to the hydrologic conditions. Thus, if a flood record were interrupted for lack of funds for data collection, the interruption could be ignored and the available data could be used as if no interruption had occurred. On the other hand, if the record were interrupted because of prolonged drought or excessive flooding, the interruption should not be ignored but rather should be used, if possible, as evidence for adding one or more estimated peaks to the systematic record. Thus, the systematic record is intended to constitute an unbiased and representative sample of the population of all possible annual peaks at the site.

In contrast to the systematic record, the historic record consists of annual peaks that would not have been observed except for evidence indicating their unusual magnitude. Flood information acquired from old newspaper articles, letters, personal recollections, and other historical sources almost invariably refers to floods of noteworthy-and hence extraordinary--size. Similarly, the very existence of an indirect discharge determination outside a period of systematic record suggests that the determination was made because an unusually large discharge had occurred. Thus, historic records, by the conditions of their collection, form a biased and unrepresentative sample of flood experience. Despite this bias, however, the historic record can be used to supplement the systematic record provided that all historic peaks above some historic threshold have been recorded.

The systematic record may contain one or more peaks for which historic information is available or which exceed the smaller historic peaks. Such peaks are called high outliers. They are used as part of the systematic record, but also are treated like historic peaks in the historic-record adjustment procedure.

C.4.b. Systematic Record Analysis

The WRC recommended computational procedure includes six major steps, as illustrated in figure 8. The first step, represented by box ASP, is to compute the statistics of the common logarithms of the peak flows in the systematic record. At some sites, annual peaks of magnitude zero can occur; more generally, the annual peak may occasionally fall below or be equal to some lower limit of measurement called the gage base (which may be zero). To account for this possibility, the number of peaks below the gage base is computed in addition to the mean, standard deviation, and skewness of the logarithms of the above-base systematic peaks. These procedures are indicated in figure 8 as flow chart boxes CSA and FCA. The statistics of the systematic peaks serve as an initial estimate of the WRC frequency curve and are modified as necessary by succeeding steps.

C.4.c. Outlier and Historic Record Tests

The second step is to detect and make appropriate adjustments for low outliers, high outliers, and historic peaks. The sequence of these tests and adjustments depends on the station skew, G, computed in the first step. Because a large skew of either sign is likely to be caused by an outlier on the corresponding end of the sample, this possibility is checked first and any necessary adjustment is applied before checking for outliers on the other

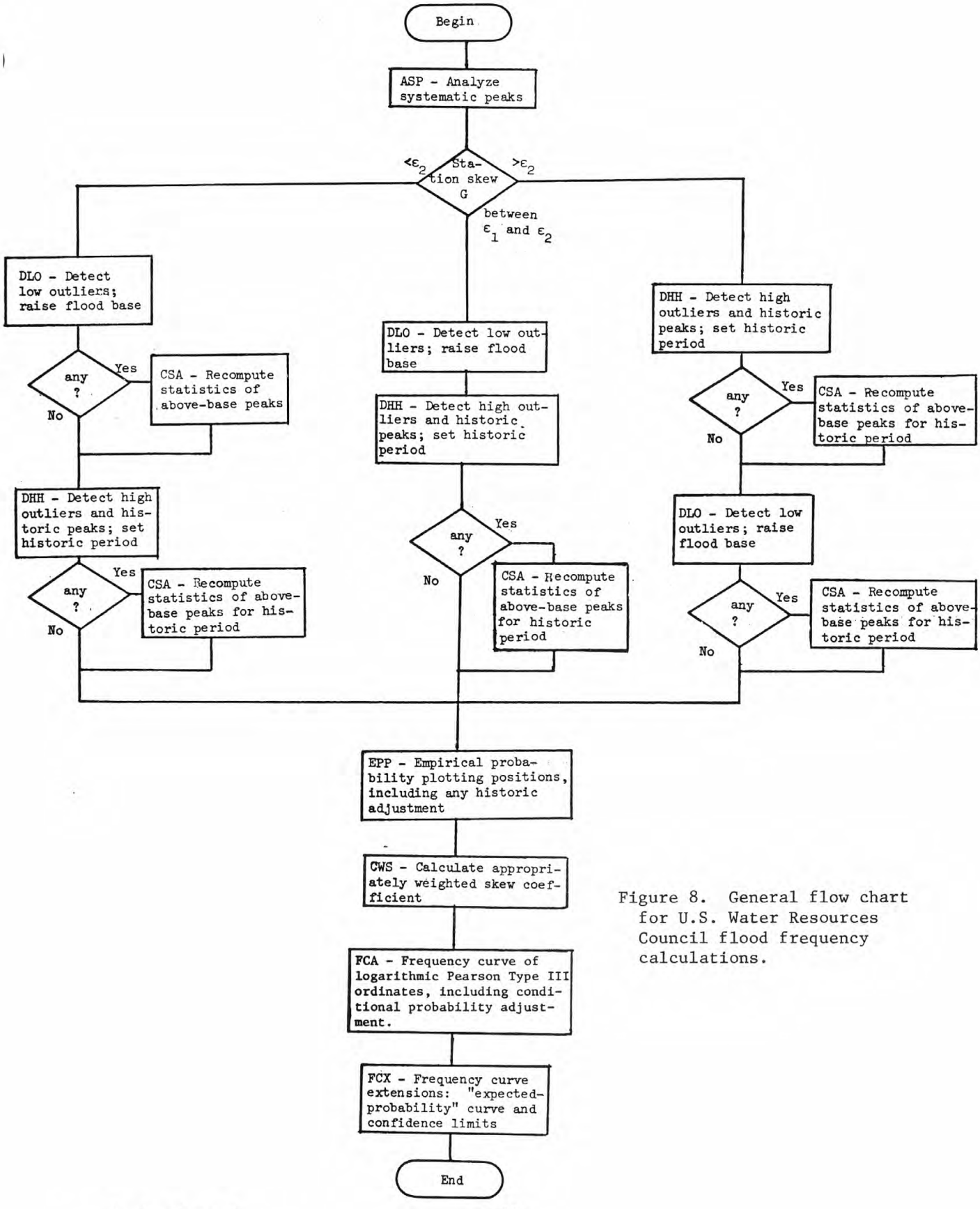


Figure 8. General flow chart for U.S. Water Resources Council flood frequency calculations.

end. If the skew is of moderate size, the existence of both high and low outliers can be checked before applying any adjustments. Program J407 detects low outliers automatically as shown in figure 8 in box DLO, using the formula specified in the WRC guidelines. At the upper end of the distribution, on the other hand, the WRC guidelines require the analyst to identify high outliers and historic peaks and to supply necessary historic information. The box DHH in figure 8 therefore simply checks to see if the user has supplied any historic information and, if so, makes it available to the next box CSA.

C.4.d. Historic Record Adjustment

Flow chart box CSA in figure 8 represents the recalculation of the statistics of the above-base peaks as required after the detection of outliers or historic information. It takes into account any zero flows or below-gage-base peaks, low outliers, high outliers, and historic peaks that have been detected, as specified in appendix 6 of the WRC guidelines. The logical basis for this calculation is the following:

> Historic adjustment criterion: Every annual peak that exceeded some historic threshold discharge (Q_H) during the historic period (H) has been recorded as either a historic peak or a systematic peak (high outlier). In other words, the record is complete for peaks above Q_H during the time period H.

The historic period H includes the systematic record period as a subset. This criterion implies that the unrecorded portion of the historic period contains only peaks below the historic threshold (Q_H). The WRC historic adjustment, in effect, fills in this ungaged period with an appropriate number of replications of the below-Q_H portion of the systematic record. This filling in is accomplished by weighting the below-threshold systematic peaks in proportion to the number of below-threshold years in the historic record, as follows:

$$W = \frac{H - N_{HP} - N_{HO}}{N_S - N_{HO}}$$

where W is the weighted time period and N_S, N_{HP}, and N_{HO} are the numbers of systematic peaks, historic peaks, and high outliers, respectively. Then the effective number of peaks, N above the flood base (Q_O) is

$$\tilde{N} = N_{HP} + N_{HO} + W(N_S - N_{HO} - N_{BB})$$

where N_{BB} is the number of peaks below the flood base, including any zeros and low outliers.

The corresponding estimated probability of a flood's exceeding the flood base is

$$P_O = \tilde{N}/H$$

Applying the historic weight W to those peaks below the historic base Q_H (and above the flood base Q_O) yields the following formulas for the historically weighted mean ($\tilde{M}$), standard deviation ($\tilde{S}$), and skewness ($\tilde{G}$):

$$\tilde{M} = (W\Sigma X + \Sigma X')/\tilde{N}$$

$$\tilde{S}^2 = \left[W\Sigma(X-\tilde{M})^2 + \Sigma(X'-\tilde{M})^2\right]/(\tilde{N}-1)$$

$$\tilde{G} = \left[W\Sigma(X-\tilde{M})^3 + \Sigma(X'-\tilde{M})^3\right]\tilde{N}/(\tilde{N}-1)(\tilde{N}-2)\tilde{S}^3$$

in which X' denotes logarithmic magnitudes of historic peaks and high outliers and X denotes logarithmic magnitudes of systematic peaks between the flood base Q_O and the historic threshold Q_H. These formulas are equivalent to those given in appendix 6 of the WRC guidelines.

These formulas remain correct even if there is no historic information (in which case $H = N_S$), no high or low outliers, and no below-gage-base peaks. Thus these formulas, in figure 8, flow chart box CSA, are used to calculate the WRC statistics under all conditions, including the unadjusted systematic-record statistics.

Flow chart box EPP in figure 8 follows the same logic: let each observed peak below the historic threshold Q_H represent an effective number W of "virtual" peaks--to arrive at the following formula for the probability plotting position of the m-th ranked observed peak:

$$\tilde{P}_m = \tilde{m}/(H + 1)$$

where

$$\tilde{m} = c_m + 1/2$$

and

$$c_m = \begin{cases} m-1/2 & \text{if } m \leq Z \quad (Z = N_{HO} + N_{HP}) \\ Z + W \cdot \left[(m-Z) - 1/2\right] & \text{if } m > Z \end{cases}$$

In this formula, $\tilde{m}$ is the historically weighted rank of the m-th largest observed peak and c_m is the centroidal position of a conceptual "cell" occupied by the peak. Cells above the historic threshold have unit width; those below have width W. The effective rank $\tilde{m}$ always is at the extreme end of a cell of unit width centered at c_m. This formula is equivalent to the one in appendix 6 of the guidelines (with a=0).

C.4.e. Weighted Skew Calculation

After taking into account any outliers and historic information, the WRC analysis next compares the calculated station skew $\tilde{G}$ with a generalized skew coefficient, $\bar{G}$, representing a skew coefficient that might be expected on the basis of experience at neighboring stations. The U.S. Geological Survey (USGS) uses the generalized skew given on the generalized skew map published in the WRC guidelines if there are no contrary indications. Flow chart box CWS (in fig. 8) simply calculates the WRC-recommended skew $\hat{G}$ as a weighted average of $\bar{G}$ and $\tilde{G}$ (historically adjusted skew) according to the weighting formula specified in the guidelines. That formula gives more weight to $\bar{G}$ than to $\tilde{G}$ when the station record is short and the station skew $\tilde{G}$ correspondingly inaccurate; it gives more weight to $\tilde{G}$ when the record is long and $\tilde{G}$ has less statistical sampling error. The guidelines allow the user to adopt either $\bar{G}$ or $\tilde{G}$ as the final skew, if desired.

C.4.f. Conditional Probability Adjustment

After flood frequency curve parameters are determined, the frequency curve is tabulated as represented in figure 8, box FCA. If no outliers or zero flows or below-gage-base peaks have been detected, this process is simply a matter of looking up the Pearson Type III standardized ordinates, $k_{g,p}$ at the desired skew, $g=\hat{G}$, and probability, p, and computing the logarithmic frequency curve ordinates by the formula

$$\log \hat{Q}_p = \tilde{M} + \tilde{S}\, k_{\hat{G},p}$$

When peaks below the flood base are present, however, the above calculation determines a conditional frequency curve $\tilde{Q}$ describing only those peaks above the base. To account for the fraction of the population below the flood base, the following argument is used: the probability that an annual peak will exceed a discharge x (above the flood base) is the product of the probability that the peak will exceed the base at all, times the conditional probability that

it will exceed x, given that it exceeds the base. The first of these factors is just the probability $\tilde{P}_0$ computed in flow chart box , figure 8; the second factor is the probability on the conditional frequency curve at discharge x. Thus the unconditional curve $\tilde{Q}^*$, assigns a probability $\tilde{P}_0 p$ to the discharge having probabililty p on the above-base curve. Conversely, an exceedance probability p on the unconditional curve $\tilde{Q}^*$ corresponds to the probability $p/\tilde{P}_0$ on the original conditional-probability curve $\tilde{Q}^*$. Thus the ordinates of the unconditional curve can be computed directly by the formula

$$\log \tilde{Q}^*_p = \tilde{M} + \tilde{S}\, k_{g,(p/\tilde{P}_0)}$$

where g is the skew of the above-base distribution.

Because this distribution does not have the Pearson Type III shape, it is used only as an intermediate step in constructing an equivalent Pearson Type III curve. Thus, the two points $Q^*_{0.50}$ and $\tilde{Q}^*_{0.04}$ are computed using the above-base station skew $g = \tilde{G}$ rather than $\hat{G}$. Then a logarithmic Pearson Type III curve having logarithmic skew $\hat{G}$ is passed through these two points; its mean and standard deviation, $\hat{M}$ and $\hat{S}$, are found by solving the simultaneous equations

$$\hat{M} + \hat{S} \cdot k_{\hat{G},p} + \log \tilde{Q}^*_p \qquad \text{(for } p = 0.50,\ 0.04\text{)}$$

Note that $\hat{M}$ and $\hat{S}$ reflect the contributions of all the observed peaks, those below the base as well as those above, whereas $\tilde{M}$ and $\tilde{S}$ did not. The final frequency curve, when floods below the base have been detected, then is

$$\log \hat{Q}_p = \hat{M} + \hat{S}\, k_{\hat{G},p}$$

This defines only the part of the distribution above the flood base; the part below the flood base is not defined, and is of no practical importance.

These frequency curve calculations also are used to construct a systematic-record frequency curve that takes into account any zero flows or below-gage-base peaks but does not reflect any historic information, outlier test, or generalized skews. In this case, the unadjusted systematic-record skew G is used in both steps of the construction of the curve.

C.4.g Expected Probability Adjustment

The final steps in the WRC analysis, as implemented in program J407, are to compute the so-called expected-probability frequency curve and a set of upper and lower confidence limits. These computations are performed as represented by box FCX in figure 8. These computations are optional and are intended primarily as an aid to the interpretation of the principal WRC-estimated frequency curve given by $\hat{Q}$ above.

The expected probability concept deals with the following problem. A sample of size n will be drawn from a normal population (of flood logarithms), and the flood having exceedance probability p will be estimated by the quantity $\bar{x} + k_p s$, in which $\bar{x}$ and s are the ordinary sample mean and standard deviation and k_p is the standard normal frequency factor for probability p. Because it is computed from a random sample, the estimate $x = k_p s$ is a random variable, which usually will differ from the true p-probability flood. Thus one is led to ask how the probability of another flood's exceeding the estimate $\bar{x} + k_p s$ compares with the nominal probability p. For a normal population one has

$$P\{X > \bar{x} + k_p s\} = P\{\frac{X - \bar{x}}{s} > k_p\} = P\{t_{n-1} > \sqrt{\left[\frac{n}{n+1}\right]} k_p\}$$

where t_{n-1} is Student's t with n-1 degrees of freedom. This probability has come to be known as the "expected probability" (Beard, 1960; WRC, 1977, Appendix 11). For nominal exceedance probabilities less than 0.50--floods above the median--the expected probability exceeds the nominal probability. This bias is removed by replacing k_p by the frequency factor

$$k_{p'} = \sqrt{\{\frac{n+1}{n}\}}\, t_{n-1,p}$$

in which $t_{n-1,p}$ is the Student-t quantile with exceedance probability p. The visible effect of this adjustment is to increase the variability of the estimated frequency curve in proportion to the statistical variability of the sample statistics.

This normal-population result is applied to the WRC-estimated Pearson Type III distribution with mean, standard deviation, and skew $\hat{M}$, $\hat{S}$, and $\hat{G}$ by first looking up the normal exceedance probability p' corresponding to $k_{p'}$ and, second, applying the Pearson Type III frequency factor, $k_{\hat{G},p'}$, having this skew and probability, to the sample mean and standard deviation,

as follows: $\hat{M} + \hat{S}k_{G,p}$. Of course, even this estimate, when evaluated for any particular sample, normally will misrepresent the true p-probability flood. With respect to a number of samples, however, the fraction of floods actually exceeding the estimated p-probability floods will be correct. Nonetheless, the WRC guidelines specify that the basic flood frequency curve (without expected probability) is the curve to be used for estimating flood risk and forming weighted averages of independent flood frequency estimates.

C.4.h. Confidence Limits

Finally, one-sided confidence limits for the p-probability flood are computed. A one-sided confidence limit is a sample statistic--hence a random variable--having a specified probability of exceeding (or not exceeding) a specified population characteristic. In the WRC analysis, these statistics are of the form $\bar{x} + Ks$, where $\bar{x}$ and s are the sample mean and standard deviation after all WRC tests and adjustments and K is a confidence coefficient chosen to satisfy the following equation

$$P\{\bar{x} + Ks > \mu + k_{\gamma,p}\sigma\} = \alpha.$$

In this equation, μ, σ, and γ are the population mean, standard deviation, and skew, and the right-hand side of the inequality is the population p-probability flood; these parameters are unknown and the idea is to find a K-value such that $\bar{x} + Ks$, which can be computed from the sample, will almost certainly be an upper (or lower) bound on this unknown population characteristic. In any particular sample the computed value $\bar{x} + Ks$ may fail to bound the population characteristic, but, over a number of samples, the specified fraction-- α (or $1-\alpha$)--will yield correct bounds. A value of α close to unity yields upper confidence limits and a value close to zero yields lower limits. In particular, the upper 95-percent confidence limit has $\alpha = 0.95$; the lower 95-percent limit has $\alpha = 0.05$. The value of K is found by rearranging the probability statement as follows:

$$\left\{\frac{(\mu-\bar{x})/(\sigma/\sqrt{n}) + \sqrt{n}\,k_{\gamma,p}}{(s/\sigma)} < \sqrt{n}\,K\right\} = \alpha$$

in which n is the sample size. If the underlying population were normally distributed and if $\bar{x}$ and s were the ordinary sample mean and standard deviation, then the random variable on the left-hand side of the inequality would have the noncentral t distribution with n-1 degrees of freedom and

noncentrality parameter $\sqrt{n}\ k_{\gamma,p}$; if the underlying population were not too skewed, if the sample size were not too small, and if the population skew γ could be replaced by the WRC estimated skew $\hat{G}$, then one might hope the variate would have approximately the noncentral-t distribution. Building upon this foundation, one obtains

$$\sqrt{n}\ K = t_{n-1,\sqrt{n}k_{\hat{G},p},(1-\alpha)}$$

which is the noncentral-t quantile with exceedance probability $1-\alpha$. A standard large-sample approximation for the noncentral t distribution (NBS, 1964) then yields the result

$$K = \frac{k_{\tilde{G},p} + \frac{k_{(1-\alpha)}}{\sqrt{n}} \{1 + (nk^2_{\tilde{G},p} - k^2_{(1-\alpha)})/2(n-1)\}^{1/2}}{\{1 - k^2_{(1-\alpha)}/2(n-1)\}}$$

in which $k_{(1-\alpha)}$ is the standard normal deviate with exceedance probability $(1-\alpha)$. As stated above, an α-value near unity yields upper confidence limits whereas a value near zero yields lower limits. This result is equivalent to that in the Guidelines.

C.5. References

Beard, L. R., 1960, Probability estimates based on small normal-distribution samples: Journal of Geophysical Research 65(7) pp. 2143-2148.

National Bureau of Standards, 1964, Handbook of mathematical functions , equation 26.7.10, Applied Mathematics Series 55.

U.S. Water Resources Council, 1977, Guidelines for determining flood flow frequency, Bulletin No. 17A of the Hydrology Committtee, p. 143.

CHAPTER I. INSTRUCTIONS FOR PEAK FLOW FILE

Section D. Peak Flow Tables (Program A534)

Prepared by:

Terry A. Wilson

August 1979

CONTENTS

ILLUSTRATIONS

I.D. PEAK FLOW TABLES (PROGRAM A534)

D.1. Introduction

The Peak Flow Tables Program (A534) is used to print tables for data stored in the Peak Flow File in accordance with the publication standards of the USGS. Rounding precision for the parameters used is listed in appendix D.

The data processed by program A534 must have been retrieved from the Peak Flow File by the retrieval procedure (PEAKRET) in a prior job step. Procedure PEAKRET is described in chapter I, section B.5. The options for program A534 are specified on the application control card (X card) and are described in section D.3. The X card is submitted with the retrieval request and is described in detail in section D.4.

In order to simplify the request for publication tables, the job control language (JCL) for program A534 has been cataloged in a procedure name PKTABLES. Procedure PKTABLES is described in section D.5.

Program A534 was written in PL/I for the IBM 370 computer by Owen O. Williams, USGS. The peak flow table module addition to A534 was written by Terry A. Wilson, USGS.

D.2. Table Descriptions

There are two types of tables available. Both types use the same basic table format (type 1) and heading information.

Type 1A Annual peak data. The annual peaks for a single station will be printed in each table for the period of years specified in the retrieval step (see fig. 1). A new table will begin each time the station ID changes. The table description in the heading will read "Annual Peak Data".

Type 1B Peaks above the base. Peaks above the base will be printed in a single table for each year of record (see fig. 2). A new table will begin each time the reporting year changes except when the option to ignore change of year is requested as described in section D.3.a. The table description in the heading will read "Peaks Above Base".

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
08056500 - TURTLE CREEK AT DALLAS, TEX.

PROCESS DATE 07/11/79
DISTRICT CODE 48

DRAINAGE AREA(SQ MI) 7.98 BASE DISCHARGE(CFS) 1200.00
CONTRIBUTING DA(SQ MI) GAGE DATUM-NGVD(FT) 428.12

ANNUAL PEAK DATA

DATE	STREAM STAGE (FT ABOVE DATUM)	STREAM STAGE CODE	STREAM-FLOW (CFS)	STREAM-FLOW CODE	HIGHEST SINCE
AUG , 1947					
27...	6.80		3350		
MAY , 1948					
11...	4.68		1630		
MAY , 1949					
18...	6.15		2800		
MAY , 1950					
01...	5.29		2060		
SEP , 1951					
12...	4.82		1700		
MAY , 1952					
17...	5.47		2220		
APR , 1953					
23...	3.54		910		
APR , 1954					
12...	6.40		2980		
JUN , 1955					
18...	3.44		852		
MAY , 1956					
01...	4.84		1740		
APR , 1957					
26...	7.30		3850		
APR , 1958					
26...	6.54		3070		
FEB , 1959					
14...	4.47		1460		
OCT					
01...	8.10		4650		
OCT , 1960					
13...	4.08		1240		
JUL , 1962					
27...	7.96		4640		
APR , 1963					
28...	7.77		4290		
SEP , 1964					
21...	6.79		3240		
MAY , 1965					
10...	7.97		4520		
APR , 1966					
28...	10.54		12200		1903
APR , 1967					
21...	5.14		1790		

Figure 1. Sample output from program A534 showing annual peak data.

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 07/10/79
08056500 - TURTLE CREEK AT DALLAS, TEX. — DISTRICT CODE 48

DRAINAGE AREA(SQ MI) 7.98 — BASE DISCHARGE(CFS) 1200.00
CONTRIBUTING DA(SQ MI) — GAGE DATUM-NGVD(FT) 428.12

PEAKS ABOVE BASE

DATE	STREAM STAGE (FT ABOVE DATUM)	STREAM STAGE CODE	STREAM-FLOW (CFS)	STREAM-FLOW CODE
MAY , 1971				
27...	5.82		2360	
JUL				
28...	4.61		1360	
AUG				
14...	5.87		2400	
24...	4.96		1640	
OCT				
03...	6.55		3000	
18...	5.38		1980	
19...	7.14		3590	
OCT , 1972				
21...	4.64		1390	
MAR , 1973				
10...	5.99		2500	
APR				
24...	6.25		2740	
MAY				
11...	6.85		3300	
JUN				
03...	7.67		4160	
03...	6.78		3230	
19...	5.31		1920	
JUL				
07...	4.57		1330	
15...	4.68		1430	
OCT				
11...	6.47		2940	
30...	5.60		2160	
NOV				
24...	4.62		1360	
MAY , 1974				
05...	6.71		3160	
JUN				
07...	5.79		2320	
07...	5.26		1880	
09...	4.89		1580	
AUG				
12...	6.20		2690	
SEP				
12...	5.77		2310	
16...	6.25		2730	

Figure 2. Sample output from program A534 showing peaks above a base.

The basic format for both tables consists of six-column headings in the following order: Date, Stream Stage, Stream Stage Code, Streamflow, Streamflow Code and Highest Since. The date of sample is automatically printed as the first item in each table.

D.3. Table Options

The table options that are available for peak flow tables using program A534 are described in section D.3.a. through D.3.f. The program options are initiated through the use of an application control card as described in section D.4.

D.3.a. Publication Table Reporting Year

Three choices are available for control of table printing by reporting year.

1) Print tables on a water year basis.

2) Print tables on a calendar year basis.

3) Disregard reporting year (no break in years) and print tables on a station ID basis.

When requesting annual peak tables, item 3 is the only choice available.

D.3.b. Print Column Headings Regardless

It may be specified to always print all column headings even when no data are retrieved for a particular parameter. Normally, if no data are present for a parameter, the entire column for that parameter is dropped and all other columns shifted one field to the left.

D.3.c. Print Parameter Code

It may be requested to have the parameter code printed in the column heading. When parameter code printing is not specifically requested, only the parameter name and units will be printed.

D.3.d. Page Size Specification

The standard page size may be increased by specifying a maximum number of lines to be printed on each page that is greater than the system default of 60. This will result in printing over the perforations in the printer paper. In addition to specifying this option on the X card, the page suppression option in the JOB card must also be initiated by coding a 0 (zero) in job card field ii shown below.

```
//wxxyyzz  JOB(aaaaaaaaa,bbbbb,cccc,dddd,eeee,ffff,g,h,ii),'your name'
```

D.3.e. Vertical Folding (double-up) Table

A vertically folded table as shown in figure 3 may be requested. This will result in the division of each table for a year or a period of years into 2 halves printed side by side on a page.

D.3.f. Page Heading Suppression

It may be requested to suppress printing of the department and agency name, processing date, and district code in the heading so that only information directly related to the table being produced is printed.

D.4 Application Control Card (X Card)

The table options are requested by means of the application control card (X card). Only one X card for requesting peak flow tables (program A534) is allowed in any one retrieval request, although any number of M cards with an associated X card may be used in a single job step when requesting peak flow tables. The X card may be coded as shown below:

Col. 1 Enter an X

Col. 2-5 Enter A534

Col. 6-9 Blank

Col. 10 Publication table reporting year type -- the type of reporting year to be used with each table and the basis for starting a new table or table page. The reporting year will be printed in the heading for peaks above the base.

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
08056500 - TURTLE CREEK AT DALLAS, TEX.

PROCESS DATE 07/11/79
DISTRICT CODE 48

ANNUAL PEAK DATA

DATE	STREAM STAGE (FT ABOVE DATUM)	STREAM STAGE CODE	STREAM-FLOW (CFS)	STREAM-FLOW CODE	HIGHEST SINCE
AUG , 1947					
27...	6.80		3350		
MAY , 1948					
11...	4.68		1630		
MAY , 1949					
18...	6.15		2800		
MAY , 1950					
01...	5.29		2060		
SEP , 1951					
12...	4.82		1700		
MAY , 1952					
17...	5.47		2220		
APR , 1953					
23...	3.54		910		
APR , 1954					
12...	6.40		2980		
JUN , 1955					
18...	3.44		852		
MAY , 1956					
01...	4.84		1740		
APR , 1957					
26...	7.30		3850		
APR , 1958					
26...	6.54		3070		
FEB , 1959					
14...	4.47		1460		
OCT					
01...	8.10		4650		
OCT , 1960					
13...	4.08		1240		
JUL , 1962					
27...	7.96		4640		
APR , 1963					
28...	7.77		4290		
SEP , 1964					
21...	6.79		3240		
MAY , 1965					
10...	7.97		4520		
APR , 1966					
28...	10.54		12200		1903
APR , 1967					
21...	5.14		1790		

Figure 3. Sample output from program A534 showing vertical folding (double-up) table.

Col. 10 (cont.) Code

0 - Water year. A table will be printed for each water year.

1 - Calendar year. A table will be printed for each calendar year.

2 - No break in water years. The entire period of record for each station will be printed in a single table. The reporting years printed in the table will be water years. The reporting year will not be printed in the heading. This code is mandatory when printing annual peak data tables.

Col. 11-17 Blank.

Col. 18 Print column heading regardless. Code a 1 in this field to print the column heading even when no data are present for a parameter. The default is suppression of column heading printing.

Col. 19 Print parameter code. Code a 1 in this field to print the parameter code in the column heading.

Col. 20 Blank.

Col. 21-23 Page size option. This field may be used to specify a maximum number of print lines that will be printed on a single page before skipping to a new page. The number coded in this field will represent the maximum number of lines that may be printed on a single page. The default page size is 60 lines. When the number coded in this field exceeds 60 it must be accompanied by the page suppression option in the job card as described in section D.3.d., which results in printing over the perforated line in the print form.

Col. 24-28 Blank.

Col. 29 Vertical folding (double-up) table. A 1 (numeric) coded in this field will result in tables that are vertically folded as described in section D.3.e.

Col. 30-31 Blank.

Col. 32 Page heading suppression. Code a 1 in this field to suppress printing of the heading "United States Department of Interior - Geological Survey", the process date, and the district code.

Col. 33-80 Blank.

D.5. Cataloged JCL Procedure PKTABLES

The job control language needed to print peak flow tables using program A534 has been stored in the WATSTORE procedure library. The procedure name is PKTABLES and is only executed after the data have been retrieved by the peak flow retrieval procedure PEAKRET as described in section B.5.

The card necessary to invoke the PKTABLES procedure is coded as follows:

```
// EXEC  PKTABLES,TIME=t
```

where t is the time in minutes needed by the computer to produce the tables. For most jobs 2 minutes is ample and is the default time when the TIME parameter is not coded.

A symbolic parameter PRINT has been made available in the PKTABLES cataloged procedure in order to simplify the JCL required for multiple copies of peak flow tables. The use of this parameter in a JOB deck is shown below.

```
COL. 1      Col. 12

.           .
//RELAY  PUNCH RE2
//useridno JOB (----)
/*PROCLIB  WRD.PROCLIB
/*OUTPUT name COPIES=nnn
//STEPA EXEC PEAKRET
//HDR.SYSIN DD *
            .
            .
      Input cards for program J980 and X card for A534
            .
            .
//STEPB EXEC PKTABLES,PRINT=name
$$$
```

where name on the OUTPUT card is any four characters designated by the user as the SYSOUT file referred to for the number of copies indicated on the OUTPUT card by COPIES=nnn (where nnn is any numeric value from 1 to 255). By setting the symbolic parameter PRINT equal to name, i.e., the same four-character name used on the OUTPUT card, the required number of copies of peak flow tables indicated on the OUTPUT card will be printed.

If only one copy of the tables is required, then omit the OUTPUT card and do not code the symbolic parameter PRINT on the EXEC PKTABLES card.

D.6. Diagnostic Messages

Diagnostic messages are printed to aid in determining the status of processing and the action needed to correct errors. The diagnostic messages are of the form TBLxxx or PKTxxx where TBL indicates an error occurred before any edit checking could be performed, PKT indicates an error occurred after processing had commenced, and xxx represents a sequence number. The diagnostic messages for the peak flow table program are listed below:

TBL001 NO X RECORD PRESENT FOR RETRIEVAL SEQUENCE nnn, SKIPPING FOR NEXT RECORD.

This message indicates that an X control record was either missing or out of sequence with the associated C record, where nnn is the retrieval sequence number. Probable retrieval error.

TBL002 NO X CARD INVOKING A534 WAS PRESENT.

Either the X card to invoke A534 was omitted or "A534" was misspelled.

PKT001 NO X RECORD PRESENT FOR RETREIVAL SEQUENCE nnn, SKIPPING FOR NEXT RECORD.

Same as TBL001 except that some table processing has already commenced.

PKT002 NO C RECORD PRESENT FOR RETRIEVAL SEQUENCE nnn, SKIPPING FOR NEXT RECORD.

Same as PKT001 except for a C control record.

PKT003 CONTROL RECORD SEQ. NO. nnn is NOT EQUAL TO DATA RECORD SEQ. NO. nnn, WILL TRY NEXT CONTROL RECORD.

A control record was created but has no matching data.

PKT004 nnnnn CODE NOT FOUND IN FILE -- PROCESSING CONTINUED FOR SEQ. NO. xxx.

An invalid parameter code (nnnnn) was encountered for retrieval sequence number xxx. The parameter code will be ignored but the table will still be printed.

PKT005 NO DATA RECORDS WERE PASSED BY THE RETRIEVAL STEP.

No data were found in the Peak Flow File by the retrieval program.

☆ U.S. Government Printing Office: 1979—281-359/99