COLORADO STATE UNIVERSITY

SMALL WATERSHED FLOOD DOCUMENTATION

Data Assembly Program and Documentation for Colorado Small Watershed Flood Data File

by

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Computer Services
Engineering Research Center
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How to Read the CSSW Tape

The tape accompanying this explanation is a 7-track BCD tape written at 556 bpi with even parity. It was written on CDC 6400 with SCOPE 3.3 operating system. If you have a similar system, read the tape in Stranger mode.

The tape was written by subroutine PU80, and after any necessary conversions it may be read by subroutine RD80. Listings of these routines have been supplied.

If any difficulty arises in the use of the tape or the programs, please feel free to contact us.

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I. DATA FILE

Watershed flood, rainfall and physiographic data are systematically assembled for observed floods from small watersheds. The data file is organized so that new watersheds having flood data can be added at any time. It is also organized so that additional new hydrographs can be added at any time. The data file is now being modified so that flood events measured on urban watersheds may be also fully documented and added to the data file. In the original concept it was assumed that the physiographic features of the watershed were stable and that the watershed was pristine - undisturbed by man. The urban watershed is being altered in the exact antithesis of the pristine watershed. The purpose of developing the urban flood data file is to document and preserve observed flood data for use in future research work on the impact of urbanization on watershed hydrology.

The information in the original flood data was divided into six groups. The urban flood information will add two additional groups of information. The first gives general information about the watershed:

<u>Watershed Information</u>

Set 1. Watershed name, location and identification number.

Set 2. Flood series if available. This provides a frame of reference for the peak discharge for any new flood being considered for inclusion in the data file.

Set 3. Physical watershed characteristics.

<u>Flood Event Information</u>

Set 4. Antecedent rainfall. Daily rainfall data prior to the storm included in Set 5.

Set 5. Mass curve of rainfall of the storm causing flood event in Set 6.

Set 6. Discharge hydrograph.

Urbanization Information (New addition)

Set 7. Physical urbanization characteristics which could be obtained from topographic maps, aerial photography or aerial observation. These include:

1. Percent of impervious area,
2. Length of streets and roads,
3. Length of curbed and guttered streets and roads,
4. Length of surface drainage channels.

Set 8. Physical urbanization characteristics which cannot be obtained from aerial observation. These include:

1. Length of underground storm sewers,
2. Capacity of underground storm sewers,
3. Street gradients,
4. Roughness of surface drainage channels,
5. Population density.

For a given watershed, there can be only one set 1, set 2, and set 3 data. There may be any number of rainfall events, each represented by some combination of set 4, set 5, and set 6 data. If it is an urban watershed and has set 4, set 5, and set 6 data, there will also be set 7 and set 8 data. In principle it is assumed that new set 7 and set 8 data will be obtained for each new flood event. The logic of the data file is shown schematically in the next diagram. The set 7 and set 8 data will simply be added after the hydrograph.

The following generalization may be made about the data:

If a watershed is represented, at least set 1 will be present.

If sets 2 and/or 3 are present, they will follow set 1 in numeric order.

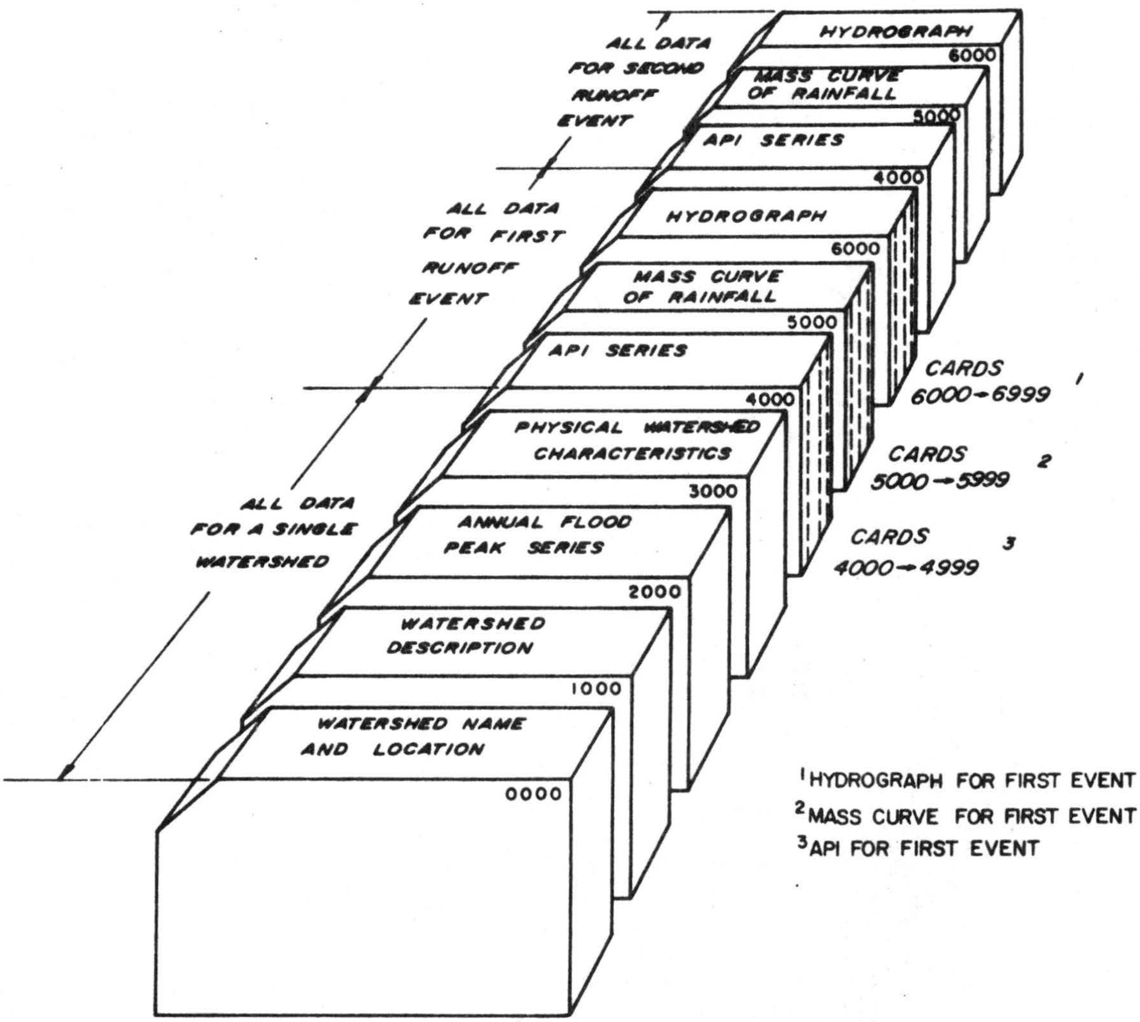
Sets pertaining to rainfall events will always follow whatever of sets 1, 2, and 3 are present.

A set 5 will always be followed by a set 6.

If any of sets 4 and 5, 6 are present for a given event they will be in numeric order.

If it is an urban watershed, sets 7 and 8 will follow each set 6 data.

DATA DECK EXAMPLE



Schematic representation of data arrangement for a single watershed with two runoff events

II. PROGRAM INFORMATION

Program

On BCD tape, the information of each set is preceded by a record identifying the kind of set to follow. This consists of the set number (1-8), the 10 digit serial number (itself a concatenation of 5 codes), and the name of the watershed.

The Binary tape is organized in similar fashion, with an identifying record preceding each record of set information.

Branching to the correct program location is done on the set number (1-8). This is provided for in the program by several brief subroutines which in turn call the appropriate entry points in the eight subroutines for the various sets:

Subroutine TAPERD	Provides for reading a binary tape, except for the identification record, which normally will be read in the main program.
Subroutine TPWRT	Provides for writing a binary tape, including the information record for each set.
Subroutine TPLIST	Outputs the data in full print lines in an easily readable listing with headings.
Subroutine PU80	Outputs the data without headings in an 80 column format.
Subroutine RD80	Provides for reading the 80 column format, except for the identification record, which will normally be read in the main program.
Subroutine TCØMP	Calls for computation of certain output data from the minimal set of input items. (Since the results of the computations are now on the BCD tape, you will not be repeating these operations on this data.)

Each subroutine for a given set, then, contains entry points corresponding to these functions.

BASIC MAIN PROGRAM SETUP

The accompanying programs were written at Colorado State University in a version of Fortran IV for the CDC 6400 computer, a machine with a core memory of 64K 60-bit words. The alphameric fields in the format statements were written with this equipment in mind, but may of course, be segmented in any way to be compatible with another word size.

If there is no provision in your Fortran for multiple entry points into a subroutine, appropriate branching may be easily achieved by adding a variable to the COMMON list, and using it in a multiple branch GO TO in the various set subroutines.

```
      PROGRAM SWCARD(INPUT,OUTPUT)
C     PUT TAPE NUMBERS NECESSARY ON PROGRAM CARD
      COMMON/L0/ISET, ISER, JSER(5), NAME(8)
      COMMON KKK, NT, NT80, NT80R, NTP
C
C     NT80 = BCD TAPE FOR PUNCH CARDS
C     NT80R= BCD TAPE READ IN 80 COLUMN IMAGES
C     NT   = BCD TAPE WRITE
C     NTP  = BINARY TAPE READ
C
C     TO READ BCD TAPE --
    1 READ(NT80R,2) ISET, ISER, NAME
    2 FORMAT(I2,2X,I10,8A8)
C
C     OR TO READ BINARY USE
C   1 READ(NTP) ISET,ISER,JSER,NAME
C
      IF(EOF(NT80R)) 21,3
C
C     NOW USE THE CALLS TO ANY SUBROUTINE TO EFFECT THE PROPER OUTPUT
    3 CALL RD80
      CALL TAPERD
      CALL TCOMP
      CALL TPLIST
      CALL PU80
      CALL TPWRT
C
      GO TO 1
   21 STOP
      END
```

BCD VARIABLES ON CARD IMAGES

Set 1 - Watershed Name and Location

Card 1

Cols	Format	Var. Name	Description
2-7	F6.2	AREA	Area (sq mi)
10-12,14-15, 19-88	I3,I2,I2	LAT(2)	Latitude (Degrees, min., seconds)
21-23,25-26, 28-29	I3,I2,I2	LON(3)	Longitude (Degrees, min., seconds)
32-36	I5	JELEV	Elevation (feet)
39-41	I3	NYRQAV	# of years of data in QAV
44-52	F9.3	QAV	Average daily discharge (cfs)
55-64	F10.3	QAREAL	A real average discharge (cfs/sq mi)
67-68	I2	NYRPAV	# of years of data in PAV
71-75	F5.2	PAV	Average annual precip-itation (in/yr)

Card 2

3-53	5A10,A1	AGENCY(6)	Agency furnishing data
56-57,59-60 62-63	I1,I2,I2	JQADT1(3)	Beginning data of QAV
66-67,69-70 72-73	I2,I2,I2	JQADT2(3)	Ending data of QAV

Set 2 - Flood Series

Cols	Format	Var. Name	Description
2-4	I3	N	# of Observations
7-8,10-11, 13-14	I2,I2,I2	JPKDAT(3,N)	Data of event occurred
15-22	F8.2	PEAK(N)	Max annual peak disch. (in/hr)

REPEAT 4 Sets/card

Set 3 Physical Watershed Characteristics

Card 1

Cols	Format	Var. Name	Description
2-7	F6.2	AREA	Area of watershed (sq. mi)
8-14	F7.2	XL	Length of main stream (mi)
15-21	F7.2	XLS	Length of extended streams (miles)
22-28	F7.2	XLC	Dist. from centroid of basin to outlet (miles)
29-35	F7.2	XLT	Mean travel distance (miles)
36-41	F6.2	ST	Standard deviation of XLT (miles)
42-47	F6.2	SD	Dimensionless ST
48-54	F7.2	PERIM	Perimeter of watershed (miles)
57-61	I5	JH	Total fall in basin (feet)
64-67	I4	JS(1)	Stream slope (ft/mi)
70-73	I4	JS(2)	Stream slope (ft/mi)
76-79	I4	JS(3)	Stream slope (ft/mi)

Card 2

Cols	Format	Var. Name	Description
2-5	I4	JS(4)	
8-12	F5.2	DD	Drainage density (mi/sq mi)
15-19	F5.2	W	Ave. width of catchment (miles)
22-26	F5.2	F	Form factor (dimensionless)
29-32	F4.2	C	Compactness coefficient (dimensionless)
35-39	F5.2	XLM	Mean travel distance (dimensionless)
42-45	I4	JR(1)	Overland Slope (ft/mi)
48-51	I4	JR(2)	
54-57	I4	JR(3)	
60-63	I4	JR(4)	
66-69	I4	JR(5)	
72-77	F6.4	R6	Overland slope (dimensionless)

Set 4 - Antecedent Rainfall

Card 1

Cols	Format	Var. Name	Description
2-3,5-6, 8-9	I2,I2,I2	JDATE(3)	Storm Date of event occurence
13-14,16-17	I2 b I2	JTIME(2)	Time of event occurence
18-24	F7.2	XIS	Season index (Is)
25-31	F7.2	F1	1 hour infiltration for soils (in/hr)
32-38	F7.2	F2	Cover factor (dimensionless)
39-45	F7.2	FS	Standard infiltration capacity F1*F2 (in/hr)

Card 2

Cols	Format	Var. Name	Description
2-4	I3	N	No. of obs
10-12	I3	JDAY4(I)	# days before
16-17,19-20	I2,I2	JHR4(I,2)	Time
24-28	F5.2	RAIN4(I)	Rainfall (in)

Repeat 3 times/card N/3 cards

Set 5 - Mass Curve of Rainfall

Card 1

Cols	Format	Var. Name	Description
2-3,5-6, 8-9	I2,I2,I2	JDATE(3)	Date of event occurence
13-14,16-17	I2,I2	JTIME(2)	Time of event occurence
21-25	F5.2	PS	(Ps) Ave. uniform total storm rainfall
29-33	I5	JTL	(TL) Lag time betw. beg. of rainfall and beg. of runoff(min)

Card 2

2-4	I3	N	No. of observations
8-13	I6	JTMES(I)	Elapsed time (min)
14-23	F10.4	RAIN5(I)	Cum. rainfall (in)

Repeat 4 sets/card N/4 cards

Set 6 - Discharge Hydrograph

Card I

Cols	Format	Var. Name	Description
2-3,5-6, 8-9	I2,I2,I2	JDATE (3)	Date of event occurence
12-13,15-16	I2,I2	JTIME (2)	Time of event occurence

Cols	Format	Var. Name	Description
17-26	F8.3	PHI	(inches/minute)
28-39	F12.4	QP1	(Q) Peak discharge (cfs)
42-48	F7.4	QP2	(q) Peak area disch. (in/hr)
51-54	I4	JTL	(T_i) Lag time betw. beg. of rainfall and beg. of runoff (min)
57-60	I4	JTR	(T_R) Time of rise of hydrograph (min)
Card 2			
2-4	I3	N	# of observations
8-13	I6	JTME6(I)	Successive time inc.
14-23	F10.4	DISCH(I)	Discharge (in/hr)
	Repeat 4 sets/card N/4 cards		

Set 7 - Physical Urbanization Characteristics

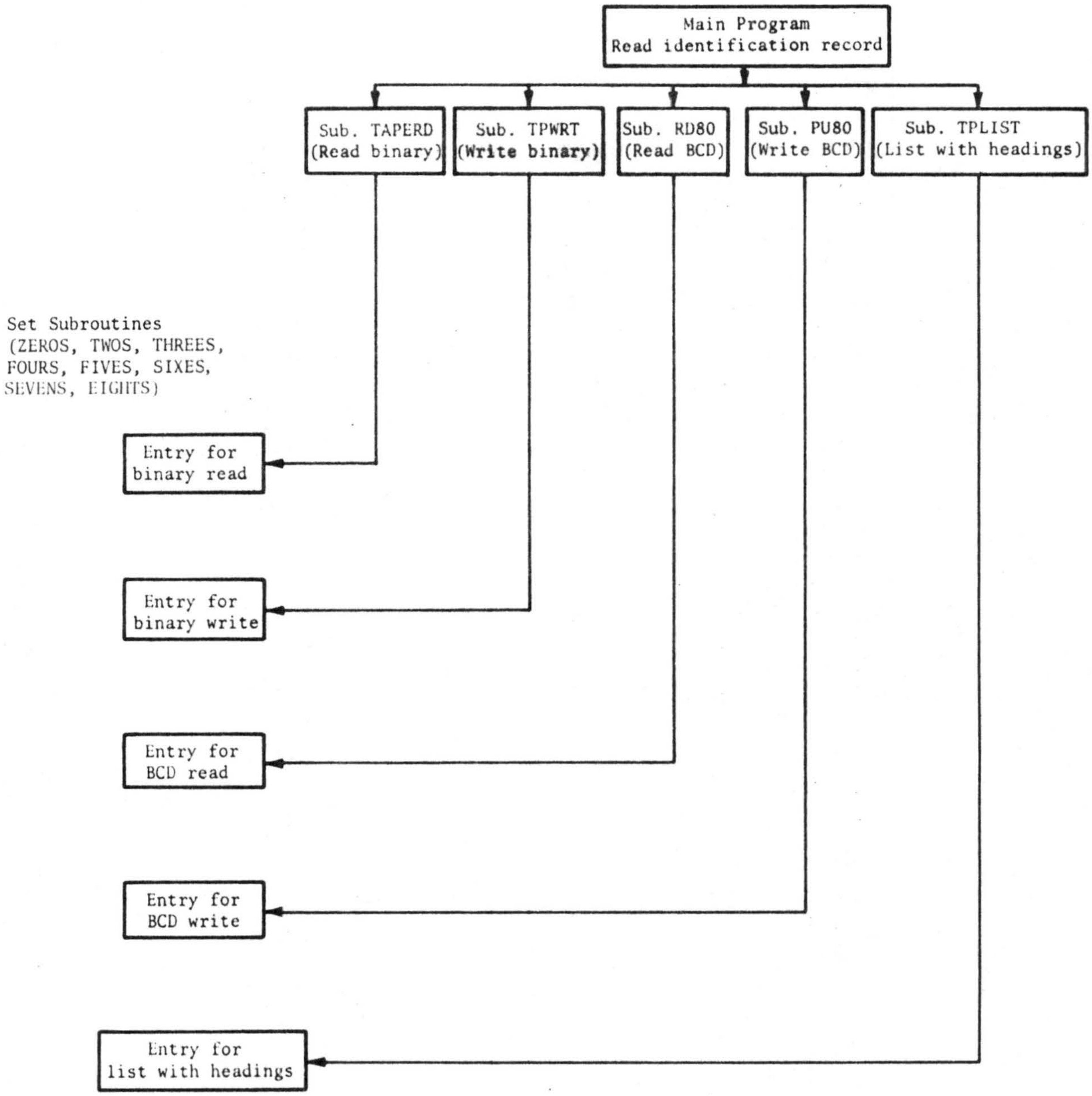
Cols	Format	Var. Name	Description
1-10	F10.3	PERIØUS	Percent of impervious area
11-20	F10.3	STREETS	Length of streets and roads
21-30	F10.3	CURBED	Length of curbed and guttered streets and roads
31-40	F10.3	DRAIN	Length of surface drainage channels

Set 8 - Physical Urbanization Characteristics

Cols	Format	Var. Name	Description
1-10	F10.3	SLENGTH	Length of underground storm sewers
11-20	F10.3	SCAPAC	Capacity of underground storm sewers

Cols	Format	Var. Name	Description
21-30	F10.3	SLOPE	Street gradient
31-40	F10.3	RØUGH	Roughness of surface drainage channels
41-50	F10.3	PEØPLE	Population density

CSSW FLOW CHART



Flow diagram for data file