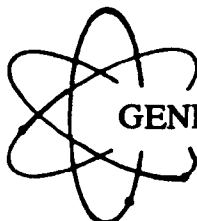


AD-A273 505



US Army Corps
of Engineers

Hydrologic Engineering Center



GENERALIZED COMPUTER PROGRAM

HYDPAR

Hydrologic Parameters

User's Manual

July 1985

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HYDPAR

Hydrologic Parameters

User's Manual

July 1985

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HYDROLOGIC PARAMETERS

(HYDPAR)

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HYDROLOGIC PARAMETERS

(HYDPAR)

INTRODUCTION

The HYDPAR (hydrologic parameters) computer program is part of a family of computer programs that make up the Hydrologic Engineering Center's Spatial Data Management and Comprehensive Analysis System (HECSAM). This system represents an ongoing effort to provide a systematic and comprehensive technique for managing and analyzing spatial data for use in water resources management investigations.

The HYDPAR program is designed to access and process data stored in a grid cell data bank. The particular methods used in storing and accessing spatial data which are utilized by this computer program are described in a guide manual available from the Hydrologic Engineering Center (U.S. Army Corps of Engineers, 1978).

An overview of the program's requirements and capabilities are presented herein. In addition, the input necessary for program execution and related output are described in detail for the benefit of the user. Sample output has also been included to demonstrate the capabilities of the system and as a data set for testing the computer program.

The HYDPAR program is maintained and distributed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, 609 Second Street, Davis, California, 95616. This agency should be contacted for any questions regarding its use or availability.

General Description

Subbasin or watershed hydrologic parameters that might be used as input to rainfall-runoff models or other analytical techniques can be determined by using the HYDPAR program. At present the parameters that can be generated are (1) those needed for the U.S. Soil Conservation Service (SCS) Curve Number (CN) technique and (2) those needed for watershed modeling using

subbasin imperviousness and characteristics of the Snyder unit hydrograph procedure. The hydrologic parameters that are computed with the aid of the HYDPAR program and a grid cell data bank may be manually input into the rainfall-runoff computer program HEC-1 (U.S. Army Corps of Engineers, 1973) or the transfer process may be automated between HYDPAR and HEC-1 by using the HEC data storage system (DSS) or some other interface.

Input Limitations. The limitation on input data to the HYDPAR program is defined through the use of a dynamic array. The variable names of the input categories are given below, as well as the expression needed to compute the maximum index value of that array.

<u>Input</u>	<u>Variable</u>
Number of Subbasins	NSUB
Number of Land Use Categories	NLUSE
Number of Slope Categories (SCS type)	NSLP
Number of Data Variables in the Grid Cell Data Bank	NVAR

$$y = (16 * NSUB) + (10 * NLUSE) + 5(NSUB * NLUSE) + NVAR + NSLP \quad (1)$$

The value of y varies depending on the type of computer being used. On Harris equipment y cannot exceed 131,000. On CDC Cybernet, y cannot exceed 80,000.

Hardware and Software Requirements. The HYDPAR program was developed in FORTRAN IV using a CDC 7600 computer. The source has been converted to FORTRAN 77 and presently is supported on Harris minicomputers and CDC mainframes. The program is also available for use on an IBM-PC or equivalent microcomputer. In general, it is compatible with other major computer systems. The HEC data storage system (DSS) provides the linkage between HYDPAR and HEC-1 and is presently only available to the U.S. Army Corps of Engineers. Work is underway to make the DSS compatible with most major computer systems.

Program Language:	FORTRAN 77
Memory Requirement:	377,000 words (octal)
(on CDC)	

Special Library Functions:	DSS software
Printer Positions:	132
File Assignments:	
Tape1:	Grid cell data bank
Tape5:	Standard record input
Tape6:	Standard line printer
Tape71:	DSS output (DSS version only)

Specific Capabilities. The HYDPAR program computes and formats for subsequent use hydrologic parameters that permit determination of precipitation loss-rate functions and surface runoff response.

The program has the capability to compute SCS Curve Numbers and unit hydrograph parameters (basin lag) based on the SCS dimensionless unit hydrograph procedure. The program also has the option to compute the percent of impervious surface within a watershed and calculate unit hydrograph parameters utilizing the Snyder approach. Example applications are contained in "Phase I Oconee Basin Pilot Study - Trail Creek Test" (U.S. Army Corps of Engineers, 1975) and the Training Document "Application of Spatial Data Techniques to HEC-1 Rainfall- Runoff Studies (U.S. Army Corps of Engineers, 1983).

The functions defining the relationships between the geographic data drawn from the grid cell data bank (land use, subbasin boundaries, hydrologic soil group, surface slope, etc.) and the selected procedure are defined externally and input to HYDPAR. The HYDPAR program performs the appropriate file manipulations, computations and bookkeeping, prints the results, and then if the user desires, writes a file for further automated processing. The results (Tape71) may be saved utilizing DSS software if the results are to be used as input to the HEC-1 program at a later time. (System control records are used to save Tape71).

The HYDPAR program computes drainage areas for subbasins by one of two methods: (1) by multiplying the size of the grid cell area by the sum of the cells falling within each subbasin, or (2) by taking a proportion of the total watershed area based on the number of cells within each subbasin.

A significant amount of bookkeeping relating to land use, computational procedures, etc. is performed and displayed as output.

COMPUTATIONAL PROCEDURES

Soil Conservation Service (SCS) Methods. The U.S. Soil Conservation Service (SCS) developed a technique for determining direct runoff from rainfall based on land use, antecedent moisture conditions and soil type. The technique (Curve Number technique) is especially attractive to many hydrologic planning evaluations since it provides a systematic and consistent method of evaluating the effect of alternative land use patterns on surface runoff within a watershed (U.S. Soil Conservation Service, 1972).

The SCS method uses a relationship in which accumulated runoff is a function of accumulated rainfall and the physiographic characteristics, land use, antecedent moisture and soil type. Curve numbers have been developed to represent various combined states of these particular physiographic parameters.

In the HYDPAR program, only land use and soil type are utilized in determining a curve number (CN). The process involves accessing the grid cell data bank and determining the land use and soil type for each grid cell. Then, based on an input relationship between CN and these two particular parameters, a value (of CN) is assigned to each cell. Based on the number of cells in each subbasin and their respective CNs, an average value of CN is then computed for each subbasin in the study area.

Since the curve number technique is used to determine the amount of surface runoff generated by a given storm (or precipitation) event, an additional technique is required to develop the shape of the discharge hydrograph (discharge versus time) at a subbasin outlet. In order to do this, the SCS has developed a simplified dimensionless unit hydrograph approach to transform excess rainfall (direct runoff) to discharge as a function of time (U.S. Soil Conservation Service, 1972). The shape of the SCS unit hydrograph is based on a single parameter, basin time lag (time response of runoff to rainfall), which in normal practice is estimated from one of several empirical equations, from travel time studies or from observed flood hydrograph reconstitutions. The HYDPAR program computes basin lag from an empirical equation recommended by the SCS.

This particular lag equation was adopted because its structure permits easy modification of the unit hydrograph based on changes in land use. The lag equation used is

$$\text{Lag (hours)} = \frac{(L)^{.8} * (S + 1)^{.7}}{(1900) * (y)^{.5}} \quad (2)$$

where L = hydraulic length of subbasin (the watercourse length from subbasin outlet to the upstream boundary which yields the longest time of travel) in feet,

y = average subbasin land slope in percent (determined from the HYDPAR program based on slope data for each grid cell)

S = $(1000/\text{CN}) - 10$, and

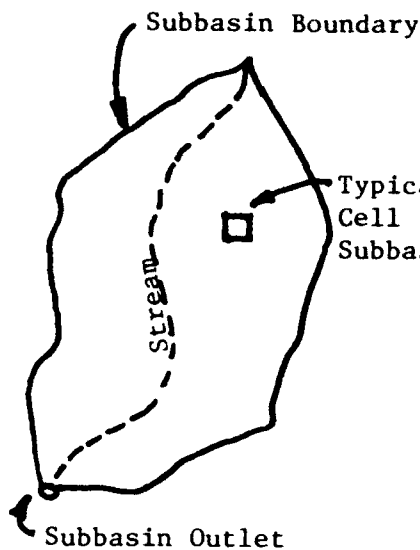
CN = arithmetic average curve number

NOTE: L is input by the user in miles and converted to feet within the program for calculation purposes.

The subbasin or watershed CN used in the lag computation is the same value previously computed with the aid of the HYDPAR program; and the land slope, y, is computed as an arithmetic average of the land slope of each cell within the subbasin under investigation.

Fig. 1, conceptually displays the data that must be available in the grid cell data bank and the computational procedures used to determine the hydrologic parameters, curve number and subbasin lag time.

DATA REQUIRED



5	Grid representation of land use (exhaustive for study area).
3	Grid representation of hydrologic soil group.
12	Grid representation of subbasin.
7	Grid representation of land surface slope.

DIRECT INPUT

_____	Tabulation of land use-soil type curve number. (Not part of grid data bank).
-- --	
-- --	

1.30 miles Subbasin hydraulic length. (Not part of grid data bank)

PROCEDURE

COMPUTATION OF SUBBASIN AVERAGE CURVE NUMBER (CN)

- Determine cell land use from grid data bank.
- Determine cell hydrologic soil group from grid data bank.
- Determine cell curve number (CN) from input relationship.
- Determine cell subbasin assignment.
- Aggregate CNs for all cells within subbasin and compute average value.

COMPUTATION OF SUBBASIN LAG TIME (EQUATION 2)

- Determine cell land surface slope from grid data bank.
- Determine cell subbasin assignment from grid data bank.
- Aggregate land surface slope for all cells within subbasin and compute mean value.
- Retrieve average CN computed above.
- Compute subbasin lag.

$$\text{Lag} = f(\text{curve number, hydraulic length, mean slope})$$

Fig. 1

HYDROLOGIC PARAMETER COMPUTATION

Composite Imperviousness and Snyder Methods. A common method utilized in urban hydrology studies is to determine a precipitation loss rate for an observed flood event (discharge hydrograph) or events associated with a particular estimated value of impervious surface. The type of loss rate function is not important but is frequently the simple initial plus uniform loss formulation commonly used by personnel of the Army Corps of Engineers (U.S. Army, Corps of Engineers, 1973). Estimation of the effect of changing land use on runoff is performed by recomputing the proportion of imperviousness for an alternative land use plan and adjusting the loss rate accordingly. The HYDPAR program computationally implements this basic concept by assigning percent values of imperviousness to each grid cell based on input land use and then computes an average percent imperviousness for the subbasins under investigation. Any change in land use contemplated for a particular grid cell would necessitate recomputation of the subbasin (containing that grid cell) imperviousness.

Several investigators have attempted to capture the rainfall-runoff response to land use change by performing regression studies of unit hydrograph parameters (Gundlach, 1976). Typically, regression expressions were derived in which a parameter, such as basin lag, was expressed as a function of subbasin area, imperviousness, and perhaps other physiographic characteristics. The HYDPAR program computes a Snyder's lag (U.S. Army Corps of Engineers, 1973) based on a generalized equation of this type in which

$$t_p = C(X^{C1}) (10^{C2I}) \quad (3)$$

where t_p = Snyder's lag in hours
 C = regression constant
 X = $\frac{L * LCA}{S}$
 L = characteristic stream length in miles
 LCA = length from subbasin outlet along stream channel to a point opposite the centroid of the subbasin area in miles
 S = characteristic stream slope in feet per mile
 $C1$ = regression coefficient
 $C2$ = regression coefficient
 I = imperviousness in percent

The applicability of expression 3 would have to be determined from an analysis of regional data. If the expression is reasonably predictive then the values of the coefficients could be determined for input to the HYDPAR program.

Fig. 1 is a conceptually accurate display of the computational steps needed for this method of calculating hydrologic parameters (needed in the determination of direct runoff) as well. However, not all the data in the grid cell data bank necessary for the SCS computations is needed when utilizing equation 3 (as will be shown later in this section).

INPUT PREPARATION

General Description. The following material describes the data (for the HYDPAR computer program) which are entered on each input record and the type of records needed for the desired analysis to be performed.

The program is flexible to a degree in the data that can be input for analysis and in the detail of the output desired. Not all of the input records are required.

Program Data Hierarchy. The general hierarchy of the major data types used in this program is displayed in Table 1.

TITLE RECORDS

JOB RECORDS

- Type of Analysis
- Size and Format of
Grid Cell Data File
- Data Variable Location

Apply to every job

SUBBASIN DATA RECORDS

- Equation Constants
- Table of CN-values
- Table of Land Use Category
Versus Percent Imperviousness

Apply to all subbasins

- Characteristic Stream Length
- Characteristic Stream Slope
- LCA

Apply to a specific subbasin

TABLE 1
PROGRAM DATA HIERARCHY

DATA RECORD DESCRIPTION

Title Records, T1, T2, T3. The title records are required. They provide output display information that can readily identify the project and the particular job. The content of the title records is optional, but it is suggested that they include a record of the project name, data notes, selected program options, and any unique features of the job. The information on the title records is printed at the top of each page of the computer printout.

First Job Record, J1. This required record specifies the type of hydrologic parameters calculated, the printout option, the dimensions of the data base, the area size of the grid cell, and whether or not the grid cell data bank is formatted.

Second Job Record, J2. This required record describes the number of data variables in the data bank and the sequence number (location) of the variables required for analysis.

DSS Pathname Data Record, ZW. This optional record describes the pathname used by the DSS when storing hydrologic loss rate and unit hydrograph parameters for later use by HEC-1.

Format Record, FT. This optional record describes the grid cell data bank format, if the data bank is formatted.

Subbasin Data Records, EQ, SL, LU, SB. These particular records are, in general, utilized in the different computational methods, either the SCS or composite imperviousness and Snyder procedures.

- Equation Constant Record, EQ. An optional record which specifies the regression constant and coefficients required by equation 3 (in the computation of Snyder's basin lag).

- Slope Record(s), SL. An optional record(s) which defines the slope values for the SCS slope categories recorded in numerical sequence in the grid cell data bank. This permits the computation of an arithmetic average

slope for each subbasin. (This record is not required if an estimated subbasin slope value is input directly.)

- Land Use Records, LU. Land use records are required and describe the range of Curve Numbers associated with each land use category in the grid cell data bank for the various soil types included. (If the subbasin imperviousness is computed, then the land use records would supply the percent imperviousness associated with each land use category).

Program Termination Record, END. This required record terminates program execution.

OUTPUT DISPLAY

The description of the output is accompanied by sample printouts, Exhibits 1 and 2. In order to simplify the output, not all specific subbasin data is included for every subbasin. The numbers in parentheses in the text refer to a specific line (or series of lines) that is numbered on the sample output.

The line printer output begins with the name of the program (see Exhibit 1), the program version date, and the origin of the program (1). The run date and time are printed as an aid in identifying the output (2).

Input Listing. A display of the input data is provided at user request (3).

Title. The information on the title records is printed at the top of each output page (4).

Job Records. The data on the job records is first displayed in a record image format (5) prior to a more descriptive definition of the variables. The variable and input values follow with a brief description of each variable (6).

DSS File Identification. If the ZW record is used to identify the pathname when storing data for later use, then an image of that record is printed and a definition of each of the record parameters is given (7)

Format Data. If the data bank is formatted, a format record is input and an image of that record is displayed (8).

Regression Constants. If the percent imperviousness technique was used in this example, the equation values would be printed as a record image, and the regression constant and coefficient values then displayed with the equation variables they represent. (No regression constants are displayed in the SCS Curve Number Technique).

Equation. The equation that is used in the requested procedure is displayed along with definitions of the equation variables. For this sample calculation, the SCS Lag equation is utilized (9).

Slope. The slope record, if required, is printed first as an image of the input record (10); then the slope class and average percent values are tabulated (11).

The remaining portion of the output depends on the type of hydrologic parameter calculation selected by the user. A description of the output for the SCS Curve Number method is given below and included in Exhibit 1, followed by a description of Snyder's Lag method, Exhibit 2.

Curve Number Table. A record image of each LU record is shown in Exhibit 1 (12). The Curve Number table identifies the Curve Numbers assigned to each hydrologic soil group within a given land use category (13).

Subbasin Parameter Records. Record images of the SB record(s) input are also included (14). This display provides an opportunity to check the input values of the subbasin data.

Subbasin Summary Table. For each subbasin under analysis, the stream length (miles), length to the centroid of the area (miles), stream slope (feet per mile), and the HYDPAR subbasin designation are given (15). (The centroid length is not needed for this computational technique and the HEC-1 stations are required only when the results are saved for automated interface with the HEC-1 computer program).

Specific Subbasin Data. Computational results are printed sequentially for each subbasin. Each subbasin is identified (16) and the land use categories that exist within its boundary are listed. For each identified land use, data is printed for four headings: Average Curve Number, surface slope (percent), area in acres, and percent of the subbasin that is occupied by a specific land use (17). For each subbasin, the computed average values of Curve Number and surface slope are given (18). The percentage of the subbasin area associated with a given land use is used to weight the curve number and surface slope and the weighted values are then used to produce the subbasin averages. A tabulation of pertinent data and computed hydrologic parameters is also printed (19). (It should be noted that in this instance stream length and slope were input directly).

Summary of Subbasin Data. The summary output is a condensed version of subbasin data (20). Each subbasin is identified and for each subbasin, computed values of drainage area, percent of watershed (represented by the identified subbasin), average curve number, subbasin lag, and subbasin slope are given. (The stream length and slope values were provided initially with the input data).

DSS File System Information. The data written to a DSS file for use by HEC-1 utilizing HECDSS software is displayed (21).

SNYDER'S LAG TECHNIQUE

The option in the HYDPAR program which permits the user to compute Snyder's basin lag according to equation 3 and the percentage of impervious surface within a subbasin is detailed below. Several pages of output relating to this computational procedure are included in Exhibit 2. As in the previous example, the numbers in parentheses in the text refer to particular parts of the sample output.

Equation. The equation that is utilized in this procedure is given (22) along with definitions of the different variables.

Percent Impervious Summary. A record image of each LU record is provided (23). A table of user-provided values is displayed showing the percent imperviousness for each land use category (24).

Subbasin Parameter Records. Record images of the SB record input are included in the output. This display provides an opportunity to verify the input values of the subbasin data (25).

Subbasin Summary Table. For each subbasin under analysis, the stream length (miles), length to the centroid of the area (miles), stream slope (feet per mile), and HEC-1 station values are given (26). HEC-1 stations are required only when the results of the job are saved for automated interfacing with the HEC-1 program through the DSS.

Specific Subbasin Data. Specific subbasin data is tabulated (27). For each land use category in the subbasin, values are output for percent imperviousness, surface slope (not required for Snyder's technique), area, and the proportion of the subbasin that is occupied by a particular land use category (28). The percentage of the subbasin area associated with a given land use is used to weight the percent imperviousness to derive the subbasin average (29).

Included in the data output for each subbasin is the computed basin lag (TP), along with drainage area, stream length, length to centroid (LCA), stream and subbasin slope, average imperviousness, and the number of grid cells (30).

Summary of Subbasin Data. One of the final pages of output is a summary table of the subbasin values (31). The subbasins are identified, and computed values are supplied for the following categories; drainage area, percent of watershed that is represented by the identified subbasin, percent imperviousness, TP (lag), and subbasin slope. The remaining headings reflect input values.

SAMPLE PROBLEMS

Sample problems illustrating the two types of calculations currently available utilizing the HYDPAR computer program are included in Exhibits 3 and 4. The sample input and output will provide the user with an overall description of the data necessary for program execution. The sample problems will also provide a valid data set to verify program operations on other computer systems. The necessary data input categories and codes used from

and codes used from the Trail Creek data bank are incorporated in each of the problems. (It should be noted that the output display is incomplete. Specific subbasin data is given for only one of the twenty-one subbasins in the Trail Creek Watershed).

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EXHIBIT 1

SCS CURVE NUMBER TECHNIQUE

HYDROLOGIC PARAMETERS

(HYDFAR)

LIST OF INPUT CARDS FOR THIS RUN

3

CC 1234567890123456789012345678901234567890123456789012345678901234567890

SCS CURVE NUMBER TECHNIQUE		EXHIBIT 1	
HYDROLOGIC PARAMETERS		HYDROLOGIC PARAMETERS	
APRIL 1985		APRIL 1985	
T1	1	92	10
T2	18	129	7
T3	21	153	7
J1	0	1	8
J2	18	4	7
ZM	TRAIL CREEK	EXISTING LAND USE	
FT	(12F4.0,2F8.2,2F4.0,2F2.0)		
SL	1.0	4.0	8.0
LU	1	36	60
LU	2	39	61
LU	3	47	66
LU	4	61	75
LU	5	80	85
LU	6	67	78
LU	7	83	88
LU	8	95	96
LU	9	49	69
LU	10	100	100
S8	1	.95	.48
S8	2	1.36	.68
S8	3	1.25	.62
S8	4	1.14	.57
S8	5	.76	.38
S8	6	.70	.35
S8	7	1.40	.70
S8	8	1.74	.87
S8	9	1.33	.66
S8	10	.85	.42
S8	11	1.00	.50
S8	12	1.08	.54
S8	13	1.46	.73
S8	14	1.76	.88
S8	15	1.14	.57
S8	16	1.80	.90
S8	17	1.59	.80
S8	18	.89	.44
S8	19	1.14	.57
S8	20	.87	.44
S8	21	1.21	.60
END			

35.0	50.0
3NATURAL VEGETATION	
8DEVELOPED OPEN SPACE	
20LOW DENSITY RESIDENTIAL	
28MEDIUM DENSITY RESIDENTIAL	
40HIGH DENSITY RESIDENTIAL	
3AGRICULTURE	
68INDUSTRIAL	
85COMMERCIAL	
3PASTURE	
100WATER BODIES	
20.0	79
73	80
74	81
77	87
83	95
90	89
85	96
92	98
97	84
79	100
100	TC-01
113	TC-02
69	TC-03
90	TC-04
118	TC-05
123	TC-06
132	TC-07
105	TC-08
61	TC-09
116	TC-10
94	TC-11
80	TC-12
105	TC-13
78	TC-14
80	TC-15
106	TC-16
78	TC-17
101	TC-18
149	TC-19
118	TC-20
138	TC-21
143	

4

SCS CURVE NUMBER TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 1

J1 CARD

CC 1234567890123456789012345678901234567890123456789012345678901234567890
J1 0 1 1 92 129 1.53

5

6

J1 JOB PARAMETERS
.....

IAWL = 0, CURVE NUMBER AND SCS LAG WILL BE COMPUTED FOR EACH SUBBASIN
ILUPRT = 1, LIST INPUT CARDS + NORMAL PRINTOUT
IFMT = 1, GRID CELL DATA BANK IS FORMATTED
NROW = '92, TOTAL NUMBER OF ROWS IN DATA BANK
NCOL = 129, TOTAL NUMBER OF COLUMNS IN DATA BANK
SIZE = 1.53, THE SIZE OF THE GRID CELL IS IN ACRES

SCS CURVE NUMBER TECHNIQUE EXHIBIT 1
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

J2 CARD
.....

CC 123456789012345678901234567890123456789012345678901234567890
J2 18 21 4 10 10 7 8 7

J2 JOB PARAMETERS
.....

NVAR = 18, THE NUMBER OF DATA VARIABLES PER GRID CELL RECORD
NSUB = 21, THE NUMBER OF SUBBASINS ANALYZED IN THIS RUN
IBS = 4, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE SUBBASIN CODE
NLUSE = 10, THE NUMBER OF LAND USE CATEGORIES IN THE GRID CELL DATA BANK
ILD = 10, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE LAND USE PATTERN TO BE ANALYZED
NSLP = 7, THE NUMBER OF SLOPE CLASSES FOR CURVE NUMBER ANALYSIS
ISLP = 8, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE SCS LAND SURFACE SLOPE CODE
IHYO = 7, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE HYDROLOGIC SOIL GROUP CODE

HECROSS WRITE CARD

7

CC 123456789012345678901234567890123456789012345678901234567890
ZU TRAIL CREEK EXISTING LAND USE

FILE SYSTEM INFORMATION - A FILE WILL BE CREATED TO PASS HYDROLOGIC
PARAMETERS TO NEC-1 USING THE NEC DATA STORAGE SYSTEM (HECROSS).

PROJ = TRAIL CREEK

ALT = EXISTING LAND USE

IYR =

.....DSS---ZOPEN NEW FILE OPENED 71 0000R108*U1 A

FORMAT CARD

8

CC 123456789012345678901234567890123456789012345678901234567890
FT(12F4.0,2F8.2,2F4.0,2F2.0)

9

LAG EQUATION

$$\text{LAG (HOURS)} = \frac{0.8}{(L)^{0.7}} \frac{0.7}{(S+1)^{0.5}} \frac{0.5}{(1900)(Y)}$$

WHERE --

L = THE HYDRAULIC LENGTH OF WATERSHED IN FEET

Y = AVERAGE SUBBASIN LAND SLOPE IN PER CENT

S = $(1000/CN) - 10$
WHERE CN IS THE CURVE NUMBER

THE SUBBASIN CURVE NUMBER IS A WEIGHTED AVERAGE FOR THE LAND USE WITHIN THE HYDROLOGIC SOIL GROUPS. SUBBASIN SLOPE IS A SIMPLE AVERAGE AND SUBBASIN STREAM SLOPE AND LENGTH ARE DETERMINED EXTERNALLY AND DIRECTLY INPUT.

SCS CURVE NUMBER TECHNIQUE
HYDPAK HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 1

10

SLOPE CLASS AVERAGES

CC 1234567890123456789012345678901234567890123456789012345678901234567890
SL 1. 4. 8. 13. 20. 35. 50. 0. 0. 0.

11

SLOPE CLASS	AVERAGE PERCENT
1	1.000
2	4.000
3	8.000
4	13.000
5	20.000
6	35.000
7	50.000

EXHIBIT 1

12

LAND USE CATEGORIES

CURVE NUMBER SUMMARY WITH
ASSOCIATED LAND USE CATEGORIES

13

LAND USE CATEGORY	TITLE	HYDROLOGIC SOIL GROUP			
		A	B	C	D
1	NATURAL VEGETATION	36.	60.	73.	79.
2	DEVELOPED OPEN SPACE	39.	61.	74.	80.
3	LOW DENSITY RESIDENTIAL	47.	66.	77.	81.
4	MEDIUM DENSITY RESIDENTIAL	61.	75.	83.	87.
5	HIGH DENSITY RESIDENTIAL	80.	85.	90.	95.
6	AGRICULTURE	67.	78.	85.	89.
7	INDUSTRIAL	83.	88.	92.	96.
8	COMMERCIAL	95.	96.	97.	98.
9	PASTURE	49.	69.	79.	84.
10	WATER BODIES	100.	100.	100.	100.

SCS CURVE NUMBER TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 1

14

SUBBASIN PARAMETER CARDS

CC	1234567890123456789012345678901234567890123456789012345678901234567890	0.95	0.48	113.0	TC-01	0.00
S8	1.	0.95	0.48	113.0	TC-01	0.00
S8	2.	1.36	0.68	69.0	TC-02	0.00
S8	3.	1.25	0.62	90.0	TC-03	0.00
S8	4.	1.14	0.57	118.0	TC-04	0.00
S8	5.	0.76	0.38	123.0	TC-05	0.00
S8	6.	0.70	0.35	132.0	TC-06	0.00
S8	7.	1.40	0.70	105.0	TC-07	0.00
S8	8.	1.74	0.87	61.0	TC-08	0.00
S8	9.	1.33	0.66	116.0	TC-09	0.00
S8	10.	0.85	0.42	94.0	TC-10	0.00
S8	11.	1.00	0.50	80.0	TC-11	0.00
S8	12.	1.08	0.54	105.0	TC-12	0.00
S8	13.	1.46	0.73	78.0	TC-13	0.00
S8	14.	1.76	0.88	80.0	TC-14	0.00
S8	15.	1.14	0.57	106.0	TC-15	0.00
S8	16.	1.80	0.90	78.0	TC-16	0.00
S8	17.	1.59	0.80	101.0	TC-17	0.00
S8	18.	0.89	0.44	149.0	TC-18	0.00
S8	19.	1.14	0.57	118.0	TC-19	0.00
S8	20.	0.87	0.44	138.0	TC-20	0.00
S8	21.	1.21	0.60	143.0	TC-21	0.00

SUBBASIN SUMMARY TABLE

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HYDPA SUBBASIN	STREAM LENGTH (MILES)	LENGTH TO CENTROID (MILES)	STREAM SLOPE (F.T./MI.)	HEC-1 STATION	SNYDER'S CP
1.	0.95	0.48	113.0	TC-01	0.00
2.	1.36	0.68	69.0	TC-02	0.00
3.	1.25	0.62	90.0	TC-03	0.00
4.	1.14	0.57	118.0	TC-04	0.00
5.	0.76	0.38	123.0	TC-05	0.00
6.	0.70	0.35	132.0	TC-06	0.00
7.	1.40	0.70	105.0	TC-07	0.00
8.	1.74	0.87	61.0	TC-08	0.00
9.	1.33	0.66	116.0	TC-09	0.00
10.	0.85	0.42	94.0	TC-10	0.00
11.	1.00	0.30	80.0	TC-11	0.00
12.	1.08	0.54	105.0	TC-12	0.00
13.	1.46	0.73	78.0	TC-13	0.00
14.	1.76	0.88	80.0	TC-14	0.00
15.	1.14	0.57	106.0	TC-15	0.00
16.	1.80	0.90	78.0	TC-16	0.00
17.	1.59	0.80	101.0	TC-17	0.00
18.	0.89	0.44	149.0	TC-18	0.00
19.	1.14	0.57	118.0	TC-19	0.00
20.	0.87	0.44	138.0	TC-20	0.00
21.	1.21	0.60	143.0	TC-21	0.00

SCS CURVE NUMBER TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 1

SUBBASIN 1.		16		17	
LAND USE CATEGORY	LAND USE	AVE CURVE NO.	SURFACE SLOPE (PERCENT)	AREA IN ACRES	PERCENT OF SUBBASIN
1	NATURAL VEGETATION	61.0	7.25	223.38	48.99
3	LOW DENSITY RESIDENTIAL	67.0	4.82	68.85	15.10
6	AGRICULTURE	78.0	6.49	157.59	34.56
10	WATER BODIES	100.0	1.00	6.12	1.34
SUBBASIN AVERAGE		68.3	6.54	455.94	

SUBBASIN 1. DATA		19	
* DRAINAGE AREA (ACRES)	=	455.94	*
* DRAINAGE AREA (SQ. MI.)	=	0.71	*
* STREAM LENGTH (MILES)	=	0.95	*
* SUBBASIN SLOPE (PERCENT)	=	6.54	*
* AVERAGE CURVE NUMBER	=	68.29	*
* SUBBASIN LAG (HOURS)	=	0.63	*
* NUMBER OF DATA CELLS	=	298.00	*

SCS CURVE NUMBER TECHNIQUE
HYDPAK HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 1

(20)

SUMMARY OF SUBBASIN DATA

SUBBASIN NUMBER	DRAINAGE AREA (SQ. MI.)	PERCENT OF WATERSHED	AVERAGE CURVE NUMBER	SUBBASIN LAG (HOURS)	STREAM LENGTH (MILES)	SUBBASIN SLOPE (PERCENT)
1.	0.71	5.58	68.3	0.63	0.95	6.54
2.	0.74	5.79	69.6	0.84	1.36	6.05
3.	0.58	4.55	73.7	0.77	1.25	5.12
4.	0.50	3.90	67.4	0.79	1.14	5.89
5.	0.22	1.76	70.6	0.53	0.76	5.71
6.	0.16	1.22	73.4	0.40	0.70	7.45
7.	0.82	6.44	71.3	0.79	1.40	6.55
8.	1.01	7.89	66.9	1.02	1.74	7.13
9.	0.66	5.21	69.9	0.72	1.33	7.86
10.	0.30	2.32	64.1	0.67	0.85	6.02
11.	0.44	3.45	72.0	0.65	1.00	5.39
12.	0.57	4.50	72.3	0.65	1.08	6.05
13.	1.15	8.97	70.4	0.86	1.46	6.39
14.	1.15	8.99	66.2	1.04	1.76	7.24
15.	0.30	2.32	62.7	0.82	1.14	6.95
16.	0.87	6.82	70.8	1.04	1.80	5.87
17.	0.59	4.59	65.3	0.89	1.59	8.69
18.	0.51	3.97	64.6	0.58	0.89	8.38
19.	0.32	2.47	63.2	0.79	1.14	7.22
20.	0.36	2.79	64.6	0.53	0.87	9.73
21.	0.82	6.46	66.6	0.69	1.21	8.79

SCS CURVE NUMBER TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 1

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DATA FOR USE BY HEC-1 THROUGH HEC2SS

HEC-1 STATION	DRAINAGE AREA (SQ.MI.)	SUBBASIN CURVE NUMBER	SUBBASIN LAG (HOURS)	SUBBASIN PERCENT IMPERV.	SNYDER'S LAG (TP) (HOURS)	SNYDER'S PEAKING COEF(CP)	HYDRO- GRAPH METHOD
TC-01	0.71	68.29	0.63	0.00	0.00	0.00	SCS CN
TC-02	0.74	69.58	0.84	0.00	0.00	0.00	SCS CN
TC-03	0.58	73.67	0.77	0.00	0.00	0.00	SCS CN
TC-04	0.50	67.43	0.79	0.00	0.00	0.00	SCS CN
TC-05	0.22	70.59	0.53	0.00	0.00	0.00	SCS CN
TC-06	0.16	73.40	0.40	0.00	0.00	0.00	SCS CN
TC-07	0.82	71.28	0.79	0.00	0.00	0.00	SCS CN
TC-08	1.01	66.92	1.02	0.00	0.00	0.00	SCS CN
TC-09	0.66	69.86	0.72	0.00	0.00	0.00	SCS CN
TC-10	0.30	64.10	0.67	0.00	0.00	0.00	SCS CN
TC-11	0.44	72.03	0.65	0.00	0.00	0.00	SCS CN
TC-12	0.57	72.32	0.65	0.00	0.00	0.00	SCS CN
TC-13	1.15	70.38	0.86	0.00	0.00	0.00	SCS CN
TC-14	1.15	66.16	1.04	0.00	0.00	0.00	SCS CN
TC-15	0.30	62.67	0.82	0.00	0.00	0.00	SCS CN
TC-16	0.87	70.84	1.04	0.00	0.00	0.00	SCS CN
TC-17	0.59	65.33	0.89	0.00	0.00	0.00	SCS CN
TC-18	0.51	64.63	0.58	0.00	0.00	0.00	SCS CN
TC-19	0.32	63.20	0.79	0.00	0.00	0.00	SCS CN
TC-20	0.36	64.4	0.53	0.00	0.00	0.00	SCS CN
TC-21	0.82	66.58	0.69	0.00	0.00	0.00	SCS CN

HECDS FILE INFORMATION		HECDS PATHNAMES FOR USE BY HEC-1	
.....			
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-01/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-02/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-03/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-04/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-05/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-06/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-07/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-08/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-09/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-10/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-11/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-12/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-13/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-14/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-15/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-16/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-17/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-18/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-19/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-20/HYDPAR///EXISTING LAND USE/	
.....DSS---ZWRITE FILE 71, VERS.	1	/TRAIL CREEK/TC-21/HYDPAR///EXISTING LAND USE/	

```

.....DSS---ZCLOSE FILE 71
NO. RECORDS= 21
FILE SIZE= 2594 WORDS, 24 SECTORS
PERCENT INACTIVE= 0.00

```

```

+++++
END OF RUN
HYDPAR PROGRAM STOP
+++++

```

EXHIBIT 2

SNYDER'S LAG TECHNIQUE

HYDROLOGIC PARAMETERS

(HYDPAR)

SNYDER'S LAG TECHNIQUE
HYDROLOGIC PARAMETERS
APRIL 1985
EXHIBIT 2

EQ CARD VALUES

CC 123456789012345678901234567890123456789012345678901234567890
EQ0.927600.387600-.003735

EQ VALUES	CONST (C)	CONA (C1)	CONB (C2)
0.927600	0.387600	-.003735	

CALCULATION OF SNYDER'S LAG (TP)

22

TP (HOURS) = (C)(X) (10) C1 (C2)I

WHERE ...

C = REGRESSION CONSTANT = 0.927600

X = (L)(Z)(S) -.5

L = STREAM LENGTH (MILES)

Z = LCA (LENGTH TO CENTROID IN MILES)

S = STREAM SLOPE (FEET/MILE)

C1 = REGRESSION COEFFICIENT = 0.387600

C2 = REGRESSION COEFFICIENT = -.003735

I = PERCENT IMPERVIOUSNESS

23

LAND USE CATEGORIES

[illegible]

PERCENT IMPERVIOUSNESS SUMMARY
WITH ASSOCIATED LAND USE CATEGORIES

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LAND USE CATEGORY	TITLE	PERCENT IMPERVIOUSNESS
1	NATURAL VEGETATION	3.00
2	DEVELOPED OPEN SPACE	8.00
3	LOW DENSITY RESIDENTIAL	20.00
4	MEDIUM DENSITY RESIDENTIAL	28.00
5	HIGH DENSITY RESIDENTIAL	40.00
6	AGRICULTURE	3.00
7	INDUSTRIAL	68.00
8	COMMERCIAL	85.00
9	PASTURE	3.00
10	WATER BODIES	100.00

52

.....

S8	1.	0.95	0.48	113.0	TC-01	0.40
S8	2.	1.36	0.68	69.0	TC-02	0.43
S8	3.	1.25	0.62	90.0	TC-03	0.43
S8	4.	1.14	0.57	118.0	TC-04	0.43
S8	5.	0.76	0.38	123.0	TC-05	0.43
S8	6.	0.70	0.35	132.0	TC-06	0.43
S8	7.	1.40	0.70	105.0	TC-07	0.40
S8	8.	1.74	0.87	61.0	TC-08	0.43
S8	9.	1.33	0.66	116.0	TC-09	0.43
S8	10.	0.85	0.42	94.0	TC-10	0.40
S5	11.	1.00	0.50	80.0	TC-11	0.40
S8	12.	1.08	0.54	105.0	TC-12	0.45
S8	13.	1.46	0.73	78.0	TC-13	0.45
S8	14.	1.76	0.88	80.0	TC-14	0.45
S8	15.	1.14	0.57	106.0	TC-15	0.45
S8	16.	1.80	0.90	78.0	TC-16	0.45
S8	17.	1.59	0.80	101.0	TC-17	0.45
S8	18.	0.89	0.44	149.0	TC-18	0.48
S8	19.	1.14	0.57	118.0	TC-19	0.48
S8	20.	0.87	0.44	138.0	TC-20	0.48
S8	21.	1.21	0.60	143.0	TC-21	0.48

SUBBASIN SUMMARY TABLE
.....

26

HYDRO- SUBBASIN	STREAM LENGTH (MILES)	LENGTH TO CENTROID (MILES)	STREAM SLOPE (FT./MI.)	HEC-1 STATION	SNYDER'S Cp
1.	0.95	0.48	113.0	TC-01	0.40
2.	1.36	0.68	69.0	TC-02	0.43
3.	1.25	0.62	90.0	TC-03	0.43
4.	1.14	0.57	118.0	TC-04	0.43
5.	0.76	0.38	123.0	TC-05	0.43
6.	0.70	0.35	132.0	TC-06	0.43
7.	1.40	0.70	105.0	TC-07	0.40
8.	1.74	0.87	61.0	TC-08	0.43
9.	1.33	0.66	116.0	TC-09	0.43
10.	0.85	0.42	94.0	TC-10	0.40
11.	1.00	0.50	80.0	TC-11	0.40
12.	1.08	0.54	105.0	TC-12	0.45
13.	1.46	0.73	78.0	TC-13	0.45
14.	1.76	0.88	80.0	TC-14	0.45
15.	1.14	0.57	106.0	TC-15	0.45

SNYDER'S LAG TECHNIQUE
HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 2

(27)

LAND USE CATEGORY	LAND USE	PERCENT IMPERVIOUSNESS	AREA IN ACRES	PERCENT OF SUBBASIN
1	NATURAL VEGETATION	3.00	223.38	48.99
3	LOW DENSITY RESIDENTIAL	20.00	68.85	15.10
6	AGRICULTURE	3.00	157.59	34.56
10	WATER BODIES	100.00	6.12	1.34
	SUBBASIN AVERAGE	6.87	455.94	

(28)

(30)

SUBBASIN 1. DATA	
DRAINAGE AREA (ACRES)	= 455.94 *
DRAINAGE AREA (SQ. MI.)	= 0.71 *
STREAM LENGTH (MILES)	= 0.95 *
LENGTH TO CENTROID (MILES)	= 0.48 *
STREAM SLOPE (FEET/MILE)	= 113.00 *
AVERAGE IMPERVIOUS. (PERCENT)	= 6.87 *
SUBBASIN TP (HOURS)	= 0.26 *
SNYDER'S PEAKING COEF. (CP)	= 0.40 *
NUMBER OF DATA CELLS	= 298.00 *

(29)

EXHIBIT 2

SNYDER'S LAG TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

(31)

SUMMARY OF SUBBASIN DATA

SUBBASIN NUMBER	DRAINAGE AREA (SQ. MI.)	PERCENT OF WATERSHED	PERCENT IMPERVIOUS.	TP (HOURS)	SNYDER'S CP	STREAM LENGTH (MILES)	LCA-LENGTH TO CENTROIC (MILES)	STREAM SLOPE (FT./MI.)
1.	0.71	5.58	6.87	0.26	0.40	0.95	0.48	113.
2.	0.74	5.79	3.61	0.38	0.43	1.36	0.68	69.
3.	0.58	4.55	3.00	0.34	0.43	1.25	0.62	90.
4.	0.50	3.90	7.01	0.29	0.43	1.14	0.57	118.
5.	0.22	1.76	3.00	0.22	0.43	0.76	0.38	123.
6.	0.16	1.22	3.00	0.20	0.43	0.70	0.35	132.
7.	0.82	6.44	3.38	0.36	0.40	1.40	0.70	105.
8.	1.01	7.89	6.34	0.47	0.43	1.74	0.87	61.
9.	0.66	5.21	11.27	0.32	0.43	1.33	0.66	116.
10.	0.30	2.32	3.14	0.25	0.40	0.85	0.42	94.
11.	0.44	3.45	3.00	0.30	0.40	1.00	0.50	80.
12.	0.57	4.50	10.42	0.28	0.45	1.08	0.54	105.
13.	1.15	8.97	7.93	0.38	0.45	1.46	0.73	78.
14.	1.15	8.99	5.33	0.45	0.45	1.76	0.88	80.
15.	0.30	2.32	3.00	0.31	0.45	1.14	0.57	106.
16.	0.87	6.82	9.90	0.44	0.45	1.80	0.90	78.
17.	0.59	4.59	4.76	0.40	0.45	1.59	0.80	101.
18.	0.51	3.97	12.49	0.22	0.48	0.89	0.44	149.
19.	0.32	2.47	8.17	0.29	0.48	1.14	0.57	118.
20.	0.36	2.79	13.21	0.22	0.48	0.87	0.44	138.
21.	0.82	6.46	16.71	0.27	0.48	1.21	0.60	143.

EXHIBIT 3

SAMPLE PROBLEM

SCS CURVE NUMBER TECHNIQUE

SAMPLE PROBLEM

SCS CURVE NUMBER TECHNIQUE

Problem Statement

Using the SCS Curve Number Technique, compute the existing hydrologic subbasin parameters for the Trail Creek Watershed utilizing values of average surface slope. Do not suppress any of the subbasin output.

The format of the data file in the Trail Creek DATA BANK is (12F4.0, 2F8.2, 2F4.0, 2F2.0). The curve numbers that have been adopted for the land use categories are tabulated in Table 1. Table 2 contains the stream length and the stream slope for each subbasin. The average slope values are given in Table 3; and Table 4 is a listing of the data base file incorporated in the Trail Creek Watershed.

Description of Input Requirements

The key input variables for this computation are IANL (J1.1), described in detail later in Exhibit 5, which identifies the type of calculation, and ISLP (J2.7) for indicating inclusion of the SL record(s). It should be noted that the alphanumeric characters within the parentheses following the variable name refer to particular input records and related record fields. As an example, the first two alphanumeric characters of (J1.1) indicate the J1-record and the character(s) following the decimal point indicates a particular field (or record column group).

The Curve Number values (LU records) are taken from Table 1. Subbasin data, Table 2, are coded on SB records, while the average slope values, Table 3, are input on SL record(s).

Discussion of Results

Average surface slope values were input on the SL record to satisfy the SCS equation requirement for slope input. The output for this sample problem includes Specific Subbasin Data for Subbasin 1 (page 55) and the Summary of Subbasin Data for the entire watershed (page 56). The subbasin averages in Specific Subbasin Data reflect a weighting of land use values based on the amount of subbasin coverage for a particular land use category. On the page of Specific Subbasin Data, the subbasin area is defined by the following units: acres, square miles and number of grid cells. The last page of output, Summary of Subbasin Data, summarizes calculated and input data for each subbasin.

TABLE 1

CURVE NUMBER TABLE

Land Use Categories	Hydrologic Soil Group			
	A	B	C	D
1	36	60	73	79
2	39	61	74	80
3	47	66	77	81
4	61	75	83	87
5	80	85	90	95
6	67	78	85	89
7	83	88	92	96
8	95	96	97	98
9	49	69	79	84
10	100	100	100	100

TABLE 2

SUBBASIN DATA

Subbasin	Stream length (miles)	LCA (miles)	Stream Slope (feet/mile)
1	.95	.48	113.
2	1.36	.68	69.
3	1.25	.62	90.
4	1.14	.57	118.
5	.76	.38	123.
6	.70	.35	132.
7	1.40	.70	105.
8	1.74	.87	61.
9	1.33	.66	116.
10	.85	.42	94.
11	1.00	.50	80.
12	1.08	.54	105.
13	1.46	.73	78.
14	1.76	.88	80.
15	1.14	.57	106.
16	1.80	.90	78.
17	1.59	.80	101.
18	.89	.44	149.
19	1.14	.57	118.
20	.87	.44	138.
21	1.21	.60	143.

Exhibit 3

TABLE 3

AVERAGE SLOPE

Slope Category	Average Slope
1	1.0
2	4.0
3	8.0
4	13.0
5	20.0
6	35.0
7	50.0

TABLE 4
DATA BASE FILE DIRECTORY
FOR
THE TRAIL CREEK WATERSHED

Data Variable Code	Data Category Code	Identifying Title
1	1	GRID CELL ROW
	2-92	Row 1 Rows 2-92
2	1	GRID CELL COLUMN
	2-129	Column 1 Columns 2-129
4	1	HYDROLOGIC SOIL GROUPS
	2-21	Subbasin 1 Subbasins 2-21
7	1	HYDROLOGIC SOIL GROUPS
	2	Group A (Low Runoff Potential)
	3	Group B (Moderate Infiltration Rates)
	4	Group C (Slow Infiltration Rates) Group D (High Runoff Potential)
8	1	LAND SURFACE SLOPE
	2	0 to 3 percent slope
	3	3 to 5 percent slope
	4	5 to 10 percent slope
	5	10 to 15 percent slope
	6	15 to 25 percent slope
	7	25 to 45 percent slope Greater than 45 percent slope
10	1	EXISTING LAND USE
	2	Natural vegetation
	3	Developed open space
	4	Low density residential
	5	Medium density residential
	6	High density residential
	7	Agricultural
	8	Industrial
	9	Commercial
	10	Pasture Water bodies

EXHIBIT 3

LIST OF INPUT CARDS FOR THIS RUN

cc 123456789012345678901234567890123456789012345678901234567890

T1 T2 T3	SCS CURVE NUMBER TECHNIQUE			HYDROLOGIC PARAMETERS			APRIL 1985			EXHIBIT 3		
	T1			T2			T3			T4		
	0	1	2	3	4	5	6	7	8	9	10	11
J1	1	36	60	73	79	84	89	94	99	104	109	114
J2	18	21	24	27	30	33	36	39	42	45	48	51
J3	1.0	4.0	8.0	12.0	16.0	20.0	24.0	28.0	32.0	36.0	40.0	44.0
FT	1254.0	258.2	254.0	252.0	250.0	248.0	246.0	244.0	242.0	240.0	238.0	236.0
SL	1.0	4.0	8.0	13.0	10	10	10	10	10	10	10	10
LL	1	39	61	74	80	85	90	95	100	105	110	115
LL	2	39	61	74	80	85	90	95	100	105	110	115
LL	3	47	66	77	81	87	92	96	100	104	108	112
LL	4	61	75	83	87	90	95	99	103	107	111	115
LL	5	80	85	88	90	92	94	96	98	100	102	104
LL	6	67	78	85	89	92	95	97	99	101	103	105
LL	7	83	88	92	96	97	98	99	100	101	102	103
LL	8	95	96	97	98	99	100	100	100	100	100	100
LL	9	49	69	79	84	89	94	99	104	109	114	119
LL	10	100	100	100	100	100	100	100	100	100	100	100
SB	1	.95	.48	113	TC-01	TC-02	TC-03	TC-04	TC-05	TC-06	TC-07	TC-08
SB	2	1.36	.68	69	TC-09	TC-10	TC-11	TC-12	TC-13	TC-14	TC-15	TC-16
SB	3	1.25	.62	90	TC-17	TC-18	TC-19	TC-20	TC-21	TC-22	TC-23	TC-24
SB	4	1.14	.57	118	TC-25	TC-26	TC-27	TC-28	TC-29	TC-30	TC-31	TC-32
SB	5	.76	.38	123	TC-33	TC-34	TC-35	TC-36	TC-37	TC-38	TC-39	TC-40
SB	6	.70	.35	132	TC-41	TC-42	TC-43	TC-44	TC-45	TC-46	TC-47	TC-48
SB	7	1.40	.70	105	TC-49	TC-50	TC-51	TC-52	TC-53	TC-54	TC-55	TC-56
SB	8	1.74	.87	61	TC-57	TC-58	TC-59	TC-60	TC-61	TC-62	TC-63	TC-64
SB	9	1.33	.66	116	TC-65	TC-66	TC-67	TC-68	TC-69	TC-70	TC-71	TC-72
SB	10	.85	.42	94	TC-73	TC-74	TC-75	TC-76	TC-77	TC-78	TC-79	TC-80
SB	11	1.00	.50	80	TC-81	TC-82	TC-83	TC-84	TC-85	TC-86	TC-87	TC-88
SB	12	1.08	.54	105	TC-89	TC-90	TC-91	TC-92	TC-93	TC-94	TC-95	TC-96
SB	13	1.46	.73	78	TC-97	TC-98	TC-99	TC-100	TC-101	TC-102	TC-103	TC-104
SB	14	1.76	.88	80	TC-105	TC-106	TC-107	TC-108	TC-109	TC-110	TC-111	TC-112
SB	15	1.14	.57	106	TC-113	TC-114	TC-115	TC-116	TC-117	TC-118	TC-119	TC-120
SB	16	1.80	.90	78	TC-121	TC-122	TC-123	TC-124	TC-125	TC-126	TC-127	TC-128
SB	17	1.59	.80	101	TC-129	TC-130	TC-131	TC-132	TC-133	TC-134	TC-135	TC-136
SB	18	.89	.44	149	TC-137	TC-138	TC-139	TC-140	TC-141	TC-142	TC-143	TC-144
SB	19	1.14	.57	118	TC-145	TC-146	TC-147	TC-148	TC-149	TC-150	TC-151	TC-152
SB	20	.87	.44	138	TC-153	TC-154	TC-155	TC-156	TC-157	TC-158	TC-159	TC-160
SB	21	1.21	.60	143	TC-161	TC-162	TC-163	TC-164	TC-165	TC-166	TC-167	TC-168
END												

SCS CURVE NUMBER TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1965

EXHIBIT 3

J1 CARD
.....

CC 123456789012345678901234567890123456789012345678901234567890
J1 0 1 1 92 129 1.53

J1 JOB PARAMETERS
.....

IANL = 0, CURVE NUMBER AND SCS LAG WILL BE COMPUTED FOR EACH SUBBASIN
ILUPRT = 1, LIST INPUT CARDS + NORMAL PRINTOUT
IPNT = 1, GRID CELL DATA BANK IS FORMATTED
NR0W = 92, TOTAL NUMBER OF ROWS IN DATA BANK
NCOL = 129, TOTAL NUMBER OF COLUMNS IN DATA BANK
SIZE = 1.53, THE SIZE OF THE GRID CELL IS IN ACRES

J2 CARD
.....

CC 123456789012345678901234567890123456789012345678901234567890
J2 18 21 4 10 10 7 8 7

J2 JOB PARAMETERS
.....

NVAR = 10, THE NUMBER OF DATA VARIABLES PER GRID CELL RECORD
NSUB = 21, THE NUMBER OF SUBBASINS ANALYZED IN THIS RUN
IBS = 4, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE SUBBASIN CODE
MLUSE = 10, THE NUMBER OF LAND USE CATEGORIES IN THE GRID CELL DATA BANK
ILD = 10, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE LAND USE PATTERN TO BE ANALYZED
MSLP = 7, THE NUMBER OF SLOPE CLASSES FOR CURVE NUMBER ANALYSIS
ISLP = 8, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE SCS LAND SURFACE SLOPE CODE
IHYO = 7, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE HYDROLOGIC SOIL GROUP CODE

FORMAT CARD
.....

CC 123456789012345678901234567890123456789012345678901234567890
FT(12F4.0,2F8.2,2F4.0,2F2.0)

LAG EQUATION

$$\text{LAG (HOURS)} = \frac{0.8 \quad 0.7}{(L) \quad (S+1)} \dots \dots \dots \frac{0.5}{(1900)(Y)}$$

WHERE ..

L = THE HYDRAULIC LENGTH OF WATERSHED IN FEET

Y = AVERAGE SUBBASIN LAND SLOPE IN PER CENT

S = $(1000/CN)^{10}$
WHERE CN IS THE CURVE NUMBER

THE SUBBASIN CURVE NUMBER IS A WEIGHTED AVERAGE FOR THE LAND USE WITHIN THE HYDROLOGIC SOIL GROUPS. SUBBASIN SLOPE IS A SIMPLE AVERAGE AND SUBBASIN STREAM SLOPE AND LENGTH ARE DETERMINED EXTERNALLY AND DIRECTLY INPUT.

SCS CURVE NUMBER TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 3

SLOPE CLASS AVERAGES

CC 1234567890123456789012345678901234567890123456789012345678901234567890
SL 1. 4. 8. 13. 20. 35. 50. 0. 0. 0.

SLOPE CLASS	AVERAGE PERCENT
1	1.000
2	4.000
3	8.000
4	13.000
5	20.000
6	35.000
7	50.000

**SCS CURVE NUMBER TECHNIQUE
HYDPAR HYDROLOGIC PARAMETERS
APRIL 1985**

LAND USE CATEGORIES

[illegible]

CURVE NUMBER SUMMARY WITH
ASSOCIATED LAND USE CATEGORIES
.....

LAND USE CATEGORY	TITLE	HYDROLOGIC SOIL GROUP			
		A	B	C	D
1	NATURAL VEGETATION	36.	60.	73.	79.
2	DEVELOPED OPEN SPACE	39.	61.	74.	80.
3	LOW DENSITY RESIDENTIAL	47.	66.	77.	81.
4	MEDIUM DENSITY RESIDENTIAL	61.	75.	83.	87.
5	HIGH DENSITY RESIDENTIAL	80.	85.	90.	95.
6	AGRICULTURE	67.	78.	85.	89.
7	INDUSTRIAL	83.	88.	92.	96.
8	COMMERCIAL	95.	96.	97.	98.
9	PASTURE	49.	69.	79.	84.
10	WATER BODIES	100.	100.	100.	100.

EXHIBIT 3

SCS CURVE NUMBER TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

SUBBASIN PARAMETER CARDS			
.....			
CC 1234567890123456789012345678901234567890123456789012345678901234567890			
S8 1.	0.95	0.48	113.0 TC-01 0.00
S8 2.	1.36	0.68	69.0 TC-02 0.00
S8 3.	1.25	0.62	90.0 TC-03 0.00
S8 4.	1.14	0.57	118.0 TC-04 0.00
S8 5.	0.76	0.38	123.0 TC-05 0.00
S8 6.	0.70	0.35	132.0 TC-06 0.00
S8 7.	1.40	0.70	105.0 TC-07 0.00
S8 8.	1.74	0.87	61.0 TC-08 0.00
S8 9.	1.33	0.66	116.0 TC-09 0.00
S8 10.	0.85	0.42	94.0 TC-10 0.00
S8 11.	1.00	0.50	80.0 TC-11 0.00
S8 12.	1.08	0.54	105.0 TC-12 0.00
S8 13.	1.46	0.73	78.0 TC-13 0.00
S8 14.	1.76	0.88	80.0 TC-14 0.00
S8 15.	1.14	0.57	106.0 TC-15 0.00
S8 16.	1.80	0.90	78.0 TC-16 0.00
S8 17.	1.59	0.80	101.0 TC-17 0.00
S8 18.	0.89	0.44	149.0 TC-18 0.00
S8 19.	1.14	0.57	118.0 TC-19 0.00
S8 20.	0.87	0.44	138.0 TC-20 0.00
S8 21.	1.21	0.60	143.0 TC-21 0.00

SUBBASIN SUMMARY TABLE

HYDRO- SUBBASIN	STREAM LENGTH (MILES)	LENGTH TO CENTROID (MILES)	STREAM SLOPE (FT./MI.)	HEC-1 STATION	SNYDER'S CP
1.	0.95	0.48	113.0	TC-01	0.00
2.	1.36	0.68	69.0	TC-02	0.00
3.	1.25	0.62	90.0	TC-03	0.00
4.	1.14	0.57	118.0	TC-04	0.00
5.	0.76	0.38	123.0	TC-05	0.00
6.	0.70	0.35	132.0	TC-06	0.00
7.	1.40	0.70	105.0	TC-07	0.00
8.	1.74	0.87	61.0	TC-08	0.00
9.	1.33	0.66	116.0	TC-09	0.00
10.	0.85	0.42	94.0	TC-10	0.00
11.	1.00	0.50	80.0	TC-11	0.00
12.	1.08	0.54	105.0	TC-12	0.00
13.	1.46	0.73	78.0	TC-13	0.00
14.	1.76	0.88	80.0	TC-14	0.00
15.	1.14	0.57	106.0	TC-15	0.00
16.	1.80	0.90	78.0	TC-16	0.00
17.	1.59	0.80	101.0	TC-17	0.00
18.	0.89	0.44	149.0	TC-18	0.00
19.	1.14	0.57	118.0	TC-19	0.00
20.	0.87	0.44	138.0	TC-20	0.00
21.	1.21	0.60	143.0	TC-21	0.00

SCS CURVE NUMBER TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 3

SUBBASIN 1.
.....

LAND USE CATEGORY	LAND USE	AVE CURVE NO.	SURFACE SLOPE (PERCENT)	AREA IN ACRES	PERCENT OF SUBBASIN
1	NATURAL VEGETATION	61.0	7.25	223.38	48.99
3	LOW DENSITY RESIDENTIAL	67.0	4.82	68.85	15.10
6	AGRICULTURE	78.0	6.49	157.59	34.56
10	WATER BODIES	100.0	1.00	6.12	1.34
					
		68.3	6.54	455.94	

SUBBASIN AVERAGE

```
*****
* SUBBASIN 1. DATA *
* *****
* DRAINAGE AREA (ACRES) = 455.94 *
* DRAINAGE AREA (SQ. MI.) = 0.71 *
* STREAM LENGTH (MILES) = 0.95 *
* SUBBASIN SLOPE (PERCENT) = 6.54 *
* AVERAGE CURVE NUMBER = 68.29 *
* SUBBASIN LAG (HOURS) = 0.63 *
* NUMBER OF DATA CELLS = 298.00 *
*****
```

EXHIBIT 3

SCS CURVE NUMBER TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

SUMMARY OF SUBBASIN DATA

SUBBASIN NUMBER	DRAINAGE AREA (SQ. MI.)	PERCENT OF WATERSHED	AVERAGE CURVE NUMBER	SUBBASIN LAG (HOURS)	STREAM LENGTH (MILES)	SUBBASIN SLOPE (PERCENT)
1.	0.71	5.58	68.3	0.63	0.95	6.54
2.	0.74	5.79	69.6	0.84	1.36	6.05
3.	0.58	4.55	73.7	0.77	1.25	5.12
4.	0.50	3.90	67.4	0.79	1.14	5.89
5.	0.22	1.76	70.6	0.53	0.76	5.71
6.	0.16	1.22	73.4	0.40	0.70	7.45
7.	0.82	6.44	71.3	0.79	1.40	6.55
8.	1.01	7.89	66.9	1.02	1.74	7.13
9.	0.66	5.21	69.9	0.72	1.33	7.86
10.	0.30	2.32	64.1	0.67	0.85	6.02
11.	0.44	3.45	72.0	0.65	1.00	5.39
12.	0.57	4.50	72.3	0.65	1.08	6.05
13.	1.15	8.97	70.4	0.86	1.46	6.30
14.	1.15	8.99	66.2	1.04	1.76	7.24
15.	0.30	2.32	62.7	0.82	1.14	6.95
16.	0.87	6.82	70.8	1.04	1.80	5.87
17.	0.59	4.59	65.3	0.89	1.59	8.69
18.	0.51	3.97	64.6	0.58	0.89	8.38
19.	0.32	2.47	63.2	0.79	1.14	7.29
20.	0.36	2.79	64.6	0.53	0.87	9.73
21.	0.82	6.46	66.6	0.69	1.21	8.79

EXHIBIT 4
SAMPLE PROBLEM
PERCENT IMPERVIOUS AND SNYDER'S METHOD

SAMPLE PROBLEM

PERCENT IMPERVIOUS AND SNYDER'S METHOD

Problem Statement

Calculate the hydrologic subbasin parameters, percent impervious surface and basin lag for the Trail Creek Watershed under existing conditions using the weighted average technique for computing imperviousness and the regression equation form, equation 3. Use Table 1 to assign values of percent imperviousness to each of the ten land use categories and Table 2 to define the necessary physiographic characteristics utilized in the regression equation. (Table 3 is a listing of the data base file used in the Trail Creek Watershed).

Description of Input Requirements

Land surface slope values (different from stream slope values) are not necessary input for this computation. The regression coefficients are input on the EQ record, providing the necessary equation values. Percent imperviousness values are provided for each land use category on the LU records, one value for each category indicated in NLUSE (J2.4). The SB records contain particular subbasin information for each subbasin to be analyzed, NSUB (J2.2).

Discussion of Results

Output for subbasin 1 and the summarized data for the entire watershed has been provided on the following pages. Since no land slope values (SCS slope class averages) were input, the specific subbasin data and the final summary printout include a 'not available' (N/A) indicator under SURFACE and SUBBASIN SLOPE. (If this summary is desired and land slope values are in the data bank, input the necessary data as done in the previous sample problem, Exhibit 3). The 'Summary of Subbasin Data' provides a condensed listing of data for each subbasin. Some of the data shown may be stored for subsequent use in the HEC-1 Flood Hydrograph Package.

Exhibit 4

TABLE 1
PERCENTAGE OF IMPERVIOUS SURFACE
WITHIN EACH LAND USE CATEGORY

Land Use Category	Imperviousness (%)
1	3.
2	8.
3	20.
4	28.
5	40.
6	3.
7	68.
8	85.
9	3.
10	100.

TABLE 2
SUBBASIN DATA

Subbasin	Stream Length (Miles)	LCA (Miles)	Stream Slope (feet/mile)
1	.95	.48	113.
2	1.36	.68	69.
3	1.25	.62	90.
4	1.14	.57	118.
5	.76	.38	123.
6	.70	.35	132.
7	1.40	.70	105.
8	1.74	.87	61.
9	1.33	.66	116.
10	.85	.42	94.
11	1.00	.50	80.
12	1.08	.54	105.
13	1.46	.73	78.
14	1.76	.88	80.
15	1.14	.57	106.
16	1.80	.90	78.
17	1.59	.80	101.
18	.89	.44	149.
19	1.14	.57	118.
20	.87	.44	138.
21	1.21	.60	143.

Exhibit 4

TABLE 3
DATA BASE FILE DIRECTORY
FOR
THE TRAIL CREEK WATERSHED

Data Variable Code	Data Category Code	Identifying Title
1	1 2-92	GRID CELL ROW Row 1 Rows 2-92
2	1 2-129	GRID CELL COLUMN Column 1 Columns 2-129
4	1 2-21	HYDROLOGIC SOIL GROUPS Subbasin 1 Subbasins 2-21
7	1 2 3 4	HYDROLOGIC SOIL GROUPS Group A (Low Runoff Potential) Group B (Moderate Infiltration Rates) Group C (Slow Infiltration Rates) Group D (High Runoff Potential)
8	1 2 3 4 5 6 7	LAND SURFACE SLOPE 0 to 3 percent slope 3 to 5 percent slope 5 to 10 percent slope 10 to 15 percent slope 15 to 25 percent slope 25 to 45 percent slope Greater than 45 percent slope
10	1 2 3 4 5 6 7 8 9 10	EXISTING LAND USE Natural vegetation Developed open space Low density residential Medium density residential High density residential Agricultural Industrial Commercial Pasture Water bodies

4 LIBHX3

LIST OF INPUT CARDS FOR THIS RUN

12345678901234567890123456789012345678901234567890

T1 T2 T3	SNYDER'S LAG TECHNIQUE				HYDROLOGIC PARAMETERS	APRIL 1965	T1 T2 T3	T4 T5 T6	T7 T8 T9	T10 T11 T12	T13 T14 T15	T16 T17 T18	T19 T20 T21	T22 T23 T24	T25 T26 T27	T28 T29 T30	T31 T32 T33	T34 T35 T36	T37 T38 T39	T40 T41 T42	T43 T44 T45	T46 T47 T48	T49 T50 T51	T52 T53 T54	T55 T56 T57	T58 T59 T60	T61 T62 T63	T64 T65 T66	T67 T68 T69	T70 T71 T72	T73 T74 T75	T76 T77 T78	T79 T80 T81	T82 T83 T84	T85 T86 T87	T88 T89 T90	T91 T92 T93	T94 T95 T96	T97 T98 T99	T100 T101 T102	T103 T104 T105	T106 T107 T108	T109 T110 T111	T112 T113 T114	T115 T116 T117	T118 T119 T120	T121 T122 T123	T124 T125 T126	T127 T128 T129	T130 T131 T132	T133 T134 T135	T136 T137 T138	T139 T140 T141	T142 T143 T144	T145 T146 T147	T148 T149 T150	T151 T152 T153	T154 T155 T156	T157 T158 T159	T160 T161 T162	T163 T164 T165	T166 T167 T168	T169 T170 T171	T172 T173 T174	T175 T176 T177	T178 T179 T180	T181 T182 T183	T184 T185 T186	T187 T188 T189	T190 T191 T192	T193 T194 T195	T196 T197 T198	T199 T200 T201	T202 T203 T204	T205 T206 T207	T208 T209 T210	T211 T212 T213	T214 T215 T216	T217 T218 T219	T220 T221 T222	T223 T224 T225	T226 T227 T228	T229 T230 T231	T232 T233 T234	T235 T236 T237	T238 T239 T240	T241 T242 T243	T244 T245 T246	T247 T248 T249	T250 T251 T252	T253 T254 T255	T256 T257 T258	T259 T260 T261	T262 T263 T264	T265 T266 T267	T268 T269 T270	T271 T272 T273	T274 T275 T276	T277 T278 T279	T280 T281 T282	T283 T284 T285	T286 T287 T288	T289 T290 T291	T292 T293 T294	T295 T296 T297	T298 T299 T300	T301 T302 T303	T304 T305 T306	T307 T308 T309	T310 T311 T312	T313 T314 T315	T316 T317 T318	T319 T320 T321	T322 T323 T324	T325 T326 T327	T328 T329 T330	T331 T332 T333	T334 T335 T336	T337 T338 T339	T340 T341 T342	T343 T344 T345	T346 T347 T348	T349 T350 T351	T352 T353 T354	T355 T356 T357	T358 T359 T360	T361 T362 T363	T364 T365 T366	T367 T368 T369	T370 T371 T372	T373 T374 T375	T376 T377 T378	T379 T380 T381	T382 T383 T384	T385 T386 T387	T388 T389 T390	T391 T392 T393	T394 T395 T396	T397 T398 T399	T400 T401 T402	T403 T404 T405	T406 T407 T408	T409 T410 T411	T412 T413 T414	T415 T416 T417	T418 T419 T420	T421 T422 T423	T424 T425 T426	T427 T428 T429	T430 T431 T432	T433 T434 T435	T436 T437 T438	T439 T440 T441	T442 T443 T444	T445 T446 T447	T448 T449 T450	T451 T452 T453	T454 T455 T456	T457 T458 T459	T460 T461 T462	T463 T464 T465	T466 T467 T468	T469 T470 T471	T472 T473 T474	T475 T476 T477	T478 T479 T480	T481 T482 T483	T484 T485 T486	T487 T488 T489	T490 T491 T492	T493 T494 T495	T496 T497 T498	T499 T500 T501	T502 T503 T504	T505 T506 T507	T508 T509 T510	T511 T512 T513	T514 T515 T516	T517 T518 T519	T520 T521 T522	T523 T524 T525	T526 T527 T528	T529 T530 T531	T532 T533 T534	T535 T536 T537	T538 T539 T540	T541 T542 T543	T544 T545 T546	T547 T548 T549	T550 T551 T552	T553 T554 T555	T556 T557 T558	T559 T560 T561	T562 T563 T564	T565 T566 T567	T568 T569 T570	T571 T572 T573	T574 T575 T576	T577 T578 T579	T580 T581 T582	T583 T584 T585	T586 T587 T588	T589 T590 T591	T592 T593 T594	T595 T596 T597	T598 T599 T600	T601 T602 T603	T604 T605 T606	T607 T608 T609	T610 T611 T612	T613 T614 T615	T616 T617 T618	T619 T620 T621	T622 T623 T624	T625 T626 T627	T628 T629 T630	T631 T632 T633	T634 T635 T636	T637 T638 T639	T640 T641 T642	T643 T644 T645	T646 T647 T648	T649 T650 T651	T652 T653 T654	T655 T656 T657	T658 T659 T660	T661 T662 T663	T664 T665 T666	T667 T668 T669	T670 T671 T672	T673 T674 T675	T676 T677 T678	T679 T680 T681	T682 T683 T684	T685 T686 T687	T688 T689 T690	T691 T692 T693	T694 T695 T696	T697 T698 T699	T700 T701 T702	T703 T704 T705	T706 T707 T708	T709 T710 T711	T712 T713 T714	T715 T716 T717	T718 T719 T720	T721 T722 T723	T724 T725 T726	T727 T728 T729	T730 T731 T732	T733 T734 T735	T736 T737 T738	T739 T740 T741	T742 T743 T744	T745 T746 T747	T748 T749 T750	T751 T752 T753	T754 T755 T756	T757 T758 T759	T760 T761 T762	T763 T764 T765	T766 T767 T768	T769 T770 T771	T772 T773 T774	T775 T776 T777	T778 T779 T780	T781 T782 T783	T784 T785 T786	T787 T788 T789	T790 T791 T792	T793 T794 T795	T796 T797 T798	T799 T800 T801	T802 T803 T804	T805 T806 T807	T808 T809 T810	T811 T812 T813	T814 T815 T816	T817 T818 T819	T820 T821 T822	T823 T824 T825	T826 T827 T828	T829 T830 T831	T832 T833 T834	T835 T836 T837	T838 T839 T840	T841 T842 T843	T844 T845 T846	T847 T848 T849	T850 T851 T852	T853 T854 T855	T856 T857 T858	T859 T860 T861	T862 T863 T864	T865 T866 T867	T868 T869 T870	T871 T872 T873	T874 T875 T876	T877 T878 T879	T880 T881 T882	T883 T884 T885	T886 T887 T888	T889 T890 T891	T892 T893 T894	T895 T896 T897	T898 T899 T900	T901 T902 T903	T904 T905 T906	T907 T908 T909	T910 T911 T912	T913 T914 T915	T916 T917 T918	T919 T920 T921	T922 T923 T924	T925 T926 T927	T928 T929 T930	T931 T932 T933	T934 T935 T936	T937 T938 T939	T940 T941 T942	T943 T944 T945	T946 T947 T948	T949 T950 T951	T952 T953 T954	T955 T956 T957	T958 T959 T960	T961 T962 T963	T964 T965 T966	T967 T968 T969	T970 T971 T972	T973 T974 T975	T976 T977 T978	T979 T980 T981	T982 T983 T984	T985 T986 T987	T988 T989 T990	T991 T992 T993	T994 T995 T996	T997 T998 T999	T1000 T1001 T1002	T1003 T1004 T1005	T1006 T1007 T1008	T1009 T1010 T1011	T1012 T1013 T1014	T1015 T1016 T1017	T1018 T1019 T1020	T1021 T1022 T1023	T1024 T1025 T1026	T1027 T1028 T1029	T1030 T1031 T1032	T1033 T1034 T1035	T1036 T1037 T1038	T1039 T1040 T1041	T1042 T1043 T1044	T1045 T1046 T1047	T1048 T1049 T1050	T1051 T1052 T1053	T1054 T1055 T1056	T1057 T1058 T1059	T1060 T1061 T1062	T1063 T1064 T1065	T1066 T1067 T1068	T1069 T1070 T1071	T1072 T1073 T1074	T1075 T1076 T1077	T1078 T1079 T1080	T1081 T1082 T1083	T1084 T1085 T1086	T1087 T1088 T1089	T1090 T1091 T1092	T1093 T1094 T1095	T1096 T1097 T1098	T1099 T1100 T1101	T1102 T1103 T1104	T1105 T1106 T1107	T1108 T1109 T1110	T1111 T1112 T1113	T1114 T1115 T1116	T1117 T1118 T1119	T1120 T1121 T1122	T1123 T1124 T1125	T1126 T1127 T1128	T1129 T1130 T1131	T1132 T1133 T1134	T1135 T1136 T1137	T1138 T1139 T1140	T1141 T1142 T1143	T1144 T1145 T1146	T1147 T1148 T1149	T1150 T1151 T1152	T1153 T1154 T1155	T1156 T1157 T1158	T1159 T1160 T1161	T1162 T1163 T1164	T1165 T1166 T1167	T1168 T1169 T1170	T1171 T1172 T1173	T1174 T1175 T1176	T1177 T1178 T1179	T1180 T1181 T1182	T1183 T1184 T1185	T1186 T1187 T1188	T1189 T1190 T1191	T1192 T1193 T1194	T1195 T1196 T1197	T1198 T1199 T1200	T1201 T1202 T1203	T1204 T1205 T1206	T1207 T1208 T1209	T1210 T1211 T1212	T1213 T1214 T1215	T1216 T1217 T1218	T1219 T1220 T1221	T1222 T1223 T1224	T1225 T1226 T1227	T1228 T1229 T1230	T1231 T1232 T1233	T1234 T1235 T1236	T1237 T1238 T1239	T1240 T1241 T1242	T1243 T1244 T1245	T1246 T1247 T1248	T1249 T1250 T1251	T1252 T1253 T1254	T1255 T1256 T1257	T1258 T1259 T1260	T1261 T1262 T1263	T1264 T1265 T1266	T1267 T1268 T1269	T1270 T1271 T1272	T1273 T1274 T1275	T1276 T1277 T1278	T1279 T1280 T1281	T1282 T1283 T1284	T1285 T1286 T1287	T1288 T1289 T1290	T1291 T1292 T1293	T1294 T1295 T1296	T1297 T1298 T1299	T1300 T1301 T1302	T1303 T1304 T1305	T1306 T1307 T1308	T1309 T1310 T1311	T1312 T1313 T1314	T1315 T1316 T1317	T1318 T1319 T1320	T1321 T1322 T1323	T1324 T1325 T1326	T1327 T1328 T1329	T1330 T1331 T1332	T1333 T1334 T1335	T1336 T1337 T1338	T1339 T1340 T1341	T1342 T1343 T1344	T1345 T1346 T1347	T1348 T1349 T1350	T1351 T1352 T1353	T1354 T1355 T1356	T1357 T1358 T1359	T1360 T1361 T1362	T1363 T1364 T1365	T1366 T1367 T1368	T1369 T1370 T1371	T1372 T1373 T1374	T1375 T1376 T1377	T1378 T1379 T1380	T1381 T1382 T1383	T1384 T1385 T1386	T1387 T1388 T1389	T1390 T1391 T1392	T1393 T1394 T1395	T1396 T1397 T1398	T1399 T1400 T1401	T1402 T1403 T1404	T1405 T1406 T1407	T1408 T1409 T1410	T1411 T1412 T1413	T1414 T1415 T1416	T1417 T1418 T1419	T1420 T1421 T1422	T1423 T1424 T1425	T1426 T1427 T1428	T1429 T1430 T1431	T1432 T1433 T1434	T1435 T1436 T1437	T1438 T1439 T1440	T1441 T1442 T1443	T1444 T1445 T1446	T1447 T1448 T1449	T1450 T1451 T1452	T1453 T1454 T1455	T1456 T1457 T1458	T1459 T1460 T1461	T1462 T1463 T1464	T1465 T1466 T1467	T1468 T1469 T1470	T1471 T1472 T1473	T1474 T1475 T1476	T1477 T1478 T1479	T1480 T1481 T1482	T1483 T1484 T1485	T1486 T1487 T1488	T1489 T1490 T1491
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SNYDER'S LAG TECHNIQUE
HYDPAR HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 4

J1 CARD
.....

CC 123456789012345678901234567890123456789012345678901234567890
J1 1 1 1 92 129 1.53

J1 JOB PARAMETERS
.....

IANL = 1, IMPERVIOUSNESS AND SNYDER'S LAG WILL BE COMPUTED FOR EACH SUBBASIN
ILUPRT = 1, LIST INPUT CARDS + NORMAL PRINTOUT
IFMT = 1, GRID CELL DATA BANK IS FORMATTED
NROW = 92, TOTAL NUMBER OF ROWS IN DATA BANK
NCOL = 129, TOTAL NUMBER OF COLUMNS IN DATA BANK
SIZE = 1.53, THE SIZE OF THE GRID CELL IS IN ACRES

SNYDER'S LAG TECHNIQUE
HYDPAR HYDROLOGIC PARAMETERS
APRIL 1985
EXHIBIT 4

J2 CARD

.....
CC 123456789012345678901234567890123456789012345678901234567890
J2 18 21 4 10 10 0 0 0

J2 JOB PARAMETERS

.....

NVAR = 18, THE NUMBER OF DATA VARIABLES PER GRID CELL RECORD
NSUB = 21, THE NUMBER OF SUBBASINS ANALYZED IN THIS RUN
IBS = 4, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE SUBBASIN CODE
MLUSE = 10, THE NUMBER OF LAND USE CATEGORIES IN THE GRID CELL DATA BANK
ILD = 10, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE LAND USE PATTERN TO BE ANALYZED
MSLP = 0, THE NUMBER OF SLOPE CLASSES FOR CURVE NUMBER ANALYSIS
ISLP = 0, NO SLOPE VARIABLE
INYO = 0, IS THE SEQUENCE NUMBER OF THE DATA BANK WHICH IS THE HYDROLOGIC SOIL GROUP CODE

FORMAT CARD

.....

CC 123456789012345678901234567890123456789012345678901234567890
FT(12F4.0,2F8.2,2F4.0,2F2.0)

SNYDER'S LAG TECHNIQUE
HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 4

EQ CARD VALUES

CC 1234567890123456789012345678901234567890123456789012345678901234567890
EQ0.927600.387600-.003735

EQ VALUES	CONST (C)	COMA (C1)	COMB (C2)
	0.927600	0.387600	-.003735

CALCULATION OF SNYDER'S LAG (TP)

$$TP \text{ (HOURS)} = (C)(X) \quad C1 \quad (C2)I$$

WHERE ...

$$C = \text{REGRESSION CONSTANT} = 0.927600$$

$$X = (L)(Z)(S) \quad -.5$$

$$L = \text{STREAM LENGTH (MILES)}$$

$$Z = \text{LCA (LENGTH TO CENTROID IN MILES)}$$

$$S = \text{STREAM SLOPE (FEET/MILE)}$$

$$C1 = \text{REGRESSION COEFFICIENT} = 0.387600$$

$$C2 = \text{REGRESSION COEFFICIENT} = -.003735$$

$$I = \text{PERCENT IMPERVIOUSNESS}$$

SNYDER'S LAG TECHNIQUE
HYDPAH HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 4

LAND USE CATEGORIES			
CC 123456789012345678901234567890123456789012345678901234567890			
LU 1	36.	60.	79.
LU 2	39.	61.	80.
LU 3	47.	66.	81.
LU 4	61.	75.	83.
LU 5	80.	85.	90.
LU 6	67.	78.	85.
LU 7	83.	88.	92.
LU 8	95.	96.	98.
LU 9	49.	69.	79.
LU 10	100.	100.	100.
			3.NATURAL VEGETATION
			8.DEVELOPED OPEN SPACE
			20.LOW DENSITY RESIDENTIAL
			28.MEDIUM DENSITY RESIDENTIAL
			40.HIGH DENSITY RESIDENTIAL
			3.AGRICULTURE
			68.INDUSTRIAL
			85.COMMERCIAL
			3.PASTURE
			100.WATER BODIES

PERCENT IMPERVIOUSNESS SUMMARY
WITH ASSOCIATED LAND USE CATEGORIES
.....

LAND USE CATEGORY	TITLE	PERCENT IMPERVIOUSNESS
1	NATURAL VEGETATION	3.00
2	DEVELOPED OPEN SPACE	8.00
3	LOW DENSITY RESIDENTIAL	20.00
4	MEDIUM DENSITY RESIDENTIAL	28.00
5	HIGH DENSITY RESIDENTIAL	40.00
6	AGRICULTURE	3.00
7	INDUSTRIAL	68.00
8	COMMERCIAL	85.00
9	PASTURE	3.00
10	WATER BODIES	100.00

SHYDER'S LAG TECHNIQUE
HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 4

SUBBASIN PARAMETER CARDS

CC	1234567890123456789012345678901234567890123456789012345678901234567890	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
SB	1.	0.95	0.48	113.0	TC-01	0.40																
SB	2.	1.36	0.68	69.0	TC-02	0.43																
SB	3.	1.25	0.62	90.0	TC-03	0.43																
SB	4.	1.14	0.57	118.0	TC-04	0.43																
SB	5.	0.76	0.38	123.0	TC-05	0.43																
SB	6.	0.70	0.35	132.0	TC-06	0.43																
SB	7.	1.40	0.70	105.0	TC-07	0.40																
SB	8.	1.74	0.87	61.0	TC-08	0.43																
SB	9.	1.33	0.66	116.0	TC-09	0.43																
SB	10.	0.85	0.42	94.0	TC-10	0.40																
SB	11.	1.00	0.50	80.0	TC-11	0.40																
SB	12.	1.08	0.54	105.0	TC-12	0.45																
SB	13.	1.46	0.73	78.0	TC-13	0.45																
SB	14.	1.76	0.88	80.0	TC-14	0.45																
SB	15.	1.14	0.57	106.0	TC-15	0.45																
SB	16.	1.80	0.90	78.0	TC-16	0.45																
SB	17.	1.59	0.80	101.0	TC-17	0.45																
SB	18.	0.89	0.44	149.0	TC-18	0.48																
SB	19.	1.14	0.57	118.0	TC-19	0.48																
SB	20.	0.87	0.44	138.0	TC-20	0.48																
SB	21.	1.21	0.60	143.0	TC-21	0.48																

SUBBASIN SUMMARY TABLE
.....

HYDPA SUBBASIN	STREAM LENGTH (MILES)	LENGTH TO CENTROID (MILES)	STREAM SLOPE (FT./MI.)	HEC-1 STATION	SNYDER'S CP
1.	0.95	0.48	113.0	TC-01	0.40
2.	1.36	0.68	69.0	TC-02	0.43
3.	1.25	0.62	90.0	TC-03	0.43
4.	1.14	0.57	118.0	TC-04	0.43
5.	0.76	0.38	123.0	TC-05	0.43
6.	0.70	0.35	132.0	TC-06	0.43
7.	1.40	0.70	105.0	TC-07	0.40
8.	1.74	0.87	61.0	TC-08	0.43
9.	1.33	0.66	116.0	TC-09	0.43
10.	0.85	0.42	94.0	TC-10	0.40
11.	1.00	0.50	80.0	TC-11	0.40
12.	1.08	0.54	105.0	TC-12	0.45
13.	1.46	0.73	78.0	TC-13	0.45
14.	1.76	0.88	80.0	TC-14	0.45
15.	1.14	0.57	106.0	TC-15	0.45
16.	1.80	0.90	78.0	TC-16	0.45
17.	1.59	0.80	101.0	TC-17	0.45
18.	0.89	0.44	149.0	TC-18	0.48
19.	1.14	0.57	118.0	TC-19	0.48
20.	0.87	0.44	138.0	TC-20	0.48
21.	1.21	0.60	143.0	TC-21	0.48

SNYDER'S LAG TECHNIQUE
HYDPAR HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 4

SUBBASIN 1.
.....

LAND USE CATEGORY	LAND USE	PERCENT IMPERVIOUSNESS	AREA IN ACRES	PERCENT OF SUBBASIN
1	NATURAL VEGETATION	3.00	223.38	48.99
3	LOW DENSITY RESIDENTIAL	20.00	68.85	15.10
6	AGRICULTURE	3.00	157.59	34.56
10	WATER BODIES	100.00	6.12	1.34
	SUBBASIN AVERAGE	6.87	455.94	

```
*****
* SUBBASIN 1. DATA *
*.....*
* DRAINAGE AREA (ACRES) = 455.94 *
* DRAINAGE AREA (SQ. MI.) = 0.71 *
* STREAM LENGTH (MILES) = 0.95 *
* LENGTH TO CENTROID (MILES) = 0.48 *
* STREAM SLOPE (FEET/MILE) = 113.00 *
* AVERAGE IMPERVIOUS. (PERCENT) = 6.87 *
* SUBBASIN TP (HOURS) = 0.26 *
* SNYDER'S PEAKING COEF. (CP) = 0.40 *
* NUMBER OF DATA CELLS = 298.00 *
*****
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SYDOR'S LAG TECHNIQUE
HYDPAK HYDROLOGIC PARAMETERS
APRIL 1985

EXHIBIT 4

SUMMARY OF SUBBASIN DATA
.....

SUBBASIN NUMBER	DRAINAGE AREA (SQ. MI.)	PERCENT OF WATERSHED	PERCENT IMPERVIOUS.	TP (HOURS)	SYDOR'S CP	STREAM LENGTH (MILES)	LCA-LENGTH TO CENTROID (MILES)	STREAM SLOPE (FT./MI.)
1.	0.71	5.58	6.87	0.26	0.40	0.95	0.48	113.
2.	0.74	5.79	3.61	0.38	0.43	1.36	0.68	69.
3.	0.58	4.53	3.00	0.34	0.43	1.25	0.62	90.
4.	0.50	3.90	7.01	0.29	0.43	1.14	0.57	118.
5.	0.22	1.76	3.08	0.22	0.43	0.76	0.38	123.
6.	0.16	1.22	3.00	0.20	0.43	0.70	0.35	132.
7.	0.82	6.44	3.38	0.36	0.40	1.40	0.70	105.
8.	1.01	7.89	6.34	0.47	0.43	1.74	0.87	61.
9.	0.66	5.21	11.27	0.32	0.43	1.33	0.66	116.
10.	0.30	2.32	3.14	0.25	0.40	0.85	0.42	94.
11.	0.44	3.45	3.00	0.30	0.40	1.00	0.50	80.
12.	0.57	4.50	10.42	0.28	0.45	1.08	0.54	105.
13.	1.15	8.97	7.93	0.38	0.45	1.46	0.73	78.
14.	1.15	8.99	5.33	0.43	0.45	1.76	0.88	80.
15.	0.30	2.32	3.00	0.31	0.45	1.14	0.57	106.
16.	0.87	6.82	9.90	0.44	0.45	1.80	0.90	78.
17.	0.59	4.59	4.76	0.40	0.45	1.57	0.80	101.
18.	0.51	3.97	12.49	0.22	0.48	0.89	0.44	149.
19.	0.32	2.47	8.17	0.29	0.48	1.14	0.57	118.
20.	0.36	2.79	13.21	0.22	0.48	0.87	0.44	138.
21.	0.82	6.46	16.71	0.27	0.48	1.21	0.60	143.

EXHIBIT 5
INPUT DESCRIPTION
HYDROLOGIC PARAMETERS
(HYDPAR)

EXHIBIT 5

INPUT DESCRIPTION HYDROLOGIC PARAMETERS (HYDPAR)

This exhibit provides a detailed description of the HYDPAR data input requirements, by record and data variable. Previous versions of this document referred to each data record as a card. The majority of new users no longer use cards but instead use utility programs, such as text editors, word processors, or spreadsheets, to produce the input data file for their programs. The term "card" in the original document has been changed to the term "record" in this version. Each record in the HYDPAR program is the equivalent of a line to a text editor program, a line with carriage return to a word processing program, or a row to a spreadsheet program.

Each record contains 11 fields, field 0 through field 10. Field 0 (zero) refers to column positions 1 and 2 and is reserved for the record identifier. Field 1 ranges from column 3-8; fields 2-10 contain eight columns each (9-16, 17-24, ..., 73-80). The field number designates the location of the variable on each input record. An abbreviated field location nomenclature is used to identify the field location. The record name is followed by a decimal point and the field number. For example, J1.3 refers to the third field on the J1 record. A field on a record may contain data in only a part of the field. In those cases, the location is referred to as columns, shown in parentheses. For example, field 6 on the ZW record contains the variable IYR in columns 45-48. All variables beginning with I, J, K, L, M, and N should have integer values (no decimal point) and be right-justified (the values shifted to the right within each field). A "+" sign under the value heading indicates the placement of a positive numerical value in the field. A "-" sign indicates a negative numerical value in that field. "AN" means that a combination of alphanumeric characters is allowed. When a number does not have a sign, a positive value will be assumed. In general, input values, both numerical and alphanumeric, should be right-justified in their fields.

TITLE RECORDS

T1, T2, T3 Records: (Required Records)

These records provide up to three lines of information at the top of each page of output

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	T1, T2 or T3	Record identification (3 records)
1-10	A TITLE	AN	Title information (center of title falls in record column 41).

JOB RECORDS

J1 Record: First Job Record (Required Record)

This record describes the type of analysis to be performed and provides specifications about the data bank.

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	J1	Record identification
1	IANL	0	Curve number and SCS lag will be computed for each subbasin.
		1	Percent imperviousness and Snyder's lag will be computed for each subbasin. EQ record will be required.
2	ILUPRT	1	Normal print with input data displayed at start of output.
		0	Normal Print.
		-1	Suppress printout of subbasin summaries and print only watershed summary.
		-2	Same as -1 with input data displayed at start of output.
3	IFMT	0	The grid cell data bank is unformatted.
		1	The grid cell data bank is formatted. A format record (FT) is required.
4	NR0W	+	The maximum row number in the data bank.
5	NCOL	+	The maximum column number in the data bank.

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
6	SIZE	+	A positive number indicates the value is the size of a grid cell in acres.
		-	A negative number indicates the value is the total area in square miles of the watershed under analysis. The total will be apportioned among the subbasins.

J2 Record: Second Job Record (Required Record)

This record gives the location of the data variables in the data bank and the number of subbasins, land use categories and SCS soil categories, if SCS slope categories are used.

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	J2	Record identification
1	NVAR	+	The number of data variables in the data bank
2	NSUB	+	The number of subbasins to be analyzed
3	IBS	+	The sequence number of the data bank variable which is the subbasin code.
4	NLUSE	+	The number of categories in the land use variable under analysis.
5	ILD	+	The data bank sequence number of the land use variable (existing, future, etc.) under analysis.
6	NSLP	0	Either actual slope or no slope values are used.
		+	The number of categories in the surface slope variable.
7	ISLP	-	The sequence number of the data bank variable which is the calculated slope.
		0	No slope data variable. Must be zero. Do not leave blank.
		+	The sequence number of the data bank variable which is the SCS land surface slope code. A positive value indicates that only average slope values from the SL record will be input.
8	IHYO	+	The sequence number of the hydrologic soil group data variable in the data bank.

Exhibit 5

ZW Record: DSS Pathname Data Record (Optional record, required for DSS file creation)

The ZW record specifies that a file will be created for use by the HEC data storage system (DSS). The DSS file will contain hydrologic loss rate and unit hydrograph parameters which can be retrieved using HEC-1. The record contains the project (part A of the pathname), alternative (part F of pathname) and optional data year (part E of pathname) that are used in the creation of the HECDSS pathname. The ZW record follows the J2 record.

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	ZW	Record identification
1-2	PROJ	(AN)	Project or study name for HECDSS pathname.
3-5	ALT	(AN)	Plan or alternative for HECDSS pathname.
6(45-48)	IYR	+	Data year (optional).

The following parameters are written to the HECDSS file.

- ISTN - HEC-1 Station number
- SQMILE - Subbasin area in square miles
- BASCN - SCS Subbasin curve number
- BLAS - Subbasin lag for SCS method
- TOTIMP - Percent imperviousness of the subbasin
- TP - Time to peak for Snyder procedure
- CP - Peaking coefficient for Snyder's lag procedure

FT EQ

FT Record: Format Record (Optional Record)

The FT record is required only when the data bank is formatted, IFMT (J1.3) = 1.

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	FT	Record identification
1-10	FMT	(AN)	The format description must have a left parenthesis in record column 3. The description of the format must be in a fixed point format. The end of the format must be followed with a right parenthesis.

SUBBASIN DATA RECORDS

EQ Record: Equation Constants Record (Optional Record)

The EQ record is required to describe the regression equation coefficients for computing Snyder's lag. Used only when IANL (J1.1) = 1. The values should be input in decimal form.

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	EQ	Record identification
1	CONST	+	The C value in the regression equation, equation 3.
2	CONA	+	The C1 value in the regression equation, equation 3.
3	CONB	+	The C2 value in the regression equation, equation 3.

SL Records: Slope Records (Optional Records)

The SL records are required when ISLP (J2.7) is positive. The first ten slope values must appear on the first SL record. If there are more than 10 slope values, the eleventh (11) through twentieth (20) values are placed on the second SL record, until all slope classes are given a slope value.

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	SL	Record identification
1-10	PERC	+	Average slopes (in percent) of the slope categories. There must be NSLP (J2.6) number of values in sequential order.

LU Records: Land Use Records (Required Records)

The LU record is used to associate curve number to the hydrologic soil group-land use complex. It is also used to assign percent imperviousness to a land use if the Snyder technique is used. There must be NLUSE (J2.4) number of LU records, one for each land use category.

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	LU	Record identification
1	LANDID	+	Identification number for the land use category described on this record within land use data variable, ILD (J2.5).

The following four fields require curve numbers by hydrologic soil group for the particular land use category. May be left blank if IANL (J1.1) is 1.

2	CVNM(I,1)	+	Curve number for hydrologic soil group A.
3	CVNM(I,2)	+	Curve number for hydrologic soil group B.
4	CVNM(I,3)	+	Curve number for hydrologic soil group C.
5	CVNM(I,4)	+	Curve number for hydrologic soil group D.

SB

END

6	PERIMP	+	The percent imperviousness (0 to 100) of this land use. Sixty percent imperviousness is input as 60. Required only if J1.1 is 1.
7	TITLE	(AM)	Land use category title.

SB Records: Subbasin Records (Required Record)

The SB record assigns physical parameters for each subbasin which cannot be captured directly from the data bank. An SB record is required for each subbasin analyzed, NSUB (J2.2).

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	SB	Record identification
1	SUBT	+	Subbasin identification number
2	LENGTH	+	Hydraulic stream length in miles (subbasin outlet to watershed boundary) of the subbasin. It is used in Snyder's lag computations in miles and for the Curve Number calculation it is converted to feet. (Length is always output in miles for both types of calculations).
3	LCA	+	The LCA (length to centroid of the area) of the subbasin in miles. May be left blank if the SCS curve number technique issued (IANL (J1.1) = 0).
4	STLOP	+	The stream slope in feet/mile. Required for Snyder's lag computation, IANL (J1.1) = 1. As with LCA (SB.3), the STLOP value may be left blank if IANL (J1.1) = 0.
5	ISTN	AM	Subbasin identification code. (Maximum of 6 alphanumeric characters, right justified).
6	CP	+	Peaking coefficient for use with the Snyder's lag procedure.

END Record: Ending Record (Required record)

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	CODE	END	Signals end of input data. Should follow last input record.

Exhibit 5

