# Appendix VII

# Input Data Description

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# 1. Introduction

This appendix contains a detailed description of the data input requirement for each variable on each input record. It also contains a Functional Use Index which can be used to determine which input variables are required for specific tasks. The Summary of Input Records shows the sequential arrangement of records. Many of the records described can be omitted if the options to which they apply are not required.

The location of the variables for each input record is shown by field number. Each record is divided into ten fields of eight columns each, except Field 1. A variable in Field 1 may only occupy record Columns 3 through 8 since record Columns 1 and 2 (called Field 0) are reserved for required identification characters. The values a variable may assume and the conditions for each are described. Some variables simply call for use of program options by using the numbers -1, 0, 1, 10, and 15. Other variables contain numbers which express the magnitude of the variable. For these a plus or minus sign is shown in the description under "value" and the numerical value of the variable is entered as input. Where the value of a variable is to be zero, the variable may be left blank since a blank field is read as zero.

Any number without a decimal point must be right justified in its field. Any number without a sign is considered positive.

The location of variables on records is often referred to by an abbreviated designation; for example, J1.5 refers to the fifth field of the J1 record.

## 2. Functional Use Index

| Task | Records Used |
|---|---|
| Basic Applications | T1, T2, T3, J1.4 - J1.9, NC, X1.1-X1.9, GR, EJ, ER |
| Archival Option | AC |
| Data Comment Records | C_ |
| Multiple Profiles, Summary Printout | J2.1, J3 |
| Printout Control | J5 |
| Traces & Input Data Printout | J1.1, J2.10, X2.10 |
| Storage-Discharge Output | J4 |
| Printer Plots of Cross Sections and Profiles | J2.2 - J2.5, X1.10 |
| Optional Friction Loss Equations | J6.1 |
| Flow Distribution | J2.10, X2.10 |
| Critical Depth Option | J2.7 |
| Direct Solution for Manning's 'n' | J1.3, X2.2 |
| Optional Records for Specifying Manning's 'n' | J2.6, NH, NV |
| Equivalent Roughness 'k' | KH |
| Options for Specifying Discharge | J1.2, J1.8, J1.10, X2.1, QT |
| Specifications of Ineffective Flow Areas & Encroachments | X3, ET |
| Additional Ground Points | X4 |
| Channel Modification Due to Excavation | J2.8, J2.9, CI |
| Bridge and Culvert Losses | X2.3 - X2.6, BT, SB, SC, X5 |
| Use of HEC-2 Data Edit Program | ED |
| Use of Free Format Input | FR, FIX, FREE |
| Use of the Flow Under Ice Option | IC |
| Water Surface Based on a Rating Curve | J1.5, JR, RC |
| Basic Applications of Split Flow Option | SF, TW, WS ,WC, EE |

## 3. ED Record (HEC-2 Data Edit Program (EDIT-2) - Optional

Controls certain run options for data edit program. Does not need to be removed for HEC-2 runs.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | ED | Record identification characters. |
| 1 | LIST | YES (Blank) | Produce listing of input data before editing it (default). |
| | | NO | Suppress listing. |
| 2 | CC | YES (Blank) | Produce 81 column output with carriage control in Column 1 suitable for line printer output or other wide carriage devices (default). |
| | | NO | Limit output width to 80 columns without carriage control (i.e., for eighty column interactive terminals). |
| 3 | GRANGE | 0 (Blank) | Use default value (150) for GR record elevation difference test. |
| | | + | Value to use for GR record elevation difference test. |

The HEC-2 data edit program (EDIT-2) is designed to accept as input any HEC-2 data file exactly as set-up for input to HEC-2. It will handle stacked jobs and all other features which are available in the September 1988 release of HEC-2.

The edit program will function with default run parameters for any HEC-2 data file. There are three parameters which may be entered on an optional ED record. If used, the ED record must be the first record in the data file and there may be only one. The format of the ED record is similar to HEC-2 data records; i.e., the letters ED in Columns 1 and 2 and the three values in the first three fields right justified to Columns 8, 16, and 24.

**Suggestion for Using the EDIT2 Program**. When RECORD OUT OF ORDER errors occur, many subsequent fallacious error messages may be triggered. It is suggested that the user correct the RECORD OUT OF ORDER errors first and rerun the edit program.

# 4 Split Flow Records

## 4.1 SF Record - Split Flow Title

The SF record is used to flag the split flow option. Only one SF record can be used. This record is **required** if the split flow option is going to be used. The SF record has to be the first record in an HEC-2 file.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | SF | Record identification characters. |
| 1-10 | | | Alphanumeric title data. |

## 4.2 JC Record - Title Job

The JC record is used to indicate that JP record follows. The JP record must follow the JC record. This record is optional.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | JC | Record identification characters. |
| 1-10 | | | Alphanumeric title data. |

## 4.3 JP - Job Parameter

The JP record is used to set several job parameters dealing with the split flow computations. The JC and JP records are optional and can be placed anywhere in the split flow data or completely left out. They should be placed normally after the SF records.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | JP | Record identification characters. |
| 1 | ISFTR | 0 | Printout control of split flow computations will be held to a minimum. |
| | | 1 | Trace each split flow iteration. |
| | | 10 | Trace both the split flow and backwater iterations. |
| 2 | AEROR | 0 | The program will use a value of two percent allowed error for convergence. |
| | | + | The user may specify the allowed percent tolerance for convergence. |
| 3 | NAITER | 0 | The maximum number of iterations for split flow to be executed per profile (20 is the default value). |
| | | + | The user may specify the maximum number of iterations. |
| 4 | IUEG | -1,0 | The program will use the water surface to determine the overflow. |
| | | 1 | The program will use the energy grade line to determine the overflow. |
| 5 | PERFR | 0 | One hundred percent of the overflow is to be returned at SNOFR (WS.4, NS.4, and CS.4). |
| | | + | Percent of overflow to be returned at SNOFR (WS.4, NS.4, and CS.4). |

**TW**
**WS**

HEC-2 Input Description
Split Flow Records

## 4.4 TW Record - Title for Weir Location

The TW record is required for each set of weir outflow data set. The TW record must be followed by a set of WS and WC records.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | TW | Record identification characters. |
| 1-10 | | | Alphanumeric title data. |

## 4.5 WS Record - Weir Parameter Data

The WS record is required for each TW record used and must follow it. The WS record contains information dealing with the number of points describing the weir, weir flow coefficient, location of the upstream and downstream limits of the weir in relation to section numbers as used in the X1 records, and the section number where the flow returns. If the flow does not return, a value of negative one should be used. It is required that the section numbers used to set-up the backwater model increase from downstream to upstream. The same rule applies for supercritical models.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | WS | Record identification characters. |
| 1 | NWPL | + | Number of coordinate points that describe the weir on the WC record. |
| 2 | DSSNO | + | Downstream section number where the first weir coordinate applies. |
| 3 | USSNO | + | Upstream section number where the last weir coordinate applies. |
| 4 | SNOFR | + | Section number where the lost weir flow returns. |
| | | -1 | The weir flow does not return. |
| 5 | COEFL | + | Coefficient of discharge for use in weir flow equation. |
| 6-10 | | | Not used. |

## 4.6 WC Record - Weir Coordinate Data

The WC record is used to input the weir coordinates. The weir coordinates must start at the downstream end and proceed upstream. The maximum number of coordinates is 100.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | WC | Record identification characters. |
| 1,3,5, 7,9 | STA(I) | + | Station value of weir coordinate. |
| 2,4,6, 8,10 | ELO(I) | + | Elevation value of weir coordinate. |

## 4.7 TN Record - Title for Normal Depth Location

The TN record is required for each set of normal depth outflow data set. The TN record must be followed by a set of NS and NG records.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | TN | Record identification characters. |
| 1-10 | | | Alphanumeric title data. |

## 4.8 NS Record - Normal Depth Parameter Data

The NS record is similar to the WS record with the exception that instead of having the weir flow coefficient, it has the energy slope and 'n' value.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | NS | Record identification characters. |
| 1 | NWPL | + | Number of coordinate points that describe the normal depth flow cross section on the NG record. |
| 2 | DSSNO | 0,+ | Downstream section number where the first coordinate point on the NG record applies. |
| 3 | USSNO | 0,+ | Upstream section number where the last coordinate point on the NG record applies. |
| 4 | SNOFR | 0,+ | Section number where the lost flow returns. |
| | | -1 | The lost flow does not return. |
| 5 | XNVND | + | The 'n' value to be used for normal depth calculation. |
| 6 | SLOPND | + | The energy slope to be used for normal depth calculations. |
| 7-10 | | | Not used. |

## 4.9 NG Record - Ground Coordinate Data

The NG record is used to input the normal depth cross section coordinates. The coordinate must start at the downstream end and proceed upstream. The maximum number of coordinates is 100.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | NG | Record identification characters. |
| 1,3,5, 7,9 | STA(I) | + | Station value of cross section. |
| 2,4,6, 8,10 | ELO(I) | + | Elevation value of cross section. |

## 4.10 TC Record - Title for Rating Curve Location

The TC record is required for each set of rating curve outflow data set. The TN record must be followed by a set of CS and CR records.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | TC | Record identification characters. |
| 1-10 | | | Alphanumeric title data. |

## 4.11 CS Record - Rating Curve Parameter Data

The CS record is similar to the WS record with the exception that the location (upstream and downstream) is a point location and therefore the value entered for USSNO and DSSNO should normally be equal.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | CS | Record identification characters. |
| 1 | NWPL | + | Number of discharge elevation pairs to be read from the CR records to follow. |
| 2 | DSSNO | 0,+ | Downstream section number where the rating curve applies. |
| 3 | USSNO | 0,+ | Upstream section number where the rating curve applies. |
| 4 | SNOFR | 0,+ | Section number where the lost flow returns. |
| | | -1 | The lost flow does not return. |
| 5-10 | | | Not used. |

## 4.12 CR Record - Rating Curve Data

The CR record is used to input the rating curve of outflows. The location of the rating curve has to be at a specific location on the river. Therefore the location has to be specified at only one point. The variables DSSNO and USSNO should be set equal. If they are not, the program will use the mean of the two locations. The maximum number of rating curve points is 100.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | CR | Record identification characters. |
| 1,3,5, 7,9 | STA(I) | + | Discharge values for rating curve. |
| 2,4,6, 8,10 | ELO(I) | + | Elevation values for rating curve. |

## 4.13 EE Record - End of Split Flow Data

The EE record is required to terminate the reading of the split flow data. The EE record should be in front of the first regular HEC-2 record, such as the AC, C, or T1 records.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | EE | Record identification characters. |
| 1-10 | | | Not used. |

# 5 Documentation Records

## 5.1 AC Record - Archival Option

To use the Archival Option, one or more AC records must be inserted at the beginning of a data file (i.e., before C records or first T1 record if C records are not used). Columns 3 through 80 of each AC record are available for alphanumeric comments to document the archival tape. As many AC records as required may be used. It is the users responsibility to provide the required job control statements to insure that the file written to Unit 96 will appear on magnetic tape or otherwise be saved by the system after execution. On an Archival execution cross section plots **should not** be requested. Also, the maximum number of summary tables is reduced by two for an Archival run.

| RECORD NUMBER | FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|---|
| 1 | 0 | IA | AC | Record identification characters. |
| 1 | 1-10 | -- | -- | Blank. |
| 2 - as many records necessary | 0 | IA | AC | Record identification characters. |
| | 1-10 | | | Alphanumeric comments to document the Archival tape. |

### Example Application

```
AC   Flood plain determination -- Spring Creek, Baker, CA
AC   Cross sections from FEMA 2 foot contour map dated 6/18/90
AC   ACE Engineers Contract No. 19675848, 11/7/90
T1
T3
J1
.
.
.
.
.
ER
```

## 5.2 C_ Record - Comments for Describing Data (optional)

Comment records for labeling a cross section must be placed immediately ahead of the first title (T1-T9) record. Comments will be printed in the data input list and in the detailed printout just ahead of the cross section whose number appears in Field 1 of records 3 - 100. Multiple comment records may be used to label a single cross section number.

| RECORD NUMBER | FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|---|
| 1 | 0 | IA | C_ | Record identification characters (C, blank). Rest of record is blank. |
| 2 | 0 | IA | C_ | Record identification character. |
| 2 | 1 | NUMCT | + | Number of data comment records to be printed. An unlimited number of comment records may be used. |
| 3-unlimited | 0 | IA | C_ | Record identification character. |
| | 1 | CNOS | | Cross section number (Field 1 of X1 record) where title is to be printed. Cross section numbers (X1.1) referenced by comment records should be unique. |
| 3-unlimited | 2-10 | COCD | | Comment to be printed ahead of cross section number CNOS. |

### Example Application

```
C
C     3
C   100 Junction with Dry Creek
C   185 Spring Creek Gage
C   256 Study Limit
T1
.
.
.
ER
```

## 5.3 T1 - T9 Records - Title Records (optional)

### 5.3.1 T1, T2, T4 - T9 Records

Title record for output title. These records are entered before the J1 record. An unlimited number of title records may be input ahead of each J1 record.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | T1<br>or<br>T2<br>etc. | Record identification characters. |
| 1-10 | none | | Numbers and alphabetical characters. |

### 5.3.2 T3 Record

Title record for output title. **The stream name should be entered in Fields 2 through 4 for output in the title of the summary tables and cross section and profile plots**.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | T3 | Record identification characters. |
| 1 | | 0 | Not used. |
| 2-4 | TITLE | | Title for summary tables and cross section and profile plots. |
| 5-10 | none | | Numbers and alphabetical characters for title. |

# 6 Job Control Records

## 6.1 J1 Record - Starting Conditions (required)

Job record specifying starting conditions and program options. This record is required for each job (profile).

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | J1 | Record identification characters. |
| 1 | ICHECK | -10 | Do not print data records NC - EJ. |
| | | 0 | Print data records NC - EJ before execution of first profile. |
| 2 | INQ | 0 | QT, ET or X5 records are not used. |
| | | 2-20 | Field number on QT, ET and X5 records to be used for this profile (job). |
| 3 | NINV | 0 | Option to compute Manning's 'n' from known high water marks will not be used. |
| | | 1 | Manning's 'n' will be computed from known high water marks. Enter known water surface elevation as variable WSELK on second field of X2 record (X2.2) for each cross section. |
| 4 | IDIR | 0 | Subcritical flow. Cross sectional data (GR records) are input starting at the downstream end of the stream. |
| | | 1 | Supercritical flow. Cross sectional data are input starting at the upstream end. |
| 5 | STRT | -1 | Start computations at critical depth. |
| | | 0 | Start with known water surface elevation. Enter WSEL in field nine. |
| | | +<1 | Start by slope-area method. Enter estimated energy slope here. This starting option cannot be used in conjunction with encroachment Methods 3, 4, 5, and 6 at first cross section. |

## J1 Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| | | +>1 | Number of rating curve (discharge elevation) pairs to be read on the following JR records to start the backwater. |
| 6 | METRIC | 0 | Input and output in English units. |
| | | 1 | Input and output in Metric units. |
| 7 | HVINS | 0 | No interpolated cross sections to be generated by computer. |
| | | + | Enter maximum allowable change in velocity head between cross sections. If this value is exceeded, interpolated cross sections will be inserted by the program. |
| 8 | Q | 0 | Discharge specified by QT record, INQ(J1.2) is two or greater. |
| | | + | Starting river flow (cfs or cms). |
| 9 | WSEL | + | If STRT(J1.5) is zero enter known starting water surface elevation. |
| 10 | FQ | 0 | A factor of 1.0 will be used to multiply all discharges (QT, X2.1 and J1.8). |
| | | + | Factor to multiply all flows by (QT, X2.1 and J1.8). |

## 6.2 JR Record - Starting Rating Curve

The JR records are used to input a starting rating curve. A set can be placed for each profile being run. They must follow the J1 record and the number of rating curve points must be greater than two. It is required that the number of rating curve points be entered on the J1 record, Field 5. A maximum of 20 discharge elevation values is allowed. The program linearly interpolates between given rating curve values and extrapolates for values outside the rating curve.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | JR | Record identification characters. |
| 1,3,5, 7,9 | QJ1(i) | + | Discharge values. |
| 2,4,6, 8,10 | XJ1(i) | -,0,+ | Water surface elevation values. |

### Example Application

```
T1
T3
J1    0     3     0     0     7     0     0     0     0     0
JR   50 204.3   100 204.8   200 205.1   350 206.2   500 207.3
JR 1000 208.5  2000 210.5
J2
.
.
.
ER
```

## 6.3 JS Record - Starting Split Flow Assumption

The JS record is used to specify the starting assumed lost discharges for each reach defined in the split flow data set. If the JS record is not entered for a profile, then the program assumes that the first trial assumed lost flow is zero for all the split flow reaches. The JS record should follow the J1 record or the JR record if used. A maximum of 100 values are allowed.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | JS | Record identification characters. |
| 1 | N | + | Number of assumed lost discharges to read. |
| 2 | ARLQ(4,1) | + | Assumed lost discharge for first reach. |
| 3 | ARLQ(4,2) | + | Assumed lost discharge for second reach. |
| . | . | . | . |
| . | . | . | . |
| . | . | . | . |
| | ARLQ(4,N) | + | Assumed lost discharge for last reach. |

Continue on in field one of additional JS records up to ARLQ(4,N).

### Example Application

```
SF
.
.
.
EE
T1
T3
J1
JS      5      404        0     1118      150      650
J2
.
.
.
ER
```

## 6.4 J2 Record - Optional Features

Optional record for first profile, **required** record for all subsequent profiles.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | J2 | Record identification characters. |
| 1 | NPROF | 0 or 1 | Data records will be read NC - EJ. |
| | | -1 | Calls for **summary printout** for a single profile run. |
| | | 2-14 | Profile number using cross section data from first profile. Up to 14 profiles can be computed using the initial cross section data records NC - EJ. |
| 2 | IPLOT | 0 | No cross sections will be plotted for this job unless individual plots are specified by using IPLOT on X1 record (X1.10). |
| | | 1 | Line printer plots for **all** cross sections in this job. |
| | | 10 | Same as above except, data points will be plotted only up to the water surface elevation. |
| 3 | PRFVS | 0 | Computer selects vertical scale of profile plot for current profile based on an elevation spread not exceeding 12 inches. |
| | | + | Users selects vertical scale to be used for current profile. Enter number of elevation units per inch. |
| | | - | No profile will be plotted. |
| 4 | XSECV | 0 | Computer selects vertical scale of cross section plot for each cross section individually. |
| | | + | User selects vertical scale to be used for **all** cross sections. Enter number of elevation units per inch. |

## J2 Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 5 | XSECH | 0 | Computer selects horizontal scale of cross section plot for each cross section individually. |
| | | + | User selects horizontal scale to be used for **all** cross sections. Enter number of horizontal units per line of output. If the vertical scale of the profile (PRFVS) is given, then the value of XSECH will be used for the horizontal scale of both the cross sections and **profiles**. |
| 6 | FN | 0 | A factor of 1.0 will be used. |
| | | + | Factor to multiply all Manning's 'n' values by. (NC, NV and NH records). |
| | | - | Factor to multiply NC channel 'n' values by (NC.3). NC record overbank 'n' values (NC.1 and NC.2) are not modified. (All NV and NH 'n' values **are** modified). |
| 7 | ALLDC | -1 | Critical depth will be computed for all cross sections using an allowable error of 2.5 percent of the depth. |
| | | - | Same as ALLDC equal to negative one, except allowable error of ALLDC percent will be used. |
| | | 0 | Critical depth will not be computed unless the actual depth is close to critical (except when low flow occurs for the special bridge method or when supercritical flow profiles are computed). An allowable error of 2.5 percent of the depth will be used. |
| | | + | Same as ALLDC equal zero except, allowable error of ALLDC percent will be used. |

## J2 Record (continued)

## Channel Modification Due to Excavation

Through the use of subroutine CHIMP the existing cross section (as described by GR records) may be modified by a trapezoidal channel excavation as specified by the use of the optional record CI and the eighth and ninth fields of the J2 record. A CI record should be located after the X1 record of the cross section where the improvement is to be initiated. The trapezoidal modification will start on the first cross section that has a CI record and will continue on each cross section until a CI record is read that has .01 for the channel bottom. Any changes in the variables on the CI record must be made by another CI record. Only those variables that change need to be shown on the CI record.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 8 | IBW | 0 | If a CI or IC record is read, the sixth field of the record will be used. |
| | | 6-10 | Field number of field on CI record where channel bottom width is specified, or ice thickness factor on IC record. |
| | | - | A negative value will create a TAPE16 file of adjusted cross section data in GR format. CI input is not required for this option. |
| 9 | CHNIM | 0 | Overbank 'n' values are unchanged. |
| | | + | NH record (horizontal 'n' value variation) is to be simulated by the computer so that the channel 'n' value is used for a distance of CHNIM on each side of the left or right bank stations (which may be modified by the channel excavation described by the CI record). NH or NV records should not be used with this option. |
| 10 | ITRACE | 0 | No trace for this job unless specified by individual cross sections using ITRACE on X2 record (X2.10). Trace printout is used by programmers to debug the program, it is not recommended for general application. |
| | | 1 | Minor trace for all cross sections. |
| | | 10 | Major and minor trace for all cross sections. (Large amount of output.) |
| | | 15 | Flow distribution printout for all cross sections (no major or minor trace for all cross sections). |

## 6.5 J3 Record - Selection of Variables for Summary Tables (optional)

Optional record (up to five records may be used). Used on the first profile of a multiple profile run to select variables for the summary printout. If a summary printout is requested (J2.1) and a J3 record is not supplied, a pre-defined table (Table 150) is printed.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | J3 | Record identification characters. |
| 1-10 | IVAR(I) | | Codes to specify summary tables. Pre-defined tables may be called as shown below (100 and 200 series). User-defined tables may be generated by specifying up to 13 variable codes per table. Where two or more user-defined tables are specified, a blank field should be used to separate the tables. Tables are printed in order specified. Pre-defined tables are printed in numerical order after any user-defined table. A maximum of five tables may be generated. |

### Codes for Pre-Defined Tables

| Code | Table |
|---|---|
| 100 | Hydraulic calculations for special bridges only. |
| 101 | Hydraulic calculations for culverts only. |
| 105 | For cross section output at special bridge or culvert. |
| 110<br>115 | Encroachment data. |
| 120 | Channel improvement data. |
| 150 | Standard summary (two tables produced). |
| 200 | Floodway data (FIA Table 1)[1]. |

[1]Flood Insurance Study, Guidelines and Specifications, Federal Emergency Management Agency, 1987.

## J3 Record (continued)

### Variable Codes for User Defined Tables

| Variable Name | Code Number |
|---|---|
| **Cross section and Reach Variables from Input** | |
| SECNO | 38 |
| STCHL | 21 |
| STCHR | 22 |
| XLBEL | 23 |
| RBEL | 24 |
| ELMIN | 42 |
| XLCH | 39 |
| CUMDS | 66 |
| CHSLOP (K*CHSL) | 33 |
| **Velocity Variables** | |
| VLOB | 55 |
| VROB | 56 |
| VCH | 26 |
| HV | 10 |
| ALPHA | 57 |
| TIME | 6 |
| **Calculated Geometric Variables** | |
| DEPTH | 8 |
| TOPWID | 4 |
| AREA | 25 |
| TWA | 37 |
| VOL | 7 |
| SSTA | 53 |
| ENDST | 54 |
| TELMX | 63 |
| **Hydraulic Parameters** | |
| CASE | 20 |
| SLOPE (10K*S) | 5 |
| KRATIO | 58 |
| SHEAR | 67 |
| FRCH | 68 |
| POWER | 69 |

| Variable Name | Code Number |
|---|---|
| **Water Surface and Energy Related Variables** | |
| CWSEL | 1 |
| CRIWS | 2 |
| WSELK | 9 |
| EG | 3 |
| HL | 11 |
| OLOSS | 12 |
| IHLEQ | 62 |
| **Difference Variables** | |
| DIFEG | 61 |
| DIFWSP | 50 |
| DIFWSX | 51 |
| DIFKWS | 52 |
| **Discharge Variables** | |
| Q | 43 |
| QLOB | 13 |
| QCH | 14 |
| QROB | 15 |
| QLOBP | 35 |
| QCHP | 60 |
| QROBP | 59 |
| .01K | 34 |
| **Manning's 'n' Variable** | |
| XNL (K*XNL) | 16 |
| XNR (K*XNR) | 18 |
| XNCH (K*XNCH) | 17 |
| WTN (K*WTN) | 19 |
| **Bridge Variables** | |
| CLASS | 49 |
| QWEIR | 46 |
| QPR | 47 |
| EGPRS | 44 |
| EGLWC | 45 |
| H3 | 48 |
| ELTRD | 40 |
| ELLC | 41 |

| Variable Name | Code Number |
|---|---|
| **Culvert Variables** | |
| H4 | 85 |
| EGOC | 83 |
| EGIC | 84 |
| QCULV | 86 |
| **Encroachment Variables** | |
| PERENC | 36 |
| STENCL | 27 |
| STENCR | 28 |
| ELENCL | 31 |
| ELENCR | 32 |
| **Channel Improvement (CHIMP) Variables** | |
| CLSTA | 29 |
| BW | 30 |
| VEXR | 64 |
| VEXT | 65 |
| **Flow Under Ice Variables** | |
| TH1 | 70 |
| XICE1 | 71 |
| XSTAB1 | 72 |
| XFCH1 | 73 |
| ZINCH | 74 |
| TVOLI | 75 |
| VOLIL | 76 |
| VOLIR | 77 |
| VOLICH | 78 |
| NICE | 79 |
| ZITL | 80 |
| ZITR | 81 |
| ZITCH | 82 |

See following pages for descriptions of variables.

## J3 Record (continued)

### Summary Printout Data Description

| Code Number | Variable Name | Description |
|---|---|---|
| 1 | CWSEL | Computed water surface elevation. |
| 2 | CRIWS | Critical water surface elevation. |
| 3 | EG | Energy gradient elevation for a cross section which is equal to the computed water surface elevation CWSEL plus the discharge-weighted velocity head HV. |
| 4 | TOPWID | Cross section width at the calculated water surface elevation. |
| 5 | SLOPE (10K*S) | Slope of the energy grade line for the current section (times 10,000). |
| 6 | TIME | Travel time from the first cross section to the present cross section in hours. |
| 7 | VOL | Cumulative volume of water in the stream from the first cross section (in acre-feet for English units or 1000 cubic meters in Metric units). |
| 8 | DEPTH | Depth of flow. |
| 9 | WSELK | Known water surface elevation. |
| 10 | HV | Mean velocity head across the entire cross section. |
| 11 | HL | Energy loss due to friction. |
| 12 | OLOSS | Energy loss due to expansion or contraction. |
| 13 | QLOB | Amount of flow in the left overbank. |
| 14 | QCH | Amount of flow in the channel. |
| 15 | QROB | Amount of flow in the right overbank. |
| 16 | XNL (K*XNL) | Manning's 'n' for the left overbank area (time 1,000). |

## J3 Record (continued)

### Summary Printout Data Description

| Code Number | Variable Name | Description |
|---|---|---|
| 17 | XNCH (K*XNCH) | Manning's 'n' for the channel area (times 1,000). |
| 18 | XNR (K*XNR) | Manning's 'n' for the right overbank area (times 1,000). |
| 19 | WTN (K*WTN) | Weighted value of Manning's 'n' for the channel based on the distance between cross sections and channel flow from the first cross section. Used when computing Manning's 'n' from high water marks (times 1,000). |
| 20 | CASE | An internal program control variable. It provides no information to the user. |
| 21 | STCHL | Station of the left bank. |
| 22 | STCHR | Station of the right bank. |
| 23 | XLBEL | Left bank elevation. |
| 24 | RBEL | Right bank elevation. |
| 25 | AREA | Cross section area. |
| 26 | VCH | Mean velocity in the channel. |
| 27 | STENCL | The station of the left encroachment. |
| 28 | STENCR | The station of the right encroachment. |
| 29 | CLSTA | The centerline station of the trapezoidal excavation. |
| 30 | BW | The bottom width of the trapezoidal excavation. |
| 31 | ELENCL | Elevation of left encroachment. |
| 32 | ELENCR | Elevation of right encroachment. |

## J3 Record (continued)

### Summary Printout Data Description

| Code Number | Variable Name | Description |
|---|---|---|
| 33 | CHSLOP (K*CHSL) | Channel slope (times 1,000). |
| 34 | .01K | The total discharge (index Q) carried with $S^{1/2}$ = .01 (equivalent to .01 times conveyance). |
| 35 | QLOBP | Percent of flow in the left overbank. |
| 36 | PERENC | The target of encroachment requested on ET record. |
| 37 | TWA | The cumulative topwidth area (acres or 1000 square meters). |
| 38 | SECNO | The cross section identification number. |
| 39 | XLCH | Channel reach length. |
| 40 | ELTRD | Minimum elevation for top of road profile. |
| 41 | ELLC | Maximum low chord elevation. |
| 42 | ELMIN | Minimum elevation in cross section. |
| 43 | Q | Discharge. |
| 44 | EGPRS | Energy elevation assuming pressure flow. |
| 45 | EGLWC | Energy elevation assuming low flow. |
| 46 | QWEIR | Total weir flow at the bridge. |
| 47 | QPR | Total pressure or low flow at the bridge. |
| 48 | H3 | Change in water surface elevation from Yarnell's equation. |
| 49 | CLASS | Controlling flow type for bridge solution. |
| 50 | DIFWSP | Difference in water surface elevation for each profile. |
| 51 | DIFWSX | Difference in water surface elevation between sections. |

## J3 Record (continued)

### Summary Printout Data Description

| Code Number | Variable Name | Description |
|---|---|---|
| 52 | DIFKWS | Difference between known and computed water surface elevations. |
| 53 | SSTA | Starting station where the water surface intersects the ground (on the left side of the cross section). |
| 54 | ENDST | Ending station where the water surface intersects the ground on the right side. |
| 55 | VLOB | Average velocity in the left overbank area. |
| 56 | VROB | Average velocity in the right overbank area. |
| 57 | ALPHA | Velocity head coefficient. |
| 58 | KRATIO | Ratio of the upstream to downstream conveyance. |
| 59 | QROBP | Percent of flow in the right overbank. |
| 60 | QCHP | Percent of flow in the channel. |
| 61 | DIFEG | Difference in energy elevation for each profile. |
| 62 | IHLEQ | Friction loss equation index. |
| 63 | TELMX | Elevation of the lower of the two end points of cross section. |
| 64 | VEXR | Volume of excavation in reach. |
| 65 | VEXT | Volume of excavation, total. |
| 66 | CUMDS | Cumulative channel distance from first cross section. |
| 67 | SHEAR | Boundary shear stress within the channel. |
| 68 | FRCH | Froude number for main channel. |
| 69 | POWER | Stream power within main channel. |

## J3 Record (continued)

### Summary Printout Data Description

| Code Number | Variable Name | Description |
|---|---|---|
| 70 | TH1 | Ratio (T/H) of ice thickness (T) to maximum depth (H) in channel. |
| 71 | XICE1 | Calculated ice stability factor X based on TM. |
| 72 | XSTAB1 | Ice stability factor based on Pariset curve based on TH1. |
| 73 | XFCH1 | Froude number (for ice stability analysis) for the channel based on H equal to the maximum depth in the channel. |
| 74 | ZINCH | Channel N value based on Belokon-Sabaneev Formula. |
| 75 | TVOLI | Cumulative volume of ice in cubic yards or cubic meters. |
| 76 | VOLIL | Cumulative volume of ice on left bank. |
| 77 | VOLIR | Cumulative volume of ice on right bank. |
| 78 | VOLICH | Cumulative volume of ice in the channel. |
| 79 | NICE | ICE N value read in. |
| 80 | ZITL | Ice thickness for the left bank. |
| 81 | ZITR | Ice thickness for the right bank. |
| 82 | ZITCH | Ice thickness for the channel. |
| 83 | EGOC | Computed energy grade elevation for outlet control. |
| 84 | EGIC | Computed energy grade elevation for inlet control. |
| 85 | H4 | Energy elevation difference from downstream to upstream of the culvert. |
| 86 | QCULV | Flow through the culvert. |

## 6.6 J4 Record - Storage-Outflow Records for HEC-1 (optional)

Optional record used only on the first profile of a multiple profile run to obtain storage-discharge output in a form that can be used as input to the HEC-1 program for modified-Puls routing. A KK record is generated by HEC-2 for each routing reach. Storage and corresponding discharge values are written to SV and SQ records, respectively. KK and KM records are printed to identify the reach, and an RS record is printed without data. The storage-routing variables required on the RS record must be added by the HEC-1 user. Routing reach cross section numbers, REACH(I), specified on this record must correspond to an X1 record SECNO value. Output is written to TAPE7.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | J4 | Record identification characters. |
| 1-10 | REACH(I) | + | Defines routing reaches by pairs of cross section numbers representing downstream and upstream ends of reaches. REACH(I), when I is an odd number, indicates a downstream end. An even number for I indicates an upstream end. Fifty reaches can be specified.<br><br>A blank field indicates that no more cross section numbers will follow.<br><br>Zeros in a field are read as a cross section number, not a blank. |

## 6.7 J5 Record - Printout Control

The optional J5 record can be used to suppress detailed (cross section by cross section) and summary printout. The J5 record(s) may be used for single or multiple profile jobs. For multiple profile jobs, the J5 record(s) is inserted with job records for the first profile. Printout of the data input list, flow distribution data, and profile and cross section plots are unaffected by this option; for printout control of these options refer to the J1, J2, X1, and X2 records. Use of the J5 record for various printout options is illustrated in the following table.

| Field | | | | | |
|---|---|---|---|---|---|
| **0 (IA)** | **1 (LPRNT)** | **2 (NUMSEC)** | **3 (SECNOS(I))** | **4 .. N** | **Desired Printout** |
| J5 | -10 | -10 | | | Summary printout only for all cross sections |
| J5 | -10 | | X | | Detailed and summary printout beginning at cross section X |
| J5 | -10 | + | $X_1$ | $X_2$ .. $X_n$ | Detailed and summary printout for cross sections ($X_1$, ... $X_n$) |

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | J5 | Record identification characters. |
| 1 | LPRNT | -10 | and NUMSEC = -10, suppress detailed printout for all cross sections. |
| | | | and NUMSEC equals zero or plus, print detailed and summary printout for only those cross sections indicated by NUMSEC and SECNOS(I) (J5.2 and J5.3). |
| | | -1 | Same as -10 except a list of cross section numbers is furnished to aid in debugging runs that do not run to completion. |

## J5 Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 2 | NUMSEC | -10 | Suppress detailed printout for all cross sections. Requested summary printout is not suppressed. |
| | | 0 | Suppress all detailed and summary printout from the first cross section to the cross section indicated in J5.3. |
| | | + | Any positive number indicates that the following fields will contain cross section numbers SECNOS(I). |
| 3-10 | SECNOS(I) | -,0,+ | If NUMSEC is plus, one hundred cross section numbers can be specified. If additional records are required, all ten fields should be used for SECNOS(I).<br><br>A blank field indicates that no more cross section numbers will follow.<br><br>Zeros in a field are read as a cross section number, not a blank. |

## 6.8 J6 Record - Friction Loss Equations (optional)

The J6 record is an optional record which can be utilized to select equations for computation of friction losses, transfer control of output print files to computer system control, choose the method of evaluating subdivision of conveyance within the channel, and select the station of the cross section at the downstream end of the model. These options may be used for single or multiple profile jobs. For multiple profiles the J6 record is inserted with job records for the first profile only.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | J6 | Record identification characters. |
| 1 | IHLEQ | 0 | Average conveyance equation used to compute friction losses. This equation has been utilized in the preceding version of HEC-2 and is recommended for general application. |
| | | 1 | Program selects, on a reach by reach basis, one of the following equations: average friction slope, geometric mean friction slope, or harmonic mean slope. Selection is based on flow conditions.[1] |
| | | 2 | Average friction slope equation used to compute friction losses. |
| | | 3 | Geometric mean friction slope equation used to compute friction losses. |
| | | 4 | Harmonic mean friction slope equation used to compute friction losses. |
| 2 | ICOPY | 0 | The program will internally handle the disk/tape units containing the output print files. |
| | | 1 | The program will transfer control of disk/tape units for output print files to the computer. |

[1]See Table 2, Chapter 4, page 22, of the User's Manual for details.

## J6 Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 3 | SUBDIV | 0 | Default value. Allow subdivision of the channel if both bank side slopes are flatter than 5H:1V (horizontal to vertical). The slope is computed from the bank station to the point of 'n' or 'k' value change. |
| | | -1 | Allow the program to subdivide if 'n' or 'k' is changed in the channel cross section for any side slope. |
| | | + | Value defining the side slope criterion for subdividing instead of the default value of five (5). |
| 4 | STRTDS | -,0,+ | Station of the first cross section of the downstream end of the model. The units of STRTDS can be either in feet or meters or in miles or kilometers as indicated by the variable RMILE (J6.5). |
| 5 | RMILE | 0 | Units for STRTDS are in feet or meters. |
| | | + | Units for STRTDS are in miles or kilometers. |

## 6.9 EJ Record - End of Job (required)

Required following data for the last cross section. This record is **only** used for the first profile of multiple profile jobs because the cross section data records are read for the first profile only. Each group of records beginning with the T1 record is considered a job.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | EJ | Record identification characters. |
| 1-10 | | | Not used. |

## 6.10 ER Record - End of Run (required)

Required at the end of a run consisting of one or more jobs in order to end computation on stop command.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | ER | Record identification characters. |
| 1-10 | | | Not used. |

# 7 Change Records

## 7.1 IC Record - Ice Data (optional)

Used to input or change ice data. Calculations with floating ice cover will start at the first cross section (X1 record) following the IC record and will continue until an IC record is read that has .01 for SPGR (Field 5). Insert IC records with other change records (NC, NH, ET, etc.) immediately ahead of record X1.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | IC | Record identification characters. |
| 1 | ZITL | + | Ice thickness for the left overbank. |
| | | 0 | No change in ice thickness for the left overbank. |
| | | -1 | Open water in left overbank. |
| 2 | ZITR | + | Ice thickness for the right overbank. |
| | | 0 | No change in ice thickness for the right overbank. |
| | | -1 | Open water in right overbank. |
| 3 | ZITCH | + | Ice thickness for the channel. |
| | | 0 | No change in ice thickness for the channel. |
| | | -1 | Open water in the channel. |
| 4 | ZIN | + | Manning's 'n' value for ice. |
| | | 0 | No change in Manning's 'n' value for ice. |
| 5 | SPGR | + | Value of ice specific gravity. |
| | | .01 | No ice calculations until another IC record is read. (Used to terminate ice calculations.) |
| | | 0 | No change in ice specific gravity if a value was entered on a prior IC record or if none has been previously specified, the default value of 0.916 will be used. |

## IC Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 6-10[1] | FZ | + | Factor to multiply ice thickness values (ZITL, ZITR, ZITCH) by. |
| | | 0 | Ice 'n' values and ice thickness will not be modified. |
| | | - | Factor to multiply ice 'n' value (ZIN) by. |

[1] Field use (6-10) for a profile corresponds to the field specified in Field 8 (variable IBW) of the J2 record.

## 7.2 NC Record - Starting Manning's 'n' Values and Shock Losses

Manning's 'n' and the expansion and contraction coefficients for transition (shock) losses are entered for starting each job, or for changing values previously specified. The NC record is required for the first cross section.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | NC | Record identification characters. |
| 1 | XNL | 0 | No change in Manning's 'n' value for the left overbank. |
| | | + | Manning's 'n' value for the left overbank. |
| 2 | XNR | 0 | No change in Manning's 'n' value for the right overbank. |
| | | + | Manning's 'n' value for the right overbank. |
| 3 | XNCH | 0 | No change in Manning's 'n' value for the channel. |
| | | + | Manning's 'n' value for the channel. |
| 4 | CCHV | 0 | No change in contraction coefficient. |
| | | + | Contraction coefficient used in computing transition losses. |
| 5 | CEHV | 0 | No change in expansion coefficient. |
| | | + | Expansion coefficient used in computing transition losses. |
| 6-10 | | | Not used. |

## 7.3 NH Record - Horizontal Variations of Manning's 'n' (optional)

Used to permanently change the roughness coefficients (Manning's 'n') to values which vary with horizontal distances from the left side of the cross section. Roughness coefficients should be redefined for each cross section with new geometry. **The NH record should not be used at cross sections employing the NV record or when utilizing the channel improvement (CI) option**. If 'n' values change within the channel, the criterion described in Section 2.3 (page 4) is used to determine whether 'n' values should be converted to a composite value using Equation 5.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | NH | Record identification characters. |
| 1 | NUMNH | 1-20 | Total number of Manning's 'n' values (maximum 20) entered on NH records. If NUMNH is greater than four, multiple NH records are required and, the first field of the second and subsequent NH record, should contain a STN(N) value. |
| 2,4,6, 8,10...etc | VALN(N) | + | Manning's 'n' coefficient between stations STN(N-1) and STN(N). The first 'n' value applies from the starting left station up to STN(N) (Field 3). |
| 3,5,7, 9,11...etc | STN(N) | + | Station corresponding to VALN(N). Each stations should equal one of the stations on the next GR records. Stations must be in increasing order. Station values will not be adjusted by X1.8 PXSECR. |

## 7.4 NV Record - Vertical Variations in Manning's 'n' (optional)

Used to change the channel roughness coefficient 'n' based on water surface elevations. Program interpolates channel 'n' value for each calculated water surface elevation based on 'n' versus elevation data. **This option should not be used at cross sections employing the NH record or CHNIM (J2.9) option.**

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | NV | Record identification characters. |
| 1 | NUMNV | 2-20 | Total number of Manning's 'n' values entered on NV records (maximum 20). If NUMNV is greater than four, multiple NV records are required and, the first field of the second and subsequent NV records should contain an ELN(N) value. |
| 2,4,6, 8, 10, 12...etc. | VAL(N) | + | Manning's 'n' coefficient for area below ELN(N). The overbank 'n' values specified on the NC record will be used for the overbank roughness regardless of the values in this table. |
| 3,5,7, 9, 11, 13 ... etc. | ELN(N) | + | Elevation of the water surface corresponding to VALN(N) in increasing order. |

## 7.5 KH Record - Horizontal Description of Equivalent Roughness 'k' (optional)

Used to specify equivalent roughness coefficients (k values on feet or meters) which vary with horizontal distances from the left side of the cross section. These specifications remain in effect unless changed by new KH, NH, or NC records at subsequent cross sections. Roughness coefficients should be redefined for each cross section with new geometry. The KH record should not be used for cross sections employing the NV record or channel improvement (CI) option.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | KH | Record identification characters. |
| 1 | NUMKH | 1-20 | Total number of equivalent roughness values of 'k' (maximum of 20) entered on KH records. If NUMKH is greater than four, multiple KH records are required, and the first field of the second and subsequent KH records should contain a STK(N) value. |
| 2,4,6 8,10,etc. | VALK(N) | + | Equivalent roughness 'k' coefficient between stations STK(N-1) and STK(N). The first 'k' value applies from the starting left station up to STK(1) (Field 3). |
| 3,5,7 9,11,etc. | STK(N) | + | Station corresponding to VALK(N). Each station should equal one of the stations on the next GR record. Stations must be in increasing order. Station values will not be adjusted by X1.8 PXSECR. |

## 7.6 QT Record - Table of Discharges for Multiple Profiles

Specifies a table of flows for use in computing a series of water surface profiles. The field of the flow being used for this job is specified by variable INQ(J1.2).

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | QT | Record identification characters. |
| 1 | NUMQ | 1-19 | Total number of flows (maximum 19) entered on the QT records. If NUMQ is greater than nine, two QT records are required, and the first field of the second QT record should contain a Q(N) value. |
| 2-20 | Q(N) | + | Flow values to be used for multiple profiles. Variable INQ(J1.2) indicates which field is used for this job. INQ may range from 2 to 20. |

## 7.7 ET Record - Encroachment Table (optional)

This record is used to specify the Method 1 through 6 and target of the encroachment. The method and target will be used until changed by another ET record, except for Method 1, which only applies to the next cross section. A zero on the first ET record indicates no encroachment, while a zero on succeeding ET records indicates no change in encroachment. The field of the ET record that is being used for a particular profile is specified by variable INQ (J1.2). Methods 3 through 6 require a natural profile for the first profile and thus require reading a zero on the ET record of the "INQ" field for the first profile. If Methods 2 through 6 are being used and it is desired to terminate the encroachment option, use Method 1 with the encroachment stations specified near the two ends of the cross section. Each method is capable of evaluating the effects of encroachments on bridges.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | ET | Record identification characters. |
| 1 | None | None | Blank field. |
| 2-10 | ENCFP(N) | 0 | No encroachment or no change in encroachment. |
| | | +<br>or<br>- | Encroachment method used. The number X.Y is used to specify that method Y is being used and X is the target to be used for that method. Up to nine values may be specified. The encroachment method or target may be changed at any cross section or on different profiles. |

**Encroachment Methods**

Positive values of X.Y for Methods 3 through 6 provide an encroachment based on a reduction of conveyance equally in both overbanks. Negative values of X.Y for Methods 3 through 6 provide an encroachment based on a reduction of conveyance in proportion to the distribution of natural overbank conveyance. For instance, if the natural cross section had twice as much conveyance in the left overbank as in the right overbank, a 10.3 would reduce conveyance by five percent in each overbank, whereas a -10.3 would eliminate 6.7 percent from the left overbank and 3.3 percent from the right overbank.

Bridge encroachments may be evaluated by adding .01 to the code X.Y for any of the methods. Thus a 9.11, 100.21, 10.31, 10.41, 10.51, or 10.61 would request the bridge encroachments for Methods 1 through 6, while a 9.1, 100.2, 10.3, 10.4, 10.5, or 10.6 would not. The table on the following page describes how each method handles encroachments on bridges.

## ET Record (continued)

| Method | Description |
|---|---|
| 1 | Bridge encroachments set as indicated by target values of Method 1. |
| 2 | Bridge encroachments set as indicated by target values of Method 2. |
| 3 - 6 | Bridge encroachments defined by encroachments determined at the cross section immediately downstream of the bridge. |

| METHOD | ET CARD VALUE | DESCRIPTION |
|---|---|---|
| 1 | X.1 or X.11 | The Xth and Xth + 1 fields of the ET record will be used for the encroachment stations STENCL and STENCR. STENCL should not be zero. |
| 2 | X.2 or X.21 | The top width of X will determine encroachment stations such that the center of the top width will be centered halfway between bank stations. |
| 3 | X.3 or X.31 | The natural cross section will be encroached so that X percent of the total conveyance will be eliminated **equally** (X/2 percent) from each overbank. |
| | -X.3 or -X.31 | Same as X.3 except the reduction of conveyance in each overbank will be in **proportion** to the conveyance in the overbanks. |
| 4 | X.4 or X.41 | The natural cross section will be encroached based on a (X/10) foot increase in water surface elevation. The reduction of conveyance will be **equal** in both overbanks. A 1 foot increase in water surface elevation would require a 10.4 and a .5 foot increase would require a 5.4. |
| | -X.4 or -X.41 | Same as X.4 except the reduction of conveyance in each overbank will be in **proportion** to the conveyance in the overbanks under natural conditions. |
| 5 | X.5 or X.51 | Operates much like Method 4 except that an iterative solution scheme attempts to obtain the desired difference in water surface elevations as closely as possible to the specified target difference. |
| | -X.5 or -X.51 | Same as X.5 except the reduction of conveyance in each overbank will be in **proportion** to the conveyance in the overbanks under natural conditions. |

## ET Record (continued)

| METHOD | ET CARD VALUE | DESCRIPTION |
|---|---|---|
| 6 | X.6<br>or<br>X.61 | Uses an optimization scheme to obtain a desired difference in energy grade line elevations as closely as possible to the specified target. |
| | -X.6<br>or<br>-X.61 | Same as X.6 except the reduction of conveyance in each overbank will be in proportion to the conveyance in the overbanks under natural conditions. |

# 8 Cross Section Records

## 8.1 X1 Record - General Items for Each Cross Section (required)

This record is required for each cross section (800 cross sections can be used for each profile) and is used to specify the cross section geometry and program options applicable to that cross section.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | X1 | Record identification characters. |
| 1 | SECNO | + | Cross section identification number.<br>NOTE: When using the Split Flow Option, cross section ID numbers must increase downstream to upstream. |
| | | - | Start new tributary backwater at this cross section. |
| 2 | NUMST | 0 | **Previous** cross section is repeated for current section. GR records are not entered for this cross section. |
| | | + | Total number of stations on the following GR records. |
| 3 | STCHL | 0 | NUMST(X1.2) is 0. |
| | | + | The station of the left bank of the channel. Must be equal to one of the STA(N) on next GR records. |
| 4 | STCHR | 0 | NUMST(X1.2) is 0. |
| | | + | The station of the right bank of the channel. Must be equal to one of the STA(N) on GR records and equal to or greater than STCHL. |
| 5 | XLOBL | + | Length of **left overbank** reach between current cross section and next downstream cross section. Zero for first cross section if IDIR = 0, (J1.4). |
| 6 | XLOBR | + | Length of **right overbank** reach between current cross section and next downstream cross section. Zero for first cross section if IDIR = 0. |
| 7 | XLCH | + | Length of **channel** reach between current cross section and next downstream cross section. Zero for first cross section if IDIR = 0. |

## X1 Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 8 | PXSECR | 0 | Cross section stations will not be changed by the factor PXSECR. |
| | | + | Factor to modify the horizontal dimensions of a cross section. The distances between adjacent GR stations (STA) are multiplied by this factor to expand or narrow a cross section. The STA of the first GR point remains the same. The factor can apply to a repeated cross section or a current one. A factor of 1.1 will increase the horizontal distance between the GR stations by ten percent. (See X2.9 for station adjustment to BT data.) This factor will adjust data from CI records and NH or NK stations for repeat sections. It will not adjust data from X4 records in repeat cross sections. |
| 9 | PXSECE | 0 | Cross section elevations will not be changed. |
| | | + or - | Constant to be added (+ or -) to GR elevation data (either previous or current). Sediment elevation data (X3.2) input at current cross section is not modified by this factor. (See X2.7 for elevation change to BT data.) Will not adjust X4 records in repeat cross sections. |
| 10 | IPLOT | 0 | Current cross section will not be plotted unless all cross sections were requested by J2 record. |
| | | 1 | Plot current cross section using all points. |
| | | 10 | Plot current cross section using only those points up to the water surface elevation. |

## 8.2 RC Record - Rating Curve for Inputting Water Surface Elevations

The RC record can be entered at any cross section and the program will determine the water surface elevation based on the rating curve and not on backwater computations. The RC record should be placed after the X1 record. A maximum of 20 discharge elevation values are allowed. The program linearly interpolates between given rating curve values and extrapolates for values outside the rating curve.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | RC | Record identification characters. |
| 1 | NRCP | + | Number of rating curve points being read in. |
| 2 | QRC(1) | + | Discharge value. |
| 3 | XRC(1) | -,0,+ | Water surface elevation value. |
| 4 | QRC(2) | + | Discharge value. |
| 5 | XRC(2) | -,0,+ | Water surface elevation value. |
| . | | | |
| . | | | |
| . | | | |
| . | | | |
| . | | | |
| | QRC(NRCP) | + | Last discharge value. |
| | XRC(NRCP) | -,0,+ | Last water surface elevation value. |

Continue on in Field 1 of additional RC records up to QRC(NRCP) and XRC(NRCP).

## 8.3 CI Record - Channel Improvement (optional)

This optional record provides input for the channel improvement (CHIMP) option of the program. This option simulates the modification of cross section data (GR records) by a trapezoidal excavation. The modification begins at the first cross section with a CI record and continues until a CI record specifying a bottom width equal to 0.01 (variable BW, Fields 6-10) is encountered. Up to five bottom widths can be specified for analysis during multiple profile runs. Multiple CI records may be used to model improved channel sections with pilot channels; up to three CI records may be used at a single cross section. The channel improvements are performed in the order that the records are specified. The natural channel may be filled prior to excavation if desired. (See variable BW.) Low areas of the natural cross section may be filled by the sediment option (variable ELSED X3.2). See J2 record, Fields 8 and 9 for further information.

Note: **The CI record cannot be used in conjunction with NH records.**

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | CI | First two columns of record for record identification. |
| 1 | CLSTA | 0 | Value on previous cross section's CI record is used. |
| | | + | Station of the centerline of trapezoidal channel excavation which is expressed in terms of the stations used in the natural cross section description (GR records). |
| | | -1 | CLSTA is determined by program as halfway between bank stations. |
| 2 | CELCH | 0 | Value on previous cross section's CI record is used. |
| | | + or - | Elevation of channel invert (but not -1). |
| | | -1 | Elevation of channel invert is equal to minimum elevation in cross section. (For pilot channel excavations, second and third CI records, the channel invert elevation should be specified). |
| | | .1≥CELCH≥.00001 | Elevation of channel invert is based on CELCH (Slope) · XLCH (Channel Reach Length) + PELMN (D.S. Minimum Elevation). |

## CI Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 3 | XLCH.CNCH | 0 or + | The value to the left of the decimal point is the channel reach length (XLCH). If 0, the channel reach length specified on the X1 record will be used. The value to the right of the decimal point is the new channel 'n' value (CNCH). If 0, the previously specified 'n' (CI or NC record) will be used. |
| 4 | XLSS | 0 | Value on previous cross section's CI record for left side slope of trapezoidal excavation is to be used, or, if not previously specified, the left side slope will be vertical. |
| | | + | Left side slope of excavation expressed as number of horizontal units per one vertical unit (i.e., 2.0 for two horizontal to one vertical). |
| 5 | RSS | 0 or + | Same as XLSS except for right side of trapezoid. |
| 6-10 | BW | 0 | Value on previous cross section's CI record is used. |
| | | .01 | End of channel improvement. If multiple CI records are being used, then all the CI records must have .01 to turn off the channel improvement. If not all of the CI records have a .01, then the records that do not have a .01 will be used to do the channel improvement. Note the channel 'n' value must be redefined if CNCH (CI.3) was used. |
| | | + | Bottom width of channel. Field used (6-10) for this profile determined by variable IBW (J2.8). |
| | | - | Same as + but the old channel will be filled up to an elevation equal to the minimum bank elevation. |

## 8.4 X2 Record - Optional Items for Each Cross Section (Bridge, etc.)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | X2 | Record identification characters. |
| 1 | QNEW | 0 | No change in flow. |
| | | + | Value of the new flow in the river. This value will be used for all remaining cross sections unless changed by another X2 record or by a QT record. |
| 2 | WSELK | 0 | High water mark elevations are not being used. |
| | | + | Elevation of known water surface elevation (i.e., high water mark) at this cross section. Required if NINV(J1.3) equals one. |
| 3 | IBRID | 0 | Special bridge method will not be used. |
| | | 1 | Special bridge method will be used. SB record is required just ahead of the X1 record for the current cross section. |
| | | 2 | Special culvert will be used. SC record is required just ahead of the X1 record for the current cross section. |
| 4 | ELLC | 0 | Bridge or culvert methods are not being used. |
| | | + or - | Elevation of a horizontal low chord for the bridge for use by the **normal bridge** method. For the **special bridge or culvert** method, the maximum upstream low chord elevation within the bridge span which is used to help distinguish between pressure flow and low flow. |
| 5 | ELTRD | 0 | Bridge or culvert methods are not being used. |
| | | + or - | Elevation of a horizontal top of roadway for use by the **normal bridge** method. For the **special bridge or culvert** method, the minimum roadway elevation on the BT records which is used to determine if weir flow exists. |
| 6 | BLOSS | 0 | Change in water surface elevation will not be entered. |
| | | + | Change in water surface elevation to be used between current and previous cross sections. |

## X2 Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 7 | REPBT | 0 | Do not repeat bridge table (BT records) used from previous cross section. |
| | | 1 | Previous bridge table (BT records) is repeated for use at the current cross section. PXSECE (X1.9) may be utilized to modify the low chord elevations of the repeated BT records (top of roadways remain the same). This option is used in describing the top of a fixed diameter culvert for several cross sections. Horizontal stations cannot be changed when a bridge table is repeated. |
| 8 | CMOM | 0 | Drag coefficient for calculating pier losses with momentum equation is equal to 2.00 (square piers). |
| | | + | Drag coefficient to be used for calculating pier losses with momentum equations (1.33 for piers with semicircular ends). |
| 9 | BSQ | 0 | No bridge skew is used. Factor of 1.0 will be used. |
| | | + | This factor is used to modify (skew) the horizontal dimensions of the bridge profile (BT records). The value of the first RDST on the BT records to be skewed should be equal to the station (STA) of the first GR data point for the current cross section (see X1.8 to skew GR data). |
| **Trace and Flow Distribution** | | | |
| 10 | ITRACE | 0 | No trace for this cross section unless ITRACE on J2 record (J2.10) is specified. |
| | | 1 | Minor trace for current cross section. |
| | | 10 | Major and minor trace for current cross section. |
| | | 15 | Flow distribution printout for current cross section. |

## 8.5 X3 Record - Optional Items for Each Cross Section (Effective Area, etc.)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| | IA | X3 | Record identification characters. |
| 1 | IEARA | 0 | Total area of cross section described on GR records below the water surface elevation is used in the computations. |
| | | 10 | Only the channel area (as defined by STCHL, X1.3 and STCHR, X1.4) is used in the computations, unless the water surface elevation exceeds the elevations of the bank stations. This option can be utilized to contain flow between levees until overtopping occurs, if the bank stations are coded at the top of the levees. Overtopping can occur on either side since the elevations of STCHL and STCHR are tested independently. The elevations can also be extended with ELLEA (X3.8) and ELREA (X3.9) to define artificial levees for bridge applications. |
| 2 | ELSED | 0 | A sediment elevation is not specified. |
| | | + or - | Elevation of sediment deposition. All elevations below ELSED are set equal to ELSED. This elevation is not modified by PXSECE (X1.9). |
| 3 | ENCFP | 0 | Width between encroachments is not changed or is not specified. |
| | | + | Width between encroachments is centered in the channel, midway between the left and right overbanks. Flow areas outside this width are not included in the computations. This width will be used for all cross sections unless changed by a positive ENCFP on the X3 record of another cross section or on an ET record or unless overridden by the use of STENCL (X3.4). |
| 4 | STENCL | 0 | Encroachments by specifying station and/or elevation will not be used on the left overbank. |
| | | + | Station of the left encroachment. Flow areas to the left of (less than) this station and below ELENCL are not included in the computations. This option will override the option using ENCFP when both are used. |

## X3 Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 5 | ELENCL | 0 | An encroachment elevation on the left side is not applicable and is therefore assumed very high or STENCL = 0. |
| | | + or - | Elevation of the left encroachment. Flow areas below this elevation and less than STENCL are not included in the computations. |
| 6 | STENCR | 0 | An encroachment station on the right is not used. |
| | | + | Station of the right encroachment. Flow areas to the right of (greater than) this station and below ELENCR are not included in the computations. |
| 7 | ELENCR | 0 | An encroachment elevation on the right side is not applicable and is therefore assumed very high or STENCR = 0. |
| | | + or - | Elevation of the right encroachment. Flow areas below this elevation and greater than STENCR are not included in the computations. |
| 8 | ELLEA | 0 | The elevation (XLBEL) on the GR records corresponding to STCHL (X1.3) is used to decide if the left flow area is effective or not when using the effective area option (IEARA = 10). |
| | | + or - | This elevation is used instead of XLBEL. This option, when used with IEARA = 10, defines artificial levees for effective flow applications at bridges. |
| 9 | ELREA | 0 | Same as ELLEA except for right bank flows. |
| | | + or - | Same as ELLEA except for right bank flows. Left bank value (ELLEA) must be nonzero for program to use the right bank value. |
| 10 | Not used. | | |

## 8.6 X4 Record - Additional Points for Cross Section (optional)

An additional input record X4 may be inserted following records X1, X2 or X3 in order to add additional points, up to twenty, to describe the ground profile of the cross section. Stations of X4 data points must fall within the range of GR stations. The X4 data point is an **added point** and cannot be used to replace any GR data point. The sum of GR and X4 data points at a cross section must not exceed 100. This option is useful when modifying data records for a proposed obstruction as it allows points to be added anywhere in the cross section.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | X4 | Record identification characters. |
| 1 | NELT | 1-20 | Total number of X4 data points (maximum of 20) to be added to the current cross sections GR data set. If NELT is greater than four, multiple X4 records are required, and the first field of the second and subsequent X4 records should contain a STAT(N) value. |
| 2,4,6, 8,10 ... etc. | ELT(N) | + or - | Elevation of additional ground point corresponding to STAT(N). Elevations added by X4 records are adjusted by PXSECE (X1.9), if input with GR data. |
| 3,5,7, 9,11, 13 ... etc. | STAT(N) | + | Station of additional ground point. All stations must be less than the maximum station on the GR records. The pairs of elevations and stations do not have to be in any particular order. Station values are adjusted by PXSECR (X1.8), if input with GR data. |

## 8.7 X5 Record - Use of Input Water Surface Elevations (optional)

An X5 record is used to input a water surface elevation at a cross section, or to input an increment of elevation to be added to the water surface elevation of the previous cross section to obtain the water surface elevation of the cross section. The X5 record can be inserted for any cross section, including a bridge cross section, and the desired elevation or elevation increment can be specified differently for each profile of a multiple profile job. The field of the X5 record that is used for a particular profile is controlled by variable INQ (J1.2).

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | X5 | Record identification characters. |
| 1 | N | 1 to 19 | Number of fields (maximum of 19) used on X5 record for desired water surface elevations. If the number of fields (N) is greater than nine, a second X5 record is required, and the first field of the second X5 record should have a SBWS(N) value. |
| | | -1 to -19 | Number of fields used on X5 record for desired increments of water surface elevation. |
| 2-20 | SBWS(N) | +<br>- | Water surface elevation (if N is positive) or elevation increment (if N is negative). Variable INQ (J1.2) indicates which field is used for a particular profile. |

## 8.8 GR Record - Ground Profiles Elevations and Stations

This record specifies the elevation and station of each point in a cross section used to describe the ground profile, and is required for each X1 record unless NUMST (X1.2) is zero. The points outside of the channel determine the subdivision of the cross section which influences calculation of a discharge-weighted velocity head for the cross section.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | GR | Record identification characters. |
| 1 | EL(1) | + or - | Elevation of cross section point one at station STA(1). May be positive or negative. |
| 2 | STA(1) | + | Station of cross section point one. |
| 3 | EL(2) | + or - | Elevation of cross section point two at STA(2). |
| 4 | STA(2) | + | Station of cross section point two. |

5-10 etc.

Continue with additional GR records using up to 100 points to describe the cross section. Stations must be in increasing order progressing from left to right across the cross section.

# 9 Bridge and Culvert Records

## 9.1 SB Record - Special Bridge (optional)

This special bridge record is used to specify data for use in the special bridge method and is only required when using the special bridge method. This record should be entered between cross sections that are upstream and downstream of the bridge. See X2 record, Fields 3 through 9, for additional input for the special bridge option.

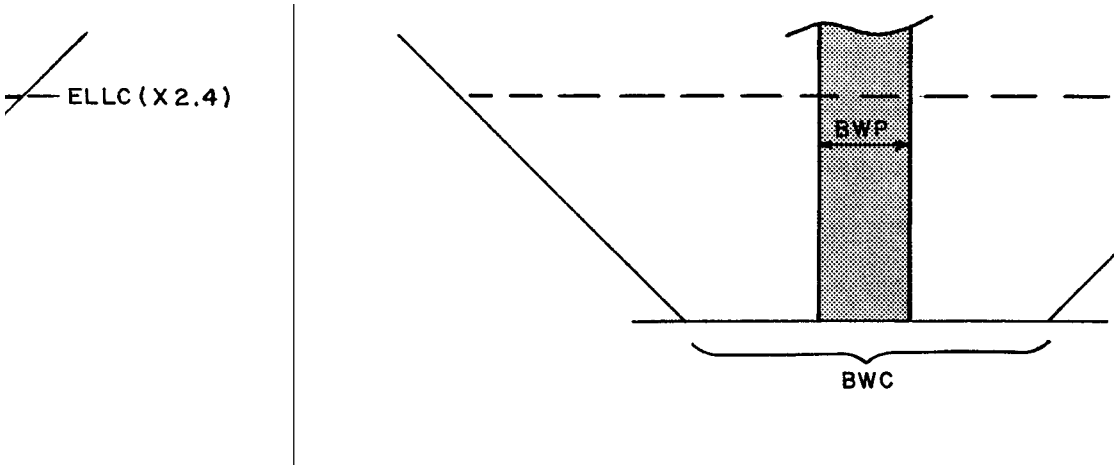
| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | SB | Record identification characters. |
| 1 | XK | + | Pier shape coefficient, "K", for use in Yarnell's energy equation for Class A flow. |
| 2 | XKOR | + | Total loss coefficient, "K", between cross sections on either side of bridge, for use in orifice flow equation. Should not be less than 1.0. |
| 3 | COFQ | + | Coefficient of discharge "C" for use in weir flow equation. Weir flow will be corrected for weir submergence based on the curves in "Hydraulics of Bridge Waterways" (Reference 13, Figure 24). The "Hydraulics of Bridge Waterways" method is based on a trapezoidal-shaped roadway embankment. |
| | | - | The absolute value of COFQ will be used as the coefficient of discharge "C" for use in weir flow equation. Weir flow will be corrected for weir submergence based on the Waterways Experiment Station's (WES) Design Chart 111-4. The WES method is based on a ogee-shaped spillway. |
| 4 | RDLEN | 0 | Flow over roadway is not being considered **or** a table of roadway elevations and corresponding stations will be read in on the BT record for determining "L" in the weir flow equation. |
| | | + | Average length of roadway "L" in feet for use in the weir flow equation. Use a constant value of "L" only if the length of weir does not change with depth of flow. Otherwise, use the BT record to read in the top of roadway. Weir elevation defined on Field 5 of X2 record. |

## SB Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 5 | BWC | + | Bottom width of bridge opening including any obstruction. |
| 6 | BWP | 0 | No obstruction (pier) in the bridge. Normal bridge method will be used in this case if low flow controls. |
| | | + | Total width of obstruction (piers). |
| 7 | BAREA | + | Net area of bridge opening below the low chord in square feet or square meters. |
| 8 | SS | 0 | Vertical side slopes. |
| | | + | Number of horizontal units per one vertical unit for the side slopes of the trapezoidal channel under the bridge. |
| 9 | ELCHU | 0 | Channel invert beneath bridge will be equal to the minimum elevation in the previous cross section. This value will not be adjusted by PXSECE (X1.9). |
| | | + or - | Elevation of the channel invert at the upstream side of the bridge. |
| 10 | ELCHD | 0 | Channel invert will be assumed equal to the minimum elevation in the previous cross section. |
| | | + or - | Elevation of the channel invert at the downstream side of the bridge. This value will not be adjusted by PXSECE (X1.9). |

## SB Record (continued)

The diagram below defines the six variables: BWC, BWP, SS, ELCHU, and ELCHD that define a trapezoid for low flow calculations. Variable BAREA provides the net area of the bridge opening for pressure flow calculations. For typical applications the net area of the trapezoid (special bridge output variable TRAPEZOID AREA) should be close to the actual net area (BAREA). If BWP is zero, standard step calculations will be used for low flow.




**Trapezoidal Approximation of Bridge Opening**

## 9.2 SC Record - Special Culvert

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | SC | Record identification characters. |
| 1 | CUNO.CUNV | + | The value left of the decimal point is the integer number of identical culverts installed at this location. The value to the right of the decimal point is Manning's roughness coefficient for the culvert barrel. |
| 2 | ENTLC | + | Entrance loss coefficient for culvert. |
| 3 | COFQ | + | Coefficient of discharge "C" for use in weir flow equation. Weir flow will be corrected for weir submergence based on the curves in "Hydraulics of Bridge Waterways" (Reference 13, Figure 24). The "Hydraulics of Bridge Waterways" method is based on a trapezoidal-shaped roadway embankment. |
| | | - | The absolute value of COFQ will be used as the coefficient of discharge "C" for use in weir flow equation. Weir flow will be corrected for weir submergence based on the Waterways Experiment Station's (WES) Design Chart 111-4. The WES method is based on a ogee-shaped spillway. |
| 4 | RDLEN | 0 | Flow over roadway is not being considered, or a table of roadway elevations and corresponding stations will be input using BT records for determining "L" in the weir flow equation. |
| | | + | Average length of roadway "L" in feet for use in the weir flow equation. Use a constant value of "L" only if the length of the weir does not change with depth of flow. Otherwise, use the BT record to input the top of roadway. The weir elevation is defined on Field 5 of X2 record. |
| 5 | RISE | + | Rise (height) of box culvert opening, or diameter of pipe culvert opening in feet. |
| 6 | SPAN | 0 | Culvert is circular. Diameter must be entered in Field 5. |
| | | + | Span (width) of box culvert opening in feet. |

## SC Record - (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 7 | CULVLN | + | Length of the culvert barrel in feet. |
| 8 | CHRT.SCL | + | Value left of decimal point is the Federal Highway Administration chart number for the culvert. Value right of the decimal point is the Federal Highway Administration scale number for the culvert. |
| 9 | ELCHU | 0 | Culvert invert elevations ELCHU and ELCHD will be assumed equal to the minimum elevation in the previous cross section. |
| | | + or - | Elevation of the culvert invert at the upstream side of the roadway crossing. ELCHU must be greater than or equal to ELCHD. |
| 10 | ELCHD | +, 0, or - | Elevation of the culvert invert at the downstream side of the roadway crossing. This value will not be adjusted by PXSECE (X1.9). ELCHD must be less than or equal to ELCHU. This value will be ignored if ELCHU (SC.9) equals zero. |

## 9.3 BT Record - Bridge Table of Elevations and Stations (optional)

The bridge geometry described by this record may be used by either the normal bridge, special bridge, or culvert methods.

**Normal bridge method** computes conveyance in the bridge section with the data from BT and GR records defining the bridge section. Each BT station must correspond to a GR or X4 station. The program eliminates the area between top-of-road and low-chord profile defined by the BT data. If the ground and the top-of-road profiles are the same in the overbank portion of the cross section, the BT data does not have to duplicate the GR data. If the top-of-road is above the overbank ground profile, the low-chord elevations should be equal to the ground (GR) elevation to fill in the overbank area between road and ground.

For the **special bridge and culvert methods**, the BT data define a top-of-road profile for weir calculations. The BT data must define the entire weir length of the roadway. For culverts, and special bridges with piers (BWP > 0), the low-chord values are not required and BT stations do not have to equal GR stations. The ELLC variable (X2.4) defines the low-chord value required by these methods. However, if the special bridge (BWP = 0), the low-flow solution is based on conveyance calculations, and the BT input data must conform to the normal bridge requirements.

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 0 | IA | BT | Record identification characters. |
| 1 | NRD | + | Number of points describing the bridge roadway and low chord to be read on the BT records. Entered only on first BT record. The maximum number of points is 100. |
| | | - | Same as a positive NRD except an optional data format is utilized for the second and subsequent BT records. |
| 2 | RDST(1) | + | Roadway station corresponding to RDEL(1) and XLCEL(1). |
| 3 | RDEL(1) | + | Top of roadway elevation at station RDST(1). Should be greater than the estimated energy elevation for special bridge applications, since weir flow calculations are based on energy elevations. |
| 4 | XLCEL(1) | + | Low chord elevation at station RDST (1). |
| 5 | RDST(2) | + | Roadway station corresponding to RDEL(2) and XLCEL(2). |
| 6 | RDEL(2) | + | Top of roadway elevation at station RDST(2). |

## BT Record (continued)

| FIELD | VARIABLE | VALUE | DESCRIPTION |
|---|---|---|---|
| 7 | XLCEL(2) | + | Low chord elevation at station RDST(2). |
| 8 | RDST(3) | + | Roadway station corresponding to RDEL(3) and XLCEL(3). |
| 9 | RDEL(3) | + | Top of roadway elevation at station RDST(3). |
| 10 | XLCEL(3) | + | Low chord elevation at station RDST(3). |

## Format for Additional BT records

### Standard Format

If NRD is positive (+) BT data RDST, RDEL, and XLCEL is to be input starting in the second and subsequent BT records, all ten fields are available for data.

### Optional Format

If NRD is negative (-) BT data is to be input in the second through the tenth fields of the second and subsequent BT records, only nine fields are available for data.

For special bridge method, the last roadway elevation RDEL (NRD) should be greater than the estimated energy elevation.

## 10 FR - Free Format Indicator Record

The FR record must be the first record in the input file if free format input is used. The free format input option allows the user to enter data using commas (,) or blank space as a delimiter between field input. A blank should separate the record ID and the first field input data. A blank should be used to delimit a field that is full (i.e., 8 digits, or 6 if the first field). If a comma is used to delimit a field that is full, the next field will be blank. Multiple commas are interpreted as blank fields. If the last fields of an input record are blank, you can limit your input to those fields that contain input data, i.e., you do not have to define the ending blank fields.

With free format, more, or less, than 10-fields of input can be entered on a single line if the record-type has continuous data (e.g., GR or BT records). The data will be processed into 10-field records of data. This option can be used to add data into an existing data set without extensive editing to maintain the fixed-field format.

EDIT2 will create a fixed-field input file from free-format data. The fixed-field file will be saved as TAPE10. You can rename and save the TAPE10 file for use as the input file in HEC-2.

***FREE** input record turns on the free-format option. This record must appear before the first free-format data.

***FIX** input record turns off the free-format option. This record must appear before the first fixed-field input, if free-format option is active.

# 11 HEC-2 Input Record Summary

Records are listed in their relative order of input in a data file.



*Required for basic applications.

# HEC-2 Input Description
## Input Record Summary

### Change Records

| | | |
|---|---|---|
| IC | Ice Data | 35 |
| *NC | Starting Manning's 'n' Values & Shock Losses | 37 |
| NH | Horizontal Variations of Manning's 'n' | 38 |
| NV | Vertical Variations of Manning's 'n' | 39 |
| KH | Horizontal Description of Equivalent Roughness 'n' | 40 |
| QT | Table Discharges for Multiple Profiles | 41 |
| ET | Encroachment Table | 42 |

### Bridge and Culvert Records

| | | |
|---|---|---|
| SB | Special Bridge | 57 |
| SC | Special Culvert | 59 |

### Cross Section Records

| | | |
|---|---|---|
| *X1 | General Items for Each Cross Section | 45 |
| RC | Rating Curve for Inputting Water Surface Elevations | 47 |
| CI | Channel Improvement | 48 |
| X2 | Optional Items for Each Cross Section (Bridges, etc.) | 50 |
| X3 | Optional Items for Each Cross Section (Effective Area, etc.) | 52 |
| X4 | Additional Points for Cross Section | 54 |
| X5 | Use of Water Surface Elevations | 55 |
| BT | Bridge Table of Elevations & Stations | 61 |
| *GR | Ground Profiles Elevations & Stations | 56 |

### End of Records

| | | |
|---|---|---|
| *EJ | End of Job (marks end of river reach data) | 34 |
| *ER | End of Run | 34 |

*Required for basic applications.