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USER'S MANUAL FOR A HEC-2 INPUT FILE PREPROCESSOR

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CHAPTER 1
INTRODUCTION

The Suwannee River Water Management District (SRWMD) has provided a grant to the Florida Water Resources Research Center of the University of Florida for development of a PC HEC-2 interface program. The original HEC-2 program was developed at the Hydrologic Engineering Center which is a division of the U.S. Army Corps of Engineers in Davis, California. The original version was developed for use on mainframe computers. The most recent release of this program was made in 1986. This version meets FORTRAN 77 standards and is suitable for use on MS-DOS compatible personal computers. A number of other related programs are included in the 1986 HEC-2 program package.

The primary goal of this project is to provide a means to manipulate existing HEC-2 input files and to add new transect and related data so that the hydrologic impacts of proposed construction projects in the flood plain of the Suwannee River are accurately represented by the input file. The newly created input file, in conjunction with the PC version of HEC-2 and related programs, can be used to predict any changes in the 100-year flood level resulting from proposed construction within the floodplain.

This manual provides the HEC-2 user with a comprehensive guide to the use of PRE-HEC. PRE-HEC is a Lotus 1-2-3 based preprocessor that provides an efficient means for editing existing HEC-2 input data-files. Included with this manual are three diskettes which contain HEC-2 input files for the Suwannee River and also the preprocessor and related files. It is suggested that the introductory sections and Chapter 3, which describes the main menu, be read before using the program. The flowcharts in Chapter 3 may be examined while reading the text, but they will be most helpful while using the various menus contained within each of the twelve modules of PRE-HEC.

Chapter 4 presents an example of using PRE-HEC to model a hypothetical construction site located in the 100-year floodplain of the Suwannee River. A number of preprocessor capabilities are utilized during this demonstration problem. Numerous figures and tables are included to aid in the understanding of the objectives and results of the example problem.

The appendices provide a description of HEC-2 input files and also the water surface elevations that are used by the SRWMD to define the 100-year flood elevation on the Suwannee River.

Appendix I contains a listing of all Suwannee River cross sections contained in the data-files included with this manual. Several unsuccessful attempts were made to run the input file covering river miles 60.38 to 206.35. This file was developed several years ago for use on a mainframe version of HEC-2. Compatibility problems appear to exist between the older main frame version and the newer PC version of HEC-2. An engineer may find it easier, and, less expensive, to correct the input file compatibility problems than to carry out a detailed survey of a particular river reach.

Advertisements for other HEC-2 preprocessor packages appear in engineering periodicals. Rampone Engineering Inc., P.O. Box 287, Beech Grove, IN 46107 and Dodson & Associates, 7015 W. Tidell #107, Houston, TX 77092 frequently advertise HEC-2 support software. Commercially available software can be used in conjunction with PRE-HEC if desired.

This manual is not designed to provide guidance on the use of the HEC-2 program itself. HEC-2 is a complex model that requires the user to select input parameters and other data in order to construct a reasonable mathematical model of a river reach. As with any model, verification of HEC-2 output should always be carried out before accepting the results.

CHAPTER 2
OVERVIEW OF HEC-2 AND PRE-HEC

HEC-2 Background

The HEC-2 program was originally developed by Bill S. Eichert of the Hydrologic Engineering Center (HEC) in Davis, California. The original versions, developed in the 1970's, were designed to run on main frame computers (HEC 1982). Modification of HEC-2 in 1984 provided compatibility with MS-DOS based personal computers. A supplemental input file format checking program, EDIT2, was released at this time also. Additional modifications in 1986 brought the programs up to FORTRAN 77 standards. In January 1987, the HEC released training document 26 entitled "Computing Water Surface Profiles with HEC-2 on a Personal Computer" (HEC 1987). Included with this release were programs that allow checking of input files for format errors, printing of summary output tables, and plotting of both cross sections and water surface profiles.

HEC-2 calculates the water surface profile in a channel for steady, gradually varied flow that is in either a subcritical or supercritical flow regime. The computational procedure involves solution of a one-dimensional energy loss equation between cross sections. Energy loss due to friction is calculated using Manning's equation. The effects of flow obstructions such as bridges, weirs etc. on the water surface elevation are accounted for also. Water surface elevations are calculated using an iterative computational procedure known as the standard step method. Under subcritical flow regimes, computation proceeds upstream from a downstream cross section (where the water surface elevation is given or has been calculated previously) to an upstream cross section where the water surface elevation is being calculated. Under supercritical flow regimes, the computation proceeds in a downstream direction. Two equations are involved in this iterative solution technique. An iteration is continued until the calculated water surface elevation changes by less than 0.01 feet. A complete discussion of HEC-2 computational procedures is included in the HEC publication "HEC-2 Water Surface Profiles Users Manual" (1982).

Water surface profiles are calculated for a variety of engineering design and management purposes. One of the more common applications of HEC-2 has been in flood insurance studies. The results of these studies have significant importance in the determination of a region's suitability for development (HEC 1986). The SRWMD requires that an applicant's engineer determine the 100-year flood elevation for projects located near flood prone areas (SRWMD 1986). Acceptable sources for this information include detailed flood studies, historical data, and calculations using an accepted methodology. Appendix II provides the water surface elevation for the 100-year flood on the Suwannee River. As is discussed later, the 100-year flood elevations in Appendix II have been generated by taking into account the effects of an oceanic storm surge. HEC-2 is not suitable for prediction of storm surge effects.

An additional requirement for development in the 100-year floodway involves documentation of flow obstruction effects caused by the proposed structure(s). One requirement for acceptance of a permit is that the project will not appreciably increase the upstream elevation of the 100-year flood. It is assumed that the most efficient means to accomplish this task is by use of HEC-2. It would be extremely expensive for the applicant to survey long sections of river reach in order to generate the topographical data required by HEC-2. A more efficient method would involve modification of existing HEC-2 files by addition of relevant topographical data from regions immediately adjacent to the proposed construction site. Additional data required when changing an input file include reach length parameters, Manning's roughness coefficients, etc. This manual and the preprocessor PRE-HEC are designed to allow manipulation of existing HEC-2 input files in an efficient manner. Appendix I includes a listing of all cross sections contained in the HEC-2 input files that model the Suwannee River from its mouth to a point located 206.35 miles upstream. Figure 1 is a map of the Suwannee River Water Management District. The Suwannee River and its tributary, the Withlacoochee River, are included in Figure 1.

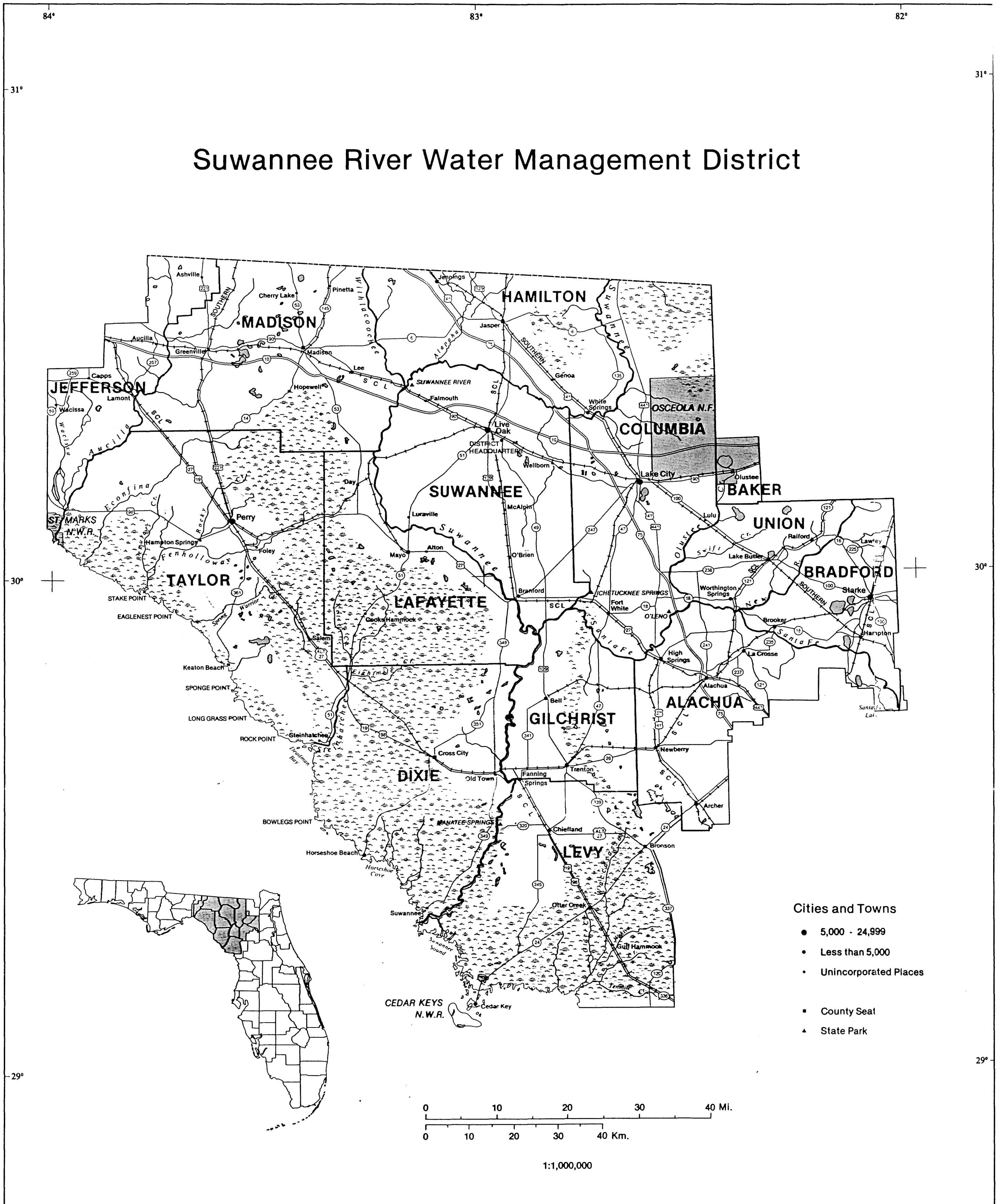


Figure 1. Suwannee River Water Management District

Format of HEC-2 Input Files

All HEC-2 input files include data regarding the discharge, starting elevation, flow regime, starting water surface elevation, loss coefficients, reach lengths, and cross section geometry. Data are arranged in rows which are called cards. The first column of each card (row) contains either one or two letters which define the card type. Twenty-seven different card types may be used in an input file. The FORTRAN format for all cards is A2, F6.0, 9F8.0. As mentioned previously, the HEC-2 Water Surface Profiles Users Manual (1982) provides a complete description of all required input, theoretical background, and other very important information. This manual will most likely be required when using HEC-2.

Table 1 shows a typical cross sectional data set from the Suwannee River. Examination of Table 1 reveals that most of the data are contained in the GR cards. These cards are used to describe the geometry (in units of feet) for each cross section. The cross section geometry data are organized in pairs of numbers which define the distance from the left part of the river bank (assuming that one were looking downstream) and the elevation of the floodplain at each site. The data pairs are read from left to right and top to bottom.

The third line in Table 1 contains the X1 card. PRE-HEC makes extensive use of the X1 card contents when cross sections are being edited, copied or plotted. The number 5.83, which appears immediately to the right of "X1", is the cross section identification number (SECNO). The cross section displayed in Table 1 is located 5.83 miles upstream from the river mouth. The second field of the X1 card (92 in this case) defines the number of GR pairs contained in the current cross section. Other parameters in the X1 card define the river channel location, distance to nearest downstream cross section, an elevation adjustment constant, and plotting options.

Table 1. Cross Section Data for River Mile 5.83 of Suwannee River.

NC	0.08	0.1	0.03	0.1	0.3					
ET		0	8.11					53257	71534	
X1	5.83	92	60957	61734	4700	5700	14280	0	0	0
GR	15	0	15	5200	10	10400	10	20200	15	20300
GR	15	20700	30	21400	10	21700	5	25500	5	35100
GR	2.8	36200	1.8	36448	1.6	37534	4.4	38040	3.2	39126
GR	1.2	39620	1.6	40258	0.6	40486	3.8	40986	2.7	41454
GR	0.6	41470	0.6	41744	2.2	41754	2.9	42194	2.8	42604
GR	1.6	42880	2.8	43188	2.6	44586	2.7	45440	0.6	45446
GR	0.6	45976	2.3	45984	2.2	47116	1.6	48270	2.2	49970
GR	0.6	49976	0.6	50188	2.5	50198	3.8	51068	3.6	51644
GR	2.2	52476	4	53420	3.2	54200	3.2	54682	3.8	55142
GR	2.20	57736	1.6	58640	2.8	59282	2.6	60340	1.5	60806
GR	2.2	60862	1.6	60957	0	60976	-7.4	60995	-9.2	61012
GR	-9.4	61038	-15.4	61062	-17.4	61079	-18.9	61106	-20.7	61142
GR	-23.9	61177	-31.4	61232	-33.4	61238	-28.4	61282	-25.9	61321
GR	-20.4	61365	-18.4	61402	-15.9	61446	-15.4	61494	-12.4	61530
GR	-10.4	61572	-8.4	61612	-6.4	61627	-3.4	61651	0.3	61670
GR	0.8	61689	1.6	61707	2.4	61734	3.2	61922	1.6	62284
GR	2.6	63032	2.9	65736	0.9	66014	1.8	67230	0.3	67287
GR	2.2	67346	1.6	68252	2.2	68548	2.8	71200	4.1	71362
GR	1.6	71752	5.6	71794						

PRE-HEC Data-File Limitations

The menu driven format of PRE-HEC has necessitated some limitations regarding the suitability of HEC-2 data-files for manipulation with the preprocessor. Generally, PRE-HEC will be used on a subset of an existing HEC-2 input file that is supplied by SRWMD. The user must ensure that the subset used in the preprocessor does not contain bridge sections. Bridge sections are designated by BT cards. Restrictions exist for the X1 cards also. The variable SECNO, which is the cross section identification number, is located in the first field of the X1 card. SECNO variables must be arranged in ascending order within the data-file. In addition, the second field of the X1 card must not equal zero. Entry of a zero in the second field indicates that the previous cross section is to be repeated and that no GR cards need to be entered for the current cross section. Duplication of cross sections in this manner makes the file unsuitable for usage in PRE-HEC. PRE-HEC requires that GR cards be present for each cross section so that individual cross sections can be delineated. Delineation of individual cross sections (transects) allows the program to automatically determine the location for insertion of new or modified cross sections. The maximum file size that PRE-HEC can utilize is limited by memory requirements and by spreadsheet size. In general, the program should be able to handle a data-file containing at least 30 transects. File size limitations are inconsequential since a data-file much less than 30 cross sections should be sufficiently large to perform the desired analysis for a particular river reach.

The user should have no difficulty in determining which sections have BT cards or X1 cards containing cross section duplication options by visually examining the files. Wordstar (a popular word processor) can be used to examine and edit ASCII files. An ASCII file can be opened using the nondocument option. COED, an editor program specifically designed for HEC-2 files, can also be used. COED has the additional advantage of containing help files which provide information on input file variables.

The HEC-2 input files described in Appendix 1 have been supplied by the SRWMD. These files were originally developed for use on an older mainframe version of HEC-2. There appears to be some compatibility problems regarding the usage of these files in the PC version of HEC-2. It is beyond the scope of the current project to edit these rather large files. However, the file SUWLOW.PRN was edited to allow it to be run with the latest version of HEC-2 for the PC. This file models the Suwannee River from river mile 3.15 to river mile 60.36. Removal of a few of the GR cards in cross section 15.40 was required in order to make the file run in HEC-2 without errors.

Lotus 1-2-3 Applications

The entire PRE-HEC preprocessor has been written using the Lotus 1-2-3 macro programming language (Lotus 1986). The spreadsheet provides an excellent programming environment. The macro programming language can utilize numerous internal functions such as graphics capabilities, data sorting, data reformatting, line parsing, and ability to build customized menus. The ease with which Lotus 1-2-3 can be learned may be largely responsible for its growing popularity in the field of environmental engineering and management. Unlike many other software and program languages, a person can learn to perform useful, nontrivial calculations in only a few hours. It is reasonable to expect that the popularity of spreadsheets will grow as more engineers are made aware of their capabilities.

The literature contains numerous references to the use of Lotus 1-2-3 in a variety of water resources and environmental engineering applications. A Lotus preprocessor for the FORTRAN program SWMM was constructed by Miles et al. (1986). Spreadsheet application to a variety of water resources problems is demonstrated by Heaney and Hancock (1987). Knowles, Heaney, and Shafer (1989) used spreadsheets to inventory and manage a database of small quantity hazardous waste generators. This program utilized expert system technology to more effectively manage a database. A heuristic programming approach using Lotus macros is applied to the optimization of drainage system design by Miles and Heaney (1988). Orvis (1987) has published a text entitled " 1-2-3 for Scientists and Engineers". It is clear that spreadsheets have the flexibility to adequately handle a wide array of engineering applications.

Program Functions

The program functions of PRE-HEC are divided into eleven different options. An option is selected when the user types a single number corresponding to the particular option number. Some of the options have several distinct functions. A very brief overview of the PRE-HEC capabilities will now be provided. Subsequent portions of this manual will provide additional information, diagrams describing in detail the working of each individual function, and an example problem which demonstrates how and when the options are used.

PRE-HEC provides the following twelve functions:

1. Plotting capabilities for each cross section.
2. Visual inspection of input data-file during all stages of development.
3. Manual addition of complete cross sections and related cards.
4. Copying of one cross section to another location in the reach.
5. Editing of a cross section.
6. Deletion of an entire cross section.
7. Automatic printing of the input data-file at any stage of development.
8. Extraction of an entire parsed input data-file into an independent Lotus 1-2-3 spreadsheet file.
9. Saving of PRE-HEC and the data contained within for subsequent use.
10. Exporting of the input data-file from PRE-HEC to an ASCII file which is directly readable by HEC-2 and related programs.
11. Ability to import an ASCII file into PRE-HEC and subsequently export an ASCII file an unlimited number of times.
12. Ability to extract up to six cross sectional profiles (as represented by GR cards) into a Lotus 1-2-3 file in a format that is directly usable by the graphics capabilities of the spreadsheet.

Getting Started

Three double sided, double density diskettes have been included with this manual. Appendix I includes a description of the contents of each diskette. Disk A contains seven files, including PRE-HEC.WK1. PRE-HEC.WK1 is a Lotus 1-2-3 spreadsheet that constitutes the main preprocessor program. The other files on diskette A serve as output and data storage files, and also provide some preprocessor program functions. Diskette B contains HEC-2 input data-files that model the Suwannee River over various reaches. Diskette C contains the remainder of a HEC-2 input file that is too large to fit on Diskette B.

If a hard drive is available, then all seven files from Diskette A should be copied to a single directory. The input files from diskettes A and B can also be copied onto the same directory; however only one input file will be used during each session with PRE-HEC. Access to the Lotus 1-2-3 software package (version 2.01) is also required to use PRE-HEC.

Although an understanding of Lotus 1-2-3 is unnecessary to use the preprocessor program, the user should understand the basic data manipulation features of Lotus 1-2-3. In particular, option 5, which allows unrestricted editing of portions of a data-file, requires some understanding of Lotus 1-2-3. A number of good reference texts on Lotus 1-2-3 are readily available, e.g., Cobb (1986), Harvey (1987),and Orvis (1987). An understanding of the more complex spreadsheet functions, such as macro programming, is not required to make full use of the preprocessor program.

To run PRE-HEC the user must do the following:

(1) Call up Lotus 1-2-3.

(2) Set up the file directory by typing "/FD" and then the directory name.

(3) The file directory must contain the following files:

(a) PRE-HEC.WK1
(b) AUTOSTRI.WK1
(c) TEMPHEC2.WK1
(d) HEC2RUN.PRN
(e) HEC123.WK1
(f) GRDATA.WK1
(g) EXPORT.WK1

Only the first two files in this list, PRE-HEC.WK1 and AUTOSTRI.WK1, contain Lotus spreadsheets. All other files are empty "scratch" files that are used to receive output from the preprocessor program.
Also, it may be convenient to include in this directory the HEC-2 input data-file that will be used.

(4) Retrieve the file named PRE-HEC in Lotus 1-2-3.

After the file is retrieved, a message will appear. This message provides instructions on how to start the Lotus 1-2-3 program. To start the program, simultaneously press the "ALT" and letter "A" keys. When the macro is started, the main menu will appear. Generally, whenever user input is required, a beep will sound. A beep is not necessarily indicative of the occurrence of an error as is true when using Lotus 1-2-3 outside of the macro mode of operation.

Most of the program is menu driven and it is not likely that the user could accidentally stop the program. As mentioned above, the only option which is not entirely menu driven is option 5. The menu driven format provided by the remainder of the preprocessor program makes the program extremely user friendly and makes understanding of Lotus 1-2-3 unnecessary.

CHAPTER 3
MAIN MENU

The main menu for PRE-HEC shown below has eleven different options. The sequence of option selection is unrestricted other than the requirement that option 1 must be the initial selection. Option 1 allows the selection of an ASCII HEC-2 input file for input into PRE-HEC.

Selection of a particular option is made by simply typing the number adjacent to it in the main menu and then pressing "RETURN".

```
                         HEC-2 INPUT FILE PREPROCESSOR

Option#                            MAIN MENU

  1 Select HEC-2 Input Data-File.
  2 View HEC-2 Input Data-File.
  3 Print HEC-2 Input Data-File.
  4 Copy a Particular Cross Section.
  5 Edit or Delete a Single Cross Section.
  6 Input Additional Cross Section Data Between Existing Sections.
  7 View or Extract Selected Cross Sectional Profiles.
  8 Extract HEC-2 Format File Named HEC2RUN.PRN & End This Session.
  9 Extract Parsed Lotus Data-File Named HEC123.WK1.
 10 Save PRE-HEC Program and Data as TEMPHEC2.WK1 for Later Use.
 11 Quit PRE-HEC Program and Return to DOS.


                                   ENTER
                                ***********
                       --------> *         * <--------
                                ***********
                                 OPTION #
```

Description of Main Menu Options

Directions for the use of each option will now be provided. Included with each option description is a flow chart displaying the various menus and functions contained within the eleven main options. In the diagrams, the presence of a menu is indicated by the branching of arrows. The reader may find it helpful to refer to the flow charts while reading the description of each option number and while using the program itself.

Option 1: Select HEC-2 Input Data-File

Option 1 has the simple function of allowing the user to define a HEC-2 input data-file, in ASCII format, that is to be brought into the Lotus 1-2-3 spreadsheet. After the desired file is selected, it is automatically parsed. Parsing of data in Lotus 1-2-3 changes the format of an imported ASCII file. When the file is initially brought into the spreadsheet, the entire data-file is placed in one column. In order to access the data in an efficient manner, each field of the data-file must be placed in a single column of the spreadsheet. Eventually, when the user has finished manipulation of the input data-file, Option 8 is used to automatically export the parsed file back into an ASCII format file. The user does not need to be familiar with the Lotus 1-2-3 parsing procedure since this process is carried out automatically by the PRE-HEC program.

Following selection of option 1, a message will appear asking the user to wait. Next, a menu is displayed asking the user to press "RETURN" and then select a file. File selection is accomplished by positioning the cursor over the desired file name and pressing "RETURN". A wait message reappears. No other input is required for option 1. As the user waits, the file is imported and parsed. Upon completion, a beep will sound and the user is returned to the main menu. This type of simple, wait-message/user input, programming style is used through out the preprocessor program. It is very important that the user understand that, each time option 1 is used, the previously imported file is erased inside PRE-HEC and the newly selected file is imported. Options 8 and 9, which are described later, provide the means to save an input file.

The flowchart for option 1 is shown in Figure 2.

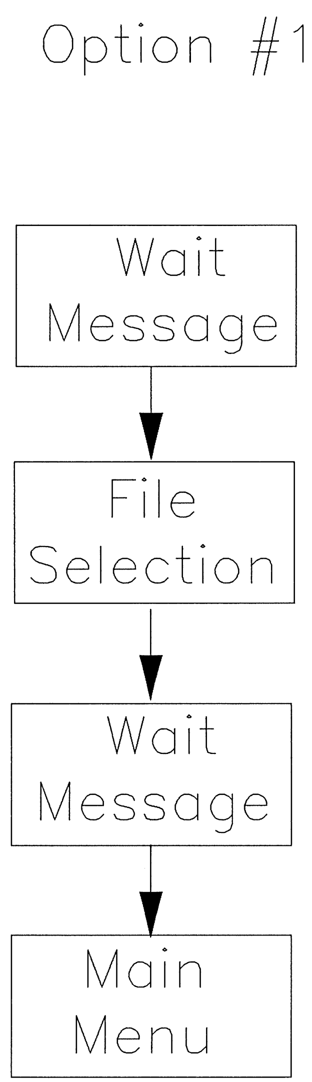


Figure 2. Flowchart for Option 1.

Option 2: View HEC-2 Input Data-File

The purpose of option 2 is to allow inspection of the HEC-2 input data-file. No editing capabilities are provided by this option. This and other options can be used repeatedly during file manipulation. Selection of option 2 will immediately cause a message to appear on the screen. This message serves as a reminder that this option is for viewing the data file only. The user is instructed to press "RETURN" when finished reading the message. The top of the input file which contains the comment cards then appears. All portions of the file can be inspected by using the cursor control keys. Incidentally, the user can view other areas of the spreadsheet, but this will serve no useful purpose other than to possibly satisfy curiosity. When inspection has been completed the user must again press "RETURN". A beep will sound and the user is returned to the main menu. This option executes extremely rapidly and will probably be most useful subsequent to file manipulation procedures. Reiterating, this and other options can be utilized repeatedly during file manipulation.

The flowchart for option 2 is shown in Figure 3.

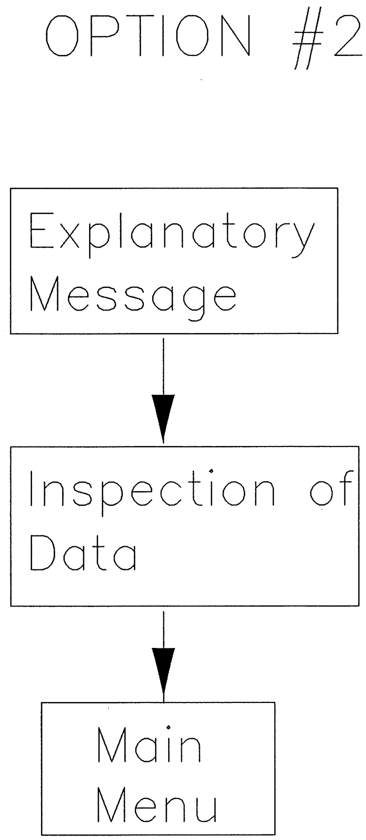


Figure 3. Flowchart for Option 2.

Option 3: Print HEC-2 Input Data-File

This option prints the entire HEC-2 input file to the printer. Prior to selection of this option the user should ensure that the printer is ready. Immediately after choosing option 3 a message will appear. This important message is shown in the box below.

> Please wait while the file is printing.
>
> If a printer error has occurred (e.g. the printer was not turned on) a message in the lower left of the screen will appear showing "printer error".
>
> IF AND ONLY IF a printer error has occurred, then the macro must be restarted by pressing "ALT" and "A" simultaneously.
>
> If there is no printer error, you will be returned to the main menu when the file is nearly finished printing.
>
> Press "RETURN" when finished reading this message.

This message is assumed to be self-explanatory. The flowchart for option 3 is shown in Figure 4.

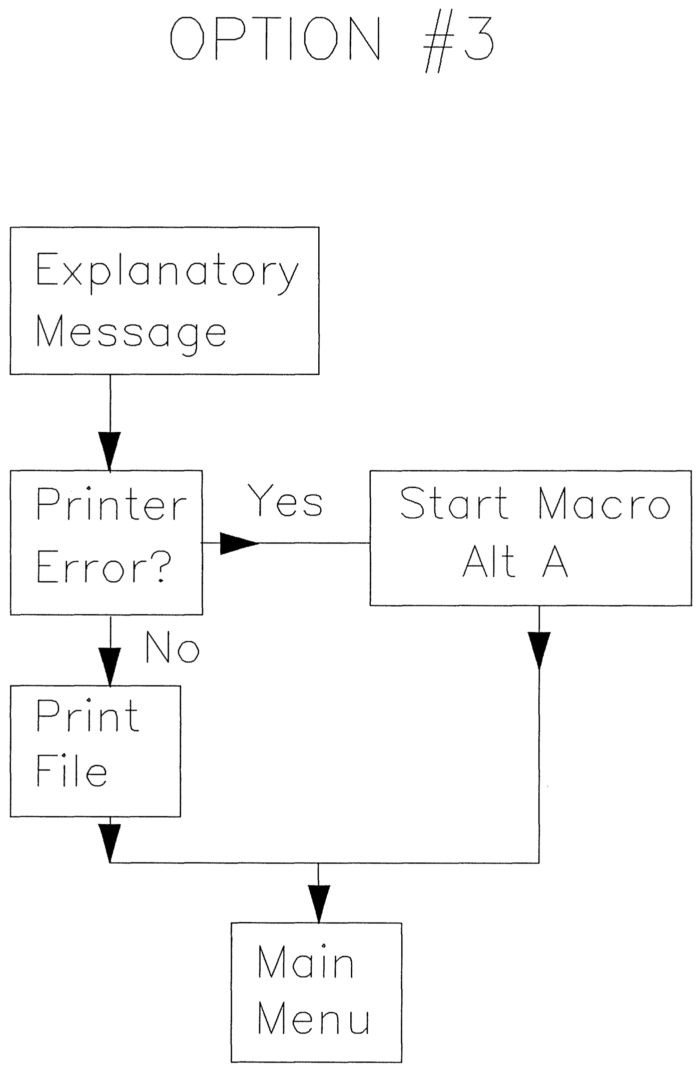


Figure 4. Flowchart for Option 3.

Option 4: Copy a Particular Cross Section

Option 4 allows the user to select a particular cross section and then copy it to another region within the input data-file. A user defined cross section is used as a template for duplication. The duplicate cross section is nearly identical to the original, except that five variables in the X1 card are changed via user input. The first field of the X1 card is the cross section identification number. This variable has the name SECNO. The SECNO is used to define the location for insertion of the duplicate cross section within the input file. Option 4, as well as some of the other options, requires that the X1 cards be arranged in ascending order within the original data-file.

Upon selection of option 4, a wait message is displayed. Then, an explanatory message directs the user to choose an X1 card cross section identification number (SECNO) that identifies the cross section that is to be copied. The program will not work properly if the user attempts to choose the first cross section in the data-file as a template for copying. The first cross section is the one furthest downstream and should be defined by having the lowest numerical value for the first field of the X1 card. A selection is made by positioning the cursor over the desired SECNO and pressing "RETURN".

Immediately following user input, another input is requested. The user then types the X1 cross section identification number that the previously selected cross section should be copied to. The SECNO variable is entered as a positive number having units of miles. This operation will not affect the original cross section from which the copy was made. The program uses the X1 cards to arrange the cross section within the data-file. This fact should be considered when choosing a SECNO value for the duplicate cross section.

The program will not function as designed if an attempt is made to locate the duplicate cross section downstream from the first cross section in the original data file. This means that the duplicate must have a SECNO entry greater than the smallest one in the original file. In PRE-HEC, this same information is provided by a message when the SECNO input is requested.

At this point in the duplication process, the only result has been the generation of a duplicate cross section that has a different value for the SECNO variable. In order for the input file to perform properly, other changes must be made to the X1 field of the duplicate cross section. The following variables must be changed: XLOBL, XLOBR, XLCH, and PSXECE. A brief description of these variables will now be provided. The user may desire to refer to the HEC-2 Users Manual for more complete information.

XLOBL, the fifth field of the X1 card, defines the distance, as measured along the left bank, from the current cross section to the cross section which is located immediately downstream. XLOBR, the sixth field in the X1 card, provides the reach length, as measured along the right bank, from the current cross section to the next downstream cross section. XLCH, the seventh field of the X1 card, represents the reach length, as measured along the channel, from the current cross section to the next downstream cross section. These variables must be entered as positive distances as measured in the units of feet.

The variable PSXECE is a constant located in the ninth field of the X1 card. This variable causes HEC-2 to read the GR cards as if a constant equal to the PSXECE value were added to each of the ground elevation points in a particular cross section. Use of this variable provides a means to avoid adjusting each of the ground elevation points of a single cross section on an individual basis. Generally, if the duplicate cross section has been copied from an upstream cross section, the PSXECE input for the duplicate should have a negative value. For example, if the cross section is copied to a downstream location, the duplicate cross section's river channel and river banks will most likely be at a lower elevation than that of the template cross section. For the situation to be otherwise would indicate an adverse river slope. Similarly, if a copy is made from a downstream cross section the PSXECE value would normally be positive. A value of zero for PSXECE can be a valid input if the field conditions indicate that no change in ground elevation occurs between the template and the duplicate cross sections. A value for PSXECE might be calculated from a linear interpolation of the original water surface slope that existed between two adjacent cross section before a duplicate cross section was inserted between them. Units of feet are used for the variable PSXECE.

PRE-HEC supplies a brief explanatory message before allowing user input of these variables. The four variables are input in the following order: XLOBL, XLOBR, XLCH, and PSXECE. Following variable entry, a wait message appears and the user is then returned to the main menu. Option 2 (the view function) should be used next in order to inspect the data-file to ensure that the desired results have been achieved.

Option 4 may be most useful when a proposed construction site is reasonably close to an existing cross section. If this was the case, the construction might only modify a portion of the existing cross section (e.g. the right bank). The engineer can use option 4 to copy the entire cross section and then use option 5 (the edit function) to modify only the affected area (e.g. the right bank) of the duplicate cross section. In this scenario, the need to input an entirely new cross section is eliminated.

When a cross section is copied and inserted between two existing cross sections, the reach length variables (XLOBL, XLOBR, and XLCH) of the original upstream cross section, must also be changed. Option 5, which is described below, can be used to change these variables. If the user is unfamiliar with Lotus 1-2-3, other software programs such as COED or Wordstar can be used rather than option 5.

The flowchart for option 4 is shown in Figure 5.

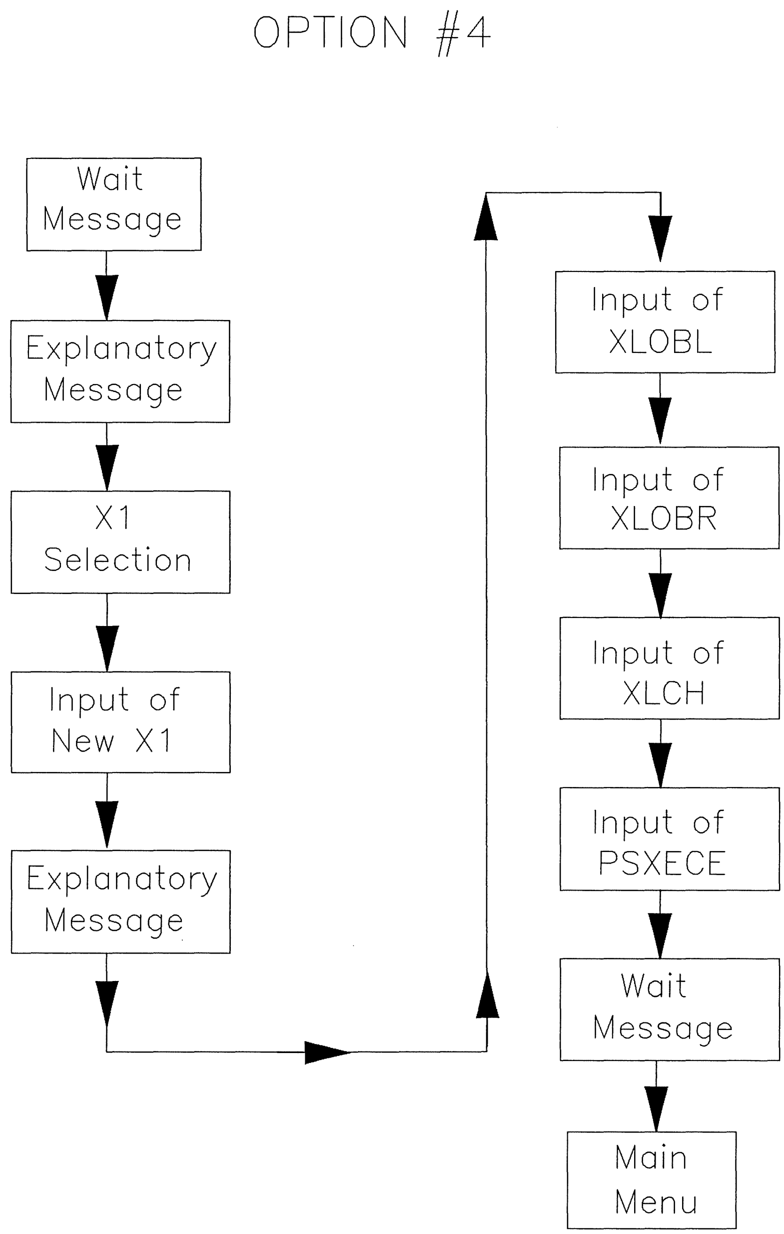


Figure 5. Flowchart for Option 4.

Option 5: Edit or Delete a Single Cross Section

Option 5 has two distinct functions. The user can select, from a constantly updated list of X1 cards, a single cross section that can be either deleted or edited. The edit function automatically inserts the selected cross section into the proper location within the data-file when the user indicates that editing is complete. These two functions have been grouped together under option 5 because the programming requirements are similar.

Upon selection of option 5, a wait message, and later an explanatory message, are displayed. The user is informed that the following screen will list all X1 cross section identification numbers (SECNO's) present in the file. Selection of a cross section is made by positioning the cursor over the desired SECNO. The program will not perform properly if the first X1 card is chosen. Notification of this fact is provided by the program before user selection of a cross section can take place. A wait message is displayed after a cross section has been selected.

Up to this point in the option, no distinction has been made as to whether deletion or editing of the cross section is desired. The next screen to appear is a menu that provides the choice of either deletion or editing of the previously selected cross section. When the deletion option is chosen, the cross section is removed from the file and the user is returned to the main menu.

When the edit option in the above mentioned menu is chosen, an editing screen appears. At this point, macro execution is stopped. This means that the user has essentially unrestricted use of the Lotus 1-2-3 spreadsheet. As was mentioned in the introductory sections, this unrestricted mode of operation must be used with extreme caution. This is the only option in the PRE-HEC macros where the user has the ability to inadvertently cause damage to the macro itself. The cursor should not be moved outside of the editing screen. The only restriction on the allowed changes to the cross section is that the X1 card cross section identification number (SECNO) must not be changed. It may be unwise for a very inexperienced Lotus user to use this portion of option 5.

When editing is complete, the user simultaneously presses both the "ALT" and "T" keys. This resumes the macro mode of operation and allows the edited cross section to be automatically inserted back into the data-file. The user is then returned to the main menu.

The flowchart for option 5 is shown in Figure 6.

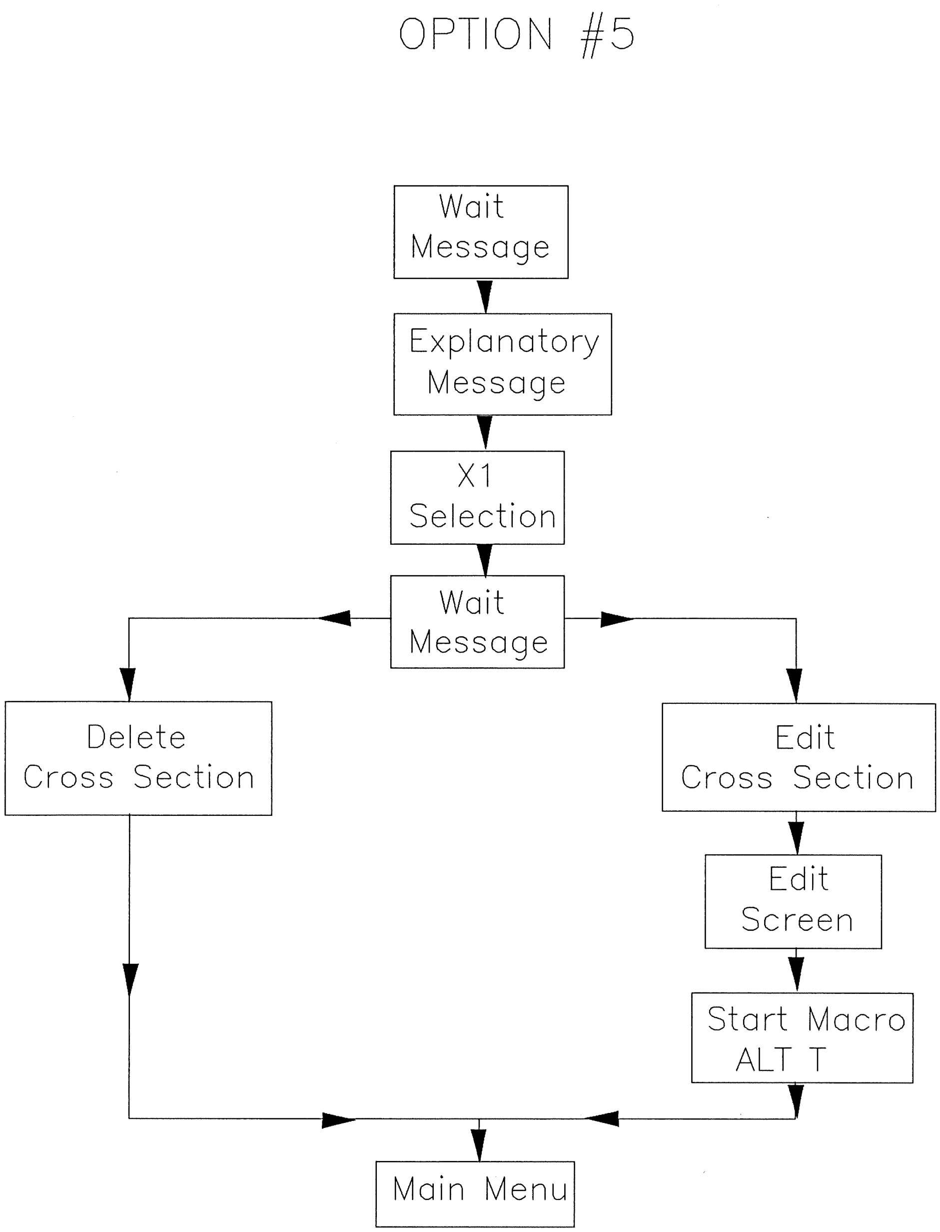


Figure 6. Flowchart for Option 5.

Option 6: Input Additional Cross Section Between Existing Sections

Option 6 allows a new cross section to be inserted into the HEC-2 input file. The X1 cross section identification number is again used to define the insertion location for the cross section in the data-file as was described in the discussion of option 4.

Upon selection of option 6, an explanatory message appears immediately. The message informs the user of the option's limitation. The user presses "RETURN" when finished reading this message. The program limitation involves the requirement that the new cross section identification number (SECNO), must be a numerical value between the largest and smallest already existing in the file. Additionally, the SECNO must not be exactly identical to an existing one present in the current data-file.

A two item menu appears after the explanatory message. If unsure of which cross sections are already present in the file, the menu option "X1 LIST" should be chosen. Following a wait message, the X1 list appears. When inspection of this list is completed, a "RETURN" is pressed. The program now branches to the data entry screen. If the user had not desired to view the X1 list, the menu option "DATA ENTRY" would have been selected from the menu. Selection of "DATA ENTRY" causes the data entry screen to be displayed immediately and display of X1 cards is omitted.

The data entry section provides a short description of each input variable. The user is allowed to type in the desired cards. This section provides an input procedure which is much easier to understand than if it were required that the data be entered in the format directly readable by the HEC-2 program. For example, the entry of the GR cards is made in pairs and then the program reformats them into the proper order for HEC-2 input. The GR cards should be entered in ascending order with the lowest lateral coordinate being first. If an erroneous value is entered, correction is made by simply typing the corrected value over the incorrect entry. Completion of data input is indicated by positioning the cursor at the cell containing the word "QUIT" and pressing "RETURN". This cell is located at the top of the data entry screen. The cursor can be positioned at this cell at any time by pressing the "HOME" key.

The program will then check to ensure that the new SECNO is not identical to an existing one. If a "match" is found, the user is notified via an error message. The user is then returned to the original data entry screen to correct the situation. Assuming that no error has been made, or that it has been corrected, a wait message appears next. At this time, the data is reformatted and inserted in the data-file in the proper location. The user is then returned to the main menu.

Option 6 provides a means to insert new data in its proper location without yielding direct access to the original input file. Reduction of direct access to the original data is desirable in that it eliminates the possibility of unintentional alteration of the original data-file and reduces the complexity of the data entry operation.

Figure 7 displays the flowchart for option 6.

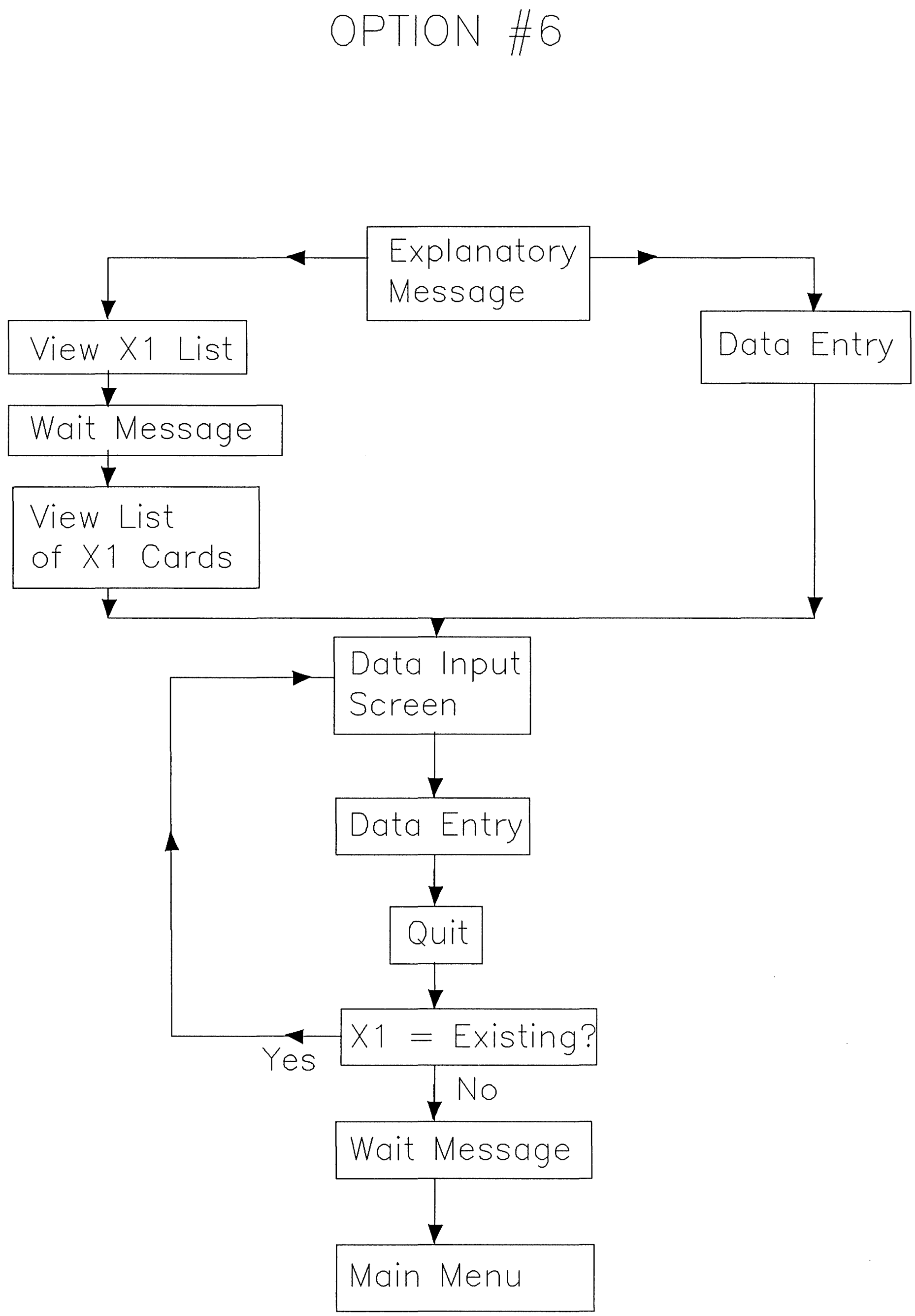


Figure 7. Flowchart for Option 6.

Option 7: View or Extract Cross Section Profiles

Option 7 provides two very powerful automated functions that allow the user to view any specific cross section transect in the data-file and to generate a Lotus 1-2-3 file containing up to six transects which are automatically extracted from the input file. The purpose of option 7 is to assist the user in visually confirming that the transects are correctly entered into the input file. The extraction option makes the HEC-2 transect data easily accessible to anyone and allows the Lotus 1-2-3 user to plot cross sections using a spreadsheet which is independent of PRE-HEC. A maximum of six transects can be extracted into a single Lotus 1-2-3 file.

Upon selection of option 7, a wait message appears and then a list of all transects contained in the data-file is provided. The transects are designated by a unique cross section identification number (SECNO) as is done in the previously described options. Cross section selection is made by moving the cursor to the cell containing the desired SECNO and pressing "RETURN". The user then presses "RETURN" to run a graphing procedure which reorganizes HEC-2 input data into a format that can be plotted with Lotus 1-2-3. A two item item menu provides the option of viewing the cross section or extracting the cross section profile to a Lotus 1-2-3 file.

When the viewing option is selected, a menu appears which gives the user the option of seeing the entire transect, the left bank area, the right bank area, or the main river channel. The designation for these areas is made in the original data input file for the HEC-2 model; it is not made by the preprocessor program. The left bank and right bank points are indicated on the plot each time a transect is viewed. Since the transects are often very wide (5 miles is common), vertical relief is greatly exaggerated. In many cases, the appearance of an entire cross section is too crowded to provide an accurate representation of what is being viewed. In this case, it is especially useful to be able to "zoom in" on a desired segment of the cross section. When finished viewing a particular cross section (or part of a cross section), "RETURN" is pressed. The user can view a cross section as often as desired and or can continue to choose others by following the self explanatory menus.

When the extraction option is selected, rather than the viewing option, the profile data for the currently selected cross section is reformatted in preparation for extraction to a separate Lotus 1-2-3 file. Reorganization of the data format is required because the HEC-2 FORTRAN code and the Lotus 1-2-3 graphing option read the data differently. The process of transect selection can be continued until a maximum of six transects are selected. The user is immediately notified if more than six transects are requested.

When the maximum allowable number of selections has been reached or when the user indicates that transect selection is complete, the program automatically extracts the data into a single Lotus 1-2-3 file named GRDATA.WK1. A table then appears listing all transects extracted to the file GRDATA.WK1. The user is also notified that before additional transects can be extracted, the PRE-HEC program must be exited and the file GRDATA.WK1 must be copied to a different file name. This will prevent overwriting of the file when the option is used again.

The PRE-HEC program reads the SECNO variable of the X1 cards from each transect and uses them for labeling the data set for each individual cross section in the file GRDATA.WK1. The profile data for each cross section is clearly delineated in the extracted file. The Lotus 1-2-3 file GRDATA.WK1 can then be used (outside of this program) to produce printed graphs of the transects or for other purposes.

Table 2 displays the data format in the extracted Lotus 1-2-3 file GRDATA.WK1. This figure contains a portion of the data of cross sections for river miles 19.92 and 21.49.

The flowchart for option 7 is shown in Figure 8.

Table 2. Sample Data Format of GRDATA.WK1 File

Cross section # 19.92

X1	19.92	72
GR	25	0
GR	20	1200
GR	15	2300
GR	15	6600
GR	10	10300
GR	10	13000
GR	15	13800
GR	15	14900
GR	8.7	18600
GR	8.6	18614
GR	7.8	18642
GR	7	18684
GR	7.4	18796
GR	6.8	18990
GR	7.7	19272
GR	7.3	19430
GR	8	19676
GR	8	20114
GR	8.4	20478
GR	8.4	20998
GR	7.8	21592
GR	7.4	22100
GR	6.8	22590
GR	6	22772
GR	1.8	22786
GR	-0.7	22802
GR	-6.8	22824
GR	-8	22844
GR	-8.2	22864
GR	-7.7	22902
GR	-10.2	22954
GR	-9.6	22999
GR	-9.2	23065
GR	-8.3	23141
GR	-8	23217
GR	-8.9	23298
GR	-9.2	23347
GR	-11.3	23400
GR	-13	23452
GR	-11.2	23477
GR	-6.9	23478
GR	1.8	23482
GR	3.4	23493
GR	6.2	23570
GR	6.4	23780
GR	6	24284
GR	6	24400
GR	6.2	24676
GR	5.8	24920

Cross section # 21.49

X1	21.49	79
GR	25	0
GR	20	400
GR	20	2200
GR	20	4600
GR	20	7800
GR	25	8800
GR	30	9200
GR	25	9400
GR	20	9500
GR	15	10100
GR	15	14600
GR	13.6	15000
GR	13.4	15068
GR	11.6	15144
GR	11.2	15234
GR	9.8	15350
GR	9.8	15508
GR	9.8	15706
GR	9.8	15898
GR	9.3	16064
GR	8.8	16222
GR	8.4	16414
GR	8.1	16570
GR	8.4	16644
GR	8.4	16780
GR	9.1	16940
GR	11.2	17156
GR	12.3	17308
GR	11.2	17412
GR	8.2	17550
GR	7.2	17748
GR	6.6	18016
GR	6	18251
GR	4.5	18255
GR	2.8	18257
GR	2.2	18261
GR	-2.5	18279
GR	-7.2	18288
GR	-8.2	18305
GR	-7.8	18343
GR	-8.3	18377
GR	-8.6	18405
GR	-7.7	18442
GR	-7.3	18495
GR	-8.6	18628
GR	-7.8	18694
GR	-7.8	18719
GR	-5.6	18850
GR	-5.1	18982

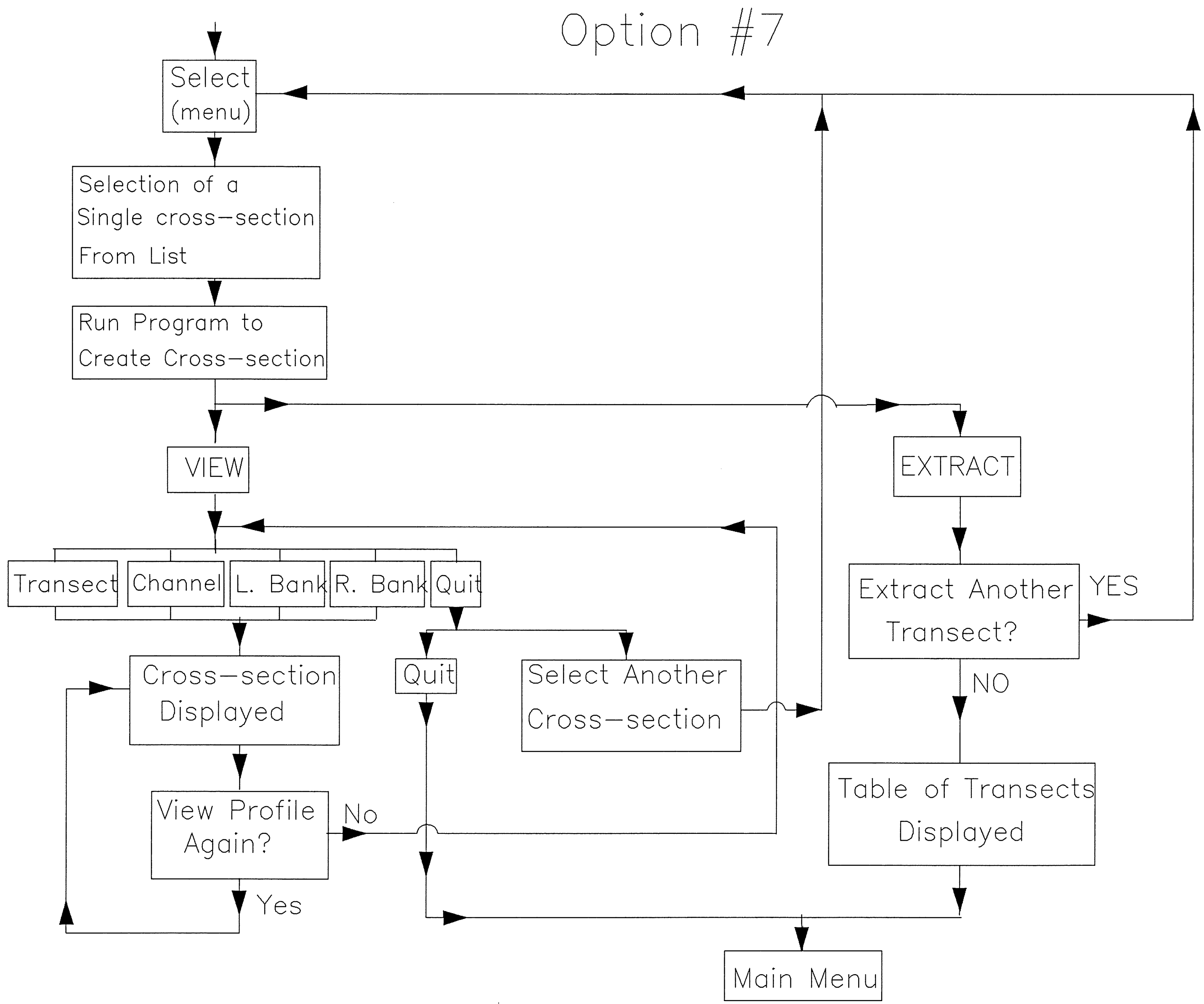


Figure 8. Flowchart for Option 7.

Option 8: Extract HEC-2 Format File and End This Session

This option provides the very important function of transforming the parsed input file contained in the Lotus 1-2-3 preprocessor into an ASCII HEC-2 readable input file. This option is different from all others in that it requires the termination of the current session with PRE-HEC.

Upon selection of option 8, an explanatory message appears. The message explains that the newly created file will be named HEC2RUN.PRN. The user is also reminded that the current session must first be terminated before the file can be produced. The user indicates that this message has been read by pressing "RETURN". Immediately, a two item menu appears. The user can decline to begin this operation by choosing the "RETURN" option. When the "RETURN" selection is made, no action is taken and the user is returned to the main menu.

When the second menu choice is selected ("PRINT FILE & END SESSION"), a message appears asking the user to start a macro as was done when the PRE-HEC program was started. The user is directed to simultaneously press the "ALT" and "J" keys. After the macro begins, a wait message is displayed. After the ASCII format file has been created, another message appears. This message serves as a reminder that the new file is named HEC2RUN.PRN. The fact that this file is over written whenever option 8 is used is also included. In order to prevent destruction of the file contents, the file HEC2RUN.PRN must be saved under another name. However, the file HEC2RUN.PRN should not be erased.

The newly created file HEC2RUN.PRN is now ready to be run in HEC-2 and related programs. If the input data-file does not work, or the output results are unsatisfactory, the file can be imported into the preprocessor again using option 1. This procedure of importing the file into PRE-HEC, subsequent manipulation, extraction, and then testing of the file in HEC-2 can be performed repeatedly until the desired results are attained. The various options included in PRE-HEC should provide enough flexibility to allow most of the more common file manipulation procedures to be performed. However, in certain circumstances, the user may need to edit parts of the input file in an independent editor program. PRE-HEC does not provide editing capabilities for comment cards, title cards, or the first cross section in the data-file.

The seemingly simple procedure of producing an ASCII file from the parsed data in the spreadsheet has proven to require a rather significant programming effort. Since the memory requirements and the macro are rather large, this function has been provided through the use of a separate spreadsheet named AUTOSTRI.WK1. Retrieval of this separate Lotus 1-2-3 file is what necessitated the prior termination of usage of the main preprocessor named PRE-HEC. This information has been included for the user's own knowledge. An understanding of the program logic or macro operation is not required in order to make effective use of the preprocessor.

The flowchart for option 8 appears in Figure 9.

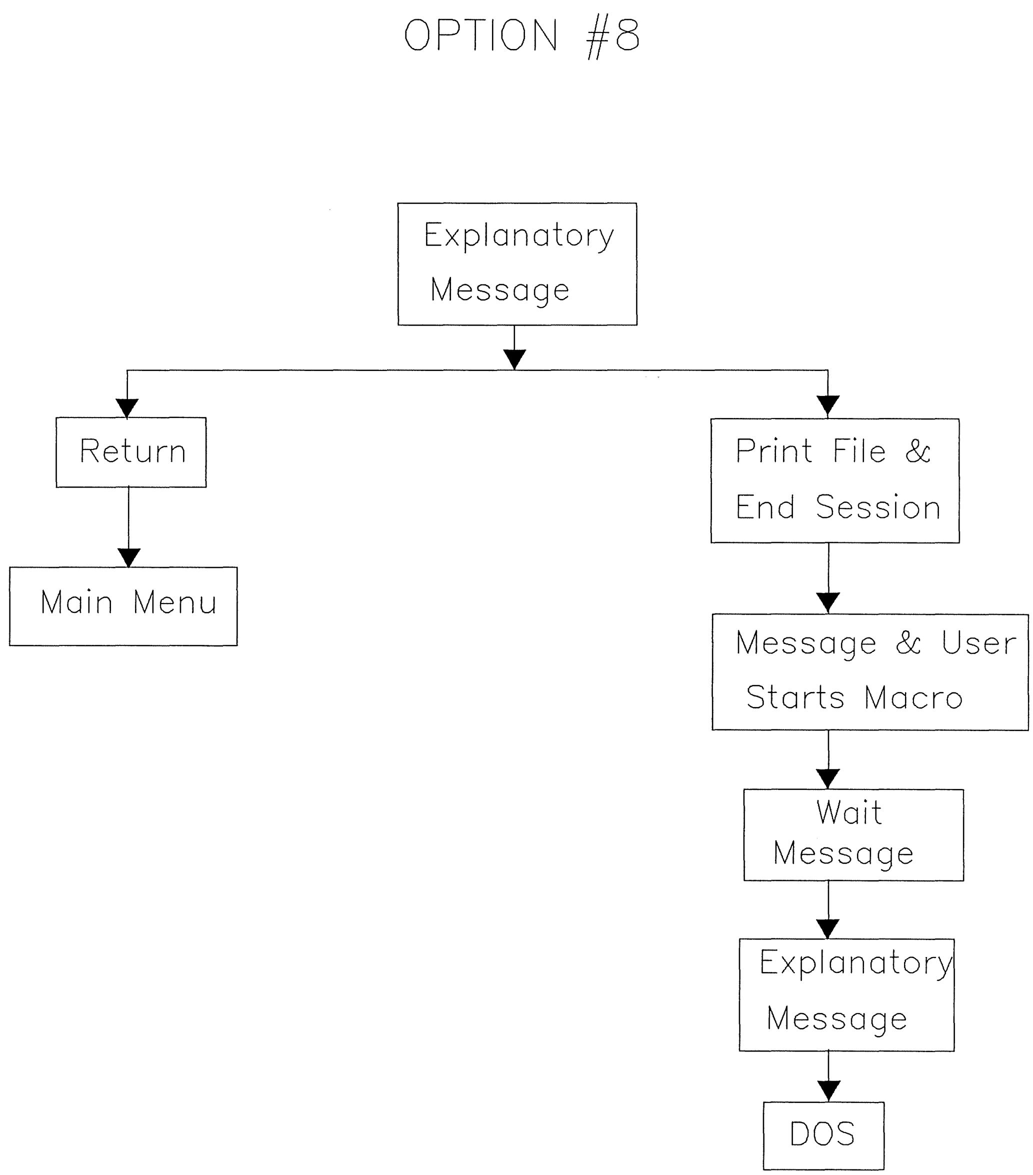


Figure 9. Flowchart for Option 8.

Option 9: Extract Parsed Lotus File Named HEC123.WK1

Option 9 is used to create a Lotus 1-2-3 worksheet file containing the entire parsed HEC-2 input data-file. The file is named HEC123.WK1. This option can be run at any time during file development. The contents of the file will represent the HEC-2 data-file contents at the time of execution. This file is over written every time the option is selected. The user must remember to copy the HEC123.WK1 Lotus file to another name after finishing a session with PRE-HEC. This will prevent destruction of the file when option 9 is used again during the next session with PRE-HEC.

Once extracted into a Lotus 1-2-3 file, the entire data-file can be accessed within an independent spreadsheet. This option is versatile because the file can be used in a completely unrestricted environment provided by an independent spreadsheet. However, the user may experience a good bit of difficulty transforming a portion of a Lotus 1-2-3 file into an ASCII file format that is usable in HEC-2 and related programs. This incompatibility arises from differences in the manner in which Lotus 1-2-3 displays numbers and the way HEC-2 reads them. HEC-2 requires that all numbers be right justified if decimals are omitted. However, Lotus 1-2-3 displays numbers with a space immediately after each number. This problem can not be easily rectified by changing column width in the spreadsheet because large numbers will appear as stars when the column is not sufficiently wide. Lotus 1-2-3 provides the capability to define the number of decimals appearing in a column. This capability is not useful in this case because of the large difference in size of numbers appearing in each column of a HEC-2 input file.

Figure 10 displays the flowchart for option 9.

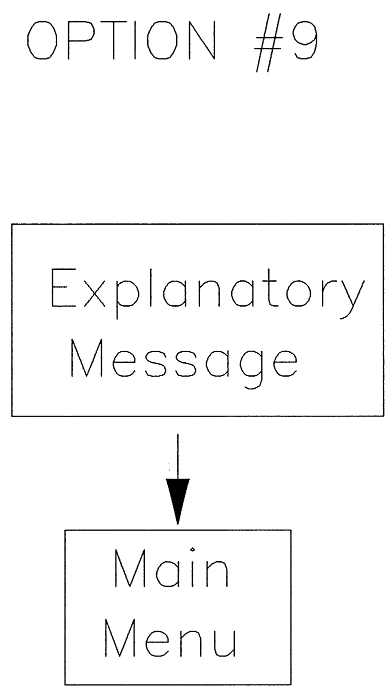


Figure 10. Flowchart for Option 9.

Option 10: Save PRE-HEC Program and Data as TEMPHEC2.WK1 for Later Use

Option 10 allows the PRE-HEC preprocessor program and the parsed HEC-2 input file, which is contained within, to be saved as a Lotus 1-2-3 file. Normally, when PRE-HEC is exited via option 8 or option 11, the current HEC-2 input file is not saved. Thus, each time PRE-HEC is used, a new file must be imported before file manipulation can be started. Option 10 allows the the current input file to be saved within the preprocessor program. This may be most applicable when the user desires to exit the program, but has not yet finished generating a suitable HEC-2 input file for exporting.

Immediately upon selection of this option a message appears. The message directs the user to wait while the file named TEMPHEC2.WK1 is created. The user is then returned to the main menu. The file TEMPHEC2.WK1 is over written each time option 10 is used. The user must exit PRE-HEC and copy the file to another name to prevent destruction when option 10 is used again. Thus, only a single TEMPHEC2.WK1 file can be generated during each session with the preprocessor.

Figure 11 shows the flowchart for option 10.

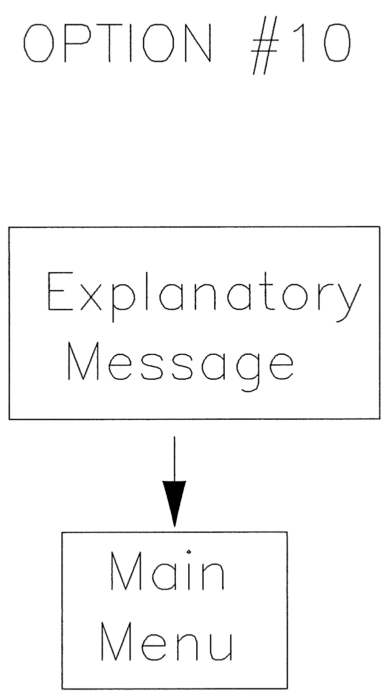


Figure 11. Flowchart for Option 10.

Option 11: Quit PRE-HEC Program and Return to DOS

Option 11 provides a means to exit the interface program without leaving the macro mode of operation. Changes made to the data-file during the execution of the program are saved only through the use of the option numbers described above. Thus, changes are saved only by extracting or printing to other files in options 7, 8, 9 or 10.

Upon selection of option 11, a message and a two item menu appear. A series of warning beeps also accompanies the message screen. Option 8 would normally be used to produce a HEC-2 readable file following a session with PRE-HEC. Selection of option 11 will terminate the current session with the preprocessor. These measures are designed to ensure that the user does not accidentally exit the program without saving any of the work accomplished during the session. When the "RETURN" option is selected from the menu, no further action is taken and the user is immediately returned to the main menu. When the "QUIT" option is selected from the menu, the current session with the program is terminated.

Figure 12 displays the flowchart of option 11.

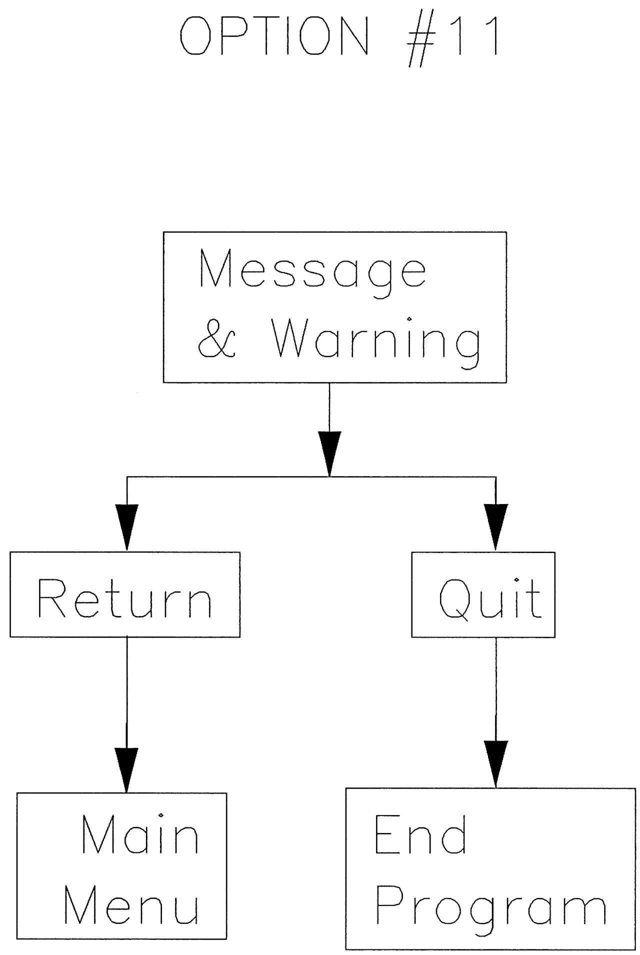


Figure 12. Flowchart for Option 11.

CHAPTER 4
EXAMPLE SESSION WITH PRE-HEC

Introduction to Example Session

This section provides an example of how a HEC-2 input data-file is manipulated using the PRE-HEC preprocessor program. A hypothetical example will be used to demonstrate the utility of the main menu options. Previous sections of this report contain detailed descriptions of each main menu option and include flowcharts depicting each function and various internal user menus. The main menu description section of this report may be referred to if the current example does not provide enough detail regarding the preprocessor. The example problem will include guidance on the use of option numbers 1, 2, 4, 5, 7, and 8. The other main menu options are not directly applicable to the example problem.

The goal of file manipulation is to produce a HEC-2 input file that represents the results of a proposed construction project located in the 100-year floodplain of the Suwannee River. One of the requirements for building in the 100-year floodplain is that the proposed construction must not increase the elevation of the 100-year flood. A comparison of projected pre- and post-construction water levels can be made using HEC-2. The example session will involve a completely hypothetical construction project. It is intended to be used as a guide for usage of the preprocessor and an existing data-file. It is not intended to provide detailed guidance regarding parameter or option selection for the input file. In order to gain meaningful results from a model such as HEC-2, the user must understand how the program works and what input is required. The simple fact that a particular HEC-2 input file runs in HEC-2 without producing errors does not necessarily indicate that the file correctly models a particular river reach.

Problem Statement

Assume that a proposal for construction of a section of a gravel road located in the floodplain has been made. This road has a length of 1.25 miles, a road surface width of 50 feet, and is oriented parallel to the river channel. The elevation of the downstream end of the road surface is 9.5 feet, while the elevation at the upstream end is 13.0 feet. The road is located in the left bank portion of the flood plain at a distance of 3000 feet from the left side of the river channel. The road extends from river mile 20.00 to river mile 21.25. River miles are measured from the river mouth and increase in value in the upstream direction. Cross section data in HEC-2 are oriented so that the viewer is looking downstream and the left side of the channel has the lowest station number. Figure 13 is a sketch of the road construction site. The location of the road is shown relative to the 100-year floodplain and the existing and duplicate cross sections.

Fill material will be trucked in to elevate the road surface above the original ground surface elevation. In order to simplify the example, assume that access to the road is available without additional modification of the floodplain. An additional simplification will include the assumption that the Manning's n value of the road and shoulder are not significantly different from the n value of the pre-construction left bank areas.

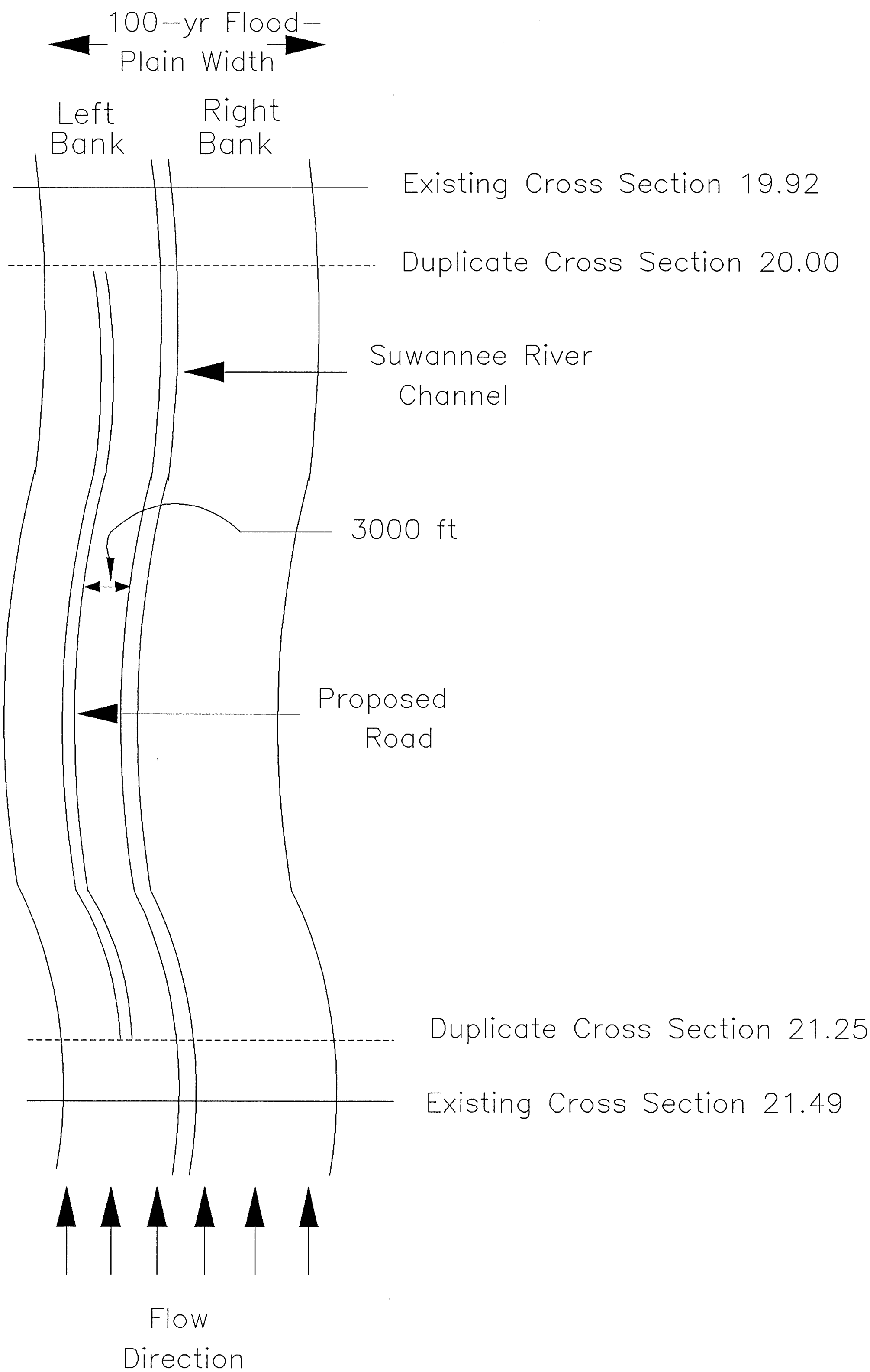


Figure 13. Sketch of Construction Site for Example Problem. (Not to Scale).

Reduction of Input File Size

After the user understands the limitations of PRE-HEC and has identified the construction site position relative to river miles, a suitable data-file can be selected. Appendix 1 of this report provides a listing of included HEC-2 input files and the river reaches contained within each file. For the current example, the file named SUWLOW.PRN, which includes the Suwannee River from river mile 3.15 to river mile 60.36, contains the desired cross sections.

The user must determine which cross sections from the original file need to be included in the file subset. For this example, assume that satisfactory results will be attained if the HEC-2 program is run using a data-file subset which includes twelve existing cross sections that model the river from mile 3.15 to 26.54. Wordstar can be used to retrieve the file and examine the contents. The river reach from mile 3.15 to 26.54 contains no BT cards and violates none of the previously mentioned restrictions. This reach of the river is a suitable file subset for input into the PRE-HEC preprocessor. The file can now be reduced in size so that it contains only the required cross sections. All cross sections upstream from river mile 26.54 are deleted. When using Wordstar, the F3 key will rapidly delete unneeded cards. The block and delete functions can also be used. The last two cards in the file are the EJ and the ER cards. These cards should not be deleted, nor should the three line space separating them be removed. During the editing procedure, the comment cards, which are located at the beginning of the file, may be changed to represent the edited file contents. However, since comment cards are optional, editing of them is not required. After the file has been reduced to the desired number of cross sections, it is ready for use in PRE-HEC. Assuming that the above mentioned changes have been made and that the example file has been saved under the name SUB.PRN, the preprocessor can now be used.

Editing of Data-File with PRE-HEC

The spreadsheet file named PRE-HEC.WK1 is retrieved in Lotus 1-2-3. The first screen to appear will provide the user simple instructions on how to start the program. Option 1 is used to select a file for importing into the spreadsheet. For the current example, the user will select the previously edited file named SUB.PRN from the menu. Previous sections of this manual contain detailed descriptions and flowcharts for all options in the main menu. Reference to these sections may be useful while reading this example problem. Also, Table 3 provides a very brief synopsis of all the editing and file manipulations that will be described in the following section of this manual. At this point, Table 3 will probably be of only limited use to the reader. However, as the example problem file manipulation procedures are developed, reference to Table 3 may help the user to understand the overall objectives of the input file manipulation.

After the desired file is contained within the spreadsheet, option 2 can be used to inspect the file contents to ensure that the desired file and cross sections have been selected. The file under manipulation should include cross sections extending from river mile 3.15 to 26.54. The next logical step might be to examine plots of the various cross sections. This function is provided by option 7. The initial screen of option 7 lists all cross sections contained within the current data-file. The user has the option of viewing on the screen any cross section plot or electing to have the cross sectional data sent to a Lotus 1-2-3 file named GRDATA.WK1. When the viewing menu option is selected, the user can automatically "zoom in" on the left bank, channel, or right bank portions of the cross section. If the user is familiar with Lotus 1-2-3, the ability to automatically have the cross sections written to a Lotus file may be very useful.

Table 3. Outline of PRE-HEC Example Problem Editing Procedures

1. Reduce file size. Only cross sections 3.15 to 26.54 are contained in subset. (An independent editing program is used).

2. Copy cross section 19.92 to 20.00. (Option 4 of PRE-HEC).

XLOBL = 397
XLOBR = 423
XLCH = 426
PSXECE = 0

3. Copy cross section 21.49 to 21.25. (Option 4 of PRE-HEC).

XLOBL = 6210
XLOBR = 6608
XLCH = 6656
PSXECE = -0.1

4. Edit cross section 20.00. (Option 5 of PRE-HEC).
   Insert data between (8.0 19,676) and (8.0 20,114).

Additional data added:

(8.0 19,707)
(9.5 19,722)
(9.5 19,772)
(8.0 19,787)
(8.0 19,788) <---"Space Filling Point"
NUMST changed from 72 to 77.

5. Edit cross section 21.25. (Option 5 of PRE-HEC).
   Insert data between (11.6 15,144) and (9.8 15,350).
   Delete point (11.2 15,234)

Additional data added:

(11.6 15,187)
(13.0 15,201)
(13.0 15,251)
(9.8 15,283)
(9.8 15,284) <---"Space Filling Point"
(9.8 15,285) <---"Space Filling Point"
NUMST changed from 79 to 84.

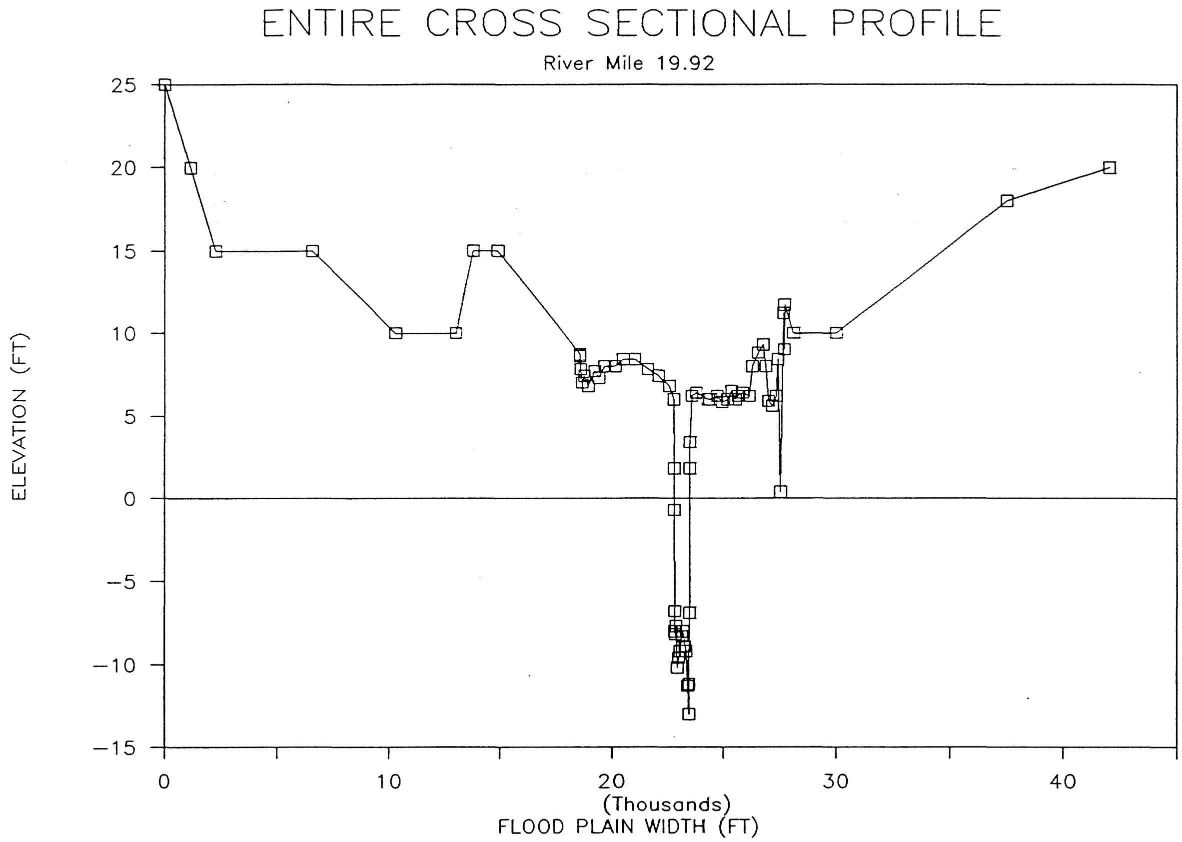
6. Edit cross section 21.49. (Option 5 of PRE-HEC).

Variable replacements:

XLOBL from 7800 to 1192
XLOBR from 8300 to 1269
XLCH from 8360 to 1278

When the file creation option is selected in option 7, a maximum of six cross sections can be individually selected and written to a Lotus 1-2-3 .WK1 file. The data are reorganized into vertical columns of x,z coordinates in a format which is directly compatible with the Lotus graphics capabilities. Table 2 shows the data format resulting from the selection of cross sections from miles 19.92 and 21.49. Figure 14 shows plots of cross sections from river miles 19.92 and 21.49 which were generated using the data which had been written to the file GRDATA.WK1. These sections are located immediately downstream and upstream from the road which extends from mile 20.00 to 21.25. By following this procedure, the user can generate .PIC files which can be used in the Lotus Pgraph software to print cross section plots.

In order to print cross sections using the GRDATA.WK1 file, the current session with PRE-HEC must be terminated. If the user desires to print the graphs of selected cross sections immediately after creation of the file GRDATA.WK1 and before continuing any other preprocessor work, option 10 is used. Selection of option 10 causes the preprocessor and the current input file to be saved as a Lotus 1-2-3 file named TEMPHEC2.WK1. The current session with PRE-HEC is then automatically ended. This option allows the user to stop work at an intermediate point in the file manipulation procedure, leave the preprocessor program, complete other tasks, and then resume work where it was previously stopped. After creation of the file TEMPHEC2.WK1, the file GRDATA.WK1 can be retrieved into Lotus 1-2-3 and the graphs can be prepared for subsequent printing with the Lotus Pgraph software program. When finished with plotting, the user can retrieve the file TEMPHEC2.WK1 into Lotus 1-2-3 and continue working with the preprocessor. To resume file manipulation at the point where it was previously discontinued, the "ALT" and "A" keys must once again be pressed simultaneously.



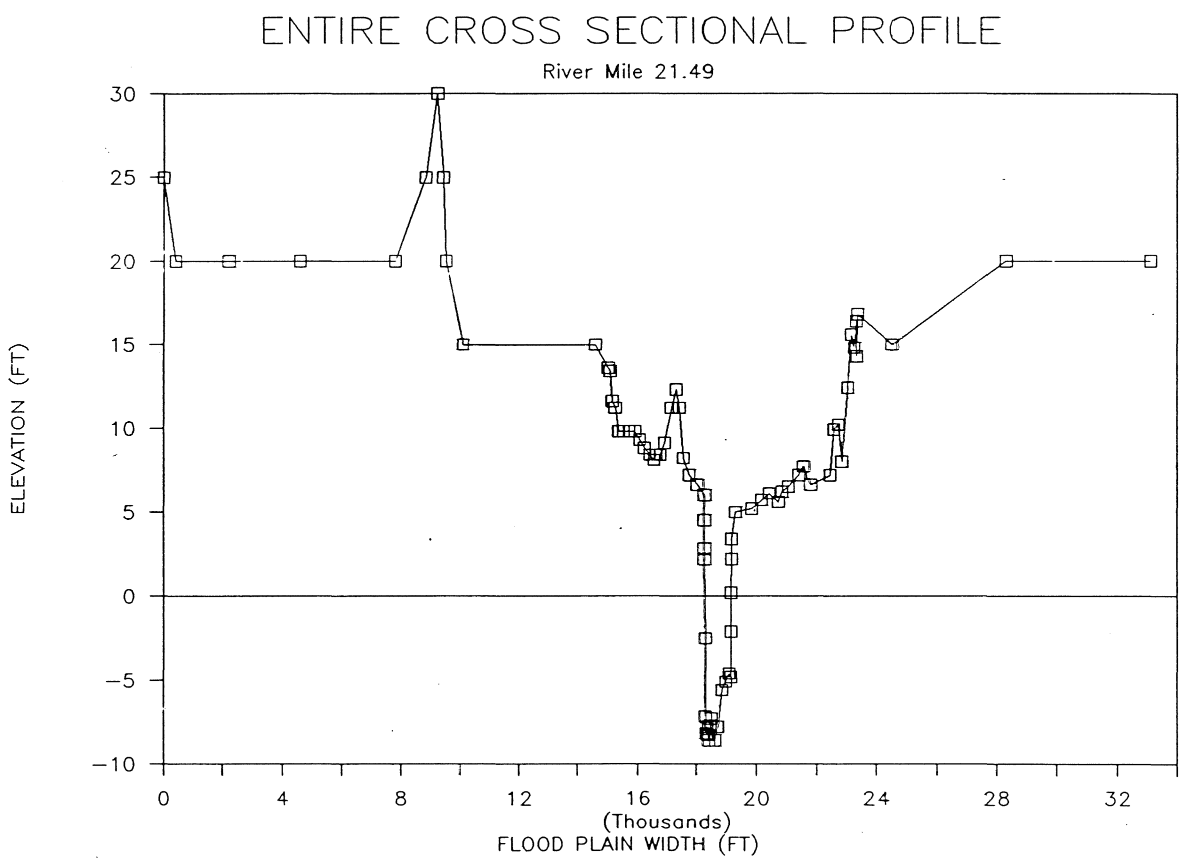


Figure 14. Cross Section Profiles for River Miles 19.92 and 21.49.

The assumption will now be made that the cross sectional profiles of the river reach are known to be relatively uniform at the construction site. This would indicate that the existing cross section from river mile 19.92 can be copied upstream to river mile 20.00. (The proposed road extends from river mile 20.00 to 21.25). The left bank portion of the duplicate cross section, which has been altered by road construction, will be modified later to represent the new cross section geometry. Likewise, the existing cross section at river mile 21.49 can be copied downstream to river mile 21.25. Necessary modifications of the left bank portion can then be made on the duplicate cross section located at river mile 21.25 also. This procedure eliminates the need to input entirely new cross sections to represent the construction site. Option 4, in the main menu of PRE-HEC, provides the means to copy a cross section. To use this option, the cross section that is to be duplicated is chosen from a list of all cross sections present in the file. For the current example, the cross section at river mile 19.92 is selected first. The desired location for the duplicate is then entered by the user (20.00).

Input of four additional variables is required next. Required input for the duplicate cross section are variables dealing with reach length and an elevation adjustment constant. The variable names are XLOBL, XLOBR, XLCH, and PSXECE. Please refer to the description of option 4 in this manual and the HEC-2 Users Manual if unsure about the meaning of these variables.

In this example, detailed site specific information is assumed to be lacking for the construction site and floodplain. The assumption will be made that the values for XLOBL, XLOBR, XLCH, and PSXECE can be determined by linear interpolation of the existing data. The user should refer to Table 4 while reading this example. Table 4 displays the portion of the HEC-2 input data-file that includes cross sections of river miles 19.92 and 21.49.

Table 4. HEC-2 Input Data-File Subset for Cross Sections 19.92 and 21.49.

ET		0	8.11					19869	26472	
X1	19.92	72	22772	23493	7600	5000	12680	0	0	0
GR	25	0	20	1200	15	2300	15	6600	10	10300
GR	10	13000	15	13800	15	14900	8.7	18600	8.6	18614
GR	7.8	18642	7	18684	7.4	18796	6.8	18990	7.7	19272
GR	7.3	19430	8	19676	8	20114	8.4	20478	8.4	20998
GR	7.8	21592	7.4	22100	6.8	22590	6	22772	1.8	22786
GR	-0.7	22802	-6.8	22824	-8	22844	-8.2	22864	-7.7	22902
GR	-10.2	22954	-9.6	22999	-9.2	23065	-8.3	23141	-8	23217
GR	-8.9	23298	-9.2	23347	-11.3	23400	-13	23452	-11.2	23477
GR	-6.9	23478	1.8	23482	3.4	23493	6.2	23570	6.4	23780
GR	6	24284	6	24400	6.2	24676	5.8	24920	6	25174
GR	6.5	25358	6	25514	6.2	25644	6.4	25826	6.2	26112
GR	8	26270	8.8	26516	9.3	26746	8	26862	5.9	26978
GR	5.6	27164	6.2	27314	8.4	27390	0.4	27536	11.2	27664
GR	9	27686	11.7	27702	11.7	27714	10	28100	10	30000
GR	18	37500	20	42000						
ET		0	8.11					17326	22173	
X1	21.49	79	18251	19177	7800	8300	8360	0	0	0
GR	25	0	20	400	20	2200	20	4600	20	7800
GR	25	8800	30	9200	25	9400	20	9500	15	10100
GR	15	14600	13.6	15000	13.4	15068	11.6	15144	11.2	15234
GR	9.8	15350	9.8	15508	9.8	15706	9.8	15898	9.3	16064
GR	8.8	16222	8.4	16414	8.1	16570	8.4	16644	8.4	16780
GR	9.1	16940	11.2	17156	12.3	17308	11.2	17412	8.2	17550
GR	7.2	17748	6.6	18016	6	18251	4.5	18255	2.8	18257
GR	2.2	18261	-2.5	18279	-7.2	18288	-8.2	18305	-7.8	18343
GR	-8.3	18377	-8.6	18405	-7.7	18442	-7.3	18495	-8.6	18628
GR	-7.8	18694	-7.8	18719	-5.6	18850	-5.1	18982	-4.6	19093
GR	-4.8	19140	-2.1	19146	0.2	19160	2.2	19171	3.4	19177
GR	5	19298	5.2	19842	5.7	20166	6.1	20426	5.6	20738
GR	6.2	20854	6.5	21082	7.2	21424	7.7	21576	6.6	21810
GR	7.2	22464	9.9	22582	10.2	22738	8	22864	12.4	23050
GR	15.6	23168	14.8	23272	16.4	23344	14.3	23362	16.8	23384
GR	16.8	23394	15	24500	20	28300	20	33100	0	0

Sample calculations of reach length variables for the duplicate cross section located at river mile 20.00 are provided by Table 5. The calculations use linear interpolation between the nearest existing cross sections to arrive at reach length estimates for the distance between existing and duplicate cross sections. The resulting estimates from Table 5 are as follows:
XLOBL = 397 ft; XLOBR = 423 ft; XLCH = 426 ft.

Estimation of the variable PSXECE is made by linear interpolation also. Since no other site specific information is available, the ground elevation adjustment constant is estimated as follows: Assume that the average slope of the floodplain can be determined by the slope of the water surface during the 100-year flood. Appendix 2 provides the 100-year flood levels as supplied by the SRWMD. Examination of this table reveals that the water surface elevation at river mile 20 is 13 feet and at river mile 22 is 14 feet. With no better parameter for determining the average floodplain slope readily available, the assumption will be made that the slope can be estimated as follows:
Water surface slope = 1 ft / 2 mile = 0.00009470 ft/ft. The constant for elevation adjustment (PSXECE) of cross section 20.00 is calculated by multiplying the slope times the reach length. Thus, 422.4 ft * 0.00009470 = 0.04 ft = (approximately 0 ft). PSXECE will be entered as zero for the cross section of river mile 20.00.

The four variables XLOBL, XLOBR, XLCH AND PSXECE are entered individually as the user is prompted for data entry in option 4. Following data entry, a wait message will appear as the duplicate cross section is automatically inserted in the proper location. The user is then returned to the main menu. At this point, option 2 may be used to view the data-file and confirm that the proper variables have been entered and that the duplicate cross section is in the desired location.

Table 5. Sample Calculations of Reach Length Variables for Cross Section 20.00.

CALCULATIONS FOR CROSS SECTION 20.00

Channel length values for cross section 21.49:

Variable Name	Card	Field Number	Numeric Value (ft)	Variable Description
XLOBL	X1	5	7800	Left Overbank Length
XLOBR	X1	6	8300	Right Overbank Length
XLCH	X1	7	8360	Channel Centerline Length

Estimated distance from cross section 21.49 to 19.92 is:
21.49 miles - 19.92 miles = 1.57 miles

Estimated distance from cross section 20.00 to 19.92 is:
20.00 miles - 19.92 miles = 0.08 miles

Ratio of reach lengths between 20.00-19.92 and 21.49-19.92 is:
0.08 miles / 1.57 miles = 5.0955%

Channel length parameters for cross section 21.49 are multipied by 5.0955 % to arrive at estimates for channel length parameters for duplicate cross section 20.00.

Variable Name	Value @ X-section @ 21.49 (ft)	Linear Interpolation Factor	Calculated Value for Duplicate X-section @ 20.00 (ft)
XLOBL	7800	0.050955	397
XLOBR	8300	0.050955	423
XLCH	8360	0.050955	426

Editing of the duplicate cross section to allow representation of the ground elevation of the road will not be initiated until after the second duplicate cross section at river mile 21.25 is created. Option 4 is selected from the main menu a second time in order to copy cross section 21.49 to river mile 21.25. Table 6 provides sample calculations for reach length variables for duplicate cross section 21.25. The format, assumptions, and calculations are the same as used in Table 5. The resulting estimates from Table 6 are as follows: XLOBL = 6210 ft; XLOBR 6608 ft; XLCH = 6656 ft.

Calculation of the PSXECE variable for the duplicate cross section 21.25 is made in the same manner as before. Water surface slope = 1 ft / 2 mile = 0.00009470 ft/ft. The distance from cross section 21.49 to 21.25 = 1267 ft. Multiplication of the slope and the reach length provides the estimated drop in elevation. Thus, 1267 ft * 0.00009470 = 0.12 ft = (approximately 0.1 ft). PSXECE will be entered as -0.1 for the cross section of river mile 21.25. The negative sign indicates that each of the cross section elevation points will be read by HEC-2 as if they were decreased by 0.1 feet. Option 2 can be used again to ensure that the desired results have been achieved.

Figure 14 shows the entire cross section profiles of river miles 19.92 and 20.49. Figure 15 shows a more detailed view of the left bank portions of these cross sections. At this point in the editing procedure, there are two pairs of nearly identical cross sections present in the current data-file. One pair is located at river miles 19.92 and 20.00 and the other pair is located at river miles 21.49 and 21.25. The duplicate transects at river miles 20.00 and 21.25 must be modified so that the proposed road profiles are represented by the ground elevation data contained within the left bank portion of both cross sections. Option 5 is specifically designed to allow editing of individual cross sections. Cross section 20.00 will be used as an example.

Table 6. Sample Calculations of Reach Length Variables for Cross Section 21.25.

Channel length values for cross section 21.49:

Variable Name	Card	Field Number	Numeric Value (ft)	Variable Description
XLOBL	X1	5	7800	Left Overbank Length
XLOBR	X1	6	8300	Right Overbank Length
XLCH	X1	7	8360	Channel Centerline Length

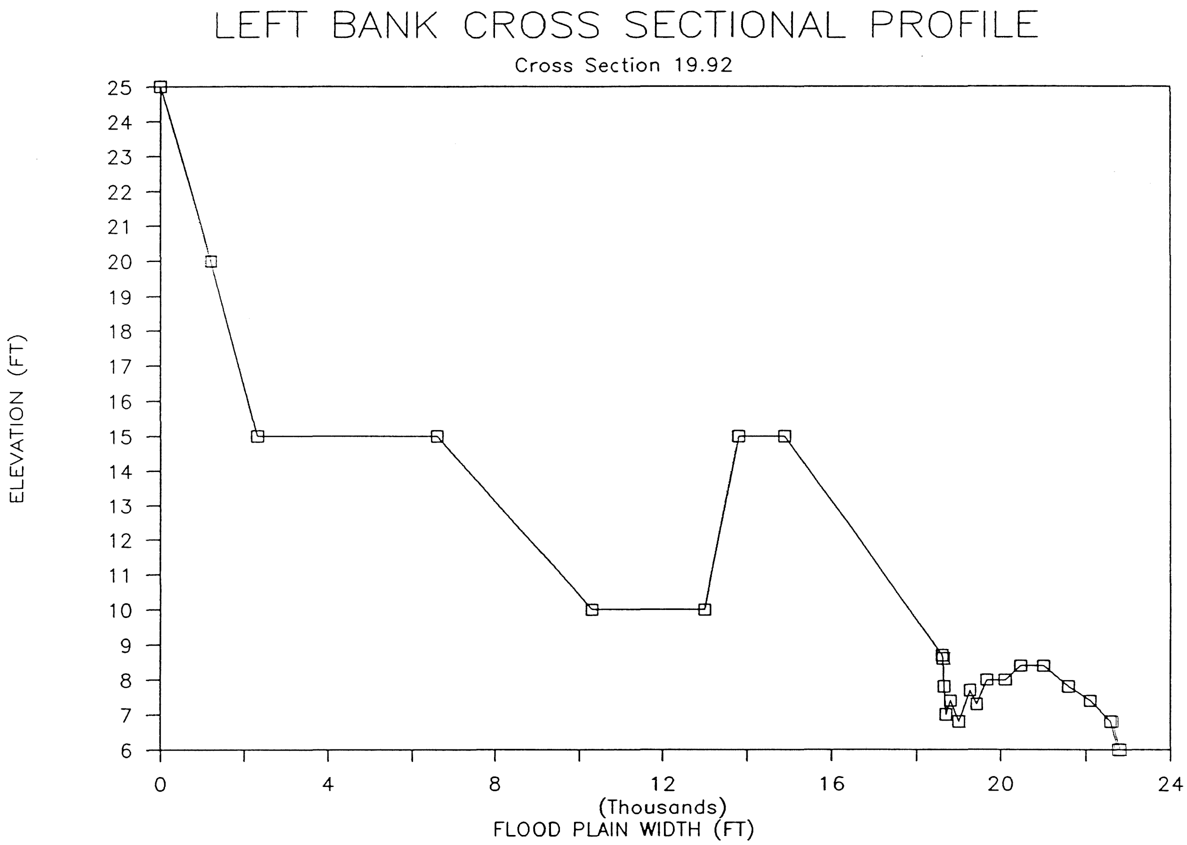
Estimated distance from cross section 21.49 to 19.92 is:
21.49 miles - 19.92 miles = 1.57 miles

Estimated distance from cross section 21.25 to 20.00 is:
21.25 miles - 20.00 miles = 1.25 miles

Ratio of reach lengths between 21.25-20.00 and 21.49-19.92 is:
1.25 miles / 1.57 miles = 79.62 %

Channel length parameters for cross section 21.49 are multipied by 79.62 % to arrive at estimates for channel length parameters for duplicate cross section 21.25.

Variable Name	Value @ X-section @ 21.49 (ft)	Linear Interpolation Factor	Calculated Value for Duplicate X-section @ 21.25 (ft)
XLOBL	7800	0.7962	6210
XLOBR	8300	0.7962	6608
XLCH	8360	0.7962	6656



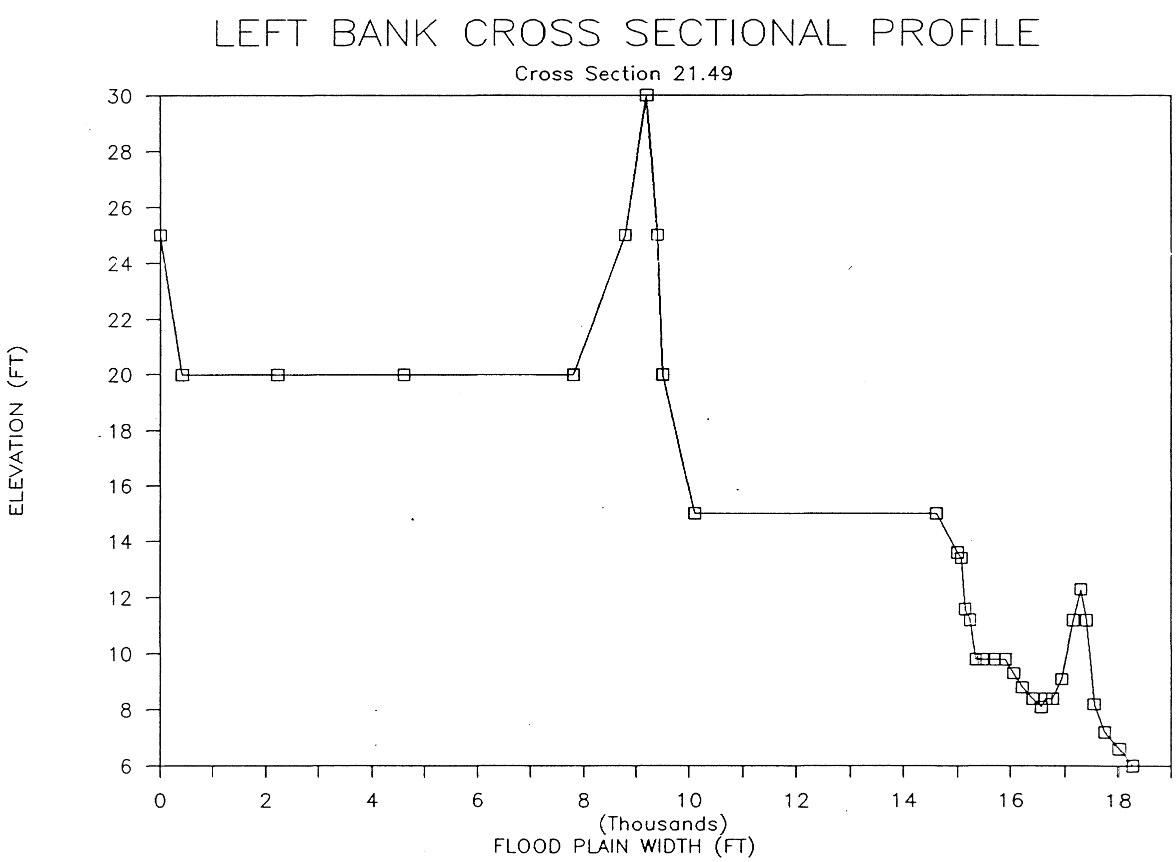


Figure 15. Left Bank Profiles for River Miles 19.92 and 21.49.

As was mentioned in previous sections, the nearly unrestricted editing capabilities of option 5 should be used with caution. The reader should refer to previous sections of this manual if unfamiliar with the capabilities and limitations of option 5. Four ground elevation data points must be added to each of the duplicate profiles in order to represent the road cross section. Examination of the input file reveals that, at river mile 20.00 (which is the duplicate from 19.92), the left side of the river channel is defined by the data pair (6.0 22,772). The first number provides the elevation of the river bank, while the second number is the lateral distance as measured from the left edge of the cross section. As was defined in the problem statement, the road is to be located 3000 feet to the left of the left side of the river channel. This means that the lateral coordinate for the right side of the road will be (22,772 feet - 3000 feet) = 19,772 feet. Since the road surface in this area is designed to be 9.5 ft high and the existing river bank is at an elevation of 8.0 feet, fill material will be required to elevate the road surface and shoulders. An arbitrary estimate of the slope of the fill material is approximately 1:10. This criterion and a linear interpolation of existing ground elevation points, provide a means to calculate the additional ground elevation points that are needed to represent the road. The four ground elevation points (GR card data) that will be added to the left bank of river mile 20.00 are the following: (8.0 19,707), (9.5 19,722), (9.5 19,772), (8.0 19,787). These points model the road cross section with a trapezoidal geometry.

A few comments will now be provided regarding the GR card format. HEC-2 requires that GR cards be assembled in sequential order within each cross section. The lateral coordinates for each data pair must increase as progression is made from left to right and also from top to bottom. This means that the four additional points must be inserted in a specific location between existing ground elevation data pairs. Lotus 1-2-3 functions can be used to move or manipulate the existing data pairs into the proper format.

Option 5 allows editing of an individual cross section in a nearly unrestricted environment using Lotus 1-2-3. Upon selection of option 5, a list of all cross sections contained within the data-file is displayed. The user selects one cross section and is then given the option to delete or edit the selection. Obviously, in this example, the edit option is chosen. The selected cross sectional data is extracted from the main data-file and is displayed on the screen. At this point, the macro mode of operation is automatically terminated. The cross section identification number (SECNO), located in the X1 card, should not be altered with option 5.

Regarding the current example dealing with cross section 20.00, the insertion must be made between the data pair (8.0 19,676) and (8.0 20,114). In order to eliminate the shuffling of ground elevation data pairs, additional data pairs can also be added. Additional transect points are not needed to represent the road, but rather to fill spaces remaining in GR card fields caused by the addition of the four required road profile points. For the current example, only one additional ground elevation point is needed. This point will be of the same elevation as an adjacent point and have a lateral coordinate incremented by only one foot. In cross section 20.00, an additional space filling point of (8.0 19,788) will be added between points (8.0 19,787) and (8.0 20,114). Addition of a few space filling ground elevation points that are nearly identical to existing points is not expected to change the HEC-2 output results. This technique is not suitable if the limit of 100 ground elevation points per transect will be exceeded by the addition of unnecessary points.

An additional variable substitution must also be made on cross section 20.00. The variable is named NUMST and is located in the second field of the X1 card. NUMST is used to define the number of ground elevation points existing within the GR card section of a single transect. The previous NUMST was 72. Inclusion of four additional ground elevation points to represent the road profile and one additional point as a space filler requires that NUMST be increased by 5. Thus, NUMST is changed from 72 to 77.

The user indicates completion of editing by simultaneously pressing the "ALT" and "T" keys. This action resumes the automated macro mode of operation. The edited cross section is then inserted back into the proper location within the data-file and the user is returned to the main menu. It is beyond the scope of this manual to provide detailed instructions regarding the use of Lotus 1-2-3. If the user desires, other editing programs can be used to make the required changes. Table 7 displays the data defining cross section 20.00 before and after addition of ground elevation points was made with the editing capabilities of option 5. Changes made with option 5 are boxed in the lower portion of data in Table 7.

A similar manipulation must be made, at the other end of the road, to the duplicate cross section located at river mile 21.25. The additional ground elevation points are the following: (11.6 15,187), (13.0 15,201), (13.0 15,251), and (9.8 15,283). These data represent a nearly trapezoidal cross section geometry for the road. The existing elevation point (11.2 15,234) must be deleted because the road surface is located over this point. The data must be inserted between the data pairs (11.6 15,144) and (9.8 15,350). The addition of two "space filling" ground elevation points will greatly reduce the amount of data manipulation required during the editing procedure. The additional points have coordinates of (9.8 15,284) and (9.8 15,285) and are nearly identical to the adjacent road profile point of (9.8 15,283). The

Table 7. Comparison of Transect Data Before and After Use of Option 5. (Changes are circled).

Duplicate Cross Section 20.00 After Copying With Option 4.

ET	0	8.11					19869	26472	
X120.00	72	22772	23493	397	423	426	0	-0.1	0
GR 25	0	20	1200	15	2300	15	6600	10	10300
GR 10	13000	15	13800	15	14900	8.7	18600	8.6	18614
GR 7.8	18642	7	18684	7.4	18796	6.8	18990	7.7	19272
GR 7.3	19430	8	19676	8	20114	8.4	20478	8.4	20998
GR 7.8	21592	7.4	22100	6.8	22590	6	22772	1.8	22786
GR -0.7	22802	-6.8	22824	-8	22844	-8.2	22864	-7.7	22902
GR-10.2	22954	-9.6	22999	-9.2	23065	-8.3	23141	-8	23217
GR -8.9	23298	-9.2	23347	-11.3	23400	-13	23452	-11.2	23477
GR -6.9	23478	1.8	23482	3.4	23493	6.2	23570	6.4	23780
GR 6	24284	6	24400	6.2	24676	5.8	24920	6	25174
GR 6.5	25358	6	25514	6.2	25644	6.4	25826	6.2	26112
GR 8	26270	8.8	26516	9.3	26746	8	26862	5.9	26978
GR 5.6	27164	6.2	27314	8.4	27390	0.4	27536	11.2	27664
GR 9	27686	11.7	27702	11.7	27714	10	28100	10	30000
GR 18	37500	20	42000						

Duplicate Cross Section 20.00 After Editing With Option 5.

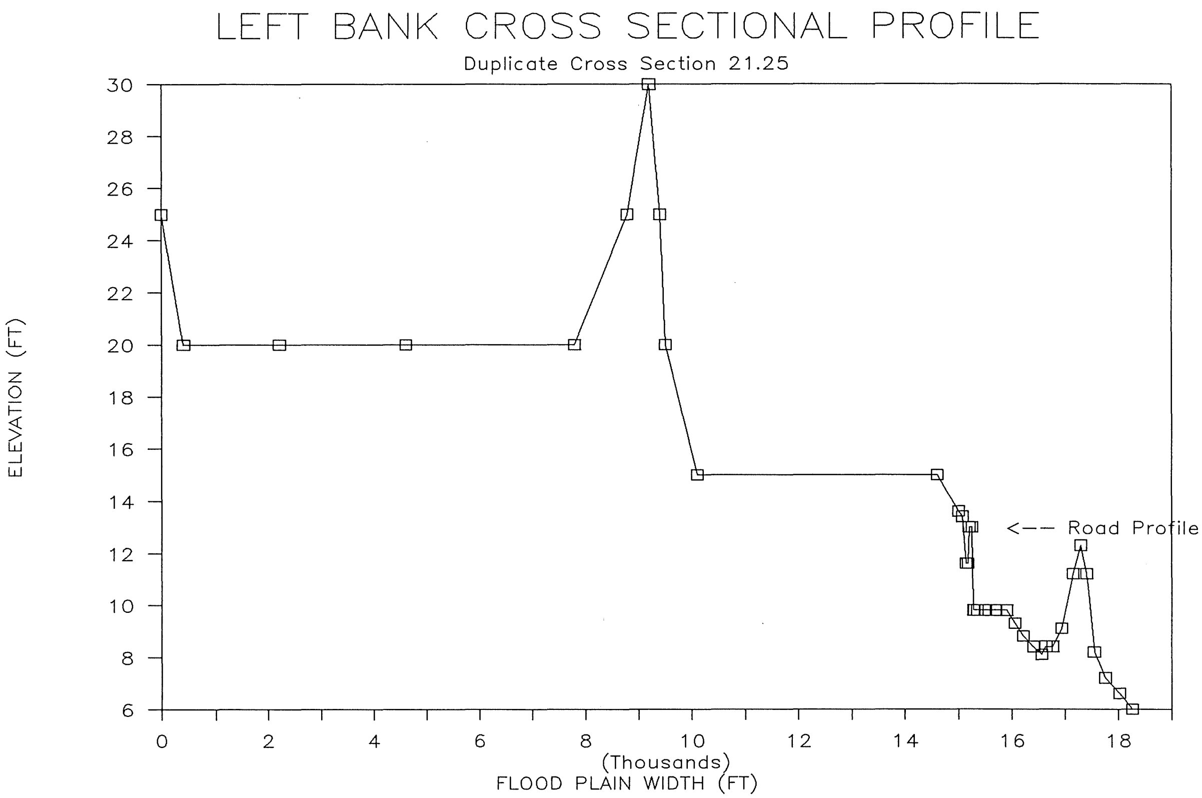
ET	0	8.11					19869	26472	
X120.00	77	22772	23493	397	423	426	0	0	0
GR 25	0	20	1200	15	2300	15	6600	10	10300
GR 10	13000	15	13800	15	14900	8.7	18600	8.6	18614
GR 7.8	18642	7	18684	7.4	18796	6.8	18990	7.7	19272
GR 7.3	19430	8	19676	8	19707	9.5	19722	9.5	19772
GR 8	19787	8	19788	8	20114	8.4	20478	8.4	20998
GR 7.8	21592	7.4	22100	6.8	22590	6	22772	1.8	22786
GR -0.7	22802	-6.8	22824	-8	22844	-8.2	22864	-7.7	22902
GR-10.2	22954	-9.6	22999	-9.2	23065	-8.3	23141	-8	23217
GR -8.9	23298	-9.2	23347	-11.3	23400	-13	23452	-11.2	23477
GR -6.9	23478	1.8	23482	3.4	23493	6.2	23570	6.4	23780
GR 6	24284	6	24400	6.2	24676	5.8	24920	6	25174
GR 6.5	25358	6	25514	6.2	25644	6.4	25826	6.2	26112
GR 8	26270	8.8	26516	9.3	26746	8	26862	5.9	26978
GR 5.6	27164	6.2	27314	8.4	27390	0.4	27536	11.2	27664
GR 9	27686	11.7	27702	11.7	27714	10	28100	10	30000
GR 18	37500	20	42000						

variable NUMST must be changed from 79 to 84 to account for deletion of one point and the addition of six additional points during the editing process. Figure 16 displays the left bank portions of the duplicate cross sections located at river mile 20.00 and 21.25 after the ground elevation points have been added. Table 8 displays that portion of the input file which contains the modified cross sections from river mile 20.00 and 21.25.

An observant reader may have noticed that, since the PSXECE variable for cross section 21.25 has been previously entered as -0.1, the HEC-2 program will subtract 0.1 feet from the elevation of each GR card in the transect when reading the data. In order to negate this effect, 0.1 feet can be added to each of the ground elevation points added during data entry in option 5. This has not been done for the current example since the construction profile is relatively small, the PSXECE variable is small, and it would add unnecessarily to the complexity of the example.

As was mentioned previously, each cross section contains reach length information regarding the downstream distance to the adjacent cross section. For the current example, the insertion of a new cross section at river mile 21.25, necessitates the adjustment of reach length variables in cross section 21.49. The nearest downstream cross section is the duplicate at river mile 21.25.

Detailed sample calculations of the reach length parameters for cross sections 20.00 and 21.25 have been provided in Tables 5 and 6. The calculation of new reach length parameters for cross section 21.49 is very similar. The required modification of cross section 21.49 involves replacement of existing XLOBL, XLOBR, and XLCH values with new ones. The required variable substitutions are as follows: Change XLOBL from 7800 to 1192; change XLOBR



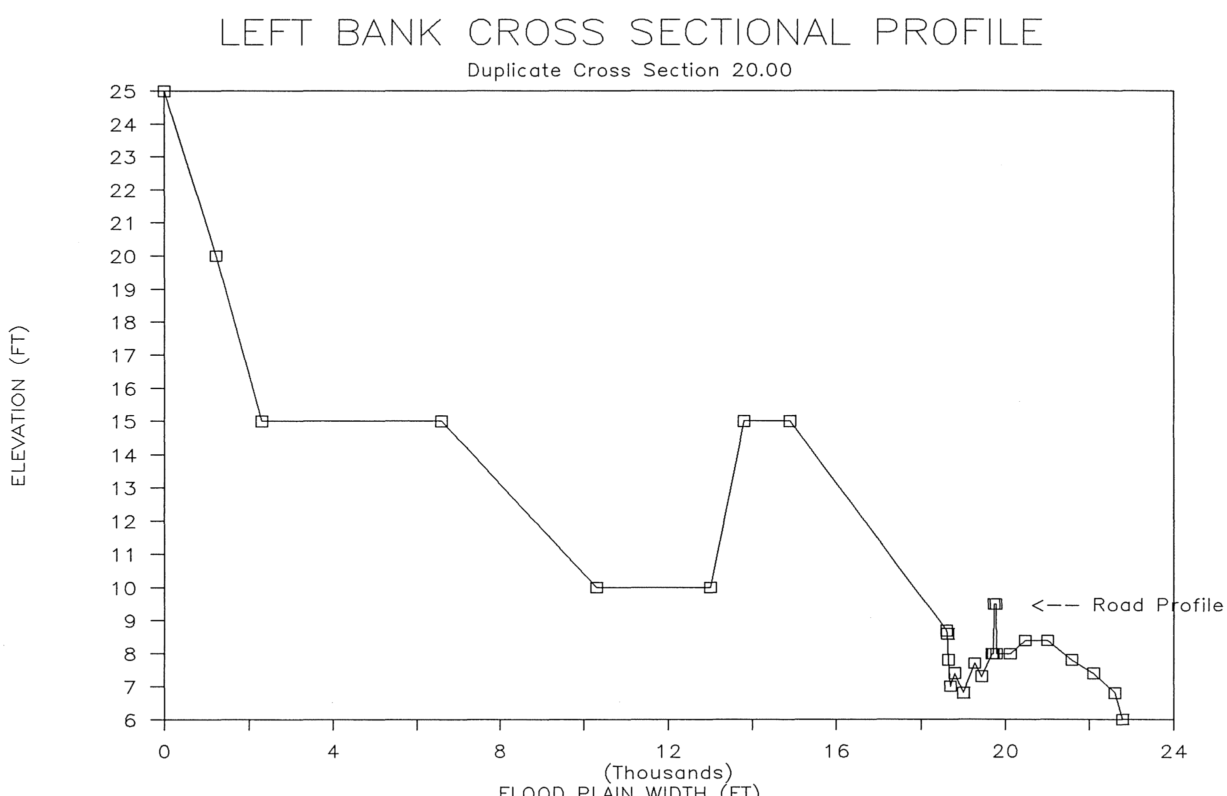


Figure 16. Left Bank Profiles for River Miles 20.00 and 21.25 After Road Profiles Have Been Added.

Table 8. HEC-2 Input Data-File Subset for Duplicate Cross Sections 20.00 and 21.25.

```
ET             0    8.11                                   19869   26472
X120.00       77   22772   23493     397     423     426       0       0       0
GR    25       0      20    1200      15    2300      15    6600      10   10300
GR    10   13000      15   13800      15   14900     8.7   18600     8.6   18614
GR   7.8   18642       7   18684     7.4   18796     6.8   18990     7.7   19272
GR   7.3   19430       8   19676       8   19707     9.5   19722     9.5   19772
GR     8   19787       8   19788       8   20114     8.4   20478     8.4   20998
GR   7.8   21592     7.4   22100     6.8   22590       6   22772     1.8   22786
GR  -0.7   22802    -6.8   22824      -8   22844    -8.2   22864    -7.7   22902
GR-10.2    22954    -9.6   22999    -9.2   23065    -8.3   23141      -8   23217
GR  -8.9   23298    -9.2   23347   -11.3   23400     -13   23452   -11.2   23477
GR  -6.9   23478     1.8   23482     3.4   23493     6.2   23570     6.4   23780
GR     6   24284       6   24400     6.2   24676     5.8   24920       6   25174
GR   6.5   25358       6   25514     6.2   25644     6.4   25826     6.2   26112
GR     8   26270     8.8   26516     9.3   26746       8   26862     5.9   26978
GR   5.6   27164     6.2   27314     8.4   27390     0.4   27536    11.2   27664
GR     9   27686    11.7   27702    11.7   27714      10   28100      10   30000
GR    18   37500      20   42000
ET             0    8.11                                   17326   22173
X121.25       84   18251   19177    6210    6608    6656       0    -0.1       0
GR    25       0      20     400      20    2200      20    4600      20    7800
GR    25    8800      30    9200      25    9400      20    9500      15   10100
GR    15   14600    13.6   15000    13.4   15068    11.6   15144    11.6   15187
GR    13   15201      13   15251     9.8   15283     9.8   15284     9.8   15285
GR   9.8   15350     9.8   15508     9.8   15706     9.8   15898     9.3   16064
GR   8.8   16222     8.4   16414     8.1   16570     8.4   16644     8.4   16780
GR   9.1   16940    11.2   17156    12.3   17308    11.2   17412     8.2   17550
GR   7.2   17748     6.6   18016       6   18251     4.5   18255     2.8   18257
GR   2.2   18261    -2.5   18279    -7.2   18288    -8.2   18305    -7.8   18343
GR  -8.3   18377    -8.6   18405    -7.7   18442    -7.3   18495    -8.6   18628
GR  -7.8   18694    -7.8   18719    -5.6   18850    -5.1   18982    -4.6   19093
GR  -4.8   19140    -2.1   19146     0.2   19160     2.2   19171     3.4   19177
GR     5   19298     5.2   19842     5.7   20166     6.1   20426     5.6   20738
GR   6.2   20854     6.5   21082     7.2   21424     7.7   21576     6.6   21810
GR   7.2   22464     9.9   22582    10.2   22738       8   22864    12.4   23050
GR  15.6   23168    14.8   23272    16.4   23344    14.3   23362    16.8   23384
GR  16.8   23394      15   24500      20   28300      20   33100       0       0
```

from 8300 to 1269; change XLCH from 8360 to 1278. These substitutions can be made via option 5 or by use of an independent editor software.

At this point the data-file is ready to be run in HEC-2. Option 8 in the main menu provides an automated means to produce a HEC-2 input file. Execution of this option is simple; however the user is reminded that selection of option 8 will terminate the current session with PRE-HEC. The file that PRE-HEC generates is named HEC2RUN.PRN. If necessary, editing of HEC2RUN.PRN with PRE-HEC can be continued at a later time. This is accomplished by selecting HEC2RUN.PRN as the file to be imported with option 1 of the main menu when PRE-HEC is used next. When the example problem is run in HEC-2 the output contains no error messages. Table 9 displays both the computed water surface elevations generated when the example file was used as input for HEC-2 and the 100-year flood elevations supplied by the SRWMD. Determination of exactly what water level rise constitutes an insignificant water level increase must be determined by the user and the SRWMD; it will not be discussed in this manual.

Table 9. Computed Water Surface Elevations for Example Problem vs 100-Year Flood Elevation Supplied by SRWMD.

HEC-2 Output		100-yr Flood	
River Mile	CWSEL (feet)	River Mile	Water Surface Elevation (feet)
3.15	2.53	3	20
5.83	4.81	6	16
7.49	5.7	8	12
9.81	7.28	10	10
13.11	9.22	13	10
15.4	10.54	15	11
17.65	11.58	18	12
19.92	12.6	20	13
20	12.65		
21.25	13.34	21	14
21.49	13.47	22	14
23.47	14.47	23	15
24.83	15.25	25	16
26.54	16.35	27	17

CHAPTER 5
DISCUSSION OF 100-YEAR FLOOD LEVELS ON SUWANNEE RIVER

Table 10 displays the 100-year water surface elevations calculated by HEC-2 using the data-file SUWLOW.PRN which contains cross sections from river mile 3.15 to river mile 60.36. In order to make this file run properly in HEC-2, a few ground elevation points were removed in cross section 15.4. Appendix 2 contains the 100-year flood elevations that the SRWMD uses for floodplain delineation. A cursory comparison of Appendix 2 with Table 10 reveals significant differences in the water surface elevations between the HEC-2 output and the data supplied by the District. The difference is specially noticeable in the downstream region of the river. Figure 17 provides a visual comparison of the difference between water levels from Appendix 2 and Table 10. The discrepancy in water height is due to the fact that the SRWMD has taken into account the probable effects of a large storm surge that could be associated with a very large flood event. HEC-2 will not predict oceanic storm surges. The 100-year storm surge elevates the water surface above that predicted by HEC-2 from the river mouth upstream to about river mile 19.00. Upstream from this region the difference is much smaller.

Table 10. Computed Water Surface Elevations for 100-Year Flood: Input File = SUWLOW.PRN.

X-sect. number	River Mile	HEC-2 Output (feet)
1	3.15	2.53
2	5.83	4.81
3	7.49	5.70
4	9.81	7.28
5	13.11	9.22
6	15.40	10.54
7	17.65	11.58
8	19.92	12.60
9	21.49	13.48
10	23.47	14.47
11	24.83	15.25
12	26.54	16.35
13	28.07	17.00
14	30.46	18.10
15	32.32	19.31
16	33.48	20.27
17	34.21	20.80
18	34.31	20.79
19	34.71	21.61
20	37.38	21.95
21	37.52	21.93
22	39.76	23.07
23	41.97	23.67
24	44.93	24.34
25	47.35	25.33
26	50.53	26.27
27	52.03	26.76
28	53.94	27.35
29	55.31	27.65
30	56.53	27.95
31	56.62	27.96
32	58.20	28.84
33	59.56	29.32
34	60.36	29.54

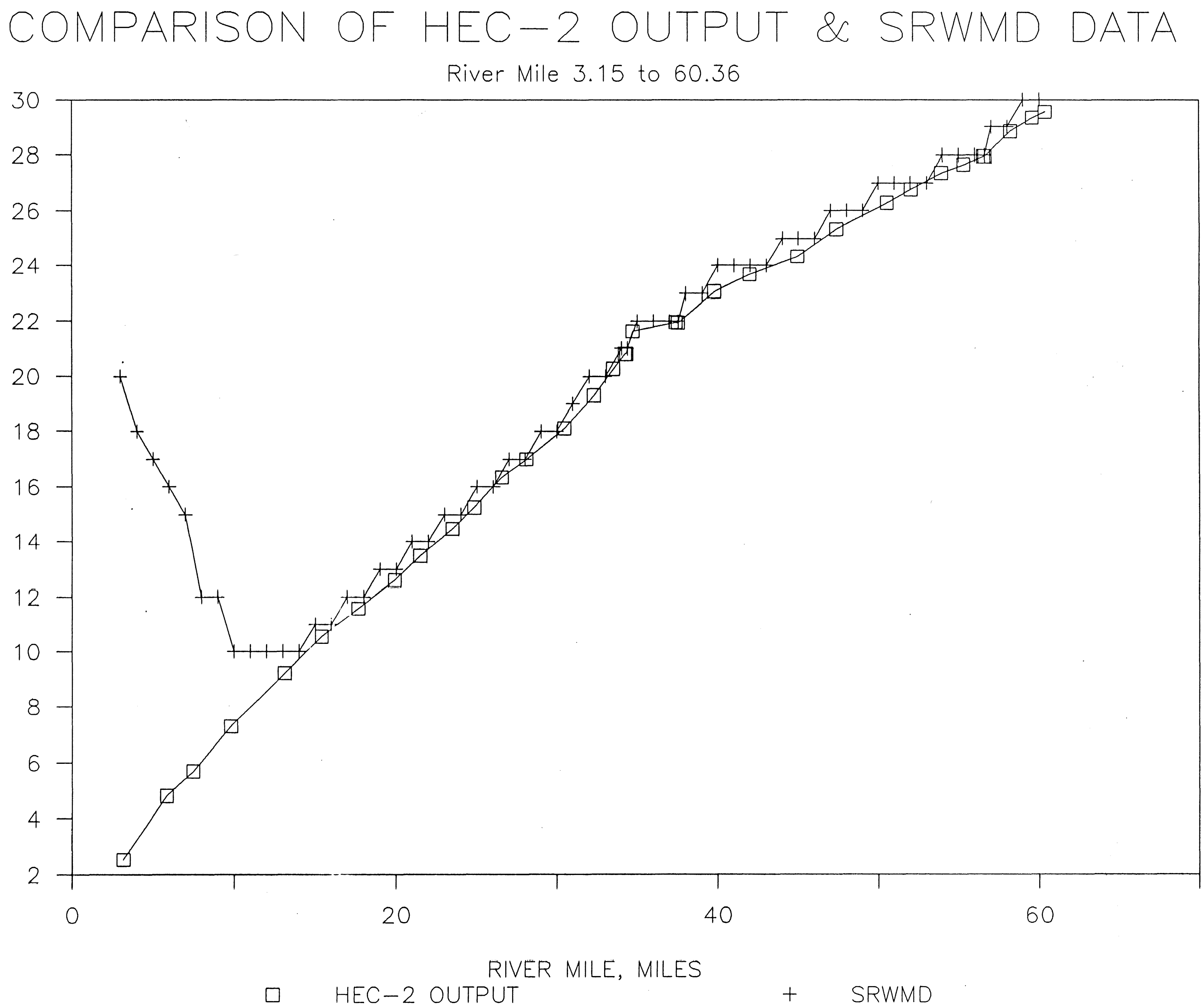


Figure 17. Comparison of HEC-2 Output and SRWMD Water Level Data

CHAPTER 6
SUMMARY AND CONCLUSIONS

The primary objective of this project has been to produce a PC compatible preprocessor program that allows efficient access to, and manipulation of, existing HEC-2 input data for the Suwannee River. Lotus 1-2-3, a spreadsheet software package, was chosen as the program language because of its availability, widespread familiarity within the engineering field, internal graphics capabilities, and simple programming language. The macro programming language of Lotus 1-2-3 simplifies the creation of interactive, menu driven programs that are quite powerful and yet easy to understand and use. PRE-HEC has been designed to meet a number of programming objectives.

An attempt was made to include as many desirable features as possible and avoid the more common software weaknesses. PRE-HEC is sophisticated enough to provide the experienced HEC-2 user an efficient, powerful package and is simple enough to be easily learned by both the experienced and novice user. The program is able to prevent obvious errors and provides a means to correct them if they do occur. The software is complemented with an easy to read, comprehensive users manual containing example problems and complete descriptions of all program functions. The program allows the experienced user to rapidly scroll past explanatory messages and provides the inexperienced user unlimited time to stop and reference the user manual or other material when these messages are unclear. After using the program a few times, the user should not have to rely on the manual frequently because the menus and associated messages are designed to be self explanatory.

The main menu options give access to a number of very useful automated functions. A major consideration when modifying an existing input file is duplication and or alteration of individual cross sections that are associated with a proposed construction project. Probably the most useful features of

PRE-HEC are the abilities to rapidly duplicate cross section data and the graphics capabilities for these data. Graphics capabilities are especially useful in detecting errors present in the ground elevation data. Nearly all of the main menu functions are provided without yielding direct access to the actual data-file. This menu driven, automated format is designed to reduce the possibility of unintentional alteration of files and to simplify the editing procedures. A considerable amount of the programming effort has been directed toward simplifying data input and editing procedures. This simplification is brought about by providing the user access to the data in the less restrictive environment provided by the spreadsheet. When data manipulation is completed, the data are automatically reformatted into the required FORTRAN format.

It may be possible to create a more powerful and flexible preprocessor by increasing user access to the raw data and by making the data-file content requirements less restrictive. However, unrestricted access to the data-file is not necessarily desirable because it increases the level of complexity of the macros that are responsible for reformatting and preparation of the data prior to export into an ASCII file. A definite trade-off exists between conflicting programming goals. On one hand, unlimited flexibility in file manipulation capabilities is desirable. On the other hand, this is impractical if the program design limits the likelihood of user error by utilizing a structure based upon a series of menu driven automated functions. When the user requires more flexibility in file manipulation functions than PRE-HEC can supply, a separate editor, such as COED, can be used in conjunction with PRE-HEC.

APPENDIX I

Included with this manual are three diskettes labeled A, B, and C. Diskette A contains Lotus 1-2-3 files that constitute the preprocessor and empty "scratch" files that serve to accept output from the preprocessor.

Diskette B contains HEC-2 input data-files for the Suwannee River. These files were supplied by the SRWMD. SUWLOW.PRN is a complete input file which models the river from river mile 3.15 to 60.36 for the 100-yr flood. This file required small modifications of the transect at river mile 15.40 in order for it to run properly on HEC-2 and EDIT2.

The file A-UPSTRM, on diskette B, is a portion of a HEC-2 file that was too large to fit on a single floppy. The original input file modeled the Suwannee River from river mile 60.38 to 206.38. A-UPSTRM is the first part of the original input file. It includes transects from river mile 60.38 to 127.49.

Diskette C contains the second portion of the original HEC-2 input file from Diskette B. The original file was split in the middle of the transect at river mile 127.49. B-UPSTRM includes transects from river mile 127.49 to 206.35. Neither A-UPSTREAM nor B-UPSTREAM are independent, complete HEC-2 input files. These two files can be combined into one file on a hard disk using a simple DOS command. The following commands will allow recreation of the original file under the file name "COMPLET": COPY A-UPSTRM+B-UPSTRM COMPLET

These files were originally created for use on a main frame version of HEC-2. There appears to be some compatibility problems with running the composite file COMPLET on the 1986 PC version of HEC-2.

The tables below provide a summary of the diskette contents.

Disk A

File Name	Description
PRE-HEC.WK1	Main Preprocessor
AUTOSTRI.WK1	Auxiliary Preprocessor
TEMPHEC2.WK1	"Scratch" File
HEC2RUN.PRN	"Scratch" File
HEC123.WK1	"Scratch" File
GRDATA.WK1	"Scratch" File
EXPORT.WK1	"Scratch" File

Disk B

File Name	Description
SUWLOW.PRN	HEC-2 Input file; Suwannee River Miles 3.15 to 60.36
A-UPSTRM	HEC-2 Input file; Suwannee River Miles 60.38 to 127.49

Disk C

File Name	Description
B-UPSTRM	HEC-2 Input file; Suwannee River Miles 127.49 to 206.35

Cross sections contained in the input files are listed below.

3.15	70.98	98.23	127.38	155.59	180.09
5.83	71.96	99.18	127.46	156.49	180.47
7.49	72.77	100.23	127.51	157.20	181.57
9.81	73.09	100.51	128.83	158.45	182.10
13.11	73.55	101.48	130.69	158.87	182.88
15.40	74.27	101.82	132.59	160.01	183.61
17.65	74.71	102.89	133.56	160.29	183.98
19.92	75.07	103.30	133.96	161.01	184.53
21.49	75.58	104.03	134.39	161.55	185.31
23.47	75.84	104.59	135.01	162.02	186.50
24.83	76.06	105.36	135.54	162.06	188.25
26.54	76.11	105.88	135.59	162.10	189.06
28.07	76.15	106.69	135.93	162.31	189.52
30.46	76.77	107.34	136.66	163.05	190.41
32.32	77.06	107.88	137.13	164.11	191.14
33.48	77.49	108.57	138.01	164.96	191.55
34.21	77.99	109.22	138.62	165.71	192.44
34.31	78.50	109.87	139.44	166.34	193.22
36.10	79.01	110.69	140.18	166.93	193.92
37.38	79.52	111.18	141.11	168.15	194.74
37.52	80.20	112.17	141.40	168.93	195.67
39.76	81.32	112.46	141.82	168.95	195.71
41.97	81.59	112.79	142.15	168.97	195.76
44.31	82.16	112.83	142.41	169.35	196.00
47.35	83.08	112.88	142.79	169.65	196.44
50.53	84.20	112.90	144.26	169.80	197.54
52.03	84.85	112.92	145.21	170.11	198.11
53.94	85.70	113.29	146.08	170.67	198.68
55.31	85.95	114.37	146.55	170.88	199.45
56.53	86.73	114.94	147.11	171.09	199.45
56.62	87.45	116.26	147.53	171.13	199.98
58.20	88.24	117.17	148.15	171.15	200.74
59.56	89.24	118.66	148.19	171.17	201.34
60.36	90.11	119.69	148.26	171.62	202.58
60.38	91.48	120.87	148.55	172.42	203.44
60.91	92.20	121.63	149.47	173.13	203.96
61.75	92.89	122.45	149.70	173.89	204.59
62.24	93.85	124.42	149.76	174.06	205.26
62.67	95.54	124.78	149.89	174.74	205.75
63.27	95.54	124.85	149.99	175.16	206.35
63.87	95.91	124.93	150.05	176.17	
65.66	96.60	125.56	151.40	176.97	
66.47	97.37	126.58	152.76	177.71	
68.53	98.12	127.24	154.03	178.26	
69.16	98.18	127.32	155.03	178.85	

APPENDIX II

The following water surface elevation data have been supplied by the SRWMD. These water surface elevations represent the 100-year flood for the Suwannee River. Note that the storm surge effect is significant near the river mouth.

100-YR FLOOD LEVEL FOR SUWANNEE RIVER

River Mile	100-YR Flood (feet)	River Mile	100-YR Flood (feet)	River Mile	100-YR Flood (feet)	River Mile	100-YR Flood (feet)
3	20	38	23	73	35	108	56
4	18	39	23	74	36	109	57
5	17	40	24	75	36	110	57
6	16	41	24	76	37	111	58
7	15	42	24	76.11	37	112	58
8	12	43	24	77	38	112.79	59
9	12	44	25	78	38	112.9	59
10	10	45	25	79	39	113	60
11	10	46	25	80	39	113.4	60
12	10	47	26	81	40	114	60
13	10	48	26	82	40	115	61
14	10	49	26	83	40	116	61
15	11	50	27	84	41	117	61
16	11	51	27	85	42	118	62
17	12	52	27	86	43	119	62
18	12	53	27	87	43	120	62
19	13	54	28	88	44	121	63
20	13	55	28	89	45	122	63
21	14	56	28	90	45	123	64
22	14	56.62	28	91	46	124	64
23	15	57	29	92	47	124.85	65
24	15	58	29	93	48	125	65
25	16	59	30	94	49	126	65
26	16	60	30	95	49	127	66
27	17	61	31	96	50	127.32	66
28	17	62	31	97	51	127.46	66
29	18	63	31	98	51	127.48	66
30	18	64	32	98.18	51	128	67
31	19	65	32	99	52	129	67
32	20	65.66	32	100	52	130	68
33	20	66	32	101	53	131	68
34	21	67	33	102	53	132	68
34.39	21	68	33	103	53	133	68
35	22	69	33	104	54	134	69
36	22	70	34	105	54	135	70
37	22	71	34	106	55	135.01	70
37.52	22	72	35	107	56	135.54	70

100-YEAR FLOOD LEVEL FOR SUWANNEE RIVER (continued)

River Mile	100-YR Flood (feet)	River Mile	100-YR Flood (feet)
136	71	171	88
137	71	171.13	88
138	71	171.15	88
139	72	172	89
140	72	173	90
141	73	174	90
142	73	175	91
143	74	176	92
144	74	177	93
145	74	178	93
146	75	179	94
147	75	180	94
148	76	181	95
148.19	76	182	96
149	77	183	96
149.76	78	184	97
149.99	78	185	97
150	78	186	98
150.29	78	187	98
151	79	188	99
152	79	189	99
153	80	190	100
154	80	191	101
155	81	192	101
156	82	193	101
157	82	194	102
158	83	195	103
159	83	195.71	103
160	84	196	103
161	84	197	104
162	84	198	104
162.06	84	199	105
163	85	200	106
164	85	201	106
165	85	202	106
166	86	203	107
167	87	204	107
168	87	205	108
168.95	87	206	108
169	87	206.73	108
170	87		

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