FLOOD CONTROL DISTRICT
of
MARICOPA COUNTY

Drainage Design Management System

User's Manual

KVL Consultants, Inc.

Table of Contents

Table of Contents

1. Introduction

System Overview

The Drainage Design Management System for Windows (DDMSW) has been written to facilitate data management and computational procedures required for drainage analysis in Maricopa County. This manual serves as a guide in the use of the program and is intended to be used in conjunction with the County's Drainage Design Manuals.

The program is written in Microsoft Visual FoxPro and currently includes modules for File Management, Hydrology and Utilities. Future versions will include modules for Hydraulics and GIS (Geographic Information System) integration.

Unlike the former DDMS which was DOS based and stored data in separate ASCII files, DDMSW is a relational Database that manages multiple projects from one single location. DDMSW is a multi-tasking window based application which enables the user to open several 'windows' simultaneously. New features include pull-down menus, user-friendly forms which the user can arrange on the desktop, and windows editing tools to facilitate data entry. DDMSW utilizes a relational Database that includes Tables for data entry and editing. Each Table appears as a separate '.dbf' file on disk. The Tables are related to each other based on the key field 'Project Id' which is established when starting a new project. Running models is automated from a menu and the data for running the models is extracted from the various Tables in the Database.

Basic Database Terminology

The application stores data (values) in a relational Database. This data is organized into *tables, fields*, and *records* to make it more meaningful. For example, 01 by itself is meaningless. However, in a table called 'Basins', in a field called 'BasinId', in a record corresponding to 'EXAMPLE1', we now understand that 01 is a major basin in project EXAMPLE1.

A *table* is a grouping of data. The data is dynamic because it can be modified, deleted, added to, and so on. Here is an example of a table:

Table: Basins

ProjectID	BasinID	Description	Sort
EXAMPLE 1	01	Major Basin 01	10
EXAMPLE 1	02	Major Basin 02	20

A table is composed of one or more *fields*. In the example, the fields are ProjectID, BasinID, Description, and Sort. Fields are similar to columns in a spreadsheet. All fields in a table have the same format (eg. text of maximum 70 characters, numeric 12 places with 2 decimals) and they share the same characteristics (eg. they are different descriptions).

A table also consists of one or more *records*. Records are similar to rows in a spreadsheet. In the example, "KVLTEST1, 01, Major Basin 01, 10' compose one record in the table 'Basins'. The example shows a total of two records and four fields.

In DDMSW, the Database is composed of numerous tables which organize and store information. These tables are linked by one common *key field*, **projectid** which identifies the project the records are associated with.

Program Installation

DDMSW

The software used in DDMSW includes:

DDMSW	Compiled application
HEC-1	Most recent HEC-1 with modifications
Prefre	Rainfall model
MCUHP1	County's DOS program
MCUHP2	County's DOS program
Rational	County's DOS program
PFE	Text editor (Programmer's File Editor)
Acrobat Reader	PDF file reader

All required software for DDMSW is contained on the CD provided with this application.

Insert the DDMSW CD in the CD drive (here denoted as X). Run X:\DDMSW\Setup from the RUN command (substitute your CD drive letter for X). Follow the instructions on the screen.

The user can choose the program's location, but assuming C:\DDMSW, the following directory structure will be created:

C:\DDMSW	Program files
C:\DDMSW\Adobe	Adobe Acrobat installation files
C:\DDMSW\Backup	Directory for archiving data
C:\DDMSW\Data	Data Files
C:\DDMSW\Help	Help files
C:\DDMSW\ModlRuns	Default directory for model runs
C:\DDMSW\Models	Model programs
C:\DDMSW \Reports	Reports

The procedure will notify the user when the DDMSW installation is complete.

Adobe Acrobat Reader

This manual and all help files require Adobe Acrobat Reader to view and print the files. If Adobe Acrobat Reader is not currently installed on your computer, then it will be necessary to install the program. The latest version can be downloaded from Adobe's website at WWW.Adobe.Com. Alternatively, a copy of Adobe Reader is included with this application. To install, click on the executable file in the 'Abobe' subdirectory of DDMSW and follow the instructions on the screen.

Windows Regional Settings

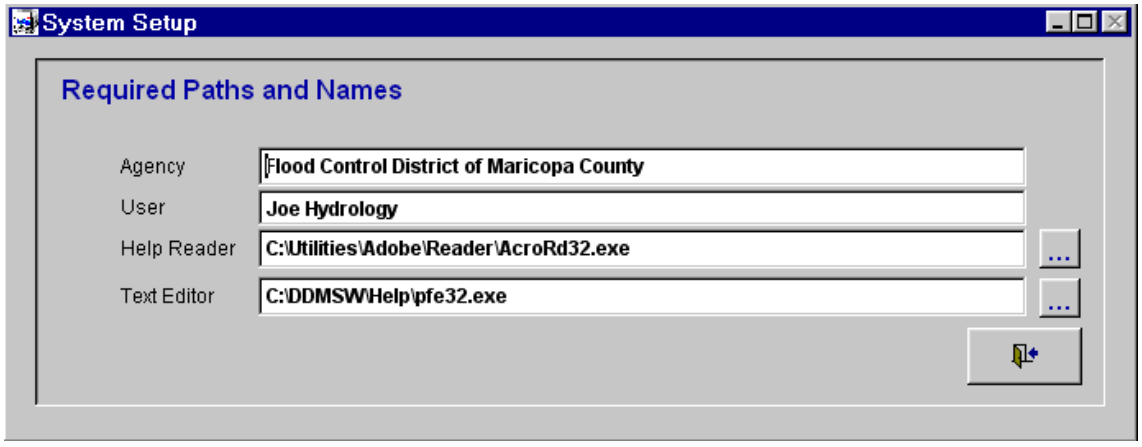
To ensure that printed reports contain the necessary number of decimal places, it is necessary to modify the regional Settings in the Windows Control Panel as follows:

Open Regional Settings (found in Control Panel) and click on 'Number'. Change “No of digits after decimal” to 5 and then click Apply.

Starting the Software

DDMSW is started by clicking on Start\Programs\DDMSW\FCDMC\DDMSW.exe (provided this was where the software was installed). The program can also be started by double clicking on DDMSW.exe in the folder where the software is installed.

When the software is first started, it is necessary to edit File\Setup to establish system settings.



2. General Features

Main Menu

The Main Menu is the center of the application. This is the screen which is displayed when the user starts the application. This is also the screen the user is always returned to after closing a submenu or form.

Specific actions can be accessed through the pull-down menus shown on the Main Menu bar. This manual will explain the functions available on each menu and will describe the individual elements shown on data entry screens.

Standard Buttons

There is a toolbar of standard buttons, which is identical on each data entry screen.

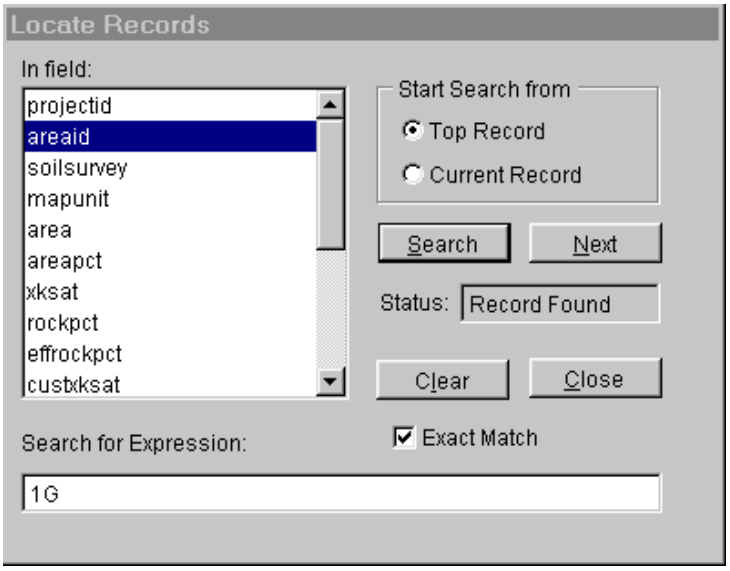
Goes to the first record in the table.

Moves to the previous record.

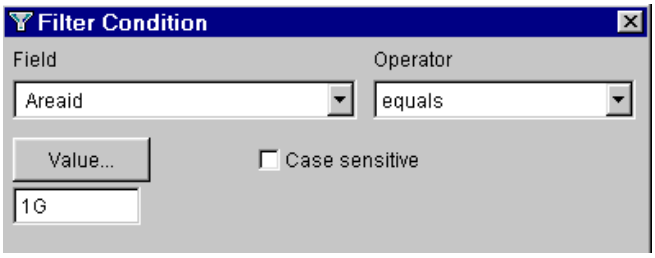
Moves to the next record.

Goes to the last record in the table.

Locates records based on a specified search criterion. Highlight the field to search and type the search expression.



Selects a subset of records according to user specifications. A *filter* consists of one or more conditions which compares a field to a value using an *operator*. Multiple conditions can be combined together with a *connector*. To create a filter, select the 'Add' button. The following 'Filter Condition' dialog box appears.



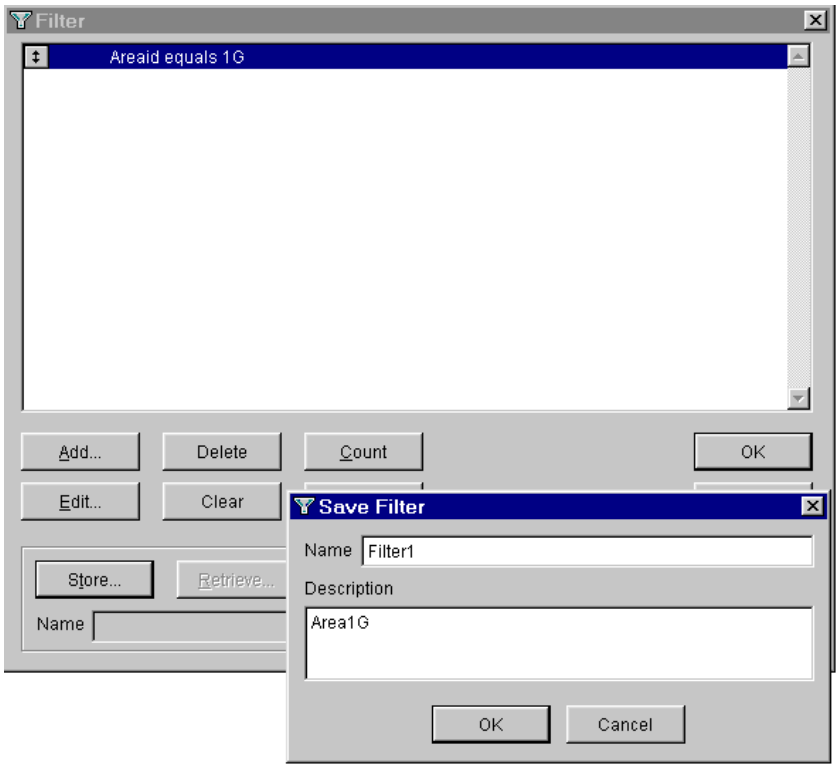
Select a field and an operator, enter a value and click 'OK'. (For alphanumeric fields, select a value from the pull down list).

On the 'Filter' dialog box, the user has the following options:

i) Click 'OK' to execute the filter and view the subset of records.

ii) Select 'Add' again to add other condition to the filter.

iii) Select 'Store' to save the filter for future use. This is useful for commonly used filters.



To use a previously saved filter, select 'Retrieve'. Highlight the filter on the 'Select Filter' dialog box and click 'OK'. Click 'OK' on the 'Filter' dialog box to execute the command.

To edit a filter, retrieve it from the list, and choose 'Edit' or double-click on the condition. After changing any of the items that make up the condition, select 'Store' and 'OK' to save the changes.

Adds a new record.

Marks the current record for deletion. Marked records are physically deleted from disk when the Table is packed. The record will no longer appear but still exists until the Table is packed.

Closes the current form and returns the user to the Main Menu or previous form. Any changes made to the record are saved. Pressing [Esc] will also close the form and return the user to the previous screen. However, changes to the current record may not take effect.

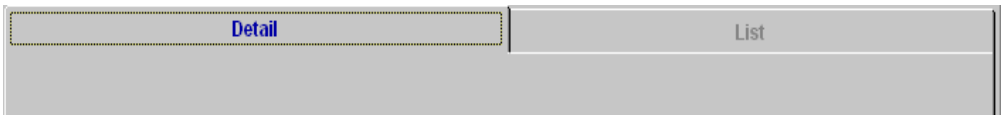
Edit Menu

The Edit menu is available to the user during data entry or editing. The menu comprises the following functions. Some or all may be available depending on the action currently being executed.

Undo	Undo the last change made to a field.
Cut	Cut out (move) the highlighted text to the clipboard.
Copy	Copy the highlighted text to the clipboard.
Paste	Paste the text from the clipboard into the current field.

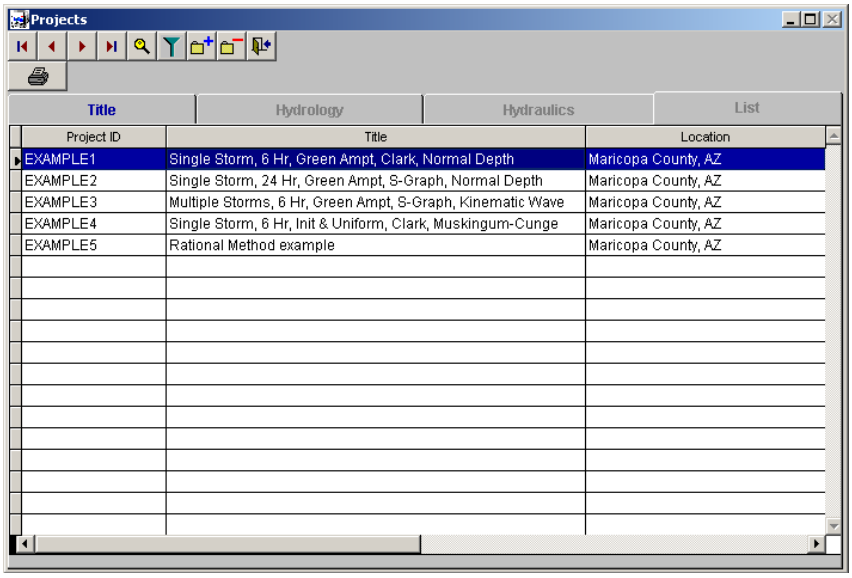
Forms

Some forms are composed of several tabs to view data. Click on the tab for the appropriate view.

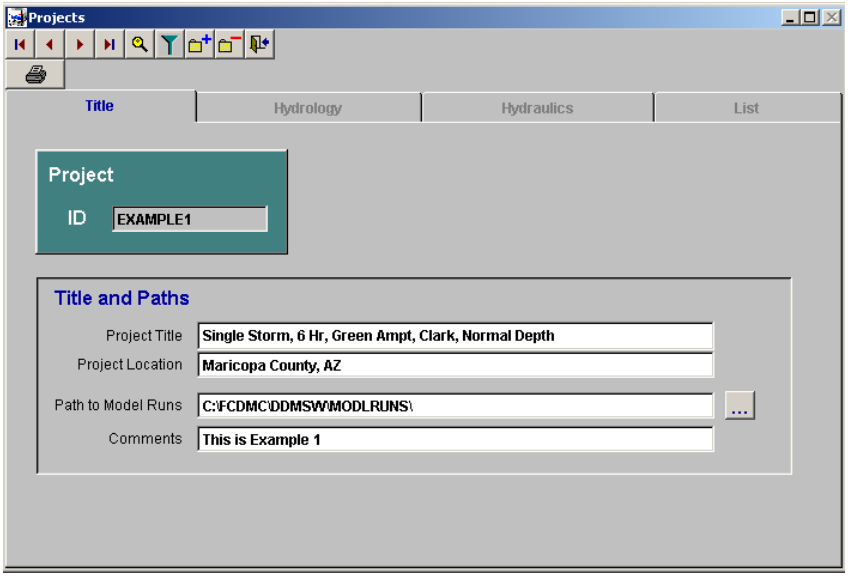


3. File

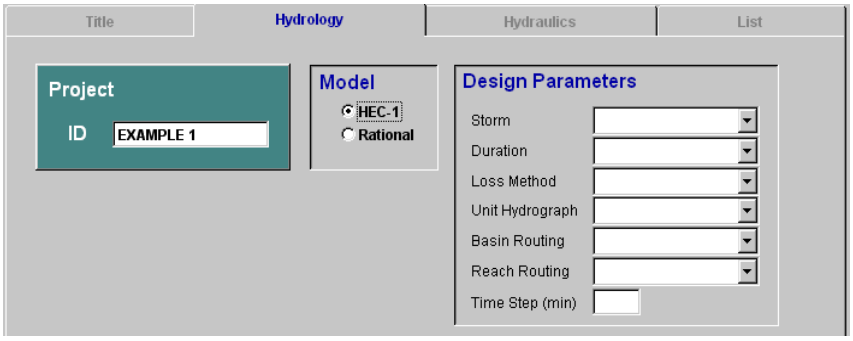
Select Project



The selection of Select Project from the File Menu is used to select, edit or create a new project. To add a new Project, click on the  button. To delete a Project, click on the  button. When adding a new Project, it is necessary to fill in the Project ID, Title and the path to the model runs on the Title form. The Project ID will be used throughout the application for all files that refer to this project. Model runs for all projects will have the same naming convention. It is therefore necessary to **establish separate folders for each project's model runs.** Create the folder using Windows Explorer and then use the  button to locate the folder.

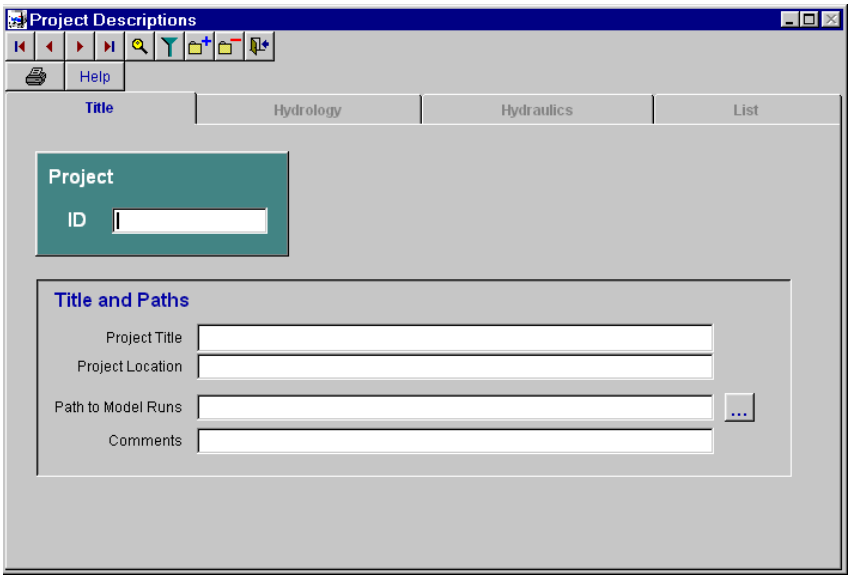


When finished with the Title data, enter the Hydrology default data. The Hydrology view varies depending on which model is selected.



All data on this form can be modified. Once the form has been closed, the Project ID cannot be edited. If it is necessary to change the Project ID, "*Rename*" the project in Management. If default data is changed, make sure that the appropriate data on other forms is also modified. For example, if the reach routing method is changed from "Normal Depth" to "Kinematic Wave", it will be necessary to modify the routing data.

New Project

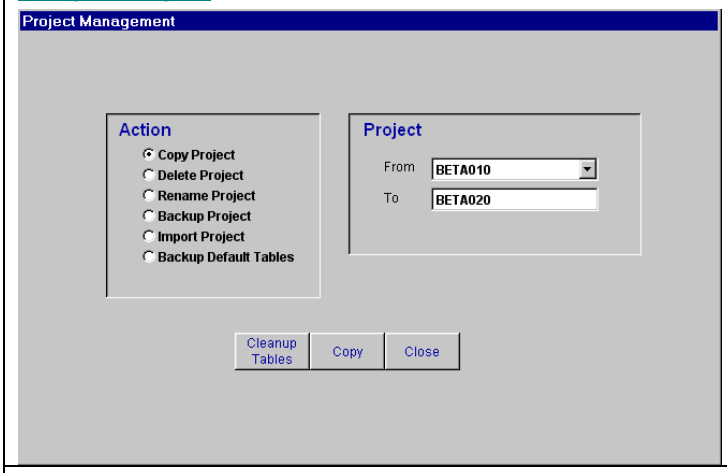


The selection of New Project from the File Menu is used to create a new project. When creating a new project, it is necessary to fill in the Project ID, Title and the path to the model runs on the Title page. All other features are the same as Select Project when adding a new record (see previous section). When selecting New Project from the menu, a new record is automatically added to the projects table.

Management

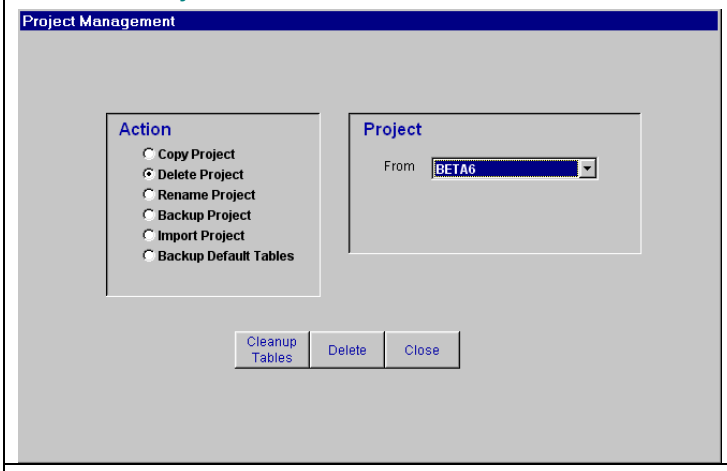
The Management menu offers the following functions:

Copy a Project



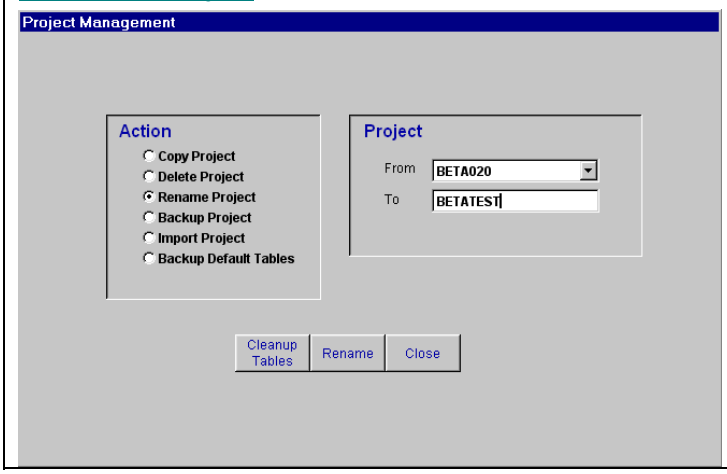
Creates a new project and copies all records in the Tables to the new project. Model files are not copied. Select the current project from the drop-down list and enter the name of the new project in the 'To' field. Click the 'Copy' button.

Delete a Project



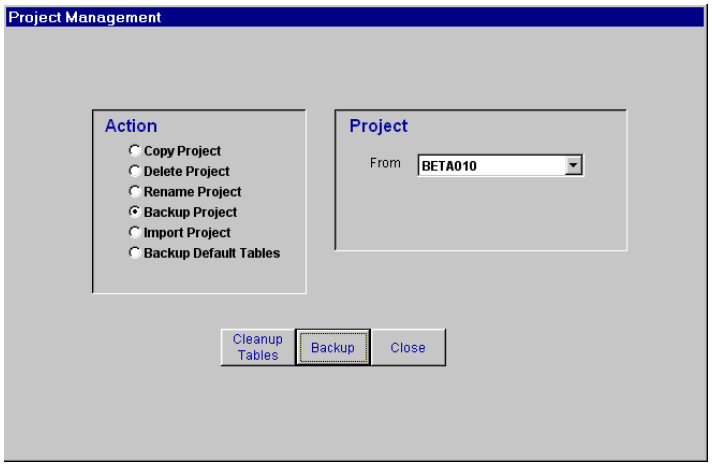
Select the project from the drop-down list and click the 'Delete' button. All relevant records in the Tables are deleted. It is recommended to pack the Database to erase the deleted records from disk (see 'Utilities').

Rename a Project



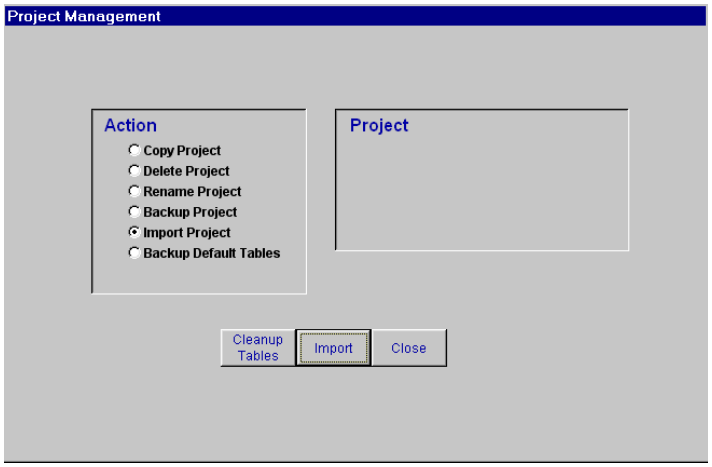
Use this function to change the name of a project. Select the project from the drop-down list and enter the new project name in the 'To' field. Click the 'Rename' button.

Backup Project



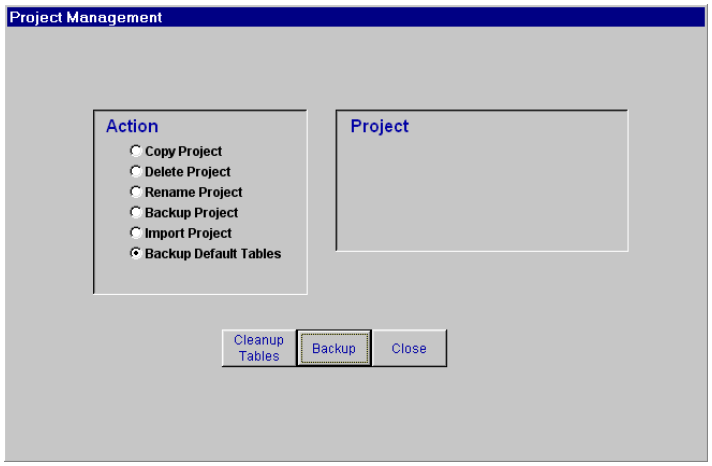
Use this option to backup project data to one '*zipped*' file. The backup file is saved to the backup subdirectory and has the project name with a '.zip' extension. This feature is useful when a DDMSW project needs to be used on a different computer.

Import Project



When the 'Import' button is clicked, a dialogue box appears for the user to select a project backup file (.zip extension). If the project already exists in the Database, a message appears to warn the user that all data in the current project will be deleted and replaced with the imported data. The user has the choice to continue or cancel. This feature allows users to import a DDMSW project (zip format) generated by DDMSW's Backup Project feature.

Backup Default Tables



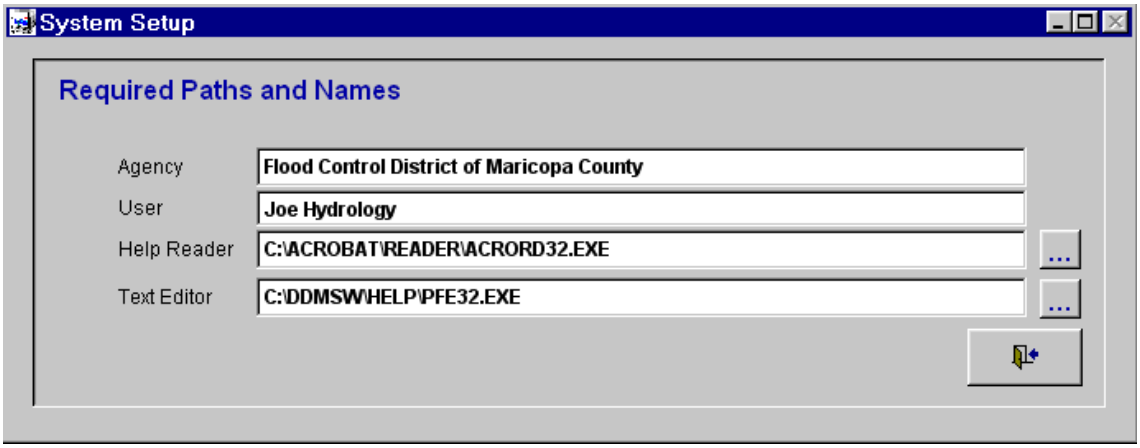
This option backs up the default data to a file 'defaults.zip' in the backup subdirectory. To restore the default data, copy the defaults.zip file to the data subdirectory and unzip the file.

This form can also be used to get rid of "orphans" in DDMSW by clicking on "Cleanup Tables". Orphans records are records in a Table that do not belong to a Project ID.

Setup

The selection of Setup from the File Menu is used to edit System settings. These include:

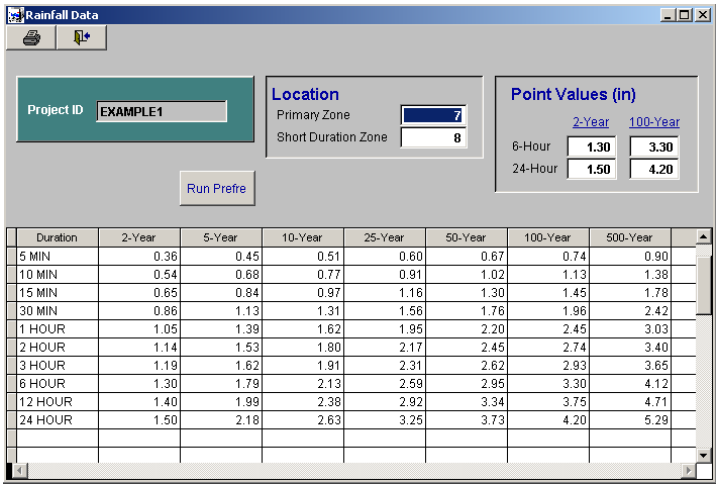
- Agency name
- User's name
- Path and file name to Adobe Acrobat Reader which is necessary to view help files.
- Path and file name for a text editor (PFE is supplied with the application and is located in the help subdirectory of DDMSW).



4. Hydrology

Rainfall

Prefre

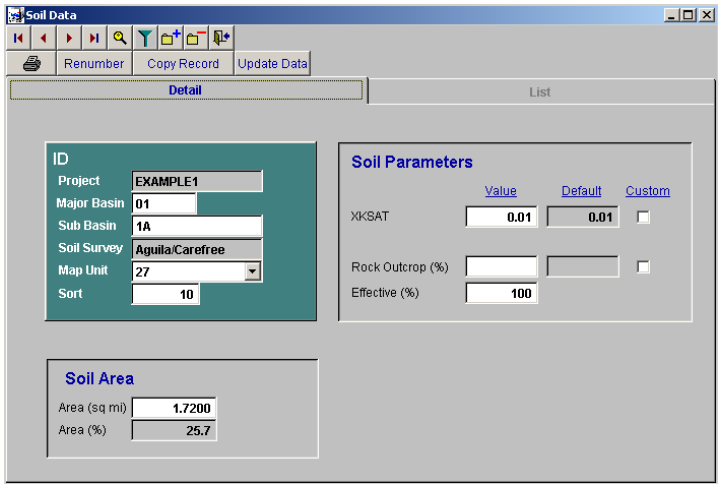


The selection of Prefre from the Hydrology\Rainfall menu is used to edit data required for running the Prefre model and to run the model. The Prefre program computes the rainfall depths for the durations and return periods shown on the form. The user must enter appropriate values for all fields shown on the form. The selection of data can be obtained from the County's Drainage Design Manuals. For Maricopa County, the Primary Zone is always 7 and the Short Duration Zone is always 8.

Soils

Data

The selection of Data from the Hydrology\Soil menu is used to add or edit soil data required for the Sub Basins.



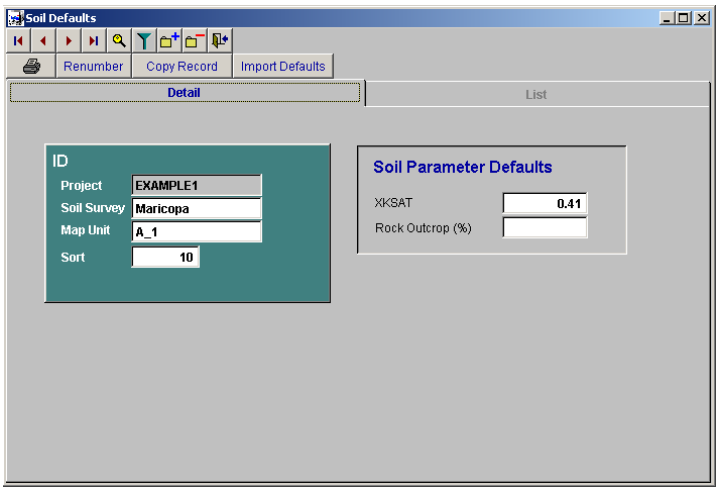
The important values to enter are the Sub Basin ID which must match a Sub Basin ID in the Sub Basins Table, a Map Unit code, which will come from the Soil Defaults and the area for this soil. All of the remaining values can be calculated using the 

button.

There are three columns in the Soil Parameters section of the form. The first column, Value, is the value that will be used in the modeling analysis. The second column, Default, is the value calculated based on soil default values. The third column, Custom, ensures that a user entered value will not be overwritten with the calculated value when updating data.

Defaults

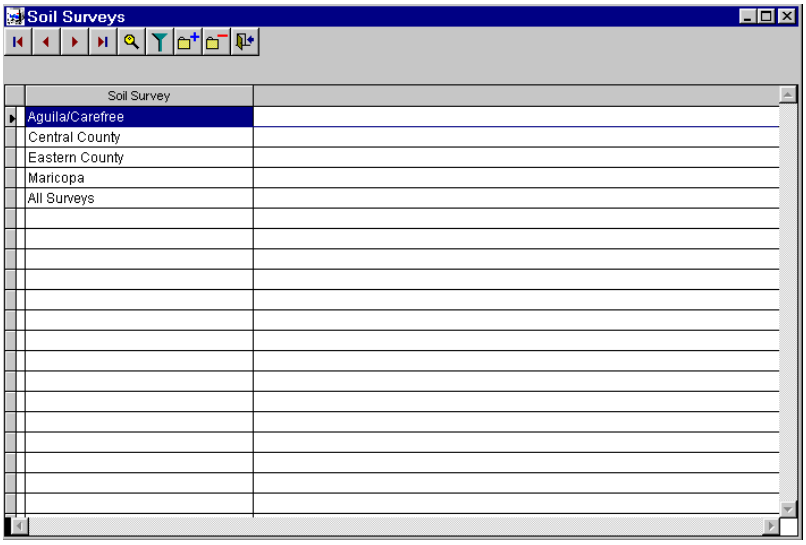
The selection of Defaults from the Hydrology\Soil menu is used to add or edit soil defaults required for the Sub Basins.



It is important to enter appropriate values for all fields as soil calculations for the entire project will be based on these values. When first entering this form for the project, if soil default data does not exist, the County's default data is loaded into the system.

Soil Surveys

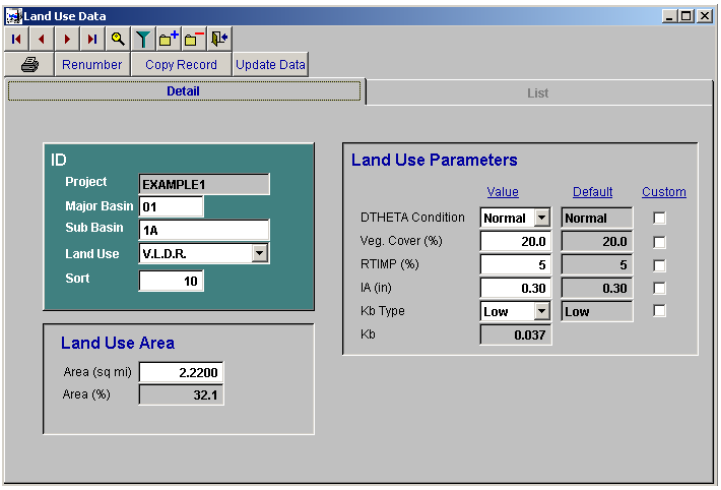
The selection of Soil Surveys from the Hydrology\Soil menu is used to add or edit soil surveys. This data is used to filter data on the Soil Data form.



Land Use

Data

The selection of Data from the Hydrology\Land Use menu is used to add or edit land use data required for the Sub Basins. The form is different for HEC-1 and Rational models.

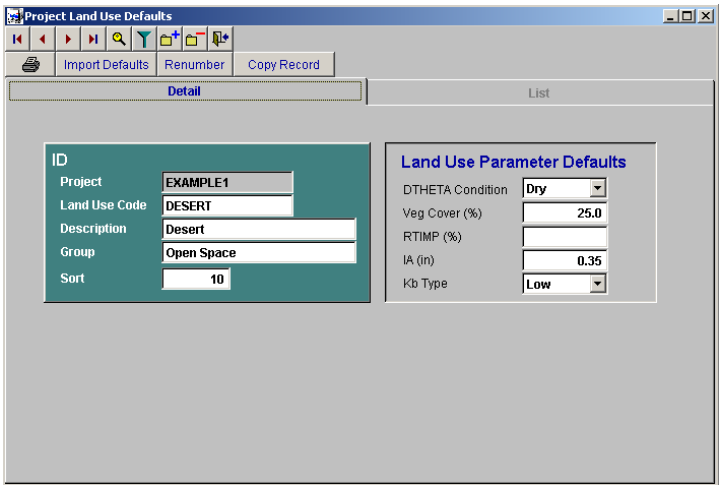


The important values to enter are the Sub Basin ID which must match a Sub Basin ID in the Sub Basins Table, a land use code, which will come from the Land Use Defaults and the area for this land use. All of the remaining values can be calculated using the *"Update Data"* button.

There are three columns in the Land Use Parameters section of the form. The first column, 'Value', is the value that will be used in the modeling analysis. The second column, 'Default', is the calculated value based on the land use default values. The third column, 'Custom', ensures that a user-entered value will not be overwritten with the calculated default value when updating data.

Defaults

The selection of Defaults from the Hydrology\Land Use menu is used to add or edit land use defaults required for the Sub Basins. The form is different for HEC-1 and Rational models.

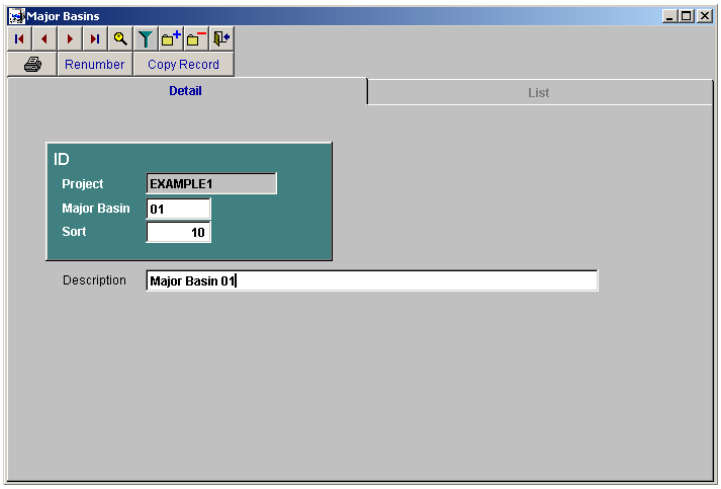


It is important to enter appropriate values for all fields as land use calculations for the entire project will be based on these values.

Basins

Major Basins

The selection of Major Basins from the Hydrology\Basins menu is used to add a new or edit an existing Major Basin.



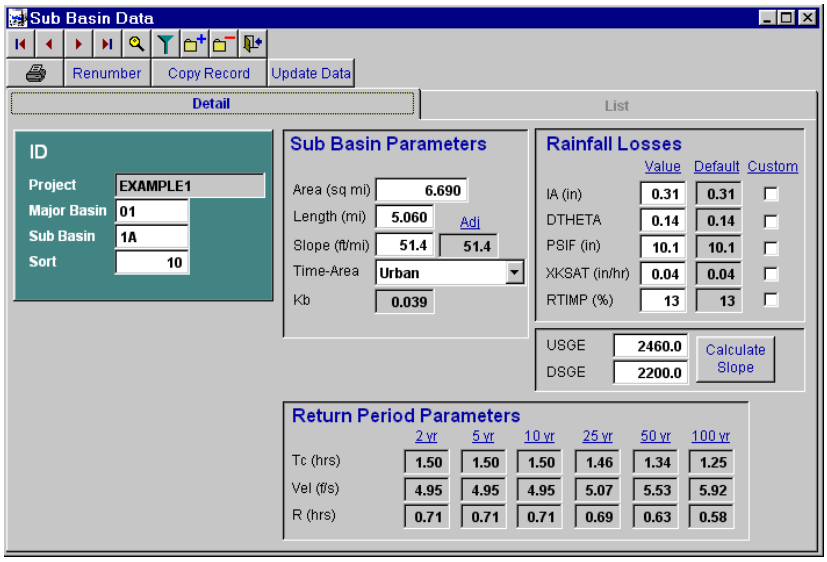
Major Basins within a project are drainage basins that generally have a major outfall. Major Basins will have separate HEC-1 input files and their ID is designated by a **two character field**. Single digit numbers must therefore be preceded by a zero. Within a project, the first Major Basin ID is designated as “01”, the second as “02” etc. until Basin “99” is reached. If the number of basins exceeds ninety-nine, a new project must be started. It is necessary to have at least one Major Basin (01) in a project.

Sub Basins

The selection of Sub Basins from the Hydrology\Basins menu is used to add a new or edit an existing Sub Basin. The form is different for HEC-1 and Rational models.

Sub Basins are drainage areas within a Major Basin. Sub Basin IDs are designated by a six character field **and must be unique within a project**. The preferred practice will be to designate the first two characters with the Major Basin ID and the remaining four characters in some systematic order.

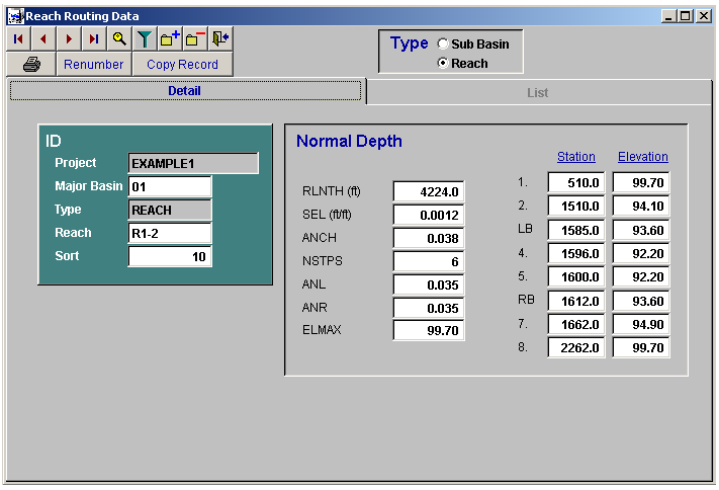
Fields appearing on the Sub Basin form will vary depending on the defaults established in the project setup. For example if the Clark Unit Hydrograph is selected as the default, then the parameters for an S-Graph will not be available. There are three columns in the Rainfall Losses section of the form. The first column, 'Value', is the value that will be used in the modeling analysis. The second column, 'Default', is the calculated value based on the default values in Land Use and Soils. The third column, 'Custom', ensures that a user entered value will not be overwritten with the calculated value when updating data.



Update Data recalculates all values based the procedures established in the County's Drainage Design Manuals. Values with the Custom box checked will not be updated.

Routing

The selection of Routing from the Hydrology\Basins menu is used to add a new or edit existing Sub Basin or Reach routing data.

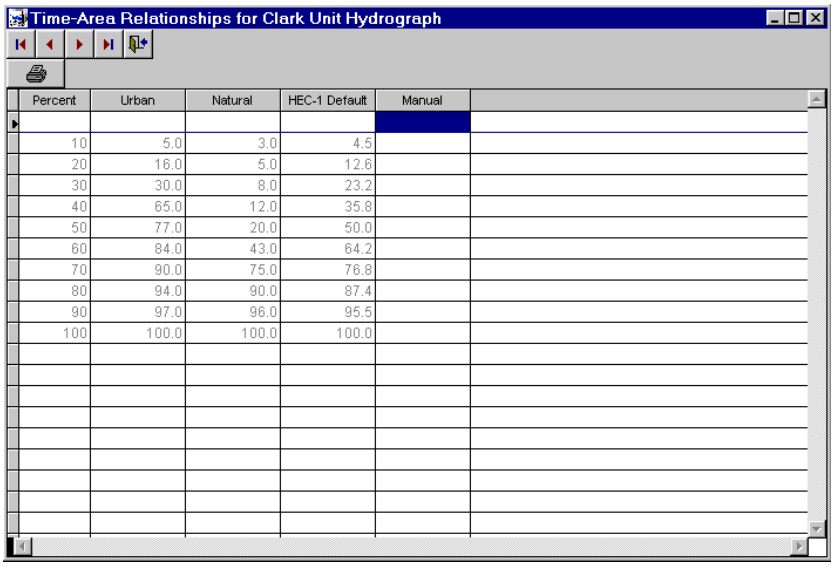


If Sub Basin is checked in the *"Type"* box at the top of the form, then Sub Basin routing data is available for editing. Likewise, if Reach is selected, then reach routing is available for editing. The Sub Basin ID must be unique and must match an ID in the Sub Basin data. The Reach ID must be unique within a project. In Maricopa County, routing is used only for Reach Routing. Basin routing is seldom used.

Distributions

Time-Area

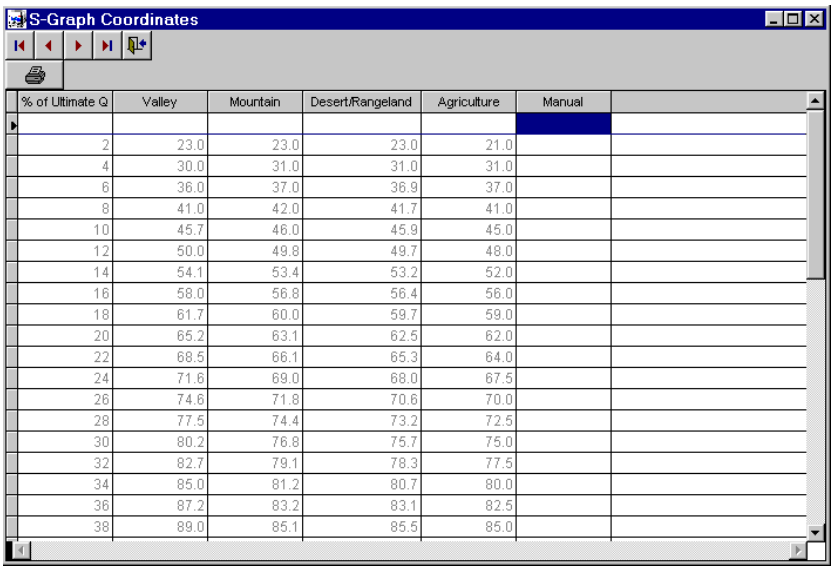
The selection of Time-Area from the Hydrology\Distributions menu is used to edit Time-Area distributions used for the Clark Unit Hydrograph. Only data in the *"Manual"* column can be edited. Time-Area is only available if "Clark" is selected as the default unit hydrograph.



Percent	Urban	Natural	HEC-1 Default	Manual
10	5.0	3.0	4.5	
20	16.0	5.0	12.6	
30	30.0	8.0	23.2	
40	65.0	12.0	35.8	
50	77.0	20.0	50.0	
60	84.0	43.0	64.2	
70	90.0	75.0	76.8	
80	94.0	90.0	87.4	
90	97.0	96.0	95.5	
100	100.0	100.0	100.0	

S-Graph

The selection of S-Graph from the Hydrology\Distributions menu is used to edit S-Graph distributions used for the S-Graph Unit Hydrograph. Only data in the *"Manual"* column can be edited. S-Graph is only available if "S-Graph" is selected as the default unit hydrograph.



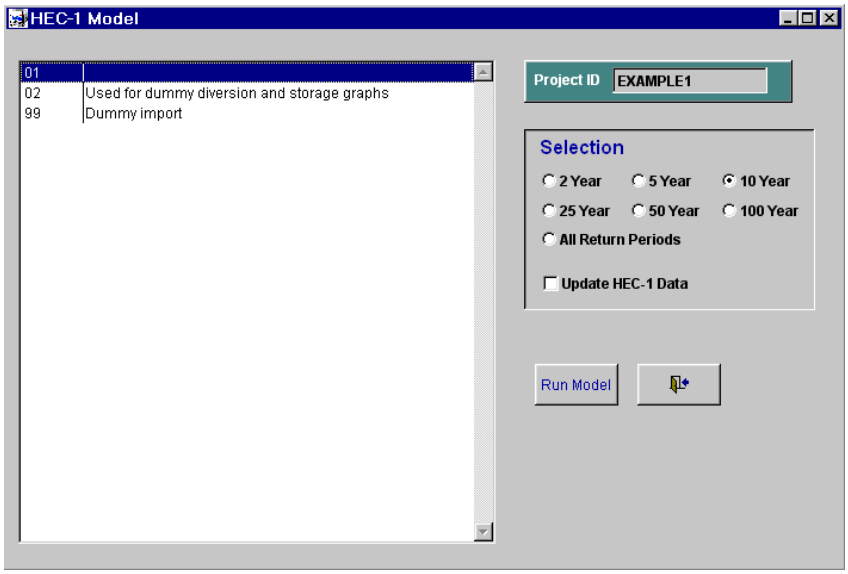
% of Ultimate Q	Valley	Mountain	Desert/Rangeland	Agriculture	Manual
2	23.0	23.0	23.0	21.0	
4	30.0	31.0	31.0	31.0	
6	36.0	37.0	36.9	37.0	
8	41.0	42.0	41.7	41.0	
10	45.7	46.0	45.9	45.0	
12	50.0	49.8	49.7	48.0	
14	54.1	53.4	53.2	52.0	
16	58.0	56.8	56.4	56.0	
18	61.7	60.0	59.7	59.0	
20	65.2	63.1	62.5	62.0	
22	68.5	66.1	65.3	64.0	
24	71.6	69.0	68.0	67.5	
26	74.6	71.8	70.6	70.0	
28	77.5	74.4	73.2	72.5	
30	80.2	76.8	75.7	75.0	
32	82.7	79.1	78.3	77.5	
34	85.0	81.2	80.7	80.0	
36	87.2	83.2	83.1	82.5	
38	89.0	85.1	85.5	85.0	

HEC-1

Run HEC-1

This function runs the HEC-1 model for selected Major Basins within a project.

HEC-1 can be run for major basins where supporting data exists and also for an imported HEC-1 input file where no supporting data exists. To run a HEC-1 model that has been developed elsewhere, simply establish either a new project or a new major basin within an existing project and import the HEC-1 input file in Edit HEC-1 Data. It is also necessary to establish whether the model uses Multiple or Single storms in "Select Project". When running the model, do not check "Update Data" as this feature will not be available.



Highlight the Major Basin to model and select the appropriate return period. The results of the model run(s) will be place in a user defined directory established in the project defaults. The resultant file names will be distinguished by the Major Basin and return period being modeled.

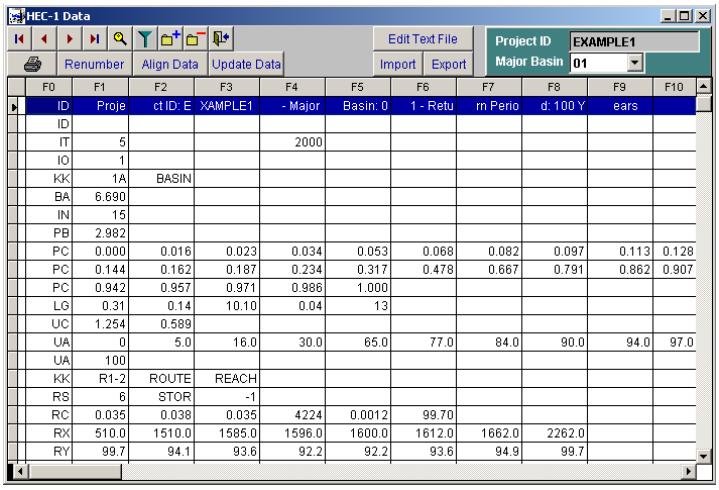
The HEC-1 data is used for all return periods. When running the model, the appropriate rainfall data is inserted for the particular return period.

When '*Update HEC-1 Data'* is selected, the sub basin and routing data is updated from the relevant Tables in the Database. ***Do not use 'Update HEC-1 Data' if you have modified the HEC-1 Data and wish to run the model with this data or do not have supporting sub-basin data in the Project.***

Note: DDMSW uses a special version of HEC-1 to facilitate data management. Using another version of HEC-1 will result in errors during the importing of final results.

Edit HEC-1 Data

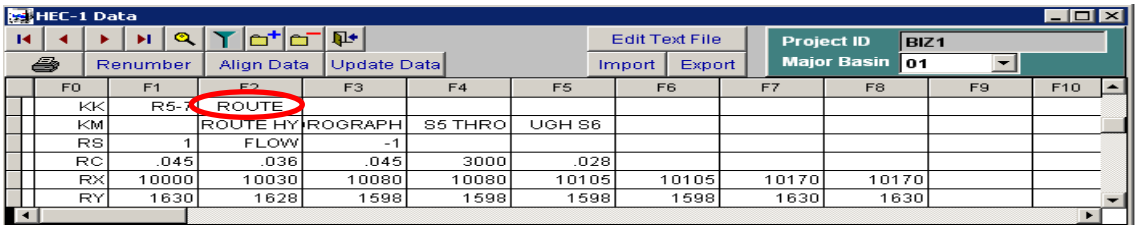
This selection allows the user to add a new HEC-1 file or edit an existing Major Basin HEC-1 file within a project.



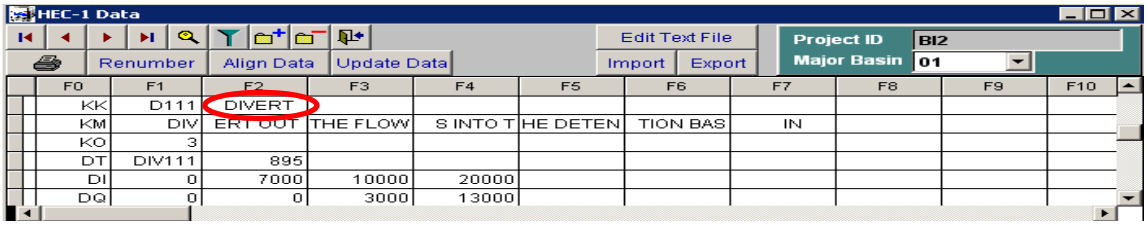
F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
ID	Proje	ct ID: E	XAMPLE1	- Major	Basin: 0	1 - Retu	rn Perio	d: 100 Y	ears	
ID										
IT	5			2000						
IO	1									
KK	1A	BASIN								
BA	6.690									
IN	15									
PB	2.982									
PC	0.000	0.016	0.023	0.034	0.053	0.068	0.082	0.097	0.113	0.128
PC	0.144	0.162	0.187	0.234	0.317	0.478	0.667	0.791	0.862	0.907
PC	0.942	0.957	0.971	0.986	1.000					
LG	0.31	0.14	10.10	0.04	13					
UC	1.254	0.589								
UA	0	5.0	16.0	30.0	65.0	77.0	84.0	90.0	94.0	97.0
UA	100									
KK	R1-2	ROUTE	REACH							
RS	6	STOR	-1							
RC	0.035	0.038	0.035	4224	0.0012	99.70				
RX	510.0	1510.0	1585.0	1596.0	1600.0	1612.0	1662.0	2262.0		
RY	99.7	94.1	93.6	92.2	92.2	93.6	94.9	99.7		

The data in this file can be exported to an ASCII file to facilitate editing by clicking on the *"Export"* button and following the instructions on the screen. After the file is exported to an ASCII file, users can use a Text Editor (Wordpad, HEC's COED or other) to arrange the sequence of the KK blocks. When finished with the editing, the file can be imported by clicking on the *"Import"* button. Importing replaces the existing data for the selected Major Basin. To view a different Major Basin's data, use the Major Basin pull-down menu. ***Do not use 'Update Data' if you have modified the HEC-1 Data and wish to run the model with this data or do not have supporting sub-basin data in the Project.***

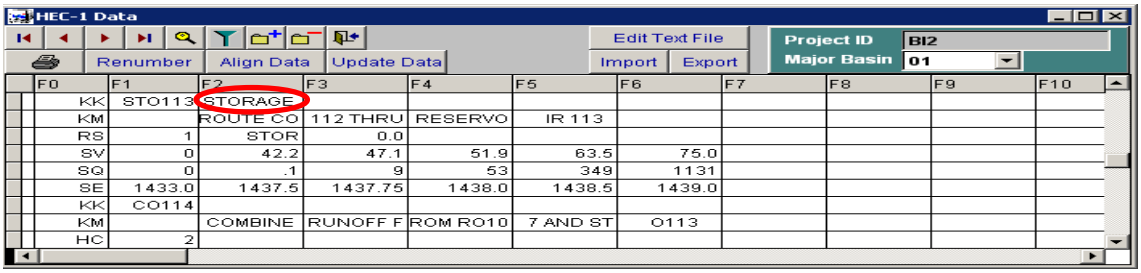
When importing a HEC-1 file where there is no supporting soil, landuse and sub-basin data, it is necessary to add "Route", "Divert" or "Storage" to the F2 field of the KK card in the HEC-1 file to make use of the graphing functions for these functions as shown below.



F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
KK	R5-7	ROUTE								
KM		ROUTE HY	ROGRAPH	S5 THRO	UGH S6					
RS	1	FLOW	-1							
RC	.045	.036	.045	3000	.028					
RX	10000	10030	10080	10080	10105	10105	10170	10170		
RY	1630	1628	1598	1598	1598	1598	1630	1630		



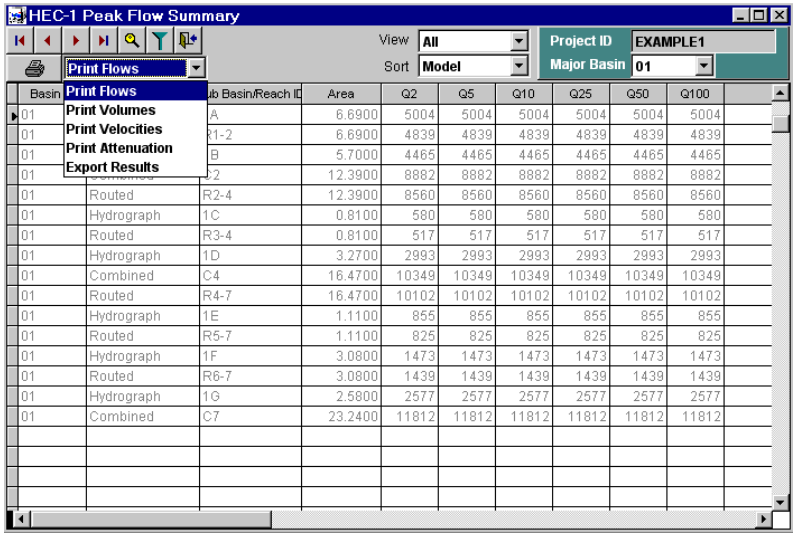
F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
KK	D111	DIVERT								
KM	DIV	ERT OUT	THE FLOW	S INTO T	HE DETEN	TION BAS	IN			
KO	3									
DT	DIV111	895								
DI	0	7000	10000	20000						
DQ	0	0	3000	13000						



F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
KK	STO113	STORAGE								
KM		ROUTE CO	112 THRU	RESERVO	IR 113					
RS	1	STOR	0.0							
SV	0	42.2	47.1	51.9	63.5	75.0				
SQ	0	.1	9	53	349	1131				
SE	1433.0	1437.5	1437.75	1438.0	1438.5	1439.0				
KK	CO114									
KM		COMBINE	RUNOFF F	ROM RO10	7 AND ST	O113				
HC	2									

View Summary Results

This displays summary results of model runs. The data cannot be edited.



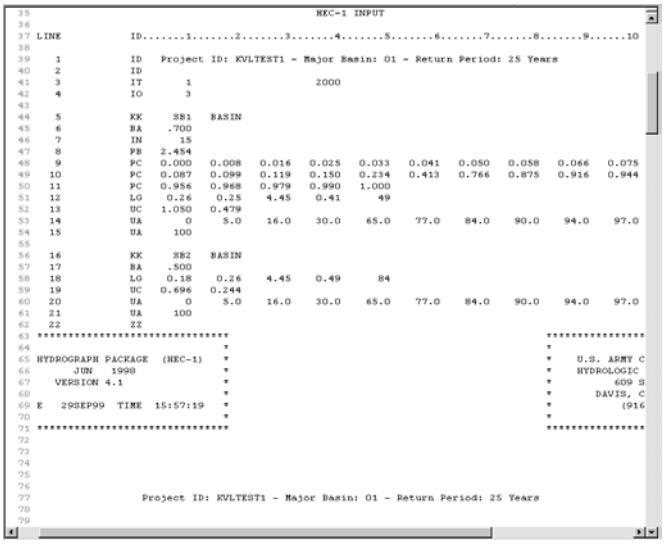
Basin		Sub Basin/Reach ID	Area	Q2	Q5	Q10	Q25	Q50	Q100
01		A	6.6900	5004	5004	5004	5004	5004	5004
01		R1-2	6.6900	4839	4839	4839	4839	4839	4839
01		B	5.7000	4465	4465	4465	4465	4465	4465
01		J2	12.3900	8882	8882	8882	8882	8882	8882
01	Routed	R2-4	12.3900	8560	8560	8560	8560	8560	8560
01	Hydrograph	1C	0.8100	580	580	580	580	580	580
01	Routed	R3-4	0.8100	517	517	517	517	517	517
01	Hydrograph	1D	3.2700	2993	2993	2993	2993	2993	2993
01	Combined	C4	16.4700	10349	10349	10349	10349	10349	10349
01	Routed	R4-7	16.4700	10102	10102	10102	10102	10102	10102
01	Hydrograph	1E	1.1100	855	855	855	855	855	855
01	Routed	R5-7	1.1100	825	825	825	825	825	825
01	Hydrograph	1F	3.0800	1473	1473	1473	1473	1473	1473
01	Routed	R6-7	3.0800	1439	1439	1439	1439	1439	1439
01	Hydrograph	1G	2.5800	2577	2577	2577	2577	2577	2577
01	Combined	C7	23.2400	11812	11812	11812	11812	11812	11812

Clicking on *"All, Combined Hydrograph or Routed"*, will filter the data to the selection. The data can also be ordered by *"Model or Numeric",* where 'Model' is the natural order from the model results and 'Numeric' is sorted by Sub Basin or Reach ID.

The user can view results by selecting 'Print Flows', 'Print Volumes', 'Print Velocities' or 'Print Attenuation' and clicking the print button. To print the report to a printer, click on the printer icon. To export the report to a PDF or other file format, click on the export button next the the printer setup icon. The default filename is the Project ID plus the Major Basin separated by "-". The default location is the 'temp' sub directory for the project. The user can override these by entering a specific filename and location for the database file.

View Output File

Select a file from the file selection dialogue box. The text editor opens the ASCII model output file. When finished viewing, close the window by clicking ✕, otherwise the text editor program will remain loaded in memory.

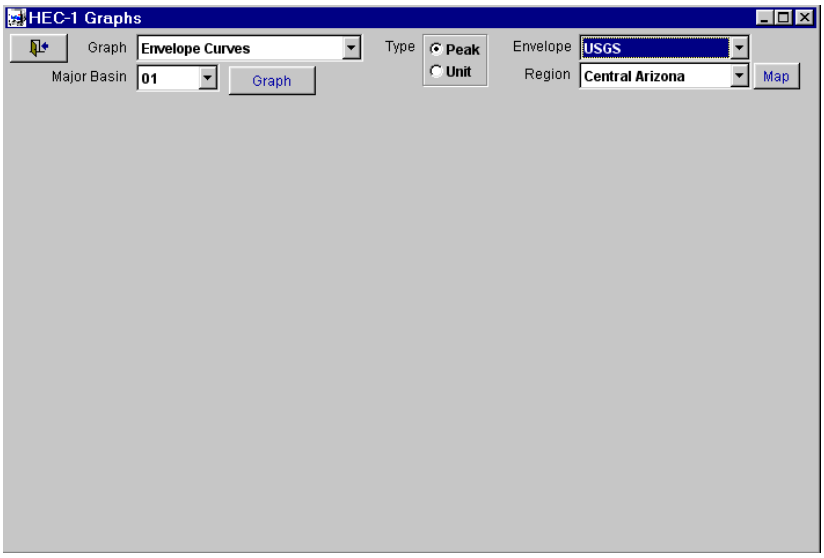


```
                                                HEC-1 INPUT

LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1         ID   Project ID: KVLTEST1 - Major Basin: 01 - Return Period: 25 Years
    2         ID
    3         IT       1                    2000
    4         IO       3

    5         KK     SB1   BASIN
    6         BA    .700
    7         IN      15
    8         PB   2.454
    9         PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.075
   10         PC   0.087   0.099   0.119   0.150   0.234   0.413   0.766   0.875   0.916   0.944
   11         PC   0.956   0.968   0.979   0.990   1.000
   12         LG    0.26    0.25    4.45    0.41      49
   13         UC   1.050   0.479
   14         UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   15         UA     100

   16         KK     SB2   BASIN
   17         BA    .500
   18         LG    0.18    0.26    4.45    0.49      84
   19         UC   0.696   0.244
   20         UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   21         UA     100
   22         ZZ
*******************************                                        ***************
*                             *                                        *
* HYDROGRAPH PACKAGE  (HEC-1) *                                        *    U.S. ARMY C
*       JUN   1998            *                                        *    HYDROLOGIC
*    VERSION 4.1              *                                        *         609 S
*                             *                                        *       DAVIS, C
*E   29SEP99  TIME  15:57:19   *                                        *          (916
*                             *                                        *
*******************************                                        ***************




                Project ID: KVLTEST1 - Major Basin: 01 - Return Period: 25 Years
```

Graphs

The 'Graphs' option has been developed to facilitate the review of hydrological results and data input. Graphs that facilitate the review of hydrological results include envelope curves for USGS, Malvick and Boughton. These curves are compared to peak or unit discharge model results. Graphs that facilitate the review of input data include channel cross-sections, diversions, stage-discharge and stage-volume relationships.

Click Map to view the map of the USGS region.



Graphs Toolbar

The following tools are available on the graph screen:

Copies the graph to the clipboard as a bitmap, metafile, text or OLE object.

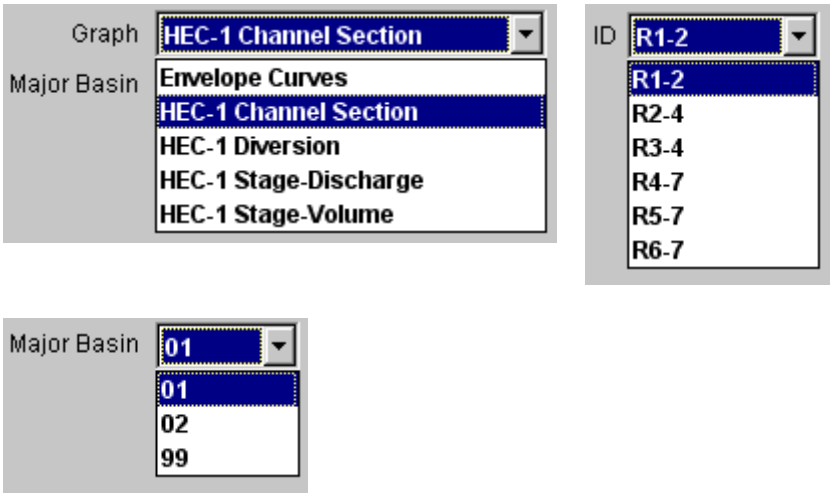
Data Editor. This displays the data values at the bottom of the screen. These values can be edited, and the graph dynamically reflects these changes.

	1	2	3	4	5	6	7	8
— 1	510	1510	1585	1596	1600	1612	1662	2262
	99.70	94.10	93.60	92.20	92.20	93.60	94.90	99.70

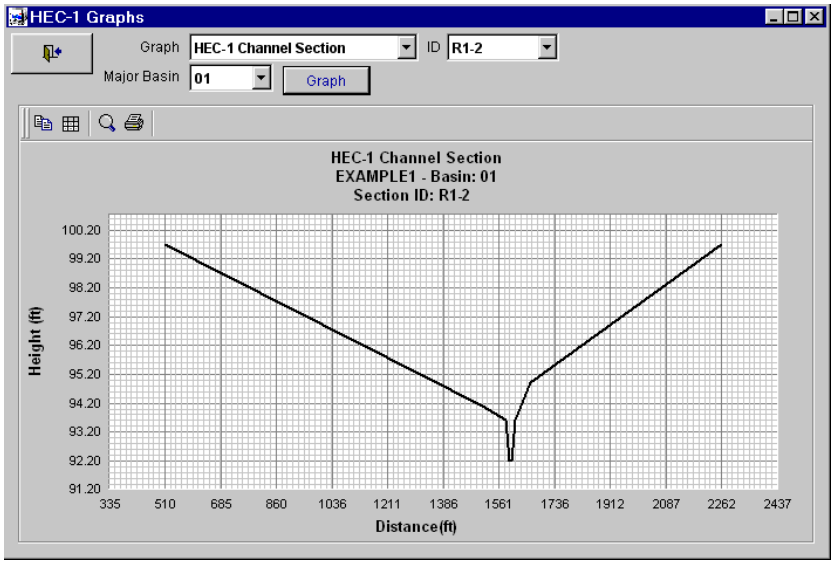
Zoom tool. Click this icon and draw an area of the graph to be magnified.

Prints the graph.

Select a Major Basin, the Section ID and the type of graph from the pull-down lists.



Click the Graph button to display the graph on the screen.



Depending on the graph type, other choices are available as follows:

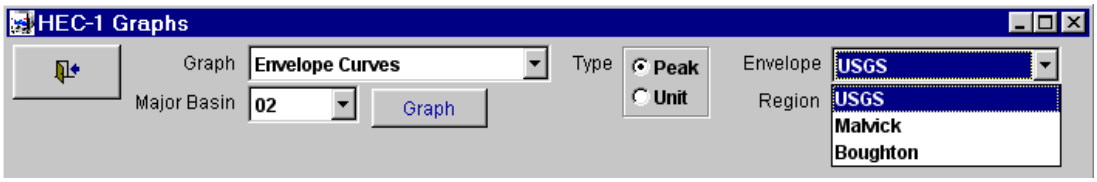
Envelope Curves (USGS, Malvick and Boughton)

Select USGS, Malvick or Boughton data. The USGS data was derived manually from the data contained in "Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States", United States Geological Survey Water-Supply Paper 2433. Northeastern Arizona – Figure 39, Central Arizona – Figure 41, Southern Arizona – Figure 42 and Upper Gila Ben – Figure 44. The legend on each of the graphs is as follows:

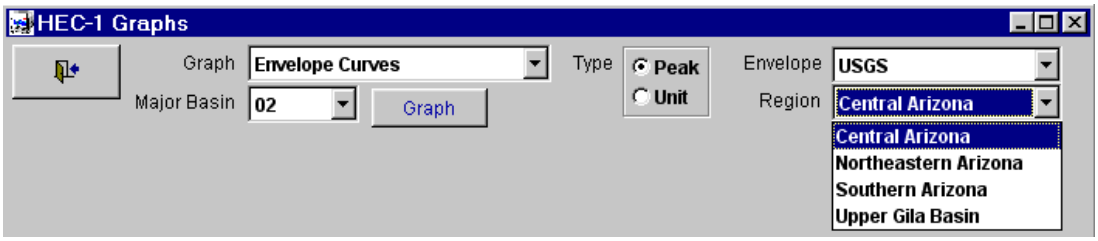
Envelope	Envelope Curve for Study Area
Region	100-Year Peak Discharge Relation for Region
Low-Mid Elevation	100-Year peak Discharge Relation for Low to Middle-Elevation Study Area

The Malvick data was derived from "A Magnitude-Frequency-Area relation for Floods in Arizona", Allan J. Malvick, January 1980, Figure 6 – 100-year curve. The Boughton data was derived from "Highway Drainage Design Manual Hydrology", Report Number FHWA-AZ93-281, March 1993, Figure 10-1 Curve H.

The selection of Envelope Curves from the Graphs pull-down provides the following choices.



If USGS is selected from the Envelope pull-down, then the user can select the appropriate Region as shown.

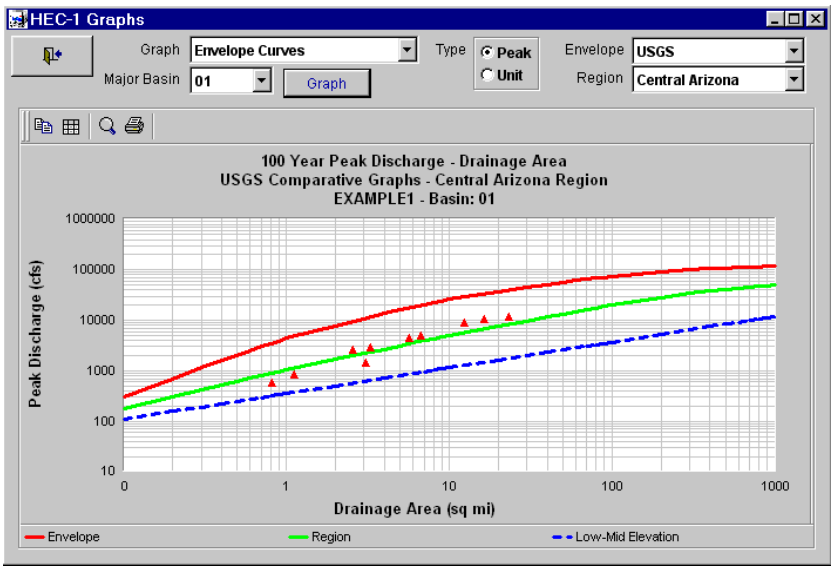


All of the envelope curves can be graphed in either Peak (Peak Discharge in cfs) or Unit (Unit Discharge in cfs/sq mi).

Peak Discharges Scatter Graph

The Peak Discharges Graph is a graph of drainage area verses peak discharge (or unit discharges) for sub-basins and combined flows. The data is generated when running HEC-1 and is saved in Table HEC1SUMM.DBF. For this analysis, only the 100-year flows are graphed. From within a specific Project, the user selects a major basin. If the major basin has been modeled, the 100-year area and discharges for "*Hydrographs"* (sub-basins) and "*Routed"* (routed flows) are copied to a temporary file for graphing.

Selection of Major Basin 01, USGS Envelope with Central Region and Peak will produce the following graph:



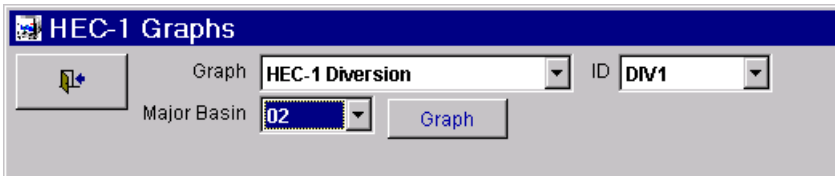
Note that the legend can moved anywhere on the graph screen.

Rating Curves Plot

Rating curves are for Stage-Discharge, Stage-Volume and Diversions. The data is developed from the HEC-1 input file as follows:

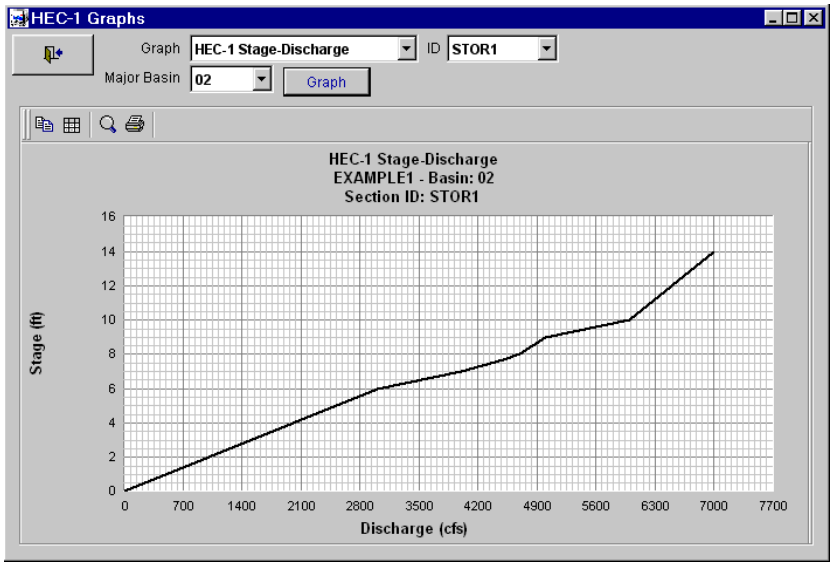
Stage-Discharge	SE and SQ cards
Stage-Volume	SE and SV cards
Diversions	DI and DQ cards

When the user selects a new Major Basin, the HEC-1 input file for the Major Basin is scanned for SE and DI cards. The KK value for all found SE and DI cards establishes the available ID's to graph. The ID's are saved to a temporary file and the data for the graphs (SE-SQ, SE-SV and DI-DQ) are saved to a separate temporary file. The user must also select an ID.

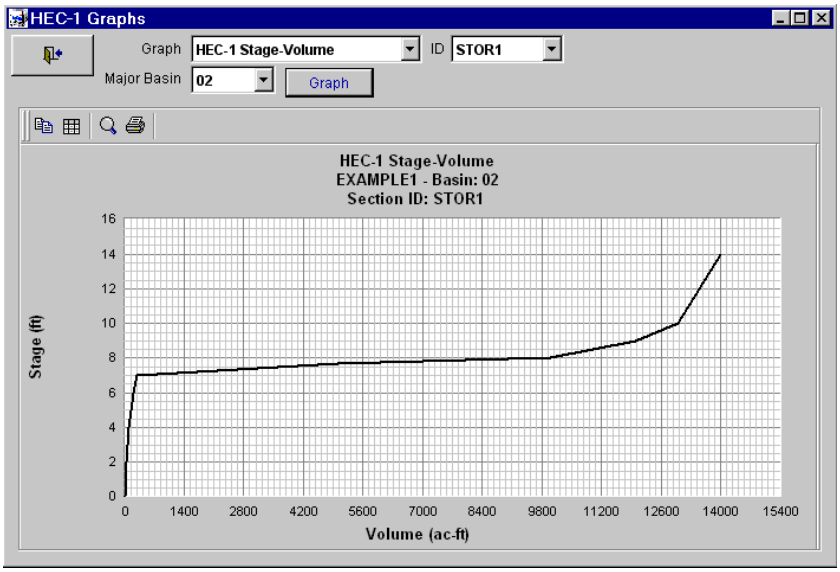


The following three Rating Curve graphs are available:

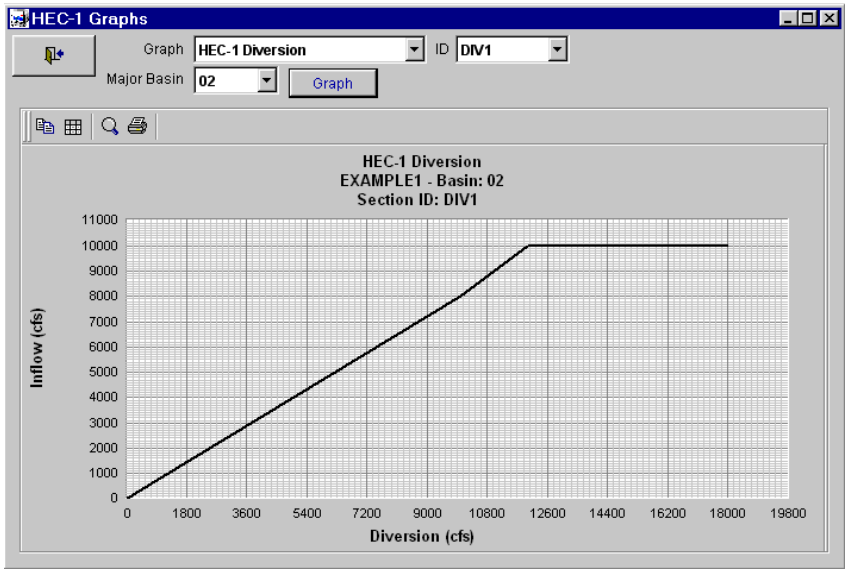
Stage-Discharge



Stage-Volume

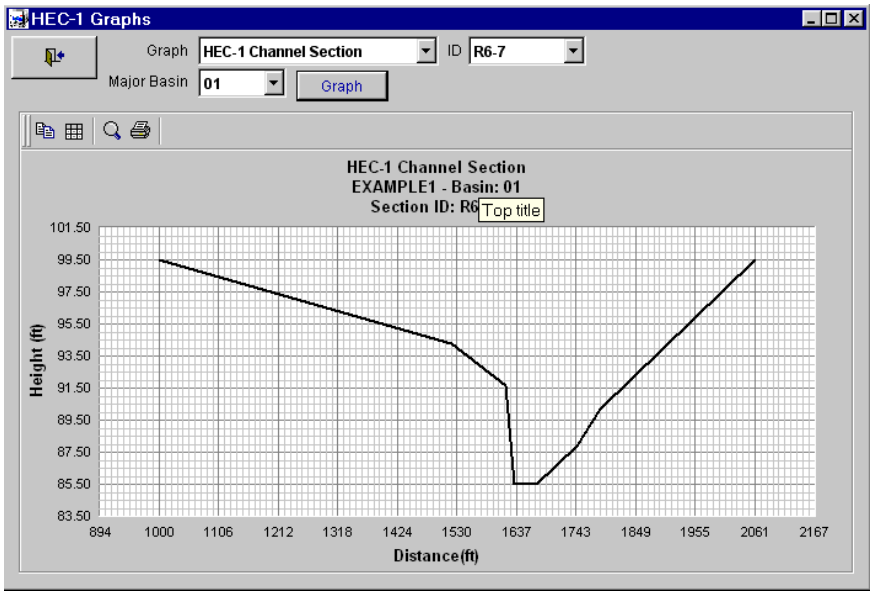


Diversion



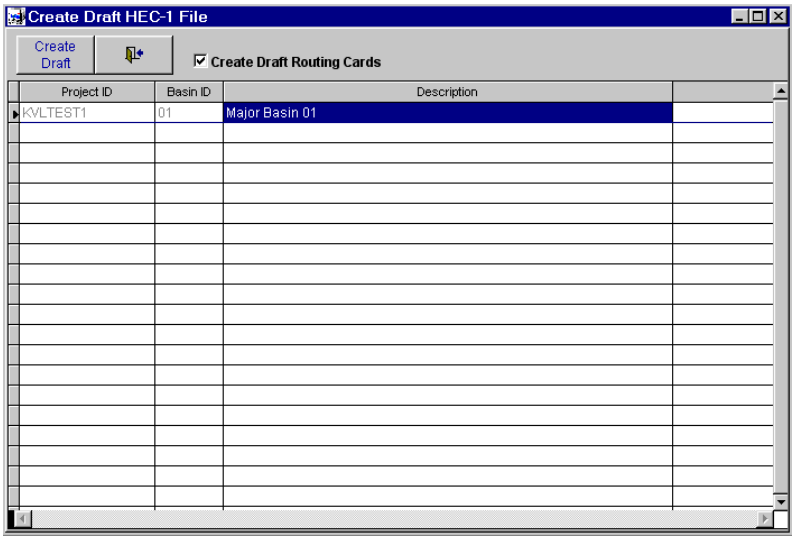
Channel Section Plot

Channel section plots are for RX-RY cards developed from the HEC-1 input file. When the user selects a new Major Basin, the HEC-1 input file for the Major Basin is scanned for RX cards. The KK value for all found RX cards establishes the available ID's to graph. The ID's are saved to a temporary file and the data for the graphs (RX-RY) are saved to a separate temporary file. The user selects an ID for the following typical graph.



Develop Draft Model Data

The selection of Develop Draft Model Data from the Hydrology\HEC-1 menu is used to develop draft HEC-1 data from the Sub Basin and default data used in the project. When "Create Draft" button is clicked, the program **will replace any existing data for the selected Major Basin** in the HEC-1 data file and should only be used at the beginning of a project. The program requires the Sub Basin data to be available. If *"Create Draft Routing Cards"* is selected, available routing data will be appended to the draft file. It will be up to the user to place the routing cards in the appropriate location.



5. Hydraulics

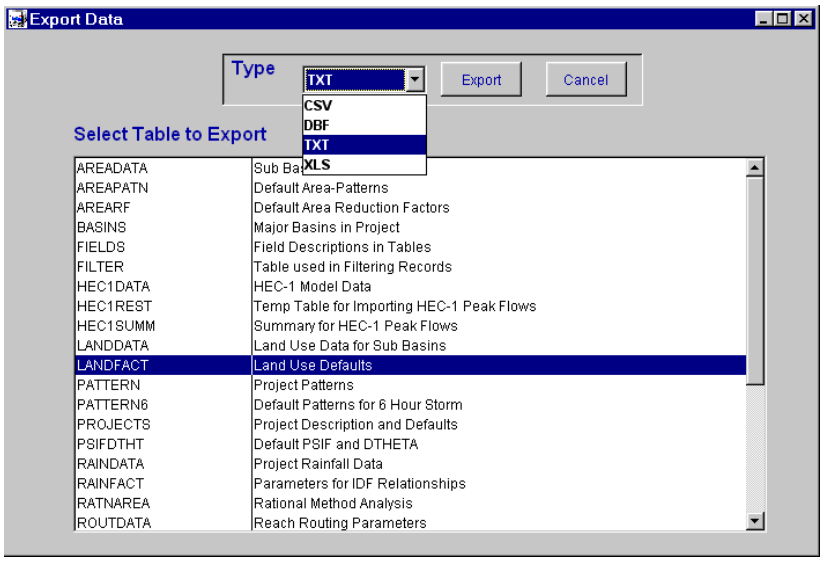
To be developed!

6. GIS

To be developed!

7. Utilities

Export Data



The selection of Export Data from the Utilities menu is used to export a Table from the Database to a file in a different format. All the record data in the Table are exported. Note that the Table contents are not removed, but are copied to a different file format. The file formats supported include:

CSV Data is exported into a file one record per line, with each field separated by a comma. Character fields are enclosed in quotes. For example:

```
projectid,lucode,dthetadesc,vegcover,rtimp,ia,kn,kbdesc,group,descript,c10,iadesc,sort
"BETA010","M","Dry",25.0,0,0.25,0.050,"Max","","MOUNTAIN",0.00,"",10
"BETA010","H","Dry",30.0,0,0.15,0.040,"Hi","","HILLSLOPE",0.00,"",20
"BETA010","D","Dry",30.0,0,0.35,0.030,"Low","","DESERT RANGELAND",0.00,"",30
```

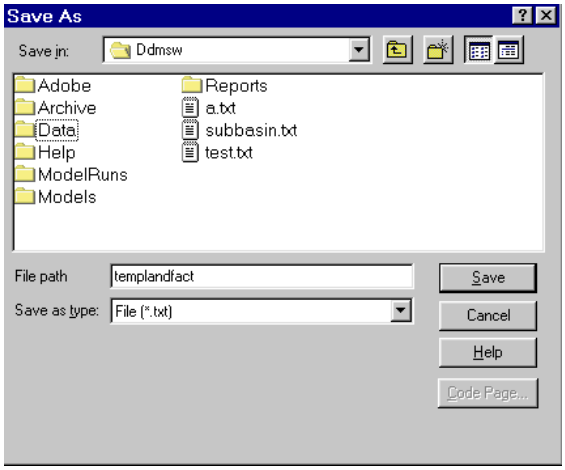
TXT Data is exported one record per line in ASCII text that can be read by any text editor. The data is in fixed format (columns). For example:

```
BETA010         M               Dry     25.0   0 0.250.050Max                                  MOUNTAIN
BETA010         H               Dry     30.0   0 0.150.040Hi                                   HILLSLOPE
BETA010         D               Dry     30.0   0 0.350.030Low                                  DESERT RANGELAND
```

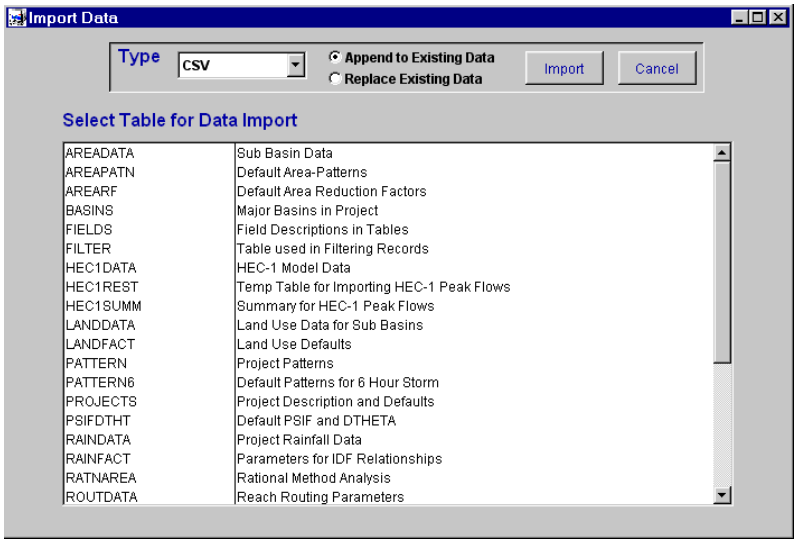
DBF Exports data into a format that can be read by a Database program such as Dbase or FoxPro.

XLS Select this type to create an spreadsheet which can be opened in Microsoft Excel.

Use the mouse to highlight the Table and select an export type from the drop down selection box, then click 'Export'. The contents (all records) of the selected Table is saved on disk in the chosen format. The user is prompted to enter a filename and location for the export file.



Import Data

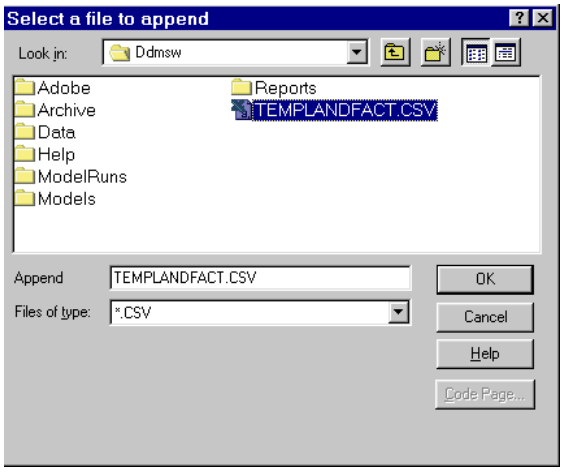


The selection of Import Data from the Utilities menu is used to import data originating from another source, such as a spreadsheet, text file or another database, into a selected table. The file formats supported include CSV, TXT, DBF, and XLS, as described in 'Export Data'. There are two options:

- Append to Existing Data — This option adds the data to the existing data. The results will include the current and the newly imported data.
- Replace Existing Data — This option deletes the current data in the table, and then replaces it with the new data.

It is important that the data to be imported has the same structure as the importing Table, otherwise fields will be truncated and records rejected. For this reason, a good practice is to first export a Table and then use the exported file as a template for the acceptable format.

Highlight the Table to append or replace, select the file type and click 'Import'. The following dialogue box appears for the user to select the file to import. Highlight the filename and click 'OK'.



Pack Tables

This function rebuilds the Table indexes, and then packs all Tables in the Database. Packing is the process of **permanently removing records** that have been marked for deletion. Once a Table is packed, records cannot be recovered. Packing recoups disk space occupied by deleted records. It should not be necessary to pack the Database frequently, but on occasion after many records have been deleted over time.

> **Caution:** **Packing Tables take a few minutes to complete. Do not interrupt the process once it has begun.**

Table Descriptions

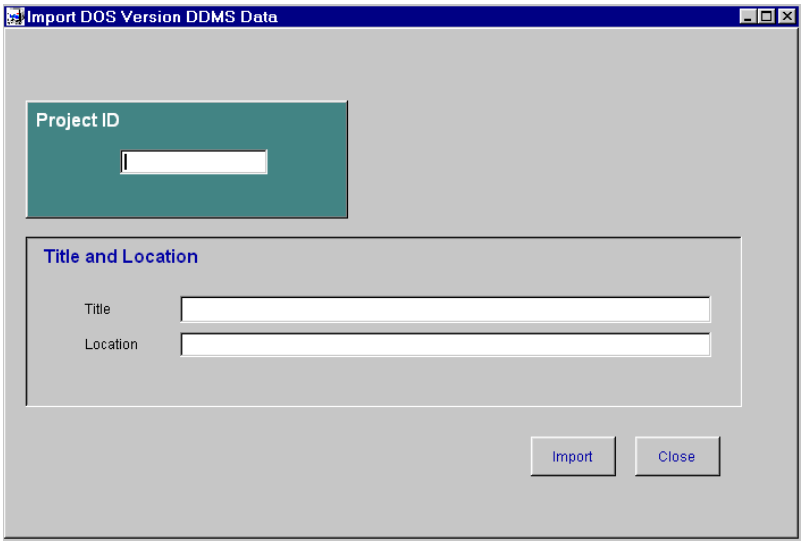
The selection of Table Descriptions from the Utilities menu is used to view the name and description of Tables used in the application. The data cannot be edited.

Field Descriptions

The selection of Field Descriptions from the Utilities menu is used to view the structure of each Table used in the application. The data cannot be edited.

Import DOS Family

The selection of Import DOS Family from the Utilities menu is used to import data developed in the DOS version of DDMS.



Enter a Project ID, title and location for the data to be imported. This is the same information as starting a new project. The click the *"Import"* button. The program will import data as follows:

Sub Basin Area data	From a file with an .SBR extension
Default Land Use data	From a file with an .LDF extension
Sub Basin Land Use data	From a file with an .SUB extension
Sub Basin Soil data	From a file with an .SUB extension
Hydrograph Type	From a file with an .SUB extension
Precipitation data	From a file with an .PFI extension
Storms, duration,Timearea,NMIN	From either *M1I or *M2I

If the above files are not available for the *"family",* then not all of the required data will be imported and the remaining required data will have to be entered manually into the Database.

8. Help and Window

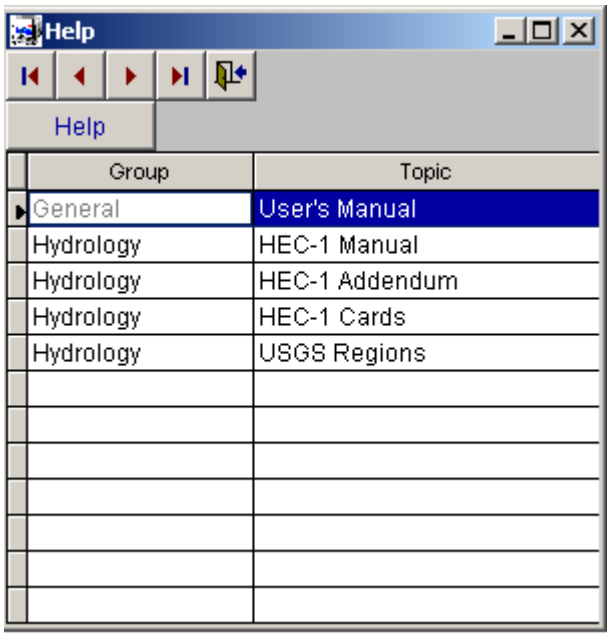
Help

About

This displays the informational screen for the application.

Help

This option on the Help menu displays a list of manuals that the user can view. Highlight a manual and click Help. Acrobat reader opens the manual on the screen. When finished viewing, close the Acrobat screen otherwise it will remain open on the desktop. (The path to Acrobat Reader must be entered in the Help Reader in File\Setup.)



Window

Two options are available on the Window Menu.

Cascade

Use this to cascade all open forms on the screen. Alternatively, the user can press 'Ctrl T' at any time to arrange forms.

Close All

Use this to close all open forms. Pressing 'Ctrl A' has the same effect.

Example

Introduction

There are a number of Projects that have been used to test the application. The data in these projects can be reviewed by importing the Project to see how data is entered for the various type of default settings. The following are Projects that come with DDMSW installation:

Project ID	Hydrograph	Storms	Duration	Loss Method
EXAMPLE1	Clark	Single	6 Hour	Green-Ampt
EXAMPLE2	S-Graph	Single	24 Hour	Green-Ampt
EXAMPLE3	S-Graph	Multiple	6 Hour	Green-Ampt
EXAMPLE4	Clark	Single	6 Hour	Init & Uniform
EXAMPLE5	Rational Method			

Establish a New Project (MYEXAMPLE1)

The steps to establish a new project through to running the HEC-1 model and viewing the results are as follows:

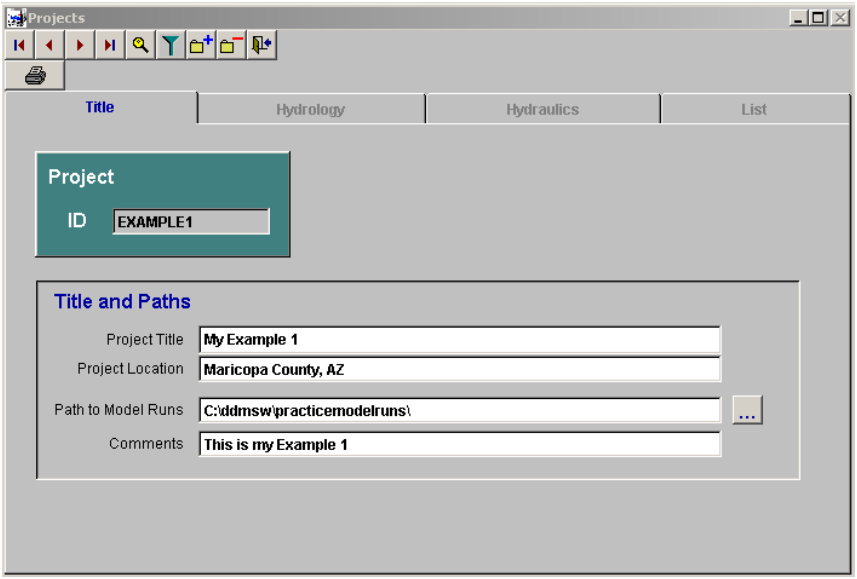
1. Establish Path for Model Runs
2. Create New Project and Establish Defaults
3. Establish Rainfall Data for Project
4. Establish Land Use Defaults
5. Establish Soil Defaults
6. Establish Land Use Data
7. Establish Soil Data
8. Establish Major Basin
9. Establish Sub Basin Data
10. Establish Routing Data
11. Develop Draft HEC-1 Input File
12. Edit Draft HEC-1 Input File
13. Run HEC-1 Model
14. View Model Summary Results

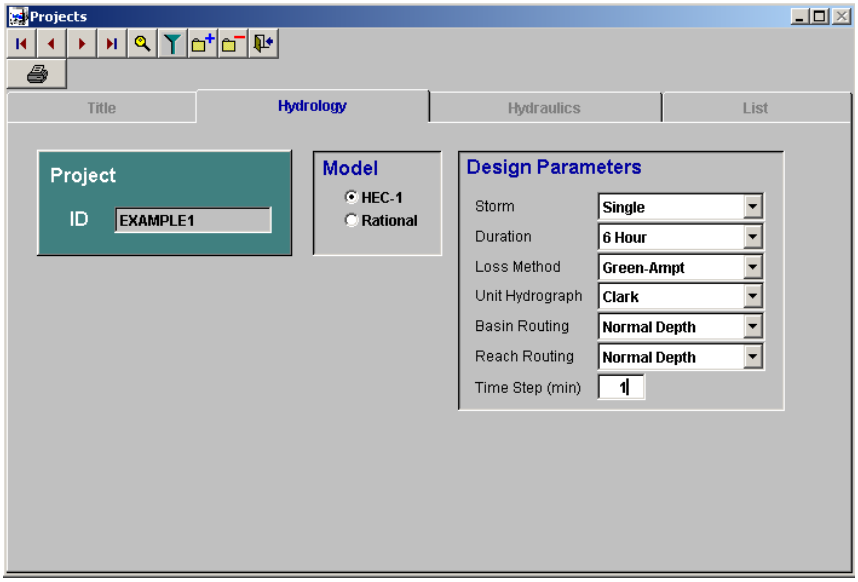
1. Establish Path for Model Runs

Create a folder for the HEC-1 model runs. For this example, a new folder C:\ddmsw\practicemodelruns has been created.

2. Create New Project and Establish Defaults

Select *New Project* from the *File* Menu and fill in data for Title and Hydrology defaults.

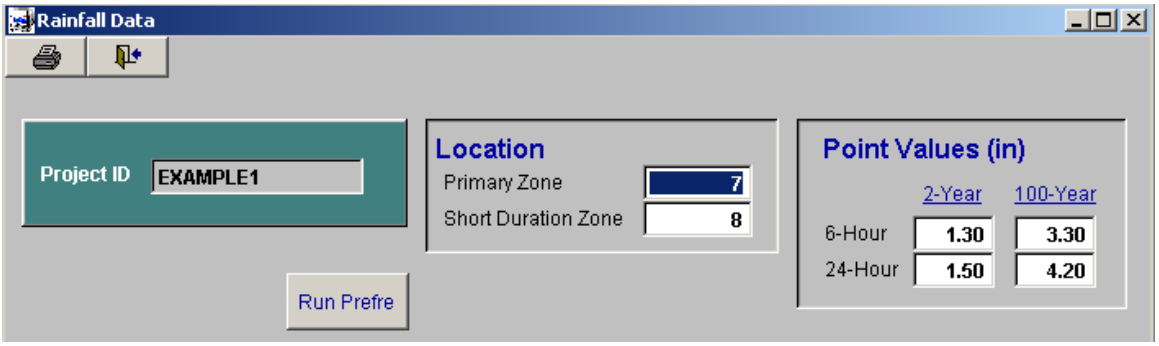




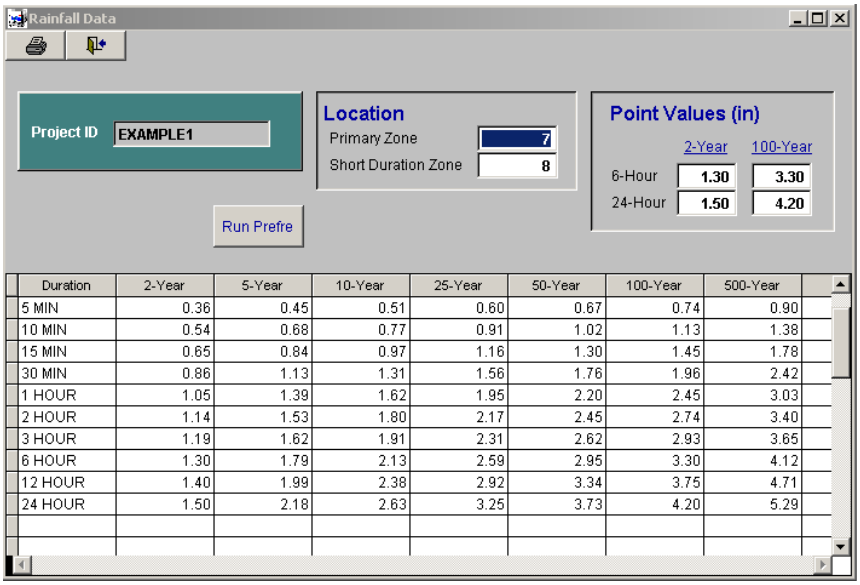
In Maricopa County, Basin Routing is seldom used but may be occasionally used for overland flow.

3. Establish Rainfall Data for Project

Select *Prefre* from the *Hydrology\Rainfall* Menu. Fill in data shown below.



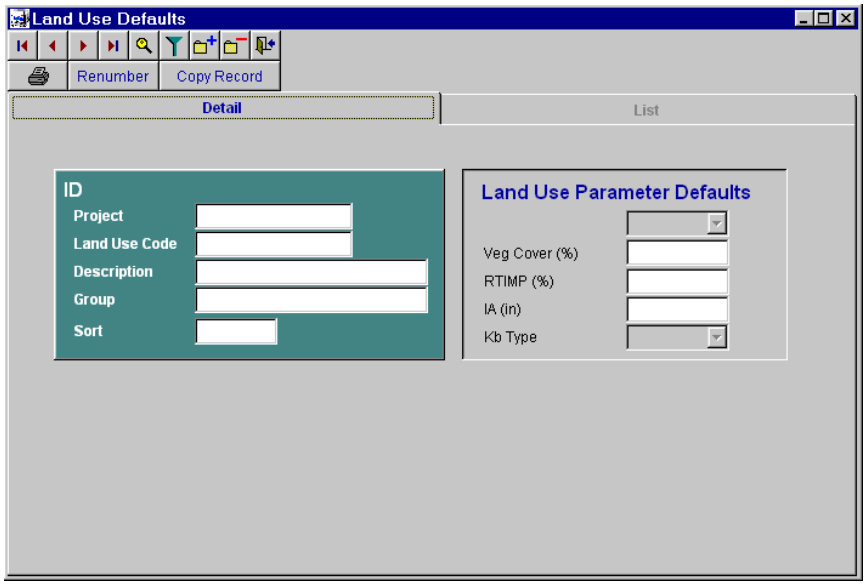
Click Run Prefre to run the Prefre model and establish rainfall data as shown below.



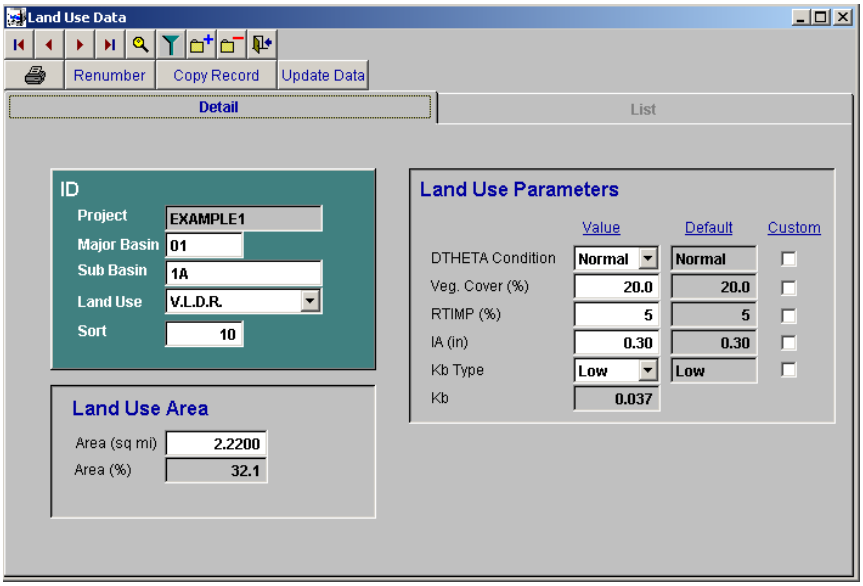
Duration	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
5 MIN	0.36	0.45	0.51	0.60	0.67	0.74	0.90
10 MIN	0.54	0.68	0.77	0.91	1.02	1.13	1.38
15 MIN	0.65	0.84	0.97	1.16	1.30	1.45	1.78
30 MIN	0.86	1.13	1.31	1.56	1.76	1.96	2.42
1 HOUR	1.05	1.39	1.62	1.95	2.20	2.45	3.03
2 HOUR	1.14	1.53	1.80	2.17	2.45	2.74	3.40
3 HOUR	1.19	1.62	1.91	2.31	2.62	2.93	3.65
6 HOUR	1.30	1.79	2.13	2.59	2.95	3.30	4.12
12 HOUR	1.40	1.99	2.38	2.92	3.34	3.75	4.71
24 HOUR	1.50	2.18	2.63	3.25	3.73	4.20	5.29

4. Establish Land Use Defaults

Select *Defaults* from the *Hydrology\Land Use* Menu. The first time you come to this screen, it will look like the following screen. This screen will look different if "Green-Ampt" is not the default Loss Method.



Click  to create a new record and fill in the data for the first record as shown below. Use appropriate Tables in the County's Drainage Manual for reference.

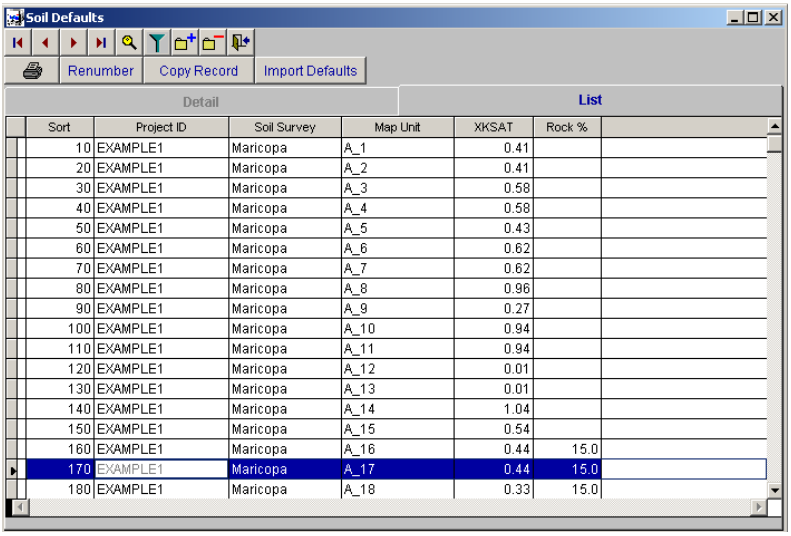


To add new records either create a new record as just described or click 

(use Browse to view data) and edit the data for the new record.

5. Establish Soil Defaults

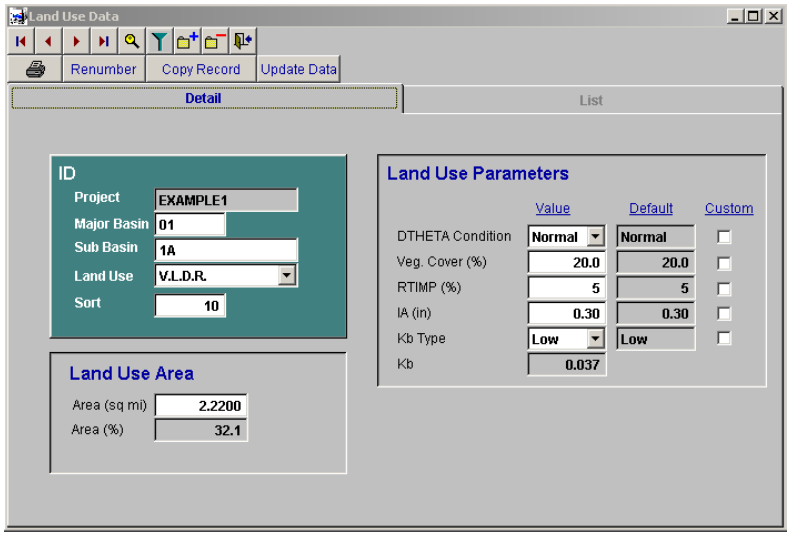
Select *Defaults* from the *Hydrology\Soil* Menu. If Soil Default data does not exist for this project, then the County default Table will be loaded. The user can then modify the data to establish different defaults to be used for this project. If it is necessary to add new data, then do it in the same manner as adding new records for the Land Use Defaults. The following view is shown in Browse mode.



Sort	Project ID	Soil Survey	Map Unit	XKSAT	Rock %
10	EXAMPLE1	Maricopa	A_1	0.41	
20	EXAMPLE1	Maricopa	A_2	0.41	
30	EXAMPLE1	Maricopa	A_3	0.58	
40	EXAMPLE1	Maricopa	A_4	0.58	
50	EXAMPLE1	Maricopa	A_5	0.43	
60	EXAMPLE1	Maricopa	A_6	0.62	
70	EXAMPLE1	Maricopa	A_7	0.62	
80	EXAMPLE1	Maricopa	A_8	0.96	
90	EXAMPLE1	Maricopa	A_9	0.27	
100	EXAMPLE1	Maricopa	A_10	0.94	
110	EXAMPLE1	Maricopa	A_11	0.94	
120	EXAMPLE1	Maricopa	A_12	0.01	
130	EXAMPLE1	Maricopa	A_13	0.01	
140	EXAMPLE1	Maricopa	A_14	1.04	
150	EXAMPLE1	Maricopa	A_15	0.54	
160	EXAMPLE1	Maricopa	A_16	0.44	15.0
170	EXAMPLE1	Maricopa	A_17	0.44	15.0
180	EXAMPLE1	Maricopa	A_18	0.33	15.0

6. Establish Land Use Data

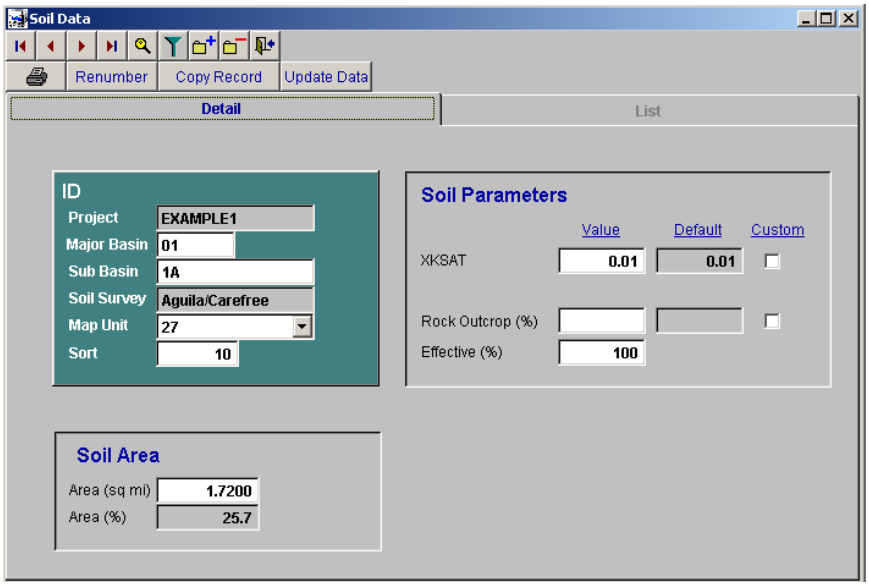
Select *Data* from the *Hydrology\Land Use* Menu. Add or Copy records to populate the necessary data as shown below. It is only necessary to add the Sub Basin ID, select the Land Use and add the Area in square miles. Then click Update Data to populate the Default Values. If a non-default value is used, it will be necessary to check the adjacent Custom box. Values with adjacent Custom box checked will not be updated.



Be sure to enter land use data for each Sub Basin ID in this Project and make sure there is sufficient land use data to cover the entire Sub Basin.

7. Establish Soil Data

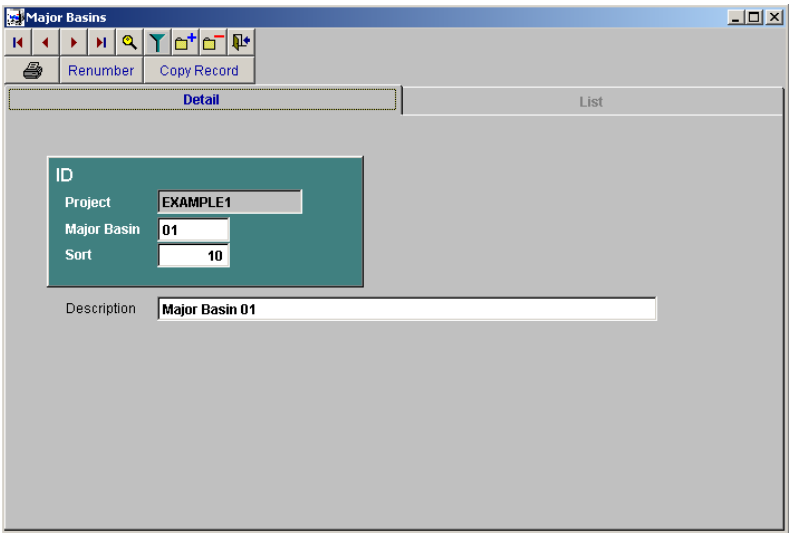
Select *Data* from the *Hydrology\Soil* Menu. Add or Copy records to populate the necessary data as shown below. It is only necessary to add the Sub Basin ID, select the Map Unit and add the Area in square miles. Then click Update Data to populate the Default Values. If a non-default value is used, it will be necessary to check the adjacent Custom box. Values with adjacent Custom box checked will not be updated.



Be sure to enter soil data for each Area ID in this Project and make sure there is sufficient soil data to cover the entire Area ID's area.

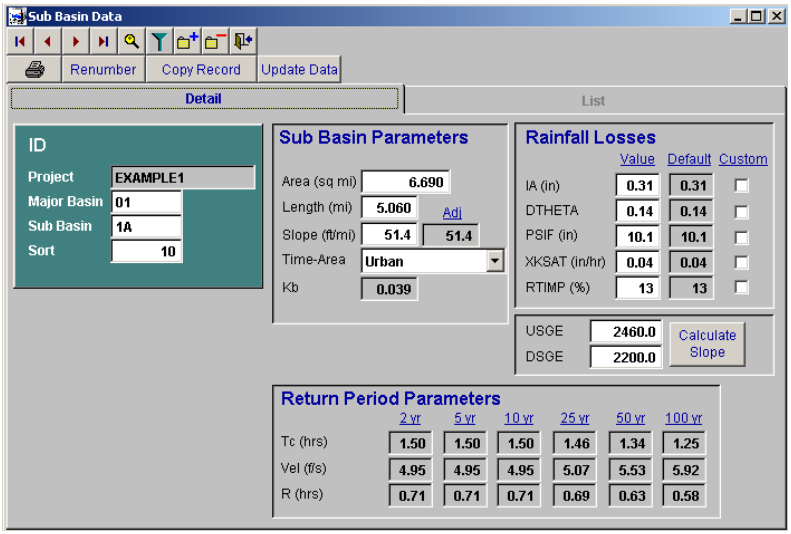
8. Establish Major Basin

Select Major Basins from the *Hydrology\Basins* Menu. Add or Copy records to populate the necessary data as shown below. Each hydrology model run will be for a unique Major Basin ID. Select 01 for the first basin, 02 through 99 for other Major Basins.



9. Establish Sub Basin Data

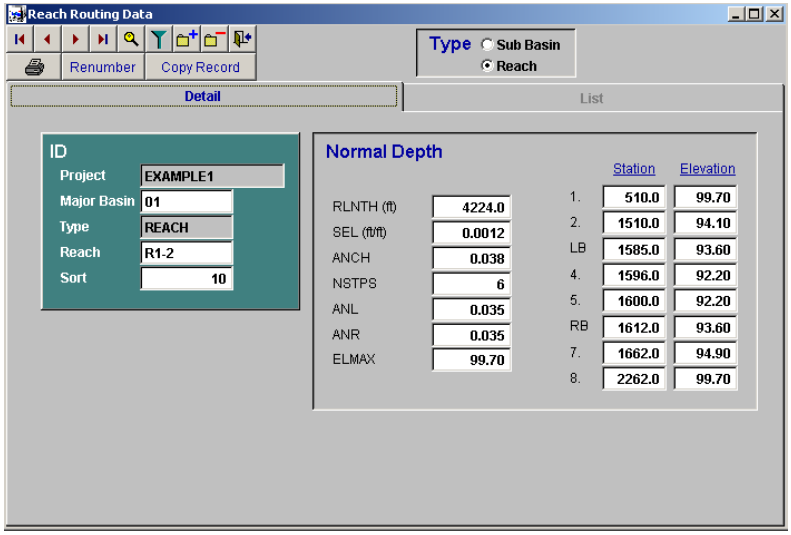
Select *Sub Basins* from the *Hydrology\Basins* Menu. Add or Copy records to populate the necessary data as shown below. Forms may look different depending on the established project defaults. To populate the remaining data, click “Update Data”. This updates all records for the Sub Basin data for this Project.



Following the Update Data, if there are any errors or values falling outside standards, then a report will come to the screen that can be printed. Review this report to see what needs to be fixed.

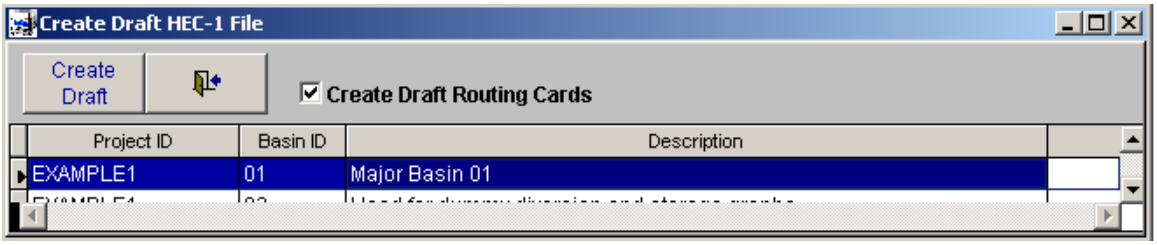
10. Establish Routing Data

Select *Routing* from the *Hydrology\Basins* Menu. Add or Copy records to populate the necessary data as shown below. Forms may look different depending on the established project defaults.



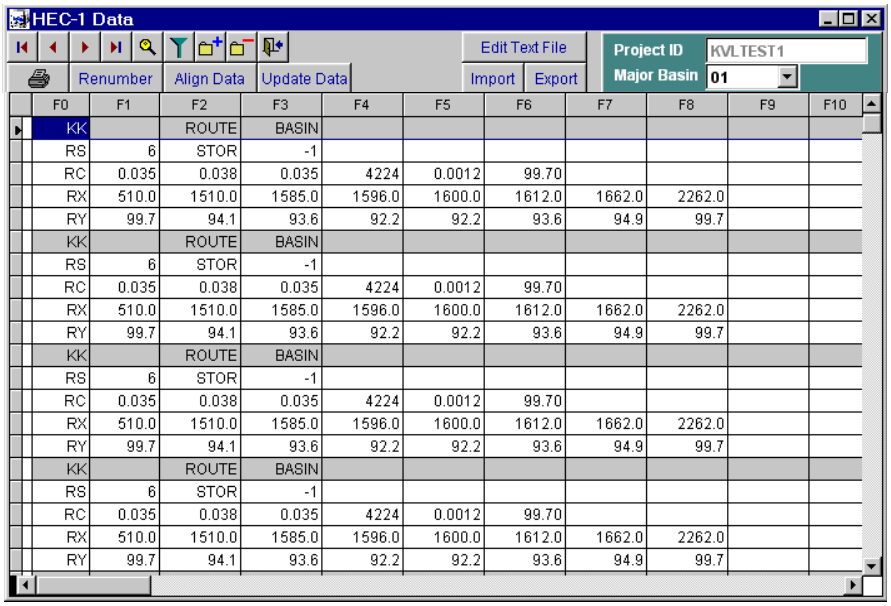
11. Develop Draft HEC-1 Input File

Select *Develop Draft Model Data* from the *Hydrology\HEC-1* Menu. Select the appropriate Major Basin and check whether or not to create Draft Routing Cards. Click on "Create Draft**".**

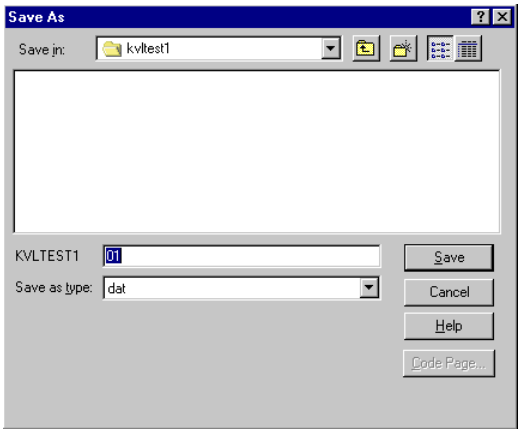


12. Edit Draft HEC-1 Input File

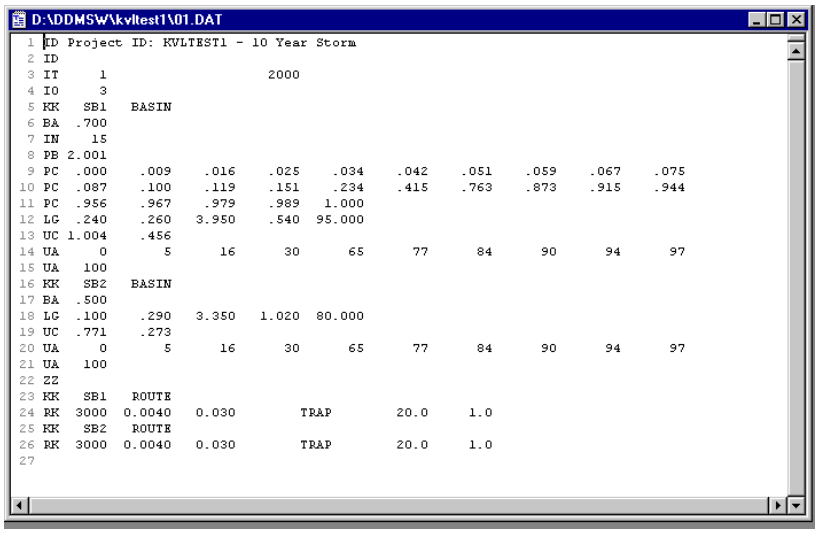
Select *Edit HEC-1 Data* from the *Hydrology\HEC-1* Menu. Select the appropriate Major Basin ID.



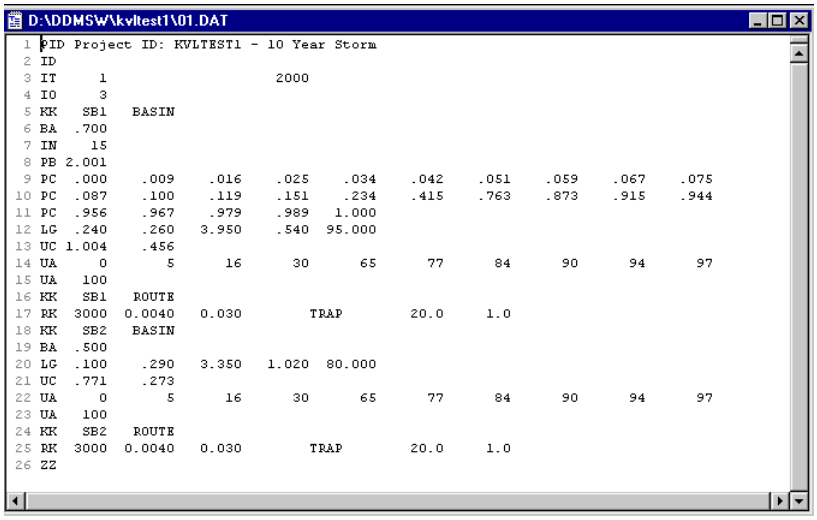
The best way to edit this data is to export the file to an ASCII file and edit the data and then import the ASCII file when edits are complete. Click **"Export"** to export the file. A dialogue box comes up with the default model runs path and the Basin ID. Click save.



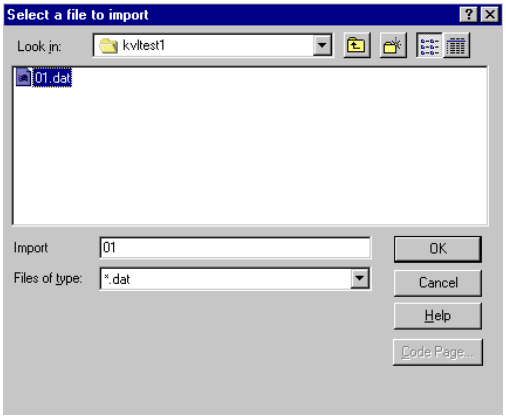
The following is an example of the draft HEC-1 ASCII file (note the routing cards are at the bottom).



Depending on the default routing option, the routing cards will be different. If the routing card option was selected when developing the draft file, the records will be at the bottom of the file. Move the routing cards to the correct location and clean up any trailing lines in the file as follows:

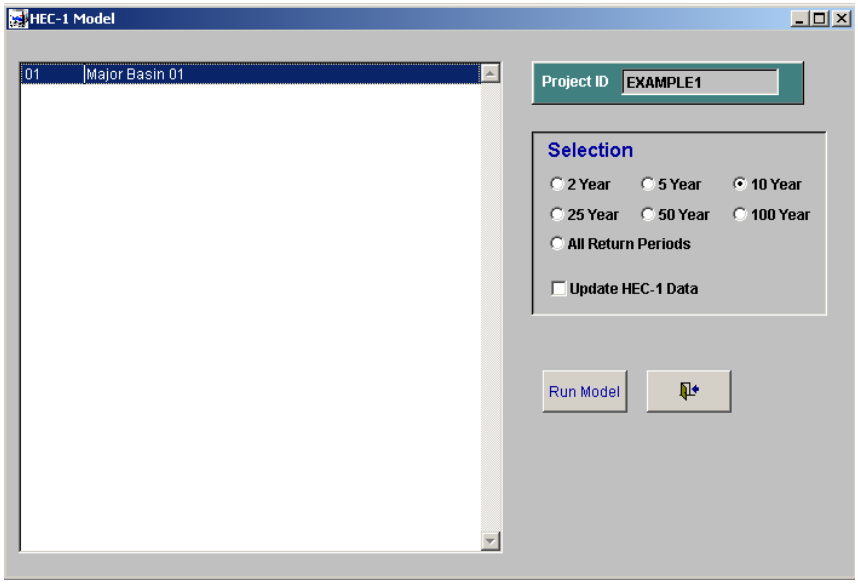


Finally after editing the ASCII file it can be imported. Click Import and select the appropriate file to import. A dialogue box comes up for the selection.



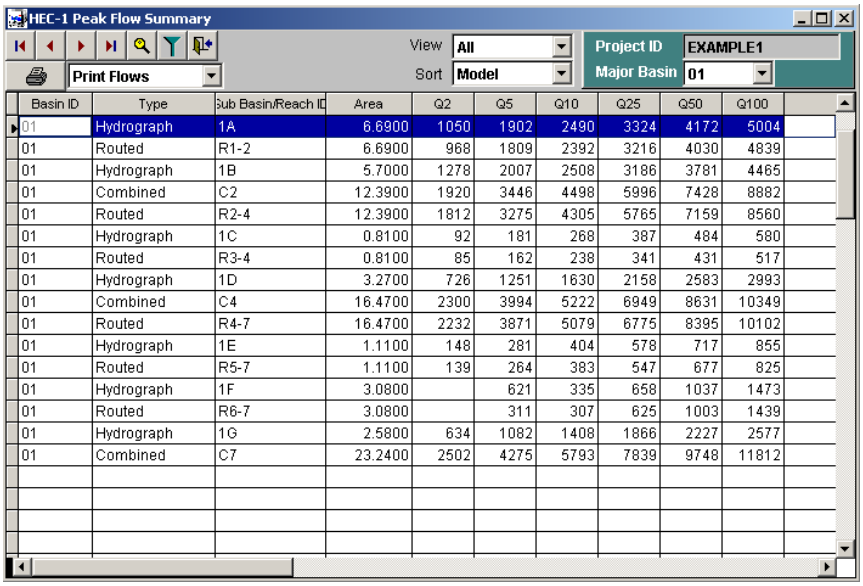
13. Run HEC-1 Model

Select *Run HEC-1* from the *Hydrology\HEC-1* Menu. Select the appropriate Major Basin ID and Return Period and click Run Model.



14. View Model Summary Results

Select *View Summary Results* from the *Hydrology\HEC-1* Menu.



Basin ID	Type	Sub Basin/Reach ID	Area	Q2	Q5	Q10	Q25	Q50	Q100
01	Hydrograph	1A	6.6900	1050	1902	2490	3324	4172	5004
01	Routed	R1-2	6.6900	968	1809	2392	3216	4030	4839
01	Hydrograph	1B	5.7000	1278	2007	2508	3186	3781	4465
01	Combined	C2	12.3900	1920	3446	4498	5996	7428	8882
01	Routed	R2-4	12.3900	1812	3275	4305	5765	7159	8560
01	Hydrograph	1C	0.8100	92	181	268	387	484	580
01	Routed	R3-4	0.8100	85	162	238	341	431	517
01	Hydrograph	1D	3.2700	726	1251	1630	2158	2583	2993
01	Combined	C4	16.4700	2300	3994	5222	6949	8631	10349
01	Routed	R4-7	16.4700	2232	3871	5079	6775	8395	10102
01	Hydrograph	1E	1.1100	148	281	404	578	717	855
01	Routed	R5-7	1.1100	139	264	383	547	677	825
01	Hydrograph	1F	3.0800		621	335	658	1037	1473
01	Routed	R6-7	3.0800		311	307	625	1003	1439
01	Hydrograph	1G	2.5800	634	1082	1408	1866	2227	2577
01	Combined	C7	23.2400	2502	4275	5793	7839	9748	11812

Alternatively, the output file can be viewed in its original format by selecting *View Output File* from the *Hydrology\HEC Model*