



DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS VERSION 6.8.0

TUTORIAL # 1 DEVELOPING A NEW HEC-1 MODEL



KVL Consultants, Inc.

DEVELOPING A NEW HEC-1 MODEL

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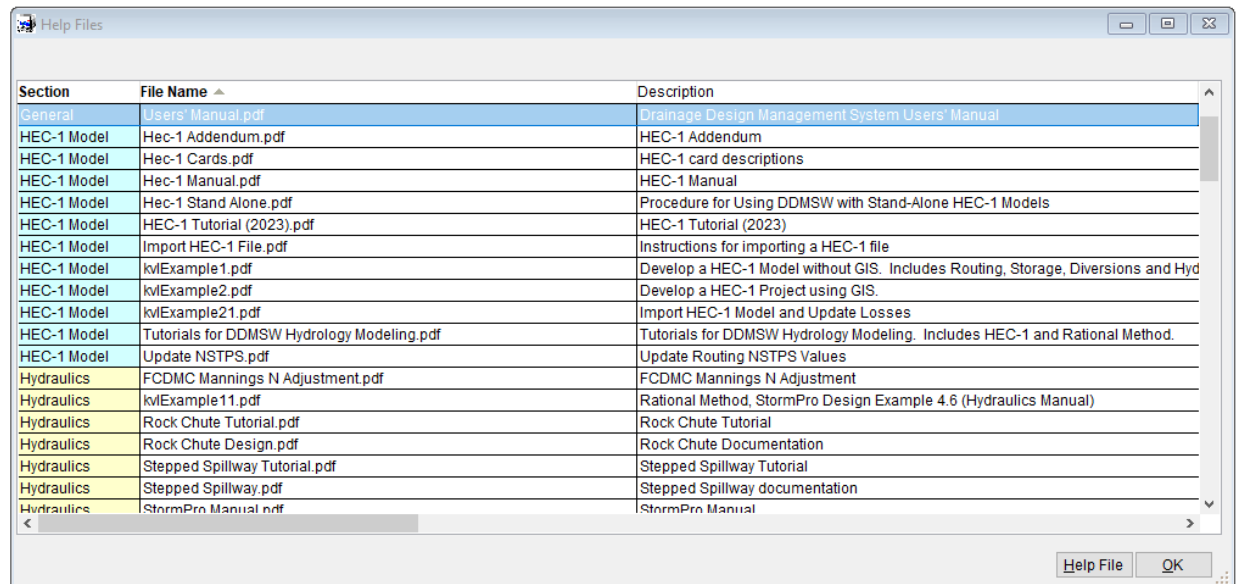
DEVELOPING A NEW HEC-1 MODEL

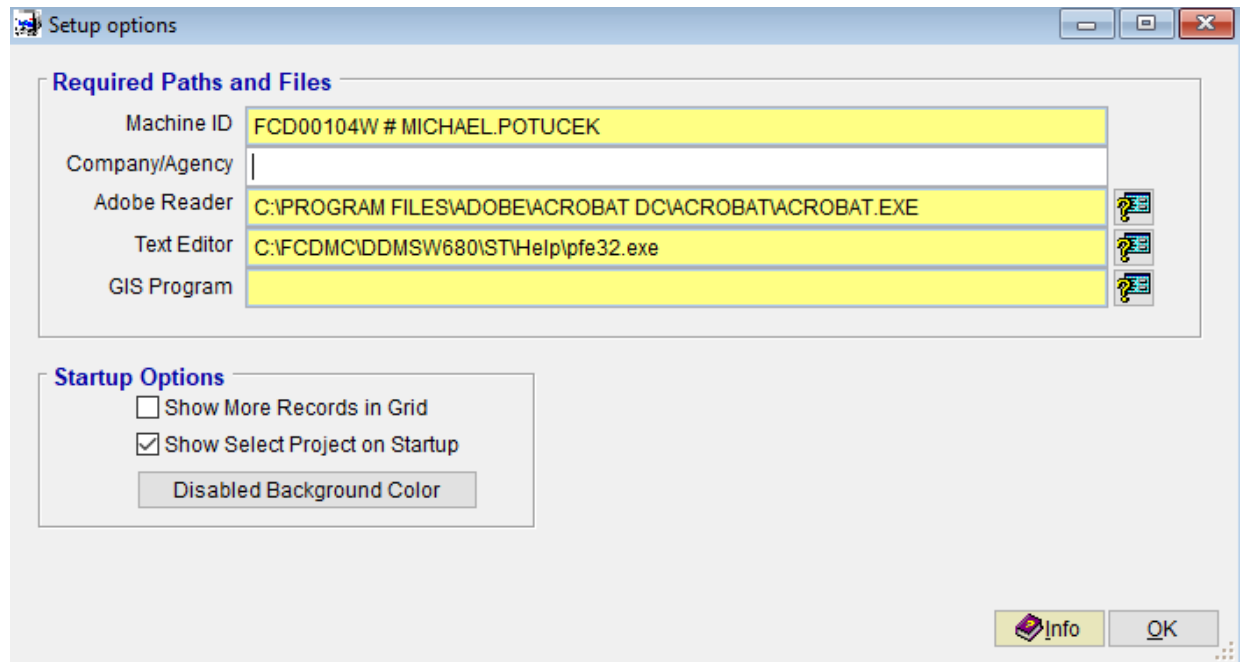
DATE UPDATED: MAY 7, 2024

TUTORIAL TIME: 30 MINUTES

1.0 USING THE HELP FEATURE OF DDMSW

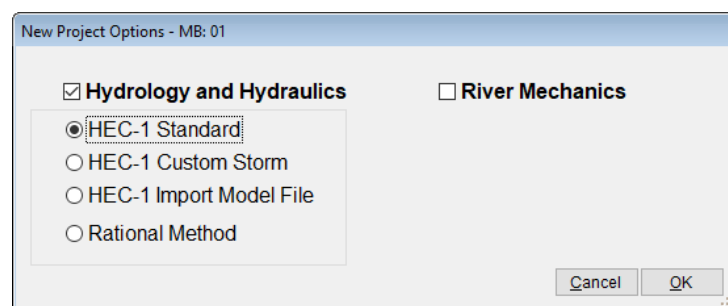
Launch the DDMSW program. Go to the ‘**Help**’ menu and go to the ‘**Other Help Files**’ submenu. For the remainder of this tutorial, this step process will be abbreviated through the use of the following convention i.e., **Help → Other Help Files**. You can read the DDMSW User’s Manual by selecting the file titled, ‘**User’s Manual**’ and pressing the ‘**Help File**’ button at the bottom of the form. This will launch Adobe Acrobat Reader (or Foxit Reader) and open the **DDMSW User’s Manual** document. If your computer does not have Adobe Acrobat or Adobe Acrobat Reader installed, please contact your IT Department. After the Adobe Acrobat Reader or Foxit Reader program is installed, the DDMSW Program should point to the Acrobat or Foxit executable file, under **Tools → Options → Adobe Reader**. Additionally, there is a text editing program (e.g., Notepad, PFE Editor, or Textpad) identified under **Tools → Options → Text Editor**. It will be used to read text files used by DDMSW. The path and file names in the ‘Adobe Reader’ and ‘Text Editor’ fields shown on the figure below are not necessarily the same as the users’ path. The paths and file names are the specific locations where the above programs are installed.





2.0 ESTABLISH A NEW PROJECT AND SET DEFAULTS

Select **File ➔ New Project**. On the **NEW PROJECT OPTIONS** form, select the **Hydrology and Hydraulics** checkbox, and the **Standard** radio button as shown. Click the **OK** button to close the dialog box.



As shown, there are four checkboxes in the **Project Reference** data group identified as **Hydrology and Hydraulics**, **HEC-1 Standard**, **HEC-1 Custom Storm**, **HEC-1 Import Model File** and **Rational Method**. Only the **Hydrology and Hydraulics** and **HEC-1 Standard** checkboxes should be checked for this tutorial.

On the **SELECT PROJECT** form, fill in the fields using the data shown on the screen capture provided below. Each project must have a unique **Reference** (without spaces) name, **Title**, and a **Project ID** (a number the software automatically gives the project). Project **Location** and an **Agency** name (this can be your firm's

name if you are a consultant) are optional data. On the **Project Defaults** data group, select the appropriate **Model** ('HEC1' or 'Rational', but select 'HEC1' for this example), data sources for **Soils**, **Land Use**, **Roads**, and **Rainfall** data. Finally, on the **HEC-1 Defaults** data group, select the appropriate HEC-1 **Loss Method**, the **Unit Hydrograph** method, **Storms**, and **Duration**. Model parameters such as **Tab Interval (NMIN)**, **No of Ordinates (NQ)** and printing **Output (IO)** level are required.

On the "Return Periods to Model" data group, six (6) default event settings are provided. They are: *2-year*, *5-year*, *10-year*, *25-year*, *50-year*, and *100-year* storm events from which the model will generate respective hydrographs and peak flows. For this tutorial, leave the default values as shown.

On the Comment box, add any appropriate comments that may include a brief description of the model, assumptions used, documentation of data sources, or other information that maybe helpful or crucial to understanding the model when the user revisits the model after a hiatus.

On the **Modification Data**, the user can now select the date when the model was developed, modified, or updated. This is to provide a timeline when the model was last accessed, used, or ran.

Select Project

List

Details

Project Reference

Project ID: 00156 Reference: KVLEXAMPLE1

Title: Example 1 HEC-1 tutorial project

Location: Maricopa County

Agency: KVL Consultants, Inc.

☒ Hydrology and Hydraulics Only ☐ Custom Storm Event

☐ River Mechanics Only ☐ Imported HEC-1 File

Project Defaults

Model: HEC1

Soils: FCDMC

Land Use: FCDMC

Rainfall: NOAA14

Roads: MCDOT

Return Periods to Model

1. 2. 3. 4. 5. 6.

2 5 10 25 50 100

This project does not use GIS, all data is manually entered.

HEC-1 Defaults

Unit Hydrograph: Clark

Loss Method: Green-Ampt

Storms: Multiple

Duration: 6 Hour

Tab Interval (NMIN): 6

No. Ordinates (NQ): 2000

Output (IO): 5

Date: 01/01/2011

Update Defaults Default Versions Info Print... Delete Add OK

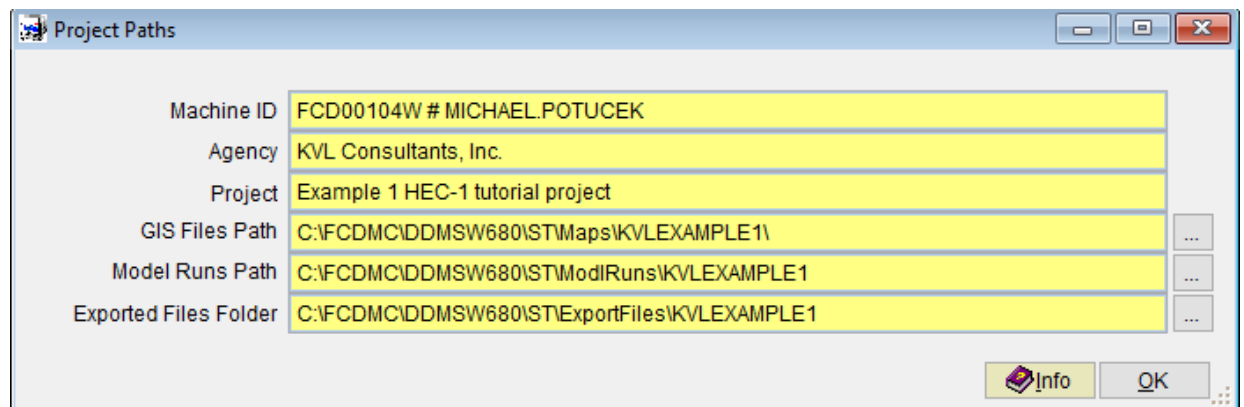
After entering the required data on the form, press the **'Save'** button. Then, press **'OK'** to exit the **SELECT PROJECT** form.

Then click **'OK'** to accept the data defaults (FCDMC land use, FCDMC soils, MCDOT roads, and MCDOT Inlets) from which the model to be developed will base its calculation for model parameters as well as in accessing standard design data for the model to use.

3.0 SETTING THE MODEL RUNS PATH

When running models, the input and result files have similar file names for each project. Therefore, to prevent one project overwriting the results of another project, it is necessary to establish a unique directory for each model runs.

Go to **File → Project Paths** to establish the Model Runs Path. Press the ellipse button (...) to the right of the *'Model Runs Path'* textbox and navigate to an appropriate directory. Select / choose this folder as the model runs path or press the *'Make New Folder'* button if the required folder does not exist. Rename the new folder, and press **'OK'** to close the *'Browse for folder'* form. Note that the file path defined in the *'Model Runs Path'* in the following figure is not necessarily the same as the user's path. The path depends on the location of the program installed.



The screenshot shows a dialog box titled "Project Paths". It contains several text input fields with labels to their left. The fields are: "Machine ID" with value "FCD00104W # MICHAEL.POTUCEK", "Agency" with value "KVL Consultants, Inc.", "Project" with value "Example 1 HEC-1 tutorial project", "GIS Files Path" with value "C:\FCDMC\DDMSW680\ST\Maps\KVLEXAMPLE1\", "Model Runs Path" with value "C:\FCDMC\DDMSW680\ST\ModlRuns\KVLEXAMPLE1", and "Exported Files Folder" with value "C:\FCDMC\DDMSW680\ST\ExportFiles\KVLEXAMPLE1". To the right of the last three fields are three vertical ellipsis buttons (...). At the bottom right of the dialog are two buttons: "Info" and "OK".

Field	Value
Machine ID	FCD00104W # MICHAEL.POTUCEK
Agency	KVL Consultants, Inc.
Project	Example 1 HEC-1 tutorial project
GIS Files Path	C:\FCDMC\DDMSW680\ST\Maps\KVLEXAMPLE1\
Model Runs Path	C:\FCDMC\DDMSW680\ST\ModlRuns\KVLEXAMPLE1
Exported Files Folder	C:\FCDMC\DDMSW680\ST\ExportFiles\KVLEXAMPLE1

4.0 ESTABLISH RAINFALL DATA FOR PROJECT

On the Rainfall Ids form (**Hydrology → Rainfall Ids**), select Manual as the *Data Source* (GIS files are used for this tutorial). For Rainfall ID, enter *"Default"*. In the Comment box, add appropriate data description of the rainfall data being used. Click **"OK"** to close the *"Rainfall IDs"* form.

ID	Source	Description
DEFAULT	Manual	Default Rainfall ID

Rainfall ID

Rainfall ID: Source:

Description:

Info Print... Delete Add OK

On the “NOAA 14 Rainfall ID” form (**Hydrology → Rainfall**), click the ‘*Rainfall ID*’ button to locate the project by identifying the appropriate cell from which to develop the Rainfall data. For this tutorial, cell 64 (*Map 64*) will be used. Before exiting the map, identify the sub cells where the project is located (let us use 1365).

Each map has a Township and Range address (T02NR04E for this example) to assist in locating the project. Street atlas maps (not included here) often show the Township and Range. Click the *Map Index* selector button and select 64. Then enter 1365 in the *From (No)* textbox. Do not enter any value on the *To (No)* textbox. Click the ‘*Save*’ and the ‘*Update*’ buttons to establish the project data for the rainfall.

This will update all the rainfall return periods and durations for Rainfall ID: DEFAULT
Rainfall Version Date: 12/31/2016

Do you want to continue?

Click 'Yes' to continue. When the 'Update' is complete, click 'OK' to exit.

Manual Map Selection

Map Index: 64
From (No): 1365
To (No): 0
Maps

Map	From	To
64	1365	0

Average Rainfall Data for ID: DEFAULT

	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
5 Min	0.245	0.331	0.398	0.488	0.557	0.629
10 Min	0.373	0.504	0.606	0.743	0.848	0.957
15 Min	0.462	0.625	0.752	0.922	1.052	1.186
30 Min	0.622	0.842	1.012	1.241	1.416	1.597
1 Hour	0.770	1.042	1.253	1.536	1.753	1.977
2 Hour	0.885	1.182	1.409	1.720	1.955	2.201
3 Hour	0.967	1.266	1.505	1.837	2.104	2.380
6 Hour	1.148	1.469	1.725	2.073	2.346	2.631
12 Hour	1.277	1.616	1.882	2.241	2.515	2.800
24 Hour	1.521	1.970	2.323	2.817	3.206	3.612

Delete Add Info Print... Update Rainfall ID OK

When the Rainfall data has been updated, observe the generated rainfall data for the six return intervals with varying rainfall time durations. Press 'OK' to close the "NOAA 14 Rainfall" form.

5.0 REVIEW SOIL DEFAULTS

Select **Hydrology** → **Soil Defaults** to view or modify Agency Soil Defaults or add a 'Custom' data. For this tutorial, custom values are not required assuming that the existing Agency Soil Defaults are sufficient. Click on the 'OK' button to close the form.

Soil ID	Book	Map Unit	XKSAT	Rock Pct	Description
6451	645	1	0.410	0.00	Antho sandy loams
6452	645	2	0.410	0.00	Antho gravelly sandy loams
6453	645	3	0.580	0.00	Antho-Carrizo-Maripo complex
6454	645	4	0.580	0.00	Antho-Carrizo-Maripo complex low precipitation
6455	645	5	0.430	0.00	Anthony sandy loam
6456	645	6	0.620	0.00	Anthony-Arizo complex
6457	645	7	0.620	0.00	Anthony-Arizo complex low precipitation
6458	645	8	0.960	0.00	Arizo cobbly sandy loam
6459	645	9	0.270	0.00	Beeline-Cipriano complex 3 to 45 percent slopes
6531	653	1	0.230	0.00	Agualt and Ripley soils
6532	653	2	0.210	0.00	Agualt and Ripley soils saline-sodic
6533	653	3	0.530	0.00	Ajo-Gunsight-Pompeii complex 3 to 25 percent slopes
6534	653	4	0.400	40.00	Akela-Rock outcrop complex 15 to 65 percent slopes
6535	653	5	0.790	0.00	Carrizo-Dateland complex 0 to 3 percent slopes
6536	653	6	1.170	0.00	Carrizo-Momoli complex 0 to 3 percent slopes

6.0 REVIEW LAND USE DEFAULTS

Select **Hydrology** => **Land Use Defaults** to view or modify Agency land use defaults or add a 'Custom' data. For this tutorial, custom values are not required assuming that the existing Agency Land Use Defaults are sufficient. Click on the 'OK' button to close the form.

Sort	Code	Group	IA	Rtmp	Cover	Dtheta	Kb	Description
10	110	Residential	0.30	5	30.0	NORMAL	MIN	Rural Residential (<= 1/5 du per s
20	120	Residential	0.30	5	30.0	NORMAL	MIN	Estate Residential (1/5 du per s
30	130	Residential	0.30	15	50.0	NORMAL	MIN	Large Lot Residential - Single F
40	140	Residential	0.25	20	50.0	NORMAL	MIN	Medium Lot Residential - Single
50	150	Residential	0.25	30	50.0	NORMAL	MIN	Small Lot Residential - Single F
60	160	Residential	0.25	40	50.0	NORMAL	MIN	Very Small Lot Residential - Sir
70	170	Residential	0.25	45	50.0	NORMAL	MIN	Medium Density Residential - M
80	180	Residential	0.25	45	50.0	NORMAL	MIN	High Density Residential - Multi
90	190	Residential	0.25	45	50.0	NORMAL	MIN	Very High Density Residential -
100	200	Commercial	0.10	80	60.0	NORMAL	MIN	General Commercial (Commer
110	210	Commercial	0.10	80	65.0	NORMAL	MIN	Specialty Commercial (<=50.00
120	220	Commercial	0.10	80	65.0	NORMAL	MIN	Neighborhood Commercial (50
130	230	Commercial	0.10	80	75.0	NORMAL	MIN	Community Commercial (100.0
140	240	Commercial	0.10	80	65.0	NORMAL	MIN	Regional Commercial (500.00
150	250	Commercial	0.10	80	70.0	NORMAL	MIN	Super-Regional Commercial (>
160	300	Industrial	0.15	55	60.0	NORMAL	MIN	General Industrial (Industrial w

7.0 ESTABLISH MAJOR BASIN ID'S

Select **Hydrology** ➔ **Major Basins** to access the *Major Basins* data. The software automatically establishes at least one *Major Basin* (01) when creating a new project. Since there is only one major basin in this project, there is no need to change or modify the project data as provided. Once the sub basins are established, we will return here to update *Major Basin* 01. Click on the 'OK' button to close the form.

The screenshot shows the 'Major Basins' window with the 'Details' tab selected. The 'Major Basin' section contains the following fields: Major Basin ID (01), Description (Major Basin 01), Area (sq mi) (12.3900), and Rain ID (DEFAULT). The 'Modeling Options' section includes a checked box for 'Model This Major Basin', a 'Custom' link, and fields for Storms (Multiple), Duration (6 Hour), Tab Interval (5), No. Ordinates (2000), and Output (5). The 'Return Period for Steps' section has a 'Step RP' field set to 100. The 'Reduction Factors' table on the right lists factors 1 through 9 with their respective Area and RF values. The bottom of the window features buttons for Info, ReSort, Print..., Delete, Add, Update, and OK.

	Area	RF
1.	0.0001	1.0000
2.	0.5	0.9940
3.	2.8	0.9750
4.	16.0	0.9220
5.		
6.		
7.		
8.		
9.		

8.0 ESTABLISH PRELIMINARY SUB BASIN DATA

Select **Hydrology** ➔ **Sub Basins** to access the sub basin data. Click on 'Add' to add the first record. On the form, enter the following:

Sub Basin	010105
Area	6.690 sq. miles
Length	5.060 miles
USGE	2760 ft (can enter Slope directly and not USGE and DSGE)
DSGE	2200 ft (can enter Slope directly and not USGE and DSGE)
Time-Area	URBAN

The data shown above is for *Sub Basin 010105*. Click 'Save' to save the data and then click 'Add' to add a second record.

Enter the following:

Sub Basin	010110
Area	5.700 sq. miles
Length	3.75 miles
USGE	2584 ft (can enter Slope directly and not USGE and DSGE)
DSGE	2195 ft (can enter Slope directly and not USGE and DSGE)
Time-Area	URBAN

The data shown above is for *Sub Basin 010110*. Click 'Save' to save the data and then click 'OK' to close the form. Note: Do not click 'Update' because Soil and Land use data have to be established.

9.0 ESTABLISH SOIL DATA

Select **Hydrology → Soils** to access the Soils data. Click on 'Add' to add the first record. Enter the following exactly as shown on the form below. Type the entries in white boxes, and use the magnifier glass to select the necessary entries in yellow boxes.

Pressing the 'Save' button will auto-populate the Soil Description, Soil Data and Area (%) values. Click 'Add' to add a second record. Enter the following:

Combined Soils and Land Use - MB: 01

List Details

Sub Basin

Major Basin ID 01

Sub Basin ID 010105

Intersected Area

Area (sq mi) 4.9600

Area (%) 74.1

Soil Data

Soil ID 64522

	Value	Default	Custom
XKSAT	0.045	0.045	<input type="checkbox"/>
PSIF	16.547	16.547	<input type="checkbox"/>
Rock Outcrop (%)	0.00	0.00	<input type="checkbox"/>
Effective (%)	100	100	<input type="checkbox"/>

Land Use Data

Land Use Code 150

	Value	Default	Custom
Moisture Deficit	NORMAL	NORMAL	<input type="checkbox"/>
DTHETA	0.096	0.096	<input type="checkbox"/>

Small Lot Residential - Single Family (4-6 du per acre)

Info Copy Print... Delete Add MB OK

Click 'Save' to save the data and then click 'Add' to add a third record. Enter the following:

Click 'Save' to save the data.

After all Soils data has been entered and updated, click on the 'OK' button to close the form.

10.0 ESTABLISH LAND USE DATA

Select **Hydrology** → **Land Use** to access the Land Use data. Click on 'Add' to add the first record. Enter the following:

Sub Basin	010105 (Click on adjacent icon to select)
Land Use Code	110 (Click on adjacent icon to select)
Area	2.00 sq. miles

Land Use - MB: 01

List Details

Land Use

Major Basin ID 01 Area (sq mi) 2.0000

Sub Basin ID 010105 Area (%) 29.9

Land Use Code 110 Rural Residential (<= 1/5 du per acre)

Land Use Data

	Value	Default	Custom
Initial Loss (IA)	0.30	0.30	<input type="checkbox"/>
Percent Impervious (RTIMP)	5	5	<input type="checkbox"/>
Vegetation Cover	30.0	30.0	<input type="checkbox"/>
Resistance Coefficient (Kb)	MIN	MIN	<input type="checkbox"/>

Comments

Info Copy Print... Delete Add MB OK

Click 'Save' to save the data.

Click 'Add' to add a second record. Enter the following:

Sub Basin	010105 (Click on adjacent icon to select)
Land Use Code	130 (Click on adjacent icon to select)
Area	4.69 sq. miles

Land Use - MB: 01

List Details

Land Use

Major Basin ID 01 Area (sq mi) 4.6900

Sub Basin ID 010105 Area (%) 70.1

Land Use Code 130 Large Lot Residential - Single Family (1 du per acre to 2 du

Land Use Data

	Value	Default	Custom
Initial Loss (IA)	0.30	0.30	<input type="checkbox"/>
Percent Impervious (RTIMP)	15	15	<input type="checkbox"/>
Vegetation Cover	50.0	50.0	<input type="checkbox"/>
Resistance Coefficient (Kb)	MIN	MIN	<input type="checkbox"/>

Comments

Info Copy Print... Delete Add MB OK

Click 'Save' to save the data.

Click 'Add' to add a second record. Enter the following:

Sub Basin	010110 (Click on adjacent icon to select)
Land Use Code	140 (Click on adjacent icon to select)
Area	5.700 sq. miles

Land Use - MB: 01

List Details

Land Use

Major Basin ID 01 Area (sq mi) 5.7000

Sub Basin ID 010110 Area (%) 100.0

Land Use Code 140 Medium Lot Residential - Single Family (2-4 du per acre)

Land Use Data

	Value	Default	Custom
Initial Loss (IA)	0.25	0.25	<input type="checkbox"/>
Percent Impervious (RTIMP)	20	20	<input type="checkbox"/>
Vegetation Cover	50.0	50.0	<input type="checkbox"/>
Resistance Coefficient (Kb)	MIN	MIN	<input type="checkbox"/>

Comments

Info Copy Print... Delete Add MB OK

Click 'Save' to save the data. After all Land Use data has been entered and updated, click on the 'OK' button to close the form.

11.0 UPDATE SUB BASIN DATA

Select **Hydrology** → **Sub Basins**. Click on the 'Details' tab to view all the data for a record. Click 'Update' to update the data.

Sub Basins - MB: 01

List Details

Sub Basin

Major Basin 01

Sub Basin 010105

Sort 2

Sub Basin Parameters - Clark

Area (sq mi) 6.690

Length (mi) 5.060

USGE (ft) 2760.0

DSGE (ft) 2200.0 Adj

Slope (ft/mi) 110.7 110.7

Time-Area URBAN

Value Default Custom

Kb 0.017 0.017

Rainfall Losses - Green-Ampt

	Value	Default	Custom
IA (in)	0.30	0.30	<input type="checkbox"/>
DTHETA	0.13	0.13	<input type="checkbox"/>
PSIF (in)	10.22	10.22	<input type="checkbox"/>
XKSAT	0.039	0.039	<input type="checkbox"/>
RTIMP (%)	12	12	<input type="checkbox"/>
XKSAT (Bare Ground)	0.028		Custom
Avg Vegetation (%)	44.0		

Return Period Parameters

	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
Custom Tc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tc (hrs)	0.999	0.827	0.749	0.684	0.644	0.611
Vel (f/s)	7.43	8.97	9.91	10.85	11.52	12.15
R (hrs)	0.458	0.371	0.332	0.301	0.281	0.265

Info ReSort Print... Delete Add MB Update OK

Update Sub Basin Data

i This will update Sub Basin data where Custom values are not checked. The update will include:

- Major Basin Area and Reduction Factors
- Land Use parameters
- Soil parameters
- Sub Basin parameters by establishing appropriate averages for Land Use and Soils.
- Tc values will be developed using the model MCUHP1.

Please Note!
It is necessary to update Sub Basins parameters whenever land use and/or soils data have changed to ensure the correct data for running the HEC-1 model.

Do you want to continue?

Yes No

Click **'Yes'** to confirm the update. Following the update, there may be a Warning message report. Address the issues and provide a comment if necessary. For this example, there is not a Warning message.

Click **'OK'** to close the Sub Basins form.

12.0 ESTABLISH PRELIMINARY ROUTING DATA

Select **Hydrology** → **HEC-1** → **Routing** to access the Routing data. Click on 'Add' to add the first record. Enter the data as shown on the following for Route ID '010105'.

Look for

ID	Type
010105	Normal Depth
010110	Normal Depth

Route

Major Basin ID: 01

Route ID: 010105

Type: NORMAL DEPTH

☐ Channel Loss

Normal Depth

			Station	Elevation
LOB N	0.035	1.	510.0	99.70
Chan N	0.038	2.	1510.0	94.10
ROB N	0.035	LB	1585.0	93.60
Length	4224.0	4.	1596.0	92.20
Slope	0.0012	5.	1600.0	92.20
Max Elev	99.70	RB	1612.0	93.60
		7.	1662.0	94.90
		8.	2262.0	99.70

NSTPS

Model	NSTPS	Custom
2 Year	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5 Year	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10 Year	<input checked="" type="checkbox"/>	<input type="checkbox"/>
25 Year	<input checked="" type="checkbox"/>	<input type="checkbox"/>
50 Year	<input checked="" type="checkbox"/>	<input type="checkbox"/>
100 Year	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Custom	<input type="checkbox"/>	<input type="checkbox"/>

Update NSTPS from HEC-1

Info Copy Print... Delete Add MB OK

After data has been entered click 'Save' and the 'Add' to add another record. Enter the following data in the new record for Route ID '010110'.

[illegible]

**DO NOT PRESS "UPDATE NSTPS FROM HEC-1" AT THIS TIME
BECAUSE THE HEC-1 MODEL HAS NOT YET BEEN ESTABLISHED!**

Press **'Save'** when finished entering the data for '010110'. Press **'OK'** to close the **HEC-1 ROUTING DATA** form.

13.0 ESTABLISH DIVERSION DATA

Select **Hydrology** → **HEC-1** → **Diversions** to access the Diversion data. Click on 'Add' to add the first record. Enter the data as shown on the following for Diversion ID (KK Card) 010105.

Enter the Retrieval ID (KK Card) and the DT Card ID as RT0105 and DT0105, respectively. These values can be left blank and DDMSW will use the Diversion ID (KK card) for these values.

Enter 35 in the % Diversion, click 'Save' and click "*Build*". DDMSW will fill in the diversion data based on a 35% diversion of flow.

HEC-1 Diversions - MB: 01

List Details

Diversion Facility

Major Basin ID 01

Diversion ID (KK) 010105

Retrieval ID (KK Card) RT0105

DT Card ID DT0105

Maximum Diversions

Volume (ac-ft)

Flow (cfs)

Diver 35% of flow for later retrieval

Inflow/Diversion Data

	Inflow (cfs)	Diversion (cfs)
1.	0.0	0.0
2.	100.0	35.0
3.	200.0	70.0
4.	500.0	175.0
5.	1000.0	350.0
6.	2000.0	700.0
7.	4000.0	1400.0
8.	10000.0	3500.0
9.	20000.0	7000.0
10.	50000.0	17500.0

% Diversion

35

Build

Info ReSort Copy Print... Delete Add Graph MB OK

14.0 ESTABLISH STORAGE DATA

Select **Hydrology** → **HEC-1** → **Storage** to access the Storage data. Click on 'Add' to add the first record. Enter the data as shown on the following for Storage ID 'ST0115'. The Peak Storage and Stage will be automatically entered from the model runs.

HEC-1 Storage Facilities - MB: 01

List Details Storage/Elevation/Discharge

Storage Facility

MB ID 01

Storage ID ST0115

Discharge Options

SL, SS, ST

Low-Level Outlet (SL) ☐

Spillway (SS) ☒

Top of Dam Overflow (ST) ☒

If the Discharge Options are changed, it is necessary to recreate the Draft HEC-1 Network to add or remove relevant data.

Option Details

Spillway Characteristics (SS)

Spillway Crest Elevation 92.0

Spillway Length 50.00

Discharge Coefficient 3.00

Weir Equation Exponent 1.50

Top of Dam Overflow (ST)

Elevation Top of Dam 100.0

Length Top of Dam 300.00

Discharge Coefficient 3.00

Weir Equation Exponent 1.50

Info ReSort Copy Print... Delete Add MB Graph OK

HEC-1 Storage Facilities - MB: 01

List Details Storage/Elevation/Discharge

Storage Facilities Rating Data

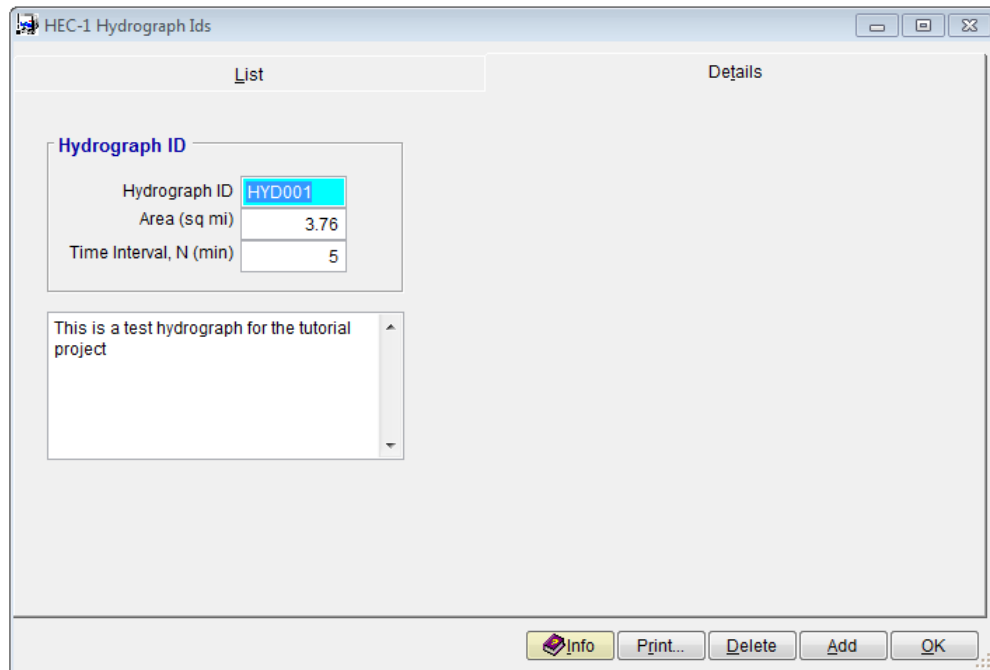
	Storage (ac-ft)	Elevation (ft)		Storage (ac-ft)	Elevation (ft)
1.	0.00	90.0	11.		
2.	100.00	92.00	12.		
3.	150.00	94.00	13.		
4.	200.00	96.00	14.		
5.	275.00	98.00	15.		
6.	350.00	100.00	16.		
7.	1000.00	101.00	17.		
8.			18.		
9.			19.		
10.			20.		

Storage ID **ST0115** Use Surface Area ☐

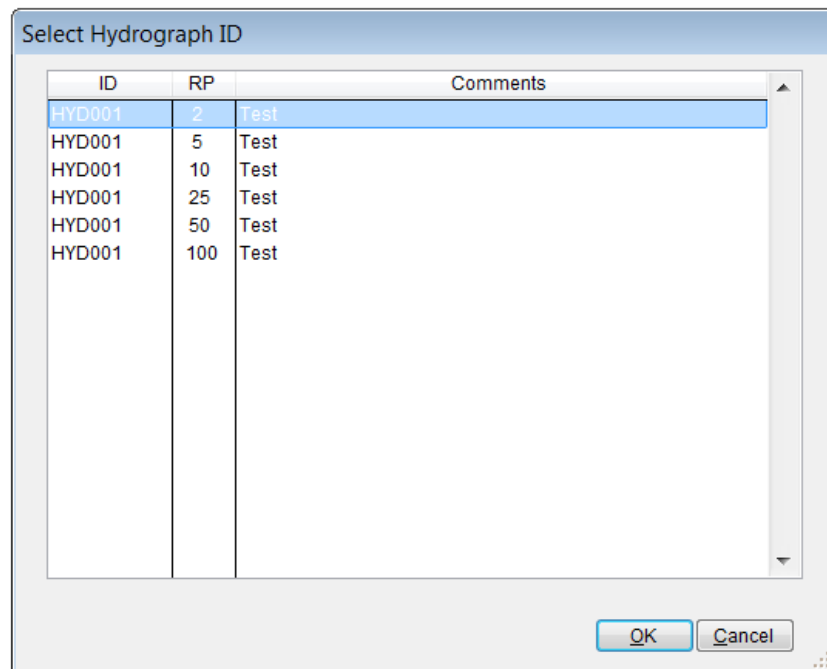
Info ReSort Copy Print... Delete Add MB Graph OK

15.0 ESTABLISH HYDROGRAPH DATA (QI CARD)

This example is going to use a hydrograph. Initially it is necessary to establish the Hydrograph IDs. Select **Hydrology → HEC-1 → Hydrograph IDs** to access the Hydrograph IDs data. Click on **'Add'** to add the first record. Enter the Hydrograph ID, the drainage area and the time interval for the hydrograph data (NMIN).

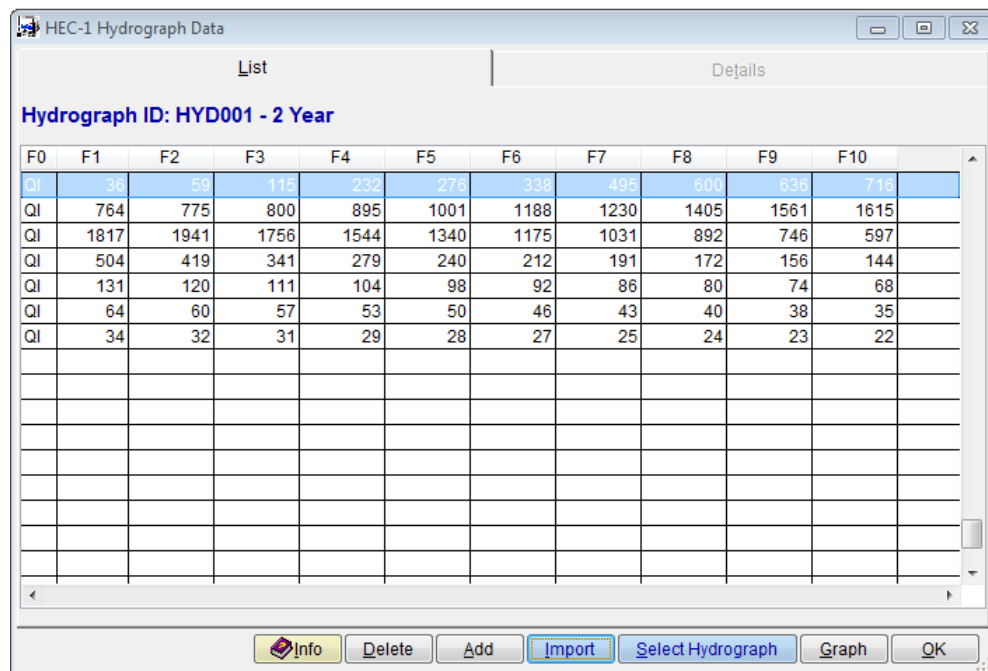
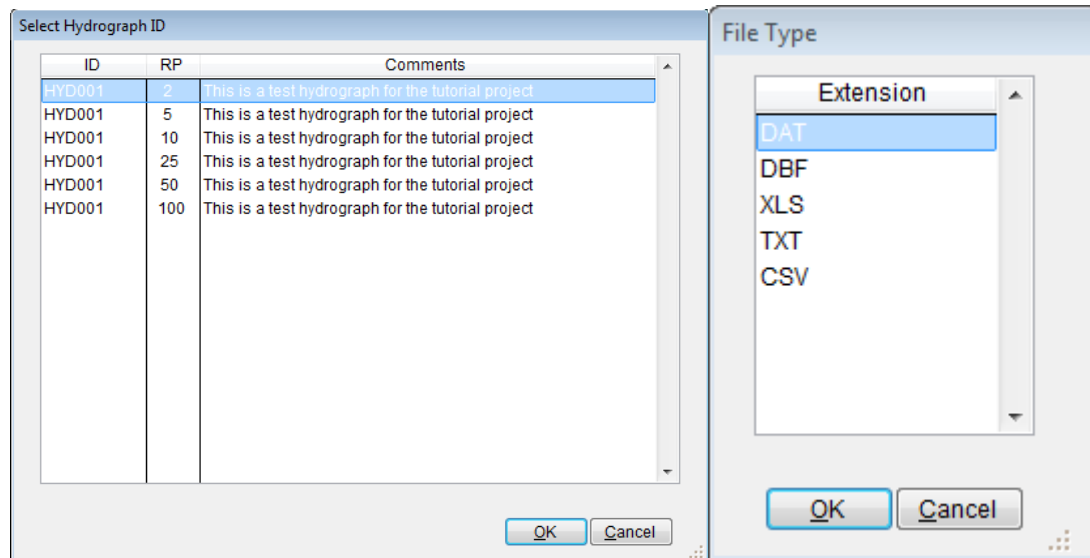


Now select **Hydrology** → **HEC-1** → **Hydrograph Data** to access the Hydrograph data. It is necessary to enter hydrograph data for each return period to be modeled. Although the data can be entered by hand, it is easier to import this data. Click “**Import Hydrograph**” to establish the ID and 2 year return period for the data.



Now click ‘**Import**’ and select the type of file (DAT, DBF, XLS, TXT or CSV). The

hydrographs for this example are located in the Modlrns\KvlExample1 directory. Select Hyd001-2.dat and click “OK” and follow the screen instructions. Repeat this process for the 5, 10, 25, 50 and 100 year hydrographs.



16.0 CREATE DRAFT HEC-1 MODEL

Select **Hydrology** → **HEC-1** → **Network** to access the model Network data.

Sort	ID	Type	Retrieve ID	Combine	Area
10		ID			
20	010105	Basin			
30	010105	Divert	DT0105		
40	010105	Route			
50	010110	Basin			
60	010105	Retrieve	DT0105		
70	010105	Combine		3	
80	010110	Route			
90	HYD001	Hydrograph			
100	HYD001	Combine		2	
102	ST0115	Storage			

Click on 'Add' to add the first record and select ID from the Select Type List and enter the following: Comment: This is the HEC-1 tutorial program example.

Click 'Save' and then Click 'Basin' and select 010105 from the list and assign 20 sort number to it. Click 'Save' and then Click 'Divert' and select 010105 from the list. Assign 30 sort number to it.

Click 'Save' and then Click 'Route' and select 010105 from the list. Select Normal Depth as the Route Type. Click 'Save' and then Click 'Basin' and select 010110 from the list.

Click 'Save' and then Click 'Retrieve' and select 010105 from the list. Click 'Save' and then Click 'Combine'. Modify the Combine No to 3. Click 'Save' and then Click 'Route' and select 010110 from the list.

Click 'Save' and then Click 'Hydrograph' and select HYD001 from the list.

Click 'Save' and then Click 'Combine'. Combine No defaults to 2 and this is OK. Click 'Save' and then Click 'Storage' and select ST0105 from the list.

After all data has been entered click 'Create Draft' and the following file is created.

```

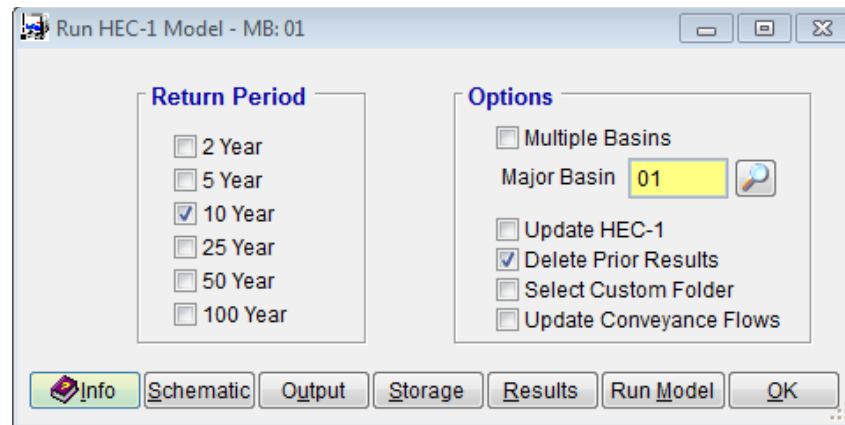
\FCDMC\DDMSW680\ST\ModIRuns\KVLEXAMPLE101.Dat
ID KVL Consultants, Inc.
ID KVLEXAMPLE1 - Example 1 HEC-1 tutorial project
ID 100 Year
ID 6 Hour Storm
ID Unit Hydrograph: Clark
ID Storm: Multiple
ID 05/16/2024
ID This is the HEC-1 tutorial program example.
*DIAGRAM
IT 6 0 2000
IO 5
IN 15
*
JD 3.2 0.0001
PC 0.000 0.008 0.016 0.025 0.033 0.041 0.050 0.058 0.066 0.074
PC 0.087 0.099 0.118 0.138 0.216 0.377 0.834 0.911 0.931 0.950
PC 0.962 0.972 0.983 0.991 1.000
JD 3.18 0.5
PC 0.000 0.008 0.016 0.025 0.033 0.041 0.050 0.058 0.066 0.074
PC 0.087 0.099 0.118 0.138 0.216 0.377 0.834 0.911 0.931 0.950
PC 0.962 0.972 0.983 0.991 1.000
JD 3.14 2.8
PC 0.000 0.009 0.016 0.025 0.034 0.042 0.051 0.059 0.067 0.076
PC 0.087 0.100 0.120 0.163 0.252 0.451 0.694 0.837 0.900 0.938
PC 0.950 0.963 0.975 0.988 1.000
JD 3.05 10.0
PC 0.000 0.015 0.020 0.030 0.048 0.063 0.076 0.090 0.105 0.119
PC 0.135 0.152 0.175 0.222 0.304 0.472 0.670 0.796 0.868 0.912
PC 0.946 0.960 0.973 0.987 1.000
*
KK010105 BASIN
BA 1.0

```

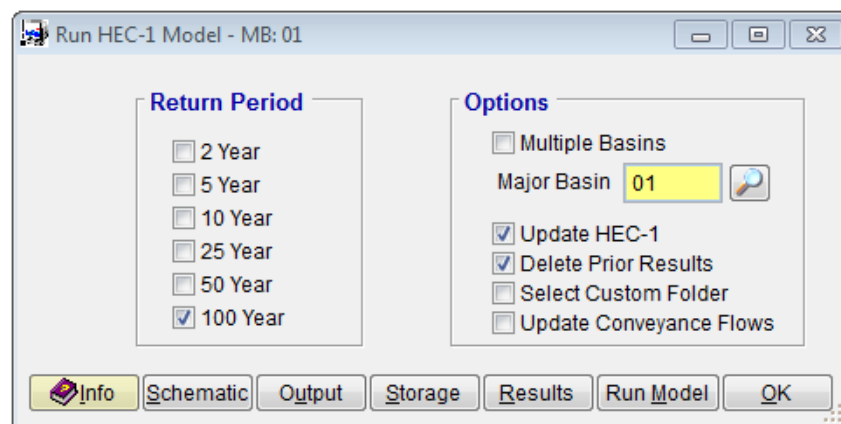
17.0 RUN DRAFT HEC-1 MODEL

Select **Hydrology** → **HEC-1** → **Model** to access the HEC-1 model.

Check the '10 Year' Return Period and the 'Delete Prior Results' option. Uncheck all other return periods and options.



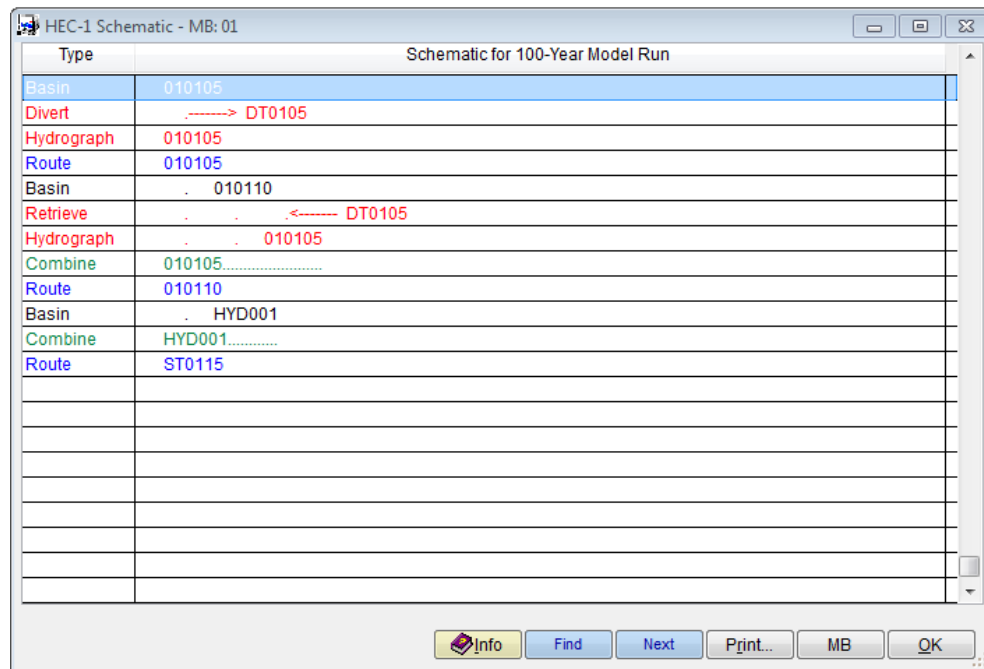
Click 'Save'. Click 'Run Model' to run the Draft HEC-1 Model. If the model runs correctly, it means the HEC-1 Network is fine. If there are no errors, run the model for the 100-year Return Period. Check the Update HEC-1 checkbox. Press Save to save the selections made and then click Run Model button.



This previous model run has performed an update on the HEC-1 model based on the model framework that was built. The update has integrated real project data into the model. To close the **RUN HEC-1 MODEL** form, press **OK**.

18.0 UPDATE ROUTING STEP VALUES

Select **Hydrology** → **HEC-1** → **Routing** to access the Routing data. Click on the 'Update from HEC-1' button to update the Steps. A note will pop up saying that the HEC-1 model will run three times and the 'Steps' field for all routing channels will be updated if the custom checkbox is not filled in. Select 'Yes'. The following will be the results for **Route ID 010105**. Press **OK** to close the **HEC-1 ROUTING DATA** form.



20.0 VIEW FLOW SUMMARY

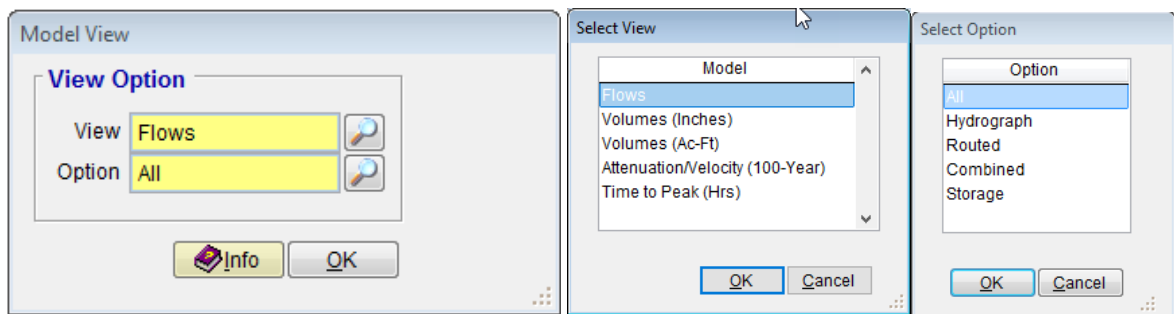
Select **Hydrology** → **HEC-1** → **Flow Summary** to access the HEC-1 model results. Click **'More Results'** to view other summary items.

HEC-1 Flow Summary - FLOWS - MB: 01

Look for:

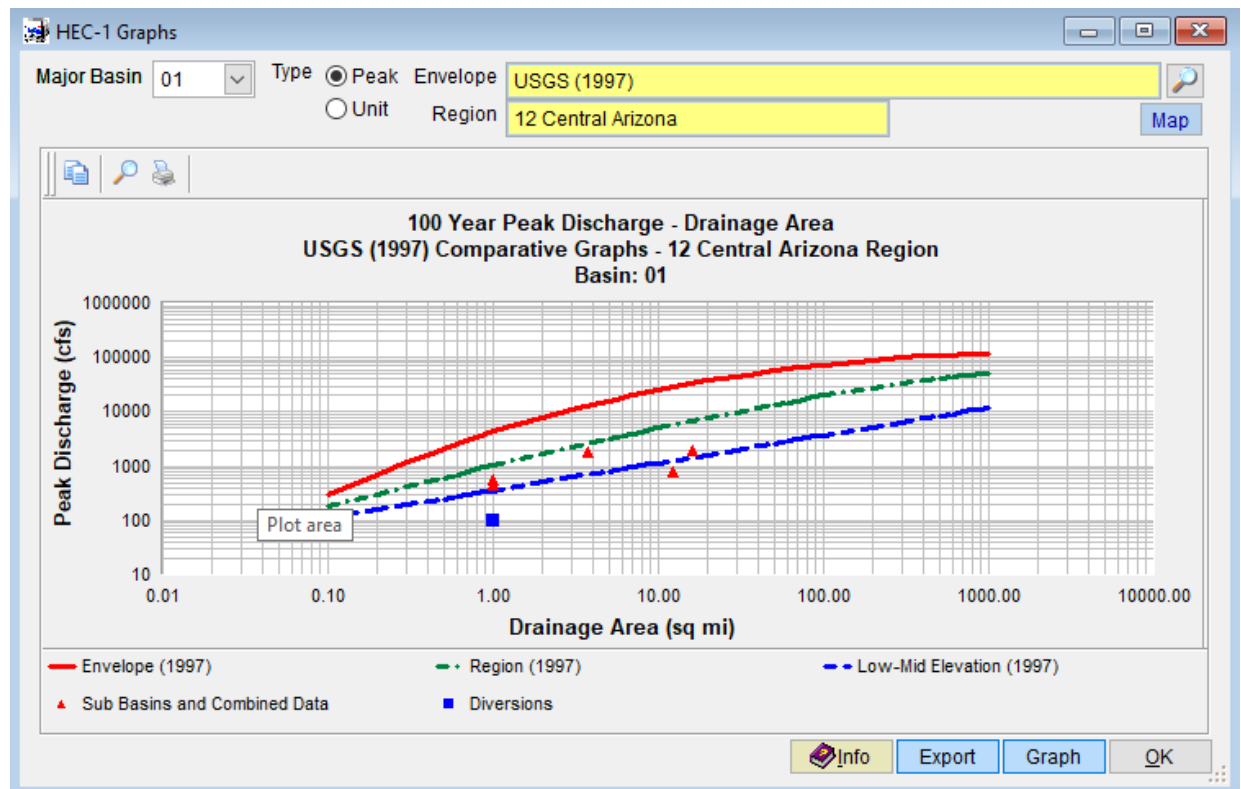
ID	Sort	Type	Area	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
010105	10	Hydrograph	1.00	553	553	553	553	553	553
DT0105	20	Diversion	1.00	100	100	100	100	100	100
010105	30	Hydrograph	1.00	453	453	453	453	453	453
010105	40	Routed	1.00	453	453	453	453	453	453
010110	50	Hydrograph	1.00	553	553	553	553	553	553
010105	60	Hydrograph	1.00	100	100	100	100	100	100
010105	70	Combined	12.39	770	770	770	770	770	770
010110	80	Routed	12.39	771	771	771	771	771	771
HYD001	90	Hydrograph	3.76	1867	1867	1867	1867	1867	1867
HYD001	100	Combined	16.15	1925	1925	1925	1925	1925	1925
ST0115	110	Routed	16.15	193	193	193	193	193	193

Buttons: Info, Export, Print..., More Results, MB, OK



21.0 GRAPH HEC-1 RESULTS

Select **Hydrology** → **HEC-1** → **Graph Envelope Curves** to access the Graphing module. Enter the appropriate data for your location and click the **'Graph'** button as follows:



22.0 BACKUP PROJECT

Select **File** → **Project Management** to access the Project Management module. Select **'Backup Project'** as the **Action** and **'KVLEXAMPLE1A'** as the project (use the adjacent icon to select). Click the **'Backup'** button to backup the project and

select the directory where your backup file should go. Finally, click **‘Yes’** after a directory has been chosen.

