DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS

VERSION 5.6.0

TUTORIAL # 8

DEVELOPING HEC-1 ROUTING DATA USING GIS

KVL Consultants, Inc.

DEVELOPING HEC-1 ROUTING DATA USING GIS

TABLE OF CONTENTS

No.	Section	Page

DEVELOPING A HEC-1 ROUTING DATA USING GIS

DATE UPDATED: APRIL 27, 2018

1.0   INTRODUCTION

This tutorial is the same as **TUTORIAL #2** (**NEW HEC-1 MODEL FROM GIS**) except that this tutorial employs the routing data that have been assembled in GIS. This tutorial describes how a routing shapefile *("Routing.shp")* is created and how the required attribute fields are defined and populated. The routing shapefile is a polyline feature which connects the drainage outlet of an upstream sub-basin to the drainage outlet of the immediate sub-basin downstream. The routing paths define the main flow paths for the drainage runoff.

This tutorial will revisit **Step 16** of **TUTORIAL #2,** and instead of manually entering the four (4) routing data for Route **ID**'s **010005, 010010, 010105,** and **010110** for the Kinematic Wave method, the routing data are read directly and imported from *"Routing.shp"* table (i.e., *"Routing.dbf"*).

2.0   CREATING THE ROUTING DATA IN GIS

To create the *"Routing.shp"* (i.e., the bold yellow green polylines in **FIGURE 1**), we need to ensure that the polyline features for the routing flow paths comprise the main flow paths from the upstream sub-basin drainage outlet to the downstream drainage outlet of the receiving sub-basin. These drainage outlets (represented by the point features on the map) are also called flow concentration points.

From **TUTORIAL #2**, the routing polylines (shown in **FIGURE 1)** are described in the following table:

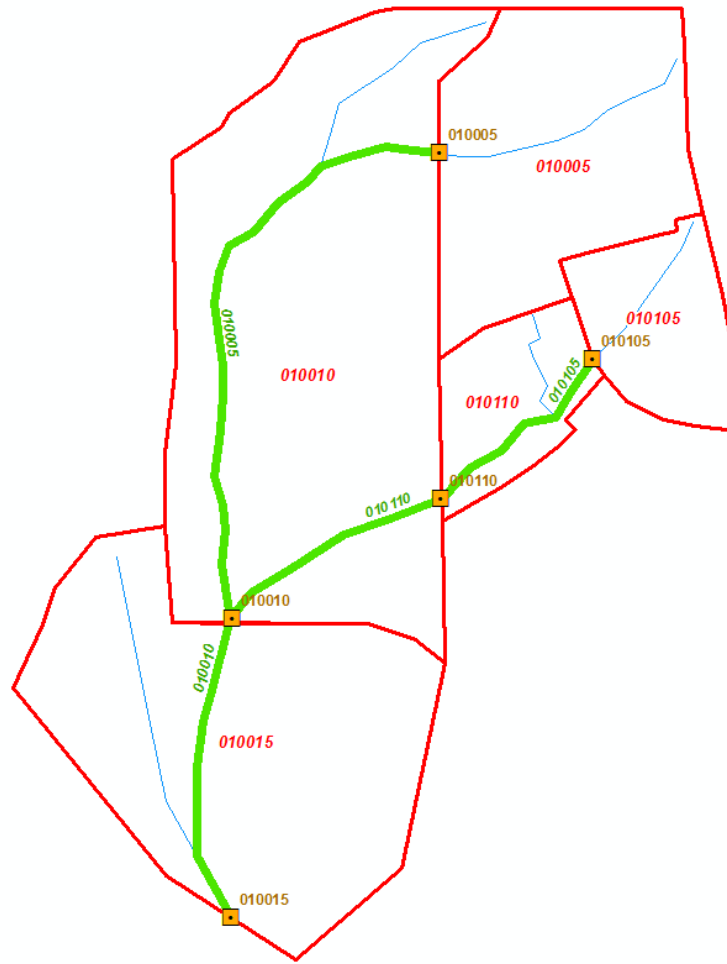| No.	RouteID	U/S Drainage Outlet ID	D/S Drainage Outlet ID
1	*010005*	010005	010010
2	*010105*	010105	010110
3	*010110*	010110	010010
4	*010010*	010010	010015

FIGURE 1 – RELEVANT GIS DATASETS FOR TUTORIAL #8

2.1   Data Specification for Required Attributes

In GIS, the associated table *("Routing.dbf")* that defines the required attributes of individual route polylines specific to the routing method used are identified and described in the **Required Mapping Fields** table (*Maps → Import Routing Data → Required Map Fields*).
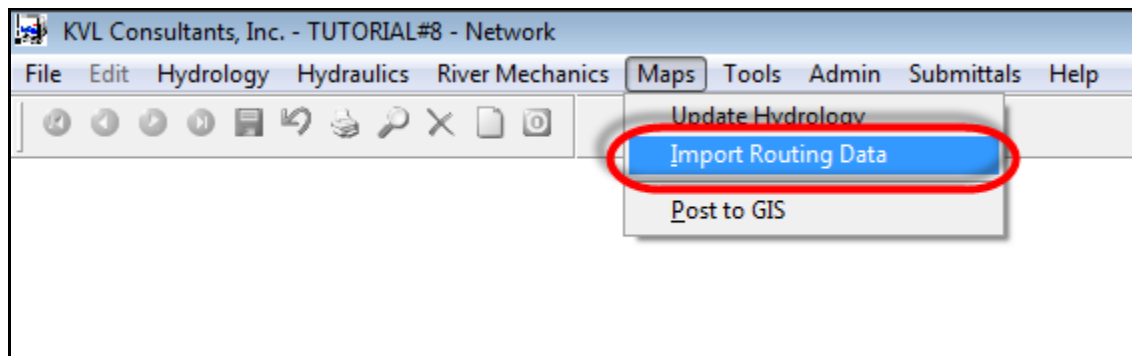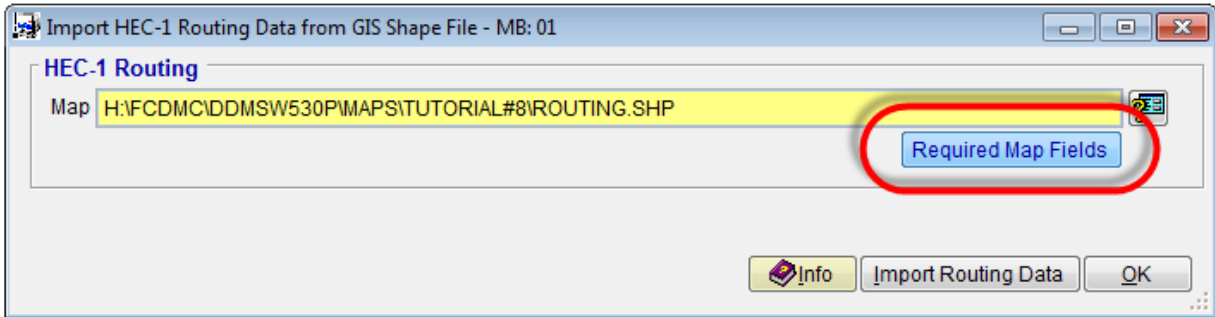
In this tutorial, which employs **Kinematic Wave** method for channel flow routing, the required attribute field names, data types and formats are provided in the said table. Specific to **Kinematic Wave** method, the table below lists the required attributes to be created and populated in the creation of the *"Routing.shp"* table:

Field Name	Type	Description
BASINID	Character 2	Major Basin ID (All)
ID	Character 6	Routing ID (All)
ROUTETYPE	Character 20	Routing Type (Kinematic Wave)
LENGTH	Numeric 8.1	Routing length in feet (All)
USGE	Numeric 8.2	Upstream ground elevation (All)
DSGE	Numeric 8.2	Downstream ground elevation (All)
MAN	Numeric 5.3	Manning's n for channel (All)
ROUTESHAPE	Character 10	Natural, Channel, Pipe, Box or Roadway
WIDTH	Numeric 7.2	Channel bottom width in feet
Z	Numeric 5.2	Channel side slopes (Z Hor:1 Ver)
DIA	Numeric 5.2	Pipe diameter in inches

2.2 Populating the Required Attribute Data

After the naming convention of attribute fields as well as their respective data types and formats are known, the attribute field data are created following those specifications. As an example and for illustration purposes, Route ID **"010005"** has the following field attribute data:

Field Name	Type	Values	Description
ID	Character 6	*010005*	The data is a string with a maximum of 6 characters.
BASINID	Character 2	*01*	The data is a string with a maximum of 2 characters
ROUTETYPE	Character 20	*Kinematic Wave*	The data is a string with a maximum of 20 characters. (Other *ROUTETYPE* options are *Normal Depth* and *Muskingum-Cunge*)
LENGTH	Numeric 8.1	*3168.0*	The data is numeric with 1-decimal point precision.
USGE	Numeric 8.2	*1585.00*	The data is numeric with 2-decimal point precision.
DSGE	Numeric 8.2	*1540.00*	The data is numeric with 2-decimal point precision.
MAN	Numeric 5.3	*0.040*	The data is numeric with 3-point decimal point precision
ROUTESHAPE	Character 10	*NATURAL*	The data is a string with a maximum of 10 characters. (Other *ROUTESHAPE* options are: *PIPE, BOX, CHANNEL,* and *ROADWAY*).
WIDTH	Numeric 7.2	*150.00*	The data is numeric with 2-decimal point precision.
Z	Numeric 5.2	*2.00*	The data is numeric with 2-decimal point precision.
DIA	Numeric 5.2	*-*	The data is numeric with 2-decimal point precision. This attribute field was not included because all the *ROUTESHAPE* used in the model are all *NATURAL*.

The completed attribute table for the *"Routing.shp"* is shown below.

|	FID	Shape *	ID	BASINID	ROUTETYPE	LENGTH	USGE	DSGE	MAN	Z	ROUTESHAPE	WIDTH
▶	0	Polyline	010005	01	Kinematic Wave	3168	1585	1540	0.04	2	NATURAL	150
	1	Polyline	010105	01	Kinematic Wave	1091.8	1590	1555	0.04	2	NATURAL	150
	2	Polyline	010110	01	Kinematic Wave	1264.8	1555	1540	0.04	2	NATURAL	150
	3	Polyline	010010	01	Kinematic Wave	1589.8	1540	1480	0.04	2	NATURAL	150

3.0 UPDATE THE ROUTING DATA IN THE HEC-1 MODEL USING "ROUTING.SHP"

To use the routing data assembled in GIS, open the **IMPORT HEC-1 ROUTING DATA FROM GIS SHAPE FILE** form (*Maps* ➔ *Import Routing Data).* Click the button located on the right side of the **HEC-1 Routing Map** textbox and navigate to the location of the *"Routing.shp"* or the flow routing shapefile that was created.
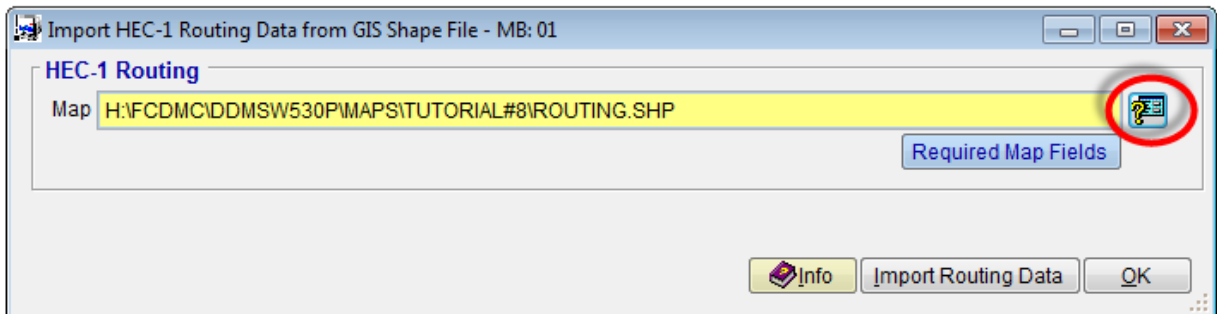
Once the file has been located and selected, click *OK* to close the **OPEN DIALOG BOX**.

On the **IMPORT HEC-1 ROUTING DATA FROM GIS SHAPE FILE** form, click the *Import Routing Data* button. Click *Yes* to continue. Further, click *Yes* to close the **WARNING** form. Click *OK* to close the gridded **HEC-1 ROUTING DATA** form.
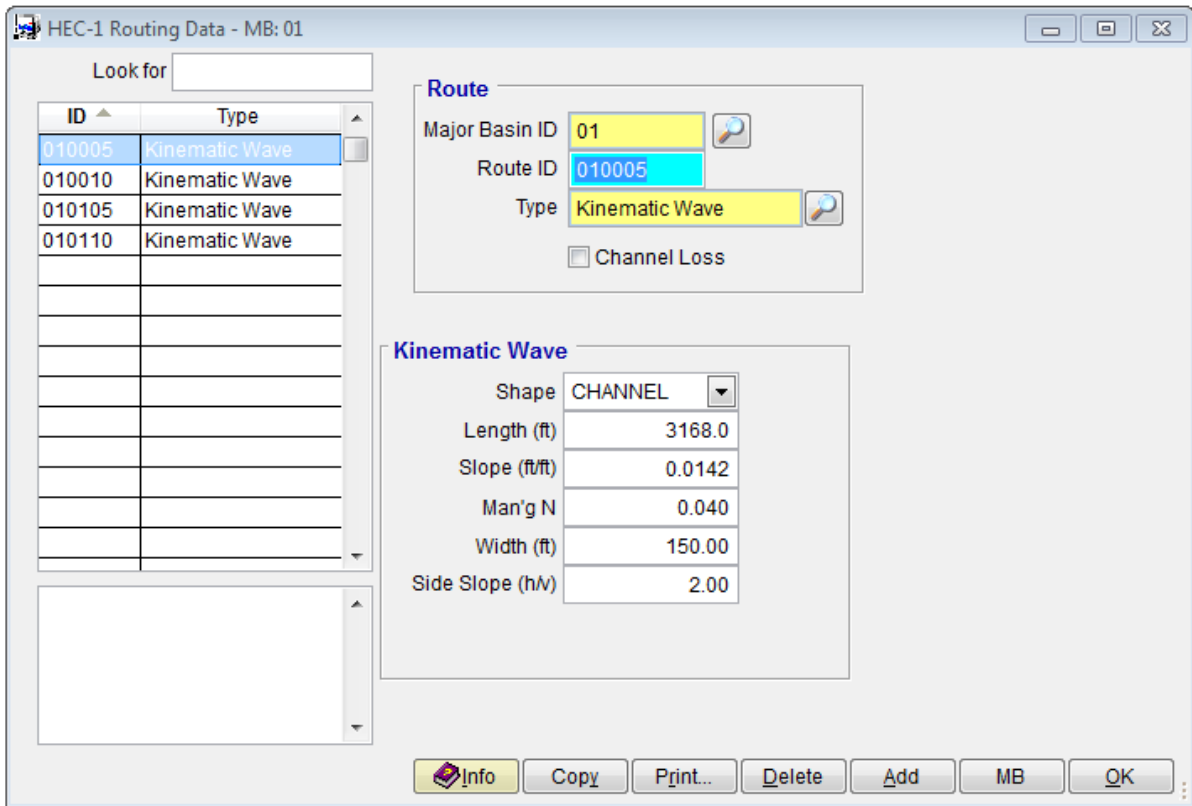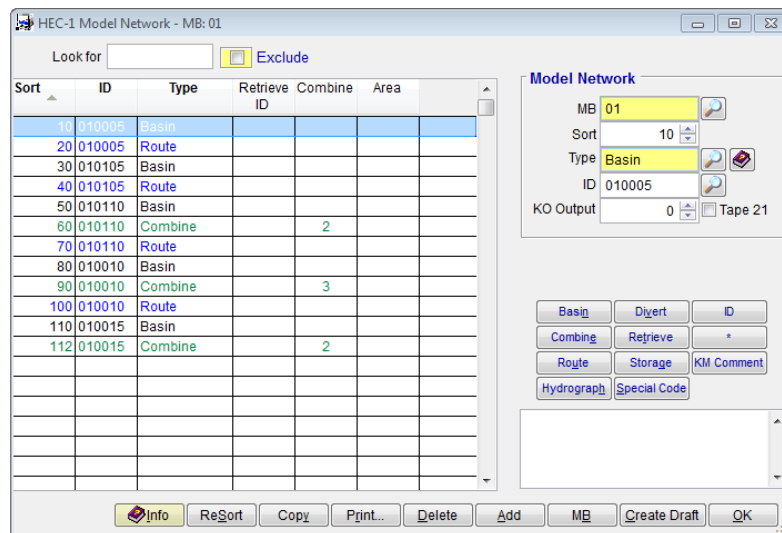
To validate if the imported routing data are correct, go through each individual data item by selecting the *Route ID*.

Click *OK* to close the **HEC-1 ROUTING DATA** form.

4.0   UPDATE THE **HEC-1 MODEL NETWORK**

Select *Hydrology* ➔*HEC-1* ➔ *Network* to open the **HEC-1 MODEL NETWORK** form.

Since the naming convention used for the flow routing data (Route *ID*s) have not changed, the original **HEC-1 MODEL NETWORK** should be correct. If changes were made on the Route *ID*s, the **HEC-1 MODEL NETWORK** should be updated to reflect the correct Route *ID*s.

To create a draft model using the updated routing data, click the *"Create Draft"* button at the bottom of the form. Click *Yes* to continue.
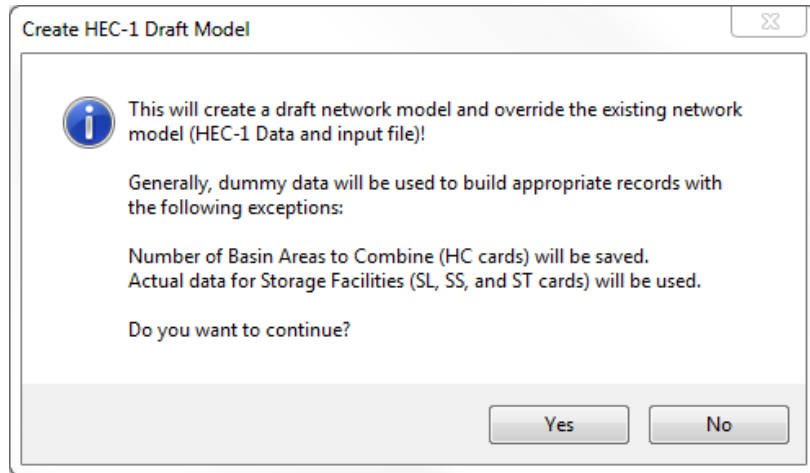
Click *OK* to close the **DRAFT HEC-1 MODEL NETWORK CREATED** form.
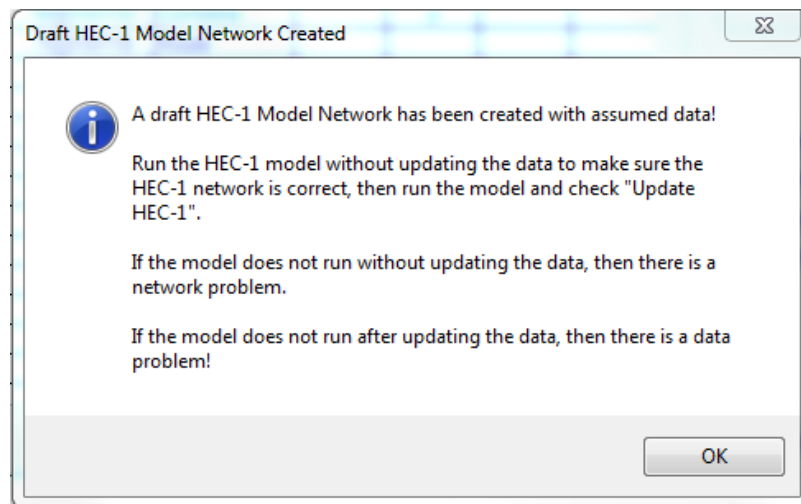
After exiting from the previous form, the program shows automatically the Draft "HEC-1 Model" file. Close the **Text Editor** after viewing file. Click *"OK"* to close the **HEC-1 MODEL NETWORK** form

```
┌─────────────────────────────────────────────────────────────────────────────┐
│ ▣ \FCDMC\ST5.5.7\MODLRUNS\KVLEXAMPLE8\01.Dat              [ _ ][ ▫ ][ ✕ ]    │
├─────────────────────────────────────────────────────────────────────────────┤
│ ID      KVL Consultants, Inc.                                              ▲  │
│ ID      KVLEXAMPLE7A - Example 2 Using Shape Files and NOAA 14            ▒  │
│ ID      100 Year                                                             │
│ ID      24 Hour Storm                                                        │
│ ID      Unit Hydrograph: Clark                                               │
│ ID      Storm: Single                                                        │
│ ID      04/16/2018                                                           │
│ *DIAGRAM                                                                      │
│ IT      3              0     2000                                            │
│ IO      5                                                                     │
│ IN     15                                                                     │
│ *                                                                             │
│ *                                                                             │
│ KK010005    BASIN                                                            │
│ BA    1.0                                                                     │
│ PB    4.0                                                                     │
│ PC 0.000     0.002    0.005    0.008    0.011    0.014    0.017    0.020    0.023    0.026 │
│ PC 0.029     0.032    0.035    0.038    0.041    0.044    0.048    0.052    0.056    0.060 │
│ PC 0.064     0.068    0.072    0.076    0.080    0.085    0.090    0.095    0.100    0.105 │
│ PC 0.110     0.115    0.120    0.126    0.133    0.140    0.147    0.155    0.163    0.172 │
│ PC 0.181     0.191    0.203    0.218    0.236    0.257    0.283    0.307    0.663    0.707 │
│ PC 0.735     0.758    0.776    0.791    0.804    0.815    0.825    0.834    0.842    0.849 │
│ PC 0.856     0.863    0.869    0.875    0.881    0.887    0.893    0.898    0.903    0.908 │
│ PC 0.913     0.918    0.922    0.926    0.930    0.934    0.938    0.942    0.946    0.950 │
│ PC 0.953     0.956    0.959    0.962    0.965    0.968    0.971    0.974    0.977    0.980 │
│ PC 0.983     0.986    0.989    0.992    0.995    0.998    1.000                            │
│ LG   0.15     0.25     4.50     0.50       50                                │
│ UC    1.0      1.0                                                            │
│ UA      0        5       16       30       65       77       84       90       94       97 │
│ UA    100                                                                     │
│ *                                                                             │
│ KK010005    ROUTE                                                            │
│ RK   1000    0.005    0.025             TRAP     100        8                │
│ *                                                                             │
│ KK010105    BASIN                                                            │
│ BA    1.0                                                                     │
│ LG   0.15     0.25     4.50     0.50       50                                │
│ UC    1.0      1.0                                                            │
│ UA      0        5       16       30       65       77       84       90       94       97 │
│ UA    100                                                                     │
│ *                                                                             │
│ KK010105    ROUTE                                                            │
│ RK   1000    0.005    0.025             TRAP     100        8                │
│ *                                                                             │
│ KK010110    BASIN                                                            │
│ BA    1.0                                                                     │
│ LG   0.15     0.25     4.50     0.50       50                              ▼  │
│ ◄ ▢                                                                    ► ░   │
└─────────────────────────────────────────────────────────────────────────────┘
```
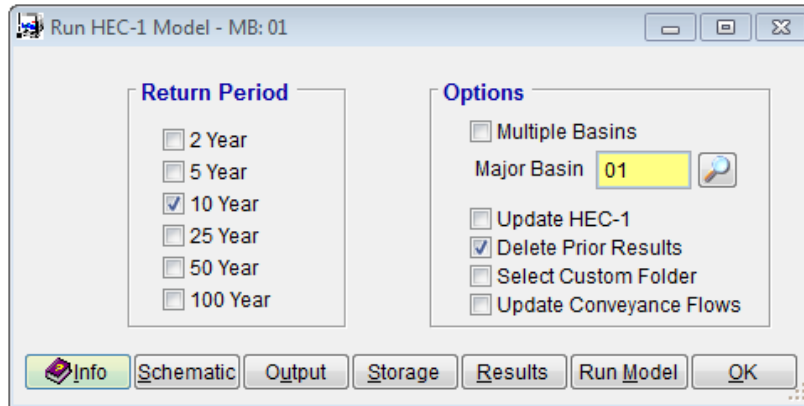
5.0   RUN THE DRAFT HEC-1 MODEL

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'* to save the entered preferences.

Click **'Run Model'** to run the **Draft HEC-1 Model**. If the model runs without issues, it means that the HEC-1 Model Network that was built for the project is fine.

6.0   RUN THE FINAL HEC-1 MODEL

To run the model for all the return periods, click all the textboxes for the six return periods, and then check the **"Update HEC-1"** and **"Delete Prior Results"** options. Click **"Save"** to save the execution settings and run the model by clicking the **"Run Model"** button.
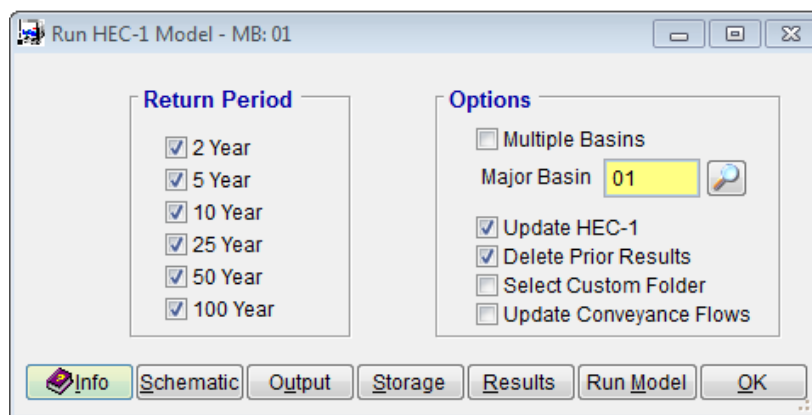
If the model runs correctly, it means that the HEC-1 network and data are fine. The results can be viewed by clicking **'Results'**. A full output file can be viewed with the **'Output'** button, selecting the specific output file to view and pressing **'OK'**. The **100-Year Schematic** can be viewed by pressing the **'Schematic'** button. Press **'OK'** to close the **RUN HEC-1 MODEL** form.

7.0   VIEW FLOW SUMMARY

Select **Hydrology ➔ HEC-1 ➔ Flow Summary** to access the HEC-1 model results. Click **'View'** to view other summary items.
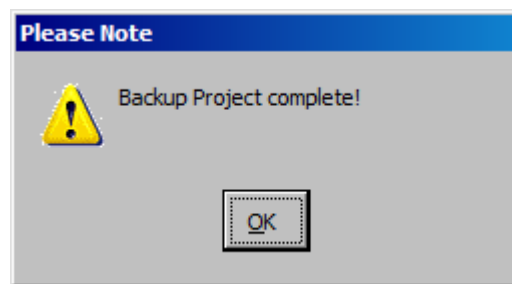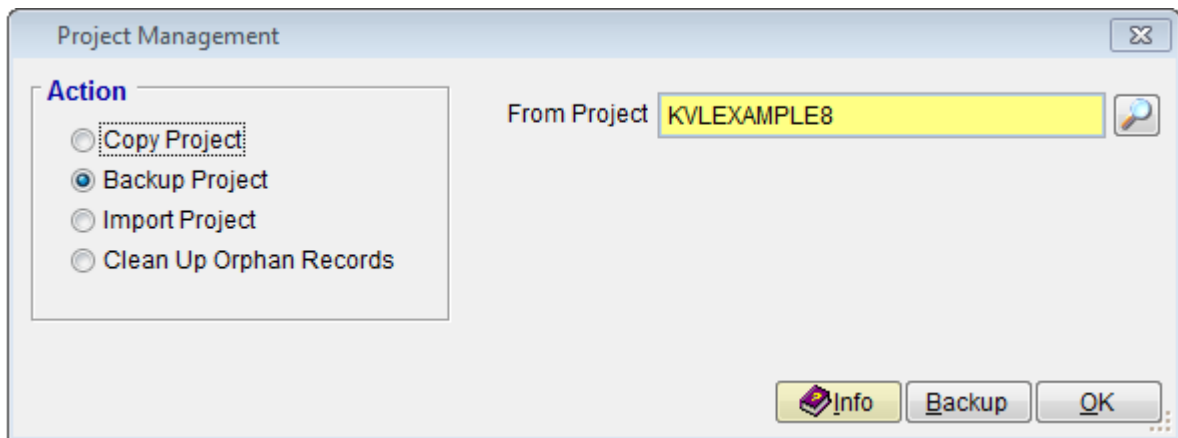
8.0   BACKUP PROJECT

Select *File* ➔ *Project Management* to access the **PROJECT MANAGEMENT** form. Select *'Backup Project'* as the *Action* and *TUTORIAL#8* as the project (use the adjacent button to select). Click the *'Backup'* button to create a backup copy of the project. Select the directory where the backup file should go and finally click *'OK'* after a directory has been chosen. Click *"Yes"* to confirm.

This ends this tutorial.