



DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS VERSION 6.8.0

TUTORIAL # 3 DEVELOPING A NEW PROJECT USING RATIONAL METHOD



KVL Consultants, Inc.

DEVELOPING A NEW PROJECT USING RATIONAL METHOD

TABLE OF CONTENTS

No.	Section	Page
1.0	Introduction	1
2.0	Establish a New Project and Set Data Defaults.....	1
3.0	Setting the Model Runs Path	2
4.0	Establishing Rainfall Data for the Project	3
5.0	Review the Land Use Defaults	8
6.0	Establish Major Basin Id's	9
7.0	Establish the Sub Basin and Land Use Data Using GIS.....	10
8.0	Establishing the Sub Basin Data Manually.....	13
9.0	Establishing the Land Use Data Manually.....	14
10.0	Update Sub Basin Data - Manual	16
11.0	Establish Conveyance Facility Data.....	16
12.0	Establish the Model Network	20
13.0	Establish the storage.....	24
14.0	Run Rational Method Model	25
15.0	Update Conveyance Facilities	27
16.0	Backup Project	27

DEVELOPING A NEW PROJECT USING RATIONAL METHOD

DATE UPDATED: MAY 7, 2024

TUTORIAL TIME: 45 MINUTES

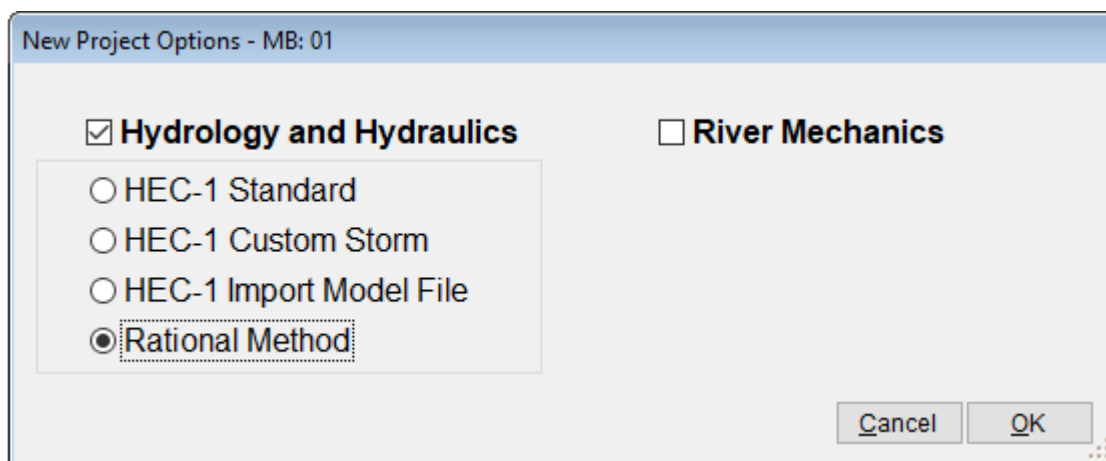
1.0 INTRODUCTION

This tutorial document is developed to guide users in developing a hydrology model using Rational Method. By following the procedure outlined in this document, one should become familiar with the approach with the ultimate objective of implementing the procedure to building a much larger hydrology model using the DDMSW program.

DDMSW has many capabilities not covered in this tutorial and it is recommended that you spend the time to read through the User's Manual and other supporting documents. Users are encouraged to explore the many features of the program through the use of pre-packaged example projects.

2.0 ESTABLISH A NEW PROJECT AND SET DATA DEFAULTS

After launching the program, select **"File → New Project"**. On the **NEW PROJECT OPTIONS** form, select the **Hydrology and Hydraulics** checkbox, and the **Rational Method** radio button as shown. Click the **OK** button to close the dialog box.



On the **SELECT PROJECT** form, type **"KVLEXAMPLE3A"** into the **Reference** textbox. This is the name of this newly created project. The users can choose the name as long as it does not exist in the DDMSW database. Each project must have a unique **Reference** (without spaces), a formal **Title**, **Location** and an **Agency** name (this can be your firm's name if you are a consultant). Then select the appropriate **Model** ('*Rational*' for this example), **Land Use**, **Rainfall**, **Roads** and **Inlet** project defaults.

Also add any appropriate comments in the Comment Box.

Select Project

List

Details

Project Reference

Project ID: 00177 Reference: KVLEXAMPLE3A

Title: Example 3 Rational Method tutorial project

Location: Phoenix, Arizona

Agency: City of Phoenix

☒ Hydrology and Hydraulics Only

☐ River Mechanics Only

Project Defaults

Model: Rational

Land Use: FCDMC

Rainfall: NOAA14

Roads: MCDOT

Inlets: PHOENIX

Min/Max Tc (minutes)

Minimum Tc: 5

Maximum Tc: 120

This is a rational Method example developed by KVL Consultants, Inc.

Date: 07/12/2016

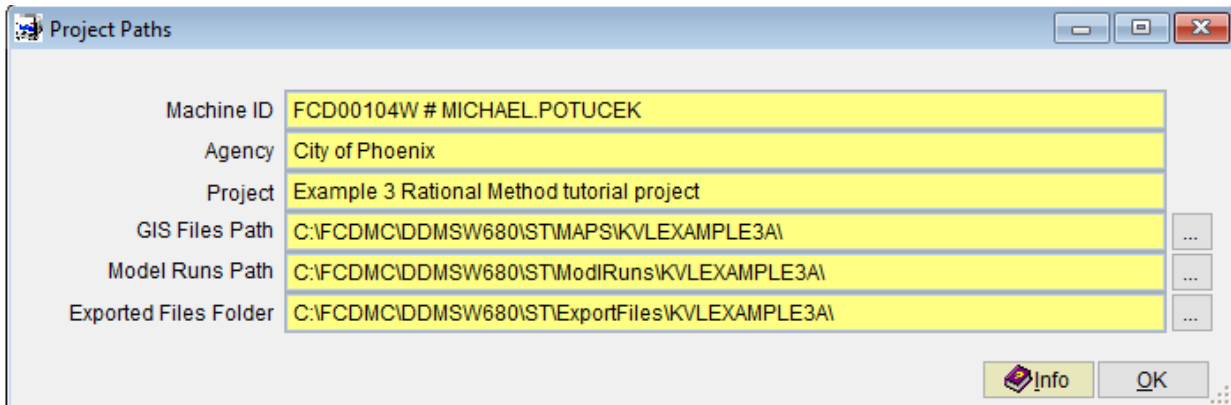
Update Defaults Default Versions Info Print... Delete Add OK

After entering the data, press **'Save'**. Then, press **'OK'** to close the **'SELECT PROJECT'** form. Hit **'OK'** to continue.

3.0 SETTING THE MODEL RUNS PATH

When running models, the input and result files have similar file names for each project. To prevent one project from overwriting the results of another project, it is necessary to establish a unique directory for each project's 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. Choose the folder as the model runs path or create one if the desired folder does not exist by pressing the **'Make New Folder'** button. Press **'OK'** to close the **'BROWSE FOR FOLDER'** form. Press **'Save'** to save the Project Path information. Click **'OK'** to exit the **'PROJECT PATHS'** form.

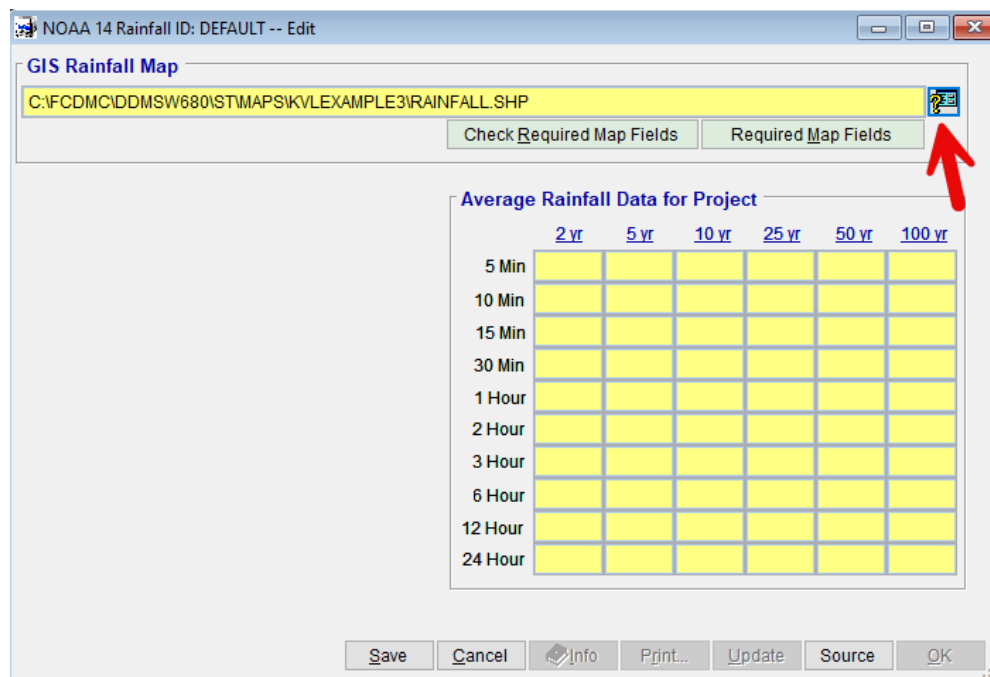


4.0 ESTABLISHING RAINFALL DATA FOR THE PROJECT

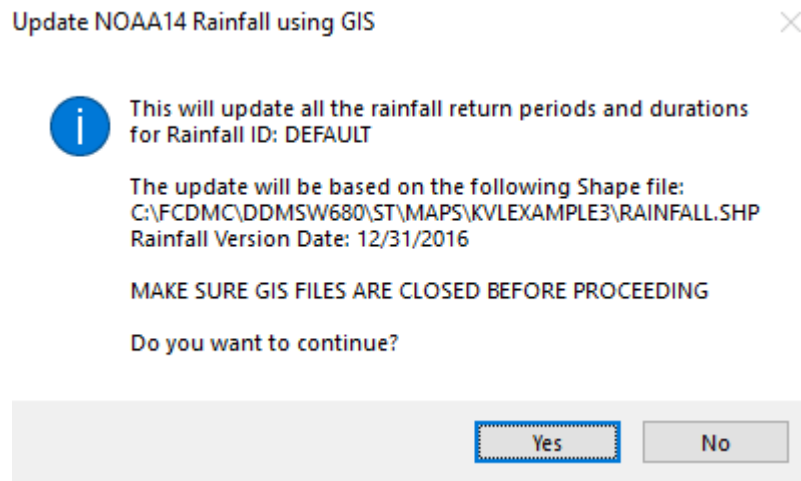
Select '**Hydrology** ➔ **Rainfall**' and click on the button **SOURCE** to select either '**Manual**', '**Lat/Long**', '**State Plane**', or '**GIS**'. After the rainfall data has been evaluated, the Rainfall Intensity graph can be viewed in '**Hydrology** ➔ **Rational Method** ➔ **Rainfall Intensity**' and clicking the '**Graph**' button.

4.1 GIS

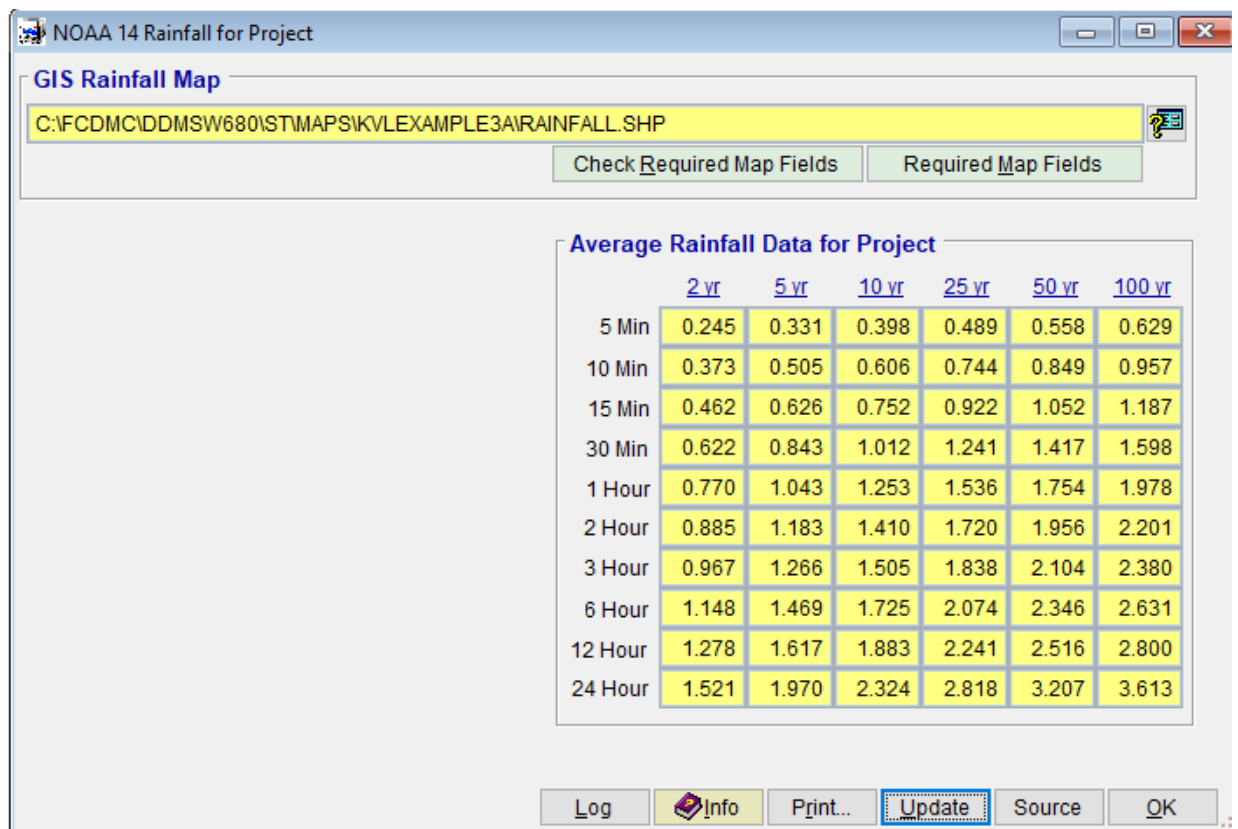
If '**GIS**' is selected as the **Source**, it is necessary to select the Rainfall Shape file. This file should cover the entire project area. The rainfall map can be found by navigating clicking the "Select a file (Right-click to reset/clear)" button shown with the red arrow below. Navigate to the /st/maps/KVLEXAMPLE3 folder where your DDMSW program is installed and selecting Rainfall.shp.



Click “**Save**” then click the ‘**Update**’ button to process the **AVERAGE RAINFALL DATA FOR THE PROJECT**. Click ‘**Yes**’ to continue.



After the update, click the ‘**OK**’ button to close the **NOAA14 RAINFALL** form.

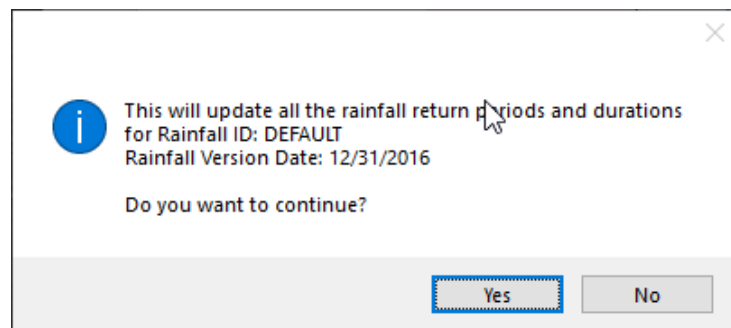


4.2 Manual

If *Manual* is selected as the **Source**, it is necessary to select the appropriate cells to develop the Rainfall data. Click the **'Maps'** button (in **DATA SOURCE** data group) and determine the project location. For this tutorial project, Map No '64' will be used.

Each map has a Township and Range (T02NR04E for this example) information to assist in locating the project. Street atlas maps (not included here) often show the Township and Range information. Each cell size on the map is at most 160 acres, and this is the recommended upper limit where the Rational Method is most effective. Selecting a single cell that is reasonably close to the project area will produce reasonable results because rainfall does not change significantly between adjacent cells.

Click the selection button on the right side of the **Map Index** textbox and select '64' from the drop down list. Enter '1365' in the **From (No)** textbox field. Click **'Save'** to save the data entered, then click the **'Update'** button to evaluate the rainfall data for the project.



After the update, click the **'OK'** button, to close the **NOAA RAINFALL** form.

NOAA 14 Rainfall for Project

Manual Map Selection

Map Index

From (No)

To (No)

[Maps](#)

Map	From	To
64	1365	0

Average Rainfall Data for Project

	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](#)
[Source](#)
[OK](#)

Note that the selection of the single cell using the ‘Manual’ method gave the same rainfall results as the ‘GIS’ method.

4.3 Lat/Long

If ‘Lat/Long’ is selected as the Source, simply type in the Lat and Long coordinates in decimal degrees. Type the coordinates in the screenshot below. Click “Save” and then click “Update.”

NOAA 14 Rainfall for Project

Lat/Long Coordinates

Lat 33.544444

Long -111.941700

Tile ID 323418

Average Rainfall Data for Project

	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
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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

Info Print... Update Source OK

State Plane

If 'State Plane' is selected as the **Source**, simply type in the Arizona State Plane Central East and North coordinates. Type the coordinates in the screenshot below. Click "Save" and then click "Update."

NOAA 14 Rainfall for Project

State Plane Coordinates

East	692383.000000
North	925623.000000
Tile ID	323418

Average Rainfall Data for Project

	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
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3 Hour	0.967	1.266	1.505	1.837	2.104	2.380
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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

Info Print... Update Source OK

5.0 REVIEW THE LAND USE DEFAULTS

Select '**Hydrology → Land Use Defaults**' to access the land use defaults data. Since we are using *FCDMC* default data, none of the records can be modified. To see all the default values, use the horizontal and vertical scroll bars of the form to scroll to the right and bottom, respectively. These Agency default data cannot be modified; however, '*Custom*' land use data can be added.

Land Use Defaults

Look for Custom

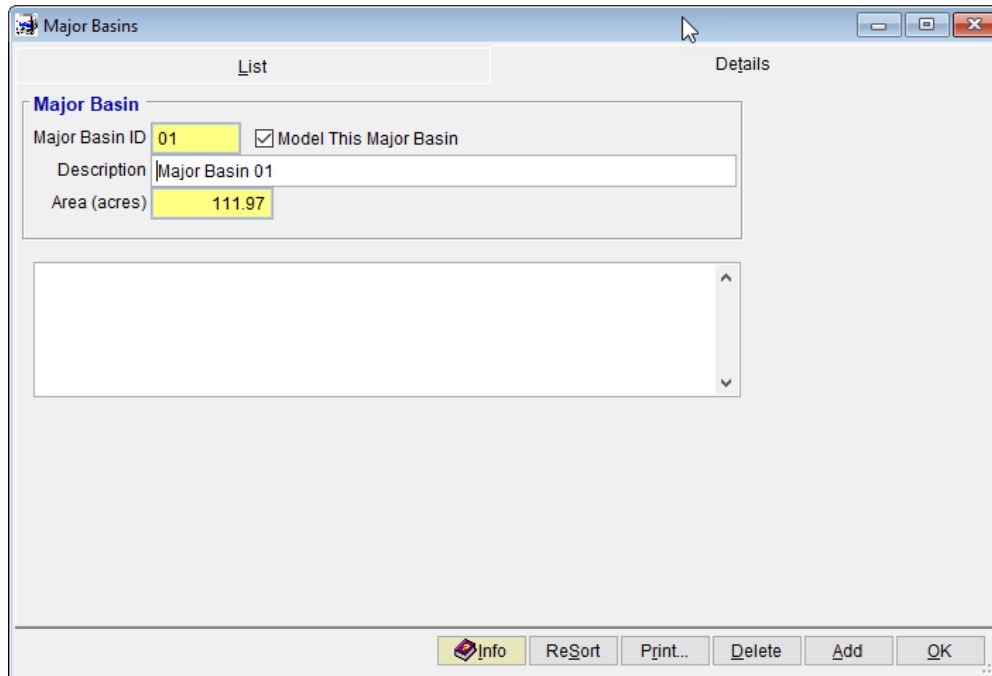
Sort	Code	Group	C2	C5	C10	C25	C50	C100	Kb	Description
10	110	Residential	0.42	0.42	0.42	0.46	0.50	0.53	MIN	Rural Residential (<= 1/2
20	120	Residential	0.42	0.42	0.42	0.46	0.50	0.53	MIN	Estate Residential (1/5 c
30	130	Residential	0.48	0.48	0.48	0.53	0.58	0.60	MIN	Large Lot Residential - S
40	140	Residential	0.65	0.65	0.65	0.72	0.78	0.80	MIN	Medium Lot Residential
50	150	Residential	0.68	0.68	0.68	0.75	0.80	0.84	MIN	Small Lot Residential - S
60	160	Residential	0.75	0.75	0.75	0.83	0.90	0.94	MIN	Very Small Lot Residenti
70	170	Residential	0.75	0.75	0.75	0.83	0.90	0.94	MIN	Medium Density Residei
80	180	Residential	0.75	0.75	0.75	0.83	0.90	0.94	MIN	High Density Residentia
90	190	Residential	0.75	0.75	0.75	0.83	0.90	0.94	MIN	Very High Density Resid
100	200	Commercial	0.85	0.85	0.85	0.94	0.95	0.95	MIN	General Commercial (C
110	210	Commercial	0.85	0.85	0.85	0.94	0.95	0.95	MIN	Specialty Commercial (<
120	220	Commercial	0.85	0.85	0.85	0.94	0.95	0.95	MIN	Neighborhood Commer
130	230	Commercial	0.85	0.85	0.85	0.94	0.95	0.95	MIN	Community Commercial
140	240	Commercial	0.85	0.85	0.85	0.94	0.95	0.95	MIN	Regional Commercial (E
150	250	Commercial	0.85	0.85	0.85	0.94	0.95	0.95	MIN	Super-Regional Comme
160	300	Industrial	0.80	0.80	0.80	0.88	0.95	0.95	MIN	General Industrial (Indus

Info ReSort Copy Print... Delete Add OK

Click on the 'OK' button to close the **LAND USE DEFAULTS** form.

6.0 ESTABLISH MAJOR BASIN ID'S

Select '**Hydrology → Major Basins**' to access the Major Basins data. **DDMSW** automatically establishes at least one Major Basin (01) when creating a new project. Since we will only have one major basin in this project, there is no need for further modification at this time. The area will be updated when updating the Sub Basins. Click the 'OK' button to close the **MAJOR BASINS** form.



7.0 ESTABLISH THE SUB BASIN AND LAND USE DATA USING GIS

Sub Basin data can be developed automatically through GIS. If the GIS data is open, make sure nothing is in the Edit mode.

1. Digitize the Sub Basin polygons (*SUBBASINS.SHP*). Create two attribute fields for the Sub Basins, namely: **AreaID** and **BasinID**. For each Sub Basin, enter the data values for these attribute fields. .
2. Digitize the Time of Concentration polylines (*TC.SHP*) representing the flow paths for the Sub Basins. It is important that the Tc polylines are digitized within the Sub Basin areas, Create two attribute fields for the Tc, namely: **USGE** (which is the upstream ground elevation), and **DSGE** (which is the downstream ground elevation). It is not necessary to enter any other data for the Tc polylines.
3. Digitize the Land Use polygons (*LANDUSE.SHP*) or obtain it from appropriate authorities). Create one attribute field called, **LUCODE**, and enter the land use code for each land use polygon. The land use codes used for the project should match the land use codes in the land use defaults.

Update hydrology from GIS - MB: 01

Name and Path of Maps for Hydrology

Sub Basins C:\FCDMC\DDMSW680\STMAPS\KVLEXAMPLE3\SUB BASIN.SHP

Land Use C:\FCDMC\DDMSW680\STMAPS\KVLEXAMPLE3\LAND USE.SHP

Tc C:\FCDMC\DDMSW680\STMAPS\KVLEXAMPLE3\TC.SHP

GIS Project

Check Required Map Fields Required Map Fields

Update Options

☒ Sub Basin

☒ Land Use

☒ Tc

Major Basin

Major Basin 01

Map File Key Field Name

Land Use Code LUCODE

Check Log Info Update OK

The **SUB BASINS** (*'Hydrology → Sub Basins'*) and **LAND USE** (*'Hydrology → Land Use'*) forms are provided below:

Sub Basins - MB: 01

List Details

Sub Basin

Major Basin 01

Sub Basin 010101

Sort 10

Sub Basin Parameters

Area (acres) 27.23

Length (ft) 1537

USGE (ft) 996.5

DSGE (ft) 993.0

Slope (ft/mi) 12.0

Value Default Custom

Kb 0.031 0.031

Sub Basin Hydrology Summary

	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
Q (cfs)	29.4	43.7	54.9	78.2	99.5	119.8
CA (ac)	20.42	20.42	20.42	22.60	24.51	25.60
Vol (ac-ft)	1.5060	2.0114	2.3976	3.2393	3.9931	4.6955
Custom Tc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tc (min)	24.3	20.9	19.2	17.4	16.4	15.5
Recession (min)	50.078	45.932	44.212	42.747	41.871	41.410
I (in/hr)	1.44	2.14	2.69	3.46	4.06	4.68

Comments

Info ReSort Print... Delete Add MB Update OK

Land Use - MB: 01

Land Use

Major Basin ID: 01 Area (acres): 9.49

Sub Basin ID: 010101 Area (%): 34.8

Land Use Code: 180 High Density Residential - Multi Family (10-15 du per acre)

Land Use Data

	Value	Default	Custom
2-Year C	0.75	0.75	<input type="checkbox"/>
5-Year C	0.75	0.75	<input type="checkbox"/>
10-Year C	0.75	0.75	<input type="checkbox"/>
25-Year C	0.83	0.83	<input type="checkbox"/>
50-Year C	0.90	0.90	<input type="checkbox"/>
100-Year C	0.94	0.94	<input type="checkbox"/>
Resistance Coefficient (Kb)	MIN	MIN	<input type="checkbox"/>

Comments

Info Copy Print... Delete Add MB OK

8.0 ESTABLISHING THE SUB BASIN DATA MANUALLY

If GIS files are not available, the required Sub Basins data can be manually entered. Select **'Hydrology → Sub Basins'** to open the **SUB BASINS** form.

Click **'Add'** to enter the first Sub Basins record. Enter the following data on the named textboxes:

Sub Basin	010101
Area (acres)	27.23
Length (ft)	1537.00
USGE (ft)	996.50
DSGE (ft)	993.00

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin	010102
Area (acres)	25.12
Length (ft)	1520.00
USGE (ft)	1001.50
DSGE (ft)	997.00

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin	010103
Area (acres)	24.00
Length (ft)	1694.00
USGE (ft)	1002.50
DSGE (ft)	1001.00

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin	010201
Area (acres)	5.25
Length (ft)	627.00
USGE (ft)	1000.00
DSGE (ft)	999.00

Click **'Save'** to save the data and then **'Add'** for the last record.

Sub Basin	010301
Area (acres)	30.37
Length (ft)	1818.00
USGE (ft)	999.00
DSGE (ft)	996.00

Click **'OK'** to close the **SUB BASINS** form.

9.0 ESTABLISHING THE LAND USE DATA MANUALLY

Select **'Hydrology → Land Use'** to access the **LAND USE** form

Click on **'Add'** for the first Land Use record.

Sub Basin ID	010101 (Use adjacent button to select)
Land Use Code	190 (Use adjacent button to select)
Area (Acres)	17.75

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010101 (Use adjacent button to select)
Land Use Code	180 (Use adjacent button to select)
Area (Acres)	9.49

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010102 (Use adjacent button to select)
Land Use Code	220 (Use adjacent button to select)
Area (Acres)	.02

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010102 (Use adjacent button to select)
Land Use Code	190 (Use adjacent button to select)
Area (Acres)	1.72

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010102 (Use adjacent button to select)
Land Use Code	180 (Use adjacent button to select)
Area (Acres)	23.38

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010103 (Use adjacent button to select)
Land Use Code	220 (Use adjacent button to select)
Area (Acres)	15.34

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010103 (Use adjacent button to select)
Land Use Code	190 (Use adjacent button to select)
Area (Acres)	0.06

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010103 (Use adjacent button to select)
Land Use Code	140 (Use adjacent button to select)
Area (Acres)	8.60

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010201 (Use adjacent button to select)
Land Use Code	180 (Use adjacent button to select)
Area (Acres)	5.02

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010301 (Use adjacent button to select)
Land Use Code	190 (Use adjacent button to select)
Area (Acres)	9.85

Click **'Save'** to save the data and then **'Add'** for the next record.

Sub Basin ID	010301 (Use adjacent button to select)
Land Use Code	140 (Use adjacent button to select)
Area (Acres)	20.52

Click **'Save'** to save the data and then click **'OK'** to close the **LAND USE** form.

10.0 UPDATE SUB BASIN DATA - MANUAL

Once all the Sub Basin and Land Use data has been entered, select '**Hydrology** → **Sub Basins**' to open the **SUB BASINS** form. Click the '**Details**' tab to view all the data for a particular record. Click '**Update**' to update the data introduced manually.

Sub Basins - MB: 01

List Details

Sub Basin

Major Basin 01

Sub Basin 010101

Sort 10

Sub Basin Parameters

Area (acres) 27.23

Length (ft) 1537

USGE (ft) 996.5

DSGE (ft) 993.0

Slope (ft/mi) 12.0

Value Default Custom

Kb 0.031 0.031

Sub Basin Hydrology Summary

	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
Q (cfs)	29.6	43.7	54.9	78.2	99.5	119.8
CA (ac)	20.42	20.42	20.42	22.60	24.51	25.60
Vol (ac-ft)	1.5060	2.0114	2.3976	3.2393	3.9931	4.6955
Custom Tc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tc (min)	24.3	20.9	19.2	17.4	16.4	15.5
Recession (min)	49.575	45.932	44.212	42.747	41.871	41.410
I (in/hr)	1.45	2.14	2.69	3.46	4.06	4.68

Comments

Info ReSort Print... Delete Add MB Update OK

Click '**OK**' to close the **SUB BASINS** form and continue.

11.0 ESTABLISH CONVEYANCE FACILITY DATA

Select '**Hydraulics** → **Conveyance Facilities**' to access the **CONVEYANCE FACILITIES** form. Select the **Details** tab and click on '**Add**' to add the first record.

Conveyance Facilities - MB: 01 -- Edit

List **Details**

ID
 MB ID: 01
 Facility ID: 010101
 Line ID: 10
 Sort: 10

Model Options
 RP (yrs): 2
 Custom Q: ☐
 Model Road: ☒
 First Pipe: ☐
 Outfall: ☐

Elevations

	U/S (ft)	D/S (ft)
Ground	993.00	988.00
Invert	988.00	984.00

Section Type
 Section: Pipe
 Length (ft): 1323.96
 Manning's n: 0.013
 Diameter (in): 54
 No. of Barrels: 1
 Road ID: MC-RMAR
 No. of Manholes: 0

Calculations

Capacity (cfs)	108.0
Slope (ft/ft)	0.0030
Velocity (fps)	7.7
Normal Depth (ft)	3.58
Critical Depth (ft)	3.02

	Q (cfs)	Road Depth (ft)	Upstream HGL (ft)
2 Yr	54.0		
5 Yr	78.4		
10 Yr	97.6		
25 Yr	135.7		
50 Yr	164.6		
100 Yr	193.7		

Comments

Save Cancel Print... Delete Add Graph MB Update OK

Enter the following data for the first record.

PARAMETERS	VALUES
Facility ID	010101
Line ID	10
Sort	10 (Sort from downstream to upstream)
RP (yrs)	2 (Use adjacent button to select)
Model Road	Check
Outfall	Check
D/S Pipe ID	Leave Blank
Section	Pipe
Length (ft)	1323.96
Manning's n	0.013 (Use adjacent button to select)
Diameter (in)	54
No. of Barrels	1
No. of Manholes	0
Road ID	MC-RMAR (Use adjacent button to select)
Ground U/S (ft)	993.00
Ground D/S (ft)	988.00
Invert U/S (ft)	988.00
Invert D/S (ft)	984.00

Click 'Save' to save the data just entered and then click 'Add' to enter the second

record.

Conveyance Facilities - MB: 01

List

ID

MB ID: 01

Facility ID: 010102

Line ID: 10

Sort: 20

Model Options

RP (yrs): 2

Custom Q: ☐

Model Road: ☒

First Pipe: ☐

Outfall: ☐

Elevations

	U/S (ft)	D/S (ft)
Ground	997.00	993.00
Invert	990.00	988.00

Section Type

Section: Pipe

Length (ft): 1348.26

Manning's n: 0.013

Diameter (in): 48

No. of Barrels: 1

Road ID: MC-RMAR

No. of Manholes: 0

Calculations

	Capacity (cfs)	Slope (ft/ft)	Velocity (fps)	Normal Depth (ft)	Critical Depth (ft)
	55.3	0.0015	4.4	4.00	2.37

	Q (cfs)	Road Depth (ft)	Upstream HGL (ft)
2 Yr	18.3	0.73	
5 Yr	25.2	1.22	
10 Yr	30.5	1.38	
25 Yr	42.1	1.58	
50 Yr	51.8	1.58	
100 Yr	58.0	1.58	

Comments

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

Click 'Save' to save the data just entered and then click 'Add' to enter the third record.

Conveyance Facilities - MB: 01

List

ID

MB ID: 01

Facility ID: 010103

Line ID: 10

Sort: 30

Model Options

RP (yrs): 2

Custom Q: ☐

Model Road: ☒

First Pipe: ☒

Outfall: ☐

Elevations

	U/S (ft)	D/S (ft)
Ground	1001.00	997.00
Invert	994.00	991.25

Section Type

Section: Pipe

Length (ft): 1299.65

Manning's n: 0.013

Diameter (in): 36

No. of Barrels: 1

Road ID: MC-RMAR

No. of Manholes: 0

Calculations

	Capacity (cfs)	Slope (ft/ft)	Velocity (fps)	Normal Depth (ft)	Critical Depth (ft)
	30.7	0.0021	4.6	1.70	1.39

	Q (cfs)	Road Depth (ft)	Upstream HGL (ft)
2 Yr	20.4		
5 Yr	30.1		
10 Yr	37.6	0.63	
25 Yr	54.9	1.05	
50 Yr	68.1	1.18	
100 Yr	81.2	1.29	

Comments

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

Click **'Save'** to save the data just entered and then click **'Add'** to enter the fourth record.

Conveyance Facilities - MB: 01

List **Details**

ID

MB ID 01

Facility ID 010201

Line ID 20

Sort 40

Section Type

Section Pipe

Length (ft) 1007.07

Manning's n 0.013

Diameter (in) 24

No. of Barrels 1

Road ID MC-RMAR

No. of Manholes 0

Calculations

Capacity (cfs) 10.1

Slope (ft/ft) 0.0020

Velocity (fps) 3.5

Normal Depth (ft) 1.22

Critical Depth (ft) 0.94

Model Options

RP (yrs) 2

Custom Q ☐

Model Road ☒

First Pipe ☒

Outfall ☐

Elevations

	U/S (ft)	D/S (ft)
Ground	999.00	994.00
Invert	992.00	990.00

Comments

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

Click **'Save'** to save the data just entered and then click **'Add'** to enter the fifth and last record.

Conveyance Facilities - MB: 01

List

ID

MB ID: 01

Facility ID: 010301

Line ID: 30

Sort: 50

Model Options

RP (yrs): 2

Custom Q: ☐

Model Road: ☒

First Pipe: ☒

Outfall: ☐

Elevations

	U/S (ft)	D/S (ft)
Ground	996.00	993.00
Invert	992.00	988.50

Section Type

Section: Pipe

Length (ft): 1318.30

Manning's n: 0.013

Diameter (in): 36

No. of Barrels: 1

Road ID: MC-RMAR

No. of Manholes: 0

Comments

Calculations

Capacity (cfs)	34.3
Slope (ft/ft)	0.0027
Velocity (fps)	5.1
Normal Depth (ft)	1.71
Critical Depth (ft)	1.48

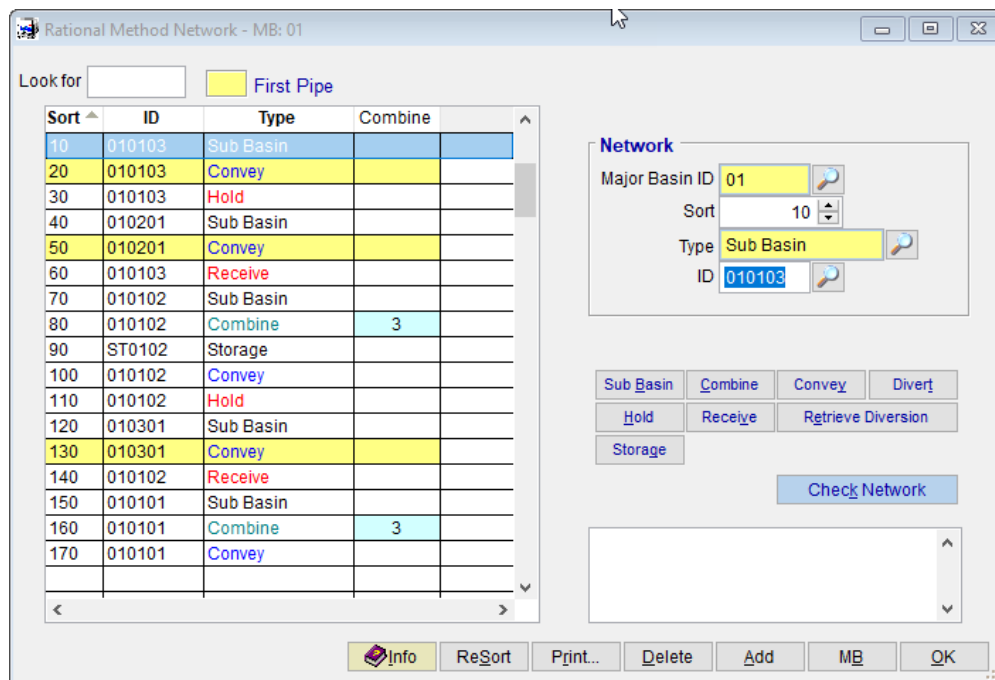
	Q (cfs)	Road Depth (ft)	Upstream HGL (ft)
2 Yr	25.2		
5 Yr	38.4		
10 Yr	48.7	0.77	
25 Yr	71.1	1.15	
50 Yr	90.9	1.31	
100 Yr	109.4	1.44	

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

Click **'OK'** to close the **CONVEYANCE FACILITIES** form and continue.

12.0 ESTABLISH THE MODEL NETWORK

Select **'Hydrology → Rational Method → Network'** to access the model Network data.



Click on **'Add'** to add the first record. Enter the following data:

PARAMETERS	VALUES
Type	Sub Basin
ID	010103 (Use adjacent button to select)
Sort	10

Click **'Save'** to save the record. Click **'Add'** to enter the second record.

PARAMETERS	VALUES
Type	Convey
ID	010103 (Use adjacent button to select)
Sort	20
First Pipe	Check

Click **'Save'** to save the record. Click **'Add'** to enter the third record.

PARAMETERS	VALUES
Type	Hold
ID	010103 (Use adjacent button to select)
Sort	30
First Pipe	Check

Click **'Save'** to save the record. Click **'Add'** to enter the fourth record.

PARAMETERS	VALUES
Type	Sub Basin
ID	010201 (Use adjacent button to select)

Sort	40
------	----

Click **‘Save’** to save the record. Click **‘Add’** to enter the fifth record.

PARAMETERS	VALUES
Type	Convey
ID	010201 (Use adjacent button to select)
Sort	50
First Pipe	Check

Click **‘Save’** to save the record. Click **‘Add’** to enter the sixth record.

PARAMETERS	VALUES
Type	Receive
ID	010103 (Use adjacent button to select)
Sort	60
First Pipe	Check

Click **‘Save’** to save the record. Click **‘Add’** to enter the seventh record.

PARAMETERS	VALUES
Type	Sub Basin
ID	010102 (Use adjacent button to select)
Sort	70

Click **‘Save’** to save the record. Click **‘Add’** to enter the eighth record.

PARAMETERS	VALUES
Type	Combine
ID	010102 (Use adjacent button to select)
Sort	80
Combine	3 (Combines prior three records)

Click **‘Save’** to save the record. Click **‘Add’** to enter the ninth record.

PARAMETERS	VALUES
Type	Storage
ID	ST0102 (Use adjacent button to select)
Sort	90

Click **‘Save’** to save the record. Click **‘Add’** to enter the tenth record.

PARAMETERS	VALUES
Type	Convey
ID	010102 (Use adjacent button to select)
Sort	100

Click **‘Save’** to save the record. Click **‘Add’** to enter the eleventh record.

PARAMETERS	VALUES
Type	Hold
ID	010102 (Use adjacent button to select)
Sort	110

Click **'Save'** to save the record. Click **'Add'** to enter the 12th record.

PARAMETERS	VALUES
Type	Sub Basin
ID	010301 (Use adjacent button to select)
Sort	120

Click **'Save'** to save the record. Click **'Add'** to enter the 13th record.

PARAMETERS	VALUES
Type	Convey
ID	010301 (Use adjacent button to select)
Sort	130
First Pipe	Check

Click **'Save'** to save the record. Click **'Add'** to enter the 14th record.

PARAMETERS	VALUES
Type	Receive
ID	010102 (Use adjacent button to select)
Sort	140

Click **'Save'** to save the record. Click **'Add'** to enter the 15th record.

PARAMETERS	VALUES
Type	Sub Basin
ID	010101 (Use adjacent button to select)
Sort	150

Click **'Save'** to save the record. Click **'Add'** to enter the 16th record.

PARAMETERS	VALUES
Type	Combine
ID	010101 (Use adjacent button to select)
Sort	160
Combine	3 (Combines prior three records)

Click **'Save'** to save the record. Click **'Add'** to enter the 17th record.

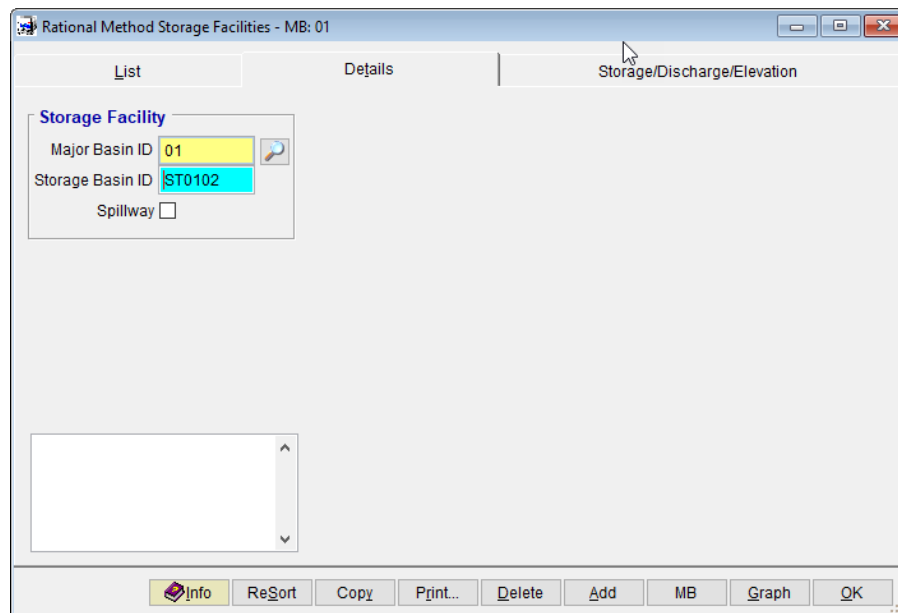
PARAMETERS	VALUES
Type	Convey
ID	010101 (Use adjacent button to select)

Sort	170
------	-----

Click '**Save**' to save the record. Click the '**Check Network**' button to determine if the model network that was built has issues.

13.0 ESTABLISH THE STORAGE

Select '**Hydrology → Rational Method → Storage**' to create the storage. Click "Add" to create the storage facility and enter ST0102 in the Storage Basin ID field. Click "Save" and "OK"



Enter the following Storage/Discharge/Elevation data in its corresponding tab as shown below.

Rational Method Storage Facilities - MB: 01

List Details Storage/Discharge/Elevation

Storage Facilities Rating Data

	Storage (ac-ft)	Discharge (cfs)	Elevation (ft)		Storage (ac-ft)	Discharge (cfs)	Elevation (ft)
1.	0.000	0.00	96.00	11.			
2.	0.500	5.00	96.50	12.			
3.	1.000	10.00	97.00	13.			
4.	1.500	15.00	97.50	14.			
5.	2.000	20.00	98.00	15.			
6.	2.500	25.00	98.50	16.			
7.	3.000	30.00	99.00	17.			
8.	3.500	35.00	99.50	18.			
9.	4.000	40.00	100.00	19.			
10.	5.000	50.00	125.00	20.			

Use Surface Area ☐

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

14.0 RUN RATIONAL METHOD MODEL

Select '**Hydrology → Rational Method → Model**' to access the **RUN RATIONAL METHOD MODEL** form.

Enter the data as shown on the following screen. Click '**Save**' to save the Model Run settings. Click '**Run Model**' to execute the model for the one return period selected.

Run Rational Method Model - MB: 01

Return Period

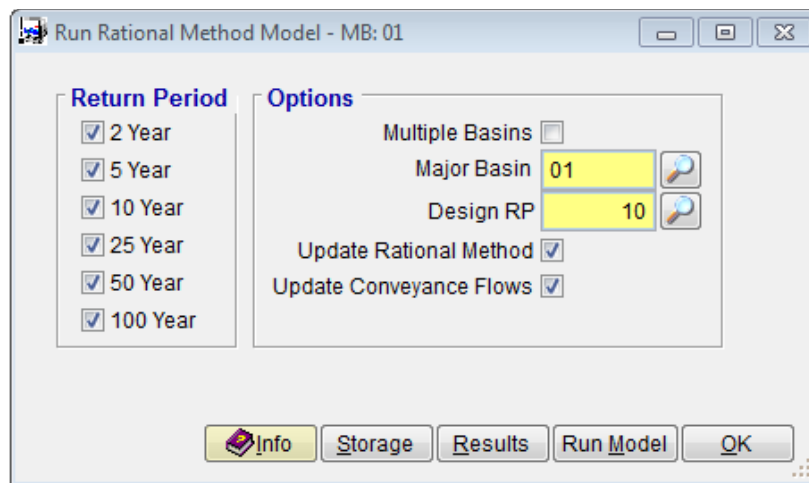
☐ 2 Year
☐ 5 Year
☒ 10 Year
☐ 25 Year
☐ 50 Year
☐ 100 Year

Options

Multiple Basins ☐
 Major Basin 01
 Design RP 10
 Update Rational Method ☒
 Update Conveyance Flows ☒

Info Storage Results Run Model OK

If the model runs correctly, check all the Return Periods and re-run the model.



The dialog box titled "Run Rational Method Model - MB: 01" contains two main sections: "Return Period" and "Options".

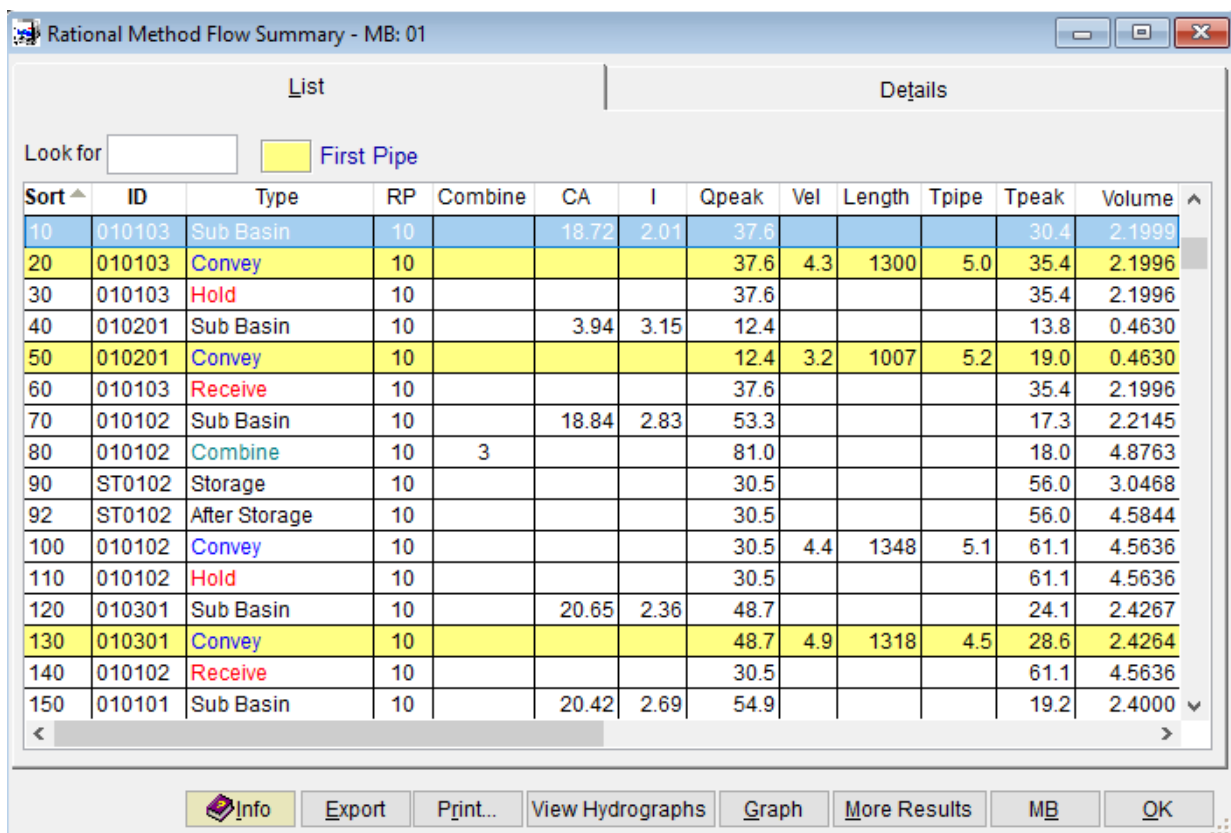
Return Period: A list of checkboxes for different return periods, all of which are checked: 2 Year, 5 Year, 10 Year, 25 Year, 50 Year, and 100 Year.

Options: A section with several settings:

- Multiple Basins:** An unchecked checkbox.
- Major Basin:** A text field containing "01" with a search icon to its right.
- Design RP:** A text field containing "10" with a search icon to its right.
- Update Rational Method:** A checked checkbox.
- Update Conveyance Flows:** A checked checkbox.

At the bottom of the dialog are five buttons: "Info", "Storage", "Results", "Run Model", and "OK".

To view the model run results, click the '**Results**' button on the **RUN RATIONAL METHOD MODEL** form.



The window titled "Rational Method Flow Summary - MB: 01" displays a table of flow summary data. It has two tabs: "List" (selected) and "Details". Below the tabs is a search bar labeled "Look for" with a text input field and a "First Pipe" button. The table has 13 columns: Sort, ID, Type, RP, Combine, CA, I, Qpeak, Vel, Length, Tpipe, Tpeak, and Volume. The data is sorted by ID.

Sort	ID	Type	RP	Combine	CA	I	Qpeak	Vel	Length	Tpipe	Tpeak	Volume
10	010103	Sub Basin	10		18.72	2.01	37.6				30.4	2.1999
20	010103	Convey	10				37.6	4.3	1300	5.0	35.4	2.1996
30	010103	Hold	10				37.6				35.4	2.1996
40	010201	Sub Basin	10		3.94	3.15	12.4				13.8	0.4630
50	010201	Convey	10				12.4	3.2	1007	5.2	19.0	0.4630
60	010103	Receive	10				37.6				35.4	2.1996
70	010102	Sub Basin	10		18.84	2.83	53.3				17.3	2.2145
80	010102	Combine	10	3			81.0				18.0	4.8763
90	ST0102	Storage	10				30.5				56.0	3.0468
92	ST0102	After Storage	10				30.5				56.0	4.5844
100	010102	Convey	10				30.5	4.4	1348	5.1	61.1	4.5636
110	010102	Hold	10				30.5				61.1	4.5636
120	010301	Sub Basin	10		20.65	2.36	48.7				24.1	2.4267
130	010301	Convey	10				48.7	4.9	1318	4.5	28.6	2.4264
140	010102	Receive	10				30.5				61.1	4.5636
150	010101	Sub Basin	10		20.42	2.69	54.9				19.2	2.4000

At the bottom of the window are six buttons: "Info", "Export", "Print...", "View Hydrographs", "Graph", "More Results", "MB", and "OK".

Click '**OK**' to exit the **RATIONAL METHOD FLOW SUMMARY** form. Click '**OK**' to exit the **RUN RATIONAL METHOD MODEL** form.

15.0 UPDATE CONVEYANCE FACILITIES

Select '**Hydraulics → Conveyance Facilities**' to access the **CONVEYANCE FACILITIES** form. Click on '**Update**' to update the hydraulics data with the design flows. If pipe sizes need to change, then keep updating until satisfied with the capacities. When finished, re-run the Rational Method Model and re-run the Conveyance Facilities Update.

16.0 BACKUP PROJECT

This final step is important. Backup your projects on a regular basis. You will save yourself from wasted time and unnecessary stress, if you keep a backup copy of your project. The backup process is done as follows:

Select '**File → Project Management**' to access the **PROJECT MANAGEMENT** form. Select '**Backup Project**' as the Action and select the project you want to backup (Use the adjacent button select the project). Click the '**Backup**' button to backup the project and select the directory where your backup project file should go. Finally, click '**OK**' to continue. Once the backup is completed, click '**OK**' to close the **PROJECT MANAGEMENT** form.

