

# Sacramento Hydrology Method

Sacramento County, California, USA has been estimating runoff flows for the design of drainage facilities since the early 1960's using charts and equations developed by George S. Nolte Consulting Civil Engineers. Use of these charts and equations has historically been referred to as the Nolte method. The City of Sacramento has used constant unit discharge rates similar to those given on the Nolte charts for small areas.

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More recently, the City and County of Sacramento have developed the Sacramento method, based on the Bureau of Reclamation urban unit hydrograph. The new method takes advantage of the advances in computer modeling techniques and the availability of current rainfall and runoff data. The Sacramento method can be used for all drainage design but is especially suited for design of large drainage facilities and masterplanning studies.

On this section:

- [Colorado Urban Hydrograph Procedure - CUHP Theory](#)
- [LA County Procedure - F0601](#)
- [Sacramento Hydrology Method](#)

1. To invoke the Sacramento Hydrology options, open the *swmxp.ini* file with a text editor and add the following block of text.

```
[RNF_SACRAMENTO]
SAC_FLOW_FILE = c:\xps\xpswmm\templates\SACH\Rnf_SacFlows.txt
SACH_TABLE4_1= c:\xps\xpswmm\templates\SACH\4_1.txt
SACH_TABLE4_3=c:\xps\xpswmm\templates\SACH\4_3.txt
SACH_TABLE4_4= c:\xps\xpswmm\templates\SACH\4_4.txt
SACH_TABLE4_5= c:\xps\xpswmm\templates\SACH\4_5.txt
SACH_TABLE4_6= c:\xps\xpswmm\templates\SACH\4_6.txt
SACH_TABLE4_7= c:\xps\xpswmm\templates\SACH\4_7.txt
SACH_TABLE4_8= c:\xps\xpswmm\templates\SACH\4_8.txt
SACH_TABLE6_1= c:\xps\xpswmm\templates\SACH\6_1.txt
SACH_TABLE5_1= c:\xps\xpswmm\templates\SACH\5_1.txt
SACH_TABLE7_6=c:\xps\xpswmm\templates\SACH\7_6.txt
SACH_TABLE7_3=c:\xps\xpswmm\templates\SACH\7_3.txt
SACH_TABLE5_2=c:\xps\xpswmm\templates\SACH\5_2.txt
SACH_TABLE7_1=c:\xps\xpswmm\templates\SACH\7_1.txt
```

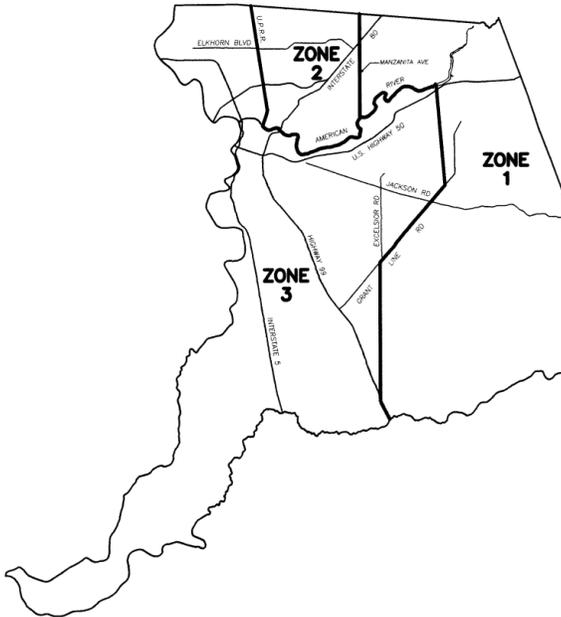
2. Verify that the text files containing the tabular data are located in the proper folder. The files mentioned above can be downloaded from the resource downloads or using this [link](#).
3. Set the [mode](#) to Runoff.
4. On the Configuration menu, select Job Control then [Mode Properties](#). Click on Methods and select Sacramento Method.
5. Note that the [Runoff Mode Job Control](#) dialog has been switched to Sacramento Hydrology. Use this dialog to specify either the [Nolte Method](#) or the [Sacramento Hydrology Method](#). In [Runoff Mode](#), the node data dialogs will be different depending on which Method is selected.

The screenshot shows the 'Sacramento Hydrology' dialog box. It includes a 'Job Title' field, a 'Simulation Details' section with input fields for Year, Month, Day, Hour, Minute, and Second for both Simulation Start and Simulation End. The 'Simulation Start' is set to 1995-01-01 00:00:00 and 'Simulation End' is set to 1995-01-01 02:00:00. The 'Sacramento' method is selected, and the 'Design Storm' option is chosen. A 'Generate User Defined Hydrographs in Hydraulics' button is visible. At the bottom are 'OK' and 'Cancel' buttons.

## Job Control Options

### Zone

Select Zone 1, Zone 2 or Zone 3 from the drop list. Refer to the diagram below for the Hydrologic Zones as defined by the Nolte Method. Click the image to view a larger version:



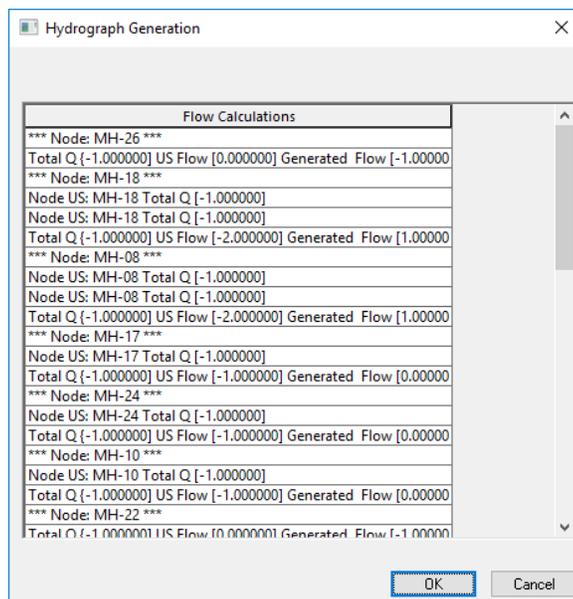
**Source:** County of Sacramento Master Drainage Plan, Part 1, County-wide Hydrology, Nolte and Assoc.

### Ramp Time

Enter the time in minutes for the runoff rate to reach the Nolte Method value.

### Generate User Defined Hydrograph in Hydraulics

When the model is solved, **xp** will generate a ramped user inflow hydrograph for each runoff node. Switch to Hydraulics Mode to view.



## Nolte Method Options

### Node Options

While in **Runoff Mode**, select the node to be edited, and select **Edit Data**. Alternatively, double-click a node to launch the node data dialog, and enter the data for each subcatchment.

The screenshot shows a dialog box titled "Hydrology" with a close button (X) in the top right corner. Inside the dialog, there is a section labeled "Subcatchments" containing a table with one row for subcatchment "1". The table has four columns: "Flag" with a checked checkbox, "Area", "Impervious Compo", and "Flow - Nolte". Below the table are three buttons: "Update", "Add", and "Delete". At the bottom of the dialog, there is a "Total Statistics" section with three input fields: "Area" (0.000), "Impervious %" (0.00), and "Flow" (0.000). At the very bottom are "OK" and "Cancel" buttons.

	1
Flag	<input checked="" type="checkbox"/>
Area	
Impervious Compo	
Flow - Nolte	

Update Add Delete

Total Statistics  
Area 0.000 Impervious % 0.00 Flow 0.000

OK Cancel

#### ***Flag***

Check if subcatchment is active

#### ***Area***

Subcatchment area, in acres

#### ***Impervious Composition***

Select value from drop list

#### ***Flow - Nolte***

Calculated when Update button is clicked

#### ***Add***

Add another subcatchment

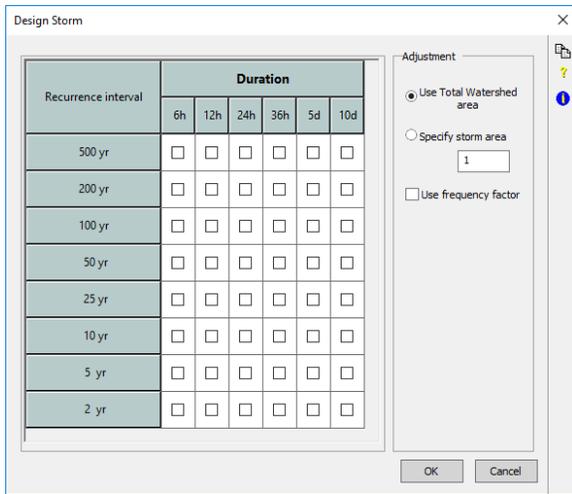
#### ***Delete***

Remove selected subcatchment

## Sacramento County Method Options

### Design Storm

Use this dialog to specify the Recurrence Interval and the Duration of the design storm in the Sacramento Method. Only one storm should be selected in this dialog. Use Scenarios to simulate a batch of different design storms.



The 'Design Storm' dialog box features a table for selecting recurrence intervals and durations, and an 'Adjustment' section on the right.

Recurrence interval	Duration					
	6h	12h	24h	36h	5d	10d
500 yr	<input type="checkbox"/>					
200 yr	<input type="checkbox"/>					
100 yr	<input type="checkbox"/>					
50 yr	<input type="checkbox"/>					
25 yr	<input type="checkbox"/>					
10 yr	<input type="checkbox"/>					
5 yr	<input type="checkbox"/>					
2 yr	<input type="checkbox"/>					

**Adjustment**

- Use Total Watershed area
- Specify storm area  
1
- Use frequency factor

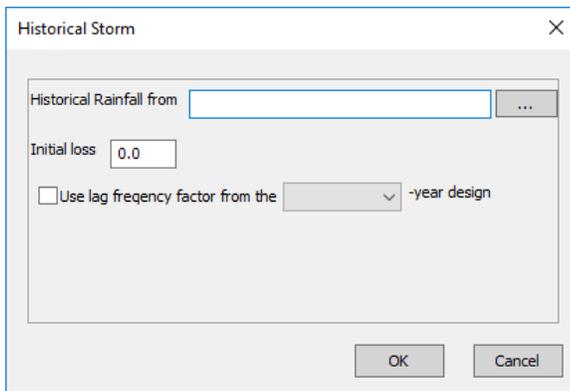
OK Cancel

#### Adjustments to design storm:

- Select Storm Area
- Use Watershed Area
- Specify Storm Area, acres
- Check to Use Frequency Factor

#### Historical Storm

Use this dialog to specify an Historical Storm in the Nolte Method.



The 'Historical Storm' dialog box includes a text field for historical rainfall data, an initial loss input, and a checkbox for using a lag frequency factor.

Historical Rainfall from  ...

Initial loss

Use lag frequency factor from the  -year design

OK Cancel

- Click on the ellipses (...) to open a Windows Explorer window. Navigate to the file containing the storm data.
- Enter the initial loss, in.
- Check the box to use a lag frequency factor for 1, 2 or 3 year design.

#### Sacramento Method Node Options

If Sacramento Method is selected in the Job Control options, double-clicking a node or selecting Edit Data from the right-click menu will launch the dialog below.

**General subcatchment parameters**

**Area**

Node area, in acres

**Mean Elevation**

Node Elevation, in feet

**Precipitation zone**

Select 1, 2 or 3 from the drop list.

**Lag: Compute from Travel Time**

Use this dialog to compute the travel time as the sum of travel times for the three flow paths.

Check to include each flow path in the calculation and enter the required data:

**Upstream land use.** Select the land use category and enter the slope, ft/ft.

**Gutter Flow.** Enter the length, ft, side slope ft/ft and the longitudinal slope, ft/ft

**Channel and pipe flow.** Insert a row for each pipe segment. Select channel type from the drop list. Enter the length, ft, slope ft/ft, diameter, ft, design flow, cfs, and Mannings n.

### Lag from Basin Characteristics

Use this dialog to enter the basic characteristics for the lag time calculation.

Enter the **Length of the longest catchment**, in feet.

Enter the **Length along the longest catchment**, in feet

Enter the subcatchment **Slope**, in feet.

For the Mannings 'n' value (**Basin "n"**) select either **Compute**, or **Specify a value**. Clicking **Compute** launches the Channel Land Use window:

Use this dialog to define the distribution of land use for calculation of Mannings n. This value is used for travel time calculation in Sacramento County runoff method.

Land Use	Channelized Area	
	Developed	Undeveloped
95% - Highways, Parking		
90% - Commercial, Offices		
85% - Intensive Industrial		
80% - Apartments, High Density Res.		
75% - Mobile Home Park		
70% - Condominiums, Med. Density Res.		
60% - Residential 8-10 du/acre Ext Industrial		
50% - Residential 6-8 du/acre Low Density Res, Sc		
40% - Residential 4-6 du/acre		
30% - Residential 3-4 du/acre		
25% - Residential 2-3 du/acre		
20% - Residential 1-2 du/acre		
15% - Residential .5-1 du/acre		
10% - Residential .2-5 du/acre, Ag Res.		
5% - Residential <.2 du/acre, Recreation		
2% - Open Space, Grassland, Ag		
1% Impervious - Open Space, Woodland, Natural		

Enter the values in the Land Use rows in percent or acres. Check the appropriate radio button.

### Infiltration options

**Loss rate.** Compute from Land Use, or Specify the rate in inches/hour.

**Impervious Area.** Compute from Land Use, or Specify the percentage of the area.

Clicking the **Land Use** button launches the **Land Use and Soil Group** dialog:

Use this dialog to define the distribution of land use for calculation of Loss Rate and Impervious Area. For each land use, enter the area in Soil Groups A, B, C or D as a percent or in acres.

Land use and soil group

Land Use	Soil Group		
	B	C	D
95% - Highways, Parking			
90% - Commercial, Offices			
85% - Intensive Industrial			
80% - Apartments, High Density Res.			
75% - Mobile Home Park			
70% - Condominiums, Med. Density Res.			
60% - Residential 8-10 du/acre Ext Industrial			
50% - Residential 6-8 du/acre Low Density Res.			
40% - Residential 4-6 du/acre			
30% - Residential 3-4 du/acre			
25% - Residential 2-3 du/acre			
20% - Residential 1-2 du/acre			
15% - Residential .5-1 du/acre			
10% - Residential .2-5 du/acre, Ag Res.			
5% - Residential <.2 du/acre, Recreation			
2% - Open Space, Grassland, Ag			
1% Impervious - Open Space, Woodland, Natur			

Specified as:  Percentage, or  absolute area

OK Cancel

Click on OK to return to the Sacramento County Method Hydrology dialog.