A Suggested Step-by-Step Procedure for
Creating a Bridge Model in HEC-RAS

A. Develop your data:

1. Plot floodplain limits on topographic map and decide on cross section locations
2. Obtain cross section data (including ineffective flow limits) and flow distances
3. Obtain bridge opening data including abutment and pier data
4. Obtain a starting slope, discharges, etc. etc.
5. (If you are clever, but not GIS-capable, you might put your data into a spreadsheet program)

B. Start HEC-RAS and create a new project

1. *"File"* → *"New Project"* (name and describe the project)

C. Enter the geometric data for a "valley only" plan

1. Click the Geometric Data Editor button
2. Click the "River Reach" button and draw a reach in the window (double-click to end)
3. Name the river and the reach
4. Click the "Cross Section" button
   - *"Options"* → *"Add a new Cross Section"*
   - Enter the river station for the cross section
5. Enter (or paste in) the station-elevation data
6. Enter the channel bank stations and Manning's n-values (but leave the reach lengths blank)
7. Enter a cross section description as needed
8. Click the "Apply Data" button
9. Plot the cross section to check it
10. Continue to add cross sections until they have been all input
11. Exit the cross section data editor

D. Enter the reach lengths (still in the geometric data editor)

1. *"Tables"* → *"Reach Lengths…"*
2. Enter (or paste in) the reach lengths

E. Name and save the geometric data (*"File"* → *"Save as…"*) and exit the geometric data editor

F. Enter the flood discharge information

1. Click on the "Steady Flow" button (it has a "q" and flow arrow on it)
2. Check and change the number of profiles
3. Click the box under "Profile Names and Flow Rates" and enter the discharges
4. Click on the "Reach Boundary Conditions" button
5. Click the box labeled "Downstream" (for a subcritical analysis)
6. Click the button labeled "Normal Depth" or "Known Water Surface" and enter the appropriate data. Click "Ok."
7. *"File"* → *"Save as…"* Name the flow data
8. Exit the flow data editor

G. Compute a profile of the valley only data

1. Click on the "Steady Flow Analysis" (running man) button
2. *"File"* → *"New Plan"* (only if this is the first time to run this data)
3. Enter a plan name and short ID
4. Push the "Compute" button (prepare to be amazed)
5. Exit the steady flow analysis dialog box

H. Enter geometric data for the bridge

1. Open the geometric data editor (the data for the valley-only plan should still be there)
2. *"File"* → *"Save as…"* Enter a name for the bridge geometry data
3. Click the "Bridge/Culvert" button
4. *"Options"* → *"Add a Bridge and/or Culvert"* Enter the river station for the bridge
5. Click the "Deck/Roadway" button
   - Enter (or paste in) the upstream bridge deck and roadway data on the left side of the table
   - If the upstream and downstream internal bridge cross sections are identical, click the "Copy Up to Down" button to create the downstream data
   - Otherwise, adjust stationing of the bridge deck and roadway data to match the downstream internal cross section and paste it into the right side of the table
   - Enter data for "Distance," "Deck Width," and embankment slopes
   - Check (and adjust if desired) the weir coefficient, maximum submergence, minimum weir flow elevation and weir shape (but the defaults should be OK)
   - Exit the dialog box
6. Click the "Sloping Abutment" button
   - Enter (or paste in) station-elevation data for abutment #1 (they are numbered from left to right) on the left side of the table, which is for the upstream bridge face

- If the upstream and downstream bridge internal cross sections are identical, click the "Copy Up to Down" button
- Otherwise adjust the abutment stationing as needed for the downstream bridge face
- Click the "Add" button and follow the same procedure for abutment #2
- Add other abutments as needed
- Exit the abutment editor

7. Click the "Pier" button
   - Enter the data for pier #1 (they are numbered from left to right with increasing elevation as you go down the table)
   - Click the "Add" button and follow the same procedure for pier #2
   - Exit the pier editor

8. Click the "Bridge Modeling Approach" button
   - Select the low flow methods
     - If using momentum, enter the pier drag coefficient (click the little "?" button for a list of the coefficients to use for specific pier types)
     - If using WSPRO, enter the many required variables by clicking the "WSPRO Variables" box
   - Select the high flow method
     - If using pressure and weir flow, check the coefficients for unsubmerged and submerged orifice flow
   - Exit the bridge modeling approach editor

9. Exit the bridge/culvert editor

I. Enter ineffective flow area data

1. Click the "Cross Section" button
2. Select a cross section where ineffective flow data is required
3. *"Options"* → *"Ineffective Flow Areas…"* Enter the ineffective flow stations and elevations as needed
4. Repeat number 3 until all of the required data has been entered
5. Exit the cross section data editor

J. Give the bridge data one last check

1. Click the "Bridge/Culvert" button
2. Zoom in on the bridge as needed to insure that all data is properly entered
3. Exit the bridge data editor

K. Save the geometric data and exit the geometric data editor

L. Compute a profile with the bridge data

1. Click on the "running man"
2. *"File"* → *"New Plan"*
3. Name and plan, give a short ID and click "Compute"

M. Check the results and adjust data as needed

(Scour Procedure on following page)

A Suggested Step-by-Step Procedure for
Computing Scour with HEC-RAS
(Assuming your bridge design or analysis is already complete)

A. Start HEC-RAS and open the appropriate project and plan files for your bridge

    1.   Click on the "running man"
    2.   *"File"* → *"Open plan"* Select the plan that contains the geometry file for your bridge

B. Compute flow distributions

    1.   *"Options"* → *"Flow distribution locations"*
    2.   Click the ▼ by the box labeled "Starting riv sta" and select the river station for the approach cross section (this is the first cross section going upstream that has no ineffective flow areas that account for flow contraction into the bridge)
    3.   Click the ▼ by the box labeled "Upstream RS & Downstream RS" and select the river station marked with "BR"
    4.   Set the number of subdivisions in the right overbank, channel and left overbank
    5.   Click the "Set selected range" button
    6.   Click "OK" to exit the dialog box
    7.   Click "Compute"
    8.   Exit the Steady Flow Analysis box

C. Enter the "Hydraulic Data Zone"

    1.   Click the button labeled "HD" on the HEC-RAS speed bar
    2.   Select the desired profile and bridge for scour computations

D. Set up the contraction scour computations

    1.   Click the tab labeled "Contraction" (if not already selected)
    2.   Click the ▼ by the box labeled "Approach XS river station" and select the river station for the approach cross section (using the same criteria as in step B2, above)
    3.   Change the equation type to "Live" for the channel (and perhaps the left and right overbanks, if appropriate)
    4.   Check the default numbers that have been filled in by the program to insure that they are correct (quite often they will be wrong)
    5.   Enter a D_{50} for the channel and for the overbanks. If D_{50} is unknown, use 0.01 mm. Do not use a lower number because HEC-RAS will not recognize it.

The program WILL NOT COMPUTE contraction scour if the box for D_{50} is left blank.

6.   Press the "K_1" button.

E. Set up the pier scour computations

1.   Click the tab marked "Pier"
2.   Click the radio button labeled "Maximum V1 Y1"
3.   Click the ▼ by the box labeled "Pier #" and select "Apply to All Piers"
4.   Click the ▼ by the box labeled "Method" and select "CSU equation"
5.   Enter a value for D_{50}
   - Enter any value you wish
   - D_{50} is not used by the CSU equation so the number you enter will not affect the result
   - HEC-RAS will not compute pier scour unless a value for D_{50} has been entered

1.   Click the ▼ by the box labeled "Shape" and make the selection that is appropriate for your bridge
2.   Check that $K_1 = 1$
3.   Enter a value for "Angle" if the piers are skew to flow
   - If the piers are parallel to flow, leave it alone
   - A value for K_2 will automatically be entered as you enter a value for "Angle"

1.   Enter a value for K_3 (normally 1.1)
2.   Be sure that K_4 is set to 1

F. Turn off the abutment scour option

1.   Click the "Abutment" tab
2.   Enter values of zero in the "V1" boxes for both the left and right abutments

G. Compute scour

1.   Click the "Apply" button
2.   Click the "Compute" button
3.   Click the "Report" button to review the results

H. Bang your head on the desk: Something wasn't set up just right.