



# **DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS VERSION 6.0.5**

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## **TUTORIAL # 19 ABUTMENT SCOUR ANALYSIS [HEC-18 PROCEDURE]**

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**KVL Consultants, Inc.**

# ABUTMENT SCOUR ANALYSIS [HEC-18 PROCEDURE]

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# ABUTMENT SCOUR ANALYSIS

## [HEC-18 PROCEDURE]

DATE UPDATED: APRIL 20, 2022

TUTORIAL TIME: 40 MINUTES

### 1.0 INTRODUCTION

Based on the ratio between the embankment projected length ( $L$ ) and the floodplain width ( $B_f$ ), abutment scour can be computed based on two conditions: **Live-Bed Condition** and **Clear-Water Condition**. If the ratio ( $L/B_f$ ) is greater than or equal to 0.75, the live-bed condition equations will be used. Conversely, if the ratio ( $L/B_f$ ) is less than 0.75, the clear-water condition equations will be used. It may be pointed out that the abutment scour already includes contraction scour. Abutment scour is a type of local scour and forms part of the total scour depth. When abutment scour is evaluated, no additional contraction scour should be added to the total scour depth.

This tutorial includes the two conditions of Abutment Scour identified as follows:

- **Condition A - Abutment Scour for Live-Bed Condition (Wingwall)**
- **Condition B - Abutment Scour for Clear-Water Condition (Spill-Through)**

### 2.0 ABUTMENT SCOUR FOR LIVE-BED CONDITION (WINGWALL)

If the  $L/B_f$  ratio is greater than or equal 0.75, the live-bed abutment scour equations should be used to evaluate the local scour from abutment structure. The procedure for evaluating Abutment Scour for live-bed conditions, also referred as **Condition A**, is from the HEC-18 Manual of the Federal Highway Administration (2012). The abutment scour in this condition could be evaluated in either of the two types: *Wingwall* or *Spill-Through*.

The following sets of data are used for evaluating the abutment scour under the live-bed condition.

❖ Embankment and Floodplain Data:

- Projected length of embankment,  $L$  (ft): 85.00
- Width of floodplain,  $B_f$  (ft): 100.00

❖ Hydraulic Data:

- Upstream flow depth,  $y_1$  (ft): 10.00
- Unit discharge at upstream floodplain,  $q_1$  (ft<sup>2</sup>/s): 57.00
- Unit discharge at constricted opening,  $q_{2c}$  (ft<sup>2</sup>/s): 78.60
- Flow depth prior to scour,  $Y_o$  (ft): 9.50

The analysis procedure for evaluating abutment scour for live-bed condition is summarized as follows:

- ❖ Step 1: Establish a New River Mechanics Project and Defaults Set-up
- ❖ Step 2: Set up Abutment Scour Basic Data
- ❖ Step 3: Calculate Abutment Scour
- ❖ Step 4: Report and Document the results

## 2.1 Step 1 - Establish a New Project and Defaults Set-up


- (a) Start **DDMSW**. Click the **OK** button to accept the software disclaimer as shown below.




After **DDMSW** is launched, the **SELECT PROJECT** form is automatically opened as shown in the following figure.

Select Project

List      Details      Default Table Versions

Group **River Mechanics** 

Project Group ^	ID	Reference	Title
HEC-1 Model	00134	KVLEXAMPLE5	HEC-1 Tutorial - Clark Unit Hydrograph
HEC-1 Model	00099	KVLEXAMPLE6	HEC-1 Tutorial - S-Graph Unit Hydrograph
HEC-1 Model	00023	KVLEXAMPLE9	HEC-1 Tutorial - Custom Storm Event
HEC-1 Model	00140	REDFOX2.0	
Rational Method	00029	KVLEXAMPLE11	FCDMC Hydraulics Manual Design Example 4.6
Rational Method	00115	KVLEXAMPLE3	Example 3 Rational Method tutorial project
Rational Method	00100	KVLEXAMPLE7	Rational Method Tutorial
Rational Method	00137	V605_DESIGNEX46	FCDMC Hydraulics Manual Design Example 4.6
River Mechanics	00057	ABUTMENT_NCHRP1	Abutment Scour using HEC-18 NCHRP Procedure
River Mechanics	00058	ABUTMENT_NCHRP2	Abutment Scour using HEC-18 NCHRP Procedure
River Mechanics	00106	BANKPROTECTIONFCD	River Mechanics Example - Bank Protection
River Mechanics	00109	BRIDGEPIERFCD	River Mechanics Example - Bridge Pier
River Mechanics	00056	GUIDEBANK_NCHRP	Guide Bank Scour using HEC-18 NCHRP Procedure
River Mechanics	00055	GUIDEBANK_NCHRP2	Guide Bank Scour using HEC-18 NCHRP Procedure
River Mechanics	00112	LATEROSIONEXAMPLE	Lateral Erosion Example
River Mechanics	00111	LAUNCHABLERIPRAP	River Mechanics Example - Launchable RipRap

Modification Date  

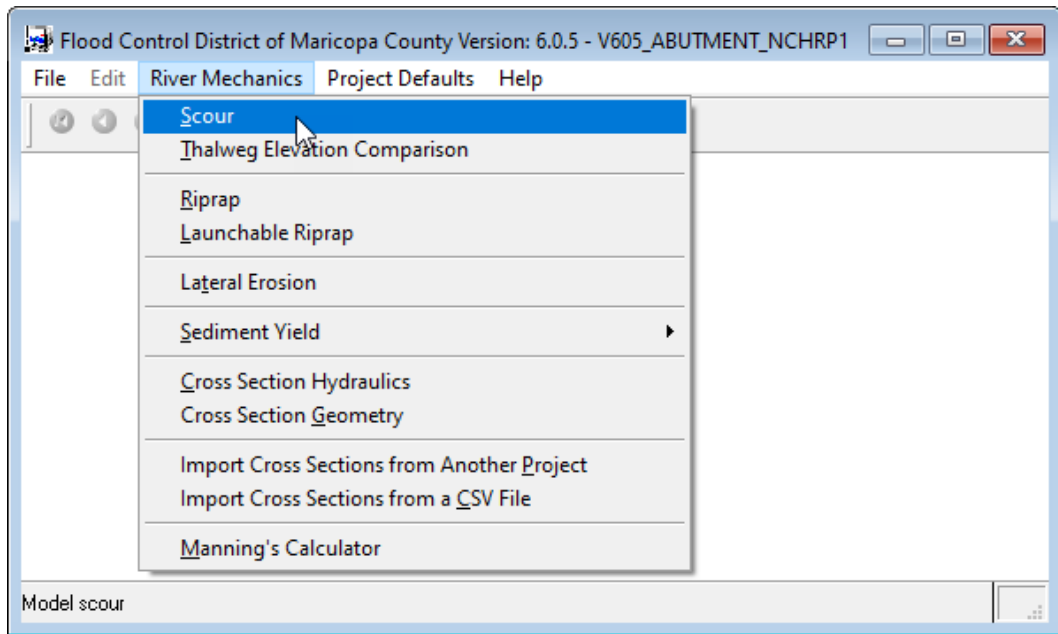
- (b) Click the **Add** button on the **SELECT PROJECT** form to start a new project (**File** → **New Project** → **Add**).
- (c) Check the **River Mechanics** checkbox, then click the **OK** button to exit the **NEW PROJECT OPTIONS** dialog box.
- (d) On the **SELECT PROJECT** form, enter 'V605\_ABUTMENT\_NCHRP1' into the **Reference** textbox. This is the name of the new project. Users can choose any name for the **Reference** textbox as long as it does not already exist in the current **DDMSW** project database.
- (e) Type into the **Title** textbox a brief descriptive title for this project (*Optional*) (e.g., 'Abutment Scour using HEC-18 NCHRP Procedure').
- (f) Type into the **Location** textbox the location of this project (*Optional*) (e.g., 'Maricopa County, Arizona')
- (g) Type into the **Agency** textbox the agency or company name (*Optional*) (e.g., 'Flood Control District of Maricopa County').
- (h) Check **River Mechanics Only** checkbox.
- (i) Type a detailed description of this project into the comment area under the **Project Reference** frame (*Optional*) (e.g., 'This is a tutorial project for evaluating Abutment Scour using HEC-18 NCHRP Procedure').
- (j) Set the **Modification Date** to today's date by clicking on the Calendar icon.
- (k) Click the **Save** button to save the entered data.

- (l) Click the **OK** button on the **SELECT PROJECT** form to exit.

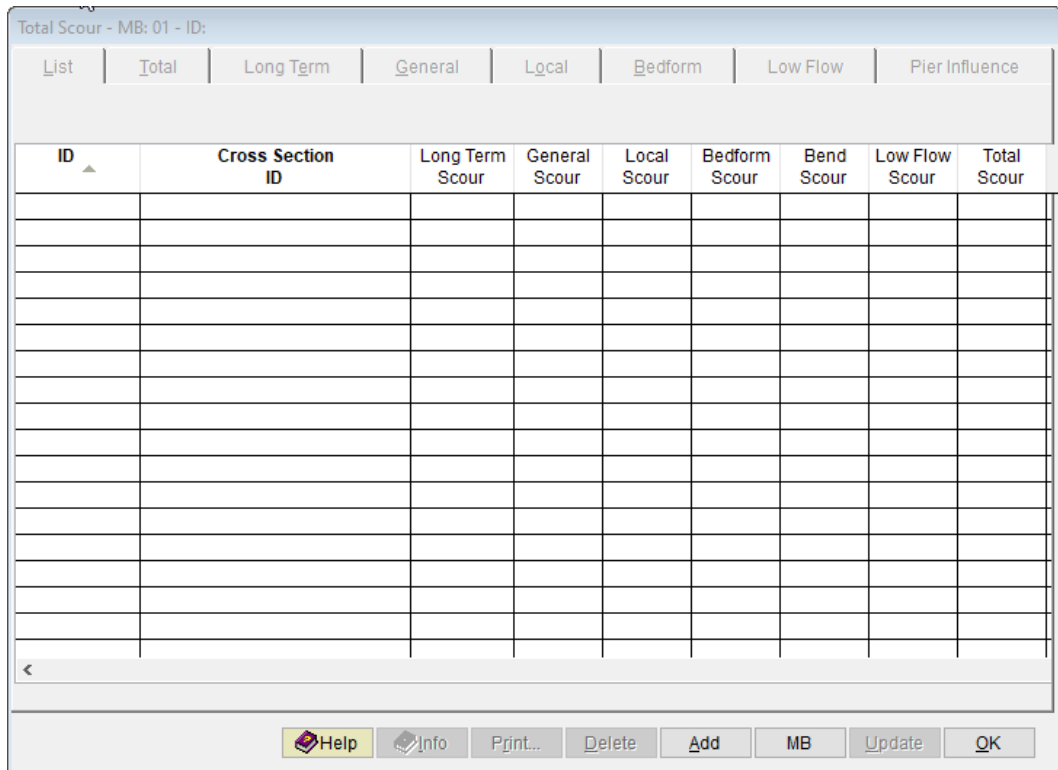
**Note:** The **Project ID 00141** in the above figure is the unique database record identifier for the project, which is automatically generated by the program when a new project is created. Each time a new project is created, a **Project ID** is assigned by the program. The **Project ID** assigned to your project will not necessarily be the same as the **Project ID** shown in the above figure

## 2.2 Step 2 - Set up Abutment Scour Basic Data

- (a) From the menu bar of the main application window, click **River Mechanics** → **Scour**, to open the **TOTAL SCOUR** form.




- (b) On the **TOTAL SCOUR** form, click the *Add* button at the bottom of the form to activate the necessary data entry fields.



- (c) Type "ABUTNO1" into the *ID* textbox (this *ID* is for Abutment No.1).

(d) Check the **Local** check box only.

The screenshot shows the 'Total Scour' software interface. The 'Local' checkbox is checked, and the 'Value' field is set to 1.3. The 'Method' column has a browse button. The 'Total (ft)' field is empty.


- (e) Click the browse button  in the **Method** column across the **Local** checkbox to access and select specific local scour method for the project.
- (f) Select “*Abutments (HEC 18 – 2012)*” from the **SELECT METHOD** dialog box, then click **OK** to exit.

The screenshot shows the 'Select Method' dialog box. The 'Abutments (HEC 18 - 2012)' option is selected. The dialog box contains a list of methods: Piers, Abutments, Abutments (HEC 18 - 2012), Culvert Outlet, Guide Banks, Guide Banks (HEC 18 - 2012), Grade Control or Drop Structure - Schoklitsch, Low Head Stilling Basin - Veronese, and Stilling Basin/End of Apron - Zimmerman/Maniak. The 'OK' and 'Cancel' buttons are at the bottom.

- (g) Click the **Save** button to save the entered data. The **TOTAL SCOUR** form should look like the figure provided below.

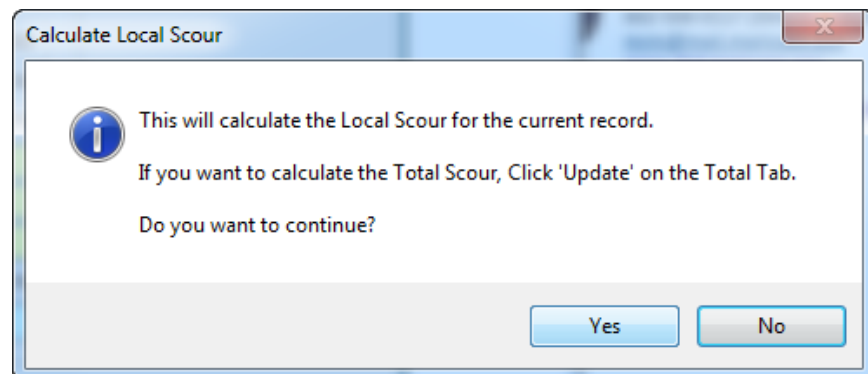
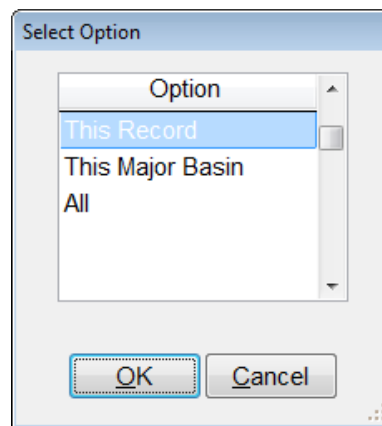


## 2.3 Step 3 - Calculate the Abutment Scour

- (a) On the **TOTAL SCOUR** form, select the *Local* tab
- (b) Enter "85" into the **Projected Length of Embankment, L (ft)** textbox.
- (c) Enter "100" into the **Width of Floodplain, B<sub>f</sub>(ft)** textbox.
- (d) Click the browse  button beside the **Abutment Condition for Amplification Factor** to select the abutment type. Choose "Wingwall" and click **OK** to exit the **ABUTMENT CONDITION** window.

Note that the **Abutment Scour Condition** is automatically set to A since the evaluated  $L/B_f$  ratio is 0.85, which is greater than the threshold value of 0.75. This classifies the problem to be under **Condition A** or a **Live-Bed Condition**.

- (e) Click the **Save** button to save the entered data.
- (f) Enter “10” into the **Upstream Flow Depth,  $y_1$  (ft)** textbox.
- (g) Enter “57” into the **Upstream Unit Discharge,  $q_1$  (sq ft/sec)** textbox.
- (h) Enter “78.6” into the **Unit Discharge in the Constricted Opening,  $q_{2c}$  (sq ft/sec)** textbox.
- (i) Enter “9.5” into the **Flow Depth Prior to Scour,  $Y_o$  (ft)** textbox.
- (j) Click the **Save** button to save the entered data.
- (k) Click the **Update** button to update past analysis results if they exist or to initiate the evaluation of the Abutment Scour for the **Live-Bed Condition**.
- (l) Select “*This Record*” from the **SELECTION OPTION** dialog box, then click **OK** to exit. On the **CALCULATE LOCAL SCOUR** dialog box, click **Yes** to continue.



After the update the **Local** tab form should look like the figure provided below.

The screenshot shows the 'Local' tab of the 'Total Scour' software. The window title is 'Total Scour - MB: 01 - ID: ABUTN01'. The 'Local' tab is selected, showing 'Abutment Parameters (HEC 18 - 2012)' and 'Condition A'.

**Abutment Parameters (HEC 18 - 2012)**

Projected Length of Abutment, L (ft)	85.00	Abutment Condition for Amplification Factor	Wingwall
Width of Floodplain, Bf (ft)	100		
Abutment Scour Condition	A		

**Condition A**

Upstream Flow Depth, y1 (ft)	10.00
Upstream Unit Discharge, q1 (sq ft/sec)	57.00
Unit Discharge in the Constricted Opening, q2c (sq ft/sec)	78.60
Flow Depth Including Live-Bed Contraction Scour, Yc (ft)	13.17
Amplification Factor for Live-Bed Conditions, aa	1.719
Maximum Flow Depth Resulting from Abutment Scour, Ymax (ft)	22.64
Flow Depth Prior to Scour, Yo (ft)	9.50
Abutment Scour Depth, Ys (ft)	13.14



Buttons at the bottom: Help, Info, Print..., Delete, Add, MB, Update, OK

## 2.4 Step 4 - Report and Document the Results

In this section, procedures will be given on how to view, print, and export the calculation results from the abutment scour analysis.

- (a) To view the results on the screen, click the **Print ...** button on the **Local** tab of **TOTAL SCOUR – MB: 01 – ID: ABUTN01** form. A report will be generated as shown in the following figure.

Flood Control District of Maricopa County Drainage Design Management System LOCAL SCOUR - ABUTMENTS HEC-18, CONDITION A Project Reference: V605_ABUTMENT_NCHRP1	
Page 1	3/30/2022
<b>ID: ABUTN01</b>	
Projected Length of Abutment, L (ft)	85.00
Width of Floodplain, Bf (ft)	100
Abutment Scour Condition	A
Select Equation Based On:	Grain Size
Upstream Flow Depth, y1 (ft)	10.00
Upstream Unit Discharge, q1 (sq ft/sec)	57.00
Unit Discharge in the Constricted Opening, q2c (sq ft/sec)	78.60
Flow Depth Including Live-Bed Contraction Scour, Yc (ft)	13.17
Amplification Factor for Live-Bed Conditions, aa	1.72
Maximum Flow Depth Resulting from Abutment Scour, Ymax (ft)	22.64
Flow Depth Prior to Scour, Yo (ft)	9.50
<b>Scour depth, ys (ft)</b>	<b>13.14</b>

- (b) To print the results, click the printer symbol (  ).
- (c) To export the results to PDF format or to other formats, click the export symbol (  )

This concludes the first tutorial for **Abutment Scour under Live-Bed Condition (or Condition A)**.

### 3.0 ABUTMENT SCOUR FOR CLEAR-WATER CONDITION (SPILL-THROUGH)

If the  $L/B_f$  ratio is less than 0.75, the clear-water abutment scour equations should be used. The clear-water condition is also called **Condition B** in the HEC-18 Manual of the Federal Highway Administration (2012). Abutment scour can be computed for either of two options: *Wingwall* or *Spill-Through*.

The data sets provided below are for evaluating Abutment Scour (Spill-Through Option).

❖ Embankment and Floodplain Data:

- Projected length of embankment,  $L$  (ft): 65.00
- Width of floodplain,  $B_f$  (ft): 100.00

❖ Hydraulic and Sediment Data:

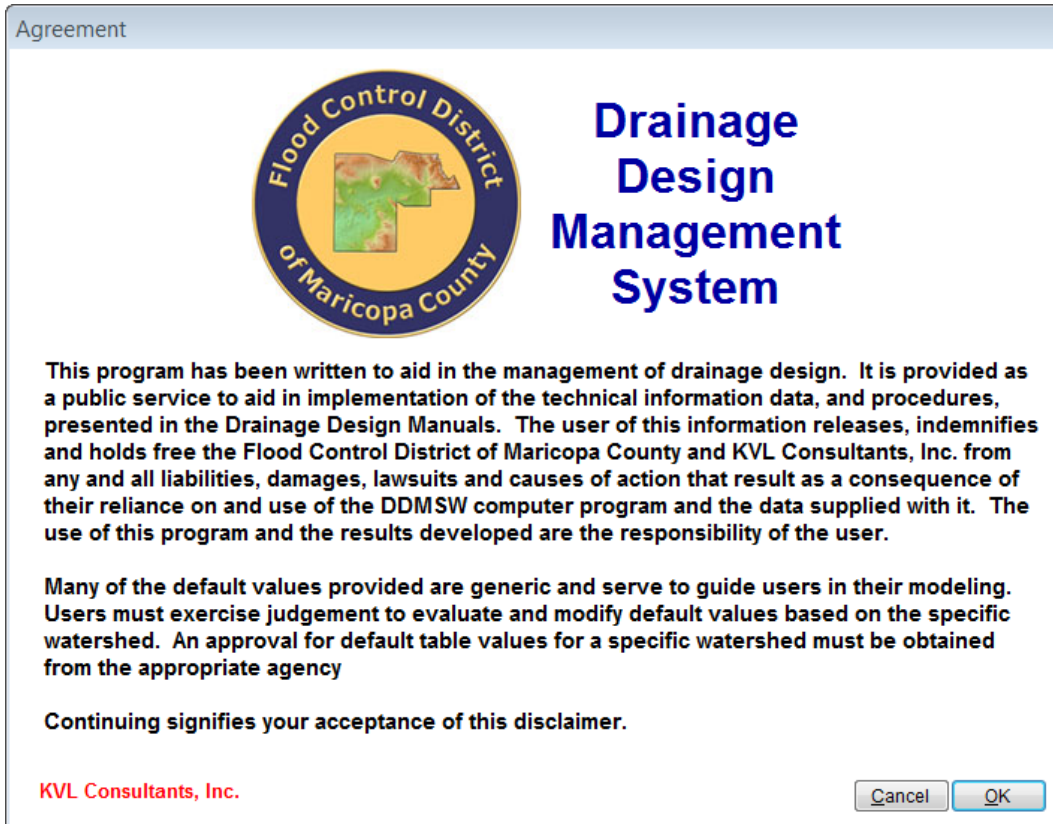
- Unit discharge at upstream floodplain,  $q_f$  (ft<sup>2</sup>/s): 5.70
- Unit discharge at constricted opening,  $q_{2f}$  (ft<sup>2</sup>/s): 10.10
- Particle size with 50 percent finer,  $D_{50}$  (ft): 0.0010
- Manning's  $n$  of floodplain under the bridge: 0.025
- Critical shear stress for floodplain material: 0.04
- Flow depth prior to scour,  $Y_o$  (ft): 3.50

The analysis procedure for evaluating Abutment Scour for clear-water condition is summarized as follows:

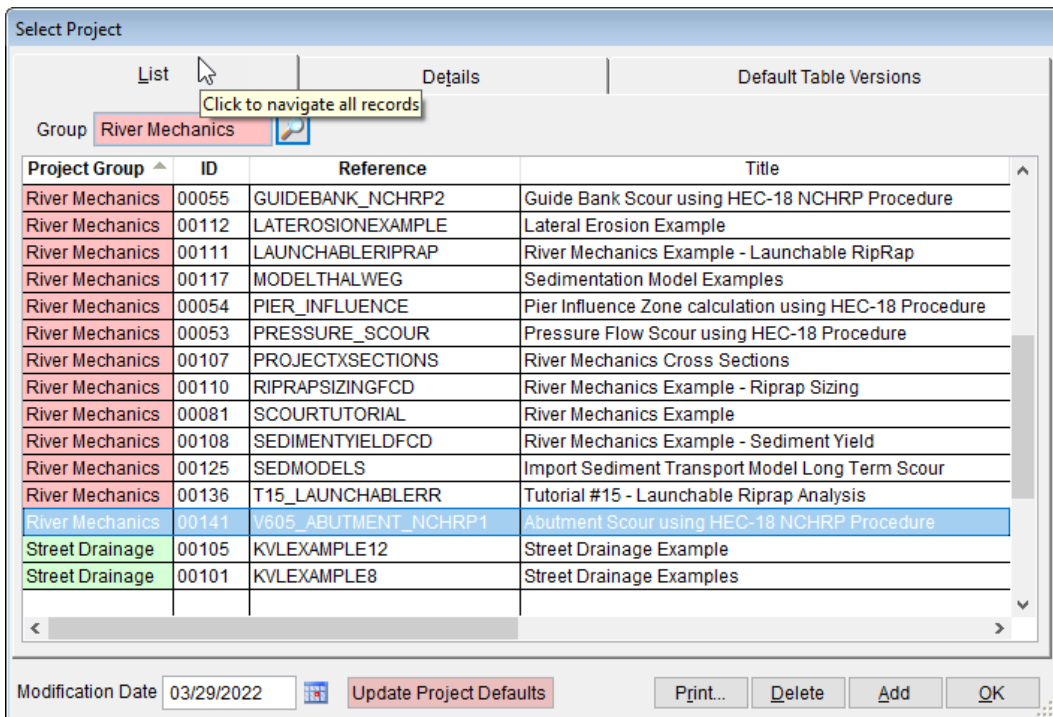
- ❖ Step 1: Establish a New River Mechanics Project and Defaults Set-up
- ❖ Step 2: Set up Abutment Scour Basic Data
- ❖ Step 3: Calculate Abutment Scour – Grain Size Equation
- ❖ Step 4: Calculate Abutment Scour – Shear Stress Equation
- ❖ Step 5: Report and Document the results

#### 3.1 Step 1 - Establish a New Project and Defaults Set-up

- (a) Start **DDMSW**. Click the **OK** button to accept the software disclaimer as shown below.



After **DDMSW** is launched, the **SELECT PROJECT** form is automatically opened as shown in the following figure.



- (b) Click the **Add** button on the **SELECT PROJECT** form to start a new project. Alternatively, one can add/create a new project by executing **File → New Project → Add**.
- (c) Select the **River Mechanics** checkbox, then click the **OK** button to close the **NEW PROJECT OPTIONS** dialog box.
- (d) On the **SELECT PROJECT** form, enter “V605\_ABUTMENT\_NCHRP2” into the **Reference** textbox. This is the name of the new project. Users can choose any name to be entered into the **Reference** textbox as long as it does not exist already in the current **DDMSW** project database.
- (e) Type into the **Title** textbox a brief descriptive title for this project. *(Optional)* (e.g., ‘Abutment Scour using HEC-18 NCHRP Procedure’)
- (f) Type into the **Location** textbox the location of this project. *(Optional)* (e.g., ‘Maricopa County, Arizona’).
- (g) Type into the **Agency** textbox the agency or company name. *(Optional)* (e.g., ‘Flood Control District of Maricopa County’)
- (h) Check **River Mechanics Only** checkbox for this project.
- (i) Type a detailed description of this project into the comment area under the **Project Reference** frame. *(Optional)* (e.g., ‘This is a tutorial project for evaluating Abutment Scour (Clear-Water Condition) using HEC-18 NCHRP Procedure’)
- (j) Set the **Modification Date** using today’s date by clicking on the Calendar icon.
- (k) Click the **Save** button to save the entered data. The figure provided below shows what the form should look like.

The screenshot shows the 'Select Project' dialog box with the following details:

- Project Reference:**
  - Project ID: 00142
  - Reference: V605\_ABUTMENT\_NCHRP2
  - Title: Abutment Scour using HEC-18 NCHRP Procedure
  - Location: Maricopa County, Arizona
  - Agency: Flood Control District of Maricopa County
  - Hydrology and Hydraulics Only
  - River Mechanics Only
- Project Defaults:**
  - Soils: FCDMC
  - Land Use: FCDMC
- Text Box:** This is a tutorial project for evaluating Abutment Scour (Clear-Water Condition) using HEC-18 NCHRP Procedure
- Modification Date:** 03/30/2022
- Buttons:** Update Project Defaults, Info, Print..., Delete, Add, OK

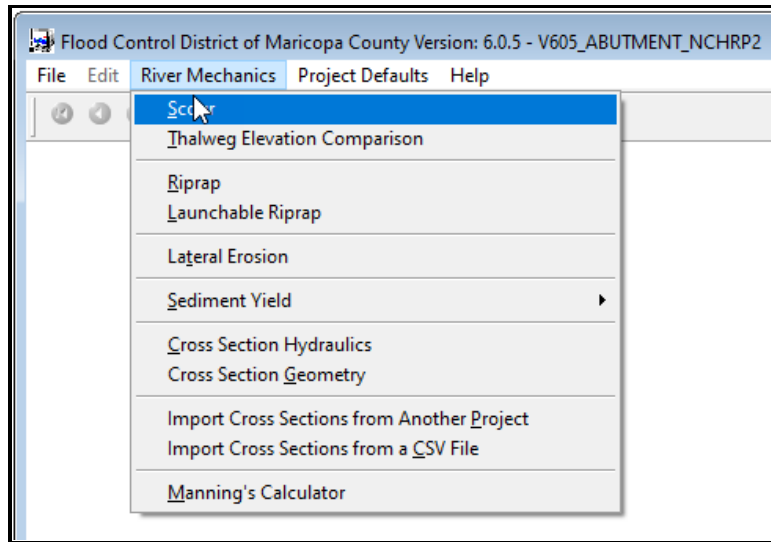
(l) Click the **OK** button to exit / close the **SELECT PROJECT** form.

**Note:** The **Project ID** “00142” in the above figure is the unique database record identifier for the project, which is automatically generated by the program when a new project is created. Each time a new project is created, a **Project ID** is assigned by the program. The **Project ID** assigned to your project will not necessary be the same as the **Project ID** shown in the above figure.

### 3.2 Step 2 - Set up Abutment Scour Basic Data


(a) From the menu bar of the main application window, click **River Mechanics** → **Scour**, to open the **TOTAL SCOUR** form.

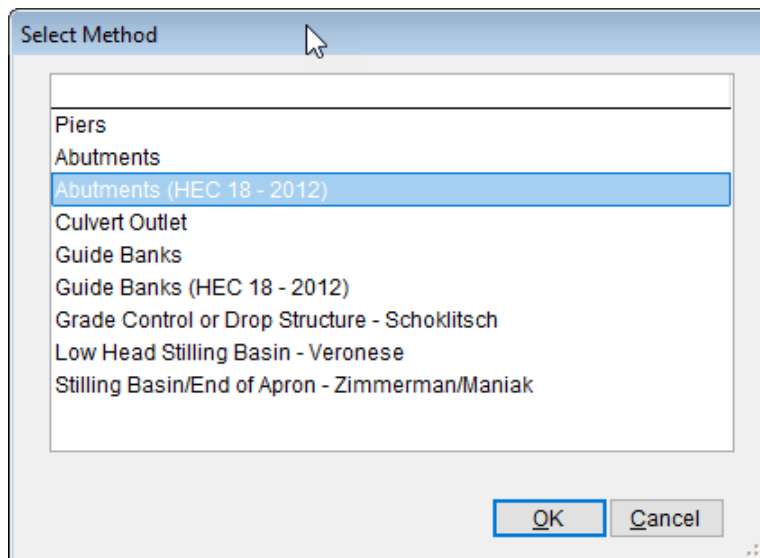




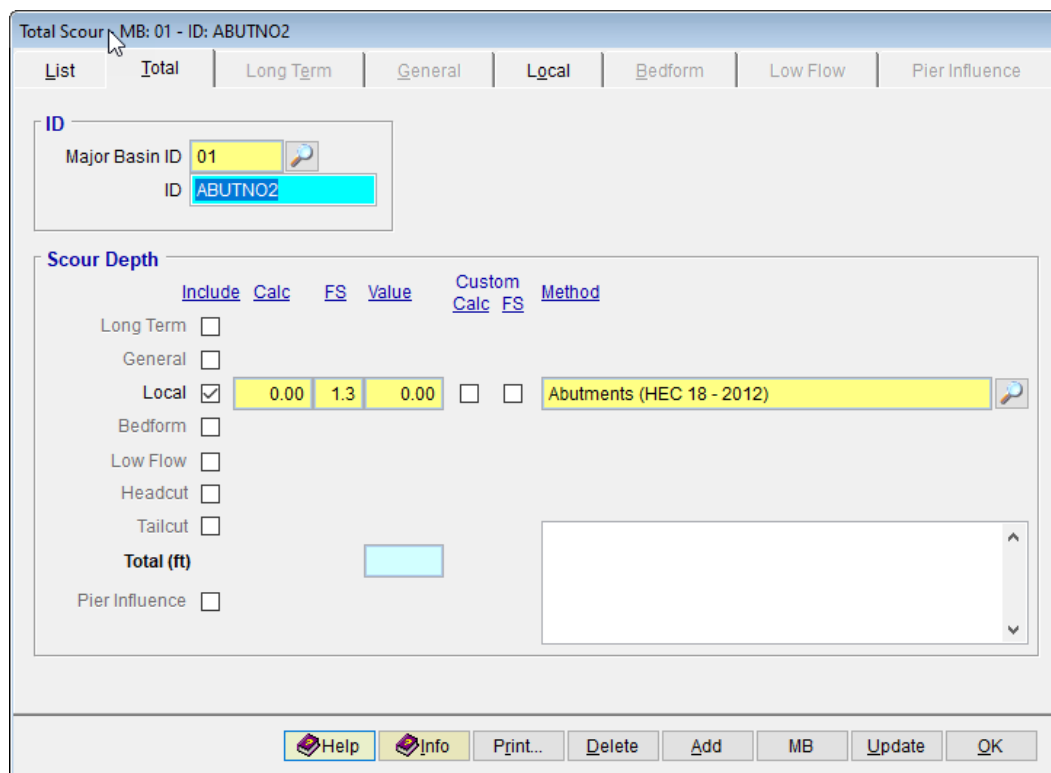
- (b) On the **TOTAL SCOUR** form, click the **Add** button to activate the necessary data entry fields for the new project.

- (c) Enter "**ABUTNO2**" into the **ID** textbox (this **ID** identifies that it is for Abutment No.2).
- (d) Check the **Local** checkbox.

- (e) Click the browse button  under the **Method** column across the **Local** checkbox to open the local scour method select menu.



- (f) Select the 'Abutments (HEC 18 – 2012)' from the **SELECT METHOD** dialog box, then click **OK** to close.
- (g) Back to the **TOTAL SCOUR – MB: 01 – ID: ABUTNO2** form, click the **Save** button to save the entered data.




### 3.3 Step 3 - Calculate the Abutment Scour – Grain Size Equation

- (a) Click the **Local** tab to open the form for entering relevant data for evaluating Abutment Scour depth.

Total Scour - MB: 01 - ID: ABUTNO2

List Total Long Term General **Local** Bedform Low Flow Pier Influence

**Abutment Parameters (HEC 18 - 2012)**

Projected Length of Abutment, L (ft)  Abutment Condition for Amplification Factor **Spill Through** 

Width of Floodplain, Bf (ft)

Abutment Scour Condition **A**

**Condition A**

Upstream Flow Depth, y1 (ft)

Upstream Unit Discharge, q1 (sq ft/sec)

Unit Discharge in the Constricted Opening, q2c (sq ft/sec)

Flow Depth Including Live-Bed Contraction Scour, Yc (ft)


Amplification Factor for Live-Bed Conditions, aa

Maximum Flow Depth Resulting from Abutment Scour, Ymax (ft)

Flow Depth Prior to Scour, Yo (ft)

Abutment Scour Depth, Ys (ft)

Help Info Print... Delete Add MB Update OK


- (b) Enter "65" into the **Projected Length of Embankment, L (ft)** textbox.
- (c) Enter "100" into the **Width of Floodplain, B<sub>f</sub> (ft)** textbox.
- (d) Click the browse  button beside the **Abutment Condition for Amplification Factor** textbox to select the Abutment type. Choose "Spill Through" and click **OK** to exit the **ABUTMENT CONDITION** dialog box.

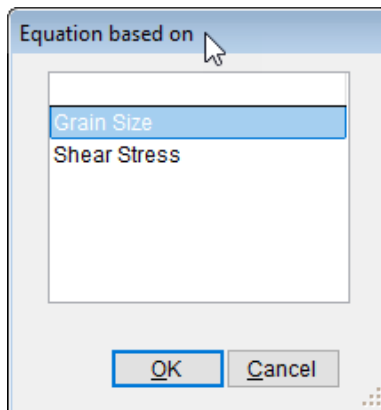
Abutment Condition

Spill Through

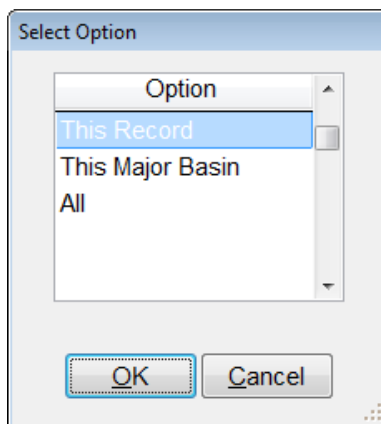
Wingwall

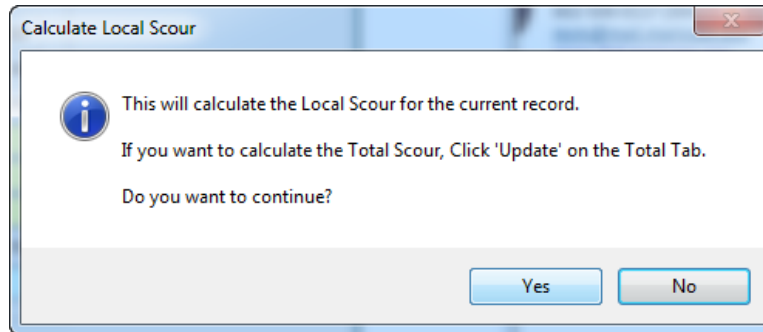
OK Cancel

- (e) Click the browse  button on the right side of the **Select Equation Based On** textbox to select which equation to use between “Grain Size” or “Shear Stress”. Choose “Grain Size”, then click **OK** to exit the **EQUATION BASED ON** dialog box.



- (f) Back on the **Local** tab form, click the **Save** button to save the entered data.
- (g) Enter “5.7” into the **Upstream Unit Discharge,  $q_f$  (sq ft/sec)** textbox.
- (h) Enter “10.1” into the **Unit Discharge in the Constricted Opening,  $q_{2f}$  (sq ft/sec)** textbox.
- (i) Enter “0.0010” into the **Particle Size with 50 Percent Finer,  $D_{50}$  (ft)** textbox.
- (j) Enter “3.5” into the **Flow Depth Prior to Scour,  $Y_o$  (ft)** textbox.
- (k) Click the **Save** button to save the entered data.
- (l) Click the **Update** button to update the analysis.
- (m) Select “This Record” from the **SELECTION OPTION** dialog box, then click **Yes** to continue.





After the update, the form should now look like the figure provided below.

Total Scour - MB: 01 - ID: ABUTNO2

List | Total | Long Term | General | **Local** | Bedform | Low Flow | Pier Influence

**Abutment Parameters (HEC 18 - 2012)**

Projected Length of Abutment, L (ft)  Abutment Condition for Amplification Factor **Spill Through**

Width of Floodplain, Bf (ft)  Select Equation Based On: **Grain Size**

Abutment Scour Condition **B**


**Condition B - Grain Size**

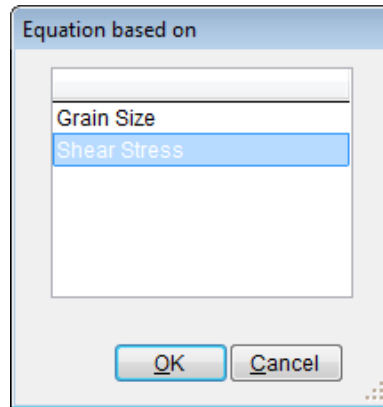
Upstream Floodplain Unit Discharge, $qf$ (sq ft/sec)	5.70
Unit Discharge in the Constricted Opening, $q2f$ (sq ft/sec)	10.10
Ku	11.170
Particle Size with 50 Percent Finer, D50 (ft)	0.0010
Flow Depth Including Clear-water Contraction Scour, $Yc$ (ft)	6.60
Amplification Factor for Clear-water Conditions, $ab$	2.111
Maximum Flow Depth Resulting from Abutment Scour, $Ymax$ (ft)	13.94
Flow Depth Prior to Scour, $Yo$ (ft)	3.50
Abutment Scour Depth, $Ys$ (ft)	10.44

Help | Info | Print... | Delete | Add | MB | Update | OK

### 3.4 Step 4 - Calculate the Abutment Scour – Shear Stress Equation

An alternative option to evaluate the Abutment Scour is to use equations for the “*Shear Stress*” option.

- On the same **Local** tab form, keep the same data that were employed for the ‘*Grain Size*’ option.
- Click the browse  button beside the **Select Equation Based On** textbox and select “*Shear Stress*”. Click **OK** to exit the **EQUATION BASED ON** dialog box.



(c) Click the **Save** button to accept the changes made on the data.

Note that the selection of “*Shear Stress*” for the **Abutment Scour Condition B analysis** has transformed the **Local** tab form as shown. Now the form has added three more input data fields. They are **Manning’s n of the Floodplain Material Under the Bridge**, **Critical Shear Stress for the Floodplain Material,  $t_c$  (lb/sq ft)**, and **Unit Weight of Water (lb/cu ft)**.

Total Scour - MB: 01 - ID: ABUTNO2

List | Total | Long Term | **General** | Local | Bedform | Low Flow | Pier Influence

**Abutment Parameters (HEC 18 - 2012)**

Projected Length of Abutment, L (ft)       Abutment Condition for Amplification Factor **Spill Through**

Width of Floodplain, Bf (ft)       Select Equation Based On: **Shear Stress**

Abutment Scour Condition **B**

**Condition B - Shear Stress**

Upstream Floodplain Unit Discharge, $q_f$ (sq ft/sec)	5.70
Unit Discharge in the Constricted Opening, $q_{2f}$ (sq ft/sec)	10.10
Manning n of the Floodplain Material Under the Bridge, n	
Critical Shear Stress for the Floodplain Material, $t_c$ (lb/sq ft)	
Unit Weight of Water (lb/cu ft)	62.40
Ku	1.486
Flow Depth Including Clear-water Contraction Scour, $Y_c$ (ft)	6.60
Amplification Factor for Clear-water Conditions, ab	2.111
Maximum Flow Depth Resulting from Abutment Scour, $Y_{max}$ (ft)	13.94
Flow Depth Prior to Scour, $Y_o$ (ft)	3.50
Abutment Scour Depth, $Y_s$ (ft)	10.44

Help | Info | Print... | Delete | Add | MB | Update | OK

(d) Enter “0.025” into the **Manning n of the Floodplain Material Under the Bridge, n** textbox.

- (e) Enter “0.04” into the **Critical Shear Stress for the Floodplain Material,  $t_c$  (lb/sq ft)** textbox.
- (f) Enter “62.4” into the **Unit Weight of Water (lb/cu ft)** textbox.

Keep the other input data to be the same as were used in the “Grain Size” option. The completed form should now look as the screenshot provided below:

The screenshot shows the 'Total Scour - MB: 01 - ID: ABUTNO2 -- Edit' window. The 'General' tab is active. The 'Abutment Parameters (HEC 18 - 2012)' section includes:
 

- Projected Length of Abutment, L (ft): 65.00
- Width of Floodplain, Bf (ft): 100
- Abutment Scour Condition: B
- Abutment Condition for Amplification Factor: Spill Through
- Select Equation Based On: Shear Stress

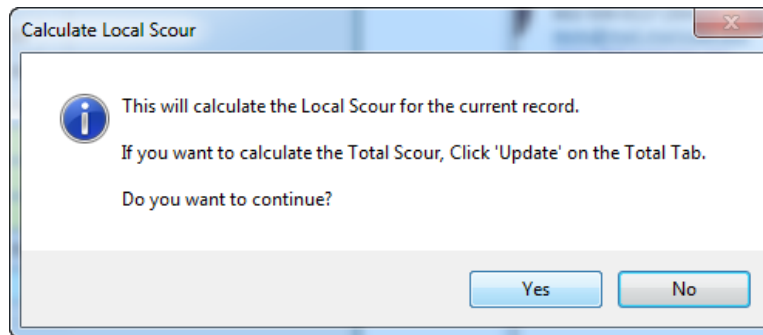
 The 'Condition B - Shear Stress' section contains a table of calculated values:
 

Upstream Floodplain Unit Discharge, qf (sq ft/sec)	5.70
Unit Discharge in the Constricted Opening, q2f (sq ft/sec)	10.10
Manning n of the Floodplain Material Under the Bridge, n	0.025
Critical Shear Stress for the Floodplain Material, $t_c$ (lb/sq ft)	0.04
Unit Weight of Water (lb/cu ft)	62.40
Ku	1.486
Flow Depth Including Clear-water Contraction Scour, Yc (ft)	6.60
Amplification Factor for Clear-water Conditions, ab	2.111
Maximum Flow Depth Resulting from Abutment Scour, Ymax (ft)	13.94
Flow Depth Prior to Scour, Yo (ft)	3.50
Abutment Scour Depth, Ys (ft)	10.44

 At the bottom, there are buttons for Save, Cancel, Print..., Delete, Add, MB, Update, and OK.

- (g) Click the **Save** button to accept all the changes made on the form.
- (h) Click the **Update** button to update the Abutment scour analysis results.
- (i) Select “This Record” from the **SELECTION OPTION** dialog box, then click **Yes** to continue.

The 'Select Option' dialog box shows a list of options: 'This Record', 'This Major Basin', and 'All'. 'This Record' is selected and highlighted in blue. At the bottom, there are 'OK' and 'Cancel' buttons.



After the update, the evaluated Abutment Scour depth for the “Shear Stress” option (*i.e.*, 7.29) appears to be less than the one evaluated for the “Grain Size” option (*i.e.*, 10.44).

Total Scour - MB: 01 - ID: ABUTNO2

List | Total | Long Term | General | Local | Bedform | Low Flow | Pier Influence

**Abutment Parameters (HEC 18 - 2012)**

Projected Length of Abutment, L (ft)  Abutment Condition for Amplification Factor

Width of Floodplain, Bf (ft)  Select Equation Based On:

Abutment Scour Condition

**Condition B - Shear Stress**

Upstream Floodplain Unit Discharge, $qf$ (sq ft/sec)	5.70
Unit Discharge in the Constricted Opening, $q2f$ (sq ft/sec)	10.10
Manning n of the Floodplain Material Under the Bridge, n	0.025
Critical Shear Stress for the Floodplain Material, $t_c$ (lb/sq ft)	0.04
Unit Weight of Water (lb/cu ft)	62.40
Ku	1.486
Flow Depth Including Clear-water Contraction Scour, $Y_c$ (ft)	5.11
Amplification Factor for Clear-water Conditions, ab	2.111
Maximum Flow Depth Resulting from Abutment Scour, $Y_{max}$ (ft)	10.79
Flow Depth Prior to Scour, $Y_o$ (ft)	3.50
Abutment Scour Depth, $Y_s$ (ft)	7.29

Help Info Print... Delete Add MB Update OK



### 3.5 Step 5 - Report and Document the Results

This section includes procedures how to view, print, and export results from performing Abutment Scour analysis.

- (a) To view the analysis results on the screen, click the **Print ...** button on the **Local** Tab of the **TOTAL SCOUR – MB: 01 – ID: ABUTNO2** form. As a result, a report is generated as shown below:



Flood Control District of Maricopa County Drainage Design Management System	
Page 1	LOCAL SCOUR - ABUTMENTS HEC-18 - CONDITION B - SHEAR STRESS Project Reference: V605_ABUTMENT_NCHRP2
3/30/2022	
<b>ID: ABUTNO2</b>	
Projected Length of Abutment, L (ft)	65.00
Width of Floodplain, Bf (ft)	100
Abutment Scour Condition	B
Select Equation Based On:	Shear Stress
Upstream Floodplain Unit Discharge, $q_f$ (sq ft/sec)	5.70
Unit Discharge in the Constricted Opening, $q_2$ (sq ft/sec)	10.10
Manning n of the Floodplain Material Under the Bridge, n	0.025
Critical Shear Stress for the Floodplain Material, $\tau_c$ (lb/sq ft)	0.04
Unit Weight of Water (lb/cu ft)	62.40
$\gamma_w$	1.486
Flow Depth Including Clear-water Contraction Scour, $Y_c$ (ft)	5.11
Amplification Factor for Clear-water Conditions, ab	2.11
Maximum Flow Depth Resulting from Abutment Scour, $Y_{max}$ (ft)	10.79
Flow Depth Prior to Scour, $Y_o$ (ft)	3.50
<b>Scour depth, <math>y_s</math> (ft)</b>	<b>7.29</b>

- (b) To print the results, click the printer symbol ().
- (c) To export the results to PDF format or to other formats, click the export symbol ().

This concludes this second tutorial for **Abutment Scour under Clear-Water Condition (Condition B)**.