MARICOPA COUNTY
FLOOD CONTROL DISTRICT

# DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS

## VERSION 6.8.0

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# TUTORIAL # 13

# RIPRAP SIZING CALCULATION

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**KVL Consultants, Inc.**

## RIPRAP SIZING ANALYSIS

## TABLE OF CONTENTS

**No. Section Page**

# RIPRAP SIZING CALCULATION FOR BANK PROTECTION

**DATE UPDATED: MAY 7, 2024**
**TUTORIAL TIME: 25 MINUTES**

## 1.0 PROBLEM STATEMENT

To estimate the riprap sizing for bank protection using "*Channel Banks on Curved Reach*" type with the following given design parameters:

- The Cross Section "*STUDYREACHROSSSECTION*"
  - Parameters for Hydraulics and Geometry:
    - **Design Flow Rate (cfs):** *3200*
    - **Channel Slope (ft/ft):** *0.015*
    - **Design Manning's n (Channel, LOB, ROB):** *0.035*
  - The geometric data (station and elevation) of the cross section:

| Station (X) | Elevation (Y) | Notes |
|---|---|---|
| *100* | *100* | |
| *106* | *98* | |
| *156* | *98* | *Left Bank Station* |
| *166* | *95* | |
| *191* | *95* | |
| *201* | *98* | *Right Bank Station* |
| *251* | *98* | |
| *257* | *100* | |

  - Parameters for Channel Banks:
    - **Bank Slope Angle (Degrees):** *45.00*
    - **Specific Weight for Stone (lb/cu ft):** *150.00*
    - **Specific Weight for Water (lb/cu ft):** *62.40*

## 2.0 STEP-BY-STEP PROCEDURES

Step 1: Establish a New Project and Default Set-up

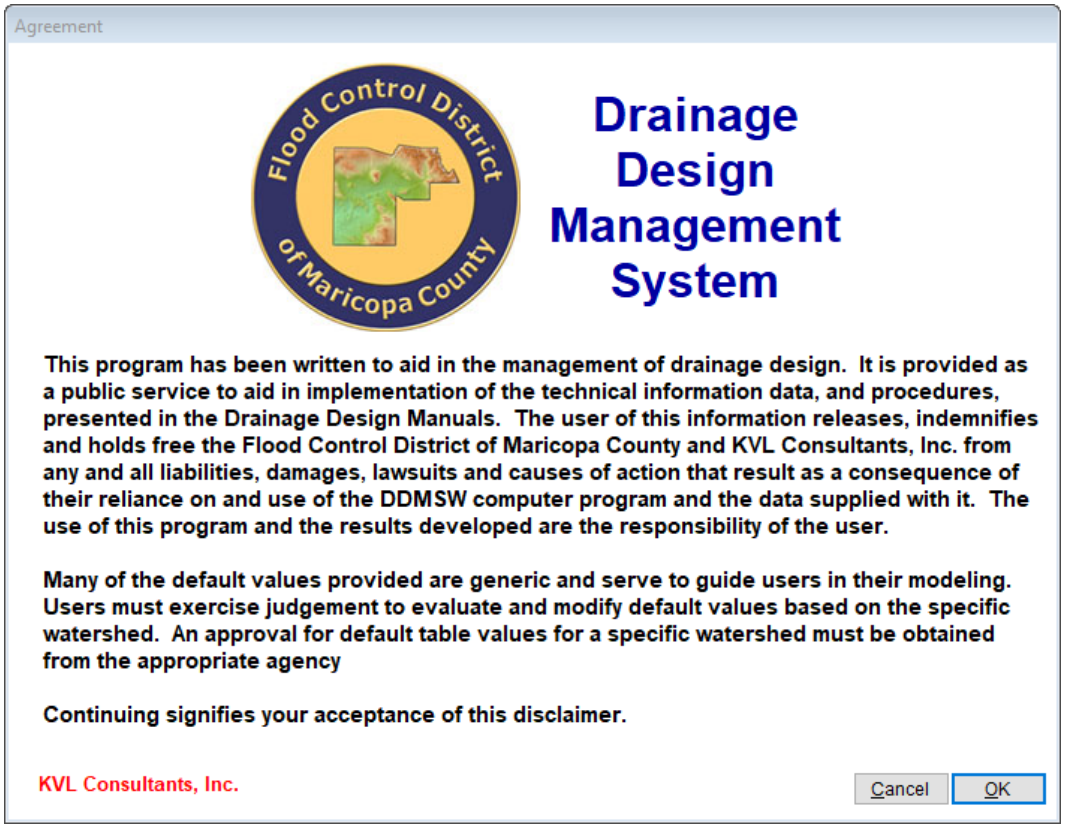
Step 2: Prepare the Cross Section Geometry

Step 3: Calculate Riprap Sizing

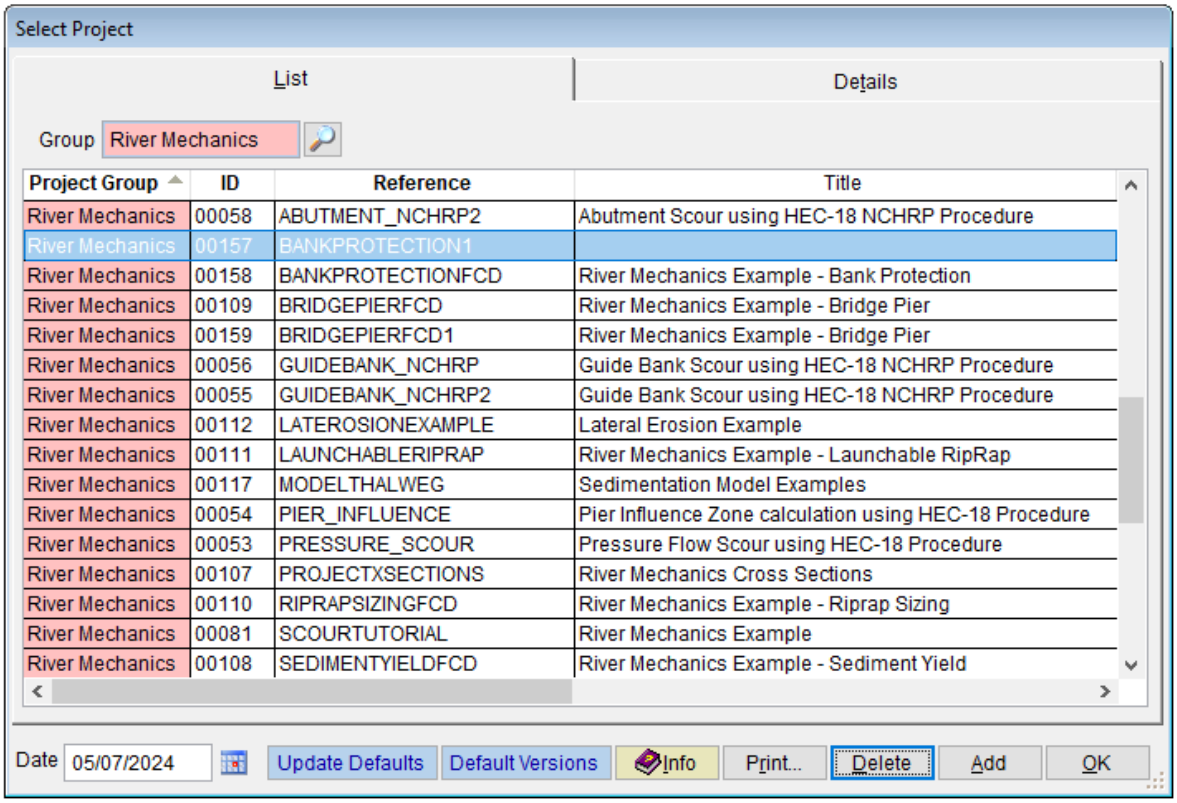
Step 4: Report and Document the Results

## 2.1 STEP 1 - ESTABLISH A NEW PROJECT AND DEFAULTS SET-UP

(a) Click the DDMSW icon on the Desktop or Program menu to launch the **DDMSW**. Click **OK** to accept the software disclaimer as is shown in the following figure.




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




(b) Click the **Add** button on the **SELECT PROJECT** window to start a new project (or you can start a new project by **File ➔ New Project ➔ Add**).

(c) Select **River Mechanics** checkbox and click the **OK** button on the **NEW PROJECT OPTIONS** form.

(d) Type "*RIPRAPSIZING1*" into the **Reference** textbox. This is the name of this newly created project. Users can choose any name for the Reference textbox as long as it does not exist in the current **DDMSW** project database.

(e) Type into the **Title** textbox a brief descriptive title of this project. ***(Optional)***

(f) Type into the **Location** textbox the location of this project. ***(Optional)***

(g) Type into the **Agency** textbox the agency or company name. ***(Optional)***

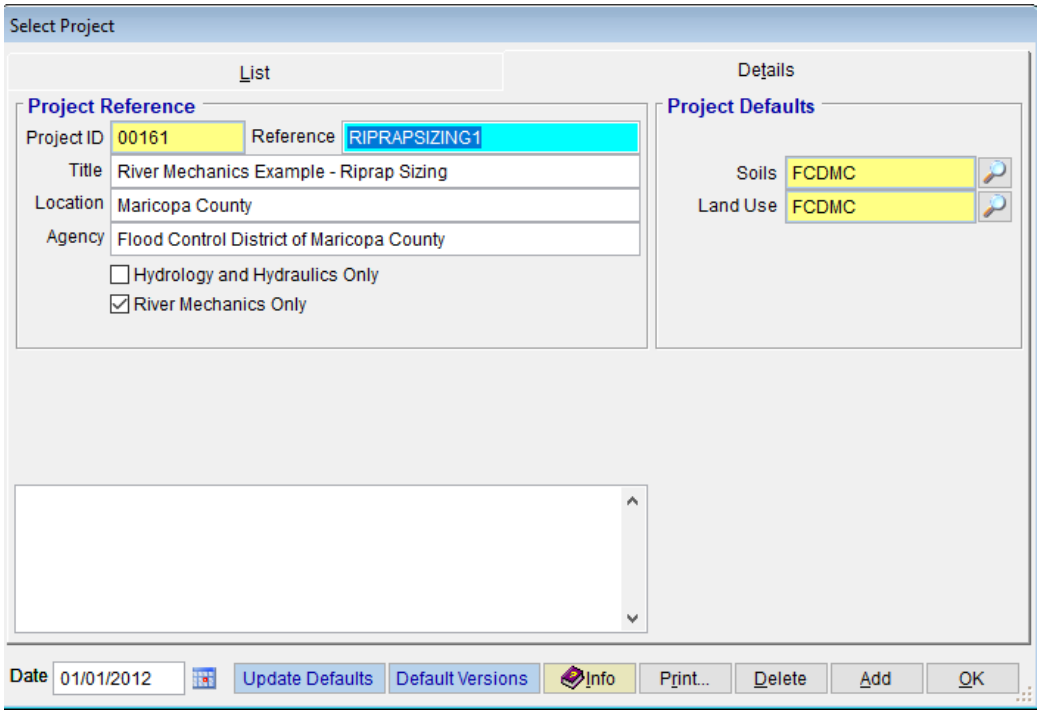
(h) Check **River Mechanics** checkbox for this project.

**(i)** Type a detailed description of this project into the comment area under the **Project Reference** frame. ***(Optional)***

(j) On the **Modification Date**, use the current date.

(k) Click **Save** button to save the entered data.

(l) Click **OK** button on the **SELECT PROJECT** window, and click **OK** button on the pop-up message box. The following figure shows what the window looks like.



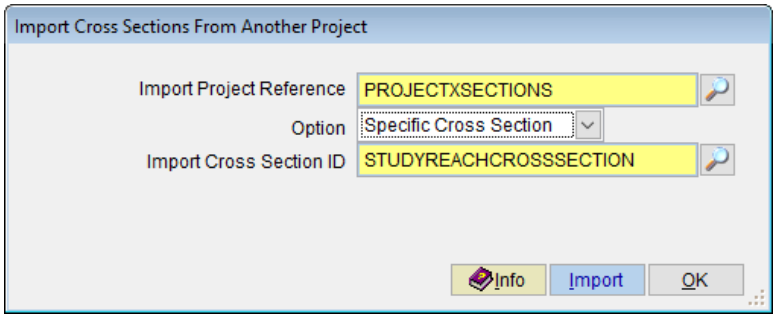

**Note:** the **Project ID** *00161* in the above figure is the database records unique read-only identifier of the project, which is automatically generated by the program when a new project is created. When the users create a new project, the **Project ID** of this new project will not be the same as the **Project ID** shown in the above figure.

## 2.2 STEP 2 - PREPARE THE CROSS SECTION AND HYDRAULIC DATA

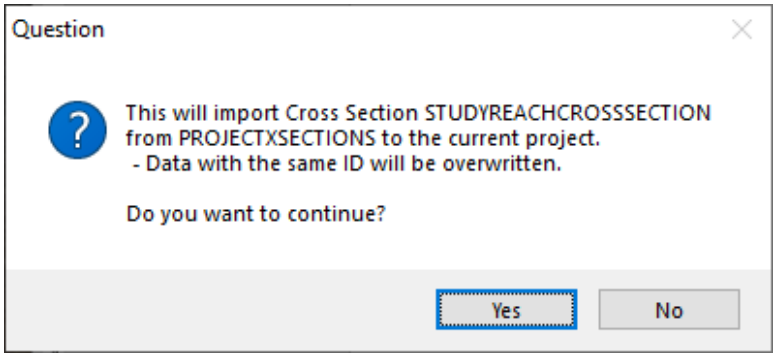
Only one (1) cross section data, the "*STUDYREACHCROSSSECTION*", will be used for this tutorial. This cross section data will be imported from another project.

(a) To import the first cross section data (Study Location Cross Section Data), open the **IMPORT CROSS SECTIONS FROM ANOTHER PROJECT** form (**River Mechanics ➔ Import Cross Sections from Another Project**). Use the following data on the form.

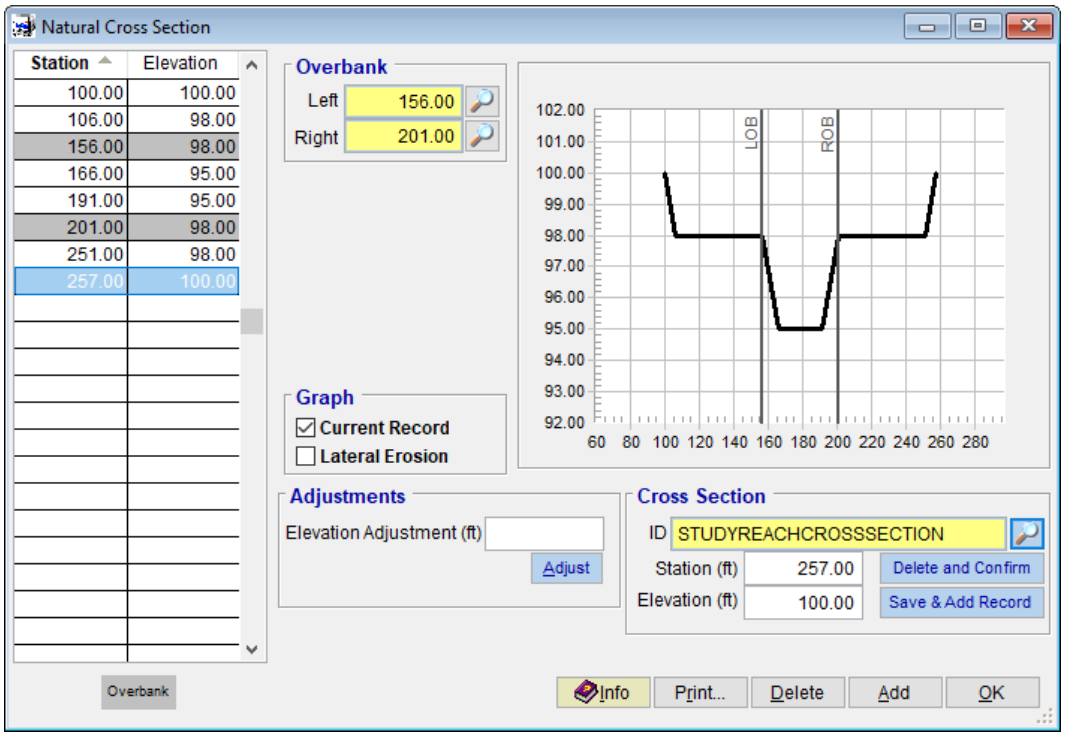
- **Import Project Reference:** *PROJECTXSECTIONS*
- **Option:** *Specific Cross section*
- **Import Cross Section ID:** *STUDYREACHCROSSSECTIONS*




(b) Once the specified data have been selected, click the **Import** button. Select **Yes** to proceed, and hit **OK** to close the **IMPORT CROSS SECTION FROM ANOTHER PROJECT** form.



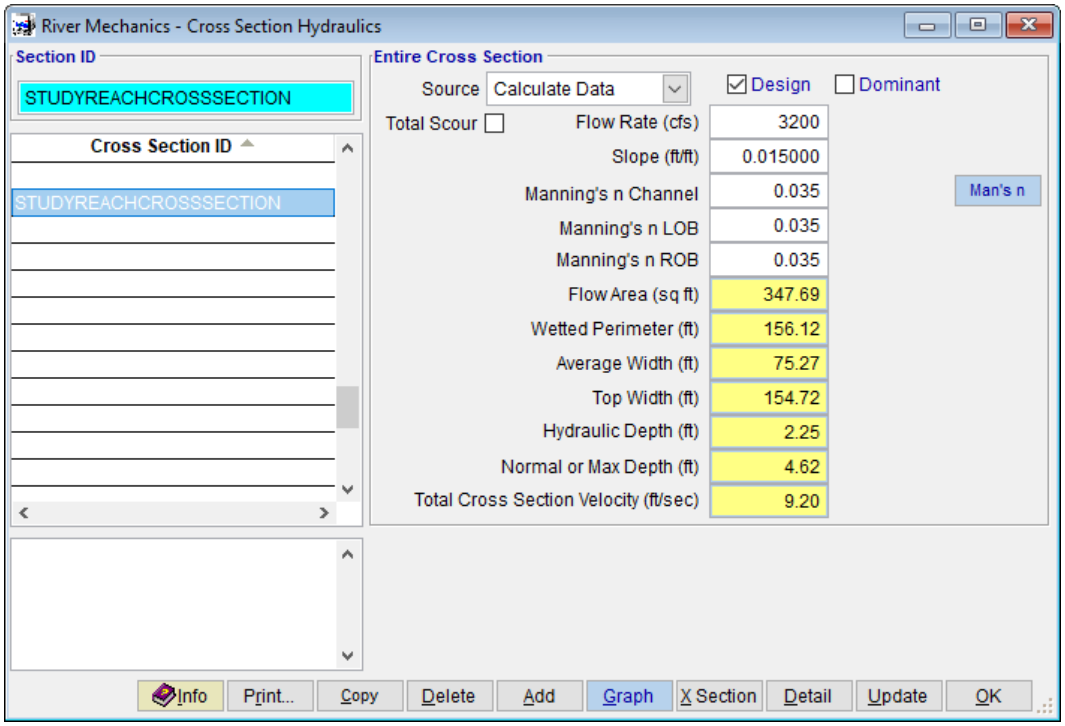

(c) To check if the bridge cross section data has been successfully imported, open the **NATURAL CROSS SECTIONS** form (**River Mechanics ➔ Cross Section Geometry**). For the **Cross Section ID**, select *"STUDYREACHCROSSSECTION"* by clicking the Selector button at the right side of the **ID** textbox.




Compare the geometric data on the **NATURAL CROSS SECTIONS** form against the tabulated data listed below. Make necessary data edits or adjustments on the form, if necessary. Click **OK** to close the form.

| Station (X) | Elevation (Y) | Notes |
|---|---|---|
| *100* | *100* | |
| *106* | *98* | |
| *156* | *98* | *Left Bank Station* |
| *166* | *95* | |
| *191* | *95* | |
| *201* | *98* | *Right Bank Station* |
| *251* | *98* | |
| *257* | *100* | |

(d) To check if the imported hydraulic data has all the correct **Flow Rates (cfs)**, **Slopes (ft/ft)**, and **Manning's n (Channel, LOB, and ROB)** data, open the **CROSS SECTION HYDRAULICS** form (**River mechanics ➔ Cross Section Hydraulics**). Make sure that the **Cross Section ID** is set to *"STUDYREACHCROSSSECTION"* and only the "Design" checkbox is checked. Please note the dominant flow event will not be used in the Riprap Sizing analysis.

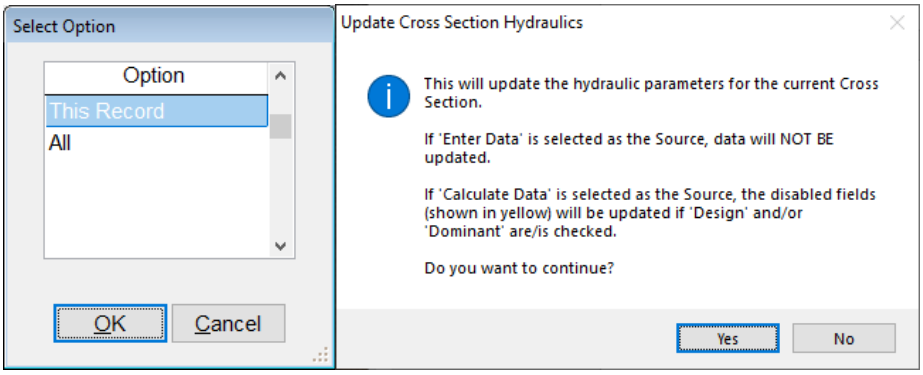



Compare the imported data on the form against the actual data as follows:

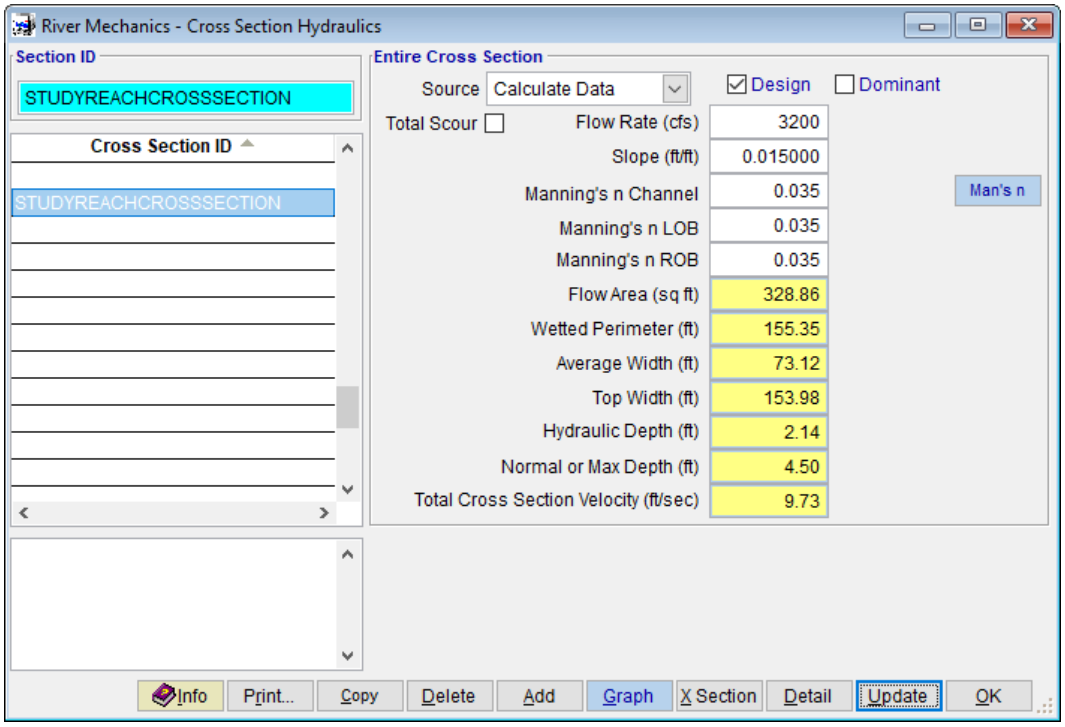
- **Cross Section ID:** *STUDYREACHCROSSSECTION*
- **Design Flow Rate (cfs):** *3200*
- **Design Slope (ft/ft):** *0.015*
- **Design Manning's n (Channel, LOB, and ROB):** *0.035*

(e) If everything checks out, click the **Update** button to update the hydraulic analysis results. If not, make sure to replicate the above figure, then click **Update.**

(f) On the **SELECT OPTION** form, select *"This Record"* and click **OK**. Hit **Yes** to continue.



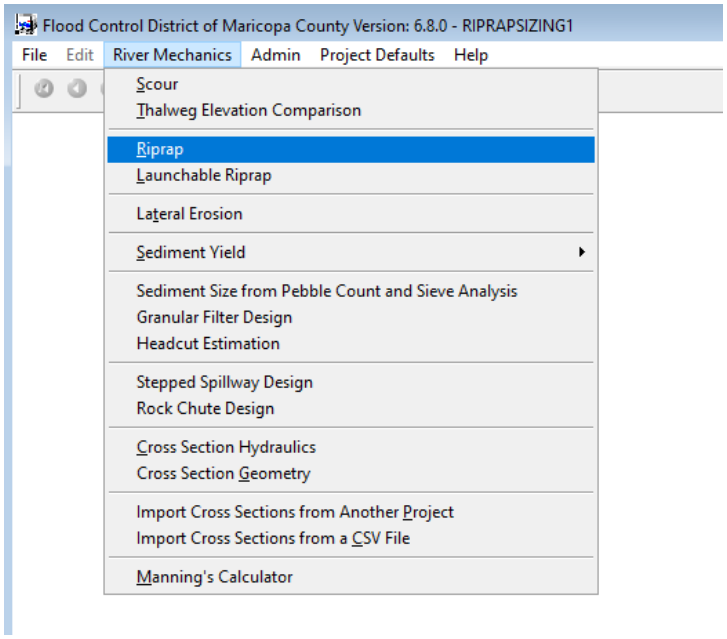

After the update, the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** window looks like the following figure.




(g) Click **OK** to close the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** form.

## 2.3 STEP 3 - CALCULATE RIPRAP SIZE

(a) From the menu bar of main application window, click **River Mechanics ➔Riprap** to open the **RIVER MECHANICS - RIPRAP** window.




(b) Click **Add** button on the **RIVER MECHANICS - RIPRAP** window.

(c) Enter "*CHNL1*" into the **Location ID** textbox

(d) Browse for "*Channel Banks on Straight Reach*" in the **Type** textbox

(e) Click **OK** on the **SELECT TYPE** dialog box.

(f) Check **Use Cross Section ID** check box

(g) Browse for "*STUDYREACHCROSSSECTION*" in the **Section ID** textbox.

(h) Click **OK** on the **SELECT CROSS SECTION ID** dialog box.

(i) Enter "*3*" into the **Bank Slope (H:V)** textbox

(j) Enter "*150.00*" into the **Specific Weight Stone (lb/cu ft)** textbox

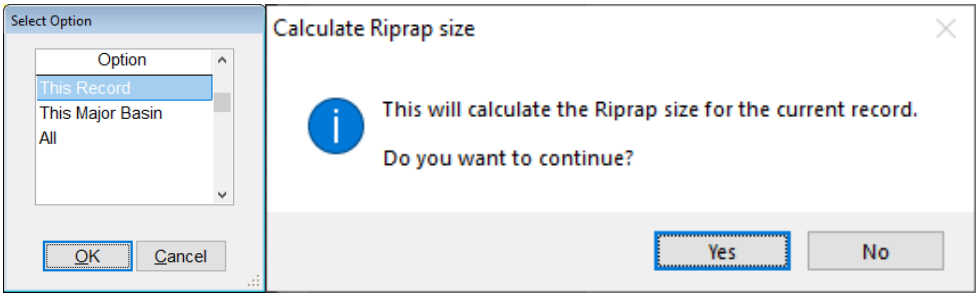
(k) Enter "*62.43*" into the **Specific Weight Water (lb/cu ft)** textbox

(l) Select "*Angular*" from the drop down for Riprap **Type** in the **Safety Factor** frame.

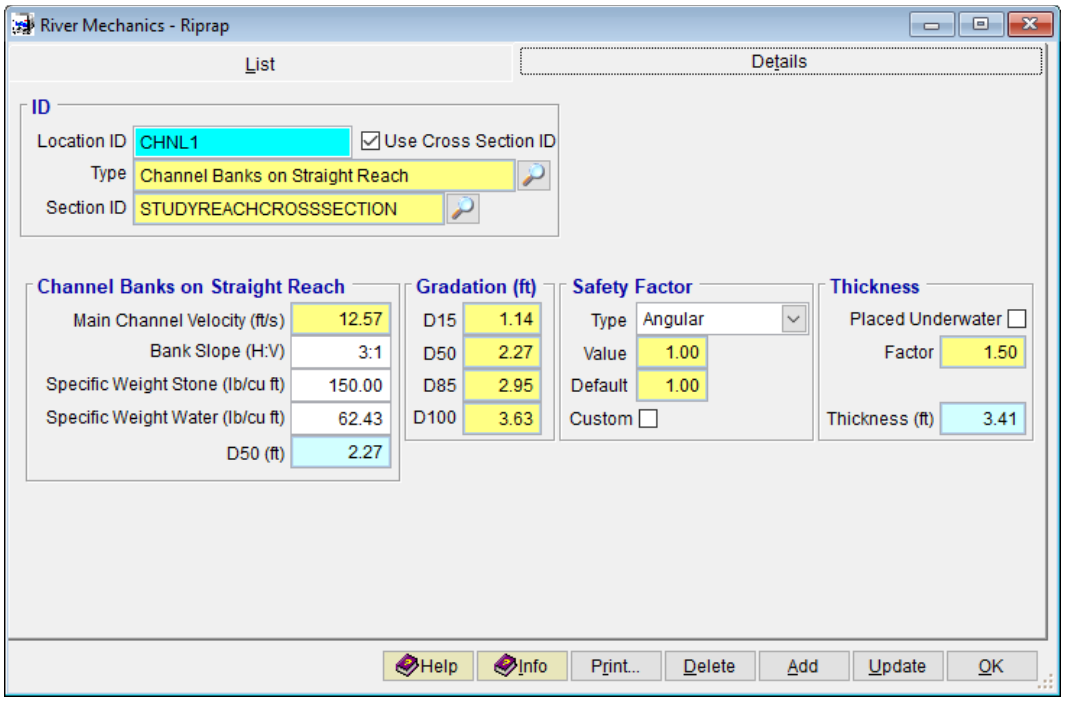
(m) Click the **Save** button.

(n) Click **Update** button to compute riprap median size **D50 (ft)**.

(o) Highlight "*This Record*" in the **SELECTION OPTION** window and click **OK**. Click **Yes** when the **CALCULATE RIPRAP SIZE** dialog box opens.




After the update process is finished, the window looks like what is shown in the following figure. Click **OK** to close the window.




## 2.4 STEP 4 - REPORT AND DOCUMENT THE RESULTS

In this section, the instruction will be given on how to view, print, and export the calculation results of the riprap sizing.

(a) Click the **Print…** button on the **RIVER MECHANICS – RIPRAP** window. A report will be generated as is shown in the following figure.

Flood Control District of Maricopa County
Drainage Design Management System
RIVER MECHANICS - RIPRAP
Page 1 **Project Reference: RIPRAP SIZING 1** 5/14/2024

| ID | Type | Section ID | Design Q (cfs) | Slope (ft/ft) | Width (ft) | Main Channel Velocity (ft/s) | Specific Weight Stone (lb/cu ft) | Specific Weight Water (lb/cu ft) | Bank Slope (H:V) | Safety Factor | D50 (ft) | Thickness (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHNL1 | Channel Banks on Straight | STUDYREACHCROSSSECTION | 3,200 | 0.02 | 73.12 | 12.57 | 150.00 | 62.43 | 3:1 | 1.00 | 2.27 | 3.41 |

(b) To print the results, click the printer symbol ( ).

(c) To export the results in PDF format or other formats, click the export symbol ( )

(d) More detailed information for cross section hydraulics can also be viewed, printed, and exported by clicking the **Print…** button under **Cross Section Hydraulics** menu.

This concludes this tutorial for sediment yield analysis.