MARICOPA COUNTY
FLOOD CONTROL DISTRICT

# DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS

## VERSION 6.8.0

---

# TUTORIAL # 12

# SEDIMENT YIELD ANALYSIS

---

**KVL Consultants, Inc.**

# SEDIMENT YIELD ANALYSIS

## TABLE OF CONTENTS

**No. Section Page**

# SEDIMENT YIELD ANALYSIS

**DATE UPDATED: MAY 7, 2024**
**TUTORIAL TIME: 40 MINUTES**

## 1.0 PROBLEM STATEMENT

To estimate the sediment yield for a watershed, including wash load and bed load, with the following given design parameters:

- The Cross Section "*STUDYREACHCROSSSECTION*"
  - Parameters for Hydraulics and Geometry:
    - **Design Flow Rate (cfs):** *3200*
    - **Dominant Flow Rates (cfs):** *800*
    - **Channel Slope** for **Design Flow (ft/ft):** *0.015*
    - **Channel Slope** for **Dominant Flow (ft/ft):** *0.015*
    - **Manning's n (Channel, LOB, ROB)** for **Design Flow:** *0.035*
    - **Manning's n (Channel, LOB, ROB)** for **Dominant Flow:** *0.030*
    - **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 **Sediment Yield**:

| Return period | Q (cfs) | Volume (ac-ft) |
|---|---|---|
| **2 year** | *277* | *12.00* |
| **5 year** | *486* | *18.00* |
| **10 year** | *645* | *23.00* |
| **25 year** | *869* | *30.00* |
| **50 year** | *1046* | *36.00* |

| | | |
|---|---|---|
| **100 year** | *1231* | *42.00* |
| **Design** | *1231* | *42.00* |

- Parameters for **Wash Load**:

  - **Sediment Area (sq mi):** *0.3508*
  - **D10 (mm)** for channel bed material soil sample: *0.500*
  - **Slope Length (ft):** *400*
  - **Slope (%):** *2.50*

- Parameters for **Bed Load**:

  - **D16 (mm)**: *0.800*
  - **D50 (mm)**: *1.500*
  - **D84 (mm)**: *10.00*

- Parameters for **Soils**:

| Sediment Area ID | Soil ID | Area |
|---|---|---|
| *SED1* | *6453* | *0.0508* |
| *SED1* | *64590* | *0.0447* |
| *SED1* | *64591* | *0.2548* |
| *SED1* | *64598* | *0.0004* |

- Parameters for **Land Uses**:

| Sediment Area ID | Land Use Code | Area |
|---|---|---|
| *SED1* | *120* | *0.1647* |
| *SED1* | *160* | *0.0620* |
| *SED1* | *180* | *0.0296* |
| *SED1* | *230* | *0.0314* |
| *SED1* | *410* | *0.0609* |

## 2.0 STEP-BY-STEP PROCEDURES

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

Step 2: Prepare the Cross Section and Hydraulic Data

Step 3: Import Cross Section and Hydraulic Data

Step 4: Prepare Sediment and Relevant Data

Step 4.1: Set up Sediment Yield Basic Data

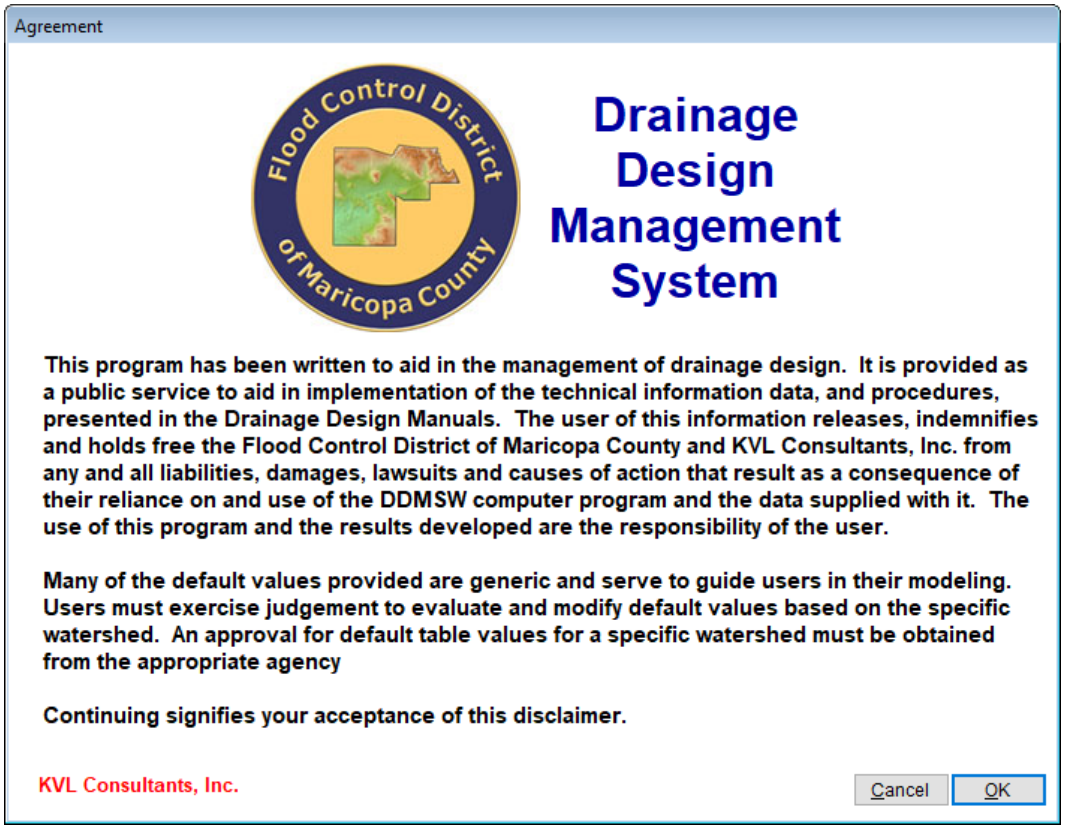
Step 4.2: Prepare Land Use and Soil Data

Step 5: Calculate the Sediment Yield

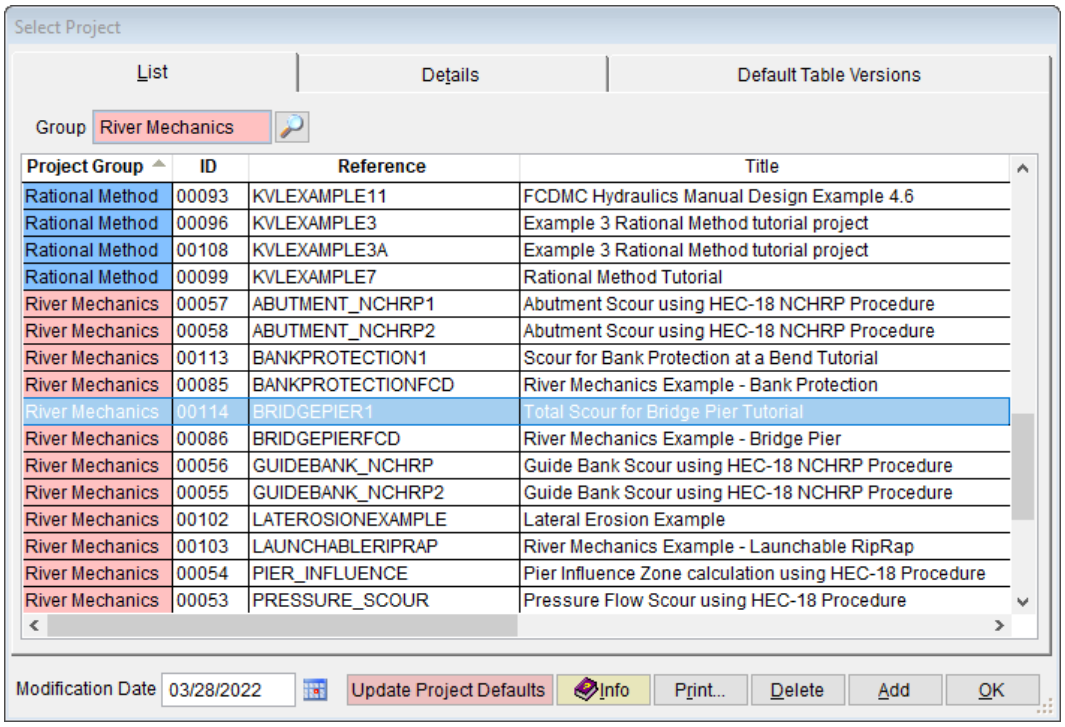
Step 6: Report the Results

## 2.1 STEP 1 - ESTABLISH A NEW PROJECT AND DEFAULT 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 (A new project can also be started by clicking **File ➔ New Project** under the menu bar).

(c) On the **NEW PROJECT OPTIONS** form, select **River Mechanics** checkbox and click the **OK** button to close the form.

(d) Type "*SEDIMENTYIELDFCD1*" 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.

(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)***

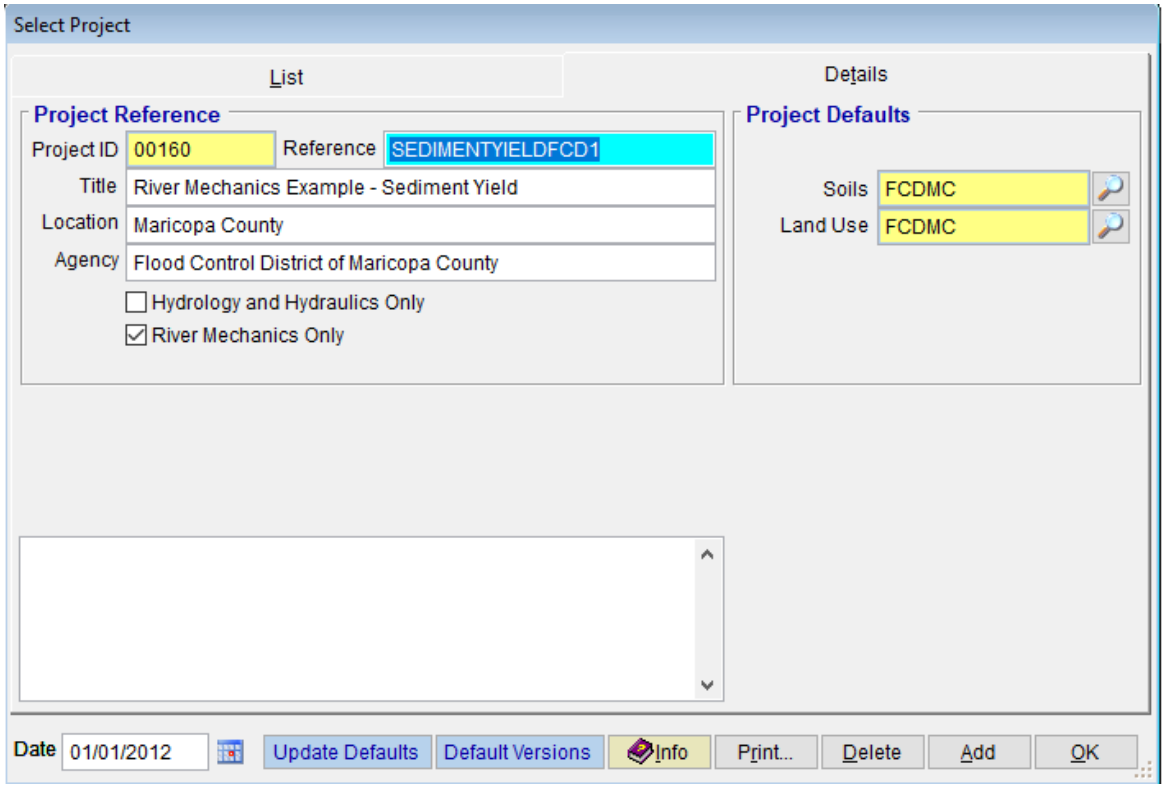
(g) Type into the **Agency** textbox the agency or company name. ***(Optional)***

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

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

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

(k) Click **OK** button on the **SELECT PROJECT** window, and click **OK** button on the pop-up message box for landuse, soils data, etc. The following figure shows what the window looks like.




**Note:** The **Project ID** *00160* 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.

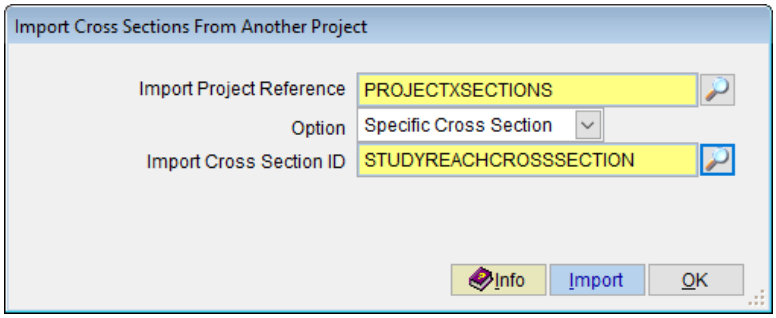
## 2.2 STEP 2 - PREPARE THE CROSS SECTION AND HYDRAULIC DATA

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

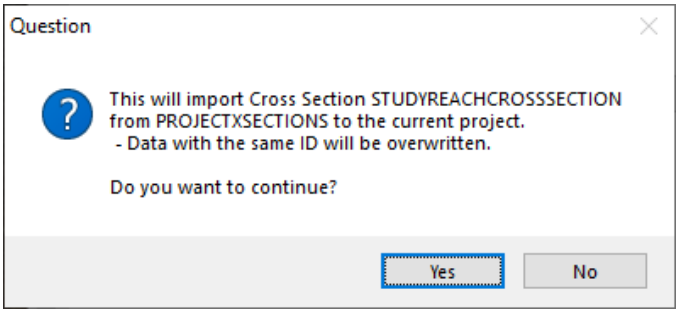
### 2.2.1 Import the Study Location Cross Section Data

(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.

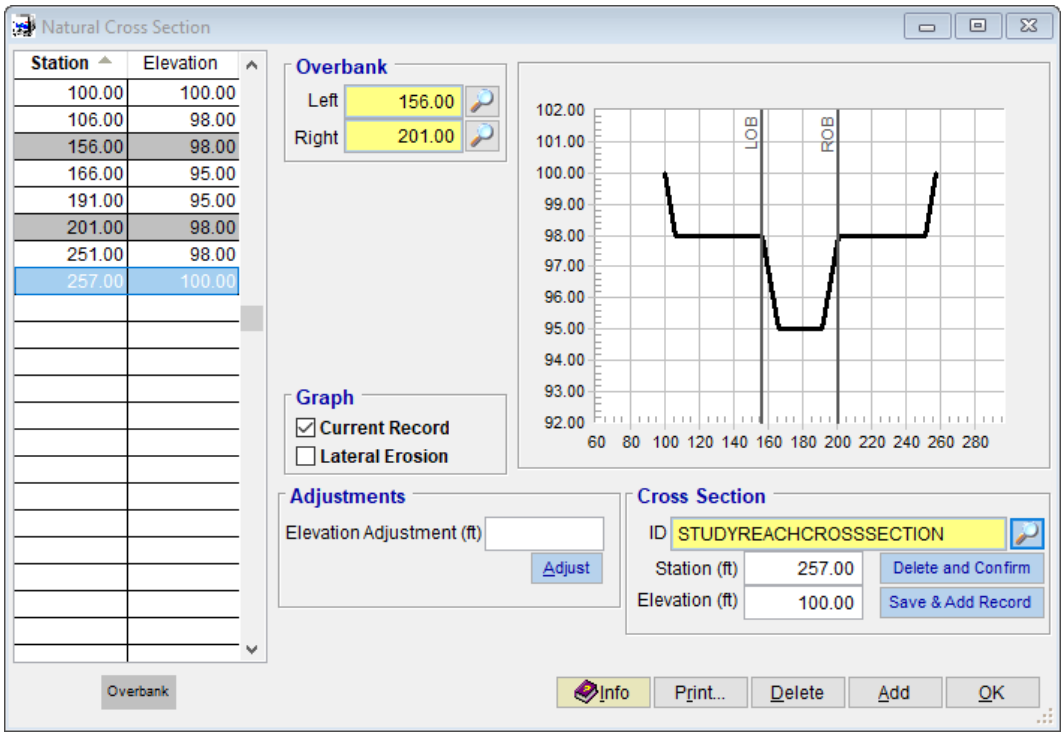
- **Import Project Reference:** *PROJECTXSECTIONS*
- **Option:** *Specific Cross section*
- **Import Cross Section ID:** *STUDYREACHCROSSSECTION*




(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.

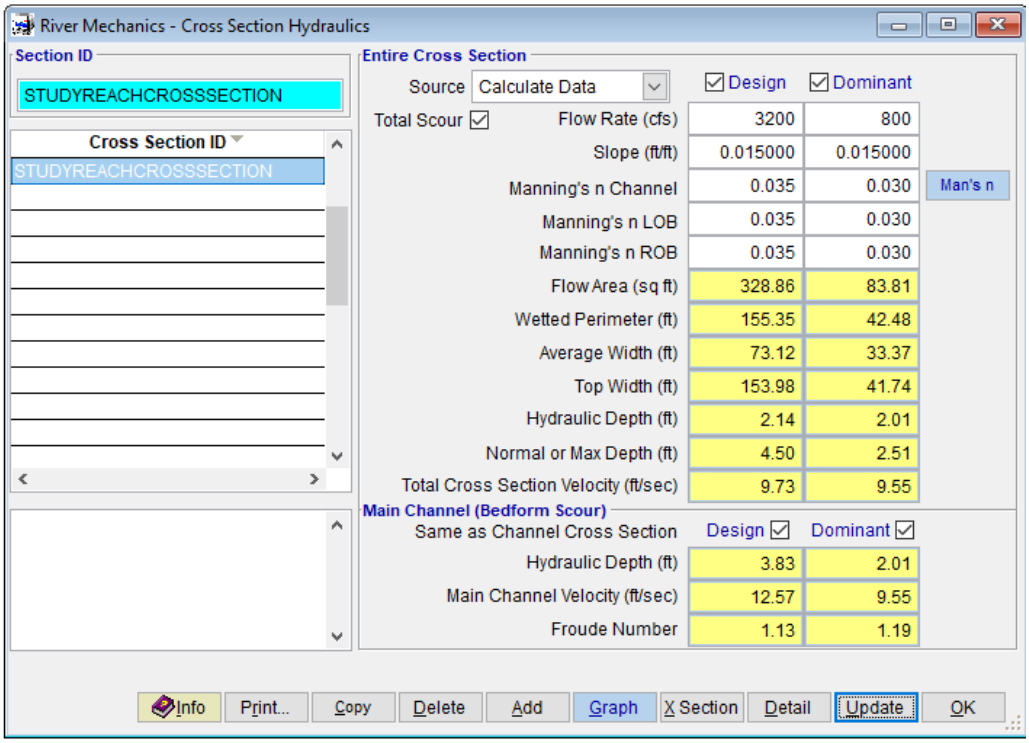



Compare the geometric data on the **NATURAL CROSS SECTIONS** form against the tabulated data listed below. Make necessary data edits or adjustments on the form, if necessary. Click **OK** to close the form.

| 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* | |

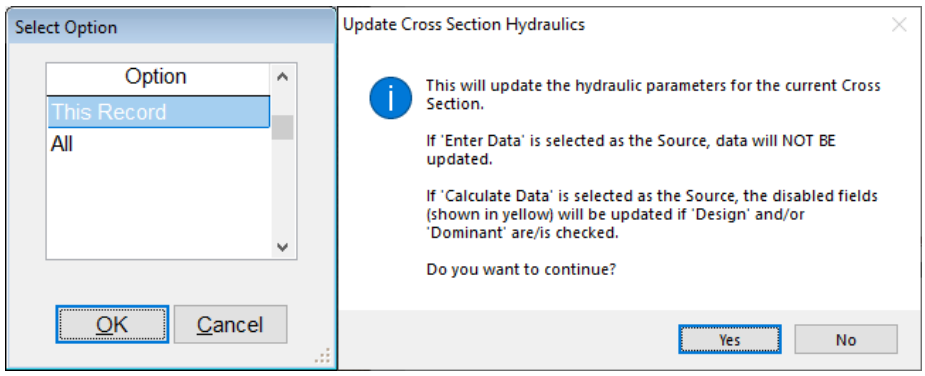
(d) To check if the imported hydraulic data has all the correct **Flow Rates (cfs)**, **Slopes (ft/ft)**, and **Manning's n (Channel, LOB, and ROB)** data, open the **CROSS SECTION HYDRAULICS** form (**River mechanics ➔ Cross Section Hydraulics**). Make sure that the **Cross Section ID** is set to *"STUDYREACHCROSSSECTION"* and compare the data on the form and the following data:

- **Cross Section ID:** *STUDYREACHCROSSSECTION*
- **Design Flow Rate (cfs):** *3200*
- **Dominant Flow Rate (cfs):** *800*
- **Design Slope (ft/ft):** *0.015*
- **Dominant Slope (ft/ft):** *0.015*
- **Design Manning's n (Channel, LOB, and ROB):** *0.035*
- **Dominant Manning's n (Channel, LOB, and ROB):** *0.030*




(e) If everything checks out, click the **Update** button to update the hydraulic analysis results.

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

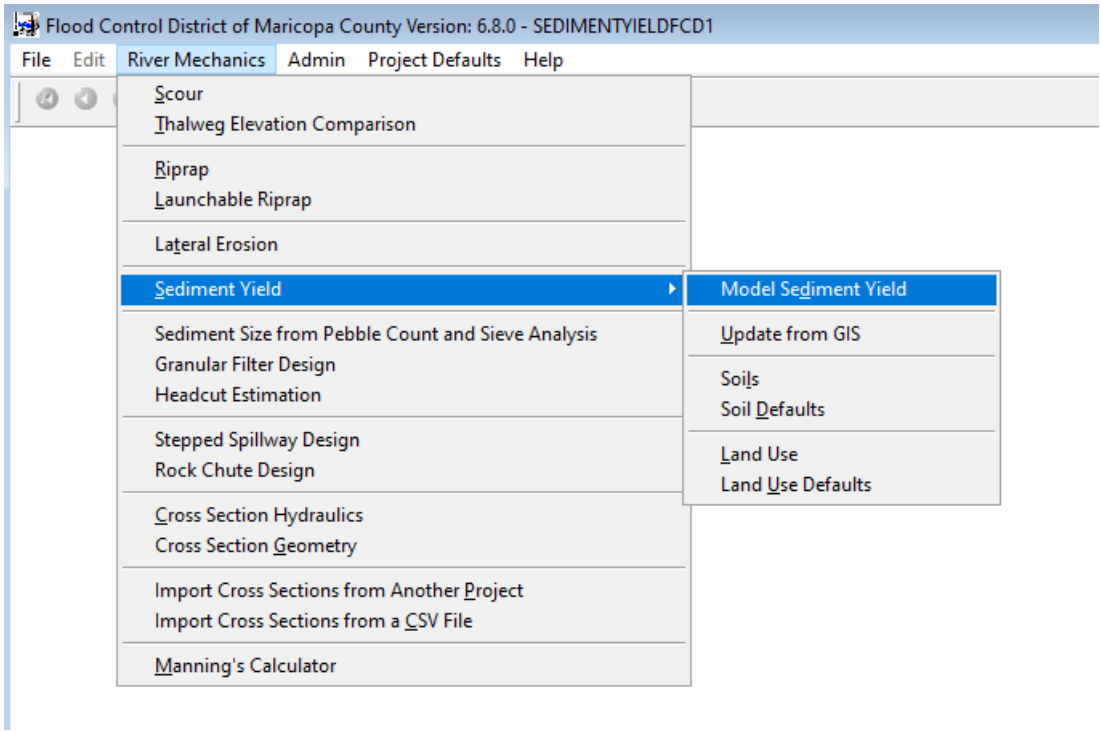


(g) Click **OK** to close the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** form.

## 2.3 STEP 3 - PREPARE SEDIMENT AND RELEVANT DATA

### 2.2.1 Set up Sediment Yield Basic Data

(a) From the menu bar of main application window, click **River Mechanics ➔ Sediment Yield ➔ Model Sediment Yield** to open the **RIVER MECHANICS – SEDIMENT YIELD - MB: 01** window.




(b) Click **Add** button to activate the necessary data entry fields.

(c) Type "*DAM1*" into the **ID** textbox, a unique **ID** for the location on the water course.

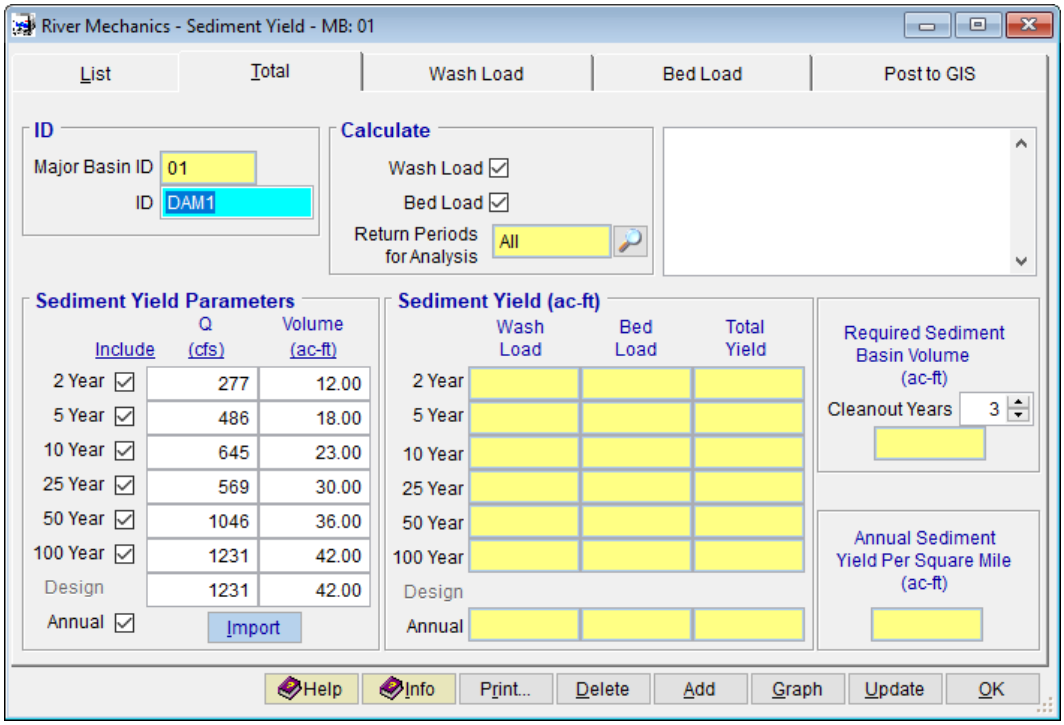
(d) Check the **Wash Load** and **Bed Load** checkboxes in the **Calculate** frame.

(e) Click the browse button beside the **Return Periods for Analysis** textbox in the **Calculate** frame to select "*All*" for the return periods.

(f) Check all the checkboxes in the **Sediment Yield Parameters** frame to activate all the discharges and volumes textboxes. Enter the following discharge and volume values for the sediment yield parameters.

| Return Period | Q (cfs) | Volume (ac-ft) |
|---|---|---|
| **2 year** | *277* | *12.00* |
| **5 year** | *486* | *18.00* |
| **10 year** | *645* | *23.00* |
| **25 year** | *869* | *30.00* |
| **50 year** | *1046* | *36.00* |
| **100 year** | *1231* | *42.00* |
| **Design** | *1231* | *42.00* |

(g) Click the **Save** button to save the entered data. After the data entry, the window should look like the following figure.




(h) Click the **Wash Load** tab.

(i) Enter *"SED1"* into the **Sediment Area ID** textbox (**Sediment Area ID** is the unique ID for the drainage area that contributes sediment to the study location. This ID is used when land use and soil data are used to compute the wash load).

(j) Enter *"0.3508"* in the **Area (sq mi)** textbox.

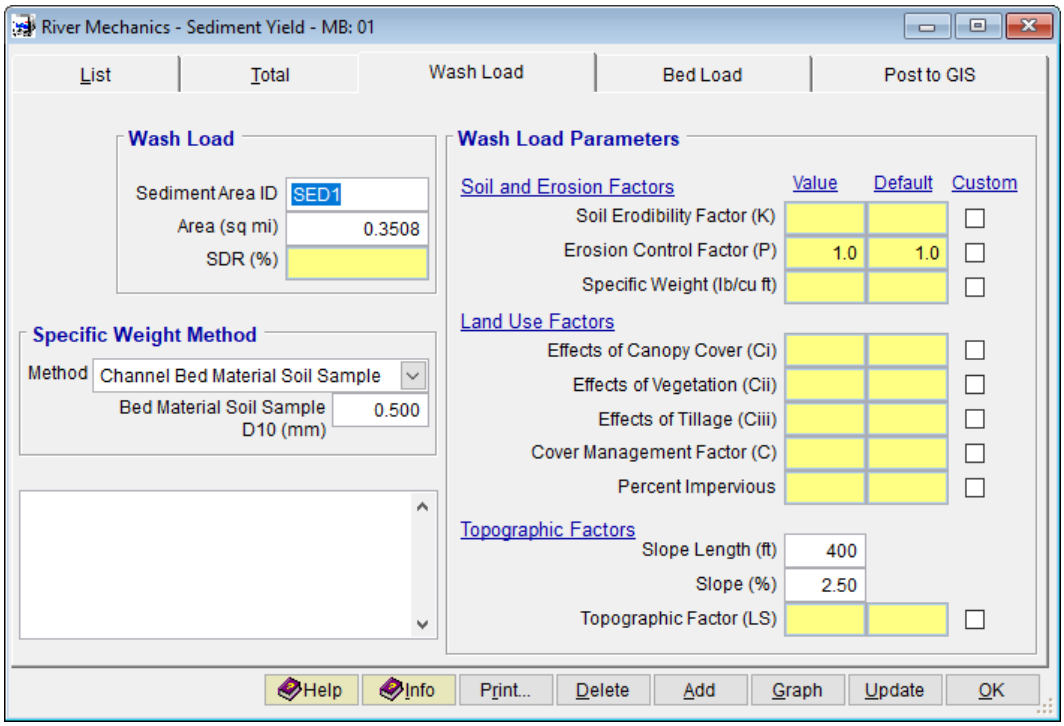
(k) Select *"Channel Bed Material Soil Sample"* as the **Specific Weight Method**.

(l) Enter *"0.50"* into the **Bed Material Soil Sample D10 (mm)** textbox.

(m) Enter *"400"* into the **Slope Length (ft)** textbox in the **Wash Load Parameters** frame.

(n) Enter *"2.50"* into the **Slope (%)** textbox in the Wash Load Parameters frame.

(o) Click the **Save** button to save data entry. The **RIVER MECHANICS – SEDIMENT YIELD** form should look like the following figure.

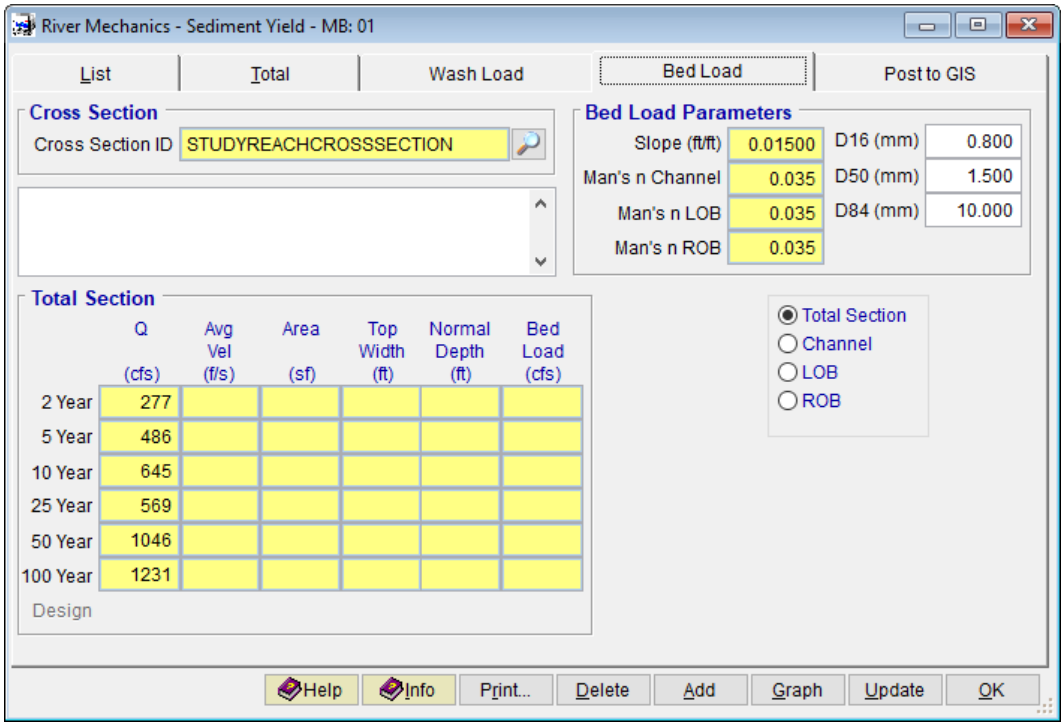



(p) Click the **Bed Load** tab and click browse button  beside the **Cross Section ID** textbox in the **Cross Section** frame to select "*STUDYREACHCROSSSECTION*" as the cross section **ID**. Click **OK** to exit the **SELECT CROSS SECTION ID** form.

(q) On the **Bed Load Parameters** frame in the **Bed Load** tab, enter the following data:

- **D16 (mm):** *0.80*
- **D50 (mm):** *1.50*
- **D84 (mm):** *10.00*

(r) Click the **Save** button to save the data entry. The **RIVER MECHANICS – SEDIMENT YIELD form** should look like the following figure.



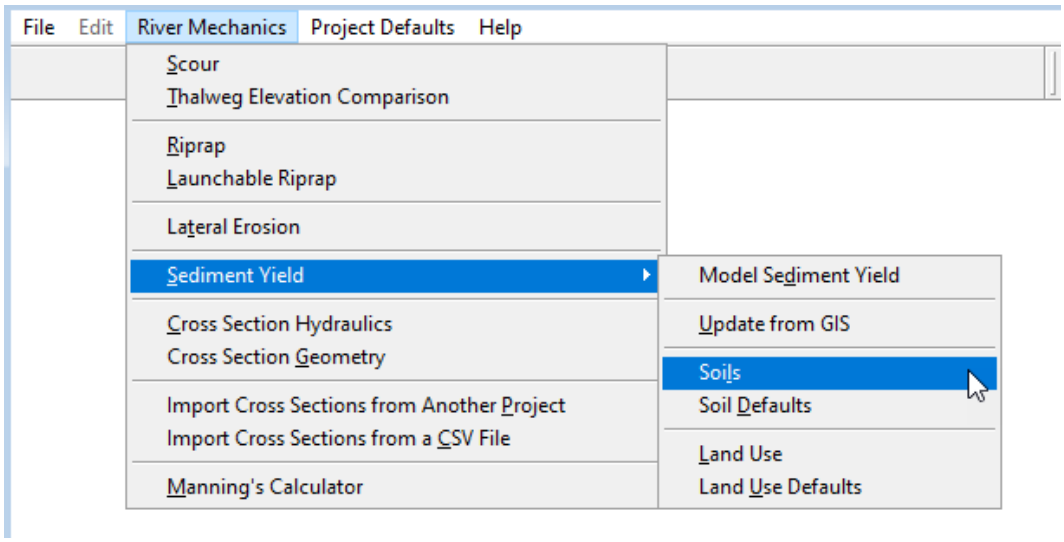

(s) Click **OK** to close the window.

### 2.2.2 Prepare Land Use and Soil Data

In this section, procedures will be provided on how to prepare the land use and soil data for the project area.

#### (A) How to Prepare Soil Data

(a) Click **River Mechanics ➔ Sediment Yield ➔ Soils** from the menu bar on the main application window as is shown in the following figure and a blank **RIVER MECHANICS – SOILS** window opens.



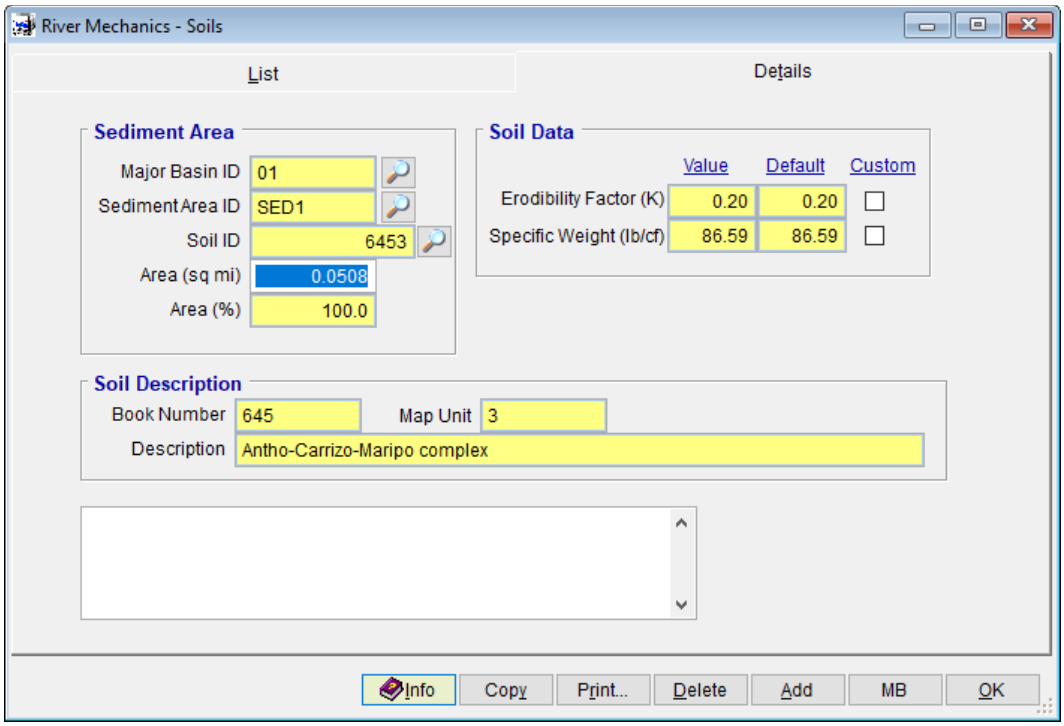

(b) Click the **Add** button on the **RIVER MECHANICS – SOILS** window to activate the data entry.

(c) On the **Details** tab of the **RIVER MECHANICS – SOILS** window, click the browse button beside the **Sediment Area ID** textbox in the **Sediment Area** frame. On the **SELECT ID** window, highlight "*SED1*" and click **OK** to close the window.

(d) Click the browse button beside the **Soil ID** textbox in the **Sediment Area** frame. On the **SELECT ID** window, highlight **Soil ID** "*6453*" and click **OK** to close the window.

(e) Enter "*0.0508*" into the **Area (sq mi)** textbox in the **Sediment Area** frame.

(f) Click the **Save** button to save the data just entered. The window should look like the following figure.



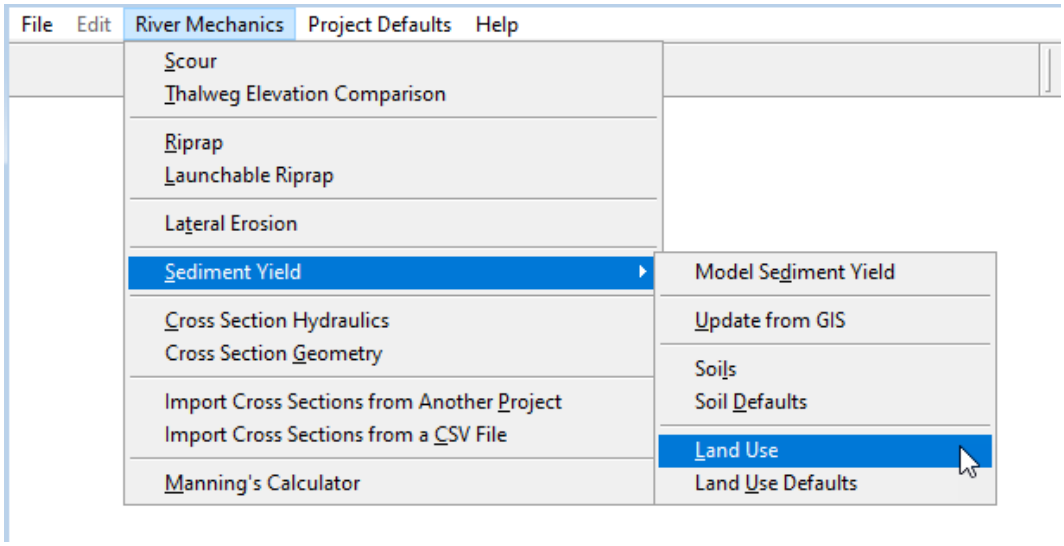

Repeat the above five steps to enter the rest of the soils data for this sediment area.

| Sediment Area ID | Soil ID | Area (sq mi) |
|---|---|---|
| *SED1* | *64590* | *0.0447* |
| *SED1* | *64591* | *0.2548* |
| *SED1* | *64598* | *0.0004* |

(g) After the data entry, click **OK** to close the window.

## (B) How to Prepare Land Use Data

(a) Click **River Mechanics ➔ Sediment ➔ Land Use** from the menu bar on the main application window as is shown in the following figure and the blank **RIVER MECHANICS – LAND USE** window opens.



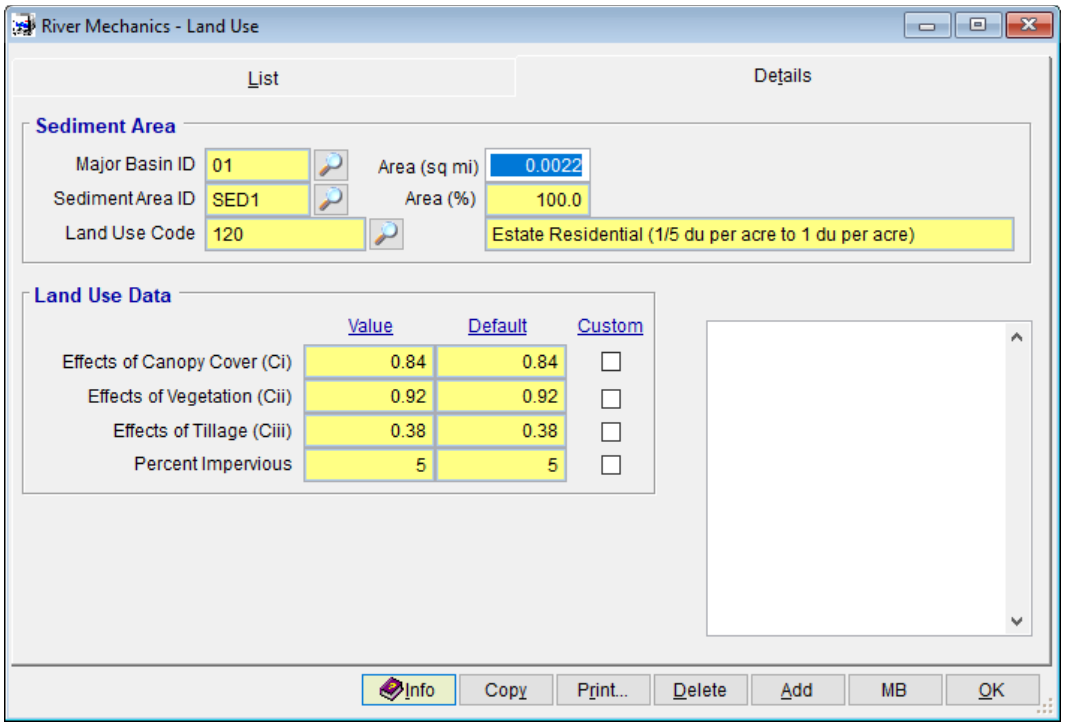

(b) Click the **Add** button to activate the data entry.

(c) Click the browse button beside the **Sediment Area ID** textbox in the **Sediment Area** frame to open the **SELECT ID** window. Highlight "*SED1*" and click **OK** to select and close the window.

(d) Click the browse button beside the **Land Use Code** textbox in the **Sediment Area** frame to open the **SELECT ID** window. Highlight code "*120*" and click **OK** to select and close the window.

(e) Enter "*0.0022*" into the **Area (sq mi)** textbox in the **Sediment Area** frame of the **RIVER MECHANICS – LAND USE** window.

(f) Click the **Save** button. The window should look like the following figure.



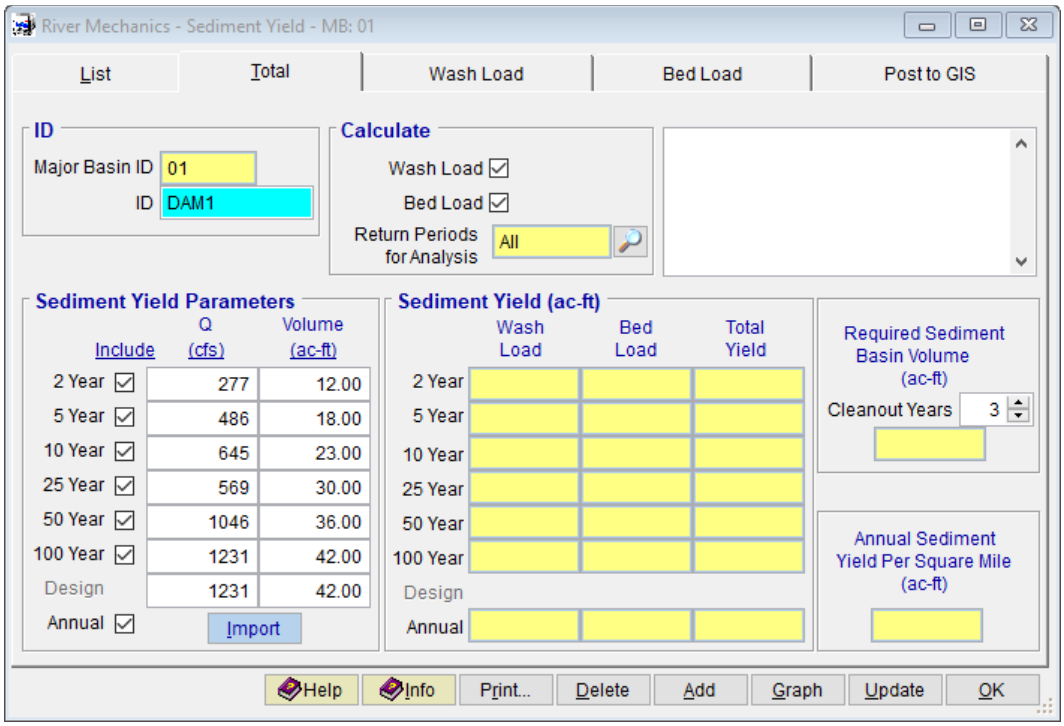

(g) Repeat the above five steps to enter the rest of the land use data for this sediment area.

| Sediment Area ID | Land Use Code | Area (sq mi) |
|---|---|---|
| *SED1* | *150* | *0.1647* |
| *SED1* | *160* | *0.0620* |
| *SED1* | *180* | *0.0296* |
| *SED1* | *230* | *0.0314* |
| *SED1* | *410* | *0.0609* |

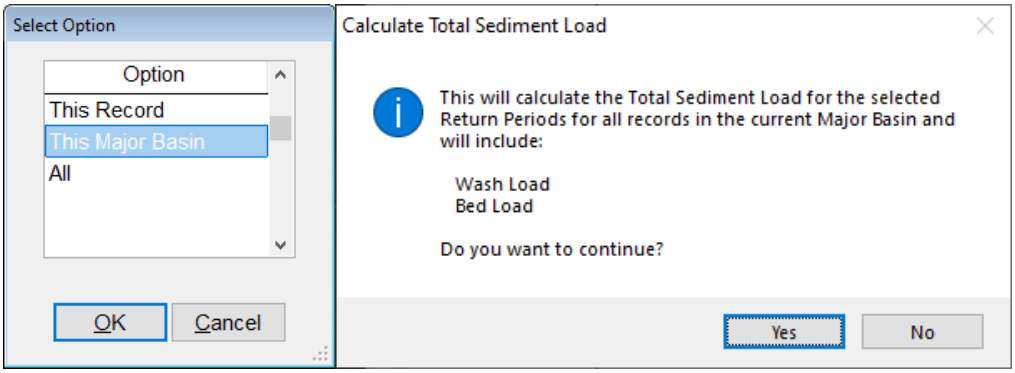
(h) After the data entry, click **OK** to close the window.

## 2.4 STEP 4 - CALCULATE THE SEDIMENT YIELD

In this section, a step-by-step instruction will be provided how to calculate the sediment yield. Open the **RIVER MECHANICS – SEDIMENT YIELD** form from the menu bar (**River Mechanics ➔ Sediment Yield ➔ Model Sediment Yield** and click the **Total** tab.

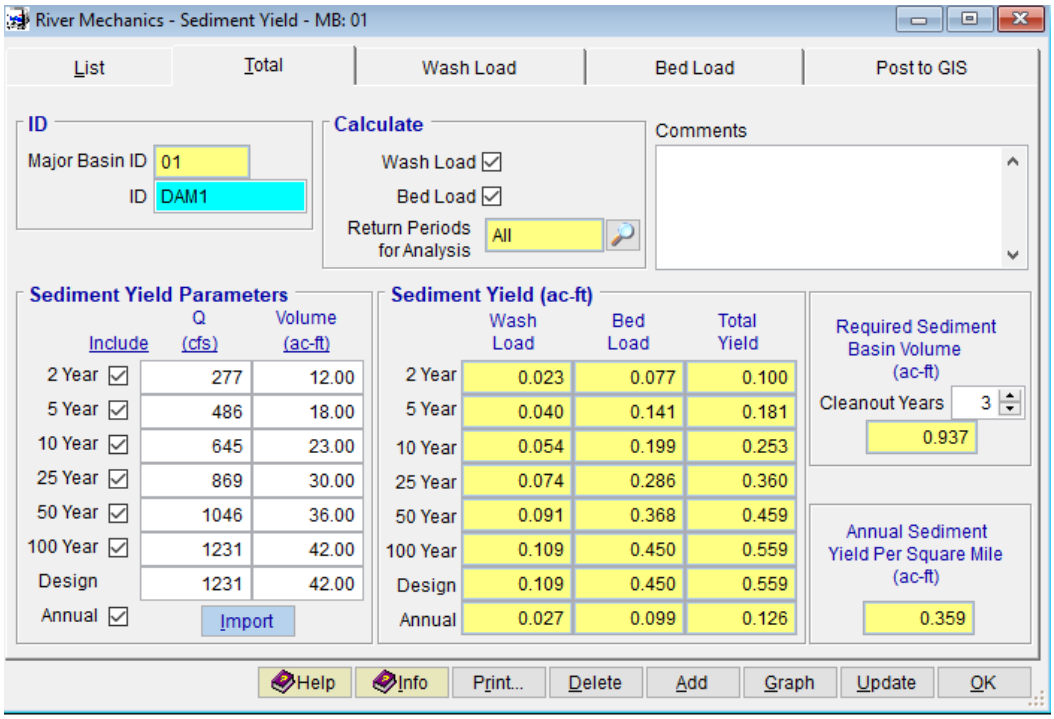


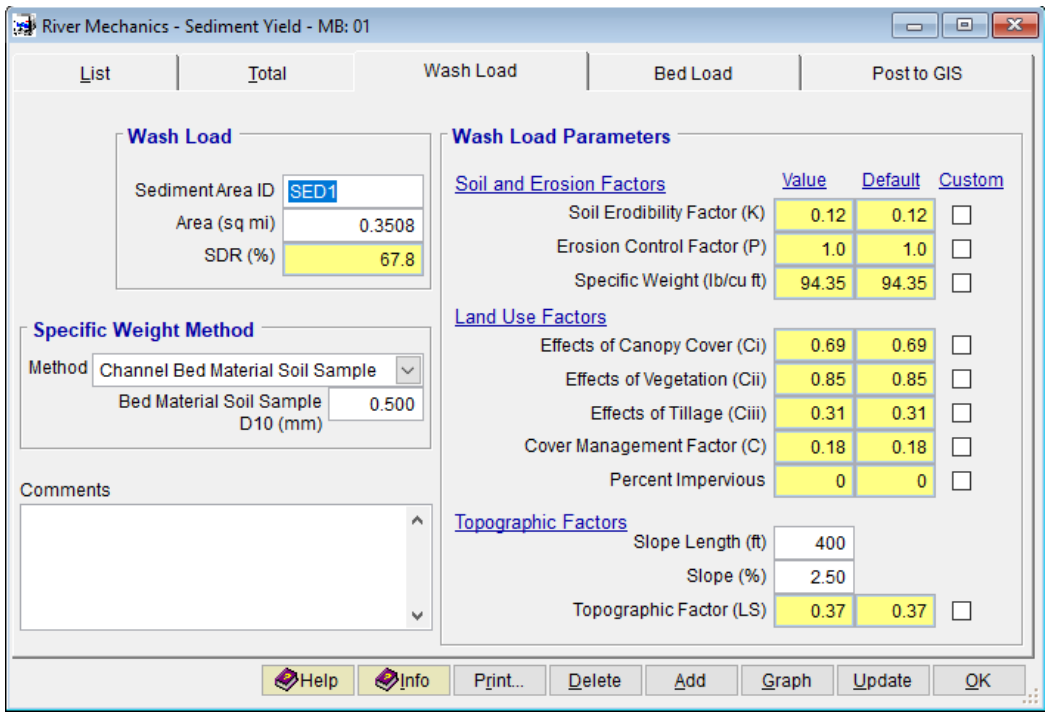

(a) Click the **Update** button on the **RIVER MECHANICS – SEDIMENT YIELD** form to compute the sediment yield. A new window **SELECT OPTION** opens, select "*This Major Basin*", and click **OK** to close it.

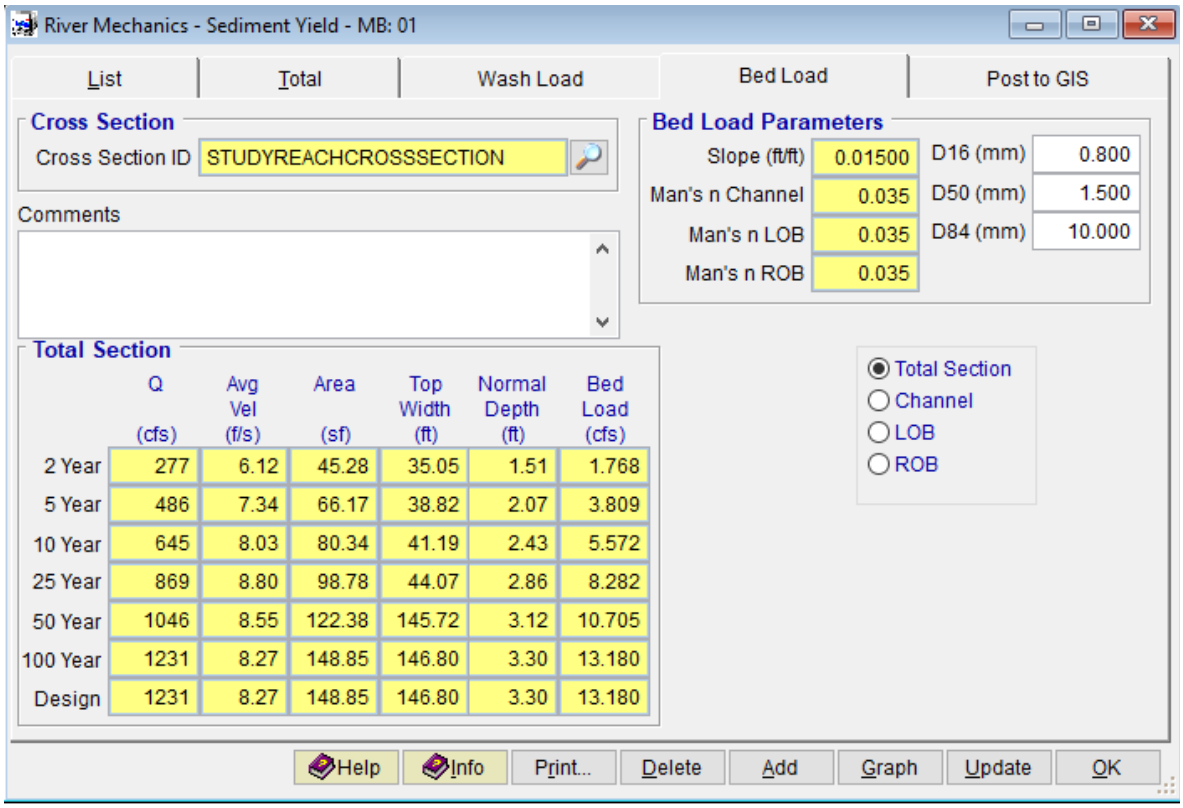



(b) On the **CALCULATE TOTAL SEDIMENT LOAD** dialog box, click **Yes** to continue.

The following three figures show the results in the **Total**, **Wash Load** and **Bed Load** tabs when the "*Channel Bed Material Soil Sample*" method is used in **Wash Load**.


River Mechanics - Sediment Yield - MB: 01
List
Total
Wash Load
Bed Load
Post to GIS
ID
Major Basin ID 01
ID DAM1
Calculate
Wash Load
Bed Load
Return Periods for Analysis All
Comments
Sediment Yield Parameters
Include
Q (cfs)
Volume (ac-ft)
2 Year 277 12.00
5 Year 486 18.00
10 Year 645 23.00
25 Year 869 30.00
50 Year 1046 36.00
100 Year 1231 42.00
Design 1231 42.00
Annual
Import
Sediment Yield (ac-ft)
Wash Load
Bed Load
Total Yield
2 Year 0.023 0.077 0.100
5 Year 0.040 0.141 0.181
10 Year 0.054 0.199 0.253
25 Year 0.074 0.286 0.360
50 Year 0.091 0.368 0.459
100 Year 0.109 0.450 0.559
Design 0.109 0.450 0.559
Annual 0.027 0.099 0.126
Required Sediment Basin Volume (ac-ft)
Cleanout Years 3
0.937
Annual Sediment Yield Per Square Mile (ac-ft)
0.359
Help
Info
Print...
Delete
Add
Graph
Update
OK


River Mechanics - Sediment Yield - MB: 01
List
Total
Wash Load
Bed Load
Post to GIS
Wash Load
Sediment Area ID SED1
Area (sq mi) 0.3508
SDR (%) 67.8
Specific Weight Method
Method Channel Bed Material Soil Sample
Bed Material Soil Sample D10 (mm) 0.500
Comments
Wash Load Parameters
Soil and Erosion Factors
Value
Default
Custom
Soil Erodibility Factor (K) 0.12 0.12
Erosion Control Factor (P) 1.0 1.0
Specific Weight (lb/cu ft) 94.35 94.35
Land Use Factors
Effects of Canopy Cover (Ci) 0.69 0.69
Effects of Vegetation (Cii) 0.85 0.85
Effects of Tillage (Ciii) 0.31 0.31
Cover Management Factor (C) 0.18 0.18
Percent Impervious 0 0
Topographic Factors
Slope Length (ft) 400
Slope (%) 2.50
Topographic Factor (LS) 0.37 0.37
Help
Info
Print...
Delete
Add
Graph
Update
OK




## 2.5 STEP 5 - 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 sediment yield.

(a) Report the results for Total Sediment Yield: Click the **Print …** button on the **Total** tab of the **RIVER MECHANICS – SEDIMENT – MB: 01** window to generate a report like the following figure.

Flood Control District of Maricopa County
Drainage Design Management System
RIVER MECHANICS - BED LOAD
Project Reference: SEDIMENTYIELDFCD1

Page 1 5/14/2024

ID: DAM1
Cross Section ID: STUDYREACHCROSSSECTION

| | |
|---|---|
| Manning's N Channel | 0.035 |
| Manning's N LOB | 0.035 |
| Manning's N ROB | 0.035 |
| Slope (ft/ft) | 0.01500 |
| D16 (mm) | 0.80 |
| D50 (mm) | 1.50 |
| D84 (mm) | 10.00 |

Comments

| | Q (cfs) | Average Velocity (ft/sec) | Area (sf) | Top Width (ft) | Normal Depth (ft) | Hydraulic Depth (ft) | Average Width (ft) | qs,Bed Load (cfs/ft) | Bed Load (cfs) |
|---|---|---|---|---|---|---|---|---|---|
| **Channel** | | | | | | | | | |
| **2 Year:** | 277 | 6.12 | 45.28 | 35.05 | 1.51 | 1.29 | 30.03 | 0.059 | |
| **5 Year:** | 486 | 7.34 | 66.17 | 38.82 | 2.07 | 1.70 | 31.91 | 0.119 | |
| **10 Year:** | 645 | 8.03 | 80.34 | 41.19 | 2.43 | 1.95 | 33.09 | 0.168 | |
| **25 Year:** | 869 | 8.80 | 98.78 | 44.07 | 2.86 | 2.24 | 34.53 | 0.240 | |
| **50 Year:** | 1,031 | 9.34 | 110.38 | 45.00 | 3.12 | 2.45 | 35.38 | 0.302 | |
| **100 Year:** | 1,161 | 9.79 | 118.52 | 45.00 | 3.30 | 2.63 | 35.91 | 0.363 | |
| **Design:** | 1,161 | 9.79 | 118.52 | 45.00 | 2.63 | 2.63 | 35.91 | 0.363 | |
| **Left Overbank** | | | | | | | | | |
| **2 Year:** | - | - | - | - | - | - | - | - | |
| **5 Year:** | - | - | - | - | - | - | - | - | |
| **10 Year:** | - | - | - | - | - | - | - | - | |
| **25 Year:** | - | - | - | - | - | - | - | - | |
| **50 Year:** | 8 | 1.26 | 6.00 | 50.36 | 0.12 | 0.12 | 50.16 | - | |
| **100 Year:** | 35 | 2.32 | 15.16 | 50.90 | 0.30 | 0.30 | 50.44 | 0.001 | |
| **Design:** | 35 | 2.32 | 15.16 | 50.90 | 0.30 | 0.30 | 50.44 | 0.001 | |
| **Right Overbank** | | | | | | | | | |
| **2 Year:** | - | - | - | - | - | - | - | - | |
| **5 Year:** | - | - | - | - | - | - | - | - | |
| **10 Year:** | - | - | - | - | - | - | - | - | |
| **25 Year:** | - | - | - | - | - | - | - | - | |
| **50 Year:** | 8 | 1.26 | 6.00 | 50.36 | 0.12 | 0.12 | 50.16 | - | |
| **100 Year:** | 35 | 2.32 | 15.16 | 50.90 | 0.30 | 0.30 | 50.44 | 0.001 | |
| **Design:** | 35 | 2.32 | 15.16 | 50.90 | 0.30 | 0.30 | 50.44 | 0.001 | |
| **Total Section** | | | | | | | | | |
| **2 Year:** | 277 | 6.12 | 45.28 | 35.05 | 1.51 | | | | **1.768** |
| **5 Year:** | 486 | 7.34 | 66.17 | 38.82 | 2.07 | | | | **3.809** |
| **10 Year:** | 645 | 8.03 | 80.34 | 41.19 | 2.43 | | | | **5.572** |
| **25 Year:** | 869 | 8.80 | 98.78 | 44.07 | 2.86 | | | | **8.282** |
| **50 Year:** | 1,046 | 8.55 | 122.38 | 145.72 | 3.12 | | | | **10.705** |
| **100 Year:** | 1,231 | 8.27 | 148.85 | 146.80 | 3.30 | | | | **13.180** |
| **Design:** | 1,231 | 8.27 | 148.85 | 146.80 | 2.63 | | | | **13.180** |

(rmBed.rpt - Version: 6.8.0)

(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 wash load, bed load, and **Cross Section Hydraulics** can also be viewed, printed, and exported by clicking the **Print…** button under **Wash Load, Bed Load** and **Cross Section Hydraulics** menu.

This concludes this tutorial for sediment yield analysis.