

I recommend reviewing the overcapacity threshold solution for the Provo River Delta. There are a few pages to read and a video stepping through the solution. Find these under FRIDAY on the course materials web page.

The post-course homework involves an overcapacity threshold problem drawn from NRCS NEH-654 Stream Restoration Design National Engineering Handbook. The problem specification is given below.

Example problem: Threshold channel design

pp 8-40 to 8-42 NRCS NEH 654

Given:

Valley slope = 0.007 (this is the maximum possible slope) $= S_{\text{valley}}$

Bed material $D_{50} = 45 \text{ mm} = 0.148 \text{ ft}$

Bed material $D_{75} = 55 \text{ mm} = 2.17 \text{ in}$

Bed material $D_{84} = 60 \text{ mm} = 0.197 \text{ ft}$

Channel side slope = 3H:1V $= m$

Specific weight of sediment = 165 lb/ft³ ($\rho_s = 2650 \text{ kg/m}^3$)

Water temperature = 68 °F

Design discharge is 25-year storm = 400 ft³/s
 $(Q = 11.33 \text{ m}^3/\text{s})$

Problem:

Design a threshold channel to convey the design discharge.

Note: There is no unique solution with the given design constraints.

The NRCS solution selects a base width of 41 ft (12.5 m) and a critical Shields Number $\tau_c^* = 0.047$. The Limerinos formula is used for flow resistance. Stress is found using $\tau_o = \rho g h S$.

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**Part 654 Stream Restoration Design
National Engineering Handbook**

Chapter 9 Alluvial Channel Design Part 654
National Engineering Handbook

Example 2: Stable channel analytical method

Given: Dimensions of the upstream natural channel reach are:

Base width = 22 ft ($B_o = 6.7 \text{ m}$)

Side slopes

Left bank = 2.2H:1V

Right bank = 1.1H:1V $m = 1.6$

Side slope roughness coefficient = 0.07

Channel slope = 0.0025

Bed material — sandy gravel

$D_{84} = 22 \text{ mm}$ $D_{50} = 3.7 \text{ mm}$

$D_{16} = 0.43 \text{ mm}$ ($Q = 11.3 \text{ m}^3/\text{s}$)

Design discharge = ~~9.500 m³/s~~

Objective: Determine stable channel dimensions for a diversion channel. Upstream natural stream is coming out of a hillside watershed.

1. **Supply reach**
Estimate sediment transport rate

2. **Design reach**
Given discharge and sediment supply rate and grain size, calculate slope needed to transport supplied sediment at a specified channel width

Design values for the bypass channel:

Side slopes = 3H:1V

Side slope roughness coefficient = 0.045 ($S_o = 0.007$)

Valley slope = ~~0.0025~~ (maximum design slope)

2024 USU Sediment Workshop Post-course Homework

You have two paths for your post-workshop homework. If you want the full deal, you can read Chapters 7, 8, and 9 of NEH-654. You can then explore the spreadsheets I provide that solve the problems as specified in the handbook and then take the analysis farther. All of this is in the folder **NRCS NEH-654 TextAndExamples**. After all that, you can proceed to the homework, which slightly modifies the NRCS alluvial channel problem so that it is consistent with the threshold channel problem. For the modified problem, the spreadsheet **OCT_iSURF_altNRCS_Example.xlsm** presents a complete solution. That's right, the solution is complete. You are to answer the following questions.

The second path? Akin to ignoring the instruction manual when you get a new tech toy, you can proceed directly to **OCT_iSURF_altNRCS_Example.xlsm** and answer the following questions.

Please put your answers in a Word or pdf document. You may wish to make some changes in the spreadsheet input. If so, copy images from the spreadsheet and paste them into your homework document. Please put your name in the title of the document (e.g. *MyName_15Aug2024_SedWorkshopHomework.docx*). Please turn in homework by Labor Day.

Homework questions

- (i) Does an overcapacity threshold range exist in the combined solution for the threshold and alluvial channels?
- (ii) If a channel were designed with 15-m bottom width and a slope of 0.4%, would it function as an overcapacity threshold channel? Explain.
- (iii) The solution presented uses a total roughness $n_T = 0.032$ and a critical Shields Number $\tau_c^* = 0.03$. These values are reasonable for a newly constructed channel. As the channel ages, it is more likely that both τ_c^* and n_T will increase rather than decrease. Why would τ_c^* and n_T increase? Would an increase in either of τ_c^* and n_T cause the channel to become more or less vulnerable to scour during the design flow?
- (iv) Sediment supply to the alluvial design reach is found by calculating sediment transport rate and grain size from an upstream reach. How can this go wrong? Under what conditions would you feel more or less confident in your estimate of sediment supply?