Schafer Creek Trib Stream Simulation Practicum

Schafer Creek trib information provided:

A. Schafer Creek background information
B. Exercises
C. Photos
D. Site sketch map
E. Site contour map
F. Longitudinal profile
G. Channel cross-sections
H. Pebble count data at 4 cross-sections
I. Basin hydrology and channel hydraulics
J. Sediment mobility worksheet
K. Structure options
L. Stream simulation design data form

A – Schafer Cr Trib Background Information

Site history and aquatic organism passage concerns

USFS Rd 22 (Wynoochee Rd) crosses the tributary to Schafer Creek about 1.2 miles from the stream's confluence with Schafer Creek and approximately 5 miles from the Wynoochee River. Most of the drainage and the project site are on private land owned by Simpson Timber Company. Much of the watershed has been logged a various times. The road right-of-way is 120 feet wide centered on the road centerline. The road fill slopes are 1:1.

The existing culvert at the crossing is undersized and deteriorated. It is a partial barrier to anadromous fish at various life stages and flows. The culvert is a 4-foot diameter round corrugated pipe by 100 ft long. There is a 1.5 foot drop at the culvert outlet, high velocities in the culvert, sediment accumulation at the culvert inlet, and a sharp channel bend at the culvert inlet.

Wood was removed from the channel in the late '70's in a mistaken effort to improve habitat. The area is now reforested with adequate buffers. Large wood will soon be naturally replenished to the channel.

Existing fish passage needs at the crossing include adult and juvenile steelhead trout, coho salmon, and resident cutthroat trout. Spawning and rearing habitat for adult and juvenile steelhead trout, coho salmon, and resident cutthroat trout is in good condition upstream.

Geomorphic Assessment

The channel upstream and downstream from the crossing has a plane-bed to pool-riffle morphology. The channel gradient is variable, but in general ranges between 1-2 percent. The channel bed surface is composedprimarily of gravel and cobble-sized materal. The bed is moderately armored. The sub-armor is poorly sorted cobbles, gravel, and sands. Channel bed structures in the riffles and plane-bed segments are primarily transverse ribs or clusters of cobbles and small boulders.

The existing culvert is skewed at an angle of 54 degrees from the upstream channel. The skewed alignment has caused significant and chronic erosion on the fillslope and floodplain upstream on the right bank.

A wedge of gravel/cobble-sized sediments has accumulated upstream of the culvert. There is a deep plunge pool at the culvert outlet and the downstream channel has incised about 0.5 to 1.0 m to at least 150 m downstream from the crossing based on evidence such as increased bank heights, undercut banks, and local bank failures. There is no evidence of channel incision upstream.

A - Interpret geomorphic site data: planform, profile, cross-sections

1. Planform assessment

    a. Using the planform and topo sketches, consider the existing alignment of the culvert and channel. Is it good or poor? Why?

    b. What site conditions affect our ability to change alignment and project boundaries?

2. Longitudinal profile and cross-sections assessment

    a. Identify unique channel slope segments and calculate the average channel gradient of each segment.

    b. What are the primary grade controls for the channel? Where are they? Are they permanent or temporary?

    c. Identify any effects (e.g.; aggradation, degradation, scour, erosion, debris loading) due to the existing culvert.

    d. What are the short- and long-term risks associated with headcutting, lateral adjustment, vertical adjust

B – Design profile and alignment

1. **Select the preferred project profile**

    a. Estimate the vertical adjustment potential through the reach.

    b. Select your preferred project design profile and draw it on the channel profile.

    c. What are the project profile bed elevations at each end of the culvert?

    d. Will the project profile work if it has to be built within the right-of-way?

    e. Describe characteristics of the desired reference reach.

2. **Select project alignment**

    a. Draw the alignment of the new crossing on the plan view sketches.

    b. Are there any special design considerations you would recommend for the transitions of the culvert to channel?

3. **Grade control**

    a. Do you expect to have to add grade controls for the project?

    b. If so, what type of grade controls are recommended?

4. **Select a preliminary reference reach**

    a. Is there a suitable reference reach within the surveyed reach? What is it?

    b. What is the bankfull width of the reference reach?

C - Design bed mix, key features, and bed/bank or edge structure

1. **Bed material size.** Particle sizes were measured using the grid count method at 3 locations (XS2, XS10, XS11).

    a. Can you identify any colluvium or key features in the reach?

    b. From the data associated with your reference reach, calculate and plot the particle-size distribution on the particle distribution graph form. From the graph, determine the D95, D84, and D50 particle sizes for the cross section.

    c. Complete the Reference Reach Bed Material in the Stream Simulation Design Data Checklist.

    d. Compare how the bed material sizes vary upstream and downstream of the crossing. Why do they vary?

2. **Bed material design**

    a. Provide an initial recommendation for grain size mix of the alluvial portion of the stream simulation bed. Complete the Stream Simulation Bed Material section of the design checklist

    e. Provide an initial recommendation for the sizes of key pieces, bank material, and rock bands. Include preliminary recommendations for structure or bed material that will compensate for any colluvium or other roughness elements you see in the reference reach. Complete the Additional Features table in the design checklist.

    f. Make a preliminary recommendation for structure or bed material that will compensate for any colluvium and other roughness elements you observed in the reference reach.

D - Bed Mobility / Stability Analysis

For the purpose of this part of the exercise assume that the reference reach is represented by cross-section 11.

1. **Mobility of the stream simulation alluvial bed material**

a. Which mobility model is most appropriate for stream simulation design based on this reference reach?

b. Estimate the flow at which D84 is mobilized in the reference channel.

c. What combination of bed material, bed width, and slope in the stream simulation channel will cause D84 to be moved at that flow?

d. Are there other flows that should be modeled for mobility?

2. Key pieces

e. Estimate the size of key pieces such as banks for the stream simulation channel.

f. Chose design flow recurrence and estimate the discharge for design of the key pieces.

g. Calculate the size of material needed.

E – Selection of Structure

1. Based on the design, what are your recommended channel and structure width?

2. Choose a preferred structure for the project from the attached structure options or other information you are aware of. Consider the following:

   - Overall fit
     Channel width
     Adequate cover height
     Adequate embedment depth for stream adjustment and bed thickness
     Adequate width to construct streambed
     What if bedrock was found four feet below the streambed?

   - Constuctability of the stream simulation bed, banks, and bedforms.

   - Debris passage

   - Costs of structure and excavation

   - Durability

3. From the vertical adjustment potential shown in the long profile and the bed material design, select the elevation of the floor of the culvert at the outlet.