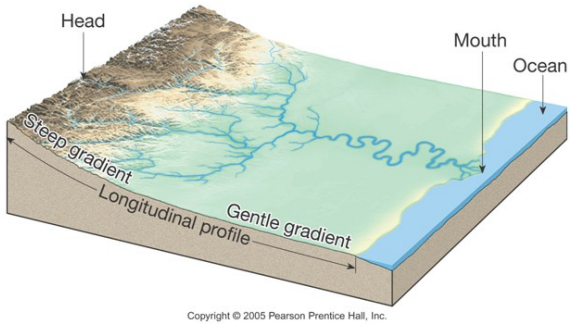
FishPAC Fact Sheet
Interagency Engineering Work Group

May 2021

LONGITUDINAL PROFILES FOR FISH PASSAGE SOLUTIONS

A longitudinal (i.e., long) profile illustrates the topography of the base of a stream. An adequate long profile survey is necessary to inform the scope of fish passage design solutions and describe site-specific conditions that influence the watercourse, such as climate and geology, watershed controls, and flow and sediment regimes. These drivers must be quantified to recommend a successful fish passage solution that results In post-construction channel function, habitat suitability, and long-term performance.



Project Site Considerations

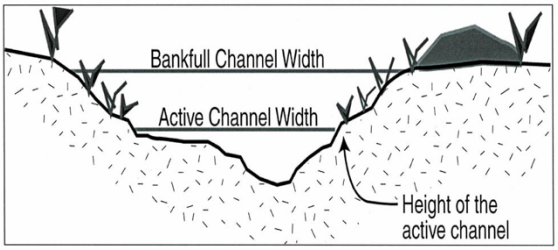
Every barrier location has unique conditions that need to be quantified.

- Is the channel profile controlled by temporary controls (e.g., sediment or debris) or permanent controls (e.g., bedrock)?
- What is the stage of channel evolution, and what will it look like in the future?
- Is the downstream channel incised, or likely to incise?
- Will land use practices affect the future channel profile by changing peak flow hydrology, sediment, and/or debris loads?
- Will channel changes in nearby reaches affect the channel profile?
- For culvert replacements, will replacement of the culvert affect the channel profile?

Site Conditions Drive Profile Length

A survey for fish passage road crossing requires significant detail in the longitudinal profile along the deepest point (thalweg) of the stream. A general rule of thumb is that an analysis of **20X bankfull width** (Figure 1) (upstream and downstream of the project site) is needed to adequately assess a project site and develop a design solution that is effective long term, requires minimal maintenance, and restores ecological stream function. In most cases, this distance significantly exceeds Caltrans right of way. Figure 2 illustrates the need for adequate long profile to help identify site specific scour and the extent of downstream channel incision.

Figure 1. Bankfull width is the point on a streambank in which overflow into the floodplain begins.



Incised channel

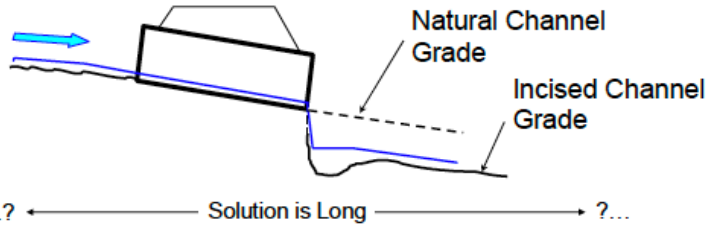


Figure 2. Incised channels require longer longitudinal surveys.

The long profile includes the reference reach, the road crossing, and the downstream reach of the crossing containing. From the chosen reference reach, a representative cross section is developed, including designation of bankfull width, channel features (i.e., bedforms, banklines, etc.), the type of channel (i.e., pool-riffle, step pool, etc.), and gradation curves (developed from soil samples). Once the longitudinal limits of the long profile are determined and it has been surveyed, a plot of the existing stream profile is generated (Figure 3) that includes channel characteristics and processes that might affect the channel in the future. The long profile of the stream and culvert are drawn considering project objectives and reference reach characteristics.

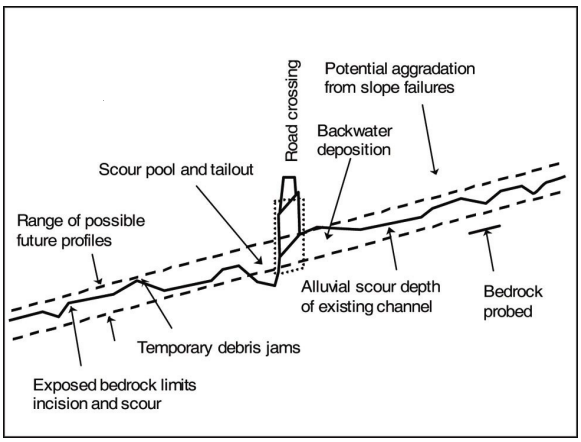


Figure 3. A long profile survey showing a range of future profiles based on field conditions.

Additional resources for long profile guidance

Caltrans Fish Passage Design for Road Crossings

Federal Highway Administration. 2010. Culvert Design for Aquatic Organism Passage. Publication No. FHWA-HIF-11-008.

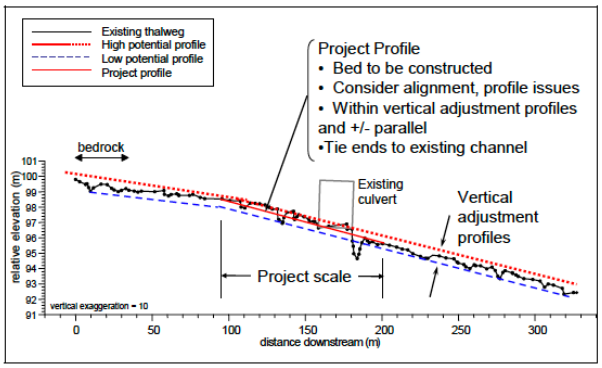
California Department of Fish and Wildlife . 1998. California Salmonid Stream Habitat Restoration Manual. 4th Ed. 525pp. Vol 1, Vol 2.

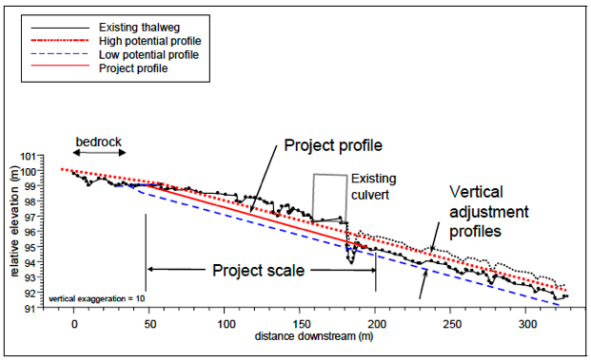
National Marine Fisheries Service Southwest Region. 2001. Guidelines for Salmonid Passage at Stream Crossings. 14pp.

United State Forest Service (USFS). 2008. Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings. Washington, DC: U.S. Dept. Agriculture, USFS National Technology and Development Program. https://www.fs.fed.us/eng/pubs/pdf/StreamSimulation/hi_res/%20FullDoc.pdf.

FishXing software and learning systems for the analysis of fish migration through culverts.

In addition to an adequate longitudinal profile, vertical adjustment profiles (VAP) demonstrate the potential for the project site to adjust in the future—the maximum degradation potential relative to design profile. In the figures below, the dotted red line illustrates the high potential profile, and the dashed blue line illustrates the low potential profile. The project profile should be between the upper and lower vertical adjustment profiles. Longer VAPs are needed for incised stream channels (Figure 4) compared to stable stream channels (Figure 5). Incised stream channels require assessment of the causes of the channel incision, the sensitivity of the channel, a prediction of how the channel will likely behave and evolve in the future, and how the condition of the upstream channel relates to project objectives.





Figures 4 (left) and 5 (right). Vertical adjustment profiles for incised (Fig. 4) and stable stream channels (Fig. 5).