2. Longitudinal Profile

Purpose

This section describes how to survey the longitudinal profile of the channel thalweg at your monitoring reach. It identifies the equipment needed, outlines the basic protocol, discusses the frequency with which the profile should be re-surveyed, and presents any site-specific considerations. As with the monumented cross-section method (see Section IV.B.1), this section does not provide detailed instruction on basic surveying techniques. See Harrelson et al. (1994) for a more complete treatment of this subject.

Minimum Equipment

- ❑ Automatic level (surveyor's level), laser level, or total station
- ❑ Leveling rod in English (to tenths and hundredths) or metric units, preferably 25-foot length
- ❑ Measuring tape in same units (300 ft or 100 m)
- ❑ Field book with waterproof paper
- ❑ Data sheets (see Appendix E)
- ❑ Pencil
- ❑ Permanent marker
- ❑ Two-way radios
- ❑ Topographic maps and/or aerial photographs
- ❑ Chaining pins
- ❑ Flagging tape
- ❑ Machete
- ❑ Wood survey stakes
- ❑ Small sledge or mallet
- ❑ Spring clamps
- ❑ Compass

Monitoring Design

Sampling Protocol

1. Define the monitoring reach.

This must be accomplished before surveying the longitudinal profile and the cross-sections. See Section IV.B.1 for general guidelines. Your longitudinal profile should extend the length of the monitoring reach, beginning at a stable channel feature (e.g., riffle) upstream of the impoundment. Your profile should always begin upstream of the uppermost cross-section and should continue to the lowermost cross-section and include survey shots at the thalweg of all monumented cross-sections.

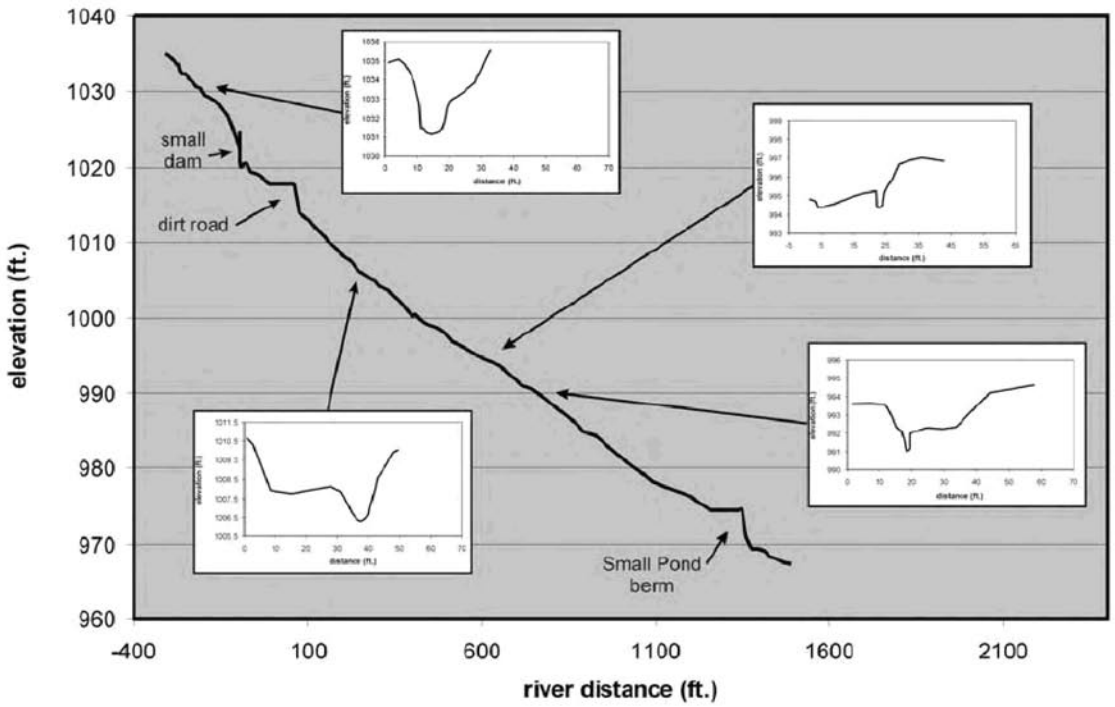

Figure 3. A longitudinal profile surveyed pre-project at Kamrath Creek, Wisconsin. The survey points for a channel bed longitudinal profile are taken at the deepest point in the channel, i.e., the thalweg (see Figure 2). Profile plot courtesy of Brian Graber.

2. Set up the survey instrument.
If possible, set up the level in a location from which the benchmark, and as much of the monitoring reach as possible, is visible (See Section IV.B.1, step 4, for information on benchmarks). You may want to consider setting up the instrument in the channel, if the flow and bed conditions permit (Harrelson et al., 1994). Choose instrument locations carefully to minimize the number of times you need to reposition.

3. Establish the stationing.
Downstream distance should be measured along the channel thalweg. A straightforward method is to station the channel with a baseline along one bank. The downstream distance of each survey shot is measured as the right-angle projection from that location to the baseline on the bank.

The baseline can be established by two people measuring along the stream thalweg with a tape, while someone on shore drives, and clearly marks, wooden survey stakes at regular intervals (commonly a channel width). The purpose of the stationing stakes is to make estimating distances easier. They do not necessarily mark the locations of actual survey shots. See Harrelson et al. (1994) for further information on stationing. Using a total station with a GPS interface, if available, can make stationing unnecessary and considerably simplify profile completion. These units can "fix" the horizontal position of survey shots in known datums such as NAD 83 for subsequent plotting in GIS and calculating distances. Total stations and laser levels are also advantageous for profile surveys because of the long distances over which they can obtain shots (Simon and Castro, 2003).

4. Survey the profile.
Begin with a rod reading on the benchmark to determine the height of the instrument (HI) (see Section IV.B). Then take readings along the thalweg (i.e., deepest part of the channel) at important bed features (e.g., pools, riffles, bedrock sills, woody debris), measuring downstream distance using the baseline. Include enough shots to well define each feature (Simon and Castro, 2003). It is particularly important to determine the highest elevation at pool-riffle (and/or run) transitions.

Along with distances and elevations, record in the field book details about the feature being measured and the locations of important changes in substrate type. Also, take elevations of the water surface at each bed elevation measurement. This can be done easily by taking the elevation of the water's edge closest to the thalweg along the projection to the baseline. Move the instrument as needed to complete the profile.

Sampling Frequency
As with the cross-section surveys, a pre-removal longitudinal profile may be accomplished most easily during an impoundment draw-down and should be integrated with any planned feasibility work (see Site Specific Considerations below). As a general guideline, post-removal re-surveys should occur annually, or every other year, for at least 5 years. However, sampling frequency and duration should reflect project objectives and site conditions. At a minimum, the frequency should conform to regulatory requirements. Note that follow-up surveys should trace the post-barrier removal thalweg, which may not be in the same horizontal position as the pre-removal thalweg.

Site-specific Considerations
A portion of the pre-removal longitudinal profile will run through the impoundment. As with the cross-sections, this may require a boat and should be done with great care. See Site Specific Considerations under Section IV.B.1 for general guidelines and considerations.

Analysis and Calculations
The data from a longitudinal profile survey are elevations and distances. Horizontal distances are recorded to tenths of feet (0.1 ft) and elevations of benchmarks and turning points to hundredths of feet (0.01 ft). Profile elevations are recorded to hundredths of feet as well. These data should be recorded in standard, level survey notation (see Longitudinal Profile Survey Data Sheet in Appendix E). Harrelson et al. (1994) also provide a nice graphic example of proper field book notation for level surveys. The horizontal and vertical datums of the survey must always be recorded (see Site Information Data Sheet in Appendix E). The distances and elevations can be plotted manually on graph paper as 'x' and 'y' coordinates, respectively, or brought into a spreadsheet program for plotting and analyses (Figure 3).

Additional Information
Harrelson et al. (1994) is an excellent reference for basic survey techniques and for specific information on conducting cross-section and longitudinal profile re-surveys. We strongly recommend that readers with minimal experience consult this reference. It also provides a useful review for those with more experience.