

Longitudinal Profile

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Longitudinal Profile Survey Forms

Longitudinal Profile

The longitudinal profile characterizes average stream slopes and depths of riffles, pools, runs, glides, rapids and step/pools. The average water surface slope is required for delineating stream types and is used as a normalization parameter for dimensionless ratios (**Figure A-12**). The water surface slopes of individual bed features (facet slopes) can be compared using longitudinal profile data (e.g., riffle facet slope *vs.* pool facet slope). In addition, the longitudinal profile can be used to obtain maximum depth of individual bed features and bed feature spacing.

The average water surface slope is measured between two bed features of the same type (e.g., top of riffle to top of riffle) over a distance of 20 to 30 bankfull channel widths. To calculate average slope, divide the change in water surface elevation by the stream length between the two features.

Longitudinal profiles require basic surveying skills and equipment. Because longitudinal profiles cover a large distance (20 to 30 bankfull channel widths), multiple instrument setups are often required.

Longitudinal profiles are measured in the downstream direction. Typically, a 300-foot tape is laid along the centerline of the channel (not Thalweg) to obtain stream length stationing. If the flow velocity or depth does not allow the tape to be stable at the channel mid-point, then station the tape along one side of channel at low flow edge of water. An elevation measurement and the associated distance along the tape (station) are taken at major breaks in the bed topography and generally at the start, mid-point and end of features (e.g., start, mid-point and end of riffle). Four types of features are measured at each station: 1. Thalweg (deepest part of channel) (THL), 2. Water Surface (WS), 3. Bankfull (BKF) (if a good indicator), and 4. Low Bank Height (LBH) (if the lowest bank height is greater than bankfull stage to indicate degree of incision). The Thalweg and water surface measurements should reflect bed elevation and water surface slope changes as the stream progresses through a bed feature sequence (e.g., riffle, run, pool, glide). Note the stationing of the cross-section locations along the profile. An example profile survey with survey notes and a plotted profile are shown in **Table A-5** and **Figure A-13**.

Longitudinal Profile Instructions

1. Setup the instrument with a clear line of sight to a benchmark. The first setup should reference (backsight) a benchmark (BM) of known elevation. Approximate the number and location of each setup needed based on potential line-of-sight limitations. The instrument should be placed at an elevation higher than the highest feature required for the survey.
2. Backsight (BS) the benchmark (place the rod on the benchmark and obtain a rod reading). Determine the height of the instrument (HI). $HI = BM \text{ elevation} + BS \text{ rod reading}$.
3. Starting at the upstream end of the reach, position a 300-foot tape along the centerline of the channel if flow permits or along edge of water to obtain stream length stationing.
4. Place the rod at the Thalweg at station 0 on the tape. Obtain the rod reading and record the value in the foresight (FS) column as shown in **Table A-5**. Record water surface, bankfull and lowest bank height measurements (if lowest bank height is greater than bankfull stage) perpendicular to the tape at station 0 as shown in **Figure A-12**. (**Note:** LBH in **Figure A-12** at station 0+00 is the same as BKF).
5. Continue the same sequence downstream to the start, mid-point and end of major bed features and repeat the same measurements at the new stations.
6. At cross-section intersection locations, note the distance (station) on the longitudinal profile tape. When using multiple instrument setups, take a measurement on top of both cross-section end points to obtain common elevations of the cross-section and longitudinal profile.
7. Profile your entire reach (20 to 30 bankfull channel widths is normally used as a minimum longitudinal profile length guideline).
8. Plot the longitudinal profile (**Figure A-13**).
9. Plot the cross-section location and the corresponding bankfull elevation on the longitudinal profile (**Figure A-13**).
10. Draw a line through the water surface data points of the same bed feature (e.g., top of riffle to top of riffle) to represent the average water surface slope. Draw a best-fit line through the bankfull data points.
11. Determine the average water surface slope and enter into forms (**Worksheet A-1** and **Worksheet A-3**). Determine bankfull slope and enter into **Worksheet A-2**. **Note:** The average water surface slope and the bankfull slope should be parallel.

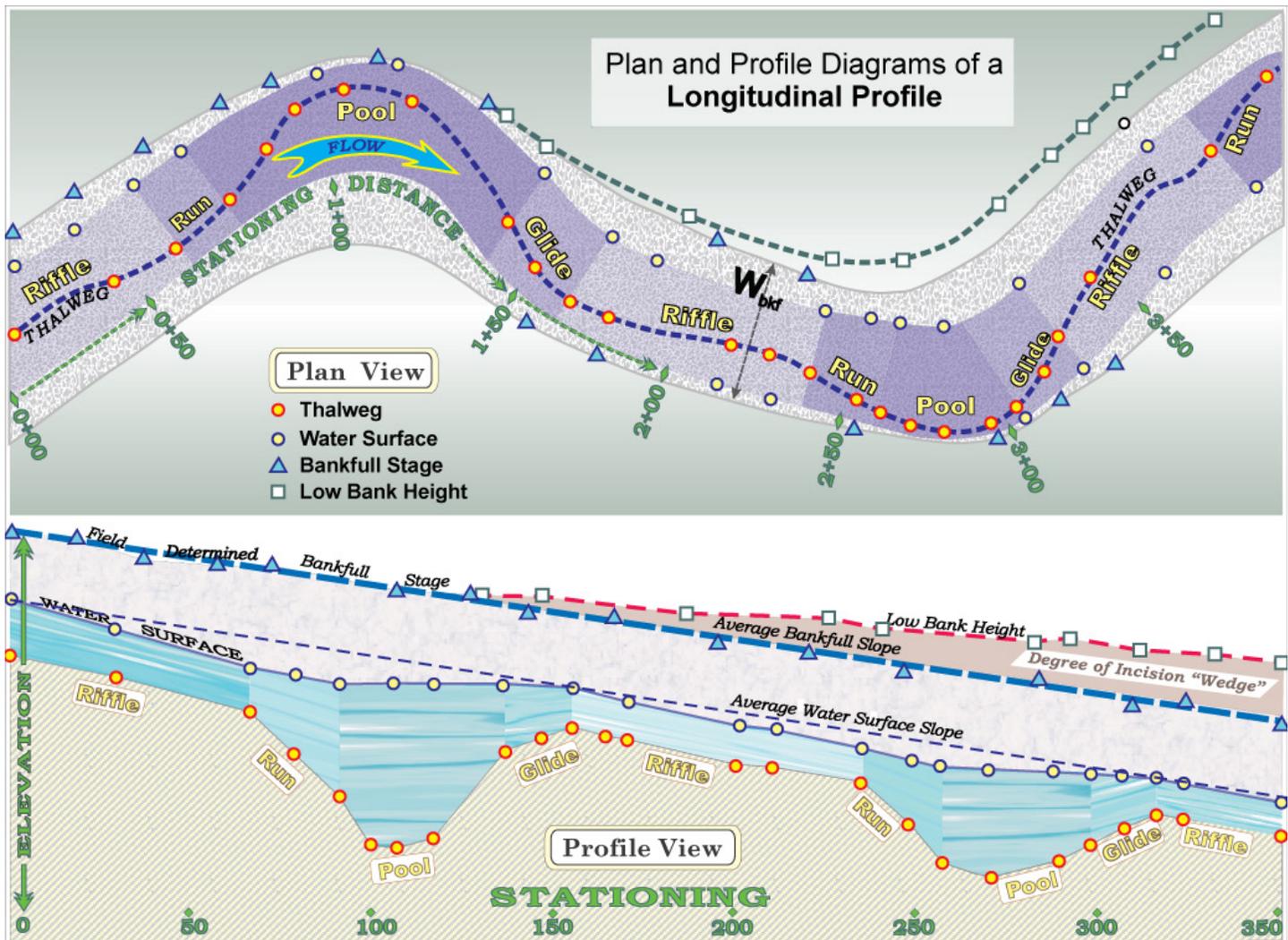


Figure A-12. Plan and profile views of a longitudinal profile indicating slope and bed feature measurement locations. **Note:** Stationing distance in this example is measured along right edge of water (REW).

Average Water Surface Slope (S): Elevation of water surface over stream length at the same position above bed features for several riffle/pool or step/pool sequences (e.g., elevation difference from the top of riffle to top of next riffle over the length of the stream). This value will normally approximate the average bankfull slope.

Average Bankfull Slope (S_{bkt}): The elevation difference of bankfull indicators along the stream length. The elevation differences are obtained from a best-fit line drawn between bankfull indicators along the longitudinal profile, which is generally parallel and similar to the average water surface slope (S).

Table A-5. Sample form to record longitudinal profile notes with example data.

<i>SURVEY DATA</i> → <i>LONGITUDINAL PROFILE 1</i>													
SITE: Raccoon Creek										Date: 3/4/07			
Location: Reference Reach - Stationing 0+00 thru 3+60													
Party / Notes: Page 1 of 3										HUC: <input type="text"/>			
STATION	Distance, Point, or	Back-Sight	Height of Instrument	Thalweg		Water Surface		Bankfull		Low Bank HI		NOTES e.g. Riffle Run Pool Glide	
				Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation		
	BS	HI	FS	Elev.	FS	Elev.	FS	Elev.	FS	Elev.	FS	Elev.	
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
1	BM1	5.28	105.28										
2	0			7.20	98.08	6.75	98.53						Riffle
3	1			7.21	98.07	6.76	98.52						
4	17			7.28	98.00	6.89	98.39						
5	19			7.26	98.02	6.91	98.37	5.83	99.45				Run
6	25			7.65	97.63	6.99	98.29						
7	30			8.25	97.03	7.05	98.23						Pool
8	32			8.65	96.63	7.06	98.22						
9	35			8.84	96.44	7.07	98.21						
10	46			9.03	96.25	7.08	98.20	6.05	99.23				
11	50			9.30	95.98	7.08	98.20						
12	56			9.25	96.03	7.10	98.18	5.91	99.37				
13	69			8.55	96.73	7.10	98.18						
14	72			7.75	97.53	7.10	98.18						Glide
15	75			7.62	97.66	7.10	98.18	6.17	99.11				
16	79			7.57	97.71	7.10	98.18						Riffle
17	90			7.60	97.68	7.15	98.13						
18	100			7.66	97.62	7.20	98.08						Run
19	105			8.12	97.16	7.28	98.00						Pool
20	112			8.91	96.37	7.30	97.98						
21	117			9.50	95.78	7.30	97.98						
22	125			8.41	96.87	7.30	97.98						
23	129			8.80	96.48	7.30	97.98						Glide
24	135			7.70	97.58	7.31	97.97	6.25	99.03				Riffle
25	152			7.78	97.50	7.38	97.90						
26	151			7.82	97.46	7.47	97.81						
27	161			6.42	97.30	5.99	97.73	5.02	98.70				Run

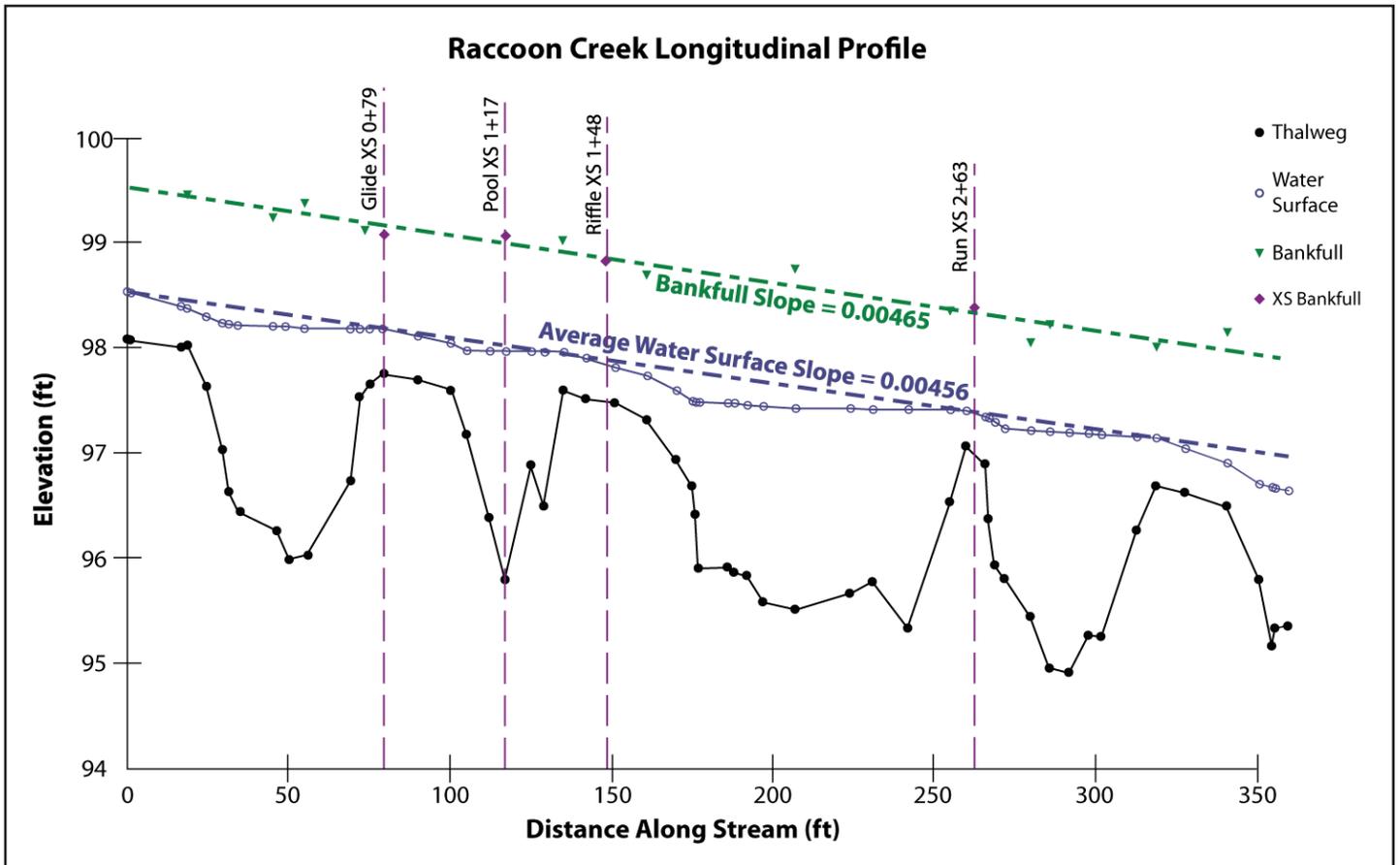


Figure A-13. Plotted longitudinal profile (RIVERMorph™, 4.3).

SURVEY DATA → <i>LONGITUDINAL PROFILE 1</i>												
SITE:										Date:		
Location:												
Party / Notes:										HUC: <input style="width: 20px; height: 20px;" type="text"/>		
	Distance, Point, or	Back-Sight	Height of Instrument	Thalweg		Water Surface		Bankfull		Low Bank HI		NOTES e.g. Riffle Run Pool Glide
	STATION	BS	HI	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
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SURVEY DATA → <i>LONGITUDINAL PROFILE 2</i>												
SITE:										Date:		
Location:												
Party / Notes:										HUC: <input type="text"/>		
STATION	Distance, Point, or	Back-Sight	Height of Instrument	Thalweg		Water Surface		Bankfull		Low Bank HI		NOTES e.g. Riffle Run Pool Glide
				Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
28												
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