

Cross-Section

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Cross-Sections

Cross-section data at riffle locations provides a majority of the morphological parameters required for stream classification. *Bankfull cross-sectional area, bankfull width, bankfull mean depth, bankfull maximum depth, bankfull width/depth ratio, and entrenchment ratio* are determined from the cross-section. Calculation of *entrenchment ratio* is illustrated in **Figure 9**. Basic surveying skills are required for the cross-sectional survey and are described in Harrelson *et al.* (1994). A summary of instructions and calculations are provided in the following section.

Inner Berm (IB)

An *inner berm* is a depositional feature in alluvial channels that represents the low flow channel boundary (**Figure 6**). It is often related to mean annual discharge.

Bankfull Cross-Sectional Area (A_{bkf})

The cross-section is divided into multiple trapezoids and the area of each individual trapezoid is computed. The total *cross-sectional area* is determined by adding the area of all the individual trapezoids (**Figure 11**).

Bankfull Width (W_{bkf})

Bankfull width is the surface width of the stream measured at the bankfull stage (**Figure 7**).

Bankfull Mean Depth (d_{bkf})

Bankfull mean depth is computed by dividing the *bankfull cross-sectional area* by the *bankfull width* (**Figure 8**).

Bankfull Maximum Depth (d_{max})

Bankfull maximum depth is the measurement of the depth of the thalweg to the bankfull stage (**Figure 8**).

Bankfull Width/Depth Ratio (W_{bkf} / d_{bkf})

Bankfull Width/depth ratio is the *bankfull width* divided by the *bankfull mean depth*. The width/depth ratio describes the channel shape (large number indicates wide and shallow; small number indicates narrow and deep).

Entrenchment Ratio (ER)

Entrenchment is the vertical containment of a river and is quantitatively defined as the *flood-prone area width* divided by the *bankfull width*. The *Flood-prone area width* (W_{fpa}) is the width of the channel at an elevation that is twice the bankfull maximum riffle depth (**Figure 9**). *Flood-prone area width* must be measured perpendicular to the fall line of the valley.

Cross-Section Locations

Appropriate locations to measure bankfull widths corresponding to a consistent normal high flow (bankfull) stage are indicated for riffle/pool and step/pool channels in **Figure 5**.

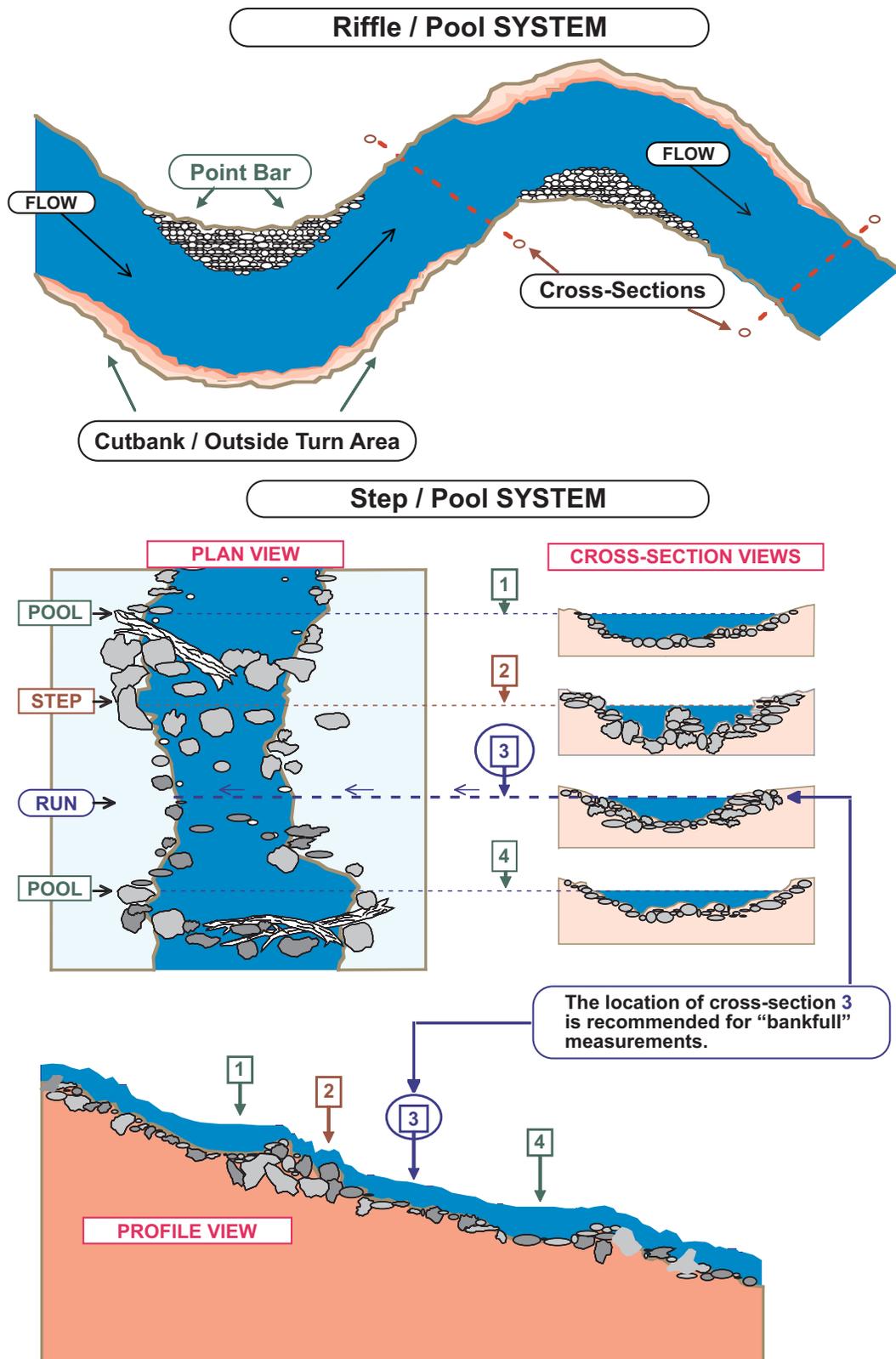


Figure 5. Recommended cross-section locations for bankfull cross-sectional area measurements.

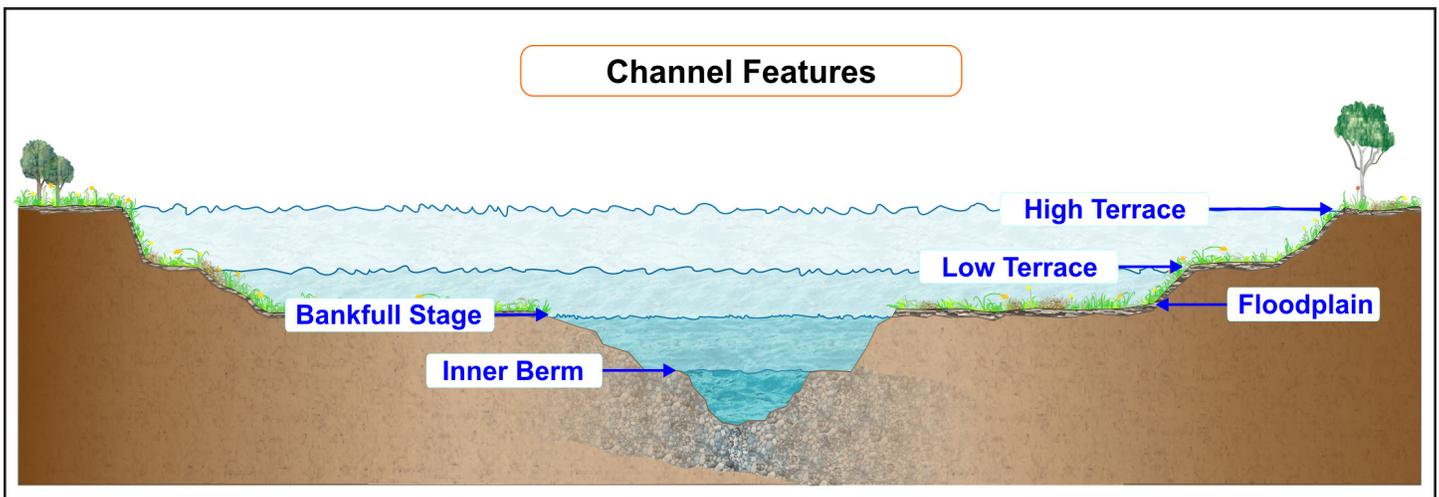


Figure 6. Typical channel features for a C Stream Type in an unconfined terraced, alluvial valley (U-AL-FD).

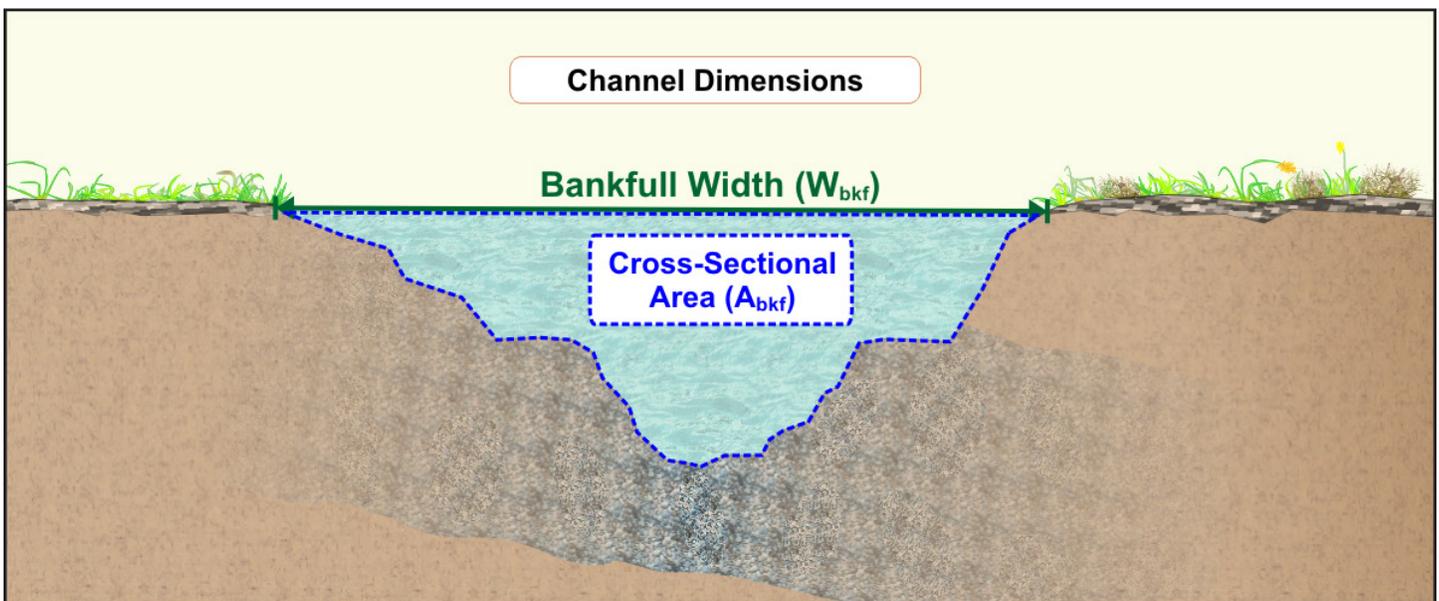


Figure 7. Bankfull width and bankfull cross-sectional area obtained from the riffle cross-section.

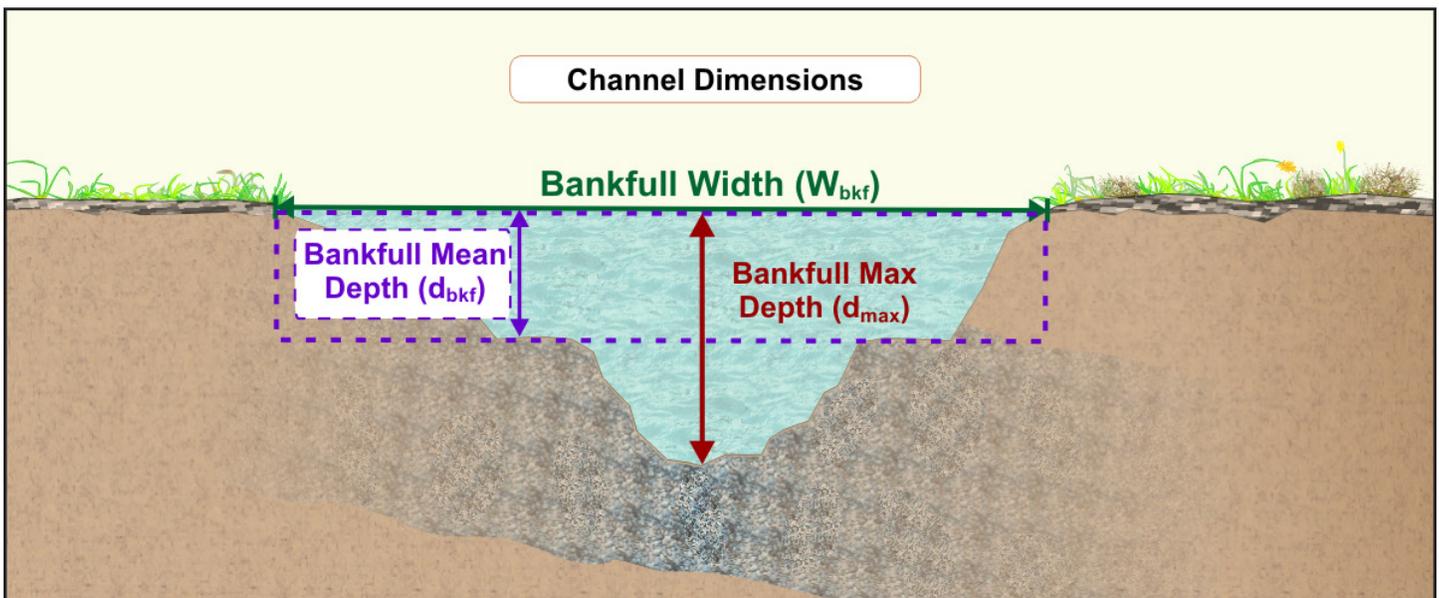


Figure 8. Bankfull mean depth and bankfull maximum depth obtained from the riffle cross-section.

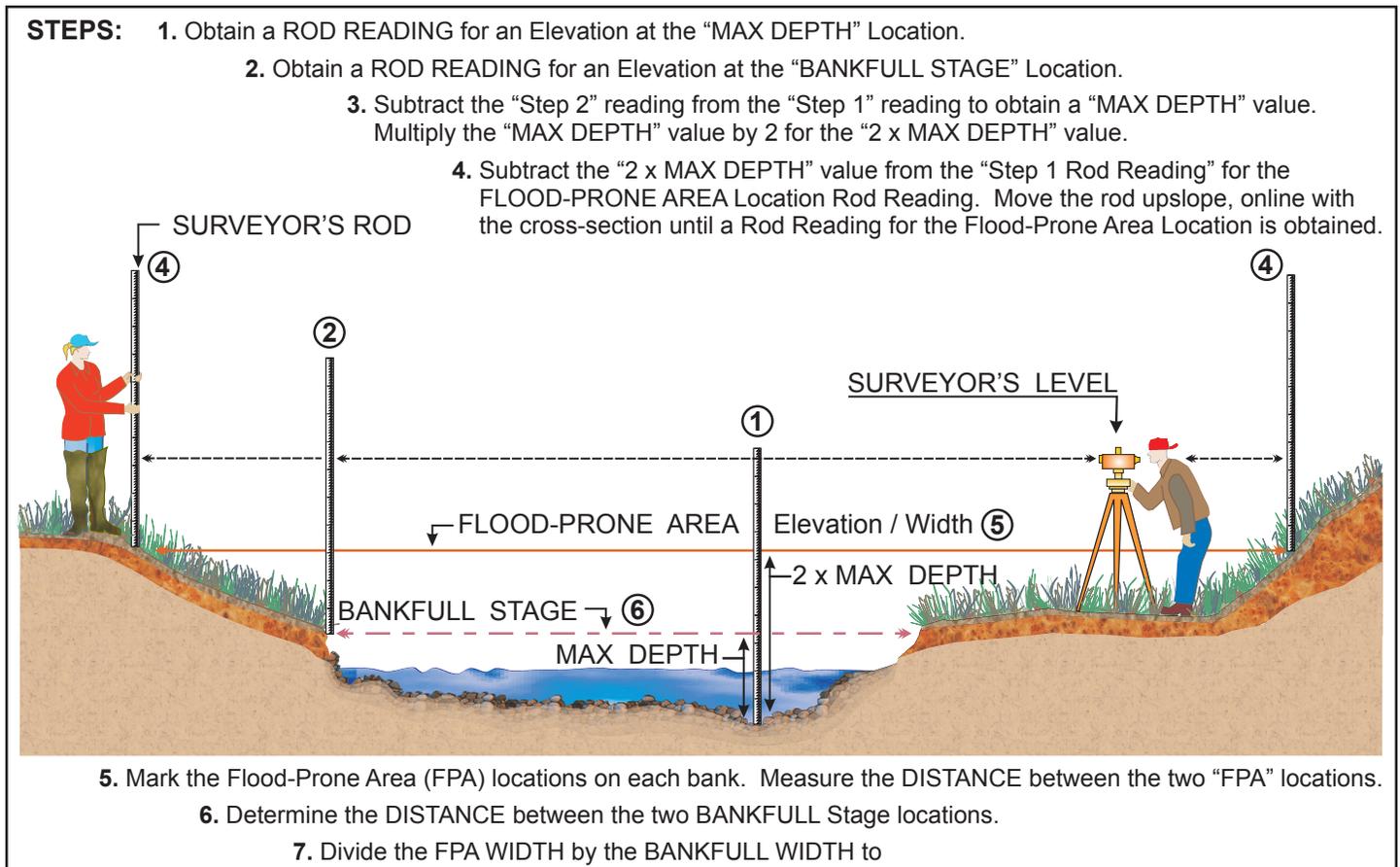


Figure 9. Determining *Entrenchment Ratio*.

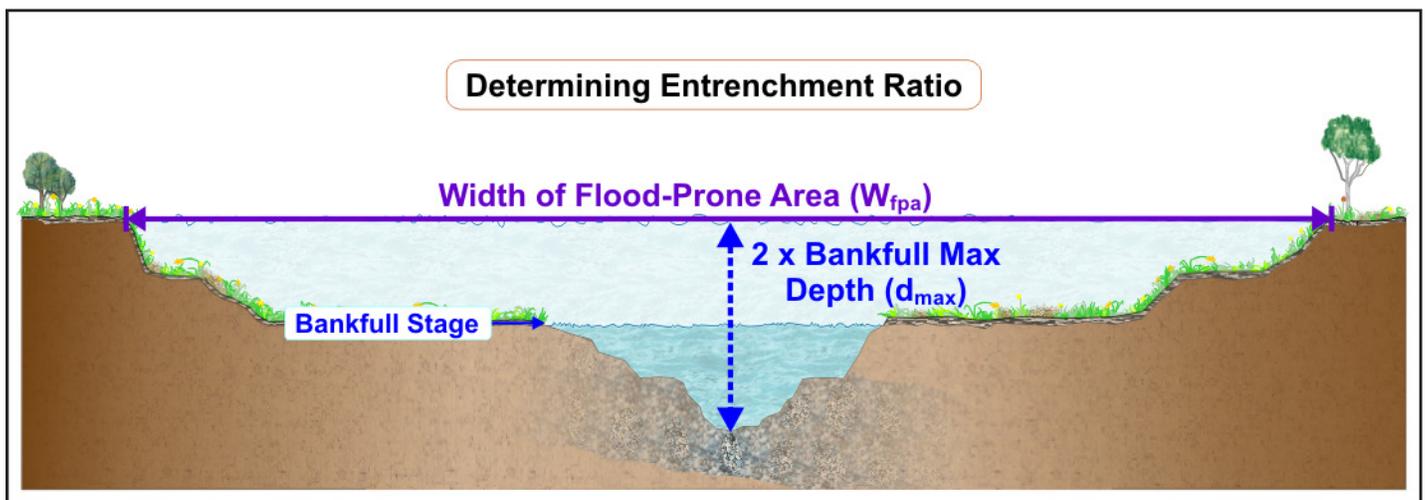


Figure 10. Determining *Flood-Prone Area Width (W_{fpa})*.

Cross-Section Instructions

1. Setup the surveying instrument in a location where the entire cross-section can be viewed. The instrument should be placed at an elevation higher than the highest feature required for the survey. Ideally, only one instrument setup will be required to survey the entire cross-section; however, determining the *flood-prone area width* may require multiple instrument setups due to dense foliage.
2. Stretch the tape across the channel (**zero on left bank**) making sure the tape is perpendicular to the bankfull discharge flow – not the baseflow.
3. Backsight (BS) a benchmark or permanent feature used for relocation or resurvey of cross-section.
4. Calculate Height of Instrument (HI); $HI = BS + \text{Elevation (known or relative)}$.
5. Obtain rod readings (Fore-Sights) at major breaks in bed elevation and key features, such as left bankfull (LBKF), left edge water (LEW), Thalweg (THL), right edge water (REW) and right bankfull (RBKF).
6. Record the distance on the stationing tape, the corresponding rod height and feature notes in the cross-section forms (see **Table 2** for example).
7. Plot the cross-section (**Figure 10b**); calculate the *bankfull cross-sectional area*, *bankfull width*, *bankfull mean depth*, *bankfull maximum depth*, and *bankfull width/depth ratio* (**Figure 11, Table 3**). Measure the inner berm dimensions.
8. Measure the *flood-prone area width* (width of the channel at an elevation that is two times the maximum bankfull depth) (**Figure 10**) – be sure to measure perpendicular to the fall line of the valley. Calculate *entrenchment ratio* (**Figure 9**).
9. For riffle cross-sections, check to make sure the cross-sectional area is reasonable using the appropriate regional curves; make sure the bankfull mean velocity is reasonable ($\text{mean velocity} = \text{bankfull discharge} / \text{bankfull cross-sectional area}$).
11. Record all data in the appropriate survey data forms.

SURVEY DATA					<i>CROSS - SECTION 1</i>	
SITE:				Date:		
Location:						
Observers:				HUC: <input style="width: 20px; height: 15px;" type="text"/>		
Item	Distance, Point, or	Back-Sight	Height of Instrument	Fore-Sight		
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Party / Notes:				HUC: <input style="width: 20px; height: 20px;" type="text"/>		
	Distance, Point, or	Back-Sight	Height of Instrument	Fore-Sight		
	STATION	B S	H I	F S	Elevation	REMARKS
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Party / Notes:					HUC: <input style="width: 20px; height: 20px;" type="text"/>		
	Distance, Point, or	Back-Sight	Height of Instrument	Fore-Sight		REMARKS	
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