GUIDELINES FOR WATER COURSE SURVEYS
IN UNDESIGNATED OR ZONE A
FLOOD ZONES

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The items discussed in this document are intended to describe the minimum requirements needed in order to construct a reasonably reliable hydraulic model for the determination of the approximate Base Flood Elevation (BFE) associated with a 100-year flood event on a limited reach of a floodplain. Since each site is unique and can pose distinct problems it is very important that the landowner, surveyor, and the person who will construct the hydraulic model to meet on site. A site visit by all parties will help insure that all of the required information is gathered during the initial survey and all of the hydraulic features needed for a reliable model are properly documented.

1. Where possible, use third-order leveling[1] to tie elevation reference points to established monuments referenced to the National Geodetic Vertical Datum of 1929 (NGVD) or the North American Vertical Datum of 1988 (NAVD). Otherwise, a common elevation datum should be established for the entire reach length. USGS Gage elevation datum can be used, or referenced, if the survey location is in the vicinity of any gauging stations.

2. Field surveys should be accompanied by trigonometric or differential leveling using transit-stadia or transit-electronic distance measurements, with vertical error tolerances of $\pm$ 0.1 foot across the width of the 100 year floodplain.

3. If the site in question is in an area with moderately steep side slopes, a moderately narrow floodplain, and 2-foot contour mapping is available, it may be used in lieu of field surveys to determine floodplain cross-sections. If the area in question has flat side slopes and a wide shallow floodplain, 2 foot contour mapping may not be acceptable, or it may require extensive ground truthing prior to drawing the map.

[1] Closure within ± 0.05 feet times the square root of distance in miles.

4. If the area to be modeled is near a USGS stream gage the information from the nearest gage on the flood source in question should be supplied. The information should include flow rate and water surface elevations for the corresponding period of the survey, the USGS Gage elevation datum, and the USGS gage cross section data. This information will help the hydraulic modeler to calibrate the model, and to more accurately reflect actual conditions.

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5. Cross-sections and cross sectional distance/elevation ground stations should be located at points representing significant breaks in ground slopes or floodplain widths, and at significant changes in the hydraulic characteristics of the floodplain (i.e., points where ground cover, soil, or rock conditions change, and changes in slopes). Elevations should be determined at the waters edge, and bathymetric measurements should be taken in order to determine the shape of the channel beneath the waters surface.

6. Each cross-section should span as closely as possible the entire floodplain. It is suggested that each cross section be extended to an elevation of at least 10 feet above the anticipated BFE. The cross- section alignment should be perpendicular to the general flow of the watercourse (approximately perpendicular to contour lines). Occasionally, wide floodplains require a dogleg alignment to be perpendicular to the anticipated flow-lines (See Figure 1).

7. The number of required cross-sections will vary depending upon the site and slope of the floodplain and the hydraulic characteristics of the reach. A minimum of five cross-sections is required. At least two cross sections must be located on the property where BFE elevations are desired. The furthest upstream section should be at the upstream property boundary. The distance below the downstream property boundary to the furthest downstream cross-section is dependent upon the slope of the channel. Table 1 and Figure 2 can be used as guidelines in determining this approximate distance. The maximum distance between cross sections should be the approximate width of the entire floodplain.

FIGURE 1 - EXAMPLE OF DOG-LEGGED CROSS-SECTION

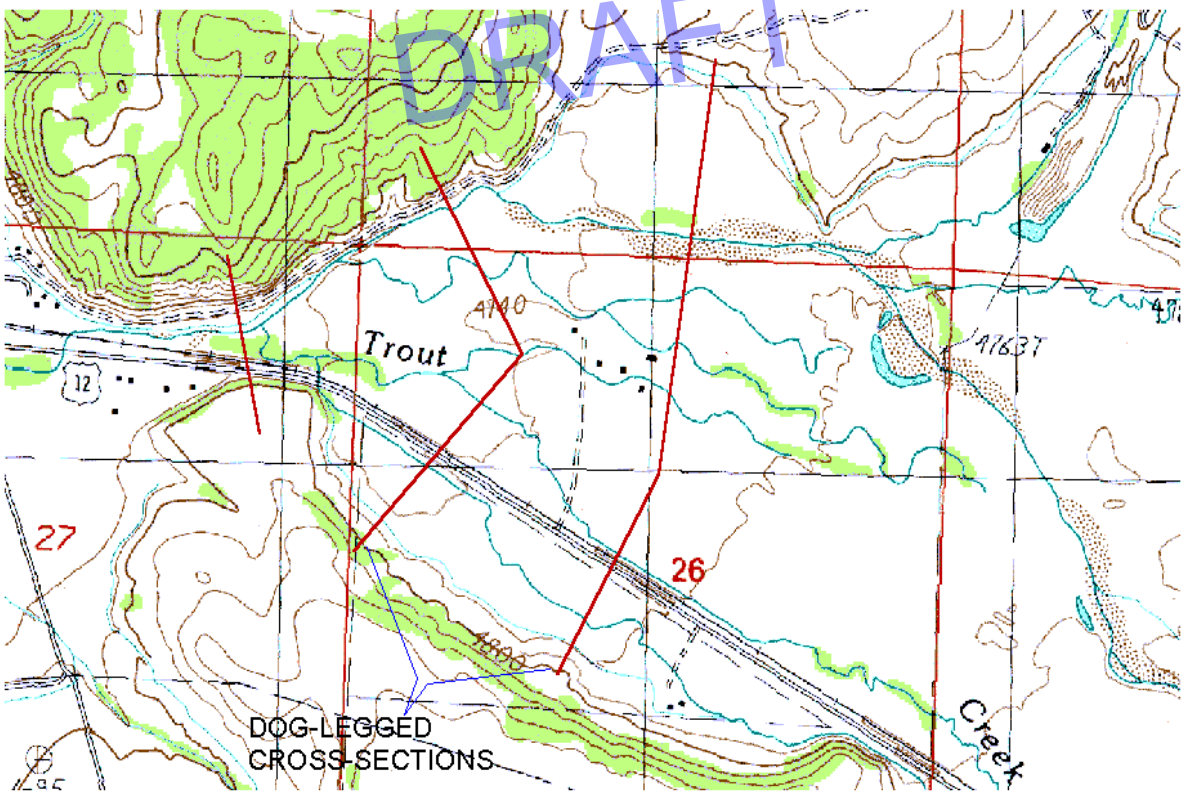
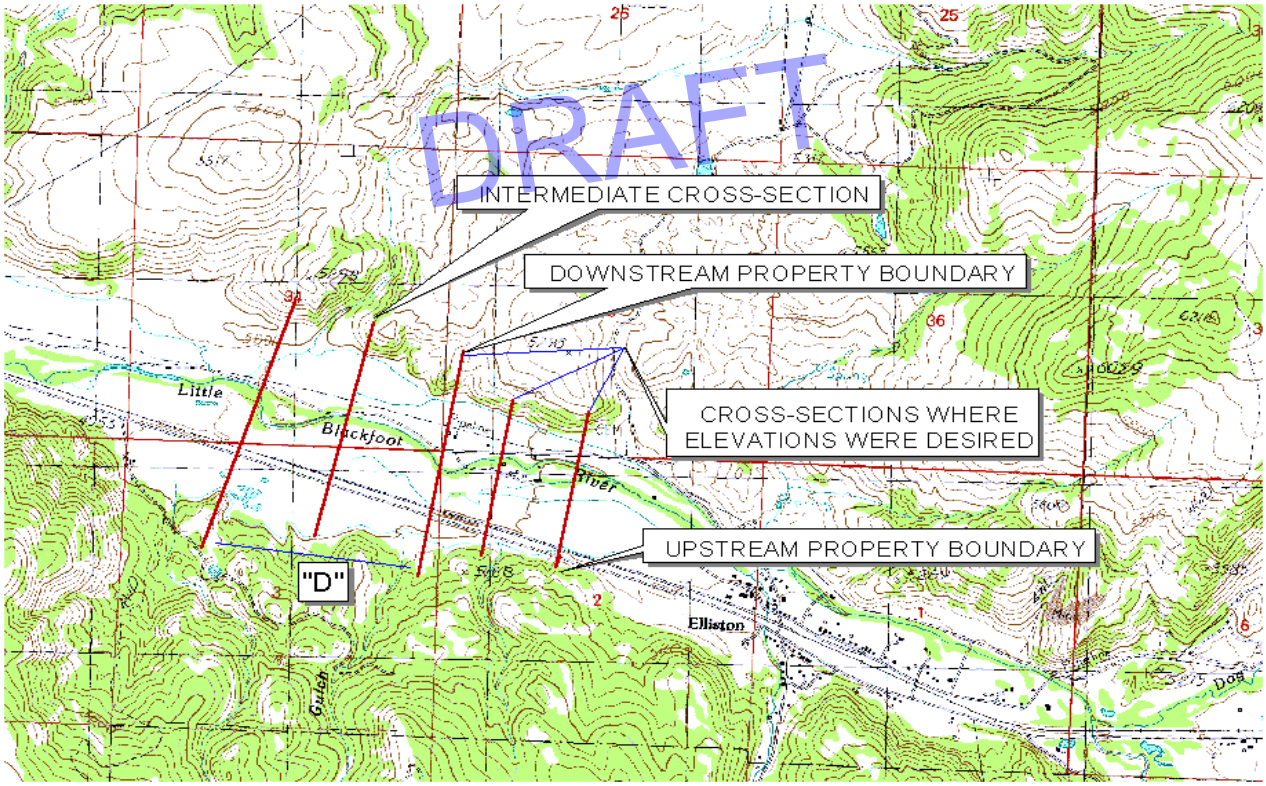


TABLE 1	
Channel Slope (ft/ft) (As determined by the average water course slope from USGS quadrangle topographic maps)	Minimum Distance "D" (ft) from the downstream property boundary to the furthest downstream cross section (See Figure 2)
< 0.001	3000
0.001 – 0.0049	1500
0.005 – 0.01	500
> 0.01	100

FIGURE 2 - EXAMPLE OF CROSS SECTION LOCATIONS



"D" - SEE TABLE 1

8. Cross-sections should be placed at representative locations throughout a floodplain reach and located in such a manner as to represent the flow reach in between cross sections. Each flow reach should be as uniform in geometry and roughness as practical. In addition, cross-sections are required at locations where changes occur in discharge, channel/floodplain slope, channel/floodplain shape, or channel/floodplain roughness; at locations where levees begin or end; and at bridges or control structures such as weirs. Several cross-sections should be used to describe areas where abrupt changes occur. Figure 3. illustrates the suggested cross sections locations for common types of changes in channel geometry.

FIGURE 3

3A. Bridge Cross Sections

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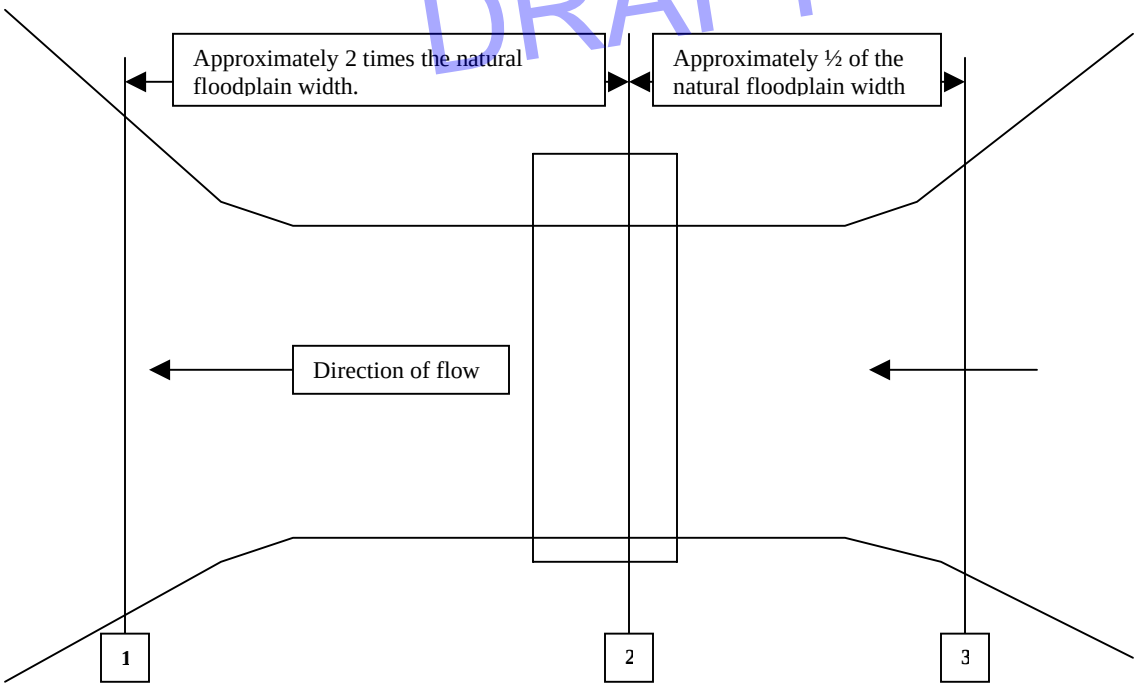
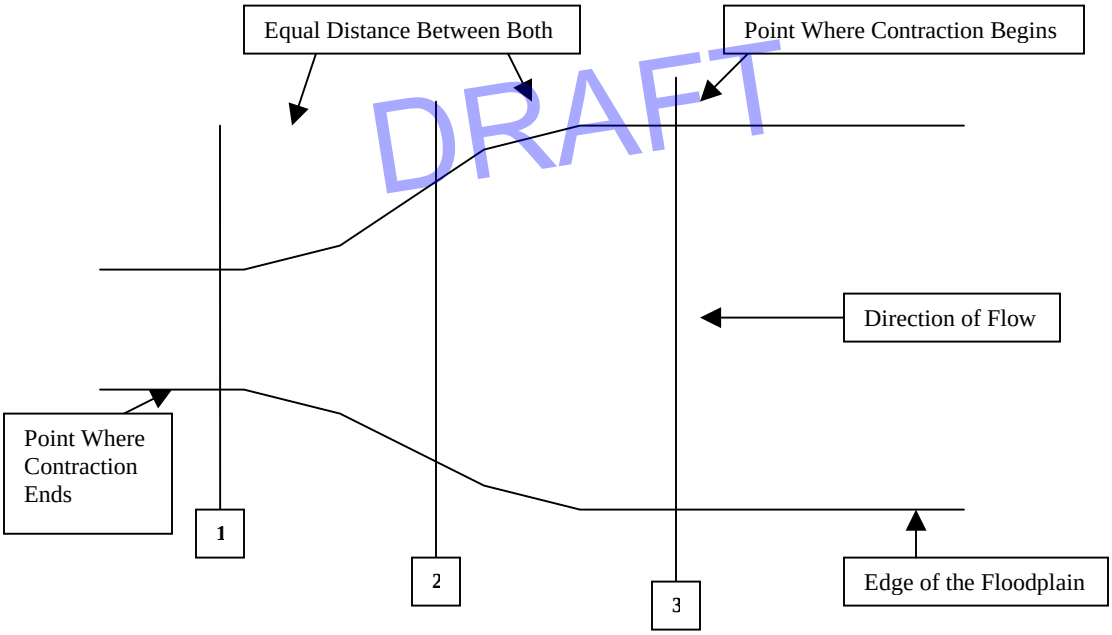


3B. Contraction Cross Sections



9. Submitted data should at least include the following:

   a. Certification by a licensed surveyor or registered professional engineer.
   b. Description of elevation reference datum.
   c. Property location description.
   d. A plan view showing the watercourse, floodplain, location of property, and location of cross-sections. Include downstream bridges or other contractions in the floodplain.
   e. Cross-section data should include distance/elevation data for each station including water surface location. The stations for each cross section should start at the far left side of the floodplain, oriented relative to the user looking downstream. (See Table 2 and Figure 4)
   f. Photographs and/or a description of the channel, overbanks, riparian area, and floodplain characteristics describing soil, rock types and sizes, and ground cover.
   g. USGS gage information (flow rate, water surface, elevation) from the nearest gage on the flood source.

TABLE 2

Sample of Cross-Section Data

Cross Section 2345

(See Figure 4)

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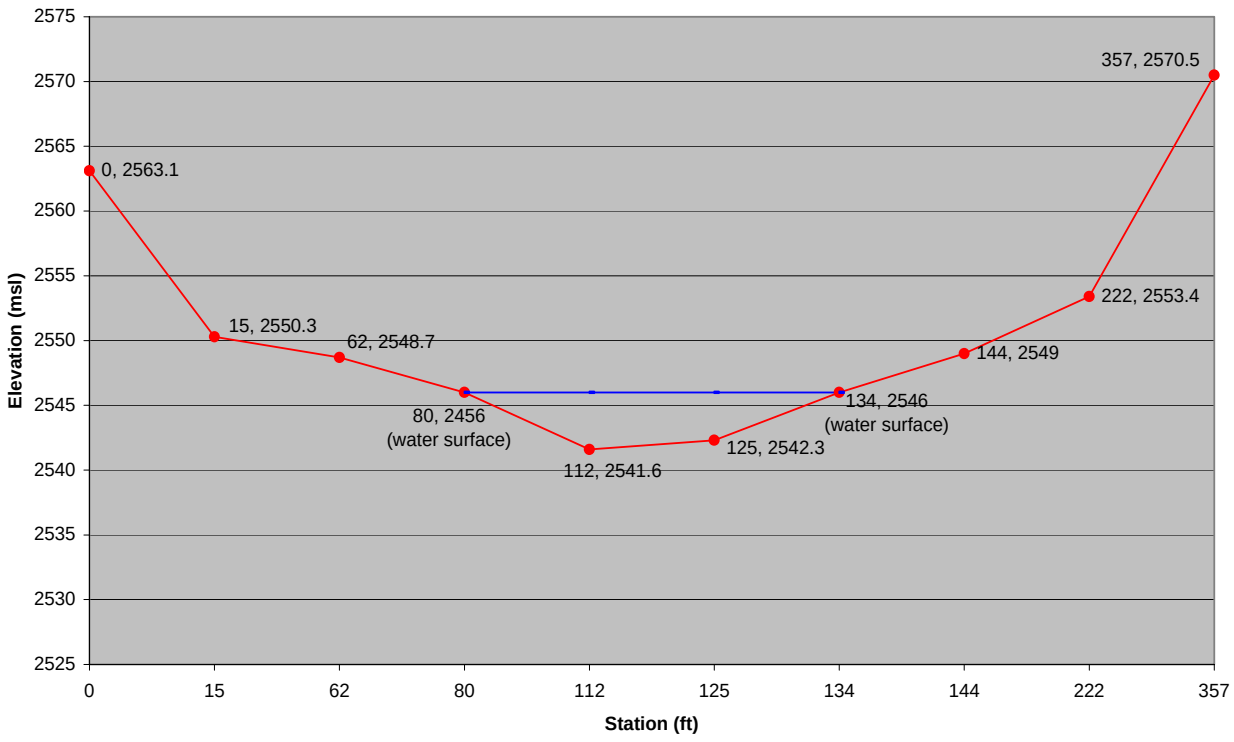
Station	Elevation	Station	Elevation
(Left Side) 0	2563.1	125	2542.3
15	2550.3	134	2546.0 (w.s.)
62	2548.7	144	2549.0
80	2546.0 (w.s.)	222	2553.4
112	2541.6	(Right Side) 357	2570.5

FIGURE 4
Cross Section 2345



References

1. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study Guidelines and Specifications for Study Contractors, FEMA 337; March 1991.

2. U.S. Geological Survey, Techniques of Water-Resources Investigations, Computation of Water-Surface Profiles n Open Channels, Book 3, Chapter A5, 1984.

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