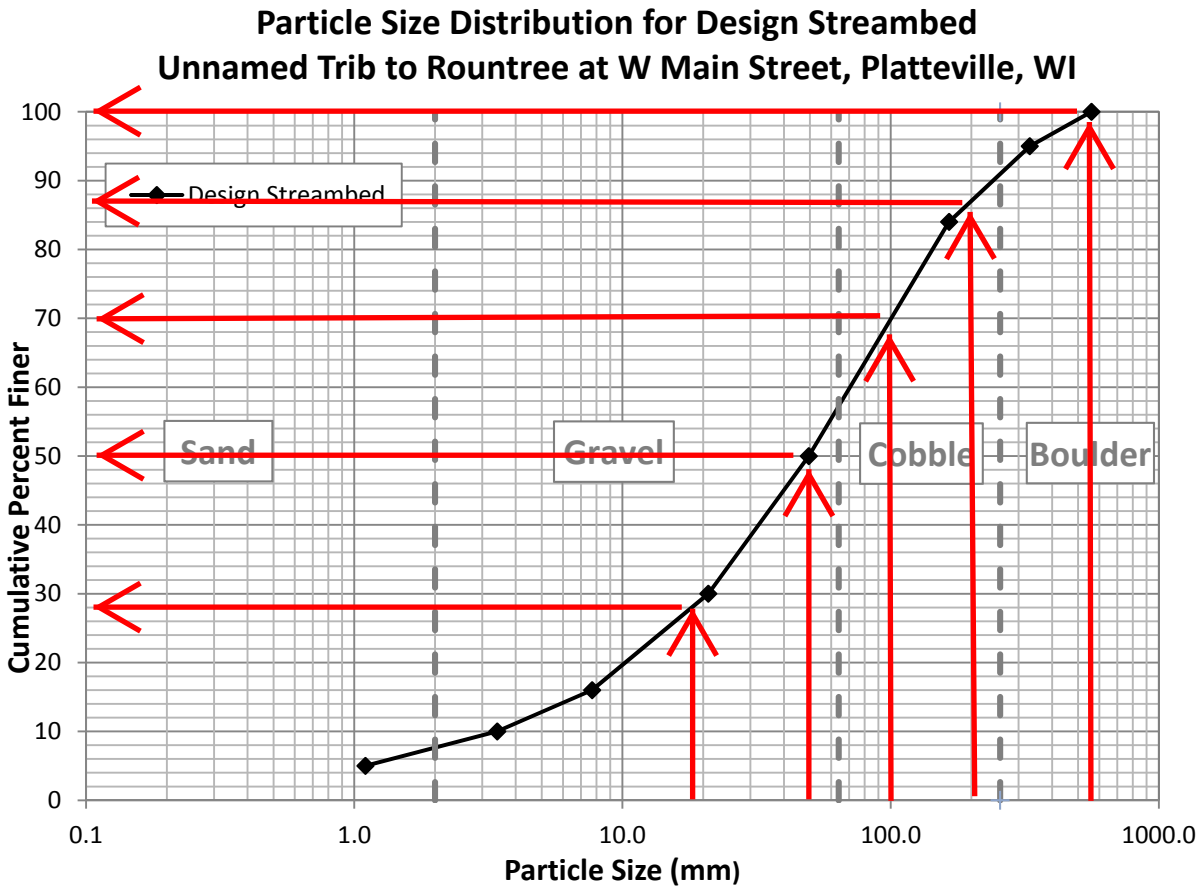
Exercise 5. Bed and Banks: Pebble Count Interpretation

Use the particle size distribution graph below to determine the percent composition of sediment needed by size class. Size classes have been developed to match typical ranges that could be obtained from a quarry or gravel crushing and sorting operation. Categories can be adjusted to fit local sources but care should be taken to ensure that size classes do not get too broad so that the final mix is an accurate representation of the reference reach. Fill in the appropriate percentages in the table provided below. Also enter the maximum particle diameter.

Size class and general description	Percent composition
Sand/Fine Gravel (<2-19 mm, ¾ in minus)	28
Gravel (19-51 mm or ¾ -2 in)	50-28 = 22
Small Cobble (51-102 mm or 2-4 in)	70-50 = 20
Large Cobble (102-203 or 4-8 in)	87-70 = 17
L Cobble/Boulder (203-508 mm or 8-20 in)	100-87 = 13

Maximum diameter (D100): __550__ mm __22__ in



Exercise 6. Structure Design: Rountree Tributary

The premise of stream simulation is to design a streambed then "wrap" the structure around it. In previous exercises, you selected a design alignment, profile, channel cross-section and bedmix. In this exercise you will use the design cross-section graph provided below and the profile graph from exercise 4 to select a structure and determine its dimensions.

First choose a structure width that will span bankfull width and also provide room for banks and any floodplain you plan to provide. The cross-section graph is located at the center of the structure and includes 2.5 ft of bank on each side. You can shorten or extend this depending on your objectives and hydraulic modeling results to be performed. Objectives in addition to passing fish, wood, sediment and water might include passage of reptiles, amphibians, small and large mammals and people.

Banfull width (ft): 15 Bank/floodplain width (ft): 5 Structure width (ft): 20

bankfull elev at center of culvert (ft): 84.6

Now identify the LVAP elevation and select an elevation for the invert or bottom of footer that extends down below the LVAP. Draw this on the cross-section and profile graphs.

Invert/bottom of footer elev (ft): center 79.0 upstream_____ downstream **draw parallel line**

Next identify the types of structures that would work including open bottom and enclosed structures. Select a preliminary structure and dimensions from the information provided below and taking into account the elevation of the road. Determine the minimum and maximum cover limits for the structure. Check to make sure the structure will extend below the LVAP and meet cover requirements. For open bottom structures, determine the top elevation of the footers. Ideally the top of the footers will extend up to bankfull elevation to allow the streambed to be constructed prior to setting the structure. Draw the structure on the cross-section.

Structure: Type conspan Material concrete Width (ft) 20 Height (ft) 8

Minimum cover (ft): 0 Maximum cover (ft): 50 Available cover (ft): 14

Top of footer elev (ft): center 84.6 upstream_____ downstream_____

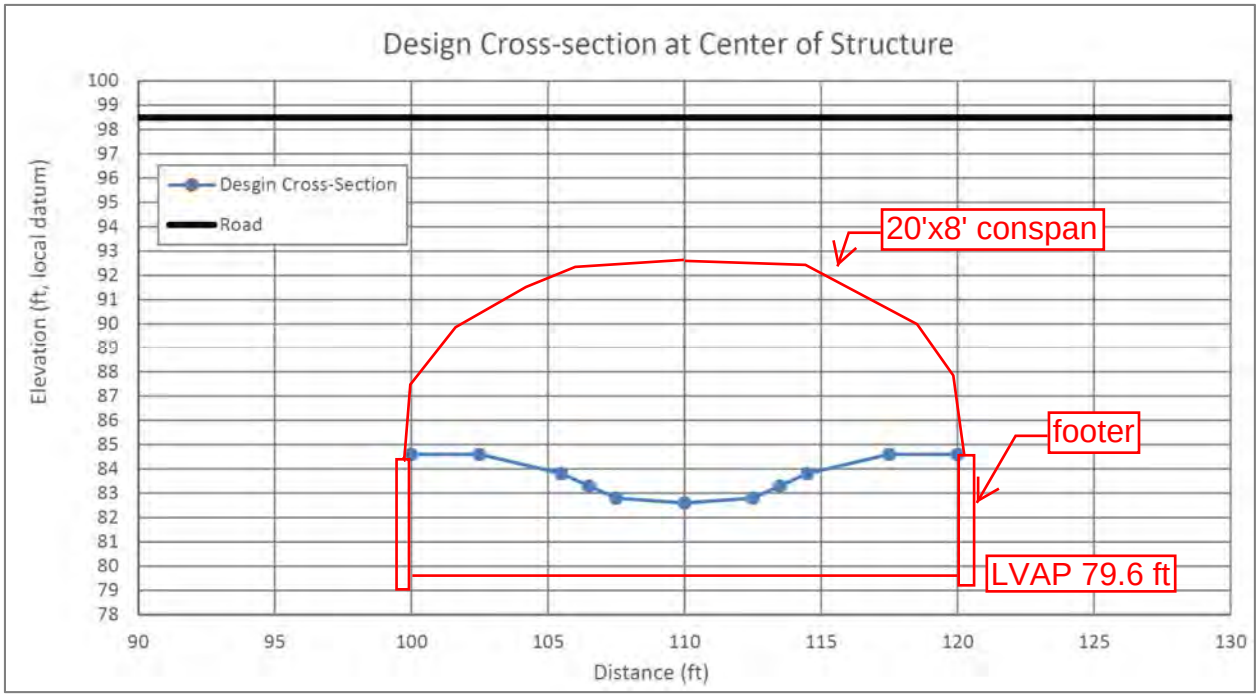
Then using the design slope, draw the structure on the profile graph. Now determine the total length of the structure. Assume you will keep the existing road width, choose an embankment slope (e.g. 2:1, 3:1, 4:1, headwalls), and sketch in your embankment if it differs from the existing. The current embankment slope is about 1½:1. The embankments should reach out from the road shoulder down to your chosen invert elevation. You can use a headwall to shorten the structure with associated cost considerations. Finally determine the total length of the structure.

End Treatment: headwall/bevel/square Side slope: 2:1 To: invert/top headwall

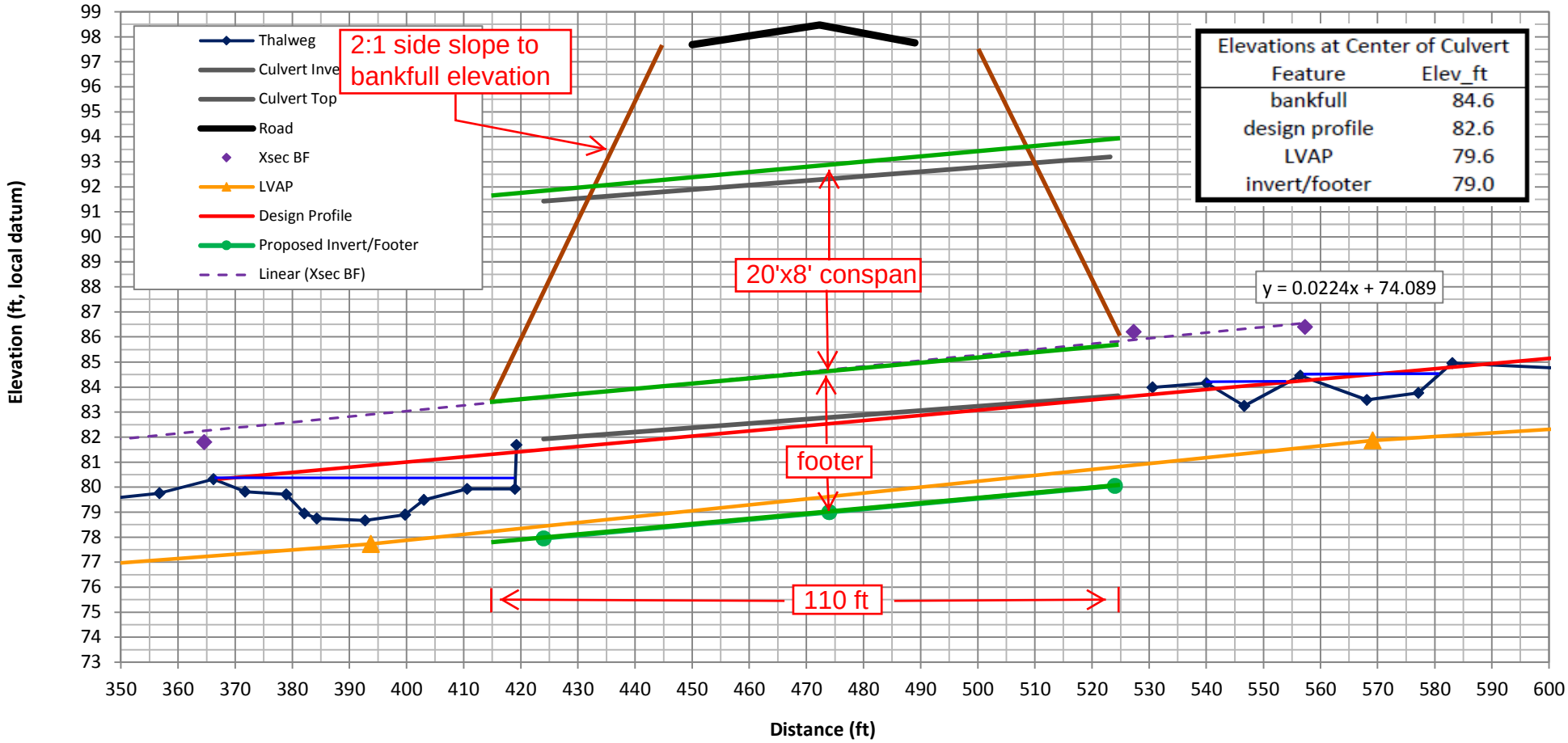
Design slope (ft/ft): 0.021 Final structure length (ft): 110

The final steps are to check hydraulic capacity to ensure the structure will pass at least the 100-yr flood with a HW/D<0.8. Then perform a sediment mobility and stability check and adjust streambed sediment sizes accordingly.

Exercise 6. Structure Design: Rountree Tributary



Rountree Tributary at W Main Street, Platteville, WI



Exercise 7. Bed and Banks: Bed Material Volumes

Determine the volume of bed material by size class along with the number and size of bank rocks to complete the bed design. Total bed volume can be determined by multiplying length by width by average depth of the proposed bed. An alternative would be to determine the average area of bed material from a typical cross-section and multiply it by the length. The minimum thickness of bed material was determined in exercise 5. Keep in mind that bank rocks will take up some volume and the bed material and bank rock must extend up and downstream to create a natural transition in and out of the structure. The plan view, photos and site sketch can be helpful when determining these transitions. It is probably easiest to account for bank rock volume when determining the width and average bed material thickness. If a plunge pool exists, determine if it should be filled and, if so, estimate that volume. If the average bed thickness would be sufficient to accomplish this objective, the bed length can be extended to account for the plunge pool.

Bed length (ft): **130** Bed width (ft): **20** Ave bed depth (ft): **3**

Total bed volume: **7,800** (cu ft) **289** (cu yd) (1 cu yd = 27 cu ft)

Next determine the volume of bed material (cubic yards) needed in each size class and enter it in the table below. Use the percentages from exercise 5 and the total bed volume from above.

Size class and approximate description	Volume (%)	Volume (cubic yards)
Sand/Fine Gravel (<2-19 mm, ¾ in minus)	**28**	**81 ~80**
Gravel (19-51 mm or ¾ -2 in)	**22**	**64 ~65**
Small Cobble (51-102 mm or 2-4 in)	**20**	**58 ~60**
Large Cobble (102-203 or 4-8 in)	**17**	**49 ~50**
L Cobble/Boulder (203-508 mm or 8-20 in)	**13**	**38 ~40**
		total = 295

Finally, determine the size and number (or volume) of rocks needed to construct banks, rock bands and other key pieces. The rock size should be at least as large as the D_{100} but can be larger since these pieces need to be stable over time. Key pieces are the best indicator of stable sizes. Banks can be constructed from these larger rocks while bed material can be used to fill voids. It is useful to have a range of rock sizes to create some irregularity or diversity in the banks and allow some interlocking of the rocks. Once an average rock size is selected, determine the total length of banks on each side and the number and length of rock bands. Then divide this total length of both by the average rock size to get the total number of rocks needed. The number of rock bands can be estimated from the longitudinal profile and pool-riffle frequency.

D_{100}: **22** (in, from exercise 5) Ave bank rock size (in): **21** **(1.75 ft)** Bank rock range (in): **18-24**

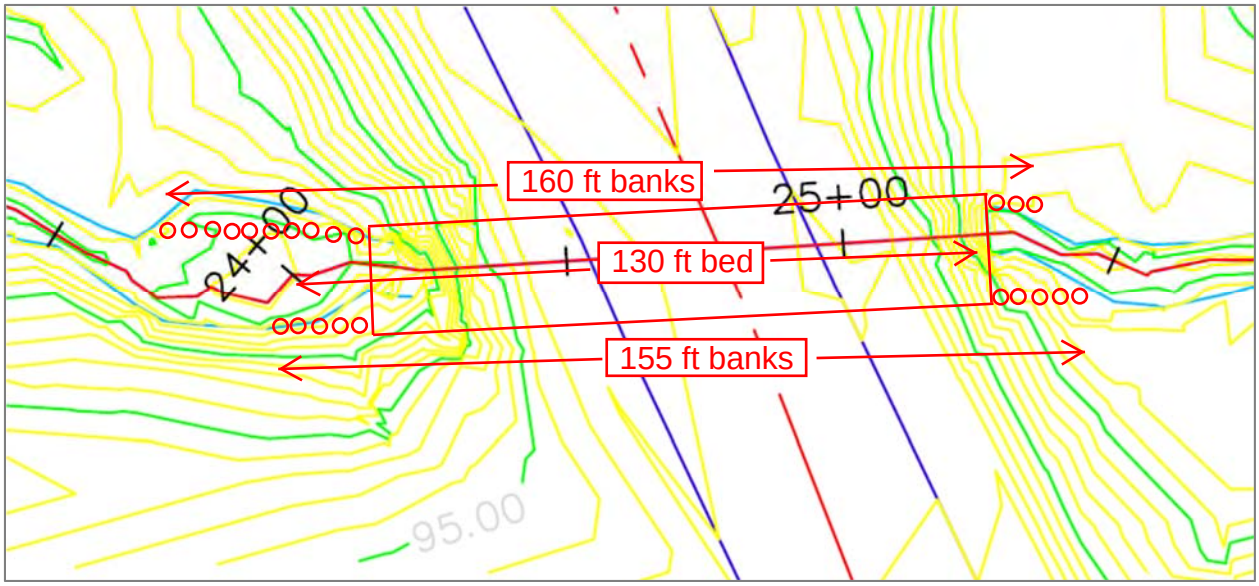
Bank length (ft): right **160** left **155** total **315**

Length of each rock band (ft): ____ # of rock bands: ____ Total length, rock bands (ft): ____

Total length for rocks (ft): **315** Total # of rocks: **270** **(315/1.75*1.5)**

or volume = 315'*2.5'*1.75' = 1,378 ft^3 or 51 yds^3

Exercise 7. Bed and Banks: Bed Material Volumes



Exercise 7. Bed and Banks: Bed Material Volumes

Unnamed Tributary to Rountree at W Main St, Platteville, WI

	Key Pieces				
	Axis (mm)			Mean Cubic	
Location	long	med	short	(mm)	(inches)
Upstream	260	105	75	126	5.0
	115	110	80	100	3.9
	240	130	80	135	5.3
	180	150	65	120	4.7
	170	95	90	113	4.4
	395	290	65	194	7.6
	300	205	30	122	4.8
	150	125	60	104	4.1
	115	95	70	91	3.6
Downstream		400		400	15.7
		470		470	18.5
		550		550	21.7
		350		350	13.8
		290		290	11.4
		530		530	20.9
		260		260	10.2
		320		320	12.6
		290		290	11.4

	Downstream Intermediate Axis	
	mm	in
D100 =	550	21.7
D95 =	542	21.3
D84 =	513	20.2
D50 =	350	13.8
D16 =	290	11.4

Flood Frequency Estimate - Walker and Krug Method Area 1
Chequamegon and Nicolet National Forests
Date: 05/03/16

Site:	Unnamed Tributary to Rountree
Location:	West Main Street
Ranger District:	

Note: Crossing located SE of historic crest gage Bear Cr near Platteville, WI, 05414200

Input Data	Site :	Crossing	Gage
	Drainage Area (sq mi):	0.64	2.72
	Main Channel Slope (ft/mi):	121	61.2
	Forest (%):	5.31	1.1
	25 Yr., 24 Hr. Rainfall (in.):	5.29	5.29

Note: Crossing drainage area is 23.5% of gage area.

Recurrence Interval (years)	Reg Eq Xing Discharge (cfs)	Crest Gage Discharges (cfs)	Discharge Adj Drainage Area Only (cfs)
1.5			90
2	90	387	115
5	184	663	194
10	229	852	247
25	325	1090	307
50	406	1260	351
100	495	1430	393
500	694		500

Reference: J.F Walker and W.R. Krug,
2003. Flood Frequency Characteristics of
Wisconsin Streams. U.S. Geological Survey-
Water-Resources Investigations Report 30-4250, 37 pp.

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May 2008

STREAM SIMULATION: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings