Montana
Engineering Practice Planning and Design Guide
for
Stream Channel Stabilization/ Streambank Protection

(See Pages 51-52/53 for Definitions)

	References	✓
STEP 1 Initial Evaluation		
A. Scope		
▪ Watershed Goals: If the project is part of an active watershed initiative, reference the goals for the watershed.	Watershed Plan	❒ ×
▪ Site Specific Goals: State the land manager's goals. Are they compatible with the watershed goals?	Conservation Plan	❒ ×
▪ Describe Site Problems: Initial stream site visit with the land manager(s) to observe existing conditions at, above, and below the altered reach.	N.P.P.M.	❒ ×
B. Compile Existing Information	Watershed or	
▪ Land use and management	Conservation Plan,	❒ ×
▪ Vegetation--upland and riparian	and F.O.T.G.	❒ ×
▪ Water quality data		❒ ×
▪ Geology and soils		❒ ×
▪ Fisheries		❒ ×
▪ Ice Impacts		❒ ×
▪ Historic and existing flows		❒ ×
▪ Aerial Photography (current and historic)		❒ ×
▪ Stream and riparian assessments/inventories.		❒ ×
C. Re-evaluation of the Problem(s)		
▪ Can we define the actual problem given the information compiled on (B)?	1	❒ ×
▪ **Would management changes or management facilitating practices suffice to correct the problem? If so, proceed to Step #3. If not, develop a Plan of Work for project showing persons responsible, tasks, and completion dates with signatures of commitment by responsible staff and proceed to Step #2.**	12	❒ ×
STEP 2 Collect Stream Corridor Characteristics		
▪ Collect necessary information not existing in Step 1 (B).	12	❒ ×
▪ After becoming thoroughly familiar with the altered reach, locate a stable reference reach (or reaches) that has like geomorphic characteristics. Collect the following information on both the altered reach and the reference reach (or reaches).		❒ ×

	References	✓
A. Longitudinal Profile	2(1), 3, 8	
▪ Profile the water surface		❒ ×
▪ Profile the thalweg of the channel. Survey two meander wave lengths, differentiating between pools, riffles, and glides/runs in the survey notes.		❒
Longitudinal profiles will give:		
1) Water surface slope 2) Riffle, pool, and glide slopes 3) Vertical stability (agrading or degrading channel).	8, 9, 10	
B. Cross Sections		
▪ Cross sections for stream classification purposes will be surveyed at a cross-over section. Additional cross sections may be needed on other significant channel features (pool, glide, etc.).	2(1), 3, 8	❒ ×
Cross sections will provide:		
1) Bankfull depth (mean and maximum) and width 2) Bankfull area 3) Width/depth ratio (bankfull) 4) Floodprone width 5) Entrenchment ratio.		
C. Other Design Parameters		
▪ Drainage area above the altered reach		❒ ×
▪ Bankfull discharge	4, 8, 9	❒
▪ Sinuosity	8, 9	❒ ×
▪ Valley slope		❒ ×
▪ Channel bed materials (D50)		
▪ Bank materials		❒ ×
▪ Radius of curvature		❒ ×
▪ Belt width		
▪ Meander length (channel wavelength)		❒ ×
▪ Assess ground water and/or overland flows entering the channel		❒ ×
▪ Sediment transport, delivery and sources		❒
▪ Sheer stress (near-bank and channel)		❒
▪ Stream hydraulics for applicable flow events.	2(3), 4, 5, 6	❒ ×
D. Topographic Survey		❒
The need for and the level of detail is determined by the complexity of the reach to be treated.	2(1), 3	

	References	✓
E. Riparian Vegetation		
▪ Plant community composition and condition	7, 11	❒ ×
▪ Key species for stabilization		❒ ×
▪ Sources of local plant materials.		❒
F. Stream Classification		
▪ Channel evolution.	8, 9	❒ ×
▪ Determine channel classification (Rosgen) from cross sections and bed material analysis.	8, 9, 10	
G. Re-evaluation of the Perceived Problem		
▪ With the additional information collected, are the perceived problems identified in Step #1 still valid?	Step 2 A through F	❒ ×
STEP 3. Alternatives		
A. Develop Alternatives		
▪ Develop conceptual plans for **management**, management and facilitating practices or management and accelerating practices (structural, vegetative, and or fish habitat improvements) that address the problems.	1, 2(16, 18), 8	❒ ×
▪ Review alternatives with the affected landowner(s) and if applicable, the watershed steering committee. Additional information may be necessary before the selected alternative is installed.		❒ ×
STEP 4. Plans and Specifications		
A. Develop Final Plans and Specifications		
▪ Obtain additional information necessary for final design. Consider the need for additional planning, survey, preliminary design, final design, and content of engineering drawings.	Step 2 A through F and 3	❒ ×
▪ Develop final drawings and specifications for selected alternative.	2, (MT.SUPP) (Ch.5 & 50)	❒ ×
▪ Develop vegetative plan and specifications.	1,7,11	❒ ×
B. Management and Operation and Maintenance		
▪ Develop Operation and Maintenance (O&M) Plan for selected alternative.	2, (MT.SUPP) (CH.52,pg.18)	❒ ×
▪ Develop Management Plan for selected alternative.	1,11	❒ ×

× This activity or documentation is usually required on each job.

REFERENCE LIST

1. USDA, NRCS (SCS), Field Office Technical Guide, Sections III and IV.

2. USDA, NRCS (SCS), National Engineering Handbook, Part 650 (Field Office Handbooks), Chapters 16 (see pages 85-88 for additional definitions) and 18; Engineering Field Manual, 1984, Chapters 1and 3; and the Montana Supplement to the Engineering Field Manual (MT.SUPP.), 1993.

3. USDA, NRCS (SCS), Technical Release 62, Engineering Layout, Staking and Calculations, 1979.

4. USDA, NRCS (SCS), National Engineering Manual, Part 530, Hydrology, Montana Hydrologic Procedures and Criteria, AmendMT34, Pages MT530-5(1) to (6), October 1996.

5. USDA, NRCS (SCS), National Engineering Handbook, Part 630 (Technology), Chapter 31, Computer Program for Water Surface Profiles (WSP2), 1993.

6. USDA, NRCS (SCS), National Engineering Handbook, Section 5, Hydraulics, 1956.

7. USDA, NRCS (SCS), Field Office Technical Guide, Section II-E-8, Ecological Site Descriptions.

8. Rosgen, D. L., Applied River Morphology, 1996.

9. Rosgen, D. L., A Classification of Natural Rivers, Catena 22, 1994, Pages 169-199.

10. Schumm, S. A., Harvey, M.D., and Watson, C. C., Incised Channels: Morphology, Dynamics and Control, Resources Publications, 1984.

11. Hansen, P. L., Pfister, R. D., Boggs, K., Cook, B. J., Joy, J., and Hinckley, D. K., Classification and Management of Montana's Riparian and Wetland Sites, Montana Forest and Conservation Experiment Station School of Forestry, The University of Montana, May, 1995, Misc. Pub. No. 54.

12. Assessments:

    A. Assessing Health of A Riparian Site, Riparian and Wetland Research Program, School of Forestry, The University of Montana, Missoula.

    B. USDI-BLM, Process for Assessing Proper Functioning Condition; Riparian Area Management. TR 1737-9, 1993.

DEFINITIONS (See Item 2. in above REFERENCE LIST)

Altered reach--A length of stream impacted by natural or man induced activity.

Bankfull depth--The maximum depth at a section measured at bankfull discharge.

Bankfull discharge--In natural streams, it is the discharge that fills the channel without overflowing onto the flood plain and determines the stream's geomorphic planform dimensions. Bankfull discharge of natural streams tends to have a recurrence interval of one to two years based on the annual flood series.

Bankfull stage--The elevation of the water surface associated with the bankfull discharge.

Bankfull width--The stream width at bankfull discharge.

Belt width--The width of the full lateral extent of the bankfull channel measured perpendicular to the fall of the valley.

Bendway Weir--A flat or nearly flat low level rock sill projecting upstream 10^{o} to 30^{o} from a line perpendicular to the bank at the junction of the sill to the bank (i.e., 60^{o} to 80^{o} out from the bank extending upstream) for the purpose of redirecting stream flows. The sill length should not exceed one-third the mean channel width.

DEFINITIONS--CONTINUED

Crossover (or Inflection Point)--The point of change in curvature in the stream flow meander where the thalweg moves from one side of the stream to the other.

Cross Vane--An in-stream structure constructed across a stream which provides grade control and elevates upstream water surfaces while reducing near bank stress. The structure is trapezoidal in plan view with the narrow cross-stream member upstream of the base.

Entrenchment--The vertical containment of a channel and the degree to which it is incised in the valley floor.

Entrenchment ratio--The ratio of the width of the flood-prone area to the bankfull surface of the channel.

Flood prone width--The width measured at an elevation which is determined at twice the maximum bankfull depth.

Geomorphology--The study of the characteristics, origin, and development of land forms.

Glide--A wide uniform channel bottom with low to moderate velocities, lacking pronounced turbulence.

Mean radius of curvature--The radius of a partial circular arc which approximates the center line of a stream meander curve.

Meander wave length--The straight line interval length of one complete sinusoidal cycle of stream bends.

Pebble count--A method of field classification of channel materials to determine the frequency distribution of particle sizes. Data is plotted as cumulative % and % of total distribution. (Example: D50 (median size) a size that 50% of the particles are the same size or finer.)

Pool--A deeper reach of slower velocity, lower gradient water.

Reference reach--A stable length of stream near the altered reach, or a stable reach on a nearby stream which has geomorphic characteristics like those of the altered reach with respect to area, depth, slope and discharge hydrology.

Riffle--A swiftly flowing reach of turbulent water with exposed substrate.

Run--A swiftly flowing reach with little surface agitation and no major flow obstructions.

Sinuosity--The ratio of stream length to valley length. Can also be described as the ratio of valley slope to channel slope.

Slope--The difference in water surface elevation per unit stream length for at least 20 channel widths (or 2 meander wavelengths).

Stream Barbs--are low rock sills projecting out from a streambank and across the stream's thalweg existing near the bank, to redirect streamflow away from an eroding bank. The acute angle between the barb and the upstream bank typically ranges from 50 to 80 degrees.

Substrate--The mineral and/or organic material that forms the bed of the stream.

Vane (Rock and/or Log)--Structure projecting upstream from the bank at a 20^{o} to 30^{o} angle, to the upstream bank designed to breakup the secondary circulation cells near the bank.

Vortex Rock Weir--A rock structure constructed across the stream, arch-shaped in plan view pointed upstream with the rock spaced to allow the bed load to pass, providing grade control and fish habitat.

W-Weir--A rock structure constructed across the stream in place of cross vanes and vortex rock weirs when the bankfull width is greater then approximately 50 feet.

Width/depth ratio--The dimensions and shape factor as the ratio of bankfull channel width to bankfull mean depth.