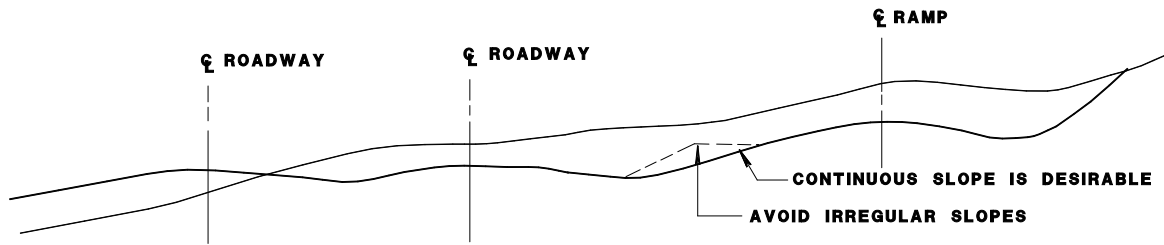
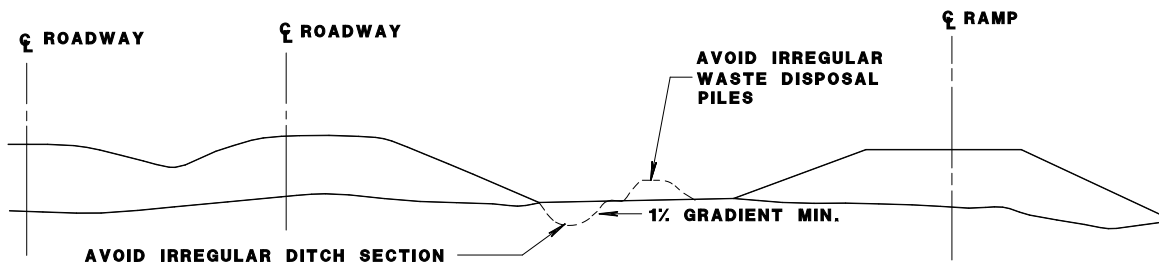


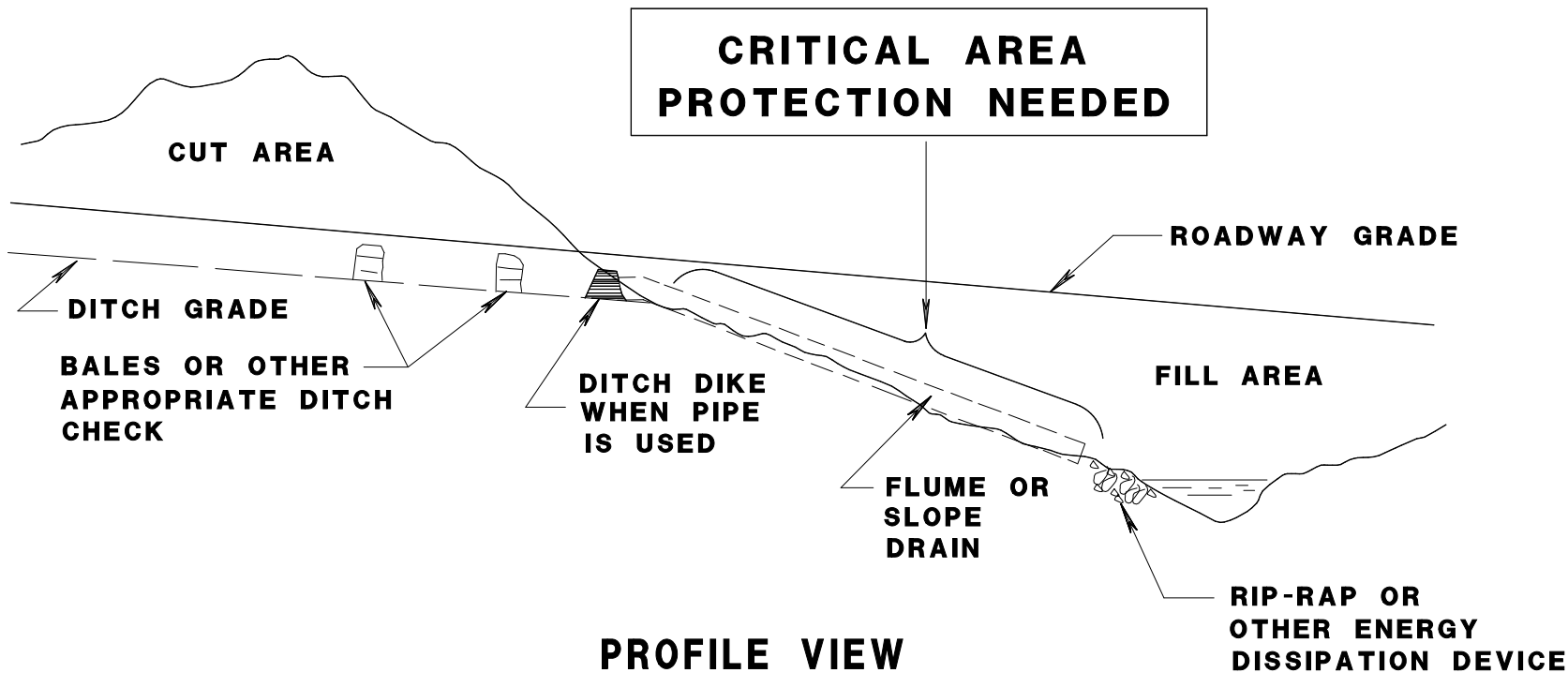
TYPICAL SECTION - ROUNDING FOR EROSION CONTROL



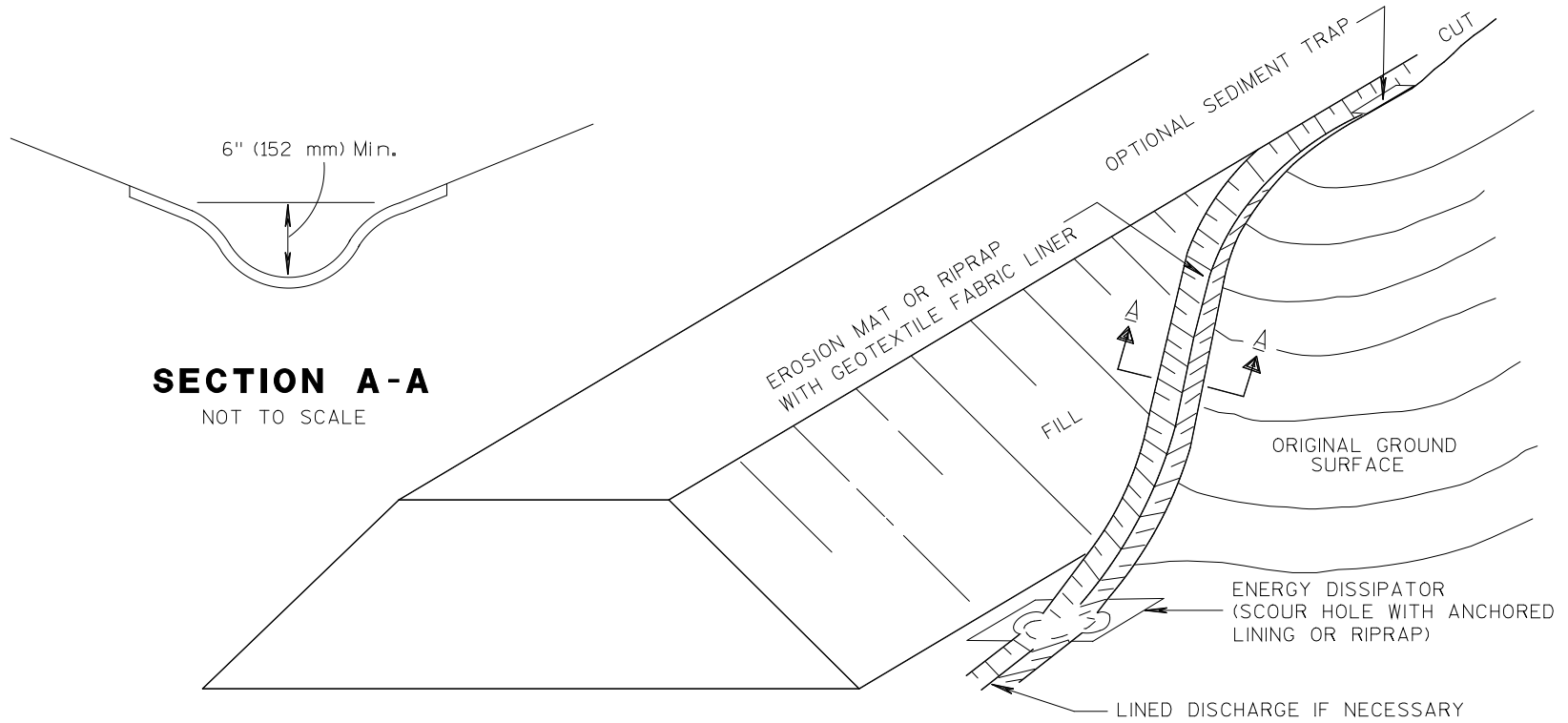
INTERCHANGE CUT



INTERCHANGE FILL



EROSION CONTROL AT CUT-TO-FILL TRANSITION



TRANSITION FROM CUT TO FILL

CHANNEL EROSION CONTROL MATRIX (Concentrated Flow Application)

TYPE OF EROSION CONTROL DEVICE	PERMISSIBLE SHEAR LB/FT.F.	DITCH GRADE															REMARKS
		< 2%			2% - 4%			4% - 6%			6% - 9%*			9% - 12%*			
		Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			
		300	600	1200	300	600	1200	300	600	1200	300	600	1200	300	600	1200	
Seed with properly anchored mulch	0.6	█	█														Anchor mulch per specifications.
Sod ditch checks with seed and mulch	N/A	█	█	█	█	C										Install one ditch check for every 1 foot of drop. Sod stakes required.	
Temporary ditch checks (hay bales or approved manufactured alternatives listed in the WisDOT PAL)	N/A	█	█	█	█	█										Install one ditch check for every 2 feet of drop. Maximum 200' spacing. Not recommended for slopes less than 1%.	
Sod ditch liner	1.0	█	█	█													Upstream end must be buried. Additional sod stakes required.
Double netted light duty (WisDOT Class I Type B) erosion mat	1.5	█	█	█	█	█										Only mat type products allowed.	
Sod reinforced with a double netted jute (WisDOT Class II Type A) erosion mat	1.5	█	█	█	█	█										Upstream end must be buried. Additional sod stakes required. Two bid items needed.	
Stone or rock ditch checks, or Rock-Filled Filter Bags	N/A	█	█	█	█	█	█	█	█	█	█	█				Use No. 2 coarse aggregate, railroad ballast, or breaker run. Install one ditch check for every 2 feet of drop. Use in conjunction with a channel lining.	
Medium duty coconut erosion mat (WisDOT Class II Type B or C)	2.0	█	█	█	█	█				⊗							
Heavy duty synthetic (WisDOT Class III Type A) erosion mat or turf reinforcement mat (WisDOT Class III Type B)	2.0	█	█	█	█	█	█	█	█	█	█	█				Germination may be a problem with Class III Type A mats. An ECRM is required for initial erosion protection for Class III Type B mats.	
Heavy duty synthetic turf reinforcement (WisDOT Class III Type C) mat	3.5	█	█	█	█	█	█	█	█	█	█	█	█	█		An ECRM is required for initial erosion protection. Contact manufacturer if higher shears are needed.	
Riprap ditch checks	N/A	█	█	█	█	█	█	█	█	█	█	█	█	█		Place top of downstream ditch check level with bottom of upstream ditch check. Use in conjunction with a channel lining.	
Heavy duty synthetic turf reinforcement (Class III Type D) mat	5	█	█	█	█	█										An ECRM is required for initial erosion protection. Contact manufacturer if higher shears are needed.	
Light riprap	4	█	█	█	█	█	█	█	█	█	█	█	█	█		Outfalling, overtopping and scour need to be addressed. Use 2' minimum ditch depth.	
Medium riprap	5	█	█	█	█	█	█	█	█	█	█	█	█	█			
Heavy riprap	8	█	█	█	█	█	█	█	█	█	█	█	█	█			

Riprap measures apply to all ditch types. Use of these measure requires engineering judgement and design.




CHANNEL EROSION CONTROL MATRIX (cont.) (Concentrated Flow Application)

TYPE OF EROSION CONTROL DEVICE	PERMISSIBLE SHEAR STRESS (lb./sq. ft.)	DITCH GRADE															REMARKS	
		< 2%			2% - 4%			4% - 6%			6% - 9%*			9% - 12%*				
		Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)				
		300	600	1200	300	600	1200	300	600	1200	300	600	1200	300	600	1200		
Grouted rip rap	N/A	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Address outfalling, overtopping and scour. Line with Grotex fabric Type "HR", (see Chap. 10, Const. Detail and special provision). Use 2' minimum ditch depth.
Articulated Concrete Block Type A	5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ACBs apply to all ditch types. Use of these measures requires engineering judgement and design.	
Articulated Concrete Block Type B	10	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Articulated Concrete Block Type C	15	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Articulated Concrete Block Type D	20	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Articulated Concrete Block Type E	30	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Standard Ditch Section		<p>Erosion control for ditches not conforming to the typical at right, that complies with FDM procedures 11-15-1 Figures 6 & 7, should be designed according to FDM Chapter 13.</p>																
<p>KEY</p> <p>Effective range of device for Sandy or Clayey Soil: </p> <p>Device applicable, may not be cost effective: </p> <p>"C" effective for clayey soil only</p> <p>Not applicable. Use in conjunction with other BMPs: </p> <p>ECRM - Erosion control revegetation mat. All Class I and II mats are ECRMs. TRM - Turf reinforcement mat. FDM - Wisconsin DOT Facilities Development Manual BMP - Best Management Practice PAL - See Note 6</p> <p>* For ditch grades over 9% special design considerations may be required. ** Soils that are not sandy should be treated as clay soils.</p>		<p>NOTES</p> <p>1) Ditch flow rates used to develop bar chart are based on a 60 ft. right of way from pavement centerline and a 2-Yr. rainfall event for temporary liners or a 25-Yr. rainfall event for permanent (Class III mat or riprap) liners. If the drainage area extends outside the 60 foot right of way or unusual flows are expected, use the shear stress column values to determine the suitability of a liner. See FDM procedures in Chapter 10 and in Section 13-30-10.</p> <p>2) Erosion mats shall extend upslope 1.0 ft. min. vertically from the ditch bottom or 8' higher than the design flow depth. There shall be no joints within 18' of the low point.</p> <p>3) Cost shall be a consideration in the selection of these devices.</p> <p>4) Add sediment traps at the bottom of channel slopes.</p> <p>5) Refer to FDM Chapter 10 for any channels exceeding the limits shown.</p> <p>6) Approved materials for erosion products are referenced from the Wisconsin Department of Transportation Erosion Control Product Acceptability Lists (PAL), found at https://wisconsin.gov/Pages/doing-business/eng-consultants/cnsit-rsces/tools/pal/default.aspx</p> <p>7) On long or steep channels that require a higher class mat, use the appropriate lower class mat for the first 300 ft to 600 ft of the channel.</p> <p>8) Effective erosion control involves minimizing the amount of time soil is exposed and the selection of a combination of practices, and not reliance on just one practice.</p>																

SLOPE EROSION CONTROL MATRIX

TYPE OF EROSION CONTROL	SLOPE																		REMARKS			
	6:1 or flatter (7)						4:1			3:1			2.5:1			2:1				1:1		
	SLOPE LENGTH			SLOPE LENGTH			SLOPE LENGTH			SLOPE LENGTH			SLOPE LENGTH			SLOPE LENGTH						
	0-30'	30-60'	60-120'	0-30'	30-60'	60-120'	0-30'	30-60'	60-120'	0-30'	30-60'	60-120'	0-30'	30-60'	60-120'	0-30'	30-60'	60-120'				
Seed with properly anchored mulch																						
Single netted light duty (WisDOT Class I Type A) erosion mat	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Light duty single netted 100% biodegradable (WisDOT Urban Type A) erosion mat	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Use only 100% biodegradable anchors for urban mats.		
Light duty double netted 100% biodegradable (WisDOT Urban Type B) erosion mat	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Use only 100% biodegradable anchors for urban mats.		
Bonded Mulch (WisDOT Type A Soil Stabilizer)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	May be applied over Class III Type B, C, or D mats in place of erosion control revegetation mats.		
Polymer (WisDOT Type B Soil Stabilizer)	Used in conjunction with other BMPs effective up to a 2:1 slope. Not effective in sand. When used alone effective up to a 3:1 slope. Stand alone use appropriate for earthen stock piles, temporary, and late season applications																					
Double netted light duty (WisDOT Class I Type B) erosion mat	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	⊗		
Sod	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	⊗		
Medium duty coconut erosion mat (WisDOT Class II Type B or C)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Sod reinforced with a double netted jute (WisDOT Class II Type A) erosion mat	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	⊗		
Heavy duty synthetic erosion control revegetation mat (WisDOT Class III Type A)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Germination may be a problem with Class III Type A mats		
Riprap	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Angle of repose must be considered, see FDM Chapter 13.		
Heavy duty synthetic turf reinforcement (WisDOT Class III Type B or C) mat	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	A soil stabilizer or ECRM will be required for initial erosion protection.		
Heavy duty synthetic turf reinforcement (WisDOT Class III Type D) mat	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	A soil stabilizer or ECRM will be required for initial erosion protection.		
Slope paving or grouted riprap	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Consider clear zone requirements. Only use in limited circumstances such as overflow areas near bridges.		

SLOPE EROSION CONTROL MATRIX (cont.)

Benches	Consider benches when cuts exceed 20', bench at approximately 15' vertical intervals to collect and drain water. Treat benches as channels (ditches). Adjust elevations to provide drainage. Consider flumes at transitions.
Intercepting embankments	Used to intercept runoff from abutting lands. Flumes may be necessary to direct runoff.
Silt fence	Used at toe of slopes to intercept and detain small amounts of sediment
Temporary ditch checks or Erosion bales	Used at toe of slopes to intercept and detain small amounts of sediment
Slope drains/flumes	May be necessary on slopes (see channel matrix for design guidance).
Sediment traps	Used to trap sediment laden runoff. Could be used at the inlet or outlet end of slope drain.
<p>KEY:</p> <p>Not applicable. Use in conjunction with other BMPs: </p> <p>Effective range of device for Sandy or Clayey Soil: Device applicable, may not be cost effective:  </p> <p>* Soils that are not sandy should be treated as clay soils.</p> <p>ECRM - Erosion control revegetation mat. All Class I and II mats are ECRMs. TRM - Turf reinforcement mat. FDM - WisDOT Facilities Development Manual PAL - See Note 5</p> <p>NOTES</p> <ol style="list-style-type: none"> 1) Cost shall be a consideration in the selection of these devices. 2) Designers should review FDM Chapter 10 prior to selection of erosion mats. 3) Install intercepting ditches to limit slope lengths to 15' vertical intervals. (See FDM Chapter 10) 4) Refer to FDM Chapter 10 for any slopes exceeding the limits shown. 5) Approved materials for erosion products are referenced from the Wisconsin Department of Transportation Erosion Control Product Acceptability List (PAL), found at the https://wisconsindot.gov/Pages/doing-business/consultants/cnslt-rsrcs/tools/pal/default.aspx 6) On steeper slopes that require a higher class mat, use the appropriate lower class mat or seed and mulch for the first 30 ft to 60 ft of the slope. 7) Unless project conditions require otherwise, seed and mulch all slopes that are flatter than a 5% grade, regardless of length. If practicable, bench the slopes. 8) Effective erosion control involves minimizing the amount of time soil is exposed and the selection of a combination of practices, and not reliance on just one practice. 	

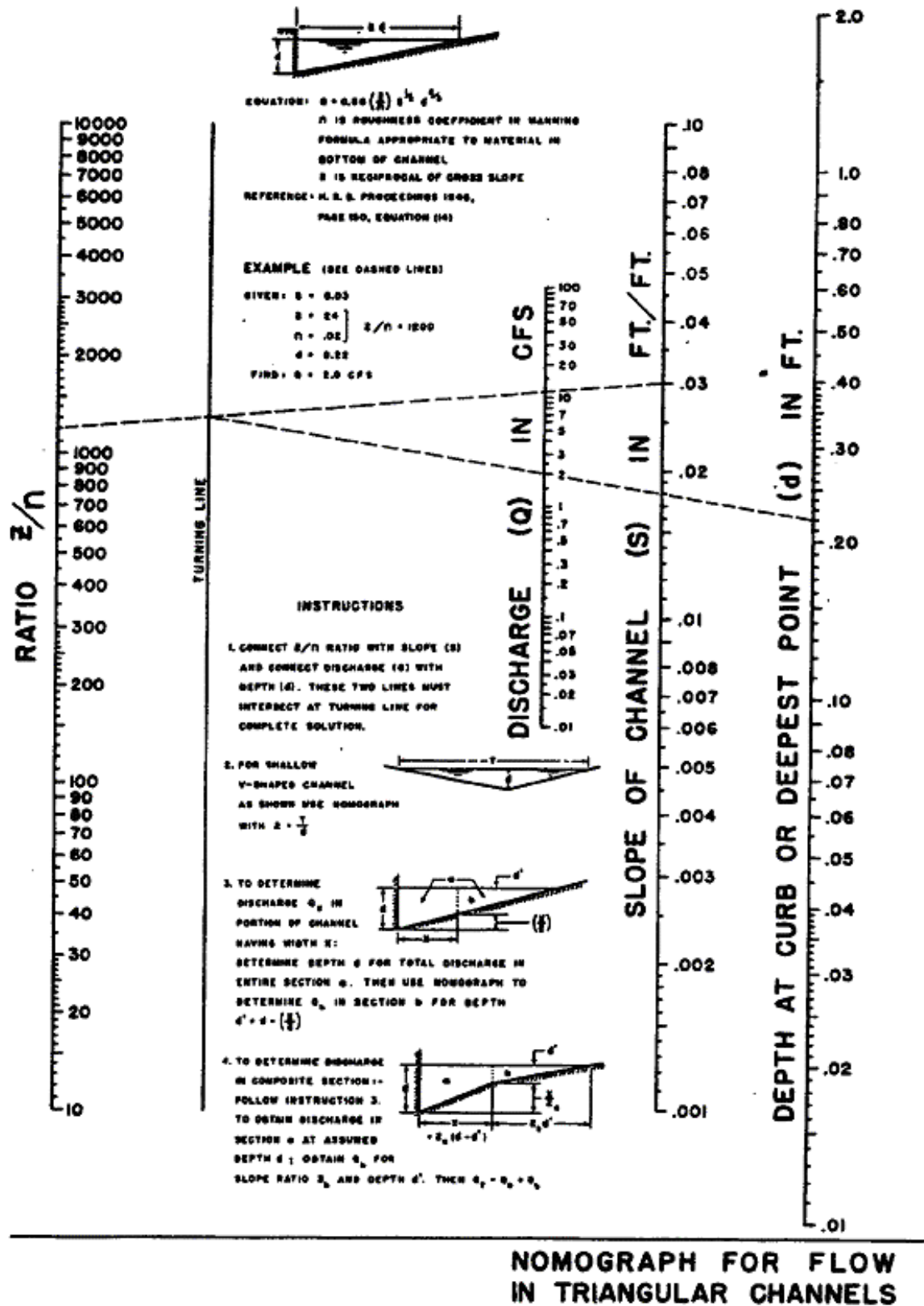
Manning's Roughness Coefficients Table

		n - value		
		Depth Ranges		
Lining Category	Lining Type	0 - 0.5 ft (0 - 150mm)	0.5 - 2.0 ft (150-600mm)	> 2.0 ft (> 600mm)
Rigid	Concrete	0.015	0.013	0.013
	Grouted Riprap	0.040	0.030	0.028
	Stone Masonry	0.042	0.032	0.030
	Soil Cement	0.025	0.022	0.020
	Asphalt	0.018	0.016	0.016
Unlined	Bare soil	0.023	0.020	0.020
	Rock Cut	0.045	0.035	0.025
Temporary*	Jute Net	0.028	0.022	0.019
	Straw with Net	0.065	0.033	0.025
	Curled Wood Mat	0.066	0.035	0.028
	Synthetic Mat	0.036	0.025	0.021
Gravel Riprap	1-inch (25mm)D ₅₀	0.044	0.033	0.030
	2-inch (50mm)D ₅₀	0.066	0.041	0.034
Rock Riprap	6-inch (150mm)D ₅₀	0.104	0.069	0.035
	12-inch (300mm)D ₅₀	--	0.078	0.040

Note: Values listed are representative values for the respective depth ranges. Manning's roughness coefficients, n, vary with the flow depth.

* Some temporary linings become permanent when buried.

(FHWA Hydraulic Engineering Circular No: 15).



Source: FHWA Hydraulic Design Series No. 3

Erosion Control Plan Checklist

I. CONTRACT PROPOSAL

- _____ A. Provide a description of the project.
(Contract Proposal cover sheet and General special provision)
- _____ B. Explain the nature of the construction activity.
(Contract Proposal cover sheet and Scope of Work special provision)
- _____ C. Include any special erosion control requirements, such as scheduling or staging of construction that must be relayed to the contractor. See the Environmental Protection and/or Erosion Control special provisions in [FDM 19-15-55](#) and [FDM 19-15-60](#) respectively.
- _____ D. Describe the sensitive areas on or near the project and any special considerations for those areas.
(Environmental Protection special provision)
- _____ E. Include any limitations to the amount of erodible surface area which may be exposed at any one time.
(Erosion Control special provision)
- _____ F. Describe the interim and permanent stabilization practices to be used on the site. Include over-winter and maintenance measures.
(Erosion Control special provision)
- _____ G. Describe the structural practices to be used on the site such as those used to divert flow away from exposed soils, store flows, or limit runoff and the discharge of pollutants. Unless otherwise specifically approved in writing by the DNR, structural measures are to be installed on upland sites.
(Erosion Control special provision)

II. STANDARD BID ITEMS

- _____ A. The following standard bid items should be included, as a minimum, on all grading projects, unless otherwise justified:

Item 627.0200 or 627.0205 - Mulching

Item 628.1140 - Erosion Bales

Item 628.1504 - Silt Fence

Item 628.1520 - Silt Fence, Maintenance

Item 628.1905 - Mobilizations, Erosion Control

Item 628.1910 - Mobilizations, Emergency Erosion Control

Item 628.2004 - Erosion Mat, Class I, Type B *

Item 629.0205 or 629.0210 - Fertilizer, Type A or B, respectively (depends on the project)

- * Other types of erosion mat may be substituted when appropriate.

III. TITLE SHEET

____ A. Indicate the quarter, quarter-quarter, section, township, range and the county in which the project is located, unless otherwise shown on the right-of-way plat or erosion control plan sheet(s).

____ B. List the location of the erosion control plan sheets on the "Order of Sheets".

Example 1: When erosion control plans are on a separate plan sheet:

ORDER OF SHEETS

Section No. 2 Typical Sections and Details
(includes erosion control plans)

Example 2: When erosion control plans are included in the Plan and Profile Sheets:

ORDER OF SHEETS

Section No. 5 Plan and Profile
(includes erosion control plans)

IV. GENERAL NOTE SHEET

____ A. Include in the Standard Detail List all pertinent erosion control standard detail drawings.

____ B. List the name, address, and phone number of the district DNR area liaison. DNR liaison staff:
<http://dnr.wi.gov/topic/sectors/transportation.html>.

V. CONSTRUCTION DETAIL SHEETS

____ A. Include all non-standard erosion control construction detail drawings.

VI. EROSION CONTROL PLAN SHEETS

____ A. Illustrate the location of all erosion and sediment control devices. Separate plan sheets are recommended in order to:

1. Avoid cluttering the plan and profile sheets.
2. Make it easier for the contractor or subcontractor to understand and implement the plan. The use of separate plan sheets is especially important for complex projects or when grading is to be done near sensitive areas. For less complex projects, it may be appropriate to illustrate the location of the devices on the plan and profile sheets.

In some cases (such as for very small, less complex projects) it may be appropriate to show only those less pertinent devices by station and location on the miscellaneous quantity sheets. Again, the object being to not clutter the plan. When this alternative is chosen, a general note indicating which erosion control devices are located on the miscellaneous quantity sheets should be noted on the plan.

____ B. Include a north arrow on all plan drawings.

____ C. Indicate right-of-way, easements, slope intercepts and construction limits.

____ D. Include velocity dissipation devices at discharge locations and along the length of any outfall channel, as necessary, to provide a non-erosive flow from the structure to a water course.

____ E. Include a legend on each erosion control plan sheet identifying the erosion control symbols or other symbols used. However, when the erosion control measures are shown on the plan and profile sheets, then the erosion control symbols should be included with the legend on the Title Sheet.

____ F. Show topographic features such as buildings, roads, tree lines and driveways.

____ G. Show the abutting boundaries of and label all environmentally sensitive areas such as lakes, streams and wetlands.

____ H. Include the name of the immediate receiving water from the United States geological service 7.5 minute series, topographic maps or another appropriate source. If desired, this information can be placed on the Project Overview Sheet instead.

____ I. Show existing and proposed drainage patterns. This may be indicated by the use of drainage arrows, contour mapping or spot elevations on topographic mapping. It is particularly important that existing drainage be indicated where overland flows enter or leave the highway right-of-way.

____ J. Show drainage devices such as storm sewer inlets, culverts, bridges and detention ponds.

- _____ K. Identify the locations where storm water is discharged to a surface water or wetland.
- _____ L. Include the runoff coefficient of the site before and after construction. To satisfy this requirement, [FDM 10-5 Attachment 60.2](#) of this procedure should be included as a detail on the erosion control plan sheet. This figure can be accessed via CADDs for plan preparation purposes. See [FDM 10-15 Attachment 5.1](#).
- _____ M. Estimate the total area of the project and the total area expected to be disturbed by construction activities. The total area of the project is typically the area bounded by the project and right-of-way limits. The total area expected to be disturbed is typically the area where bare soil is exposed. On the bottom of the CADDs detail, discussed in Item VI (L) above, space has been allocated for listing the total area and total disturbed area of the project. As an alternative, however, designers could include this information as a general note on the erosion control plan sheet.

VII. MISCELLANEOUS QUANTITY SHEETS

- _____ A. List the location and estimate the quantities needed for the erosion control measures identified in the plan. See Section II for items that should be specified on all grading projects. When using these items, up to an additional 25% of the total estimated quantity should be included as "Undistributed" (does not apply to mobilization items).

VIII. CROSS SECTION SHEETS

- _____ A. Show all existing and proposed drainage features such as channel and slope sections, intercepting embankments, culvert pipes and other drainage structures, as well as, slope intercepts, right-of-way and easement lines.

IX. SOILS REPORT

- _____ A. Include existing data describing the surface soil as well as the subsoils.
- _____ B. Include depth to groundwater, as indicated by soil conservation service soil information, where available. When permanent infiltration systems are used the depth to groundwater shall be identified as outlined in items C and/or D below. Contact the DNR liaison to help determine locations where this information is needed. *
- _____ C. When permanent infiltration systems are used, appropriate on-site testing shall be conducted to determine if seasonal high water (groundwater) is within 5 feet of the bottom of the proposed infiltration system. *

* Items IX B, C and D can be supplied as a separate document.

- _____ D. If permanent infiltration structures are to be used and there is a municipal well within 400 feet or a non-public well within 100 feet, the groundwater flow must be identified in accordance with the provisions specified in either ch. NR 110 or 214 (DNR Administrative Code). *

* Items IX B, C and D can be supplied as a separate document.

RUNOFF COEFFICIENT TABLE

	Hydrologic Soil Group											
	A			B			C			D		
	Slope Range (Percent)			Slope Range (Percent)			Slope Range (Percent)			Slope Range (Percent)		
Land Use:	0 - 2	2 - 6	6 & Over	0 - 2	2 - 6	6 & Over	0 - 2	2 - 6	6 & Over	0 - 2	2 - 6	6 & Over
Row Crops	.08	.16	.22	.12	.20	.27	.15	.24	.33	.19	.28	.38
Median Strip Turf	.22	.30	.38	.26	.34	.44	.30	.37	.50	.34	.41	.56
Side Slope Turf	.19	.20	.24	.19	.22	.26	.20	.23	.30	.20	.25	.30
	.24	.26	.30	.25	.28	.33	.26	.30	.37	.27	.32	.40
			.25			.27			.28			.30
			.32			.34			.36			.38
Pavement												
Asphalt	.70 - .95											
Concrete	.80 - .95											
Brick	.70 - .80											
Drives, Walks	.75 - .85											
Roofs	.75 - .95											
Gravel Roads, Shoulders	.40 - .60											

Total Project Area = _____ Acres

Total Area Expected To Be Disturbed By Construction Activities = _____ Acres

File Name: de_hwys_std:erosionc.cel

Cell Name: RCCHRT