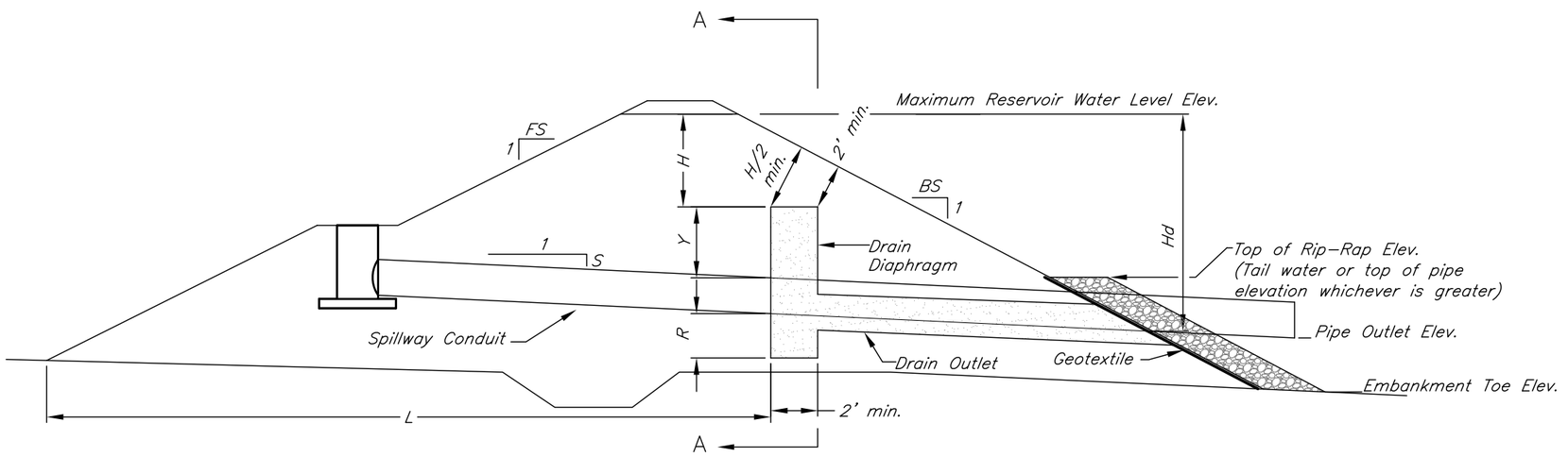
Minnesota Standard Drawing
Revised 8/11/21 – LAH



PROFILE ALONG ℄ OF CONDUIT

SUMMARY OF DESIGN

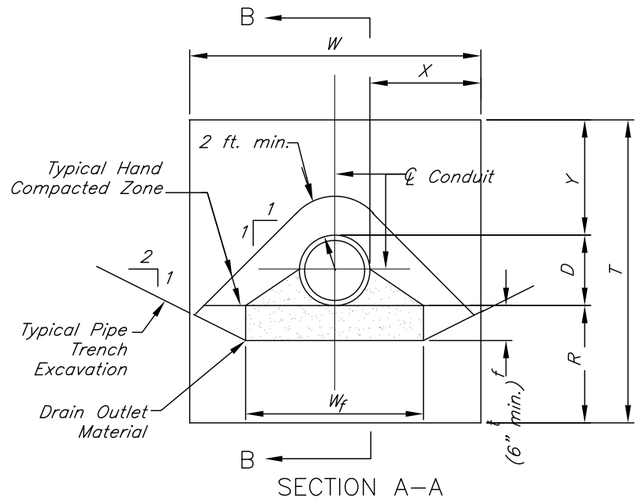
BS = _____ Feet		S = _____ Feet	
D = _____ Feet		t = _____ Feet	
FS = _____ Feet		T = _____ Feet	
H = _____ Feet		W = _____ Feet	
Hd = _____ Feet		X = _____ Feet	
R = _____ Feet		Y = _____ Feet	

Max. Reservoir Water Level Elev. _____
Top of Rip–Rap Elevation _____
Pipe Outlet Elevation _____
Bedrock at Elevation _____

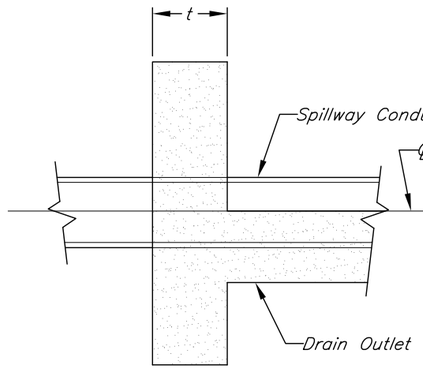
ESTIMATED QUANTITIES

Drain Filter Material _____ Cubic Yards
Geotextile _____ Square Feet
Rip–Rap _____ Cubic Yards

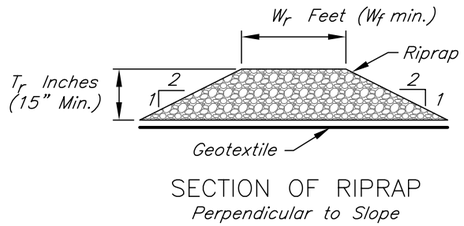
This standard drawing applies to structures designed to meet the requirements of Conservation Practice Standard 378, Pond.



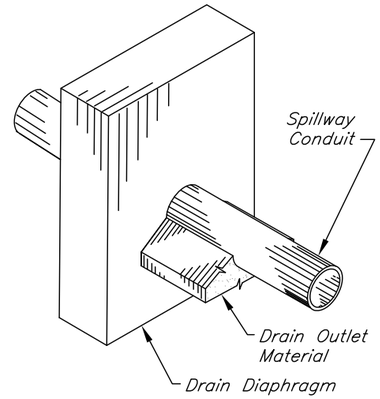
SECTION A–A



SECTION B–B



SECTION OF RIPRAP
Perpendicular to Slope



PARTIAL ISOMETRIC
Showing conduit, drain diaphragm, & drain outlet material

DEFINITIONS:

- A_d = Area of drainage diaphragm, sq.ft.
- A_f = Required area of filter outlet, sq.ft.
- BS = Back slope of dam in feet of fall per horizontal foot
- D = Outside diameter of circular conduit, ft
- FS = Front slope of dam in feet of fall per horizontal foot
- H = Seepage head flow over diaphragm, ft
- Hd = Vertical distance from maximum potential reservoir water level to conduit invert at D.S. face of slope, ft
- i = Hydraulic gradient
- k_e = Permeability of embankment material, ft/day
- k_f = Permeability of filter material, ft/day
- L = Seepage flow path into diaphragm, ft
- Q = Flow rate from drain diaphragm, cfs
- R = Vertical extension downward from the bottom of the diaphragm, ft
- S = Slope of conduit in feet of fall per horizontal foot
- t = Thickness of drain diaphragm, ft
- t_f = Thickness of filter outlet, ft
- T = Total height of drain diaphragm, ft
- T_r = Thickness of riprap, ft
- W = Total width of drain diaphragm, ft
- W_f = Width of filter outlet, 2.5 D minimum, ft
- W_r = Top width of riprap, ft
- X = Distance between the edge of the conduit and the edge of the diaphragm, ft
- Y = Vertical distance from top of conduit to top of diaphragm, ft

DESIGN CALCULATIONS:

- R = 18 inches minimum, but not to extend beyond a bedrock surface
- t = 2 feet minimum.
- T = R + D + Y
- W = 2X + D
- X = 3D or 5 feet beyond any excavation made to install the conduit.
- Y = 3D or no higher than maximum potential reservoir water level
- A = W * T

- i = H / L
- Q = 100 * k_e * i * A_d
- A_f = Q / k_f * i
- W_f = A_f / t_f

QUANTITY CALCULATIONS:

Volume of Drainfill in Drain Diaphragm (cu.yds.)

$$V_{dd} = \frac{1}{27}(W * T * t)$$

Volume of Drain Outlet Material Per Unit Length Along Spillway Conduit (sq.yds./ft.)

$$V_{dc} = \frac{1}{9}\left[W_f t_f + \frac{DW_f}{4} + \frac{D^2(2-\pi)}{8}\right]$$

Volume of Riprap (cu.yds.)

$$V_{rr} = \frac{1}{27}(2T_r^2 + W_r T_r) * (\text{Top of Riprap Elev.} - \text{Bottom of Riprap Elev.})$$

Date .
Designed . Drawn . Checked . Approved .

DRAIN DIAPHRAGM AND OUTLET
Layout for Drop–Inlet & Drain Filter
Instructions

. County, Minnesota

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

Drawing Name
MN–ENG–301A Inst

Eng. Job Class
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Sheet . of .