1845.00 Vollmer Substation
Utility Yard Interior Cutoff Swale Drain Pipe Outfall
Riprap Sizing (pipe that drains into sand filter from yard)
Max Pipe Q=0.5 cfs, 6" PVC pipe

$$H_a = \frac{(H + Y_n)}{2}$$ Equation 9-19

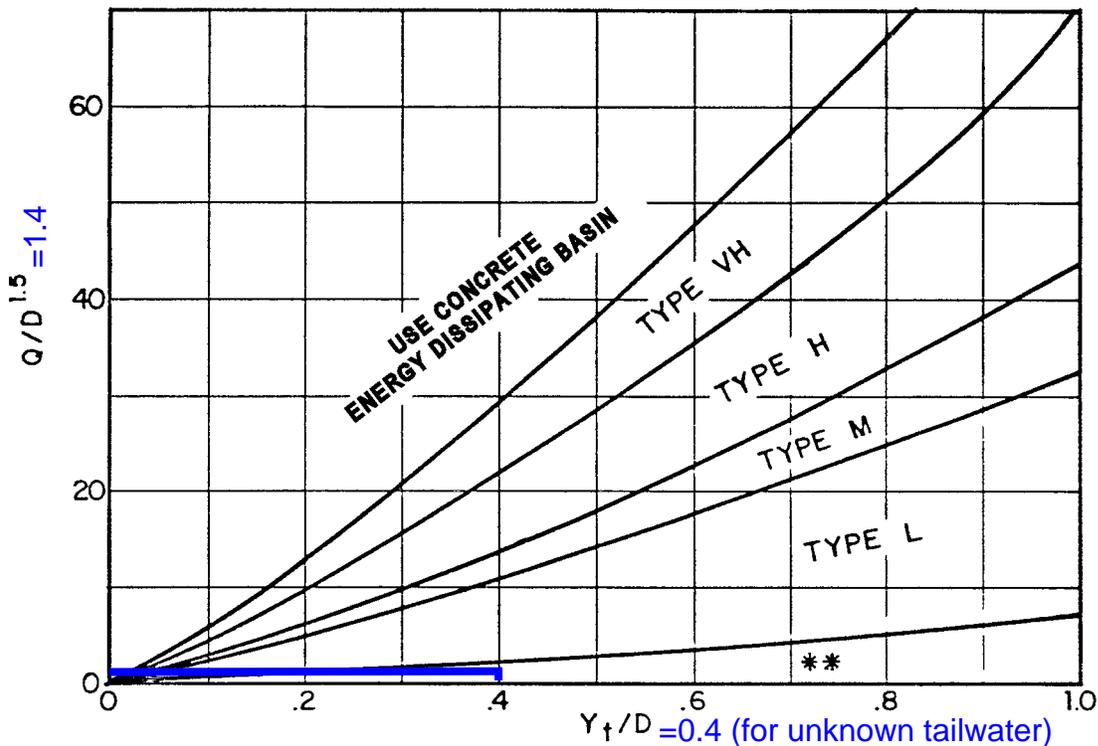Where the maximum value of H_a shall not exceed H, and:

D_a = parameter to use in place of D in Figure 9-38 when flow is supercritical (ft)

D_c = diameter of circular culvert (ft)

H_a = parameter to use in place of H in Figure 9-39 when flow is supercritical (ft)

H = height of rectangular culvert (ft)

Y_n = normal depth of supercritical flow in the culvert (ft)

USE CONCRETE ENERGY DISSIPATING BASIN

TYPE VH

TYPE H

TYPE M

TYPE L

**

$Q/D^{1.5} = 1.4$

$Y_t/D = 0.4$ (for unknown tailwater)

Use D_a instead of D whenever flow is supercritical in the barrel.
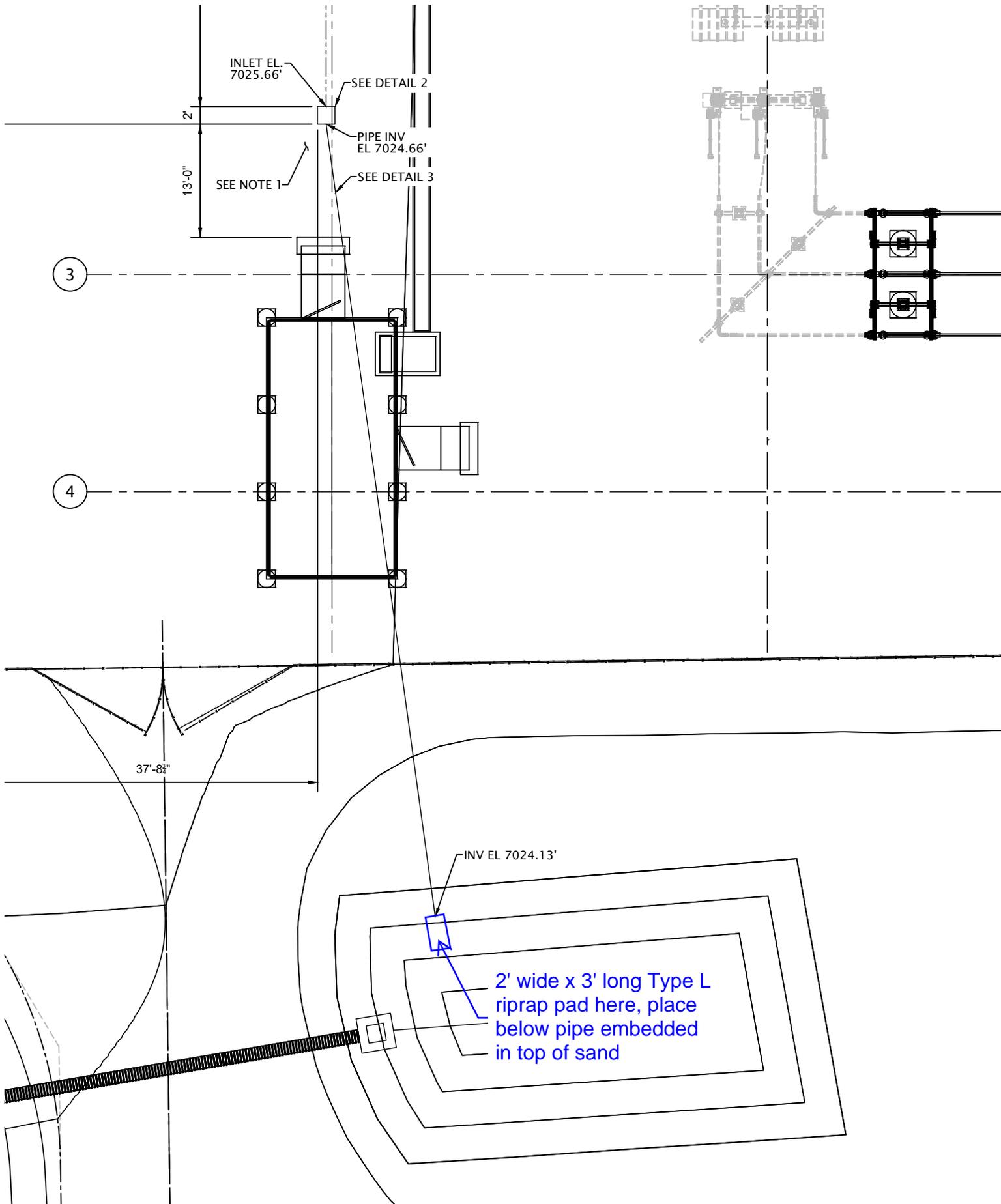** Use Type L for a distance of 3D downstream.

Result: Type L, D50=9" riprap
Note: Pipe outfall invert is 0.13' above top of sand.
Use: Single layer of Type L riprap below pipe, 2' wide x 3' long.

Type VL = 6"
Type L = 9"
Type M = 12"
Type H = 18"
Type VH = 24"

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

INLET EL.
7025.66'

SEE DETAIL 2

2'

PIPE INV
EL 7024.66'

13'-0"

SEE NOTE 1

SEE DETAIL 3

3

4

37'-8¾"

INV EL 7024.13'

2' wide x 3' long Type L
riprap pad here, place
below pipe embedded
in top of sand

MANNING'S EQUATION FOR PIPE FLOW

Project:	Vollmer Substation	Location:	Utility Yard Interior Cutoff Swale Drain Pipe Cap
By: Dane Frank		Date:	5/2/2023
Chk. By:		Date:	mdo version 12.8.00

Clear Data Entry Cells

INPUT

D=	6	inches
d=	5.5	inches
n=	0.012	mannings coeff
θ=	67.1	degrees
S=	0.0058	slope in/in
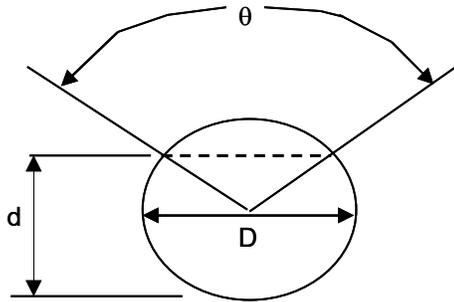
Mannings Formula

$$Q = (1.486/n)AR_h^{2/3}S^{1/2}$$

R=A/P
A=cross sectional area
P=wetted perimeter
S=slope of channel
n=Manning's roughness coefficient

$$V = (1.49/n)R_h^{2/3}S^{1/2}$$
$$Q = V \times A$$

			Solution to Mannings Equation			Manning's n-values	
Area, ft^2	Wetted Perimeter, ft	Hydraulic Radius, ft	velocity ft/s	flow, cfs		PVC	0.01
0.19	1.28	0.15	2.63	0.50		PE (<9"dia)	0.015
						PE (>12"dia)	0.02
						PE(9-12"dia)	0.017
						CMP	0.025
						ADS N12	0.012
Created by: Mike O'Shea						HCMP	0.023
						Conc	0.013