NEW SMALL TOWN SCHOOL
SAMPLE PLAN

TEMPORARY SEDIMENT BASIN
DESIGN DATA SHEETS

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(✓ with or without an emergency spillway)

Project NEW SMALL TOWN SCHOOL

Basin # 1 Location EAST END OF PROJECT

Total area draining to basin: 9.5 acres.

Basin Volume Design

Wet Storage:

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 9.5 acres = 636.5 cu. yds.

2. Available basin volume = 663 cu. yds. at elevation 66. (From storage - elevation curve)

3. Excavate Ø cu. yds. to obtain required volume*. (Use natural contours)

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required. → Actually ½ of our wet storage = 331.5 cy

   33 cu. yds. x 9.5 acres = 313.5 cu. yds.

5. Elevation corresponding to cleanout level = 64.2. (Provides 331.5 cy)

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 1.8 ft. (Min. = 1.0 ft.)

Dry Storage:

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 9.5 acres = 636.5 cu. yds.

8. Total available basin volume at crest of riser* = 646 cu. yds. at elevation 68.5. (From Storage - Elevation Curve)

however, as a result of colloidal clay soils, we utilized 815 cy at elev. 68.5

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = _____ in. ? FIND

10. Diameter of flexible tubing = _____ in. (diameter of dewatering orifice plus 2 inches).

? FIND

Preliminary Design Elevations

11. Crest of Riser = 69.0

Top of Dam = 72.0

Design High Water = 71.0 (to allow 1' FREEBOARD)

Upstream Toe of Dam = 59.0

Basin Shape

12. Length of Flow / Effective Width $\frac{L}{We}$ = 1.6 $\left(\frac{126}{79}\right)$

If > 2, baffles are not required _____

If < 2, baffles are required ✓

(Place ½ way between inflow & outflow)

Runoff

13. Q_2 = 24.3 cfs (From Chapter 5)

14. Q_{25} = 39.5 cfs (From Chapter 5)

Principal Spillway Design

15. ✓With emergency spillway, required spillway capacity $Q_p = Q_2$ = 24.3 cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = N/A cfs. (riser and barrel)

16. ✓With emergency spillway:

Assumed available head (h) = 1 ft. (Using Q_2)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = N/A ft. (Using Q_{25})

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter (D_r) = 33 in. Actual head (h) = 1 ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions. OK ✓

18. Barrel length (l) = 76 ft. (0.04 ft./ft. barrel slope)

Head (H) on barrel through embankment = 11 ft.

(From Plate 3.14-7).

19. Barrel diameter = 18 in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = 54 inches.

Height = 17 inches.

(From Table 3.14-D).

* FIND MIN. DIAM. FOR CORRUGATED METAL BARREL DIAM. = _____ in.

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = 15.2 cfs.

22. Bottom width (b) = 8 ft.; the slope of the exit channel (s) = .03 ft./foot; and the minimum length of the exit channel (x) = 51 ft. (From Table 3.14-C).

(Cut into insitu soil at abutment — not into embankment fill)

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = 10 ft.

Slope of upstream face of embankment (Z) = 2½ :1

Slope of principal spillway barrel (S_b) = 4 %

Length of barrel in saturated zone (L_s) = 76 ft. [entire length]

24. Number of collars required = 4 dimensions = 3.75' x 3.75'

(from Plate 3.14-12).

* FIND # COLLARS & DIMENSIONS FOR 21" CM BARREL: NO. ____ DIMENSIONS ____ x ____

Final Design Elevations

25. Top of Dam = 72.0

Design High Water = 71.0 (ALLOWS 1' FREEBOARD)

Emergency Spillway Crest = 70.0

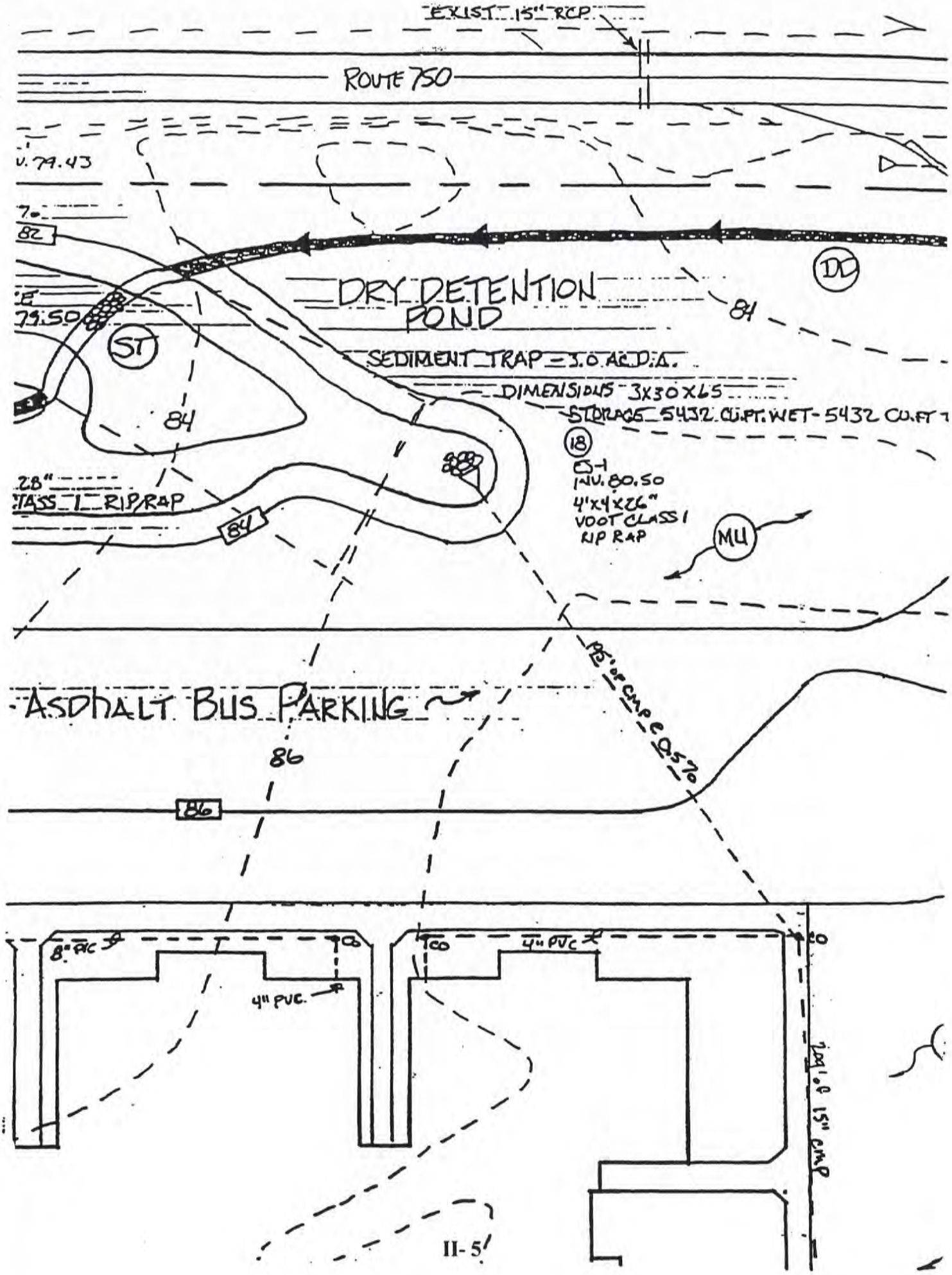
Principal Spillway Crest = 69.0

Dewatering Orifice Invert = 66.0

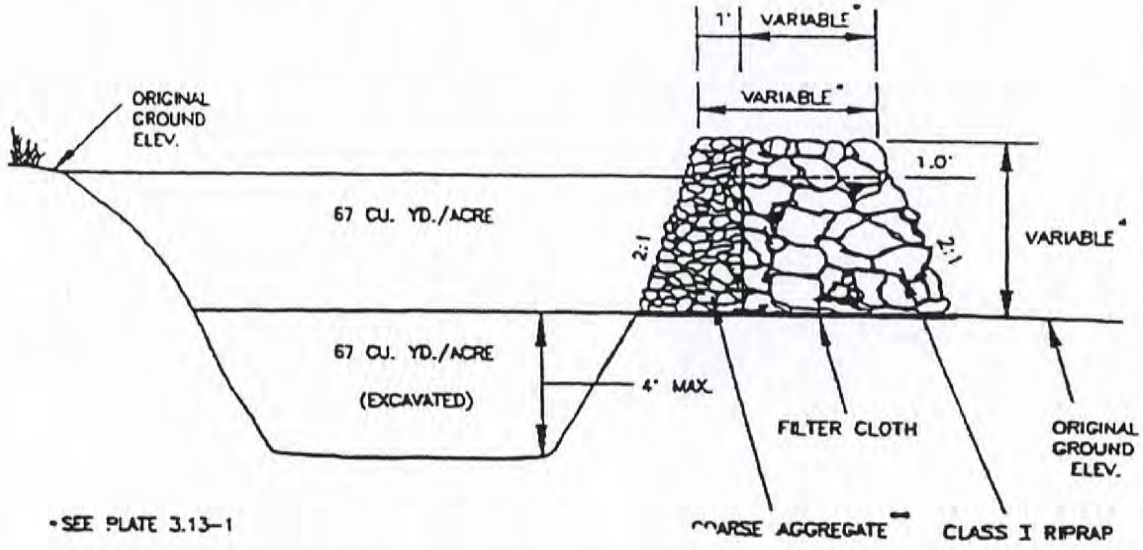
Cleanout Elevation = 64.2

Elevation of Upstream Toe of Dam

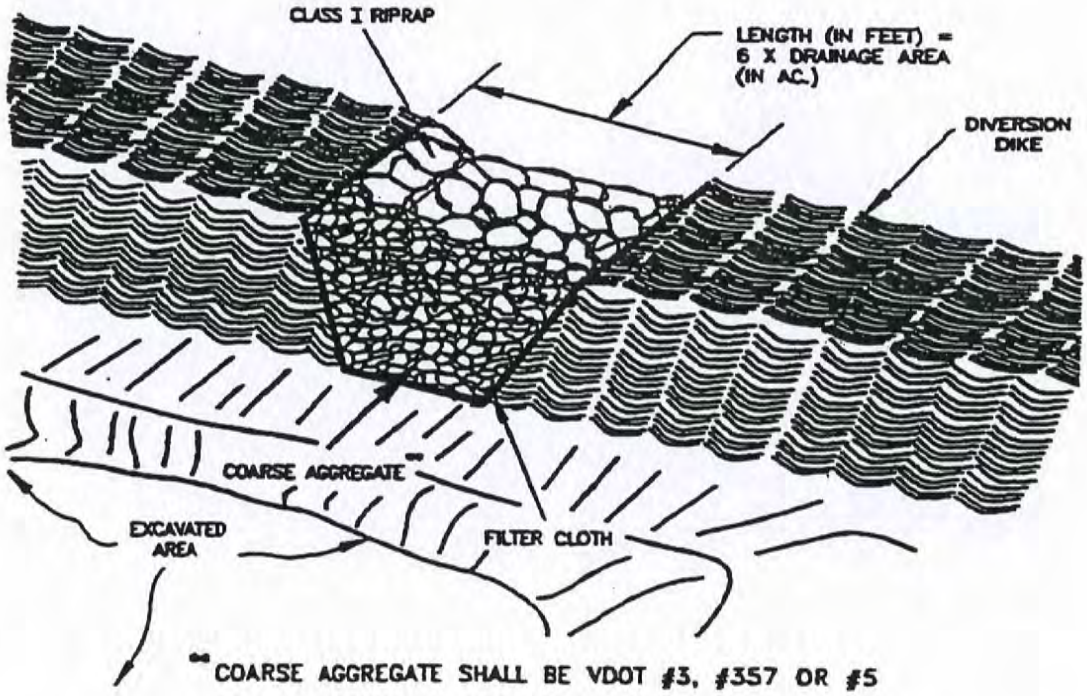
Area" (if excavation was performed) = 59.0


EXIST 15" RCP
ROUTE 750
V. 79.43
82
DRY DETENTION POND
DD
84
79.50
ST
SEDIMENT TRAP - 3.0 AC D.A.
DIMENSIONS 3X30X65
STORAGE 5432 CU.FT. WET - 5432 CU.FT
84
18
INV. 80.50
4'X4X26"
VDOT CLASS I
RIP RAP
28"
CLASS I RIP RAP
84
MU
ASPHALT BUS PARKING
86
86
8" PVC
CO
CO
4" PVC
4" PVC
CO
209' of 15" CMP

TEMPORARY SEDIMENT TRAP



CROSS SECTION OF OUTLET



**COARSE AGGREGATE SHALL BE VDOT #3, #357 OR #5

OUTLET (PERSPECTIVE VIEW)

Source: Va. DSWC

Plate 3.

New Small Town School
Sediment Trap

1) Determine storage needed for 3-acre trap:

* **3 acres x 134 cubic yards/acre**

= 402 cubic yards

2) **Translate to cubic feet required (plan uses feet):**

* **cubic feet x 0.037 = cu.yds.**

* **402 cu.yds./0.037 = 10,864 cubic feet**

Divide in half = 5432 cf (wet)
5432 cf (dry)

New Small Town School Sediment Trap *(continued . . .)*

* **Determine storage provided for dimensions given:**

3 x 30 x 65 = 5850 cf (wet)
3 x 30 x 65 = 5850 cf (dry)

5432 cubic feet needed in each, therefore,

storage is adequate.✔

* **Maximum depth of wet storage is 4 feet.**

Wet storage depth = 3 feet.✔

* **Length to Width Ratio = 2:1**

65 feet/30 feet = 2.1✔

* **Length of outlet weir?**

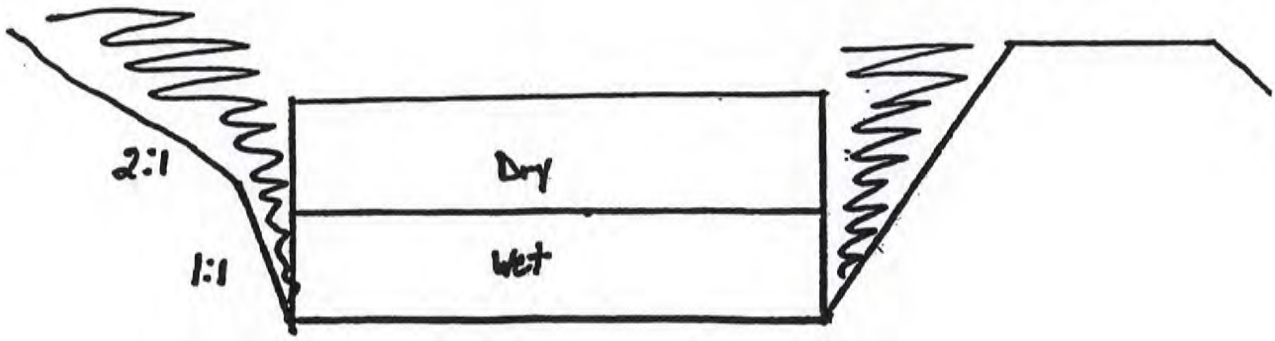
weir length = 6x drainage area

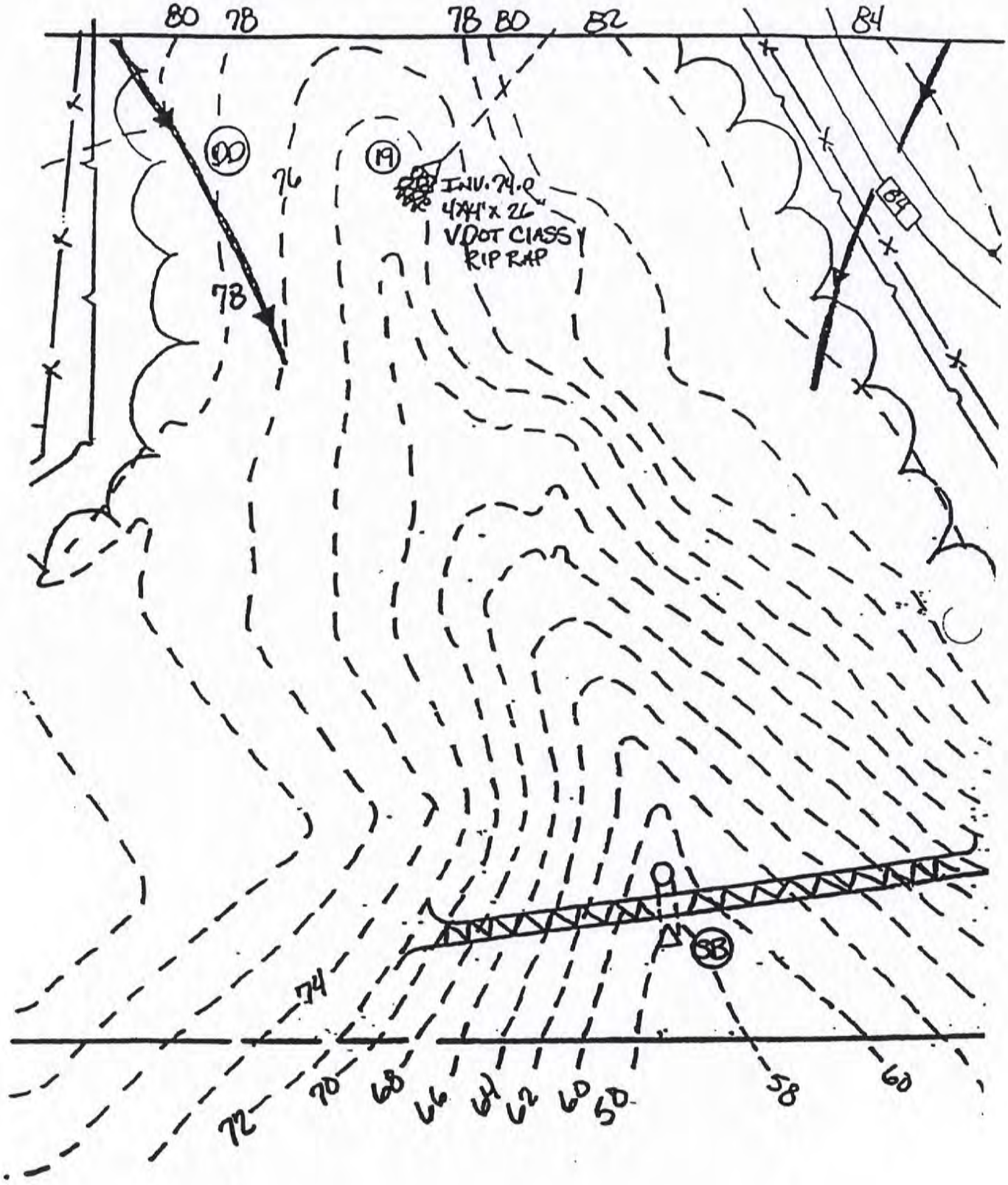
6 x 3 = 18 feet ✗ (not on plan)

New Small Town School
Sediment Trap *(continued . . .)*

* **Is the method used to approximate wet and dry storage volume acceptable?**

Yes, because it approximates a rectangle, not taking into account the minimum 1:1 side slopes of the wet storage and the minimum 2:1 side slopes of the dry storage.




80
78
78
80
82
84
DD
19
76
INV. 74.0
4X4'x 26"
VDOT CLASS
RIP RAP
78
84
SB
74
72
70
68
66
64
62
60
58
58
60

New Small Town School
Sediment Basin Design

Wet Storage:

1) Verify the acreage draining to the sediment basin and determine the wet storage volume required (bottom to dewatering orifice).

67 cu.yds. x 9.5 acres = 636.5

2) Determine the available basin volume using the storage-elevation curve (AP-1).

663 cu.yds. at elevation 66

3) This basin is a natural basin, therefore, the following equation was used in determining storage volumes for the stage storage curve:

$$V_1 = 0.4 \times A_1 \times D_1$$

where,

V_1 = storage volume in cubic feet.

A_1 = the surface area of the flooded area, in square feet.

D_1 = the max. depth in feet.

Because natural contours were used, no excavation is required to obtain the required volume.

4) Determine the cleanout volume (half the volume of the wet storage).

33 cu.yds. x 9.5 acres = 313.5 cu.yds. (needed)

331.5 cu.yds. = half of wet storage from curve (AP-1).

5) **Determine the elevation corresponding to the cleanout level from the curve (AP-1).**

Elevation 64.2 provides 331.5 cu.yds.

6) **Ensure that the distance from the dewatering orifice is at least 1.0 ft. from the cleanout level.**

= 1.8 ft. (AP-2)

Dry Storage:

7) Determine the dry storage volume required (dewatering orifice to top of riser).

67 cu.yds. x 9.5 acres = 636.5

8) Determine the available basin volume using the storage-elevation curve (AP-1).

646 cu.yds. at elevation 68.5 (Used 815 cu.yds. at elevation 69 due to soil conditions.)

9) Calculate the diameter of the dewatering orifice using the following equations:

$$A = \frac{Q}{[64.32 \times h]^{1/2} (0.6)}$$

where,

A = flow area of orifice, in square feet.

h = average driving head (maximum possible head measured from radius of orifice to crest of principal spillway divided by 2, in feet).

Q = volumetric flow-rate through orifice needed to achieve approx. 6-hour drawdown, in cubic feet per second.

$$Q = S/21{,}600 \text{ seconds}$$

S = total storage available in dry storage area, in cubic feet.

Then, using calculated A, find d using the following equation:

$$d = 2 \times \left[\frac{A}{3.14}\right]^{1/2}$$

Finding Q:

S = 815 cu.yds. (dry storage volume used from item #8)

815 cu.yds./0.037 = 22,027 cf

Q = S/21,600

22,027/21,600 = 1.02

Finding h/2:

h = 3 feet (taken from AP-2)

3/2 = 1.5 feet

Calculate A:

$$A = \frac{Q}{[64.32 \times h]^{1/2} (0.6)}$$

$$A = \frac{1.02}{[64.32 \times 3]^{1/2} (0.6)}$$

$$A = \frac{1.02}{8.33}$$

A = 0.12 square feet

Calculate d:

$$d = 2 \times \left[\frac{A}{3.14}\right]^{1/2}$$

$$d = 2 \times \left[\frac{0.17}{3.14}\right]^{1/2}$$

d = 0.46 feet, d = 5.52 inches

> 3 inch diameter ✔ 3inch minimum or it wi

Use diameter = 5.5 inches.

Enter under item #9 of checklist.

10) Calculate the diameter of the flexible tubing (= diameter of orifice + 2 inches).

5.5 + 2 = 7.5 inches

Enter under item #10 of checklist. (AP-3 provides detail of flexible tubing)

11) **Verify the preliminary design elevations recorded on AP-2. Note that the design high water allows 1 foot of freeboard to top of dam.**

$$We = 9{,}986/126 = 79.0$$

$$\text{Length to Width Ratio} = \frac{L}{We}$$

$$= \frac{126}{79}$$

$$= 1.6$$

1.6 < 2, baffles are needed.
Consult AP-4.

12) **Verify the length to width ratio:**

$$= \frac{L}{We}$$

where,

We = A/L = the effective width.

A = the surface area of the normal pool (9,986 square feet as planimetered).

L = the length of the flow path from the inflow to the outflow (126 feet, measured from plan).

13) Determine the Q_2.

$Q_2 = 24.3$ cfs

Found using the rational method. See AP-5.

14) Determine the Q_{25}.

$Q_{25} = 39.5$ cfs

Found using the rational method. See AP-5.

15) With emergency spillway, required spillway capacity is $Q_p = Q_2 = 24.3$ cfs

16) With emergency spillway, find the assumed available head (h).

h = distance between crest of riser and crest of emergency spillway.

h = 1 foot (See AP-6).

17) **Calculate the riser diameter:**

Go to AP-7 and use a $Q_2 = 24.3$ and h = 1 to pick the riser diameter off the chart.

Riser diameter equals 33 inches (no orifice flow encountered).

18) Calculate barrel length (l).

The procedure for calculating barrel length is provided in AP-8. In this case, assume 76 feet is correct.

* **the min. top-width and side slopes of the embankment are on Page III-80 of the VESCH.**

  For embankments 10-14 feet (this one is 13 feet), min. top-width is 8 feet and side slopes must be 2.5:1 or flatter.

* **barrel slope (4%) is taken from the plan.**

Also, determine the head (H) on the barrel.

H = the difference in elevation of the centerline of the outlet of the barrel and the crest of the emergency spillway.

H = 11 feet (See AP-6).

19) Determine the barrel diameter for concrete pipe (n = 0.013).

Refer to AP-9. Use H = 11 feet and Q_2 = 24.3 to find min. barrel diameter.

Barrel diameter = 18 inches

* **Check correction for pipe length using the correction factor. Use a conservative measure (e.g., 80- foot barrel length) or interpolate as shown in AP- 10.**

0.98 x 27.5 cfs = 27 cfs ✔

* **Find barrel diameter for corrugated metal pipe (n = 0.025). Use AP-11.**

Barrel diameter = 21 inches

(Refer to AP-12)

20) **Determine the trash rack and anti-vortex device design.**

Use a riser diameter of 36 inches (actually 33 inches) and AP-13.

Diameter = 54 inches

Height = 17 inches

[Note: Thickness gage data is recorded on detail AP-14.]

21) Determine required spillway capacity:

$$Q_e = Q_{25} - Q_p$$

$$Q_e = 39.5 - 24.3 = 15.2 \text{ cfs}$$

22) **Determine spillway parameters based on 1 foot depth of water (from AP-2) and 15.2 cfs using AP-15.**

* **bottom width = 8 feet**
* **slope = 3%**
* **length = 51 feet**
* **velocity = 4 cfs**

[Note: Spillway is cut into in-situ soil at abutment, not into fill.]

Spillway data is also identified on detail AP-16.

23) Determine length of barrel in the saturated zone (L_s).

Use the depth of water at the principal spillway crest (taken from AP-2; 69-59 = 10 feet), the slope of the barrel (4%), and the slope of the embankment (2.5:1) and AP-17 to determine the length of pipe in the saturated zone.

= >76 feet (entire length)

24) **Determine the number of anti-seep collars required (height of embankment exceeds 10 feet).**

Use the 76-foot length of saturated pipe, elect the number of collars desired, and use the pipe diameter in feet (18-inch concrete barrel = 1.5 feet) to determine collar dimensions from AP-18.

4 collars, 3.5 x 3.5 (checklist is incorrect).

Determine the collar spacing for the 21-inch corrugated metal barrel, using 4 collars and AP-19.

21-inch barrel = 1.75 feet

4 collars, 3.75 x 3.75 (See AP-20).

25) Verify final design elevations (no changes from preliminary design elevations entered in item #11) using AP-2.