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Advanced Design Workshop: Enhanced Dry Swales

Always check the current edition of the GDOT Drainage Design for Highways Manual for current policies.

This presentation shall not supersede any policies in the GDOT Drainage Design for Highways Manual (current edition) or any other GDOT policy publications.

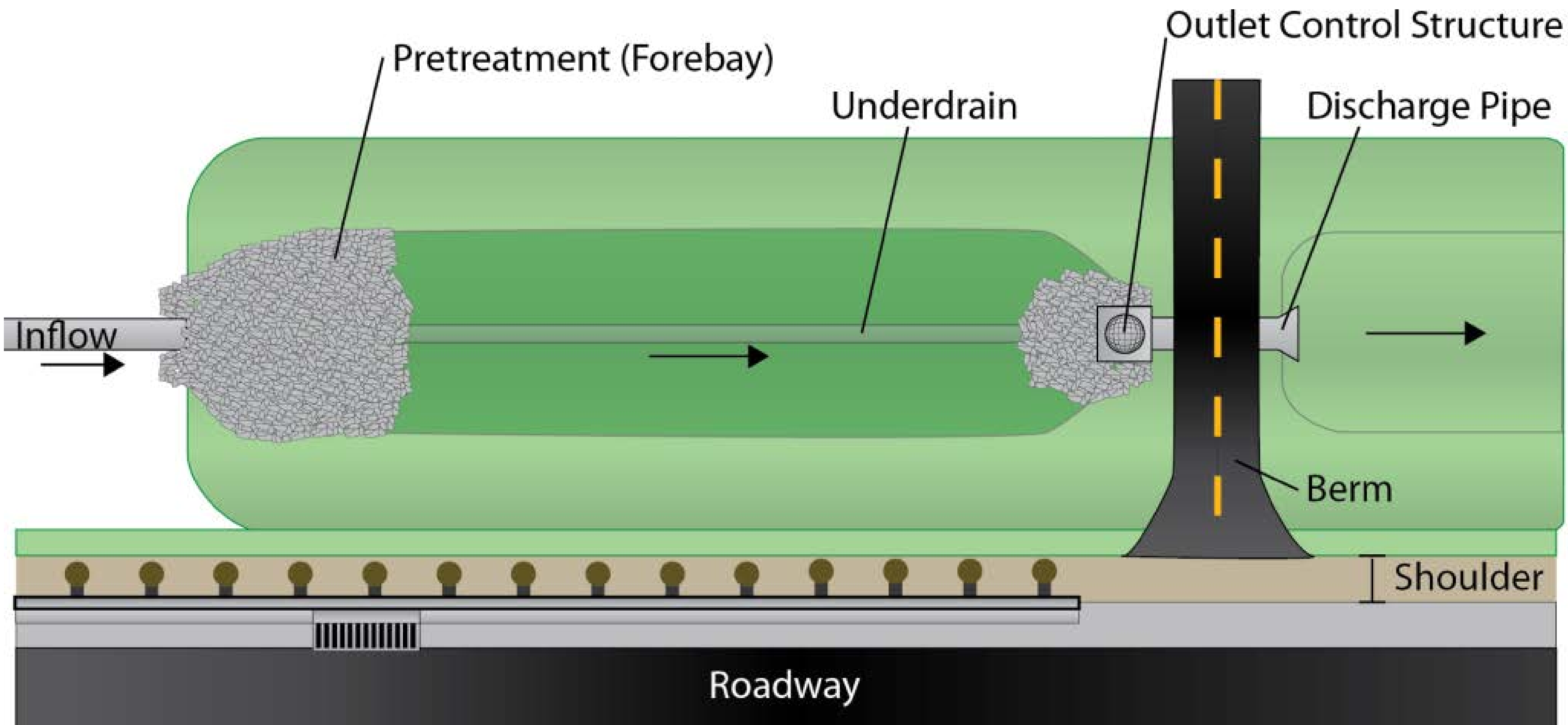
Why are we here?

…to discuss process of designing an enhanced dry swale

WHY?

Enhanced Dry Swale

A vegetated open channel designed to capture and treat stormwater runoff in dry cells



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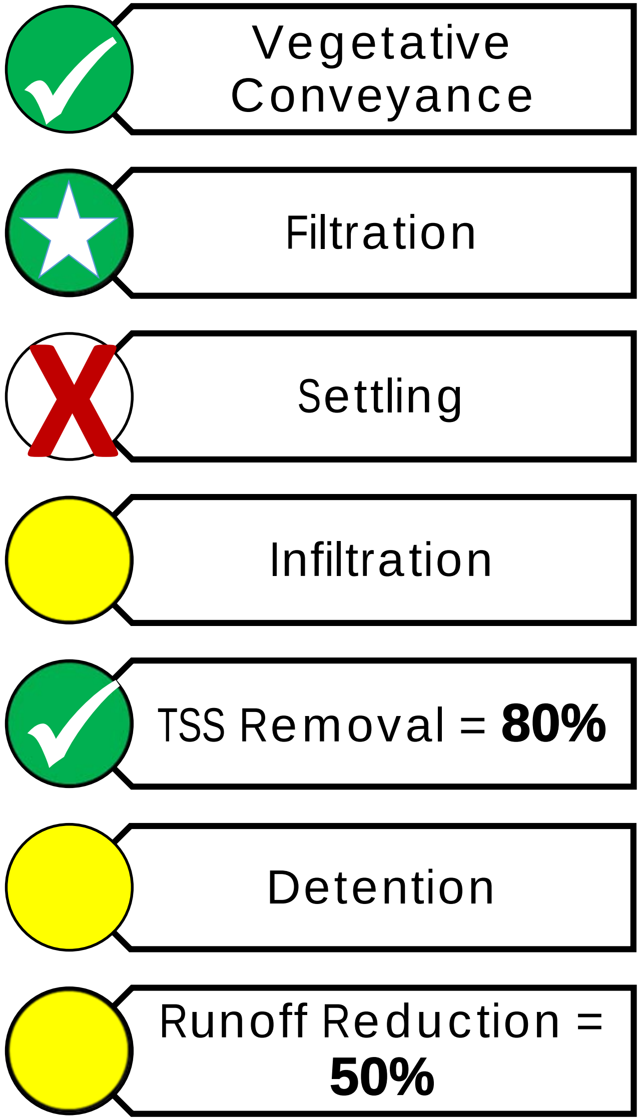
Enhanced Dry Swale

Purpose

- To remove pollutants by vegetative filtering and biofiltration

Considerations

- Forebay required with curb and gutter applications
- Easily incorporated into highway landscape plans



Enhanced Dry Swale with Capped Underdrain

Purpose

- Remove pollutants by vegetative filtering, infiltration, and biofiltration

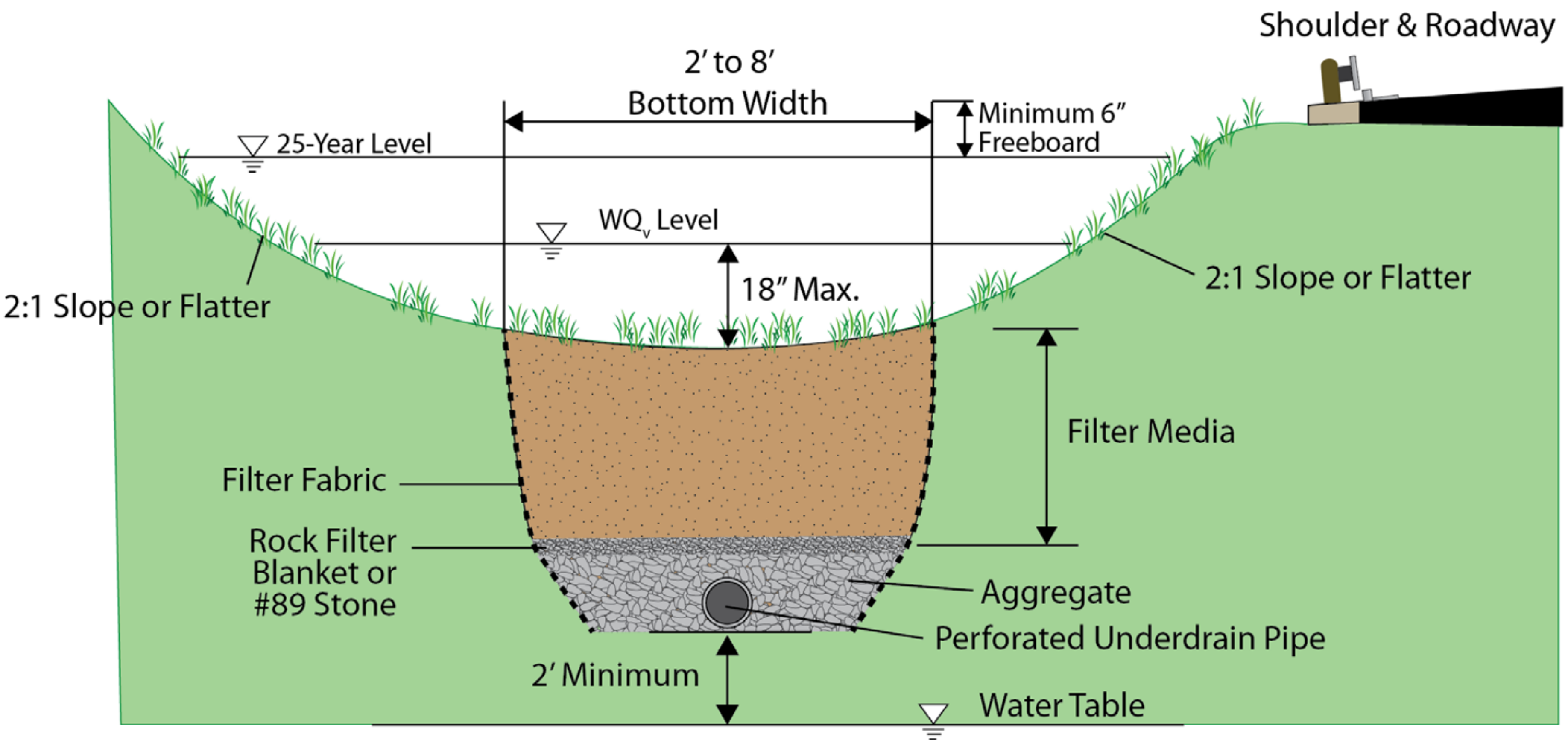
Considerations

- Forebay required with curb and gutter applications
- Easily incorporated into highway landscape plans

✓	Vegetative Conveyance
★	Filtration
✗	Settling
✓	Infiltration
✓	TSS Removal = **100%**
●	Detention
✓	Runoff Reduction = **100%**

Enhanced Dry Swale

A vegetated open channel designed to capture and treat stormwater runoff in dry cells



Design Considerations

- **Drainage area <5 ac**
- **Longitudinal slope <4%**
  - 1 to 2% slopes recommended – regrade as appropriate
- **2 ft between seasonal high water table & bottom of swale**
- **Footprint typ. 10-20% of the contributing impervious area**
- **<u>Inflow/outflow head elevation difference minimum 3 to 5 ft</u>**
- **Use impermeable liner in areas subject to aquifer protection**

Enhanced Dry Swale

Advantages

- Water quality benefits
  - ✓80% TSS
  - ✓100% TSS with capped underdrain
- Can be configured to provide stormwater attenuation
- Moderate maintenance burden

Enhanced Dry Swale

Disadvantages

- Potential large land requirement
- Limited to small drainage areas
- Unsuitable for steep terrains
- Moderate capital cost

Enhanced Dry Swale

How does it compare to other BMPs?

BMP	TSS	Total Phosphorus	Total Nitrogen	Fecal Coliform	Metals
Filter Strip	60 %	20 %	20 %	----------	40 %
Grass Channel	50 %	25 %	20 %	----------	30 %
Enhanced Dry Swale	80%	50%	50%	----------	40%
Enhanced Dry Swale (w/ capped Underdrain)	100 %	100 %	100 %	----------	100 %
Enhanced Wet Swale	80 %	25 %	40 %	----------	20 %
Infiltration Trench	100 %	100 %	100 %	100 %	100 %
Sand Filter	80 %	50 %	25 %	40 %	50 %
Dry Detention Basin	60 %	10 %	30 %	----------	50 %
Wet Detention Pond	80 %	50 %	30 %	70 %	50 %
Stormwater Wetland – Level I	80 %	40 %	30 %	70 %	50 %
Stormwater Wetland – Level II	85 %	75 %	55 %	85 %	60 %
Bioslope	85 %	60 %	25 %	60 %	75 %
OGFC	50 %	----------	----------	----------	----------
Bioretention Basin	50-75- 100 %	80 %	60 %	90 -100%	95-100 %

Sediment Forebay

Purpose:

- Slows down the velocity of the inflow
- Reduces large particulates and trash entering the BMP
- Keeps the BMP filter media functioning

Sizing:

- Capacity of 0.1 inch runoff/Impervious acre

Filter Media

Filter Media (see Special Provision 169)

- Place on top of aggregate blanket
- Engineered soil mix, covered with sod
- Soil media is recommended to contain a high level of organic material to promote pollutant removal
- See Special Provision 169 for media specifications

Check dams

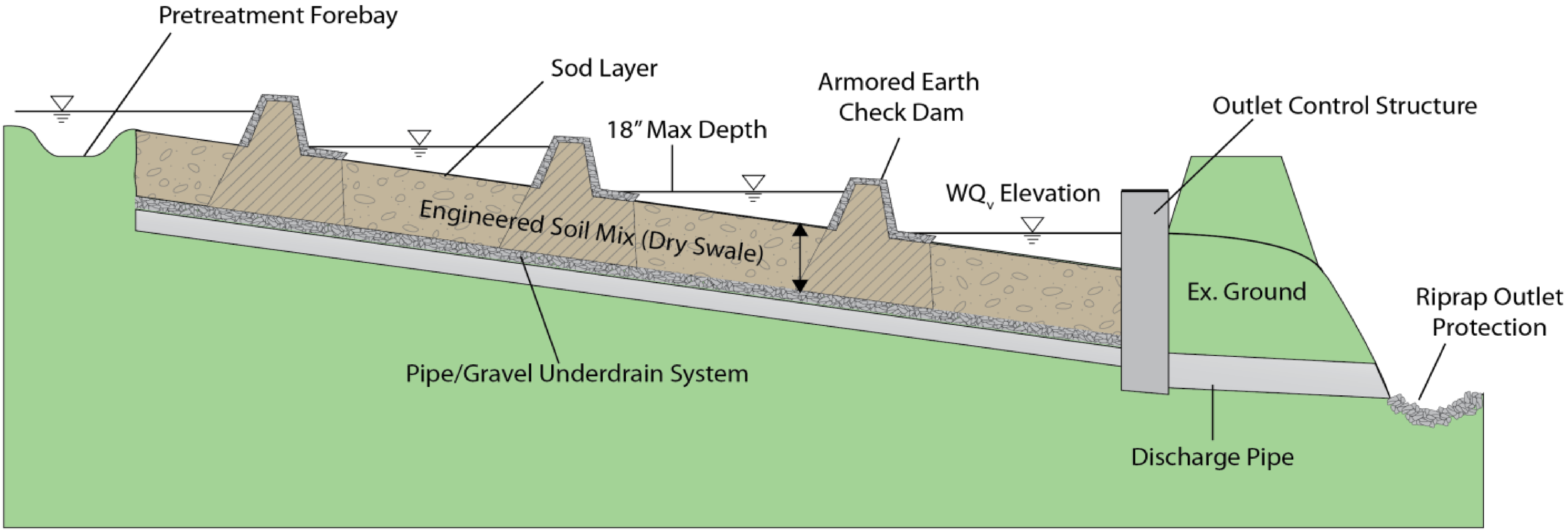
Purpose:

- Reduce the effective slope of the swale and lengthen the contact time to enhance filtering and/or infiltration

Sizing:

- Volume at the ponding depth should equal Runoff Reduction or Water Quality volume
- 18” maximum depth
- Space where bottom of upstream check dam matches elevation of next downstream check dam
- Outlet protection and energy dissipation required

Enhanced Dry Swale
Check Dams



SOD

Sod

- Obtain from approved nurseries having a GA Live Plant License
- Obtain from supplier that grows in non-clay soils
- Half cut or thin cut to maximize infiltration
- Ensure ≥75% of plants are of designated grass species
- See Special Provision 169 for media specifications

Underdrain

- Place minimum 24” above water table
- Pipe: 8" diameter polyethylene (typ.) in a No. 57 aggregate layer
- Rock filter bed: No. 8 or 89 stone
- Discharge to storm drainage infrastructure or stable outlet
- See Underdrain Special Construction Detail for more information

Outlet Control Structure

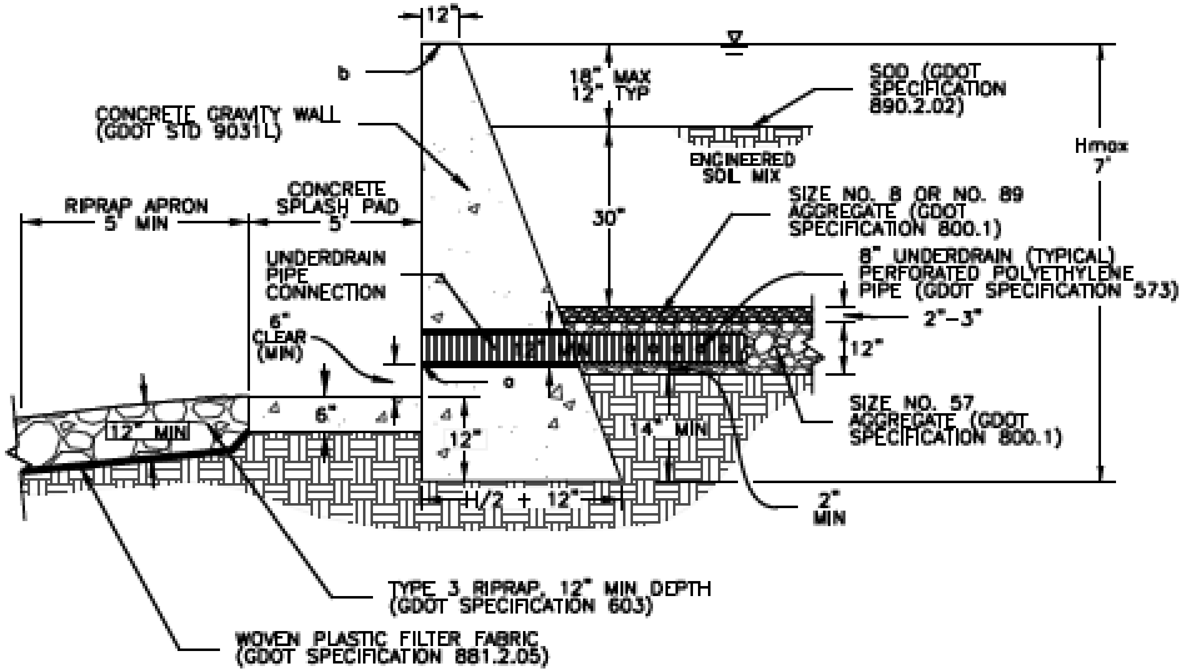
Purpose: Retain WQv

Sizing:

- Overflow weir placed at the elevation of the WQv
- Maximum of 18-inches above the bottom of the swale
- Length designed to allow safe passage of 25-year, 24-hour storm event with a minimum 6 inches of freeboard

Design Considerations:

- Ensure design prevents clogging by floating debris
- Ensure design allows access to drain pond for maintenance



Additional Considerations

Inspection & Maintenance

- Design for adequate access to all elements
- Provide adequate access to the BMP and appropriate components
- Maintaining the vegetative cover is essential to the proper operation of the enhanced swale

Driveway | Access crossings

- Provide surface area to account for driveways
- Driveway crossings can also be located within the limits of the dry enhanced swale

Additional considerations

Roadside Safety

- Space and grade requirements may limit applicability in the linear environment
- Channel shape can be elongated to accommodate roadway applications
- Potential for flooding
- Vehicle impact hazards

Design Process

1. **Delineate Drainage Basin**
    - Determine the goals and primary function (runoff reduction or water quality target)
    - Determine if the enhanced dry swale will be on-line or off-line

Design Process

2. Design for Runoff Reduction

- Calculate the Stormwater Runoff Reduction Target Volume
- Determine the Storage Volume of the Practice & Pretreatment Volume

Volume of enhanced swale

$$\boldsymbol{VP = PV + VES(N_{ES}) + VA(N_A)}$$

Where: $\boldsymbol{VP}$ *= volume provided*

$\boldsymbol{PV}$ *= ponding volume*

$\boldsymbol{VES}$ *= volume of engineered soils*

$\boldsymbol{N_{ES}}$ *= porosity of engineered soils (0.25)*

$\boldsymbol{VA}$ *= volume of aggregate*

$\boldsymbol{N_A}$ *= porosity of aggregate (0.4)*

- Verify that Total Volume provided $\geq$ RRv (target)
- Verify that the enhanced swale will drain in the specified timeframes
- Compute Number of Check Dams required to detain the RR_v

Design Process

3. OR Design for Water Quality (If the Enhanced Dry Swale is not able to meet the RRv)

- Calculate the Target Water Quality Volume
- Determine the Footprint of the Enhanced Swale & Pretreatment Volume required

Size bottom, width, depth, length, and slope for WQv with less than 18” ponding

$$A_f = \frac{WQ_v d_f}{k(h_f + d_f)t_f}$$

Where:

A_f = *surface area of filter media (ft²)*

WQ_v = *water quality volume (ft³)*

d_f = *media depth (typically 2.5 ft)*

k = *coefficient of permeability of media (2-4 ft/day)*

h_f = *average depth of ponded water (ft) (1/2 h_{max}; 18 inches maximum)*

t_f = *design filter bed drain time (2 days max)*

- Compute Number of Check Dams required to detain the WQ_v

Design Process

4. Check 2-year and 25-year velocity erosion potential, if the BMP is online

5. Confirm the swale can pass all design requirements with required freeboard

6. Design Outlet Control Structure & Emergency Overflow

Example 1

Project/Outfall Information

- This is an 8 mile long new state route construction project located in Walton County.
- Roadway design has rural typical section.
- ROW is being acquired for this project.
- This drainage area outfalls directly into an existing channel that flows to the southwest and outfalls into an unnamed tributary 250’ outside of the proposed right of way.

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Example 1

1. Delineate Drainage Basin

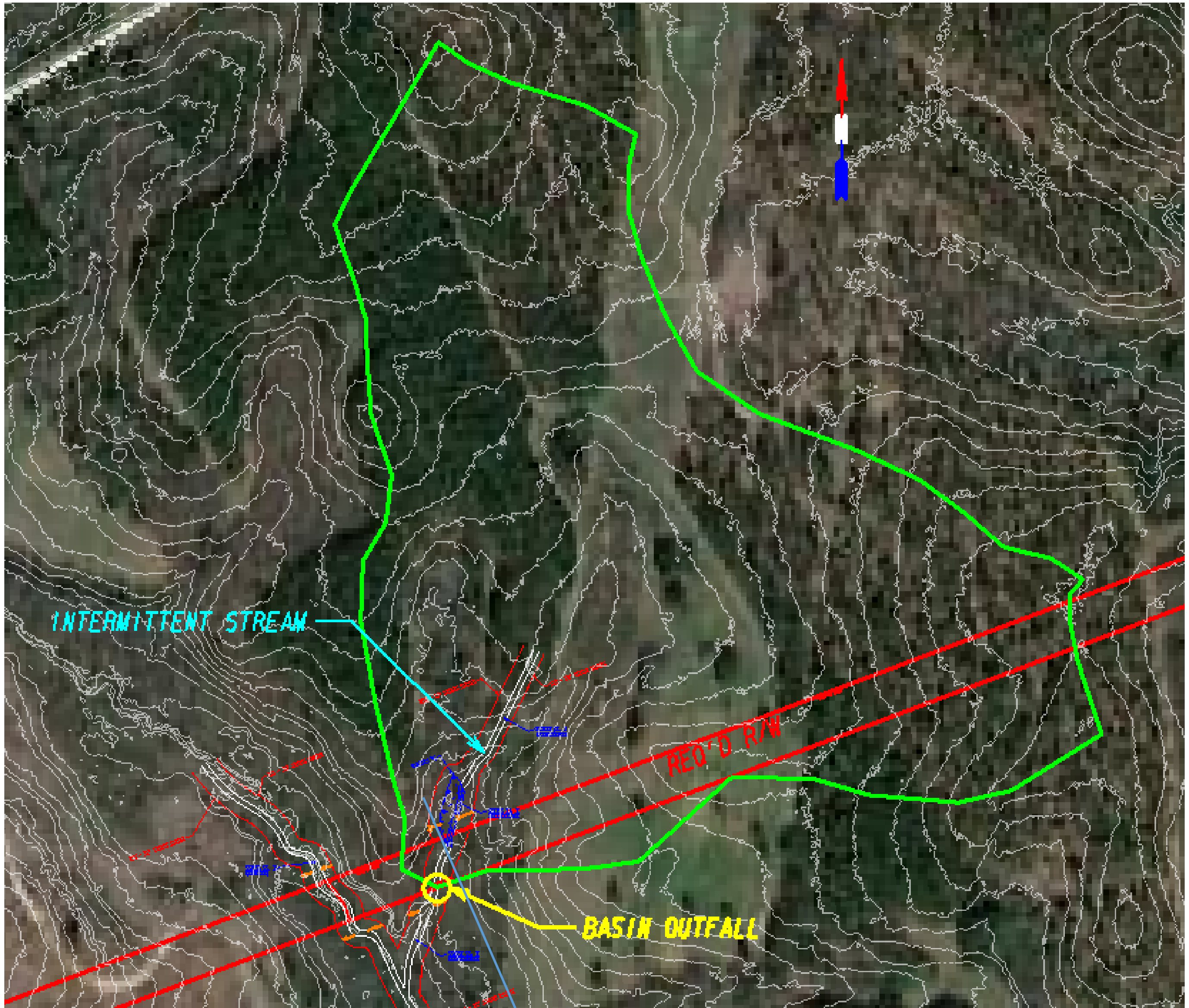
- Soils do not allow for infiltration
- Primary function = Water Quality
- Enhanced dry swale will be on-line

2. Design for Runoff Reduction

- ~~Calculate the Stormwater Runoff Reduction Target Volume~~
- ~~Determine the Storage Volume of the Practice & Pretreatment Volume~~
- ~~Verify that Total Volume provided ≤ RRv (target)~~
- ~~Verify that the enhanced swale will drain in the specified timeframes~~
- ~~Compute Number of Check Dams required to detain the RR_V~~

Example 1

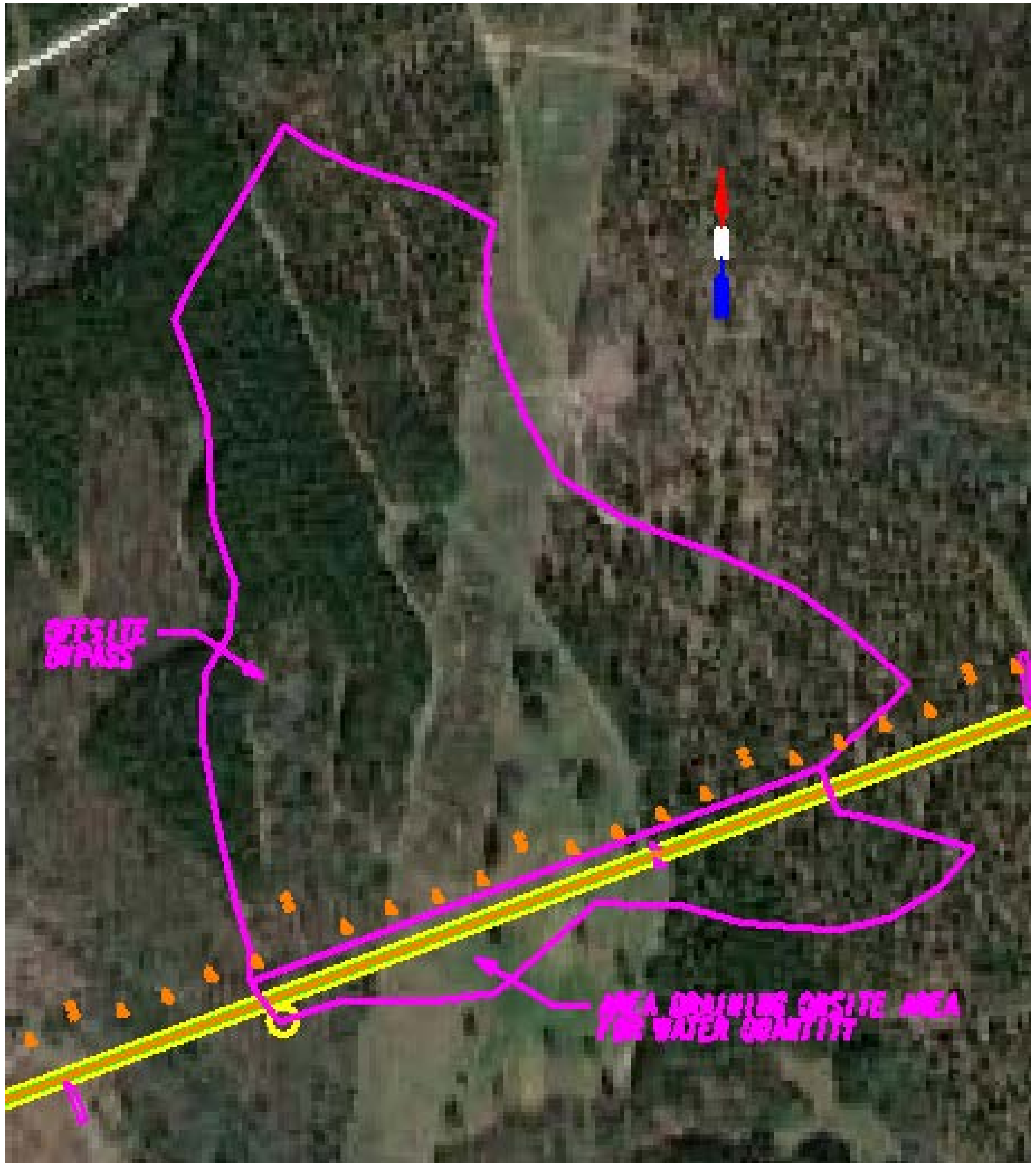
Pre-Developed Basin



Post-Developed Basin

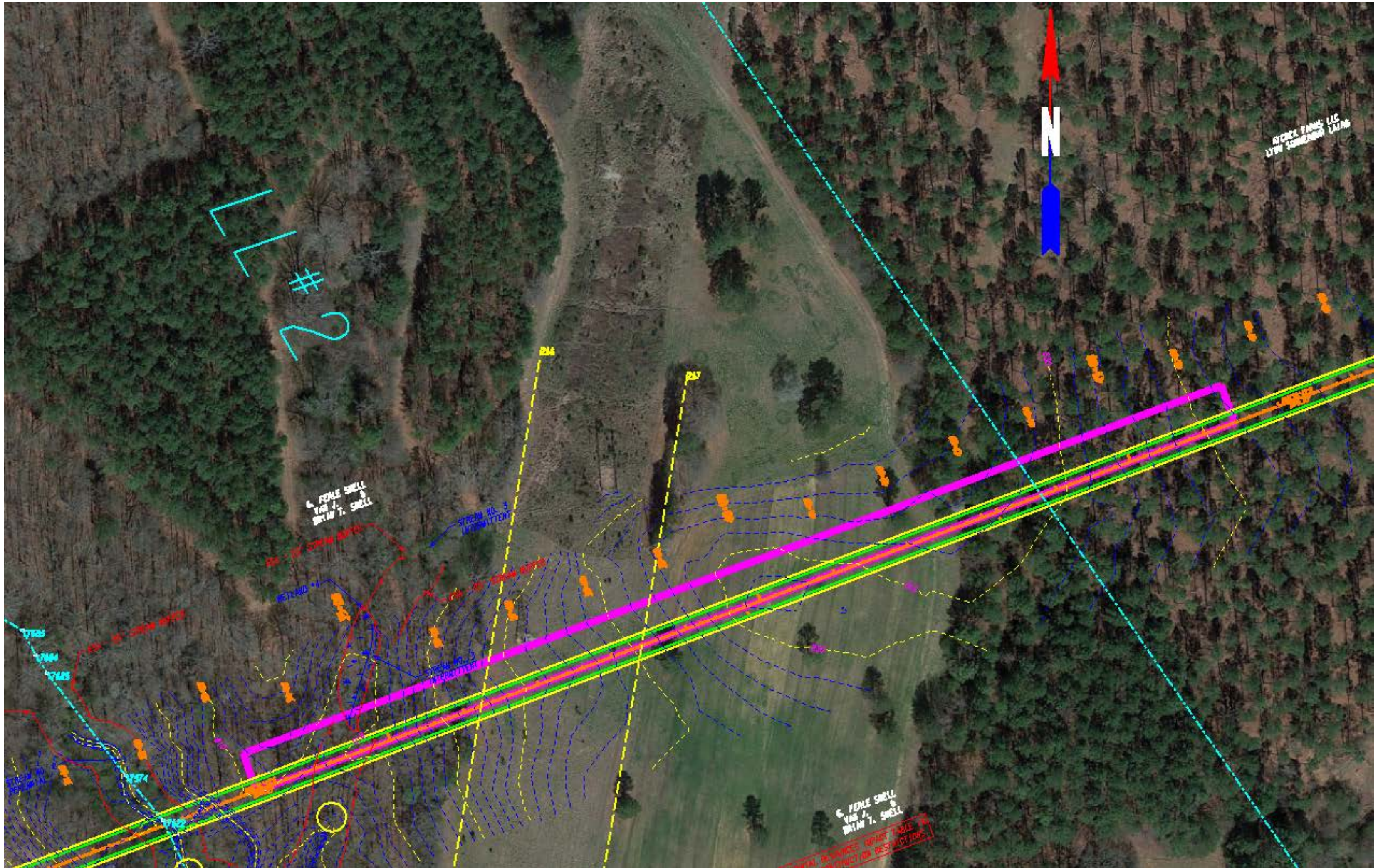
Example 1

Post-Developed Basin



Example 1

- The northern sub-basin will be analyzed in this example



Example 1

Step 1: Determine Sub-Basin Physical Parameters

Property	Quantity	Unit
Drainage Area Pre (A_{Pre})	1.51	ac
Drainage Area Post (A_{Post})	1.51	ac
SCS Curve Number Pre (CN_{Pre})	64	
SCS Curve Number Post (CN_{Post})	73	
Time of Concentration (T_C) - Pre	10.0	min
Time of Concentration (T_C) - Post	10.0	min
Percent Imperviousness (I)	31.79	

	1-Year (cfs)	25-Year (cfs)	100-Year (cfs)
Pre-Development	1.06	5.00	7.54
Post-Development	2.15	6.90	9.72
Change (Post - Pre)	1.09	1.90	2.18
Percent Change	102.8%	38.0%	28.9%

Example 1

Step 3: Design for Water Quality

- Calculate the Target Water Quality Volume

Water Quality Volume:

$$WQ_V = \frac{1.2 \times (R_v) \times A \times 43{,}560}{12} \qquad R_v = 0.05 + 0.009(\mathrm{I})$$

$$WQ_V = \frac{1.2 \times \left(0.05A + 0.9A_{imp}\right) \times 43{,}560}{12}$$

$$WQ_V = \frac{1.2 \times (0.05(1.51) + 0.9(0.48)) \times 43{,}560}{12} = \boxed{2{,}211\ \mathrm{ft}^3}$$

Step 3: Design for Water Quality

- An enhanced dry swale can be constructed with the existing topography and site constraints.
- Using the SCS method, determine the hydrographs for pre- and post-developed onsite basins with a 25-year storm event.
- Follow the GDOT Drainage Design for Highways Manual to size the swale longitudinal slope, width, back slope, front slope.

Enhanced Dry Swale Design Data		
Front Slope	2.0	H : 1V
Back Slope	2.0	H : 1V
Swale Width	4.00	ft
Longitudinal Slope	0.040	ft/ft

Step 3: Design for Water Quality

- Calculate the Water Quality Volume Peak Flow (Q_{wq})
- Apply the Water Quality Volume Peak Flow (Q_{wq}) to calculate the normal flow depth and velocity.
- Reference the Drainage Manual and iterate the swale dimensions to obtain an acceptable flow depth (max. 18 in.)

$$Q = VA = \left(\frac{1.49}{n}\right)AR^{\frac{2}{3}}\sqrt{S}$$

	Quantity	Units
Q_{wq}	0.77	cfs
Manning's n Roughness Coefficient	0.240	NA
Flow Area (A)	1.47	sf
Wetted Perimeter (P)	5.42	ft
Hydraulic Radius (R)	0.27	ft
Normal Flow Depth	0.32	ft
Velocity (V)	0.52	ft/s

Example 1

Step 3: Design for Water Quality

- Calculate the filter media surface area and the filter media design length, applying typical and recommended media values.

$$A_f = \frac{WQ_v d_f}{k(h_f + d_f)t_f}$$

$$L = \frac{A_f}{W}$$

	Quantity	Units	Recommended
Water Quality Volume (WQ_V)	2,211	cf	
Filter Media Depth (d_f)	2.50	ft	*Typically 2.5 ft*
Media Coefficient of Permeability (k)	2	ft/day	*2-4 ft/day*
Average Water Height Above Filter Bed (h_f)	0.32	ft	*½ h_{max}, which varies based on design but h_{max} typically 1.5 ft; WQv normal depth used*
Filter Bed Drain Time (t_f)	2.0	days	*2 days recommended maximum*
Surface Area of Filter Media (A_f)	490.0	sf	
Minimum Filter Media Length* (L)	123	ft	*Filter media width equal to swale bottom width*

*The steeper the swale slope, the bigger the difference between this calculated minimum length based on filtration rate and what is feasible given the slope and max WQ_v depth.

Step 4: Check 2-year and 25-year velocity erosion potential, if the BMP is online

- Apply the Q_{p25} to verify that the swale size will provide an acceptable flow velocity (maximum 4 ft/s) and depth during a 25-year storm.

	Quantity	Unit
Q_{P25}	6.90	cfs
Flow Area (A)	6.71	sf
Wetted Perimeter (P)	8.86	ft
Hydraulic Radius (R)	0.76	ft
Normal Flow Depth	1.09	ft
Velocity (V)	1.03	ft/s

Example 1

5. Confirm the swale can pass all design requirements with required freeboard

- Approximate design swale bottom elevation
- Minimum swale design depth = weir height + water depth above weir crest + freeboard

6. Design Outlet Control Structure & Emergency Overflow

- The overflow weir is placed at the WQv elevation (max 18 inches from swale bottom)

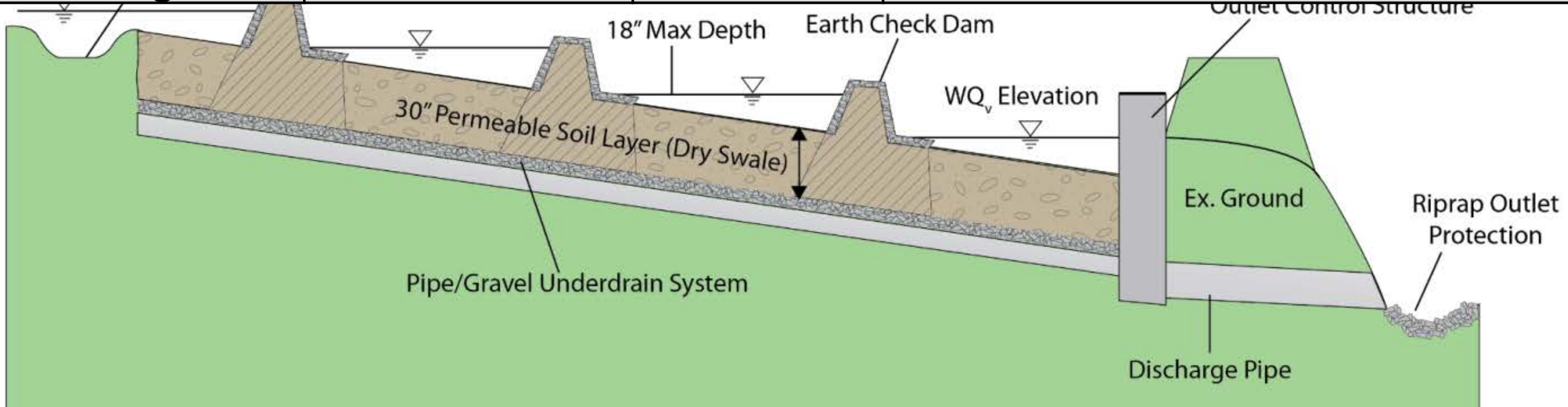
$$Q = C_d \times L \times H^{\frac{3}{2}}$$

	Quantity	Units
Q_{P25}	6.90	cfs
Weir Coefficient (C_d)	3.00	
Water Depth Above Weir Crest (H)	0.40	ft
Length of Weir (L)	9.00	ft
Outlet Swale Bottom Elevation	812.00	ft
Desired WQ_v Depth	Maximum of 18 inches (1.5 feet)	
Weir Elevation	813.5	ft
Minimum Swale Depth	2.40	ft
Swale Design Depth	2.50	ft

Finalize Design

- Determine the minimum swale length required for the water quality volume capacity.
- Calculate the number of check dams, height, and spacing needed for the minimum swale length.

	Quantity	Units	Notes
Water Quality Volume (WQ_V)	2,211	cf	
Check Dam Height	1.50	ft	
Segment Length	37.50	ft	*Check dam spacing = check dam height / swale slope*
Design Segment Length	50.0	ft	*Minimum 50 ft; 10 ft increments preferred*

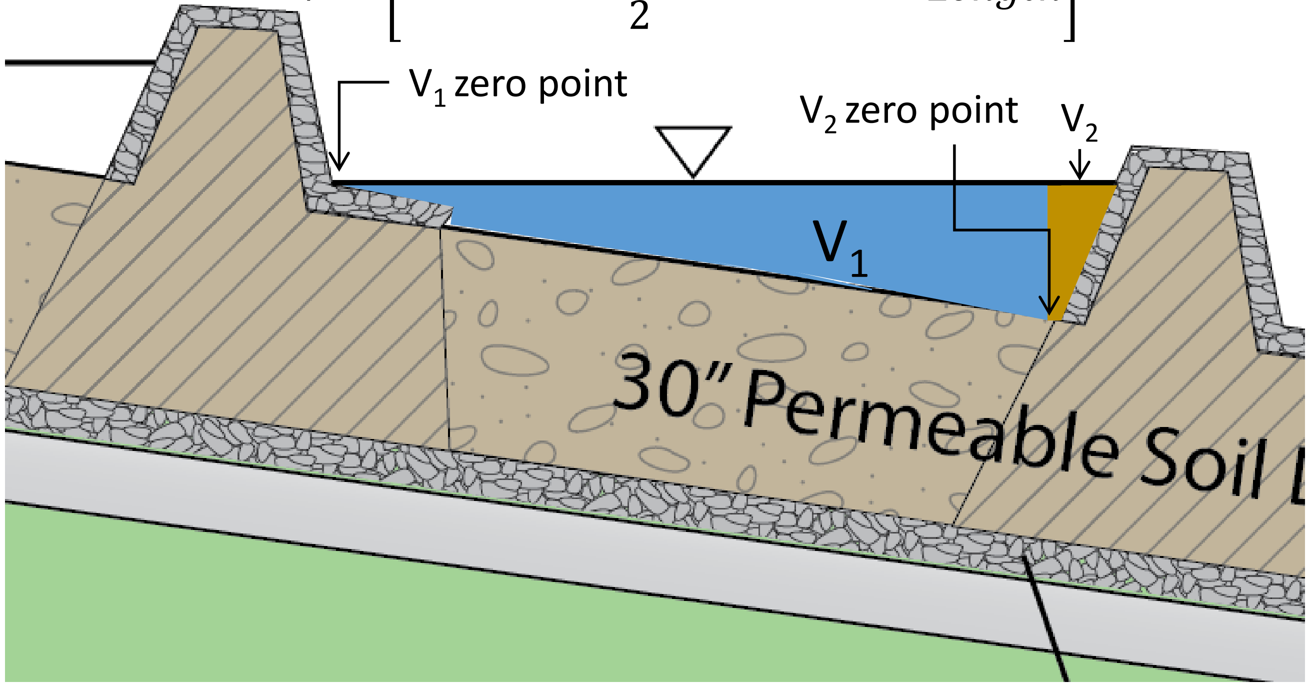


Example 1

Finalize Design

	Quantity	Units	Notes
Segment Volume	219.5	cf	*Between check dams - see equation below*
Number of Segments Required	10.07→11		*WQv / Segment Volume and round up*
Minimum Swale Length	550	ft	*11 * 50 = 550*
Number of Check Dams	10		

$$V = \left[\frac{End\ Area\ 1 + End\ Area\ 2}{2} \times Length\right]$$



Volume 1

$End\ Area\ 1 = 0 \qquad End\ Area\ 2 = \frac{(4+10)}{2} \times 1.5 = 10.5\ ft^2$

$$V_1 = \frac{(0+10.5)}{2} \times 37.5 = 197\ ft^3$$

Volume 2

$End\ Area\ 1 = 0 \qquad End\ Area\ 2 = 10(3) = 30\ ft^2$

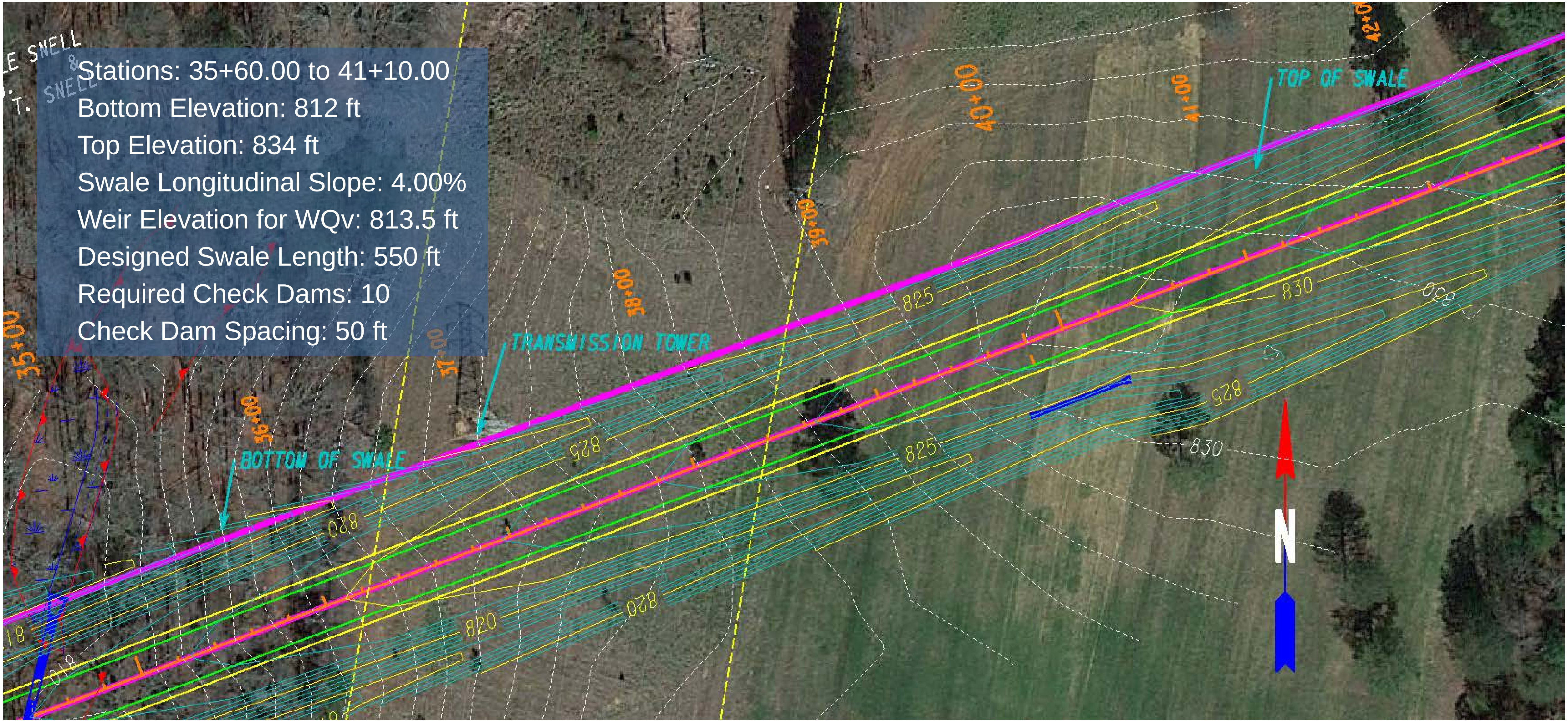
$$V_2 = \frac{(0+30)}{2} \times 1.5 = 22.5\ ft^3$$

Segment Volume

$$Segment\ Volume = V_1 + V_2 = 197 + 22.5 = 219.5\ ft^3$$

Finalize Design

Stations: 35+60.00 to 41+10.00
Bottom Elevation: 812 ft
Top Elevation: 834 ft
Swale Longitudinal Slope: 4.00%
Weir Elevation for WQv: 813.5 ft
Designed Swale Length: 550 ft
Required Check Dams: 10
Check Dam Spacing: 50 ft

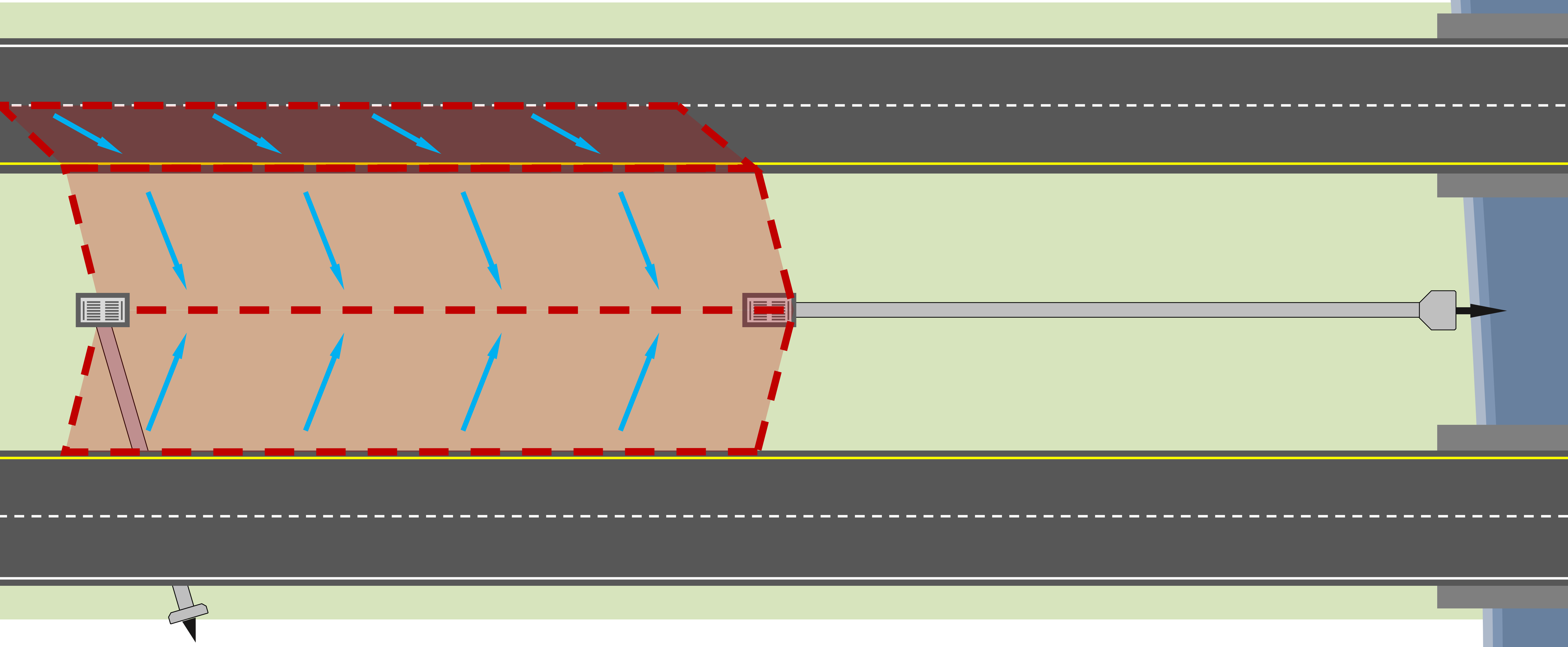


Example 2

Given:

- Roadway widening project
- New lanes drain to a green space with potential for enhanced swale
- Runoff Reduction is not possible due to poor soils
- P25yr = 6.08 in

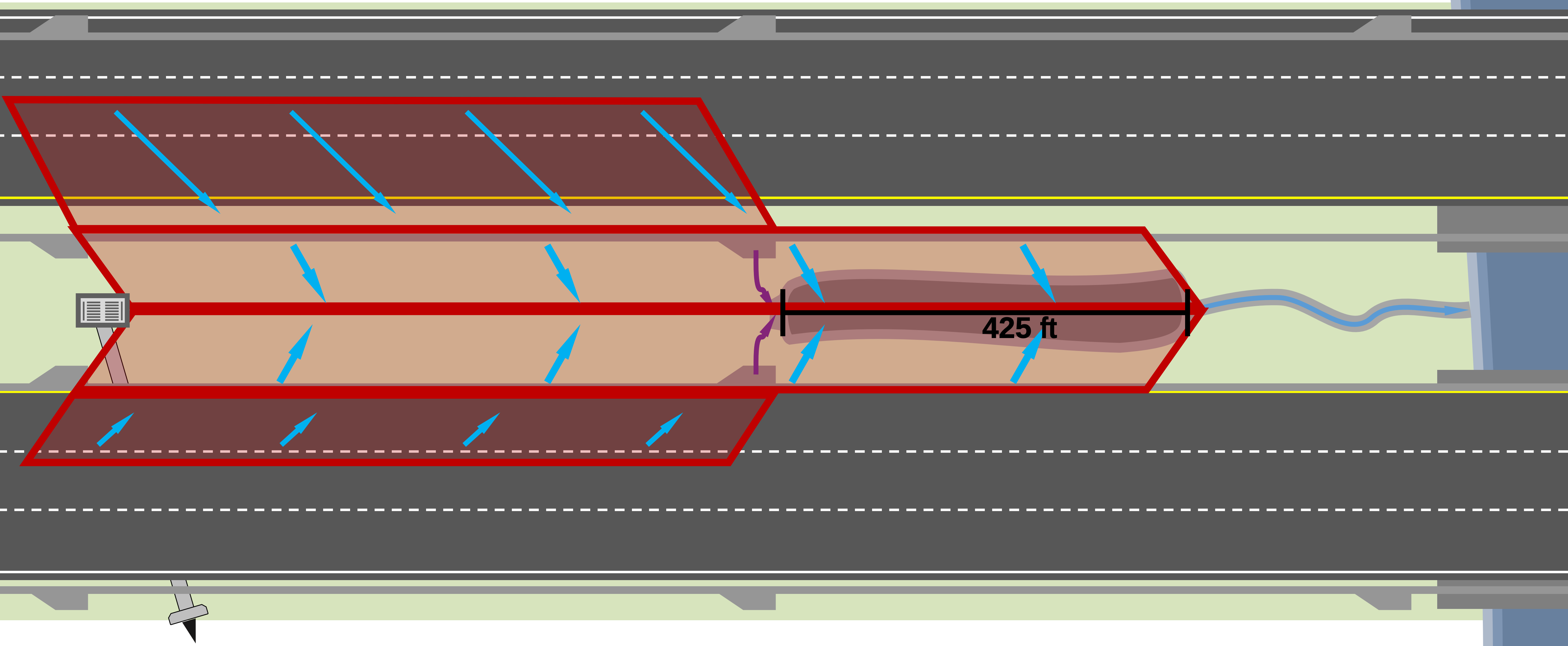
Example 2: Pre-development



Impervious area = 0.65 ac

- Total area = 2.48 ac

Example 2: Enhanced dry swale design



Impervious area =1.86 ac

- Total area = 2.07 ac

Determine CNW

Pre-Development	Area (ac)	CN
Open space – Good condition (HSG B)	1.83	61
Impervious	0.65	98
TOTAL	**2.48**	**71**

Post-Development	Area (ac)	CN
Open space – Good condition (HSG B)	0.21	61
Impervious	1.86	98
TOTAL	**2.07**	**94**

$$CN_W = \frac{1.83(61) + 0.65(98)}{2.48} = 71$$

$$CN_W = \frac{0.21(61) + 1.86(98)}{2.07} = 94$$

Determine WQv (finding rV)

Pre-Development	Area (ac)	CN
Open space – Good condition (HSG B)	1.83	61
Impervious	0.65	98
TOTAL	**2.48**	**71**

Post-Development	Area (ac)	CN
Open space – Good condition (HSG B)	0.21	61
Impervious	1.86	98
TOTAL	**2.07**	**94**

$$\boldsymbol{R_v = 0.05 + 0.009 * (\%\, Imp.)}$$

$$R_{v(pre)} = 0.05 + 0.009 * \left(\frac{0.65}{2.07} * 100\right) = 0.333$$

$$R_{v(post)} = 0.05 + 0.009 * \left(\frac{1.86}{2.07} * 100\right) = 0.859$$

$$\boldsymbol{R_{v(net)} = 0.859 - 0.333 = 0.526}$$

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Determine WQv

Pre-Development	Area (ac)	CN
Open space – Good condition (HSG B)	1.83	61
Impervious	0.65	98
TOTAL	**2.48**	**71**

Post-Development	Area (ac)	CN
Open space – Good condition (HSG B)	0.21	61
Impervious	1.86	98
TOTAL	**2.07**	**94**

$$WQ_v = 0.526 * 1.2\ in.* \frac{1\ ft}{12\ in.} * 2.07\ ac * \frac{43{,}560\ ft^2}{ac} = 4{,}743\ ft^3$$

Example 2

Size media surface area for WQ_v

$$A_f = \frac{WQ_v * d_f}{k * \left(h_f + d_f\right) * t_f} = \frac{4{,}743*2.5}{2*(0.75+2.5)*2} = 912 \text{ ft}^2$$

Where:

- A_f = surface area of filter media (ft^2)
- WQ_v = water quality volume (ft^3)
- d_f = filter media depth (ft) – typ. 2.5 ft
- k = coefficient of permeability of filter media (ft/day) –2-4 ft/day
- h_f = average height of water above filter bed (ft) – max=1.5 ft, avg=0.75 ft
- t_f = design filter bed drain time (days) – 2 days max.

Example 2

Determine filter media & swale bottom width

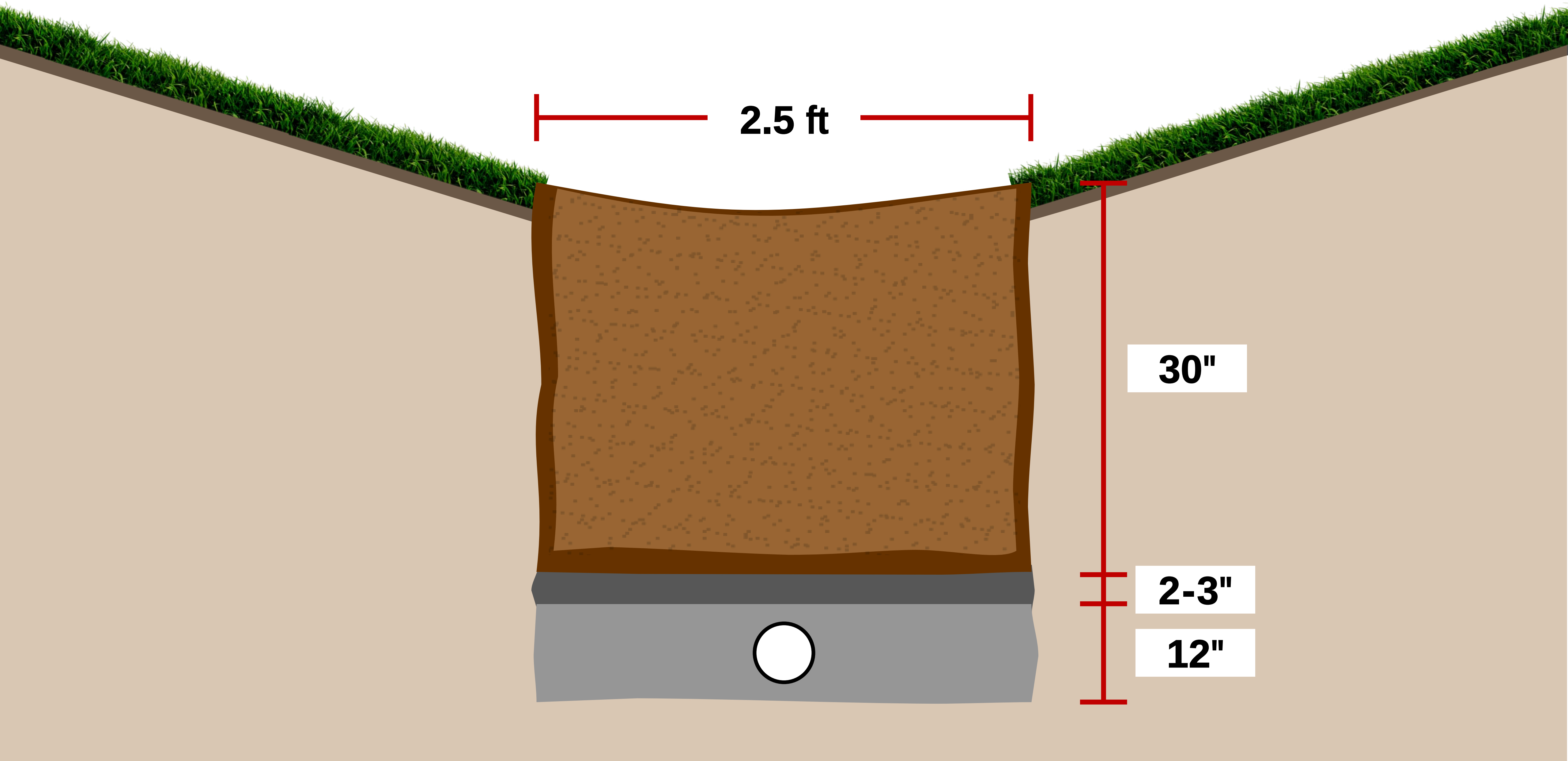
$$W = \frac{A_f}{L} = \frac{912\ ft^2}{425\ ft} = 2.1\ ft\ (min.\ width)$$

Round up to 2.5 ft for constructability

Where:

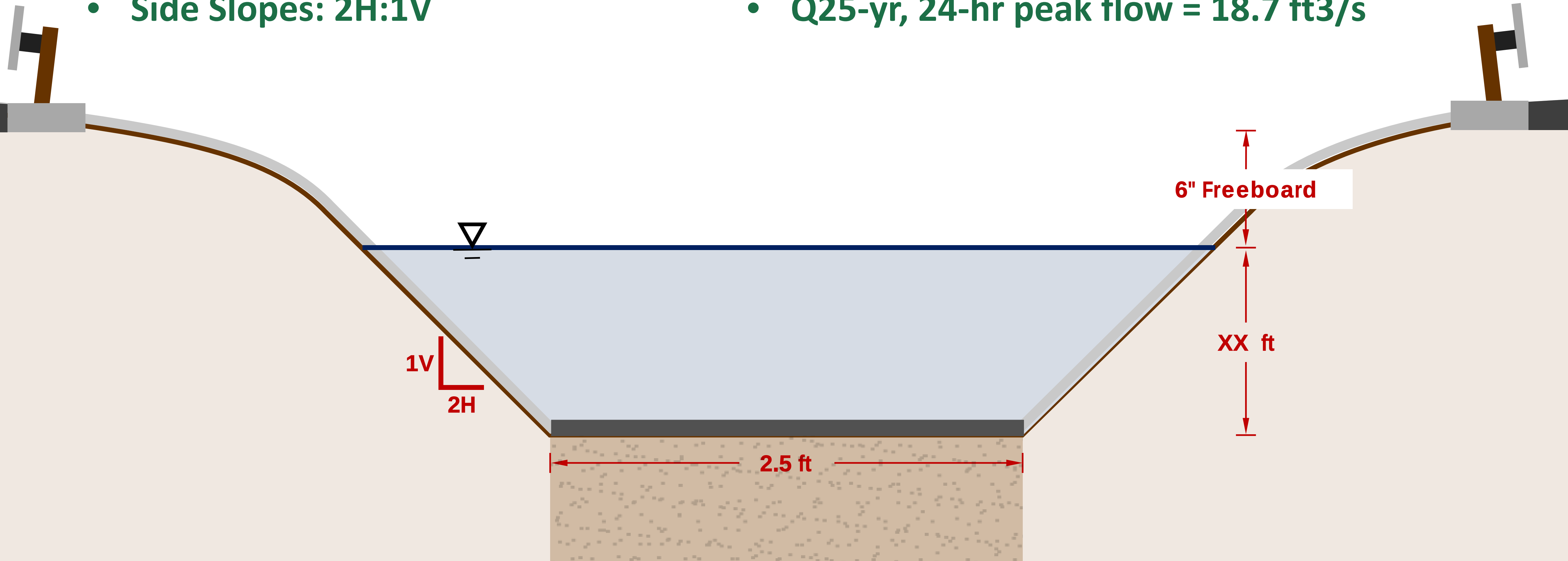
- **W = filter media width | swale bottom width (ft)**
- **L = swale length (ft)**
- **A_f = surface area (ft^2)**

EXAMPLE 2



Determine Channel Cross Section

- Length = 425 ft
- Channel base width = 2.5 ft
- Side Slopes: 2H:1V
- Longitudinal Slope = 0.02 ft/ft
- Manning's n = 0.24
- Q25-yr, 24-hr peak flow = 18.7 ft3/s



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Channel Sizing Calculator

Channel Geometry	
Filter Media Top Length (ft)	425
Filter Media Top Width (ft)	2.5
Filter Media Depth, d_f (ft)	2.50
Left Side Slope, H:V z_1 (ft/ft)	2.0
Right Side Slope, H:V z_2 (ft/ft)	2.0
Channel Slope, S (ft/ft)	0.02
Vegetation	Dense Grass
Manning's Roughness, n	0.24

Flow Parameters	25 Yr	2 Yr
Design Flow, Q (ft^3/s)		
Override: Design Flow, Q (ft^3/s)	18.7	10.7
Top Width, T (ft)	12.15	9.96
Cross-Sectional Area, A (ft^2)	17.66	11.61
Wetted Perimeter, P (ft)	13.29	10.84
Hydraulic Radius, R (ft)	1.33	1.07
Hydraulic Depth, D (ft)	1.45	1.17
Froude's Number, F_r	0.15	0.15
Normal Depth, y (ft)	2.41	1.86
Critical Depth, y_c (ft)	0.94	0.69
Velocity, V (ft/s)	1.06	0.92
Top of Channel (ft)	2.41	
Flow Condition	Sub.	Sub.

Filter media top width = channel bottom width

Normal Depth (ft)

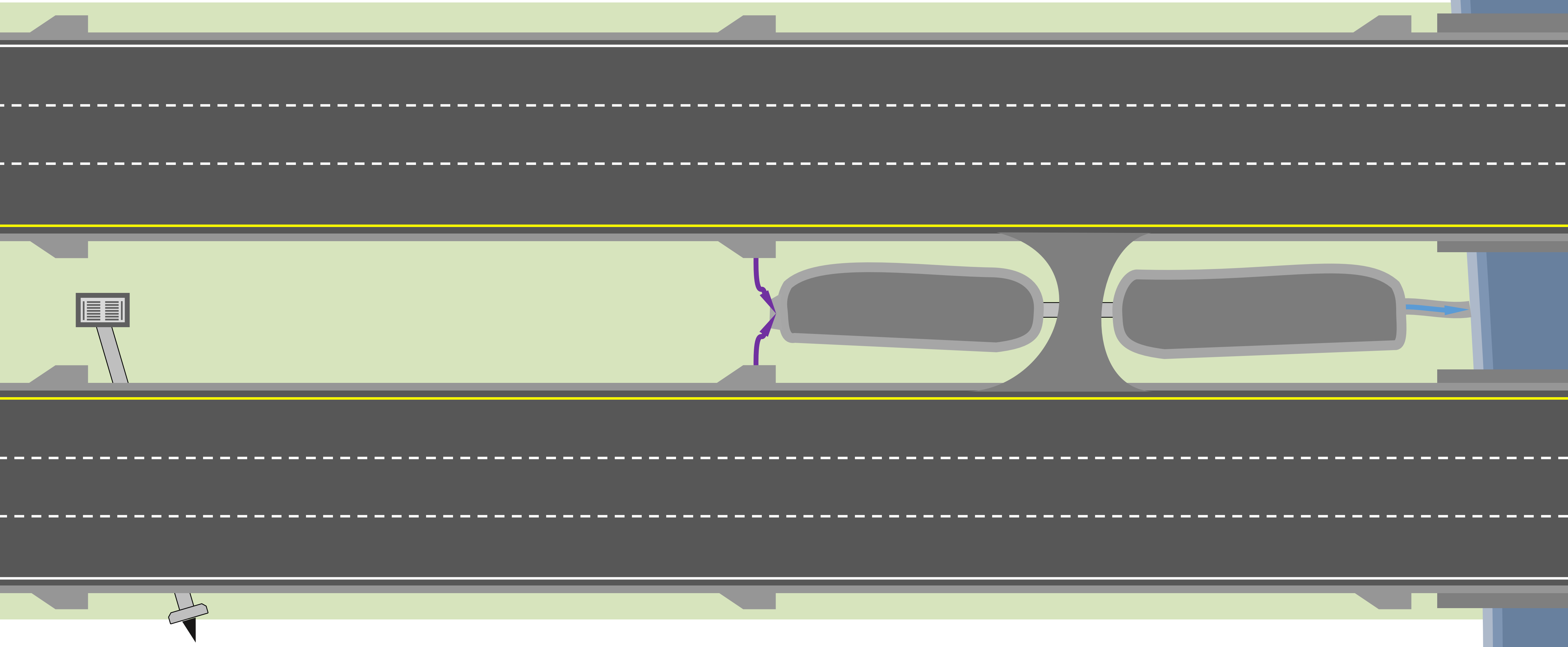
Velocity < 4 ft/s

- **If the Channel has:**
  - High Velocity
  - Supercritical Flow
- **Consider:**
  - Flattening Slope
  - Channel Armoring

Example 3

- **Given**
  - New lanes drain to a green space with potential for enhanced swale
  - Runoff Reduction is not possible due to poor soils
  - The Enhanced Dry Swale will be sized for water quality volume with two cells provided instead of only one

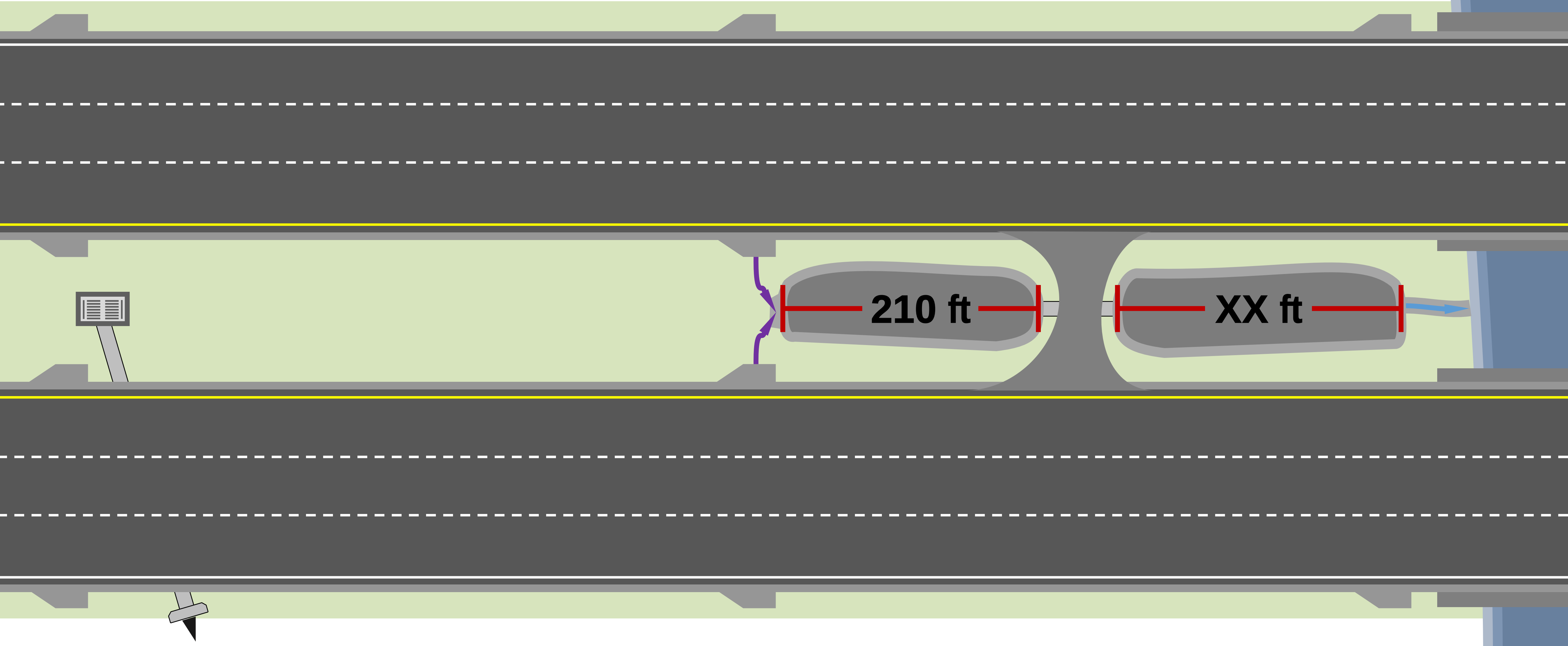
Example 3: Enhanced Dry Swale Design



Impervious area =1.86 ac

Total area = 2.07 ac

Example 3: Enhanced Dry Swale Design



WQv = 4,743 ft3

Width = 3.0 ft

Example 3: Solve for capacity of Cell No.1

$$W = \frac{A_f}{L}$$

$$A_{f\,(cell\ 1)} = W * L = 3.0\ ft\ *\ 210\ ft = 630\ ft^2$$

$$A_f = \frac{WQ_v * d_f}{k * \left(h_f + d_f\right) * t_f}$$

$$WQ_{v\,(cell\ 1)} = \frac{A_f * k * \left(h_f + d_f\right) * t_f}{d_f}$$

$$= \frac{630\ ft^2 * 2\frac{ft}{d} * (0.75\ ft + 2.5\ ft) * 2\ days}{2.5\ ft} = \boxed{3{,}276\ ft^3}$$

WQ_v capacity of Cell No. 1

Example 3: Determine Length of Cell No. 2

$$WQ_{v(cell\ 2)} = WQ_v - WQ_{v(cell\ 1)} = 4{,}743\ ft^3 - 3{,}276\ ft^3 = 1{,}467\ ft^3$$

$$A_{f\,(cell\ 2)} = \frac{WQ_v * d_f}{k * \left(h_f + d_f\right) * t_f} =$$

$$= \frac{1{,}467\ ft^3 * 2.5\ ft}{2\frac{ft}{d} * (0.75\ ft + 2.5\ ft) * 2\ days} = 282\ ft^2$$

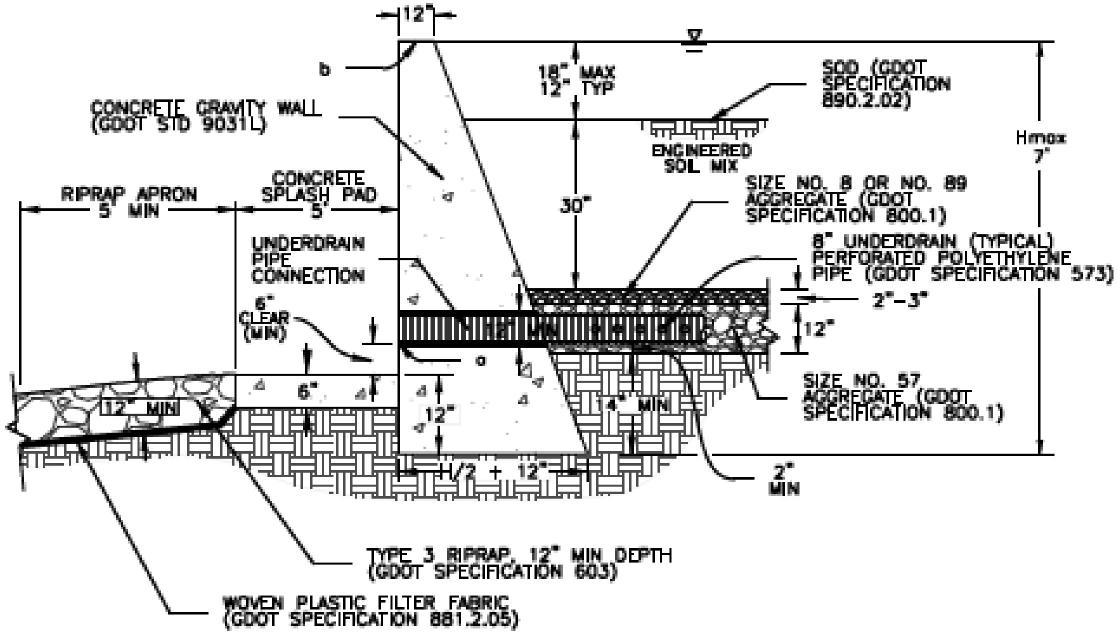
$$L_{(cell\ 2)} = \frac{A_f}{W} = \frac{282\ ft^2}{3.0\ ft} = \boxed{94\ ft}$$

Length of Cell No. 2

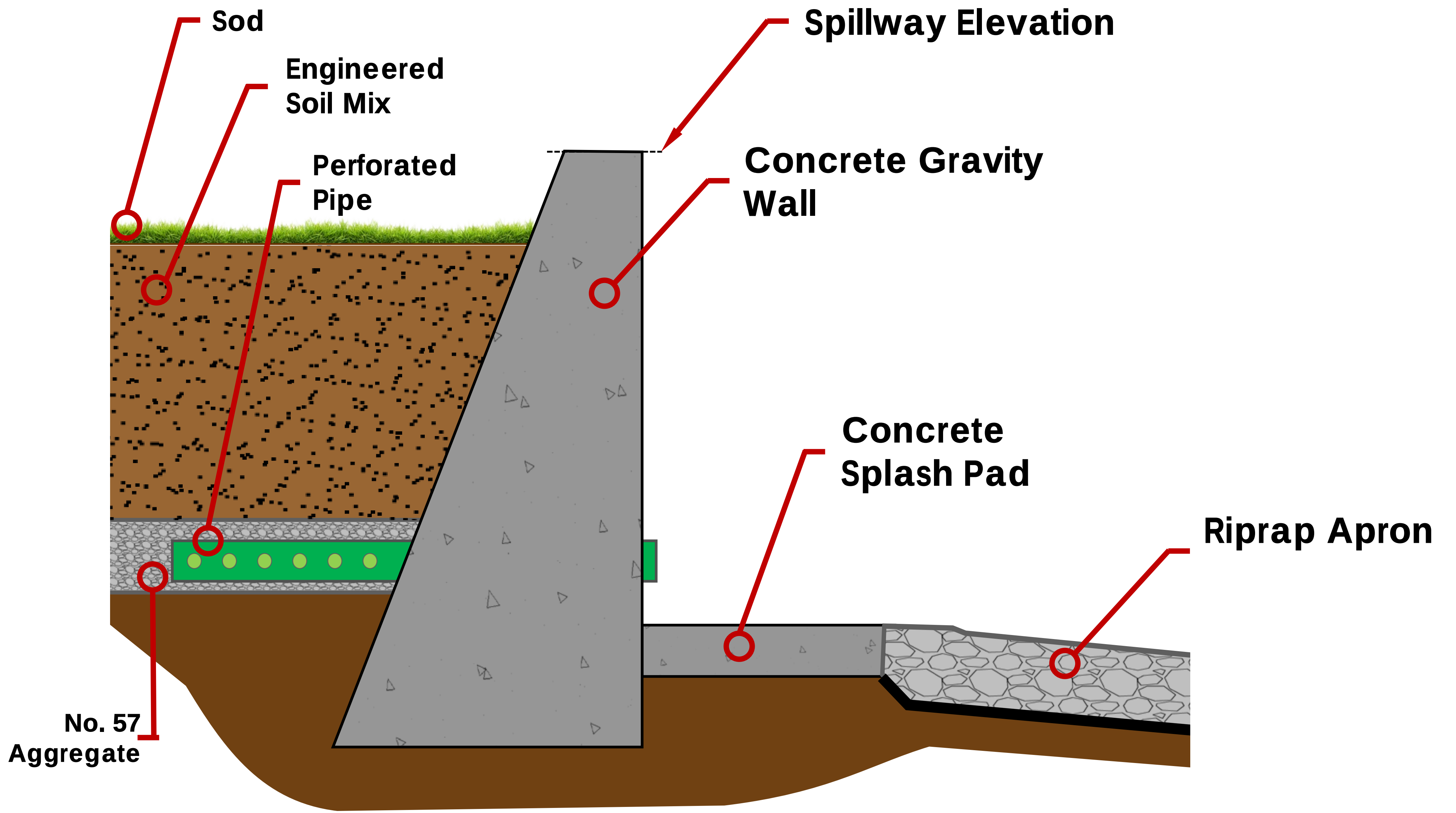
Outlet Control Structure design

Design outlet control structure and emergency overflow

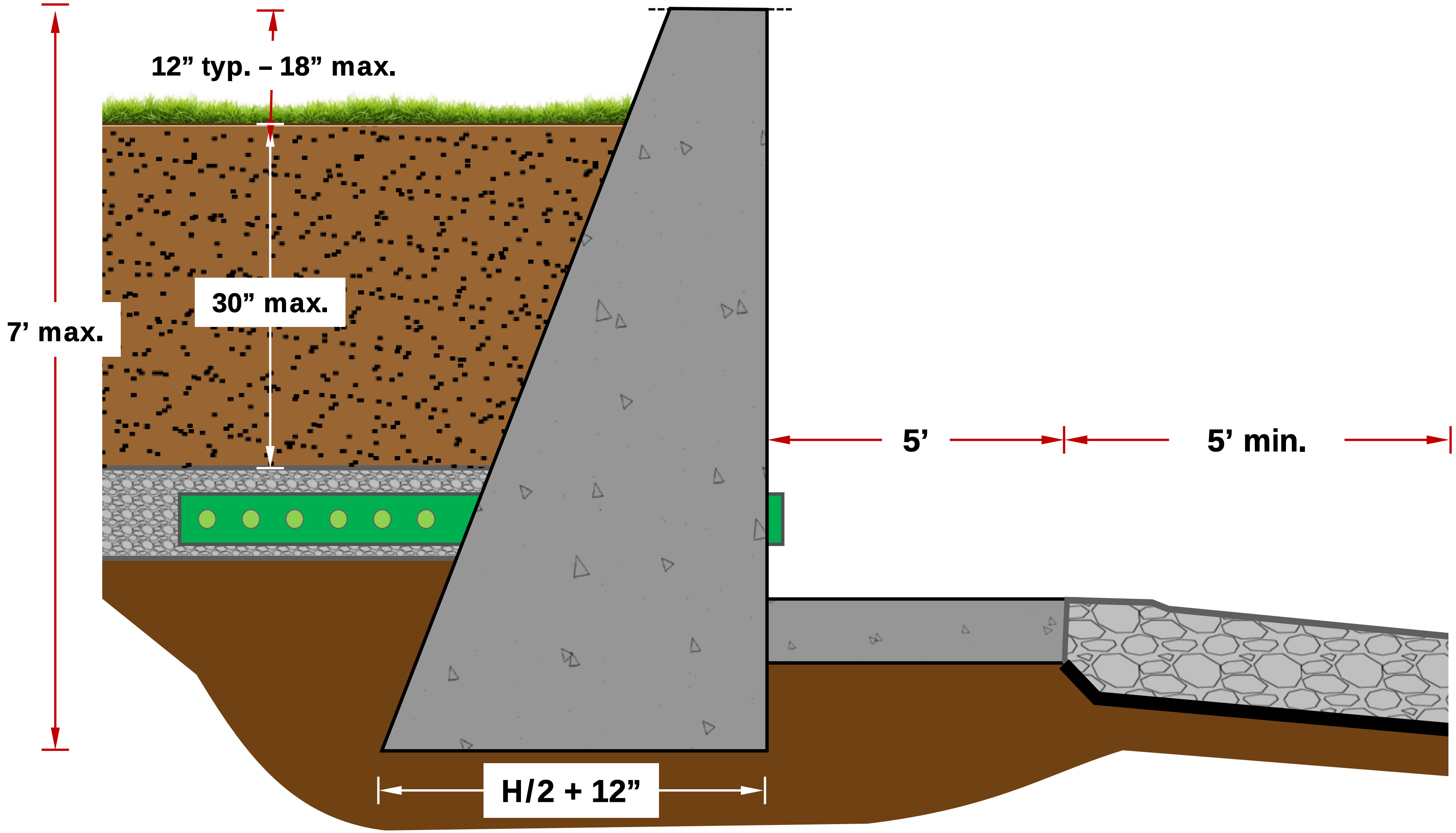
- Set overflow weir elevation at WQv (max. 18" above bottom of swale)
- Design weir to pass 25-yr, 24-hr flows
- Provide a minimum 6" of freeboard
- Design outlet control structure or channel to convey 100-yr, 24-hr flows



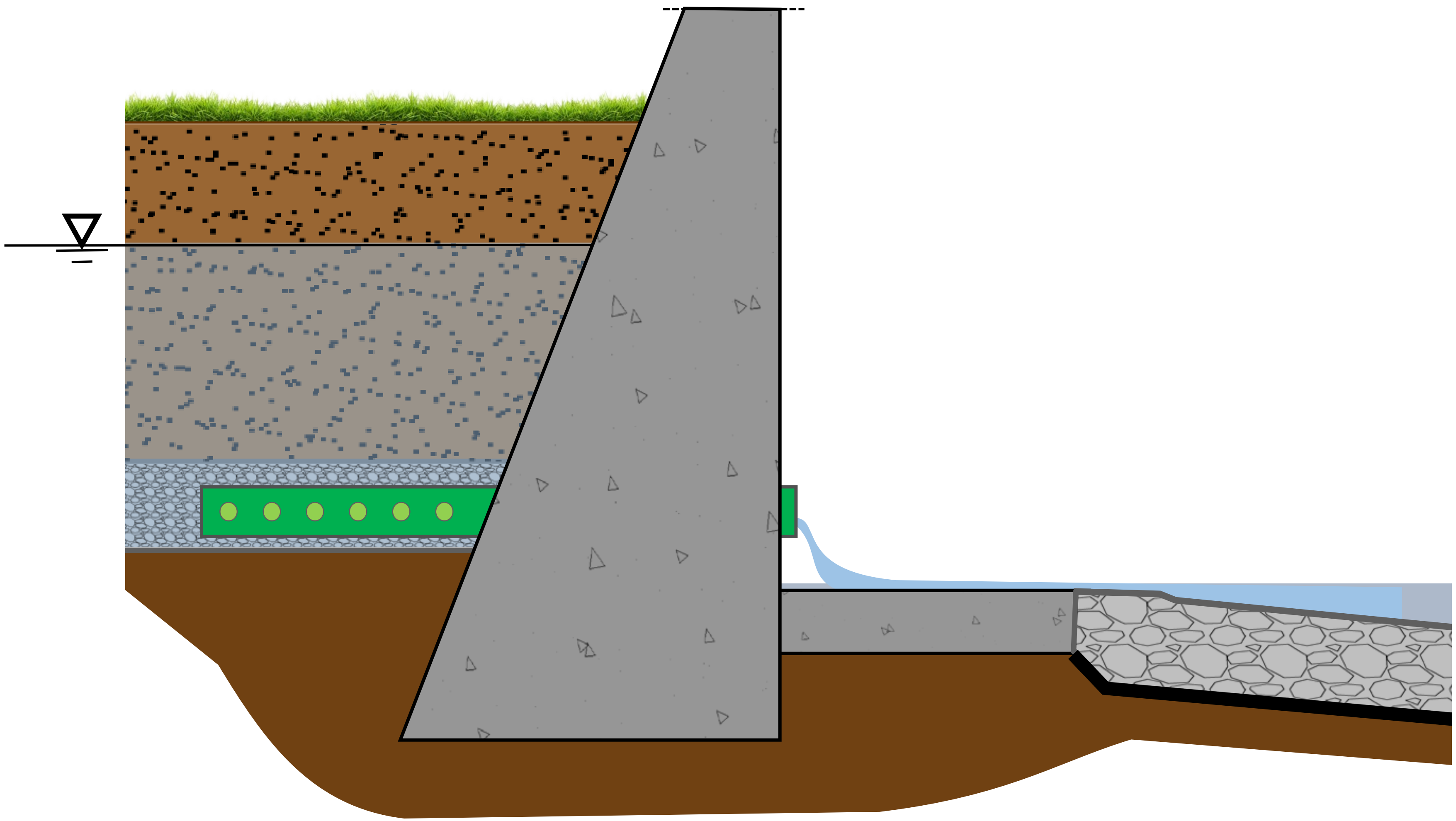
Outlet Control Structure



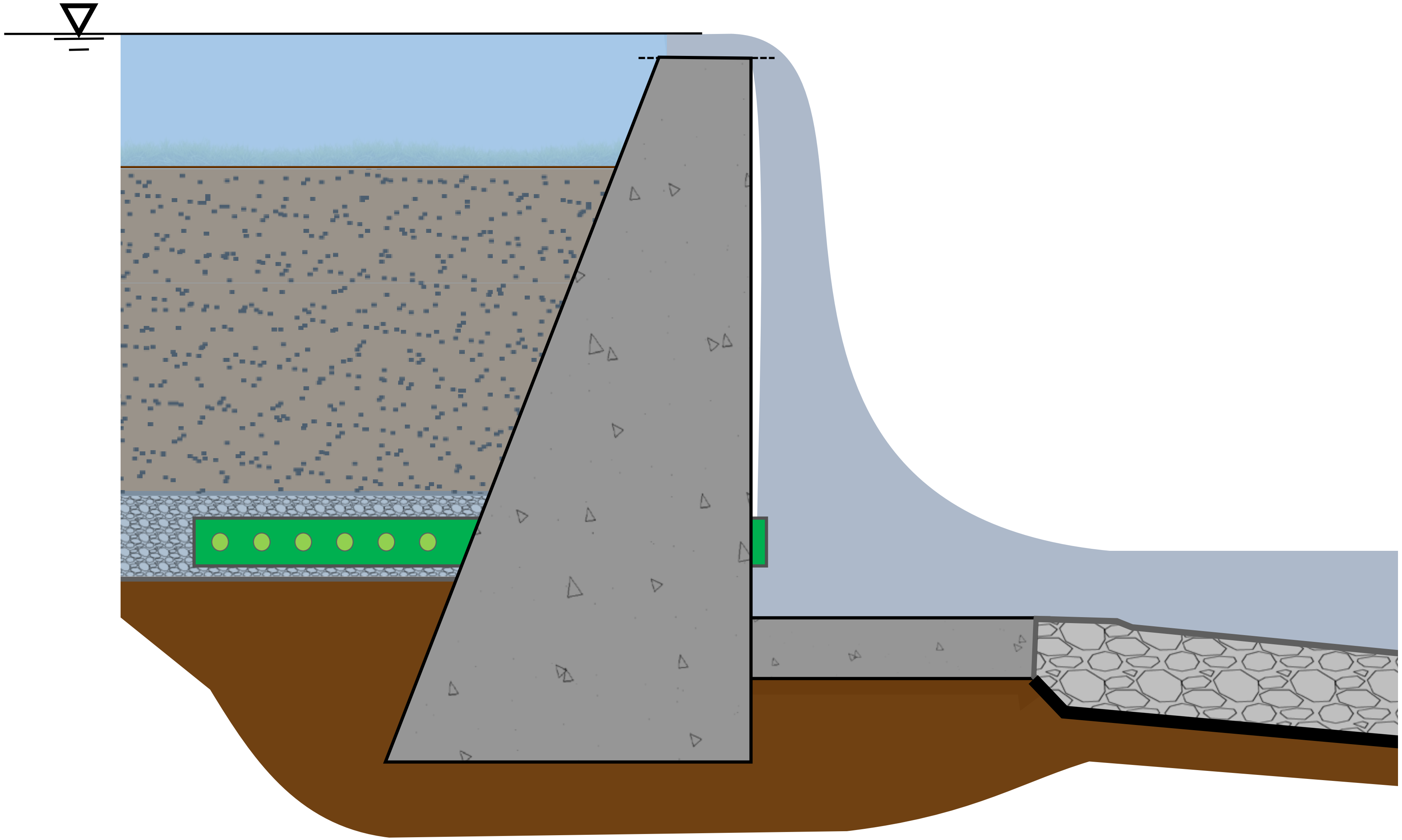
Outlet Control Structure

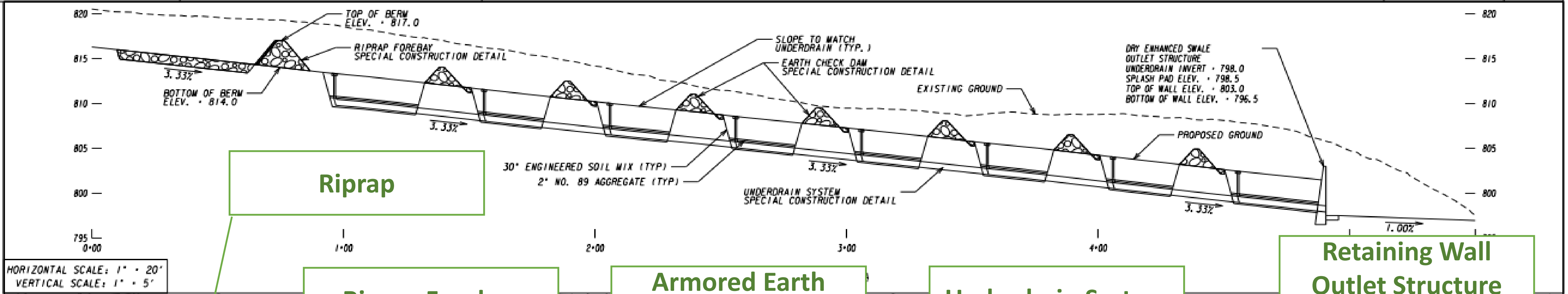


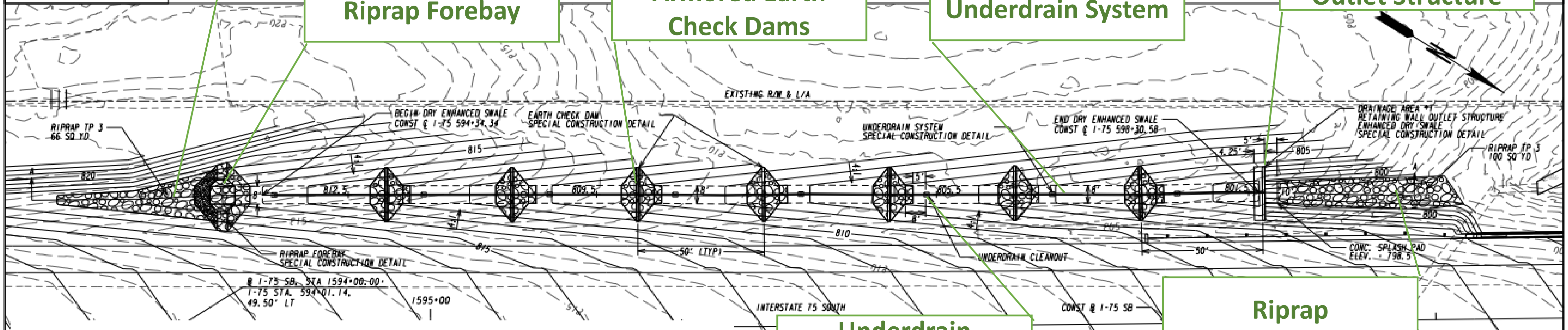
Outlet Control Structure



Outlet Control Structure







NOTES:

1. CHECK DAMS ARE TO BE USED ONLY IN SMALL OPEN CHANNELS (THEY ARE NOT TO BE USED IN LIVE STREAMS).
2. THE DRAINAGE AREA FOR STONE CHECK DAMS SHALL NOT EXCEED TWO ACRES.
3. THE CENTER OF THE CHECK DAM MUST BE AT LEAST 9 INCHES LOWER THAN THE OUTER EDGES.
4. THE DAM HEIGHT SHOULD BE A MAXIMUM OF 2 FEET FROM CENTER TO RIM EDGE.
5. THE SIDE SLOPES OF THE CHECK DAM SHALL NOT EXCEED A 2:1 SLOPE.
6. GEOTEXTILE SHALL BE USED TO PREVENT THE MITIGATION OF SUBGRADE SOIL PARTICLES INTO THE STONES (REFER TO AASHTO M288-96, SECTION 7.3, TABLE 3).

CONST ℄ I-75

INTERSTATE 75 NORTH

APPLICABLE DETAILS (NOT REQUIRED ON PLANS)
ENHANCED DRY SWALE OUTLET STRUCTURE SPECIAL CONSTRUCTION DETAIL
UNDERDRAIN SYSTEM SPECIAL CONSTRUCTION DETAIL
CHECK DAM SPECIAL CONSTRUCTION DETAIL
RIPRAP FOREBAY SPECIAL CONSTRUCTION DETAIL

OUTLET STRUCTURE DESIGN DATA

X	Y	H	Event	INVERT ELEV.	UNDERDRAIN DIA. (IN)	WEIR LEN. (FT)
4.25 FT	24 FT	6.5 FT	a	798.0	8	N/A
			b	803.0	N/A	20.0

SPLASH PAD ELEV. = 797.5
BOTTOM OF WALL ELEV. = 796.5
25-YR, 24-HR WSE = 803.62
TOP OF BERM / WALL ELEV. = 803.0
TOP OF BERM WIDTH = N/A

OUTLET STRUCTURE AS-BUILT DATA

X	Y	H	Event	INVERT ELEV.	UNDERDRAIN DIA. (IN)	WEIR LEN. (FT)
			a			N/A
			b		N/A	

SPLASH PAD ELEV. =
BOTTOM OF WALL ELEV. =
TOP OF BERM / WALL ELEV. =
TOP OF BERM WIDTH =

SCALE IN FEET
0 20 40 80

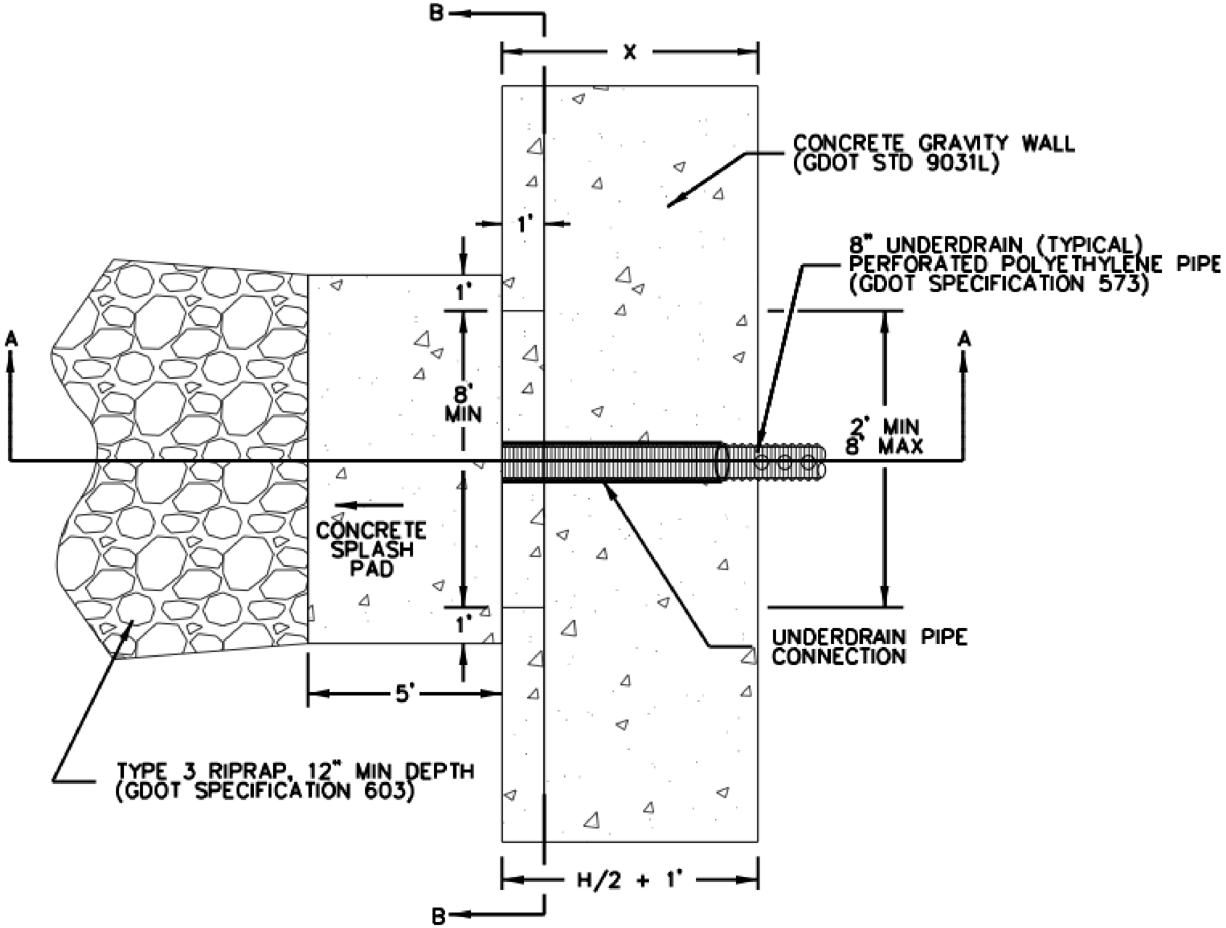
REVISION DATES

SPECIAL CONSTRUCTION DETAIL
ENHANCED DRY SWALE
SHEET 1 OF 2

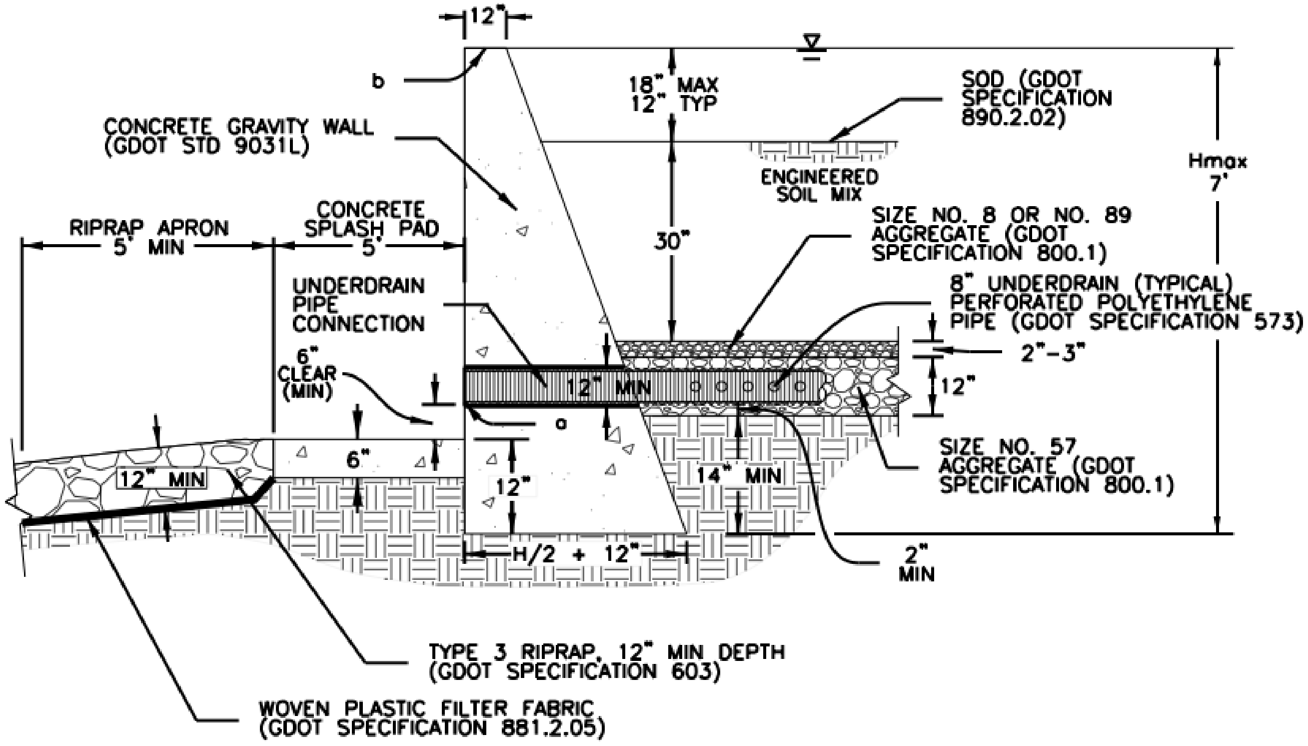
CHECKED: DATE:
BACKCHECKED: DATE:
CORRECTED: DATE:
VERIFIED: DATE:

DRAWING No. 38-

OCS Option a – retaining wall



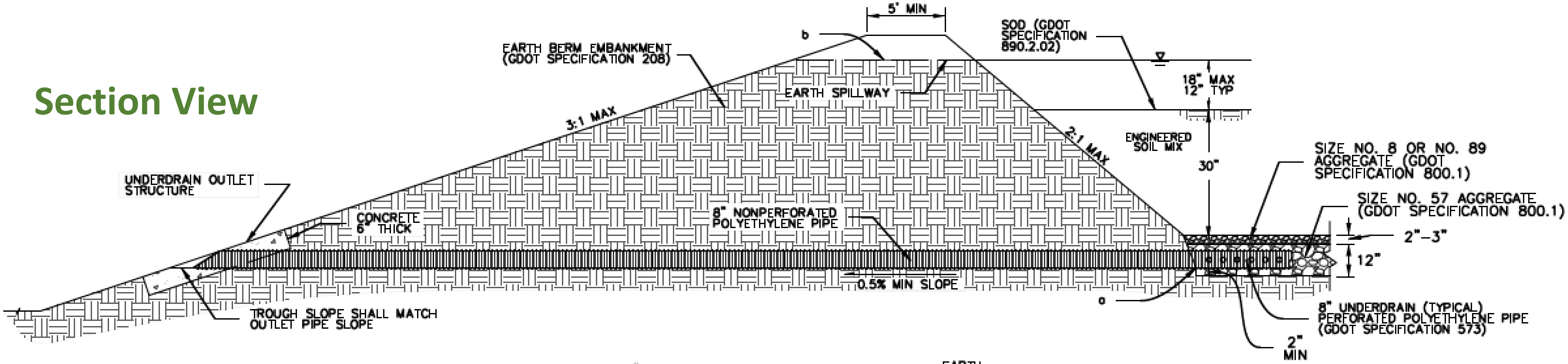
RETAINING WALL OUTLET
PLAN VIEW



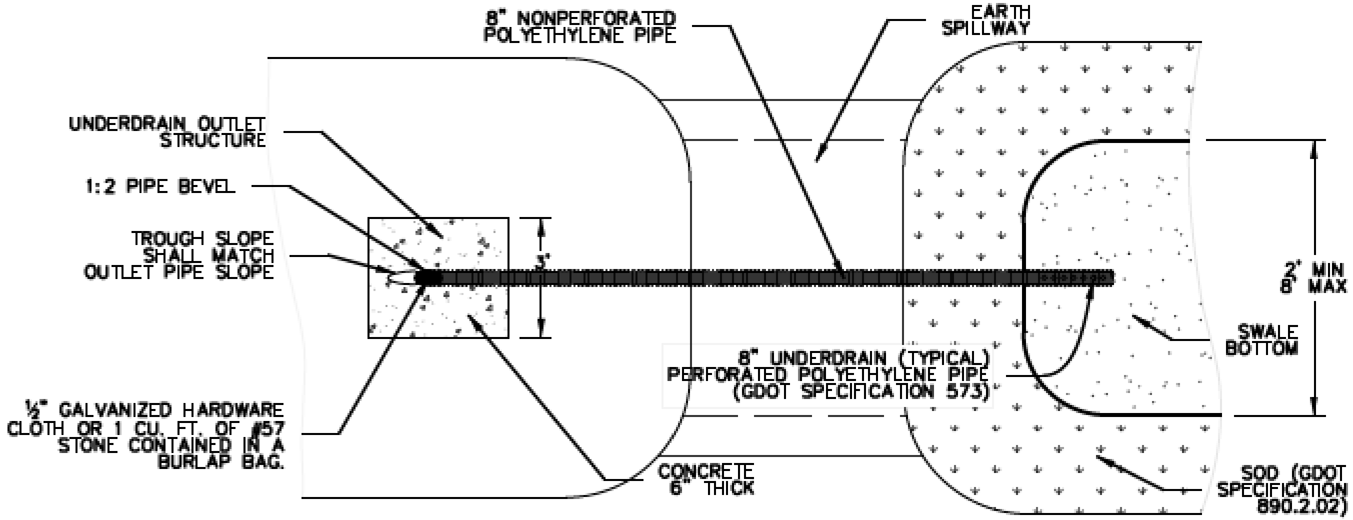
RETAINING WALL OUTLET
SECTION A–A

OCS Option B – earth berm

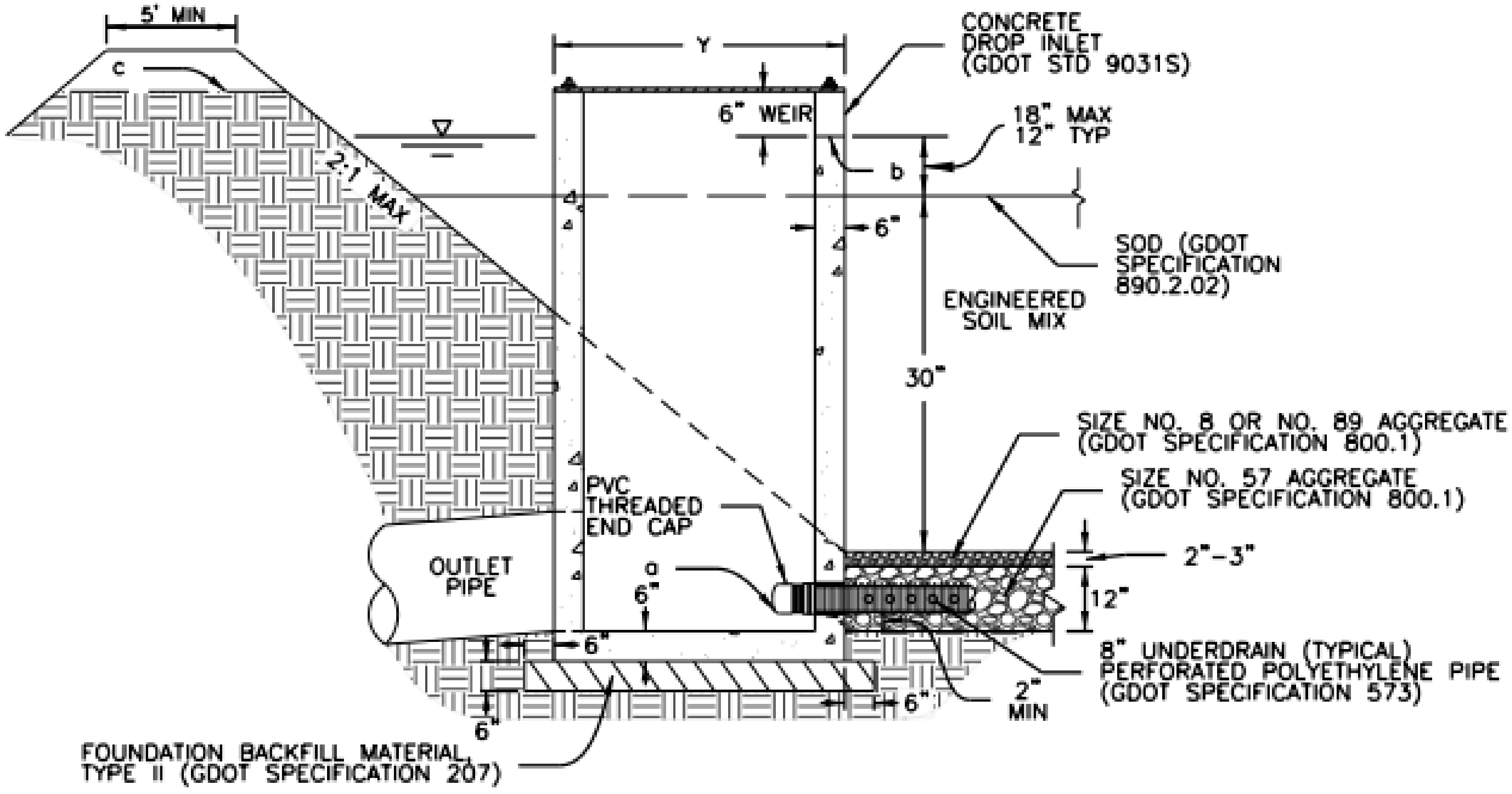
Section View



Plan View



OCS Option C – concrete drop inlet



CONCRETE DROP INLET

SECTION C–C

Questions

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More GDOT Advanced Design Workshops are available at https://learning.dot.ga.gov