Extended Detention Practices
Table 4a

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Division of Surface Water

Northeast Ohio Stormwater Training Council

Cleveland, Ohio — **July 12, 2018**

Richfield, Ohio — **July 25, 2018**

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Table 4a Extended Detention Post-Construction Practices with Minimum Drain Times

Extended Detention Practices	Minimum Drain Time of WQv
Wet Extended Detention Basin[1,2]	**24 hours**
Constructed Extended Detention Wetland[1,2]	24 hours
Dry Extended Detention Basin[1,3]	**48 hours**
Permeable Pavement – Extended Detention[1]	24 hours
Underground Storage – Extended Detention[1,4]	**24 hours**
Sand & Other Media Filtration – Extended Detention[1,5]	24 hours

- What did the Construction General Permit change ?
- What may change in the RWLD manual ?
- Common issues / challenges

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Dry Extended Detention Basin

What did the permit change ?

- Allows for acceptable pretreatment in place of a forebay and micropool.
- Must include a protected outlet.

What will be changing in the RWLD Manual ?

- Standards for acceptable pretreatment practices and protected outlet. (Appendix 10)

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Dry Extended Detention Basin

Acceptable alternatives must be equivalent to a forebay & micropool:

- Remove 50% of annual TSS load.
- Require minimal maintenance and oversight for long-term functioning of the extended detention volume.
- Prevent scour/erosion at pipe outfalls.

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Pretreatment Alternatives

IMAGE SOURCE: VA DEQ Stormwater Design Specification No. 10

Grass Swale

Vel. ≤1 ft/s @ d ≤ 4 in.

W = 4 ft. to 8 ft.

L ≥ 50 ft.

S ≤ 4% (< 1% may be an issue)

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Pretreatment Alternatives

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Pretreatment Alternatives

Grass Filter Strip

Full width of pavement

L ≥ 10 ft.

Dense turf

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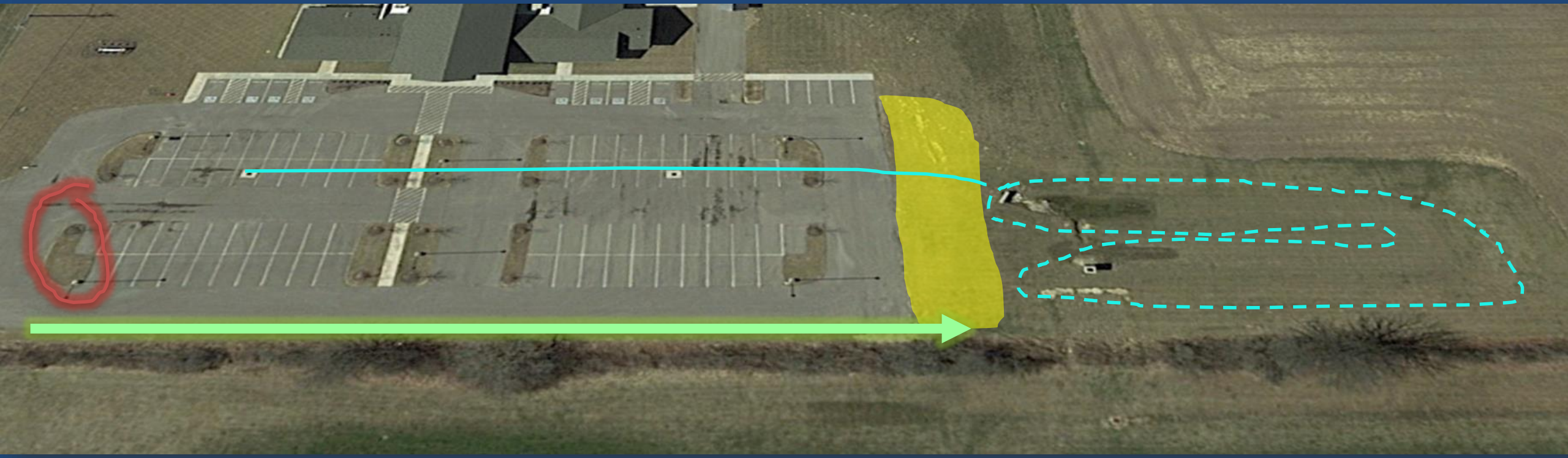
Pretreatment Alternatives



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Pretreatment Alternatives

Manufactured Treatment Device

Still need erosion/scour protection at basin inlet.

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Pretreatment Alternatives

Deep Sump Trap or Catch Basin

Possible for small drainage areas:

parking lot catch basin (6 ft dia.)
4 ft x 28.3 ft^2 = 113 ft^3
@ 10%, WQv = 1,132 ft^3
~ 1,600 ft^2 max. impervious d.a.

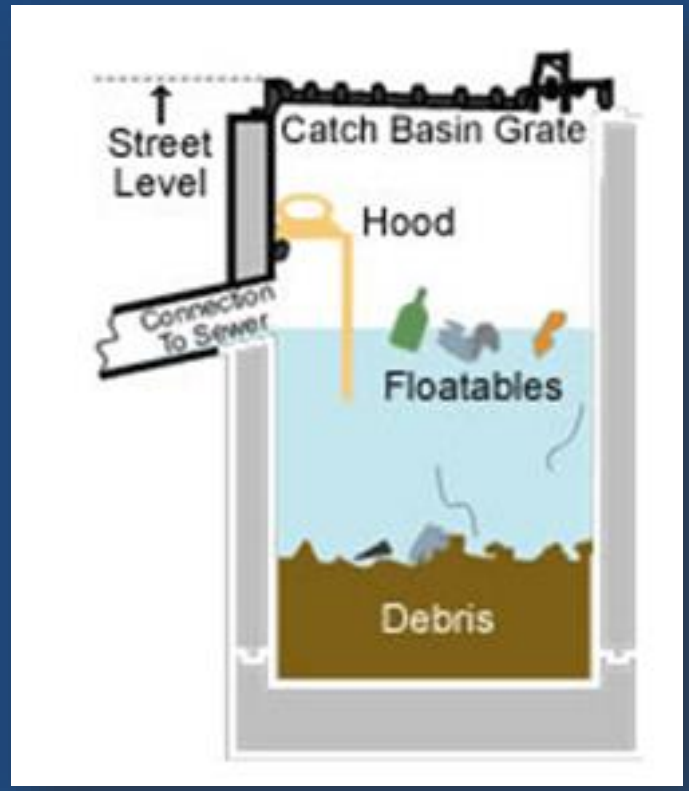

IMAGE SOURCE: USEPA

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Dry Forebay… Possibly

- Not much research
- Need to develop standards
- May need test sites

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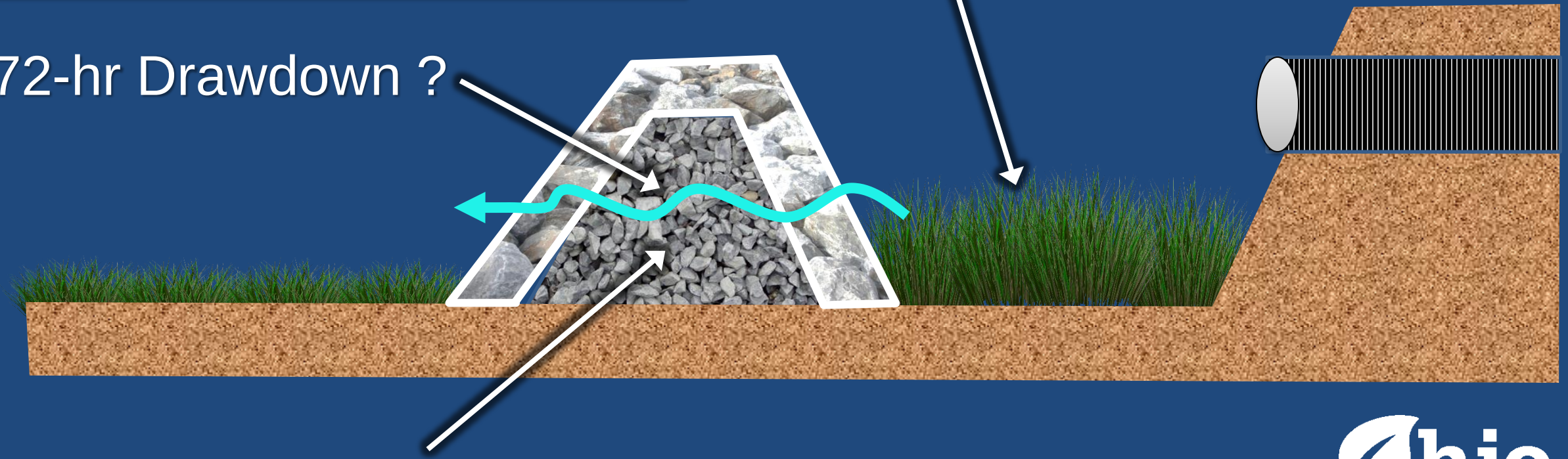
Dry Forebay… Possibly

Concept based on: UDFCD, Urban Storm Drainage Criteria Manual Vol. 3 (2015)

10% - 20% WQv

72-hr Drawdown ?



Permeable Dike

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Dry Forebay… Possibly

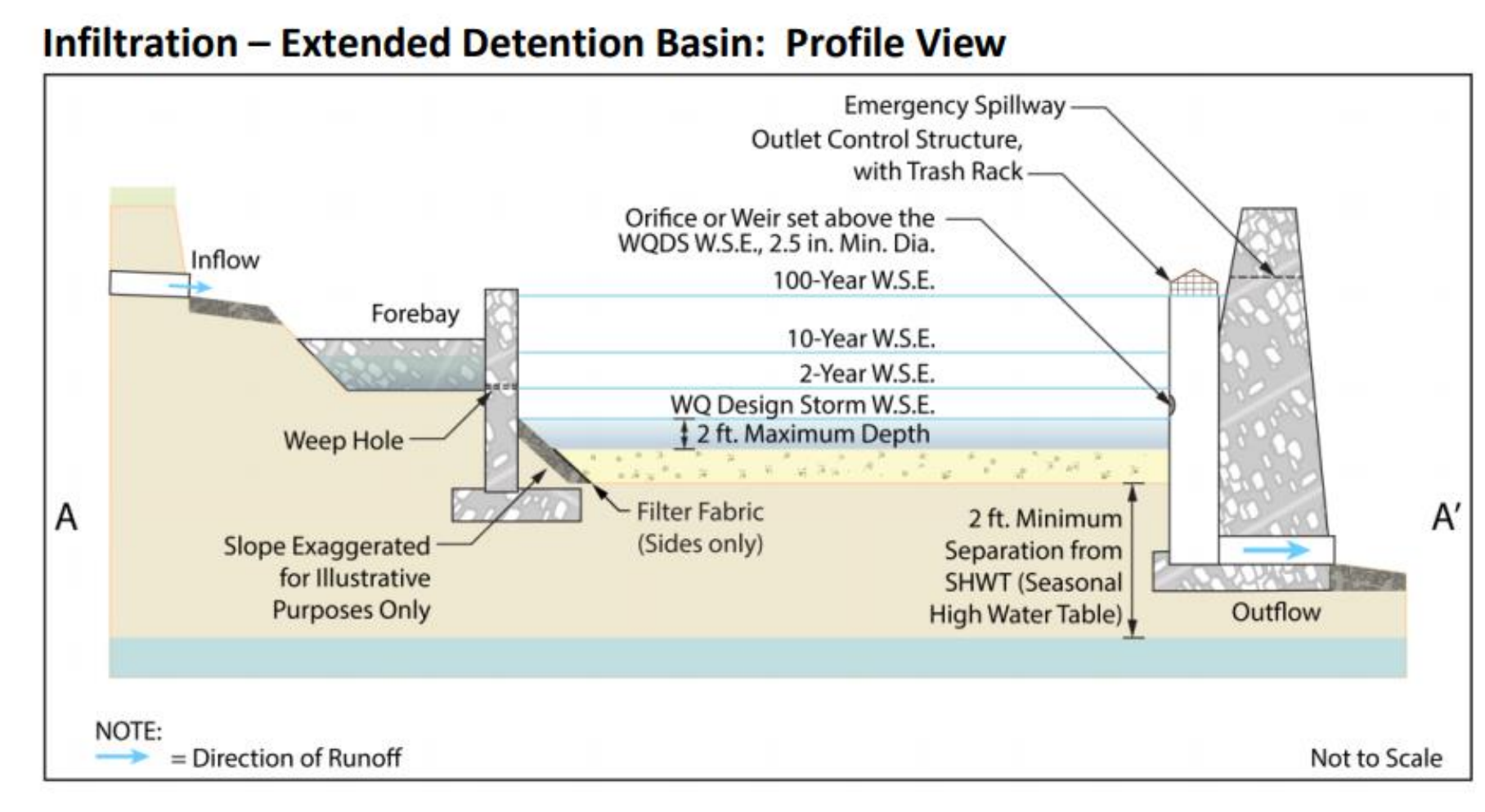

IMAGE SOURCE: NJ Stormwater BMP Manual, Chapter 9.5 Infiltration Basins

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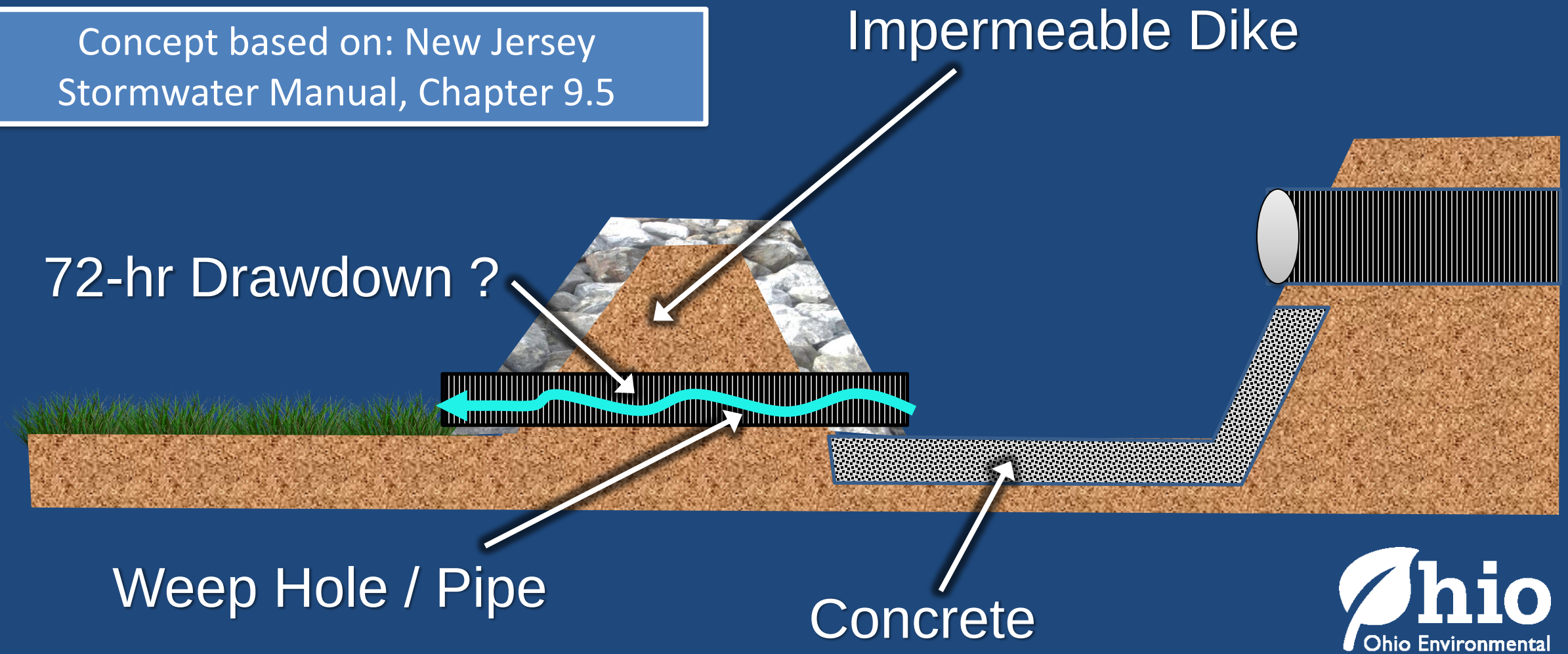
Dry Forebay… Possibly

Concept based on: New Jersey Stormwater Manual, Chapter 9.5



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Protected Outlet

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Protected Outlet

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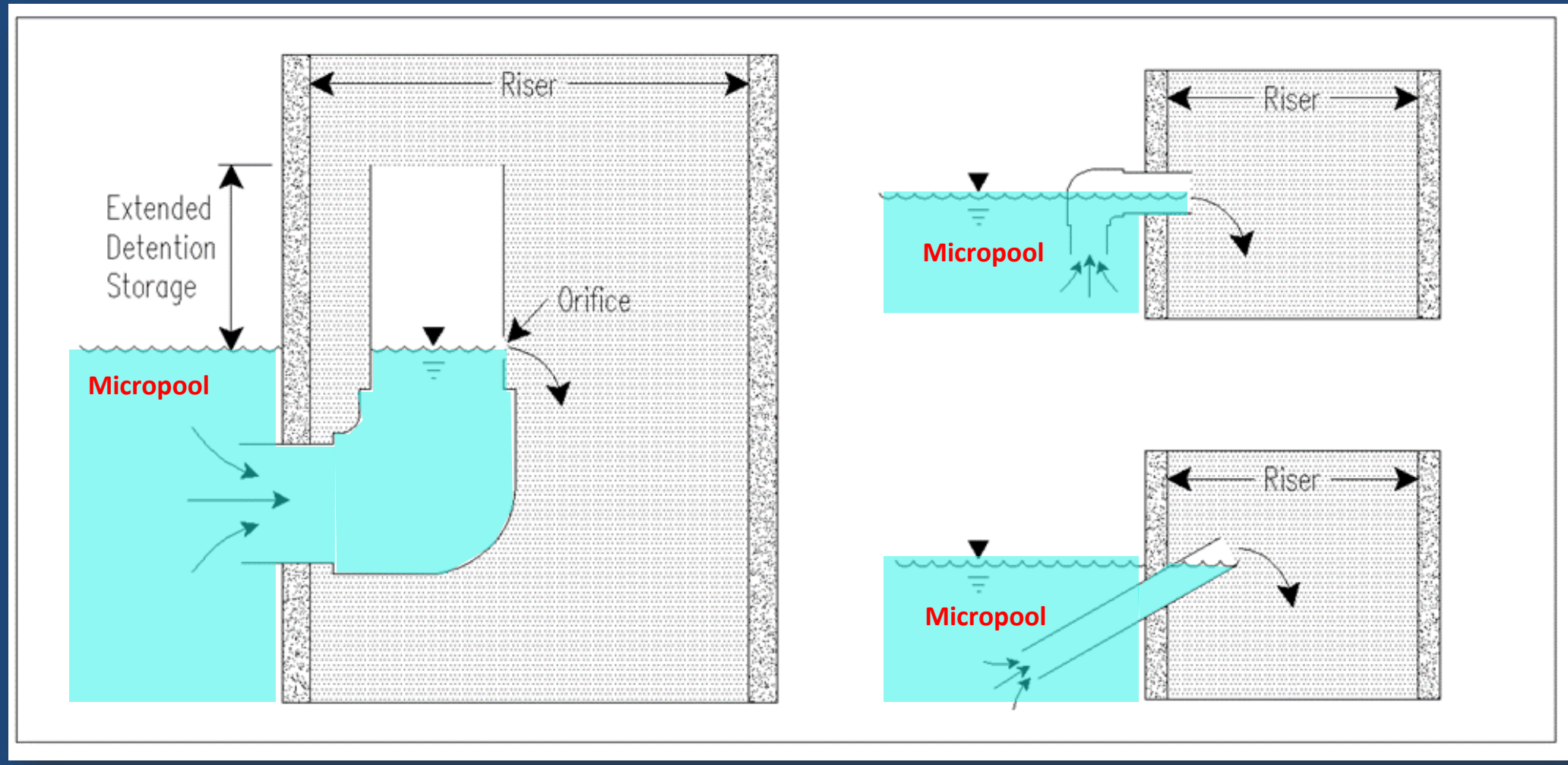
Protected Outlet



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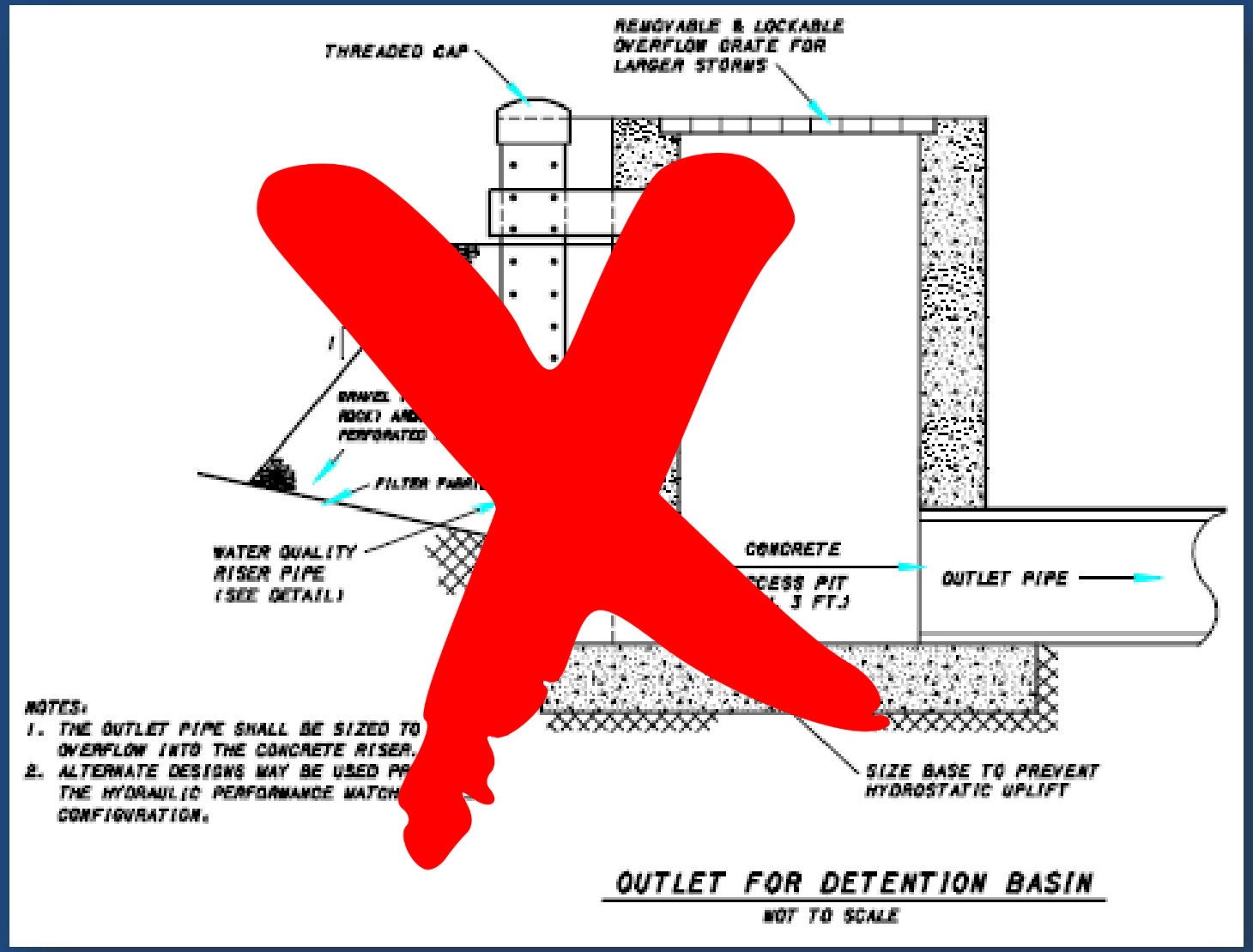
Protected Outlet



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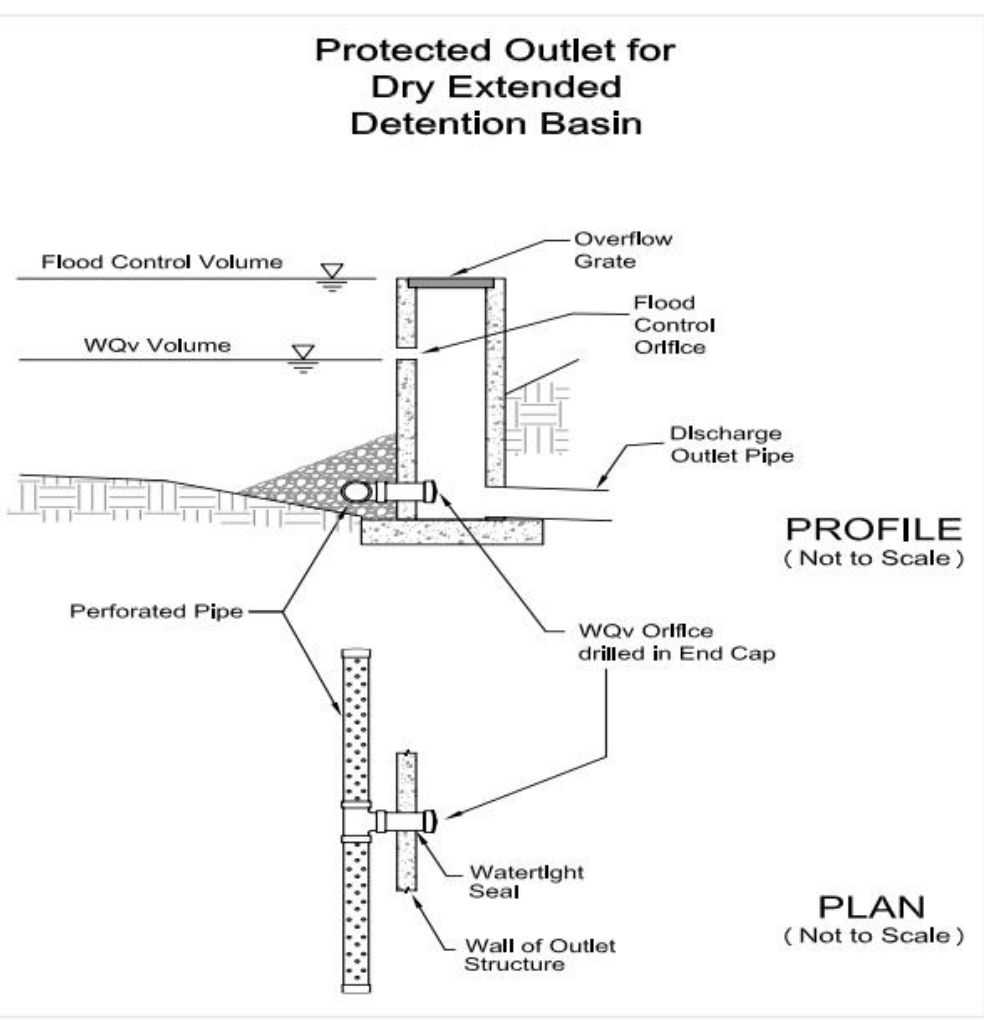
Protected Outlet



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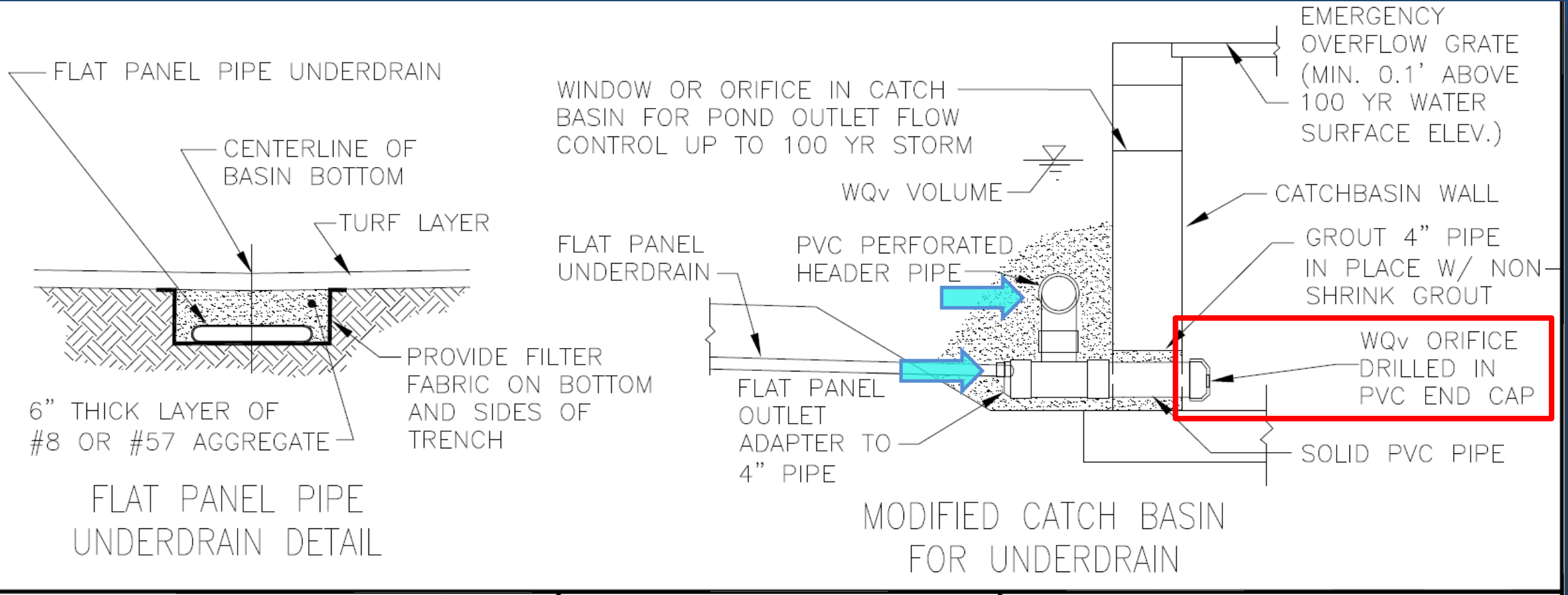
Protected Outlet



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STANDARD CONSTRUCTION DRAWING

DETENTION BASIN

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Protected Outlet

IMAGE SOURCE: www.ads-pipe.com/products/pipes/advanedge-panel/advanedge-site-drain-pipe

Protected Outlet

"The filter under drain system at Carver County dry detention pond exhibited poor hydraulic performance and failed to keep the pond dry between the storm events."

"Continual maintenance is required to maintain the filter system in an operational condition."

-Minnesota DOT. 2006. Water Quality Performance of Dry Detention Ponds with Under-Drains. Mn/RC-2006-43.

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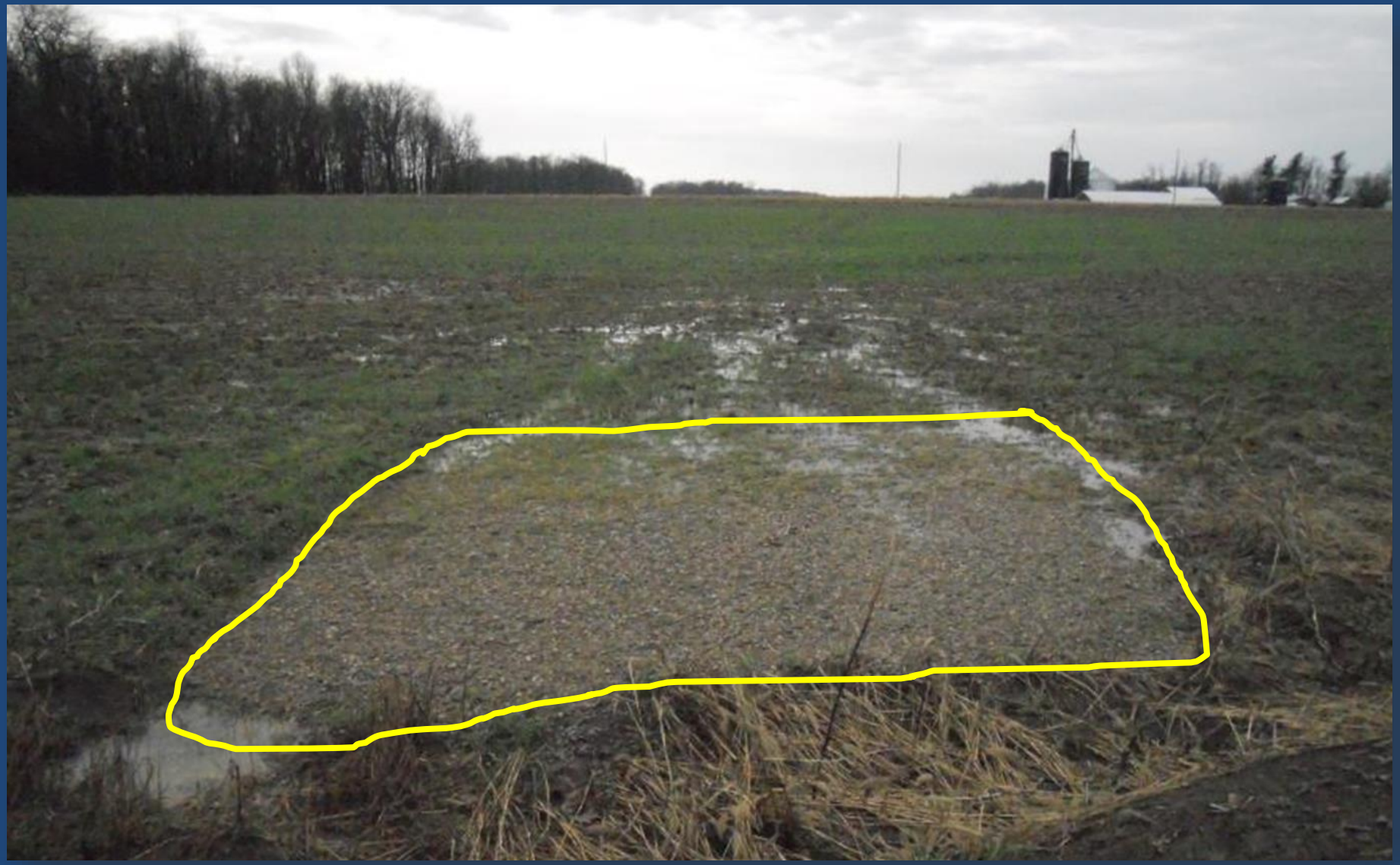
Protected Outlet



Agricultural "blind inlet" to field tile

24-hr drawdown

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Protected Outlet

"designed to catch sediment and therefore, eventually fail and require maintenance"

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Dry Extended Detention Basin

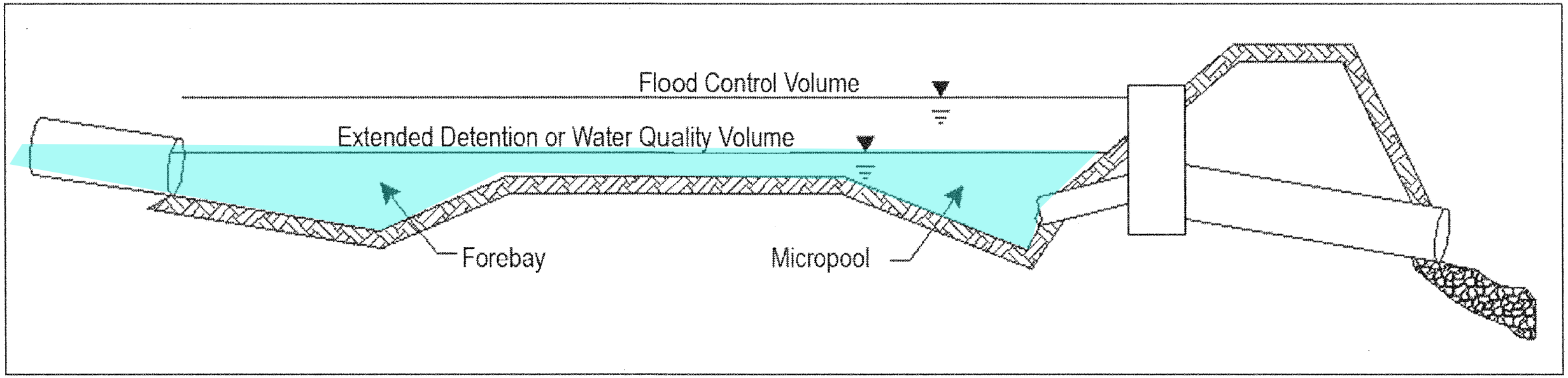

Fig 2.6.4 Storm Water Pond with Extended Detention and Flood Control Volumes

Pool Volume = WQv + 20% sediment

Pool Volume = WQv + 10% forebay + 10% micropool

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Wet Extended Detention Basin

What did the permit change ?

– Permanent pool volume and extended detention volume are now both equal to the WQv (was ¾ WQv).

What will be changing in the RWLD Manual ?

– Not much.

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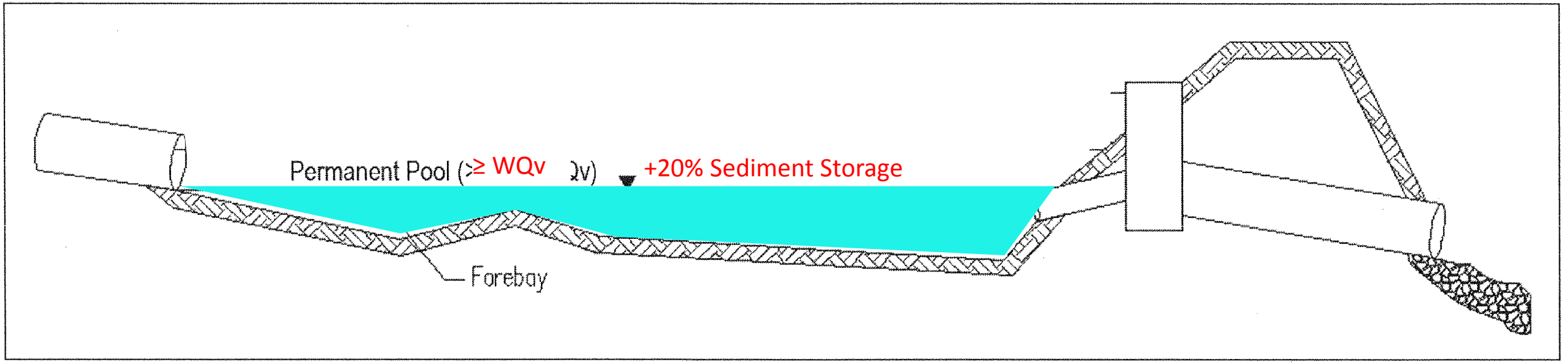

Figure 2.6.5 Wet Storm Water Pond with Extended Detention and Flood Control Volumes

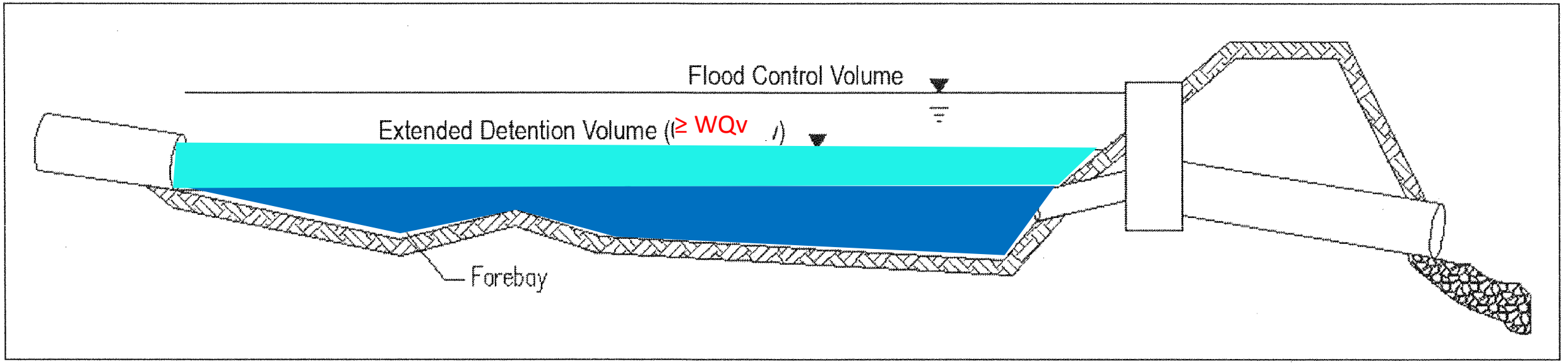

Figure 2.6.5 Wet Storm Water Pond with Extended Detention and Flood Control Volumes

Extended Drawdown

- Wet & underground: 24-hour minimum
- Dry: 48-hour minimum

- Shall not discharge more than the first half of the WQv in less than one-third of the drain time.

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Extended Drawdown

Subwatershed Details

Subwatershed ID/Label:	NEOSTC Example				
Subwatershed Drainage Area, A_{total} =	**5.00**	**acres**	**=**	**217,800**	**ft^2**
Subwatershed Impervious Area, A_{imp} =	**2.75**	**acres**	**=**	**119,790**	**ft^2**
Imperviousness fraction, i =	**0.55**		**=**	**55**	**%**
Volumetric Runoff Coefficient, Rv =	**0.55**				
Water Quality Volume, WQv =	**8,903**	**ft^3**			

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Extended Drawdown

Step 2 - Dry ED Basin Volume Requirements		
Extended Detention Volume, EDv =	8903	ft^3
Minimum Sediment Storage Volume, $V_{sediment}$ =	1781	ft^3
Minimum Forebay Volume, $V_{forebay}$ =	890	ft^3
Minimum Permanent Micropool Volume, $V_{micropool}$ =	890	ft^3

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Extended Drawdown

Step 3 - Basin Stage-Storage Relationship					
				Incremental	Cumulative
	Elevation	Area		Volume	Volume
	ft	ft^2		ft^3	ft^3
Bottom of Permanent Micropool =	96.00	400			
(include forebay area if below EDv)	99.90	700		**2,118**	**2,118**
	100.00	5,000		**252**	**2,370**
	100.50	5,433		**2,608**	**4,978**
	101.00	5,884		**2,829**	**7,806**
	101.50	6,353		**3,059**	**10,865**
	102.00	6,841		**3,298**	**14,163**
	102.50	7,346		**3,546**	**17,709**
	103.00	7,869		**3,803**	**21,512**
	103.50	8,410		**4,069**	**25,581**
	104.00	8,970		**4,344**	**29,925**

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Extended Drawdown

Step 4 - Outlet Elevations and Storage Volumes					
WQ Orifice Invert Elevation =	100.00				
Elevation of Top of EDv =	101.60				
Secondary Outlet Invert Elevation =	101.60				OKAY
WQ Treatment Volume Provided, $V_{treatment}$ =	8,932	ft^3			
Treatment Vol Provided Relative to EDv, $V_{treatment}/Edv$ =	1.00		=	100%	OKAY
Permanent Pool Volume Provided, PPv =	2,963	ft^3			
Forebay Volume Provided, $V_{forebay}$ =	1,000	ft^3	=	1.12	
Is forebay volume below WQ outlet? (Yes or No)	Yes		=	112%	OKAY
Permanent Micropool Volume Provided, $V_{micropool}$ =	1,963	ft^3			
Ratio $V_{micropool}$ Provided to $V_{micropool}$ Required =	2.20		=	220%	OKAY
Sediment Storage Volume Provided, $V_{sediment}$ =	2,963	ft^3			
Ratio $V_{sediment}$ Provided to $V_{sediment}$ Required =	1.66		=	166%	OKAY

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Extended Drawdown

Step 5 - Outlet (Orifice) Sizing

Maximum Hydraulic Head, Hmax =	1.59	ft			
Orifice Coefficient, C =	0.6				
Target (Minimum) Draw-down Time, T_d =	48	hr			
Target Average Discharge, Q_{avg} =	0.05	cfs			
Average Hydraulic Head, H_{avg} =	0.79	ft			
Estimated Orifice Area, $A_{orifice}$ =	1.73	in^2	=	0.012	ft^2
Estimated Orifice Diameter, $D_{orifice}$ =	1.48	in	=	0.12	ft
Design Orifice Diameter, $D_{orifice}$ =	1.50	in	=	0.13	ft
Design Orifice Area, $A_{orifice}$ =	1.76	in^2	=	0.012	ft^2
Time to Completely Drain EDv, T_d =	68	hr	must be ≥ 48 hr		OKAY
Volume Drained in First 16 hr =	3,728	ft^3			
% of EDv =	41.9	%	must be ≤ 50%		OKAY

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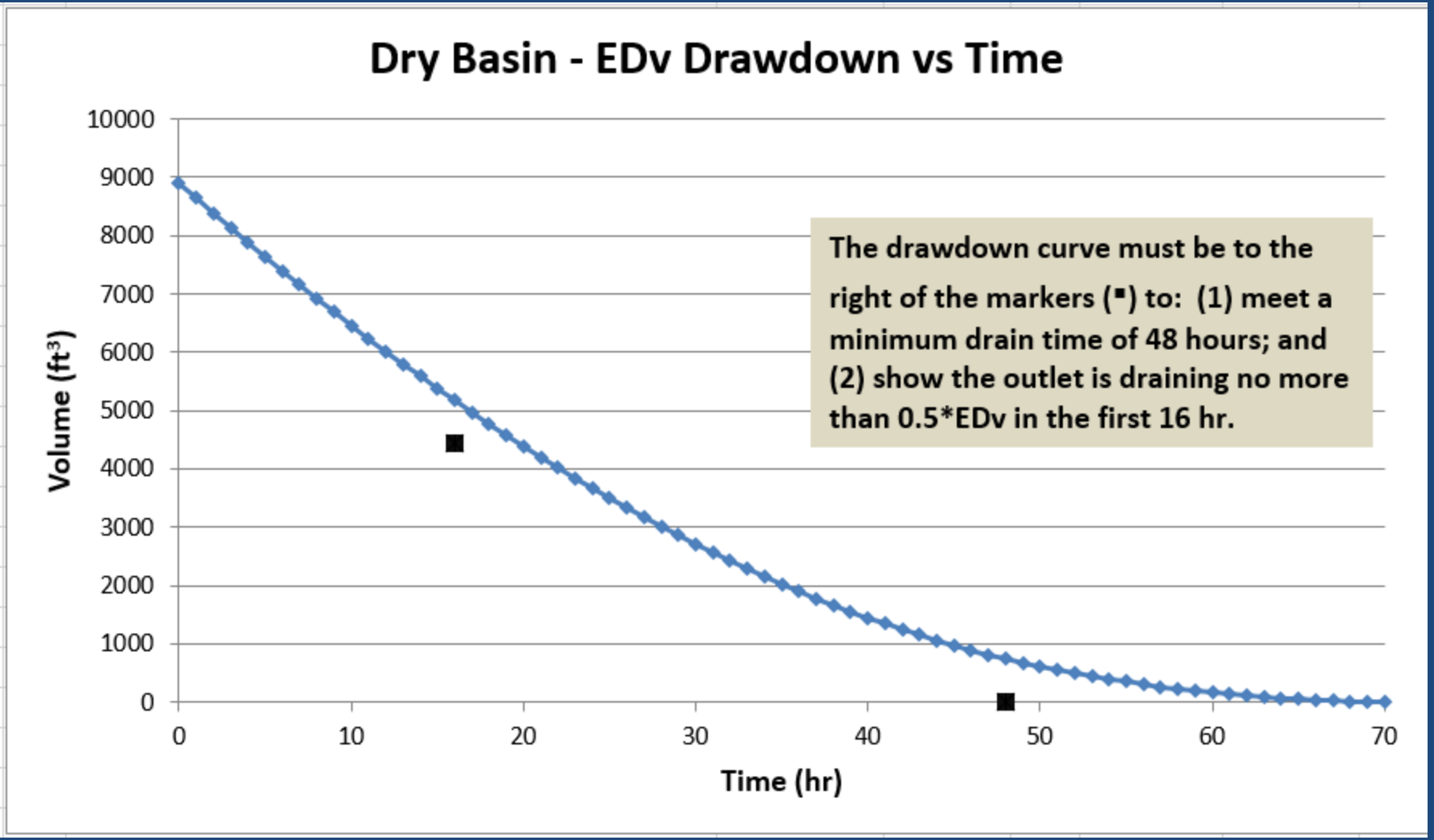
Extended Drawdown



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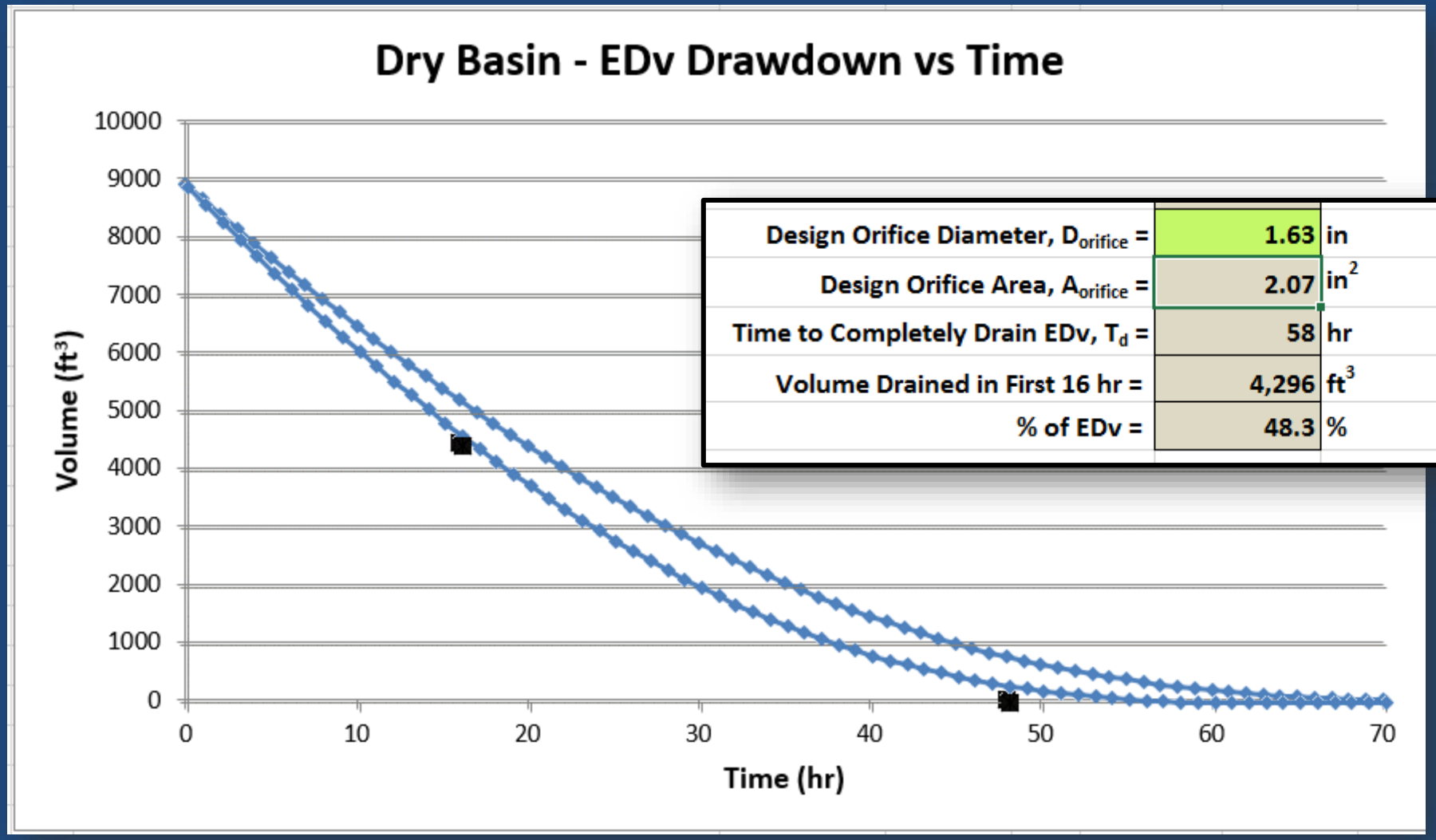
Extended Drawdown



Design Orifice Diameter, $D_{orifice}$ =	1.63	in	=	0.14	ft
Design Orifice Area, $A_{orifice}$ =	2.07	in^2	=	0.014	ft^2
Time to Completely Drain EDv, T_d =	58	hr	must be ≥ 48 hr	OKAY	
Volume Drained in First 16 hr =	4,296	ft^3			
% of EDv =	48.3	%	must be ≤ 50%	OKAY	

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Extended Drawdown – 2” Min.

- As designed, the acre basin with a 1⅝ in. diameter orifice.
- What if the local authority has a minimum 2 in. orifice diameter requirement ?

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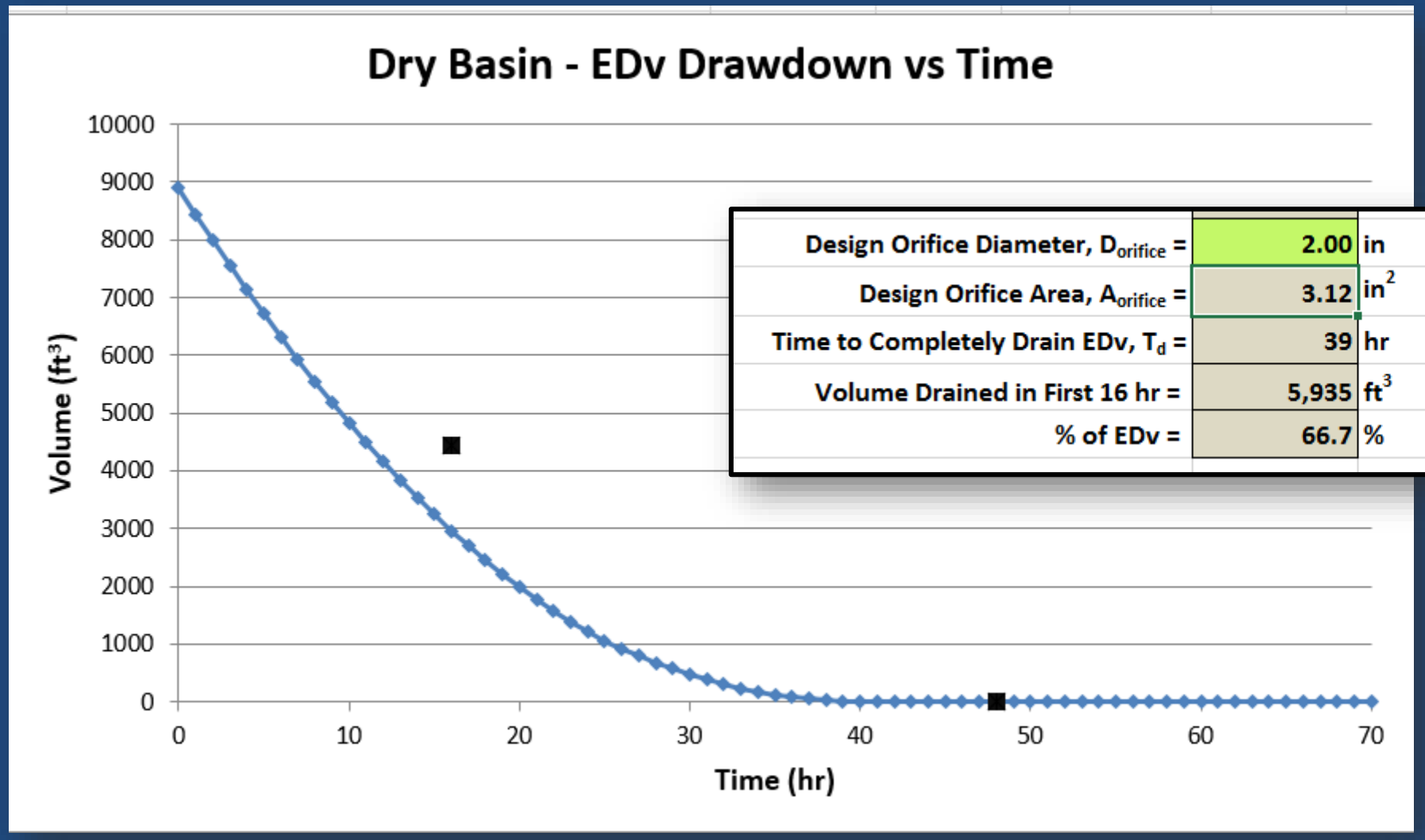
Extended Drawdown – 2” min.



Design Orifice Diameter, $D_{orifice}$ =	2.00	in	=	0.17	ft
Design Orifice Area, $A_{orifice}$ =	3.12	in^2	=	0.022	ft^2
Time to Completely Drain EDv, T_d =	39	hr	must be ≥ 48 hr	NOT MET	
Volume Drained in First 16 hr =	5,935	ft^3			
% of EDv =	66.7	%	must be ≤ 50%	NOT MET	

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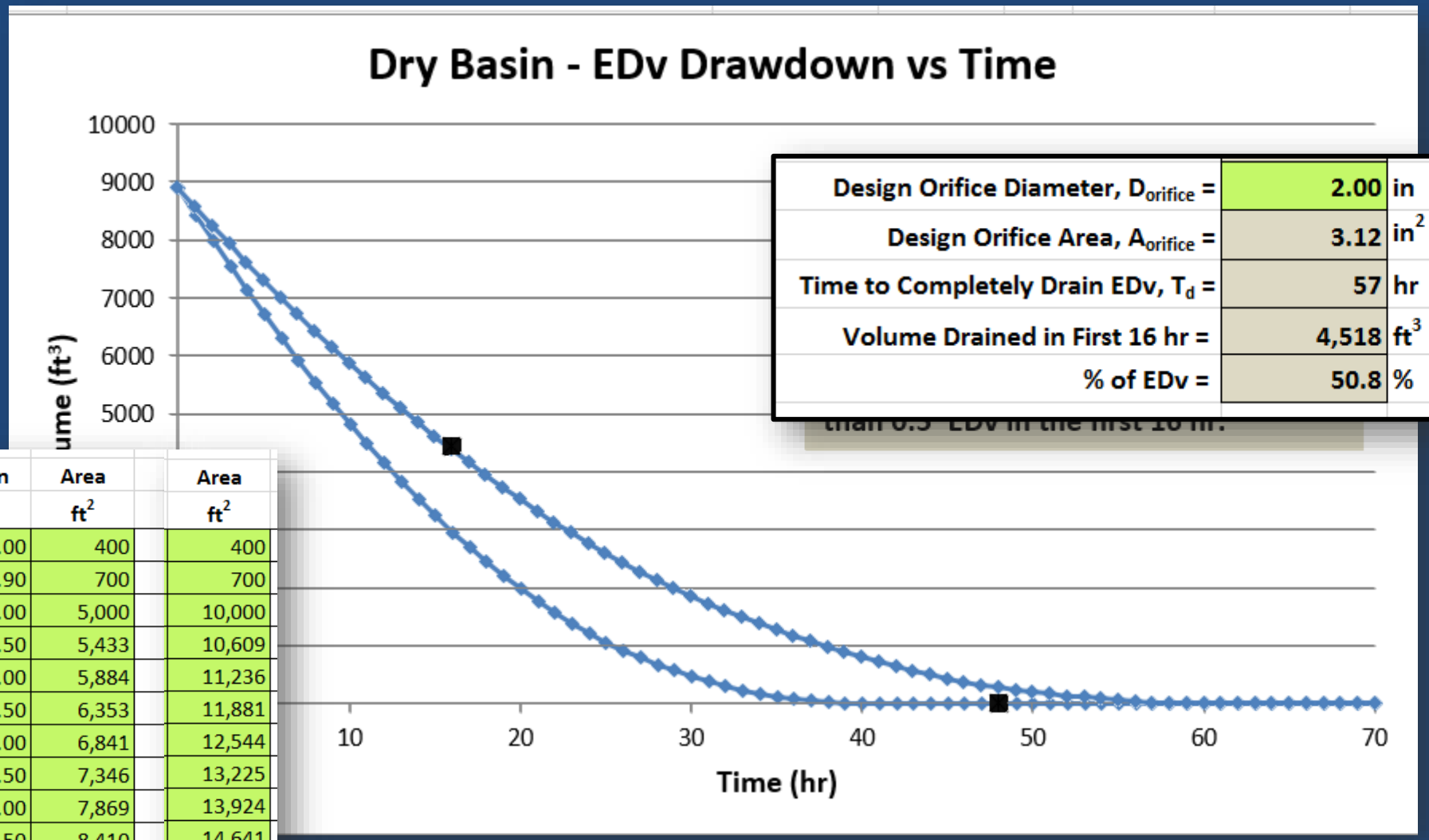
Extended Drawdown – 2” min.



Design Orifice Diameter, $D_{orifice}$ =	2.00	in	=	0.17	ft
Design Orifice Area, $A_{orifice}$ =	3.12	in^2	=	0.022	ft^2
Time to Completely Drain EDv, T_d =	57	hr	must be ≥ 48 hr		OKAY
Volume Drained in First 16 hr =	4,518	ft^3			
% of EDv =	50.8	%	must be ≤ 50%		NOT MET

Elevation	Area		Area
ft	ft^2		ft^2
96.00	400		400
99.90	700		700
100.00	5,000		10,000
100.50	5,433		10,609
101.00	5,884		11,236
101.50	6,353		11,881
102.00	6,841		12,544
102.50	7,346		13,225
103.00	7,869		13,924
103.50	8,410		14,641
104.00	8,970		15,376

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Underground Stormwater Management Systems

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Underground Stormwater management Systems

What did the permit change ?

- Added infiltrating and extended detention USMS as standard practices pre-approved for general use.
- Requires pretreatment at verified efficacy.

What will be changing in the RW&LD Manual ?

- Provisional standard has been posted.
- Welcome input.

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USMS – Ext. Det. Pretreatment

- Verified 50% TSS removal.
- Can use NJDEP list.
- Max treatment flow rate/hydraulic loading @ WQf.
- Size according to each inlet.
- Can be used in parallel, but does not increase TSS removal.

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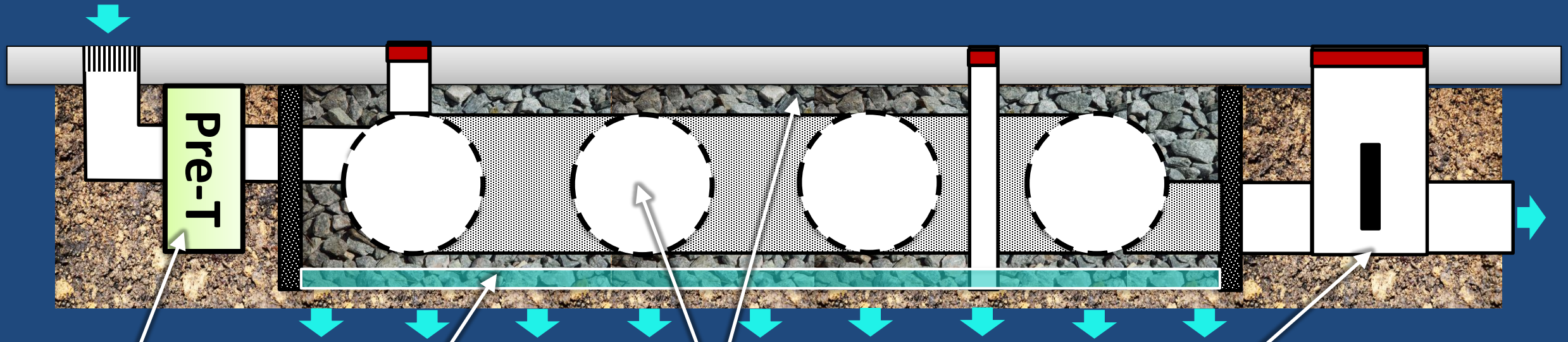
Infiltrating System

Open System



80% TSS @ WQF

WQv @ d ≤ IWS
No Sediment Storage

Flood Control Volume

Verified Infl. Rate

Flood Control Outlet

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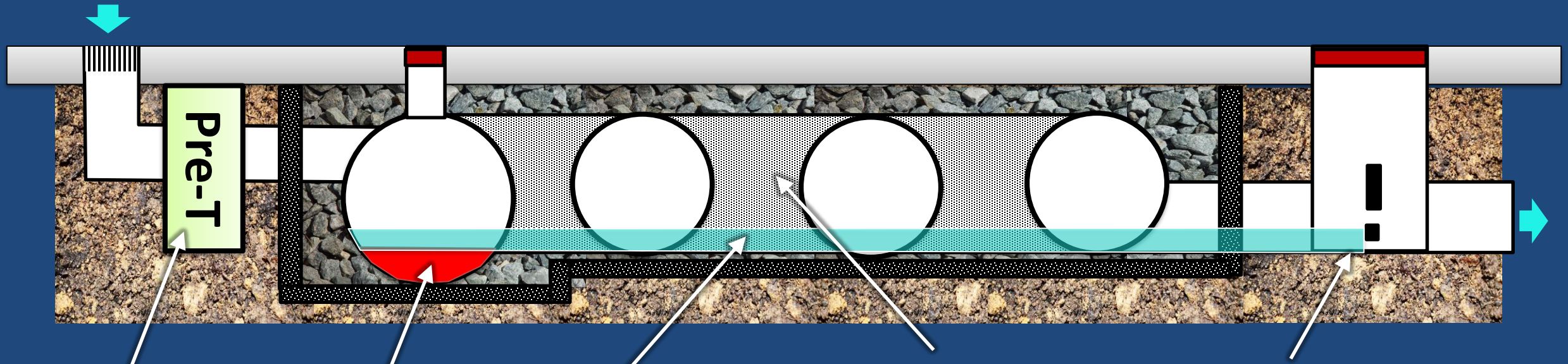
Extended Detention System

All Solid Wall



50% TSS @ WQF

Wet Sump (20% Sediment)

WQv

Flood Control Volume

WQ, FC & Overflow Outlets

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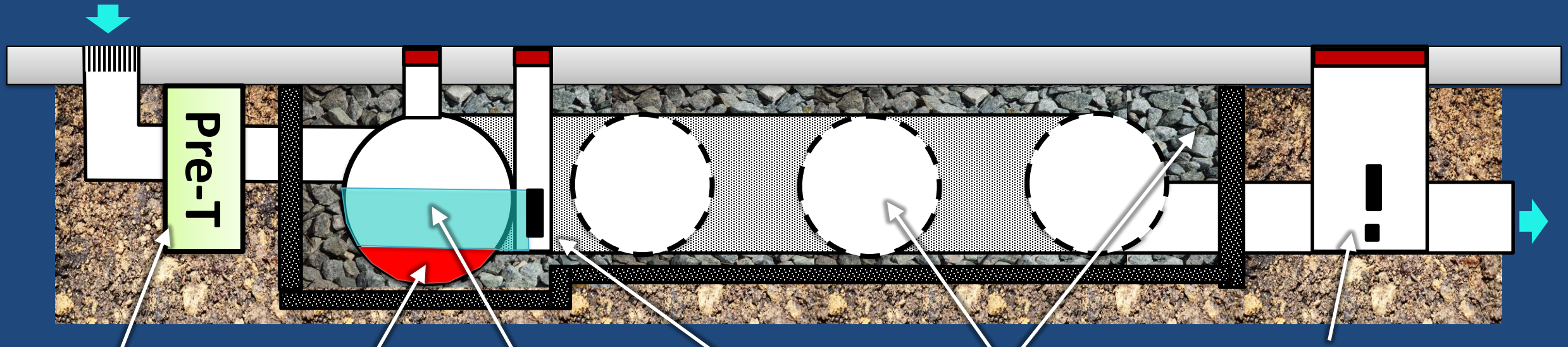
Extended Detention System

Lined



50% TSS @ WQF

Wet Sump (20% Sediment)

Contained WQv

WQ Outlet

Flood Control Volume

Flood Control & Overflow Outlets

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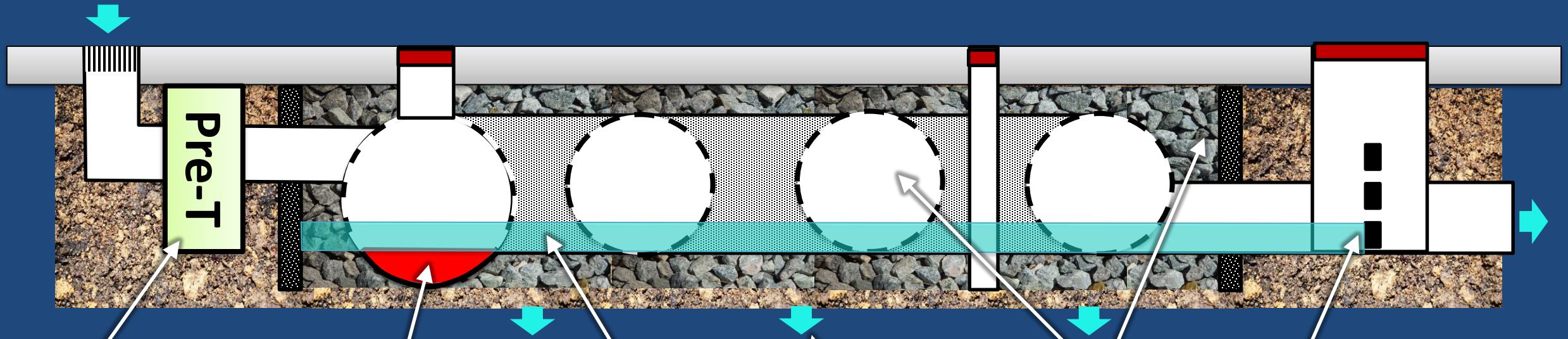
Extended Detention System

Partially Infiltrating



50% TSS @ WQF

Wet Sump (20% Sediment)

WQv above IWS

Infiltration

Flood Control Volume

Outlets

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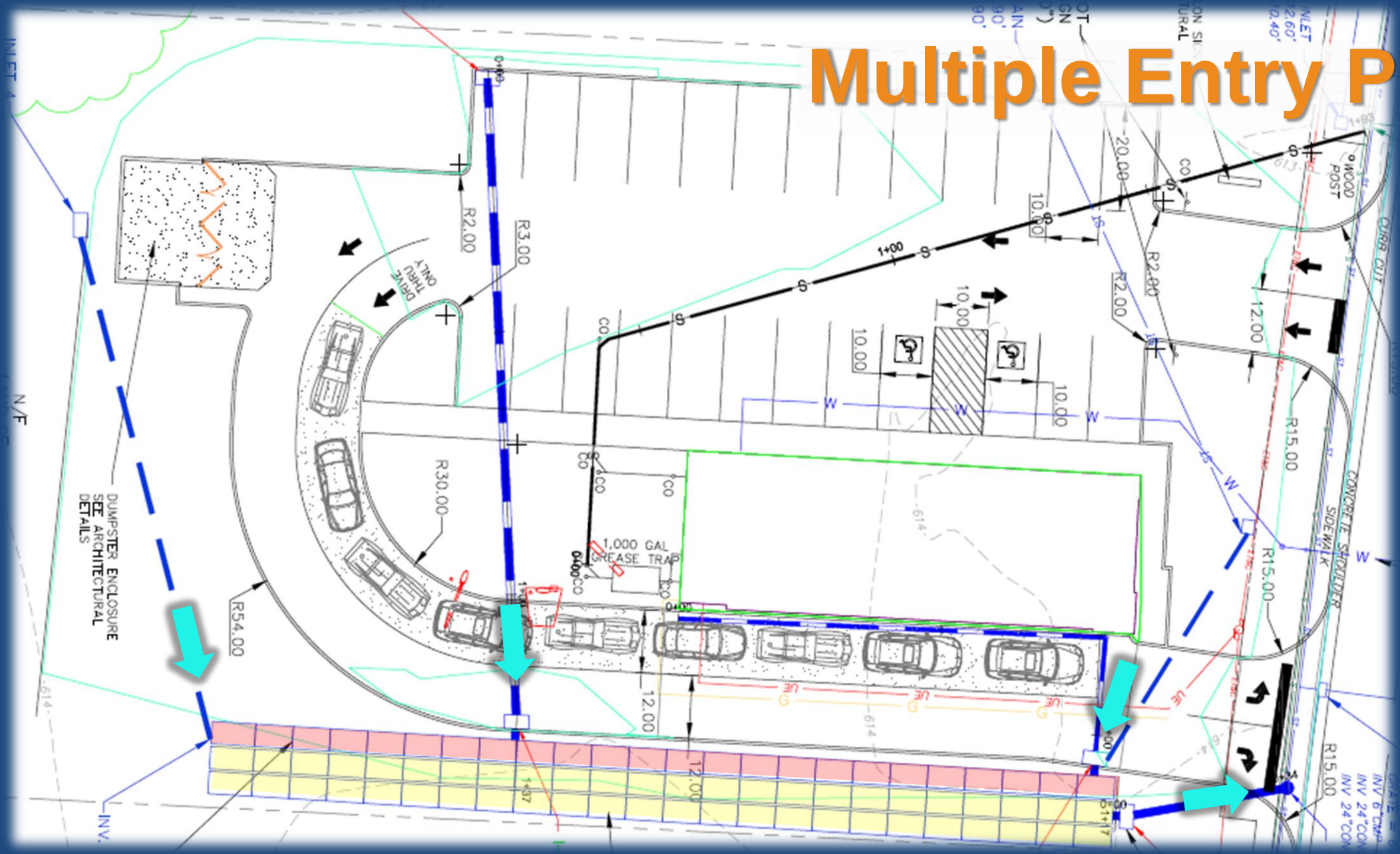
Multiple Entry Points



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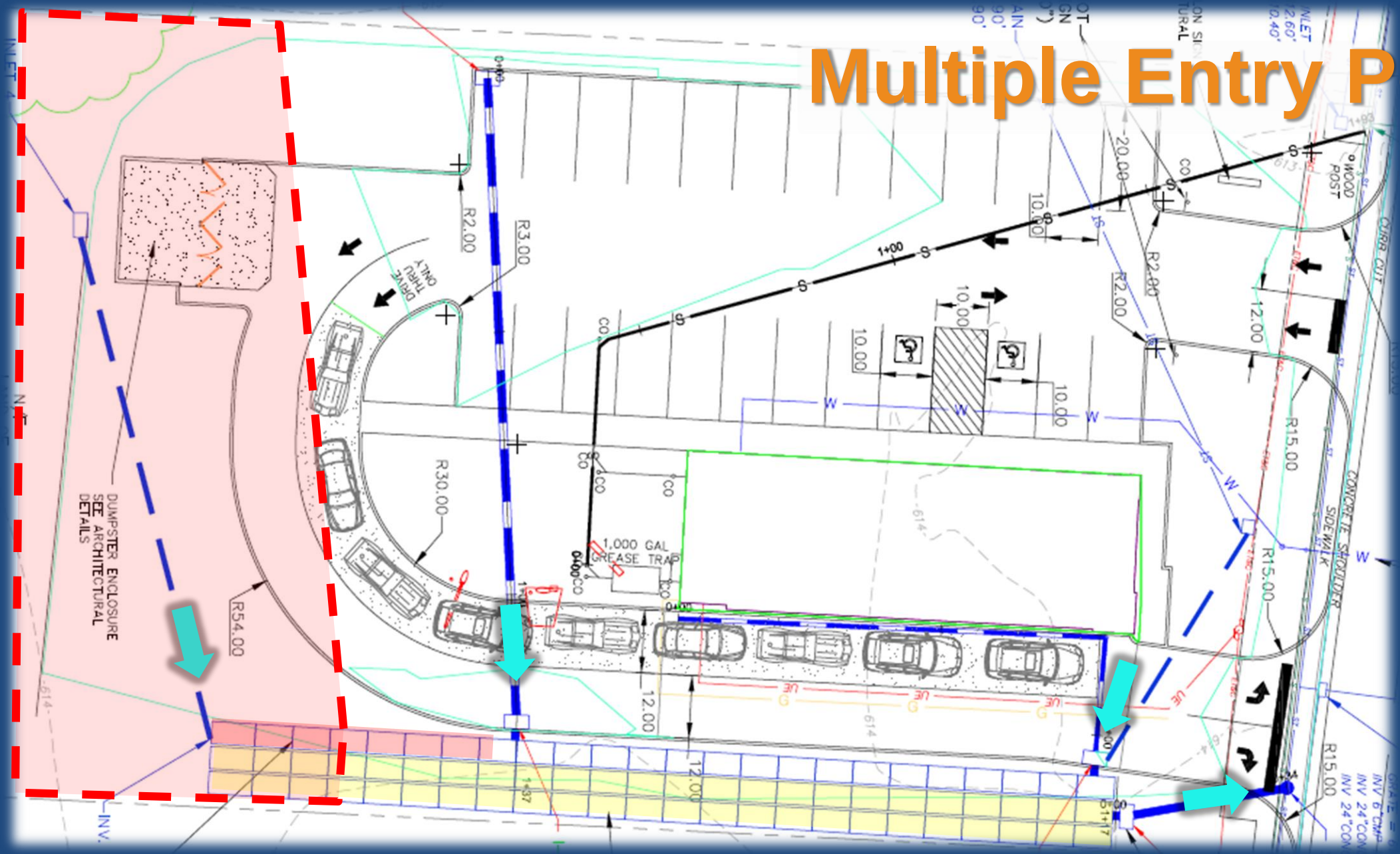
Multiple Entry Points



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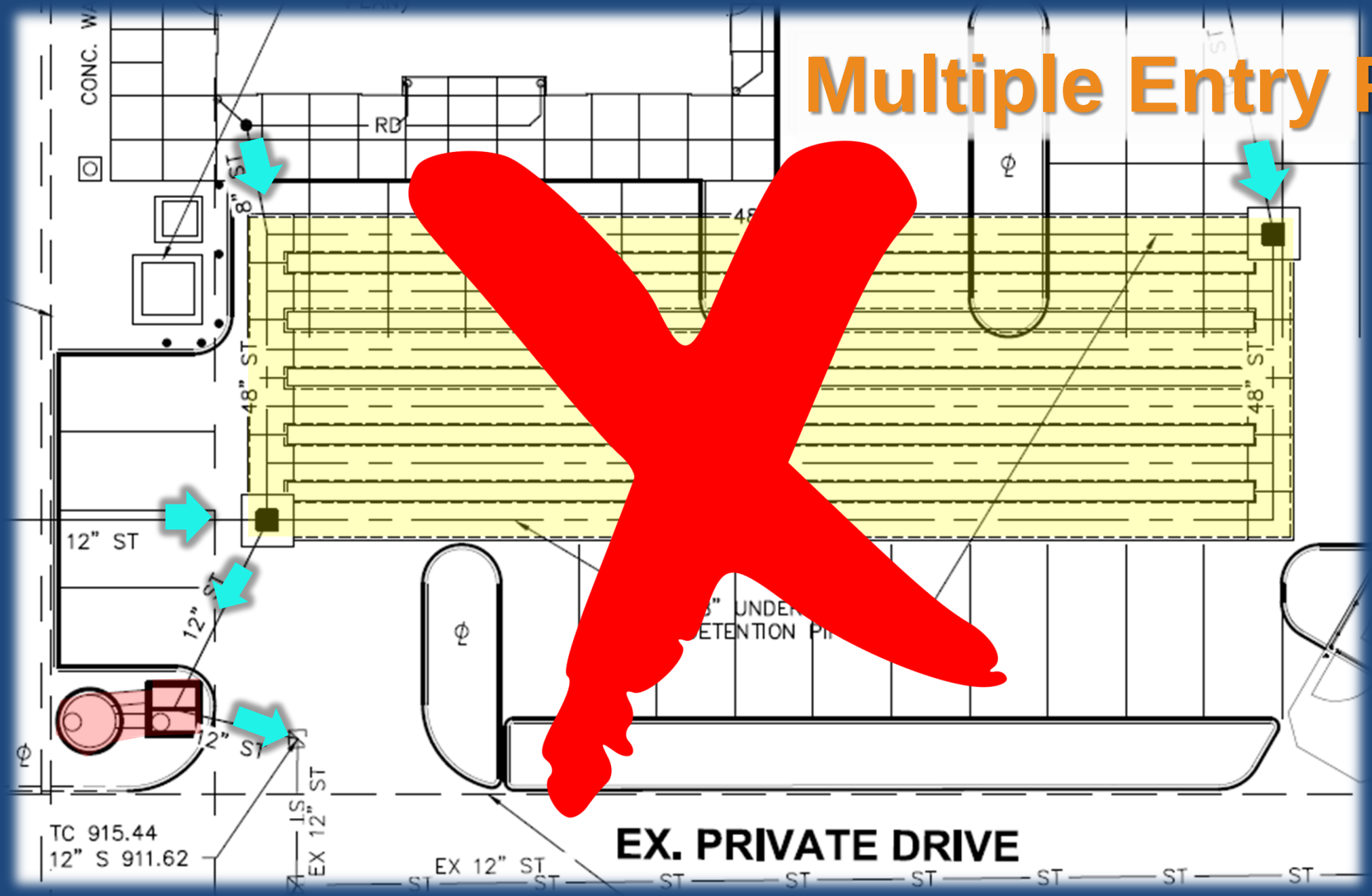
Multiple Entry Points



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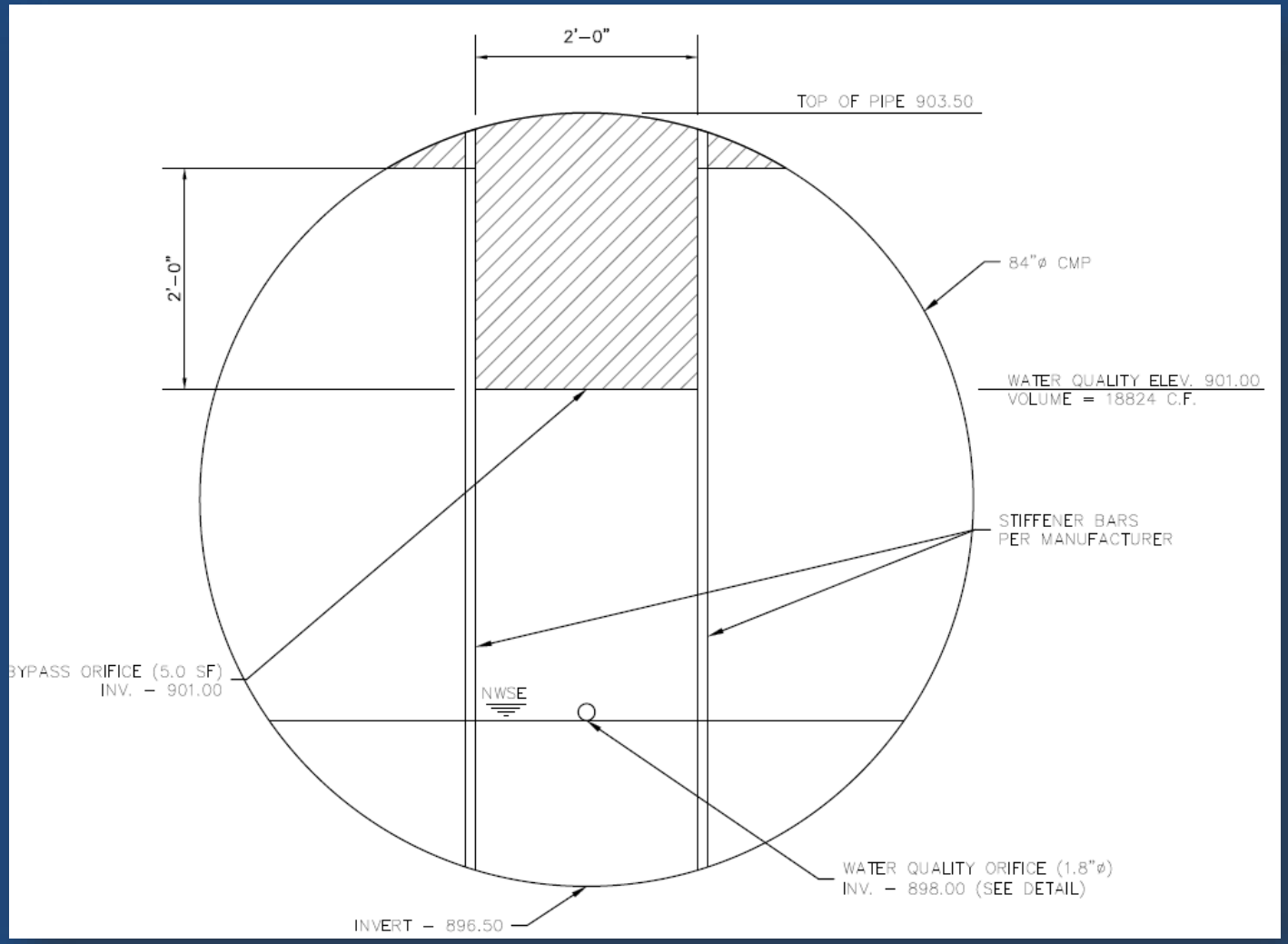
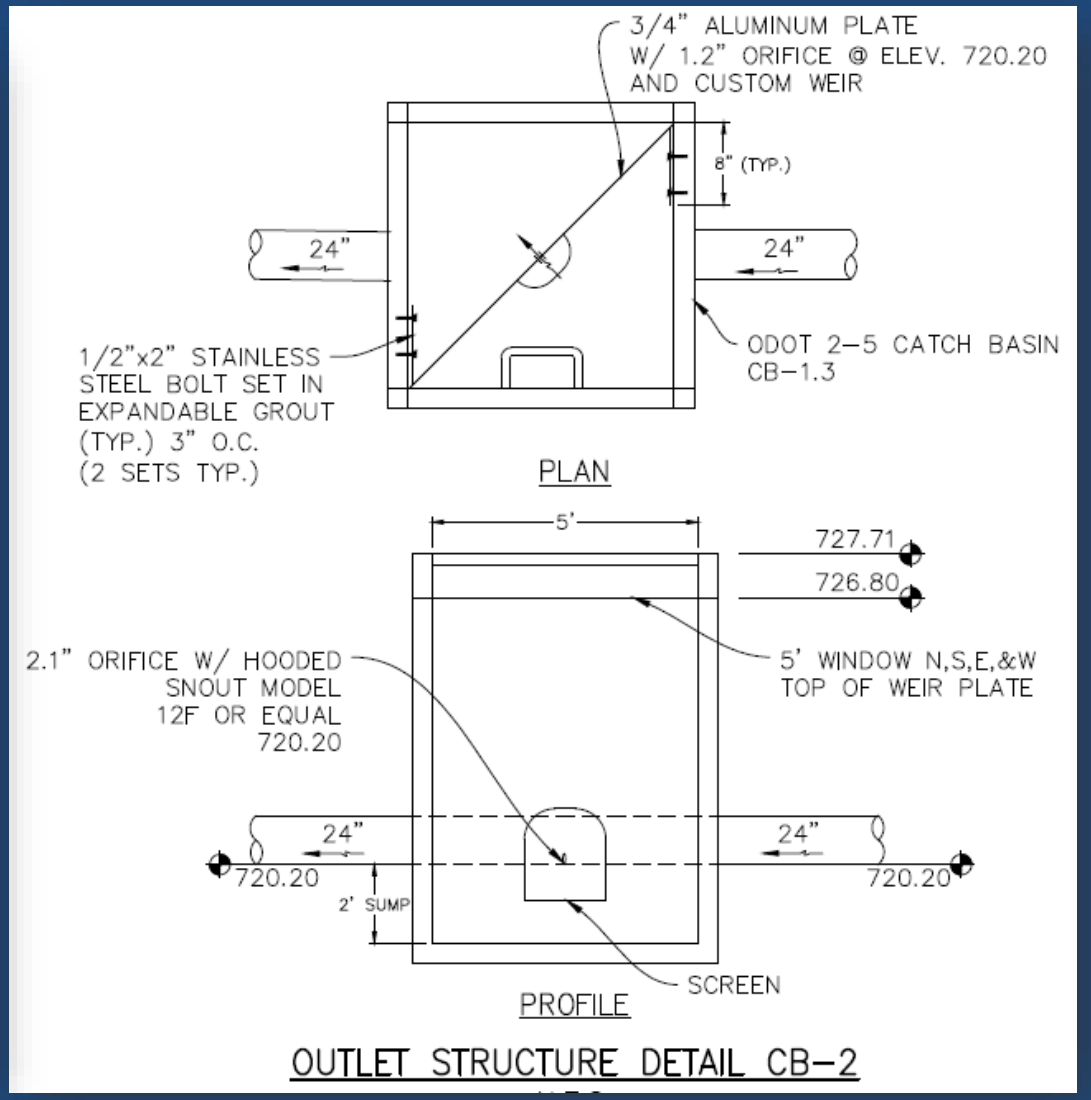
WQ Outlet Configuration





Maintenance Feasibility

- Access manholes at inlet, outlet and within storage as necessary for cleaning.
- Observation wells.

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Maintenance Feasibility

Type of BMP	Sediment Removal Frequency	Facility Life Span*
Wet Pond	5 to 15 years	20 to 50 years
Dry Pond	2 to 10 years	20 to 50 years
Infiltration Trench	Monthly or as needed	10 years
Sand Filter	Every 6 months or as required	20 to 50 years
Bioretention System	5 to 10 years	10 to 25 years
Vegetated Swale	As needed	10 to 25 years
Underground Detention	Annually or as needed	10 to 30 years
Vegetated Rooftop	Every 5 years	25 years
Permeable Paving Materials	3 to 4 times per year	25 years
Manufactured BMP	Annually or as required	20 to 100 years

*Assumes the facility is maintained on a regular basis.

- Costs ?
- Depth ?
- Surface Accessibility ?
- How Often ?
- How ?

SOURCE: "Maintaining Stormwater Systems", Northern Virginia Regional Commission, 2007

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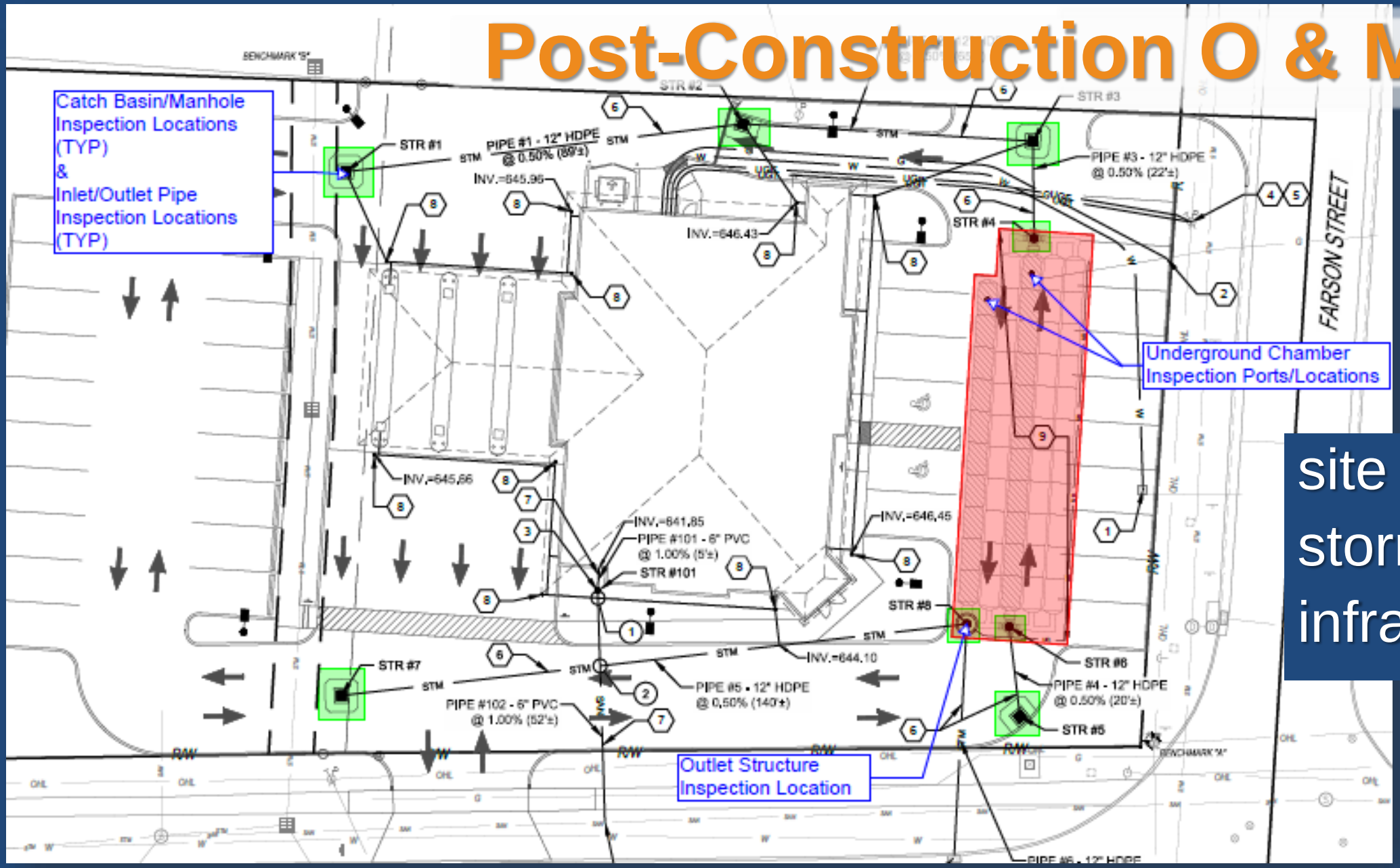
Post-Construction O & M Plan



site map w/ stormwater infrastructure

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Storm Water Technical Assistance

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614-705-1149

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