Implementing Post-Construction Water Quality Treatment On Non-Traditional Sites

Justin Reinhart, PE

Ohio EPA Storm Water Technical Assistance

Objective

1. Review common questions regarding post-construction requirements
2. Look at how post-construction controls can be applied is common but atypical situations
3. Try not to get stuck in the weeds

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Engineering drawings herein may not reflect the entire actual situation. Drawings are used to provide a realistic example for discussion which is not a critique of or reflective of what was actually designed.

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Construction Disturbances Less Than 2 Acres

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Construction Disturbances Less Than 2 Acres

A BMP is required to treat storm water pollutants and adverse impacts on receiving waters

- Compliance with WQS ("free-froms", beneficial use designations, numeric criteria & antidegradation)
- Adverse impacts » destructively high flow rates
- Contend WQv and standard practice is best way to do this

Must justify in SWPPP why a table 4a/4b practice is not feasible and an alternative practice/design is necessary

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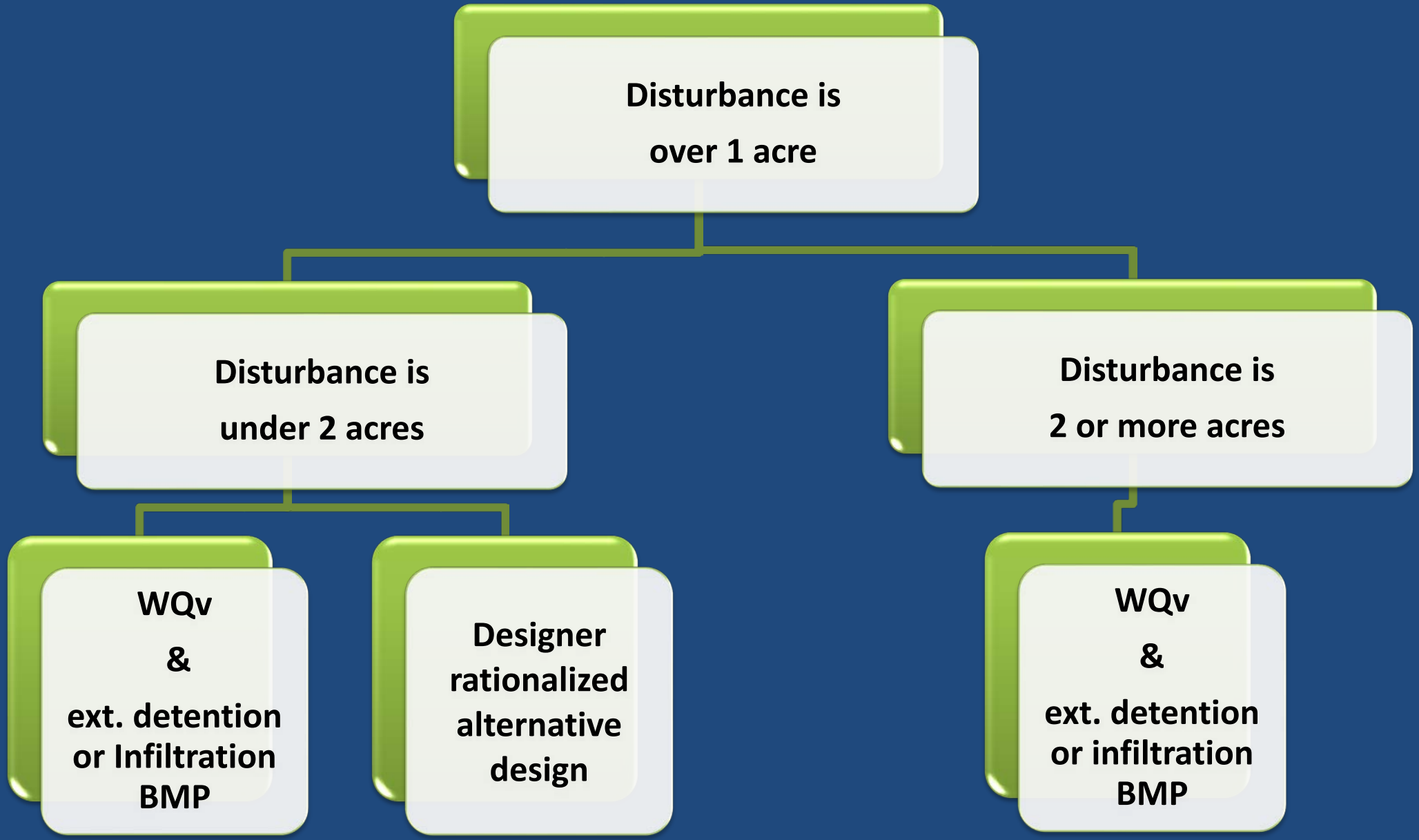

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Previously Developed Areas

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Previously Developed Areas

Do I have redevelopment ?

- If you have measurable existing impervious landcover, you could

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Previously Developed Areas

Do I have redevelopment ?

- If you have measurable existing impervious landcover, you could

How do I treat my redevelopment ?

- Reduce runoff coefficient (Rv) by 20% with soil restoration
- Use Equation 3 in permit to calculate a reduced WQv

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EXAMPLE

Existing Parcel: 11.3 ac

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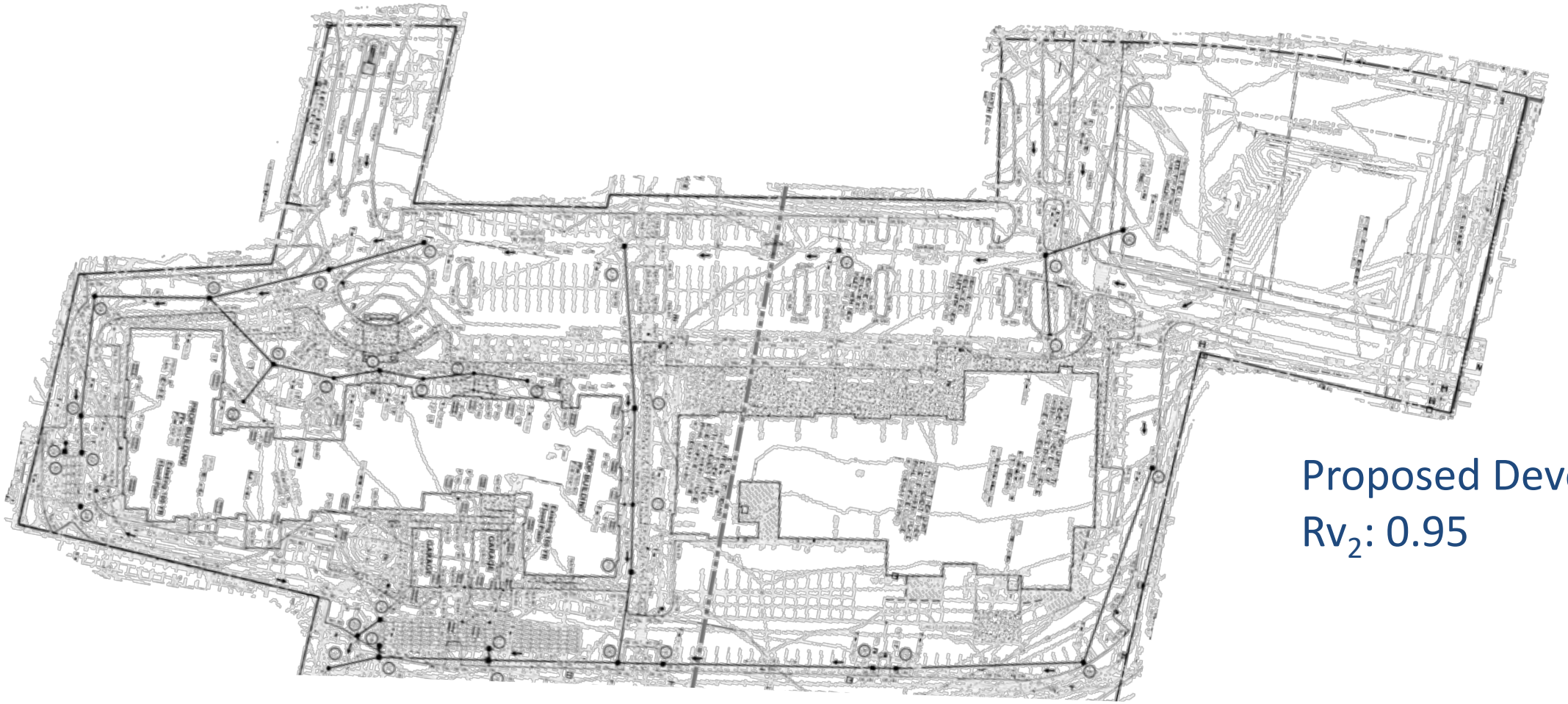
Disturbed Area: 7.3 ac

Rv_1: 0.94



Proposed Development

Rv_2: 0.95

$WQv_{required}$: 0.9 in. x 7.3 ac x [(0.94 x 0.2) + (0.95 - 0.94) / 12 = 0.11 ac-ft

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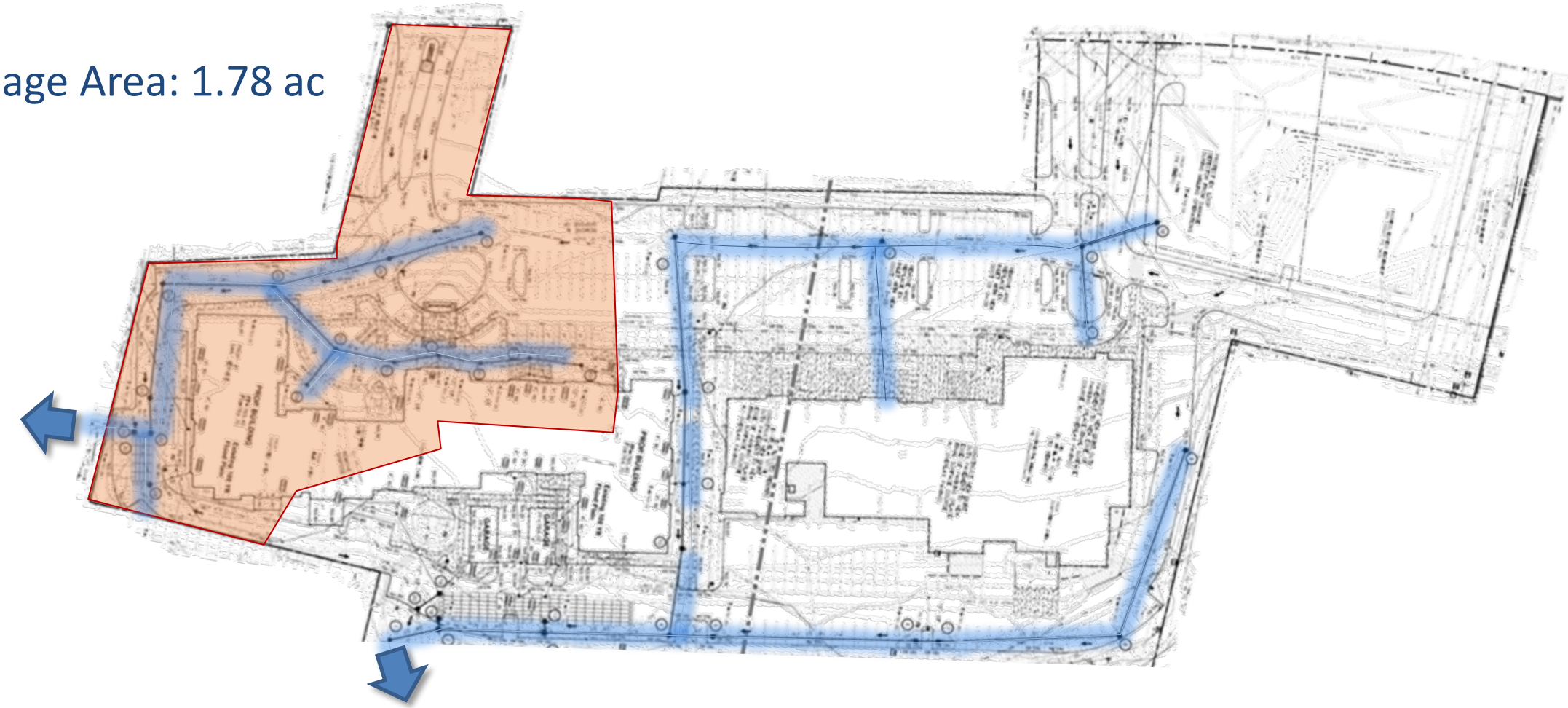
Sub-drainage Area: 1.78 ac
Rv = 0.91



$WQv_{required}$: 0.11 ac-ft

$WQv_{sub\text{-}area}$: 0.9 in. x 1.78 ac x 0.91 / 12 = 0.12 ac-ft

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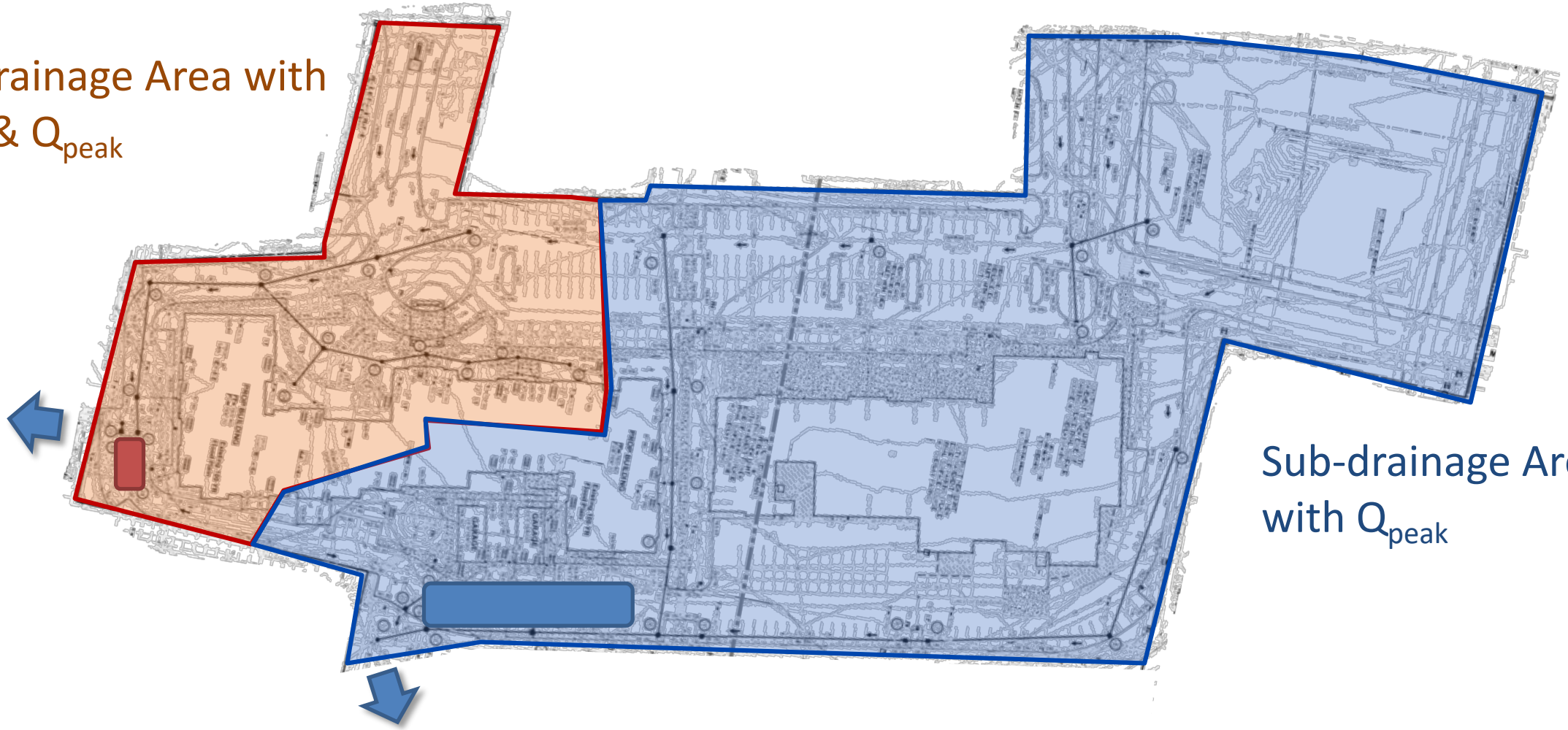
Sub-drainage Area with WQv & Q_{peak}



Sub-drainage Area with Q_{peak}

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Wetlands

- Often location of interaction with groundwater with potential for contamination
- Most natural wetland are considered a WQ sink
  - in a static (unnatural) state, their ability to store TSS and consume nutrients is limited
  - Generally low in flood storage capability
- Waters of the State to be protected from pollutants and destructively high flows
  - *"concentrated runoff from BMPs to natural wetlands shall be converted to diffuse flow"*
  - *"the applicant shall attempt to match the pre-development hydroperiods and hydrodynamics that support the wetland."*

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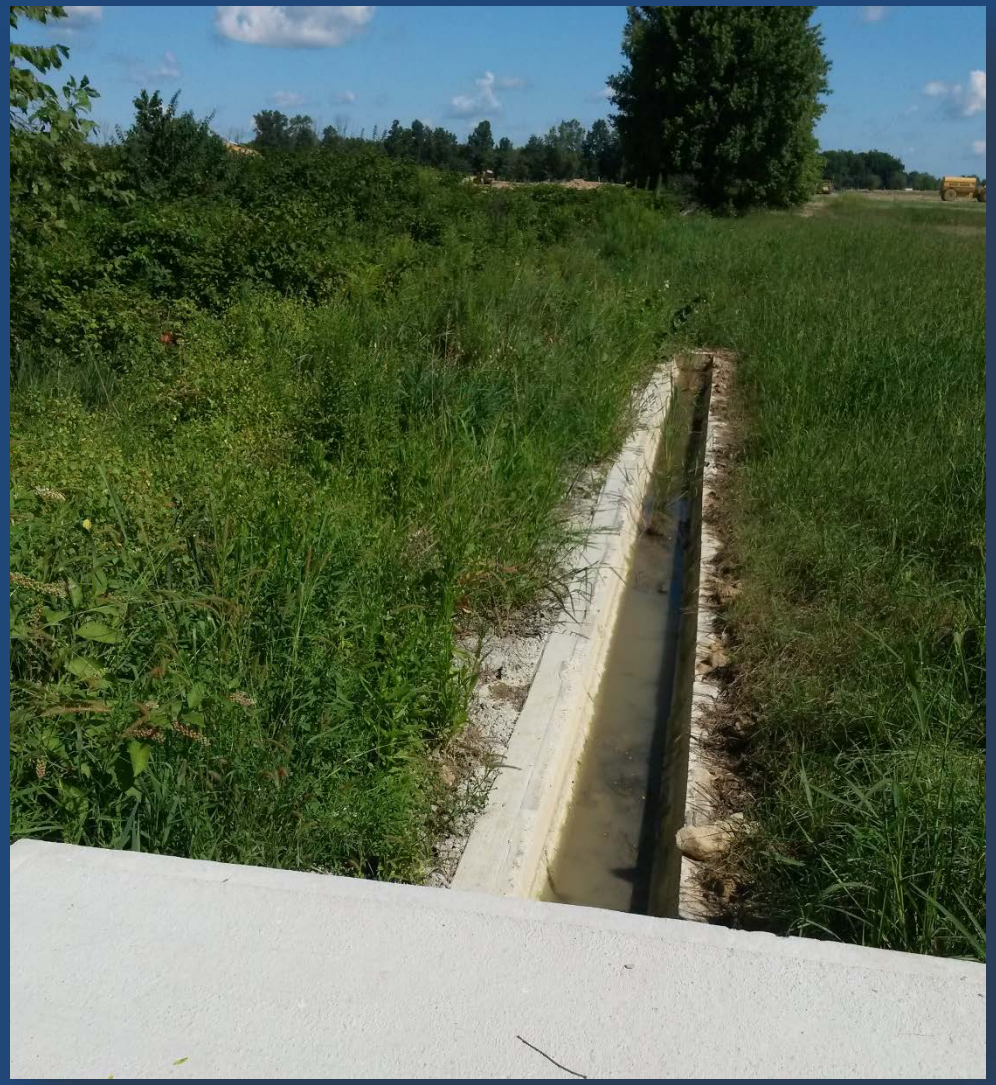
Wetlands

Two permit conditions:

"concentrated runoff from BMPs to natural wetlands shall be converted to diffuse flow"



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Wetlands

Two permit conditions:

"concentrated runoff from BMPs to natural wetlands shall be converted to diffuse flow"

"the applicant shall attempt to match the pre-development hydroperiods and hydrodynamics that support the wetland"

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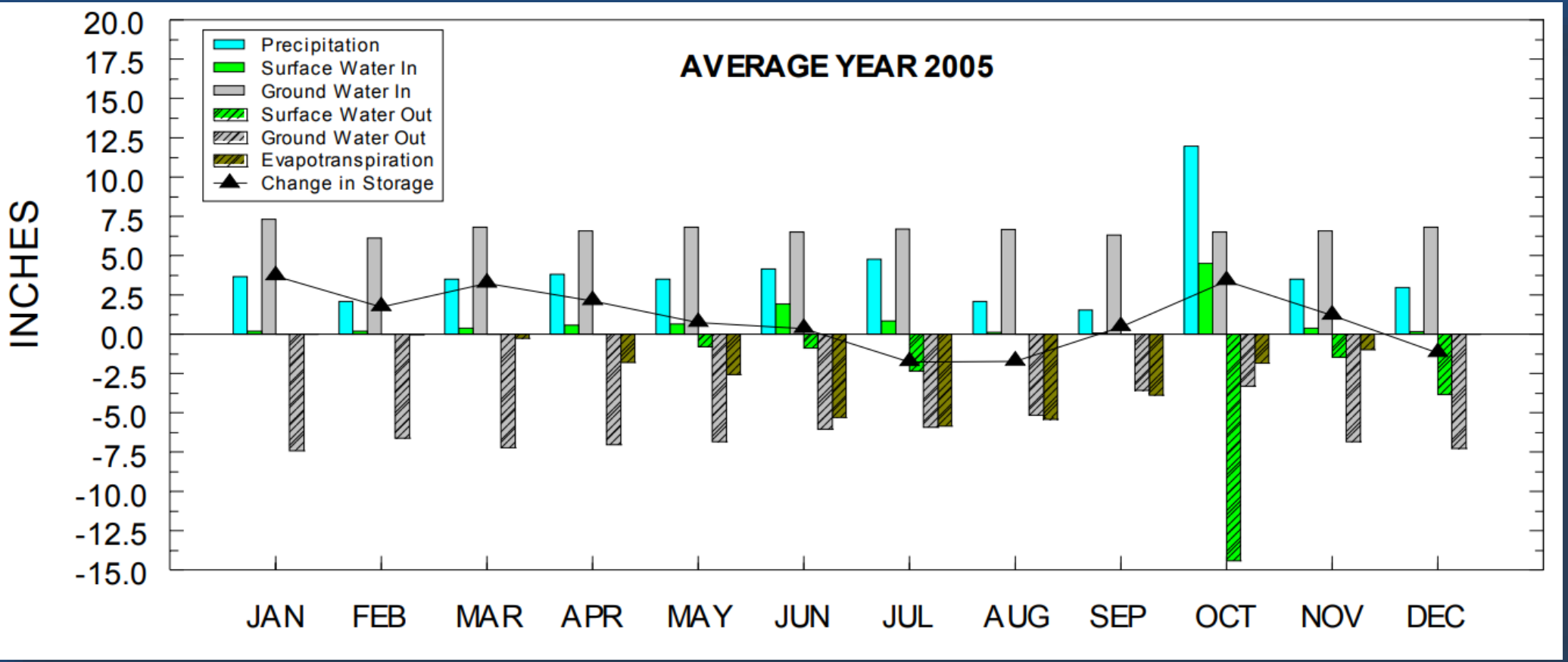
Wetlands

Hydroperiod/pattern is annual, seasonal & daily variation in water level



Source: NJDEP. *Regionalized Water Budget Manual for Compensatory Wetland Mitigation Sites in New Jersey.* undated.

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Transportation Projects

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Transportation Projects

What is a transportation project ?

- New roadway or road improvement
- Capital projects funded & directed by state, county, city, village

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Transportation Projects

What is a transportation project ?

- New roadway or road improvement
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May comply with ODOT *Location and Design* (L&D) manual

Does not apply to subdivision ROW to be dedicated

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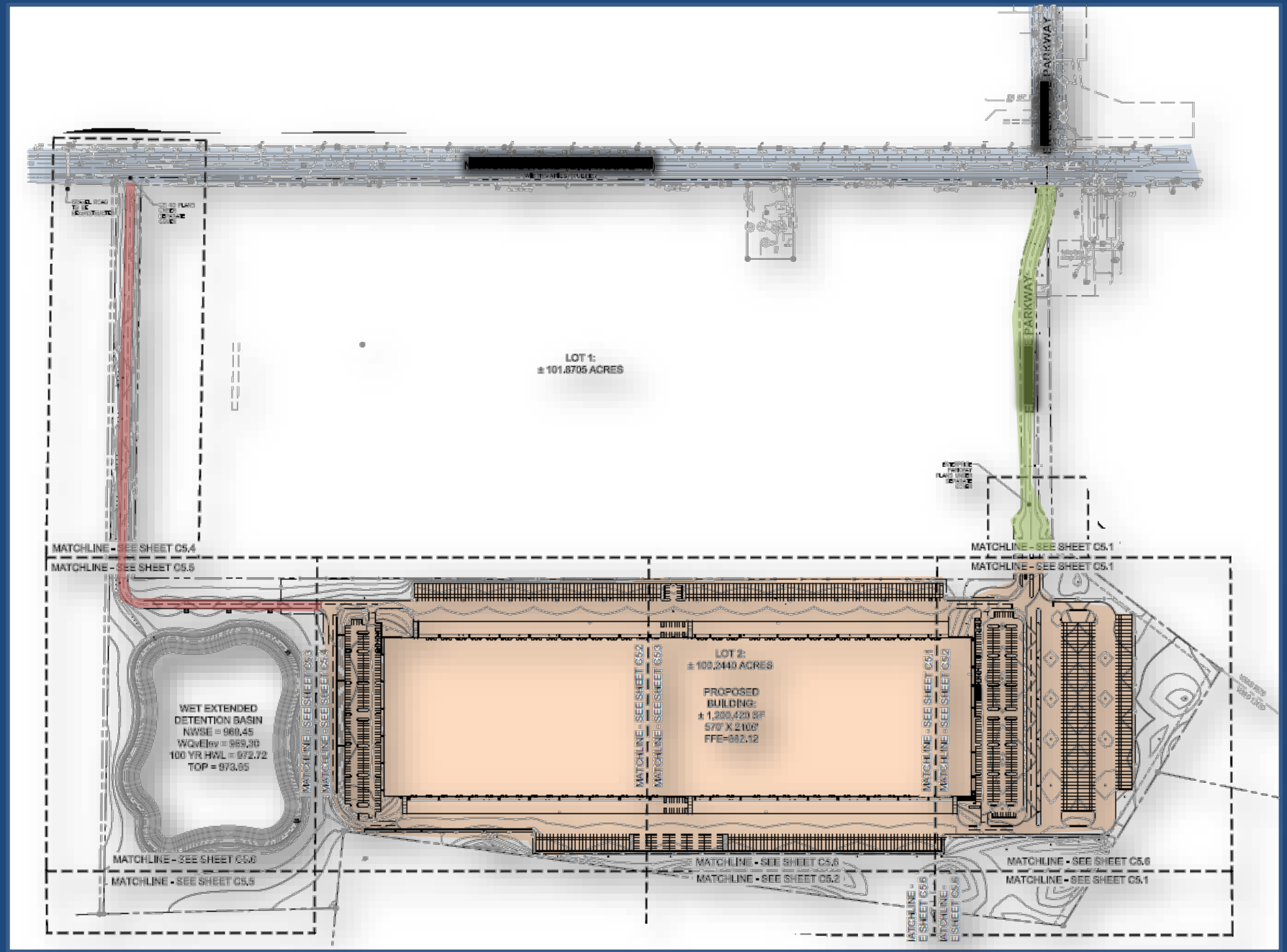
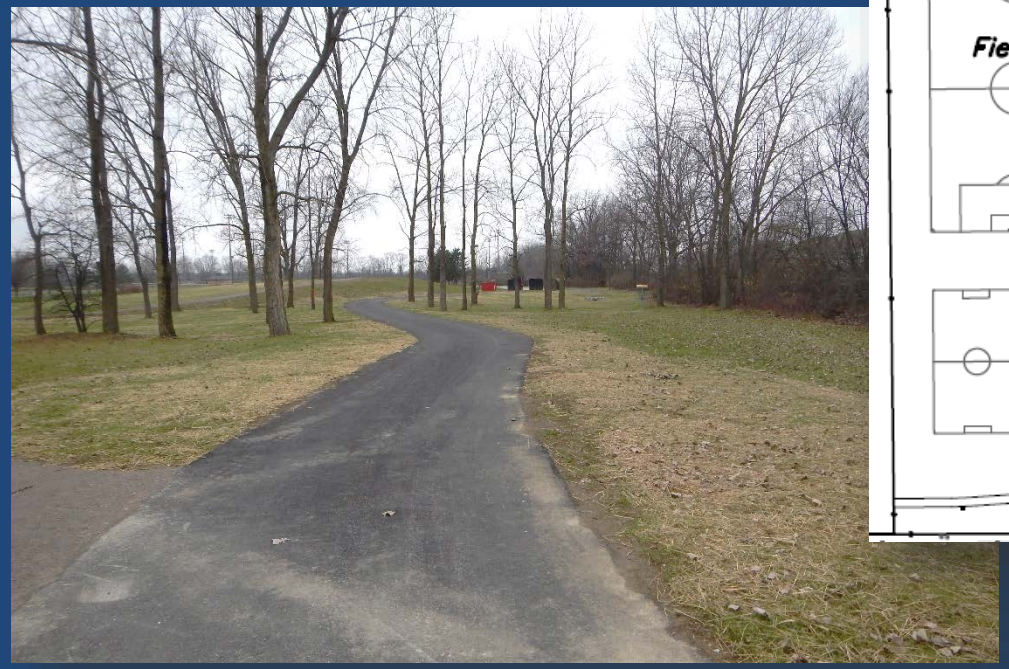
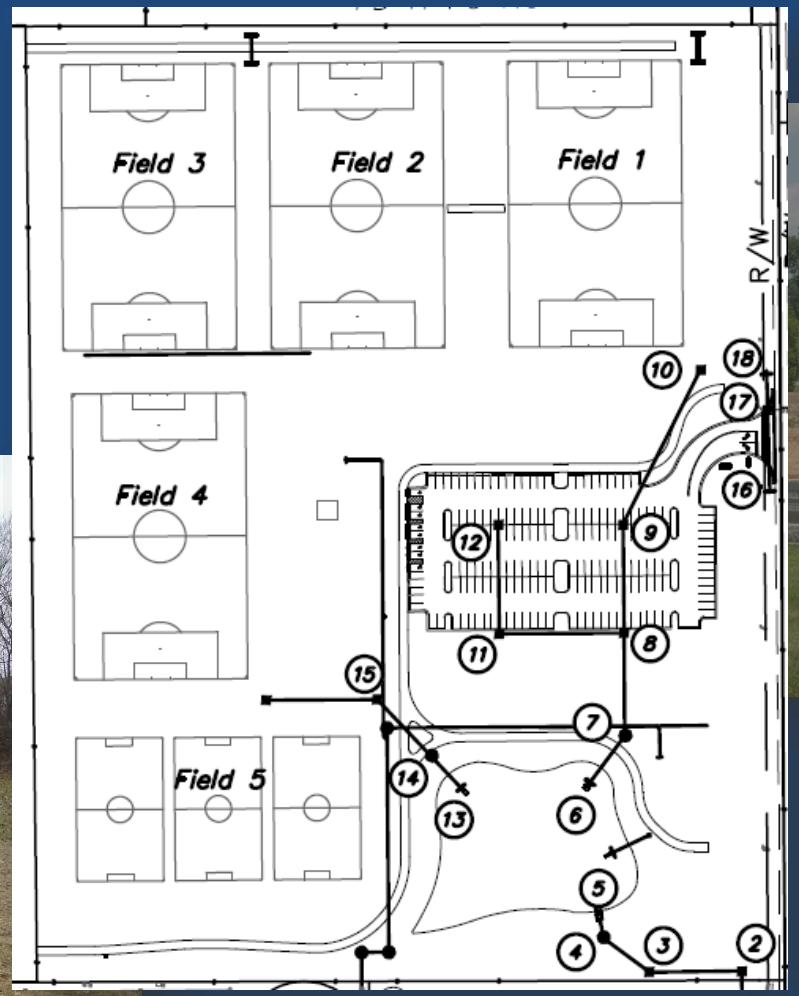
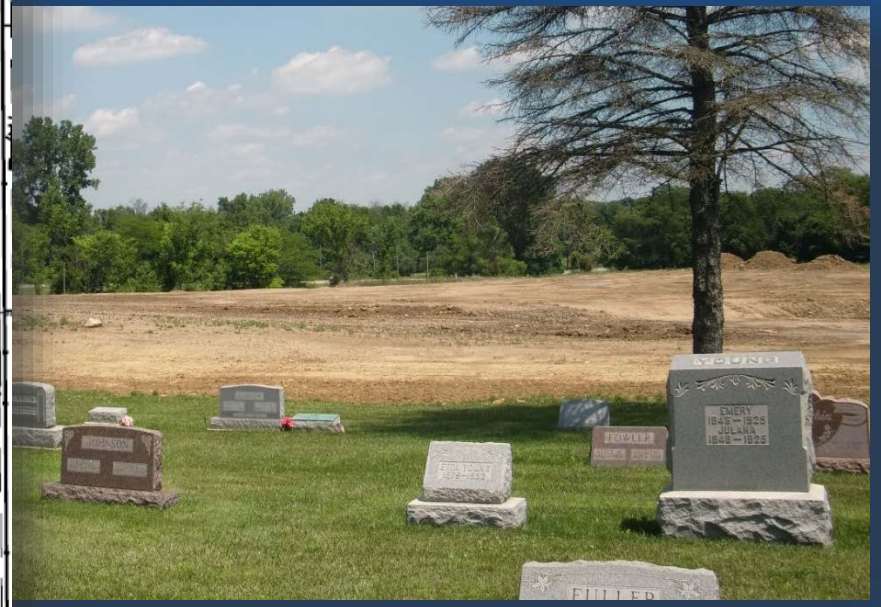


What about stubs, turnoffs and access roads ?

Trails, Parks, Cemeteries, Oh My !







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Trails, Parks, Cemeteries, Oh My !

Construction activities that do not include the installation of any impervious surface…are not required to comply with [post-construction permit requirements]

Assumptions:

- will be vegetated or landscaped
- hydrology will be typical to pervious areas (Rv = 0.05)
  - graded areas use Soil Management Standard

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Soil Management Standard

RAINWATER AND LAND DEVELOPMENT PROVISIONAL PRACTICE STANDARD #.#

SOIL MANAGEMENT

DATE: 12/20/18

Description

Good soil quality and healthy vegetation are the most important determinants of stormwater runoff from urban and suburban pervious areas. The vigorous root growth that comes with healthy vegetation - whether trees, lawn or landscaping- helps maintain soil structure and associated soil conditions (collectively called soil tilth) that, in turn, provide the right combination of nutrients, air and water for healthy plant growth.

Good soil structure promotes infiltration of rainfall and runoff, and supports the vigorous root growth that maintains soil infiltration over time. Mass soil grading and compaction that accompanies most site development destroys this soil structure by breaking down soil aggregates into individual soil particles and closing off pathways for air, water and root growth. The increased soil density makes it much more difficult for plant roots to play their role in re-building good soil health and hydrologic function.

Unless effort is made to alleviate compaction and restore a healthy root zone, graded soils act more like an impervious surface than pasture land or meadow to which they are often equated. It is expected for all development sites, post-construction soil conditions will be restored to a minimum set of criteria that allow healthy plant growth without fertilizers or irrigation and which provides hydrologic function consistent with open space in good hydrologic condition (NRCS, 1986) and a volumetric runoff coefficient (Rv) of 0.05 (Ohio EPA, 2018). Two levels of soil management are specified:

1. Topsoil Replacement – this is the minimum allowable restoration of the shallow (8”-10”) soil root zone often referred to as “topsoil” or the soil’s A horizon.
2. Soil Profile Restoration (Amended Soil) – this is a more extensive alleviation of soil compaction and improvement of soil hydrologic function through restoration of a deeper soil root zone and the incorporation of soil amendment (compost) using subsoiling (also called “soil ripping”) and other appropriate tillage.

Condition Where Practice Applies

The replacement of topsoil or restoration of the soil profile with tillage and soil amendments should be used wherever soil grading and/or compaction of pervious open space has occurred.

Credits

Topsoil Replacement is required for all site pervious areas where the soil was graded or compacted.

Source: Cornell Univ. BEE

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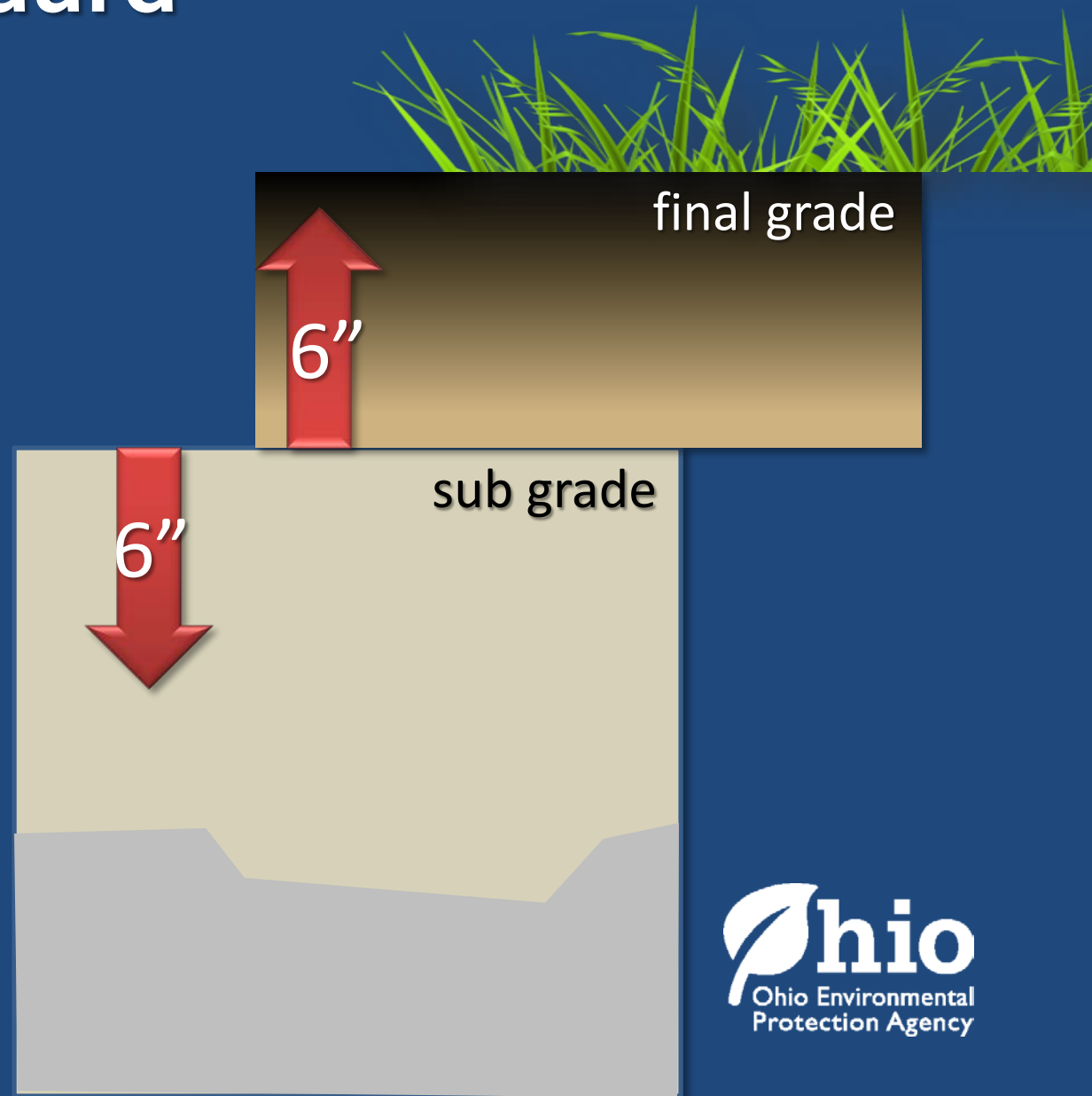
Soil Management Standard

1. Topsoil Replacement
   - Subgrade loosed to 6" depth
   - 6" loose, friable Loam, Silt Loam or Sandy Loam
     - <20% clay, >5% organic matter



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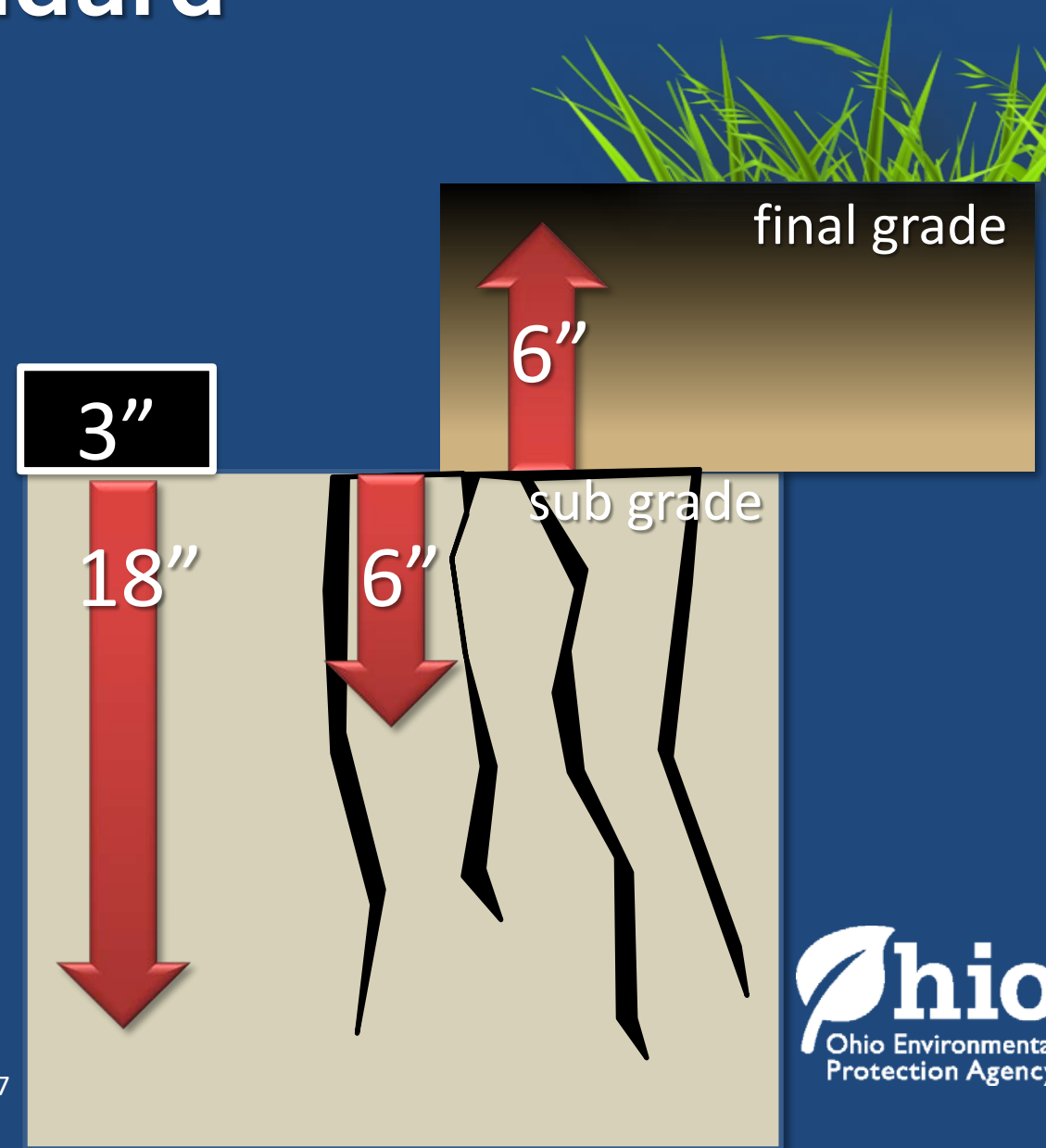
Soil Management Standard

2. Soil Profile Restoration
   - Subsoil to 18" depth w/ compost
   - Subgrade loosed to 6" depth
   - 6" loose, friable Loam, Silt Loam or Sandy Loam
     - <20% clay, >5% organic matter



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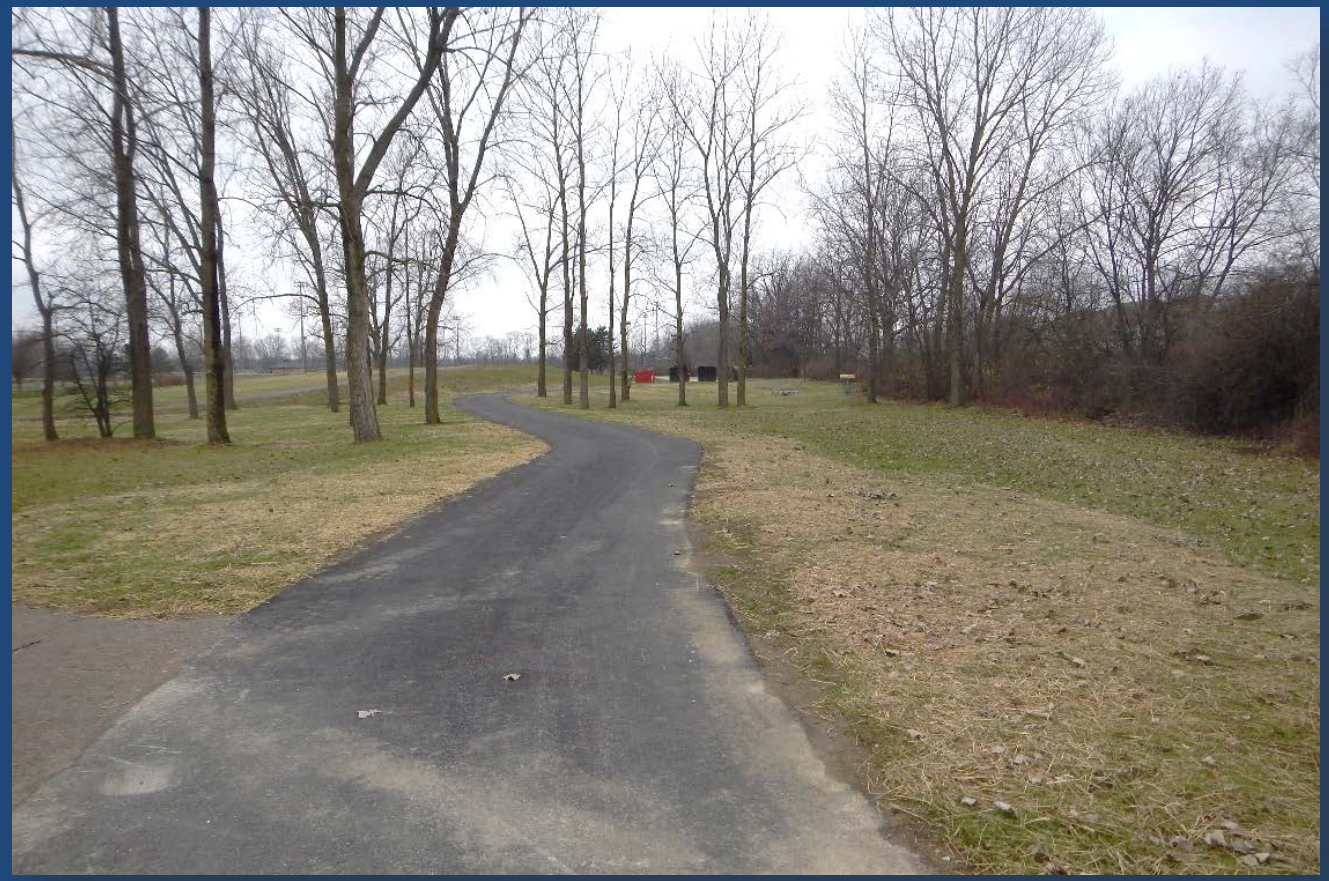
Pedestrian Trails

Sheet flow

No storm water collection



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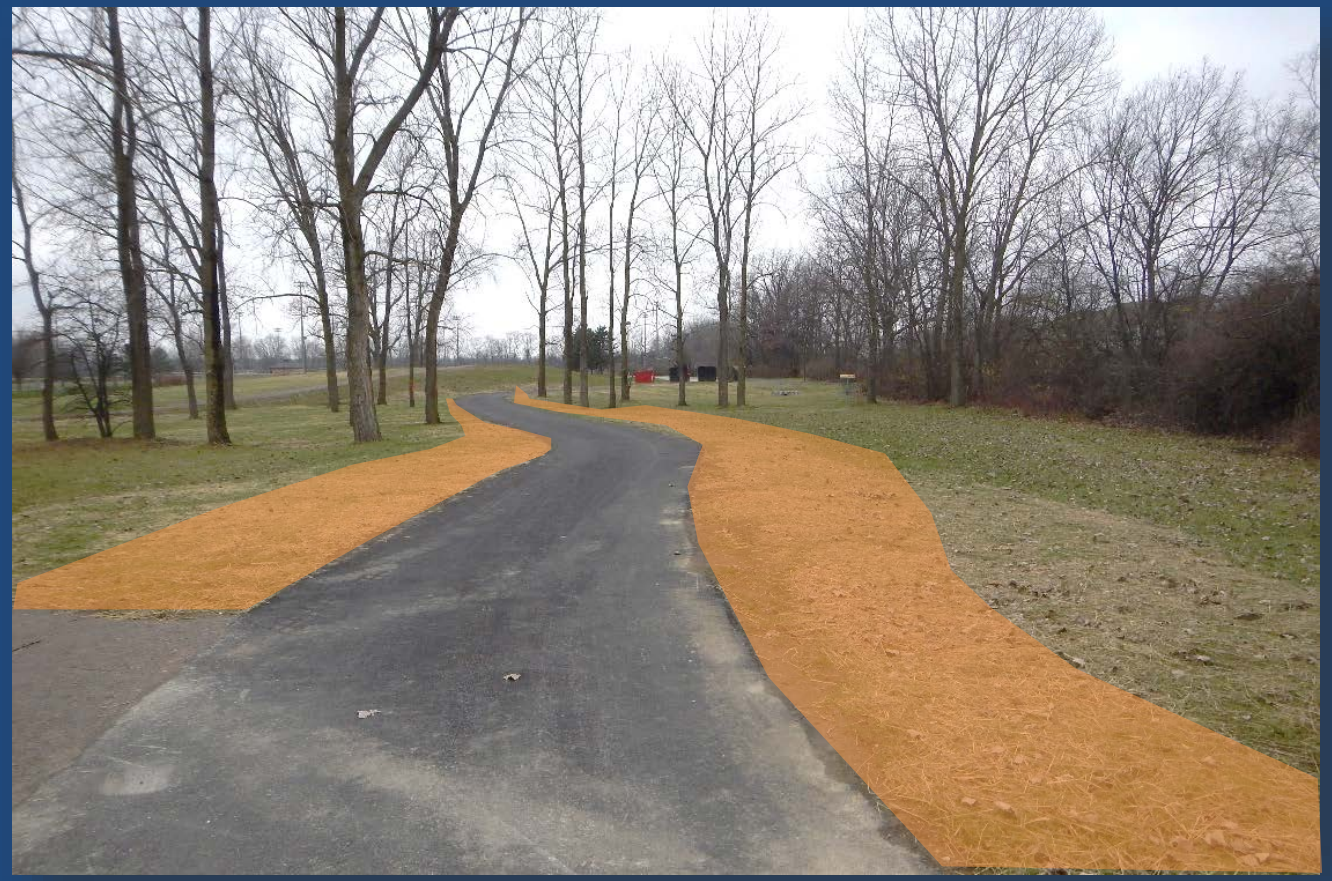
Pedestrian Trails

Sheet flow

No storm water collection

ODOT L&D 1117.2.1

- ✓1:1 width
- ✓3:1 slope
- ✓Sheet flow
- ✓Soil Management



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Synthetic Turf

Synthetic Turf

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Synthetic Turf

Synthetic Turf

Compacted Stone Dust	Sand	Shock Pad	Plastic Drain
Compacted Stone	Drain Rock	Leveling Layer	Compacted Stone
Geotextile	Geotextile	Sub Base	Compacted Soil
Compacted Soil	Soil	Compacted Soil	

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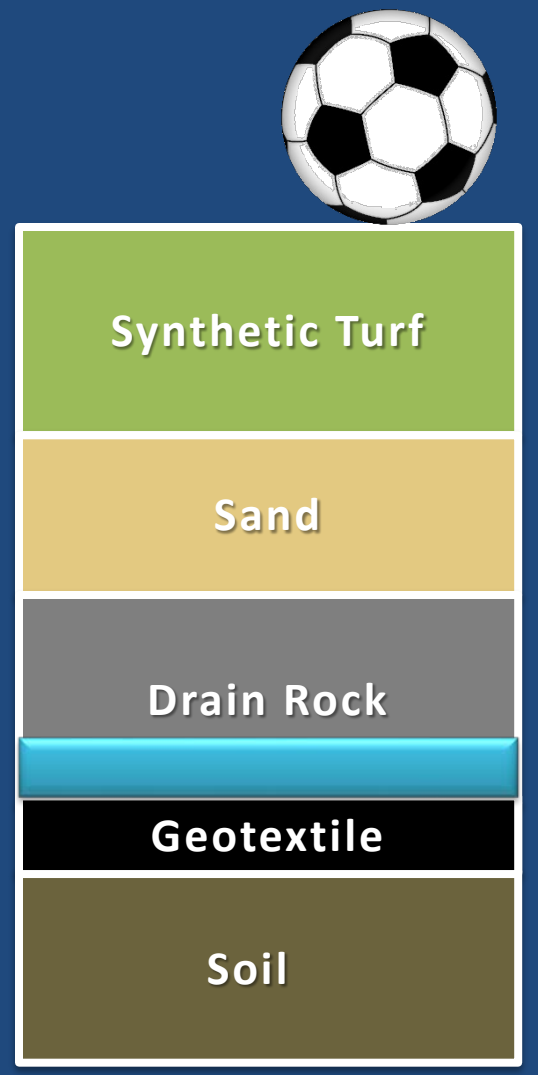
Synthetic Turf

- Treatment via sand layer as filter
- @ 0.4 void space ratio & no run-on, 0.9" WQv requires 2.25" depth
- +24 hr. drawdown should be obtainable



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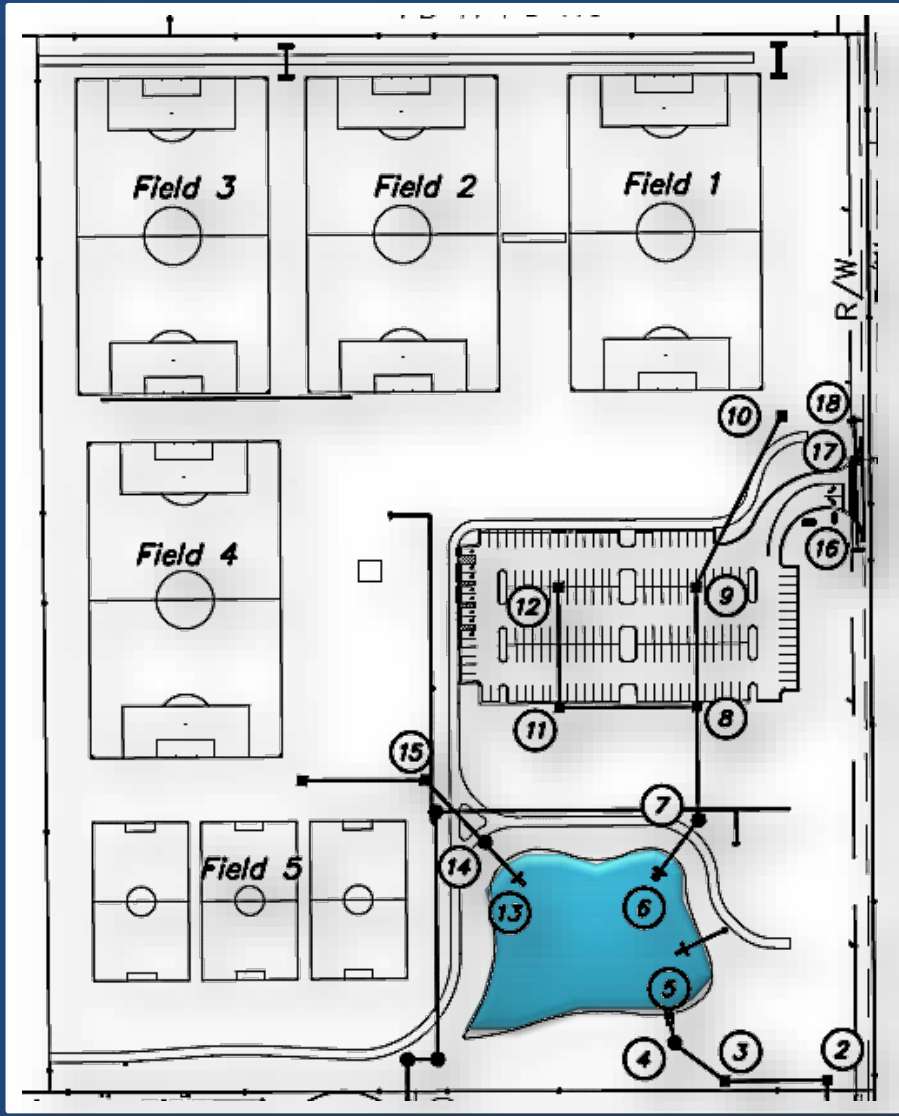
Parks, Cemeteries, Oh My !



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Difficult Areas to Capture

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Difficult Areas to Capture

- Is there another site layout ?
- Can the disturbed area be limited ?
- Cane runoff reduction reduce the BMP size or absorb entire WQv ?
- Is there an alternative BMP or creative design ?
- Off-site mitigation

  (Same HUC-12, 1.5 * WQv)

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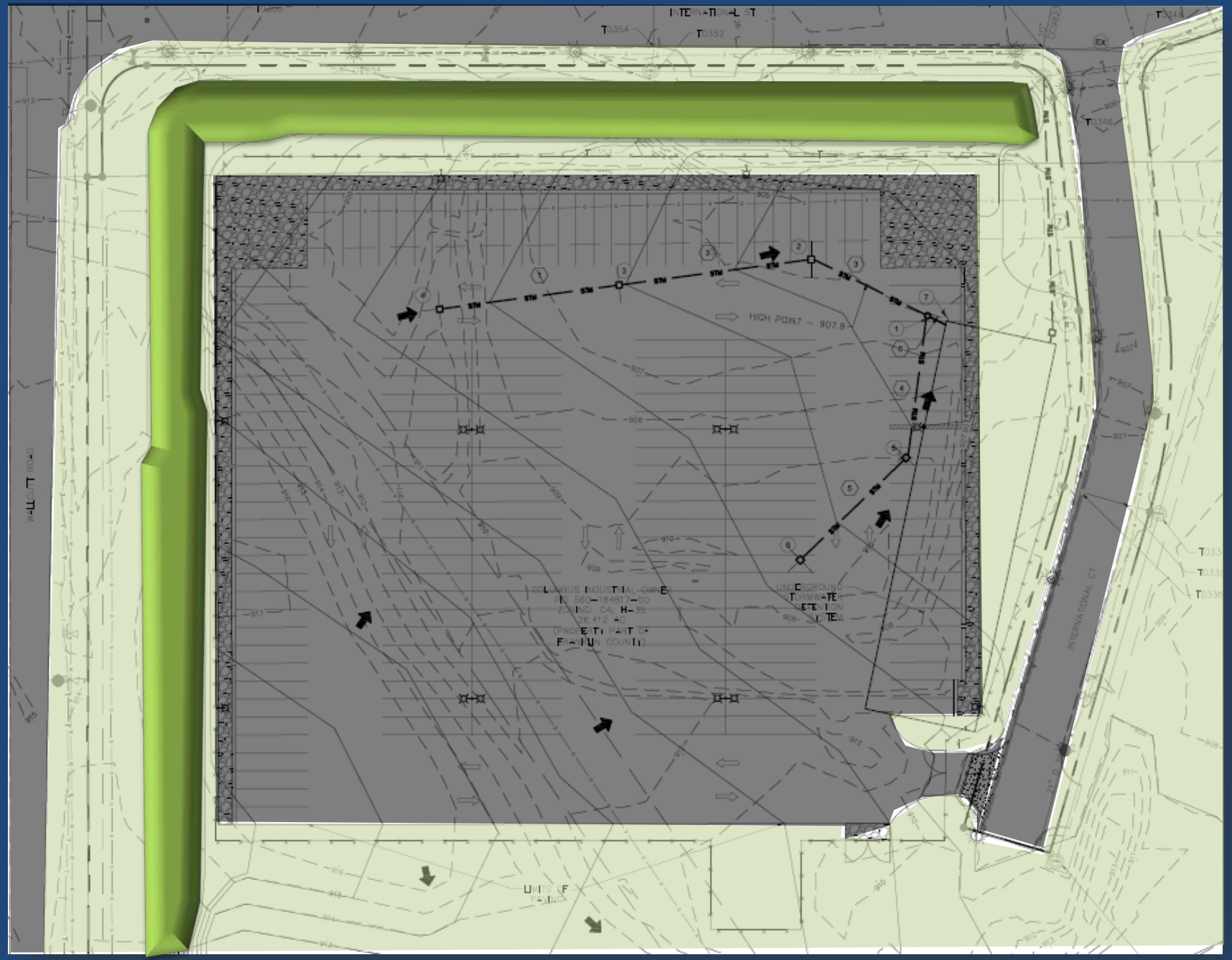

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Disturbed Area: 7.00 ac
New Impervious: 5.06 ac
Rv: 0.72
WQv: 0.37 ac-ft

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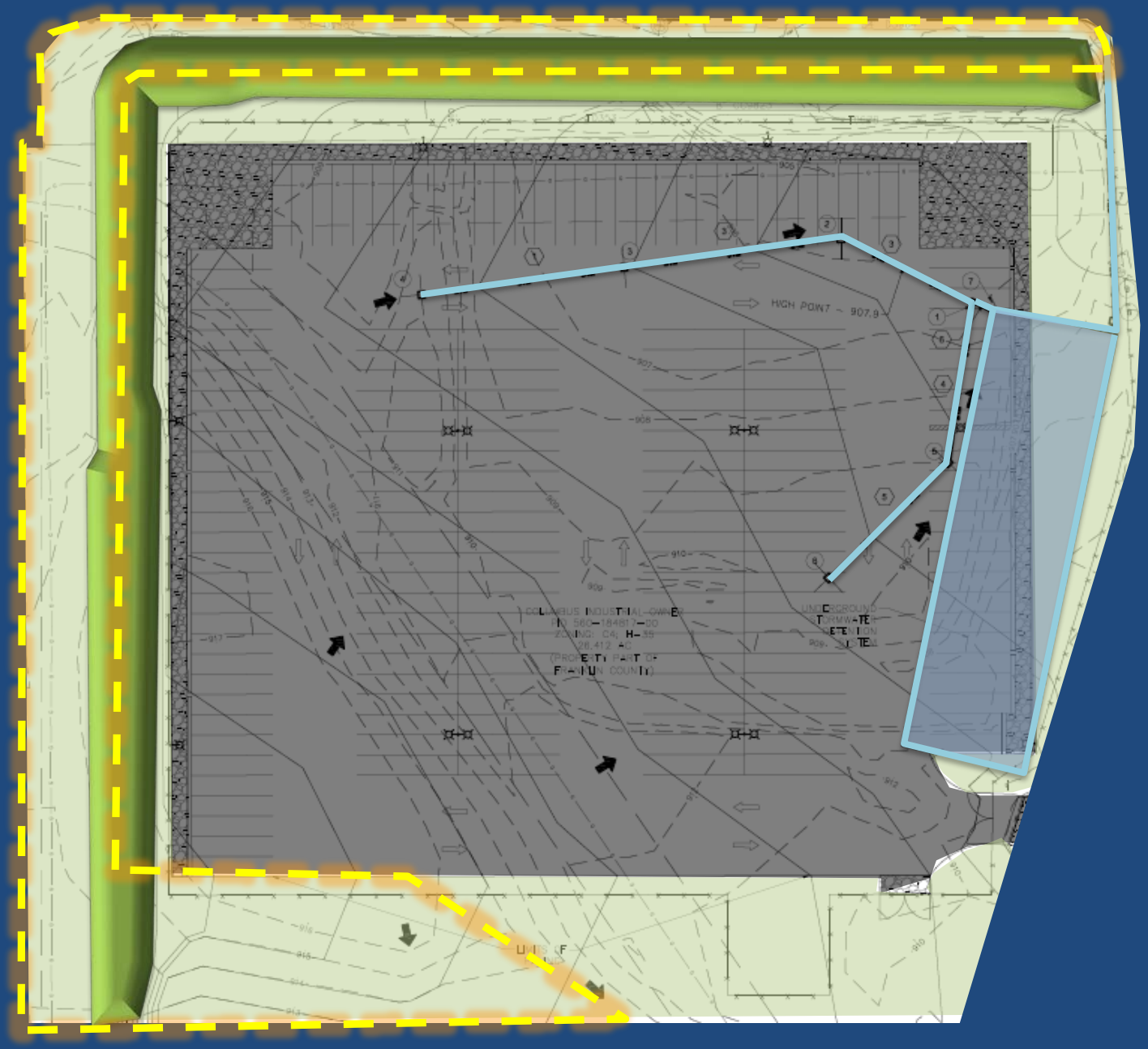

Disturbed Area: 7.00 ac
New Impervious: 5.06 ac
Rv: 0.72
WQv: 0.37 ac-ft

Uncaptured Area: 1.25 ac
Rv: 0.05
WQv: 0.005 ac-ft (1.4%)

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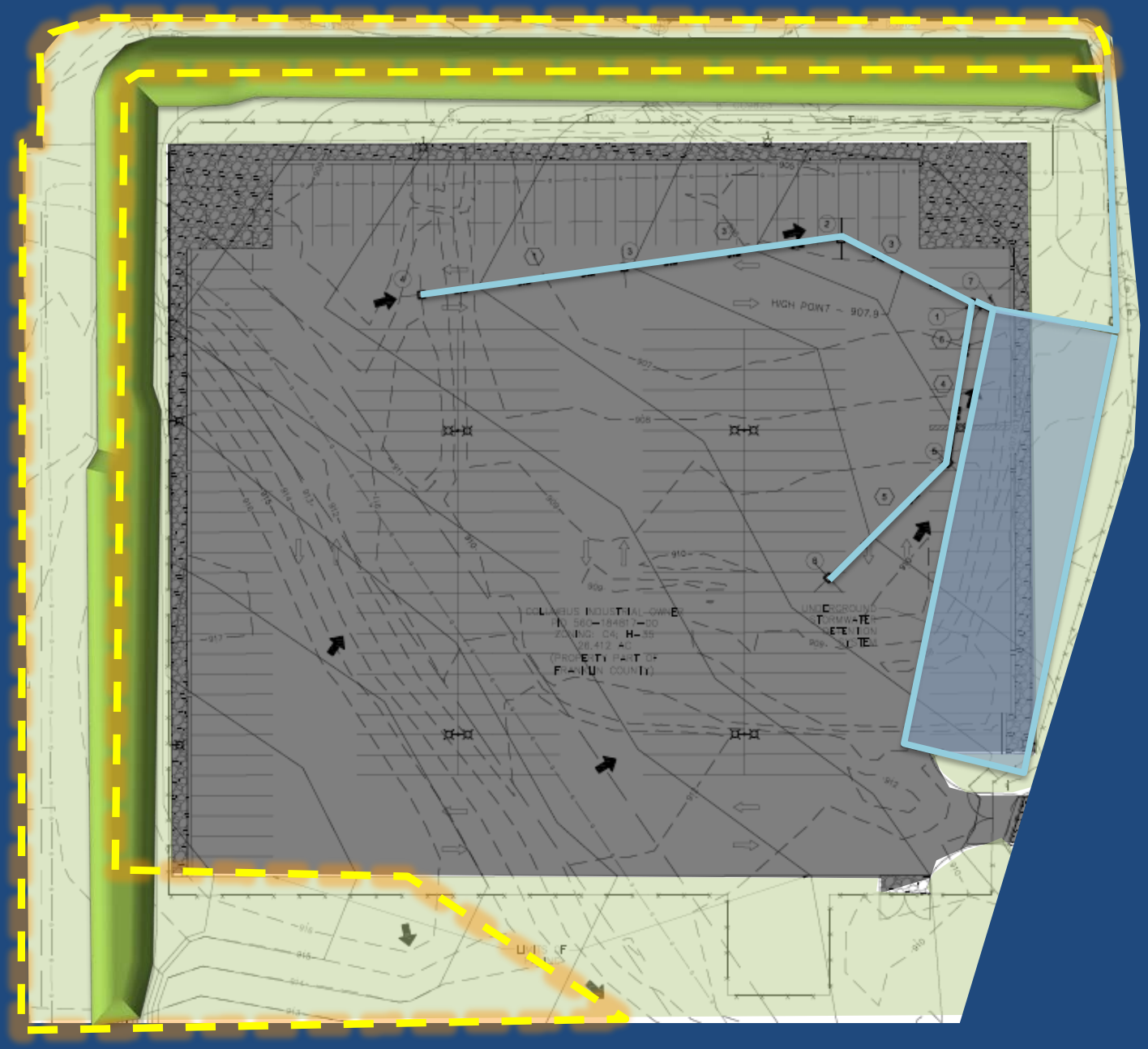

Disturbed Area: 7.00 ac
New Impervious: 5.06 ac
Rv: 0.72
WQv: 0.37 ac-ft

Uncaptured Area: 1.25 ac
Rv: 0.05
WQv: 0.005 ac-ft (1.4%)

Grass Filter Strip
HSG C or D soil
RR Credit: 0.02 cu. ft. per sq. ft.
0.02 cu. ft. x 1.25 ac = 0.025 ac-ft

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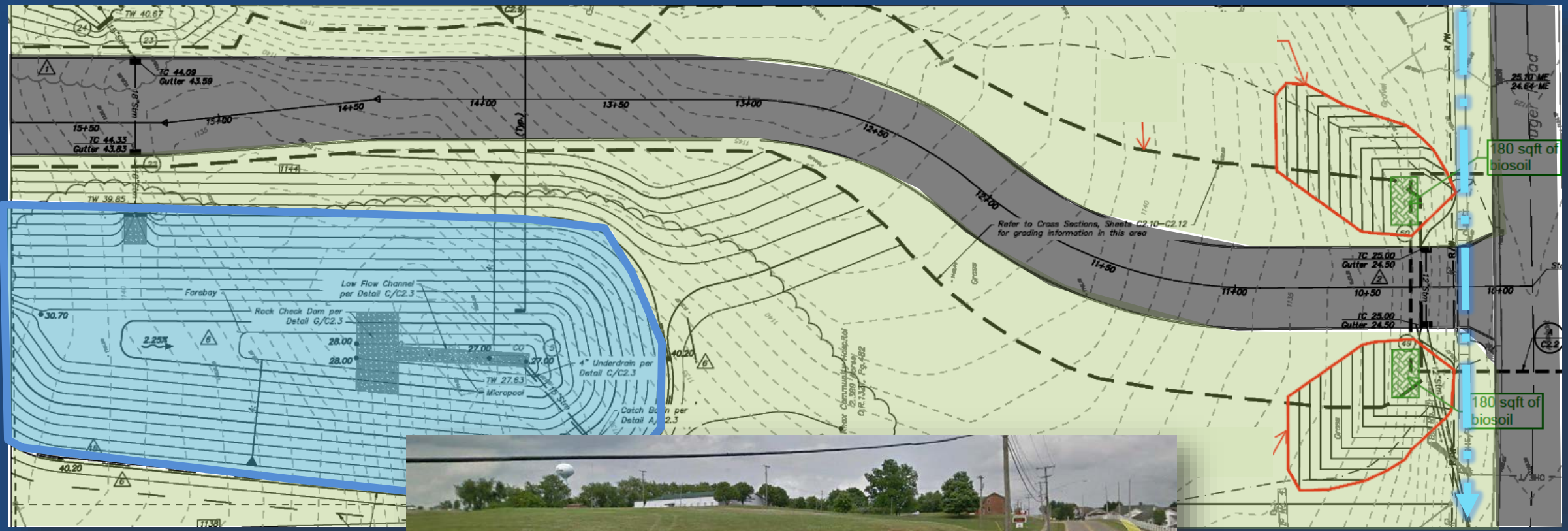

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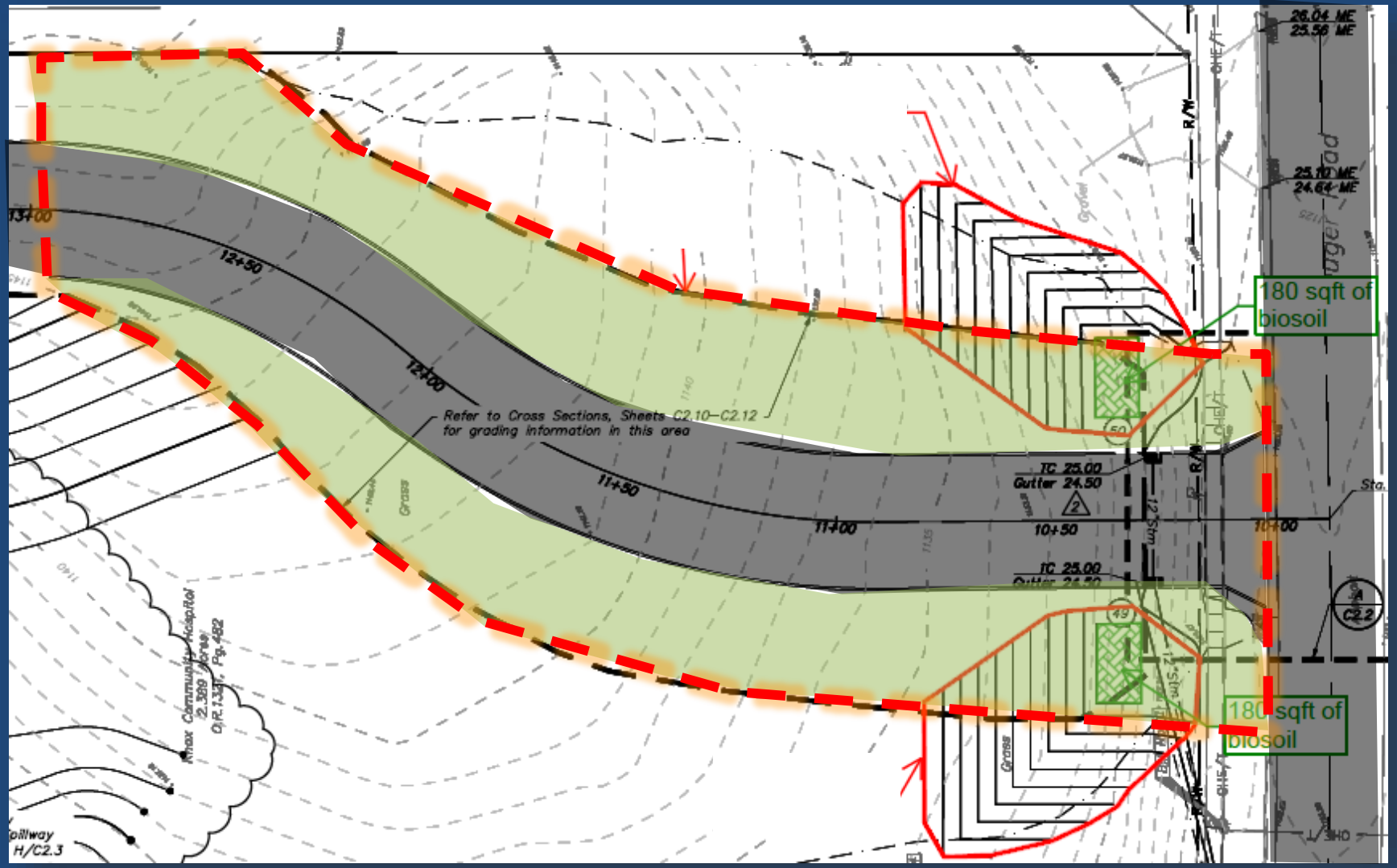
Uncaptured area: 0.75 ac
Rv: 0.30
WQv: 0.017 ac-ft



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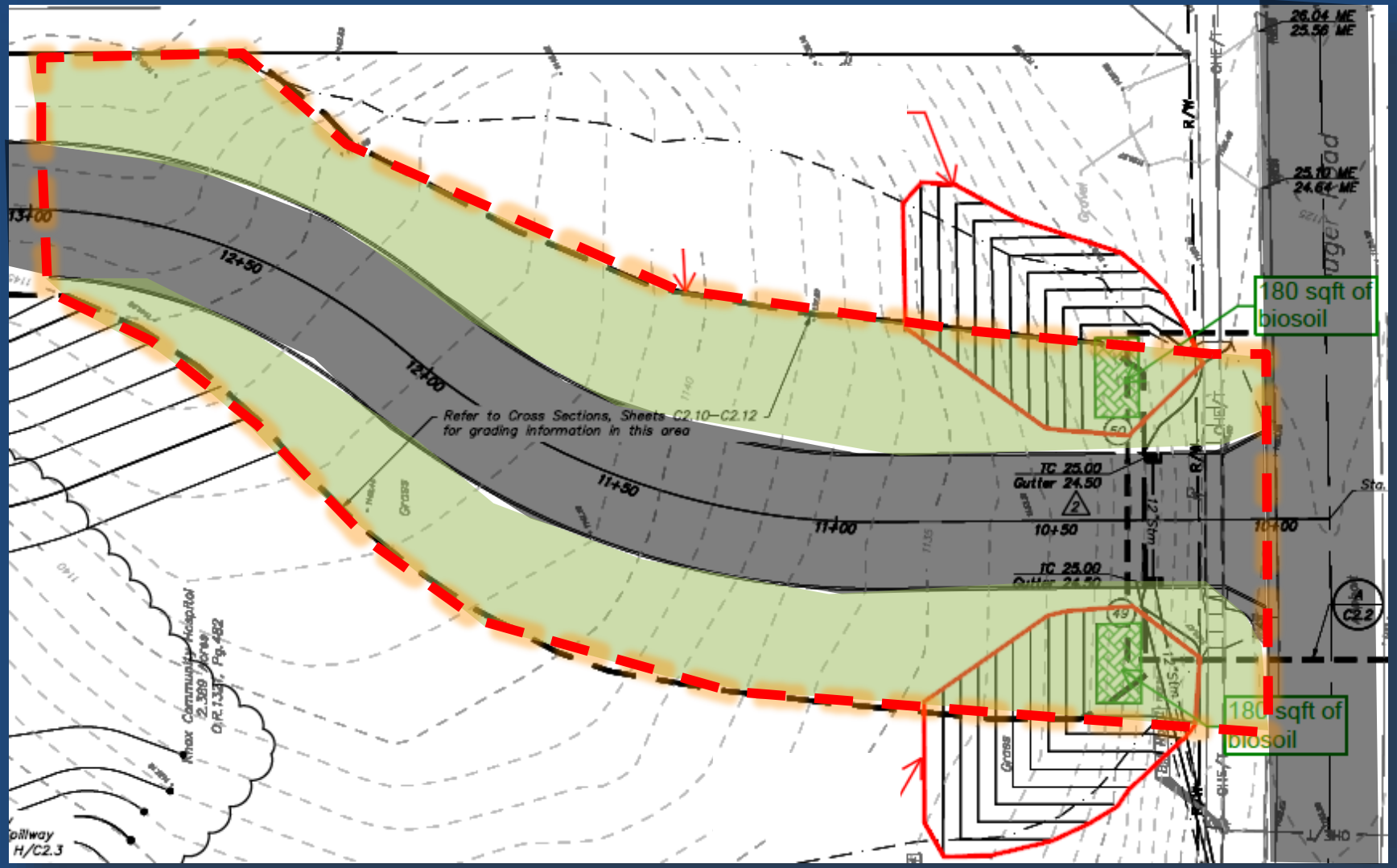
Uncaptured area: 0.75 ac
Rv: 0.30
WQv: 0.017 ac-ft

- Disconnection w/ swale: -38%
- w/ amendments: -55%



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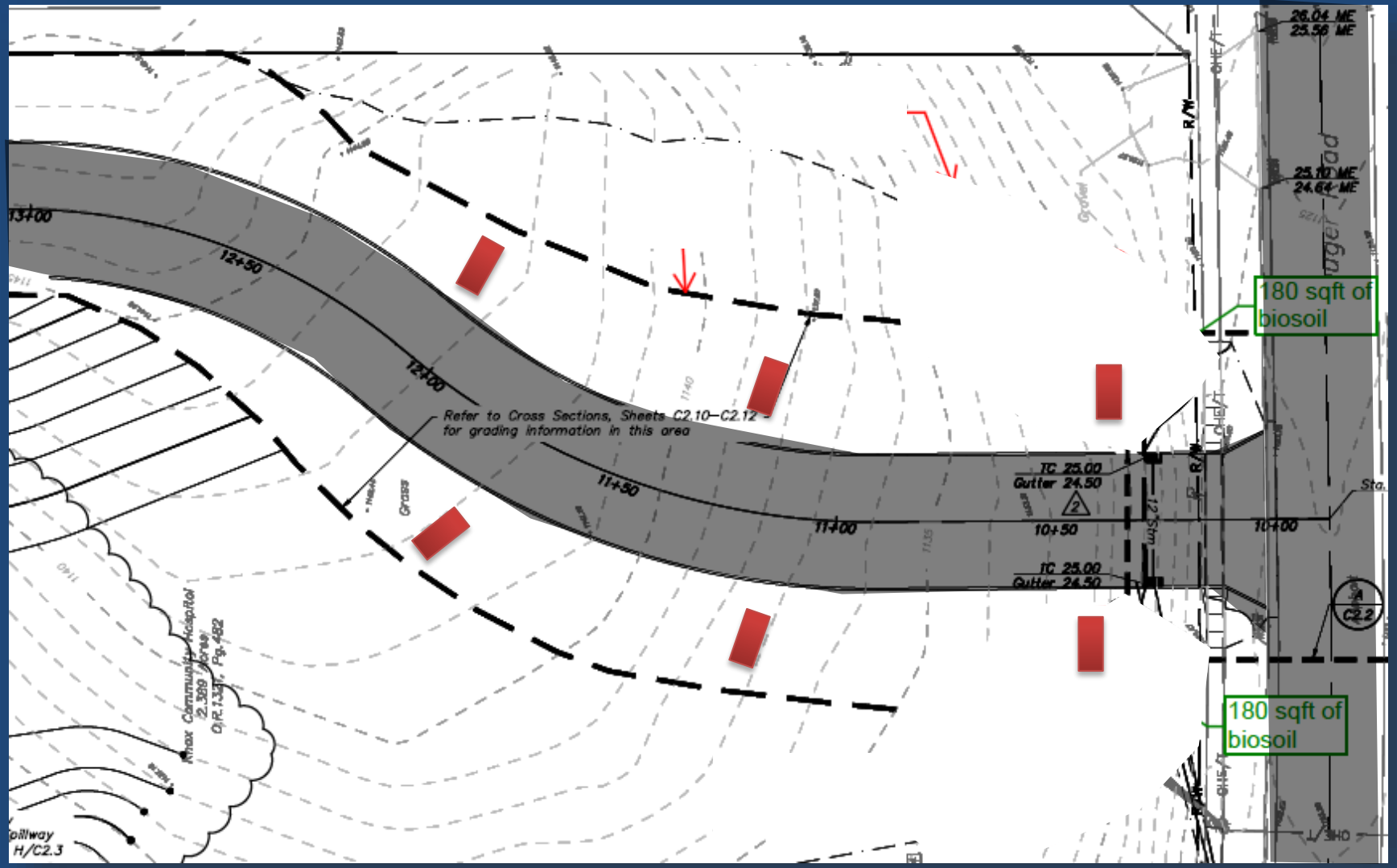
Uncaptured area: 0.75 ac
Rv: 0.30
WQv: 0.017 ac-ft

- Series of smaller bioretention cells ?



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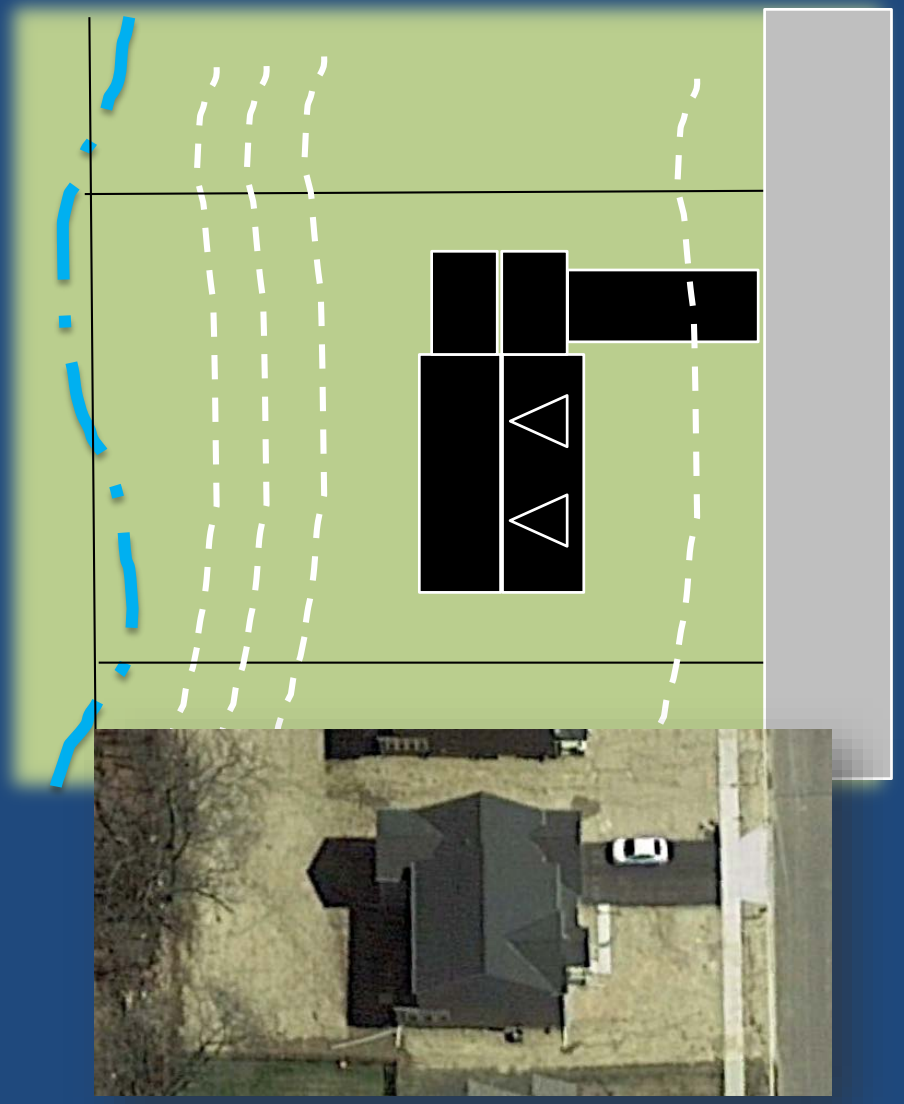
Residential Rear Yards



Lot size: ¼ ac

Avg. home footprint: 2,100 sq. ft.

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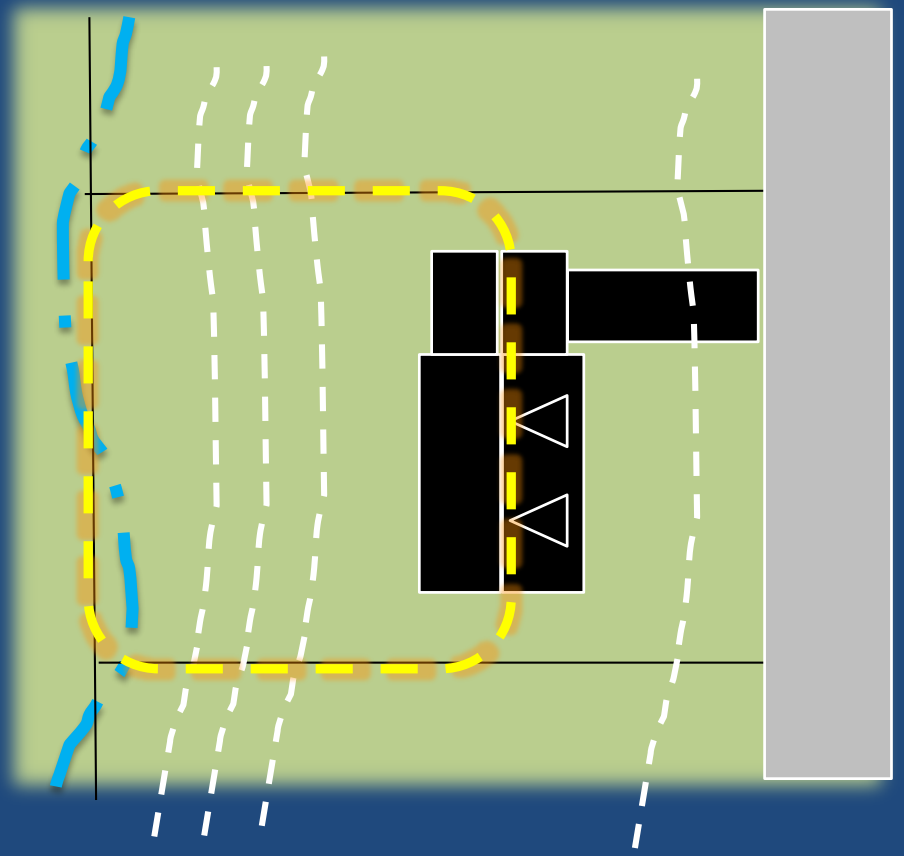
Residential Rear Yards



Rear drainage:

Rv: 0.22

WQv: 91 cu. ft. (35% of lot total)

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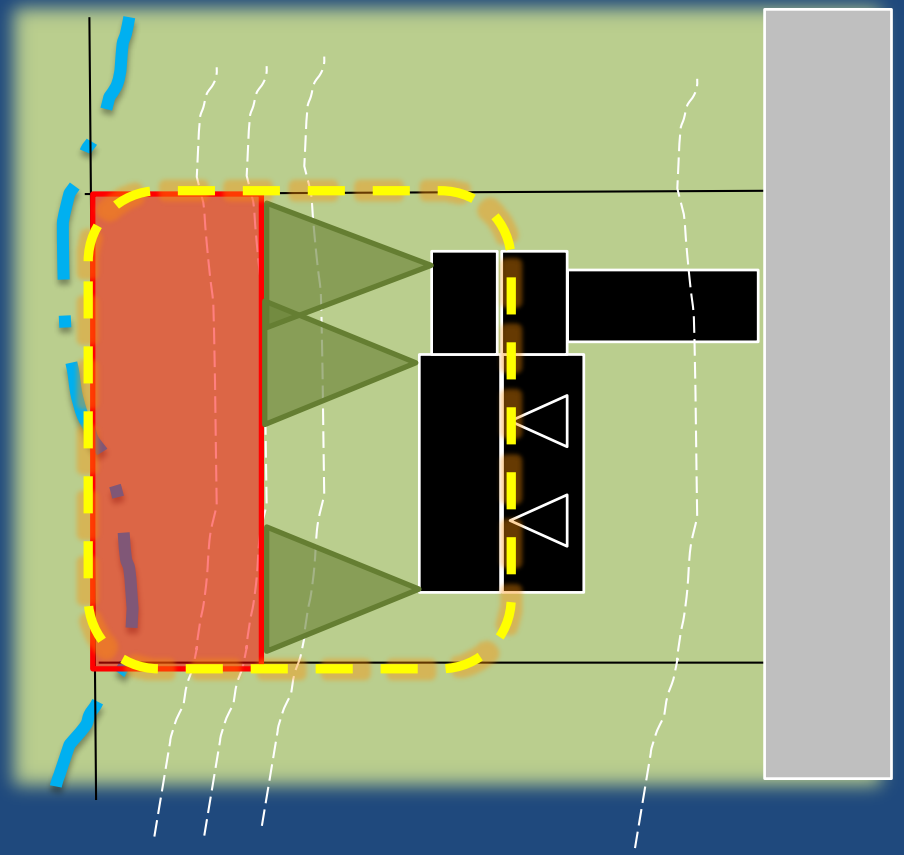
Residential Rear Yards



WQv: 91 cu. ft.

Simple Downspout Disconnections
3 @ 25 ft x 12.5 ft
C or D soil
RRM credit: 38 cu. ft.

Conservation Area
70 ft x 25 ft
C or D soil
RRM credit: 54 cu. ft.

38 + 54 = 92 cu. ft.

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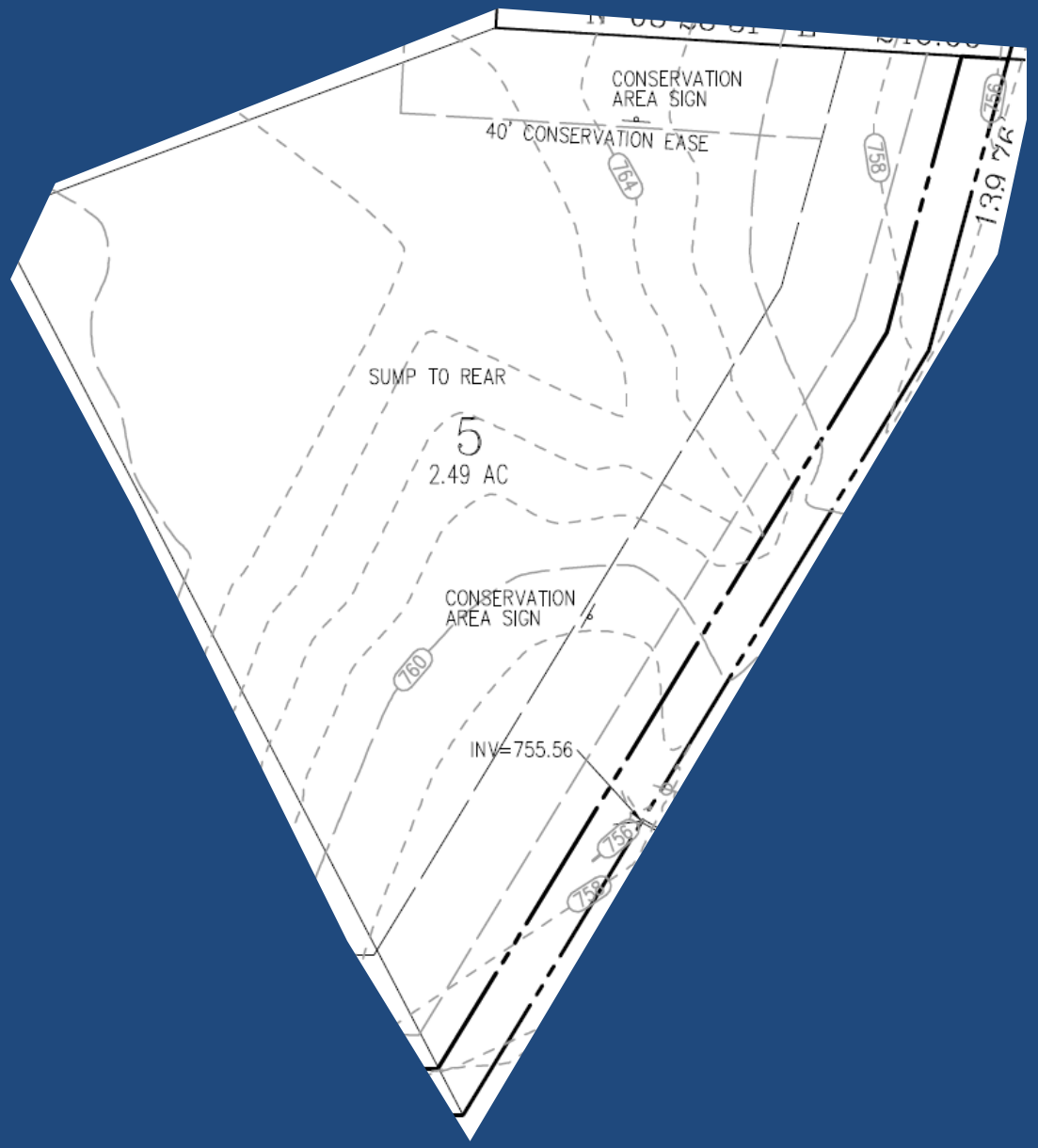

Large Lots

1.5+ ac

i <20%

Avg. home footprint: 4,000 sq. ft.

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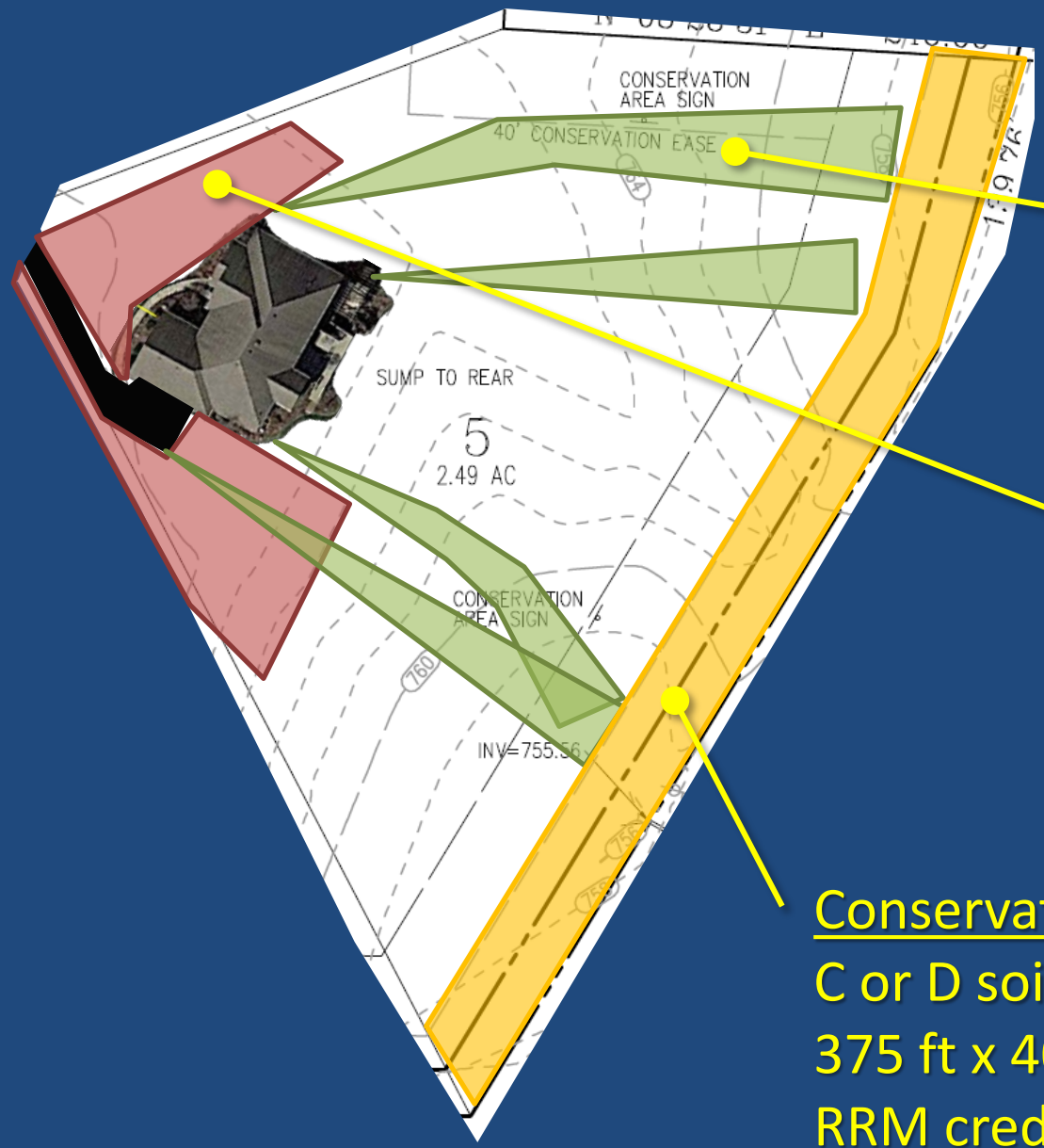

House WQv: 285 cu. ft.
Drive WQv: 86 cu. ft.
Yard WQv: 389 cu. ft.

Simple Downspout Disconnection
C or D soil
4 @ 200 ft x 20 ft
RRM credit: 284 cu. ft.

Simple Pavement Disconnection
C or D soil
8000 ft^2
RRM credit: 86 cu. ft.

Conservation Area
C or D soil
375 ft x 40 ft
RRM credit: 389 cu. ft.

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Area A	Drainage Area ID:	Roof				
	Drainage Area, A_A =	0.09	acres	=	4,000	ft^2
	Impervious Area, A_{Aimp} =	0.09	acres	=	4,000	ft^2
	Imperviousness Fraction, i_A =	1.00		=	100	%
	Volumetric Runoff Coefficient, Rv_A =	0.95				
	Water Quality Volume, WQv_A =	285	ft^3			
	Runoff Reduction Volume, RRv_A =	290	ft^3			
	Remaining Water Quality Volume, WQv_{AR} =	-5	ft^3			

Area B	Drainage Area ID:	Driveway				
	Drainage Area, A_B =	0.03	acres	=	1,200	ft^2
	Impervious Area, A_{Bimp} =	0.03	acres	=	1,200	ft^2
	Imperviousness Fraction, i_B =	1.00		=	100	%
	Volumetric Runoff Coefficient, Rv_B =	0.95				
	Water Quality Volume, WQv_B =	86	ft^3			
	Runoff Reduction Volume, RRv_B =	86	ft^3			
	Remaining Water Quality Volume, WQv_{BR} =	0	ft^3			

Area C	Drainage Area ID:	Yard				
	Drainage Area, A_C =	2.38	acres	=	103,700	ft^2
	Impervious Area, A_{Cimp} =	0.00	acres	=	0	ft^2
	Imperviousness Fraction, i_C =	0.00		=	0	%
	Volumetric Runoff Coefficient, Rv_C =	0.05				
	Water Quality Volume, WQv_C =	389	ft^3			
	Runoff Reduction Volume, RRv_C =	389	ft^3			
	Remaining Water Quality Volume, WQv_{CR} =	0	ft^3			

Area D	Drainage Area ID:					
	Drainage Area, A_D =	0.00	acres	=	0	ft^2
	Impervious Area, A_{Dimp} =	0.00	acres	=	0	ft^2
	Imperviousness Fraction, i_D =			=		%
	Volumetric Runoff Coefficient, Rv_D =					
	Water Quality Volume, WQv_D =		ft^3			
	Runoff Reduction Volume, RRv_D =	0	ft^3			
	Remaining Water Quality Volume, WQv_{DR} =		ft^3			

Project Totals						
	Drainage Area, A_{total} =	2.50	acres	=	108,900	ft^2
	Impervious Area, A_{imp} =	0.12	acres	=	5,200	ft^2
	Imperviousness Fraction, i =	0.05		=	5	%
	Volumetric Runoff Coefficient, Rv =	0.09				
	Water Quality Volume, WQv =	759	ft^3			
	Runoff Reduction Volume, RRv =	764	ft^3			
	Remaining Water Quality Volume, WQv_R =	-5	ft^3			

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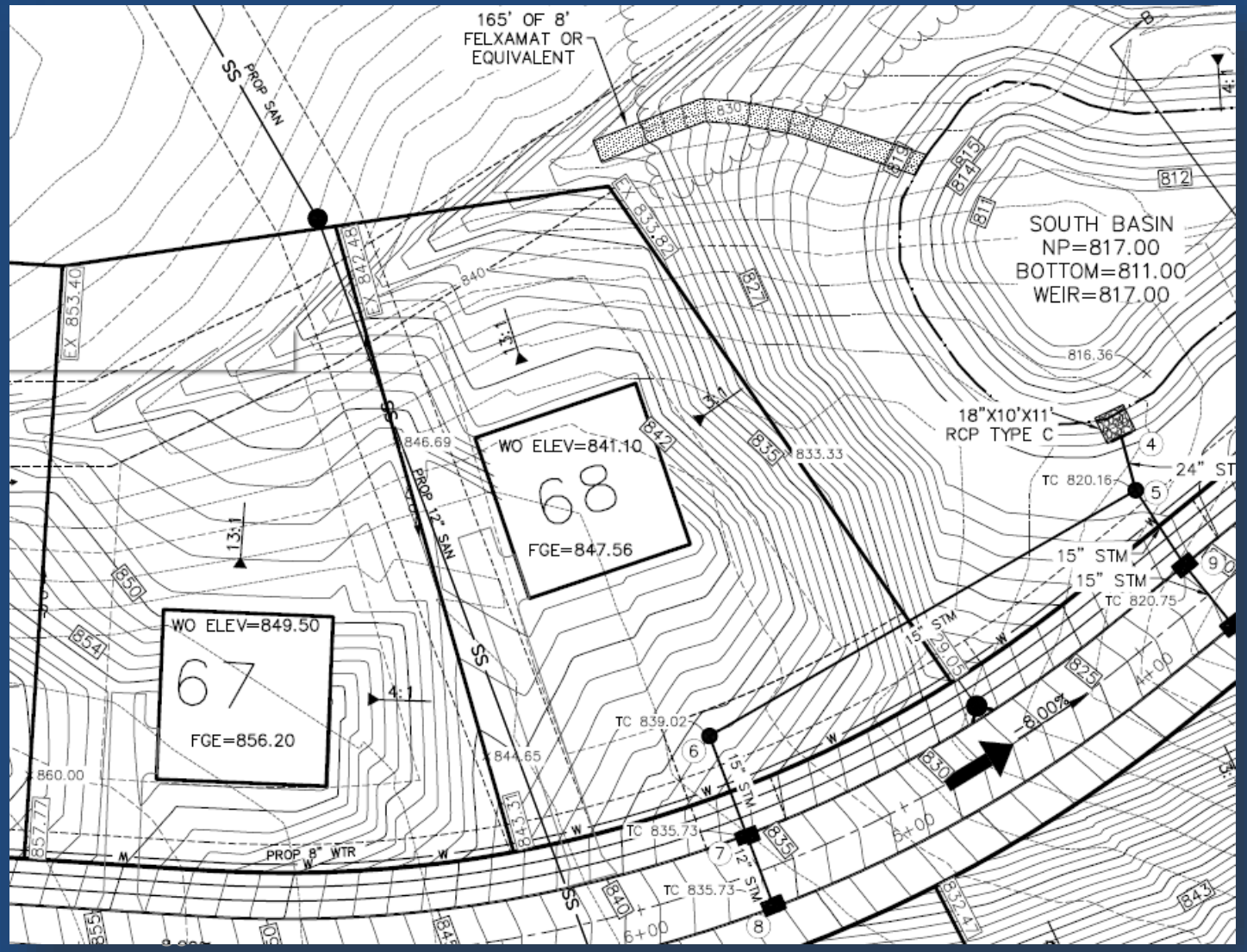
Runoff Reduction

- ✓Identify
  - Planned impervious areas
  - Flowpaths
  - Credit areas



Runoff Reduction

✓Establish sheetflow

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Runoff Reduction

- ✓ Design to the Practice Standard
- ✓ Document

Area A	**Drainage Area ID:**	**Roof**				
	Drainage Area, A_A =	0.09	acres	=		
	Impervious Area, A_{Aimp} =	0.09	acres	=		
	Imperviousness Fraction, i_A =	1.00		=		
	Volumetric Runoff Coefficient, Rv_A =	0.95				
	Water Quality Volume, WQv_A =	285	ft^3			
	Runoff Reduction Volume, RRv_A =	290	ft^3			
	Remaining Water Quality Volume, WQv_{AR} =	-5	ft^3			
Area B	**Drainage Area ID:**	**Driveway**				
	Drainage Area, A_B =	0.03	acres	=		
	Impervious Area, A_{Bimp} =	0.03	acres	=	1,	
	Imperviousness Fraction, i_B =	1.00		=	1	
	Volumetric Runoff Coefficient, Rv_B =	0.95				
	Water Quality Volume, WQv_B =	86	ft^3			
	Runoff Reduction Volume, RRv_B =	86	ft^3			
	Remaining Water Quality Volume, WQv_{BR} =	0	ft^3			
Area C	**Drainage Area ID:**	**Yard**				
	Drainage Area, A_C =	2.38	acres	=	103,700	ft^2
	Impervious Area, A_{Cimp} =	0.00	acres	=	0	ft^2
	Imperviousness Fraction, i_C =	0.00		=	0	%
	Volumetric Runoff Coefficient, Rv_C =	0.05				
	Water Quality Volume, WQv_C =	389	ft^3			
	Runoff Reduction Volume, RRv_C =	389	ft^3			
	Remaining Water Quality Volume, WQv_{CR} =	0	ft^3			
Area D	**Drainage Area ID:**					
	Drainage Area, A_D =	0.00	acres	=	0	ft^2
	Impervious Area, A_{Dimp} =	0.00	acres	=	0	ft^2
	Imperviousness Fraction, i_D =			=		%
	Volumetric Runoff Coefficient, Rv_D =					
	Water Quality Volume, WQv_D =		ft^3			
	Runoff Reduction Volume, RRv_D =	0	ft^3			
	Remaining Water Quality Volume, WQv_{DR} =		ft^3			
Project Totals						
	Drainage Area, A_{total} =	2.50	acres	=	108,900	ft^2
	Impervious Area, A_{imp} =	0.12	acres	=	5,200	ft^2
	Imperviousness Fraction, i =	0.05		=	5	%
	Volumetric Runoff Coefficient, Rv =	0.09				
	Water Quality Volume, WQv =	759	ft^3			
	Runoff Reduction Volume, RRv =	764	ft^3			
	Remaining Water Quality Volume, WQv_R =	-5	ft^3			

RAINWATER AND LAND DEVELOPMENT PROVISIONAL PRACTICE STANDARD #.#

IMPERVIOUS AREA DISCONNECTION

DATE: 12/20/2018

Description

Impervious area disconnection is the practice of directing stormwater runoff from impervious surfaces through grassy lawn areas, rain gardens or stormwater planters before the runoff reaches the site's drainage network to reduce runoff volumes and discharge rates.

There are two categories of impervious area disconnection:

Simple Disconnection - Runoff directed from rooftops or paved areas (e.g., driveways, bike paths, parking areas) to appropriately sized, sloped and grassed pervious areas. A simple disconnection r used to established sheet flow into a raingarden, grass filter strip, or structural practice in a treat train.

Enhanced Disconnection - Runoff directed from impervious areas to an appropriately sized infiltration/filtration practice such as a rain garden or stormwater planter.

Condition Where Practice Applies

Simple disconnection applies to medium to low density residential or commercial sites wh create flooding, drainage or structural problems. Residential use should be restricted to ft².

Enhanced disconnection may be used where there is insufficient pervious area for a si disconnection, or a higher volume reduction credit is desired. Rain gardens are well- and treating rooftop runoff in residential applications where the landscaping and st management function will be maintained. Bioretention (Practice Standard 2.10) is larger commercial or institutional applications. Stormwater planters (sometimes bioretention") are well-suited for treating rooftop runoff in commercial or ultra-

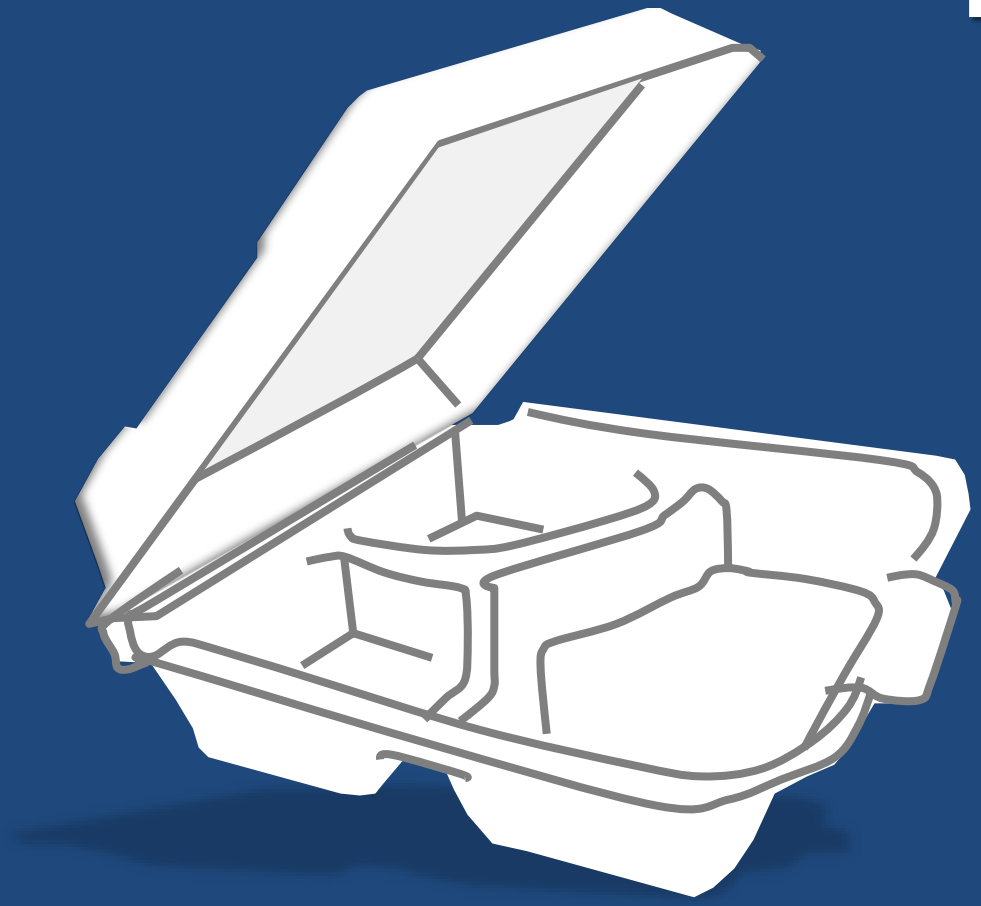
Credits

Purpose/Objective	Credit Available	Requ
Water Quality Pretreatment	Used in conjunction with filter strips or grass swales, Impervious Area Disconnection can provide pretreatment for primary post-construction BMPs such as bioretention, infiltration basin, infiltration trench, or dry extended detention basin	
Runoff Reduction Volume (RRv)	Simple Disconnection	

Runoff Reduction

- ✓ Implement
  - Easements & restrictions
  - Sales contracts
  - Construction specifications
  - SWPPP documentation

Take Home



1) Opportunities for creativity
2) Diligence is required
3) Make pervious, pervious again
   - Use Soil Management Practice

Ohio Environmental Protection Agency

Thank You

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