

# **Preparing and Documenting Your LID Design**

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**For Stormwater Treatment  
and Flow Control**

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Contra Costa  
Clean Water Program



# Topics

- 💧 Principles for LID Site Design
- 💧 Drainage Management Areas
  - Delineation
  - Definition
  - Self-treating and Self-retaining DMAs
  - DMAs draining to Integrated Management Practices
- 💧 IMP Selection and Design
- 💧 Setting up Calculations
  - Using the IMP Calculator

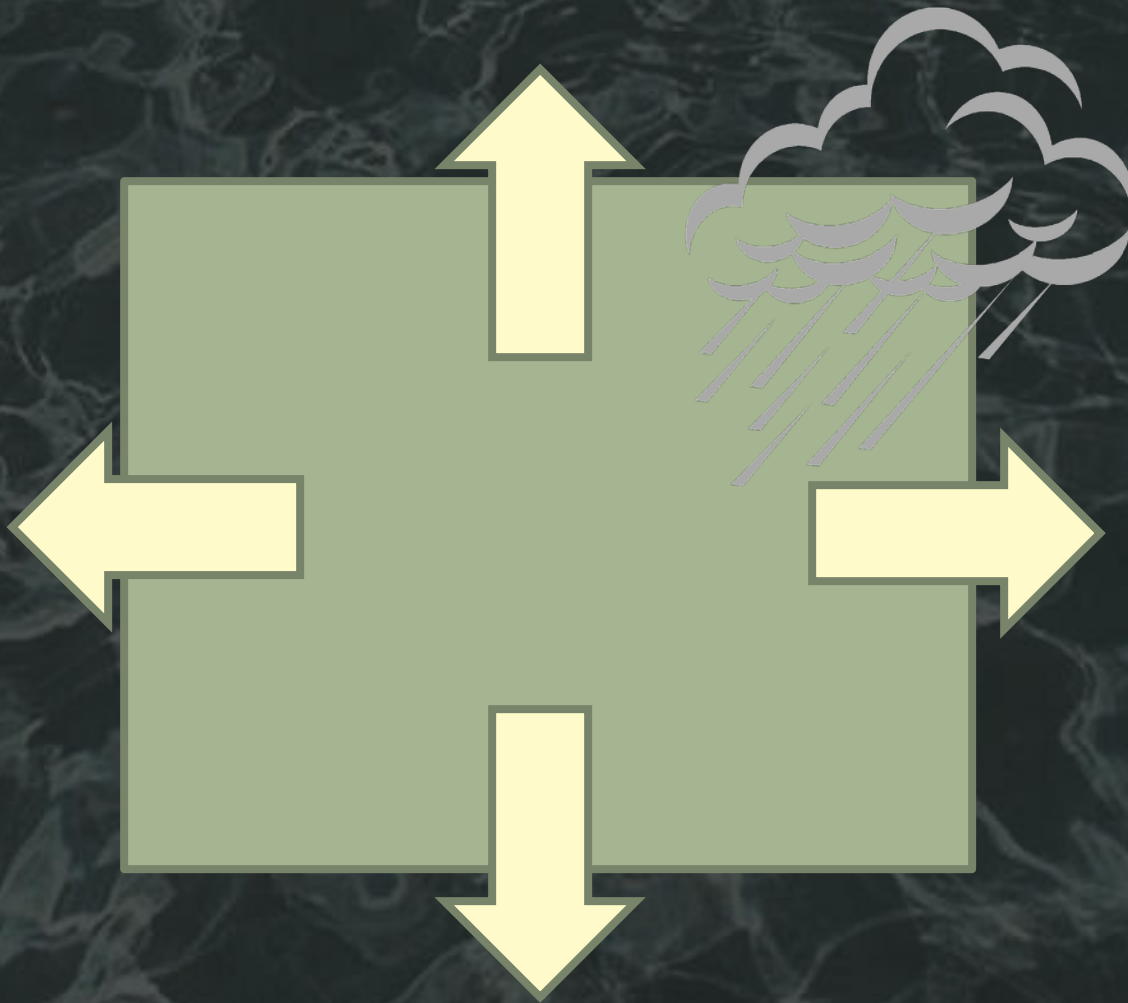


# LID Site Design Principles

Paved or  
Roof Area



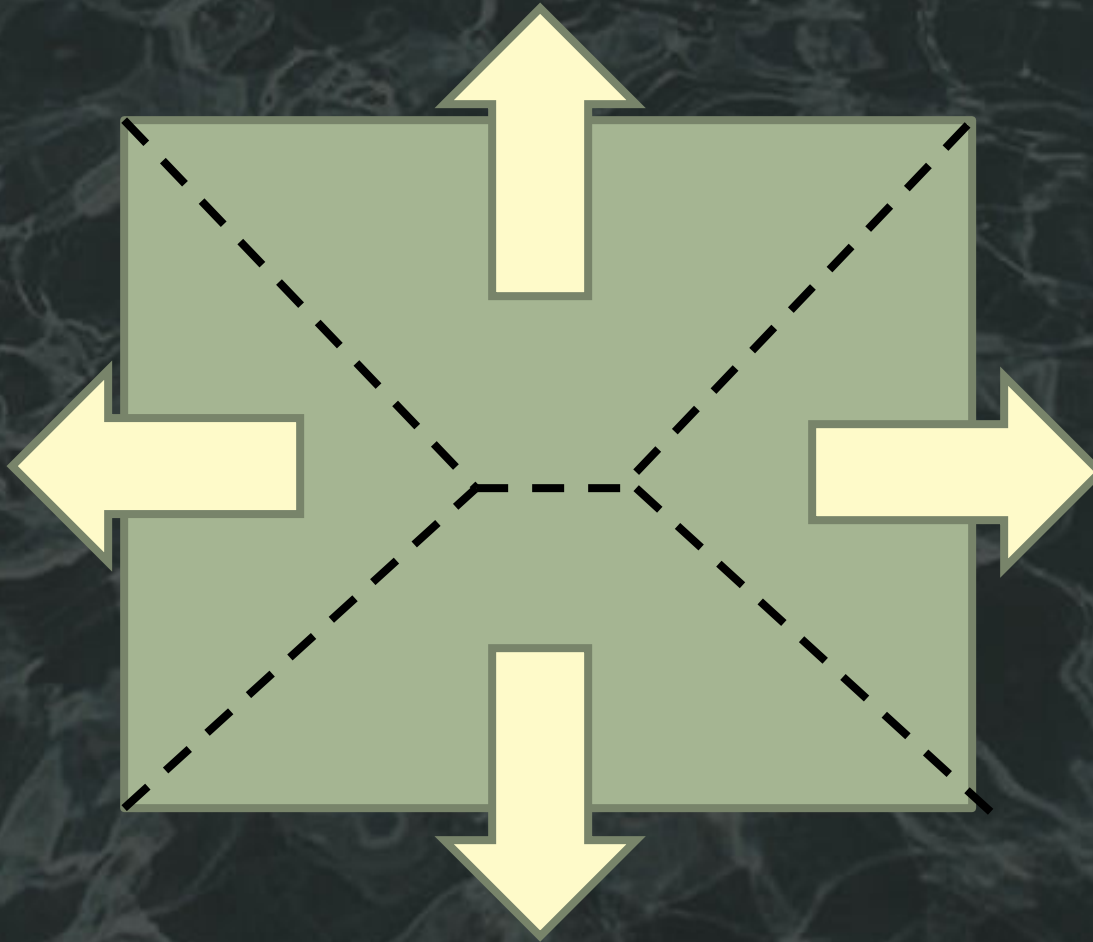
# LID Site Design Principles



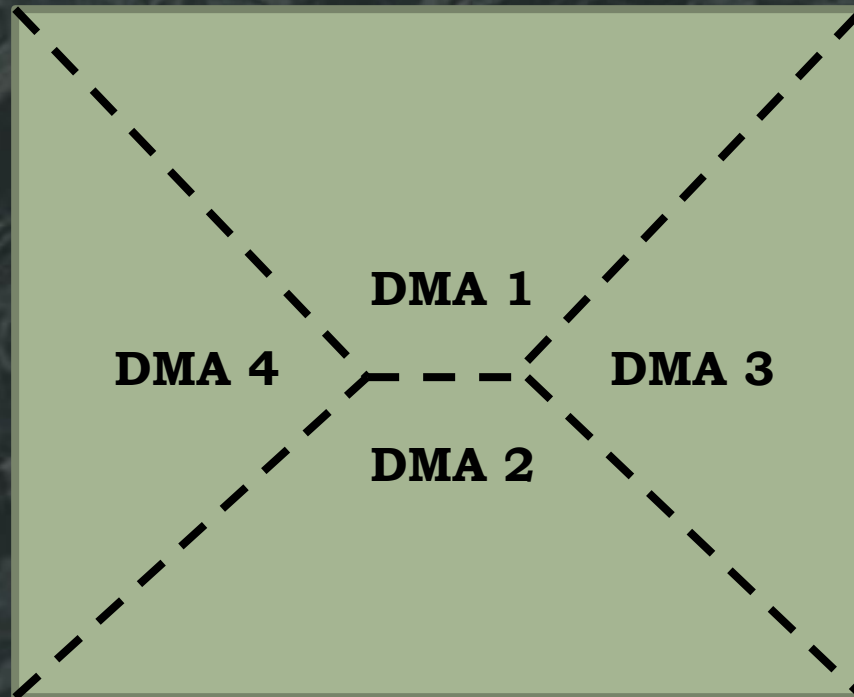
# LID Site Design Principles



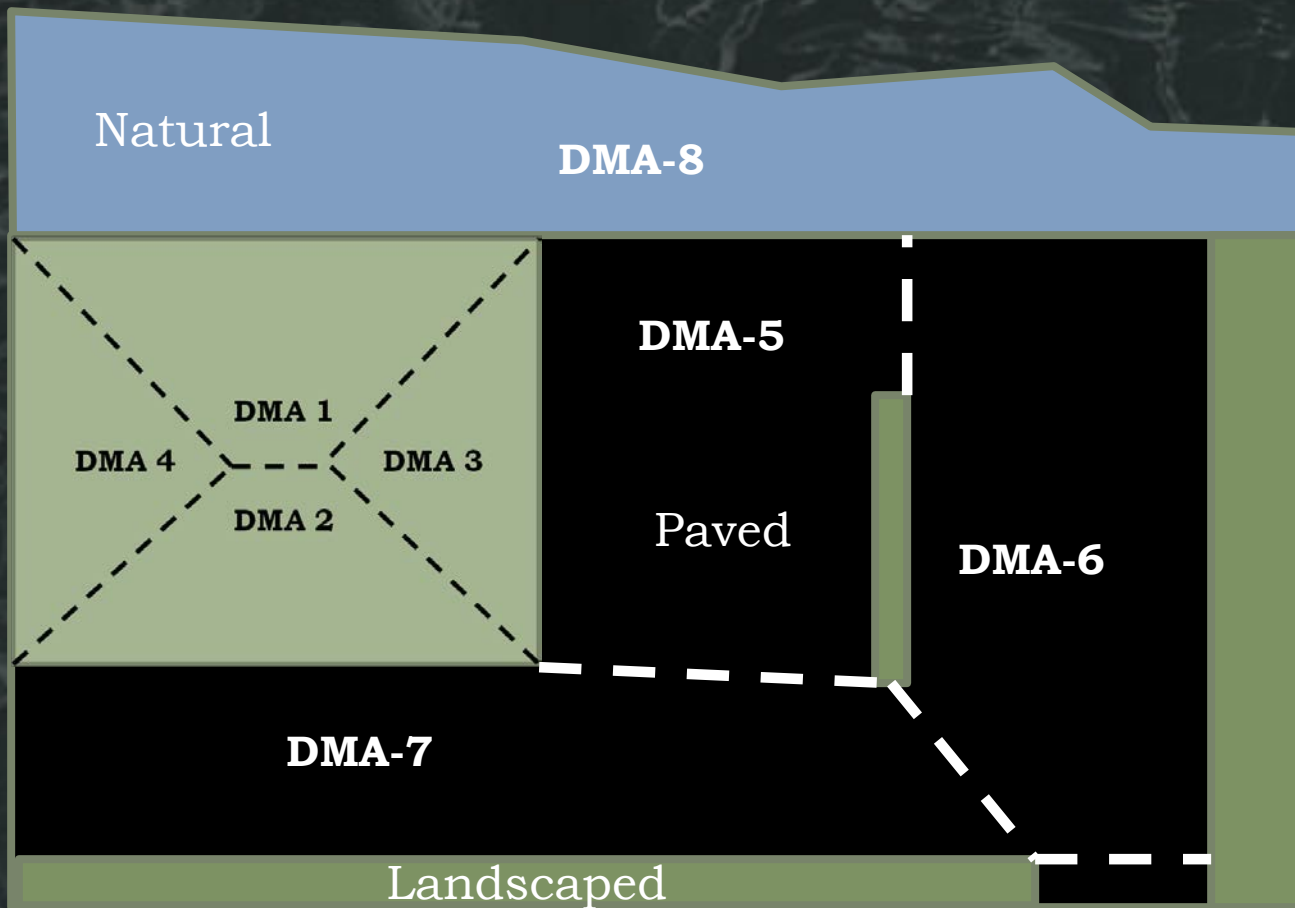
# Drainage Management Areas



# Drainage Management Areas

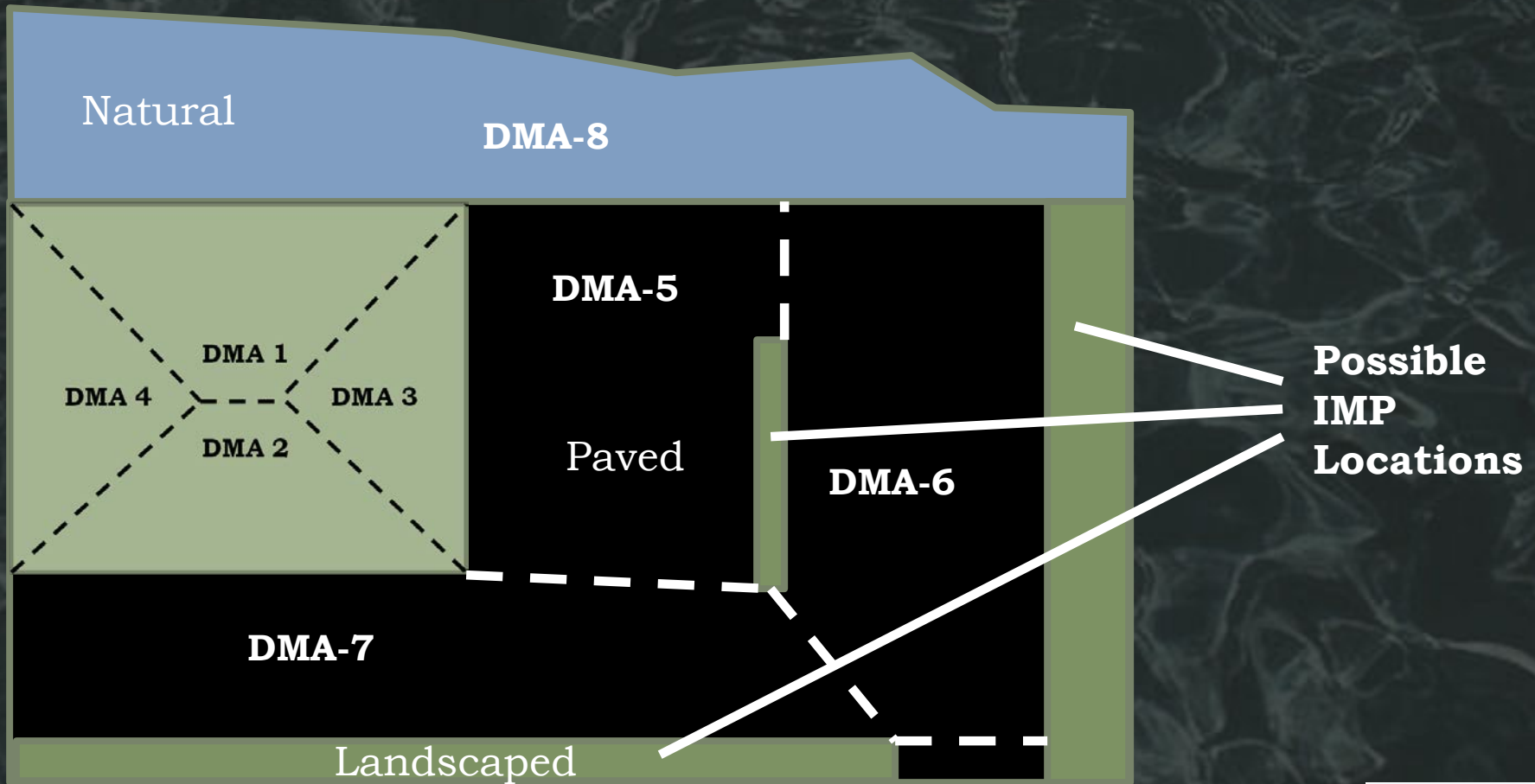


# Drainage Management Areas





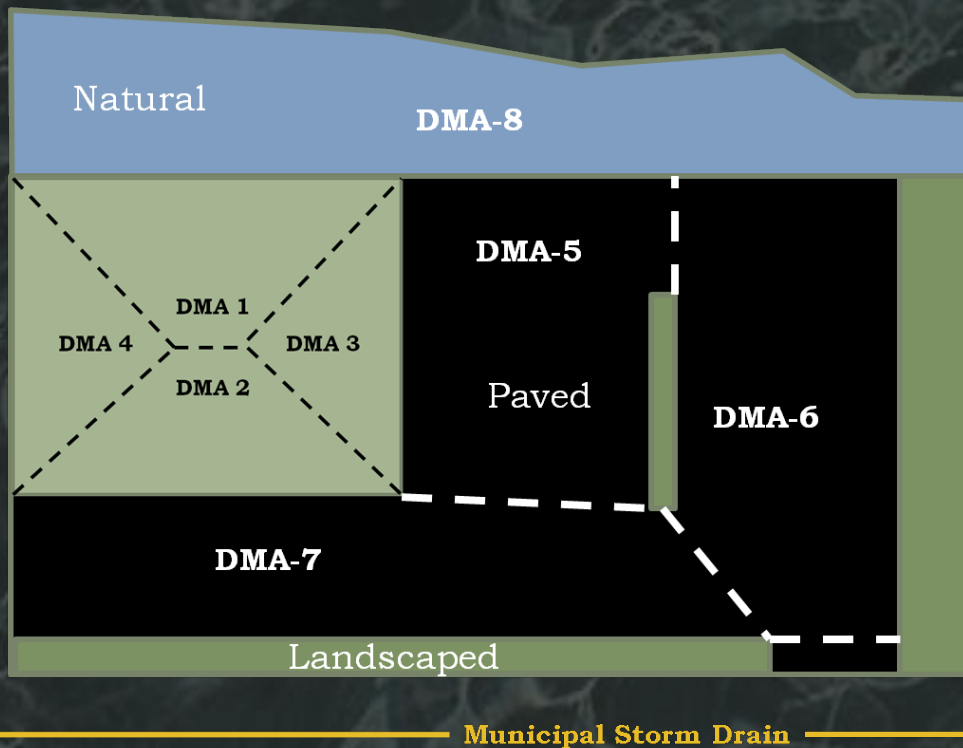
# Drainage Management Areas



Municipal Storm Drain



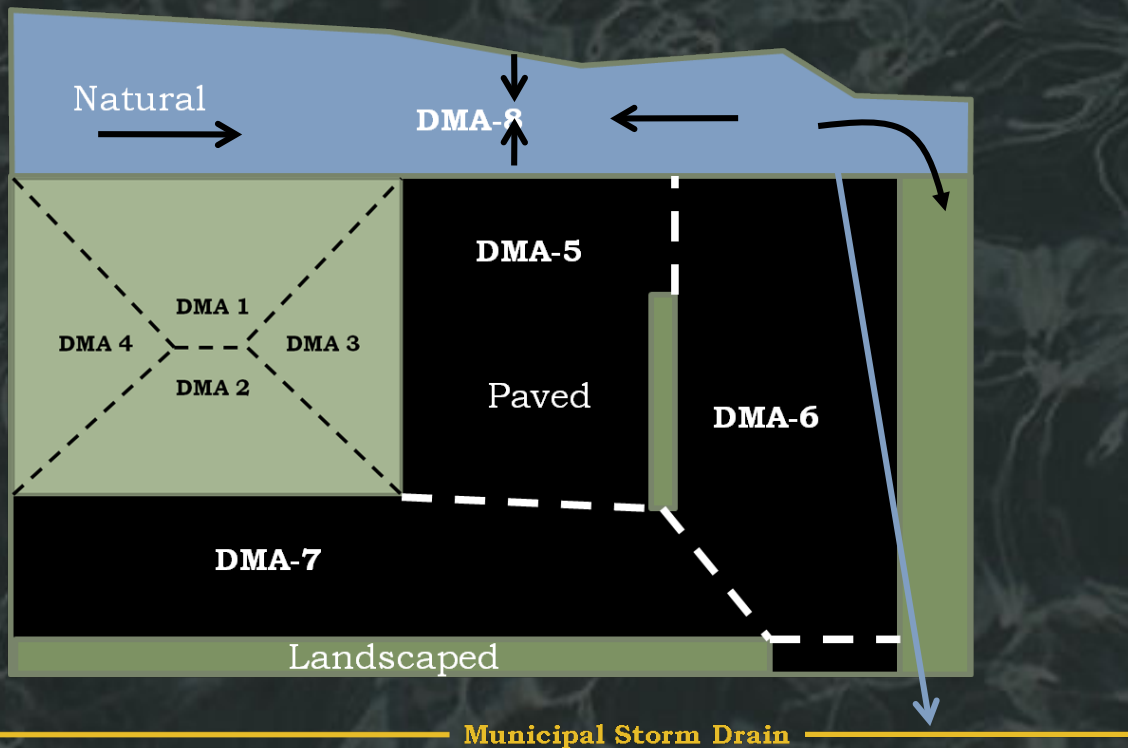
# Options – Pervious DMAs



- DMA-8
  - Self-treating?
  - Self-retaining?
  - Drain to IMP?



# DMA 8

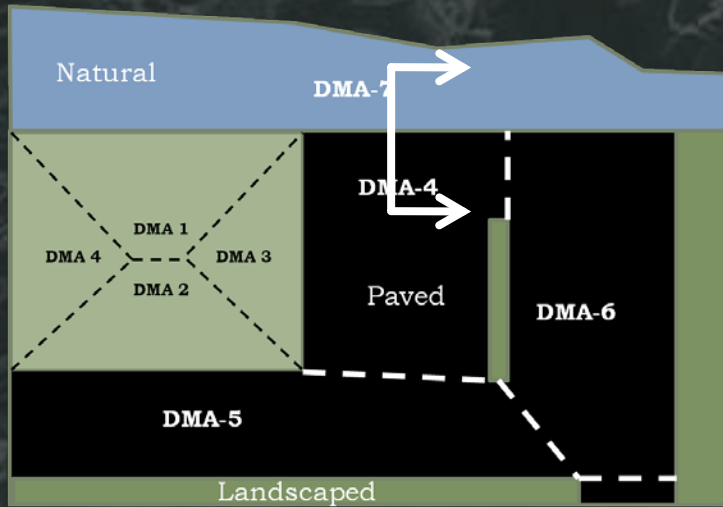


- Self-Treating
  - Drain directly to storm drain system
- Self-Retaining
  - Retain first inch of rainfall without producing runoff
- Drain to IMP
  - Use runoff factor to account for contribution

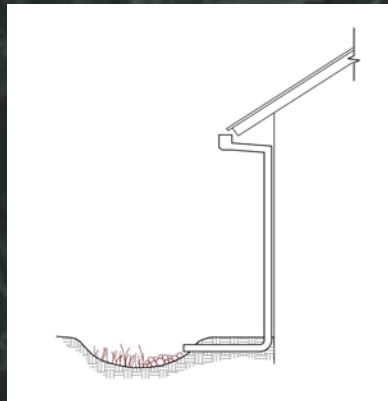
Best choice may depend on slope and relative elevation



# Details



Municipal Storm Drain



Consider that adjacent roofs or paved areas could drain to self-retaining areas (not to exceed 1:1)

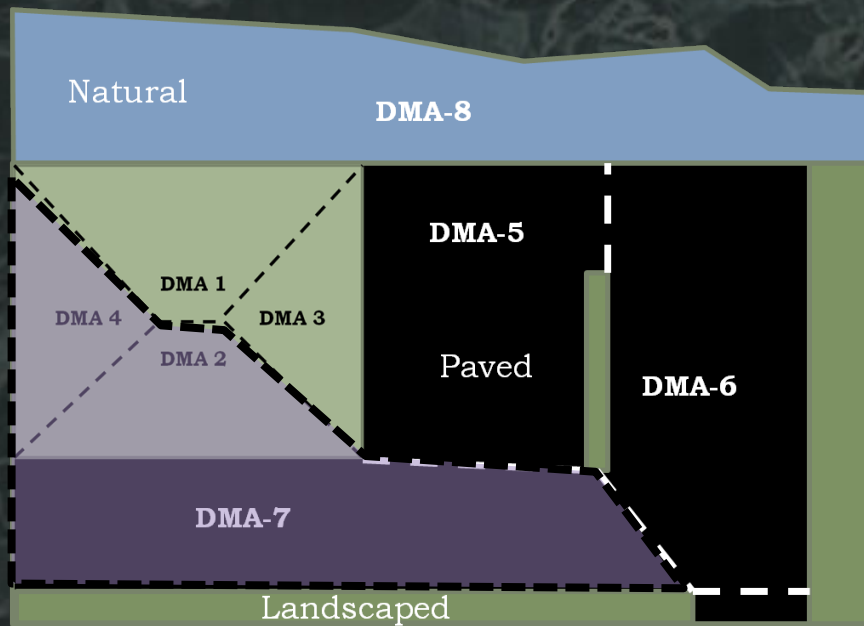
Use a curb to avoid run-on from self-treating areas



Grade self-retaining areas to drain inward. Set any area drains to pond 3"-4"



# Options – Combining DMAs



Option to combine DMAs if they have identical runoff factors (for example, roofs and paving) and drainage is routed to the same location.



Carefully follow grade breaks and roof ridges to delineate DMAs



# Plan-checking DMAs

- 💧 Consistency with grading, paving, and architectural plans
  - Some municipalities require the stormwater compliance exhibit be drawn over a screen of the grading plan
- 💧 Sufficient head to ensure drainage across the DMA and from the DMA to the receiving IMP
- 💧 Follow-through in final design and during construction



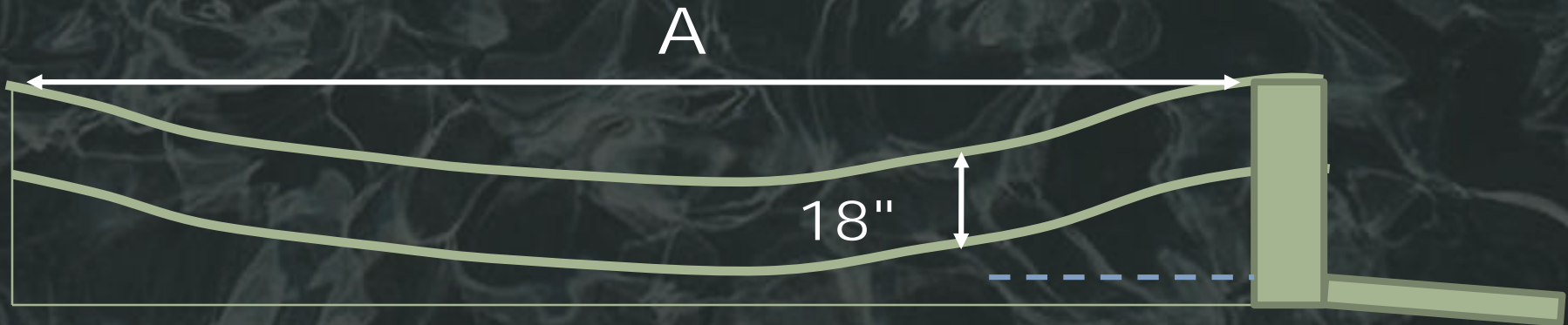
# IMPs

- 💧 Integrated Management Practices
- 💧 Bioretention facilities
  - Applicable to most sites
- 💧 Flow-through planters
  - Bioretention without infiltration
  - Use on elevated plazas and near foundations
- 💧 Dry wells and infiltration basins
  - Good solution where soils are highly permeable
- 💧 Cisterns and vaults
  - Used in combination with bioretention



# Sizing Bioretention

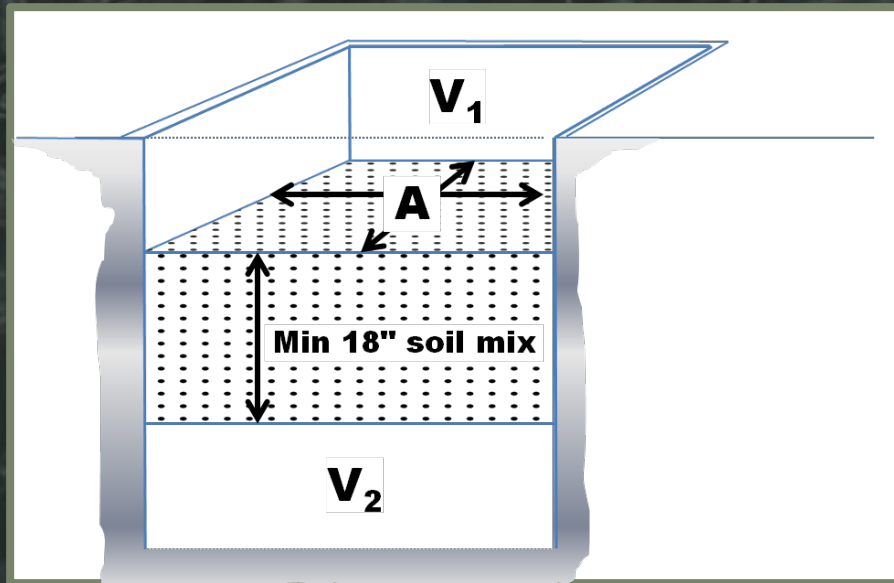
- Treatment only
  - Sized to 4% of equivalent impervious area
  - Design to ensure entire treatment area is flooded prior to overflow
  - Class 2 perm layer provides some storage
  - Underdrain discharges directly to storm drain





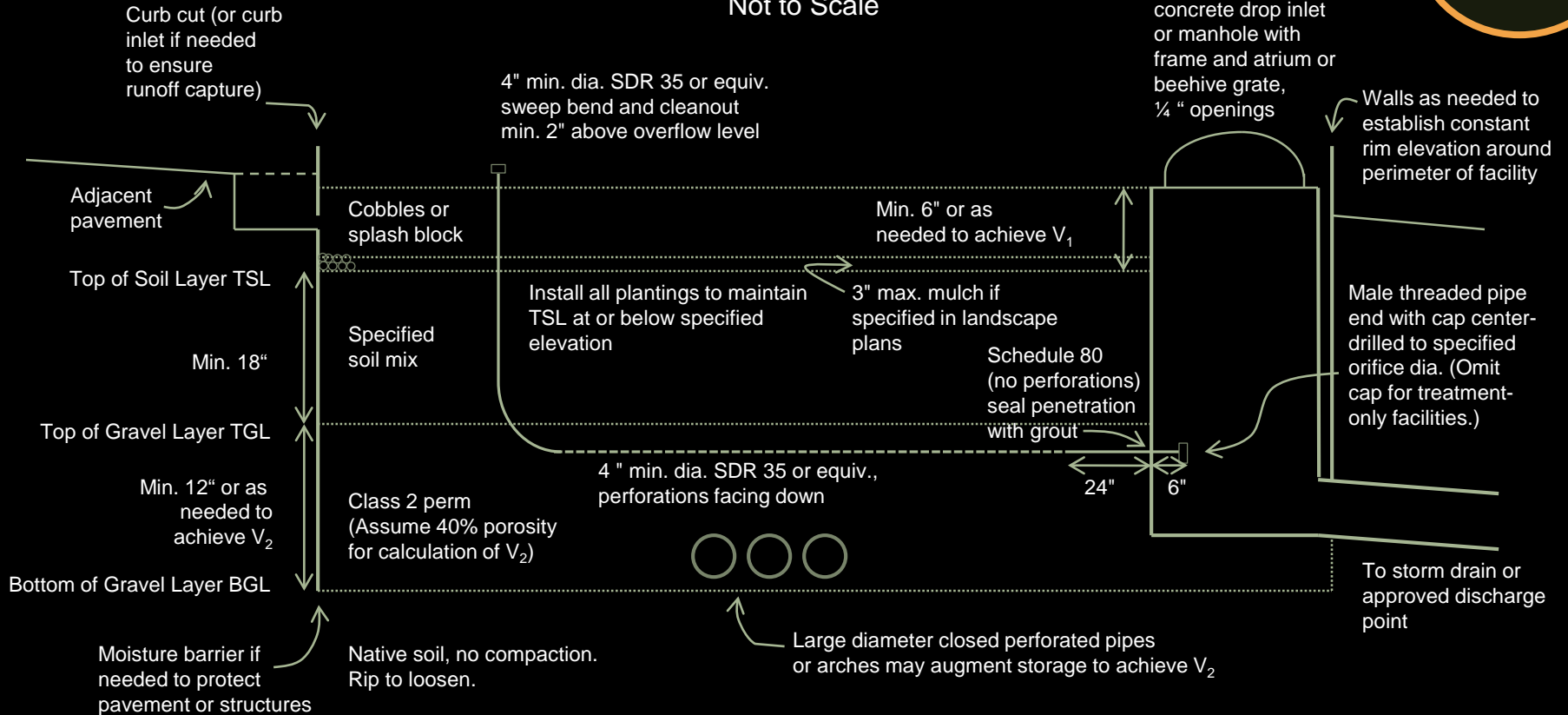
# Sizing Bioretention

- Treatment + Flow Control
  - $A$ ,  $V_1$  and  $V_2$
  - 12" surface depth and 18" deep gravel layer
  - Design flexibility if same volumes are achieved
  - Orifice limits maximum underdrain discharge



# Bioretention Facility

Cross-section  
Not to Scale

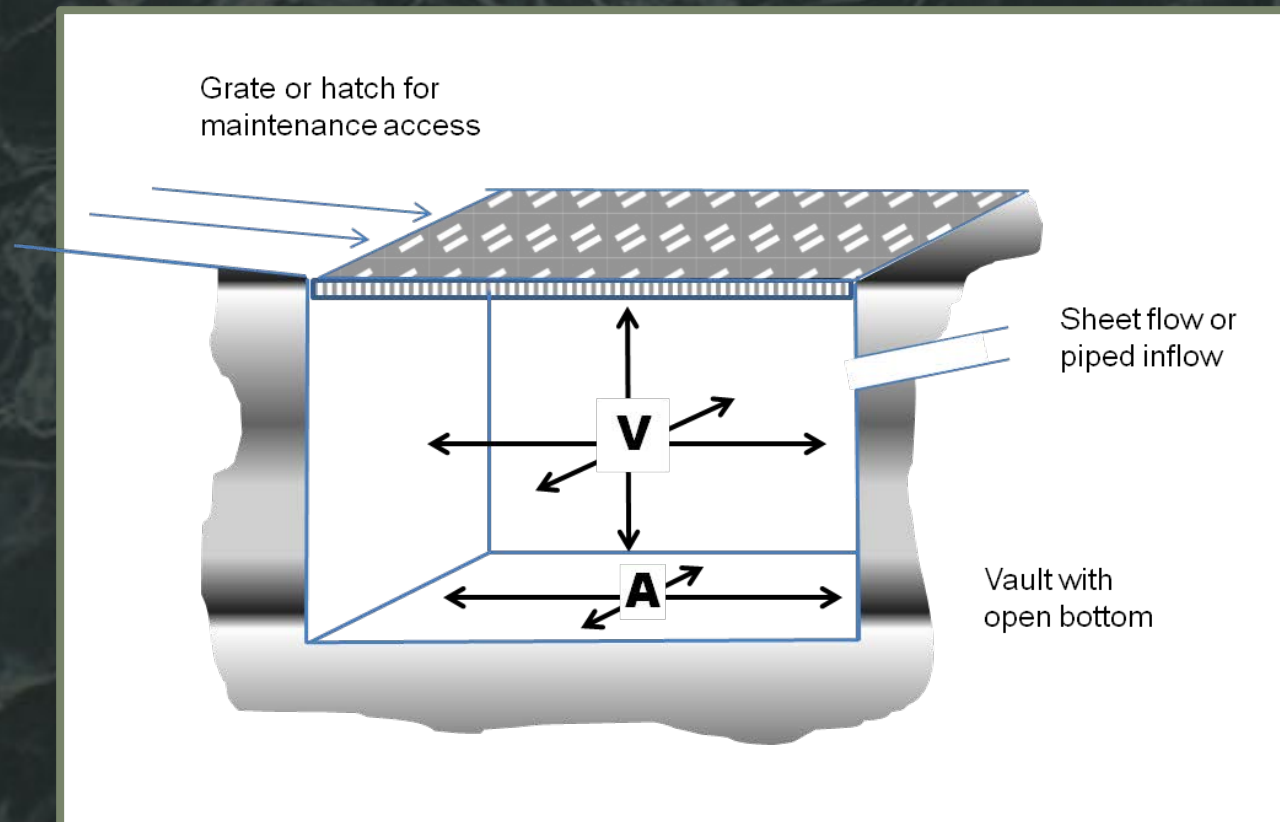


Notes:

- No liner, no filter fabric, no landscape cloth.
- Maintain BGL, TGL, TSL throughout facility area at elevations to be specified in plan.
- Class 2 perm layer may extend below and underneath drop inlet.
- Preferred elevation of perforated pipe underdrain is near top of gravel layer.
- See Appendix B for soil mix specification, planting and irrigation guidance.
- See Chapter 4 for factors and equations used to calculate  $V_1$ ,  $V_2$ , and orifice diameter.

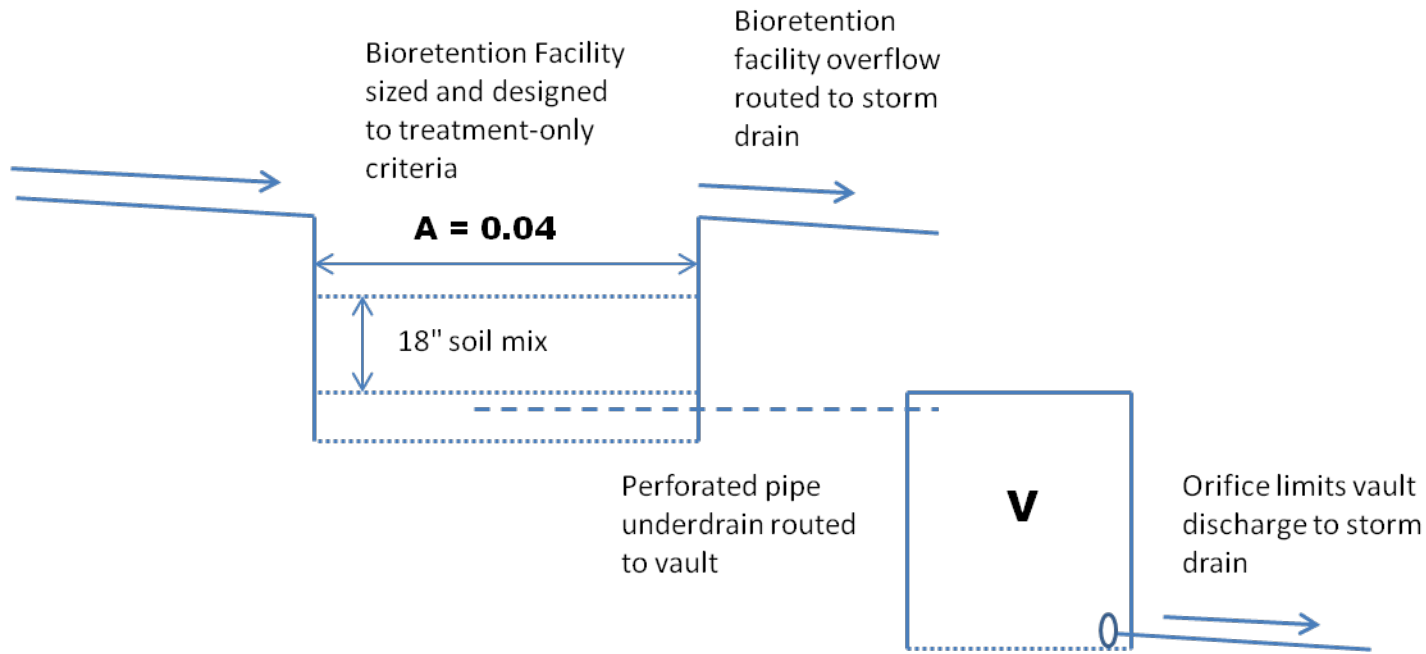
# Sizing Dry Wells

- 💧 Treatment + Flow Control
  - A and V

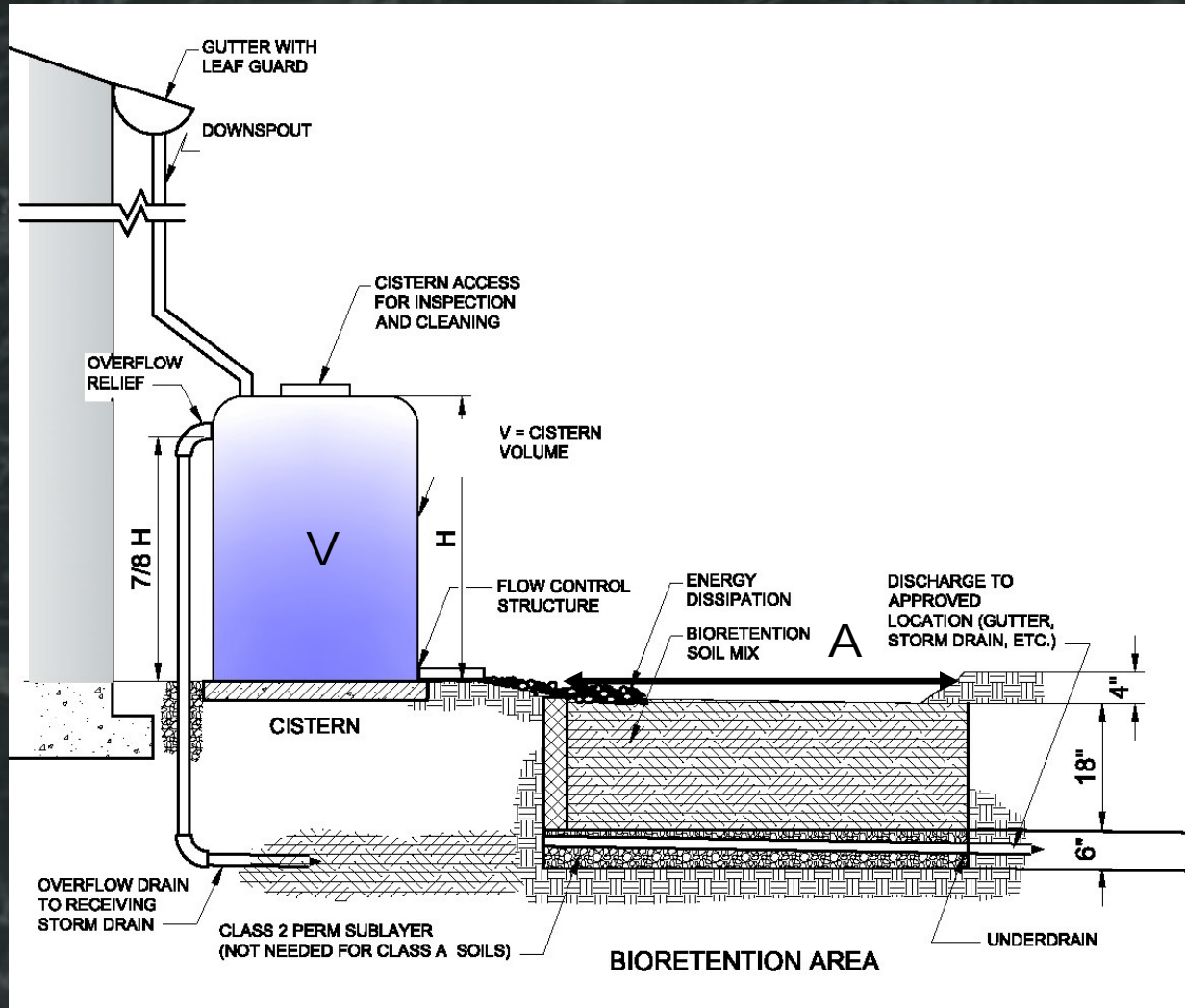


# Bioretention + Vault

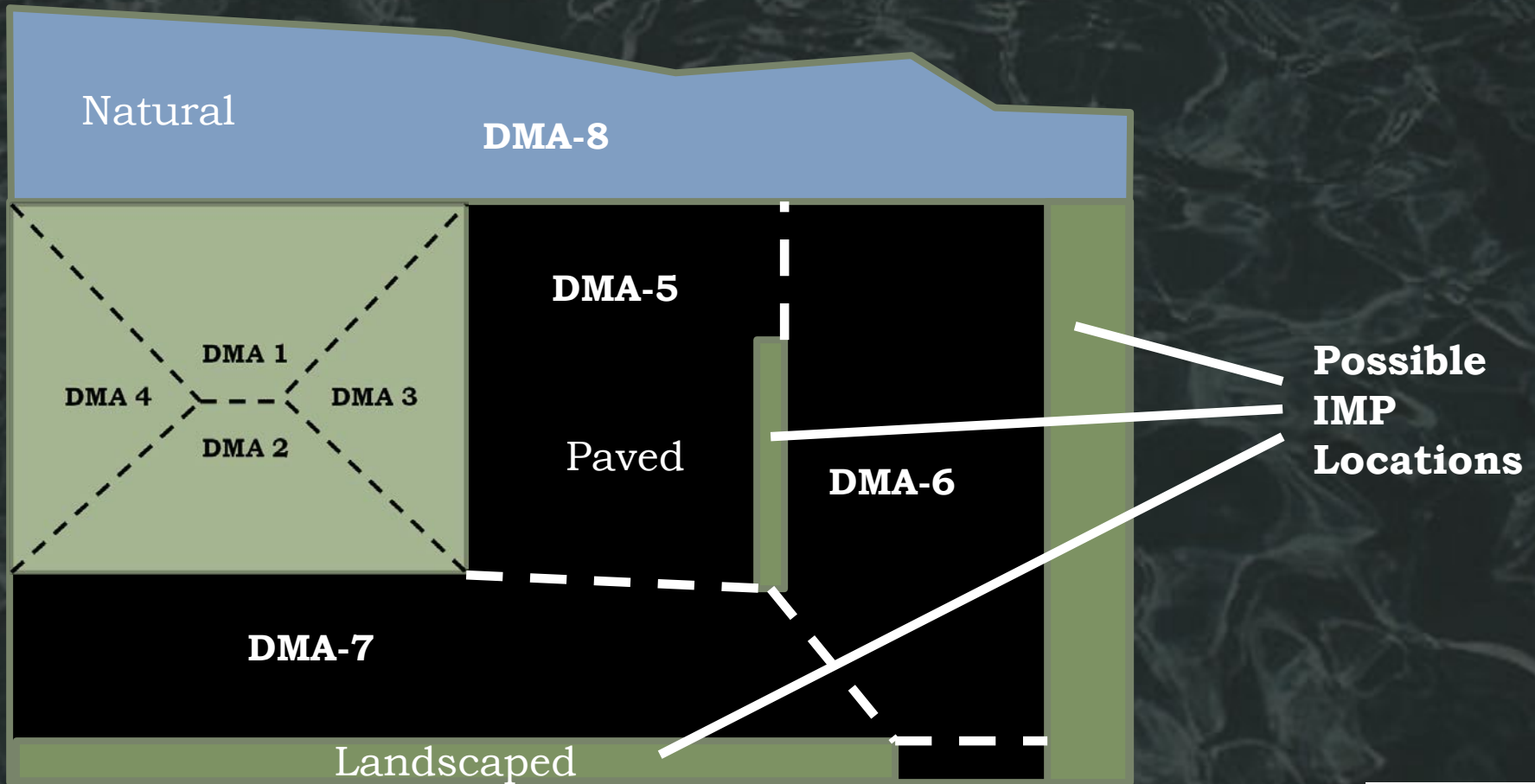
Bioretention + Vault  
Schematic



# Cistern + Bioretention



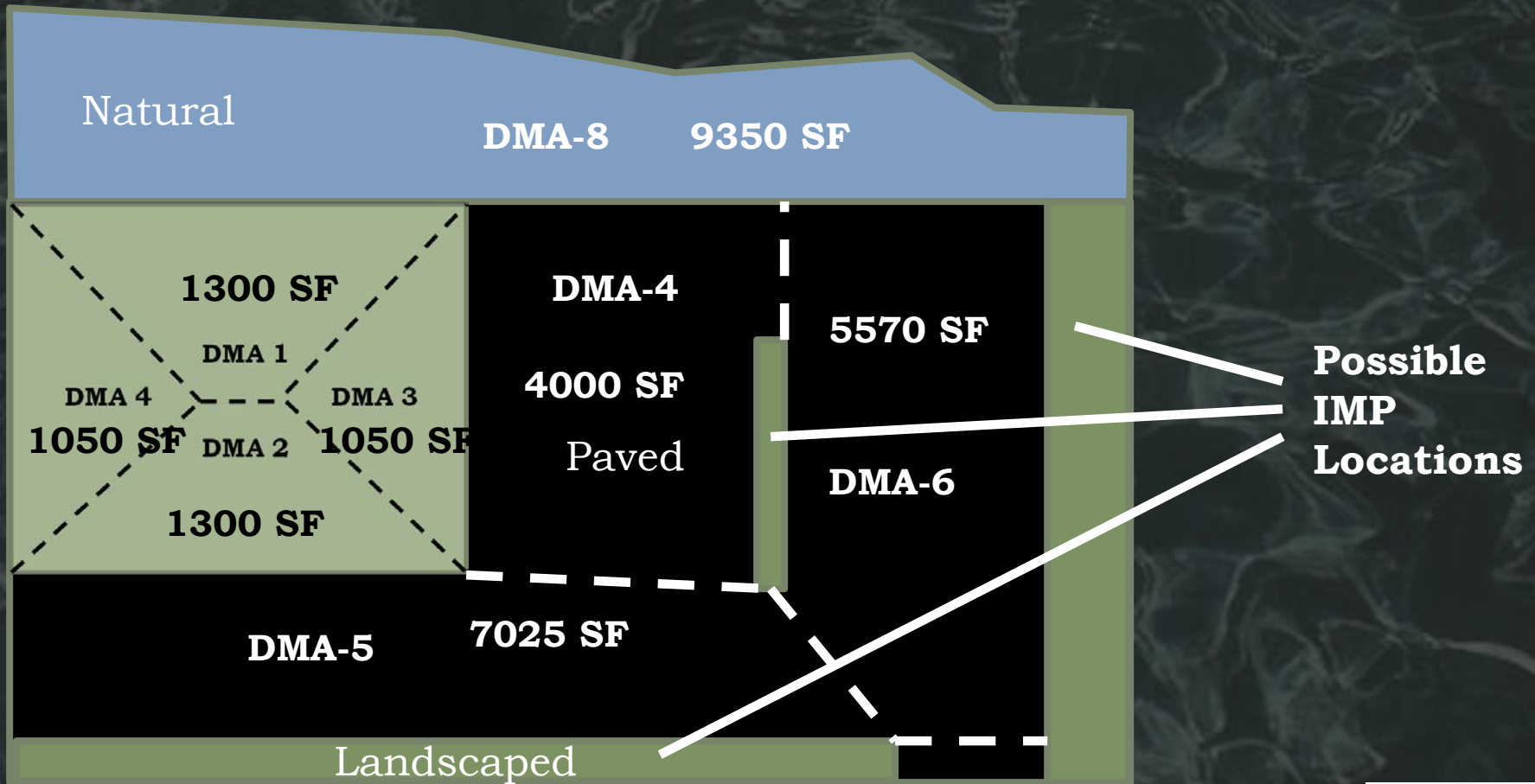
# Example Site



Municipal Storm Drain



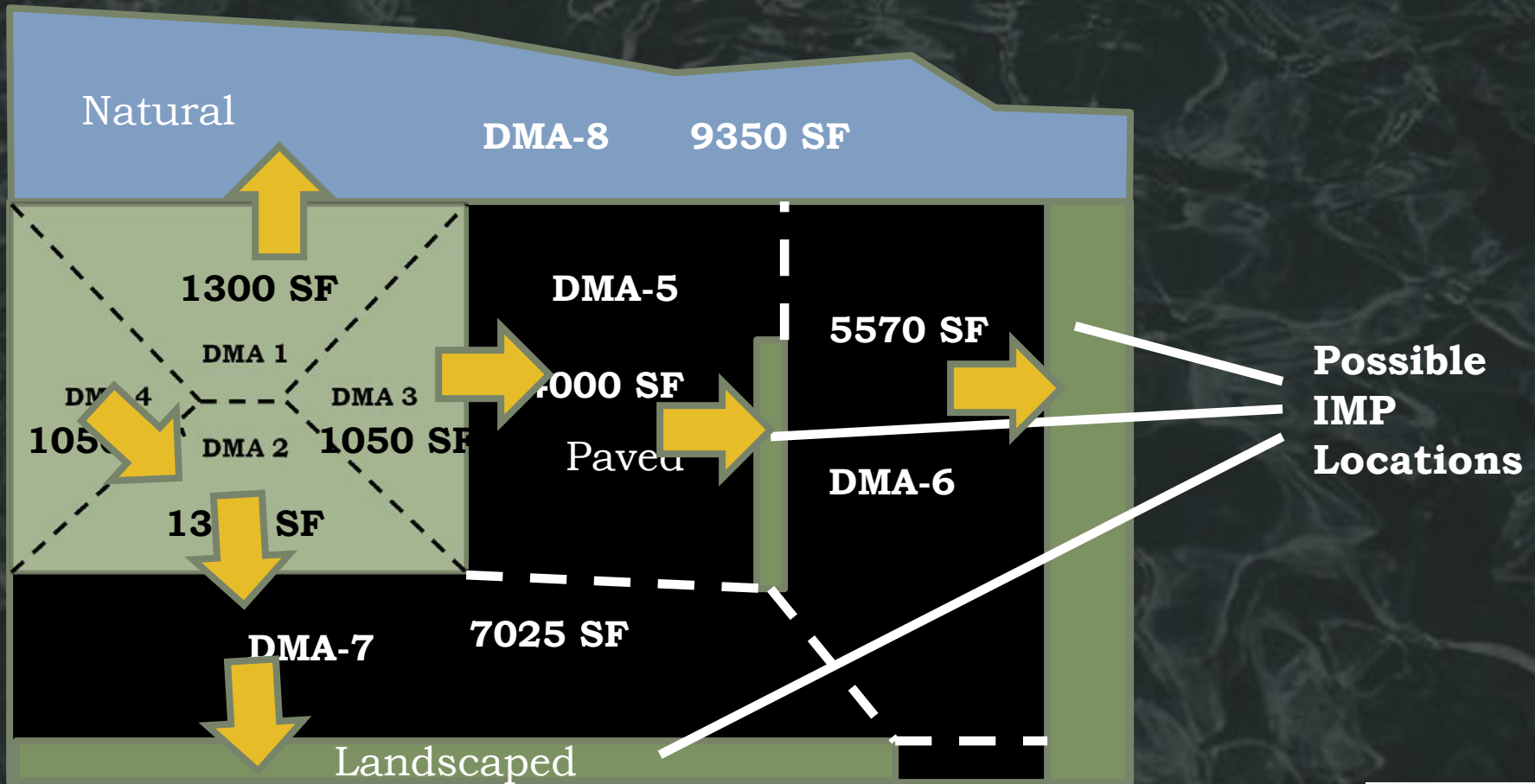
# Example Site



Municipal Storm Drain



# Example Site



Municipal Storm Drain





# Setting Up Calculations

## 💧 Self-retaining Area

DMA Name	Square Feet
DMA-8	9350

## 💧 Area Draining to Self-retaining Area

DMA	Square Feet	Surface	Runoff Factor	Receiving DMA	Receiving Area
DMA-1	1300	Roof	1.0	DMA-8	9350



# Setting Up Calculations

## 💧 Areas Draining to IMPs

DMA	Area	Surface	Runoff Factor	Area × Runoff Factor	Soil Type				
DMA-2	1050	Roof	1.0	1050	D				
DMA-4	1300	Roof	1.0	1300					
DMA-7	7025	Paved	1.0	7025					
					IMP Sizing Factor	Rain Adjust Factor	Min Area or Volume	Proposed Area or Volume	
				A					
				V1					
				V2					
				Orifice Size:					

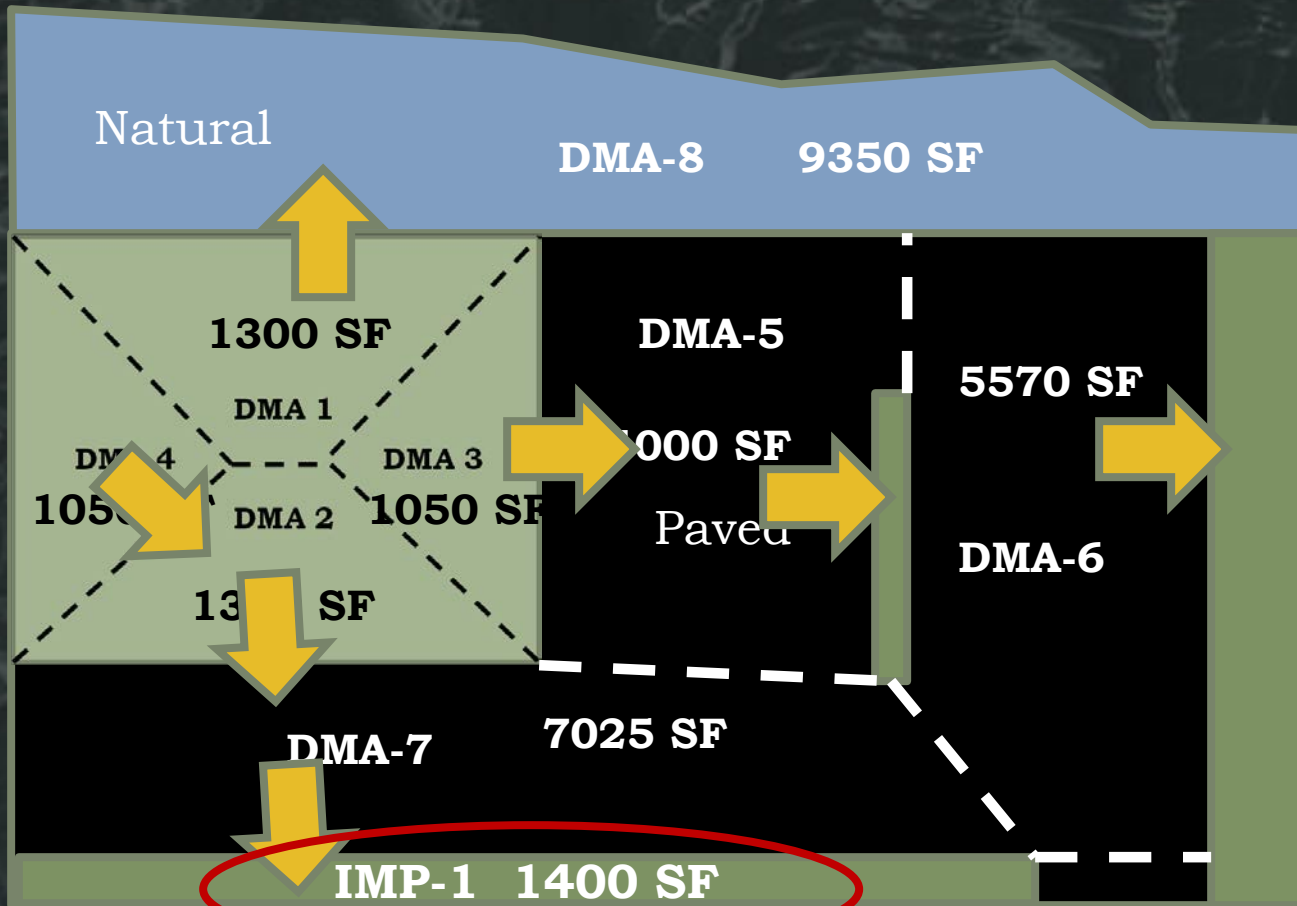


# Setting Up Calculations

## 🔹 Areas Draining to IMPs

DMA	Area	Surface	Runoff Factor	Area x Runoff Factor	Soil Type			
DMA-2	1050	Roof	1.0	1050	D			
DMA-4	1300	Roof	1.0	1300				
DMA-7	7025	Paved	1.0	7025				
				<b>9375</b>	<b>IMP Sizing Factor</b>	<b>Rain Adjust Factor</b>	<b>Min Area or Volume</b>	<b>Proposed Area or Volume</b>
				<b>A</b>	<b>0.06</b>	<b>1.0</b>	<b>562.5</b>	
				<b>V1</b>	<b>0.04</b>	<b>1.0</b>	<b>375.0</b>	
				<b>V2</b>	<b>0.05</b>	<b>1.0</b>	<b>468.8</b>	
				<b>Orifice Size:</b>				

# Example Site



Municipal Storm Drain

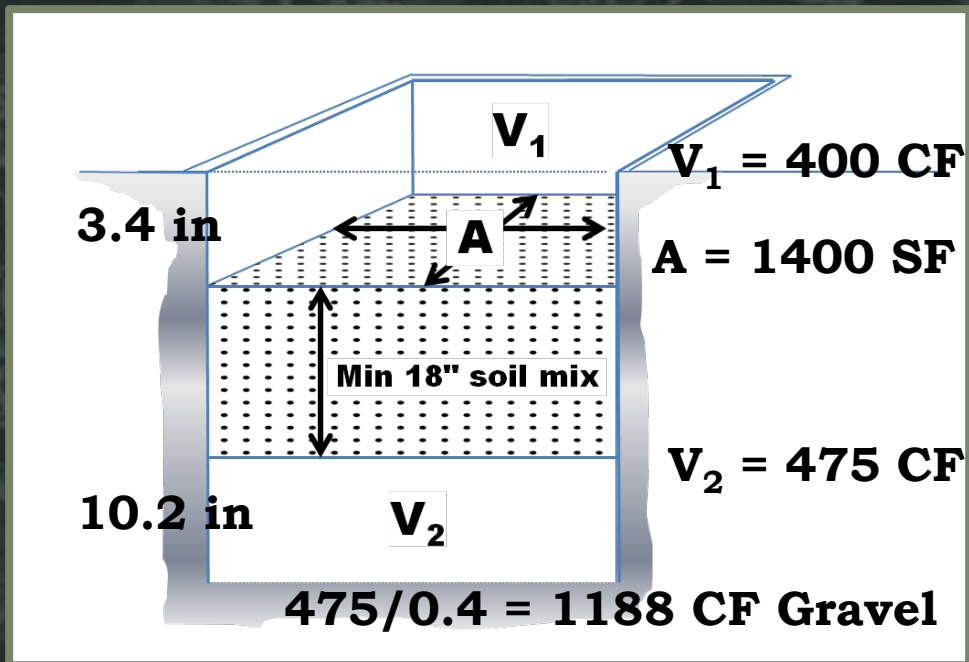


# Setting Up Calculations

## 👉 Areas Draining to IMPs

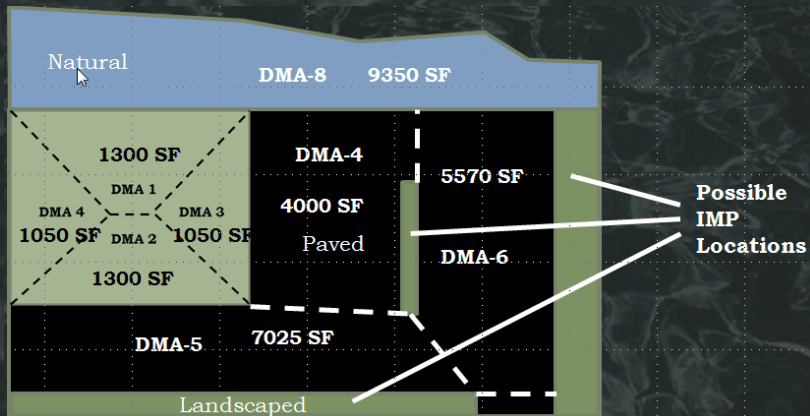
DMA	Area	Surface	Runoff Factor	Area x Runoff Factor	Soil Type			
DMA-2	1050	Roof	1.0	1050	D			
DMA-4	1300	Roof	1.0	1300				
DMA-7	7025	Paved	1.0	7025				
				<b>9375</b>	<b>IMP Sizing Factor</b>	<b>Rain Adjust Factor</b>	<b>Min Area or Volume</b>	<b>Proposed Area or Volume</b>
				<b>A</b>	<b>0.06</b>	<b>1.0</b>	<b>562.5</b>	<b>1400</b>
				<b>V1</b>	<b>0.04</b>	<b>1.0</b>	<b>375.0</b>	<b>400</b>
				<b>V2</b>	<b>0.05</b>	<b>1.0</b>	<b>468.8</b>	<b>475</b>
				<b>Orifice Size:</b>				<b>0.6 in.</b>

# Sizing Bioretention



# Using the IMP Calculator

	A	B	C
1			
2	<b>DMA</b>	<b>SF</b>	<b>Surface</b>
3			
4	<b>1</b>	<b>1300</b>	<b>Roof</b>
5	<b>2</b>	<b>1050</b>	<b>Roof</b>
6	<b>3</b>	<b>1300</b>	<b>Roof</b>
7	<b>4</b>	<b>1050</b>	<b>Roof</b>
8	<b>5</b>	<b>4000</b>	<b>Paved</b>
9	<b>6</b>	<b>5570</b>	<b>Paved</b>
10	<b>7</b>	<b>7025</b>	<b>Paved</b>
11	<b>8</b>	<b>9350</b>	<b>Landscape</b>
12			
13			



Integrated Management Practice Calculator

File Tools Help

Project Information

All of the project information is required. Please fill in all of the information before editing the DMAs and IMPs.

Project Name

Location

APN

Total Area  sq ft Mean Annual Precip  in

Design Goal

Treatment Plus Flow Control

Treatment Only

Drainage Management Areas (DMAs) Integrated Management Practices (IMPs) Calculation Warnings Summary Report

Add New DMA Remove Current DMA Rename Current DMA

Total Area (Calculated)

Drainage Management Areas	<input type="text" value="0"/>	sq. ft.
Integrated Management Practices	<input type="text" value="0"/>	sq. ft.
Total	<input type="text" value="0"/>	sq. ft.

# Using the IMP Calculator

Integrated Management Practice Calculator [Example Project.xml]

File Tools Help

Project Information

All of the project information is required. Please fill in all of the information before editing the DMAs and IMPs.

Project Name: Example Site

Location: Your Town

APN: 000-00-000

Total Area: 30645 sq ft

Mean Annual Precip: 20 in

Design Goal

Treatment Plus Flow Control

Treatment Only

Drainage Management Areas (DMAs) | Integrated Management Practices (IMPs) | Calculation Warnings(1) | Summary Report

Add New DMA Remove Current DMA Rename Current DMA

Total Area (Calculated)

Drainage Management Areas	0	sq. ft.
Integrated Management Practices	0	sq. ft.
Total	0	sq. ft. (WARNING: Total area of DMAs and IMPs does not equal the total project area)





# Using the IMP Calculator

Integrated Management Practice Calculator [Example Project.xml]

File Tools Help

Project Information

All of the project information is required. Please fill in all of the information before editing the DMAs and IMPs.

Project Name: Example Site  
Location: Your Town  
APN: 000-00-000  
Total Area: 30645 sq ft Mean Annual Precip: 20 in

Design Goal  
 Treatment Plus Flow Control  
 Treatment Only

Drainage Management Areas (DMAs) | Integrated Management Practices (IMPs) | Calculation Warnings(2) | Summary Report

DMA1

DMA Type: Drains to Self-Retaining DW IMP: Please select  
Drainage Area (sq. ft.): 1300 Drains to DMA: Please select  
NRCS Soil Group: D  
Post-project Surface Type: Conventional Roof

NOTE: The DMA can drain only to IMPs with the same soil type.

Add New DMA Remove Current DMA Rename Current DMA

Total Area (Calculated)

Drainage Management Areas	1300	sq. ft.
Integrated Management Practices	0	sq. ft.
Total	1300	sq. ft. (WARNING: Total area of DMAs and IMPs does not equal the total project area)



# Using the IMP Calculator

Integrated Management Practice Calculator [Example Project.xml]

File Tools Help

Project Information

All of the project information is required. Please fill in all of the information before editing the DMAs and IMPs.

Project Name: Example Site

Location: Your Town

APN: 000-00-000

Total Area: 33695 sq ft Mean Annual Precip: 20 in

Design Goal

Treatment Plus Flow Control

Treatment Only

Drainage Management Areas (DMAs) Integrated Management Practices (IMPs) Calculation Warnings(8) Summary Report

DMA1 DMA2 DMA3 DMA4 DMA5 DMA6 DMA7 DMA8

DMA Type: Drains to Self-Retaining DM IMP Please select

Drainage Area (sq. ft.): 1300 rains to DMA Please select

NRCS Soil Group: D

Post-project Surface Type: Conventional Roof

NOTE: The DMA can drain only to IMPs with the same soil type.

Add New DMA Remove Current DMA Rename Current DMA

Total Area (Calculated)

Drainage Management Areas	30645	sq. ft.
Integrated Management Practices	0	sq. ft.
Total	30645	sq. ft. (WARNING: Total area of DMAs and IMPs does not equal the total project area)



# Using the IMP Calculator

Integrated Management Practice Calculator [Example Project.xml]

File Tools Help

Project Information

All of the project information is required. Please fill in all of the information before editing the DMAs and IMPs.

Project Name: Example Site  
Location: Your Town  
APN: 000-00-000  
Total Area: 33695 sq ft  
Mean Annual Precip: 20 in

Design Goal:  
 Treatment Plus Flow Control  
 Treatment Only

Drainage Management Areas (DMAs) | Integrated Management Practices (IMPs) | Calculation Warnings(8) | Summary Report

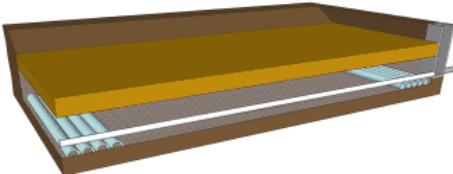
IMP1

NRCS Soil Group: D  
IMP Type: Bioretention Facility

Parameter	Minimum	Proposed
Area (sq ft)	0	1400
Surface Vol. V1 (cubic ft)	0	0
Subsurface Vol. V2 (cubic ft)	0	0
Orifice Diameter (in)		

Connected

Connect IMP | Disconnect Selected IMP



Add New IMP | Remove Current IMP | Rename Current IMP

Total Area (Calculated)  
Drainage Management Areas: 30645 sq. ft.  
Integrated Management Practices: 0 sq. ft.  
Total: 30645 sq. ft. (WARNING: Total area of DMAs and IMPs does not equal the total project area)



# Using the IMP Calculator

The screenshot displays the 'Integrated Management Practice Calculator' software interface. The main window shows a site plan with several Drainage Management Areas (DMAs) and an Integrated Management Practice (IMP). The site plan includes:

- Natural area: 9350 SF (DMA-8)
- DMA-1: 1300 SF
- DMA-2: 1050 SF
- DMA-3: 1050 SF
- DMA-4: 1050 SF
- DMA-5: 1000 SF (Paved)
- DMA-6: 5570 SF
- DMA-7: 7025 SF
- IMP-1: 1400 SF (circled in red)

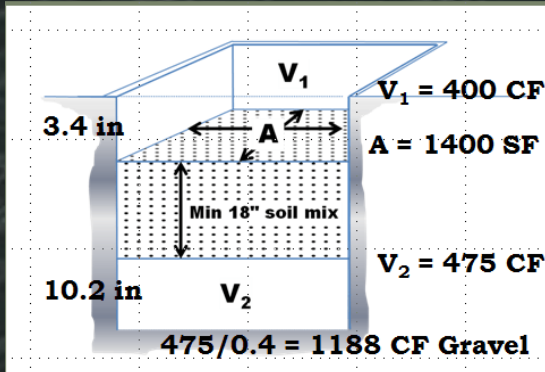
A 3D model of a practice is shown on the right side of the interface. Below the site plan, there is a 'Connected' section with a list of connected practices and buttons for 'Connect IMP' and 'Disconnect Selected IMP'. A 'Connect To DMA' dialog box is open, prompting the user to select a DMA to connect to.

At the bottom of the interface, a summary table provides the following information:

Total Area (Calculated)	
Drainage Management Areas	30645 sq. ft.
Integrated Management Practices	0 sq. ft.
Total	30645 sq. ft. (WARNING: Total area of DMAs and IMPs does not equal the total project area)



# Using the IMP Calculator



Integrated Management Practice Calculator [Example Project.xml]

File Tools Help

Project Information

All of the project information is required. Please fill in all of the information before editing the DMAs and IMPs.

Project Name: Example Site  
 Location: Your Town  
 APN: 000-00-000  
 Total Area: 33695 sq ft  
 Mean Annual Precip: 20 in

Design Goal  
 Treatment Plus Flow Control  
 Treatment Only

Drainage Management Areas (DMAs) | Integrated Management Practices (IMPs) | Calculation Warnings(3) | Summary Report

IMP1 | IMP2

NRCS Soil Group: D  
 IMP Type: Bioretention Facility

Parameter	Minimum	Proposed
Area (sq ft)	460	1400
Surface Vol, V1 (cubic ft)	387	390
Subsurface Vol, V2 (cubic ft)	506	510
Orifice Diameter (in)		0.83

Connected  
 DMA4 DMA2 DMA7

Connect IMP | Disconnect Selected IMP

Add New IMP | Remove Current IMP | Rename Current IMP

Total Area (Calculated)

Drainage Management Areas	30645	sq. ft.
Integrated Management Practices	3050	sq. ft.
Total	33695	sq. ft.



# Using the IMP Calculator

Integrated Management Practice Calculator [Example Project.xml]

File Tools Help

Project Information

All of the project information is required. Please fill in all of the information before editing the DMAs and IMPs.

Project Name: Example Site  
Location: Your Town  
APN: 000-00-000  
Total Area: 33695 sq ft  
Mean Annual Precip: 20 in

Design Goal  
 Treatment Plus Flow Control  
 Treatment Only

Drainage Management Areas (DMAs) | Integrated Management Practices (IMPs) | Calculation Warnings(0) | Summary Report

**Project Name:** Example Site  
**Project Type:** Treatment and Flow Control  
**Location:** Your Town  
**APN:** 000-00-000  
**Drainage Area:** 33695 sf  
**Mean Annual Precipitation:** 20 in

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## II. Self-Retaining Areas

DMA Name	Area (sq ft)
DMA8	9350

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## III. Areas Draining to Self-Retaining Areas

DMA Name	Area (sq ft)	Surface Type	Runoff Factor	Product (Area x Runoff Factor) [A]	Receiving Self Retaining DMA	Receiving Self-Retaining DMA Area (sq ft) [B]	Ratio [A]/[B]
DMA1	1,300.0	Conventional Roof	1.0	1,300.0	DMA8	9,350	0.14

Total Area (Calculated)

Drainage Management Areas	30645	sq. ft.
Integrated Management Practices	3050	sq. ft.
Total	33695	sq. ft.



# Discussion

