Managed Release Concept

(MRC)

- **What Is It?**

- **Justification for Use**

- **System Components**

- **Benefits**

- **Design Criteria**

- **Reporting**

- **Example (Time Permitting)**

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What is It?

- Approved Alternative BMP

  - Go to Alternative BMP's List on DEP Website
    www.dep.pa.gov/constructionstormwater
    - Design Criteria
    - FAQ
    - Design Examples
    - MRC Design Summary Sheet-Submitted as Part of Application

- Bridges the Gap between volume reduction (infiltration) and volume management (MRC) to satisfy 102.8.(g)(2)

- Used When Infiltration is <u>Proven</u> not to be Feasible

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What is It?

- Used to Meet Volume, possibly Water Quality Requirements for all or a portion of a Site (2 year Storm)

- Can be above ground or underground

- Can be incorporated into rate control feature (Basin)

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Justification for Use

- <u>Thorough</u> Pre-Development Site Characterization
  - Infiltration is extremely limited (testing rates below 0.2 " / hr.)
  - Infiltration not feasible (high water table, shallow limiting zone)
  - Infiltration undesirable (sinkholes, contamination)
- Structural and Non Structural BMP's and Evapotranspiration (ET) Maximized
- Downstream flow path will remain stable for anticipated flows
- Can be used for general and individual permits
- Calculations by a PE

- Soils Testing:
  - Overall Site Testing- test every 40,000 sf of ED, minimum of 4 tests
  - Site restoration areas may be removed from required testing area
  - Tests in most accommodating soil horizon based on "deep hole" soil analysis and classification.

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Review

- DEP Review (unless delegated to Conservation District)

  - Total Drainage Area to MRC > 3 acres

  - Total Impervious to MRC > 1.5 acres

  - Overall Project Impervious Increase over 10 acres (including gravel)

  - Impaired Waters for Siltation or Flow Alterations

  - If Deviations from Design Standards-Individual Permit

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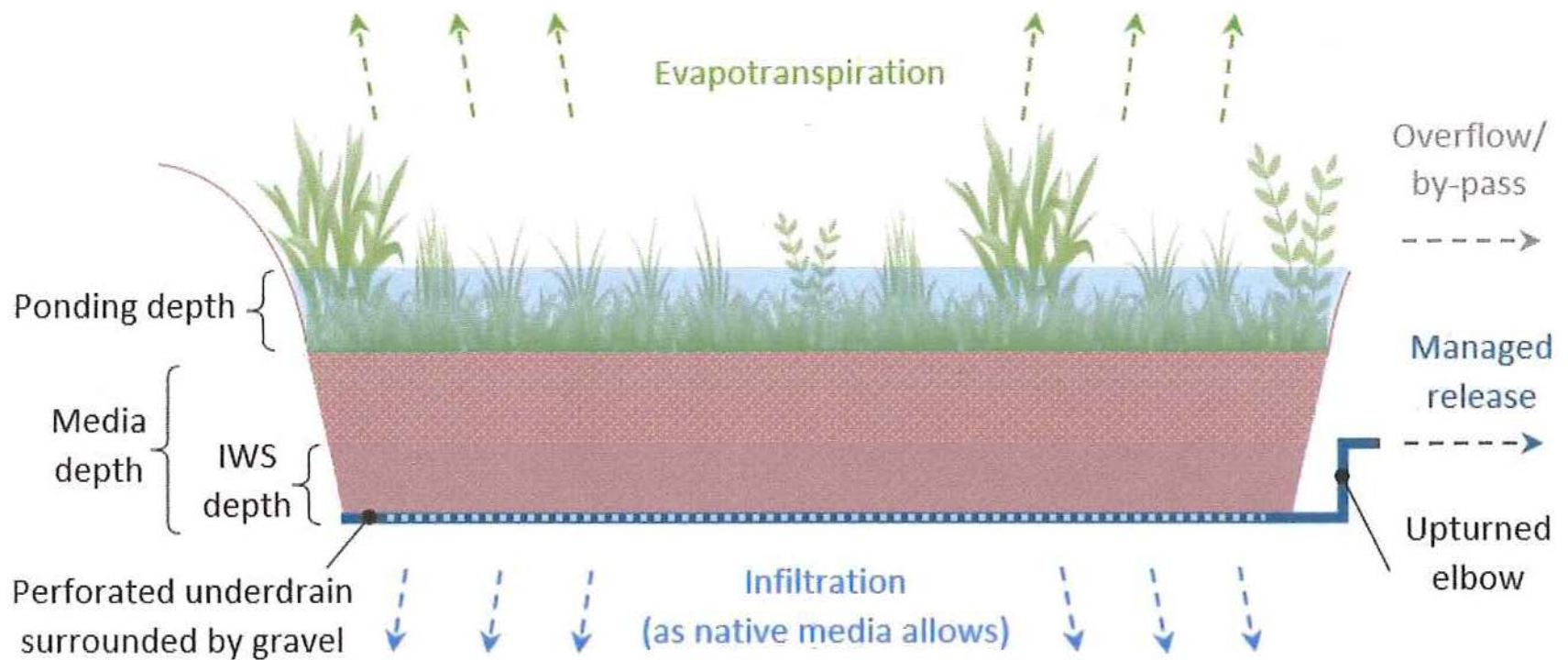
Vegetated MRC Components

System Components

Perforated Underdrain

- At Base of System
- 24" depth to Limiting Zone Preferred
- 12" Minimum Above Limiting Zone or Use a Liner
- No Separation required above bedrock
- Underdrain Within Gravel Envelope- Size for 110 gpm/LF of pipe.
- Receives Filtered Water from Internal Water Storage (IWS) above
- Infiltration into Ground as Feasible below Underdrain
- Discharges to Upturned Elbow/Orifice/ Weir in Outlet Structure
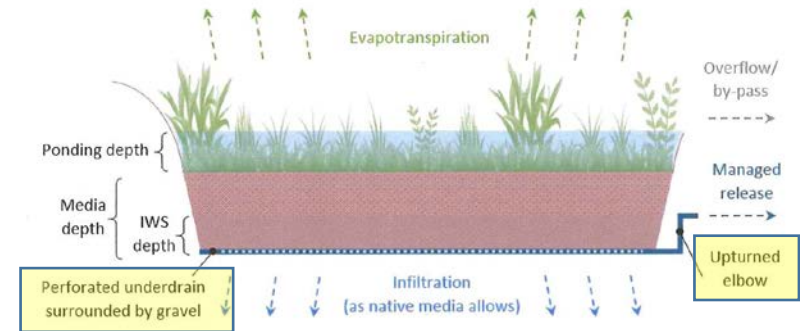
Upturned Elbow / Orifice/ Weir

- Control Structure
- Set at top of the IWS Elevation
- Controls 1.2"/ 2 hour storm outflow (0.01 cfs/ impervious acre)
- Discharge considered Volume Permanently Removed

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System Components
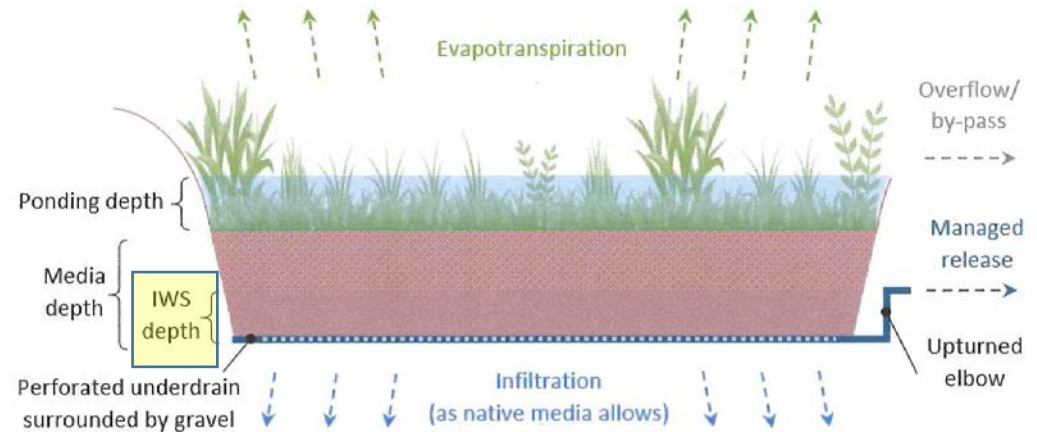
Internal Water Storage (IWS)

- Soil Media with Suitable Infiltration Rate (0.1 -10 inches/hr.)
- Minimum 1 foot depth below First Outlet (Upturned Elbow)
- Maximum Depth of 4 feet
- Assumed 30 % Void Space in Soil
- Assume Half of the IWS is saturated for Routing Considerations (15% Voids for Calculations)
- Performs Water Quality Function
- Promotes ET
- Half of IWS Water Storage considered Volume Permanently Removed

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System Components
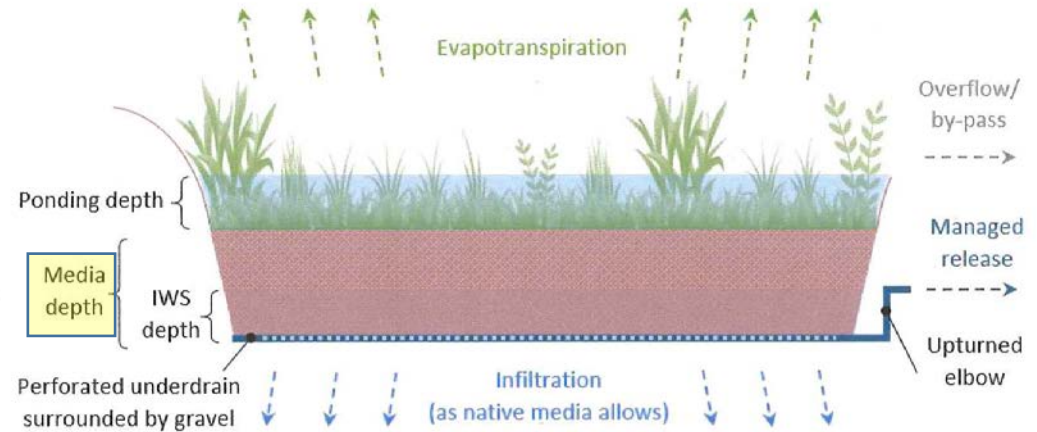
Media Depth

- Soil Media with Suitable Infiltration Rate (0.1 -10 inches/hr.)
- Minimum 2 foot depth , *Including IWS depth*
- Maximum Depth of 4 feet
- Assumed 30 % Void Space in Soil above IWS
- Media Above IWS is assumed dry for Routing Considerations (30% Voids)
- Water Quality Function
- Promotes ET

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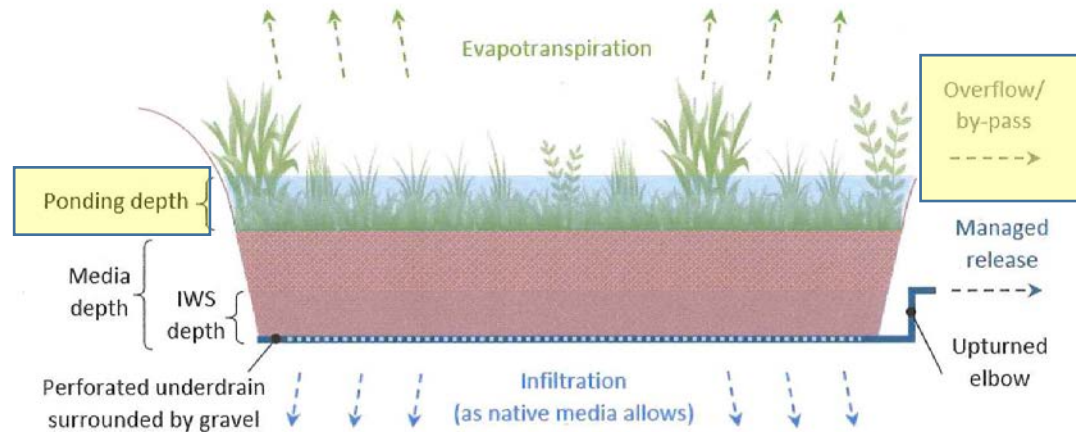
System Components

Ponding Depth
- Size and Depth determined so that 2 yr./ 24 hour storm is fully drawn down within 72 hours. (Water only in soil component)
- Vegetation in 75% of the MRC Surface (above ground system)

Overflow Device
- Handle storms > 2 year or provides Rate Control Function

Benefits

- MRC designed in accordance with design standards meets the Volume Requirements for the contributing disturbed area to the MRC.

- A <u>Vegetated</u> MRC designed in accordance with design standards meets the Volume and Water Quality Requirements for the contributing disturbed area to the MRC.

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Variations

Underground MRC with Porous Pavement
- No IWS (Gravel System)
- Underdrain to Control Structure
- Porous Pavement Designed and Maintained to Meet Water Quality Criteria
- MRC not utilized in WQ Calculations

Underground MRC with Storage Chambers
- No IWS (Gravel System)
- Adequate Pre and Post Treatment Needed to Meet WQ Requirements
- MRC not Utilized in WQ Calculations

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Design Criteria

- **The Release Rate for the *1.2" / 2 Hour Storm* should not exceed 0.01 cfs / acre from the *Equivalent Impervious Area***

    - Determines the *Volume Permanently Removed*

- **The Peak Flow from the Post Construction 2 year/ 24 hour storm should be managed back to the 1 year/24 hour predevelopment peak flow.**

    - Determines the *Geomorphic Volume and Volume Managed*

- **The Ponding Area should drain within 72 hours for the 2 year / 24 hour storm.**

    - This requirement will drive the surface area/ open ponding depth of the system

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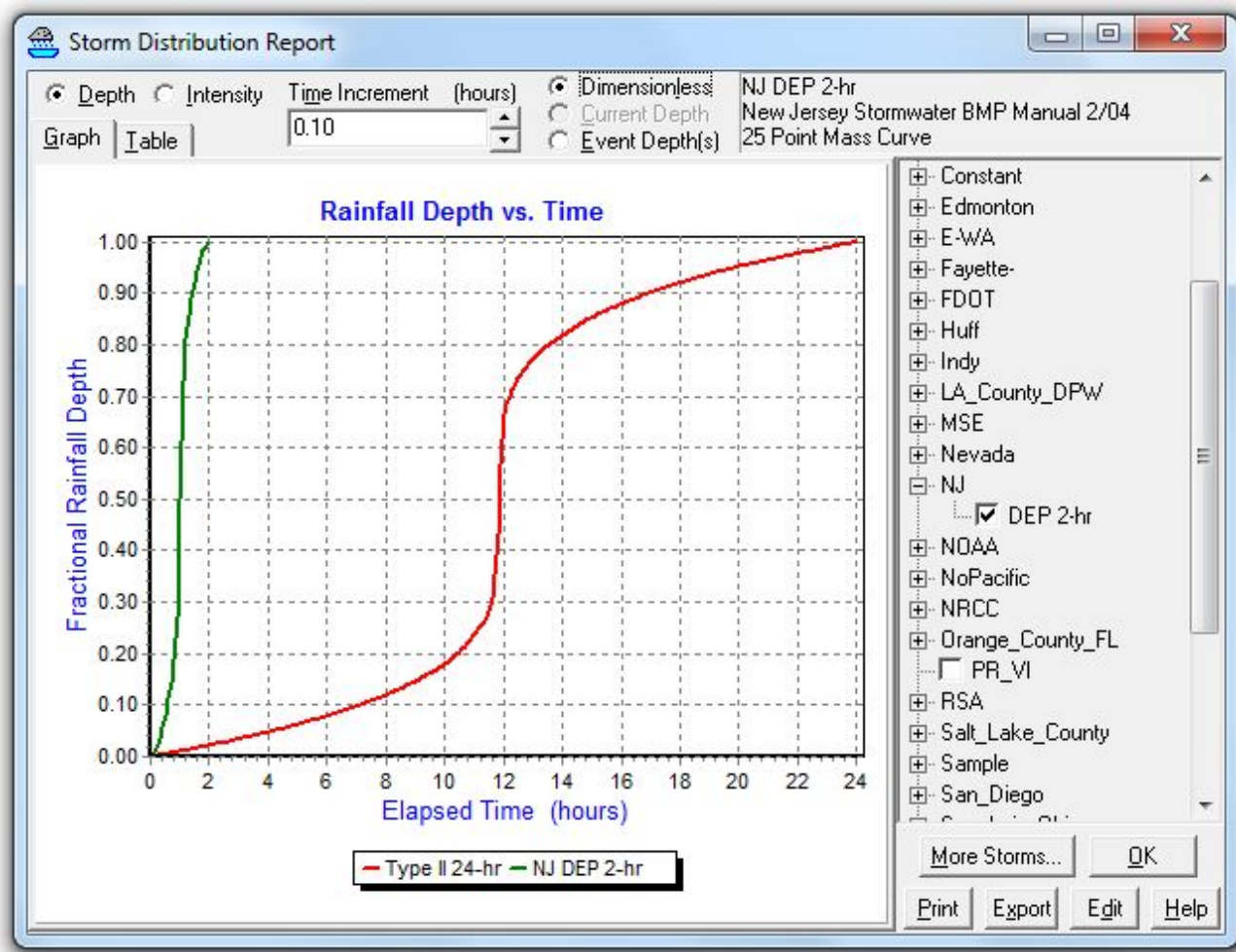
1.2 "/ 2 Hour Storm
(NJ DEP Storm)

Storm Distribution Report

Depth ○ Intensity   Time Increment (hours)   ○ Dimensionless   NJ DEP 2-hr
                     [0.10]   ○ Current Depth   New Jersey Stormwater BMP Manual 2/04
Graph | Table   ● Event Depth(s)   25 Point Mass Curve

Time (hours)	Type II 24-hr (inches)	NJ DEP 2-hr (inches)
0.00	0.00	0.00
0.10	0.00	0.01
0.20	0.00	0.02
0.30	0.00	0.04
0.40	0.00	0.07
0.50	0.00	0.10
0.60	0.00	0.14
0.70	0.00	0.18
0.80	0.00	0.23
0.90	0.00	0.34
1.00	0.00	0.63
1.10	0.00	0.91
1.20	0.00	1.02
1.30	0.00	1.07
1.40	0.00	1.11
1.50	0.00	1.15
1.60	0.00	1.18
1.70	0.00	1.21
1.80	0.00	1.23
1.90	0.00	1.24
2.00	0.00	1.25
2.10	0.00	
2.20	0.00	

Tree list:
- ⊞ Constant
- ⊞ Edmonton
- ⊞ E-WA
- ⊞ Fayette-
- ⊞ FDOT
- ⊞ Huff
- ⊞ Indy
- ⊞ LA_County_DPW
- ⊞ MSE
- ⊞ Nevada
- ⊟ NJ
  - ☑ DEP 2-hr
- ⊞ NOAA
- ⊞ NoPacific
- ⊞ NRCC
- ⊞ Orange_County_FL
- ☐ PR_VI
- ⊞ RSA
- ⊞ Salt_Lake_County
- ⊞ Sample
- ⊞ San_Diego

More Storms...   OK
Print | Export | Edit | Help

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Volume Removed:

- **1.2" / 2 Hour Storm**

    - Determine the Allowable Discharge through the Underdrain/ Upturned Elbow

        - 0.01 cfs/ acre from the "Equivalent Impervious Area" = **IMP_{EQ}**

    - Determine total hydrograph volume to MRC from 1.2"/ 2Hr Storm =**$V_{1.2}$**

        - **IMP_{EQ} = $V_{1.2}$ (cubic feet) / (.0833 feet X 43,560 ft^2)**

    - Storm is routed through system (15% void in IWS and 30% in soil above)

- **Volume Permanently Removed = Volume in IWS (15% voids) +Discharge Volume Through Underdrain**

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Geomorphic Volume and Volume Managed

- 2 Year 24 Hour storm reduced to the 1 year Predevelopment Rate

- **Volume Managed=Volume Discharged through the Underdrain**

  - Total 2 year Volume into MRC or Volume below First Discharge

- **Geomorphic Volume= Volume Managed – Volume Permanently Removed**

Reporting

- MRC Design Summary Sheet

- PCSM Module 2

- Worksheet 5

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PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

MANAGED RELEASE CONCEPT (MRC) DESIGN SUMMARY

Complete One Design Summary Sheet for Each BMP Designed for MRC

GENERAL INFORMATION

Applicant Name: _____   Project Name: _____

Applicant Address: _____   Municipality: _____

City, State, Zip: _____   County: _____

Permit Type: ☐ NPDES PAG-02 ☐ NPDES IP ☐ ESCGP ☐ ESP

	Pre-Development	Post-Development	Change
Impervious Area (acres):			

MRC BMP INFORMATION

MRC BMP Type: _____   Stormwater BMP Manual Section: _____

Will the BMP Include Vegetation? ☐ Yes ☐ No

If Yes, Identify Proposed Vegetation: _____

For Non-Vegetated BMPs Will There Be Pre- or Post-Treatment? ☐ Yes (Pre-) ☐ Yes (Post-) ☐ No

If Yes, Identify Proposed Pre- or Post-Treatment: _____

Name of Surface Water to Receive MRC BMP Discharges: _____

Designated Use of Surface Water: _____   Existing Use of Surface Water (if different): _____

Is the Surface Water Impaired? ☐ Yes ☐ No

If Yes, Identify Cause(s): _____

Will the BMP Have a Liner? ☐ Yes ☐ No

If Yes, Identify the Type or Liner Material: _____

BMP Media Description: _____

Are Any Deviations from MRC Design Standards Proposed? ☐ Yes ☐ No

If Yes, Identify Deviations: _____

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MRC BMP DESIGN VALUES AND STANDARDS

Parameter	Design Value	Design Standard
Actual Contributing Impervious Area to BMP (acres)		
Equivalent Contributing Impervious Area to BMP (acres)		
MRC BMP Release Rate (cfs)		*No greater than 0.01 cfs / acre of equivalent contributing impervious*
BMP Footprint Area (ft^2)		
Total Drainage Area to BMP (acres)		
Bottom BMP Elevation (ft)		
Parameter	**Design Value**	**Design Standard**
2-Yr/24-Hr Storm Ponding Depth (ft)		*1 ft (recommended) (2 ft max)*
Max. Ponding Depth (ft)		*4 ft (max)*
Overflow Bypass Elevation (ft)		
Media Depth (ft)		*2 ft (min) – 4 ft (max)*
Media Void Space (%)		
Internal Water Storage (IWS) Depth (ft)		
Top of IWS Elevation (ft)		
Underdrain Pipe Diameter (in)		
Underdrain Orifice Diameter (in)		
Underdrain Outlet Elevation (ft)		
IWS Used for Routing (%)		*50% max*
Separation Distance (Groundwater) (ft)		*1 ft (min) (2 ft recommended)*
Infiltration Rate (in/hr)		
1-Yr/24-Hr **Pre**-Development Peak Rate (cfs)		

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2-Yr/24-Hr **Post**-Development Peak Rate (cfs)		1-Yr/24-Hr Pre-Development Peak Rate (or per approved Act 167 Plan)
10-Yr/24-Hr **Post**-Development Peak Rate (cfs)		10-Yr/24-Hr Pre-Development Peak Rate
50-Yr/24-Hr **Post**-Development Peak Rate (cfs)		50-Yr/24-Hr Pre-Development Peak Rate
100-Yr/24-Hr **Post**-Development Peak Rate (cfs)		100-Yr/24-Hr Pre-Development Peak Rate
a. Total 2-Yr/24-Hr Runoff Volume Managed by BMP (cf)		
b. Total 1.2-inch/2-Hr Runoff Vol. Permanently Removed (cf)		
c. 2-Yr/24-Hr Volume Managed (cf)		*Difference of a. and b.*
Ponding Time @ 2-Yr/24-Hr Storm (hrs)		*72 hrs max*
Ponding Time @ 10-Yr/24-Hr Storm (hrs)		*72 hrs max*
Ponding Time @ 50-Yr/24-Hr Storm (hrs)		*72 hrs max*
Ponding Time @ 100-Yr/24-Hr Storm (hrs)		*72 hrs max*

Licensed P.E. Name

Licensed P.E. Signature

License No.

Date

*Licensed
Professional's
Seal*

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PCSM Module 2

STORMWATER ANALYSIS – RUNOFF VOLUME

Surface Water Name: **Discharge Point(s):**

1. ☐ The design standard is based on volume management requirements in an Act 167 Plan approved by DEP within the past five years.

2. ☐ The design standard is based on managing the net change for storms up to and including the 2-year/24-hour storm.

3. ☐ An alternative design standard is being used.

4. ☐ A printout of DEP's PCSM Spreadsheet – Volume Worksheet is attached.

5. 2-Year/24-Hour Storm Event: inches   Source of precipitation data:

6. Stormwater Runoff Volume, Pre-Construction Conditions: CF   ☐ Calculations attached

7. Stormwater Runoff Volume, Post-Construction Conditions: CF   ☐ Calculations attached

8. Net Change (Post-Construction – Pre-Construction Volumes):   CF

9. Identify all selected structural PCSM BMPs and provide the information requested.   ☐ Calculations attached

DP No.	BMP ID	Series	Vol. Routed to BMP (CF)	Inf. Area (SF)	Inf. Rate (in/hr)	Inf. Period (hrs)	Veg?	Media Depth (ft)	Storage Vol. (CF)	Inf. Credit (CF)	ET Credit (CF)
							☐				
							☐				
							☐				
							☐				
							☐				
							☐				
							☐				
							☐				
							☐				

Total Infiltration & ET Credits (CF):

Report <u>Volume Managed</u> from Summary Sheet On Module 2 Summary

Non-Structural BMP Volume Credits (CF) (Attach Calculations):

Managed Release Credits (CF) (Attach MRC Design Summary):

Volume Required to Reduce/Manage (CF):

Total Credits (CF):

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Worksheet 5

6.4.9	Vegetated Filter Strip		
6.4.10	Berm		
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond / Retention Basin		
6.7.1	Riparian Buffer/Riparian Forest Buffer Restoration		
6.7.2	Landscape Restoration / Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
Other	MRC (Volume Removed)		
Other	MRC (Geomorphic Volume)		

Total Structural Volume (cubic feet):	0.00
Structural Volume Requirement (cubic feet):	12,829.16
DIFFERENCE	-12,829.16

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Design Example

- 2.80 Acre Site
- 80% Impervious
- 20% Grass

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WORKSHEET 4. - CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT:	Example MRC			
Drainage Area:		2.80	(acres)	
2-Year Rainfall:	3.30	in.		

Total Site Area:		2.80	acres
Protected Site Area:		0.00	acres
Managed Area:		2.80	acres

Existing Conditions:

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[2] (ft³)
Forest	C	121,968	2.80	79	2.66	0.53	1.41	14,354.29
					0.00	0.00	3.30	0.00
TOTAL:		121,968	2.80					14,354.29

Developed Conditions:

Cover Type	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[2] (ft³)
Impervious	C	97,574	2.24	98	0.20	0.04	3.07	24,939.33
Lawn	C	24,394	0.56	74	3.51	0.70	1.10	2,244.12
					0.00	0.00	3.30	0.00
TOTAL:		121,968	2.80					27,183.45

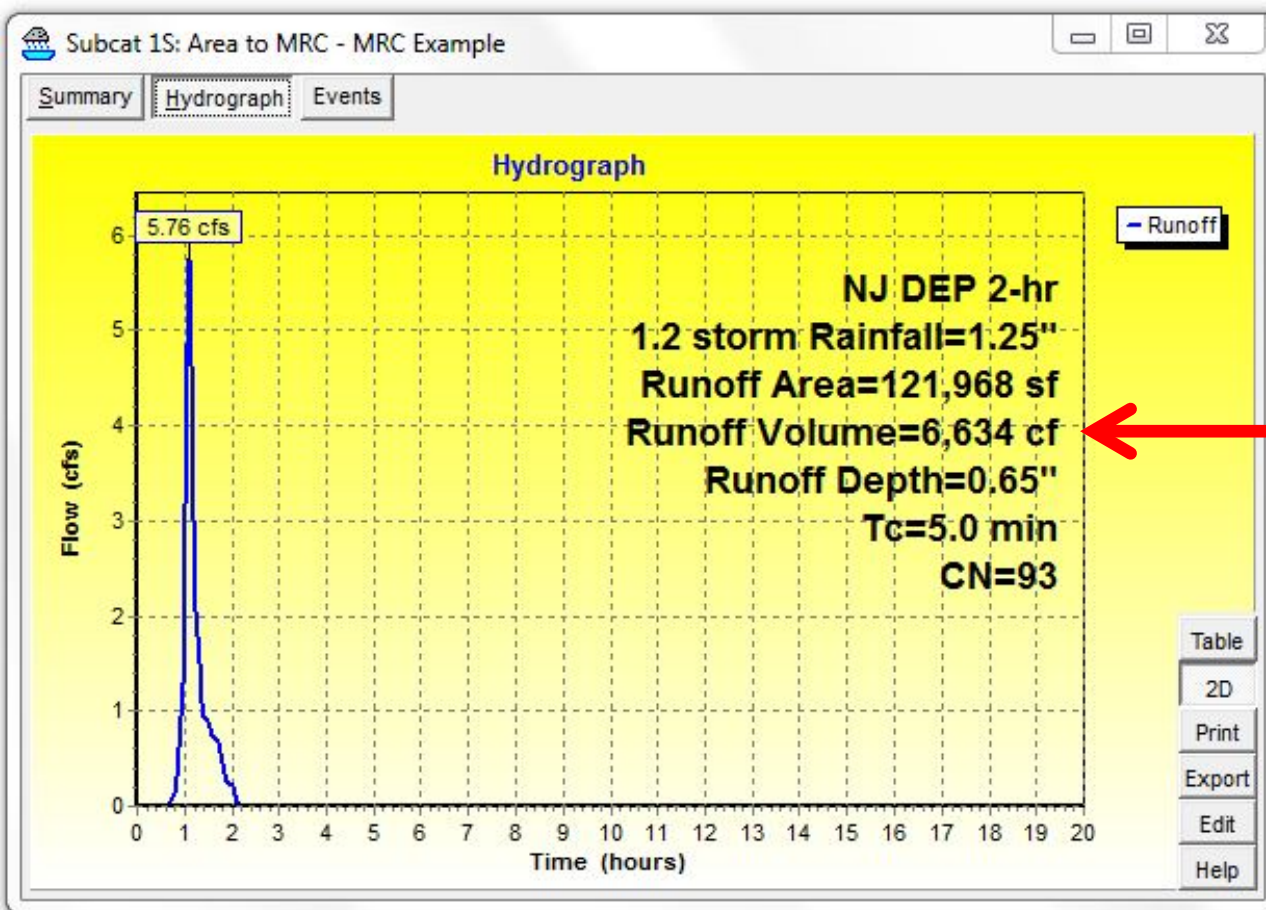| 2-Year Volume Increase (cubic feet):	12,829.16

Required Volume= 12,829 cf

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IMP$_{EQ}$ = 6,634 cf / (.0833 feet X 43,560 ft^2) = 1.83 acres
Design Outflow = 0.01 cfs x 1.83 = .0183 cfs = Use 0.02 cfs

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Subcat 3S: Equiv Impervious - MRC Example

Summary | Hydrograph | Events

Hydrograph

5.47 cfs

— Runoff

NJ DEP 2-hr
1.2 storm Rainfall=1.25"
Runoff Area=79,715 sf
Runoff Volume=6,873 cf
Runoff Depth=1.03"
Tc=5.0 min
CN=98

Flow (cfs)

Time (hours)

Table | 2D | Print | Export | Edit | Help
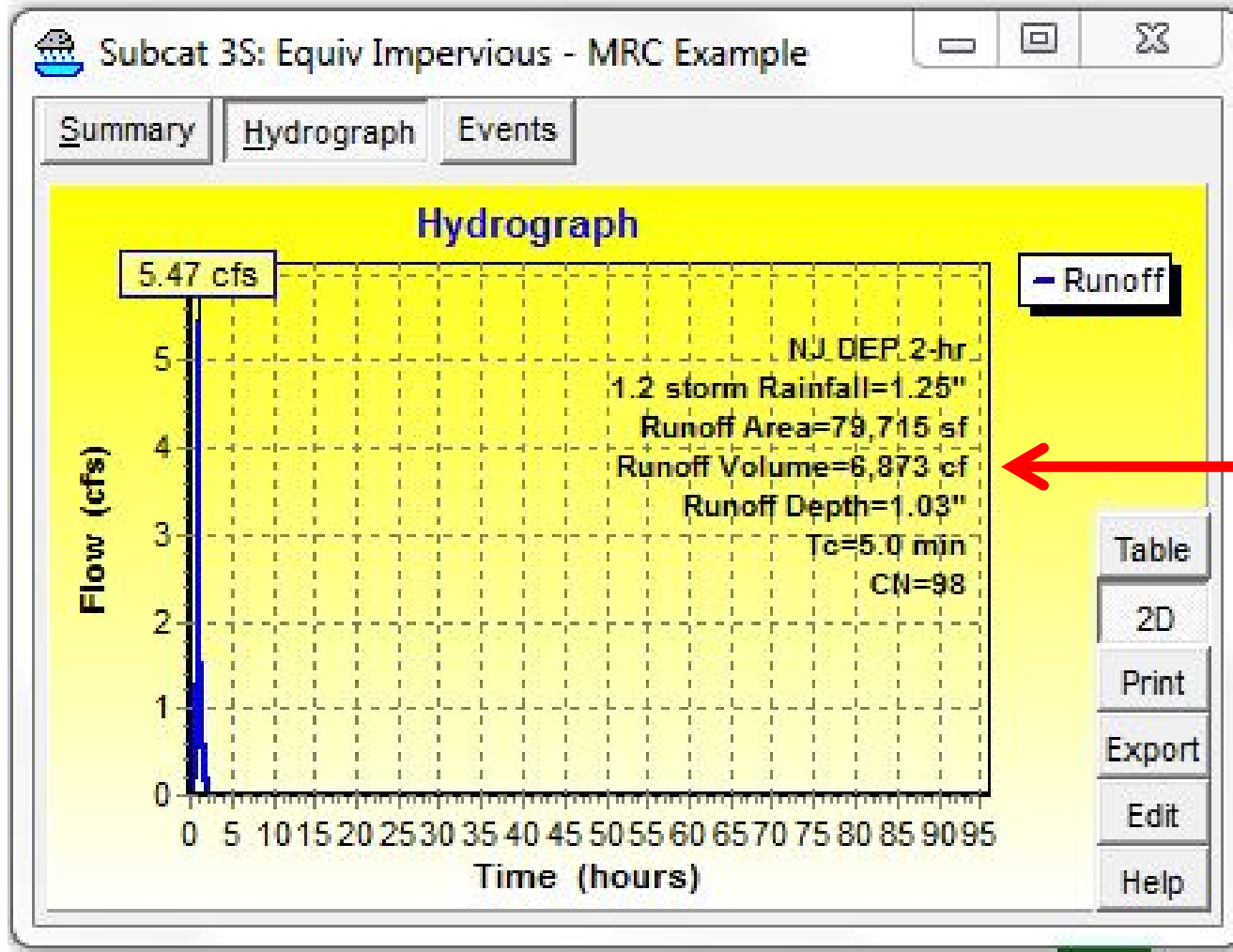
IMP$_{EQ}$ = 6,634 cf vs 6,873 cf for 1.83 acres of impervious

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MRC Design

Above Ground Basin

- 1 foot deep Internal Water Surface- Volume based on 15% voids
- 1 foot soil media above IWS- 30 % void space
- 2 feet open ponding depth above soils

- For Target discharge of 0.02 cfs and h=2 feet +/-, use 1" orifice in underdrain at top of IWS
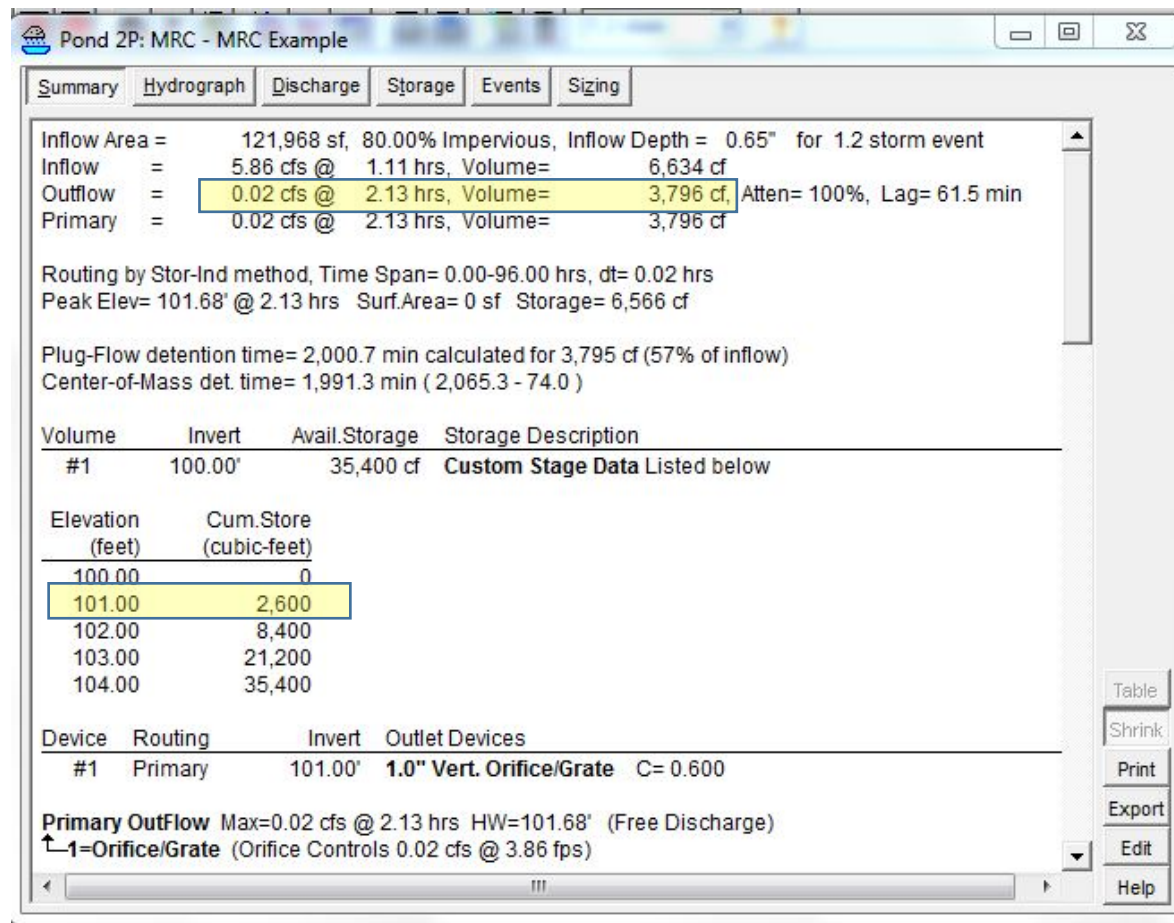
Volume Permanently Removed = Volume in IWS (15% voids) +Underdrain Discharge Volume

2,600 cf +3,796 cf = 6,396 cubic feet

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MRC Design
2 yr / 24 hour storm

- Size 2 Year Outflow based on 1 Year Pre-development Rate = 1.8 cfs
- **Hint**-Set Orifice Elevation where the Basin Volume=Worksheet 4 Required Volume
- **Hint**-72 Hour Dewatering time and associated water depth/volume to drain ponding area will dictate sizing of the system.

- **For our Example:**

  - Worksheet 4 Volume= 12,900 cubic feet
  - Set Orifice elevation at 102.35 - corresponds to Volume =12,900 cf
  - Storage Area above soil and below orifice elevation should be roughly :

    - (0.02 cfs)*(3600)*(72)=5,184 cubic feet or less between top of soil (102.00) and orifice elevation (102.35) to meet 72 hour drain time

      Underdrain Discharge Rate*conversion to Hours * 72 Hours

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Pond 2P: MRC - MRC Example2

Summary | Hydrograph | Discharge | Storage | Events | Sizing

Inflow Area =   121,968 sf, 80.00% Impervious, Inflow Depth = 2.54"   for 2-Year event
Inflow   =   9.19 cfs @   12.12 hrs, Volume=   25,836 cf
Outflow   =   0.60 cfs @   13.33 hrs, Volume=   19,260 cf, Atten= 94%, Lag= 72.7 min
Primary   =   0.60 cfs @   13.33 hrs, Volume=   19,260 cf

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.02 hrs
Peak Elev= 102.66' @ 13.33 hrs   Surf.Area= 0 sf   Storage= 16,890 cf

Plug-Flow detention time= 1,193.6 min calculated for 19,256 cf (75% of inflow)
Center-of-Mass det. time= 1,106.0 min (1,899.1 - 793.2)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	35,400 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
100.00	0
101.00	2,600
102.00	8,400
103.00	21,200
104.00	35,400

Device	Routing	Invert	Outlet Devices
#1	Primary	101.00'	**1.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	102.35'	**12.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.60 cfs @ 13.33 hrs HW=102.66' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.03 cfs @ 6.13 fps)
└─**2=Orifice/Grate** (Orifice Controls 0.56 cfs @ 1.80 fps)

Table | Shrink | Print | Export | Edit | Help

2 Year / 24 hour Routing

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Pond 2P: MRC - MRC Example2

Summary | Hydrograph | Discharge | Storage | Events | Sizing

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	100.00	0.00
2.00	0.00	0	100.00	0.00
4.00	0.00	1	100.00	0.00
6.00	0.03	135	100.05	0.00
8.00	0.09	584	100.22	0.00
10.00	0.24	1,651	100.64	0.00
12.00	5.09	7,898	101.91	0.02
14.00	0.40	16,626	102.64	0.54
16.00	0.22	15,544	102.56	0.34
18.00	0.15	14,862	102.50	0.23
20.00	0.13	14,442	102.47	0.17
22.00	0.11	14,196	102.45	0.14
24.00	0.11	14,014	102.44	0.12
26.00	0.00	13,433	102.39	0.06
28.00	0.00	13,083	102.37	0.04
30.00	0.00	12,848	102.35	0.03
32.00	0.00	12,632	102.33	0.03
34.00	0.00	12,418	102.31	0.03
36.00	0.00	12,206	102.30	0.03
38.00	0.00	11,995	102.28	0.03
40.00	0.00	11,785	102.26	0.03
42.00	0.00	11,577	102.25	0.03
44.00	0.00	11,370	102.23	0.03
46.00	0.00	11,164	102.22	0.03
48.00	0.00	10,960	102.20	0.03
50.00	0.00	10,757	102.18	0.03
52.00	0.00	10,556	102.17	0.03
54.00	0.00	10,356	102.15	0.03
56.00	0.00	10,157	102.14	0.03

Dewatering Time:

Volume to Dewater = 12,848 (elev. 102.35) -8,400 (elev 102.00) = 4448 cf

Time to Dewater:

4448/ (0.02 cfs *3600)=61 hours < 72 hours (ok)

Volume Managed=12,848 Cubic Feet at Elevation 102.35

Geomorphic Volume = 12,848-6,396 = 6,452 cf

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Questions?