Managed Release Concept (MRC)

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 Proven not to be Feasible
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)

Justification for Use

- Thorough 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.

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 Sediment or Flow Alterations
  - If Deviations from Design Standards-Individual Permit
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

**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
**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
- Media Above IWS is assumed dry for Routing Considerations (30% Voids)
- Promotes ET

**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 Vegetated MRC designed in accordance with design standards meets the Volume and Water Quality Requirements for the contributing disturbed area to the MRC.
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

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
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<sub>EQ</sub>
  - Determine total hydrograph volume to MRC from 1.2”/2Hr Storm = V<sub>1.2</sub>
    - IMP<sub>EQ</sub> = V<sub>1.2</sub> (cubic feet) / (.0833 feet X 43,560 ft<sup>2</sup>)
  - 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

Geomorph 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
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 / Re-vegetation
- 6.7.3 Tea Amendment
- 6.8.1 Jeep Sprinkler
- 6.8.2 Special Storage Areas

Other MGC (Volume Swallowed)
Other MGC (Geomorphic Volume)

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Total Structural Volume (cubic feet) = 12,629.16
Structural Volume Requirement (cubic feet) = 12,629.16
DIFFERENCE = 0.00
Design Example

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

Required Volume = 12,829 cf

\[
\text{IMP EQ} = \frac{6,634 \text{ cf}}{(0.0833 \text{ feet} \times 43,560 \text{ ft}^2)} = 1.83 \text{ acres}
\]

Design Outflow = 0.01 cfs x 1.83 = .0183 cfs
= Use 0.02 cfs

\[
\text{IMR}_{\text{comp}} = 6,534 \text{ cf} / (0.0833 \text{ feet} \times 42,560 \text{ ft}^2) = 1.83 \text{ acres}
\]

Design Outflow = 0.01 cfs x 1.83 = .0183 cfs = Use 0.02 cfs
IMP EQ = 6,634 cf vs 6,873 cf for 1.83 acres of impervious.

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
**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:
  - \(0.02 \text{ cfs} \times 3600 \times 72 = 5184\) cubic feet or less between top of soil (102.00) and orifice elevation (102.35) to meet 72 hour drain time

**Dewatering Time:**

- Volume to Dewater = 12,848 (elev. 102.35) - 8,400 (elev 102.00) = 4448 cf
- Time to Dewater:
  - \(4448 / (0.02 \text{ cfs} \times 3600) = 61\) hours < 72 hours (ok)

Volume Managed = 12,848 Cubic Feet at Elevation 102.35
- Geomorphic Volume = 12,848 - 6,396 = 6,452 cf

2 Year / 24 hour Routing
Questions?