



Sediment Basin Design Requirements

A Regulatory Perspective

South Carolina Department of Health and Environmental Control

Promoting and Protecting the Health of the Public and the Environment

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South Carolina Department of Health and Environmental Control
Promoting and Protecting the Health of the Public and the Environment





Presentation Overview

- Sediment Basin's Regulatory Influences
- Recent Basin Requirement Changes
- Walk Through of BMP Handbook's Sediment Basin Section
 - Requirements Vs. Considerations
 - Skimmers, Baffles, and Forebays
 - Spillways & Spillway Capacities
 - Sediment Basin Design Aids



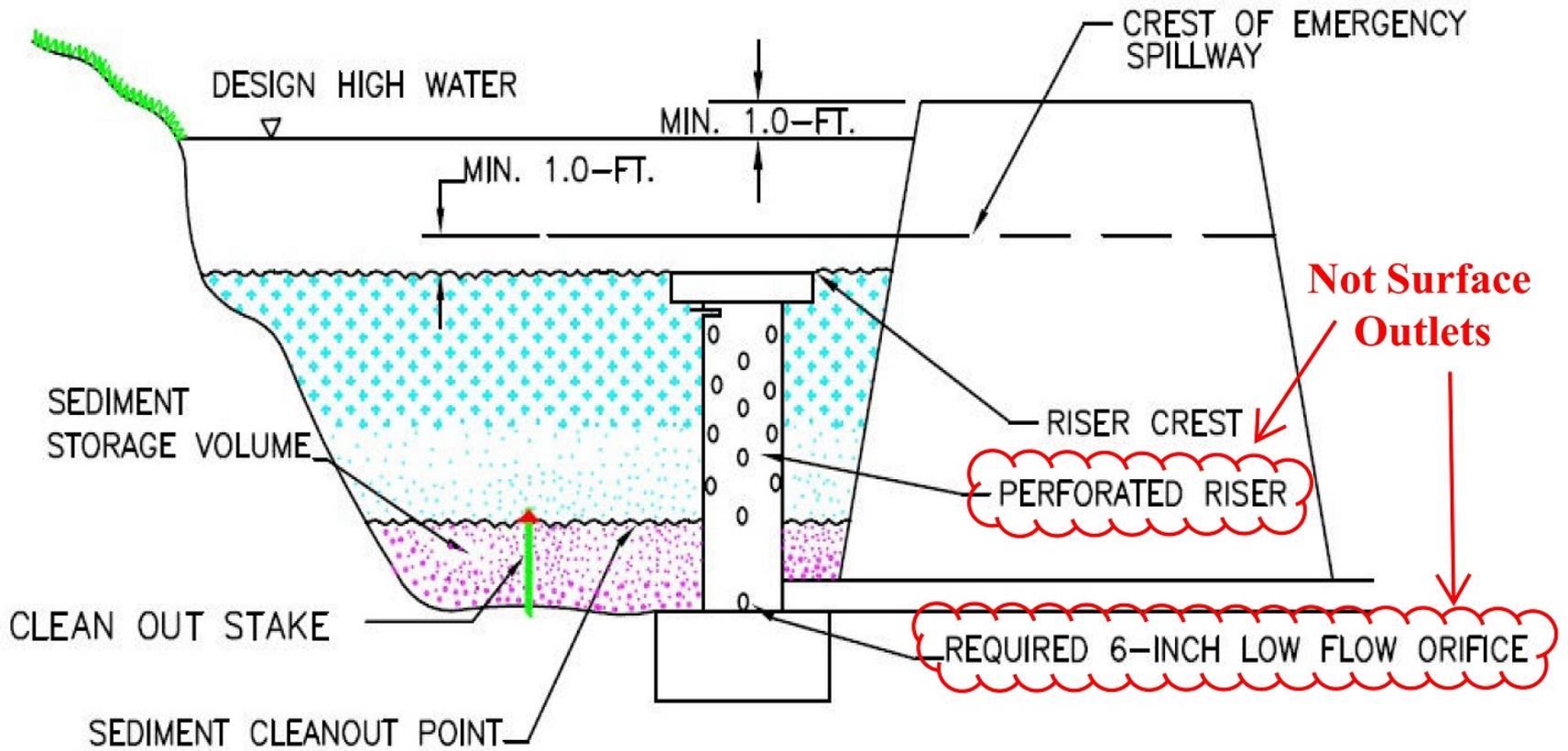
Regulatory Influences

- There Are Three (3) Sources of Regulatory Influences
 - **Federal** Acts, Rules and other Regulations
 - **State** Regulations, Permits and Design Handbooks
 - **Local** Ordinances and Design Standards
- Each Of These Influences May Affect Basin Design
- Basins Will Differ from Site-To-Site Due to These Influences



Federal Influences

- **The Water Quality Act of 1987**
 - Control Pollutants in Stormwater Runoff
 - Protect Water Quality of Receiving Waters
 - Runoff from Construction, Industrial, and MS4s
- **Non-Numeric Effluent Limits (Final Rule)**
 - Utilize Surface Outlets when Discharging from Basins!
 - Other Basin Related Requirements
 - Slope Stabilization And Energy Dissipation





State Influences

- **Stormwater Management and Sediment Reduction Act**
 - Passed in 1991 (Lead to R. 72-300 and R. 72-405)
- **R. 72-300 - Statewide Standards**
 - Source of the 80% TSS Trapping for Sediment Basins
 - 10+ Disturbed Acres To Common Point Use Sediment Basin
 - 10-YR, 24-HR Design Events – SCS Distribution
 - Volume Based Hydrograph Methods
 - Basin Bottom Slopes (Not Less than 0.5%)



More State Influences

- **Stormwater Construction General Permit (CGP)**
 - See Section 3.2.6.A.II.(c)
 - Basins to be Size for Entire Drainage Area Unless Diverted
 - On-site Conditions Must be Factored Into Design
 - Public Safety Where Necessary
 - Use of Porous Baffles and Sediment Forebays
 - Surface Outlet Capacity for 10-yr, 24-hr SCS Storm
 - Use Cleanout Stakes to Promote Maintenance

And Yet Another State Influence

- **SC DHEC BMP Handbook**

- Detailed Overview of Requirements and Other Design Criteria
- Standard Construction Details for Wet and Dry Basins
- Slope Stabilization, Inlet & Outlet Dissipation, Spillways





Local Influences

- **Ordinances**

- Varies from City-to-City or County-to-County
- May Need to Address:
 - Set Backs, Discharge Locations, Vector Control
 - Downstream Impacts (Quality and Quantity)
 - Peak Discharges

- **Design Handbooks and Other Guidance**

- Local Review Requirements and Design Standards



Recent Basin Requirement Changes

- **December 2009** - EPA Rulemaking (Now Final Rule)
 - Non-Numeric Effluent Limits – Surface Outlets
- **October 2012** - Reissued of Stormwater CGP
 - Section 3.2.6.A.II.(c) – Addition of Baffles and Forebays
- **March 2014** – Revised Sections in BMP Handbook
 - New Standard Construction Details
 - Slope Stabilization, Inlet/Outlet Dissipation, Spillways



What Do These Changes Mean?

- **Basin Principle Spillway Design Has Changed**
 - No More Perforated Risers
 - Must Use Skimmers or Other Surface Outlet Mechanisms
- **More Internal Components**
 - Porous Baffles
 - Sediment Forebays
 - Stabilized Slopes, Inlets, and Outlets
 - Skimmer Rock Berms, Pits, Pads, etc.

**Principle Spillway Prior To
Basin Requirement Changes**



**Principle Spillway After
Basin Requirement Changes**



BMP Handbook – Sediment Basin

SC DHEC Stormwater BMP Handbook
 Sediment Control BMPs – Sediment Basins

Sediment Basins



Introduction

Sediment Basins are a Best Management Practice (BMP) used to collect and impound stormwater runoff from disturbed areas (typically 5 acres or more) at construction sites to restrict sediments and other pollutants from being discharged off-site. These basins may also be used to control the volume and velocity of the runoff through a timed release by utilizing multiple spillways. It is through this attenuation of runoff that sediment basins may be capable of meeting South Carolina's Design Requirements, specifically the Total Suspended Solids (TSS) removal efficiency of 80%.

These basins work most effectively in conjunction with additional sediment and erosion control BMPs installed and maintained up gradient of the basins.

Guidance Disclaimer

This is a guidance document and may not be feasible in all situations. Alternative means and methods for sediment basin design and construction also may be employed.

FEATURES

- Sediment Control
- Volume Control
- Velocity Control

SECTIONS

- General Design
- Forebays
- Porous Baffles
- Basin Dewatering
- Skimmers
- Spillways
- Permanent Pools
- Maintenance
- Design Aids

ALSO ADDRESSED

- Inlet Protection
- Basin Safety
- Sediment Storage
- Slope Stabilization
- Rock Berms
- Outlet Protection
- Basin Removal

PLAN SYMBOL

Quick Walkthrough of Document

- Requirements Vs. Considerations
- Placement And Sizing
- Dewatering the Basin
- Stabilization
- Internal Components
- Spillways
- Design Aids

<http://www.scdhec.gov/Environment/docs/sedim-Basin.pdf>



Requirements Vs. Considerations

- **Requirement Section**

- Identifies Regulation and Permit Requirements

- **Consideration Section**

- Identifies Other General Design Criteria
- Employ Based on Best Professional Judgment
- Will Help Ensure a Good Basin Design That Meets Requirements
- Under Most Circumstance – All Should Be Addressed



Placement of a Sediment Basin

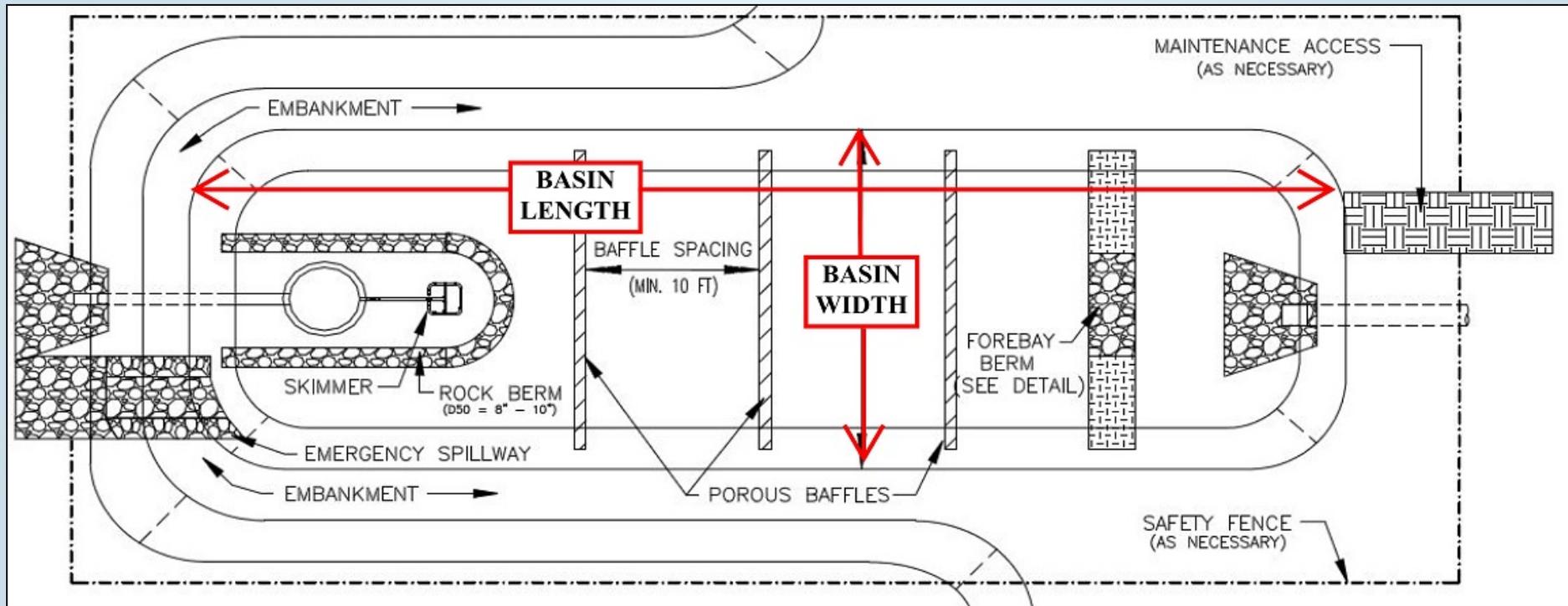
- **Not Within Waters of the State!**
- **Suggested Locations**
 - Near Identified Outfalls of Construction Site
 - Where Basin Captures Majority of Runoff From Disturbed Area
 - Low Lying Areas
 - Where Offsite and Undisturbed Area Can Bypass Basin
 - Where Basin Can Be Easily Converted to Detention Pond
 - Referred to As a Multipurpose Basin



Shaping a Sediment Basin

- **Length to Width Ratio**
 - No Less than 2:1
- **Surface Area**
 - Maximize Surface Area To Increase % Trapping
- **Depth**
 - As Needed to Meet Basin Storage & Capacity Criteria

2:1 - Length To Width Ratio





Sizing – Storage & Capacities

- **Sediment Storage Volume**
 - 3600 Cubic Feet Per Acre Draining to the Basin
 - Provides Storage for Deposited Sediment
- **Principle Spillway Discharge Capacity**
 - Must Handle the 10-yr, 24-hr SCS Storm Event
 - Runoff Volume Based Off Entire Drainage Area to Basin
 - Routing of Basin Is Necessary with During Constr. CNs
 - Will Govern The Size of Basin In Most Cases



Dewatering Of Impounded Runoff

- **10-yr, 24-hr SCS Storm Event**
 - Through Principle Spillway
 - Completely Dewater this Storm Event Between 2-5 Days
 - Target Dewatering Time is Typically 3 Days
- **Other Storm Events**
 - Larger Events – Through Principle and Emergency Spillways
 - Smaller Events – Through Principle Spillway's Surface Outlets



Stabilization

- **Embankment - Side Slopes**

- Surface Roughening (Tracking)
- Seeding/Hydroseeding
- Erosion Control Blankets

- **Inlets**

- Plunge Pools
- Riprap Aprons
- Cite Invert at Bottom of Pond and Not Along Side Slopes

Lack of Slope Stabilization





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Proper Slope Stabilization



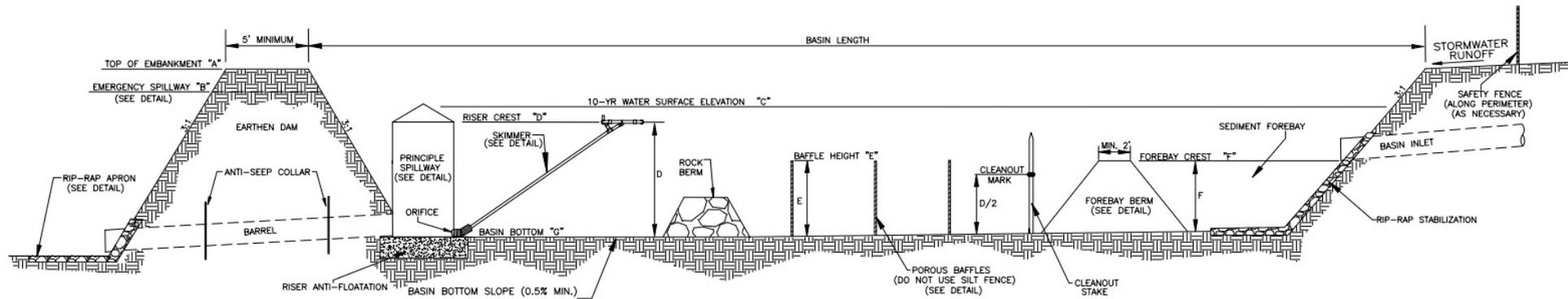
Internal Components

- Sediment Forebay
- Porous Baffles
- Surface Outlets
- Spillways
- Permanent Pools



Internal Components

*Starting From the Inlets
 Through the Basin's Outlets*





Sediment Forebays

- **Applicability**
 - May Be Infeasible In Smaller Basin Serving 3 or Less Acres.
- **Volume of Forebay**
 - 20% of the Sediment Storage Volume of Basin.
- **Composition**
 - Riprap Berms, Gabion, or an Earthen Berm with a Rock Filled Outlet.
- **Alternatives**
 - Large Plunge Pools or Smaller Rock Berms with Combined Storage Equal to 20% of Sediment Storage



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Sediment Forebay Outlet





Porous Baffles

- **Applicability**
 - Must Be Provided in all Sediment Basins During Construction
- **Height & Width**
 - 3-ft High
 - Spans Entire Width of Basin (Including Side Slopes)
- **Rows & Spacing**
 - 3 Rows With a Minimum Spacing of 10-ft
 - May be Reduced to 2 Rows When Basin is Less than 50-ft Long



Porous Baffles (Continued)

- **Composition**

- Turf Reinforcement Matting (TRM) Materials or Coir-Based Products
- No Loose Straw Materials
- Do Not Use Silt Fence
- Material Light Penetration (Open Spaces) Should be 10-30% of Material.

Porous Baffles Installation





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Porous Baffles – Close Up



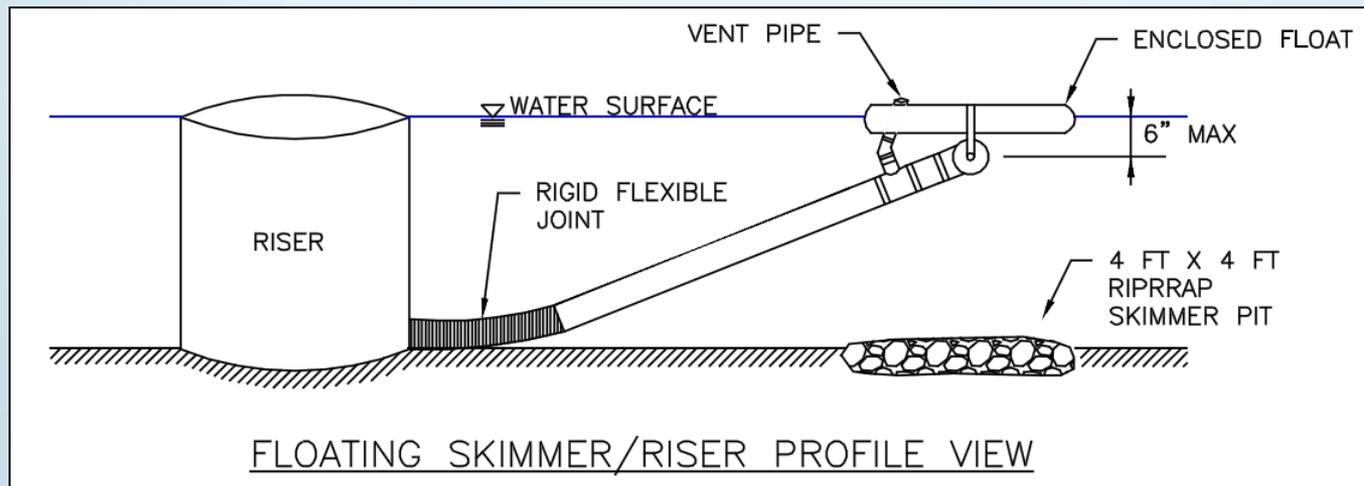


Surface Outlets

- **Applicability**
 - Must Be Provided in all Sediment Basins During Construction
 - Provide on Principle Spillway
- **Options for Surface Outlets**
 - Floating Skimmers
 - Flashboard (Stop Log) Risers

Floating Skimmers

- Skimmer Design
- Discharge Rates
- Water Surface Elevations
- Skimmer Orifices
- Skimmer Manufacturers
- Equivalent Skimmers





Skimmer Design

- **Applicability**

- Must Be Provided in all Sediment Basins During Construction
- Attached to Riser of Principle Spillway
- Multiple Skimmers May be Attached to a Single Spillway

- **Discharge Capacity**

- 10-YR, 24-HR SCS Storm Event
 - Through Skimmer and May Discharge Over Riser Crest of the Principle Spillway
 - Dewatering This Event within 2-5 Days (3 Days Target)

- **Skimmer Sizes**

- Range from 1-Inch Up to 8 Inch
- Skimmer Size Does Not Necessary Reference Orifice Size

Skimmer with Rock Berm

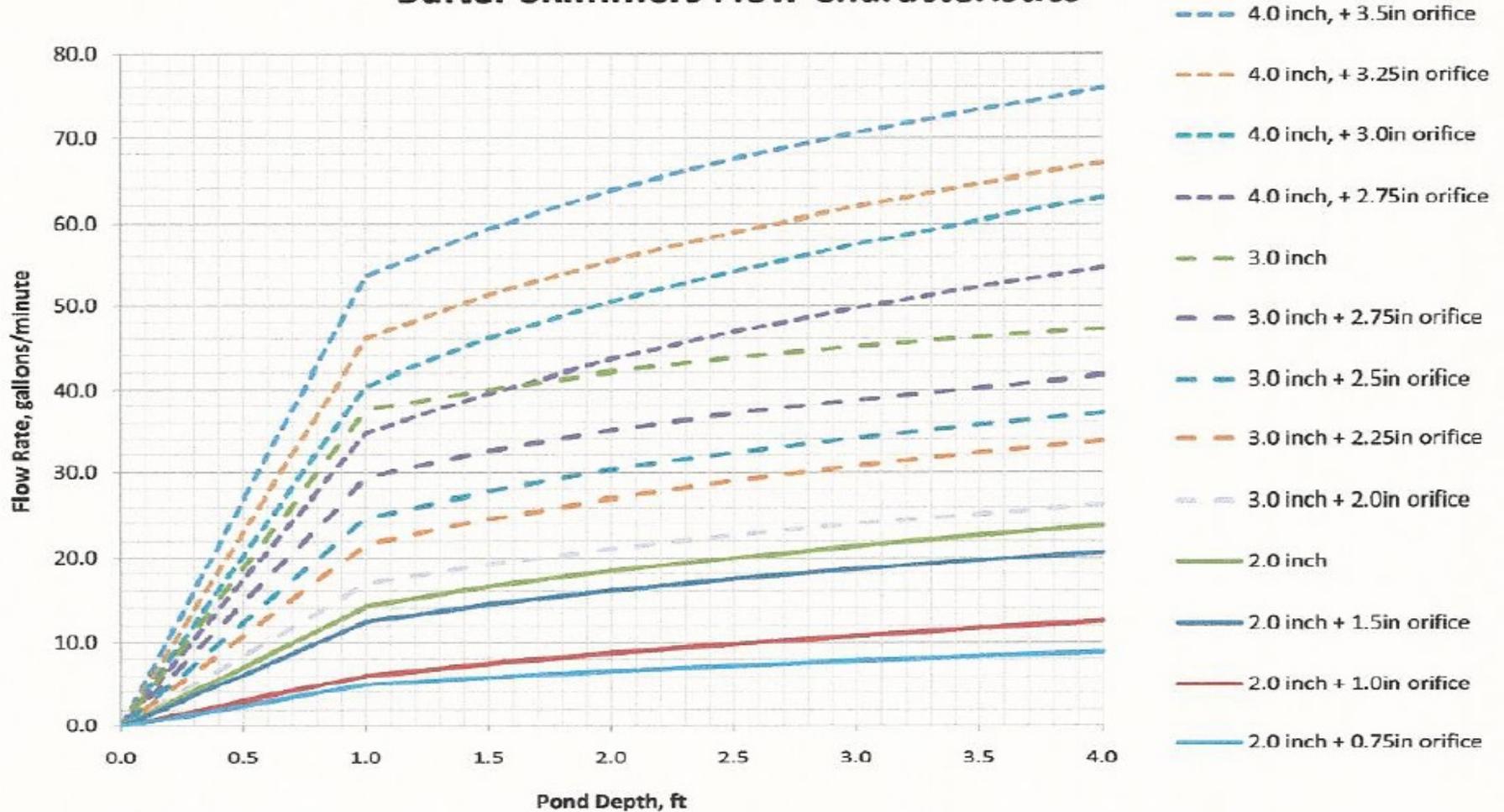




Skimmer Discharge Rates

- **Are Not Constant!**
 - Will Vary Based on Water Surface Elevation in Basin
 - Tend to Approach a Constant Rate as Elevation Increases
 - Multiple Skimmers May be Attached to a Single Spillway
- **Average Discharge Rates**
 - Provided By Manufacturer
 - As Volume Discharge Per X Days (CF/Days)
 - Daily Discharge Capacity (CF) – 1 Day Discharge Volume
 - Use to Determine a Constant Discharge Rate (CFS)
- **Basin Routing w/ Skimmers**
 - May Use Constant Rate Derived from Average Discharge Rates
 - May Use Variable Discharge Rate From Product-Specific Testing

Bafer Skimmers Flow Characteristics

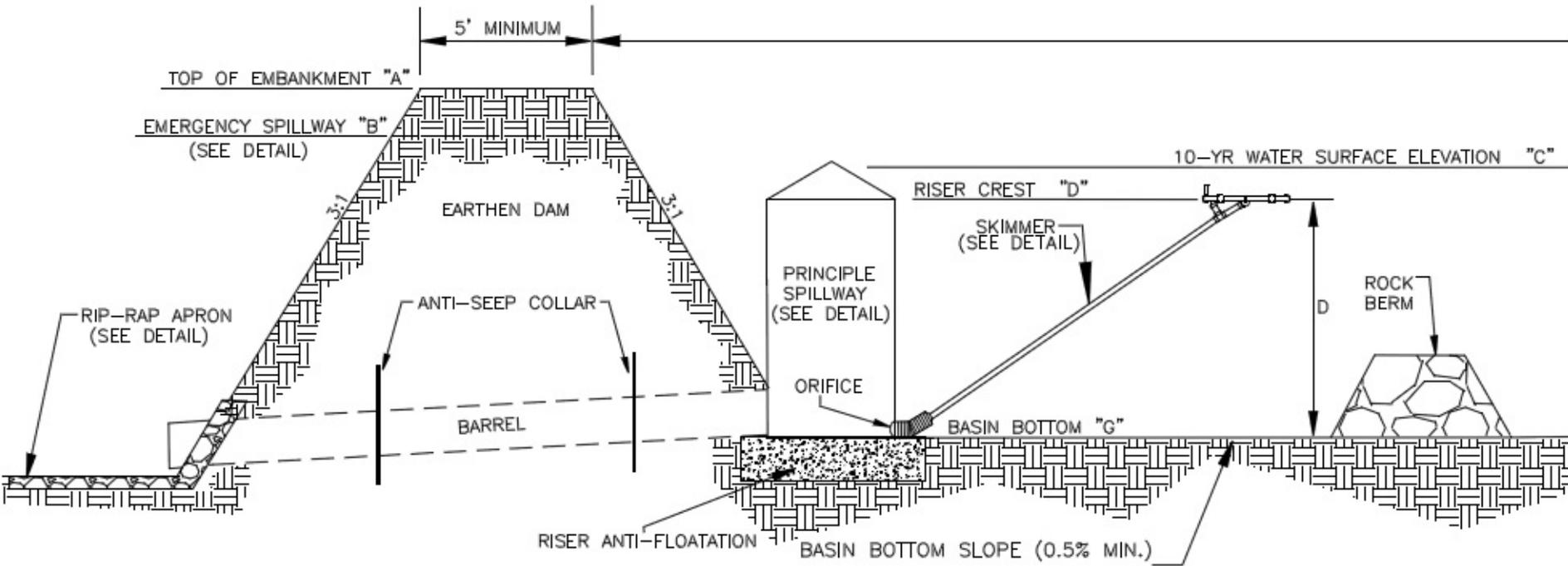




Water Surface Elevations (WSE)

- **10-YR, 24-HR Storm's WSE**
 - May Overtop Riser Crest on Principle Spillway
 - Should Limit to 1 Foot Over Crest
 - Should Not Discharge Through Emergency Spillway
- **Smaller Storm Events (When Required)**
 - Discharge Through Skimmer Only
- **Larger Storm Events (When Required)**
 - 25-YR and 100-YR May Discharge Through Emergency Spillway
 - 100-YR Storm's WSE – Freeboard of 0.5 Feet From Top of Embankment

10-YR Water Surface Elevation





Skimmer Orifices & Arms

- **Orifice Size May Differ From Skimmer Size**
 - Plugs and Flaps Used to Decrease Orifice Size
 - May be Smaller Than Cited Skimmer Size
 - Should be Cited on Skimmer or Basin Detail on Approved Plans
- **Skimmer Arms**
 - Typically Smaller than Skimmer Size
 - Length Based Off Equation Provided By Manufacturer
 - Using Wrong Length or Diameter Will Cause Skimmer to Malfunction



Skimmer Manufacturers

- **Use Manufacturer's Recommendations**
 - May Required Skimmer Pad, Rock Pit, or Rope
- **Skimmer Details**
 - Use Manufacturer's Provide Detail
 - Cite Average Discharge Rate (CFS) from Calculations
 - Cite Daily Discharge Capacity (CF) from Manufacturer
 - Cite the Calculated Dewatering Time (Days)

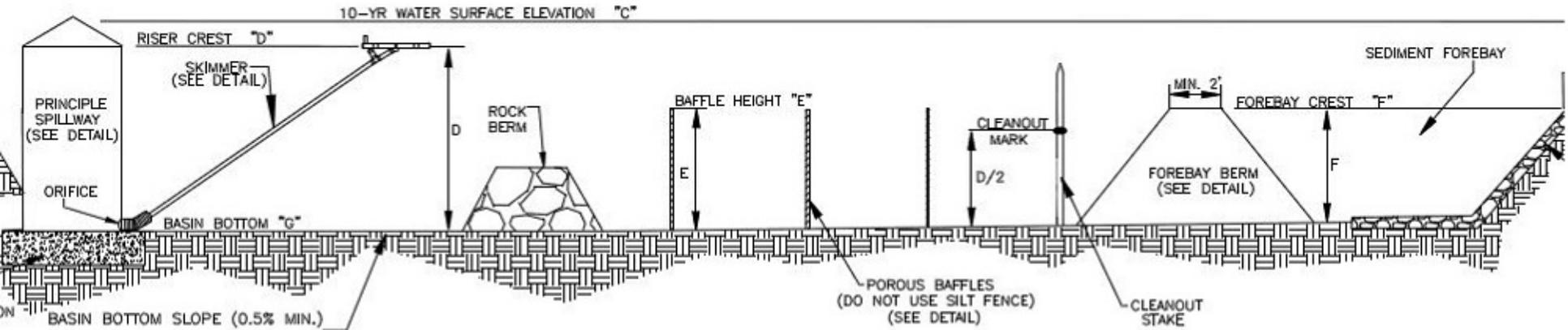


Selecting Equivalent Skimmers

- **Average Discharge Rates**
 - Equal to or Greater Than Approved Skimmer's Cited Rates
- **Daily Discharge Capacity**
 - Equal to or Greater Than Capacity of Approved Skimmer
- **Dewatering Time**
 - 2-5 Days
 - Stay as Close to Approved Dewatering Time as Possible

SEDIMENT BASIN DESIGN TABLE

Sediment Basin Number/Name	"A"	"B"	"C"	"D"	"E"	"F"	"G"	Skimmer Size (in.)	Skimmer Orifice (in.)	Skimmer Daily Discharge Capacity (FT ³ /DAY)	Skimmer Average Discharge Rate (CFS)	Dewatering Time (Days)	No. of Skimmers
Basin 001	617'	616'	615'	614'	613'	613'	610'	8"	7.5"	93,312 cf	1.08 cfs	3.2 Days	3





Basin Spillway's

- **Principle Spillway**
 - Incorporate Surface Outlet (Skimmer or other)
 - Capacity to Handle 10-Yr, 24-HR SCS Storm Event
- **Emergency Spillway**
 - Capacity to Handle 100-yr, 24-HR SCS Storm Event



Principle Spillway

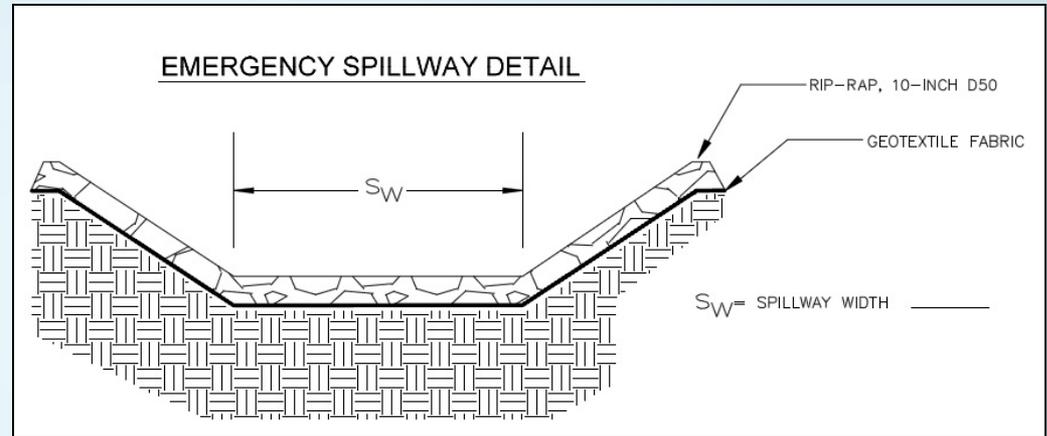
- **Riser/Barrel Configuration**
 - Equipped with Trash Rack and Anti-Vortex Device
- **Orifices**
 - Only allowed for Skimmer Attachment
 - No Open Orifice Along Riser During Construction
- **Weirs**
 - May Be Place within 1-Ft of Riser Crest
 - Weirs Placed Lower Along Riser Are Not Permitted
- **Anti-Floatation Mechanism**
 - Weight of Anti-Flotation Should Be 1.1 Times or Greater than the Weight of the Volume of Water Displaced By the Riser Structure

Principle Spillway



Emergency Spillway

- **Height**
 - 1-Foot Minimum
- **Width**
 - 10-Foot Minimum
- **Side Slopes**
 - 2:1 (H:V)
- **Stabilization**
 - Entire Spillway Must be Stabilized (Including Side Slopes)
 - Use Riprap and Underlying Fabric when Placed on Fill Material





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Emergency Spillway





Permanent Pool (Wet Basin) Options

- **Key Differences:**
 - Sediment Forebays – Not Required
 - Porous Baffles Could Be Replaced with Turbidity Curtains
- **On Approval May Use a Single Weir as Surface Outlet**
 - Contact **DHEC** Prior to Submitting Design for Review
 - The Following Factors will Be Used To Determine Applicability:
 - Basin's Length-To-Width Ratio
 - Submerged Inlets
 - Dispersion of Flow within Basin
 - Depth of Permanent Pool
 - Maximum Head on Weir During 10-YR, 24-HR SCS Storm



Safety Considerations

- **When To Address?**
 - Projects in Urbanized Areas
 - Areas Where General Public May Have Direct Access
- **Examples on How to Address**
 - Lateral Shelf To Prevent Accidental Falls into Basin
 - Safety Fence and Warning Sign
 - Vector Control – Prevent Those Pesky Mosquitoes



Trapping Efficiency Calculations

- **When To Address?**

- 10 Acres or More Draining To Basin
- Downstream Impairments – BIO, TN, TP, Turbidity, Chlorophyll-A, and Bacteria (FC & E. Coli) in Shellfish Waters

- **What is Required to Be Trapped?**

- 80 % of Total Suspended Solids (TSS)

- **How to Address?**

- Sediment Modeling Software
- DHEC BMP Handbook Design Aids

DHEC's BMP Handbook Design Aids

- **Limitations**

- Maximum Drainage Areas of 30 Acres

- **Figures and Charts**

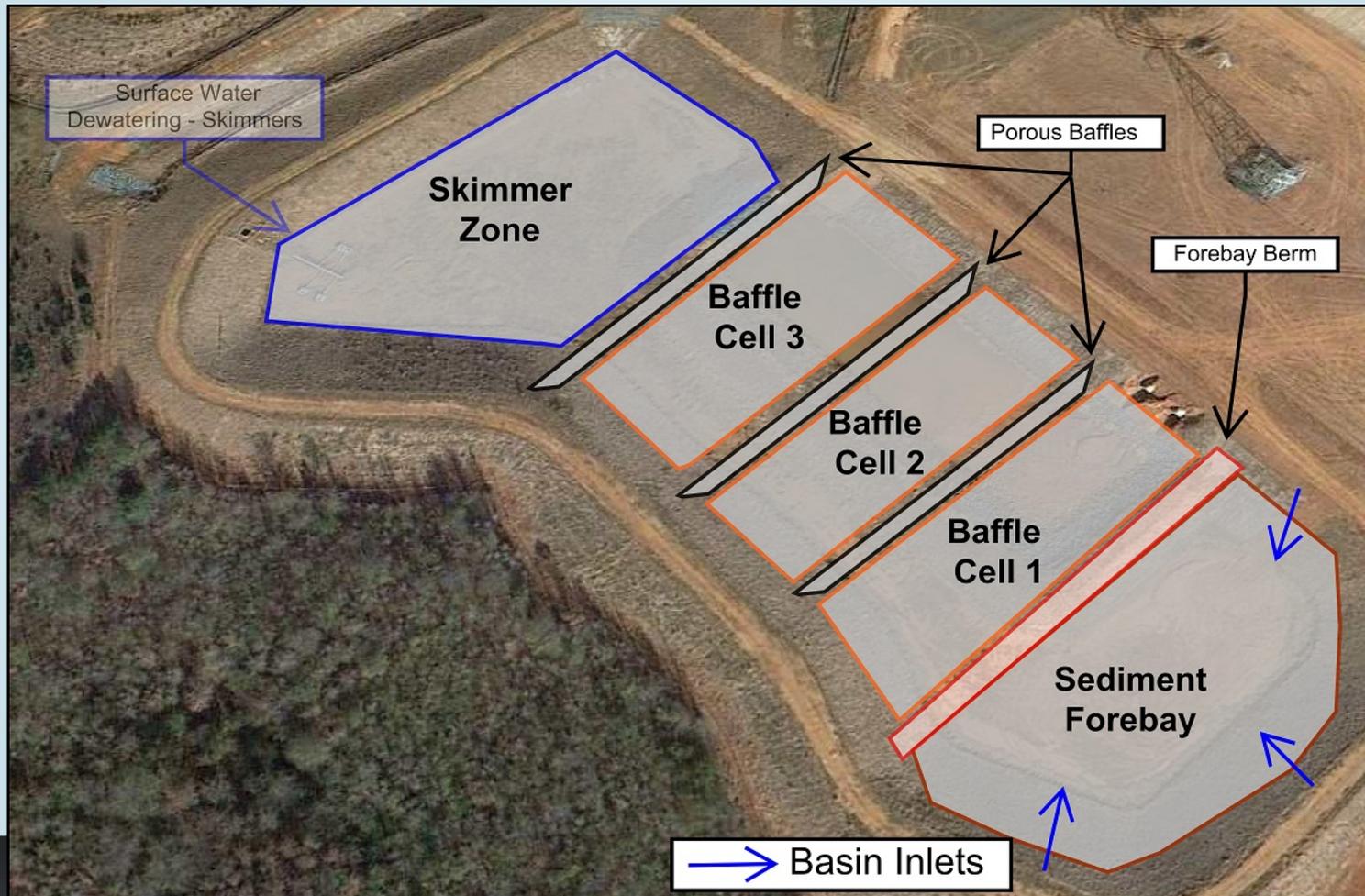
- Used to Determine Settling Velocity and Basin Trapping
- Submit Charts with Calculations

- **Basin Ratio Determine With**

- Surface Area @ Riser Crest
- Peak Outflow of Basin (Required Routing)
- Soil Settling Velocity

$$\text{Basin Ratio} = \frac{q_{po}}{A V_{15}}$$

Basin Configuration Example





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David P. Johnson, PE

Bureau of Water

Stormwater Permitting Section



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