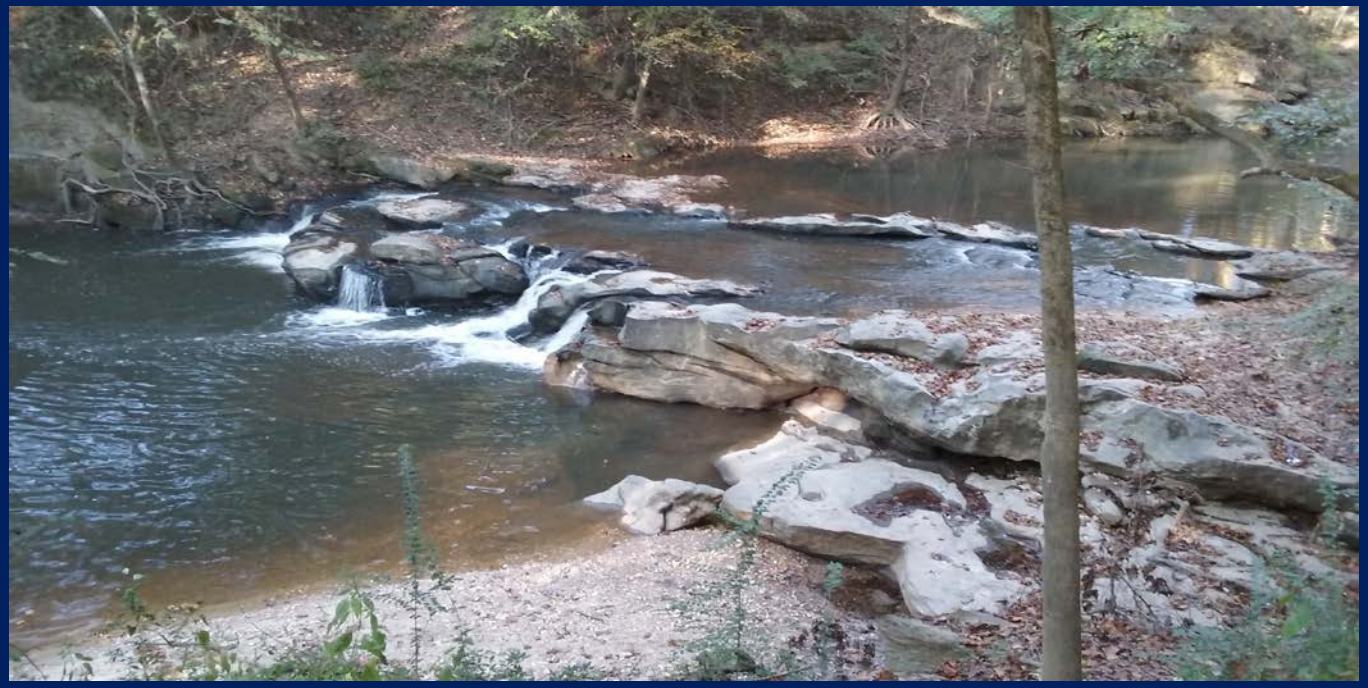
Answering the FAQs about ALDOT Post-Construction Stormwater Management



Scott W. Rogers, PhD, PE, CPMSM
Environmental Coordination Engineer

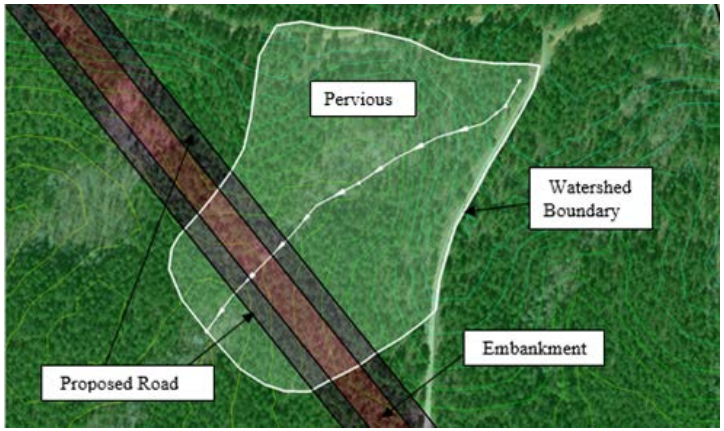
ALDOT Pre-Construction Conference
11 April 2019

Post-Construction Stormwater Management FAQs

- What is post-construction stormwater management?
- Why do we have to do it?
- What good does it do?
- When do we have to do it?
- Where does it fit in the planning & design phase?
- How do we perform necessary hydrologic analyses?
- What analysis tools are available?
- What practices meet post-construction needs?
- Will post-construction stormwater management change in the future?

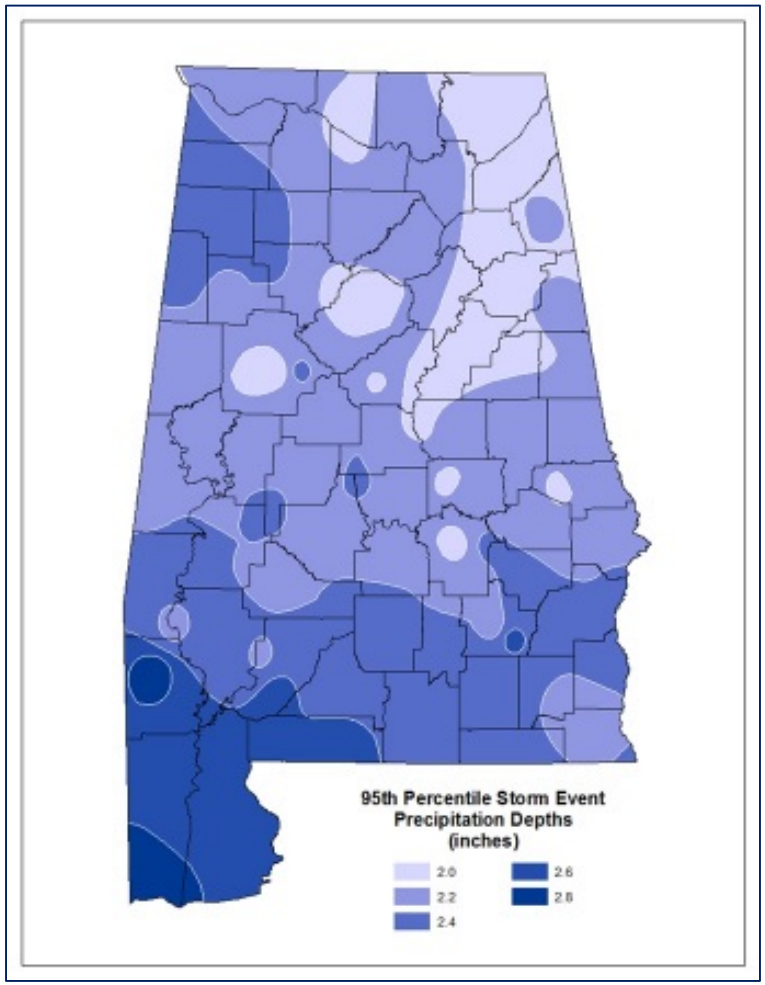
Environmental Impacts of Development

- From pervious natural surface to more impervious developed surface
- Stormwater runoff in greater volumes & at higher velocities
  - More erosion & sedimentation potential
  - Increased flood risk
- Ecosystem/habitat alteration



Post-Construction Stormwater Management

- Managing impacts of development
  - Mimicking pre-development hydrology to the maximum extent practicable
    - For 95th-percentile rain event & events of less rainfall
- Methods encouraged
  - Minimize impervious surfaces
  - Preserve & promote vegetation
  - Approximate natural processes
    - Low-Impact Development (LID)
    - Green Infrastructure (GI)



Post-Construction & the ALDOT MS4 Permit

- NPDES permit issued by ADEM to regulate MS4 stormwater discharges in particular urban areas
- "Post-Construction Stormwater Management" is required by the MS4 permit

ALDOT Post-Construction Policy: GFO 3-73

ALABAMA

DEPARTMENT OF TRANSPORTATION

GUIDELINES FOR OPERATION

SUBJECT: POST-DEVELOPMENT STORMWATER RUNOFF MANAGEMENT

The following guidelines should be followed during drainage design on all ALDOT projects requiring new development and re-development let to contract after April 1, 2015.

Designers must provide features and practices that cause post-development hydrology to mimic pre-development hydrology of the site to the maximum extent practicable, working within the constraints of the project, at all locations of discharge. The basis for design to meet this requirement shall be small, frequent rain events up to and including the 95th percentile rain event for the site.

While working toward this design goal, initial consideration should be the use of decentralized practices and features near the source of the runoff. Design elements that utilize natural materials and processes will be considered whenever possible.

- Small, frequent rain events are those storm events with rainfall depths up to and including the 95th percentile event for a specific county.
- Pre-development and Post-development hydrology include both peak discharge and runoff volume.
- Pre-development hydrology is the existing hydrological condition of the site just prior to construction of the planned development or re-development.
- New Development describes the creation of a new transportation facility or a new support facility that causes a ground disturbance of greater than one acre.
- Re-Development with respect to transportation facilities describes non-maintenance work performed to or on an existing transportation facility that provides for an increased number of thru lanes of travel, and causes a ground disturbance of greater than one acre. Work on an existing road that does not result in an additional thru lane does not constitute re-development.
- Re-Development with respect to support facilities describes non-maintenance work performed to or on an existing support facility that causes a ground disturbance of more than one acre.

The Chief Engineer may approve exceptions to this policy so long as downstream property will not be significantly impacted, and the bed and bank structure of receiving stream channels will not be significantly degraded by the increased stormwater discharge. Justification for an exception will be described and quantified in a written request to the Chief Engineer, including a description of the analysis and conclusions regarding downstream impacts.

Effective Statewide, though permit only requires for MS4 regulation-eligible areas

For projects let after 1 April 2015

Mimic pre-development hydrology to MEP

95th-percentile rain event threshold

"New Development" & "Re-Development" explained

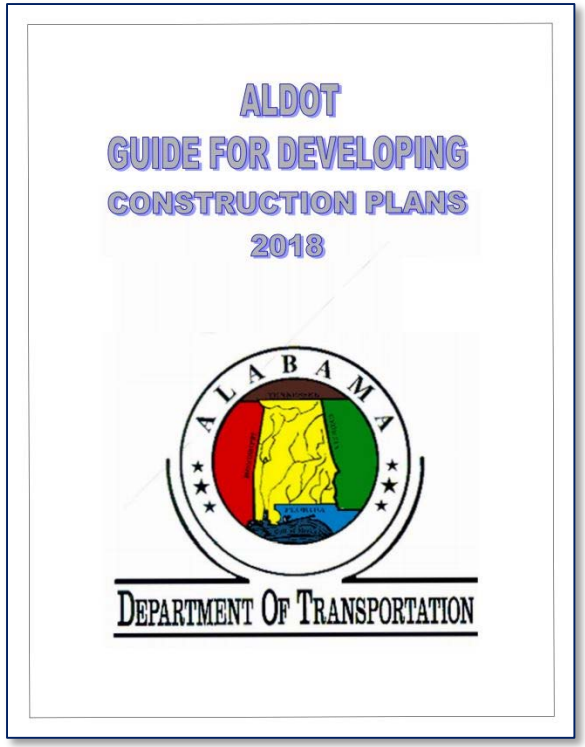
Chief Engineer can grant exceptions

Post-Construction Policy Triggers (for Transportation Facilities)

- New Development
  - Creation of a new roadway
  - Ground disturbance > 1 acre
- Re-Development
  - Non-maintenance work on an existing roadway
  - Provides a higher number of thru-lanes for travel
  - Ground disturbance > 1 acre
- Rule-of-Thumb
  - If adding **thru-lanes**, post-construction stormwater management should be considered

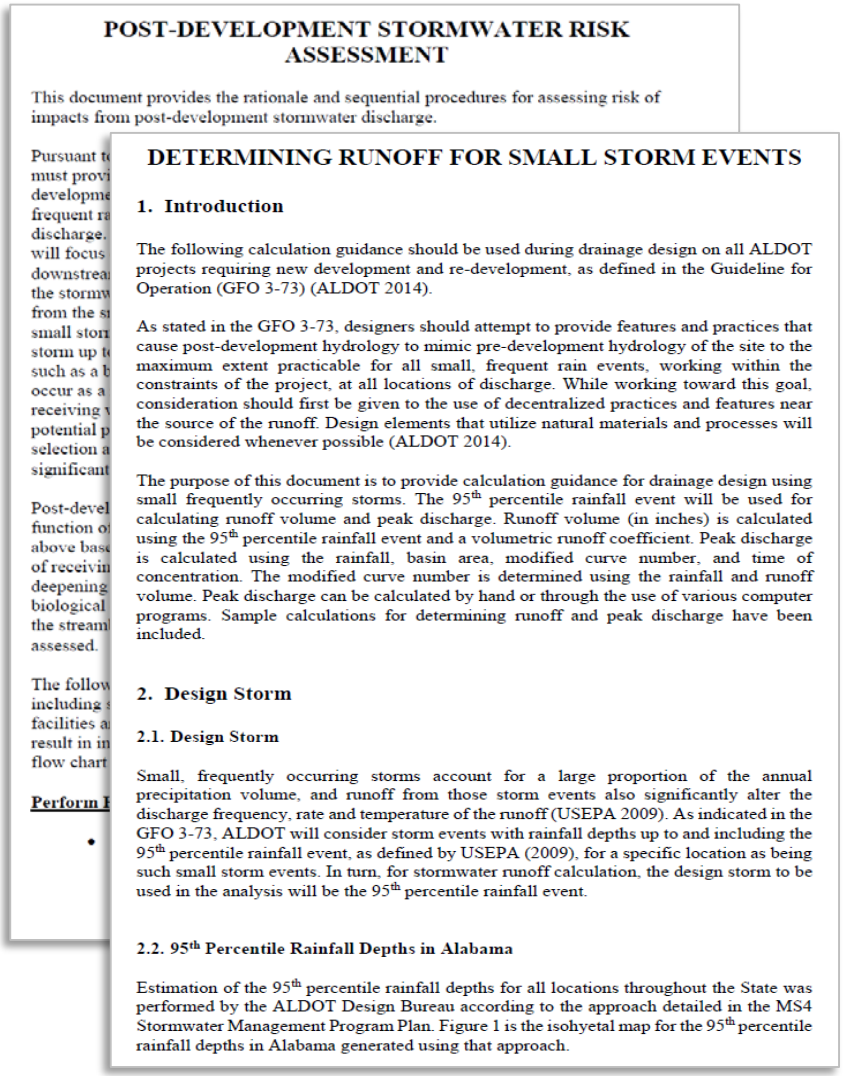
Post-Construction in the GDCP Process

- Key post-construction steps **early** in the GDCP process
  - Step **5.04**
    - Determination of overall project stormwater management requirements
    - Coordination with Design Bureau
    - Prior to Project Scope Development
  - Step **15.04**
    - Preliminary Drainage Design
  - Step **15.07**
    - Preliminary ROW requirements to accommodate GFO 3-73
    - Coordination with Design Bureau Stormwater Section
- Early action provides valuable time
  - Preparation to acquire ROW
  - Working around challenging site characteristics
  - Selecting & designing BMPs
    - Not yet "cookbook" – trial & error often needed



Post-Construction Design Guidance

- To estimate changes in peak flow & runoff volume due to development



POST-DEVELOPMENT STORMWATER RISK ASSESSMENT

This document provides the rationale and sequential procedures for assessing risk of impacts from post-development stormwater discharge.

DETERMINING RUNOFF FOR SMALL STORM EVENTS

1. Introduction

The following calculation guidance should be used during drainage design on all ALDOT projects requiring new development and re-development, as defined in the Guideline for Operation (GFO 3-73) (ALDOT 2014).

As stated in the GFO 3-73, designers should attempt to provide features and practices that cause post-development hydrology to mimic pre-development hydrology of the site to the maximum extent practicable for all small, frequent rain events, working within the constraints of the project, at all locations of discharge. While working toward this goal, consideration should first be given to the use of decentralized practices and features near the source of the runoff. Design elements that utilize natural materials and processes will be considered whenever possible (ALDOT 2014).

The purpose of this document is to provide calculation guidance for drainage design using small frequently occurring storms. The 95th percentile rainfall event will be used for calculating runoff volume and peak discharge. Runoff volume (in inches) is calculated using the 95th percentile rainfall event and a volumetric runoff coefficient. Peak discharge is calculated using the rainfall, basin area, modified curve number, and time of concentration. The modified curve number is determined using the rainfall and runoff volume. Peak discharge can be calculated by hand or through the use of various computer programs. Sample calculations for determining runoff and peak discharge have been included.

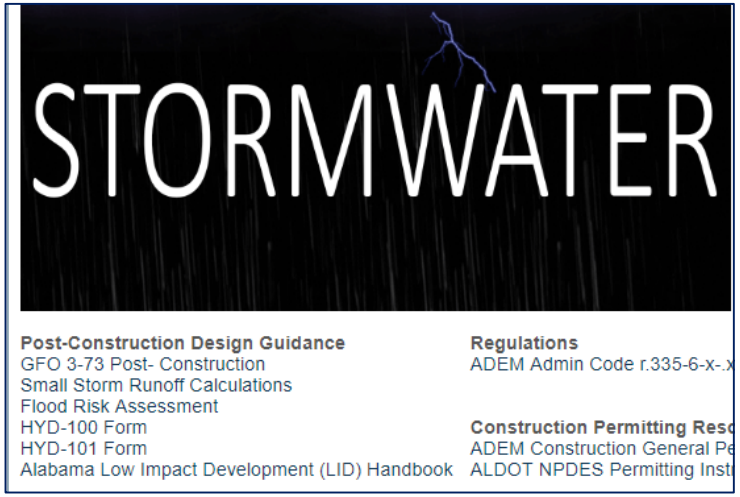
2. Design Storm

2.1. Design Storm

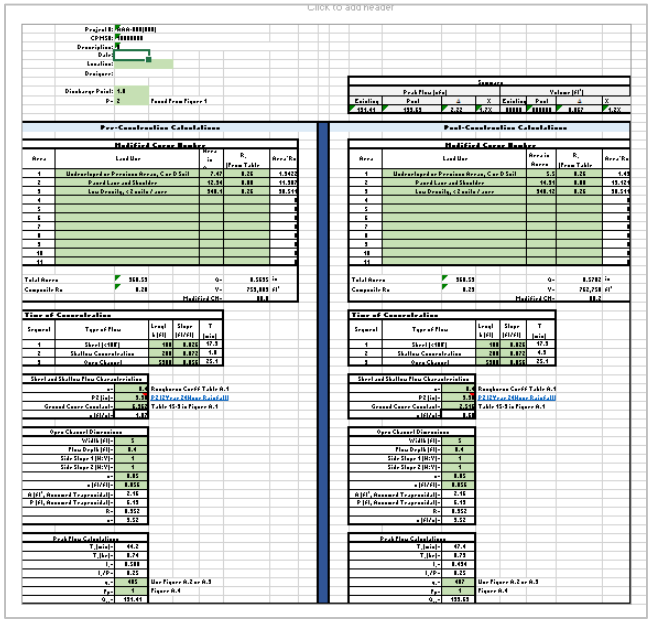
Small, frequently occurring storms account for a large proportion of the annual precipitation volume, and runoff from those storm events also significantly alter the discharge frequency, rate and temperature of the runoff (USEPA 2009). As indicated in the GFO 3-73, ALDOT will consider storm events with rainfall depths up to and including the 95th percentile rainfall event, as defined by USEPA (2009), for a specific location as being such small storm events. In turn, for stormwater runoff calculation, the design storm to be used in the analysis will be the 95th percentile rainfall event.

2.2. 95th Percentile Rainfall Depths in Alabama

Estimation of the 95th percentile rainfall depths for all locations throughout the State was performed by the ALDOT Design Bureau according to the approach detailed in the MS4 Stormwater Management Program Plan. Figure 1 is the isohyetal map for the 95th percentile rainfall depths in Alabama generated using that approach.

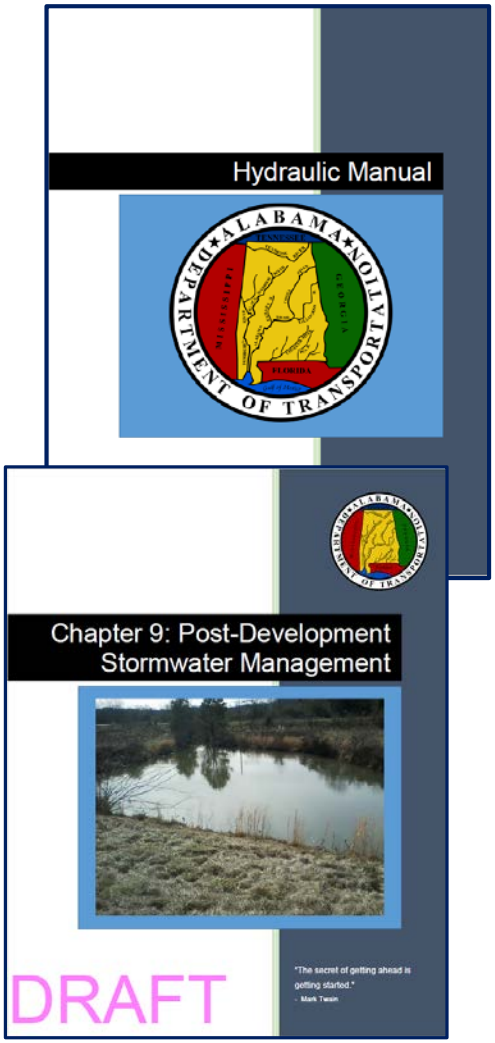


https://www.dot.state.al.us/dsweb/divped/stormwater/index.html



Post-Construction in the ALDOT Hydraulic Manual

- **Chapter 9** essentially consolidates
  - ALDOT post-construction policy (GFO 3-73)
  - "Determining Runoff for Small Storm Events"
- *For now*, manual recommends coordination with Stormwater Section for guidance on selecting specific BMPs
  - No prescriptive selection criteria
  - Case-by-case considerations
  - Ongoing trial & error



Common Post-Construction Practices

- Generally, most are <u>not</u> appropriate for ALDOT roadways


Bleyl Engineering


City of Atlanta


UC Arts & Society Group Three


Daily Hive


ASCE

DOT-Appropriate Post-Construction Practices

- Managing significant flow & volume quantities
  - "Traditional"
    - **Detention Basin (Dry Pond)**
    - Retention Basin (Wet Pond)
  - LID/GI
    - "**Infiltration Swale**"
    - Bioretention Cell

- "Supplemental" LID/GI practices
  - Level spreaders
  - Step pools
  - Vegetated filter strips
  - Grassed channels
  - Riparian buffers

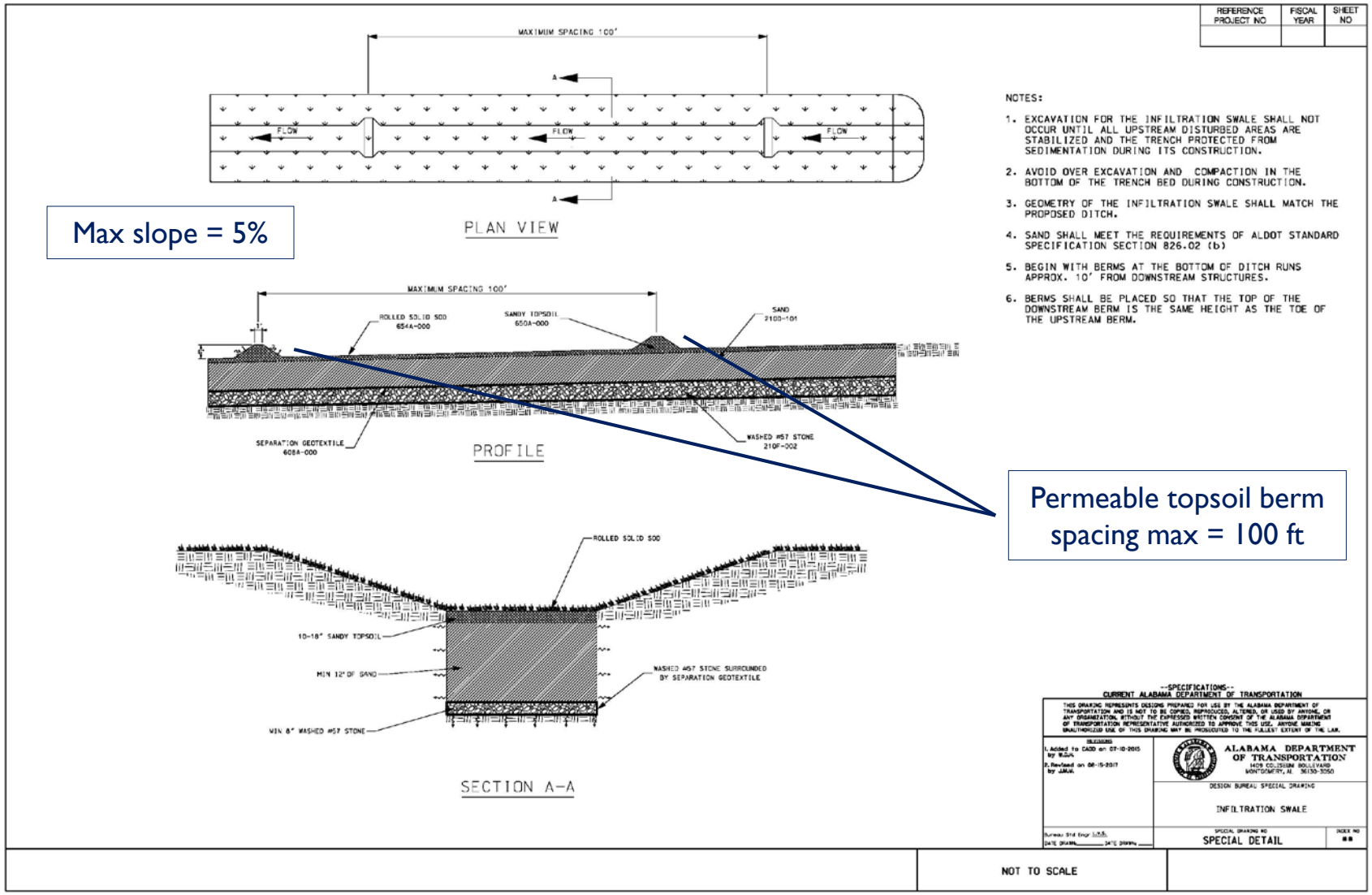
Optimal Post-Construction Practices for a DOT

- Specific DOT challenges to navigate
  - Linear roadway facilities
  - Limited ROW for placement of BMPs
  - Proximity of BMPs to travel lanes
  - Widespread network of roadways to maintain
- Preferences for a DOT post-construction BMP
  - Promote infiltration
  - Small footprint
  - Safe for motorists
  - Minimal maintenance requirements

More on the "Infiltration Swale"

- A vegetation-lined, "bottomless" ditch
- Adapted fundamentals from the *Alabama LID Handbook* to meet ALDOT needs
- Trial & error
  - Learning with each new project
  - No official special drawing yet
- Design Options
  - "Standard"
  - "Enhanced" (for slower infiltration rates)
  - Others being considered
- Key Considerations
  - Underlying soil permeability
  - Water table level
- In line with post-construction BMP preferences
  - But <u>detention basin</u> may be employed if more reasonable

Evolving Infiltration Swale Drawing

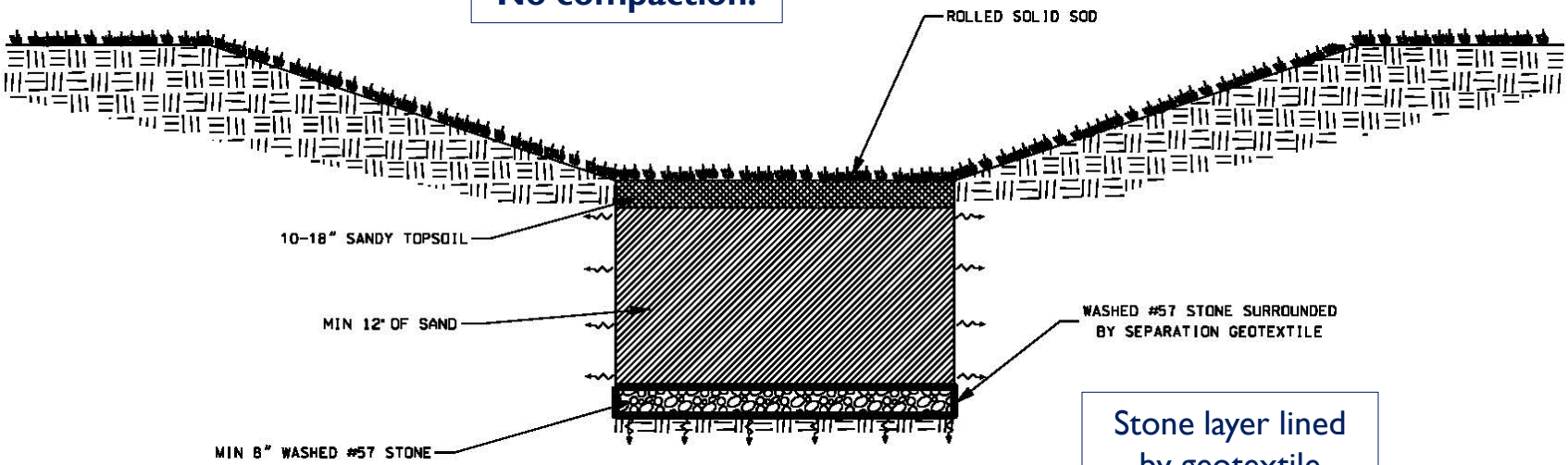


Max slope = 5%

Permeable topsoil berm spacing max = 100 ft

Infiltration Swale Cross-Section Closeup

No compaction!



Stone layer lined by geotextile

Scarify before placing media

Current Media Recommendations

- 10-18" sandy topsoil
- Min 12" sand
- Min 8" washed #57 stone

Depth < 5 ft
(OSHA worker safety regulation)

Width < 8 ft
(To keep mowers & other heavy equipment out – avoids compaction)

Answering the FAQs....

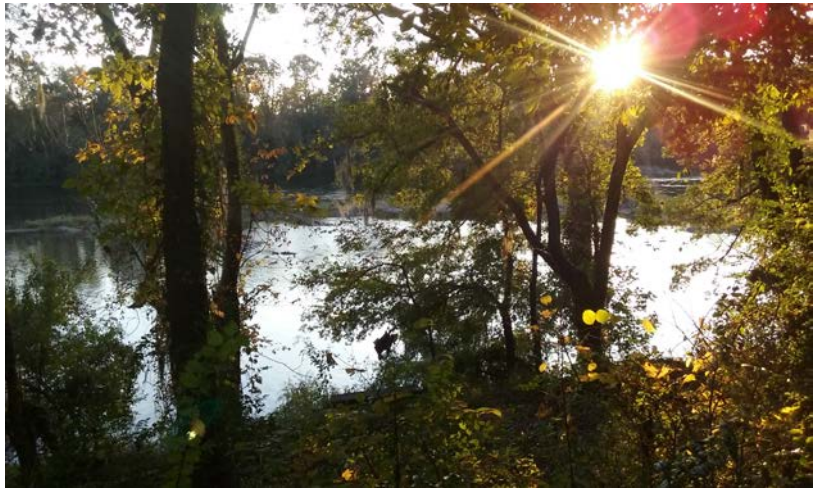
- What is post-construction stormwater management?
  - Employing practices intended for mimicking pre-development hydrology
- Why do we have to do it?
  - ADEM MS4 permit
  - ALDOT GFO 3-73
- What good does it do?
  - Attempts to offset the potential negative hydrologic impacts of development
- When do we have to do it?
  - In short, it should be considered when the addition of at least one thru-lane for travel is planned

Answering the FAQs....

- Where does it fit in the planning & design phase?
  - Consideration needs to begin as early as possible
  - The need to implement post-construction practices should be determined at GDCP Step 5.04 (prior to Project Scope Development)
- How do we perform necessary hydrologic analyses?
  - Follow ALDOT Hydraulic Manual (Chapter 9) to estimate changes in peak flow and runoff volume due to development
  - Guidance can also be found on the Stormwater Section Web page
- What analysis tools are available?
  - Environmental Coordination Section maintains an analysis spreadsheet

Answering the FAQs....

- What practices meet post-construction needs?
  - LID/GI practices are encouraged when reasonable
  - The "infiltration swale" is an LID/GI BMP that fits ALDOT preferences
  - If employing the infiltration swale is not reasonable, a detention basin may be considered
  - "Supplemental" LID/GI practices may also provide benefit
- Will post-construction stormwater management change in the future?
  - **Yes, of course!**
  - ALDOT's ongoing trial & error
  - New regulations
  - More research / better technology



Answering the FAQs about ALDOT Post-Construction Stormwater Management

Scott W. Rogers, PhD, PE, CPMSM
Environmental Coordination Engineer
Design Bureau
rogerssc@dot.state.al.us
https://www.dot.state.al.us/dsweb/divped/EnvironmentalCoordination/index.html

Acknowledgment:
Jason M. Masters, CFM