EVALUATING STORMWATER CONTROLS
FOR STORMWATER POLLUTION PREVENTION PLANS

W.C. Zech, Ph.D., W. N. Donald, Ph.D., M.A. Perez, X. Fang, Ph.D., R. A. Bugg, PE

Big Sky, MT
August 18, 2016
Wesley C. Zech, Ph.D.

AUBURN UNIVERSITY
Samuel Ginn College of Engineering
Research Motivation

**Triple Bottom Line Approach**

- **Reduce environmental impact**
  - 80 million T/yr of construction generated sediment
  - Water quality & aquatic ecosystem degradation

- **Social responsibility**
  - Endangering waterways, which may cause human harm

- **Economics**
  - Proactive (SWPPP investment) vs. reactive (mitigation & fines)
Storm Water Pollution Prevention Plans (SWPPPs)

A SWPPP is a site specific, written document that:

- Identifies potential sources of stormwater pollution at a construction site
- Describes procedures and practices to reduce pollutants in stormwater discharges from the construction site.
- Identifies procedures and practices the operator will implement to comply with the terms and conditions of a construction general permit.
Provide a scientific understanding of erosion and sediment control (E&SC) practices used in construction to minimize impacts to the surrounding environment through performance based, large-scale testing.
Conduct third-party, independent, performance-based testing to evaluate manufactured devices/practices
Use knowledge learned to provide training to practitioners in proper design, installation, maintenance, and inspection of E&SC practices.
Runoff Control Practices

Used to control and convey stormwater flows, reduce flow velocities, and facilitate the settlement of suspended soil particles
Evaluation of Ditch Check Practices Using Large-Scale Testing Techniques
Ditch Checks:

Small barrier | dam constructed in a swale subjected to concentrated flow
Purpose: impound water by flattening the gradient of flow and slowing velocity.
**Ditch Check Channel Setup**

- 3:1 wing walls
- 4 ft bottom width
- 13 ft top width
- 1.5 ft depth
ALDOT’s (OLD) STANDARD INSTALLATION – 20 IN. WATTLE
ALDOT’s (OLD) STANDARD INSTALLATION – 20 IN. WATTLE

PERFORMANCE
- Stakes pierce wattle
- Undermined
- Ponding Depth 1.24 ft
- Ponding length: 10 ft
- Never overtopped
MODIFIED INSTALLATION – 20 IN. WATTLE
MODIFIED INSTALLATION – 20 IN. WATTLE
RIP RAP INSTALLATION – NO CHOKER
Test flow rate: 1.7 cfs
RIP RAP INSTALLATION – 8 OZ. FF CHOKER

Flow Rate @ 1.7 cfs
MODIFIED SAND BAG INSTALLATION

Middle Row Is

Rotated 90

○

Additional Bags

Provide Structural Support
MODIFIED SILT FENCE INSTALLATION

UPSTREAM VIEW

DOWNSTREAM VIEW

Pinned Installation

Weir

Splash pad
Effective Ditch Check Designs

- Underlay increases wattle impoundment performance by 80%.
- Choking pore passages of riprap increase impoundment by 100%.
- Sandbag installation modification increase flow capacity from 0.56 to 1.68 cfs.
- Silt fence pinned installation is a plausible option.
- TnDOT silt fence installation performance adequately.
Evaluation of Inlet Protection Practices (IPPs) Using Large-Scale Testing Techniques
IPP

Failure Modes

- Short-circuiting
- Bypass & restriction
- Undermining
- Structural failure
- Improper installation
- Downstream impacts
INSTALLATION PARAMETERS

- Four 20 in. by 10 ft wattles
- 11 ft inside diameter
- 18 in. staking depth / 2 ft spacing
- 12 in. wattle connections
ALDOT STANDARD INSTALL – SEDIMENT DEPOSITION

PERFORMANCE
- Buoyancy / poor anchoring
- Significant undercutting
- No impoundment
- Downstream sediment deposition
- Non-destructive tee-pee staking
- 18 total stakes
- 12 in. staking depth / 4 ft spacing
- Wattle perimeter stapling
WATTLE BARRIER MFE-I – MAX. IMPOUNDMENT

PERFORMANCE
- Ponding Depth: 1.10 ft
- Ponding Length: 10.4 ft
- Dewatering: 9.0 min
- Sediment Retention: ~70%
WATTLE BARRIER MFE-I – DEPOSITION

**IMPROVEMENTS**

- Underlay and staples reduced undercutting
- Resultant impoundment prevented erosion
SILT FENCE BARRIER – TYPICAL INSTALLATION

INSTALLATION PARAMETERS

- 6.8 ft post spacing (10 ft max.)
- 6 x 6 in. trenching
- 32 in. fence height + wire backing
- 24 in. wire lap, 12 in. fabric lap
SILT FENCE BARRIER – TYPICAL INSTALLATION
SILT FENCE BARRIER – PINNING TECHNIQUE
SILT FENCE BARRIER MFE-I – REINFORCED T-POST
PERFORMANCE

- Ponding Depth: 2.3 ft
- Ponding Length: 31 ft
- Dewatering Time: 90 minutes
- Sediment Retention: ~90%
INSTALLATION PARAMETERS

- 3 rows of sand filled Bags
- 8 ft diameter / 125 bags total
PERFORMANCE

- Bag dislodgment: 13 min
- Catastrophic failure
- Undercutting
- Dewatering: 6.0 min
SAND BAG BARRIER MFE-I – ROTATED CONFIGURATION

INSTALLATION PARAMETERS

- 3 rows of sand filled bags
- 6 ft diameter / 84 bags total
- Rotated middle row
- Geotextile underlay
PERFORMANCE

- Ponding Depth: 1.08 ft
- Ponding Length: 14.5 ft
- Dewatering: 120 min
- Sediment Retention: ~71%
SAND BAG BARRIER MFE-I – DEPOSITION
Effective IPP Designs

- Structural Reinforcement
  - Adequate Staking, Bracing

- Provide for Overtopping
  - Dedicated Spillways, Weirs

- Prevent Undercutting
  - Stapling, Underlay, Material Pinning

- Efficient Dewatering Mechanism
  - Minimize Flood Hazard
Evaluation of Sediment Barriers (SBs) Using Large-Scale Testing Techniques
TEST APPARATUS DESIGN FEATURES

- Water/Sediment Mixing System
- Impervious Slope
- Earthen Test Area
- Collection Tank
- Diversion Vanes
- Access Doors
Training & Outreach

- Training events
  - class & field components

- Attendees
  - designers, contractors, inspectors, installers, & regulators

- IPP education
  - installation & test demos
This research is sponsored by the Alabama Department of Transportation. The support provided is gratefully acknowledged.