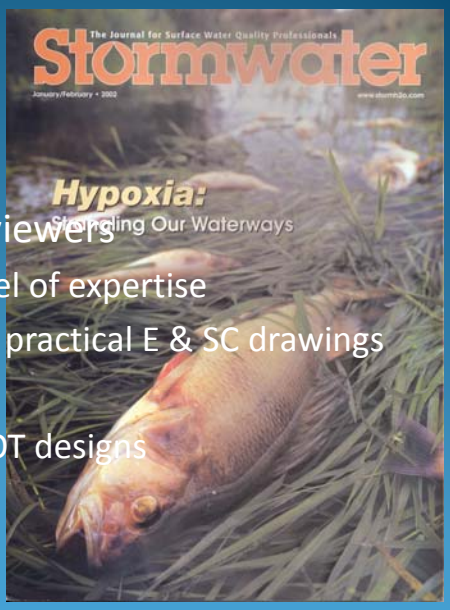
State of Florida

Erosion and Sediment Control Designer & Reviewer Manual

What is it?

- A statewide, collaborative effort
  - DEP, WMDs, USGS, FDOT
- Direction for designing and reviewing effective Stormwater Pollution Prevention Plans (SWPPP)
- A storehouse of guidance on E & SC tools

Why Should I Care?



- Assists designers and reviewers
  - Presents a consistent level of expertise
  - Provides meaningful and practical E & SC drawings
  - "Toolbox" of latest BMPs
  - Clear expectations for DOT designs

Do I Have to Use It?

- State (ERP) and Federal (NPDES) permits:
  - Must use BMPs to prevent the downstream discharge of sediment and turbid water
- FDEP and FDOT:
  - Manual is <u>the</u> source for BMPs in both permits.

What's In It?

- Five separate sections covering different aspects of the Stormwater Pollution Prevention and Erosion Control Plans.
- Five appendices that cover specific scenarios and provide inspection forms and typical detail examples.

What's In It?

- Section I – General Information
- Section II - Developing Effective SWPPPs and E&SC Drawings
- Section III – Erosion Control Methods
- Section IV – Sediment Containment Systems
- Section V – Temporary Construction Site BMPs

What's in it?

- Most current BMPs and methods
  - Selection – when to use / when NOT to use
  - Maintenance – when and how often
  - Installation - typical details
- For example…

Rolled Erosion Control Products

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Rolled Erosion Control Product for a Drainage Channel

WHAT IS ITS PURPOSE?

To protect a drainage channel against erosion due to flowing water.

WHERE AND HOW IS IT COMMONLY USED?

- In drainage channels where vegetation needs to be established and significant flows occur.

WHEN SHOULD IT BE INSTALLED?

- While construction activities are occurring.
- After Grading activities are finished.

WHEN SHOULD IT NOT BE INSTALLED?

- Over impervious surfaces.
- On very rough ground.

WHAT NEEDS TO BE INSPECTED?

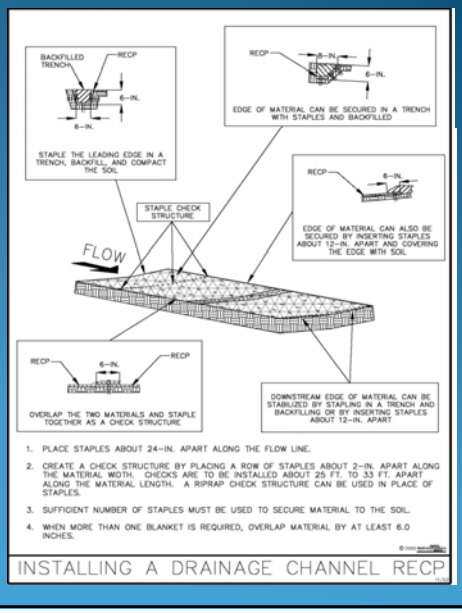
- Does the RECP display any damage?
- Was the channel bed smooth when the RECP was installed?
- Have check structures (staple or trench) been installed?
- Is water flowing under the blanket and causing erosion?
- Are sufficient numbers of staples used?
- Is the correct material used?
- Was seed planted before installing the RECP?
- Should straw mulch be used?

WHAT MAINTAINENCE ACTIVITIES CAN BE EXPECTED?

- Repair and replacement of material.
- Repair of eroded ground.

NOTES

- Erosion Control Blankets (ECBs) are composed of natural material including straw, straw-coconut, coconut (or coir), wood excelsior, and so forth. They must be held in place with netting sewn on both sides of the material.
- One type of Turf Reinforcement Mats (TRMs) is composed of 100% polypropylene or nylon and held in place with netting sewn on both sides of the material.
- Another type of TRM is composed of straw-coconut or coconut matter reinforced with strands of polypropylene threads and all held in place with netting sewn on both sides of the material.
- Designers must complete shear stress and velocity calculations in selecting an ECB or TRM for drainage channels.
- Additional information about ECBs and TRMs can be found at www.ectc.org.



Slope Drains

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Slope Drain for Small Basins

WHAT IS ITS PURPOSE?

To protect hillside surfaces against erosion due to concentrated flows of runoff waters.

WHERE AND HOW IS IT COMMONLY USED?

- On fill slopes.
- On cut slopes.

WHEN SHOULD IT BE INSTALLED?

- While construction activities are occurring.
- After Grading activities are finished.

WHEN SHOULD IT NOT BE INSTALLED?

- When contributory basins are large (usually greater than five acres).

WHAT NEEDS TO BE INSPECTED?

- Are there areas where the earthen berm has been breached?
- Is water discharging onto an embankment?
- Is there protection (i.e. riprap) at the end of the slope drain?
- Is water flowing around the slope drainpipe?
- Is the pipe secured to the hillside?

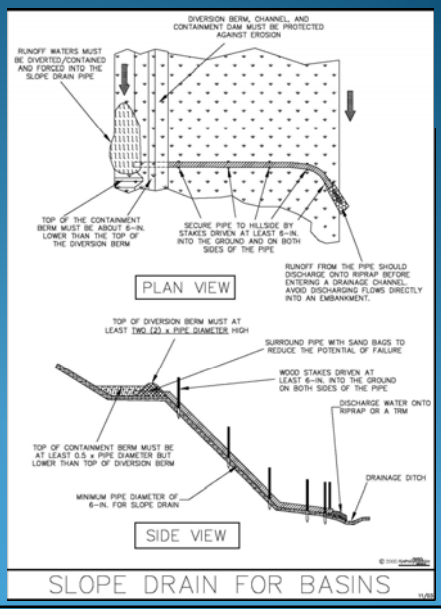
WHAT MAINTAINENCE ACTIVITIES CAN BE EXPECTED?

- Repair or replacement of slope drain.
- Repair breached sections of earthen berm.
- Replacement of riprap.

EQUATION USED TO CALCULATE PIPE DIAMETER:

$$D = 4.29 \times Q^{0.50} = 4.29 \times (CiA)^{0.50}$$

Where D = Pipe diameter (inches)
Q = Peak flood flow for the design storm event (cfs)
C = Runoff coefficient
i = Rainfall intensity (inches/hour)
A = Contributing area (acres)



Sediment Containment Systems

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Sediment Containment System Double Chamber

WHAT IS ITS PURPOSE?

To cause the deposition of large diameter suspended particles in runoff waters from small contributory basins.

WHERE AND HOW IS IT COMMONLY USED?

- On construction sites.
- Areas where limited space exists for a sediment containment system.
- Low point of small drainage basins.
- Where capture of larger size particles found in runoff waters is required.

WHEN SHOULD IT BE INSTALLED?

- Before construction activities begin.
- While construction activities are occurring.
- To treat waters being pumped from behind cofferdams and for dewatering activities.

WHEN SHOULD IT NOT BE INSTALLED?

- After grading activities are finished.
- As the only method to capture suspended particles without some type of chemical treatment.

WHAT NEEDS TO BE INSPECTED?

- How much sediment is in the chamber?
- Will the structure capture runoff?
- Should the riprap outlet structure be wider?
- Will runoff flow over the riprap outlet structure?
- Are the lengths and widths correct as calculated by the Designer?
- Is the inflow higher than the outflow?

WHAT MAINTAINENCE ACTIVITIES CAN BE EXPECTED?

- Removal of sediment.
- Repair of destroyed embankments.
- Repair of destroyed riprap.
- Ensure establishment of vegetation occurs on all embankments.

Notes

- The length parameter is to be reduced by 50% (i.e., L_{final} = ½ x Length) as calculated by the Designer from equations found in the pre-sedimentation basin section.
- Develop the outlet structure so that it is able to safely convey flood flows for design storm events.

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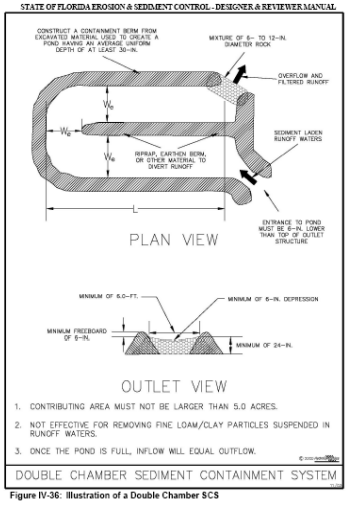

Figure IV-36: Illustration of a Double Chamber SCS

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IV-25

Inlet Protection Devices

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Frame & Filter Barrier for Area Drain (a.k.a. Drop, Catch Basin, or Ditch Bottom) Inlets

WHAT IS ITS PURPOSE?

Temporary barriers to cause waters to pond and drain so that sediment can settle out of runoff waters while construction activities occur.

WHERE AND HOW IS IT COMMONLY USED?

- Around median inlets.
- Around inlets to which runoff flows.

WHEN SHOULD IT BE INSTALLED?

- While construction activities are occurring.
- Only where "sump" conditions exist.

WHEN SHOULD IT NOT BE INSTALLED?

- After construction activities are completed.
- Where "sump" conditions do not exist.
- In locations that could lead to potential flooding such as encroachment on travel lanes of a roadway.

WHAT NEEDS TO BE INSPECTED?

- Has the unit been placed over the grate?
- Is there sufficient soil or gravel to seal the cover?
- Does accumulated sediment cover 2/3 of the filter barrier height?
- Does it appear that runoff is flowing under the fabric material?
- Do "sump" conditions exist?
- Is the fabric material torn?
- Is the frame still supporting the fabric material?
- Does runoff drain through the fabric material?

WHAT MAINTAINENCE ACTIVITIES CAN BE EXPECTED?

- Repair and replacement of gravel in the pocket.
- Replacement of fabric material.
- Removal of sediment around the unit.

NOTES

- These barriers are to be installed in "sump" conditions only. If placed in front of inlets on a grade, runoff will be diverted to downstream locations and could cause flooding.
- It is critical that a good seal exist between the ground and fabric material using adequate amounts of soil or gravel.
- Multiple types of filter media are available for this system. The correct type of filter fabric should be chosen that considers both safety and environmental concerns.

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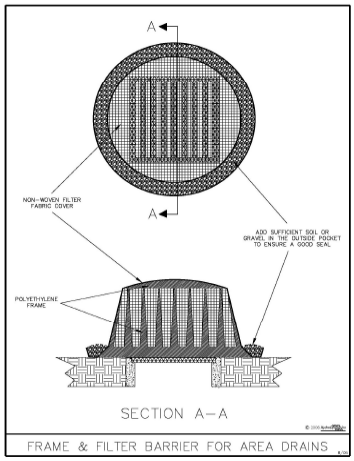

Figure V-47: Illustration of a Frame & Filter Barrier for Area Drains

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V-21

What's in it?

- Appendix I – Coastal Applications
- Appendix II – Dewatering
- Appendix III – Polymers and Alum
- Appendix IV – Inspection Forms
- Appendix V – Big Box/Highway E&SC Plan typical details

Coastal Applications

- Construction sites in a coastal environment present unique challenges because of the direct link to sensitive water bodies and the limited available area to implement erosion and sediment control practices.

- This Appendix presents technologies available to designers, hydrologists, and construction personnel for mitigating erosion and sedimentation in coastal areas of Florida.

Coastal Applications

The information provided for each technology includes:

- A description of the technology.
- The general purpose(s) of the technology.
- Considerations for implementation of the technology in coastal areas.
- When the technology should be installed.
- Where and when the technology should *not be installed.*
- Inspection and maintenance needs

Coastal Applications

Establishing Permanent, Salt-Tolerant Vegetation

-- Establishing permanent vegetation through seeding, sodding, or transfer of adult plants that are tolerant to low-nutrient mineral soils and saline moisture. Common seed types used in Florida are bahia, bermuda, bahia/bermuda mix, and annual type ryegrass. Additional seed types that are being tested by the Natural Resource Conservation Service for temporary or permanent stabilization of soil in construction areas and soon may be available for use are eastern gamagrass, lopsided indiangrass, chalky bluestem, hairawn muhly, switchgrass, and wiregrass (NRCS, 2006). Common sod types used in (but not native to) Florida are centipede, bahia, and bermuda sod. --

WHAT IS ITS PURPOSE?

- To protect exposed soil from wind and raindrop impact.
- To provide a long-term, aesthetically pleasing, natural erosion-resistant environment during or after construction activities.

WHERE AND HOW IS IT COMMONLY USED IN COASTAL AREAS?

- Seeds that are tolerant to salt water and salt-laden moisture should be selected. In addition, chosen plants should be able to grow quickly in mineral soils with few nutrients.
- This section serves only as a guide. Consultation with an agronomist or landscape architect who is familiar with the area is highly recommended prior to selecting an appropriate plant species. Likewise, the bulk availability of the plant should be verified through the Association of Florida Native Nurseries via their website: www.afnn.org.
- In addition to the grass types listed in the description above, plant species that are native to Florida and are able to grow well in low- to high-salt environments are listed in **Table 2**.
  - Plants that are considered to have **"good"** salt tolerance are very resistant to salt drift and moisture and should be selected for highly exposed environments.
  - Plants that are considered to have **"moderate"** salt tolerance are resistant to some salt drift and moisture but should be protected by structures, fences, or more salt-tolerant plant species.
  - The geographical range in Florida is indicated by: **n** = north, **c** = central, **s** = south.
- Plant seeds can be applied by hand or hydroseeder.
- For most effective coverage, exposed soil surface should be loose (uncompacted) at time of application. Soil areas can be roughened by rolling the surface with a crimping or punching-type roller or by track walking to increase the soil surface area available for seeding.
- For best results, cover seeds or plants with a light, coarse mulch layer to keep applied seeds in place, to retain soil moisture, and to control soil temperature during seed establishment. Follow guidelines for selection and application rates for mulch under "Hydraulic Mulch" in this Appendix.
- The application of a soil binder may be necessary to stabilize hydraulic mulch and seed to allow for germination and continued growth of vegetation. Follow guidelines for binder selection and application rates under "Soil Binders" in this Appendix.
- Due to the lack of nutrients in most coastal soils, seeding may need to be used in conjunction with another control measure, such as the application of mulch and fertilizer, in order for the seeds to take hold and become effective in reducing erosion.
- Fertilizers should be used only when soil tests indicate a lack of adequate nutrients to establish and sustain the selected vegetation.
- Another method of rapid soil stabilization while allowing native plant species to develop is to lay sod along the exposed soil area and plant small, native plants by hand within small perforations of the sod. The native plants eventually over-grow and out-compete the surrounding sod for available nutrients.

Table 2. Salt-Tolerant Native Plant Species in Florida (Source: David Chiappini, 2006)

Common name	Scientific name	Area of Florida	Relative salt tolerance
Youpon Holly	Ilex vomitoria	n, c, s	good
Southern Red Cedar	Juniperus silicicola	n, c, s	good
Wax Myrtle	Myrica cerifera	n, c, s	good
Sand Pine	Pinus clausa	n, c	good
Live Oak	Quercus virginiana	n, c, s	good
Sand Live Oak	Quercus geminata	n, c, s	good
Dahoon Holly	Ilex cassine	n, c, s	moderate
Southern Magnolia	Magnolia grandiflora	n, c, s	moderate
Florida Red Bay	Persea borbonia	n, c	moderate
Slash Pine	Pinus elliottii	n, c, s	moderate
Sycamore	Platanus occidentalis	n, c	moderate
Chickasaw Plum	Prunus angustifolia	n, c	moderate
Cherry Laurel	Prunus carliniana	n, c	moderate
Laurel Oak	Quercus laurifolia	n, c, s	moderate
Water Oak	Quercus nigra	n, c	moderate
Bald Cypress	Taxodium distichum	n, c, s	moderate
Christmas Berry	Lycium carolinianum	n, c, s	good
Cabbage Palm	Sabal palmetto	n, c, s	good
Saw Palmetto	Serenoa repens	n, c, s	good
Spanish Bayonet	Yucca aloifolia	n, c, s	good
Adams Needle	Yucca filamentosa	n, c, s	good
Gallberry	Ilex glabra	n, c, s	moderate
Paurotis Palm	Acoelorrhaphe wrightii	c, s	moderate
Groundseltree	Baccharis halimifolia	c, s	good
Devil's Backbone	Pedilanthus tithymaloides	c, s	moderate
Dune Sunflower	Helianthus debilis	n, c, s	good
Beach Morning Glory	Ipomoea pes-caprae	n, c, s	good
Virginia Creeper	Parthenocissus quinquefolia	n, c, s	good
Purslane	Portulaca sp	n, c, s	good
Sea Oats	Uniola paniculata	n, c, s	good
Coontie	Zamia pumila	n, c, s	good
Seaside Paspalum	Paspalum vaginatum	n, c, s	good
Blanket Flower	Gaillardia pulchella	n, c	moderate
Mahogany	Swietenia mahogani	s	good
Pigeon Plum	Coccoloba diversifolia	s	good
Satin Leaf	Chrysophyllum	s	good

Coastal Applications

Construction Site Barrier

-- Installing a permanent barrier at the soil/water interface to protect construction area from erosion and to limit sediment transfer to adjacent water body. Types of barriers include sheet piles, concrete walls, or earthen dikes. --

WHAT IS ITS PURPOSE?

- To protect construction area from erosion due to waves, tides, and runoff.
- To limit sediment leaving a construction site and transfer to an adjacent water body.

WHERE AND HOW IS IT COMMONLY USED IN COASTAL AREAS?

- Barriers should be designed to provide protection over the full range of tidal fluctuations and a reasonable design storm surge.
- A temporary barrier may be placed while the permanent barrier is installed landward of the temporary barrier.
- Installation of barrier is specific to type of barrier.

WHEN SHOULD IT BE INSTALLED?

- Before construction activities begin.
- While construction activities are occurring.

WHERE AND WHEN SHOULD IT NOT BE INSTALLED?

- In areas where coastal wildlife habitat must not be disturbed.
- In areas where the maintenance of landscape aesthetics is a priority.

WHAT NEEDS TO BE INSPECTED?

- Inspect area periodically during construction for any breach in barrier, particularly any breaches or openings that allow passage of water and subsequent erosion and/or transfer of sediment from construction site to water body.

WHAT MAINTENANCE ACTIVITIES CAN BE EXPECTED?

- Maintain and re-construct barriers as needed.

Notes

- Area available for construction activities may be limited after placement of barrier.
- Installation of barriers may be equipment- and labor-intensive.
- Development of a plan using this method may require the professional skills of a structural engineer.

Coastal construction along US Hwy 1, Key West, FL
(Source: James Smoot, 2006)

Coastal Applications

Design Example

A designer on a coastal construction project needs to determine the expected range of tide elevations at the site over the period of construction—June 15 – September 30, 2007—to correctly locate and design a construction site barrier. The construction site is near Naples, FL.

The designer visits the National Oceanic and Atmospheric Administration (NOAA) website:

http://tidesandcurrents.noaa.gov/station_retrieve.shtml?type=Historic+Tide+Data

The designer selects a nearby tidal station by scrolling through the list of stations on the website. Once the station is selected, actual tidal data from the previous 2 days can be viewed. To pull predicted values for tide elevations for the period of construction, the designer selects the "Tide Predictions" tab on the left side of the screen (see screen capture). The designer selects the dates of the planned period of construction and can view a graphical or tabular summary of hourly tide elevations for that period.

From the predicted data for the construction period, the expected maximum high tide elevation is 3.60 feet above mean low-low water elevation. The expected minimum low tide elevation is 1.00 foot below mean low-low water elevation. Therefore, there is an expected tide range of 4.60 feet during the construction period.

The designer can specify the height of the barrier so that it rises well above the expected maximum high tide elevation to protect the construction site from erosion from waves and tides.

Another NOAA web resource for current and historical data from tidal monitoring sites is as follows: http://tidesonline.nos.noaa.gov/geographic.html

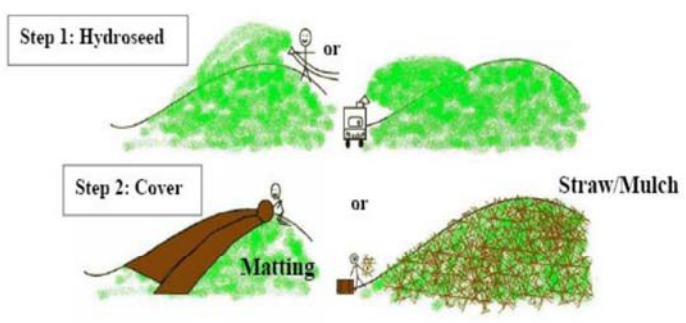
Polyacrylamides (PAM)

- Water-soluble anionic polymers
- Used ….
  - to minimize soil erosion
  - to decrease loss by binding soil particles, especially clays
  - as a water treatment additive to remove suspended particles from runoff.

Polyacrylamides (PAM)

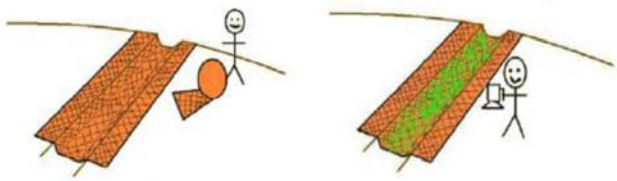
- In use in other industries
  - still considered an "emerging technology"
- Agencies involved in this Manual recognize the potential of PAMs for preventing erosion and controlling sedimentation

From the simple…..



Limitations: Soil Samples must be tested for effectiveness so that a performance based criteria is implemented. Other limitations include slope steepness, type of clay (solubility, swelling characteristics, etc.)

Polyacrylamide Application

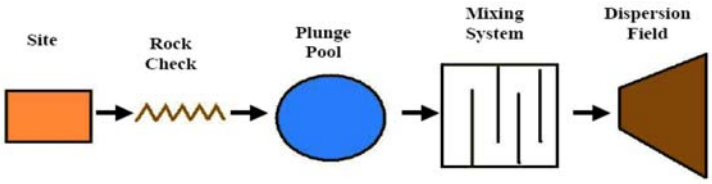


Step 1: Matting

Step 2: Apply powder

Limitations: Soil Samples must be tested for effectiveness so that a performance based criteria is implemented. Other limitations include slope steepness, type of clay (solubility, swelling characteristics, etc.)

To the not so simple!!



Polyacrylamide Enhanced Water Treatment Systems

Was This Manual Necessary?

Yes!

Practices have not kept pace with developments

- Wrong BMPs used – hay bales and silt fence
- New BMPs not being used
- PAM
- "Cookie cutter projects"

What is FDOT Doing Now?

Erosion and Sediment Control Task Team

- Design, Drainage, Construction, Specifications, Estimates, Environmental Management
- Crafting New Specification
- Training for the Manual

Developmental Section 104 Specification

- References the Manual as the source for erosion prevention and sediment control materials and methods for contractors.
- Requires the contractor to develop their own site specific sediment and erosion control plan as part of the SWPPP.
- Establishes performance standards for the design, implementation and maintenance of the contractor's plan.

Developmental Section 104 Specification

- The contractor has to be involved in a site specific E&SC plan since they know how they want to build the job.
- End job site "discussions" over design versus implementation in the event of a failure
- Provide the contracting industry with the best "toolbox" of materials and methods available to erosion and sediment control

Proposed Training Course

- Developed by the UCF Stormwater Management Academy in conjunction with
  - HydroDynamics Inc.
  - Applied Polymer Systems
- Course will consist of three days of instruction centered on problem solving followed by a comprehensive final exam.
- Tentatively, will be taught at UCF.

Research

Dr. Marty Wanielista

Dr. Manoj Chopra

UCF Stormwater Academy

- Rainfall Simulator
- Future Manual Updates
- PAM Toxicity Testing Standards
- Performance and Index Testing of BMPs

DOT Direction

- Use Manual on Design / build Projects
- Future: Require Manual on All Projects
  - Specs and training needed first
- Contractor-driven E & SC Plans
- NO MORE FINES FROM FDEP

DESIGNERS….

WE WANT YOU!!

To Check Out This Manual!!

http://www.stormwater.ucf.edu/

Questions or Comments?

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