NAME:

Erosion & Sediment Control Training

September 10-12, 2012

Tumon, Guam

Guam Erosion and Sediment Control (ESC) Training for Contractors, Designers, and Site Inspectors

September 10-12, 2012

Agenda

Monday, Sept. 10th

Participants will be given a copy of the 2012 Guam ESC Field Guide and a workshop notebook.

8:00-8:30 **Registration**

8:30-8:45 **Welcome and Introductions**

8:45-9:15 **Why ESC Matters**
What are the economic and environmental impacts of sediment loss from construction activities and why should contractors, engineers, and agency staff care about good ESC implementation?

9:15-9:45 **Regulatory Compliance**
What are the territorial and federal requirements for ESC during new development, redevelopment, and military construction activities?

BREAK

10:00-12:00 **ESC Practices: Part 1**
Introduction to non-structural practices to avoid erosion and sedimentation during construction, as well as temporary sediment barriers; diversions and conveyance structures; settling devices; temporary stabilization techniques, and inlet/outlet protection.

LUNCH *Provided*

1:00-3:00 **ESC Practices: Part 2**
A continuation from the previous session.

BREAK

3:15-4:45 **Erosion Control Plans** (CONCURRENT Sessions)

Reading an ESC Plan Activity (installers and inspectors)
In small groups, evaluate an ESC plan, identify practices on the plan, follow construction sequencing, and translate installation details.

ESC Plan Design Activity (designers and plan reviewers)
In small groups, evaluate and complete the design of an ESC plan for a proposed development site.

4:45-5:00 **Instructions for Day 2**

You must bring your own hard hat, safety vest, and boots to go on the field trip.

Tuesday, Sept. 11th

8:00-12:00 **Field Demonstrations and Construction Site Visits**
Break into groups, review site plans and instructions for day's activities. Travel to field locations to see how ESC practices are being installed and maintained.

LUNCH Provided

1:00-2:00 **Inspecting and Maintaining Practices through Project Closeout**
Discuss findings from field trip. Review inspection and maintenance procedures for construction activities and how to properly transition from temporary ESC practices to permanent stormwater management.

2:00-3:00 **Top 10 tips for improved compliance on Guam**
In small groups, brainstorm ideas for how to improve ESC implementation; report back to full group.

BREAK

3:15-4:00 **Certification Exam Review**
In small groups, brainstorm ideas for how to improve ESC implementation; report back to full group.

4:00-5:00 **Certification Exam (optional)** ***The exam is open book. There are two options for when you can take the exam.***

Wednesday, Sept. 12th

8:00-9:00 **Certification Exam (alternative time)**

10:00-12:00 **Guam ESC Program: Inter-Agency Work Session (Agency Staff)**

10:00-10:30	ESC Program Elements
10:30-11:00	Recommendations & Debrief from Day 2 Training
11:00-12:00	Facilitated group discussion on program recommendations

WORKSHOP EVALUATION FORM

Thank you for attending the Erosion and Sediment Control Training. We would like to get your feedback on the program and ways to improve it in the future. Please take a moment of your time to fill out the following evaluation form.

CLASSROOM TRAINING

How would you rate the classroom training portion of the workshop? (circle number)

1=Poor 2=Fair 3=Adequate 4=Good 5=Excellent

Comments: _____

READING AN ESC PLAN EXERCISE or DESIGNING AN ESC PLAN EXERCISE (circle one)

How would you rate the group plan exercise?

1=Poor 2=Fair 3=Adequate 4=Good 5=Excellent

Comments: _____

FIELD DEMONSTRATIONS

How would you rate the usefulness of the hands-on field activities?

1=Poor 2=Fair 3=Adequate 4=Good 5=Excellent

Comments: _____

LOGISTICS

Venue – The workshop was held at the *Marriott*. How well did it meet the needs of the training?

1=Poor 2=Fair 3=Adequate 4=Good 5=Excellent

Comments: _____

EXAM

How would you rate the difficulty of the exam? How well do you think it reflected the training program?

1=Poor 2=Fair 3=Adequate 4=Good 5=Excellent

Comments: _____

PROGRAM

Time – How satisfied were you with the length of the workshop?

1=Poor 2=Fair 3=Adequate 4=Good 5=Excellent

Comments: _____

MATERIALS

How satisfied were you with the field guide and training handouts?

1=Poor 2=Fair 3=Adequate 4=Good 5=Excellent

Comments: _____

OVERALL WORKSHOP

How satisfied were you of the overall workshop?

1=Poor 2=Fair 3=Adequate 4=Good 5=Excellent

Comments: _____

What is the likelihood that you would attend a future workshop on a similar or related topic?

1=Poor 2=Fair 3=Adequate 4=Good 5=Excellent

Comments: _____

GENERAL QUESTIONS

How do you plan to apply your training to your work?

Are there any additional Erosion Control Practices you would like more information on?

If you have additional suggestions for improving future workshops, please state them here:

Thank you for your time and your feedback.

Guam Erosion and Sediment Control Training

Additional Resources

Reference Materials

- Guam Soil Erosion and Sediment Control Regulation (22GAR-2 Chapter 10) and associated permits
- 2006 CNMI/Guam Stormwater Management Manual www.deq.gov.mp/article.aspx?secID=6&artID=55
- 2011 Transportation Stormwater Design Manual
- 2012 Guam Erosion and Sediment Control Field Guide Version 1.0 for Contractors and Inspectors
- 2010 NRCS Pacific Island Vegetation Guide ftp://ftp-fc.sc.egov.usda.gov/HI/pub/pmc/1_PI_Veg_Guide_Text_Revised_Apr_23_2010.pdf
- NRCS Brochure – Vetiver Grass: The Grass that can protect your land from soil erosion.
- Link to US EPA NPDES Phase II Stormwater Discharges from Construction Sites http://cfpub.epa.gov/npdes/stormwater/const.cfm
- Erosion Control Magazine http://www.erosioncontrol.com, free subscriptions
- International Erosion Control Association www.ieca.org
- Erosion Control Technology Council www.ectc.org

Tips for Site Inspectors

- 2008 Delaware Stormwater Inspector's Guidebook
- 2008 Minnesota Stormwater Construction Inspection Guide

Speaker Contact Information

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Guam Erosion and Sediment Control Training

Quick List of Practices

Practice	Definition
Sediment Barriers	Temporary practices used mainly as perimeter controls to keep eroded sediment from leaving the site
Natural Area Protection	Fencing used to mark limits of disturbance and protect natural areas from clearing and grading
Construction Entrance	Rock pad used to prevent vehicles from tracking sediment off of site and on to public roads or adjacent paved areas
Silt Fence	Staked fabric fencing to block runoff from leaving the area. Works by ponding water behind fence and allowing sediment to settle out
Silt Fence Alternatives	Compost filters, silt dikes, or other products used instead of silt fences that slow and filter runoff rather than allowing it to pond behind practice.
Turbidity Curtain	Flexible floating barrier used to contain suspended sediment along shorelines or within a waterbody
Diversions/Conveyances	Practices used to move runoff through or around site
Berms	Mounds of compacted sediment strategically placed to divert runoff to a stable outlet or settling device
Swales	Channels created to intercept and convey “dirty” runoff to stable outlet or settling device
Check Dams	Small dams of rock or other durable material placed across a channel to slow runoff and allow sediment to settle out
Vegetated and Lined Waterways	Permanent channels (grass, rock, concrete) used to convey “clean” runoff from stabilized areas
Dewatering	Methods for cleaning dirty water pumped from excavations at construction sites
Temporary Stream Diversions	Pipes, channels, or cofferdams used to temporarily divert natural waterways around stream or shoreline construction projects
Settling Devices	Practices used to collect and pond runoff that allow sediment to settle out before discharging
Sediment Trap	Small depressions (excavated or created with an embankment) used to collect/pond runoff and allow sediment to settle out
Sediment Basin	Similar to traps, but capturing a larger drainage area and having more complex outlet structure and embankments. Can be converted to permanent stormwater practices
Stabilization Practices	Techniques to protect bare soils and exposed slopes from erosion
Vegetation, Mulch, Topsoil	Seeding and organic mixes uniformly applied to an area to quickly establish temporary or permanent ground cover
Surface Roughening	Using equipment to create depressions, steps, and grooves in exposed soils to slow and break up runoff
Pipe Slope Drains	Pipe used in conjunction with other stabilization practices to convey concentrated flow down a slope
Erosion Control Blankets	A biodegradable or synthetic matting used to cover exposed area on slopes and in channels to prevent erosion and help establish vegetation
Inlet Protection	Temporary practices to block sediment from entering storm drains but still allow inflow during construction
Outlet Protection	Practices used to protect outlet discharge points from erosion by slowing and spreading flow
Rock Outlet Protection	Rocks used to stabilize outlet pipes and prevent erosion from concentrated discharge
Level Spreaders	Converts concentrated flow at outlets into non-erosive sheet flow

BREAK

Acknowledgements

Additional photos: Guam Environmental Protection Agency, American Samoa Environmental Protection Agency; Palau Environmental Quality Protection Board; CNMI Department of Environmental Quality; Dr. Patrick Colin, Coral Reef Research Foundation; Jon Vogt; Coral Bay Community Council; Center for Watershed Protection; Clemson University; North Carolina State University; NOAA; Carroll County, MD; Albemarle County, VA; Filtrexx; MD Department of Environment; DE Erosion Control Program; University of North Carolina; North Carolina DOT

Schematics adapted from: State of New York, University of Minnesota Extension Service, Wisconsin Department of Natural Resources, British Columbia Ministry of Forests; North Carolina DOT

Purpose of Workshop

- To provide concurrent **training** for designers, contractors, reviewers, and inspectors on ESC standards and practices.
- To **demonstrate** installation procedures for ESC practices.
- To **improve** on-the-ground success.

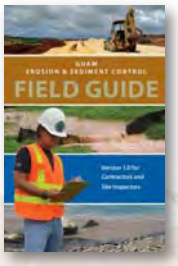
Course Agenda

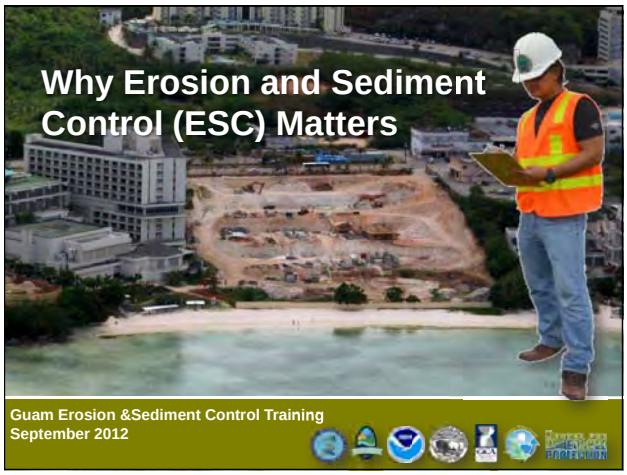
Day 1: Classroom training
- Why ESC matters
- Regulatory requirements
- ESC practices
- Reading **OR** preparing an ESC plan

Day 2: In the field/classroom
- Installations
- Maintaining and closing projects
- Improving implementation
- Exam

Day 3: Classroom
- Exam
- Inter-Agency Work Session

Bring your own hard hat, safety vest, and boots for the field trip !!

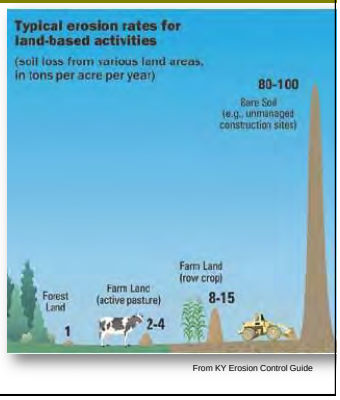




A significant concern across the Pacific Islands is watershed sediment loads. There are many contributors, shown here.

Topics to Cover

1. Impacts of construction site runoff
2. Regulatory requirements
3. 11 ESC standards
4. Construction sequencing
5. Contractor responsibilities



From KY Erosion Control Guide

1. Impacts of Construction Site Runoff

Why do we care about sediment loading?

Sedimentation can impact Guam's:

- **Environmental resources**
- **Economy**
- **Function of existing infrastructure**
- **Abutting properties**

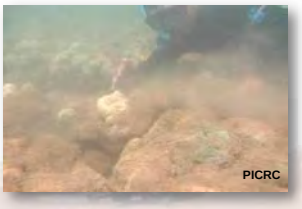
Environmental Impacts = Economic Impacts

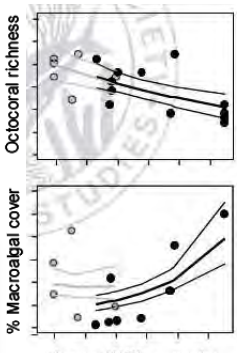
- Reduces water quality
- Limits photosynthesis
- Reduces oxygen availability
- Clogs fish gills
- Fills spawning grounds
- Increases coral bleaching
- Smothers bottom communities
- Reduces visibility for feeding and predator avoidance

→

- Costs more to filter drinking water
- Causes sedimentation of reservoirs
- Less fish, hard on fishermen and seafood lovers
- Swimming areas closed, reduced recreation
- Looks bad, fewer tourists

Models estimate that 22% of all coral reefs world-wide are at high or medium threat from inland pollution and soil erosion (Bryant et al. 1998)





(Fabricus and De'ath, 2004)

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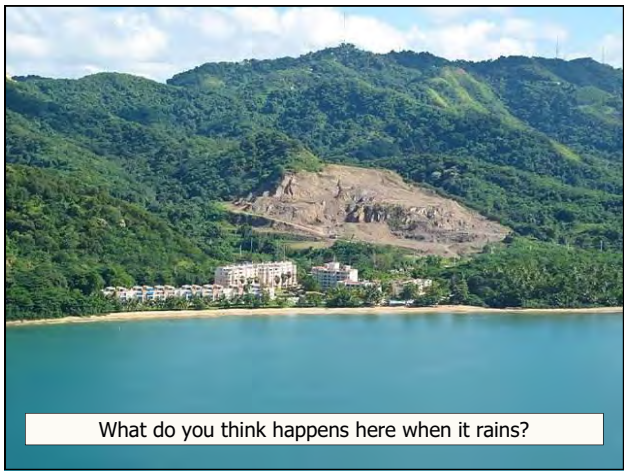
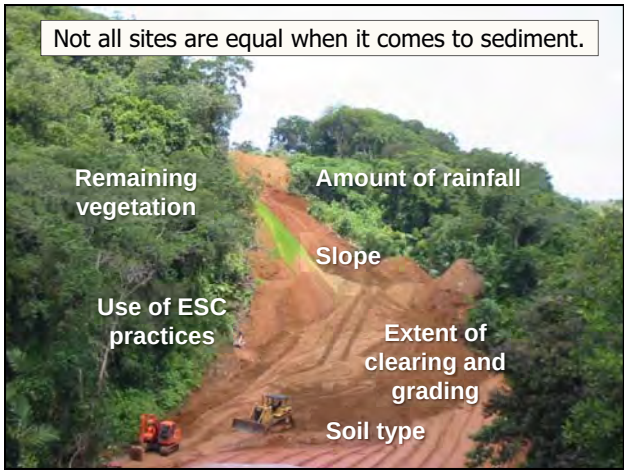


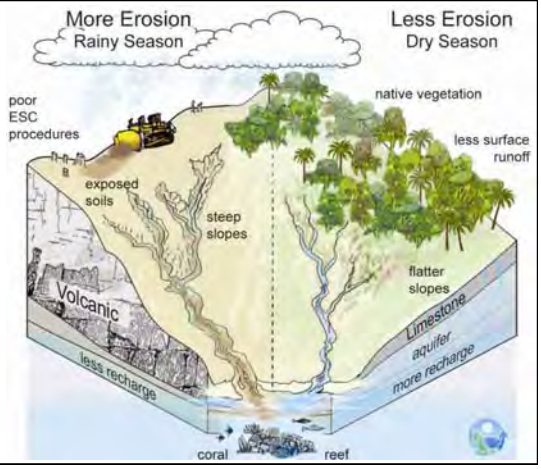
What do you think happens here when it rains?

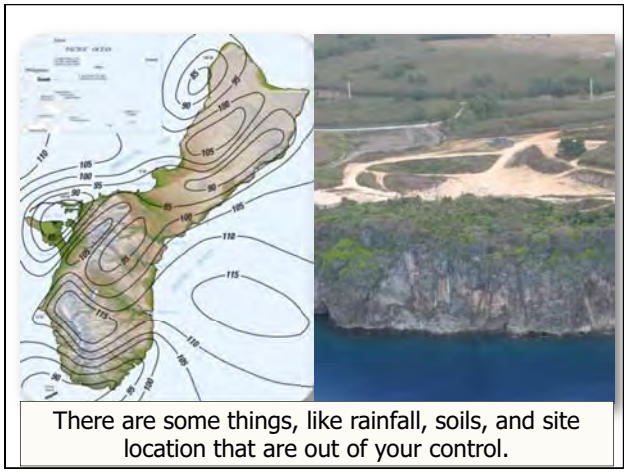
Impacts to Infrastructure

- Filling-in of permanent stormwater ponds
- Clogging of infiltration devices/ponding basins
- Smothering of swales and buffers
- Clogging of drain pipes and inlet/outlet structures
- Can contribute to flooding



Factors Influencing Erosion



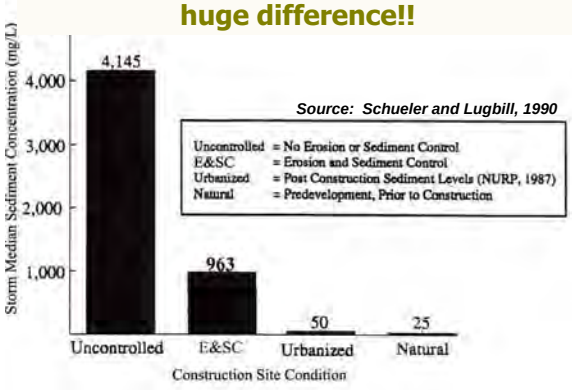


There are some things, like rainfall, soils, and site location that are out of your control.

But some decisions can have a significant influence…

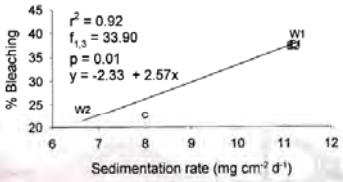
You can make a difference on your site!

Proper use of ESC practices can make a huge difference!!



Caret Bay, USVI

- Nemeth and Nowlis, 2001
- Turbidity sampling during construction process
- Correlation between sediment loading and coral bleaching
- Key problems:
  - Timing of development
  - Failure to maintain ESC practices



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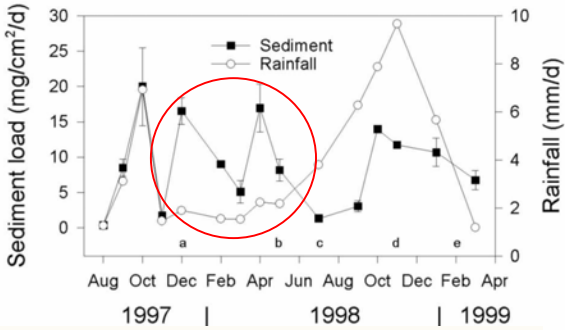
Sediment Load vs. Rainfall



When soils are exposed and ESC practice not maintained, expect high sedimentation

Nemeth & Nowlis, 2001

REALITY: Compliance for Commonly Used ESC Practices *(North Carolina +128 ESC plans, >1000 practices)*

Practice	Installed	Installed Properly	Adequately Maintained
Silt Fence	67%	58%	34%
Sediment Trap	86%	86%	58%
Stabilized Construction Entrance	89%	89%	67%

Center for Watershed Protection

2. Relevant Regulations and Standards in Guam

- USEPA National Pollutant Discharge Elimination System (NPDES)
- Guam Soil Erosion and Sediment Control Regulation (22GAR-2 Chapter 10) and associated permits
- 2006 CNMI/Guam Stormwater Management Manual
- 2011 Transportation Stormwater Design Manual

What You Should Know

- New construction and redevelopment sites should meet (some activities are exempted):
  - ESC plan requirements & Guam Regs
  - 11 ESC standards
- All **sites over 1 acre** of disturbance must:
  - Submit NOI to USEPA and GEPA
  - Prepare and implement a Stormwater Pollution Prevention Plan (SWPPP)
- Measures to convey the **10-yr storm** (~10 in.) and trapping devices to retain the **1.5 in. storm**.

Which site should meet ESC Standards?

Small | >1 acre, private | >1 acre, public road

ESC Plans (see page 7 of ESC Guide)

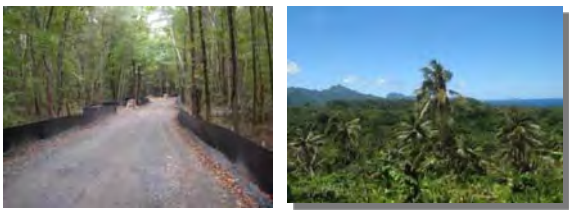
- What is included in an ESC plan?
- Do road projects have additional requirements?
- Who develops plan?
- Who reviews plan?
- Are there copies available on site?
- How are plans revised?

3. ESC Standards (see pages 8-9)

1. Minimize clearing and grading
2. Protect waterways (minimum 25' buffer) and stabilize drainage ways
3. Phase construction to limit soil exposure
4. Stabilize exposed soils immediately (14 days)
5. Protect steep slopes and cuts
6. Install perimeter controls to filter sediments
7. Employ advanced sediment settling devices
8. Certify contractors on ESC plan implementation
9. Conduct a pre-permit site meeting and adjust plan if necessary
10. Schedule construction during dry season (if possible)
11. Maintain ESC throughout construction

ESC #1: Minimize Unnecessary Clearing & Grading

- Only be performed within areas needed to build the project
- Should occur in dry season as possible



Maintaining trees/vegetation is a proactive ESC strategy

ESC #2: Protect Waterways (Minimum 25-ft Buffer) and Stabilize Drainage Ways

- Clearing limited within the 25-ft buffer
- Clearly mark limit of disturbance in field
- Install temporary diversions for activities in waterways
- Conveyance channels should convey flow without erosion


ESC #3: Phase Construction to Limit Soil Exposure

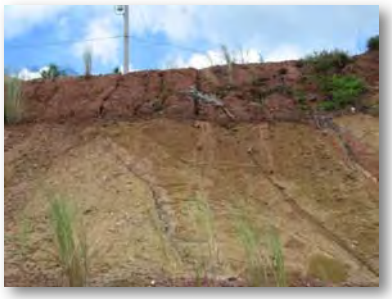
- Limit disturbance to only one area of active construction at a time.
- Future phases not disturbed until construction of prior phases is complete and area is stabilized.

ESC #4: Stabilize Exposed Soils Immediately (14 days)

- Disturbed areas shall be stabilized as soon as possible after construction completed
- In no case longer than 14 days after completion of construction


ESC #5: Protect Steep Slopes and Cuts

- limit clearing of steep slopes in the first place.
- prevent runoff from flowing down a steep slope to prevent gullying.



ESC #6: Install perimeter controls as sediment barriers

- Perimeter controls/barriers shall be applied to trap or retain sediment before it leaves a site.
- Upland runoff should be diverted around excavations


ESC #7: Employ Advanced Sediment Settling Controls

Sediment trapping devices shall be installed to trap/ retain suspended sediments and allow time for them to settle out

ESC #8: Certify Contractors on ESC Plan Implementation

All construction site managers should have received adequate ESC training

ESC #9: Conduct a Pre-permit Site Meeting and Adjust Plan if Necessary

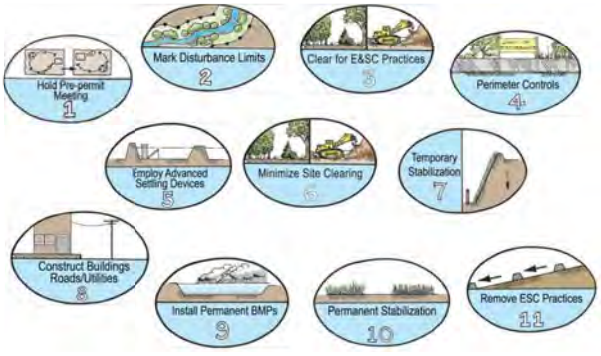
- All construction site managers must participate in a pre-permit meeting
- All construction site managers must make on-going field adjustments as necessary

ESC #10: Where Feasible, Minimize Construction During Rainy Season

ESC #11: Maintain ESC Controls Throughout Construction

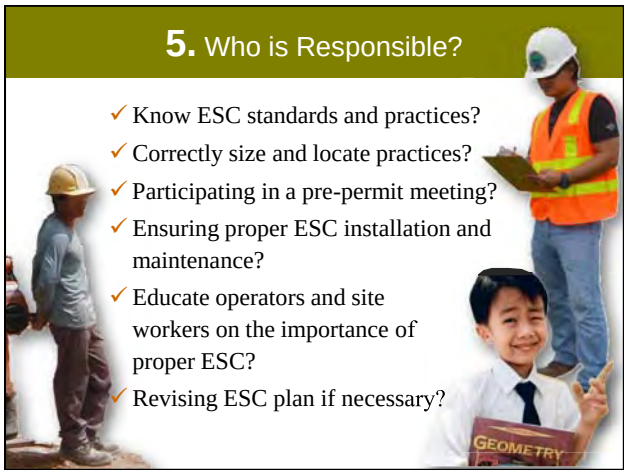
- Aggressively maintain ESC after installation
- ESC plans are an enforceable operation and maintenance agreement

4. Proper Construction Sequencing (see page 10-11)



5. Who is Responsible?

- ✓ Know ESC standards and practices?
- ✓ Correctly size and locate practices?
- ✓ Participating in a pre-permit meeting?
- ✓ Ensuring proper ESC installation and maintenance?
- ✓ Educate operators and site workers on the importance of proper ESC?
- ✓ Revising ESC plan if necessary?



For the exam, you should know:

- Why sediment leaving construction sites is a problem
- Which sites need to follow ESC Standards (not just those >1 acre of disturbance)
- The 11 ESC Standards
- Proper sequence of construction
- Who is responsible

...Questions???

BREAK

ESC Practices Covered

Sediment Barriers/ Perimeter Controls

- Natural area protection
- Stabilized construction entrance
- Silt fence
- Alternative "fencing"
- Turbidity curtains

Diversions & Traps

- Berms
- Swales
- Check dams
- Vegetated/lined waterways
- Temporary Stream Diversions
- Sediment traps
- Sediment basins
- Dewatering practices

As organized in the Field Guide

ESC Practices Covered

Stabilization

- Surface roughening
- Vegetation, mulch, soil
- Erosion control blankets
- Pipe slope drains

Inlet Protection

- Fabric
- Block and rock
- Wattles
- Inserts

Outlet Protection

- Rock outlet protection
- Level spreader

As organized in the Field Guide

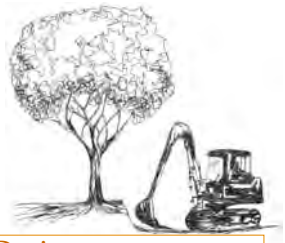
Additional ESC References

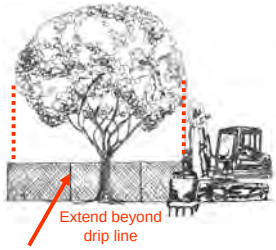
- Guam ESC Field Guide for Contractors/Inspectors (2012)
- CNMI/Guam Stormwater Management Manual (2006)
- Guam Transportation Stormwater Design Manual (2011)
- Guam ESC Manual (1998): "Guidance for Best Management Practices (BMPs) in the Preparation of a Soil Erosion and Sedimentation Control Plan"
- New York State ESC Manual (2005): www.dec.state.ny.us/website/dow/toolbox/escstandards/
- US EPA NPDES Phase II Stormwater Discharges from Construction Sites http://cfpub.epa.gov/npdes/stormwater/const.cfm
- NRCS Pacific Mulching Specification (2007)

Sediment Barriers/Perimeter Controls

Objective: Prevent disturbance and keep sediment from leaving site

See Field Guide Chapter 2





Design

1. 25 ft min. from waterway
2. Distance from tree:
   - extend to drip line, or
   - allow 1.5 ft for every inch of trunk diameter
3. Select materials based on protection needs

Alternative Example:

For a tree with 10-inch trunk
10 X 1.5 ft= 15 ft radius

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Installation

1. Mark areas to be preserved before clearing
2. Install temporary fencing and/or signage
3. Protect critical root zone during installation
4. Instruct all site workers
5. NO equipment inside fencing
6. Do not remove until end of construction

Common Problems

- Not shown on ESC plans
- Not installed on site
- Run over by equipment
- Doesn't protect buffer
- Doesn't extend beyond tree drip line
- Fence installed, but materials stored inside

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Does this fencing fully protect this tree?

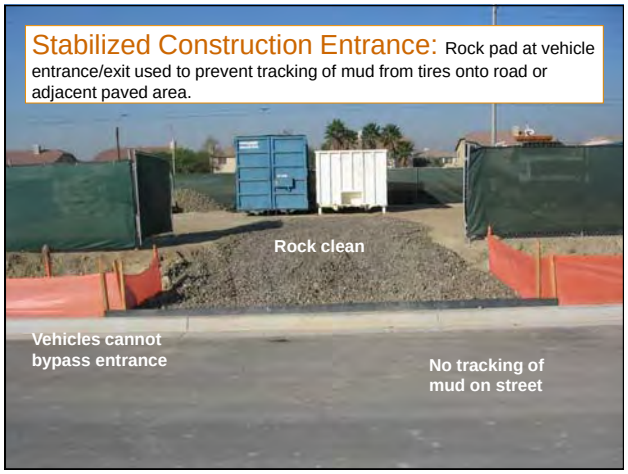
MAINTENANCE

- Check daily
- Restore damaged fencing immediately
- Remove sediment and debris if necessary
- Address tree injuries immediately

vegetative buffer/filter strip

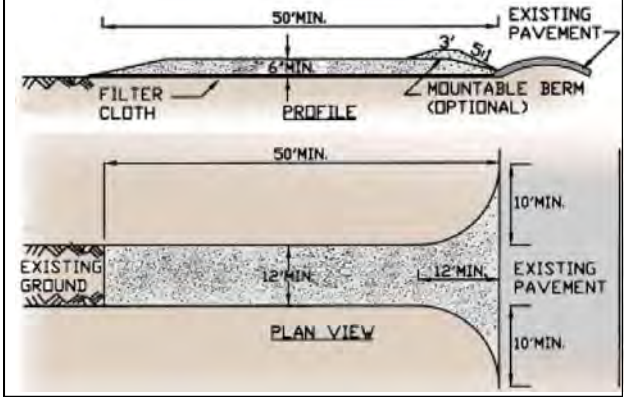
Stabilized Construction Entrance:

Rock pad at vehicle entrance/exit used to prevent tracking of mud from tires onto road or adjacent paved area.



Why Construction Entrances are important

Design Features



Adding a tire wash

Should drain to sediment trapping device

Installation

1. Locate entrance point
2. Place fabric down
3. Use ~1-4 inch diameter rock
4. Spread rock on top (6-inch thick)
5. Full width, flare at street
6. Install barriers to keep traffic on pad

Common Problems

- Does not meet street
- Too short or narrow
- Vehicles drive around it
- No underlying fabric, rock pad gets buried
- Not maintained

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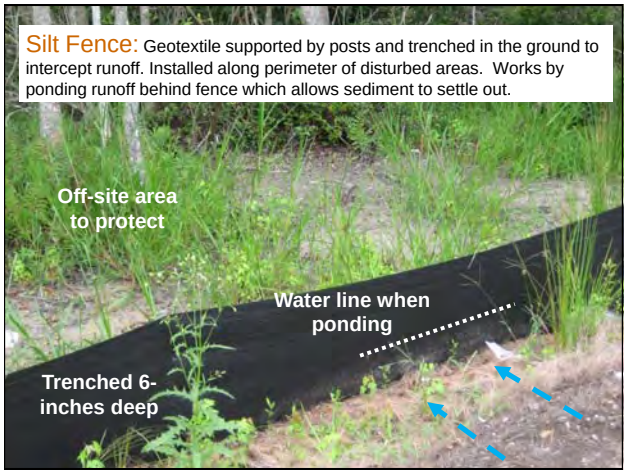
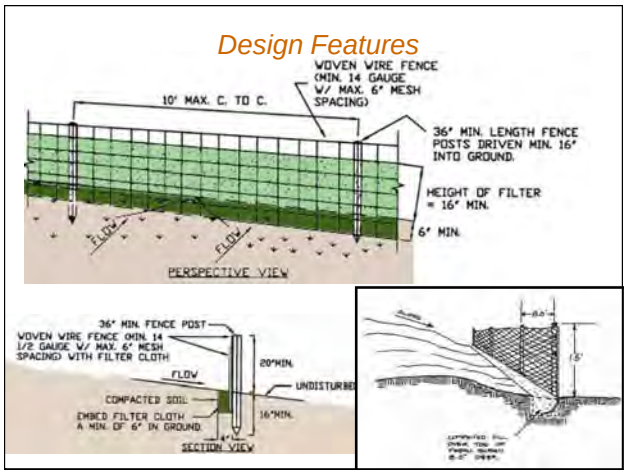
Is this working?


Maintenance
1. Monitor periodically
2. Wash or add more rock when sediment fills gaps
3. Remove tracked dirt from road
Rock pad needs to be washed or replaced.


Silt Fence: Geotextile supported by posts and trenched in the ground to intercept runoff. Installed along perimeter of disturbed areas. Works by ponding runoff behind fence which allows sediment to settle out.
Off-site area to protect
Water line when ponding
Trenched 6-inches deep


Works by ponding runoff behind fence and trapping sediment.
Copyright Center for Watershed Protection 2007


Design Features
WOVEN WIRE FENCE (MIN. 14 GAUGE W/ MAX. 6" MESH SPACING)
10' MAX. C. TO C.
36" MIN. LENGTH FENCE POSTS DRIVEN MIN. 16" INTO GROUND.
HEIGHT OF FILTER = 16" MIN.
6" MIN.
FLOW
PERSPECTIVE VIEW
36" MIN. FENCE POST
WOVEN WIRE FENCE (MIN. 14 1/2 GAUGE W/ MAX. 6" MESH SPACING) WITH FILTER CLOTH
FLOW
20"MIN.
UNDISTURBED
COMPACTED SOIL
EMBED FILTER CLOTH A MIN. OF 6" IN GROUND
16"MIN.
SECTION VIEW


Good installation around stockpile area. Be sure to leave space for material to deposit behind fence and for maintenance.

Installation

1. Dig trench 6-8 inches deep

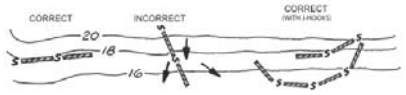
2. Install sturdy posts 1.5 feet deep

3. Fasten fabric to posts, connect ends

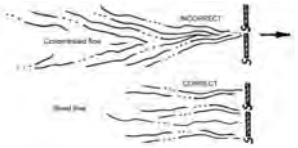
4. Backfill and compact

5. Check it.

Common Problems (see page 21)

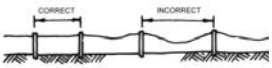


3. Installed perpendicular to slope



1. Receives concentrated flow

4. Installed uphill from flow

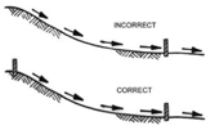


2. Post spacing too wide

5. Flow by-passes ends of fence

Common Problems

6. Not properly trenched



9. Too much drainage area or length of slope

7. Follows site boundary only

8. Lack of maintenance

Slope Steepness	Max. distance between rows
2:1	25 ft
3:1	50 ft
4:1	75 ft
5:1 or flatter	100 ft

Too much drainage area/slope length to fence. Install more rows.

Poorly trenched fences will not hold back runoff.

Do not install across streams unless trying to trap Karabao.

You can use alternative materials if they work!!

What factors are contributing to this failure?

Maintenance

- Inspect daily
- Repair if sagging or bulging
- Remove sediment when reaches **1/3 height** of fence

Silt Fence Alternatives: Practices used as perimeter controls instead of silt fences that filter runoff, trap sediment, that may be easier to install/maintain.

Filter/compost socks

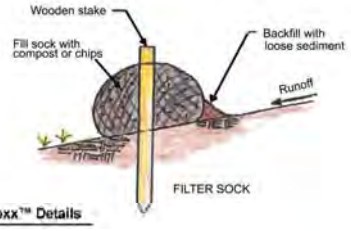
Filter strip

Perimeter berm

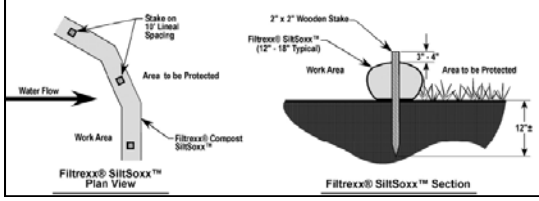
Silt dike

Design & Installation

- Follow manufacturer's instructions for diameter and mesh material
- Be sure to connect with ground
- Back fill with loose sediment
- Potential for reuse



Filtrexx® SiltSoxx™ Details




Fill on site or bring in pallets

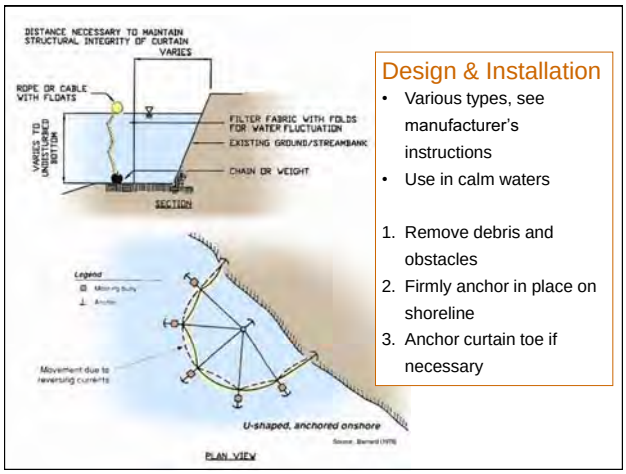

Auger attachment


Use local materials for compost material…


Maintenance
• Check daily and after rain events
• Make sure in contact with ground
• Remove sediment that builds up ½ way behind sock


Alternative products are only as good as your installation and maintenance.

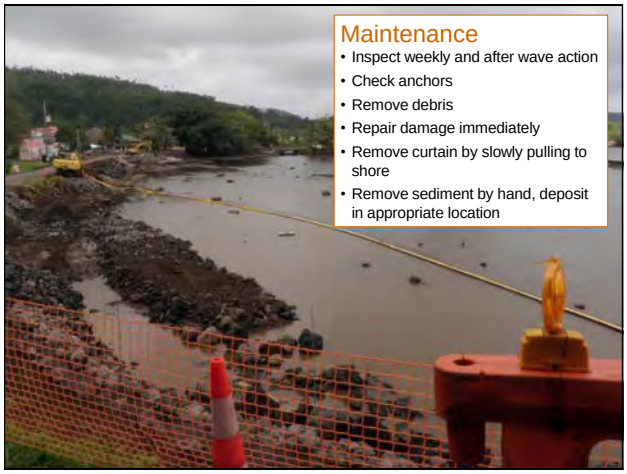

Turbidity Curtain: Flexible floating barrier used to trap suspended sediment along shoreline or in waterbody



Design & Installation

- Various types, see manufacturer's instructions
- Use in calm waters

1. Remove debris and obstacles
2. Firmly anchor in place on shoreline
3. Anchor curtain toe if necessary



Maintenance

- Inspect weekly and after wave action
- Check anchors
- Remove debris
- Repair damage immediately
- Remove curtain by slowly pulling to shore
- Remove sediment by hand, deposit in appropriate location

For the exam, you should know:

- Purpose of sediment barriers is to prevent disturbance or to stop sediment from leaving the site and often are placed around perimeter of site
- How they work
  - Tree protection prevents disturbance
  - Silt fences pond water and allow dirt to settle out
  - Construction entrances clean mud off of tires
  - Compost socks filter water
  - Turbidity curtain contains sediment
- Recognize why they fail
- Basic maintenance requirements
  - Remove sediment when 1/3 filled behind silt fence

...Questions???

Diversions & Traps

Convey the10-yr storm (2-yr for temporary stream div)

Objective: Convey "clean" and "dirty" runoff safely around or through site.

See Field Guide, Chapter 3

Diversions & Traps

Objective: Collect "dirty" water & allow time for particles to settle out.

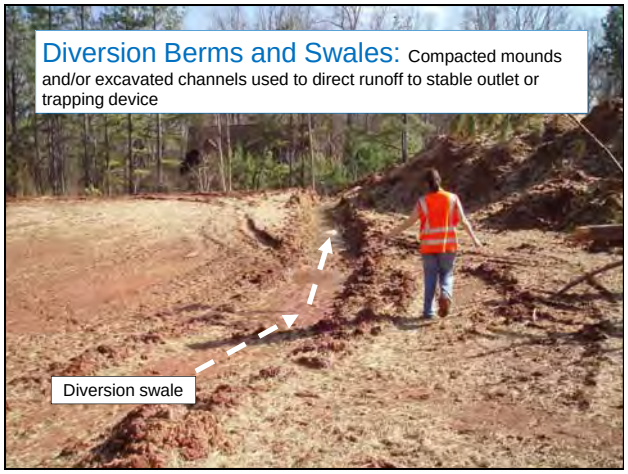
Should retain 1 ½ inch storms

Objective: settling device, filter, or other practice to clean "dirty" water before discharge.

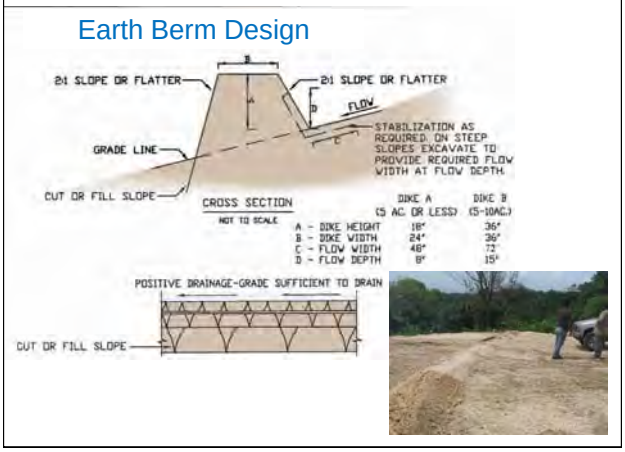
See Field Guide, Chapter 3

Diversion Berms and Swales:

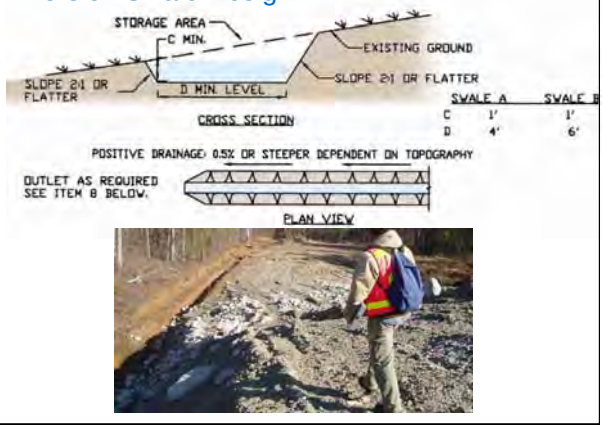
Compacted mounds and/or excavated channels used to direct runoff to stable outlet or trapping device



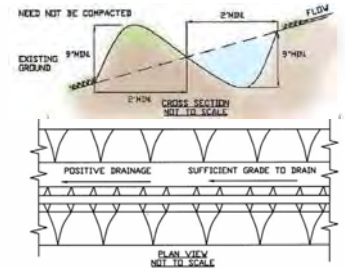
Earth Berm Design



Diversion Swale Design



Combined Perimeter Berm/Swale



Diverts “dirty” runoff to sediment basin.

Vegetated berm diverts runoff from site along perimeter to stabilized outlet. Note stabilization with vegetation and matting.

Diverts “clean” runoff around site and away from exposed area.

Design & Installation

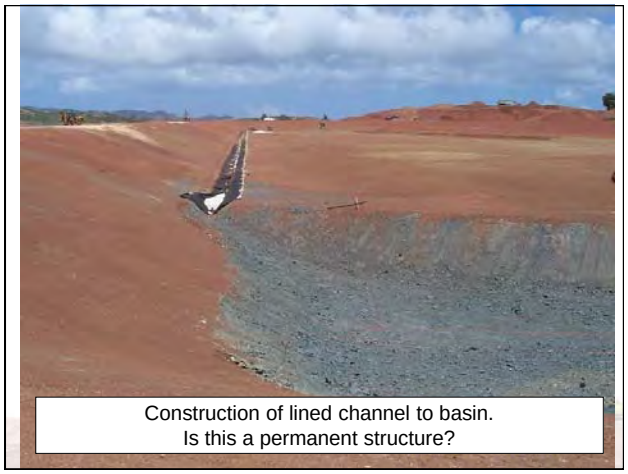
- Must safely convey the 10-yr storm (~10 inches on Guam)
- Do not construct diversions outside the property boundary
- Berms should be compacted, (except for berm/swale combo)
- Stabilize berms within 1 week
- Outlets should be stabilized

Common Problems

- Berms wash out, too much drainage area
- Berms not compacted or stabilized
- Outlets not stabilized

Maintenance

- Check full length weekly or after rain events
- Make sure outlets are stable, if not may need to relocate
- If too steep, may need to install matting

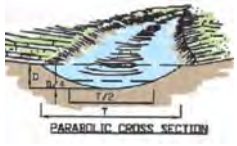


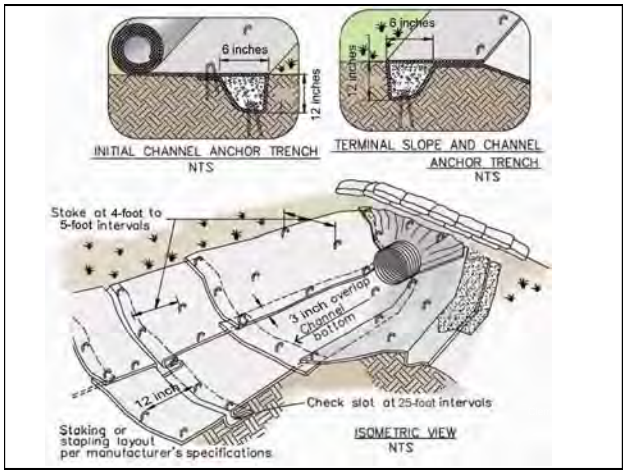
Construction of lined channel to basin.
Is this a permanent structure?

Vegetated and Lined Waterways: Permanent grass, rock, or concrete channel used to convey stormwater runoff from stabilized site.

Grass Channels

- Gentle grades and side slopes
- Warm season grasses with some perennial rye (see NRCS)
- Erosion control fabric
- May need some topsoil, fertilization, liming to get grass started
- Becomes permanent conveyance





Installation

1. Clear foundation of stumps, roots, loose rocks
2. Excavate and install as shown on plans
3. May need filter fabric below hard linings
4. Follow manufacturer's instructions for erosion control matting
5. Stabilize with vegetation according to specifications (see NRCS)
6. Requires stabilized outlet
7. Do not use until fully stabilized

Maintenance

- Maintain lining as built to prevent undermining
- Inspect vegetation establishment/survival
- Inspect for erosion resulting from out-of-bank flows
- May need to install liner along center of channel if scour occurs

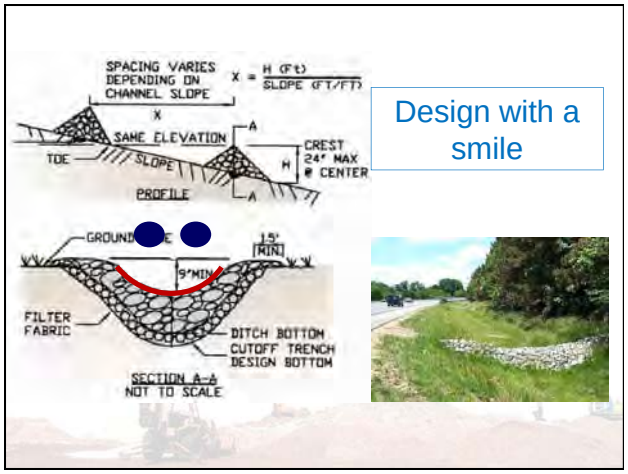
Source: Center for Watershed Protection

Permanent concrete channels provide no water quality benefits. When does it make sense?

Check Dams: Ridge of rock or other durable material used in a channel to slow erosive velocities. Often used in series.

Source: Center for Watershed Protection

Why are check dams needed?



Design with a smile

Good example of synthetic check installation. Placement, spacing and surface contact provide sediment control until permanent vegetation is established.

23

Design & Installation

- Anchor with cutoff trench (1½ ft wide x ½ ft deep)
- Rock matrix of 2-9 inches
- Dams less than 2 ft high with lower center
- Tie into banks
- Space according to plan/slope

Table B.14. Standard stone check dam design (*Maryland Department of the Environment, 1994*)

Slope	Spacing (feet)
2% or less	80
2.1% to 4%	40
4.1% to 7%	25
7.1% to 10%	15
over 10%	use lined waterway design

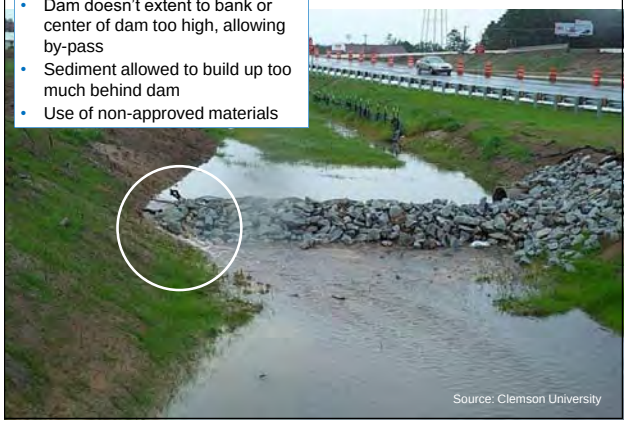
limited to slopes with < 10% grade

Albemarle County, VA

Source: MDE, 2001

Common problems

- Dam doesn't extent to bank or center of dam too high, allowing by-pass
- Sediment allowed to build up too much behind dam
- Use of non-approved materials



Maintenance

- Inspect after rainfall events
- Check for displaced rocks
- Remove sediment behind dams when fills **½ height**

Settling Devices (sediment basins & traps):
Excavated areas to temporarily pond "dirty" runoff and provide time for sediment to settle out before discharging off site.

Basins vs. Traps

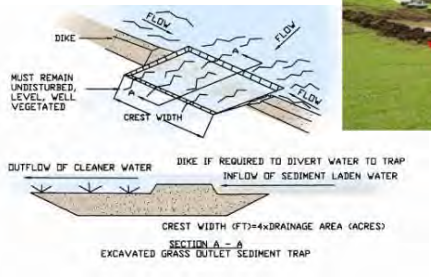
Should retain 1 ½ inch storms

	Basins	Traps
Max Drainage Area	100 acres	5 acres
Size	5,500 cubic ft/acre of drainage; >2:1 length to width	
Dam Height	10-15 ft max.	5 ft max.
Dam Width	8-10 ft min.	4 ft min.
Dam Side Slopes	2.5:1 or flatter	2:1 or flatter
Outlet	Riser with spillway	Riser or grass/rock outlet
Riser Height	2 ft below top of dam, 1 ft below spillway.	1 ½ ft below top of dam
Status	Temporary or Permanent	Temporary

- larger excavation
- can be permanent
- more infrastructure

- small depression
- simpler outlet structure

Sediment Trap: grass outlet



Sediment Trap: rock or pipe outlet

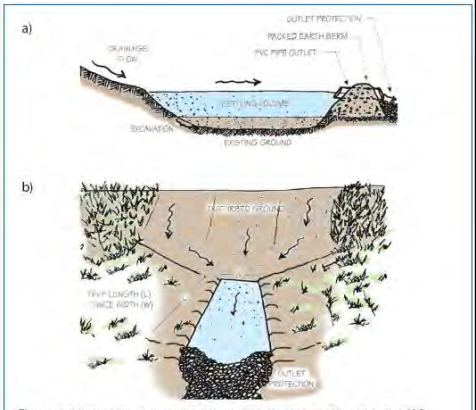
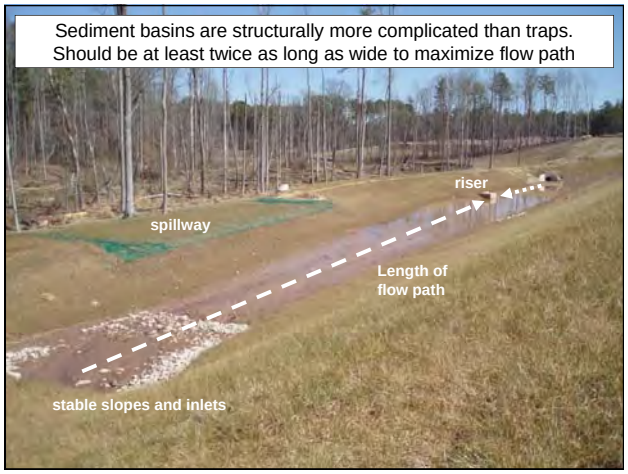
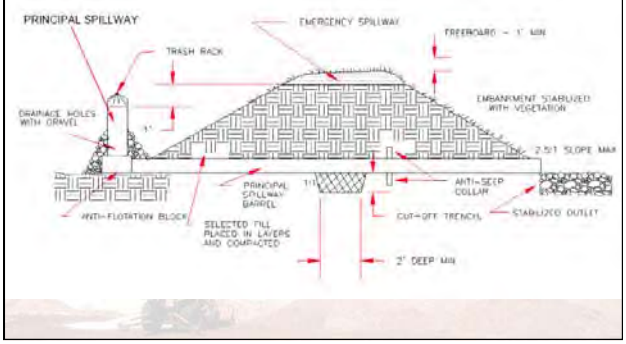


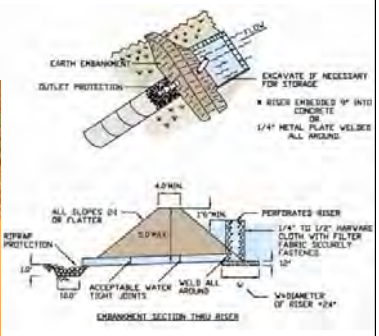
Figure 3.7. Examples of excavated traps with (a) pipe or (b) rock outlet (AS-EPA Guidance Manual for Runoff Control, 2001).



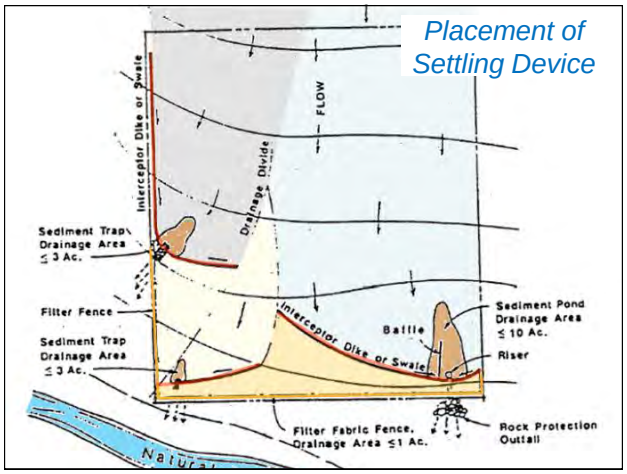
Sediment Basin – Spillway Profile



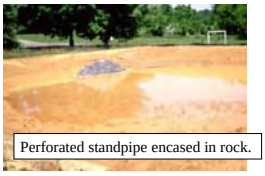
Pipe Outlets



Placement of Settling Device



Fine sediment removal is limited in basins and traps, advanced designs to enhance effectiveness:


Perforated standpipe encased in rock.


Berm dividing multi-cell basin.

Baffles to increase length of flow path.

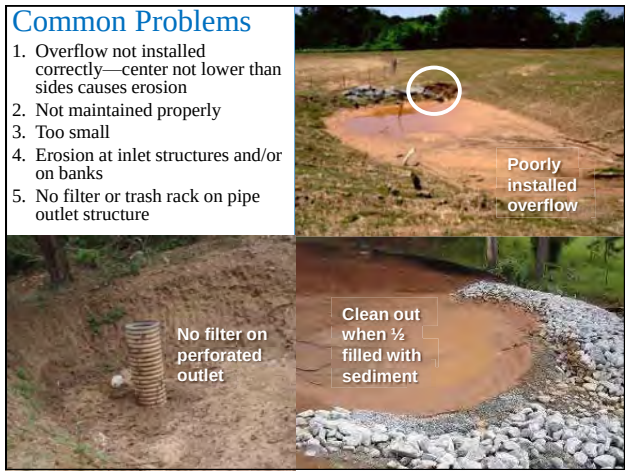

skimmers

Installation

1. Install before major site clearing
2. Locate and construct according to plans
3. Make sure pipe connections are watertight
4. Install water permeable covers on risers and filter fabric over dewatering holes
5. Stabilize outlets, side slopes, and inlets

Common Problems

1. Overflow not installed correctly—center not lower than sides causes erosion
2. Not maintained properly
3. Too small
4. Erosion at inlet structures and/or on banks
5. No filter or trash rack on pipe outlet structure



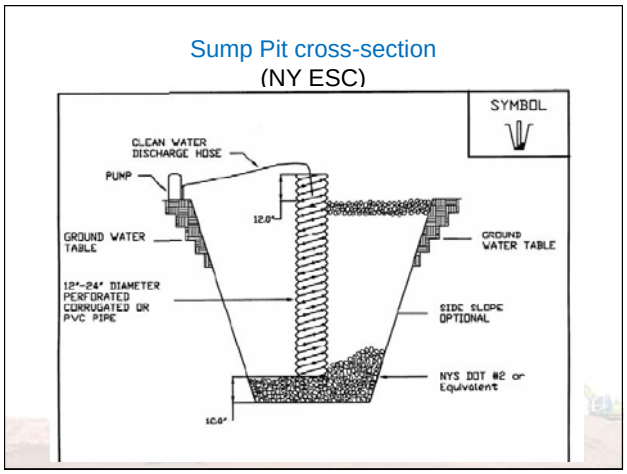
Maintenance

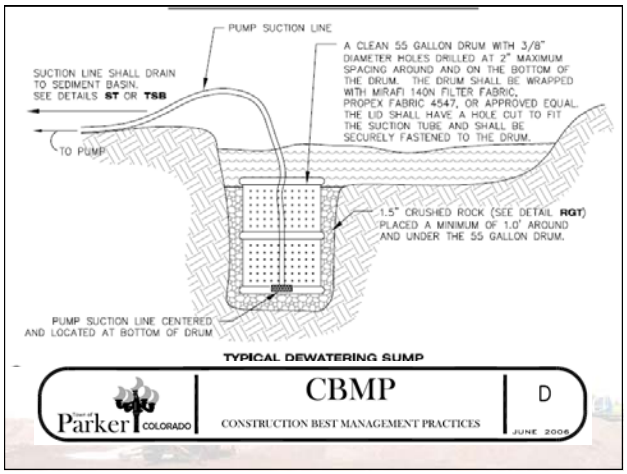
1. Remove accumulated sediment when basin **volume is reduced by ½**
2. Do not dispose of sediment in waterways
3. Check inlets and side slopes for erosion. Stabilize.
4. Check outlets for erosion

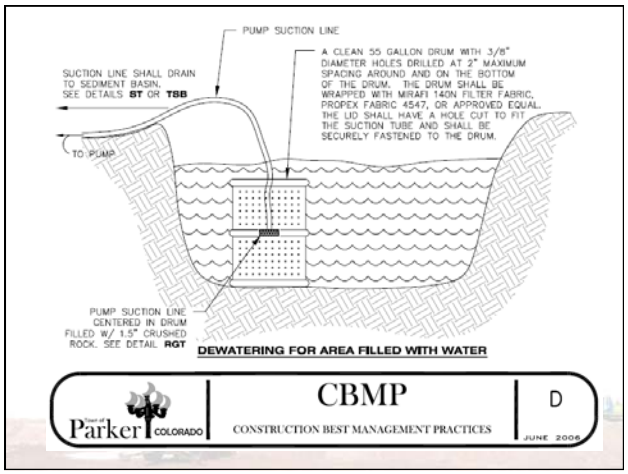
Dewatering devices: To clean "dirty" water that is pumped out of excavations or from other wet areas on the construction site.

- Sump Pits
- Dewatering Bags
- Containment Areas
- Weir Tanks

Sump Pit cross-section (NY ESC)



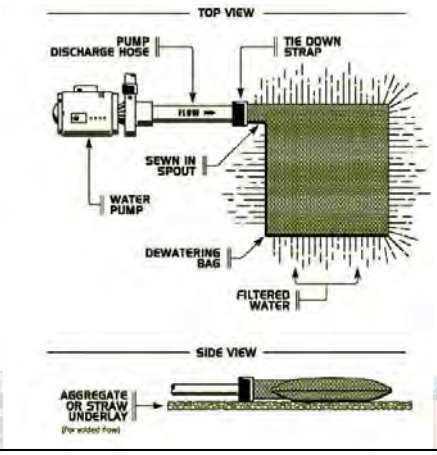




Bag Filters

- Sizing should be based on:
  - Expected volumes
  - Pumping rates
- Type of geotextile bags based on manufacturer recommendations.
- Discharge to stabilized containment area
- Follow manufacturer's instructions for sediment removal or bag replacement
- Proper disposal
- Keep an eye on this at all times when pump is running

Dandy ™



Be sure to place bag on stabilized discharge area.

www.spillcontainment.com/dewatering-bag

Design and Installation

- Size based on expected volumes and pump rates
- Do not use in place of sediment traps
- Locate for ease of cleanout and to minimize interference with consturciotn activities

Table 3.4. Sizing of Containment Area

Flow Rate		Required Surface Area	Length/Width=2:1	
Q (gpm)	Q (ft³/s)	As (ft²)	L (ft)	W (ft)
25	0.0565	131.86	16.24	8.14
50	0.1130	263.82	22.97	11.48
100	0.2225	527.54	32.48	16.24
200	0.4450	1055.19	45.93	22.97
300	0.6674	1582.73	56.27	28.12
400	0.8899	2110.09	64.96	32.48
500	1.1124	2637.80	72.64	36.32

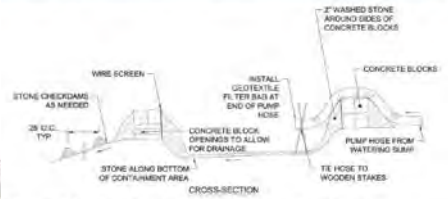


Figure 3.11. Example schematic showing a stone and block dewatering containment area (Horsley Witten Group).

Weir Tanks with Baffles

Figure 7-1: Weir Tank

TSDM manual

Design and Installation

- Storage is equal to pump discharge (GPM) x 16, assuming 2 hrs of residence time.
- Direct discharge to another ESC practice.
- Be sure to properly dispose of sediment

Be wary of this

Figure 7-2: De-Watering Tanks

TSDM manual

This can be hauled off site

www.sandsfilter.com/images/206.JPG

For dewatering practices

Maintenance

- Inspect and monitor on an hourly basis while pumps are running
- Ensure final discharge is not causing additional erosion and sedimentation
- Follow manufacturer's instructions for sediment removal or bag replacement
- Have a plan for proper disposal

Common Problems

- Poor sizing of pumps and practice
- Turbid discharge
- Sump pit not filtering well
- Bag explosions

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Temporary Stream Diversion: To isolate the construction area from surrounding waters and minimize contact of flowing water with exposed soils.

- Cofferdams & impervious dikes
- Piped diversions
- Diversion channels

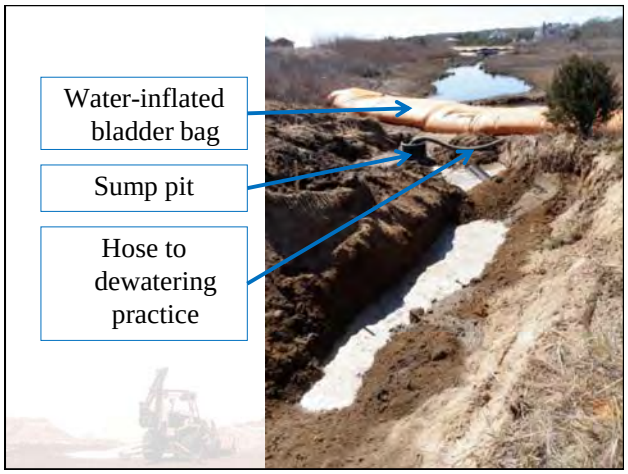

Existing stream flow should be separated from exposed soils in work area.
HYUNDAI

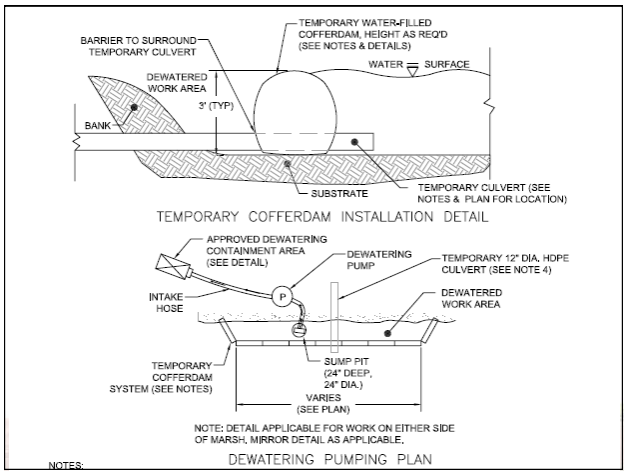

Cofferdams/impervious dikes
Sheet piling
Sand bags
Gravel bags
Inflatable bladders


Silt fence and earth may not always be reliable

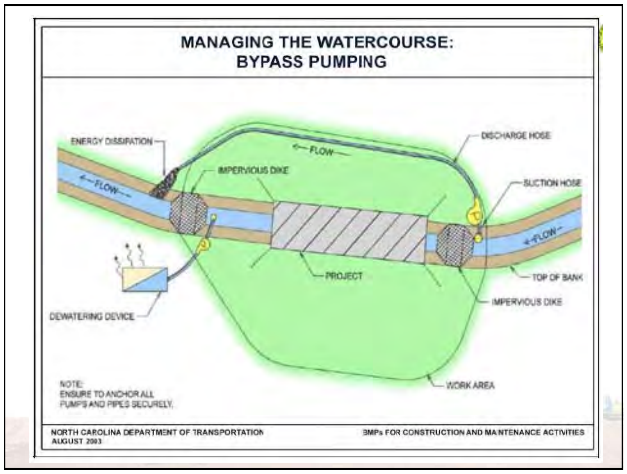

Is this silt fence diversion working?

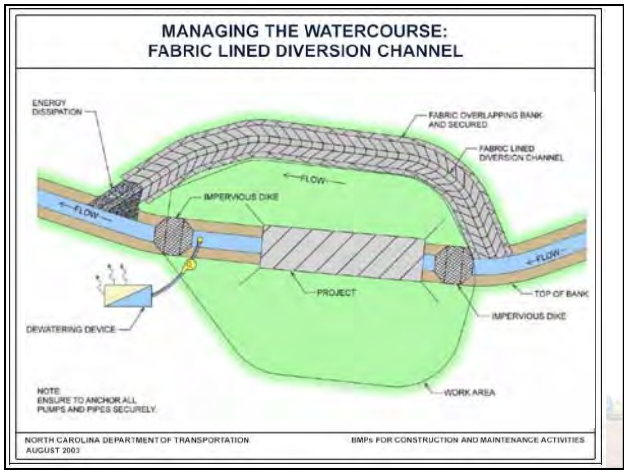

Concrete blocks work well though


Water-inflated bladder bag
Sump pit
Hose to dewatering practice

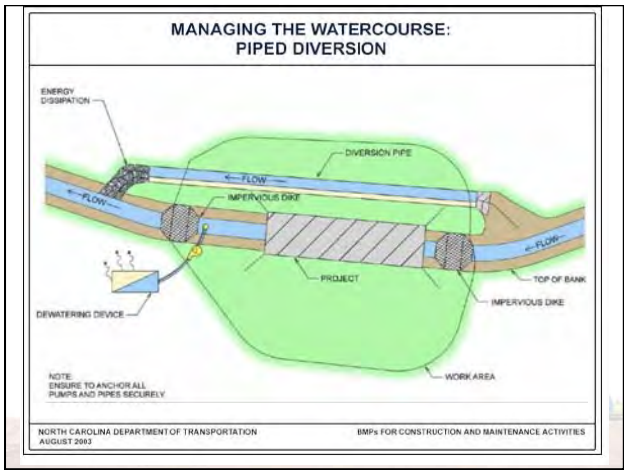

BARRIER TO SURROUND TEMPORARY CULVERT
TEMPORARY WATER-FILLED COFFERDAM, HEIGHT AS REQ'D (SEE NOTES & DETAILS)
WATER SURFACE
DEWATERED WORK AREA
3' (TYP)
BANK
SUBSTRATE
TEMPORARY CULVERT (SEE NOTES & PLAN FOR LOCATION)
TEMPORARY COFFERDAM INSTALLATION DETAIL
APPROVED DEWATERING CONTAINMENT AREA (SEE DETAIL)
DEWATERING PUMP
TEMPORARY 12" DIA. HDPE CULVERT (SEE NOTE 4)
INTAKE HOSE
P
DEWATERED WORK AREA
TEMPORARY COFFERDAM SYSTEM (SEE NOTES)
SUMP PIT (24" DEEP, 24" DIA.)
VARIES (SEE PLAN)
NOTE: DETAIL APPLICABLE FOR WORK ON EITHER SIDE OF MARSH. MIRROR DETAIL AS APPLICABLE.
DEWATERING PUMPING PLAN
NOTES:


Do not remove coffer dam until work area is stabilized


MANAGING THE WATERCOURSE:
BYPASS PUMPING
ENERGY DISSIPATION
FLOW
IMPERVIOUS DIKE
DISCHARGE HOSE
SUCTION HOSE
PROJECT
TOP OF BANK
DEWATERING DEVICE
WORK AREA
NOTE:
ENSURE TO ANCHOR ALL PUMPS AND PIPES SECURELY.
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
AUGUST 2003
BMPs FOR CONSTRUCTION AND MAINTENANCE ACTIVITIES


MANAGING THE WATERCOURSE:
FABRIC LINED DIVERSION CHANNEL
ENERGY DISSIPATION
FABRIC OVERLAPPING BANK AND SECURED
FABRIC LINED DIVERSION CHANNEL
FLOW
IMPERVIOUS DIKE
PROJECT
TOP OF BANK
DEWATERING DEVICE
WORK AREA
NOTE:
ENSURE TO ANCHOR ALL PUMPS AND PIPES SECURELY.
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
AUGUST 2003
BMPs FOR CONSTRUCTION AND MAINTENANCE ACTIVITIES


Mississippi DOT
(Source: Aukland Regional Council – Stream Facts)


MANAGING THE WATERCOURSE:
PIPED DIVERSION
ENERGY DISSIPATION
DIVERSION PIPE
FLOW
IMPERVIOUS DIKE
PROJECT
TOP OF BANK
DEWATERING DEVICE
WORK AREA
NOTE:
ENSURE TO ANCHOR ALL PUMPS AND PIPES SECURELY.
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
AUGUST 2003
BMPs FOR CONSTRUCTION AND MAINTENANCE ACTIVITIES

Design & Installation

- Try to work during dry season
- Ensure good seal for coffer dams
- Use appropriate pump size
- Size channels to convey **2-yr storm** with 2:1 side slope
- Do not install temp. channels in fill
- Protect channels from erosion
- Ensure coffer dams are working properly
- Minimize amount of disturbance at diversion points
- Avoid earthen dams
- Specify dewatering procedures

Maintenance

- Inspect dams daily
- When pumps are being used, inspect hourly
- Check for upstream or downstream erosion
- Check stability of side-slopes on diversion channels

Common Problems

- Not sized appropriately
- Erosion of channel and diversion points
- Leaky cofferdams

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For the exam, you should know:

- Purpose of diversions and settling devices
  - **Diversions**: to convey non-erosive runoff through or around a site
  - **Traps**: to pond runoff and allow sediment to settle out before discharging "clean" water
  - **Dewatering**: to clean "dirty" water that is being pumped from wet construction areas
- How they work and why they fail
- Basic design/installation procedures
  - Swales and channels to convey 10-yr storm
  - Temporary stream diversions 2-yr storm min.
  - Store 1.5 inches of rain
- Basic maintenance requirements for practices
  - Remove sediment from basin ½ full

...Questions???

BREAK

ESC Practices Covered

Stabilization
- Surface roughening
- Vegetation, mulch, soil
- Erosion control blankets
- Pipe slope drains

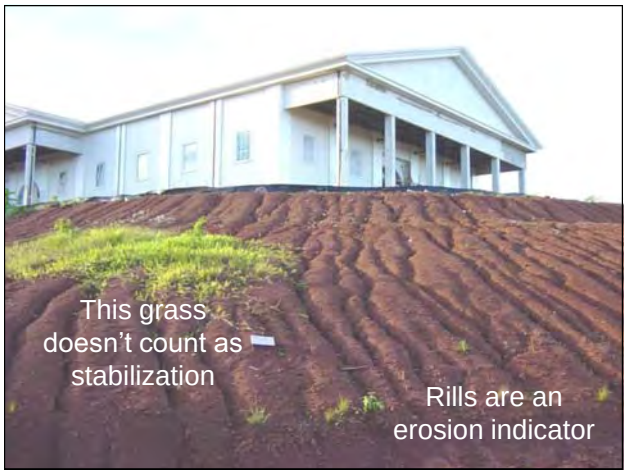
Inlet Protection
- Fabric
- Block and rock
- Wattles
- Inserts

Outlet Protection
- Rock outlet protection
- Level spreader

As organized in the Field Guide

Stabilization Practices

Objective: Protect bare soils and slopes from eroding



A lot of dirt came off this site. This gully indicates:
- lack of stabilization
- failure to comply with ESC requirements
- failure to enforce ESC regs.

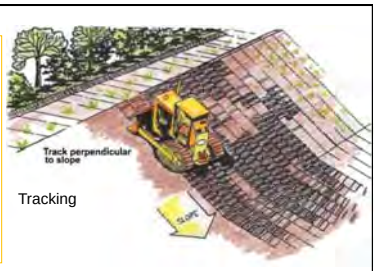
Surface Roughening: Creation of horizontal depressions, steps, or grooves that run parallel to contour of land and slow runoff.

Installation

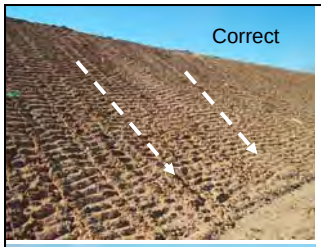
- Perform as soon as vegetation has been removed
- Combine with seeding/mulch
- Avoid excessive compacting of soil if possible

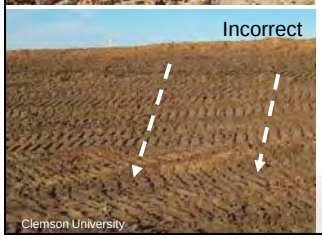
Maintenance

- May need to reapply at end of day or until other stabilization in place
- If rills appear, re-grade and re-seed



Tracking





Common Problems

- Tracking across slope instead of going up and down slope
- Rills appear and no corrective action taken
- Not done frequently

Clemson University

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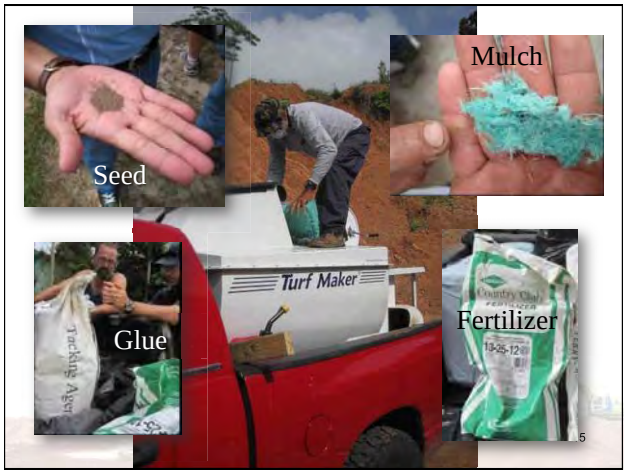
Vegetative, Mulch, or Soil Stabilization: Uniform application of seed and organics to rapidly stabilize exposed soil either temporarily or permanently.

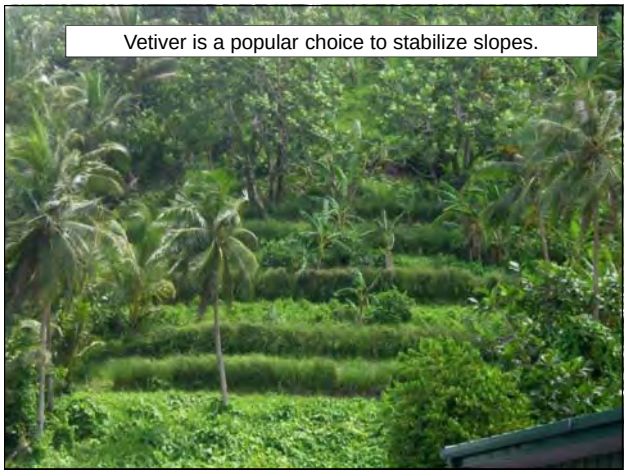
Installation

- Apply grass or mulch cover within 14 days of soil exposure
- Clear debris
- Apply native seeds and grasses uniformly with seed spreader or hydroseeder
- Use appropriate combination of tackifier, mulch, and seed.
- Add fertilizer where needed
- Permanently stabilize disturbed areas at end of construction
- Contingency plan for replacing vegetation that does not survive

Common Problems

- Coverage too thin
- Mulch blows away
- Seed not watered
- Area subject to concentrated flow and erosion
- Soil too compacted





Notes on Seeding

- Poor quality of some island soils may require fertilization, liming and other soil amendments
- Take soil test
- Use only warm season grasses, with some annual rye grass to get temporary stabilization
- Grasses vary greatly in tolerance for drought, and shade, and requirements for nitrogen and maintenance

Table 4.1. Common Grasses Suitable for Stabilizing Waterways and Exposed Soils (Source: 2010 NRCS Pacific Islands Area Vegetative Guide[1])

Common Name	Scientific Name/ Cultivar	Elevation (ft.)	Rainfall (in.)	Planting Rate[2]
Bermuda Grass[3]	*Cynodon dactylon*	0 - 3,000	20 - 100 (-170)	35 lbs/PLS/ac
Carpet Grass[3,4]	*Axonopus affinis*	0 - 5,000	40 - 80 (-160)	40 lbs/PLS/ac
Centipede Grass[4]	*Eremochloa ophiuroides*	0 - 2,500	40+	20 lbs/PLS/ac
Digit Grass	*Digitaria eriantha*, 'Pangola,' 'Transvala'	0 - 3,500	50 - 160	80 bu/ac
Paspalum	*Paspalum hieronymii*, 'Tropic Lako'	0 - 3,000	50 - 150	80 bu/ac
St. Augustine Grass[4]	*Stenotaphrum secundatum*	0 - 3,000	40 - 80	80 bu/ac
Vetiver Grass	*Chrysopogon zizanioide* 'Sunshine'	0 - 3,000	35 - 200	Sprigs planted 3" apart
Zoysia Grass	*Zoysia japonica*, 'El Toro'	0 - 4,000	40 - 100	80 bu/ac

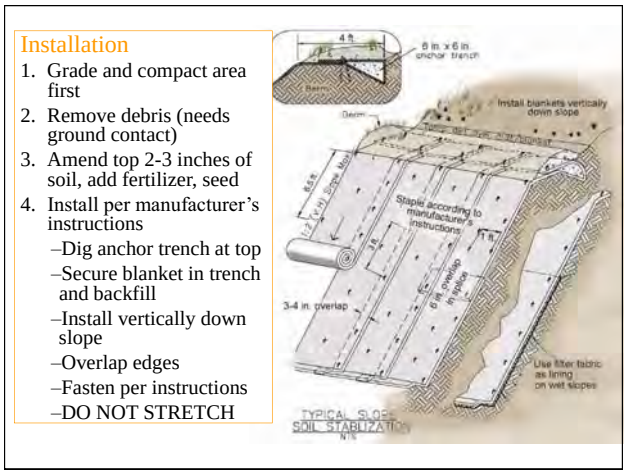
[1] List is not all-inclusive. Ideal species for seeding and stabilizing disturbed areas should be fast growing, non-invasive, tolerant of low fertility soils, and readily available.
[2] Tolerant of soil salinity and wind-bourne salt.
[3] Tolerant of acidic, low fertility soil
[4] May have potential to become invasive.
[5] Pure Live Seed (PLS). One bushel (bu) equals 1.25 cu. ft. **May need to double these seeding rates when hydroseeding.**


Maintenance
• Irrigate as necessary to establish plants
• Reapply seed mulch or soil as needed
• Maintain other ESC practices until plants fully established


Erosion Control Blankets: Biodegradable or synthetic matting used to cover bare slopes and channels to prevent erosion and help vegetation establish.
Unprotected slope
Protected slope

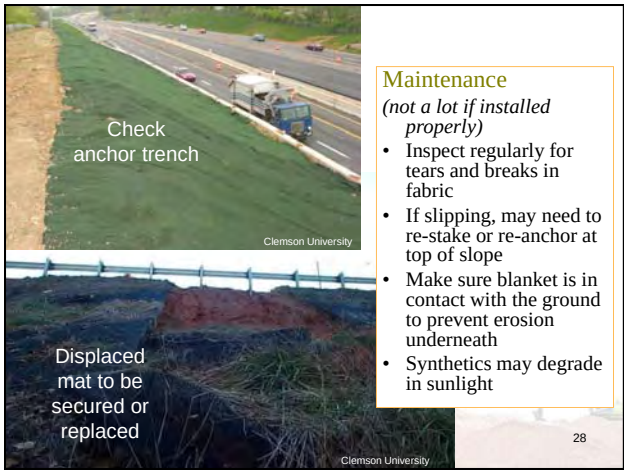

There are a variety of ECBs types to use depending on slope, flow velocities, durability, and access to supplies
Consider using on all cut/fill slopes 15% or more

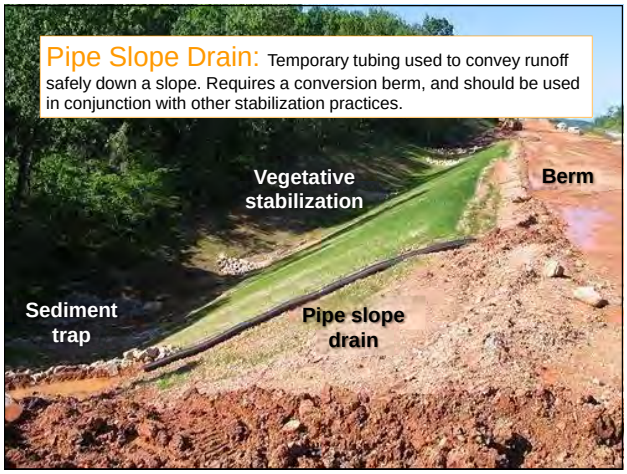

Erosion Control Blankets
Erosion Control Blankets are typically made by sewing materials onto a plastic netting or between two plastic nets...
...and are pinned/stapled into place with 6" staples to prevent sliding...
...and hold the seed in place to enhance germination.
Straw products normally last about 6 months.
Coconut products can last up to 3 years.
Synthetic could last for a long time
ACF Environmental

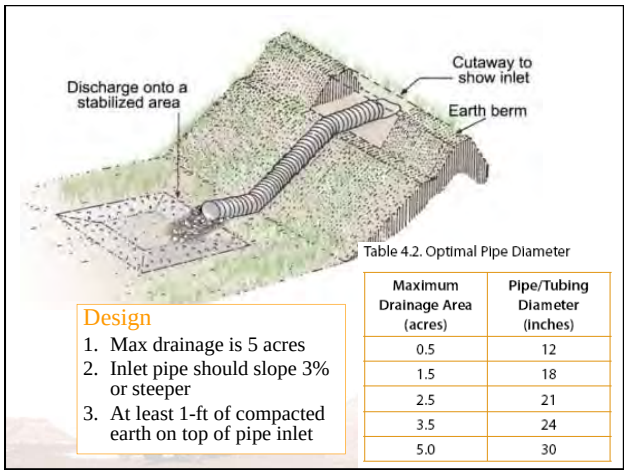

Installation
1. Grade and compact area first
2. Remove debris (needs ground contact)
3. Amend top 2-3 inches of soil, add fertilizer, seed
4. Install per manufacturer's instructions
–Dig anchor trench at top
–Secure blanket in trench and backfill
–Install vertically down slope
–Overlap edges
–Fasten per instructions
–DO NOT STRETCH
4 ft
6 in x 6 in anchor trench
Install blankets vertically down slope
Staple according to manufacturer's instructions
3-4 in. overlap
6 in. overlap in ditch
Use filter fabric as lining on wet slopes
TYPICAL SLOPE SOIL STABILIZATION


ECTC
After

Combination of blankets with coir logs to establish vegetation on bank.







Inlet Protection

Objective: Keep sediment out of inlets, but still let water in

Filter Fabric Installation

1. Use approved fabric
2. Reinforce with wire mesh if necessary
3. Stake as close as possible to inlet
4. Trench fabric and backfill
5. Alternative to add mesh and/or rock filter

Block and Rock Inlet Protection

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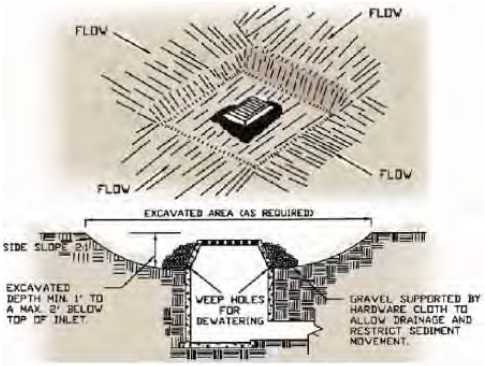
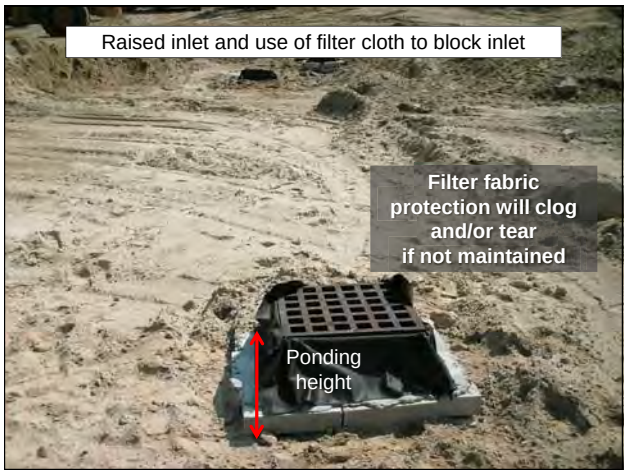
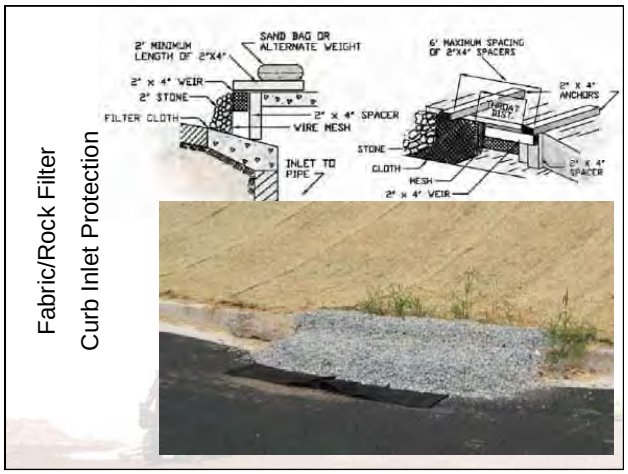


Excavated Drop Inlet Protection



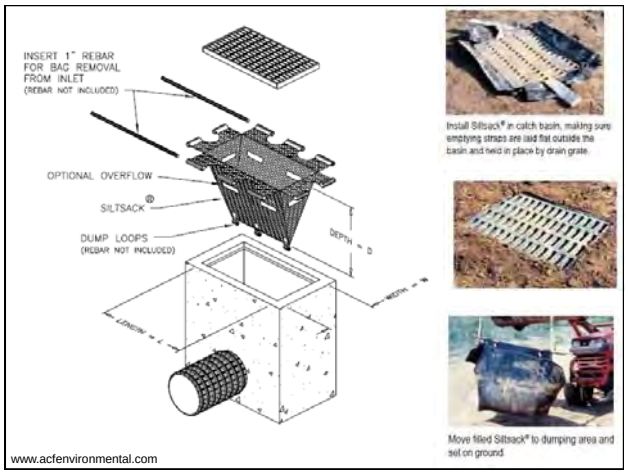
Fabric/Rock Filter
Curb Inlet Protection



Install wattles per manufacturer's instructions.
Extend 1 ft beyond either end of inlet opening

Correct

Incorrect in so many ways



Common Problems

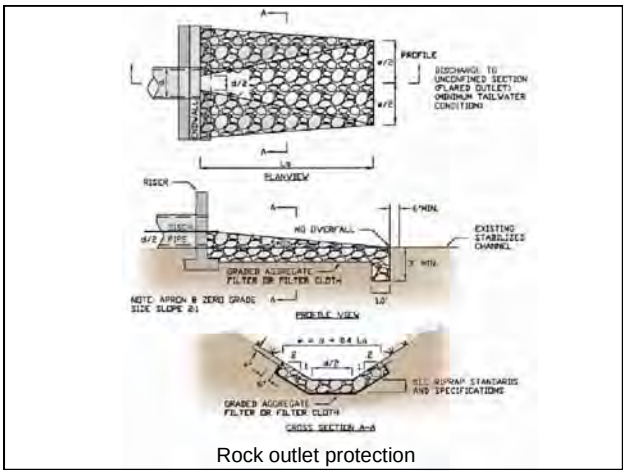
- Not installed or maintained correctly
- Don't allow for water overflow
- Filter media not sufficient

Maintenance

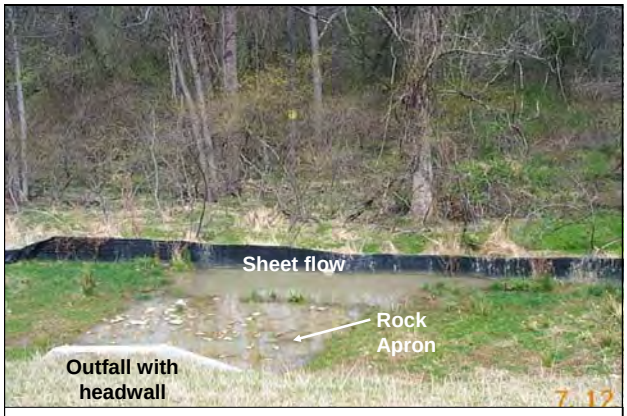
1. Check after each rain storm
2. Make repairs as needed
3. Remove sediment when storage is ½ full or accumulation on curb significant
4. Remove when drainage area fully stabilized

Outlet Protection

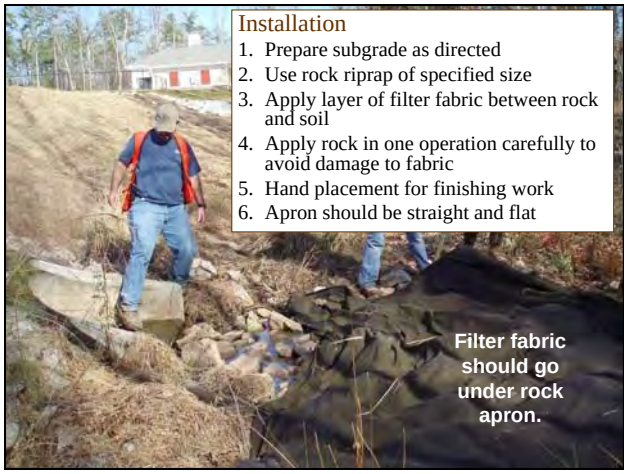
Objective: Prevent erosion at point of discharge by slowing and spreading flow



Rock outlet protection



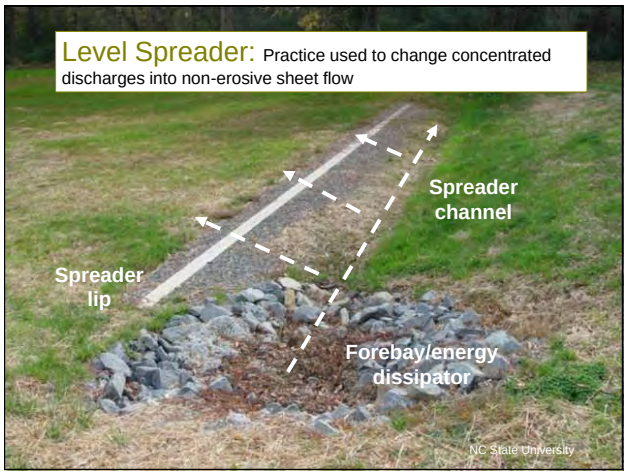
Rock aprons should be straight and flat to slow flow and distribute flow uniformly

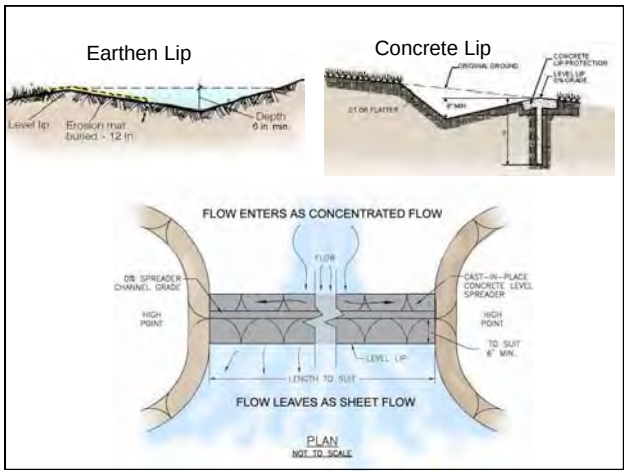


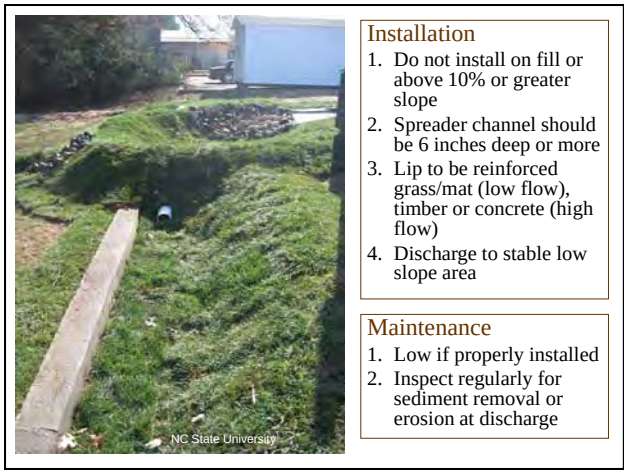

Probably not enough space to slow/spread flow out at discharge point.

Nice use of dissipation pool at outlet.

Concentrated discharges into highly erodible soil can be a challenge.







Installation

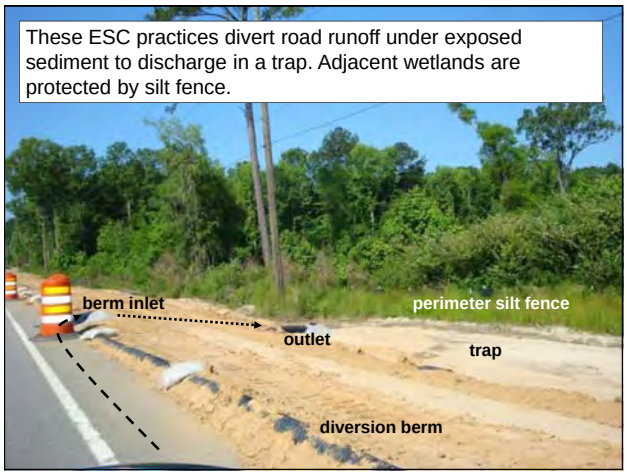
1. Do not install on fill or above 10% or greater slope
2. Spreader channel should be 6 inches deep or more
3. Lip to be reinforced grass/mat (low flow), timber or concrete (high flow)
4. Discharge to stable low slope area

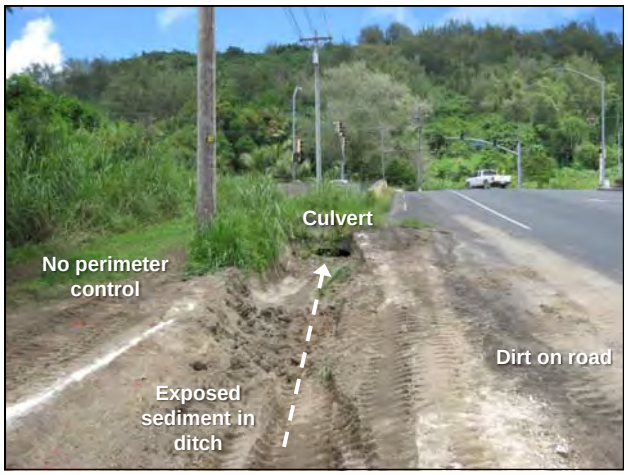
Maintenance

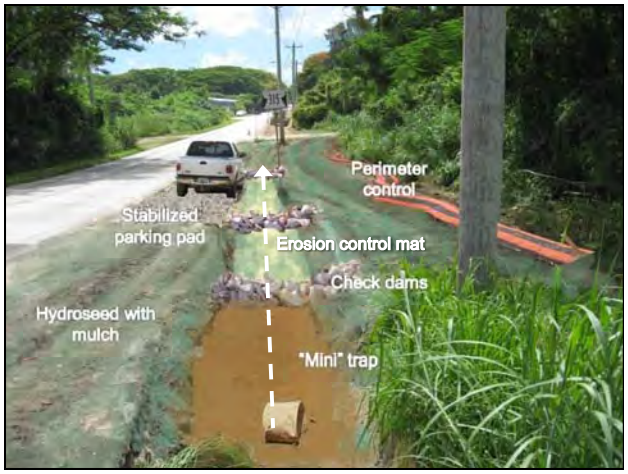
1. Low if properly installed
2. Inspect regularly for sediment removal or erosion at discharge

Applying ESC Practices to Road Projects

1. Inlet protection
2. Sediment barriers/ perimeter control
3. Outlet protection
4. Traffic management
5. Check dams in roadside ditches
6. Slope stabilization
7. Stockpile management/ designated storage







For the exam, you should know:

- Purpose of stabilization practices and inlet/outlet protection devices
  - **Stabilization** – To prevent erosion of bare soils and slopes
  - **Inlet protection** – To let water pass, but keep sediment out
  - **Outlet protection** – To prevent erosion at discharge points by slowing and spreading flow
- Timeframe for when you need to stabilize exposed, un-worked soils
- How they work and why they may fail
- Basic installation procedures
- Basic maintenance requirements for practices

...Questions???

BREAK

Outline

1. Inspections and maintenance
2. Managing trash, supplies, and materials
3. Removing temporary ESC practices
4. Permanent stormwater management

2

1. Inspections and Maintenance

3

Compliance for Commonly Used ESC Practices

Practice	Installed	Installed Properly	Adequately Maintained
Silt Fence	67%	58%	34%
Sediment Trap	86%	86%	58%
Stable entrance	89%	89%	67%

NC Study, CWP

It helps if you:
- Include ESC maintenance $ in budget
- Designate on-site contractor for maintenance
- Set self-inspection schedule

4

Relative Maintenance Burden

Practice	High	Med	Low	Frequency
Silt fence	✓			Daily
Stable entrance		✓		Daily
Berms/swales		✓		Weekly
Check dams			✓	After rain event
Traps/basins		✓		When ½ full
Erosion mats			✓	After rain events
Inlet protection	✓			
Rock outlet			✓	
Level spreaders			✓	

Routine maintenance by workers

- Removing sediment tracked on road
- Repair torn fabrics in fencing, inlet protection, and erosion control matting
- Replace natural area protective fencing
- Replace rocks from entrances, check dams, and outlet protection
- Repair diversions daily if disrupted by construction activities
- Fill gullies and rills
- Irrigate vegetation
- Remove sediment behind sediment barriers, check dams, and in trapping devices

7

Assess ESC Practices After Storms

Objectives:

- Repair the damage done during storm events
- Prepare ESC practices for the next storm

Techniques:

- Modify ESC plans
- Reinforce or cleanout existing practices

8

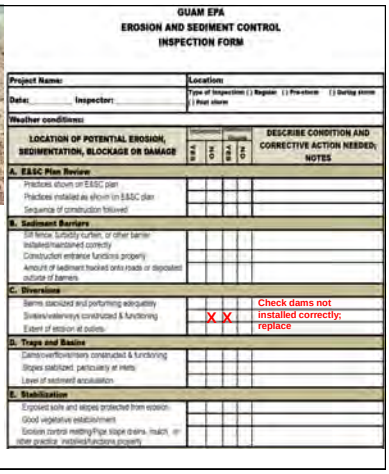
Inspectors should:

- Know the ESC plan
- Inspect at required frequency (14 days, after storm events, installation, final)
- Evaluate practice effectiveness
- Identify corrective actions
- Concentrate on areas with highest failure potential:
  - Where sediment can build up
  - Concentrated flow areas
  - Steep cut and fills
  - Around outfalls
- Document conditions and required actions
- Notify/provide report copies to all parties
- Follow up with enforcement

9

Make sure you inspect areas receiving drainage from your construction site…

Document with approved inspection report, take photos, describe corrective actions to be taken and timeframe for completion



GUAM EPA
EROSION AND SEDIMENT CONTROL
INSPECTION FORM

Project Name: Location:
Date: Inspector:
Weather conditions:

LOCATION OF POTENTIAL EROSION, SEDIMENTATION, BLOCKAGE OR DAMAGE	YES	NO	N/A	DESCRIBE CONDITION AND CORRECTIVE ACTION NEEDED; NOTES
A. E&SC Plan Review				
Practices shown on E&SC plan				
Practices installed as shown on E&SC plan				
Sequence of construction followed				
B. Sediment Barriers				
Silt fence, turbidity curtain, or other barrier installed/maintained correctly				
Construction entrance functions properly				
Amount of sediment tracked onto roads or deposited outside of barriers				
C. Diversions				
Berms stabilized and performing adequately				
Swales/waterways constructed & functioning	X	X		Check dams not installed correctly; replace
Extent of erosion at outlets				
D. Traps and Basins				
Dams/overflow/risers constructed & functioning				
Slopes stabilized, particularly at inlets				
Level of sediment accumulation				
E. Stabilization				
Exposed soils and slopes protected from erosion				
Good vegetative establishment				
Erosion control matting/Pigs, slope drains, mulch, or other practice installed/functions properly				

Inspectors should follow up on repair jobs…

Commonly Observed Problems

- No ESC plan
- Improper installation and/or substitution of practices
- Lack of proper maintenance – biggest cause of failure!!
- Lack of temporary and permanent stabilization :
  - Proper use of erosion control blankets and vegetation could greatly reduce amount of eroded sediment
  - Most severe on-site erosion takes place at cut and fill slopes, yet these areas tend to be least properly stabilized

Which one shows good maintenance ?

17

18


Good or Bad?
Clemson University CEPSCI


Good or Bad?
Clemson University CEPSCI


Good or Bad?
Copyright Center for Watershed Protection, 2001


What needs to happen here?


What needs to happen here?


Clemson University CEPSCI
Clemson University CEPSCI
Which of these two is working?

2. Trash, Supplies, and Materials

Goal:

- Keep debris and contaminants out of contact with stormwater
- Improve worker safety
- Save money
- Comply with SWPPP

- Cover waste, stockpiles, supplies to protect from wind and stormwater
- Manage designated wash, fuel, servicing, storage areas
- Store hazardous materials in containment unit
- Have spill response plan
- Recycle or reuse waste materials

25

Establish designated storage areas

Store hazardous materials in containment unit to avoid spills

Locating storage areas adjacent to unprotected stream channels is not good.

Designate an area for concrete truck wash-outs

SoCal Sandbags, Inc

Once it hits the ground, trash usually never makes it to the dumpster…

Pickup trash at end of each day

Cover and protect stockpiles from rain and wind.
What is wrong in this picture?

3. Removing ESC Practices

No site can be closed out until:

- Temporary practices removed
- Permanent stormwater management in place
- Construction waste removed/properly disposed
- Vegetation established on all bare soil areas
- All ditches and slopes are stable
- Final inspection

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When removing ESC practices

- Remove accumulated sediments from practices, dispose of properly and use a dewatering practice when necessary
- Fill in, re-grade, re-seed where necessary
- Do not remove inlet protection until drainage area is stable (~30 days) and permanent practices are ready
- Remove perimeter controls
- Clean culverts and inlets
- Stabilize ditch banks and bottoms
- Remove loose or excess erosion control blankets, re-seed bare areas

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When converting sediment basins to permanent stormwater practices

- Remove accumulated sediment
- Dispose of sediment properly; if basin is wet, use an appropriate dewatering practice
- Regrade to new post-construction specifications as designed
- Replace/install water quality risers for detention basins
- Add appropriate media, underdrains, media, and vegetation for filtration practices
- Stabilize banks, inlets, and outlets
- Submit “as-built” to approval authority

35

What needs to be done to this sediment basin before it can be used for post-construction stormwater?

4. Permanent Stormwater Management

- Install permanent practices as designed
- Protect practices from sediment during construction activities
- Maintain drainage paths during final site grading and paving
- Make sure all permanent practices are inspected before temporary practices are removed
- Remove sediment and debris before "turning on" practices

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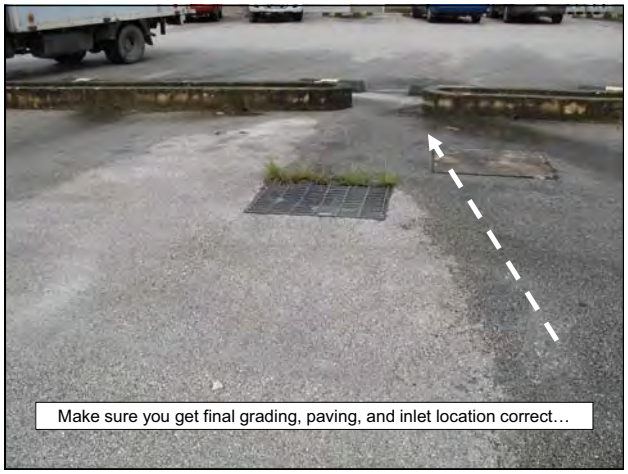
During construction, protect practices from sediment which can clog infiltration devices.

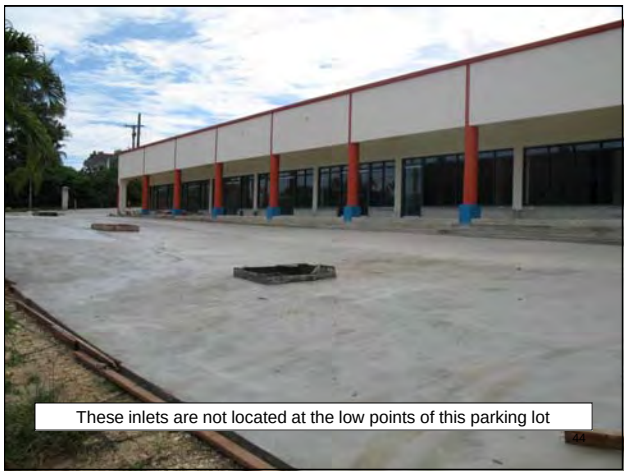
Conversion of sediment basins to permanent ponding basins should be according to approved engineering design.

This basin is accepting stormwater tourists before site has been cleaned, and final vegetative stabilization has been completed.

2 years later…this pond is overgrown…



Make sure you get final grading, paving, and inlet location correct…



What you should know for exam

- Maintenance requirements for various practices
- Routine maintenance and when to inspect
- Techniques for managing waste materials and construction supplies
- What has to happen before removing ESC practices
- How to go from temporary to permanent stormwater management

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BREAK

Guam Erosion and Sediment Control (ESC) Training
Designing an ESC Plan: Group Exercise

Task 1 – Review the site plan and use highlighters to identify the following features:

- Use the blue highlighter to outline the stream and stream buffer (100 feet for this site). What is the minimum required stream buffer in Guam? _____
- Locate the proposed tree line and highlight with green.

  Is this also the limit of disturbance? **Yes** or **No** (circle one)
- Identify the highest point on the site and mark it with an "X."
- Locate the proposed storm sewer system and highlight it with orange.
- Locate areas of cut and fill slopes, highlighting them with yellow and pink, respectively.

Task 2 – How do you propose to show the limit of disturbance in the field before mass clearing and grading.

_____

_____

Task 3 -- Determine the best location for a Stabilized Construction Entrance.

- Draw it on the plan to scale, using at least the required minimum dimensions and the appropriate symbol from the ESC legend.
- Create a basic cross-section for the practice on the plan in the space provided.

Task 4. Identify and add to the plan an appropriate Materials Stockpile location.

- What practices will you use to protect the stockpile? Draw them on the plan.

_____

_____

Task 5. – How will you move runoff through the site?

- Locate areas up-gradient from the site where "clean" water will flow onto the site during construction. How should this water be handled? Sketch in any ESC practice you recommend to keep this clean water off the construction site and identify on plan using the appropriate symbol from the ESC legend.

- The site plan shows two proposed entrances that cross streams. Sketch on the plan how you propose to temporarily divert the stream during construction and create a detail for the practice(s) on the plan in the space provided.

Task 6 – Design a Temporary Settling Device.

- The Site Plan shows a post-construction stormwater practice ("Biofilter") in the bottom left corner. Is this the best place for a temporary settling device? Why or why not?

_____

_____

_____

- The drainage area to this practice is 3.04 acres. Would this need to be designed as a Sediment Trap or a Sediment Basin? (circle one)

- The volume of this practice as proposed is 20,000 cubic feet. Is this big enough to meet the required volume? Calculate the required volume here:

Yes or **No** (circle one)

- Does this practice meet the required length-to-width ratio? **Yes** or **No** (circle one)
- How do you propose to convey dirty runoff from the proposed roadway to the temporary settling device before the storm sewer is constructed? Show these measures on the plan using the appropriate symbol(s) from the ESC legend.

_____

_____

Task 7 – How do you propose to stabilize steep slopes?

- Determine the method that you would recommend to temporarily stabilize the cut and fill slopes before the permanent storm drain system is in place. Add locations on the plan using the appropriate symbol(s) from the ESC legend.

_____

_____

- Determine the method that you would recommend to provide stabilization for the slopes AFTER the storm sewer is installed and functioning (for permanent stabilization).

_____

_____

Task 8 – The permanent stormwater system includes drain inlets in the parking lots. What kind of inlet protection do you propose?

- Circle all proposed inlets and draw in arrows that indicate the direction of flow for all storm sewer pipes.
- Assuming that these will be curb inlets, what inlet protection practice would you recommend?

_____

_____

Task 9 – Determine the outlet protection practice(s) needed at this site and identify on the plan using the appropriate symbol(s) from the ESC legend.

_____

_____

Task 10 -- Sequence of Construction Scramble

This site is proposed to be constructed in 2 phases. Unscramble the following Sequence of Construction within each phase to show the correct sequence by putting the appropriate sequence number (1, 2,3, etc).

Phase 1: Site Access & Preparing for Site Grading

☐ After road crossing embankment is in place, install outlet structure and grade embankment for permanent stormwater BMP (shown as "Proposed Biofilter" on plan) so that this can function as a temporary sediment basin. Stabilize immediately with seed and straw.

☐ For the construction site, install all temporary diversion dikes and level spreaders to divert upgradient clean water around the construction site and release it in a non-erosive manner.

☐ Create temporary stream diversion channel so that the road crossing of stream can be installed. Install culvert and outlet protection in dry conditions. Direct upstream flow through culvert and remove stream diversion. Grade road crossing embankments and stabilize with erosion control matting.

☐ Install construction entrance at the location shown on the plan.

Phase 2: Site Grading, Install Storm Sewer System, Stabilization

☐ Perform necessary grading operations for the site. Seed and apply erosion control matting to all slopes with a 3:1 grade or steeper. BEFORE the storm sewer system is in place, use temporary fill diversions and slope drains for newly graded slopes to convey runoff down the face of graded slopes.

☐ Once the site is adequately stabilized with vegetation, as approved by the erosion and sediment control inspector, complete conversion of temporary sediment basin to permanent biofilter. Remove all temporary erosion and sediment control measures.

☐ After the storm sewer system is in place, complete the remainder of site construction (other than proposed biofilter areas) in accordance with the site development plan.

☐ Install proposed storm sewer system as shown on the plan. Apply inlet protection at each inlet. Construct proposed curbing to ensure conveyance to storm sewer inlets. Remove temporary fill diversions and slope drains as needed.

☐ When all site disturbed areas have been seeded and mulched, conduct grading to convert temporary sediment basin to permanent biofilter. DO NOT INSTALL BIORETENTION UNDERDRAIN OR SOIL MIX.

☐ Stabilize all disturbed areas with permanent seeding and mulch.

Guam ESC Training
Reading an ESC Plan: Group Exercise Handout

Task 1 – Review the Site Plan and use colored highlighters to identify the following items:

- Use the blue highlighter to outline the stream and stream buffer.
- Locate the proposed tree line and highlight with green. What else is located in the same place as the proposed tree line?_____
- Identify the highest point on the site and mark it with an "X."
- Locate the proposed storm sewer system and highlight it with orange.
- Locate the following ESC measures and highlight them with yellow:
  - construction entrance
  - materials stockpile area
  - inlet protection
  - pipe slope drain
  - level spreaders
  - diversion and temporary dikes
  - outlet riprap protection
  - sediment basin

Task 2 – How is runoff and stream flow conveyed?

- Draw a flow path from the highest point on the site to the stream. What practices are used to divert this "clean," offsite runoff around the site?_____
- What practices convey runoff through the site and into the sediment basin?

  _____
- What ESC practices should be used during construction of the new culverts?

  _____

Task 3 – Review the construction sequence. Indicate which step in the sequence the following activities belong (for example, "construction entrance" belongs in Step 1 of the sequence):

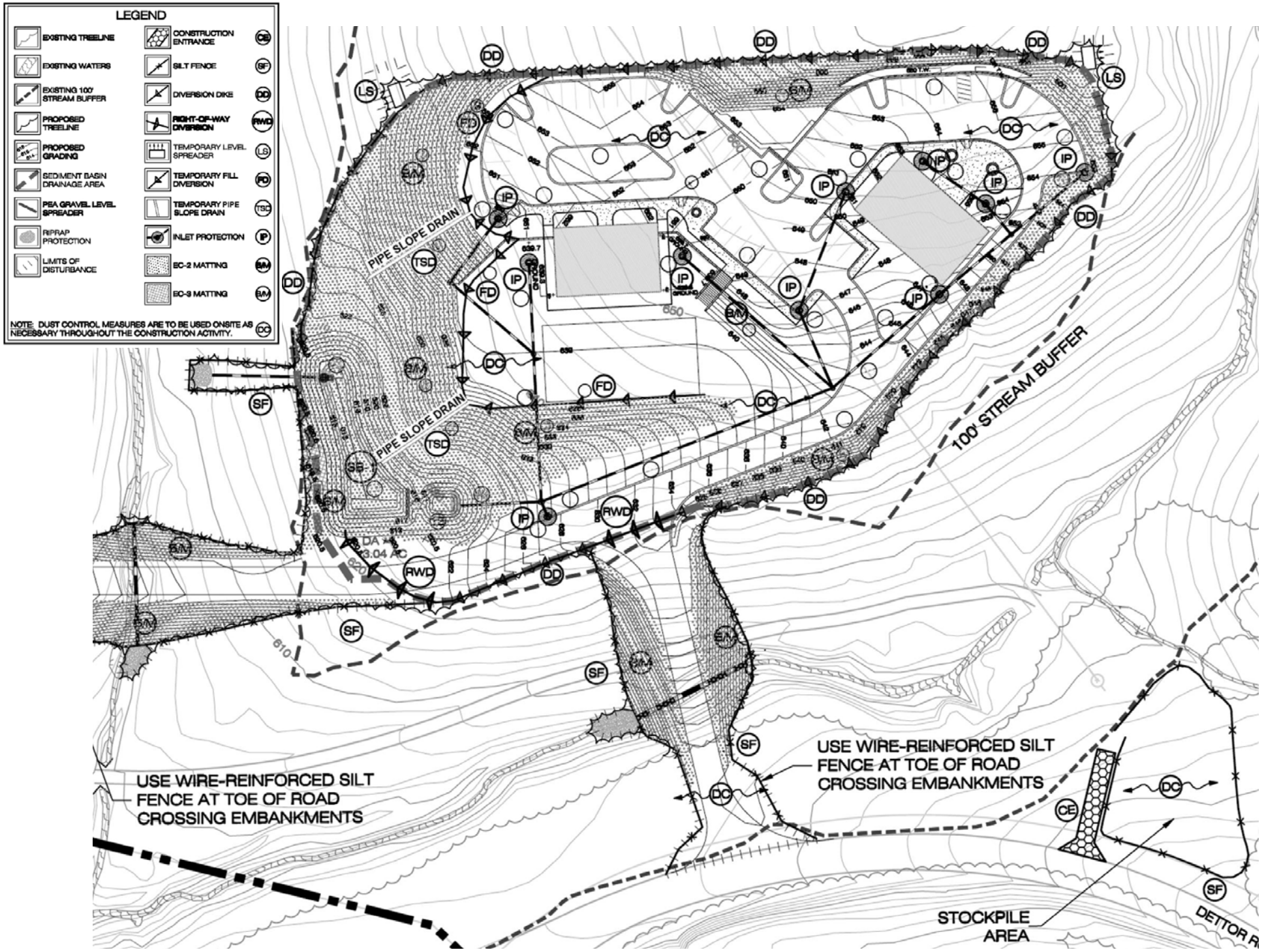
	Sequence Step
Clearing of site	_____
Removal of all temporary ESC Measures	_____

Task 4 – Locate and circle the Maintenance section of the notes. When should sediment be removed from behind the silt fences at this site?_____

Task 5 – Review the Erosion and Sediment Control Notes. According to #6, who is responsible for the installation of any additional ESC measures required at the site? _____

Task 6 – Review the detail for a diversion dike. What is the minimum height for the dike?_____ Should the dike be compacted? Yes or No (circle one).

Additional Notes:


LEGEND
EXISTING TREELINE
EXISTING WATERS
EXISTING 100' STREAM BUFFER
PROPOSED TREELINE
PROPOSED GRADING
SEDIMENT BASIN DRAINAGE AREA
PEA GRAVEL LEVEL SPREADER
RIPRAP PROTECTION
LIMITS OF DISTURBANCE
CONSTRUCTION ENTRANCE
SILT FENCE
DIVERSION DIKE
RIGHT-OF-WAY DIVERSION
TEMPORARY LEVEL SPREADER
TEMPORARY FILL DIVERSION
TEMPORARY PIPE SLOPE DRAIN
INLET PROTECTION
EC-2 MATTING
EC-3 MATTING
NOTE: DUST CONTROL MEASURES ARE TO BE USED ONSITE AS NECESSARY THROUGHOUT THE CONSTRUCTION ACTIVITY.
PIPE SLOPE DRAIN
PIPE SLOPE DRAIN
100' STREAM BUFFER
DA = 3.04 AC
USE WIRE-REINFORCED SILT FENCE AT TOE OF ROAD CROSSING EMBANKMENTS
USE WIRE-REINFORCED SILT FENCE AT TOE OF ROAD CROSSING EMBANKMENTS
STOCKPILE AREA

BREAK

Guam Erosion and Sediment Control Training

ESC Practice - Field Notes

#1. Type of Practice:

Installation:

Maintenance:

Removal:

#2. Type of Practice:

Installation:

Maintenance:

Removal:

#3. Type of Practice:

Installation:

Maintenance:

Removal:

#4. Type of Practice:

Installation:

Maintenance:

Removal:

#5. Type of Practice:

Installation:

Maintenance:

Removal:

#6. Type of Practice:

Installation:

Maintenance:

Removal:

#7. Type of Practice:

Installation:

Maintenance:

Removal:

#8. Type of Practice:

Installation:

Maintenance:

Removal:

#9. Type of Practice:

Installation:

Maintenance:

Removal:

Other notes: