Slide 1

Keeping Soil in Its Place:

A Presentation on Erosion and Sediment Control (ESC)

by
The Center for Watershed Protection

Slide 2

Slide 3

Why Is ESC Important?

- ESC reduces runoff and sediment loads to streams, lakes, wetlands and estuaries
- ESC mitigates the impacts of erosion and sedimentation:
  - Direct environmental impacts
  - Economic impacts
  - Impacts to stormwater treatment practices (STPs)

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Construction Site Runoff: Environmental Impacts

- Turbidity limits sunlight penetration and photosynthesis
- Reduces oxygen availability
- Clogs fish gills
- Fills spawning and breeding grounds
- Smothers bottom communities
- Transports toxic pollutants and nutrients
- Reduces visibility for feeding and upsets food chain

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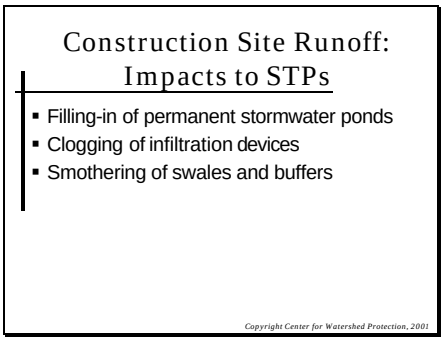

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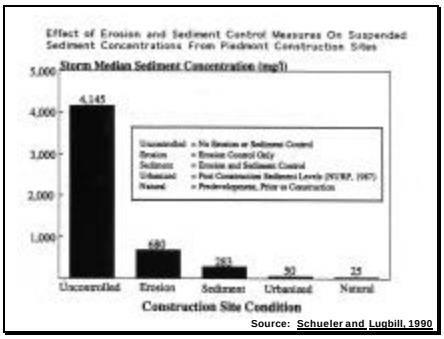

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ESC Reality

- Recent surveys reveal:
  - 16% of ESC practices prescribed in plans are never installed
  - 16% not installed correctly and fail to perform
  - 18% of practices fail due to lack of maintenance
  - Only 50% of ESC installation budget actually spent
  - Local governments spend 3 to 6 times more effort on plan review than inspection

Sources: Paterson, 1994 and Paterson *et al*., 1993

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Compliance for Commonly Used ESC Practices

Practice	Installed	Installed Properly	Adequately Maintained
Silt Fence	67%	58%	34%
Sediment Trap	86%	86%	58%
Anti-Tracking Pad	89%	89%	67%

Source: Paterson, 1994

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10 Elements of an Effective ESC Plan

- Plan to minimize area to be disturbed, eliminate unnecessary clearing and grading.
- Protect waterways and stabilize drainageways.
- Phase construction to limit duration of soil exposure.
- Stabilize exposed soils immediately.
- Avoid grading on steep slopes and cuts, protect them if avoidance impossible.

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10 Elements of an Effective ESC Plan

- Install perimeter controls to filter sediments including Silt Fences, Stabilized Construction Entrances, flow diversions, etc.
- Employ advance sediment settling devices including Sediment Traps and Basins.
- Certify contractors on ESC plan implementation.
- Adjust ESC plan at construction site to adapt to field conditions.
- Assess ESC practices routinely and after storms.

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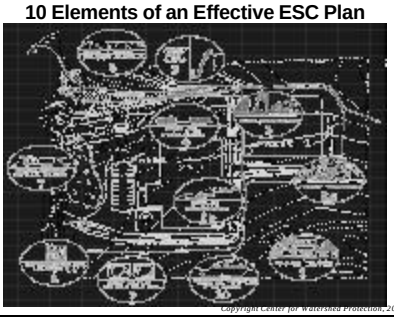
10 Elements of an Effective ESC Plan



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1. Minimize Clearing

- Objectives:
  - Prevent erosion by never clearing/grading portions of the work site
  - Protect sensitive areas from grading
  - Preserve natural vegetation/forest
- Techniques:
  - Site fingerprinting
  - Restrict clearing to minimum needed
  - Use of "tree-save"

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Clearing Restrictions

Areas never cleared or activities sharply restricted:

- Stream buffers
- Forest conservation areas
- Wetlands, springs and seeps
- Steep slopes, highly erodible soils
- Stormwater infiltration areas

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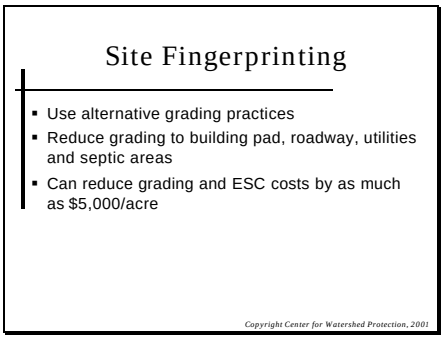

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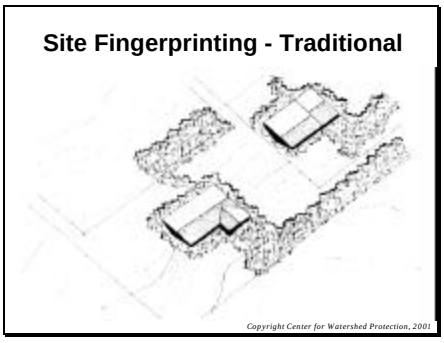

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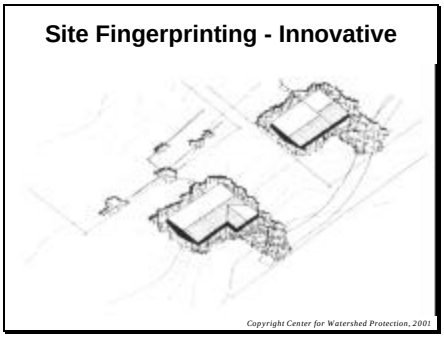

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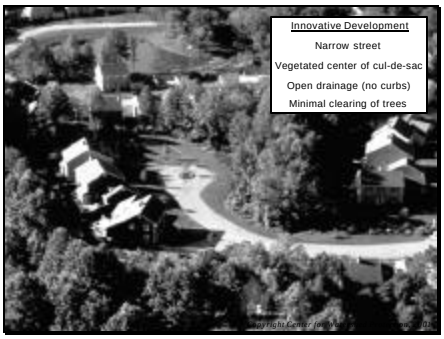

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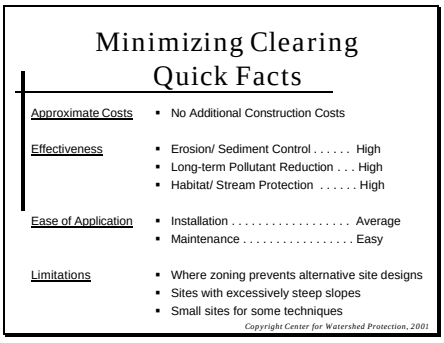

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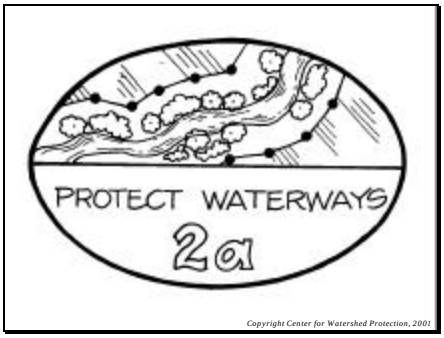

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2a. Protect Waterways

Objective:

- Protect streams and waterways from sedimentation during construction

Techniques:

- Restrict clearing within 25 feet of waterway (Integrate with existing buffer regulations).
- Special crossings required if work is planned across the waterway
- Permit needed to work in stream

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Protecting Waterways: Vegetated Buffers Quick Facts

Approximate Costs	▪ No Additional Construction Costs
Effectiveness	▪ Erosion/ Sediment Control . . . . . .Moderate ▪ Long-term Pollutant Reduction . . .Moderate ▪ Habitat/ Stream Protection . . . . . .High
Ease of Application	▪ Installation . . . . . Average ▪ Maintenance . . . . . .Easy
Limitations	▪ Steep slopes or slopes w/ rills limit filtering capacity ▪ Sites with limited space

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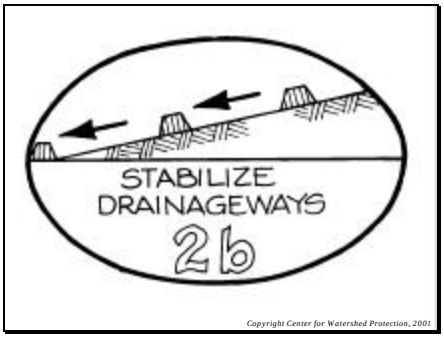

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2b. Stabilize Drainageways

Objectives:
- Prevent erosion in vulnerable drainageways
- Promote infiltration

Techniques:
- Checkdams
- Sod
- Erosion control blankets or mats
- Rip rap (use sparingly)

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Check Dams

- Reduce flow velocities in channels
- Provide limited sediment trapping
- Require spacing so that the bottom of each dam lines up with the top of the next one
- Ineffective on slopes > 10%

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Swales

- Often used in conjunction with earth dikes.
- Can be used to divert clean water around a site or convey runoff to ESC device.
- Keeps flow velocity non-erosive if designed carefully.

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Stabilizing Drainageways Quick Facts

Approximate Costs	▪ $5 to $6 / lf (depending on depth of cut)
Effectiveness	▪ Erosion/ Sediment Control . . . . . High ▪ Long-term Pollutant Reduction . . .Low ▪ Habitat/ Stream Protection . . . . . .Low
Ease of Application	▪ Installation . . . . . Moderate ▪ Maintenance . . . . . Difficult
Limitations	▪ Very small sites

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3. Phase Construction

Objective:

- Reduce soil erosion by minimizing the amount of time and area of exposed soil
- Grade only portion of site where construction is active ("just-in-time" grading)
- Should not be confused with construction sequence

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3. Phase Construction

- Can reduce erosion by 40% over traditional mass grading
- Requires careful planning
  - "Cut" soil matches "fill" requirement
  - Provisions for temporary stockpiling and construction access
  - Phases should correspond to existing and future drainage boundaries where possible

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Phase Construction Quick Facts

Approximate Costs	▪ No Additional Construction Costs
Effectiveness	▪ Erosion/ Sediment Control . . . . . High ▪ Long-term Pollutant Reduction . . . Low ▪ Habitat/ Stream Protection . . . . . Low
Ease of Application	▪ Installation . . . . . Difficult ▪ Maintenance . . . . . Easy
Limitations	▪ Where it is impossible to balance earthwork by phase ▪ Where alternative access is not feasible for both construction equipment and occupants ▪ Small sites

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4. Rapid Soil Stabilization

Objective:

- Reduce soil erosion by minimizing the amount of time soil is exposed

Techniques:

- Hydroseeding
- Mulching
- Erosion control blankets/mats

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4. Rapid Soil Stabilization

- Establish grass or mulch cover within two weeks of soil exposure
- Permanently stabilize disturbed soils at conclusion of each phase of construction
- Contingency line item for replacing cover that does not take
- Require heavy mulching after the growing season

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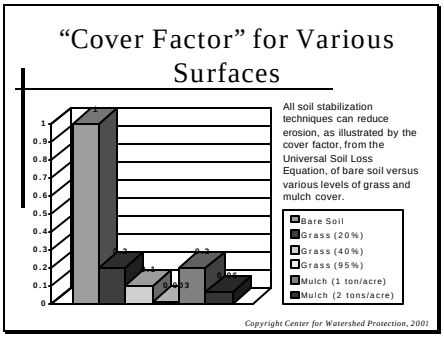

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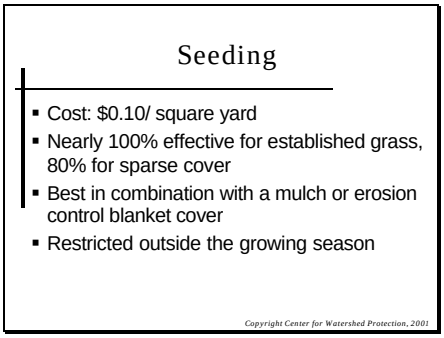

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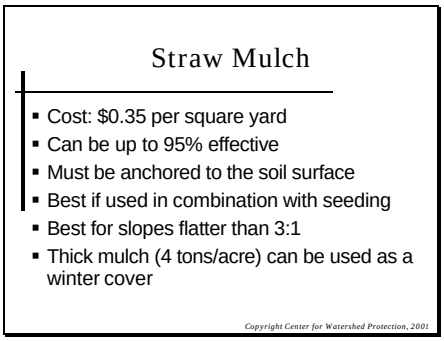

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Fiber Mulch

- Cost: $0.25 per square yard
- Can be up to 90% effective
- Typically used in combination with hydroseeding
- Can apply with seeding in one step
- Not appropriate for steep slopes or long time periods

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Blankets

- Cost: $1.50 per square yard.
- Up to 90% effective.
- Best when used with seeding.
- Effective for steep slopes or channels.
- Two Types: Temporary and Permanent
  - Temporary erosion control blankets
  - Permanent turf reinforcement matting

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Plastic Sheeting

- Cost: $0.10 per square yard
- Only effective on areas less than ½ acre
- Good for short term cover
- Plastic edges should be weighed down to prevent displacement by wind
- Example use: stockpiles

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Comparison of Erosion Control Materials

Material Types	Cost ($/sq yard)	Uses	Limitations and Disadvantages
Seeding	0.10	As a permanent or temporary erosion control, established grass is the most effective control	Climate (dry or cold weather), infertile soils (needs fertilizer, lime, etc), needs some other surficial cover on most slopes
Straw mulch	0.20 – 0.35	As a protection for seeds, alone as a temporary erosion control	Slopes steeper than 20% for straw mulch, can interfere with grading operations, straw or hay mulch needs to be secured to the soil surface

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Comparison of Erosion Control Materials

Material Types	Cost ($/sq yd)	Uses	Limitations and Disadvantages
Blankets	1.00 – 2.00	Useful on steeper slopes than mulches, protects seed and prevents erosion	Installation is more complicated and time-consuming than for mulches
Plastic Sheeting	0.05 – 0.15	Temporary control for very small areas	Does not allow infiltration, edges must be weighed down. unsuitable for areas greater than 2,000 sq feet
Sodding	1.80	Use of sod to provide vegetative cover, can be used in low-flow channels	Drought or poor soils can impede growth, most expensive

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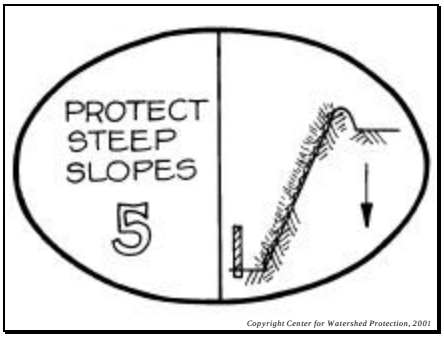

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5. Protect Steep Slopes

Objective:

- Reduce erosion from steep (>3:1) slopes

Techniques:

- Limit clearing of steep slopes
- Divert upland flow using earthen dike, temporary swale or pipe slope drain
- Use upslope line of silt fence
- Erosion control blankets with seed
- Sodding

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Pipe Slope Drain

- Cost: $5-6 per linear foot
- Used to convey runoff past steep slopes.
- Limited to <3 acres for each 24" pipe.
- Effective in combination with a sediment trap or basin.
- Requires stable outlet.

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Protecting Steep Slopes Quick Facts

Approximate Costs	▪ $5-6 / lf
Effectiveness	▪ Erosion/ Sediment Control . . . . . .Mod ▪ Long-term Pollutant Reduction . . .Low ▪ Habitat/ Stream Protection . . . . . .Low
Ease of Application	▪ Installation . . . . . Average ▪ Maintenance . . . . . Average
Limitations	▪ Very small sites ▪ Sites with no room for basin or trap below disturbed slope

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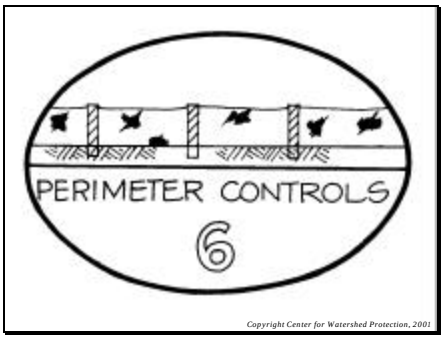

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6. Perimeter Controls

Objective:

- Retain or filter runoff before it leaves the site.

Techniques:

- Earth dikes or diversions.
- Silt fences.
- Stabilized construction entrances.

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Silt Fences

- Popular practice due to low cost: $3.50 per linear foot.
- Between 65% and 85% TSS removal in field studies.
- Real life performance (recent North Carolina field study).
  - Only 67% of silt fences on the ESC plan were installed.
  - Only 58% were installed correctly.
  - Only 34% were adequately maintained.
- Ongoing maintenance is typically required that can cost as much as original installation over project life.
- Challenges include proper placement and construction.

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Improving Silt Fences

- Improvements to silt fences
  - Strengthen geotextiles
  - Use longer, thicker poles for support
  - Include a 10 foot grass buffer
  - Practice effective erosion control to reduce sediment buildup

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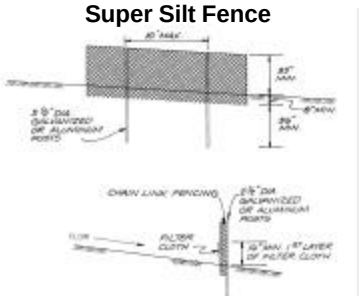
Super Silt Fence



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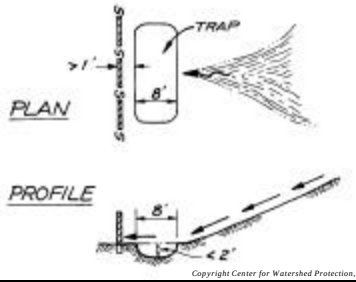
Super Silt Fence with Scoop Trap



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Perimeter Control: Silt Fence Quick Facts

Approximate Costs	▪ $2.50 - $3.50 / lf
Effectiveness	▪ Erosion/ Sediment Control . . . . . Moderate ▪ Long-term Pollutant Reduction . . . Low ▪ Habitat/ Stream Protection . . . . . Low
Ease of Application	▪ Installation . . . . . Difficult ▪ Maintenance . . . . . .Difficult
Limitations	▪ Steep slopes or channels ▪ Construction traffic

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7. Employ Advance Settling Devices

Objective:

- Trap sediment in runoff before it leaves the site

Techniques:

- Sediment traps
- Sediment basins

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Settling Devices

- TSS removal varies between 50% to 90%
- Trapping limited by
  - Difficulty in settling fine-grained soils
  - Simplistic design of existing basins

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Ways to Improve Trapping

- Increase storage volume / residence time.
- Perforated risers.
- Use of baffles, skimmers, other devices.
- Multiple cell construction.
- Gentler side slopes and inflow protection.

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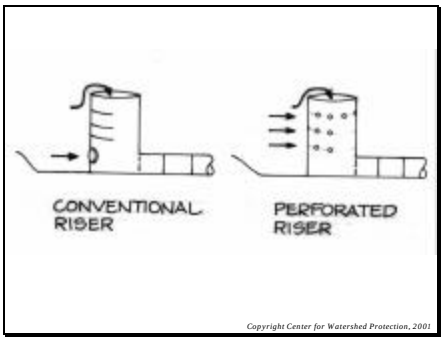

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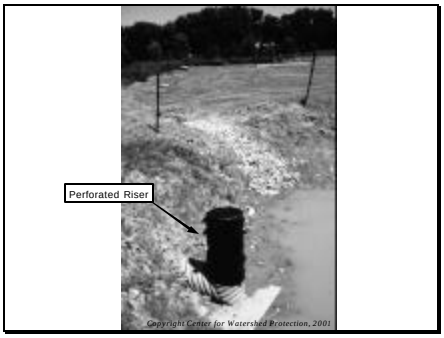

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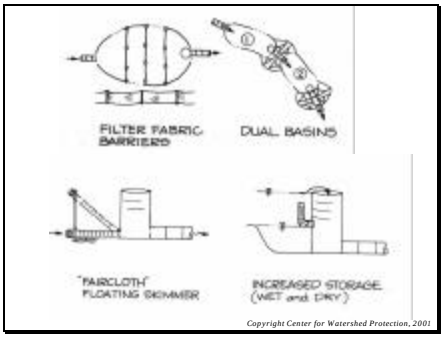

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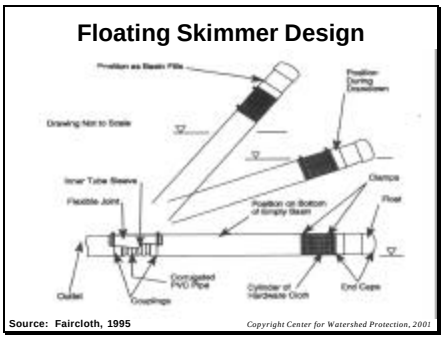

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Employing Advanced Settling Devices Quick Facts

Approximate Costs	▪ $15/ cy (for earthwork)
Effectiveness	▪ Erosion/ Sediment Control . . . . . Moderate ▪ Long-term Pollutant Reduction . . . High ▪ Habitat/ Stream Protection . . . . . Moderate
Ease of Application	▪ Installation . . . . . .Average ▪ Maintenance . . . . . Average
Limitations	▪ Small sites especially for basins ▪ Extreme weather conditions ▪ Fine Soils

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8. Certified Contractors Implement Plan

Objectives:

- Improve performance of ESC through proper installation and maintenance.
- Involve contractors in the ESC process.

Techniques:

- State mandated and sponsored ESC training.
- Applies to contractors responsible for installation and maintenance of ESC devices.
- Pre-construction meetings.

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Maintenance of ESC Practices

- Cost of ESC maintenance and repair should be included in construction plan
- Designate on-site contractor for maintenance
- Set minimum maintenance and periodic self inspection schedule

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Maintenance Costs (% of Installation Costs)

Practice	Annual maintenance as % of installation
Seeding	20%
Mulching	2%
Silt Fence	100%
Sediment Trap	20%
Sediment Basin	25%
Inlet Protection	60%

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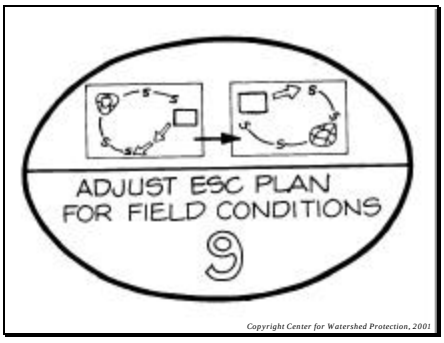

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9. Adjust ESC Plan for Field Conditions

Objectives:

- Keep plans up to date with changing field conditions
- Modify poorly-designed plans

Stage	Basis of Plan Change
Pre-construction meeting	Plan impractical from contractors' standpoint, site visit confirms plan unsuitability
After clearing/grading and sediment controls installed	"As built" grading or sediment controls different from original plan

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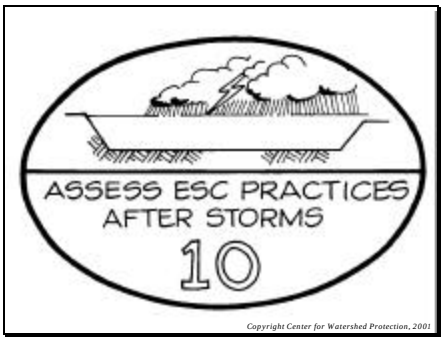

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10. Assess ESC Practices After Storms

Objectives:

- Repair the damage of storm events
- Prepare ESC practices for the next storm

Techniques:

- Modify ESC plans
- Reinforce or cleanout existing practices

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ESC Planning at the Local Level

- Most ESC programs are mandated by State laws or are in place to conform with Federal permits.
- 90% are implemented by local agencies.
- Minimal funding is available.

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Management Tips for Better Local ESC Planning

- Have a committed local leadership
- Re-deploy existing staff from office to field or training room
- Cross train local development review and inspection staff
- Submit erosion prevention elements for early planning review
- Prioritize inspection based on erosion risk
- Require designer to certify initial installation of ESC practices
- Invest in contractor certification and private inspector programs

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Management Tips for Better Local ESC Planning

- Use public-sector construction projects to demonstrate effective ESC controls
- Enlist the talents of developers and engineering consultants
- "Reinvent" the local ESC manual

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