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Preparing the Erosion and Sedimentation Control Plan

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GENERAL CONSIDERATIONS

Before preparing an erosion and sedimentation control plan, the designer should have a sound understanding of the requirements of the North Carolina Sedimentation Control Law (*Chapter 1*), erosion and sedimentation control principles (*Chapter 2*), the role of vegetation and other surface protection in the erosion process (*Chapter 3*), and the appropriate uses of the principal erosion and sedimentation control practices (*Chapter 5*).

Developers and builders can minimize erosion, sedimentation, and other construction problems by selecting areas appropriate for the intended use. Tracts of land vary in suitability for development. Knowing the soil type, topography, natural landscape values, drainage patterns, flooding potential, and other pertinent data helps identify both beneficial features and potential problems of a site.

Purpose of the Plan

The purpose of an erosion and sedimentation control plan is to establish clearly which control measures are intended to prevent erosion and off-site sedimentation. The plan should serve as a blueprint for the location, installation, and maintenance of practices to control all anticipated erosion and prevent sediment from leaving the site.

The approved erosion and sedimentation control plan—showing the location, design, and construction schedule for all erosion and sedimentation control practices—should be a part of the general construction contract. State specifically the method of payment for implementing this plan in the contract, and consider erosion and sedimentation control an early pay item.

Elements of the Plan

An erosion and sedimentation control plan must contain sufficient information to describe the site development and the system intended to control erosion and prevent off-site damage from sedimentation. As a minimum, include in the plan:

- a site location or vicinity map,
- a site development drawing,

- a site erosion and sedimentation control drawing,
- drawings and specifications of practices designated with supporting calculations and assumptions,
- vegetation specifications for temporary and permanent stabilization,
- a construction schedule,
- a financial/ownership form, and
- a brief narrative.

Although a narrative is not specifically required by the law, it can clarify details of the plan as an aid for the inspector and the contractor. The narrative should be concise, but should describe:

- the nature and purpose of the proposed development,
- pertinent conditions of the site and adjacent areas, and
- the proposed erosion and sedimentation control measures.

The designer should assume that the plan reviewer has not seen the site, and is unfamiliar with the project. Map scales and drawings should be appropriate for clear interpretation.

Data Collection and Preliminary Analysis

The base map for the erosion control plan is prepared from a detailed topographic map. If available, a soil map should be obtained from the local office of the USDA Soil Conservation Service. Transferring the soil survey information to the topographic map is helpful for site evaluation.

The design engineer responsible for the plan should inspect the site to verify the base map with respect to natural drainage patterns, drainage areas, general soil characteristics, and off-site factors.

The base map should reflect such characteristics as:

- soil type and land slopes,
- natural drainage patterns,
- unstable stream reaches and flood marks,
- watershed areas,
- existing vegetation (noting special vegetative associations),
- critical areas such as steep slopes, eroding areas, rock outcroppings, and seepage zones,
- unique or noteworthy landscape values to protect,
- adjacent land uses—especially areas sensitive to sedimentation or flooding, and
- critical or highly erodible soils that should be left undisturbed.

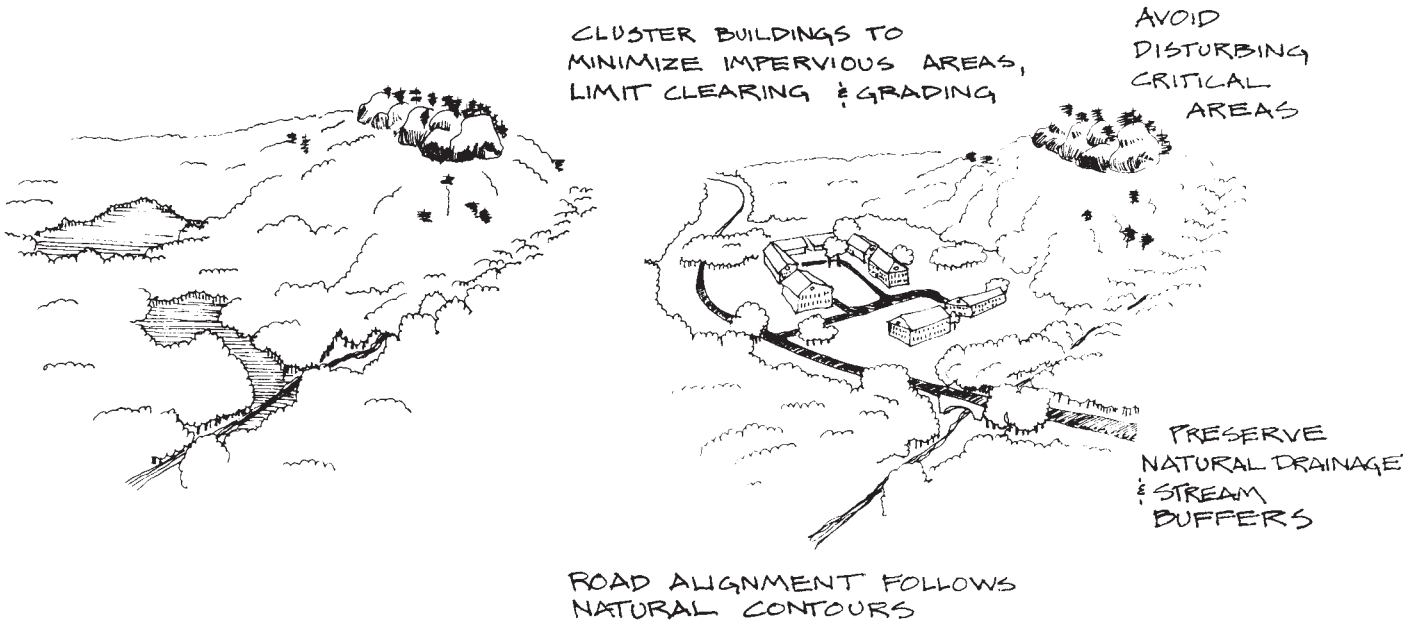


Figure 4.1 Site evaluation.

In the analysis of these data, identify:

- buffer zones,
- suitable stream crossing areas,
- access routes for construction and maintenance of sedimentation control devices,
- borrow and waste disposal areas, and
- the most practical sites for control practices.

The analysis of the topography, soils, vegetation, and hydrology should define the limitations of the site and identify locations suitable for development.

Principles of Site Development

The site evaluation data and the information shown on the field map serve as the basis for both the site development plan and the erosion and sedimentation control plan (Figure 4.1). Plan development to fit the proposed site, recognizing constraints determined in the site analysis. To determine the best layout of the site, observe the following principles:

Fit the development to the site—Follow natural contours as much as possible. Preserve and use natural drainage systems.

Limit clearing and grading—Clearly define work limit lines. Grade to minimize cut-and-fill slopes, preserve natural buffer areas, and limit the time that bare soil is exposed.

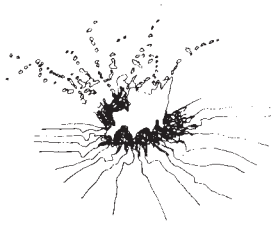
Minimize impervious areas—Build in clusters to provide more open space, minimize parking areas, and reduce disturbance for utility line construction. Use porous paving materials when practical. Maintain existing vegetation where possible.

Avoid disturbing critical areas—Identify and avoid areas vulnerable to concentrated runoff.

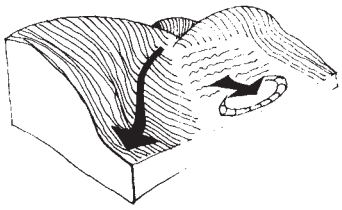
Maintain and enhance existing site values—Retain significant trees and other plant groups. Avoid disturbing unique land forms, very steep slopes, and rock outcroppings.

Strategy

The erosion and sedimentation control plan should seek to protect the soil surface from erosion, control the amount and velocity of runoff, and capture all sediment on-site during each phase of the construction project. Strategies for controlling erosion and sedimentation should consider the following elements:

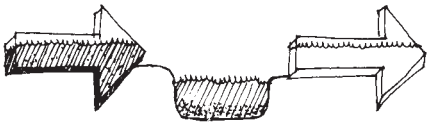


Schedule activities—Coordinate the installation of erosion and sedimentation control practices to coincide with the construction activities as the most cost-effective control strategy. Many sedimentation control practices should precede grading activities.



Protect the soil surface—Limit the extent of disturbance, and stabilize the soil surface immediately. Once the surface has been disturbed, it is subject to accelerated erosion, and should be protected with appropriate cover, such as mulch or vegetation, in an expedient manner.

Control surface runoff—Divert water from undisturbed areas to avoid disturbed areas. Break up long slopes with temporary diversions to reduce the velocity of runoff. Divert sediment-laden water to sediment impoundments. Make all outlets and channels stable for the intended flow.



Capture sediment on-site—Divert runoff that transports sediment to an adequate sediment-trapping device to capture sediment on the site.

Chapter 5 provides a practice selection guide (Table 5.1) for the selection of appropriate control practices. *Chapter 6* contains standards and specifications for the implementation of recommended erosion and sedimentation control practices.

WRITING THE PLAN

Phase I: Runoff-Erosion Analysis

Development of the erosion and sedimentation control plan can be viewed as a series of phases that occur in approximate chronological order. The phases overlap considerably and so are not presented as steps.

Landscape—Evaluate proposed changes in the landscape to determine their effect on runoff and erosion. Note all physical barriers to surface runoff, such as roads, buildings, and berms. Check slope grades and lengths for potential erosion problems. Designate intended collection points for concentrated flow and specify controls to dissipate energy or stabilize the surface. Designate areas to be protected or used as buffer zones in this phase (Figure 4.2).

Runoff yield—Evaluate surface runoff for the entire contributing drainage area—on-site and off-site. Delineate small subwatersheds on-site, and estimate peak runoff rates and volumes at selected collection points identified. Base runoff determinations on the peak discharge from the 10-year storm with site conditions during and after development—**not predisturbance conditions**. See *Appendix 8.03* for procedures for estimating peak runoff.

Sediment yield—Estimate sediment yield by subwatersheds. This aids in identifying preferred locations for sediment traps and barriers, and can be used to estimate the expected cleanout frequency. An area that is subject to excessive erosion may call for extra storage capacity in traps or additional precautions during construction.

Phase II: Sediment Control

Erosion control practices reduce the amount of sediment generated, but they do not eliminate the need for sediment control devices such as barriers and traps. Sediment control practices operate by reducing flow velocity, and creating shallow pools that reduce the carrying capacity of runoff. Thus, sedimentation occurs on-site rather than off-site. Sediment is generally not controlled by filtering, but by deposition. The designer should locate all traps and barriers

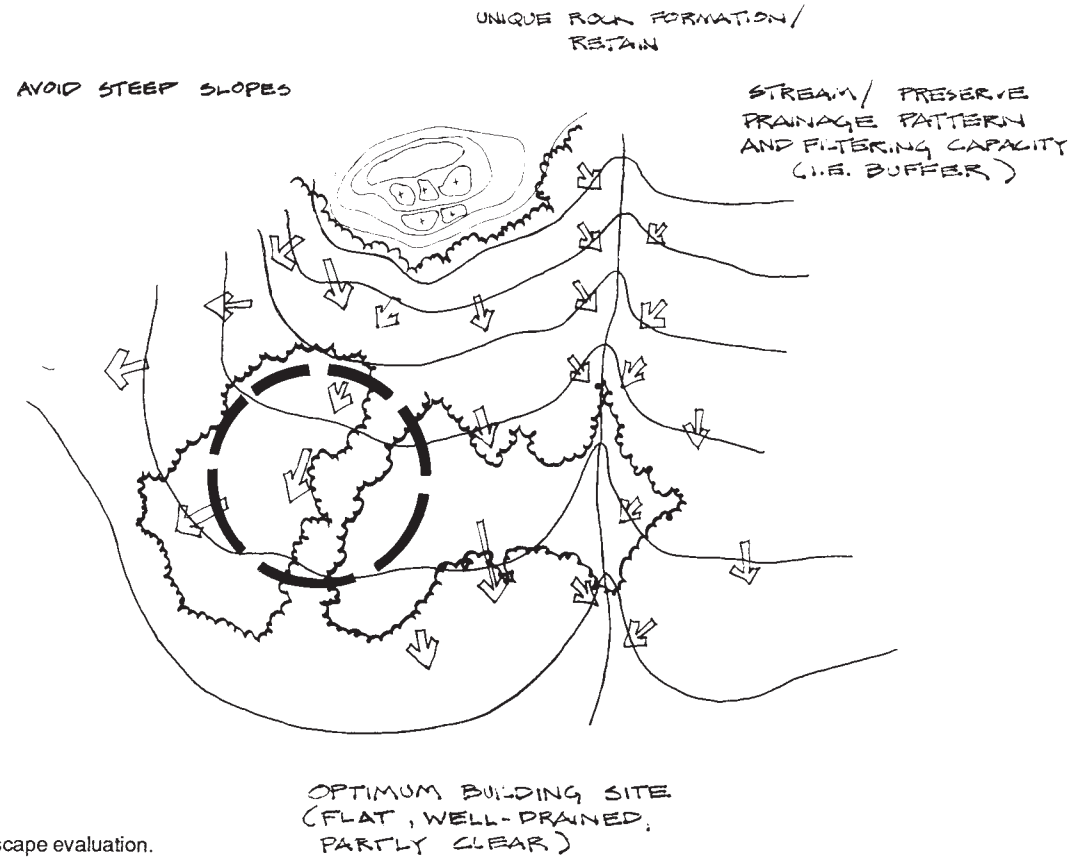
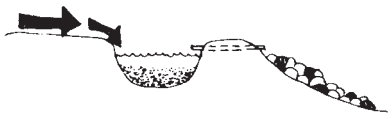


Figure 4.2 Landscape evaluation.

recognizing that they represent deposition points where access for maintenance will be necessary.

Sediment basins and traps—Select sites and install sediment basins and traps before other construction activities are started. Also consider locations for diversions, open channels, and storm drains at this time so that all sediment-laden runoff can be directed to an impoundment structure before leaving the construction site.

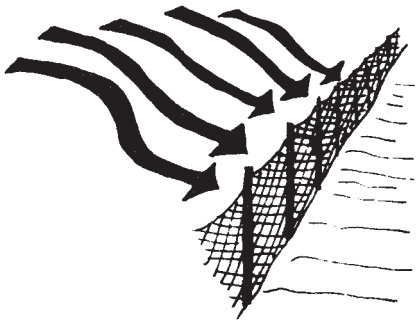


Divert sediment-free water away from sediment basins, and release it through stable outlets. This reduces construction costs, and improves basin efficiency.

This plan should show access points for cleanout of all traps and basins and indicate sediment disposal areas. Maintenance of storage capacity is essential throughout the construction period.

Practice standards in *Chapter 6* provide design criteria and construction specifications for sediment traps (Practice 6.60), sediment basins (Practice 6.61), rock dams (Practice 6.63), and skimmer sediment basins (Practice 6.64). Procedures for the design of sediment basins are contained in *Appendix 8.07*.

Sediment fences—Sediment fences (Practice 6.62) provide effective control of sediment carried in sheet flow. They are particularly useful where there is limited space to work such as near property lines, among trees, or near sidewalks or streets.



Sediment fences should never be used across streams, ditches, channels, or gullies.

The sediment fence operates primarily by reducing flow velocity and causing a shallow pool to form. If filtering action is required, the designer should assume that the barrier will clog rapidly so that all runoff must be retained behind the fence or released through a designated outlet. Any outlet points must be reinforced and stabilized, and should be designated in the plan.

Place sediment fences on relatively flat ground with sufficient area for a pool to develop without putting unnecessary strain on the fence. If a level area is not available at the fence location, excavate a trench directly upslope from the fence.

Show sediment fences on the topographic map, and clearly indicate deposition areas and needed overflow or bypass outlet points. Also show access routes for maintenance.

Inlet protection—Inlet protection devices for storm sewers, conduits, slope drains, or other structures make effective, low-cost deposition areas for trapping and holding sediment. A shallow excavation in conjunction with a sediment barrier can be effective at many locations. In the plan, show where these measures will be located, what type of device will be used, and how these devices will be constructed and maintained. Practice standards for the design of several types of inlet protection devices are included in *Chapter 6* (Practices 6.50, 6.51, 6.52, 6.53, 6.54, and 6.55).

Phase III: Protection of Disturbed Areas

Once an area is disturbed, it is subject to accelerated erosion. In the plan, show how erosion will be controlled on these disturbed areas. Erosion control can be achieved by:

- limiting the size of clearing and time of exposure by proper scheduling,
- reducing the amount of runoff over the disturbed surface,
- limiting grades and lengths of slopes, and
- re-establishment protective cover immediately after land-disturbing activities are completed or when construction activities are delayed for 30 or more working days.

Cut-and-fill slopes—Steep cut or fill slopes are particularly vulnerable to erosion. Protect such slopes by temporary or permanent diversions just above the proposed slope before it is disturbed. Provide a stable channel, flume, or slope drain, where it is necessary to carry water down a slope. Flow conveyances may have vegetative, mechanical, or combined vegetative and mechanical liners, depending on slope and soil conditions.

Shorten long slopes by installing temporary diversions across the slope to reduce flow velocity and erosion potential. Install permanent diversions with slope drains and protected outlets on long steep slopes (over 20%) as the slopes are constructed.

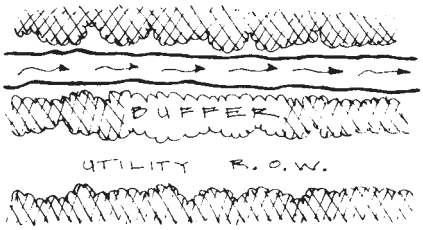
Finish final slope grades without delay, and apply the appropriate surface stabilization measures as soon as possible. Roughen slope surfaces to improve the success of vegetative stabilization. Consider both the stabilization measures and how they will be maintained before planning the steepness of the finished slope. For example, if the finished slope is to have smooth grass cover, it should be constructed on a grade of 3:1 or flatter to allow mowing.

Surface covers—Riprap, gravel, straw and other land covers can provide immediate surface protection to disturbed soil areas. Riprap is especially useful where concentrated runoff over steep slopes occurs. Riprap should be installed on a gravel or filter fabric bed.

Construction traffic—Carefully plan stabilization of construction access areas, construction roads, and parking areas. Ensure that traffic patterns follow site contours, and limit the length of routes up steeper slopes. Generally, road grades should not exceed 12%. Controlling surface runoff is necessary to prevent serious roadside erosion. Proper grading of the road surface, stable channel design, the use of water bars, other diversions, and culverts help prevent erosive flows. Where water tables are high, subsurface drainage may be needed to stabilize the sub-grade. Storm drains should be considered for water disposal where channel grade exceeds 5%. Plans should show all stabilization measures needed to control surface runoff from all roads.

Borrow and waste disposal areas—Clear borrow and waste disposal areas only as needed and protect them from surface runoff. Maintain berms as fill slopes are constructed to reduce slope length and control runoff. Slope all areas to provide positive drainage, and stabilize bare soil surfaces with

permanent vegetation or mulch as soon as final grades are prepared. Direct all runoff that contains sediment to a sediment-trapping device. In large borrow and disposal sites, shape and deepen the lower end to form an in-place sediment trap, if site conditions warrant it. Off-site borrow areas may be governed by the N.C. Mining Act.



Utilities—Use the spoil from utility trench excavations to divert flow from upslope areas, but use care in spoil placement to avoid blocking natural surface outlets. Diversions and water bars can reduce erosion when properly spaced across utility rights-of-way. When utilities are located near a stream, maintain an undisturbed buffer zone wherever possible. If site dewatering is necessary, pump or divert muddy water to sediment traps before discharging it to the stream. If streams must be crossed, make sure all necessary materials and equipment are on-site before construction begins, and complete work quickly. Finish all disturbed surfaces to design grade and immediately stabilize them with permanent vegetation or other suitable means. When utilities cross the stream, you must specify the plans to prevent sedimentation.

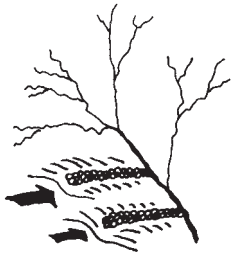
Perimeter protection—Consider diversion dikes for perimeter protection for all proposed developments, and install them where appropriate before clearing the site. Exercise care not to create flooding or erosion by blocking the natural drainage pattern. Be sure to provide an adequate outlet.

Dust control—Exposed soil surfaces that are nearly level have little potential for runoff erosion, but may be subject to severe wind erosion. Keeping the disturbed surface moist during windy periods is an effective control measure, especially for construction haul roads.

Preserving vegetation—Preserve existing vegetation on the site as long as possible as a cost-effective way to prevent on-site erosion and off-site sedimentation.

Phase IV: Runoff Conveyance

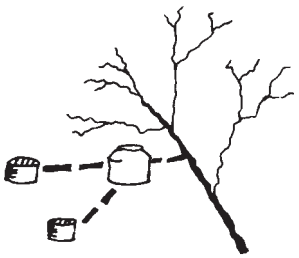
The safe conveyance of runoff water from a construction site is achieved by: (1) utilizing and supplementing existing stable watercourses, (2) designing and constructing stable open channels, or (3) installing storm drains with stable outlets. The plan should indicate locations and designs for these facilities. Complete and stabilize outlets for channels, diversions, slope drains, or other structures before installing the conveyance measure.



Existing watercourses—When using existing watercourses, either show that flow velocities are acceptable for increased runoff conditions, or indicate how necessary stabilization will be achieved.

Excavated channels—When channels are to be excavated, base a stability analysis on allowable velocity, or tractive force procedures. Include all calculations as part of the plan documentation.

Wide, shallow channels with established grass linings are usually stable on slopes up to 5%. These channels must be protected with temporary liners until grass is established. If channel gradients are too steep to use vegetation, riprap or concrete linings may be required, and in some instances grade stabilization structures may be needed.



Storm drains—Where the site plan calls for a system of storm drains, the drains may be used effectively in the erosion and sedimentation control plan. Build junction boxes or inlets early in the construction sequence, and grade the adjacent area to drain toward the inlet. Install an inlet protection device at all open pipe inlets, and excavate a shallow basin in the approach to the inlet for sediment storage. The storm drain flow from the protected inlets may be diverted to a sediment basin for additional sediment control. Restrict the drainage area for inlets to less than 1 acre, and frequently inspect inlet protections for needed maintenance.

Standards for runoff conveyance (Practices 6.30, 6.31, 6.32, and 6.33) and outlet protection measures (Practices 6.40 and 6.41) in *Chapter 6* provide the criteria necessary for the design of these practices. Design procedures for channels and outlet structures are contained in *Appendices 8.05, 8.06,* and *8.07*. Standards for the design of storm drains are not included.

Phase V: Stream Protection

Streambanks, streambeds, and adjoining areas are susceptible to severe erosion if not protected. Include sufficient detail to show that streams are stable for the increased velocities expected from the development activity. At a minimum, all streams should be stable for flows from the peak runoff from the 10-year storm.

When stability analysis shows that the stream requires protection, vegetation is usually the preferred approach because it maintains the stream nearest to its natural state. When flow velocities approach 4-6 ft/sec, or if frequent periods of bankful flows are expected, structural measures such as riprap lining or grade stabilization structures are usually necessary. In the plan, show where stream protection is needed, and how it will be accomplished.

Runoff into stream—Only sediment-free runoff may be discharged from construction sites directly into streams. Ensure that all other flows enter from desilting pools formed by sediment traps or barriers.

Velocity control—Keep the velocity of flow discharged into a stream within acceptable limits for site conditions. Control velocity by installing an appropriate outlet structure. Standards for two types of outlet protection devices are given in *Chapter 6* (Practices 6.40 and 6.41). Design procedures for riprap outlet structures are contained in *Appendix 8.06*.

Buffer zone—Areas adjoining streams should be left undisturbed as buffers (Figure 4.3). Existing vegetation, if dense and vigorous, will reduce flow velocities and trap sediment from sheet flow. However, the principal benefit of leaving natural buffer zones along streams is that they prevent excessive erosion in these sensitive areas. Maintaining stream canopies also protects fish and wildlife habitats; provides shade, wind breaks and noise barriers; protects the bank from out-of-bank flood flows; and generally preserves natural site aesthetics.

Indicate stream buffer zones in plans that involve natural streams. The width is determined by site conditions, but generally should not be less than 25 feet on each side of the stream. Where natural buffers are not available, provide artificial buffers. **Where work is required along a stream, you must provide a mechanical or artificial buffer**.

Figure 4.3 Wooded buffer zone.

Off-site stream protection—Increased rate and volume of runoff from development activities may cause serious erosion at points some distance downstream. The developer should work with downstream property owners to stabilize sensitive downstream channel areas.

Stream crossing—Minimize the number of stream crossings. Construct crossings during dry periods; if necessary, divert water during construction. The plan should show the type of crossing to be used and the associated control measures to minimize erosion from surface runoff such as diversions, outlet structures, riprap stabilization, etc. Design guidelines are given in *Chapter 6* (Practices 6.70, 6.71, 6.72, 6.73, and 6.74) for stream protection practices.

Phase VI: Construction Scheduling

Appropriate sequencing of construction activities can be the most effective means for controlling erosion and sedimentation. Consequently, present the construction activity schedule of the general contract as part of the erosion and sedimentation control plan. **Put into place the primary erosion and sedimentation control practices for the site, i.e., sediment basins and traps, and a water conveyance system before undertaking major land-disturbing activities**.

Install sediment basins and primary sedimentation control practices as the first structural measures. Next install the overall water disposal outlet system for the site.

Stabilize all construction access routes, including the construction entrance/exit and the associated drainage system, as the roads are constructed. Install storm drains early in the construction sequence, and incorporate them in the sedimentation control plan. Then install low-cost inlet protection devices for efficient sedimentation control in the area around the inlets. This allows early use of the inlets and the drain system.

Install diversions above areas to be disturbed and, where appropriate, locate diversion dikes along boundaries of areas to be graded before grading takes place.

After all principal erosion and sedimentation control measures are in place, perform the land clearing and rough grading. Clear areas only as needed.

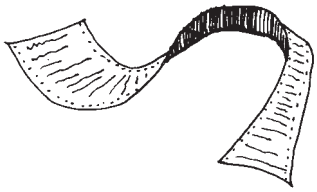
Complete final grading and surface stabilization in an expedient manner and within the construction schedule. Minimize the time of exposure, and select temporary ground cover according to the location and season. Temporary surfaces should be stabilized as soon as active grading is suspended, and graded slopes and fills must be stabilized within 21 calendar days, regardless of the time of year.

Phase VII: Maintenance

In the erosion and sedimentation control plan, indicate who is responsible for maintenance and when it will be provided. The maintenance schedule should be based on site conditions, design safeguards, construction sequence, and anticipated weather conditions. Specify the amount of allowable sediment accumulation, design cross-section, and required freeboard for each practice and what will be done with the sediment removed. The plans should also state when temporary practices will be removed and how these areas and waste disposal areas will be stabilized.

Phase VIII: Performance Requirement

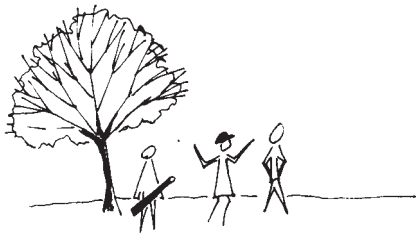
Even though the developer may have an approved plan that is properly installed and maintained, he/she is not relieved of responsibility for off-site sediment damage resulting from his/her construction activities. Therefore, frequently inspect the property boundary for evidence of sedimentation. If off-site damage occurs, the developer may be responsible for immediate corrective measures. Modification of the plan and re-approval may also be necessary.



The erosion and sedimentation control plan should be flexible enough to allow for modification to correct problems. It is common for unanticipated events or construction changes to occur during project development that may require major alterations in the plan. Resubmit significant changes for approval before they are implemented.

Phase IX: Preconstruction Conference

A preconstruction conference with the owner, contractor, and erosion control personnel at the site is recommended as a means of assuring proper implementation of the erosion and sedimentation control plan. This conference is required by some local ordinances. A preconstruction conference allows all parties to meet, review the plans and construction schedule, and agree on responsibility and degree of control expected. Discuss maintenance requirements, phasing of operations, and plan revisions at this time.



A preconstruction meeting is especially important for large, complex jobs or when the contractor and/or developer has had little experience in this type of work.

If the job foreman assigned responsibility for on-site sediment control cannot be present at the conference, give his/her name to the erosion control representative at this time.