
CATERPILLAR

FUNDAMENTAL BMPs

Most BMP techniques are based on a few basic principles. This section provides an overview of these fundamental BMPs and how they protect water quality.

Understanding these principles will enable you to select or adapt the BMPs that are the most appropriate and effective. Think of these principles as goals. Any single practice or combination of practices that effectively achieves one or more of these key goals could be considered an appropriate BMP.

1. DEFINE OBJECTIVES AND RESPONSIBILITIES

- **Determine the harvest objectives with the landowner, forester, and logger.** The first step in planning, prior to beginning work, is to communicate with everyone involved what the harvest objectives are. Discuss what's going to be cut, where, and the desired condition of the remaining forest.

- **Decide who is responsible for BMPs.** You will want to agree in advance (and in a written contract) who is responsible for implementing the BMPs, including deciding when to operate, locating streams, laying out the operation, and planning and maintaining the BMPs.

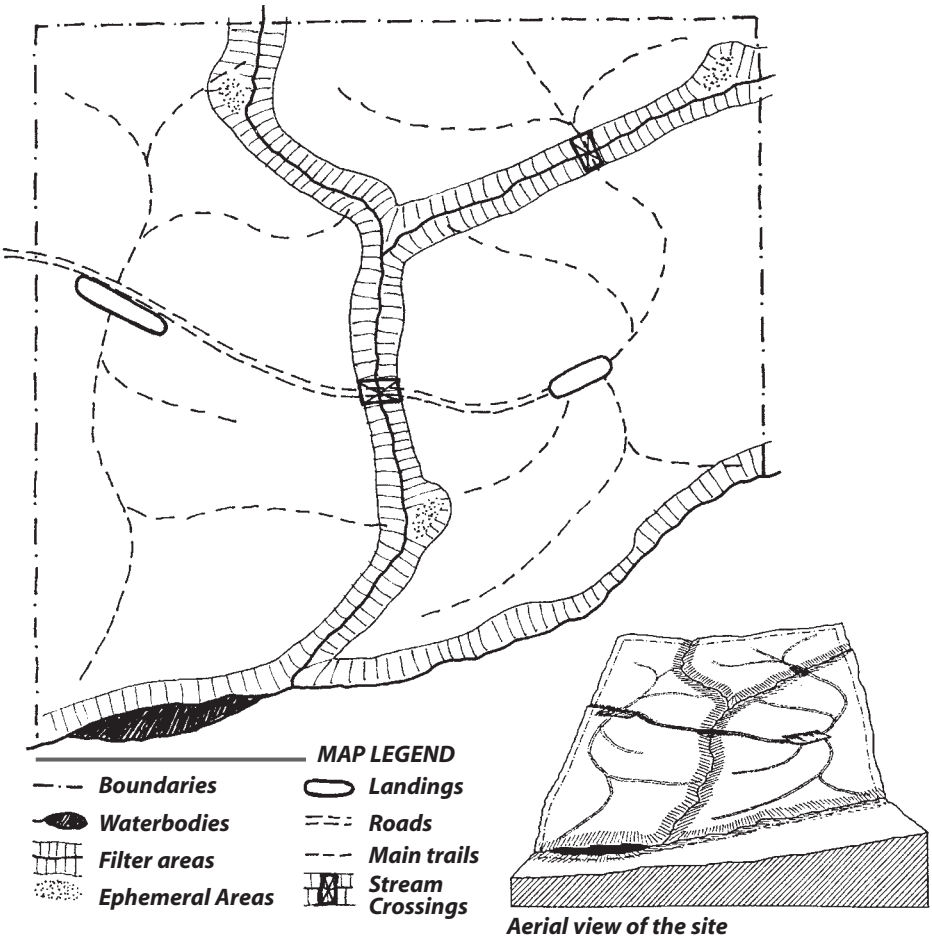
- **Find out what legal requirements apply to waterbodies in the harvest area.** The basic legal requirement in Maine is to keep pollution—including mud, silt, rock, soil, brush, or chemicals—out of the water. When working near waterbodies, find out what town, state, or federal standards apply, and if permits are needed.

STOP **Know the laws! Landowners, foresters, and loggers should determine what laws apply on a particular job. However, it is Maine landowners who are responsible *by state law* for preventing mud, sediment, and other pollutants from entering waterbodies. This manual does not replace legal standards, and reading it is not a substitute for knowing legal restrictions in your situation.**

2. PRE-HARVEST PLANNING

Pre-harvest planning is good business practice and avoids many problems. Planning will help reduce costs, make the job more efficient, protect roads and trails that will stay in place after the job, leave the job looking better, *and* protect water quality.

- **Determine the harvest area limits and property boundaries on the ground. Know whose responsibility it is to identify the property boundaries correctly.** While not essential to protecting water quality, locating property boundaries is common sense and good planning. There may be survey pins, blazes, wire fences, or stone walls that mark boundaries or property corners. Forest type maps, soil or topographic maps, or aerial photos help, too.



Example of map showing planning and layout on large lot.

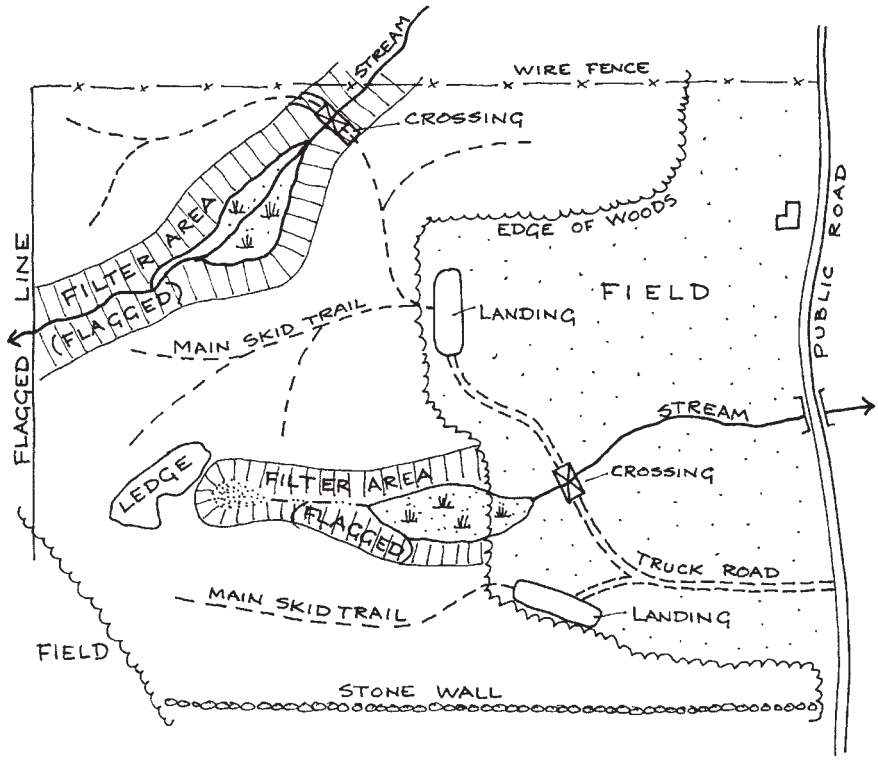
When in doubt, stop! Get more information or professional advice. Call The Maine Forest Service at 1 (800) 367-0223 (in-state only) or (207) 287-2791 for answers and referrals to professionals who can help.

- **Identify streams, lakes or ponds, wetlands, and other features on maps and on the ground.** Maps and aerial photographs can help identify features like waterbodies, steep slopes, or poorly drained soils. Walking the property to locate important features on the ground is essential. If possible, do your planning on bare ground in wet seasons when surface water is visible.

- **Identify the areas where you need BMPs.** Forest harvesting BMPs are most critical in and immediately next to waterbodies including intermittent and perennial streams, lakes or ponds, wetlands and coastal areas—wherever direct impacts to surface water may occur. You may also need to use BMPs in other areas of the watershed where flowing water could be substantially altered or carry sediment into these waterbodies.

- **Lay out the harvest operation on the ground.** Harvest planning includes determining where operational features such as roads, stream crossings, landings, cut-and-fill areas, main skid trails, and particular BMPs will be needed. While on-site, make sure everyone involved in the harvest operation is aware of the layout—especially roads, skid trails, and filter areas next to waterbodies.

There is no substitute for laying out the harvest operation on the ground.



Example of map showing planning and layout on small lot.

- **Choose BMPs that are appropriate to the site conditions.** Most sedimentation occurs during short periods of heavy rain or snowmelt. How much rain falls during a storm, how much water streams carry, how stable the soils are, and what type of vegetation is present are all conditions that vary. BMPs that are sited, designed, and installed to anticipate adverse conditions work best.

- **Decide on BMPs for the entire harvest area and for closeout before beginning work.** BMP systems need not be complicated, but they require planning across the entire harvest area and over the entire duration of the operation, including closeout. Applying BMPs in one location can sometimes solve problems elsewhere on the site, or prevent problems after the operation is complete. When you understand the natural drainage system in the watershed, often you can use a combination of simple BMPs that are more effective—and cheaper—than more complex or expensive techniques.

- **Consider the needs of future operations on the same property.** Will roads, trails and landings be used again in five years, 15 years, or longer? Are there other areas of the property that can be accessed using the same roads? If you need to access the lot in the future, plan roads and trails accordingly. Otherwise, consider restricting vehicle access after the harvest. Because of the possibility of extreme weather conditions, it is important to design and close out roads properly. Identify which structures—such as culverts—will be left in place, and which will be removed. Considering the future can avoid problems and costly solutions.

3. ANTICIPATE SITE CONDITIONS

- **Time operations appropriately.** Harvesting under frozen, snow-covered, or dry conditions can minimize the need for additional BMPs. At the same time, a range of BMPs that are appropriately chosen, installed, and maintained can extend the harvest season. Use extra caution during fall and spring when streams are high and the ground is typically wetter—you may need to use additional BMPs to control the larger volume of water.

BMPs may extend the harvest season, reduce equipment wear and the amount of mud on logs, increase skidding efficiency, and protect your investment in roads and stream crossings.

Site conditions both during and after the harvest are likely to change.

- **Determine whether previous operations in the harvest area created conditions that are impacting—or could impact—water quality.** Old roads, log landings, and skid trails can be reused or upgraded. However, in some situations, avoiding or retiring them is a better choice. Using old roads, landings, and trails may be cheaper in the short run, but may be more costly to fix or maintain later. Pre-existing conditions may also influence your choice of BMPs.

- **Plan to monitor, maintain, and adjust BMPs as needed, especially to deal with seasonal or weather-related changes.** After installation, many BMPs require maintenance or modification. Conditions—such as the amount of water flowing in streams, soil moisture, or the depth of frost—can change quickly, even with one storm. Take into account how conditions may change, and maintain or install additional BMPs as needed. Determine who will be responsible for this work. In many instances, the landowner will want to periodically check and maintain BMPs that have been installed after harvesting is done. This often prevents washouts and a loss of access while protecting water quality at the same time.

4. CONTROL WATER FLOW

- **Understand how water moves within and around the harvest area, and decide how water flow will be controlled.** Concentrated flows of water on roads, skid trails, landings, and in drainage systems develops more force and a greater ability to erode soil and carry sediment. It is easiest and most effective to control small volumes of water, before they converge and accumulate into concentrated flows.

- **Slow down runoff and spread it out.** Many BMPs work by directing small amounts of water into areas of undisturbed forest floor where it can be absorbed.

Properly sized ditches capture and slow down runoff.

- **Protect the natural movement of water through wetlands.** Wetlands play an important role in the environment by storing water in wet periods and slowly releasing it back into the surrounding ground and streams. Logging roads and trail crossings can affect the flow of water within or through a wetland. This changes how much water the wetland stores, the degree of flooding that occurs, and the rate at which water leaves the wetland. Such impacts can affect the health of the wetland and waterbodies downstream.

5. MINIMIZE AND STABILIZE EXPOSED SOIL

Limiting soil disturbance and stabilizing areas where mineral soil is exposed are among the most important BMPs for preventing erosion. These practices are most critical in and around filter areas—forest areas bordering waterbodies. A detailed discussion of filter areas, how best to work in them, and soil stabilization starts on page 21. Generally speaking, there are two major objectives:

- **Minimize disturbance of the forest floor, especially in filter areas.** The forest floor absorbs water and filters out sediment and other pollutants. Exposed soil, on the other hand, can erode very rapidly. Most of the sediment that ends up in streams near managed forests comes from exposed soil on roads, landings, and skid trails. Know where the filter areas are and how to protect their capacity to absorb and filter runoff.

- **Stabilize areas of exposed soil within filter areas and in other locations where runoff has the potential to reach filter areas.** Use BMPs during or immediately after the harvest to prevent exposed soil or fill from eroding. These techniques and materials can be used near waterbodies, at stream crossings, road cut-and-fills, ditches, landings, and skid trails. In some situations, you may need to seed and/or plant vegetation in order to stabilize the soil.

6. PROTECT THE INTEGRITY OF WATERBODIES

- **Protect stream channels and banks.** Blocking or altering streams (with slash, for instance) may keep fish from swimming past the blockage. Damaged stream banks erode quickly, causing sedimentation and siltation. By protecting the physical integrity of streams, BMPs prevent these problems.

- **Leave enough shoreland vegetation to maintain water quality.** BMPs maintain the benefits that nearby trees and plants provide waterbodies. Streamside vegetation shades the water, minimizing temperature changes. Live roots stabilize the banks and maintain the soil's physical and chemical properties. Trees along the banks drop leaf litter and woody debris that supply nutrients and become habitat for plants and animals in the stream. Shoreland vegetation plays an important role in maintaining water quality.

7. HANDLE HAZARDOUS MATERIALS SAFELY

For assistance with spills of hazardous materials, call the Department of Environmental Protection's Division of Response Services office nearest you:

Augusta (207) 287-7800
Bangor (207) 941-4570
Presque Isle (207) 764-0477
Portland (207) 822-6300

In an emergency, call
1 (800) 482-0777 (oils/fuels)
1 (800) 452-4664 (other chemicals)

- **Be prepared for any emergency.** Keep an emergency response kit and contact information at the site for fuel, oil, or chemical spills. Remember that fertilizers, herbicides, pesticides, and road chemicals (calcium chloride, road salt, etc.) are hazardous materials, too. Know whom to call for help with unexpected erosion, accidents, or other emergencies. Having a backup plan and being prepared for unexpected and special situations can help avoid or minimize negative impacts to water quality. Industry groups, equipment suppliers, and local and state government agencies all have specialists available to help. Refer to "Section 4. For More Information" on page 92 for agency names, addresses, and telephone numbers.

- **Use and store hazardous materials properly.** The best way to avoid accidental spills of hazardous materials is to store and handle them so that the chance of these types of emergencies occurring is minimized. You'll find several BMPs in this manual that describe how to do this, starting on page 89.

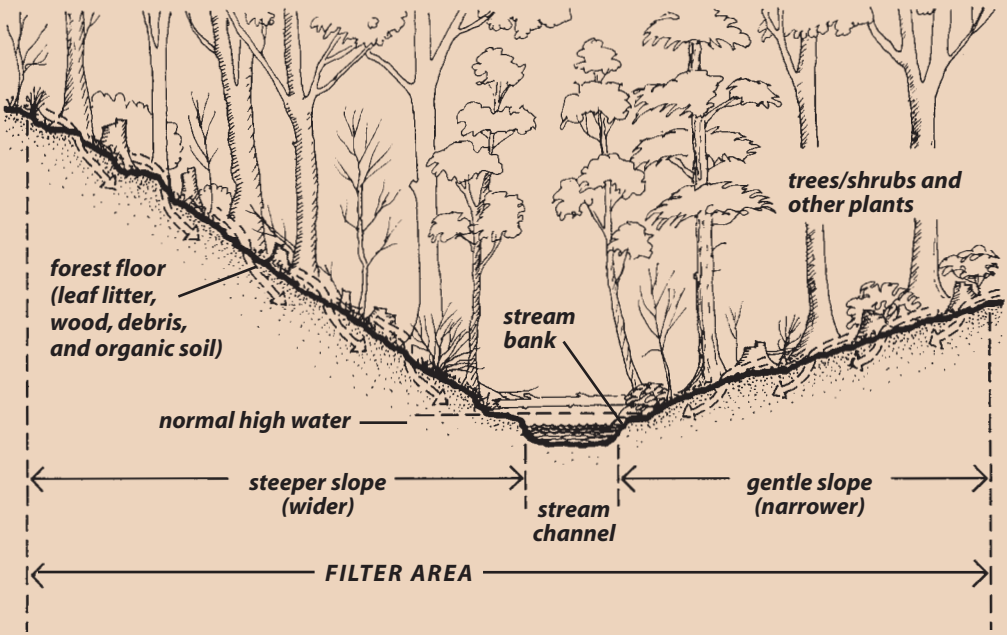
KEY ISSUE

Filter Areas

Filter areas, broadly speaking, are forested areas bordering waterbodies that provide important functions, especially filtering sediment and debris from runoff and preventing pollutants from reaching waterbodies. Filter areas have several components.

- The **banks** of streams (or other waterbodies) protect and contain the water channel.
- The **forest floor**—especially the leaf litter, woody debris, and organic soil layer—absorbs and filters water as it moves over and through the soil.
- **Trees and other vegetation** shade the water (minimizing changes in water temperature), stabilize the banks, and add woody debris and organic matter to the water and forest floor.

Limiting impacts to these components within a minimum distance from the waterbody (depending on slope) typically maintains these benefits and protects water quality.



WORKING IN FILTER AREAS

Forested filter areas are not "no-harvest" zones; you can often cut within them. You may also use logging equipment in filter areas if the forest floor is protected. However, it is important that you take extra precautions within filter areas to prevent water pollution.

Note that the filter areas described here may be wider or narrower than regulatory requirements for forestry activities.

Table A
Minimum Filter Area Width

Slope (%)	Width from High Water Mark (ft)
0	25
10	45
20	65
30	85
40	105
50	125
60	145
70+	165

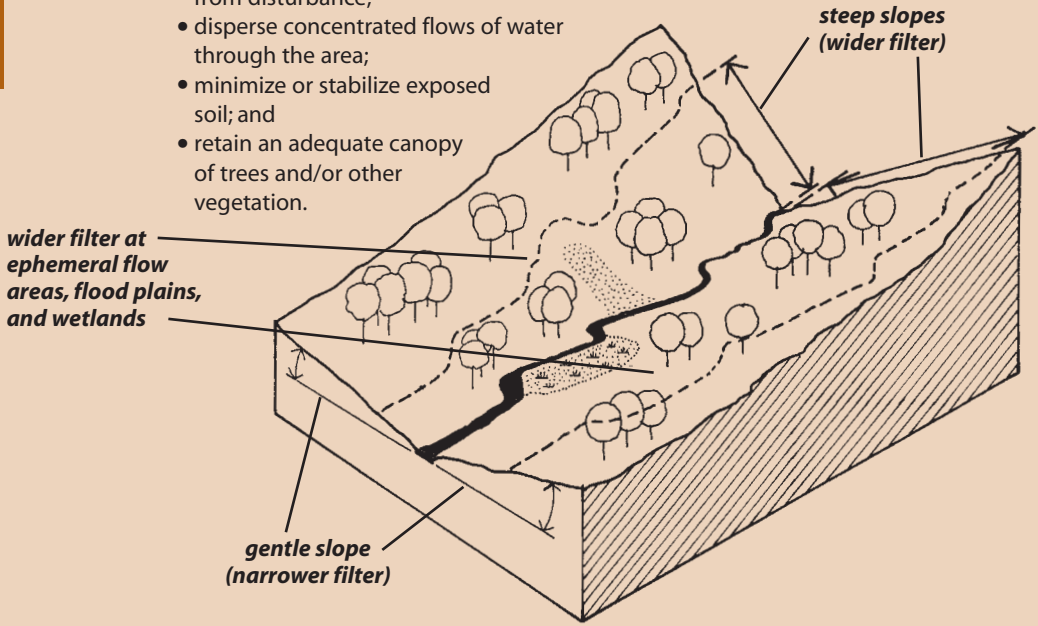
BMPs

1. **Determine what legal requirements you must meet when working near waterbodies.**

2. **Delineate filter areas next to streams, lakes and ponds, and non-forested wetlands.** Minimum recommended widths (from the normal high water mark) for filter areas appear in Table A.

3. **Apply BMP techniques for roads, landings and skid trails (described in later sections) when working in filter areas to:**

   - minimize damage to the stream channel and stream banks;
   - protect the forest floor next to streams and other waterbodies from disturbance;
   - disperse concentrated flows of water through the area;
   - minimize or stabilize exposed soil; and
   - retain an adequate canopy of trees and/or other vegetation.



The minimum filter width varies with slope and site conditions.

BMPs

4 **Increase the width of the filter area and install more BMPs when local conditions call for it.** The recommended minimum filter area widths are based on the ability of the undisturbed forest floor to absorb water and filter sediment. The actual width needed for the filter area to be effective may be greater than the minimums listed in Table A, depending on the site conditions and planned activity. Examples of situations where it is best to designate a filter area wider than that stated in Table A include:

- **ephemeral flow areas next to waterbodies.** Water from ephemeral flow areas may carry sediment or other materials directly into streams (especially during wetter seasons).
- **forested wetlands and floodplains next to waterbodies.** Typically, these are wetter, weaker soils. They are more likely to develop ruts and produce rapid runoff into nearby waterbodies.
- **water diversions that concentrate flow.** Culverts, ditches, and other drainage structures may increase the amount of water flowing into the filter area. They could also create a new channel through the filter area, reducing its effectiveness. In these cases, increasing the filter area width and making sure the drainage structures and BMPs are properly installed will help disperse the water.
- **some stand conditions.** Some sites may warrant wider filter areas to maintain the wind-firmness of the stand or provide adequate shade on the waterbody.

Forest harvesting operations in both non-forested and forested wetlands may have legal requirements. However, the definitions of forested and non-forested wetlands vary in different federal, state, and local laws. Forestry activities may be exempt in some cases, but not in all. Know which law applies to your situation.

KEY ISSUE

Stabilization

STABILIZING EXPOSED SOIL

Stabilizing exposed soil is most important where sediment can be carried to waterbodies. Different materials may be used to reduce erosion on exposed soils. Temporary materials are often ones that will rot and/or that will be replaced by natural vegetation. Permanent stabilization is provided by long-lasting, sturdy vegetation, stone or artificial materials designed to withstand the force of moving water. Often, stabilization materials are used in combination with each other, providing both immediate, temporary stabilization and permanent revegetation.

TEMPORARY MATERIALS

Hay or **straw mulch** can help minimize soil movement, and usually lasts one or two seasons, holding the soil until the natural vegetation grows back. Mulch is often used after seeding exposed soil. Hay and straw are not effective in areas of concentrated flows. Be aware that hay mulch typically contains non-native grass seed, while straw does not.

- When mulching exposed soil with hay or straw, use enough mulch to cover the soil completely or nearly completely. A common guide is approximately 90 lbs. of mulch per 1,000 square feet (or about 2 square bales for a 30 x 30 foot area). On steep slopes (greater than 4:1 or 25%) or exposed windy sites, it may be necessary to anchor the mulch with staples, netting, or twine.

Hay mulch on landing.

Brush, slash, and tops from harvesting are often readily available, and are an excellent means of stabilizing exposed soils until the area revegetates naturally. Brush typically does not need to be removed except if it falls below the normal high water mark of waterbodies.

- Use brush on trails that could erode and deliver sediment to streams. Wherever possible, put brush down before the soil becomes disturbed and the soil exposed. The more brush, the better.
- Use brush as a berm on the lower shoulder of roads running across slopes to help stabilize exposed soil and disperse water being shed off the road.
- Use brush on landings or similar high traffic areas (if it will not present a hazard to equipment).
- Use brush at the outfall of road culverts, dips, water bars, and other drainage structures to help hold the soil and disperse concentrated runoff.

Harvesting during frozen winter conditions and putting slash in the skid trails are both excellent ways to limit soil disturbance.

Seeding grasses that will establish themselves quickly can help minimize erosion of exposed soil. Temporary seeding works best on slopes less than 4:1 (25%). The recommended grasses for temporary seeding include winter rye (110 lbs./acre), oats (80 lbs./acre), or annual ryegrass (40 lbs./acre). See "Seeding," page 28, for instructions on how to sow seed.

Temporary erosion control blankets are available in rolls and are made of a wide variety of materials. Usually they are biodegradable. They are often used with grass seed to establish vegetation as the blankets rot. Erosion control blankets must be in contact with the soil to prevent water flowing between the blanket and the soil. On slopes greater than 4:1, blankets may need to be anchored with staples or by other means. Blankets work best in ditch and swale sections (where there is concentrated runoff) when the slopes are gentle.

PERMANENT MATERIALS

Wood chips, waste wood, or bark mulch may last several seasons, depending on the material and its depth. Occasionally, these materials are combined with soil in an erosion control mix. Spread the material to a depth of 2–6 inches, primarily on slopes less than 4:1 (25%). Wood chips, waste wood, and bark mulch are not recommended in areas of concentrated water flow or where they may be subject to wind erosion.

Permanent erosion control blankets are usually made of synthetic materials and are used in high-flow areas such as ditches.

Gravel can provide adequate stabilization, especially on travel surfaces with low slopes and little concentrated flow. Ideally, gravel used in critical areas is screened and/or washed to remove the fines.

Riprap or cobbles are larger stones used to stabilize ditches, heavily traveled areas, and areas of high flow. They are also used to armor steep slopes (up to 1.5:1 or 67%) and culvert inlets and outlets. You can use riprap in combination with erosion control blankets to prevent flowing water from undercutting steep slopes. Use very large stone in combination with smaller cobbles and/or blankets.

Permanent vegetation or revegetation is commonly used to permanently stabilize disturbed areas. Permanent vegetation may include grasses, shrubs, and/or trees. Seeding is recommended on exposed soils within filter areas, at waterbody crossings, and at similar critical sites that are not stabilized by other means. Most other areas will reseed naturally within two years, provided BMPs have been used to control the water flow.

Hay mulch holds exposed soil while grass becomes established.

Wide varieties of seed mixtures for permanent revegetation are available. Usually, they contain combinations of creeping red fescue, annual ryegrass, tall fescue, flatpea, switchgrass, bluestem, deertongue, and other species. Commercially available "Conservation Mix" is often appropriate. A typical mix consists of: creeping red fescue (40%); annual ryegrass (31%); Dutch white clover (20%); birdsfoot trefoil (5%); and hairy vetch (4%). Select a seed mixture based on:

- the site conditions;
- how quickly the soil needs to be stabilized to avoid sedimentation;
- the time of year and predictable weather conditions;
- the soil's moisture and fertility; and
- shade conditions.

Native, non-invasive grass species are preferable if they are available and affordable.

For more detailed and site-specific recommendations, see the USDA Natural Resource Conservation Service's guidelines for Critical Area Planting, Section IV of their Field Office Technical Guide, referenced on the inside back cover.

SEEDING

Whether you are seeding for temporary or permanent vegetation, the sowing process is the same.

Use fertilizer with care near waterbodies, and never put it directly in any waterbody.

- Prepare the seedbed (if necessary) by raking, grading, removing debris, and/or smoothing the exposed topsoil.
- Apply the seed mix immediately after preparing the seedbed, at the supplier's recommended rate (generally from 20–50 pounds per acre) by hand, seed spreader, or hydro-seeder.
- If possible, apply seed in the spring, fall, or after rain to help ensure germination.
- Consider liming and fertilizing the site before seeding, based on soil conditions, or if it is recommended by the seed supplier. Fertilizer-coated seed mixtures may also be available. A few seed types, such as legumes, require inoculants (available from the supplier) in order to become established.
- On critical areas (near waterbodies), dry soils, highly erodible sites, or sites seeded during the summer, mulch the seeded area with hay or straw.
- Do not allow vehicles or heavy foot traffic in areas that have been seeded until the cover is well established.

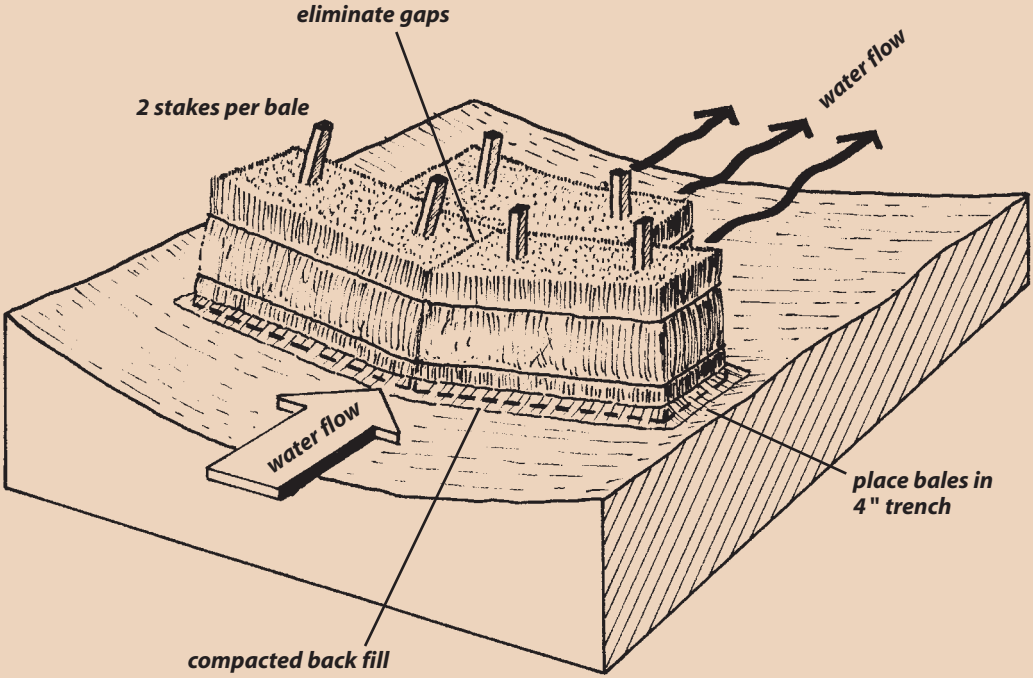
Seeding with grass seed will help stabilize exposed soil, often within a single growing season.

TEMPORARY SEDIMENT BARRIERS

Temporary sediment barriers such as hay bales and filter fences are used to trap sediment during the construction of roads, ditches, and BMPs until other measures, especially permanent vegetation, can be installed. Hay bales and silt fences are not intended as permanent structures and should be removed during closeout or after the site has stabilized.

HAY BALE INSTALLATION

- Excavate a trench 4 inches deep and the width of the bale;
- position the hay bales in a single row or stagger them, making sure there are no gaps between the bales where water could flow through;
- place the bales in the trench and stake with at least two stakes per bale; and
- backfill with soil on the uphill side to keep water from flowing underneath the bale.



FILTER FENCE INSTALLATION

- Install a synthetic filter fence by first setting stakes at least every 3–10 feet. Three feet is needed for light fabric, while 10 feet is adequate when using extra strength fabric and/or a wire mesh support fence.
- Follow the manufacturer's recommendations and choose a filter fabric capable of handling the expected water flow. The fabric may be 15-36 inches high.
- Excavate a 4-inch deep trench upslope, along the line of stakes.
- Place an 8-inch skirt of fabric in the trench; staple the other side of the fabric to the stakes; then backfill and compact the soil.

Hay bales and filter fences are temporary measures. Remember to remove them after the harvest, or when the site has stabilized.