



# NEW YORK STATE FORESTRY VOLUNTARY BEST MANAGEMENT PRACTICES FOR WATER QUALITY

**BMP FIELD GUIDE** | 2018  
EDITION

## **This BMP Field Guide is the property of**

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## Introduction

Protecting our natural resources is a critical part of a successful timber harvest. Studies have shown that timber harvesting is not a major cause of water quality problems. However, the forest truck roads, skid trails, and landings used to remove trees from the forest are vulnerable to erosion. Erosion can damage or destroy these access systems making it more expensive or impossible to use them in the future. Sedimentation—caused when the eroded soil finds its way into a stream, wetland, pond, or lake—can damage fish and other wildlife habitat as well as drinking water supplies. These problems can trigger a negative reaction from neighbors and the general public, and they may violate state or local water protection laws. They've also led to local timber harvesting ordinances. A good way to avoid controversies and restrictions on timber harvesting is to use Best Management Practices (BMPs).

BMPs are simple techniques you can use on your timber harvest to protect our natural resources. BMPs are designed to:

- Protect water quality by minimizing erosion and surface water run-off.
- Maintain hydrologic processes by limiting disturbances to water flow patterns.
- Maintain water temperature along shorelines and streambanks.
- Protect nutrient balances in the soil.

Ultimately, BMPs help keep forests healthy and maintain public support for timber harvesters and forest management.

This field guide is a practical tool for loggers, foresters, woodlot owners, and others involved in harvest operations. It provides a menu of options to give professionals the flexibility they need to make decisions in the field.

BMPs aren't just something you do at the end of a job. They're a mindset, an approach to the whole timber harvesting process that respects the land. That's why this guide is organized by time, with different BMPs to consider before, during, and after the harvest.



The BMPs in this guide are compliant with *Section 319 of the 1987 Amendment to the Clean Water Act* as well as the EPA-approved *New York State Nonpoint Source Pollution Management Plan*. That plan outlines a voluntary, education, and promotion-based approach to implementing BMPs.

**This field guide focuses on water quality. BMP manuals from other States may include guidelines to protect other forest values such as visual quality and wildlife habitat. These values are also important, but they are not the focus of this guide.**

**This field guide has not been designed to provide a required standard for use in enforcement. It is not a regulatory handbook. It does not present a single prescription that can or should be applied in all cases. The ultimate objective is to have a safe, economically viable timber harvest that protects water quality.**

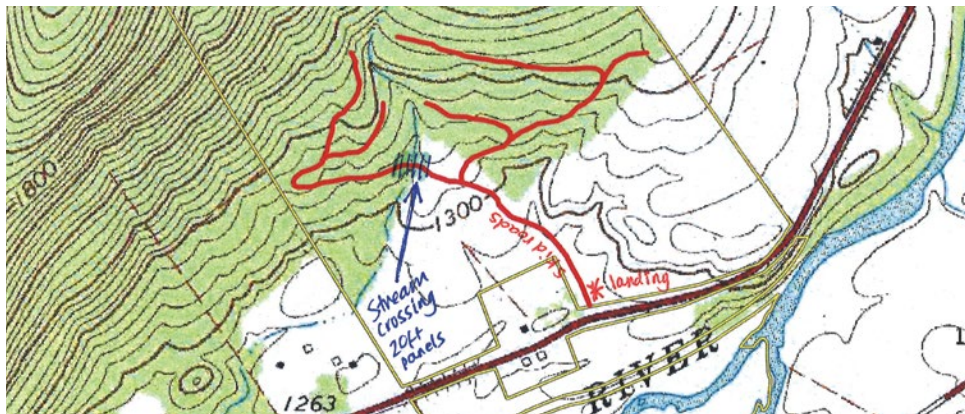






## Before the Harvest: Introduction

Planning a harvest is the most important BMP. Timber harvesting should follow a plan that protects soil and water. The thoughtful layout of skid trails, landings and truck roads will provide complete access while minimizing erosion and sedimentation. Proper layout also reduces the number of BMPs required to stabilize the site following operations, saving time and money.



## Before the Harvest: A Step-by-step Process

This step-by-step process will help you plan your harvest to get the most productive operation while protecting the site. Key steps include:

- 1. Collect site-specific resources:** Forest management plans, aerial photographs, soil survey maps, forest inventories, information from a timber sale bid package, topographic maps, property surveys, classified stream maps, Natural Heritage database maps (for threatened and endangered species), and tax maps can all help you develop your plan. You can get much of this information from regional New York State (NYS) Department of Environmental Conservation (DEC) offices, the landowner, and online at Google Earth or other websites. Some useful websites for locating much of this information are:
  - a. [www.dec.ny.gov/gis/erm](http://www.dec.ny.gov/gis/erm)** - The DEC's Environmental Resource Mapper shows important natural features like regulated wetlands, classified streams, and rare plants and animals. The site is an excellent "one-stop shop" to determine if your project site is likely to require a DEC permit, and if so, next steps to obtain one.

- b. **[www.dec.ny.gov/eafmapper/](http://www.dec.ny.gov/eafmapper/)** - In addition to the Environmental Resource Mapper, the DEC has another website. After locating your area of interest, the EAF mapper generates and automatically fills out the Environmental Assessment Form. The EAF Form provides specific information on issues such as rare and endangered species and aquifers.
- c. **<https://ngmdb.usgs.gov/topoview/viewer/#4/40.01/-100.06>** - TopoView is a great source for aerial photos as well as current and historic USGS topo maps. You can download maps in different formats including a JPEG and a geo-referenced PDF for use with a smartphone mapping app like Avenza.
- d. **<https://casoilresource.lawr.ucdavis.edu/soilweb-apps/>** - UC Davis's SoilWeb map is an easy-to-use soils map for the US. Choose the "SoilWeb" link, then zoom in to your project site. Click on a soil type to learn about its slope, composition, and drainage class.
- e. **If you want tax maps for a property** try searching the internet for a specific county's real property office. Many counties have free access to tax maps online and in PDF form.

- 2. Identify sensitive features:** Use the site-specific resources you collected in step 1 to identify potentially sensitive features in the harvest site such as streams, ponds, lakes, wetlands, steep slopes, highly erodible soils, poorly drained soils, riparian management zones (RMZs) and stream crossings.
- 3. Plan your harvest on a map:** Draw the harvest boundaries, landing locations, preliminary skid trails, and any sensitive features on a topographic map.
- 4. Plan your harvest on the ground:** Walk the property prior to the harvest and translate your map to the ground. Flag your skid trails, stream crossings, and riparian management zones. While you're walking, take note of sensitive features that may not have shown up on maps like seeps, vernal pools, rocky terrain, and unstable slopes. Adjust your plan in light of this new knowledge.
- 5. Determine the need for permits and get them if necessary:** Local and State regulations can potentially apply to your timber harvest. For example, a permit is required to cross protected streams. Protected streams have a classification of AA, A, B, or C with a standard of (T) or (TS). See the Stream Crossing section starting on page 59 for more information.



6. **New York is a home-rule State** so each Town may have its own permit. Always check to see if a permit is required before logging starts. A good starting point is to contact the Town where you'll be logging as well as the DEC regional office. To find DEC office contact information, visit **[www.dec.ny.gov/about/558.html](http://www.dec.ny.gov/about/558.html)**. Click on the area of the state where your project will occur, then look for the phone number beside "Permits."
7. **Contact Utilities:** When crossing utility right-of-ways like pipelines or power lines, call the company to secure permission. Look for markers or owner plaques. Always call 811 (Dig Safely NY) or visit **[www.call811.com](http://www.call811.com)** when digging along roads or in developed areas to identify buried utilities. Using the property address, Dig Safely will check with utility companies or governments. Contact the appropriate highway department for proper sizing and installation of roadside culverts.
8. **Schedule your operation:** Operating when the ground is dry, frozen, or when water levels are low is an excellent way to reduce or eliminate erosion and sedimentation. On wet sites and when working in or around wetlands, time operations to coincide with frozen ground if possible. Take additional precautions or suspend harvesting during wet periods. If you need to continue

a harvest during a wet period, consider avoiding skidding and limiting your activities to cutting and bunching. If alternate work is not an option and skidding cannot be avoided, use BMPs from this field guide to minimize the damage or try using a temporary landing where site conditions are suitable.

- 9. Monitor and adjust:** Logging is dynamic. Weather changes. Timber prices fluctuate. Equipment breaks down. As you confront these challenges, consider changing your plan, maintaining existing BMPs, and adding new ones.

## Before the Harvest: Locating Roads, Trails, and Landings

Timber harvesting has a long history in NYS, so many woodlots already have a network of log landings, truck roads, and skid trails. When possible, use these existing access systems when consistent with the voluntary BMPs in this manual. Create new truck roads, skid trails, and landings when use of the existing access network may harm water quality. Old skid trails that go through a wetland or ones that ignore topographic contours and head straight up steep hills are examples of potential water quality threats.

When locating new landings, keep these BMPs in mind:

- Locate landings at least 200 feet from water bodies and regulated wetlands. If the landing must be closer than 200 feet, use weed-free straw bales, silt fencing, or both to minimize erosion. See page 42 and on for information on these short-term erosion control devices.
- Locate landings on firm, well-drained soils with a slight slope (2-5%) to promote drainage. If possible, slope landings to direct surface water run-off into a filtration area and away from streams.

- If a landing must be on a poorly drained site, cover the landing with gravel to help stabilize the surface. Other options include coarse gravel over geotextile fabric (page 49), rubber tire mats (page 57) or a ditch to divert the flow of water around the landing.
- Size landings to the minimum necessary for the acreage to be harvested, yet with enough room for safe, efficient equipment operation and log sorting.
- Design all entrances and exits to the landing such that water cannot flow into or out of the landing through them. Install water control devices like water bars and broad-based dips on the truck roads and skid trails leading to the landing to help achieve this goal.

When locating new truck roads or skid trails, keep these BMPs in mind:

- Consider topography and soil type when laying out truck roads and skid trails. Avoid steep slopes, poorly drained soils, unstable soils subject to slumping or creep, and riparian management zones. Never use natural drainages like streams, springs, and seeps as skid trails.
- Locate truck roads and skid trails in accordance with the recommendations contained in the Riparian Management Zone section starting on page 30.

- Truck roads and skid trails should be run cross-slope where possible to minimize erosion and to provide for cross-drainage.
- Locate truck roads and skid trails to minimize the amount of cut and fill.
- Keep skid trail slopes less than 15% where possible.
- Where slopes greater than 15% are unavoidable, they should not exceed 300 feet in length. Use turn-ups to break the grade. To make a turn-up, install the skid trail so that it periodically turns uphill for a short distance prior to resuming the skid trail's downward course.
- Truck roads should have slopes less than 10% with slopes up to 15% for no more than 200 feet in mountainous terrain. A slope of 3% to 5% is preferred. On highly erodible soils (identified on soil maps), maximum slopes of 5% are recommended.
- Minimize the number of stream crossings. If you need to cross a stream, refer to the Stream Crossing section on page 59 for more information.
- Minimize total truck road and skid trail length while avoiding long, sustained grades.
- When possible, lay out skid trails so the turns and curves are gentle. Doing

this helps prevent the hitch from sweeping off the trail, which disturbs more soil than necessary.

- Lay out skid trails to use low-value trees as “bumper trees” at turns and on the downhill side of a trail. Bumper trees keep a hitch on the trail, reduce soil disturbance on the trail’s downhill side, and prevent damage to trees behind them. Consider leaving bumper trees behind to use during future harvests.



## DURING THE HARVEST





## During the Harvest: Introduction

In the past, the majority of BMPs focused on post-harvest activities. But it's equally important to use BMPs during the harvest to protect soil and water.



## During the Harvest: Protecting Roads, Trails, and Landings

Your access system, especially the landing, is the most visible part of your timber harvest. These BMPs will help protect water quality while letting you keep on working:

- Locate residue piles such as slash, sawdust, and woodchips away from drainages where surface water run-off could wash the residue into water bodies or regulated wetlands.
- Place coarse rock on the landing or truck road just before the public road. The rock creates a running surface for trucks that keeps excessive amounts of mud off the public road.
- Use on-site equipment such as the blade of your skidder or dozer to maintain existing water control devices and install new ones as needed. Soil will often fill in and block water control device outlets during active operations. Focus on clearing these outlets so water can leave the truck road or skid trail.
- Minimize skidding when soils are saturated to prevent excessive rutting and soil compaction. Ruts and compacted soils concentrate surface water run-off, which speeds up erosion.

- Consider using tree tops and slash to stabilize sensitive areas on your skid trails.
- Avoid causing ruts that have the potential to cause significant erosion or channel sediment into a stream, waterbody, or regulated wetland. If these ruts do form, smooth them out.
- Install temporary water control devices if work will be suspended for several days or more, or if a heavy storm is likely during off hours. Most sediment enters streams following heavy rain.
- If you're working a winter job, plan ahead and install water control devices before the ground freezes, if possible, to control surface water run-off resulting from winter thaws.

## During the Harvest: Leaks, Spills, and Hazardous Materials

Fuel, grease, oil, and hydraulic fluid are essential on a logging job, but they can have serious effects on the environment when they spill. Practice these BMPs to reduce the chances of a spill happening on your job:

- At the beginning of each work day, check equipment hoses and fittings regularly to prevent leaks. Repair all leaks immediately.
- Store equipment at least 200 feet away from water bodies and wetlands whenever possible.
- Collect and transport offsite all waste oil, hydraulic fluid, and soiled cleaning rags daily for proper disposal.
- If hazardous materials need to be stored onsite, including fuel and oil, use a secondary container to limit the chance of spills.
- Keep a spill-response kit at the landing. Suggested items for this kit are safety goggles, non-latex gloves (disposable 4-mil nitrile gloves work well), and an absorbent material (loose powder, pads - not cat litter, which will not draw oil out of the ground). You should also have a heavy, sealable plastic or vinyl

bag suitable for transporting the contaminated contents of the kit after it has been used.

- Do not apply pesticides or other chemical control agents unless you are a NYS DEC Licensed Pesticide Applicator. The only exception is when working on property you own.
- Prevent fires by removing leaves, twigs and other flammable materials that accumulate in equipment from daily operation.

If a spill does occur, don't panic. An accidental petroleum spill is not a crime. However, the failure to report it is. The penalty for not reporting a spill may include a fine for every day since the spill occurred, as well as the cost of cleanup and remediation. Spills must be reported unless ALL of the following apply:

- It is less than five gallons.
- It has not and will not reach soil or water.
- It is contained and controlled.
- It is cleaned up within two hours of discovery.

**To report a spill,  
call the NYS DEC  
Spills Hotline toll-free  
at 800-457-7362.**

## During the Harvest: Riparian Management Zones

Riparian Management Zones (RMZs) are lands bordering the banks of streams, lakes, ponds, regulated wetlands, or other water bodies. These zones are important because they:

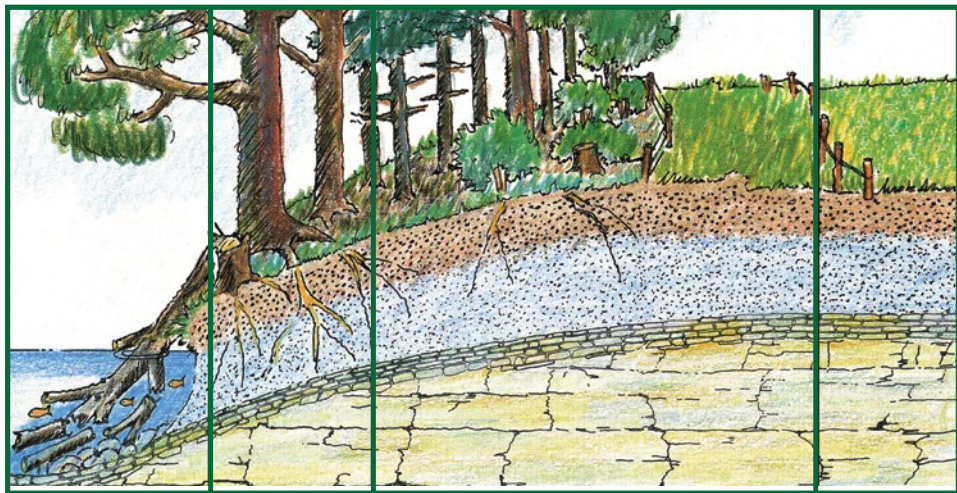
- Filter nutrients and sediment.
- Regulate water temperature by shading streams.
- Enhance bank stability.
- Enhance wildlife habitat.
- Provide a buffer between timber harvesting and water supplies.

The RMZ is an area where special consideration should be given due to its sensitivity to disturbance.

The RMZ should be measured from the “high water mark”. The high water mark is where high water has eroded the bank, destroyed bank vegetation, piled dead branches and other debris or deposited fine sediments like sand and small pebbles.



**DURING THE HARVEST**



Stream, Wetland  
or Water body

Zone 1  
(15 feet)

Zone 2  
(variable width see chart on page 34)

The size of a RMZ varies along the water body, may vary from one bank to another, and is unrelated to the size of the water body. The RMZ is divided into two zones:



**Zone 1** is the 15 foot fixed portion of the buffer closest to the water body starting from the high water mark. Within Zone 1 (15 ft.) of the RMZ:

- Disturbance is discouraged.
- Equipment should be excluded except in designated crossings areas.
- Forest cover should be maintained.

**Zone 2** is the variable width portion of the buffer that changes depending on the slope of the land adjacent to the waterbody. Within Zone 2 (variable width) of the RMZ:

- Distance will vary between 35 ft. ( $\leq 10\%$  slope) and 100 ft. ( $> 40\%$  slope) (see Table on page 34).

Selective harvesting of stems is allowed:

- An average of 60 square feet per acre of residual basal area per acre or at least 50% canopy cover is recommended.
- Trees should be felled away from streams.
- Equipment operation is permissible but should be minimized.
- Truck roads and skid trails should be limited to designated crossing areas.

## Riparian Management Zone Recommended Widths

Slope Class (%)*	Zone 1 (ft.)	Zone 2 (ft.)	Total RMZ width (ft.)
0 – 10	15	20	35
11 – 20	15	50	65
21 – 40	15	55	75
40 – 70	15	85	100

\*Slope is measured running perpendicular to the water body.

## During the Harvest: Regulated Wetlands

Section 404 of the Clean Water Act (CWA) regulates the discharge of dredged or fill material into waters of the United States. Like farming, this section of the CWA provides an exemption for silvicultural activities and associated forest roads. However, State and local laws may still apply to your harvest.

The NYS DEC regulates activities in freshwater wetlands and their adjacent areas under the Freshwater Wetlands Act. DEC regulates activities in and around wetlands to prevent, or at least minimize, the impairment of wetland functions.

- Adjacent areas outside wetlands are also regulated. Adjacent areas extend 100 feet from the wetland boundary, measured horizontally. In rare cases, this adjacent area distance measurement may be larger.
- Wetlands 12.4 acres or larger are regulated by the DEC under the Freshwater Wetlands Act.
- The Adirondack Park Agency administers the Freshwater Wetlands Act in the Adirondacks. The APA requires a permit when wetlands are larger than 3 acres. They also require a permit if a wetland smaller than 3 acres is adjacent to a body of water with which there is free interchange of water at the surface.

- Smaller wetlands may be protected when the DEC commissioner determines they have unusual local importance.

## General Criteria for Identifying a Wetland



A wetland is an area where standing water or saturated (hydric) soils are present long enough to support unique, water-loving plants. Here are some general tips for finding wetlands:

- **Look for areas where water collects.** Look for standing water and areas where the soil is waterlogged or saturated. You can also look for signs that water has been there recently. Look for signs like water rings (or staining) on trees, rocks and fence posts. Look for debris in a line (like at the edge of a lake). The best

time to look is during the wet season or after several soaking rains.

- **Look for wetland plants.** Walk the site during the wet portion of the growing season and look for water-loving plants. The US Army Corps of Engineers recognizes over 2,800 wetland indicator plants and trees in the Northeast US. Common indicator plants include cattail and purple loosestrife. Common indicator trees include willow and black spruce. Learn about other wetland plants and trees by visiting the USACE website <http://wetland-plants.usace.army.mil>.
- **Look at a soil map.** The Natural Resources Conservation Service (NRCS) has created maps of the different soil types all over the US. You can find soils maps on [www.websoilsurvey.nrcs.usda.gov](http://www.websoilsurvey.nrcs.usda.gov) or on the UC Davis soil website <https://casoilresource.lawr.ucdavis.edu/soilweb-apps/>. If there are hydric soils on or near the area in question then the area may be a wetland.
- **Look at aerial photos.** Wetlands often show up as darker areas in aerial photographs. This is because water absorbs light, so wet soils tend to look dark from the air. The reverse can also be true with wetlands appearing brighter than the surrounding uplands early in the growing season. This happens when water suppresses plant growth then dries up, leaving

more bare ground than the surrounding landscape. You can find aerial photos on the website TopoView <https://ngmdb.usgs.gov/topoview/viewer/#4/40.01/-100.06> or Google Earth.

- Identifying wetlands is complicated. If you suspect there's a regulated wetland on your logging job check the DEC's Environmental Resource Mapper ([www.dec.ny.gov/gis/erm/](http://www.dec.ny.gov/gis/erm/)) and contact your local DEC office for confirmation.

Almost any activity which may adversely impact the natural values of the wetlands or their adjacent areas is regulated. Some activities associated with harvesting timber require a permit. These activities include:

- Constructing roadways, bulkheads, dikes, and dams.
- The clearcutting of more than 3 acres within the Adirondack Park.
- Excavation, grading, or placement of fill.
- Drainage, except for agriculture.
- Application of pesticides.

**Do Not Start A Project Before Obtaining a Permit!** You must obtain all necessary permits before commencing work on a project that requires any DEC permit. Persons commencing work on such a project before obtaining the required permits are subjected to enforcement action by the DEC.

**Exempt Activities Do Not Require A Permit.** The following are the most common activities exempted from regulation. No DEC permit is required for:

- Normal agricultural practices, except filling, clear cutting of trees, or construction of non-agricultural structures.
- The clearcutting of less than 3 acres within the Adirondack Park.
- Recreational activities (ex. fishing, hunting, trapping, hiking, swimming, picnicking).
- Continuance of lawfully existing land uses.
- Routine maintenance of existing functional structures such as repairing broken docks, repainting a structure, or resurfacing paved areas.
- Selective cutting of trees and harvesting fuel wood (not clear cutting). The skid trails used to harvest trees and fuel wood are generally allowed in regulated wetlands. But forest roads are not allowed in regulated wetlands. It is best to contact DEC prior to cutting trees in a regulated wetland just to be sure.

## During the Harvest: Unregulated Wetlands, Seeps and Vernal Pools

Unregulated wetlands, seeps, and vernal pools represent important water resources that filter sediment and nutrients from surface water run-off, improving water quality. They also provide unique habitat for plants and animals. They are very sensitive to disturbance and warrant special attention during timber harvests.



*photos: Stacy McNulty/SUNY ESF Adirondack Ecological Center*



To identify unregulated wetlands, seeps and vernal pools follow the General Criteria for Identifying a Wetland on page 36. To protect unregulated wetlands, seeps, and vernal pools during timber harvests, follow these BMPs:

- Avoid working in these areas when possible. Consider alternate routes through the property.
- Carry out harvests when the ground is frozen if possible. (CAUTION: Just because the rest of the property is snow-covered or frozen doesn't mean wetlands are frozen. Seeps, for example, are groundwater-fed and rarely if ever freeze. Even in winter, it's best to avoid working in these areas).
- If you must cross these areas, minimize impacts by crossing at the narrowest point or moving across islands (high spots).
- Retain ground cover like logs, surface rocks, and deep leaf litter within proximity of a wetland as cover for amphibians.
- Maintain a moist, shaded environment.
- Minimize rutting as much as practicable. Ruts should not impede or change the flow of an unregulated wetland, seep or vernal pool.
- Use brush mats, corduroy (page 80), and coarse woody debris (<6 inches) to distribute equipment load and stabilize skid trails.

## During the Harvest: Short-term Erosion Control

Logging jobs rarely provide ideal conditions. Slopes may be steep. The landing may have to be close to a stream or on poorly drained soil. When these situations arise, short-term erosion control devices can help limit water quality impacts.



## Straw Bales



### **Description:**

Straw bales placed in the path of water trap sediment while allowing the water to pass through.

### **Pros:**

- Cheap and easy to install.
- Provide a temporary barrier to trap sediment resulting from the erosion of exposed soils.

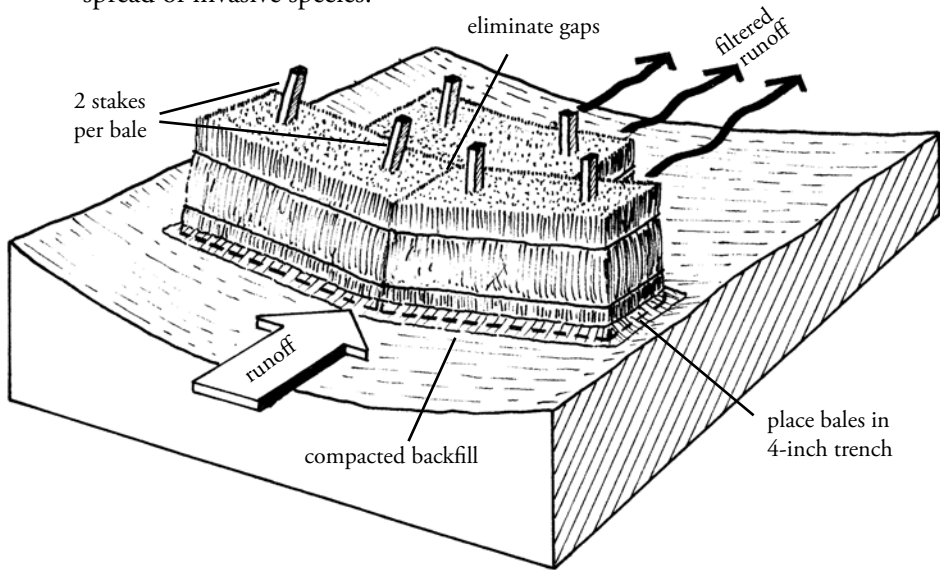
### **Cons:**

- They can fill up with sediment quickly, and as a result need to be monitored and changed, often weekly.
- Weed-free straw isn't available in a traditional bale that's suitable for use in this application. Traditional straw bales should be used in its place.

### **Construction Guidelines:**

- Excavate a trench 4 inches deep and the width of the bale.
- Position the bales in a single row or stagger them. Make sure there are no gaps between the bales where water could flow through.
- Place the bales in the trench. Stake them with at least two stakes per bale.
- Backfill with soil on the uphill side to keep water from flowing under the bale.

- Remove after exposed soil has been stabilized permanently with other BMPs.
- Straw bales, instead of hay, should be used when available to reduce the spread of invasive species.



## Silt Fence



### **Description:**

Silt fence is a manufactured alternative to straw bales for filtering surface water runoff from a truck road, skid trail, or landing.

**Pros:**

- Provides a temporary barrier to trap sediment resulting from the erosion of exposed soils.

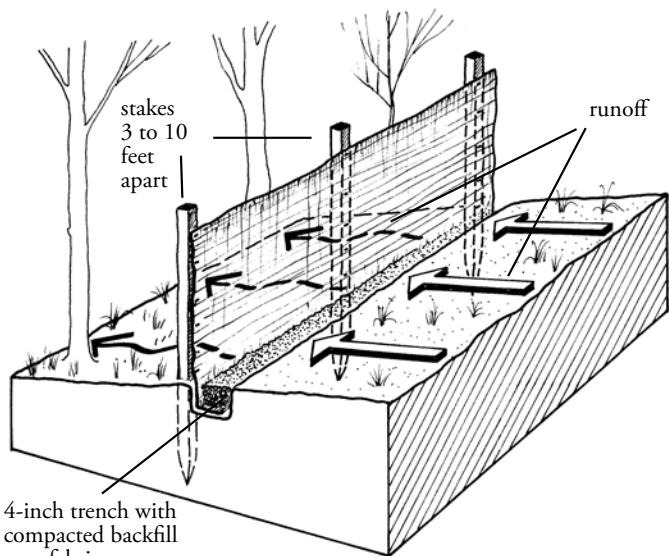
**Cons:**

- Will not biodegrade, unlike straw, and will need to be removed when no longer functional.

**Construction Guidelines:**

- Purchase from erosion control supply companies identified through an Internet search.
- Install by first setting stakes. Space stakes 3 feet apart for light silt fence fabric. Space stakes ten feet apart for extra strength fabric or if using a wire mesh support fence.
- Follow the manufacturer's recommendations and choose a filter fabric capable of handling the expected water flow. The fabric can be 15 to 36 inches high.
- Dig a 4-inch deep trench up-slope, along the line of stakes.

- Place an 8-inch skirt of fabric in the trench. Staple the fabric to the stakes, then backfill with soil.
- Remove after exposed soil has been stabilized. permanently with other BMPs. Sometimes it is best to remove silt fence by cutting it at grade level to minimize soil and vegetation disturbance.





## Geotextile Fabric



DURING THE HARVEST

### Description:

Geotextiles are special fabrics used to stabilize soil by keeping gravel and soil separated. They are laid out over a surface and generally covered with stone or corduroy to help keep the truck road, landing, or stream crossing stable.

### **Pros:**

- Reduces the amount of gravel needed to create a stable surface by preventing gravel from mixing with soil.
- Minimizes cost by reducing the amount of gravel needed to stabilize a surface.

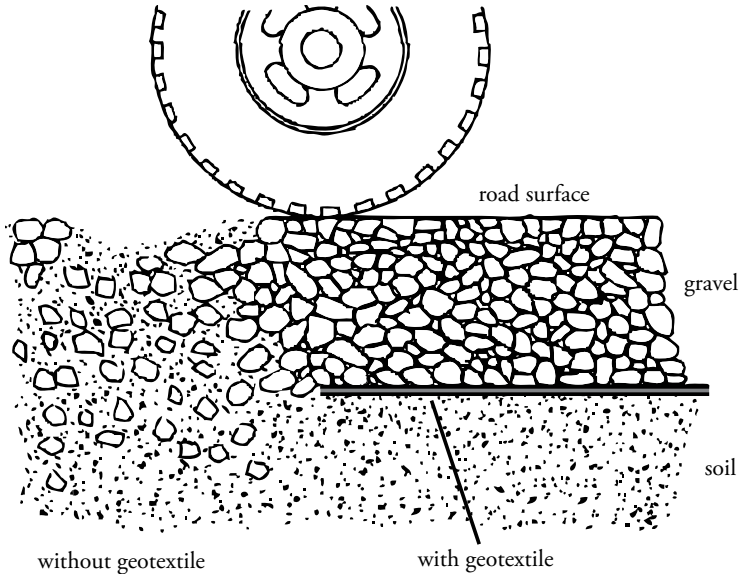
### **Cons:**

- Expensive and may not be locally available.

### **Installation Guidelines:**

- Purchase from erosion control supply companies identified through an Internet search.
- Clear the area of vegetation so you can lay the fabric flat against the ground.
- Smooth the surface the geotextile fabric will be applied to.
- Use gravel that is approximately 3 to 4 inches in size.
- Dump the gravel on the edge of the fabric and push it evenly across the fabric. Maintain a minimum gravel depth of 3 inches.

- Avoid using bank run gravel when possible. Bank run may have a lot of soil mixed in with it, making for a less stable surface.



## Erosion Control Blankets



### **Description:**

Erosion control blankets help keep large, sloped areas of exposed soil stable long enough for grass seed or other plants to grow and provide longer-term stabilization.

**Pros:**

- Easy and fast way to protect large areas of exposed soil quickly.
- Work well on steep banks and difficult sites.
- Very portable compared with straw bales.

**Cons:**

- Can't be used on skid trails because the netting can get tangled around axles.
- Take time for the biodegradable netting to break down.

**Installation Guidelines:**

- Purchase from erosion control supply companies identified through an Internet search.
- Install in direct contact with the soil.
- Place the roll on the uphill side of the area to be covered and roll into place.
- Secure the netting with rocks, stakes or wire landscaping staples.

## Straw Wattles



### **Description:**

Straw packed inside a mesh tube creates this flexible, movable short-term erosion barrier.

**Pros:**

- Effective and adaptable to various needs from temporarily stabilizing a stream crossing to providing a sediment barrier around a landing or riparian management zone.
- Much like water bars, straw wattles can direct the flow of water off a trail.
- Easy to install.
- You don't need to dig a trench to bury a portion of the wattle like silt fence.
- Wattles decompose.
- A great way to temporarily control surface water run-off on the approaches to a stream crossing prior to installing permanent BMPs.

**Cons:**

- Not vehicle friendly. Driving over them will destroy their ability to control run-off.
- Relatively expensive.

## Installation Guidelines:

- Purchase from erosion control supply companies identified through an Internet search.
- Place straw wattles at the same intervals as water bars dependent on slope. See the water bar spacing chart on page 96.
- Lay the wattle in position and step on it to make sure it has good ground contact.
- Use two stakes to secure each wattle in position.
- Install at a 30-degree downhill angle for drainage.

## Straw Wattle Spacing Guidelines

Slope (percent)	Spacing (feet)
2	250
5	135
10	80
15	60
20	45
25	35
30	30



## Tire Mats



DURING THE HARVEST

### **Description:**

Made from recycled tires, tire mats weave together tire treads to distribute vehicle loads and reduce rutting in sensitive soils. Rubber mats can be purchased or made from recycled tires. They can be used in many situations to prevent or reduce erosion.

### **Pros:**

- Help float trucks and equipment over muddy or wet areas.
- Portable so they can be removed afterward if the project requires that nothing be left in place, like a wetland crossing.

### **Cons:**

- Heavy and difficult to move.
- Slippery when wet, making it difficult to position trucks on a landing.
- Bound together with wire and bolts, so they can become tangled in chains and chokers.
- Skidding over tire mats is not recommended.

### **Installation Guidelines:**

- Smooth the area where the mats will be used to remove ruts, holes, and debris that may interfere with placement and traction.
- Place mats over wet or muddy areas that need reinforcement. The mats are heavy, so an excavator or loader is ideal for positioning.





## Stream Crossings: Introduction

When properly located and constructed, stream crossings can reduce damage to the bed and banks of streams and minimize the movement of sediment into the water. Stream crossings that are poorly located or constructed can damage stream banks and beds, increasing the chance for erosion. Stream crossings should be designed, constructed, and maintained to safely handle expected vehicle loads and to minimize disturbance of stream banks and beds.

A permit is required for any disturbance to the bed or bank of a protected stream, including a temporary stream crossing. Protected streams have a classification of AA, A, B, or C with a standard of (T) or (TS). You can find the classification of a stream by using the NYS Environmental Resource Mapper ([www.dec.ny.gov/is/erm/](http://www.dec.ny.gov/is/erm/)) and by contacting your regional DEC office. For more information on how to get a stream crossing permit go to [www.dec.ny.gov/permits/6554.html](http://www.dec.ny.gov/permits/6554.html)

The NYS DEC has issued two general permits for stream crossings on timber harvests. If your stream crossing meets the requirements of a general permit it can speed up the permitting process. You can get more information on how to apply for these general permits at [www.dec.ny.gov/permits/93482.html](http://www.dec.ny.gov/permits/93482.html)

All waters in New York are assigned a class and standard designation based on existing or expected best use.

- The classification AA or A is assigned to waters used as a source of drinking water.
- Classification B is for waters used for swimming and other contact recreation, but not for drinking water.
- Classification C is for waters supporting fisheries and suitable for non - contact activities.
- The lowest classification and standard is D.
- Waters with classifications A, B, and C may also have a standard of (T), indicating that it may support a trout population, or (TS), indicating that it may support trout spawning. Special requirements apply to sustain these waters that support these valuable and sensitive fisheries resources.

If you have a question about whether the stream in question is protected, contact your nearest DEC office.

## Stream Crossings: Best Management Practices

Appropriate stream crossings can use bridges, culverts, fords or corduroy and brush mats installed for use by skidders, trucks, and other logging vehicles. Regardless of the stream crossing method you choose, these BMPs will help keep the stream and banks stable, protect water quality, and safeguard habitat for fish and other aquatic wildlife:

- Cross streams only when necessary and minimize the number of crossings.
- Consider streambed material, stream size, storm frequency, flow rates, and intensity of use when planning crossings.
- Cross streams where the banks are stable, the stream bottom is firm, the approaches have a gentle slope, and the stream is straight and unobstructed.
- Install stream crossing structures at right angles to the stream channel.
- The approaches to the stream crossing should be as straight as possible for 50 feet on each side of the crossing.
- Install stream crossings using materials that are clean, non-erodible, and non-toxic to aquatic life.
- Minimize the use of equipment in the stream. In-stream excavation should be limited to what is necessary to install the crossing.

- Limit construction in the water to periods of low or normal flow.
- Stabilize the exposed soil around all culverts and bridges with weed-free straw and seed immediately after installation.
- Install temporary sediment control structures to manage the flow of surface water on the approaches to the stream crossing. BMPs suitable for this purpose are water bars, gravel, geotextile fabric, rubber belt deflectors, open top culverts, straw bales, silt fences, erosion control blankets and straw wattles. (see Short-term Erosion Control page 42 and Best Management Practices page 86).
- Divert truck road drainage into undisturbed forest soils, preferably outside the riparian management zone, so surface water run-off does not enter the stream.
- Keep culverts and bridges clear and free of debris so water can pass unimpeded at all times.
- At closeout, smooth out ruts that have the potential to channel sediment into a stream or waterbody. Also install at least two water control devices in the 100 feet on either side of the crossing (the “approaches”) to prevent chronic sedimentation. BMPs suitable for this purpose are water bars, rubber belt deflectors, and open-top culverts.
- Finish your closeout by applying weed-free straw and grass seed to all exposed soils on the approaches (page 87).



## Stream Crossings: Methods



## Portable, Temporary Bridges



### Description:

Portable, temporary bridges are the recommended stream crossing method on logging jobs for both truck roads and skid trails. They come in a variety of sizes from small arch culverts to 50-foot truck bridges.

**Pros:**

- Easy to install.
- Cheap alternative to permanent structures like culverts.
- Retain the stream bottom and slope to allow for movement of fish and other wildlife.

**Cons:**

- Limits post-harvest access by the landowner. Because the crossing is temporary.
- Availability can be an issue, but there are organizations that loan bridges in New York. For example, the Watershed Agricultural Council's (WAC) Forestry Program has ten 20 foot bridges, three 30 foot bridges, one 40 foot bridge and one 50 foot bridge available for loan free of charge. If you are logging in the Catskill or Lower Hudson regions and you need a bridge, call WAC at (607) 865-7790. Saw mills may also loan portable bridges so make sure to check with them too.

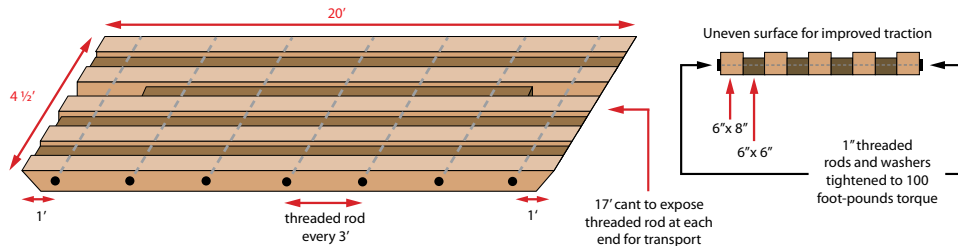
**Construction Guidelines:**

- Anchor temporary bridges on one end with a cable if flash flooding is a

concern so they don't float away during high water.

- Install bridges so they can be easily removed when no longer in use, regardless of the season.
- Remove debris from the bridge surface prior to installation and removal. Do not push debris into the stream.
- The photos and diagrams on the next few pages illustrate some design options:

### 20 foot Skidder Bridge Panel Construction





## STREAM CROSSINGS



This arch culvert is made from plastic sewer pipe manufactured by KWH Pipe in Ontario, Canada. It was tested by driving a fully loaded CAT 250B articulated dump truck over it multiple times. It is strong enough to support a range of logging equipment.







## Culverts



### **Description:**

Culverts create a permanent crossing by building up the truck road surface over the stream. Although primarily used for forest truck roads, culverts can be used on main skid trails when the landowner requires access after the harvest.

### Pros:

- Can be used to create a permanent crossing.

### Cons:

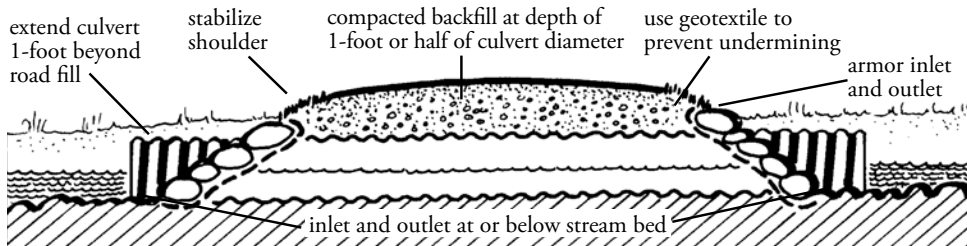
- Requires regular maintenance, especially after storms, to ensure it doesn't become plugged with debris.
- Not a good option for crossing streams on skid trails. The skidder or hitch can potentially crush the ends of the pipe, making it useless. Consider using a longer culvert, more fill or bumper trees to prevent this.
- Disrupts the stream ecosystem. Mayflies, caddisflies, and other stream life can't crawl through the culvert. When you install one you're limiting habitat for these animals as well as the fish that feed on them, like brook trout.
- Can limit fish movement if improperly installed.

### Construction Guidelines:

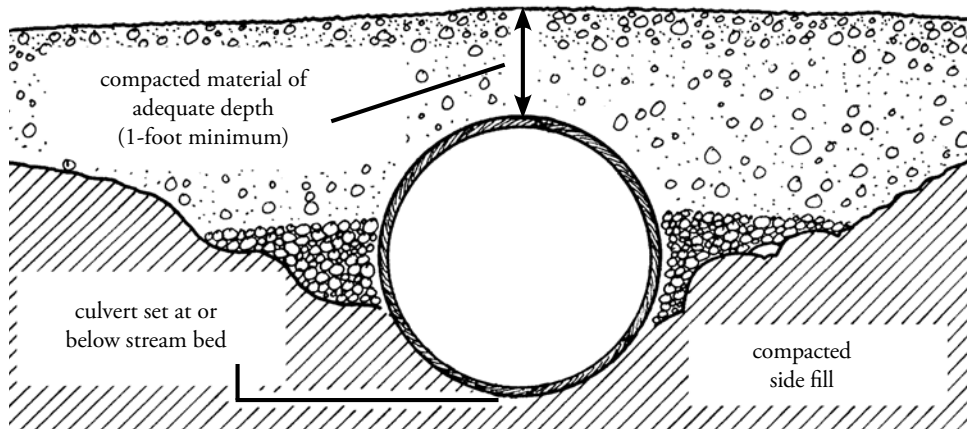
- Culverts must be sized large enough to handle seasonal high water flow. Culverts that are too small can plug with debris and result in the truck road

or skid trail washing out or flooding upstream. Seasonal high water flow is measured from the “high water mark”. The high water mark is where high water has eroded the bank, destroyed bank vegetation, piled dead branches and other debris or deposited fine sediments like sand and small pebbles.

- The culvert needs enough fill over it so it doesn't get crushed. Cover the culvert with material to a depth of half the culvert diameter, or a minimum of 1 foot, whichever is greater.



## Stream Crossing Using Pipe Culvert



- To size your culvert, use the following tables:

## Recommended Pipe Culvert Sizes for Well-defined Stream Channels

Stream Width* (inches)	Stream Depth (inches)	Culvert Diameter for Maintained Road (inches)	Culvert Diameter for Unmaintained Road (inches)
18	6	16	22
18	9	23	27
18	12	26	31
24	6	21	25
24	12	30	36
30	6	24	28
30	12	34	40
36	6	26	31
36	12	37	44
48	6	30	36
48	12	43	51
60	12	48	57
60	18	60	70
60	24	68	80

\*width as measured at the high water mark

## Recommended Pipe Culvert Sizes for Undefined Streams, Channels and Cross Drains

Area (acres)	Pipe Size (inches)
10	18
20	20
30	24
40	26
50	28
75	30
100	34
150	38
200	42

## Fords



### **Description:**

Where streams are too wide to cross with bridges or culverts, vehicles may have to enter the stream to make the crossing. Fords should be used where the substrate is hard and stable, where low flow conditions exist and where light use is expected.

**Pros:**

- Allow for crossing the largest streams where bridges and culverts are impractical.

**Cons:**

- Because equipment enters the stream itself, fords have a high risk of water quality impacts.

**Construction Guidelines:**

- Fords should be considered as stream crossings of last resort when no practical alternative exists.
- Install fords only where streambanks are stable and stream bottoms are hard. Stable banks are composed of coarse textured soil (gravel). Unstable stream banks are composed of fine textured soils (silt/clay).
- If a ford must be used where streambanks are unstable, reinforce the streambank with rock or other non-erosive material.
- Stabilize the approaches to prevent sediment from entering the stream from the trail.

## Corduroy and Brush Mats



### **Description:**

Brush, slash, and small logs (often interspersed with iron pipes to facilitate water flow) are laid across a wet area or seep to create a surface for equipment to drive over. Corduroy and brush mats can be especially useful in sensitive areas like wetlands because they spread out equipment weight and help reduce rutting.



**Pros:**

- Can also be used on the approaches to other stream crossing methods to provide temporary stabilization.
- Do not require outside materials.
- Low financial cost.

**Cons:**

- Time-consuming to install.
- If you're operating in a regulated wetland, large pieces of corduroy may be considered fill that needs to be removed after the harvest. Removal can be done with either a grapple or cable skidder.

**Construction Guidelines:**

- If possible, cover the crossing area with geotextile fabric to increase stability by preventing sediment movement under your crossing.
- Lay small logs, iron pipes, brush, and slash over the wet area at a right angle to the direction equipment will travel.
- Each piece of corduroy should be at least as long as the width of the

equipment using the crossing.

- Longer corduroy pieces may be needed if soils have an especially low weight-bearing strength.
- Small culverts may be used to ease the flow of water through the corduroy.
- For additional strength, use multiple layers of corduroy.
- All materials should be removed from the stream or water body once the job is completed.



*photo: Dan Little, NYS DEC Division of Lands & Forests--Bureau of Forest Resource Management*





## After the Harvest: Introduction

Your post-harvest wrap-up is your last opportunity to protect water quality and positively impact the environment.



## After the Harvest: Best Management Practices

- Remove and properly dispose of all trash.
- Smooth ruts that have the potential to cause significant erosion or channel sediment into a stream, waterbody, or regulated wetland.
- Install water control devices (page 90) to prevent or minimize erosion and sedimentation from truck roads, skid trails, and landings.
- Restore watercourses to their approximate natural condition by removing temporary crossings and stabilizing the soil along the banks. See Stream Crossings (page 59) for more information.
- Stabilize exposed soils on the landing and in the RMZ with weed-free straw and seed as soon as possible to minimize erosion (page 87).
- When the ground is frozen, you may not be able to fill in ruts, smooth skid trails and install BMPs. In these cases, effort should be made to return to the site as soon as the ground thaws to complete this work.
- Traffic barriers should be placed where appropriate to prevent off-road vehicles from disturbing recently stabilized areas. Barriers should be visible and well-marked, and they should not present a safety hazard.

## Seeding & Straw Mulch



### Description:

Seeding exposed soil and mulching it with weed free straw can reduce soil erosion by 90%. Seed and straw mulch should be used to stabilize the exposed soil on landings, on roads and trails within the riparian management zone and on exposed soils around stream crossings.

### **Pros:**

- A cheap way to prevent erosion.
- Improve the appearance of logged areas.
- Protects the exposed soil while the seed germinates.

### **Cons:**

- Spreading seed and straw by hand can be time consuming.
- Large sites may require specialized equipment.
- Uncontrolled vehicle traffic may quickly damage seeded areas.
- It may take up to one year for grass to become completely established.

### **Construction Guidelines:**

- Site preparation may include smoothing ruts.
- Water control devices, such as water bars, are used to control run-off.
- Seed can be spread by hand or with a cyclone seeder on smaller site, and with a hydro-seeder or other commercial equipment on larger sites.



- The type of seed to use varies with soil type, drainage class, and degree of shading. Contractor Mix is generally suitable and commonly available at local hardware stores.
- Seeding and straw mulch should be completed immediately after logging activities cease.
- All seed should be immediately mulched with weed-free straw at 2 tons per acre (approximately 100 pounds per 1000 square feet). Although it is best to wait for spring to spread seed, seed spread on snow (dormant seeding) will germinate when the snow melts, helping protect trails and landings during mud season. Note that dormant seeding effectiveness will depend on seed type.

## After the Harvest: Water Control Devices

As water gains volume and speed, its destructive power increases. Truck roads and skid trails gather and channel water, increasing its volume and speed. This gives concentrated water, or surface water run-off, the strength to wash away the road or trail surface, funneling sediment and pollutants into water bodies. Water control devices can be installed to control this run-off and minimize erosion, protecting both water quality and access to the woods.



There are a variety of water control devices available, but they are all designed to do the same thing: divert water off a truck road or skid trail into undisturbed forest soil before the water gains enough volume or speed to cause erosion.

This section lists several types of water control devices. Each has pros and cons. Some are cheap and easy to install but may limit vehicle access. Others are more expensive but can stand up to regular traffic. Choosing between the different types of control devices depends on how the landowner uses their roads and trails and how much money they are willing to invest.

Regardless of the water control device used, there are a few common tips for making sure they work well:

- Ensure the device has a clear outlet into undisturbed forest soil.
- Install the device so it spans the entire width of the truck road or skid trail.
- Install the device at a 30-degree downhill angle for drainage. This downhill angle is especially important for culverts to minimize clogging.
- Avoid draining surface water from truck roads or skid trails directly into streams, regulated wetlands, or other water bodies.

- Do not use erosion control devices for crossing streams. They are not suitable for handling constant water flows.
- Successful water control devices rely on handling water in small amounts. Space multiple water control devices throughout the truck road or skid trail network.
- The steeper the slope of a truck road or skid trail, the greater the number of water control devices needed to protect it. Refer to the spacing charts on the following pages to determine the distance between water control devices for various slopes. **NOTE: These spacing charts serve as a guide. They are not designed to dictate the precise spacing of devices for all situations. Professional judgement will be necessary to make adjustments to the spacing of water control devices to allow for variation in site conditions.**
- On skid trails, a good general rule for spacing water control devices is to stand on the trail facing uphill and look straight ahead at the slope. The spot where your eyes rest on the trail is approximately where you should install the next water control device if site conditions allow.

- All water control devices require maintenance to ensure they remain functional. Encourage the landowner to inspect and repair their water control devices annually, if feasible. This work generally involves scraping loose dirt, leaves, and other debris out of the device into undisturbed forest soil.



## Water Bars



### **Description:**

Water bars are large earthen berms installed using soil in the trail itself. They are the go-to water control device on skid trails.

**Pros:**

- Fast and cheap to install.
- Require no outside materials or preparation.
- Effective for retiring skid trails.

**Cons:**

- The large berm and trough can limit vehicle access if not installed properly.

**Construction Guidelines:**

- Excavate a trench 1-3 feet below the surface of the trail. Use the spoil materials to develop the berm.
- Install the device at a 30-degree downhill angle for drainage.
- Dig into the subsoil for long-term stability.
- Anticipate future trail use. ATV traffic may require a wide, gentle berm and wide, deep trough.
- Allow the soil to dry and harden after installation before resuming use of the trail.

- Bulldozers are ideal for water bar construction. When a dozer is not available, functional water bars can be installed with a skidder blade. Skidder-constructed water bars will not have a trench that is 1 – 3 feet deep due to equipment limitations. To compensate, make the berm higher.



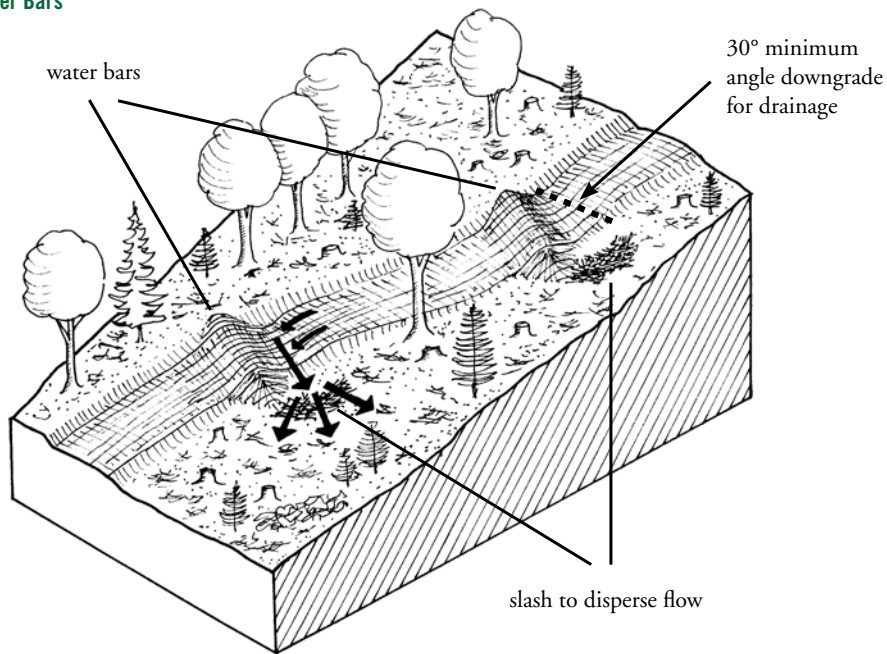
#### Water Bar Spacing Guidelines

Slope (percent)	Spacing (feet)
2	250
5	135
10	80
15	60
20	45
25	35
30	30

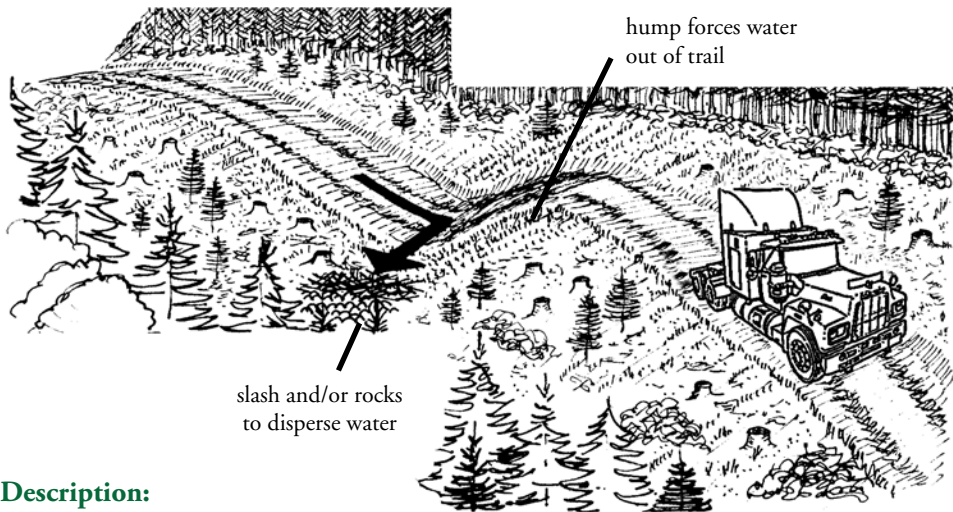




## Water Bars



## Broad-based Dips



### Description:

Broad-based dips pair a gentle downhill grade with a shallow, stable berm. They are most commonly associated with truck roads, but can also be effective on skid trails.

### Pros:

- Require no outside materials or preparation.
- Provide access for a variety of vehicle traffic.

### Cons:

- Take a lot of time to excavate the trail during installation.
- Only suitable on truck roads and skid trails with slopes less than 10%.

### Construction Guidelines:

- A 50-70 foot long reverse grade is excavated into the existing truck road bed by cutting from above the dip location.
- On sandy or unstable soils, a 5-8 inch diameter pole can be placed across the width of the trench to provide a stable berm. This pole should be pegged and filled with soil on the downslope side.

#### Broad Based Dip Spacing Guidelines

Slope (percent)	Spacing (feet)
2-4	300-200
5-7	180-160
8-10	150-140

## Rolling Dips



### **Description:**

Rolling dips are a cross between water bars and broad-based dips. They use a shorter reverse grade than a broad-based dip, and have a smaller soil berm than water bars. They are most commonly associated with skid trails.

### Pros:

- Require no outside materials or preparation.
- Provide access for ATVs.

### Cons:

- Take more time and excavation than a water bar to install.

### Construction Guidelines:

- A 10-15 foot long, 3% to 8% reverse grade is excavated into the existing skid trail bed by cutting from above the dip location and using the cut material to build up the mound for the reverse grade.
- Mound the excavated material from the dip on the downhill side to form a berm.

### Rolling Dip Spacing Guidelines

Slope (percent)	Spacing (feet)
2	250
5	135
10	80
15	60
20	45
25	35
30	30

## Rubber Belt Deflectors



AFTER THE HARVEST

### **Description:**

Rubber belt deflectors use an old conveyor belt or tire tread to divert water while allowing vehicles to drive over them.

### **Pros:**

- Provide access for moderate post-harvest vehicle traffic. The rubber is easily pressed down by vehicles but pops back up to divert run-off from the truck road or skid trail.

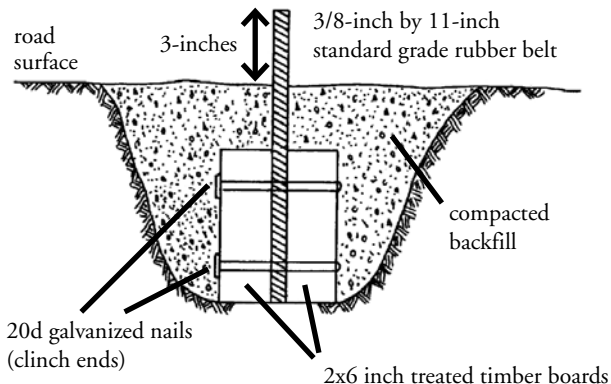
### **Cons:**

- Require outside materials like treated lumber, rubber belt, and screws.
- Require time to build the deflector prior to installation.
- Old rubber conveyor belts are ideal but may be difficult to acquire. The tread cut from used tires can be used as a substitute.
- Require extra effort to dig a small trench to place the deflector level with the surface of the trail.
- Unsuitable for truck roads that get plowed in winter and skid trails during a harvest. The equipment will catch on the rubber belt and cut it or rip it out of the ground.



## Construction Guidelines:

- Sandwich a piece of 12 inch wide rubber between two 2x6 boards. The rubber can come from an old conveyor belt or the tread cut out of an old tire.
- Bury the deflector in the truck road so the rubber strip is the only part showing.



## Open-top Culverts



### **Description:**

Open-top culverts are primarily used for truck roads but can also serve main skid trails that support light truck and ATV traffic post-harvest. They can be made from a variety of materials. Metal well casings with slots cut into one side can be used on trails that carry heavy trucks and equipment. Pressure-treated lumber is a good option for truck roads and skid trails that carry light trucks and ATVs. Small diameter trees are a cheap and easy option for trails that carry ATVs and foot traffic.

**Pros:**

- Provide great access for regular post-harvest vehicle traffic.
- Unlike conventional culverts, open-top culverts divert water from the surface of a truck road or skid trail.

**Cons:**

- Require outside materials like treated lumber, pole timbers, or old well casings.
- Require time to build the culvert prior to installation.
- Cost may be high depending on materials used.
- Require extra effort to dig a small trench to place the open-top culvert level with the surface of the truck road or skid trail.

**Construction Guidelines:**

- Bury the open-top culvert flush with the surface of the truck road or skid trail so run-off flows into the culvert and off the truck road.
- When using pressure-treated lumber and small diameter trees, reinforce the structure with cross supports to prevent culvert collapse.



## Open-top Culvert Spacing Guidelines

Slope (percent)	Spacing (feet)
2-4	300-200
5-7	180-160
8-10	150-140

- 6-inch solid
- 24-inch x 3-inch opening
- 18-inch solid (at both ends)
- 8-inch thick-walled pipe
- Rip-rap

## Ditch Relief Culverts



### **Description:**

Ditch relief culverts are less about diverting water from the truck road and more about managing the flow of water in truck road ditches. They transport run-off from a ditch on one side of the truck road to undisturbed forest soil on the other side of the truck road.

### **Pros:**

- Provide the best access for a variety of vehicles because the truck road grade is smooth and crowned.

### **Cons:**

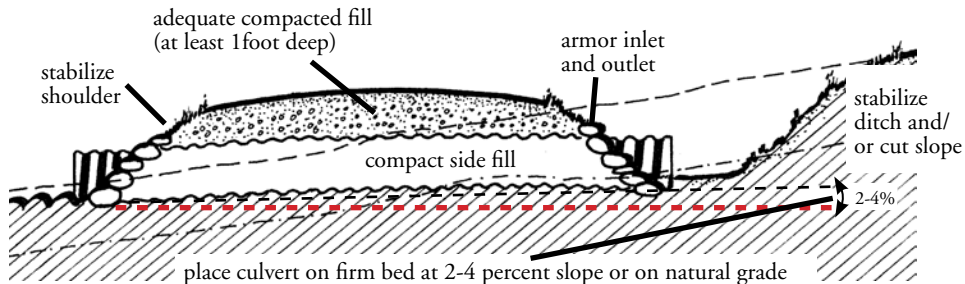
- Ditch relief culverts rely on fully functional ditches and truck road crowns in order to successfully manage run-off. Periodic maintenance to re-crown the truck road and excavate ditches can be expensive.

### **Construction Guidelines:**

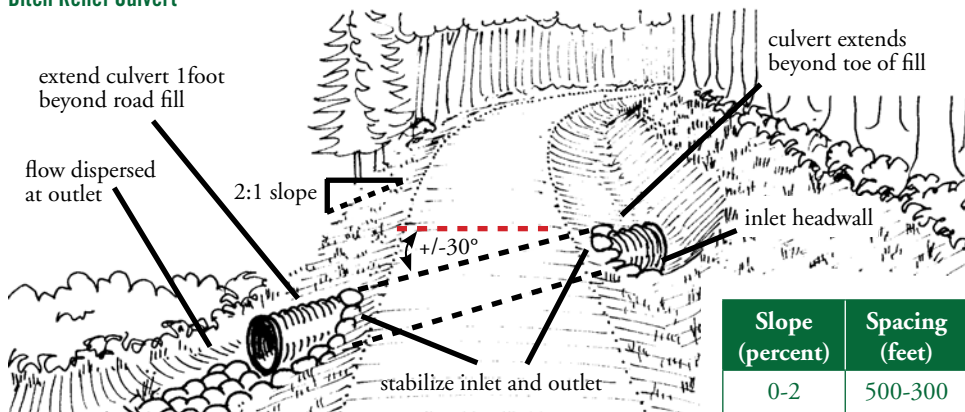
- Install at a 30-degree downhill angle with a 2-4 percent slope.
- Avoid draining excessively long sections of ditch (see spacing chart) where possible.
- Ditches should have stable side slopes of 2ft:1ft or flatter and not outlet into streams.
- Lay culvert in firm ground.
- Set the entrance of the culvert level to the ditch being drained.
- Protect the outlet of the culvert from excessive erosion with rocks or gravel.

- Choose larger culvert diameters (>12 inches) to minimize clogging.
- Use a culvert long enough that the end extends beyond the road fill on both ends.
- Cover steel culverts with compacted material to a depth of half the culvert diameter, or a minimum of 1 foot, whichever is greater. Cover plastic culverts to a depth equal to the culvert diameter or 2 feet, whichever is greater.
- Install a berm or diversion headwall that directs ditch water into the culvert and protects the culvert end.

### Ditch Relief Culvert (cross-section)



## Ditch Relief Culvert



Slope (percent)	Spacing (feet)
0-2	500-300
3-4	250-180
6-10	167-140
11-15	136-140
16-20	126-120
21+	100

**Suggested Spacing for Ditch Relief Culverts**



## Diversion Ditches (Turn-outs)



### **Description:**

Another way to manage water from a truck roadside ditch is to let it collect in a diversion ditch, where it can seep slowly into undisturbed forest soil.

### **Pros:**

- Disperse water from a side ditch without the need for a ditch relief culvert, saving time and money.

### **Cons:**

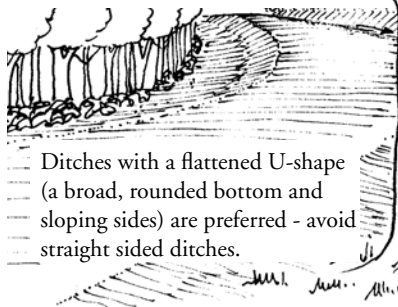
- There's not always a good place to install them.

### **Construction Guidelines:**

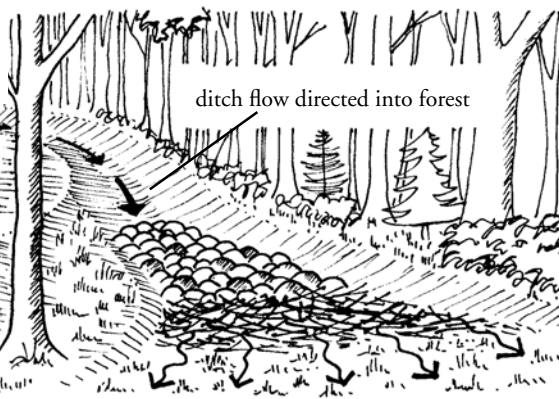
- Begin the diversion ditch with its bottom at the same depth as the ditch being drained.
- Construct the diversion ditch at a 30-degree angle away from the ditch being drained. Ensure that water being drained cannot reenter the truck road downhill,
- Give the diversion ditch a slight downward slope (2-3%).
- Drain the diversion ditch into undisturbed forest soil. Do not drain the diversion ditch into a Riparian Management Zone (RMZ), stream, wetland or the ditches on public roads.
- Blend the end of the diversion ditch into undisturbed forest soil to spread the water out as much as possible.
- May need to incorporate rip-rap to diffuse flow into forest.

Slope (percent)	Spacing (feet)
0-2	500-300
3-4	250-180
6-10	167-140
11-15	136-140
16-20	126-120
21+	100

### Suggested Spacing for Diversion Ditches



Ditches with a flattened U-shape (a broad, rounded bottom and sloping sides) are preferred - avoid straight sided ditches.



flow dispersed at outlet with rock and/or slash







**Basal area:** The cross-sectional area 4½ feet above ground expressed in square feet per acre of all trees with a diameter of 5 inches and larger.

**Best management practices (BMPs):** Practical and economically achievable practices for preventing or reducing nonpoint source pollution.

**Broad-based dip:** A surface drainage structure specifically designed to drain water from an access road while vehicles maintain normal travel speeds.

**Bumper trees:** Lower quality residual trees used along skid trails to pivot a hitch on turns and reduce damage to residual crop trees.

**Contour:** An imaginary line on the surface of the earth connecting points of the same elevation or a line drawn on a map connecting the points of the same elevation. The steeper the slope, the closer the contour lines will be.

**Crown:** A convex road surface that allows runoff to drain to either side of the road prism.

**Culvert:** A metal, wooden, plastic, or concrete conduit through which surface water can flow under roads.

**Cut and fill:** Earth-moving process that entails excavating part of an area and using the excavated material for adjacent embankments or fill areas.

**Drainage structure:** Any device or landform constructed to intercept and/or aid surface water drainage.

**Erosion:** The process by which the surface of the earth is worn away by the action of wind or water.

**Erosion control blanket:** A biodegradable plastic mesh used to stabilize soil on sloped areas until grass and other herbaceous plants become established.

**Filter strip:** A strip of land located adjacent to wetlands that traps sediment and other pollutants from runoff before it reaches the wetlands.

**Floodplain:** Land which has been or may be covered by flood water during a regional flood (floods expected to occur once every 100 years).

**Ford:** Submerged stream crossing where the streambed may need to be reinforced to bear intended traffic.

**Forest road:** A temporary or permanent road connecting the most remote part of the forest land to existing public roads.

**Geotextile fabric:** A special fabric used to stabilize soil by keeping gravel and soil separated.

**Grade (gradient):** The slope of the road or trail expressed as a percentage of change in elevation per unit of distance travelled.

**Landing:** A place in or near the forest where logs are gathered for further processing or transport.

**Nonpoint source pollution:** Occurs when rainfall or snowmelt moves across the ground, carrying pollutants into lakes, streams, wetlands and groundwater. For example, soil can



become a pollutant when runoff moves across a road and carries large amounts of soil into a waterbody.

**High water mark:** The point on the bank or shore up to which the presence and action of water is so continuous as to leave a distinct mark either by erosion, destruction of terrestrial vegetation, or other easily recognized characteristics.

**Out-slope:** A road surface shape that causes drainage to flow towards the outside shoulder.

**Riparian management zone (RMZ):** Areas next to streams and other water bodies where management practices are modified to protect water quality, fish habitat and other aquatic resources. These areas are complex ecosystems that provide food, habitat and movement corridors for both aquatic (water) and terrestrial (land) communities as well as help to minimize nonpoint source pollution to surface water.

**Riprap:** Rock or other large aggregate that is placed to protect streambanks, bridge abutments, outflows of drainage structures, or other erodible sites from runoff or wave action.

**Rut:** A depression made by the passage of a vehicle or equipment.

**Sediment:** Soil that has eroded from the land surface, often by overland water action, and is then transported and deposited away from its original location.

**Sedimentation:** The process of eroded soil entering streams, wetlands, pond or lakes, potentially impacting fish and other wildlife habitat as well as drinking water supplies.

**Seep:** A small (<1 acre) area in upland forests where ground water emerges on a slope or at the base of one, sometimes serving as the source of a stream headwaters, or may be isolated with the water absorbed into the surrounding area.

**Silt fence:** A temporary barrier used to intercept sediment-laden runoff from small areas.

**Skid trail:** A temporary, non-structural travel way for logging equipment, called skidders, to drag felled trees or logs to the landing for further processing, loading and transport to a mill.

**Slash:** Any tree tops, limbs, bark, abandoned forest products, windfalls, or other debris left on the land after timber or other forest products have been cut.

**Stream:** A watercourse that (1) has an ordinary high water mark, (2) has a defined bed and banks, (3) flows at least periodically, and (4) does not lose its character as a water course even though it may become braided in a wetland complex.

**Vernal pool:** Temporary pools of water that provide habitat for distinctive plants and animals.

**Water bar:** A shallow trench or diversion dam which diverts roadside ditch and surface water runoff from roads (inactive or closed), firebreaks, or skid trails (active or inactive) into a dispersion area. Water bars are used to minimize erosion.

**Wetland:** An area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic (water loving) vegetation and has soils indicative of wet conditions.





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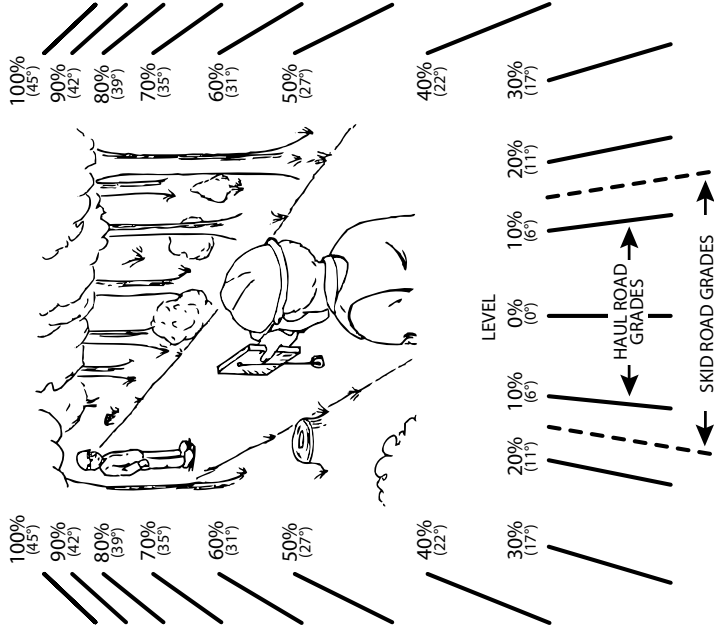
A series of 15 horizontal dotted lines for writing notes.

## GRADE METER INSTRUCTIONS

1. Punch a small hole in back cover,
2. Put a short (6 inch) piece of string through the hole,
3. Tie a knot large enough to hold string,
4. At the other end of the string, tie a small weight (nut, bolt, pen),
5. Use spiral binding as sight,
6. Read slope using string.



Put tack or nail  
here and attach  
string with nut  
or bolt on end.



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