NEW YORK STATE FORESTRY

BEST MANAGMENT PRACTICES FOR WATER QUALITY

DRAFT

BMP FIELD GUIDE | 2018 EDITION

This BMP Field Guide is the property of

For more information about forestry and water quality, contact:

Watershed Agricultural Council Forestry Program
(607) 865-7790

www.nysbmpguidelines.com

NYS DEC: Division of Lands and Forests
(518) 402-9425

Empire State Forest Products Association
(518) 463-1297

MOHAWK windpower
This guide is printed on Mohawk 50/10, 15% PC which is manufactured entirely with Green-e certified wind-generated electricity.

TABLE OF CONTENTS

4.

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 skid trails and landings used to remove trees from the forest are vulnerable to erosion. Erosion can damage or destroy skid trails and landings, 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 habitats and drinking water supplies. These problems can trigger a negative reaction from neighbors and the general public and may violate state or local water protection laws. They've also led to local timber harvesting ordinances. The best 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 keep our water clean, maintain the productivity of forest soils, and help maintain public support for timber harvesters and forest management.

This field guide is a practical tool for loggers and foresters. It provides a menu of options, allowing flexibility for professional discretion and decision-making 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 and water we all depend on. 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 consistent with the EPA-approved State Nonpoint Source Pollution Management Plan. That plan outlines a voluntary, education, and promotion-based approach to implementing BMPs. This manual has not been designed to provide a required standard for use in enforcement. 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 our natural resources.

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 your trails 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.

image of landing? or map with trail system laid out?

Before the Harvest: A Step-by-step Process

This step-by-step process will help you plan your harvest so you get the most productive harvest while protecting the site:

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 DEC offices, the landowner, and online. Three useful websites for locating much of this information are:

    a. http://www.dec.ny.gov/gis/erm
    The DEC's Environmental Resource Mapper shows important natural features like 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. 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.

c. store.usgs.gov
The USGS's free site for downloading aerial photos and topographic maps. Click on "Map Locator & Downloader," zoom to your project, then mark a point somewhere on your project. A list of downloadable maps will appear. Select the first one to get a combination aerial photo and topographic map of the area.

2. **Identify sensitive features:** Use the site-specific resources you collected to identify potentially sensitive features in the harvest site such as streams, ponds, lakes, wetlands, steep slopes, highly erodible soils, poorly drained soils, riparian areas, unique habitats, threatened or endangered species, and stream crossings.

3. **Plan your harvest on a map:** Sketch the property and harvest boundaries, landing locations, preliminary skid trails, and any sensitive areas on a USGS 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 areas. While you're walking, take note of sensitive features that may not have shown up on maps like seeps, vernal pools, nesting sites, and unique habitats. Adjust your plan in light of this new knowledge. Now you know where you need to go, what you need to avoid, and how you're going to minimize your impact in the woods through the use of BMPs.

5. **Determine the need for permits and obtain them if necessary:** Local, state, and federal regulations can all potentially apply to your timber harvest. For example, a permit is required for stream crossings across classified streams. Always check to see if a permit is required before logging starts. A good starting point is your DEC regional office. To find your office and its contact information, visit 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."

6. **Contact utilities:** If your harvest will cause you to operate beneath power lines or cross a buried pipeline or other underground utility, get in touch with that company to secure permission if needed.

7. **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. Avoid wet seasons like early spring. Plan water crossings (including the installation of culverts and bridges) for May-September when water is low and fish eggs are not incubating. On wet sites and when working in or around wetlands, time operations to coincide with frozen ground. Take additional precautions or suspend harvesting during wet periods. If you need to continue a harvest during a wet period, avoid skidding and limit your activities to cutting and bunching.

8. **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 New York State, so many woodlots already have a network of log landings, roads, and skid trails. In general, use these existing access systems if possible. Create new roads, trails, and landings only when use of existing access would cause greater harm to water quality, such as trails that go through a wetland or ones that head straight up a steep hill.

When locating **new landings**, keep these BMPs in mind:

- Construct new landings at least 200 feet from water bodies and wetlands if possible. If the landing must be closer than 200 feet, use straw bales, silt fencing, or both to minimize erosion. See pages # for information on these short-term erosion control devices.
- Locate landings on frozen ground or firm, well-drained soils with a slight slope (2-5%) to promote drainage. Landings may need a crown shape to allow for drainage.
- If a landing must be on a poorer drained site, surface the landing with woodchips or gravel to help stabilize the surface. Other options include rubber

tire mats or coarse gravel over geotextile fabric. See pages # for information about these techniques.

- Size landings to the minimum necessary for the acreage to be harvested, yet with enough room for 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 roads and trails leading to the landing to help achieve this goal.

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

- Consider topography and soil type when laying out roads and trails. Avoid steep slopes, poorly drained soils, unstable soils subject to slumping or creep, and riparian areas. Never use natural drainages like streams, springs, and seeps as trails.
- Locate roads at least 100 feet from streams, ponds, lakes, and wetlands whenever possible. Do not locate trails in wetlands without a permit.
- Locate roads and 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 trail so that it periodically turns uphill for a short distance prior to resuming the trail's downward course.
- Truck roads should have slopes less than 10%. On highly erodible soils (identified on soil maps), maximum slopes of 5% are recommended. The grade meter on the back cover of this guide can help calculate slope.
- Minimize the number of stream crossings. If you will need to cross a stream, refer to the Stream Crossing section on page # for more information.
- Minimize total road and trail length while still keeping slopes shallow.
- 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 and help prevent damage to the more valuable trees behind them.

DURING THE HARVEST

During the Harvest: Introduction

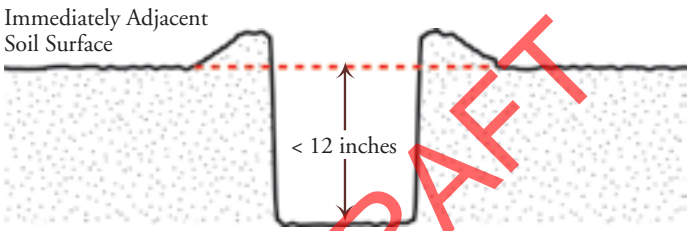
When you're in the middle of a job, your focus is probably on getting the wood out as quickly as possible. But even while you're producing, you can take steps to protect the soil, water, and forest around you.

During the Harvest: Protecting Roads, Trails, and Landings

Your access system, especially your landing, is the most visible part of any timber harvest. Garbage, muddy roads, and piles of slash all give a poor impression of logging. These BMPs will help protect the site and improve the look of your job while letting you keep on working:

- Locate residue piles such as slash, sawdust, and woodchips away from drainages where runoff may wash the residue into water bodies or wetlands.
- Place coarse rock on the landing or forest road just before the public road to shake mud off vehicle tires.
- If vehicles do track mud onto public roads, remove the mud immediately.
- Remove all trash daily.
- Minimize debarking and other damage to residual trees.
- Minimize skidding when soils are saturated to prevent excessive rutting and soil compaction, which accelerate and funnel erosion.

- Ruts may be acceptable provided they are not causing significant erosion, not channeling mud or water, and will be repaired prior to final closeout. In general ruts should not exceed 12 inches deep.



- Smooth out ruts and install water control devices if work will be suspended for 14 days or more, or if a heavy storm is likely during off hours. Most sediment enters streams following heavy rain events.

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:

- Check equipment hoses and fittings regularly to prevent leaks. Repair all leaks immediately.
- Place an oil-absorbent mat under any equipment that will sit unused for an extended period to catch slow leaks.
- Store equipment at least 200 feet away from water bodies 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, use a secondary container to limit the chance of spills. Keep a spill-response kit at the landing. This kit should contain safety goggles, non-latex gloves (disposable 4-mil nitrile gloves work well), and an approved absorbent material (loose powder, pads, or socks). Do <u>not</u> use cat litter, because it 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 any pesticides, herbicides, insecticides, or other chemical control agents unless you are a NYS DEC Licensed Pesticide Applicator.

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:

1. The spill is less than five gallons.
2. It has not and will not reach soil or water.
3. It is contained and controlled.
4. 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 Areas

Riparian areas (also called streamside management zones or SMZs) are lands bordering the banks of a stream, wetland, or other water body. The total width of a riparian area is 100 feet from the high water mark along the stream or water body.

Riparian areas are important because they:

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

Riparian areas do <u>not</u> need to be "no-cut" or "no-equipment" zones. But they should be given special consideration because of their sensitivity and the potential for water pollution if they aren't managed properly.

The riparian area is divided into two sections (Zone 1 and Zone 2), each with its own set of recommended BMPs:

Stream, Wetland or Water body

Zone 1 (15 feet)

Zone 2 (85 feet)

BMPs for Riparian Zone 1: 15 feet from the high water mark

- Limit tree removal, especially along the stream bank.
- Exclude equipment except for water body crossings.
- Remove timber by either directionally felling trees into Zone 2 and using a cable to winch the trees out, or by reaching into Zone 1 with a mechanical felling arm.
- Retain dead or dying trees to provide large woody material. This wood provides wildlife habitat and supports stream health.

BMPs for Riparian Zone 2: 85 feet from the end of Zone 1

- Periodic harvesting of timber is appropriate.
- Maintain different ages and species of trees to create a resilient forest.
- Equipment operation is permissible but should be minimized.

During the Harvest: Wetlands

Wetlands like bogs, seeps, and vernal pools filter sediment and nutrients, 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.

Timber harvests are often exempt from permitting normally required for other activities in wetlands. However, it is important not to harm wetlands and the values they provide during a timber harvest. Timber harvesters can be fined if a wetland's flow or functions are seriously changed by timber harvesting.

To protect wetlands during timber harvests, follow these BMPs:

- Avoid working in wetlands where possible. Consider alternate routes through the property. If you must cross a wetland, minimize impacts by crossing at the narrowest point or moving across islands (high spots).
- Carry out wetland harvests when the soil is frozen. (CAUTION: Just because the rest of the property is snow-covered doesn't mean wetlands are frozen. Many wetlands are groundwater-fed and rarely if ever freeze. Even in winter, it's best to avoid working in wetlands.)
- Retain ground cover like logs, surface rocks, and deep leaf litter within 300 feet of a wetland as cover for amphibians.
- Minimize tree removal within 300 feet of a wetland to maintain a moist, shaded environment.
- Minimize rutting as much as practicable. Do <u>not</u> allow ruts to impede or change the flow of a wetland.
- Use brush mats and corduroy (page #) to distribute equipment load and stabilize skid trails. Remove all material six inches and larger from corduroy trails upon completion. This material may be considered fill if left in place.

During the Harvest: Short-term Erosion Control

Logging jobs are rarely ideal. Slopes may be steep. The landing may have to be close to a stream or in poorly drained soil. When these situations arise, short-term erosion control devices can limit water quality impacts while allowing you to get on with your job.

List and give page numbers

Hay Bales

HAY BALES IN USE

Description:

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

30.

Pros:

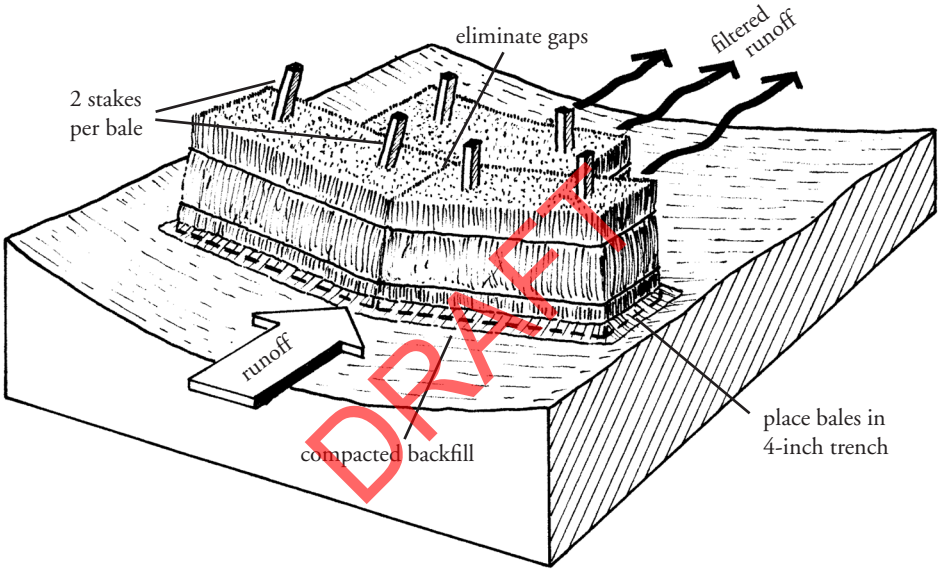
- Cheap and easy to install.
- Provide a temporary barrier to trap sediment resulting from the erosion of exposed soils.

Cons:

- Fill up with sediment quickly, and as a result need to be monitored and changed, often weekly.

Construction Guidelines:

- Excavate a trench 4 inches deep and the width of the bale.
- Position the 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.
- 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.



Hay bales require regular maintenance. They should be inspected weekly and after storms and replaced as needed to maintain effectiveness.

Silt Fence

Description

Silt fence is a manufactured alternative to hay bales for filtering runoff from a road, trail, or landing.

Pros:

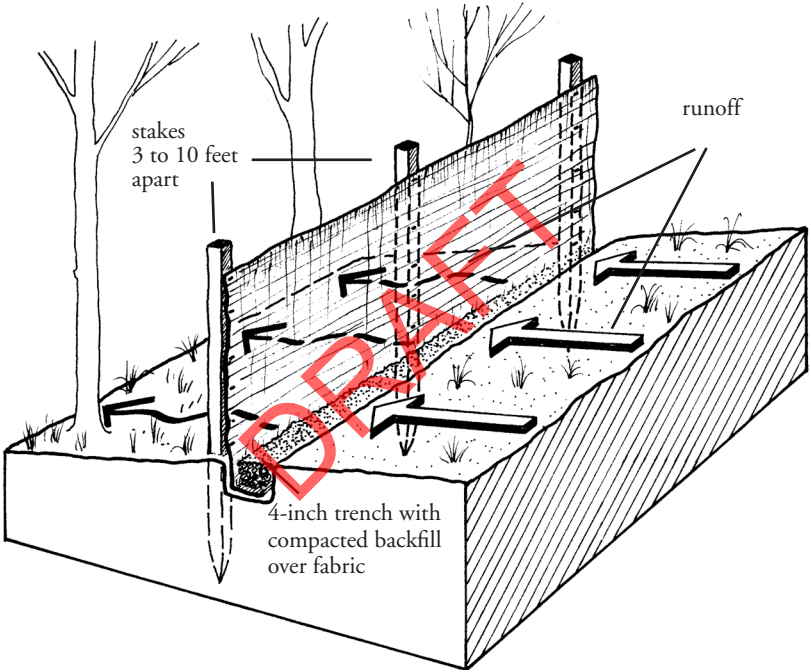
- Provides a temporary barrier to trap sediment resulting from the erosion of exposed soils.

Cons:

- Will not biodegrade, unlike hay bales.

Construction Guidelines:

- Install by first setting stakes. Space stakes three feet apart for light silt fence fabric, and 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.
- Excavate a 4 inch deep trench up-slope, 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, and backfill with compacted soil.
- Remove after exposed soil has been stabilized permanently with other BMPs.


stakes
3 to 10 feet
apart
runoff
4-inch trench with
compacted backfill
over fabric

Geotextile Fabric

Description:

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

Pros:

- Lowers costs by reducing the amount of gravel needed to create a stable surface, since the fabric prevents gravel from mixing with the soil.

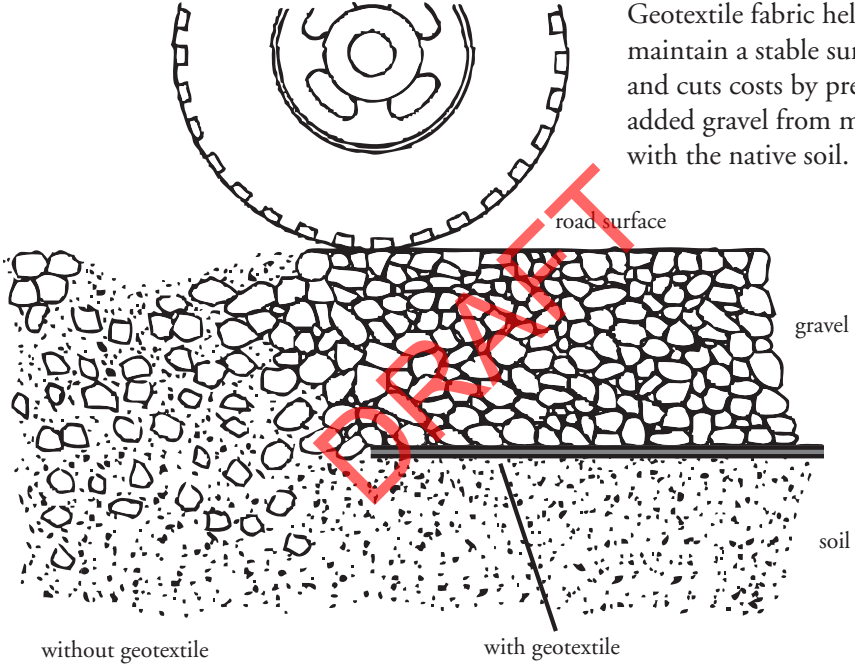
Cons:

- Expensive and not readily available.

Construction Guidelines:

- 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.
- Dump the gravel on the edge of the fabric and push it evenly across the fabric. Maintain a minimum gravel depth of 3 inches.

Geotextile fabric helps maintain a stable surface and cuts costs by preventing added gravel from mixing with the native soil.



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 soi.
- Works well on steep banks and difficult sites.
- Very portable compared with hay bales.

Cons:

- Don't use it on trails because the netting can get tangled around axles.
- Takes time for the biodegradable netting to break down.

Construction Guidelines:

- Install in direct contact with the soil.
- Place the roll on the uphill side of the area to be covered and roll downhill into place.
- Secure the netting with rocks or stakes.

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 area.
- 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 runoff 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 runoff.
- Bulky and difficult to move.

Construction Guidelines:

- Place straw wattles at the same intervals as water bars dependent on slope. See the straw wattle spacing chart below.
- 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

Description:

Made from recycled tires, tire mats weave together tire treads to distribute vehicle loads and reduce rutting in sensitive soils.

Pros:

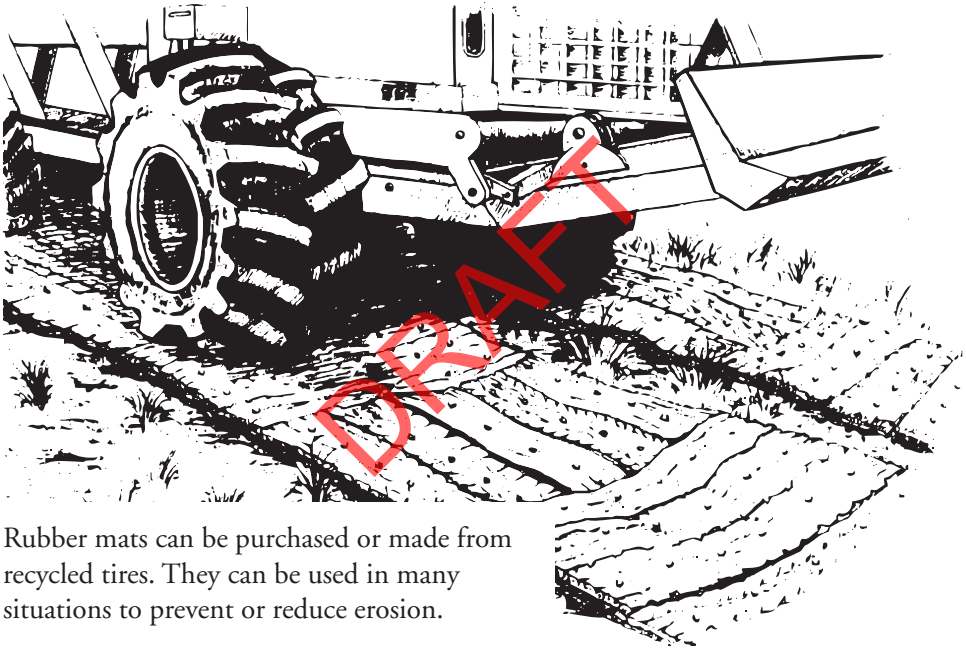
- Help float trucks and equipment over muddy or wet areas.
- Portable so they can be removed at closeout.

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.
- Not suitable for skidding over.

Construction Guidelines:

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



Rubber mats can be purchased or made from recycled tires. They can be used in many situations to prevent or reduce erosion.

After the Harvest: Introduction

Your post-harvest wrap-up is your last opportunity to protect water quality and positively impact the environment. By cleaning up after yourself, your harvest's impact will be lessened for waterways, the landowner, and those of the public concerned about logging.

After the Harvest: Best Management Practices

- Remove and properly dispose of all trash.
- Fill in any ruts.
- Repair and smooth all skid trails.
- Install water control devices (see page #) to prevent or minimize erosion and sedimentation from 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 #) for more information.
- Stabilize exposed soils with hay and seed as soon as possible to minimize erosion. There's no need to wait for winter to end. Seed spread on snow will germinate when the snow melts, helping protect trails and landings during mud season.
- When seeding, the type of seed to use varies with soil type, drainage class, and degree of shading. All seed should be immediately mulched with hay or straw at 2 tons per acre (approximately two and a half 40-pound bales per

1000 square feet). Mulch netting may be necessary on slopes steeper than 30 percent.

- Landings should be left free of excess woody debris.
- 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.

After the Harvest: Water Control Devices

As water gains speed and volume, its destructive power increases. Roads and trails channel water, allowing it to gather strength and wash away the road surface. Water control devices can be installed to minimize this erosion and protect 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 road or trail into undisturbed forest soil before the water gains enough speed or volume to damage the road.

This section lists and describes 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 trails and how much money they are willing to invest in their access system.

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 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 roads directly into streams, wetlands, or other water bodies.

- Do not use erosion control devices for crossing streams, springs, or seeps. 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 road or trail network.
- The steeper the slope of a road or 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.
- 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 where you should install the next water control device.
- All water control devices require maintenance to ensure they remain functional. Encourage the landowner to inspect and repair their water control devices annually. 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.
- Great for retiring trails that don't get used.

Cons:

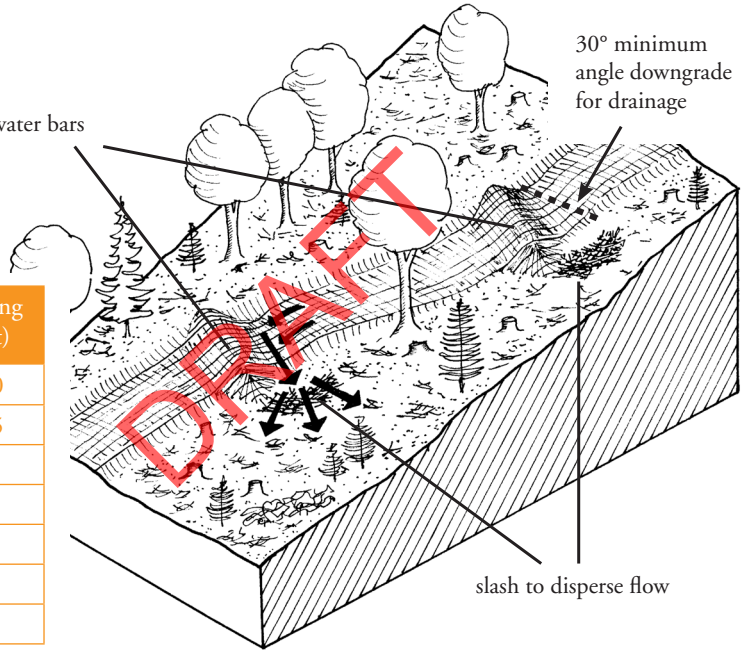
- The large berm and trough can limit vehicle access if not installed properly.

Construction Guidelines:

- Excavate a trench 1-3 feet below the surface of the trail. Use the spoil materials to develop the berm.
- Install the water bar 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.

Water bar Spacing Guidelines

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



Rolling Dip

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 they have a smaller soil berm than water bars.

Pros:

- Require no outside materials or preparation.
- Quick to install, though taking more time than a water bar to excavate the trail during installation.
- Provide access for ATVs.

Cons:

- Only suitable for trails with slopes less than 15%.

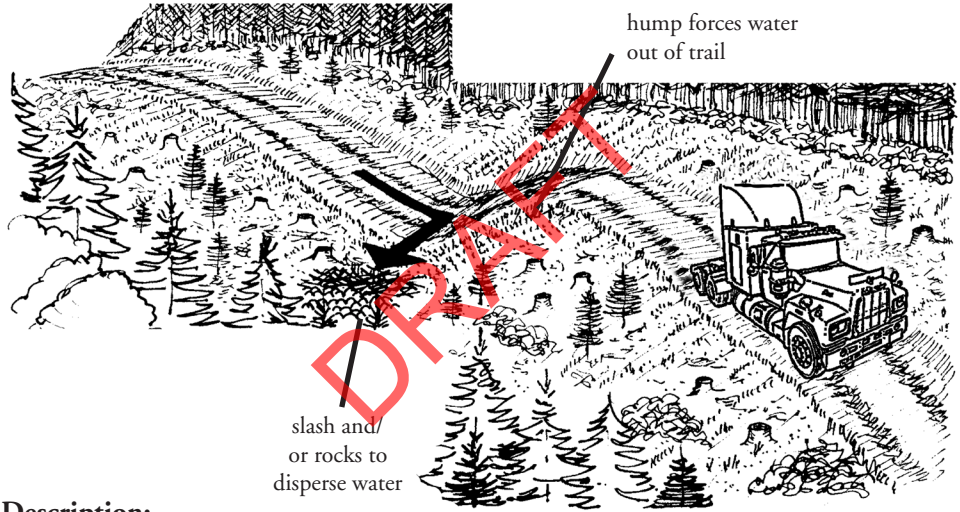
Construction Guidelines:

- A 10-15 foot long, 3% to 8% reverse grade is excavated into the existing roadbed 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

Broad-based Dips



Description:

Broad-based dips pair a gentle downhill grade with a shallow, stable berm.

Pros:

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

Cons:

- Time consuming to excavate the trail during installation.
- Only suitable on roads with slopes less than 10%.

Construction Guidelines:

- A 50-70 foot long reverse grade is excavated into the existing 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 length 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

Rubber Belt Deflector

Description:

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

Pros:

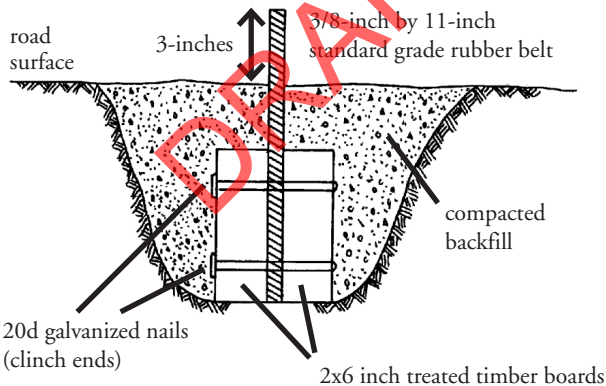
- Provide access for moderate post-harvest vehicle traffic. The rubber is easily pressed down by vehicles but pops back up to divert runoff from the trail.

Cons:

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

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.
- 10° minimum downgrade angle for drainage.
- Bury the deflector in the road so the rubber strip is the only piece showing.



Open-top Culverts

Description:

Open-top culverts 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 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:

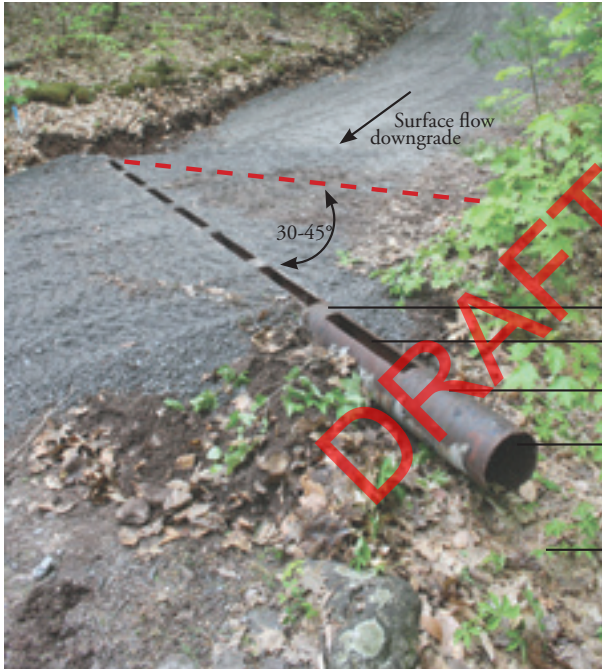
- Provide great access for regular post-harvest vehicle traffic.
- Unlike conventional culverts, open-top culvert divert water from the surface of a trail.

Cons:

- Require outside materials like treated lumber, pole timbers, or old well casings.
- Require time to build 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 trail.

Construction Guidelines:

- Bury the open-top culvert flush with the surface of the road so runoff flows into the culvert and off the 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 road and more about managing the flow of water in roadside ditches. They transport runoff from a ditch on one side of the road to undisturbed forest soil on the other side of the road.

Pros:

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

Cons:

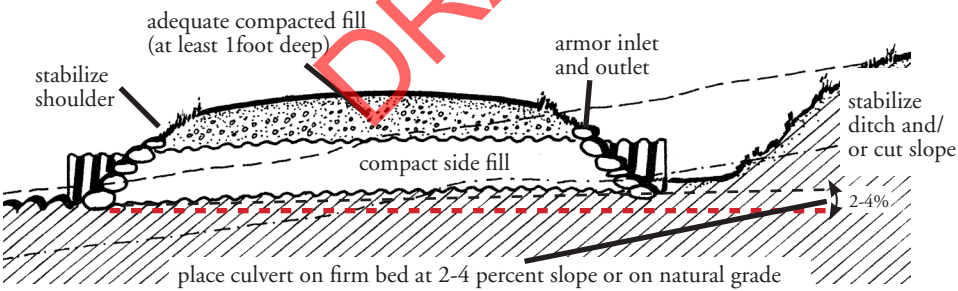
- Ditch relief culverts rely on fully functional ditches and road crowns in order to successfully manage runoff. Periodic maintenance to re-crown the road and excavate ditches can be expensive.

Construction Guidelines:

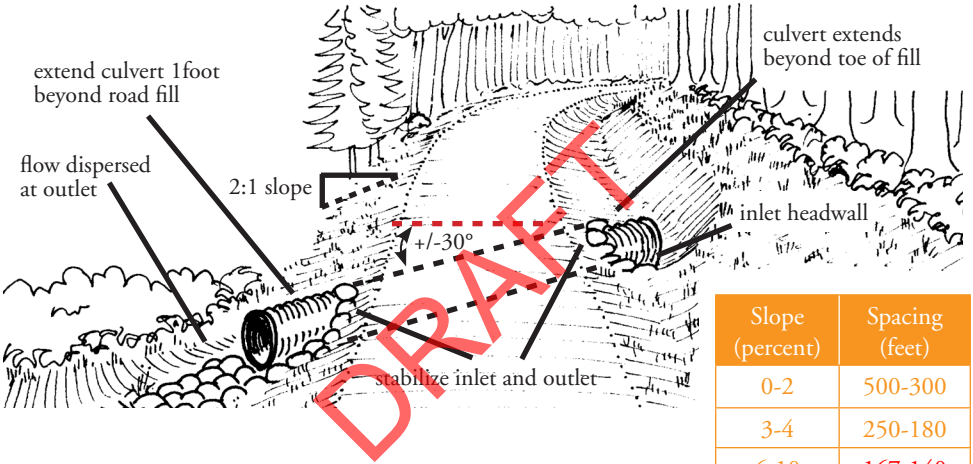
- Install at a 30-degree downhill angle with a 2-4 percent slope.
- Avoid draining excessively long sections of ditch (see spacing chart).
- Seat culvert into firm ground.
- Set the entrance of the culvert level to the ditch being drained.
- Protect the outlet of the culvert from excessive erosion with rocks or gravel.
- Choose larger culvert diameters (>12”) to minimize clogging.

- Use a culvert long enough that the end extends beyond the road fill on both ends.
- Cover the culvert with compacted material to a depth of half the culvert diameter, or a minimum of 1 foot, whichever is greater.
- Install a berm or diversion headwall that directs ditch water into the culvert and protects the culvert end.
- It is also recommended to fill roughly half the diameter around the culvert with a coarse aggregate, such as #3 stone.

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 Ditch (Turn-out)

Description:

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

Pros:

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

Cons:

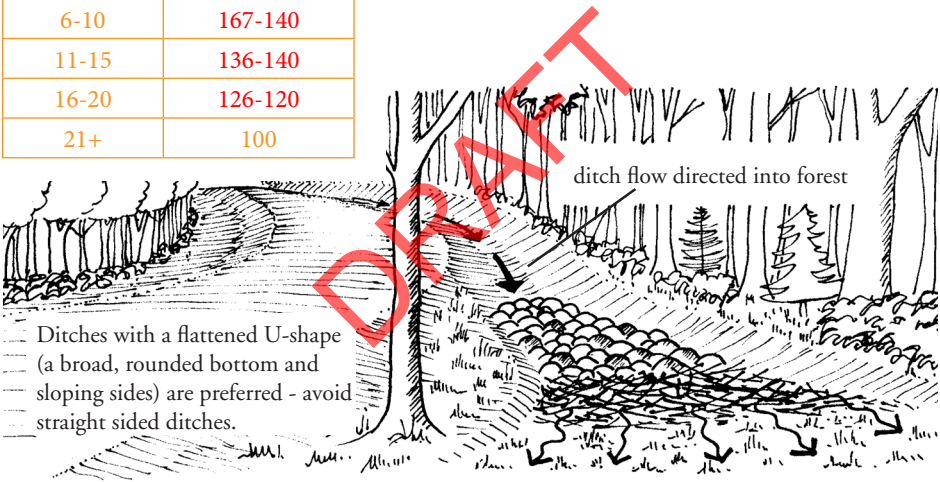
- There's not always a good place to install them.

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 trail downhill.
- Give the diversion ditch a slight downward slope (2-3%).
- Blend the end of the diversion ditch into undisturbed forest soil to spread the water out as much as possible.

Suggested Spacing for Diversion Ditches

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



STREAM CROSSINGS

Stream Crossings: Introduction

When properly located and constructed, stream crossings can prevent 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 bed.

A permit is required for any disturbance to the bed or bank of a protected stream, including a temporary stream crossing. If you have a question, contact your nearest DEC office.

Stream Crossings: Best Management Practices

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.
- Install stream crossings using materials that are clean, non-erodible, and non-toxic to aquatic life.
- Minimize the use of equipment in the stream.
- Limit construction in the water to periods of low or normal flow.

- Stabilize the soil around all culverts and bridges with hay and seed immediately after installation, regardless of the time of year. Install temporary sediment control structures, such as straw bales, silt fences, erosion control blankets, and straw wattles (see Page #) immediately following construction to minimize erosion and sedimentation. Maintain these practices until the soil is permanently stabilized.
- Divert road drainage into undisturbed forest soils, preferably outside the riparian area, so runoff does not enter the stream.
- Keep culverts and bridges clear and free of debris so water can pass unimpeded at all times.
- At closeout, 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 hay and grass seed to all exposed soils on the approaches.

general stream crossing pic

Portable, Temporary Bridges

Description:

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

Pros:

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

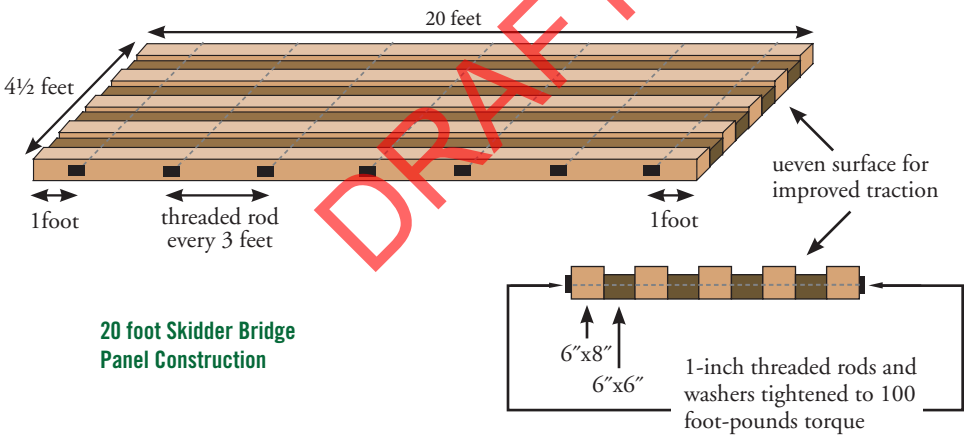
Cons:

- Because the crossing is temporary, limits post-harvest access by the landowner.
- Availability can be an issue, but there are organizations that loan bridges in New York. The Watershed Agricultural Council's (WAC) Forestry Program has six 20 foot bridges, two 30 foot bridges 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.

Construction Guidelines:

- Anchor temporary bridges on one end with a cable so they do not 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

20ft bridge

84.


DRAFT

newer arch culvert pic?

86.

Culverts

Description:

Culverts create a permanent crossing by building up the road surface over the stream.

Pros:

- Create a permanent crossing.

Cons:

- Require regular maintenance, especially after storms, to ensure they don't become plugged with debris.
- Not a good option for crossing streams on skid trails. The skidder or hitch will often crush the ends of the pipe, making it useless.
- Disrupt 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 critters 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 road washing out or flooding upstream.

- To size your culvert, use the following tables:

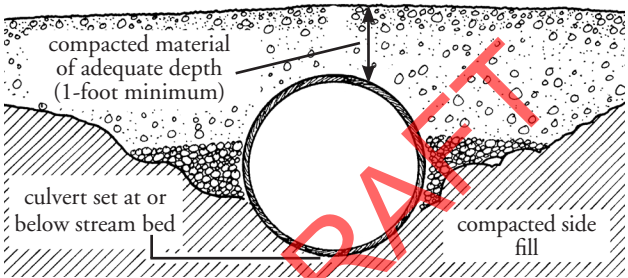
Recommended Pipe Culvert Sizes for Well-defined Stream Channels

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

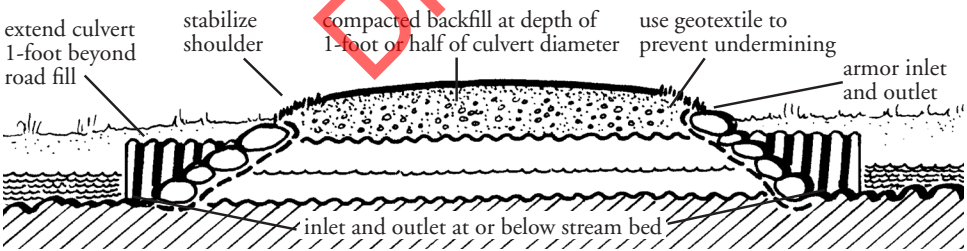
Recommended Pipe Culvert Sizes for Undefined Streams, Channels and Cross Drains

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

- 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



Fords

Description:

Where streams are too wide to cross with bridges or culverts, vehicles may have to enter the stream to make the crossing.

Pros:

- Allow for crossing the largest streams where bridges and culverts are impractical.
- A good option for dry stream beds where bridges and culverts are unnecessary

Cons:

- Because equipment enters the stream itself, fords have a higher risk of water quality impacts than bridges and culverts.
- Mud on equipment is easily deposited in the stream.
- The approaches to the crossing can provide a channel for run-off to enter the stream without appropriate BMP's.

Construction Guidelines:

- Fords should be considered stream crossings of last resort when no practical alternative exists.
- Locate the ford where the stream has a firm rock or gravel base.
- Install only where streambanks are low and stable.
- Stabilize the approaches with corduroy, slash or gravel to minimize soil disturbance and sediment deposition in the stream by equipment.
- Control the flow of water on the approaches with water bars to prevent run-off from traveling down the trail and reaching the stream.

Corduroy and Brush Mats

Description:

Brush, slash, and small logs are laid across a wet area 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.
- Large pieces of corduroy (greater than 6 inches in diameter) must be removed post-harvest or may be considered fill.

Construction Guidelines:

- Cover the crossing area with geotextile fabric to increase stability by preventing sediment movement under your crossing.
- Lay small logs, 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.
- For additional strength, use multiple layers of corduroy.

brush mat image?

96.

BIOMASS GUIDELINES

DRAFT

Whole Tree Harvesting Guidelines for the Production of Woody Biomass and other Timber Products

Introduction

As federal, state, and regional programs encourage increased use of woody biomass for heat and power, there are concerns about its potential adverse effects on biodiversity, soil productivity, wildlife habitat and other forest attributes. At the same time, biomass removal and use have the potential to provide a renewable energy source, promote the growth of higher-value trees and forest products, support the removal of invasive species, and help to meet the economic development needs of rural communities.

For the purpose of these guidelines, woody biomass refers to parts of trees that have historically had a low value and are often not considered merchantable due to species, size, and quality. It refers to wood material removed from the forest, usually in the form of chips, topwood or roundwood from tops, limbs, whole trees, or parts of whole trees not considered merchantable or underused in traditional low-grade markets. Downed woody material (DWM) includes all types and sizes of residual tree parts remaining on site after a timber harvest as well as pre-existing material from prior harvests or natural processes. It includes foliage and twigs known as fine woody material (FWM), tops and branches known as coarse woody material (CWM), and logs over 12 inches. DWM is informally known as "slash."

While DWM and decaying trees and snags have historically had little commercial value, they do have significant ecological value providing numerous benefits to people and wildlife. CWM plays an important role in preventing erosion by reducing overland flow and has substantial water holding capacity. It also plays an important role in maintaining nutrients in forest soils as it decomposes more slowly than leaf litter. Hundreds of different wildlife species depend on CWM and snags. Snags provide foraging opportunities and cavity nesting sites for various woodpeckers and cavity-using birds and mammals. Large down logs and CWM

provide habitat for such species as spotted salamanders, American martens, and red-back voles. Maintaining and promoting DWM in New York State's forests will aid in sustaining the health of forests and provide habitat for a diversity of wildlife.

These voluntary guidelines have been developed not as rules to be implemented and maintained at all times and under all conditions, but as flexible targets that can be adapted and included in site-specific recommendations developed by a forester or harvesting contractor. They are intended to inform landowner or forest manager decision-making as they review the planned harvesting operation. Most importantly, implementation of these practices on the ground depends on the professional judgment, knowledge, and skill of the logger conducting the harvest operation. These guidelines are intended to be used by loggers, foresters, and landowners in this context. The guidelines can provide value to any whole tree operation, and especially on harvests where woody biomass is a significant portion of the harvested product mix.

The following recommendations are applicable across a range of forest types and existing site conditions in New York. It is recognized that forests naturally contain different initial densities of snags, live decaying trees, and DWM, and that retention

needs for additional DWM can be variable. The recommendations in this section suggest retention guidelines beneficial to wildlife habitat and maintaining the integrity of ecological processes such as soil nutrient cycling. It is also recommended, wherever feasible, to exceed the retention guidelines as a buffer against the limitations of current research.

While the focus of these guidelines is on harvesting woody biomass for heat and power, they are also applicable to the harvest of other timber products such as pulpwood. The shift toward mechanized logging equipment in various parts of the state has produced a class of harvesting operation that harvests whole trees but may or may not produce a woody biomass product for heat or power.

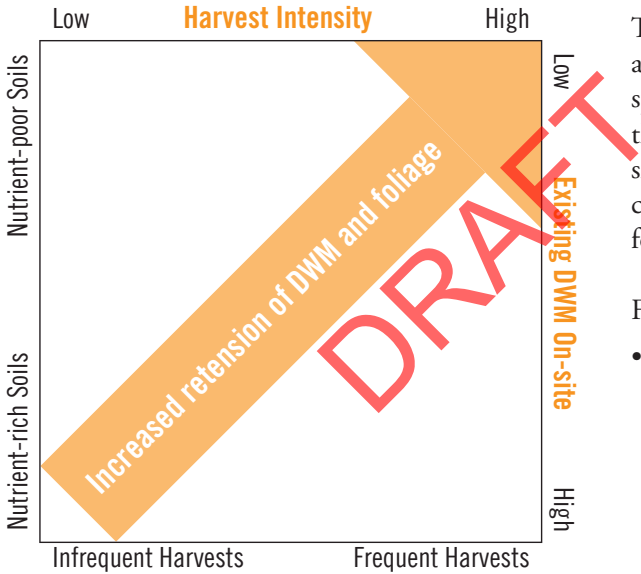
Recommendations

Retention of Downed Woody Material (DWM)

Four main factors influence the amount of DWM that should be left on site during harvest:

1. Harvest Intensity (based on stocking measures)
2. Harvest Frequency (cutting cycle)
3. Existing DWM on Site
4. Soil Fertility

Additional factors may also be considered such as special wildlife habitat goals and forest regeneration or aesthetic concerns.



This graphic can be used as a "sliding scale" to make site-specific recommendations on the amount of DWM that should be left on site after considering the level of the four main factors.

For example:

- As harvesting intensity increases (and the three other factors move either up or to the right) more DWM from harvest should be left on-site.

- As harvesting intensity decreases (and the three other factors move either down or to the left) less DWM from harvest is required to protect productivity.
- DWM retention should include woody material of all sizes including FWM, CWM, large downed logs, and foliage.
- Woody biomass harvesting on nutrient-poor sites is a particular concern. Avoid biomass harvesting on nutrient-poor sites or increase the retention of DWM. The following website, as well as specialized training or professional assistance, can be used to assist in investigating soil fertility: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.
- In general, leave retained DWM distributed across the harvest site. However, there may be cases to favor piles of DWM to produce habitat or when redistribution of DWM collected at the landing would cause excessive damage to soil, regeneration, and the residual stand.
- On nutrient poor sites, and where practical, minimize the removal of needles and/or leaves by harvesting in winter, retaining additional FWM on-site. If harvesting in summer months with leaves on, consider retaining additional FWM on-site.

- Use DWM to control water flow, prevent soil disturbance, stabilize exposed mineral soil, and build up the growth potential of the soil especially on:
  - » Trails and the approaches to stream crossings
  - » Nutrient poor sites
  - » Coarse sandy soils
  - » Poorly drained soils
  - » Steep slopes
  - » Other erosion-prone sites
- Avoid disturbance of the forest floor in riparian zones by retaining all DWM already present in riparian zones.

Retention of Forest Structures for Wildlife and Biodiversity

- Leave and protect litter, forest floor, roots, stumps, and large downed woody material.
- Leave and protect live cavity trees, den trees, other live decaying trees, and snags (i.e., dead standing trees). Diversify choice of retention trees by species.
- Maintain retention patches around large legacy trees, den or cavity trees, large snags, and large downed logs, to maximize structural and habitat diversity and to address safety concerns.
- Marking retention trees will help ensure that sufficient numbers are retained during the current harvest and that they will not be removed in subsequent harvests.
- Stream buffers, retention patches, and other protection zones provide an opportunity to leave more large trees than may be possible in other harvest areas.

**** Loggers should place personal safety ahead of other goals in any specific instance****

The guidelines in the table opposite may be used as a starting point in considering retention of forest structure for wildlife and biodiversity. They are based on a scientific literature review in *The Ecology of Dead Wood in the Northeast* as well as other biomass harvesting and retention guidelines. They are not necessarily meant to be attained on every acre, or on all sites at all times. Rather, they are average targets that can be considered across a stand, harvest block, ownership or landscape. It is recognized there can be challenges to setting specific targets at the site-level and it is not always possible or appropriate to manage the habitat requirements for all species in all areas at the same time.

- If these forest structures do not currently exist, select and identify live trees that will produce these structures in the future.

- If forest disturbances such as wind or ice storms and insect/disease infestations create large areas of dead trees, leave patches of a salvage operation un-salvaged. However, in certain situations, the potential for undesirable insect population build-up in dead trees should supersede the goal of retaining un-salvaged patches.

Tree Type	Minimum Target Number (per Acre)	Considerations
Live decaying trees 12-18 inches DBH	4	Where suitable trees for retention in these size classes are not present or may not reach these targets due to species or site conditions, leave the largest trees possible that will contribute toward these targets.
Live decaying trees >18 inches DBH	1	
Snags >10 inches DBH	5	Worker safety is top priority. Retain as many standing snags as possible, but if individual snags must be felled for safety reasons, leave them in the forest.

Source: The Forest Stewards Guild

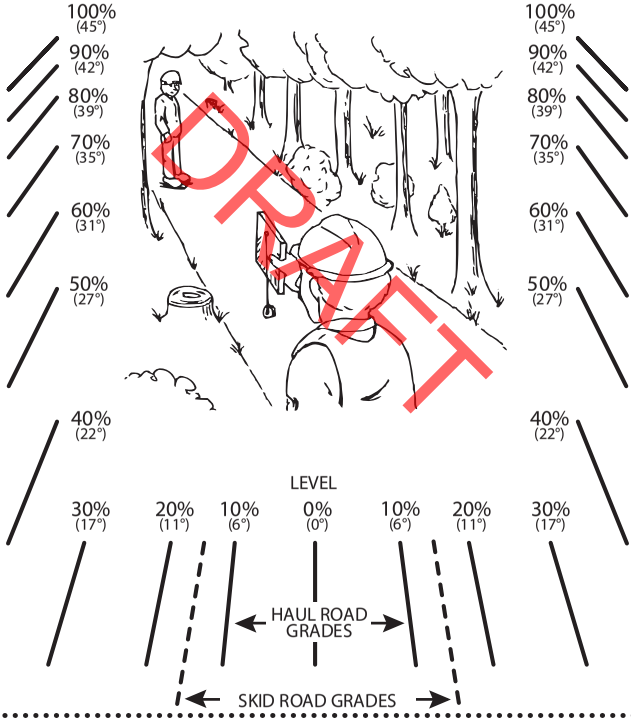
NOTES

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.



WWW.NYSBMPGUIDELINES.COM

Watershed Agricultural Council
Forestry Program
www.nycwatershed.org

Empire State Forest Products Association