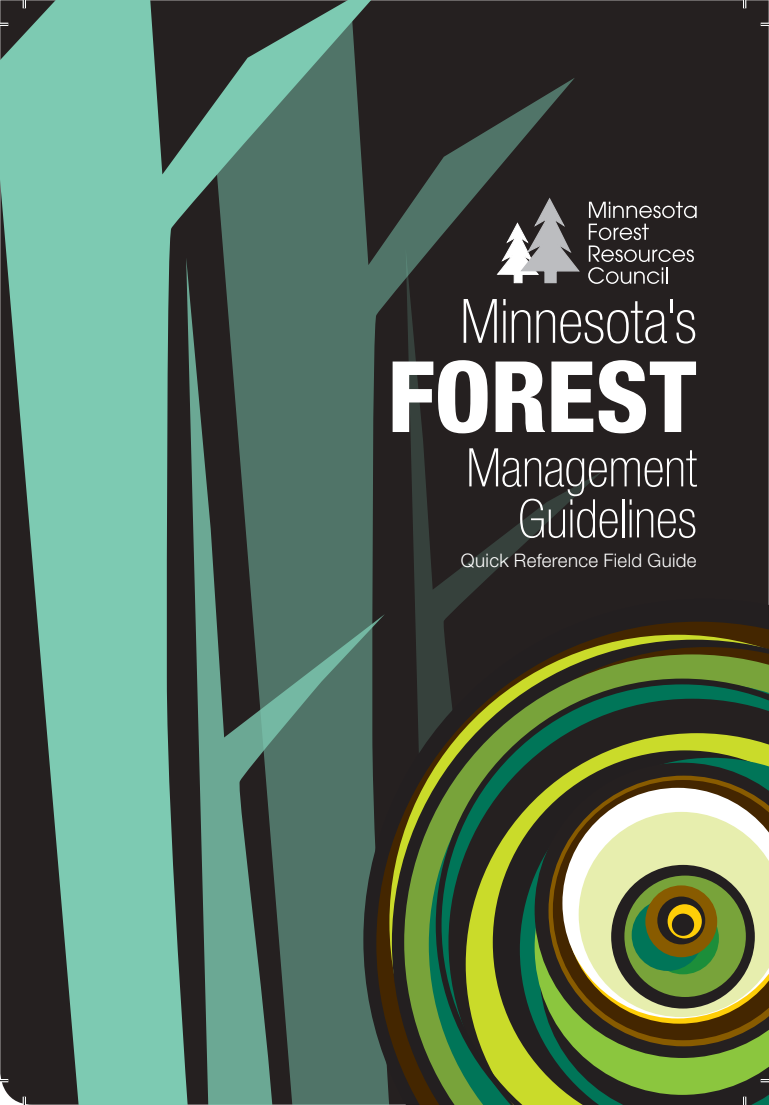
Minnesota
Forest
Resources
Council
Minnesota's
FOREST
Management
Guidelines
Quick Reference Field Guide

Pocket Guide
MFRC
2014

Minnesota Forest Resources Council

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Table Of Contents

Introduction

The purpose of this field guide is to serve as a quick reference of Minnesota's Forest Management Guidelines for timber harvesting. Users are strongly encouraged to consult the full Forest Management Guidebook for more information on additional guidelines, flexibility considerations, and supporting technical resources and information.

Minnesota Forest Resources Council
1530 Cleveland Avenue North
St. Paul, Minnesota 55108
Phone: (651) 603-0109
http://mn.gov/frc

Minnesota Forest Resources Council

Minnesota's voluntary forest management guidelines are a set of best practices designed to mitigate impacts to soil and water quality, wetlands, riparian areas, wildlife habitat, historic and cultural sites, and visual quality during activities such as timber harvesting.

This field guide is:

✓ **Focused exclusively on timber harvesting guidelines.**

✓ **Written primarily for loggers, foresters, and landowners.**

✓ **A subset of the more comprehensive Forest Management Guidebook.**

This field guide does not:

× **Replace or supersede any content in the full Forest Management Guidebook.**

× **Comprehensively cover every guideline or best practice related to timber harvesting.**

× **Address many other management activities covered in the full guidebook, such as site preparation and forest recreation management.**

How to use this field guide

Flexibility is a central theme of guideline application to account for variable conditions and objectives. Use of alternative practices is acceptable as long as conservation of forest resources is achieved.

Multiple benefits can be achieved when applying guidelines. Be creative during guideline application to efficiently maximize resource conservation during operations.

Creative placement of leave tree clumps can provide multiple benefits to forest resources. For example, this leave tree clump was placed around a cultural resource to protect it while simultaneously providing habitat for wildlife. Placing clumps around sensitive features maximizes resource conservation.

Key points listed at the beginning of each topical section are the primary take-home messages to be aware of. **Remembering these main points will greatly assist you to effectively apply the guidelines in this field manual.**

Symbols are used throughout the guidebook to identify guidelines, regulations, and useful information.

Symbol	Meaning
	Recommended guideline
	Regulation or permit requirements
	Rule of thumb or other useful information

List of Acronyms

BA	Basal area
CWD	Coarse woody debris
DBH	Diameter at breast height
DNR	Department of Natural Resources
ETS	Endangered, threatened, and special concern species
MPCA	MN Pollution Control Agency
RMZ	Riparian Management Zone
SWCD	Soil and Water Conservation District
WCA	Wetland Conservation Act

Planning

Planning is the most important factor influencing proper implementation of the Forest Management Guidelines while maintaining efficient harvesting operations.

Key Points

1. Collect information and anticipate potential problems that may occur.
2. Develop strategies to avoid, mitigate, and document those problem situations.

Planning Sequence

Gather information

↓

Survey the site

↓

Evaluate considerations

↓

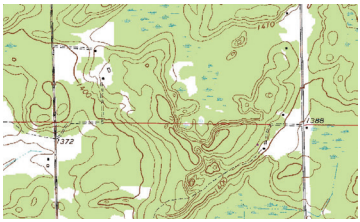
Create harvest plan and map

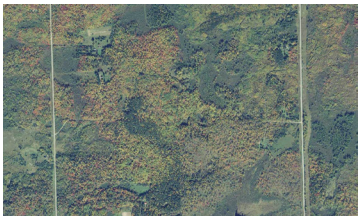
↓

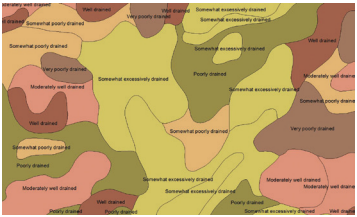
Communicate the plan to those involved

Gather and review existing information about the harvest site (sources of information are listed in the resource directory):

- Topographic maps.
- Aerial photos.
- Plat books.
- Soil maps.
- Protected waters maps.
- Visual quality maps.
- Inventory reports for endangered and threatened species and cultural resources.
- Landowner knowledge about the site.







Conduct an on-the-ground site survey to identify and evaluate:

- Site access points and visual quality issues.
- Existing roads, landings, and skid trails.
- Soil conditions (texture and drainage class).
- Steep slopes, poorly drained soils, and other areas that should be avoided if possible.
- Streams, lakes, and wetlands.
- Ideal locations for stream and wetland crossings.
- Cultural resource potential (**see page 12**).
- Snags and nesting areas.
- Presence of invasive species.

Seasonal pond - Summer

Seasonal pond - Winter

Field surveys should be conducted when conditions are ideal for evaluation of the harvest site. Identification of the seasonal pond shown above would be very difficult during snow-covered conditions.

Determining Soil Drainage

Drainage Class	Mottling Depth (in)
Very poor	<10 and >8" of peat
Poor	<10 and <8" of peat
Somewhat poor	10-20
Moderately well	20-40
Well	40-60
Somewhat excessive	>60

Mottling is the presence of dull gray and bright soil colors as shown in the above picture.

Areas where you may find cultural resources

Terraces adjacent to lakes and large streams, areas for camping, processing wild rice, maple sugaring or homesteading.

Peninsulas, points, and islands, which would have offered American Indians and early settlers respite from summer insects.

Stream junctions, lake outlets and inlets, where resources like spawning fish and wild rice may be plentiful.

Areas adjacent to old travel routes, including railroad grades and portages.

Wildlife openings and conifer plantations, which were often established on land initially cleared for homesteading.

Develop a harvest plan that incorporates the following considerations:

- ✓ Conduct activities during preferred operating seasons for soil and site conditions.

Preferred operating season is dependent on soil conditions, equipment, and operating techniques.

Potential for soil compaction and rutting is higher:
- for fine- and medium-textured soils (**see pg. 28**).
- when soils are saturated (spring and early summer).
- for very poor and poorly drained soils (harvest under frozen ground conditions only).
- when soil is not frozen or completely dry.

Equipment – low ground pressure equipment or load adjustment may extend the operating season.

Operating techniques – utilizing corduroy, mats, or back to front felling and skidding patterns may extend the operating season.

- ✓ Conduct management activities to maintain, promote or enhance ETS species.
- ✓ Avoid cultural resource areas or protect them if unavoidable.
- ✓ Minimize impacts to visual quality with recommended practices, especially at visually sensitive sites.
- ✓ Avoid operations in wetlands or conduct under frozen soil conditions.
- ✓ Utilize a back to front felling and skidding pattern when possible.

A back to front felling and skidding pattern can minimize impacts to soil productivity while also allowing operations to continue or resume sooner if wet conditions occur.

Create a harvest site plan which documents:

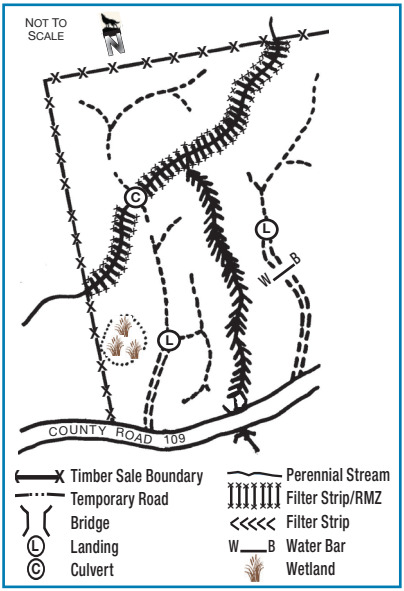
- The width and residual basal area of the RMZ.
- The leave tree approach to be used (clumps, scattered, or a combination).
- The type and spacing of erosion control devices to be used on roads, trails, and water crossings.
- The soil types present and any operability limitations associated with them.
- The slash retention plan and any reasons for deviating from recommended amounts.
- The number and location of landings.

Minnesota's Forest Management Guidelines

Create a harvest site map to indicate the location of any special concern areas.

The site map or on-site review should clearly identify the location of:

- Streams, lakes, wetlands, and seasonal ponds.
- Roads and landings.
- Road and skid trail crossings of waterbodies.
- Fueling and maintenance areas.
- Leave tree clumps, boundary lines, cultural resources, and other protected features.



A good harvest site map should clearly identify the locations of roads, landings, skid trails, crossings, and special concern areas. Poor planning without site-specific considerations can result in problems during the harvest that could have been avoided.

Check to see what permits may be required and secure them prior to beginning activities.

- Contractor Responsibility and Landowner Statement Form.
- Wetland permits.
- Water crossing permits.
- Railroad/pipeline crossing.

Stream crossings such as this one may require a permit if the stream is listed in the DNR's Public Water Inventory. Check with DNR's Public Waters Permitting Program to see if a permit is needed for your stream crossing.

Conduct an on-site meeting with the landowner, forester, and logger before on-site activities begin. Communicate the plan to all parties and members.

Roads, Landings, and Skid Trails

Although essential to any timber harvesting operation, roads, landings, and skid trails have potential to reduce soil productivity and increase sediment delivery to streams and wetlands. Planning landing, skid trail, and road layout to utilize existing infrastructure and avoid sensitive areas will minimize impacts to soil and water.

Key Points

1. Minimize the amount of new road, skid trail, and landing area at a harvest site.

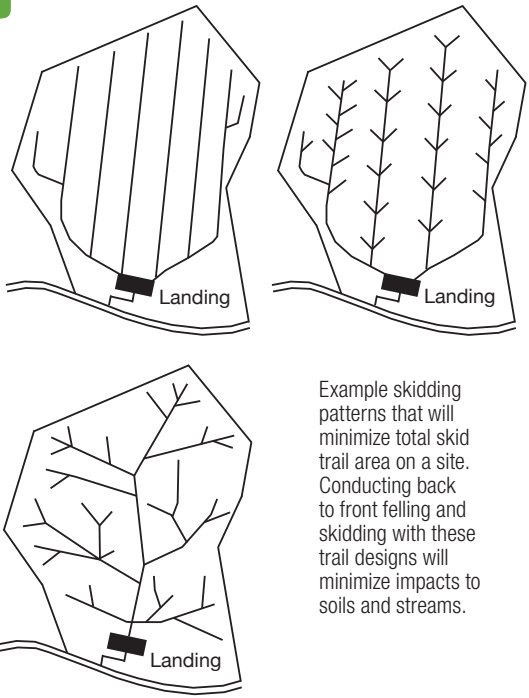
2. Locate new roads, landings, and skid trails away from sensitive features such as RMZs and wetlands.

3. Minimize erosion, compaction, and rutting.

Total road and landing area should not exceed the following amounts:

For harvest areas	Road and landing area should be less than:
<20 acres	1 acre
20–30 acres	5% of harvest area
>30 acres	3% of harvest area

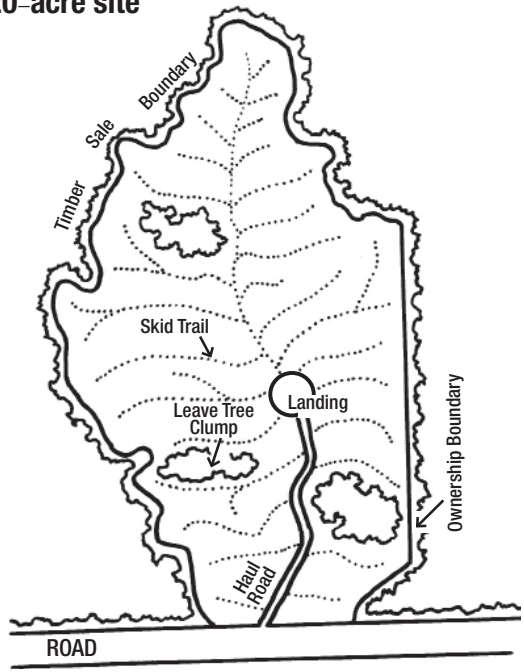
Limit skid trails to <15% of the harvest area.



Example skidding patterns that will minimize total skid trail area on a site. Conducting back to front felling and skidding with these trail designs will minimize impacts to soils and streams.

Traffic off skid trails should be limited to less than 30% of the harvest area, with no more than 2 equipment passes at off-trail locations.

20-acre site



An Example of Infrastructure Proportions

1% Road (16 feet wide x 545 feet long)
3% Landing (0.6 acre)

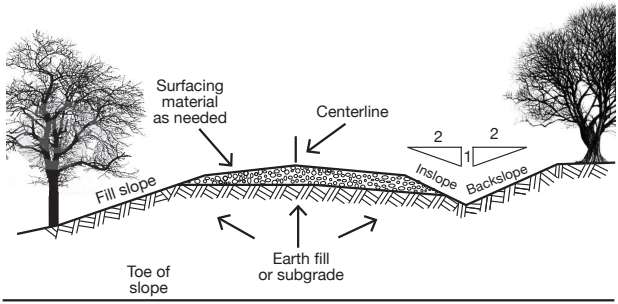
Locate roads in a configuration that:

- Minimizes the amount of cut and fill.
- Minimizes the number of water crossings.
- Avoids water features including streams, lakes, wetlands, and seasonal ponds.
- Avoids placement in or near filter strips.
- Limits concentration of water runoff.
- Minimizes sedimentation of waterbodies.

Construct roads as follows:

- On grades between 1-10%.
- Crown all roads and ditch if needed.
- Shape inslopes and backslopes to a slope of 1.5:1 or less.
- Stabilize exposed soil by seeding or applying gravel to reduce erosion.

Crowned Road Cross-Section



Crowning a road will inhibit runoff from concentrating on the road surface and reduce erosion potential.

Utilize water diversion and drainage structures on roads to reduce erosion and improve operability. **See section on Water Diversion and Erosion Control for appropriate techniques.**

Use of water diversion structures such as these log water bars will reduce erosion after road closure. There are many alternative techniques to reduce erosion from roads and trails during operations and following the harvest.

Landing considerations

Locate landings:

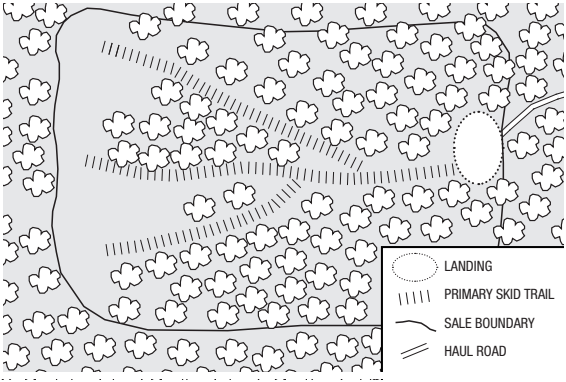
- On upland areas and stable ground.
- Outside of filter strips, wetlands, and RMZs.
- Away from cultural resources.
- In areas where runoff will not concentrate.
- In central areas that are operationally efficient.

The landing above was located where runoff was concentrated, creating risks for water quality and reducing operability. The landing below was located in an upland area where runoff will not concentrate, reducing the likelihood of impacts to soil and water.

Skid trail considerations

Skidding should:

- Occur away from cultural resources, RMZs, and filter strips.
- Be concentrated on primary skid trails for sites with mineral soils.
- Occur on organic soils only when frozen.
- Occur at the toe of the slope or across the slope to minimize erosion.
- Not occur on slopes >35%.

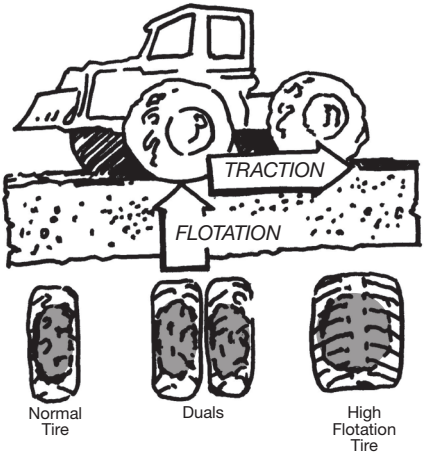


Back to front felling and skidding, where the farthest timber is harvested first and skidded on primary trails, will reduce impacts to soil and improve operability under adverse conditions.

Operability considerations

- ✓ When skid trails do not hold up, stop operations until soils dry out or freeze.
- ✓ Minimize rutting during harvesting with the following techniques when needed:

- Shift operations to dry portions of the site.
- Use low ground pressure equipment.
- Place slash on skid trails or wet spots.
- Reduce equipment loads.
- Pack snow to enhance soil freezing.



Use of wide, high flotation tires is one way to limit rutting by reducing ground pressure of harvesting equipment. Loads should not be increased with high flotation tires, as the additional load weight will negate the reduction in ground pressure.

If operating techniques fail to eliminate rutting, stop harvesting operations.

Knowing when to stop operations during poor operating conditions is the primary means to avoid excessive rutting as shown in the examples above.

Water Diversion and Erosion Control

Removal of vegetation and increased soil disturbance that is concentrated at roads, landings, and skid trails can increase erosion. Proper placement of roads, landings, and skid trails, and application of erosion control structures can reduce the potential for erosion to negatively impact water quality and soil productivity.

Key Points

1. Know when and where erosion control is needed and necessary.
2. Install and maintain appropriate erosion control structures when needed.

Avoiding sedimentation of streams and wetlands is the primary objective!

Factors influencing erosion potential

1. **Soil texture and drainage** – medium texture soils are most erodible.

Determining soil texture in the field

Coarse – moist soil does not form into a cohesive ball or form a ribbon when pinched between thumb and finger.

Medium – soil forms a ribbon <1-2 inch in length and has a gritty to smooth feel when moist, or floury feel when dry.

Fine – moist soil can be formed into a ribbon >1-2 inch in length and has a greasy feel when rubbed between fingers

2. **Slope steepness and length** – long, steep slopes have a much higher erosion potential.
3. **Vegetative cover** – the most important factor. More cover equals less erosion.

Prevent sedimentation by following these steps:

- Minimize soil disturbance and promptly re-vegetate.
- Slow down and inhibit concentration of runoff.
- Direct runoff to stable areas away from water.
- Capture any sediment within the runoff.

Install erosion control devices when the following conditions exist:

- At all approaches to stream and wetland crossings.
- When slope on landings, roads, and skid trails is >2% and sedimentation of water and wetlands is possible.

This steep road experienced significant damage from erosion. Installation of erosion control structures at the top third of the slope and below that point as needed is one of the most effective ways to reduce erosion.

Utilize the following erosion control structures and others as appropriate:

Broad-based dips

- Useful for active haul roads with gentle slopes.
- Angle the dip perpendicular to the road and slope outward at 3% into vegetated area.

- Install at appropriate spacing depending on slope.

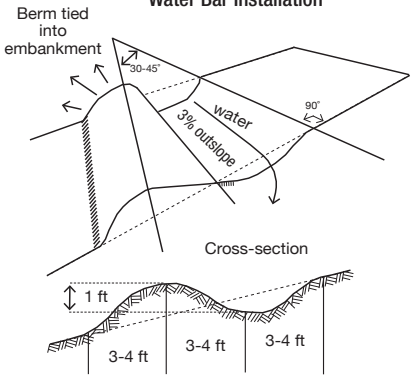
Slope	Space between dips
0-2%	500 feet
3-4%	300 feet
5-7%	180 feet
8-10%	150 feet
11-15%	130 feet
16%+	110 feet

Water bars

- Useful for closed roads, skid trails, and landings.
- Construct out of soil, logs, or other material.
- Install at appropriate spacing depending on slope.

Water Bar Spacing	
Slope	Spacing between water bars
2%	250 feet
5%	130 feet
10%	80 feet
15%	50 feet
25%+	40 feet

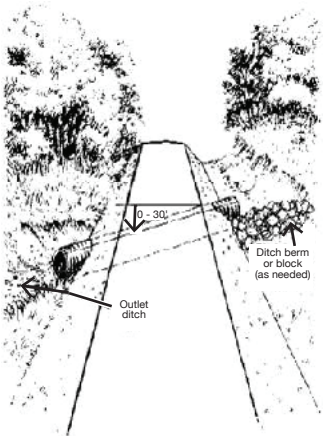
Water Bar Installation



- Construct a shallow trench (approximately 6 inches deep) on the upslope side of the bar to funnel runoff.

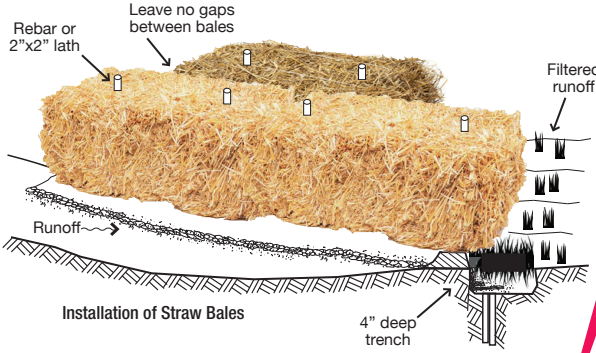
Cross-drain culverts

- Minimum diameter of 12 inches.
- Install at 2% grade steeper than the ditch.
- Direct outflow into vegetated area.
- Armor culvert inlet and outlet.



Straw bales and excelsior rolls

- Useful for closed roads, trails, and landings.



Brush and slash barriers

- Useful for active skid trails and during frozen conditions.

This slash barrier has good contact with the soil surface which will stop water from flowing down the skid trail.

This log barrier has poor contact with the soil surface which will allow water to flow under it and increase erosion further down the skid trail.

- Place scattered slash across the entire trail and at top of slope.
- Make sure slash has good contact with ground surface.

Stabilize bare soil areas with scattered slash, mulch, and native seed mixes as soon as possible following disturbance.

Scattered slash can be used to stabilize bare soil areas as shown on this skid trail.

Conduct follow-up visits to make sure that erosion control structures are functioning properly.

Erosion control structures should be periodically checked and maintained to ensure they are properly functioning. Here, an improperly maintained culvert washed out of the road, creating sedimentation risks to water quality and inhibiting road traffic.

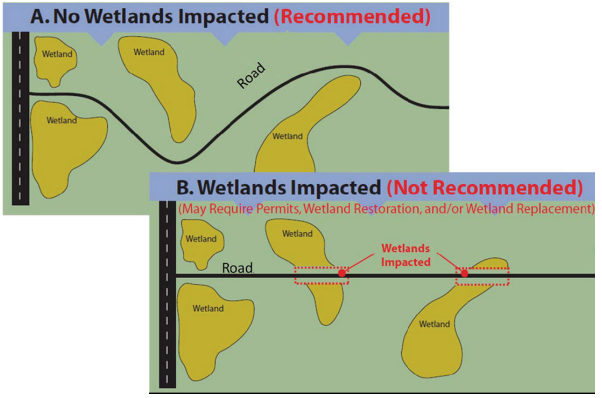
Stream and Wetland Crossings

Protecting water resources is a central objective of the Forest Management Guidelines. Crossing streams and wetlands has the highest potential to degrade water quality through alteration of water flow, delivery of sediment, and spills of fuel and lubricants.

Key Points

1. Identify all streams and wetlands and avoid crossing them whenever possible.
2. Secure all necessary permits prior to crossing.
3. Use appropriate structures and techniques to minimize impacts to streams and wetlands.

Avoid crossing streams and wetlands whenever possible.



Utilize the following general guidelines when installing crossings:

- Minimize the number of crossings.
- Design approaches to divert water away from streams and wetlands.
- Install crossings at 90-degree angle to the waterbody.

- Install at firm soil/bank areas.
- Install at low gradient and short slopes.
- Maintain the cross-sectional area of a stream.
- Use and maintain erosion control on all approaches during and after operations.
- Reshape and stabilize crossings after use.

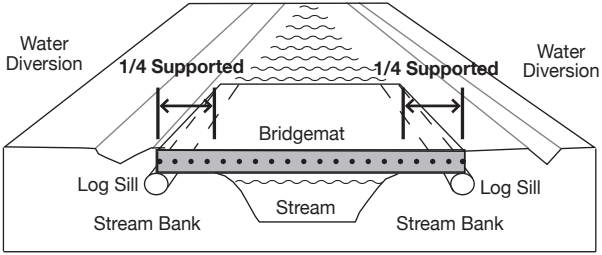
This crossing was installed at an ideal stream location with firm banks and low gradient approaches. Seed was applied on the approaches for stabilization after operations were complete.

Summary of some stream crossing options

CROSSING STRUCTURE	STREAM CONDITIONS	USES	POTENTIAL PROBLEMS
Temporary Bridge	Small stream, maximum span <16 feet; firm, stable <30 feet high bank	Deep water, larger spans, steep banks	Requires proper design, may require engineering study
Ice Bridge	Slow velocity or frozen streams	Winter crossing over open water	Melting, limited season. Need source of water
Ford	Shallow (<2 feet water), low velocity, hard bottom	Intermittent stream, infrequent use	Sediment suspension, pollution from vehicles
Culvert	Narrow streams with well-defined channels	Channel up to 2 feet deep	Blockage by debris, sediment, may require engineering design

Temporary bridges—Stream crossing

- Utilize logs, lumber, steel, or other materials to create a strong and stable structure to handle anticipated loads.
- Create a solid surface to reduce gaps that will allow debris to fall into the stream.
- Install on firm, stable banks <30 feet high.
- Install water diversion structures on approches to both sides of the bridge.
- Secure one end of the bridge to a nearby anchor point.
- Place a sill log on each bank to reduce sinkage, distribute the load, and facilitate removal of the structure.



Bridgemat for Stream Crossing

Ice bridges—Stream crossing

- Do not use in fast-moving streams.
- Do not install in early winter when water is warmer, ice is thin, and snow cover is light.
- Push snow into stream, saturate with water, and pack down when cold conditions are forecasted for the following evening.
- Make sure ice is uniform and clear of debris.
- Avoid hauling during sudden thaws.

Snow was packed and frozen to increase ice thickness at this stream crossing. Ice bridges are an economical and environmentally sound way to cross creeks, streams, and rivers when appropriately installed.

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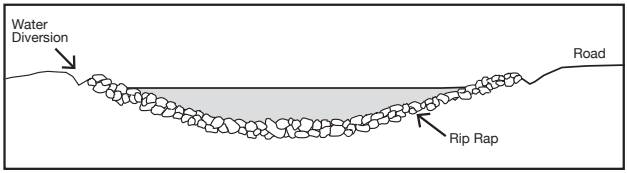
Fords—Stream crossing

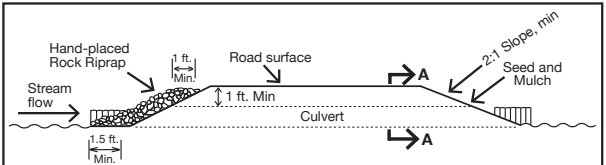
- Generally the least desirable option.
- Cannot be used on designated trout streams.
- Use only when water is <2 feet deep.
- Stabilize the streambed and approaches with rock and gravel as needed.
- Install water diversion structures on approaches to both sides of the ford.



Fords should be used infrequently and when water flow is low to limit stream sedimentation. Rock, steel mats, and other materials can be placed in the stream channel to stabilize the streambed.

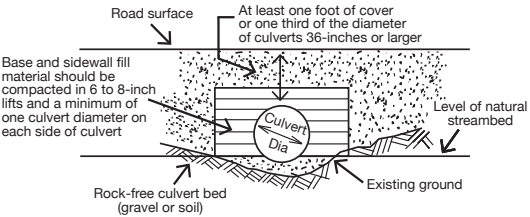
Culverts—Stream crossing

- Culvert inlet should be installed at or below the streambed.
- Install at same slope as the streambed.
- The minimum diameter of the culvert should be equal to the width of the stream. A single culvert is ideal, but use multiple culverts if needed.
- Extend the culvert beyond either side of the road or trail.



Install culvert so that there is no change in the stream bottom at the culvert inlet and outlet

TYPICAL ROAD CROSS-SECTION AT STREAM CROSSING



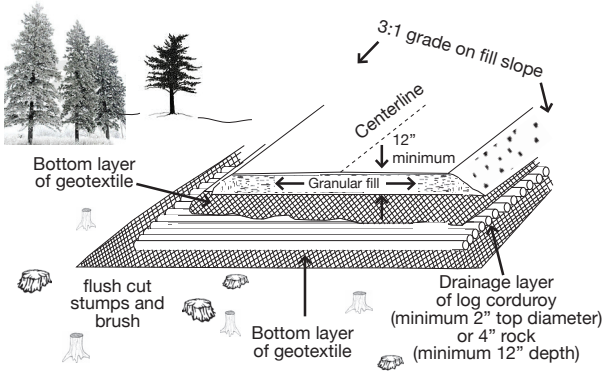
CROSS SECTION A-A

Wetland crossings

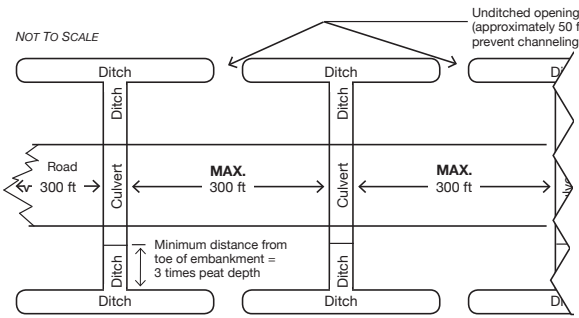
Cross wetlands when soil is frozen whenever possible.

Utilize the following guidelines when crossing wetlands during non-frozen conditions:

- Install culverts or free water flow methods to provide adequate cross-drainage. Construct ditches to facilitate flow into and out of culverts.



Maintaining wetland subsurface flow is a primary objective when constructing wetland crossings. Use these techniques to allow water to flow through the road and maintain wetland hydrology.



- Use conventional road crossing methods for mineral soils and when peat is <4 feet deep.
    - Minimize the road width and length.
    - Use water diversion structures at all approaches.
    - Use clean granular fill.
    - Dispose of excavated material at upland site.
- Consult an engineer for proper crossing design when peat is >4 feet deep.
- Refer to Roads section of the full Forest Management Guidebook for more detailed specifications.

Rutting

Minimize rutting at all crossings, approaches, wetlands, and seasonal ponds.

- Utilize slash mats or corduroy on approaches and crossings to minimize rutting. Leave materials in place following operations.
- Cease operations if repeated rutting >6 inches is occurring.
- Rutting should never exceed 300 feet or bisect a wetland or seasonal pond.

Placing slash on approaches to stream crossings and wetlands can minimize rutting while also controlling erosion.

RMZs and Filter Strips

Riparian areas are areas that transition from aquatic to terrestrial ecosystems along streams, lakes, and open water wetlands. Riparian areas are important for many forest resources including plant and animal diversity, habitat, water quality, and forest recreation. Timber harvesting in or near riparian areas has the potential to impact these resources if proper care is not taken to minimize negative effects.

Key Points

1. Maintain relatively continuous forest cover in the RMZ.
2. Minimize soil disturbance in filter strips.

A Riparian Management Zone (RMZ) is the defined portion of the riparian area adjacent to a stream, lake, or open water wetland where RMZ guidelines apply. RMZ area is dependent on the recommended RMZ width which varies according to stream, lake, or open water wetland characteristics.

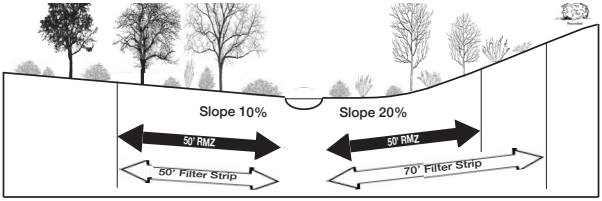
Waterbody characteristics	RMZ widths (ft)
Designated trout streams, tributaries, and lakes*.	165
All non-trout streams ≥3 feet wide, and lakes and open water wetlands ≥1 acre in size.	120
All non-trout streams <3 feet wide and lakes and open water wetlands <1 acre in size.	50

*a link to this list can be found in the resource directory of this guide.

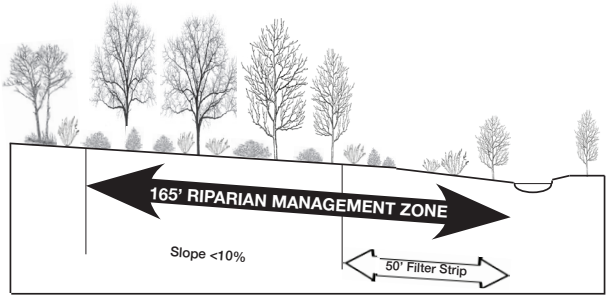
Note that RMZ guidelines do not apply to non-open water wetlands, seasonal ponds, seeps, and springs. Filter strip guidelines do apply to these waterbodies.

Aerial view of RMZs placed around streams within a harvest area. The strips of trees within the harvest area maintain relatively continuous forest cover within the RMZ. RMZs are recommended for many types of water features.

A filter strip is the area of land adjacent to a water-body that traps sediment before it reaches surface water. Harvesting is permitted in a filter strip as long as the integrity of the filter strip is maintained.



Schematic showing the distinction between RMZs and filter strips. The width of the filter strip and RMZ if present may be the same or different depending on slope and water feature type.



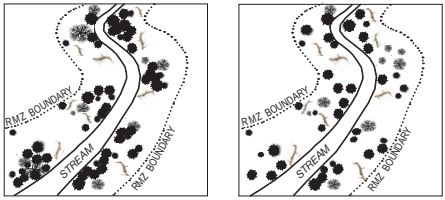
Designated Trout Stream

Apply filter strips to all perennial and intermittent streams, lakes, open water wetlands, non-open water wetlands, seasonal ponds, seeps, and springs.

- Minimum filter strip width is 50 feet for slopes <10%. Increase the width by 2 feet for each slope percent above 10%.
- Limit soil disturbance in the strip to <5% of the area and do not concentrate at any one location.
- Minimize compaction in all filter strips.
- Avoid placing roads, skid trails, and landings in filter strips.

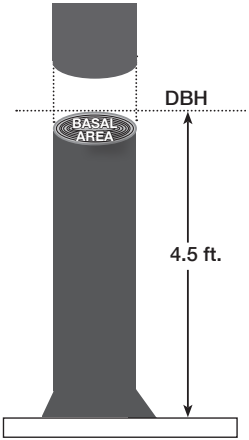
Apply the following guidelines to all RMZs:

- Clearly mark the RMZ boundary prior to cutting.
- Minimize disturbance to understory vegetation.
- Keep equipment away from the water's edge.
- Retain a minimum of 60 ft^2 basal area per acre distributed relatively continuously in the RMZ.
- Create or retain at least 4 leave logs per acre.



Relatively continuous cover can be maintained with gap-clump or well distributed tree retention as shown above.

Determining basal area in RMZs



Basal area (BA): the cross sectional area of trees at breast height (DBH; 4.5 feet above the ground).

There is no minimum tree diameter when determining residual BA in the RMZ, but larger trees are generally more desirable and contribute more basal area as shown.

Table showing the number of trees and spacing by size class equal to 60 ft² of BA per acre.

Tree DBH	Basal area per tree	Trees per acre	Spacing (ft.) between trees
2	0.02	3667	3.4
4	0.09	917	6.9
6	0.20	407	10.3
8	0.35	229	13.8
10	0.55	147	17.2
12	0.79	102	20.7
14	1.07	75	24.1
16	1.40	57	27.6
18	1.77	45	31.1
20	2.18	37	34.3

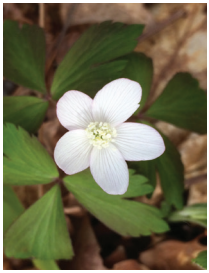
A general rule of thumb is that crown closure of 55-60% is approximately 60 ft² of basal area.

Wildlife

Health and diversity of wildlife depends on the availability of suitable habitat. Application of guidelines during harvesting operations can mitigate impacts to wildlife habitat and help maintain healthy populations into the future.

Key Points

1. Retain live trees, snags, and dead wood to promote habitat structure after harvesting.
2. Check for the presence of ETS species and modify harvest activities as needed.



As used in the guidelines, the term wildlife encompasses all forms of life that are wild including plants, animals, and microorganisms.

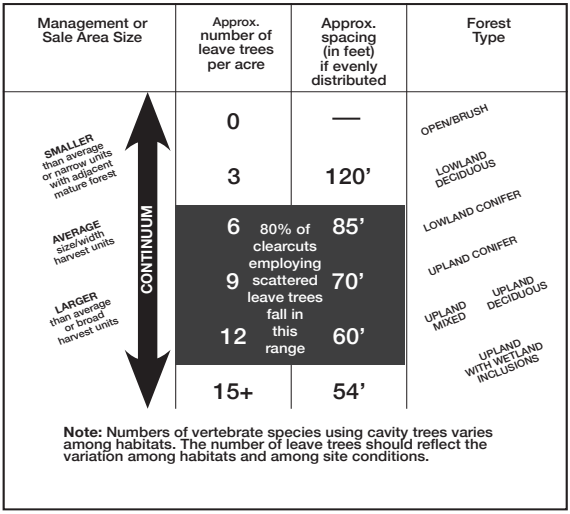
- Check ETS species inventories to see if these species may be present on site. Modify the harvest plan to promote ETS species if needed.
- Leave some live trees during clearcut harvesting with one of the following options:

Option 1: Clumps (preferred option)

- 5% of site area in clumps >0.25 acre in size.
- Locate clumps around sensitive areas (seasonal ponds, cultural resources, etc.).
- Clumps within sensitive areas and RMZs count towards the 5% retention/area.

Option 2: Scattered trees

- 6-12 per acre for most clearcut harvests.



Note: Numbers of vertebrate species using cavity trees varies among habitats. The number of leave trees should reflect the variation among habitats and among site conditions.

Option 3: Combination of scattered trees and clumps in a configuration that achieves wildlife and silvicultural objectives

Retain live trees with the following characteristics:

1. A mix of preferred species.

Leave Tree Preferences For Longevity, Wildfirmness, and Cavity Potential

EXCELLENT	GOOD	FAIR
White Pine	Red Pine*	White Birch
Oaks	Tamarack	Balsam Fir*
Elms	Cedar	Jack Pine*
Ashes	Red Maple	Black Spruce*
Sugar Maple	White Spruce*	Balsam Poplar
Yellow Birch	Black Cherry	
Basswood	Hickories	
Aspen	Cottonwood	
	Walnut	
	Hackberry	

* Leaving these species in the overstory can imposes a risk of insect and disease infestation to understory regeneration of the same species

2. A range of tree sizes.

- All leave trees should be >6 inches DBH.
- 50% of leave trees should be >12 inches DBH.

3. A range of conditions and economic value.

- Some healthy, some with decay evident.
- Some with poor form, some with good form.

Exceptions to leave tree and snag (see below) guidelines may be made for the following reasons:

- Operator safety.
- Public safety.
- Specific forest management applications.
- Visual quality.
- Alignment of skid trails.
- Surrounding landscape concerns.
- Forest insects and disease concerns.

Retaining leave trees in stands infested with dwarf mistletoe would allow the disease to infect the succeeding stand and spread to other stands. It is appropriate to not retain leave trees during clear cut harvesting in this situation.

Retain all snags possible during harvesting.

Apply the following coarse woody debris (CWD) (dead logs >12 inches in diameter and longer than 6 feet) recommendations during all harvesting activities.

- Limit disturbance to all pre-existing CWD.
- Create 2-5 pieces of CWD per acre across the site if less than that amount is present.
- Create at least 4 pieces of CWD per acre when harvesting in RMZs if not already present.

Retain at least 1/3 of all slash and scatter across the site when possible.

Retain and scatter all slash when:

- In riparian management zones.
- Within 25 feet of a dry wash bank.
- At erosion prone sites with slopes >35%.
- At sites with soils <8 inches deep.
- At sites with ombrotrophic soils >24 inches deep.
- Sensitive plant communities are present.
- Slash-dependent ETS species are present.

Ombrotrophic wetlands such as this black spruce bog are characterized by low nutrient availability. Retention of all slash limits nutrient loss and helps to maintain site productivity.

- Keep slash out of streams, lakes, seasonal ponds, and wetlands except when part of a wildlife management strategy.
- Protect conifer regeneration (<4 inches DBH) when harvesting mixed deciduous coniferous stands.

Retention of conifer regeneration in mixed deciduous/coniferous stands can provide important habitat for a variety of wildlife species. In some instances it may be appropriate to remove conifer regeneration for insect and disease considerations or maintenance of native plant communities. Check with your local DNR office to see if these situations apply to your site.

Biomass Harvesting

Biomass harvesting removes more wood and nutrients from a site than conventional harvests, increasing the potential for impacts to wildlife, biodiversity, and site productivity.

Key Points

1. Know the site conditions when biomass harvesting should not be conducted.
2. Retain recommended amounts of slash or woody debris when biomass harvesting.

Stumps and woody debris shown in this picture provide important habitat for a variety or organisms such as the tree seedling growing in this old stump.

Woody biomass is any organic material produced by trees including roots, stumps, boles, limbs, and leaves. Biomass harvesting generally refers to the utilization of waste wood or slash that is primarily composed of tops and limbs of trees not normally utilized in a conventional harvest.

Avoid removal of biomass above the amount normally removed in a conventional bole wood harvest in the following situations:

- In riparian management zones.
- Within 25 feet of a dry wash bank.
- At erosion prone sites with slopes >35%.
- At sites with soils <8 inches deep.
- At sites with ombrotrophic soils >24 inches deep. These sites typically have vegetative cover that is:
  - sparse (25-75%).
  - predominantly black spruce.
  - <30 feet tall.
- Sensitive native plant communities are present*.
- If slash-dependent ETS species are present*.

* Consult with local DNR offices to determine if these communities and species are present at your site.

When harvesting more biomass than during a conventional bole wood harvest, retain the following types and amounts of woody material:

- All pre-existing coarse woody debris.
- The forest floor and the litter layer.
- All stumps and roots.
- 1/3 of all tops and limbs from harvested trees well-distributed across the site.

Retention of 1/3 of tops and limbs is attained through a combination of incidental breakage that occurs during felling and deliberate retention of some tops and limbs if needed.

Incidental breakage is generally *higher* when:

- Harvesting in winter compared to summer.
- Harvesting deciduous trees compared to coniferous trees.
- Harvesting with a conventional system compared to a cut-to-length system.

Examples of slash retention levels - Aspen

Insufficient amount of retention in foreground.

Sufficient amount of retention.

All slash retention.

Examples of slash retention levels - Pine

Insufficient amount of retention in foreground.

Sufficient amount of retention.

All slash retention.

Ensure that landings or on-site areas used to store biomass are left in a condition that favors regeneration and growth.

Leaving biomass and slash piles on site will inhibit regeneration and growth as shown in these pictures. Minimize biomass storage time on site and rehabilitate areas following removal as needed.

Sale Closure Checklist

Remove temporary drainage structures and stabilize soil along the banks of watercourses.

Do not remove slash or corduroy placed at approaches, wetland crossings, or around cultural resources.

Rehabilitate landings and skid trails when necessary to mitigate soil compaction and minimize erosion.

Remove flagging or other markings that identify a cultural resource or ETS area.

Clean up all garbage on site.

Remove equipment and harvested wood from wetlands prior to spring thaw.

Close or obliterate temporary forest access roads after management activities are complete.

Ensure that the road surface is in stable condition when the road is closed.

Place traffic barriers to prevent vehicles from disturbing recently stabilized areas.

Limiting access to, and use of, forest roads following harvest operations can reduce maintenance costs, minimize disturbance of stabilized areas, and limit damage to sensitive features such as cultural and water resources.

Spills and Emergencies

State law requires immediate action to clean up all petroleum spills to minimize or abate pollution of waters of the state.

What to do if a spill occurs

1. Stop the spill.
2. Contain the spill.
3. Capture as much spill material as possible before it infiltrates the soil.
4. Call the State Duty Officer if spill volume is >5 gallons.
5. Conduct appropriate actions to clean up the spill.

You are required to call the State Duty Officer if spill volume is >5 gallons!

1-800-422-0798

Emergency preparation and avoidance

Call 811 prior to digging in the vicinity of pipelines and utility cables.

Always wear your personal protective equipment for the head, ears, face, feet, and hands.

Provide all crew members with written directions to the harvest site to convey to emergency personnel, if needed.

Keep well-stocked first aid kits in all vehicles and make sure all crew members are trained in CPR and first aid.

Make alternative plans for emergency contact if cell phone coverage is not available.

Make safety a habit!
Be Seen, Be Safe, Be Alive.

Petroleum products, such as fuels and lubricants in logging equipment, contain toxic chemicals that can produce harmful effects to human health, destroy food webs and wildlife habitat, and impair drinking water resources. Pollution from petroleum spills causes serious damage to terrestrial and aquatic environments.

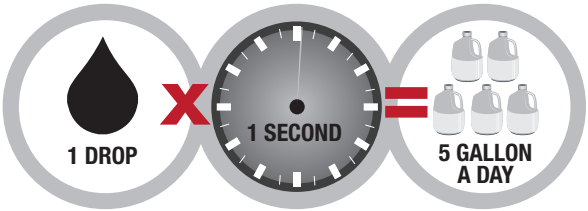
Key Points

1. Take action to prevent spills and accidents from occurring.
2. Conduct appropriate actions following a spill or an emergency event.

Preventing Spills Saves Money!

1 fluid drop per second = 5 gallons a day

Petroleum products are not cheap…think of all the things you could be spending that wasted money on.



Utilize the following guidelines to prevent and minimize petroleum spills:

- Inspect equipment on a regular basis for small drips, spills, and worn hoses. Repair if needed.
- Replace worn equipment before failures occur.
- Use caution when adding or removing petroleum products and fuels.
- Locate fuel and maintenance areas away from open water and outside of filter strips or the riparian management zone when possible.
- Provide necessary equipment to collect and store lubricants or fuel drained during repair activities or collected following spills.

Kits to contain and capture petroleum spills

Spill kits should include:

- Emergency phone numbers.
- Absorbent pads, snakes and booms.
- Trash bags (softner salt bags work great).
- Loose absorbent (kitty litter).
- Plastic gloves.
- Plugs.
- Puncture repair putty.

Example of a large kit to be stored at each site

Example of a small kit for individual machines

Contaminated soil <10 yds^3 may be thin-spread as long as the following conditions are met:

- The landowner has given permission to thin-spread.
- The area where soil is spread is >200 feet from surface water, wells, and sewers.
- Thin-spreading occurs between April 1 and November 1.
- Contaminated soil is spread at <2 inch thickness and incorporated into the native soil.

For contaminated soil >10 yds^3 contact the State Duty Officer (1-800-422-0798) who will put you in touch with the on-call MPCA emergency responder for immediate advice and approval of your cleanup plan.

Regulations

In addition to the voluntary guidelines in this field guide, there are several regulations that require certain actions when conducting forestry activities. The following is a summary of the most commonly applicable rules and regulations to timber harvesting operations. Contact local SWCD offices for further information on local ordinances and contacts.

Wetland Conservation Act (WCA):

State law regulates work activity in non-public wetlands. Forestry activities are exempt from regulation as long as certain conditions are met.

Conditions that must be met include:

- Impacts to hydrology and biology are limited in the wetland.
- No dikes, ditches, tile lines, or buildings are constructed.
- The wetland is not drained.
- Placement of fill is avoided whenever possible.

In addition, the following conditions must be met for wetland crossings and roads:

- Appropriate erosion control must be used.
- Fish migration cannot be blocked.
- Comply with all applicable federal, state, and local requirements and guidelines.

Additional guidance on whether or not a given forestry activity is exempt from WCA rules can be downloaded from the following link.
http://www.mlep.org/efmg/5.htm

Public Waters Law:

Work affecting a lake, wetland, river, or stream identified on DNR Public Water Inventory maps may require a permit. **Work activities that do not require a DNR Public Waters Work Permit are identified in Appendix H within the full Forest Management Guidebook.**

Public Water maps, permitting requirements, and additional information can be found at:

http://www.mlep.org/efmg/6.htm

Contractor Responsibility Form:

Landowners, land managers, loggers, and construction contractors working for a logger or landowner need to file a completed Landowner Statement and Contractor Responsibility Form whenever working in wetlands or public waters. Unless you are certain that submitting this form is not necessary, it is recommended that you complete and submit the form to the appropriate Local Governmental Unit.

The form can be downloaded at the link below.

http://www.mlep.org/efmg/3.htm

Petroleum Spills:

State law requires immediate action to clean up all petroleum spills to minimize or abate pollution of waters of the state. In addition, spills >5 gallons must be reported to the State Duty Officer. See spill section in this guide for more information.

Noxious Weed Law:

State law requires the control and eradication of certain plant species such as buckthorn, garlic mustard, and non-native thistles.

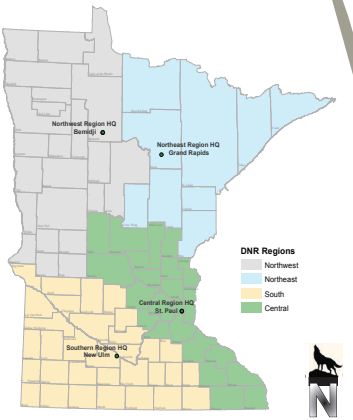
The full list can be found at:

http://www.mlep.org/efmg/37.htm

Resources

DNR Regional Offices

Northwestern:
(218) 308-2700
Northeastern:
(218) 327-4455
Central:
(651) 259-5800
Southern:
(507) 359-6000



County Land Departments

Aitkin:	(218) 927-7364
Becker:	(218) 847-0099
Beltrami:	(218) 333-4210
Carlton:	(218) 384-9179
Cass:	(218) 947-3338
Clearwater:	(218) 694-6227
Cook:	(218) 387-3653
Crow Wing:	(218) 824-1115
Hubbard:	(218) 732-4270
Itasca:	(218) 327-2855
Koochiching:	(218) 283-1127
Lake:	(218) 834-8340
Lake of the Woods:	(218) 634-1945
Pine:	(320) 216-4220
St. Louis:	(218) 726-2606

Permitting Resources

Army Corps of Engineers
http://www.mlep.org/efmg/32.htm

Wetland Conservation Act
Forestry exemption guidance:
http://www.mlep.org/efmg/5.htm

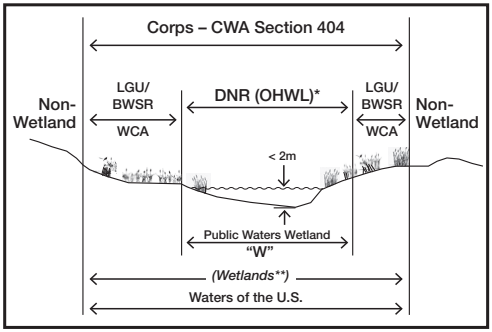
BWSR Area contacts for WCA
http://www.mlep.org/efmg/38.htm

Minnesota Public Waters Permitting information

http://www.mlep.org/efmg/15.htm

Public waters maps
http://www.mlep.org/efmg/6.htm

DNR Division of Ecological and Water Resources
(651) 259-5100 / (651) 259-5654



Schematic depicting regulatory authority associated with stream and wetland permitting

Planning Resources

Minnesota Logger Education Program
http://www.mlep.org
(218) 722-5442

Uuniversity of Minnesota Forest Resources Extension
http://www.mlep.org/efmg/39.htm

Link to soil maps
http://www.mlep.org/efmg/11.htm

Link to topo maps
http://www.mlep.org/efmg/40.htm
http://www.mlep.org/efmg/41.htm

Link to aerial photos
http://www.mlep.org/efmg/13.htm
http://www.mlep.org/efmg/42.htm

Link to visual quality maps
http://www.mlep.org/efmg/14.htm

Link to Landview
http://www.mlep.org/efmg/43.htm

ETS Species

Species list
http://www.mlep.org/efmg/44.htm

ETS Inventory Contacts
http://www.mlep.org/documents/ETSCulturalList.pdf

Cultural Resources Inventory

http://www.mlep.org/documents/ETSCulturalList.pdf

Sensitive Native Plant Communities

Red Pine–White Pine Woodland (Minnesota Point)	FDn32b
Spruce–Fir Woodland (North Shore)	FDn32e
Jack Pine–Oak Woodland (Sand)	FDs27a
White Pine–Oak Woodland (Sand)	FDs27b
Swamp White Oak Terrace Forest	FFs59b
White Pine–Sugar Maple -Basswood Forest (Cold Slope)	MHc38a
Jack Pine–(Bearberry) Woodland	FDc12a
Jack Pine–(Yarrow) Woodland	FDc23a
Jack Pine–Oak Woodland	FDc25a
Oak–Aspen Woodland	FDc25b
Red Pine–White Pine Forest	FDc34a
Jack Pine Woodland (Sand)	FDn12a
Red Pine Woodland (Sand)	FDn12b
Red Pine–White Pine Woodland (Eastcentral Bedrock)	FDn22d
Black Spruce–Jack Pine Woodland Jack Pine–Balsam Fir Sub.	FDn32c1
Jack Pine–Black Spruce Woodland (Sand)	FDn32d
Black Spruce Woodland	FDn33c
White Pine–Red Pine Forest	FDn43a
Black Oak–White Oak Woodland (Sand)	FDs27c
Oak–Shagbark Hickory Woodland	FDs38b
Bur Oak–(Prairie Herb) Woodland	FDw24a

Sensitive Native Plant Communities (cont'd)

Elm–Ash–Basswood Terrace Forest	FFs59c
White Pine–White Spruce–Paper–Birch Forest	MHn44b
White Cedar–Yellow Birch Forest	MHn45b
White Pine–Oak - Sugar Maple Forest	MHs38a
Red Oak - Sugar Maple–Basswood (Bitternut Hickory) Forest	MHs38c
Sugar Maple–Basswood–Red Oak (Blue Beech) Forest	MHs39b
Elm–Basswood–Black Ash–(Blue Beech) Forest	MHs49b
Green Ash–Bur Oak - Elm Forest	MHw36a
Black Ash–(Red Maple) Seepage Swamp	WFs57a
Black Ash–Sugar Maple–Basswood Seepage Swamp	WFs57b
Dry Barrens Jack Pine Savanna (Northern)	UPn13a
Dry Sand - Gravel Oak Savanna (Northern)	UPn13c
Dry Hill Oak Savanna (Northern)	UPn13d
Mesic Oak Savanna (Northern)	UPn24a
Dry Barrens Oak Savanna (Southern)	UPs14a
Dry Hill Oak Savanna (Southern)	UPs14c
Mesic Oak Savanna (Southern)	UPs24a
Dry Barrens Oak Savanna (Northern)	UPn13b
Dry Sand–Gravel Oak Savanna (Southern)	UPs14b
Algific Talus	CTs46a

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Minnesota Forest Resources Council

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MINNESOTA FORESTRY ASSOCIATION

Minnesota Timber Producers Association

MFI MINNESOTA FOREST INDUSTRIES

MFRP MINNESOTA FOREST RESOURCES PARTNERSHIP

Blandin Foundation™ STRENGTHENING RURAL MINNESOTA

A steering committee provided guidance on the development of this field manual including identification of relevant content. The committee members were:

Wayne Brandt (MFRC - representing forest industry)
David Chura (MN Logger Education Program)
Bruce Cox (Land Commissioner, Clearwater County)
Amber Ellering (MN DNR - Forestry)
Tom McCabe (Timber Producers Association)
Dave Parent (MFRC - representing private landowners)
Shawn Perich (MFRC - representing game species organizations)
Susan Solterman Audette (MFRC - representing environmental organizations)
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Robert Slesak, MFRC Site-level Program Manager, led the development and publication of this field guide.

Minnesota Forest Resources Council

The purpose of this field guide is to serve as a quick reference of Minnesota's Forest Management Guidelines for timber harvesting. Users are strongly encouraged to consult the full Forest Management Guidebook for more information on additional guidelines, flexibility considerations, and supporting technical resources and information.