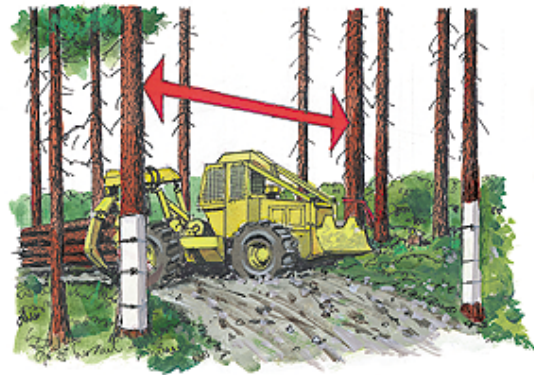


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## Skidding/Forwarding Trails

- Logging supervisors should ensure that:
  - ~ trails have been clear-felled and danger trees removed before skidding commences
  - ~ trails are of the appropriate width to minimize skidding damage to roots and residual stems
  - ~ there are no tight or unnecessary turns, and access is angled into the landing or roadside, or junctions widened to minimize swing
  - ~ selected rub trees are firm enough to resist being pulled over by logs being skidded past (consider topping if necessary to improve stability)
  - ~ where tight turns cannot be avoided (due to uneven terrain or partial-cut requirements), options such as short- or medium-wood systems, or more gentle curves can be considered to minimize the sweep of the turn and the brushing/rubbing of standing timber
  - ~ intersections of more than two trails are avoided
  - ~ branch trails are angled 35° or less to the felling pattern (herringbone) or to the main trails to minimize the sweep of the turn and the possibility of brushing/rubbing of standing timber
  - ~ the maximum grade of the skid trail conforms to the safe operating range of the skidding equipment being used
  - ~ trails are spaced as widely as possible, taking into account the maximum reach of the feller buncher/hoe (e.g., crane zone) and any manual felling to occur between crane zones
  - ~ the skid trail system accesses all areas of the logging project, so as to not put the skidder in a compromised winching position
  - ~ the skid trail system utilizes favourable grades and natural topographic features to facilitate skidding and minimize soil disturbance
  - ~ there is no cross-slope skidding on steep terrain, unless excavated skid trails are built to obtain a flat running surface to help control the rollover hazard and turns swinging downhill and damaging leave-trees
  - ~ to minimize trail wear and the likelihood of turns swinging downhill on side-slope trails, the top side of trails should be skidded first, and then the lower side from back to front
  - ~ steep trails have adequate and designated turnarounds.



*Consider using protective devices to improve durability of rub trees.*



*An efficient trail network is essential to safe operations.*

## Felling

### Mechanical felling

- The logging supervisor should ensure that:
  - ~ safety procedures for tree processors and feller bunchers working with hand fellers are followed
  - ~ buncher size is matched to the size of timber being felled
  - ~ a buncher with sufficient reach is used to fell trees within the crane zone and reach any trees manually felled between crane zones
  - ~ operators know the capacity of their equipment, operate within the specified grade maximums of the equipment, and do not attempt to cut oversized timber
  - ~ all oversized timber is left for the hand fellers, and not brushed up by the buncher
  - ~ bunchers are placed at an advantageous angle close to the skid trail to facilitate skidding, minimize hang-ups, and reduce the distance that skidders have to back around leave-trees.
- Logging supervisors must establish slope limitations for the equipment combinations being used, and plan the operations accordingly.
- Where stub creation is specified, the logging supervisor must choose a stub height that allows for the safe cutting and handling of each tree. Selected stems should have some defect (e.g., scar, split trunk, conks) in the lower bole which would make them suitable as future wildlife trees.



*When using feller bunchers, stubs can safely be left for wildlife habitat.*

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## Hand felling

- Fallers must identify all overhead hazards, hung-up trees and branches, and control the hazards. Hung-up trees must be pushed down/removed immediately or a safe no-work zone established.
- Fallers must remove danger trees within standing timber as soon as it is safe to do so.
- Fallers should take extra care when felling oversized trees (left by mechanical felling machines), especially if the amount of holding wood has been compromised by an unsuccessful mechanical felling attempt.
- A suitable mancheck system for fallers must be employed when felling oversized trees, since the spacing of oversized trees makes for rapidly changing felling locations. This requires effective communication between the faller and other workers.
- Fallers must fell trees at an advantageous angle to the skid trail to facilitate skidding and minimize hang-ups.
- When manual felling is employed between crane zones, trees should be felled towards and into the crane zone so that bucked logs are retrievable by the feller buncher/hoe-forwarder.



*Always remove danger trees that can impact the work area.*

## Skidding

- Skidder operators will inspect mainlines and chokers frequently, and replace them when necessary.
- Skidder operators should maximize the use of winches to avoid backing around and causing damage to leave-trees.
- Skidder operators will set the turn in such a way that logs will pull into lead without hanging up on leave-trees.
- When hang-ups occur, the machine operator will inspect the problem, re-set chokers and re-position the machine, if necessary, to dislodge hang-ups.
- If unable to dislodge hang-ups, the machine operator should get a faller to buck the hung-up log or fell timber preventing the hang-up from being dislodged.
- Machine operators will ensure that the weight of the turn does not exceed the safe operating limits of the machine.
- In partial cutting, machine operators and swampers must use the WCB-specified hand signals and voice commands.
- When more than one skidder is using the same trail and landing, machine operators must establish and adhere to a traffic plan.
- Logging supervisors must confirm that:
  - ~ rub trees are large and firm enough to resist being pulled over by passing equipment and turns
  - ~ standing dead trees are not used as rub treesand ensure that:
  - ~ rub trees are felled last, from the back of the project to the front, after skidding from side trails or a herringbone pattern is complete
  - ~ rub trees made unstable as a result of skidding operations are removed immediately.



*Poorly set turns will hang up on leave trees.*



*Utilize favourable grades and natural topographic features in locating skid trails to efficiently access the cutblock, facilitate skidding and minimize site disturbance.*



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## Safety Check List for Horse-Logging Methods

While horse logging can be an effective way to skid logs, it can also be hazardous. The guidelines provided below are designed to ensure that anyone involved with horse logging operates in a safe and successful manner.



*Horse logging requires a high degree of awareness.*

### Training and Preparation

- Before beginning horse logging, the faller/teamster should obtain extensive training from an experienced and well-qualified horse logger or horse logging instructor.
- When a faller and teamster are working together, regular checks should be made to ensure the safety of each worker.
- Before beginning work, the faller and teamster should walk the area to be logged and become familiar with:
  - ~ felling boundaries
  - ~ reserve patches
  - ~ actual or potential hazards or problem areas
  - ~ locations of landings and skid trails.
- All workers must wear adequate eye, face and hand protection.

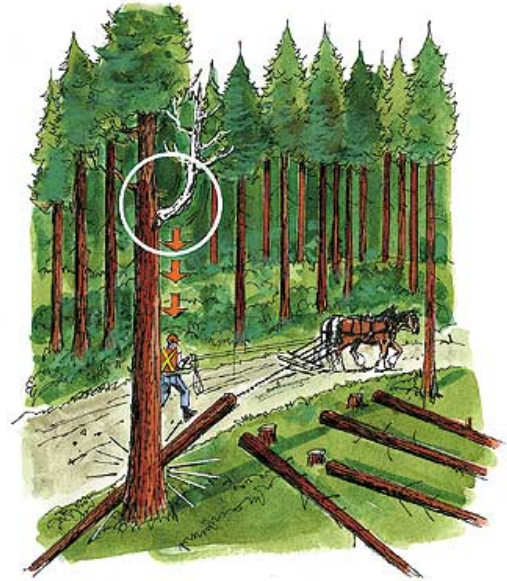
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## Horses and Their Equipment

- Teamsters should always work to improve their understanding of how individual horse(s) will react to the wide variety of situations encountered in horse logging. Teamsters should exercise a great degree of caution in all aspects of the logging operation until a working familiarity is achieved between the teamster and the horse. Horses that work well together and with the teamster are of the utmost importance for safe operations.
- Teamsters should:
  - ~ consider having more than one team or an additional horse, and follow a horse rotation schedule because overexcited or tired horses may cause accidents
  - ~ ensure that equipment is adequate and in good condition; for example:
    - the harness is of proper size and shape to fit the horse comfortably
    - the reins are long enough for the work to be undertaken—the minimum suggested length is 5–7 metres
    - make sure collars and other gear are not age weakened and are properly adjusted.
  - ~ skid only with horses that have been well-broken to ensure they will not spook; desirable attributes are:
    - at least five years old, with exposure to a variety of working conditions under harness
    - trained to pick up their feet on request
    - do not become overly excited by strange noises or sights
  - ~ work to improve their understanding of each horse's temperament and reactions to various situations and stimuli. For example, know how each horse:
    - responds after not having worked for two or more days
    - reacts to a new team member
    - responds when in season or to another horse in season
    - is affected by weather
    - responds to equipment such as chainsaws, crawler tractors, log loaders, trucks, and other loud noises
    - reacts to dogs, bears, wasps, horseflies, etc.
    - reacts to being hit by chainsaw dust or chips.
  - ~ ensure that a humane killing device is available, in case of mortal injury to a horse
  - ~ check horses over carefully on a daily basis for sores on the mouth, shoulders, rump and legs, and cuts on the legs and feet
  - ~ treat cuts immediately; if a horse is painfully injured it must be returned to the barn
  - ~ equip all horses with blinders, particularly in light thinnings, to prevent scratch and puncture injury to the eyes
  - ~ use fly spray, since horses may be sensitive to fly bites or may become annoyed or irritable from bites.

## Trails

- Teamsters should:
  - ~ make a good clear skid trail, removing rocks, stumps, saplings, holes or other obstructions that could catch the log and swing it up sideways or stop it
  - ~ remove all stumps, trees and small saplings (with stubs cut flat and close to the ground) on or adjacent to the skid trail that could be rubbed or bent over by the turn being skidded and spring up unexpectedly to strike the horse or the teamster
  - ~ brush trails out and remove dead limbs from bottom two metres of trees on each side of skid trails
  - ~ lay out trails to maintain two tree-lengths between the teamster/horses and the felling area.
  - ~ where possible, locate trails where there are no depressions or rock outcrops that a log can hang up on
  - ~ constantly monitor for overhead hazards and snags which the faller may have missed; if a significant overhead hazard exists, it must be removed or the trail re-routed.



*Keep trails clear of overhead hazards.*

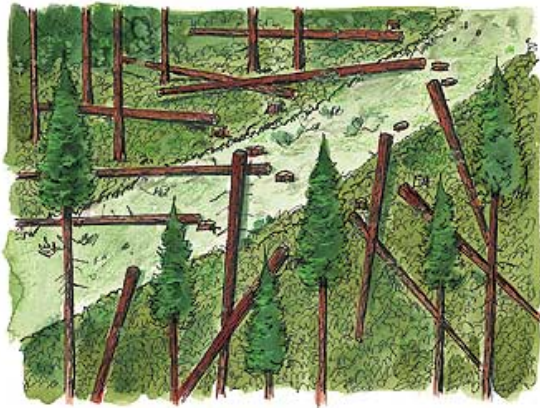


*Always maintain a safe distance of at least two tree-lengths between fallers, horses and other workers.*

## Felling

- Fallers must work at least two tree-lengths away from the team—further away if the ground is sloping.
- If possible, the faller should fell trees so they can be skidded butt-first, which is easier and safer for the horses.
- Fallers should fell trees at the most advantageous angle to the skid trail so horses do not get caught up in adjacent trees or obstacles.
- Fallers should ensure that trees are well limbed so friction is reduced and the chances of a limb hitting or tripping the teamster are reduced.
- Fallers must buck trees to lengths and weights that permit safe loading and minimize sweep.





*Fell trees in a herringbone pattern to the skid trail to prevent horses hanging up turns on leave-trees.*

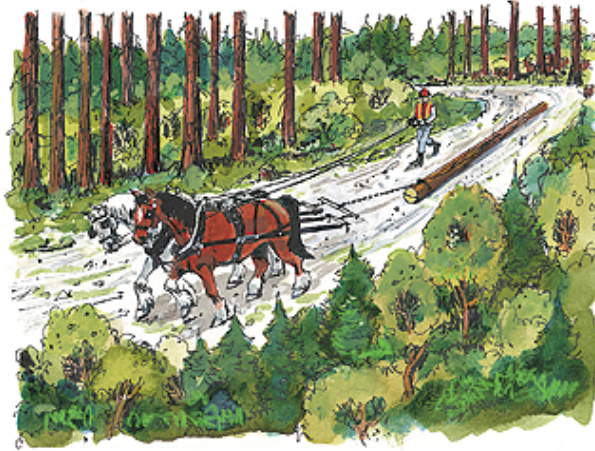
## Yarding

- When yarding with horses, the teamster should:
  - ~ pay extra attention to sudden stops or bolting of the horses to avoid being thrown off when using a yarding arch/cart
  - ~ inspect yarding arch/cart daily for weak points or damage
  - ~ select firm trees for block tailholds
  - ~ ensure horses are warmed up before having to pull heavy loads
  - ~ alternate easy drags with heavy drags so horses do not get too tired and difficult to control
  - ~ begin at the back end of the skid trail and work toward the landing to keep debris behind the horse and the teamster
  - ~ trim all stub limbs off the log before skidding
  - ~ prune broken limbs from the base of trail side trees to prevent stabbing injuries
  - ~ leave horses facing the turn while hooking the chain, choker or tongs to turn the logs
  - ~ not hook up the turn to the team until ready to go
  - ~ not use tongs or other self-tensioning devices to hook up a load on steep hills where the load may slide on the way down and come loose from the tongs
  - ~ hook close to the end of short logs to prevent them from flipping end-for-end if they hit an obstacle while being skidded
  - ~ use two or more chains when necessary to pull a log to a better position for closer choking of the log



*Use two or more chains if required to pull tree into better position for closer choking of logs.*

- ~ hook the skidding chain into the “D” on the whippetree so it will not drag on the ground where it can catch and damage the harness or injure the worker or the horse
- ~ always undo the chain choker from the harness hook when hooking up a log to the horses
- ~ ensure the pathway is clear of debris before starting off with the drag
- ~ ensure that the log is free of hang-ups and will twist free as the drag begins
- ~ start out slow and steady—the first 10 metres is the most dangerous part of the skid



*Keep a safe position to the side and uphill of the log being skidded.*

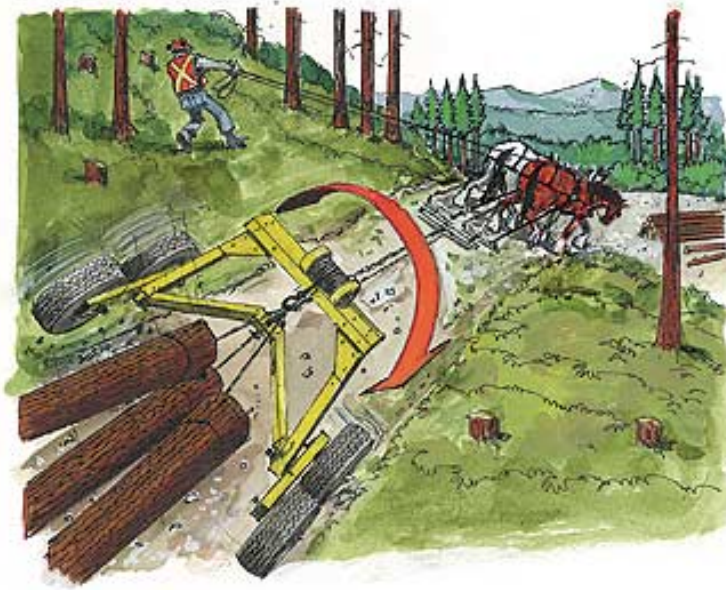
- ~ keep horses to a controlled walk when travelling to the bush and especially when skidding the turn out of the bush
- ~ keep a safe position to the side and uphill of the log being skidded
- ~ not walk alongside the horses on slippery or broken ground in case they lose their balance
- ~ never be positioned in front of the log being skidded
- ~ step over rather than on the log being skidded, and stay outside the rigging
- ~ change sides to stay clear of the swing load on turns in the trail because the load may pivot against a standing tree and swing sideways



*Watch for pivots and swinging logs.*

- ~ if an unsafe situation arises, halt the team and immediately move to a safe position
- ~ alternatively, let go of the reins and wait until the horses have moved past the danger area; then tell them to “whoa” before moving forward to pick up the reins and carry on with the drag
- ~ always unhook the chain from the doubletree before unhooking it from the logs.

- 
- When using a logging arch or cart to skid logs, the teamster should always:
    - ~ avoid operating on slopes where tipping is a hazard
    - ~ hook up to the front of the log and drag it straight ahead to avoid tip-overs
    - ~ be sure the bullboard is high enough to prevent the teamster from falling forward.
    - ~ be aware of the fatigue level of the team; although the teamster may be quite fresh, as the day progresses, the team may become very tired.



*Avoid operating on steep side slopes where tipping over is a hazard.*

### **At the Landing**

- The teamster should:
  - ~ ensure that all logs are either decked or out of the way on the landing so there is plenty of room for the next turn or logs
  - ~ remove small debris or branches from the landing so horses don't trip or step on them causing them to flip up.

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## Appendix 1: Controlling Windthrow

Traditional weather patterns and history of winds must be considered in controlling windthrow. For example, if a clearcut is creating a wind funnel endangering an adjacent riparian management zone, feathering trees in the management zone may decrease windthrow.

Partial-cutting treatments open the canopy and increase the drag force on individual trees: this increases the risk of overturning and is especially likely to happen on high and moderate windthrow-prone sites.

Dominant trees shelter other trees; windfirmness is a function of height, dominance, tree form and root stability. Non-dominant trees may require close appraisal.

If you are working in a canopy of uniform height, windfirmness is a function of shelter, intercrown damping, and root stability. The denser the stand, the more likely it is that the roots on the perimeter have been stressed. Close appraisal of each tree for root damage is advisable.

The amount of canopy removal should reflect the windfirmness of the original stand. Poorly-drained areas, with shallow soils and pockets of root rot are particularly sensitive to wind.

In all stands, one should consider visible forest health concerns such as root rot, fungal fruiting bodies, and beetle or moth infestation.

In order to manage for wind in partial cutting:

- retain sound, well-rooted veterans (e.g., snag-top cedars) or deciduous trees;
- retain sound trees (strong roots and high taper) with relatively small, open crowns;
- retain sound snags where safety is not compromised;
- remove the most vulnerable stems first (e.g., unsound trees, especially those with large crowns; trees with asymmetric or stilt roots; trees growing on unstable substrates such as rocky knolls, boulders, nurse logs, or poorly drained depressions; and tall, non-veteran trees with disproportionately large crowns or any of the previous characteristics);
- ensure that small leave patches are located on deep, well-drained soils or other topographically protected sites where windthrow hazard is low.

*Logging contractors, supervisors and fallers with experience in the area being considered can provide a wealth of information useful for assessing windthrow risk and developing management strategies.*

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*The information that follows is drawn from the Riparian Management Area Guidebook, Forest Practices Code of British Columbia (1995).*

## **Windthrow Hazard Management**

Riparian management areas in stands of moderate or high windthrow hazard require special management practices to reduce windthrow potential when logging is proposed within and adjacent to them. Where a reserve zone is required, windthrow hazard management should be designed primarily to protect the reserve zone and only secondarily to protect trees within the management zone.

### **Assessing Windthrow Risk**

The Windthrow Handbook for British Columbia Forests (Research Program Working Paper 9401) should be consulted for guidance when assessing windthrow risk or developing prescriptions to reduce the risk of windthrow. Windthrow risk assessments should incorporate local knowledge and experience, and should be assessed for the general area and, in greater detail, for each area with significantly different soil depth or drainage, stand structure, and tree species composition. Windthrow risk assessment should be a best judgement interpretation based on an evaluation of regional, local and site-specific information.

Windthrow risk is determined by the interaction between factors that affect the force of the wind acting on the tree and factors that affect the resistance of the tree to overturning. Force of the wind is increased by higher wind velocity and turbulence, increased exposure to wind, greater tree height-to-diameter ratio, greater crown size and density, and reduced stand density. Resistance to overturning is reduced by poor root anchorage due to saturated soils and restricted rooting depth, the occurrence of root or bole rot, the extent of interlocking root systems, and past exposure to winds. Soil factors that control rooting depth contribute most significantly to windthrow risk.

High risk stands generally occur where high wind force is likely to occur and resistance to overturning is low. Moderate risk stands occur where root anchorage is poor but wind force is low, root anchorage and wind force is moderate, or root anchorage is good but wind force is likely high. Low risk stands occur where there is a high resistance to overturning and wind force is moderate or low.

Windthrow risk is generally greatest on the windward edge of a stand and decreases a short distance into the stand, although turbulence can result in windthrow several tree heights into the stand. Most windthrow occurs within the first three years following harvesting. However, windthrow risk can increase over time as management activities affect windflow and soil conditions.

Local knowledge is an important consideration when assessing windthrow risk. Certain areas are known to be particularly windy. A history of frequent windthrow and evidence of windthrow or stem breakage in natural stands is an indication that windthrow is likely to occur after harvesting.

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## Windthrow Management Strategies

Strategies to reduce the risk of windthrow should be considered wherever trees are retained and windthrow risk is moderate or high along all or a portion of the riparian management area (RMA). Windthrow management strategies include locating the tree retention boundary to reduce the risk of windthrow, selecting the most windthrow resistant trees within the management zone for retention, and reducing the force of the wind on the crowns of retained trees. Selected strategies should not only address windthrow risk but also the other values that are being protected in the RMA.

## Options to Reduce Windthrow Risk to the Reserve Zone

Where windthrow risk is moderate or high in the reserve zone, a sufficient number of trees should be retained within the management zone to protect the windfirmness of the reserve zone. Options include location and design of logging boundaries and edge stabilization treatments.

### Location and Design of Logging Boundaries

- Realign the RMA or block boundary to a windfirm edge, such as rock bluffs, non-merchantable timber, bogs, landslides or snow avalanche tracks.
- Leave a buffer at least 20 m wide of well-drained, deep soils between areas of poorly drained or shallow soils of the RMA and the edge of the harvested opening.
- Avoid locating boundaries in areas that show evidence of previous or chronic windthrow.
- Where no natural windfirm features are available, consider widening the management zone to a moderate to low windthrow risk stand and align the boundary so that it is at an angle or parallel to the prevailing storm winds.
- Leave relatively straight boundaries on the outer edge of the RMA. This can be accomplished adjacent to meandering streams by leaving variable width patches of trees in the management zone. Do not leave any sharp corners or indentations that are exposed to the wind.

*Where a riparian management zone is more prone to windthrow than the reserve zone, and blowdown of residual trees is inevitable, low tree retention of only the most windfirm trees in the management zone may be the best windthrow management option.*

### Edge Stabilization Treatments

- Feather the outer edge of the management zone by removing trees prone to windthrow; preference should be given to removing: unsound trees including diseased, deformed, forked, scarred, mistletoe infested, and root rot infested trees; trees with asymmetric or stilt roots; trees growing on unstable substrates such as rocky knolls, large boulders, nurse logs, or wet depressions; tall non-veteran trees, especially those with disproportionately large crowns.



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- Preference for retention should be given to sound, well-rooted veterans (e.g., snag-top cedars) or deciduous trees; sound trees (strong roots and good taper) with relatively small, open crowns; and sound snags when safety is not compromised.
  - In multi-storied stands, the outer wind-exposed edge of the management zone may be additionally feathered by removing dominant trees from the leading edge, partially retaining co-dominant trees, and fully retaining suppressed trees within 20–30 m of the edge. This practice is not recommended in single-storied, high density stands.
  - Top, prune (limb) and/or crown thin individual trees with a high windthrow risk in the management zone and/or reserve zone; reduce the crown of these trees by 20–30 per cent; topping or pruning in the reserve zones should include only high windthrow risk trees that may cause significant detrimental effects to stream channels or wildlife habitat if they were windthrown.
  - combine edge feathering and topping, pruning, and/or crown thinning in high hazard areas.

### **Options to Reduce Windthrow Risk in the Management Zone**

Options to reduce the risk of windthrow to trees retained in the management zone include crown-thinning, pruning and topping, and/or selection of the most windfirm trees for retention. Trees with the following characteristics tend to be the most windfirm:

- short trees and trees with small open crowns, all else being equal;
- trees that have been growing in relatively open stand conditions;
- low height-to-diameter ratio for the stand (e.g., relatively large taper);
- sound, well-rooted veteran trees;
- sound snags;
- good root anchorage in deep, well-drained soils;
- no root or bole rot;
- specific conifer species (dependent on form and rooting habit);
- broad-leafed deciduous species, provided they are not over-mature.

### **Removal of Windthrown Trees**

When windthrow occurs within an RMA, the remaining standing trees should be left as a protective buffer for the other trees. Windthrown trees should not be removed from the RMA as they provide valuable wildlife habitat. Windthrown trees should be removed only if habitat would be improved by their removal, and if removal would not result in damage to the surviving trees. Windthrown trees should be assessed for removal by a forest health specialist where there is a risk of increasing bark beetle populations. Windthrown trees that have entered a stream should be removed only if they will destabilize the streambank or channel. Unnecessary removal of windthrown trees from streams can result in significant channel destabilization. Any removal of windthrown trees from an RMA must be specified in an approved silviculture prescription.