A large stack of cut logs in a forest, with the text 'CHAPTER 13 Timber Harvesting' overlaid.

CHAPTER 13 Timber Harvesting

CHAPTER 13 TIMBER HARVESTING

Integrated Resource Management Considerations	13-2
PLANNING AND DESIGN CONSIDERATIONS.....	13-3
Soil Productivity	13-3
Water Quality and Wetlands	13-3
BMPs: Planning and Design.....	13-3
Invasive Species	13-3
Visual Quality	13-4
Cultural Resources	13-10
Slash Management and Landings	13-10
Reserve Trees, Wildlife Trees, Coarse Woody Debris, and Snags	13-11
Harvesting Implementation	13-11
OPERATIONAL CONSIDERATIONS	13-12
Protecting Soil Productivity	13-12
Protecting Water Quality and Wetlands	13-12
BMPs: Protecting Sensitive Areas.....	13-12
Dry Washes.....	13-14
BMPs: Dry Washes.....	13-14
Protecting Cultural Resources	13-15
Skid Trails	13-15
BMPs: Skid Trails	13-15
Landings	13-16
BMPs: Landings.....	13-16
Minimizing Rutting	13-16
BMP: Rutting	13-16
Managing Slash	13-16
BMP: Slash	13-16
Snags (Standing Dead Trees)	13-17
Reserve (Leave) Trees.....	13-17
Providing Coarse Woody Debris	13-18
Managing the Harvesting Process	13-18
Understanding Harvesting Equipment and Harvesting Systems	13-19
The Timber Sale Contract.....	13-23
Five Steps in a Careful and Successful Timber Sale	13-24
Understanding the Sample Timber Sale Contract.....	13-25
Contract Breach: A Very Serious Decision	13-25
What is Reasonable?	13-25
POST-OPERATIONAL CONSIDERATIONS	13-28
BMPs: Invasive Species	13-28
RESOURCES FOR ADDITIONAL INFORMATION	13-29

Timber harvesting involves: 1) cutting trees and moving them to a landing, 2) processing them into various products, sorting and loading, and 3) transporting these products to markets.

Integrated Resource Management Considerations

- Special soil conditions and topographic features make some areas of the state more sensitive than others to soil disturbance. Two primary examples of these localized sensitive areas are the red clay soils along Lake Superior, and the steep slopes in the driftless area in southwestern Wisconsin.
- If done incorrectly, harvesting activities can result in sediment, chemical, nutrient, and debris movement into streams, lakes, wetlands, seasonal ponds, and groundwater.
- Wetlands are highly productive sites for a variety of ecological functions, as well as for the enhancement of water quality. All forest management operations in or adjacent to wetlands should be planned and conducted in a manner that protects these functions.
- Visual sensitivity levels should be considered in determining the level of effort appropriate to minimize visual impact.
- The silvicultural system needed to regenerate a stand affects the visual impact of the harvest. In general, partial cutting has less impact in more aesthetically sensitive areas. The type of harvest (partial cut versus clearcut) also affects user perception of apparent size.
- The visual impact of a harvest and the timing of adjacent harvests will be affected by 1) the length of time needed to re-establish forest regeneration; and 2) the intensity of treatments required to assure survival of the new growth.
- Wildlife habitat quality is influenced by timber harvesting activities. Maintain or enhance the structural components of the stand (live trees, snags, woody debris, shrubs, and ground cover) needed by wildlife during a timber harvest.



Figure 13-1: An aerial view of part of the Northern Highland-American Legion State Forest where aesthetic management guidelines have been applied for many years to manage the visual impact of harvesting operations.

- The average life span of a species affects the frequency of regeneration harvests and the time available to complete a harvest before the trees begin to deteriorate. Upon reaching old age, short-lived species tend to lose vigor over a relatively short time period with entire stands suffering disease or insect mortality all at once. Long-lived species tend to lose vigor more slowly, and suffer mortality on an individual tree basis.
- Timber harvesting activities may affect the population of invasive species, particularly if these organisms are already present on the site or adjacent to the site. Proliferation of invasive species could threaten the ecological function of your forest. All forest management operations should be planned and conducted in a manner that limits the introduction and spread of invasive species to protect these functions.
- Timber harvesting activities can impact cultural resources if not identified and protected (NOTE: Not all such resources require protection).

PLANNING AND DESIGN CONSIDERATIONS

- A comprehensive, detailed plan is a critical part of any successful harvesting operation. In addition to what, where and how, the plan should consider follow-up regeneration needs and specific measures designed to address other important forest resources.

Soil Productivity

- Identify areas with special soil conditions and topographic features that make them more sensitive to disturbance than others, and design operations accordingly to minimize any adverse impacts.
- Minimize soil impacts by limiting the soil area impacted by infrastructure (roads, landings and primary skid trails) and by careful consideration of timing, equipment being used, and harvesting methods. Planning considerations should include careful determination of appropriate operating seasons for any given soil, as well as using harvest layouts, strategies, and equipment that minimize the surface area of a site that is trafficked. As a general rule, no more than three percent of the harvest area should be occupied by permanent roads and landings that remove forestland from production. Roads, landings, and skid trails should not occupy more than 15 percent of the harvest area (see [3.4](#) and [4.3](#)).
- Employ appropriate timber harvesting strategies and practices to ensure harvest operations do not reduce the productive capacity of forest soils through removal of nutrients or disruptions of nutrient cycles. Harvests of small diameter biomass should adhere to the Biomass Harvest Guidelines (see the resources at the end of this chapter). Biomass harvests should not occur on soil types with low nutrient availability. Where applied, biomass harvests should leave a portion of the logging slash on site.

Water Quality and Wetlands

- Consider water quality concerns as harvest plans are developed:
 - Include provisions for water protection in the timber sale contract.
 - Avoid building landings, skid trails and roads in wetlands.

See Chapter 5: Riparian Areas and Wetlands and Chapter 12: Forest Road Construction and Maintenance, for general BMPs related to wetlands and planning.

BMPs: Planning and Design

- Limit the length and number of skid trails, landings and stream crossings, to the minimum necessary to conduct the harvest operation and to meet the landowners objectives.

Invasive Species

(For more information, see Chapter 8)

A comprehensive, detailed plan that considers invasive species is divided into two parts – property planning and activity planning. Property planning is intended to reduce the likelihood of invasive species introductions, mitigate the effect of invasive species that may arrive and manage species that are already present. Likewise, activity planning addresses practices that brings people and equipment into the forest, like timber harvesting. Skillful execution of routine timber harvesting activities can help minimize or even reduce the threat of invasive species (see [3.2](#), [4.5](#), and [5.2](#)).

- Consider guidance for timing of harvests to minimize the risk of introducing or spreading invasive insects and diseases.
- Consider guidance for treatment of conifer stumps to minimize the risk of introducing Annosum root rot.



Figure 13-2: Dame's rocket is a quickly spreading invasive plant that invades the edges and understories of woods. It is often mistaken for the native phlox, but is quite different in that it has four flower petals rather than five.

Visual Quality

Wisconsin forests are composed of a wide variety of species. Some occur as pure stands, while others occur in association with each other in complex communities. Each species has a unique set of silvical characteristics, which result in different silvicultural requirements (see Chapter 2: Generally Accepted Silvicultural Principles). As a result of these differences, each species presents a different aesthetic management challenge. In order to most effectively reduce the visual impact of harvesting, it is necessary to carefully evaluate the specific biological requirements of each species as

well as the physical and structural characteristics of the stands in which they occur. Elements that can be used to minimize or enhance visual impact must be identified and imaginatively employed. At the same time, alternative management strategies must be devised to overcome less favorable elements.

- When stands contain mixtures of short- and long-lived species, careful consideration should be given to the opportunities available to mitigate the visual impact of a harvest operation through retention of some portion of the long-lived species as individual trees or in scattered clumps.

SHORT-LIVED SPECIES

Aspen, Balsam Fir, Jack Pine, Paper Birch

MEDIUM-LIVED SPECIES

Hickory, Red Maple, Tamarack

LONG-LIVED SPECIES

Ash, Basswood, Beech, Cedar, Elm, Hemlock, Oak, Red Pine, Spruce, Sugar Maple, White Pine, Yellow Birch



Figure 13-3: In visually sensitive areas, thought should be given to retaining selected long-lived trees until the new stand is fully developed.



Figure 13-4: In this Jack pine clearcut, long-lived red pine trees were left in both clumps and as scattered individuals to minimize the visual impact of this harvest along a major recreational highway.



Figure 13-5: Residual trees were left in this clearcut as both “islands” and “fingers” to provide better wildlife cover and travel corridors.

- Tree selection criteria and residual density levels can be modified in more visually sensitive portions of a

particular stand to foster a more natural appearance and/or enhance visual diversity.

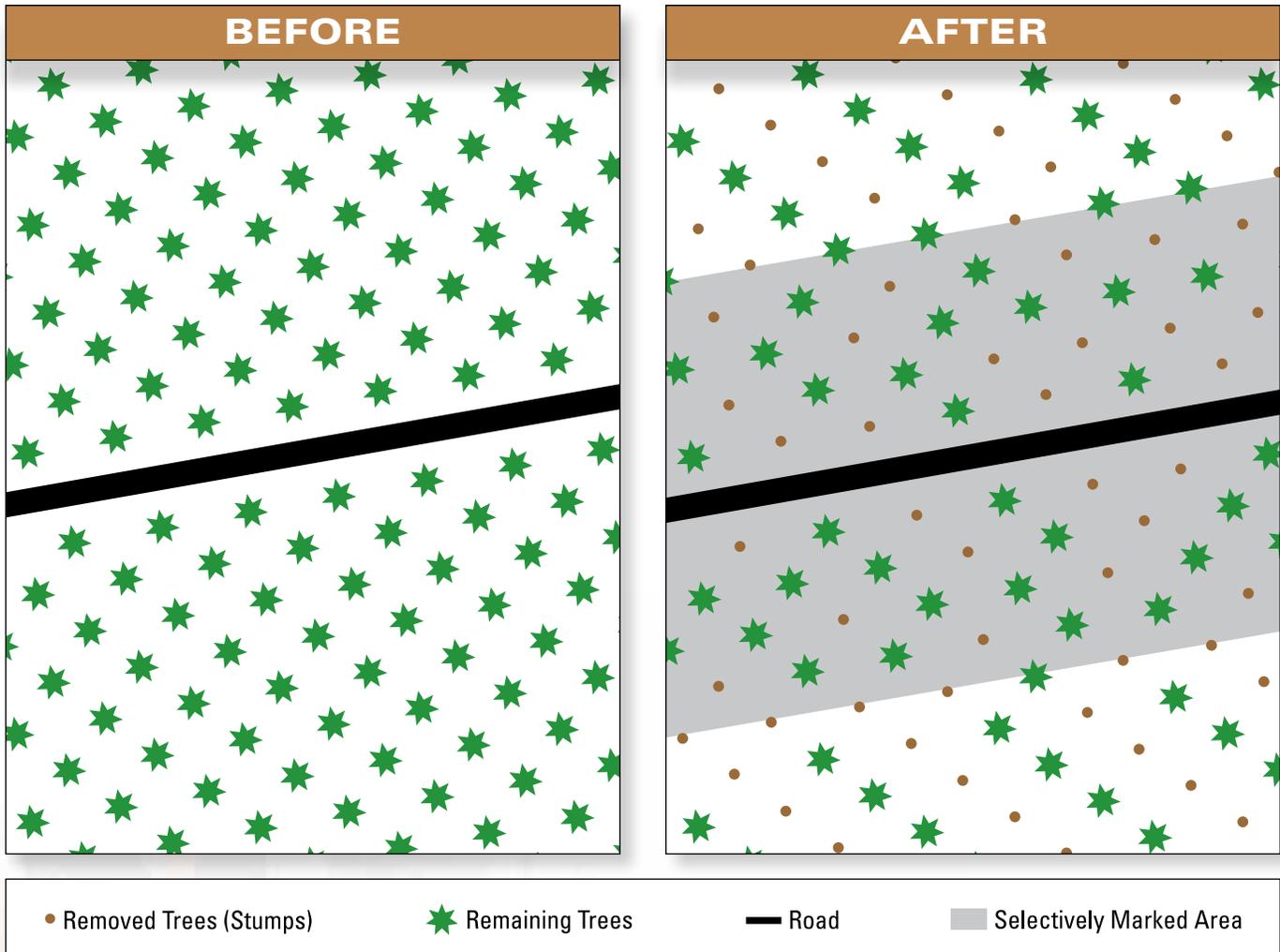


Figure 13-6: When plantations are established with the rows perpendicular to primary roadways, the appearance can be somewhat artificial. The first thinning in such plantations normally requires the removal of entire rows in order to allow harvesting machinery room to gain access, which creates an even more unnatural appearance. In this example, an area along the roadway was selectively thinned to create a more natural appearance. Harvesting entire rows in the remainder of the stand will make it possible to selectively thin the entire stand in subsequent thinnings.

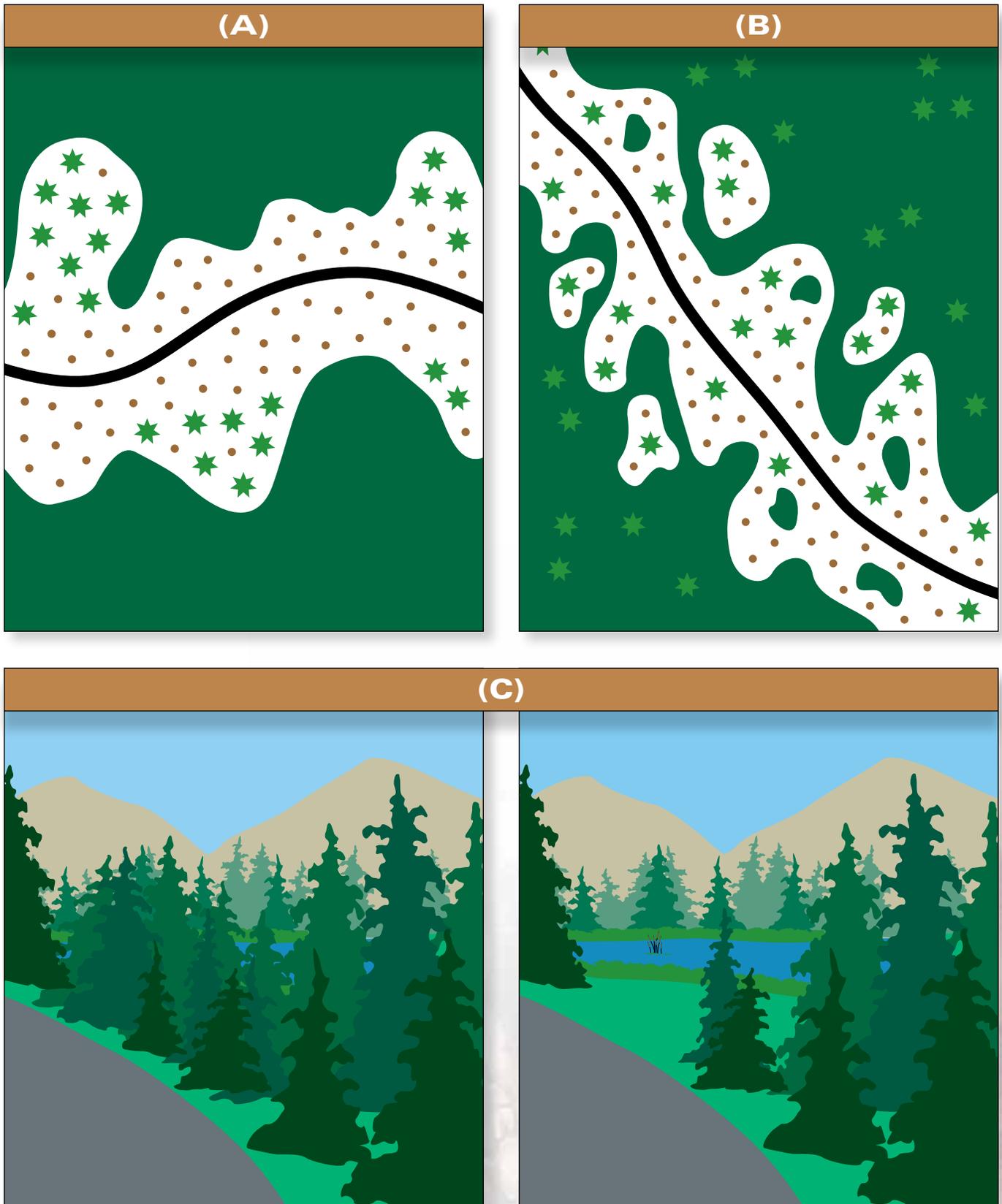


Figure 13-7: In the first of these examples, clumps of long-lived trees were retained along the roadside (A). In the second, individual trees were retained (B). In the third, a small vista was created through the judicious removal of selected trees (C). All of these treatments enhance visual diversity.

- As a stand of trees grows, it passes through a number of stages in its life cycle. Each of these stages presents differing degrees of aesthetic management value and flexibility. Harvesting strategies should reflect the positives and negatives of each.



Figure 13-8



Figure 13-10

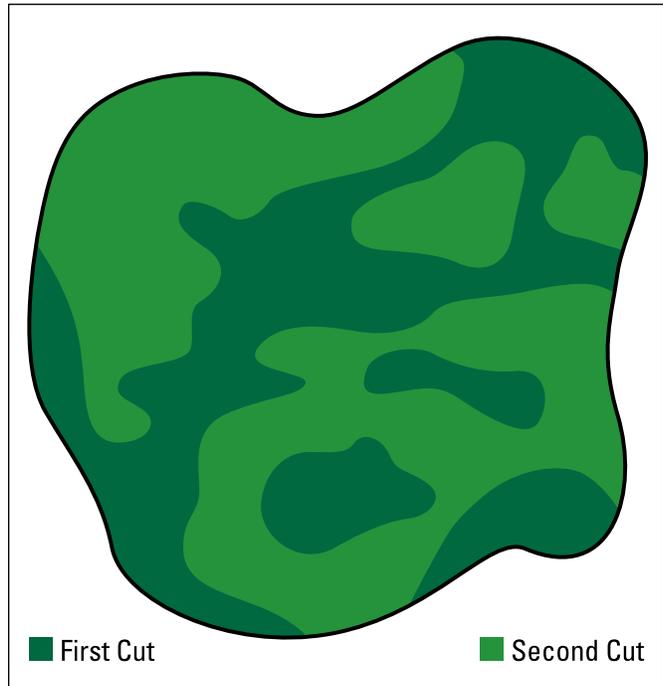


Figure 13-9: This stand of mature timber has been divided into two harvest areas to allow as much time as possible between harvests. Shape was used to reduce the visual impact. If this stand were younger, smaller blocks could be harvested separately over a longer period with a still greater reduction in visual impact.



Figure 13-11

Figures 13-8, 13-10 and 13-11: These aerial and ground photographs show a mosaic of stands with different species, age classes, densities and shapes. They were developed over many years to reduce the visual impact of future harvest operations in what was once a large monotype.

- The entire vegetative community occurring in a stand should be considered in the development of an aesthetic management plan – not just that portion being harvested. A well-developed understory can be used to great advantage in reducing the visual impact of a harvest operation.
- Use topography and other land features when possible to minimize the visual impact of harvest operations.



(WDNR Archive)

Figure 13-12: This even-aged, short-lived white birch stand occurs in a visual zone classified as “most sensitive.” Creative integration of the understory and topography into the harvest design would be crucial for protecting visual quality during a timber sale. Seasonal harvesting restrictions, logging methods, road systems, slash treatment, and follow-up site preparation are also important considerations that could have an effect on visual objectives.

- Use natural features and avoid artificial patterns where possible. These natural features may correspond to changes in topography, soils, wetland interfaces, and timber types.
- Use shape to address viewing duration and intensity when designing harvest boundaries in areas of high visual sensitivity.



(WDNR, Jeff Martin)

Figures 13-13: Stream corridors provide excellent opportunities for both visual screening and the protection of riparian areas. When used as a sale boundary, the need for stream crossings is also reduced.

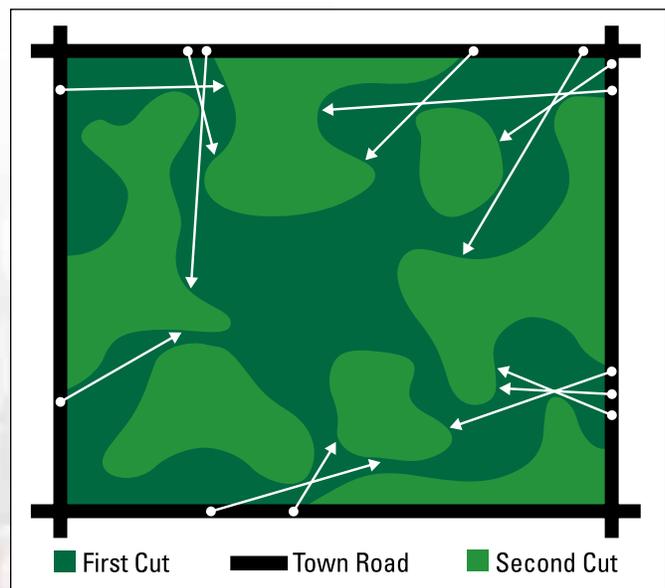
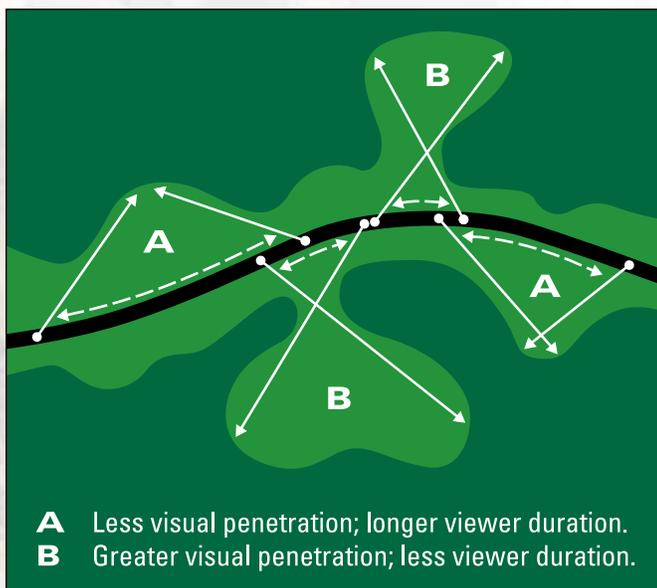


Figure 13-14: In these examples, the harvest area has been designed so that the longer a viewer can see an area (viewing duration), the shorter the distance they can see (visual penetration). The goal is to provide some visual diversity, while at the same time reducing the apparent size of the harvest area.

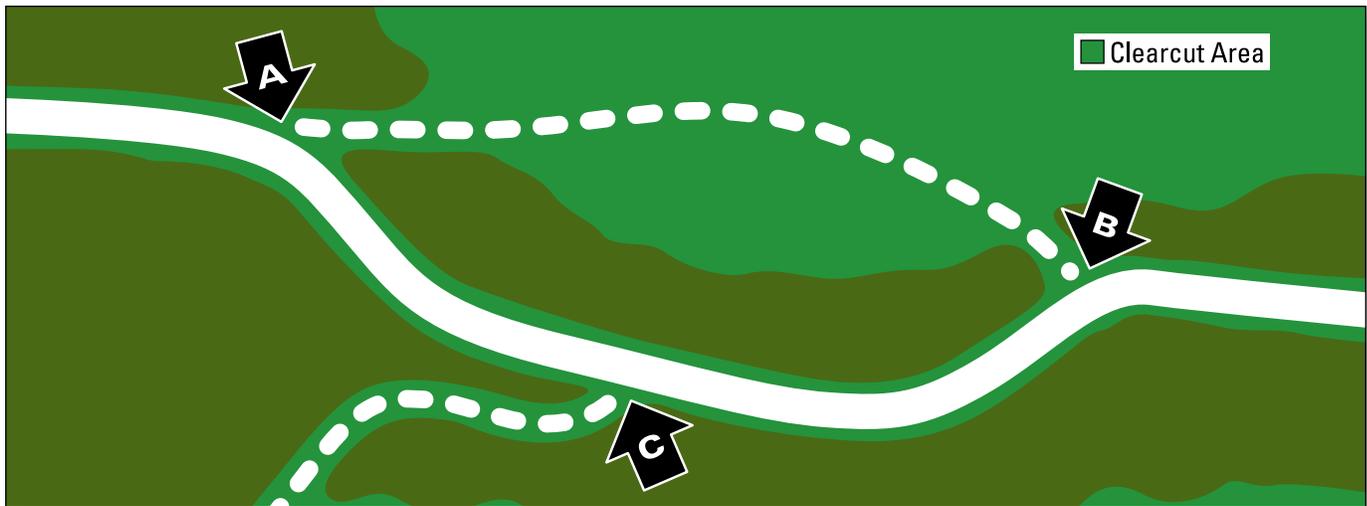


Figure 13-15: The logging road entrances at “A” and “B” permit excessive visual penetration directly into the harvest area. They also present a safety hazard by joining the main road on curves. A more preferred entrance location at “C” breaks the line of sight into the harvest area and also exits onto the main road at a 90° angle in a safe area.

- Road layouts should consider visual quality as well as timber management needs. A good road system should:
 - Minimize the number of exits onto sensitive roadways.
 - Facilitate re-entry of deferred harvest areas.
 - Be compatible with follow-up management operations (firebreak needs, tree planting, timber stand improvement, etc.).

Modifications of a timber harvest for aesthetic concerns should weigh operational considerations that would significantly impact logging efficiency. Aesthetic modifications increase the cost for foresters to establish a timber sale, and for loggers to harvest it.

Cultural Resources

- If practical and feasible, protect cultural resource areas by:
 - Excluding cultural resource areas from the timber sale area. No unauthorized soil disturbance of any kind is allowed in burial areas.
 - Keeping roads, skid trails and landings away from cultural resource areas.

Slash Management and Landings

- Slash near lakes and streams, and in wetlands is subject to special regulations.

- Slash is unavoidable when harvesting timber. Slash management plans should be developed prior to beginning the harvest, and also spelled out in the harvesting contract.
- Slash treatment has a definite cost.
- Slash falling onto the land of an adjoining landowner must be removed.
- Slash provides soil nutrients.
- Slash can provide shelter for wildlife.
 - If non-native invasive plants are present on a harvest site or have the potential to invade the site, their control may be hindered by the presence of slash. Consider treating the invasive plants prior to a harvest (see [4.2](#) and [4.3](#)).
- The size and number of landings are affected by silvicultural considerations, the logging system used, sale size, and timber sale design.
- Proximity of harvest to sensitive travel routes or use areas can affect placement of landings.
- Topography can limit both the placement and number of landings.
- Proposed use of a landing area (e.g., as a parking area along a recreational trail or as a wildlife opening) can affect the size and placement of a landing.



Figure 13-16: In this Jack pine clearcut, residual trees were left in both clumps and as scattered individuals to maintain good wildlife habitat and reduce the visual impact of the harvest.

Reserve Trees, Wildlife Trees, Coarse Woody Debris, and Snags

- Retain individual trees and/or groups of trees unharvested for reasons other than providing seed for regeneration of the stand (see Appendix A). Such reasons may include:
 - Provision of den and nest trees, food sources, cover, travel corridors, and special habitat needs for wildlife.
 - Reduce the unobstructed line of vision in clearcut areas, and provide additional diversity in future stands.
 - Retain selected high quality trees for additional growth and future harvest.
 - Reduce runoff and erosion in sensitive areas.
- Consider retaining coarse and fine woody debris for wildlife habitat purposes (see Chapter 3: Wildlife Habitat for more information).

- A number of operational considerations are necessary when planning for tree retention (see Reserve (Leave) Trees on page 13-7 for discussion).

Harvesting Implementation

- Minimize road building and facilitate efficient skidding of timber during sale design.
- Provide for the most efficient transport of wood from sale, anticipating haul routes to markets and ingress/egress points onto public roads, minimizing conflicts with Forestry BMPS for Water Quality.
- All considerations should be clearly communicated to potential timber sale bidders during the bidding process to insure all parties understand the limitations and expectations placed on the harvest and can evaluate the impacts on their operations and bid accordingly.

OPERATIONAL CONSIDERATIONS

- Conduct on-site meetings with the logger, landowner and resource manager prior to moving equipment onto a site. Such pre-sale meetings can help assure common understanding of landowner objectives, timber harvest specifications and site conditions.

Protecting Soil Productivity

- Identify soil or site conditions that may dictate specific timing, harvest methods or equipment to be used, or that may lead to weather-related or seasonal closure of the operation. These are important considerations for a logger and should be included when initially advertising a sale for harvest.

Protecting Water Quality

- Minimize stream, dry wash and wetland crossings. Use temporary crossings, such as portable bridges, timber mats, pole fords or ice bridges, if permanent access is not required to achieve forest management and landowner objectives. **IMPORTANT:** Such activity may require a permit from the Wisconsin DNR.
- Install stream and dry wash crossings at right angles to the water flow, where practicable.
- Incorporate water diversion devices where needed during timber harvesting activity. Divert surface flow before it enters landings or a water body. Incorporate water diversion devices during construction rather than as a remedial activity (see Chapter 12: Forest Road Construction and Maintenance).
- Identify lakes, streams, dry washes and wetlands prior to designating locations for new roads, skid trails and landings.
- Avoid crossing ephemeral ponds, harvesting in close proximity to and dropping slash or trees into ephemeral ponds (see Chapter 3: Wildlife Habitat and Biodiversity).
- To prevent rutting deeper than six inches on wetlands, shift harvest operations to a stable portion of the harvest area or alter operating techniques.

Alternative techniques include:

- Employing low ground pressure (LGP) equipment
 - Using slash on skid trails as a driving surface.
 - Minimizing the amount of off-trail equipment operation to reduce the area disturbed by heavy equipment.
 - Waiting for colder weather to freeze the site or enhance freezing of the site by packing snow and ground vegetation with LGP equipment.
- Harvesting during frozen ground conditions is often ideal to protect a site; however, loggers and the forest products industry cannot limit operation to only the two well-frozen months. Many sites can be suitable for all-season logging by following the appropriate Forestry BMPS for Water Quality.

BMPs: Protecting Sensitive Areas

When harvesting near lakes, streams, and wetlands, follow the applicable BMPs (see Chapter 5: Riparian Areas and Wetlands), in addition to the following BMPs.

- ◆ Avoid operating equipment where excessive soil compaction, rutting or channelized runoff may cause erosion that affects water quality. The use of low ground pressure (LGP) equipment may allow operations to continue.
- ◆ Whenever possible, winch logs from steep slopes, if conventional skidding could cause erosion that affects water quality.
- ◆ Inspect soil-stabilization practices periodically, during and immediately after, harvest operations to insure they are successful and remain functional. Follow BMPs in Chapter 12: Forest Road Construction and Maintenance.
- ◆ For winter harvesting, mark stream channels and existing culvert locations before snowfall.



(WDNR © Jeff Martin, JMAR Foto-Werks)

Figure 13-17: Conducting on-site meetings with a logger, landowner and resource manager prior to moving any equipment helps ensure a common understanding of contract specifications, timber harvesting regulations, landowner objectives, and site conditions.



(WDNR, Carmen Wagner)

Figure 13-18: Ephemeral ponds provide important wetland habitat for a number of important species, like the fairy shrimp, four-toed salamander, and wood frog.

Dry Washes

Dry washes are incised, often v-shaped, hillside gullies experiencing active erosion. Dry washes are common along the steep slopes of southwestern Wisconsin's Driftless Area and Lake Superior's coast. Occasionally, conditions may also lead to the development of dry washes in other parts of the state.

Found in steep, hilly landscapes, large amounts of sediment can be swiftly eroded from dry washes and deposited elsewhere. In southwest Wisconsin, they are commonly found in wooded slopes below agricultural fields, pastures and ditch culverts. Dry washes are not found in flat areas.

Dry washes only receive water flow as surface runoff from snowmelt and rainstorms. They receive little to no flow from springs or seeps. If springs or seeps are

present, it more likely a stream with associated aquatic plants and animals rather than a dry wash.

Dry washes are actively experiencing soil erosion. If the stability of the dry wash is compromised by equipment, this can lead to more erosion, causing the dry wash to widen, deepen, and progress further uphill (headcutting).

To differentiate dry washes from streams, ravines, valleys and other landforms, consider the following:

- Dry washes are not identified on topographical maps
- Dry washes have deeply cut, steep sides.
- Dry washes have bare, eroding soil.
- Dry washes show signs of active erosion by concentrated water flow.

BMPs: Dry Washes

The following BMPs apply within 35 feet of each side of dry washes. The goal is to allow landowners to harvest timber while preventing further erosion in the dry wash during forest management activities.

- ◆ Use selection harvests or patch clear-cuts within 35 feet of the dry wash to promote tree species appropriate to the site. No more than 50 percent of the area within 35 feet should be clear-cut.
- ◆ Avoid locating roads and landings within 35 feet of the dry wash unless necessary for crossings. To the extent possible, avoid crossing the dry wash with equipment during harvesting operations. For crossings, follow the recommendations in Chapter 12: Forest Road Construction and Maintenance.
- ◆ Operate wheeled or tracked equipment within 15 feet of the dry wash only when the ground is frozen or dry. Minimize equipment activity around head of the dry wash in order to prevent further uphill progression (head-cutting) of the dry wash.
- ◆ Do not harvest fine woody material within 15 feet of the dry wash. NOTE: This BMP may be modified for specific site conditions, for specific operational issues or to meet specific management objectives if water quality will not be impacted. Additional guidelines can be found in Wisconsin's Forestland Woody Biomass Harvesting Guidelines.
- ◆ Minimize soil exposure and compaction to protect ground vegetation and the duff layer.
- ◆ Avoid cabling logs across the dry wash, where feasible, to prevent damage to the bank of the dry wash.

Stabilizing dry washes often requires addressing runoff problems beyond the tops of dry washes. Many times the source of these problems is agricultural lands or roads, which is beyond the scope of this field manual. Your County Land Conservation Department may be able to provide some direction on what actions you may take to repair a dry wash.

Protecting Cultural Resources

- If harvesting will take place in the area of a cultural resource, employ measures to reduce soil disturbance, including (but not limited to) hand felling, limited-area feller buncher, low ground pressure (LGP) equipment, cut-to-length systems, and temporary protection such as slash, corduroy, tire mats, or fill over geotextile. Again, all burial sites are protected against unauthorized disturbance in any case.

Skid Trails

- Plan progressive harvesting techniques that avoid trafficking over pre-cut areas when possible.
- Design skid trail layout to minimize wounding of residual trees (see Wisconsin DNR *Silviculture Handbook*, 2431.5).

BMPs: Skid Trails

Skid trail restrictions in riparian management zones are described more in detail in Chapter 5: Riparian Areas and Wetlands.

- ◆ Where possible, keep skid trail grades less than 15 percent. Where steep grades are unavoidable, break the grade, install drainage structures, and use soil stabilization practices (as described in Chapter 12: Forest Road Construction and Maintenance) where needed to minimize runoff

and erosion. Grades greater than 15 percent should not exceed 300 feet in length.

- ◆ Use existing trails if they provide the best long-term access. Consider relocating existing trails if access can be improved and environmental impacts lessened.
- ◆ 5.1 To the extent practical, use existing skid trails to reduce disturbance.



Figure 13-19: A skid trail during active harvesting.

Landings

BMPs: Landings

- ◆ Locate landings on frozen ground or firm, well-drained soils with a slight slope, or on ground shaped to promote efficient drainage. Landings may need a crown shape to allow for drainage.
 - ◆ Use existing landings if possible. Close existing landings in riparian management zones unless construction of new landings will cause greater harm to water quality than using existing landings.
 - ◆ Locate residue piles (sawdust, field chipping residue, and other material) away from areas where runoff may wash residue into streams, lakes or wetlands.
- 🍃 5.1 To the extent practical, use existing skid trails to reduce disturbance.

REDUCING THE VISUAL IMPACTS OF LANDINGS

- When possible, avoid landings within view of travel routes or recreation areas. If it is not possible to avoid landings within these areas, screen landings from view as long as possible during logging.
- Keep the number of landings to a minimum, and plan them to access future sales.
- Seed, plant and regenerate landings promptly.
- Remove all products promptly when development of visible landings is necessary.
- Dispose of grubbed stumps and trees so they are not visible.
- Treat any slash at landings as soon as possible.
- Remove all trash upon completion of harvesting.

Minimizing Rutting

- Minimize rutting on primary skid trails, roads and landings, and avoid rutting in the general harvest area.
- If alternative operating techniques fail to eliminate rutting, stop harvesting operations.

BMP: Rutting

- ◆ Fill in ruts, apply seed and mulch, and install sediment control and drainage structures on skid trails and landings where needed to prevent erosion and sedimentation into surface waters (see Chapter 12: Forest Road Construction and Maintenance).

Managing Slash

- Favor practices that allow for dispersed slash on the site, rather than piling slash, where dispersed slash does not conflict with management objectives or reforestation. When piling slash, piles should be kept away from cultural resources.
- If moving slash on-site is desirable, use equipment that minimizes soil disturbance.
- Stump heights should not exceed the diameter of the stump.

REDUCING VISUAL IMPACTS OF SLASH

- Encourage maximum utilization of all felled trees in the harvest area.
- Minimize visual exposure to slash piles and windrows.
- Limit slash not screened from view to a reasonable height to avoid a negative visual effect.

BMP: Slash

- ◆ Do not dispose of or pile slash in areas where runoff may wash slash into lakes, streams, or wetlands.

Snags (Standing Dead Trees)

- Leave as many snags as possible standing in harvest areas, consistent with the exceptions outlined below.

Reserve (Leave) Trees

Two general options are recommended for retaining reserve trees (live trees left unharvested when a stand is rotated). Plans for retaining leave trees may utilize one or, when appropriate, they may use the two options in combination (see Chapter 3: Wildlife Habitat and Biodiversity and Appendix A for more information).

OPTION 1: CLUMPS, STRIPS OR ISLANDS

- Retain leave trees in clumps, strips or islands in each harvest unit. Benefits of clumping leave trees include:
 - Potential to meet multiple management objectives simultaneously.
 - Visual quality.
 - Equipment maneuverability.
 - Longevity and durability of leave trees.
 - Potential for greater biodiversity within clumps.
 - Easier application in larger harvest units.
 - Breakup of harvest area and reduction in apparent harvest size.
 - Better regeneration and growth of sun-loving species on the rest of the site.
 - Potential to provide nesting sites for some interior forest species when clumps exceed two acres.
 - Increased animal feeding efficiency and protection from predators.
- Clumps, islands or strips should:
 - Be distributed throughout a harvest unit.
 - Be adjacent to the RMZ for even-aged management.
 - Vary in size, with a minimum of one-tenth acre per clump.
 - Center around or coincide with such features as:
 - 1) Wetland inclusions and seasonal ponds
 - 2) One or more large (greater than 18 inches DBH) active den trees or cavity trees
 - 3) Mast trees
 - 4) Preferred tree species (such as large white pine), particularly large, vigorous individuals
 - 5) Raptor nests or rookeries
 - 6) Sensitive communities or sites

OPTION 2: SCATTERED INDIVIDUALS

- As an alternative or supplement to clumps, employ scattered individual leave trees, especially if they are larger, wind-firm specimens of preferred species. Scattered leave trees may be easier to apply to small or narrow harvest units than clumps. Use the guidelines outlined in Chapter 3 and Appendix A.
- During initial harvest entries of seed-tree or shelterwood cuts, select ultimate leave trees using the following guidelines:
 - Leave a variety of sizes and species of trees, along with the intended seed-/shelter trees, to be retained during the final harvest.
 - Plan for and protect integrity of reserve tree clumps in initial harvest entries.
 - Prevent damage to leave trees in initial and follow-up harvest entries.
- **Exceptions** to the previous leave tree and snag guidelines may be made for a number of reasons:
 - Operator safety (of loggers, aerial spray applicators, and others).
 - Public and contractor safety (hazard trees near right-of-way, recreation sites, roads, or airport vicinities).
 - Specific forest management applications (e.g., genetic considerations for seed reproduction systems).
 - Surrounding landscape concerns (e.g., adjacent sites to sharp-tailed grouse management units).
 - Forest insects and diseases (e.g., dwarf mistletoe on black spruce, Jack pine budworm, or gypsy moth).
 - Shallow-rooted trees with little wind resistance.
 - Excessive shade inhibiting forest regeneration.

For the most part, these potential problems can be avoided by intelligently designing the retention of reserve trees and considering their distribution and composition.

NOTE: Don't forget, during partial harvests such as thinnings and uneven-aged selection harvests, be sure that the remaining stand includes a minimum of three large mast trees and (potential) cavity trees per acre, as well as at least three snags per acre if available (see Chapter 3 and Appendix A for more information).

Providing Coarse Woody Debris

- Avoid having equipment disturb pre-existing large downed logs, stumps and uprooted stumps.
- If a snag must be dropped, leave it where it falls whenever possible.
- Create at least two to five bark-on downed logs greater than 12 inches in diameter per acre, if fewer than this number already exist. In choosing candidates for leave logs, consider the following:
 - Hollow butt sections or other defective lengths of at least six feet are preferred.
 - Sound logs and six to 12-inch diameter logs may be used if they represent the best available candidates.
 - Hardwood logs have more hollows or cavities, and are favored by certain amphibians.
 - Conifer logs decay more slowly, thus remain present as structure on a site longer than hardwoods.
 - Using pines as downed logs, especially in summer, increases the risk of bark beetle damage to adjacent healthy pines.
- Scatter leave logs across the site, including a few near wetlands.
- **Exceptions** to guidelines for providing coarse woody debris may be made for a number of reasons, including:
 - Alignment of skid trails
 - Specific silvicultural applications (e.g., insect pests)

Managing the Harvesting Process

Even the best harvesting design may fail for lack of vigorous, on-going, contract administration. Harvesting operations may extend over several months, and sometimes years. Problems need to be identified and dealt with early, before they become unmanageable. Efforts to minimize logging damage to the residual stand or to advance regeneration, the lopping and scattering of slash, the clean-up of road entrances, control of erosion, and many other activities need to be done concurrently with the cutting operation if they are to be most effective.

- The creation of “cutting zones” can be used to help administer large harvest areas. In this way, the cutting can be limited to only a specific portion of the harvest area until that “zone” is satisfactorily completed.
- A complete, accurate timber sale map (see Figure 13-24) is an extremely important tool for effective harvest administration. On complex cutting operations, it is absolutely essential. The map should be a part of the timber sale contract, and copies provided to everyone working on the job.

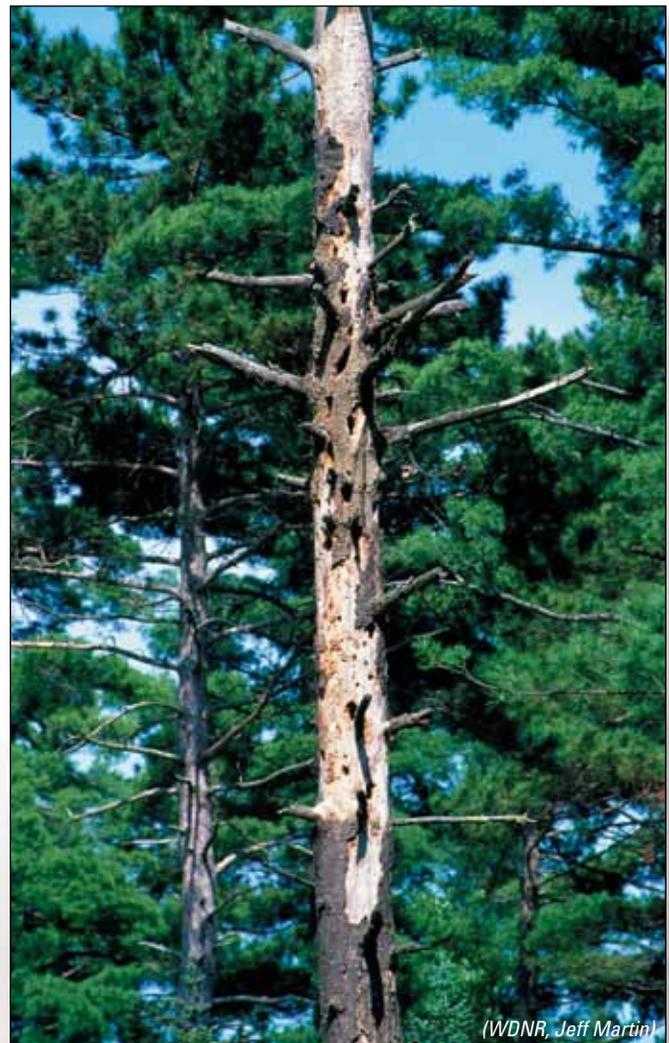


Figure 13-20: One harvesting option is to leave a minimum of three to nine scattered cavity/potential cavity trees, mast trees, or snags per acre to enhance wildlife habitat.

Understanding Harvesting Equipment and Harvesting Systems

COMMON TIMBER HARVESTING EQUIPMENT IN WISCONSIN

A basic understanding of the most common harvesting equipment and harvesting systems in Wisconsin can have a big impact on planning harvests in order to improve outcomes. For a landowner, knowledge of the capabilities and limitations of equipment can foster realistic expectations of what can and cannot be accomplished and what to expect once harvesting begins.

Timber harvests can be broken down into steps or processes which are common to all timber harvests. These steps are felling, processing the felled trees, extraction (moving felled trees from stump to landing or road) and hauling to market. Timber harvesting equipment is designed to accomplish one or more of these steps in the most efficient and safe manner. No one machine can accomplish all the steps, but instead a combination of equipment is used. This combination of equipment is called a harvesting system. The best combination of harvesting equipment for a specific harvest depends on the silvicultural objectives (thinning versus regeneration), soils, topography, size and quantity of timber to be harvested, and costs.

It should be noted that the quality of a harvest under any system can vary widely and is strongly related to the skill level of the equipment operator. Highly skilled operators can overcome many limitations of the equipment.

MACHINES IN GENERAL

Tracked machines are more stable on slopes than rubber-tired machines. Tracked machines typically cause less soil compaction and rutting than rubber-tired machines as weight is distributed over a larger area. Rubber-tired machines are faster and more maneuverable than tracked machines.

STEP 1: COMMON FELLING EQUIPMENT HAND FELLING

Hand felling refers to work done by hand with a chain saw.

Advantages:

- No limitations on soils or terrain.
- Few restrictions on size of timber to be harvested.
- Often used to process the trees in the woods or on the landing.
- Inexpensive equipment costs.
- Highly versatile.

Disadvantages:

- Exposes the operator to higher safety risks
- Lower production levels than mechanized felling
- Higher labor costs make it more difficult to be cost efficient in smaller timber.



Figure 13-21: Hand felling in Price County.



(WDNR, Dale Rochon)

Figure 13-22: A feller buncher in Douglas County.

FELLER BUNCHER

A tracked or wheeled machine that severs the tree from the stump and holds it while additional trees are severed and collected, and then lays them down in bunches. Often used in conjunction with grapple skidders (described later).

Advantages:

- Lower labor costs versus hand felling.
- Safer than hand felling.
- Efficiency allows harvesting of smaller timber.
- Can be less damaging to regeneration as trees are directionally felled in bunches, but skidding must be carefully planned.
- Used in conjunction with tree length skidding can facilitate biomass harvesting.

Disadvantages:

- Not well suited for steep slopes.
- Tree length skidding can result in potential for more damage to residual trees.
- Impacts on advanced regeneration can be greater.
- Requires processing in another step with additional equipment.

PROCESSORS

These are tracked or wheeled machines that sever a tree and then process the tree into products by feeding it through the processor head to limb the stem and then cut it into lengths suitable for market. Some machines even tally the amount of timber cut as it is fed through the machine. Most commonly used in conjunction with forwarders (described later).

Advantages:

- Lower labor costs.
- Trees are felled in a much safer environment than hand felling.
- Processors eliminate the need to process trees in another step with additional machinery.
- The direction and placement of felled trees can be controlled to minimize damage to those trees not being harvested.
- Can harvest smaller trees efficiently.
- Can place tops and limbs in front of the machine which it can drive over to help minimize rutting or compaction.
- Can reach into tight spots to thin out trees.

Disadvantages:

- High equipment costs.
- Limited ability to work on steep slopes.
- Some processor head types cause defect in saw logs.



(WDNR, Rich LaValley)

Figure 13-23: A processor in Iron County.



Figure 13-24: A cable skidder in Iron County.

STEP 2: COMMON EXTRACTION EQUIPMENT

Skidders are machines that lift one end of a tree or log and drag the tree from the site. The other end of the log skids along the ground hence the name. Skidders come in a range of types and sizes.

CABLE SKIDDERS

These machines use cables to winch trees to the skidder. The cable then suspends one end off the ground to reduce friction and drags the trees with the other end skidding on the ground to a landing.

Advantages:

- Because it winches tree to the machine it can pull trees up relatively steep slopes that other machines cannot reach.
- Lower costs relative to other machines.

Disadvantages:

- Higher labor costs because driver must get off the machine and pull cable to the trees to attach it to them.
- Higher exposure to safety concerns.
- The distance that the operator must pull cable can limit efficiency.
- Tree length skidding will increase site disturbance including damage to residual trees and advanced regeneration.
- Require additional product processing on landing.

GRAPPLE SKIDDERS

These types of skidders are used in conjunction with feller bunchers. Instead of using cables like cable skidders, these machines have a grapple or clam to grab and lift a number of trees and then drag them to a landing.

Advantages:

- Moves timber to landing more efficiently with less labor since the operator does not need to leave the machine.
- Can handle large and small timber efficiently.
- Can move trees and tops to a landing to facilitate biomass harvesting.

Disadvantages

- Cannot operate on as steep of slopes as cable skidders.
- Tree or log length skidding can cause more site impacts including damage to residual trees and advanced regeneration and soil compaction.



Figure 13-25: A grapple skidder in Waushara County.



Figure 13-26: A single bunk forwarder.

FORWARDERS

These machines pick up processed timber and carry it out to a landing where it is sorted for various markets. Because the wood is carried out instead of skid along the ground, the term forwarder is used.

Advantages:

- Because nothing is skidded they can have very low impacts on the site or remaining trees.
- Slash can be left in the forest or can be loaded and forwarded out.

Disadvantages:

- Higher center of gravity limits uses on steep slopes.
- Not well suited to long length forest products such as utility poles.

STEP 3: PROCESSING TREE TO PRODUCTS

If the trees are not processed into forest products in the woods they are brought to a landing (small clearing in the forest) where they are prepared for market. There are a few common pieces of equipment in Wisconsin that process trees on the landing.

CUT-OFF SAWS

One of the more common pieces of equipment in Wisconsin is a cut-off (slasher) saw. These machines are typically mounted on a truck frame with a loader boom to pick up and handle the trees that are dragged up to the machine. The loader places the log on a carriage where a large circular saw or chain saw bar cuts them to length. The tops are either dragged back into the forest or processed further into chips at the landing.

Disadvantages:

- Requires a fairly large landing to accommodate large amount of equipment, trees and processed products.
- Disposal of cut off pieces of wood should be planned for.

Advantages:

- Lower labor costs.
- Able to cut logs as well as pulp.
- With a self loader can sort various products for trucking.



Figure 13-27: A cut-off saw in Waushara County.



(WDNR, Dale Rochon)

Figure 13-28: A self-feeding chipper in Iron County.



(WDNR, Jeff Barkley)

Figure 13-29: A self-feeding tub grinder in Douglas County.

CHIPPERS AND GRINDERS

Whole tree chipping has been used in Wisconsin for a long time but with the increased interest in biomass harvesting the use of chippers is becoming even more common today. Harvesting operations can either chip the entire tree or cut out the higher valued logs, bolts, and pulp and then chip what remains. Chips are hauled to mills for paper, wood pellets or fuel. There are a wide variety of chippers and grinders used today in Wisconsin. Both process the timber into small pieces. Chippers produce a more uniform-sized chip. While grinders can tolerate a higher degree of dirt and other contaminants.

COMMON HARVESTING SYSTEMS IN WISCONSIN

CONVENTIONAL SYSTEMS

A chain saw is used to hand fell and limb and top the trees, then a cable skidder skids them to a landing where a chain saw is used to buck them into lengths.

This system is most widely used in areas with higher value timber and steep topography.

MECHANICAL SYSTEMS

The trees are felled by a feller buncher or processor and left tree length. Then a grapple skidder pulls groups of trees to a landing where they are processed into products by a cut off saw or chipped. This system requires larger landings to accommodate tree length storage, has higher equipment costs, and is capable of handling small diameter timber or low value timber efficiently. This system may have higher site disturbance and potential for soil compaction.

CUT TO LENGTH

Trees are felled, limbed and cut to length by a processor. Then a Forwarder picks up the products and forwards them to a landing and sorts them by product in preparation for trucking. This system does not require as extensive system of landings and improved skid trails compared to other systems, has potentially lower site impacts and has higher equipment costs than conventional systems.

The Timber Sale Contract

A timber sale contract is the most important document involved in the timber harvesting process.

A well-prepared contract, along with a timber sale map, ensures that all parties have a mutual understanding of the operational considerations previously discussed. This section describes and clarifies the Sample Timber Sale Contract included in Appendix B. The Wisconsin DNR, the Wisconsin Woodland Owners Association, and University of Wisconsin-Extension jointly developed it as part of the Forestry Facts series. The sample contract suggests key elements for inclusion in any private timber sale contract whether a landowner uses the one in the appendix or one from another source. The same concepts are also generally present in timber sale contracts on public land.

Five Steps to a Successful Timber Sale

Landowners are encouraged to hire a professional forester to help with any of these steps. *A Directory of Foresters* (PUB-FR-021) is available from the Wisconsin DNR. Useful information can also be found in the University of Wisconsin-Extension Forestry Fact #75: Hiring a Consulting Forester.

STEP 1: Prepare a written forest management plan that addresses your personal objectives and the desired future condition of the woodland. The plan should explain harvesting techniques, and any follow-up work that may be needed to achieve the preferred results.

STEP 2: Develop a harvest plan that describes the practices, locations, and expectations for the harvest. This document should include a map of the harvest site.

STEP 3: Develop a comprehensive, written timber sale contract* that will be available as part of your timber sale advertisement.

STEP 4: Get competitive bids to help secure a fair offer and to find a skilled, careful logger that is experienced with your type of sale.

STEP 5: Check references and the performance history of both the consulting forester (if you plan to hire one) and the timber producer (logging contractor) you are considering for your timber harvest. The Wisconsin Department of Agriculture and Consumer Protection (DATCP) has a Consumer Protection Hotline at **1-800-422-7128** that you can call to check for past complaints. The Great Lakes Timber Professionals Association (GLTPA) maintains records of training completed by logging contractors and also maintains lists of contractors who have attained Master Logger status. Master Logger's operations are periodically audited independently to a high standard. If the forester you select is expected to scale or grade the cut products, make sure that he/she is qualified to perform the work.

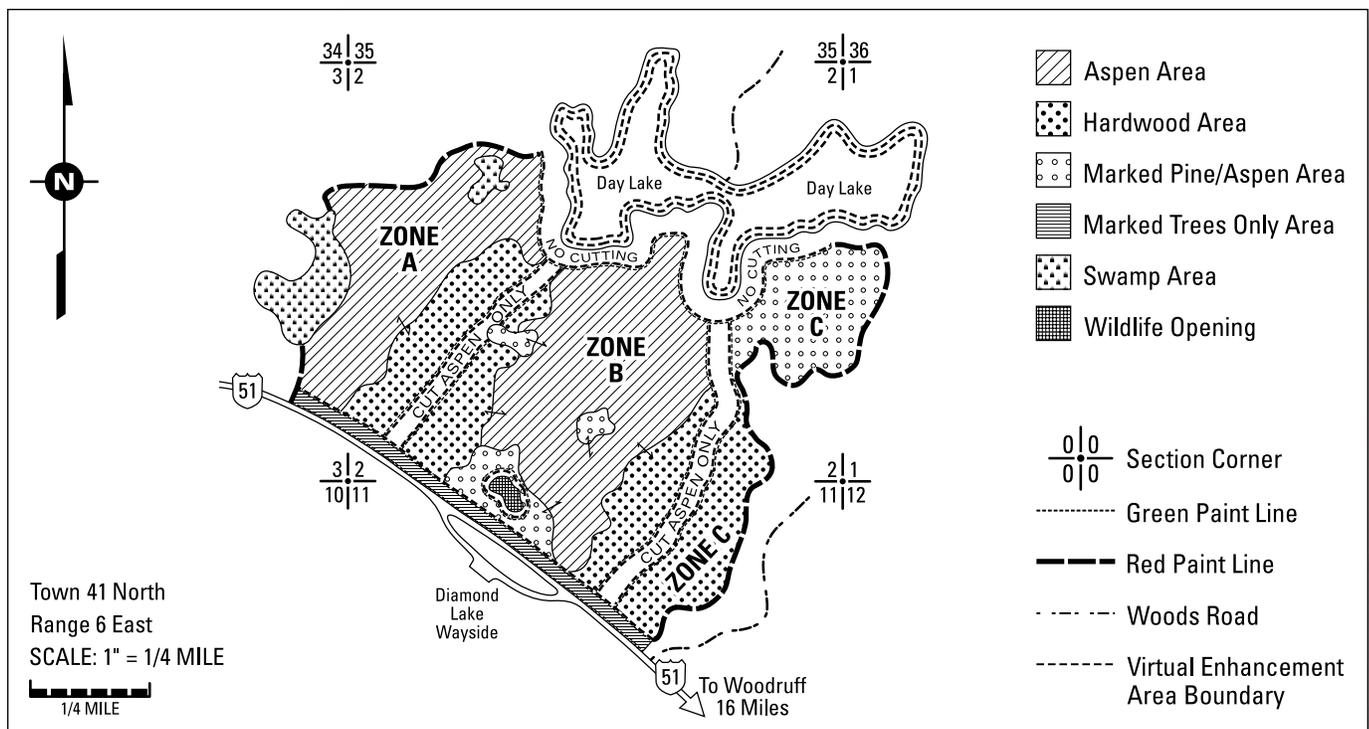


Figure 13-30: A timber sale map should be clear, concise, and contain all the information a logger needs to determine what needs to be done and where. Boundary line locations, other ownerships, paint line colors, cutting specifications, cutting zones (if any), and any other pertinent information, should be completely spelled out.

* A sample timber sale contract may also be downloaded in digital format from the following web site: <http://dnr.wi.gov/forestry/publications/pdf/FR-202.pdf>

Understanding the Sample Timber Sale Contract

The Sample Timber Sale Contract explained in this section contains a number of options. You will need to select the provisions and language that are appropriate for your harvest. The list of contract provisions is not meant to be exhaustive or necessarily applicable to every situation. You may choose to add or delete (by striking out) provisions. Landowners are encouraged to work with an attorney and professional forester in drafting a timber sale contract. Timber sale contracts usually include provisions that outline who, what, where, when, and how a timber sale will occur. Contracts will also spell out remedies in the event of a dispute. More stringent contracts may result in fewer bidders and, potentially, lower bids. Less restrictive contracts provide for less control. The section titles and provision numbers in the following explanations correspond to the section titles and paragraph numbers in the Sample Timber Sale Contract in Appendix B. Some sections are self-explanatory and contain less information.

Contract Breach: A Very Serious Decision

Deciding that the Purchaser has breached a timber sale contract should not be made lightly or over trivial matters. Contract breach is a very serious step that can have ramifications for you and the Purchaser well beyond this one event. Reputation is critical to a timber harvester's livelihood and to your ability to sell or resell your timber. You may also be sued – it is that important. Breach should truly be the final straw. Intermediate steps might include visiting with the Purchaser to hash out differences, having a third party intervene, or shutting the sale down temporarily.

What is Reasonable?

Throughout the Sample Timber Sale Contract, there are references to actions being “reasonable.” In legal terms, reasonable means fair, proper, just, moderate, and suitable under the circumstances. The basic question to ask is: Would an outside observer familiar with harvesting practices feel the action was adequate and satisfactory?

If you have never harvested timber before or visited a logging site, it is important that you learn about and understand normal logging practices and their impact. Either visit logging sites or hire a consultant forester to help you determine if your expectations of post-harvest conditions are “reasonable.”

PROVISIONS 1

Contracting Parties. Beyond the actual Purchaser(s) and Seller(s) named in the contract, other individuals may be able to act in their place. For the Seller, this could be a partner in an LLP or one's heir. Of particular note is 1.c., which requires that the Seller to provide written approval of subcontracting.

PROVISIONS 2-3

Entire Contract. This section defines what documents comprise the entire contract (to include a harvest site map). It also outlines what constitutes a legal amendment to the contract.

PROVISIONS 4-7

Contract performance, period, extensions, and termination. Beginning and ending dates of the contract are established. The phrase “FOR TIME IS OF THE ESSENCE” demands reasonable diligence and completion within the period of the contract. Delays should only be authorized for reasons beyond the control of the Purchaser. This is essential to achieve your management objectives. Some provisions give you the flexibility to protect the land should unanticipated events or conditions occur. The Purchaser's authority to go on your land and conduct operations is through the contract.

PROVISIONS 8-11

Down payment, bond, remedies and damages. Down payments are earnest money, and are not performance bonds. Performance bonds assure that costs incurred due to breach can be recovered from the bond, rather than going to court or otherwise recovering costs from the Purchaser. A performance bond may take the form of cash, a check, letter of credit, or escrow account. Be aware that many Purchasers may not agree to provide a performance bond unless it is to be held by a consulting forester or an objective third party such as an escrow agent. The Seller's remedies in the event of a breach are not just limited to routine contract damages. Other penalties or remedies may be pursued if the Seller so chooses.

PROVISIONS 12-14

Products to be removed. Specifications for how trees are marked or designated for harvesting are explained (for example, "trees marked with orange paint," or "all trees within a red marked boundary"). Be certain that your property boundaries are well marked and/or designated, and understood by the Purchaser. If the boundary has not been formally surveyed, you should meet with the adjoining landowners to agree on the location of the property boundary. The Seller retains sole control over the timber and other wood products (e.g., woody biomass) until payment is made. Timber cannot be removed from the property until paid for or payment has been arranged.

PROVISIONS 15-21

Sale type, scaling, hauling, and payments. There are many ways to sell timber. Each affects at what point ownership of cut products moves from the Seller to the Purchaser and who reaps the benefit of product sort and grade. This section defines under what conditions cut products may be removed from the property, how and by whom the cut products are to be measured, and when the Seller receives payment.

Scaling procedures include on-site and mill scales. The Seller should be aware that while some mills are willing to send mill slips to the Seller, others are not.

Prior to signing the contract, seek the advice of a tax specialist to determine whether income may be treated as a capital gain or regular income. Spreading the payment over two years may minimize your tax liability in any single year.

The Timber Products Table (#17) summarizes the type and volume of timber expected from the harvest and the price the Purchaser agrees to pay by unit. This information is important in all sales, even lump sum sales where the price per unit information can be used for damages or contract adjustments, if necessary.

In some cases, the term, *mixed hardwoods*, is used to describe products to be removed. Mixed hardwoods are small quantities of hardwood tree species of low relative value or not in sufficient quantity to be marketed in separate species categories. High-value species or products should be identified separately, even if the volume is small. In general, the use of mixed hardwoods should be restricted to pulp and/or woody biomass.

In some cases (e.g., woody biomass), wood fiber may be sold by weight or by cord. These situations may require conversions between volume and weight measures. Specifying the conversion factors in the contract is recommended.

PROVISIONS 22-34

Utilization and operations. Detail any timber and site protection measures here. Be specific about erosion control, weather, invasive disease and insect prevention, non-native invasive plants, timing, equipment use (such as width or size limitations, use of a forwarder rather than a skidder, horses, etc.), operations during hunting seasons or other constraints you or your foresters consider necessary.

Wisconsin has Best Management Practices (BMPs) to protect water quality and reduce the spread of invasive species. The State has also developed guidelines for the harvesting of woody biomass. If there are critical BMP needs or you want the Purchasers to comply with the biomass guidelines, you should list those, being as precise as possible.

(Continued on page 13-27.)

(Continued from page 13-26.)

Include consideration for archeological sites or endangered and threatened species (e.g., Natural Heritage Index listed species) where appropriate or required by law. Be aware that some requirements may affect the price that the Purchaser can afford to offer for the timber.

PROVISIONS 34-38

Notice of intent to cut and compliance with laws.

Specify the party responsible for filing cutting notices and reports with the county clerk and the Wisconsin DNR. County cutting notices must be filed 14 days before cutting starts and renewed on January 1 of each year.

If the land is enrolled in the Managed Forest Law (MFL) or Forest Crop Law (FCL) the Wisconsin DNR notice must be filed at least 30 days before cutting begins and a report of volumes cut must be filed within one year or when cutting is completed depending on the program. The landowner will be responsible for paying a MFL yield tax or FCL severance tax on the timber cut. Regardless of contract provisions, state statutes hold landowners liable for penalties related to non-compliance with MFL and FCL cutting notice and reporting requirements.

PROVISIONS 39-41

Title, boundary lines, and access. These clauses outline three important duties of you as the Seller.

1. You assure that you have the authority to sell the timber and will defend that right in court if necessary. A mortgage or land contract may require that the seller seek permission of creditors before selling. Where there are multiple owners, all should consent. Tax program participants should ensure that the harvest is consistent with the approved forest management plan and that all required notices are submitted.
2. You will mark the boundary of the timber sale prior to harvest.
3. You will acquire written permission to cross a neighbor's land, if necessary.

PROVISION 42-48

Liability and insurance. These provisions protect the Seller from liability arising from the Purchaser's harvesting operation. The Purchaser is required to show proof of workers' compensation and public liability insurance. Be aware that a logger's liability insurance does not normally include damages caused by fire or timber trespass unless purchased as an option.

PROVISION 49

Training. Loggers can access training opportunities related to safety, forest management, and various BMPs and guidelines. If you expect them to have certain training, check and document that the Purchaser and the timber operators working on the site have completed the pertinent training programs.

PROVISIONS 50-52

Forest certification. If the land is certified (e.g., American Tree Farm Program, Forest Stewardship Council, etc.), additional contract language will be necessary. Sellers should provide Purchasers with certificate number(s), which you can find either on your certification documents or from the organization that certified your land. Timber from certified and noncertified land should be divided into separate timber sale contracts or otherwise clearly delineated to avoid mixing.

PROVISION 53

Contact information. This exchange of information between the Purchaser and Seller will ensure that both parties can contact each other easily. If you are using a Seller's agent (e.g., consulting forester), you'll want to provide his or her contact information, too.

POST-OPERATIONAL CONSIDERATIONS

- Evaluate the harvesting operation, and plan future adaptations at post-harvest conferences with the logger and landowner.
- Plan for removal of equipment and cut material from wetland areas at the end of the winter season prior to thawing.
- Avoid removing soil from the general harvest area to rehabilitate roads, landings and skid trails. Use already disturbed soil, if needed, rather than disturbing additional soil.
- Inspect and maintain any soil stabilization practices installed. Rehabilitate landings and skid trails when necessary to mitigate soil compaction and help to reduce erosion.
- Monitor the sale area and access routes for non-native invasive plants, and take the necessary steps to control any species that may have been introduced through harvesting activities (see 🍃 6.5).
- Evaluate the adequacy of advance regeneration, and/or the need for reforestation.
- Conduct additional site preparation work, as needed, to ensure successful regeneration.



Figure 13-31: A forwarder offloads pulpwood at a woods landing. Forest management objectives may influence your equipment choice. Forwarders carry wood, thus causing little soil disturbance. Skidders scarify the soil by dragging trees or logs – a plus for natural regeneration where erosion is not a problem.

Revised 2011

BMPs: Invasive Species

The following are Forestry BMPs for Invasive Species (IS-BMPs) that should be considered when planning and conducting timber harvests.

- 🍃 3.2 Prior to implementing management activities, scout for and locate invasive species infestations, consistent with the scale and intensity of operations.
- 🍃 3.4 Plan management activities to limit the potential for the introduction and spread of invasive species.
- 🍃 4.2 If pre- or post-activity control treatments are planned, ensure that they are applied within the appropriate time window.
- 🍃 4.3 Consider the likely response of invasive species or target species when prescribing activities that result in soil disturbance or increased sunlight.
- 🍃 4.5 Take steps to minimize the movement of invasive plants, insects, and diseases to non-infested areas, during forest stewardship activities.
- 🍃 5.1 To the extent practical, use existing roads, skid trails, and landings to reduce disturbance.
- 🍃 5.2 Avoid constructing new roads, skid trails, and landings in areas infested with invasive species where possible.
- 🍃 6.5 Plan for post-planting management of invasive species.

