Biomass Harvesting on Forest Management Sites in Minnesota

Prepared by

The Minnesota Forest Resources Council
Biomass Harvesting Guideline Development Committee

Approved by

The Minnesota Forest Resources Council
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Note: These forest biomass harvesting guidelines were developed as an additional chapter in *"Sustaining Minnesota Forest Resources; Voluntary Site-Level Forest Management Guidelines"* (SLFMGs). Full understanding of these biomass guidelines is dependent upon references to the General Guidelines, Timber Harvesting, and Forest Roads chapters within the SLFMGs.

Forest Woody Biomass Harvesting

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Introduction

Interest in biomass energy in Minnesota has increased recently driven by higher energy prices and state-supported incentives to produce renewable energy. While a variety of wood-fired energy facilities have been in operation in the state for quite some time, recent expansion of the energy industry has raised concerns about the impact of increased removal of biomass from the state's forests. Projects such as the Laurentian Energy Authority municipal energy project on the Iron Range and the installation of a wood gasifier at the Central Minnesota Ethanol Cooperative in Little Falls are examples of new capacity in the renewable fuels industry. While there are numerous benefits of biomass energy such as providing jobs locally and reducing use of fossil fuels, increasing removal of biomass from forested sites has the potential to impact long-term site productivity, biodiversity, and wildlife populations.

In response to these concerns, the Minnesota State Legislature, as part of legislation on energy production from woody biomass, required the Minnesota Forest Resources Council (MFRC) and the Minnesota Department of Natural Resources (DNR) to develop guidelines or best management practices for "sustainably managed woody biomass" (MN Statute 216B.2424). The legislation specifically states that "*Guidelines …must be adopted....for logging slash, using the most recent available scientific information regarding the removal of woody biomass from forest lands, to sustain the management of forest resources as defined by section 89.001, subdivisions 8 and 9, with particular attention to soil productivity, biological diversity as defined by section 89A.01, subdivsion3, and wildlife habitat. "*
Biodiversity is defined in section 89A.01, subdivsion3 *as "the variety and abundance of species, their genetic composition, and the communities and landscapes in which they occur, including the ecological structures, functions, and processes occurring at all of these levels."*

For the purposes of these guidelines biomass harvesting includes the process of collecting and removing woody biomass from forested sites. In addition to the utilization of tops and limbs from trees harvested in a roundwood operation, biomass harvest might include the utilization of small diameter trees, or stems which have historically been "non-merchantable", dead trees, down and dead woody material, and brush. Biomass harvest removes more woody material from a site than would be removed under typical roundwood harvest. Often biomass harvesting is conducted in addition to roundwood harvesting on the same site, either in conjunction with the roundwood harvest or soon after. However, biomass harvest is also conducted on sites where a roundwood harvest is not occurring.

Rationale

Wildlife and Biodiversity

A general premise of forestry that considers wildlife and biodiversity is that silvicultural practices more closely resemble relevant natural disturbance regimes and natural stand development. Furthermore, there is a greater opportunity for sustaining biodiversity when the disparity between managed stands and their natural analogs is reduced.

Biological legacies (defined in glossary) are central to development of silvicultural systems that emulate natural models. Creating and leaving biological legacies maintains critical structural elements of managed stands, thereby sustaining many organisms and ecological processes dependent upon these structures (Franklin *et al*., 1997, 2000).

Natural disturbances rarely eliminate all structural elements from the preceding stand, even in the case of extreme or multiple disturbances (Franklin *et al*., 1995, 2002; Foster *et al*., 1997). The lack of significant biological legacies is a major difference between traditional even-aged harvesting methods and natural stand replacement disturbances, whether by fire, wind or insects (Lee and Crites 1999). Most prominent among the legacies lacking from harvested stands is remnant live trees, abundant snags, and down boles (with associated pit-and-mound topography) (Franklin *et al*. 1995). Many roundwood harvesting strategies involve the removal of most large trees from a site, but natural disturbance, even fire, does not. Therefore, recent forest management guidelines, including the MFRC Site-level Forest Management Guidelines, include recommendations to maintain minimum amounts of snags and down logs. Biomass harvesting following roundwood harvest increases the disparity between managed stands and their natural analogs by removing additional coarse woody debris (CWD) as well as slash; thus further challenging natural resource managers to manage sustainably.

These biomass harvesting guidelines in conjunction with existing forest management guidelines attempt to incorporate natural disturbance patterns and processes into any harvesting scheme. This can be accomplished by maintaining biological legacies through leave tree clumps, and maintaining structural complexity throughout the harvest area by retaining a level of snags, down CWD, and slash (or fine woody debris).

Role of Woody Debris in Maintaining Forest Biodiversity with Special Reference to Slash Harvests

There is an abundance of literature that shows the importance of standing and down CWD in providing habitat for vertebrate species. However, small life forms related to fine woody debris (FWD), particularly fungi, lichens, bryophytes, and arthropods, which are central to the health and productivity of forest ecosystems (Crow 1988; 1990), have not been as well studied. Woody debris, both CWD and FWD, provides habitat for many of these species (Samuelsson et al. 1994). Those relatively few studies of the importance of woody debris for invertebrates often reveal an immense diversity of species that require woody debris. For example, one three-year study in the Canadian boreal forest reported that 257 taxa (mostly species) of saproxylic beetles utilized decaying aspen logs

(Hammond et al. 2004). However, few studies have quantified amounts of woody debris needed to maintain specific populations, much less whole communities.

Harvest of slash and other woody debris for biomass as part of or following timber harvest decreases the amount of decaying wood on the forest landscapes and changes the chemical and physical environment in clear-cuts (Astrom et al. 2005). Astrom also reported that slash harvests in Sweden significantly reduced the species richness of liverworts with one third of the species disappearing (but didn't affect the species richness of vascular plants) (Astrom et al. 2005). In Finland where biomass removals have occurred for a longer time, recommendations are to retain 30% of harvest residue in stands to help maintain biodiversity.

In clear-cuts, slash or FWD

- provides shelter, reducing wind velocity and fluctuations in ground surface temperature (Mahendrappa and Kingston 1994; Proe et al. 1994)
- provides habitat for small mammals (Eckeet al. 2002) and ground-active beetles (Gunnarsson et al. 2004)
- may shelter plants sensitive to desiccation, immediately following clearcuts (cf. McInnis and Roberts 1994; Brakenhielm and Liu 1998).

The development of a market for woody biomass means that much of coarse woody debris and slash (or fine woody debris) that would have remained on site following timber harvest for roundwood is likely to be removed. Although a certain amount of woody debris retention is essential for sustaining biodiversity and wildlife populations, science does not tell us how much woody debris can be sustainably removed from forest harvest sites. The science is clear, however, that natural disturbances create and retain considerably more woody debris than commercial timber harvest and that this difference is increased by woody biomass harvest. These guidelines provide a best scientific judgment, tempered by the consensus process of a broad group of forest management interests, of practices that will sustain a high level of biodiversity.

Water Quality

The existing Site-Level Forest Management guidelines focus on retaining water quality by avoiding sediment and nutrient movement into wetlands and waterbodies through the use of filter strips and water diversion practices. Current guidelines also focus on minimizing impacts to wetland form and function by avoiding direct damage to wetlands due to trafficking, drainage or filling.

However, re-entry into sites increases the potential for sediment movement into wetlands through disturbance of erosion control features and rehabilitated infrastructure. Re-entry into sites for the purpose of recovering biomass is not covered in the current guidelines. Nor is removal of stand components such as small diameter trees, CWD, and brush, within filter strips addressed in the current guidelines. Increased biomass harvest activity in filter strips increases the potential of filter strip disturbance. Consideration must be given to how much non-merchantable and residual coarse woody debris material should be harvested or retained in filter strips.

Riparian Management Zones (RMZs)

RMZ guidelines in the current Site-Level Forest Management guidelines deal with most issues related to harvest of biomass in or near RMZs. However, they do not specifically address removal or disturbance of brush, small trees, or CWD in RMZs. Current guidelines use residual basal area (BA) as a measure of how much roundwood should be retained in RMZs.

Issues related to biodiversity mentioned in previous sections have particular relevance to management within riparian zones. Current Site-Level Forest Management guidelines allow for harvesting of some trees in RMZs and it seems reasonable to utilize the tops and limbs of these harvested trees. However, removal of additional biomass must be balanced with the protection of biodiversity in these special management zones.

Soil Productivity

These guidelines are designed to maintain the productive capacity of forest soils in Minnesota during biomass harvesting activities. A decrease in soil productivity could affect the level of timber harvesting (including biomass harvesting) the forest can sustain, as well as other forest values, such as wildlife habitat and biodiversity. Identifying and reducing impacts to this resource should be an essential part of any strategy to achieve sustainable forest management.

In *most* cases evidence suggests biomass harvesting will not create additional or increased physical impacts to soil productivity as compared to conventional forest harvesting if the current site-level guidelines are followed. Where biomass harvesting may create an increased impact compared to conventional forest harvesting, is with respect to nutrient removals. Removing more biomass from a site inevitably removes more nutrients. However, even in the case of biomass harvesting where more nutrients are removed than in conventional forest harvesting, new research resulting in updated nutrient budgets and the results of long-term studies indicate that for most mineral soils in Minnesota the nutrient capital is sufficient to tolerate a large number of such harvest rotations without deleterious effects (Grigal, 2004). On deep organic soils (ombrotrophic sites), however, potassium and phosphorus depletion may occur if aggressive biomass removal is practiced over multiple rotations. Very shallow to bedrock mineral soils are also susceptible to nutrient loss. Based on current available information and technology, the guidelines outlined in the following pages will protect the nutrient capital of the average forested site in Minnesota.

The current MFRC Site-Level Forest Management Guidelines with respect to nutrient depletion were developed using information in the Minnesota's Generic Environmental Impact Statement on Timber Harvesting and Forest Management (GEIS). The portion of the GEIS dealing with soils was completed in 1992, and the nutrient budgets in the report were based on state-of-the-science information available at that time (Grigal and Bates 1992). Over a decade has passed since the GEIS was published, and an update of the nutrient portion of the GEIS was recently completed (Grigal 2004) based on research that has been published since 1992.

The update revisited the assumptions that were used in the original GEIS and modified

them based on current knowledge. Major changes included (a) slightly modifying the magnitude of atmospheric inputs, (b) reducing the magnitude of nutrient inputs by weathering (by 2 to 3 times), (c) adding inputs via groundwater flow to organic soils (peatlands), (d) eliminating leaching of nutrients to groundwater during the normal silvicultural rotation, (e) increasing the estimated removal of nutrients associated with merchantable bole harvesting and reducing the removal associated with whole tree-harvesting, (f) increasing nutrient capital for mineral soils by assuming uniform nutrient availability to 40 inches depth and by calculating release of nutrients from soil organic matter over 10 years rather than over one year, and (g) altering nutrient capital for organic soils and forest floor by calculating release of nutrients from organic matter over 10 years.

Specifically with respect to biomass harvesting, the update assumed that 100% of the logging residue would not be removed following conventional harvest. The material that remains would primarily be high-nutrient small branches and leaves. On the average, about 25% of the above-ground nutrients in the pre-harvest stand would be retained following residue removal, compared to about 40% retained following conventional harvest. Future technology however, may make it possible to remove much more of the woody material from sites, along with the nutrients associated with that material. For example, Fig. 1 qualitatively compares the increasing removal of biomass and nutrients with the natural nutrient inputs estimated to occur over a rotation. Data are for harvest from the aspen-birch cover type, 50-year rotation, 20 cords per acre yield, on an average Minnesota forest soil. As biomass removal increases, natural inputs are no longer sufficient to replace nutrients that have been removed, and depletion of the nutrient capital of the site will occur.

Because the nutrient capital of an average Minnesota forest soil is about 20 times that removed under the G scenario, even that extreme scenario would be unlikely to affect site productivity over multiple rotations. If the frequency of biomass harvest increases (decreased rotation age) accumulation of natural inputs between harvests will be less. For example, natural inputs over a 25-year period will be roughly half of natural inputs over a 50-year period. Depending on the amount of woody material being removed, likelihood for impacts to site productivity over multiple rotations will increase with decreased rotation ages.

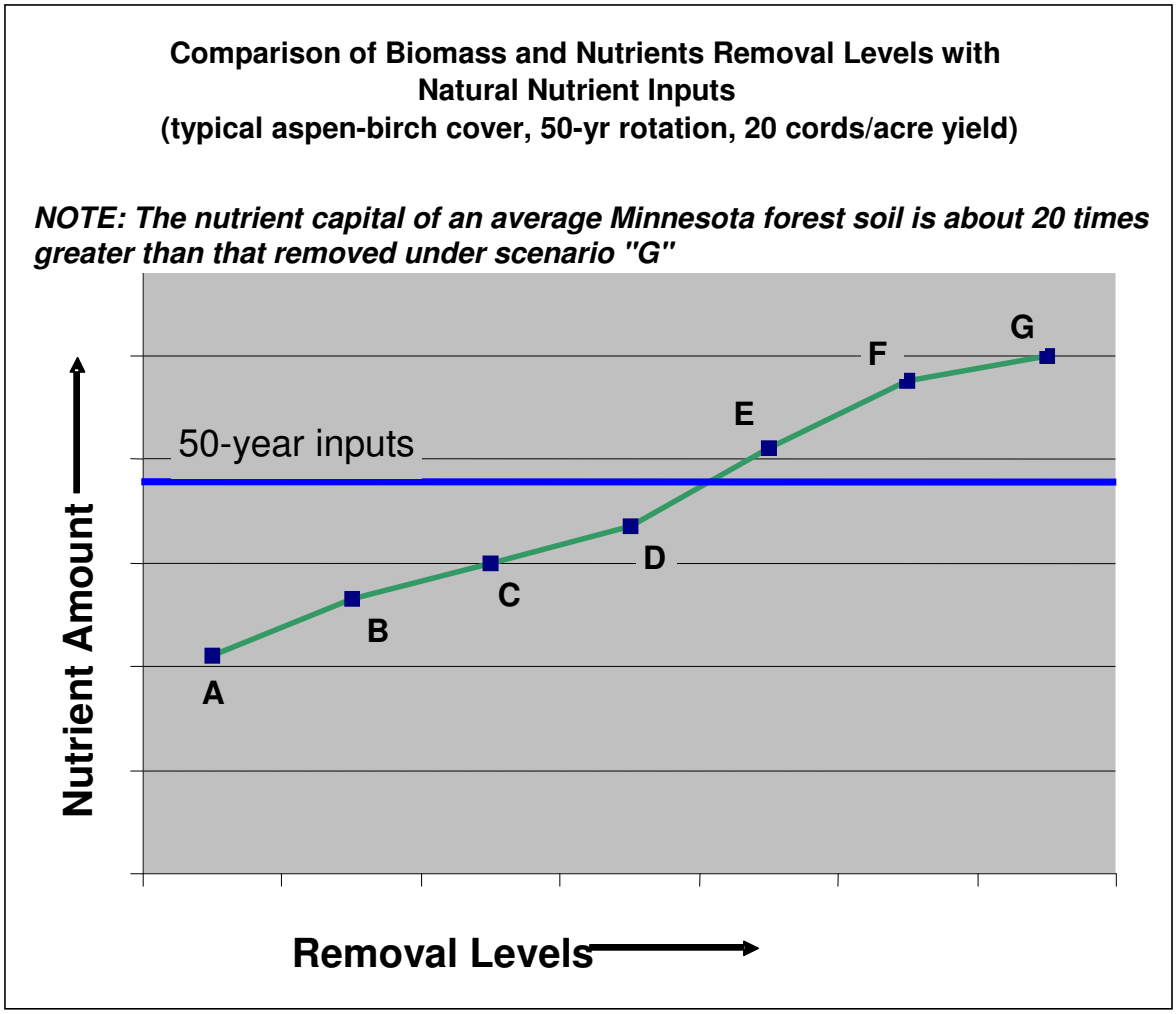


Fig. 1. Comparison of relative amounts of nutrients removed with increasing biomass removal compared to natural nutrient inputs. Scenarios are for harvest from the aspen-birch cover type, 50-year rotation, 20 cords per acre yield, on an average Minnesota forest soil.

A = conventional merchantable bole harvest,
B = whole-tree harvest (not including breakage and loss of tops and limbs that stay on the site),
C = whole-tree harvest with an additional 50% of the remaining tops and limbs removed,
D = whole-tree harvest with removal of all tops and limbs,
E = D harvest plus removal of all dead logs on forest floor,
F = E harvest plus removal of all standing snags, and
G = F harvest plus removal of all brush.

** The biomass harvesting guidelines in this chapter recommending that approximately 1/3 of FWD be retained on site represents a point close to nutrient removal in B.*

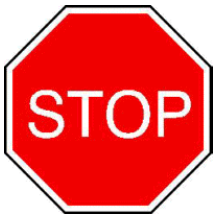
Some Minnesota soils, such as those that are very shallow on rock or are deep ombrotrophic peats, have lower nutrient capital than the average soil. In the cases of those soils, high levels of biomass removals are likely to negatively affect their productivity. Nutrient storage in coarse-textured (sandy) soils is lower than in an "average" mineral soil. For example, the calcium capital for an average soil is about

15,000 lb/ac while that for coarse-textured soils is about half, or 7,000 lb/ac. Even on those soils, however, less than 3% of the system potassium and less than 1% of the calcium would be removed in each 50-year rotation, *including* residue removal.

Soils provide an environment suitable for a vast array of plant and animal populations ranging from microscopic bacteria to small mammals. Careful guideline implementation that sustains the physical and chemical characteristics of the soil will, in large part, maintain the biological characteristics as well as organic material at the soil surface; the forest floor, and leaf litter that might be targeted for biomass removal under some intensive harvesting scenarios. Most biological activity in the soil takes place in the surface soil or litter layers. Although this is a potential source of biomass, it is extremely important to maintaining a wide variety of ecosystem functions such as nutrient supply, erosion control, water retention, and rooting medium and should not be removed without strong overriding silvicultural reasons. This is true for all sites, not just the nutrient-sensitive sites.

Additional trafficking by biomass harvesting or collection equipment may, increase physical impacts to the soil. Existing guidelines such as keeping equipment on trails & infrastructure, avoidance of rutting, and operating on frozen ground should be adequate for biomass harvest as well. However, re-entry into the general harvest area of a site to collect forest residue (slash) may be problematic and is discouraged. Re-entry while operating equipment on existing infrastructure (roads & landings) is best. Any re-entry onto a site may impact regeneration and disturb rehabilitated infrastructure. Restoring erosion control features and rehabilitating infrastructure is necessary.

GUIDELINES



■ Have you identified your objectives?
■ Have you conducted a site inventory?
■ Considered the suitability of the site for biomass harvest based on the level of habitat and species sensitivity?
■ For ALL activities review and implement the **General Guidelines**
■ For all biomass harvest on forest sites review and implement the **Timber Harvesting guidelines except where identified or modified in this chapter.**
■ If an access road will be constructed / utilized for this biomass harvest – review and implement the **Forest Roads guidelines**
■ For TSI activities follow applicable guidelines in this chapter as well as the guidelines found in the TSI chapter.

Biomass Harvest on Sensitive Sites

Reminder – Review General Guidelines and Timber Harvest guidelines, especially those relating to checking for the presence of known endangered, threatened and special concern species (ETS), sensitive plant communities or cultural resources.

In addition:

- ✓ **Avoid biomass harvest in native plant communities that are listed in Appendix J**. To determine whether these native plant communities are known to occur on the site, consult with the local MDNR Area Forestry Office and/or the MCBS native plant community GIS layers, which can be downloaded from the MDNR's Data Deli at http://deli.dnr.state.mn.us (GIS software and skills are necessary).

  Biomass harvesting may be appropriate if:

  - Management plans specifically include strategies to maintain habitat for rare species and/or to restore degraded native plant communities.
  - Used as a tool to restore degraded native plant communities (e.g., overgrown savanna plant communities). Consult appropriate MDNR Ecological Services Regional Plant Ecologist.
  - Used as a management tool to assist with ecological management of the native plant community (e.g., creating a fire break as part of burning a fire-dependent native plant community). Consult appropriate DNR Wildlife Manager and DNR Regional Plant Ecologist.

- ✓ **Avoid biomass harvest within specific sites where Endangered or Threatened species** (plant or animal species listed as endangered or threatened at the state or federal level) are known to exist or are discovered during operations and where biomass harvesting would harm them, (e.g., sites identified in the DNR natural heritage database) unless harvest has been demonstrated to maintain or improve habitat for these species.
    - To determine whether these species are known to occur on the site, consult the local MDNR Office.
    - If a bald eagle nest occurs on or near the site, see Recommendations for Avoiding and Minimizing Impacts http://files.dnr.state.mn.us/natural_resources/animals/birds/eagles/factsheet.pdf).

- ✓ **Reference M.S. 216B.2424 for Biomass Power Mandate in the appendix and urge affected utilities to follow the statute as reference.**
    - (M.S. 216B.2424 Subd. 1a,f) *No wood may be harvested from any lands identified by the final or preliminary Minnesota County Biological Survey as having statewide significance as native plant communities, large populations or concentrations of rare species, or critical animal habitat.*

Managing Water Quality and RMZs

Reminder - It is important to follow the water quality and RMZ management guidelines found in the General Guidelines as well as the Timber Harvesting guidelines in previous chapters.

In addition:

✓ Avoid harvest of additional biomass from within RMZs over and above the tops and limbs of trees normally removed in a roundwood harvest under existing timber harvesting guidelines.

✓ Avoid additional biomass removal within 25 feet of a dry wash bank except tops and limbs of trees normally removed in a roundwood harvest under existing timber harvesting guidelines when managing near a dry wash in southeast Minnesota.

Managing Soil Productivity

Reminder - Review the General Guidelines and Timber Harvesting guidelines relating to soil productivity including infrastructure management, nutrient conservation and avoiding impacts to physical properties.

In addition:

- ✓ Avoid biomass harvesting (over and above bolewood utilization) on:

- Organic soils deeper than 24 inches that are ombrotrophic.
  - Ombrotrophic sites typically have over 90% of the basal area in black spruce with no alder or willow in the understory. These sites fit the Northern Spruce Bog (APn80) and Northern Poor Conifer Swamp (APn81) described in "*Field Guide to the Native Plant Communities of Minnesota – The Laurentian mixed Forest Province"*, MDNR 2003.

- Aspen or hardwood cover types on shallow soils (8 inches or less) over bedrock.

PHOTO FIGURE representing an ombrotrophic site (APN80)

■ **Additional Consideration**
For soils with 8-20 inches of soil over bedrock, consider retaining one third or more of the fine woody debris (FWD) on the site. Slash and residue (FWD) should be relatively evenly distributed throughout the site rather than piled (see also section titled Managing /Retaining Wildlife Habitat and Structural Diversity)

✓ Do not remove the forest floor, litter layer and/or root systems for utilization as biomass.

- Some silvicultural prescriptions may call for disturbance of forest floor, but removal of this material or piling should be avoided

✓ Plan roads, landings, and stockpiles to occupy no more than 1-3% of the site.

✓ Avoid additional biomass harvest from erosion-prone sites (e.g., those sites on steep slopes of 35% or more) over and above the tops and limbs of trees normally removed in a roundwood harvest under existing timber harvesting guidelines.

✓ Ensure that landings or on-site areas used to store biomass are in a condition that favors regeneration and growth of native vegetation and trees after use.

■ **Additional Consideration**
When biomass products are piled on landings for the majority of one growing season or longer, natural regeneration will usually be reduced.

✓ Install temporary erosion control devices, such as straw bales, mulch or woody debris, to help stabilize soils prior to establishment of vegetative cover (see Forest Roads – page 32). Care should be taken to avoid introduction of invasive species in bales or mulches.

✓ Encourage native seed mixes and avoid invasive species seed sources appropriate to site to stabilized exposed soils.

Re-entry into Previously Harvested Sites to Remove Biomass

Residue from timber harvests and other forest management activities often remain piled on-site after harvesting activities are completed. The preference is to remove biomass at the time of harvest. If re-entry is necessary, caution should be used so that future forest regeneration is not reduced and infrastructure rehabilitation efforts are not compromised.

■ Re-entry into the general harvest area of a site by a second operation for the purpose of harvesting biomass should be avoided once regeneration has begun or planting has been completed.

■ Re-entry into a site using existing infrastructure (roads and landings) may be permitted as long as roads and landings are rehabilitated and erosion control features re-established.

✓ Re-establish erosion control measures, including vegetative cover after re-entering a site for biomass harvest.

✓ Avoid re-entry of sites across non-frozen wetlands.

✓ Avoid trafficking over the general harvest area including skid trails or over regeneration.

■Additional Consideration
Piles left on site for an extended period may be inhabited by species such as Canada lynx, black bears, and other wildlife known to den in slash piles. Retain the slash piles showing evidence of use and consider retaining those that are difficult to access.

PHOTO FIGURE representing piles with good access versus piles at difficult access location and surrounded by re-generation.

Managing / Retaining Wildlife Habitat and Structural Diversity

Reminder – Review and incorporate leave tree, snag, and CWD guidelines in the Timber Harvesting (TH-33) and General Guidelines (GG-79) chapters. The intent of these biomass harvesting guidelines is to leave all pre-existing CWD and snags possible. For exceptions, see Timber Harvesting Guidelines (TH-33).

In addition:

✓ Leave all snags possible standing in harvest areas.
- Snags cut for safety reasons should be left where they fall (TH-33)

✓ Retain and limit disturbance to all pre-existing CWD (GG-79-80) (except those in skid trails or landings).

✓ Retain stumps and uprooted stumps

✓Avoid removal of pre-existing CWD material from the forest floor in filter strips (see filter strip guidelines)

✓ Follow the leave tree guidelines the General Guidelines (GG-75-78) and the Timber Harvesting Guidelines (TH 33-39)

✓ Avoid biomass harvest in leave tree clumps except tops and limbs of trees normally removed in a roundwood harvest under existing timber harvesting guidelines (TH 33-39).

✓ Avoid biomass harvest from within RMZs over and above the tops and limbs of trees normally removed in a roundwood harvest under existing timber harvesting guidelines.

✓Retain and scatter tops and branches from 20% of trees harvested in the general harvest area (1 "average-sized" tree out of every 5 trees harvested).

✓ Avoid removing tops and limbs resulting from incidental breakage from the general harvest area.

✓ If harvesting brush and small trees for biomass associated with a timber harvest, leave 20% of this material on the site (this material can be run over or cut, but should remain on the site).

The over-all goal for FWD retention is to retain about 1/3 of the FWD on a site. This is achieved by intentionally retaining 20% of the FWD (tops and limbs from 1 "average sized" tree out of every 5 trees harvested), with an additional 10 –15% achieved by incidental breakage during skidding. Usually more breakage occurs in winter than in summer.

Examples - Below are two examples of how to implement the FWD retention guidelines. Specific operations may vary depending on the type(s) of equipment used.

■ When using a cut – to – length system, the tops and branches from 1"average sized" tree out of every tree out every 5 trees should be processed and left on the site. The tops and limbs from the remaining 4 trees could be piled for utilization as biomass.

■ When utilizing a full tree skidding operation, the tops and limbs from 1"average sized" tree out of every tree out every 5 trees processed at the landing should be hauled out and relatively evenly distributed over the entire general harvest area.

PHOTO FIGURE depicting acceptable methods of brush retention (both standing and run over).

Biomass Harvest for Fuel Reduction

These guidelines should be used when harvesting understory vegetation for purposes of mechanical fuel reduction. Biomass utilization may need to be modified in some cases such as sites with excessive fuel loading or urban interface situations.

✓ Retain understory vegetation in several reserve patches that total at least 20% of the harvest unit.

✓ Reserve patches should represent soil moisture conditions within the harvest unit

✓ Retain snags >12-inch dbh and down logs where at least one end is >12-inch in diameter and 6 feet in length. . Emphasis is placed on retaining only the larger snags and pre-existing CWD because these larger fuels do not contribute as much to the intitial speed and flame length of a wildfire.

✓ Modify management activities to maintain, promote, or enhance ETS species (endangered, threatened, or special concern) on the site.

PHOTO FIGURE depicting fuel reduction research (reserve patches, snags, etc.) at Superior National Forest.

Biomass Harvest Considerations as a tool for Silviculture Management

Harvesting of biomass may provide an excellent tool to help accomplish various silvicultural management objectives on many sites. However, on other sites biomass harvesting may not fit within management strategies, or facilitate silvicultural objectives. Utilization standards and harvesting techniques may need to be modified to fit site conditions and management objectives. Some brief examples are given below where biomass harvest may or may not help accomplish management objectives. These are generalized examples and are intended to stimulate critical thinking; they are not intended to be specific guidelines.

■ **Swamping** - Removal of live woody vegetation may temporarily increase the wetness of some sites due to decreased transpiration which may increase the chances of poor regeneration. When harvesting lowland hardwood stands, consider retaining understory vegetation and non-merchantable stems. Retention of transpiring vegetation reduces the potential for "swamping" of some sites.

■ **Artificial Regeneration -** If planning for artificial regeneration of a site, consider biomass utilization as a means of preparing or improving a site for planting. Utilization of biomass from a site can reduce the need for some site preparation practices such as brush raking or shearing.

■ **Browse Deterrent** - Consider the use of heavy slash, or strategically placed slash as a deterrent to browsing by large ungulates (deer and moose). For example, when working in oak stands with the goal of natural oak regeneration – consider leaving heavy oak tops and branches that form a "cage" type structure when felled to the ground. This technique has been shown to reduce deer browse within the "cage" and increase survival of oak regeneration from seed. Heavy slash loads (even on clearcut sites) can be a used as a deterrent to browsing.

■ **Natural Regeneration** - Consider modifying biomass harvest if planning natural regeneration of conifers from seed (especially serotinous cones) by retaining all or some cone bearing slash to provide a seed source. Timing of harvest, site conditions, and species being managed for will influence strategies. In some cases, prior removal of understory brush (such as hazel or balsam fir) may facilitate natural regeneration by removing competition and scarifying the seedbed.

■ **Bark Beetles** - Biomass harvesting may promote management strategies for insect and disease control. For example, consider the utilization of slash and non-merchantable stems in red pine thinnings to prevent bark beetle build-ups. In red pine harvests, biomass removals could benefit nearby and residual pines by preventing or mitigating bark beetle populations. Care must be taken to avoid damage to residual trees by biomass and harvesting machinery that would negate this benefit. Removal of fresh slash and non-merchantable stems, and logs from abandoned piles and log decks on harvested sites will prevent bark beetle build-up during the following season. Complete all removals by June 1st. If necessary during the late spring or summer, bark beetle populations can be directly controlled by harvesting the infestation pockets, removing slash and non-merchantable stems on the site and removing logs from abandoned piles and log decks. Complete removals within 3 weeks of initial cutting. Do not permit biomass retrieval at this critical time of year if the activity is likely to cause wounding of red pine stems or root systems.

■ **Thinning Stands -** Many plantations may benefit from pre-commercial thinning - before individual stems are large enough to provide traditional roundwood products. Consider biomass harvest as a means of marketing early thinning in these plantations. For example, some studies show that thinning white spruce plantations at age 25 yields the best growth response in the residual stand, but typically there is not enough pulp volume at that age to make a commercial sale. Biomass harvesting may provide a commercial avenue to accomplish the thinning in these stands. Benefits of thinning stands early include better growth and form of residual crop trees and improved in-stand structure for some wildlife species. Damage to residual stems and root systems should be strongly avoided.

Glossary

Biological Legacy: Anything handed down or carried over from a predisturbance forest ecosystem, including green trees, patches of undisturbed vegetation, surviving propagules and organisms (e.g., buried seeds, seeds stored in serotinous cones, surviving roots, basal buds, mycorrhizal fungi and other soil microbes, invertebrates and mammals), dead wood, and certain aspects of soil chemistry and structure. (Definition from Perry, D.A. and M.P. Amaranthus, 1997. IN Kohm, K.A. and J.F. Franklin, Creating a Forestry for the 21st Century: The Science of Ecosystem Management. Island Press. Washington, D.C.).

Biomass: The organic materials produced by plants, such as leaves, roots, seeds, and stalks. In some cases, microbial and animal metabolic wastes are also considered biomass. The term "biomass" is intended to refer to materials that do not directly go into foods or consumer products but may have alternative industrial uses. Common sources of biomass are (1) agricultural wastes, such as corn stalks, straw, seed hulls, sugarcane leavings, bagasse, nutshells, and manure from cattle, poultry, and hogs; (2) wood materials, such as wood or bark, sawdust, timber slash, and mill scrap; (3) municipal waste, such as waste paper and yard clippings; and (4) energy crops, such as poplars, willows, switchgrass, alfalfa, prairie bluestem, corn (starch), and soybean (oil). (***McGraw-Hill Encyclopedia of Science and Technology*, 5th edition, published by The McGraw-Hill Companies, Inc.)**

Coarse Woody Debris (CWD): Stumps and fallen trunks or limbs of more than 6-inches in diameter at the large end.

Fine Woody Debris (FWD): Tops, limbs and woody debris less than 6-inches at the large end.

Ombrotrophic: A condition where minerals and nutrients are received solely from precipitation and dust fall and not from runoff or groundwater; characteristic of bogs. (Field Guide to the Native Plant Communities of Minnesota – The Eastern Broadleaf Forest Province).

Roundwood harvest: Roundwood harvest refers to a timber harvest where only the main stem of trees are removed from the site. For the purposes of this definition, "main stem" refers to those parts of the tree that meet the utilization standards for pulpwood, posts, bolts, or sawtimber as described in the Minnesota Department of Natural Resources Division of Forestry Timber Sales Manual, 1998, as amended as of May 1, 2005, and the Minnesota Department of Natural Resources Timber Scaling Manual, 1981, as amended as of May 1, 2005 (see brief description below), except woody material that is intentionally cultivated, harvested, and prepared for use, in whole or in part, as a fuel for the generation of electricity OR (1) brush, trees, and other biomass harvested from within designated utility, railroad, and road rights-of-way (2) upland and lowland brush harvested from lands incorporated into brushland habitat management activities of the Minnesota Department of Natural Resources; (3) upland and lowland brush harvested

from lands managed in accordance with Minnesota Department of Natural Resources "Best Management Practices for Managing Brushlands".

Description of Utilization Standards from the Minnesota Department of Natural Resources Division of Forestry Timber Sales Manual:

F.3.1 Top Diameters:

Each species/product must be utilized down to a minimum merchantable top diameter outside bark (dob) as follows:

- 3 inches for cordwood material (all species)
- 6 inches for sawtimber (conifers, aspen, balm of Gilead, birch)
- 10 inches for sawtimber (other hardwoods)

Appraisers may apply more restrictive top-diameter standards based on local markets. For example, in areas with hardwood pallet markets, sales with the appropriate quality of wood could be marketed with the statement: "This permit contains hardwoods suitable for processing at sawmills down to a six (6) inch minimum top diameter outside bark." In this case, the minimum top diameter for hardwood saw logs would be set to 6 inches on the permit appraisal.

Sustainably Managed Woody Biomass: For purposes of biomass guideline development and in accordance with MN Statute 216B.2424 subd.1(d) "sustainably managed woody biomass" is defined as:

(1) brush, trees, and other biomass harvested from within designated utility, railroad, and road rights-of-way (guidelines will not be developed for this category of biomass);

(2) upland and lowland brush harvested from lands incorporated into brushland habitat management activities of the Minnesota Department of Natural Resources;

(3) upland and lowland brush harvested from lands managed in accordance with Minnesota Department of Natural Resources "Best Management Practices for Managing Brushlands";

(4) logging slash or waste wood that is created by harvest, by precommercial timber stand improvement to meet silvicultural objectives, or by fire, disease, or insect control treatments, and that is managed in compliance with the Minnesota Forest Resources Council's "Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Mangers" as modified by the requirement of this subdivision; and,

(5) trees or parts of trees that do not meet the utilization standards for pulpwood, posts, bolts, or sawtimber as described in Minnesota Department of Natural Resources Division of Forestry Timber Sales Manual, 1998, as amended as of May 1, 2005, and the Minnesota Department of Natural Resources Timber Scaling Manual, 1981, as amended as of May 1, 2005, except as provided by state statute 216B.2424 –

Biomass Power Mandate, Subdivision 1, in paragraph (a), clause (1), and this paragraph, clauses (1) to (3).

Appendix L
216B.2424, Minnesota Statutes 2006

216B.2424 BIOMASS POWER MANDATE.

Subdivision 1. **Farm-grown closed-loop biomass.**
(a) For the purposes of this section, "farm-grown closed-loop biomass" means biomass, as defined in section 216C.051, subdivision 7 , that:(1) is intentionally cultivated, harvested, and prepared for use, in whole or in part, as a fuel for the generation of electricity; (2) when combusted, releases an amount of carbon dioxide that is less than or approximately equal to the carbon dioxide absorbed by the biomass fuel during its growing cycle; and (3) is fired in a new or substantially retrofitted electric generating facility that is:(i) located within 400 miles of the site of the biomass production; and (ii) designed to use biomass to meet at least 75 percent of its fuel requirements.
(b) The legislature finds that the negative environmental impacts within 400 miles of the facility resulting from transporting and combusting the biomass are offset in that region by the environmental benefits to air, soil, and water of the biomass production.
(c) Among the biomass fuel sources that meet the requirements of paragraph (a), clauses (1) and (2), are poplar, aspen, willow, switch grass, sorghum, alfalfa, cultivated prairie grass, and sustainably managed woody biomass.
(d) For the purpose of this section, "sustainably managed woody biomass" means:(1) brush, trees, and other biomass harvested from within designated utility, railroad, and road rights-of-way;(2) upland and lowland brush harvested from lands incorporated into brushland habitat management activities of the Minnesota Department of Natural Resources;(3) upland and lowland brush harvested from lands managed in accordance with Minnesota Department of Natural Resources "Best Management Practices for Managing Brushlands";(4) logging slash or waste wood that is created by harvest, by precommercial timber stand improvement to meet silvicultural objectives, or by fire, disease, or insect control treatments, and that is managed in compliance with the Minnesota Forest Resources Council's "Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers" as modified by the requirement of this subdivision; and(5) trees or parts of trees that do not meet the utilization standards for pulpwood, posts, bolts, or sawtimber as described in the Minnesota Department of Natural Resources Division of Forestry Timber Sales Manual, 1998, as amended as of May 1, 2005, and the Minnesota Department of Natural Resources Timber Scaling Manual, 1981, as amended as of May 1, 2005, except as provided in paragraph (a), clause (1), and this paragraph, clauses (1) to (3).

Subd. 1a. **Municipal waste-to-energy project.**
(a) This subdivision applies only to a biomass project owned or controlled, directly or indirectly, by two municipal utilities as described in subdivision 5a, paragraph (b).
(b) Woody biomass from state-owned land must be harvested in compliance with an adopted management plan and a program of ecologically based third-party certification.
(c) The project must prepare a fuel plan on an annual basis after commercial operation of the project as described in the power contract between the project and the public utility, and must also prepare annually certificates reflecting the types of fuel used in the preceding year by the project, as described in the power contract. The fuel plans and certificates shall also be filed with the Minnesota Department of Natural Resources and the Minnesota Department of Commerce within 30 days after being provided to the public utility, as provided by the power contract. Any

person who believes the fuel plans, as amended, and certificates show that the project does not or will not comply with the fuel requirements of this subdivision may file a petition with the commission seeking such a determination.
(d) The wood procurement process must utilize third-party audit certification systems to verify that applicable best management practices were utilized in the procurement of the sustainably managed biomass. If there is a failure to so verify in any two consecutive years during the original contract term, the farm-grown closed-loop biomass requirements of subdivision 2 must be increased to 50 percent for the remaining contract term period; however, if in two consecutive subsequent years after the increase has been implemented, it is verified that the conditions in this subdivision have been met, then for the remaining original contract term the closed-loop biomass mandate reverts to 25 percent. If there is a subsequent failure to verify in a year after the first failure and implementation of the 50 percent requirement, then the closed-loop percentage shall remain at 50 percent for each remaining year of the contract term.
(e) In the closed-loop plantation, no transgenic plants may be used.
(f) No wood may be harvested from any lands identified by the final or preliminary Minnesota County Biological Survey as having statewide significance as native plant communities, large populations or concentrations of rare species, or critical animal habitat.
(g) A wood procurement plan must be prepared every five years and public meetings must be held and written comments taken on the plan and documentation must be provided on why or why not the public inputs were used.
(h) Guidelines or best management practices for sustainably managed woody biomass must be adopted by:(1) the Minnesota Department of Natural Resources for managing and maintaining brushland and open land habitat on public and private lands, including, but not limited to, provisions of sections 84.941, 84.942, and 97A.125; and(2) the Minnesota Forest Resources Council for logging slash, using the most recent available scientific information regarding the removal of woody biomass from forest lands, to sustain the management of forest resources as defined by section 89.001, subdivisions 8 and 9, with particular attention to soil productivity, biological diversity as defined by section 89A.01, subdivision 3 , and wildlife habitat.These guidelines must be completed by July 1, 2007, and the process of developing them must incorporate public notification and comment.
(i) The University of Minnesota Initiative for Renewable Energy and the Environment is encouraged to solicit and fund high-quality research projects to develop and consolidate scientific information regarding the removal of woody biomass from forest and brush lands, with particular attention to the environmental impacts on soil productivity, biological diversity, and sequestration of carbon. The results of this research shall be made available to the public.
(j) The two utilities owning or controlling, directly or indirectly, the biomass project described in subdivision 5a, paragraph (b), shall fund or obtain funding from nonstate sources of up to $150,000 by April 1, 2006, to complete the guidelines or best management practices described in paragraph (h). The expenditures to be funded under this paragraph do not include any of the expenditures to be funded under paragraph (i).

Subd. 2. **Interim exemption.**
(a) A biomass project proposing to use, as its primary fuel over the life of the project, short-rotation woody crops, may use as an interim fuel agricultural waste and other biomass which is not farm-grown closed-loop biomass for up to six years after the project's electric generating facility becomes operational; provided, the project developer demonstrates the project will use the designated short-rotation woody crops as its primary fuel after the interim period and provided the location of the interim fuel production meets the requirements of subdivision 1, paragraph (a), clause (3).
(b) A biomass project proposing to use, as its primary fuel over the life of the project, short-rotation woody crops, may use as an interim fuel agricultural waste and other biomass which is

not farm-grown closed-loop biomass for up to three years after the project's electric generating facility becomes operational; provided, the project developer demonstrates the project will use the designated short-rotation woody crops as its primary fuel after the interim period.
(c) A biomass project that uses an interim fuel under the terms of paragraph (b) may, in addition, use an interim fuel under the terms of paragraph (a) for six years less the number of years that an interim fuel was used under paragraph (b).
(d) A project developer proposing to use an exempt interim fuel under paragraphs (a) and (b) must demonstrate to the public utility that the project will have an adequate supply of short-rotation woody crops which meet the requirements of subdivision 1 to fuel the project after the interim period.
(e) If a biomass project using an interim fuel under this subdivision is or becomes owned or controlled, directly or indirectly, by two municipal utilities as described in subdivision 5a, paragraph (b), the project is deemed to comply with the requirement under this subdivision to use as its primary fuel farm-grown closed-loop biomass if farm-grown closed-loop biomass comprises no less than 25 percent of the fuel used over the life of the project. For purposes of this subdivision, "life of the project" means 20 years from the date the project becomes operational or the term of the applicable power purchase agreement between the project owner and the public utility, whichever is longer.

Subd. 3. **Fuel exemption.** Over the duration of the contract of a biomass power facility selected to satisfy the mandate in subdivision 5, fuel sources that are not biomass may be used to satisfy up to 25 percent of the fuel requirements of a biomass power facility selected to satisfy the biomass power mandate in subdivision 5, except that agricultural crop wastes, such as oat hulls, may be used to satisfy more than 25 percent of the fuel requirements of a power facility selected to satisfy the biomass power mandate in subdivision 5 if the wastes are co-fired with the fuel authorized for the facility. A biomass power facility selected to satisfy the mandate in subdivision 5 also may use fuel sources that are not biomass during any period when biomass fuel sources are not reasonably available to the facility due to any circumstances constituting an act of God. Fuel sources that are not biomass used during such a period of biomass fuel source unavailability shall not be counted toward the 25 percent exemption provided in this subdivision. For purposes of this subdivision, "act of God" means any natural disaster or other natural phenomenon of an exceptional, inevitable, or irresistible character, including, but not limited to, flood, fire, drought, earthquake, and crop failure resulting from climatic conditions, infestation, or disease.

Subd. 4. **Financial viability.** A biomass project developer must demonstrate to the public utility evidence of sufficient financial viability necessary for the construction and operation of the biomass project.

Subd. 5. **Mandate.**
(a) A public utility, as defined in section 216B.02, subdivision 4, that operates a nuclear-powered electric generating plant within this state must construct and operate, purchase, or contract to construct and operate (1) by December 31, 1998, 50 megawatts of electric energy installed capacity generated by farm-grown closed-loop biomass scheduled to be operational by December 31, 2001; and (2) by December 31, 1998, an additional 75 megawatts of installed capacity so generated scheduled to be operational by December 31, 2002.
(b) Of the 125 megawatts of biomass electricity installed capacity required under this subdivision, no more than 55 megawatts of this capacity may be provided by a facility that uses poultry litter as its primary fuel source and any such facility:(1) need not use biomass that complies with the definition in subdivision 1;(2) must enter into a contract with the public utility for such capacity, that has an average purchase price per megawatt hour over the life of the contract that is equal to or less than the average purchase price per megawatt hour over the life of the contract in contracts

approved by the Public Utilities Commission before April 1, 2000, to satisfy the mandate of this section, and file that contract with the Public Utilities Commission prior to September 1, 2000; and(3) must schedule such capacity to be operational by December 31, 2002.
(c) Of the total 125 megawatts of biomass electric energy installed capacity required under this section, no more than 75 megawatts may be provided by a single project.
(d) Of the 75 megawatts of biomass electric energy installed capacity required under paragraph (a), clause (2), no more than 33 megawatts of this capacity may be provided by a St. Paul district heating and cooling system cogeneration facility utilizing waste wood as a primary fuel source. The St. Paul district heating and cooling system cogeneration facility need not use biomass that complies with the definition in subdivision 1.
(e) The public utility must accept and consider on an equal basis with other biomass proposals:(1) a proposal to satisfy the requirements of this section that includes a project that exceeds the megawatt capacity requirements of either paragraph (a), clause (1) or (2), and that proposes to sell the excess capacity to the public utility or to other purchasers; and (2) a proposal for a new facility to satisfy more than ten but not more than 20 megawatts of the electrical generation requirements by a small business-sponsored independent power producer facility to be located within the northern quarter of the state, which means the area located north of Constitutional Route No. 8 as described in section 161.114, subdivision 2, and that utilizes biomass residue wood, sawdust, bark, chipped wood, or brush to generate electricity. A facility described in this clause is not required to utilize biomass complying with the definition in subdivision 1, but must be under construction by December 31, 2005.
(f) If a public utility files a contract with the commission for electric energy installed capacity that uses poultry litter as its primary fuel source, the commission must do a preliminary review of the contract to determine if it meets the purchase price criteria provided in paragraph (b), clause (2). The commission shall perform its review and advise the parties of its determination within 30 days of filing of such a contract by a public utility. A public utility may submit by September 1, 2000, a revised contract to address the commission's preliminary determination.
(g) The commission shall finally approve, modify, or disapprove no later than July 1, 2001, all contracts submitted by a public utility as of September 1, 2000, to meet the mandate set forth in this subdivision.
(h) If a public utility subject to this section exercises an option to increase the generating capacity of a project in a contract approved by the commission prior to April 25, 2000, to satisfy the mandate in this subdivision, the public utility must notify the commission by September 1, 2000, that it has exercised the option and include in the notice the amount of additional megawatts to be generated under the option exercised. Any review by the commission of the project after exercise of such an option shall be based on the same criteria used to review the existing contract.
(i) A facility specified in this subdivision qualifies for exemption from property taxation under section 272.02, subdivision 45.

Subd. 5a. **Reduction of biomass mandate.**
(a) Notwithstanding subdivision 5, the biomass electric energy mandate must be reduced from 125 megawatts to 110 megawatts.
(b) The Public Utilities Commission shall approve a request pending before the commission as of May 15, 2003, for amendments to and assignment of a power purchase agreement with the owner of a facility that uses short-rotation, woody crops as its primary fuel previously approved to satisfy a portion of the biomass mandate if the owner of the project agrees to reduce the size of its project from 50 megawatts to 35 megawatts, while maintaining an average price for energy in nominal dollars measured over the term of the power purchase agreement at or below $104 per megawatt-hour, exclusive of any price adjustments that may take effect subsequent to commission approval of the power purchase agreement, as amended. The commission shall also approve, as necessary, any subsequent assignment or sale of the power purchase agreement or

ownership of the project to an entity owned or controlled, directly or indirectly, by two municipal utilities located north of Constitutional Route No. 8, as described in section 161.114, which currently own electric and steam generation facilities using coal as a fuel and which propose to retrofit their existing municipal electrical generating facilities to utilize biomass fuels in order to perform the power purchase agreement.
(c) If the power purchase agreement described in paragraph (b) is assigned to an entity that is, or becomes, owned or controlled, directly or indirectly, by two municipal entities as described in paragraph (b), and the power purchase agreement meets the price requirements of paragraph (b), the commission shall approve any amendments to the power purchase agreement necessary to reflect the changes in project location and ownership and any other amendments made necessary by those changes. The commission shall also specifically find that:(1) the power purchase agreement complies with and fully satisfies the provisions of this section to the full extent of its 35-megawatt capacity;(2) all costs incurred by the public utility and all amounts to be paid by the public utility to the project owner under the terms of the power purchase agreement are fully recoverable pursuant to section 216B.1645;(3) subject to prudency review by the commission, the public utility may recover from its Minnesota retail customers the Minnesota jurisdictional portion of the amounts that may be incurred and paid by the public utility during the full term of the power purchase agreement; and(4) if the purchase power agreement meets the requirements of this subdivision, it is reasonable and in the public interest.
(d) The commission shall specifically approve recovery by the public utility of any and all Minnesota jurisdictional costs incurred by the public utility to improve, construct, install, or upgrade transmission, distribution, or other electrical facilities owned by the public utility or other persons in order to permit interconnection of the retrofitted biomass-fueled generating facilities or to obtain transmission service for the energy provided by the facilities to the public utility pursuant to section 216B.1645, and shall disapprove any provision in the power purchase agreement that requires the developer or owner of the project to pay the jurisdictional costs or that permit the public utility to terminate the power purchase agreement as a result of the existence of those costs or the public utility's obligation to pay any or all of those costs.

Subd. 6. **Remaining megawatt compliance process.**
(a) If there remain megawatts of biomass power generating capacity to fulfill the mandate in subdivision 5 after the commission has taken final action on all contracts filed by September 1, 2000, by a public utility, as amended and assigned, this subdivision governs final compliance with the biomass energy mandate in subdivision 5 subject to the requirements of subdivisions 7 and 8.
(b) To the extent not inconsistent with this subdivision, the provisions of subdivisions 2, 3, 4, and 5 apply to proposals subject to this subdivision.
(c) A public utility must submit proposals to the commission to complete the biomass mandate. The commission shall require a public utility subject to this section to issue a request for competitive proposals for projects for electric generation utilizing biomass as defined in paragraph (f) of this subdivision to provide the remaining megawatts of the mandate. The commission shall set an expedited schedule for submission of proposals to the utility, selection by the utility of proposals or projects, negotiation of contracts, and review by the commission of the contracts or projects submitted by the utility to the commission.
(d) Notwithstanding the provisions of subdivisions 1 to 5 but subject to the provisions of subdivisions 7 and 8, a new or existing facility proposed under this subdivision that is fueled either by biomass or by co-firing biomass with nonbiomass may satisfy the mandate in this section. Such a facility need not use biomass that complies with the definition in subdivision 1 if it uses biomass as defined in paragraph (f) of this subdivision. Generating capacity produced by co-firing of biomass that is operational as of April 25, 2000, does not meet the requirements of the mandate, except that additional co-firing capacity added at an existing facility after April 25,

2000, may be used to satisfy this mandate. Only the number of megawatts of capacity at a facility which co-fires biomass that are directly attributable to the biomass and that become operational after April 25, 2000, count toward meeting the biomass mandate in this section.
(e) Nothing in this subdivision precludes a facility proposed and approved under this subdivision from using fuel sources that are not biomass in compliance with subdivision 3.
(f) Notwithstanding the provisions of subdivision 1, for proposals subject to this subdivision, "biomass" includes farm-grown closed-loop biomass; agricultural wastes, including animal, poultry, and plant wastes; and waste wood, including chipped wood, bark, brush, residue wood, and sawdust.
(g) Nothing in this subdivision affects in any way contracts entered into as of April 25, 2000, to satisfy the mandate in subdivision 5.
(h) Nothing in this subdivision requires a public utility to retrofit its own power plants for the purpose of co-firing biomass fuel, nor is a utility prohibited from retrofitting its own power plants for the purpose of co-firing biomass fuel to meet the requirements of this subdivision.

Subd. 7. **Effect on existing projects.** The commission may not approve a project proposed after April 25, 2000, which would have an adverse impact on the ability of a project approved before April 25, 2000, to obtain an adequate supply of the fuel source designated for the project.

Subd. 8. **Agricultural biomass requirement.** Of the 125 megawatts mandated in subdivision 5, or 110 megawatts mandated in subdivision 5a, at least 75 megawatts of the generating capacity must be generated by facilities that use agricultural biomass as the principal fuel source. For purposes of this subdivision, agricultural biomass includes only farm-grown closed-loop biomass and agricultural waste, including animal, poultry, and plant wastes. For purposes of this subdivision, "principal fuel source" means a fuel source that satisfies at least 75 percent of the fuel requirements of an electric power generating facility. Nothing in this subdivision is intended to expand the fuel source requirements of subdivision 5.

History: *1994 c 641 art 3 s 3; 1995 c 224 s 76; 1996 c 450 s 1; 1998 c 345 s 2; 2000 c 443 s 1-5; 2001 c 7 s 46; 1Sp2001 c 5 art 3 s 13; 2002 c 379 art 1 s 55; 2003 c 127 art 2 s 3; 1Sp2003 c 11 art 2 s 7,16; 2005 c 97 art 5 s 1-6; 1Sp2005 c 1 art 2 s 140; 2006 c 259 art 4 s 4*

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