CONSERVATION INNOVATION GRANTS
FINAL REPORT

Grantee Name: Forest Guild	
Project Title: Promoting Adoption of Innovative Conservation Practices for Sustainable Forest Biomass Harvesting	
Period Covered by Report: 10/1/10- 6/30/2012	
Project End Date: 6/30/2012	Date of Submission: 9/28/2012

Deliverables

1. Educate landowners about the opportunities to sustainably produce and harvest forest biomass from renewable energy.
2. Work with foresters and loggers to assist producers in the sustainable production of forest biomass for renewable energy.
3. Build and document demonstrations of sustainable production of forest biomass for renewable energy.
4. Create and disseminate outreach materials that explain and encourage the adoption of sustainable practices for forest biomass production.
5. Develop a resource guide for producers and those who work with them.
6. Hold field trainings for producers and those who work with them.
7. Create interactive website to share sustainable biomass resource guide, outreach materials, and producers' experiences.
8. Attend at least one NRCS CIG Showcase or comparable NRCS event during the period of the project agreement.
9. Submit semi-annual progress report and a final report documenting project results.
10. Develop a fact sheet describing the new technology or approach.

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EXECUTIVE SUMMARY

Our goal for the project was to empower EQIP-eligible producers and those who work with them to produce, harvest, and handle forest biomass sustainably for renewable energy without ecological damage to the forest. Objectives of the project were:

- Promote adoption of new innovative conservation practices for the production, harvest, and handling of sustainable forest biomass for renewable energy in the Northeast.
- Educate and train EQIP-eligible producers and those who work with them to produce, harvest, and handle forest biomass sustainably for renewable energy.
- Contribute to the long-term sustainability of both forest productivity and ecosystem health by increasing the use of sustainable biomass harvesting and retention guidelines throughout the nine state project region.

The project achieved the following accomplishments:

- Convened a 21 member outreach team representing each state engaged in the project.
- Planned and delivered 4 webinars
- Created and printed three outreach documents. 1) A hard copy version of the full report *Forest Retention and Harvesting Guidelines for the Northeast*. 2) A tri fold field-friendly shortened version of our retention guidelines. 3) A cover letter that encourages participation and feedback in our project.
- Working through our network of foresters and partners, the Forest Guild distributed the guidelines to over 300 practitioners.
- Coordinated 9 meetings and field tours on sustainable biomass harvesting.

- At the state level, the Forest Guild guidelines were evaluated and considered in Maine, Massachusetts, New Hampshire, Vermont and Connecticut and received accolades in New York as being the best of kind.
- Completed an interactive sustainable biomass harvesting website (http://www.forestbiomassguidelines.org/).

The overall goals of the project were met. Time to complete the project took longer than initially planned. The ability to build awareness of the harvesting guidelines was contingent on providing foresters, loggers, and producers with the opportunity to see the guidelines applied in the field. Additional time was needed to plan harvests that incorporated the guidelines and work around weather setbacks to find opportune times to conduct field tours. We also experienced a change in key personnel that required us to seek a 3 month no-cost extension to complete the project.

Foresters, loggers, and EQIP eligible producers directly benefit from this grant by having a clear set of guidelines to help determine how much biomass should remain in the forest after harvest.

The most significant change to the project budget was a shift in personnel costs to contracting costs. The budget modification did not result in a change in project scope, but did shift some project implementation work to contractors. We were also fortunate to be able to secure matching funds that enabled us to reduce the CIG travel line item.

Publications, presentations, webinars, and one-on-one outreach were used to build awareness of and familiarity with the guidelines. Field tours and workshops were used to demonstrate the guidelines in the forest and build support among managers and producers. Depending on the forest type and harvesting operation, costs associated with applying the harvesting guidelines will vary. Costs associated with applying the harvesting guidelines can be minimized as foresters and loggers become more familiar with guideline implementation.

Biomass harvesting and retention guidelines can be incorporated into state-level best management practices where existing BMPs are not sufficient to protect forest soils, wildlife habitat, and water quality from biomass harvesting. NRCS conservation management practices (384 and 666) can be revised to include sustainable biomass harvesting and retention guidelines developed for local forest types.

Forest Guild biomass harvesting and retention guidelines represent a viable and effective tool to determine how much biomass needs to remain on site to protect soil nutrients, wildlife habitat, and water quality after harvests. The guidelines were developed using best available science and field experience from forestry professionals. The following are key recommendations resulting from the project.

- Use biomass harvesting and retention guidelines to protect soil, wildlife, and water attributes impacted from harvesting operations that remove wood biomass.

- Develop a clear understanding of the costs associated with implementing harvesting guidelines on different scale and intensity of biomass harvests.
- Use biomass harvesting and retention guidelines to improve state-level BMPs that may not adequately address issues of soil nutrients, wildlife habitat, and water quality from biomass harvesting.
- Revise NRCS conservation management practices (384 and 666) to include sustainable biomass harvesting and retention guidelines developed for local forest types.

INTRODUCTION

The purpose of this project was to promote the adoption of new, innovative on-the-ground biomass harvesting and retention guidelines for the production, harvest, and handling of sustainable forest biomass for renewable energy in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, and Maryland. The project was led by the Forest Guild beginning in October 2010 and terminating in June 2012. Key project personnel included:

Mr. Robert Perschel (Northeast Region Director, Forest Guild) Bob led the producer outreach effort, oversaw the education and field training components, and was involved in monitoring and evaluating the project. Mr. Perschel has 30 years experience as a consulting forester in New England and holds a masters from the Yale School of Forestry. He is a member of the team contracted by the Massachusetts Department of Energy Resources (M-DOER) to write a white paper on biomass harvesting and carbon. Along with Dr. Evans (below), he co-authored the *Forest Biomass Retention and Harvesting Guidelines for the Northeast* that will be utilized in this project.

Dr. Zander Evans (Research Director, Forest Guild) - has authored a number of articles and reports related to forest biomass retention and sustainable biomass harvesting. He successfully completed a national 2009 Joint Fire Sciences Program grant on biomass harvesting case studies. Dr. Evans advised the team contracted by M-DOER to write a white paper on biomass harvesting and carbon. He received his PhD in forestry from the Yale School of Forestry. Dr. Evans was involved in developing education and field training components as well as conducting webinars, developing website content, and monitoring and evaluating the project.

Dr. Jeffrey Benjamin (Assistant Professor of Forest Operations, University of Maine) received a PhD in Forestry from the University of New Brunswick and has a strong background in forest engineering including research related to operational issues associated with biomass harvesting in this region. Dr. Benjamin developed a major demonstration site in Maine, evaluated harvest sites with respect to Maine's Woody Biomass Retention Guidelines, hosted field training, reviewed education and field training components, and contributed to overall project evaluation.

Mr. Brian Kittler (Project Director, Pinchot Institute for Conservation) received a masters in environmental science and policy from Johns Hopkins University. Over the last year he has worked with a stakeholder committee of over 15 individuals and the Maryland Department of Natural Resources to develop forthcoming biomass harvesting

guidelines for Maryland. He led the producer outreach, education, and field training components for Maryland and was also involved in Pennsylvania and New York outreach work. Brian was involved in developing materials, planning and participating in the regional meetings, contributing to and reviewing materials and evaluating the project.

Our goal was to empower EQIP-eligible producers and those who work with them to produce, harvest, and handle forest biomass sustainably for renewable energy without ecological damage to the forest.

Project Objectives:

- Promote adoption of new innovative conservation practices for the production, harvest, and handling of sustainable forest biomass for renewable energy in the Northeast.
- Educate and train EQIP-eligible producers and those who work with them to produce, harvest, and handle forest biomass sustainably for renewable energy.
- Contribute to the long-term sustainability of both forest productivity and ecosystem health by increasing the use of sustainable biomass harvesting and retention guidelines throughout the nine states.

Project Tasks:

- Identify and contact eligible producers, foresters, and loggers
- ID and develop demonstration sites
- Develop a biomass harvesting guidelines website
- Produce/distribute introductory flyer
- Hold introductory and follow-up webinar series
- Plan and hold a region-wide meeting for producers, foresters, and loggers
- Hold sub-regional field workshops and demonstration site visits for producers, foresters, and loggers
- Synthesize lessons learned and impact of sustainable biomass retention and harvesting guidelines for national publication

The project utilized the expertise and technical resources of academic staff at the University of Maine, Pinchot Institute for Conservation, University of Vermont, and the Biomass Energy Resource Center.

The $147,000 federal investment was matched over 100% by a combination of third-party cash and in-kind contributions. We were able to successfully leverage the federal NRCS CIG investment with cash support from private donor foundations. The ability to raise additional project funds helped meet project objectives and create a framework carry on the project beyond the life of the federal grant.

BACKGROUND

Forest material that is not harvested as woody biomass is classified as downed woody material (DWM). DWM has historically had a low economic value and was not considered merchantable in traditional markets. However, DWM does have high ecological value. DWM and associated leaves and needles represent a large pool of nutrients and are important contributors to soil organic material. DWM is a central element of wildlife habitat in forests, and in New England at least 40 species rely on DWM. Because of the important ecological role of forest biomass, removing too much can have devastating long-term effects on forest biodiversity, watershed health, and wildlife habitat.

Guidelines for the sustainable harvesting and retention of biomass present an innovative way to protect forest ecosystems, maintain productivity, and provide additional income to producers. There is a need for producers to understand and be able to apply biomass harvesting guidelines on the ground to assure long-term sustainability and safeguard ecological health.

All 50 states have Best Management Practice (BMPs) programs that are intended to protect water quality and other values. State programs range from laws that prescribe mandatory practices to voluntary BMPs and education and outreach programs. These programs are routinely monitored, and literature indicates that when these BMPs are properly implemented they do protect water quality.

With so much existing regulation, why are guidelines specific to biomass harvesting necessary? Biomass harvesting guidelines are designed and needed to fill the gaps where existing BMPs and forest practice regulations may not be sufficient to protect forest resources under new biomass harvesting regimes. New biomass harvesting guidelines need to integrate differences in forest types and site conditions to ensure that critical ecological and economic conditions are met when harvesting biomass.

States vary on their approach to biomass harvesting guidelines. Some do little to address biomass in their current BMPs, while others such as New Hampshire are completing updates to BMPs that incorporate helpful guidelines for biomass without specifically calling them “biomass” guidelines. Other states are more specific about the intent of the guidelines and reference them as biomass guidelines.

Both forestry and renewable energy sectors benefit from sustainable harvesting and retention guidelines. Guidelines benefit the forestry sector by providing clear, science-based guidance on how much and what kind of material to leave in the woods when harvesting biomass. Guidelines benefit the energy sector, because along with sustainable forest management, they provide an assurance of sustainable supply that is import to energy end users and domestic and foreign energy markets.

Sustainable biomass harvesting and retention guidelines specifically address the issue of downed woody material requirements to maintain essential soil nutrients, wildlife habitat, and water quality.

Without science-based guidelines to help practitioners determine how much material to leave in the woods, soil nutrients, wildlife habitat, and water quality may be negatively affected. Continual degradation of forest soils and habitat, can have long term effects on productivity and plant and animal species health.

REVIEW OF METHODS

This project was innovative because it provided an ecological, science-based, operational approach to implementing new sustainable biomass harvesting and retention guidelines.

The Forest Guild developed and published regional biomass harvesting and retention guidelines for major Northeastern forest types (*Forest Biomass Retention and Harvesting Guidelines for the Northeast*, May 2010). They are science-based, conservation practices that provide operational recommendations on how much forest biomass to leave on the ground to help preserve biodiversity, wildlife habitat, and clean water resources across the forest landscape. (*Ecology of Deadwood in the Northeast* summarizes the science behind the guidelines.)

Current best management practices may not adequately address issues of soil nutrient availability and wildlife habitat in the face of increased wood removal from biomass harvesting. Adoption of biomass harvesting and retention guidelines fill the gaps in existing best management practices by providing producers with clear recommendations on the amount and type of woody biomass to leave in the forest. The following methods were used to integrate the harvesting guidelines into functioning harvest operations:

- Engaged and built on existing partnerships with cooperators including state forestry, state conservationists, conservation districts, cooperative extension, state master logger programs to further their understanding of the purpose and application of biomass harvesting and retention guidelines.
- Created and disseminated outreach materials including factsheets that explained and encouraged the adoption of sustainable practices for forest biomass production.
- Contacted and educated landowners about opportunities to sustainably produce and harvest forest biomass for renewable energy. Initial contact was used to further tailor the field workshops to optimally meet producer interest and needs in applying sustainable biomass retention and harvesting guidelines.
- Worked with foresters and loggers to assist producers in the sustainable production and harvest of forest biomass for renewable energy.
- Built and documented demonstrations of sustainable production of forest biomass for renewable energy. Demonstration sites were implemented in Maine, New Hampshire, Vermont, Pennsylvania, and Maryland.
- Developed a resource field sheet for producers and those who work with them.

- Created an interactive website to share sustainable forest biomass resources guide, outreach materials, and producers' and forester/loggers' experiences.

Outreach efforts were successful in promoting the importance on sustainable biomass harvesting and biomass retention. Outreach efforts, publication materials, presentations, and webinars were successful in building awareness of the Forest Guild's biomass harvesting and retention guidelines.

Field workshops demonstrated how guidelines can be applied by practitioners in the field. The most significant concern expressed about the guidelines from producers was the potential to increase harvesting costs and add operational constraints. Depending on the forest type and harvesting methods, costs associated with applying the harvesting guidelines will vary. Field tours were necessary to demonstrate what the biomass retention targets look like on the ground and compare the operational differences between following and not following the guidelines.

In Maine, for example, following biomass harvesting guidelines in spruce-fir systems using whole tree harvesting systems did not result in a significant difference in the amount of material maintained on the site or significant changes in harvest operations. In cases where meeting the harvesting guidelines results in leaving more material or changes in harvest operations, analysis will be needed to determine additional costs necessary to follow the guidelines.

Acceptance of new management and harvesting components takes time – longer than the timeframe of the grant. We were able to increase producer and practitioner awareness and familiarity with harvesting guidelines through the grant, but more time will be needed to institutionalize the guidelines across the 9 state project region. If we were starting the project today, we would benefit from over two years' experience using the guidelines in the field. It is likely that producers and practitioners would have had more opportunity to see the guidelines applied in the field or use the guidelines themselves on their own harvests.

DISCUSSION OF QUALITY ASSURANCE

The Forest Guild Biomass Harvesting and Retention Guidelines were developed by a working group consisting of 21 Forest Guild members representing public and private field foresters and resource managers, academic researchers and members of major regional and national environmental organizations. The process was led by Forest Guild staff and was supported by two Forest Guild reports: *Ecology of Dead Wood in the Northeast* and *An Assessment of Biomass Harvesting Guidelines.*

Wherever possible we based our recommendations on peer-reviewed science. However, in many cases, research was inadequate to connect practices, stand level outcomes, and ecological goals. Where the science remains inconclusive, we relied on field observation and professional experience. The guidelines provide both general guidance and specific targets that can be measured and monitored. These guidelines should be revisited

frequently, perhaps on a three-year cycle, and altered as new scientific information and results of field implementation of the guidelines become available.

FINDINGS

The project achieved the following accomplishments:

- Convened a 21 member outreach team representing each state engaged in the project.
- Planned and delivered 4 webinars
- Created and printed three outreach documents. 1) A hard copy version of the full report *Forest Retention and Harvesting Guidelines for the Northeast*. 2) A tri fold field-friendly shortened version of our retention guidelines. 3) A cover letter that encourages participation and feedback in our project.
- Working through our network of foresters and partners, the Forest Guild distributed the guidelines to over 300 practitioners and producers.
- Coordinated 9 meetings and field tours on sustainable biomass harvesting.
- At the state level, the Forest Guild guidelines were evaluated and considered in Maine, Massachusetts, New Hampshire, Vermont and Connecticut and received accolades in New York as being the best of kind.
- Completed an interactive sustainable biomass harvesting website.

The first few months of our project were focused on conducting webinars for Guild members and non-members, organizing our outreach team, producing and distributing our outreach materials and planning and scheduling our field demonstrations which were conducted in more favorable weather conditions.

We developed a 21 member outreach team of Forest Guild members that covers each of our nine state program region. Individual coordinators were responsible for outreach and activities at the state level and combined with our three major partners-Pinchot, University of Maine and TNC- we addressed harvesting guidelines in each state. The team met once a month via conference call to share technical information and outreach tips. Each call had a theme such as contact with Master Logging Programs or technical information on how to measure retention in the field.

We created and printed three outreach documents. One is a hard copy version of the full report *Forest Retention and Harvesting Guidelines for the Northeast*. We also produced a tri fold field-friendly shortened version of our retention guidelines and a cover letter that encourages participation and feedback in our project. These documents were distributed to over 300 practitioners across the region.

Our CIG project allowed us to enhance our work with the Northern Forest Investment Zone Partnership, an effort funded by the US Endowment for Forestry and Communities. Within that project's pilot area in the Mahoosuc Region of Maine and New Hampshire we targeted all major landowners, all community and town forests, and all biomass

facilities for biomass guidelines outreach. We presented the guidelines at two evening community meetings regarding biomass and are working directly with potential biomass users.

In Vermont, we participated in a Hubbard Brook sponsored biomass roundtable at Green Mountain College. GMC has a biomass system installed but would like to insure that the wood supply is sustainably produced. We introduced the Guild guidelines as one step on the path to sustainability and they were enthusiastically received as a critical ingredient in an overall sustainability index the college will eventually develop.

At the state level, the Forest Guild guidelines were evaluated and considered in Maine, Massachusetts, New Hampshire, Vermont, and Connecticut and received accolades in New York as being the best of kind. At an April, 2011 University of Vermont Biomass Symposium we organized a panel discussion that involved representatives from each of the Northern Forest states to discuss state based guidelines and the prospect for enhancing voluntary practices. The symposium also included a biomass retention field day where we led participants on the first of our field demonstrations through visits to woodlots harvested by Vermont Family Forests.

We took advantage of speaking opportunities at conferences and workshops and presented the guidelines at a Yale University biomass conference, at the North East Sustainable Energy Association annual conference in Boston and at a meeting of the Maine Master Loggers program. Each of our state coordinators were involved in dozens of different outreach activities at the state level along with direct individual outreach to producers.

Working through the Forest Partnership in VT, the Guild guidelines were incorporated into a green biomass procurement process. The Forest Partnership consists of five forest businesses that work to buy and consolidate wood from landowners following FSC Certification and Guild guidelines. The Forest Partnership then sells the wood to institutional biomass heating facilities that demand sustainable biomass supply. The Forest Partnership model is an example of a green biomass procurement system that provides landowners with access to new markets and biomass facilities with a consistent supply of sustainably-harvested wood.

We developed and launched an interactive sustainable biomass harvesting website. The website is the most comprehensive collection of sustainable biomass harvesting knowledge and resources available online.
http://www.forestbiomassguidelines.org/

CONCLUSIONS AND RECOMMENDATIONS

Biomass harvesting and retention guidelines serve as new innovative conservation practices for the production, harvest, and handling of sustainable forest biomass for renewable energy in the Northeast. The Guild guidelines are widely considered the best

of breed and have served as the model for developing sustainable biomass harvesting guidelines for Southeastern and Pacific West forest types.

As harvesting guidelines vary by forest type, it was important to demonstrate the guidelines broadly to better understand the variety of factors that influence guideline implementation. For example, in northern Maine, harvesting guidelines were applied to a 22-acre harvest area in a spruce-fir-pine forest. The study examined four combinations of harvesting equipment and trail spacing that might be effective in treating ~40-year-old stands regenerating from the spruce budworm outbreak. In all scenarios, the guidelines resulted in enough woody biomass being left on site. The bigger concern of loggers in Maine was the type of silviculture applied and the type of equipment used. Most loggers are committed to doing right by the woods, but want to be able to operate effectively and profitably. Understanding how harvesting guidelines are applied to current practices is necessary for building support.

While our outreach and education materials have helped foresters and loggers understand the basis for implementing biomass harvesting guidelines, we learned that visual tools to help managers estimate the amount of wood to leave after harvest is important. Ideally, the visual guide would include a series of photographs depicting what certain percentages of biomass retention look like. In addition to hands-on resources, showing people how the guidelines have been applied on the ground is important for making the link between a retention target and actual wood left on site.

To bring the guidelines into mainstream forestry practice, the costs of implementing the guidelines on certain forest harvesting operations need to be understood. It is likely, depending on the type and extent of harvest operation, that implementing harvesting guidelines come at an additional cost. Like Best Management Practices for water quality, it will take time for producers to build familiarity and acceptance. The best way to move the process of acceptance and adoption forward is to implement harvesting guideline on a variety of harvesting operations under a variety of conditions.

The Biomass Retention and Harvesting Guidelines will help accomplish the Forest Stand Improvement conservation practice standard (666) by facilitating harvest of forest products, improving wildlife habitat, and restoring natural plant communities. Code (384) includes Considerations pertaining to wildlife habitat and Additional Criteria for soil organic matter, but does not include specific guidelines or recommendations. We recommend including regional biomass harvesting guidelines as Additional Criteria to conservation management practice (384) Woody Residue Treatment.

An opportunity exists to incorporate the guidelines as part of a sustainable biomass procurement strategy for institutional wood boilers in New England. No consistent green procurement system exists in places like VT making it hard for biomass users that want to buy sustainably-harvested wood. A sustainable green procurement system that includes a combination of harvesting guidelines, management plans, BMPs, master loggers, and third-party certification could meet the sustainable biomass needs of a variety of biomass

users. Incorporating the Guild guidelines into green procurement systems is one of the best ways for institutionalizing the guidelines.

APPENDICIES

A. Publications/Websites

Forest Biomass Retention and Harvesting Guidelines for the Northeast
http://www.forestguild.org/publications/research/2010/FG_Biomass_Guidelines_NE.pdf

Forest Biomass Retention and Harvesting Guidelines for the Northeast – Trifold

Forest Biomass Retention and Harvesting Guidelines for the Northeast – Intro sheet

Ecology of Deadwood in the Northeast
www.forestguild.org/publications/research/2010/ecology_of_dead_wood.pdf

Revised Assessment of Biomass Harvesting and Retention Guidelines
http://www.forestguild.org/publications/research/2009/biomass_guidelines.pdf

A Guide for Biomass Harvesting and Retention
http://www.forestbiomassguidelines.org/

B. Meetings and Workshops

Hubbard Brook research Foundation. Biomass Roundtable – Wood Biomass Energy. Poultney, VT. November 18, 2010.

University of Vermont Woody Biomass Energy Research Symposium. Burlington, VT. April 28-30, 2011 http://www.uvm.edu/~cfcm/symposium/

Maryland/Deleware SAF Spring Meeting. Wood energy and Biomass Opportunities. Wye Mills, MD. May 25, 2011

Biomass Harvesting Sustainability Workshop. University of Pennsylvania. September 1, 2011

Forest Guild Northeast Regional Meeting – Biomass harvesting field tour. Fairlee, VT. September 22-23, 2011

Establishing Sustainable Biomass Supply Chains. Milford, PA. November 14, 2011

University of Maine CFRU - Early Commercial Thinning Site Visit. Summit Township, ME. Thursday, May 24

Buffers, Biomass, and BMPs: Management Considerations in Maine's Crooked River Watershed, Norway, ME, June 28, 2012
http://www.forestguild.org/meetings/NE_mtg_12_BMPs.pdf

A Look at Forest Structure and Complexity in the Context of the Forest Guild's Biomass Harvesting and Retention Guidelines**.** Newfields, NH. Friday, June 29, 2012

C. Webinars
US EPA Webinar: Biofuels and Sustainability, September 21, 2010
http://www.forestguild.org/webinars.html#EPA

Forest Biomass Harvesting and Retention in Maryland, October 20, 2010
http://www.forestguild.org/webinars.html#MD

Webinar: Sustainable Harvest Guidelines for Biomass, November 9, 2010
http://www.forestguild.org/webinars.html#USendowment

Webinar: Biomass Harvesting Guidelines: Forest Management Issues October 28, 2011 (requires registration)
https://extension.psu.edu/energy/wood-energy/northeast-wood-biomass-energy-program/webinars/2011-10-28

TECHNOLOGY REVIEW CRITERIA

A description of the technology (method)
The Biomass Retention and Harvesting Guidelines provide a method to ensure that biomass harvesting for renewable energy does not jeopardize the long-term sustainability of both forest productivity and ecosystem health. The Guidelines set specific targets for retention of critical forest structures, including retention of tops and limbs, standing dead trees, and large trees for wildlife. They also provide recommendations for water quality, riparian zones, and operations.

An explanation of how this technology or measure will accomplish one or more of the purposes of an existing standard
The Biomass Retention and Harvesting Guidelines will help accomplish the Forest Stand Improvement conservation practice standard (666) by facilitating harvest of forest products, improving wildlife habitat, and restoring natural plant communities. Code (384) includes Considerations pertaining to wildlife habitat and Additional Criteria for soil organic matter, but does not include specific guidelines or recommendations. We recommend including regional biomass harvesting guidelines as Additional Criteria to conservation management practice (384) Woody Residue Treatment.

Process monitoring and control system requirements, if applicable
Monitoring implementation of Biomass Retention and Harvesting Guidelines should be part of standard forest timber harvest monitoring conducted by professional forester or other harvest administrator.

An example of warranties on all construction materials, equipment, or applied processes not covered by other NRCS Conservation Practice standards
Since this technology does not include physical parts a maintenance plan is not applicable.

An operation and maintenance plan that includes performance monitoring requirements and a replacement schedule for components that will not last for the practice lifespan
Since this technology does not include physical parts a maintenance plan is not applicable.

Estimated installation and annual operation cost
There is no installation cost. Annual operation costs will vary by forest type, silvicultural prescription, harvest system, and topography. In general, costs of implementation will be minimal after a brief learning period.

Independent, verifiable data demonstrating results for the use of the measure, equipment, facility or process in other similar situations and locations
See final report.

The credentials of the individual collecting the data along with a disclaimer of any conflict of interest on the part of the individual
The team who developed the Biomass Retention and Harvesting Guidelines included professional foresters and forest researchers:

- Nick Bennett, Natural Resource Council of Maine, Maine
- Marcus Bradley, Redstart Forestry, Vermont
- Steve Broderick, Connecticut Forest and Park Association, Connecticut
- David Brynn, Vermont Family Forests, Vermont
- Robert Bryan, Forest Synthesis LLC, Maine
- Richard Campbell, Yale School of Forestry and Environmental Studies, Connecticut
- Mike DeBonis, Forest Guild, New Mexico
- Harry Dwyer, Ghost Dancer Forestry, Maine
- Dr. Alexander Evans, Forest Guild, New Mexico
- Jamey Fidel, Vermont Natural Resources Council, Vermont
- Ehrhard Frost, Full Circle Forestry, Vermont
- Brian Holt Hawthorne, Massachusetts Division of Fisheries and Wildlife, Massachusetts
- Ann Ingerson, The Wilderness Society, Vermont
- Donald Mansius, Department of Conservation, Maine Forest Service, Maine
- Rick Morrill, Maine
- Bob Perschel, Forest Guild, Massachusetts
- Dave Publicover, Appalachian Mountain Club, New Hampshire

- Chris Riely, Providence Water, Rhode Island
- Jeff Smith, Butternut Hollow Forestry, Vermont
- Mary Snieckus, Forest Policy Consultant, Maryland
- Pieter van Loon, Vermont Land Trust, Vermont
- Bob Williams, Land Dimensions Engineering, New Jersey

No one on the team works for a bioenergy firm or has a conflict of interest.

Contact information for the technology provider

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