Niagara Phase II Biomass Supply Analysis: Detailed Market Analysis, Logger Interest, Logger Capability and Other Potential Agricultural Fiber Supplies

Prepared by

Jeff Groeschl, Groeschl Forestry Consulting
and
Jan J. Hacker, Resource Analytics

October, 2009
FINAL DRAFT

New North Inc.
1716 Lawrence Dr.
De Pere, WI 54115

Table of Contents

1.0 Introduction.

New North contracted with Resource Analytics to conduct a biomass supply analysis within a fifty, sixty and sixty-five mile radius of Niagara, WI for the purpose of evaluating this site as a location for a cellulosic biomass ethanol plant. Initial primary focus was on logging residues as a source of biomass. As the study progressed, analysis of potential available fiber from round wood and agricultural sources was added.

The study was divided into two parts. The first part described the timber resources of the area, assessed the volumes of available fiber from logging residue from various ownerships, given current harvest levels & policy environments, and potential agricultural sources of fiber.

Results indicated that:

- Approximately 460,000 green tons of fiber could be obtained from logging residue within 65 miles of the project site.
- Policy constraints in harvesting logging residue are minimal on all ownerships except National Forests.
- Roundwood would be an additional source of fiber since there is currently a void in the market for this product given the closure of two mills in the area at Niagara & Kimberly.
- There is an opportunity to utilize agricultural crops in the region to supplement logging residue chips and roundwood as a source of fiber.
- Flexibility in feedstock supply would be beneficial to allow a cellulosic ethanol company to better manage their supply chain.
- The logging contractor infrastructure appears to be more than adequate to undertake chipping operations if a market develops.

Phase one conclusions relied almost exclusively on Forest Inventory and Analysis data, U.S. Department of Agriculture data, and interviews with forest managers from various ownerships. Missing in the phase one analysis was detailed investigation of the logging and farming sectors to determine interest, capability and delivered price to a potential cellulosic ethanol plant at Niagara. The results from phase two of the project seeks to answer these questions, refine the assumptions and conclusions developed in phase one and provide a more detailed analysis of potential fiber supply chains now and in the future.

2.0 Methods.

The forest products related information contained in this report was collected during late July 2009 from personal visits with selected potential biomass suppliers at their offices or work sites. Potential suppliers to be interviewed for this process where selected from a very large pool of logging contractors in Michigan and Wisconsin. Bidder lists for loggers were obtained from county and state agencies to determine those that repeatedly showed up on various lists. The firms known to be utilizing any residue material were immediately included and then additional firms were selected based on area of coverage. The final list was determined through personal contacts with agency foresters and private foresters in the region to select the firms with the best reputations for work performance and innovative approaches.

Potential suppliers interviewed were typically the owner of the business or in some cases as many as three co-owners of a single business. Five of the potential suppliers were traditional, well established logging firms within the forest products industry. One of the potential suppliers is a wood waste recycling firm that operates outside the realm of the traditional forest products industry.

The following information will be presented as a summary of the items which appear to be consistent between all potential suppliers of wood fiber. While all suppliers may not be similar, there are distinct trends present that will be addressed together. Following this summary section, information specific to each potential supplier will be presented.

Methods utilized to investigate equipment options for harvesting/processing available fiber are written from the perspective of a possible fiber user. The logging contractors interviewed in this project expressed no interest in information regarding equipment options to supply a fiber user. Consequently, this section will outline the facilities needed by the receiving mill to process various forms of delivered fiber received and a general discussion of activities/equipment developments to make the collection of logging slash more economical.

Methods utilized to investigate possible use of agricultural products included a literature search on switchgrass and willow and contact with agricultural extension personnel in the target supply area to determine price ranges of hay and other forage crops which might be utilized by a cellulosic ethanol producer.

3.0 Logging Residue Markets & Competition.

3.1 Interviewed companies actively producing chipped or ground wood residue within the supply area.

Three of the five forest products firms interviewed currently utilize residue as a ground wood product delivered to market as boiler fuel. Their production ranges from 30,000 tons to 55,000 tons annually. Their current production is limited only by the amount that they can sell within the current market. One firm has three chippers that are currently not being utilized. Another firm indicated that they could increase residue production an additional 100,000 tons annually if requested to do so. The waste wood recycling firm utilizes wood waste generated by municipalities in the Green Bay area as a ground wood product delivered for boiler fuel.

The forest products firms that currently have the capability to produce chipped wood or ground wood do not recognize wood fiber as “residue”. The term “residue”, they feel implies waste or otherwise unusable material, whereas the limbs and tops of trees have been used for decades by sectors of the forest products industry. Whole tree utilization or top utilization has been conducted by various firms and mills throughout the Lake States region and is not considered within the industry as a new market or concept. The degree to which this market has been utilized in the past has been based on economics, as with all types of forest products – particularly in this case, the cost of wood fuel verses alternative fuels.

Firms with long histories in the forest products industry have worked through at least one or two cycles of expansion and decline in the chipped wood market. Many referenced machinery

purchased specific for this market opportunity, only to be held idle as the market quickly declined. Federal, state, and county forestland ownership have also recognized "residue" as a forest product and have typically required payment for harvest of this material.

3.2 Use & prices paid.

Currently and historically, the use of both whole-tree chips and chipped logging residue has been used for boiler fuel. Use of chips for paper furnish requires a higher quality chip, free of bark and dirt, and meeting tight specifications regarding size and consistency and consequently is not a competitor within this market.

The last major market increase in demand for wood as boiler fuel was during and immediately after the Arab oil embargo in 1973 during the Carter Administration when U.S. energy policy was strongly focused on alternative sources of energy in response to increased prices for virtually all fossil fuels, particularly oil and natural gas. Later, as supplies increased and prices decreased, the interest in alternative sources of energy faded – until recently.

Historically, price increases and decreases for woody biomass closely followed the price trends of alternative fossil fuels. In response to increases in oil and natural gas prices, prices paid for biomass boiler fuel also rose to the point that it became economical for logging contractors to harvest and deliver it to users. Most often the market for such material resulted from co-firing woody biomass within industrial boiler systems where this could be done as a partial substitute for more expensive fossil fuels.

Wholesale conversion to industrial scale woody biomass only boiler systems was not wide-spread except in the Northeast where such conversion was heavily subsidized. These large scale wood burning enterprises later were converted back to fossil fuels when subsidies were removed and the price of fossil fuels dropped making the price needed to keep the production of chipped logging residue economically viable uncompetitive in the market compared to the fossil fuel alternatives.

The pulp & paper and composite board industries have displayed a similar dynamic in regards to the species used to make their products. Oriented strandboard was essentially created partially to utilize a species that forest managers couldn't give away at one time – aspen. As aspen prices rose, industries focused on other under-utilized species and re-engineered their processes to substitute these cheaper sources of fiber for aspen as part of their procurement volume. This same dynamic is at play in the use of wood residue as either boiler fuel or as a feedstock for pellet manufacturing or biomass ethanol. Industries continuously adjust in an attempt to use the cheapest feedstock available which will not compromise the quality of the product they produce.

How a similar dynamic might play out in the current intense focus on alternative energy sources is unclear. It seems likely that current policy initiatives to promote alternative energy will be more long lasting than past initiatives, primarily because demand for fossil fuels continues to grow world-wide and all indications are that prices will continue to increase over time.

In 1973, focus on alternative energy resulted from a spike in prices and reduced supply due to the oil embargo. This event was not long lasting and, consequently, did not result in a sustained

focus on alternative energy. The situation today is different in that it seems clear that energy prices in the long-run from fossil fuels will not come down to a substantial degree given the demand from developing countries (particularly China) and somewhat fixed supplies/production. The current situation suggests that focus on alternative energy production will be more long lasting in the U.S. than it was in the 1970's as it has been true in Europe. For example, Europe represents the strongest market currently for wood pellets which most new U.S. wood pellet manufacturers are profitably exploiting. It is unknown when the U.S. will catch up to their European counterparts in this regard, but it is bound to happen in the coming years.

In the case of the Niagara mill situation, another factor comes into play – the weakness in the pulp and paper sector in all developed countries – which has resulted in considerable industry shrinkage. There is great concern throughout the Lake States that more such shrinkage and mill closures will occur resulting in a glut of un-used fiber – exactly the current situation in the proposed Niagara supply area. This may keep wood fiber supply costs very reasonable for a long period of time since the most likely new competitors for wood fiber in the region appear to be wood pellet mills, new wood burning only boiler systems and retro-fits of existing boiler systems currently designed to burn only fossil fuels. Within this scenario, market conditions may not strengthen for fiber for new entrants but simply represent the substitution of one industry type for another for the existing or expanded available fiber supply, thus having a neutral effect on price.

Current prices paid for ground wood delivered for boiler fuels within the market are outlined later in this report.

3.3 Species purchased.

The species purchased by a cellulosic ethanol manufacturer will be reflective of the current harvests in the procurement area, in whatever form the fiber is delivered. The species will, most likely, be primarily mixed hardwoods and, at least initially, a heavy percentage of aspen which has limited markets due to the closure of the Niagara mill and the reduction of production at the current mills using this fiber source.

3.4 Volumes purchased over time.

Interviewed firms were not willing to divulge much information on current residue outlets. The intensely tight and competitive market situation for disposing of residue products does not foster open discussion on volumes, delivery points or precise pricing. Given the reduced overall wood production and idle residue equipment, it would be reasonable to assume that the current residue market is as depressed as the round wood market.

There is no evidence that other mills within the region are considering conversion to bio-refinery as is the case at the Park Falls, Wisconsin mill. The current use of residue by the Park Falls mill appears to be inconsequential in the overall wood fiber demand within the Park Falls area or within the region.

4.0 Pulpwood Markets & Competition Within the Supply Area.

4.1 Companies actively purchasing pulpwood within the supply area.

Verso Paper Holdings in Quinnesec MI, NewPage in Escanaba MI, and LP in Sagola MI are the current outlets most closely located to the Niagara site. Some of the potential suppliers also currently utilize Thilmany in Kaukauna WI and Smurfit-Stone in Ontonagon MI.

4.2 Species purchased.

Following is a table of the "current" species consumption by mill. Keep in mind that species demand by mills has changed over time with some changes occurring abruptly and others more methodically. Several suppliers described the almost spastic swings in species composition demands by several of the mills within very short timeframes. Mills have been attempting to shift species compositions for purposes of end product quality, but also in the constant quest for the cheapest material.

Mill	Aspen	Hardwood	Conifer
Verso		X	x
NewPage	X	X	X
LP	X		
Thilmany		X	X
Smurfit-Stone	x	X	

X = primary specie(s) x = secondary specie(s)

4.3 Volumes purchased over time.

No information is available as to the purchasing history of the mills within the procurement area. One can only surmise that if the largest producers within a fixed area are at 30% to 50% reduced output, then the consuming mills must be at a similar level of reduced activity. This is typically accomplished by pulp and paper users by shutting down one or more of their most inefficient paper machines thus reducing production and the need for fiber supply. Existing contracting terms, as outlined later in this report, also suggest that the volumes of fiber purchased by existing users is at a low ebb. Logging contractors report that it is a buyers market at present and consequently they have had to give up a lot in regards to certainty of market outlets to remain in production.

4.4 Utilization standards.

The forest product firms interviewed all produce round wood to a minimum industry standard piece of 4 inches on the small end (inside bark) and 102 inches long. Most producers indicated that this is the standard minimum piece size, but does fluctuate slightly depending upon market conditions or species. The ground wood that is currently produced by two firms has no specifications due to its use as a boiler fuel. The wood waste recycling firm also produces a ground wood product for boiler fuel.

4.5 Prices paid.

Current delivered wood prices provided by all firms ranged between $30 to $45/green ton of unknown moisture content (most likely, 50 % moisture content). It must be noted that the firms

that currently produce ground wood and have chip wood capability DO NOT distinguish pricing differences between round wood and ground or chip wood. Pricing is considered the same for **all fiber**, regardless of delivered form. Aspen was typically quoted as being between $30/green ton and $36/green ton delivered to current markets. Mixed hardwood was quoted as being between $35/green ton and $42/green ton delivered to current markets. Oak was quoted as between $30/green ton and $32/green ton, while pine was quoted between $38/green ton and $45/green ton delivered to current markets. There are currently no price modifiers available to suppliers.

4.6 Estimated surplus pulpwood due to Niagara pulp mill closure.

Prior to its closing, the Niagara mill had the capacity to utilize 480 cords of pulpwood daily or 175,200 cords annually assuming production every day of the year. Three quarters of this raw material was sourced from Wisconsin, 21% from Michigan and 4% from other areas. The wood harvesting radius was 150 miles. Suppliers to the Niagara mill totaled 150 with the top five suppliers representing approximately 30% of the volume.

While past species utilization data is not currently available, it is likely that a large component of wood use at the Niagara mill consisted of Aspen since that is the species most in surplus currently in the proposed procurement area following the Niagara mill closure.

5.0 Logging Community Capabilities.

5.1 Interviewed producers & annual production capability by product/species/forest type.

Following is a summary of the round wood and residue production by each forest products firm interviewed in **green tons**. Aspen, hardwood, and conifer are round wood products and residue is a non-sorted mix of species produced in ground wood form.

Firm	Aspen	Hardwood	Conifer	Residue	Total
St. John	92,000	96,000	90,000	55,000	333,000
Carey	38,640	40,320	18,900	50,000	147,860
Olson	17,250	36,000	16,875	30,000	100,125
Wild Rivers	23,000	33,600	18,000	0	74,600
DeLeat	9,200	21,600	15,750	0	46,550
Waste Wood	0	0	0	10,000	10,000
	180,090	227,520	159,525	145,000	712,135

5.2 Harvesting systems

The five forest products firms reflect the recent trends within the forest products industry to move toward more specialized equipment. Many forces within the forest products industry within the last twenty years has resulted in the movement of more producers toward the cut-to-length systems commonly seen on logging sites today.

A typical cut-to-length system includes a processor and forwarder working as a team to produce the variety of wood products from a specific timber sale. The processor fells the tree, removes

the limbs, and cuts the tree into the appropriate length segments for marketing. The forwarder follows the processor and gathers up the various forest products and stacks them for hauling along the access road. The "residue" from this process are the limbs and the top of the tree where the main bole is less than 4 inches in diameter. The residue can be left scattered throughout the harvest area as each tree is harvested or the processor operator can attempt to create pilings of the residue by processing several trees in the same area.

The cut-to-length systems differs from pole-length or tree-length systems in that the latter two drag the entire bole or tree to a centralized landing area for processing into various forest products or simply fed into a chipper. The pole-length and tree-length methods are quite efficient at utilization of residue because they tend to centralize residue at the landing area and minimize handling of a low value product. However, these systems have been replaced by cut-to-length systems due to a variety of reasons including, environmental concerns, forest product markets, timber sale sizes, types of harvests, and road and landing development.

Two of the five forest products firms continue to maintain and utilize a tree-length operation along with their cut-to-length operations. The tree-length operations utilize a grinder as opposed to a chipper to produce boiler fuel. This product tends to be less consistent in size and form and contains a much higher percent dirt and debris. Chip wood typically is cleaner, more uniform in chip size, and contains much less bark and non-wood matter.

5.3 Trucking capability.

Direct truck delivery to markets accounts for nearly all current wood delivery. Rail was utilized by only two firms accounting for only about 10% of their wood volume. All firms indicated the ownership of trucks for delivery of either their roundwood or their residue product. All firms also indicated that they contract some portion of their wood hauling to independent truckers.

The varying truck configurations showed no consistency between all firms, other than they all utilized nearly all the available configurations, such as truck with pup trailer, truck with straight trailer (with or without loader), box vans, and box vans with a live bottom. Most trucks were configured to carry the maximum legal limit in each state, 98,000 pounds in Wisconsin and 164,000 pounds in Michigan. All firms felt that the most efficient form in which to haul wood was as roundwood or chips. They felt these two forms allowed the maximum utilization of the allowable legal weight and thus optimized the economics of the haul. Ground wood normally could not be loaded to maximize legal payload due to the bulky nature of the material.

5.4 Current ground wood capability & slash removal machinery/technology.

The three logging firms with chipping capability are currently using two methods for utilization of residue. Two firms use their cut-to-length systems to bring the tops out to the access roads for grinding and loading into van trailers. One firm utilizes their cut-to length system for approximately 90% of their residue production with approximately 10% produced through a whole tree harvest system. None of the firms currently chip any residue, but rather grind it due to the potential for dirt in the material and the variety of input material, stems, limbs, leaves, etc.

Chipping historically has been utilized when there is a need for a product with a higher percentage of uniform solid wood that needs to be lower in dirt, bark, or other debris in the

product. One firm indicated that the economics of handling only residue in ground or chipped material was very marginal and that chipping of the entire tree was by far the most efficient means to utilize the residue in conjunction with the roundwood portion of the tree. All firms agreed that the cut-to-length process of handling residue has very sensitive economics that will be disrupted by any change in operating costs such as fuel.

5.5 Average haul distances for pulpwood & chips.

Most firms indicated that haul distance is flexible depending upon the site they are working, the quality of the haul route, stumpage price and delivered product rate. The most common desirable haul distance was quoted as between 50 to 70 miles. The two largest firms indicated that a 100 mile haul (one way) was not a problem as long as the other economic factors allowed a profitable return.

5.6 Satellite yard opportunities.

Seasonal weight restrictions (spring) were cited by all firms as potentially disruptive to wood delivery. All agreed that prudent planning for spring woods work as well as potential pre-hauling to staging areas can minimize the risk of down time during the spring thaw and road weight restrictions. Several firms indicated that they already utilize satellite wood yards to provide for hauling and wood deliveries from class A roads. Spring road weight limitations reduced one firm's production by 50% while others said it had it was as little as 10%.

The use of satellite yards for stockpiling on Class A roads is currently utilized for roundwood due to the ability to handle and stack the product. Currently no firms stockpile ground or chipped material due to handling costs. Any form of pre-hauling to satellite yards, either roundwood or ground material creates another cost of handling material. The benefit of hauling work and income flow during the spring thaw period is the most attractive aspect of use of satellite yards for logging contractors. However, if the cost of double handling material exceeds its benefit to the producer, they will not utilize the process. Handling of roundwood is currently the most common and cost effective means of double handling wood with existing machinery.

5.7 Current delivered wood pricing & price modifiers.

All firms were asked to provide a rate or range of rates for wood delivered to the Niagara site. These rates are all based on a per green ton basis for either roundwood or residue and include all species. The waste wood recycling firm indicated a delivered rate of $35/ton (ground wood). One forest products firm also indicated a rate $35.00/ton (roundwood). One firm indicated a range of $36/ton to $44/ton (all wood) with the remainder of the firms at $40/ton (all wood).

5.9 Greatest opportunity to add residue to the production process.

It is clear from the information above and what follows that the greatest opportunity to add residue to the production process is the creation of a market for such residue at a price which makes it economically viable for logging contractors to service that market. There appears to be few equipment limitations to such an expanded market, few policy/harvesting logistics constraints, few delivery constraints if fiber can be delivered in a variety of forms and few supply chain constraints **IF** contractual arrangements are satisfactory to the wood fiber suppliers.

6.0 Potential Expansion of Residue Production

6.1 Loggers definition of residue and form of delivery.

Residue, for purposes herein, will be considered material not utilized by the traditional roundwood market. The residue market has historically been limited by the demand for the product and the market price. Historically, many mills utilized the residues from their own operations to fuel boilers for power or heating needs and required limited additional supply needs. Large power plant consumers also utilized wood residue only as a portion of their needs and only in response to favorable economic configurations with other fuels. All firms felt that the greatest potential for utilization of all wood fiber in the future will be development of non-traditional uses such as wood pellet plants, small power plants, ethanol production, or combinations thereof. The producers also felt that within the next five to ten years most of the large traditional paper or wood products plants will be closed in this region.

6.2 Limitations on collection of residue.

As outlined in phase one of the project, there are few policy limitations on collection of residue in the form of logging slash. Some silvicultural limitations exist as well as physical limitations on the maximum volume of material that can be removed from a site without inclusion of dirt (estimated maximum of 60%). The economic viability is all dependant on the price paid for the material. This section discusses handling and delivery limitations.

The logistics of handling ground or chipped material is complicated by how the material is loaded and unloaded into the trailer units used for hauling. Loading of ground or chipped material must be done with conveyor or front end loaders. Trailer units are available that have a moving bottom (live bottom) that allows for the unloading of the trailer unit independent of other machinery. Most trailer units do not have this feature and are unloaded on a large machine at the delivery point that tilts the entire tractor/trailer unit until all the material slides out of the trailer. Pricing for a standard box trailer unit may be $5,000 while the “live bottom” unit may cost $80,000. The capability for unloading ground or chipped wood from trailer units at the delivery point would minimize the investment requirements of the potential providers of the material.

Additionally, as also stated in a previous section, double handling of ground or chipped material at satellite yards is not economically feasible and, consequently, delivery of this type of material as a supply source during spring break-up will be problematic.

6.3 Additional machinery needed & market assurances needed to acquire it.

All firms indicated a desire to expand their residue operations or to add residue to their current operations. The lack of a market outlet was their limiting factor for not doing so. All firms indicated a willingness to provide wood fiber as roundwood, chip wood, or ground wood. Roundwood delivery would accommodate all five forest products firms in their current operations with no risk of additional financial investment.

The larger firms which are currently diversified in ground or chip wood, indicated that they have no need for any financial assistance from any potential client to expand their delivery capability. They either currently own the equipment necessary to expand production or would make required purchases for expansion. Two firms indicated they could expand residue production by

100,000 tons this year if the demand was there and pricing was acceptable. The smaller forest products firms indicated the desire for some financial interest by the consuming mill, such as loans for equipment purchases. Loans or assistance with loans for machinery purchases is a practice utilized in the past by consuming mills. Mills assisted logging contractors with loan arrangements to purchase equipment to increase desired volume output by the logger for delivery to the consuming mill.

6.4 Percent of sales that have the potential for residue collection.

The firms currently utilizing residue indicated that approximately 80% to 90% of their timber sales would be available for utilization of residue. These timber sales included federal, state, county, and private lands on which they hold current contracts. One firm currently not utilizing residue indicated that perhaps 30% to 50% of their timber sales had potential to collect residue. Of those firms utilizing residue, they currently pay stumpage between $0.00/ton to $2.00/ton to the landowner. The most common rate is $0.50/ton.

There was difficulty in placing their harvesting practices in a category such as clearcut, shelterwood, or selective thinning. All firms indicated that they conduct significantly fewer clearcuts on all ownerships than they had in the past. The contractors are being required to leave trees in harvest areas that had been traditionally clearcut for species such as aspen and jack pine. The silvicultural practices of the forestry community have created confusion as to the regeneration method being applied or the name of the treatment that is appropriate. Therefore, for our purposes clearcut was defined as those harvests that removed 80% of the trees in a traditionally clearcut forest type. The producers referred to the remainder of their harvests as select cut because they felt they were “thinning” the forest, in both pine and hardwood types. The forest products firms consistently felt that clearcutting comprised between 20% and 30% of their entire operations with select cuts comprising the remaining 70% to 80%.

6.5 Delivery logistics.

All firms indicated that they experience varying degrees of impact on their production as a consequence of seasonal changes. The greatest impact during spring are the road weight restrictions that either prohibit hauling or are reduced to such a degree as to make hauling impractical. All firms indicated that this impact is highly variable from year to year based on the weather conditions and their ability to secure wood in favorable locations. One firm indicated that season of year was a “minimal” impact on their operations while another firm indicated reduction in operations as much as 50%.

While spring road weight restrictions are of significant concern, there are other factors which affect forest operations. Firms operating within the oak wilt restriction areas experience extended delays in entering forest stands covered by these restrictions. The oak wilt restriction may prohibit operations in affected stands between April and July annually. Each firm must deal with the limitations posed by weather and stand restrictions deemed necessary for forest health.

6.6 Degree of interest in serving a user of logging residue.

The forest products firms, as well as the waste wood recycling firm, all expressed sincere interest in assisting in any way possible to bring in new wood using industry. The level of interest by all firms was **extremely high** while guarded due to the current economic crisis they all face in their

businesses. All were very forthcoming during our discussion on the various issues and topics contained herein.

Current market conditions have created significant concern with all firms as to the security of their future operations. All firms indicated varying reductions in production due to inability to dispose of all forms of wood products. Several firms indicated that they have reduced production by as much as 50% due to lack of markets, with the remaining firms reducing production between 20% and 30%. The void between production capability and market demand has resulted in idle equipment and reductions in workforce.

7.0 Equipment Options for Utilizing Residue

There has been considerable attention over the last 5 years to the logistics of harvesting logging slash and equipment which can do this most economically. John Deere was the first company to introduce a machine into the U. S. market specifically designed for this purpose. This machine, called a bundler, is a modified John Deere forwarder which compresses the slash into a cylindrical "log" ties it with a type of heavy duty twine and cuts the "log" to length for transport on a regular logging truck -- identical to the manner in which pulpwood is transported. These machines are widely used in Scandinavian Countries where such harvest of slash has been common for many years. They have received a muted reception in the U.S. primarily due to the fact that they are a single use machine (they can only be used to bundle slash), require the receiving company to have equipment to utilize the material in this form and cost approximately $500,000.

Ponsse recently introduced a new model of forwarder designed to both transport logs (as traditional forwarders do) and compress slash for transport to the landing for chipping. This dual purpose machine has modified stakes on the transport bed which can be fixed in place for the transport of logs or can be hydraulically operated to compress slash deposited in the bed to maximize slash payload for transport to the landing. This machine is an improvement in utilizing a regular forwarder to transport the slash (which is done by current logging contractors who chip or grind slash with cut-to-length systems) due to the increased payload per trip the machine allows. One logging contractor interviewed for this project has already purchased one of these machines in anticipation of a future market for biomass material. This is also an expensive machine but its dual purpose capabilities appears to make it more suitable for use in the U.S. given current market conditions for biomass in the U.S.

Rather than chipping or grinding the slash at the landing, the U.S. Forest Service has a working proto-type of an articulated chip van which can travel on the same haul routes as a forwarder for chipping slash on the job site negating the need to transport the material to the landing. This chip van is currently undergoing field trials in the Western U.S.

As stated previously in this report, it would be wise for a cellulosic ethanol producer to design their facility to be able to utilize a wide range of possible feedstocks for maximum supply chain flexibility. For delivered chips and ground wood, a hydraulic truck lift is essential to unload the delivered material given the differential cost of a regular chip van and a live bed chip van which is self unloading.

If roundwood is procured, some chipping or grinding equipment at the receiving mill will be required to produce a more consistent feedstock. Use of roundwood is also advantageous from a storage and moisture content perspective. Roundwood is more easily stockpiled, compared to chips or ground wood, and can be left to dry for some time to reduce moisture content as is commonly done in Wisconsin for pulpwood supplies destined for pulp mills. Utilization of roundwood would also produce a feedstock that has a higher wood as opposed to bark component, than chipped or ground material, if that is an important consideration in the production of cellulosic ethanol.

Additional equipment may also be needed to utilize agricultural products which would be delivered in baled form.

8.0 Existing and Past Contractual Relationships With Mills.

8.1 Typical contractual terms.

All firms indicated that they hold their own contracts with the mills to which they deliver wood. All indicated that the current method by which mills procure wood does not resemble any form of contract they are typically familiar with. Contracts are typically considered binding on both parties unless modified and accepted by both parties.

All firms indicated that the method by which mills procure wood is totally unilateral in design. The procuring mill can modify or cancel any aspect of the contract with no involvement from the logging contractor. This main aspect of the current wood procurement system causes the greatest distress for all wood suppliers in this procurement region. The ability to plan finances, wood deliveries and timber sale contracts is seriously jeopardized by the lack of any binding commitment in the wood delivery contracting system.

8.2 Mill contracting history.

All forest products firms indicated some degree of dissatisfaction with the current system of wood procurement, which they feel has deteriorated rapidly in recent years. Several firms cited the need to maintain consistent procurement personnel to develop long term relationships with. The recent history of mill sales and the economic decline has resulted in loss of many procurement personnel that the loggers had come to know and work with.

All firms felt that they would like to be part of the “process” of developing their relationships and procurement contracts with consuming outlets. They also felt that an emerging industry could benefit from developing relationships with “quality” individuals and firms within the forest industry. Some firms felt that in the past mills were focused on getting the wood in as cheap as possible, resulting in poor performance by some in the industry. They feel that sincere, longer term relationships will provide security for both the supplier and consuming mill through all economic conditions.

9.0 Preferred Contractual Arrangements.

All firms indicated the need for very basic conditions within a procurement contract:

- The contract is binding on both parties, NO exceptions.
- Includes the specifications of the product to be delivered.
- Specifies a volume of product and the delivery schedule.
- Specifies delivery hours at the site.
- Contains any rate modifiers such as, fuel adjustment, cost of living, etc.
- Provides a contact person and dependable number to reach the person.
- Specifies the length of the contract period.

Most firms agreed that the need for an initial longer term contract, such as 5 years, would result in the security potential providers needed to improve or expand their operations within a viable economic window. Some of the smaller firms indicated that the lack of a 5 year commitment would make additional investment questionable.

10.0 Potential Wood Supplier Summary.

St. John Forest Products, Inc.
P. O. Box 130
Spalding, MI 49886
Office#: 906-497-5119 or 906-497-5667
Fax#: 906-497-5938

Contact Person: Thomas St. John

Very large diversified forest products firm with the greatest volume of production of all firms contacted. They currently produce round wood and ground wood and possess the ability to produce chip wood. Currently own three chipper units not in use. Very interested in continued dialogue to provide wood fiber in any form required by a consuming mill. They possess the machinery and capability to increase residue production immediately in the event a demand is created. They indicated a delivered rate of $40/ton for wood fiber (in any form) delivered to the Niagara site. Feel they can respond to nearly any level of residue demand based on current machinery inventory as well as potential subcontractor supply. Indicated no need for any financial incentive or involvement by any consuming mill.

Carey Logging, Inc.
N12846 Sawyer Lake Road
Channing, MI 49815
Office#: 906-542-3420
Cell#: 906-282-3265

Contact Person: James Carey

Large diversified forest products firm producing a significant volume of wood fiber. They currently produce round wood, ground wood and chip wood. Very interested in continued

dialogue to provide wood fiber in any form required by a consuming mill. They possess the machinery and capability to increase residue production immediately in the event a demand is created. They indicated a delivered rate of $36/ton to $44/ton for wood fiber (in any form) delivered to the Niagara site. Feel they can respond to nearly any level of residue demand based on current machinery inventory as well as potential subcontractor supply. They indicated the immediate capability to increase residue production by 100,000 tons per year. Indicated no need for any financial incentive or involvement by any consuming mill.

Olson Brothers Enterprises, LLC
W9297 Moonshine Hill Road
Crivitz, WI 54114
Office#: 715-856-5285
Cell#: 715-923-2307

Contact Person: Jim or Dan Olson

Mid- sized diversified forest products firm producing a moderate volume of wood fiber. They currently produce round wood and ground wood with the capability to produce chip wood. Very interested in continued dialogue to provide wood fiber in any form required by a consuming mill. They possess the machinery and capability to increase residue production immediately in the event a demand is created. They indicated a delivered rate of $40/ton for chip wood delivered to the Niagara site. Feel they can respond to an increase in residue demand based on current machinery inventory as well as potential subcontractor supply. They indicated the desire to provide chip wood developed from whole tree chipping operations based on optimal economics. They indicated that financial investment by an emerging market would be attractive for expansion of operations, such as additional machinery financing. Incentives would not be a requirement for their participation, but would foster faith in the emerging market.

Wild Rivers Forestry, Inc.
W6666 Judy Street
Wausaukee. WI 54177
Office#: 715-856-5888
Home#: 715-856-5864
Cell#: 715-927-0264

Contact Person: Mark A. Huempfner

Mid- sized forest products firm producing a moderate volume of wood fiber. Mr. Huempfner is a certified forester as well as Master Logger Certified. They currently produce round wood only with no current capability for utilization of residue. Very interested in continued dialogue to provide wood fiber as round wood or chip wood form required by a consuming mill. They currently do not possess the machinery to produce residue in the event a demand is created. They indicated interest in expansion of operations in the event of realistic demand for residue. A chipper would be added to current operations for production of chip wood. They indicated a delivered rate of $40/ton for hardwood chip wood delivered to the Niagara site and $45/ton for pine chip wood. They indicated that financial investment by an emerging market would be

attractive for expansion of operations, such as additional machinery financing. A solid contracting process would be required in the absence of any financial assistance to demonstrate market security.

DeLaet Enterprises, Limited
168 Van Buren Avenue
Wausaukee, WI 54177
Office#: 715-856-5791
Cell#: 715-927-2396

Contact Person: Mike DeLeat

Mid- sized forest products firm producing a moderate volume of wood fiber which is also heavily diversified into the excavating business. They currently produce round wood only with no current capability for utilization of residue. Very interested in continued dialogue to provide wood fiber as round wood or chip wood form required by a consuming mill. They currently do not possess the machinery to produce residue in the event a demand is created. They indicated interest in expansion of operations in the event of realistic demand for residue. They expressed interest in expanding into ground wood or chip wood depending upon need. They indicated a delivered rate of $30/ton for aspen round wood delivered to the Niagara site and $35/ton for hardwood round wood. They indicated that financial investment by an emerging market would be important for expansion of operations, such as additional machinery financing. An initial five year contract commitment would be required in the absence of any financial assistance to demonstrate market security.

Wisconsin Waste Wood Recycling
1339 Flobengo Lane
Sobieski, WI 54171
Home#: 920-822-3936
Cell#: 715-923-1412

Contact Person: Jesse Allen

An emerging wood waste recycling firm producing a moderate volume of ground wood fiber from municipal wood waste. Currently limited in production by amount of material their current outlet needs for boiler fuel. Also looking to expand their wood recycling to industrial products such as pallets and other wood crating. They are very interested in continued dialogue to provide wood fiber in ground wood form. May have ability to expand operations to chip wood production when appropriate material is available for chipping. They indicated a delivered rate of $35/ton for ground wood delivered to the Niagara site. They also indicated that financial investment by an emerging market would be important for expansion of operations, such as additional machinery financing.

11.0 Opportunities Within the Agricultural Sector to Secure Biomass.

11.1 Area and quantity of hay and other forage crops.

The 2007 Census of Agriculture was consulted to determine acres devoted to and harvests from agricultural lands in counties within the project area devoted to production of forage. This included land used for all hay, haylage, grass silage and greenchop. Hay is dried alfalfa or an alfalfa/grass mix at 10-20% moisture content. Haylage is the same as hay but at a 45-70% moisture content. Grass silage is a forage grass used for feed and greenchop is any of the above not stored but fed directly to livestock. It should be noted that the information in the following table is for the entire counties indicated. The agricultural database does not allow for circle plot retrievals. Data is only available for entire counties.

Forage Land used for all hay and all haylage, grass silage and greenchop, 2007.			
Michigan			
County	**# of Farms**	**Acres**	**Quantity (Tons, Dry Equivalent)**
Baraga	45	4,787	6,626
Delta	179	20,289	34,021
Dickinson	94	5,916	7,675
Iron	72	5,940	6,813
Marquette	53	6,976	12,504
Menominee	267	28,163	48,249
Totals	**710**	**72,071**	**115,888**
Wisconsin			
County	**# of Farms**	**Acres**	**Quantity (Tons, Dry Equivalent)**
Door	366	26,383	65,209
Florence	79	7,176	9,486
Forest	120	8,438	12,562
Langlade	251	22,411	49,438
Marinette	380	31,151	82,690
Oconto	768	45,755	120,084
Oneida	65	4,705	5,146
Vilas	21	1,040	NA
Totals	**2,050**	**147,059**	**344,615**
Two State Total			
MI & WI	**# of Farms**	**Acres**	**Quantity (Tons, Dry Equivalent)**
Totals	**2,760**	**219,130**	**460,503**

This table shows that **460,503 dry equivalent tons** are produced from these counties. If only 10% of this material could be captured as feedstock for a cellulosic biomass facility, this could supplement the logging residue by 46,000 dry ton equivalents. If it is assumed that dry ton equivalents have a 10% moisture content, this equates to 64,400 green tons at 50% moisture content.

Marinette and Oconto Counties in Wisconsin and Menominee County in Michigan are three of the largest producers of this type of agricultural biomass. These counties are also closest to the project area. Materials shipped from these counties would incur lower transportation costs compared to more distant locations. A total of **251,023 dry equivalent tons** are produced in these three counties alone. The productivity of acres in these crops is also among the highest of

all the counties included in the table above. Only Door County, at 2.47 dry equivalent tons/acre exceeds the composite productivity in these three counties of 2.39 dry equivalent tons/acre.

If used upon delivery, this source of biomass would have seasonal variability. Typically alfalfa hay undergoes three cuttings annually in the project area (late spring, mid-summer & fall). It is common, however, for farmers to "store" baled hay on-site for use or sale in the winter. Contractual arrangements could be made for delivery of this material in late winter (just before spring break-up) or the material could be stored at the ethanol plant for use in the facility during spring break-up when wood deliveries decrease. The discussion in the next section describes why this may not be a realistic scenario.

Not included in the table above are acreages of land which are currently fallow and not producing any salable or harvestable agricultural products but are clear of trees. These acreages often exist because of their inherent lower productivity. No statistics on these types of acreages are available. Correspondence with an agricultural expert at Northwest Technical College in Wisconsin suggests that the only significant fallow acreage in the project area exists in northern Door County (outside of the analyzed 65 mile procurement radius of the project). This land is marginally productive which has slowly been coming back under cultivation due to higher crop/vegetable prices. These lands total 3,000-5,000 acres. Within Wisconsin fallow land is taxed at a higher rate than agricultural land which provides an additional incentive to bring these acreages under cultivation. The significance of these acreages as a potential source of biomass will become clear in section 11.3.

11.2 Existing markets for forage crops and farmer market relationships.

The majority of hay, haylage, grass silage and greenchop is used for cattle feed either on-site for same farm cattle herds or sold to other cattle operations. Baled hay is the product most often sold because of its storage, handling and transportation advantages.

Hay in the project area is mostly produced in large rectangular squares which can weigh between 600 and 1,200 pounds. Dry hay is baled from 10-20% moisture content and a preservative is applied at higher moisture to prevent mold. A common practice, especially for round bales, is wrapping individual bales in white plastic. The purpose for wrapping dry bales is to keep additional moisture from entering and causing mold. "Wet" bales are wrapped to maintain an air tight seal which will allow the bale to ferment to make haylage for feed.

Much of the information presented in the next few paragraphs is from a paper published by Dr. Roger Palmer from the UW-Madison Dairy Science Department. Prices for sold product vary considerably based on the relative feed value of the product and the amount produced regionally as a result of crop season weather variability.

The relative feed value of a product is an index used to compare the quality of forages relative to the feed value of full bloom alfalfa. The higher the RFV, the more energy is available from the forage. Lactating cows, 2-3 month calves and 3-12 month heifers require the highest quality feed (125 – greater than150 RFV). Dairy operations require higher quality feed relative to beef cattle operations. Price differentials based on forage quality are relatively consistent in the 100 RFV to

150 RFV range increasing 95 cents/ton for each unit of RFV increase. For example, the 10-year average from 1985-1986 to 1994-1995 was $137/ton for Prime hay (150 RFV or higher), $110/ton for #1 hay (125-150 RFV) and $81/ton for #2 hay (103-124 RFV).

As discussed in a previous section of this report, wood producers stated that they could deliver product profitably to a facility at Niagara, WI for $40/ton. Comparing this delivered price to that of the various grades of hay in Wisconsin, as a whole, from 1984 through 2001 suggests that a cellulosic ethanol producer could only compete within existing markets for # 4 (75-86 RFV) and #5 (below 75 RFV) grade hay. Prices for these grades in Wisconsin, as a whole, ranged from a high of $100/ton to a low of $30/ton in the period from 1984-2001.

Within the Niagara, WI project area, typically high quality 130-150 RFV hay is produced. Lower quality is a factor of uncooperative weather not usually the lack of inherent land productivity. This fact would put delivered hay prices well above $40/ton in most years.

Of greater concern, as far as securing a consistent supply of agricultural biomass at a consistent price compared to woody biomass, is the annual variability of prices as a result of growing season weather. Unlike woody biomass, harvested quantities of agricultural biomass can vary widely from year to year as a result of drought or abundant rainfall. For example, the price of # 4 grade hay was $100/ton in Wisconsin in 1998 as a result of drought and dropped to $40/ton in 2000 when better weather conditions prevailed and yields were higher. This wide of a range in variability is unlikely with woody biomass. In the case of woody biomass, product demand and operating costs are more likely to affect delivered wood prices, both of which tend to be less variable year-to-year compared to the weather and its effects on the price of agriculturally produced products.

One of the primary purposes of undertaking this Phase II of the Niagara, WI project was to determine the relative strength of potential supplier networks to a cellulosic ethanol plant in Niagara and their receptivity to such a start-up. Logger networks were found to be very receptive to such a development being able to deliver wood fiber in a variety of forms without a large investment in new equipment.

Within the agricultural sector in the project area dried hay is the only existing product that can be economically transported. There is not a steady active market for hay given the fact that most of the forage is produced for feed and not as a cash crop. Forage is marketed in good years of production when farmers have excess for their needs and storage capacity. This market has all the characteristics of a spot market which is highly dependant on variable annual production levels (depending on the weather) with farmers selling among themselves for whatever the market will bear at the time.

Farmers who know they will need hay (i.e. be short) will contract ahead, usually from out west, where quality is less variable. Otherwise, it is hard to sell something ahead of time when you cannot guarantee what the quality will be after harvest. A farmer needing hay will pay what s/he has to for a quality supply. Multi-year contracts within the project area are non-existent. When sales do occur, the hay can be sold off the field or stored for later shipment.

These types of existing market dynamics would make it extremely difficult for a cellulosic ethanol producer to compete for biomass within existing hay markets while simultaneously securing reliable supplies. Multi-year contracts with guaranteed delivered prices would not fit in with the highly volatile nature of hay yields/qualities and production which drives annual market prices.

11.3 Potential for hybrid poplar, willow & switchgrass cultivation.

Hybrid Poplar
Much research has been done regarding the cultivation of hybrid poplar for the production of both pulpwood and energy crops. In the Lake States, such cultivation has been successfully demonstrated in Western and Southwestern Minnesota. Various cultivars of hybrid poplar have been tested in various parts of the Lake States. Similar to the cultivars of willow and switchgrass, cultivars of hybrid poplar are regionally specific and need to be matched to the area where they are grown.

In all cases, given the correct cultivars for the region, the cultivation of hybrid poplar requires relatively nutrient rich soil (similar to the quality of agriculturally productive soils) and considerable initial tending at the establishment stage and sometimes fertilization to maintain volume production through various rotations. Hybrid poplar can be grown to pulpwood size (with the remaining volume harvested for biomass) or harvested on a shorter rotation for biomass alone. In either case, establishment, tending and harvesting costs can be considerable despite the fact that the cultivars used reproduce using a coppice system (ie. Once established they reproduce from stump stems after repeated cuttings).

The fact that hybrid poplars need to be grown on nutrient rich soils puts such cultivation in direct competition with the use of similar soils for the production of other agricultural crops. Within the projected supply area of the Niagara, WI project, it seems unlikely that cultivation of hybrid poplar would be economically feasible as a biomass source for biomass for a cellulostic ethanol plant.

Willow
Investigation of willow as a biomass crop has been focused, in the United States, in New York State – more specifically at the New York College of Environmental Science and Forestry (SUNY-ESF). In 1993, the Salix Consortium was formed which included the college and a number of power companies to pursue commercialization of willow biomass crops. The Consortiums focuses on such development is in the Northeastern and Great Lakes regions in the U.S. and includes development of willow hybrids for different types of sites in these regions. Field trials and co-firing of willow biomass in pulverized coal fired power plants have been conducted in New York State. There is no evidence of trials of willow biomass for use as a feedstock in the production of ethanol.

Cultivation of willow biomass crops occurs on agricultural or fallow land. Willow is initially established from unrooted cuttings and current production systems employ a high density (6,200 plants/acre) in a double row configuration which facilitates the use of modified agricultural equipment to harvest and chip the crop in one pass. Crops are harvested on a three to four year

cycle. The willow resprouts after harvest and seven to ten harvests are possible from a single planting. The willow is fertilized after each harvest and sometimes is irrigated depending on site conditions. First cuttings on unirrigaged trials in central New York produced yields of 3.4 – 4.7 oven dry tons/acre/year. Other yields on fertilized and irrigated willow grown for three years have exceeded 9.3 ovendry tons/acre/year. Two nurseries are in New York State are licensed to produce willow cuttings and whips.

Prior to 2000, 18 willow clone-site and genetic selection trials had been established in New York, six in other states and two in Quebec and southern Ontario. At each site between 6 and 40 different clones of willow and poplar are being screened for their suitability to different soils and climate conditions. In addition to these trials, Alberta is focusing on willow culture for both woody biomass production and wastewater clean-up since willow can use large amounts of water and nutrients and absorbs heavy metals. At this two hectare site willow and hybrid poplar clones are irrigated with treated wastewater from an adjacent sewage treatment plant. Irrigation and the increased nutrients from the treatment plant were found to increase yields by 22% for one willow clone up to 20 metric tones/hectare/year (9 tons/acre/year) on a three year rotation.

There is no evidence that willow clone field trials have been established near Niagara Wisconsin. Land suitable for willow production would ideally be wet to avoid the need for irrigation. While such cultivation could probably occur on poor quality land, these same characteristics are also likely to limit the amount of suitable acreage making widespread cultivation in the vicinity of Niagara, unlikely.

Switchgrass

Switchgrass appears to be the most suitable agricultural alternative for production of a biomass crop in the Niagara area. Switchgrass is a native warm-season perennial grass indigenous to Central and North American tall-grass prairies. It is widely adaptable to a variety of soil types and regions growing well in fine to course-textured soils in regions with annual precipitation of 15 to 30 inches. Southern and eastern varieties are more adapted to higher moisture conditions and western and northern varieties adapted to drier conditions.

Switchgrass evolved across North America into varieties with genetic and morphological characteristics that provide a good fit to particular places. Upland varieties grow in drier soils while lowland varieties grow better in heavier wetter soils. Seed has been collected at various agricultural research stations and various strains developed adapted to particular locations. Many strains are registered as cultivars and are readily available today.

Switchgrass is a perennial and harvested annually in late October or November after the top has completely died using conventional agricultural harvesting equipment. Switchgrass can be established utilizing a warm-season grass drill into either chemically killed sod or crop residue. The timing of planting and planting depth is critical to avoid competition from cool-season weeds. Annual grasses such as barnyard grass, crabgrass, fall panicum and foxtails are the most competitive in the establishment phase. Full yields can be expected three years after initial establishment.

Once established, switchgrass can be harvested for 15 to 20 years. To maintain yields, nitrogen must be added to via by maintaining a legume component of at least 30 percent in the stand or by adding manure broadcast at a rate of 2 to 3 tons/acre following harvest. Relying on a legume within the stand can be problematic if the intent is to use the crop to produce ethanol. Average yields under good management can produce 3-3.5 dry tons/acre in the upper Midwest.

Work at Michigan State University has identified two cultivars (Carthage and Cave-in-Rock) as the highest yielding varieties in trials in East Lansing Michigan. Two-year dry matter yields totaled 18 and 17 tons/acre. There has been long standing interest by farmers in Michigan's Northern Lower and Upper Peninsula in growing switchgrass as an alternative energy crop. Switchgrass appears to be a viable option in these areas, characterized by a short growing season and marginally fertile soils.

Michigan State University has also been studying the grass at the U.P. Experiment Station in Chatham for several years. Researchers there are testing nine different varieties at various sites in Chatham, Escanaba and Bark River. Researchers have found that switchgrass can be grown on marginal, fallow fields and grows up to six feet tall in U.P. test plots. Switchgrass can grow on nutrient poor soils, withstands drought well and can be used as emergency cattle feed. Other advantages are pest and disease resistance, high yields of cellulose, excellent wildlife habitat especially for ground nesting birds and high carbon sequestration in its extensive and very deep root system. In addition to being a biomass source to produce ethanol, research is on-going on using switchgrass to produce fuel pellets to burn in conventional pellet stoves and as a fuel to co-fire with coal in conventional power plants. The University of Wisconsin and other Wisconsin organizations have also devoted some attention to the cultivation of switchgrass.

Research in Nebraska, South Dakota and North Dakota have shown that an acre of switchgrss could potentially produce enough biomass to make 300 gallons of cellulosic ethanol. This five-year research project also found that switchgrass grown to process into ethanol produced 540% more energy than needed to grow, harvest and process it. Estimated ethanol yields were similar to those from corn.

The state of Tennessee offers a glimpse of how the growing of switchgrass might be managed and organized to support a cellulosic ethanol plant. In eastern Tennessee, 38 farmers will be planting 1,901 acres of switchgrass in 2009 (up from 26 the year before) in the University of Tennessee's second year operating their switchgrass farmer incentive program. The U. of T. partnered with DuPont-Danisco Cellulosic Ethanol LLC who will build that state's first demonstration-scale biorefinery. The switchgrass acreage is spread out over nine counties. Farmers are paid $450/acre to establish the crop. U. of T. provides the seed and university extension agents help with the planting after which the farmers are responsible for harvesting and baling. Genera Energy, LLC, formed by the university to operate the biorefinery, has hired private contractors to pick up the baled switchgrass and is also responsible for its storage. The U. of T. expects acreage to expand by 3,000 acres in 2010.

From the experiences of other states, it is clear that development of a market for switchgrass and promoting its cultivation must go on simultaneously for the crops potential to be realized. This would be a more complicated supply network effort for an ethanol plant at Niagara compared to

use of wood, however, cultivation of switchgrass would provide an excellent alternative crop for area farmers which could be grown on lower productivity sites and which could utilize existing equipment for harvest. Harvest of switchgrass in late fall and storage over the winter would provide a fiber source during the spring break-up period, similar to how forest products industries fill their woodyards in winter to get through this period.

12.0 Summary.

The interest expressed by the individuals and firms during this phase was significant. All participants recognize the changing business climate within their industry and seek to expand into emerging markets. Many of the individuals are involved in other emerging wood utilizations markets such as wood pellets for fuel or livestock bedding. The industry has a strong desire to provide the product that an emerging market demands but stress the need to remain profitable. Several of the firms indicated they had no desire to expand into residue further simply as a marketing tool if it did not return a profit to their company. The firms involved in this phase are all second and third generation wood supplier and remain viable because of prudent business decisions. Their insight into the economic reality of wood and wood fiber production was significant and valuable.

All participants agree that any new facility will have stable wood supply, especially if their supply is diversified in its form. The ability to handle round wood, chip wood, or ground wood at the consuming facility would provide for the most stable and cost effective supply. Limitations on the form of the wood supply will limit supplier participation and potentially create lapses in supply.

Agricultural sources of fiber are not as promising as wood sources. The primary purpose of growing forage crops is to provide cattle feed either on-site or locally. Forage crops in the area are not grown as a cash crop. Forage crop availability is highly variable from year-to-year as a result of the weather in any particular year. Constructing a supply chain based on existing sources would create a high level of uncertainty within the year due to harvest patterns and from year to year. Even when farmers have a good year and have excess hay to sell, price information suggests that they can sell the excess hay for a higher price to other farmers than a cellulosic ethanol plant could pay compared to the alternative (wood).

Establishing switchgrass supplier cooperatives shows more promise. Field trials are currently underway to determine cultivars suitable for cultivation in the U.P. of Michigan and Northeast Wisconsin. Switchgrass supplier cooperatives have been established in other part of the United States specifically to supply cellulosic ethanol plants. What is clear from these efforts, is that establishing such supplier networks is a multi-year effort and must be done simultaneously with establishment of an ethanol plant to utilize the material. As such, in the short-term, utilization of wood to supply a cellulosic ethanol plant at Niagara, WI appears to be the easiest route to quickly and effectively establishing a reliable raw material supply chain.