Pre-Feasibility Study for a Pulpwood-Using Facility Siting in the State of Wisconsin

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Foreword

The goal of the study was to identify the opportunity for expansion of manufacturing capacity in the state of Wisconsin that can sustainably utilize pulpwood resources with minimal impact on environmental resources and on current pulpwood using industries. The challenge of determining the feasibility of specific locations where existing pulpwood using capacity could be expanded or developed is ultimately left up to the initiative of our free enterprise system, the environmental permitting process, and the citizens of Wisconsin. When siting forest product manufacturing facilities, a multitude of factors must be considered. Impact on air and water resources along with the sustainability of the raw material resource are the top considerations in determining the size and scope of manufacturing facilities. The Wisconsin Wood Marketing Team, a public-private partnership of forest industry stakeholders, brought together professionals from Wisconsin's forest industry, the University of Wisconsin system, the U.S. Forest Service, the Wisconsin Departments of Agriculture, Trade & Consumer Protection, Natural Resources, and Transportation to complete this study. The results of this effort demonstrate a successful collaboration of state agencies, the U.S. Forest Service, and the private sector to proactively identify opportunities for significant economic development in Wisconsin.

This report is produced with the caveat that it was written during the COVID-19 pandemic which will have unknown impacts on multiple factors reported on in the study including unemployment and market demand. As such, the current status of the industry as of today, July 31, 2020, may not be reflective of the historical or future economic climate in Wisconsin, the U.S. or the world. During the pandemic, the U.S. Department of Homeland Security recognized the wood products industry as an essential critical infrastructure workforce by designating "*workers who support the manufacture and distribution of forest products, including, but not limited to timber, paper, and other wood products as essential in the nation's response to the coronavirus pandemic*." Throughout the pandemic, forest industry workers continued to produce materials and supplies critical to our society, including components used in production of health care PPE and stand-alone products such as tissue products and shipping packaging.

While the long-term impacts of the pandemic are still unknown, the short-term impacts have already affected the industry. Demand for many essential products has increased, while demand for some non-essential products such as building products has decreased. On June 9, 2020 Verso Corporation announced that it would indefinitely idle its paper mills in Wisconsin Rapids, WI and in Duluth, MN citing an accelerated decline in graphic paper demand resulting from the COVID-19 pandemic and post-pandemic demand forecasts and capacity. Verso stated they will explore sustainable alternatives for both mills, including restarting if market conditions improve, marketing for sale or closing permanently. The Wisconsin Rapids mill will be shut down on July 31, 2020 impacting approximately 1,000 mill employees and thousands of other jobs associated with raw material supply, finished product production, and support industries.

Wisconsin forest industry associations have played an important role in advocating for the industry and its workers throughout the pandemic. Industry associations have worked together to find collaborative solutions to issues, a task that is not always easy for associations that represent global competitors (Wisconsin Paper Council) or small businesses that not only compete with one another but are also fiercely independent by nature (Great Lakes Timber Professionals Association [GLTPA] and Lakes States Lumber Association [LSLA]). These associations have a long history of solving problems and identifying

opportunities for their members as well as working together to address common issues, and their ability to effect change became even more important during the pandemic.

Despite the impacts of the pandemic, we are confident that the resiliency and interconnectivity of the state's forest industry make Wisconsin an ideal location to expand. However, this report can't possibly address the constantly changing circumstance brought on by the pandemic; we can only report on the most current data available at the time of writing. While it is likely that the pandemic will only be a blip on the timeline, its impacts on unemployment rates, government incentive programs, and market demand make it even more critical to do an in-depth feasibility study before expanding current facilities or building new ones.

Executive Summary

The goal of this study was to identify the opportunity for expansion of forest industry manufacturing capacity in the state of Wisconsin that can sustainably utilize pulpwood resources with minimal impact on current pulpwood using industries and on environmental resources. Further research will be needed to determine the feasibility of specific locations for facility expansion or new siting, including assessment of the sustainability of the raw material resource and environmental impacts.

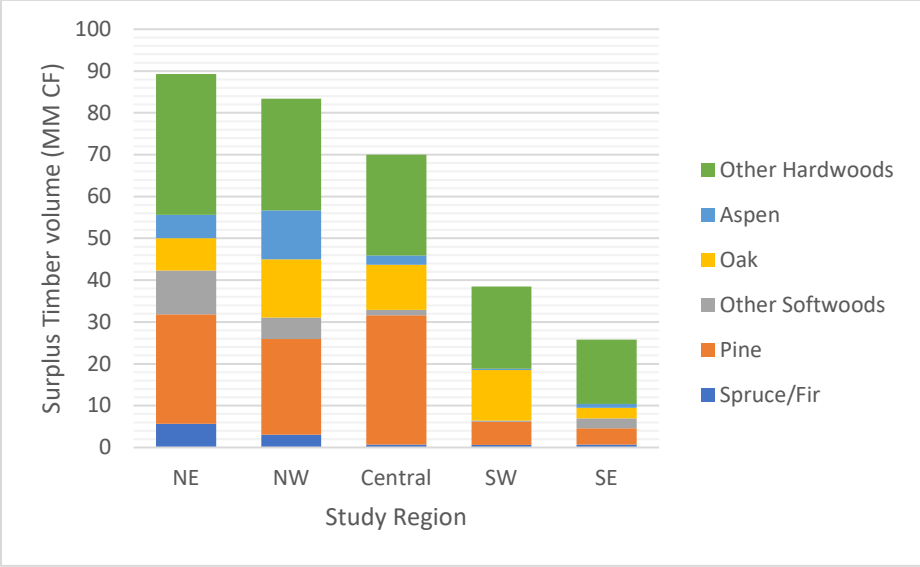
This study was conducted with support from the Wisconsin State Legislature through a grant from the Wisconsin Department of Natural Resources and a 2016 grant from the U.S. Forest Service Wood Innovations Program. The Wisconsin Wood Marketing Team brought together professionals from Wisconsin's forest industry, the University of Wisconsin, the U.S. Forest Service, and the Wisconsin Departments of Agriculture, Trade & Consumer Protection, Natural Resources, and Transportation to conduct the study.

This study was produced during the COVID-19 pandemic, which may have unknown long-term impacts on the industry. Short-term impacts have already affected the industry by increasing demand for tissue, packaging, and PPE component products and by decreasing demand for construction products. In addition, on the day this study was completed, an integrated pulp and paper mill in Wisconsin went idle as did their sister mill in adjacent Minnesota. Future impacts of these closures are unknown.

Wisconsin's is a national leader in forestry and the state's forest industry is important to its local communities, its economy, and to the sustainable management of its forest resources. In 2017, Wisconsin's forest industry generated an output of $24.1 billion.

If certified fiber is a resource need, then Wisconsin is one of the best places in the country to find it. Over 44% of its forest land is certified including state, county and private ownerships

There is opportunity for increased utilization of both the hardwood and softwood resource across the state. The volume of surplus timber statewide in 2019 was 207 million cubic feet as shown in the figure below. While nearly 80% of that surplus is located in the northern part of the state, there is could be potential for expansion of existing pulpwood using facilities and/or recruitment of new facilities across the state.



The WIDNR's Forest Products Services Team surveyed Wisconsin's value-added forest industry manufacturers in 2018 and survey results demonstrated a substantial market for wood composite panel products. Of the 205 survey respondents, 65 companies reported purchasing fiberboard or MDF, 51 reported purchasing particle board, 35 reported purchasing Orientated Strand Board (OSB)/waferboard, and 26 reported purchasing hardboard. There are currently two structural wood composite panel mills in Wisconsin, but there is only one *non*-structural wood composite mill currently operating in the state. That company utilizes all of its own product in their value-added operations, meaning that all other non-structural wood composite panels used by value-added manufacturers are currently imported.

Potential growth in the pulp and paper sector includes increased demand for packaging materials driven by the surge in e-commerce and its concurrent demand for shipment packaging, often referred to as "the Amazon effect." Other specialty papers such as coated and/or laminated materials that can compete with plastic and are more sustainable and environmentally sound also show growth potential. Tissue and paper towel, a sizeable segment of Wisconsin paper production, is seen as stable and relatively recession-proof; it's expected to grow at roughly GDP levels. All of the pulp mills that produce virgin pulp in Wisconsin are either integrated on site with a paper mill to use most of their production, or have other paper mills within their ownership that utilize the pulp. Very little of the pulp produced in Wisconsin is sold outside of company ownerships. With 34 paper mills in Wisconsin there is an opportunity to produce pulp in state that can be utilized by these mills, thereby lessening the dependence on long distance transport of raw material. Estimated siting requirements of pulpwood using manufacturing facilities is shown in the following table.

	Units	**Pulp Mill**	**Wood Composite Panel Mill**	
Site Feature		**Non-Integrated**	**Structural**	**Non-Structural**
Land Size	Acres	150	100	300
Raw Material	Type	Roundwood, chips	Roundwood	Roundwood, chips, sawdust
Raw Material Volume	Green tons, annually	700,000	425,000	850,000
Workforce	No.	200	200	200
Water	Gal/day	758,500	11,616	598,630
Electricity Demand	MWH	11.67	10.5	42.3
Natural Gas	MM CF	1,955.7	373.5	1,349.5

Results of this study indicate that there is expansion potential of both the pulp and the non-structural wood composite panel industries in Wisconsin. Wisconsin has over 17 million acres of forest land that sustainably supply raw material to the state's forest industry sector. There is both the market demand generated by Wisconsin's value-added forest products industry for packaging and wood composite panels, and the available pulpwood resources. Further feasibility assessment of siting production facilities at specific sites should be explored to maximize efficiencies.

Wisconsin DNR Forest Products Services Team can be the lead on developing specific resource data, directing permitting discussions and providing contacts with economic development personnel. For questions related to this report and for additional information, contact the DNR's Forest Products Team Leader whose contact information is available on the DNR's website.

Chapter 1: Introduction and Overview

The purpose of this study is to identify the opportunity in Wisconsin for existing pulpwood using facilities to expand or new facilities to be built that are aligned with community needs and desires while also providing markets for sustainable forest management activities. This study was supported in part by funding designated by the Wisconsin State Legislature via the "Forestry and Fire Study" grant agreement awarded by the Wisconsin Department of Natural Resources to the Great Lakes Timber Professionals and Wisconsin County Forests Associations, who contracted the Wisconsin Wood Marketing Team to conduct the "Pulpwood Analysis" portion of the grant. The last time a study like this was done was in 1989; *Investing in Wisconsin's Forest Industry: Pulp Mill Siting Feasibility Study* was commissioned by Governor Tommy Thompson and produced by a team led by the Wisconsin Department of Natural Resources. There are two major differences between this study and the one published in 1989. Firstly, the previous study was specific to pulp mills only, whereas the scope of this study is broadened to include any mill that utilizes small diameter material generally referred to as "pulpwood". The term pulpwood is used throughout this report and is a commonly accepted industry term referring to small diameter roundwood that isn't being utilized to produce a sawn product including, but not limited to, roundwood going to pulp mills. Typically, pulpwood is utilized down to a four-inch diameter inside bark on the small end. Secondly, this study focuses on statewide resources and identifies forest resources by study regions that align with Forest Inventory Analysis (FIA) survey units, rather than identifying specific sites as was done in the 1989 feasibility study. Facility-specific requirements including environmental permitting and transportation and public utility infrastructure will guide potential businesses in narrowing their search to specific site locations. This broadened approach provides information useful to a wide variety of facilities with varying timber resource needs.

This report focuses on the two most common industries that currently use pulpwood: the pulp and paper industry and the wood composite panel industry. However, new technologies and/or rapidly expanding markets might bring about new industries that utilize pulpwood resources. This report is not meant to exclude new or evolving products and markets, only to concentrate on the existing prominent, established uses. Any responsible, environmentally sound user of the pulpwood resource can use this study as a tool to investigate the feasibility of siting a plant in Wisconsin.

Although we refer to pulpwood that comes directly from the forest to the production facility, debarked wood chips are another potential fiber source identified in the study. There are three sources of debarked wood chips: sawmill residue chips from debarked logs, chips produced by mills that take in pulpwood and debark and chip it for other users, and chips from in-woods flail chipping operations that debark and chip whole trees as a part of logging operations.

Wisconsin's thriving paper industry creates a strong pulp market. Wisconsin has been the leading manufacturer of paper in the U.S. for over 50 years and the American Forest & Paper Association estimated Wisconsin's paper products shipments at US $13.8 billion in 2018. There is currently not enough pulp produced in the state to meet the demand of its paper mills and Wisconsin paper mills was forced to import US $401.6 million of wood pulp in that same year (U.S. Census Bureau, 2020).

In addition, Wisconsin has a multitude of value-added wood manufacturing facilities that use large volumes of non-structural wood composite panels in their products, and almost all many of these panels are imported from outside of the state. In many cases, these panels are transported hundreds of miles. Non-structural wood composite panels encompass a wide range of products and further research is

needed to determine if there is enough demand for a specific non-structural wood composite product to justify siting a plant in Wisconsin. Many opportunities for utilizing a variety of wood products currently exist and new products and opportunities will continue to arise. Being open to complementary wood using facilities being built on the same site – either built concurrently with a pulpwood using facility or allowing for future expansion with other facilities – could help ensure long-term economic success. Wood industry clusters are made up of facilities that complement each other, such as utilizing the residue from one facility for the raw material in the next one's process or using a product from one facility to package the product from another. Possibilities such as co-generation, scragg or chip-n-saw sawmills, a sawmill specializing in over-sized logs, mulch production, and pallet manufacturing for finished product shipping, etc. should be considered for this type of wood industry cluster.

Results of this study indicate that there is expansion potential of both the pulp and the non-structural wood composite panel industries in Wisconsin. Wisconsin has over 17 million acres of forest land that sustainably supply raw material to the state's forest industry sector. There is both the market demand generated by Wisconsin's value-added forest products industry for packaging and wood composite panels, and the available pulpwood resources. Further feasibility assessment of siting product production facilities at specific sites should be explored to maximize efficiencies.

The findings in this report should not be interpreted to imply that a mill will or even should be developed or expanded. Rather, this report is an analysis of the feasibility of new pulpwood using mills being located in Wisconsin or existing mills being expanded taking into account impacts on air, water, and forest resources. In fulfilling the purpose of the study, the project team did not attempt to draw conclusions about what should happen. It is up to individual communities, their elected representatives, forest product businesses, other interest groups, and the public to work together to determine where development should occur.

This study presents considerations for Wisconsin communities, existing businesses, and entrepreneurs interested in developing new or expanded manufacturing capacity to utilize the pulpwood resource. Corporations that wish to develop or expand mills in Wisconsin can use this study to help them identify areas that best meet their needs and communities can use the report to identify the types of mills that might be attracted to their area.

Scope

This study was commissioned to identify the opportunity for expansion of forest industry manufacturing capacity in the State of Wisconsin that can sustainably utilize pulpwood resources with minimal impact on environmental resources or current pulpwood using industries. The project scope was further defined by the Wisconsin Wood Marketing Team.

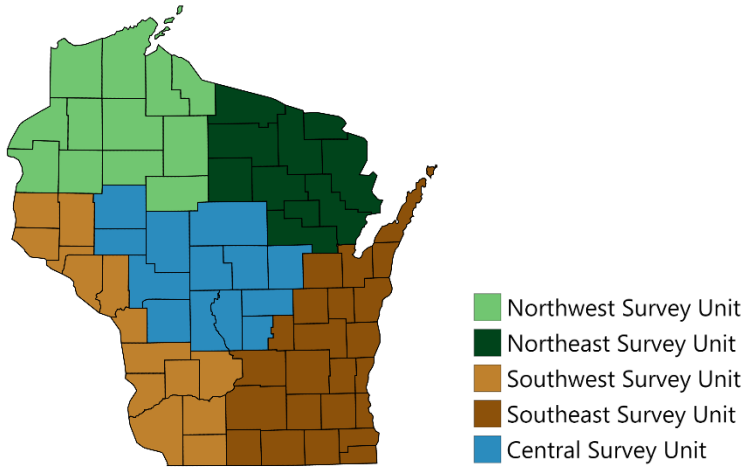
In addition to identifying potential expansion opportunities to supply pulp to current paper manufacturing facilities, other wood products were considered that can be manufactured from pulpwood sized material. Structural and non-structural wood composite panels were both included in the product mix for this study. These products were included because ever changing factors in international trade and markets for wood products warranted that we examine product options beyond pulp and paper.

Overall, manufacturers of pulp, structural wood composite panels, and non-structural wood composite panels need the same five components in order to operate;

1. Sustainable source of raw materials
2. Willing and able workforce
3. Compliance with environmental regulations
4. Transportation network for incoming raw materials and outgoing finished products
5. Adequate public utility infrastructure (electricity, natural gas, water)

While these five fundamental needs may be similar, there does exist differences in the quantity and quality of resources needed by the different forest product manufacturers considered in this study. The one resource that has the greatest impact on business success is the sustainability of the raw materials used in the manufacturing process. Availability of timber resources is the most critical need. Because of this, we initiated our study by first looking at available forest resources across different regions of Wisconsin. The regional boundaries were delineated based upon forest inventory survey units established by the Forest Inventory and Analysis (FIA) Program of the U.S. Forest Service (USFS). The five regions as defined in this study are identified in Figure 1.

Figure 1. Study regions



The identified regions, which align with FIA survey units, are where forest resources have been inventoried and the resource volumes have been made available to the public. In general, facilities that require smaller volumes of timber and those that are able to utilize a wider array of species will have more site options than those that require larger timber volumes and/or those that require very specific species as their raw products. In addition, depending on the specific needs of a facility, there could be several feasible sites within each identified region.

As a *pre*-feasibility study, this is an analysis of technologies that have the same fundamental needs for a mill placement. Because particular needs will vary, specific sites within a region might be suitable for one type of facility, but not for another. The suitability of individual sites within a region should then be assessed by interested companies based on their unique resource needs. Once regional interest is determined, in-depth site-specific feasibility studies will be essential.

Assessment Process

This study used the following approach to assess the suitability of regions across Wisconsin for siting of a pulpwood using facility:

1. Identify processing technologies that convert pulpwood sized material into either pulp, structural wood composite panels, or non-structural wood composite panels
2. Quantify pulpwood availability
3. Define state and federal environmental regulations
4. Describe transportation infrastructure
5. Describe utility services

Given the available resources, individual entities will decide what regions may meet their needs and will identify specific sites within those regions for further analysis. To identify specific sites, entities will consider the intersections of adequate pulpwood supply, environmental regulations, transportation networks capable of bringing in raw material and moving finished products to markets, and adequate public utility infrastructure (electricity, natural gas, water).

The study identified the most common pulp and wood composite panel technologies that might be compatible with the other factors that need to be considered before expanding existing facilities or building a new facility. Each type of technology varies in the amount and species of wood it requires and the amounts and types of pollution discharges it produces. In some areas, several different types and sizes of mills are feasible. In other areas, one or more factors may limit the types/sizes of facilities that are feasible. Our results show a broad range of opportunities exist for companies seeking to expand or establish new pulpwood using operations in Wisconsin.

Identify potential pulp and wood composite panel technologies

There are three broad manufacturing technologies that are the most prevalent pulpwood using systems in operation today and these three were selected for inclusion in the study. Included technologies are: a kraft non-integrated pulp mill, a structural wood composite panel plant, and a non-structural wood composite panel plant. Note that non-integrated pulp mills are defined as those that only manufacture pulp and do not have an associated plant that converts the raw pulp into finished paper products.

Define pulpwood availability

The availability of pulpwood is identified by species group in each region or survey unit as previously illustrated in Figure 1. The survey units are arbitrary divisions defined by the FIA and are not correlated to actual physical boundaries; in practice, the procurement radius of forest resources for a specific manufacturing facility is not defined by the survey units and is based upon logistical and economic factors. Because of this, county data may be useful and can be obtained from the WIDNR's Forest Products staff identified in Chapter 6.

Pulpwood availability data is based on U.S. Forest Service FIA data and is reported for parts of Michigan and Minnesota as well as for Wisconsin. The amount of available (surplus) pulpwood is defined as net annual growth minus the 2019 harvest removals data and is reported by species. Available pulpwood in each region is estimated; actual volumes could be dependent on a number of variables that are not assessed in this study, and more in-depth assessments of the available resource should occur once specific sites have been identified.

Identify state and federal environmental regulations

Environmental quality regulations could limit the types of facilities sited in certain regions. Manufacturing technologies that require larger quantities of water and discharges into waterways may be limited to particular regions or to particular sites within a region. Likewise, air quality standards and

the air emissions expected from each type of technology may eliminate air quality non-attainment zones in areas within regions. In addition, other factors that might impact site locations are landfill for solid waste disposal, recycling options, state or federal designations on certain rivers, endangered species restrictions, floodplain restrictions, and local zoning restrictions. These are not assessed in this study, but should be considered once specific sites have been identified.

The results of the project do not substitute for Wisconsin's environmental permitting process. A proposal for facility development in Wisconsin will require a detailed site evaluation. Public input and involvement of all interested parties is a part of the permitting process. Chapter 3 of this report details environmental regulations for pulpwood using facilities.

Describe transportation infrastructure

Trucking and rail infrastructure are described in this study. Class A highway access is assumed to be a minimum requirement and fortunately class A highways are widely available across the state. Facilities requiring on-site rail access will narrow the available sites to be considered within regions. There are multiple rail service providers in Wisconsin and depending on the location, switching to a different provider(s) to complete a haul could present logistical challenges. Traffic from other commercial facilities as well as residential and school traffic should be considered when considering transportation infrastructure for specific sites.

Describe public utility infrastructure

Availability of adequate public utilities, specifically electric power and natural gas are presented. The determination of electrical and natural gas needs was identified through meta-analysis of peer reviewed publications on the topic life-cycle analysis of the manufacturing technologies highlighted in this report. This process yielded data that was able to buffer areas with the delineated study regions that have the public utility infrastructure needed to meet manufacturing needs. Water is a critical resource for all pulpwood using facilities to a varying degree. Adequate water supply for specific sites will have to be evaluated in concert with environmental regulations pertaining to water.

Chapter 2: Wisconsin Profile

General Overview

Wisconsin leads the world in cheese production, and Wisconsin's rich, gently rolling farmlands are also leading producers of beef, poultry, feed grains, vegetables, cranberries, and cherries. Wisconsin, however, is far more than the "America's Dairyland" that our license plates proclaim. Wisconsin's landscape is a diverse mosaic of agriculture, forests, and lakes and rivers, as well as urban, suburban and rural communities. Wisconsin's abundant water resources include Lake Michigan, Lake Superior and the Mississippi River which make up substantial portions of its borders, as well as the Wisconsin River known as the hardest working river in the nation. Wisconsin also has over 15,000 inland lakes covering nearly one million surface acres and 56,884 miles of river, 537 of which are designated as National Wild and Scenic Rivers or as Wisconsin Wild Rivers. Wisconsin is noted for its recreational opportunities, created in part by these water resources. In 2018, 112 million visitors vacationed in Wisconsin making tourism and recreation the state's second largest industry (WEDC, 2019).

However, the manufacturing of non-durable and durable goods in Wisconsin eclipses both the tourism and recreation and agriculture sectors in several key economic factors. Wisconsin's manufacturing industry has more than 9,400 manufacturers employing 475,000 workers, making up 16% of Wisconsin's workforce. The manufacturing industry makes up 19% of the state's GDP and produced more than 63 billion dollars of output in 2018; the forest products sector represents nearly 40% of that (WEDC, 2019).

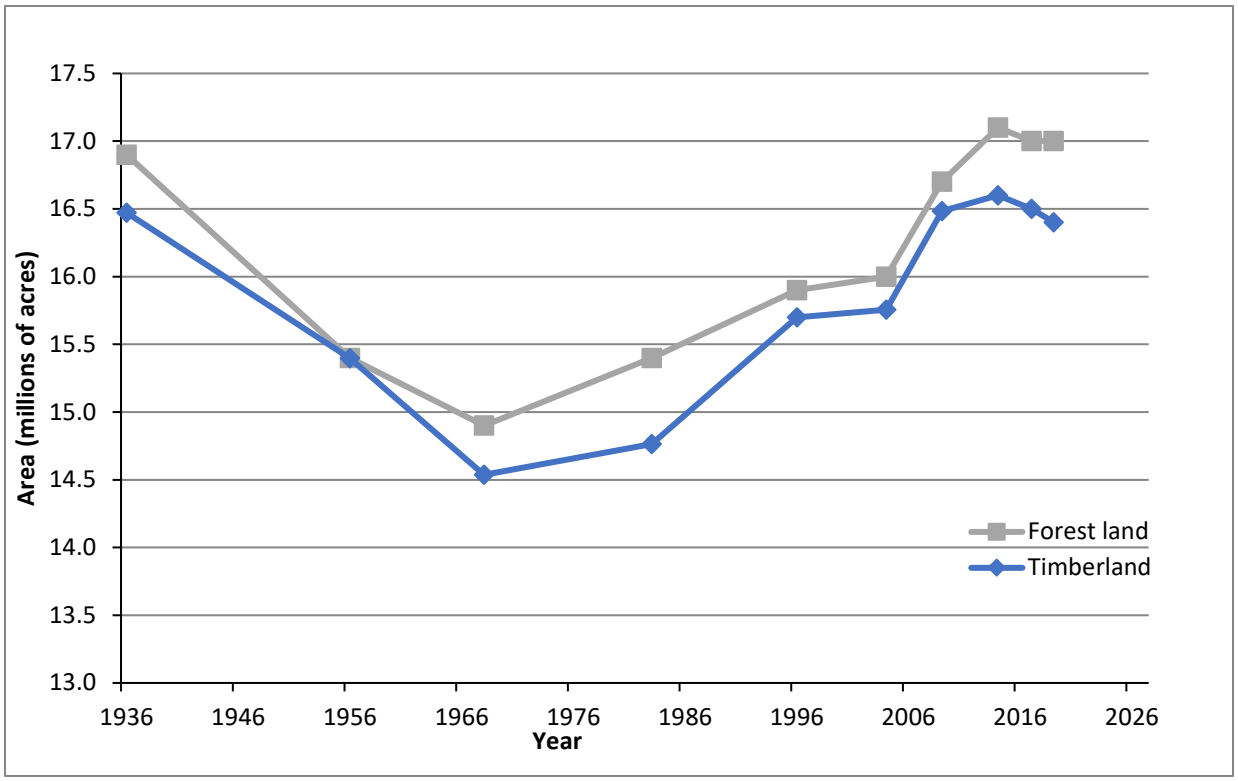
Wisconsin has a consistent, hardworking and educated workforce. The Midwestern work ethic was born in Wisconsin and it is deep-rooted in the ethics of its residents. Wisconsin's educational system, both at the high school and secondary levels has a long history of contributing to the state's economic potential. The high school graduation rate is consistently ranked among the top in the nation, and Wisconsin's technical college system has been training its workforce for more than 100 years, longer than any other state. The University of Wisconsin System is a leader in innovation and quality education, and along with Wisconsin's private universities and technical colleges, supports industry and policy makers throughout the state in the development of novel, innovative products to fulfill market needs (WEDC, 2019).

Wisconsin's central location and robust transportation infrastructure provide its manufacturers with easy access to multiple modes of transportation to reach their consumers. Wisconsin is located less than 60 miles north of Chicago, which provides intermodal access to U.S. and world markets.

Forest Resource

Forest land covers over 40% of the state's landscape (WIDNR, 2020). Wisconsin's timber resources have increased since the 1960's, primarily due to the conversion of marginal agricultural lands to forest land in the northern and central regions of the state (Figure 2). Forest land is defined as all forested land while timberland is that land capable of producing industrial wood products.

Figure 2. Area of forest land and timberland, Wisconsin, 1938-2019

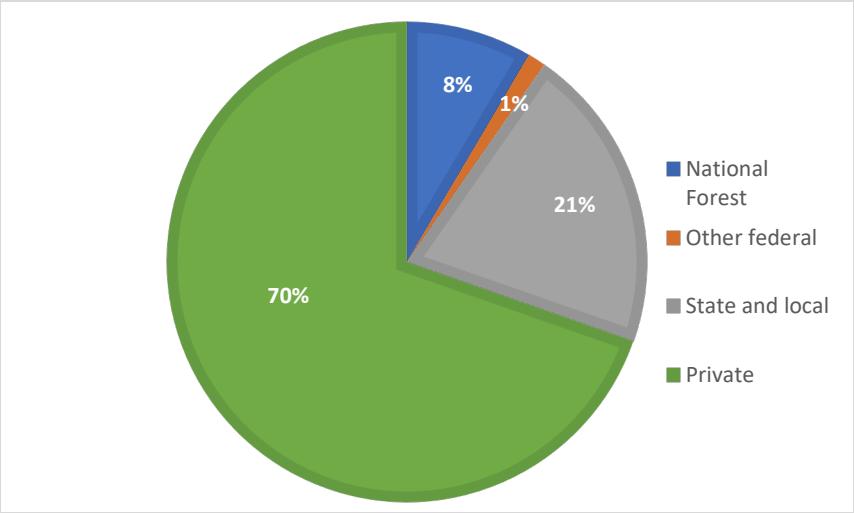


Ownership

In 2019, Wisconsin had 16.4 million acres of timberland that supplied the forest products industry. The fate of these forest resources is primarily in the hands of those who own and control the land; therefore, it is critical to understand forest ownership and how the applicable policies and available state and federal programs affect the management of the resource.

Of Wisconsin's 17 million acres of forest land, the majority (70%) was privately owned in 2019. Private includes family, corporate, tribal and other private ownerships. Public owners controlled 5.1 million acres of Wisconsin's forest land. The percentage of forest land ownership categories is shown in Figure 3.

Figure 3. Percentage of Wisconsin forest land ownership categories, 2019



Landowner policy, program and attitudes toward land management affect the availability of timber resources. Management of public and tribal forest land is governed by legal policy and forest management plans. These policies and plans will govern forest land that is managed, as well as areas set aside for non-management.

The Chequamegon-Nicolet National Forest (CNNF) covers 1.5 million acres in eleven counties across northern Wisconsin and plays a vital role in the region's economy. Every year, millions of cubic feet of saw logs and pulpwood are responsibly harvested from this forest by local loggers. Wisconsin is leading the way in the use of two innovative tools to accomplish sustainable forest management of its national forest resource, the U.S. Forest Service's Stewardship Authority programs and the Good Neighbor Authority. Through collaborative efforts, local stakeholders, state agency staff, and CNNF leadership work together to identify and administer projects that yield timber for forest industry use and improved forest health. Stewardship agreements fund restoration activities on the national forest through timber production. The Good Neighbor Authority allows the Forest Service to contract with state agencies to conduct forest management and watershed restoration on Forest Service lands. Both of these tools help ensure a robust supply of timber to the forest products industry while supporting the forest health (WEDC, 2019).

The Wisconsin Department of Natural Resources implements sustainable forestry practices to manage state owned forest lands for multiple uses. State lands include 500,000 acres on ten state forests and 1 million acres in state parks, wildlife areas and natural areas. The agency's management strategies on these multi-use lands balances the goals of timber production, forest land conservation, wildlife habitat protection and recreational opportunities. More than 60% of the harvests on state owned forest lands aim to improve the growth of existing trees through thinning. Stands that are harvested for regeneration purposes are either reforested naturally or with planted seedlings (WIDNR, 2019).

Wisconsin's county forests represent the state's largest public forest landholding. There are twenty-nine county forests totaling 2.4 million acres across the state, and these contribute significantly to the state's forest products industry and the economy as a whole. In addition to timber production which

provides income to local counties and towns, county forests provide recreation and tourism opportunities (USDA Forest Service, 2019).

Private ownership, including corporate and tribal, is 70% of all forest land in Wisconsin (Figure 3). Private landowners supplied 65% of Wisconsin's total harvest removals from growing stock in 2018 indicating that non-industry privately owned woodlands are available for timber harvest. In 2014, there were an estimated 183,000 family forest ownerships across Wisconsin with an average forest holding size of forty-nine acres. The average age of family forest owners in Wisconsin, in 2014, was 61 years and 37% of the family forest land was owned by people who are at least 65 years of age (USDA Forest Service, 2019).

Wisconsin's Managed Forest Law (MFL) Program is a landowner incentive program that encourages sustainable forestry on private forest land. In exchange for following sound forest management, landowners pay substantially reduced property taxes. The MFL Program is open to private woodland owners who have a minimum of contiguous 20 acres that are at least 80 percent productive. Enrolled lands must be managed according to a multiple-use forest management plan drafted by a professional forester, and agreed to by the landowner. Timber production is the program's primary goal and participants must complete mandatory cutting practices in accordance with their management plan. As of 2019, over 3.4 million acres were enrolled in the MFL program (WIDNR, 2019).

Certification

According to the WIDNR (2019), Wisconsin's forest resources include 7.4 million acres certified by the Sustainable Forestry Initiative® (SFI®), the Forest Stewardship Council® (FSC®), and/or American Tree Farm System® (ATFS), and in many cases forest land is certified under two of these systems. There are more acres of FSC Certified forest in Wisconsin than any other state, with over 6.4 million acres. Minnesota follows with 6.1 million FSC Certified areas (Minnesota Department of Natural Resources, 2019) and together, Wisconsin and Minnesota account for 36% of all FSC Certified forest acreage in the U.S. There are over 3.9 million acres of SFI certified forest in Wisconsin equating to over 6% of all SFI certified acres in the U.S. There are also over 2.7 million acres certified under ATFS, a program of the American Forest Foundation.

In total, 44.8% of Wisconsin's forest land is certified. The high percentage of certified forests is accomplished through the certification of state and county forests and through the MFL Program for private landowners. The MFL program provides FSC and ATFS certification for its participants. If certified fiber is a resource need, then Wisconsin is one of the best places in the country to find it.

Forest Industry

The harvesting and processing of timber products produces an income stream for landowners and managers, loggers and foresters, primary and value-added producers in addition to a number of associated industries. Wisconsin's forest industry generated an output of $24.1 billion in 2017; Wisconsin leads the nation in paper products manufacturing, with approximately 5.3 million tons of paper and 1.1 million tons of paperboard are produced in the state annually (WIDNR, 2019). World leaders in the pulp and paper products industry started in Wisconsin more than 100 years ago and the industry has grown and prospered here since. Over the years, the industry has faced economic challenges due to reduced demand for paper products caused in part by a troubled economy, increased use of electronic media, and competition from overseas. However, innovative corporate management

teams, technological advances, modernization of programs, and a quality workforce and have led to the industry's long-term success. The industry is crucial to Wisconsin's high quality of life as an important contributor to the economy. Nearly 31,000 people were employed in the industry in 2018 accounting for 7% of Wisconsin's manufacturing workforce. The industry has some of the highest paid manufacturing jobs in the state. In addition, every job in the pulp and paper industry supports 2.1 additional jobs in the state creating 65,610 additional jobs indirectly associated with the industry. The pulp and paper industry and Wisconsin's overall forest economy are summarized in Table 1 (WIDNR, 2020).

Table 1. Wisconsin's forest economy, 2019

	Direct Employment Number	Direct Industry Output MM $	Indirect + Induced Employment Number	Indirect + Induced Output MM $
Forestry and logging	5,745	517.44	2,766	347.98
Sawmills and wood products	27,618	5,936.88	28,109	4,207.46
Pulp and paper	30,262	17,912.32	65,610	10,583.89
Total	63,625	24,366.64	96,485	15,139.33

Primary Producer Industry

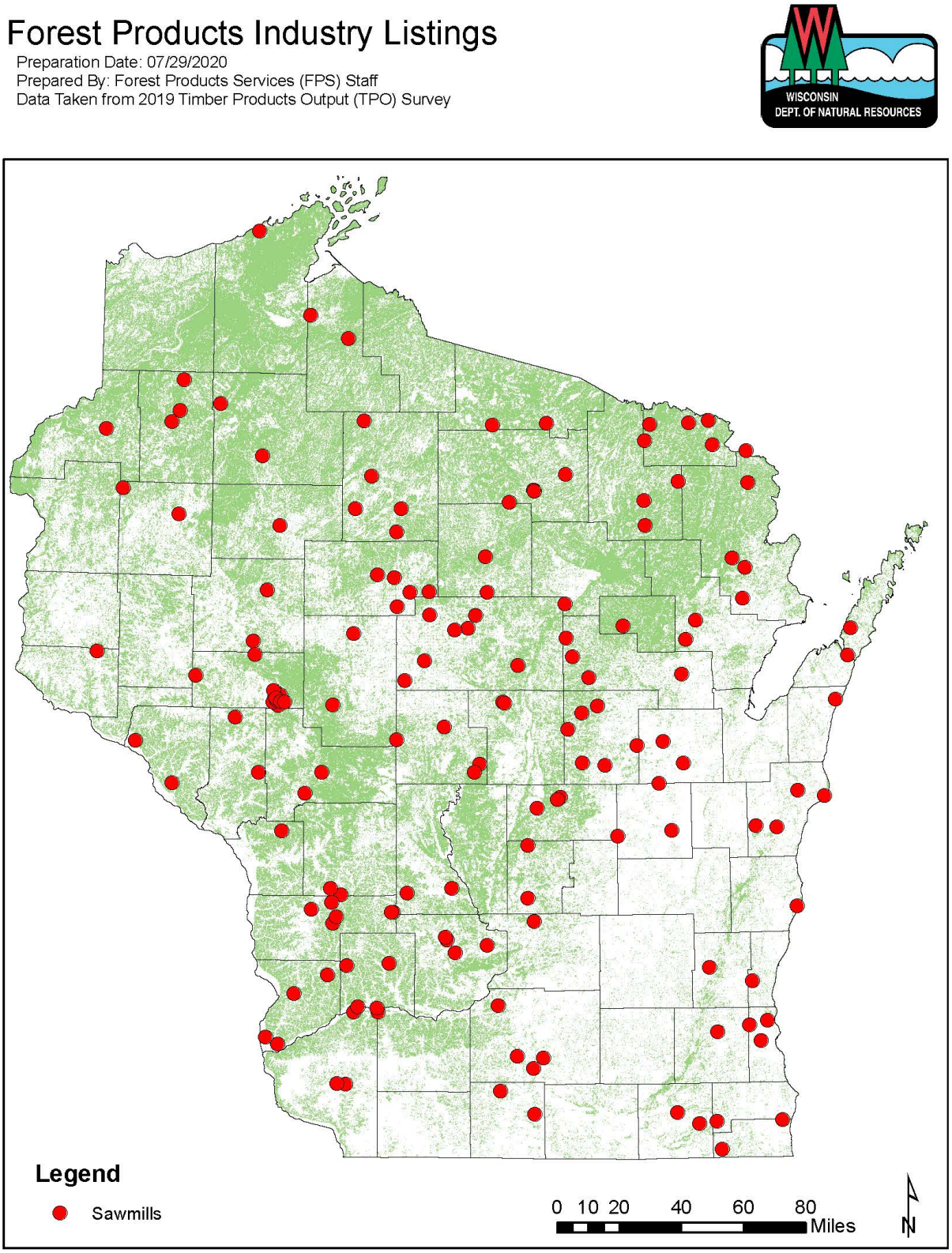
There were an estimated 265.6 million cubic feet of industrial roundwood harvested in 2019 from Wisconsin's forests (USDA Forest Service, 2020), which supplied raw material for primary producers in Wisconsin, surrounding states and Canada. Wisconsin's primary forest products industry is made up of businesses that manufacture logs and pulpwood into wood and paper products, including pulp and composite product mills, sawmills, veneer mills, cabin log mills, etc.

In 2018, Wisconsin's primary wood-using industry included 213 businesses, including custom sawyers and portable mills (Wisconsin Department of Natural Resources, 2020). Primary producers are described in Table 2 and the location of sawmills is shown in Figure 4.

Table 2. Number primary forest product producers in Wisconsin, 2018

Manufacturer Type	Number of Businesses
Sawmill	172
Pulp mill	8
Log building manufacturer	9
Chip plant	5
Biomass/residue mill	4
Composite panel mill	3
Pole mill	4
Industrial fuelwood/biofuels	1
Other wood manufacturer	7

Figure 4. Location of sawmills in Wisconsin, 2018



The number of pulp mills and wood composite panel mills in Wisconsin has declined over the past thirty years. The number of active pulp mills from 1990 to 2020 is shown in Figure 5 and the number of active wood composite panel mills from 1990 to 2020 is shown in Figure 6.

Figure 5. Active pulp mills in Wisconsin

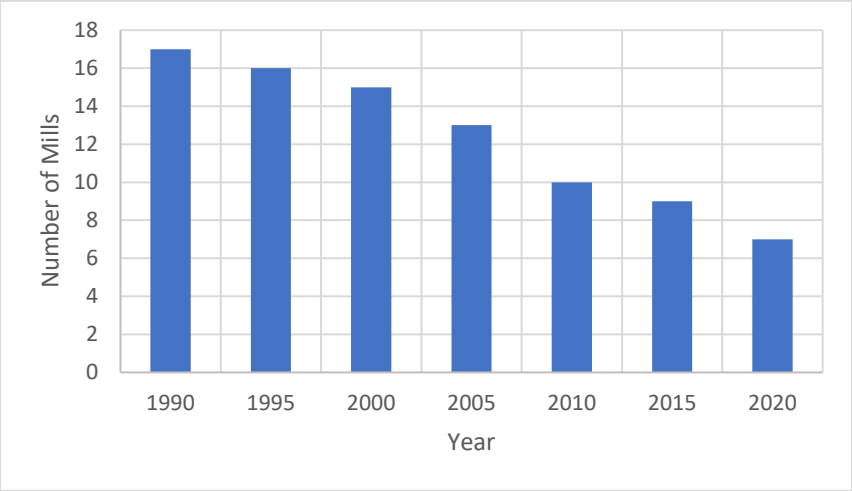
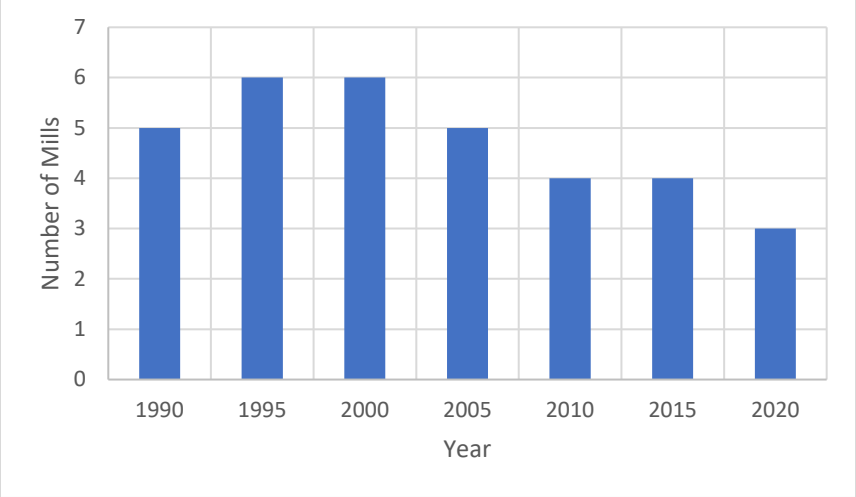
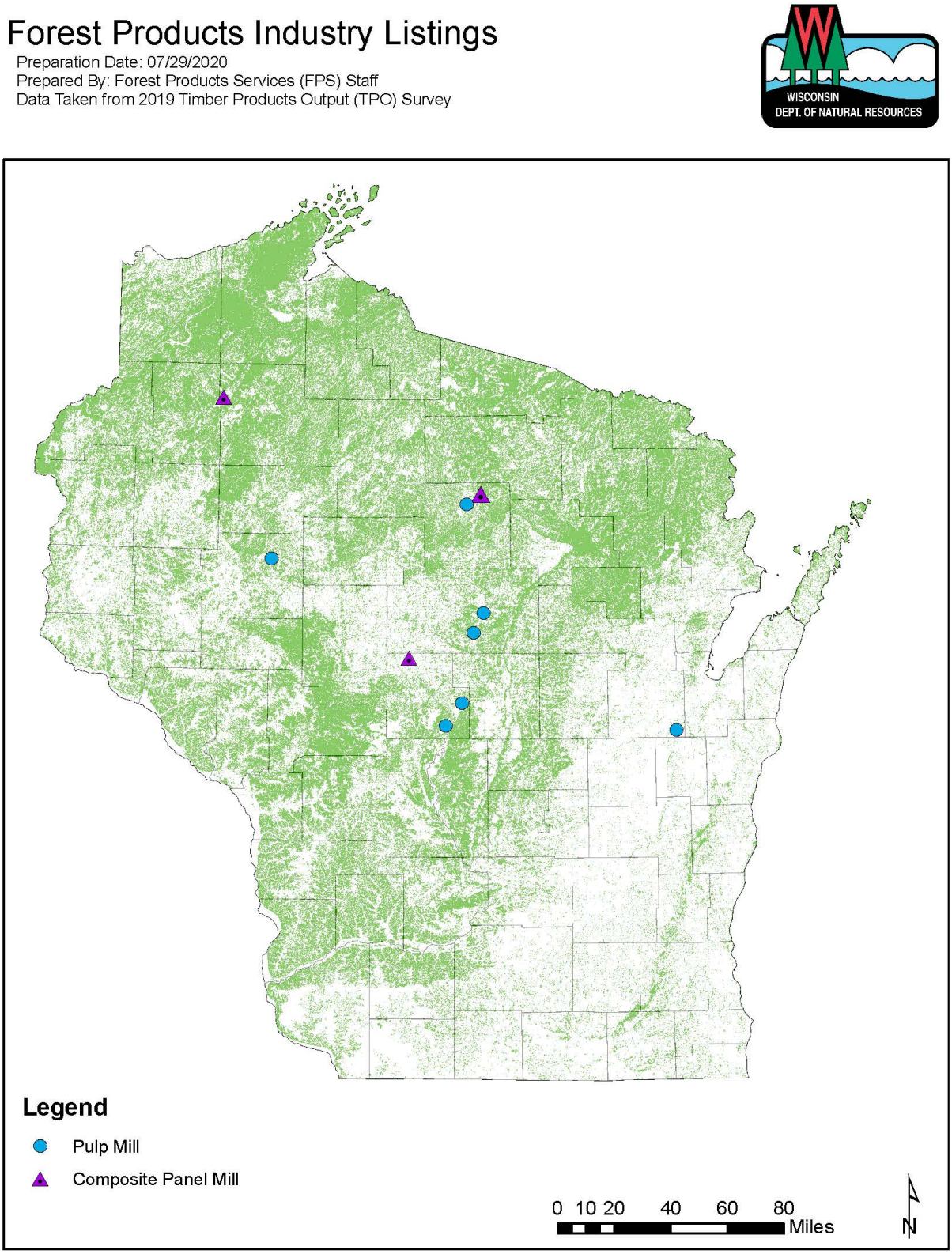


Figure 6. Active wood composite panel mills in Wisconsin



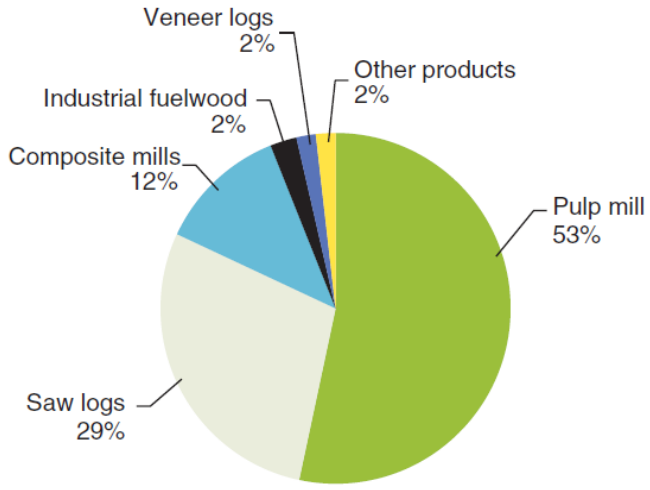
As of the publishing of this report, there are seven pulp mills and three wood composite panel mills (two structural and one non-structural panel producer), operating in Wisconsin as shown in Figure 7.

Figure 7. Location of pulp mills and wood composite panel mills in Wisconsin, 2019



According to the most recent data available (2013), the majority of industry roundwood and fuelwood in Wisconsin was made into pulp (53%), followed by saw logs (29%) and composite wood products (12%). A minor portion was used to produce industrial fuel wood, veneer logs and other products like excelsior/shavings and posts, poles, and pilings. Percent of total production by product in Wisconsin in 2013 is shown in Figure 8 (Kurtz, et al. 2014). Note that as of the writing of this report, product data from 2018 had been collected, but was not yet published.

Figure 8. Industrial roundwood and fuelwood percent of total production by product, 2013



Timber Harvesting

A 2016 survey of Wisconsin's logging industry showed that of the 295 timber production companies surveyed, 186 of them reported that they were not operating at full capacity and could potentially have harvested an additional 700,000 cords if they were at full capacity (Rickenbach, 2018). Several logging equipment manufacturers have major distribution centers in Wisconsin and provide training on innovative technologies allowing Wisconsin loggers to be on the cutting edge of the industry. As forest management techniques have changed over time, Wisconsin's loggers have adjusted their harvesting methods to meet the need. This adjustment, in combination with the continuous improvements in mechanized logging equipment, has led to an efficient and effective modern-day logging workforce with the capacity to use multiple technologies as described in the following sections. Note that some companies use two or more systems in combination, depending on forest type and equipment availability.

Cut-to-Length (CTL)

Cut-to-length harvesting typically involves two pieces of mechanized harvesting equipment – a harvester and a forwarder. The harvester fells, delimbs and bucks trees into saw logs and pulpwood at the stump. The forwarder hauls the processed wood to the landing. Because trees are delimbed at the stump, the slash stays in the forest. The slash can also be used in trail armoring to protect wet and sensitive soils from compaction and rutting. This system has become popular in Wisconsin because it can be used in thinnings and selective harvests, where a lack of damage to the residual trees is of paramount importance.

Mechanized Whole Tree

Whole tree harvesting systems are either tree length or pole length operations. Tree-length systems fell trees with a feller-buncher that places the trees into bunches which are then typically extracted by a grapple skidder. Then at the landing, trees are delimbed and bucked into saw logs and pulpwood. Delimbing and bucking on the landing can be accomplished by processors, delimbers, slashers, and/or chainsaw operators. In pole length operations, chainsaw operators limb and top the bunches of trees, so that the limbs and tops are left in the woods rather than brought to the landing. This system works best in a harvest area where most or all the trees are being removed such as in regeneration harvests.

In-woods Chipping

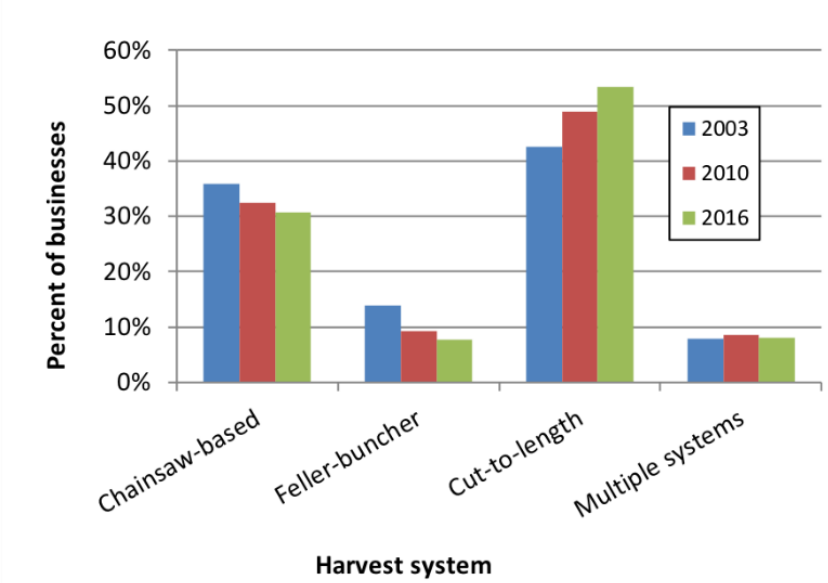
This is a variation of the mechanized whole tree operation where the entire tree or parts of it are chipped once the tree is delivered to the landing. The chips are typically blown directly into waiting chip vans to be delivered to a mill.

Hand Felling

Hand felling operations can be either cut-to-length or pole-length. In cut-to-length operations, the sawyer cuts the tree up into product lengths and a forwarder picks up the products and brings them to the landing. In pole-length, the sawyer will delimb the tree and top it at, which point a grapple or cable skidder will bring it to the landing where it will then be cut into different products. Even though there are a substantial number of hand felling harvesting operations in Wisconsin, they typically harvest small volumes of timber annually and focus on high value saw log stands.

Rickenbach (2018) surveyed Wisconsin logging businesses in 2003, 2010 and 2016 and found that the use of the CTL systems increased over that time period while the number of logging operations that use chainsaws or feller-bunchers decreased. In 2016, 53% of Wisconsin logging businesses surveyed used the mechanized CTL harvesting system while 31% and 8% used chainsaw-based and feller-buncher systems, respectively. Operations that use both feller-buncher and cut-to-length harvesting systems are considered as using multiple systems and accounted for an additional 8% of logging businesses (Figure 9).

Figure 9. Percent of Wisconsin logging business by harvest system used over survey years



Rickenbach's survey results indicate that the majority of logging companies produced between 1,001 and 10,000 cords annually in 2016. Large logging companies, those producing over 15,000 cords annually, are less than 15% of businesses; however, they are on the rise and their annual production increased from 2013 to 2016 (Figure 10). The annual median production for other harvest systems remained relatively steady over the same time period. Large logging businesses are typically those that can afford to carry additional equipment and use multiple systems as indicated by the annual median production rates in Figure 11.

Figure 10. Annual harvest amount by percent of businesses and percent of total harvest volume over survey years

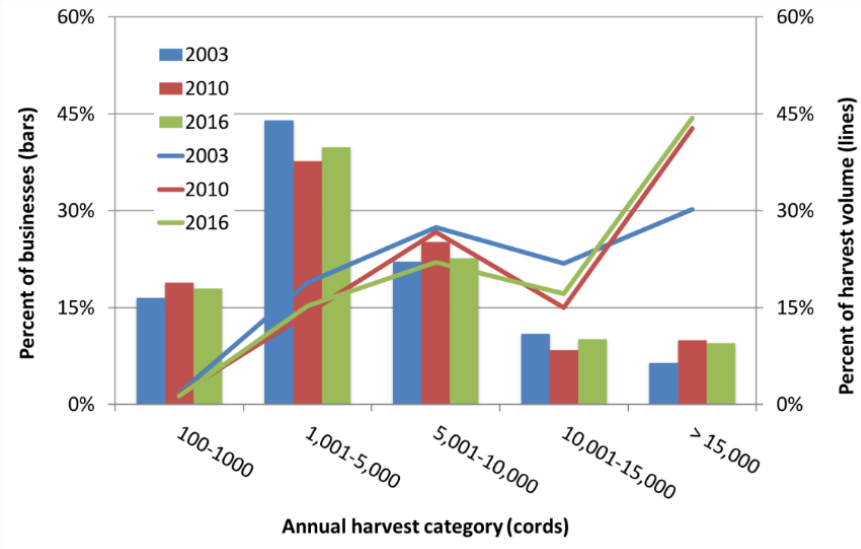
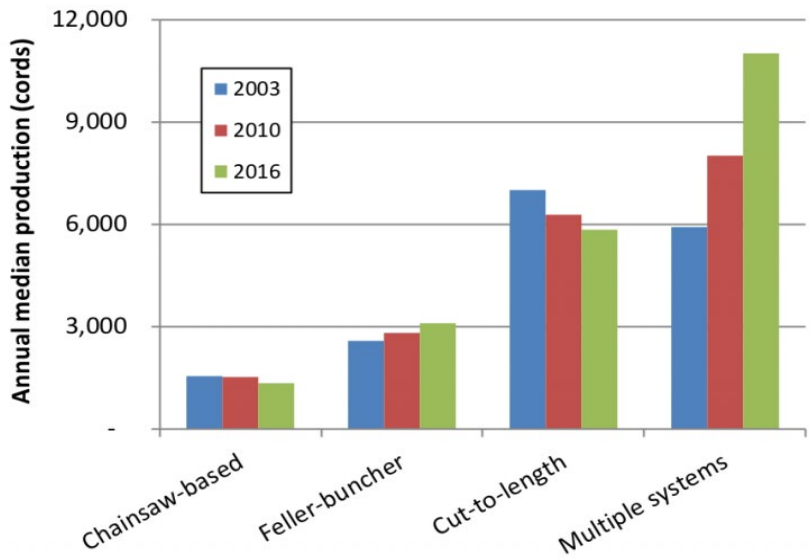


Figure 11. Annual median production of Wisconsin logging businesses by harvest system used over survey years



Transportation Infrastructure

Wisconsin's robust transportation infrastructure of roads, rail and shipping provides access to major markets across the U.S. In addition, Wisconsin has an intermodal transportation hub in Wisconsin Rapids, is located nearby intermodal hubs in Duluth, Minnesota and Chicago, Illinois. Wisconsin has seven harbors that provide access to either the Atlantic Ocean through the St. Lawrence Seaway or the Gulf of Mexico by way of the Mississippi River.

Utility Infrastructure

There is adequate electric service capacity throughout the state. Though there might not currently be adequate electric service to meet an individual facility's needs at some specific sites, there is capacity to upgrade services is most areas. Natural gas service is available in most areas of the state. Natural gas service territories are described in Chapter 6.

Workforce Labor

Wisconsin continued to see moderate growth from 2010 to 2019 and the population was estimated at 5.9 billion in 2019. The most populous counties in the state include Milwaukee, Dane, Waukesha, Brown and Racine in descending order. The median household income (in 2018 dollars) was $59,209. According to the Bureau of Labor Statistics, the median annual wage for those working as sawing and woodworking machine setters, operators and tenders was approximately $30,600 in 2018. The U.S. Census Bureau reported that 61% of the state's population was between 19 and 64 years of age in 2018. Wisconsin's workforce is well-educated; 92% of residents 25 years and older have a high school diploma and 30% have a bachelor's degree.

According to the U.S. Bureau of Labor and Statistics, the employment rate in Wisconsin was 3.4% in March of 2020. Labor statistics are summarized in Table 3. Note that this data pre-dates the impacts of COVID-19 on Wisconsin's economy.

Table 3. March 2020 Wisconsin labor statistics

Labor Data	Quantity
Labor Force	3,104,804
Employment	2,999,100
Unemployment	105,700
Unemployment Rate	3.4%
Labor Force Participation Rate	66.8%
Manufacturing	482,400

Wisconsin's nearly 6 million people are spread out over 54,200 square miles with an average of 108 people per square mile across the state. Wisconsin's population is more concentrated in the southern portion of the state. Density as person per square mile was calculated based on data from the U.S. Census Bureau and the Wisconsin Department of Administration and is presented in Table 4.

Table 4. Person per square mile in Wisconsin, January 2019

Region	Persons/Square mile
Northwest	22
Northeast	28
Central	62
Southwest	59
Southeast	332

Based on assumed workforce needs of 200 employees for a pulp mill and for both non-structural and structural wood composite panel mills, all of the study regions would have the needed workforce to support a pulpwood using facility. There may be a limited number of specific sites within a region that would not easily support this work force need.

Chapter 3. Overview of Environmental Regulations for Pulpwood Using Facilities

Before the development or expansion of a pulpwood using facility may occur, site specific environmental analyses of necessary permits and approvals must be obtained. The WIDNR regulates many of those requirements and this chapter will only pertain to where the department has jurisdiction.

It is important to know that this type of facility qualifies for the WIDNR Complex Project Program. Under this program, the WIDNR proactively assigns a Single Point of Contact (SPOC) that coordinates all environmental aspects of proposed projects that are anticipated to have significant environmental impacts. The WIDNR works to provide exceptional customer service by ensuring clarity on development projects. To do so, a multi-program team will be compiled for a pre-permit meeting to ensure that each step of the development will be coordinated and both developer and WIDNR will understand how to collaborate for a successful outcome. To initiate conversations about participating in the WIDNR's Complex Project program, contact the Chief of Sustainability and Business Support.

Please note that this document should only be utilized for understanding what might be required, not what will be required. What will be required depends on the site selected and the regulatory applicability associated with the project proposed. Once a refined concept of the type of facility, and a specific site selection is made, the WIDNR will provide timely assistance through the Complex Project process.

Permits/Regulatory Requirements

When assessing the types of permits and regulatory requirements that facilities are subject to, it is important to separate the analysis into those that are necessary prior to construction and those that are necessary for operation.

Preconstruction Activities and Permitting Requirements

Stormwater Permitting

The DNR's stormwater program may require different permits depending on the construction actions that will take place on site as well as the ongoing operation of the facility. For the purpose of this section, the focus will be construction stormwater practices. A stormwater construction permit will be necessary should the land be disturbed.

The DNR's stormwater construction site permit requires landowners to install practices to help decrease the amount of sediment that pollutes Wisconsin's waterways from construction projects. Land disturbance during a construction project exposes bare soil which can erode during storm events. Practices help decrease the amount of sediment that runs off during a storm event.

Air Permitting

With the exception of a few state specific rules (ie. ch. NR 445, Wis. Adm. Code), Wisconsin's air rules are generally not more stringent than the federal regulations applicable in all other states in the country. Unless proposing to locate in a nonattainment area, the development of a pulpwood using facility likely requires a Prevention of Significant Deterioration (PSD) major air pollution control construction permit under ch. NR 405, Wis. Adm. Code and an air pollution control operation permit under ch. NR 407, Wis. Adm. Code. An air pollution control construction permit is required to be issued prior to commencing construction, with limited allowances for activities of a non-permanent nature.

NOTE: If the facility does need an air permit, then that permit must be obtained BEFORE the start of construction. For the air program 'start of construction' has a very specific definition, and it includes any clearing of the land (i.e. removing trees, grading, or other land disturbance) as well as letting of contracts for equipment to be purchased specific to use in the facility's operations.

The SPOC will work with the air program to obtain a permit writer for the proposed project. The permit writer will endeavor to:

- Communicate what non-permanent activities are allowed prior to air pollution control construction permit issuance;
- Coordinate a pre-air permit application meeting;
- Understand the proposed project;
- Communicate what air permit application materials are to be submitted to the program;
- Understand your expectations for project timing;
- Communicate permit review progress, which may be done through regularly scheduled check-ins if requested; and
- If approvable, process both the air pollution control construction permit and the air pollution control operation permit in an integrated fashion.

Additional Pre-construction activities:

In addition to stormwater and air permits, a facility such as this should be prepared to work with the DNR to conduct several other assessments. These include:

1. Determination if there are wetlands on the property where construction is to take place and if there are, what are the boundaries of that wetland and how does that affect the placement of the intended facility. It is advised that a DNR assured delineator is hired for this activity.
2. Evaluation of any water body on site (lake, river, pond), even those that are intermittent in nature, must be identified and evaluated to determine appropriate set-backs.
3. Assessment for rare and endangered plants and animals.
4. Assessment for archeological sites on or near the area that will need to be constructed upon.
5. Though not required, the DNR highly recommends lining up the recycling and/or disposal path for any waste generated. This can include understanding businesses in the area that could incorporate waste generated from a proposed facility into their raw material stream as well as understanding options for disposal such as local industrial boilers or other appropriate disposal facilities.
6. The DNR also encourages potential developers to reach out to the local municipality to understand the capacity for needs such as water and wastewater. It is also recommended to inquire with the municipality about any local regulations that development could be subject to.

Operation Requirements

Should a facility need an air permit, and the developer is successful in obtaining a 'construction' permit, then the next step is to apply for and secure an operation air permit. The DNR will work with applicants to set deadlines and assist with the process should this be necessary. NOTE: The DNR does offer air permits that are faster and easier to obtain. These permits are called Registration Operation Permits. They are available to facilities that are able to maintain emission levels below established thresholds. There are three annual thresholds: 25 tons, 50 tons, and a new Green Tier Registration Operation

Permit, which caps emissions at 80 tons of air pollutants. Depending on the actual emissions of the constructed facility, a discussion with the DNR will be helpful to understand your options.

1. The air pollution control construction permit will contain notification and submittal requirements associated with initial operation. The air pollution control operation permit most likely will be processed in parallel with the air pollution construction permit.
2. Developers will likely need to obtain an industry specific stormwater permit. Stormwater permitting is broken into two processes. This permit is different than the construction stormwater permit mentioned above which has the purpose of maintaining site integrity during the building process. Once the facility is up and running and based upon the SIC (Standard Industrial Code), the developer will be required to obtain a permit for the successful running of a facility. These types of permits often have monitoring, and site maintenance requirements. Facilities able to demonstrate 'no exposure' may apply for an exemption from this permit.
3. Developers will need to determine how any source of wastewater will be handled. All facilities will have traditional sanitary sewer discharge requirements, and facilities such as those proposed in this report will need to understand if they will have additional wastewater discharge that will need to be managed. If facilities will be on municipal sewer, then they will need to connect with the community's pre-treatment coordinator to understand any requirements to treat waste water prior to sending it to the treatment plant.
4. An assessment will need to be made of all waste streams. Wastes will need to be characterized into categories (solid, universal, hazardous) and disposed of appropriately.
5. In Wisconsin, all businesses must have a recycling program. Contractors to assist with finding markets for materials that cannot be recycled on site need to be aligned.
6. Facilities that have, or plan to have, an ISO 14000 Environmental Management System or a system that functions in the same way are encouraged to consider joining the DNR's Green Tier program. This voluntary program celebrates and acknowledges the 'beyond compliance' work that Wisconsin facilities are undertaking.

Again, this list is information around permits and efforts that may affect you or that you might want to explore. The WIDNR will be able to provide more specific information as developers provide the parameters and location of potential facilities.

Water Supply

Before constructing, installing or operating wells to withdraw water from underground sources for any purpose where the capacity and rate of withdrawal of all wells on one property is in excess of 100,000 gallons per day, an approval must be obtained from WIDNR. The approval criteria and information which must be submitted to the WIDNR for review for any high capacity well proposal is contained in NR 112.26, Wis. Adm. Code. The WIDNR is required by statute to complete the review within 65 business days of receipt of the completed application. The principal criteria used in determining whether a high capacity proposal is approvable is the impact on a public utility well. If there is an impact, the DNR may deny the proposal or approve it with such limitations or conditions as may be necessary to prevent impairment of the ability of the public utility to furnish water to the public.

If a proposal for water use is such that it will result in a water loss as defined in section 144.026(1) (L), Wis. Statutes, of greater than 2 million gallons per day in any 30-day period, a more detailed review and

approval process as specified in section 144.026, Wis. Statutes, and Chapter NR 142, Wis. Adm. Code, is required.

Antidegradation

The objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The CWA requires states to adopt water quality standards for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. Water quality standards consist of three components: antidegradation, designated uses, and water quality criteria. Information on designated uses and water quality criteria can be found on the DNR's website.

The antidegradation policy is designed to maintain and protect high quality waters. Antidegradation implementation procedures establish how proposed new or increased discharges to high quality waters are addressed to ensure that water quality is protected. Antidegradation does not prohibit all activities that would lower water quality in high quality waters, but instead requires a demonstration that the lowering of water quality is necessary and would result in social or economic development in the area where the waterbody is located. Wisconsin's antidegradation policy is in NR 102 and implementation procedures are in NR 207.

Should an activity be deemed subject to this policy, the 7 key areas of focus will be:

1. Public participation;
2. Protection of existing uses;
3. Definition of increased load;
4. Threshold for determining significant lowering of water quality;
5. Increased limits due to revised and less stringent water quality criteria;
6. Criteria for determining necessary social and economic development; and
7. Application of antidegradation to stormwater discharges. A scope statement to address these issues is currently under development.

Solid Waste Disposal Options for Pulpwood Using Facilities

Residue/waste produced by any facility utilizing pulpwood may require disposal including ash from boilers and bark from debarking operations.

Solid Waste Disposal Options for Pulp Mills

The major waste produced by the pulp and paper making industry is wastewater treatment sludge. There are several options available for disposal of the sludge. The most common disposal method is to landfill the sludge. Other disposal options include landspreading the sludge as a beneficial soil additive and incineration of the sludge to produce energy. Innovative methods that have been proposed for reuse of paper mill sludge have included composting and use as an absorptive substitute for clay in cat litter products.

Landfill

Privately-owned sludge landfills and municipal-waste landfills are generally not willing to accept waste from other pulp and paper companies due to many disposal concerns including: the difficulty of handling sludge because of the high water content; the limited amount of space remaining in existing

landfills; and specific limits on the refuse to sludge ratio allowed by the WIDNR. Therefore, constructing a new landfill is likely the most feasible alternative if the sludge is to be landfilled.

Landfill Licensing and Siting Laws

All new landfills must obtain both state and local approval before construction. The state licensing and the negotiation/arbitration of local approvals are two separate processes although they occur concurrently. The state licensing process is administered by WIDNR, Bureau of Solid and Hazardous Waste Management, and is a technical decision-making process focusing on the ability of the proposed landfill design to meet all standards to protect public health and the environment. The local approval process focuses on the local economic, social and land use impacts of the facility.

State Approval Process

The state approval process includes four major steps. The first step, an initial site report, is optional and the remaining steps including feasibility report, plan of operation, and facility documentation are mandatory.

An applicant may submit an initial site report (ISR) to the WIDNR to obtain an opinion on the potential for the site to be developed as a landfill. This step allows the applicant to avoid the cost of doing major feasibility studies on sites which would have little potential of ever being approved by the WIDNR. The WIDNR also assists the applicant by specifying the information which should be developed for a feasibility report. An unfavorable ISR review has been an effective way for the WIDNR to discourage an unsuitable site before the applicant makes an irrevocable financial or political commitment to the site.

The feasibility report is the most important step in the state licensing process. Obtaining a favorable feasibility determination from the WIDNR virtually assures the applicant that the landfill can be developed from a technical standpoint. The feasibility report contains detailed information on the characteristics of the facility including geology, hydrogeology and soil properties of the site, the volume and characteristics of the waste, documentation for the need for the landfill and a discussion of alternatives to landfilling such as reuse, recycling and energy recovery. The report also proposes a preliminary engineering design for the facility. Within 60 days of receipt of the feasibility report, the WIDNR 1) determines if all the required minimum information is in the report; 2) determines whether or not an environmental impact statement is needed; and 3) if the report does contain all the necessary information issues a public notice inviting public comment including the possibility of holding either an informational or contested case hearing on the feasibility of the proposal. The hearings are intended to address the technical issue of site feasibility including the need for the facility and the ability of the proposal to meet design and performance standards and protect public health, welfare and the environment.

Following the approval of the feasibility report by the WIDNR, the applicant prepares a plan of operation. The plan of operation includes the final engineering design for the landfill. It contains information on the construction, sequencing of operations, daily operations, monitoring, closure design and long-term care of the closed facility. The owner may begin construction of the landfill following approval of the plan of operation. Landfills are often constructed one module at a time. During construction, facility documentation reports are prepared documenting the construction process.

Following construction of the landfill, the owner must submit detailed documentation of construction. This includes surveys of various grades, field and laboratory materials test results and photo

documentation. Only after the facility documentation report has been approved, the proof of financial responsibility has been secured with the WIDNR, a final inspection is done and a biannual license fee paid, will a license be issued which allows the landfill owner to begin accepting waste.

Landfill Standards:

The state requires that landfills be located and built in accordance with stringent locational, performance, design, monitoring and financial responsibility standards.

Locational criteria prohibit siting of landfills within wetlands, critical habitats, floodplains and within certain distances of surface water, state or federal highways, parks, airports and public or private water supply wells. Exemptions to these criteria (except the floodplain prohibition) may be granted upon proper justification. Performance standards have been established to ensure that landfills will not cause detrimental effects to surface water and groundwater and to ensure that explosive gases which may migrate from the landfill and hazardous air contaminants which may emit from the landfill are below detrimental levels. Design standards require landfills to maintain specific separation distances to groundwater and bedrock and to contain and collect leachate within the landfill. Standard landfill design includes a 5 foot clay liner, perforated leachate collection pipe placed in gravel filled trenches excavated into the clay liner and a one foot granular drainage blanket placed over the clay liner. The leachate is continuously removed from the landfill through gravity drainage and is then collected and treated at a wastewater treatment plant. Upon reaching final grades at the landfill, the sludge is covered with a filter fabric, 2 feet of clay, 1.5 to 2.5 feet of cover soil and 6 inches of topsoil. The monitoring standards require that all landfills monitor the surrounding environment. Monitoring is required for: groundwater; surface water runoff; the unsaturated zone beneath the landfill; leachate quantity and quality; leachate head buildup in the site; and methane migration. Finally, financial responsibility standards required that a facility owner provide proof that they have the financial capability to close the facility and care for it for an additional 20 or 30 years.

As described above, Wisconsin landfill siting is complex, comprehensive and time consuming. It can take three to five years to plan, design and construct new facilities. The siting process does provide, however, environmental protection and an orderly and fair process for siting.

Landspreading:

Three Wisconsin pulp and paper mills are currently landspreading wastewater treatment plant sludge under the Wisconsin Pollutant Discharge Elimination System permit program. Two of the mills are landspreading sludge on agricultural land while the third is spreading the sludge on their own tree plantations. Several other mills are actively seeking WIDNR approval of landspreading proposals.

Under the administrative rules, the WIDNR can only permit the landspreading of sludge under this program if it has both beneficial and nondetrimental properties as either a fertilizer or liming material or a soil conditioner. These requirements have been satisfied in the past by mills submitting the results of laboratory analyses and field experimentation. Besides documenting that the sludge is beneficial and will not result in the contamination of the environment, the mill must also prepare and submit a sludge management plan. This plan must document 1) how the sludge will be managed on a day-to-day basis; 2) what kind of lands are to be used for landspreading sites; 3) the availability of sufficient sites which are approvable; and 4) sufficient interest by landowners. Upon approval of the sludge management plan, the WIDNR may issue or modify the WPDES permit to allow the landspreading of the sludge.

A major concern which has arisen since 1986 is the concentration of dioxin and dioxin related compounds in certain paper mill sludges. Concern about the impacts of this compound on landspreading sites has caused the WIDNR to evaluate the need for establishing limits or guidelines specific to that contaminant. The results of this evaluation are not completed at this time and therefore the WIDNR is taking a very cautious approach in evaluating new sludge spreading proposals if dioxin is present.

Environmental Analysis and Public Disclosure

Regulatory decisions made by the WIDNR are subject to the requirements of the Wisconsin Environmental Policy Act (WEPA, section 1.11, Wis. Statutes). WEPA requires that state agencies consider and publicly-disclose the environmental impacts of their actions. For most projects, these requirements are met during normal review of the various permit applications submitted to the WIDNR (e.g., air emissions, effluent discharges, wetland fill, construction stormwater, etc.) under section NR 150.20(2), Wisc. Admin Code. Before applying for permits or approvals, prospective applicants for pulping projects are encouraged to consult with the WIDNR. Early consultation enables the WIDNR to: 1) identify the required regulatory authorities; 2) determine the appropriate WEPA review process; and 3) provide the prospective applicant with any information it has that may affect the feasibility of the proposed project.

If the scope and complexity of a pulping project and its anticipated environmental impacts are considerable, in relation to project characteristics listed under NR 150.20(4)(b), the WIDNR may decide to prepare a detailed Environmental Impact Statement (EIS) to meet its WEPA compliance requirements under s. 1.11(2)(c), Wis. Statutes. To aid in this process, the WIDNR may require the applicant to submit an Environmental Impact Report (EIR) under section 23.22 (5), Wis. Statutes and NR 150.30(1)(g). An EIR describes in detail the project, environmental conditions in the area of proposed development, and alternatives considered by the project proponent. The WIDNR uses the EIR in its review of the various applications and in the preparation of an EIS.

The decision to prepare an EIS is made on a case by case basis and is relatively rare. All else being equal, proposed mills using bleached kraft pulping technology are more likely to have significant environmental impacts than smaller, "cleaner" facilities using other pulping technologies.

Preparing an EIS can appreciably extend the DNR's review and permitting process because of the analytical detail and level of public review and comment opportunities required. The WIDNR must consider the final EIS and public comments along with the regulatory review information before issuing decisions on a project.

Negotiations/Arbitration of Local Approvals:

In addition to the state licensing process, the site applicant must seek and obtain any applicable local approvals. These will include any permits or approvals required by preexisting local ordinances to construct or operate the facility such as zoning variances, building permits, etc. Although local approvals need only be obtained prior to construction of a facility, as a practical matter most applicants do not proceed with a plan of operation until the issue of local approvals is resolved. The local approvals process has two steps, negotiation and state arbitration.

A company proposing a new or expanded facility must apply for all local approvals at least 120 days before submitting a feasibility report to the WIDNR. At that time, any affected municipality may choose

to enter into negotiations with the applicant. In general, the site owner will offer design, financial and operational incentives to the affected municipalities as compensation for "hosting" the landfill.

If the parties are unable to reach a negotiated settlement, they may petition the state "Waste Facility Siting Board" to issue an arbitration award. Each party must submit its final offer for a negotiated settlement and after a hearing, the siting board must select without modification, the final offer of either the landfill applicant or the local siting committee.

Assistance from WIDNR

As stated at the beginning of this chapter, the WIDNR is committed to supporting businesses through permitting efforts. We advise that you reach out to the WIDNR early in your planning process so that we are able to help you understand the choices you have and the results of those choices on the permits that you will need to obtain.

Chapter 4: Raw Materials Supply

This study identifies potential regions in which plants could potentially be sited. The state was divided into five regions based on FIA survey units: Northwest, Northeast, Central, Southeast, and Southwest. The counties included in each survey unit are identified below.

- **Northwest:** Ashland, Barron, Bayfield, Burnett, Douglas, Iron, Price, Polk, Rusk, Sawyer, Taylor, and Washburn
- **Northeast:** Florence, Forest, Langlade, Lincoln, Marinette, Menominee, Oconto, Oneida, Shawano, and Vilas
- **Central:** Adams, Chippewa, Clark, Eau Claire, Jackson, Juneau, Marathon, Marquette, Monroe, Portage, Waupaca, Waushara, and Wood
- **Southwest:** Buffalo, Crawford, Dunn, Grant, Iowa, La Crosse, Lafayette, Pepin, Pierce, Richland, Sauk, St. Croix, Trempealeau, and Vernon
- **Southeast:** Brown, Calumet, Columbia, Dane, Dodge, Door, Fond du Lac, Green, Green Lake, Jefferson, Kenosha, Kewaunee, Manitowoc, Milwaukee, Outagamie, Ozaukee, Racine, Rock, Sheboygan, Walworth, Washington, Waukesha, and Winnebago

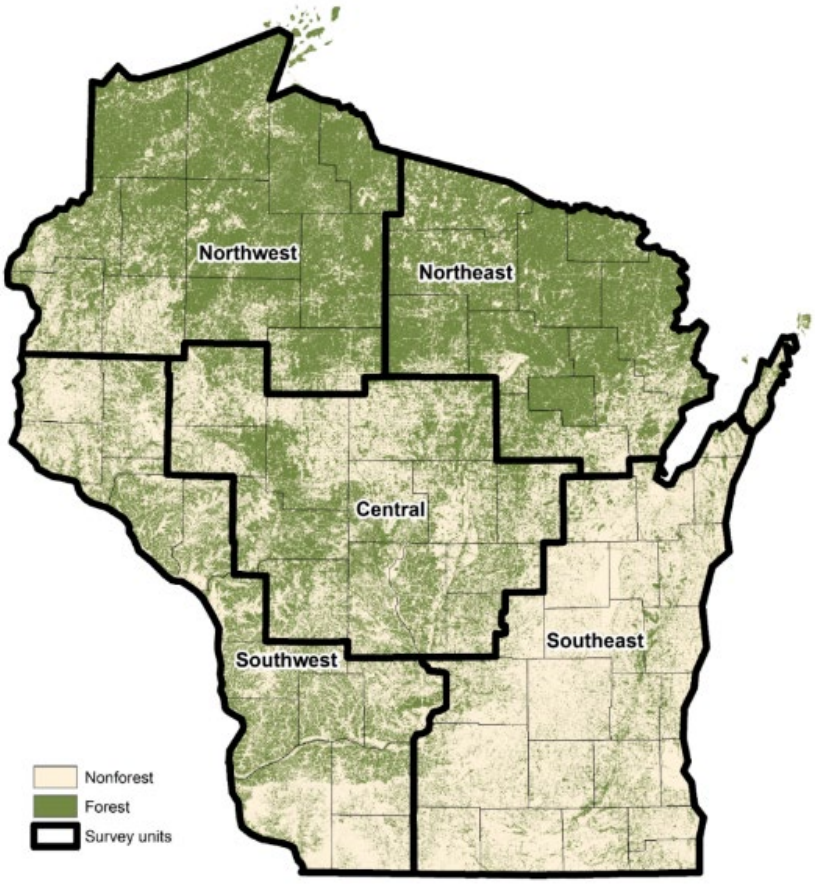
Timber Resource

Overview

Forest Inventory Data presented here was obtained from the Wisconsin DNR and is from the U.S. Forest Service's EVALIDator Version 1.8.0.01. Estimates of volume, growth, mortality, and removals are derived from Wisconsin's most recent Forest Inventory Analysis that was completed in 2019. At the time of this report, the data was in draft form.

Wisconsin's timber resources are extensive, and they have been increasing in both acreage and volume. Wisconsin's 17 million acres of forest land make up over 40% of the state's total land area and are concentrated in the northern study regions as shown in Figure 12.

Figure 12. Study regions across Wisconsin's forest land, 2019



Growing Stock Volume

In 2019, the growing-stock volume of all species across the state was 22.4 billion cubic feet, a 44% increase of the volume in 1983 which was 15.5 billion cubic feet (Schenborn, 1989); growing-stock volume is the volume of live trees with 5-inch minimum diameter at breast height (DBH). Of the total growing-stock volume in 2019, the Northwest and Northeast regions each held approximately 30%, the Central region had 19% and there was 12% and 8% in the Southwest and Southeast regions, respectively (Table 5). Across the state, 18% of the 2019 growing-stock volume was pine, 4% was spruce or fir and 7% was other softwoods. Oak made up 17% of total growing-stock volume, aspen was 11% and other hardwoods were 43% (Table 5). While the forest composition remained relatively stable from 1983 to 2019, there was 6% increase in softwood volume and a 6% decrease in aspen volume.

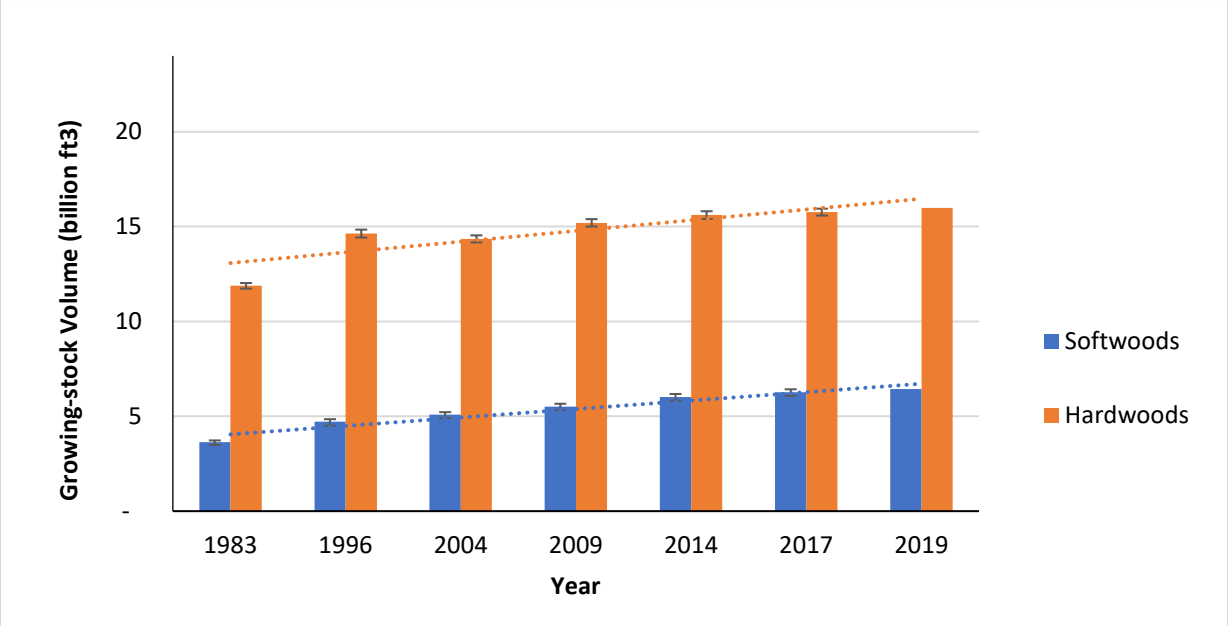
Table 5. Growing stock volume of trees on timberlands by species group and study region, 2019, MM CF

Study Region	Spruce/Fir	Pine	Other Softwoods	Oak	Aspen	Other Hardwoods	Total
NE	450.7	1,312.4	793.0	485.3	768.9	2,870.7	6,680.9
NW	373.0	1,058.5	426.1	941.8	1,022.8	3,042.7	6,864.8
Central	39.2	1,275.9	113.8	1,098.2	291.3	1,456.7	4,275.1
SW	15.9	211.3	12.5	991.2	183.3	1,337.5	2,751.7

SE	29.8	155.5	176.0	355.7	97.9	1,036.3	1,851.2
Wisconsin	908.6	4,013.5	1,521.4	3,872.1	2,364.1	9,743.9	22,423.7

The volume of softwood has increased steadily in each inventory since 1983, except for a drop from 2017 to 2019 which is difficult to explain. During this time, several pulp mills switched to more of a hardwood mix which would seeming have led to increased softwoods; however, jack pine budworm and spruce budworm are continuing problems that could have accounted at least partially for this reduction in softwood growing stock. Conversion of pine acreage to agriculture, oak or savannah in central Wisconsin may also have contributed to this reduction. Though hardwood volume decreased slightly from 1996 to 2004, it has trended upward since 2004 (Figure 13). Most of the major commercial species have increased substantially over the last few decades with the exception of aspen, paper birch, and jack pine. (USDA Wisconsin's Forests 2014)

Figure 13. Volume of growing stock by species group and year, trend lines are superimposed



Defining the Surplus Timber Resource

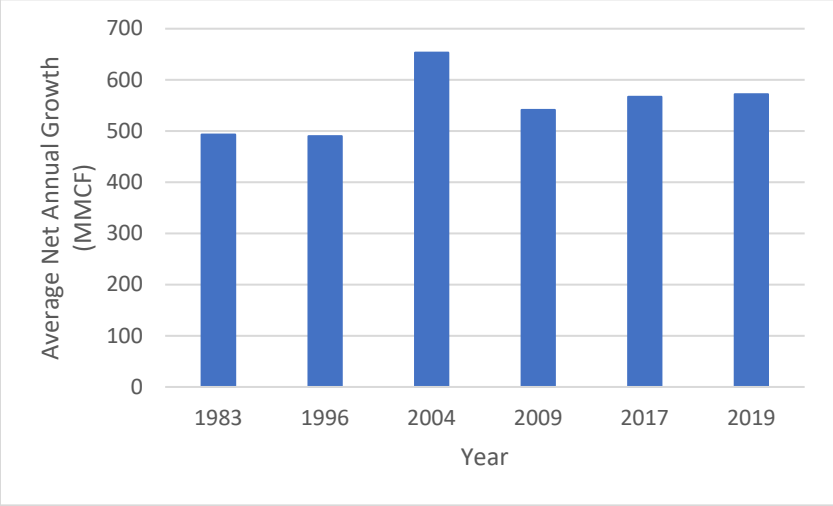
To estimate the surplus timber, the timber resource that would potentially be available to harvest, net annual growth (growth minus mortality) was established and removals were deducted from it. This value is the *surplus.* This simplified methodology to determine potential surplus was used because it is straightforward, provides consistent estimates between geographic areas, and is based on readily available data. If removals are less than net annual growth, then surplus timber is likely available and additional timber harvest could be sustained without drawing from the standing inventory. This surplus volume is the timber that could supply new or expanding industries.

As individual company supply requirements are determined, additional analyses should be made to further evaluate harvest potential. Several factors can affect availability of the timber resource and are noted in the Timber Availability section of this chapter.

Growth

Net annual growth of growing stock on timberlands was estimated at 572.7 MM CF in 2019. Average net annual growth from 1983 through 2019 are shown in Figure 14. Note that net annual growth takes mortality into account.

Figure 14. Average net annual growth, MM CF



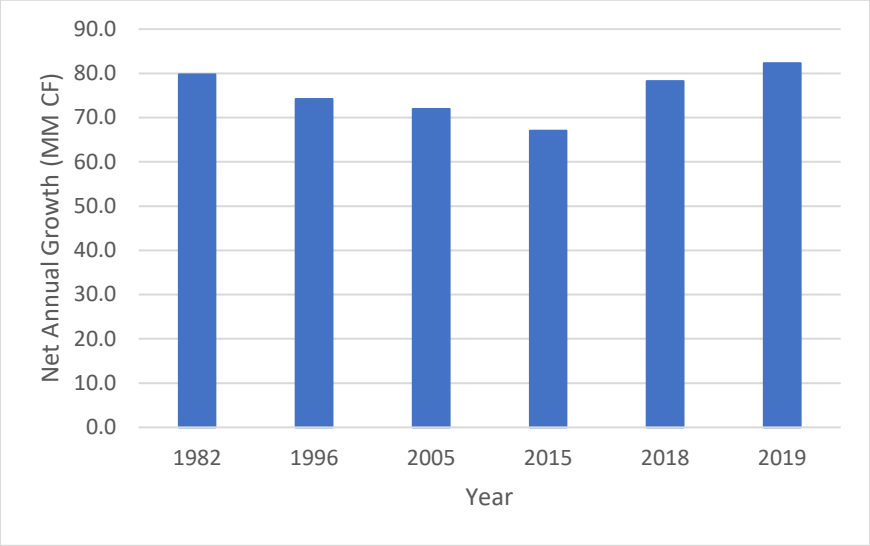
Net annual growth of softwoods accounts for 33% of total growth, totaling 186.0 million cubic feet in 2019, as compared to only 142.5 million cubic feet in 1983 (Schenborn, 1989). Pine accounts for 76% of the net annual softwood growth. Other relevant species include northern white cedar (6% of softwood growth), balsam fir (7% of softwood growth), tamarack (4% of softwood growth), and spruce (4% of softwood growth). Annual net growth of oak totaled 84.9 million cubic feet and accounted for 15% of the total growth in 2019. Net annual growth of other hardwoods was 219.6 million cubic feet, or 38% of total growth in 2019. Growth of sawtimber accounts for 67% of other hardwoods growth as compared to 30% of the total growth in 1983 (Schenborn, 1989). The more detailed growth data from 2017 showed that a majority of oak growth (88%) and other hardwoods growth (67%) was in sawtimber trees. Note that sawtimber growth refers to trees designated as saw log trees, and that the vast majority of these trees have substantial pulpwood volumes in addition to the saw logs. Net annual growth of growing stock in on timberlands in 2019 is shown in Table 6 by species group and study region.

Table 6. Net annual growth of growing stock on timberlands by species group and study region, 2019, MM CF

Study Region	Spruce/Fir	Pine	Other Softwoods	Oak	Aspen	Other Hardwoods	Total
NE	11.4	39.3	13.9	13.5	27.4	62.1	167.6
NW	5.9	37.8	6.3	22.3	40.1	61.9	174.3
Central	0.8	50.1	2.0	24.5	10.6	40.9	128.9
SW	0.6	8.6	0.3	19.1	1.8	31.1	61.5
SE	1.0	5.3	2.6	5.5	2.4	23.7	40.5
Wisconsin	19.7	141.1	25.1	84.9	82.3	219.6	572.7

Net annual growth of aspen growing stock accounted for 82.3 million cubic feet, 14% of total growth. While aspen annual growth had generally decreased since 1983, it increased significantly since 2015 (Figure 15). Analysis of more detailed available data from 2017 indicates that 52% of Wisconsin's aspen resource is over-mature. Aspen between 30 and 40 years old had the highest growth rate in 2019 as compared to other ten-year age classes. Aspen typically reaches maturity between 40 and 60 years and most aspen less than 20 years of age will not reach the 5-inch DBH requirement to be included in growing stock. Figure 15 shows net annual growth of aspen since 1982.

Figure 15. Net annual growth of aspen over time, MM CF



Mortality

The average annual mortality of growing-stock trees on Wisconsin's timberlands has been increasing since the mid-1960s; however, the rate of increase has slowed since 1996 (USDA Wisconsin's Forests, 2014). In 2019 annual mortality was estimated at 234.2 million cubic feet (Table 7), as compared to 137 million cubic in 1983 (Schenborn, 1989). Dead tree volume was not included in the estimation of surplus timber volume.

Table 7. Annual mortality of growing stock on timberlands by species group and study region, 2019, MM CF

Study Region	Spruce/Fir	Pine	Other Softwoods	Oak	Aspen	Other Hardwoods	Total
NE	10.8	3.3	4.7	2.1	16.7	16.3	53.9
NW	13.1	5.8	4.4	5.4	23.2	25.9	77.8
Central	1.8	6.5	1.4	10.2	8.6	12.7	41.4
SW	0.1	1.7	0.0	7.2	6.4	20.2	35.6
SE	0.5	1.4	1.5	3.0	2.2	16.9	25.5
Wisconsin	26.3	18.7	12.1	28.0	57.0	92.0	234.2

Major storm events do periodically occur in the state and can have significant impacts on the timber resource. In the summer of 2019, over 300,000 acres of forest land suffered considerable wind damage, and the resulting mortality is not included in the above estimates. Although mortality was significant in

the localized areas where it occurred, the impacted acreage represents less than 2% of total forested acreage in the state; however, those 300,000 acres are approximately the acreage that is typically harvested annually in Wisconsin. These types of events can cause ripple effects in the supply chain even in areas not directly affected by the storm event. Significant impacts on the timber supply stream during salvage harvests can occur and adaptability could be an important component of a company's success.

Timber Harvest Removals

Average annual harvest removals were estimated at 265.6 million cubic feet in 2019 (Table 8). Thirty-four percent of harvest removals were from the Northwest region, 29% were from the Northeast and 22% were from the Central region. Softwood harvest was fairly similar across these three regions, while the harvest of aspen was highest in the Northwest and Northeast regions. The harvest of Oak was highest in the Central region, while the harvest of other hardwoods was highest in the Northwest and Northeast regions. Average annual harvest removals are summarized by species group and region in Table 8.

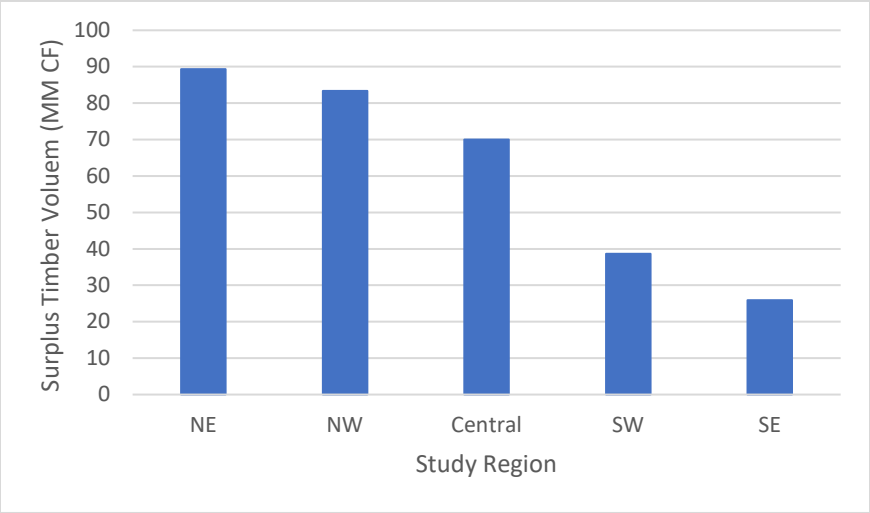
Table 8. Average annual harvest removals from growing stock on timberland by species group and study region, 2019, MM CF

Study Region	Spruce/Fir	Pine	Other Softwoods	Oak	Aspen	Other Hardwoods	Total
NE	5.7	13.1	3.5	5.8	21.8	28.4	78.3
NW	2.8	15.0	1.1	8.4	28.4	35.2	90.9
Central	0.1	19.2	0.7	13.7	8.3	16.8	58.9
SW	0.0	3.1	0.0	6.9	1.5	11.3	22.9
SE	0.2	1.4	0.1	3.0	1.5	8.3	14.6
Wisconsin	8.9	52.0	5.4	37.9	61.4	100.0	265.6

Surplus

Surplus is the growing-stock volume that would potentially be available for new or expanded industrial uses, defined as net annual growth (growth minus mortality) minus removals. The surplus timber resource in 2019 was substantial at 307.1 million cubic feet (Figure 16) as compared to 207 million cubic feet in 1983 (Schenborn, 1989). All of the study regions have surplus timber, and it is concentrated in the Northeast, Northwest, and Central regions as shown in Figure 16.

Figure 16. Total surplus timber volume by survey unit, 2019, MM CF

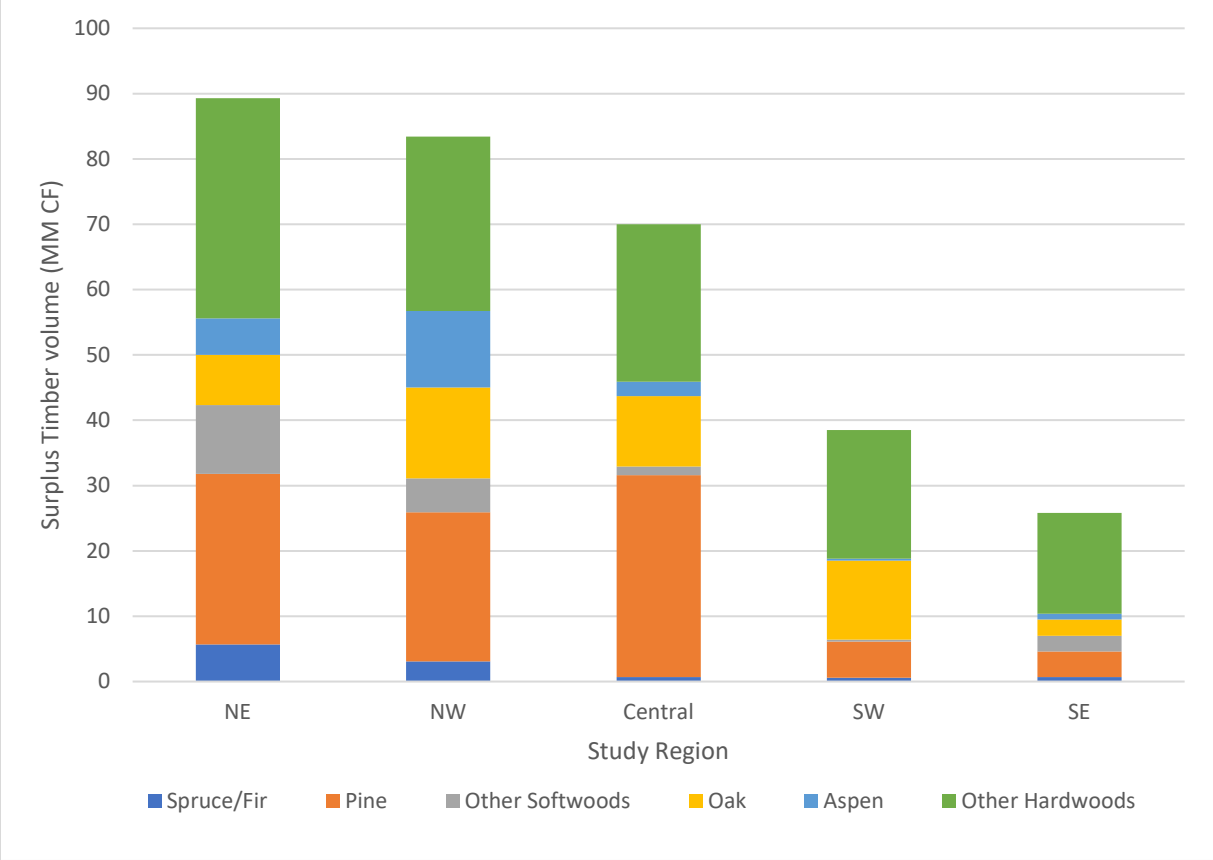


There is a substantial amount of surplus pine, 89.2 million cubic feet, which makes up 75% of softwood surplus timber volume and 30% of the total surplus timber volume. Combining pine with spruce/fir and other softwoods would bring the statewide softwood surplus up to 119.7 MM CF. The opportunity for increased utilization of softwood offers good potential in the Central, Northeast and Northwest regions. Currently about half of the hardwood growth is harvested each year, excluding aspen, but there was still a significant surplus hardwood timber volume in each of the study regions in 2019. The largest hardwood surplus volume was in the Northeast region with 33.7 million cubic feet. Across the state, other hardwoods also offer potential for expanded harvest with an annual surplus of 119.6 million cubic feet (Table 9, Figure 17). A surplus of 47.0 million cubic feet of oak was identified in 2019, accounting for 27% of the hardwood surplus and 16% of the total surplus. The largest oak surplus volumes were found in the Northwest and Southwest survey units. The oak surplus combined with the "other hardwoods" surplus, excluding aspen, was 166.6 million cubic feet, as compared to 125 million cubic feet in 1983 (Schenborn, 1989). Oak has certain properties that make it a less desirable species for the production of certain paper products and wood composite panels. Some mills may not use any oak, while others will limit the percentage of oak they purchase. Annual surplus timber volume in 2019 is summarized by species group and study region in Table 9 and Figure 17.

Table 9. Annual surplus timber volume by species group and study region, 2019, MM CF

Study Region	Spruce/Fir	Pine	Other Softwoods	Oak	Aspen	Other Hardwoods	Total
NE	5.7	26.1	10.5	7.7	5.6	33.7	89.3
NW	3.1	22.8	5.2	13.9	11.7	26.7	83.4
Central	0.7	30.9	1.3	10.8	2.2	24.1	70.0
SW	0.6	5.5	0.3	12.1	0.3	19.7	38.6
SE	0.7	3.9	2.4	2.5	0.9	15.4	25.9
Wisconsin	10.8	89.2	19.7	47.0	20.8	119.6	307.1

Figure 17. Annual surplus timber volume by species group and study region, 2019, MM CF



Currently, 75% of the annual aspen growth is harvested and the aspen surplus statewide was 20.8 MM CF in 2019. The vast majority of the surplus aspen is concentrated in the Northwest region (11.7 MM CF) and the Northeast region (5.6 MM CF). In 1983, harvest exceeded growth in these regions (Table 10). This demonstrates that aspen age classes have evened out to some extent, and that the current resource is sustainable with current or slightly increased consumption levels.

Although Wisconsin's aspen resource is growing much faster than it has in the past, the acreage of aspen forest type continues to decrease due to changes in forest management techniques. The stigma associated with clearcutting for regeneration has led to some landowners letting aspen stands naturally succeed to other forest types. In addition, some aspen acreage was historically grown on sites that were better suited to other timber types, and those sites have more recently been converted to other species compositions through natural regeneration of underplanting. Because the acreage in the aspen type has declined by 22% from 1983 and 2019 (Table 10), the opportunity for a long-term increase in aspen consumption is unlikely without a corresponding decline in current aspen usage. Table 10 summarizes the number of acres of aspen forest type over time from 1983 to 2019.

Table 10. Aspen forest type acres over time by study region

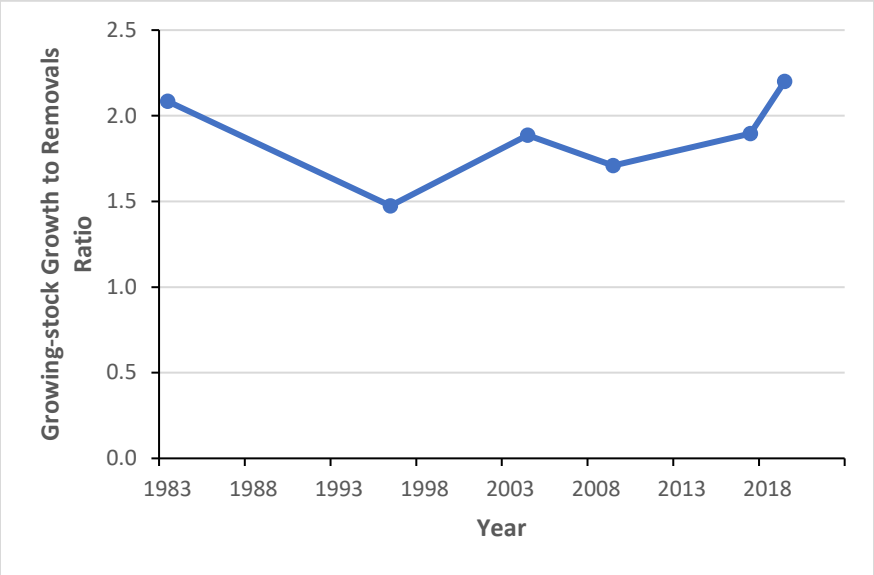
Study Region	1983	1996	2004	2009	2014	2019
NE	1,026,636	1,004,296	938,288	891,547	846,303	853,626
NW	1,507,819	1,384,905	1,352,835	1,318,862	1,318,416	1,307,998

Central	577,459	372,105	295,839	317,042	302,388	275,971
SW	86,044	85,402	63,932	72,853	63,999	64,026
SE	63,307	38,372	43,958	46,689	49,091	39,203
Wisconsin	3,261,265	2,885,081	2,696,288	2,647,229	2,580,197	2,540,824

Growth-to-Removals Ratio

The ratio of annual net growth of growing stock to removals (G/R ratio) is an assessment of whether or not timber removals are reducing the total volume of trees on timberland and is a primary measure of forest sustainability. The G/R ratio could also be a secondary measure of surplus timber. The G/R ratio is defined as the annual net growth divided by annual removals. A ratio greater than 1.0 indicates that net annual growth exceeds removals and that removal rate is sustainable. A ratio less than 1.0 indicates that growth is less than removals and the timber resource cannot be sustained at that removal level. Figure 18 shows the annual G/R ratio for all species from 1983 to 2019. The annual G/R ratio in 2019 was 2.2, similar to the ratio in 1983 which was 2.1.

Figure 18. The G/R ratio of growing stock on Wisconsin timberland by year



G/R ratios for different ownership types have been changing. Over the last several years, many industrial lands have changed hands, some staying in industrial ownership and some going to other ownership classes. This may have led to lower harvest removals on lands that are no longer in industrial ownership and resulted in lower overall harvest removals on private lands (Wisconsin DNR, 2014).

Pulpwood Specification

Pulpwood specifications are based on the type of product that it will be manufactured into; therefore, pulpwood using mills may have varying specifications for the quality of wood they purchase. Common pulpwood standards require a minimum four-inch inside bark top diameter and a 100-inch length. Quality is reflected in wood straightness, proper trimming of branches and soundness. Pulpwood quality in Wisconsin continues to improve largely as a result of improved forest management.

Timber Availability

Beyond surplus timber volumes, several factors may influence the availability of pulpwood in Wisconsin. The 2019 FIA data show that 49% of the net annual growth was harvested. Much of the volume harvested was from over-mature or overstocked stands that were in need of harvest and where growth is substantially less than in recently managed stands or in younger stands. The volume of growing stock timber that silviculturally needs to be harvested over next 15 years is greater than the estimated 307.1 million cubic feet of surplus timber resource because of the accumulated growth that hasn't yet been harvested.

Note that the U.S. Forest Service's Forest Inventory Analysis methodology estimates removal volumes by quantifying growing-stock trees (live and minimum of 5-inch DBH) that were in the previous inventory, but have since been removed or died as a result of silvicultural or land clearing activity. Any volume harvested from dead trees and those trees less than 5-inch DBH are not included in growing stock volume estimates nor are they included in removal estimates. Therefore, it is likely that the surplus estimates described herein are understated.

Which forest stands are silviculturally ready for harvest also affect the availability of surplus timber. Most timber types in Wisconsin require either periodic thinnings in even-aged stands or selection harvests in uneven-aged stands. These removals typically occur every 10 to 20 years to keep stands healthy and resilient, but the timing of removals is based on multiple factors including landowner objectives, management history, growth rates, and site quality. Timing is also influenced by operational considerations including the volume available for harvest, site conditions and access influenced by wet soils or lack of dry or frozen ground, timber markets, and weather events. Certain even-aged timber types are typically not thinned and are instead harvested on a rotation age schedule. Rotation ages may be determined by landowner objectives, attainment of a physical or value growth rate, and stand condition. The two most common timber types in Wisconsin managed in this manner are aspen and Jack pine, which are typically harvested on 40 to 60-year rotations.

The surplus volume estimate is based on all growing stock and includes timber that may be harvested as saw bolts, saw logs, veneer logs, pulpwood, and other products. Sawtimber-size trees also have sections that are utilized as pulpwood. Some sawmills utilize saw bolts as small as 5-inch top diameter, and in these cases, timber that is traditionally thought of as pulpwood may be sawn into lumber products. A majority of sawmills and bolt mills sell their residues (chipped slabs) to pulp mills. Retired Forest Products professor Robert Govett, reported that approximately 15% of the wood volume in a log becomes chip residue in a typical sawmill. In a bolt mill, approximately 30% or more of a log becomes residue.

Timber availability can be influenced by markets and, for a timber sale to be economical for both the landowner and the logger, there needs to be strong markets for various forest products as well as markets for variety of tree species. Even though pulpwood makes up a majority of the total product volume coming off of many timber sales, it typically doesn't bring the highest value. Saw logs and veneer logs command a much higher price than pulpwood, and trees that produce saw and veneer logs also produce pulpwood. A strong market for high value products ensures that harvesting lower value products like pulpwood is economically feasible. Conversely, harvesting a timber sale with scattered saw log or veneer log trees would not be economically viable without a strong pulpwood market. Loggers cut timber sales according to both management practices and market demands, so it is important to

cultivate markets for a variety of forest products to maintain future forest health and quality. An example of the diversity and interconnection of the forest product industry in Wisconsin can be found in how sawmill residuals are distributed to make other forest products. Sawmills sell chips made from debarked slabs to pulp and wood composite panel mills, sawdust to pellet or animal bedding producers, and bark to mulch manufacturers or for boiler fuel. These residues have evolved over time from a waste disposal problem to an added income source resulting in better utilization of the forest resource.

Timber sale restrictions and requirements due to environmental conditions can affect the availability of timber. Sale restrictions and requirements are put in place to protect soils and water quality and to reduce the spread of pests and disease. In the past it was common to find "winter only" or "frozen ground" requirements on timber sale contracts to prevent rutting and soil compaction; however, as the Wisconsin winters have changed and frozen ground conditions can now often be short-lived or non-existent, timber sale contracts have adapted. Other methods are used to harvest timber on sensitive areas while still minimizing residual soil damage, including trail armoring used in association with CTL systems, dry ground condition exceptions, excluding particularly sensitive areas from the sale, and using specialized equipment such as flotation tires to reduce ground pressure. Restrictions due to insects and disease are often state mandated and can affect harvesting economics as well as planning. For instance, there are seasonal restrictions and guidelines on harvesting oak stands, and, depending on ownership, harvesting is typically restricted from April 15 to July 15 due to susceptibility to oak wilt during that time. Another example is that there is a requirement on many ownerships to treat freshly cut stumps in red pine stands with a fungicide to prevent the spread of *Heterobasidion annosum*, a detrimental fungus, to residual trees. Stump treatment can be affected by weather conditions and therefore can impact the timing of harvest operations.

Pulpwood Stumpage Prices

The process of selling timber or the rights to harvest timber has historically been done once the timber sale has been established by the landowner or their representative. After the sale is set up, the sale is advertised to potential bidders, and in most cases, the contract is awarded to the highest bidder that meets all requirements of the sale. A secondary method used, primarily by smaller private landowners whose volumes are insufficient to support the costs of the competitive bidding process, is a negotiated price with a selected logger.

Competition for wood among pulpwood using mills generally raises stumpage prices. Forests in the Northwest, Northeast and Central regions are closer to large mills and because many of these mills share overlapping procurement areas, stumpage prices increase for certain species as logging contractors compete for pulpwood.

Prices paid for pulpwood stumpage of the same species vary across the state. These variations are the result of relative abundance, wood quality, logging difficulty, seasonal restrictions, and distance to markets. Market demand for wood is considered the most important factor in determining stumpage prices.

Pricing by species also varies greatly around the state and can be impacted by a variety of internal variables including: fiber length, wood density, debarking characteristics, and available volumes at any given time. In addition, several variables external to the state can influence pulpwood stumpage prices including: national and global production levels, increase of similar products in domestic and

international markets, natural disasters around the world that increase demand and/or decrease production of similar products.

Price variations among species and between selected regions of the state, as derived from county and state forest timber sales are provided annually by the WIDNR and are available on the WIDNR website. Average prices across the state for 2020 timber sales are shown in Figures 19 through 24, along with the

Figure 19. Mean, minimum and maximum prices of spruce/fir on state and county timber sales in 2020

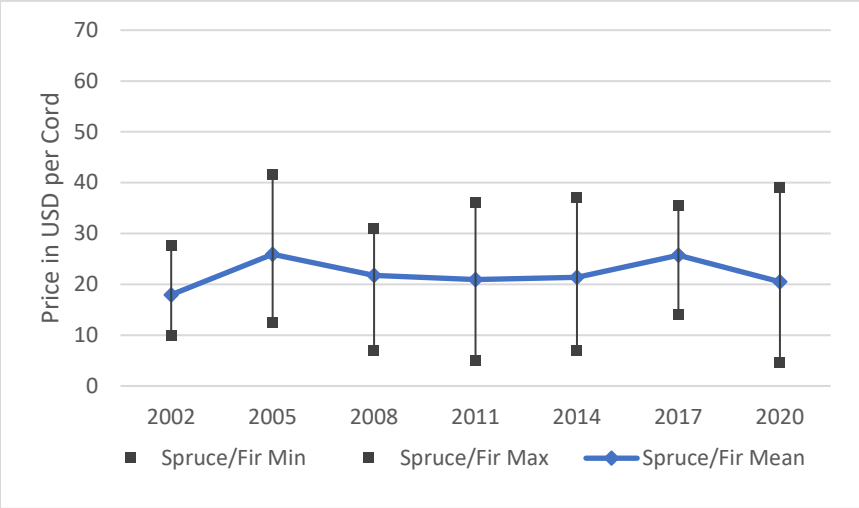


Figure 20. Mean, minimum and maximum prices of pine on state and county timber sales in 2020

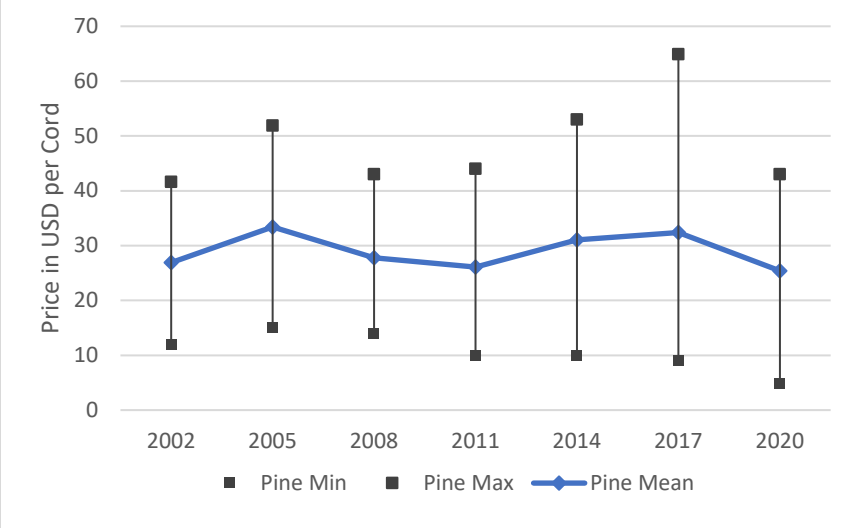


Figure 21. Mean, minimum and maximum prices of other softwoods on state and county timber sales in 2020

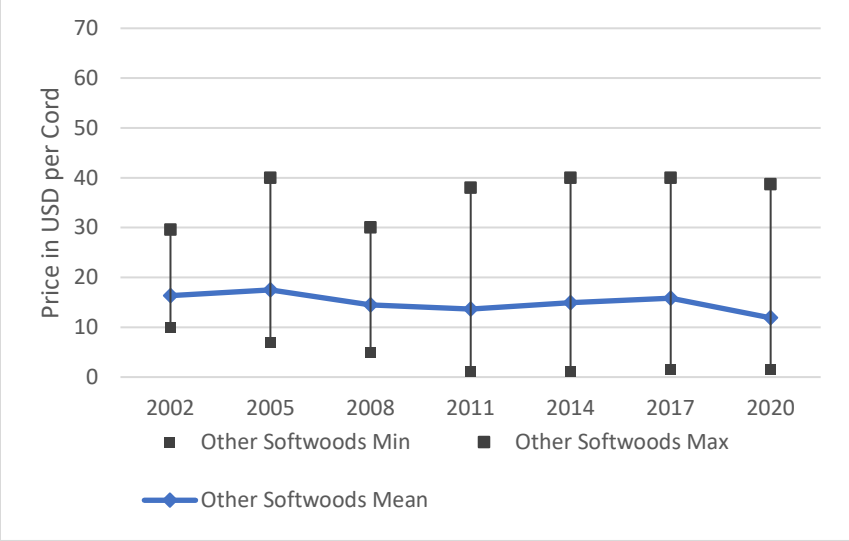


Figure 22. Mean, minimum and maximum prices of oak on state and county timber sales in 2020

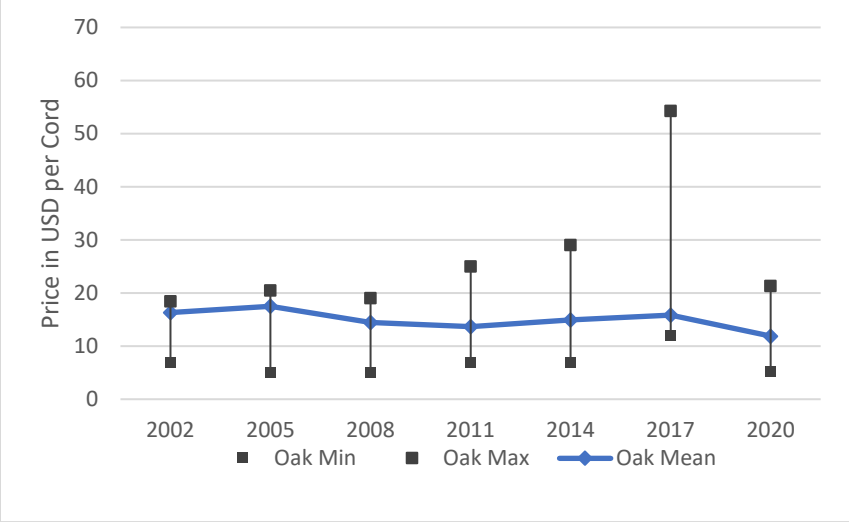


Figure 23. Mean, minimum and maximum prices of aspen on state and county timber sales in 2020

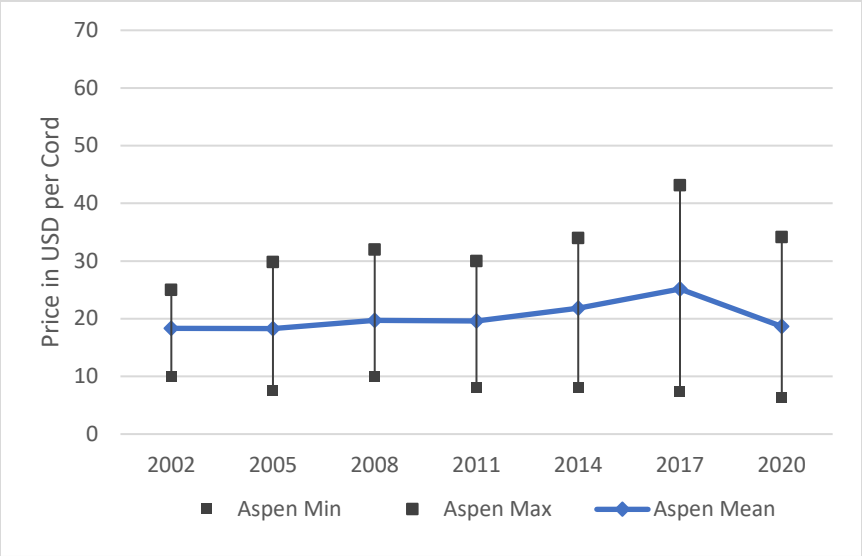
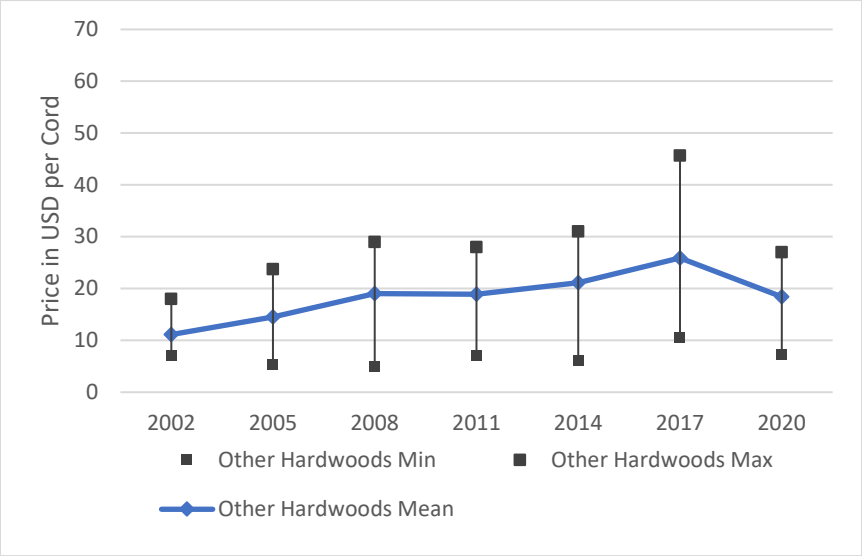


Figure 24. Mean, minimum and maximum prices of other hardwoods on state and county timber sales in 2020



Pulpwood Delivery Considerations

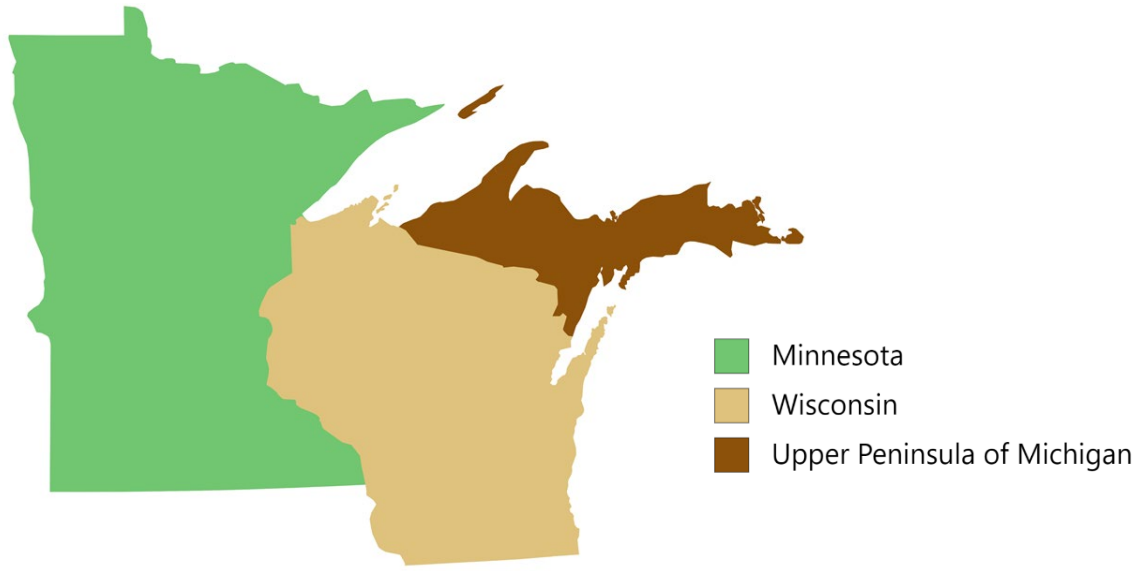
Factors affecting the cost of transporting woody material include specific gravity of the species, moisture content, local road weight limits and truck configuration. The majority of pulpwood in Wisconsin is delivered by truck, and federal trucking laws that affect drivers' hours have put limitations on the amount of wood that can be hauled by companies, which in turn affects hauling costs. Rail delivery availability has decreased considerably in Wisconsin over the past 30 years due to the removal or closure of numerous rail lines and, in many cases, a pricing structure that makes the economics of rail delivery impractical. The actual siting of a mill and what rail line it is on or near can have a dramatic effect on the viability of rail usage on any particular site.

Timber Resource in Minnesota and Michigan

The data in this section was taken from the U.S. Forest Service's EVALIDator Version 1.8.0.01, 2020.

Michigan and Minnesota adjoin Wisconsin and have abundant timber resources that are and can be imported into Wisconsin (Figure 25). In 2017, Wisconsin mills imported about 30 million cubic feet of pulpwood and chips, and Michigan and Minnesota supplied most of imported wood (Haugen, 2017).

Figure 25. Map of potential timber resource area



An expanded demand for pulpwood could draw from forests in neighboring states. Inclusion of the timber volumes from parts of Minnesota and Michigan adds significant additional volume of timber. The estimated surplus timber volume for Wisconsin, including adjoining areas of Minnesota and Michigan's Upper Peninsula is 517.9 million cubic feet annually.

This report only looks at the timber resources in Minnesota counties within 100 miles of Wisconsin, as these areas are more likely to be feasible sources of raw materials for Wisconsin facilities. These counties are located in the Northeast, Central and Southeast regions for Minnesota as identified by USDA Forest Service FIA Program. The Metro region was not considered because of its largely urban/suburban makeup. Minnesota counties included in the analysis are provided in Table 11.

Table 11. Minnesota counties included in the analysis

Aitkin	Goodhue	Olmsted
Benton	Houston	Pine
Carlton	Itasca	St. Louis
Cass	Kanabec	Stearns
Cook	Lake	Wabasha
Crow Wing	Mille Lacs	Winona
Dodge	Morrison	Wright
Fillmore	Mower	

The timber resource in Minnesota counties within 100 miles of Wisconsin are summarized in Table 12. The estimate for standing volume in the Minnesota counties within 100 miles of Wisconsin is 10.7 billion

cubic feet (Table 12), an increase from the 7.2 billion cubic feet identified in 1983. 1.5 billion cubic feet of that volume is pine, 1.4 billion is spruce and fir, 898 million is “other softwoods”. Oak accounts for 1.1 billion cubic feet, 2.4 billion is aspen and 3.4 billion is “other hardwoods”.

Table 12. Minnesota timber resource on timberland in counties within 100 miles of Wisconsin by species group, 2018, MM CF

	Pine	Spruce/Fir	Other Softwoods	Oak	Aspen	Other Hardwoods	Total
Growing Stock Volume	1,506.4	1,385.9	897.8	1,133.7	2,393.8	3,395.9	10,713.5
Net Annual Growth	42.2	35.0	16.7	21.2	92.8	59.9	267.9
Annual Mortality	10.2	31.4	7.1	9.7	50.3	50.7	159.3
Annual Removals	18.5	14.3	3.2	6.0	57.8	31.5	131.2
Annual Surplus	23.7	20.8	13.6	15.2	35.0	28.3	136.6

Growing-stock volume in the Upper Peninsula of Michigan totals 13.2 billion cubic feet, an increase from the 9.8 billion cubic feet identified in 1989 and is similar in composition to forests in northern Wisconsin. Oak, aspen and other hardwoods account for about a third of the standing volume, but the majority of the surplus timber volume, 57.4 MM CF, is in pine, spruce, fir and other softwoods. Spruce and fir in the western part of the Upper Peninsula have been impacted by insects and disease in recent years, likely impacting the surplus timber. Michigan’s Upper Peninsula’s timber resource is summarized in Table 13.

Although rail access is lacking, there is a good primary highway network connecting Michigan's Upper Peninsula timber resource to Wisconsin allowing Wisconsin’s forest products industry to economically use these timber resources. The posting of several Wisconsin highways for Michigan truck weights (11-axle up to 164,000 pounds), as mentioned previously, has made obtaining wood from Michigan even more economical than in the past.

Table 13. Michigan Upper Peninsula timber resource on timberland by species group, 2019, MM CF

	Pine	Spruce/Fir	Other Softwoods	Oak	Aspen	Other Hardwoods	Total
Growing Stock Volume	1,608.9	2,596.4	24.8	228.9	1,346.1	645.1	6,450.2
Net Annual Growth	42.1	41.8	1.9	5.9	42.1	9.7	143.5
Annual Mortality	6.3	26.7	0.2	1.7	23.0	9.8	67.7
Annual Removals	12.9	15.3	0.0	1.8	34.7	4.5	69.2
Annual Surplus	29.1	26.5	1.9	4.1	7.4	5.2	74.2

Uses for Pulpwood

Wood pulp and wood composite panels are the primary products made from pulpwood. Saw bolts are also produced from pulpwood-sized material that meet this product specification and the residual chips from processing saw bolts can then be used in wood pulp and wood composite panel production. Other products made from pulpwood remain a minor component of the Wisconsin industry despite speculation in the early 2000s that liquid biofuels might create competition for the pulpwood resource.

Wood Pulp

Wood pulp is primarily used to make paper products and is comprised of two main categories, hardwood pulp and softwood pulp. The shorter fibers in hardwood pulp lend to its use in the production of printing and writing papers and tissue products. Softwood pulp has longer fibers which provide strength and durability and is used to produce packaging materials such as paperboard and containerboard. Hardwood pulp has been gaining market share over softwood pulp due to emerging market demands and global supply changes (Timberland, 2019).

Though Wisconsin ranks first in the nation for paper product production, it falls short on pulp production and a significant portion of the state's papermaking industry imports its wood pulp from other states and countries. Although 4.7 million tons of Wisconsin pulpwood was used by pulp mills in 2018, there is considerable potential for more pulp making capacity in Wisconsin.

Besides paper products, a number of other products can be made from wood pulp including textiles, rayon, and cellophane. Other products can be made from by-products of the pulping process including, black liquor and lignin, which in turn can be used to create value-added products such as turpentine.

Wisconsin's timber resources and logging capacity are both more than adequate to support additional pulping capacity, but capital costs for a new mill, perceived uncertainty in paper markets, and environmental regulations have been barriers to additional wood pulp production. Capital costs continue to be a hurdle but may be overcome by the long-term economic benefits of locating pulp production facilities in the same state as paper production. The decline of the paper industry in the U.S. has often been misrepresented, in that declining market demand for printing paper has been equated to lack of demand for paper in general. However, tissue paper product markets have shown long-term stability and the ubiquity of e-commerce is creating unprecedented demand for container board use and production and is expected to continue into the foreseeable future.

Wood Composite Panels

The wood composite panel family of products is made up of individual product types, whose names are often used inaccurately. With guidance from multiple industry experts, this study uses the terms "structural wood composite panels" and "non-structural wood composite panels." Structural wood panels are used in building projects and include waferboard, oriented strand board (OSB), laminated veneer lumber (LVL), and laminated strand lumber (LSL). Non-structural wood panels are used in furniture, cabinets, and other individually constructed items. This product category includes medium density fiberboard (MDF), flakeboard, particleboard and hardboard.

Today, wood composite panels are most often made from pulpwood. In the past, sawmill or value-added wood industry residues (sawdust, shavings, etc.) were typically the primary raw material. Residues can still be utilized in some of these products; however, increased market competition for these residues as well as a decrease in production of these residues has led to less residue use in wood panel production.

Wisconsin has two structural wood panel mills and there are several nearby in neighboring states. The one non-structural wood composite panel mill in Wisconsin uses their panels internally for their own value-added production. Numerous value-added wood industry manufacturers in Wisconsin use non-structural wood composite panels and there could be an opportunity for expansion of non-structural wood composite panel production in Wisconsin.

Saw Bolts

Saw bolts are a log product with smaller diameter specifications than typical saw logs. Bolts are sawn from pulpwood-sized material and are used to mass produce lumber for pallet stock and other low-grade lumber material. Bolts can be made from hardwoods, aspen and softwoods. Because the bolt logs are smaller in diameter than saw logs, a larger percentage of wood is left in the residual slabs and edgings that are cut off during bolt production. This results in 30% or more of the bolt being chipped for use at a pulp mill or wood composite panel plant. The bolt wood market has the most potential to grow of any of the competing pulpwood markets and would be dependent on increased demand for lower grade lumber, such as for pallet stock.

Commercial Boiler Fuel

There is a wide range of commercial boilers in operation in Wisconsin, ranging from 100 ton per year units used to heat smaller commercial buildings up to 500,000 ton per year combined heat and power units used at pulp mills. Demand for wood as a source of commercial boiler fuel will fluctuate along with the prices for other fuels sources and with government incentives for renewable fuel sources or against fossil fuel use. The most economical use of wood products for a commercial boiler fuel continues to be in the forest industry itself at the facility where the residue is produced. Transportation of residues to other facilities for fuel is often cost prohibitive. Even if there is a dramatic increase in the use of wood for commercial fuel there is a significant resource of mill residue (bark) that is underutilized and logging residue resources that have barely been tapped. These two sources would have to be exhausted, or the demand for pulpwood by the pulp and wood composite panel industries would have to be significantly reduced before pulpwood ever became economically competitive as a significant source of commercial boiler fuel.

Compressed Wood Pellets and Briquettes

Other types of wood-based fuel include pellets and other compressed wood products. Starting around 2005, several wood pellet plants operating in Wisconsin began utilizing pulpwood to produce pellets. Although the drop in fossil fuel prices has reduced additional capacity development in this industry, pulpwood is still being used. There has been some shift in Wisconsin's pellet production from residential heating pellets to grilling pellets. Species used for grilling are typically sugar maple, hickory, cherry, and oak. There is also some production of animal bedding pellets from pulpwood, but most of the raw material for these pellets comes from saw dust residue. Overall, the wood pellet industry in Wisconsin has a minimal impact on the pulpwood supply.

Commercial Firewood Markets

Pulpwood delivered by loggers to commercial firewood producers or to homeowners by the log truck load is a market that varies tremendously depending on a number of factors such as price of other fuels, low mill price or limited markets for hardwood pulpwood, and severity of the winter. Although this market can have some localized impact on pulpwood supply, it is typically seasonal and has not had a significant impact on pulpwood availability in the long term.

Homeowner Firewood Use

In addition to homeowners who purchase firewood from commercial firewood producers, including loads of pulpwood length firewood from loggers, there are many homeowners that cut their own firewood. Depending on the winter this can be a significant use of wood in Wisconsin. This type of use

has very little impact on pulpwood supply in that most of these users will either cut firewood from the logging residue left after timber sales are closed out or they utilize dead and downed trees.

Excelsior

This is a product that consists of thin, narrow, ribbon-like strands of wood and has a wide variety of uses. The product is known for its resilience or its ability to expand readily after compression, which makes the product ideal for packaging. Other applications include erosion control blankets, use with oil booms, pipeline padding, in archery targets, animal bedding and evaporative cooler pads. Excelsior is made from lower density, softer wood species. The main species that is utilized in the production of excelsior in Wisconsin is aspen.

Excelsior is a desirable product for shipping because it is an all-natural, biodegradable product, unlike substitute materials such as packing peanuts. It is a sought-after packaging material for high end electronics because it does not conduct static electricity. Excelsior has been manufactured for over a century, meaning that there is little innovation in the process. There is one company in Wisconsin that has produced excelsior for decades. There are many substitute products for excelsior, meaning the market growth potential is lower for this product. The annual pulpwood consumption for this product is less than 2% of total pulpwood production in Wisconsin.

Shavings

There are a several companies in Wisconsin that produce wood shavings along with other animal bedding products from pulpwood. These historic established markets will likely remain stable but do not show any great potential for substantial growth. The annual consumption for these products is less than 2% of total pulpwood production in Wisconsin. This product is typically made from pine or less dense deciduous tree species such as aspen and basswood.

Posts

Posts are another product that has a history dating back to the 1800s, ranging from production and uses on individual farms to small commercial producers. Both of these uses are still going on today but the consumption of this product using pulpwood sized material is minor. The main species used for these products are red pine, cedar and tamarack.

Bio Products

For years, there have been efforts to develop a variety of bioproducts from forest feedstock to replace or augment traditional petroleum products. However, most of these products, despite years of development in many cases, have not reached commercial production levels.

Potential Uses for Pulpwood

Nano-cellulose Products

Nanocellulose is simply wood fiber broken down to the nanoscale. Although the potential applications for nanocellulose products are numerous and varied, the cost of commercial production is not even close to being economical. The potential for this product is tremendous, but not immediate.

Biochar

Biochar is produced by burning forest or wood residue (biomass) in a controlled process called pyrolysis. Although utilized as a soil amendment its cost-benefit ratio has not been proven on a large scale. With the availability of far less expensive residues the use of pulpwood to produce this product is not likely.

Mulch

This market is currently saturated with input from mills (bark) and municipal and tree service tree removals (urban wood chips). It is highly unlikely that this market would utilize pulpwood in the foreseeable future.

International Pulpwood Export Markets for Wisconsin

Canada would be the logical export market for Wisconsin pulpwood because of its proximity as compared to other countries, but the relative abundance of timber resources in Canada makes this an unlikely market. Additionally, any potential pulpwood markets that arose in Canada would more likely be filled by Michigan or Minnesota timber resources since both of those states border Canada. In 2016, Canadian mills didn't receive any pulpwood from Wisconsin (Haugen, 2017).

The opportunity to export pulpwood to countries other than Canada is very limited, if not non-existent. Debarked chips would seem to make the most sense, but still the sheer distance to market and the expense of transferring chips from one mode of transportation to another and potentially back again (rail to ship to rail or truck) makes overseas markets doubtful at best. The transportation costs make this product uncompetitive in most international markets.

In-Woods Chips

In some parts of the country in-woods flail chipping, which produces a clean chip, is a common raw material source for pulp mills and wood composite panel mills. To date, this type of production system has seen only limited use in Wisconsin. However, if this proves to be a product that shows economic viability for the logging industry in Wisconsin, a shift to this type of raw material production could happen quickly.

Separate Chipping Facilities

Historically there have been several stand-alone wood chip plants in Wisconsin that have purchased pulpwood and debarked and chipped it into a product that is sold to pulp mills or other chip-using facilities. Chip plants are a viable supply option for any mill that can utilize clean wood chips. If a facility doesn't have a means to utilize or market all of the bark they produce, then getting raw material from clean chips will reduce these unused residues.

Mill Residue

Most sawmills in Wisconsin that have a debarker and produce over a million board feet of lumber annually have a chipper to produce clean chips for a variety of markets. These sawmill chips have become a substantial raw material source for many pulpwood using facilities. In converting industrial roundwood into products such as lumber, Wisconsin's primary wood-using industries generated nearly 2.8 million tons of wood (coarse and fine residues) and bark residues in 2017(USFS 2020). Historically 40% of the mill residues were from bark, 26% from fine wood residue (e.g., sawdust) and the remaining 34% from coarse wood residue (e.g., slabs and edgings) (Haugen, 2017).

Chapter 5 Pulpwood Using Industries

Pulp and Paper Industry

Pulp Definition

Pulp is made from breaking down the fibrous part of trees or recycled paper and is the major ingredient in making paper. Pulp is used to make a variety of paper and cardboard products such as; shopping bags, food wrappers paper cups, tissue, and cardboard boxes, and a plethora of other products.

There are a variety of methods used for producing wood pulp depending on the type of paper and the characteristics needed in the final paper product, however the two primary methods of producing pulp utilize a chemical process or mechanical grinding.

- Chemical Pulp: Pulp produced by processing of wood with various chemical solutions. The paper produced from the chemical pulping process are not prone to discoloration. The principal chemical processes used are the sulfate (kraft), sulfite, and soda processes. These pulps are used to make a variety of products that require fiber strength including: paper bags, packaging paper and printing/writing papers. The kraft pulping process is the most common chemical process. Kraft pulps are typically divided into two types; hardwood (deciduous) kraft pulps and softwood (conifer) kraft pulps
- Dissolving Pulp**:** A grade of chemical pulp typically made from wood for making derivatives such as acetate, cellophane, and rayon.
- Fluff Pulp: Pulp that can be made from a chemical or mechanical process and sometimes by a combination of the two processes. Fluff pulp is typically bleached and is used in products such as: disposable diapers, incontinence products and feminine hygiene products.
- Mechanical Pulp: Any wood pulp processed mechanically either in totality or in combination with other processes. Mechanical pulp has a better yield than chemical pulp because of the high residual lignin content remaining in the pulp following processing. The disadvantage to paper produced from this pulping process is it is weaker and discolors easily with exposure to light. Products produced from this pulp include newsprint, tissue, toweling and paperboard.
- Recovered Paper Pulp**:** Pulp that comes from recycled paper. Several types of paper can be recycled including; newspapers, magazines, copy paper, and cardboard. Pulp is made by combining the recycled paper with water in a pulper (blender type apparatus) that reduces the paper to individual fibers, making a paper slurry. The paper slurry goes through several mechanical and/or chemical processing steps to remove contaminants. Water is drained from the slurry to created recycled pulp.

As noted above these different processes produce different types of paper products. Different pulps can also be mixed to produce products with certain characteristics. For instance, magazine paper typically utilizes more mechanized pulp combined with lesser amounts of bleached kraft pulp. The natural color of wood pulp is light brown and depending on the desired coloration of the final product, the pulp might go through a bleaching process. The pulp is then either sent to the paper making facility on site at integrated mills or is dewatered and treated to prevent mold and stored or shipped to a separate, off site paper mill.

Paper and Paperboard Definitions

Paper

The broad definition of paper is material manufactured in thin sheets from the pulp of wood and used in a wide range of products and uses including paper used for writing, drawing, or printing, wrapping paper, etc. However, the paper industry is more complex than this general description, there are many types and grades of paper. One method of categorizing types is as follows:

- Printing Paper
- Coated Paper
- Tissue Paper
- Newsprint
- Cardboard
- Paperboard
- Fine Art Paper

Wisconsin's Pulp and Paper Industry

In Wisconsin there are twenty-four paper companies that operate mills at 34 locations. Some are integrated mills, producing both pulp and paper. Others produce only pulp or paper. There are over 200 paper converting facilities in Wisconsin. Converters take paper produced at a paper mill and produce a wide range of finished products, including; parcel packaging, food wrappers, toilet paper, tissues, health care products, newspapers, copy paper, etc. There seems to be a perception that there is an overall decrease in the use of paper, which is only true for some uses such as newspaper. Other uses of paper are expanding and continue to evolve such as packaging materials, adult incontinence products, and tissue products.

All of the pulp mills that produce virgin pulp in Wisconsin are either integrated on site to use most of their production or have other paper mills within their ownership that utilize the pulp. Very little of the pulp produced in Wisconsin is sold outside of company ownerships. With 34 paper mills in Wisconsin there is an opportunity to produce pulp in state that can be utilized in state, thereby lessening the dependence on long distance transport of raw material. Optimizing the transportation of raw material can be especially critical during times of high transportation fuel prices, national emergencies, or other unforeseen calamities.

Having pulp produced in Wisconsin for paper mills in Wisconsin has the advantage of the infrastructure stability that Wisconsin offers in the way of forest ownership, timber type variability, harvesting stability/multiple markets, and voluntary forest management guidelines.

Many states/countries have most of their forests under the control of one or two agencies, which can cause timber supplies to be reduced with administration/policy changes. The diversity of forest ownerships in Wisconsin lends itself to a more available/sustainable supply of wood products.

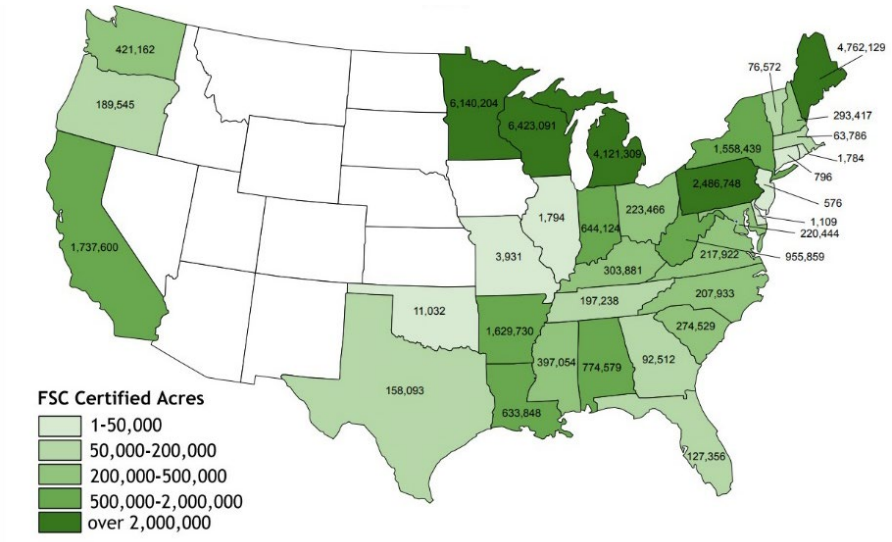
The diversity in timber types with a mix of deciduous and conifer forests throughout the state gives Wisconsin a tremendous advantage over states with mono-type forests which are more susceptible to forest health issues. These issues range from catastrophic forest fire threats with large contiguous acreages of coniferous forests to insect/disease outbreaks that can be particularly devastating in large monotype areas.

Whereas some states have strict forest practices laws that add both complexity and cost to timber harvesting, Wisconsin has been a leader in promoting voluntary guidelines through manuals, workshops, articles, and other information transfer systems developed by the DNR with industry input.

Forest Certification

Another benefit for the Wisconsin Paper Industry is the efforts between the forest industry mills, landowners (agency, industrial, and private), and the Wisconsin DNR to adopt forest certification as support for the state's forest industry. This certification is third party verification that the harvesting practices followed within Wisconsin are to the highest standards of current day sustainable practices. Figure 26 (FSC, 2020) shows WI with 6.4+ million acres under FSC setting it apart as the leader in this type of forest certification in the U.S. Currently 7.4 million acres, or 44.79% of the States forest land resource (Wisconsin Department of Natural Resources, 2019) is covered under one or more of the three forest certification options (American Tree Farm, FSC, or SFI). Considering average growth rates, one could project that Wisconsin forests are producing more than 7 million tons of certified wood each year. This provides Wisconsin with a clear advantage in providing certified products that are highly desired by the world market.

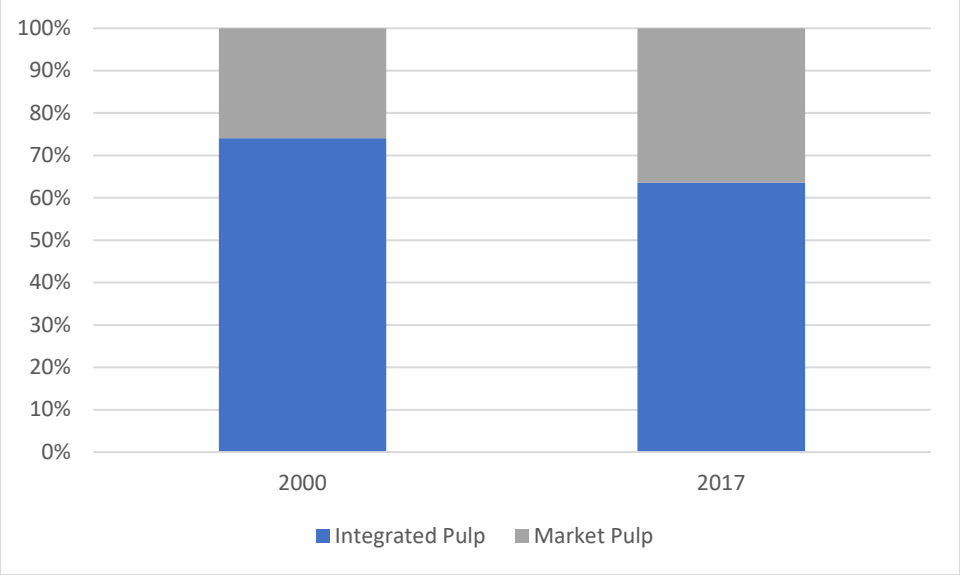
Figure 26. FSC certificated acres by state, 2019



Pulp Supply

The market for wood pulp is a significant portion of wood product markets worldwide and accounts for approximately 10.5% of global industrial roundwood production. Of that 10.5 %, about 35% is market pulp (Timberland, 2019). Market pulp is pulp that is sold to paper mills that are not integrated with a pulp mill or have more demand for pulp than their integrated pulp mill can supply. The remaining wood pulp production is pulp used internally in integrated pulp and paper operations. Figure 27 shows a 40.5% increase in the demand for market pulp from 2000 to 2017 (Timberland, 2019).

Figure 27. Total wood pulp capacity and market pulp share, 2000 and 2017



The U.S. contributes a larger percentage of the global softwood pulp market supply than it does to the hardwood pulp market, and this gap has grown since 2006. The U.S.'s percentage of the global hardwood market supply has decreased 11 percentage points from 2000 to 2017 while the U.S. softwood pulp supply market share increased 5 percentage points as shown in Figures 28 and 29 (Timberland, 2019).

Figure 28. Hardwood market pulp supply by region, 2000 and 2017

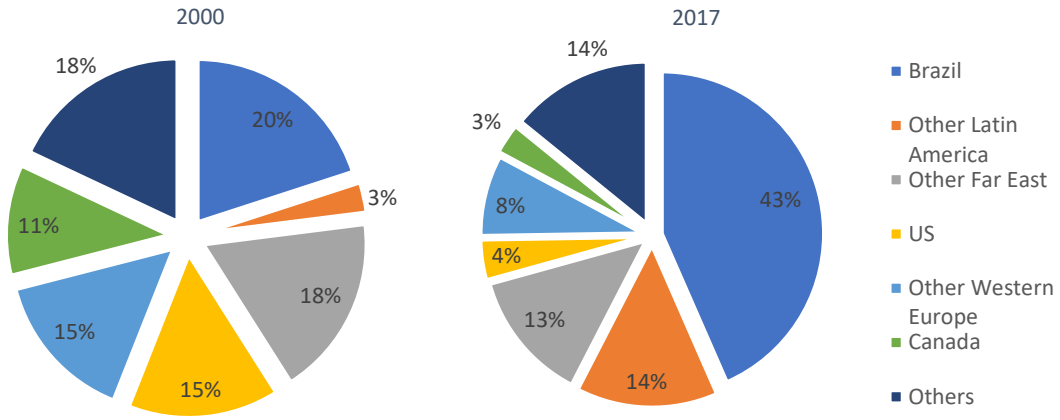
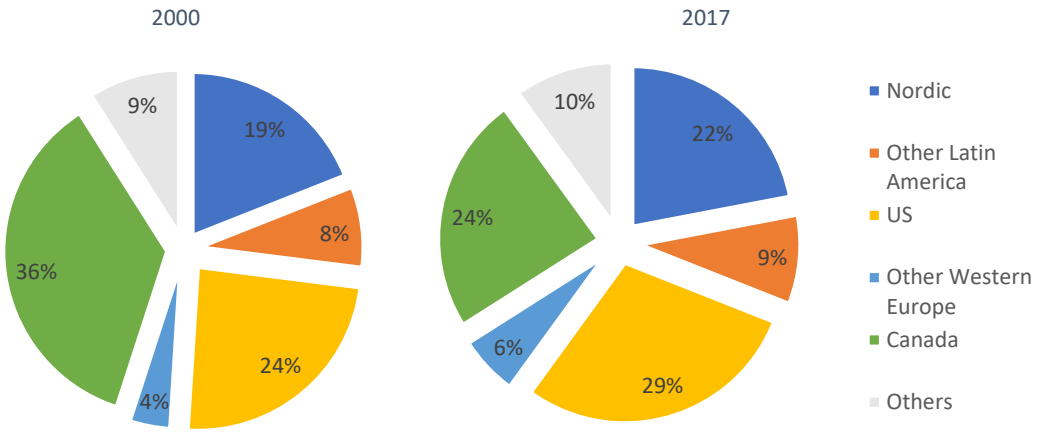


Figure 29. Softwood market pulp supply by region, 2000 and 2017



In the next several years, global market pulp supply is expected to grow in both the hardwood and softwood pulp markets in concert with the continuing increase in market pulp demand.

Dissolving pulp, used in the production of non-paper products like rayon and acetate, is a product that can be produced with the same production line as produces paper grade pulp. Industry experts estimate that approximately 40% of global dissolving pulp capacity has the ability to readily shift to paper grade pulp production. Currently, both dissolving pulp and paper grade pulp are seeing decreasing demand. Facilities with the ability to shift production to either product have the potential to take advantage of future demand increases should they occur.

Recent decisions by Sun Paper in Arkansas to cancel a proposed 4,400 ton per day pulp mill project in March of 2020 and by Verso Paper to indefinitely shut down integrated facilities in Minnesota and Wisconsin in the summer of 2020, and with other mill uncertainties due to recent world events leaves many questions, along with many opportunities. As of 2018 the Food and Agricultural Organization of the UN shows a 52.0 million metric ton pulping capacity in the U.S. (Food and Agriculture Organization of the United Nations, 2019). This is certain to fluctuate and adjust as conditions continue to evolve.

It is estimated by industry experts that between 1.0 and 1.2 million tons of pulp, from virgin wood, are produced annually by Wisconsin pulp mills, typically more than 95% of this production is used by paper mills in Wisconsin. This is roughly a quarter of the estimated pulp (both virgin and recycled fibers) usage at Wisconsin paper mills. Wisconsin paper mills are estimated to use between 4.2 and 4.5 million tons of pulp (combined virgin and recycled fiber) annually. Market demand for specific products and characteristics of the pulp needed to produce those specific products will influence the proportion of recycled to virgin pulp that is used. Note that these estimates include production and use data from the Verso mill Wisconsin Rapids, which closed July 31, 2020. Additional virgin pulp production in Wisconsin could potentially replace pulp imports.

Wood consumption, the proportion of softwood to hardwood, and specific species changes annually with market demand. Specific products typically need specific pulp mixtures, meaning species utilized is dependent on market demand for those products. Historically the percentage of hardwood to softwood

has fluctuated based on both raw material prices and market demand for the end paper products but recently the ratio has been approximately 60% hardwood and 40% softwood within Wisconsin.

Paper and Paperboard Supply

The United States is the second largest producer of paper and paperboard in the world, behind China. According to the American Forest and Paper Association (2019), in 2017, worldwide production of paper and paperboard was 419.7 million metric tons. This is more than double the 200.0 million metric tons that were produced worldwide in 1986. Even though the United States produced 72.3 million metric tons in 2017, up from the 67.0 million metric tons it produced in 1986, its percentage of total production dropped from 30% to 17%. In comparison, Canada dropped from 20.0 million metric tons in 1986 to 10.0 million in 2017 with its percentage of worldwide production dropping from 10% to 2%. Containerboard capacity increased 1.9 percent in 2018 to reach a record 39.7 million tons. Containerboard accounted for 47.6 percent of U.S. paper and paperboard capacity in 2018, up from 38.3 percent in 2008. Tissue paper capacity rose 1.3 percent in 2018 to 8.8 million tons. Over the 2009-2018 ten-year period, tissue capacity rose 7.0 percent.

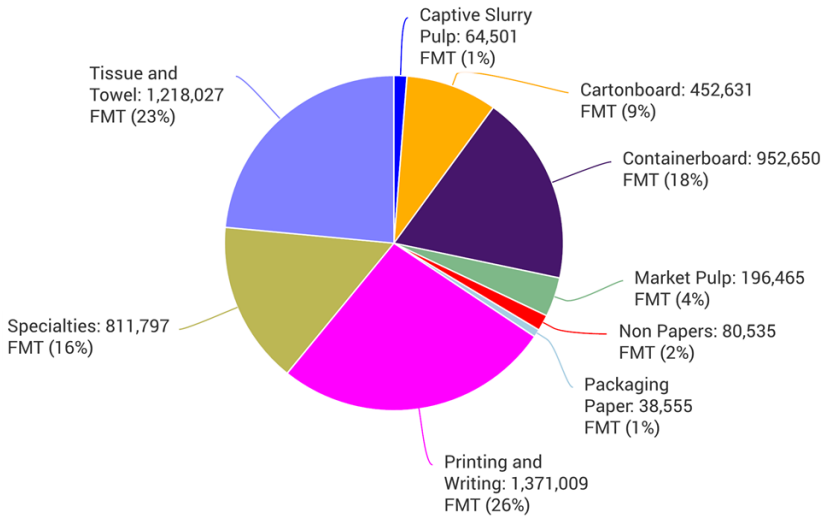
The Great Lakes is one of the largest paper manufacturing regions of the U.S. and Wisconsin's paper manufacturing industry leads the nation by several important measures. Wisconsin is the top state in paper manufacturing, shipping more value in paper products than any other state. It is home to 34 paper mills, 11.0% of the nation's mills, more than any other state (Cohen, 2017). In 2019, Wisconsin produced nearly 6.4 million tons of paper and paperboard and the direct output of its manufacturing industry was over $18.2 billion (WIDNR, 2019).

As reported by the Wisconsin Economic Development Corporation in 2019, opportunities for the pulp and industry are numerous. Potential growth includes increased demand for packaging materials driven by the surge in e-commerce and its concurrent demand for shipment packaging, often referred to as "the Amazon effect." Other specialty papers such as coated and/or laminated materials that can compete with plastic and are more sustainable and environmentally sound also show growth potential. Tissue and paper towels, a sizeable segment of Wisconsin paper production, is seen as stable and relatively recession-proof; it's expected to grow at roughly GDP levels.

Capital investment has been relatively low since the mid-1990s, leaving the industry with an aging infrastructure. That trend appears to be reversing. Interviews with industry leaders along with published reports show substantial planned capital investments in the next several years in Wisconsin, led by a more than $500 million new paper plant being constructed by Green Bay Packaging, the first completely new mill constructed in the state in decades. The mill is expected to open in the first quarter of 2021.

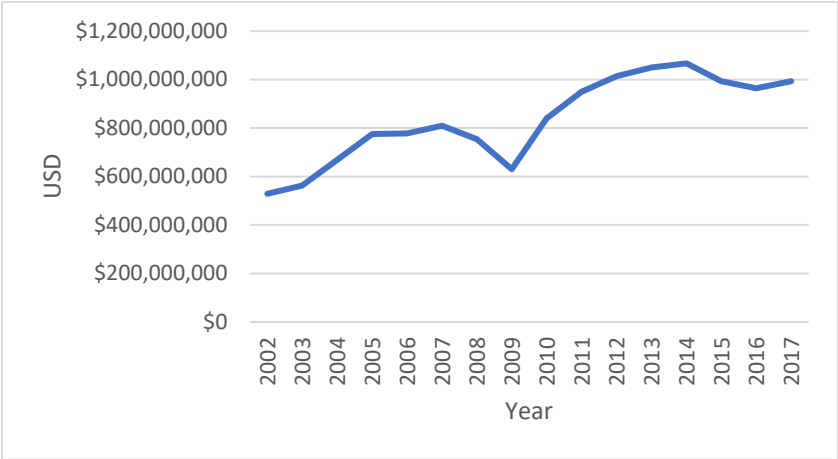
With the exception of newsprint mills, there are businesses operating in every other subsector of paper manufacturing in Wisconsin. Figure 30, comprising data reported by the WEDC (2019) and provided by Fisher International's ITS FischerSolve Next Database, illustrates the diversity of the current manufacturing output.

Figure 30. Nominal production of pulp, paper and paperboard in Wisconsin, 2018, finished metric tons



Wisconsin's pulp and paper producers are an important segment of the national paper and paperboard market. Wisconsin specializes in the production of printing, writing, and tissue papers, as well as specialty papers. Wisconsin companies export paper and paper products to 100 countries around the world. Canada is by far the largest trading partner, receiving 62% of Wisconsin's paper exports. Paper exported by Wisconsin manufacturers has increased by nearly 90% over 15 years (values not adjusted for inflation) as shown in Figure 31.

Figure 31. The value of exports of Wisconsin's paper manufacturing sector



Wisconsin has more hardwood resource than many other paper-making states. The abundance of hardwood gives Wisconsin an advantage over other states in the production of paper and paper grade products made from hardwood pulp. Hardwoods have an advantage in printing and writing and in specialty paper production because the smaller hardwood fibers provide good sheet smoothness and opacity, which can be more important than sheet strength. Hardwood also provides adequate performance as the sandwiched fluting material in corrugated paperboard. Hardwood provides bulk and

absorbency in tissue products where sheet strength is not as important. For some products, hardwood fibers are blended with softwood to enhance the strength of the paper.

In addition to using large amounts of hardwood fiber, the printing and writing, tissue, and recycled board products made in Wisconsin use substantial quantities of recycled fiber. The use of recycled fiber is highest in tissue products, and it is also used in paperboard and printing and writing paper to a lesser extent. Because Wisconsin paper mills produce both tissue and printing and writing paper, some mills probably use considerable amounts of recycled fiber, while others use relatively little.

Pulp Demand

Although the demand for certain types of paper products is changing the demand for pulp will continue to increase. Reports and Data (2020) valued the global Paper and Pulp market at $518.83 billion in 2019 and projected it to reach $679.72 billion by the year 2027.

Trends for certain types of paper products has varied, in looking at the time period from 1992 to 2017, three paper types, (tissue, containerboard, and printing/writing), have shown distinctly different trajectories. Tissue paper has shown a slow but steady increase with global market demand more than doubling in that time frame. Containerboard has also shown a steady increase over the same time period with a more accelerated demand since 2010 and an overall 2.5 times increase. Whereas printing/writing paper showed a much more gradual increase from 1992 to 2007 and it is showing a steady but gradual decline since then, but the 2017 demand is still significantly higher than in 1992 (Timberland, 2019).

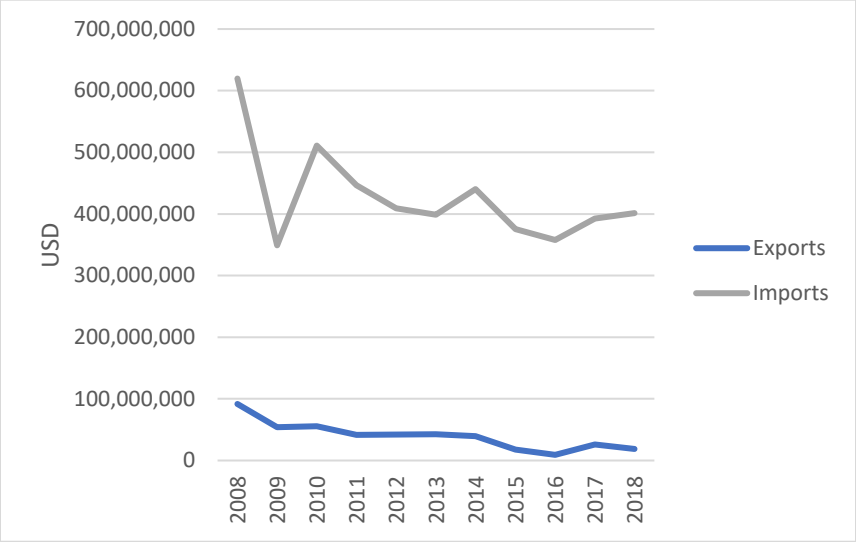
According to the American Forest & Paper Association (2019), more than 95% of all products in the US are shipped in cardboard boxes. This product is very well-positioned in the growing e-commerce market, as online orders arrive in high-grade cardboard boxes to prevent damage during shipping. Over the last several years, this segment has increased production by nearly 2% annually.

While demand for printing and writing papers has declined, demand for other pulp products has increased. Several pulp mills dedicated to manufacturing printing and writing papers are converting to producing fluff pulp, tissue, and other products. Several facilities have already made this transition, including two International Paper Company mills in Franklin, Virginia and Riegelwood, North Carolina and one Domtar Inc. mill in Ashdown, Arkansas.

China's national sword policy enacted in January 2018 to ban the importation of solid waste categories (including mixed papers) deemed to be too highly contaminated is resulting in a large domestic surplus/supply of recovered mixed papers as a potential source of recycled fiber. Old corrugated containers (OCC), which are not banned until 2021 when the importation of all recovered paper grades are banned, will create an additional supply of OCC domestically. One mill in Wisconsin currently uses recovered paper as its sole feedstock and two other mills rely heavily on recycled fiber for their feedstocks. It is expected that the China's policy will continue to impact the paper products industry, but the extent is unknown. Although recycled paper is a major component in some products, recycled paper alone is not adequate on its own to produce the quality material needed for many paper products. In particular, fiber strength is diminished each time paper is recycled which makes the addition of virgin fiber necessary to creating the paper products that the market requires. If the demand for packaging paper continues to grow there will be the need to supplement or in some cases replace recycled paper with virgin fiber.

In 2018 Wisconsin paper mills imported $401,575,729 of pulp and related processing residues. Of this value, 96% is chemical wood pulp, both softwood (69%) and hardwood (27%). Conversely, in 2018 Wisconsin pulp and paper mills exported $18,655,179 of pulp and related processing residue. Of this, 61% is waste or scrap from processing and 26% is pulp from recycled fiber. The ratio of imports to exports was more than 20 to 1. Figure 32 shows an 11-year history of pulp imports and exports. Average annual pulp imports were at a high of over $620 million in 2008 and dipped to a low of $349 million in 2009; imports jumped back up to $511 million in 2010. Since then, average annual imports have remained relatively stable. Average annual pulp exports were at a high of almost $92 million in 2008 and dropped to a low of just over $9 million in 2016. From 2011-2018 average annual pulp exports have been just under $30 million. (U.S. Census Bureau, 2019).

Figure 32. Annual value of forest products commodity imports and exports, 2008 – 2018, USD



Paper and Paperboard Demand

Paper and wood product exports are a significant portion the U.S.'s forest product industry's total annual sales. 2018 forest products industry's global exports were estimated at $33 billion, $22.8 billion of which were exports of pulp, paper and packaging and $10.2 billion were exports of wood products (American Forests & Paper Association, 2019).

Wisconsin has a strong value-added paper industry with companies throughout the state that take the paper from the 34 paper mills and make a wide range of products. There are over 200 paper converting companies in Wisconsin which either produce end products themselves or produce a supply product for another manufacturer. Of these, 100 companies produce medical products. The importance of this sector during the current pandemic was noted by Governor Tony Evers and U.S. Senator Tammy Baldwin (press releases) as being critical to not only Wisconsin's economy, but also to the medical community nationwide. Some of the essential consumer and medical products noted as produced by Wisconsin's paper and converting industries follow:

- Medical Personal Protective Equipment – including the base papers and support materials to produce face masks and gowns
- Patient gowns, lab coats, scrubs, O.R. caps, and EMT items

- Disposable bags, sterilizer bags, SWABS, and infection control products
- Disposable cleaning wipes and antibacterial wet wipes used for hand and surface cleansing
- Packaging for medication and medical instruments
- Liners used in medical applications
- Medical tapes used to keep IVs in place
- Carryout bags used in fast food facilities
- Food packaging products
- Sterile packaging solutions and packaging fill
- Saturating papers used for residential and commercial building
- Tissue papers, toilet papers, napkins, adult briefs

Wood Composite Panel Industry

Wood Composite Panel Definitions

The wood composite panel industry has two main categories. The first is non-structural which includes medium density fiberboard (MDF), particle board, wet and dry hardboard, and flakeboard. Composite panels in this category are typically used to make furniture, cabinets, and similar products. The second is structural which includes oriented strand board (OSB), parallel strand lumber (PSL) laminated veneer lumber (LVL), and laminated strand lumber (LSL). These types of panels are typically used as building components.

Some of the dominant production factors governing the production of wood composite panels are type of raw material, wood species, particle size and geometry, resin level and type layering by particle size and density, mat moisture content and distribution and the board density.

Non-structural Wood Composite Panels

Medium Density Fiberboard (MDF)

Medium density fiberboard (MDF) is a general term for a panel mainly composed of wood that has been reduced in size to individual fibers or fiber bundles. Those fibers are then combined with a synthetic resin and bound together with a combination of heat and pressure.

Particleboard

Particleboard is a panel made by compressing small particles of wood together with a binder in a heating and pressurizing process. Depending on the specific end use there are many variables that can be adjusted to achieve the specifications desired, these include; particle geometry, particle size, amount and type of adhesive, and processing standards.

Hardboard

Hardboard is a panel made from wood fibers pressed together under heat and pressure in a hot press. Hardboard has applications as a paneling and siding product as well as an array of other uses.

Flakeboard

Flakeboard is produced by adhering thinly shaven pieces of wood together using resin before applying extreme pressure. The result is a synthetically constructed piece of wood that will not warp like natural cut wood.

Structural Wood Composite Panels

Oriented Strand Board (OSB)

OSB is an engineered wood product made from strands of wood that are dried mixed with resin, formed into panels and pressed under high temperatures. OSB can be produced from different tree species, and is typically produced from pulpwood material. OSB is typically used in construction.

Parallel Strand Lumber (PSL)

Parallel Strand Lumber (PSL) is manufactured from veneers laid into long, parallel strands and bonded together. PSL beams are primarily used in beam and header applications where high strength is required.

Laminated Veneer Lumber (LVL)

Laminated Veneer Lumber (LVL) is a commonly available engineered product that is manufactured similarly to PSL. Available sizes, strengths, and stiffnesses are similar to PSL but are generally cheaper, making it a commonly specified beam type. A benefit to LVL is that it can be fabricated in narrower beam widths and multiple plies can be nail-laminated together to form a larger beam.

Laminated Strand Lumber (LSL)

Laminated Strand Lumber (LSL) is manufactured from flaked wood strands and resembles oriented strand board (OSB) in appearance, though the strands are arranged parallel to the longitudinal axis of the member. LSL is typically less expensive than other engineered wood beams.

Wisconsin's Wood Composite Panel Industry

Wisconsin's wood composite panel industry currently only has three operational plants in Wisconsin, two OSB plants (structural) and one particleboard plant (non-structural) that utilizes all its production in their own value-added products. With 800 plus value-added wood product manufacturers in Wisconsin of which a significant portion, 13-32% according to a recent WIDNR survey (Lyon, 2018), use wood composite panels to manufacture their products, the opportunity to produce non-structural wood composite panels for use in that industry seems to be worth further investigation.

Wood Composite Panel Supply

There are two structural wood composite panel mills in Wisconsin that combined produce over 600 million square feet of structural wood composite panels annually. Along with several other plants of this type nearby in Michigan and Minnesota, the production and capacity for this sector appears to be sufficient for this region.

However, the non-structural wood composite panel industry has only one relatively small plant in Wisconsin that produces panels only for their own value-added production. The supply of non-structural wood composite panels is currently transported hundreds of miles from out of state to Wisconsin's value-added manufacturers.

Wood Composite Panel Demand

The demand for structural wood composite panels, which are primarily used in the construction and building industry, is closely tied to housing and construction markets. The consumption of wood-based panels in North America is tied to economic growth and housing starts. GDP growth in the U.S. decreased from 2.9% in 2018 to 2.3% in 2019 (U.S Dept. of Commerce, 2020). U.S. housing starts grew from 1.24 million in 2018 to 1.29 million in 2019 (U.S. Census Bureau, 2020).

As reported by the Food and Agriculture Organization (2019), North American exports of wood composite panels was $3.4 billion in 2018. Canada and Mexico are the primary importers of U.S. composite wood products. In 2018, 72% of U.S. fiberboard exports went to Canada and 13% were exported to Mexico. In addition, 56% percent of U.S. particle board production was exported to Canada and 31% was exported to Mexico in 2018.

For non-structural wood composite panel demand, Wisconsin has a vibrant and diverse value-added wood manufacturing industry of more than 800 companies, which vary in size from sole proprietors to companies with hundreds of employees. Due to this diversity and the independence of these companies, it is impossible to quantify wood composite panel use in Wisconsin, however the following industry overview by the Wisconsin DNR (WIDNR, 2020) provides some scope to the use of wood composite panels in the state's value-added manufacturing industry.

Wisconsin's valued-added wood manufacturing industry, also known as the secondary wood manufacturing industry, includes firms that use primary wood products such as lumber or veneer to produce higher value products. These products include flooring, cabinets, millwork, furniture, sporting goods, doors, windows, roof trusses, wall panels, and other building materials. In Wisconsin, the industry includes more than 800 facilties, employs more than 20,000 workers, and generates a direct economic impact of $3 billion.

The DNR conducted a survey of the Wisconsin value-added wood industry in 2018 to better understand the current economic impacts, markets, and needs of this industry. The adjusted response rate for the survey was 51%.

Of responding companies, manufacturer demographics consisted of 163 firms with a single facility and 27 with multiple facilities. Twenty responding companies had additional production locations outside of Wisconsin. The majority of responding companies (66%) had fewer than 25 full time employees and produced less than $5,000,000 in sales annually. Companies ranging from 25-99 employees (22%) reported sales up to $50,000,000, with 12% of respondents having more than 100 employees. As shown in Table 14, most respondents identified as millwork manufacturers (n = 66 firms), architectural woodwork manufacturers (62), followed by cabinets manufacturers (59), and furniture (55). Some of the respondents indicated that their companies were identified as more than one manufacturer type.

Table 14. Number of value-added manufacturers by wood product produced (Lyon, 2018)

Wood Product	**Respondents**
Millwork	66
Architectural Woodwork	62
Cabinets	59
Furniture	55
Hardwood and Softwood Lumber	47
Hardwood Dimension Components	41
Flooring	31
Laminated Counters & Laminated Other	28
Containers, Crates, Pallets or Skids, Pallet Parts	27
Wood Doors and Windows	23

Figure 33 shows products purchased by survey respondents and demonstrates a substantial market for wood composite panel products; 65 companies reported purchasing fiberboard or MDF, 51 reported purchasing particle board, 35 reported purchasing OSB/waferboard, and 26 reported purchasing hardboard. These are not stand-alone statistics and a single company could be purchasing multiple wood composite panel products. There are two OSB plants in Wisconsin, and there is only one non-structural wood composite plant currently operational in Wisconsin and that company utilizes all of its own product in their value-added operations. Meaning that currently all other non-structural wood composite panels used by the value-added wood industry in Wisconsin come from outside of the state.

Figure 33. Wood products purchased by value-added manufacturing survey respondents, 2018

Chapter 6: Siting Logistics

Physical Site

There are thousands of potential facility sites throughout Wisconsin that have the necessary acreage and zoning requirements for the sized facilities this study is considering.

Wisconsin has the plus of having both the resource (trees) and the end markets (paper mills and value-added manufacturers) balancing the location of the facility in relation to the resource and the end user is a great situation to be in. Transportation is often a major cost and anything that can be done to reduce this cost for both input and output can be a major factor in where to site a facility.

Woodyard location and size is critical in a couple of ways. Having a woodyard that is large enough to keep the necessary inventory on site, will prevent the double handling cost of having to use a remote yard for inventory. Also having a fast and effective system for truck entry, processing, unloading, and exiting is a major benefit for log truck drivers and can often mean the difference between being able to deliver another load in a day.

The same type of fast and efficient system for unloading chip vans is also critical for chip deliveries whether for walking-floor trailers or stationary trailers.

Transportation

In Wisconsin, trucks with a raw forest products permit may operate on state roads at 98,000 pounds on six axles to haul products such as pulpwood, logs, wood chips, and sawdust. Five-axle log trucks have an 80,000-pound weight limit on state roads except in winter when the ground under highway pavement is frozen to a depth of at least 18 inches; then maximum gross weight is 98,000 pounds. The Wisconsin State Highway System is shown in Figure 34.

There are several highways in Wisconsin that allow for “Michigan-configured trucks”, which have 11 axles and can operate at 164,000 pounds. These trucks can operate on any state highway within eleven miles of the Michigan-Wisconsin border. In addition, the highways listed below allow for 11-axle, up to 164,000 pound trucks. These designated highways are shown in Figure 35.

- USH 2 anywhere in Iron, Florence, and Ashland counties.
- USH 2 in Bayfield County from the Ashland County line through Hart Lake Road.
- USH 8, from the Wisconsin-Michigan border in Marinette County to USH 45 in Oneida County.
- STH 13, from the junction of USH 2 and STH 13 in the city of Ashland to the intersection of STH 13 and Old Airport Road in Ashland County.
- USH 45, from the Wisconsin-Michigan border to Sunnyside Road south of the city of Antigo, in Vilas, Oneida, and Langlade counties.
- USH 51, from the USH 2/51 interchange north of the city of Hurley to Maple Ridge Road in the town of Mercer in Iron County.
- STH 70, from the junction of STH 70 and USH 45 in the city of Eagle River to the junction of STH 70 and USH 51 in Vilas County.
- STH 70, from the junction of STH 70 and STH 139 each to USH 2 in Florence County.
- STH 77, from 2nd Avenue in the city of Hurley to Olson Road in the city of Mellen, in Iron and Ashland counties.
- STH 139, from the Wisconsin-Michigan border to USH 8, in Florence and Forest counties.

Figure 34. Wisconsin highway system

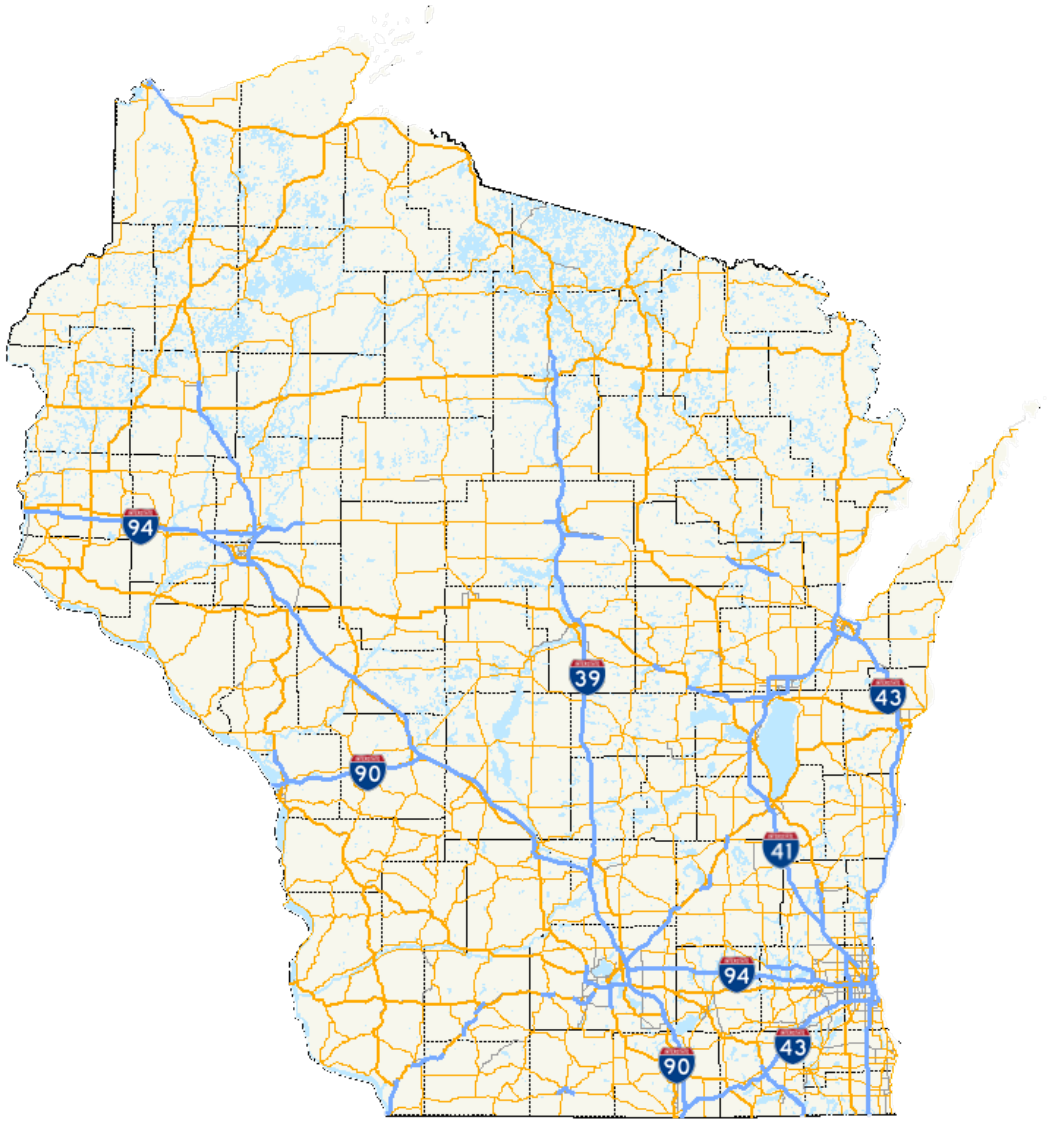
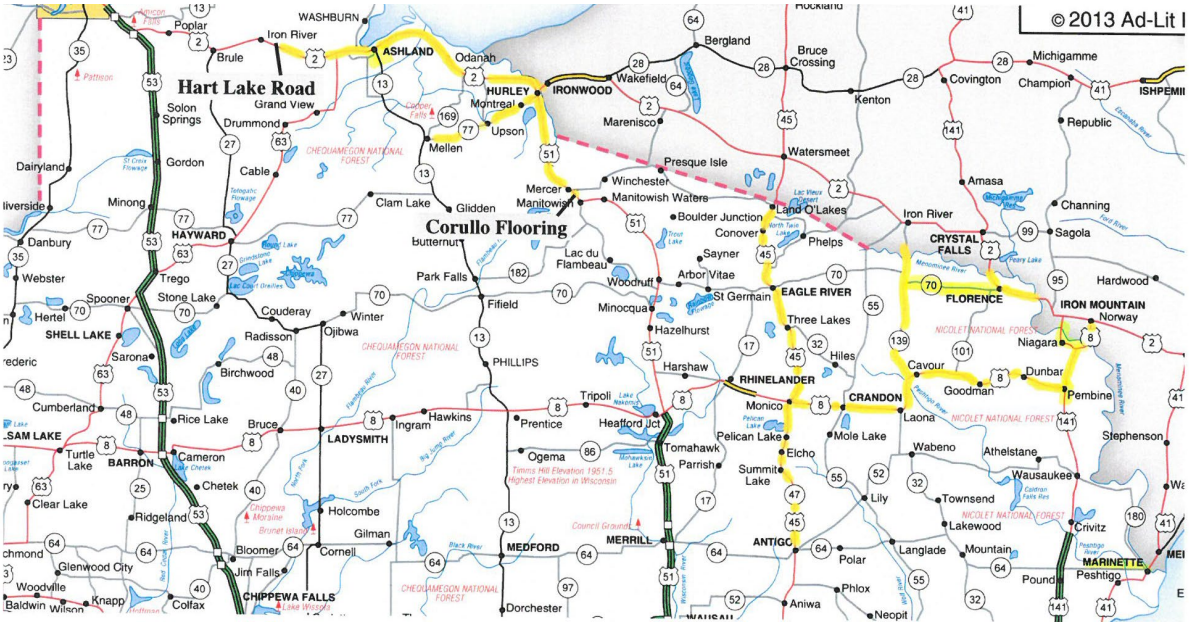


Figure 35. Wisconsin highways designated for 11-axle, 164,000 pound weight limits



Although rail service to rural areas of Wisconsin has over the past 50 years, there are still locations throughout the state that have nationwide connections. In addition, Canadian National announced on July 21, 2020 that they are looking for a purchaser for portions of their non-core network that would provide rural Wisconsin with other service options. Switching fees between rail ownerships is one issue that has been mentioned repeatedly in numerous studies. Locating a mill where switching fees are not an issue would make finished product shipments potentially much more economical. Receiving raw material by rail would also be a potentially viable option, especially when receiving residues from other forest industry mills that are located on a rail line. Receiving round wood from the forest has potential but may be limited because of the rail lines throughout rural Wisconsin. Wisconsin's rail system is shown in Figure 36.

Canadian National Railroad has intermodal rail facilities located in Chippewa Falls, WI and in Duluth, MN (across the border from Superior, WI). Wisconsin is just 55 miles north of Chicago, Illinois, a major global intermodal transportation hub. There are other intermodal capable facilities in Wisconsin that could be beneficial to a plant siting.

Export of finished product by ship or barge to U.S. and global markets has potential from ports on Lake Superior (Superior) and Lake Michigan (Green Bay, Manitowoc, Marinette, and Milwaukee) as well as barge loading facilities on the Mississippi River at LaCrosse and Prairie Du Chien. Wisconsin's major ports are shown in Figure 37.

Figure 36. Wisconsin railway system

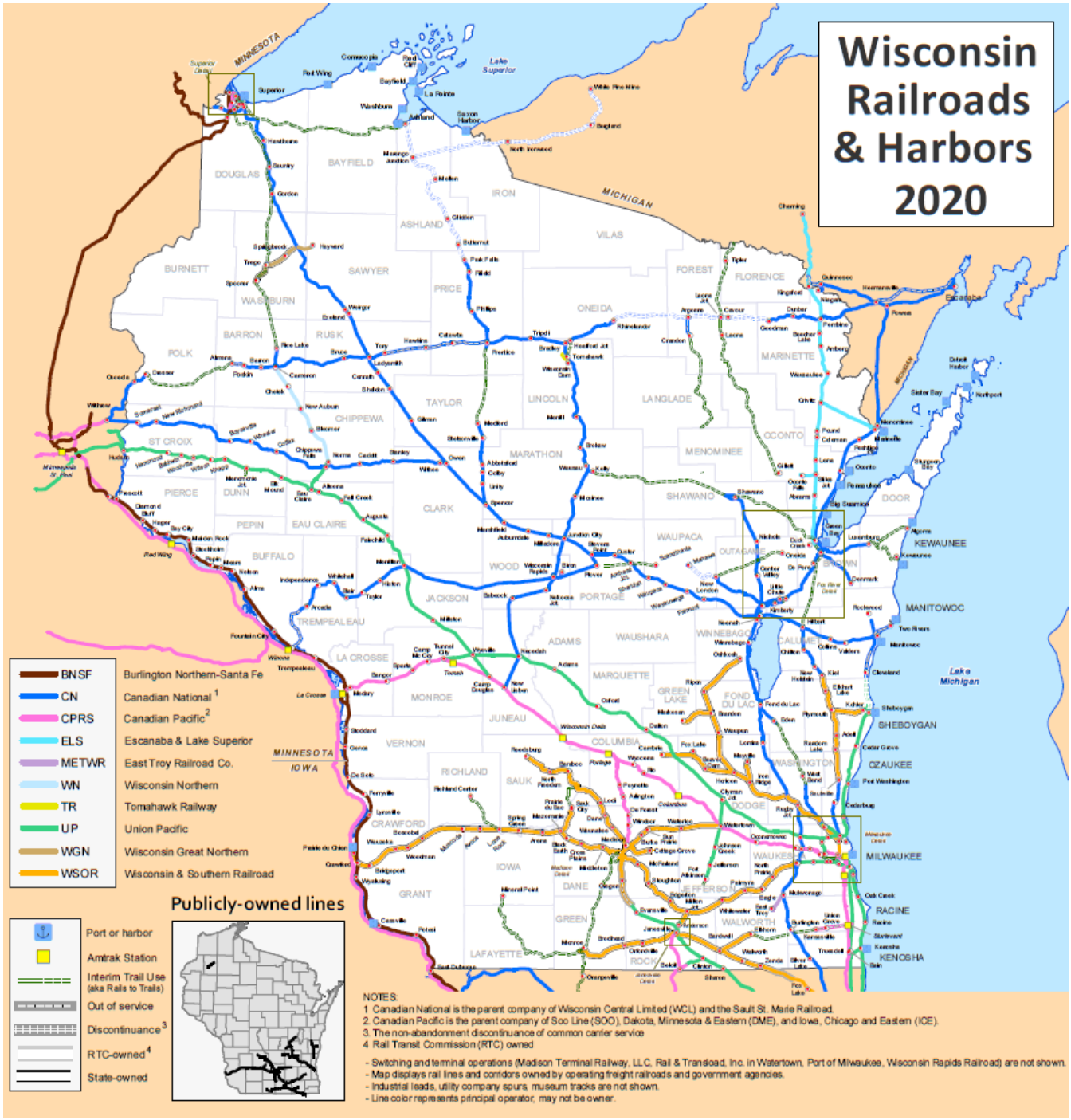


Figure 37. Wisconsin's major ports

Water

Water is a critical component of the pulp mill process and an adequate sustainable water supply is essential at any pulp mill site. Table 15 provides general guidance on initial water requirements for a new pulp mill. There are four components of water consumption for a pulp mill, paper mill or an integrated pulp and paper mill, whereas Total Water – Evaporation Loss = Production Water and Production Water + Make-up Water = Total Water. The components are defined as:

- Total Water = The total water required to fully charge the entire system
- Evaporation Loss = The amount of water that is lost in a 24-hour period due to evaporation
- Production Water = The amount of water that remains in the system and is recycled
- Make-up Water = The amount of water that is added to the system to keep it fully charged

Pulp mills are large water consumers and water consumption is a factor of the expected air-dried ton (ADT) of output. Water extraction at this level requires a permit. The parameters of this permit would be concerned with the amount of volume drawn each day to replace system losses due to evaporation or other means. The permitting body may require a one-time permit to cover the initial extraction to withdraw the "Total Water" that would be required for the initial start-up. Table 15 will help estimate water consumption for a non-integrated pulp mill. It estimates water consumptions for a "non-integrated pulp mill" that has a pulp production of 500 ADT/day as well as the estimated consumption

per ADT so that quantities can be estimated based on anticipated production volumes. Because pulping systems are not all alike, a range of low to high and an average water volume based on data from different types of pulping processes are provided. This is expected to be an estimate of magnitude, not an exact calculation. Please refer to Chapter 3 for information regarding water usage permitting.

Table 15. Low, high and average water consumption per day for a non-integrated kraft pulp mill (Malmberg, 2017)

	Make up water			**Production water**		
	Low	High	Ave	Low	High	Ave
Gal/ADT	1083	2022	1517	6000	9000	7368
Gals/500 ADT	541,500	1,011,000	758,500	2,947,200	4,420,800	3,684,000
	Total Water			**Permit**		
	Low	High	Ave	Low	High	Ave
Gal/ADT	7083	11022	8885	n/a	n/a	n/a
Gals/500 ADT	3,541,500	5,511,000	4,442,500	541,500	1,011,000	758,500

Water is also necessary for both structural and non-structural wood composite panel mills and is especially critical for the "wet process" in non-structural plants.

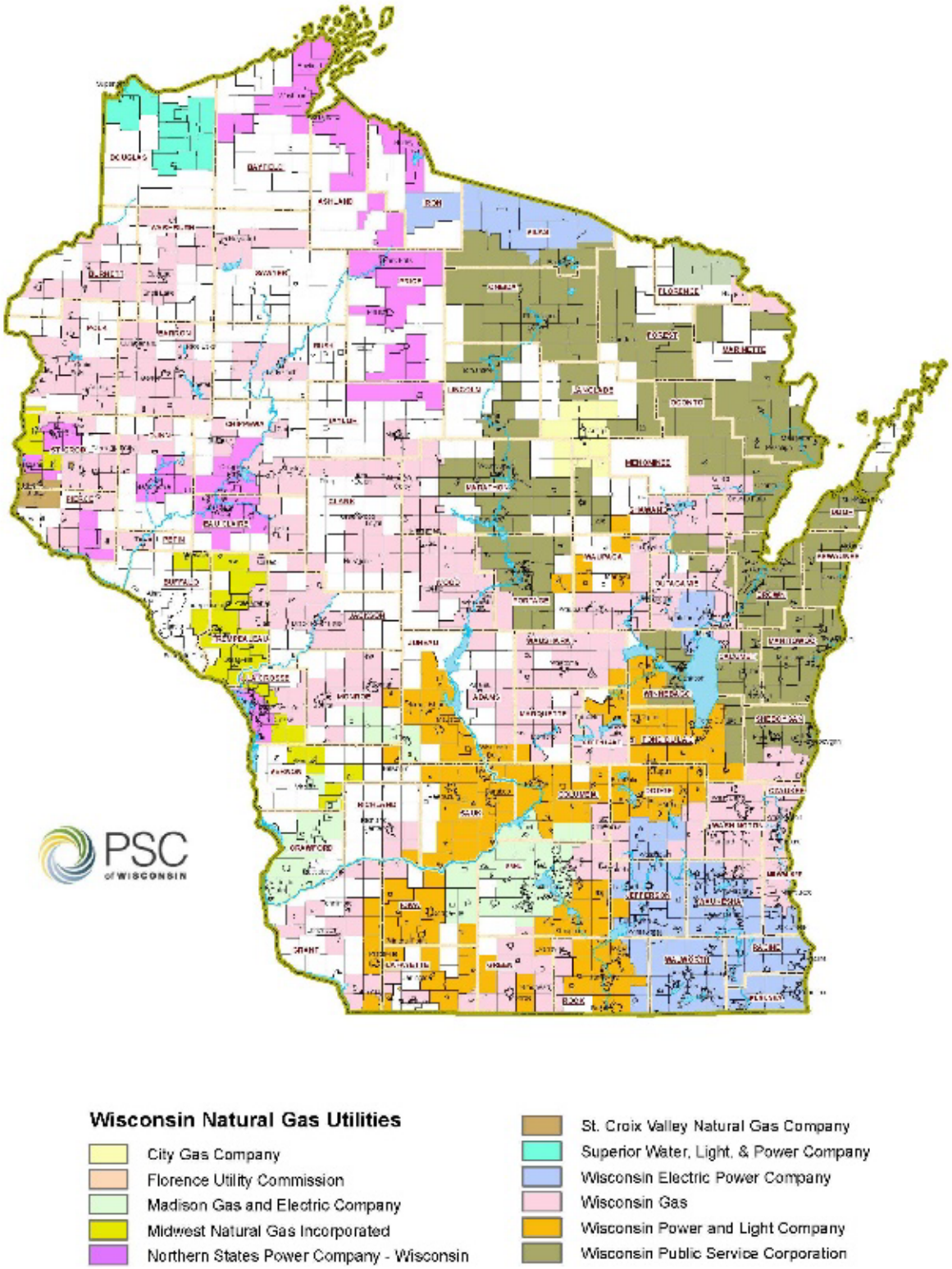
Utilities

Electrical service is excellent Wisconsin with 12 major utility companies and 24 electrical cooperatives providing service throughout the state. Any site that meets the other facility siting requirements will either have adequate electrical power available or it would be able to be upgraded in short order.

Natural gas service is available throughout most of the state. Figure 38 shows companies that provide gas service as well those areas in white where natural gas is not available. This listing may not be inclusive of all available options in a specific area.

Combined heat and power systems are commonly found at most pulpwood using facilities in Wisconsin and is an excellent use of residue such as bark that is generated on site. There is state and federal assistance available to help determine the feasibility of and best type of systems for a specific facility's needs.

Figure 38. Wisconsin natural gas service areas



Siting Summary

Table 16 below summarizes site requirements for pulpwood using facilities in Wisconsin. As with most of this study, this table is a broad overview of the requirements. If interest warrants it, then facility-specific requirements should be determined and used to identify specific site options.

As noted previously, this study considered three types of mills: a pulp mill and two broad categories of wood composite panel mills, structural and non-structural. Note however that there are variations in facility requirements within these three broad mill types and there could also be potential for a pulpwood using facility outside of these categories which has different site requirements.

Requirements for land size, work force, and raw material type were based on general industry information and are for general reference. Raw material type and volumes were derived from industry knowledge of mills in the state. These values could vary greatly depending on the mill type and the product being produced.

Water, electrical and natural gas requirements were based on existing data for specific types of facilities. These requirements can vary considerably depending on the processing technology, the type of equipment, and other factors. Note that the electrical and natural gas figures are based on outside purchase of these services and does not consider any offset from a combined heat and power system on site.

Table 16. Estimated site requirements of potential mills

	Units	**Pulp Mill**	**Wood Composite Panel Mill**	
Site Feature		**Non-Integrated**	**Structural**	**Non-Structural**
Land Size	Acres	150	100	300
Raw Material	Type	Roundwood, chips	Roundwood	Roundwood, chips, sawdust
Raw Material Volume	Green tons, annually	700,000	425,000	850,000
Workforce	No.	200	200	200
Water	Gal/day	758,500[1]	11,616	598,630[2]
Electricity Demand	MWH	11.67	10.5	42.3
Natural Gas	MM CF	1,955.7	373.5	1,349.5

Wisconsin DNR Forest Products Services Team can be the lead on developing specific resource data, directing permitting discussions and providing contacts with economic development personnel. For questions related to this report and for additional information, contact the DNR's Forest Products Team Leader whose contact information is available on the DNR's website.

Conclusions

Forests are a renewable resource that have provided stability and diversity to Wisconsin's economy for over 100 years, during which time Wisconsin has become a national leader in multiple forestry sectors

[1] Make up water used only.

[2] For a "wet process" MDF plant, water consumption figures would be considerably less for a "dry process" plant.

starting with sustainable forest management. Wisconsin excels in sustainable forest management across multiple ownerships:

- A National Forest that leads the nation in utilizing Stewardship Authority and the Good Neighbor Authority to be a leader among national forests in timber production;
- State owned forest lands that are managed for diverse primary purposes and all of which use forest management as a tool to achieve their goals;
- A unique county forest system with 29 separate but linked county forests that are collectively the second largest forest owner in Wisconsin; and
- Tribal forests which are the smallest ownership sector, but all of which practice active forest management. The Menominee Tribal Enterprises (nationally recognized for its long history of forest management) has the largest forest management program of the 11 tribes.

Private forest land is by far the largest sector of ownership and is spread out amongst more than 180,000 different ownerships. Connecting those ownerships is the MFL Program which requires landowners to follow a forest management plan in return for getting reduced property taxes. Approximately, 29% percent of private lands in Wisconsin are in the MFL Program. The MFL database shows acres by timber type that are required to be harvested each year. This gives industry some predictability in a sector that is known for its unpredictable timber supply.

Wisconsin has over 6 million acres of certified forest land across all ownership categories, with the exception of the National Forest, which can provide certified forest products to mills, their value-added customers, and the end consumers that are preferentially purchasing certified products.

WIDNR's forestry assistance provides continuity across ownerships. The Division of Forestry has more than 400 employees that not only manage state forest land, but also provide assistance to the National Forest (Good Neighbor Authority), county forests (county forest liaison loan programs), and private forests (MFL, DNR service forester assistance in each county, and a cooperating forester program). WDNR has also developed best management practices for water quality and invasive species, has forest health specialists around the state who advise on insect and disease issues, and the Forest Products Services Team that provides assistance to forest products industry businesses throughout the state. In addition, the Business Sector Assistance Section that can provide assistance to businesses in navigating through any regulatory or permitting process that a company needs to deal with for expansion or development. This section can provide critical time and money saving services to help guide companies through the regulatory process.

Wisconsin has a stable and strong logging industry able to process the standing trees into products. Wisconsin's logging industry has evolved and adapted to changing forest types such as conversion to mechanized harvesting that has substantially increased the efficiency and production of state's industry while continuing to operate sustainably. While other states have adopted forest practices acts, in Wisconsin, natural resource agencies and the state's forest industries have collaborated to adopt guidelines and acceptable practices that allow professionals the flexibility to adapt to on site conditions. In 1991 the logging industry in Wisconsin created the Forest Industry Safety and Training Alliance (FISTA) to address safety training. Since 1996, FISTA has become an all-inclusive logger training program working in concert with the State's SFI Implementation Committee in Wisconsin to develop and implement an annual training schedule. In 2003, Wisconsin loggers organized the Master Logger

Certification Program that has grown to 70 members and was recognized as the most successful logger certification program in the country by an independent study in 2019.

GLTPA is a leader in not only resolving issues, but also in developing guidelines to preempt issues. To ensure timber and other raw materials are delivered to market safely, the GLTPA continuously works with WisDOT, the Wisconsin Counties Association, and the Wisconsin Towns Association to address issues and concerns. Together, they improve the safety and efficiency of transportation of logs to the mills. GLTPA has also worked with truck and trailer manufacturers/dealers on truck driver training and equipment design. In the wood processing industry, there are active associations representing their respective sectors. The Wisconsin Paper Council, headquartered in Madison, advocates for their membership on legislative and regulatory issues. The LSLA has over 70 members in Wisconsin and works to address issues of concern for their membership. Sawmills will likely be an essential partner of any pulpwood using facility that expands or locates in Wisconsin.

Results of this study indicate that there is expansion potential of both the pulp and the non-structural wood composite panel industries in Wisconsin. Wisconsin's thriving paper industry creates a strong pulp market. Wisconsin has been the leading manufacturer of paper in the U.S. for over 50 years and the state's paper products shipments were estimated at $13.8 billion in 2018. Currently, there is not enough pulp produced in the state to meet the demand of its paper mills, and Wisconsin's paper mills imported more than $401.6 million of wood pulp in 2018. In addition, Wisconsin has a strong value-added wood manufacturing industry, and many facilities use large volumes of non-structural wood composite panels in their products, most of which are imported from outside of the state.

The findings in this report should not be interpreted to imply that a mill should or will be expanded or built. This study presents considerations for Wisconsin communities, existing businesses, and entrepreneurs interested in developing new or expanded manufacturing capacity to utilize the pulpwood resource. Corporations that wish to develop or expand mills in Wisconsin can use this study to help them identify areas that best meet their needs, and communities can use the report to identify the types of mills that might be attracted to their area. Further feasibility assessment of siting manufacturing facilities at specific sites should be explored to maximize efficiencies. It is ultimately up to individual communities, their elected representatives, forest product businesses, and the public to work together to determine where development should occur.

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This study was led by the Wisconsin Wood Marketing Team, a public-private partnership of forest industry stakeholders. The Wisconsin Wood Marketing Team works to preserve and expand Wisconsin's forest industry by improving current processes, products and markets and by exploring opportunities for new technologies, innovative wood products, and new local, national and global markets for Wisconsin's forest products. The Wisconsin Wood Marketing Team was established through a 2016 grant from the U.S. Forest Service Wood Innovations Program.

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