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**Wood Supply Chain Component Costs Analysis:
A Comparison of Wisconsin and U.S. Regional Costs – 2015 Update
(Data Period: Q3 2013 through Q2 2015)
(SLS 4458)**

Client:

National Council for Air and Stream Improvement, Inc.

Prepared for:

Great Lakes Timber Professionals Association

Wisconsin County Forests Association

Prepared by:

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Effective Date: November 20, 2015

Wisconsin Forest Practices Study

Factors Influencing Wisconsin's Forest-Based Manufacturing Competitiveness

Summary of Facts and Conclusions

| | |
|--------------------------|--|
| Project | Wood Supply Chain Component Costs Analysis; A Comparison of Wisconsin and U.S. Regional Costs – 2015 Update |
| Prepared for | Great Lakes Timber Professionals Association Wisconsin County Forests Association |
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| Effective Date | November 20, 2015 |
| Project Objective | Update the previously published assessment of wood fiber supply chain costs in Wisconsin, including a comparison to other U.S. regions, to address the question of how Wisconsin can continue to provide sustainably grown wood fiber to support a competitive wood-using industry and attract investment in primary forest-based manufacturing. |

| | |
|--------------------|--|
| Results | <p>When compared to the U.S. Northeast region, Wisconsin's total delivered fiber cost for pulpwood was lower for aspen and mixed hardwood and higher for conifer. However, the total delivered prices for aspen and hardwood increased substantially in the Lake States between the initial and extended study periods, while prices remained relatively stable in the Northeast. Both northern regions generally incurred higher delivered costs compared to the U.S. South and Pacific Northwest. Stumpage costs increased for all species groups in Wisconsin relative to the initial study period, and Wisconsin had the highest Stumpage cost for conifer and hardwood pulpwood. Harvesting costs in the Lake States were lower than the Northeast and the Pacific Northwest, but higher than the South. Wisconsin delivered fiber costs typically include higher Freight and "Other" costs (handling, procurement, etc.) in most instances. Results of this study reflect a snapshot for a period of time, as the data set included a summary of eight quarters (Q3 2013 through Q2 2015).</p> |
| Conclusions | <p>Wisconsin and the U.S. Northeast will be at a competitive disadvantage when total delivered pulpwood fiber costs are compared to the South, due largely to differences in seasonal weather-related impacts on operability, such as prolonged spring breakup periods, along with other unique forest and operational characteristics. The expanded data period for this study revealed this fact, as Stumpage cost and Margin increased substantially in Wisconsin, likely due to operations limitations resulting from weather-related events. Wisconsin also has inherent challenges that appear to increase Freight and Other costs. Lowering costs or, minimally, being mindful of issues that increase these costs, such as restrictions limiting activity to winter months, will be a factor in maintaining Wisconsin's position in the U.S and global timber industry.</p> |

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1. Project Overview

1.1 Investigators

This research investigation is a collaborative effort including team members from Steigerwaldt Land Services, Inc. (Steigerwaldt) and Forest2Market (F2M). The primary investigator for the project is Forrest M. Gibeault (Steigerwaldt), along with the project partner from F2M, Peter J. Coutu.

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1.2 WFPS Overview

The Wisconsin Forest Practices Study (WFPS), pursuant to s.26.105(1), Wis. Stats., was made possible by means of a grant awarded by the Wisconsin Department of Natural Resources (WDNR) to the Great Lakes Timber Professionals Association (GLTPA) and the Wisconsin County Forests Association (WCFA). The broad objective of the WFPS is to obtain research results that will help guide decisions and policy development for investment in forest-based manufacturing industries in Wisconsin, while ensuring that social and ecological benefits provided by Wisconsin's forests remain viable for future generations.

GLTPA and WCFA selected the National Council for Air and Stream Improvement (NCASI) to serve as research coordinator for this study. NCASI is an independent, non-profit 501(c)(6) research institute formed in 1943, focusing on environmental and sustainability topics relevant to forest management and the manufacturing of forest products.

Essentially, the question posed was: 'How does Wisconsin continue to provide sustainably grown wood fiber to support competitive wood-using industries in the future?' The WFPS study included three general topic areas of research. This research addressed the topic of: 'What forestry-related factors are expected to enhance or reduce the competitiveness of forest-based manufacturing in Wisconsin?'

The specific objective for this topic was to:

- Complete an assessment of forestry-related factors that are likely to enhance or impede Wisconsin's ability to attract investment in primary forest-based manufacturing facilities.

1.3 Objective and Outcomes

This report is an update of the original analysis titled, *Wood Supply Chain Component Costs Analysis: A Comparison of Wisconsin and U.S. Regional Costs*, published November 30, 2014. This update includes an additional year of benchmarked cost data, creating a dataset that spans eight quarters, beginning the third quarter of 2013 through the second quarter of 2015.

The focus of this research centers on evaluation of the costs of each link in Wisconsin's wood fiber supply chain and a comparison of these costs to other regions in the United States. We assessed why cost factors may exist and identify options to potentially address competitiveness with other U.S. forest industry regions with regard to delivered fiber cost.

1.4 Region Introduction

Four regions within the U.S. are included in the analysis. An updated comparative analysis is based on the following U.S. regions: the Northeast, Lake States, Pacific Northwest, and the South (regions depicted in Figure 1).

Figure 1 – Reporting Regions



* Lake States region adjusted to represent the Wisconsin market

F2M provided quarterly data summarized by region and species/product group. For the purpose of this report, the Lake States data, which includes a data set sourced primarily in northeastern Minnesota (MN), Wisconsin (WI), and the western Upper Peninsula (UP) of Michigan (MI), was considered the Wisconsin baseline. Many Wisconsin mills procure timber across state lines and, conversely, timber harvested within Wisconsin is shipped and sold to mills in Minnesota and Michigan. Therefore, the supply chain components of the Lake States region include costs that originate from both inside and outside of Wisconsin. An evaluation performed by F2M suggests that about 80 percent of loads originating from Wisconsin forests are shipped to mills within the state lines. As a result, the data set used in this report included all F2M reporting mills within Wisconsin, as well as border mills that procure material from Wisconsin forests. This representation of the Wisconsin marketplace is referenced as the Lake States region throughout this report.

1.5 Detailed Regional Overview

The text in this section was adapted from the final report for the original study.

Total delivered wood fiber cost is dependent upon many factors, as the forest industries of each region have characteristics that directly impact the supply chain components. Factors such as harvest methodology, logging contractor population and business size, transportation details, and seasonality are examples of the characteristics this study evaluated. An overview of these items by reporting region is provided in the following subsections.

1.5.1 Lake States (Wisconsin) Market Summary

Wood fiber is procured from a variety of owners in the Lake States region, but the majority of the material originates from small private landowners, followed by public sources such as county and state forests and larger tracts under private ownership. Data from 2011 suggests that about 60 percent of the harvest volume in Wisconsin originated from family or single, small private ownership, while 8 percent was from forest industry lands, 30 percent from public lands, and 2 percent from Native American ownership (Stoltzman, WDNR). Compared to other regions, the Lake States has many smaller sized, cut-to-length contractors, which generally produce, on average, two to five loads per day. Research completed by RISI suggests that logging crews using a mixture of harvesting techniques in the North Central U.S. average about four to five loads per day (RISI, Barynin 2013). North Central U.S. logging contractors purchased the majority of their timber on the open market (80 percent), which is unique when compared to the other reporting regions (Baker et al. 2013). Research completed for the Wood Supply Research Institute found that the majority of contractors in the Northeast and West regions worked on a contract basis for larger companies, while about one-half of the contractors in the South purchased timber (Baker et al. 2013).

The forest economy in the Lake States is dominated by hardwood logs and round pulpwood. Harvesting is generally based on lower production levels due to growing and maintaining high-quality hardwood stands. Timber Products Output (TPO) data from 2008 indicates that 30 percent of the annual harvest volume is comprised of sawlog products, while about 60 percent is considered pulpwood (Stoltzman, WDNR). Additionally, trucking costs in the Lake States are quite high and, according to F2M data, average approximately \$0.19 per ton per mile. The transportation of pulpwood by rail is also somewhat unique in the Lakes States region.

This region also has the highest percentage of hardwood when looking at the species mix harvested, which correlates to the predominance of uneven-aged management and hardwood single tree and group selection thinning when compared to all other regions. A major consideration in the Lake States region is logging seasonality; extreme variation in deliveries from winter to spring and, to a lesser extent, from fall to summer, occurs in most locations.

1.5.2 Northeast U.S. Market Summary

This region's timber supply is reliant upon large private owners to a great extent and, as such, this ownership base can influence fiber pricing. Harvest operations are focused on whole-tree harvesting in much of this region, and the average logging contractor is considered mid-sized. According to industry contacts, most contractors produce an average of five to ten loads per day (F2M). Whole-tree operations in the Northeast average about seven loads per day (RISI, Barynin 2013). Transportation costs are also high in this region and are comparable to, or slightly lower than, the Lake States (F2M reports about \$0.18 per ton per mile). Species mix is similar to that of Wisconsin, but the component of softwood and hardwood is more evenly split in this region, as each contributes about 50 percent of the volume produced in the Northeast. This region is more geared toward even-aged management, especially in the northern portion. However, harvesting methods transition toward uneven-aged management and production levels generally decrease proceeding south and west from Maine into central New York, Vermont, and New Hampshire.

Softwood and hardwood logs and round pulpwood material are the main products. Primary and secondary chips are also an important product mix in some locations.

1.5.3 South U.S. Market Summary

The South is generally reliant on private forestland owners for stumpage. Harvesting in this region is almost entirely whole-tree with fewer and larger contractors when compared to the northern regions. Trucking costs are likely the lowest in the country and are generally under \$0.16 per ton per mile. Softwood species make up the bulk of the production volume, and most forest acreage is managed on an even-aged basis. The forest economy in this region is impacted less by seasonal weather. The primary wood fiber products are softwood logs and pulpwood, and harvesting is quite mechanized and production-based. The average logging crew in the South, according to regional research, averages about 11 loads per day (RISI, Barynin 2013).

1.5.4 Pacific Northwest U.S. Market Summary

This region produces timber from large private and public ownerships. Harvesting is whole-tree and generally performed by medium- to large-sized logging contractors. The species mix in the Pacific Northwest is largely softwood, with hardwood production limited to a few regions. Forest management techniques are typically even-aged, and operations are generally production-based. Freight costs in this region are quite high and are estimated at \$0.20 per ton per mile (F2M). Harvest production in this region is similar to the South, as research suggests daily production averages about 11 to 12 loads per day.

1.5.5 Summary of Regional Characteristics

Differences in regional characteristics of the four study regions may affect components of the supply chain. The notable characteristics are as follows.

- Transportation costs are comparatively high in the Lake States and Northeast regions when compared to the South.
- The South is characterized by high production and little seasonal variability in wood supply.
- Daily production levels are highest in the South and Pacific Northwest.
- The Northeast is variable in production levels, but the bulk of the volume harvested originates from whole-tree operations.

2. Methods

2.1 Supply Chain Cost Data

This work utilized delivered fiber supply cost data collected and compiled by F2M. F2M maintains a complete and highly accurate delivered price database that is one of the most extensive and credible wood product benchmarks in the industry. The F2M data is based on actual delivered raw material costs and component costs through the supply chain.

Additional detail regarding the data utilized for this updated study is outlined in the following sections.

2.1.1 Data Source

The source data originates from mills and wood producers that subscribe to F2M transaction-based market price and trend reports and analytics products. Delivered wood data provided to F2M is sourced directly from subscriber wood settlement systems. In most cases, cost components are reported for individual loads. In instances of unreported costs, F2M has developed methodology to assign costs from market averages within the benchmark regions (see section 1.5 for more information). The data sourced from F2M is reported by quarter (weighted average of quarterly data). As stated earlier, this study used data from the second half of 2013 through the first half of 2015 (hereafter "extended study period"). The original report included data from the second half of 2013 through the first half of 2014 (hereafter "initial study period").

2.1.2 Supply Chain Component Descriptions

Supply chain component data is derived from wood settlement statements collected and housed within the F2M database. These costs sum to the total delivered cost, including all costs a mill or wood dealer incurred in the process of acquiring the material. It is the sum of costs categorized as *Other*, *Harvesting*, *Freight*, *Margin*, and *Stumpage*. These component categories are described in more detail below.

- *Stumpage* – The stumpage cost component is known on mill purchased deliveries. In many cases, however, where a supplier has purchased the stumpage, this component is not tied to a specific load. F2M tracks and collects stumpage data from a variety of sources within each region and uses this data to add the stumpage cost into the delivered load total. The stumpage price is the weighted average of compiled sale data within a given procurement radius. The Stumpage component is defined as the amount paid to the landowner for standing timber.
- *Harvesting* – This cost is known on loads where the mill pays harvesting directly, or it is derived from data provided by a wood supplier. Harvesting costs are also aggregated and applied to loads where harvest costs are unknown. Harvesting costs include cutting, skidding, and all costs associated with producing wood to a landing. Loading trucks is also included in harvesting for most locations operating in tree-length markets.
- *Freight* – The freight cost is a known value for loads where the mill pays freight directly. Freight rates (\$/ton/mile) are calculated and applied in instances where freight is unknown, using the weighted average based on load miles. Freight generally includes all loading and shipping costs to the mill location. In Wisconsin, freight includes loading (due to cut-to-length logging and production of 100-inch material), as most trucks include loaders. In other regions, the loading cost is generally included in the harvesting component.
- *Other* – This cost component is generally not contained in a company's wood accounting system. The cost is typically provided to F2M on a total basis for a total purchase amount and then converted to a per ton basis appropriately. This cost component includes procurement expenses, wood yard expense, wood yard freight and transfer expenses, and other adjustments.
- *Margin* – This component is calculated as the total delivered cost less Harvesting, Freight, and Stumpage (excluding the Other cost component). Margin is defined as the dealer's net after paying cut, skid, load, and haul costs. Essentially, it is what the supplier has left after all expenses have been paid.

2.1.3 Species Groups and Products

This study evaluated three general species groups: aspen, hardwood, and conifer, with the focus limited to pulpwood fiber. The sawtimber product group was not included in this study, as measurement, product, and sale specifications vary considerably. Sawlog and bolt product specifications are ever changing and quite different from region to region. Log scale measurement units and methodology are also inconsistent and often dictated by the harvest operations and the infrastructure in a specific region. Given these considerations, the sawtimber product group is too variable for use in a broad comparative analysis. Details regarding the various regions will be discussed in the following sections.

3. Results

3.1 Total Delivered Price Comparisons

Quarterly data is summarized by total delivered price and species group in this section. Pricing is displayed

in a series of figures, with the raw data presented in Exhibit 1.

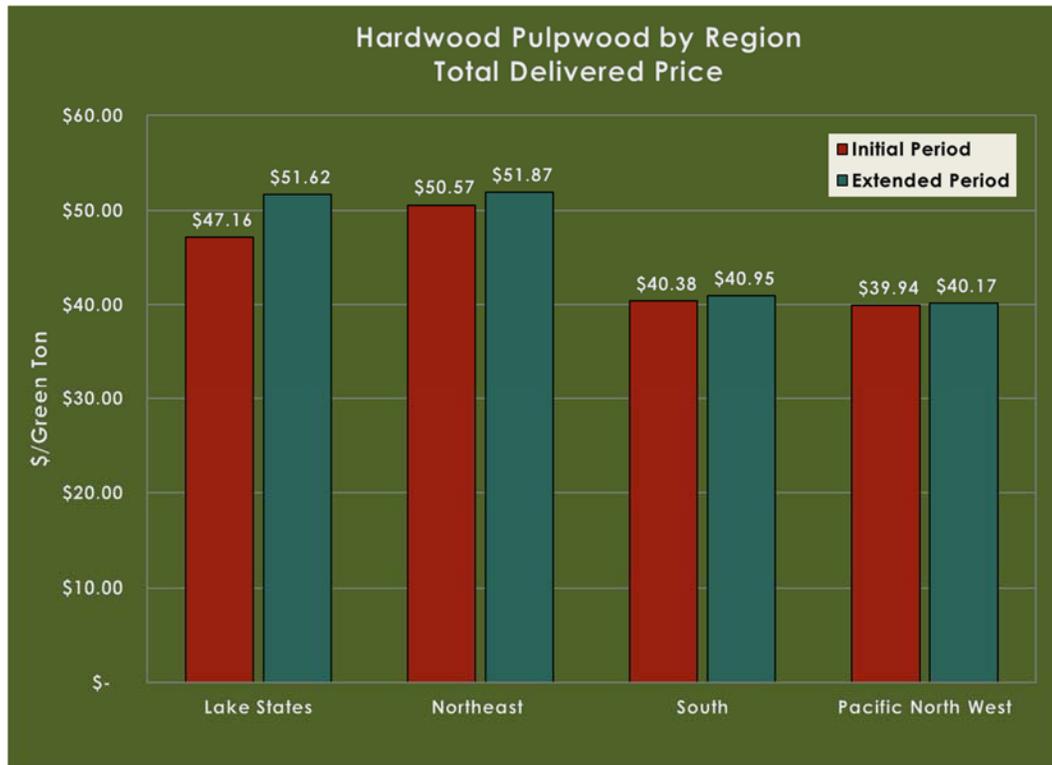
During the extended study period, total delivered pricing for the aspen product group in the Northeast region continued to exceed the average delivered price in the Lake States. The price differential between the two regions decreased from 19 percent in the initial study period to only 10 percent for the extended study period. Relative to price in the initial study period, price in the extended study period increased by 9 percent in the Lake States, while delivered price decreased by about 1.5 percent in the Northeast (Figure 2).

Figure 2 – Total Delivered Pricing for the Aspen Group by Data Period



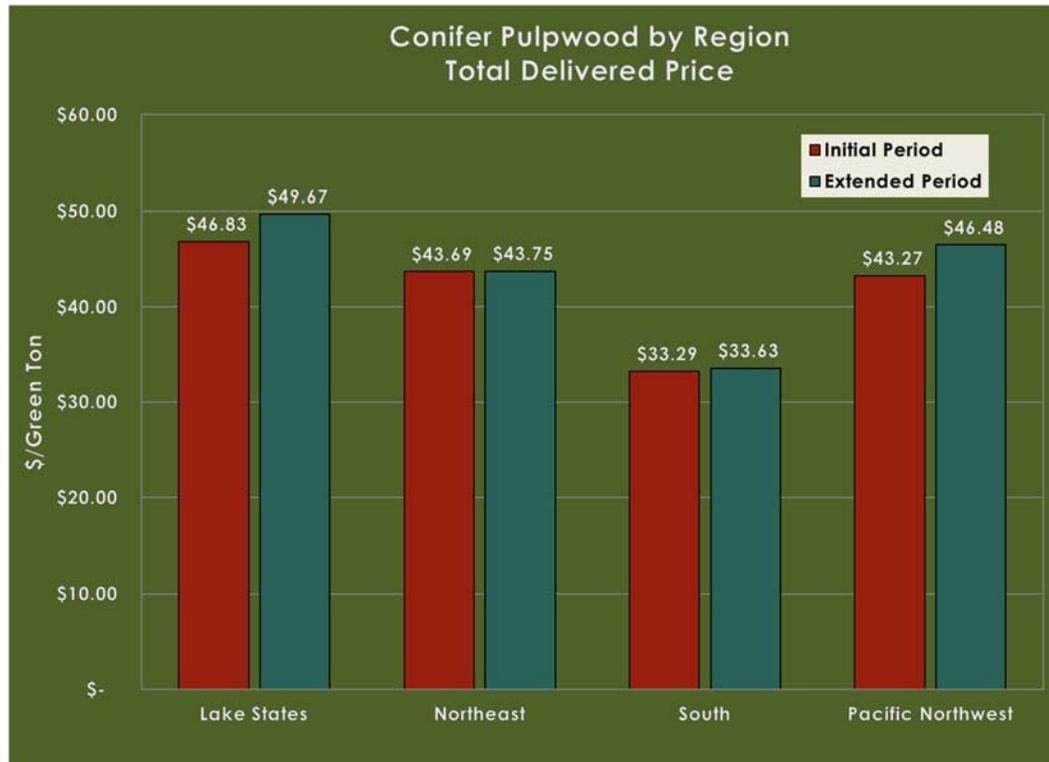
Hardwood pulpwood prices for the South and the Pacific Northwest were similar between the two study periods, remaining at approximately \$40.00 per ton (Figure 3). The Lake States and Northeast regions averaged around \$52.00 a ton during the extended study period, an increase for both regions from the initial study period. Relative to the initial study period, the Lake States delivered price increased by over 9 percent for the expanded study period, whereas the Northeast region increased by about 3 percent. Hardwood pulp prices for the South and Pacific Northwest were only marginally higher for the expanded study period than for the initial study period. As discussed in the previous report, seasonal raw material availability typically impacts pricing in northern markets. Notable increases in delivered costs were observed during the second quarter of 2014 and once again in 2015. Additional discussion regarding the seasonality of northern markets is provided in Section 3.2 and 3.3 (Figure 3).

Figure 3 – Total Delivered Pricing for the Hardwood Group by Data Period



As in the initial study period, the delivered price for conifer pulpwood was highly variable across the study regions during the extended study period. Relative differences in conifer pulpwood prices between regions were similar in the two study periods. Prices for Northeast and Southern regions differed little between the two study periods, while price in the Lake States and Pacific Northwest were about 6 percent and 7 percent higher, respectively, in the expanded study period than in the initial study period (Figure 4).

Figure 4 – Total Delivered Pricing for the Conifer Group by Data Period



3.2 Supply Chain Regional Analysis

Costs associated with the supply chain components described previously in the report are exhibited in the following figures. Each species group is presented in a separate figure that presents the average cost (\$) of each component and the total delivered value (sum of the component costs) for each region. We also calculated variance within each supply chain component between species groups. Variance is defined as the measure of how variable the costs are relative to the mean cost within each supply chain component grouping as provided by F2M. The following formula was applied to these groupings to derive the variance metric:

$$\frac{\sum(x-\bar{x})^2}{(n-1)}, \text{ where } \bar{x} \text{ is the sample mean average, and } n \text{ is the sample size}$$

Variance summary statistics are provided in Exhibit 3.

More detailed analysis of each component is provided in the following sections. The supply chain components are presented as a percentage of the total delivered cost and are also compared with the values from the initial period (Tables 1 and 2).

Table 1 – Cost Components as a Percent of Total Delivered Cost, Q3 2013 through Q2 2015

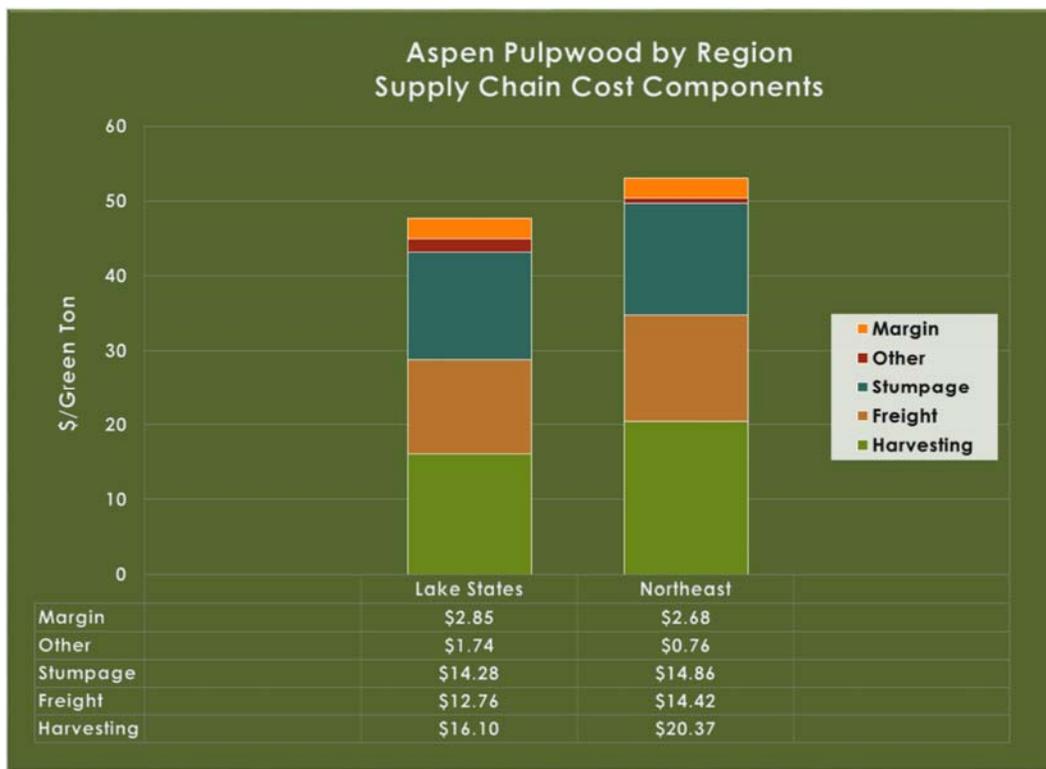
| Supply Chain Cost Component (%) | | | | | | |
|---------------------------------|---------------------------------|-------|------------|---------|--------|----------|
| Aspen Pulpwood | | | | | | |
| Region | Total Delivered (\$ per ton) | Other | Harvesting | Freight | Margin | Stumpage |
| Lake States | \$ 47.74 | 4% | 34% | 27% | 6% | 30% |
| Northeast | \$ 53.08 | 1% | 38% | 27% | 5% | 28% |
| Hardwood Pulpwood | | | | | | |
| Region | Total Delivered (\$ per ton) | Other | Harvesting | Freight | Margin | Stumpage |
| Lake States | \$ 51.62 | 12% | 32% | 25% | 4% | 28% |
| Northeast | \$ 51.87 | 3% | 40% | 28% | 4% | 24% |
| South | \$ 40.95 | 7% | 30% | 24% | 11% | 27% |
| Pacific Northwest | \$ 40.17 | 25% | 47% | 22% | 4% | 2% |
| Conifer Pulpwood | | | | | | |
| Region | Total Delivered (\$ per ton) | Other | Harvesting | Freight | Margin | Stumpage |
| Lake States | \$ 49.67 | 10% | 34% | 25% | 5% | 26% |
| Northeast | \$ 43.75 | 2% | 48% | 31% | 5% | 15% |
| South | \$ 33.63 | 2% | 35% | 24% | 5% | 33% |
| Pacific Northwest | \$ 46.48 | 22% | 38% | 21% | 5% | 15% |

Table 2 – Cost Component Comparison Table (Initial vs. Extended Period)

| Supply Chain Price Component (\$/green ton) | | | | | | |
|---|--------------|----------|------------|----------|---------|----------|
| Conifer | | | | | | |
| Region | Study Period | Other | Harvesting | Freight | Margin | Stumpage |
| Lake States | Initial | \$ 4.75 | \$ 16.45 | \$ 12.45 | \$ 2.20 | \$ 10.99 |
| Lake States | Extended | \$ 4.81 | \$ 16.72 | \$ 12.45 | \$ 2.60 | \$ 13.09 |
| Northeast | Initial | \$ 1.23 | \$ 21.04 | \$ 12.91 | \$ 1.81 | \$ 6.71 |
| Northeast | Extended | \$ 0.89 | \$ 20.81 | \$ 13.66 | \$ 1.99 | \$ 6.41 |
| Pacific Northwest | Initial | \$ 10.45 | \$ 16.86 | \$ 9.56 | \$ 1.74 | \$ 4.65 |
| Pacific Northwest | Extended | \$ 10.12 | \$ 17.63 | \$ 9.77 | \$ 2.15 | \$ 6.80 |
| South | Initial | \$ 0.81 | \$ 11.92 | \$ 8.31 | \$ 1.51 | \$ 10.75 |
| South | Extended | \$ 0.84 | \$ 11.88 | \$ 8.18 | \$ 1.64 | \$ 11.09 |
| Hardwood Pulpwood | | | | | | |
| Region | Study Period | Other | Harvesting | Freight | Margin | Stumpage |
| Lake States | Initial | \$ 6.36 | \$ 15.93 | \$ 12.26 | \$ 1.67 | \$ 10.94 |
| Lake States | Extended | \$ 6.15 | \$ 16.30 | \$ 12.80 | \$ 2.09 | \$ 14.28 |
| Northeast | Initial | \$ 1.87 | \$ 20.72 | \$ 12.58 | \$ 1.84 | \$ 13.55 |
| Northeast | Extended | \$ 1.58 | \$ 20.90 | \$ 14.44 | \$ 2.31 | \$ 12.64 |
| Pacific Northwest | Initial | \$ 10.34 | \$ 18.64 | \$ 8.34 | \$ 1.32 | \$ 1.30 |
| Pacific Northwest | Extended | \$ 10.08 | \$ 18.79 | \$ 8.74 | \$ 1.58 | \$ 0.98 |
| South | Initial | \$ 1.86 | \$ 12.53 | \$ 9.96 | \$ 4.81 | \$ 11.21 |
| South | Extended | \$ 2.71 | \$ 12.48 | \$ 9.85 | \$ 4.68 | \$ 11.24 |
| Aspen Pulpwood | | | | | | |
| Region | Study Period | Other | Harvesting | Freight | Margin | Stumpage |
| Lake States | Initial | \$ 1.76 | \$ 16.10 | \$ 12.00 | \$ 1.86 | \$ 12.12 |
| Lake States | Extended | \$ 1.74 | \$ 16.10 | \$ 12.76 | \$ 2.85 | \$ 14.28 |
| Northeast | Initial | \$ 0.92 | \$ 20.69 | \$ 13.32 | \$ 3.20 | \$ 15.74 |
| Northeast | Extended | \$ 0.76 | \$ 20.37 | \$ 14.42 | \$ 2.68 | \$ 14.86 |

During the extended study period, cost components within the two regions that produce aspen pulpwood were similar when evaluated as a percent of total delivered price. The difference between some individual components increased slightly since the previous report (Table 2, Figure 5).

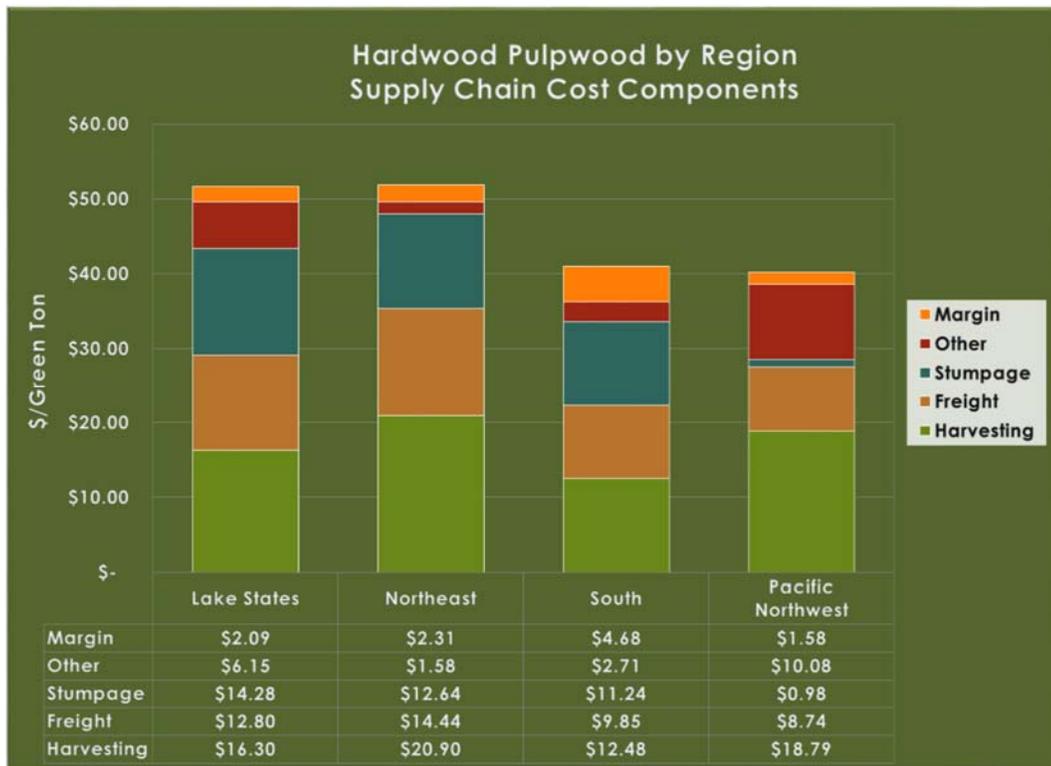
Figure 5 – Aspen Pulpwood Cost Component Summary, Q3 2013 through Q2 2015



Of cost components in aspen-producing regions, Margin and Stumpage costs were most similar between the two regions (Figure 5). Costs in the Harvesting and Other categories differed most between the two regions (by more than 25 percent for both). Other costs were higher in the Lake States relative to the Northeast, and Harvesting costs were lower in the Lake States than in the Northeast. During the extended study period, Other costs were 28 percent lower in the Northeast than in the initial report (Figure 5 and Table 2).

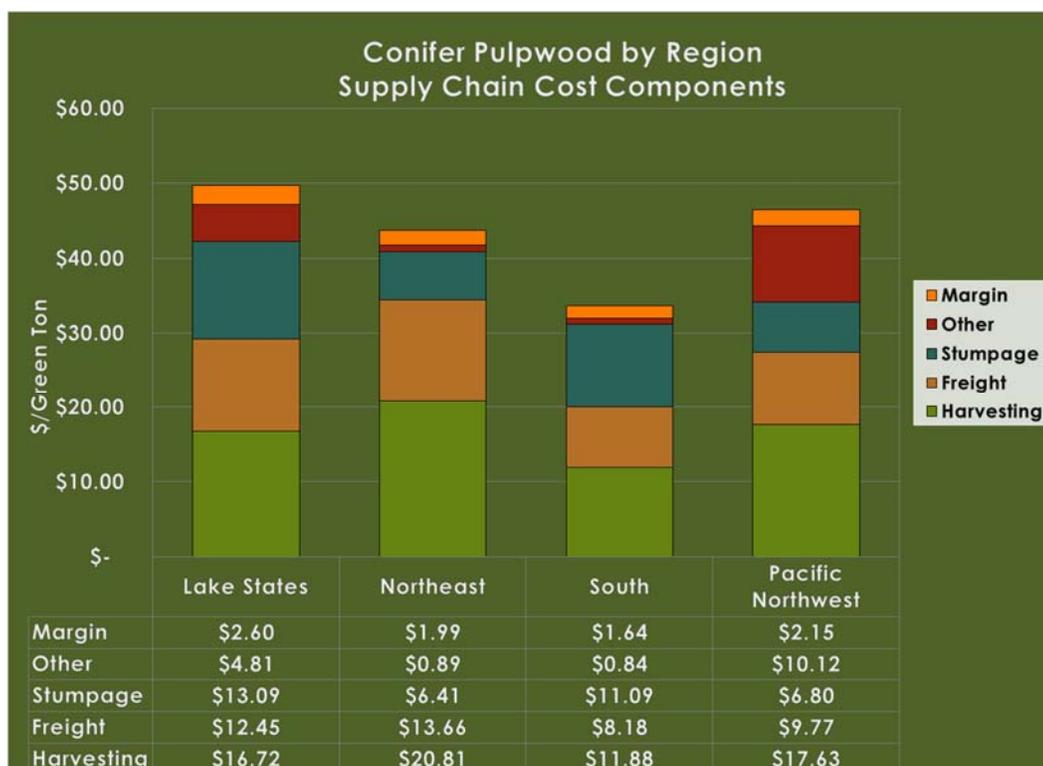
Cost components for hardwood pulpwood differed more between regions than aspen pulpwood (Figure 6, Exhibit 3, variance metrics). As in the initial study period, variance for Stumpage costs in the extended study period was greater than for other cost components, and average costs ranged from \$14.28 in the Lake States to \$0.98 in the Pacific Northwest. Variance was second largest for Other costs, and regional averages ranged from \$6.15 in the Lake States to \$10.08 in the Pacific Northwest. Other costs include costs specific to a region’s wood transportation system, as well as handling and processing costs. Additional details on factors that affect hardwood pulpwood costs are discussed later in this section (Figure 6 and Table 2).

Figure 6 – Hardwood Pulpwood Cost Component Summary, Q3 2013 through Q2 2015



As in the initial study period, the Lake States region again had the highest Stumpage and Margin costs for conifer pulpwood during the extended study period (Figure 7). Stumpage costs are 18 percent higher in the Lake States than in the South, compared to a 2 percent difference between the two regions in the initial study period. Of conifer pulpwood supply chain components, costs in the Other category had the greatest variance, and regional average costs ranged from \$0.84 to \$10.12 per ton (Figure 3). Average Harvesting costs also had a large variance (Exhibit 3).

Figure 7 – Conifer Pulpwood Cost Component Summary, Q3 2013 through Q2 2015



3.3 Discussion

In the following sections, we further discuss results for each cost component.

Stumpage

Stumpage was one of the most variable cost components analyzed, with hardwood pulpwood exhibiting the greatest variance. Stumpage pricing is derived for each mill, predominantly from documented timber sale results, and is tied to the mill's procurement zone.

When compared to other regions, Lake States Stumpage was lowest for aspen pulpwood, but highest for hardwood pulpwood and conifer pulpwood. Among the three species groups, aspen stumpage had the lowest measure of variance (variance = 0.17, Exhibit 3). This variance was lower than in the initial study period, which suggests less difference between the Lake States and the Northeast for this cost component.

Results from the extended study period suggest that the Lake States may not have a large competitive

advantage in Stumpage costs. During the initial study period, Stumpage rates in the Lake States were lower than other regions for both aspen and hardwood. However, hardwood stumpage was 23 percent higher than in the initial study period, while aspen stumpage was 15 percent higher. As a percent of total delivered cost, pulpwood stumpage costs in the Lake States exhibited little difference between the initial and extended study periods for conifer and aspen. However, costs for hardwood pulpwood increased from 23 percent in the initial study period to 28 percent in the extended study period.

Harvesting

Harvesting costs in the Lake States were quite competitive when compared to the other regions studied. The Lake States region had the lowest harvesting cost for aspen pulpwood and ranked third for hardwood and conifer pulpwood, which was consistent with results from the initial study period. Once again, our results suggest that the Lake States is competitive at the national level for cost to produce timber at the landing.

Cut-to-length harvesting is the most common method of producing pulpwood for aspen, hardwood, and most conifer species in the Lake States. As a primary harvesting method, cut-to-length systems are fairly unique to the Lake States region. Baker et al. (2013) suggests that the average logging contractor in the Lake States harvests about 1,800 tons per week, which is less than one-half that produced by a similar sized contractor in the South and the Northeast. Yet, our study revealed that the Lake States has higher production per woodworker than the Pacific Northwest or Northeast (Baker et al. 2013). The dominance of this system, as well as the high percentage of forests being managed using uneven-aged techniques, is likely one of the reasons that the Lake States lags behind other regions in average production (Baker et al. 2013).

A separate, but similar study, completed for the Wood Supply Research Institute, found the fewest number of logging weeks per year in the Lake States and Northeast, especially for cut-to-length and cable skidder operations (RISI, Barynin 2013).

Freight

The Lake States region had some of the highest transportation costs in the country, exceeded only by the Northeast. Freight costs were similar in the both study periods.

Conversations with industry experts suggest that freight costs are typically about \$0.19 per ton per mile in the Lake States, followed by the Northeast (\$0.18 per ton per mile) and the South (\$0.16 per ton per mile) (F2M). When evaluating the F2M results, it should be noted that in most regions, truck loading is part of harvesting cost, especially where whole-tree harvesting is the common technique and trailers are without loaders. However, a large percentage of haul trucks in the Lake States include loaders, which add to the hauling costs. In this study, total freight costs were highest in the Northeast, with the Lake States ranked as a close second. The freight cost component was similar for these two regions, with the largest price difference occurring for aspen pulpwood. In general, regions with harvesting operations and industry infrastructure that facilitate haul trucks without on-board loaders result in the loading costs being accounted for in the Harvesting cost component. Freight includes all types of raw material transportation, which includes rail. Roundwood transportation in Wisconsin is more dependent upon rail than the other study regions, a factor contributing to the longer haul distances.

In the Northeast region, hardwood pulpwood freight costs were 15 percent higher in the extended study period than in the initial study period, compared to the Lake States, which was only 4 percent higher in the extended study period.

The average haul distance reported by F2M represents the weighted average from all loads within the selected data set (reported by product, region, and quarter). Table 3 provides average haul distances for the extended study period.

Table 3 – F2M Derived Average Haul Distance by Region and Product Grouping, Q3 2013 through Q2 2015

| Region | Average Haul Distance | | |
|-------------------|-----------------------|----------|-------|
| | Conifer | Hardwood | Aspen |
| Lake States | 106 | 115 | 71 |
| Northeast | 76 | 90 | 77 |
| South | 54 | 66 | - |
| Pacific Northwest | 48 | 41 | - |

The haul distance for hardwood pulpwood in the Northeast was 6 miles further in the extended study period than in the initial study period, and represents the largest change in haul mileage between the two study periods. This increase in haul distance mirrors the 15 percent increase in freight costs identified above.

The regional cost analysis survey developed in cooperation with the Wood Supply Research Institute found that the respondents' average load traveled 75 miles to a mill in the Lake States and Northeast regions (Baker et al. 2013). This haul distance is similar to haul distances in these regions derived from F2M data and suggests that the regions used in each analysis are similar in terms of contractor characteristics and general location. Haul distances derived in our study from F2M for the Lake States region were about 30 percent higher on average for conifer and hardwood pulpwood than haul distances presented by Baker et al. (2013); however, both sources identify the Lake States as a region with some of the longest haul distances.

Margin

This cost component exhibited the least variance among the supply chain components. There was little difference between the initial and extended study periods; however, Margin costs did increase between the two periods in the Lake States region across all markets analyzed. Moreover, the Lake States region now has the highest margin for aspen pulpwood. As described earlier in the report, this is a calculated cost and is considered the net after paying cut, skid, load, and haul costs (excluding the Other cost component).

Other

Other costs were highly variable between regions in both the initial and extended study periods. The Other category includes costs associated with procurement, wood yard expense, and wood transfer, so variation between reporting mills for this supply chain component is expected. In both study periods, the Pacific Northwest and the Lake States regions had the highest costs for this component. It should be noted that these costs are tied to markedly different production processes within these two regions. In the extended study period, Other costs were 1 percent higher for conifer pulpwood, 3 percent lower for hardwood pulpwood, and 1 percent lower for aspen pulpwood relative to costs in the initial study period (Exhibit 3 and Table 2).

In the Lake States, major components of the Other category are the transfer of wood during seasons of wood supply shortages and general costs associated with wood yard operations. Wood yard transfers and direct yard costs are believed to be high in the Lake States due to shortwood handling and the stockpiling of raw material to hedge against potential seasonal supply constraints. These costs are common to the Wisconsin/Lake States region and, to a lesser extent, the Northeast region, as well as to other select areas

utilizing the cut-to-length harvest model. Shortwood handling adds considerable cost to the Lake States region, and the Other category contributed over 10 percent of the total delivered cost for both hardwood and conifer pulpwood.

The primary cost that contributes to the Other cost component in the Pacific Northwest is the transfer of chips. Pulpwood material in the Pacific Northwest is mostly sourced from sawmills in the form of residue chips. Therefore, pulpwood is mostly topwood volume in the form of chips. The handling and re-hauling of this material from sawmill to the pulp mill adds significant cost to pulpwood in this region.

3.3.1 Review of Wisconsin Fiber Costs and Comparison to the Previous Analysis

The load data selected to represent the Wisconsin marketplace continues to suggest competitive advantages associated with this region. When compared to the Northeast region, mills/suppliers included in the Wisconsin data set reported lower total delivered costs for both hardwood and aspen pulpwood. However, the difference in total delivered costs between these two regions decreased between the initial and extended study periods. Total delivered cost in the Lake States region is now less than 1 percent lower than the Northeast for hardwood pulpwood, and has reduced from 23 to 11 percent for aspen pulpwood. In the initial study period, Wisconsin Stumpage, Harvesting, and Margin costs occupied a smaller percentage of the total delivered cost for aspen pulpwood in comparison to the Northeast region. In the extended study period, only the Harvesting cost is lower when compared to the Northeast. Stumpage, Margin, and Freight costs are now all higher in Wisconsin for aspen pulpwood. Results for hardwood pulpwood were similar between the two study periods; however, Wisconsin now has higher Stumpage and lower Freight costs when compared to the Northeast (refer to Section 3.2). Conifer pulpwood results were similar between the two study periods. For this group, the Northeast has many advantages over the Wisconsin marketplace. Again, Stumpage, Margin, and Other component costs are higher in the Lake States for conifer pulpwood deliveries. Overall, Wisconsin data indicates more efficiencies in the Harvesting and Freight cost components when compared to the Northeast region. The previous report provides detailed insight into the differences between the harvesting methodologies in the Lakes States and Northeast regions.

While the cost of Harvesting is lower in the Lake States when compared to the Northeast, Other and Stumpage costs for conifer pulpwood are higher at 81 and 51 percent, respectively. This represents a 7 to 12 percent increase for these supply chain components between the initial and extended study periods. The previous sections document that wood transfer costs are included in the Other category. Stumpage also plays a role in the Lakes States having higher delivered conifer cost. Similar to wood transfer costs, higher conifer pulpwood stumpage in the Lake States may be connected to seasonal logging constraints. In some cases, red pine stumpage is purchased to ensure that logging crews have harvestable ground during periods of wet soil conditions (generally in the fall and spring months). As a result, conifer stumpage could be above general market values, since contractors appear willing to pay more for stumpage that is accessible throughout the year. Product competition, especially for red pine, could also be affecting conifer stumpage in the Lake States. As Wisconsin's pine plantations mature, pulpwood markets must compete with mills manufacturing sawn and pole products.

In the Lake States, there was no difference in Freight costs for conifer pulpwood between the initial and extended study periods, as the price remained at \$12.45 per green ton. In comparison, Freight costs for conifer pulpwood for the Northeast were 6 percent higher in the extended study period than in the initial study period.

The South and Pacific Northwest regions are less comparable to the Lake States than the Northeast. However, the supply chain component costs for these regions suggest areas of competitive disadvantage for the Lake States at a national level. Areas of disadvantage identified in the last report are the Freight and Other categories. In addition, Stumpage costs, particularly for conifer pulpwood, were an area of high cost in the extended study period.

Freight cost advantage in the South, relative to the Lakes States, remains relatively unchanged for the hardwood and conifer pulpwood groups between the two study periods. Truck loading likely is responsible for some of the difference between Wisconsin and the South. Freight costs in Wisconsin are also pressed higher by the fact that less raw material can be moved over the road, due to the burden of the on-board loader.

In the initial study period, Wisconsin's Harvesting costs were reasonably competitive at the national level. In the extended study, Harvesting costs were minimally higher for conifer and hardwood pulpwood and unchanged for aspen relative to the initial study period. Harvesting cost was a smaller percentage of total delivered prices for aspen and conifer softwood in the Lake States than in other regions, and only the South was lower for hardwood pulpwood. Since this species group is managed quite differently in the Lake States and the South, harvesting efficiencies within the current industry structure may not result in great cost savings. Whole-tree harvesting, as is common in the hardwood type in the South, is not likely to be adopted in Wisconsin's quality hardwood stands.

The supply chain component costs of Other, Freight, and Stumpage remain areas that warrant attention. In the Lake States, the Other cost component is more than double that of the South and Northeast regions in most cases, and in excess of five times the cost of conifer pulpwood in the South and Northeast region. Similar to results from the initial study period, the Other cost component accounts for 4 to 12 percent of total delivered cost in Wisconsin, exceeded only by the Pacific Northwest for hardwood and conifer pulpwood. This cost component is largely tied to industry structure in the Lake States; however, efficiencies in the category may create notable cost savings over time.

Based on results from the extended study period, Stumpage costs in Wisconsin may not be as competitive as indicated in the previous report. This cost is driven by many economic factors and is generally an area for which it is difficult to find room for cost savings, especially in regions with competitive and healthy wood product industries. In addition, advantages for the aspen pulpwood group identified during the initial study period were not as evident in the extended study period.

4. Summary

4.1 Project Overview

This study continued evaluation of the topic question: 'What forestry-related factors are expected to enhance or reduce the competitiveness of forest-based manufacturing in Wisconsin?' The primary project objective focused on evaluating supply chain costs in Wisconsin as compared to other significant wood baskets in the United States. The aggregated delivered load data provided by F2M was expanded to eight quarters and now represents an average over a longer period time. This study investigated the wood product markets effective the second half of 2013 through the first half of 2015. Further evaluation of the F2M data, provided that it is summarized in a similar manner going forward, would yield a more conclusive and statistically significant dataset into the future. This new dataset provides insight into market changes and events that affect the greater market and the downstream responses of the supply chain components. We caution that our results represent averages over numerous reporting mills and wood suppliers over broad regions, and may not capture or recognize smaller scale individual market or mill situations.

4.2 Conclusions

Results from analyses of the initial and extended data sets indicated that an aggregation of the data should be used as the baseline for regional comparison. Thus, the total delivered and supply chain component costs were averaged across eight quarters (refer to Section 2.2), and we utilized the F2M weighted average data. As a result, the conclusions of this study are based on an averaged period of time.

The various analyses and regional comparisons resulted in the following supply chain cost inferences.

Total delivered price summation:

- Aspen pulpwood total delivered prices were 9 percent higher for the eight-quarter data period than in the initial study period.
- Wisconsin total delivered aspen pulpwood cost was \$5.34 per ton lower than the Northeast region, about one-half the difference in cost identified in the initial study period (representing a softening of the competitive advantage of Wisconsin in the aspen marketplace).
- Wisconsin remains the second highest for total delivered cost for hardwood pulpwood, and during the extended study period, was within 1 percent of the Northeast, which was highest.
- Total delivered price for conifer pulpwood was highest in Wisconsin, and was 6 percent higher during the extended study period than in the initial study period, a higher rate of increase than observed in the Northeast region.

Supply chain cost inferences:

- Aspen pulpwood Stumpage as a percentage of total delivered cost is now higher in Wisconsin (increasing from 28 to 30 percent), which represents a loss in competitive advantage relative to the initial study period (the previous dataset found the Stumpage cost to be a lower component cost in Wisconsin when compared to the Northeast in the aspen group).
- For aspen pulpwood, there was little variation in cost components as a percent of total delivered price, except for Freight costs, where the percentage share was 2 percent higher in the Northeast region in the extended study period versus the initial study period.
- Costs for the Stumpage and Other categories had high levels of variance between regions (which was consistent between both study periods).
- Wisconsin had the second highest cost for Freight for all products analyzed (which was consistent between both study periods).
- Wisconsin had some of the highest Other costs across all product groups (which was consistent between both study periods).
- In the extended study period, Freight costs, evaluated as a percent of the total delivered costs, were now higher in the Northeast for hardwood pulpwood and conifer pulpwood (representing a competitive shift in favor of Wisconsin relative to the initial study period).
- Conifer pulpwood Stumpage in Wisconsin was 19 percent higher in the extended study period than in the initial study period (Wisconsin continues to have the highest total delivered price).
- Wisconsin Harvesting costs were competitive when compared to the other regions, as this cost was \$4.09 to \$4.60 per ton lower than the Northeast and only \$3.82 to \$4.84 per ton higher than the South (there was little change between the initial and extended study periods).
- Wisconsin now has the highest hardwood pulpwood Stumpage cost (\$14.28 per ton), where, during the initial study period, it was ranked second lowest amongst the regions analyzed (a competitive disadvantage).

Other and Freight costs are components of the supply chain where opportunity may exist to capture savings through streamlining and efficiencies (see Section 3.3). The costs included in the Freight component are documented throughout this report. Freight costs are a large percentage of the total delivered cost in the Lake States, representing 25 to 27 percent of the total delivered cost for the products analyzed. However, in the extended study period, Wisconsin Stumpage costs were a higher percentage of costs than Freight for the products analyzed. In the initial study period, Freight exceeded Stumpage for all products other than aspen when evaluated as a percent of the total delivered cost.

In the extended study period, Freight costs were quite high in the Northeast region, representing 25 to 30 percent of the total delivered price across the species groups. Freight costs varied little across regions within product groups, and Freight had lower variance than some of the other component costs, which is consistent with the initial study period (Harvesting, Other, and Stumpage show high variance).

As discussed in the previous report, efficiencies in Freight and Other costs are not easy to address, as portions of these costs are influenced by seasonal climatic conditions and forest industry infrastructure. The adoption of whole-tree harvesting and investment in changes to all supply chain components to facilitate change would be difficult, but could lower costs in Freight (although some costs would be moved to other categories, such as loading to Harvesting) and the Other cost component. Other costs could be lowered near levels observed in the Northeast and South if double handling of wood was reduced, haul trucks were reconfigured without loaders, and mills (including new industry) could accept tree-length segments. These changes would be quite significant due to the current investment in these infrastructure components. Although these supply chain cost components come to the surface as potential areas of opportunity when evaluating the F2M data, the foundational changes necessary to support logistical efficiencies may be considered implausible due to the capital costs required to change the infrastructure. Reasonable efforts to facilitate delivering wood directly from the landing to the mill could minimize a portion of costs included in the Other category. Different truck configurations might minimize empty backhaul situations, as is common in the Northeast, with roundwood going into Canada and finished product coming back to the United States.

The fact that all Stumpage costs are now reported as higher than Freight (when evaluated as a percent of total delivered) was studied further. During the extended study period, Wisconsin total delivered costs were 18 percent higher for aspen, 19 percent higher for hardwood, and 12 percent higher for conifer pulpwood relative to the initial study period. However, total delivered price for aspen pulpwood in the Northeast decreased by 3 percent in the extended study period. Most of this additional cost in Wisconsin occurred in the Stumpage and Margin cost components, where the aspen pulpwood prices increased by 36 and 106 percent, respectively, between the initial and extended study periods (Exhibits 1 and 3). Similar trends were observed in the hardwood pulpwood category. This substantial increase in Stumpage and Margin was likely related to roundwood availability and the resulting supply pressures that occurred during the 2014/2015 winter and 2015 spring period. Operational limitations related to weather events during the second half of 2014 and early 2015 resulted in low mill inventories and roundwood supplies, which translated into higher delivered rates and stumpage; this was particularly evident in aspen pulpwood markets. Therefore, substantial increases in Stumpage and Margin costs are not surprising given the events that occurred during the latter half of the extended study period.

Generally, the relationship among the study regions for conifer pulpwood remained consistent between the two study periods. Noteworthy differences include an increase of 19 percent for Wisconsin Stumpage in the extended study period and a 6 percent increase in Freight costs in the Northeast region. High conifer pulpwood stumpage in Wisconsin likely resulted from dynamics in several regional market and operational characteristics. Shortwood infrastructure and contractors seeking pine plantation harvests operable nearly year-round could be some of the factors contributing to this notably high cost. Also, the Lake States region has some of the highest haul distances in the nation. Therefore, strategic placement of new industry could reduce Freight and Other costs. The average haul distance in the Lake States region provides evidence that the average mill in this region is not well placed, especially when compared to the South and Pacific Northwest.

This study found that Wisconsin continues to have a slight overall delivered cost advantage over the Northeast, the region most similar in forest cover, seasonality issues, and harvest operations. However, the expanded dataset suggests that during periods of limited roundwood availability, the competitive advantages are quite narrow for aspen and hardwood pulpwood. Once again, we found that the Lake States and Northeast regions are less competitive when compared to the South. This disadvantage will be difficult to overcome given inherent differences in weather and forest and operational characteristics.

Submitted by:

STEIGERWALDT LAND SERVICES, INC.



Forrest Gibeault, ACF
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FOREST2MARKET, INC.



Peter J. Coutu
Sales Director – North America

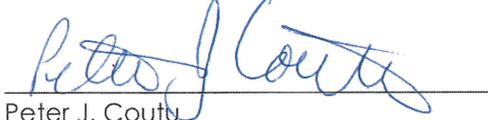
STATEMENT OF LIMITING CONDITIONS

I certify that, to the best of my knowledge and belief:

- a. The statements of fact contained in this report are true and correct.
- b. The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, impartial, and unbiased professional analyses, opinions, and conclusions.
- c. The F2M data was aggregated to allow for confidentiality, and the dataset provided for the study only allowed for inference at the regional levels reported.
- d. I have no present or prospective interest in the subject of this report and no personal interest with respect to the parties involved.
- e. I have no bias with respect to the subject of this report or to the parties involved with this assignment.
- f. My engagement in this assignment was not contingent upon developing or reporting predetermined results.
- g. My compensation for completing this assignment is not contingent upon the development or reporting of predetermined results or directions that favors the cause of the client, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this report.

STEIGERWALDT LAND SERVICES, INC.

Forrest Gibeault, ACF
Analysis and Investments Operations Director

FOREST2MARKET, INC.

Peter J. Couty
Sales Director – North America

Exhibit 1

Quarterly Data Summary



Exhibit 1

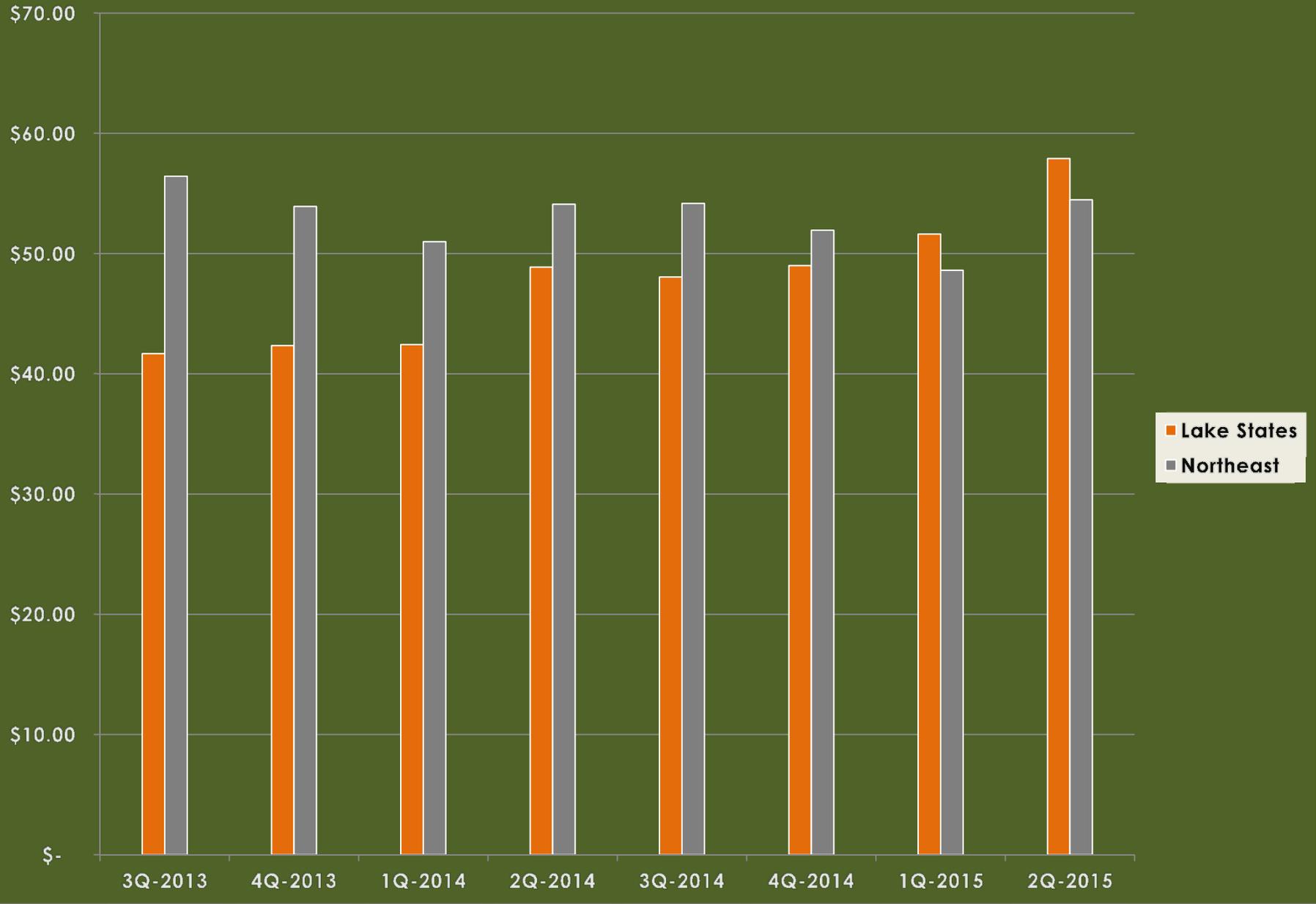
Total Delivered By Quarter/Region (\$ per ton)

| Aspen | | | | | | | |
|--------------|-------------|-------|-----------|-------|--|--|--|
| Quarter-Year | Lake States | | Northeast | | | | |
| 3Q-2013 | \$ | 41.68 | \$ | 56.43 | | | |
| 4Q-2013 | \$ | 42.34 | \$ | 53.92 | | | |
| 1Q-2014 | \$ | 42.44 | \$ | 50.99 | | | |
| 2Q-2014 | \$ | 48.87 | \$ | 54.11 | | | |
| 3Q-2014 | \$ | 48.05 | \$ | 54.17 | | | |
| 4Q-2014 | \$ | 49.00 | \$ | 51.94 | | | |
| 1Q-2015 | \$ | 51.62 | \$ | 48.62 | | | |
| 2Q-2015 | \$ | 57.90 | \$ | 54.47 | | | |

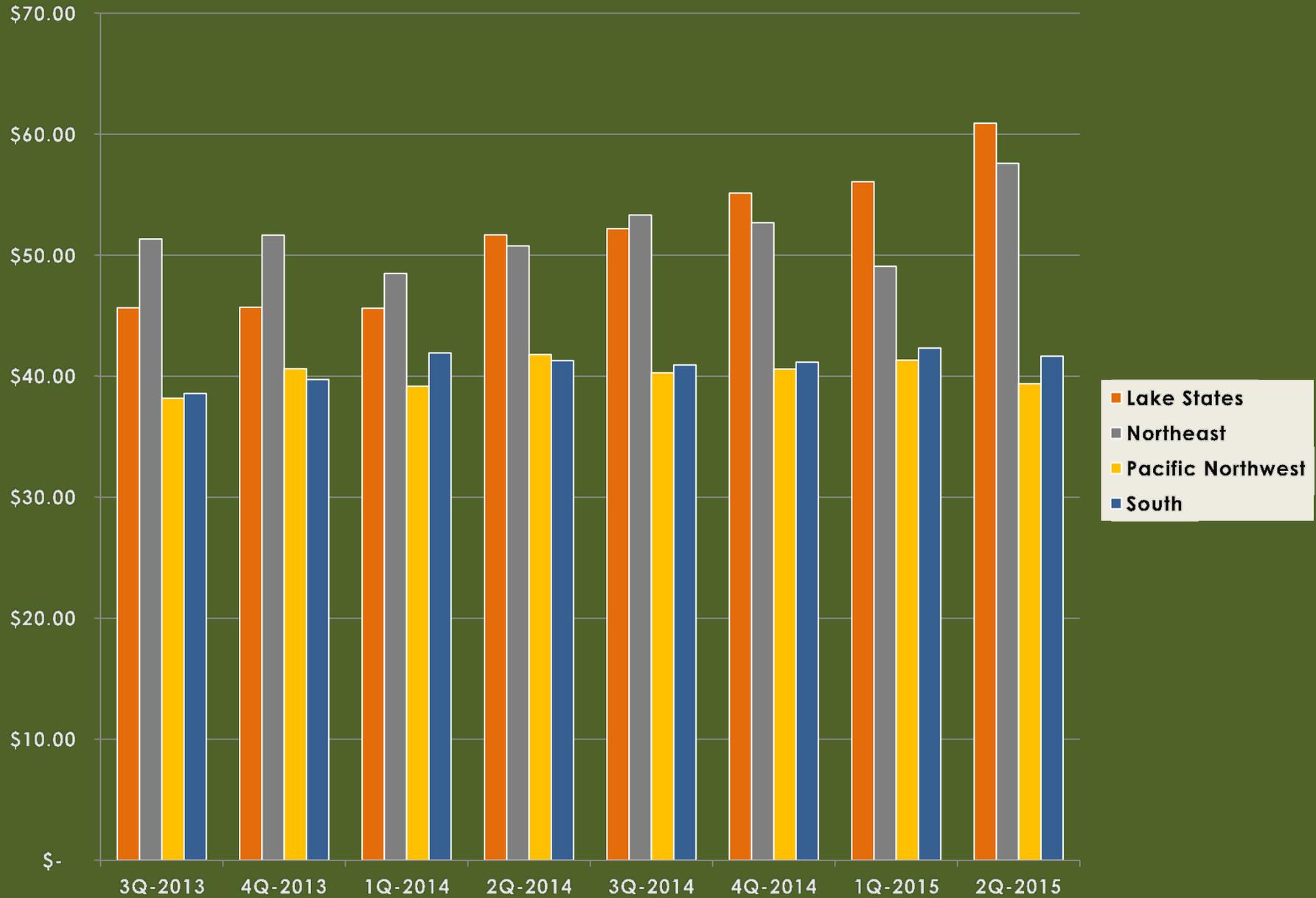
| Hardwood | | | | | | | | |
|--------------|-------------|-------|-----------|-------------------|----|-------|----|-------|
| Quarter-Year | Lake States | | Northeast | Pacific Northwest | | South | | |
| 3Q-2013 | \$ | 45.66 | \$ | 51.34 | \$ | 38.18 | \$ | 38.57 |
| 4Q-2013 | \$ | 45.71 | \$ | 51.66 | \$ | 40.62 | \$ | 39.73 |
| 1Q-2014 | \$ | 45.62 | \$ | 48.50 | \$ | 39.17 | \$ | 41.92 |
| 2Q-2014 | \$ | 51.68 | \$ | 50.77 | \$ | 41.79 | \$ | 41.29 |
| 3Q-2014 | \$ | 52.20 | \$ | 53.32 | \$ | 40.28 | \$ | 40.93 |
| 4Q-2014 | \$ | 55.13 | \$ | 52.69 | \$ | 40.59 | \$ | 41.17 |
| 1Q-2015 | \$ | 56.07 | \$ | 49.08 | \$ | 41.33 | \$ | 42.32 |
| 2Q-2015 | \$ | 60.90 | \$ | 57.59 | \$ | 39.38 | \$ | 41.66 |

| Conifer | | | | | | | | |
|--------------|-------------|-------|-----------|-------------------|----|-------|----|-------|
| Quarter-Year | Lake States | | Northeast | Pacific Northwest | | South | | |
| 3Q-2013 | \$ | 46.18 | \$ | 43.91 | \$ | 41.78 | \$ | 32.72 |
| 4Q-2013 | \$ | 45.94 | \$ | 44.38 | \$ | 41.61 | \$ | 33.13 |
| 1Q-2014 | \$ | 45.14 | \$ | 42.07 | \$ | 44.80 | \$ | 33.90 |
| 2Q-2014 | \$ | 50.07 | \$ | 44.41 | \$ | 44.89 | \$ | 33.42 |
| 3Q-2014 | \$ | 49.23 | \$ | 44.65 | \$ | 46.24 | \$ | 33.32 |
| 4Q-2014 | \$ | 50.20 | \$ | 43.79 | \$ | 50.21 | \$ | 34.01 |
| 1Q-2015 | \$ | 52.05 | \$ | 42.89 | \$ | 52.00 | \$ | 34.60 |
| 2Q-2015 | \$ | 58.53 | \$ | 43.93 | \$ | 50.28 | \$ | 33.97 |

Aspen Pulpwood - Total Delivered Price Comparison



Hardwood Pulpwood - Total Delivered Price Comparison



Conifer - Total Delivered Price Comparison



Exhibit 2

Total Delivered Price Summary



Exhibit 2 – Total Delivered Price Summary

| Total Delivered Price (\$ per ton) | |
|------------------------------------|-----------------|
| Aspen Pulpwood | |
| Region | Total Delivered |
| Lake States | \$ 47.74 |
| Northeast | \$ 53.08 |

| Hardwood Pulpwood | |
|-------------------|-----------------|
| Region | Total Delivered |
| Lake States | \$ 51.62 |
| Northeast | \$ 51.87 |
| South | \$ 40.95 |
| Pacific Northwest | \$ 40.17 |

| Conifer Pulpwood | |
|-------------------|-----------------|
| Region | Total Delivered |
| Lake States | \$ 49.67 |
| Northeast | \$ 43.75 |
| South | \$ 33.63 |
| Pacific Northwest | \$ 46.48 |

Averages from the eight most recent quarters
(Q3 and Q4 2013, all of 2014, Q1 and Q2 2015)

Exhibit 3

Supply Chain Summary Tables



Exhibit 3 – Supply Chain Summary Tables

| Supply Chain Price Component (\$/green ton) | | | | | | |
|---|-----------------|----------|------------|----------|---------|----------|
| Aspen Pulpwood - Region | | | | | | |
| Region | Total Delivered | Other | Harvesting | Freight | Margin | Stumpage |
| Lake States | \$ 47.74 | \$ 1.74 | \$ 16.10 | \$ 12.76 | \$ 2.85 | \$ 14.28 |
| Northeast | \$ 53.08 | \$ 0.76 | \$ 20.37 | \$ 14.42 | \$ 2.68 | \$ 14.86 |
| Variance* | | | | | | |
| | 14.274 | 0.483 | 9.125 | 1.364 | 0.015 | 0.166 |
| Hardwood Pulpwood - Region | | | | | | |
| Region | Total Delivered | Other | Harvesting | Freight | Margin | Stumpage |
| Lake States | \$ 51.62 | \$ 6.15 | \$ 16.30 | \$ 12.80 | \$ 2.09 | \$ 14.28 |
| Northeast | \$ 51.87 | \$ 1.58 | \$ 20.90 | \$ 14.44 | \$ 2.31 | \$ 12.64 |
| South | \$ 40.95 | \$ 2.71 | \$ 12.48 | \$ 9.85 | \$ 4.68 | \$ 11.24 |
| Pacific Northwest | \$ 40.17 | \$ 10.08 | \$ 18.79 | \$ 8.74 | \$ 1.58 | \$ 0.98 |
| Variance* | | | | | | |
| | 41.814 | 14.686 | 13.101 | 6.881 | 1.900 | 35.992 |
| Conifer - Region | | | | | | |
| Region | Total Delivered | Other | Harvesting | Freight | Margin | Stumpage |
| Lake States | \$ 49.67 | \$ 4.81 | \$ 16.72 | \$ 12.45 | \$ 2.60 | \$ 13.09 |
| Northeast | \$ 43.75 | \$ 0.89 | \$ 20.81 | \$ 13.66 | \$ 1.99 | \$ 6.41 |
| South | \$ 33.63 | \$ 0.84 | \$ 11.88 | \$ 8.18 | \$ 1.64 | \$ 11.09 |
| Pacific Northwest | \$ 46.48 | \$ 10.12 | \$ 17.63 | \$ 9.77 | \$ 2.15 | \$ 6.80 |
| Variance* | | | | | | |
| | 48.078 | 19.240 | 13.636 | 6.207 | 0.158 | 10.709 |

* Variance measured across the average regional cost by supply chain component. This measure of variance assumes that the arguments are a sample of the population. The formula used is as follows:

$$\frac{\sum (x - \bar{x})^2}{(n-1)}$$

, where \bar{x} is the sample mean average, and n is the sample size

(A higher variance value equates to more variance)

Exhibit 4

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Stoltzman, Andrew. Wisconsin Department of Natural Resources. Personal Correspondence, 2014.

Exhibit 5

Author Biographies



Steigerwaldt Land Services, Inc.

Steigerwaldt Land Services, Inc. (Steigerwaldt) is a Wisconsin based forestry and real estate consulting company in operation since 1957, with offices in Tomahawk and Hayward, Wisconsin. Steigerwaldt employs a staff of 50 foresters, real estate specialists, appraisers and brokers, GIS specialists, right-of-way acquisition specialists, and surveyors. This staff has extensive experience in all facets of the timber industry, including in-depth and on-the-ground experience with Wisconsin forest policy, regulations, and day-to-day field operations on timberland ownerships ranging from small non-industrial private family forestlands to lands owned by large timberland investment entities. Over the last two years, Steigerwaldt has administered the sale and harvest of approximately 179,000 cords of timber on private Wisconsin forestlands through stumpage sales and direct delivery contracts.

As consultants, our range of services extends beyond Wisconsin to projects across the United States including a variety of assignments centered on valuation and forestland resource analysis. Examples of analysis projects include numerous biomass related resource analyses in the Lake States and Central United States, a Lake States softwood resource study centered on timber availability and ownership, markets and mill competition, various mill and resource capacity studies, and a Wisconsin watershed level forest resource analysis including detailed forest, ownership, and timber market study components. Steigerwaldt routinely works with partner firms in our assortment of projects either as lead or as a collaborator.

The Steigerwaldt team will be led by the following individual:

Forrest M. Gibeault, ACE

Analysis and Investment

Operations Director

Masters in Forestry, Michigan Technological University

10 years of experience in forest resource analysis

Forest2Market

Forest2Market provides market pricing data as well as wood and fiber supply chain expertise to customers in the forest, wood and paper products, recycled paper and packaging, and bioenergy industries. Founded in 2000, our product suite includes price reports for stumpage and lumber, price forecasts for stumpage, wood basin supply and demand assessments, and benchmarking services for delivered wood raw materials and lumber traders. Headquartered in Charlotte, North Carolina, the company also has offices in Eugene, Oregon, Appleton, Wisconsin, and Curitiba – Parana, Brazil.

The Forest2Market team will be led by the following two key individuals:

Peter J. Coutu

Director of Sales – North America

Masters in Forest Management, Michigan State University
Bachelors in Forest Management, University of Maine
24 years of experience in the Forest Products Industry

Daniel Stuber

VP of Data Operations

M.F.R. in Forest Resources, University of Georgia
Bachelors in Forest Resources, University of Georgia
15+ years of experience in Forest Products Industry
and Data Management