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Professional Report

Aspen Harvest Scheduling Analysis
(SLS 5648)

Prepared For:
Chippewa County

Mike Dahlby

Prepared By:
Steigerwaldt Land Services, Inc.

Forrest M. Gibeault

Effective Date:
October 9, 2017

Aspen Harvest Scheduling Analysis

Summary of Facts and Conclusions	
Project	Harvest schedule for the aspen forest type on the Chippewa County Forest
Location	Chippewa County, Wisconsin
Client	Mr. Mike Dahlby County Forest Administrator and Public Liaison Chippewa County Department of Land Conservation and Forest Management 711 N. Bridge Street Chippewa Falls, Wisconsin 54729
Submitted by	Steigerwaldt Land Services, Inc. (Steigerwaldt) 856 North 4th Street Tomahawk, Wisconsin 54487 T: (715) 453-3274 F: (715) 453-8325 Qualifications of Steigerwaldt Land Services, Inc., and the staff for this assignment are provided in Exhibit 2.
Effective Date	October 9, 2017
Project Objective	The project objective is to develop a harvest schedule that improves age-class diversity and spatial arrangement at both the property and aspen management unit level.
Results	This study found the average (weighted by acres) site index to increase by 12 percent, suggesting high site potential resulting in greater model flexibility. The model successfully developed individual stand harvest dates and average harvest levels established in five-year harvest buckets. Over the first 20 years, annual harvest averages about 227 acres per year.
Conclusions	Balancing the objectives of the forest and historic management practices, the final stand harvest dates and buckets produce a scheme that moves the forest closer to the outcomes of the property within the defined scope of the analysis. The harvest plan dates resulted in an average rotation age (weighted by acres) of 48 years, which is only a two year decrease from the existing typical 50-year rotation.

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1. Project Overview

1.1 Overview

The Chippewa County Forest is investigating the ongoing harvest regime of the aspen forest type. Steigerwaldt was retained to evaluate the current aspen stand data and create a harvest schedule that meets the objectives of the county forest. The county manages ±8,566 acres of aspen-dominated forest stands, which represents about 25 percent of the entire ±34,000-acre forest.

1.2 Objectives/Project Background

The project objective is to define a harvest schedule that develops and improves age-class diversity over time while considering the spatial arrangement of age classes over the property. During the project scoping efforts, the following objectives and areas of study were identified.

- Verify forest data - testing site quality
- Develop a harvest schedule resulting in five to seven age classes
- Maximize the spatial distribution within the aspen management units and greater property
- Develop an approach that considers site capabilities and potential for aspen groupings (strata)

Following the initial site visit, it was determined that a more in-depth review of site index was needed to better understand site capabilities for modeling. Site quality is key to any stand modeling analysis, so correlation between habitat type, soil type, and site index was investigated.

The study components and steps used to build the project strata and recommended harvest plan are described in the following section.

2. Methods

The project included four components or steps to develop the harvest plan.

1. Review existing data, test site quality data, and sample site quality (site index) measurements on the ground
2. Process site index results, test data correlations, and build project strata
3. Build model base assumptions and create preliminary harvest plan dates
4. Complete spatial test and adjust individual stand harvest dates with consideration for age class distribution (across property and within management units) and adjacency.

These projects steps are described in detail below.

2.1 Preliminary Data Review, Site Index Sampling, and Project Strata

Stand level county forest data, queried from WisFIRS (Wisconsin Forest Inventory and Reporting System), was provided as the basis of the analysis. This dataset was reviewed and vetted in a preliminary analysis prior to our first field visit.

Our preliminary review and field visit found that habitat data did not exist for the majority of the aspen forest stands, so our modeling efforts would need to focus on site index and soils. Using open-source USDA soil survey GIS (Geographic Information System) layers, we joined the dominant soil type to each stand. Evaluating stands that did have habitat type information did reveal some correlation between site quality

(nutrient/moisture regime) and USDA soil survey type. Site quality correlation with stand soils guided the grouping of stands into four preliminary site capacity groups. These groups are as follows.

- 1: Very good – generally well drained, medium to rich quality site
- 2: Good/Very good – some drainage issues, medium to above average sites
- 3: Good - moderately drained, medium sites
- 4: Fair/Good – poorly drained, low to medium quality

The existing county data determined the weighted average (acres) site index to range from ±71 in site class 1 to ±63 in site class 2.

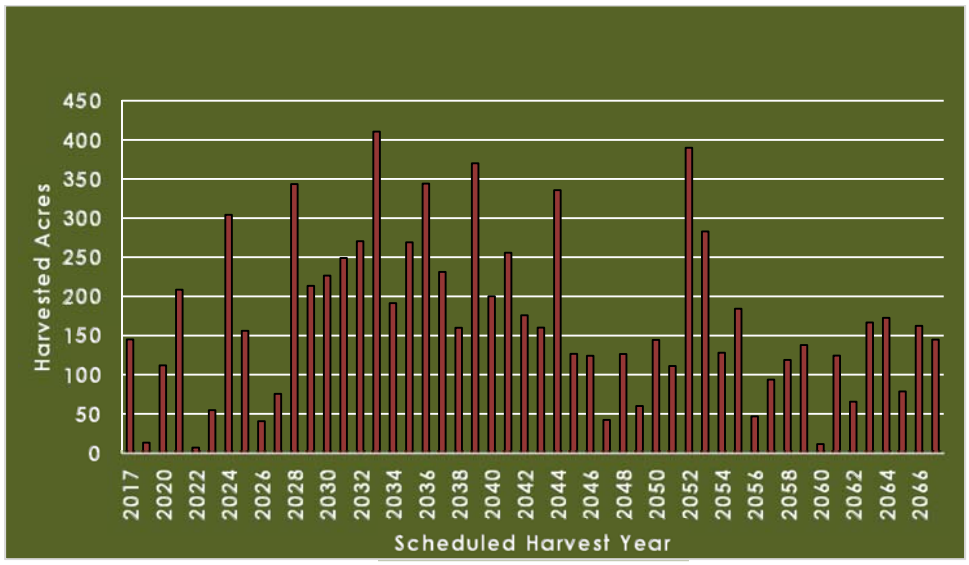
A review of the dataset captured during the preliminary visit suggested that site index may be higher than reported in the WisFIRS database. As a result, field efforts included the establishment of 104 additional samples in the most common soil types. Site index estimation from the new samples relied on the existing age data and the average of two height measurements captured at each of the 104 sample sites.

The final site capacity groupings reflect the results of the site index remeasurement effort. This data also guided the development of the final model strata.

2.2 Model Base Assumptions and Preliminary Harvest Plan

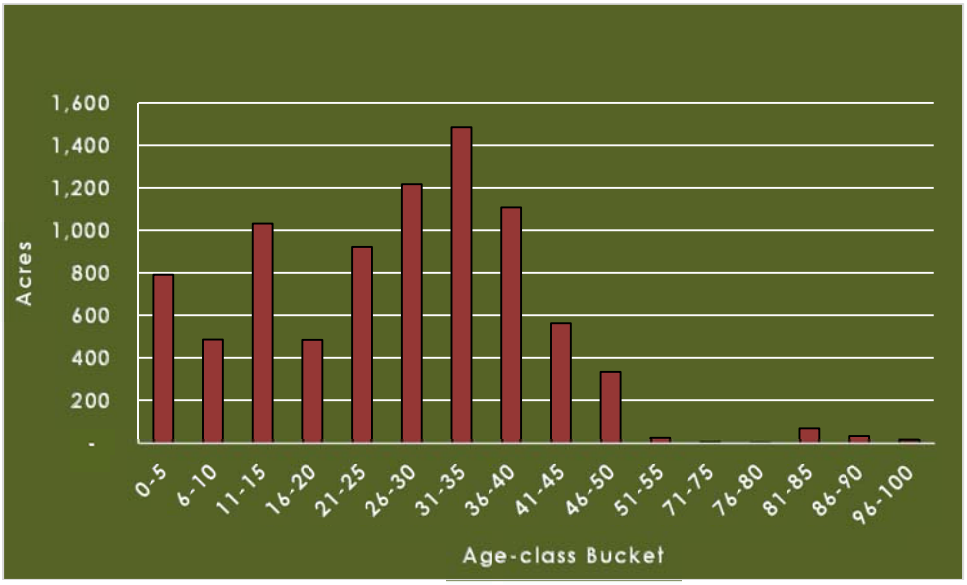
The modeling process used a two-step approach in creating the final stand dates. The first step evaluated the harvest schedule assuming the "base case" of a continued 50-year rotation plan. The base case suggests two main age class groups would occur from 2028 through 2044 and from 2052 to 2067, in the absence of plan adjustments. Refer to Figure 1 below for the base case distribution.

Figure 1 – Base Case Age Class Distribution; 50-year Rotation Applied to Current Forest



This base case distribution is based off the current age class structure, which is displayed below (Figure 2).

Figure 2 – Current Age Class Distribution



The base case age class distribution above identifies opportunities for improving age classes across the forest, suggesting that the analysis would focus on moving harvests outside of the 26- to 40-year range. This understanding was established early on, allowing site classifications and stand characteristics to guide the preliminary model assumptions.

Additionally, revised site index figures were applied to an optimal financial rotation age analysis. This analysis was performed for the site capacity groups, testing site index and stumpage price variables. These tests suggest that growth rate is the primary driver to optimizing financial rotation and long-term income generation. This is especially true for aspen stands ranging from site index 70 to 80 (base age 50), as exists on this property. Even when the stumpage rate was changed by more than 50 percent, the resulting rotation ages changed by only 5 percent. Using inputs that reflect the site capability of the forest and supply chain rates, a financially-optimized rotation age was determined to range from about 33 to 38 years. Considering the fact that the county is currently implementing a 50-year rotation, the analysis parameters were adjusted to accept the varied objectives of the forest. Exhibit 1 displays examples of the financial analysis, using site index settings of 70 and 80 (base age 50). As a result, the preliminary harvest plan considered both site index and the site capacity of each individual stand.

2.3 Spatial Analysis – Final Harvest Date

Following the establishment of the preliminary harvest plan structure, the results of the individual stand dates were tested. Since spatial adjacency and age class diversity needed to be considered at both the property and aspen management unit levels, the harvest dates set via the preliminary model structure were tested within the GIS environment. The preliminary harvest plan structure created adequate age-class diversity in many cases; yet, a property-wide analysis was required to test all locations. The GIS analysis utilized the following set of rules to ensure age-class diversity.

- A minimum three year difference between adjacent, contiguous stands
- Develop five distinct age classes (five-year buckets) per aspen management unit (this was not possible in some of the smaller units)

- Adjust harvest dates outside of the preliminary harvest rules when significant harvest "pulses" resulted in poor spatial age class diversity (see section 3.2 for details)

The primary objective of the spatial analysis was to improve adjacency across the property, while maintaining the age class diversity improvements established during the preliminary harvest plan analysis. The balance of these model constraints resulted in the final harvest date and five-year bucket period for each stand.

3. Results

3.1 Remeasurement and Site Index Analysis

The site index resample effort resulted in considerably higher figures for the majority of the forest. Our sample of 104 sites across the forest found the Chippewa County average site index (weighted average, acres) to be 25 percent below the figures derived from our analysis. The most common soil types on the aspen forest have a calculated site index of 85, compared to the county's historic average of 68. These results triggered an adjustment to the site capacity ratings, requiring a change from four to two classes. Site classes 1 and 2, along with the AIF soil class, were grouped into the upper (or better) class, while site classes 3 and 4 (excluding the AIF soils from class 3) were considered the lower class. For the purpose of this analysis, site class 1 is considered the better class exhibiting a higher site index, while site class 2 is the lower quality grouping.

Since not all stands were sampled during this effort, we used the results of the site index resample study to adjust the current stand level figures. The average site index in site class 1 is adjusted upward by 14 percent, while site class 2 is adjusted upward by 8 percent. This change increased the average stand to a site index of 80 for site class 1 and to about 68 for site class 2. The applied adjustment produces a similar differential to the historic data when the aspen stands are grouped into the final site classes.

This change in site index is considered significant and speaks to the quality of the Chippewa County Forest. Similar upward adjustment of site index has occurred on other public forests in Wisconsin, so these results are not surprising.

3.2 Final Strata and Preliminary Model

The preliminary harvest plan approach evaluated the current state of the forest, the base case future harvest, and the financial site capabilities discussed in the methods section. These inputs resulted in the following adjustments to the base case rotation age (50 years) for each stand (Table 1).

Table 1 – Harvest Schedule Analysis Preliminary Harvest Settings

Model Class	Description	Change from Base Case (years)
1	Site Capacity 1, SI = 81+	-8 (rotation = 42 years)
2	Site Capacity 1, SI < 81	-3 (rotation = 47 years)
3	Site Capacity 2, SI = 70+	= (rotation = 50 years)
4	Site Capacity 2, SI < 70	+4 (rotation = 54 years)

To assist with the implementation of the analysis approach, the preliminary model assumptions are applied to the aspen forest via strata groupings. The aspen forest stands are grouped into 23 strata consisting of like stand characteristics. These model strata are summarized in the following table, which is referred to as the Model Blueprint (Table 2).

Table 2 – Model Blueprint: Strata Summary

Model Blueprint										
Model Strata	Site Capacity	Acres	Age Class (years)	Primary Soil	Average Age (years)	Average Site Index	Average Basal Area (sq. ft./acre)	Average Pulpwood (cords)	Average Sawtimber (bd. ft.)	Model Class
101	1	666	0-5	AID	3	75	17	3	0	2
102	1	263	6-10	AID	8	75	9	1	84	2
103	1	244	11-15	AID	14	78	6	0	0	2
104	1	246	16-20	AID	17	74	20	2	0	2
105	1	617	21-25	AID	23	82	26	4	78	1
106	1	625	26-30	AID	28	82	25	3	154	1
107	1	1,270	31-35	AID	33	83	55	9	90	1
108	1	876	36-40	AID	38	82	58	12	44	1
109	1	450	41-45	AID	43	80	83	18	172	2
110	1	320	46-50	AID	47	81	113	22	812	2
111	1	23	51-55	AID	52	77	99	15	240	2
112	1	115	71-100	AID	84	79	122	26	1330	2
201	2	125	0-5	Cb	3	67	28	7	34	4
202	2	223	6-10	MbB	8	63	11	3	8	4
203	2	788	11-15	MbB	13	62	5	1	59	4
204	2	238	16-20	MbB	17	70	10	0	0	4
205	2	306	21-25	MbB	23	65	9	1	0	4
206	2	592	26-30	MbB	28	74	42	7	0	3
207	2	216	31-35	MbB	32	72	56	8	0	3
208	2	232	36-40	MbB	38	71	112	25	24	3
209	2	112	41-45	Srb	43	71	62	15	0	3
210	2	14	46-50	MdC	47	89	127	34	800	3
211	2	7	86-90	OsC2	86	81	109	28	500	3

The preliminary model rotation age, based on the model class assumptions (refer to Tables 1 and 2), is displayed below in a side by side comparison with the base case (50-year rotation). Figure 3 displays the base case rotation structure, while Figure 4 reports the resulting adjustment from the model class settings.

Figure 3 – Base Case Age-class Distribution by Year (50-year Rotation Example)

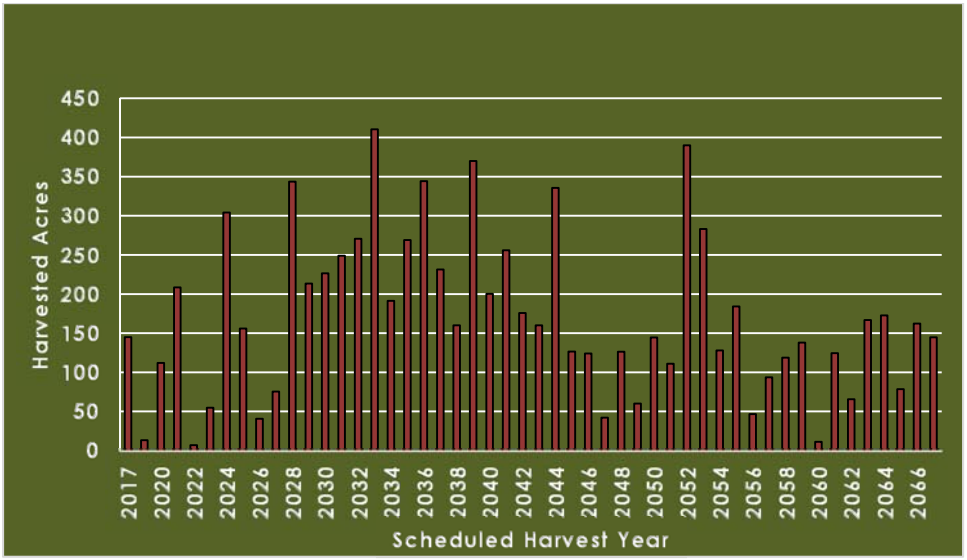
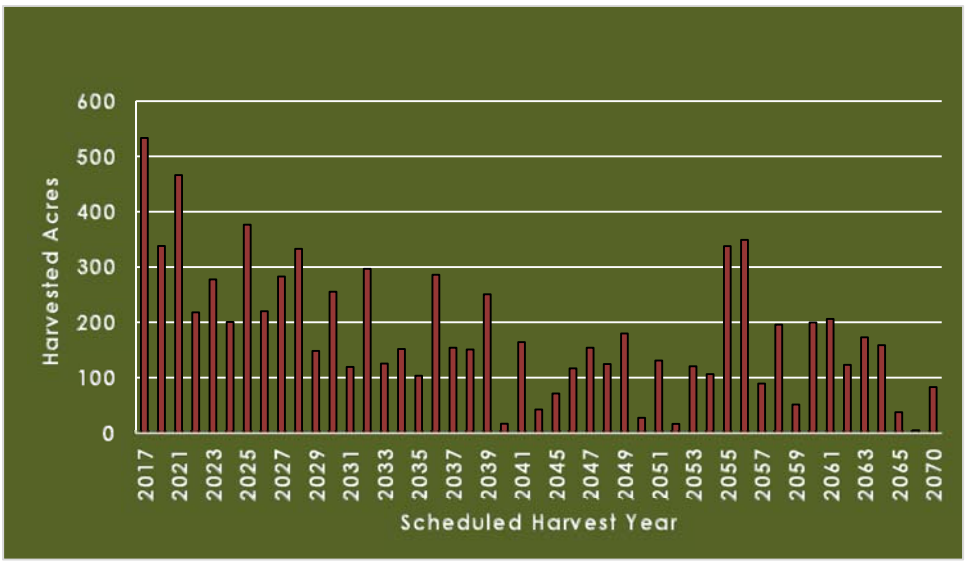


Figure 4 – Preliminary Model Rotation Results (Model Class settings)

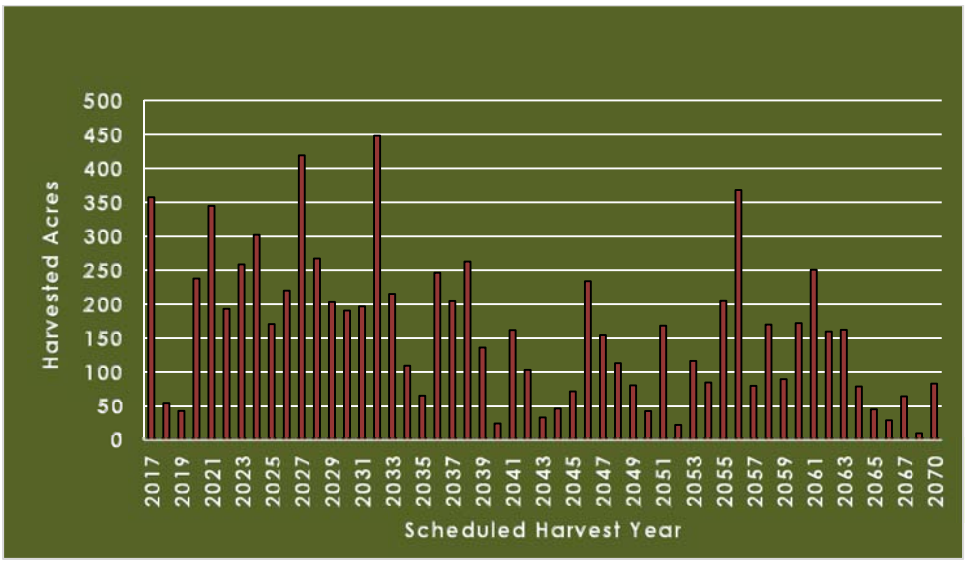


The results of the model class settings produce a much-improved age-class structure exhibiting a more flattened distribution. The largest harvest years generally occur early in the model period, during the first ten years. This is primarily due to overdue stands (about 130 acres in 2017) and the needed correction to move harvests out of the "pulse" of acres that would have occurred during 2030 to 2040, given strict adherence to the 50-year rotation rule. These results were further adjusted in the subsequent spatial analysis (Figures 3 and 4).

3.3 Spatial Model Results

The final model adjustments were made via an on-screen GIS analysis. This process developed spatial adjacency across the Chippewa County Forest, applying rotation age dates to each stand. The following figure displays the final harvest plan results (Figure 5).

Figure 5 – Final Harvest Schedule – Raw Annual Harvest



For planning purposes, the resulting harvest dates are grouped into five-year harvest buckets. Since individual harvest years are dependent upon the historic age structure of the forest and other site factors (site quality of a given area or soil type, backlogged harvests, etc.), harvest buckets can provide clarity when determining property level planning decisions. Figure 6 and Table 3 display the harvest bucket statistics.

Figure 6 – Final Harvest Schedule – Five-Year Harvest Buckets

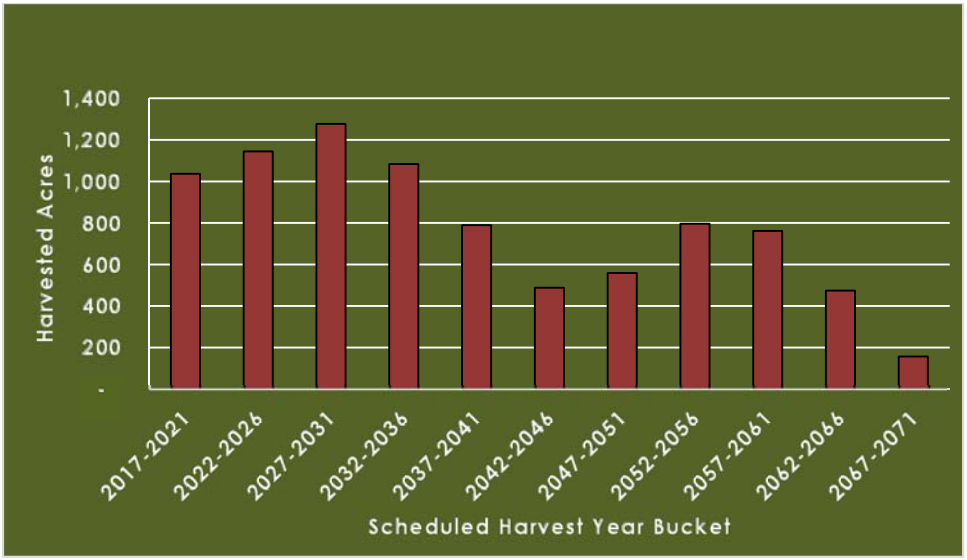


Table 3 – Final Harvest Schedule – Summary Table

Harvest Schedule Summary		
Scheduled Harvest Year Bucket	Total Acres	Average Annual Harvest
2017-2021	1,037	207
2022-2026	1,144	229
2027-2031	1,277	255
2032-2036	1,084	217
2037-2041	790	158
2042-2046	488	98
2047-2051	559	112
2052-2056	796	159
2057-2061	762	152
2062-2066	475	95
2067-2071	156	31

The above table outlines the total harvest acres by harvest year bucket and the average annual recommended harvest within a given period. The annual harvest levels range from 255 (2027 to 2031) to about 31acres per year later in the analysis (2067 to 2071). Harvest levels set for later in the analysis are likely to change as adjustments made during the early years will result in needed amendments over time. Harvest levels during the first four periods average about 227 acres per year, which is only slightly higher than the calculated even flow rate of 175 acres per year. The annual average harvest levels during the early model periods are reasonable and should be supported by regional stumpage market constraints.

4. Summary

This project evaluated the planning goals and objectives of the Chippewa County Forest, studied the site quality of the forest, and developed a harvest schedule for the aspen forest acres. An investigation and resample of site index resulted in an adjustment of stand-level data for all aspen stands. The site index resample produced an average site index (weighted by acres) of ±76 across the aspen forest.

The harvest schedule analysis identified the need to move harvests forward (earlier than 50 years) to achieve the desired goal. A financial analysis clearly supports harvesting earlier than 50 years, due to a better understanding of the forests' growth rates. Balancing the objectives of the forest, historic rotation age settings, and the need to develop age class diversity and considerations for spatial adjacency, the final stand harvest dates and buckets reflect a scheme that moves the forest closer to the objectives of the property.

The harvest plan dates resulted in an average rotation age (weighted by acres) of 48 years, which is only a two year decrease from the existing 50-year rotation. This minimal change suggests that stands can be successfully scheduled earlier or later than the historic rotation when stands are prioritized by growth characteristics across the forest.

Submitted by:

STEIGERWALDT LAND SERVICES, INC.

Forrest M. Gibeault

Forrest M. Gibeault, ACF
Analysis and Investment Operations Director

5. Certification

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

1. The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, unbiased professional analyses, opinions, and conclusions.

2. I have no present or prospective interest in the property that is the subject of this report, and I have no personal interest or bias with respect to the parties involved.

3. My compensation is not contingent on an action or event resulting from the analyses, opinions, or conclusions in, or the use of, this report.

4. Forrest M. Gibeault prepared this report. Steigerwaldt staff provided GIS and data analyses.

5. The analysis is intended for information purposes only. Any opinion contained in this analysis is only a statement of Steigerwaldt's views and is based on information Steigerwaldt believes to be reliable. No guarantee is presented or implied as to the accuracy of specific forecasts, projections, or predictive statements contained herein. While Steigerwaldt has taken care in the preparation of this analysis, neither Steigerwaldt, nor any of its subsidiary companies, accept any liability for any loss that might arise from reliance on any of this information.

STEIGERWALDT LAND SERVICES, INC.

Forrest M. Gibeault, ACF
Analysis and Investment Operations Director

Exhibit 1

Financial Rotation Analysis

Site Index 70 Example

Inputs

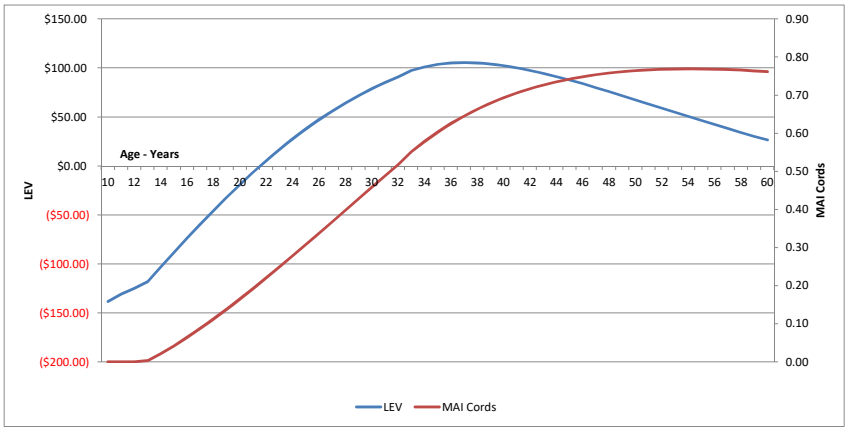
Establishment costs	0	$ per acre
Annual net management cost	3.73	$ per acre
Stumpage price cord	40	$ per cord
Conversion	79	cu ft per cord
Stumpage price cu ft	0.5063291	$ per cu ft
Harvest cost	40.00	$ per acre
Site Index	70	Feet at age 50
Real discount rate	5.0%	Percent

Site Class 2
Rotation Age for Stands

Calculation

One Rotation

Age	Yield cu cft	Yield Cords	MAI cds	PV costs	PV rev	PV	FV	LEV
10	0.0	0.0	0.00	($53.36)	$0.00	($53.36)	($86.92)	($138.20)
11	0.0	0.0	0.00	($54.37)	$0.00	($54.37)	($92.99)	($130.91)
12	0.0	0.0	0.00	($55.33)	$0.00	($55.33)	($99.37)	($124.86)
13	3.1	0.0	0.00	($56.25)	$0.83	($55.42)	($104.50)	($118.00)
14	24.0	0.3	0.02	($57.12)	$6.13	($50.99)	($100.96)	($103.03)
15	50.0	0.6	0.04	($57.96)	$12.17	($45.79)	($95.18)	($88.22)
16	81.2	1.0	0.06	($58.75)	$18.84	($39.91)	($87.12)	($73.65)
17	117.8	1.5	0.09	($59.50)	$26.03	($33.47)	($76.71)	($59.38)
18	159.9	2.0	0.11	($60.22)	$33.65	($26.57)	($63.95)	($45.46)
19	207.6	2.6	0.14	($60.91)	$41.59	($19.32)	($48.82)	($31.97)
20	260.7	3.3	0.17	($61.56)	$49.75	($11.81)	($31.33)	($18.95)
21	319.4	4.0	0.19	($62.18)	$58.05	($4.14)	($11.52)	($6.45)
22	383.6	4.9	0.22	($62.77)	$66.39	$3.62	$10.58	$5.50
23	453.2	5.7	0.25	($63.34)	$74.71	$11.37	$34.93	$16.86
24	528.2	6.7	0.28	($63.87)	$82.93	$19.06	$61.45	$27.62
25	608.5	7.7	0.31	($64.38)	$90.99	$26.60	$90.09	$37.75
26	694.0	8.8	0.34	($64.87)	$98.83	$33.96	$120.75	$47.25
27	784.6	9.9	0.37	($65.33)	$106.41	$41.08	$153.36	$56.11
28	880.2	11.1	0.40	($65.77)	$113.69	$47.91	$187.82	$64.32
29	980.6	12.4	0.43	($66.19)	$120.62	$54.43	$224.04	$71.90
30	1085.7	13.7	0.46	($66.59)	$127.19	$60.60	$261.90	$78.84
31	1195.3	15.1	0.49	($66.98)	$133.37	$66.39	$301.30	$85.16
32	1309.4	16.6	0.52	($67.34)	$139.14	$71.80	$342.12	$90.87
33	1439.4	18.2	0.55	($67.68)	$145.67	$77.99	$390.19	$97.47
34	1555.3	19.7	0.58	($68.01)	$149.90	$81.89	$430.17	$101.14
35	1668.4	21.1	0.60	($68.33)	$153.15	$84.82	$467.87	$103.60
36	1778.8	22.5	0.63	($68.63)	$155.50	$86.88	$503.17	$105.01
37	1886.2	23.9	0.65	($68.91)	$157.04	$88.13	$535.98	$105.48
38	1990.7	25.2	0.66	($69.18)	$157.85	$88.67	$566.21	$105.14
39	2092.3	26.5	0.68	($69.44)	$158.00	$88.56	$593.80	$104.09
40	2190.8	27.7	0.69	($69.69)	$157.57	$87.88	$618.69	$102.43
41	2286.4	28.9	0.71	($69.92)	$156.61	$86.69	$640.81	$100.25
42	2379.0	30.1	0.72	($70.14)	$155.19	$85.05	$660.13	$97.63
43	2468.7	31.2	0.73	($70.35)	$153.37	$83.02	$676.59	$94.63
44	2555.5	32.3	0.74	($70.56)	$151.21	$80.65	$690.15	$91.32
45	2639.5	33.4	0.74	($70.75)	$148.74	$77.99	$700.76	$87.76
46	2720.7	34.4	0.75	($70.93)	$146.02	$75.09	$708.39	$83.99
47	2799.3	35.4	0.75	($71.11)	$143.08	$71.98	$712.98	$80.06
48	2875.3	36.4	0.76	($71.27)	$139.97	$68.69	$714.50	$76.00
49	2948.7	37.3	0.76	($71.43)	$136.71	$65.27	$712.88	$71.85
50	3019.7	38.2	0.76	($71.58)	$133.33	$61.75	$708.08	$67.65
51	3088.3	39.1	0.77	($71.73)	$129.86	$58.14	$700.03	$63.40
52	3154.5	39.9	0.77	($71.86)	$126.34	$54.47	$688.68	$59.15
53	3218.6	40.7	0.77	($71.99)	$122.76	$50.77	$673.95	$54.90
54	3280.5	41.5	0.77	($72.12)	$119.16	$47.05	$655.77	$50.68
55	3340.270635	42.3	0.77	($72.24)	$115.56	$43.32	$634.06	$46.50
56	3398.056117	43.0	0.77	($72.35)	$111.96	$39.61	$608.73	$42.37
57	3453.895168	43.7	0.77	($72.46)	$108.38	$35.93	$579.68	$38.30
58	3507.854809	44.4	0.77	($72.56)	$104.83	$32.27	$546.81	$34.30
59	3559.999947	45.1	0.76	($72.66)	$101.32	$28.67	$510.02	$30.38
60	3610.393308	45.7	0.76	($72.75)	$97.87	$25.12	$469.18	$26.54
							MaxLEV	$105.48



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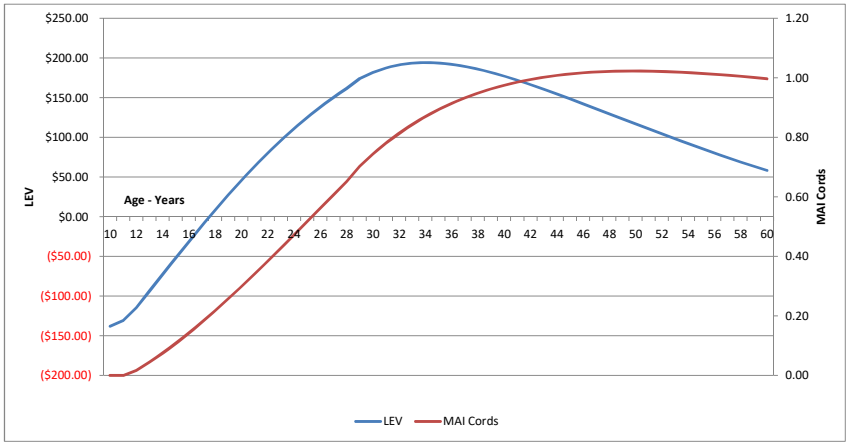
Inputs

Establishment costs	0	$ per acre
Annual net management cost	3.73	$ per acre
Stumpage price cord	40	$ per cord
Conversion	79	cu ft per cord
Stumpage price cu ft	0.506329	$ per cu ft
Harvest cost	40.00	$ per acre
Site Index	80	Feet at age 50
Real discount rate	5.0%	Percent

Site Class 1
Rotation Age for Stands

Calculation

Age	Yield cu cft	Yield Cords	MAI cds	PV costs	One Rotation PV rev	PV	FV	LEV
10	0.0	0.0	0.00	($53.36)	$0.00	($53.36)	($86.92)	($138.20)
11	0.0	0.0	0.00	($54.37)	$0.00	($54.37)	($92.99)	($130.91)
12	16.3	0.2	0.02	($55.33)	$4.58	($50.75)	($91.14)	($114.52)
13	46.0	0.6	0.04	($56.25)	$12.36	($43.89)	($82.76)	($93.44)
14	83.3	1.1	0.08	($57.12)	$21.29	($35.83)	($70.95)	($72.40)
15	128.2	1.6	0.11	($57.96)	$31.21	($26.74)	($55.60)	($51.53)
16	181.0	2.3	0.14	($58.75)	$41.97	($16.78)	($36.62)	($30.96)
17	241.8	3.1	0.18	($59.50)	$53.42	($6.09)	($13.95)	($10.80)
18	310.8	3.9	0.22	($60.22)	$65.39	$5.17	$12.43	$8.84
19	388.0	4.9	0.26	($60.91)	$77.74	$16.83	$42.54	$27.86
20	473.4	6.0	0.30	($61.56)	$90.33	$28.77	$76.35	$46.18
21	566.9	7.2	0.34	($62.18)	$103.04	$40.86	$113.82	$63.73
22	668.6	8.5	0.38	($62.77)	$115.73	$52.96	$154.91	$80.46
23	778.3	9.9	0.43	($63.34)	$128.30	$64.96	$199.54	$96.32
24	895.9	11.3	0.47	($63.87)	$140.65	$76.78	$247.62	$111.28
25	1021.2	12.9	0.52	($64.38)	$152.70	$88.31	$299.06	$125.32
26	1154.2	14.6	0.56	($64.87)	$164.36	$99.49	$353.76	$138.42
27	1294.6	16.4	0.61	($65.33)	$175.57	$110.24	$411.58	$150.57
28	1442.3	18.3	0.65	($65.77)	$186.28	$120.51	$472.42	$161.78
29	1610.3	20.4	0.70	($66.19)	$198.08	$131.89	$542.88	$174.22
30	1763.1	22.3	0.74	($66.59)	$206.55	$139.96	$604.88	$182.09
31	1912.5	24.2	0.78	($66.98)	$213.38	$146.41	$664.41	$187.79
32	2058.3	26.1	0.81	($67.34)	$218.72	$151.38	$721.31	$191.59
33	2200.3	27.9	0.84	($67.68)	$222.68	$154.99	$775.45	$193.71
34	2338.5	29.6	0.87	($68.01)	$225.39	$157.37	$826.73	$194.37
35	2472.6	31.3	0.89	($68.33)	$226.97	$158.64	$875.06	$193.77
36	2602.8	32.9	0.92	($68.63)	$227.54	$158.91	$920.40	$192.08
37	2729.0	34.5	0.93	($68.91)	$227.21	$158.30	$962.68	$189.45
38	2851.2	36.1	0.95	($69.18)	$226.08	$156.90	$1,001.89	$186.04
39	2969.5	37.6	0.96	($69.44)	$224.25	$154.81	$1,037.98	$181.95
40	3084.0	39.0	0.98	($69.69)	$221.81	$152.12	$1,070.95	$177.31
41	3194.8	40.4	0.99	($69.92)	$218.83	$148.91	$1,100.77	$172.21
42	3301.9	41.8	1.00	($70.14)	$215.40	$145.26	$1,127.44	$166.74
43	3405.5	43.1	1.00	($70.35)	$211.58	$141.22	$1,150.93	$160.98
44	3505.6	44.4	1.01	($70.56)	$207.43	$136.87	$1,171.23	$154.98
45	3602.4	45.6	1.01	($70.75)	$203.01	$132.26	$1,188.33	$148.82
46	3696.0	46.8	1.02	($70.93)	$198.36	$127.43	$1,202.20	$142.54
47	3786.5	47.9	1.02	($71.11)	$193.54	$122.43	$1,212.82	$136.18
48	3874.0	49.0	1.02	($71.27)	$188.58	$117.31	$1,220.17	$129.79
49	3958.6	50.1	1.02	($71.43)	$183.52	$112.09	$1,224.20	$123.39
50	4040.4	51.1	1.02	($71.58)	$178.40	$106.81	$1,224.88	$117.02
51	4119.5	52.1	1.02	($71.73)	$173.23	$101.50	$1,222.16	$110.70
52	4196.0	53.1	1.02	($71.86)	$168.04	$96.18	$1,216.00	$104.44
53	4270.0	54.1	1.02	($71.99)	$162.87	$90.87	$1,206.32	$98.27
54	4341.6	55.0	1.02	($72.12)	$157.71	$85.59	$1,193.07	$92.21
55	4410.93604	55.8	1.02	($72.24)	$152.60	$80.36	$1,176.17	$86.26
56	4478.005382	56.7	1.01	($72.35)	$147.54	$75.19	$1,155.54	$80.43
57	4542.91969	57.5	1.01	($72.46)	$142.55	$70.10	$1,131.08	$74.73
58	4605.754928	58.3	1.01	($72.56)	$137.64	$65.09	$1,102.71	$69.17
59	4666.583583	59.1	1.00	($72.66)	$132.82	$60.16	$1,070.32	$63.75
60	4725.474794	59.8	1.00	($72.75)	$128.09	$55.34	$1,033.78	$58.47
							MaxLEV	$194.37



STEIGERWALDT
Your confidence lands here.

Exhibit 2

Qualifications

STEIGERWALDT
FORESTLAND MANAGEMENT PROJECTS

The Conservation Fund (TCF) – 2014 to present – Services include forest management planning on approximately 14,000 acres of timberland in Iron County, Wisconsin, including supervision of road maintenance, assisting with the addition of a conservation easement, preparing a Managed Forest Law management commitment, and general administration.

Price Family – 2013 to present – Services have included forest inventory and stewardship plan development. Current work includes the implementation of forest management practices and stewardship plan objectives.

Timber Investment Resources (TIR) – 2013 to present – Responsibilities include oversight of all forest management activities on ±4,900 acres of oak sawtimber dominated timberland in Sawyer County, Wisconsin. In June 2014**,** an additional 49,000 acres of timberland were acquired, and another ±13,000 acres were acquired in February 2016. Forest management on these properties are primarily in red pine, aspen, and northern hardwood forest types. Property acquisition assistance, and brokerage services are also provided.

3M – 2012 to present – Services include preparation of a forest management plan on approximately 1,200 acres, implementing the plan and administering timber sales and tree planting contracts.

The Lyme Timber Company – **2012 to present** – Responsible for all facets of managing approximately 73,000 acres of timberland located in northwest Wisconsin, including direct marketing and cut-and-haul logging operations, inventory, and extensive pine reforestation activities.

MWP Preservation, LLC – 2011 to present – Efforts include inventory and MFL plan development for ±3,200 acres in Oneida County, Wisconsin. Ongoing work includes consulting and oversight of forest management activities.

Tahltan Forest Lands - 2010 to present – Work on this family estate includes the completion of management level inventory on approximately 4,600 acres in Vilas County, Wisconsin. Services also include the development of a detailed forest management plan, GIS mapping, and harvest planning applications.

Wisconsin Managed Forest Law Applications and Plans – 2006 to present – Since the inception of the Certified Plan Writer program for MFL plans, Steigerwaldt plan writers have written approximately 250 plans covering more than 30,000 acres in Adams, Lincoln, Oneida, Rusk, Sawyer, Taylor, Marathon, Oconto, Price, Vilas, Langlade, Marinette, Forest, and Iron Counties.

Coleman Lake Club – 2009 to present – After enrolling approximately 8,000 acres into the Managed Forest Law, work presently includes timber sale setup, administration, and oversight of all forest related management activities on this multi-use property in Marinette County.

Cedar Island Conservancy, Ltd. – 2009 to present – Forest management services including timber sale setup, contracting, administration, and tree planting on this ±3,600-acre family estate. After completing a 748-acre salvage timber harvest, Steigerwaldt is currently working on a long range forest management plan incorporating estate values. GIS mapping applications include TNC easement boundaries along the Bois Brule Riverway, recreation trails and roads, and post harvest forest cover typing.

Upper Peninsula Power Company – 2009 to 2012 – Work includeed timber management and all aspects of timber harvest administration on lands located in Ontonagon, Alger, and Marquette Counties, in Michigan's Upper Peninsula.

FORESTLAND MANAGEMENT PROJECTS (CONTINUED)

Hanson – 2006 to present – Enrolled over 3,800 acres of forestland in Lincoln County into the MFL program. Responsible for all forest management activities, which includes the sale of timber on approximately 750 acres. Work also includes the management of timberland in St. Croix County.

Tyler – 2005 to present – Forest management includes timber harvest setup, administration, and related activities, including MFL plans for this multiple-parcel ownership of approximately 3,000 acres in north central Wisconsin.

Xcel Energy (Northern States Power) – 2005 to 2010 – Management work focused on locating, mapping, and resolving unauthorized land use and encroachments on Federal Energy Regulatory Commission–licensed lands around the Holcombe Flowage in Chippewa and Rusk Counties.

Wisconsin River Power Company – 2002 to 2012 – Services have included forest inventory and mapping on approximately 18,500 acres in Juneau and Adams Counties, Wisconsin, along with developing forest management plans in compliance with FERC license requirements and WDNR forest tax laws. All aspects of forest management activities including timber sale setup, contracting, and administration were completed. Efforts included an extensive stand level re-inventory on about 10,200 acres of forestland and an inventory and management plan for about 35 miles of shoreline special use areas.

BTG Pactual (formerly Regions Timberland Group) – 1999 to present – All forest management services on approximately 179,000 acres. Duties include timber sale setup and administration, permitting for timber sales and road use, timber inventories, working with snowmobile and ski clubs in maintaining trail use agreements, and assisting with land sale administration.

Berg – 1998 to present – All forest management services on approximately 9,000 acres. Duties include timber sale setup and administration and obtaining road use permits from USFS for access to parcels within the National Forest.

Dairyland Power Cooperative – 1996 to present – Management work includes developing management plans and entering portions of this Rusk County property into the Managed Forest Law Program. Steigerwaldt continues to follow through with setting up and administering the scheduled timber sale harvests and related plan activities.

We Energies – 1990 to 2013 – Responsible for all aspects of forest management including long-range planning, timber sale layout and administration, tree planting and plantation maintenance, and forest inventory updates on this 26,000-acre ownership in northeast Wisconsin and Michigan's Upper Peninsula.

Woodland Security, Inc. – 2005 to 2007 – Working for this firm, which specializes in forestland and timber harvest surveillance and timber industry security, Steigerwaldt is responsible for placing video cameras, collecting video tapes, and documenting activities on active harvest sites and landings. Similar services have also been provided directly to Steigerwaldt clients.

STEIGERWALDT
GIS PROJECTS

We Energies, Eau Claire and Jackson County Forests – 2014 – Completed mapping to determine the forest area impacted by transmission line easements, and to implement fixed area forest inventory sample plots. Work also included the development of ROW centerline shape files, all of which facilitated the calculation of timber volumes and present net value of timber resources.

The Lyme Timber Company – 2012 to present – Development and ongoing maintenance of a comprehensive GIS database to facilitate forest and land records management on ±73,000 acres of timberland in northwest Wisconsin. Work includes utilizing GIS for a variety of applications including conservation easement needs.

LandVest – 2007 to present – Steigerwaldt, in formal partnership with LandVest, has provided extensive GIS resource analysis and mapping products to facilitate land brokerage services on over 150,000 acres of timberland in Wisconsin and Michigan.

American Transmission Company (ATC) – 2006 to present – Developed a Microsoft Access and GIS application to assist right-of-way staff and agents in ROW acquisition projects. The GIS application is used daily to track and display parcel and project status and ROW geographic features.

BTG Pactual (formerly Regions Timberland Group) – 1999 to present – Completed a GIS for ongoing forestland management purposes on ±35,000 acres of former PCA lands in Oneida and Lincoln Counties, Wisconsin. Partial data obtained from previous owners was utilized and formatted to fit the client's GIS system in place on other lands nationwide. In years 2008 through 2010, RMK added ±185,000 acres of ownership in northern Wisconsin and has retained Steigerwaldt to provide GIS and forest management services.

Minnesota Power – 2013 – Extensive GIS ownership and land cover mapping completed to facilitate timber inventory and land analysis work.

City of Spooner Wisconsin – 2013 – Contracted to upgrade the existing GIS infrastructure and develop a new GIS network of the sanitary and stormwater discharge system. Stage one entailed upgrading existing GIS and CAD data from different departments and combining, converting, and repackaging the data into an ArcGIS geodatabase. ArcGIS projects were then created for the various departments to use for ongoing GIS work. Stage two involved field data capture, using GPS, to identify the city's entire sanitary and storm sewer manhole system, and creating a sub-foot accurate representation of the system.

Florence County Forest and Wisconsin DNR – 2011 – Contracted to produce an Emergency Services Atlas for emergency responders. Work included extensive GIS layer development, edits of existing data, and cartographic layout for an 11- by 17-inch spiral bound final product.

Xcel Energy – 2010 to 2011 – Work includes ownership research and GIS mapping for lands located around the Gile Flowage in Iron County, Wisconsin.

We Energies (Wisconsin Electric Power Company) – 1992 to 2013 – A GIS was designed and implemented in the early 1990s and is used on almost a daily basis for routine management activities on ±27,000 acres of hydroelectric project lands in Michigan and Wisconsin. GIS applications include forest management, mapping endangered and threatened species and archaeological sites, components of an archaeological predictive model, recreational uses, FERC and inundation EAP mapping issues, and real estate needs.

GIS PROJECTS (CONTINUED)

Wisconsin River Power Company – 2002 to 2013 – Projects included converting to GIS format forest cover map and stand data originally compiled by Consolidated Papers for this 18,500-acre ownership in Juneau and Adams Counties, Wisconsin. In 2008, a new comprehensive remapping of the property took place to align property features more closely with high-resolution orthophotography and to match new parcel mapping efforts. New forest cover and Shoreline Commons Area information was also compiled in the GIS. The GIS is used in everyday forest management by Steigerwaldt foresters.

Minnesota Energy Resources and Michigan Gas Utilities – 2006 to 2010 – GIS work includes ownership parcel mapping and locating and mapping encumbrances and leases on lands owned by these Wisconsin Public Service Corporation subsidiaries.

Wisconsin DNR State Properties – 2008 – Completed forest reconnaissance, GIS mapping, and WISFIRS data entry for ±500 acres in Florence County.

Wisconsin DNR State Properties – 2007 – Completed the GIS conversion and master table updates for the Menard Island Resource Area, the Ackley, Peters Marsh, and Bill Cross Wildlife Areas, the Pine-Popple Wild Rivers Property, and the Spread Eagle Barrens Natural Resource Area. These properties, totaling approximately 23,000 acres, are located in Lincoln, Langlade, and Florence Counties. Work included entering data into the new WISFIRS program.

Nicolet Hardwoods Corporation – 2007 – Work included developing "wall-sized" forestland ownership maps for company lands located in northeastern Wisconsin and Michigan's Upper Peninsula. Maps included versions utilizing USGS, GIS, and orthophoto backdrops. In 2008, GIS forest cover mapping was completed to enhance property and real estate management efforts.

We Energies – 2006 to 2007 – Services provided included extensive mapping efforts to facilitate the client's sale of approximately 7,400 acres of forestland in northeastern Wisconsin and Michigan's Upper Peninsula. Products included legal document exhibits.

Wisconsin DNR – 2007 – Completed structure mapping and map development for a 144-page Emergency Response book for Oconto County, Wisconsin.

Langlade County Forestry Department – 2007 – Work included updating the county forest's GIS layer of woods roads and trails using recent orthophotography. Several sets of E-size, township and range, orthophoto maps were printed on glossy photo paper for the county forest, surveyor's, and sheriff's offices.

Huber Engineered Woods, LLC – 2006 – GIS played an integral role in a resource study completed in the northeast United States. Forest cover information, mill locations, and related features were analyzed to assess forest resources and availability.

Wisconsin Public Service – 1993 to 2010 – Several GIS projects have been completed on WPS and affiliated lands in Wisconsin and Michigan's Upper Peninsula. These include GIS applications for FERC forest management plans, endangered resources inventories, forest management activities, FERC licensing issues, real estate valuations and transactions, and ownership parcel mapping.

STEIGERWALDT
RESOURCE ANALYSIS PROJECTS
Client Names Are Kept Confidential for Resource Analysis Projects

2016 – Lake States Wood Fiber Analysis – This full market evaluation investigated wood fiber availability and future demand, as well as supply chain constraints. Forestland ownership and mill demand trends helped to refine estimations and gave insight into future raw material potential.

2016 – Update to Fiber Resource Analysis – This effort expanded upon a previous effort investigating the availability of a specific fiber species and product. The analysis studied a new project area extent, providing new growing stock and removal figures, relying on U.S. Forest Service Forest Inventory and Analysis (FIA) and Timber Products Output (TPO) data sources.

2015 – Timber Market Analysis – Study focused on implications of changing market fiber dynamics, including supply and demand, for a particular component of the fiber supply chain. Efforts included reviewing historic markets to assess how past similar events may have influenced market dynamics.

2015 – Wood Fiber Economic Analysis – Efforts included analyzing and developing correlated relationships between regional stumpage and micro- and macro-economic indices and events. Statistical tests were used to evaluate the validity of the outcomes.

2015 – Fiber Resource Analysis – This study focused on determining the availability of a specific fiber species and product. The study area included a multi-state area, refined for a specific facility location, considering growing stock and removal volumes from the U.S. Forest Service Forest Inventory and Analysis (FIA) and Timber Products Output (TPO) programs and data specific to certain landowners. Availability was further refined considering forest silviculture and policy, market characteristics, harvesting and transportation, mill competition, and seasonality issues. The study also included a regional stumpage price analysis.

2015 – Growth and Yield Modeling – Modeling of forest inventory data from the Ozark Plateau region, focusing on pine and hardwood management scenarios for property evaluation. Analysis performed using Forest Vegetation Simulator (FVS) modeling software.

2014 to present – Wisconsin Forest Practice Studies Topic #2 – A look at the economic and ecological consequences of certain forest policy, regulations, and guidelines including an analysis of two particular forest management practices: single tree selection order-of-removal procedures in northern hardwood forests and rotation lengths in red pine plantations and aspen forests. The project evaluated the potential economic and ecological effects through the supply chain of following commonly used harvest guidelines on private lands enrolled in Wisconsin's forest tax law programs and on certain public state and county forestlands. Case study northern hardwood harvest sites were selected for pre-harvest field inventory and analysis to include evaluations of marked cut and leave trees and forest stand characteristics. Future stand modeling based on the residual forest resulting from the case study samples, as well as alternative marking scenarios, were completed. The study also researched the potential effects of the Wisconsin forest tax law silvicultural guidelines relating to rotation age recommendations for even-aged management of aspen and red pine forest types. The analysis included several simulations modeling varied rotation lengths. Implications of these current forest management harvest guidelines and modeled scenarios were examined as they relate to wood supply, financial implications to landowners and the supply chain, timber sale viability, and ecological considerations potentially influenced by forest stand characteristics impacted by these management practices.

RESOURCE ANALYSIS PROJECTS (CONTINUED)

2014 to present – Wisconsin Forest Practice Studies Topic #3 – This specific analysis focused on documentation of the costs of each link in the wood fiber supply chain and a comparison of these costs to three other U.S. regions. Included were an assessment as to why the various component costs may differ as compared to other regions with considerations for Wisconsin's ability to compete in the U.S. timber industry relative to fiber supply costs. The analysis also included an overview of the current timber marketing system for eastern Canada for a perspective comparison to the U.S. and Wisconsin timber markets. The foundational data to support the fiber cost analysis was derived from compiled transactional delivered load cost data including cost components from the stump to the mill. The initial report was published in November 2014 and an updated report published in December 2015.

2014 – Logistical Fiber Supply Analysis – The analysis generated a list of counties for each fiber supplier that were all or partially within the calculated suppliers' procurement zone. The procurement zone, or "hauling range," was determined based on a logical analysis of the fiber and haul costs including a reasonable distance buffer and covered a five-state area. An updated report was provided in 2015.

2008 – Biomass Resource Analysis – Two biomass resource studies for the same client included analyzing available biomass from a specific tract of timberland as well as from regional areas in the northern Lake States. Issues included assessing resource ownership, production costs, demand, and other relevant issues affecting possible biomass supply.

2008 – Biomass Resource Analysis – A biomass study was completed for a client interested in analyzing the emerging forest biomass market in Wisconsin and Michigan's Upper Peninsula. This project included an FIA-based analysis of the gross and extractable logging residue volumes within this region. FIA-derived data was also used to analyze roundwood production and to identify under-utilized species. Biomass production costs and delivered prices were also presented.

2008 – Biomass Resource Analysis – This study focused on analyzing the biomass availability in northeastern Indiana. The main issues included evaluating the current logging infrastructure, as well as estimating potential woody biomass supply, consumption, and cost.

2007 – Softwood Resource Analysis – This resource study was comprised of two separate efforts, which included a broad analysis of the softwood resource across the Lake States and a later analysis that focused on two 100-mile procurement zones in Wisconsin. The studies focused on analyzing softwood timber volumes (using FIA data), resource ownership, markets, and mill competition. A growth and harvest analysis based on FIA data was also completed, which was supplemented with federal, state, and county forest historical harvest information.

2006 – Mill Resource Analysis – As part of this analysis, Steigerwaldt reviewed the recommendations of another firm regarding the expansion of a mill in northern Maine. A resource study was conducted to test the validity, methods, and conclusions of the initial study. Issues included assessing the timber volumes of certain species, mill competition, production capacity, and growth and drain for specific procurement zones.

2005 – Lake States Forest Resource and Timber Industry Analysis – Key factors assessed in this analysis included: the extent of available timber volume, stumpage, and production costs, delivered prices, mill competition, and the available logging force. These components were analyzed using FIA data and surveys of forest professionals, consulting foresters, and timber producers. The main goal of this resource analysis was to research factors that would affect the successful placement and operation of a new wood-using facility in the Lake States region.

RESOURCE ANALYSIS PROJECTS (CONTINUED)

2001 – Timber, Forest Vegetation, and Transportation Environmental Assessment – Completed portions of an environmental assessment on a Lake States National Forest including describing the existing condition and potential silvicultural opportunities for the designated forest stands including the direct, indirect, and cumulative effects of proposed and alternative management scenarios. Work also included analyzing the transportation network to determine effects of altering the system to meet the needs of the proposed management alternatives.

2000 – Watershed Forest Resource Analysis – Using GIS, remote sensing, and statewide forest inventory data, a forest resource analysis was completed on a ±450,000-acre watershed in northwest Wisconsin. Work included a detailed report on land ownership, forest inventory data, forest management, and timber markets. The initial report was followed by timber inventories, appraisals, and forest management assessments on 18 individual tracts.