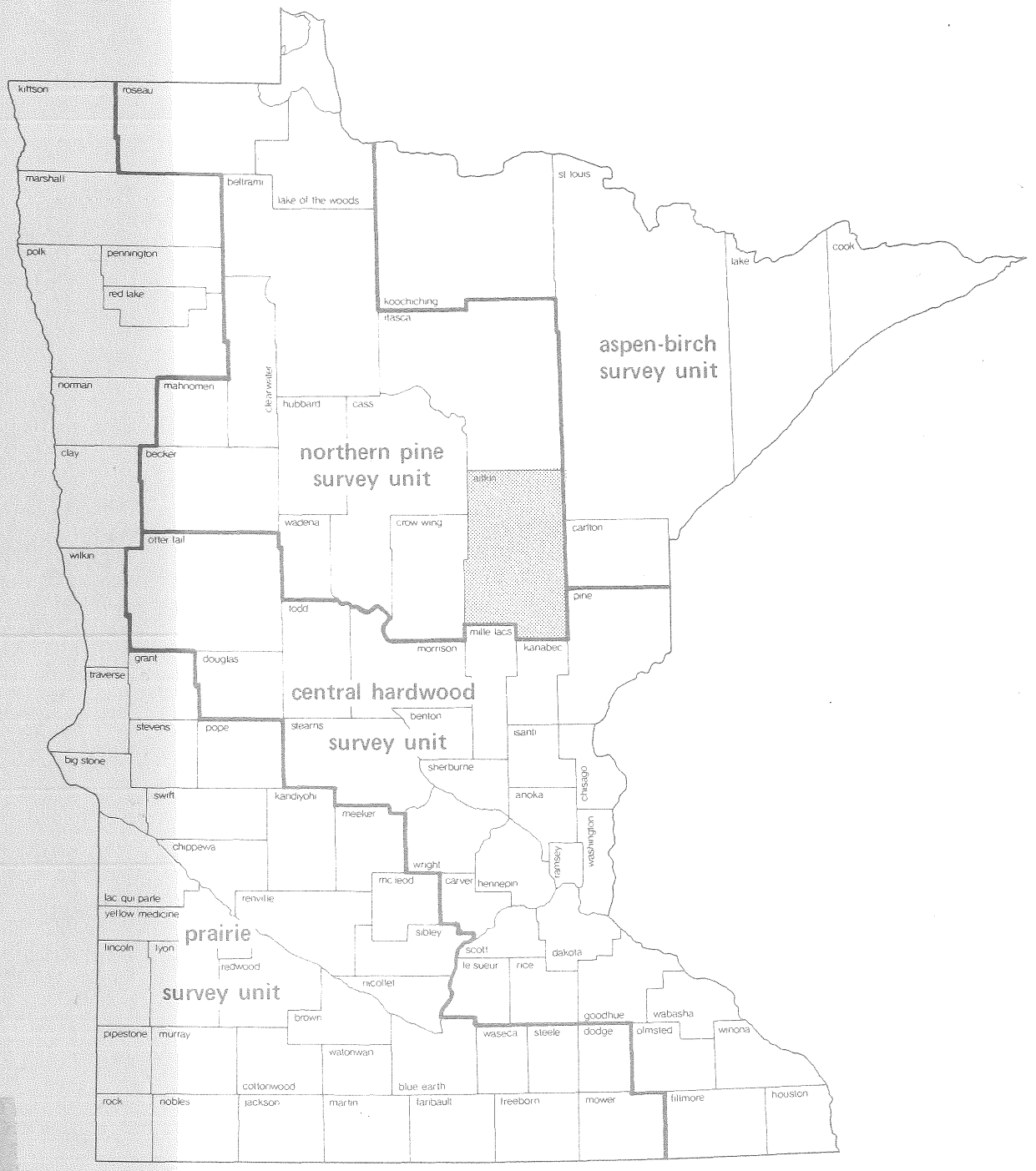
Timber Resource of Aitkin County, Minnesota — 1977



DEPARTMENT OF NATURAL RESOURCES
Division of Forestry

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FOREWORD

Resources Evaluation (formerly called Forest Survey) is a continuing endeavor as mandated by the Forest and Rangeland Renewable Resources Planning Act of 1974 which was preceded by the McSweeney-McNary Forest Research Act of 1928. Its objective is to periodically inventory the Nation's forest land to determine its extent, condition, and volume of timber, growth, and depletions. This kind of up-to-date information is essential to frame intelligent forest policies and programs.

Fieldwork for the 1977 Minnesota Forest Survey began in July, 1974 and was completed in July, 1978. Three previous surveys of Minnesota's timber resource were in 1936, 1953, and 1962.

More accurate information was obtained during the 1977 survey than in previous years because of intensified field sampling. This was made possible by funding and manpower provided the North Central Forest Experiment Station by the State Legislature through the Minnesota Department of Natural Resources. The Department also assisted in a canvass of primary wood-using plants in the state. This survey was used to estimate the quantity of timber products harvested in Minnesota.

Reports containing statistical highlights and detailed tables on the timber resource of the following counties in Minnesota are also available:

ASPEN-BIRCH SURVEY UNIT

1. Carlton
2. Cook
3. Koochiching
4. Lake
5. St. Louis

CENTRAL HARDWOOD SURVEY UNIT

1. Kanabec
2. Mille Lacs
3. Morrison
4. Otter Tail
5. Pine
6. Todd

NORTHERN PINE SURVEY UNIT

1. Aitkin
2. Becker
3. Beltrami
4. Cass
5. Clearwater
6. Crow Wing
7. Hubbard
8. Itasca
9. Lake of the Woods
10. Mahnomen
11. Roseau
12. Wadena

HIGHLIGHTS
AITKIN COUNTY, MINNESOTA, 1977

AREA

1 – The area of commercial forest land declined 2% between surveys, from 687,500 acres in 1962[1] to 672,500 acres in 1977.

2 – Public owners hold 60% of the commercial forest land. The State of Minnesota is the largest landowner with 217,400 acres.

3 – Private owners hold 40% of the commercial forest land. Farmers are the major private landowners with a total of 180,800 acres.

4 – Aspen is the dominant forest type covering 38% of the commercial forest land.

5 – Poletimber stands constitute the largest stand-size class, 49% of the commercial forest land is in this class.

6 – Unproductive sites make up 10% (75,100 acres) of the total forest land area.

VOLUME

7 – Growing-stock volume on commercial forest land totals 6,172,300 cords. Included in that total is 1,040,000,000 board feet of sawtimber.

8 – Growing-stock volume averaged 9.18 cords per acre total for all species.

9 – Hardwoods make up 84% of the total growing-stock volume and 84% of the total sawtimber volume.

10 – Net annual growth was 137,100 cords in 1976 for an annual average of .20 cord per acre total for all species.

11 – Timber removals in 1976 were estimated at 91,000 cords; 75,800 cords of hardwoods and 15,200 cords of softwoods.

12 – Aspen accounted for 59% of the timber removals in 1976.

13 – Recommended annual harvests estimate a total of 196,790 cords of removals; 35,189 cords of softwoods and 161,601 cords of hardwoods.

[1]Previously published 1962 statistics have been adjusted to be comparable with 1977 data. Adjustments were necessary because survey procedures have changed between surveys.

FOREST AREA

Forested areas make up 65% of the total land area in Aitkin County. Of the forested land, 88% is classified as commercial forest land and 12% is noncommercial. Unproductive areas, such as lowland conifer bogs, account for 83% of the noncommercial forest lands.

Land Class	Area (Acres)
Gross area	1,273,000
Census water	103,300
Total land area	1,169,700
Nonforest land	407,100
Forest land	762,600
Commercial forest land	672,500
Noncommercial forest land	90,100
Unproductive	75,100
Productive – reserved	15,000

Forest Land Ownership

Public owners hold 60% of Aitkin County's commercial forest land. The State of Minnesota is the largest owner with 217,400 acres. County and municipal governments own 180,000 acres, and miscellaneous federal owners occupy 8,300 acres.

The remaining 40% of commercial forest land is held by private owners. Farmers are the largest private owners with a total of 180,800 acres. Forest industries own 4,200 acres, miscellaneous private individuals hold 76,600 acres, and private corporations own 5,200 acres. (See Table 1.)

Forest Types

In the 1977 Forest Survey, 14 forest types were recognized. Table 2 shows the area of commercial forest land by forest type.

Softwood Forest Types – Softwood forest types cover 18% of the commercial forest land. Acreages for the softwood types are:

Forest Type	Area (Acres)
Black spruce	50,000
Tamarack	43,400
Balsam fir	15,200
Northern white-cedar	8,200
Jack pine	2,500
Red pine	1,600
White pine	1,200
White spruce	1,200
Total Softwoods	**123,300**

Hardwood Forest Types – Hardwood forest types cover 81% of the commercial forest land. Acreages for the hardwood types are:

Forest Type	Area (Acres)
Aspen	253,400
Maple-basswood	142,800
Elm-ash-cottonwood	71,200
Paper birch	40,200
Balsam poplar	23,400
Oak	15,400
Total Hardwoods	**546,400**

Age Class Distributions of Forest Types

Age class distributions reveal the relative acreages within the various stand-age classes of a forest type. An even-age class distribution, one in which each age class has the same number of acres, is ideal. As forest stands reach maturity and are harvested, an equivalent acreage of stands replaces them to provide for a sustained yield of timber products.

Age class distributions of the more prominent forest types are shown in Figures 1 and 2. A horizontal line, labeled "Recommended level"[2], appears on each of these figures. It indicates the acreage to harvest over a ten year period to establish an even-age class distribution within that respective forest type at the conclusion of one technical rotation period.

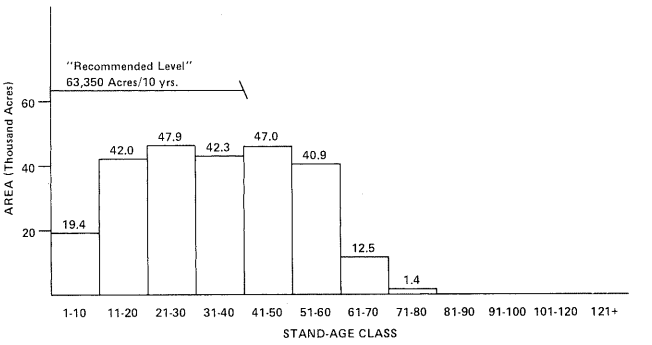

Figure 1. Area of Commercial Forest Land by Aspen Forest Type and Stand-Age Class, Aitkin County, Minnesota, 1977

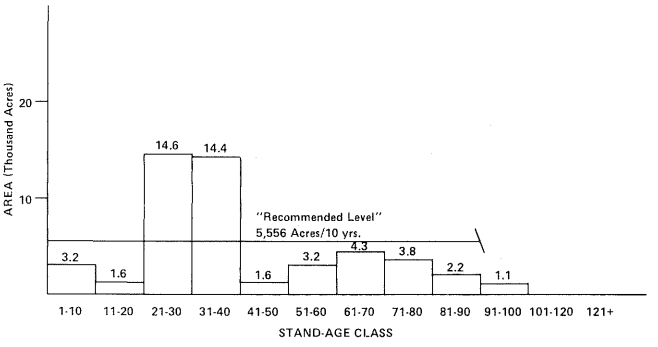

Figure 2. Area of Commercial Forest Land by Black Spruce Forest Type and Stand-Age Class, Aitkin County, Minnesota, 1977

[2]See appendix unit for the definition of "recommended annual harvest" from which the "recommended levels" were determined.

Stand-Size Classes

The Forest Survey separated forest lands into four stand-size classes: sawtimber, poletimber, seedling and sapling (restocking) stands, and nonstocked areas. This classification helps to determine a stand's stage of development, the forest products it can produce, and whether or not deforested areas are being restocked.

Of the total 672,500 acres of commercial forest land, 21% of the area is sawtimber, 49% poletimber, and 29% seedling and sapling stands. Only 1% of the commercial forest land is nonstocked.

Hardwood forest types account for 93% of the total sawtimber stand acreage, 86% of the poletimber stands, and 66% of the seedling and sapling stands. Softwood forest types comprise the remainder of each stand-size class.

Of the total 546,400 acres covered by hardwood forest types, 24% is classified as sawtimber, 52% poletimber, and the remaining 24% seedling and sapling stands. In a similar comparison, 8% of the total 123,300 acres covered by softwood forest types is sawtimber, 39% poletimber, and 53% seedling and sapling stands. (See Figure 3 and Table 2.)

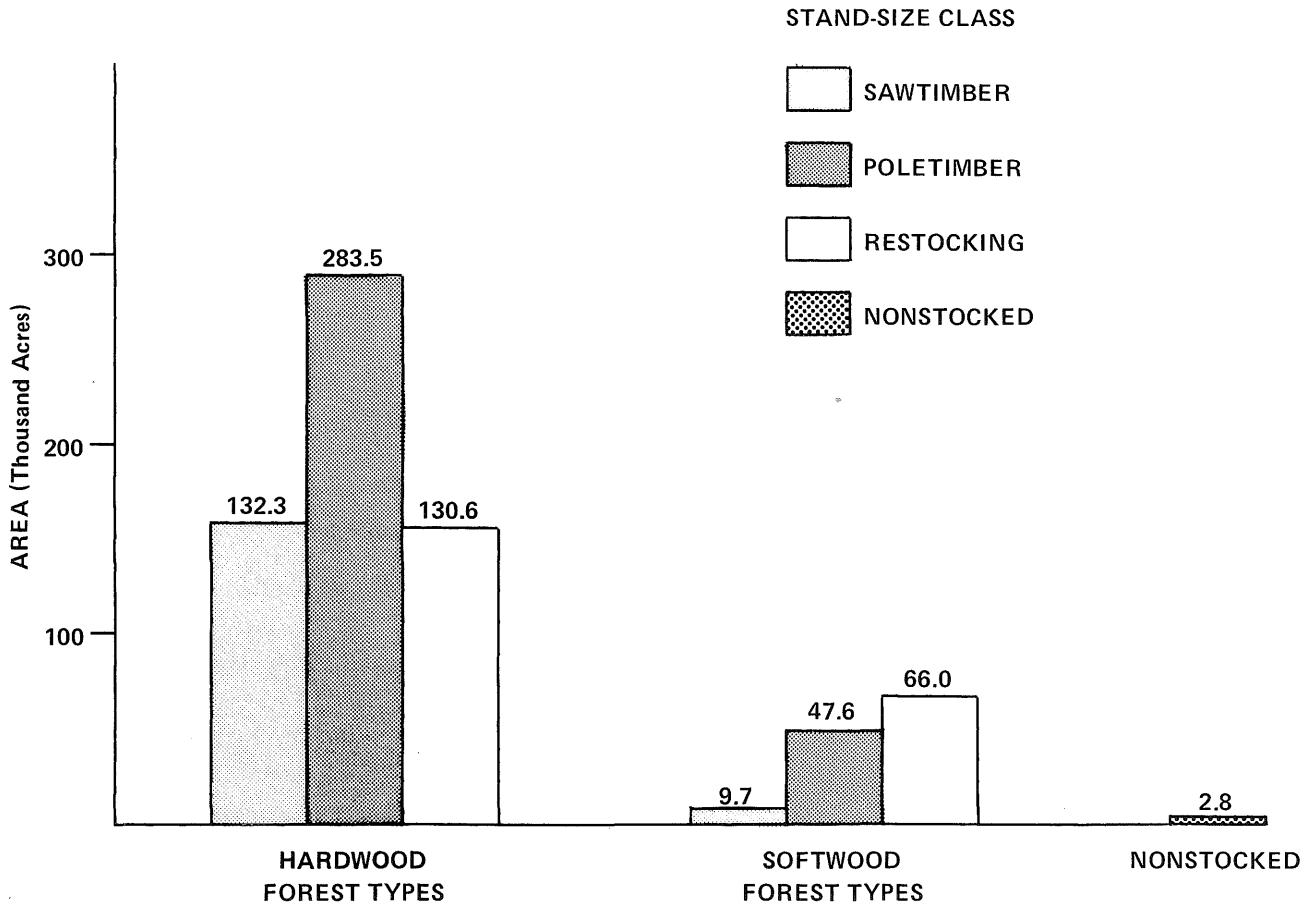

Figure 3. Areas of Commercial Forest Land by Stand-Size Class and Hardwood and Softwood Forest Types, Aitkin County, Minnesota, 1977

TIMBER VOLUME

In 1977, growing-stock volume on commercial forest land in Aitkin County was 6,172,300 cords, including 1,039,900,000 board feet[3] in sawtimber. Growing-stock volume averaged 9.18 cords per acre; the average for the Northern Pine Survey Unit was 11.04 cords per acre.

Hardwood Volume

Hardwood species make up 84% (5,175,400 cords) of the total growing-stock volume. Volumes for the major hardwood species (see Table 7) are:

Species Group	Volume (Cords)
Aspen	1,562,000
Ash	747,000
Paper birch	690,000
Basswood	509,000
Hard maple	426,000
Red oak	333,000

About 58% of the hardwood growing-stock is poletimber and the remaining 42% is sawtimber. In sawtimber volume, the major hardwood species (see Table 8) are:

Species Group	Volume (Million Bd. Ft.[3])
Aspen	251.8
Hard maple	103.7
Basswood	94.0
Ash	90.2
Elm	78.6
Red oak	69.7
Paper birch	69.7

Softwood Volume

Softwood species make up 16% (996,900 cords) of the growing-stock volume on commercial forest land. Volumes for the dominant softwood species (see Table 7) are:

Species Group	Volume (Cords)
Tamarack	339,000
Balsam fir	290,000
Black spruce	124,000
Northern white-cedar	90,000
White pine	53,000

Softwood growing-stock is 58% poletimber and 42% sawtimber. Sawtimber volumes for the major softwood species (see Table 8) are:

Species Group	Volume (Million Bd. Ft.)
Balsam fir	43.9
Tamarack	38.8
White pine	23.8
Northern white-cedar	21.3
White spruce	15.8

[3]All sawtimber volumes used in this report were scaled using the International ¼-inch rule.

Sawlog Quality

In general, the sawtimber in Aitkin County is of poor quality. Sawtimber classified as butt log grade 1[4], the best sawlog material, amounts to only 8% of the total sawtimber volume graded. Most of the sawtimber, 65%, is classified as grade 3. The remaining board footage is in grade 2 (22%) and grade 4 (5%). In hardwood species, 26% of the grade 1 volume is in basswood. Red pine accounts for 69% of the grade 1 volume in softwood species. (See Table 13.)

Timber Growth

The net annual growth of growing-stock on commercial forest land in 1976 was 137,200 cords, including 34,900,000 board feet in sawtimber volume. This is equivalent to .20 cord of annual growth per acre. A major reason this growth rate is not larger is the presence of stands which exceed rotation age. These over-age stands, characterized by low growth rates and high mortality, should be harvested. Restocking these logged areas with young, vigorous trees would stimulate net annual growth and ultimately increase timber production. (See Table 10.)

Timber Removals From Growing-Stock

In 1976, 90,900 cords of growing-stock volume were removed, consisting of 75,800 cords of hardwood species and 15,200 cords of softwood species. Aspen accounted for 71% of the hardwood species removed. Tamarack had 29% of the softwood species removed. (See appendix unit for the definition of "Timber Removals".)

Major Softwood Species Removed	Volume (Cords)	Major Hardwood Species Removed	Volume (Cords)
Tamarack	4,370	Aspen	53,940
Balsam fir	3,600	Red Oak	7,530
Jack pine	2,250	Paper birch	5,450
Black spruce	1,420	Ash	4,110

Recommended Annual Harvest

Regulation of area by forest type determines the recommended annual harvest. At the conclusion of the first rotation period, an even distribution of age classes should be established to provide for a sustained yield of wood products in the future. The recommended annual harvest is 196,790 cords; 161,601 cords of hardwoods and 35,189 cords of softwoods. Aspen is the major forest type to be harvested at a projected removal rate of 108,980 cords per year. (See Table 12, and the appendix unit for the definition of "recommended annual harvest".)

[4]Sawtimber was graded according to the Forest Survey Handbook, FSH 4809.11.

Timber Balance

Generally, increased harvests are recommended for the future compared to what was actually logged in 1976. This imbalance can be mainly attributed to shorter prescribed rotation ages than those which were used in 1976. Assumptions used in calculating the recommended harvests, such as marketability of species and accessibility to stands, provide for higher predicted yields than were economically feasible in 1976.

Technological improvements in harvesting and processing should lead to greater utilization of the timber resource in the future. Creation of new markets should also increase the actual cut in years to come. Intensified management, the removal of stands which exceed rotation age, and the establishing of young, vigorous trees should increase net annual growth. These factors require the future survey of the timber resource to provide up-to-date information essential to re-evaluating forest policies and programs. (See Figure 4.)

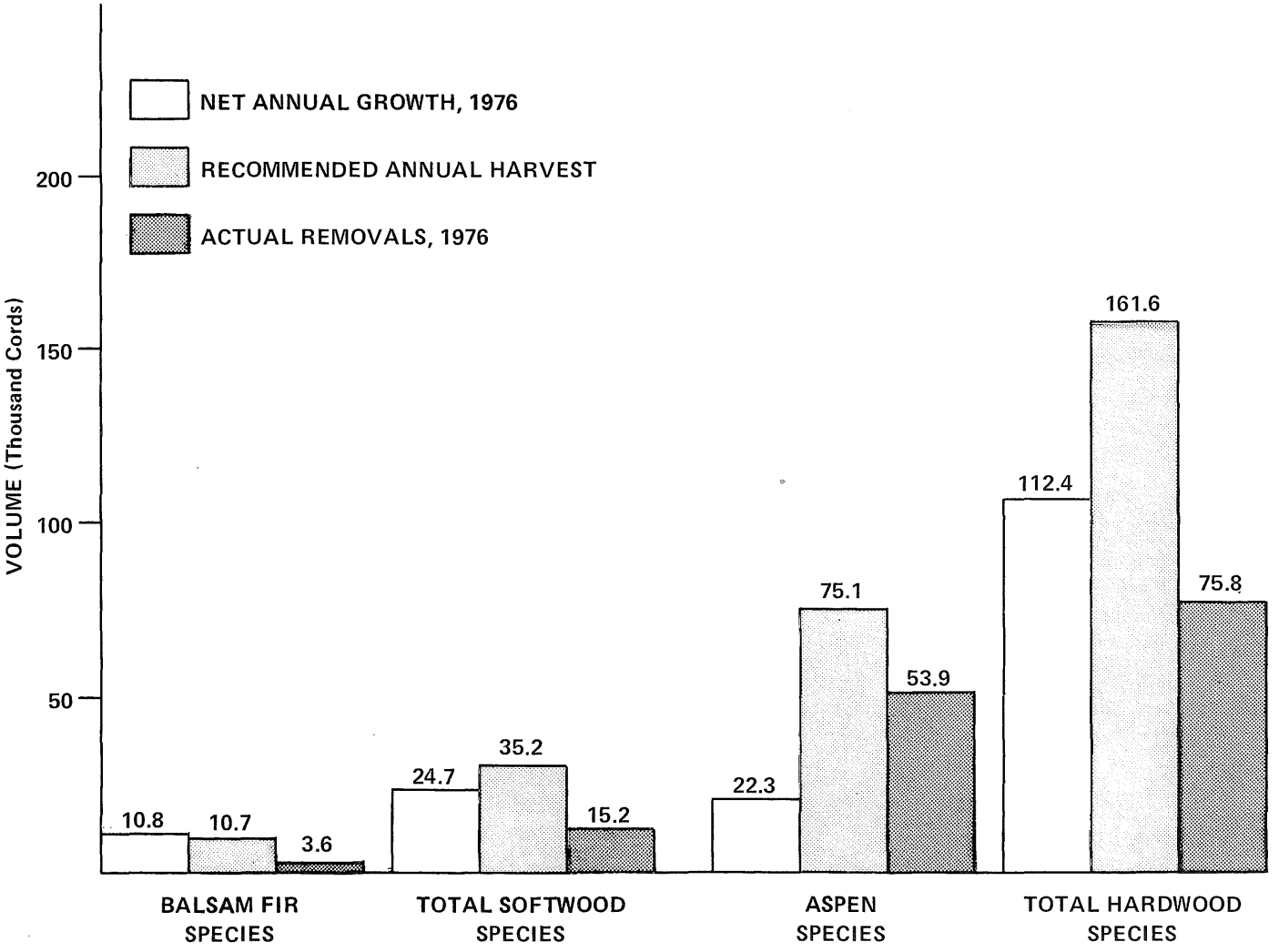

Figure 4. Comparison of Net Annual Growth, Recommended Annual Harvest, and Actual Harvest of Growing-Stock Volume, Aitkin County, Minnesota, 1977

TABLES

Table 1. Area of Commercial and Unproductive Forest Land, By Owner and Stand-Size Class (Thousand Acres)
Aitkin County, Minnesota – 1977

Owner	Sawtimber	Poletimber	Restocking	Nonstocked	Total Commer. Forest Land	Unproductive Forest Land	Total[1]
National Forest					0		0
Bureau of Land Mgmt.					0		0
Indian					0		0
Misc. Federal	4.0	4.3			8.3		8.3
State	41.1	90.5	84.6	1.2	217.4	47.6	265.0
County and Municipal	32.9	105.5	41.6		180.0	19.3	199.3
Forest Industry		4.2			4.2		4.2
Farmer	43.1	83.7	54.0		180.8	8.2	189.0
Farmer-Owned Leased					0		0
Misc. Private Corp.	1.2	4.0			5.2		5.2
Misc. Private-Indiv.	19.7	38.9	16.4	1.6	76.6		76.6
Misc. Priv.-Corp. Leased					0		0
Misc. Priv.-Indiv. Leased					0		0
TOTAL All Owners	**142.0**	**331.1**	**196.6**	**2.8**	**672.5**	**75.1**	**747.6**

[1] Does not include productive-reserved forest land.

Table 2. Area of Commercial Forest Land, By Forest Type and Stand-Size Class (Thousand Acres)
Aitkin County, Minnesota – 1977

Forest Type	Sawtimber	Poletimber	Restocking	Nonstocked	All Classes
Jack Pine		1.4	1.1		2.5
Red Pine			1.6		1.6
White Pine	1.2				1.2
Balsam Fir	1.1	10.2	3.9		15.2
White Spruce	1.2				1.2
Black Spruce		11.9	38.1		50.0
N. White-Cedar	1.4	5.3	1.5		8.2
Tamarack	4.8	18.8	19.8		43.4
Oak	2.8	9.8	2.8		15.4
Elm-Ash-Cottonwood	21.9	31.4	17.9		71.2
Maple-Basswood	59.2	69.2	14.4		142.8
Aspen	29.4	139.5	84.5		253.4
Paper Birch	9.7	29.4	1.1		40.2
Balsam Poplar	9.3	4.2	9.9		23.4
Nonstocked				2.8	2.8
TOTAL All Types	**142.0**	**331.1**	**196.6**	**2.8**	**672.5**

Table 3. Area of Commercial Forest Land, By Forest Type and Stand-Age Class (Thousand Acres)
Aitkin County, Minnesota – 1977

Forest Type	STAND-AGE CLASS (YEARS)												All Ages
	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-120	121+	
Jack Pine	1.1		1.4										2.5
Red Pine		1.6											1.6
White Pine										1.2			1.2
Balsam Fir	1.3	2.6			2.9	5.7	1.1	1.6					15.2
White Spruce									1.2				1.2
Black Spruce	3.2	1.6	14.6	14.4	1.6	3.2	4.3	3.8	2.2	1.1			50.0
N. White-Cedar					1.5	1.6		2.6			1.1	1.4	8.2
Tamarack	4.5	5.6	2.4	2.5	3.9	5.5	1.5	4.1	7.7	4.4	1.3		43.4
Oak		1.4	1.3	5.8		2.7	2.8				1.4		15.4
Elm-Ash-Cottonwood	3.1	4.7	10.1	3.1	5.8	8.8	12.2	10.8	5.5	4.0	2.0	1.1	71.2
Maple-Basswood	1.6	6.9	5.9	11.8	22.0	31.3	22.4	18.2	4.3	13.5	3.7	1.2	142.8
Aspen	19.4	42.0	47.9	42.3	47.0	40.9	12.5	1.4					253.4
Paper Birch	1.1			4.5	8.2	19.4	4.2	1.4	1.4				40.2
Balsam Poplar		6.5	5.0		1.4	2.3	8.2						23.4
Nonstocked	2.8												2.8
All Types	**38.1**	**72.9**	**88.6**	**84.4**	**94.3**	**121.4**	**69.2**	**43.9**	**22.3**	**24.2**	**9.5**	**3.7**	**672.5**

Table 4. Area of Commercial Forest Land By Forest Type and Site Index Class (Thousand Acres)
Aitkin County, Minnesota – 1977

Forest Type	SITE INDEX CLASSES									All Sites
	1-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91+	
Jack Pine						1.4	1.1			2.5
Red Pine							1.6			1.6
White Pine					1.2					1.2
Balsam Fir			1.1	5.5	6.1	1.1	1.4			15.2
White Spruce				1.2						1.2
Black Spruce	1.1	22.4	18.8	6.1		1.6				50.0
N. White-Cedar		6.8	1.4							8.2
Tamarack		4.3	13.1	17.0	7.4	1.6				43.4
Oak			3.1	2.7	1.4	5.4	1.4	1.4		15.4
Elm-Ash-Cottonwood			12.2	14.6	23.6	16.3	3.4	1.1		71.2
Maple-Basswood			3.0	30.0	69.7	30.7	8.0	1.4		142.8
Aspen			6.2	13.6	32.8	83.8	83.7	30.7	2.6	253.4
Paper Birch				6.0	13.2	16.8	2.8		1.4	40.2
Balsam Poplar				3.2	9.2	6.7	4.3			23.4
Nonstocked					1.6		1.2			2.8
TOTAL All Types	**1.1**	**33.5**	**58.9**	**99.9**	**166.2**	**165.4**	**108.9**	**34.6**	**4.0**	**672.5**

Table 5. Number of Growing-Stock Trees By Species Group and 2-Inch Diameter Class (Thousand Trees)
Aitkin County, Minnesota – 1977

Species	DIAMETER CLASS 2	4	6	8	10	12	14	16	18	20	22	24-28	30+	All Classes
White Pine				45	58	37	20	30	20	6		9	2	227
Red Pine	1,282	310	46	25		6	5	4	6	8	5	2		1,699
Jack Pine	281	111	308	139	50	7	5	3						904
White Spruce	424	622	138	90	77	29	37	13	3	8				1,441
Black Spruce	15,828	12,423	2,786	711	96									31,844
Balsam Fir	10,709	5,176	2,733	1,284	537	161	76	8	7					20,691
Tamarack	9,239	7,947	4,023	1,502	492	153	8	8						23,372
N. White-Cedar	1,474	1,650	686	420	208	147	48	7	6	3				4,649
Other Softwoods			76											76
Total Softwoods	**39,237**	**28,239**	**10,796**	**4,216**	**1,518**	**540**	**199**	**73**	**42**	**25**	**5**	**11**	**2**	**84,903**
White Oak	3,142	3,209	1,115	621	293	118	84	33	3	18	4	2		8,642
Red Oak	2,076	825	1,218	770	658	420	167	80	55	16	6	6		6,297
Hickory		123		41										164
Yellow Birch	135	123	120	36	23	18	10	4	3					472
Hard Maple	18,869	8,519	2,246	938	635	312	307	169	68	18	10	2	1	32,094
Soft Maple	12,139	7,064	2,550	942	386	161	51	31	34	12	2	5	3	23,380
Ash	18,827	11,635	5,477	2,772	1,501	574	202	69	23	14	3	2		41,099
Balsam Poplar	4,987	1,643	747	535	257	354	130	59	20	4	1	5		8,742
Paper Birch	6,467	6,104	4,378	2,905	1,181	491	158	44	13	4				21,745
Bigtooth Aspen	2,125		78	73	115	46	65	39	5		2			2,548
Quaking Aspen	49,706	12,439	4,902	4,157	3,312	1,603	567	219	49	6	6			76,966
Basswood	3,479	3,953	1,937	1,885	979	634	233	94	52	16	6	3		13,271
Elm	3,683	2,447	1,278	739	500	224	186	114	57	45	20	12	3	9,308
Other Hardwoods	1,018			17	19	6		7						1,067
Total Hardwoods	**126,653**	**58,084**	**26,046**	**16,431**	**9,859**	**4,961**	**2,160**	**962**	**382**	**153**	**60**	**37**	**7**	**245,795**
All Species	**165,890**	**86,323**	**36,842**	**20,647**	**11,377**	**5,501**	**2,359**	**1,035**	**424**	**178**	**65**	**48**	**9**	**330,698**

Table 6. Volume of Growing-Stock on Commercial Forest Land By Species Group and 2-Inch Diameter Class (Thousand Cords), Aitkin County, Minnesota – 1977

Species	DIAMETER CLASS 6	8	10	12	14	16	18	20	22	24-28	30+	All Classes
White Pine		2	5	5	5	10	8	5		10	3	53
Red Pine	2	2		1	1	2	4	6	4	2		24
Jack Pine	9	9	6	1	2	2						29
White Spruce	4	4	8	5	10	7	2	6				46
Black Spruce	68	46	10									124
Balsam Fir	78	83	65	34	24	3	3					290
Tamarack	129	108	63	34	3	3						339
N. White-Cedar	13	20	17	21	11	3	3	2				90
Other Softwoods	2											2
Total Softwoods	**305**	**274**	**174**	**101**	**56**	**29**	**20**	**19**	**4**	**12**	**3**	**997**
White Oak	24	33	30	20	20	9	2	8	3	1		150
Red Oak	35	51	74	68	40	25	24	9	3	4		333
Hickory		3										3
Yellow Birch	3	2	2	3	2	1						13
Hard Maple	58	58	72	55	79	59	29	7	6	2	1	426
Soft Maple	55	47	37	27	11	9	15	7	2	6	5	221
Ash	151	185	189	115	57	26	12	8	2	2		747
Balsam Poplar	25	34	35	69	37	20	10	2	1	5		238
Paper Birch	145	213	160	101	45	16	7	3				690
Bigtooth Aspen	3	5	16	9	19	15	2		1			70
Quaking Aspen	165	316	433	315	160	76	21	3	3			1,492
Basswood	48	113	108	110	60	31	24	9	4	2		509
Elm	19	30	39	31	41	35	24	26	14	12	5	276
Other Hardwoods		1	3	1		2						7
Total Hardwoods	**731**	**1,091**	**1,198**	**924**	**571**	**324**	**170**	**82**	**39**	**34**	**11**	**5,175**
All Species	**1,036**	**1,365**	**1,372**	**1,025**	**627**	**353**	**190**	**101**	**43**	**46**	**14**	**6,172**

Table 7. Volume of Growing-Stock on Commercial Forest Land By Species Group and Forest Type (Thousand Cords)
Aitkin County, Minnesota – 1977

Species	FOREST TYPE														All Types
	Jack Pine	Red Pine	White Pine	Balsam Fir	White Spruce	Black Spruce	Northern White Cedar	Tamarack	Oak	Elm-Ash-Cottonwood	Maple-Basswood	Aspen	Paper Birch	Balsam Poplar	
White Pine			7	1	6			4		4	10	13	7	1	53
Red Pine				3				1	2			6	12		24
Jack Pine	19							1				9			29
White Spruce				6	4			1		5	5	20	4	1	46
Black Spruce				6		87	6	17			1	6	1		124
Balsam Fir			3	51		4	5	1	2	22	70	102	14	16	290
Tamarack				5		35	2	242		14	2	18	7	14	339
N. White-Cedar				1	3	1	38	1		11	1	28		6	90
Other Softwoods											1			1	2
Total Softwoods	**19**	**0**	**10**	**73**	**13**	**127**	**51**	**268**	**4**	**56**	**90**	**202**	**45**	**39**	**997**
White Oak									25	16	26	56	15	12	150
Red Oak	4	3				1			84	4	93	114	30		333
Hickory									1		2				3
Yellow Birch										6	7				13
Hard Maple			3						2	9	351	40	19	2	426
Soft Maple				4		2			6	49	100	46	14		221
Ash				1			4	4		449	185	75	14	15	747
Balsam Poplar				2	1				6	12	30	74	12	101	238
Paper Birch	1	2	1	14	2	11	6	2	16	22	177	202	230	14	690
Bigtooth Aspen						3					19	44	4		70
Quaking Aspen	5			9	1	11			8	24	111	1,234	58	31	1,492
Basswood			2						4	27	401	52	21	2	509
Elm				1					4	92	142	27	6	4	276
Other Hardwoods									3	1	2	1			7
Total Hardwoods	**10**	**5**	**6**	**31**	**4**	**18**	**10**	**6**	**159**	**711**	**1,646**	**1,965**	**423**	**181**	**5,175**
All Species	**29**	**5**	**16**	**104**	**17**	**145**	**61**	**274**	**163**	**767**	**1,736**	**2,167**	**468**	**220**	**6,172**

Table 8. Volume of Sawtimber on Commercial Forest Land By Species Group and Forest Type (Million Board Feet)[1]
Aitkin County, Minnesota – 1977

Species	FOREST TYPE														All Types
	Jack Pine	Red Pine	White Pine	Balsam Fir	White Spruce	Black Spruce	Northern White Cedar	Tamarack	Oak	Elm-Ash-Cottonwood	Maple-Basswood	Aspen	Paper Birch	Balsam Poplar	
White Pine			3.3	.5	2.8			1.9		1.8	4.8	5.1	3.0	.6	23.8
Red Pine				1.3					.8			2.9	5.1		10.1
Jack Pine	2.4											1.8			4.2
White Spruce				2.0	1.3		.2			1.2	2.3	7.0	1.8		15.8
Black Spruce				1.2		1.8	.2	.4				.6			4.2
Balsam Fir			.7	5.2		.7	.7		.5	3.6	13.5	16.4	1.7	.9	43.9
Tamarack				1.3		2.8	.7	21.1		2.6	.5	5.2	1.6	3.0	38.8
N. White-Cedar					.7		6.8	.5		3.8	.4	7.6		1.5	21.3
Other Softwoods															0
Total Softwoods	**2.4**	**0**	**4.0**	**11.5**	**4.8**	**5.3**	**8.6**	**23.9**	**1.3**	**13.0**	**21.5**	**46.6**	**13.2**	**6.0**	**162.1**
White Oak									4.4	2.5	5.7	8.0	2.9	2.3	25.8
Red Oak	.5	1.2							16.1		23.9	19.2	8.8		69.7
Hickory															0
Yellow Birch										1.5	1.0				2.5
Hard Maple			1.4							1.9	92.5	5.4	2.5		103.7
Soft Maple				.4		.7			.5	11.2	14.0	2.2	2.0		31.0
Ash							.3			62.2	20.6	6.3		.8	90.2
Balsam Poplar					.4				1.3	3.4	8.0	19.3	3.1	24.1	59.6
Paper Birch	.7		.4	.9	.8		.5		1.1	6.1	22.6	14.9	19.0	2.7	69.7
Bigtooth Aspen						.4					4.2	12.0	.9		17.5
Quaking Aspen	.5			1.4	.3	.3			2.9	5.1	17.6	185.2	12.0	9.0	234.3
Basswood			.8							6.3	76.4	7.1	3.0	.4	94.0
Elm				.4					.7	28.1	44.0	3.9	.9	.6	78.6
Other Hardwoods										.3	.4	.5			1.2
Total Hardwoods	**1.7**	**1.2**	**2.6**	**3.1**	**1.5**	**1.4**	**.8**	**0**	**27.0**	**128.6**	**330.9**	**284.0**	**55.1**	**39.9**	**877.8**
All Species	**4.1**	**1.2**	**6.6**	**14.6**	**6.3**	**6.7**	**9.4**	**23.9**	**28.3**	**141.6**	**352.4**	**330.6**	**68.3**	**45.9**	**1,039.9**

[1] International ¼-inch rule, sawtimber volumes extracted from growing-stock volumes in Table 7.

Table 9. Volume of Growing-Stock and Sawtimber on Commercial Forest Land By Ownership Class and Hardwoods and Softwoods, Aitkin County, Minnesota – 1977

Ownership Class	Growing-Stock (Thousand Cords)			Sawtimber (Million Board Feet)[1]		
	All Species	Softwood Species	Hardwood Species	All Species	Softwood Species	Hardwood Species
National Forest	0			0		
Bureau of Land Mgmt.	0			0		
Indian	0			0		
Misc. Federal	130.9	6.5	124.4	22.4	.3	22.1
State	1,795.3	440.7	1,354.6	287.2	53.2	234.0
County and Municipal	1,726.5	225.1	1,501.4	279.8	42.9	236.9
Forest Industry	67.4		67.4	11.1		11.1
Farmer	1,583.5	243.5	1,340.0	283.5	52.1	231.4
Farmer-Owned Leased	0			0		
Misc. Private Corp.	71.4	4.0	67.4	9.2		9.2
Misc. Private Indiv.	797.3	77.1	720.2	146.7	13.6	133.1
Misc. Priv.-Corp. Leased	0			0		
Misc. Priv.-Indiv. Leased	0			0		
Total All Owners	**6,172.3**	**996.9**	**5,175.4**	**1,039.9**	**162.1**	**877.8**

[1] International ¼-inch rule, sawtimber volumes are extracted from the adjoining growing-stock table.

Table 10. Net Annual Growth of Growing-Stock on Commercial Forest Land By Species Group and Forest Type (Thousand Cords/Year), Aitkin County, Minnesota – 1976

Species	FOREST TYPE														All Types
	Jack Pine	Red Pine	White Pine	Balsam Fir	White Spruce	Black Spruce	Northern White Cedar	Tamarack	Oak	Elm-Ash-Cottonwood	Maple-Basswood	Aspen	Paper Birch	Balsam Poplar	
White Pine			.3		.2			.2		.1	.2	.7	.3	.1	2.1
Red Pine				.1								.4	.2		.7
Jack Pine	1.3											.4			1.7
White Spruce				.3	.3					.2	.1	1.8	.4	.1	3.2
Black Spruce				.3		4.0	.1	.7			.1	.4	.1		5.7
Balsam Fir			.2	2.1		.1	–.2	.2	.1	–.8	2.9	5.0	.7	.5	10.8
Tamarack				.1		.1		3.2		–.8		–3.3	–1.3	–.7	–2.7
N. White-Cedar				.1		.1	1.4			.3	.1	.9		.2	3.1
Other Softwoods						.1									.1
Total Softwoods	**1.3**	**0**	**.5**	**3.0**	**.5**	**4.4**	**1.3**	**4.3**	**.1**	**–1.0**	**3.4**	**6.3**	**.4**	**.2**	**24.7**
White Oak									.6	.3	.6	3.5	.4	.3	5.7
Red Oak	.2	.1							.3	.1	.5	3.5	.7		5.4
Hickory											.1				.1
Yellow Birch										.1	.3				.4
Hard Maple										2.2	6.1	1.5	.5	.1	10.4
Soft Maple				.1					.3	.7	3.1	3.6	.6		8.4
Ash							.1	.1		4.1	4.2	2.4	.5	.6	12.0
Balsam Poplar				.1					.3	.5	1.0	3.3	–1.6	7.2	10.8
Paper Birch				.6	.1		.2	.1	.5	–.4	2.5	6.1	5.7	.3	15.7
Bigtooth Aspen						.1					.5	1.1			1.7
Quaking Aspen	–1.8			.4		.6			.2	1.0	–5.2	25.4	–1.1	1.2	20.7
Basswood									.1	.8	14.0	.3	.7	.1	16.0
Elm									.3	–3.4	5.6	1.9	.4	.2	5.0
Other Hardwoods									.1		.1				.2
Total Hardwoods	**–1.6**	**.1**	**0**	**1.2**	**.1**	**.7**	**.3**	**.2**	**2.7**	**6.0**	**33.4**	**52.6**	**6.8**	**10.0**	**112.5**
All Species	**–.3**	**.1**	**.5**	**4.2**	**.6**	**5.1**	**1.6**	**4.5**	**2.8**	**5.0**	**36.8**	**58.9**	**7.2**	**10.2**	**137.2**

Table 11. Volume of Growing-Stock on Commercial Forest Land By Forest Type and Stand-Age Class (Thousand Cords) Aitkin County, Minnesota – 1977

Forest Type	STAND-AGE CLASS (YEARS) 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-120	121+	All Ages
Jack Pine	7.8		20.9										28.7
Red Pine		4.6											4.6
White Pine										16.1			16.1
Balsam Fir	4.0	3.7			31.4	33.1	13.6	17.3					103.1
White Spruce									17.8				17.8
Black Spruce	2.5		33.5	34.3	2.8	10.1	28.9	13.8	14.7	4.2			144.8
N. White-Cedar					6.0	6.1		24.4			14.1	9.8	60.4
Tamarack	3.7	5.3	4.8	4.4	16.9	66.4	7.9	36.9	52.8	55.5	18.8		273.4
Oak		2.3	2.9	45.4		48.4	27.8				36.2		163.0
Elm-Ash-Cottonwood	11.7	18.3	30.1	26.6	92.5	98.5	213.7	145.6	61.4	48.6	14.3	4.8	766.1
Maple-Basswood		16.4	16.7	147.6	222.4	398.2	322.6	245.1	69.4	238.4	40.6	19.0	1,736.4
Aspen	58.8	104.9	268.0	459.7	565.4	542.7	141.1	26.1					2,166.7
Paper Birch	2.0			43.5	95.9	199.2	93.8	22.5	11.2				468.1
Balsam Poplar		12.0	32.9		5.8	30.1	138.7						219.5
Nonstocked	3.6												3.6
All Types	**94.1**	**167.5**	**409.8**	**761.5**	**1,039.3**	**1,432.8**	**988.1**	**531.7**	**227.3**	**362.8**	**124.0**	**33.6**	**6,172.3**

Table 12. Recommended Annual Harvest of Growing-Stock Volume on Commercial Forest Land By Species Group and Forest Type (Cords/Year), Aitkin County, Minnesota – 1977

Species	FOREST TYPE Jack Pine	Red Pine	White Pine	Balsam Fir	White Spruce	Black Spruce	Northern White Cedar	Tamarack	Oak	Elm-Ash-Cottonwood	Maple-Basswood	Aspen	Paper Birch	Balsam Poplar	All Types
White Pine	4	25	231	45	20	5	1	29	15	25	293	763	324	19	1,799
Red Pine	67	259	89	86	14			19	37		59	2,071	681	10	3,392
Jack Pine	804	32	26	49	79	27	1	38	74	12		2,724	409	47	4,322
White Spruce	3	3	7	130	106	21	4	14	7	61	176	981	170	85	1,768
Black Spruce	13	1	3	200	11	3,702	118	461		25		327	68	38	4,967
Balsam Fir	6	10	19	1,905	52	225	78	77	7	639	1,346	4,468	1,141	758	10,731
Tamarack	1	1		155	10	851	75	3,783	2	98	29	327	68	180	5,580
N. White-Cedar				298	20	230	733	110		467	146	218	273	114	2,609
Other Softwoods						11								10	21
Total Softwoods	**898**	**331**	**375**	**2,868**	**312**	**5,072**	**1,010**	**4,531**	**142**	**1,327**	**2,049**	**11,879**	**3,134**	**1,261**	**35,189**
White Oak	3	1	5	16	1			5	331	184	1,083	2,833	272	76	4,810
Red Oak	9	3	2	4		5			944	37	1,551	3,487	954	19	7,015
Hickory									2				17		19
Yellow Birch										37	176	109	17		339
Hard Maple			3						13	37	4,098	763	187	38	5,139
Soft Maple				16		11		5	33	381	1,083	872	204	9	2,614
Ash		1		74		22	28	14	22	6,428	2,605	2,180	528	455	12,357
Balsam Poplar	2	2	1	184	17	5	20	82	9	701	615	5,122	613	5,204	12,577
Paper Birch	23	14	37	473	13	64	52	77	252	737	2,985	9,917	7,936	512	23,092
Aspen	54	27	20	404	37	166	9	67	313	578	2,195	67,459	2,248	1,517	75,094
Basswood			7	12					92	344	7,581	2,288	443	76	10,843
Elm	1	1		29		5	1	19	26	1,487	3,132	1,962	460	313	7,436
Other Hardwoods									11	12	117	109	17		266
Total Hardwoods	**92**	**49**	**75**	**1,212**	**68**	**278**	**110**	**269**	**2,048**	**10,963**	**27,221**	**97,101**	**13,896**	**8,219**	**161,601**
All Species	**990**	**380**	**450**	**4,080**	**380**	**5,350**	**1,120**	**4,800**	**2,190**	**12,290**	**29,270**	**108,980**	**17,030**	**9,480**	**196,790**

Table 13. Volume of Sawtimber By Species Group and Butt Log Grade (Million Board Feet)[1]
Aitkin County, Minnesota – 1977

Species	Not Graded[2]	Log Grade 1	Log Grade 2	Log Grade 3	Log Grade 4	All Grades
White Pine	19.8	1.8	.4	1.3	.5	23.8
Red Pine	4.2	4.1		1.8		10.1
Jack Pine	1.7			2.5		4.2
White Spruce	11.5		.9	3.4		15.8
Black Spruce	1.7			2.5		4.2
Balsam Fir	28.4			15.5		43.9
Tamarack	30.2		.5	8.1		38.8
N. White-Cedar	18.2		.4	2.7		21.3
Other Softwoods						0
Total Softwoods	**115.7**	**5.9**	**2.2**	**37.8**	**.5**	**162.1**
White Oak	19.3	.4	1.3	4.2	.6	25.8
Red Oak	44.9	.7	5.5	15.9	2.7	69.7
Hickory						0
Yellow Birch	2.5					2.5
Hard Maple	55.7	4.3	12.6	30.4	.7	103.7
Soft Maple	19.0	1.7	1.9	8.4		31.0
Ash	64.3	1.6	10.3	14.0		90.2
Balsam Poplar	29.7	.8	7.1	18.5	3.5	59.6
Paper Birch	44.9	1.8	8.1	13.6	1.3	69.7
Bigtooth Aspen	9.4	.9	.9	5.8	.5	17.5
Quaking Aspen	139.6	2.7	11.5	71.9	8.6	234.3
Basswood	49.7	6.9	14.9	21.9	.6	94.0
Elm	51.4	4.9	11.5	10.8		78.6
Other Hardwoods	.8			.4		1.2
Total Hardwoods	**531.2**	**26.7**	**85.6**	**215.8**	**18.5**	**877.8**
All Species	**646.9**	**32.6**	**87.8**	**253.6**	**19.0**	**1,039.9**

[1]International ¼-inch rule.
[2]Sawtimber volumes in this column should be distributed proportionately among Log Grades 1-4 of their respective species.

APPENDIX

PRINCIPAL TREE SPECIES[5] IN MINNESOTA

SOFTWOOD SPECIES

Eastern white pine	*Pinus strobus*
Red pine	*Pinus resinosa*
Jack pine	*Pinus banksiana*
Black spruce	*Picea mariana*
White spruce	*Picea glauca*
Balsam fir	*Abies balsamea*
Tamarack	*Larix laricina*
Northern white-cedar	*Thuja occidentalis*
Eastern red cedar	*Juniperus virginiana*
Scotch pine	*Pinus sylvestris*

HARDWOOD SPECIES

White oak	*Quercus alba*
Bur oak	*Quercus macrocarpa*
Swamp white oak	*Quercus bicolor*
Northern red oak	*Quercus rubra*
Northern pin oak	*Quercus ellipsoidalis*
Black oak	*Quercus velutina*
Shagbark hickory	*Carya ovata*
Butternut hickory	*Carya cordiformis*
Yellow birch	*Betula alleghaniensis*
Sugar maple	*Acer saccharum*
Black maple	*Acer nigrum*
Red maple	*Acer rubrum*
Silver maple	*Acer saccharinum*
White ash	*Fraxinus americana*
Black ash	*Fraxinus nigra*
Green ash	*Fraxinus pennsylvanica*
Balsam poplar	*Poplus balsamifera*
Paper birch	*Betula papyrifera*
Bigtooth aspen	*Populus grandidentata*
Quaking aspen	*Populus tremuloides*
Basswood	*Tilia americana*
American elm	*Ulmus americana*
Slippery elm	*Ulmus rubra*
Rock elm	*Ulmus thomasii*
Black walnut	*Juglans nigra*
Butternut	*Juglans cinerea*
Black cherry	*Prunus serotina*
Boxelder	*Acer negundo*
Eastern cottonwood	*Populus deltoides*
Black willow	*Salix nigra*
River birch	*Betula nigra*
Hackberry	*Celtis occidentalis*
Kentucky coffee tree	*Gymnocladus diaicus*

SURVEY PROCEDURES

The major steps in the survey of the Northern Pine Unit were as follows:

1. A total of 72,591 one-acre points were distributed systematically across aerial photos of the entire area, except the Chippewa National Forest. To make a preliminary estimate of forest area, these points were classified as either forest land (31,050), unproductive forest land (2,223), nonforest land (38,702), or questionable (616). Next, all 31,050 of the forest points, 298 of the unproductive forest points, 47 of the nonforest points with trees, and all 616 of the questionable points were stereoclassified as to forest type, stand-size class, and density. Then 4,202 points classed as forest, 298 points classed as unproductive, and 81 points classed as questionable were examined on the ground to correct the preliminary area estimate for errors in classification and for actual changes in land use since the photos were taken. At each of the 3,718 commercial forest locations, 10-point variable-radius plots (basal area factor 37.5) were established uniformly over the sample acre. Tree measurements made on these plots were the basis for estimates of timber volume, growth, mortality, number of trees, and other forest classifications.

2. Growth and mortality on all commercial forest land were estimated using the Forest Resources Evaluation Program (FREP)[6], an individual tree-growth projection system that uses stand characteristics such as tree diameter to estimate volumes.

3. Area statistics for the Chippewa National Forest were prepared by the Forest Timber Management staff from compartment examination records. In 1975, the Forest conducted its own forest inventory using 10-point variable-radius plots established by Forest personnel under the direction of the North Central Station. Data from these plots was used as input for FREP, which was used to update volumes to 1977. The updated Chippewa National Forest data was approved by the Forest and merged with Survey data from non-National Forest commercial forest land to estimate volume, growth, and mortality for the Unit.

4. Statistics on timber utilization during 1975 were obtained from mill surveys. The Minnesota Department of Natural Resources and the North Central Forest Experiment Station canvassed resident sawmills, veneer mills, and other primary wood-using resident

[5]The common and scientific names are based on LITTLE, Elbert L., Jr., 1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Department of Agriculture, Agricultural Handbook 41, 472 pp.

[6]For more information on FREP, see: U.S. Department of Agriculture, Forest Service. 1979. A generalized forest growth projection system for the Lake States Region. U.S. Department of Agriculture Forest Service, Gen. Tech. Rep. NC-49, 96 pp. U.S. Department of Agriculture Forest Service, North Central Forestry Experimental Station, St. Paul, MN.

pulpmills as well as out-of-state sawmills, pulpmills, and veneer mills to determine their use of timber from Minnesota. Fuelwood and fencepost output was based on a sample of private landowners (to determine their production of fuelwood and fenceposts) and on a canvass of industrial and public timber owners. Estimates of primary mill residue used for fuelwood were obtained from the canvass of Minnesota primary wood-using plants. Timber cut for products by ownership class was determined by a canvass of public and industrial timber owners. The portion of timber cut unaccounted for by the latter owners was grouped under "farmer and other owners".

5. To develop wood utilization factors used in converting timber products output to timber removals for sawlogs and pulpwood, 1,028 felled trees throughout the state were measured during 1975-1976. Factors for veneer logs were obtained during the 1967-1968 Wisconsin utilization study. Factors for all other products were obtained during the 1960-1961 Minnesota utilization study.
6. Field data were sent to St. Paul, Minnesota, for compilation.

ACCURACY OF SURVEY

Resources Evaluation Information is based on a sampling procedure designed to provide reliable statistics at the state and Survey Unit levels. Consequently, the reported figures are only estimates. However, a measure of reliability of these figures is given by sampling errors. These sampling errors may be interpreted as meaning that the chances are two out of three that if a 100-percent inventory had been taken, using the same methods, the results would have been within the limits indicated.

For example, the estimated area of commercial forest land in the Northern Pine Unit in 1977 is 5,758,400 acres and has a sampling error of ±0.69 percent (±39,700 acres). The chances are two out of three that the commercial forest area from a 100-percent inventory, then, would fall between 5,798,100 and 5,718,700 acres.

Sampling errors were calculated separately for National Forest land and other land, reflecting the higher sampling intensity on other land. For example, the sampling error for growing-stock inventory on National Forest land is ±7.47 but on other land it is ±1.18.

As survey data are broken down into units smaller than state or Survey Unit totals, the sampling error increases. The smaller the breakdown, the larger the sampling error. For example, the sampling error for area of commercial forest land in a particular county is higher than for total commercial forest area in the Survey Unit. Sampling errors for estimates smaller than the Northern Pine Survey Unit totals are given in the following table:

SAMPLING ERRORS FOR ESTIMATES SMALLER THAN THE NORTHERN PINE SURVEY UNIT TOTALS

Sampling Error Percentage[1]	Commercial Forest Land (Thousand Acres)	Growing-Stock (Thousand Cords)			Sawtimber (Million Board Feet)[2]		
		Volume	Growth	Removals	Volume	Growth	Removals
1	2,722.5	124,805.1	6,562.0	26,493.7	91,776.4	4,243.6	3,372.6
2	680.6	31,201.3	1,640.5	6,624.1	22,944.1	1,060.9	848.1
3	302.5	13,875.9	729.1	2,944.3	10,195.3	472.0	374.7
4	170.6	7,800.0	410.1	1,655.7	5,736.0	265.2	210.8
5	108.9	4,992.4	262.0	1,059.5	3,671.1	169.7	134.9
10	27.2	1,248.1	65.8	264.6	917.8	42.4	33.7
15	12.1	553.2	29.1	117.7	408.3	18.8	15.0
20	6.9	312.7	16.5	65.8	229.4	10.6	8.4
25	4.4	201.3	5.1	41.8	146.7	6.7	5.4
50	1.1	50.6	2.5	10.1	36.9	1.7	1.3
100	0.3	12.7	1.3	2.5	9.2	0.4	0.3

Formula for determing sampling error of unknown value (Y) from that of a known value (X).

$$SE_y = SE_x \left(\sqrt{\frac{x}{y}} \right)$$

X = Survey estimate of known value from above table.
Y = Survey estimate of unknown value.
SE_x = Sampling error of known value x from above table.
SE_y = Sampling error of unknown value y.

[1] At the 67% level.
[2] International ¼-inch rule.

DEFINITION OF TERMS

LAND-USE CLASSES

Gross area – The entire area of land and water as determined by the Bureau of Census, 1970.

Land area – The area of dry land and land temporarily or partially covered by water such as marshes, swamps, flood plains, streams, sloughs, and estuaries. Canals less than 1/8-mile wide, and lakes, reservoirs, and ponds smaller than 40 acres are included as land area. These figures are from the Bureau of Census, 1970.

Forest land – Land at least 16.7 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for non-forest use. Includes afforested areas. The minimum forest area classified was one acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, and clearings in forest areas were classed as forest if less than 120 feet in width.

Commercial forest land – Forest land that is producing or is capable of producing crops of industrial wood and that is not withdrawn from timber utilization by statute or administrative regulation. This includes areas suitable for management to grow crops of industrial wood generally of a site quality capable of producing in excess of .25 cord per acre of annual growth. This includes both inaccessible and inoperable areas.

Noncommercial forest land – (a) Unproductive – forest land incapable of yielding crops of industrial wood because of adverse site conditions, (b) Productive-reserved – forest land withdrawn from commercial timber use through statute or administrative regulation, or exclusively used for Christmas tree production.

Nonforest land – Land that has never supported forests, and land formerly forested where forest use is precluded by development for nonforest uses, such as cropland, improved pasture, residential areas, and city parks. Also includes improved roads and adjoining rights-of-way, powerline clearings, and certain areas or water classified by the Bureau of Census as land. Unimproved roads, streams, canals, and nonforest strips in forest areas must be more than 120 feet wide, and clearings in forested areas must be more than one acre in size, to qualify as nonforest land.

FOREST TYPES

A classification of forest land based upon the species forming a plurality of live-tree stocking. Major forest types in Minnesota are:

Jack pine – Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)

Red pine – Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)

White pine – Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch and maple.)

Balsam fir – Forests in which balsam fir and white spruce comprise a plurality of stocking with balsam fir the predominant species. (Common associates include white spruce, aspen, maple, birch, northern white-cedar, and tamarack.)

White spruce – Forests in which white spruce and balsam fir comprise a plurality of stocking with white spruce the predominant species. (Common associates include balsam fir, aspen, maple, birch, northern white-cedar, and tamarack.)

Black spruce – Forests in which swamp conifers (black spruce, tamarack and northern white-cedar) comprise a plurality of the live-tree stocking with black spruce the predominant species. (Common associates include tamarack and northern white-cedar.)

Northern white-cedar – Forests in which swamp conifers comprise a plurality of the live-tree stocking with northern white-cedar the predominant species. (Common associates include tamarack and black spruce.)

Tamarack – Forests in which swamp conifers comprise a plurality of the live-tree stocking with tamarack the predominant species. (Common associates include black spruce and northern white-cedar.)

Oak – Forests in which northern red oak, white oak, or bur oak, singly or in combination, comprise a plurality of the stocking. (Common associates include elm, maple, and aspen.)

Elm-ash-cottonwood – Forests in which lowland elm, ash, cottonwood, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include basswood and balsam poplar.)

Maple-basswood – Forests in which sugar maple, basswood, yellow birch, upland American elm, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include white pine and elm.)

Aspen – Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir, and paper birch.)

Paper birch – Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen, and balsam fir.)

Balsam poplar – Forests in which balsam poplar comprises a plurality of the stocking. (Common associates include aspen, elm, and ash.)

OWNERSHIP CLASSES

National forest – Federal land that has been designated by executive order or statute as National Forests or purchased units, and other land under the administration of the USDA Forest Service.

Other Federal – Federal land other than National Forest.

State, county and municipal – Land owned by states, counties, or local public agencies, or land leased by them for more than 50 years.

Forest industry – Land owned by companies or individuals operating primary wood-using plants.

Farmer-owned – Land owned by operators of farms. A farm must include 10 or more acres from which the sales of agricultural products totals $50 or more annually, or if less than 10 acres, the yield must be at least $250 annually.

Farmer-owned, leased – Land owned by an operator of a farm but leased to another party.

Miscellaneous private-corporation – Land owned by a private corporation not in the business of operating primary wood-using plants.

Miscellaneous private-individual – Land owned by a private individual.

Miscellaneous private corporation, leased – Land owned by a private corporation but leased to another party.

Miscellaneous private-individual, leased – Land owned by a private individual but leased to another party.

STAND-SIZE CLASSES

Stand – A growth of trees on a minimum of one acre of forest land that is stocked by forest trees of any size.

Sawtimber stands – Stands at least 16.7 percent stocked with growing-stock trees, with half or more of this stocking in sawtimber or poletimber trees and with sawtimber stocking at least equal to poletimber stocking.

Poletimber stands – Stands at least 16.7 percent stocked with growing-stock trees, and with half or more of this stocking in sawtimber and/or poletimber trees, and with poletimber stocking exceeding that of sawtimber.

Seedling and Sapling (restocking) stands – Stands at least 16.7 percent stocked with growing-stock trees and with seedlings and/or saplings comprising more than half of this stocking.

Nonstocked areas – Commercial forest land on which stocking of growing-stock trees is less than 16.7 percent.

TREE CLASSES

All live trees – Growing-stock, rough, and rotten trees 1 inch d.b.h. and larger.

Growing-stock trees – All live trees of commercial species except rough and rotten trees.

Sawtimber trees – Growing-stock of commercial species containing at least a 12-foot sawlog or two noncontiguous sawlogs, each 8 feet or longer. At least 33 percent of the gross volume of the tree must be sound wood. Softwoods must be at least 9.0 inches d.b.h. and hardwoods must be at least 11.0 inches.

Poletimber trees – Growing-stock trees of commercial species at least 5.0 inches d.b.h. but smaller than sawtimber size and of good form and vigor.

Saplings – Live trees of commercial species 1.0 to 5.0 inches d.b.h. and of good form and vigor.

Seedlings – Live trees of commercial species less than 1.0 inch d.b.h. that are expected to survive according to regional standards. (Examples of seedlings not expected to survive are those that are diseased or heavily damaged by logging, browsing, or fire.) Only softwood seedlings more than 6 inches and hardwood seedlings more than 1 foot tall are counted.

Rotten trees – Live trees (any size) of commercial species that do not contain a merchantable 12-foot sawlog or two noncontiguous 8-foot or longer sawlogs, now or prospectively, because of rot (that is, when more than 50 percent of the cull volume of the tree is rotten).

Rough trees – Live trees that do not contain at least one merchantable 12-foot sawlog or two noncontiguous 8-foot or longer sawlogs, now or prospectively, because of roughness and poor form, as well as all live noncommercial species.

Short-log (rough trees) – Sawtimber-sized trees of commercial species that contain at least one merchantable 8- to 11-foot sawlog, but not a 12-foot sawlog.

OTHER CLASSIFICATIONS

Site index – An expression of forest site quality based on the height of a free-growing dominant or codominant tree of a representative species in the forest type at age 50.

Stand-age – Age of the main stand. Main stand refers to trees of the dominant forest type and stand-size class.

Diameter at breast height (d.b.h.) – The diameter of a tree at 4.5 feet above the ground level.

Diameter class – Trees in a 2-inch diameter range, each class including diameters from 1.0 inch below the midpoint of the class to 0.9 inch above the midpoint (e.g., the 6-inch class would include trees from 5.0 to 6.9 inches d.b.h.).

TIMBER VOLUME

Cord – The amount of stacked wood contained in a pile whose dimensions total 128 cubic feet. It is equivalent to 79 cubic feet of solid wood.

Board feet – A unit of measure for lumber. A board twelve inches square by one-inch thick contains one board foot.

Volume of growing-stock – Net volume in cords of sound wood in the bole of growing-stock trees 5.0 inches d.b.h. and over, including all live merchantable sawtimber and poletimber trees of all commercial species from a 1-foot stump to a minimum of 4.0 inches top diameter outside bark, or to the point where the central stem breaks into limbs. Growing-stock volumes are shown in cords and may be converted to cubic feet by a factor of 79 cubic feet per solid wood cord.

Volume of sawtimber – Net volume of the sawlog portion of live sawtimber trees in board feet, International ¼-inch rule, from stump to a minimum 7 inches top diameter outside bark for softwoods and 9 inches for hardwoods.

GROWTH AND MORTALITY

NET VOLUME GROWTH OF GROWING-STOCK – Net annual growth of growing-stock is the change in volume of sound wood that occurred during 1976 in growing-stock trees that were 5.0 inches d.b.h. or larger at the beginning of the year,

plus

the volume of sound wood in growing-stock trees smaller than 5.0 inches d.b.h. at the beginning of the year that grew sufficiently during the year to be reclassified into the 5.0 inches-or-larger d.b.h. classes (ingrowth),

plus

the volume of sound wood in trees that had been classified either as rough or rotten trees at the beginning of the year but were reclassified during the year as growing-stock trees,

plus

the annual change in volume of sound wood that occurred during the year on growing-stock trees that died during the year,

plus

the annual change in volume of sound wood that occurred in growing-stock trees included among timber removals for the year,

plus

the annual change in volume of sound wood in trees that had been classified as growing-stock at the beginning of the year but were reclassified during the year as rotten or rough trees. Only the volume change that occurred during the portion of the year the trees were classified as growing-stock was included,

minus

the volume of sound wood in growing-stock trees that died from natural causes during the year,

minus

the volume of sound wood in trees that had been classified as growing-stock at the beginning of the year, but were reclassified during the year as rough or rotten trees.

TIMBER REMOVALS

Timber removals from growing-stock – The volume of sound wood in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other removals. Roundwood products are logs, bolts, or other round sections cut and used from trees. Logging residues are the unused portions of cut trees plus unused trees killed by logging. Other removals are growing-stock trees removed but not utilized for products or trees left standing but "removed" from the commercial forest land classification by land use change – examples are removals from cultural operations such as timber stand improvement work, land clearing, and changes in land use.

Timber removals from sawtimber – The net board-foot volume of live sawtimber trees removed for forest products annually (include roundwood products and logging residues) and for other removals.

TECHNICAL ROTATION AGE – Period of years required to establish and grow timber crops to a specified condition of maturity taking into consideration the business factors having to do with the production capabilities of the species, the character of the market for specific products, the amount of capital required for different rotations, and the rate of interest which may be earned on the capital investment.

Forest Type	Technical Rotation Age
Jack Pine	50
Red Pine	100
White Pine	100
Balsam Fir	50
White Spruce	60
Black Spruce	90
Northern White-Cedar	100
Tamarack	90
Oak	80
Elm-Ash-Cottonwood	90
Maple-Basswood	80
Aspen	40
Paper Birch	40
Balsam Poplar	40

RECOMMENDED ANNUAL HARVEST – Managing timber harvests to create an equal distribution of area among age classes within a forest type to assure a continuous annual yield of forest products. It is based on the present distribution of age classes, the total present volume of timber in the forest, and the condition of this timber. Highest cutting priority should be given to overmature stands. The basic management premise is to provide and maintain a broad, healthy forest base, where the volume of cut is fixed at the point where society benefits the most now and for the future.

Unit Table A. Volume of Growing-Stock Per Acre on Commercial Forest Land By Forest Type and Stand-Age Class
Northern Pine Survey Unit, Minnesota – 1977 (Cords/Acre)
(Does Not Include Chippewa National Forest)[1]

Forest Type	STAND-AGE CLASS (YEARS) 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-120	121+	Merchantable Average	Average All Ages
Jack Pine	6.0	2.1	7.4	12.8	15.0	15.0	17.0	13.9		14.2			15.3	12.7
Red Pine	1.4	2.0	13.9	21.9	19.7	21.8	17.8	33.8	15.4	14.7	14.3		22.3	17.8
White Pine				12.9	18.6	21.0	16.6	13.9	23.7	25.8			19.4	19.0
Balsam Fir	2.7	2.1	6.5	7.2	12.9	12.2	15.3	19.0	14.4		7.6		13.8	10.0
White Spruce		1.6	3.1			8.6	17.0		14.8				11.3	8.2
Black Spruce	1.1	1.1	1.9	2.2	6.0	7.0	6.9	6.6	8.8	7.1	4.3	8.1	7.3	4.3
N. White-Cedar	2.8	2.3	3.4	9.3	8.9	7.5	8.6	7.7	8.9	9.8	7.1	12.2	9.1	8.6
Tamarack	1.1	1.9	2.2	4.0	7.5	8.6	8.5	7.7	6.4	11.0	9.4	8.5	8.3	6.0
Oak	1.2	3.2	2.8	8.8	12.5	11.7	13.1	11.9	9.7	10.2	11.0		12.2	10.3
Elm-Ash-Cottonwood	2.6	3.6	3.0	6.0	11.6	12.7	13.9	13.1	11.2	13.1	14.3	17.9	13.0	10.5
Maple-Basswood	3.3	4.0	3.2	8.3	11.8	14.4	15.7	14.1	15.7	16.5	11.6	19.6	14.4	13.2
Aspen	2.8	3.5	7.6	11.3	15.0	15.4	14.8	14.3	17.3	18.5	11.8	22.5	15.1	11.5
Paper Birch	2.3	3.9	6.3	12.1	13.2	12.1	14.3	15.8	17.4	15.9	15.4		13.4	12.5
Balsam Poplar	2.2	2.5	5.5	7.5	13.4	13.9	14.5	11.1	28.8				13.7	8.7
Nonstocked	0.4				1.3								1.3	0.5
All Types	**2.3**	**3.0**	**5.9**	**11.1**	**13.9**	**13.8**	**14.1**	**13.6**	**11.8**	**13.8**	**10.1**	**12.6**	**13.7**	**10.7**

[1] Inadequate stand-age distribution of National Forest Land data.

Unit Table B. Percentage of Growing-Stock Volume on Commercial Forest Land By Species Group Within a Forest Type
Northern Pine Survey Unit, Minnesota – 1977
(Does Not Include Chippewa National Forest)[1]

Species	FOREST TYPE Jack Pine	Red Pine	White Pine	Balsam Fir	White Spruce	Black Spruce	Northern White-Cedar	Tamarack	Oak	Elm-Ash-Cottonwood	Maple-Basswood	Aspen	Paper Birch	Balsam Poplar	All Types
White Pine	.4	6.6	51.3	1.1	5.3	.1	.1	.6	.7	.2	1.0	.7	1.9	.2	1.2
Red Pine	6.8	68.2	19.7	2.1	3.8			.4	1.7		.2	1.9	4.0	.1	3.4
Jack Pine	81.2	8.4	5.7	1.2	20.7	.5	.1	.8	3.4	.1		2.5	2.4	.5	7.5
White Spruce	.3	.8	1.6	3.2	27.8	.4	.4	.3	.3	.5	.6	.9	1.0	.9	.9
Black Spruce	1.3	.4	.8	4.9	3.0	69.2	10.5	9.6		.2		.3	.4	.4	2.4
Balsam Fir	.6	2.6	4.3	46.7	13.8	4.2	7.0	1.6	.3	5.2	4.6	4.1	6.7	8.0	5.6
Tamarack	.1	.2		3.8	2.6	15.9	6.7	78.8	.1	.8	.1	.3	.4	1.9	3.3
N. White-Cedar				7.3	5.2	4.3	65.4	2.3		3.8	.5	.2	1.6	1.2	2.6
Other Softwoods						.2								.1	
Total Softwoods	**90.7**	**87.2**	**83.4**	**70.3**	**82.2**	**94.8**	**90.2**	**94.4**	**6.5**	**10.8**	**7.0**	**10.9**	**18.4**	**13.3**	**26.9**
White Oak	.3	.2	1.0	.4	.3			.1	15.1	1.5	3.7	2.6	1.6	.8	2.6
Red Oak	.9	.8	.4	.1		.1			43.1	.3	5.3	3.2	5.6	.2	4.7
Hickory									.1				.1		
Yellow Birch										.3	.6	.1	.1		.1
Hard Maple			.7						.6	.3	14.0	.7	1.1	.4	1.9
Soft Maple		.1	.1	.4		.2		.1	1.5	3.1	3.7	.8	1.2	.1	1.1
Ash		.1		1.8		.4	2.5	.3	1.0	52.3	8.9	2.0	3.1	4.8	5.1
Balsam Poplar	.2	.6	.2	4.5	4.5	.1	1.8	1.7	.4	5.7	2.1	4.7	3.6	54.9	5.8
Paper Birch	2.3	3.8	8.2	11.6	3.4	1.2	4.6	1.6	11.5	6.0	10.2	9.1	46.6	5.4	10.6
Aspen	5.5	7.0	4.5	9.9	9.6	3.1	.8	1.4	14.3	4.7	7.5	61.9	13.2	16.0	34.0
Basswood			1.5	.3					4.2	2.8	25.9	2.1	2.6	.8	4.1
Elm	.1	.1		.7		.1	.1	.4	1.2	12.1	10.7	1.8	2.7	3.3	3.0
Other Hardwoods		.1							.5	.1	.4	.1	.1		.1
Total Hardwoods	**9.3**	**12.8**	**16.6**	**29.7**	**17.8**	**5.2**	**9.8**	**5.6**	**93.5**	**89.2**	**93.0**	**89.1**	**81.6**	**86.7**	**73.1**
All Species	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

[1] Inadequate species group distribution of National Forest Land data.