The Board of Examiners,
Association of British Columbia Foresters.

Dear Sirs:

I herewith beg to submit the manuscript of a thesis,

"Forest Survey Report and Recommendations for Sustained Yield Management of the Drainages of Phillips, Apple, and Stafford Rivers, and Upper Loughborough Inlet",

as partial fulfilment of the requirements for registration with the Association of British Columbia Foresters.

Yours respectfully,

Victoria, British Columbia,
October 31st, 1954.
FOREST SURVEY REPORT
AND RECOMMENDATIONS FOR
SUSTAINED YIELD MANAGEMENT
of
the Drainages of
Phillips, Apple, and Stafford Rivers,
and Upper Loughborough Inlet.

by
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A thesis submitted
in partial fulfilment
of the requirements for registration
with the Association of British Columbia Foresters.

Victoria, British Columbia,
1954
Foreword

The author is indebted to Mr. H. M. Pogue, Forester i/c of the Surveys and Inventory Division, B. C. Forest Service, for the permission to use the files, maps, aerial photographs, and equipment of the Division, thus providing the basis of this report.

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All ground photographs were taken by the author during the field survey in 1952.
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Pictorial Appendix
PHILLIPS, APPLE, AND STAFFORD RIVER DRAINAGES

Scale 1:250,000
2 Introduction

21 Purpose and Scope

The subject of this report shall be, after a short description of area and forest cover, to suggest a possible development of these forests according to present knowledge and experience in management and silvicultural treatment, resulting in a continuous and improved yield.

An area was selected which contains a certain compactness and capability to produce merchantable timber, including all technical and commercial problems, yet staying within capacity limits of Lower Coast operators.

22 Main Source

The survey of the area concerned was carried out by the B.C. Forest Service, Surveys and Inventory Division, in the summer of 1952.

Air photographs, taken in the years from 1947 to 1951, and photo lay-down maps served mainly to establish type lines and randomly chosen samples in mature forest types. Maps of a survey carried out in 1930 to 1932 were used as a basic guide, but data given on them were often found misleading and rather approximate.

Boundaries, type lines, coast lines, creeks, rivers, and other information were Karl plotted from the photographs onto the lay-down maps with a scale of 1 inch = 40 chains. A grid planimeter was used to measure the area of compartments, forest types, lakes, and other basic types.

The volume of mature timber types was calculated on a per acre basis by samples consisting of four circular one quarter acre plots,
two chains apart from a common centre, and tied in by a strip run with topographic chain and Abney level from a point easily recognizable on a photograph. Trees were tallied by 2-inch classes, and were distinguished as residual, suspect, or dead, the latter further classified as "with potential use" or "useless" (see 452).

No samples were taken of immature, non-commercial, and not sufficiently restocked (NSR) types, but information on them was laid down on code sheets.

It is thought advisable, however, to consider the given figures not strictly valid, because of the lack of time during the survey the number of samples taken was insufficient by statistical rules. Some forest types and type groups had to be calculated on the basis of samples taken in similar stands outside the area.

Also, classification of the forest cover could not be done on the ground over the entire area and had to be supplemented by photo interpretation.

23 Summary

231 Classification of total area (see table in Appendix)
232 Table of Forest Productive Area (see table in Appendix)
233 Map of type groups (in Appendix)
234 Result of this report

Not even a third of the total area of close to 300,000 acres can be considered forest productive. Almost all of this is covered by mature or overmature timber, while the area of immature stands remains proportionally small. The area not sufficiently restocked after logging is negligibly small.
The main type of timber is pulp which with some mixed-in cedar covers more than three quarters of the productive area. Timber of better quality likely will not exceed 20 p.c. of the present total volume, which was calculated as being about half a billion net cubic feet.

The average net volume per acre in all types is close to seven thousand cubic feet. The annual allowable cut in a 100-year rotation is given as about six million cubic feet.

3 Description of Area

31 General Location

The area to be described by this report is located about 130 miles northwest of Vancouver. Here the main land and Vancouver Island are separated from each other only by narrow channels and a singular chain of islands.

Roughly the area consists of the drainages of three small rivers, the Phillips, Apple, and Stafford, and of the upper, northern half of Loughborough Inlet. Both Knight and Bute Inlet with their own drainage systems frame the area naturally on three sides, with the remainder of Loughborough Inlet, Johnston Strait, and Phillips Arm to the south.

The area is part of Region 31, B.C. Forest Service Inventory Area Reference System, and consists of compartments 5, 6, 7, 11, 12, 13, 14, and 15 thereof.

32 Boundaries

From the mouth of Phillips River the boundary runs along the
southern and western limits of lots 381 and 559 and the northern
and eastern limit of lot 56c until it meets the height of land
north of Shirley Creek. From here the boundary follows the divide
between Phillips River and Frederick Arm, Estero Basin, and Bute
Inlet in succession. General direction at first is east, then
northeast, then northwest. The height of land between Bute Inlet
and Apple and Stafford Rivers, respectively, is followed until it
meets the divide between Bute and Knight Inlet.

Here the most northern point within the area is reached, and
the boundary now follows the divide between Stafford River and
Knight Inlet in generally southwestern and later southern direc-
tion, until it reaches the closest point to the northwest corner
of lot 1097. From here the boundary is determined by the western
and southern limits of lot 1097 and the eastern and southern limits
of lot 1092. From the southwest corner of the latter the boundary
then follows the divide between Knight and Loughborough Inlet
until it meets the eastern limit of Timber Licence 196c.

In succession as described the northern and eastern limits of
Timber Licences 1961, 6262, 12073, and of lot 93 are followed
down to the shore of Loughborough Inlet.

From here the boundary goes north for about a mile and a half
until near Campbell Point it follows the southern limits of
S. T. L. 35129, 35130, and 35132 up to the height of land between
Poison and George Creek. This divide is followed until its end
at the divide between Phillips River and Loughborough Inlet.

The boundary follows this and a short distance later the divide
between Phillips Arm and Phillips River until it meets the northern
limit of Timber Licence 3723, follows it to the west, south, and then east until the northwest corner of Timber Licence 6470, thence south along its western limit and east until it meets lot 360, along its western and northern limits down to the shore of Phillips River, from there across to the point of beginning.

Two rugged mountain ranges divide the drainages of the three main rivers from each other, therefore it was felt to be convenient to split the area into three nearly equal parts by means of these divides. Within the whole area as a management unit these three parts can be treated as operational units or Logging Blocks. Management of these is limited only by the given figure of the allowable annual cut of the whole management unit. Thus any treatment may be applied so long as this figure is not exceeded.

Logging Block 1 consists of compartments 5, 6, and 7 and includes the whole Phillips River drainage. Its boundary with Block 2 is the height of land between Phillips and Apple Rivers and part of Loughborough Inlet as far south as the boundary of the entire management unit.

Logging Block 3 consists of compartments 13 and 14 and as such comprises the drainage of Stafford River.

Its boundary with the central Logging Block 2 first consists of the height of land between Stafford and Apple Rivers as far south as the shore of Loughborough Inlet below Mt. Henry. From here the boundary goes south and to the western shore of the inlet towards the southern limit of Timber Licence 6624. From here the boundary is determined by the southern and western limits of Timber Licenses 6624, 4303, and 6622 until it meets
the eastern limit of lot 1093 and with it the boundary of the whole area as described above.

Therefore, Logging Block 2 consists of compartments 11, 12, and 15, taking in the drainage of Apple River and both sides of upper Loughborough Inlet.

33 Climate

Due to its geographical location the climate of the area can be determined as typical northern temperate with strong oceanic influences. This means a high amount of precipitation with a winter maximum, and a small range of temperatures; hence a cool and, further inland short, summer and a mild winter with heavy snow fall.

Chapman differentiates Köppen's three classes Cfb, Dfb, and Dfc within the area which might be supplemented by class E, polar, for all elevations above 5000'. These, however, are restricted to small areas along the divides.

Cfb determines a warm temperate (average of coldest month more than 26.6°F) rainy climate with no distinct dry season (driest month of summer with more than 1.2" rain) and a cool summer (average of warmest month less than 71.6°F). This climatic class lies within the area in form of a more or less narrow belt and is confined to the sheltered lowlands near the coast. The weather station at Roy in Loughborough Inlet registers an average precipitation of 82 inches (2083 mm) per annum with a minimum of 2.8" in August and a maximum of 11.9" in December, and the temperature at Thurston Bay on Sonora Island is as follows:


The amount and annual distribution of precipitation in both D climates is more or less the same. The difference to the former class rather is given by temperature. The average temperature of the coolest month is less than 26.6°F, and in a Dfc climate there are less than four summer months with an average of more than 50°F.

Of course, these two climatic types follow the former with increasing distance and elevation from the coast. They are more or less strongly influenced already by the influx of continental air through low gaps in the Coast Range, especially during the winter. Snow cover at Fraser Bay often reaches ten feet during one season.

34 Geology

The bedrock of the whole area largely consists of the Coast Range batholith and probably was intruded in the Upper Jurassic. The roof-pending, under which this was pressed by volcanic forces in the form of magma, has almost completely been eroded and exists only in very small patches and narrow strips.

All larger valleys within the area are the result of the abrasive forces of pleistocene glaciation, which reached up to an elevation of about 4000'. Glaciers created U-shaped valleys, cirques of all sizes, and many other typical forms of glacial action. A glacial creation of certain importance are numerous "hanging valleys", which in their almost flat parts represent
valuable forest and even agricultural land.

Minerals are mostly granite, gneiss-diorite, diorite, and gneiss, therefore more or less acidic. The investigated patches of the roof-pending usually revealed limestone and similar minerals heavily converted by contact metamorphosis and interspersed with quartz veins.

35 Topography

The proportionally young age and the decayance-resistant qualities of the bedrock can be counted upon as main reasons for the ruggedness of the country. The broken hillsides rise very steeply from the sea, and the valleys, particularly all secondary ones, are very narrow, short, and steep.

Only near the mouths of the three rivers there are flats, although of very small extent.

Sheer rock bluffs of all sizes are found frequently throughout. Nearly all creeks and rivulets run at all times, since snow does not melt away completely in elevations above 4000' on northern exposures and above 5000' even on southern exposures. All three rivers are fed mainly by small glaciers at their heads. Both Stafford and Phillips River form narrow lakes near their mouths, both about 20' above sea level.

The main direction of the ridges is NW to SW, and secondary ridges spread almost perpendicularly from this direction.

All three rivers run west first and southwest or south later. Numerous small lakes and ponds are found at all elevations. Swamps and sloughs have formed near the rivers' mouths.
Elevations range from sea level to about 7000' throughout the area.

36 Access and Settlement

The only way of access to this area is by boat and aircraft. Short logging roads are built only at the mouths of Stafford and Phillips River. None of the three rivers is navigable because of log jams. Stafford River has falls of about 12' two miles above the mouth. The entrance into Phillips River is barred by sand banks and open only at high tide through a narrow channel which is marked by a target on shore.

Nearest ports of call for a weekly steamship service are Shoal Bay on East Thurlow Island, Blind Channel on West Thurlow Island, and Hayden Bay in Loughborough Inlet. Nearest place serviced regularly by aircraft is Shoal Bay. Post Offices and general stores are located at both Shoal Bay and Blind Channel. The Post Office of Bay in Loughborough Inlet was not rebuilt after it burned down years ago.

Settlement within the area is scarce. Only a handful trappers and fishermen live permanently at the heads of Phillips Arm and Loughborough Inlet. The lack of adequate transportation and distance to markets so far have prevented farm settlement. Cattle raising has previously been tried in the area but has failed because of degradation by bees. Yet soil and climatic conditions prove to be suitable for intensive farming, gardening, and pasture development.

Two logging camps are on Phillips Lake and Fraser Bay.
37 Present Ownership

Timber licences covering about ten per cent of the forest productive area are held around Phillips Lake and Fraser Bay, nearly all of them by the same companies who are the most probable future holders of a Forest Management Licence of the whole watershed. Therefore, no regard was given to these licences while calculating area and volume into the allowable annual cut of the area.

There are no Timber Sales in this area except for two narrow strips along the shore line of Loughborough Inlet where hand logging is still being practised.

The area of privately owned lots is negligible compared to the entire area.

Most of the area either belongs to the Crown, or is Provincial Forest Reserve, and therefore it was felt most convenient to handle the whole area as one management unit.

38 Power Supply

Both Phillips and Apple Rivers have valleys too wide and with too slight a grade to be considered a future source of power.

Stafford River, on the other hand, represents quite a possible site for damming and storage as a power source. About thirty years ago a hydrographical survey of this river was made and resulted in a realizable plan which would use Stafford Lake as part of the reservoir, increased by a dam near Horseshoe Falls, about two miles from the river's mouth. A power house site most suitable was found on the north shore of Fraser Bay at the foot of Mt.
Henry. Potential capacity after development is given with 12,070 hp.

Numerous small streams which do not run dry in summer are reliable sources of water power for small projects as they are used by logging camps and saw mills already.

33 Wildlife and Recreation

The abundance of both Black and Grizzly bear makes deer scarce throughout the area. Mink, marten, and other small fur-bearing animals provide fair trapping. Mountain goat is said to occur in Bassetgette Range and on Mt. Henry.

Various kinds of salmon are caught at the mouth of Phillips River, and Stafford River and Lake are rich in trout. Phillips Arm and Loughborough Inlet provide good fishing for both commercial gill netters and sport fishermen.

Gude, badly grown-over trails exist only a few miles up the three rivers; on Phillips River about four miles past the lake, on Stafford River to the Lake only, and along Apple River for about three miles.

4 Description of Forest

41 Tree Species

41.1 Pseudotsuga taxifolia Britt., Douglas fir, Symbol F, finds its northern limit within the area. In no place a dominant species, it usually is confined to steep and rocky south exposures, where it forms rather open stands with hemlock and occasionally cedar. Only these sites can be considered as fir sites.
The plentiful occurrence of fir in present immature stands, however, shows that fir acts as a pioneer species, or one of an early successional stage, over a much more extensive area than it appears in older stands.

For example, there is a large immature stand west and north of Phillips Lake and partly above an old cedar-hemlock-balsam stand. It was established after a fire about 100 years ago and in parts consists almost of pure fir as dominant and codominant species. Only the dense and uniform understory of hemlock and cedar and their predominance on north exposures and in numerous creek draws led to classify this stand as hemlock-cedar-fir.

The further development of this stand will doubtlessly be towards a mixture of hemlock, cedar, and fir, with growing emphasis on the two first species. Fir will fade out more and more since it does not, at least not on the coast, regenerate in shade and on unexposed ground.

This course of a natural succession is pointed out by the generally sparse occurrence of huge fir snags and stumps in very mature hemlock-cedar-balsam stands throughout the southern half of the area. (See page 7 of pictorial appendix).

The quality of fir is poor, of course, on the above mentioned south exposed sites. Trunks are short and limby, although healthy, and thus are subject to frequent snow and wind damage. Living and dead specimens found on better sites consisting of deep, fresh, and well-drained soils in creek bottoms and on level plains of the lower slopes had long, straight, and clean trunks of good quality.
412 Thuja plicata Donn., Western Red Cedar, symbol C, is the dominant species of all creek bottoms, draws, and poorly drained parts of the "hanging valleys", where often it forms pure stands of limited extent. Undergrowth of these "cedar swamps" consists of scattered balsam fir, yew (Taxus brevifolia), and devil's club (Oplopanax horridum). Skunk cabbage (Lysichiton kamtschaticus) indicates stagnating moisture of high acidity. Such swamps are found in Wickson, Latelle, and a third unnamed creek which all drain through hanging valleys from southeast into Loughborough Inlet.

Usually, however, cedar is a more or less important part of nearly all mixed stands in this area, tending to form small pure patches with hardly any undergrowth. A large amount of thrifty trees which appeared to be healthy were found along Meadow Creek, and young specimens in good shape just about everywhere. Old vets, of course, were hollowed and spike-topped.

4131 Tsuga heterophylla Sarg., Western Hemlock, symbol H, by far the most important species of this area with more than a third of the entire volume, is found almost equally distributed. It is the most common understory species and as such often forms very dense thickets. Together with cedar and balsam fir as secondary species, it covers nearly 90% of the area in large, very often already decadent and uneven-aged, stands of a very late successional stage.

After Douglas fir, it is the most common species of the immature stands. It dominates where no fire had exposed the
ground, and its tremendous regenerative power covers the ground and even old fallen snags with a dense carpet of seedlings just about every year. There the only competition arises from the even more tolerant balsam fir which predominates on very shady and wet north slopes.

Quality is medium to good in most of the sites, poor in badly suppressed stages, on rocky south slopes, and in higher altitudes. Best quality found was near the divide in Meadow Creek, where it is part of a considerably large stand mixed with cedar, balsam fir, and Sitka spruce. Here all four species grow very tall and straight and except for cedar are noted for little taper.

4132 Tsuga Mertensiana Carr., Mountain Hemlock, is confined to elevations above 2500' where it substitutes Western Hemlock in mixed stands with balsam fir and cypress. If of any commercial value at all, these stands usually are quite inaccessible. Most of these stands, however, belong to the upland scrub type.

414 Abies amabilis Forbes, referred to as Balsam Fir in this report, symbol B, is of secondary importance only. Mixed with cedar and hemlock it represents an integral part of these stands, but rarely becomes dominant. Few pure stands of rather small size have been noticed. The importance of this species is merely a silvicultural one, since by ready and easy deterioration of its needle litter it saves the soil from accumulating undecomposed litter which would form a thick raw humus and become increasingly acidic. By preventing this dangerous situation balsam fir serves an important purpose and should
be left as an understory species, even if the wood is of rather poor utilization value.

415 Picea sitchensis Carr., Sitka Spruce, symbol S, occupies the area to a limited extent only. In one type group it occurs on alluvial soil along the bottoms of the three main rivers in very open stands, surmounting a second story of cottonwood, cedar, balsam fir, and often a third of balsam fir, alder, willow, aspen over a very dense thicket of devil's club, salmon berry, elder berry, cedar regeneration, and other shrubs. The enormous scattered spruce grow linky from the ground and thus have little value as timber (see pages 4 and 5 of pictorial appendix).

In the other type group spruce leaves a completely different impression. In a rather dense stand and with competition of hemlock, balsam fir, and cedar, the spruce grows like the two first ones straight, clean, with little taper, and very tall, though they are never that numerous to make it a dominant species in volume. Such a stand was found at the height of land on Meadow Creek between Knight Inlet and Stafford River, and partly along this and Apple River, and to a smaller extent along Phillips River. It never is found, however, more than a few miles from the sea inland. There it fades out and in stands is replaced by balsam fir.

Quality of investigated trees was found to be good and sound.

416 Chamaecyparis nootkatensis (Lamb) Spach., Yellow Cedar or Cypress, symbol Cy, is of minor importance only. It occurs
very rarely in altitudes below 3000', and thus merchantable stands are inaccessible or confined to small pockets in cirques, as found east of Phillips Lake half way up to the summit of Mount Jones. Usually it was found in the wettest locations on steep west and north slopes scarcely exposed to sunshine. Here it forms, together with various species of Vaccinium, a dense underbrush and understory.

Accompanied by slide alder, Alnus sinuata (Nelson) Sarg. (Alnus sinuata), both creeping downhill as a protection against snow breakage, it covers vast areas just below the alpine zone and down numerous slides.

Further back in the valleys of the three main rivers and their large tributaries cypress is an integral part of secondary importance in open hemlock-balsam stands which are subject to regular snow damage.

An interesting stand was found along Meadow Creek. Here cypress comes down to near sea level associated by cedar and hemlock, some balsam fir and mountain hemlock in a very open stand. The ground is covered by a six feet high thicket of Vaccinium ovatifolium and V. parvifolium allowing no regeneration of any one tree species. Most likely this is a much later successional stage of a former cedar-hemlock or hemlock-balsam stand affording an example of how such stands might develop if undisturbed.

4171 Pinus monticola Dougl., Western White Pine, symbol Pw, was not found in this area but might occur sporadically in its southern part.
4172 Pinus contorta Dougl., Lodgepole or Shore Pine, symbol Fl, is found occasionally along the shore of Loughborough Inlet on dry rock outcrops. It has no importance whatsoever.

418 Populus trichocarpa T. & C., Black Cottonwood, symbol Cot, can be found along the three main rivers on alluvial soil, being a part of the above described spruce stands. It can attain considerable height and volume and thus should be taken into consideration as a valuable commercial part of the stand.

419 Also apparent on the same site are Alnus rubra Bong., Red Alder, and Populus tremuloides Michx., Aspen, which together with various species of willow are pioneer species on alluvial soil, e.g. river sand banks etc. There they play an important role of fixing the ground against being washed away and prepare the soil for more commercial species of later successions.

42 Soil Types

According to bedrock (see section 34 Geology) and climate there is hardly any basic soil in this area, except perhaps in small patches where the roof-pending, a highly metamorphosed limestone, is still existent at the surface. These areas, if any, will be rare and of little extent.

By far most of the forest productive area concerned is covered by a more or less heavy layer of glacial drift consisting of well-rounded rocks of all sizes, gravel, and sand bound by scarce amounts of clay or loam.
Although no soil profiles were taken, cut banks etc. offered a view of the extent and depth of the more important zones near the surface. Generally it could be stated that the soil of the forest productive area has reached maturity, with a humus-enriched zone of up to two feet depth. On exposed south slopes, a tendency towards soil deterioration by desiccation was observed.

Podsolization is the main soil forming process in this region, but its development rarely reaches a condition of a severe podsol. Only once, on top of a small plateau above Phillips Lake, about 2000' high, under a stand of poor balsam fir and mountain hemlock, a layer of about one foot of raw humus typical of a cool-humid climate with snow covering the ground for at least five months, was found, and led to the conclusion that there might be more of these conditions in the same elevations.

The best soil type, occurring on the lower, near level or moderate slopes of the three rivers; likely is almost neutral and at least six feet deep.

43 Site Quality

The area of a really excellent site, if any, is very small due to climatic and topographical conditions. It covers approximately the same area as described in section 42 for the best soil provided that the drainage is good. Much of the better site especially in hanging valleys is spoiled by the lack of drainage and has developed into a cedar swamp.

On the other hand, an extensive area of poorer site covers a large part of the area. High snowfall and steep slopes invite
the frequent occurrence of mountain slides which usually remove
the whole soil layer leaving the bedrock. Accumulation of soil
and humus on these bare mountain sides is slower generally than
on locations where fire had denuded the soil, despite erosion
by runoff.

Forested sites are on dry, rocky, exposed knolls near the
shore and on steep mountain sides, particularly with southern
aspect.

44 Forest Types (see map 233 in appendix)

Six Type Groups as species combinations are distinguished
within the area concerned, according to the rule that at least
20% of a species participates in the stand volume, and according
to main utilization and merchantability. These six groups are:

- Fir plus pulp;
- Fir-Cedar;
- Cedar plus pulp;
- Pulp;
- Spruce (river bottom);
- Deciduous.

The extent and volume of these type groups is given in tables
232 and 521-523 in the appendix, and additional information can
be obtained from the description of the individual tree species
in section 41.

Generally, the largest type and, therefore, the most important,
is Cedar plus pulp, covering more than half of the entire forest
productive area.
The Pulp type, consisting mostly of hemlock, balsam fir, and some spruce, is about half as extensive.

Third in size is the Fir-Cedar type with about an eighth of the productive area. This type often contains very little fir due to overmaturity of the stand. Nevertheless, it is thought advisable to consider this type as primarily Douglas fir, at least because of the higher value of this species. An establishment of a new timber stand on the site of this type group recommendedly will put emphasis on Douglas fir striving for a valuable fir-hemlock-cedar mixture.

45 Infestations and Diseases.

451 Infestations

The area in general can be considered calamity proof. So far no serious damage has been reported or noticed.

Loughborough Inlet was sampled in 1951 and again in 1953 by the Forest Insect Survey. Insect conditions in the Inlet area are good, with all species present in low population numbers.

Lambdina f. lugubrosa Hbst, Hemlock looper, was present both years with no real change in the number of collections. However, this insect is capable of destroying large amounts of hemlock trees and should be carefully considered.

Neodiprion tsugae, Hemlock sawfly, is also present in the inlet area but is causing no damage. Large numbers of Melampsophia imitata Wlk., green-striped Forest looper, were found in 1951, but no larvae were collected in 1953.
Others insects present in the area in 1953 were: Notropis crepuscularia (Saddle-backed looper), Hemichroa crocea Fourc. (Striped elder sawfly), Pisonema alaskensis (Yellow-headed spruce sawfly), and Pisonema diimockii (Green-headed spruce sawfly).

452 Diseases

On disease, the same can be said as was about insects. Stands in general appear sound and thrifty, at least up to around 200 years of age.

Older stands, of course, are in a more or less far progressed stage of deterioration and break-up. In a very advanced stage of overmaturity and decadence are the cedar-hemlock stands west of the mouth of Phillips River, where balsam fir increasingly gains ground, and the under section 416 mentioned stand of cedar, cypress, both of the hemlocks, and balsam fir, south of Meadow Creek.

In both these deteriorating stands are many hollowed and spike-topped old Douglas fir and cedar trees. But these can not be considered contaminated by a serious, dangerous disease but rather are decrepit and ready to die.

No stands were found affected by any fungal calamity, only singular scattered trees.

When taking samples in mature timber stands only trees with no visible defects or failures were counted as "residual". Forks, scars, conks, pronounced crooks, woodpecker holes, dead or broken tops, frost cracks, butt swellings, mistletoe infections, and cankers in any degree inevitably led to characterize a tree "suspect".
5 Summary of Logging Blocks (see Appendix)

51 Classification of Total Area of

511 Logging Block 1
512 Logging Block 2
513 Logging Block 3

52 Tables of Forest Productive Area showing acreage, volume, volume per acre, and percentages of mature timber stands by Type Groups and species, of

521 Logging Block 1
522 Logging Block 2
523 Logging Block 3

53 Type Maps

Attached type maps of the whole area at a scale of one inch equals half a mile show the forest productive area coloured according to type group and age of immature stands.

Following colours and patterns were used:

<table>
<thead>
<tr>
<th>Description</th>
<th>Colour/Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fir plus pulp</td>
<td>light blue</td>
</tr>
<tr>
<td>Fir-Cedar</td>
<td>orange</td>
</tr>
<tr>
<td>Cedar plus pulp</td>
<td>light green</td>
</tr>
<tr>
<td>Pulp</td>
<td>yellow</td>
</tr>
<tr>
<td>Spruce (river bottom)</td>
<td>light brown</td>
</tr>
<tr>
<td>Deciduous</td>
<td>dark green</td>
</tr>
<tr>
<td>M.S.R. (see sec. 8115)</td>
<td>red</td>
</tr>
<tr>
<td>Age up to 20 yrs.</td>
<td>dots</td>
</tr>
<tr>
<td>Age 21 - 60 yrs.</td>
<td>hatched horizontally</td>
</tr>
<tr>
<td>Age 61 - 120 yrs.</td>
<td>hatched vertically</td>
</tr>
</tbody>
</table>

A secondary stand of mature timber over a main immature stand
is shown in alternating hatches according to their type group and age of the immature stand.

Others symbols shown on the same type maps:

\[\begin{align*}
\mathbb{A} & = \text{Alpine, heather}, \\
\mathbb{X} & = \text{Upland scrub}, \\
\mathbb{R} & = \text{Rock}, \\
\mathbb{L} & = \text{Lake}, \\
\mathbb{S} & = \text{Swamp}, \\
\mathbb{S} & = \text{Slide}, \\
\mathbb{E} & = \text{Logging road}.
\end{align*}\]

6 Forest Utilization

61 Accessibility

Access to the area is poor. The shoreline is broken and rugged, often very steep. None of the rivers is navigable, except for a short distance during high tide. A possible use for drifting logs is not given because of many log jams, rapids, and falls in their course.

Phillips River can be entered in high tide up to the first island, about half a mile from the mouth. There a little harbour on the right-hand side offers shelter, and a gravel road leads up to Phillips Lake. There are a few small boats on the lake. A trail starts from the other end of the lake where the river passes a small lagoon, and follows the river on its west bank. It is in good shape for approximately two miles, after that it is badly overgrown and soon after just a blazed trap line with a few side branches going up some tributaries.
Apple River can be entered during high tide until past its junction with Mink Creek. A once good trail has not been maintained for about 25 years and is almost useless. It follows the river’s south bank for about three miles.

The four miles to Stafford Lake up Stafford River can be covered about half way by means of a logging road leading towards Meadow Creek. From its end a good trail runs alongside the river to the south end of the lake where it ends at a newly built cabin. The lake can be crossed by a cedar raft moored near the cabin. An old, fallen-in cabin marks the start of a trail from the other end of the lake, following the river on its east bank for a few miles. This too is badly overgrown and has not been maintained for years.

The main road from Fraser Bay leads up Fraser Creek for about two and a half miles and marks the extent of a Timber Licence logged off up to 1955.

62 Utilisation

621 History

Along the shore line of Loughborough Inlet, hand-logging is still practised to a small extent. Nearly all timber suitable for hand-logging has been removed and leads to an extensive hemlock regeneration under scattered old growth (see sec. 615).

A second strip was high-graded by A-frame wherever it was possible. A shingle mill was operated at the mouth of Vickson Creek until about 25 years ago.

What was left behind in this zone has been logged in recent
years, using mostly tractors for hauling. This is done on both sides of the inlet.

The comparatively large flat areas around the mouths of both Phillips and Stafford Rivers have also been logged clear in recent years. During the four years, 1947 to 1950, when operations ceased, about five million cubic feet were taken off from land at the mouth of Stafford River, with main species being cedar, hemlock, Douglas fir, and balsam fir amounting to 47, 33, 10, and 9 per cent, respectively, of the total net volume.

During the six years, 1947 to 1952, about three and a half million cubic feet were cut around Phillips Lake and down to the river's mouth, with hemlock, balsam fir, cedar, and spruce making up 42, 24, 17, and 9 per cent, respectively, of the total, the remainder being Douglas fir and cottonwood. Logging proceeds now along the shore of Phillips Lake by A-frame.

Logging operations have ceased in the valleys of Stafford and Apple Rivers.

622 Present Crop.

Utilization of mature timber will mostly be for pulp and related products. A much more intensive survey will have to be carried out in order to obtain an accurate estimate of the volume and proportion of saw timber and other high grade products.

Its proportion hardly will be more than twenty or even ten per cent of the total volume, main species being hemlock, spruce, cedar, and Douglas fir.

Of the minor products, there should be an abundance of cedar pole material, due to the high percentage of cedar present in
the area. However, butt rot is frequent even in trees of small size and lessen quality considerably. It is doubtful whether cedar poles by long butting would warrant a main crop in any part of the area.

623 Immature Timber.

Proposed thinnings (see sec. 622) will bring a certain amount of Douglas fir material suitable for ties and small pilings. Long piling does not occur in any abundance.

Of the younger stands, mostly hemlock and cedar will be cut in thinnings and, if there is no market for their sizes, must be left on the ground. But they should be opened up by a road system before maturity and thus enabling utilization of thinnings as pulp and minor products.

63 Logging and Transportation

631 Proposed Road Systems.

Road construction is only feasible along the main rivers. The forest productive area of each logging block will be made accessible with good logging roads alongside Phillips, Apple, and Stafford River. With some secondary roads laid up the main tributaries and less steep sidehills, development of the area will be accomplished.

Two ways are open to connect the area with adjacent ones, both are low divides with low adverse grades. One is a side creek four miles from Phillips Lake up the river on the east side, connecting with Moh Creek of Bute Inlet. Road construction along this route would be difficult for a short distance about
half a mile from Phillips River, where the valley is canyon-like with steep rocky slopes and slides on both sides. The large amount of good pulp and timber available on both sides of the divide would more than compensate for additional expenses.

The other is an equally low pass up Meadow Creek towards Knight Inlet. Here road building would present few difficulties since the valley is fairly wide, and ground conditions are favourable except for the steep grade down to Knight Inlet. A road from Fraser Bay has been established part way along this proposed route.

Gravel suitable for road surface exists all the way along the rivers, but with the exception of Stafford River there are no benches where it could be obtained and loaded by gravity. It would have to be lifted by crane, the best sites being the bottom of Phillips Lake, and the deltas of all three rivers. Near Fraser Bay gravel has been obtained in the past from a moraine north of Fraser Creek half a mile from shore, by sifting and cracking glacial drift of high rock proportion.

A road system on the east side of Loughborough Inlet presents a different problem. Here all creeks come out of hanging valleys with an acute drop into the inlet. Since the best site along Apple River would be its south bank, it might be suggested that a link be made with another road leading up the moderately steep sidehill from Heard Point to the south. It would cross the side creeks, such as Vickson and Latelle, about 300 ft. above sea level, thus avoiding the steepest and rockiest parts of the shoreline. From this main stem side roads could lead up the
creek and sidehills. Glacial drift is heavy in this part and should make construction fairly easy.

Total length of a proposed primary road system would consist of approximately 25 miles in Logging Block 1, 26 miles in Block 2, and 25 miles in Block 3, totalling 74 miles for the whole area. The total length for all secondary roads will likely amount to at least the same figure.

All primary roads should be kept in good shape so that they can serve at all times as access roads in case of fire.

632 Logging and Hauling.

Some form of a high-load system will have to be employed due to rough topography. This system will apply for all mature timber stands.

Where the surface is less broken and slopes only moderately steep, or in flat river bottoms, and for all thinnings done in immature stands, a method easier on soil, minor vegetation, and timber left standing, is advisable. More selective cutting should be strived for even in mature stands where hauling could be done by tractor. Where minor products are to be removed and where little disturbance is desired, horse logging should be used.

For the steepest and most inaccessible parts of the area, e.g. small plateaux on top of ridges between side creeks of Phillips River and east of the inlet, the only feasible logging method is by skyhook (Wyssen crane). Timber found on these sites often was of good quality and worth logging.

Hauling may be done by either tractor or rubber-wheeled crawler, as has proved successful on moderate slopes, and truck hauling
from landings will be the main method employed. Goodumping sites on the ends of the proposed roads exist in Fraser and McBride Bays on the inlet, and Phillips Lake.

633 Sorting and Towing.
The same sites are suitable as sorting grounds; the ones in Loughborough Inlet will also serve as booming grounds. They were used for that purpose in previous operations, and in Fraser Bay facilities are still present.

In Phillips Lake, sorting facilities are maintained near the outlet by one operator who also runs a towing barge on the lake. He has done an admirable job of digging a mile-long canal from the river’s mouth to within 100 yards of the lake. The canal is about 30 feet wide and is being used for sorting. During high tide and near its wider mouth it serves as a booming ground.

From its upper end a log chute sheet steel on a concrete foundation was built to connect the canal with the lake which have a difference of elevation of about 20 feet between each other. A steel gate on the upper end can be lifted by crane. Logs let down the chute gain so much speed that they freely travel three quarters of a mile down the canal into the booming ground. (See page 3 of pictorial appendix).

Booms can be towed south through either Johnston and Discovery Straits or through Cordero and Calm Channels.

/7 Forest Protection

71 Fire Damage.
The high amount of precipitation and its generally equal dis-
tribution over the year have left the area with comparatively very little fire damage. Additionally, lightning storms are rare along the Pacific Coast.

The Fire Atlas of the Protection Division, B.C. Forest Service, lists only two fires of small extent within the area, both caused by man.

One burned off 75 acres on the northern end of Stafford Lake in 1924. The area now is covered by scrubby fir and hemlock.

The other one occurred in the course of logging operations in 1928 south of the mouth of Apple River and burned off about 200 acres of partly logged area, which by now is covered with a good hemlock-cedar-fir regeneration with patches of deciduous cover.

Even though there has been found more evidence of fire in the field, hazard can be classified as low, and medium only on dry, south-exposed sites.

72 Organisation.

Due to its low hazard rate it was not found necessary to cover the area by an intensive and steady look-out system. The nearest look-out is on Sonora Island and covers only very little of the area around Phillips Lake.

Steady patrol by B.C. Forest Service launches does a job deemed sufficient to detect a fire in time. If the need arises, aircraft is called for additional patrol.

Provided that sufficient care is taken, slash burning to a limited extent should be allowed especially to propagate Douglas fir regeneration.
73 Roads and Trails.

The means of transportation are completely insufficient for suppression crews and fire fighters in the case of fire. The few existing roads and trails are not maintained and cover only part of the area.

Therefore, more and better trails, at least along the three rivers and their main tributaries, should immediately be cut and kept open.

Even better would be the construction of crude jeep roads as far as possible, and to keep fire tools ready at their start point. This measure should be introduced before operations begin.

8 Forest Management

8.1 Sustained Yield Calculations.

8.1.1 Data and Definitions.

8.1.1.1 Yield Table.

There are no yield tables for mixed stands available yet which would be applicable to this part of British Columbia. Therefore, it was necessary to decide upon one species and assuming closely related figures for the secondary species.

Doubtlessly hemlock is the most common species in immature types as well as mature ones of this particular area. Douglas fir might prevail in patches, as was pointed out in the description of this species (section 4.11). Usually hemlock predominates, up to 90 per cent of the total volume of immature stands, and on the average, 75 per cent should be a rather conservative figure.

Hence the hemlock table by Barnes was chosen and proved
suitable. Present age and height of measured sample trees within the stands were used to determine the site index and present mean diameter in breast height (Dbh) of each immature stand.

3112 Rotation Age.

A rotation age of 100 years was thought sufficient on average for an area mostly covered by pulp types. The actual rotation age likely will fluctuate between 80 and 120 years according to site productivity and merchantable dimensions strived for.

3113 Forest Productive Area.

Of the 2,910 acres not sufficiently restocked, 2,370 acres were caused by clear logging in recent years and hence, highly capable to reproduce immediately a crop suitable for their site. These 2,370 acres were included in all calculations, assuming an age of one year for the purpose of multiplication.

The remaining 540 acres NSR are definitely unproductive at present and were excluded together with 11,935 acres of non-commercial cover, even though part of it lies on very productive sites which after logging restocked with brushy willows and red alder.

No attempt is made to decide about the degree of accessibility of the mature timber. Technical development of logging and hauling machinery already has brought operators to a point where there are no longer any serious problems to be solved.

The term "inaccessible" can be used now at the most as a commercial one, determining the boundary up to where existing timber crops can be harvested with a reasonable margin for profit.
This boundary, however, will fluctuate with the "know-how" used by particular operators, their machinery and man power, and — more important — with the market situation of each species and product.

This is unforeseeable for such a long period as a whole rotation, and its investigation cannot be the subject of this report.

814 Area of Protection Forest.

Much more important would be the investigation of which parts of the timbered area should be excluded from any or be recommended for only partial cutting. This fact exists, for instance, on very steep sidehills where clear logging inevitably would induce dangerous erosion. It should be noted also that on south exposures the fertility of the soil may be lessened indirectly by unobstructed insolation.

Here some kind of patch or strip logging system, or even an intensive selection system, will have to be applied to prevent loss of site quality. If these practices still do not solve the problem of excess runoff it would be advisable to exclude the stand from any cutting at all.

The extent of these stands whose utilization is affected by such a situation, can only be guessed at and would have to be subject to a special survey. Perhaps 25 to 35 per cent of all mature timber in the area might fall into this category. This would decrease the allowable annual cut by 1,5 to 2,1 million cu.ft. and would have to be taken into account.
8115 Mature Volume.

Per-acre volume of mature stands was calculated by species, Dbh, and height, on the basis of samples as described in section 22. Regional volume tables by species, two-inch diameter classes, and 30-foot height classes were used to compile gross cubic volumes.

Net cubic volume for all living trees with 9.1" Dbh and over was achieved by reducing the volume of "residual" trees by 15 per cent, of "suspect" trees by 50 per cent. These figures are empirical and had to be used because more accurate ones on a regional basis or even by type were not available.

Experience gained by a thorough volume and decay study carried out in 1955 in adjacent areas shows that the figure for "suspect" trees probably is too high. This would mean that the actual net volume of the area is considerably higher than given in attached tables (section 52 in appendix).

Not included in the figure for present mature volume is a Secondary Volume stand covering 3,680 acres in compartments 11 and 15 of Logging Block 2, over a Main stand of immature hemlock. This stand came up after handlogging 50 to 70 years ago. All the merchantable trees along the shores of Loughborough Inlet, notably well-sized and -shaped Douglas fir and cedar, were removed.

Logging of the remaining stand now would inevitably destroy the thrifty and dense hemlock regeneration, with patches of Douglas fir and cedar. Additionally, the residual stand is mainly composed of non-commercial or at least non-merchantable hemlock and balsam fir.
Therefore, it would be advisable to leave this stand until its main immature part is due to be logged, and it will be revealed how much volume of the old growth is left.

3116 Immature Volume.

All immature types were coded as fully stocked, hence no reductions of the table figures were made for stocking degree.

The mean Dbh was used to find in given stand tables the proportions of the eight-inch diameter class in each age class. This was deemed necessary because in the yield tables used the merchantable volume is given of all trees with seven inches Dbh and over while figures available for mature stands give the net volume of all trees with a Dbh of 9.1" and over.

To put both immature and mature volumes onto the same basis, the proportions of the eight-inch Dbh class as found in the stand table were transformed into volume and deducted from the figures given in the yield table, or achieved by interpolation.

Therefore, eight per cent of the volume of age class 105 and 21 per cent of class 60 were deducted after the volumes of the table had been reduced by ten per cent call allowance for breakage and other defects. Age classes under 60 have no merchantable volume and, therefore, are not considered.

3117 Table of Present Volume and Proportional Area.

The figures achieved as explained in foregoing sections, and multiplied by the area occupied by each age class, are used to determine the present volume of the whole forest productive area (see table in appendix).
812 Calculation of Mean Annual Increment.

To find the Mean Annual Increment, an average site class and age for all immature types was established arithmetically. The average age and site index were found to be 61.6 years and 100, respectively. Both were rounded off conveniently to 60 and 100.

The net yield per acre at the age 100, reduced by eight percent for the eight-inch Dbh class, is interpolated from the table for hemlock (site index 100 for tree with medium Dbh) and found as 8,328 cu.ft. That means a yearly ingrowth of 87.3 cu.ft. per acre.

Mean annual increment is the product of net yield per acre and area in acres, divided by rotation age, therefore

\[
\frac{8,328 \times 10,560}{100} = 852,780, \text{ and after}
\]

\[
\text{deducting 10\% call} = 776,500 \text{ cu.ft. (approx.)}
\]

813 Calculation of Indicated Annual Cut

Thus all figures needed to apply Hanzlik's (modified) formula of the Indicated Annual Cut are present. Indicated Annual Cut is the present volume of the mature timber divided by rotation age plus Mean Annual Increment, thus

\[
\frac{528,410,000}{100} + 776,500 = 6,066,500 \text{ cu.ft.}
\]

For the convenience of comparison the same formula is repeated with usual units of the metric system (cubic metres):
$14,937,000 \div 100 + 22,000 = 171,370 \text{ m}^3$.

814 Area-Volume Computation.

To check the attained Indicated Annual Cut, volumes of all age classes are projected into the future.

To conform with the volume given for mature stands, the new immature age classes in their table volume again will be reduced by the proportion of the eight-inch Dbh class at cutting age as well as by a general 10 per cent deduction for cull.

For special reasons which will be explained in section 821 the oldest immature class, now 105 years old, should be cut during the third decade of the first rotation.

Following table (see appendix) checks the Indicated Annual Cut by Area-Volume Computation.

A cutting time for the 20 year old age class was not calculated because it covers too small an area, but was included in the last year of the 30 year age class.

The attained rotation age of 105 years deviates from the assumed rotation age within the allowable five per cent limit.

That means, the Indicated Annual Cut can serve as the final figure for the allowable annual cut on a sustained yield basis.

815 Production Schedule.

Based on the area-volume computation table a production schedule showing the actual distribution of future cuttings by decades can be set up (see table in appendix).
Actually, a revision of this plan should be made at the end of every decade, based on newly established, permanent sample plots, and using the same formulas and yield tables.

The plan has to be revised immediately after an unplanned loss of mature volume or immature stands due to a natural catastrophe, e.g. fire, insect infestations, fungus disease, etc.

82 Management Recommendations

82.1 Cutting Plan

All existing immature stands except the 105 year age class, will be left until all virgin timber of this area has been cut.

A priority schedule for cutting cannot be made for the mature timber, since all of it is more or less decadent.

It would be of no value to give cutting priority to stands which are the farthest ones back in valleys and on steep side-hills. As desirable it is for protection purposes to construct an intensive network of access roads over the entire area, this procedure will have to be kept in pace with the general development. Otherwise costs would exceed logging returns.

Therefore, only a general view towards a cutting plan can be given recommending that obviously decadent and overmature stands should be cut first.

There are two such stands within immediate reach of present operation facilities:

a) In Logging Block 1, Compartment 5, west of the mouth of Phillips River and southwest from Phillips Lake, about 2,700 acres of decadent cedar-hemlock with patches of balsam fir, and
b) in Logging Block 3, Compartment 14, the open cedar-cypress-hemlock stand south of Meadow Creek which was described in section 416.

Other stands will have to be cut within the production schedule, as soon as operations are within their reach.

622 Silviculture.

There will always be a demand for Douglas fir logs of a quality and size better than average, to be utilized for either good quality lumber or as peeler logs for plywood production. A well-stocked stand of such fir will represent a fortune in any case of commercial distress.

By its technological qualities Douglas fir will always be valued more than other species present, and it would be a disadvantage to concentrate on pulp production only because pulp is the most common product of this area. A forest on sustained yield management cannot be versatile enough to meet every demand of the market.

Even though fir is a minor species in volume in this region, its wood qualities and silvicultural value make it a species whose area of distribution should be enlarged. As was pointed out in section 411, the fir producing site area is likely much greater than the area actually covered by fir at present.

Advantage should be taken of this fact and fir stands, mixed with hemlock and cedar as secondary, understory species, afforested on all better sites within the area after clear logging of the presently occupying, often decadent stands of hemlock, balsam fir, and cedar.
If no natural abundant seed source is available, planting should provide the best results in reforestation of the desired type. A careful, low heat slash burning after logging would create an ideal seed bed for Douglas fir and give it at least an early start on other species and weeds. In a much later stage of development, slash burning eventually might be abandoned and substituted by methods less dangerous for both forest and soil, e.g., ploughing up the ground of suitable sites by some kind of mechanical cultivator.

But there is no doubt that at the expense of less desirable species the Douglas fir crop in subsequent rotations could be increased considerably.

It is doubtful, however, whether a single rotation, even under best conditions and growth-increasing silvicultural methods like thinnings, would grow enough big trees to make the stand produce valuable ponderosa logs. A method used successfully in European forests could be applied easily to Douglas fir stands: holding over the best stems of a stand, not more than three per acre, through two full rotations.

These elite stems could serve as seed trees after selective cutting of the original stand, and after the second rotation is over, that is when they have attained an age of 160 to 240 years, they have grown into satisfying ponderosa log dimensions. Together with the second generation these are cut, and the third generation is seeded or planted on a clear cut area.

There are many sites in this area applicable to this peculiar method. Investigations will have to be made as to whether these
sites are safe from wind, snow, and ice breakage. The danger from this will not be so severe if thinnings are carried out periodically.

Thinning, and in some cases pruning, will be necessary to create high quality Douglas fir. Methodical thinning with a view towards these future pioleeer trees will lessen wind and snow damage. Intensive silviculture certainly will pay off in the end and, after the virgin timber has been clear cut and a more or less dense network of roads and trails maintained, many technical problems will have been solved.

The 135 year old stand in Logging Block 1, previously mentioned in section 411, would be suitable for an experiment in this direction.

It would be wise to treat this immature stand before all priority mature timber has been cut. At present it has almost reached maturity and should be left growing until the net annual increment levels off. Thinning among dominants and codominants (release cutting) should be made about twenty years before the final cut.

In about 20 to 30 years the area should be that well developed to permit such an experiment, and by then the rapid increment of the stand will have ceased.

Therefore, it is recommended to cut this stand during the third decade, leaving only the best one to three Douglas fir stems per acre to grow a second generation, as described above.

Silvicultural treatment of the other species, mainly hemlock, balsam fir, and cedar, will be less difficult. They are tolerant
species and some method will have to be devised to keep them
from spreading into and suppressing seeded and planted fir
stands. Here too, thinnings in ten year periods will essentially
improve wood quality where desired, even if total volume in the
end is not greater than that of unthinned stands.

With the exception of the above method, patch logging will be
the only advisable method to induce regeneration. In connection
with careful planning against wind breakage and initiating
thinnings and release cuttings, profitable logging and regeneration
should be successful.

Further silvicultural qualities and features of each species
were treated while describing them in section 41.

823 Pathological and Entomological Considerations.

It is recommended that an insect survey be carried out every
year in representative permanent sample plots throughout the
area. This would provide valuable information concerning fluctua-
tions in insect populations and could serve to anticipate
threatening calamities.

Stands comprised of only one species should be avoided. An
insect calamity, as well as a fungus disease, infecting this
pure stand might destroy it completely, while in mixed stands
the remaining, unaffected species at least would leave the
ground covered and warrant sheltered regeneration where wanted.

During logging operations timber margins should be such that
there will be minimum wind breakage. The south and west side of
a stand will require special attention and protection since main
wind direction in this area is southeast to southwest due to topography.

824 Subsequent Rotations.

As was suggested in section 821 it is intended to increase the proportion of Douglas fir regeneration after logging. This procedure will only be successful on suitable sites. Of course, that concerns the other species likewise.

The future aim would be to try to maintain a volume proportion of about 30 per cent hemlock, 20 per cent each Douglas fir and cedar, and ten per cent each spruce and balsam fir, with the remainder of other species, equally distributed over age classes and suitable sites.

The limit of five years for the re-establishment of a stand should and could be reduced to one or two years.
9 List of References

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231 Classification of Total Area

<table>
<thead>
<tr>
<th>Category</th>
<th>Acres</th>
<th>Hectares</th>
<th>% of Total</th>
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<tbody>
<tr>
<td>Mature timber stands</td>
<td>77,675</td>
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<tr>
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<td>7,990</td>
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<td>1,300</td>
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<tr>
<td>21 - 40</td>
<td>2,740</td>
<td>1,080</td>
<td></td>
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<tr>
<td>41 - 60</td>
<td>3,080</td>
<td>1,190</td>
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</tr>
<tr>
<td>101 - 120</td>
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<tr>
<td>Not sufficiently restocked, after logging</td>
<td>2,370</td>
<td>959</td>
<td>.8</td>
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<tr>
<td>Forest productive area</td>
<td>67,995</td>
<td>35,612</td>
<td>30.2</td>
</tr>
<tr>
<td>Not sufficiently restocked, other causes</td>
<td>540</td>
<td>216</td>
<td>.2</td>
</tr>
<tr>
<td>Non-commercial cover</td>
<td>11,935</td>
<td>4,830</td>
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<tr>
<td>Barren (snow, ice, alpine, rock, slides, etc.)</td>
<td>123,669</td>
<td>50,049</td>
<td>42.4</td>
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<tr>
<td>Upland scrub</td>
<td>62,959</td>
<td>25,480</td>
<td>21.6</td>
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<tr>
<td>Water (rivers, lakes, swamps)</td>
<td>4,100</td>
<td>1,650</td>
<td>1.4</td>
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<tr>
<td>River sand flats</td>
<td>440</td>
<td>178</td>
<td>.1</td>
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<td>Forest non-productive area</td>
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<td>82,414</td>
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<tr>
<td>Total</td>
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</table>
Table of Forest Productive Area showing acreage, volume, volume per acre, and percentages of mature timber stands by Type Groups and Species.

<table>
<thead>
<tr>
<th>Type Group</th>
<th>Area</th>
<th>% of</th>
<th>upper line: in cu. ft. per Acre</th>
<th>lower line: total in 1,000 cu. ft.</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>F</td>
<td>C</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td>Acre.</td>
<td>% of</td>
<td>Total</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fir-Cedar</td>
<td>10,981</td>
<td>14.1</td>
<td>1,730</td>
<td>25.8</td>
<td>2,070</td>
</tr>
<tr>
<td>Cedar-Pulp</td>
<td>40,490</td>
<td>52.1</td>
<td>3,290</td>
<td>1.3</td>
<td>2,450</td>
</tr>
<tr>
<td>Pulp</td>
<td>20,452</td>
<td>26.3</td>
<td>1,380</td>
<td>7.0</td>
<td>4,880</td>
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<td>Spruce</td>
<td>5,612</td>
<td>7.2</td>
<td>2,320</td>
<td>32.4</td>
<td>1,560</td>
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<tr>
<td>Deciduous</td>
<td>500</td>
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<td>500</td>
</tr>
<tr>
<td>Total</td>
<td>77,635</td>
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<td>24,160</td>
<td>310</td>
<td>1,830</td>
</tr>
<tr>
<td>% of Grand Total</td>
<td>4.6</td>
<td>26.9</td>
<td>34.9</td>
<td>17.6</td>
<td>6.1</td>
</tr>
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</table>
Table of Forest Productive Area showing area, volume, volume per hectare (both in cubic metres) and percentages of mature timber stands by Type Groups and Species.

<table>
<thead>
<tr>
<th>Type Group</th>
<th>Area (ha)</th>
<th>% of 301+</th>
<th>Net Volume (cubic metres)</th>
<th>% of 31,460 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% of</td>
<td>F</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31,460</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fir-Cedar</td>
<td>4,420</td>
<td>14.1</td>
<td>122</td>
<td>552</td>
</tr>
<tr>
<td>Cedar-Pulp</td>
<td>16,400</td>
<td>52.1</td>
<td>6</td>
<td>93</td>
</tr>
<tr>
<td>Pulp</td>
<td>8,230</td>
<td>26.3</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>Spruce</td>
<td>2,270</td>
<td>7.2</td>
<td>17</td>
<td>161</td>
</tr>
<tr>
<td>Deciduous</td>
<td>80</td>
<td>.3</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>31,460</td>
<td>100.0</td>
<td>21</td>
<td>683</td>
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### 511 Logging Block 1:

**Classification of total area.**

<table>
<thead>
<tr>
<th></th>
<th>Acres</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature timber stands</td>
<td>29,230</td>
<td>25.2</td>
</tr>
<tr>
<td>Immature stands, Age Class 100-120</td>
<td>2,040</td>
<td>1.8</td>
</tr>
<tr>
<td>Not sufficiently restocked, after logging</td>
<td>980</td>
<td>.8</td>
</tr>
<tr>
<td><strong>Forest productive area</strong></td>
<td></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>Not sufficiently restocked, other causes</td>
<td>540</td>
<td></td>
</tr>
<tr>
<td>Non-commercial cover</td>
<td>6,080</td>
<td>5.2</td>
</tr>
<tr>
<td>Barren (snow, ice, alpine, rock, slides, etc.)</td>
<td>53,347</td>
<td>46.0</td>
</tr>
<tr>
<td>Upland scrub</td>
<td>21,447</td>
<td>18.4</td>
</tr>
<tr>
<td>Water (rivers, lakes, swamps)</td>
<td>2,330</td>
<td>2.0</td>
</tr>
<tr>
<td>River sand flats</td>
<td>50</td>
<td>.1</td>
</tr>
<tr>
<td><strong>Forest non-productive area</strong></td>
<td></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td></td>
<td>83,824</td>
<td>72.2</td>
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<tr>
<td><strong>Total</strong></td>
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512 Logging Block 2:

Classification of total area.

<table>
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<th>Nature timber stands</th>
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<th>30.7</th>
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<tr>
<td>Immature stands</td>
<td>5,490</td>
<td>6.6</td>
</tr>
<tr>
<td>(Age class 11 - 20)</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>&quot; 21 - 40</td>
<td>2,280</td>
<td></td>
</tr>
<tr>
<td>&quot; 41 - 60</td>
<td>3,030</td>
<td></td>
</tr>
<tr>
<td>Not sufficiently restocked, after logging</td>
<td>330</td>
<td>.4</td>
</tr>
<tr>
<td>Forest productive area</td>
<td>31,425</td>
<td>37.7</td>
</tr>
<tr>
<td>Not sufficiently restocked, other causes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Non-commercial cover</td>
<td>545</td>
<td>.7</td>
</tr>
<tr>
<td>Barren (snow, ice, alpine, rock, slides, etc.)</td>
<td>29,135</td>
<td>35.0</td>
</tr>
<tr>
<td>Upland scrub</td>
<td>21,201</td>
<td>25.5</td>
</tr>
<tr>
<td>Water (rivers, lakes, swamps)</td>
<td>660</td>
<td>.8</td>
</tr>
<tr>
<td>River sand flats</td>
<td>280</td>
<td>.3</td>
</tr>
<tr>
<td>Forest non-productive area</td>
<td>51,871</td>
<td>62.3</td>
</tr>
<tr>
<td>Total</td>
<td>83,296</td>
<td>100.0</td>
</tr>
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</table>
### 513 Logging Block 3:

**Classification of Total Area.**

<table>
<thead>
<tr>
<th>Category</th>
<th>Acres</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature timber stands</td>
<td>22,850</td>
<td>24.8</td>
</tr>
<tr>
<td>Immature stands, Age class 21-40</td>
<td>460</td>
<td>0.5</td>
</tr>
<tr>
<td>Not sufficiently restocked, after logging</td>
<td>1,010</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Forest productive area</strong></td>
<td>24,320</td>
<td>25.4</td>
</tr>
<tr>
<td>Not sufficiently restocked, other causes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-commercial cover</td>
<td>5,310</td>
<td>5.8</td>
</tr>
<tr>
<td>Barren (snow, ice, alpine, rock, slides, etc.)</td>
<td>41,137</td>
<td>44.5</td>
</tr>
<tr>
<td>Upland scrub</td>
<td>20,311</td>
<td>22.0</td>
</tr>
<tr>
<td>Water (rivers, lakes, swamps)</td>
<td>1,110</td>
<td>1.2</td>
</tr>
<tr>
<td>River sand flats</td>
<td>80</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Forest non-productive area</strong></td>
<td>67,948</td>
<td>73.6</td>
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<tr>
<td><strong>Total</strong></td>
<td>92,268</td>
<td>100.0</td>
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### 921 Logging Block 1:

Table of Forest Productive Area showing acreage, volume, volume per acre, and percentages of mature timber stands

by Type Groups and species.

<table>
<thead>
<tr>
<th>Type Group</th>
<th>Area</th>
<th>Net Volume (dbh 3.1&quot; end and over)</th>
<th>% of Total</th>
<th>% of T.E.</th>
<th>% of T.G.</th>
<th>% of T.C.</th>
<th>% of B.C.</th>
<th>% of Ry.</th>
<th>% of Py.</th>
<th>% of C.G.</th>
<th>% of Decid.</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fir-Cedar</td>
<td>1,800</td>
<td>6.2</td>
<td>2,046</td>
<td>33.3</td>
<td>3,296</td>
<td>2,070</td>
<td>34.3</td>
<td>188</td>
<td>1.5</td>
<td>17</td>
<td>30</td>
<td>9</td>
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<tr>
<td>Cedar-Julp</td>
<td>15,656</td>
<td>54.6</td>
<td>62</td>
<td>1,000</td>
<td>33.3</td>
<td>1,566</td>
<td>26.6</td>
<td>26,320</td>
<td>7,140</td>
<td>1,850</td>
<td>2,010</td>
<td>9,200</td>
</tr>
<tr>
<td>Tulip</td>
<td>9,297</td>
<td>31.4</td>
<td>67</td>
<td>630</td>
<td>3.3</td>
<td>2,270</td>
<td>3.4</td>
<td>3,730</td>
<td>42.9</td>
<td>3,246</td>
<td>40.9</td>
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<td>540</td>
<td>1,120</td>
<td>14.0</td>
<td>1,920</td>
<td>14.0</td>
<td>100</td>
<td>3.6</td>
<td>2,670</td>
<td>31.9</td>
<td>500</td>
</tr>
<tr>
<td>Deciduous</td>
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<td>500</td>
<td>5.6</td>
<td>500</td>
<td>5.6</td>
<td>500</td>
<td>5.6</td>
<td>500</td>
<td>5.6</td>
<td>500</td>
</tr>
<tr>
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<td>100.0</td>
<td>1,440</td>
<td>42,580</td>
<td>62,950</td>
<td>38,140</td>
<td>10,250</td>
<td>3,120</td>
<td>2,180</td>
<td>480</td>
<td>17,960</td>
<td>100,560</td>
</tr>
</tbody>
</table>

% of Grand Total: 2.8 22.6 33.2 20.2 5.4 4.8 1.2 .3 9.5 100.0
<table>
<thead>
<tr>
<th>Type Group</th>
<th>Area</th>
<th>Net Volume (Dbh 9.1&quot; and over)</th>
<th>F</th>
<th>C</th>
<th>H</th>
<th>B</th>
<th>S</th>
<th>Gy</th>
<th>Fw</th>
<th>Fl</th>
<th>Decid.</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres</td>
<td>Total</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>Subtotal</td>
<td></td>
</tr>
<tr>
<td>Fir-Cedar</td>
<td>6171</td>
<td>24.1 1,650</td>
<td>10,180 20.7 2,770 34.8 18,990 37.7 2100 450 9 2420 5.2 26 160 3 11 70 1 7,590 27.9</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cedar-Pulp</td>
<td>13,314</td>
<td>51.0 92</td>
<td>1,200 1.5 2,550 41.6 33,230 46.0 9,640 12.1 2,900 44.2 2100 170 2.8 350 5.4 17 3 170 2 6 1 6,114 45.3</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulp</td>
<td>4,900</td>
<td>19.2 90</td>
<td>430 1.2 180 3.7 2,800 44.2 2100 15,740 43.7 1,500 5.1 1 1 350 3.2 1 1 270 1 10 1 36,070 20.5</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spruce</td>
<td>1,470</td>
<td>5.7</td>
<td>510 2.3 2,070 44.2 1,870 43.6 1,600 5.1 2,510 53.3 1,100 110 1.4 7,580 6.3</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25,555</td>
<td>100.0 460</td>
<td>11,310 54,300 65,690 26,970 10,230 4,340 1,520 170 320 175,810</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Grand Total</td>
<td>6.7</td>
<td>31.2</td>
<td>37.5</td>
<td>15.1</td>
<td>5.9</td>
<td>2.5</td>
<td>.9</td>
<td>.1</td>
<td>.2</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Logging Block 3:

Table of Forest Productive Area showing acreage, volume, volume per acre, and percentages of mature timber stands by Type Groups and species.

<table>
<thead>
<tr>
<th>Type Group</th>
<th>Area</th>
<th>% of Total</th>
<th>Net Volume (Dia. 9.1&quot; and over)</th>
<th>F</th>
<th>C</th>
<th>H</th>
<th>B</th>
<th>S</th>
<th>Cy</th>
<th>Dv</th>
<th>Ml</th>
<th>Decid.</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres</td>
<td>% of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>upper line: in cu. ft. per acre</td>
<td>lower line: total in 1,000 cu. ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pine-Cedar</td>
<td>2,910</td>
<td>12.7</td>
<td></td>
<td>1,840</td>
<td>26.6</td>
<td>1,660</td>
<td>45.2</td>
<td>248</td>
<td>7.6</td>
<td>150</td>
<td>2.5</td>
<td>110</td>
<td>2.1</td>
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<tr>
<td>Cedar-Pulp</td>
<td>11,320</td>
<td>50.8</td>
<td></td>
<td>2,610</td>
<td>36.6</td>
<td>2,320</td>
<td>31.8</td>
<td>740</td>
<td>10.6</td>
<td>130</td>
<td>2.6</td>
<td>240</td>
<td>4.5</td>
</tr>
<tr>
<td>Pulp</td>
<td>7,255</td>
<td>27.3</td>
<td></td>
<td>1,310</td>
<td>3.7</td>
<td>1,290</td>
<td>45.2</td>
<td>288</td>
<td>8.9</td>
<td>160</td>
<td>4.4</td>
<td>120</td>
<td>3.3</td>
</tr>
<tr>
<td>Spruce</td>
<td>2,105</td>
<td>9.2</td>
<td></td>
<td>3,380</td>
<td>44.5</td>
<td>3,360</td>
<td>20.8</td>
<td>500</td>
<td>5.6</td>
<td>2,510</td>
<td>38.0</td>
<td>110</td>
<td>1.7</td>
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<td>Total</td>
<td>22,535</td>
<td>100.0</td>
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<td>510</td>
<td>44.5</td>
<td>56,080</td>
<td>28,650</td>
<td>11,790</td>
<td>5,950</td>
<td>1,360</td>
<td>150</td>
<td>400</td>
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% of Grand Total: 4.3 27.0 34.2 17.1 7.2 2.4 8.1 6.9 100.0
### Table of Present Volume and Proportional Areas

<table>
<thead>
<tr>
<th>Age Class</th>
<th>Site Index</th>
<th>Acres</th>
<th>Proportional Area</th>
<th>Net Volume cu.ft.p.a.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>105</td>
<td>H₁₀₀</td>
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<td>6,800</td>
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<td>HS₁</td>
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<tr>
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<td></td>
<td>67,995</td>
<td>39.9</td>
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<td>549,690,000</td>
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<td>Current Age Class</td>
<td>Area</td>
<td>Cutting Age Limit and Aver.Age</td>
<td>Merchant Volume at Cutting Age given in Table</td>
<td>Percent. of 8&quot; Dbh Cl. to deduct</td>
<td>Net Vol. per acre minus 10% call at attained Aver.Age</td>
</tr>
<tr>
<td>-------------------</td>
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<td>---------------------------------</td>
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<tr>
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<td>2,040 129 - 131</td>
<td>11,300</td>
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<tr>
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<td>130</td>
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<tr>
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<td>3,850 150 - 154</td>
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<tr>
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<td>130 119 - 119</td>
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<tr>
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<td>2,370 93 - 102</td>
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## Production Schedule

<table>
<thead>
<tr>
<th>Decade</th>
<th>Current Age of Stand</th>
<th>Age at Time of Cutting</th>
<th>Volume cut in each decade by Age Class (MCM)</th>
<th>Total (MCM)</th>
<th>Average cut annually (MCM)</th>
</tr>
</thead>
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<td>Mature 105</td>
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<td>6,060</td>
</tr>
<tr>
<td>10</td>
<td>60 150 - 154</td>
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<td>33,100</td>
<td>(</td>
<td>(</td>
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<td>(13 yrs)</td>
<td>30 125 - 129</td>
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<td>25,700</td>
<td>1,176</td>
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<tr>
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<td>20 99 - 102</td>
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<td>18,300</td>
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<td><strong>Total 524,626</strong></td>
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