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MANITOBA FOREST CAPABILITY CLASSIFICATION

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Due to the frequent occurrence of perennially frozen soils in the northern part of the Manitoba C.L.I. area, and the related effects on tree growth, the need was felt to introduce a new limiting factor. Suggested was K (from Greek Kryos). The subclass K now is defined as: limitations due to the presence of perennially frozen material.

The fact that in most of the C.L.I. areas permafrost occurs mainly in peat soils and its special influence under these conditions on tree growth, has made many people slightly skeptical about the validity of the use of K as a subclass, as the occurrence of permafrost seems to improve the forest site conditions.

Hopefully the following paragraphs will show a justification for the use of K.

It is quite obvious that perennially frozen layers in mineral soils will limit rooting depth and rooting development. Apart from the soil temperature influence on root growth and tree growth also some geomorphological and soil mechanical processes may reduce stand density and tree growth.

An example of such a condition is given in Stereotriplet No. S.I.1.

The main problem with the use of K arises in the organic soils, as here on the first glance, permafrost seems to be favoring tree growth. After studying the cycle involved in the formation of wooded peat plateaux and palsa, it becomes clear permafrost will not occur on the same site forever. There is a period of growing, maturity and collapsing. We have at this moment not yet a definite idea about the time involved in this cycle, however, studies of photographs taken 20 years apart in parts of the discontinuous zone show a relatively fast collapsing process.

In the zone 3Sm, permafrost in organic soils started after a bog island developed in the sedge. It thickens to several yards. This growing process takes a considerably long time, perhaps hundreds of years. The better black spruce stands (occasionally white birch) are usually found on peat plateaux or palsa in their mature and overmature stages. Removal of the stand by mechanical means is likely to disturb the heat budget, especially in the delicate stage of maturity, when natural collapsing starts. Increased melting of the frost could be introduced by, e.g. removal of the tree cover, mechanical disturbance of ground cover, compaction and exposure of bare peat, and perhaps weight of machinery.

Regeneration in these areas plays a very important role in the "salvaging" of the frost. Observations on the influence of forest fires on the permafrost show that in most cases after a fire and establishment of dense black spruce regeneration, the rate of collapsing does not increase. It seems to have slowed down in some cases, perhaps because of the removal of the weight of the stand. In at least one case, however, complete collapse followed after fire.

Many stands on the permafrost landform are of fire origin and are often in the range of 100-120 years old, indicating that fire is not usually too destructive.

One conclusion one can make is that it will be important to get a dense regeneration of black spruce back. This might have some management implications.

Mature, well stocked stands measured on palsa or peat plateaux usually give a gross merchantable M.A.I. varying between the 10 and 30 cu. ft./acre/year which would put most of them in a class 6. A relatively well drained peat producing this stand would have been classified as a $\begin{smallmatrix} 6w \\ bs \end{smallmatrix}$, even occasionally a $\begin{smallmatrix} 5w \\ bs \end{smallmatrix}$. Because of reasons mentioned earlier, it is expected that most likely not more

than two rotations are possible before the permafrost is largely collapsed. (I am thinking of a kind of rotation introduced by fire). After collapsing this area will not produce anything for a long time.

As it is our work to do a potential productivity classification (not a forest inventory which would indicate that many of these sites are presently producing 15 or 18 cu. ft./acre/year) it seems to be more realistic to include the future expectation to indicate the specific problems related to this site, and classify it as a class 7. In this way, the K is used corresponding to the guidelines in the C.L.I. report No. 4. It lowers the class level from a 6 to a 7.

In Manitoba we proceeded classifying on this basis and the following combinations of capability classes, limiting factors and indicator species are used in site region 3Sm (Boreal, moist subhumid).

- 7w - Saturated organic soils with no significant tree cover. Vegetation might be composed of grasses, sedges, alder, willow, dwarf birch, etc.
Less than 5% of treed permafrost sites can occur.
- 7w
tL - As above, only stunted tamarack forms the main tree cover.
- 7w
bS - As above only stunted black spruce forms the main tree cover.
If both tree species occur their order will depend on the relative dominance.
- 7k
bS - Organic sites which have more than 80% of permafrost, in the form of relatively well drained palsas or peat plateaux. Black spruce is the only indicator species. Less than 20% non-frozen areas of a sedge, or sphagnum type can be included.
- 7k
w
bS
(tL) - Mapping units characterized by a combination of 7k and 7w; permafrost in the form of palsas and peat plateaux is dominating.

Usually the 7w areas are formerly collapsed permafrost, but frequently a 7w is intermixed. In that case tL will be added as second indicator species.

7^w
k
tL or bS
bS or tL

- Mapping units characterized by poorly drained organic soils with permafrost occurring in less than 50% of the unit. The mapping unit can either be a combination of 7^w_{tL} or 7^w_{bS} (no collapse scars) with "solid" islands of permafrost, 7^k_{bS} or 7^k_w, or it can be an area which shows more than 50% collapse bS
tL scars. The order of tL and bS will depend on the relative dominance of these species.

6^w
k
bS

- Sites or combination of sites, characterized by shallow organic soils or peaty cryic gleysol (usually lacustrine clays or silts). The occurrence of permafrost is less than 50%. The black spruce on the non-frozen sites is usually of a poorer quality than the stands on the frozen sites.

6^k
w
bS

- Sites which have more than 50% peaty cryic gleysol 6^k_{bS} and for the remaining part shallow organic soils (6^w_{bS}). The present production of the cryic humic gleysol can be approaching a class 5. For former mentioned reasons the site is classified as a 6. Also because frequently the organics barely make a class 6.

6^k
bS

- Sites which have usually a shallow layer of mesic organic material (less than 2 feet) over mineral soils. Present stand conditions can be good and occasionally show increments of more than 30 cu. ft./acre/year.

Class 7 (permafrost) occurs quite a bit more frequently than class 6 (permafrost).

Any combination of the above mentioned symbols is used to characterize more complex mapping units. e.g.

$\begin{matrix} 76,4 \\ w w \end{matrix}$; $\begin{matrix} 78,2 \\ w k \end{matrix}$ etc.
tL k tL w
tL bS
bS

If mapping units are of a small size and complex symbols are impractical the following variations are added:

$\begin{matrix} 7w \\ k \\ tL \end{matrix}$ - Unit with less than 20% permafrost, but 80% or more of stunted tamarack.

$\begin{matrix} 7w \\ k \end{matrix}$ - Unit with less than 20% permafrost, but with 80% or more of collapse scars (sedge) without significant tree growth.

A number of stereotriplets with interpretation were prepared as examples of the use of the above definitions.

STEREOTRIPLET: S.I. 1 Sample Collection
Jean Thie

LOCATION: Southern Indian Lake area; North zone, N.T.S. 64G10.
Site Region 1, Arctic boreal.

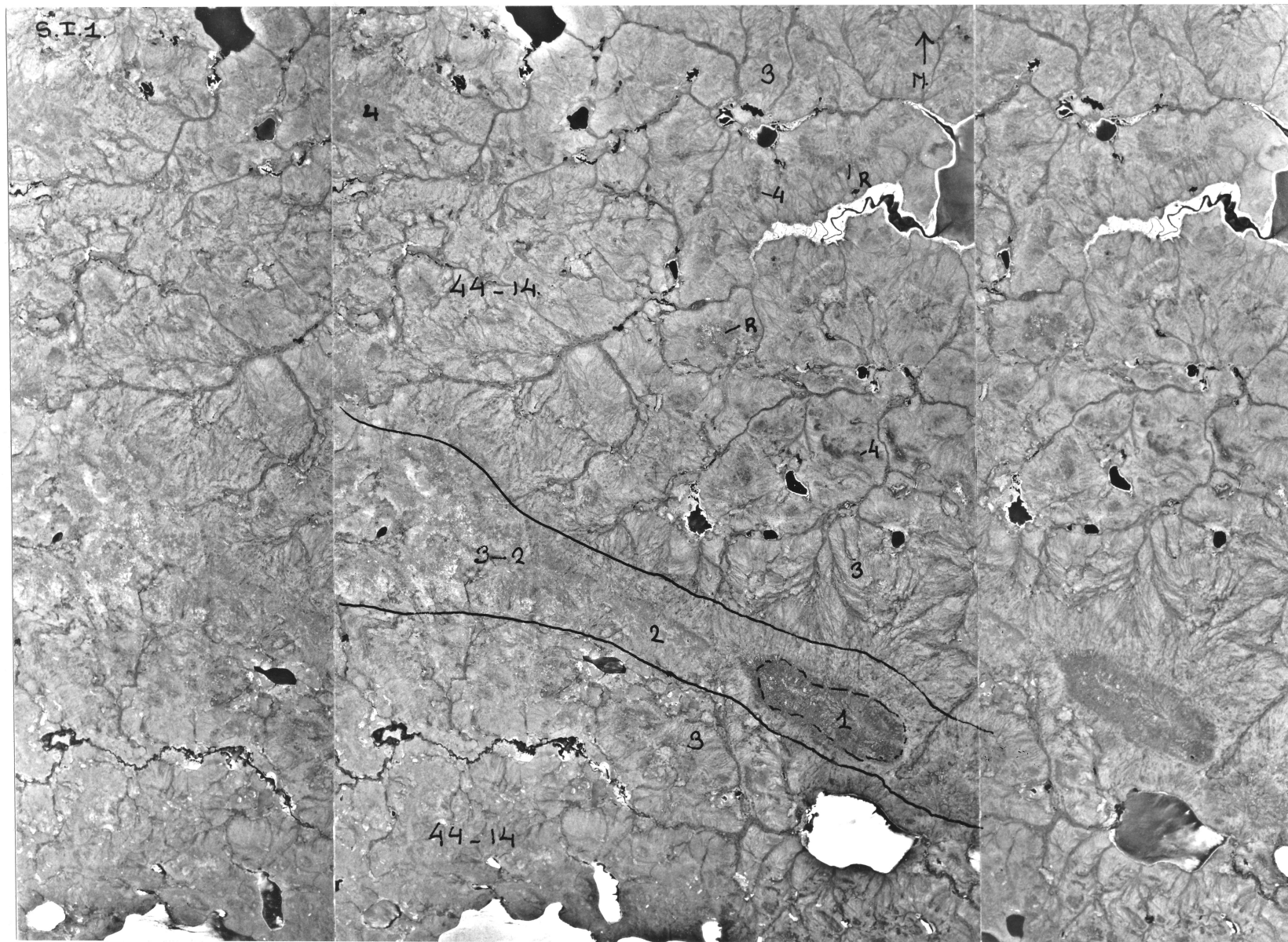
PHOTO INFO: Scale approximately 1 mile = 1 inch. Panchromatic, minus blue.

CLIMATE: Arctic boreal, discontinuous permafrost in mineral soils.

TOPOGRAPHY: Controlled by precambrian bedrock and esker deposits.

LANDFORMS: The surficial material is mainly formed by lacustrine clay over bedrock and till. Even the glaciofluvial material, as delineated, is for a large part (2) overlain by clay. The part around 1 is sand.

Rock is exposed sporadically R, usually covered with a lichen open, black spruce stand. The abundant "flow pattern" (3) indicates the areas where there is permafrost in mineral soils. These areas are classified as 7_{ws}^k . No permafrost was found in areas with a closed black spruce stand (4). These sites are usually classified as 6bs (site region 1). The sand around one would be classified as 6_{bs}^{jp} .



STEREOTRIplet: 63G36

Sample Collection
Jean Thie - 1970

LOCATION: 63G - Grand Rapids map sheet
T.57, Rge. 9 W.
Just north of Limestone Bay.

PHOTO INFO: Small scale photography (1:68,000) - 1957,
Panchromatic, poor quality. A13933, 16, 17 - A14603-9

CLIMATE: 3Sm, boreal, moist subhumid.
Discontinuous permafrost zone.

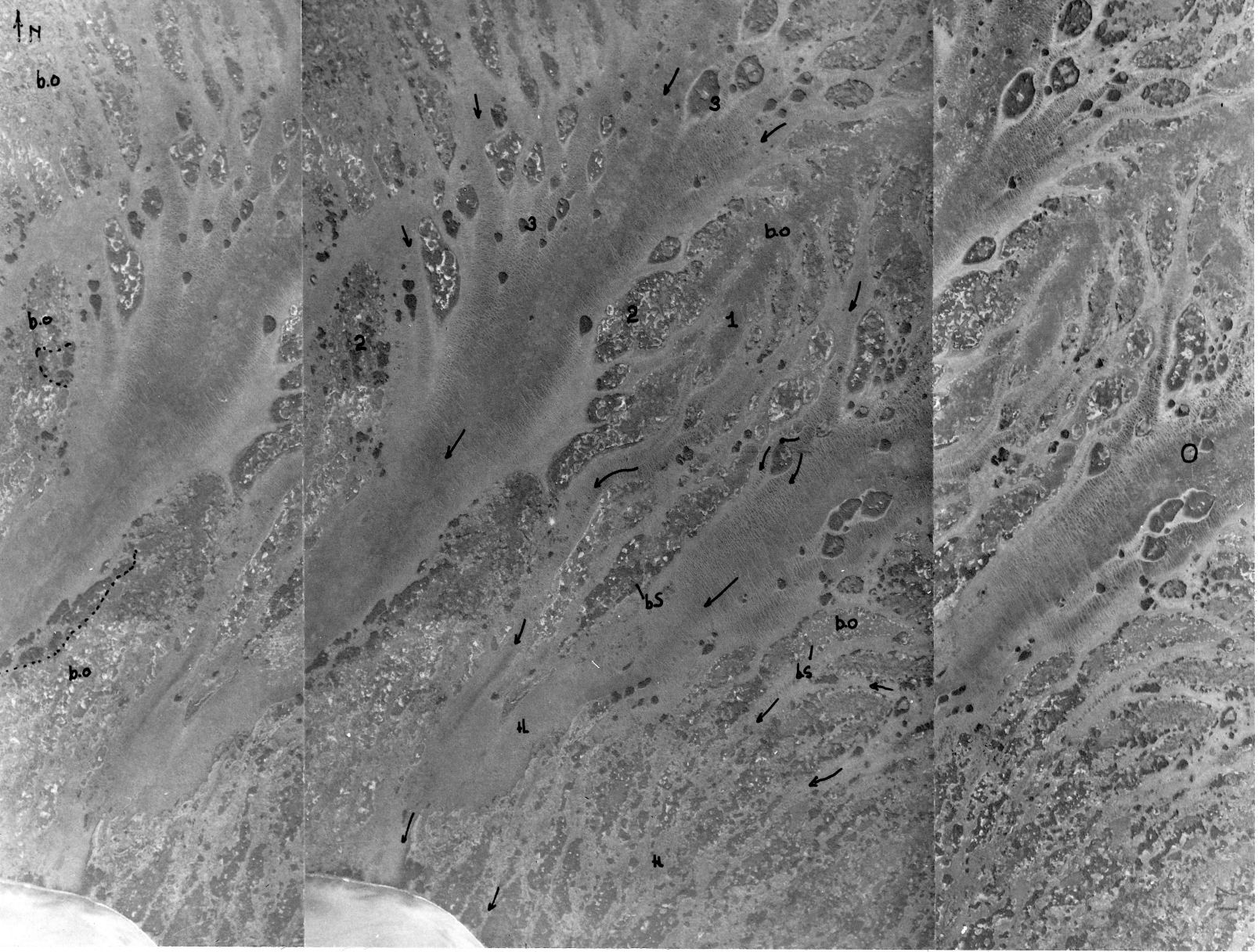
TOPOGRAPHY: Flat, Lake Basin.

LANDFORMS: Peat plateaux (2) and palsas (3), ribbed fens. Notice the
shape of the permafrost landforms. Conforms to the drainage
flows.
Depth of the organic (mainly mesic and fibric) is about 5-10 ft.
over lacustrine clays and silts.

VEGETATION: Black spruce (bS) - tamarack (tL).
Large parts of the area have been burned (b.o.). Some areas
seem to have been transformed into raised bogs.

LAND CLASSIFICATION: This stereotriplet gives some appreciation of the
extent of areas with occurrence of permafrost in Manitoba. About
40 square miles are covered by this triplet. About 60-70% has
been or is under influence of the "permafrost cycle". About 20%
of the total area contains permafrost.

630 36



STEREOTRIPLET: 63G9

Sample Collection
Jean Thie - 1970

LOCATION: N.T.S. 63G - Grand Rapids
T.57, Rge.10W.
±4 miles north of Limestone Bay.

PHOTO INFO: Scale - 1" = 1 mile (approx.)
Taken in 1967,
Panchromatic

CLIMATE: Ecological site Region 3Sm, moist subhumid, Boreal. Short cool summers, long cold winters, little precipitation.

TOPOGRAPHY: Flat, no slopes.

LANDFORMS: Peat plateaux and palsas.
Note the updoming of the peat as a result of the permafrost. Especially easily visible in the burned over areas. It is expected that in the strongly domed (1) areas, permafrost is reaching into the underlying mineral soil. Collapse scars are conspicuous, especially the very recent ones (2). Open water can be seen here with a surrounding sedge area. Collapse areas like (3) are perhaps the result of a slower process. They are older than 2, but not as old as, e.g. (4). In that one tamarack and white birch are already closing in.

VEGETATION: Black spruce occurs only on the permafrost sites, as regeneration after burn (7), or unburned (6). The difference between (A) and (B) must be a burn too. It looks like a climax black spruce stand, open and unevenaged; B should be younger, and evenaged black spruce. In stands like A, black spruce of 60 feet tall and 13" in diameter was measured.
Tamarack is very abundant in the fens and on some ribbs.

LAND CLASSIFICATION: The area is classified on three different scales. The right side at a very detailed level (±1:15,000); the left side in less detail (±1:30,000) and the middle at a ±1:60,000 scale.

STEREOTRIplet: 63G38

Sample Collection
Jean Thie

LOCATION: N.T.S. Sheet 63G
Williams River - Limestone Bay Area.
T.57, Rge.10W. A14603-12,13,14.

PHOTO INFO: Scale $\pm 1:68,000$, flightline from East-West, taken in 1957.
Panchromatic, minus blue.
Below average quality of photography.

TOPOGRAPHY: Level, draining towards Lake Winnipeg, see drainage arrows. The "valley" of the Williams River is locally ± 40 feet deep.

LANDFORMS:
and sur-
ficial
deposits

Peat plateaux (p.p.) and palsas (p.), the former dominant. Collapse scars (c.s.). The relation between the occurrence of permafrost on drainage patterns is rather striking. Apart from the fact that the peat plateaux have an elongated form, conforming to the drainage. In this area most permafrost occurs in areas where the peat is not excessively deep (± 5 feet) or less. The patterned fens in this area (no permafrost) have about 10 feet deep organic material over lacustrine silt and clays. The abundance of permafrost seems to be also related to the depth of the mineral soil. Some strandline buried under peat can be traced (1). The strandline in itself is related to the underlying limestone bedrock (Ordovician age). As Lake Agassiz covered this area for a considerable time, a fairly thick layer of lacustrine clays and silts covers the bedrock. Deposits along the Williams River are clayey in the lower parts. Some of the well drained areas along the sides of the River Valley are sandy (2) and seem to have a podzolic character. On these sites Jack pine regenerated after burn.

VEGETATION: Tamarack (tL) and black spruce (bS) are the dominating species. Jack pine (jP) occurs on the northern part of the beach ridge and at some well drained sites along the Williams River (around 2). Here it is a fire regeneration. White spruce can be found just along the river. It grows on the slopes and floodplain, mixed

with black spruce and white birch, and occasionally balsam fir. Generally speaking the area classified as 4 is a good white spruce site. The area classified as a 5, a good bS one. A recent burn can be seen on the northern half (b.o). See triplet 63G16 (large scale). This was not the only burn in the area. Most likely it is the abundant disappearance of permafrost in the N.E. quarter of the photo accelerated by burns.

LAND CLASSIFICATION: The forest capability classification is given on a transparent sheet. A small fringe area along the river is able to produce stands of attractive merchantable size. The area just along the class 4 and 5, has a fairly high percentage of class 6 in which not too much permafrost occurs. Seasonal frost, however, seems to remain in the mineral soil under these stands for a fairly long period of time.