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# PLANTATIONS OF WHITE SPRUCE UNDER ASPEN ON DIFFERENT SOILS, FOOTHILLS SECTION, ALBERTA. THE ROCKY MOUNTAIN HOUSE PLANTATIONS - ESTABLISHMENT REPORT, 1965 -

(Project - A.83)

by
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FOREST RESEARCH LABORATORY
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# Plantations of White Spruce Under Aspen on Different Soils, Foothills Section, Alberta

## The Rocky Mountain House Plantations

by

P.J.B. Duffy and Z. Nemeth[1]

## INTRODUCTION

The Alberta Department of Lands and Forests has initiated a program of underplanting trembling aspen (Populus tremuloides Michx.) stands with white spruce (Picea glauca (Moench) Voss) seedlings to increase the wood yield of forest land. Several hundred thousand spruce have been planted to date and the rate of planting is rising annually.

To assist this program the Department of Forestry began a series of plantation experiments to study effects of site and initial spacing on planting chance, seedling mortality and periodic growth. The first experimental plantation was established near Marlboro in the Edson Forest. Nine acres of spruce plantations were established on each of four different soils. Each plantation consisted of three treatments (9 x 9, 12 x 12, and 15 x 15 foot spacings) replicated three times and assigned randomly in each block (Duffy, 1963).

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The experiment was repeated in 1963 on three different soils near Rocky Mountain House, in the Foothills Section of west-central Alberta. This report describes these plantations and their installation by the Department of Forestry and the Alberta Department of Lands and Forests. The survival and growth of the planted stock will be the subject of continuing study and will not be reported here.

## EXPERIMENTAL AREA

### Location

The three plantations are located west of Rocky Mountain House (52°14' North latitude and 114°55' West Longitude) in the Clearwater Rocky Forest. Figure 1 depicts a location map and stereo-pairs of aerial photographs are shown in Figure 6. The legal descriptions are as follows:

1. "Horburg Road Plantation - 1963." Legal Subdivision 15 of Section 5, Township 40, Range 9, West of the 5th Meridian.
2. "Great Plains Road Plantation - 1963." Legal Subdivisions 6, 7, 10 and 11 of Section 13, Township 40, Range 9, West of the 5th Meridian.
3. "Killico Road Plantation - 1963." Legal Subdivisions 2, 3, 5 and 6 of Section 17, Township 39, Range 9, West of the 5th Meridian.

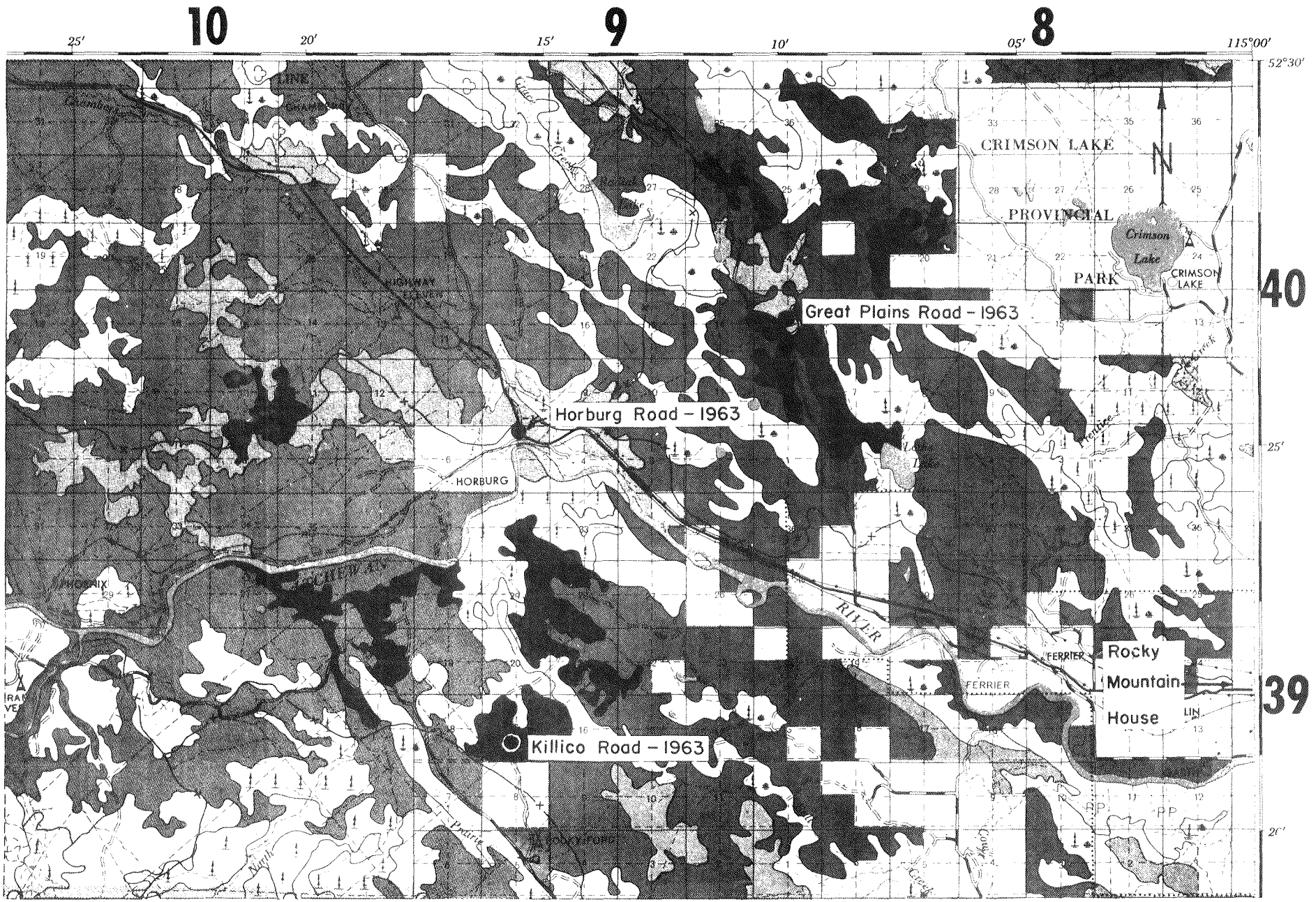



Figure 1. Location of the Rocky Mountain House Plantations (1963).

Scale: ——— = 2 miles

## Soils and Forest Cover

The landscape is an eroded plateau which slopes down from west to east. The study area is near the presumed meeting ground of Cordilleran and Continental (Laurentide) ice sheets of the Pleistocene Epoch. Therefore a wide range of parent materials and soils are to be found in close proximity; in general, till of varying depth covers the uplands, and the lowlands are filled with lacustrine and fluvial deposits. Aeolian sands and gravel terraces cover large areas. These deposits and soils are described in a soil survey report on the Rocky Mountain House Sheet (Peters and Bowser, 1960). In the Canadian classification the soils are classed in the sub-group Bisequa Grey Wooded in the Grey Wooded Great Group of the Podsolic Order (N.S.S.C.C., 1963). Specific soil profiles are described later.

The forest cover is mature trembling aspen with scattered white spruce stems. Ground vegetation offers light to heavy competition to young trees. The degree of competition differs with the shrub and herb species and with the per cent cover. These vary between sites.

## Climate

Cold winters and moderately warm summers characterize the climate at Rocky Mountain House. The mean summer temperature (May to September inclusive) is 50°F. and the average daily maximum is 65°F. January is the coldest month with an average temperature of 10°F. Annual precipitation is about 19 inches and the year-to-year variation

is not great although the total has ranged from 10 inches to 30 inches. Over 60 per cent of the precipitation falls during the growing season (April to October) and much of the moisture from winter snowfall is lost in the spring run-off (Peters and Bowser, 1960).

Table 1. Climatological data, Rocky Mountain House, Alberta.

(Peters and Bowser, 1960)

| | |
|---|---|
| Mean annual temperature (°F) | 34.8 |
| Mean annual precipitation (inches) | 19.09 |
| Mean annual snowfall (inches) | 61.5 |
| Average length of frost-free period (days) | 50 |

## FIELD METHODS

Following an inspection of the forest and soil conditions in May, 1963, three sites were chosen for planting. Department of Forestry personnel surveyed and referenced the boundaries on the ground and Alberta Forest Service staff installed the plantations under the direction of Mr. G. Ontkean, Division Forester.

### Experimental Design and Layout

To describe the optimum spacing level for each soil type, three spacing levels (9 x 9 feet, 12 x 12 feet, 15 x 15 feet) are replicated three times and assigned randomly. The design is illustrated in Figure 2.

Figure 2

Field Layout of the Rocky Mountain House White Spruce Plantations-Under-Aspen, Clearwater Rocky Forest, Alberta

Project A-83. 1963

Note: Each cell is one acre

Soil type I — Horburg Road

| | | | |
|---|---|---|---|
| Replication 1. | b | c | a |
| " 2. | c | b | a |
| " 3. | a | c | b |

Spacing Levels

a.) 9 x 9 (4,662 trees) (518 trees/acre)

b.) 12 x 12 (2,718 trees) (302 trees/acre)

c.) 15 x 15 (1,746 trees) (194 trees/acre)

Soil type II — Great Plains Road

| | | | |
|---|---|---|---|
| Replication 1. | a | c | b |
| " 2. | c | b | a |
| " 3. | b | c | a |

Total number of trees required 9,126

Soil type III — Killico Road

| | | | |
|---|---|---|---|
| Replication 1. | b | a | c |
| " 2. | c | b | a |
| " 3. | b | a | c |

Total number of acres planted 27

A nine-acre block is established on each of three soil types, namely a Prentice Sandy Loam overlying till, a deep Prentice Sandy Loam overlying till and a Caroline Loam overlying till. Staff compass and chain were used and all bearings were based on true north. One-acre compartments were then laid out with string and compartment boundaries were marked with paint. Outside boundaries are painted blue and compartment boundaries are painted orange facing southeast and northeast. A creosoted four-foot post is located at the southeast corner of each 1-acre compartment. To this is attached an aluminum sign showing the compartment number, spacing interval and the year (Figure 3).

The planting stock was 3-0 white spruce, obtained from the Oliver Nursery near Edmonton. The condition of the seedlings on arrival was generally good; however tops of larger seedlings appeared to be dried. Size of stock ranged from large through medium to small. The stock was transported to Rocky Mountain House in polyethylene bags and was "heeled in" on arrival. Stock used at the Great Plains Road site was "heeled in" twice, first at the Horburg Road site and again at the Great Plains Road site.

A one foot-long shingle marker was dipped in red paint and then placed at the point where a tree was to be planted. Each plantation was so marked and then trees were planted one foot from the markers (Figure 4). There were 36 rows with 15 trees per row in the 9 x 9 compartments, 27 rows with 11 trees per row in the 12 x 12 compartments and 22 rows with 8 trees per row in the 15 x 15 compartments. Thus each 9-acre plantation was made up of 3,039 trees.

Figure 3. Corner post, Compartment 8, Horburg Road Plantation. Note heavy windfall.

Figure 4. Planted seedling with stake.

Figure 9. Great Plains Road Plantation. Compartment 5, 60-year old aspen.

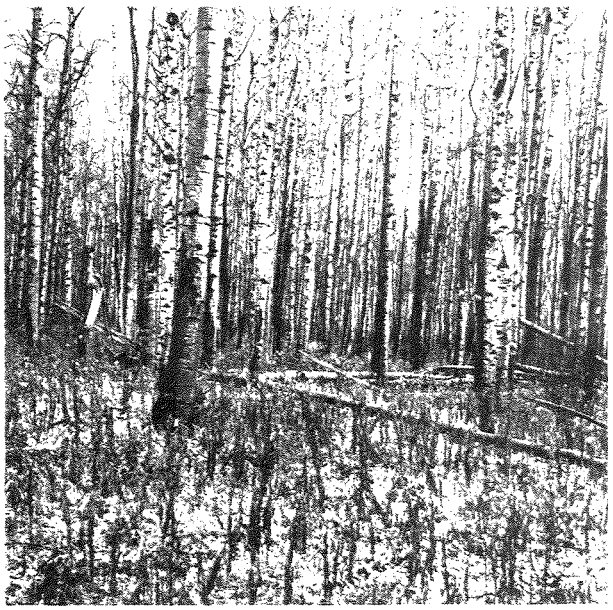


Figure 12. Killico Road Plantation. 80-year old aspen. Windfall from July, 1963 storm.

Planting commenced on May 22, 1963, and the slit method and planting bar were used with no site or ground preparation. The Horburg Road Plantation was established first, the Great Plains Road Plantation was second and the Killico Road Plantation was planted last. Each plantation was tied to a prominent landmark using a staff compass and steel tape (Figures 5, 7 and 10).

## RECORDS

At each plot, growth and yield data were taken and a soil and site description was recorded. For trembling aspen, age, height and diameter (d.b.h.) was measured on ten dominant trees at each plantation site. For white spruce and lodgepole pine, the same measurements were made on all free growing dominants. Basal area was estimated from two plotless samples in each one-acre block, using a Spiegel relascope (10 factor). One sample was taken at the one-chain (66 feet) mark on the center line and a second at the three-chain mark.

A general site description was prepared, ground vegetation was described and cover was estimated. Soil samples of the main horizons were taken at several locations using a Bull truck-mounted hydraulic soil sampler. Particle size analyses were done in the laboratory using a modified Bouyoucos hydrometer method (Bouyoucos, 1951).

## THE PLANTATIONS

### Horburg Road - 1963

The plantation is located about 1 mile northeast of the

Horburg settlement on the west side of Highway 11 at the junction with the Horburg Road (Figures 5 and 6). The soil is a sandy loam cap of variable depth overlying till. The topography is gently rolling.

The forest cover is mainly 80-year-old trembling aspen with a few scattered white spruce dominants. The average annual height growth of dominants is less than one foot. Basal area per acre averages 114 square feet. A summary of growth data for dominants at the three plantation sites is given in Table 2. It is given here as a record of growth at present; a more detailed discussion of soil-growth relationships will be given following new field studies.

The stand was selectively cut for white spruce about 25 years ago and some aspen has been taken since. There are several small openings in the stand and aspen suckers are coming in together with alder (Alnus crispa Ait., Pursh), Salix sp., Rubus pubescens Raf., Ribes americanum Pursh, Ledum groenlandicum Oeder, and Rosa acicularis Lindl. Grass is abundant.

The average wage of the field men in the study is $13.00/day. Using this wage as a basis, the costs at the Horburg Road Plantation were calculated. They are given (Table 3) together with costs for the other plantations:

Table 2. Growth data for dominants by plantation

| Plantation | Aspen | | | White Spruce | | Lodgepole Pine | |
|---|---|---|---|---|---|---|---|
| | Average Age in years | Average Height in feet | Average Basal Area in square feet. All species | Average Age in years | Average Height in feet | Average Age in years | Average Height in feet |
| Horburg Road | 80 | 71 | 114 | 53 | 48 | 56 | 59 |
| Great Plains Road | 62 | 74 | 157 | -- | -- | -- | -- |
| Killico Road | 82 | 75 | 153 | 43 | 64 | 73 | 67 |

Table 3. Planting costs of the Rocky Mountain House Plantations.

| | Horburg Road | Great Plains Road | Killico Road |
|---|---|---|---|
| 1. Plot corner establishment | $ 9.78 | $ 9.78 | $ 9.78 |
| 2. Shingle markers production | 13.04 | 13.04 | 13.04 |
| 3. Plot layout | 78.24 | 52.16 | 48.90 |
| 4. Planting | 39.12 | 32.60 | 29.34 |
| Total | $140.18 | $107.58 | $101.06 |
| Average cost per seedling | $ 0.046 | $ 0.035 | $ 0.033 |

Dense alder slowed the staking and planting operation.

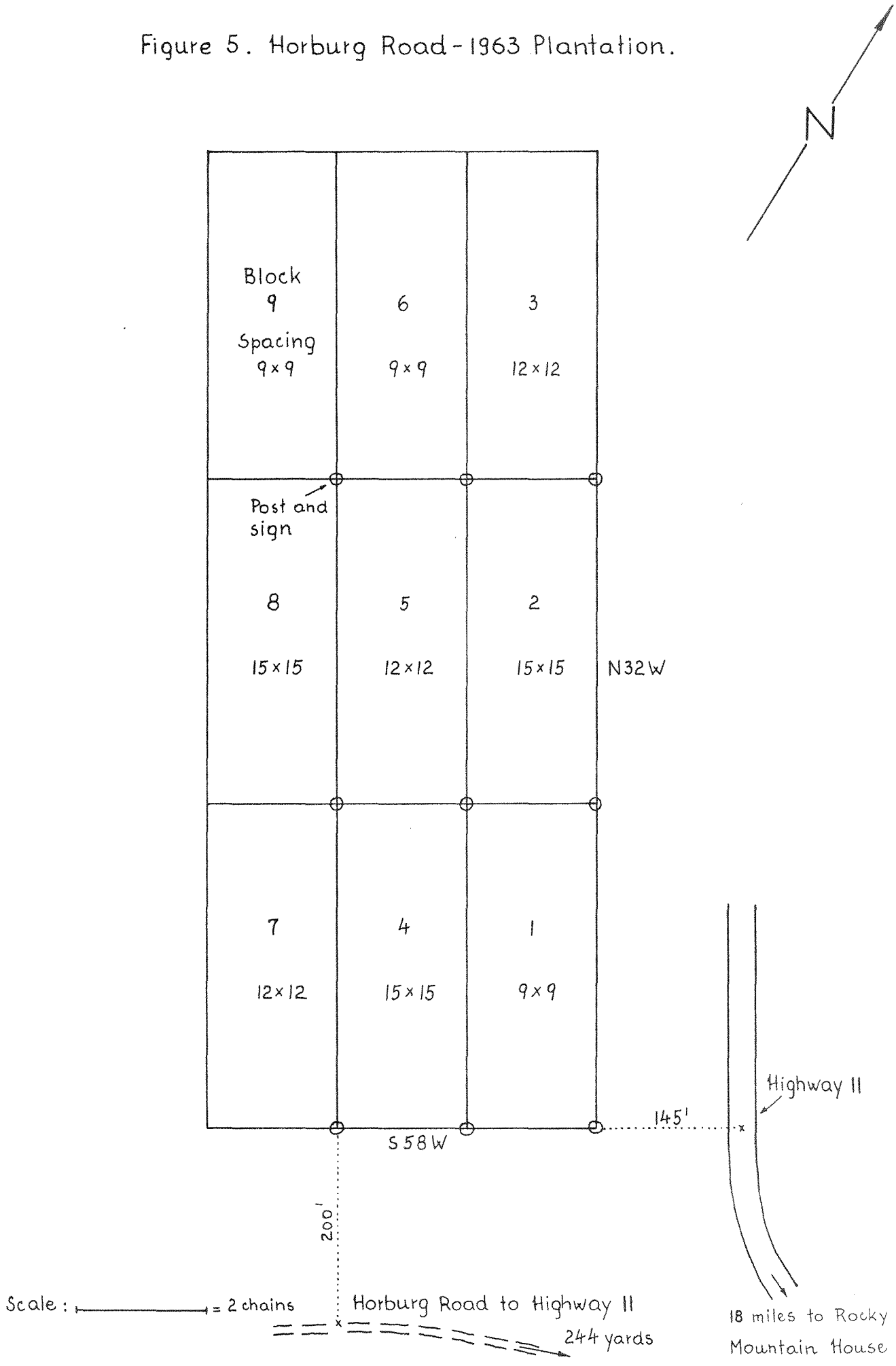
The soil at the Horburg Plantation is developed in a sandy loam cap which overlies stony till to variable depths. One shallow soil pit was described as follows:

| | | |
|---|---|---|
| 3" - 1" | | deciduous litter |
| 1 - 0 | | mull humus |
| 0 - 1 | Ah | black loam |
| 1 - 3 | Ae | grey brown silt loam |
| 3 - 6 | Bf | buff sandy loam |
| 6 - 18 | C/ | brownish sandy loam |
| 18 plus | Bt | reddish brown sandy clay loam in till |

Great Plains Road - 1963

The plantation is located northeast of the Great Plains Road and a seismic line intersection about four miles north of Highway 11 (Figures 7 and 8). The soil is a Prentice Sandy Loam overlying till to various depths.

Figure 5. Horburg Road - 1963 Plantation.



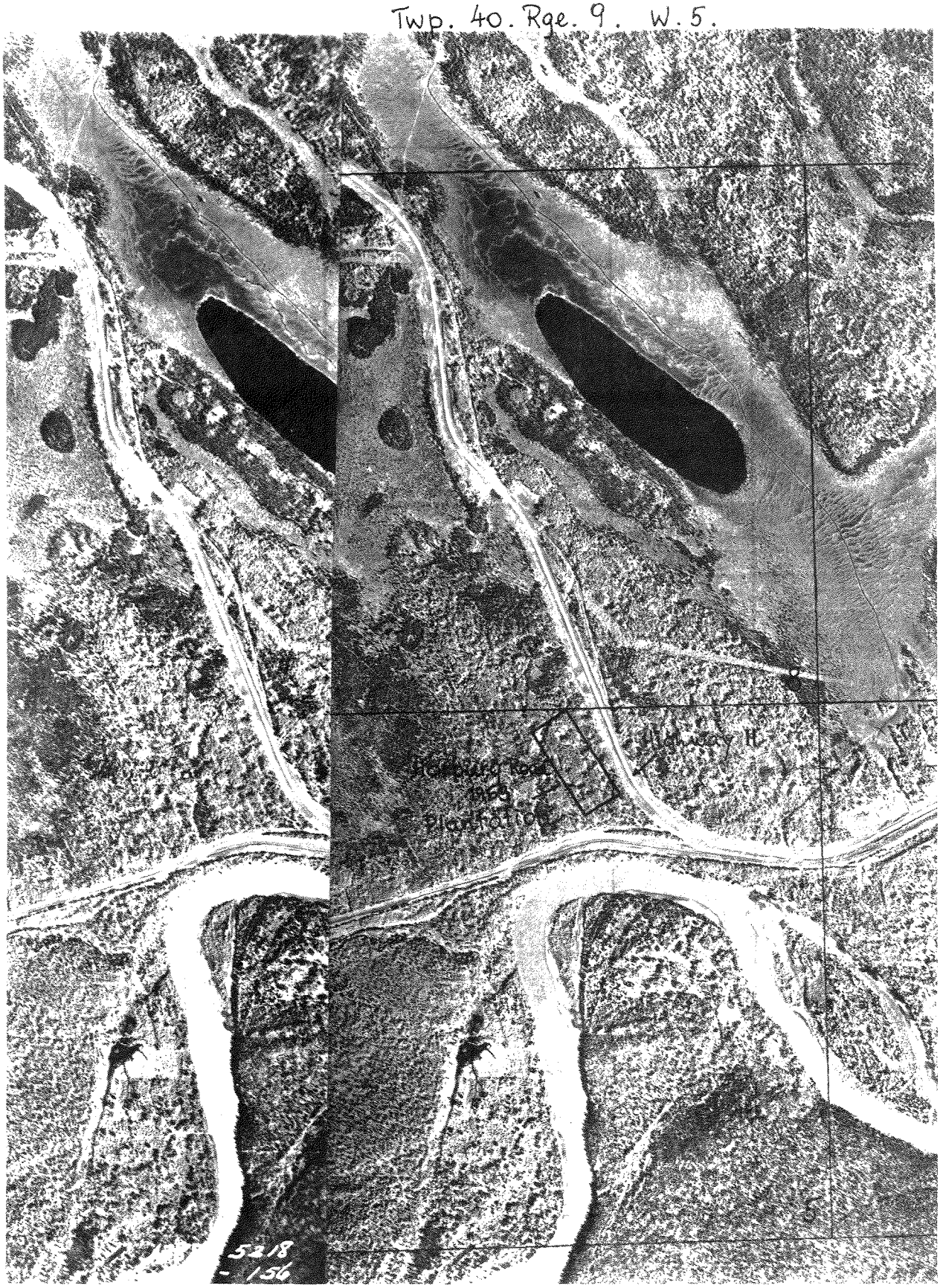



Figure 6. Stereopair of aerial photos showing the Horburg Road Plantation and the North Saskatchewan River.
Scale: 1 inch = 1320 feet

One soil profile core was described as follows:

| | | |
|---|---|---|
| 3" - 0 | mull humus | |
| 0 - 1 | Ae | grey brown sandy loam |
| 1 - 3 | Bf | brown sandy loam |
| 3 - 6 | C/ | light brown sandy loam |
| 6 - 9 | Bt | grey brown loam |
| 9 - 23 | C | grey brown loamy sand |
| 23 - 37 | D | brown sandy clay loam till |
| 37 plus | | weathered sandstone and till |

The forest cover is a pure even-aged 60 year old aspen stand (Figure 9) and height growth for dominant trees is over one foot per year. Vegetation competition was classed as light. About one-third of the area has an alder cover and grass is the dominant cover on the remainder.

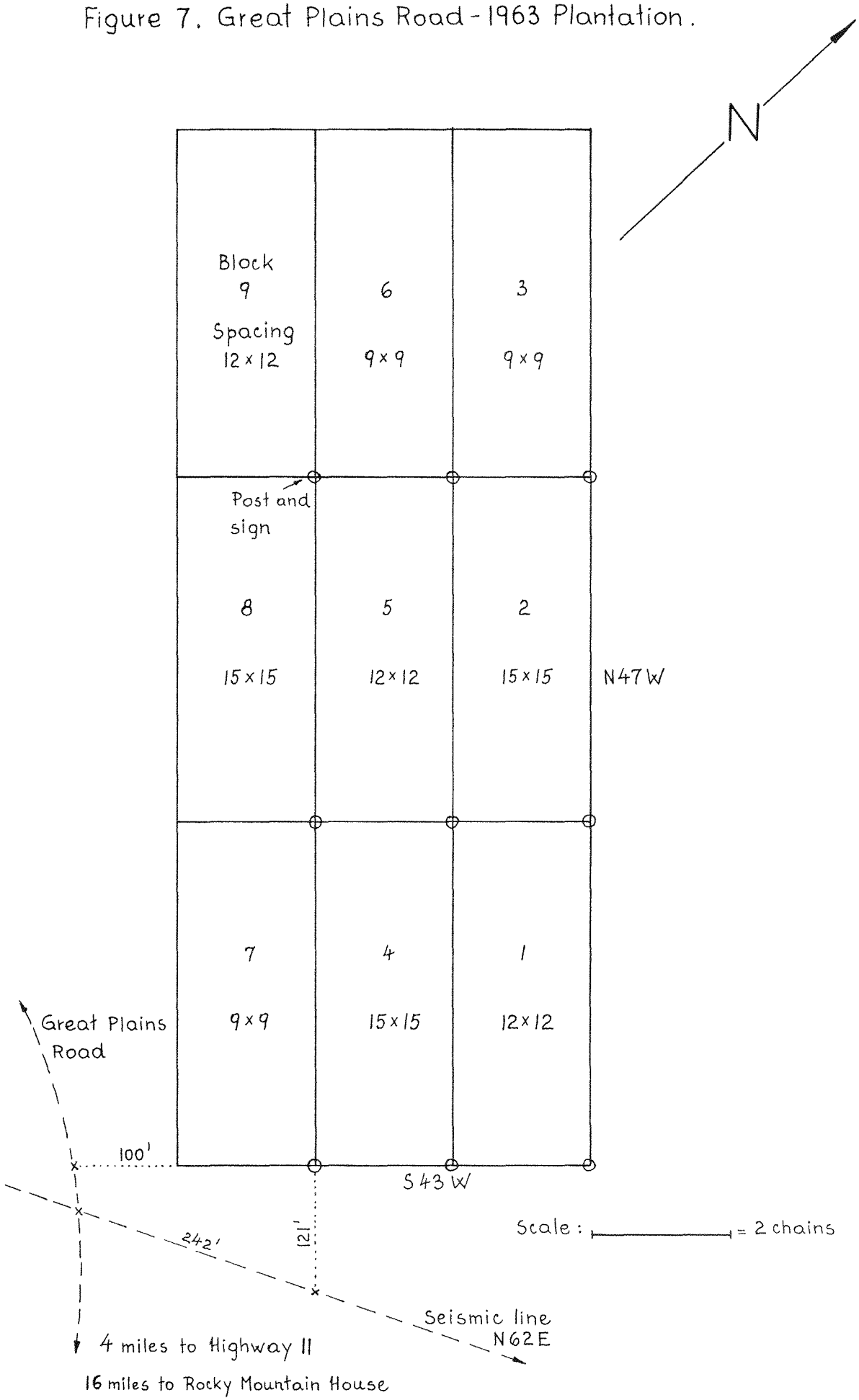
Planting and staking conditions were good and no problems were encountered.

Killico Road - 1963

The plantation is on the east side of the Killico Road about two miles north from the Strachan-Ram River Road (Figures 10 and 11). The soil is a Caroline Loam overlying till. One soil profile core was described as follows:

| | | |
|---|---|---|
| 2" - 0 | mull humus | |
| 0 - 3 | Ae | grey brown silt loam |
| 3 - 5 | Bf | brown silt loam |

Figure 7. Great Plains Road - 1963 Plantation.



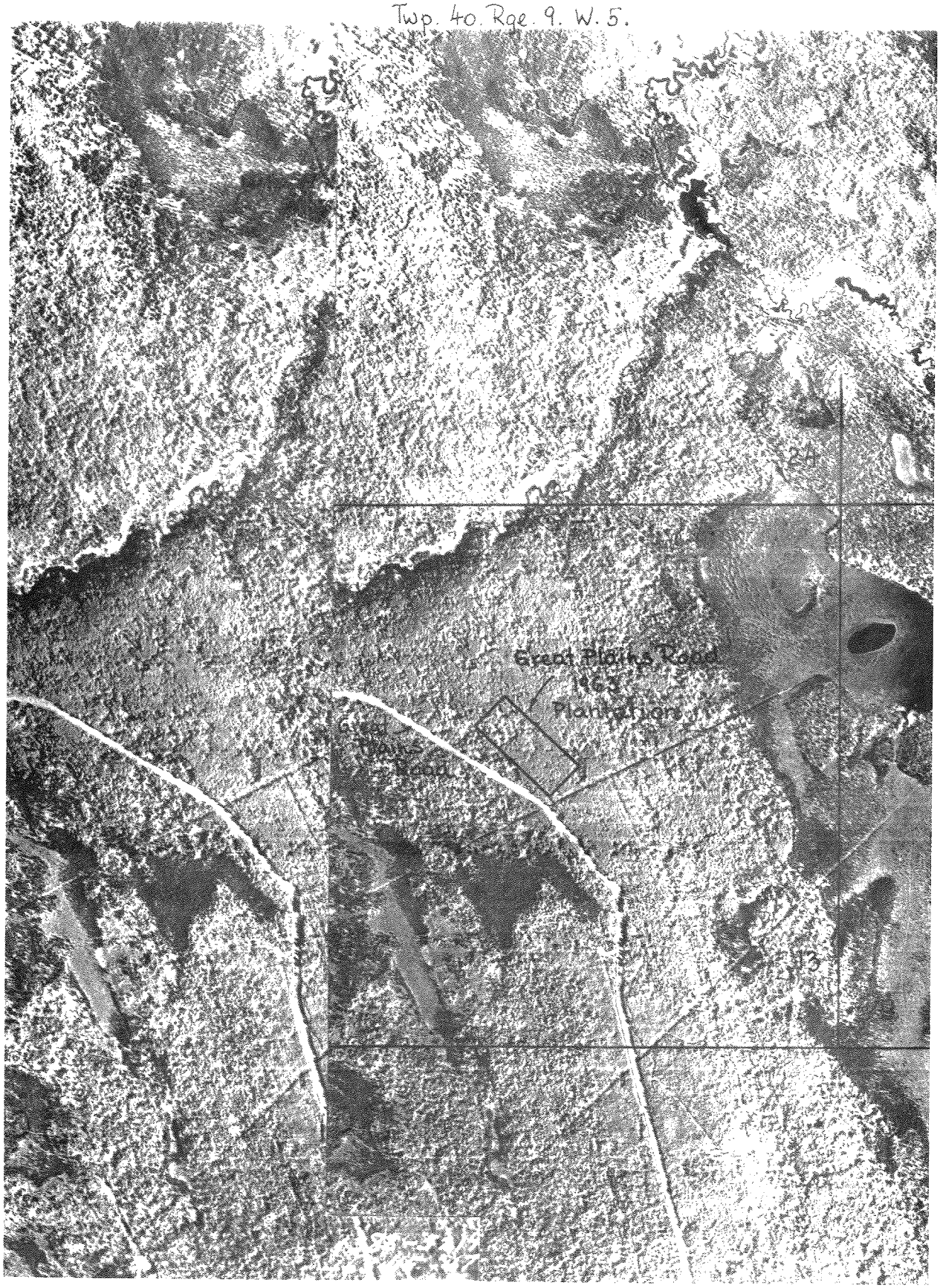



Figure 8. Stereopair of aerial photographs showing the Great Plains Road Plantation.
Scale: 1 inch = 1320 feet.

| | | |
|---|---|---|
| 5 - 10 | C/ | light brown silt loam |
| 10 - 22 | Bt | brown sandy clay loam with some sandstone |
| 22 plus | C | brown massive sandy clay loam and stones |

The forest cover is pure 80-year old aspen with scattered spruce (Figure 12). Dominant heights average 75 feet or slightly under one foot per year. Basal area averaged 153 square feet per acre. Ground cover was classed as moderate and the dominant species were Alnus crispa (Ait.) Pursh, Rosa acicularis Lindl., Cornus canadensis L., and grasses.

Staking and planting conditions were good and no difficulties were encountered.

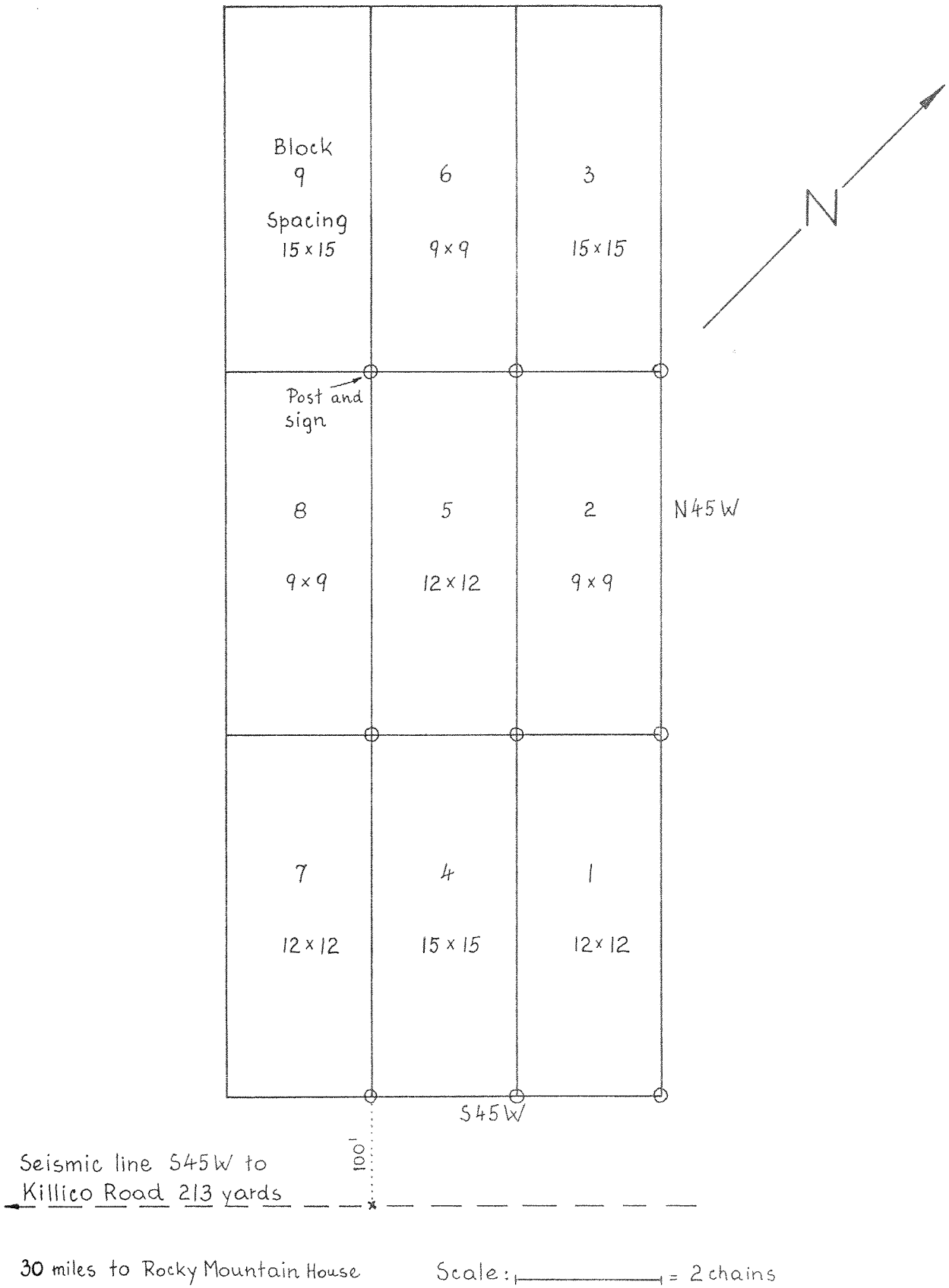
In 1965 the Alberta Department of Lands and Forests staff planted two rows of white spruce at 12 x 12 spacing around each plantation. This "surround" of planting stock will act as a buffer zone as the plantations mature.

It is important to note that in July, 1963, a heavy windstorm caused considerable windfall damage to occur at the Horburg Road and Killico Road plantations (Figures 3 and 12).

## ANALYSIS OF DATA

The analysis of data will be the same as for the Edson plantations (Duffy, 1963). Data from periodic remeasurement of mortality, young growth and volume growth will be compiled by sites, by spacing levels, and by blocks (replications). These effects will be analyzed using this analysis of variance table:

Figure 10. Killico Road - 1963 Plantation.



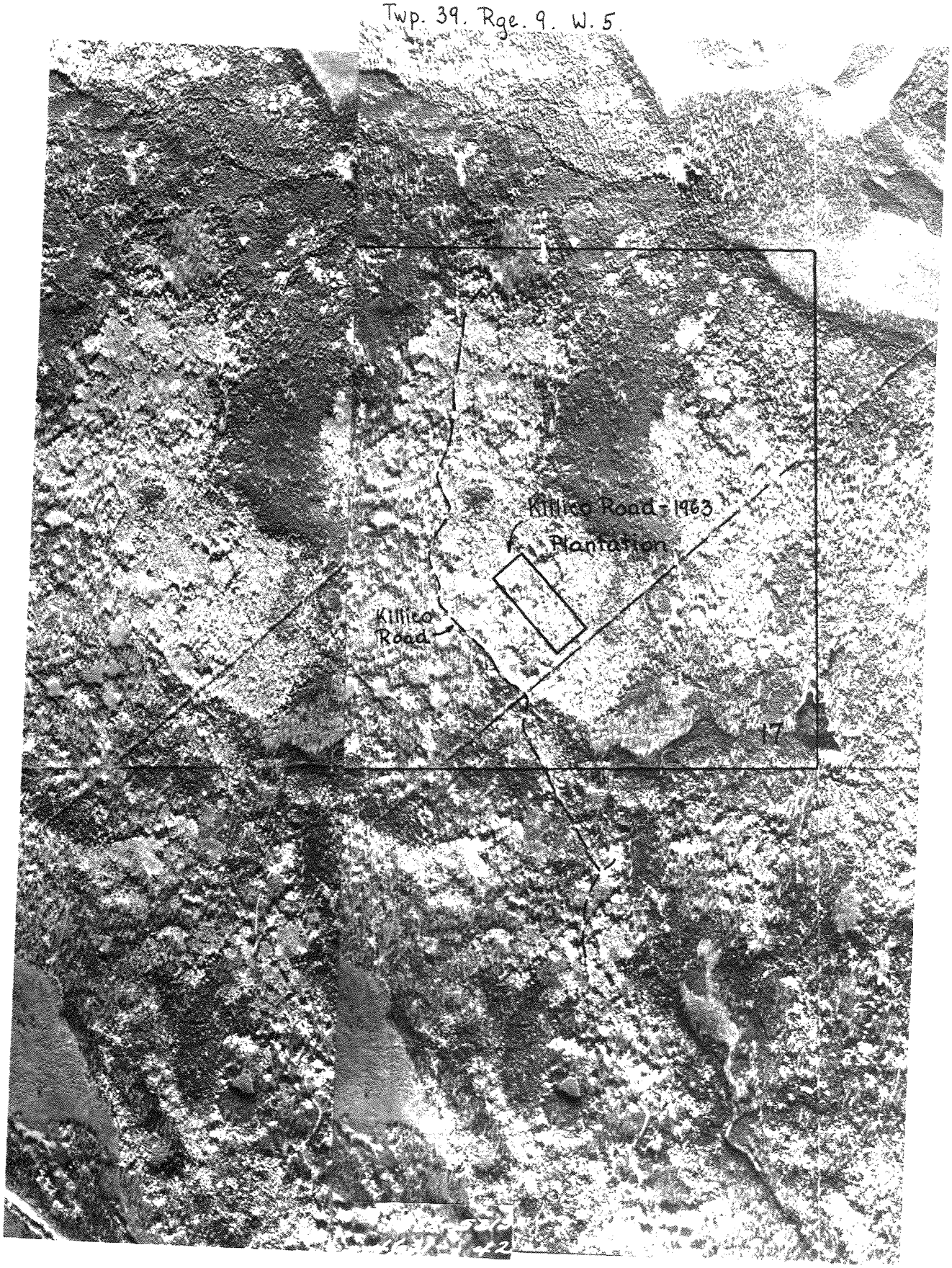



Figure 11. Stereopair of aerial photographs showing the Killico Road Plantation.
Scale: 1 inch = 1320 feet.

| Source of Variation | Degrees of freedom |
|---|---|
| Soil Type (3) | 2 |
| Spacing Levels (3) | 2 |
| ST x SL | 4 |
| Replication (blocks) | 2 |
| Error | 16 |
| Total | 26 |

Mean values of mortality and growth will be computed for those effects which are shown to be significant and meaningful. It is expected that mortality will vary with parent material and that young growth and periodic yields will vary with parent material and spacing level. A significant parent material-spacing level interaction is also expected.

## FUTURE WORK

A mortality survey was run in May, 1964, and another was run in May, 1965. An appraisal of the results will be presented in a forthcoming report. In 1968 the dead seedlings will be replaced and full stocking will be established. At prescribed dates thereafter, height growth and volume yields will be measured and the production per acre will be traced throughout the life of the spruce plantations.

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