

Final File Report
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GROWTH AND SURVIVAL OF YOUNG LODGEPOLE PINE

REGENERATION IN WEST-CENTRAL ALBERTA

V. Field Methods - Plot Locations and Survival
1981-1990

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INTRODUCTION

This is the fifth file report dealing with the survival of young lodgepole pine regeneration after clear-cutting in West-Central Alberta. The first report (Ives & Rentz 1982) outlined the methods used in establishing the plots and presented maps showing the location of plots established in 1981 and 1982: the second file report (Ives & Rentz 1983), summarized 1981 and 1982 survival data and attempted to project long-term survival; the third file report (Ives & Rentz 1985) summarizes 1982-1983 and 1983-1984 survival data; the fourth file report (Ives & Rentz 1986) summarizes the 1984-1985 data. This fifth and final file report will summarize all previous file reports and give survival results for the years 1981-1982 to 1989-1990 by area and age class (Tables 2-10); and by working circle and age class (Table 11).

A progress report on the Life tables for juvenile lodgepole pine in the foothills of West-Central Alberta using data obtained between 1981 and 1987 has also been prepared (Ives and Rentz, 1988).

FIELD METHODS

Maps and cutting records were used to make a preliminary selection of cut-over areas that represented a wide variety of age and site classes. A large number of those potential areas were checked in the field to determine which ones were suitable. In each area selected, a metal post was driven into the ground near an access road or trail to provide a reference point from which the bearing and distance to a cedar stake marking a corner of the first plot was recorded. Cedar posts were then driven at fixed intervals (usually 12.2 m) on a transect across the cut-over area.

Temporary 10m² square plots were established to the right and beyond each cedar stake (as one looked down the row of posts). The numbers of trees (by species) and the predominant ground

vegetation was recorded for those areas in which at least one lodgepole pine was present. Groups (up to 20) of potential crop trees in and around each fixed-area plot, at a spacing approximating that used during thinning operations, were then marked with yellow paint and aluminum tags. Special double-numbered tags ranging from 1-0 to 1.20 up to 40-0 to 40-20 were used. The first tag in each series (1-0, 2-0, etc.) was nailed to the cedar post used to mark the corner of the fixed-area plot to indicate the plot number. The remaining tags (1-1, 2-1, etc.) in each series were used in identifying the selected trees in each plot. Wires were used to fasten the tags to branches or stems or to wire pins if the trees were very small. The height, to the base of the current years growth was recorded for each tree, along with notes on its condition (Fig. 10). A sketch map showing the approximate location of each tagged tree was prepared for each plot (Fig. 11). After all the plots had been established in an area, aluminum plates bearing pertinent information were prepared and bolted to the metal post.

LOCATION OF PLOTS

Plots were established between 1981 and 1989 in 73 areas cut between 1956 and 1982 (Table 1). All age classes are fairly well represented, as is shown by the following breakdown: 8 areas were cut between 1956 and 1960; 20 between 1961 and 1965; 21 between 1966 and 1970; 16 between 1971 and 1975; 5 between 1976 and 1980; and 3 between 1981 and 1985. The rather poor representation for the early years is due to the scarcity of accessible areas. A limited number of plots in the 1976-1980 and 1981-1985 age classes were established to provide on-going representation in young stands.

The cut-over areas are situated in a number of locations in the Hinton area (Fig. 1). These locations represent a number of working circles, each containing a number of sampling areas as follows: McLeod II - 9 areas (Fig. 2); McLeod IX - 6 areas, (Fig. 3); McLeod VI - 16 areas (1 with 3 lines of

plots) (Fig. 4 and 9B); McLeod VII - 1 area (Fig. 9C); Embarrass I - 1 area (Fig. 9A); Embarrass III - 3 areas (1 with 2 lines of plots) (Fig. 5); Berland III - 7 areas (Fig. 6); Athabasca XIX - 17 areas (2 with 2 lines of plots each) (Fig. 7); Marlboro III - 4 areas (Fig. 8); and Marlboro VII - 4 areas (Fig. 8). The relatively high concentration of sampling areas in McLeod VI and Athabasca XIX working circles is attributable to the fact that there are good pine sites, readily accessible from Hinton. Other working circles are not as well represented, but there should be enough sampling areas to provide a good cross section of broad site classes, since a wide range of soil types and elevations are represented (Table I).

SURVIVAL

The plot data on survival and mortality has been grouped into 5-year age classes, based on when the original stands were cut (Table 2). Survival rates for each area within these age classes was averaged and the principal causes of mortality listed when these were known.

The survival in all areas was high, except where there were high rodent, (Hare & Squirrel) populations. These populations appeared to be related to the amount of cover available, which in turn is partially related to the number of years since the original stands were cut. Consequently, the curvilinear relationship (normal distribution) between cumulative survival and age class noted in the 1981-1982 survival may be an artifact.

All trees were re-examined annually, between mid July and late August, and all mortality recorded, along with the agents responsible, if this could be determined. Notes were also taken on all living tagged trees as to condition, damage, etc. In 1985 the diameters, at breast height, of a subsample of trees from each cut-over area was taken, and in 1986 the heights of a subsample of trees from each

area was taken. Data was also collected, in collaboration with Dr. Ian Corns, for the preparation of site classifications for lodgepole pine sites near Hinton, Alberta.

REFERENCES

- Ives, W.G.H. and C.L. Rentz. 1982. Growth and survival of young lodgepole pine regeneration in west-central Alberta. I. Field methods and plot locations. Northern Forestry Centre, Canadian Forestry Service, Environment Canada, 5320-122 Street, Edmonton, Alberta. File Report study NOR-9-181. October, 1982.
- Ives, W.G.H. and C.L. Rentz. 1983. Growth and survival of young lodgepole pine regeneration in west-central Alberta. II. 1981-82 Survival. Northern Forestry Centre, Canadian Forestry Service, Agriculture Canada, 5320-122 Street, Edmonton, Alberta. File Report Study NOR-9-181. May 1983.
- Ives, W.G.H. and C.L. Rentz. 1985. Growth and survival of young lodgepole pine regeneration in west-central Alberta. III. 1982-83 and 1983-84 survival. Northern Forestry Centre, Canadian Forestry Service, Agriculture Canada, 5320-122 Street, Edmonton, Alberta. File Report Study NOR-10-08.
- Ives, W.G.H. and C.L. Rentz. 1986. Growth and survival of young lodgepole pine regeneration in west-central Alberta. IV. 1984-85 survival. Northern Forestry Centre, Canadian Forestry Service, Agriculture Canada, 5320-122 Street, Edmonton, Alberta. File Report Study NOR-10-08.

Ives, W.G.H. and C.L. Rentz. 1986. Growth and survival of young lodgepole pine regeneration in west-central Alberta. IV. 1984-85 survival. Northern Forestry Centre, Canadian Forestry Service, Agriculture Canada, 5320-122 Street, Edmonton, Alberta. File Report Study NOR-10-08.

Ives, W.G.H; Rentz, C.L. 1988. Life tables for juvenile lodgepole pine in the foothills of west-central Alberta: a progress report. Gov. Can., Can. For.Serv., North For. Cent., Edmonton, Unpublished Rep.

Table 1. Areas selected near Hinton, Alberta, to monitor the growth and survival of young lodgepole pine regeneration

Area number	Cut area	Year cut	Mean height ¹ (meters)	Mean density ²	Aspect	Soil Type ³	Elevation (meters)	Bearing to first plot ⁴ (degrees)	Distance to first plot ⁴ (meters)	Bearing of post line (degrees)	Number positive plots	Number negative plots	Post locations with negative plots ⁵	Remarks
McLeod II Working Circle														
01	16	1960	3.04	4.0	Flat	JRV3	1310	350	22.9	23	34	6	4.7,13,15-17	
02	27	1961	3.56	4.2	SSE	FBB1	1340	260	18.3	260	21	3	2.5,8	
03	179	1965	1.52	14.2	ESE	RBB4	1540	78	12.2	78	34	3	8.9,36	
04	182	1965	1.55	12.4	ENE	RBB1	1480	90	24.4	90	34	3	21	
05	187	1967	1.06	11.6	Flat	JRV3	1400	142	15.2	210	40	0	6.8,20,23,33,37,38	
06	188	1967	0.77	7.0	Flat	JRV3	1400	144	23.8	205	33	7	26,33,40	
07	527	1968	0.74	8.2	Flat	JRV3	1310	298	61.0	38	37	3	36,38,-40	
08	562	1975	0.12	7.4	Flat	FBB1-Rbb3	1440	244	137.2	285	37	4	25	
09 ^a	684	1980	0.39	11.5	Flat	RBB1	1480			340	39	1		L-M winter browning
McLeod VII working circle														
10 ^a	104	1982	0.27	5.25	Flat	RBB1	1310			44	20	5	11,12,14,20,21	L-M winter browning
McLeod IX working circle														
11	8	1956	4.70	3.3		MLB3	1430	212	23.8	295	23	17	8,10,11,18,22-30,32,36,38	
12	23	1956	4.47	2.4		MLB3+MLB3/T	1370	70	25.9	108	27	6	17,18,23,29,31,32	Bearing change to 86° at post 15
13	24	1956	4.55	1.3		MLB3+MLB3/T	1395	360	30.5	304	16	24	1.3,6-8,14-19,21,23,25 27-29,31-34,35-37,40	
14	244	1972	0.55	11.2	FlatE	MLB2	1310	70	21.0	94	36	1	16	T-post not near road
15	245	1972	0.39	4.5	W to NW	MLB2	1395	110	24.4	310	30	10	11,14,18,19,23,25,27 28,37,38	
16	246	1972	0.35	4.8	Flat	MLB2	1310	186	18.9		33	7	8,10,12,28,33,35,37	
McLeod VI working circle														
21	45	1964	2.70	4.6	N to NW	RBB1	1350	144	26.8	80	31	9	3,4,6,7,9,10,13,26,30	
22	56	1964	2.55	5.4	N	RBB1	1370	38	44.2	38	35	5	19,24,27,29,39	
23	57	1964	2.58	5.3		MLB4	1335	27	61.0	98	36	4	10,28,30,40	
24	119	1962	2.43	4.7	E	RBB1	1250	200	30.5	290	22	10	2,4,6,9,11,12,17,19,22 24,25,28,30,31,35,36,38 12,15,20,22-24,26,31, 32,35,36	No plot 9 tags, severe hail damage No plot 21 or 22 tags, severe hail damage
25	120	1962	2.17	5.9	E	RBB1	1235	220	30.5	295	23	11	32,35,36	Tag numbers 21-28 used
26	139	1961	2.44	5.6	S	RBB1	1290	325	12.2	325	18	2	12,17	Tag numbers 21-28 used
27	165	1963	2.87	4.4	N	MLB6+MLB6/T	1220	61	45.7	25	31	5	3,21,24,27,29	
28	189	1970	1.52	19.9	E to SE	MLB6+MLB6/T	1235	37	87.2	118	28	1	18,26	
29	189	1970	1.21	6.7	Valley	MLB6+MLB6/T	1220	37	120.7	118	27	3	7,19,23	
30	189	1970	1.43	7.6	Ridge	MLB6+MLB6/T	1235	37	163.4	118	22	8	6,9,10,21,24,26-28	
31	209	1966	2.07	8.0	NE & SW	RBB1	1310	164	21.9	258	23	17	15,17-21,23,25,26,28-30, 32,35,36,38,40	
32	214	1973	0.27	6.6	Flat,	RBB1	1325	332	12.2	330	26	14	11,13,18,19,25,27	Bearing change to 324° at post N to NE
33	215	1971	0.58	6.0	N to NE	RBB1	1325	200	30.5	130	39	1	30	
34	528	1969	1.51	14.0	FlatSE	RBB1	1235	360	12.2	110	25	0		Severe hail damage
35	534	1969	1.46	4.6	S	RBB1	1310	298	12.2	298	20	0	2,4,5,12-17,20,21,27	Tags 21-40 used
36	536	1969	1.96	5.0	N	RBB1	1325	155	15.2	155	23	17	32,34,35,37,39	
37	537	1969	1.96	4.1	NE	RBB1	1295	22	42.7	50	20	20	10-14,21-25,28-34,37-39	24.4 m between plots 16 & 17 Trace
38 ^a	696	1981	0.74	28.4	Flat	MLB6	1160	138	201.0	318	40	0		winter browning

Embarass III working circle

41	9	1960	4.63	2.3	Flat	MLB6	1130	156	15.2	132	29	11	4.5,8,12,14,16,17,20,21,32,38
42	18	1973	0.56	11.9	Flat	MLB6	1130	232	36.0	323	40	0	
43*	27	1974	0.40	10.4	Flat	LDM4	1130	328	36.6	50	19	0	
44*	27	1974	0.40	19.3	Flat	LDM4	1130	200	9.1	120	21	1	Tags 20-40 used

Embarass I working circle

45*	39	1981	0.63	8.25	S	RBB1 + MSK3	1280	240	77	150	32	8	6,12,13,14,15,27,29,33	Trace winter browning
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Atahasca XIX working circle

51	26	1964	2.01	2.1	Flat,NW	MLB6	1310	262	20.1	334	30	10	7.8,22,24,25,29,34,37,39,40
52	33	1964	2.36	3.2	Flat,NE	MLB6	1265	66	36.0	48	34	6	23,26,32,34,36,38
53	34	1964	2.53	17.6	NNE	MLB5	1220	32	26.2	340	17	3	2,12,15
54	34	1964	2.98	12.0	NNE	MLB5	1220	340	12.8	14	17	3	7,12,19
55	36	1964	2.32	3.5	Flat,E	MLB6	1280	270	22.9	230	33	7	19,20
56	61	1964	2.32	10.8	Flat,rolling	MLB5	1320	100	9.1	180	38	2	3,33
57	61	1964	2.49	10.8	Flat	MLB5	1310	102	35.1	75	35	2	10,33,37,40
58	113	1967	1.28	5.9	Flat,W	MLB6/S	1355	270	16.5	180	36	4	10
59	133	1969	1.33	11.8	W	MLB5	1265	84	55.5	60	39	1	7.33
60	173	1968	1.24	9.4	Hillocrest	MLB6(S,MLB5)	1330	350	11.6	52	33	2	22,31,39
61	176	1969	0.99	10.0	Rolling	MLB5	1325	270	19.8	250	37	3	7,15,16,31,38
62	555	1969	1.07	9.1		MLB6(MLB5)	1280	292	47.5	330	35	5	3,15,16,34,36,38-40
63	601	1972	0.46	17.6	Flat,gulleys	MLB6	1310	210	22.9	280	32	8	16
64	624	1972	0.49	12.4	Flat,S	MLB6	1300	160	23.8	160	39	1	35,37
65	633	1972	0.47	15.3	Ravine	MLB6	1310	232	65.5	258	38	2	
66*	611	1977	0.17	10.5		HTR(BKM)	1290	271	44.2	8	25	0	
67*	629	1976	0.30	26.6		MLB5	1320	44	24.4	17	25	0	
68*	609	1978	0.21	11.8		MLB6	1280	4	18.3	57	36	4	14,15,16,21
69*	661	1977	0.36	14.7		MLB6/S	1355	180		231	33	0	

Bertrand III working circle

71	15	1959	2.62	4.5	S		1525	43	38.4	110	36	4	4,12,15,22
72	C15	1970	0.47	7.7	SW		1430	26	28.3	10	35	4	8,9,11,31
73	C23	1970	0.37	2.5	Flat		1430	240	32.9	310	37	3	2,35,36
74	33	1962	2.05	4.4	Flat,crest		1480	80	18.3	80	40	0	
75	41	1961	2.44	4.1	NE to NNE		1455	170	39.6	170	33	7	4.5,19,26,28,30,33
76	501	1973	0.20	12.2	NE		1455	242	29.3	230	36	1	7.8,16,31
77	514	1973	0.21	8.5	Flat,S		1525	52	31.1	136	33	8	10,11,24,25,31,34,36,37

Marlboro VII working circle

81	2	1958	3.89	5.1	Flat	MBN2/S/T	1035	360	48.8	10	34	6	3,15,18,37
82	7	1958	5.43	3.9	Ridge top	MBN2	1035	330	12.8	324	33	7	28,29,34,37,40
83	537	1971	0.96	11.2	Flat	MBN2	1035	360	30.2	7	33	7	5,33,35,39
84	567	1972	0.57	8.3	Flat	MBN1/S	1035	220	36.6	194	34	6	27,28,30,32,34

Marlboro III working circle

85*	51	1965	1.52	7.9	Flat	MBN3/S	1400	88	41.4	33	29	11	4.8,12,16,19,33,35,39
86*	61	1970	0.94	10.4	Flat	MBN3/S	1370	24	82.3	20	33	7	13,14,25,26,30,32,35
87*	67	1970	0.79	6.8	Flat	MBN3/S	1390	66	24.7	347	34	6	2,7,8,13,18,38
88*	78	1969	0.80	12.9	Flat	MBN3/S	1375	70	44.5	70	40	0	

Bearing change to 354° at post 26

Bearing change to 140° at post 4

Planted

Tags 21-40 used, bearing change to 340° at post 16

- ¹Mean height of tagged trees at a spacing approximating that following thinning.
- ²Mean density of lodgepole pine in 10 m² temporary plot established to right and beyond plot post.
- ³JRY - Jarvis; RBB-Robb; MLB-Marlboro; LDM-Lendrum; HRT-Heart; BKM-Blackmud; MEN-Maybe; etc.
- ⁴Bearing and distance from mortal T-post to first post marking plot locations.
- ⁵Posts marking plot locations were placed at uniform spacings (usually 12.2 m) but were not numbered if plot was negative.
- ⁶Plots established in 1982.
- ⁷Plots established in 1983.
- ⁸Plots established in 1984.
- ⁹Plots established in 1989.

Table 2. Survival during 1981-1982 in lodgepole pine plots near Hinton, Alberta

Area	Weldwood designation		Number of trees	Survival	Major Cause
1956-60 Age Class					
01	McLeod II	(16)	525	0.998	Rodents
11	McLeod IX	(8)	253	0.972	Rodents - Browsing
12	McLeod IX	(23)	336	0.973	Rodents
13	McLeod IX	(24)	125	0.976	Rodents
41	Embarrass III	(15)	319	0.991	Hylobius
71	Berland III	(15)	469	1.000	
81	Marlboro VII	(2)	457	0.943	Rodents, Browsing Armillaria
82	Marlboro VII	(7)	543	<u>0.989</u>	Rodents, Gall Rust
			Average survival	0.980	
1961-65 Age class					
02	McLeod II	(27)	360	0.992	Armillaria, Hylobius
03	McLeod II	(179)	576	0.990	Armillaria, Blister Rust
04	McLeod II	(182)	584	1.000	
21	McLeod VI	(43)	487	0.932	Rodents, Browsing
22	McLeod VI	(56)	566	0.972	Rodents, Gall Rust, Browsing, Armillaria
23	McLeod VI	(57)	577	0.993	Rodents, Hylobius, Unknown
24	McLeod VI	(119)	226	0.991	Unknown
25	McLeod VI	(120)	360	0.994	Armillaria, Rodents
26	McLeod VI	(139)	289	0.993	Armillaria, Rodents
27	McLeod VI	(165)	366	0.986	Hylobius, Unknown
51	Athabasca XIX	(26)	365	1.000	
52	Athabasca XIX	(33)	465	0.981	Armillaria, Gall Rust, Rodents
53	Athabasca XIX	(34)	320	0.997	Rodents
54	Athabasca XIX	(34)	311	1.000	
55	Athabasca XIX	(36)	492	0.994	Gall Rust Stem
56	Athabasca XIX	(61)	678	0.996	Armillaria
57	Athabasca XIX	(61)	642	0.986	Armillaria
74	Berland III	(33)	589	1.000	
75	Berland III	(41)	551	<u>0.998</u>	Unknown
			Average survival	0.989	
1966-1970 age class					
05	McLeod II	(187)	763	0.993	Rodents, Blister Rust, Unknown
06	McLeod II	(188)	536	0.992	Armillaria, Unknown
07	McLeod II	(527)	593	1.000	
28	McLeod VI	(189)	539	0.993	Rodents, Armillaria
29	McLeod VI	(189)	502	0.996	Armillaria
30	McLeod VI	(189)	362	0.994	Armillaria, Unknown
31	McLeod VI	(209)	328	0.805	Rodents
34	McLeod VI	(528)	491	0.980	Armillaria, Unknown

35	McLeod VI	(534)	332	0.964	Rodents, Armillaria, Hylobius
36	McLeod VI	(536)	291	0.804	Rodents
37	McLeod VI	(537)	244	0.893	Rodents, Armillaria
58	Athabasca XIX	(113)	638	0.994	Armillaria
59	Athabasca XIX	(133)	723	0.996	Armillaria
60	Athabasca XIX	(173)	566	0.989	Armillaria
61	Athabasca XIX	(176)	636	0.998	Armillaria
62	Athabasca XIX	(555)	585	0.991	Rodents
72	Berland III	(C15)	632	1.000	
73	Berland III	(C23)	601	<u>0.997</u>	Gall Rust

Average survival¹ 0.992

1971-75 Age Class

08	McLeod II	(562)	570	0.998	Armillaria
14	McLeod IX	(244)	623	0.994	Armillaria, Unknown
15	McLeod IX	(245)	473	0.998	Armillaria
16	McLeod IX	(246)	429	0.995	Armillaria
32	McLeod VI	(214a)	373	0.997	Unknown
33	McLeod VI	(215)	669	0.997	Unknown
42	Embarrass III	(18)	734	0.986	Armillaria, Hylobius
63	Athabasca XIX	(601)	586	0.995	Armillaria
64	Athabasca XIX	(624)	736	0.997	Armillaria
65	Athabasca XIX	(633)	747	0.993	Armillaria, Hylobius
76	Berland III	(501)	617	1.000	
77	Berland III	(514)	557	1.000	
83	Marlboro VII	(530)	598	0.980	Armillaria
84	Marlboro VII	(567)	571	<u>0.986</u>	Hylobius, Armillaria

Average survival 0.994

¹Average excluding areas 31, 36 & 37 which were severely damaged by rodents.

Table 3. Survival during 1982-1983 in lodgepole pine plots near Hinton, Alberta

Area	Weldwood designation		Number of trees	Survival	Major Cause
1956-60 Age Class					
01	McLeod II	(16)	524	0.996	Rodents, Gall Rust
11	McLeod IX	(8)	228	0.930	Rodents, Gall Rust
12	McLeod IX	(23)	327	0.945	Rodents, Browsing, Armillaria, Gall Rust
13	McLeod IX	(24)	122	1.000	
41	Embarrass III	(15)	316	0.994	Hylobius
71	Berland III	(15)	469	1.000	
81	Marlboro VII	(2)	430	0.967	Rodents, Armillaria, Hylobius
82	Marlboro VII	(7)	537	<u>0.989</u>	Rodents, Armillaria
			Average survival	0.978	
1961-65 Age class					
02	McLeod II	(27)	357	0.994	Hylobius, Gall Rust
03	McLeod II	(179)	569	0.984	Armillaria, Gall Rust
04	McLeod II	(182)	584	1.000	
21	McLeod VI	(43)	454	0.945	Rodents, Browsing
22	McLeod VI	(56)	550	0.978	Rodents, Armillaria
23	McLeod VI	(57)	573	0.995	Hylobius, Gall Rust
24	McLeod VI	(119)	224	0.996	Unknown
25	McLeod VI	(120)	358	0.992	Armillaria, Rodents
26	McLeod VI	(139)	287	0.990	Armillaria, Rodents
27	McLeod VI	(165)	361	0.989	Hylobius, Armillaria, Gall Rust
51	Athabasca XIX	(26)	365	0.997	Hylobius
52	Athabasca XIX	(33)	456	0.987	Armillaria, Rodent
53	Athabasca XIX	(34)	318	0.991	Rodent, Hylobius
54	Athabasca XIX	(34)	311	1.000	
55	Athabasca XIX	(36)	489	0.990	Gall Rust, Hylobius, Armillaria, Browsing
56	Athabasca XIX	(61)	675	0.994	Armillaria, Rodents
57	Athabasca XIX	(61)	634	0.989	Armillaria, Hylobius
74	Berland III	(33)	589	1.000	
75	Berland III	(41)	550	1.000	
85	Marlboro III	(51)	523	<u>1.000</u>	
			Average survival	0.991	
1966-1970 age class					
05	McLeod II	(187)	758	0.997	Hylobius
06	McLeod II	(188)	532	0.998	Unknown
07	McLeod II	(527)	593	0.998	Hylobius
28	McLeod VI	(189)	535	0.992	Hylobius

29	McLeod VI	(189)	500	0.994	Armillaria, Hylobius
30	McLeod VI	(189)	360	1.000	
31	McLeod VI	(209)	264	0.883	Rodents, Browsing
34	McLeod VI	(528)	482	0.975	Armillaria, Unknown
35	McLeod VI	(534)	320	0.962	Rodents, Armillaria, Browsing
36	McLeod VI	(536)	234	0.893	Rodents
37	McLeod VI	(537)	218	0.963	Rodents
58	Athabasca XIX	(113)	635	0.978	Armillaria, Hylobius, Gall Rust
59	Athabasca XIX	(133)	720	0.994	Armillaria, Unknown
60	Athabasca XIX	(173)	558	0.995	Armillaria
61	Athabasca XIX	(176)	635	0.991	Hylobius, Gall Rust
62	Athabasca XIX	(555)	580	0.993	Rodents
72	Berland III	(C15)	632	0.997	Rodents, Unknown
73	Berland III	(C23)	599	0.998	Armillaria
86	Marlboro III	(61)	601	0.993	Hylobius
87	Marlboro III	(67)	620	0.997	Armillaria
88	Marlboro III	(78)	763	<u>0.995</u>	Armillaria

Average survival¹ 0.992

1971-75 Age Class

08	McLeod II	(562)	569	1.000	
14	McLeod IX	(244)	619	0.989	Armillaria, Unknown
15	McLeod IX	(245)	472	0.992	Armillaria, Blister Rust
16	McLeod IX	(246)	427	0.998	Armillaria
32	McLeod VI	(214a)	372	1.000	
33	McLeod VI	(215)	667	1.000	
42	Embarrass III	(18)	724	0.985	Armillaria, Hylobius
43	Embarrass III	(27)	375	0.987	Hylobius, Armillaria
44	Embarrass III	(27)	415	0.976	Armillaria
63	Athabasca XIX	(601)	583	0.990	Armillaria, Hylobius
64	Athabasca XIX	(624)	734	1.000	
65	Athabasca XIX	(633)	742	0.993	Armillaria, Hylobius
76	Berland III	(501)	617	0.998	Unknown
77	Berland III	(514)	557	1.000	
83	Marlboro VII	(530)	586	0.968	Armillaria, Hylobius
84	Marlboro VII	(567)	563	<u>0.995</u>	Hylobius

Average survival 0.992

¹Average excluding areas 31, 36 & 37 which were severely damaged by rodents.

Table 4. Survival during 1983-1984 in lodgepole pine plots near Hinton, Alberta

Area	Weldwood designation		Number of trees	Survival	Major Cause
1956-60 Age Class					
01	McLeod II	(16)	522	0.998	Rodent
11	McLeod IX	(8)	213	0.958	Rodents
12	McLeod IX	(23)	309	0.990	Rodents, Gall Rust
13	McLeod IX	(24)	123	1.000	
41	Embarrass III	(15)	314	1.000	
71	Berland III	(15)	469	1.000	
81	Marlboro VII	(2)	415	0.969	Browsing, Gall Rust
82	Marlboro VII	(7)	531	<u>0.991</u>	Rodents
			Average survival	0.988	
1961-65 Age class					
02	McLeod II	(27)	354	0.997	Hylobius
03	McLeod II	(179)	561	0.993	Armillaria
04	McLeod II	(182)	584	1.000	
21	McLeod VI	(43)	429	0.979	Rodents, Browsing
22	McLeod VI	(56)	537	0.981	Browsing
23	McLeod VI	(57)	570	0.986	Browsing, Rodents
24	McLeod VI	(119)	223	1.000	
25	McLeod VI	(120)	355	0.997	Gall Rusts
26	McLeod VI	(139)	284	0.986	Armillaria, Rodents, Gall Rust
27	McLeod VI	(165)	357	0.989	Gall Rust, Browsing
51	Athabasca XIX	(26)	364	1.000	
52	Athabasca XIX	(33)	450	0.996	Browsing
53	Athabasca XIX	(34)	316	0.990	Browsing
54	Athabasca XIX	(34)	311	0.990	Browsing
55	Athabasca XIX	(36)	484	1.000	
56	Athabasca XIX	(61)	671	0.988	Rodents, Browsing
57	Athabasca XIX	(61)	627	0.989	Armillaria, Browsing
74	Berland III	(33)	589	1.000	
75	Berland III	(41)	550	1.000	
85	Marlboro III	(51)	523	<u>1.000</u>	
			Average survival	0.993	
1966-1970 age class					
05	McLeod II	(187)	756	1.000	
06	McLeod II	(188)	531	1.000	
07	McLeod II	(527)	592	1.000	
28	McLeod VI	(189)	531	1.000	
29	McLeod VI	(189)	497	0.998	Unknown
30	McLeod VI	(189)	360	0.997	Browsing
31	McLeod VI	(209)	233	0.923	Rodents, Browsing

34	McLeod VI	(528)	470	0.968	Armillaria, Unknown
35	McLeod VI	(534)	308	0.974	Rodents, Hylobius, Browsing
36	McLeod VI	(536)	209	0.933	Rodent, Unknown
37	McLeod VI	(537)	210	0.976	Browsing, Hylobius
58	Athabasca XIX	(113)	621	0.989	Armillaria, Needle Cost
59	Athabasca XIX	(133)	716	0.999	Hylobius
60	Athabasca XIX	(173)	555	0.995	Armillaria
61	Athabasca XIX	(176)	629	0.995	Armillaria
62	Athabasca XIX	(555)	575	0.991	Armillaria, Hylobius, Gall Rust
72	Berland III	(C15)	630	1.000	
73	Berland III	(C23)	598	0.998	Unknown
86	Marlboro III	(61)	598	0.993	Armillaria, Needle Cast
87	Marlboro III	(67)	619	0.998	Armillaria
88	Marlboro III	(78)	759	0.999	Armillaria

Average survival¹ 0.994

1971-75 Age Class

08	McLeod II	(562)	569	0.998	Unknown
14	McLeod IX	(244)	612	0.990	Armillaria, Rodent
15	McLeod IX	(245)	468	0.987	Armillaria, Browsing
16	McLeod IX	(246)	426	0.991	Armillaria
32	McLeod VI	(214a)	372	0.997	Armillaria
33	McLeod VI	(215)	667	0.998	Unknown
42	Embarrass III	(18)	713	0.970	Armillaria, Rodent
43	Embarrass III	(27)	370	0.986	Hylobius, Armillaria
44	Embarrass III	(27)	405	0.965	Armillaria, Gall Rust
63	Athabasca XIX	(601)	577	0.996	Hylobius
64	Athabasca XIX	(624)	734	1.000	
65	Athabasca XIX	(633)	737	0.988	Armillaria, Hylobius, Gall Rust
76	Berland III	(501)	616	0.998	Unknown
77	Berland III	(514)	557	1.000	
83	Marlboro VII	(530)	567	0.984	Hylobius, Rodent
84	Marlboro VII	(567)	561	0.986	Hylobius, Armillaria, Browsing

Average survival 0.990

1976-81 Age Class

66	Athabasca XIX	(611)	471	0.998	Hylobius
67	Athabasca XIX	(629)	485	0.996	Hylobius

Average survival 0.997

¹Average Excluding areas 31, 36 & 37 which were severely damaged by rodents in 1981-82 and 1982-83.

Table 5. Survival during 1984-1985 in lodgepole pine plots near Hinton, Alberta

Area	Weldwood designation		Number of trees	Survival	Major Cause
1956-60 Age Class					
01	McLeod II	(16)	521	0.992	Rodents, Browsing
11	McLeod IX	(8)	204	0.971	Rodents, Wind
12	McLeod IX	(23)	306	0.993	Rodents
13	McLeod IX	(24)	123	0.959	Rodents
41	Embarrass III	(15)	314	0.997	Unknown
71	Berland III	(15)	469	1.000	
81	Marlboro VII	(2)	402	0.975	Armillaria, Gall Rust
82	Marlboro VII	(7)	526	<u>0.996</u>	Unknown
			Average survival	0.985	
1961-65 Age class					
02	McLeod II	(27)	354	0.989	Gall Rust, Browsing
03	McLeod II	(179)	557	0.986	Unknown, Rodents
04	McLeod II	(182)	584	0.993	Rodents, Unknown
21	McLeod VI	(43)	420	0.983	Rodents, Browsing, Gall Rust
22	McLeod VI	(56)	528	0.981	Browsing, Unknown
23	McLeod VI	(57)	562	0.986	Rodents, Gall Rust, Armillaria
24	McLeod VI	(119)	223	0.991	Armillaria, Unknown
25	McLeod VI	(120)	354	0.994	Gall Rust, Unknown
26	McLeod VI	(139)	280	0.993	Unknown
27	McLeod VI	(165)	353	0.980	Hylobius, Rodents
51	Athabasca XIX	(26)	363	1.000	
52	Athabasca XIX	(33)	448	0.975	Browsing, Hylobius
53	Athabasca XIX	(34)	311	0.994	Armillaria, Gall Rust
54	Athabasca XIX	(34)	305	1.000	
55	Athabasca XIX	(36)	484	0.998	Gall Rust Browsing
56	Athabasca XIX	(61)	661	0.983	Gall Rust, Rodent, Unknown
57	Athabasca XIX	(61)	617	0.987	Armillaria, Unknown
74	Berland III	(33)	589	1.000	
75	Berland III	(41)	549	1.000	
85	Marlboro III	(51)	523	<u>0.998</u>	Hylobius
			Average survival	0.991	
1966-1970 age class					
05	McLeod II	(187)	756	0.993	Blister Rust
06	McLeod II	(188)	531	0.992	Blister Rust, Armillaria
07	McLeod II	(527)	592	1.000	
28	McLeod VI	(189)	531	0.994	Unknown
29	McLeod VI	(189)	496	0.992	Unknown
30	McLeod VI	(189)	357	0.992	Unknown
31	McLeod VI	(209)	215	0.963	Rodent

34	McLeod VI	(528)	455	0.978	Unknown
35	McLeod VI	(534)	300	0.970	Rodents, Blister Rust
36	McLeod VI	(536)	195	0.964	Rodent
37	McLeod VI	(537)	205	0.961	Rodent, Unknown
58	Athabasca XIX	(113)	614	0.990	Unknown
59	Athabasca XIX	(133)	712	0.983	Armillaria, Unknown
60	Athabasca XIX	(173)	551	0.989	Unknown
61	Athabasca XIX	(176)	626	0.986	Armillaria, Unknown
62	Athabasca XIX	(555)	569	0.995	Rodent, Gall Rust
72	Berland III	(C15)	629	1.000	
73	Berland III	(C23)	597	0.997	Blister Rust, Unknown
86	Marlboro III	(61)	593	0.988	Unknown, Gall Rust
87	Marlboro III	(67)	618	1.000	
88	Marlboro III	(78)	758	<u>0.996</u>	Armillaria, Unknown
			Average survival ¹	0.991	
1971-75 Age Class					
08	McLeod II	(562)	568	0.995	Gall Rust, Unknown
14	McLeod IX	(244)	606	0.985	Armillaria, Hylobius, Rodent
15	McLeod IX	(245)	462	0.985	Blister Rust, Hylobius
16	McLeod IX	(246)	422	0.990	Armillaria, Hylobius
32	McLeod VI	(214a)	369	1.000	
33	McLeod VI	(215)	665	0.998	Armillaria
42	Embarrass III	(18)	692	0.971	Armillaria, Hylobius, Gall Rust
43	Embarrass III	(27)	365	0.975	Armillaria
44	Embarrass III	(27)	391	0.951	Armillaria
63	Athabasca XIX	(601)	575	0.979	Armillaria, Unknown
64	Athabasca XIX	(624)	734	0.997	Unknown
65	Athabasca XIX	(633)	728	0.972	Armillaria, Hylobius
76	Berland III	(501)	615	1.000	
77	Berland III	(514)	553	1.000	
83	Marlboro VII	(530)	558	0.977	Armillaria, Hylobius
84	Marlboro VII	(567)	536	<u>0.985</u>	Armillaria, Suppression Unknown
			Average survival	0.985	
1976-81 Age Class					
66	Athabasca XIX	(611)	469	0.991	Armillaria, Unknown
67	Athabasca XIX	(629)	483	0.994	Armillaria
68	Athabasca XIX	(609)	534	0.992	Armillaria, Unknown
69	Athabasca XIX	(661)	438	<u>1.000</u>	
			Average survival	0.994	

¹Average excluding areas 31, 36 & 37 which were severely damaged by rodents in 1981-82 and 1982-83.

Table 6. Survival during 1985-1986 in lodgepole pine plots near Hinton, Alberta

Area	Weldwood designation		Number of trees	Survival	Major Cause
1956-60 Age Class					
01	McLeod II	(16)	517	1.000	
11	McLeod IX	(8)	198	0.929	Rodent, Gall Rust
12	McLeod IX	(23)	304	0.987	Gall Rust, Armillaria
13	McLeod IX	(24)	118	0.983	Gall Rust
41	Embarrass III	(15)	313	1.000	
71	Berland III	(15)	469	1.000	
81	Marlboro VII	(2)	390	0.985	Armillaria, Hylobius
82	Marlboro VII	(7)	524	<u>0.996</u>	Armillaria
			Average survival	0.985	
1961-65 Age class					
02	McLeod II	(27)	350	1.000	
03	McLeod II	(179)	549	0.994	Armillaria, Hylobius
04	McLeod II	(182)	580	1.000	
21	McLeod VI	(43)	412	0.993	Rodent, Gall Rust
22	McLeod VI	(56)	517	0.994	Browsing
23	McLeod VI	(57)	554	0.993	Browsing, Armillaria
24	McLeod VI	(119)	221	0.995	Gall Rust
25	McLeod VI	(120)	352	0.991	Gall Rust, Armillaria
26	McLeod VI	(139)	278	0.996	Gall Rust
27	McLeod VI	(165)	346	0.983	Armillaria, Gall Rust
51	Athabasca XIX	(26)	364	0.994	Armillaria, Gall Rust
52	Athabasca XIX	(33)	436	0.991	Armillaria, Rodent
53	Athabasca XIX	(34)	172	0.994	Unknown
54	Athabasca XIX	(34)	199	1.000	
55	Athabasca XIX	(36)	483	1.000	
56	Athabasca XIX	(61)	390	0.977	Rodent, Armillaria
57	Athabasca XIX	(61)	400	0.998	Armillaria
74	Berland III	(33)	589	1.000	
75	Berland III	(41)	550	1.000	
85	Marlboro III	(51)	552	<u>0.998</u>	Gall Rust
			Average survival	0.994	
1966-1970 age class					
05	McLeod II	(187)	751	0.992	Blister Rust, Gall Rust
06	McLeod II	(188)	527	0.990	Blister Rust
07	McLeod II	(527)	592	1.000	
28	McLeod VI	(189)	528	0.994	Armillaria Gall Rust
29	McLeod VI	(189)	491	0.998	Unknown
30	McLeod VI	(189)	356	0.997	Unknown
31	McLeod VI	(209)	207	0.981	Hylobius, Gall Rust

34	McLeod VI	(528)	445	0.984	Armillaria
35	McLeod VI	(534)	292	0.993	Armillaria
36	McLeod VI	(536)	188	0.995	Rodent
37	McLeod VI	(537)	197	0.990	Gall Rust
58	Athabasca XIX	(113)	608	0.990	Unknown
59	Athabasca XIX	(133)	703	0.990	Armillaria
60	Athabasca XIX	(173)	547	0.996	Armillaria
61	Athabasca XIX	(176)	617	0.997	Gall Rust
62	Athabasca XIX	(555)	568	0.996	Rodent, Blister Rust
72	Berland III	(C15)	630	0.997	Blister Rust
73	Berland III	(C23)	594	0.998	Gall Rust
86	Marlboro III	(61)	587	0.990	Armillaria
87	Marlboro III	(67)	618	1.000	
88	Marlboro III	(78)	754	<u>0.996</u>	Armillaria

Average survival 0.994

1971-75 Age Class

08	McLeod II	(562)	565	0.995	Armillaria
14	McLeod IX	(244)	597	0.985	Armillaria, Blister Rust
15	McLeod IX	(245)	455	0.967	Armillaria, Gall Rust
16	McLeod IX	(246)	418	0.976	Armillaria
32	McLeod VI	(214a)	371	0.995	Armillaria
33	McLeod VI	(215)	664	0.997	Armillaria, Gall Rust
42	Embarrass III	(18)	672	0.949	Armillaria, Gall Rust
43	Embarrass III	(27)	344	0.965	Armillaria, Hylobius, Blister Rust
44	Embarrass III	(27)	369	0.948	Armillaria, Hylobius
63	Athabasca XIX	(601)	272	0.974	Armillaria
64	Athabasca XIX	(624)	732	0.997	Armillaria
65	Athabasca XIX	(633)	708	0.982	Armillaria
76	Berland III	(501)	615	0.998	Unknown
77	Berland III	(514)	557	0.996	Gall Rust
83	Marlboro VII	(530)	545	0.989	Armillaria, Blister Rust
84	Marlboro VII	(567)	528	<u>0.990</u>	Unknown

Average survival 0.981

1976-81 Age Class

66	Athabasca XIX	(611)	466	0.989	Armillaria
67	Athabasca XIX	(629)	479	0.998	Unknown
68	Athabasca XIX	(609)	529	0.994	Unknown
69	Athabasca XIX	(661)	438	<u>1.000</u>	

Average survival 0.995

Table 7. Survival during 1986-1987 in lodgepole pine plots near Hinton, Alberta

Area	Weldwood designation		Number of trees	Survival	Major Cause
1956-60 Age Class					
01	McLeod II	(16)	517	0.996	Gall rust, Rodent
11	McLeod IX	(8)	184	0.956	Rodent, Wind
12	McLeod IX	(23)	300	0.987	Rodent, Gall Rust, Wind
13	McLeod IX	(24)	116	0.991	Unknown
41	Embarrass III	(15)	313	0.994	Gall Rust, Blister Rust
71	Berland III	(15)	469	1.000	
81	Marlboro VII	(2)	386	0.995	Armillaria, Gall Rust
82	Marlboro VII	(7)	522	<u>0.994</u>	Gall Rust, Rodent
			Average survival	0.989	
1961-65 Age class					
02	McLeod II	(27)	350	0.991	Gall Rust, Hylobius
03	McLeod II	(179)	474	0.994	Armillaria, Unknown
04	McLeod II	(182)	580	0.993	Rodent, Gall Rust
21	McLeod VI	(43)	409	0.995	Rodent
22	McLeod VI	(56)	515	0.996	Gall Rust, Browsing
23	McLeod VI	(57)	550	0.984	Rodent, Browsing, Gall Rust
24	McLeod VI	(119)	220	0.995	Wind
25	McLeod VI	(120)	349	1.000	
26	McLeod VI	(139)	277	1.000	
27	McLeod VI	(165)	340	0.994	Blister Rust
51	Athabasca XIX	(26)	362	0.997	Armillaria, Browsing
52	Athabasca XIX	(33)	431	0.988	Armillaria, Gall Rust
53	Athabasca XIX	(34)	171	0.994	Gall Rust
54	Athabasca XIX	(34)	199	0.995	Gall Rust
55	Athabasca XIX	(36)	483	0.998	Gall Rust
56	Athabasca XIX	(61)	381	0.997	Unknown
57	Athabasca XIX	(61)	399	0.987	Rodent, Gall Rust
74	Berland III	(33)	589	1.000	
75	Berland III	(41)	550	0.998	Gall Rust
85	Marlboro III	(51)	520	<u>1.000</u>	
			Average survival	0.995	
1966-1970 age class					
05	McLeod II	(187)	745	0.999	Blister Rust
06	McLeod II	(188)	522	0.992	Unknown
07	McLeod II	(527)	592	1.000	
28	McLeod VI	(189)	525	0.992	Hylobius, Armillaria
29	McLeod VI	(189)	491	0.988	Hylobius, Rodent
30	McLeod VI	(189)	355	0.997	Hylobius
31	McLeod VI	(209)	203	1.000	

34	McLeod VI	(528)	438	0.989	Gall Rust, Hylobius
35	McLeod VI	(534)	290	0.986	Blister Rust
36	McLeod VI	(536)	187	0.984	Unknown
37	McLeod VI	(537)	195	0.995	Armillaria
58	Athabasca XIX	(113)	602	1.000	
59	Athabasca XIX	(133)	696	0.999	Unknown
60	Athabasca XIX	(173)	545	1.000	
61	Athabasca XIX	(176)	615	0.998	Armillaria
62	Athabasca XIX	(555)	566	0.995	Gall Rust, Rodent
72	Berland III	(C15)	628	1.000	
73	Berland III	(C23)	591	1.000	
86	Marlboro III	(61)	581	0.997	Armillaria
87	Marlboro III	(67)	618	1.000	
88	Marlboro III	(78)	751	<u>1.000</u>	

Average survival 0.996

1971-75 Age Class

08	McLeod II	(562)	562	0.993	Hylobius, Gall Rust
14	McLeod IX	(244)	586	0.978	Hylobius, Armillaria
15	McLeod IX	(245)	440	0.973	Armillaria, Hylobius
16	McLeod IX	(246)	408	0.980	Armillaria, Blister Rust
32	McLeod VI	(214a)	368	0.997	Unknown
33	McLeod VI	(215)	660	1.000	
42	Embarrass III	(18)	638	0.964	Armillaria, Gall Rust
43	Embarrass III	(27)	332	0.979	Hylobius, Armillaria
44	Embarrass III	(27)	350	0.966	Armillaria, Hylobius
63	Athabasca XIX	(601)	265	0.970	Armillaria
64	Athabasca XIX	(624)	728	0.997	Hylobius, Gall Rust
65	Athabasca XIX	(633)	695	0.974	Armillaria, Hylobius, Gall Rust
76	Berland III	(501)	614	1.000	
77	Berland III	(514)	555	1.000	
83	Marlboro VII	(530)	538	0.996	Unknown
84	Marlboro VII	(567)	523	<u>0.988</u>	Armillaria, Blister Rust

Average survival 0.985

1976-81 Age Class

66	Athabasca XIX	(611)	460	0.987	Hylobius, Unknown
67	Athabasca XIX	(629)	478	0.992	Armillaria
68	Athabasca XIX	(609)	524	0.971	Hylobius, Armillaria
69	Athabasca XIX	(661)	439	<u>0.998</u>	Armillaria

Average survival 0.987

Table 8. Survival during 1987-1988 in lodgepole pine plots near Hinton, Alberta

Area	Weldwood designation		Number of trees	Survival	Major Cause
1956-60 Age Class					
01	McLeod II	(16)	515	0.994	Gall Rust, Armillaria
11	McLeod IX	(8)	176	0.926	Rodent, Wind, Gall Rust
12	McLeod IX	(23)	296	0.993	Rodents
13	McLeod IX	(24)	115	1.000	
41	Embarrass III	(15)	311	0.990	Gall Rust, Armillaria, Unknown
71	Berland III	(15)	469	1.000	
81	Marlboro VII	(2)	385	0.984	Wind, Hylobius, Gall Rust
82	Marlboro VII	(7)	519	<u>0.992</u>	Wind, Rodent
			Average survival	0.985	
1961-65 Age class					
02	McLeod II	(27)	347	0.997	Armillaria
03	McLeod II	(179)	471	0.992	Hylobius, Gall Rust
04	McLeod II	(182)	576	0.995	Blister Rust, Gall Rust
21	McLeod VI	(43)	408	0.990	Unknown, Wind
22	McLeod VI	(56)	513	0.998	Hylobius
23	McLeod VI	(57)	541	0.993	Hylobius, Armillaria, Rodent, Gall Rust
24	McLeod VI	(119)	218	0.986	Gall Rust, Unknown
25	McLeod VI	(120)	349	0.997	Gall Rust
26	McLeod VI	(139)	277	1.000	
27	McLeod VI	(165)	338	0.994	Gall Rust, Unknown
51	Athabasca XIX	(26)	361	0.994	Hylobius, Gall Rust
52	Athabasca XIX	(33)	427	0.991	Hylobius, Gall Rust
53	Athabasca XIX	(34)	170	1.000	
54	Athabasca XIX	(34)	198	1.000	
55	Athabasca XIX	(36)	482	0.992	Gall Rust, Wind
56	Athabasca XIX	(61)	380	0.982	Wind, Rodent, Blister Rust
57	Athabasca XIX	(61)	394	0.990	Gall Rust, Wind
74	Berland III	(33)	589	1.000	
75	Berland III	(41)	549	1.000	
85	Marlboro III	(51)	520	<u>0.996</u>	Hylobius, Blister Rust
			Average survival	0.994	
1966-1970 age class					
05	McLeod II	(187)	742	0.997	Blister Rust
06	McLeod II	(188)	518	0.990	Blister Rust, Armillaria
07	McLeod II	(527)	592	0.998	Gall Rust
28	McLeod VI	(189)	521	0.994	Blister Rust, Wind, Unknown
29	McLeod VI	(189)	485	0.988	Unknown, Blister Rust
30	McLeod VI	(189)	354	0.994	Unknown

31	McLeod VI	(209)	203	0.985	Browsing, Blister Rust
34	McLeod VI	(528)	433	0.979	Mechanical, Gall Rust, Unknown
35	McLeod VI	(534)	286	0.972	Browsing, Blister Rust, Armillaria
36	McLeod VI	(536)	184	1.000	
37	McLeod VI	(537)	194	0.995	Wind
58	Athabasca XIX	(113)	602	0.980	Hylobius, Armillaria, Wind
59	Athabasca XIX	(133)	695	0.990	Hylobius, Armillaria, Unknown
60	Athabasca XIX	(173)	544	0.987	Hylobius, Armillaria, Gall Rust
61	Athabasca XIX	(176)	614	0.997	Hylobius, Armillaria
62	Athabasca XIX	(555)	563	1.000	
72	Berland III	(C15)	628	0.998	Blister Rust
73	Berland III	(C23)	590	1.000	
86	Marlboro III	(61)	560	0.996	Unknown
87	Marlboro III	(67)	618	0.998	Gall Rust
88	Marlboro III	(78)	751	<u>0.999</u>	Gall Rust

Average survival 0.992

1971-75 Age Class

08	McLeod II	(562)	558	0.977	Gall Rust, Unknown
14	McLeod IX	(244)	573	0.986	Gall Rust, Armillaria
15	McLeod IX	(245)	428	0.977	Armillaria, Unknown
16	McLeod IX	(246)	400	0.978	Armillaria, Hylobius, Blister Rust
32	McLeod VI	(214a)	367	1.000	
33	McLeod VI	(215)	663	0.998	Unknown
42	Embarrass III	(18)	615	0.964	Hylobius, Armillaria, Unknown
43	Embarrass III	(27)	325	0.991	Armillaria
44	Embarrass III	(27)	337	0.967	Armillaria, Unknown
63	Athabasca XIX	(601)	257	0.996	Unknown
64	Athabasca XIX	(624)	727	0.999	Unknown
65	Athabasca XIX	(633)	677	0.976	Hylobius, Armillaria, Gall Rust
76	Berland III	(501)	614	0.998	Gall Rust
77	Berland III	(514)	555	1.000	
83	Marlboro VII	(530)	537	0.993	Wind, Blister Rust, Rodent
84	Marlboro VII	(567)	517	<u>0.990</u>	Blister Rust, Armillaria

Average survival 0.987

1976-81 Age Class

66	Athabasca XIX	(611)	454	1.000	
67	Athabasca XIX	(629)	472	0.997	Hylobius, Armillaria, Unknown
68	Athabasca XIX	(609)	511	0.986	Hylobius, Unknown
69	Athabasca XIX	(661)	438	<u>0.995</u>	Armillaria, Gall Rust

Average survival 0.990

Table 9. Survival during 1988-1989 in lodgepole pine plots near Hinton, Alberta

Area	Weldwood designation		Number of trees	Survival	Major Cause
1956-60 Age Class					
01	McLeod II	(16)	512	1.000	
11	McLeod IX	(8)	163	0.975	Rodent, Wind, Gall Rust
12	McLeod IX	(23)	294	0.997	Rodent
13	McLeod IX	(24)	115	0.991	Rodent
41	Embarrass III	(15)	308	0.974	Hylobius, Wind, Blister & Gall Rust
71	Berland III	(15)	469	0.996	Gall Rust, Blister Rust
81	Marlboro VII	(2)	377	0.989	Gall Rust, Blister Rust, Wind
82	Marlboro VII	(7)	515	<u>0.996</u>	Hylobius
			Average survival	0.990	
1961-65 Age class					
02	McLeod II	(27)	345	0.997	Gall Rust
03	McLeod II	(179)	467	0.987	Hylobius, Armillaria, Rodent
04	McLeod II	(182)	573	0.998	Unknown
21	McLeod VI	(43)	404	0.995	Blister Rust, Rodents
22	McLeod VI	(56)	511	0.988	Gall Rust
23	McLeod VI	(57)	536	0.996	Rodents
24	McLeod VI	(119)	216	1.000	
25	McLeod VI	(120)	348	0.994	Gall Rust
26	McLeod VI	(139)	277	0.996	Unknown
27	McLeod VI	(165)	336	0.991	Browsing, Blister Rust
51	Athabasca XIX	(26)	359	0.997	Gall Rust
52	Athabasca XIX	(33)	423	0.988	Gall Rust, Rodents
53	Athabasca XIX	(34)	170	0.994	Hylobius
54	Athabasca XIX	(34)	198	1.000	
55	Athabasca XIX	(36)	478	0.994	Gall Rust, Unknown
56	Athabasca XIX	(61)	373	0.997	Rodents
57	Athabasca XIX	(61)	390	0.992	Rodents, Gall Rust
74	Berland III	(33)	589	0.998	Blister Rust
75	Berland III	(41)	549	1.000	
85	Marlboro III	(51)	512	<u>0.998</u>	Blister Rust
			Average survival	0.995	
1966-1970 age class					
05	McLeod II	(187)	741	0.995	Blister Rust, Rabbit
06	McLeod II	(188)	513	0.998	Blister Rust
07	McLeod II	(527)	591	0.998	Armillaria
28	McLeod VI	(189)	518	0.994	Browsing, Blister Rust
29	McLeod VI	(189)	478	0.994	Browsing, Unknown
30	McLeod VI	(189)	352	0.980	Browsing, Blister Rust
31	McLeod VI	(209)	200	1.000	

34	McLeod VI	(528)	424	0.991	Gall Rust, Blister Rust, Armillaria
35	McLeod VI	(534)	278	0.989	Blister Rust
36	McLeod VI	(536)	184	0.984	Gall Rust, Rodents
37	McLeod VI	(537)	193	0.979	Rodents, Gall Rust
58	Athabasca XIX	(113)	590	0.993	Hylobius, Armillaria, Gall Rust
59	Athabasca XIX	(133)	688	0.998	Unknown
60	Athabasca XIX	(173)	536	0.996	Rodents
61	Athabasca XIX	(176)	612	0.993	Hylobius
62	Athabasca XIX	(555)	562	0.995	Gall Rust, Rodents
72	Berland III	(C15)	627	1.000	
73	Berland III	(C23)	590	1.000	
86	Marlboro III	(61)	558	0.995	Blister Rust, Hylobius
87	Marlboro III	(67)	617	1.000	
88	Marlboro III	(78)	750	<u>0.999</u>	Gall Rust

Average survival 0.994

1971-75 Age Class

08	McLeod II	(562)	545	0.987	Hylobius, Gall Rust, Rodent
14	McLeod IX	(244)	565	0.989	Hylobius, Gall Rust
15	McLeod IX	(245)	417	0.988	Hylobius, Armillaria, Blister Rust
16	McLeod IX	(246)	390	0.995	Hylobius, Armillaria
32	McLeod VI	(214a)	367	0.995	Gall Rust
33	McLeod VI	(215)	662	1.000	
42	Embarrass III	(18)	593	0.993	Hylobius, Gall Rust
43	Embarrass III	(27)	322	0.994	Armillaria, Gall Rust
44	Embarrass III	(27)	319	0.987	Armillaria
63	Athabasca XIX	(601)	256	0.973	Gall Rust, Hylobius, Unknown
64	Athabasca XIX	(624)	725	0.999	Gall Rust
65	Athabasca XIX	(633)	661	0.997	Gall Rust
76	Berland III	(501)	612	1.000	
77	Berland III	(514)	555	0.998	Gall Rust
83	Marlboro VII	(530)	532	0.991	Hylobius
84	Marlboro VII	(567)	512	<u>0.980</u>	Rodent, Hylobius, Unknown

Average survival 0.992

1976-81 Age Class

66	Athabasca XIX	(611)	455	0.967	Gall Rust, Armillaria, Blister Rust, Hylobius
67	Athabasca XIX	(629)	463	0.983	Gall Rust, Hylobius, Armillaria, Blister Rust
68	Athabasca XIX	(609)	504	0.984	Armillaria, Hylobius, Unknown
69	Athabasca XIX	(661)	435	<u>0.993</u>	Gall Rust

Average survival 0.982

Table 10. Survival during 1989-1990 in lodgepole pine plots near Hinton, Alberta

Area	Weldwood designation		Number of trees	Survival	Major Cause
1956-60 Age Class					
01	McLeod II	(16)	512	0.998	Unknown
11	McLeod IX	(8)	159	0.994	Rodent
12	McLeod IX	(23)	293	0.993	Rodent, Unknown
13	McLeod IX	(24)	114	0.991	Rodent
41	Embarrass III	(15)	300	0.997	Hylobius
71	Berland III	(15)	467	1.000	
81	Marlboro VII	(2)	375	0.928	Browsing, Blister Rust, Unknown
82	Marlboro VII	(7)	513	<u>0.992</u>	Hylobius, Armillaria
			Average survival	0.987	
1961-65 Age class					
02	McLeod II	(27)	344	0.988	Gall Rust, Rodent, Unknown
03	McLeod II	(179)	461	0.989	Gall Rust, Unknown, Rodent
04	McLeod II	(182)	572	0.996	Unknown
21	McLeod VI	(43)	402	0.992	Rodent, Unknown
22	McLeod VI	(56)	506	0.984	Rodent, Gall Rust
23	McLeod VI	(57)	535	0.991	Gall Rust, Unknown
24	McLeod VI	(119)	216	0.991	Gall Rust, Unknown
25	McLeod VI	(120)	346	0.988	Gall Rust, Hylobius, Unknown
26	McLeod VI	(139)	276	0.996	Browsing
27	McLeod VI	(165)	333	0.988	Gall Rust, Unknown
51	Athabasca XIX	(26)	358	0.994	Rodent, Gall Rust
52	Athabasca XIX	(33)	418	0.969	Gall Rust, Unknown
53	Athabasca XIX	(34)	169	0.988	Gall & Blister Rust
54	Athabasca XIX	(34)	198	0.990	Gall Rust
55	Athabasca XIX	(36)	475	0.983	Gall Rust, Browsing, Rodent
56	Athabasca XIX	(61)	373	0.984	Rodent, Hylobius
57	Athabasca XIX	(61)	387	0.995	Gall Rust, Unknown
74	Berland III	(33)	588	1.000	
75	Berland III	(41)	549	0.998	Unknown
85	Marlboro III	(51)	511	<u>0.996</u>	Broken Stem, Unknown
			Average survival	0.990	
1966-1970 age class					
05	McLeod II	(187)	738	0.999	Unknown
06	McLeod II	(188)	512	0.998	Blister Rust
07	McLeod II	(527)	590	0.997	Gall Rust, Unknown
28	McLeod VI	(189)	506	0.994	Hylobius, Gall & Blister Rust
29	McLeod VI	(189)	469	0.966	Gall Rust, Rodent, Unknown
30	McLeod VI	(189)	345	0.991	Browsing, Gall & Blister Rust
31	McLeod VI	(209)	200	0.995	Rodent
34	McLeod VI	(528)	420	0.986	Armillaria, Hylobius, Unknown

35	McLeod VI	(534)	275	0.993	Hylobius, Browsing
36	McLeod VI	(536)	181	0.994	Rodent
37	McLeod VI	(537)	189	0.963	Rodent, Blister Rust, Unknown
58	Athabasca XIX	(113)	586	0.990	Rodent, Unknown, Gall Rust
59	Athabasca XIX	(133)	687	0.984	Gall Rust, Rodent, Unknown
60	Athabasca XIX	(173)	534	0.979	Rodent, Unknown
61	Athabasca XIX	(176)	608	0.990	Gall Rust, Rodent, Browsing
62	Athabasca XIX	(555)	559	0.980	Unknown, Gall Rust
72	Berland III	(C15)	627	0.998	Unknown
73	Berland III	(C23)	590	0.998	Hylobius
86	Marlboro III	(61)	555	0.996	Unknown
87	Marlboro III	(67)	617	0.998	Hylobius
88	Marlboro III	(78)	748	<u>0.999</u>	Unknown
Average survival				0.990	
1971-75 Age Class					
08	McLeod II	(562)	538	0.981	Gall Rust, Unknown
14	McLeod IX	(244)	559	0.996	Rodent, Unknown
15	McLeod IX	(245)	413	0.968	Mechanical Damage, Unknown
16	McLeod IX	(246)	389	0.985	Armillaria
32	McLeod VI	(214a)	366	1.000	
33	McLeod VI	(215)	662	0.994	Gall Rust, Unknown
42	Embarrass III	(18)	589	0.988	Hylobius, Armillaria, Gall Rust
43	Embarrass III	(27)	320	0.991	Hylobius, Unknown
44	Embarrass III	(27)	315	0.997	Unknown
63	Athabasca XIX	(601)	249	0.980	Hylobius, Browsing, Gall Rust
64	Athabasca XIX	(624)	721	0.992	Gall Rust, Unknown
65	Athabasca XIX	(633)	659	0.986	Gall Rust, Browsing
76	Berland III	(501)	613	1.000	
77	Berland III	(514)	554	1.000	
83	Marlboro VII	(530)	528	0.989	Unknown
84	Marlboro VII	(567)	502	<u>0.952</u>	Browsing, Armillaria, Blister and Gall Rust
Average survival				0.987	
1976-81 Age Class					
66	Athabasca XIX	(611)	440	0.954	Armillaria, Gall Rust
67	Athabasca XIX	(629)	455	0.976	Gall Rust, Armillaria
68	Athabasca XIX	(609)	497	0.974	Unknown, Hylobius, Gall Rust
69	Athabasca XIX	(661)	433	0.979	Gall Rust, Unknown
09	McLeod II	(684)	676	<u>1.000</u>	
Average survival				0.976	
1981-01985 Age Class					
10	McLeod VII	(104)	299	0.980	Armillaria, Browsing
38	McLeod VI	(696)	800	0.970	Unknown
45	Embarrass I	(39)	614	<u>0.997</u>	Hylobius, Armillaria
Average Survival				0.982	

Table 11. Survival by working circle and age class

Area	Weldwood Designation		Number of trees		Trees missing and or cut	Survival	Major cause
			Est.	1990			
1956-60 age class – (30-34) years							
01	McLeod II	(16)	525 (81)	511	m-01	0.975	Rodent, Gall Rust, Armillaria
11	McLeod IX	(8)	253 (81)	158	c-37	0.731	Rodent, Gall Rust, wind
12	McLeod IX	(23)	336 (81)	291		0.866	Rodent, Gall Rust, Broken stems
13	McLeod IX	(24)	125 (81)	113		0.904	Rodent, Gall Rust
			Average Survival			0.834	
41	Embarrass III	(15)	325 (81)	299	m-06	0.937	Hylobius, Gall and Blister Rusts
71	Berland III	(15)	469 (81)	467		0.996	Gall and Blister Rusts
81	Marlboro VII	(2)	457 (81)	348	c-01	0.763	Gall & Blister Rusts, Armillaria Browsing
82	Marlboro VII	(7)	543 (81)	509		0.937	Rodent, Gall Rust, Hylobius
			Average Survival			0.850	
1961-65 age class – (25-29) years							
02	McLeod II	(27)	360 (81)	340	c-01	0.947	Hylobius, Gall Rust
03	McLeod II	(179)	576 (81)	456	c-72	0.905	Armillaria, Hylobius, Rusts
04	McLeod II	(182)	584 (81)	570		0.976	Rusts, Rodent
			Average survival			0.943	
21	McLeod VI	(43)	487 (81)	399		0.819	Rodent, Browsing, Rusts
22	McLeod VI	(56)	566 (81)	498		0.880	Browsing, Gall Rust, Rodent
23	McLeod VI	(57)	577 (81)	530		0.918	Rodent, Gall Rust, Hylobius
24	McLeod VI	(119)	226 (81)	214		0.947	Gall Rust, Armillaria
25	McLeod VI	(120)	361 (81)	342	m-01	0.950	Gall Rust, Armillaria, Rodent
26	McLeod VI	(139)	289 (81)	275		0.952	Rodent, Armillaria, Gall Rust
27	McLeod VI	(165)	366 (81)	329		0.899	Gall rust, Hylobius, Browsing
			Average Survival			0.909	
51	Athabasca XIX	(26)	365 (81)	356		0.975	Gall Rust, Armillaria, Hylobius
52	Athabasca XIX	(33)	465 (81)	405	c-01	0.873	Gall rust, Browsing, Armillaria
53	Athabasca XIX	(34)	320 (81)	167	c-139	0.923	Gall rust, Rodent, Hylobius

Area	Weldwood Designation		Number of trees		Trees missing and or cut	Survival	Major cause
			Est.	1990			
54	Athabasca XIX	(34)	311 (81)	196	c-109	0.970	Gall Rust, Browsing
55	Athabasca XIX	(36)	492 (81)	467		0.949	Gall Rust, Browsing, Armillaria
56	Athabasca XIX	(61)	679 (81)	367	c-262	0.880	Rodent, Gall Rust, Armillaria
57	Athabasca XIX	(61)	642 (81)	385	c-212	0.895	Armillaria, Gall Rust, Rodent
Average Survival						0.924	
74	Berland III	(33)	589 (81)	588		0.998	Blister Rust
75	Berland III	(41)	551 (81)	548		0.995	Gall Rust
Average Survival						0.996	
85	Marlboro III	(51)	523 (82)	509	c-07	0.986	Hylobius, Blister Rust
1966-70 age class – (20-24) years							
05	McLeod II	(187)	763 (81)	737		0.966	Blister Rust, Rodent, Gall Rust
06	McLeod II	(188)	536 (81)	511		0.953	Blister Rust, Armillaria
07	McLeod II	(527)	593 (81)	588		0.992	Gall Rust, Hylobius, Armillaria
Average Survival						0.970	
28	McLeod VI	(189)	539 (81)	503	c-09	0.949	Gall & Blister Rusts, Armillaria, Hylobius
29	McLeod VI	(189)	502 (81)	453	c-07	0.915	Armillaria, Rodent, Gall & Blister Rust
30	McLeod VI	(189)	362 (81)	342		0.945	Browsing, Blister & Gall Rust, Hylobius
31	McLeod VI	(209)	328 (81)	199		0.607	Rodent, Browsing, Gall & Blister Rust
34	McLeod VI	(528)	492 (81)	414		0.841	Armillaria, Gall & Blister Rust, Hylobius
35	McLeod VI	(534)	333 (81)	273		0.820	Rodent, Armillaria, Hylobius
36	McLeod VI	(536)	291 (81)	180		0.619	Rodent, Gall Rust
37	McLeod VI	(537)	244 (81)	182		0.746	Rodent, Armillaria
Average Survival						0.805	
58	Athabasca XIX	(113)	640 (81)	580	m-01	0.908	Armillaria, Hylobius, Gall Rust
59	Athabasca XIX	(133)	723 (81)	676		0.935	Armillaria, Hylobius, Rodent
60	Athabasca XIX	(173)	566 (81)	523	c-02 m-01	0.929	Armillaria, Rodent, Gall Rust

Area	Weldwood Designation		Number of trees		Trees missing and or cut	Survival	Major cause
			Est.	1990			
61	Athabasca XIX	(176)	636 (81)	602		0.946	Armillaria, Hylobius, Rodent
62	Athabasca XIX	(555)	585 (81)	548	m-01	0.938	Gall Rust, Browsing, Rodent
			Average survival			0.931	
72	Berland III	(c15)	632 (81)	626		0.990	Blister Rust, Rodent
73	Berland III	(c23)	601 (81)	589	c-04	0.987	Gall Rust, Armillaria, Hylobius
			Average survival			0.988	
86	Marlboro III	(61)	602 (82)	553	c-19	0.948	Armillaria, Gall Rust, Hylobius
87	Marlboro III	(67)	621 (82)	616		0.992	Armillaria, Gall Rust, Hylobius
88	Marlboro III	(78)	763 (82)	747	c-02	0.982	Armillaria, Gall Rust
			Average survival			0.974	
1971-75 age class – (15-19) years							
08	McLeod II	(562)	570 (81)	528		0.926	Gall Rust, Armillaria, Hylobius
14	McLeod IX	(244)	623 (81)	557	m-02	0.897	Armillaria, Gall Rust
15	McLeod IX	(245)	473 (81)	400		0.846	Armillaria, Hylobius, Rodent
16	McLeod IX	(246)	429 (81)	383		0.893	Armillaria, Blister Rust, Hylobius
			Average survival			0.879	
32	McLeod VI	(214a)	373 (81)	366		0.981	Gall Rust, Armillaria
33	McLeod VI	(215)	670 (81)	658	m-01	0.984	Gall Rust, Armillaria
			Average survival			0.982	
42	Embarrass III	(18)	734 (81)	582		0.793	Armillaria, Gall Rust, Hylobius
43	Embarrass III	(27)	375 (81)	317	c-12	0.873	Armillaria, Hylobius, Rusts
44	Embarrass III	(27)	415 (81)	314	c-11	0.777	Armillaria, Hylobius, Rusts
			Average survival			0.814	
63	Athabasca XIX	(601)	586 (81)	244	c-291	0.827	Armillaria, Hylobius, Gall Rust
64	Athabasca XIX	(624)	736 (81)	715	m-05	0.978	Gall Rust, Armillaria
65	Athabasca XIX	(633)	747 (81)	650		0.870	Armillaria, Hylobius, Gall Rust
			Average survival			0.892	

Area	Weldwood Designation		Number of trees		Trees missing and or cut	Survival	Major cause
			Est.	1990			
76	Berland III	(501)	617 (81)	613		0.993	Gall Rust
77	Berland III	(514)	557 (81)	554	c-01	0.996	Gall Rust
Average survival						0.994	
83	Marlboro VII	(530)	598 (810)	522		0.873	Armillaria, Hylobius, Rodent
84	Marlboro VII	(567)	572 (81)	478	c-17	0.861	Armillaria, Blister Rust, Hylobius
Average survival						0.867	
1976-80 age class - (10-14) years							
66	Athabasca XIX	(611)	471 (83)	420		0.892	Armillaria, Hylobius, Gall Rust
67	Athabasca XIX	(629)	485 (83)	444	m-1	0.917	Armillaria, Hylobius, Rusts
68	Athabasca XIX	(609)	534 (84)	484		0.906	Hylobius, Armillaria Rusts
69	Athabasca XIX	(661)	439 (84)	424		0.966	Gall Rust, Armillaria
Average survival						0.920	
09	McLeod II	(684)	677 (89)	676	m-1	1.000	
81-85 Age Class - (5-9) yrs.							
10	McLeod VII	(104)	299 (89)	293		0.980	Armillaria, Mechanical Damage
38	McLeod VI	(696)	800 (89)	776		0.970	Unknown
45	Embarrass I	(39)	614 (89)	612		0.997	Hylobius, Browsing

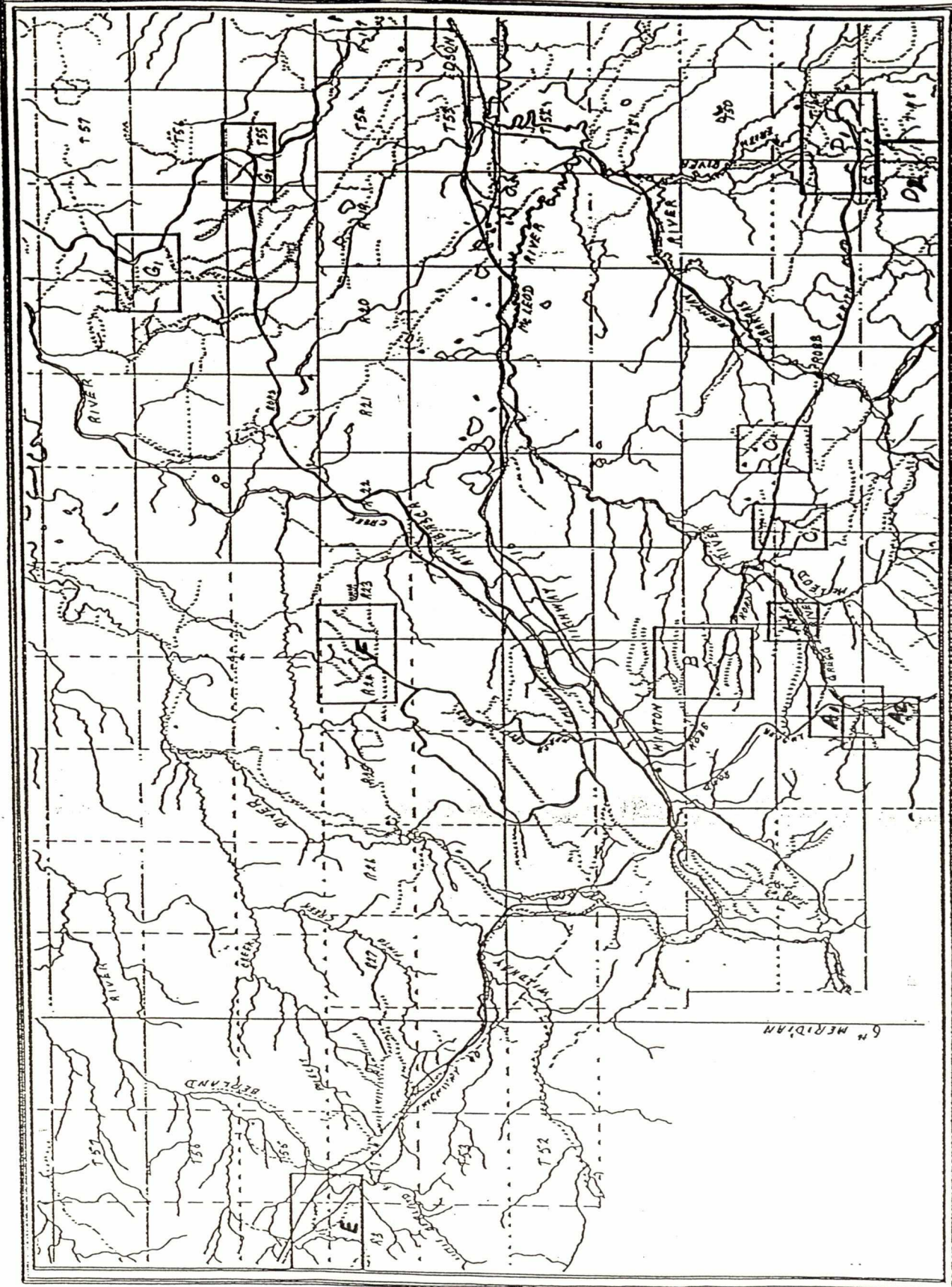


Figure 1. General locations of sampling areas established near Hinton, Alberta, to monitor the survival of lodgepole pine regeneration. Details for boxed areas are given in subsequent figures.

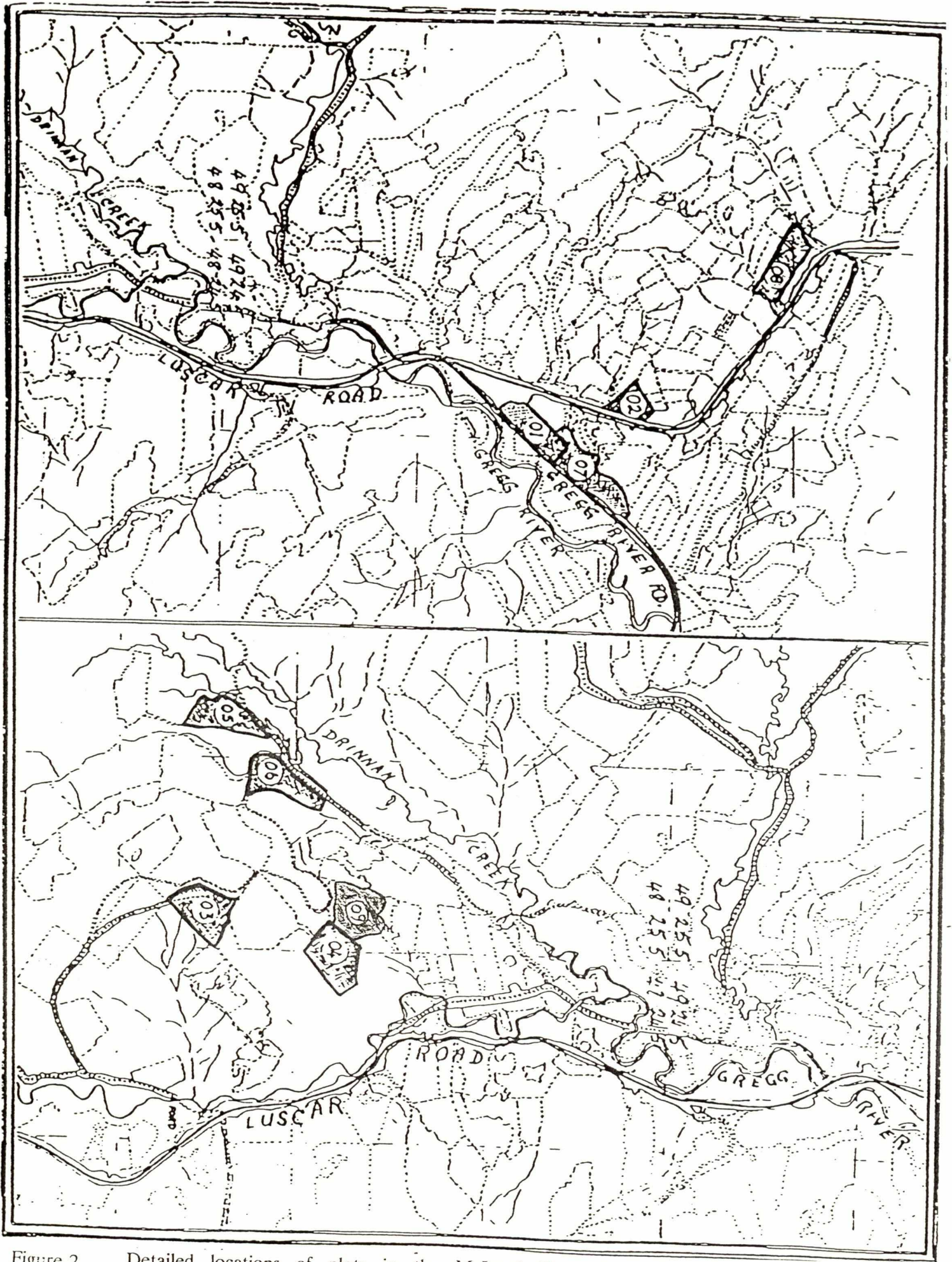


Figure 2. Detailed locations of plots in the McLeod II working circle (areas A_1 and A_2 in Figure 1)

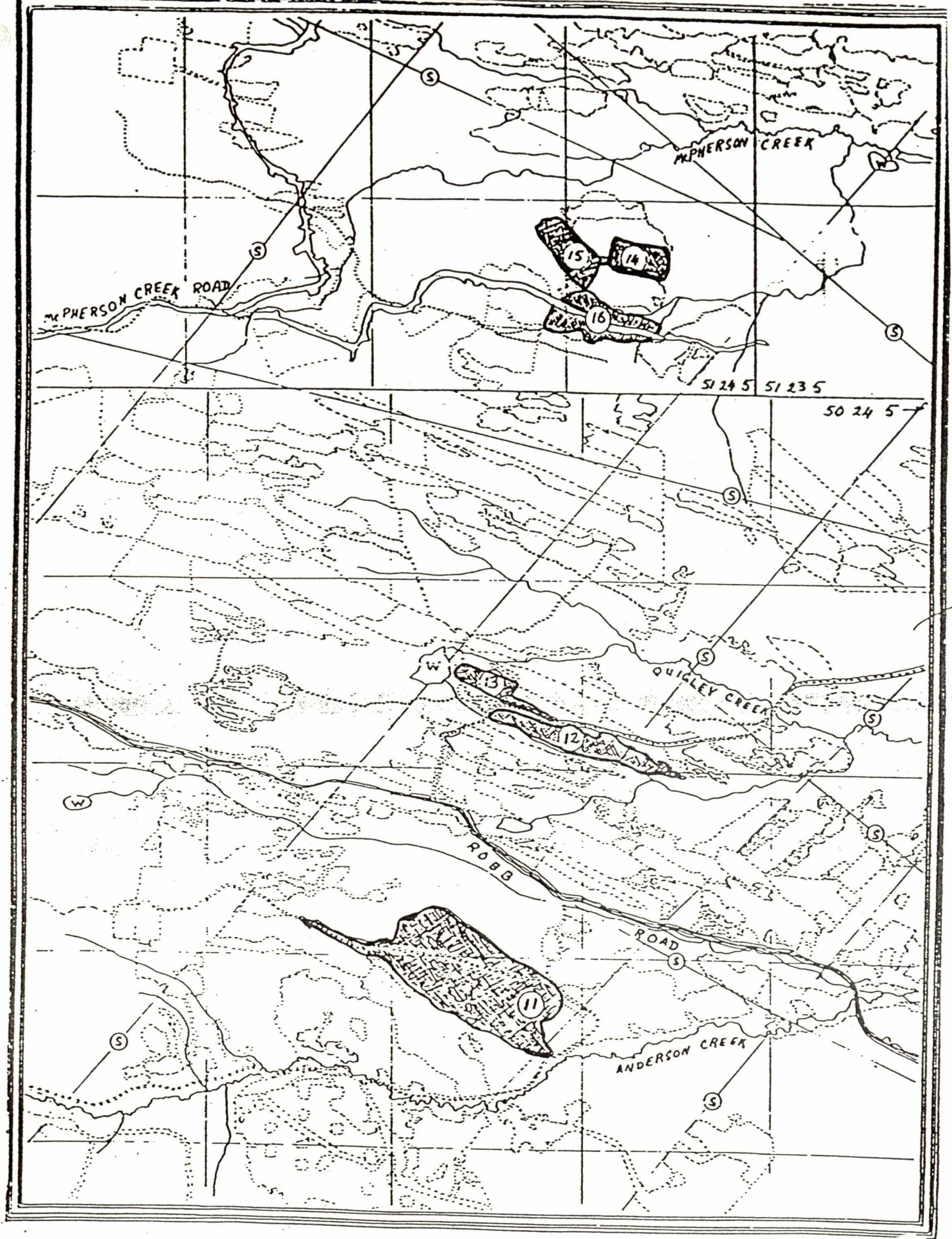


Figure 3. Detailed locations of plots in the McLeod IX working circle (area B in Figure 1).

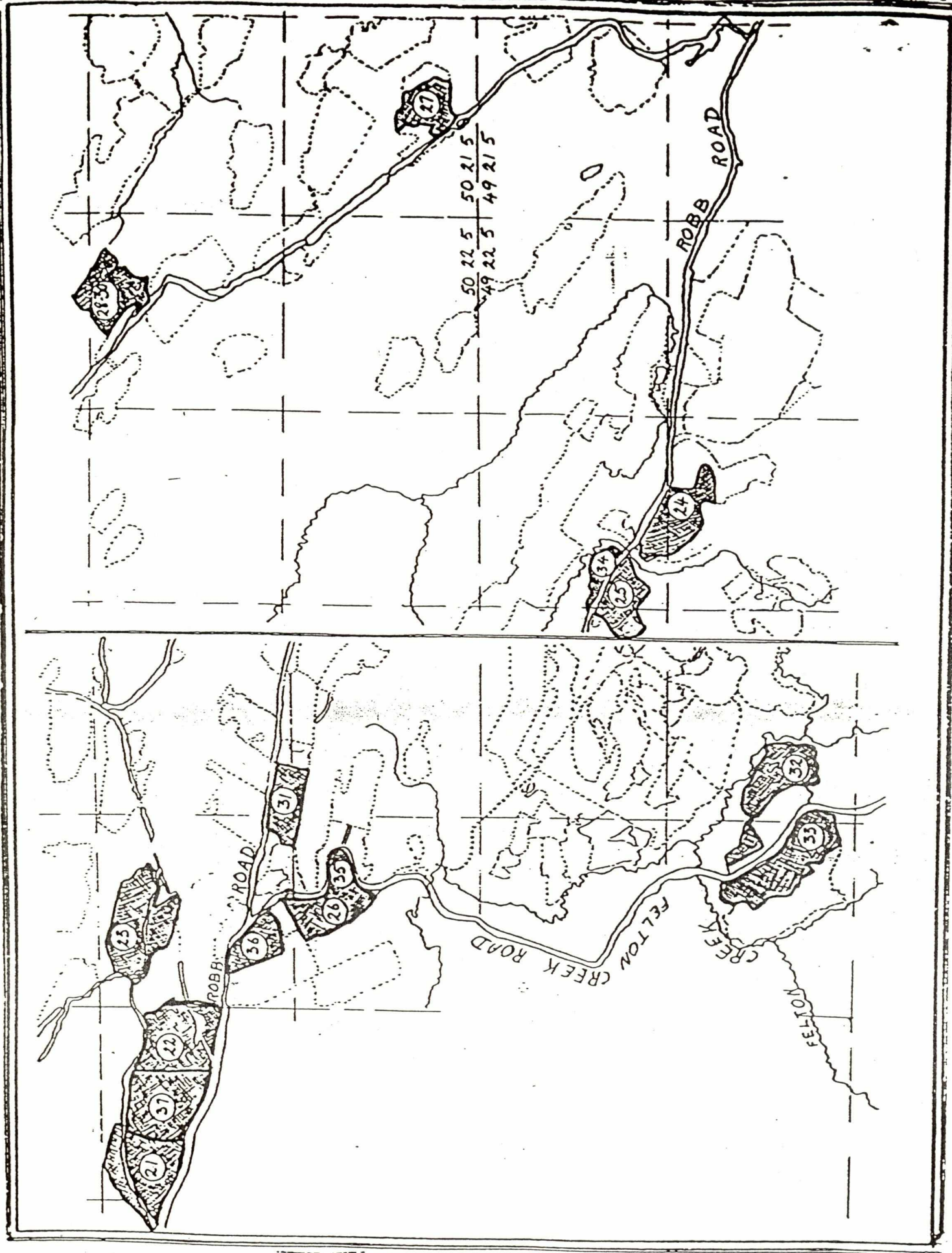


Figure 4. Detailed locations of plots in the McLeod VI working circle (areas C₁ and C₂ in Figure 1).

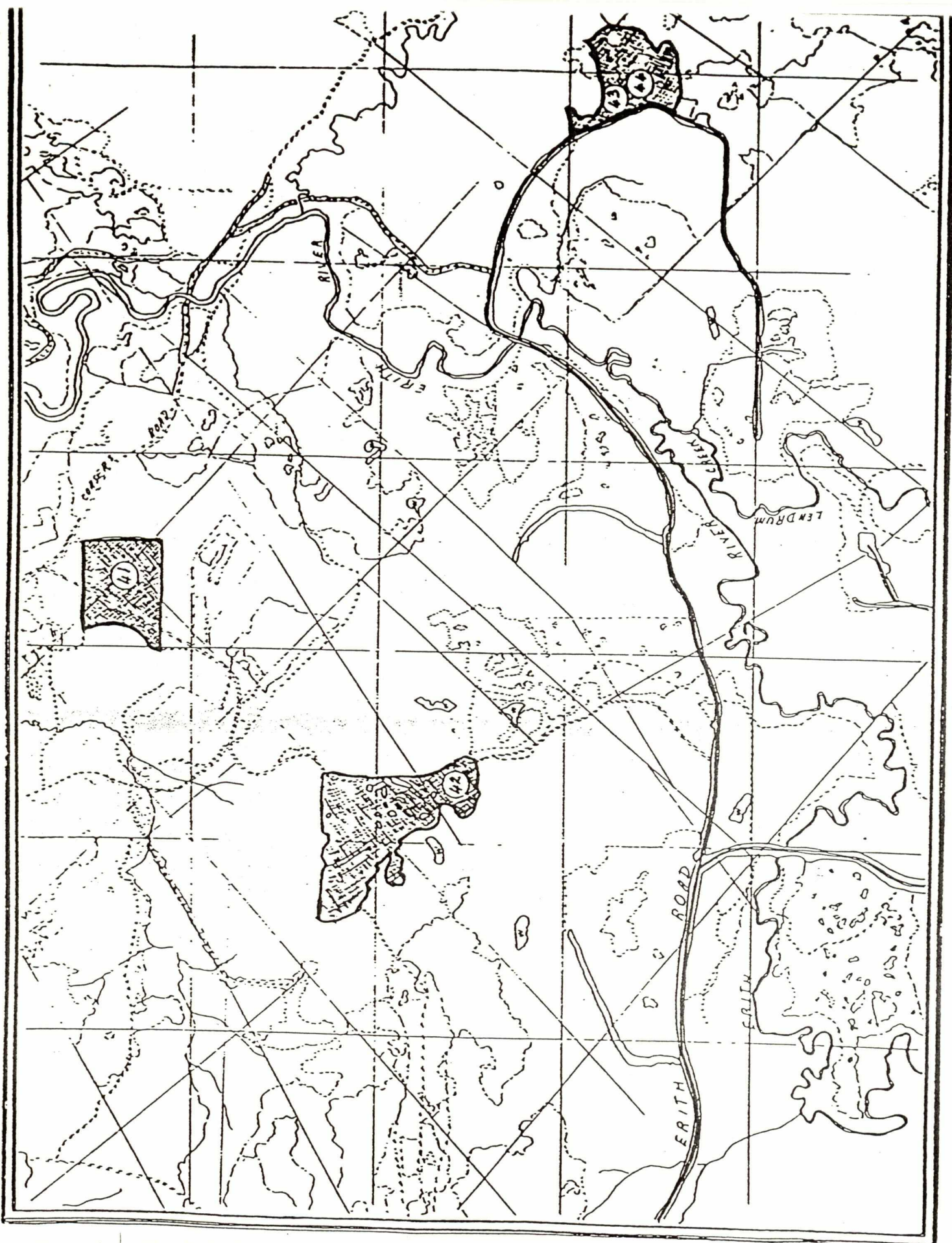


Figure 5. Detailed locations of plots in the Embarrass III working circle (area D in Figure 1).

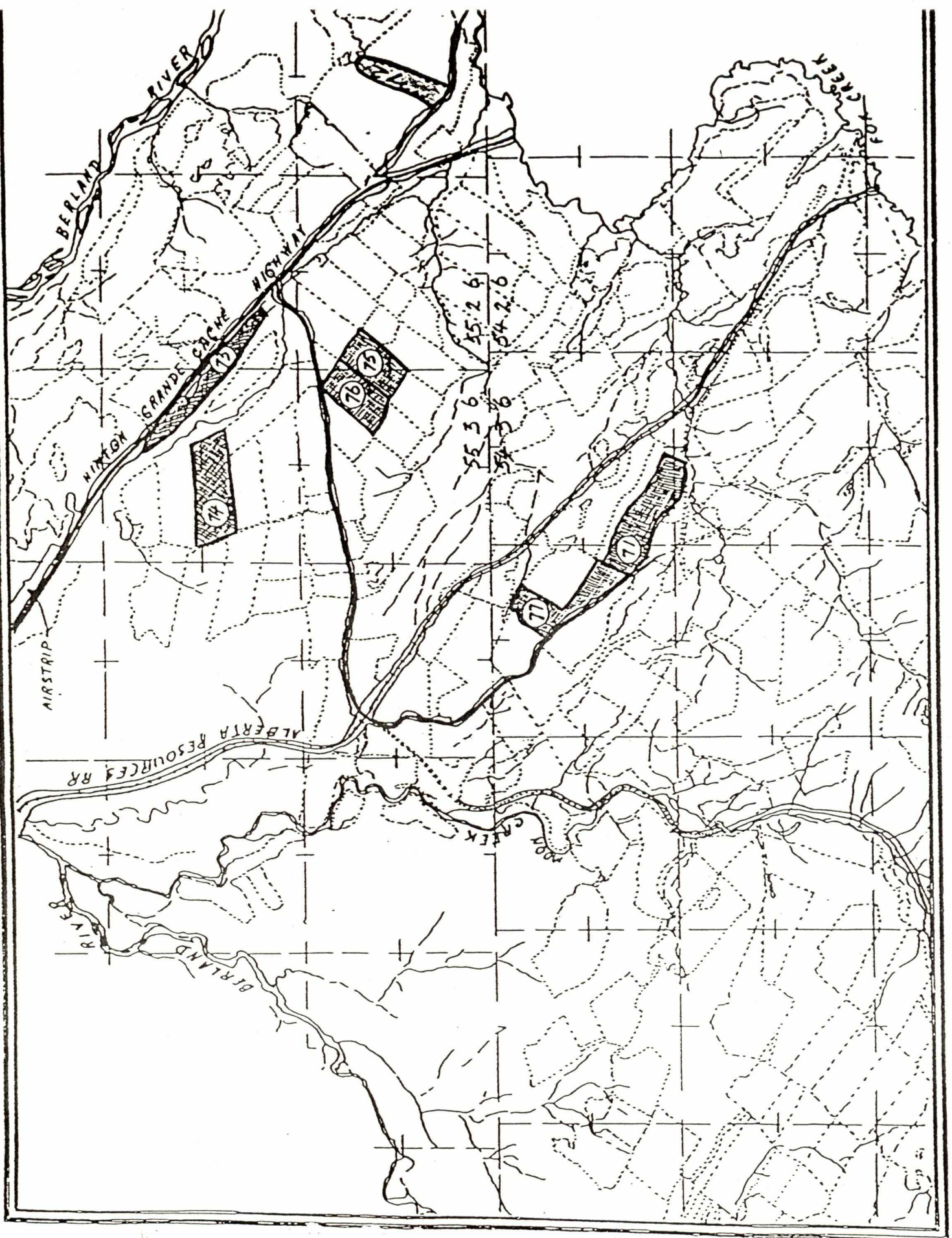


Figure 6. Detailed locations of plots in Berland III working circle (area E in Figure 1).

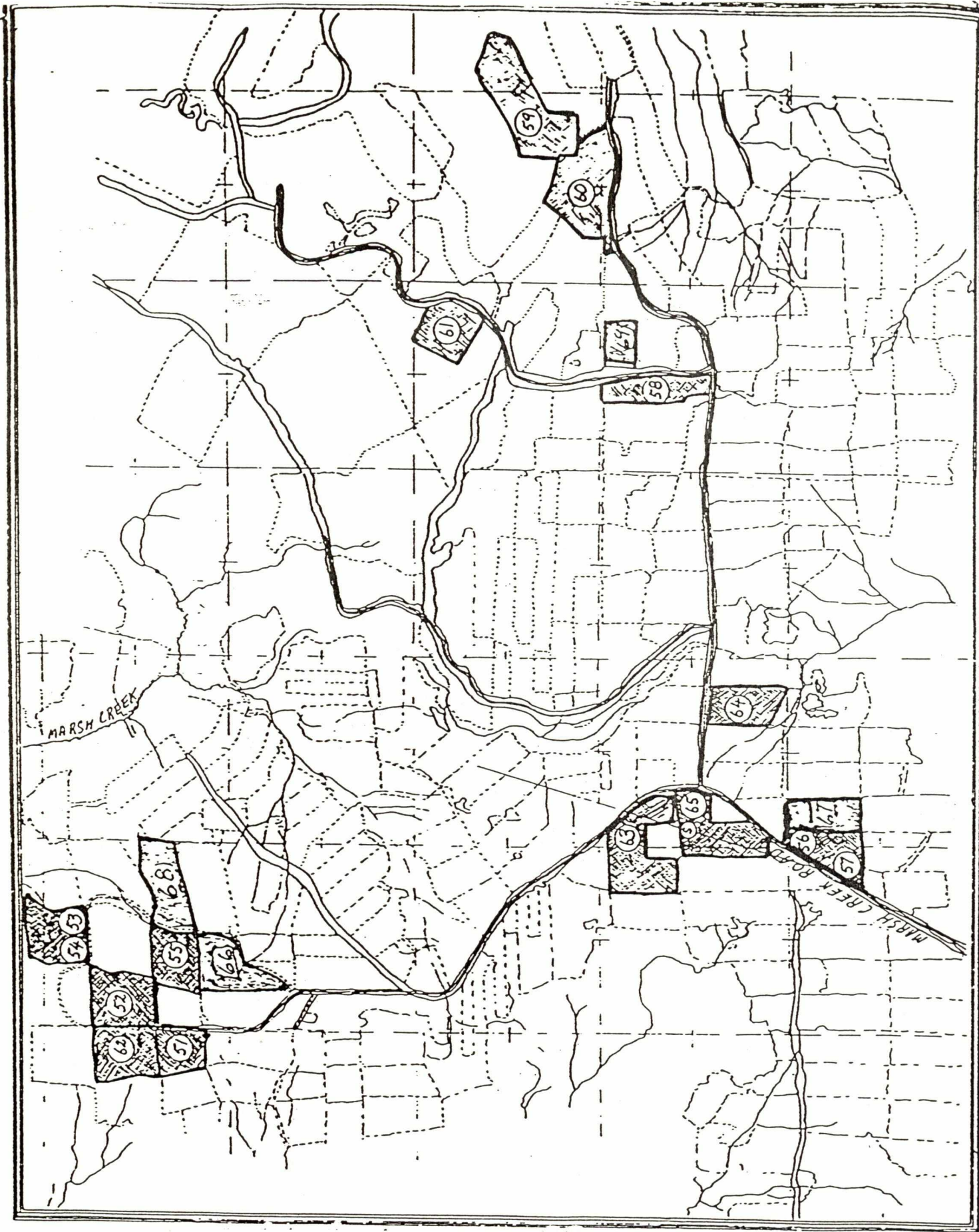


Figure 7. Detailed locations of plots in Athabasca XIX working circle (area F in Figure 1).

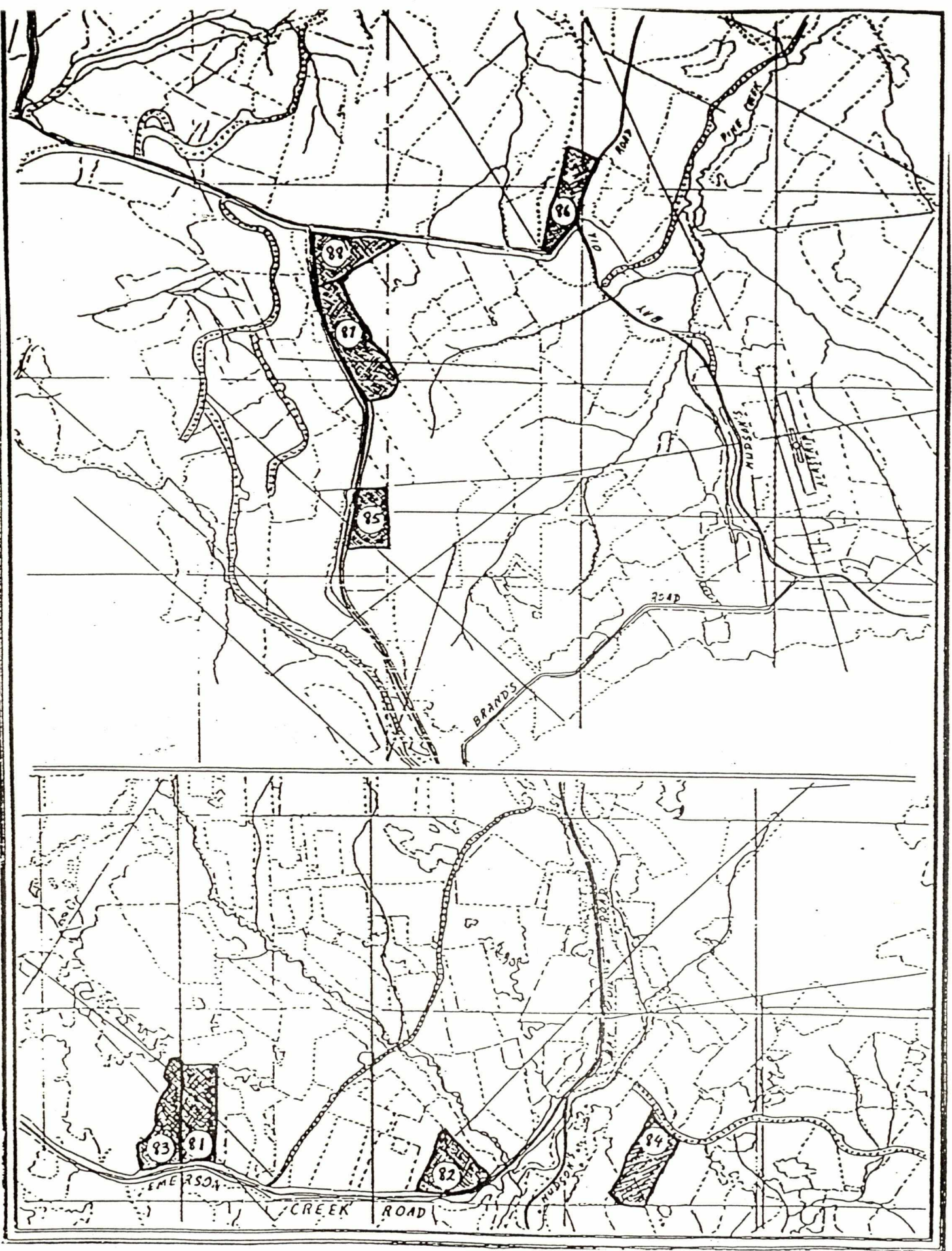


Figure 8. Detailed locations of plots in the Marlboro III and Marlboro VII working circles (areas G_1 and G_2 in Figure 1).

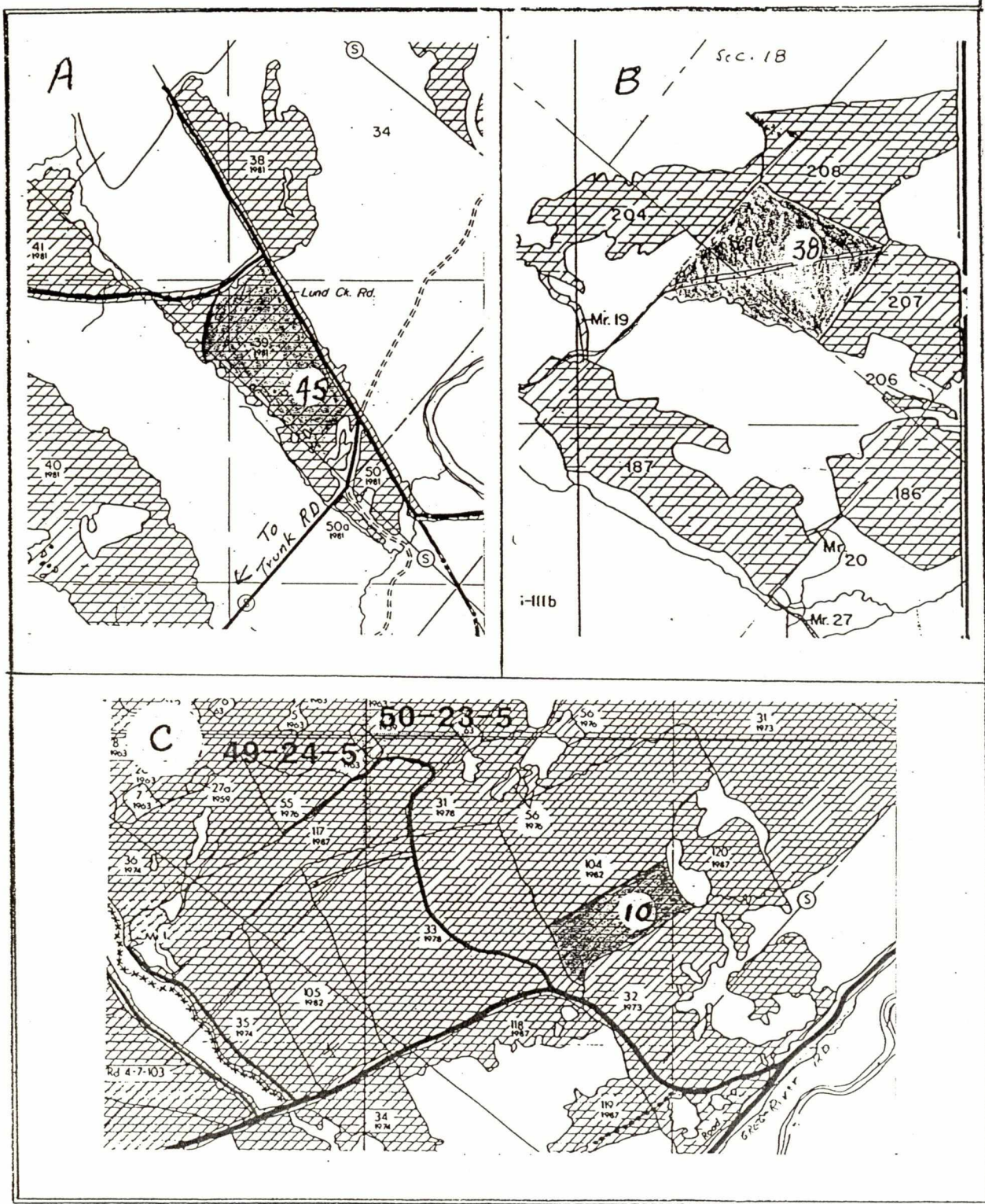


Figure 9. Detailed location of plots added in 1989 in:
 A - Embarrass I working circle (Area D2 in Figure 1)
 B - McLeod VI working circle (Area C2 in Figure 1)
 C - McLeod VII working circle (Area H in Figure 1)

Plot Establishment Records

Athapasca 19 61 9 July 13/81
 Working Circle Cut Area Plot No. Date

grass epilobium

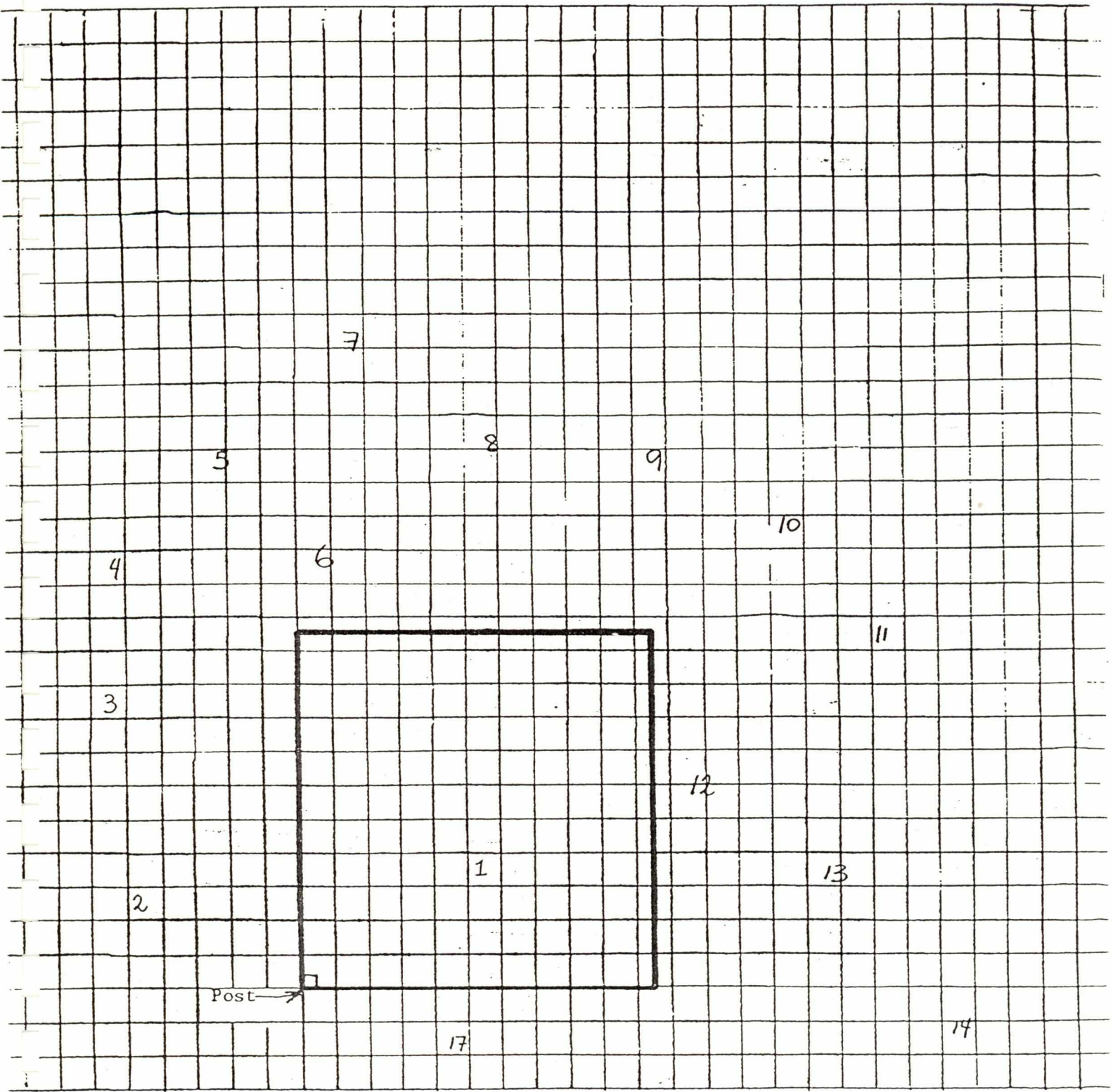
Tree Number	Height	Tree Condition*
1	9.3	forked
2	9.5	pitch nodule maker
3	11.3	healthy
4	9.9	pitch nodule maker
5	8.8	healthy
6	1.6	browsed leader
7	5.5	healthy
8	8.3	slight hail damage
9	12.2	healthy
10	9.5	"
11	10.6	"
12	4.5	gall rust-stem
13	6.5	healthy
14	7.0	"
15	9.0	"
16	12.0	"
17	7.4	pitch nodule maker, chlorotic
18	9.0	healthy
19		
20		

* Tree condition may be in three broad categories: 1) Healthy with no deformities; 2) Healthy but showing results of some pest attack (i.e. multiple leaders, gall rust on main stem, partially girdled, etc.); and 3) Unhealthy but still alive (describe symptoms or identify agent if possible).

Figure 10.

Approximate tree locations

(Each square = 1 foot)



18

PLOT 9

16

15

Atbabasca 19

61

WORKING CIRCLE

CUT AREA

Figure 11.