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A COMPARISON OF THE B-26 AND THRUSH COMMANDER AIRTANKERS IN ALBERTA

by

J.E. Grigel* and R.J. Lieskovsky**

ABSTRACT

A study was conducted to compare the performance of the B-26 and the Thrush Commander airtankers in southern Alberta. Four fires were simulated in the Crowsnest Forest and three in the Bow Forest. A group of four Thrush were dispatched to these fires from Cowley retardant base in the Crowsnest Forest and Jumping Pound base in the Bow Forest. Both a single and a pair of B-26's were dispatched to the same fires from the Lethbridge and Calgary airports respectively. The total cost per fire, cost per foot of fire-line and total time of each operation were determined for varying lengths of fire-line required. Results show that the B-26, operating either singly or as a pair, outperforms the Thrush group. The B-26 operating from either the Lethbridge or Calgary airport is a suitable alternative to a group of four Thrush airtankers operating from either the Cowley or Jumping Pound retardant bases.

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* Research was conducted by the Canadian Forestry Service and this report prepared by J. E. Grigel under contract to the Canadian Forestry Service.

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INTRODUCTION

One of the prime requisites of an effective air attack program is the construction of a network of retardant bases capable of handling the largest airtanker that may be used. Such a network permits maximum utilization of all airtankers under contract and also facilitates the use of all types of airtankers based during emergency periods.

In Alberta, the Thrush Commander[1], B-26 and PBY Canso (amphibian) are used as airtankers. The B-26 airtanker, which has a capacity of 900 gallons, has proven to be a very effective fire suppression tool in northern Alberta. Operating from five retardant bases, the airtanker works effectively within an operating radius of 80 miles. Initial attack distances are sometimes considerably greater. With the advent of a wet spring and summer in norther Alberta, it is possible that the B-26 may receive little call for work. Also, with the general shift of fire hazard from north to south as the fire season progresses, it is possible that the B-26 is not being utilized to maximum potential because of the restricted area of operation. At present, the B-26 airtanker is not utilized in the southern part of the province because of the lack of airstrips which are considered suitable for use as retardant bases.

In the southern forested part of Alberta, the Thrush airtanker, with a tank capacity of 330 gallons is used. The effective operating

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[1] Henceforth referred to as the Thrush.

radius of the Thrush is considered to be 20 - 25 miles. However, the present network of retardant bases in the southern part of the province does not provide this operating radius (Figure 1). For example, only a small part of the overall area to be protected actually falls within a 20-mile radius of either the Cowley, Jumping Pound or Rocky Mountain House retardant bases. The operating range for initial attack is, of course, greater but return trips for the Thrush airtanker are usually required because of its limited line-building capability. When larger fires or numerous smaller fires occur in an area, temporary retardant bases are sometimes established at a suitable airstrip near the fire. However, this is usually done after the fact, that is, after the fire(s) has reached a size to warrant such action.

The initial attack airtanker concept is no longer in effect if auxilliary mixing/loading operations are established near the fire to keep within the 20-mile operating radius. This becomes a support action, the benefits of which are sometimes doubtful in the case of fixed-wing airtankers. In many cases, helicopters operating from portable retardant stations close to or actually at the fire site are more effective. Also, an airstrip may be only 12 miles from a fire, but because of rough terrain and high elevation, the Thrush must meander its way to the fire with less than a full load. The close proximity of the airtanker group to the same fire may in fact be a disadvantage, since the group is at times not utilized until a blow-up condition occurs and effective action is not possible.

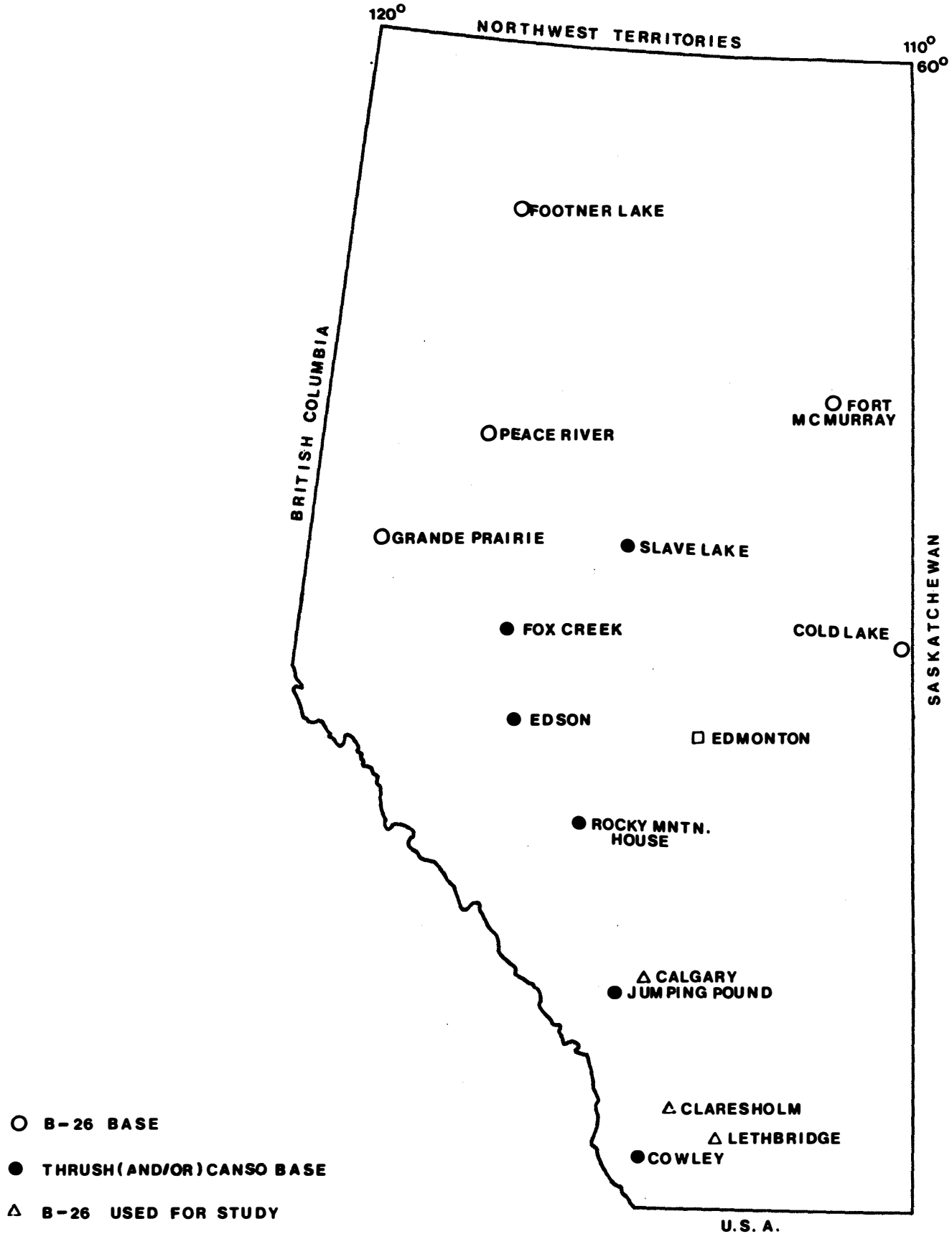

FIG. 1 RETARDANT BASES USED IN ALBERTA (1971) ○ ●

Does the use of small airtankers like the Thrush in the southern part of Alberta, i.e. south of Edson, permit the initial attack concept, which is agreed by most to be the most effective method of attack, to be followed? Is the maximum benefit being realized with this airtanker? Is it possible that initial attack using different airtankers operating from different retardant bases could be more effective at less cost?

Airstrips at which retardant bases can be established for use by the B-26 airtanker in the southern part of the province are limited. Only Lethbridge, Calgary and Edmonton are suitable. Claresholm and Penhold can be considered potential bases, but their present length limits the operation to smaller airtankers such as the TBM Avenger and PBY Canso. At first glance, the first three airports are eliminated because of their distance from the forested areas (Figure 1). Certainly Edmonton is marginal (at least with the B-26 size airtanker), but what about Lethbridge and Calgary? Can a B-26 operation out of Lethbridge or Calgary be carried out at the same or less cost with equal or greater effectiveness than can a Thrush operation from Cowley or Jumping Pound? Does the low fire incidence and small fire-size upon discovery in the Crowsnest and Bow Forest actually warrant the expenditure of funds to phase into larger airtanker operations using present retardant base locations or to continue use of small airtankers?

To answer some of these questions, a study to compare the effectiveness of the B-26 airtanker operating from Lethbridge, and

Calgary, and the Thrush airtanker operating from Cowley and Jumping Pound was made. Claresholm was also used for the B-26 to compare short operating distance with the Thrush from Cowley. Results of the study are presented in this report.

DESCRIPTION OF AIRTANKERS

B-26 Airtanker

The 1,000 Imperial gallon capacity B-26 airtanker operating in Alberta has four interconnecting 250-gallon tanks, each of which is equipped with a drop gate (Figure 2). The normal retardant load, however, is 900 Imperial gallons. Cruising speed loaded is 240 m.p.h. and normal drop speed approximately 140 m.p.h. Airstrips in the vicinity of 5,000 feet are required for safe operations.

The tank design of the B-26 permits the compartments to be activated in salvo, in pairs, individually, or trailed, i.e. two 450-gallon or four 225-gallon drops in sequence (Figure 3). This versatility allows the airtanker to be easily adapted to a particular fire situation. The length of fire-line established by the B-26 with a thickened retardant in an open area is shown below (Grigel, 1971).

Drop type	Length (feet)	Average Width (feet)
900 gal. salvo	260	60
450 gal.	180	30
225 gal.	90	20
2-450	380	30
900 gal.		
4-225	540	20

Application rate .04 inches or 2.1 Imperial gallons per 100 square feet. Retardant fire-line width to a minimum of 10 feet.
Drop speed 140 m.p.h.: Drop height 75 - 95 feet.

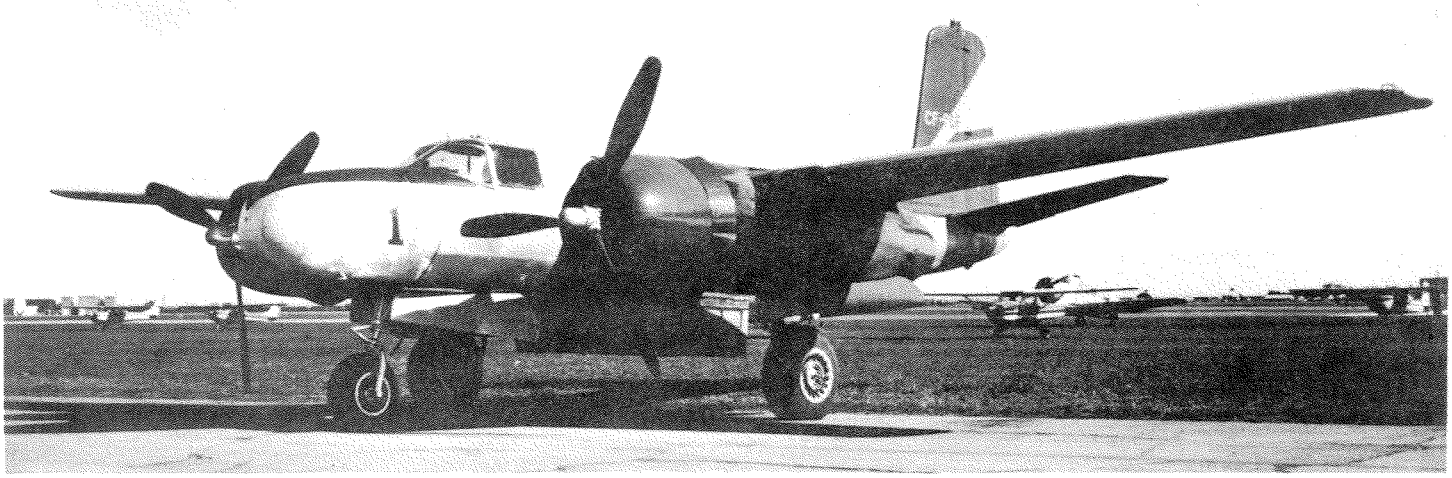

Figure 2. B-26 airtanker fitted with a four-door drop system.

Figure 3. A B-26 airtanker dropping 900 Imperial Gallons of long-term retardant.

Thrush Airtanker

The Thrush is a low-winged agricultural aircraft converted for retardant-bombing (Figure 4). The airtanker has a load capacity of 330 Imperial gallons, although operational testing has indicated that the maximum retardant load is 310 Imperial gallons (Grigel, 1971). However, operational use on wildfires has shown that the normal retardant load is reduced to 250 gallons, and this may be reduced even further with adverse operating conditions, i.e. mountainous terrain and high density-altitude. Cruising speed loaded is 120 m.p.h. and normal drop speed approximately 95 m.p.h. Airstrips in the vicinity of 2,800 feet are required for safe operations.

The retardant is contained in a single tank and the entire load is always dropped (Figure 5). The length of fire-line established by the Thrush with a thickened retardant in an open area is 95 feet, to a minimum width of 10 feet, at the .04 inches or 2.1 Imperial gallons per one hundred square feet level (Grigel, 1971).

PROCEDURES

A group of four Thrush airtankers[2], and a single and a pair of B-26 airtankers were selected for this study. Two separate comparisons of the Thrush and B-26 aircraft were made:

Case (1) Four Thrush operated from Cowley retardant base while the one and two B-26 operated from both Lethbridge and Claresholm airports.

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[2] Four Thrush airtankers are normally used as a working group in Alberta.

Figure 4. Thrush Commander airtanker equipped with a single drop tank.

Figure 5. Thrush Commander releasing 310 Imperial gallons of thickened fire retardant.

Case (2) Four Thrush operated from Jumping Pound retardant base while the one and two B-26 operated from Calgary airport.

Four fire locations were randomly selected in the first comparison and three fire locations in the second (Figure 6). At each of the fire locations, the airtanker or respective group of airtankers was required to establish 2.5, 5.0, 10.0, 15.0, 20.0, 25.0 and 30.0 chains of fire-line, or 165, 330, 660, 990, 1,320, 1,650 and 1,980 feet of fire-line respectively. Actual fire size upon discovery, fire growth until the initial retardant strike, fire growth and between succeeding retardant loads were not considered in this study.

The distance to each fire location from the respective retardant base or airport is summarized in Table 1.

Operational Data

The procedures used for this study were similar to those developed for another study to compare the effectiveness of the B-26 and Thrush airtankers for different operating distances from a standard retardant base[3].

The Operational Data used for the airtankers were as follows:

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[3] Grigel, J.E. and R.J. Lieskovsky. A Comparison of the B-26 and Thrush Commander airtankers. Northern Forest Research Centre, (Unpublished report on file).

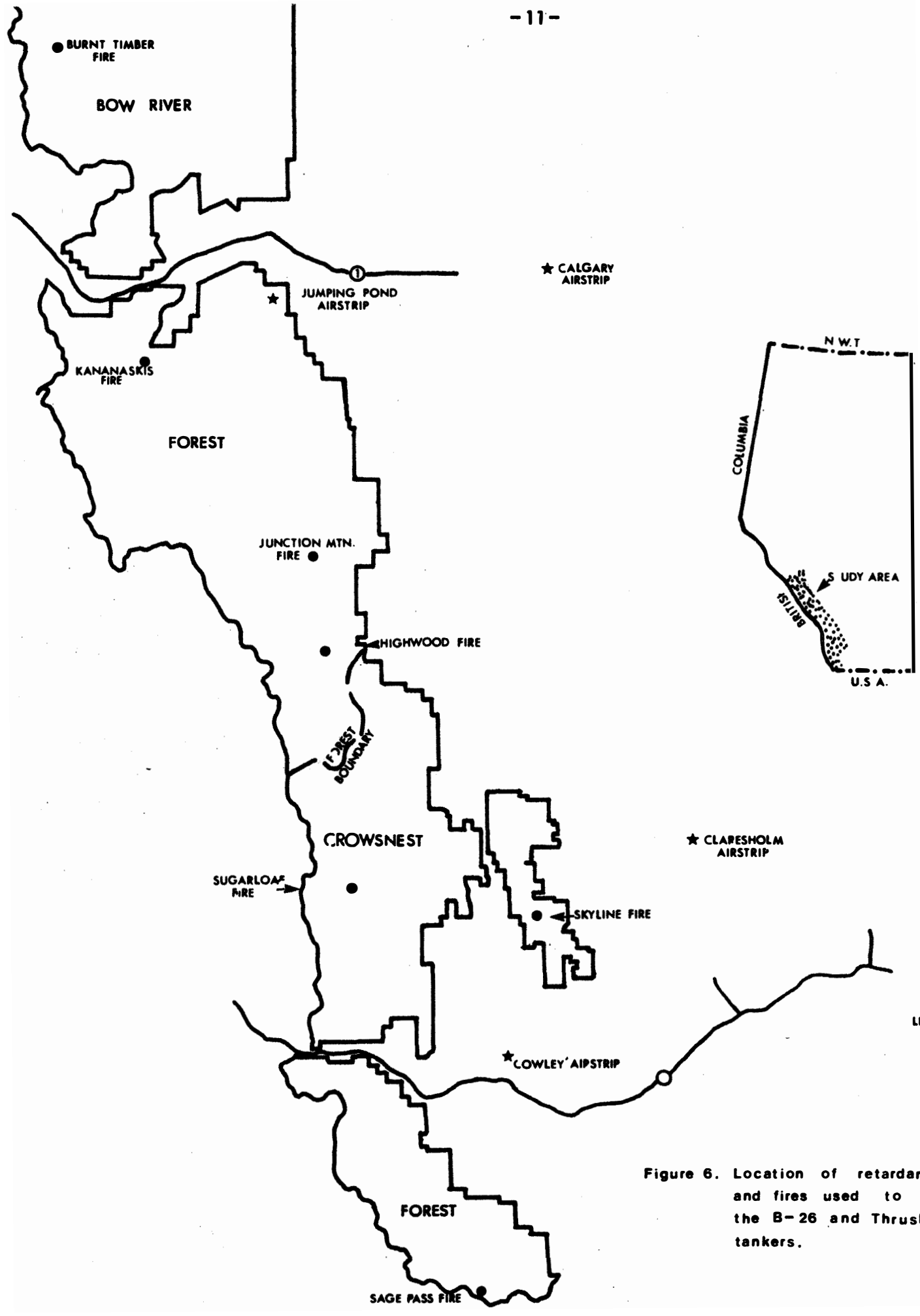

Figure 6. Location of retardant bases and fires used to compare the B-26 and Thrush air-tankers.

TABLE 1

Distance (miles) of Each Fire Location from Respective Retardant Base or Airport

Fire Location	Distance (miles) from retardant base or airport		
	Lethbridge	Claresholm	Cowley
CASE I			
Skyline	54	18	18
Sugarloaf	80	40	30
Sage Pass	72	62	32
Highwood	92	52	56
	Calgary	Jumping Pound	
CASE II			
Kananaskis	48	19	
Junction Mtn.	46	33	
Burnt Timber	64	44	

	B-26	Thrush
Cruise speed (m.p.h.)	240	120
Time for initial dispatch and additional loads (minutes)	8	6
Maneuvering time over fire (minutes)	8	4
Available fuel (flying hours)	3	1½
Refueling time (minutes)	30	15
Cost per hour, charter rate ($)	480.00	220.00
Retardant load capacity (gallons)	900 (2-450)	310
Length of line built per load at .04-inch (2.1 gal/100 sq. ft.) application rate (feet)	180	95
Cost of retardant per gallon ($)	.50	.50

Number of Retardant Loads Required

The number of retardant loads required to build the fire-line in each length class was determined for the Thrush and B-26. The Thrush dropped its full load while the B-26 dropped a half-load (450 gallons) each time. In a case where the fire-line required to complete the task was less than the line built by a retardant load, the drop was still made. This may have resulted in some "overkill".

For example, if 5.0 chains (330 feet) of fire-line was required, the following load(s) would be needed:

(i) the Thrush builds 95 feet per drop, therefore

$\frac{330 \text{ ft.}}{95 \text{ ft.}} = 3.5$ loads were required; however, actual line built was 4 x 95 feet = 380 feet.

(ii) the B-26 builds 180 feet per 450-gallon drop, therefore one (1) load is required; however, the total load was dropped and 2 x 180 feet = 360 feet of line was built.

If 10 chains (660 feet) of fire-line was required, the following loads would be needed:

(i) Thrush: $\frac{660 \text{ ft.}}{95 \text{ ft.}}$ = 6.9 or 7 drops (and loads).

(ii) B-26: $\frac{660 \text{ ft.}}{180 \text{ ft.}}$ = 3.7 or 4 drops (2 full airtanker loads).

Total Time and Flying Time

The following criteria were used to determine flying time and cost:

1. The aircraft flew in a straight line from the retardant base to the fire location.
2. Total time was considered as "engine on - engine off" basis. For each additional Thrush load of retardant six minutes was added to total time; for each additional B-26 load eight minutes was added to total time.
3. The actual flying time, which was less than total time, was calculated for refueling purposes. For each additional Thrush load of retardant two minutes was added to flying time; for each additional B-26 load four minutes was added to flying time. The assumption was that the fuel consumed by the Thrush and B-26 during taxiing and loading was equivalent to two and four minutes flying time respectively.
4. The time flying to the fire location and the time to return to the retardant base was calculated by dividing the straight line distance to the fire by the cruising speed of the aircraft in miles per

minute, i.e. Thrush 120 m.p.h. = 2 miles per minute and B-26 240 m.p.h. = 4 miles per minute. The speeds encountered during the climb-out and approach for landing segments of the flight were less than the cruising speed, however, the extra time allotted for "additional loads" and "maneuvering time over the fire" partly compensated for this discrepancy.

5. The maneuvering time over the fire to release the retardant load(s) was four minutes for the Thrush and eight minutes for the B-26.

Flying Cost and Total Operational Cost

Each individual or group of airtanker(s) was dispatched to each fire and the appropriate fire-line length was built. The total time ("engine on - engine off") required to build that line was calculated, using the criteria outlined previously. This time was multiplied by the charter rate per hour for each aircraft to determine the total flying cost. Flying time was also recorded on an accumulative basis for each aircraft to determine when refueling was required.

Total operational cost for each fire and each fire-line length class was determined by adding the respective flying cost and the cost of the retardant required to build that length of fire-line. From this, the cost per foot of fire-line required was determined for each length class.

Length of Operation

The length of each operation was determined by dividing the total time by the appropriate number of airtankers. Towards the end of

several fire operations, the fire-line was completed by sending only those airtankers required to complete the operation. In these instances, airtankers may have been available for use on other targets.

RESULTS

Results of the study show that one or two B-26 airtankers can operate from Lethbridge, Claresholm and Calgary with equal or greater effectiveness than can the four Thrush airtankers from Cowley and Jumping Pound. The total cost per fire operation for the B-26 is less; correspondingly, the cost per foot of fire-line required is less. The time required to complete a fire operation varies with distance but generally favors the B-26.

Case I

Lethbridge and Claresholm (B-26) versus Cowley (Thrush)

(i) Total cost per fire

The total cost of constructing the fire-line required is shown in Table 2 and Figures 7 to 10. For all four fires, the total cost of a Thrush group operation is greater than for either a one or two B-26 operation.

As the distance from the retardant base to the fire increases, the cost of the Thrush operation increases at a greater rate than does the B-26 operation. For example, the total cost of constructing 15 chains (990 feet) of fire-line on the Skyline fire is $2,358.00 for the B-26 from Lethbridge (54 miles) and $2,834.00 for the Thrush from

Cowley (18 miles). The same fire costs $1,950.00 for the B-26 from Claresholm, which is the same distance to the fire (18 miles) as Cowley (Figure 7).

On the Highwood fire, the B-26 from Lethbridge (92 miles) costs $2,646.00 for 15 chains, the Thrush from Cowley (56 miles) $4,752.00 and the B-26 from Claresholm (52 miles) $2,358.00. As the length of fire-line required increases at this operating distance, the use of the Thrush airtanker becomes marginal (Figure 10).

(ii) Cost per foot of fire-line

The cost per foot of fire-line required, using one B-26 operating from Lethbridge as the unit factor, is presented in Table 3 and Figures 11 to 14. The effect that an increase in operating distance has on the Thrush group is evident. A comparison of the B-26 and Thrush operating from the same distances, i.e. 18 miles to the Skyline fire from the Claresholm and Cowley airports respectively, shows that at this distance the cost per foot of fire-line averages 1.5 times greater for the Thrush ($2.86 vs. $1.96) (Figure 11); at a 52 - 56 mile operating distance to the Highwood fire, the cost per foot of fire-line averages twice as great for the Thrush ($4.80/ft.) as for the B-26 ($2.38/ft.) (Figure 14).

In all instances the B-26 airtanker operating either singly or in a pair is less costly than a group of four Thrush airtankers. This occurs even when the operating distance for the B-26 is three times as great as for the Thrush, i.e. 54 miles versus 18 miles (Figure 11).

(iii) Time to complete fire operation

The total time required to complete each fire operation is presented in Table 4. One B-26 operating from the same close distance as the Thrush group can complete most of the fire operations in less time. For example, on the Skyline fire, 18 miles from both Claresholm and Cowley, one B-26 completes 15.0 chains of fire-line in 1.2 hours and four Thrush complete the same fire-line in 1.3 hours. As the distance to the fire increases, the time advantage for one B-26 becomes greater. For the Highwood fire, the lone B-26 constructs 15.0 chains of fire-line in 2.1 hours while the Thrush group takes 3.5 hours.

The use of two B-26 airtankers greatly increases the efficiency of the operation. For example, on the Sugarloaf fire two B-26 operating from Lethbridge, a distance of 80 miles, constructs 10 chains of fire-line in 0.9 hours while the four Thrush operating from Cowley, a distance of 30 miles, completes the task in 1.2 hours.

At greater fire-line length requirements and distances, the time difference is more pronounced. To build 30.0 chains (1,980 feet) of fire-line on the Highwood fire, two B-26 from Lethbridge (92 miles) take 2.7 hours while the Thrush group from Cowley (56 miles) takes 6.8 hours. The total cost of the operation for the two B-26 is $5,292.00 ($2.67/ft.) and for the Thrush group $9,272.00 ($4.68/ft.).

Case II

Calgary (B-26) versus

Jumping Pound (Thrush)

(i) Total cost per fire

The total cost of constructing the fire-line required is shown in Table 5 and Figures 15 to 17. For all three fires, the total cost of a Thrush group operation is greater than for either a one or two B-26 operation. As the distance from the retardant base to the fire increases the cost of the Thrush operation increases at a greater rate than does the B-26 operation. For example, the total cost of constructing 15 chains (990 feet) of fire-line on the Kananaskis fire is $2,310.00 for the B-26 from Calgary (48 miles) and $2,873.00 for the Thrush from Jumping Pound (19 miles) (Figure 15). On the Burnt Timber fire, the B-26 from Calgary (64 miles) costs $2,502.00 for 15 chains while the Thrush from Jumping Pound (44 miles) costs $4,268.00 (Figure 17).

(ii) Cost per foot of fire-line

The relative cost per foot of fire-line required, using one B-26 operating from Calgary as the unit factor, is presented in Table 6 and Figures 18 to 20. With the B-26 operating from 2.5 times the distance of the Thrush on the Kananaskis fire (48 miles from Calgary and 19 miles from Jumping Pound respectively) the cost per foot of fire-line for the Thrush averages 1.2 times that of the B-26 ($2.85/ft. versus $2.40/ft.) (Figure 18). At a greater operating distance for both the B-26 and the Thrush, the difference in the cost

TABLE 2

Total Cost Per Fire for B-26 and Thrush Airtankers (Dollars)

Case I

Fire Location and Distance (miles)		Retardant Base	Number of Airtankers	Fire-Line Length (chains)						
				2.5	5.0	10.0	15.0	20.0	25.0	30.0
	54	Lethbridge	1	786	786	1572	2358	3144	4170	4956
			2	-	-	1572	2358	3144	3930	4716
SKYLINE	18	Claresholm	1	647	647	1298	1950	2597	3248	3900
			2	-	-	1298	1950	2597	3248	3900
	18	Cowley	4	(515)*	1029	1802	2834	3717	4858	5631
	80	Lethbridge	1	896	896	1793	2694	3830	4726	5628
			2	896	896	1793	2694	3590	4487	5388
SUGARLOAF	40	Claresholm	1	738	738	1476	2214	2952	3930	4668
			2	-	-	1476	2214	2952	3690	4428
	30	Cowley	4	(603)	1205	2110	3483	4443	5760	6775
	72	Lethbridge	1	863	863	1730	2648	3701	4568	5436
			2	-	-	1730	2648	3461	4328	5196
SAGE PASS	62	Claresholm	1	824	824	1649	2478	3542	4367	5196
			2	-	-	1649	2478	3302	4127	4956
	32	Cowley	4	(618)	1236	2163	3564	4546	5892	6924
	92	Lethbridge	1	944	944	1764	2646	3768	4650	5532
			2	-	-	1764	2646	3528	4410	5292
HIGHWOOD	52	Claresholm	1	786	786	1572	2358	3144	4170	4956
			2	-	-	1572	2358	3144	3930	4716
	56	Cowley	4	(794)	1588	2944	4752	6108	7916	9272

Lethbridge & Claresholm: B-26: Cowley: Thrush

* ( ) Two Thrush only

Total cost of fire line constructed in chains at the .04" application rate.

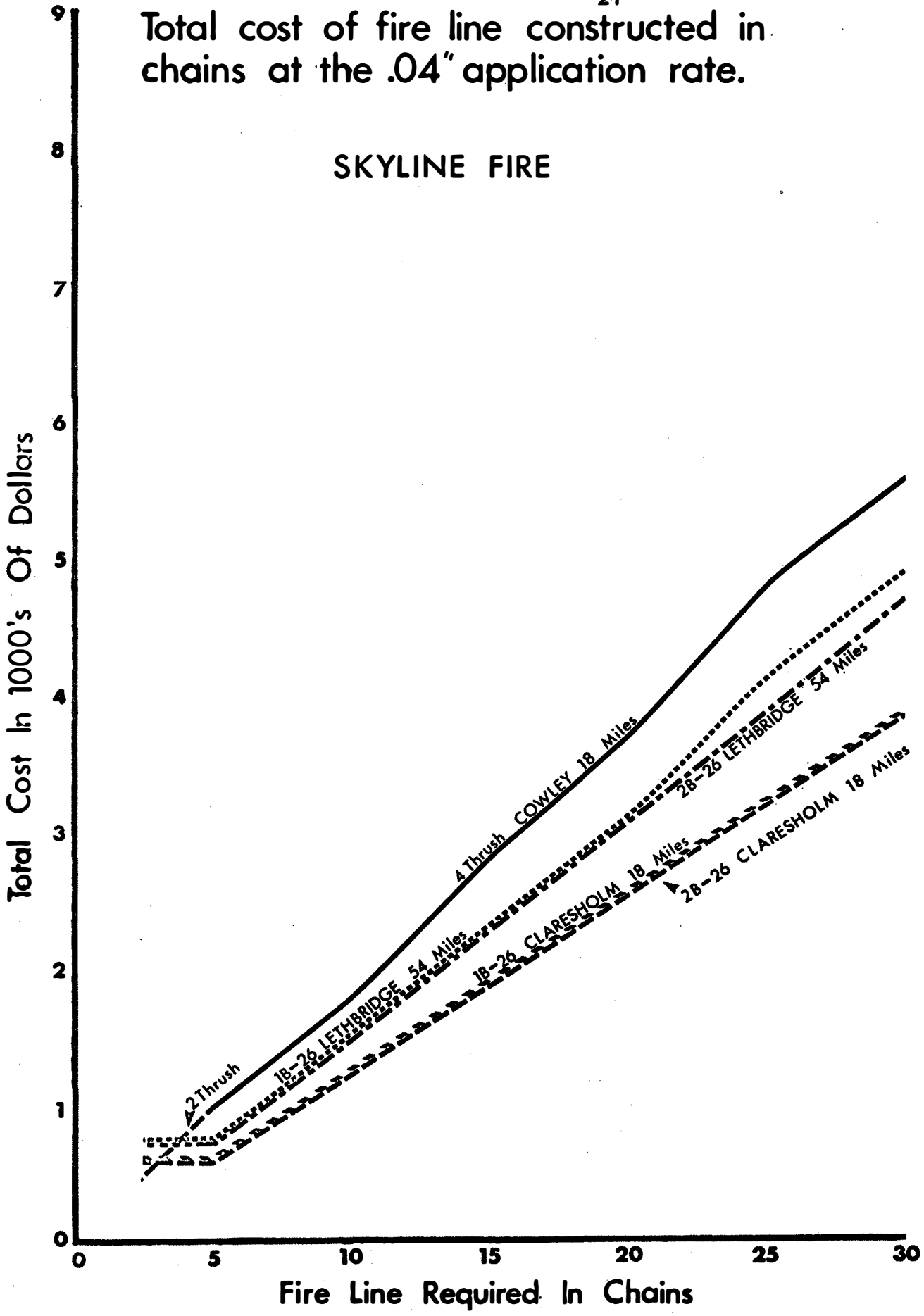

Figure 7

Total cost of fire line constructed in chains at the .04" application rate.

SUGARLOAF FIRE

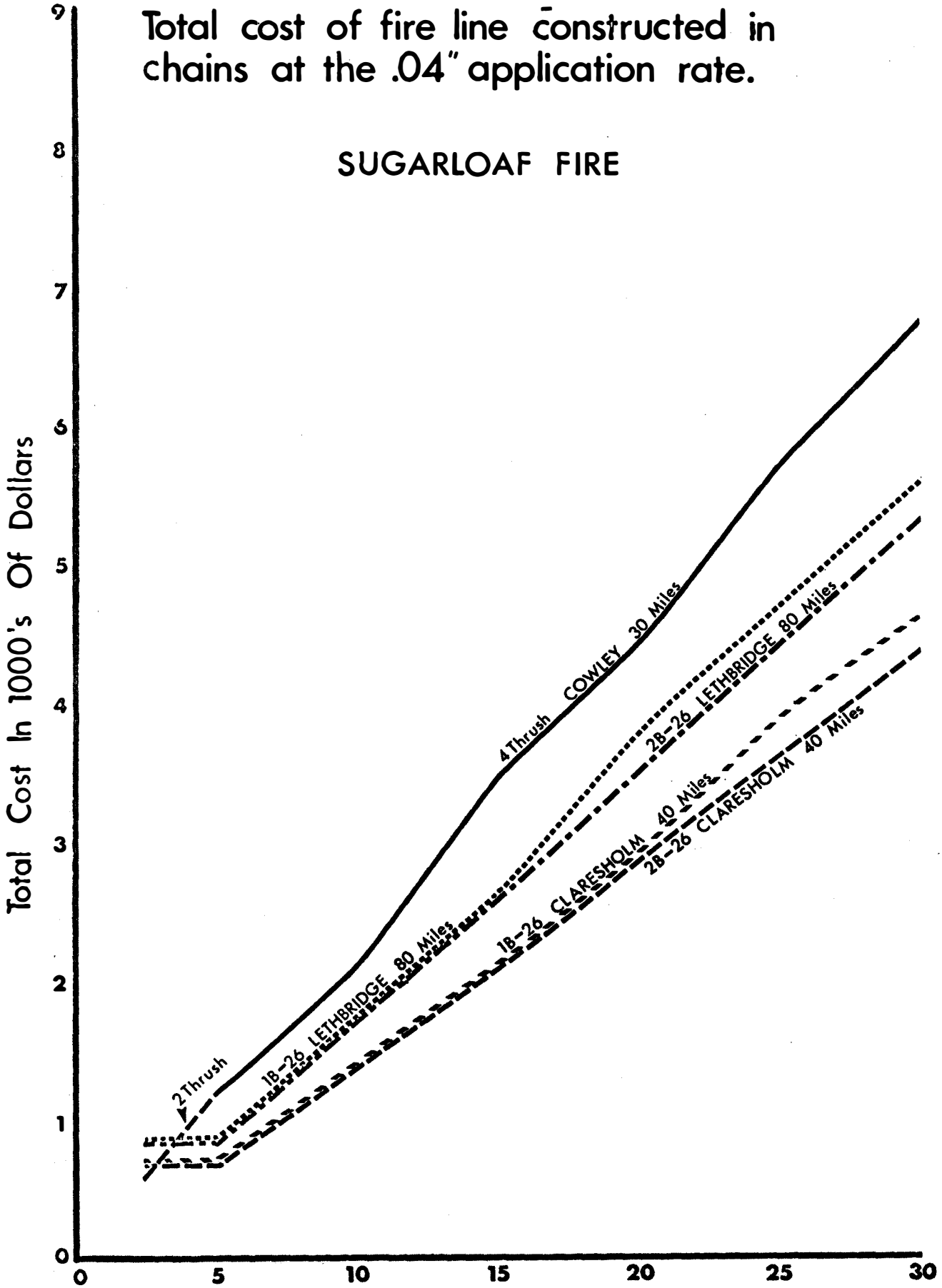

Figure 8

TABLE 3

Relative Cost Per Foot of Fire-Line Required Using One B-26 Operating from Lethbridge as Unit Factor

Case I

Fire Location and Distance (miles)		Retardant Base	Number of Airtankers	Fire-Line Length (chains) 2.5	5.0	10.0	15.0	20.0	25.0	30.0
	54	Lethbridge	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			2	-	-	1.0	1.0	1.0	0.9	1.0
SKYLINE	18	Claresholm	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8
			2	-	-	0.8	0.8	0.8	0.8	0.8
	18	Cowley	4	(0.6)*	1.3	1.1	1.2	1.2	1.2	1.1
	80	Lethbridge	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			2	-	-	1.0	1.0	0.9	0.9	1.0
SUGARLOAF	40	Claresholm	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8
			2	-	-	0.8	0.8	0.8	0.8	0.8
	30	Cowley	4	(0.7)	1.3	1.2	1.3	1.2	1.2	1.2
	72	Lethbridge	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			2	-	-	1.0	1.0	0.9	0.9	1.0
SAGE PASS	62	Claresholm	1	1.0	1.0	1.0	0.9	1.0	1.0	1.0
			2	-	-	1.0	0.9	0.9	0.9	0.9
	32	Cowley	4	(0.7)	1.4	1.2	1.3	1.2	1.3	1.3
	92	Lethbridge	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			2	-	-	1.0	1.0	0.9	1.0	1.0
HIGHWOOD	52	Claresholm	1	0.8	0.8	0.9	0.9	0.8	0.9	0.9
			2	-	-	0.9	0.9	0.8	0.8	0.8
	56	Cowley	4	(.8)	1.7	1.7	1.8	1.6	1.7	1.7

Lethbridge & Claresholm: B-26; Cowley: Thrush

* ( ) Two Thrush only

Total cost of fire line constructed in chains at the .04" application rate.

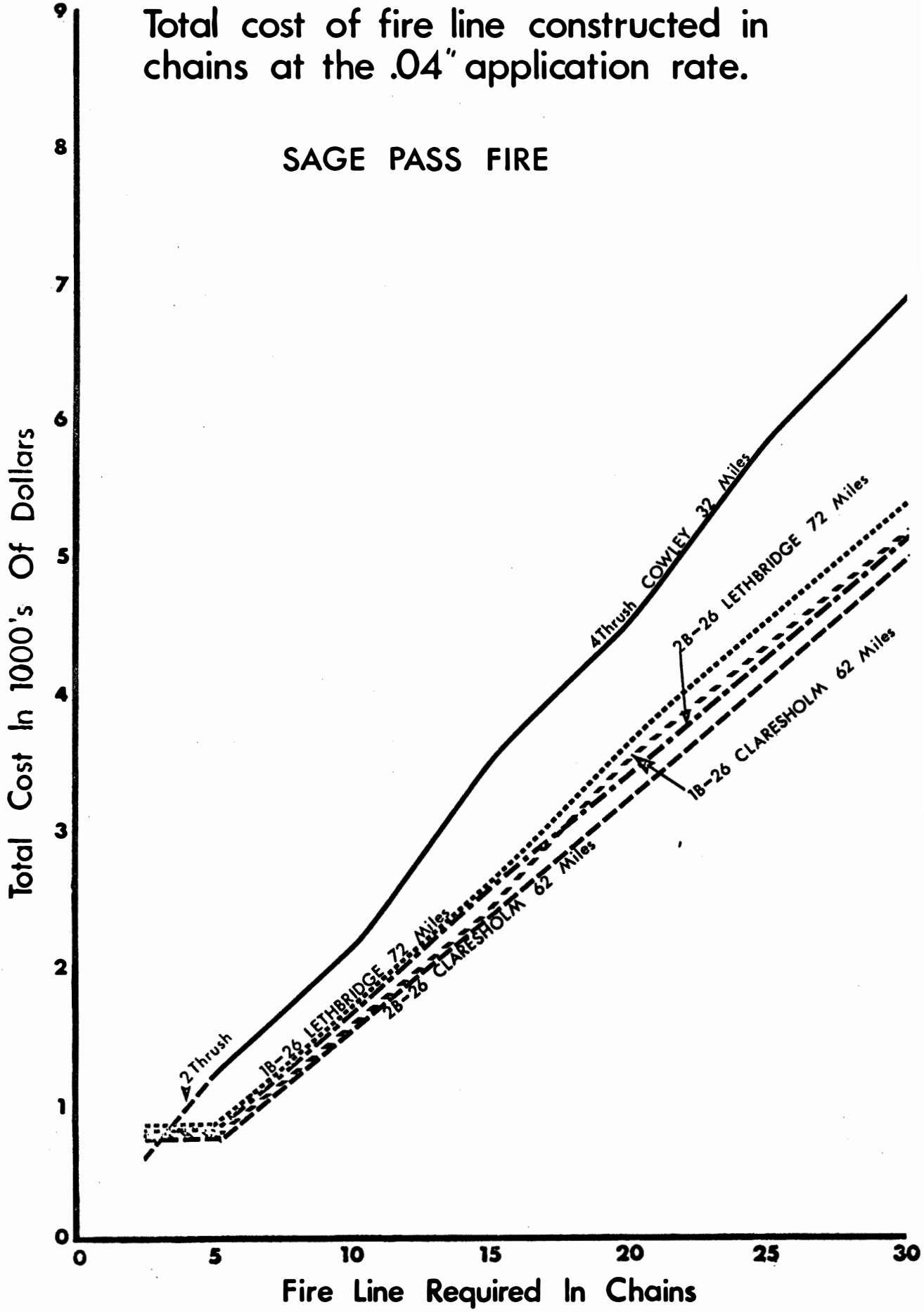

Figure 9

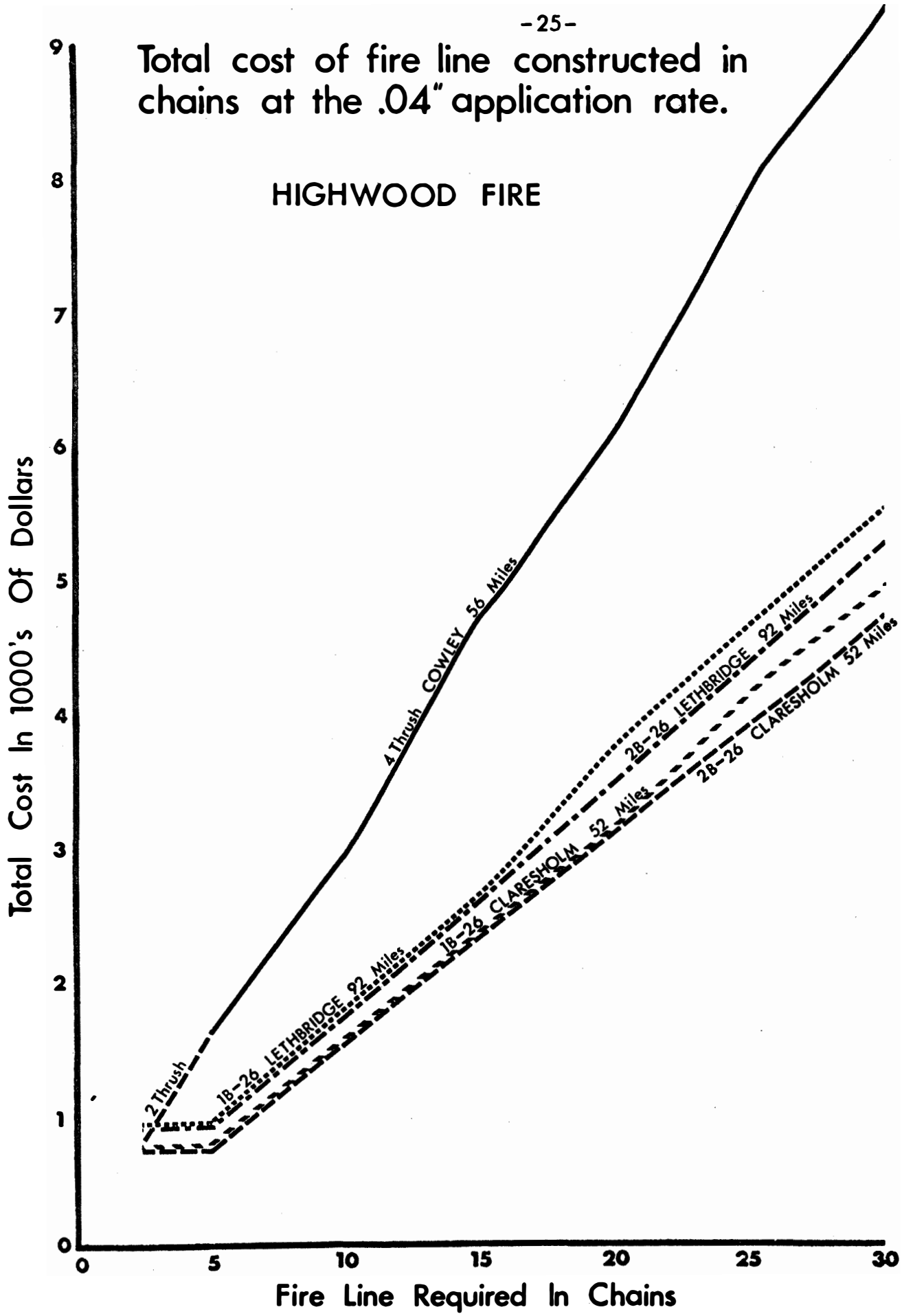
Total cost of fire line constructed in chains at the .04" application rate.
HIGHWOOD FIRE
Total Cost In 1000's Of Dollars
Fire Line Required In Chains
0
1
2
3
4
5
6
7
8
9
0
5
10
15
20
25
30
4 Thrush COWLEY 56 Miles
2B-26 LETHBRIDGE 92 Miles
1B-26 LETHBRIDGE 92 Miles
2B-26 CLARESHOLM 52 Miles
1B-26 CLARESHOLM 52 Miles
2 Thrush

Figure 10

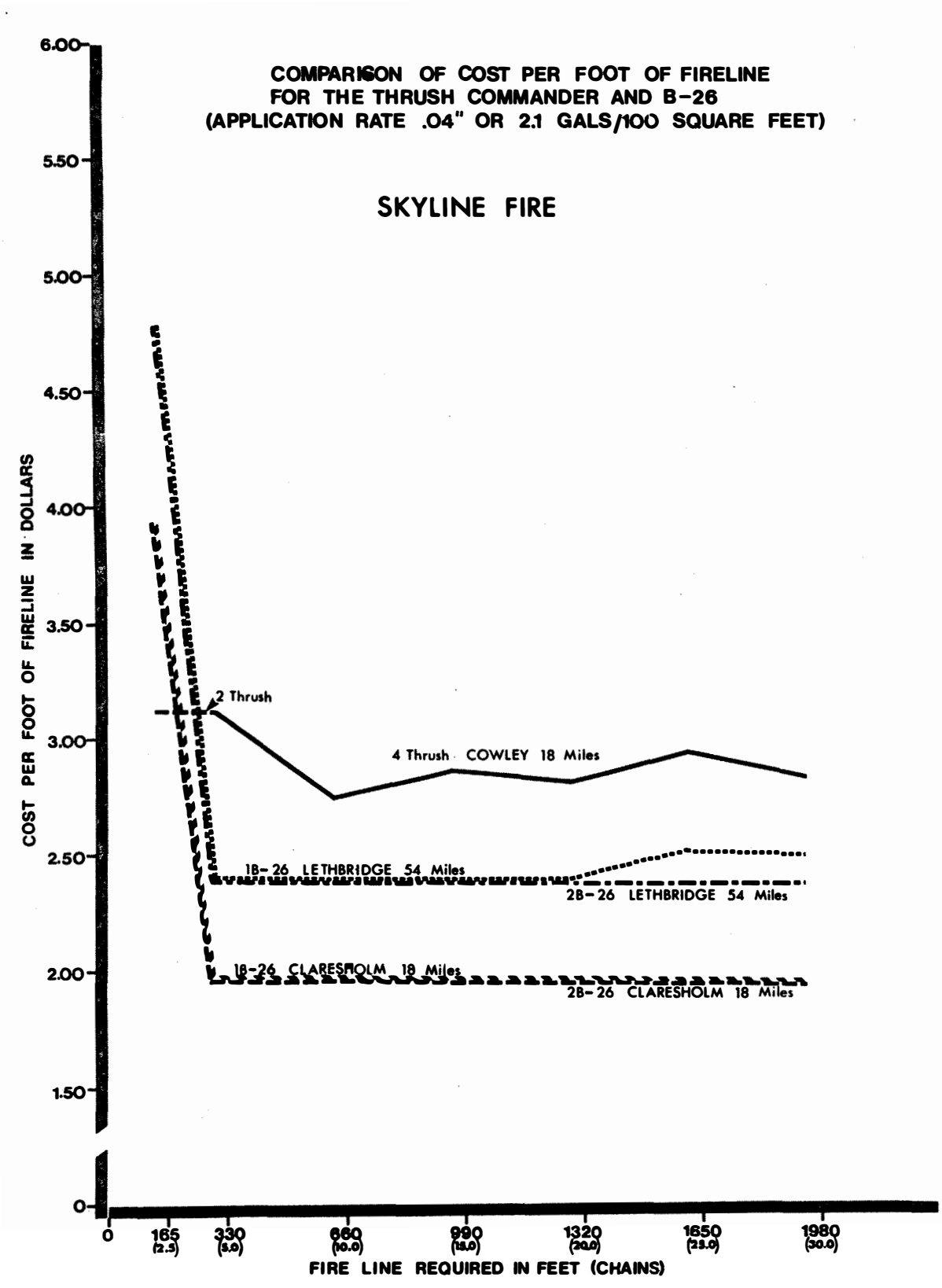
COMPARISON OF COST PER FOOT OF FIRELINE
FOR THE THRUSH COMMANDER AND B-26
(APPLICATION RATE .04" OR 2.1 GALS/100 SQUARE FEET)
SKYLINE FIRE
COST PER FOOT OF FIRELINE IN DOLLARS
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
0
2 Thrush
4 Thrush COWLEY 18 Miles
1B-26 LETHBRIDGE 54 Miles
2B-26 LETHBRIDGE 54 Miles
1B-26 CLARESHOLM 18 Miles
2B-26 CLARESHOLM 18 Miles
0
165 (2.5)
330 (5.0)
660 (10.0)
990 (15.0)
1320 (20.0)
1650 (25.0)
1980 (30.0)
FIRE LINE REQUIRED IN FEET (CHAINS)

Figure 11

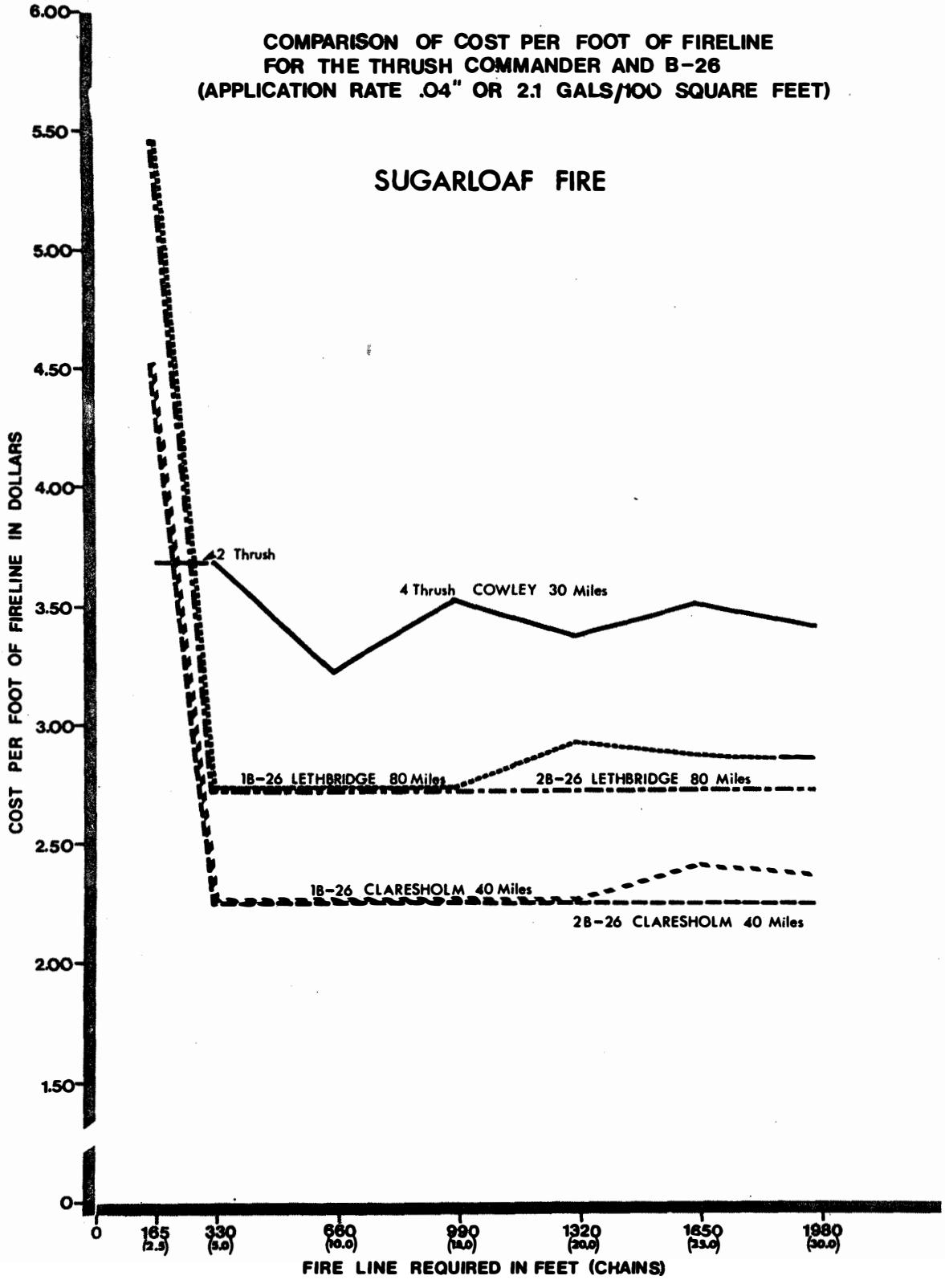
COMPARISON OF COST PER FOOT OF FIRELINE
FOR THE THRUSH COMMANDER AND B-26
(APPLICATION RATE .04" OR 2.1 GALS/100 SQUARE FEET)
SUGARLOAF FIRE
COST PER FOOT OF FIRELINE IN DOLLARS
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
0
4.2 Thrush
4 Thrush COWLEY 30 Miles
1B-26 LETHBRIDGE 80 Miles
2B-26 LETHBRIDGE 80 Miles
1B-26 CLARESHOLM 40 Miles
2B-26 CLARESHOLM 40 Miles
0
165 (2.5)
330 (5.0)
660 (10.0)
990 (15.0)
1320 (20.0)
1650 (25.0)
1980 (30.0)
FIRE LINE REQUIRED IN FEET (CHAINS)

Figure 12

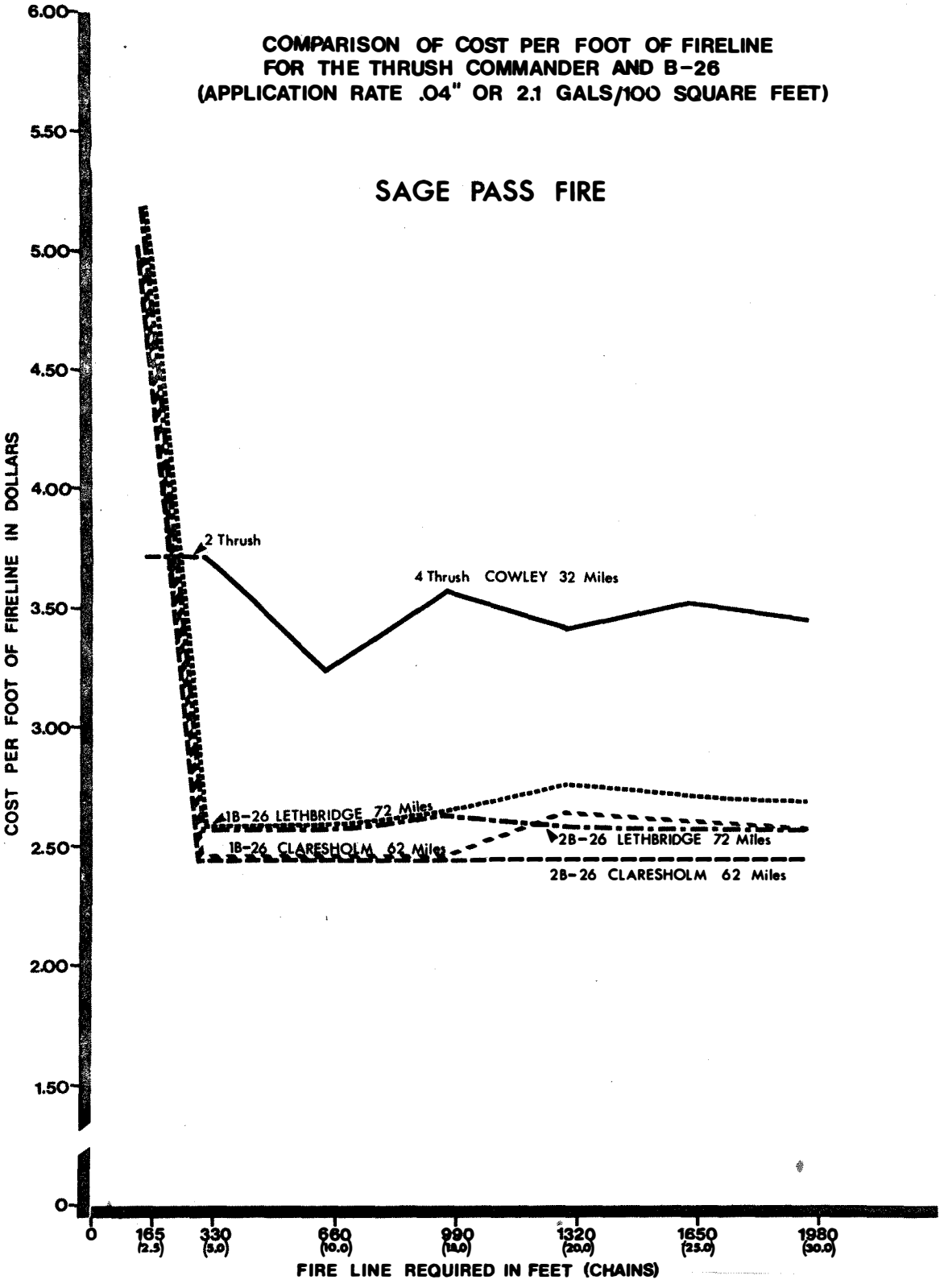
COMPARISON OF COST PER FOOT OF FIRELINE
FOR THE THRUSH COMMANDER AND B-26
(APPLICATION RATE .04" OR 2.1 GALS/100 SQUARE FEET)
SAGE PASS FIRE
COST PER FOOT OF FIRELINE IN DOLLARS
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
0
2 Thrush
4 Thrush COWLEY 32 Miles
1B-26 LETHBRIDGE 72 Miles
2B-26 LETHBRIDGE 72 Miles
1B-26 CLARESHOLM 62 Miles
2B-26 CLARESHOLM 62 Miles
0
165 (2.5)
330 (5.0)
660 (10.0)
990 (15.0)
1320 (20.0)
1650 (25.0)
1980 (30.0)
FIRE LINE REQUIRED IN FEET (CHAINS)

Figure 13

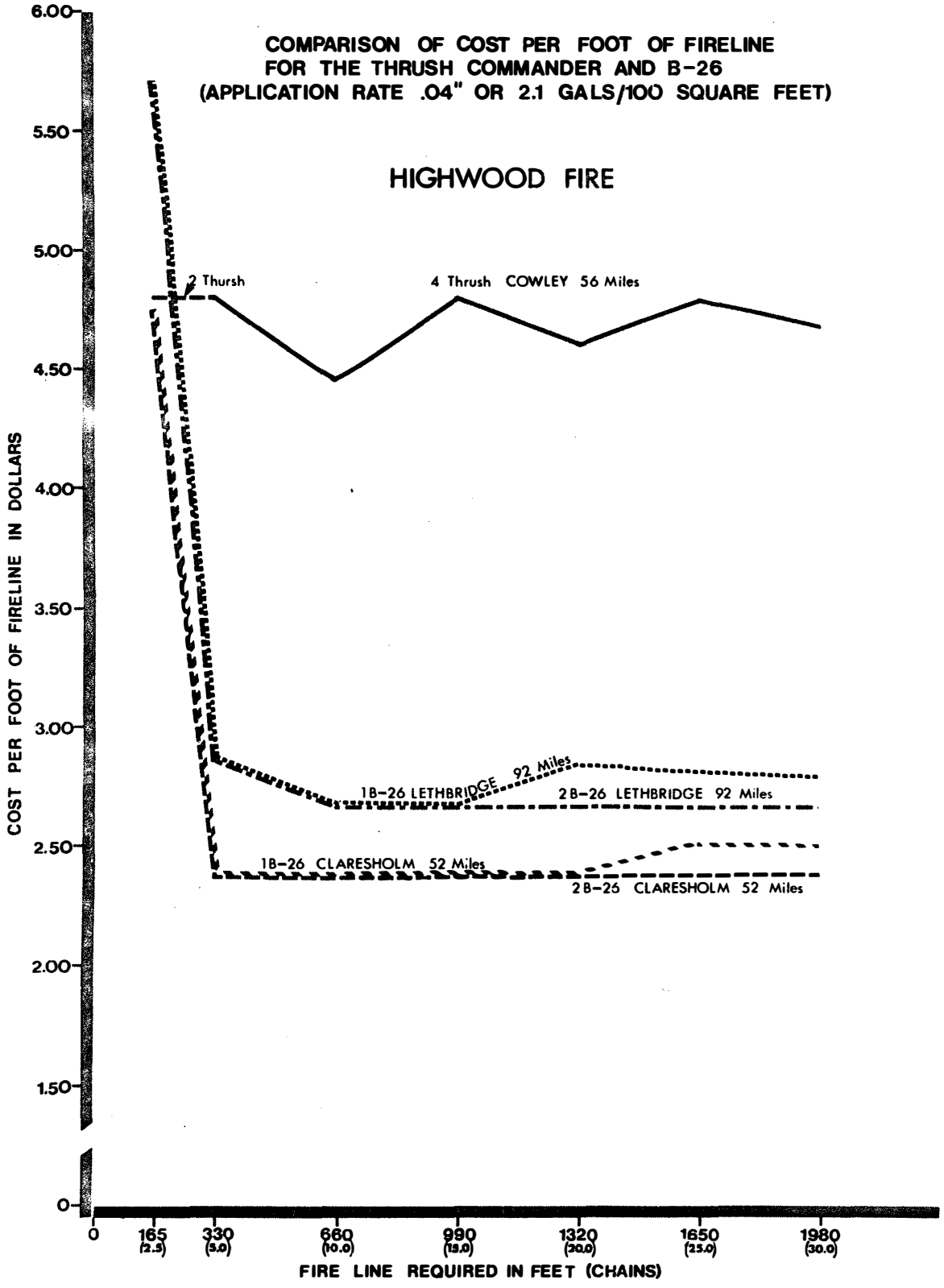
COMPARISON OF COST PER FOOT OF FIRELINE
FOR THE THRUSH COMMANDER AND B-26
(APPLICATION RATE .04" OR 2.1 GALS/100 SQUARE FEET)
HIGHWOOD FIRE
2 Thursh
4 Thrush COWLEY 56 Miles
1B-26 LETHBRIDGE 92 Miles
2B-26 LETHBRIDGE 92 Miles
1B-26 CLARESHOLM 52 Miles
2B-26 CLARESHOLM 52 Miles
COST PER FOOT OF FIRELINE IN DOLLARS
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
0
0
165 (2.5)
330 (5.0)
660 (10.0)
990 (15.0)
1320 (20.0)
1650 (25.0)
1980 (30.0)
FIRE LINE REQUIRED IN FEET (CHAINS)

Figure 14

TABLE 4

Total Time to Complete Fire Operation (hours)
Per Unit Airtanker

Case I

Fire Location and Distance (miles)		Retardant Base	Number of Airtankers	Fire-Line Length (chains) 2.5	5.0	10.0	15.0	20.0	25.0	30.0
	54	Lethbridge	1	0.7	0.7	1.4	2.1	2.8	4.0	4.7
			2	-	-	0.7	1.0	1.4	1.8	2.1
SKYLINE	18	Claresholm	1	0.4	0.4	0.8	1.2	1.7	2.1	2.5
			2	-	-	0.4	0.6	0.8	1.0	1.2
	18	Cowley	4	(0.5)*	0.5	0.8	1.3	1.8	2.4	2.7
	80	Lethbridge	1	0.9	0.9	1.9	2.8	4.2	5.2	6.1
			2	-	-	0.9	1.4	1.9	2.3	2.8
SUGARLOAF	40	Claresholm	1	0.6	0.6	1.2	1.8	2.4	3.5	4.1
			2	-	-	0.6	0.9	1.2	1.5	1.9
	30	Cowley	4	(0.7)	0.7	1.2	2.0	2.6	3.4	4.0
	72	Lethbridge	1	0.9	0.9	1.7	2.6	4.0	4.8	5.7
			2	-	-	0.9	1.3	1.7	2.2	2.6
SAGE PASS	62	Claresholm	1	0.8	0.8	1.6	2.4	3.6	4.4	5.2
			2	-	-	0.8	1.2	1.6	2.0	2.4
	32	Cowley	4	(0.7)	1.4	2.4	2.1	2.7	3.5	4.2
	92	Lethbridge	1	1.0	1.0	1.8	2.7	4.1	5.0	5.9
			2	-	-	0.9	1.4	1.8	2.3	2.7
HIGHWOOD	52	Claresholm	1	0.7	0.7	1.2	2.1	2.8	4.0	4.7
			2	-	-	0.6	1.0	1.4	1.8	2.1
	56	Cowley	4	(1.1)	1.1	2.1	3.5	4.5	5.8	6.8

Lethbridge & Claresholm: B-26; Cowley: Thrush

* ( ) Two Thrush only

per foot of fire-line is more pronounced. For example, on the Burnt Timber fire, 64 miles from Calgary and 44 miles from Jumping Pound, the cost per foot of fire-line averages 1.6 times higher for the Thrush ($4.25/ft. versus $2.65/ft.) (Figure 20).

In all instances the B-26 airtanker operating either singly or in a pair is less costly than a group of four Thrush airtankers. The relative cost per foot of fire-line is higher for the Thrush group in Case II than in Case I because the Calgary airport is located closer to the forested area and to the Jumping Pound retardant base (Figure 2).

(iii) Time to complete fire operation

The total time required to complete each fire operation is presented in Table 7. With the exception of the Kananaskis fire, one B-26 completes the fire operations in less time than does the Thrush group; two B-26 airtankers complete the fire operations in less time in all instances. As an example, on the Burnt Timber fire located 64 miles from Calgary and 33 miles from Jumping Pound, one B-26 constructs 15 chains (990 feet) of fire-line in 2.4 hours and four Thrush in 2.9 hours. Two B-26 complete the task in only 1.2 hours.

TABLE 5

Total Cost Per Fire for B-26 and Thrush Airtankers (Dollars)

Case II

Fire Location and Distance (miles)		Retardant Base	Number of Airtankers	Fire-Line Length (chains) 2.5	5.0	10.0	15.0	20.0	25.0	30.0
KANANASKIS	48	Calgary	1	767	767	1538	2310	3077	4088	4860
			2	-	-	1538	2310	3077	3848	4620
	19	Jumping Pound	4	(521)*	1045	1829	2873	3767	4924	5704
JUNCTION MOUNTAIN	46	Calgary	1	762	762	1524	2286	3048	4050	4812
			2	-	-	1524	2286	3048	3810	4572
	33	Jumping Pound	4	(625)	1249	2187	3604	4597	5958	7006
BURNT TIMBER	64	Calgary	1	834	834	1668	2502	3576	4410	5244
			2	-	-	1668	2502	3336	4170	5004
	44	Jumping Pound	4	(706)	1412	2636	4268	5492	7124	8348

* ( ) Two Thrush only

Calgary: B-26; Jumping Pound: Thrush

Total cost of fire line constructed in chains at the .04" application rate.

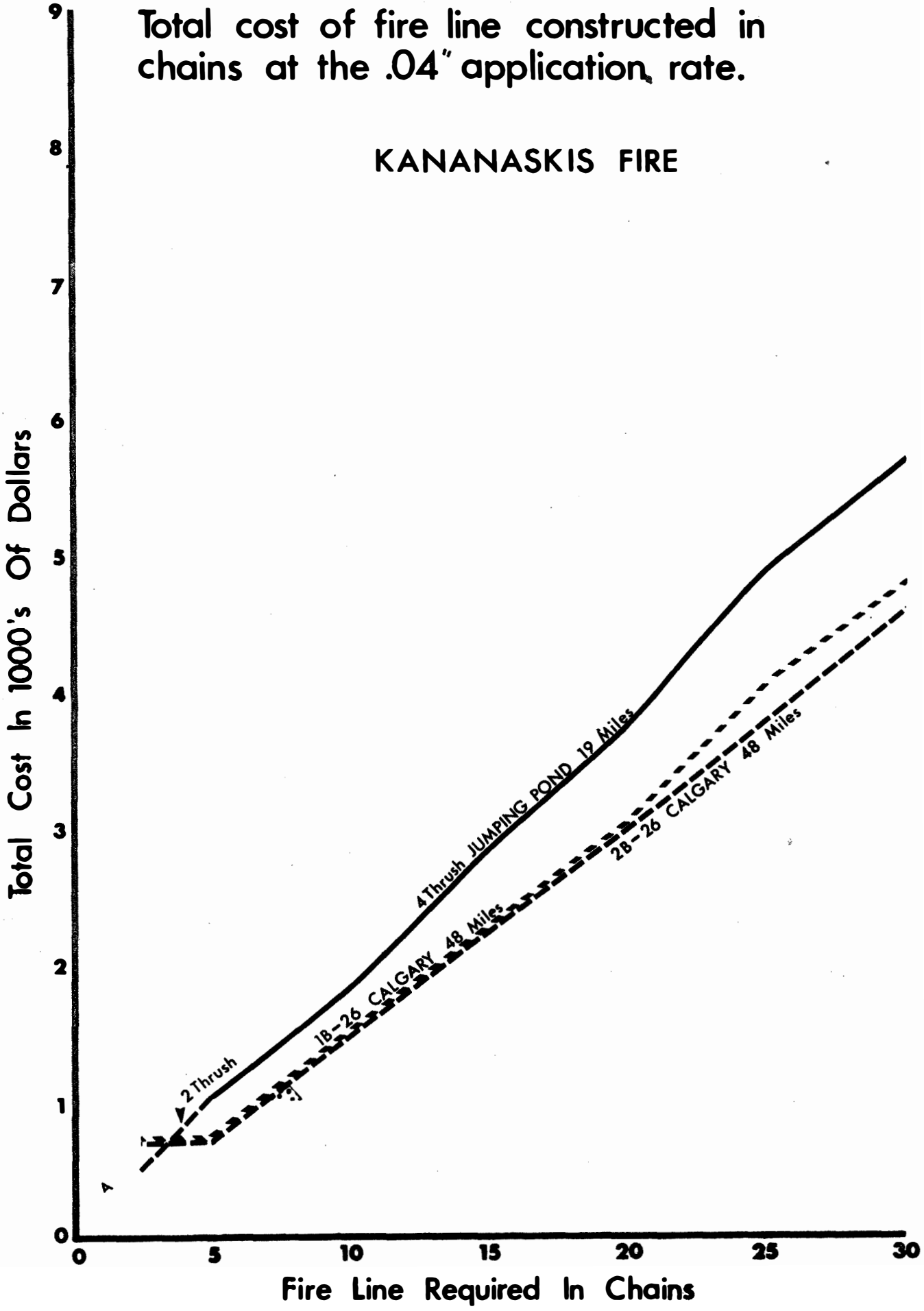

Figure 15

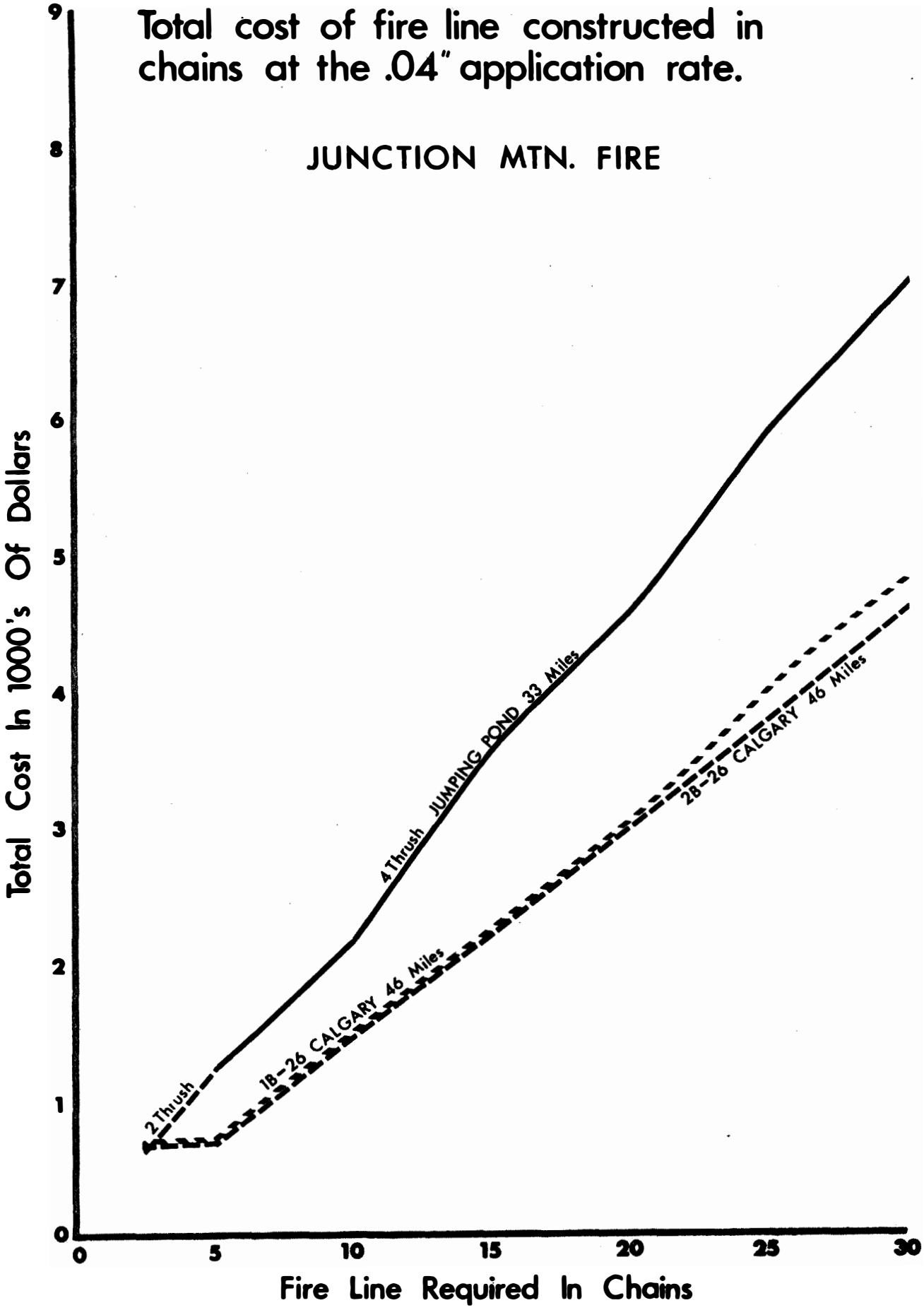
Total cost of fire line constructed in chains at the .04" application rate.
JUNCTION MTN. FIRE
Total Cost In 1000's Of Dollars
Fire Line Required In Chains
0
1
2
3
4
5
6
7
8
9
0
5
10
15
20
25
30
2 Thrush
4 Thrush JUMPING POND 33 Miles
1B-26 CALGARY 46 Miles
2B-26 CALGARY 46 Miles

Figure 16

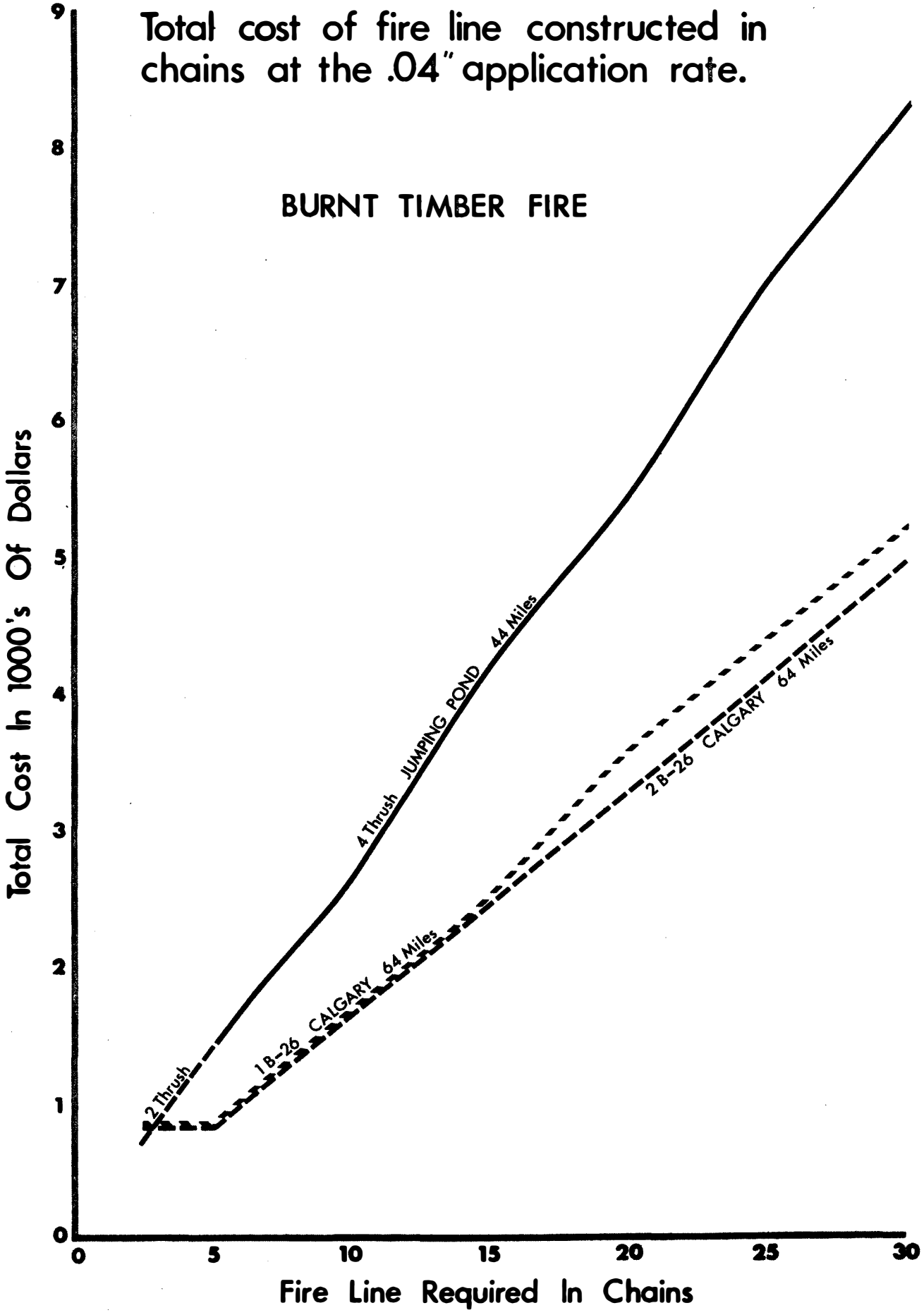
Total cost of fire line constructed in chains at the .04" application rate.
BURNT TIMBER FIRE
Total Cost In 1000's Of Dollars
Fire Line Required In Chains
0
1
2
3
4
5
6
7
8
9
0
5
10
15
20
25
30
4 Thrush JUMPING POND 44 Miles
2 Thrush
1B-26 CALGARY 64 Miles
2B-26 CALGARY 64 Miles

Figure 17

TABLE 6

Relative Cost Per Foot of Fire-Line Required Using One B-26
Operating from Calgary as Unit Factor

Case II

Fire Location and Distance (miles)		Retardant Base	Number of Airtankers	Fire-Line Length (chains) 2.5	5.0	10.0	15.0	20.0	25.0	30.0
KANANASKIS	48	Calgary	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			2	-	-	1.0	1.0	1.0	0.9	1.0
	19	Jumping Pound	4	(0.7)*	1.4	1.2	1.2	1.2	1.2	1.2
JUNCTION MOUNTAIN	46	Calgary	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			2	-	-	1.0	1.0	1.0	0.9	0.9
	33	Jumping Pound	4	(0.8)	1.6	1.4	1.6	1.5	1.5	1.4
BURNT TIMBER	64	Calgary	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			2	-	-	1.0	1.0	0.9	0.9	1.0
	44	Jumping Pound	4	(0.8)	1.7	1.6	1.7	1.5	1.6	1.6

* ( ) Two Thrush only

Calgary: B-26; Jumping Pound: Thrush

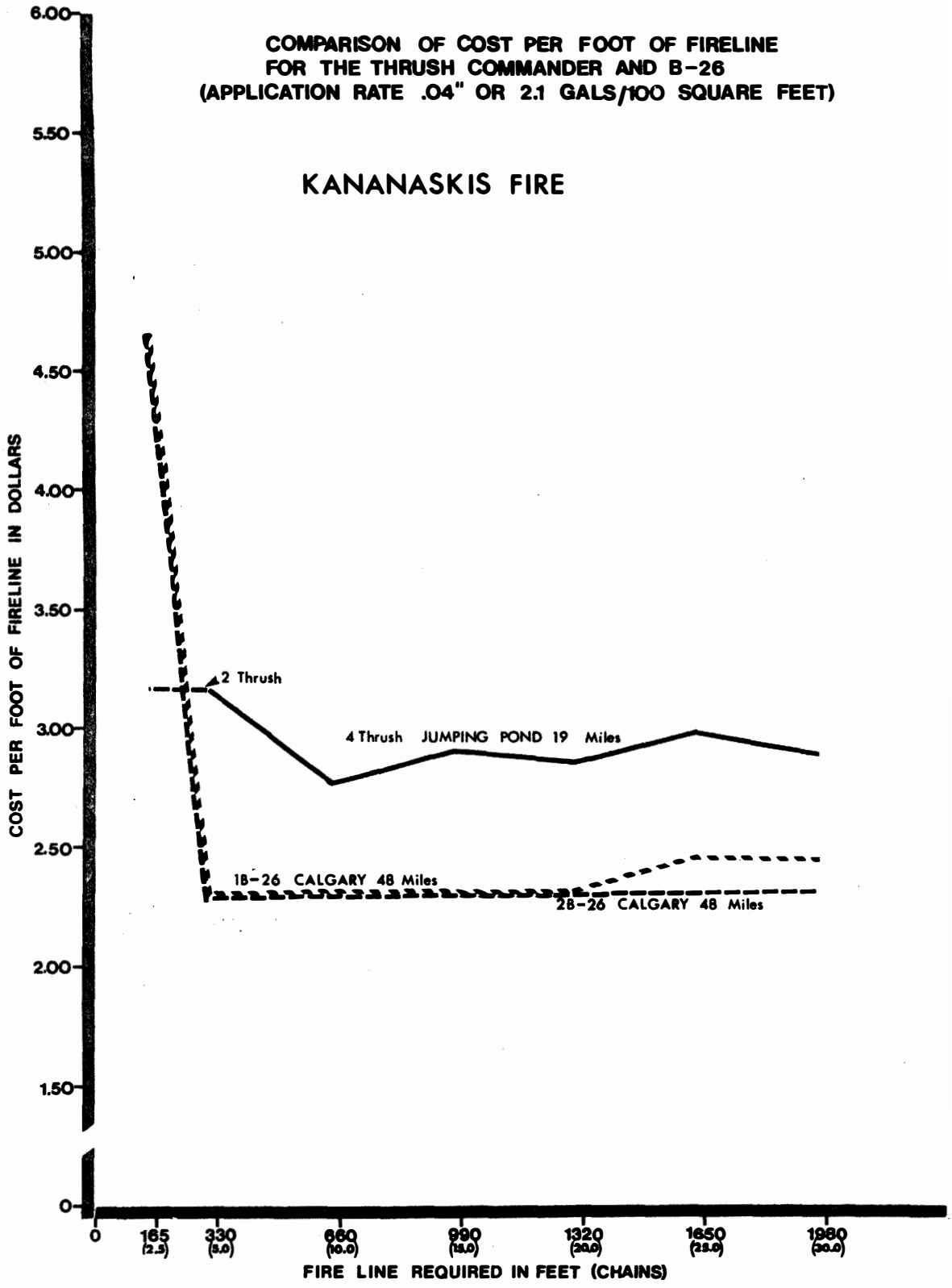
COMPARISON OF COST PER FOOT OF FIRELINE
FOR THE THRUSH COMMANDER AND B-26
(APPLICATION RATE .04" OR 2.1 GALS/100 SQUARE FEET)
KANANASKIS FIRE
COST PER FOOT OF FIRELINE IN DOLLARS
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
0
2 Thrush
4 Thrush JUMPING POND 19 Miles
1B-26 CALGARY 48 Miles
2B-26 CALGARY 48 Miles
0
165 (2.5)
330 (5.0)
660 (10.0)
990 (15.0)
1320 (20.0)
1650 (25.0)
1980 (30.0)
FIRE LINE REQUIRED IN FEET (CHAINS)

Figure 18

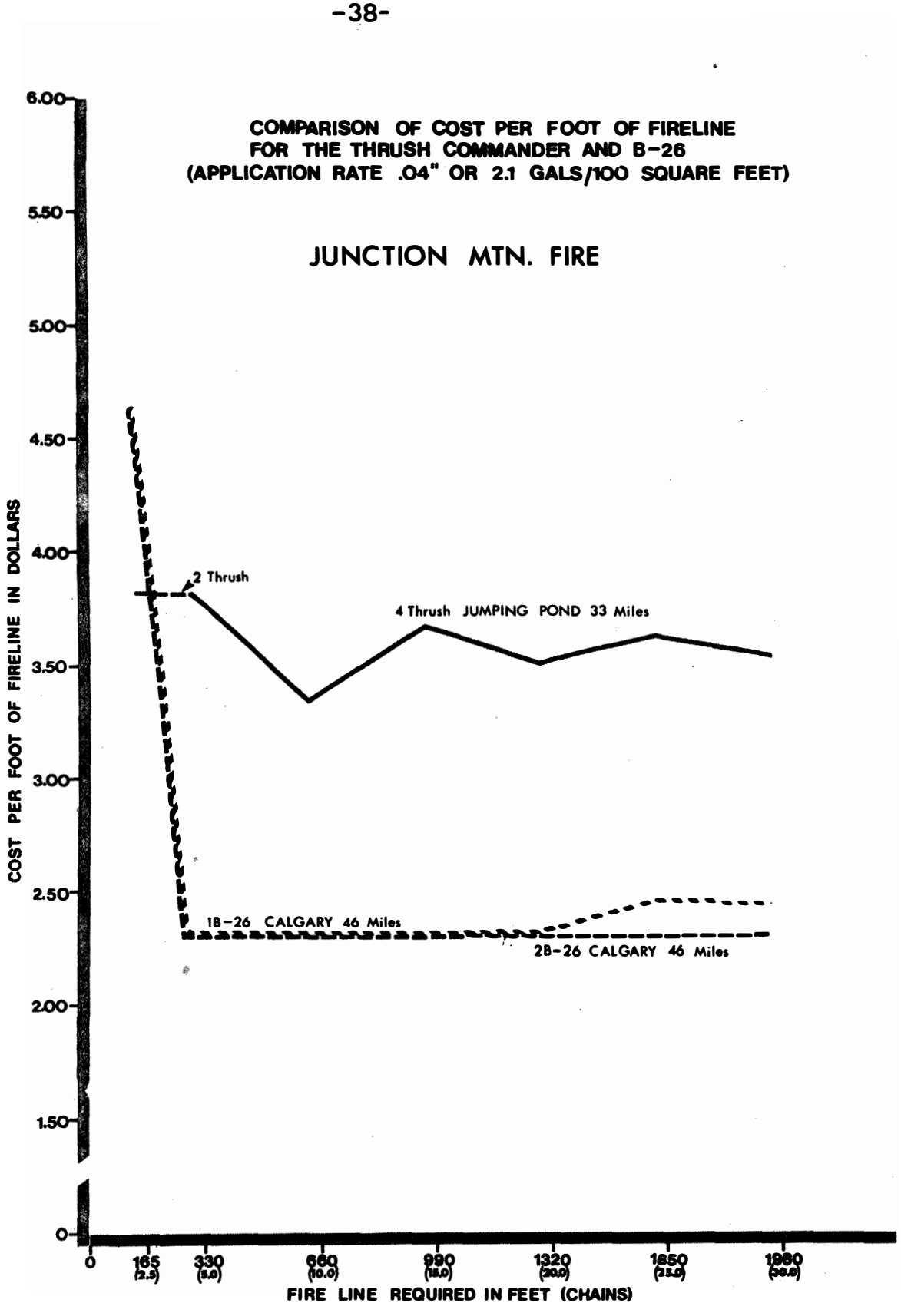
COMPARISON OF COST PER FOOT OF FIRELINE
FOR THE THRUSH COMMANDER AND B-26
(APPLICATION RATE .04" OR 2.1 GALS/100 SQUARE FEET)
JUNCTION MTN. FIRE
COST PER FOOT OF FIRELINE IN DOLLARS
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
0
2 Thrush
4 Thrush JUMPING POND 33 Miles
1B-26 CALGARY 46 Miles
2B-26 CALGARY 46 Miles
0
165 (2.5)
330 (5.0)
660 (10.0)
990 (15.0)
1320 (20.0)
1650 (25.0)
1980 (30.0)
FIRE LINE REQUIRED IN FEET (CHAINS)

Figure 19

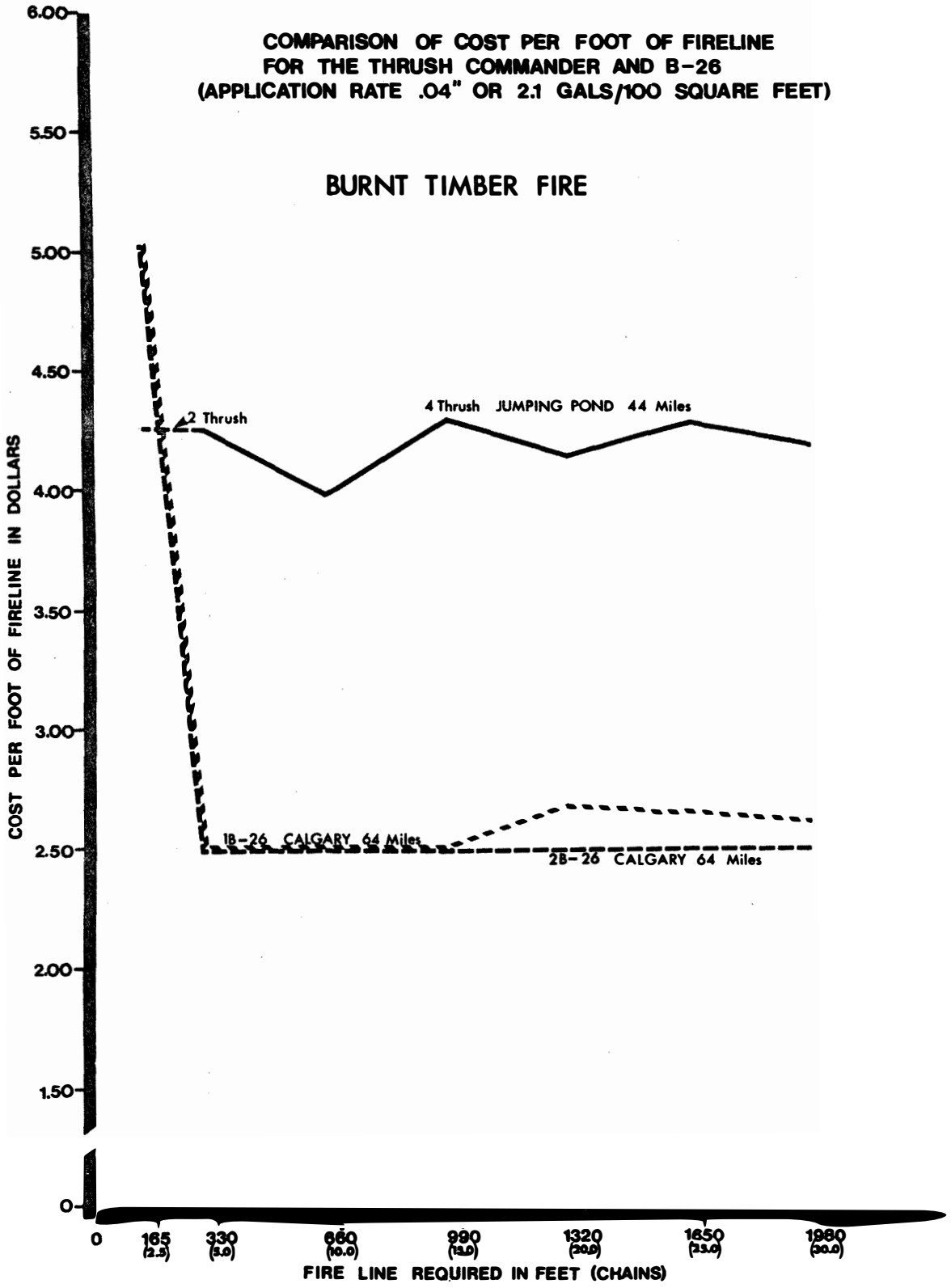
COMPARISON OF COST PER FOOT OF FIRELINE
FOR THE THRUSH COMMANDER AND B-26
(APPLICATION RATE .04" OR 2.1 GALS/100 SQUARE FEET)
BURNT TIMBER FIRE
COST PER FOOT OF FIRELINE IN DOLLARS
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
0
2 Thrush
4 Thrush JUMPING POND 44 Miles
1B-26 CALGARY 64 Miles
2B-26 CALGARY 64 Miles
0
165 (2.5)
330 (5.0)
660 (10.0)
990 (15.0)
1320 (20.0)
1650 (25.0)
1980 (30.0)
FIRE LINE REQUIRED IN FEET (CHAINS)

Figure 20

TABLE 7

Total Time to Complete Fire Operation (hours)
Per Unit Airtanker

Fire Location and Distance (miles)		Retardant Base	Number of Airtankers	Fire-Line Length (chains) 2.5	5.0	10.0	15.0	20.0	25.0	30.0
KANANASKIS	48	Calgary	1	0.7	0.7	1.3	2.0	2.7	3.8	4.5
			2	-	-	0.7	1.0	1.3	1.7	2.0
	19	Jumping Pound	4	(0.5)*	0.5	0.8	1.3	1.8	2.4	2.8
JUNCTION MOUNTAIN	46	Calgary	1	0.6	0.6	1.3	2.0	2.6	3.8	4.4
			2	-	-	0.6	1.0	1.3	1.6	2.0
	33	Jumping Pound	4	(0.7)	0.7	1.3	2.2	2.8	3.6	4.3
BURNT TIMBER	64	Calgary	1	0.8	0.8	1.6	2.4	3.7	4.5	5.3
			2	-	-	0.8	1.2	1.6	2.0	2.4
	33	Jumping Pound	4	(0.9)	0.9	1.8	2.9	3.8	4.9	5.8

* ( ) Two Thrush only

Calgary: B-26; Jumping Pound: Thrush

DISCUSSION OF RESULTS

The study shows that two and sometimes one B-26 airtankers operating from either Lethbridge (and Claresholm) or Calgary are as effective as a group of four Thrush airtankers operating from either Cowley or Jumping Pound respectively. The advantage of using two rather than one B-26 is very evident.

The operational data used in this study somewhat favor the Thrush airtanker for several reasons. The length of fire-line constructed per Thrush drop (95 feet at the .04-inch application rate) is based on a 310-gallon retardant load, while the normal operational load is 250 gallons or less in the mountainous terrain encountered in the study area.[4] Thus, the actual fire-line built by the Thrush in reality is less than that used in this study. The use of a reduced fire-line length would further improve the performance of the B-26 when compared to the Thrush.

A straight-line distance is assumed between the retardant base and the fire, when in fact the Thrush must follow the valleys and meander its way to several of the fire locations. This increases the time required to get to the fire. The B-26, on the other hand, has climbed to a cruising altitude in most instances and uses a descent approach to the exact fire locations.

Although a full B-26 load was always dropped onto a fire

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[4] It should be noted that a 450-gallon retardant drop from the B-26 produces 180 feet of fire-line at the .04-inch application rate while a 310-gallon load from the Thrush produces only 95 feet; or the B-26 builds slightly less than twice the length of fire-line with only 1.5 times the retardant.

using two separate drops, operational use sometimes precludes this and the remaining half-load is released onto another fire or otherwise dispensed. This, of course, also applies to the Thrush group but the versatility of the B-26 with its four interconnecting tanks should not be overlooked. One B-26 retardant load is in effect comparable in volume to the combined load of the Thrush group.

The results of this study indicate that serious consideration should be given to the replacement of the Thrush airtanker group in southern Alberta by one or preferably two B-26 airtankers. The high operating speed of the B-26 allows the airtanker to be easily transferred from base to base and, in conjunction with the remaining airtanker fleet, provide a better coverage of the forested area in Alberta.

REFERENCES

Grigel, J.E. 1971. The B-26 Airtanker. In Forestry Report Vol. 1, No. 1, Canadian Forestry Service, Prairies Region, March, 1971.

_____1971. Air drop tests with Fire-Trol 100 and Phos-Chek 205 fire retardants. Dept. of the Environment, Canadian Forestry Service, Northern Forest Research Centre. Inform. Rep. NOR - X - 8, 41 p., illus.