COST OF AIRCRAFT USED

FOR

TRAFFIC LAW ENFORCEMENT

BY

THE STATE POLICE OF ILLINOIS

ILLINOIS DEPARTMENT OF LAW ENFORCEMENT
DIVISION OF ADMINISTRATION

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May, 1980

ACKNOWLEDGEMENTS

The data presented in this report were collected by members of the Field Operations and Staff Services Commands of the Division of State Police, Illinois Department of Law Enforcement. Sources of the data included the Traffic Information Planning System (TIPS) maintained by the Bureau of Data Processing, Bureau of Personnel, and Bureau of Logistics, all reporting to the Division of Administration, Illinois Department of Law Enforcement.

Questions concerning this paper should be directed to the authors. They assume full responsibility for the validity of the information presented.

TABLE OF CONTENTS

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SUMMARY AND PURPOSE

The costs of traffic law enforcement aided by aircraft are not substantially different from those costs incurred when aircraft are not used. This comparability arises because the personnel in the airplanes can patrol more distance and can initiate more activity than police officers in squad cars. Further, the equivalence is valid regardless of whether the aircraft are used for line patrol or are flown at fixed locations above the ground for enforcement of the speed limit.

The fully allocated costs of operating an airplane by the Illinois Department of Law Enforcement, Division of State Police (ISP), based on costs recorded from November 1, 1978, through October 31, 1979, were $137.32 per hour. These costs reflect 4960.6 hours of flight in law enforcement related activity. The money spent on salaries, fuel, maintenance, hangers, offices, and depreciation was included in these costs. Only those hours flown in activities directly related to law enforcement were used for the hourly computation. (The hours spent for training, maintenance, and meetings were excluded on the basis that these hours are unavoidable when aircraft are used.) Further, because more than 80 per cent of the operating costs were fixed, substantial increases in the hours flown would have significantly lowered the hourly operating costs.

To these hourly costs were added the costs of ground personnel completing activity initiated by the pilots. Because the officer on the ground must assist the pilots in making the traffic stop, serving a disabled vehicle, or attending to an accident, the cost of the officer must be included. The costs of court appearances also were added.

These costs of assistance were divided into two categories dependent upon the function of the airplanes. When the aircraft are operated on line patrol, the officers on the ground are called by the pilots to handle each activity as detected. When finished, that officer returns to his normal patrol. The costs for assistance to line patrol have amounted to $7.80 per action (which included subsequent appearances in court). On the other hand, when the airplane is used for detecting speeders, the officers on the ground are assigned for a given period. Their hourly costs have amounted to $14.13. Court costs have not been included in the hourly costs because they are based on actions and the number of actions per hour can vary. The court costs estimated for this report were $0.30 per action.

On a comparable basis to the aircraft in line patrol, the officer on the ground (including the vehicle) conducting line patrol costs $28.20 per hour. An additional cost of $1.61 occurred with each action taken. This latter amount was derived from the costs incurred by attendance in court, times the percentage of actions that were challenged in court. While the hourly costs of operating the airplane in line patrol were approximately five times higher than the cost of an officer on the same patrol, the pilots in the airplane covered more than 3.5 times the distance of those on the ground. Including the costs of

actions the cost per mile of patrol was approximately $0.80 regardless of whether the patrol was performed in an airplane or on the ground.

The equivalent to the airspeed check, the other mode of aerial operation, is the radar operator with chase cars. The cost for the operator and chase car was $29.26 per hour. Each additional chase car was $14.13 per hour. Court costs for each stop made was $2.96. The airplane was, at the time of this report, not competitive with the ground operation. The cost per stop was higher. However, these higher costs occurred because the airplanes were flown fewer hours than available and because the support from the ground was less productive than expected. Increases in both categories would make the airplane operating in an air-speed check competitive to the radar and chase car operation.

The costs of the trooper on the ground patrol have been included because the airplane must be supported. The pilots detect the speeder and motorists who need assistance. It remains the role of the ground personnel to make the stop or give assistance. Any comparison of the activity to that on the ground without aircraft assistance and subsequent cost-benefit analysis requires the inclusion of the ground personnel costs.

This paper is divided into four sections. The first is devoted to the review of airplanes used in traffic law enforcement, including their costs. The second section presents the calculation of the costs in Illinois, including the assumptions used for the computations. A comparison between air and ground costs is shown in the third section, and the final section presents recommendations for improving the cost-effectiveness of the airplanes.

USE OF AIRPLANES IN TRAFFIC LAW ENFORCEMENT

The Illinois State Police have operated fixed-wing aircraft, primarily for the enforcement of the speed limit, since 1959. The airplanes have also been used for manhunts, surveillance, and relay of emergency medical supplies. This parallels that use of both fixed-wing aircraft and helicopters by other state and local agencies. Numerous reports and articles on the benefits of aerial patrol have appeared over the years. Most of these have appeared in journals and did not include adequate analyses of costs. A few reports have attempted to show the costs of airplanes or helicopters. For airplanes, the costs so calculated have ranged between $7.00 and $43.76 per hours.[1] The helicopter costs have ranged from $23.01 to $119.64 per hour.[2] All the referenced material showed costs computed before 1973. In none of the referenced reports were fully allocated costs computed. Generally, the expenses of pilots and ground support were omitted.

Fixed-wing aircraft, rather than helicopters, have been used in Illinois because they cover long distances rapidly. The state has an area of 56,200 square miles. Also, fixed-wing aircraft are cheaper to operate and maintain. Certain jurisdictions such as Los Angeles County[3] and Washington, D.C.[4], both

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[1] See reports by Kidder and Guthrie (Bibliography).

[2] See reports by Kidder, Bennett, Guthrie, Caroll, and the Washington, D C. Police Department (Bibliography).

[3] Beall, J. R. and Downing, R. E., Helicopter Utilization in Municipal Law Enforcement, Charles C. Thomas, Springfield, Illinois, 1972.

[4] Crime Reduction Through Aerial Patrol, Metropolitan Police Department, Washington, D.C., 1973.

more urbanized, have found the helicopter more advantageous, generally because of mobility. These advantages have outweighed their higher operating costs and lower reliability.

The Illinois State Police have used Cessna aircraft. Their tricycle landing gear, high-wings (improved visibility of the ground), and relatively wide range between slowest and fastest speed have generally given them an edge over other makes. The fleet currently consists of seven Cessna Model 182 (single engine) and one Model 310 (twin engine) aircraft. The latter is used solely for executive transportation throughout the state. Six of the seven single-engine aircraft were in operation prior to November 1979. Because the seventh was not placed into service until after that date, all costs and computations shown in this report will be based on six airplanes.

Until 1976, the airplanes were used in "area patrol". In this mode, the airplanes are assigned to sections of the state where the pilots assist State Police District Commanders with manhunts, surveillance, and emergency services in their respective areas. Their primary function, however, is "air-speed checks". These checks are similar to an operation with radar and chase car, except that the pilots circle 2000 to 3000 feet above a zone marked by painted lines on the highway perpendicular to the lanes of travel. Using electronic stopwatches, the pilot-observer times the vehicles through the zone and contacts the chase cars on the ground to make the stops. Because the length of the zones are known, these times are readily converted to speeds.[5]

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[5] The zones are 660 ft. long. Even an error of 1/10 of a second in activating the stopwatch will only result in a deviation of one mile per hour (at 60 mph.) from the true speed. Partly because of this mechanical accuracy and because generally higher speeds are clocked, approximately 80% fewer citations have been contested in the courts than as a result of more traditional methods.

Starting in 1976, the National Highway Traffic Safety Administration (NHTSA), through the Illinois Department of Transportation, Division of Traffic Safety (DTS), made available grants to purchase and operate aircraft for "line patrol" along Interstate Highways.

This method of augmenting patrol of these highways was undertaken because aircraft could patrol longer segments than troopers in squad cars. With approximately 2,300 miles of controlled access highway, most of which is rural, adequate patrol by ground personnel would require for more sworn officers than currently authorized. A detailed discussion of the rationale and recommended methodology for this patrol were described by Cunningham in 1976 prior to authorization of the first grant.[6]

This first grant paid for the purchase and operation of two airplanes (except salaries of the pilots which were paid fom the budget of the Division of State Police). These were assigned to a 320-mile segment of Illinois Interstate 57 running from Kankakee (near I-80 on the north) to Cairo at the southern border. Subsequent grants have enabled ISP to add a patrol to a segment of I-80 from west of Joliet (near I-55) to Moline, the western border, and to I-55 from I-80 near Joliet, to I-74, south of Bloomington. Costs of operating the first three airplanes are included in this report; the fourth airplane started operation in December 1979. Its costs are not included.

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[6]Cunningham, C.L., Assessment of the Illinois State Police Concept of Aerial Patrol of Interstate Highways, Illinois Department of Transportation, Divison of Traffic Safety, Springfield, Illinois, March 1976.

As an integral part of this grant, DTS is scheduled to evaluate the effectiveness of these patrols of the Interstate Highways in terms of improved traffic safety. This evaluation should also include an analysis of the cost effectiveness in terms of traffic safety.[7] A preliminary evaluation was released in May 1979, and a more comprehensive report is expected in 1980.[8] The initial findings suggest that the airplanes that have been used for patrol of the Interstate Highways have contributed to a decrease in accidents along the patrolled segments.

ESTIMATION OF COSTS

Criteria Used for Estimations

The costs used for this report are derived, where possible, from those costs incurred for a period November 1978, through October 1979. Only the costs for six of the seven single-engine airplanes are included; the seventh was placed in service December 1979. An important cost of operating the airplanes is the cost of support by the troopers on the ground. Without these personnel, the pilots of the airplanes would not be able to enforce traffic laws or assist motorists in disabled vehicles. The costs for the aircraft are derived

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[7] Raub, R.A., Interstate Aerial Patrol, Illinois State Police, Evaluation Plan, Illinois Department of Transportation, Division of Traffic Safety, Springfield, Illinois, December 1977.

[8] Madonia, P.P. and Raub, R.A., Interstate Aerial Patrol, Illinois State Police, Interim Evaluation, Illinois Department of Transportation, Division of Traffic Safety, Springfield, Illinois, May 1979.

from records maintained by the Air Operations Section of the Division of State Police. Costs for ground personnel as well as their activity were derived from the Traffic Information Planning System (TIPS - a computerized accounting of activity) and the Bureaus of Logistics and Personnel of the Division of Administration.

Assumptions for Aircraft Costs

There were six assumptions used for gathering the data and calculating the costs of the airplanes:

1. All single-engine airplanes have the same cost of operation for fuel, oil, insurance, and maintenance.

2. One hour of flight is equal to one hour on the tachometer.

3. Depreciation is straight-line and is equal to the purchase price less the value at trade (based on the historic ratio of traded value to purchase price) divided by 3.5 years of service (the estimated life of the airplanes at current usage.

4. All costs are calculated on an annual basis. The hourly cost is found by dividing annual cost by the hours flown in those activities traditionally associated with law enforcement.[9] The costs of flight proficiency, meetings, and maintenance are included in the annual costs, but the hours flown as part of these activities are not included in the time used to calculate hourly costs. (The reason for excluding these hours from the division is that the hours must be flown if the planes are to be operated for any form of patrol.)

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[9]Patrol, surveillance, speed checks, relay of emergency supplies, photography, and assistance at disasters.

5. Three of the six aircraft are used for area patrol, the other three for line patrol. Because the hours of flight for each function are slightly different, the costs for each function are also slightly different.

6. Those costs incurred in support of the twin-engine air-craft were eliminated. The following costs were decreased by the amount associated with the twin-engine airplane:

    Office Space at Capitol Airport - 50%
    Insurance - 33%
    Charts and Aircraft Use Tax - 20%

Assumptions for Costs of Ground Personnel

In addition to the calculation of costs for the airplanes, calculations of the costs of ground personnel were made. These are used for two purposes. When the aircraft are supported, such as in a traffic stop, the costs of the ground personnel are part of the costs of aerial patrol. The costs of the ground operation, such as line patrol, also are compared to the costs of a similar operation from the air. The assumptions used include:

1. Time and mileage associated with the activity do not include the time and mileage for appearances in court, these are computed on a "per action" basis.

2. Costs for only four activities are relevant: traffic enforcement, motorist assistance, traffic control, and assistance at accidents.

3. The hourly costs for a trooper are based on a ten-year salary plus ten percent benefits - $10.81 per hour.

4. Mileage costs are equal to the actual costs of operation, plus depreciation. A vehicle is assumed to cost $7,000. including scrap value and is driven 60,000 miles. The cost of operation used for this report is $0.255 per mile.

5. The time, mileage, and activities are an average from all State Police Districts and generally cover a period November 1978, through October 1979.

6. The time used for court appearances was estimated from the times recorded by troopers. Mileage was estimated, from the size of the counties served by troopers.

7. Based on a twelve-month summary of activity, the trooper spent 58 percent of his day on patrol (including enforcement, motorists assists, etc.). Patrol speed is assumed to be 50 mph.

Cost of the Airplane

The costs of operating the airplane for the period covered averaged $137.42 per hour - $140.62 for line patol and $134.41 for area patrol. The slight difference in costs of the aircraft used in line patrol and area patrol arose from several sources. First, there were differences in hours of operation between the two uses. Second, the cost of the pilots was divided evenly even though the flying hours were not. The methods used in the derivation of the costs, as well as the costs themselves, are discussed in the remainder of this section.

Table 1 contains a summary of flight hours. The aircraft used in area patrol have been flown slightly more hours than those used for line patrol. One possible reason for the difference is that the pilots who fly area patrol have more flexibility in selecting the locations for patrol; thus, they generally can more easily avoid bad weather.

The amounts used in the calculation of hourly operating costs are shown in Table 2. These cover a period November 1978 through October 1979. With the exception of periodic maintenance (VI), all costs were annualized. Periodic maintenance was calculated on an hourly basis. For the period covered, the major cost was salaries for the 18 pilots--$470,112. Other important costs included fuel--$65,920, depreciation --$47,747, and insurance--$13,233.

TABLE 1

HOURS OF OPERATIONS

Hours of Operation Include the Following Activities:

Speed Check
Surveillance
Photographic Detail
Traffic Control
Manhunt
Transportation
Line Patrol
Relay
Disaster Control

Not included is flying time allocated to: flight proficiency, court, traffic surveys, maintenance, and meetings.

HOURS

AIRCRAFT	LINE PATROL	AIRCRAFT	AREA PATROL
L-2	738.7	L-5	759.5
L-3	852.1	L-6	854.5
L-4	816.5	L-7	939.3
TOTAL	2407.3		2553.3

Proportion - Line Patrol to Total	0.4853	
Area Patrol to Total	0.5147	

TABLE 2

COSTS OF OPERATING AIRPLANES

(Six Cessna Model 182)

NOVEMBER 1978 THROUGH OCTOBER 1979

I. Depreciation

Number of Airplanes Traded 1975 - 1979

Original Costs $242,052

Traded Value $104,331

Ratio: Traded Value to Original Costs - 0.431

Estimated Life - 3.5 years

Current Aircraft - 6

Original Costs	$293,699
Expected Value at Trade	125,584
Depreciated Cost	$167,115

Cost Per Year

All Airplanes	$47,747
Per Airplane	$ 7,958

II. Gas and Oil

Total Annual Cost - $65,920

Distribution of Costs

Line Patrol (0.4853) - $31,991

Area Patrol (0.5247) - $33,929

III. Hangar and Office Rental (includes furnishings)

Line Patrol		Area Patrol	
L-2	$2580	L-5	$1980
L-3	2340	L-6*	2730
L-4	1740	L-7	2220
	$6660		$6930

*Office costs for L-6 are 50% of Office costs at Capitol Airport.

TABLE 2 (continued)

IV. Other Annual Costs

Maintenance (other than periodic)	$ 2,000	
Insurance*	13,223	
Federal Aircraft Tax	210	
Charts and Commodities	100	
Pilots physicals ($70 per pilot @ 18 pilots)	1,260	
Painting speed zones**	5,189	
Total		$ 21,982

Distribution of Costs

Line Patrol (0.4853)	$10,668	
Area Patrol (0.5147)	11,314	

*Total costs are adjusted by proportion of expenses allocated to twin-engine airplane.

**The painting of lines for speed-check zones annually is estimated at two man-weeks for each airplane.

V. Salaries

Pilots (18)		$470,112

Distribution

Line Patrol (0.5)	235,056	
Area Patrol (0.5)	235,056	

VI. Periodic Maintenance (per occurrence)

50-Hour	$ 84.49	
Per Tach Hour	1.69	
100-Hour	473.41	
Per Tach Hour	4.73	
Major Overhaul (1500 hours)	6,300.00	
Per Tach Hour	4.20	
Total Cost Per Tach Hour -		$ 10.62

Table 3 shows a summary of the costs, both annually and per hour of flying. For the ease of calculation, hours of flying were made equal to tachometer hours. Operationally, flying hours and tachometer hours are not an equivalence, but the differences in "per hour" costs are too small to warrant adjustment to tachometer hours. Because the costs of the pilots were evenly distributed between the two functions, even though the hours were not, the line patrol aircraft cost $6.21 per hour more to operate than the area patrol. The six aircraft combined cost $137.42 per hour. Of the costs shown, all except gas, oil, and periodic maintenance were considered fixed. Thus, 82.6 percent or $113.51 per hour were fixed costs.

Of the 4906.6 hours of flying, 4293.5 hours, 86.5 percent, were flown on patrol or speed checks. The remaining time was spent in other activity. For the line patrol, 88.7 percent, 2134.6 hours, were spent on patrol; for the area patrol, it was 2149.9 hours or 84.2 percent related to law enforcement. A summary of the time spent and services rendered by pilots of the airplanes is shown in Table 4. The majority of the activity initiated by each method of patrol, line and area, resulted in citations. Because the area patrol is devoted to speed checks and is assisted by one or more chase cars at a fixed location, the pilots of the area patrol have initiated 2.7 citations per hour more than the pilots in the line patrol aircraft.

Costs of Ground Support

-Support of Airplane

Finally, without the support of troopers on the ground, the airplanes could not be used effectively for traffic law enforcement and services to the

TABLE 3

SUMMARY OF COSTS

ON A PER-HOUR BASIS

	Line Patrol		Area Patrol		Total	
Flying Hours	2407.3		2553.3		4960.6	
Costs	Annual	Per Hour	Annual	Per Hour	Annual	Per Hour
Fixed						
Depreciation	$ 23,874	$ 9.92	$ 23,874	$ 9.35	$ 47,748	$ 9.63
Hangars & Office	6,600	2.77	6,930	2.71	13,590	2.74
Salaries						
Pilots	235,056	97.64	235.056	92.06	470,112	94.77
Secretary	4,688	1.95	4,972	1.95	9,660	1.95
Other Annual	10,668	4.43	11,314	4.43	21,982	4.43
Gas and Oil	31,991	13.28	33,929	13.29	65,920	13.28
Total	$312,937	$130.00	$316,075	$123.79	$629,012	$126,80
Periodic Maintenance		10.62		10.62		10.62
Total Per Hour		$140.62		$134.41		$137.42
Variable/Total Costs		0.170		0.178		0.174

TABLE 4

HOURS OF PATROL AND SERVICES RENDERED

	Hours Of Flight	Activity	Activity Per Hour
Line	2134.6	3184	1.5
Citations		207	0.1
Assists		2	0.0
Accidents		3393	1.6
Area	2149.9		
Citations		9107	4.2

motorists. In the current mode, the pilots operating airplanes in line patrol request assistance from a nearby ground unit when they detect a motorist who has violated a traffic law, who needs assistance, or who is involved in an accident. These troopers on the ground are not dedicated to the operation of the aircraft. For this reason, their costs are calculated based on each action taken. On the other hand, when the pilots establish a speed check, one or more troopers on the ground are dedicated to that operation. Their costs can be shown hourly.

A summary of the costs of ground support for the aerial operation are shown in Table 6. The costs are shown separately for the line patrol and area patrol (speed check) aircraft. Court costs have also been estimated (see Table 5) and are included in the calculation of the costs of ground patrol as well as operations. These court costs are an important part of the estimate. From ISP records, approximately two percent of the citations as a result of aerial operations have been brought to court; ten percent of those resulting from ground operations (five times the amount) have been brought to court.

-Ground Patrol

The hourly costs for the trooper are derived from salary and mileage. State Police records for the period January through October 1979, showed that the trooper spent 58 percent of the available eight hours on patrol (including enforcement). The remainder of the time was devoted to administrative,

TABLE 5

COURT COSTS

Court Appearance

(Ground Personnel Only)*

Driving (round trip)

Mileage - 20 Miles	$ 5.10
Time - 24 Minutes	4.32
Court - 30 Minutes	5.41
Total	$14.83

Cost Per Citations Issued

Aerial Patrol (2% of Citations)	$ 0.30
Ground Patrol (10% of Citations)	1.48

*The court costs for the pilots are included in the costs of the airplane. Segregation of those costs would not be meaningful.

TABLE 6

COST OF GROUND SUPPORT

FOR AERIAL SUPPORT

Line Patrol	
Driving to Assist Pilots (round trip)	
Mileage - 10 miles	$ 2.55
Time - 12 minutes	2.16
Completing Stop - 13.5 minutes	2.43
Total	$ 7.14
Court	.30
Total Cost Per Citation	$ 7.44
Average Additional Cost, All other Activities	.36
Total Cost Per Activity	$ 7.80
Area Patrol	
Driving to Location (round trip)	
Mileage - 20 miles	$ 5.10
Time - 24 minutes	4.32
Organizing Team - 3 minutes	.54
Total	$ 9.96
Cost Per Hour (based on three hours devoted to speed-check)	$14.13
Additional Court Costs Per Action	$ 0.30

court, meetings, etc. During the 4.64 hours devoted to patrol, the trooper drove, on the average, 174 miles. Table 7 shows a summary of the costs of ground patrol. The cost of line patrol was $28.20 per hour plus an additional $1.61 in court costs for each action (stop or assistance), When the troopers operated a stationary speed check with one radar operator and additional chase car, the cost was $28.26 per hour. Each additional chase car added $14.13 per hour. Court costs amounted to $2.96 for each citation written.

COMPARISON OF AERIAL AND GROUND SUPPORT

In making this comparison between the costs of operating airplanes and ground vehicles, two common bases have been used: cost per action and cost per mile. Both bases are applicable to the comparative analysis of line patrol costs. Cost per citation is used for the comparative analysis of speed checks (area patrol).

Line Patrol

In a line patrol function, as was shown in Table 4, the pilots in the airplane initiated 1.6 actions, including stops for traffic violations, each hour. Based on records of time kept by the State Police, the trooper in a squad car on line patrol initiated 0.9 actions, including stops for traffic violations, each hour. The costs of making these stops for both the aerial and ground mode are summarized in Table 8.

Although the pilots currently were initiating 90 percent more stops than

TABLE 7

COST OF GROUND PATROL

Trooper Salary	$10.81 per hour
Cost of the Squad Car	$0.255 per mile
Average Number	
Hours on Patrol	4.64 hours
Miles Driven	174 miles
Line Patrol - Cost Per Hour	
Salary	$ 18.64
Driving	9.56
Total	$ 28.20
Court Cost Per Citation	$ 1.48
Average Additional Court Costs for All Activities	.13
Court Cost Per Action	$ 1.61
Speed-Check (with radar and chase cars)	
Driving to Location Per Trooper (See Table 6)	$ 9.96
Operation (1 radar operator and 1 chase car, 3 hours)	64.86
Cost Per Hour	28.26
Cost Per Hour Each Additional Trooper	14.13
Court Cost Per Citation (Radar and Arresting Officer)	2.96

TABLE 8

COMPARISON OF AERIAL AND GROUND

LINE PATROL COSTS

(Current Level of Operation)

	Air	Ground
Cost Per Hour Operation	$140.62	$28.20
Average Number of Actions Per Hour		
Stops	1.5	0.8
All Actions	1.6	0.9
Additional Costs Per Action Including Court		
Stops	$ 7.44	$ 1.48
All Actions	7.80	1.61
Cost Per Hour		
Stops	$151.71	$29.34
All Actions	152.94	29.67
Cost Per Action		
Stops	$101.14	$36.60
All Actions	95.39	32.97
Miles Covered Per Period	557*	174**
Cost Per Mile Including All Actions	$ 0.806	$0.791

*Estimated at 120 mph., 4.64 hours of flight.

**Estimate based on TIPS data

were initiated by a trooper on the ground, the cost per stop remained higher. As shown in Figure 1, the airplane can never be competitive to a ground unit in line patrol if only the number of actions are used as the denominator. On the other hand, the airplane is competitive with ground patrol in terms of cost per mile. Moreover, the pilots in the airplane not only can cover a greater length of highway, but, because of their superior vantage point, can observe an area of approximately 7,800 square miles. This is many times the estimated 90 square miles that can be observed by a ground officer during patrol.

An argument that could be introduced is that an increase in the productivity of the ground trooper would create a wider gap between the costs per action. It would make the airplane even more costly to operate regardless of the measure. However, this argument is not valid. The aircraft also have not been flown to an extent expected. From November 1978 to October 1979, the airplanes on the average were flown 800 hours. Based on an average of 12 hours of daylight, the airplanes operated at 20 percent of the maximum available time. Even if weather, maintenance, court, vacations, and other restrictions were taken into account, 1500 hours of flying would have been a reasonable estimate of available hours. Because 82.6 percent of the costs of operating the aircraft were fixed, each increase of 100 hours of operation would have reduced the operating cost per hour by approximately nine percent. Table 9 contains a brief summary of the costs dependent upon the number of hours flown and stops initiated each hour. It is possible to closely match the cost per stop of ground line patrol by a substantial increase in both the number of hours flown and number of stops per hour.

FIGURE I

COMPARISON OF COSTS FOR LINE PATROL

AERIAL AND GROUND

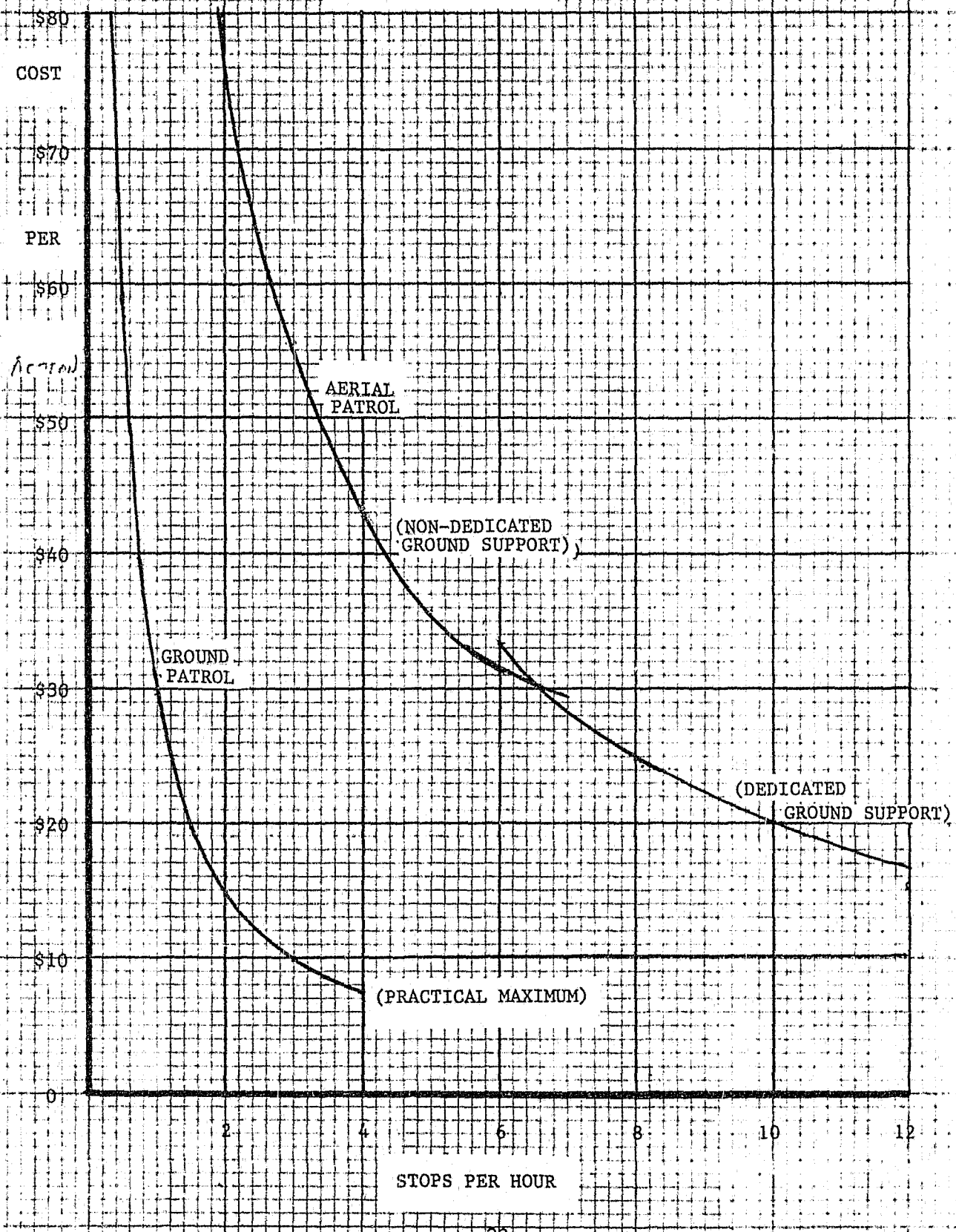

TABLE 9

COST PER HOUR OF OPERATION

OF AIRPLANE IN LINE PATROL

Number Of Hours Of Patrol	Stops Per Hour 1.0	2.0	3.0	6.0
600	$187.40	$194.90	$202.30	$224.60
800	148.40	155.80	163.30	185.60
1000	125.00	132.40	139.90	162.20
1200	109.40	116.80	124.30	146.60
1500	93.00	101.20	108.70	131.00
2000	78.20	85.60	93.00	115.40

Note: To find the cost per stop, divide the cost per hour by stops per hour, e.g., at 1200 hours and 3.0 stops per hour, the cost per stop would be $41.43.

Area Patrol

As shown in Table 10, the cost for each stop initiated by the pilots in a speed check was approximately twice the cost of radar with a chase car. This varied from $20.13 with two cars assisting to $17.34 with four cars. The problem encountered in preparing a cost comparison for the airspeed check was the substantial loss in productivity when more than two cars assisted Based on records kept by the Air Operations Section of the Division of State Police, activity decreased 27 percent with three cars assisting and 34 percent with four cars assisting. The reasons for the decreases were not clear, but may have been related to a need for greater supervision. While the airspeed check was more costly than an equivalent operation on the ground, there were two elements in its favor:

- The likelihood of the trooper appearing in court is lower. This means that the costs of driving to court for two men (radar operator and arresting officer) are not incurred.

- The probability of detection of the operation and lessened productivity as a result is virtually eliminated. The airplane, which can operate at a relatively high altitude several miles from the chase vehicles is not likely to be detected.

As was the case with the aircraft used in line patrol, increased hours of operation of the area patrol would have reduced its costs. The costs of area patrol estimated in this report were based on an average of 851 hours of flight per airplane. If the number of hours of operation had been increased by a

TABLE 10

COMPARISON OF ESTIMATED COSTS FOR SPEED CHECKS

(Area Patrol Aircraft)

Cost Basis

Airplane:		Ground Radar:	
Cost Per Hour	$134.41	Two-Man Team Per Hour	$28.26
Cost Per Supporting Trooper	14.13	Cost Per Additional Trooper	14.13
Additional Cost Per Stop	0.29	Additional Cost Per Stop	2.96*

	Number Of Chase Cars		
Aircraft Speed Check	2	3	4
Stops Per Hour Per Trooper	4.1	3.0	2.8
Cost Per Hour	$162.67	$176.80	$190.93
Additional Costs	2.38	2.61	3.25
Total Cost	$165.05	$179.41	$194.18
Cost Per Stop	$ 20.13	$ 19.93	$ 17.34
Radar and Chase			
Stops Per Hour Per Trooper**	3.0	2.6	2.3
Cost Per Hour	$ 42.39	$ 56.52	$ 70.65
Additional Costs	17.76	23.09	27.23
Total Cost	$ 60.15	$ 79.61	$ 97.88
Cost Per Stop	$ 10.03	$ 10.21	$ 10.64

*The radar operator also attends court.

**Stops per trooper for radar speed checks are estimates based on observed operations.

NOTE: There was a 34 percent decrease in productivity when four chase cars, instead of two, were supporting the airplane speed check. A 25 percent decrease in productivity has been assumed for the radar speed check.

factor of two, the cost per stop, using two chase cars, would have decreased 33 percent from $20.13 to $13.39. This would have made the airplane competitive with an operation on the ground.

CONCLUSIONS AND RECOMMENDATIONS

The airplane is an expensive tool for use in law enforcement. These expenses arise because of high fixed costs, particularly for pilots and depreciation. However, this report has shown that on a "per-mile" basis, the airplane used in line patrol is no more expensive than equivalent patrol on the ground. It is superior in terms of area patrolled. On the other hand, as currently used by the Illinois State Police, the airplanes have not proven cost-effective in terms of costs incurred for activity rendered. This has arisen primarily because the aircraft have not been used to their fullest capabilities.

1. The aircraft are being operated 800 hours per year when substantially more hours could be flown. At a 50 percent increase in hours flown, the fully allocated costs would have decreased approximately 25 percent.

2. The costs per action of the line patrol can be reduced by increasing both the number of stops for traffic violations and the number of motorists assists each hour. This increase may require dedicated patrol to certain segments of the Interstate Highways. It does require a greater availability of supporting ground personnel, therefore, greater administrative and supervisory control of the assisting personnel on the ground.

3. The airspeed operation can be more productive. Currently, two chase cars may be handling the maximum number of stops possible per trooper (4.1) per hour, but the activity decreases rapidly as the number of chase cars are increased. Again, improved supervisory control appears to be the solution. In the air speed mode, the supervisor would be responsible for pulling the vehicles, and

obtaining the driver's documents. He would turn over the information to a trooper who would complete the citation. An increase in productivity with four cars from 2.7 stops per hour to 4.0 stops per hour would decrease the cost per stop by 30 percent.

Because airplanes are an important tool for law enforcement in such areas as manhunts, surveillance, photography, and for relays in emergencies, they should be part of a state police operation. They can also be used in conjunction with traffic enforcement at a cost similar to that of traditional ground methods. Thus, the cost of maintaining aircraft for the specialty functions can easily be offset by the continuous use in daily traffic operations.

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APPENDIX A

DATA USED FOR CALCULATIONS

TABLE A1

DATA USED FOR CALCULATIONS

AIR OPERATIONS (Source: Division of State Police, Air Operations Section)
November 1978 - October 1979

Line Patrol

Arrests	3184
Warnings	68
Assists	207
Hours of Patrol	1804.5

Area Patrol

Arrests	8821
Hours of Patrol	2099.2

Total Hours of Flight

Line	2531.3
Area	2836.6

Contested Arrests	262

TABLE A2

DISTRIBUTION OF STOPS PER CHASE CAR

AUGUST TO OCTOBER 1979

Number Of Assisting Squads	Stops Per Hour Per Squad										
	0.0 0.9	1.0 1.4	1.5 1.9	2.0 2.4	2.5 2.9	3.0 3.4	3.5 3.9	4.0 4.4	4.5 4.9	5.0 5.4	5.5 +
2	-	-	-	1	4	7	12	8	4	1	5
3	-	2	5	9	18	11	3	7	5	-	-
4	-	1	8	12	13	11	7	-	-	-	-
5	1	1	1	4	4	-	-	-	-	-	-

AVERAGE NUMBER OF STOPS PER HOUR PER SQUAD

Assisting Squads	Per Hour	Average Per Squad
2	8.2	4.1
3	9.0	3.0
4	10.8	2.7
5	11.0	2.2

TABLE A-3

DIVISION OF STATE POLICE

GROUND ACTIVITY

(DISTRICTS 1 THRU 16, EXCLUDING 15*)

Twelve Month Summary (Source: Manpower Tabulations)

Line Patrol - 779,100 hours

Stops - 598,700 (Arrests - 313,600)

Stops Per Hour - 0.77

Other Activity - 106,400

Activity Per Hour - 0.91

Accidents - 80,900 Arrests - 21,050

All Other Enforcement - 252,300

Estimated Time In Court (Source: Estimate from Individual Troopers and Manpower Tabulations)

Total Hours - 64,050

Average County (Source: Illinois Bluebook)

Size - 551 Square Miles

Average District across - 23 miles

Driving estimated at 10 miles (approximately one-half the average distance across the county)

*District 15 is devoted only to patrol of the tollways.

END