THE EFFECT OF RAMP CONTROL AT THE MONTGOMERY AND UNIVERSITY ENTRANCE RAMPS ON WESTBOUND IH 30 IN FORT WORTH

STATE DEPARTMENT OF HIGHWAYS AND
PUBLIC TRANSPORTATION
FORT WORTH, TEXAS
FEBRUARY, 1977

TABLE OF CONTENTS

LIST OF FIGURES

THE EFFECT OF RAMP CONTROL AT THE MONTGOMERY AND UNIVERSITY ENTRANCE RAMPS ON WESTBOUND IH 30 IN FORT WORTH

INTRODUCTION

On October 1, 1975, the State Department of Highways and Public Transportation in Fort Worth began the control of traffic entering the westbound lanes of IH 30 (West Freeway) at the Montgomery and University entrance ramps during the afternoon peak period (Figure 1). Two different types of control were used at these locations. At the University entrance, ramp control was by means of ramp metering using a local traffic responsive controller (Figure 2). At Montgomery, ramp metering as well as ramp closure was used (Figures 3-5). The ramp closure was by means of a railroad gate with a 24' arm. Closure of the ramp normally lasts for 15-20 minutes.

PREVIOUS STUDIES

In 1973 a comprehensive study was made of traffic flow on the West Freeway during the afternoon peak period. As a result of this study, it was determined that the basic cause of congestion in this area was twofold. First, there is a decrease in capacity caused by the reduction from three through lanes to two. Secondly, immediately following this reduction, the demand is increased by the input from the University and Montgomery entrance ramps (Figure 6). The principal bottleneck was not the lane reduction, but the input from the University and Montgomery ramps. Congestion started at Montgomery and backed up approximately 1.8 miles on a daily basis. This congestion began at 4:30 p.m. and lasted one hour.

Closure of the Montgomery entrance ramp for the peak hour reduced the congestion but did not eliminate it. Closure of both the University and Montgomery entrance ramps virtually eliminated all congestion.

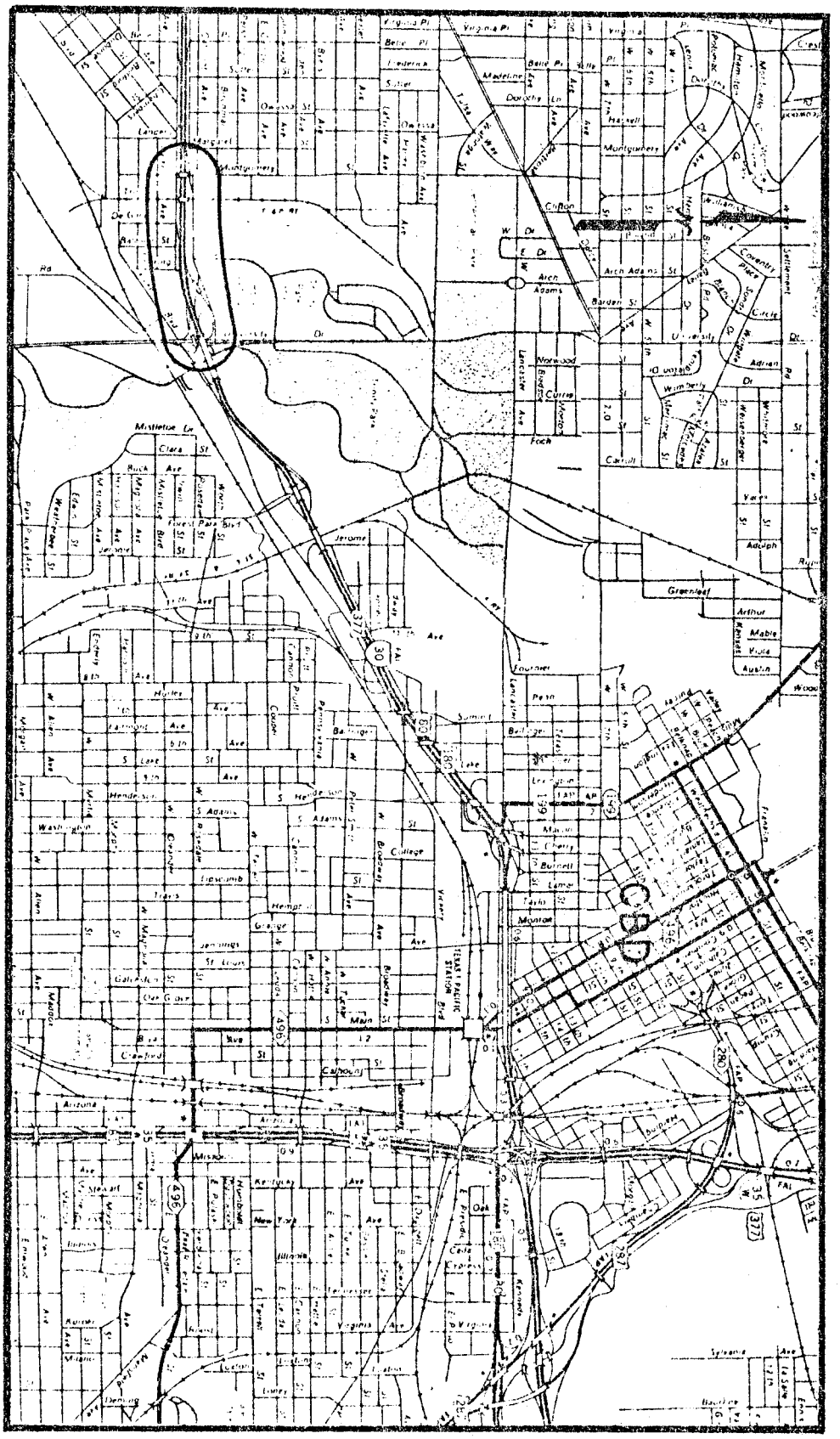
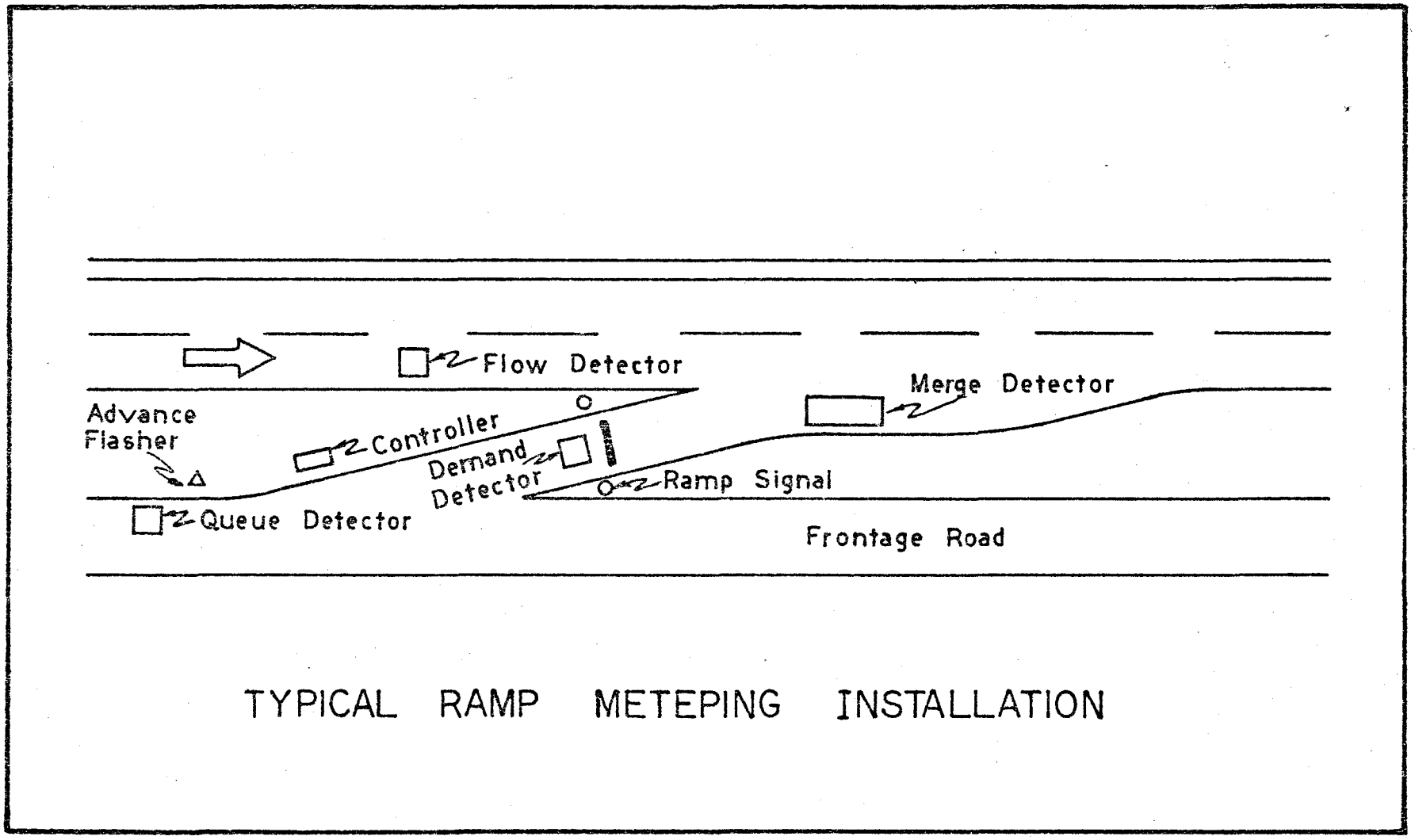


Figure 1: I 30 West Freeway in Fort Worth



TYPICAL RAMP METEPING INSTALLATION

Figure 2

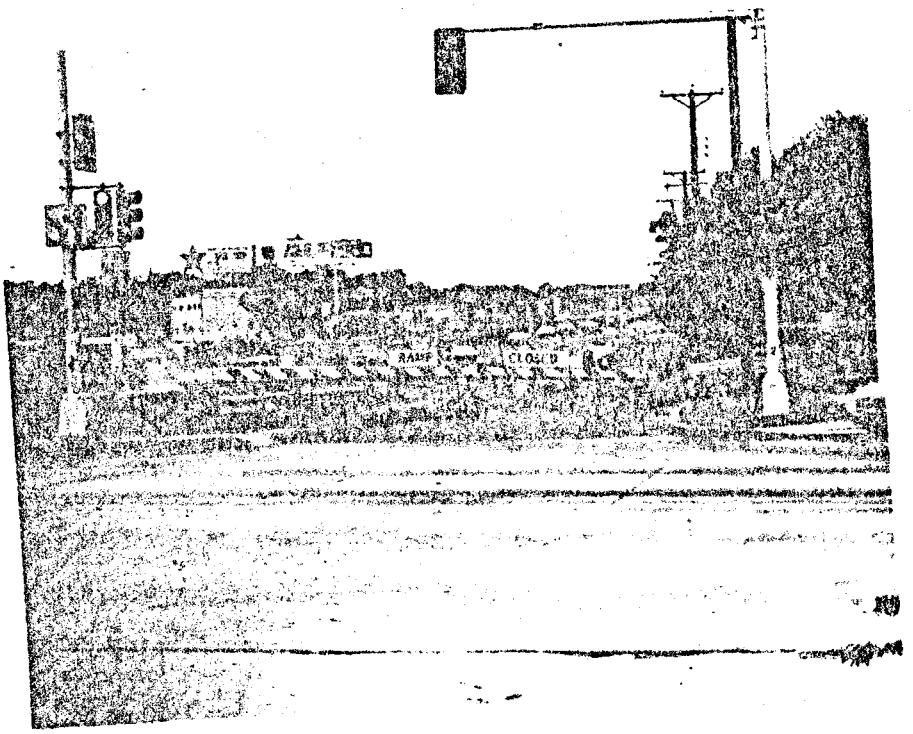


Figure 3: Montgomery Ramp Closure Gate

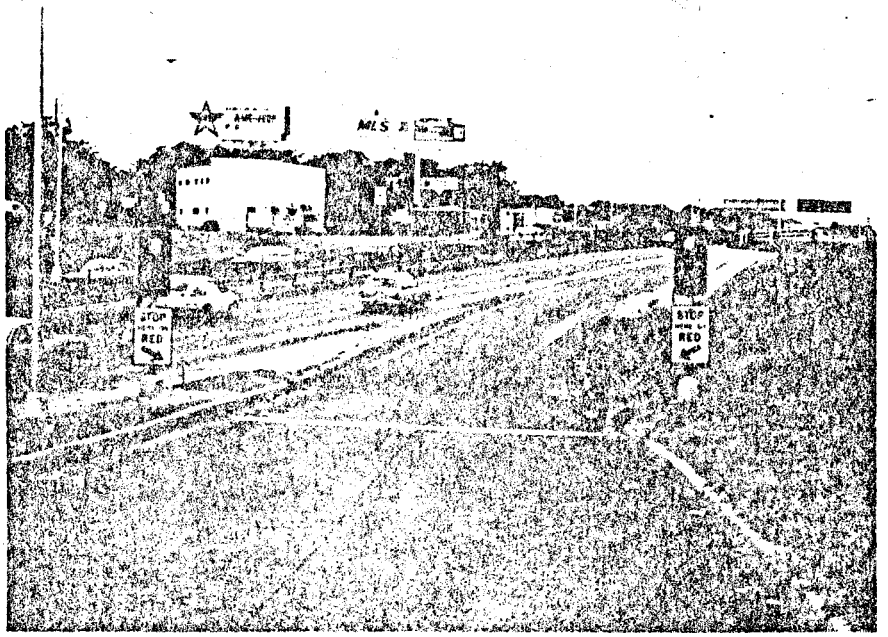


Figure 4: Montgomery Ramp Metering Signals

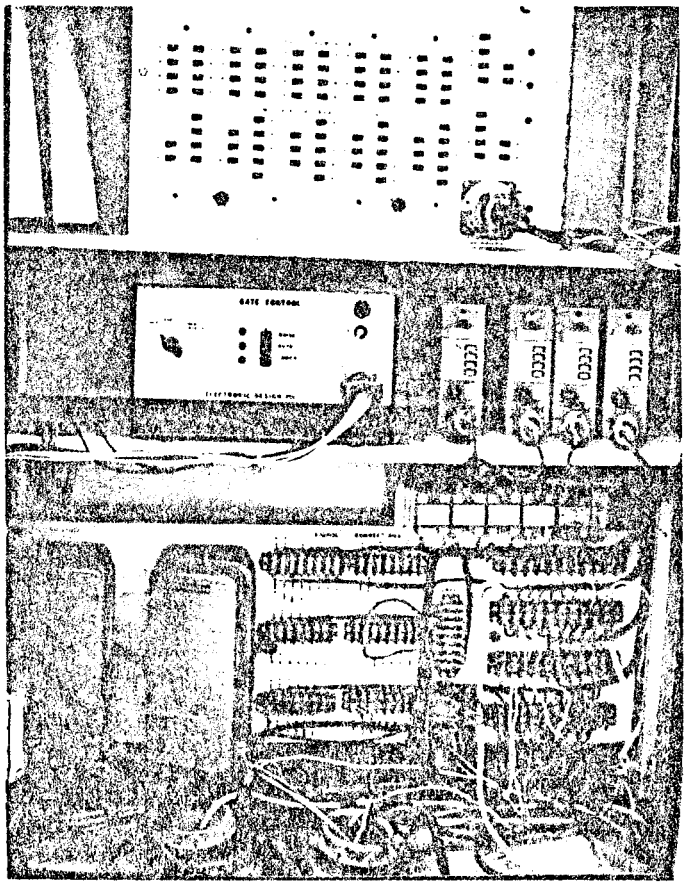


Figure 5: Montgomery Controller

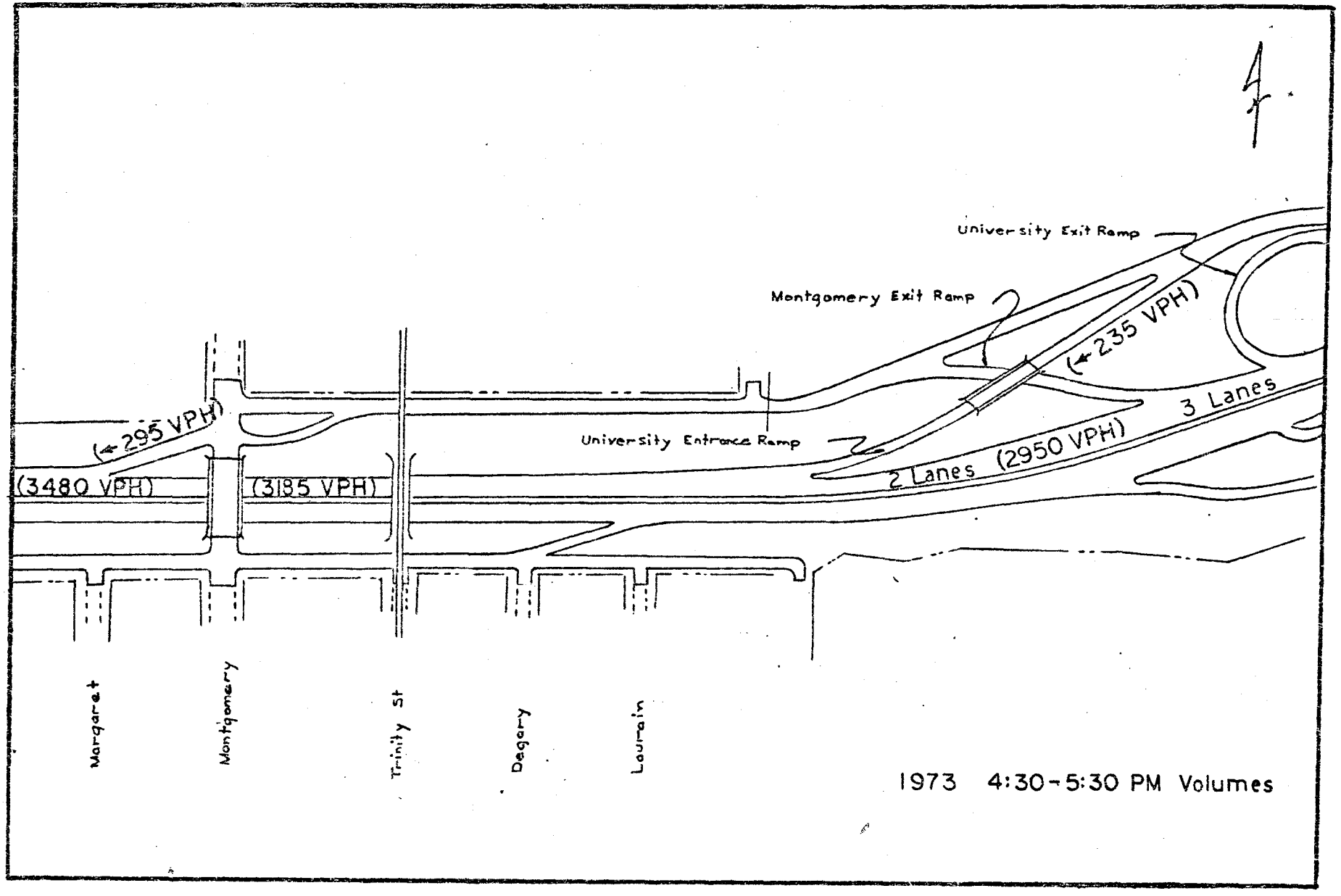


Figure 6: Montgomery and University Entrance Ramps

Based on the results of this study several conclusions were reached. The closure of both the University and Montgomery ramps would relieve the recurrent congestion that existed on the West Freeway, but this closure would place a great hardship on those motorists using these ramps since no good alternate route exists in the nearby vicinity. Metering of these ramps would provide the motorist with an alternative; either wait at the ramp to enter the freeway or seek some different route. At Montgomery, the ramp had limited storage available due to its short length. A heavy demand existed for 15-20 minutes. Metering at this peak demand would back traffic into the intersection. Therefore, closure was considered feasible, but only for this peak flow period. After this peak, metering would be adequate control.

Based upon these conclusions, a contract was let in September, 1974 for the installation of ramp metering equipment at the University and Montgomery ramps and a ramp closure gate at Montgomery. It was also concluded that this control scheme, metering at University and a combination of closure and metering at Montgomery, would not be sufficient to eliminate all congestion on the West Freeway. Additional ramps would need to be metered. The control of these ramps was delayed because of construction upstream of University.

TYPE OF INSTALLATION AND OPERATION

The ramp metering equipment consisted of traffic signal heads mounted on each side of the ramp, an advance flasher with a warning sign and ramp metering controller. The controller is traffic actuated and traffic responsive. Control is based on input from four different detectors; three on the ramp and one on the freeway.

The signals are dark in the off peak. The signals are activated by the freeway detector, time clock or a combination of the two. When the occupancy reaches a preset level, the signals and the advance flasher are activated. The green signal comes on for 15 seconds, followed by a three (3) second amber,

then goes red. Four metering rates are available, which are determined by the freeway occupancy.

When a vehicle stops at the signals, once the red has time out, a green indication will be given followed by an amber. If the vehicle should stop at the nose of the ramp, the merge detector will hold the signal red for a preset time or until the vehicle enters the freeway. This feature is used to prevent rear-end collisions. If ramp traffic should back up to the queue detector, placed near the intersection, the existing metering rate will be overriden and a faster metering rate will be initiated to prevent traffic from backing into the intersection.

The ramp closure system at Montgomery consists of a gate with flashing lights mounted on the arm, two automatice fold-out signs (Figures 7-8) and a controller. The controller permits closure by time clock, when ramp controller reaches highest preset occupancy level or a combination of the two.

Since the Montgomery entrance ramp is located at a signalized intersection, the gate controller and the intersection controller are interconnected. When ramp closure is initiated, the two fold-out signs on Montgomery Street are opened. The signs are used to prohibit turning movements into the ramp. The left turn arrow indication on Montgomery is prevented from being indicated. The flashing red lights on the gate arm are activated and after 15 seconds the arm begins to come down. An obstruction detector is mounted on the bottom of the arm to reverse the arm if it contacts a vehicle or other obstruction.

Typically, the metering at the University entrance ramp begins between 4:15 to 4:30 p.m. and ends between 5:30 to 5:45 p.m. The gate at Montgomery closes at approximately 4:25 p.m. and remains closed for 20 minutes. By the time the ramp is opened, the ramp metering signals are on.

The day before the ramp control system was turned on, handouts were given to motorists using these ramps. These handouts explain the purpose and opera-

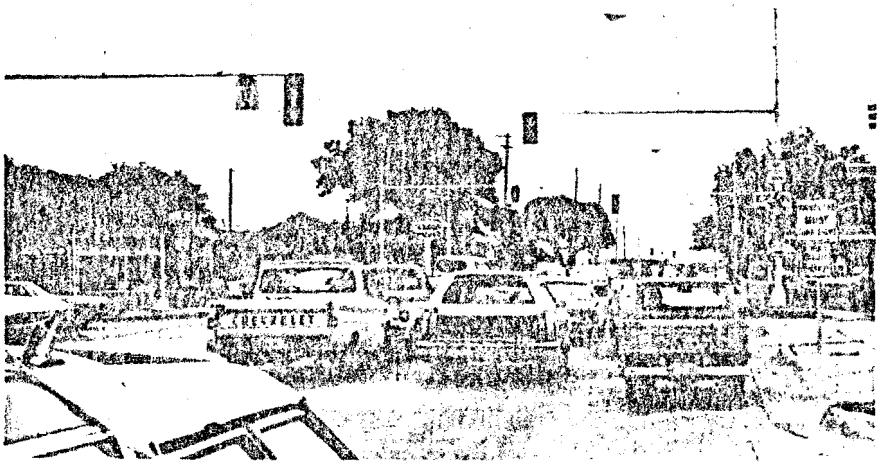


Figure 7: Automatic Fold-out Sign
Southbound Montgomery

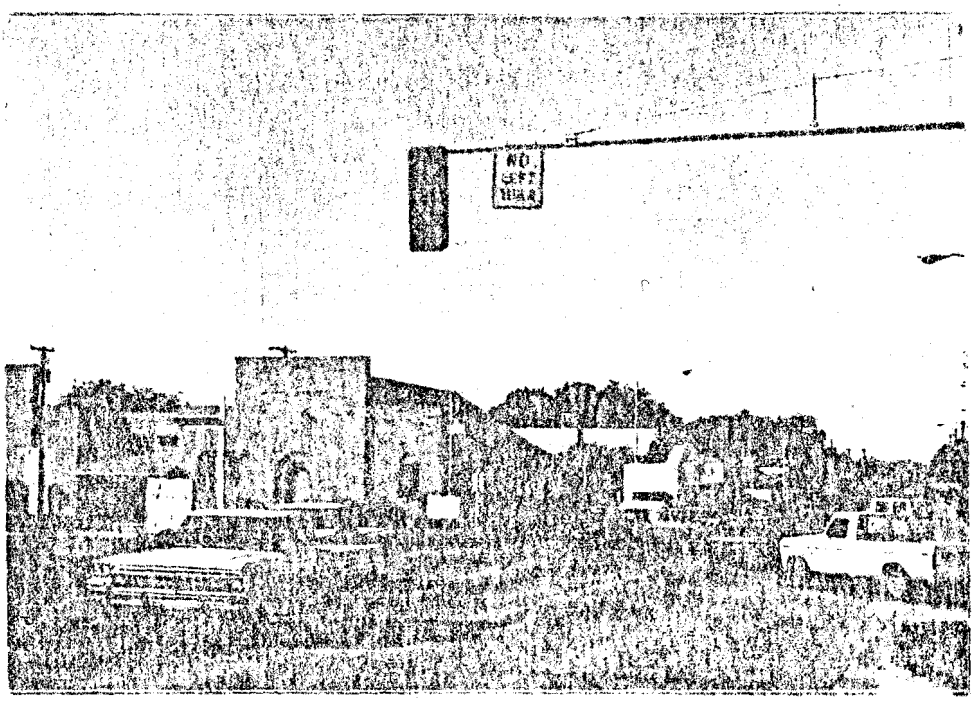


Figure 8: Automatic Fold-out Sign
Northbound Montgomery

tion of the signals. A week prior to this, the handouts were given to major employers in the area. Also, the control of these ramps received much newspaper, radio and television publicity.

RESULTS OF CONTROL

In May, 1976 after the construction was completed upstream, data was collected to determine the results of ramp control at the University and Montgomery entrance ramps. A permanent counting station is located between the University and Montgomery entrance ramps. Based on counts from this station, the afternoon peak volumes (4-6 p.m.) were only slightly higher (+1.2%) in May, 1976 as compared to August, 1973.

Ramp control produced significant improvements in average speeds on the West Freeway during afternoon peak periods. However, this does not mean that congestion was eliminated. The length and severity of the congestion is less with control of the Montgomery and University ramps. Speeds are also generally greater. In August, 1973 (no control) congestion extended from Montgomery back to Summit (1.8 miles). After control was initiated, congestion extended from Montgomery back to Forest Park Boulevard (1.1 miles). Figure 9 shows the comparison of typical speeds during the most congested period, approximately 5:15 p.m.

Three different control schemes were also evaluated, primarily to determine the effectiveness of ramp closure. The control schemes were: (1) Metering Ramp Closure (2) Metering Only (3) No Control. The average travel speeds from Summit to Montgomery were used as the basis of comparison. The lowest average speed with metering and ramp closure was 25 mph. This compared to 12 mph (May, 1976) and 17 mph (August, 1973) when no control was implemented. Metering only resulted in an average speed of 15 mph during the most congested period (Figure 10). Thus, the use of ramp closure increased the average speed from 15 mph to 25 mph.

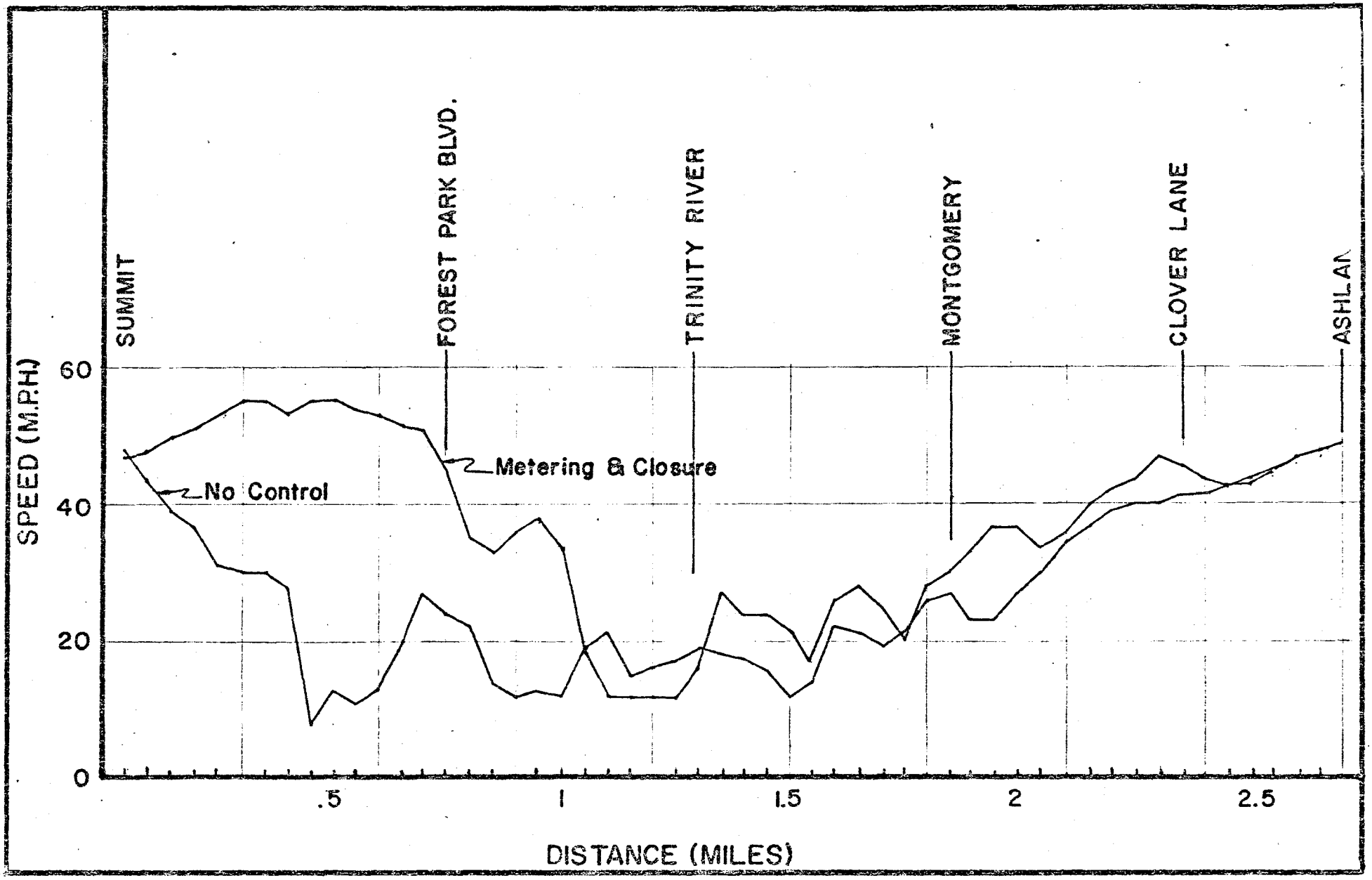


Figure 9: Typical Speed Profiles on Westbound I 30 During Afternoon Peak Hour

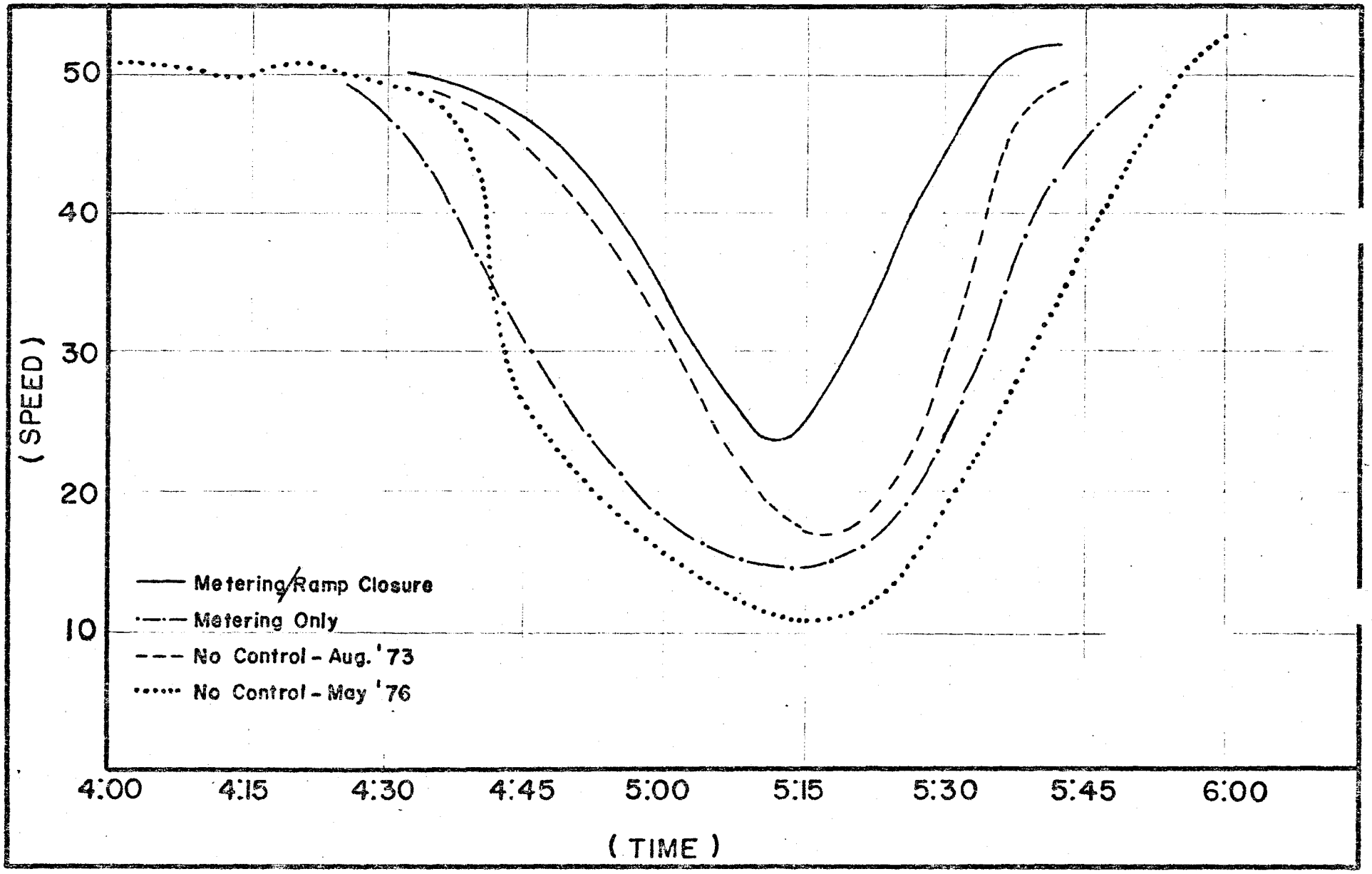


Figure 10: Average Freeway Speeds From Summit To Montgomery

The average speed during the entire peak hour was 27 mph with no control. With both ramp closure and metering, the average speed was 37 mph. This data was based on days with similar traffic patterns. Freeway volume at the Montgomery entrance ramp was 3,480 vph with no control and 3,560 vph with control.

Although peak hour freeway volumes had only increased slightly during the time interval between the two studies, there has been a continued increase in both peak hour volumes and daily volumes (Figure 11). Volumes are now highest recorded.

CONCLUSIONS AND RECOMMENDATIONS

Control of the Montgomery and University entrance ramps has improved freeway flow conditions during the afternoon peak period. The control of only two ramps has not, however, eliminated all problems. Other ramps must be controlled to achieve maximum benefits. Of the two ramps controlled, the closure of Montgomery has contributed more to improving freeway conditions than the metering.

Although there are many warning devices to notify motorists that the ramp is closed, it appears that more are needed. The gate arm has been hit several times by motorists making right or left turns from Montgomery. Since this intersection is signalized, the primary focus of most motorists is on the signal lights. Even though signs are placed adjacent to the signal lights, most motorists do not notice the signs. On a busy aterial street, it would be wise to install advance warning signs with flashers to warn motorists that the ramp is closed. This advance sign should be located at least 250-300 feet prior to the intersection.

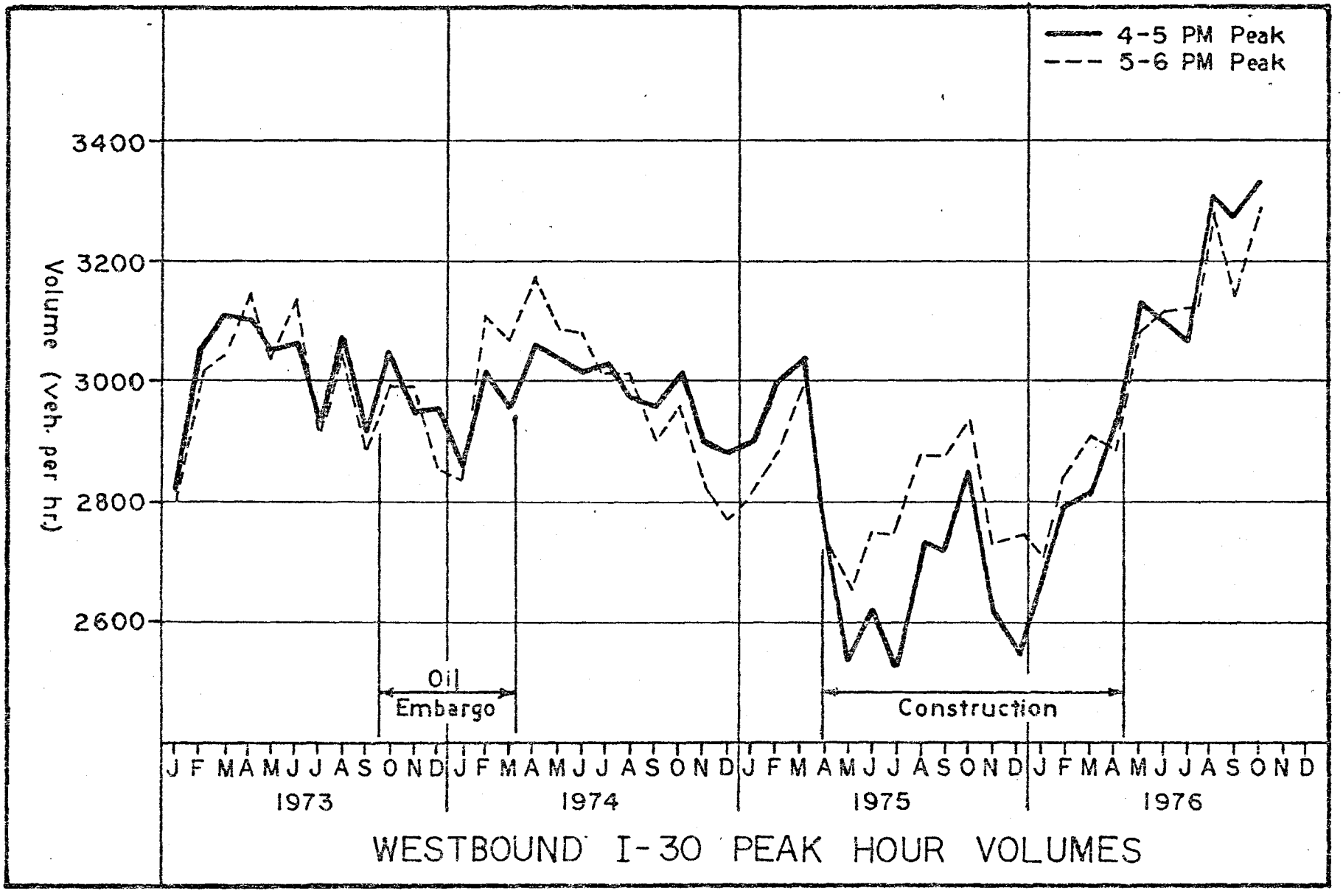

4-5 PM Peak
5-6 PM Peak
3400
3200
3000
2800
2600
Volume (Veh. per hr.)
Oil Embargo
Construction
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1973
1974
1975
1976
WESTBOUND I-30 PEAK HOUR VOLUMES

Figure 11