Technical Report Documentation Page

1. Report No. FHWA/TX-86/ 476-2F	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Lane Distribution Factors for Design		5. Report Date April 1987
		6. Performing Organization Code
7. Author(s) W. D. Cunagin		8. Performing Organization Report No. Research Report 476-2F
9. Performing Organization Name and Address Texas Transportation Institute, The Texas A&M University System, College Station, Texas 77843		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. Study No.2-8-85-476
12. Sponsoring Agency Name and Address Texas State Department of Highways and Public Transportation, Transportation Planning Division, P.O. Box 5051, Austin, Texas 78763		13. Type of Report and Period Covered Final - September 1984 November 1986
		14. Sponsoring Agency Code

15. Supplementary Notes

Research performed in cooperation with DOT, FHWA
Research Study Title: Investigate and Improve Current Methods of Predicting Load Equivalents for Design.

16. Abstract

This report is the final report of Study 2-8-85-476, entitled "Investigate and Improve Current Method of Predicting Load Equivalents for Design." The report gives details of the results of a survey of truck lane distribution on Interstate multilane facilities in Texas. The data were collected for 24 consecutive hours during the summer at nine locations in both directions of 4-lane, 6-lane, and 8-lane facilities, and in urban and rural settings

Summary information is presented in the report and compared with current design practice in Texas, recommendations in the current AASHTO pavement design guide, predictions from the NCHRP Report 277 equations for truck lane distributions. Although the data are not extensive enough to warrant the development of new predictive equations, they do show significant deviations from the previous and current methods and indicate that even the NCHRP Report 277 equations are conservative when compared with Texas traffic conditions. The effects of travel direction, urban or rural environment, and percent trucks in the traffic stream appear to be significant in altering the truck lane distributions.

17. Key Words Truck traffic, truck lane distribution, percent trucks, hourly variations of traffic, directional distributions of truck traffic, pavement design.	18. Distribution Statement No restriction. This document is available to the public through the National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	64	

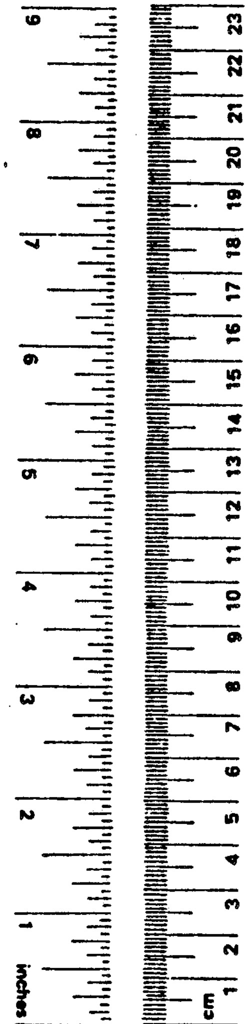
Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

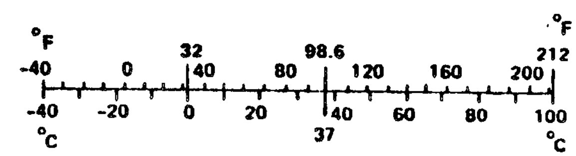
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

This report is the second and last report in Study 2-8-85-476, entitled, "Investigate and Improve Current Methods of Predicting Load Equivalents for Design", summarizes the results of a survey of interstate traffic in the summer of 1986 in nine locations and compares the observed results with the truck lane distributions that are currently assumed in Texas pavement design practice, as well as with current recommendations in the 1986 AASHTO pavement design guide and the predictions made with the equations published in the 1985 NCHRP Report No. 277, which represents data from 129 sites and six states.

The report shows that the NCHRP Report 277 equations are conservative when compared with the survey data and are thus useful for design practice in Texas until similar equations for Texas conditions can be developed.

The previous report in this study developed equations for load equivalence factors for flexible pavements in all four climatic zones in Texas.

Taken together, these two reports provide a basis for improving pavement design practice in Texas.

SUMMARY

This report, the second and final report of Study 2-8-85-476, "Investigate and Improve Current Methods of Predicting Load Equivalents for Design" is the second part of a two-pronged effort to improve the prediction of 18-kip equivalent single axle loads used for the design of flexible pavements in Texas. The first of these is presented in TTI Research Report 476-1 "Development of New Load Equivalence Factors for Flexible Pavement Design in Texas" in which equations for load equivalence factors for each of the four climatic zones in Texas were developed. The second effort is reported here, in which a better method of estimating the percentage of trucks that will be found in each lane of multi-lane highway facility is developed based upon observed traffic patterns in Texas.

Traffic data were collected for 24 continuous hours at each of nine interstate highway sites distributed widely across the State, in both directions, on 4-lane, 6-lane, and 8-lane facilities, and in urban and rural environments. The report summarizes the hourly traffic count and hourly percent of trucks observed in each location, in each lane, and in each direction.

The results are compared with the percent trucks that are currently assumed in the Texas FPS method of pavement design, as well as with the percent trucks that are recommended in the 1986 AASHTO pavement design guide, and that are calculated using the predictive equations in NCHRP Report No. 277. The observed data show significant deviations from currently used methods.

It is shown that the NCHRP Report 277 equations are conservative when compared with the observed data, although both the NCHRP equations and the observed data show the same trends. Also, the effects of the direction of travel, urban or rural environment, and percent trucks in the traffic stream appear to alter the truck lane distributions. The number of sites observed were not numerous enough to warrant the development of new predictive equations for Texas conditions, but the indications are that these conditions are sufficiently distinctive as to require a new set of predictive equations.

In the meantime, use of the NCHRP Report 277 equations will provide conservative estimates of truck lane distributions for pavement design in Texas. The cost savings due to this more refined estimate of design loads in multi-lane facilities may be significant.

IMPLEMENTATION STATEMENT

The results of the traffic surveys conducted in this study show that the predictive equations for truck lane distributions in NCHRP Report 277, which were developed from data on 129 sites in six states, are conservative when compared to the observed data. Until better equations are developed which more accurately describe Texas conditions, the NCHRP equations may be used to estimate the distribution of the percent trucks by lane in multi-lane facilities throughout the State.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration or the State Department of Highways and Public Transportation. This report does not constitute a standard, specification, or regulation.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF FIGURES (CONTINUED)

LIST OF TABLES

LANE DISTRIBUTION FACTORS FOR DESIGN

Study 2-8-85-476, entitled "Investigate and Improve Current Method of Predicting Load Equivalents for Design," was initiated in response to a request from the Department to evaluate current Texas methods for predicting load equivalents for design.

The effort in the first part of Study 476 was to develop a method of calculating load equivalence factors for flexible pavements in Texas. The method was developed primarily as a refinement and eventually, a replacement of the load equivalence factors which were developed from AASHTO Road Test data, and which are the basis of the method currently used in the State of Texas. The AASHTO method is deficient because it cannot consider the effect of the following on load equivalence factors: climatic conditions, subgrade soil stiffness, and the thickness of the asphalt surface layer.

The new method that has been developed is based upon VESYS-IVB output data from the Cost Allocation Study for the Federal Highway Administration which was concluded in 1982 (1). The new method has the following advantages over the method in current use: (1) it considers four environmental zones in Texas; (2) it uses the elastic modulus of the subgrade; (3) it considers both the structural number and the thickness of the asphalt layer; (4) it makes use of the S-shaped performance curve which has been found to fit actual Texas pavement data (2); and (5) it considers three different types of pavement damage: loss of serviceability index, rutting, and alligator cracking.

The new method shows that a typical traffic stream will damage the same pavement approximately 60 times more in east Texas than it will in west Texas. The method that is currently used in Texas, which is based on AASHTO Road Test results, indicates that there is no difference in the amount of damage done to the same pavement in the two locations.

A research report (TTI Research Report 476-1) was written which documents the development of the new load equivalence factors and presents tables of the factors, arranged by climatic zones, subgrade modulus, asphalt layer thickness, and type of pavement distress. Comparison of the load equivalence factors for the wet, freeze zone on a soft subgrade for serviceability loss correspond very closely with the AASHTO Road test load equivalence factors, just as they should.

Application of these new load equivalence factors to Texas conditions will require the designation by the Texas SDHPT of a standard pavement and standard climatic conditions to which all damage levels can refer as a datum.

TTI also undertook a major data collection effort to determine truck lane distributions of trucks on interstate multilane facilities in Texas. The data were collected automatically (in most cases) for 24 consecutive hours. Both rural and urban locations were studied. The following sections of this report discuss this data collection effort and subsequent analyses and results.

DATA COLLECTION

Table 1 shows the distribution of the study sites by area type (rural/urban), geographical area, and number of lanes. A conscious effort was made to obtain samples representative of truck lane distributions in Texas. The data were collected by hour of the day for 24 continuous hours according to the following vehicle types: passenger cars; single unit commercial vehicles; and tractors with semitrailers. Some of the data were acquired using automated electronic traffic data collection equipment. Where this was not feasible, teams of observers were used to acquire manually the data in a continuous 24-hour period.

COMPARISON OF OBSERVED DATA WITH RECOMMENDED VALUES

The trends that were observed in the data will be illustrated and discussed in a subsequent section of this report. In this section, the resulting observations will be compared with current design practice in Texas with recommendations in the new AASHTO pavement design guide, and with calculations made with a recently published NCHRP equation.

Current practice in Texas assumes that 100% of the truck traffic is in the design lane (3). The recommendation found in the recently issued "AASHTO Guide for Design of Pavement Structures," (4) for estimating the percent of truck traffic in the design lane (i.e., lane distribution factor) is shown in Table 2. As indicated, AASHTO suggests different ranges of the lane distribution factor for different multilane facilities, including 50 to 75 percent for highways with eight or more lanes.

Table 3 compares actual observed values with the AASHTO recommendation. In addition, Table 3 includes the lane distribution factor produced by using the equations presented in National Cooperative Highway Research Program (NCHRP) Report 277, entitled "Portland Cement Concrete Pavement Evaluation System (COPES)." (5) In that document, the authors studied lane distribution data from more than 100 locations in the U.S. and developed predictive equations for the percentages of trucks in each lane of facilities with four or more lanes based on the one-way ADT at that site. The equations developed are as follows:

1. Proportion of all one-directional trucks in outermost right lane:

$$T3R = (1.567 - 0.0826 * Ln(\text{One-Way ADT}) - 0.12368 * LV)$$

where:
LV = 0 if the number of lanes in one direction is 1 or 2;
LV = 1 if the number of lanes in one direction is 3 or more; and
Ln = natural logarithm (base = 2.718).

Statistics: R-squared = 0.52
Std. Dev. = 13.0
n = 129 cases from six states

2. Proportion of all one-directional trucks in lane adjacent to (to the left of) outermost lane:

T3L = (-0.520 + 0.0772 * Ln(One-Way ADT) + 0.0564 * LV)

where:
LV = 0 if the number of lanes in one direction is 1 or 2;
LV = 1 if the number of lanes in one direction is 3 or more; and
Ln = natural logarithm (base = 2.718).

Statistics: R-squared = 0.47
Std. Dev. = 11.0
n = 129 cases from six states

Table 1. Data Collection Site Summary.

SITE #	ROUTE	LOCATION	RURAL/ URBAN	NUMBER OF LANES
1	IH-35	San Marcos	R	4
2	US 59	Lufkin (Inside City Limits)	U	4
3	US 59	Lufkin (Outside City Limits)	R	4
4	IH-35	San Antonio	U	4
5	IH-45	Huntsville	R	4
6	IH-10	Brookshire	R	4
7	IH-10	Houston	U	6
8	IH-635	Dallas	U	8
9	IH-410	San Antonio	U	8

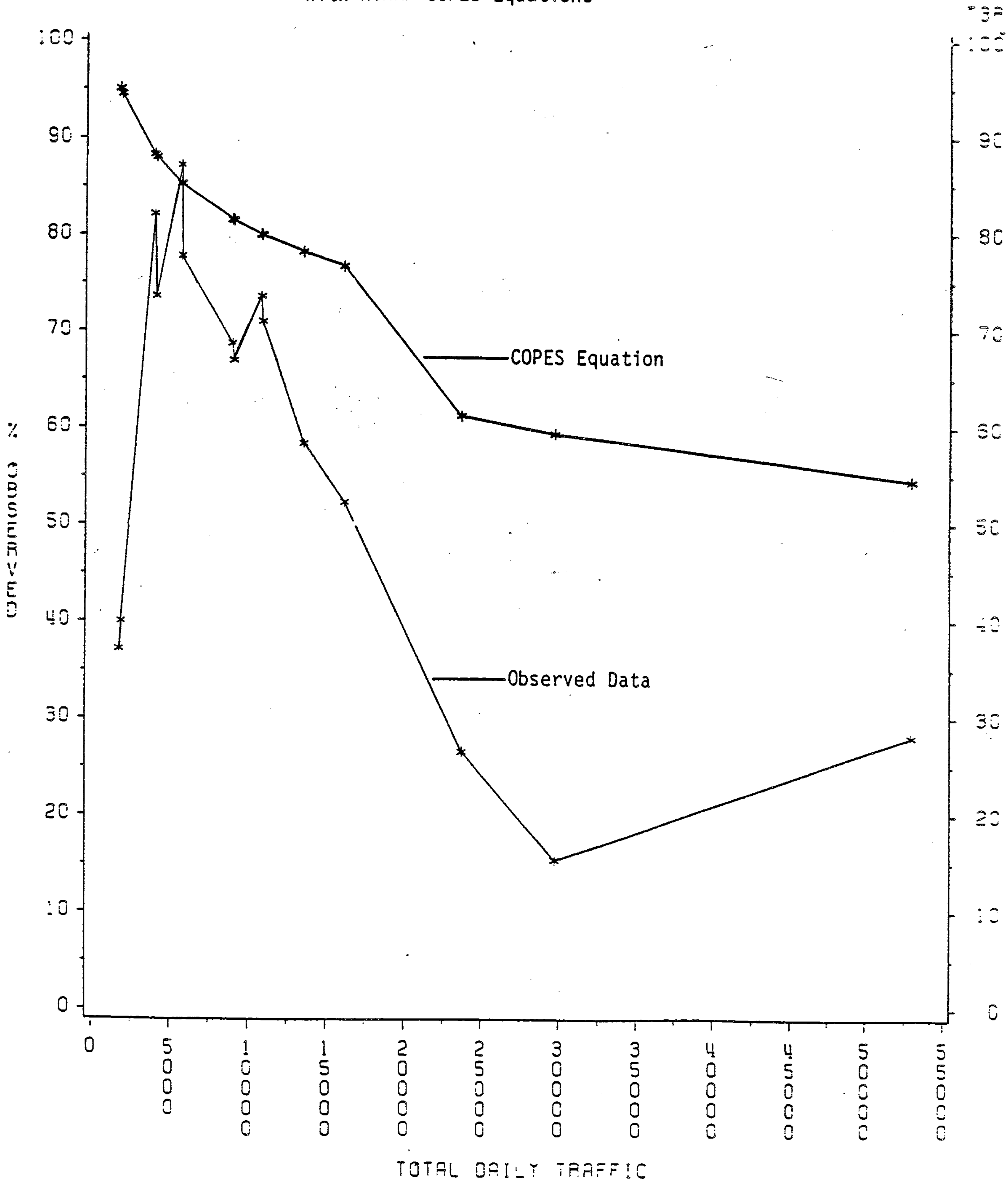
Table 2. Lane Distribution Factors from 1986 AASHTO Guide for Design of Pavement Structures.

Number of Lanes In Each Direction	Percent of 18-Kip ESAL Traffic In Design Lane
1	100
2	80-100
3	60-80
4 or more	50-75

Table 3. Comparison of Lane Distribution Factors

SITE #	ROUTE	RURAL/ URBAN	# OF LANES	AASHTO FACTOR	OBSERVED FACTOR	COPES FACTOR	TOTAL 24-HOUR TRAFFIC	PERCENT TRUCKS
1	IH-35	R	4	80-100	.73-NB/.71-SB	.78	14,100	12.4
2	US 59	U	4	80-100	.74-NB/.82-SB	.86	5,300	4.2
3	US 59	R	4	80-100	.78-NB/.87-SB	.84	7,200	14.2
4	IH-35	U	4	80-100	.58-NB/.52-SB	.76	18,750	5.8
5	IH-45	R	4	80-100	.86-NB/.85-SB	.88	4,000	45.0
6	IH-10	R	4	80-100	.69-EB/.67-WB	.80	10,350	27.5
7	IH-10	U	6	60-80	.40	.55	52,900	3.0
8	IH-635	U	8	50-75	.50	.56	46,300	7.9
9	IH-410	U	8	50-75	.41	.59	31,000	6.5

Figure 1. Comparison of Observed Percent Trucks in Lane 1 with NCHRP COPES Equations



ESTIMATION VS OBSERVATION

It is apparent from the data that the use of a 100% truck traffic allocation to the design lane can significantly overestimate the actual truck traffic in the design lane at sites in Texas. In addition, the use of the AASHTO recommendation of a particular range requires some knowledge of the appropriate values to be selected for specific local highway sections. Even with the fairly wide AASHTO lane distribution factor ranges, six of the nine locations observed in this study had design lane percentage values less than the corresponding AASHTO minimum value.

As illustrated in Figure 1, the COPES equation consistently produced design lane truck distribution factor values which exceeded the observed design lane truck distribution percentages. Also, the COPES assumption that the truck lane distribution percentage decreases with increasing average daily traffic (ADT) was confirmed. The COPES values provided a reasonable, if conservative, estimate of the truck lane distribution percentages.

SUMMARY OF DATA TRENDS

The data were entered into computer files and processed to provide summary information. The heavy trucks were grouped together for this analysis. Figures 2 through 15 show plots of total traffic volume by hour of the day and direction for each of the sites surveyed.

The peaking characteristics are typical of rural and urban sites in Texas. Specifically, the urban sites show morning and evening peaks superimposed on a cycle of lower traffic volumes during the night hours and higher traffic volumes during the daylight hours. The rural sites show this cyclical variation without the morning and evening peaks.

More interesting are the plots of the percents of trucks in each lane as shown in Figures 16 through 46. Please note that Lane 1 is defined as the rightmost (design) lane and the other lanes are numbered sequentially toward the median. The hourly variation is significant in most of the observed cases, principally due to the cyclical fluctuation in the number of passenger cars. The truck traffic (i.e., trucks per hour), taken separately, is more nearly constant. This finding is in keeping with many previous studies and with information obtained by the Texas weigh-in-motion (WIM) studies.

CONCLUSION

The use of 100% assignment of trucks to the design lanes appears to be very conservative. The observed values of percent trucks dropped below the lower limit of the AASHTO recommended range in six out of nine cases. The collection of 24 hours of truck lane distribution data at nine Texas locations confirmed the assertion in the COPES lane distribution predictive equations that the factors decrease with increasing ADT. However, these equations appear to provide consistent and conservative estimates of the percentage trucks in the design lane.

Although the amount of data collected and the number of sites surveyed were not sufficient to develop equations such as the COPES lane distribution equations, they raise the following questions that are not covered by the COPES equations:

1. The data were collected during the summer. What effect will other

seasons have upon the observed truck lane distribution?

2. Would a sample of 100 sites provide truck lane distribution similar to the COPES equations predictions or will Texas traffic patterns prove to be different?

3. Almost certainly the direction of travel and the commodity carried will have an effect upon the design load levels. With the possibility of low-cost Weigh-in-Motion equipment becoming available, it appears desirable to determine the effect of these factors (direction and commodity) on the design truck traffic.

It is believed that the above questions can be answered with a more extensive survey than that accomplished in this study, and the results may provide significant differences in pavement design practices suggested either in the current AASHTO pavement design guide or by the NCHRP Report No. 277 COPES predictive equations.

In the meantime, the COPES equations will provide an apparently conservative approach to estimating truck traffic for pavement design.

REFERENCES

1. Rauhut, J. B., Lytton, R. L., and Darter, M. I., "Pavement Damage Functions for Cost Allocation", Research Report Nos. FHWA/RD-84/018,019, Volumes 1 and 2, Office of Research, Federal Highway Administration, Washington, D.C., June 1984.

2. Garcia-Diaz, A., Riggins, M., and Liu, S. J., "Development of Performance Equations and Survivor Curves for Flexible Pavements", Texas Transportation Institute Research Report 284-5, Texas A&M University, March 1984.

3. ______________________, "Flexible Pavement Designer's Manual, Pavement Design System, Part I", Highway Division, Texas Highway Department, 1972, Revised, June 1984.

4. ______________________, "AASHTO Guide for Design of Pavement Structures, 1986." American Association of State Highway and Transportation Officials. Washington, D.C., 1986.

5. Darter, M. I., Becker, J. M., Snyder, M. B., and Smith, R. E., "Portland Cement Concrete Pavement Evaluation System (COPES)", Report 277, National Cooperative Highway Research Program, Transportation Research Board, Washington, D.C., September 1985.

Figure 2. Total Number of Vehicles in the North-Bound Direction on I-35 at San Marcos

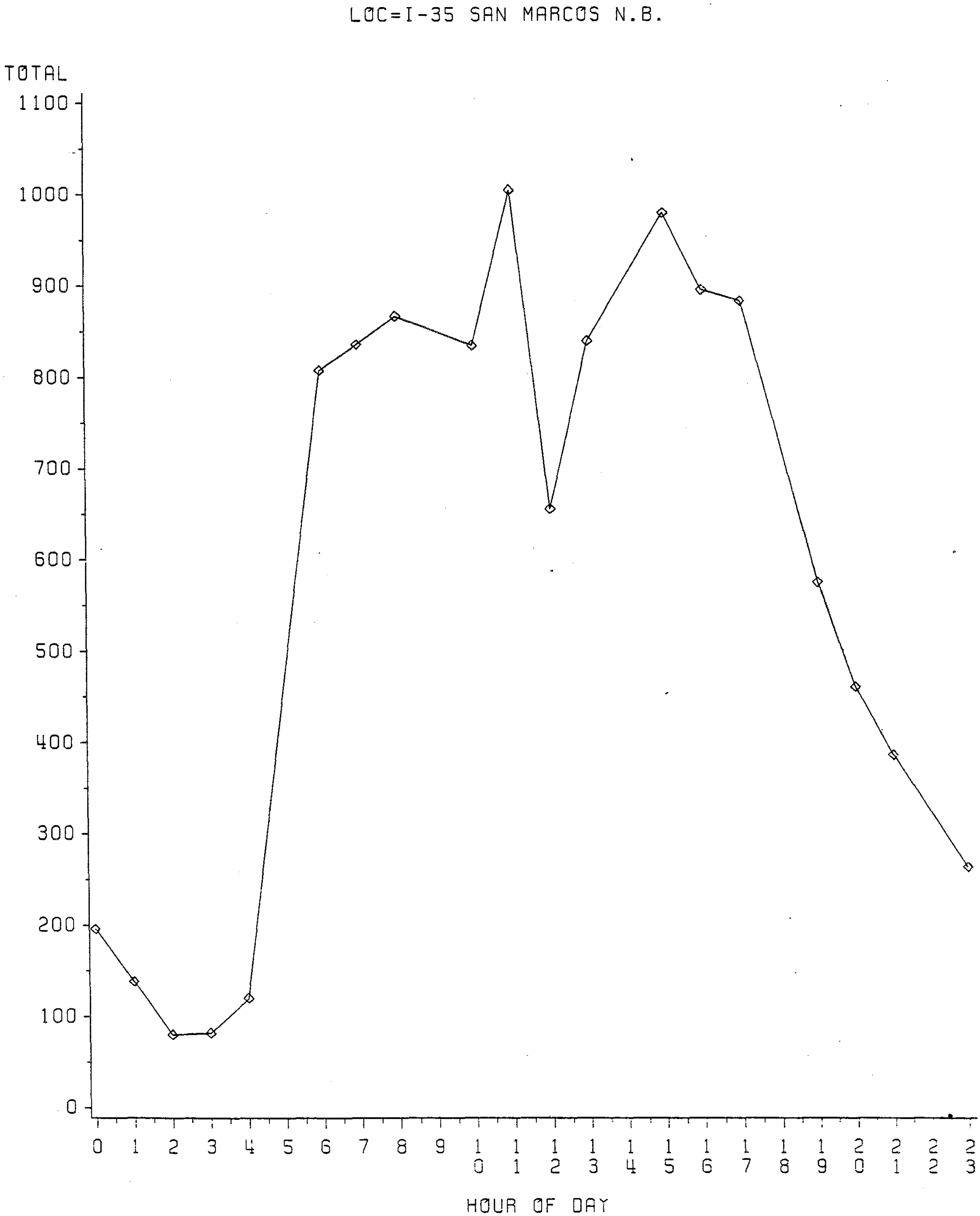


Figure 3. Total Number of Vehicles in the South-Bound Direction on I-35 at San Marcos

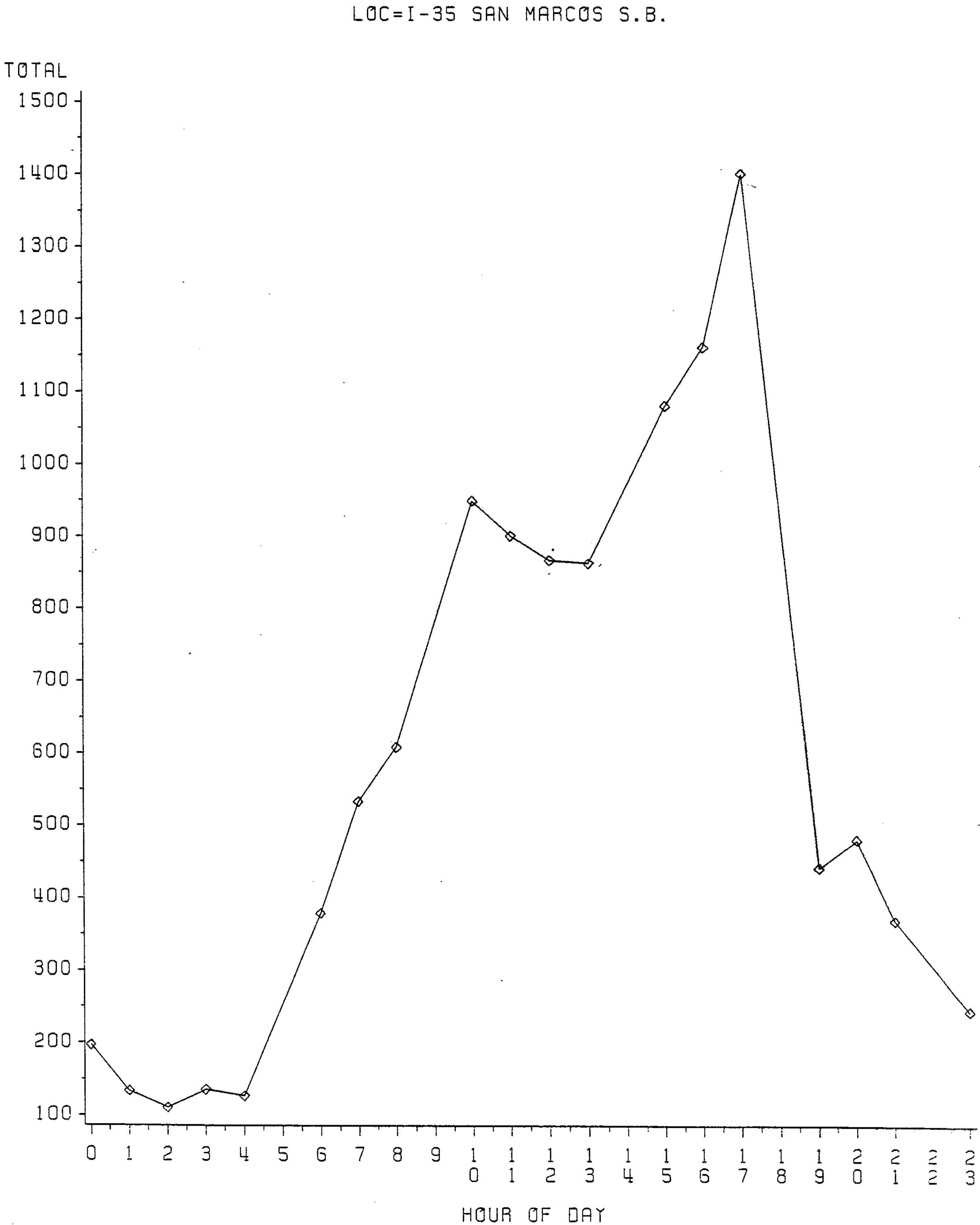


Figure 4. Total Number of Vehicles in the North-Bound Direction on US-59 at Lufkin

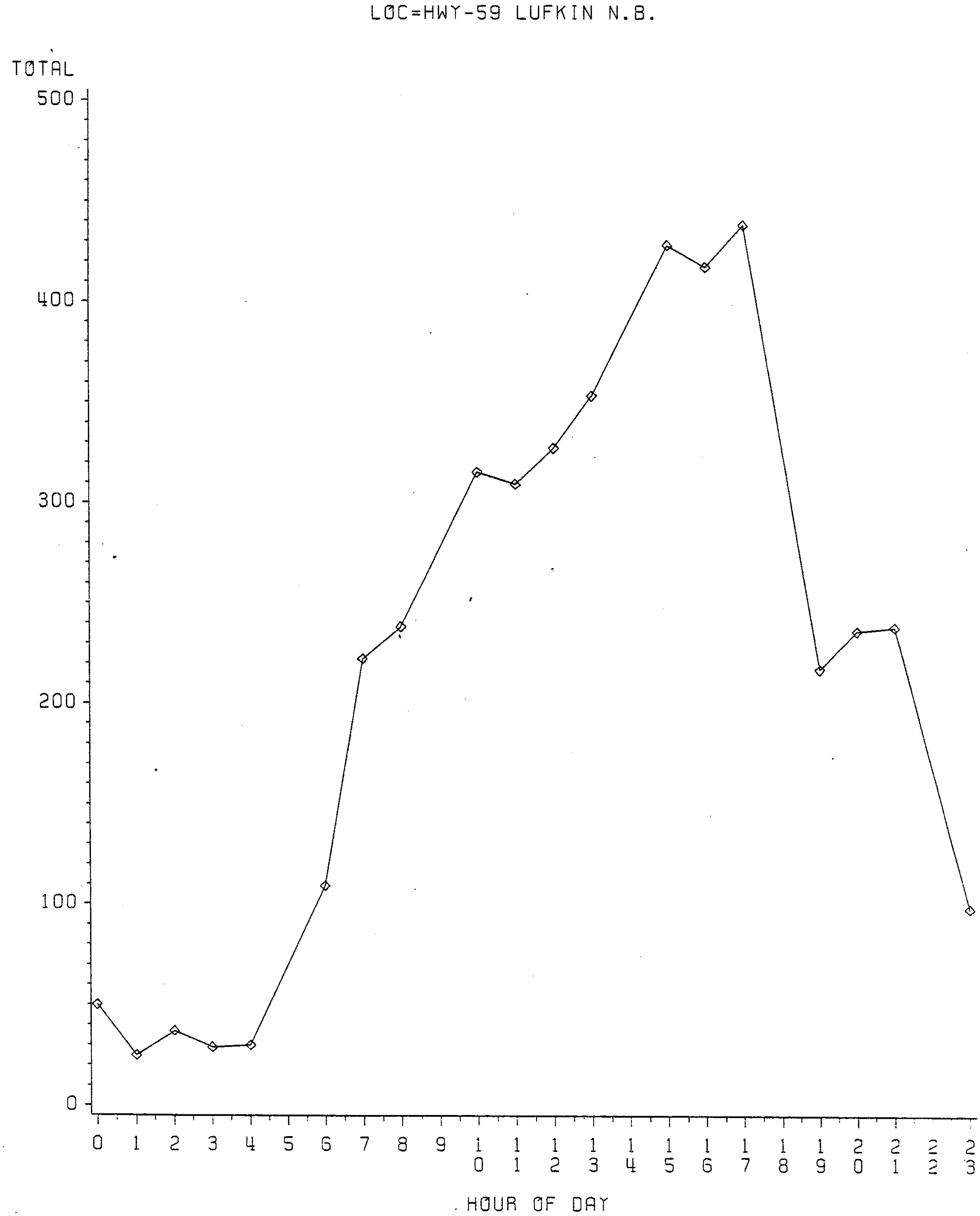


Figure 5. Total Number of Vehicles in the South-Bound Direction on US-59 at Lufkin

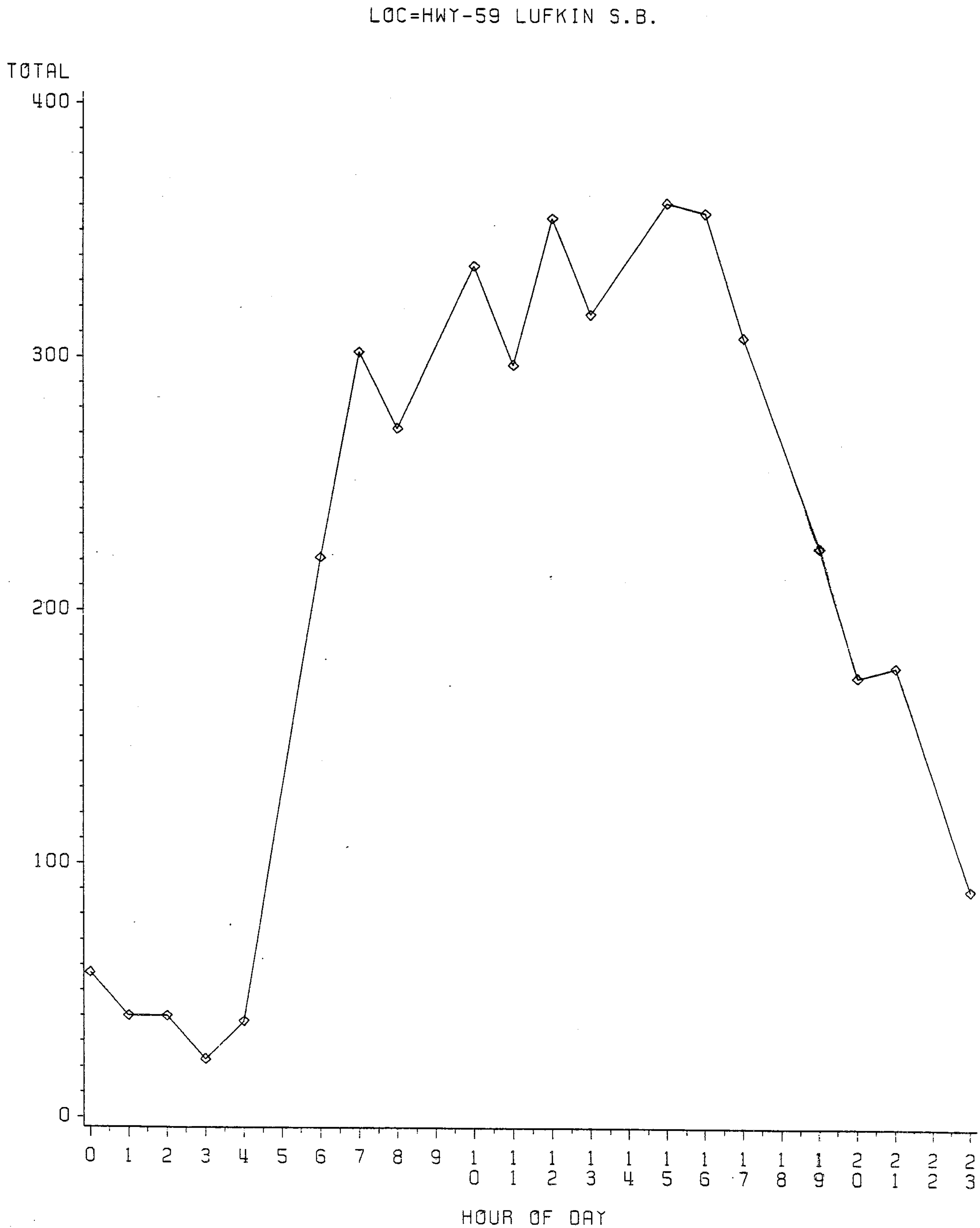


Figure 6. Total Number of Vehicles in the North-Bound Direction on US-59 at Angelina

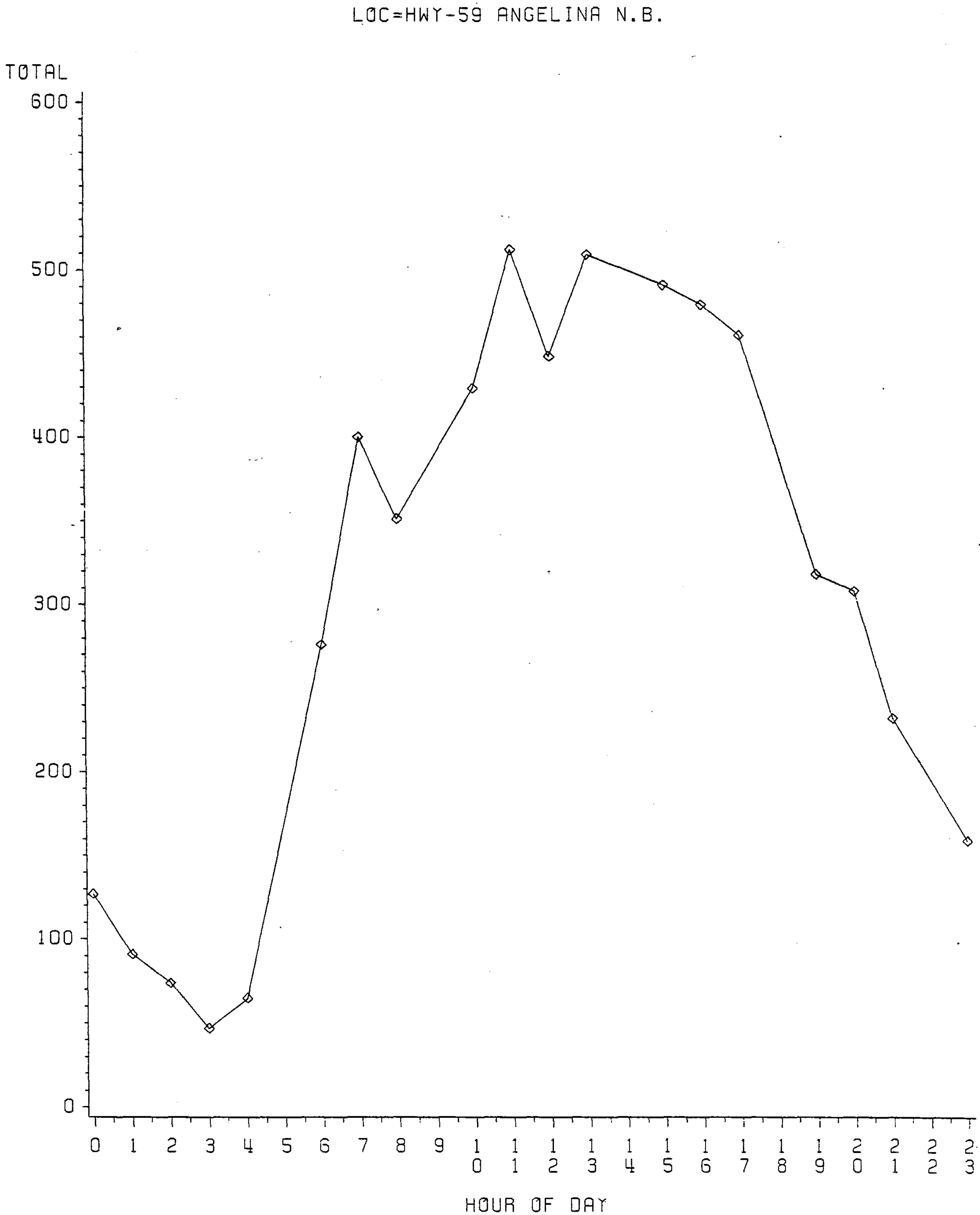


Figure 7. Total Number of Vehicles in the South-Bound Direction on US-59 at Angelina

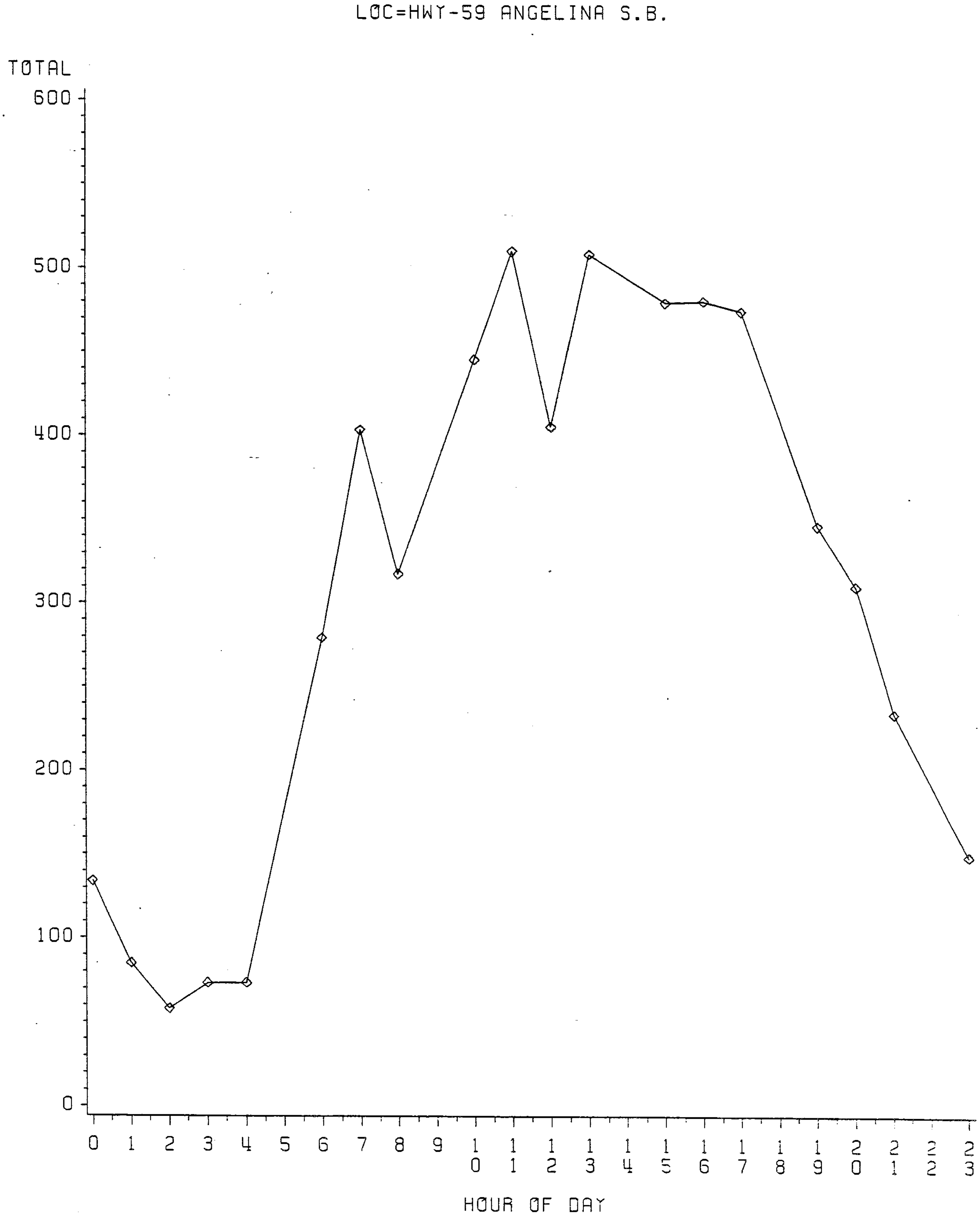


Figure 8. Total Number of Vehicles in the North-Bound Direction on I-35 at San Antonio

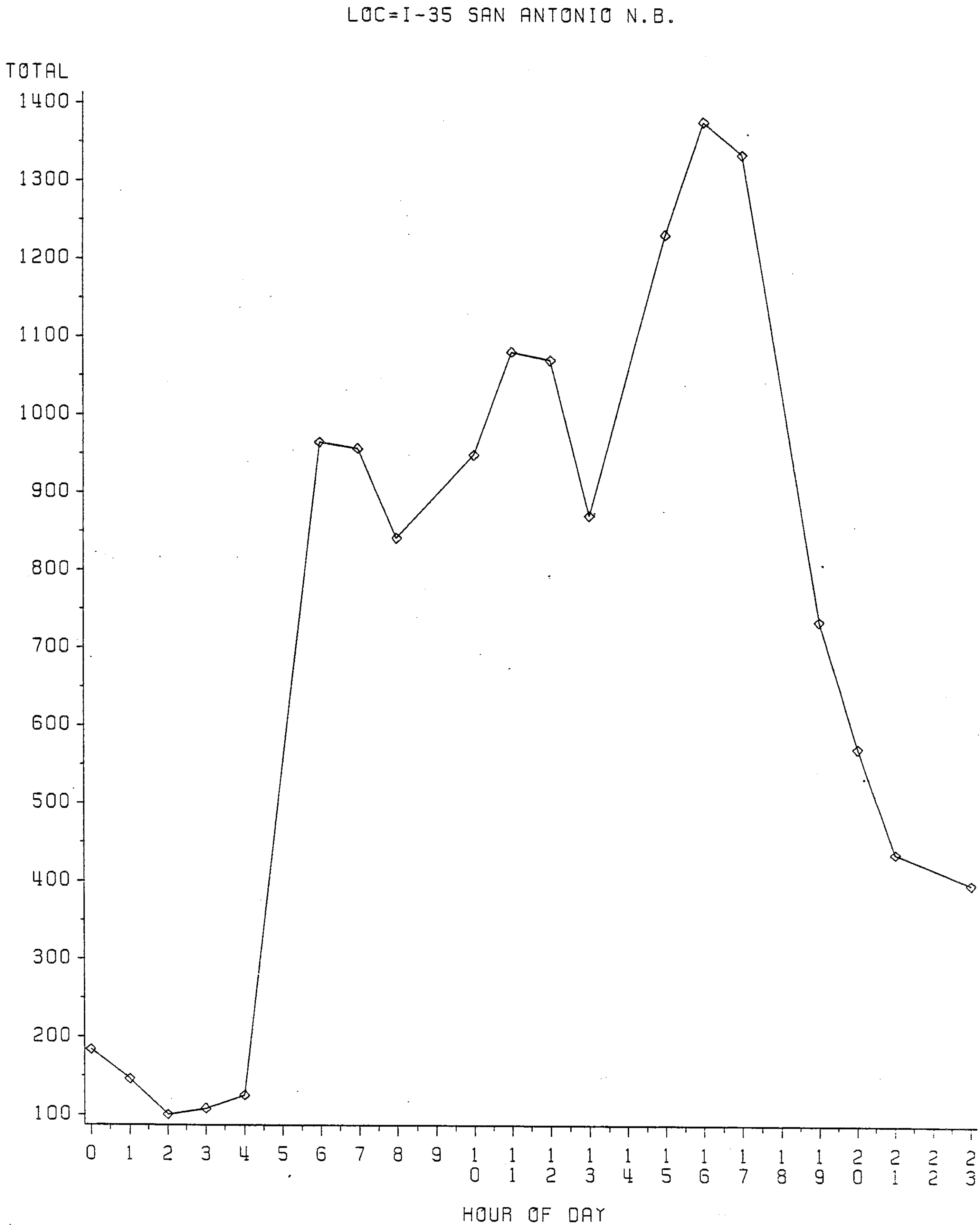


Figure 9. Total Number of Vehicles in the South-Bound Direction on I-35 at San Antonio

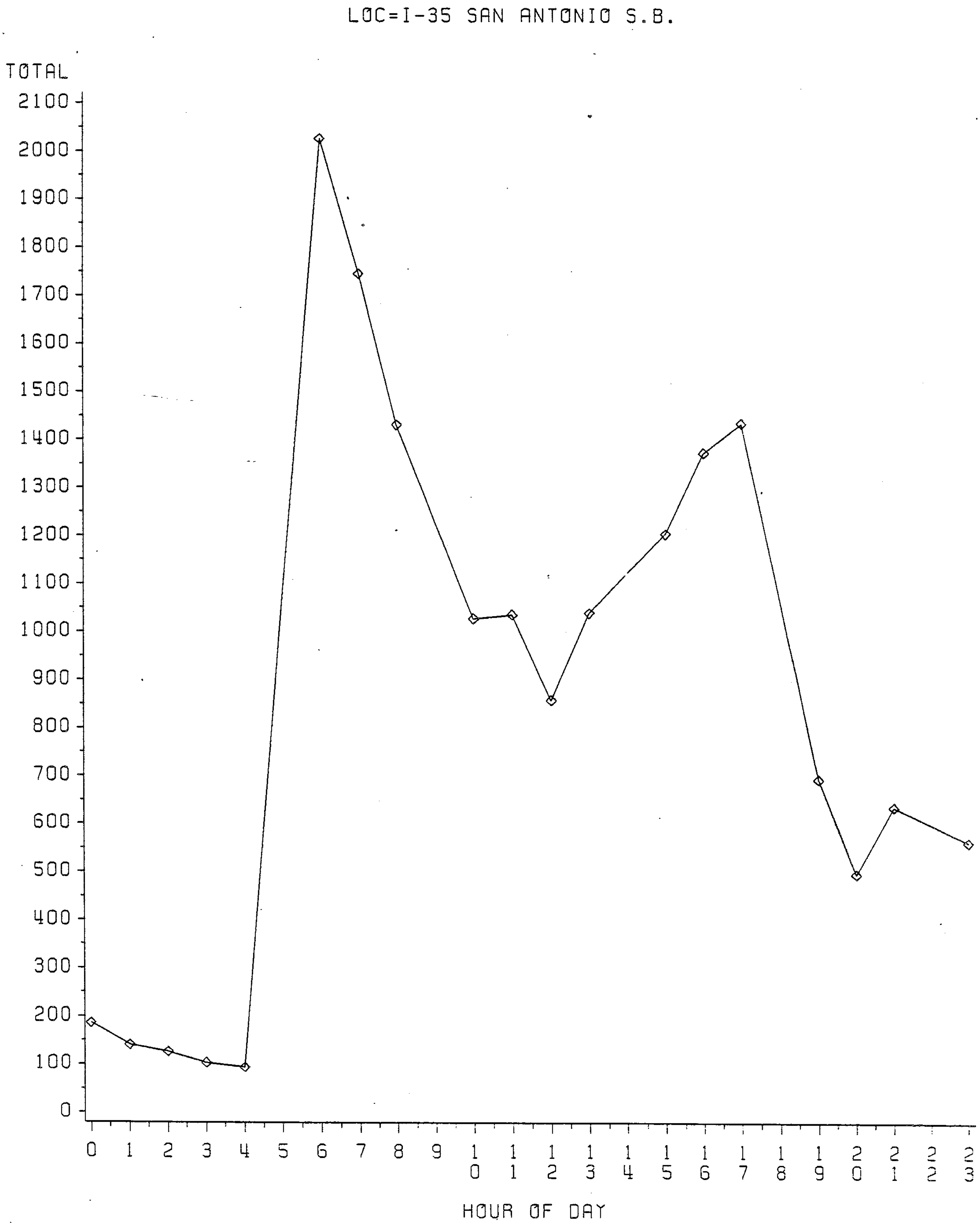


Figure 10. Total Number of Vehicles in the East-Bound Direction on I-10 at Brookshire

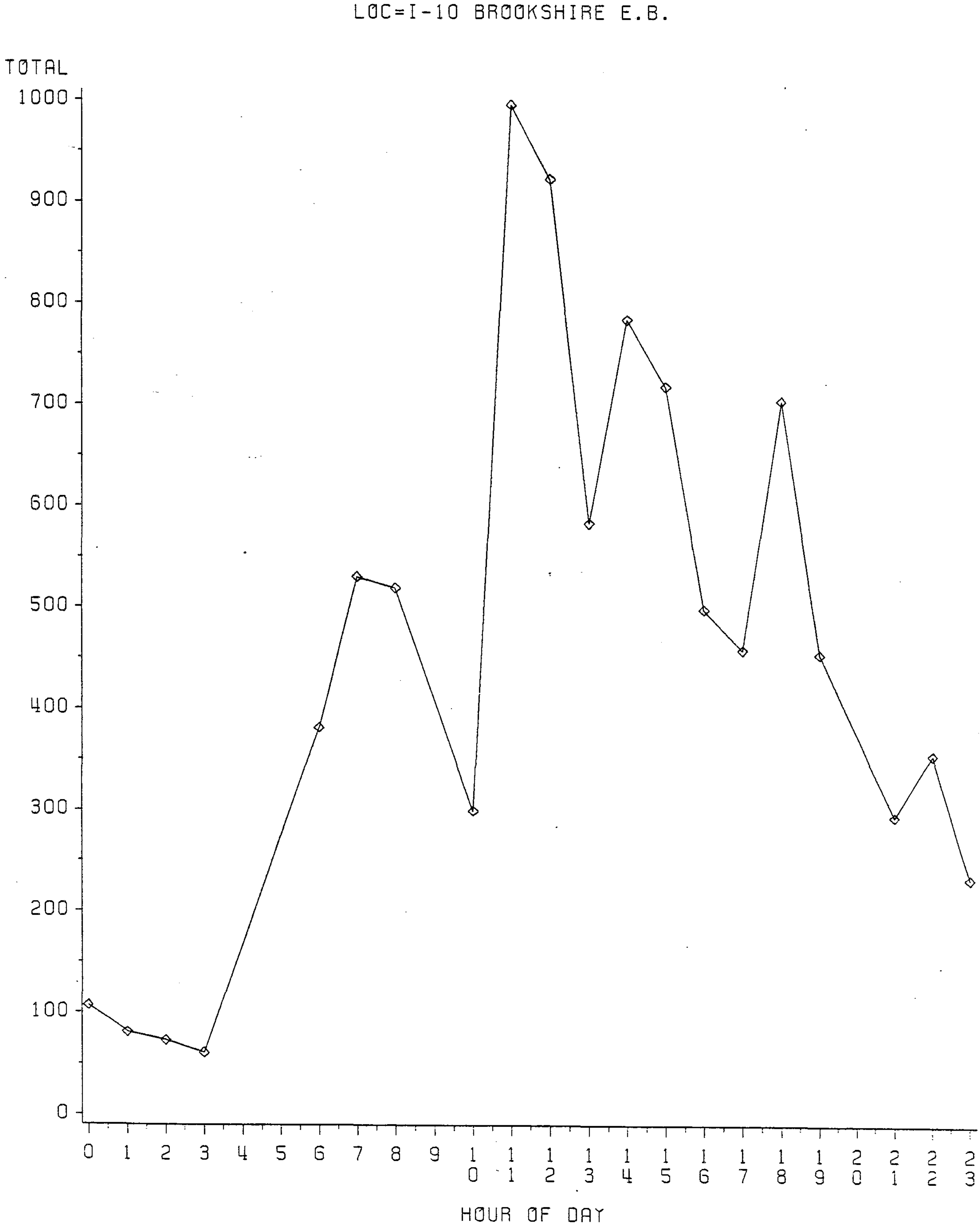


Figure 11. Total Number of Vehicles in the West-Bound Direction on I-10 at Brookshire

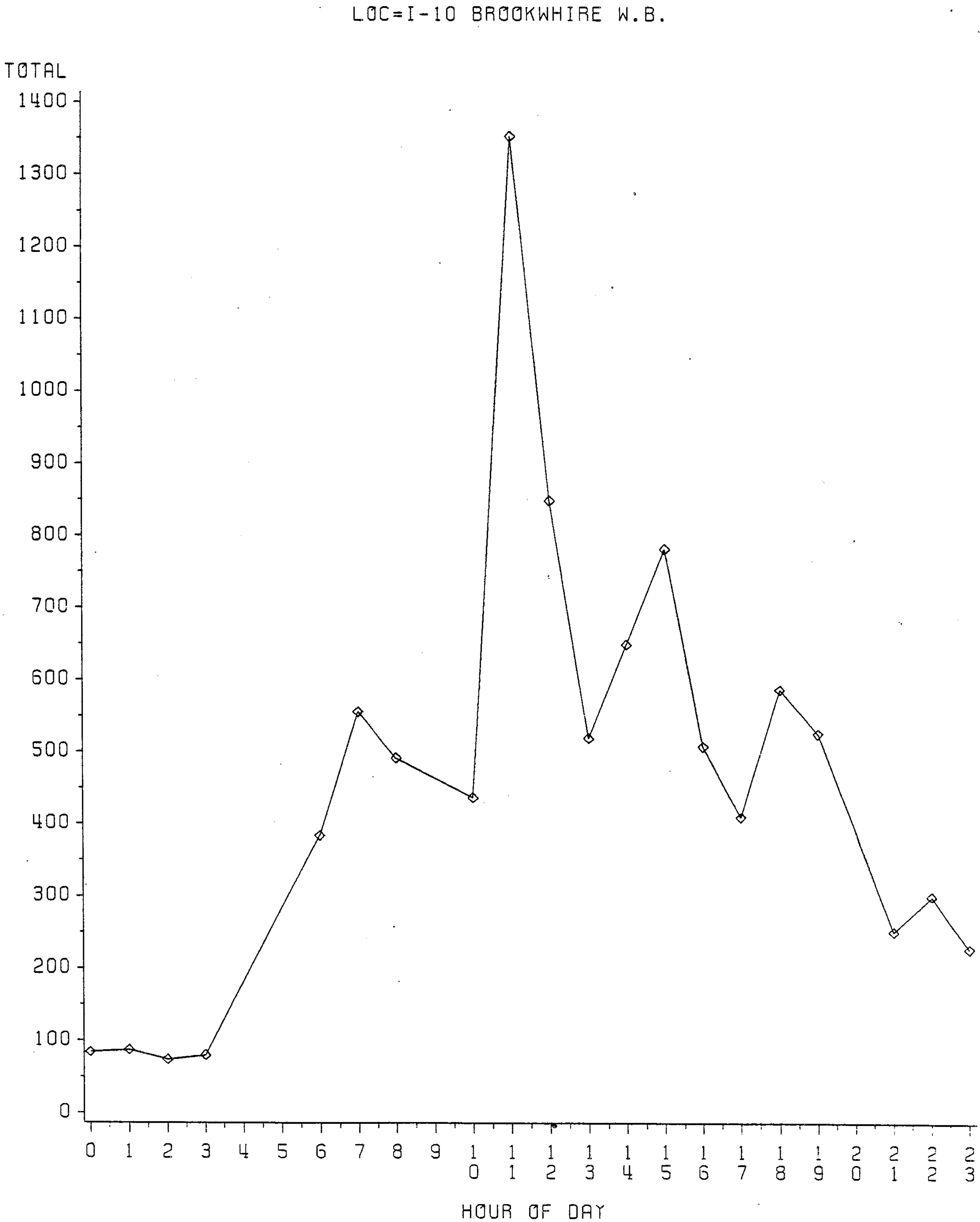


Figure 12. Total Number of Vehicles in the West-Bound Direction on Loop-635 (Inner Lanes) at LBJ and Preston in Dallas

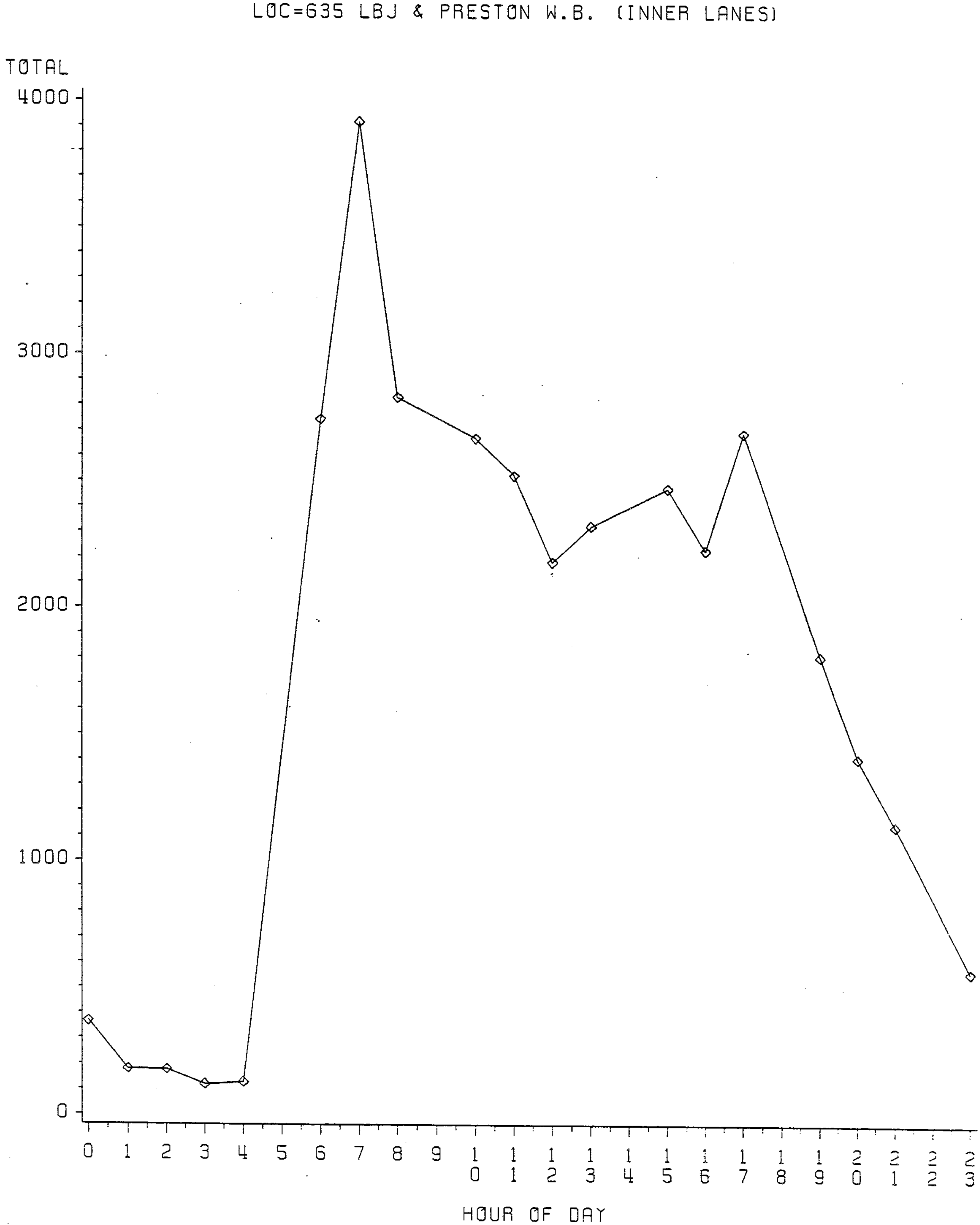


Figure 13. Total Number of Vehicles in the West-Bound Direction on Loop-635 (Outer Lanes) at LBJ and Preston in Dallas

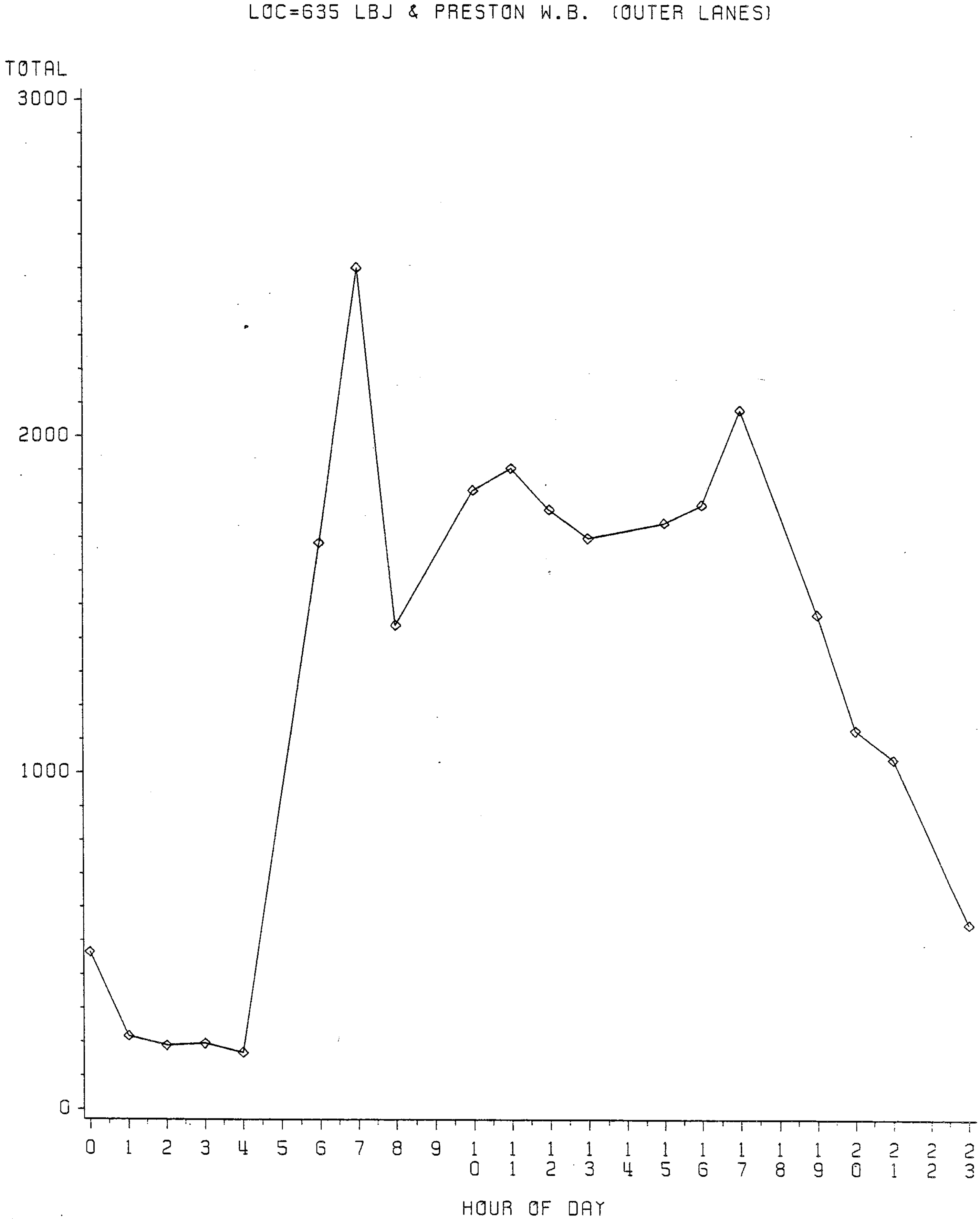


Figure 14. Total Number of Vehicles in the East-Bound Direction on I-10 (Inner Lanes) at San Antonio

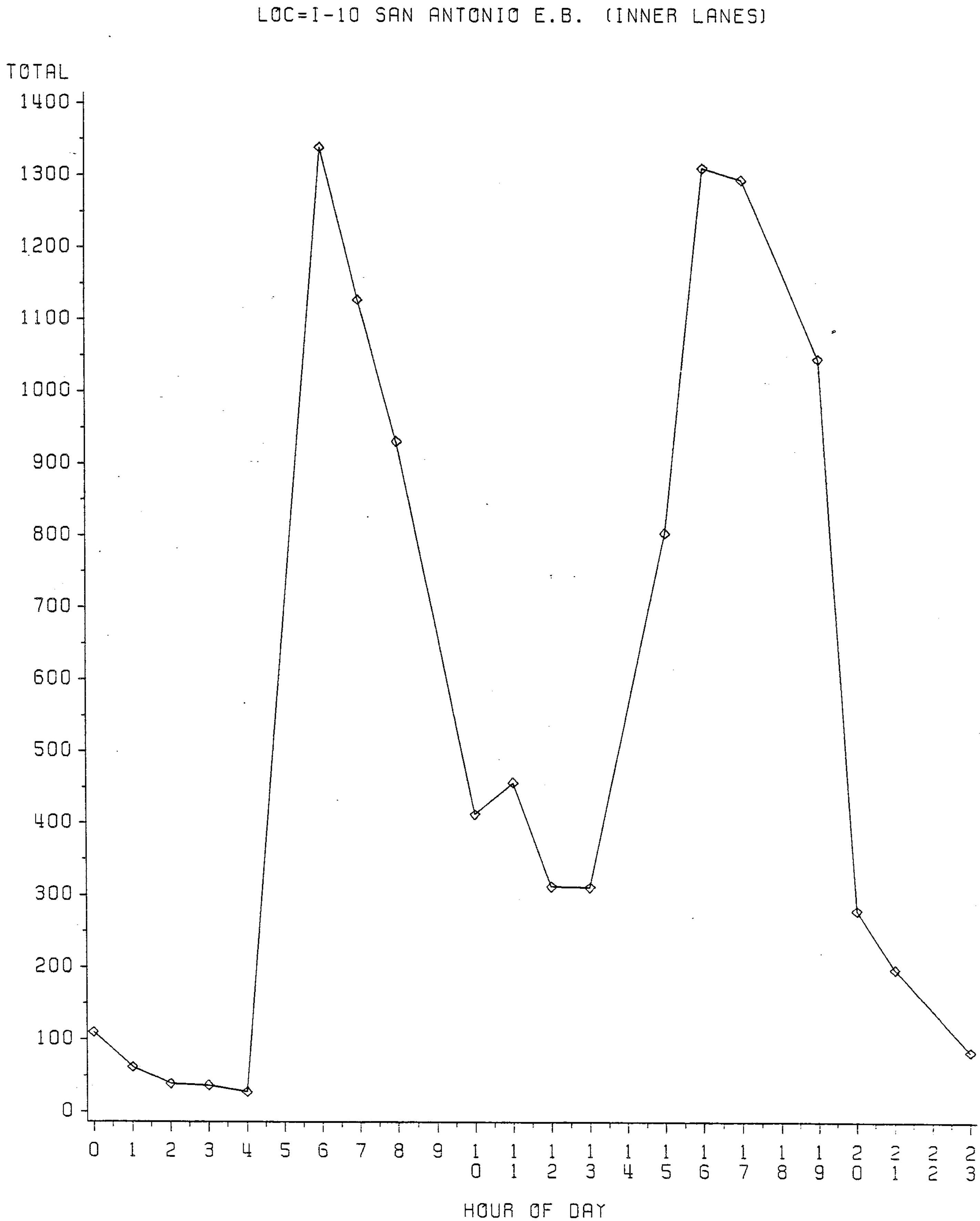


Figure 15. Total Number of Vehicles in the East-Bound Direction on I-10 (Outer Lanes) at San Antonio

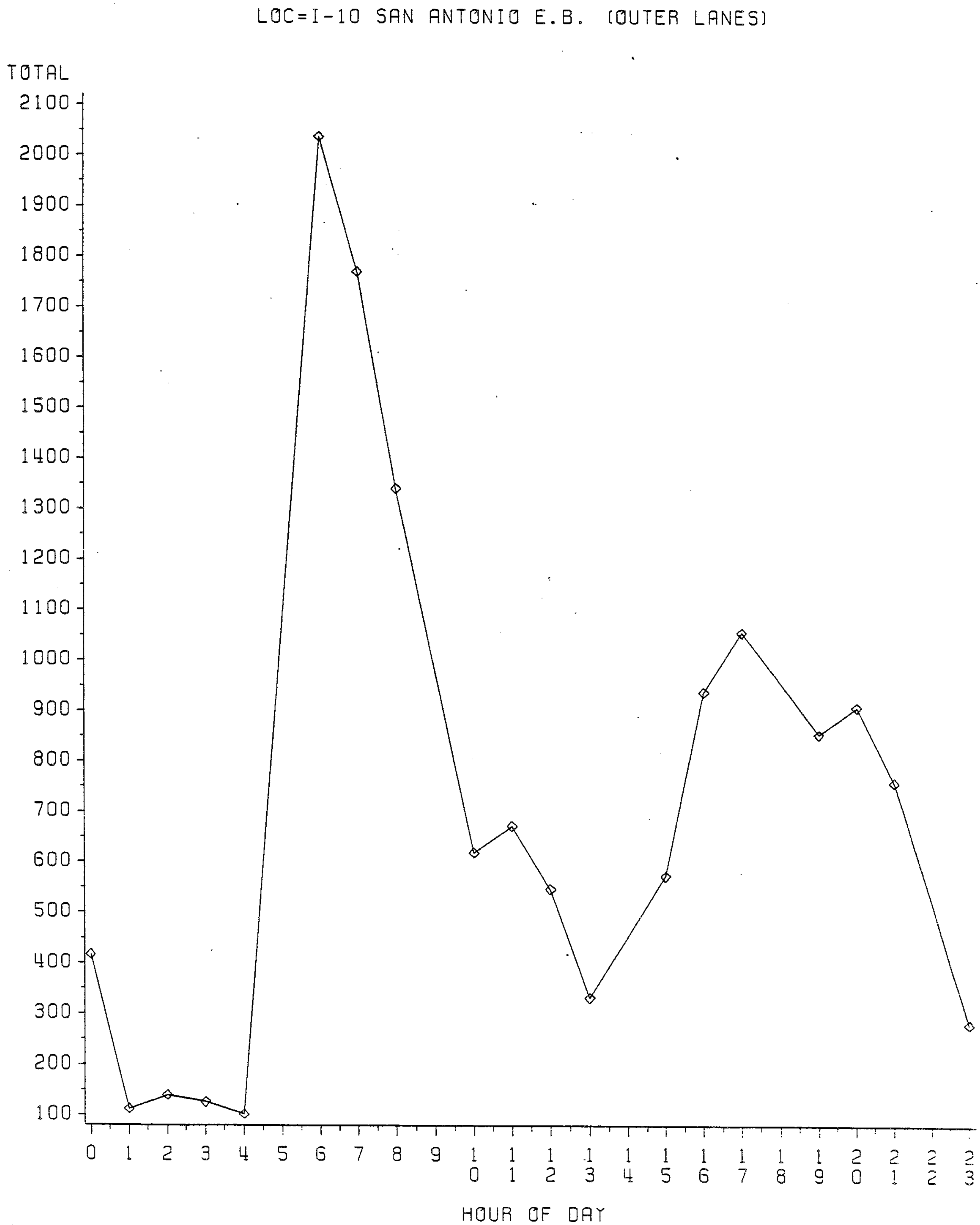


Figure 16. Percent Trucks in Lane 1 in the North-Bound Direction on I-35 at San Marcos

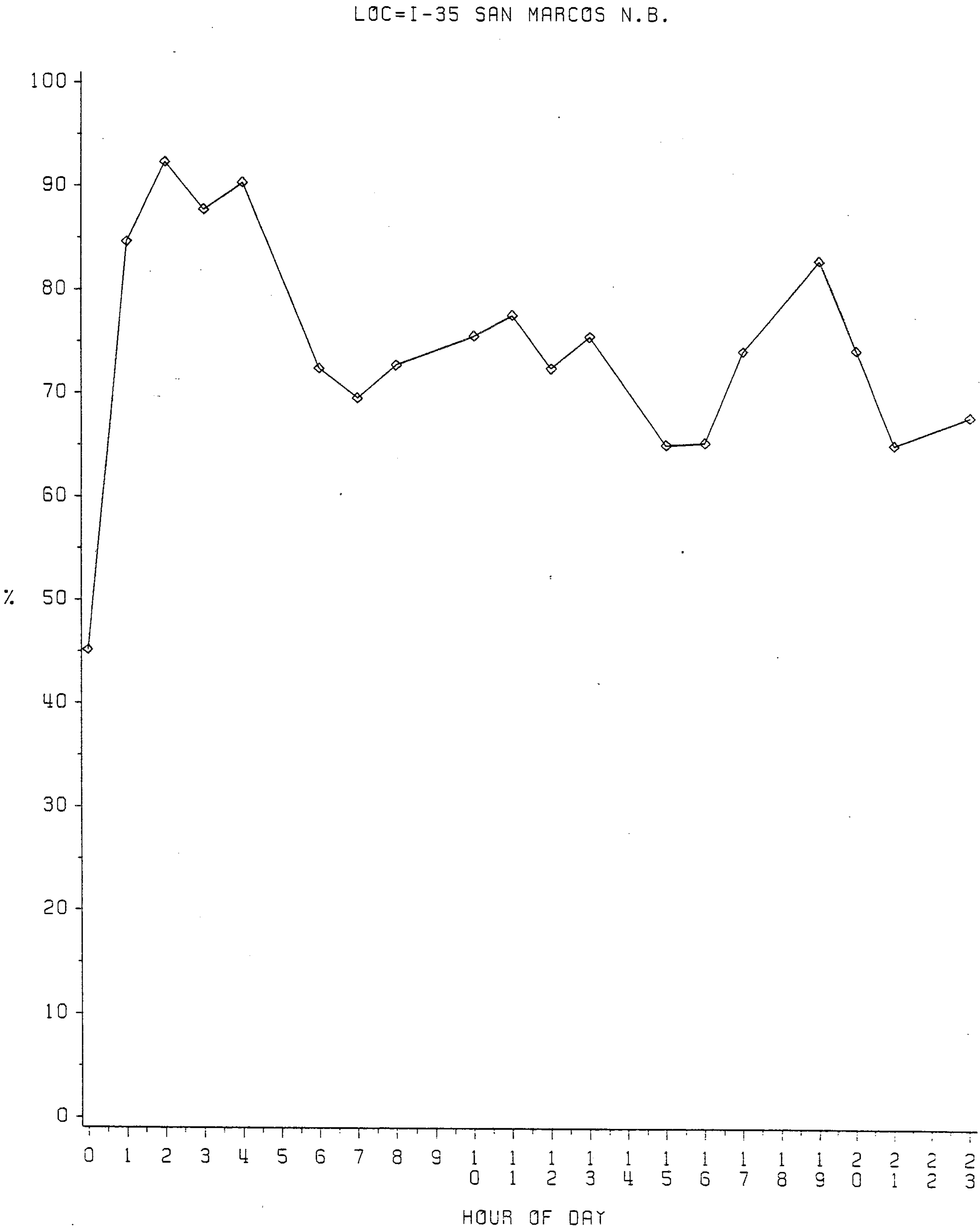


Figure 17. Percent Trucks in Lane 2 in the North-Bound Direction on I-35 at San Marcos

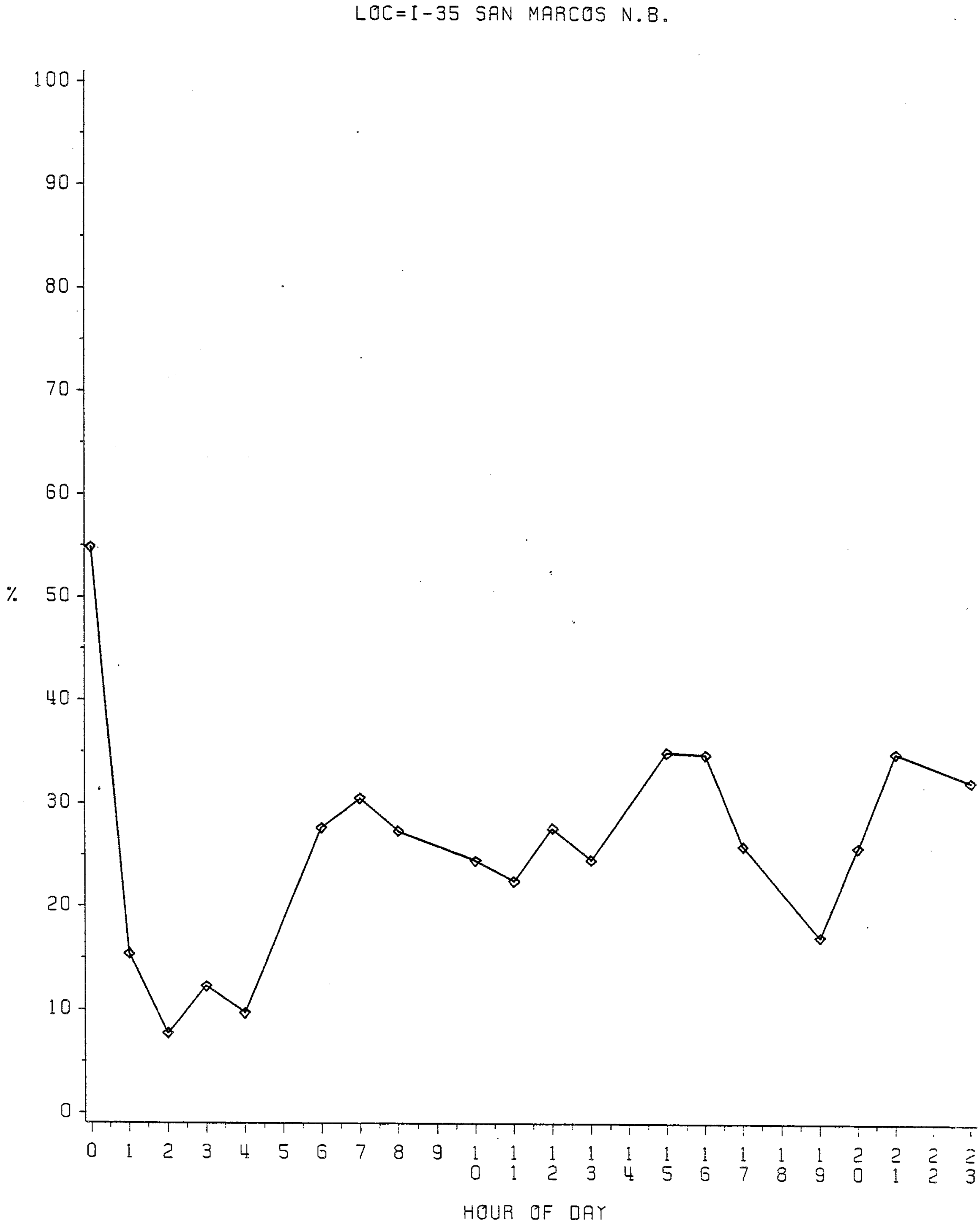


Figure 18. Percent Trucks in Lane 1 in the South-Bound Direction on I-35 at San Marcos

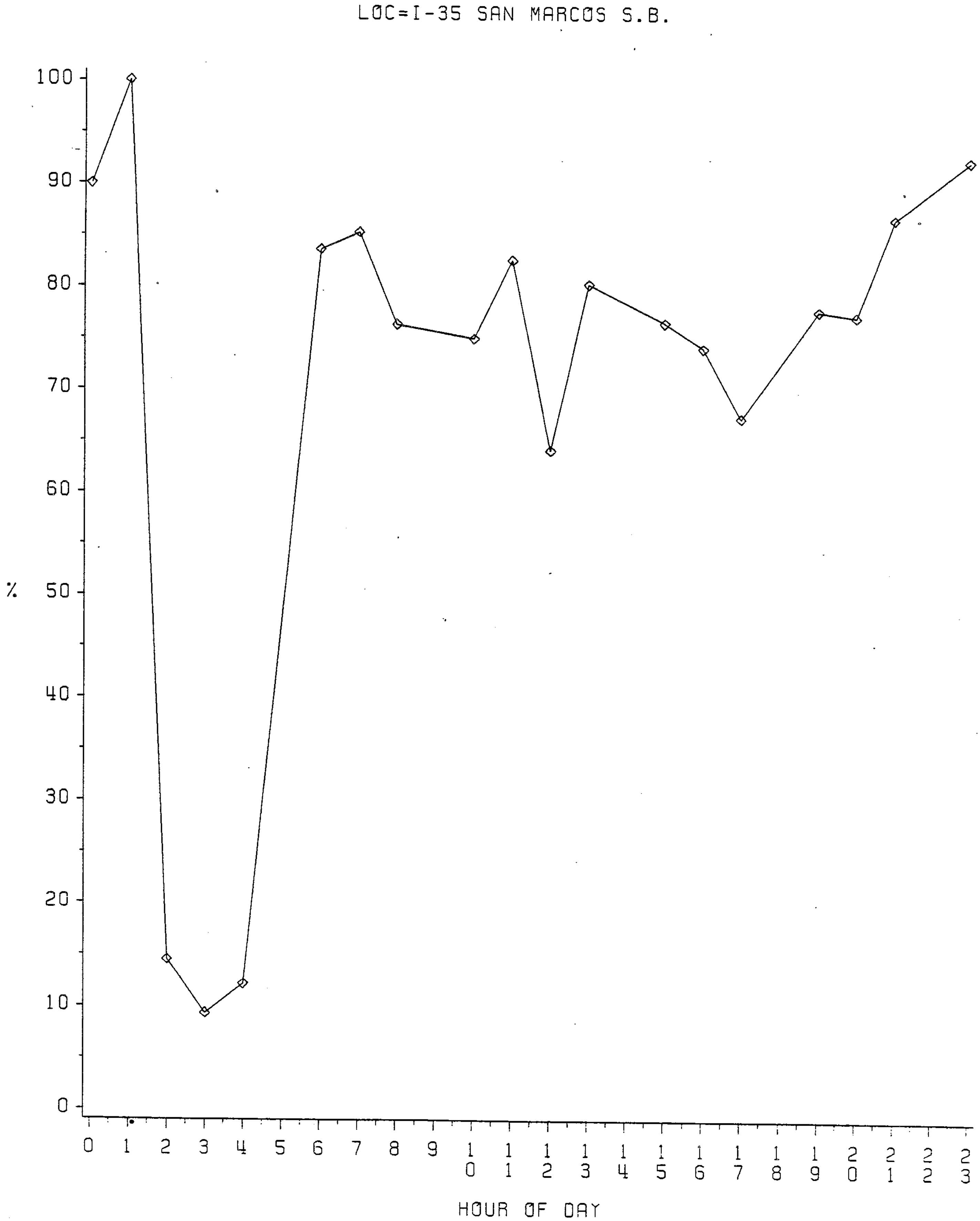


Figure 19. Percent Trucks in Lane 2 in the South-Bound Direction on I-35 at San Marcos

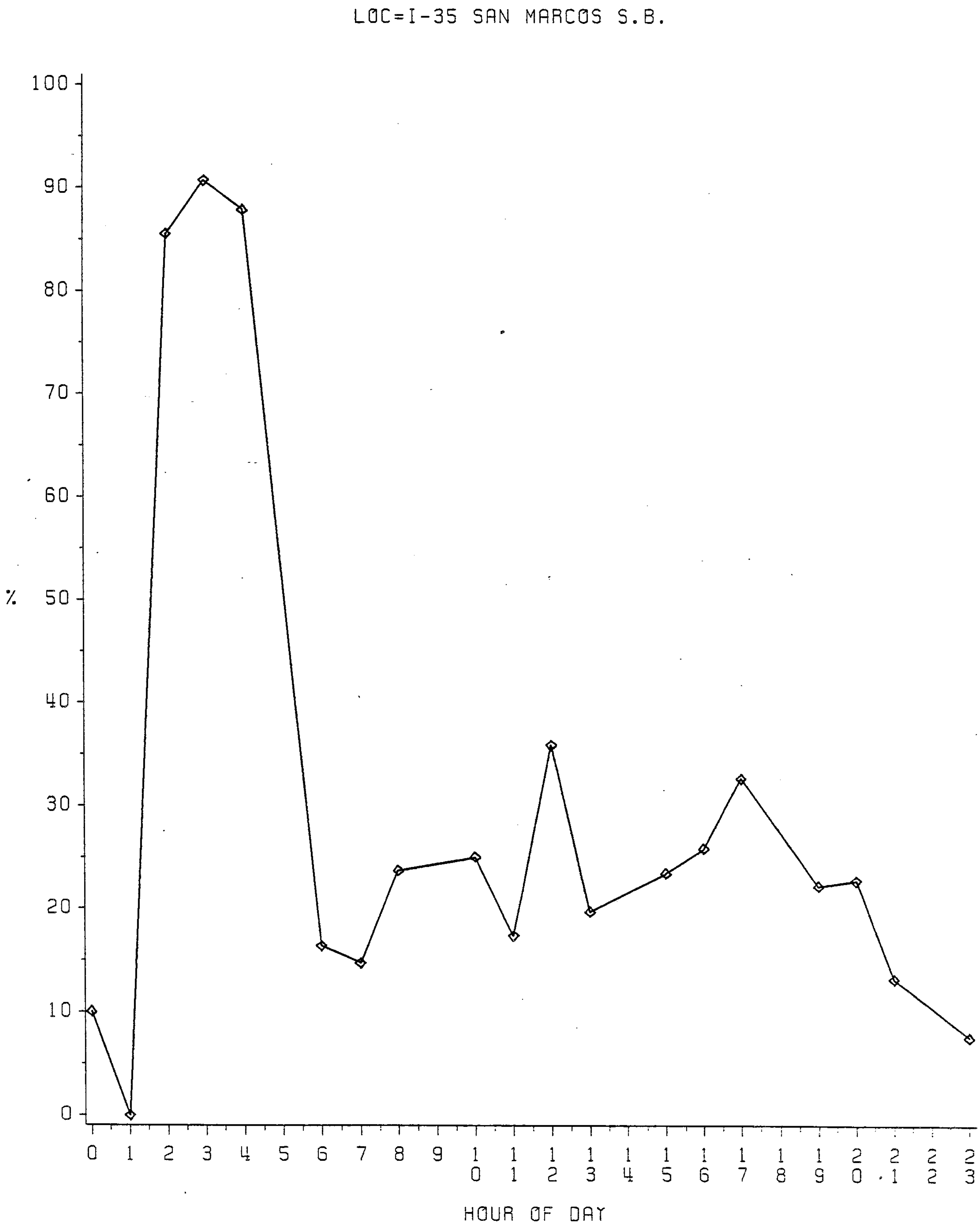


Figure 20. Percent Trucks in Lane 1 in the North-Bound Direction on US-59 at Angelina

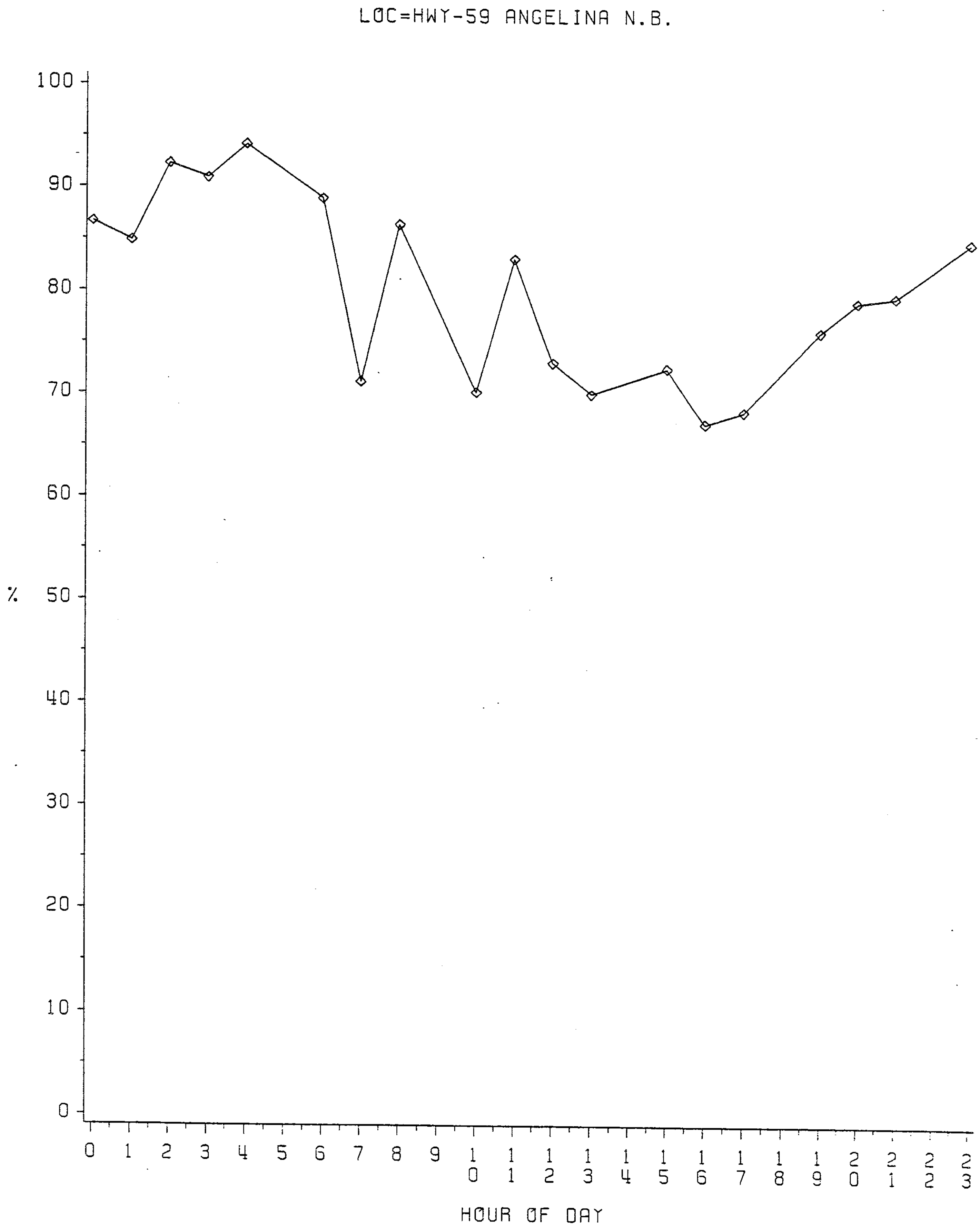


Figure 21. Percent Trucks in Lane 2 in the North-Bound Direction on US-59 at Angelina

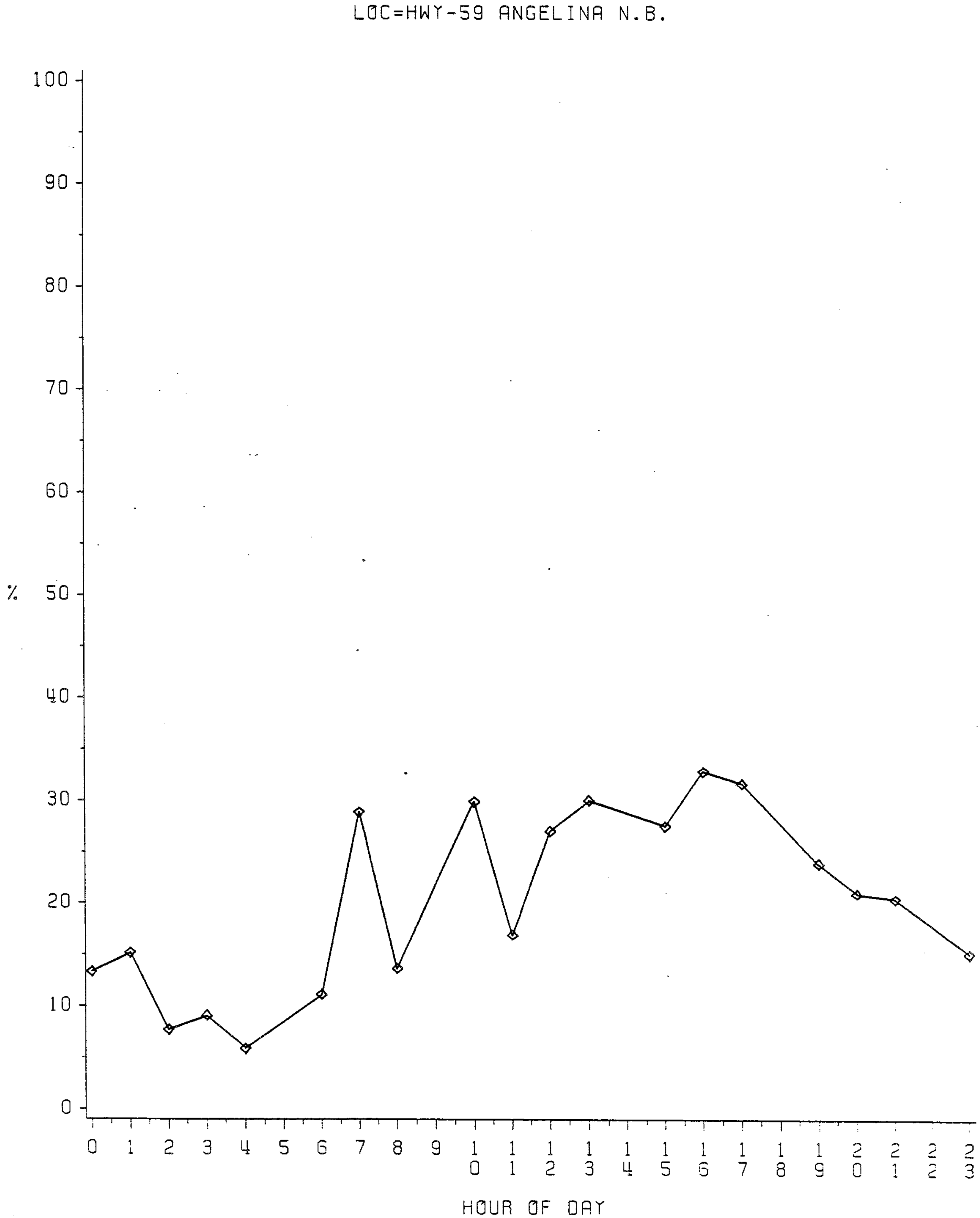


Figure 22. Percent Trucks in Lane 1 in the South-Bound Direction on US-59 at Angelina

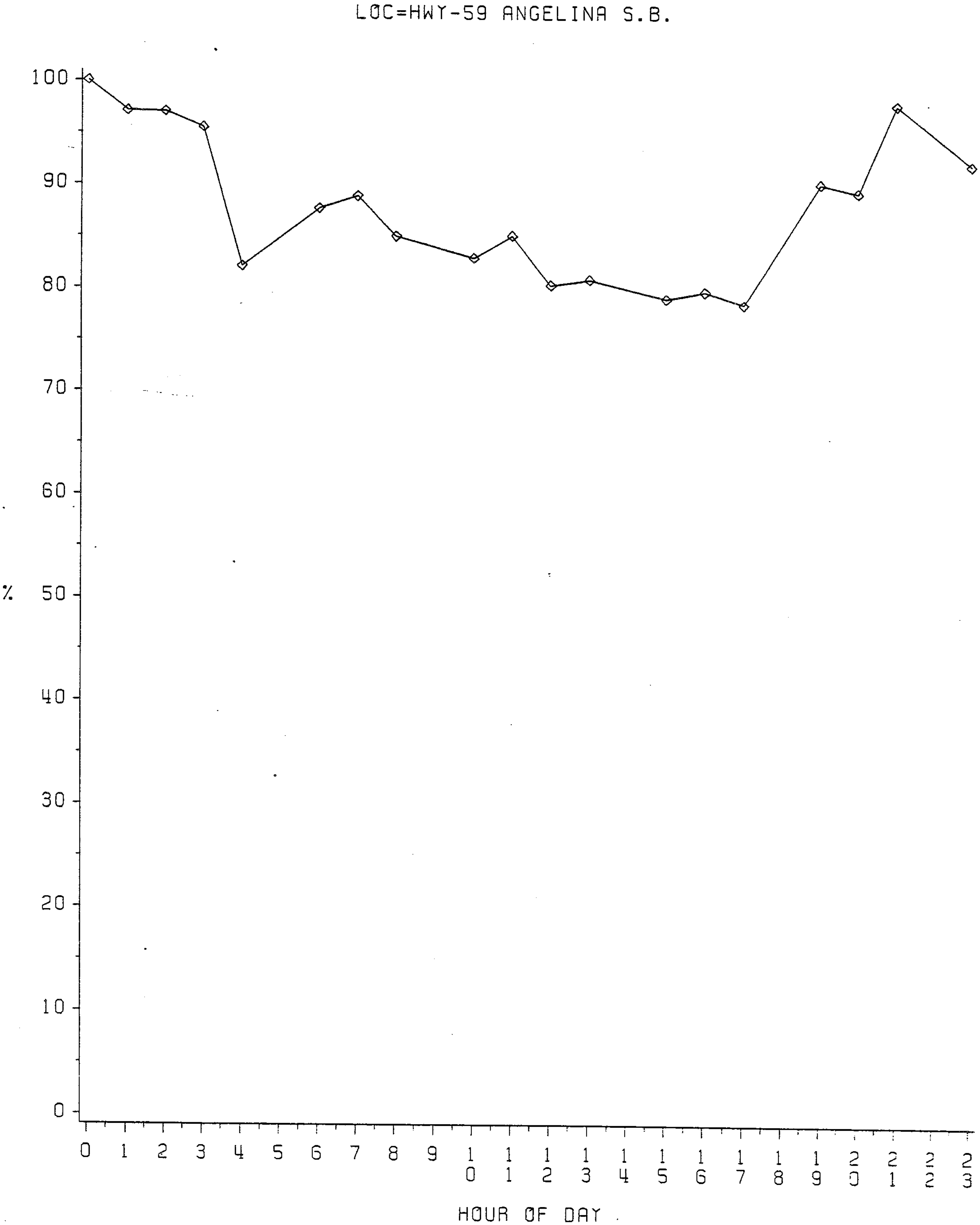


Figure 23. Percent Trucks in Lane 2 in the South-Bound Direction on US-59 at Angelina

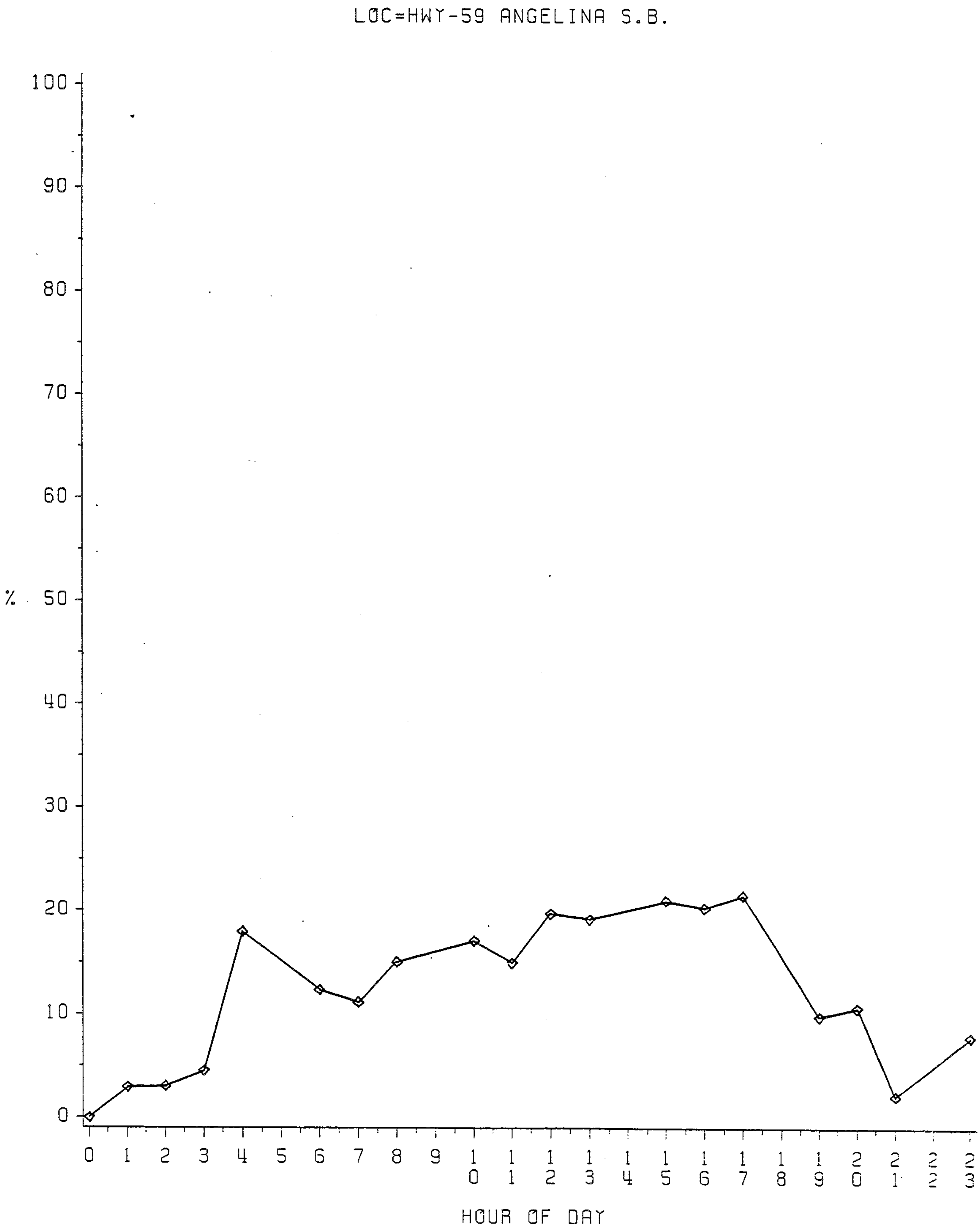


Figure 24. Percent Trucks in Lane 1 in the North-Bound Direction on US-59 at Lufkin

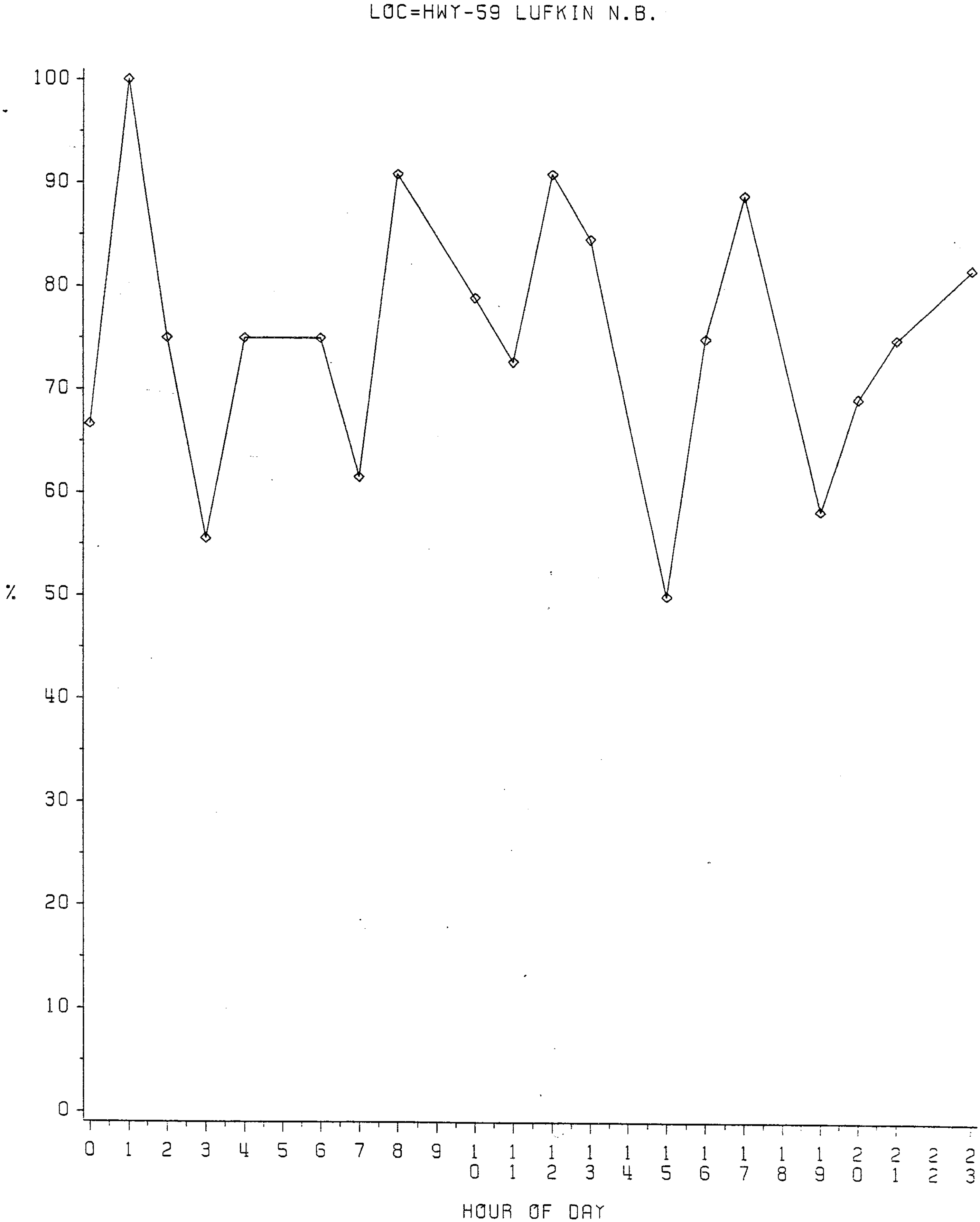


Figure 25. Percent Trucks in Lane 2 in the North-Bound Direction on US-59 at Lufkin

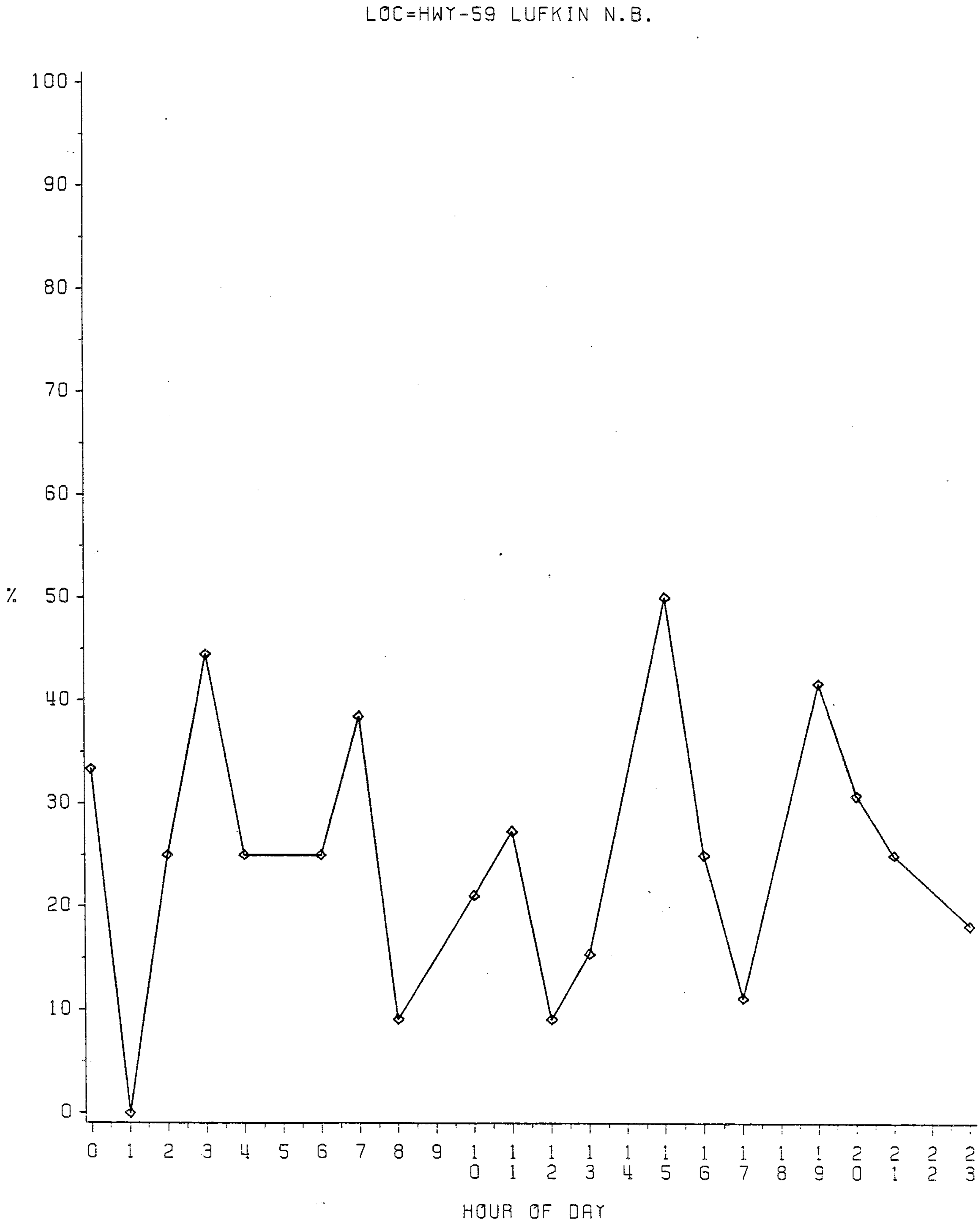


Figure 27. Percent Trucks in Lane 2 in the South-Bound Direction on US-59 at Lufkin

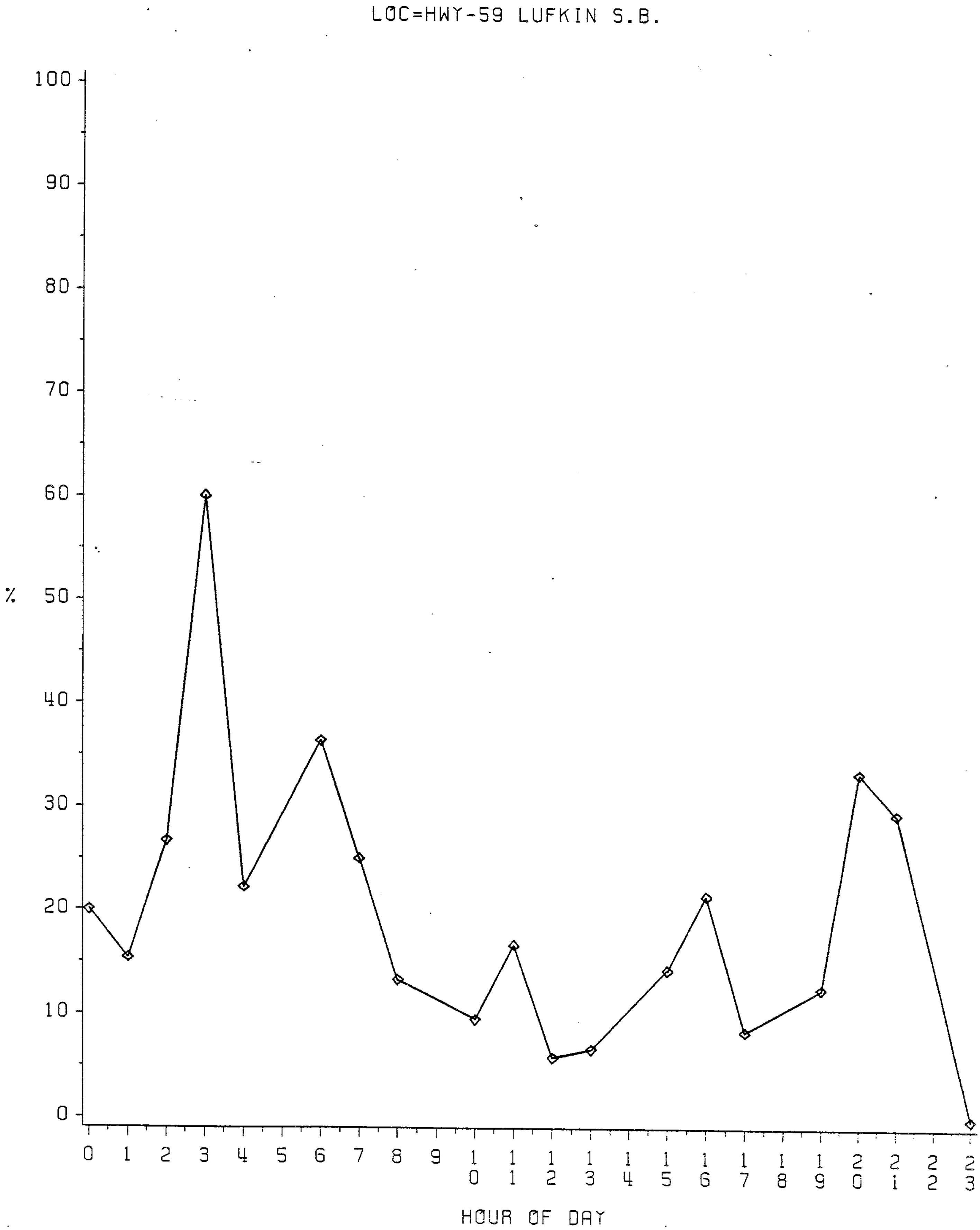


Figure 26. Percent Trucks in Lane 1 in the South-Bound Direction on US-59 at Lufkin

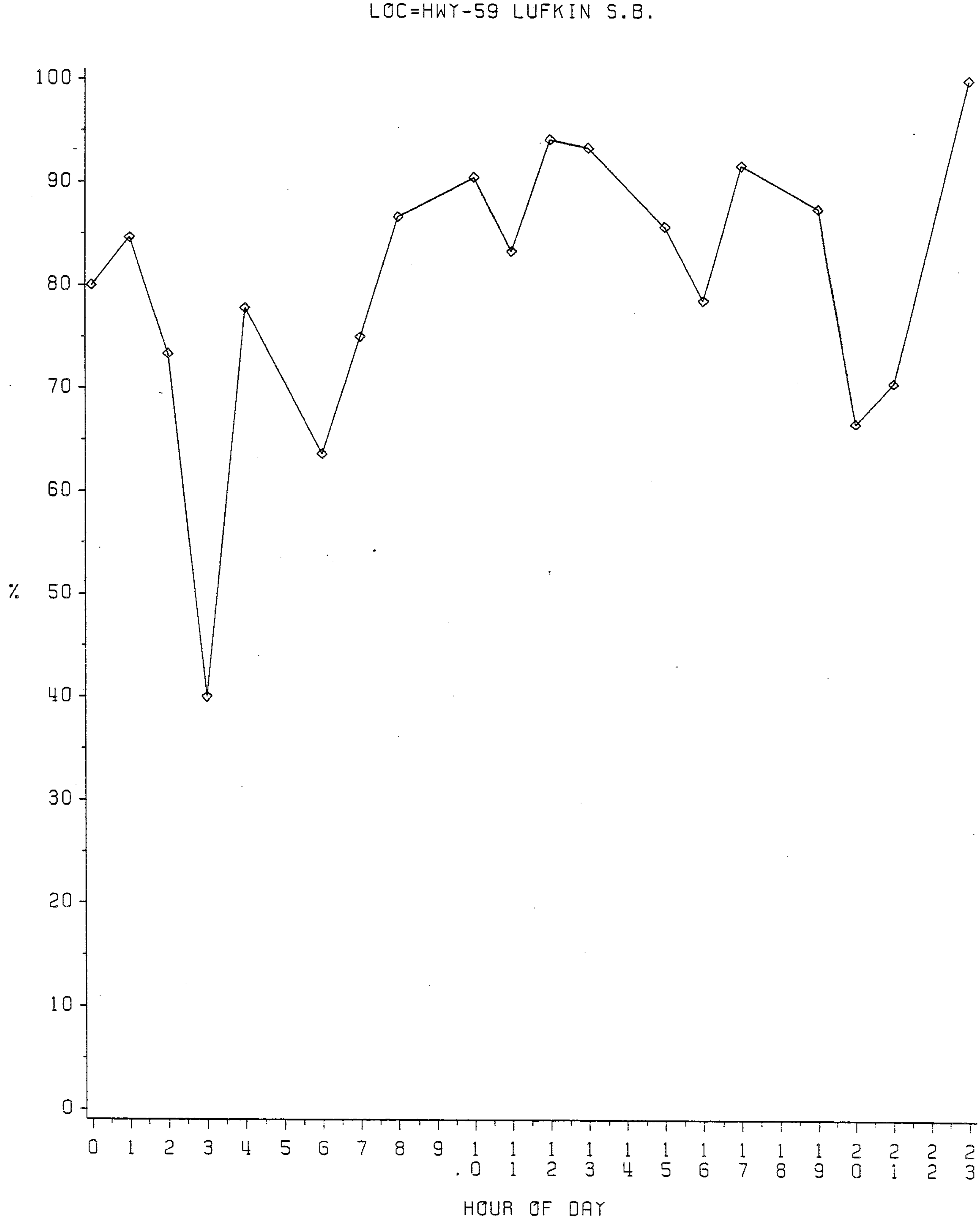


Figure 28. Percent Trucks in Lane 1 in the North-Bound Direction on I-35 at San Antonio

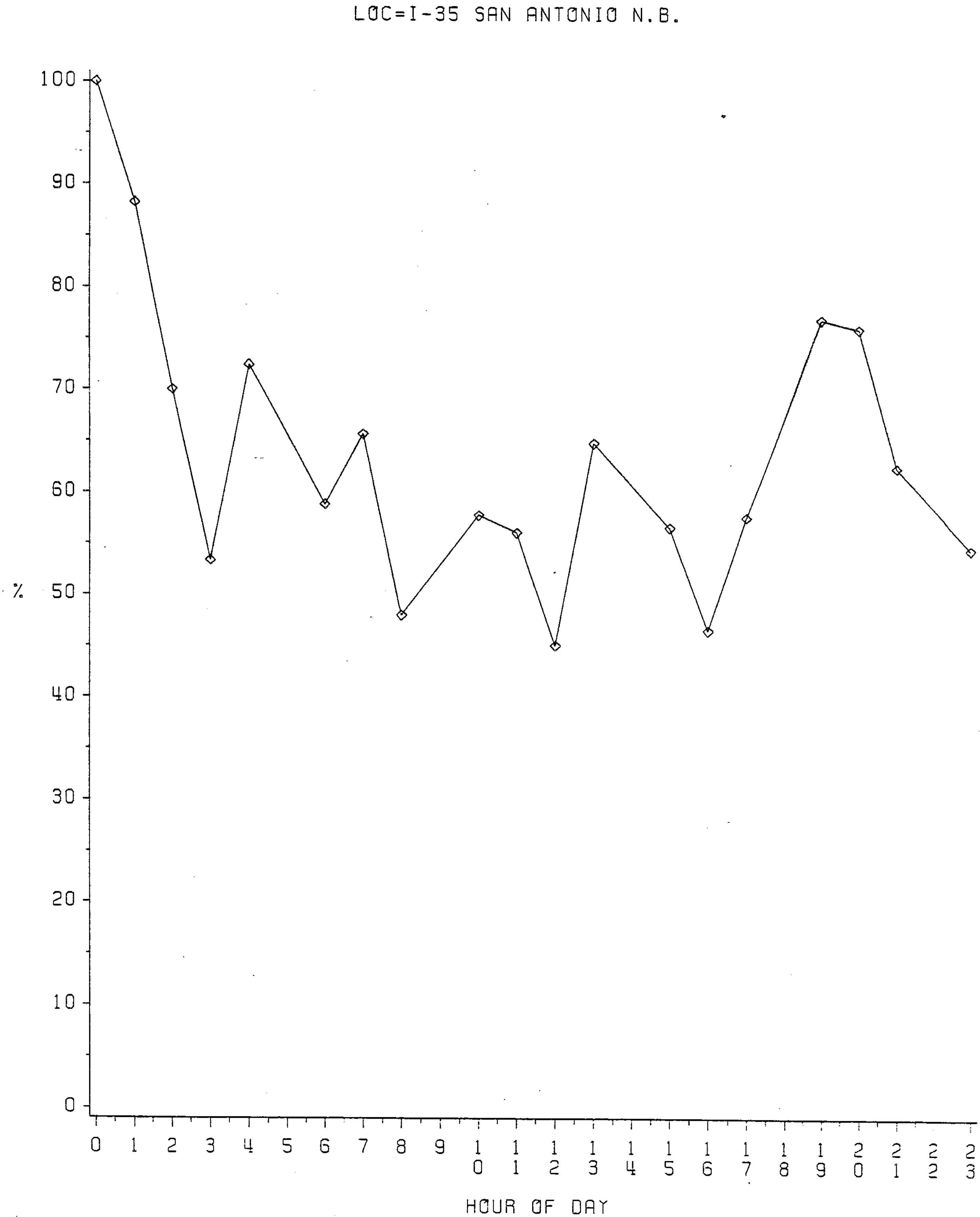


Figure 29. Percent Trucks in Lane 2 in the North-Bound Direction on I-35 at San Antonio

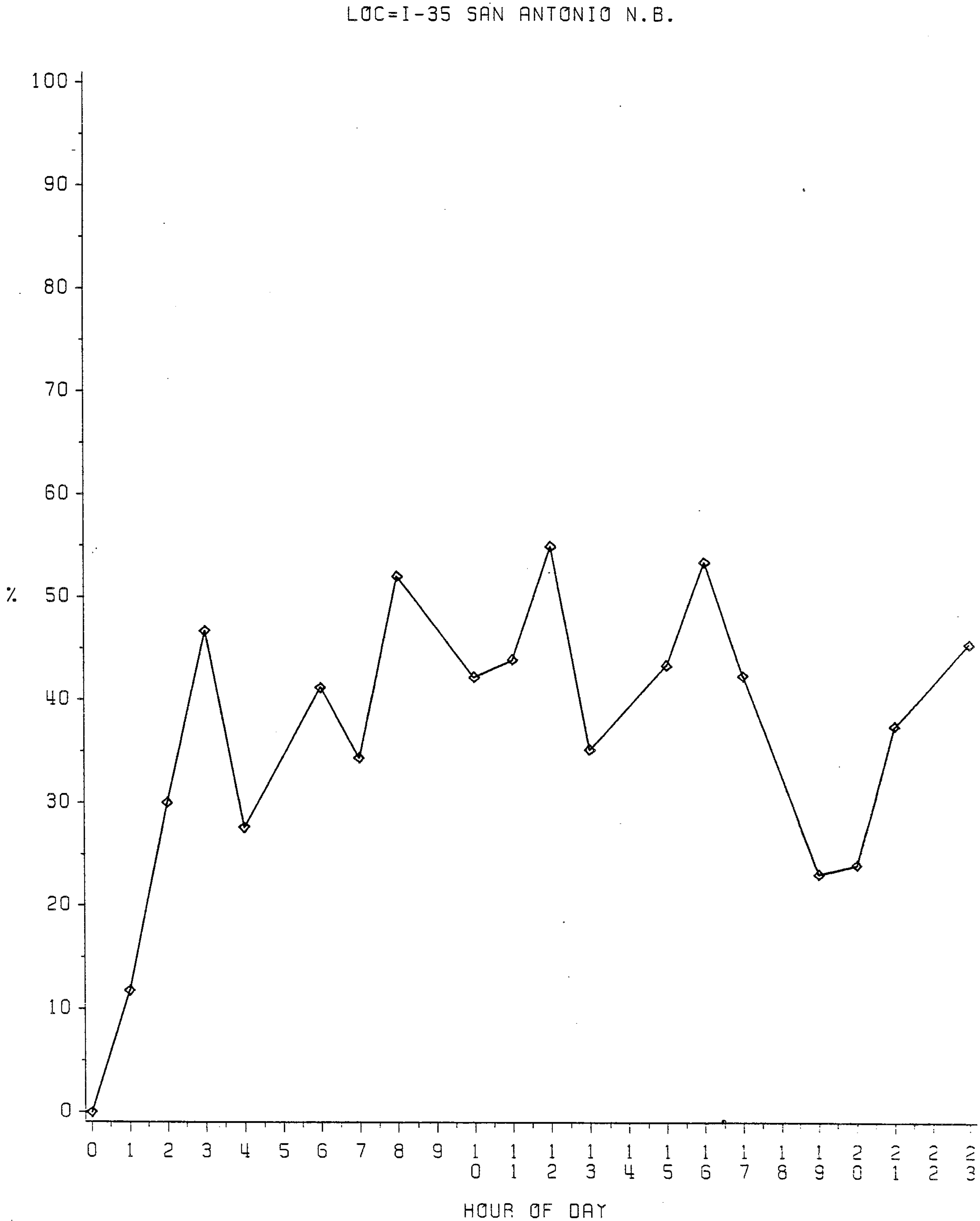


Figure 30. Percent Trucks in Lane 1 in the South-Bound Direction on I-35 at San Antonio

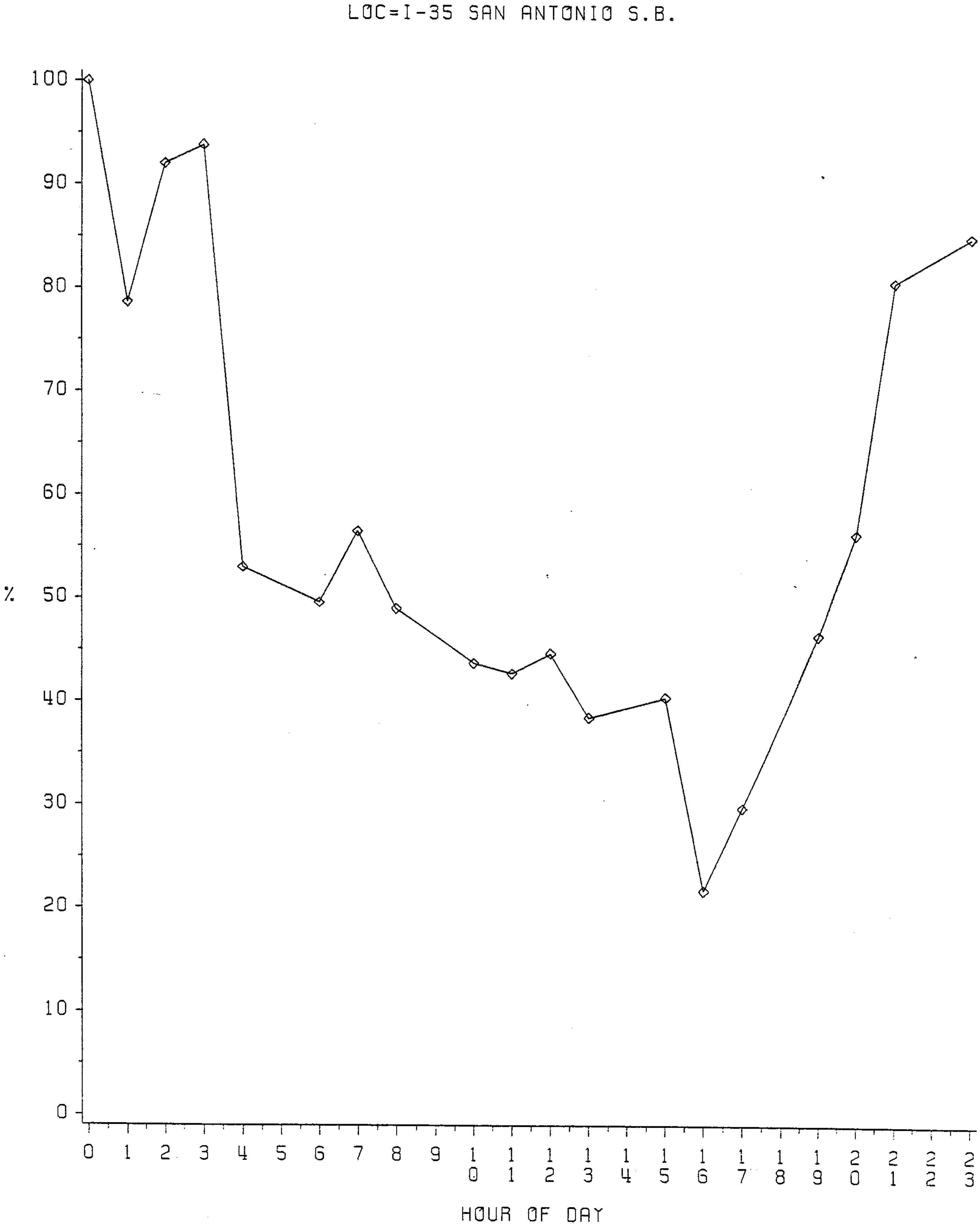


Figure 31. Percent Trucks in Lane 2 in the South-Bound Direction on I-35 at San Antonio

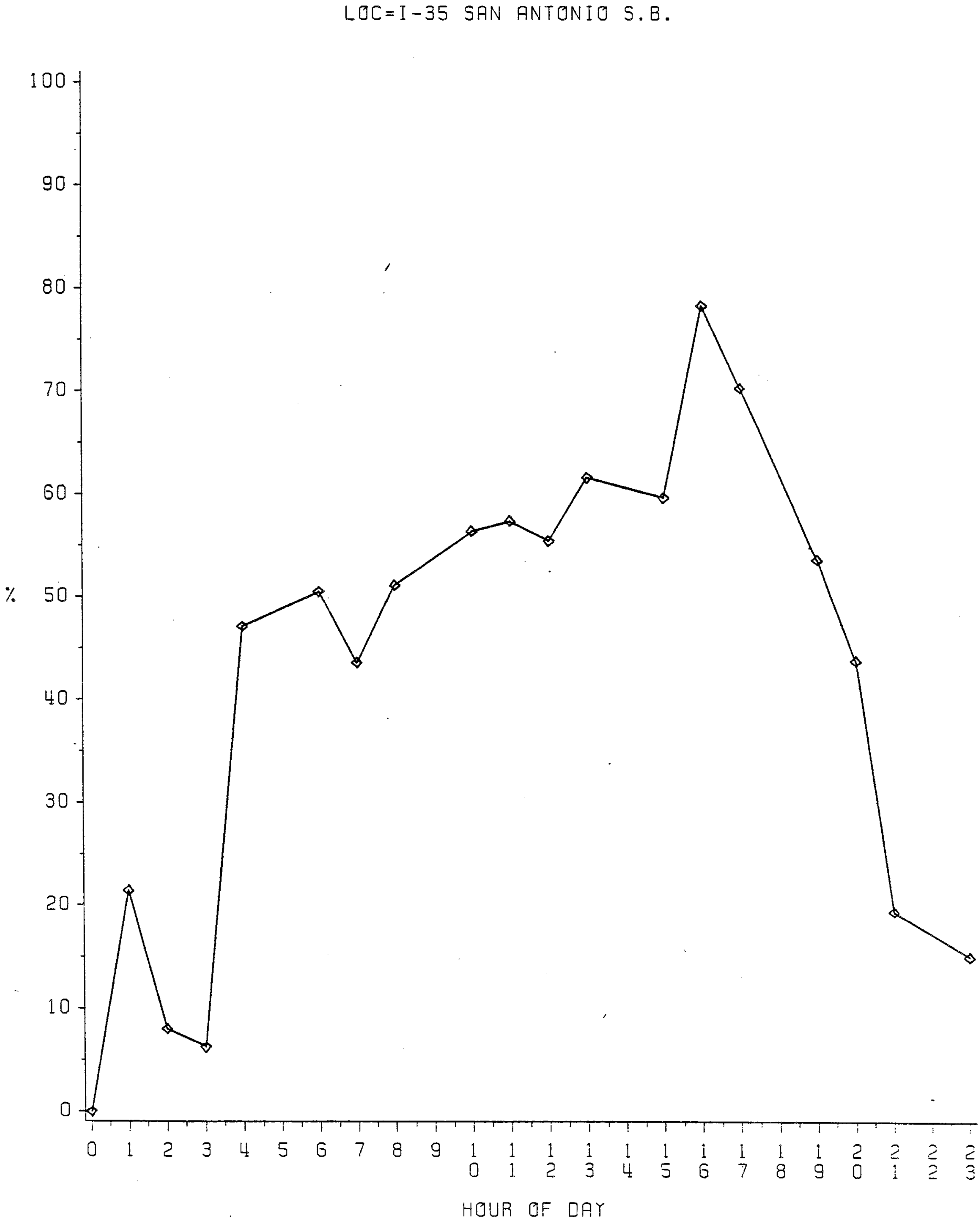


Figure 32. Percent Trucks in Lane 1 in the East-Bound Direction on I-10 at Brookshire

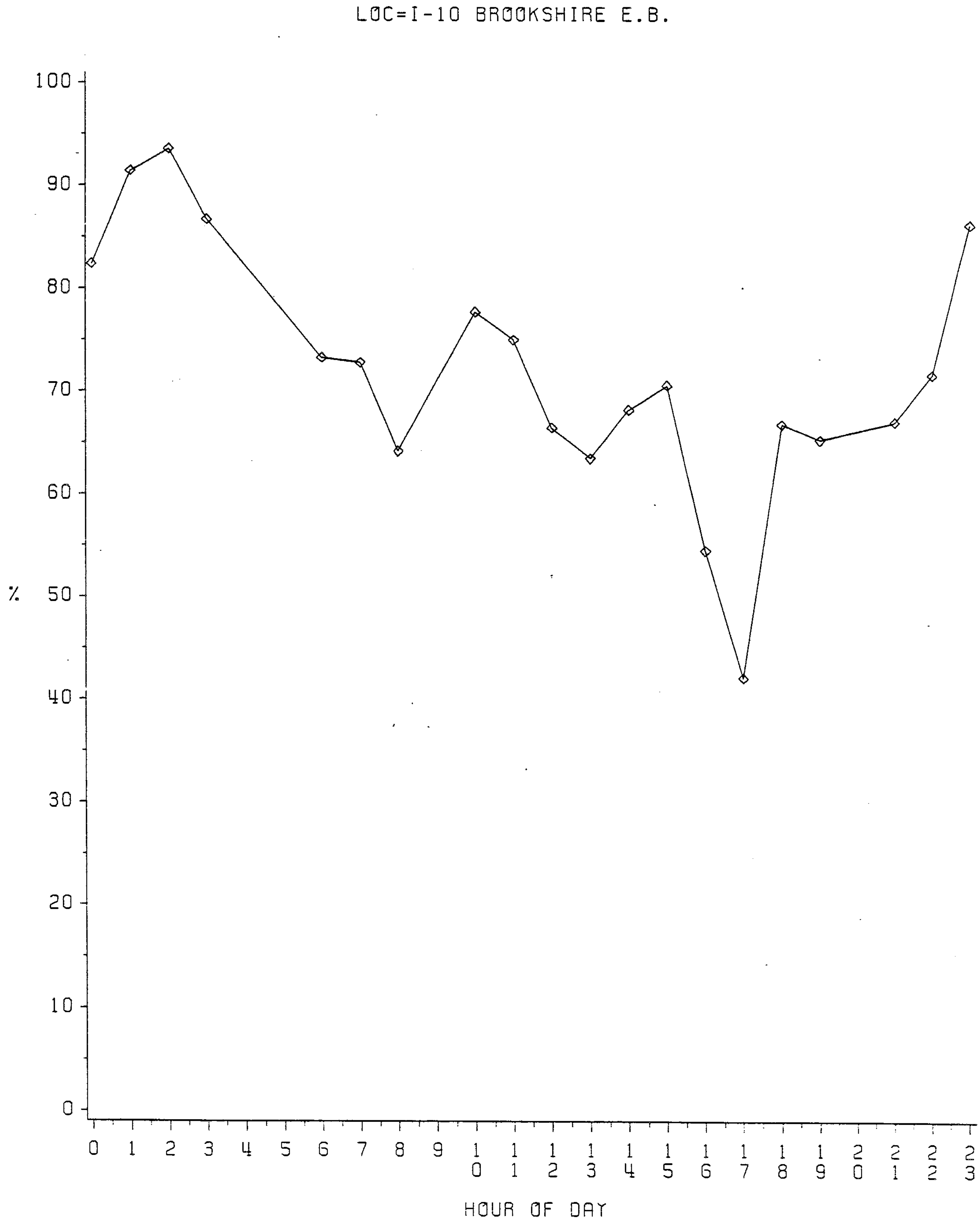


Figure 33. Percent Trucks in Lane 2 in the East-Bound Direction on I-10 at Brookshire

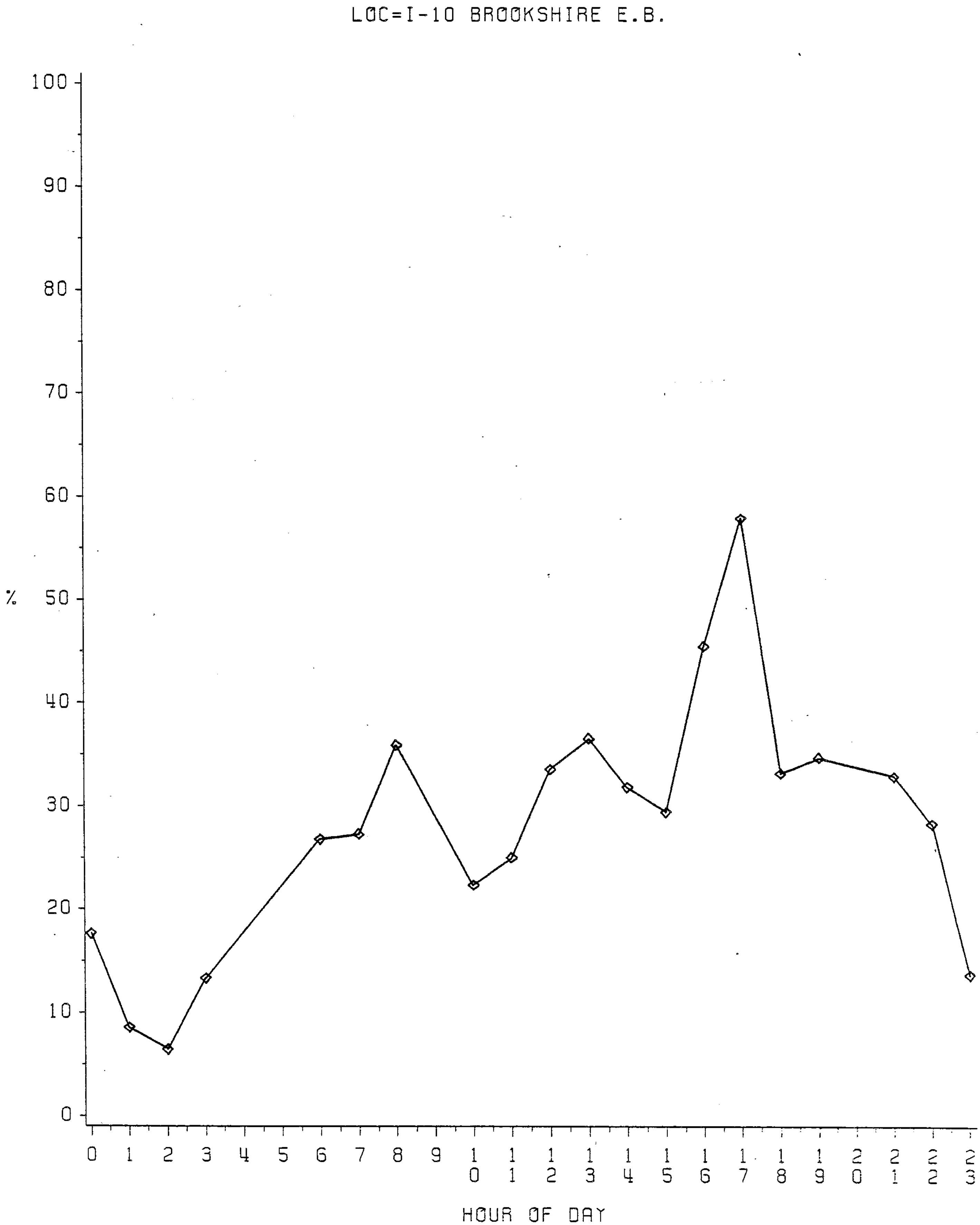


Figure 34. Percent Trucks in Lane 1 in the West-Bound Direction on I-10 at Brookshire

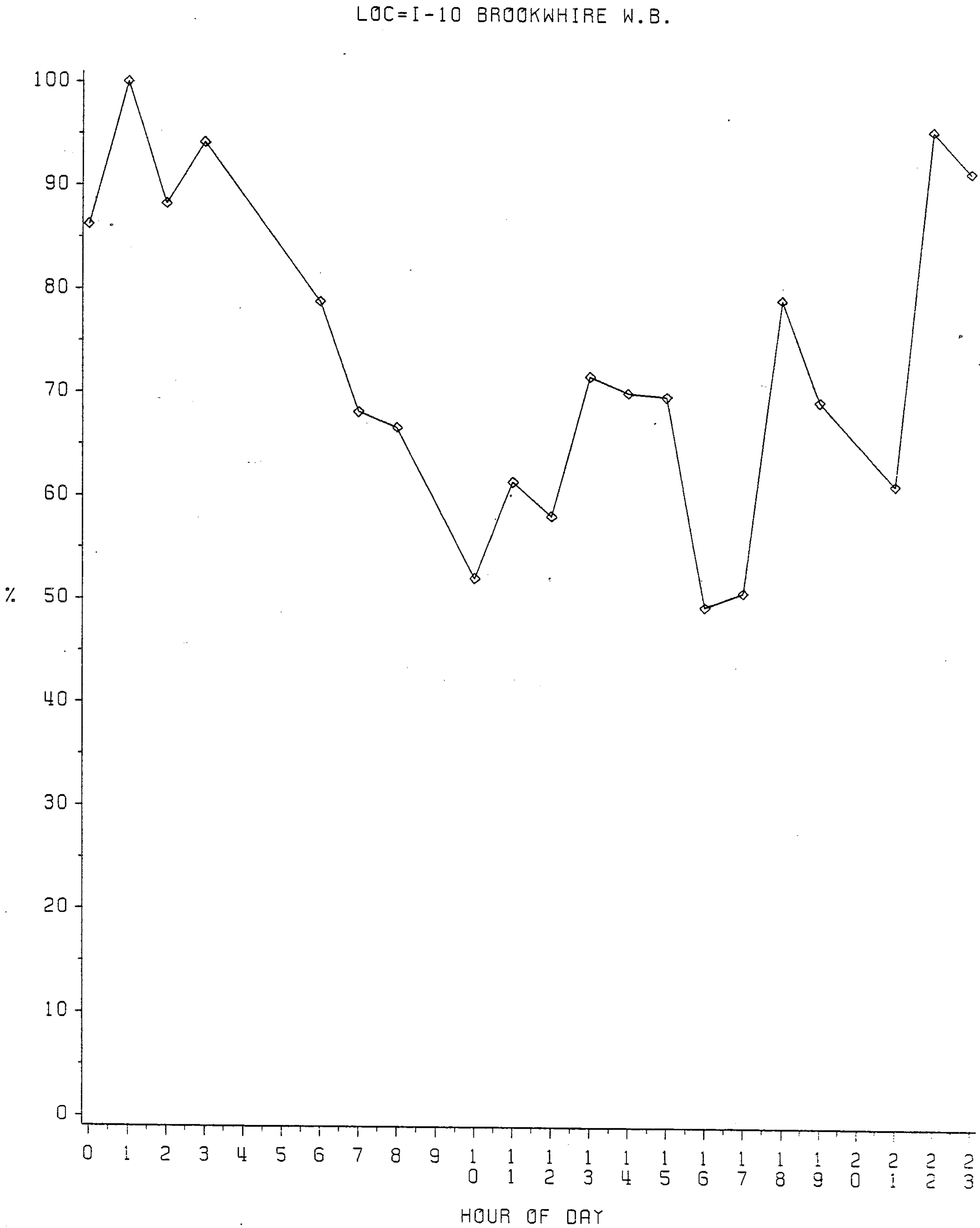


Figure 35. Percent Trucks in Lane 2 in the West-Bound Direction on I-10 at Brookshire

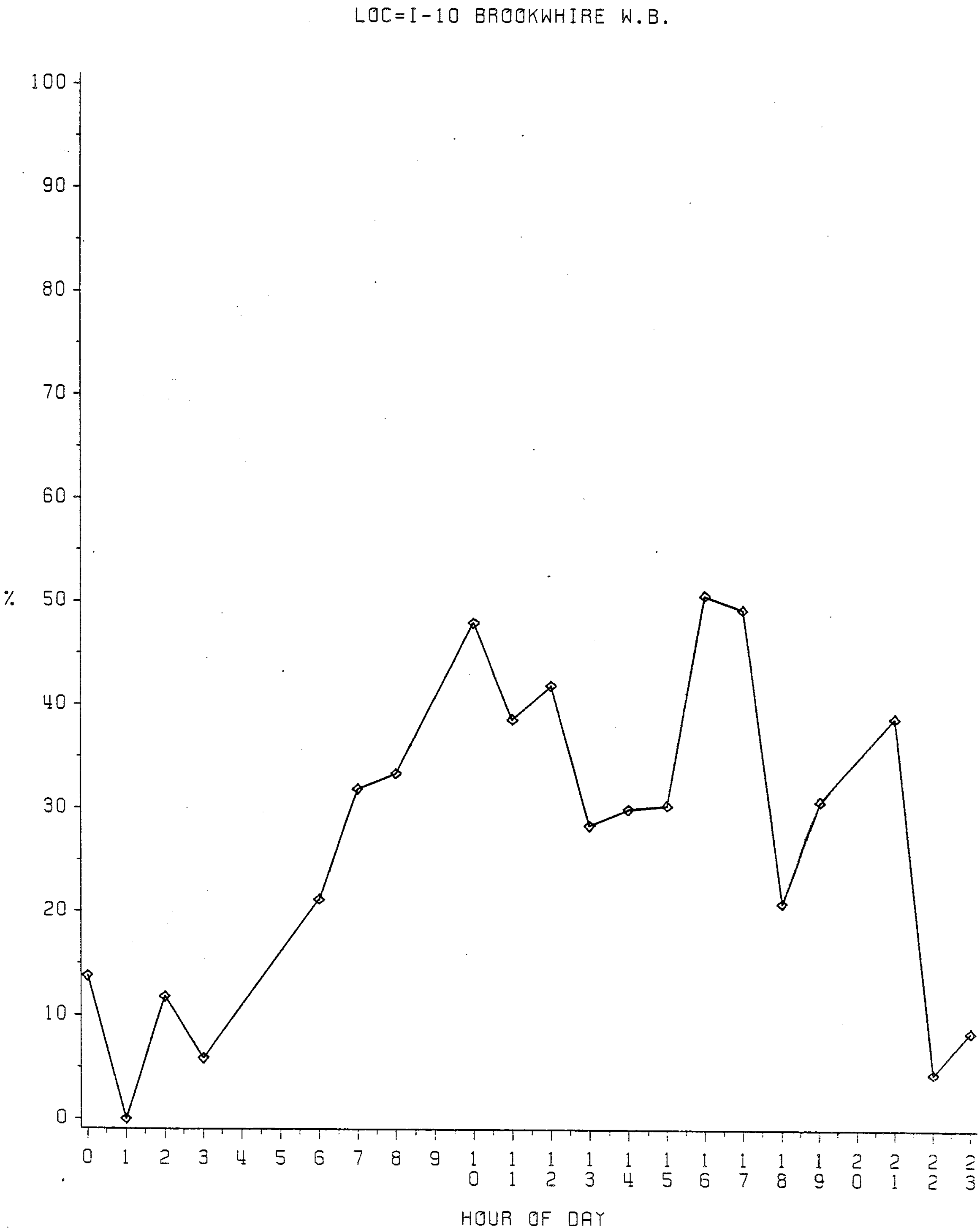


Figure 36. Percent Trucks in Lane 1 in the West-Bound Direction on I-10 at Houston

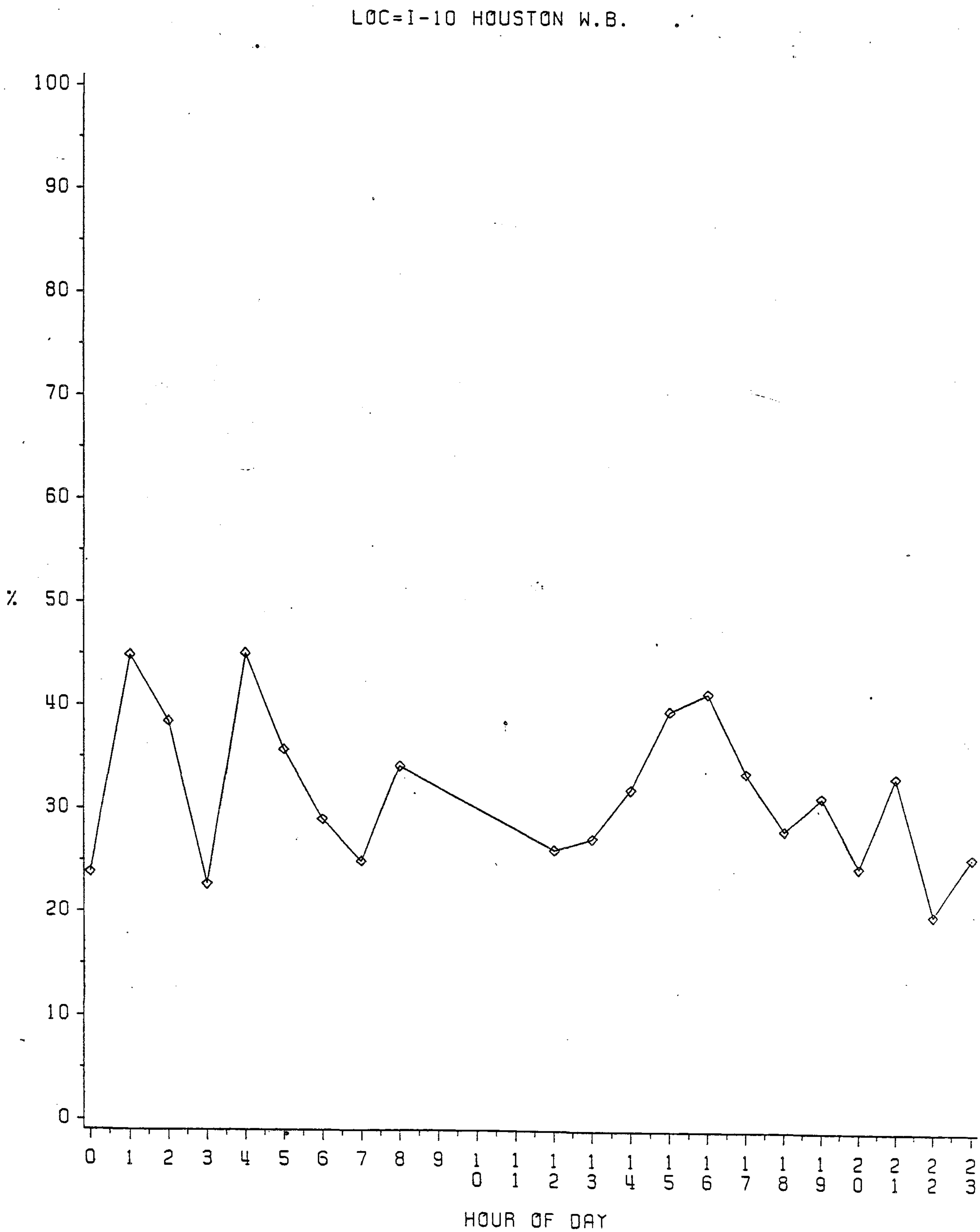


Figure 37. Percent Trucks in Lane 2 in the West-Bound Direction on I-10 at Houston

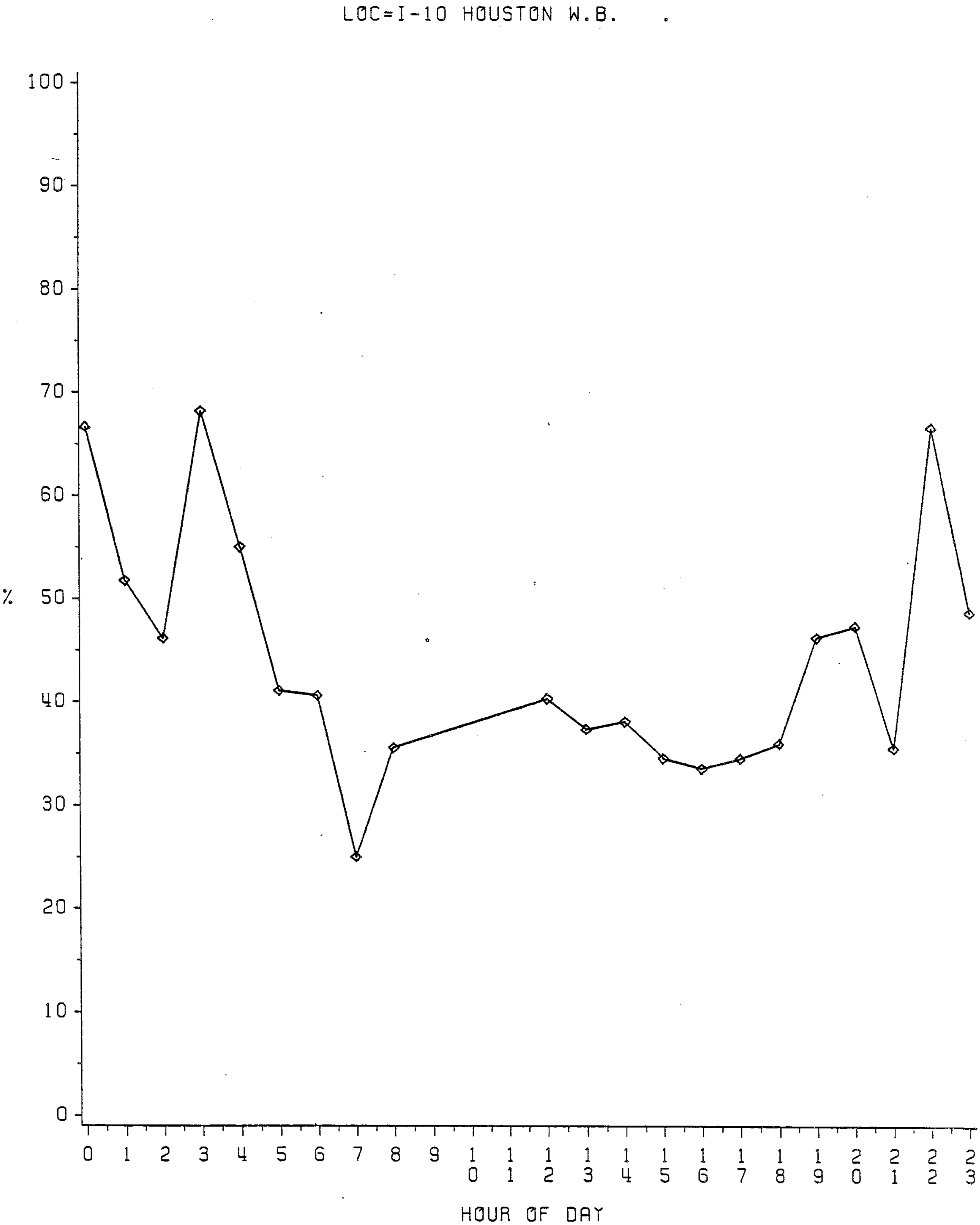


Figure 38. Percent Trucks in Lane 3 in the West-Bound Direction on I-10 at Houston

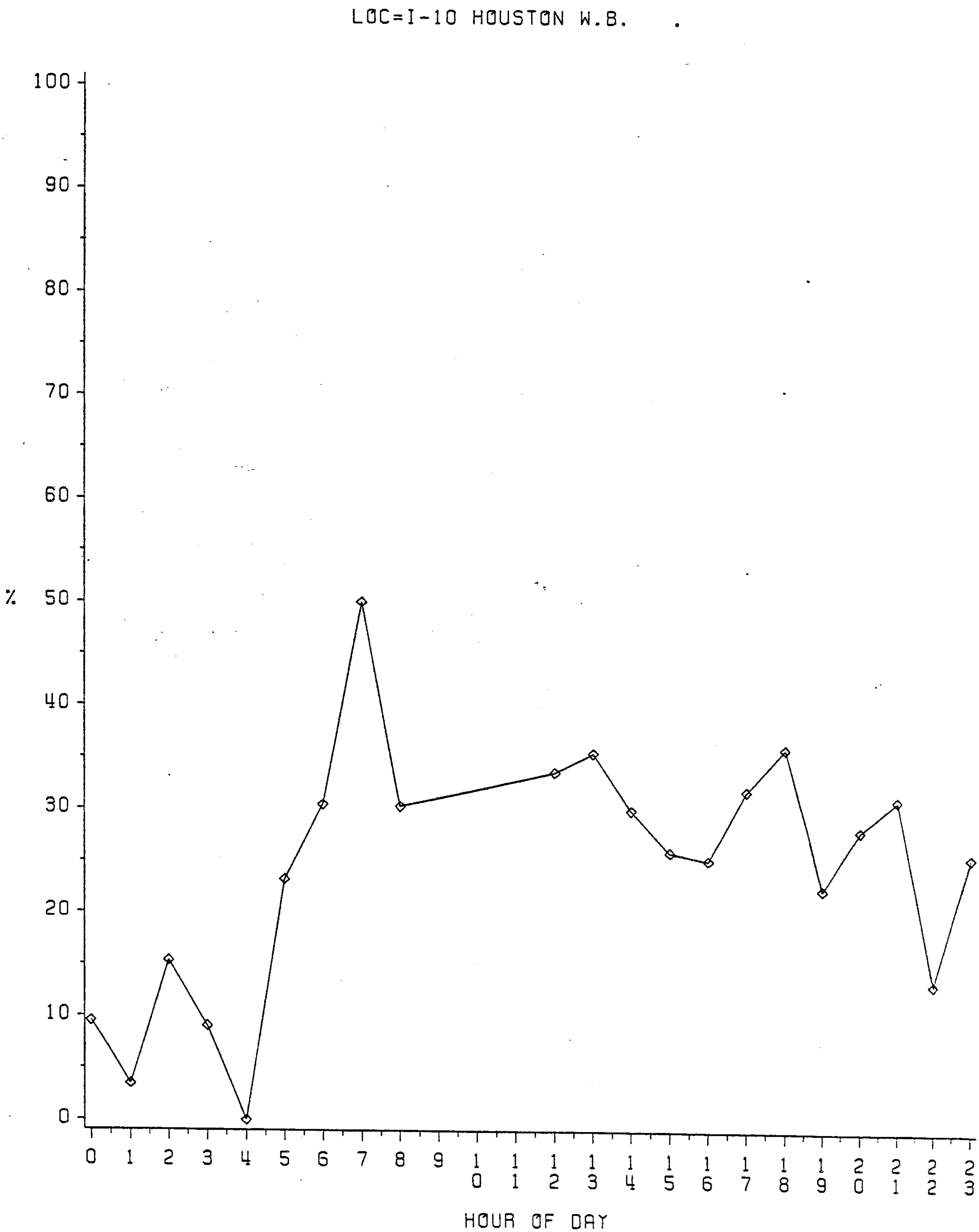


Figure 39. Percent Trucks in Lane 1 in the West-Bound Direction on Loop-635 at LBJ and Preston in Dallas

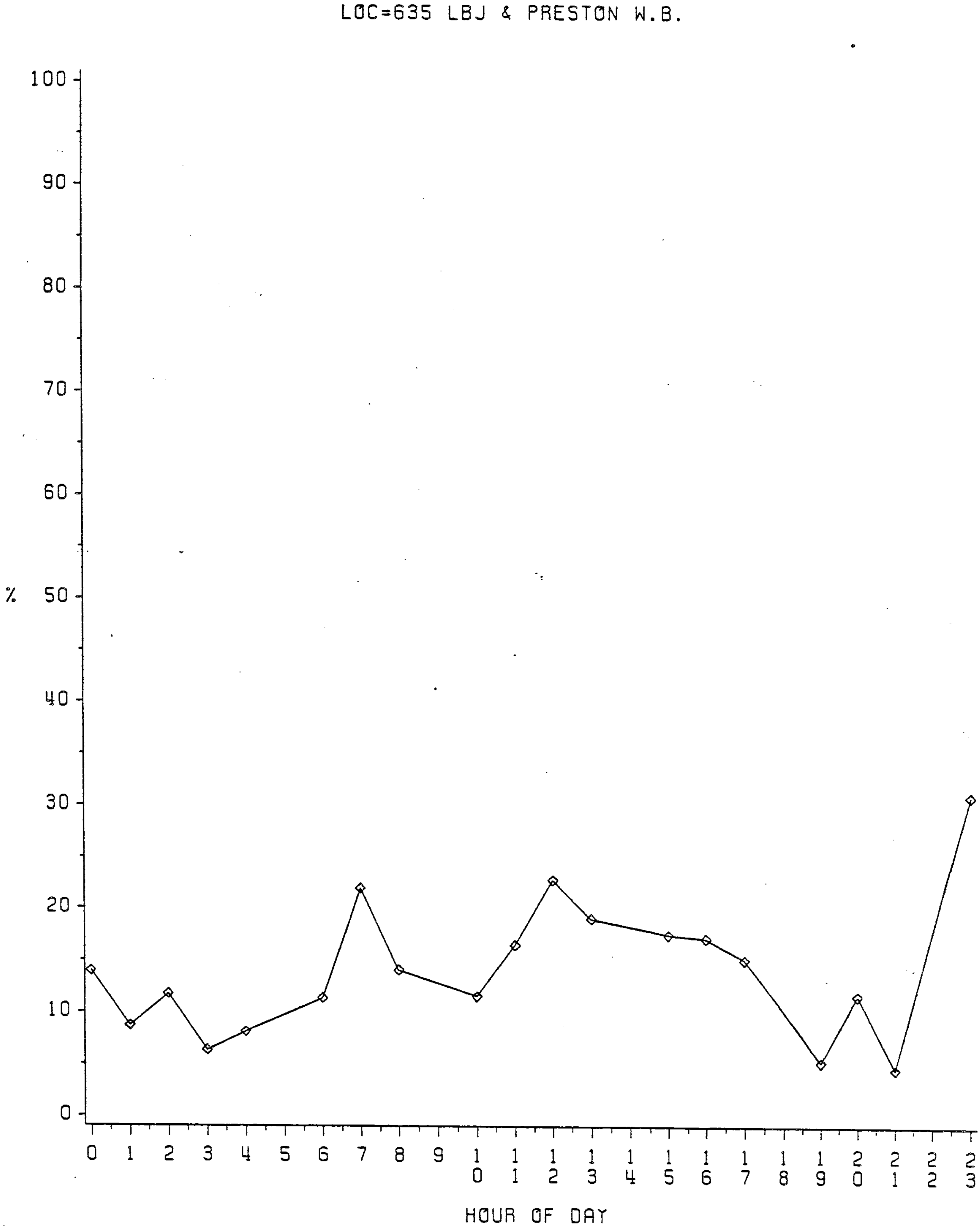


Figure 40. Percent Trucks in Lane 2 in the West-Bound Direction on Loop-635 at LBJ and Preston in Dallas

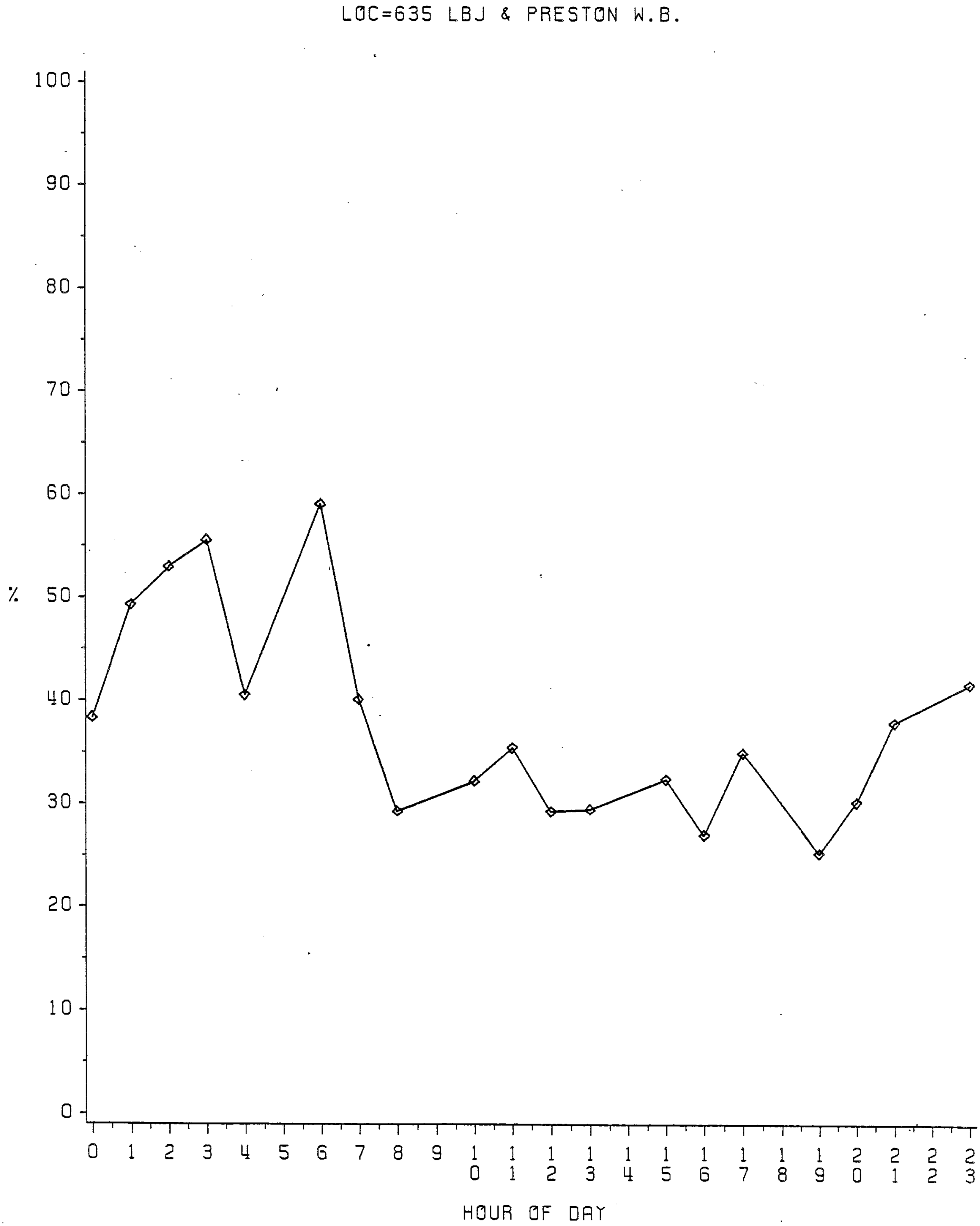


Figure 41. Percent Trucks in Lane 3 in the West-Bound Direction on Loop-635 at LBJ and Preston in Dallas

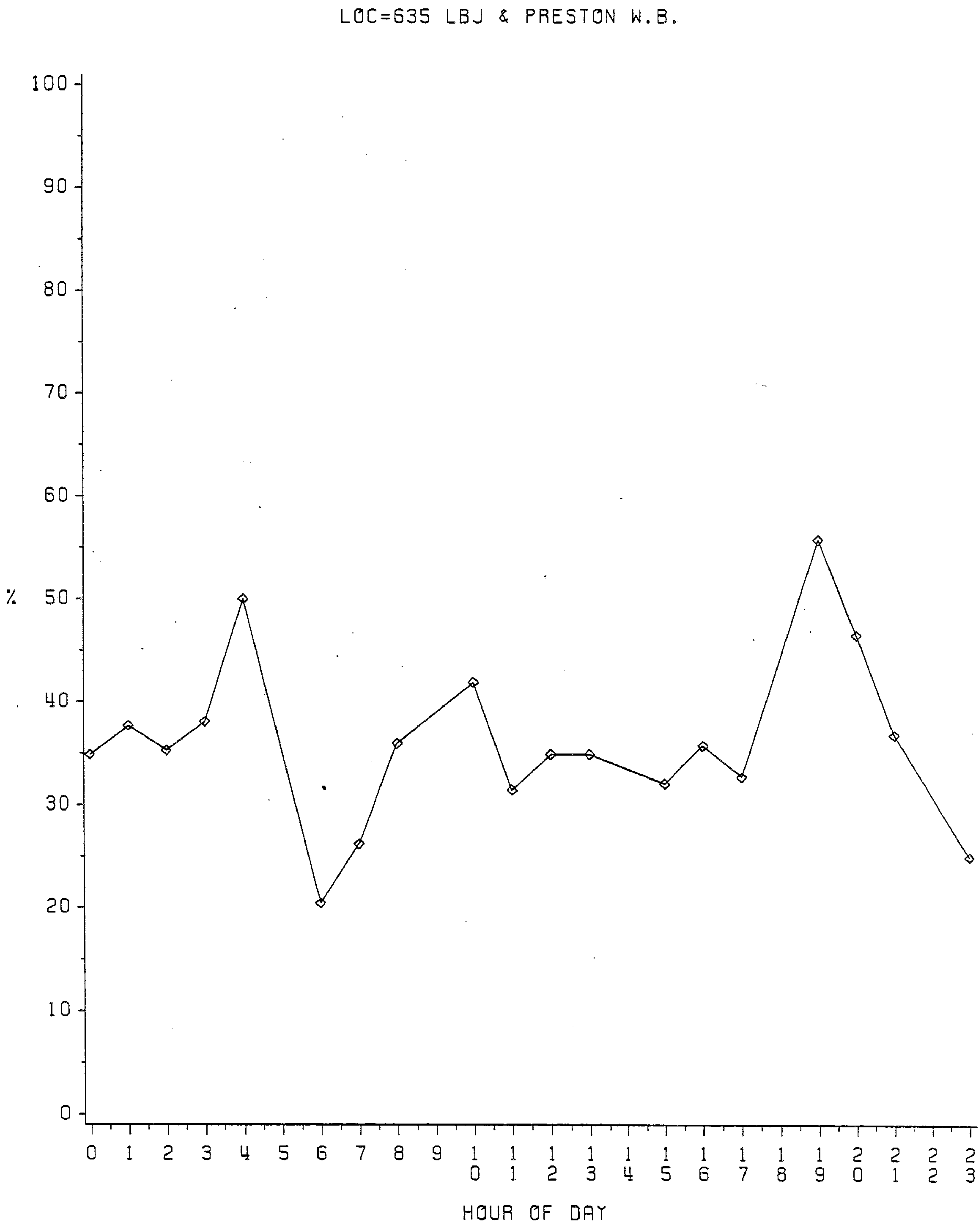


Figure 42. Percent Trucks in Lane 4 in the West-Bound Direction on Loop-635 at LBJ and Preston in Dallas

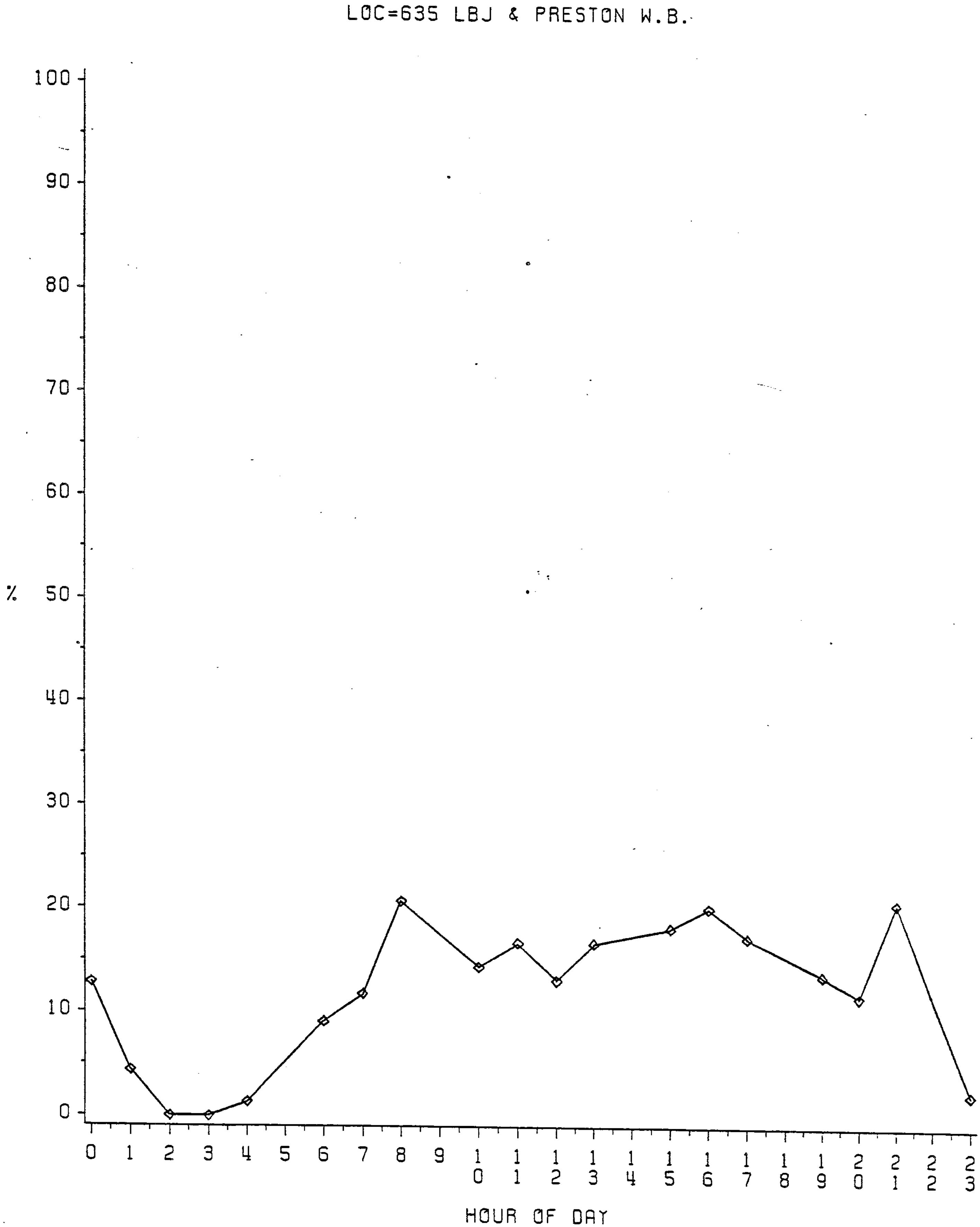


Figure 43. Percent Trucks in Lane 1 in the East-Bound Direction on I-10 at San Antonio

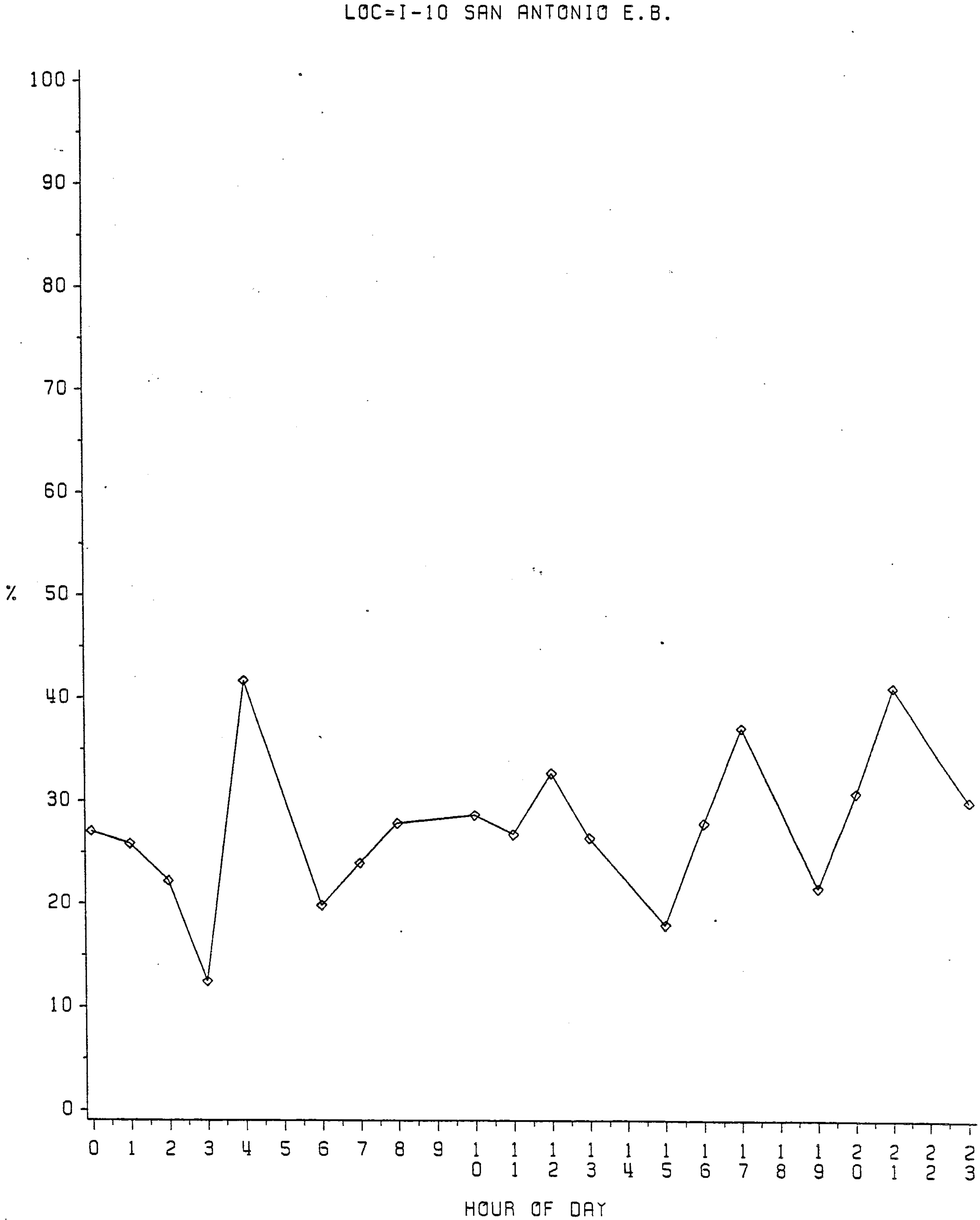


Figure 44. Percent Trucks in Lane 2 in the East-Bound Direction on I-10 at San Antonio

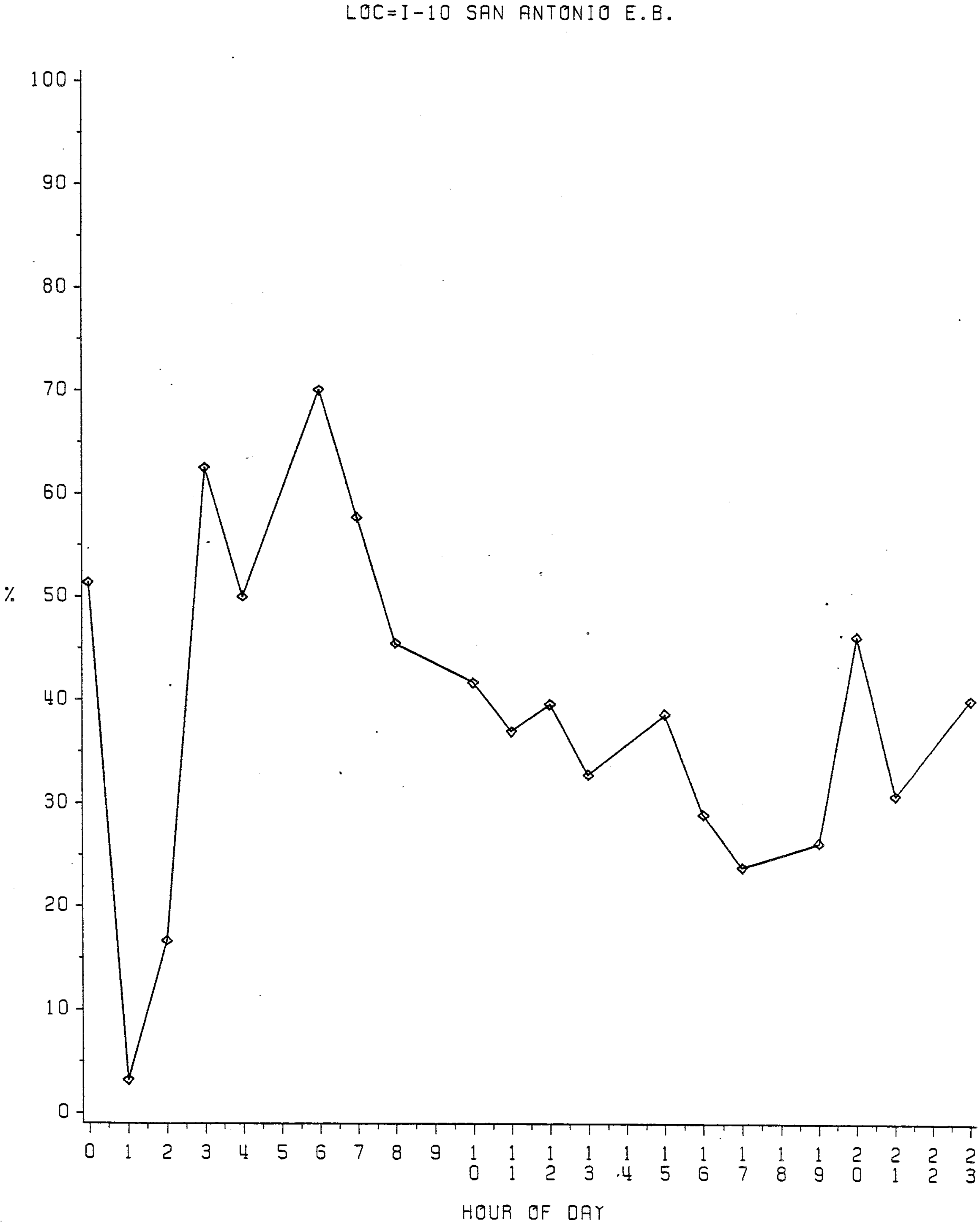


Figure 45. Percent Trucks in Lane 3 in the East-Bound Direction on I-10 at San Antonio

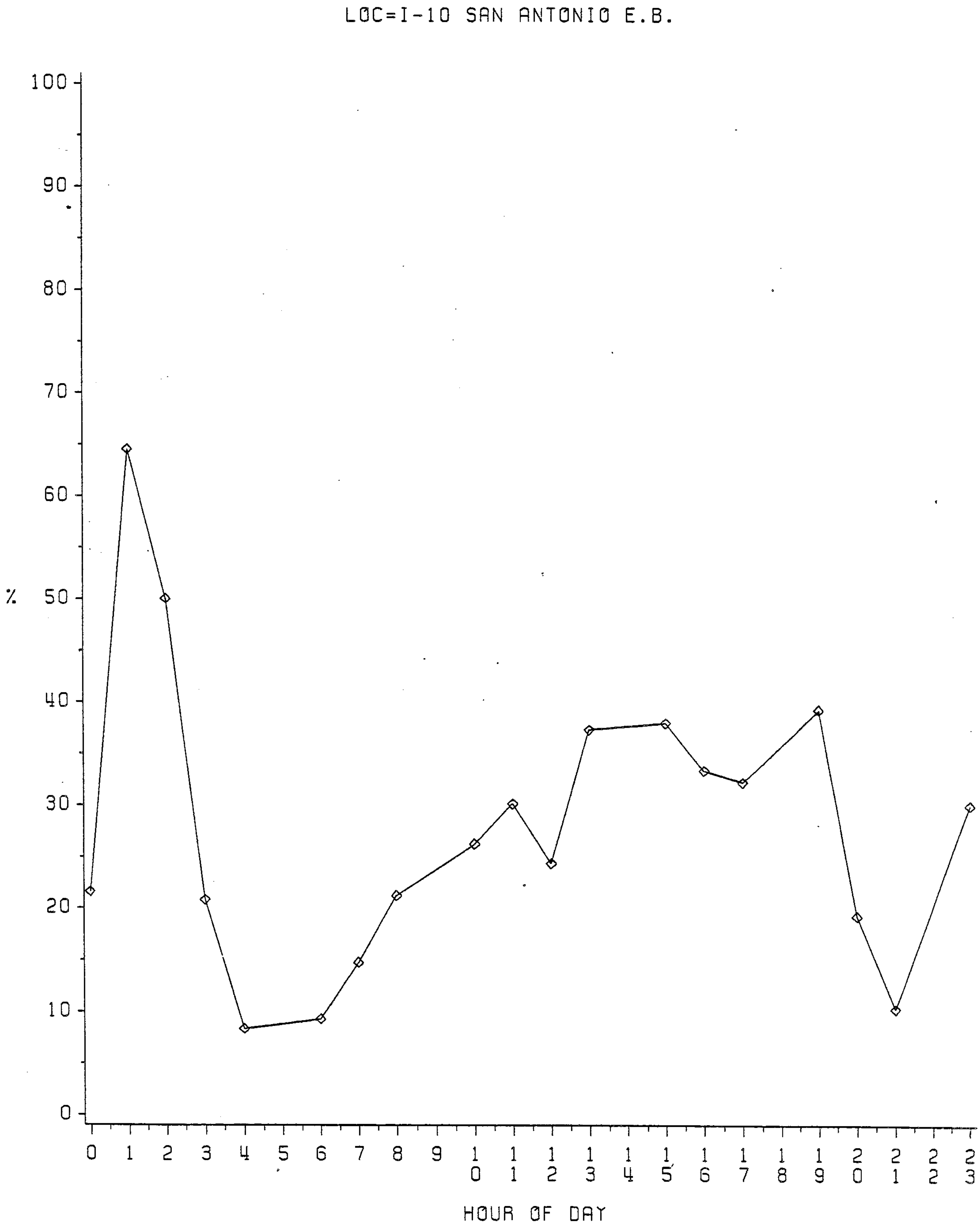


Figure 46. Percent Trucks in Lane 4 in the East-Bound Direction on I-10 at San Antonio