Title
LTL Trucking in Los Angeles: Congestion Relief Through Terminal Siting

Authors
Hall, Randolph W.
Lin, Wei Hua

Publication Date
1990-10-01

LTL Trucking in Los Angeles: Congestion Relief Through Terminal Siting

Randolph W. Hall
Wei Hua Lin

October 1990
Working Paper No. 43

The University of California
Transportation Center

University of California
Berkeley, CA 94720

The University of California Transportation Center

The University of California Transportation Center (UCTC) is one of ten regional units mandated by Congress and established in Fall 1988 to support research, education, and training in surface transportation. The UC Center serves federal Region IX and is supported by matching grants from the U.S. Department of Transportation, the California State Department of Transportation (Caltrans), and the University.

Based on the Berkeley Campus, UCTC draws upon existing capabilities and resources of the Institutes of Transportation Studies at Berkeley, Davis, and Irvine; the Institute of Urban and Regional Development at Berkeley; the Graduate School of Architecture and Urban Planning at Los Angeles; and several academic departments at the Berkeley, Davis, Irvine, and Los Angeles campuses. Faculty and students on other University of California campuses may participate in Center activities. Researchers at other universities within the region also have opportunities to collaborate on selected studies. Currently faculty at California State University, Long Beach, and at Arizona State University, Tempe, are active participants.

UCTC's educational and research programs are focused on strategic planning for improving metropolitan accessibility, with emphasis on the special conditions in Region IX. Particular attention is directed to strategies for using transportation as an instrument of economic development, while also accommodating to the region's persistent expansion and while maintaining and enhancing the quality of life there.

The Center distributes reports on its research in working papers, monographs, and in reprints of published articles. For a list of publications in print, write to the address below.

University of California Transportation Center

108 Naval Architecture Building
Berkeley, California 94720
Tel: 415/643-7378
FAX: 415/643-5456

Authors of papers reporting on UCTC-sponsored research are solely responsible for their content. This research was supported by the U.S. Department of Transportation and the California State Department of Transportation, neither of which assumes liability for its content or use.

LTL Trucking In Los Angeles: Congestion Relief Through Terminal Siting

Randolph W. Hall
Wei Hua Lin

The University of California
Transportation Center

Working Paper No. 43

October 1990

Department of Industrial Engineering & Operations Research
University of California at Berkeley

TABLE OF CONTENTS

TABLES

FIGURES

I. EXECUTIVE SUMMARY

Traffic congestion in the Los Angeles region may cost individuals and industry as much as $2 billion a year, in lost time and lost productivity. Much of this cost is borne by the trucking industry and its customers. To address this concern, this report develops and evaluates strategies for reducing congestion delays incurred by less-than-truckload (LTL) motor carriers in Los Angeles.

LTL common carriers are highly service oriented, and cannot easily avoid congestion by changing their hours of operations. Therefore, our study concentrated on the selection of terminal locations. Through analysis of traffic flow data, existing terminal locations and manufacturing employment in Los Angeles, we have made the following findings:

Findings

- Despite some notable exceptions (portions of the Santa Monica, Ventura, San Diego and Santa Ana Freeways), surplus capacity exists in the L.A. freeway system throughout much of the day.
- Currently, trucks naturally avoid congested highways. In all time periods, the trucks make up a smaller percentage of the traffic volume on heavily traveled freeways than on lightly traveled freeways. Further, the truck percentage is largest at midday, when traffic is lightest, and smallest during the p.m. peak, when traffic is heaviest.
- Existing terminals tend to be well located. However, some locations in the region -- most notably West L.A. and the L.A. Airport/El Segundo area, are not well served from existing terminals. Further, carriers provide duplicate service, choosing to establish terminals in the same locations.
- A shortage of vacant land in the South-central industrial core may be forcing carriers to build terminals in more remote locations. This trend will contribute to congestion delays.

The second finding demonstrates that congestion caused, and experienced, by trucks could be far worse than it is. Nevertheless, there is potential for improvement, through implementation of the following programs.

Proposals

- Motor carriers should be encouraged to establish terminals in South-central L.A., to provide good access to the Downtown and the South-central industrial core. Given that there is a shortage of vacant industrial property, this goal may best be accomplished through redevelopment.
- Motor carriers should improve service to West L.A., L.A. Airport and El Segundo. This would best be accomplished through the addition of terminals in the vicinity of Inglewood.
- Motor carriers should be encouraged to consolidate and merge their pickup/delivery operations, to facilitate service from more terminals. If all motor carriers served the region from 16 terminals, as Consolidated Freightways does, rather than just six or seven, then LTL truck travel on congested freeways would be reduced.

Finally, future analyses of terminal sites and operations would be facilitated if good data were available on system-wide highway congestion. Average daily counts and average peak hour counts provide an incomplete picture. CALTRANS has the mechanism in place to collect and disseminate necessary data through its Main Line Demand System (MLD).

Proposal

- CALTRANS should distribute data on average traffic flow, by hour of day and direction, for selected sites in the L.A. region. Data should be available on floppy disk as well as in printed form.

II. ACKNOWLEDGEMENTS

We wish to express our gratitude to Paul Chow of the Traffic Department at CALTRANS District 7 for his help in collecting traffic counts. We also wish to thank Fred Gey of the State Data Program for providing data essential to this project. Don Bain, of the Department of Geography at University of California at Berkeley must be thanked for his kind help in digitizing the zip code map and for his valuable advice. Ned Devlin of Yellow Freight System, Inc., and Joe Finney and Mike Jordan of Viking Freight Inc. must be thanked for their generous assistance in allowing visits to their terminals. Finally, all seven trucking companies studied in this project provided information on terminals and service regions.

1. OPPORTUNITIES FOR CONGESTION RELIEF

The state of California recently commissioned the Urban Freeway Gridlock Study [1] "to investigate the impact of large trucks on peak-period freeway congestion." Among the study findings was that "congestion in Los Angeles, San Francisco, and San Diego may cost as much as $2 billion per year."

While the motivation for this, and other, studies (e.g. [2],[3]) was to measure, and reduce, congestion caused by trucks, it is clear that a large portion of the congestion costs are borne by trucks. According to [1], each hour that a truck spends on the road costs $44, in wages, maintenance, fuel and overhead, a number considerably larger than the value of an automobile's time. On top of this amount, delays impose additional costs on the shippers and receivers who depend on carriers for timely service.

1.1 LTL Terminal Operations

Less-than-truckload (LTL) motor carriers transport medium size shipments -- shipments that are too large for Parcel Post of UPS, but too small for truckload service. According to [1], approximately 45% of the truck miles in the Los Angeles region are by LTL carrier, of which approximately half is by LTL common carrier (e.g., Consolidated Freightways or Yellow Freight System) and half is by LTL private carrier.

A typical LTL carrier transports shipments in three phases: local pickup, linehaul, and local delivery. The pickup phase ordinarily occurs in the afternoon, after most of the days' orders have been received. After visiting multiple stops, the pickup/delivery truck deposits its load at an end-of-line terminal (usually the carrier's closest terminal to the shipment origins). From there, shipments are transported in larger linehaul vehicles, either to another end-of-line terminal or, in some cases, to a breakbulk terminal for further sorting. After the linehaul phase, shipments are delivered in the morning from an end-of-line terminal (usually the closest to the shipment destinations) in pickup/delivery vehicles. In terms of congestion relief, the important characteristics of the system are: (1) deliveries occur in the morning, (2) linehaul occurs overnight, and (3) pickups occur in the afternoon.

Because linehaul occurs overnight, it is not greatly affected by road congestion (nor does it contribute greatly to congestion). Pickups and deliveries, on the other hand, must occur during the day when businesses are open, and often must occur during the morning and afternoon travel peaks. These trucking routes are affected by congestion, especially if pickup/delivery vehicles travel in the same direction as commuters. That is, congestion has the biggest impact on delivery routes heading toward work centers in the morning and pickup routes heading away from work centers in the evening.

One way to provide congestion relief would be to schedule trucks so that they travel in off-peak periods. However, for LTL common carriers, this would require major changes in carrier, shipper and receiver operations. Pickups

and deliveries would either have to occur at midday, after deliveries are needed and before pickups are available, or they would have to occur overnight. But overnight pickups and deliveries would disrupt linehaul operations, and could be costly to shippers and receivers that do not currently have nighttime staffing.

Alternatively, trucking delay could be reduced by selecting better locations for LTL terminals. This can have the following beneficial effects:

- By strategically locating more satellite terminals, the lengths of pickup and delivery routes can be reduced.
- By strategically locating terminals, travel across congested road segments can be reduced.

To achieve the second objective, pickup/delivery trucks can be routed like "reverse commuters." For instance, if an LTL terminal were located near a work center, then trucks would travel in the opposite direction of commuters in the morning, as they leave to make deliveries, and in the opposite direction of commuters in the evening, as they return with their pickups.

1.2 Study Objective

The objective of this study is to assess the potential for reducing trucking delays caused by urban road congestion in the Los Angeles region, with emphasis on improved selection of terminal sites for LTL common carriers. In particular, the feasibility of placing terminals at locations which exploit surplus freeway capacity (e.g., "reverse commuting") will be examined.

The next four chapters of this report address the following issues in order:

- Where and when is there excess capacity on the LA freeway system?
- To what extent are carriers currently exposed to congestion?
- Where are trucking terminals currently located?
- Where are the opportunities for improved terminal sites?

Although the focus is on reducing delays incurred by trucks, any strategy that reduces trucking delay would benefit motorists in general through reduced traffic volume on congested roadways.

2. SURPLUS CAPACITY IN THE LA FREEWAY SYSTEM

It has been said that Los Angeles is a city without a center, where work and residences are spread amorphously throughout a massive region. Indeed, compared to other major cities, Los Angeles is decentralized. But it is not true that it has no center. In recent years, the Downtown of Los Angeles has experienced tremendous job growth, including the construction of high-rises topping the 1000 foot mark. This large concentration of employment has come to have a significant impact on traffic patterns throughout the region. Like all major cities, roadways leading toward the Downtown are congested in the morning and roadways leading away are congested in the evening. The reverse commute directions tend not to be as congested, and roadways located far from the center tend to be less congested.

The dominance of the traditional Downtown is evident in L.A.'s ring-radial freeway network, shown in Figure 2.1. The Santa Monica (Route 10), Hollywood (101), Golden State (5), Pasadena (110), San Bernadino (10), Pomona (60), Santa Ana (5), Long Beach (710) and Harbor (110) freeways all radiate from the Downtown. The San Diego (405), Redondo Beach (91), San Gabriel (605) and Foothill (210) form a ring beltway around the center. In the newer parts of the region -- San Fernando Valley, and Orange, Riverside and San Bernadino Counties -- Downtown L.A. is less dominant, and freeways follow more of a grid structure.

Our goal was to determine when and where surplus capacity exists on the Los Angeles freeway system through the analysis of traffic flow data. As an initial illustration, Figure 2.2 shows the highway congestion map issued by California Department of Transportation (CALTRANS) for the L.A. region. The map provides an overview of which roads experience the greatest congestion, for both the morning and evening.

Observations

- Few freeway segments are congested in both directions at the same time. The major exceptions are: Ventura Freeway (101); San Diego Freeway (405), from I-10 to I-110; Santa Monica Freeway (10); and several road segments Downtown and in the vicinity of Anaheim.
- In the a.m., congestion is most prominent along the Ventura Freeway (101), leading to the 405 interchange; along the Santa Monica Freeway (10), heading east toward Downtown; along the San Diego Freeway (405), heading north toward the 10 interchange; and in the general vicinity of the Downtown (especially on 110 north and 5 north).
- Congestion is also significant in the vicinity of Anaheim and Santa Ana, along routes 5, 22, 55 and 91, and in the vicinity of Westminster along 405.
- In the evening, congestion patterns are largely reversed, but amplified. More locations experience congestion in the evening than in the morning.

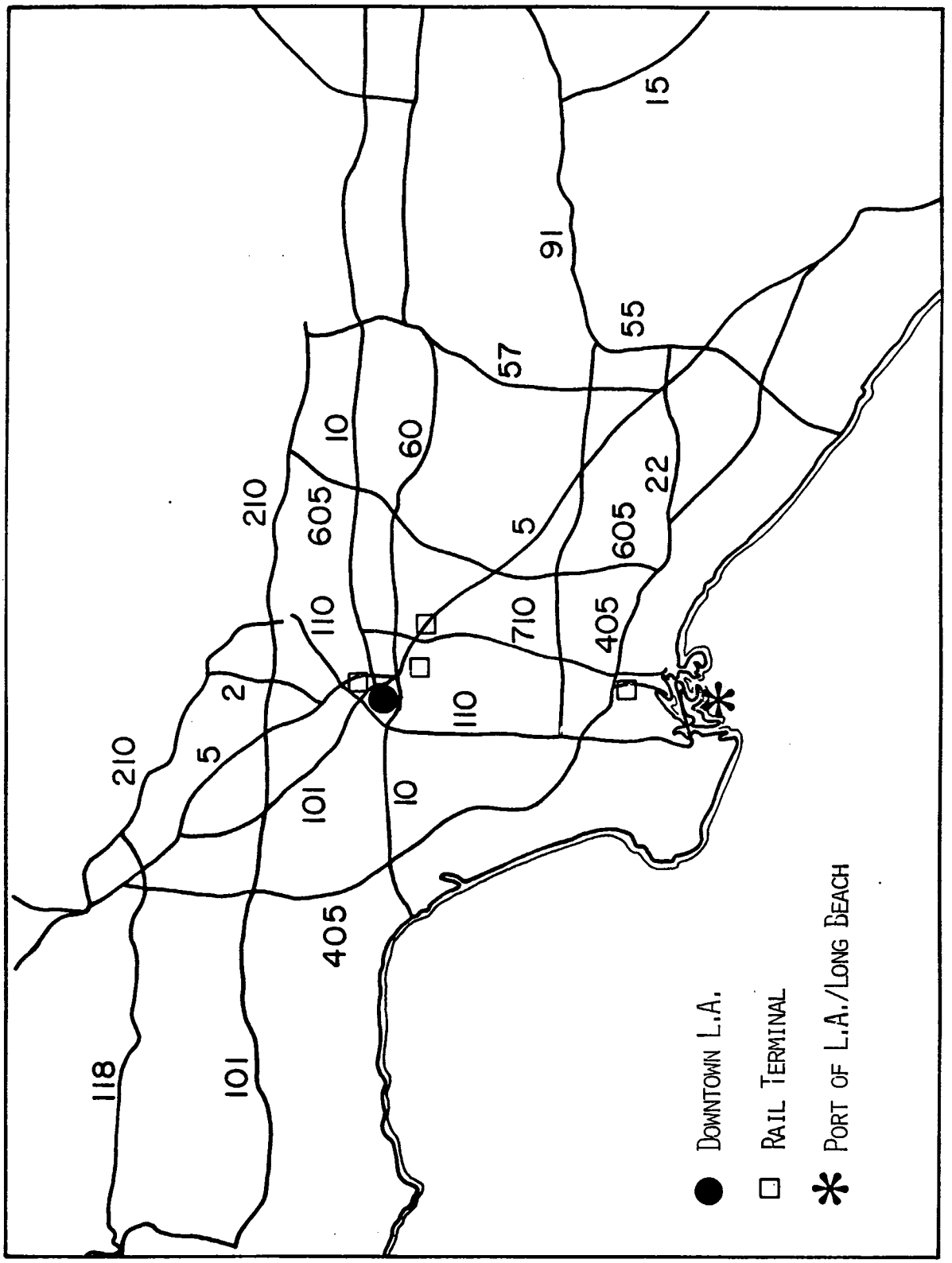


Figure 2.1 Major Transportation Facilities in Los Angeles Region

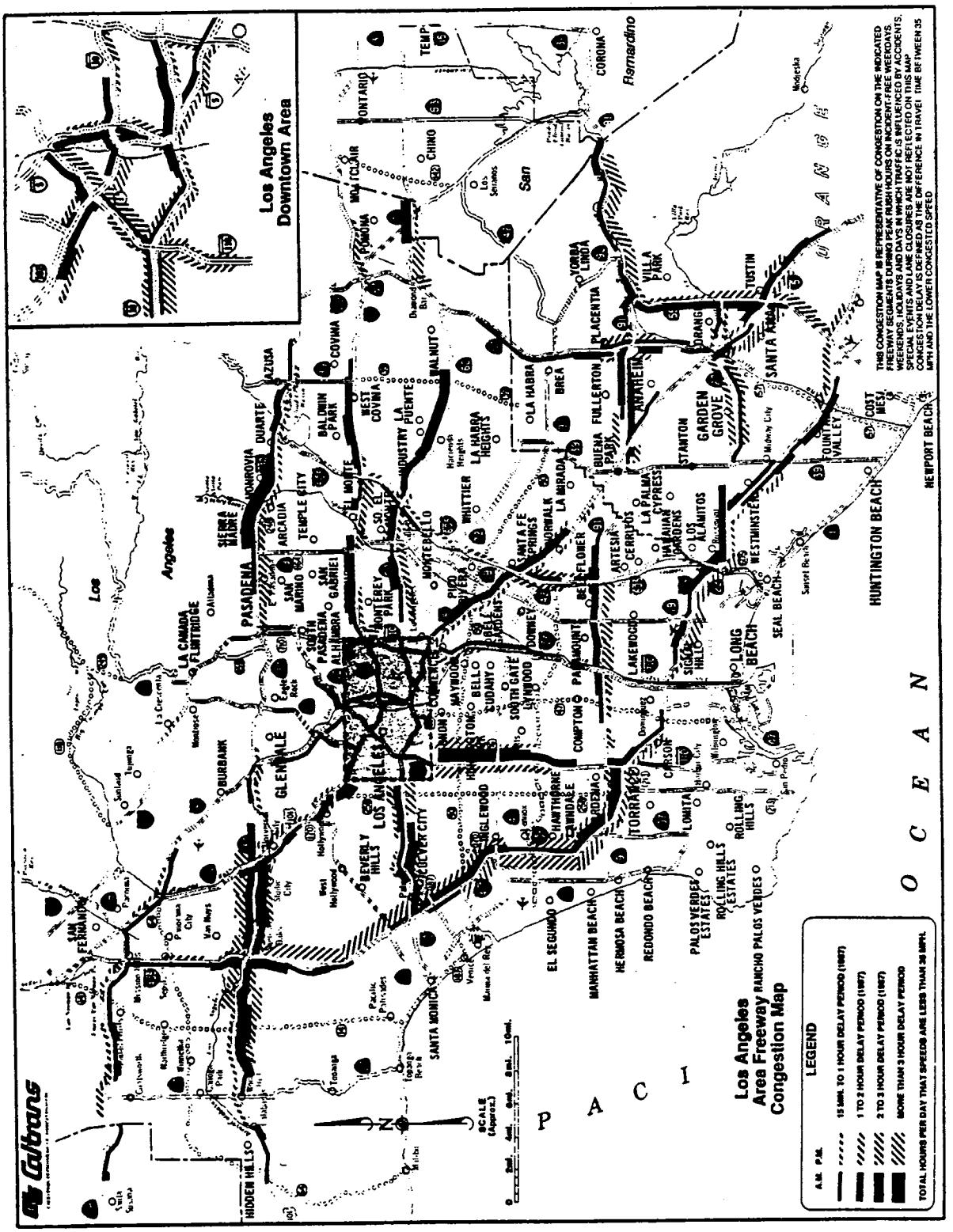


FIGURE 2.2 FREEWAY CONGESTION MAP FOR L.A. REGION

2.1 Average Daily Traffic Counts

Average-daily-traffic (ADT) and peak hour counts are surveyed annually by CALTRANS at hundreds of sites in the region [4]. Unfortunately, the survey provides no indication of how traffic levels vary by direction and time of day.

In our analysis, ADT counts were sampled at five-mile intervals along the L.A. and Orange county freeway system, and the ratio of ADT to number of lanes [5] was calculated as a measure of congestion. Finally, the freeway sites were sorted to identify the most congested roads, listed in Table 2.1a for L.A. County and 2.1b for Orange County.

Observations

- In L.A. County, the highest ratio of 33,625 vehicles/lane-day (an average of 1400 vehicles/lane-hr) was recorded on the San Diego Freeway (405), in the vicinity of Century Boulevard.
- In Orange County, the highest ratio of 35,500 vehicles/lane-day was recorded on the Santa Ana Freeway (5), just north of the 55 interchange.
- The San Diego Freeway experiences severe congestion from the 22 interchange north to the 101 interchange. It accounts for 3 of the top ten L.A. County sites.
- Also among the top ten L.A. County sites are the Ventura (101), in the vicinity of the 405 interchange; the Santa Monica (10), east of 405; the Santa Ana (5), immediately south of the Downtown and the Harbor (110), immediately south of the Downtown.
- In Orange county, the most severe congestion is on the Santa Ana (5) and Costa Mesa (55) Freeways, near their intersection; and on the San Diego Freeway, near the 22 interchange.

These observations confirm the data on the congestion map, which showed that congestion is greatest along the San Diego freeway corridor, in the vicinity of the Downtown, and in the Santa Ana/Anaheim area.

2.2 Hourly Traffic Counts

A second source of traffic data is CALTRANS' automated freeway control system. This is one of the most sophisticated systems in the world for monitoring real-time traffic flows. Flow detectors have been installed at over 900 sites, covering most of the major freeways in Los Angeles and Orange Counties.

At the outset of this study, we had hoped that the data collected by this system would provide a detailed picture of historical traffic flows over the freeway system. Unfortunately, the system has not been set up to routinely generate summary reports, or to easily analyze systemwide traffic. From the Main Line Demand System, traffic counts can be generated by 15-second to 15-minute interval for any selected site, for the previous 72 hours. Each run demands about 15 minutes of operator time, making the analysis quite laborious. In our study, 22 sites were selected, spaced roughly at five mile intervals along the routes radiating from Downtown Los Angeles. Figure 2.3

Table 2.1a Average Daily Traffic - Los Angeles County

Freeway	Mile Post	Description	Number of Lanes +		Peak Hour *	ADT Annual *	ADT / Lanes
405	22.22	Century Blvd.	4	4	16000	269000	33625.00
5	13.78	Commerce, Jct. Rte. 710	4	4	15000	267000	33375.00
101	17.17	Sherman Oaks, Van Nuys Blvd.	4	4	14400	266000	33250.00
110	17.98	Los Angeles, Slauson Ave.	4	4	15000	258000	32250.00
10	6.40	West Los Angeles, Overland Ave.	4	4	14700	256000	32000.00
405	16.57	Jct. Rte. 91	4	4	16000	254000	31750.00
10	21.38	Monterey Park, Jct. Rte. 710	4	4	20500	246000	30750.00
5	24.33	Los Angeles, Los Feliz Blvd.	4	4	18000	245000	30625.00
10	11.39	Los Angeles, Crenshaw Blvd.	5	5	20000	305000	30500.00
405	33.00	Bel Air, Sunset Blvd.	4	5	18000	274000	30444.45
405	6.08	Long Beach, Jct. Rte. 710	5	4	18000	273000	30333.33
101	22.25	Tarzana, Tampa Ave.	4	4	14400	242000	30250.00
405	27.96	Culver City, Jct. Rte. 187	5	5	20000	300000	30000.00
5	8.31	Downey, Jct. Rte. 19	4	4	14700	236000	29500.00
10	16.90	Los Angeles, San Pedro St.	4	4	14600	234000	29250.00
91	13.59	Long Beach, Paramount Ave.	5	4	16200	259000	28777.78
405	11.22	Carson, Avolon Blvd.	4	4	15200	230000	28750.00
91	8.44	Compton, Central Ave.	4	4	15200	227000	28375.00
5	2.14	Santa Fe Springs, Carmenita Rd.	3	3	11300	168000	28000.00
101	27.36	Calabasas, Mulholland Dr.	3	3	10800	166000	27666.67
10	2.16	Santa Monica, Jct. Rte. 1 & 2	3	2	11000	138000	27600.00
91	18.66	Cerritos. Norwalk Blvd.	4	4	14700	216000	27000.00
605	16.65	Peck Road	4	4	15500	215000	26875.00
110	12.90	Athens District, El Segundo Blv	4	4	15000	215000	26875.00
101	11.75	N. Hollywood, Jct. Rte. 170	4	4	14400	214000	26750.00
405	0.45	Long Beach, Studebaker Rd.	5	4	17100	238000	26444.45
405	39.43	Los Angeles,Jct Rte 101	5	5	20000	264000	26400.00
710	23.28	Commerce, Jct. Rte. 5	4	4	15000	210000	26250.00
101	6.38	Hollywood,Hollywood Blvd.	4	4	14400	209000	26125.00
10	32.22	Baldwin Park, Baldwin Park	4	4	14900	207000	25875.00
10	26.86	El Monte, Jct. Rte. 164	4	4	14900	207000	25875.00
170	14.50	Jct. Rtes. 101 and 134	3	3	12200	149000	24833.33
605	11.54	Slauson Ae.	4	4	15500	198000	24750.00
405	44.74	Los Angeles, Nordhoff St.	4	4	15000	197000	24625.00
5	19.20	Los Angeles, N. Main St.	4	5	16200	220000	24444.45
210	26.94	Pasadena, Hill Ave.	5	5	18000	240000	24000.00
605	0.29	Long Beach, Spring St.	4	4	15500	191000	23875.00
710	16.99	South Gate, Imperial Hwy.	4	4	14900	188000	23500.00
60	28.04	Philips Ranch Road	3	3	10800	141000	23500.00
60	15.93	Hacienda Blvd.	4	4	13500	188000	23500.00
210	48.52	Jct. Rte. 10 Fwy	3	3	11300	139000	23166.67
210	32.91	Monrovia, Jct. Rte. 248	4	4	15000	185000	23125.00
110	7.02	Carson St.	4	4	14900	180000	22500.00
57	0.91	Diamond Bar, Brea Canyon Rd.	4	4	15200	179000	22375.00
605	5.81	Norwalk, Alondra Blvd.	5	5	18000	222000	22200.00
60	9.51	Jct. Rte. 164, Rosemead	5	4	16800	198000	22000.00
10	43.66	Ganesha Blvd.	5	5	15000	218000	21800.00
22	1.14	Long Beach, Studebaker Rd.	2	2	7600	87000	21750.00
60	21.48	Industry, Fairway Drive	4	4	13800	173000	21625.00
5	29.78	Burbank, Burbank Blvd.	4	4	14100	171000	21375.00

(Sorted By ADT/Lanes in Descending Order)

+ source: "1987 California State Highway Log District 7." by CALTRANS.

* source: "1989 Traffic Volumes on California State Highway." by CALTRANS.

Table 2.1b Average Daily Traffic - Orange County

Freeway	Mile Post	Description	Number of Lanes +		Peak Hour *	ADT -------- Annual *	ADT / Lanes
5	30.90	Santa Ana, First St.	3	3	13300	213000	35500.00
55	7.85	Santa Ana, Dyer Road	3	3	15200	204000	34000.00
55	12.97	Jct. Rte. 22 West	3	3	11400	195000	32500.00
91	6.12	Anaheim, Jct. Rte. 57	3	4	15900	220000	31428.57
405	12.64	Fountain Valley, Euclid	5	4	17100	278000	30888.89
5	36.37	Anaheim, Katella Ave.	3	3	11400	179000	29833.33
405	17.75	Westminster, Bolsa Ave.	4	4	16000	233000	29125.00
405	23.28	Seal Beach, Jct. Rte. 22 West	5	5	19000	289000	28900.00
5	42.10	Fullerton, Jct. Rte. 91	4	3	13300	199000	28428.57
22	4.81	Garden Grove, Magnolia St.	3	3	13600	159000	26500.00
22	9.73	Orange, City Dr.	3	5	15200	209000	26125.00
57	15.60	Anaheim, Jct. Rte. 91	4	4	15200	201000	25125.00
57	20.88	Brea, Lambert Rd.	4	4	15200	180000	22500.00
57	11.25	Orange, Chapman Ave.	4	4	15200	177000	22125.00
91	11.54	Peralta, Jct. Rte. 90	5	5	15900	220000	22000.00
91	0.49	La Palma, Orangethorpe Ave.	4	4	14300	176000	22000.00
22	12.87	Tustin Ave.	4	4	11400	143000	17875.00

+ source: "1987 California State Highway Log District 7." by CALTRANS.
* source: "1989 Traffic Volumes on California State Highway." by CALTRANS.

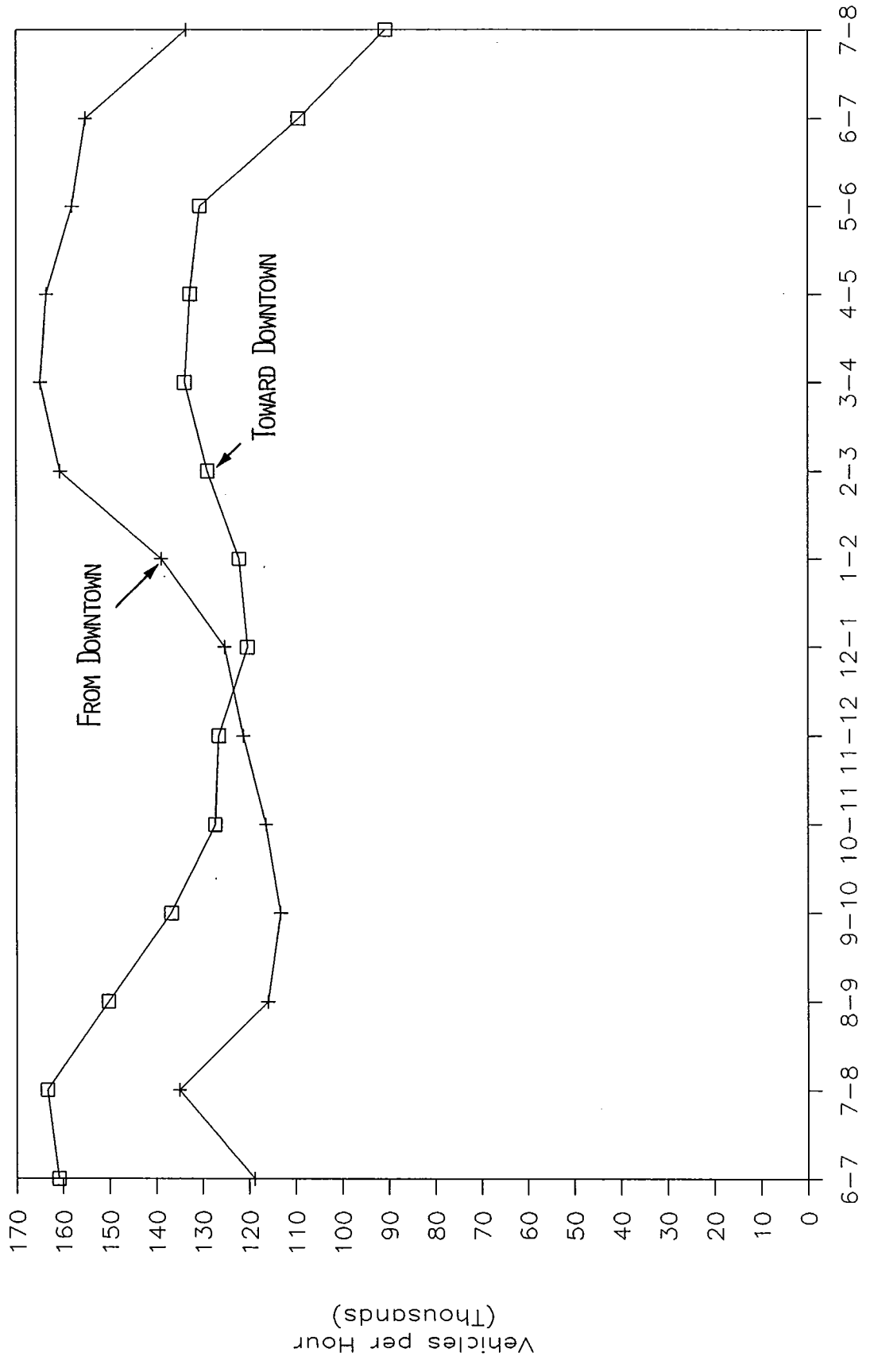


FIGURE 2.3 TRAFFIC FLOW ON RADIAL ROUTES BY TIME AND DIRECTION

displays the total traffic count among all 22 sites by direction and time of day, and Table 2.2 provides traffic counts for individual sites.

Observations

- From 6-9:00 a.m., traffic leading toward the Downtown exceeds traffic heading away by 28%.
- From 2:00-6:00 p.m., traffic leading away from the Downtown exceeds traffic heading toward by 23%.
- Between 9:00 and 2:00, traffic levels leading toward the Downtown average 80% of the peak-period count. Traffic level heading away from the Downtown average 76% of the peak-period count.
- Heading toward the downtown, the p.m. count is nearly the same as the midday count. Heading away from the downtown, the a.m. count is nearly the same as the midday count.

It appears that most radial freeways operate below capacity for most of the day. Most radial roads leading toward the Downtown only operate at peak capacity from about 6:00 - 9:00 a.m.. Most roads heading away from the Downtown only operate at peak capacity from about 2:00 to 6:00. Among the sites surveyed, the major exceptions are on the Ventura Freeway (101) at Van Nuys, the Santa Monica Freeway (10), and the Santa Ana Freeway (5) at Orangethorpe (Buena Park). These roads operate at or near capacity throughout much of the day -- in both directions at the same time. Based on ADT counts, there are likely exceptions along the San Diego Freeway and in the Anaheim/Santa Ana area as well.

2.3 Summary

The L.A. freeway system is highly congested in many locations, especially on portions of the San Diego, Santa Monica, Santa Ana and Ventura Freeways. These roads operate at or near capacity throughout the workday -- from about 6:00 a.m. to 6:00 p.m. -- in both directions. But these are the exceptions. The majority of the freeway system only experiences severe congestion during a few hours out of each day, in only one direction at a time.

Motor carriers have the potential to reduce congestion delays, both for themselves and for other vehicles. Carriers can exploit surplus capacity and reduce their congestion delays by strategically locating their terminals.

Table 2.2. Traffic Counts by Time and Direction

Freeway	Location	Direction	Average Hourly Traffic 6-9	9-2	2-6
5	Burbank	To	7700	4800	5800
5	Burbank	From	5300	4200	6600
5	Tuxford	To	7100	3900	4000
5	Tuxford	From	3600	3700	6100
5	S. of 710	To	7900	6000	6000
5	S. of 710	From	5700	5500	6100
5	Los Feliz	To	7400	5400	6900
5	Los Feliz	From	6100	5100	7200
5	Rosencrans	To	5300	4500	4900
5	Rosencrans	From	4500	4400	4900
5	Orangethorpe	To	5800	5100	5700
5	Orangethorpe	From	10500	9100	11500
10	Crenshaw	To	6800	7300	7900
10	Crenshaw	From	5200	7500	7900
10	Westwood	To	7900	8000	8200
10	Westwood	From	8400	8000	8500
10	E. of 710	To	6000	5000	4000
10	E. of 710	From	3300	4400	5600
10	Atlantic	To	6700	5800	5400
10	Atlantic	From	4100	5100	6800
10	Rosemead	To	7100	6100	5900
10	Rosemead	From	4100	5300	7400
10	Citrus	To	7500	4800	5100
10	Citrus	From	4200	4300	7300
60	Atlantic	To	9700	6300	5400
60	Atlantic	From	4500	4900	7700
60	Rosemead	To	9000	6000	5800
60	Rosemead	From	4400	4600	7200
60	Turnbull	To	7400	5700	6500
60	Turnbull	From	5200	5700	8700
101	Western	To	6800	5700	5100
101	Western	From	5300	5400	7000
101	Vineland	To	8500	6800	5900
101	Vineland	From	5600	5600	8400
101	Van Nuys	To	6800	7200	7400
101	Van Nuys	From	9000	9900	9400
110	Slauson	To	6600	6500	5000
110	Slauson	From	6500	5900	7600
710	Imperial	To	6700	4800	6200
710	Imperial	From	5900	4200	6500
710	Del Amol	To	6000	4600	6400
710	Del Amol	From	6200	4300	5600
TOTAL		**TO**	**158000**	**127000**	**131000**
TOTAL		**FROM**	**123000**	**123000**	**162000**

3. EXPOSURE OF TRUCKS TO CONGESTION

Ordinary two-axle automobiles and light-trucks compose the vast majority of vehicles on the Los Angeles freeway system and general traffic patterns are dominated by personal trips. During peak hours, traffic is further dominated by commute trips, which are reflective of where people live and where people work.

On most L.A. Freeways, less than 5% of the vehicles are large trucks (3 axles or more), whose traffic patterns differ substantially from personal vehicles. Most of their trips begin and end at manufacturers, transportation terminals or warehouses. Consequently, truck travel patterns are reflective of where industrial facilities are located.

In the L.A. region, the largest concentration of manufacturers and warehouses is in South-central L.A. along the Santa Ana (5) Freeway corridor. The largest transportation terminals are the Port of Los Angeles/Long Beach and Southern Pacific's Long Beach intermodal terminal, 20 miles south of Downtown; and the Santa Fe, Southern Pacific, and Union Pacific intermodal terminals in the vicinity of the Downtown (Figure 2.1). In addition, unlike automobile traffic, which is dominated by commuting, truck trips are spread throughout their workday. These factors combine to cause truck travel patterns to differ substantially from general traffic patterns, both in terms of where they are on the road and when they are on the road.

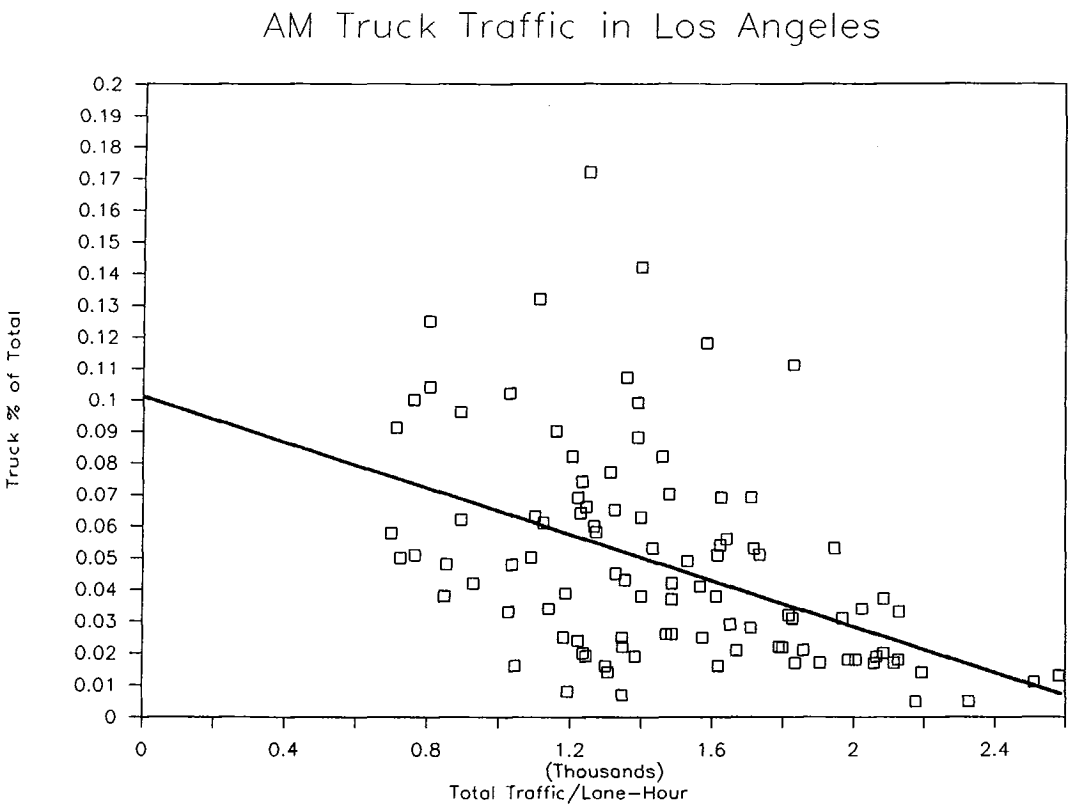
The Urban Freeway Gridlock study found that "a substantial number of freeway sites had a smaller percentage of large trucks than is suggested by the statistical average" [1]. We decided to examine this issue in depth through a statistical analysis of truck and automobile traffic in the Los Angeles region. Our data was collected by video camera at 40 sites by Cambridge Systematics as part of the Gridlock study. For each site, truck (3 or more axle) and automobile counts were obtained for six 15-minute periods, two in the a.m. peak, two at midday, and two in the p.m. peak. In all, recordings were made for 221 15-minute periods (19 data points were missing).

3.1 General Truck Traffic Patterns

Figures 3.1a, 3.2a and 3.3a display truck-traffic as a percentage of total traffic for the a.m. peak, midday and p.m. peak periods, respectively. In each case, the relationship between truck-traffic and total traffic was approximated by linear regression, to produce the lines shown.

Observation: There is a natural tendency for trucks to avoid the most congested roadways

- As a % of total traffic, truck traffic declines as traffic volume increases in all three periods.
- As a % of total traffic, truck traffic is largest at midday, when roadways are the least congested, and smallest in the p.m., when roadways are the most congested.



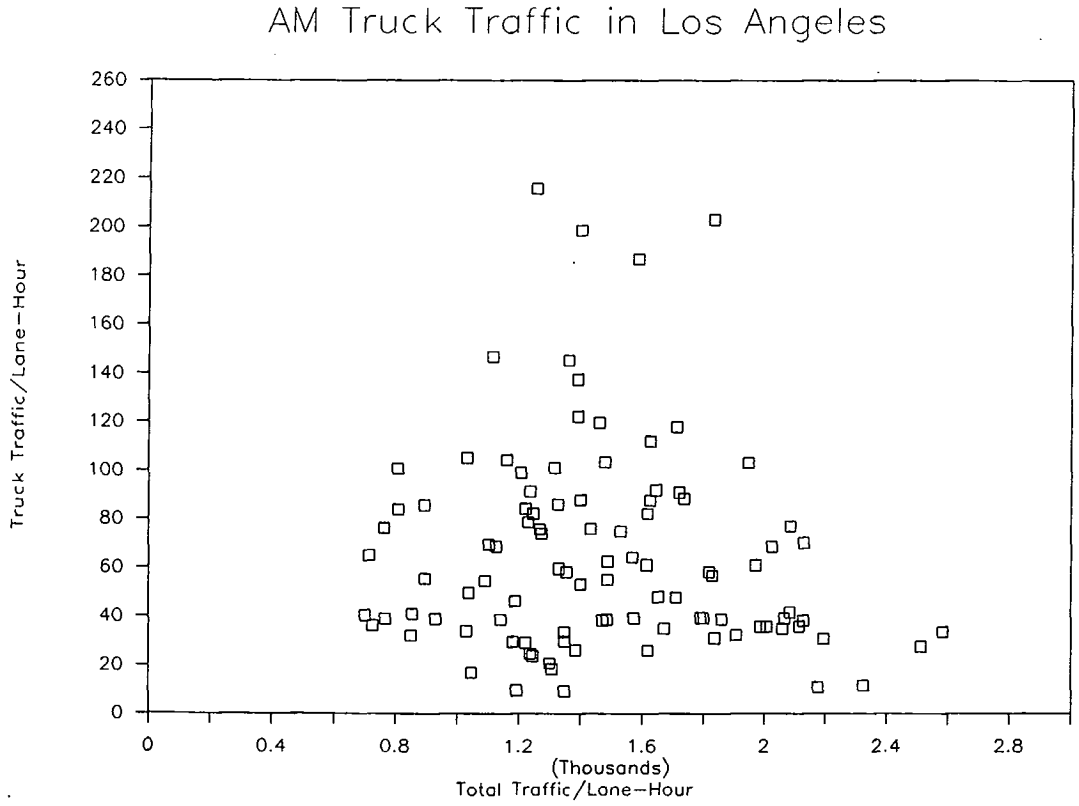
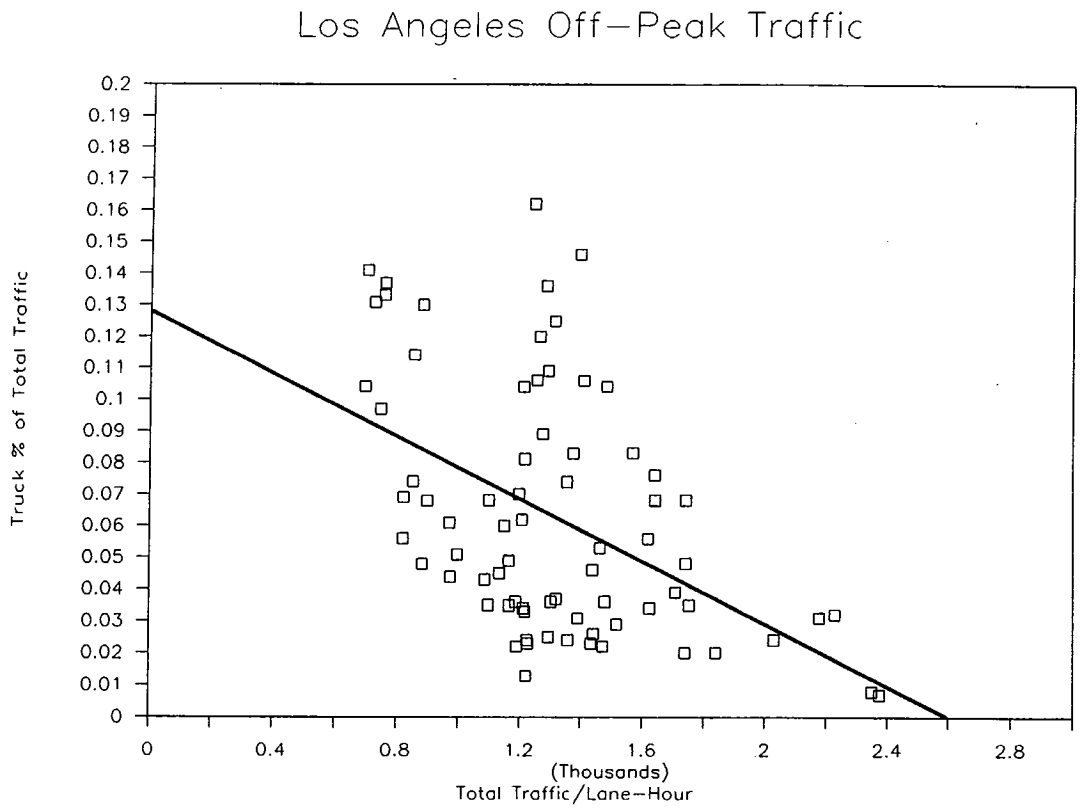


FIGURE 3.1 TRUCK TRAFFIC VERSUS TOTAL TRAFFIC PER LANE-HOUR



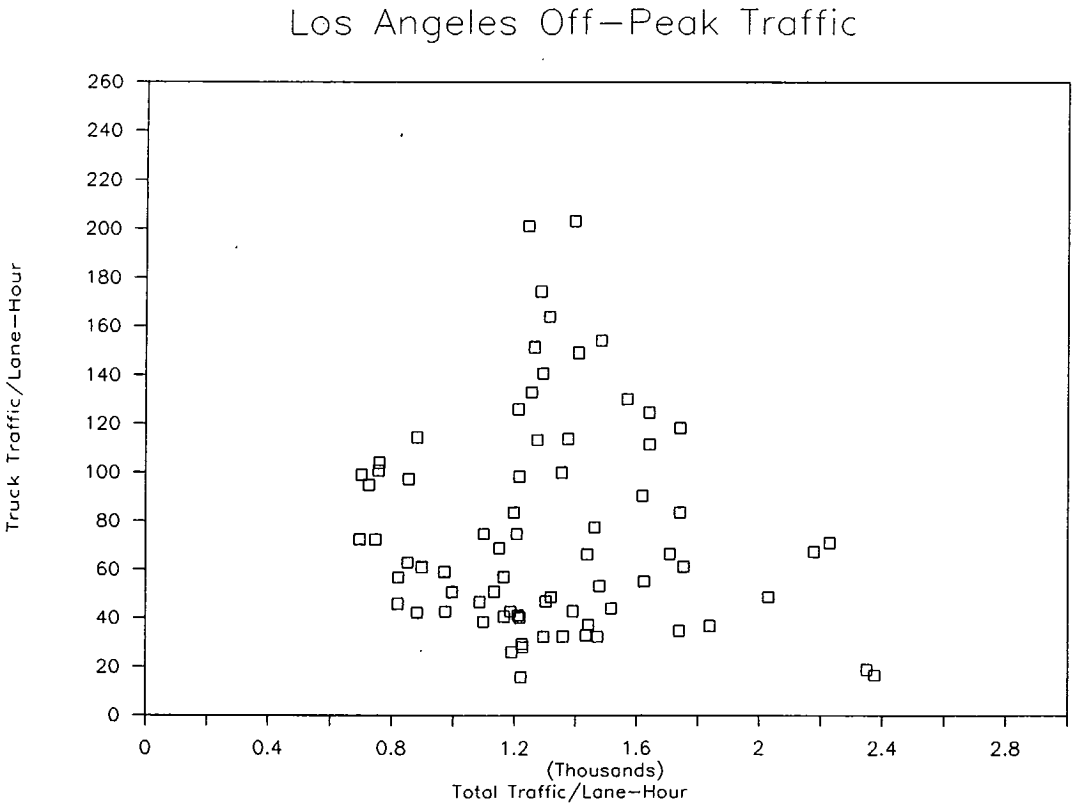
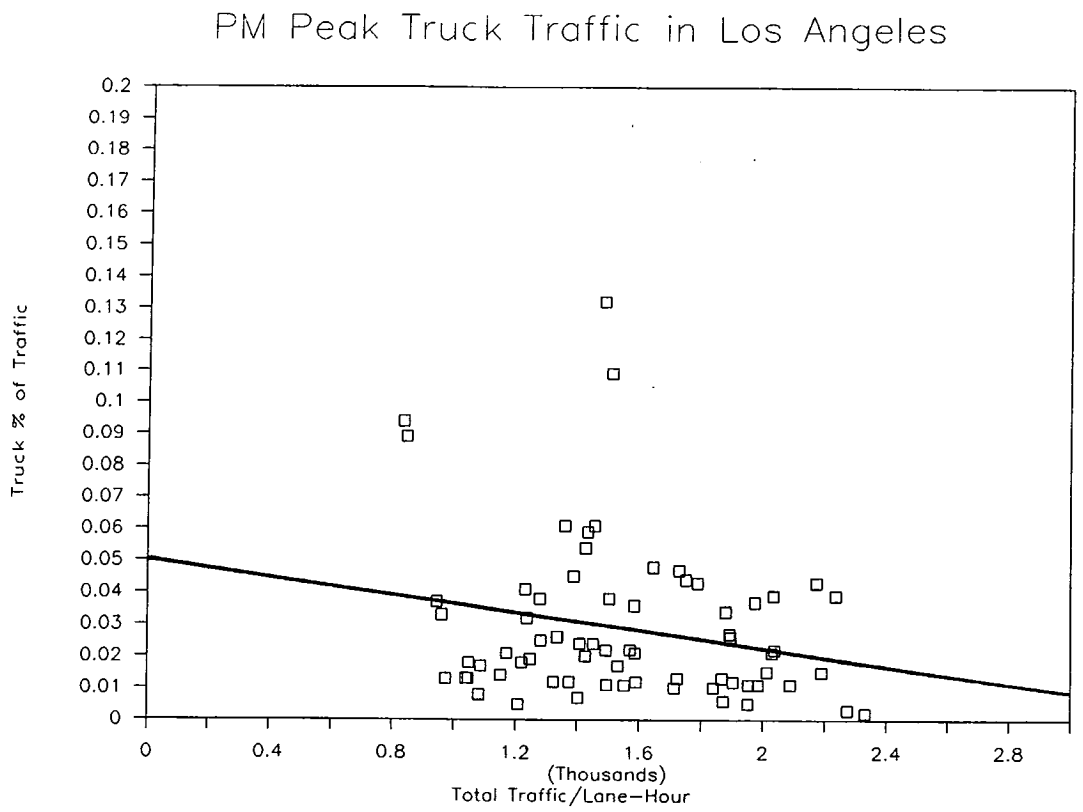


FIGURE 3.2 TRUCK TRAFFIC VERSUS TOTAL TRAFFIC PER LANE-HOUR



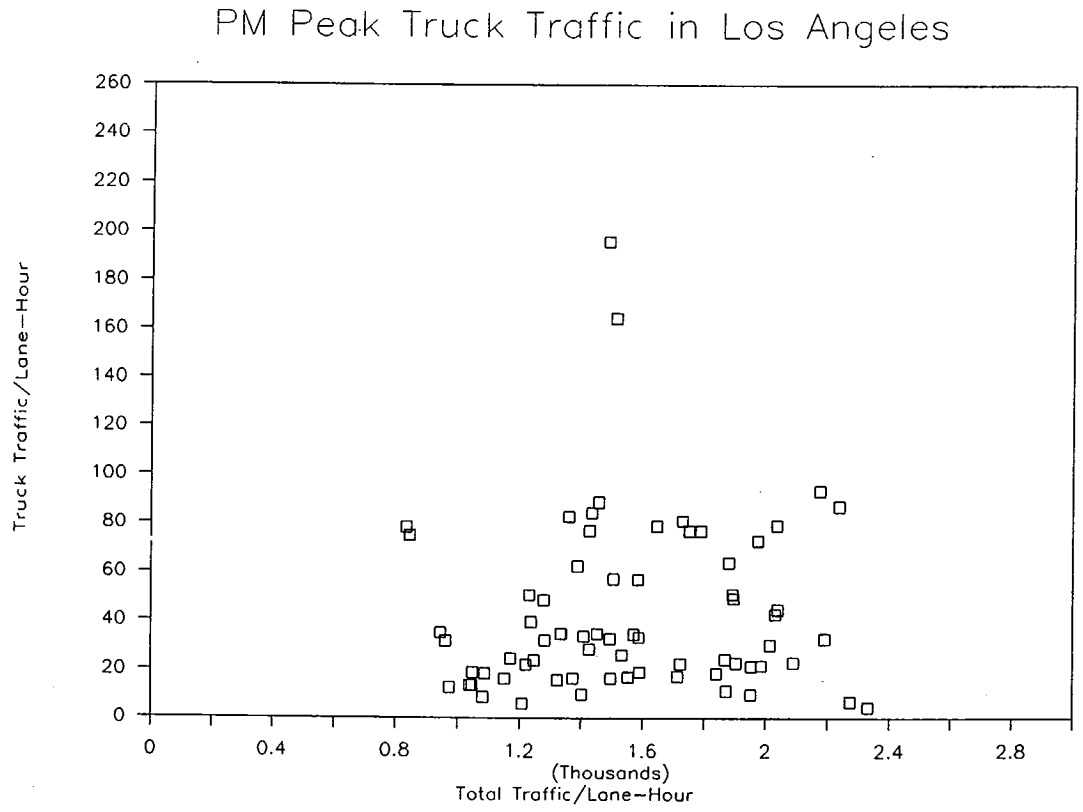


FIGURE 3.3 TRUCK TRAFFIC VERSUS TOTAL TRAFFIC PER LANE-HOUR

Figures 3.1b, 3.2b and 3.3b convert the percentages into trucks per lane-hour. These figures demonstrate the following additional points:

Observations

- Truck traffic is nearly the same during the a.m. and midday, but considerably smaller during the p.m.
- Total traffic is largest during the p.m., slightly smaller during the a.m. and considerably smaller during the off-peak.
- The largest truck volumes occur on freeways with medium traffic volumes (on the order of 1400 vehicles/lane-hour). Truck traffic is smaller on roads that have either a very large or very small traffic level.

Roughly the same number of trucks is on the road during the a.m. peak and midday, likely because driver workshifts run from early morning through the afternoon. The higher percentage of trucks at midday is due to fewer automobiles being on the road, not more trucks. During the p.m. peak, there are fewer trucks on the road because many carriers have terminated operations for the day. And, in all periods, there is a natural tendency for trucks to avoid congested routes.

3.2 Truck Traffic at Individual Sites

On a microscopic level, several sites stand out as having especially large, or small, truck volumes. In the a.m. peak, the truck percentages were smallest and largest at the following locations

Small Truck Percentages: A.M. Peak

Rte	Freeway/Location	Total/Lane-hr	Trucks/Lane-hr	Truck %
10-E	Santa Monica/La Brea	2250	11	.5 %
101-S	Hollywood/Hollywood	1270	10	.7 %
10-W	Santa Monica/La Brea	2547	30	1.2 %
110-N	Harbor/Torrance	2153	33	1.6 %
10-W	San Bernadino/W.Covino	2022	35	1.7 %
55-N	Costa Mesa/Villa Park	1428	25	1.8 %
55-S	Costa Mesa/Santa Ana	1882	36	1.9 %
101-E	Ventura/Tarzana	2035	38	1.9 %
110-N	Harbor/USC	1818	35	1.9 %
405-N	San Diego/Fountain Valley	1326	26	2.0 %
405-S	San Diego/Fountain Valley	1958	39	2.0 %

Large Truck Percentages

710-S	Long Beach/Long Beach	1326	207	15.6 %
605-S	San Gabriel/Whittier	1708	195	11.4 %
605-N	San Gabriel/El Monte	807	92	11.4 %
60-E	Pomona/Industry	1120	102	9.1 %
710-N	Long Beach/Long Beach	1551	128	8.2 %
5-N	Golden State/Sun Valley	798	62	7.8 %
110-S	Harbor/Long Beach	1538	101	6.6 %
5-S	Santa Ana/Bell Gardens	1374	88	6.5 %
60-W	Pomona/Industry	1260	78	6.2 %

The emergent pattern is that the heaviest a.m. truck volumes occur on roadways located near to the Port of L.A./Long Beach and near to the South-central industrial corridor, over roads that are relatively uncongested. The smallest truck volumes occur on roadways heading toward the Downtown or other employment centers, over roads that are quite congested. The absolute lowest truck percentages occur on the Santa Monica Freeway, the most densely developed commercial corridor in the region.

3.3 Summary

Trucks in the Los Angeles region naturally avoid the most congested roadways. In every time period, there is a negative correlation between percentage truck volume and total traffic. Further, truck percentage is largest at midday and smallest during the p.m. peak. Nevertheless, it is impossible for trucks to avoid congested freeways completely. The congested Santa Ana and San Diego Freeways are surrounded by major industrial centers. Trucks must travel these roads to serve their customers. Thus strategies are needed to minimize the exposure of trucks to congestion.

4. LOCATIONS OF EXISTING TRUCKING TERMINALS

The travel patterns for trucks in the L.A. region is dependent on the locations of the major trip generators -- manufacturers, warehouses, the Port and rail yards -- as well as on locations of trucking terminals. By locating terminals closer to trip generators, the total number of truck miles can be reduced. By strategically locating terminals to exploit excess freeway capacity, the number of truck miles over congested roadways can be reduced.

We now examine the existing locations of trucking terminals in the region. The analysis is based on two data sources: (1) the California Trucking Association (CTA) file of L.A. and Orange County terminals (San Bernadino and Riverside Counties were excluded), and (2) Service directories for seven major LTL Carriers. Neither data source is comprehensive. Nevertheless, each provides a representative sample of existing terminal locations, and provides insight into truck travel patterns in the L.A. region.

4.1 General Terminal Locations

The CTA data file contains the addresses of 600 terminals covering a wide variety of trucking -- LTL and truckload, private and common, as well as specialized carriers. The CTA data was coded by zip code, then the zip codes were ranked from largest to smallest according to number of terminals. Table 4.1 gives the top 23 zip codes.

Observation

- The greatest concentrations of terminals are in South-central L.A. -- in the Santa Ana corridor stretching from Downtown to Santa Fe Springs -- and in the vicinity of the Port of L.A./Long Beach, stretching up to Gardena.

The first area is the manufacturing core of the region, and the second is the distribution core. Clearly, large numbers of motor carriers have selected sites to serve these customers.

Specific terminal locations are shown for the South-central and Port areas in Figures 4.1 and 4.2. The single largest concentration of terminals is south of I-5, in the vicinity of Vernon, Bell and Commerce. Terminals in the Port area are somewhat more dispersed.

Comparison to Manufacturing Employment If terminals are to be located effectively, they should be placed close to their customers. Because manufacturers comprise the single largest source of customers, we compared the terminal location pattern to the pattern of manufacturing employment in the region [6]. Through statistical regression, the relationship between number of terminals and manufacturing employment, by zip, was approximated by a linear equation. Some zip codes contain considerably more terminals than predicted. For instance, Zip 90250, which has 10,000 manufacturing employees and 4 terminals, is close to average, with one terminal per 2,500 employees. Zip 90706, which has three terminals and just 500 manufacturing employees, is far above average, with one terminal per 170 employees.

Table 4.1 Zip Code Ranking for Number of Terminals+

Rank	Zip	Location	Terminals
1	90058	South-central Los Angeles	30
2	90040	Commerce	27
3	90670	Santa Fe Springs	25
4	90744	Wilmington	22
5	90810	Long Beach	18
6	90640	Montebello	14
7	90021	South Central Los Angeles	12
8	92667	Orange	11
8	90723	Paramount	11
10	90807	Long Beach	9
10	90701	Artesia	9
10	90023	East Los Angeles	9
10	90248	Gardena	9
14	90022	East Los Angeles	8
15	90048	Hollywood	7
15	90806	Long Beach	7
15	90660	Pico Revera	7
15	92665	Orange	7
15	90745	Carson	7
15	91706	Baldwin Park	7
15	90501	Torrance	7
15	92805	Anaheim	7
15	91746	La Puente	7

+ Data extracted from California Trucking Association terminal database for Los Angeles and Orange Counties, 10/23/89. In some cases, numbers were supplemented to include omitted LTL terminals. These numbers are not all inclusive, but should be indicative of which zip codes contain the greatest concentrations of terminals.

Figure 4.1 Locations of Trucking Terminals, South-central L.A.

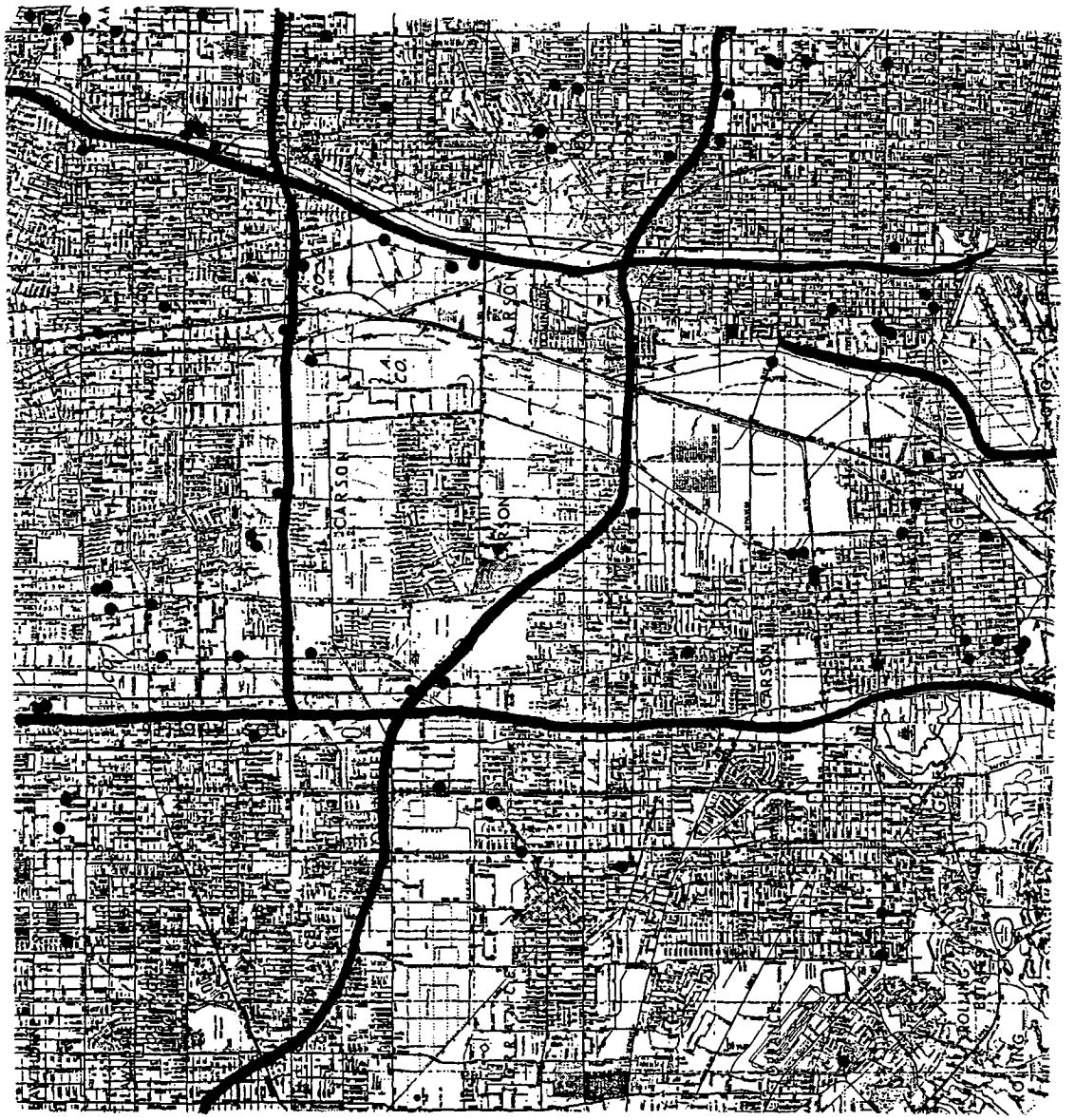


FIGURE 4.2 LOCATIONS OF TRUCKING TERMINALS, PORT VICINITY

Figure 4.3 shows the zip codes where the number of terminals differs substantially from expected, given manufacturing employment.

Observations

- Zips 90058, 90040, 90640, 90670 in the Santa Ana Freeway corridor, and 90744 and 90810 in the Port area stand out as having especially large concentrations of terminals. Each has at least 10 more terminals than expected. These zips are also large manufacturing centers, averaging 15,000 employees each.
- Zips 91311 (Chatsworth), 91406 (Van Nuys), 91504 (Burbank), 90245 (El Segundo), 90278 (Redondo Beach), 90503 (Torrance), 92705 (Santa Ana) and 92714 (Irvine) stand out as having far fewer terminals than expected. These zips have at least four fewer terminals than expected, and average 19,000 manufacturing employees each. In addition, all are distant from Downtown, located in the suburbs.

Explanation of Terminal Clusters Manufacturing employment is just one determinant of the number of terminals in a zip code. Other factors include manufacturing employment in nearby zips and location of major transportation facilities. The latter factor surely explains the large concentration of terminals in the Port area. It would be inefficient for carriers that serve the Port to locate elsewhere.

The concentration of terminals along the Santa Ana corridor can be explained by neither employment in nearby zips nor transportation facilities: the total number of terminals along the Santa Ana far exceeds the expected number, given the manufacturing employment. An imbalance does not exist in one or two zips, but in most of the zips. Though the Santa Ana corridor is adjacent to the Union Pacific and Santa Fe intermodal terminals, the traffic generated here is not comparable to the traffic generated at the Port of L.A./Long Beach, and cannot alone explain the cluster of terminals.

The likely explanation is that South-central L.A. is an ideal location for carriers that serve the entire L.A. region from a single terminal. To test this reasoning, alternative terminal sites were analyzed according to the average straight-line distance to manufacturing job sites in L.A., Orange, Riverside and San Bernadino Counties. The single most central location was found to be in Bell, west of I-710 and south of I-5, which is within a mile of the cluster of terminals in Figure 4.1.

To further test the reasoning, locations were analyzed to see which sites are nearly optimal with respect to minimizing average straight-line distance. In Figure 4.4, the average distance from any location in the central circle to the region's manufacturers is within 1% of the optimum; within the middle circle, the distance is within 5% of optimum and within the outer circle the distance is within 10% of optimum. The middle and outer rings almost directly coincide with the pattern of Figure 4.3, showing zips with excess terminals.

In addition, the Santa Ana corridor provides excellent freeway accessibility. The Port can be reached via I-710, Riverside/San Bernadino can be reached via

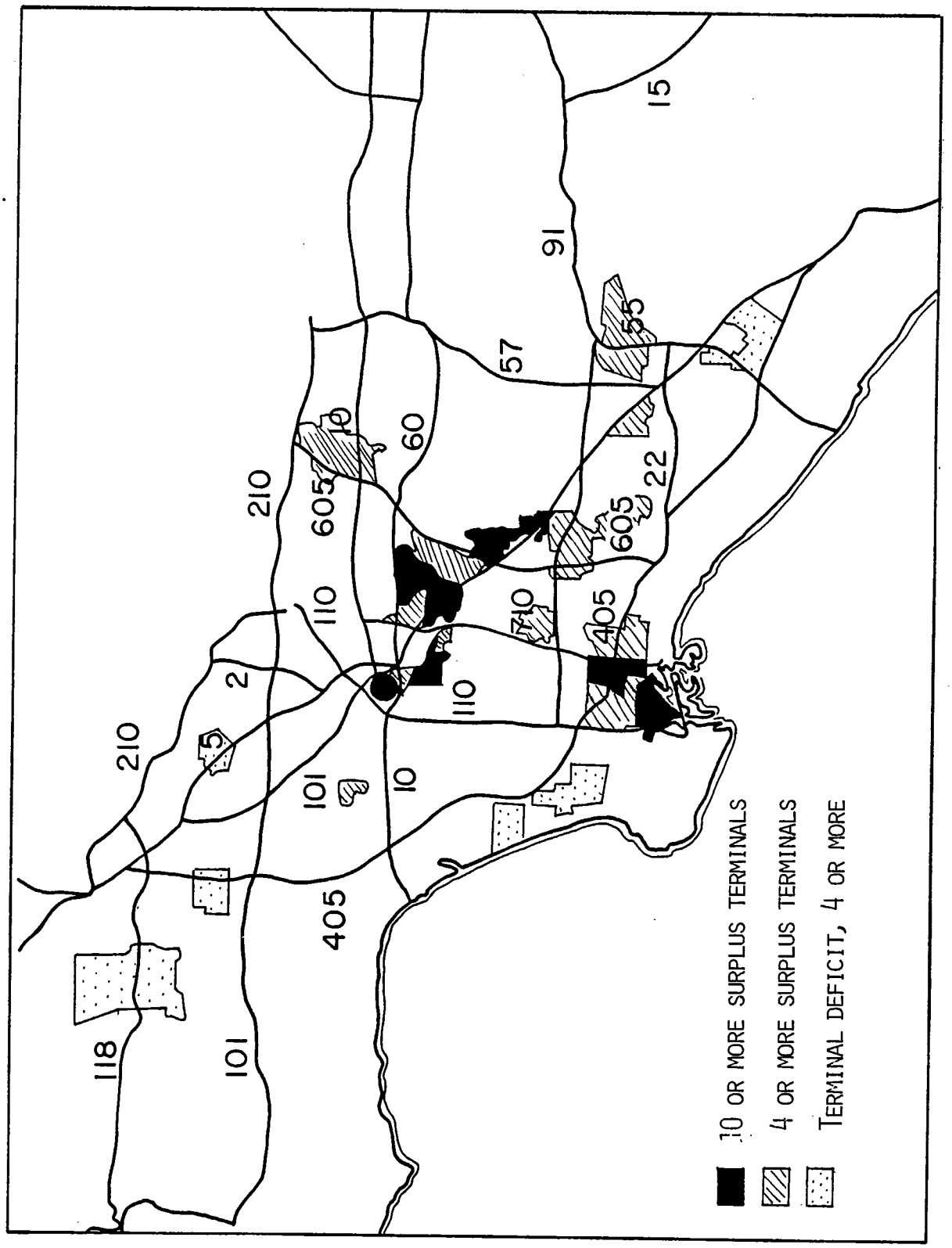


FIGURE 4.3 ZIP CODES CONTAINING MANY, OR FEW, TRUCKING TERMINALS

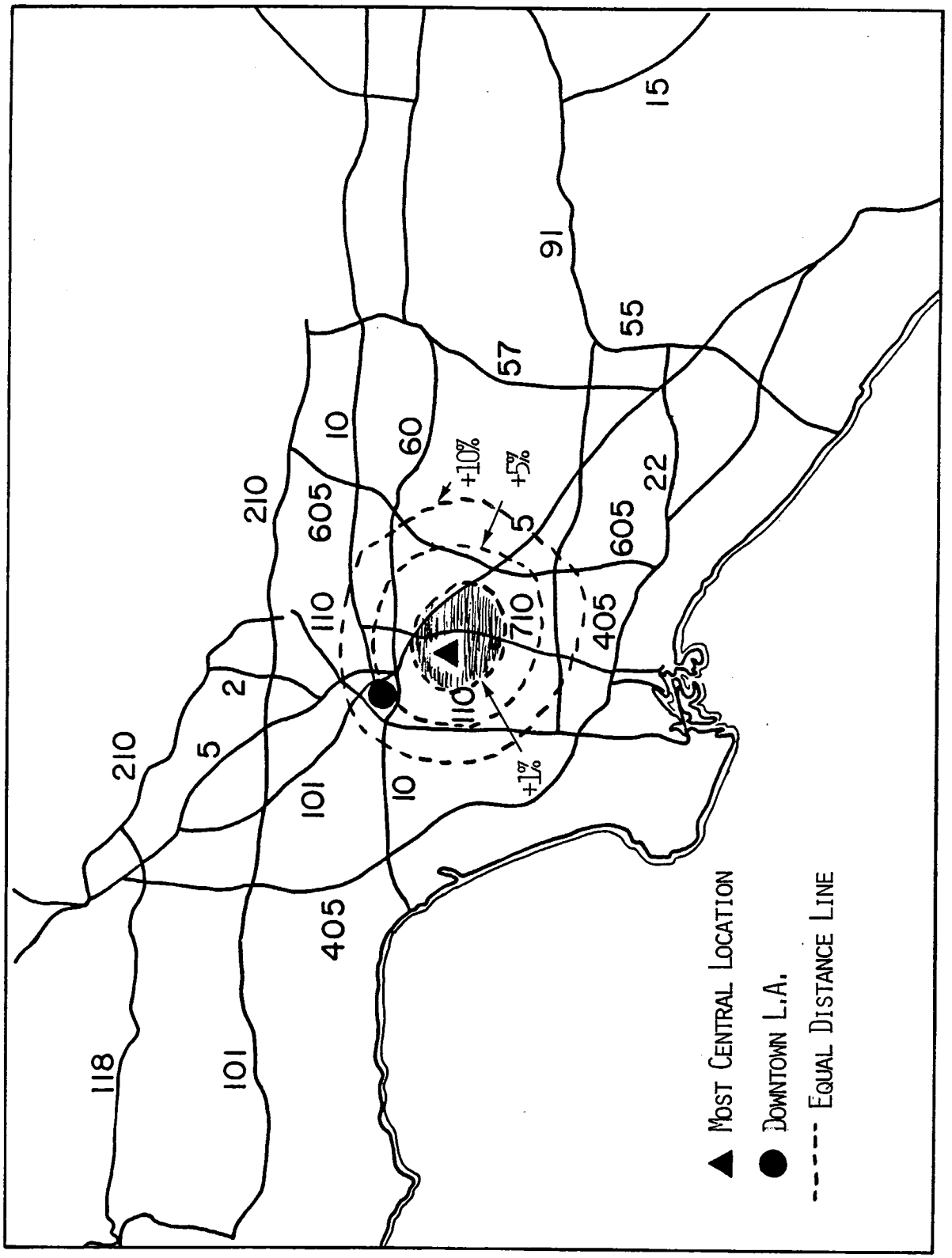


Figure 4.4 Most Central Location Relative to Manufacturing Employment

I-60, and Orange County can be reached via I-5, all reverse-commute directions. The flip side is that San Fernando Valley, West L.A. and the El Segundo/LAX can only be reached via the Downtown or by circuitous routes. Although the construction of the Century freeway will partially remedy this situation, access to San Fernando Valley will remain a problem for carriers based in South-central L.A. The twin obstacles of the Santa Monica Mountains, and the routing of the Golden State and Hollywood freeways through the congested Downtown, may make the Valley increasingly isolated in future years.

4.2 LTL Terminals

Terminals were evaluated for seven LTL common carriers: the three "majors" (Consolidated Freightways, Roadway and Yellow), three smaller nationwide carriers (ABF, ANR and P.I.E.) and a large regional carrier (Viking). Terminal locations, and boundaries of terminal service regions, were obtained from published service directories [7].

Topography and, to a lesser extent, governmental boundaries, play a key role in dictating terminal locations and service regions. All carriers appear to have divided L.A. into four distinct regions:

Region	Boundaries
San Fernando	Santa Monica and San Gabriel Mountain Ranges
Eastern	San Gabriel and Santa Ana Ranges
Orange	Santa Ana Range and Orange County line
Central	Santa Monica and Santa Ana Ranges, and Orange County line

To illustrate the region's topography, Figure 4.5 shows the positioning of 1000 foot contour lines. Areas located above the 1000 foot level tend to be sparsely populated and difficult to traverse. Consequently, service regions have been drawn to minimize pickup/delivery truck travel across the mountains.

Table 4.2 lists the terminals by region and associates terminals having similar locations. For instance, the first line gives the terminal serving locations to the west of San Fernando Valley. In all seven cases, that terminal is located in either Ventura or Oxnard. The second line gives the terminal serving central San Fernando Valley. Again, the locations are similar. All carriers have a terminal in Pacoima or the adjacent Sun Valley.

In Figure 4.6, locations of all seven carriers have been plotted. Figures 4.7 to 4.13 show terminal locations and service region boundaries for individual carriers. These figures also show the number of tractors (does not include all types of trucks) and the number of loading docks at each terminal.

Observations

- It appears that a minimum of six terminals is needed to serve the region competitively, one each for: Oxnard, San Fernando Valley, Long Beach, Central L.A., Orange County, and San Bernadino/Riverside.
- The larger carriers have divided L.A. into smaller service regions and established more terminals. Roadway, for instance, serves Central L.A. from five terminals: Gardena, Industry, Long Beach, South-central L.A.,

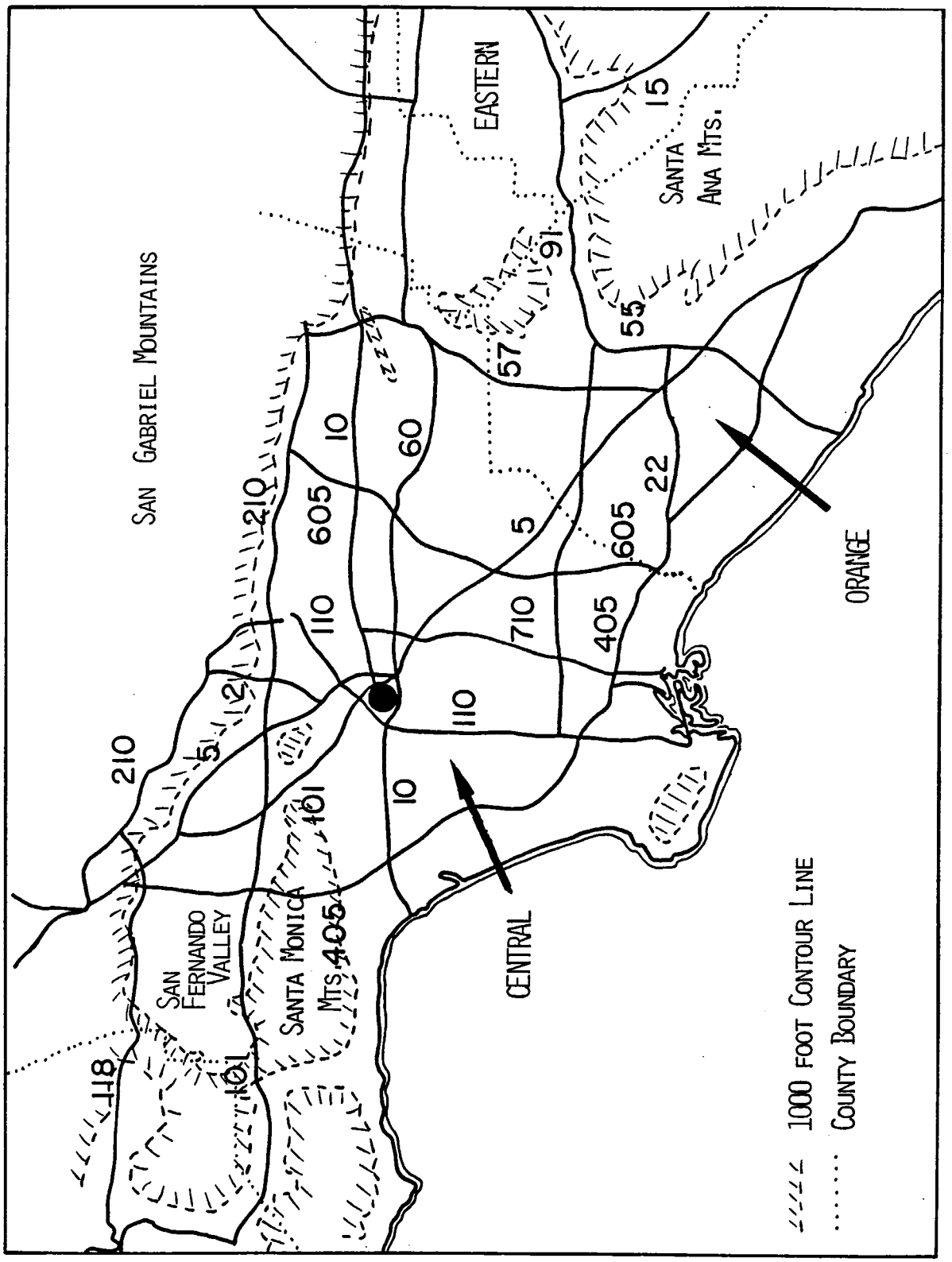


FIGURE 4.5 L.A. REGION TOPOGRAPHY

Table 4.2 LTL Terminals for Seven Carriers

Large LTL Carriers

Consolidated		Roadway		Yellow	
San Fernando/Ventura					
Oxnard	92613	Ventura	93001	Ventura	93003
Pacoima	91331	Pacoima	91331	Sun Valley	91352
Simi	93065				
Central: Santa Ana					
L.A.	90021	L.A.	90058	L.A.	90021
Montebello	90640			Pico Rivera	90660
Santa Fe S.	90670	Santa Fe S.	90670	Santa Fe. S.	90670
Central: San Diego					
Carson	90745	Wilmington	90744	Carson	90810
Compton	90220	Gardena	90248	Gardena	90247
Inglewood	90304				
Central: East County					
Industry	91789	Industry	91746		
Irwindale	91706				
Orange Country					
Irvine	92718	Irvine	92718	Irvine	92718
Los Alamit.	90720				
Orange	92665	Orange	92667	Orange	92668
Eastern					
Fontana	92335	Ontario	91743	Fontana	92335
San Bern.	92324	San Bern.	92316	Riverside	92507

Medium LTL Carriers

ABF		ANR		PIE		Viking	
San Fernando/Ventura							
Oxnard	93001	Oxnard+	93030	Ventura	93003	Oxnard	93030
Pacoima	91331	Pacoima	91331	Pacoima	91331	Sun Valley	91352
Central							
Carson	90810	Long Beach	90810	Carson	90746	Gardena	90248
Pico River	90660	L.A.	90023	L.A.	90058	Whittier	90601
				Montebello	90023		
				Industry	91769		
Orange							
Orange	92667	Orange	92665	Orange	92665	Anaheim	92806
Eastern							
Pomona	91767	San Bern.	92408	Fontana	92234	Pomona	91767
Colton	92324			San Bern.	92402	San Bern.	92408

+ Recently closed

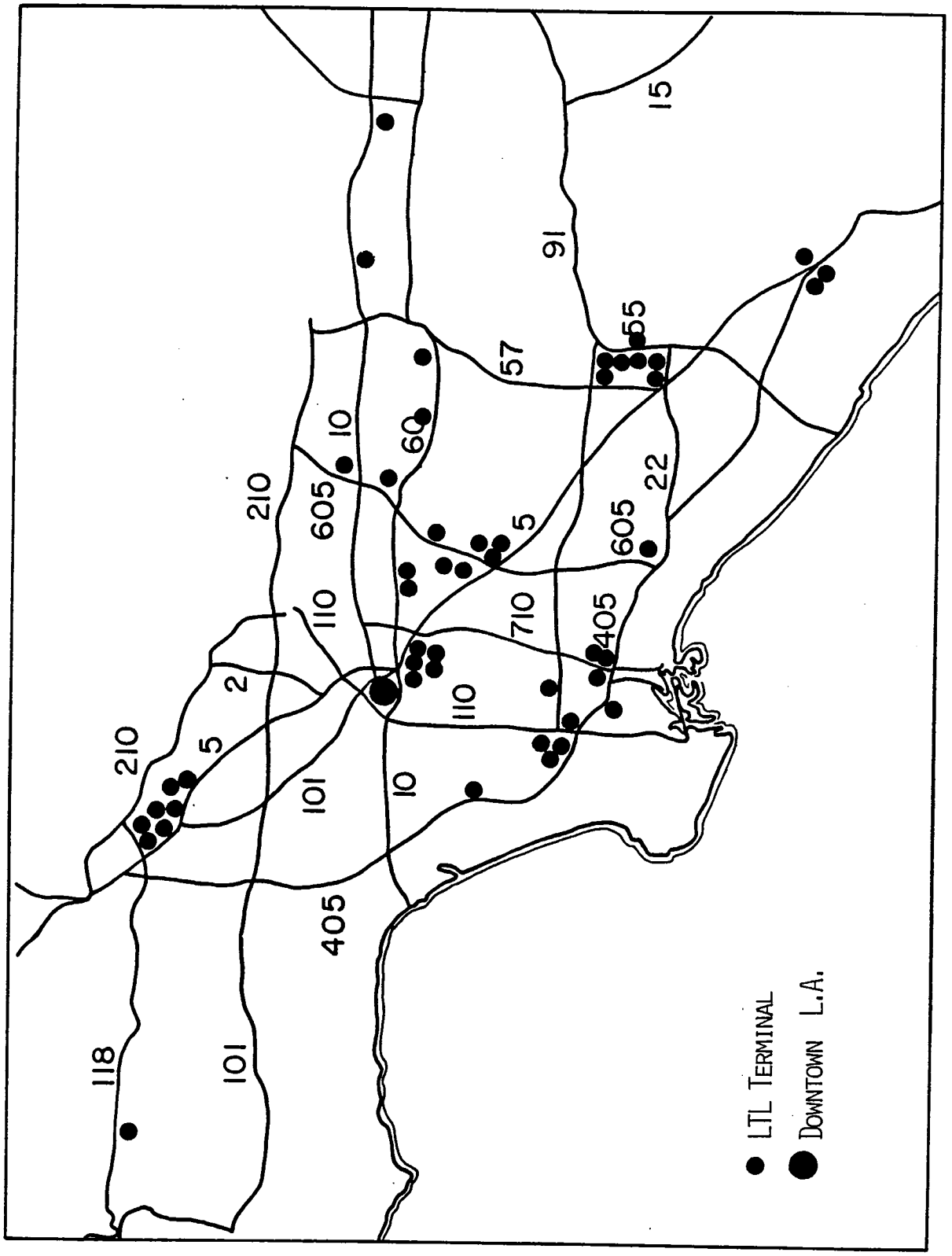


FIGURE 4.6 LOCATIONS OF LTL TERMINALS

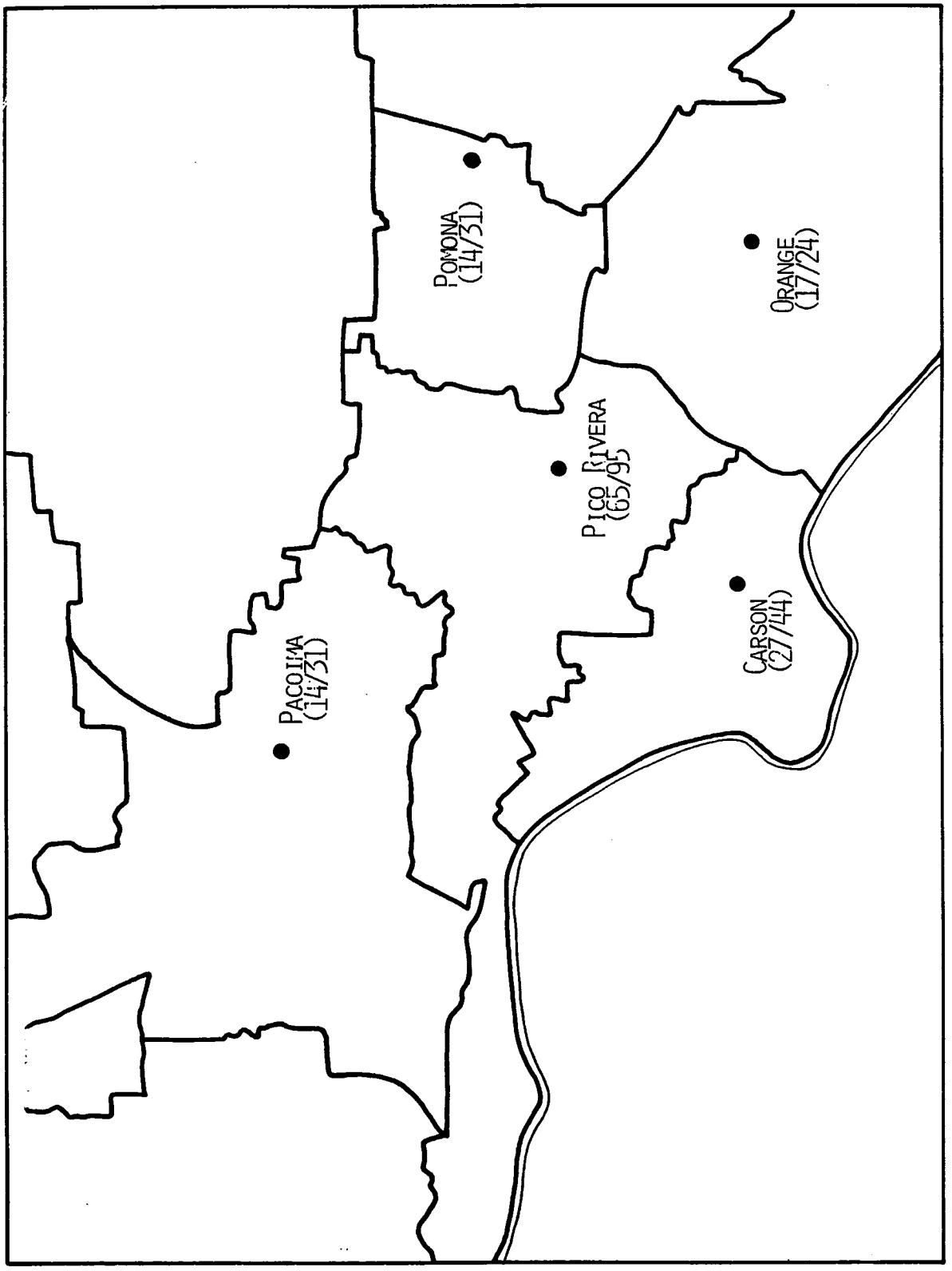


FIGURE 4.7 MAP OF ABF TERMINALS AND SERVICE REGIONS (BASED ON PUBLISHED SERVICE DIRECTORY)
PARENTHESES: TRACTORS/DOORS

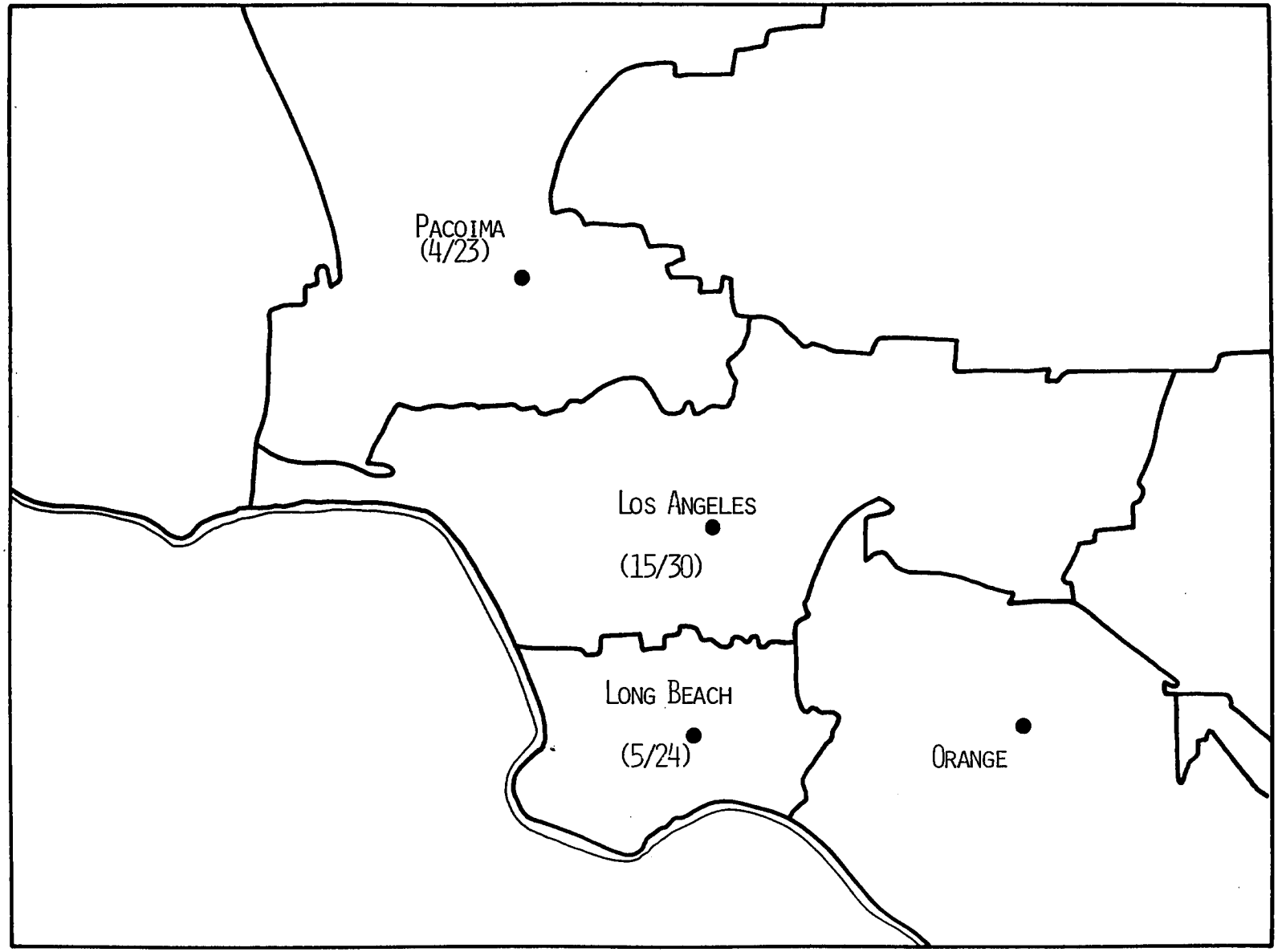


FIGURE 4.8 MAP OF ANR TERMINALS AND SERVICE REGIONS (BASED ON PUBLISHED SERVICE DIRECTORY)
PARENTHESES: TRACTORS/DOORS

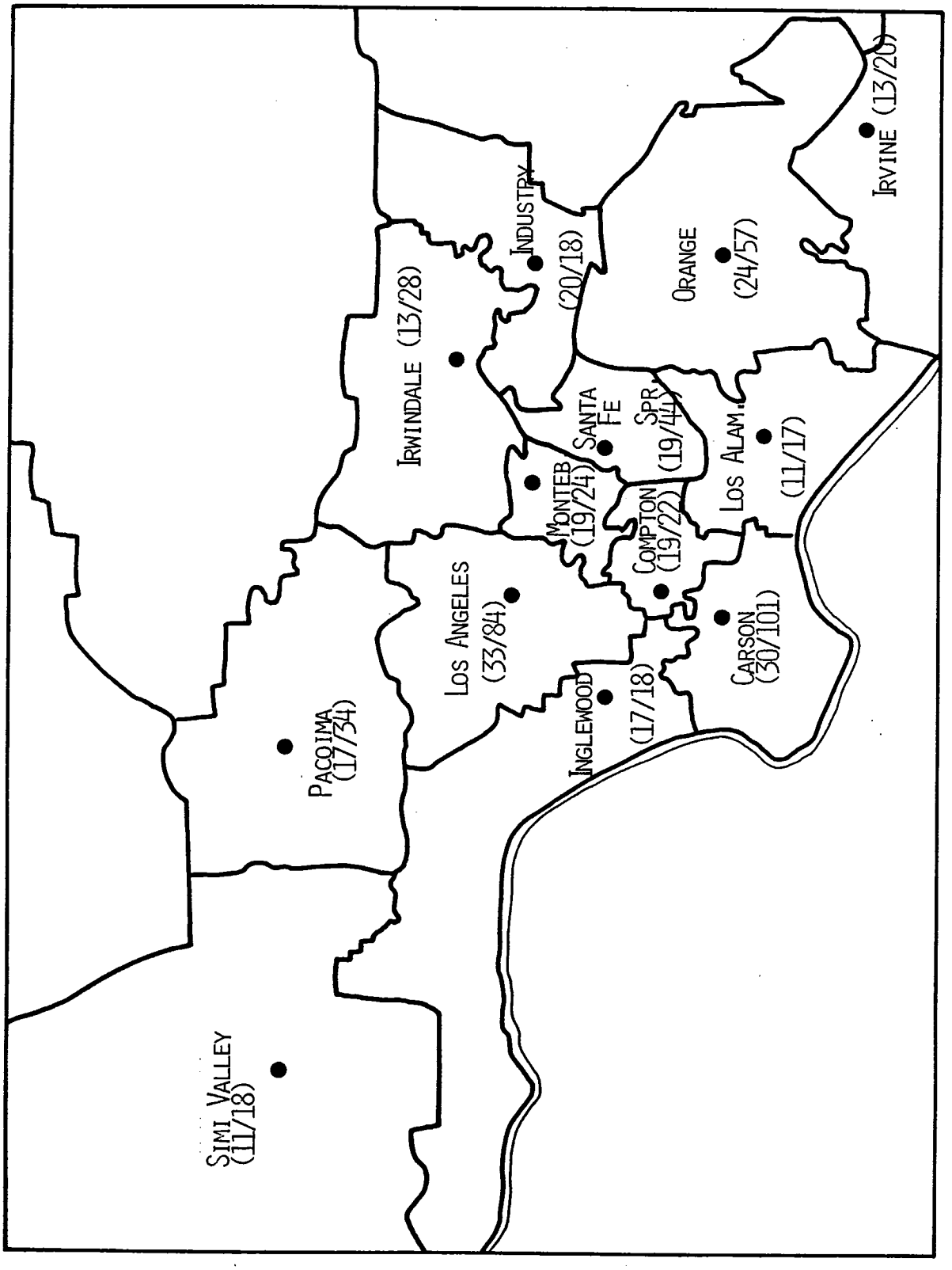


FIGURE 4.9 MAP OF CONSOLIDATED FREIGHTWAYS TERMINALS AND SERVICE REGIONS (BASED ON PUBLISHED SERVICE DIRECTORY). PARENTHESES: TRACTORS/DOORS

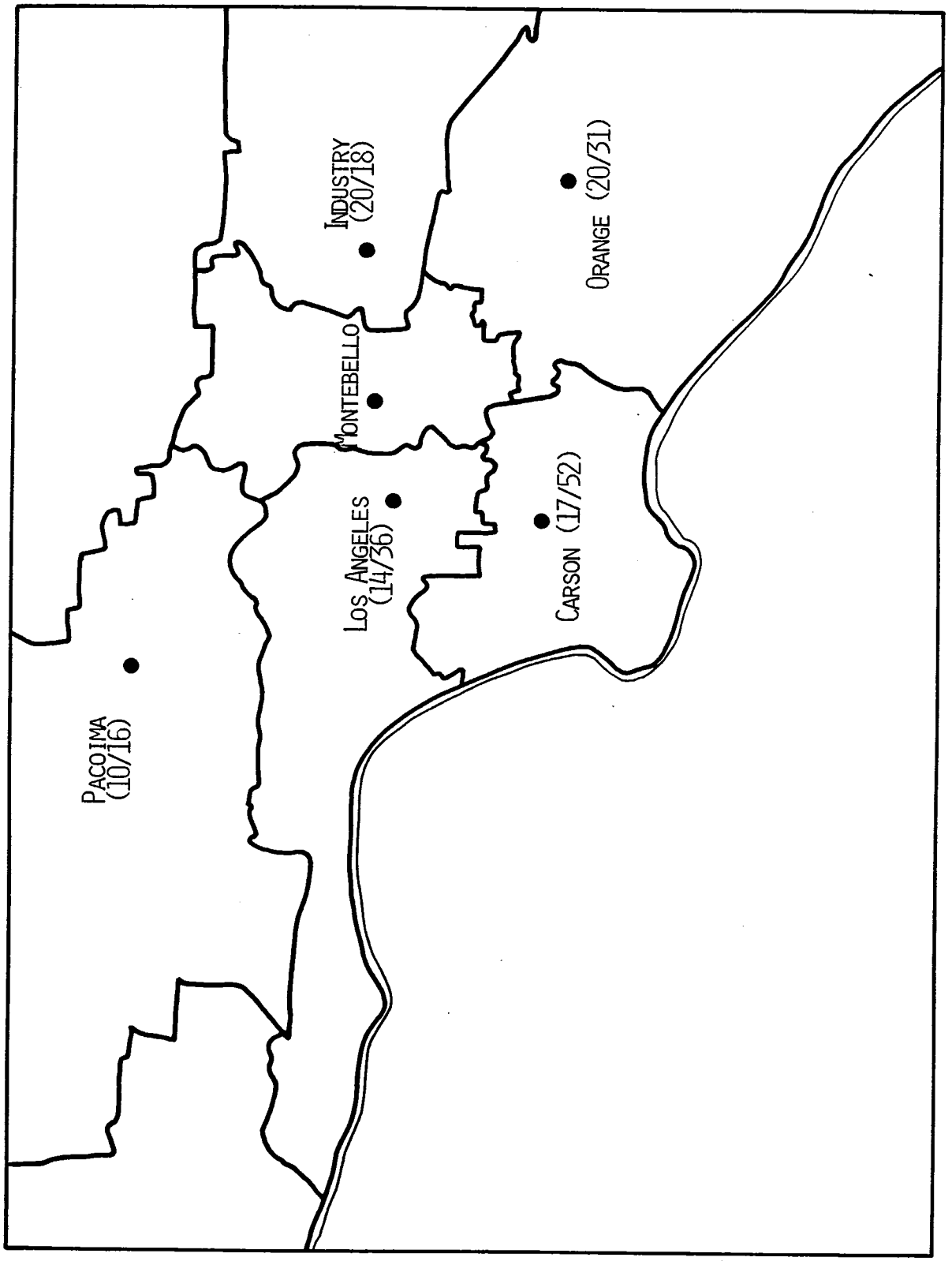


FIGURE 4.10 MAP OF PIE TERMINALS AND SERVICE REGIONS (BASED ON PUBLISHED SERVICE DIRECTORY)
PARENTHESES: TRACTORS/DOORS

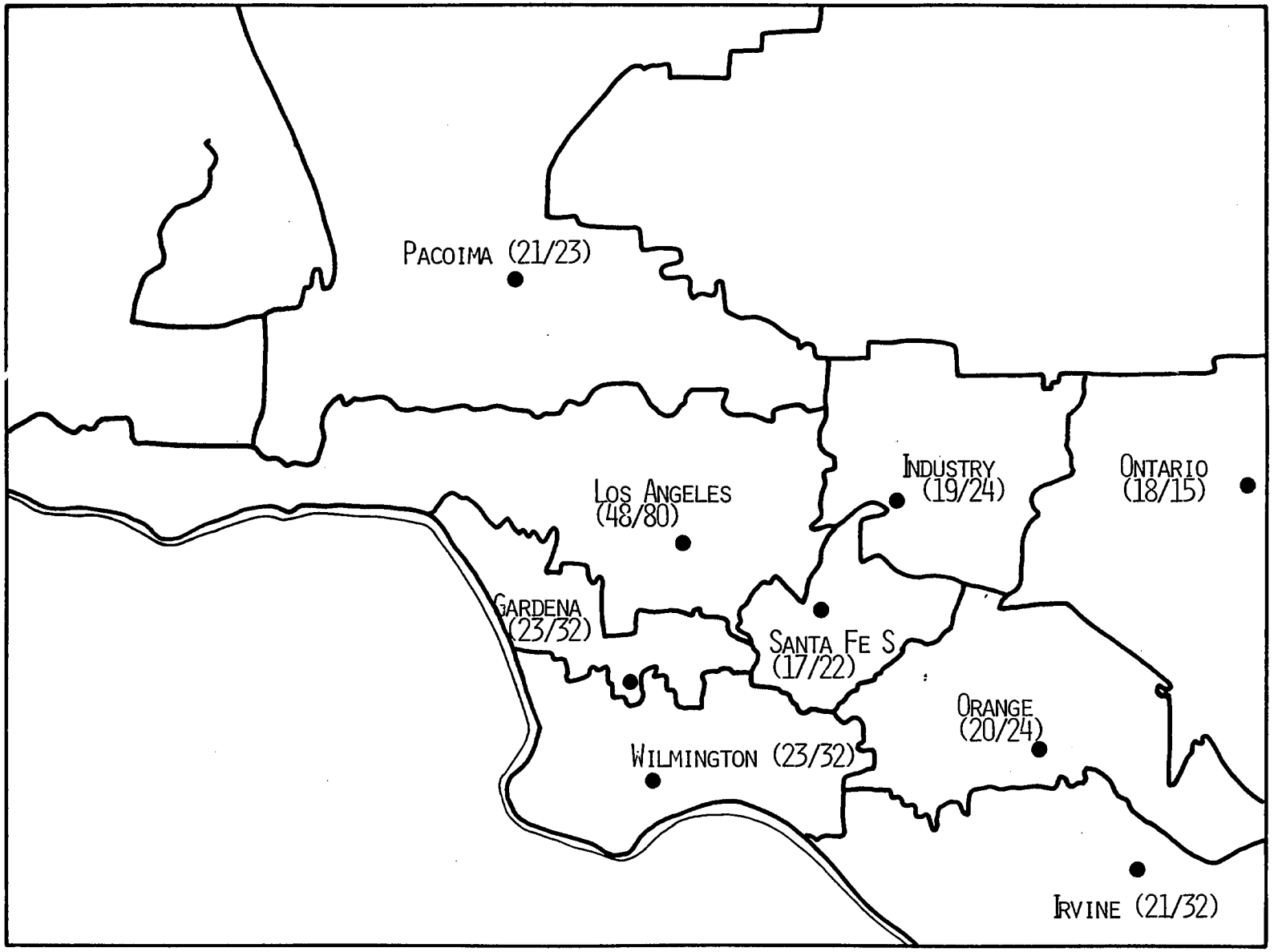


FIGURE 4.11 MAP OF ROADWAY TERMINALS AND SERVICE REGIONS (BASED ON PUBLISHED SERVICE DIRECTORY)
PARENTHESES: TRACTORS/DOORS

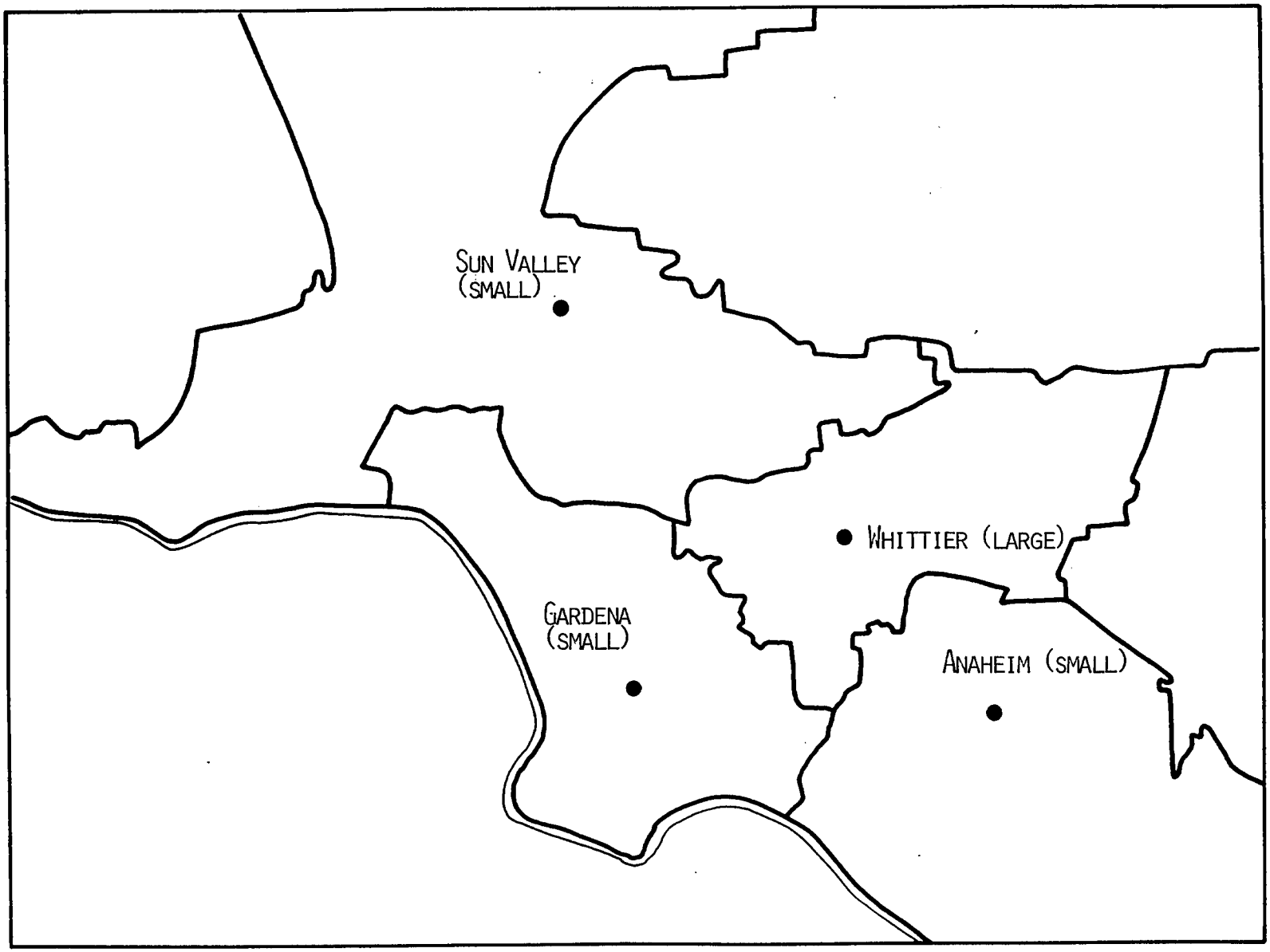


FIGURE 4.12 MAP OF VIKING TERMINALS AND SERVICE REGIONS (BASED ON PUBLISHED SERVICE DIRECTORY)

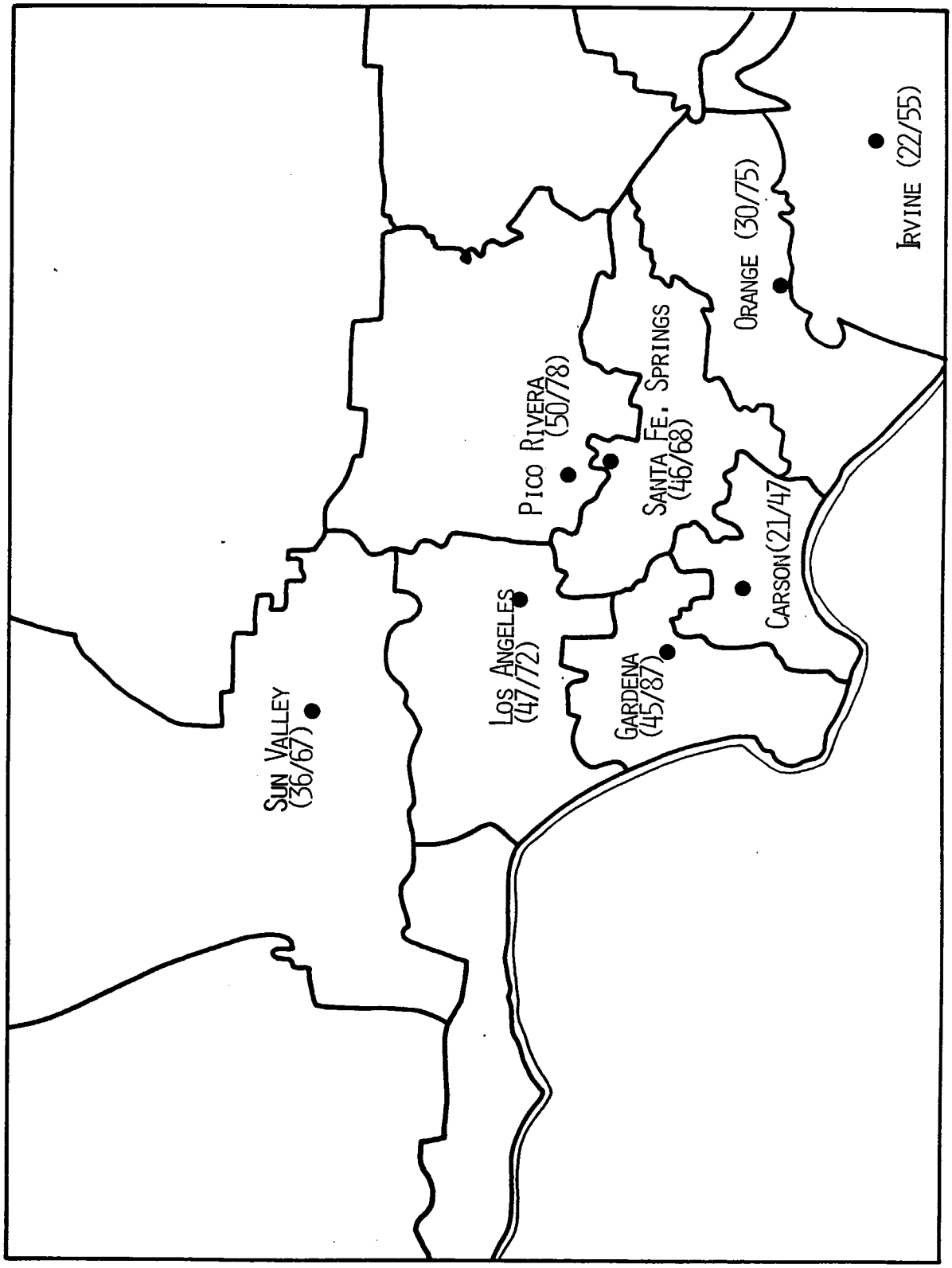


FIGURE 4.13 MAP OF YELLOW TERMINALS AND SERVICE REGIONS (BASED ON PUBLISHED SERVICE DIRECTORY)
PARENTHESES: TRACTORS/DOORS

and Santa Fe Springs. Roadway has also established two terminals in Orange County (Irvine and Orange) and two terminals in the eastern region (Ontario and San Bernadino).

- Consolidated Freightways has the most terminals. With 16 total, it has five more than its nearest competitor.
- There is no precise relationship between carrier size and number of terminals. Yellow has 75 more tractors and 73 more docks than Consolidated, but five fewer terminals. Viking, with six terminals, has a comparable number of docks as Roadway, with eleven.
- Terminals are not always centrally located relative to their service regions. This is especially apparent for Yellow.

The large carriers hold a natural advantage over the small in terms of minimizing their pickup/delivery costs. With more terminals, large carriers can serve their customers from closer terminals, on average. Consequently, they are not as exposed to road congestion delays. Consolidated, for instance, can serve the manufacturing center in El Segundo from nearby Inglewood. All other carriers would have to dispatch a truck from the Long Beach/Gardena area, or from South-central L.A.

4.3 LTL Service to Manufacturing Centers

The distance, and route, from terminal to customer dictates the extent to which trucks are exposed to highway congestion. Some manufacturing centers enjoy much closer service than others, as indicated in Table 4.3. The following describes the regional needs for LTL service.

San Fernando Manufacturing employment is concentrated along the S.P. Railroad lines, with one corridor paralleling the Golden State Freeway (5) and a branch heading west toward Sepulveda and Chatsworth [6,8]. The LTL terminals are concentrated on the east side of the valley, which makes access to Chatsworth and Sepulveda somewhat distant. However, the San Fernando Valley Freeway (118) provides relatively uncongested, if circuitous, routes. Glendale is also distant but, given the relatively light traffic on the Golden State Freeway, access is not a major problem. By far the most congested freeway in the Valley is the Ventura (101). However, there is little manufacturing employment in the vicinity and LTL trucks can avoid the route.

Eastern Sparse development and good east-west freeway coverage make congestion a much smaller issue in San Bernadino and Riverside counties. Major manufacturing centers can be reached without encountering large delays. However, as the counties develop their vast stocks of vacant, industrially zoned, property [8], congestion is sure to increase. Of particular concern is the area between Ontario and Fontana along the Devore Freeway (15).

Orange Manufacturing employment is concentrated in two areas: in Irvine along the Costa Mesa (55) Freeway; and in the Riverside (91)/Santa Ana (5)/Orange (57) Freeway triangle, surrounding Anaheim. The major carriers afford good access, with terminals in both locations, but the smaller carriers only have terminals in Orange or Anaheim. The distance from Orange to Irvine is not

Table 4.3. Major Manufacturing Centers

Center/zip		Ave Dist to Terminal+	CF Dist to Terminal@	Access Route*
San Fernando				
Burbank	91504	5	6	5 south
Chatsworth	91311	11	10	5 north/118 west
San Fernan.	91342	5	5	5 north
Sepulveda south	91406	5	5	surface,5 north/405
Central: I-5				
Commerce	90040	3	2	5 south
Santa Fe Sp	90670	4	0	surface
Vernon	90058	3	2	surface
Central: I-405				
Compton	90221	4	2	91 east,710 north
Culver Cty	90230	10	5	10 west
El Segundo	90245	8	2	405 north(CF:405 south)
Gardena	90248	2	3	surface
Redondo Bch	90278	6	3	405 north/surface
San Pedro	90731	6	5	110 south,surface
Santa Mon.	90404	13	8	10 west
Central: East County				
Azusa	91702	10	3	605 north
El Monte	91733	5	4	605 north
La Puente	91746	6	4	605 north/60 east
Orange				
Fullerton	92631	4	4	55 north
Hunt. Bch	92649	11	5	22 west
Irvine	92714	8	6	405 north
East				
Pomona	91766	8	6	10 west
Rancho Cuc.	91730	8	7	10 west,surface
Riverside	92507	7	6	215 south

+ Average straight-line distance from zip code to zip code.
@ Straight-line distance for Consolidated Freightways, zip to zip.
Zero value indicates that terminal is located in manufacturing zip code.
* Most common access route among seven LTL carriers

enormous. However, southbound a.m. congestion and northbound p.m. congestion are significant. West Orange County, and the manufacturers around Huntington Beach, are even more difficult to reach. Most carriers access the area from Orange, on the Grove (22) and San Diego (405) freeways. Both are congested.

Central The central district has by far the largest number of manufacturing employees, especially along the San Diego Freeway (405), from Long Beach north to Santa Monica, and along the Santa Ana Freeway (5), from Downtown south to La Mirada. Smaller concentrations exist in east L.A. county, along the San Gabriel (605) and Pomona (60) Freeways.

Santa Ana The large carriers are well positioned to serve the corridor, the single largest manufacturing concentration in the region. Consolidated, PIE, Roadway and Yellow each has two or three terminals. Service from the smaller carriers is somewhat inferior. In particular, Viking has located its terminal in outlying Whittier. To reach the South-central industrial core, Viking must travel north on the Santa Ana Freeway or west on the Pomona Freeway, following the same direction as commuters, or traverse slow surface streets. The outlying Whittier location has also forced Viking to serve Downtown from Sun Valley -- the only carrier to do so -- rather than from South-central L.A.

San Diego This heavily developed corridor is currently the most difficult to serve in the region. Only one carrier (Consolidated) has built a terminal north of the Harbor interchange, making access to the manufacturing centers in Santa Monica, Culver City and El Segundo very difficult. Access to the commercial centers along the Santa Monica Freeway (10) and to LAX is also hard. For most carriers, the only ways to reach these cities are to travel west from South-central L.A. on the Santa Monica freeway, or to travel north from the Long Beach area on the San Diego freeway. Both routes are heavily congested in the direction of travel (especially the latter).

East County Only Consolidated has sited a terminal in the Azusa/ Irwindale area. The smaller carriers serve these cities, and Pasadena, from as far away as South-central L.A or Sun Valley. The more central El Monte/Industry area is somewhat better served by all carriers. Fortunately, access is in the reverse commute direction, so carriers are not exposed to substantial congestion.

4.4 Summary

The largest concentrations of trucking terminals in L.A./Orange counties are in the vicinity of the Port of L.A./Long Beach and along the Santa Ana (5) Freeway corridor. The former is a good location for serving the large truck demand at the Port, and the latter is a central location from which to serve the entire L.A. region.

Among seven LTL carriers examined, all had terminals in at least six locations: Oxnard/Ventura, Pacoima/Sun Valley, Central L.A., Long Beach/Gardena, Orange, and San Bernadino/Pomona. Larger carriers --

especially Consolidated Freightways -- have established more terminals and, consequently, can reduce truck travel over congested freeways.

Accounting for existing terminal locations, freeway capacities and prevailing traffic patterns, several industrial areas are especially difficult to serve from existing terminals.

Carriers serving the entire region from South-central L.A.
- San Fernando Valley
- West L.A./Santa Monica
- LAX/El Segundo

LTL carriers serving region from multiple terminals (other than Consolidated)
- Glendale/Pasadena
- Huntington Beach
- South-central L.A. (ABF and Viking only)
- Irwindale/Azusa
- West L.A./Culver City
- LAX/El Segundo

The San Diego Freeway corridor, from West L.A. down to Redondo Beach, presents the biggest challenge. The San Diego Freeway is highly congested, often in both directions, and there is a shortage of trucking terminals.

5. LOCATIONS FOR NEW TERMINALS

Strategic terminal siting provides an opportunity for LTL carriers to reduce their congestion delays. In this section, positions for new terminals are examined in relationship to the existing manufacturing base and in relationship to freeway congestion. Because all carriers have made substantial investments in their existing facilities, and because additional terminals would require bigger investments, neither change could come quickly. Nevertheless, the cost of constructing a terminal is far less than the cost of constructing other industrial buildings, such as factories or even warehouses. So establishing new terminals would not be impossible.

5.1 Serving Entire Region from a Single Terminal

South-central L.A. is the most central location from which to serve the entire L.A. region. If offers the minimum average travel distance to the region's manufacturing employment, and it offers good freeway accessibility to all but San Fernando Valley and West L.A./El Segundo. It effectively exploits surplus freeway capacity heading south, to the Port and to the Santa Ana corridor.

Our analysis of existing terminals shows that a large number of motor carriers have wisely selected South-central L.A. for their terminals. Our only concern is that future carriers will avoid the area for the reasons of high land costs and lack of vacant industrial land. In its 1989 analysis of the L.A. industrial real estate market, Grubb and Ellis Reality stated:

> The scarcity of available land and the area's high prices have combined to keep construction activity low. The small amount of development activity that does occur consists primarily of teardowns of old structures, particularly multi-story industrial warehouse space, which is considered unsafe by earthquake or fire standards. [9]

One alternative to South-central L.A. is the Santa Fe Springs/La Mirada area, to the south-east, where there is some vacant industrial land. This area offers improved access to the fastest growing areas in the region: Orange, Riverside and San Bernadino Counties. With the construction of the Century Freeway, access to LAX/El Segundo would also be good. San Fernando Valley, on the other hand, could only be reached by the circuitous I-605/I-210 route, or through the congested Downtown via the Santa Ana Freeway. Access to the manufacturing core in South-central L.A. would also be made more difficult.

A second alternative is the Carson/Dominguez area to the south. The advantages here are excellent access to the Port and the San Diego corridor, and good access to South-central L.A., via the Long Beach Freeway (710). Vacant industrial property is available and prices are relatively low. The biggest drawbacks would be very difficult access to San Fernando Valley, and increased distance from the growing Riverside and San Bernadino Counties.

In the future, lower land prices and vacant property may draw carriers even further from the center, to East L.A. county or San Bernadino/Riverside counties. This would certainly be harmful to congestion, as average travel

distances would increase and trucks would be forced to travel in the same direction as commuters.

With the lack of vacant land in South-central L.A., and the lack of a direct route to San Fernando Valley that circumvents the Downtown, carriers may find it impossible to serve the entire region from a single location in the future. Santa Fe Springs would be workable for serving central L.A., and Orange, Riverside and San Bernadino counties, but a second terminal would be needed for San Fernando Valley and, perhaps, West L.A. (which could be accessed by I-405, the San Diego Freeway). Quite independently of freeway congestion, the sheer size of the L.A. region presents an enormous challenge. The urbanized area encompasses a region larger than the state of Delaware, and a population bigger than Pennsylvania. In the future, L.A. may be difficult or impossible to serve from a single location.

5.2 Multiple Terminals

We now examine for multiple terminals opportunities in the four L.A. regions: San Fernando, Eastern, Orange County and Central.

San Fernando All seven LTL carriers currently serve the valley from the Pacoima/Sun Valley location. This places the carriers strategically at the intersection of the Golden State (5) and Hollywood (170) freeways, and near to the manufacturing center of the valley. The most difficult manufacturing sites to access are Glendale and Chatsworth. However, because access routes are relatively uncongested -- even in the direction of peak traffic flow -- it would be difficult to improve on the current location.

Orange County If a carrier can only provide one terminal in Orange County, then Orange -- used by all 7 LTL carriers surveyed -- is a reasonable choice. Orange provides immediate access to the I-5/I-91/I-57 triangle and close access to the manufacturing center in Irvine. However, given the size of the Orange County market, and the congestion heading toward Irvine, two terminals are warranted, with the second in Irvine.

Eastern The concern here is not so much with existing congestion but with future congestion. The Ontario/Fontana area, along the Devore Freeway (15), is prime for development, and the larger carriers have wisely established terminals here. Because the area is large, a reasonable combination of terminals is San Bernadino and Fontana.

Central The region contains at least three distinct manufacturing centers -- San Diego corridor, Santa Ana corridor, and East L.A. County -- which suggests that a minimum of three terminals is needed to serve the region.

San Diego Service to the northern part of the corridor would improve if the smaller carriers moved further north to the Gardena/Torrance area (as Viking has already done). Gardena provides good reverse-commute access to the port, and improved access to El Segundo, LAX and Santa Monica. Ideally, the corridor would be served by two terminals,

one to the north in the Inglewood area and one to the south in the Carson/ Long Beach area.

Santa Ana Vernon/Commerce in South-central L.A. provides immediate access to the industrial core and the Downtown, and reverse commute access to Santa Fe Springs and South Gate. Unfortunately, the lack of vacant land is an obstacle to location there, and some carriers have moved further south. Ideally, two terminals would be used here, with the second in the Santa Fe Springs area.

East County El Monte, near the intersection of the San Gabriel (605) and Pomona (60) freeways provides excellent reverse-commute access to the manufacturing centers of Azusa/Irwindale and Industry/La Puente.

5.3 Addition of Terminals

The ideal way to avoid road congestion would be for motor carriers to establish more terminals, closer to their customers. In this regard, Consolidated Freightways, with sixteen terminals, serves as a model. Among the seven carriers studied, Consolidated is the only one with a terminal in Inglewood, to serve West L.A./El Segundo; the only carrier with a terminal in Irwindale, to serve Azusa and Pasadena; and the only carrier with a terminal in Los Alamitos, to serve Huntington Beach. For the other LTL carriers, these three manufacturing centers (and especially the first) are the most difficult to serve in the L.A. region. It would be highly desirable if all carriers had terminals in these areas.

Unfortunately, other individual carriers may not have the volumes to justify sixteen terminals. On the other hand, they could justify more terminals if they pooled their traffic. Here are some possibilities:

- Jointly operated terminals for several LTL carriers, to minimize the investment of each.
- A pooled fleet of pickup/delivery trucks to be shared among carriers.
- Independently operated terminals to serve multiple LTL carriers, with terminals acting as agents for pickup/delivery. LTL carriers would be responsible for line-haul between terminals.

In this era of deregulation, trucking is a highly competitive, but fragmented, industry, with many small operators. While shippers have benefited from low prices, some efficiency has been lost. From the standpoint of highway congestion, a reduction in the number of competitors would allow individual carriers to strategically locate terminals in more locations and reduce truck travel over congested roads.

5.4 Summary

The San Diego corridor and the Santa Ana corridor present the biggest challenges, and opportunities, for motor carriers. The regions are industrialized and congested. They demand excellent service from nearby terminals.

Unfortunately, there is little vacant industrial property in portions of these corridors. Available property is high priced. South-central L.A., along the Santa Ana corridor is built out and new construction requires teardown of older buildings. Land at the north end of the San Diego corridor is expensive. Nevertheless, carriers need to establish terminal in these areas if they are to avoid congestion delays.

6. REFERENCES

[1] *Urban Freeway Gridlock Study.* Cambridge Systematics, Inc. Cambridge, MA (1988).

[2] "Estimating the Full Economic Costs of Truck Incidents on Urban Freeways." R.F.Teal, Institute of Transportation Studies, University of California, Irvine, CA (1988).

[3] "Truck Operations on Arterial Streets," D. Gerard and R. Wunderlich, in *Strategies to Alleviate Traffic Congestion*, Institute of Transportation Engineers, 1988.

[4] *1989 Traffic Volumes on California State Highways.* State of California, Business, Transportation and Housing Agency, Division of Traffic Engineering, Sacramento, CA. 1988.

[5] *1987 California State Highway Log*, District 7 and 12. State of California, Business and Transportation Agency, Department of Transportation, Office of Traffic Engineering, Sacramento, CA 1987.

[6] *Distribution of Manufacturing Employment in the Los Angeles Five County Area.* Western Economic Research Co. Encino, CA. 1988.

[7] *Routing and Zip Code Directory, 1989-1990.* ABF Freight System, Inc. Fort Smith, AR.

1989 Service Guide. ANR Freight System, Inc. Denver, CO.

Customer Service Guide. Consolidated Freightways. Menlo Park, CA. (January, 1990)

Service Directory. P.I.E. Nationwide. Jacksonville, FL (March, 1988)

1990 Routing Guide. Roadway. Akron, OH.

Direct Points via Viking. Viking Freight System. San Jose, CA.

1990 Service Guide. Yellow Freight System. Overland Park, KS.

[8] *Industrial Map of the Los Angeles 5-County Area.* Western Economic Research Co. Encino, CA 1988.

[9] *Los Angeles Basin Real Estate 1989.* Grubb and Ellis Realty, Los Angeles 1989.