Analysis of Park-and-Ride Lot Use in the Sacramento Region

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Rideshare programs and their associated park-and-ride lots in California are administered by the California Department of Transportation. In the Sacramento region, Sacramento Rideshare operates 38 park-and-ride lots with use ranging from zero to 100 percent. As a first step toward developing improved site location and lot size selection techniques, use and service areas of existing lots have been analyzed. Lot occupancy was counted on two days, in June 1988 and in May 1989. In May 1989, a survey of lot users was also conducted. Highly used lots were found to have the expected desirable characteristics of clearly identifiable commute corridors and relatively high-density service area populations. Many were served by vanpools, and two were used by commuters traveling from Sacramento to work in other cities. Underused lots lack these characteristics, are poorly located relative to other lots, or are located very close to or very far from Sacramento. In order to identify service area boundaries, respondents to the May 1989 survey were asked about their travel distance to the lot. Overall, 60 percent of respondents lived within 5 mi of the lot; 71 percent lived within 7.5 mi. Some service areas were found to be more compact with up to 79 percent of respondents coming from within 7.5 mi; others were very dispersed with as few as 32 percent of respondents coming from within 7.5 mi of the lot. Most of the highly used lots draw between 60 and 75 percent of their users from within 5 mi. Analysis of lot use for service areas in the Sacramento region is continuing with the objective of developing a service area index that can be used to predict use of new park-and-ride lots.

The California State Department of Transportation (Caltrans), District 3, operates a system of 38 park-and-ride lots in the Sacramento region (see Figure 1 and Table 1). These lots are used daily by approximately 670 vehicles and thus contribute significantly to the reduction of peak-hour traffic on the area's regional and urban highway networks.

In developing this park-and-ride lot system, important decisions regarding lot location and size had to be made without the benefit of past experience or local area research. Caltrans guidelines (*1*) were followed. These guidelines suggest that the lots should be located at natural staging areas that are evidenced by commuter parking on the street. The guidelines also stress the importance of local community support and of ensuring consistency with long-range plans. The Caltrans guidelines do not provide a method for estimating the required lot size.

Available parking spaces at lots in the existing system are used at an average of 48 percent, but use ranges from zero to 100 percent. Clearly, the use at some locations has reached expectations, whereas at other locations use is far below expectations. Caltrans District 3 park-and-ride lot system operators (Sacramento Rideshare) are now seeking ways to improve the site location and lot size selection techniques for future park-and-ride lots.

Although models have been developed to estimate park-and-ride demand (*2*) and to predict park-and-ride lot use by bus commuters (*3,4*), an attempt to produce a similar model for park-and-ride lots used by members of car- and vanpools was unsuccessful (*5*). Weak correlation was found between lot use and possible explanatory variables. The use of models for site selection and sizing of park-and-ride lots is not recommended in the Caltrans *Design Guidelines for Park-and-Ride Facilities* (*1*).

Although no quantitative models have been developed, the factors that contribute to high use of park-and-ride lots are well understood. The following factors have been identified in the literature (*3,5*):

1. Existence of a well-defined travel corridor,
2. Size of population within easy access of the site,
3. Availability of transit at the site,
4. Significance of savings over automobile commute cost,
5. Distance from the site to the employment centers,
6. Availability of high-occupancy vehicle lanes,
7. Quality of access to and from the site, and
8. Degree of security at the site.

As a first step toward understanding park-and-ride lot use and future needs in the Sacramento region, users of the existing park-and-ride lot system were surveyed in May 1989. Survey forms were placed on the windshields of the 689 users; 264 responses were returned. These responses came from 32 of the 38 park-and-ride lots in the Sacramento system. Results from this survey are presented later in this paper.

EXISTING PARK-AND-RIDE LOT SYSTEM

Figure 1 shows that most of the park-and-ride lots in the Sacramento region are located east of the city. Nine are on State Route (SR) 50 and 16 are on or adjacent to Interstate 80. One site is in Grass Valley and five are on SRs 49 and 20. Two lots are south of Sacramento on SR 99 and one is on SR 99 north of the city. There are two lots west of the city, one in West Sacramento and one in Winters. Finally, two lots are located a considerable distance from Sacramento, in Chico and Oroville.

The 38 lots have a total of 1,372 automobile parking spaces and 146 bicycle lockers. Lot capacities for automobiles vary

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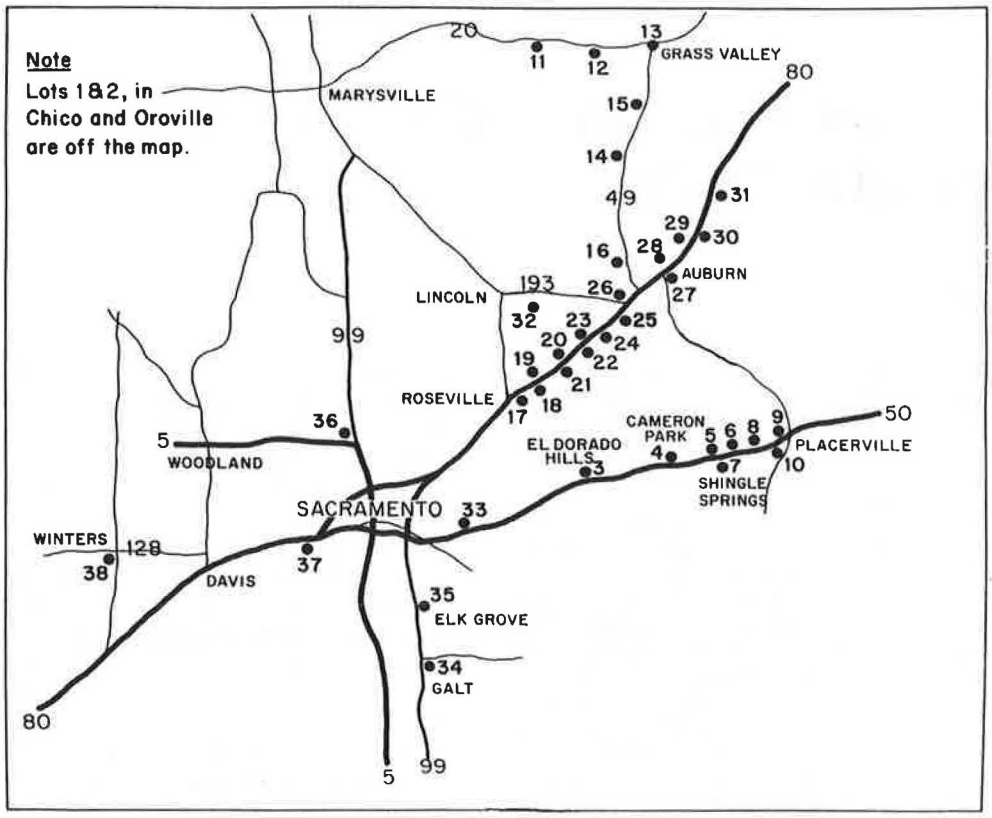

FIGURE 1 Park-and-ride locations, Sacramento region.

from 10 to 111 spaces. Two lots are exceptionally large (Lots 5 and 37), but most lots (22 of the 38) have between 20 and 40 parking spaces. For this study, the lots have been grouped into seven service areas, as presented in Table 2.

Park-and-ride lot occupancy was observed on June 15, 1988, and on May 20, 1989. The average numbers of automobiles using the park-and-ride lots on these two dates are presented by grouped service area in Table 3. (Use of bicycle lockers was also observed.)

Only one lot, Number 37 in Group 1, is fully used. This lot differs from the others in the region in that it serves long-distance commuters traveling to the San Francisco–Oakland area and other points west of Sacramento. Other highly used lots are Lots 34 and 35 in Group 7. These lots serve commuters traveling to Stockton as well as to Sacramento. Lots in Group 3, east of Auburn, and Group 5, west of Placerville, are highly used. Groups 1, 2, 4, and 7 have the lowest percentage of use. Group 1 lots serve commuters traveling between Chico and Oroville, whereas Groups 2, 3, 4, 5, and 7 all serve commuters traveling to Sacramento. A small percentage of users in Groups 2, 3, and 4 commute to Roseville.

Percentage use of park-and-ride lots provides a measure of the accuracy of the predictions or expectations of planners and designers of the existing park-and-ride lot system. As indicated by the data, the degree to which expectations have been met is variable. In order to understand the factors influencing use, the actual numbers of park-and-ride lot users are of more interest.

In Table 4, lots are listed in descending order of use. Lots that draw users for the same or overlapping service areas have been grouped in the table. Excepting Lot 37, which serves commuters traveling to points west of Sacramento, the highest concentration of users is found in lots west of Placerville. A group of four lots there draws 84 users, and a group of two lots draws 63 users. As indicated in Table 4, the lot in Chico draws 48 users; seven other lots, or lot pairs, attract between 21 and 40 users. Seven lots attract between 11 and 20 users and 13 lots attract between 0 and 10 users.

A preliminary review of these data confirms the expected influence of factors listed in the introduction. Lots with large numbers of users serve clearly identifiable population centers and are located to provide easy access to well-defined travel corridors. Lots with low use exhibit one or more of the following: (a) low population in the service area, (b) lack of a well-defined travel corridor, (c) poor location relative to other lots with the same service area, and (d) distance from employment centers is either very long or very short. The factors influencing park-and-ride lot use in this region are explored more fully in the following sections.

FACTORS INFLUENCING PARK-AND-RIDE LOT USE

Well-Defined Travel Corridors

In the Sacramento area, the predominant directions of inbound commute traffic are SR 50 and SR 80 from the east, and SR 5 and SR 99 from the south. Most of the highly used lots serving Sacramento are on three of these routes. SR 5

TABLE 1 PARK-AND-RIDE LOT LOCATIONS IN SACRAMENTO AREA

	County	Route	Location	Spaces	
				Autos	Bikes
1.	But	70	Grand Ave/3rd St Oroville	30	4
2.	But	99	Hwy 32/Fir St., Chico	73	8
3.	ED	50	Saratoga Way/El Dorado Hills	30	4
4.	ED	50	Cambridge Rd in Cameron Park	33	12
5.	ED	50	Ponderosa Rd./Wild Chapparal	111	4
6.	ED	50	Ponderosa Rd./North Shingle	28	0
7.	ED	50	Durock Rd./S. Shingle Springs	56	4
8.	ED	50	Shingle Springs Dr./NW	20	0
9.	ED	50	Greenstone Rd	22	4
10.	ED	50	Missouri Flat Rd./Mother Lode	70	0
11.	Nev	20	Pleasant Valley Rd	23	4
12.	Nev	20	Penn Valley Rd.	23	4
13.	Nev	49	Grass Valley/under freeway	53	8
14.	Nev	49	Streeter Rd.	34	4
15.	Nev	49	Lime Kiln Rd./Alta Sierra	47	4
16.	Pla	49	Atwood Rd, Nr Auburn	42	4
17.	Pla	80	Orlando and Cirby-Calvary	40	0
18.	Pla	80	Douglass Blvd in Roseville	36	12
19.	Pla	80	Taylor Rd/Hwy 65	51	0
20.	Pla	80	Sierra College Blvd N. of Fwy	23	0
21.	Pla	80	Sierra College Blvd S. of Fwy	24	4
22.	Pla	80	Horse Shoe Bar Rd/Loomis	24	4
23.	Pla	80	Penryn Rd/Penryn	39	8
24.	Pla	80	Newcastle Rd/Newcastle	39	4
25.	Pla	80	Newcastle/Indian Hills Rd.	27	0
26.	Pla	80	Lincoln/Ophir at Rte 193	37	8
27.	Pla	80	Lincoln Way/Bowman	21	4
28.	Pla	80	Bell Rd/Bowman Rd in Bowman	33	8
29.	Pla	80	Dry Creek Rd/Lake Arthur Rd	10	0
30.	Pla	80	Clipper Gap Rd near Applegate	15	4
31.	Pla	80	Weimar Cross Rd in Weimar	12	4
32.	Pla	193	Sierra College Blvd/ Lincoln	14	0
33.	Sac	50	Hazel Ave/Natoma	33	4
34.	Sac	99	Rte 99/Rte 104, nr Galt	38	4
35.	Sac	99	Sheldon Rd, nr Elk Grove	45	6
36.	Sac	99	Elkhorn Blvd.	12	0
38.	Yol	128	Main/Railroad Sts., Winters	25	4

TABLE 2 LOTS GROUPED BY SERVICE AREA

Group	Lots	Service Area
1	1, 2	Chico-Oroville.
2	11, 12, 13, 14, 15, 16	Route 49-Grass Valley-Route 20.
3	27, 28, 29, 30, 31	Interstate 80, east of Auburn.
4	17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 32	Interstate 80, west of Auburn, and one lot near Lincoln.
5	3, 4, 5, 6, 7, 8, 9, 10	SR 50, west of Placerville.
6	37, 38	West of Sacramento.
7	34, 35	South of Sacramento.
8	33, 36	North and east of Sacramento, close to the city.

TABLE 3 SPACE AVAILABILITY AND USE BY SERVICE AREA

Group	Number of Lots	Total Number of Spaces	Number of Automobiles		Average Occupancy (percent)
			June 1988	May 1989	
1	2	103	?	56	27
2	6	222	88	59	33
3	5	91	17[a]	52	54
4	11	340	144	123	39
5	8	370	180	208	52
6	2	131	118	116	89
7	2	83	49	64	68
8	2	45	9	13	24
Totals	38	1,385	605	689	47

[a]For three out of the five lots in this group.

TABLE 4 PARK-AND-RIDE LOTS IN DESCENDING ORDER OF USE

Lot No.	Location	Average Number of Users
37	West Sacramento	108
5	Ponderosa Road	84
6	Ponderosa Road	
7	Ponderosa Road	63
8	Shingle Spring Road	
9	Greenstone	
10	Missouri Flat	48
2	Chico	
17	Roseville	39
18	Roseville	37
35	Elk Grove	
24	Newcastle	34
25	Newcastle	31
4	Cameron Park	
13	Grass Valley	28
28	Bowman	26
20	Sierra College	22
21	Sierra College	20
34	Galt	
3	El Dorado Hills	18
22	Horseshoe Bar	15
26	Lincoln/Ophir	13
16	Atwood Road	12
14	Streeter Road	12
15	Limekiln	11
11	Pleasant Valley	10
38	Winters	10
33	Hazel Avenue	10
1	Oroville	9
23	Penryn	9
27	Bowman	9
30	Clipper Gap	8
31	Weimar	8
19	Taylor Road	5
12	Penn Valley	2
29	Dry Creek	2
36	Elkhorn Boulevard	1
32	Lincoln	0

had no park-and-ride lots at the time of this study. A highly used lot in Grass Valley indicated that SR 49 also serves as a commute route.

Lack of a well-defined (or highly traveled) commute corridor contributes to the low use of a few park-and-ride lots in the Sacramento area. These include Lots 11, 12, 32, and 38, none of which are located on the corridors defined earlier.

There is potential for expanding the Sacramento park-and-ride lot system on well-defined routes where there are few or no lots at present (such as on SR 5 and SR 99 from the south). A moderately well-used commute route, SR 80 from the west, is also a candidate for expansion of the system.

Size of Population With Easy Access to the Site

Although some commuters are willing to travel a considerable distance to the park-and-ride lot, higher lot use will be achieved if population density in the vicinity of the lot is high. For long commutes, the high-density population may extend as far as 15 or 20 mi from the park-and-ride lot. This case holds for Lot 37, which serves car- and vanpools traveling 60 to 90 mi each way. However, most of the lots in the Sacramento area serve poolers traveling distances of 15 to 50 mi from the lot to work destinations. The residential service areas of these lots may be effectively limited to an area within 5 to 8 mi of the lot.

In order to define the service areas of park-and-ride lots in the Sacramento area, the May 1989 survey included questions about travel time and distance to the lot. The results, summarized by group number, are presented in Table 5.

Overall, 60 percent of park-and-ride lot users come from within 5 mi of the lot and 71 percent come from within 7.5 mi of the lot. However, these percentages vary considerably between the service groups. Groups 2, 4, and 5 have the most compact service areas; Groups 1 and 2 have compact service areas; and Groups 6 and 7 have dispersed service areas.

For Groups 2, 4, and 5, 77 to 79 percent of the survey respondents travel no more than 7.5 mi to their park-and-ride lot. However, Groups 2 and 4 exhibit a significant percentage (15 to 17 percent) of users traveling over 10 mi; whereas Group 5 exhibits only 9 percent traveling over 10 mi. Groups 2 and 4 serve areas with a mixture of high and low population density, whereas Group 5 lots serve more compact suburban and urban areas.

Group 1 and 3 lots also serve areas with a mixture of high and low population densities. They have a higher percentage (29 to 32 percent) of users traveling over 7.5 mi. These two groups are located the longest distance away from Sacramento. Group 3 serves commuters traveling to Sacramento, Roseville, and Auburn, whereas Group 1 serves commuters traveling between Chico and Oroville.

Lots in Groups 6 and 7 exhibit the most dispersed service areas. Survey respondents coming from within 7.5 mi make up only 32 and 58 percent, respectively, of the total respondents. The large percentages of users traveling more than 7.5 mi, and even more than 10 mi, reflect the fact that these lots serve commuters traveling away from Sacramento. Thus their service area is in effect the entire Sacramento metropolitan area. Lot 37, in Group 6, serves outward-bound commuters only, whereas the other lots in these two groups serve a combination of outward and inward bound commuters.

A more detailed analysis of distance to the lot (see Table 6) reveals that some lots exhibit very low or very high percentages of respondents living within 5 mi of the lot. Five lots have less than 25 percent of respondents within 5 mi, five lots have 26 to 50 percent within 5 mi, and six lots have more than 75 percent of respondents living within 5 mi. Most of these 21 lots have less than 15 daily users; because they produced fewer than six responses in the survey, the data could be biased. However, in some cases it is intuitively clear that

TABLE 5 DISTRIBUTION OF RESPONDENTS BY TRAVEL DISTANCE FROM HOME TO PARK-AND-RIDE LOT

Distance (mi)	Percent by Group							
	1	2	3	4	5	6	7	Total
≤5	65	68	54	63	68	18	53	60
>5 and ≤7.5	6	11	14	15	9	14	5	11
>7.5 and ≤10	24	4	9	6	14	25	11	11
>10	5	17	23	15	9	43	31	18

NOTE: No survey responses were received from Group 8.

TABLE 6 PERCENTAGES OF RESPONDENTS WITHIN 5 mi OF EACH LOT

≤25 Percent			26 to 50 Percent			51 to 75 Percent			76 to 100 Percent		
Lot No.	Responses	Percent	Lot No.	Responses	Percent	Lot No.	Responses	Percent	Lot No.	Responses	Percent
6	14	0	1	9	30	25	22	54	14	12	80
9	5	0	35	37	36	28	26	56	34	20	83
37	108	11	16	12	50	3	18	60	11	10	100
27	9	20	26	13	50	13	28	60	17	10	100
21	13	25	31	8	50	10	58	62	29	2	100
						5	30	65	38	10	100
						8	4	67			
						18	29	67			
						19	5	67			
						23	9	67			
						2	48	71			
						4	31	73			
						7	37	73			
						22	15	75			
						30	8	75			

NOTE: No responses were received from Lots 12, 20, 24, 32, 33, and 36.

the data are reasonable. The 21 lots include some with compact service areas. Lots 34 and 38, for example, serve the small towns of Galt and Winters. Conversely, park-and-ride lots with large service areas are also included in the 21 lots with very high or very low percentages of respondents living within 5 mi of the lot. Lots 35 and 37, for example, serve the larger Sacramento area for commuters traveling away from the city; thus only a small percentage of users come from within 5 mi of the lot.

All but two of the more highly used lots draw between 60 and 75 percent of their users from within 5 mi. It is likely that underused lots, with less than 51 percent of their users coming from within 5 mi, are underused because there is no concentration of population within 5 mi. Underused lots with more than 75 percent of their users from within 5 mi may be underused because they are too close to competing lots that are more convenient for users.

Availability of Transit at the Site

The May 1989 survey of park-and-ride lot users included a question about the commute mode; its responses are presented in Table 7. Only four of the park-and-ride lots administered by Sacramento Rideshare were served by transit and only 21 (8 percent) of the 273 survey respondents indicated that they used transit. Significant transit service was available from the south on SR 99 (Lot 35), from the east on SR 80 (Lot 18), and in Chico (Lot 2). In the lots where transit was available, 27 to 75 percent of the survey respondents rode transit.

Vanpools play a much higher role than transit in the Sacramento park-and-ride lot system. As indicated in Table 7, 44 to 53 percent of users in all groups, except Groups 1 and 7, ride in vanpools. Noticeably high vanpool use is found in Group 2 lots, which are those most distant from Sacramento. A more detailed analysis also revealed that a very high percentage of park-and-ride users of the lots just west of Placerville ride in vanpools. Seventy-five percent of the respondents from Lots 5, 6, 7, and 8 gave vanpool as their commute mode. The availability of a vanpool in this location contributes to the high park-and-ride lot use in these lots.

Significant Savings over Automobile Commute

Most respondents of the June 1988 survey indicated that their primary reason for vanpooling was to save money. Many added that pooling saved wear and tear on the automobile, indicating that costs other than gasoline are considered when the pooling decision is made.

Savings in travel time was not given as a reason for pooling; many respondents in fact indicated that their travel time was increased by pooling. This is a reflection of the fact that no high-occupancy vehicle lanes existed on the access freeways at the time of the survey. Reduced aggravation by not driving was the second most frequently given reason for pooling. Clearly the savings in cost and aggravation that accrue from pooling in the Sacramento area are a function of commute distance.

Distance to Employment Centers

Park-and-ride lots serving Sacramento are located between 12 and 60 mi from the central business district (CBD). A number of employment opportunities exist outside the CBD

TABLE 7 TRANSPORTATION MODE OF SURVEY RESPONDENTS

	Carpool		Vanpool		Transit	
Group	Number	Percent	Number	Percent	Number	Percent
1	10	59	3	18	4	23
2	10	31	22	69	0	0
3	11	48	12	52	0	0
4	24	41	26	44	9	15
5	40	44	48	53	3	3
6	14	48	15	52	0	0
7	11	50	5	23	6	27

NOTE: No survey responses were received for Group 8.

on SR 80, thus the commute distance for some users is less than the distance to the CBD. Significant lot use (25 or more automobiles) has been observed in lots between 16 and 55 mi of the CBD. However, no correlation was found between distance to the CBD and lot use. For example, a town with population of about 9,000, located 55 mi from the CBD, produced about the same number of users as a suburban community of the same size located 27 mi from the CBD.

West Placerville and Shingle Springs (Lots 5 through 10), which produce the highest concentration of users, are located between 35 and 40 mi from the CBD. Thus, this distance may be the optimum for park-and-ride lot uses. However, other factors such as density of population and availability of vanpools clearly play a role. There is no corresponding concentration of park-and-ride lot use on SR 80 west of Auburn (30 to 35 mi from the CBD). Another influencing factor on SR 80, moreover, is that commute destinations include Rocklin and Roseville as well as Sacramento, whereas commute destinations for park-and-ride lot users west of Placerville are confined to Sacramento.

Park-and-Ride Lot Access and Security

The park-and-ride lots in this study are located in rural and suburban areas or in small towns. Although 205 out of 264 survey respondents said that they feel comfortable leaving their vehicles in the lot, 40 respondents commented on the lack of security and occurrence of vandalism and theft in the lots. Seventeen respondents complained that the lots were not swept regularly and some requested telephone facilities at the lot.

Some of the lots in the Sacramento Rideshare system have been designed specifically as park-and-ride lots. These are located on residential collector roads and they generally provide good access to the freeway. Other lots are existing parking areas (such as church parking lots), which are leased by Sacramento Rideshare. These generally do not provide the same good access to the freeway.

Although survey respondents overwhelmingly stated that access to and from their park-and-ride lot was good, it seems likely that accessibility plays a major role in use of the park-and-ride lots in this study area. Accessibility is expected to play a particularly important role in locations where the service areas of two or more lots overlap. It is expected that relative accessibility explains the low use of Lot 6 in the group of Lots 5, 6, 7, and 8, as well as the low use of Lot 9 relative to Lot 10. The influence of accessibility is undergoing further investigation in a current follow-up study in which service areas of selected park-and-ride lots are being mapped.

SUMMARY OF INFLUENCING FACTORS IN THE SACRAMENTO AREA

Well-defined commute corridors have been used for the location of most park-and-ride lots in the Sacramento region. The lots operated by Sacramento Rideshare are generally outside the transit service area; thus car- and vanpooling are the predominant commute modes of lot users. The extent to which these modes are used on the commute corridors is influenced by the lack of HOV facilities. Time lost in freeway congestion, though not extensive, is not avoided by pooling. Nevertheless, a significant number of commuters make use of the park-and-ride lots.

Park-and-ride lot users choose to ride in car- or vanpools because of cost savings and reduction in wear and tear on their automobiles. The most highly used lots are located outside the metropolitan area, 35 to 40 mi from the Sacramento CBD, or they are located on the fringes of the metropolitan area. The former locations serve commuters heading toward the city and the latter locations serve commuters destined for other cities. A high level of vanpooling was found at these more highly used lots.

Accessibility of park-and-ride lots is likely to influence use, but this could not be deduced from the survey responses. Most respondents were satisfied with the accessibility of the lot that they were using.

FUTURE PLANS

Future demand for park-and-ride lots will be influenced by many factors. Enormous growth is taking place around Sacramento; furthermore, air pollution is a major problem in the area and people are becoming more aware of the automobile's role in creating this pollution. Thus, attitudes are changing. In addition, the first HOV lanes are now being introduced on some freeways. All of these factors will contribute to increased use of car- and vanpooling and hence to increased use of park-and-ride lots. In addition, Sacramento Rideshare is now working with local transit agencies to provide transit service at park-and-ride lots. There are opportunities for expanding the park-and-ride lot system to the areas not currently served; on the other hand, underused lots in the existing system could be considered for abandonment.

In order to accommodate this growth and change in the most cost-effective way, and to make informed decisions about lot abandonment, Sacramento Rideshare is seeking a model or procedure for site selection and sizing of future park-and-ride lots. Existing lots are being monitored on a continuing basis so that growth or decline in use can be detected. Service areas of selected existing lots are being mapped and characteristics such as population, distance to the lot, population distribution within the service area, lot accessibility, and the extent of vanpool and transit service are being examined. The objective of the current work is to develop a service area index that can be used as a measure of expected use.

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