WA-PL-77-005

Preferential Facilities for Carpools and Buses
Seven Reports

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May 1976

PREFACE

These seven reports on preferential facilities for carpools and buses have been assembled and reprinted by the Federal Highway Administration. The reports provide information on several recent projects to increase the person-moving capacity of the highway system by designating facilities for preferential use by high-occupancy vehicles.

The reduced traveltime and more favorable travel conditions on priority facilities provide an effective incentive to entice commuters into these more efficient modes.

The reports presented here cover many different types of priority treatment. Some of the reports analyze and evaluate the effectiveness of particular projects. Other reports emphasize the project design and operational features; others simply describe the current operation of unique or unusual projects. Further information on the planning, design, implementation, and evaluation of priority projects for carpools and buses is available from the Federal Highway Administration. More detailed information on the specific projects described here is available in many cases from the responsible operating agencies.

In general, any transportation corridor with recurrent traffic congestion could be a candidate for a priority treatment project regardless of metropolitan area size. Priority vehicles can often utilize marginal increments of highway capacity made available by operational changes or minor construction. The projects described in these reports demonstrate considerable ingenuity in designating preferential facilities through operational changes or incremental construction within existing rights-of-way.

Fringe parking facilities often complement preferential highway treatments. Fringe lots serve as carpool staging areas as well as terminal areas for express bus service. Lots can be provided along major commuter routes to facilitate carpool formation and bus use even where opportunities for preferential highway lanes are not readily available.

The cooperation of all persons and organizations who supplied papers and information for this publication is greatly appreciated.

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BYPASS LANES FOR

CARPOOLS

AT METERED RAMPS

SUMMARY REPORT

CALIFORNIA DEPARTMENT OF TRANSPORTATION

OCTOBER 1975

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EXPERIENCE WITH CAR POOL BYPASS LANES IN THE LOS ANGELES AREA

Robert G. B. Goodell
Freeway Operation Branch
California Department of Transportation

Abstract

Two and one half years ago the first car pool bypass lane opened in the Los Angeles area. This special lane allowed cars with two or more occupants to bypass the queue at a ramp meter and enter the freeway without the normal wait. Today there are 13 bypass ramps in operation. This paper deals with the evaluation of the existing installations based on their effectiveness in forming car pools, operational problems, public reaction and enforcement required.

1. INTRODUCTION

In an effort to increase the people carrying capacity of our existing freeway systems many methods have been proposed through the years. Some have received limited experimentation during the past several years.

This report deals with implementation and results of providing special lanes at 13 metered on-ramps which allow multi-occupant vehicles to bypass the single occupant vehicles that are waiting in line at a metered signal and enter the freeway without delay. This is an extension of the bus (and emergency vehicle) bypass concept that has been in operation since the late 1960s.

The purpose of the experiment was to evaluate the effectiveness of time savings as a positive incentive to form car pools. Also to evaluate the operational problems and public reaction that could arise from such a departure from the tradition of "equal rights for all vehicles regardless of space (occupied), speed, paint job or country of national origin."

This method is only one of many that are being tried in the hope of luring the single-occupant-vehicle driver from his vehicle and into a more economical and less system taxing, energy wasting and pollution producing method of commuting. While being the first of this type, because of its low cost and ease of implementation, it is certainly not viewed as the only method or necessarily the best method. This method could be used alone or in conjunction with other methods to increase the "person throughput" of our existing system. It is felt that a combination of incentives and conveniences such as park and ride facilities, computer matching, preferential parking and preferential lanes on the mainline freeway may be needed to cause any significant increase of car pooling in this area.

Using the word "car pool" may seem rather ridiculous to transportation planners in other areas of the country or the world when applied to a vehicle with 2 occupants but the creation of a peak period average occupancy approaching 1.5 or 1.6 persons per vehicle would be a major accomplishment in the Los Angeles area. Even during the gas shortage with long lines waiting for gas (if stations were even open) and prices almost double, this area still

Figure 1. Lakewood Boulevard at San Diego Freeway (I-405) in Long Beach. This is the first car pool bypass lane and is now in its 28th month of operation.

Figure 2. Hawthorne Boulevard at San Diego Freeway (I-405) in Lawndale. This is the only bypass lane now being metered.

maintained a 1.2 person per vehicle occupancy rate and 80 to 85% of the vehicles carried only the driver during peak commuter periods. For this reason, it is quite logical to consider a large number of 2-person car pools formed from single occupant vehicles as important as the formation of a moderate number of 3, 4 and 5 or more person car pools. This does not, however, rule out future experiments with different qualifications for preferential lane usage.

There are some that say we are fighting a losing battle or struggling with an immovable object. One popular concept among those studying human behavior is probably summed up by Dr. Jean Rosenbaum in his book "Is Your Volkswagen a Sex Symbol" when he says "Air pollution problems may cause technical and mechanical modifications to be made in automobiles, and restrictions may be placed on when and where they may be driven, but automobiles as a symbol of aggression and sexual power will only be challenged when our society itself and our social structure are changed."

Are we in that period of change now? Many other incentives that have and are becoming factors in the choice of transportation mode have shown up since our first special ramp was opened. As I mentioned, the energy shortage became a reality and the cost of fuel made a dramatic jump. Recently, inflation is making us take a good, hard look at the cost of commuting. As we all know, highway building throughout the country (and especially in Los Angeles) has come to a screeching halt. We can no longer look to "completing the system" as a short or long term solution to individual or area wide transportation problems.

In a Time magazine article on the "Hidden Side of Inflation," sociologist David Caplovitz is quoted as saying, "With residents forming car pools, entertaining more at home and happily exchanging useful junk at garage sales, keeping up with the Joneses is gone, and a lifeboat camaraderie has taken its place." How much society has to change to overcome the deep-seated need for independence or to give up this fantastic convenience we have created remains to be seen. And can the random criss-cross trips that serve our recreational, social and day-to-day needs, along with the conveyance of people in mass to and from their places of employment all be served by rubber tired vehicles of varying dimensions operating on our existing system? Only if we remain open to innovative uses of our existing system can we hope to make progress within our present economic limitations and short-term goals.

While this report is not primarily a study of the social and psychological factors involving modal choice, we must keep them in mind when we analyze the car pool formation aspects of this report.

2. PROJECT DESCRIPTION

2.1 LOCATIONS

At the beginning, ramps were not picked for their location primarily but for the lack of existing operational problems. This allowed us to evaluate the car pool formations and enforcement problems without being side-tracked by operational problems. After the success of the first two locations, we tried to incorporate the concept into the general ramp metering program to test it "in the market place" so to speak. The thirteen ramps are on three different freeways and range from two miles to 20 miles from the Central Business District in residential, commercial and industrial areas.

2.2 TYPES OF RAMPS

Various types of ramps have been used for bypass lanes including cloverleafs, long and short hook ramps and diamond ramps with and without left turns to the ramp. Eight ramps have the bypasses on the left side of the ramp and five on the right. The geometrics of the ramp and cross street determine the choice in each case. Storage for metered traffic ranged from all on the ramp (Los Feliz) to almost all on the city street (Hawthorne). Substandard lane widths and merging areas on the ramps were required to eliminate costly and time consuming construction to expedite the initial projects.

2.3 TIMES OF OPERATION

Seven of the ramps operate in the afternoon peak hours (3:30 to 6:00 p.m.) with six operating in the morning peak hours (6:00 to 9:00 a.m.).

2.4 DURATION AND BEGINNING OF OPERATION

The length of operation ranges from 28 months at Lakewood Boulevard to five months at Stadium Way. Four of the ramps were put into operation well over a year after the ramp metering system had been in operation. Four (westbound Santa Monica) were put into operation a few months after the beginning of the meter system and four (eastbound Santa Monica) were put into operation the same day as the metering. The remaining ramp (Western at I-5) opened after four days of metering.

Figure 3. Los Feliz Boulevard at Golden State Freeway (I-5) in Los Angeles. This bypass lane is used by twelve buses as well as 500 to 600 car pools daily between 4:00 and 6:00 p.m.

Figure 4. Los Feliz Boulevard at Golden State Freeway (I-5). This is the only bypass ramp that utilizes two metered lanes in addition to the bypass lane.

2.5 SIGNING, STRIPING AND SIGNALIZATION

Signs and striping were designed and modified as we gained experience. The national standard of the "diamond" became the preferential lane symbol during the period of experimentation. Future ramps will have signing futher modified from that seen in Figures 2-6. Six of the ramps initially metered the car pool lane as well as the single occupant vehicle lane. While it did provide some control over car pools, the car pool lane meter seemed to somewhat defeat the purpose of the installation. Four of the bypass lane signals (westbound Santa Monica) were removed and one (Vermont) was converted to a regular metered lane when the bypass lane was discontinued. Hawthorne at 405 is the only one still operating with a signal. It will be used in the future to experiment with metering the car pool lane and the normal lane at different rates.

2.6 BUS USAGE

Seven of the ramps serve a regular bus line and one (Lakewood) serves eight charter buses (bus pools) in the peak hours. All the rest serve an occasional private bus.

2.7 COSTS

In most cases the installations cost an additional $3,000 to $6,000 per ramp over the cost of the meter system. If major ramp widening and major signal modifications are required, the cost can be significantly higher. On the Los Feliz ramp, the cost of widening, a new signal system with a mast arm and "programmed (3M) heads" cost $66,000. The Western Avenue (on Route 5) widening cost $10,000.

2.8 PUBLICITY

We relied on three methods of publicity to alert potential users and all seemed to be equally effective. First, information handouts on the ramps in the area a few days before opening date; second, press releases to area and local newspapers; and third, the signs on the ramp. Major network television news shows covered the first two projects on opening day and all other projects shortly after opening day.

3. RESULTS

3.1 CAR POOL INCREASES

Figure 7 gives the before, maximum and latest daily figures for all the operating bypass lanes. As shown on the chart, the increases in car pools varied greatly from ramp to ramp. The greatest increase was 277% on the Lakewood Boulevard ramp eight months after the ramp had been operating and in the middle of the fuel shortage. The smallest increase, which was actually a decrease of 22%, was at the Vermont ramp to the Santa Monica Freeway before it was discontinued. On the average. there are approximately 50% more car pools using the thirteen operating bypass ramps than there were before the bypasses were installed. The average vehicle occupancy of all the ramps with bypasses has now risen from 1.24 to 1.33 and the percent of total traffic that is car pooling from 19% to 26%.

All ramps where a reduction in car pools took place were ramps where the bypass lanes became operational at the same time as the metering system or shortly after. The simple explanation of the reduction is that car pools using these ramps were actually using ramps downstream of the ramp they wanted to use (due to freeway congestion at that point) and, after the bypass opened, went back to the bypass ramps that were closest to their desired freeway entry point. Also, the time savings for car poolers on the ramps with car pool reductions were very short and hardly an incentive to form car pools from existing ramp traffic.

Only two ramps have been surveyed to determine how many of the additional car pools had been formed since the installation of the car pool bypasses. Based on these two surveys, 50% of the <u>additional</u> car pools (58% at Lakewood, 42% at Hawthorne) had formed since the car pool lane. If we assume that 50% of all car pool increases are newly formed car pools (the remainder shifting from other ramps or city streets) we now have 575 new car pools in the Los Angeles area due to this limited experiment and may have had as many as 720 additional car poolers at one time since the experiment began.

In general, it is noted that the greater time saving, the greater the increase in car pools. Although this is true in most cases, the moderate increase in car pools at Manning Avenue (a high income area) points out the great effects that the economics of commuting have on modal choice. We also found this out in our survey from those who were asked, "The <u>most important</u> reason for their forming car pools" - time savings, cost of commuting and fuel savings ran neck and neck.

3.2 OPERATIONAL EFFECTIVENESS

The operation of most bypasses has been fairly trouble-free from the very beginning. Our initial experiments (Lakewood and Hawthorne) consisted of handpicked, trouble-free ramps. Extensive publicity and police presence on the

Figure 5. Manning Avenue at Santa Monica Freeway (I-10). This is one of the five right lane bypasses. The compliance rate on this ramp is the highest of all bypasses.

Figure 6. Western Avenue at Golden State Freeway (I-5) in Glendale. This ramp was installed primarily for the 13 scheduled buses in the AM peak period but the number of car pools using it doubled in 2 months.

opening days of operation kept problems to a minimum. Two minor problems did surface at these locations. The first was at Lakewood Boulevard where confusion occurred about whether car pools using the non-signalized car pool lane should stop at the signal in the metered lane. At present, we are using signs on the bypass lane side of the ramp informing motorists that this lane need not stop. The second problem was the adjustment of the meter rates to keep the additional car pool traffic from congesting the freeway. Although adjusting the meter rates in some instances can maintain freeway flow there still exists the problem of how strictly we can meter the non-car pool traffic without mass violations. And, of course, the more successful we are with increasing car pools at these critical locations, the more serious the problem of metering non-car pools becomes. Probably exploring other methods of controlling freeway traffic such as metering freeway-to-freeway connections will provide the degree of control we need for smooth bypass lane operation.

Diamond type ramps with left turns allowed from the city street cause the severest operational problems. Most of the ramps of this type have inadequate storage on the ramp for vehicles waiting at the meter. Therefore, the queue usually extends onto the city street during a portion of the peak hours. This forces left turning vehicles to use the car pool lane illegally or block the intersection waiting for a break in the queue of right turners. If this problem occurs for an extended period of time each day and left turn prohibition cannot be obtained from the local agency, then (as at Vermont Avenue and westbound I-10) we recommend converting to a normal two-lane metering ramp with no preferential lane.

The merging of car pools and metered traffic into one lane before entering the freeway, while sometimes done in a very short distance, has been orderly and has not caused any unusual fighting for position. While there is some switching of lanes by drivers realizing they should (or in the case of car poolers could) be in the other lane, no reckless lane changing has been observed. There are no accidents recorded to date that are attributed to the car pool lanes.

3.3 VIOLATIONS

Figure 7 shows the number and the percentage violations on all of the operating ramps. The latest average compliance for all the ramps is 87.6%.

The amount of enforcement needed is not yet completely known. It seems to lie somewhere between the pessimistic prediction of most that compliance would require constant enforcement during all the hours of operation and the optimistic prediction of a few (the author not included) that it would be self enforcing. It seems that each location has its own enforcement characteristics. There are two things that seem to increase compliance in general. They are the immediate issuance of warnings upon the opening of a project and the issuing of citations beginning within a few weeks of the opening of the project and on a fairly regular basis.

If a figure has to be picked at this time to determine the feasibility of keeping a bypass open, I guess it would be an 85 - 90% compliance rate (10 - 15% of single occupants violating)with "reasonable" enforcement. Reasonable in this instance means the amount of enforcement normally employed on any high volume freeway section,with a periodic intensive enforcement campaign. This means that we should keep the bypass open if it is possible to keep in the 85 - 90% compliance range with existing enforcement manpower.

3.4 PUBLIC ACCEPTANCE

The only survey so far has been of the car poolers using the first two bypasses installed. Understandably, they were very enthusiastic about the concept and were crying for more installations. Single occupant vehicle drivers who use the metered lanes next to the bypass lanes have been surprisingly patient and understanding. Except for the few non-verbal comments to myself or our data taking team, most seem to look straight ahead when they see us and appear a little guilty for not doing their part to reduce air pollution and conserve energy.

On projects where bypasses have opened well after the metering project, we have received almost no telephone or written complaints. On those that opened at the same time as the meter system, the complaints were usually about an operational problem and not the concept itself. To my knowledge, there has been only one person (not a user of an affected ramp) who has aggressively protested this concept, writing a series of letters to State officials.

In 1974, the existing laws authorizing this concept were modified by the State Legislature to make it easier to implement and enforce. No public or media comment about this action came to my attention at that time. Apparently, the public is ready to accept this type of preferential treatment for others as long as we don't take away

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DATA ON CARPOOL BY-PASS RAMPS LOS ANGELES AREA

DATE: Oct. 1, 1975

		L.A.-405		L.A.-10 W/B					L.A.-10 E/B				L.A.-5		
		LAKEWOOD	HAWTHORNE	HOOVER	VERMONT *	WESTERN	CRENSHAW	FAIRFAX	MANNING	VENICE	WESTERN	VERMONT	LOS FELIZ	WESTERN	STADIUM WAY
MONTHS IN OPERATION		27	17	11	7*	11	11	11	4	4	4	4	10	4	3
PEAK HOUR OPERATION		P.M.	A.M.	P.M.	P.M.	P.M.	P.M.	P.M.	A.M.	A.M.	A.M.	A.M.	P.M.	A.M.	P.M.
NO. OF CARPOOLS (Daily)	Before	125	150	230	283	194	142	183	233	115	335	273	350	67	125
	Max.	471	443	294	246	191	185	210	322	312	382	285	587	130	147
	Latest	351	422	258	—	191	185	192	322	312	382	285	495	129	147
% INCREASE IN NO. OF CARPOOLS	Max.	277	195	28	-22	-2	30	15	38	171	14	4	68	94	18
	Latest	180	181	12	—	-2	30	6	38	171	14	4	41	93	18
TIME SAVINGS BY CARPOOLS (minutes)	Max.	7 1/2	6 1/2	6	—	2 3/4	5	2	5 1/2	6	1 1/2	1	5 1/2	5	1
	Min.	1 1/2	1	1 1/2	—	1	1 3/4	1/2	1/2	1	1/4	1/4	1/2	1/4	0
	Avg.	5	4 1/2	3 1/2	—	2	3	1 1/4	3 1/2	4 1/2	1/2	1/2	3 1/4	2 1/2	1/2
% CARPOOLS USING RAMP	Before	17	15	20	24	27	22	22	13	13	18	22	16	17	25
	Max.	50	34	24	19	27	24	23	19	32	21	23	27	24	26
	Latest	39	31	24	—	27	24	21	19	31	21	23	25	23	26
TOTAL RAMP OCCUPANCY PERSONS/VEHICLE	Before	1.23	1.18	1.28	1.35	1.31	1.29	1.33	1.16	1.16	1.21	1.28	1.20	1.22	1.28
	Max.	1.79	1.47	1.31	1.24	1.31	1.30	1.30	1.24	1.40	1.27	1.31	1.34	1.29	1.37
	Latest	1.56	1.38	1.31	—	1.31	1.29	1.30	1.24	1.39	1.27	1.30	1.30	1.26	1.35
NUMBER OF VIOLATORS (Daily)	Max.	63	147	156	456	285	315	239	55	119	81	67	349	45	27
	Min.	11	35	80	328	144	165	64	18	52	46	47	137	22	11
	Latest	72	137	104	—	144	165	69	44	119	81	67	137	45	11
% OF VIOLATORS VIOLATORS/SINGLE OCC. VEH.	Max.	13.3	16.7	14.6	44.3	50.7	47.2	31.3	2.3	17.3	5.7	7	19.6	10.6	7
	Min.	1.6	3.6	6.3	34.3	27.6	27.7	8.9	1.3	7.3	3.2	5	9.0	5.4	2.6
	Latest	13.3	14.4	12.9	—	27.6	27.7	9.6	3.3	17.3	5.7	7	9.4	10.6	2.6
CARPOOL SIZE (Latest)	% 2 pers.	72	82	80	83	85	75	73	87	81	92	77	84	92	78
	% 3 pers.	18	13	15	11	12	15	16	10	14	6	16	13	6	14
	% 4 pers.	10	5	5	6	3	10	11	3	5	2	7	3	2	8
BUSES PER PEAK PERIOD		8	1	0	12	1	1	1	3	16	61	10	12	13	—

* Discontinued may 10th, 1975

FIGURE 7

Figure 8. Crenshaw Boulevard at the W/B Santa Monica Freeway. Note the signal for the car pool lane has been turned and disconnected.

Figure 9. Lakewood Boulevard at San Diego Freeway (I-405). Oncoming bus is one of eight "bus pools" that use this ramp daily. Drivers and passengers are employed at nearby plant.

their right to drive (or wait) alone in their own vehicle.

4. CONCLUSIONS

The operation of the 13 bypass lanes in the Los Angeles area has answered many questions about the feasibility and the workability of this time-saving incentive to induce car pool formations. We now know that people will accept others getting special treatment because of the occupancy of their vehicle. While many don't seem to like the idea and don't think it will make much difference in the amount of energy used or the amount of pollution emitted, they still seem to realize that they are doing nothing to alleviate the problem while car poolers are at least trying. The fact that 13,500 motorists witness this concept in action each day with no public outcry about individual rights seems to indicate that the public is aware of the problems facing our existing system. It also seems to indicate an acceptance on the public's part that privileges may have to be extended to commuters who voluntarily use their vehicles more efficiently if we are to weather the transportation, pollution and energy crisis in the next decade.

We now know that it is possible, in most cases, to keep violations to a reasonable level (±10%) with some special enforcement on a periodic basis. But I feel an examination of enforcement techniques and manpower requirements is essential before the full impact of a systemwide implementation of this concept can be evaluated.

And last but not least, ramp bypasses do form car pools. They also serve as a substantial time saver for the passengers of 127 buses that use the bypasses daily. While an estimated 575 car pools have now been formed on a limited experimental basis, let's first look at the potential of the bypasses alone and ignore other dramatic future happenings that might tend to increase the effectiveness. There will be approximately 1000 metered ramps in the Los Angeles area in the next 5 to 7 years. These metered ramps will serve approximately one million vehicles daily during peak hours (the period of metered operation). Let's say that 20% or 200,000 vehicles are 2 or more person car pools. If the existing 13 ramps are any indication of the effectiveness of this concept, then 50,000 (25% of 200,000) new car pools could be formed by installing 250 bypasses at a cost of 1½ million dollars. This means that at least 50,000 drivers leave their vehicles at home and ride with 50,000 existing single occupants. Assuming the average freeway commute trip is 20 miles round trip, then a reduction of one million vehicle-miles per day could be realized. Now let's look at the case of a dramatic happening such as gas rationing or the fuel shortage similar to early 1974. If we look at the Lakewood Boulevard ramp (the only one in operation at that time) we can conservatively say that a 100% increase in car pools could take place because of the combination of incentives (or disincentives). Applying that to the previous figures, a reduction of 4 million vehicle-miles per day appears to be within the realm of possibility.

Because of this theoretical potential, I think we should remain open to the possibility that changes in this range could occur rather than take the pessimistic attitude that people will never give up their freedom at any price. While I obviously look upon this concept as an important tool in our toolbox of incentives to build a modal shift, I also think the other incentives such as computer matching, preferential parking, preferential lanes on freeways, and park and ride facilities should be pursued aggressively. For only when we make it a distinct advantage to car pool or ride the bus will the accompanying modal shift take place.

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6. BIOGRAPHY

Mr. Goodell is a Project Engineer in the Freeway Operation Branch of the California Department of Transportation. Since receiving a B.S.C.E. Degree from Northeastern University in Boston, he has been involved with Traffic Engineering Projects and Public Information work for the Department. He is a Member of I.T.E. He is currently involved in studies for the California Department of Transportation concerning ways of increasing the person throughput of the freeway system.

LOS ANGELES AND SAN FRANCISCO
HIGH OCCUPANCY VEHICLE LANES

FOR DISTRIBUTION AT THE 55TH ANNUAL MEETING OF THE

TRANSPORTATION RESEARCH BOARD

JANUARY 19-23, 1976

WASHINGTON, D.C.

CHARLES P. SWEET, CHIEF
OFFICE OF TRAFFIC
CALIFORNIA DEPARTMENT OF TRANSPORTATION
SACRAMENTO, CALIFORNIA

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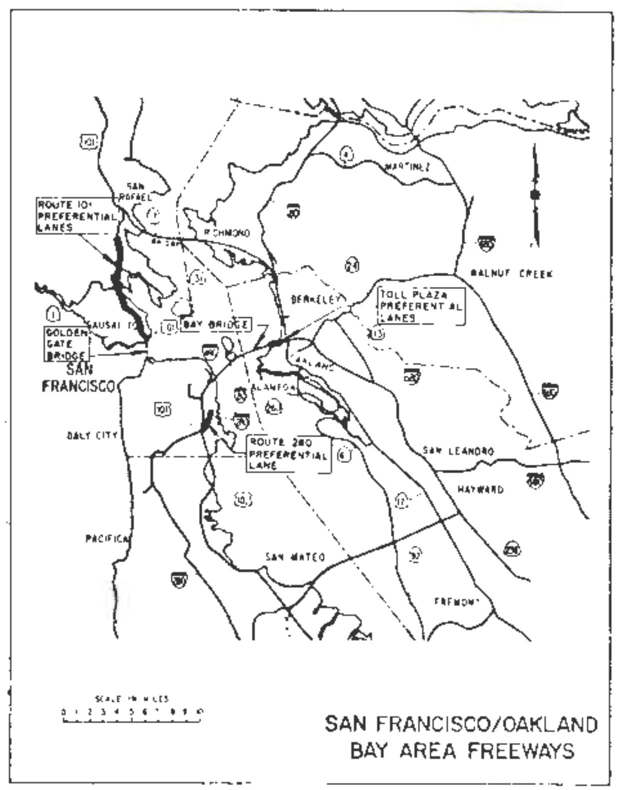
Cover: Ramp meter bypass for carpools and buses at Los Feliz Boulevard on the Golden State Freeway in Los Angeles

Prepared by: Ted Berg
John Mieras



Exclusive Bus Lane on Route 101 in Marin County

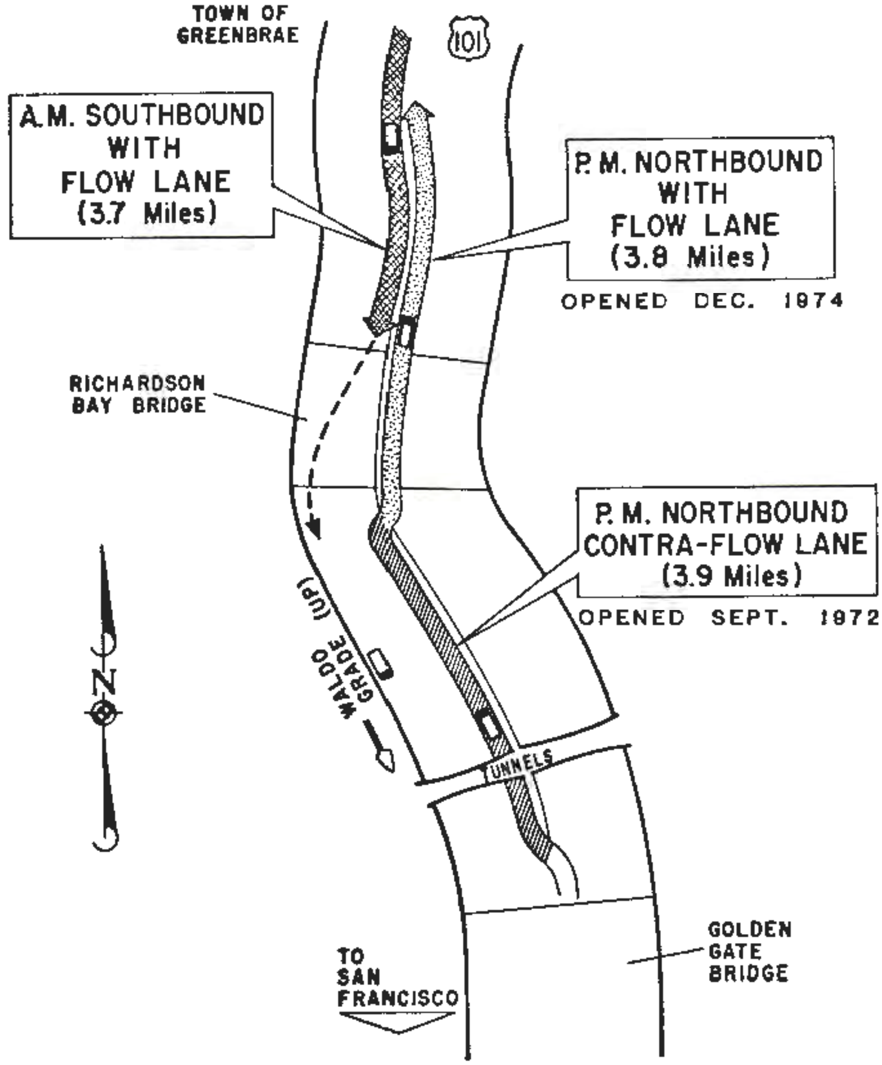
North of San Francisco

Introduction

The Golden Gate Corridor is a beautiful, hilly, residential suburban area just north of San Francisco passing through Marin and Sonoma Counties. It has a major rush period flow of traffic as many of its residents commute back and forth to San Francisco using the U.S. 101 freeway and the Golden Gate Bridge, the only continuous north-south land route into the city.

Exclusive p.m. concurrent flow bus lane northbound. Note that southbound left lane has been closed before the contra-flow lane is encountered.

Northbound p.m. contra-flow lane on Waldo Grade. Note the closed buffer lane on the left.



PLAN VIEW SKETCH OF BUS LANES

FIGURE 1

System Description

The U.S. 101 freeway is the north-south arterial of the Golden Gate Corridor and the central trunk line of the transit system. The freeway has four auto lanes operating in each direction (five at some points).

In its presently developed stage, the bus priority system has a 3.7-mile southbound bus lane used during the morning rush period, and a 7.7-mile northbound bus lane used during the evening rush period. Figure 1 is a simplified sketch indicating the basic pattern of flow over the bus lanes. The design is best understood by following the pattern of bus movement and bus lane designations over the course of the day.

In the morning from 6:00 to 9:00, the southbound inside lane from Greenbrae to the Richardson Bay Bridge (See Figure 1) is designated as a reserved bus lane indicated by fixed "Bus Only" signs. After about four miles, a fixed sign reads "End Bus Lane." Beyond this point, the freeway operates in a conventional fashion (until the evening contra-flow operation begins). At this point, buses must maneuver across lanes to get into the outside lane to climb up Waldo Grade. This is a two-mile long six percent grade that slows a loaded bus down to approximately 25 mph. Thus, the last four miles, from the Richardson Bay Bridge to the Golden Gate Bridge have no reserved roadway for the buses.

During the morning peak period, there are four southbound lanes and two northbound lanes on the Golden Gate Bridge. After 9 a.m., all traffic runs in normal fashion on the Bridge, three lanes operating in each direction.

Around 2:30 p.m., bridge personnel begin to redesignate the direction of certain of the bridge lanes increasing the number of northbound lanes to four. They also begin setting up the contra-flow lane on which buses travel northward into Marin County on the southbound side of U.S. 101. Pylons (1.5-foot high yellow, flexible poles) are inserted into holes in the southbound number three lane taking it out of traffic use. This lane will act as a buffer, separating the two remaining southbound lanes of automobile traffic from the inside contra-flow lane that will be filled with northbound buses. The contra-flow lane operates from 4 to 7 p.m., Monday through Friday.

While the pylons are being set out, electronic signs come on north of Richardson Bay Bridge telling the southbound traffic to move to the right, that the two inside lanes are ending and that there are "oncoming buses."

Before crossing the Richardson Bay Bridge, the evening northbound buses cross over the median strip moving from the contra-flow lane (in the southbound section of U.S. 101) and onto the inside, exclusive concurrent flow bus lane (in the northbound section of U.S. 101). Signs indicate to the northbound automobile traffic that buses are entering from the left and to keep out of the "Bus Only" lane. The first 0.9 mile of concurrent flow lane is separated from the auto lanes by a solid stripe; then the solid stripe changes to a broken line. This northbound concurrent lane operates from 4 to 7 p.m.

The cost of converting the contra-flow lanes for bus use included $180,000 to prepare the lanes and $25,000 for signing. The initial cost of widening the freeway from six to eight lanes for the with-flow lanes was $3,200,000.

The cost of setting up the contra-flow lanes daily is currently running about $6,700 per month which is anticipated to remain about the same. The State's share is about $2,500 per month. The remainder is paid by Golden Gate Bridge, Highway and Transportation District.

The cost of traffic enforcement is an additional $4,200 per month, which is borne by the California Highway Patrol.

<u>Performance Evaluation</u>

Express buses save about six minutes in the morning and three minutes in the afternoon. Trip time reliability, which has improved materially, is considered a significant benefit of the project.

Auto volume and congestion conditions are essentially unchanged by the bus lane. The average number of autos southbound across the Golden Gate Bridge between 6 a.m. and 9 a.m. has dropped from 16,000 to 15,500 or 3.1 percent. Auto occupants decreased 2.9 percent from 21,000 to 20,500. Whether the bus lane caused the decrease in auto traffic is uncertain. The California Highway Patrol has encountered no safety problems related to the contra-flow lane.

In the first six months of with-flow bus lane operation beginning December 1974, accident data for the northbound direction shows a 70 percent increase in accidents. There were 30 accidents before the bus lane and 51 after. Almost all the increase was of the "rear end" type. Of the 51 accidents occurring after the bus lane was opened, five occurred in the bus lane.

Southbound accidents have dropped slightly from before the bus lanes.

A short-term increase in accidents occurred in 1972 when the contra-flow bus lanes were established. Overall, the impact of the bus lane on accidents and safety is inconclusive at this time. A more complete accident analysis will be included in the final evaluation report due in 1976.

Violations of the exclusive bus lane by auto drivers is not a serious problem. The violations rate has dropped and, coupled with a reduced enforcement effort by the California Highway Patrol, only 39 citations were issued in June 1975.

Prior to opening the preferential lane, letters were strongly in support of the project (440 to 170). Subsequent to opening, there have been only 34 letters and phone calls. Twenty-eight of these were against the preferential lane; six were for it.

Changes in the hours of operation and the addition of carpools will be considered upon completion of the first year of operation.

Exclusive Bus and Carpool Lane on Route 280 in San Francisco

System Description

On October 1, 1975, a two-mile long exclusive bus and carpool lane was added to Interstate Route 280 in San Francisco.

Buses and carpools (three or more per car) may use the special southbound inside lane for 24 hours a day. This commuter lane extends the two miles from the Sixth Street on-ramp to a half mile south of Army Street where the four southbound lanes narrow to three lanes. This will permit high-occupancy vehicles to bypass congestion. Unauthorized use of the lane is a violation of the Vehicle Code.

During the first year of operation, Caltrans will conduct studies to examine the lane's safety, to evaluate any enforcement problems and to determine if buses and carpools are shifting from Route 101 to Interstate 280.

The existing four-lane section at the north end of the project, which originally dropped to three lanes near Army Street, was lengthened one-half mile to the southwest by restriping to four 11-foot lanes. These lanes then transition into three 12-foot lanes at the west end of the project. Other work consisted of signing, and marking the pavement with the diamond symbol. (See photo.)

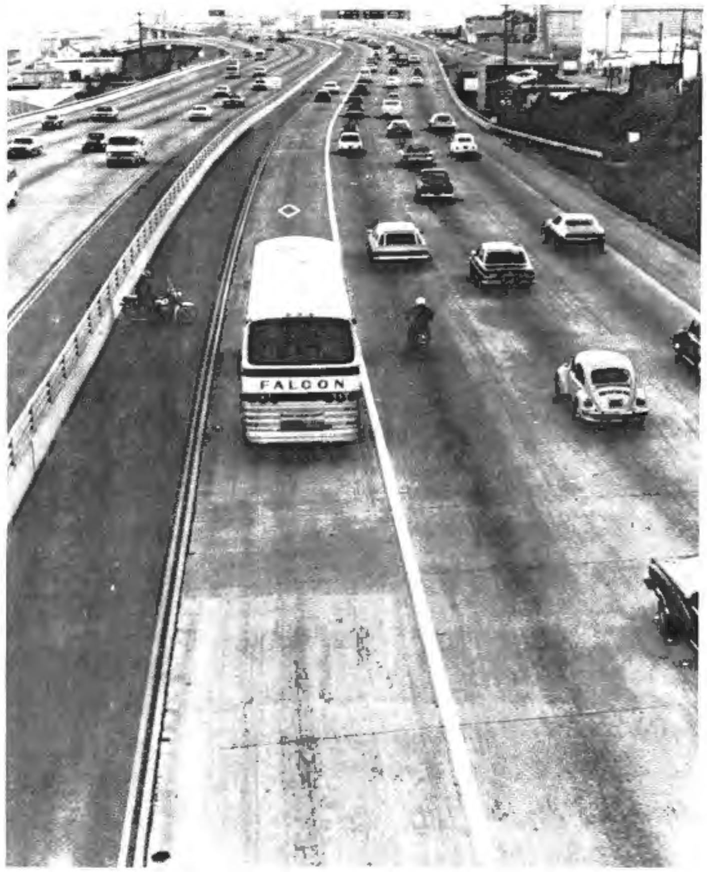
Cost of this project for signing, stripes and pavement markings was $22,000.

Performance Evaluation

Capacity of the freeway has decreased slightly as a result of the exclusive bus/carpool lane. The congestion has increased in duration and length due to the reduced capacity.

Maximum delay to mixed flow traffic is now about three minutes compared to two minutes without the exclusive lane. Buses and carpools are able to save two to three minutes compared to mixed flow traffic.

During the first month of operation, enforcement of the exclusive lane by the Highway Patrol was almost non-existent. However, since November 1, enforcement has lowered the number of violators from about 80 percent of the traffic to about 16 percent.



Looking south at the Route 280 exclusive bus and carpool lane. Note why violators have been greatly reduced.

A recent peak hour (4:40 to 5:40 p.m.) exclusive lane traffic count showed 189 carpools, 39 violators, and 14 buses for a flow rate of 242 vehicles per hour.

Westbound Bus and Carpool Lanes Through Toll Plaza Area of the San Francisco-Oakland Bay Bridge

System Description

Exclusive with-flow bus and carpool lanes are provided through the congested toll plaza area of the San Francisco-Oakland Bay Bridge. A carpool is defined here as a vehicle with three or more occupants.

There are six traffic lanes upstream of the toll plaza. In this area, one lane is set aside as the approach to the exclusive lanes. As the roadway flares out approaching the toll plaza, the exclusive lane begins. This widens to three exclusive lanes and 14 non-exclusive lanes at the toll plaza itself. One of these lanes is for buses and two are for carpools. Where the roadway begins to narrow west of the toll plaza, a signal system controls traffic flow. At this location, there are two exclusive lanes and 13 non-exclusive lanes. West of here, the roadway narrows down to five lanes at the bridge.

Peak period mixed traffic is regulated by the signal system, while priority vehicles proceed non-stop through the signals.

The exclusive lanes are marked by solid white traffic stripes, pavement markings, overhead signs, and removable plastic stanchions. Stanchion spacing varies depending upon location, and is 12.5 feet in critical areas.

These exclusive lanes are in operation during the morning peak period from 6 a.m. to 9 a.m. and again during the afternoon peak period from 2 to 6 p.m. Commute buses and carpools are allowed to pass through the toll gates free of charge and through the signal system without stopping. This exclusive lane installation enables priority vehicles to bypass almost all of the congested area.

The initial cost of the exclusive lanes was $48,000, including $3,000 for a carpool matching program. Operating costs are $2,000 per month. However, construction of the traffic signal system later added another $350,000 to initial costs and $300 per month to operating costs. Financing was with State funds.

Performance Evaluation

Five hundred buses use the exclusive lanes each morning peak period. Prior to the opening of BART's transbay tube in September 1974, the number of buses had been 550. Nineteen hundred carpools now use it each morning compared to 2,200 before BART opened.

The full range of public information techniques has been used in conjunction with this facility, including newspaper articles, television, radio, and distribution of handouts at the toll booths. There have not been any significant safety problems.

Persons in priority vehicles like the exclusive lanes, but persons in other vehicles frequently complained. Their main complaints concerned the supposed nonequity of virtually toll-free passage for carpools, and the number of violators. However, overall public reaction tended to be favorable.

The exclusive lane has had only a negligible effect on bus patronage. However, it caused an immediate and dramatic doubling of the number of carpools. (A questionnaire survey indicated that less than 200 persons switched from buses to carpools.)

This increase in carpooling was not accompanied by a decrease in the number of vehicles using the bridge each morning. The three-hour total remained approximately 23,000. However, the occupancy (exclusive of buses) increased from approximately 1.33 persons per vehicle to 1.43. That is, the bridge carried more people during the peak period without any increase in the number of vehicles.

Following installation of the exclusive lanes, normal congestion appeared to decrease slightly. Buses and carpools saved an average of five minutes. Journeys of drivers who were not in carpools were neither significantly expedited nor delayed by the exclusive lanes.

Installation of the signal system resulted in improved operation, smoother vehicle flow, and a decrease in accidents.

Revenues to the State decreased by $25,000 per month due to the reduced tolls for priority vehicles. The capacity of the bridge itself is 8,700 vehicles per hour westbound.

Exclusive bus and carpool lanes just west of toll plaza. Other traffic is regulated by the signal system while priority traffic is allowed to proceed nonstop.

Express Busway on the San Bernardino Freeway, Route 10 in Los Angeles

System Description

The San Bernardino busway extends for 11 miles from the outskirts of the central Los Angeles business district east to El Monte, a suburb.

The separated, exclusive bus use system cost $56 million. The seven easterly miles were completed in 1973 and are located within the freeway median. The Southern Pacific Railroad tracks are located between the two busway lanes. Each bus lane measures 17 feet across, and is separated from regular traffic by a ten-foot wide paved shoulder. Plastic flexible barriers are placed between the busway lane and the common shoulder.

Patronage has grown steadily from 1800 total daily person trips to over 15,000 in the 35 months of busway operation

The remaining four-mile westerly section of the busway consists of two 25-foot lanes which run along the north side of the freeway. The busway lanes in each direction are separated by a concrete barrier.

There are currently 1000 parking spaces at the station in El Monte. Other stations without added parking are located at California State College and at a major regional hospital.

Performance Evaluation

Approximately 62 percent of the busway passengers ride during the five and one-half hours designated as "peak" commute periods in the morning and evening--92 percent of these passengers are going to or from work.

Commuters who switch from auto to busway commuting save up to $2 per one-way trip. Savings depend upon a number of factors. Average per trip saving is about $1.

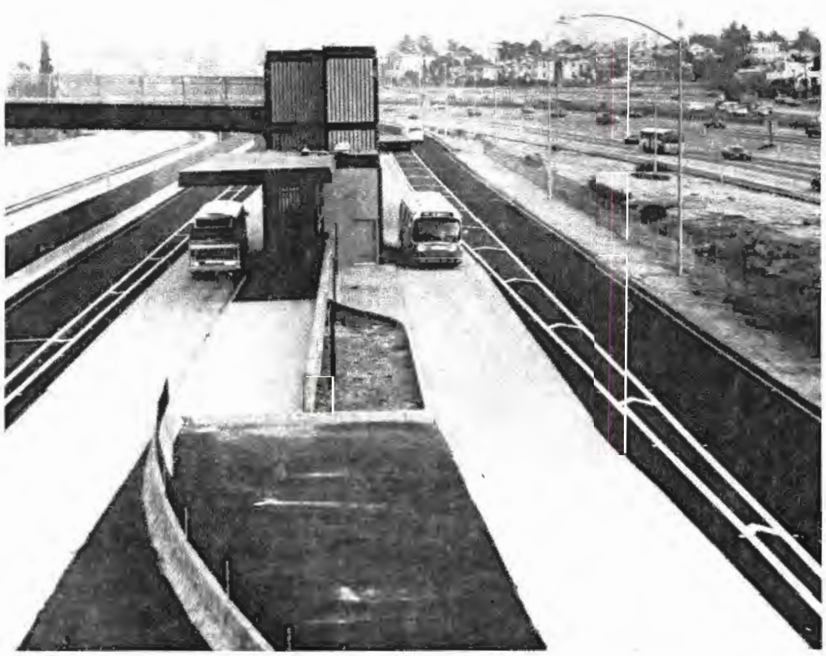
For those who must travel from their residences or work places to the busway, its use does not provide any overall door-to-door time savings.

Busway usage today is responsible for diverting an average 5,550 one-way automobile trips from the freeway daily. It is estimated that the busway is responsible for a net savings of 77,000 vehicle-miles of travel and 5,000 gallons of vehicular fuel per day.

The busway has not significantly reduced peak hour traffic on the San Bernardino Freeway.

The busway is very popular with its users. Complaints center around lack of restrooms, shelters and adequate parking at the three stations.

In conclusion, the busway is an attractive alternative to the auto for commute trips. It makes possible a significant reduction in vehicle miles travelled which helps to improve air quality and conserve energy.



Hospital Station

Preferential Lanes for Buses and Carpools on the Santa Monica Freeway, Route 10 in Los Angeles

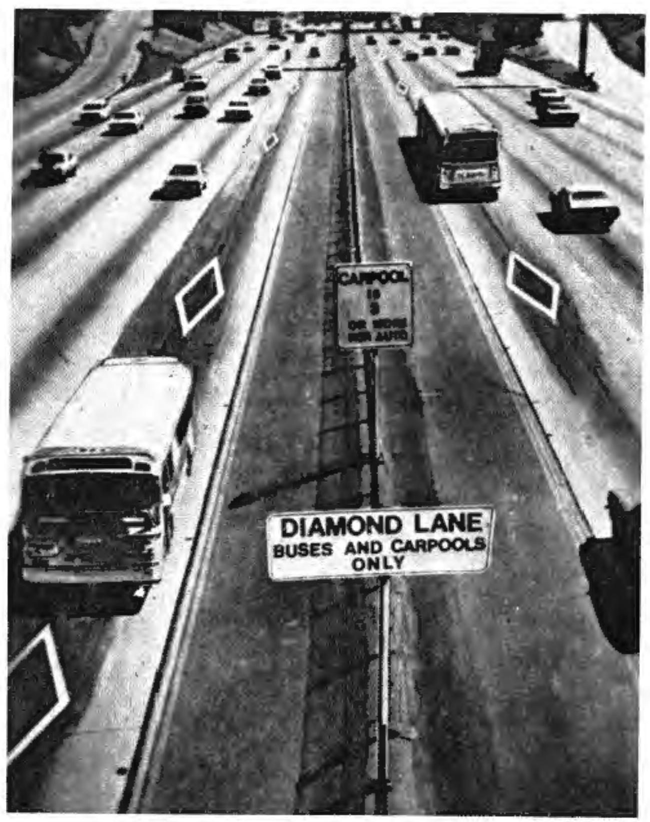
System Description

This project is presently in the planning stage with opening anticipated in Spring 1976. The project involves allowing carpools and buses to travel in preferential lanes adjacent to normal traffic flow. The preferential lane project will, no doubt, be a crucial test of this concept as it runs along one of the busiest freeways in the world. Traffic volumes on this section of freeway reached nearly 250,000 vehicles per day.

The project will use the freeway between Santa Monica, a suburb west of Los Angeles, and the central Los Angeles business district, a distance of 12.6 miles. It will reserve the existing east and westbound median (inside) lanes for bus and three-person carpool traffic at all times.

To maintain an acceptable level of traffic service for general freeway traffic (i.e., speeds of 35 to 50 mph) in nonpreferential freeway lanes, traffic volumes will be controlled by metering signals at on-ramps. Preferential by-passes for buses and carpools around the meters will be provided.

The objectives of the project are to increase vehicle occupancy, improve air quality, conserve energy, reduce traffic congestion, and reduce vehicle miles traveled.



Artist's drawing of the proposed Santa Monica Freeway preferential bus and carpool lane.

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Greatly improved bus service is being made available in the freeway corridor and three park-and-ride lots are planned to gain maximum benefit from the preferential freeway lanes.

Performance Evaluation

The project and other transportation facilities in the freeway corridor will be closely monitored for evaluation of the project's impact upon travel in the area.

The impact upon city streets, where possible increases in congestion may be disruptive, will be of particular concern to local agencies.

Close cooperation is required and is occurring among the bus transit operators (of which there are two operating in their exclusive areas), the law enforcement agencies, the several local governments, and the State Department of Transportation.

Due in part to the implications of the project in encouraging a change of travel "lifestyle" for many people in Los Angeles, the project is viewed with anticipation by many and with concern by others.

Addendum (April 1976*)

Beginning on Monday, March 15, 1976, the median lane in both directions along 12.6 miles of the Santa Monica Freeway was reserved for the exclusive use of buses and carpools of three or more between 6-10 a.m. and 3-7 p.m., Monday through Friday. Although a series of accidents and operational problems on opening day increased congestion and delay, by the second day of operation freeway traveltimes had generally returned to preproject levels.

Results from the first several weeks of the "Diamond Lane" operation are summarized below:

1. Average peak period bus ridership increased from 6,300 to 15,900 persons per day after four weeks of operation.

2. Average peak period carpools increased from 2,040 to more than 3,900 carpools per day after four weeks of operation.

3. After four weeks of operation, the freeway carries 32,850 persons inbound in the morning peak period (97.2 percent of the former person volume) in 3,000 fewer vehicles.

4. First day violations accounted for 36 percent of the vehicles using the Diamond Lane. By the end of the first week this had been reduced to about 10 percent.

* Based on information supplied by CALTRANS and the FHWA California Division.

OREGON DEPARTMENT OF TRANSPORTATION

HIGHWAY DIVISION

BANFIELD FREEWAY HIGH-OCCUPANCY VEHICLE LANES

JANUARY 1976

ROBERT N. BOTHMAN
ASSISTANT STATE HIGHWAY ENGINEER

Introduction

On December 15, 1975, the Oregon State Highway Division opened high-occupancy vehicle (HOV) lanes on the Banfield Freeway in metropolitan Portland. The opening commenced an experimental effort designed to use preferential lanes to increase vehicle occupancy and reduce congestion.

The project was initiated in January 1975, when the Oregon State Highway Division proposed the project to the city and regional transit agency to solve the severe congestion problems occurring on the Banfield Freeway. The facility had experienced a growth in average daily traffic volumes from 26,000 in 1958, to 100,000 in 1974 (Figure 1). The Banfield was designed to carry 60,000 ADT. The growth rate had stabilized, indicating that the facility was unable to accept further increase in traffic volume. Adjacent, parallel arterials were operating within 100 to 200 vehicles of capacity, and not able to absorb additional traffic diverted from the freeway. It became clearly evident that the accommodation of projected growth needs was conditional to added east/west transportation capacity.

Objectives

A three-fold desire to: (1) increase capacity without resorting to additional paved surface, (2) improve the air quality, and (3) obtain quick improvement, resulted in the proposal to implement high-occupancy vehicle (HOV) lanes as a carpool and bus-use incentive.

The purpose of the project is to relieve traffic congestion in the Banfield corridor, and develop a facility that provides for a flexibility in operation that will aid in the development of a suitable long-term solution.

The general objectives are to: (1) test the feasibility of using exclusive bus and HOV lanes on an established freeway, and (2) lay the foundation for continuing transportation innovation in the Portland metropolitan area.

The specific objectives are to:

1. Assist in implementing the State of Oregon Clean Air Act Implementation Plan, Portland Transportation Control Strategy, by increasing the person per vehicle ratio on the Banfield;
2. Provide for carpooling and bus-use incentives in the corridor through use of HOV lanes:
3. Reduce traffic congestion on the Banfield Freeway and adjacent arterial streets;
4. Provide a safe transportation facility by improving the roadway surface;
5. Provide a time and fuel savings to the traveler; and
6. Provide an interim, low-cost improvement to the Banfield as an expedient, until such time as a major revision can be accompli

(OVER)

Project Setting

The Banfield corridor is situated in the northeast quadrant of metropolitan Portland, and passes through some of the most densely developed residential, commercial, and industrial areas of this sector. Additionally, the East Multnomah County area served by the freeway is one of the faster growing residential sections in Portland, with a projected population increase in excess of 100 per cent by 1990. It is the only east/west freeway from the Portland central business district, and serves as the primary commuter arterial to and from the central business district and the industrial complex to the north.

The freeway is constructed in a natural drainage depression, known as Sullivan's Gulch. The gulch, which begins at grade in the easterly portion of the project area, gradually increases in relief in a westerly direction, where it attains a 20 to 30 foot depth below the adjacent terrain. This meandering depression has long been used as a natural, gentle-grade, transportation route from the Willamette River, east to the Columbia River floodplain.

Prior to the start of project construction in July 1975, the freeway's configuration consisted of a six-lane facility for the western half of the project section, and a four-lane facility for the eastern portion. The overall project length is 4.76 miles.

Project Justification

For the past eight years, peak-hour volumes on the Banfield have exceeded design capacity. Present lane volumes, under peak conditions, vary from 1800 to 2000 vehicles a lane. Levels of service exceed the desired optimum, varying from forced (F) to unstable (E) flow. For the past five years, average weekday traffic has averaged between 95,000 and 100,000 vehicles a day. This is in contrast to the 26,000 vehicles a day in 1958 (Figure 1).

Speed of average peak period traffic indicated the congestion existing immediately prior to project construction (Figure 2). Average speeds drop to 30 m.p.h. for eastbound evening traffic, with westbound morning traffic dropping to 38 m.p.h. over the length of the project.

Traffic growth trends over the past ten years indicated that the peak-hour volumes reached a high in 1967. Since that time, the peak-hour levels have stabilized near the maximum. The lack of any significant increase in the past eight years illustrates that under present conditions the Banfield is not capable of accepting additional traffic in the peak-hour periods. The peak hour has lengthened to a three-hour period in the p.m., and to a two-hour period in the a.m.

The arterial street system in the vicinity of the Banfield has a limited capacity to absorb additional traffic. During the morning peak, under level service D conditions, major parallel arterials could accommodate no more than 100 to 200 additional vehicles. During the afternoon peak, these arterials were already operating at unstable flow conditions.

A survey conducted in January 1975, indicated about 23.6 per cent of the vehicles using the Banfield Freeway contained two or more persons. The survey also revealed that 4.2 per cent of the vehicles were carrying three or more persons. The average occupancy per vehicle was 1.3 persons.

Figure 1

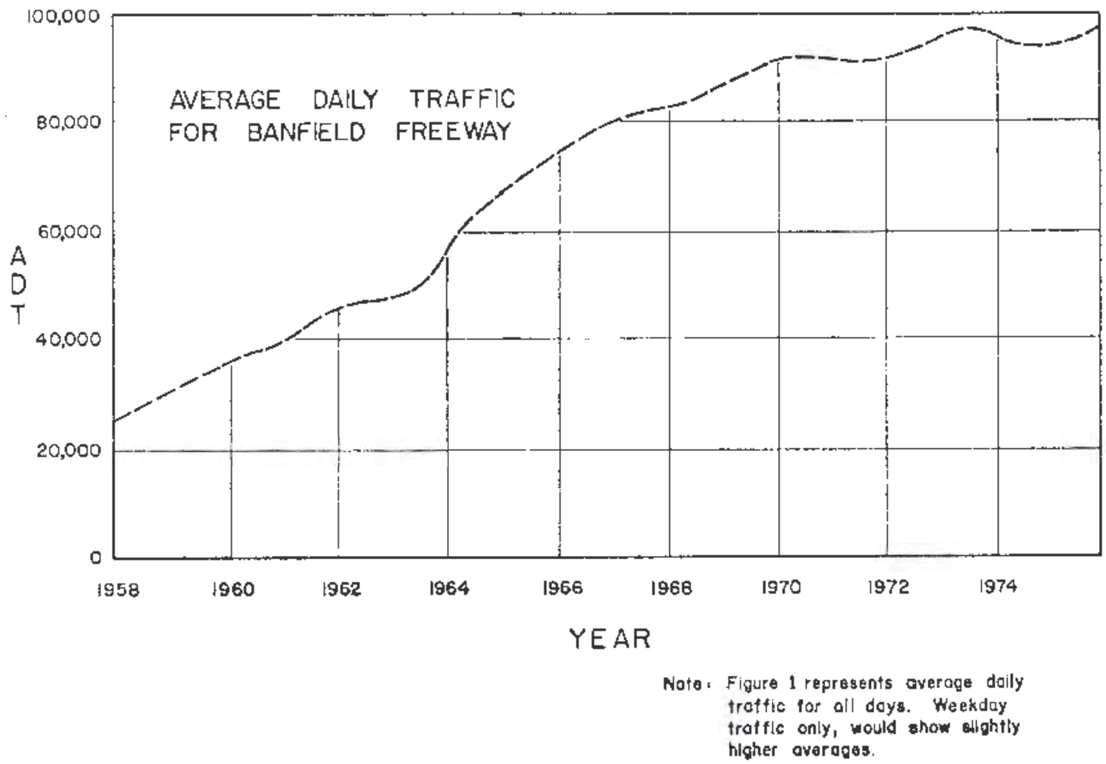
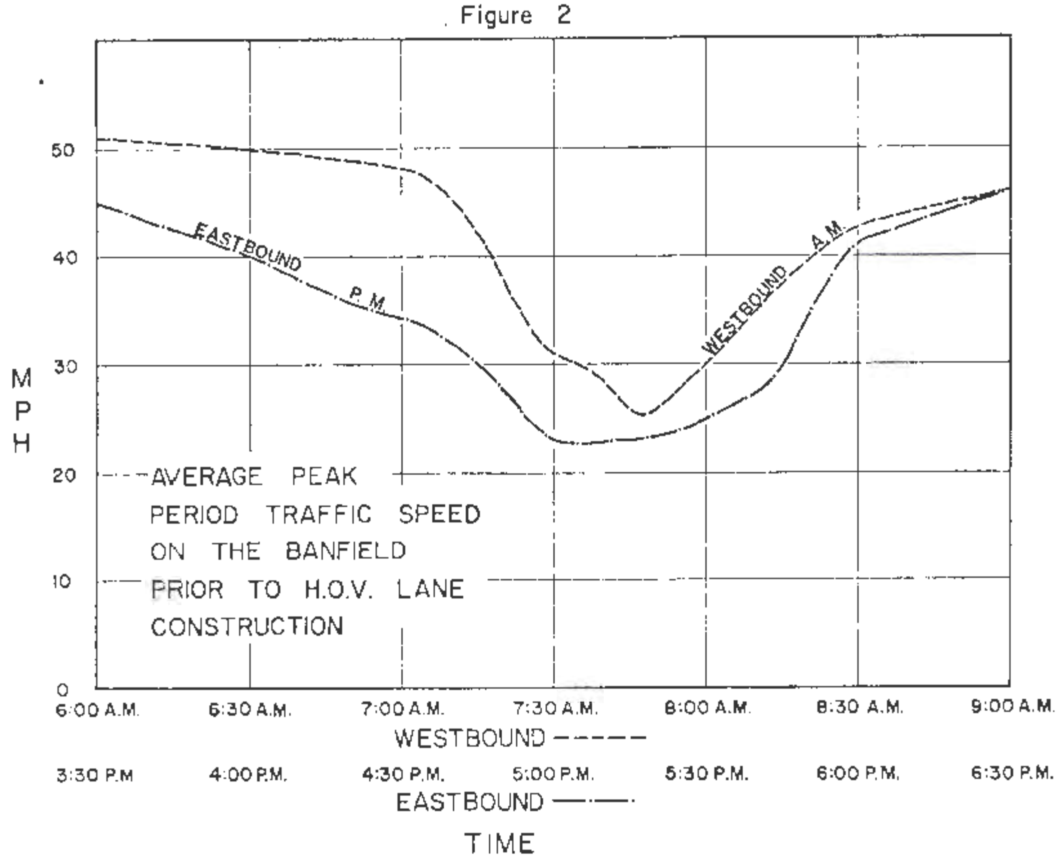


Figure 2



In addition to the need to alleviate congestion, the existing roadway was badly in need of repair. The extremely heavy use of the Banfield Freeway had caused extensive lane rutting of the asphaltic concrete pavement. This situation presented driving problems in wet weather when standing water created tire hydroplaning, and under both wet and dry conditions created vehicle control problems. Further, median and shoulder barriers were in a degraded condition.

Project Description

In the new roadway,travel lanes occupy all of the pavement between curbs, using the shoulder areas. The high-occupancy vehicle lane is next to the median barrier and provides exclusive use for buses and other vehicles containing three or more people. There is no reduction in the number of lanes available to normal truck and car usage. The additional lane was derived by reducing the width of lanes by 1 foot and using the existing shoulder area. Relative lane widths are 11.5 feet for the outside lane, 11 feet for the center lane, and 12 feet for the inside lane (Figure 3).

Eastbound from the central business district, limitations in the existing cross section prevented the development of an additional lane from the Union Avenue structure (M.P. 0.46) to Northeast 39th Avenue (M.P. 2.55), where the transition section begins (Figure 4). The eastbound HOV lane is fully developed and commences at Northeast 44th Avenue (M.P. 2.88).

The HOV lane designation is terminated at Northeast 74th Avenue (M.P. 4.59), with the actual additional lane ending at Northeast 86th Avenue.

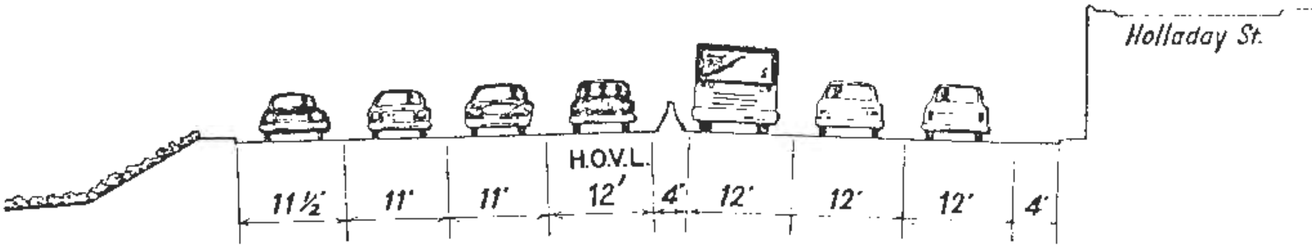
The westbound (inbound) HOV lane begins at Northeast 74th Avenue (M.P. 4.59), and is continued to its designated end at Northeast 21st Avenue (M.P. 1.36), with the actual lane ending at Northeast 14th Avenue (M.P. 0.98). There is no reduction in the number of lanes available to trucks and non-high-occupancy vehicles as a result of this project.

One requirement for the project was the replacement of the metal guardrail with the New Jersey type of concrete median barrier. Precast members were used with the exception of transition sections, terminal sections, and one sawtooth section, where the barrier was cast in place. Concrete shoulder barrier was placed for those structure abutments and columns where the travel lanes were moved to the shoulder area. Exceptions are where continual runs of metal guardrail existed.

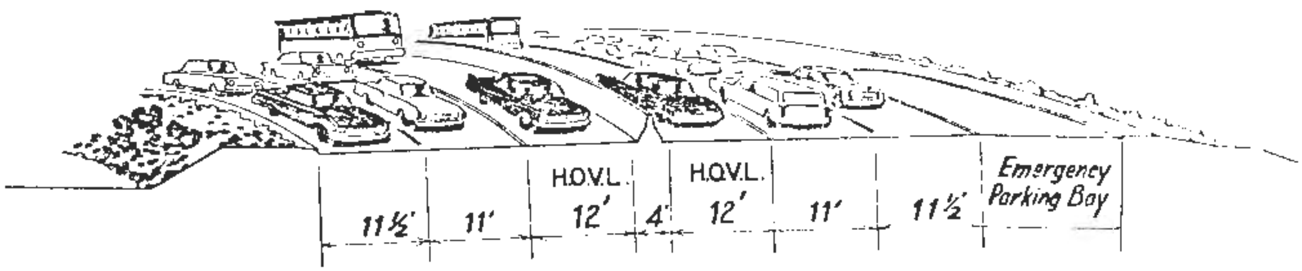
A pavement overlay was included in the project. The surfacing consisted of patching the rutted areas with asphaltic concrete and overlaying the entire area with an open-graded asphaltic concrete.

Restriping of the entire section was necessary. Standard raised-button striping was used in a pattern consisting of 4 opaque and 1 reflectorized buttons in a 15 foot strip, at 40 foot cycles, for the nonrestricted travel lanes; and a continual button stripe containing a reflectorized button every 40 feet for delineation of the HOV lane. The existing illumination along the project section is limited. A lighting improvement was cost prohibitive.

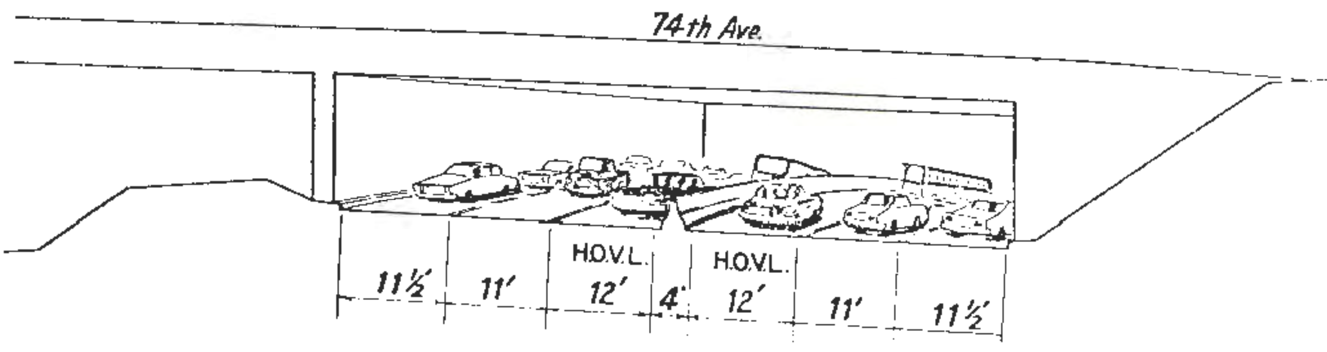
BANFIELD FREEWAY
HIGH OCCUPANCY LANES



Section A–A
Looking East at NE 23rd Ave.



Section B–B
Looking East Near Providence Hospital



Section C–C
Looking East at NE 74th Ave.

Figure 3

Pavement buttons were a necessity due to dark sections, the glare of oncoming headlights, a long rainy season, and 11 foot lanes. These factors preclude painted stripes. The buttons provide reflective light, plus a rumble strip if the motorist wanders from the lane.

A louvered glare screen will be installed on the median rail throughout the project section to minimize headlight glare. The screening will consist of 24 inch paddles placed at intervals varying from 30 to 40 inches, dependent on highway alignment. Glare reduction is expected to be 90 per cent.

The transition into the HOV lane, eastbound and westbound, is achieved through a tapered median which moves the alignment of the nonrestricted travel lanes the width of one lane to the right. The shoulder area is eliminated to gain the necessary width for an additional lane. At the completion of moving all traffic to the right, the median taper is reversed, creating an additional lane reserved for high-occupancy vehicles. No lane changing is required for normal traffic. Eligible vehicles choosing to use the HOV lane must move left into the restricted lane. At the terminus of the HOV lanes, the lane continues as a normal travel lane. The right-hand, unrestricted lane is eventually terminated.

Because of the use of the shoulder area, emergency parking bays were constructed along the project section at about 2000 foot intervals. An emergency call box, tied directly to the state police dispatch unit,is located at each bay.

Signing for the HOV lanes consists of:

1. "Restricted Lane Ahead", to provide advance notice of the HOV lane;
2. "Buses and 3-Person Carpools Only", posted at the beginning, and periodically throughout the HOV lane section (Figure 5);
3. "Restricted Lane Ends", posted at the terminus of the HOV lane; and
4. Large diamond symbols painted on the road surface every 1000 feet throughout the restricted lane.

A speed limit of 45 m.p.h. is currently in effect, and will remain so until it is determined that a speed change would be operationally appropriate. The posted speed prior to the project was 55 m.p.h.

Public Relations and Marketing

In view of the fact that the Banfield HOV lane project represented an unprecedented innovation to the Portland area, it was recognized that an extensive marketing program would be required. The resulting program included:

1. News conferences;
2. Periodic use of major local media to inform and educate the public;
3. Distribution of informational brochures to Banfield users to promote bus-use, carpooling, and operational safety (Figure 6);
4. Distribution of posters for employee bulletin boards, public buildings, and markets;
5. Encouragement of feature stories by local media;
6. The erection of 22 informational billboards at strategic locations along the feeder streets; and
7. Slide presentations and discussions to central business district employers, designed to encourage commuter use of buses and carpools.

Figure 4

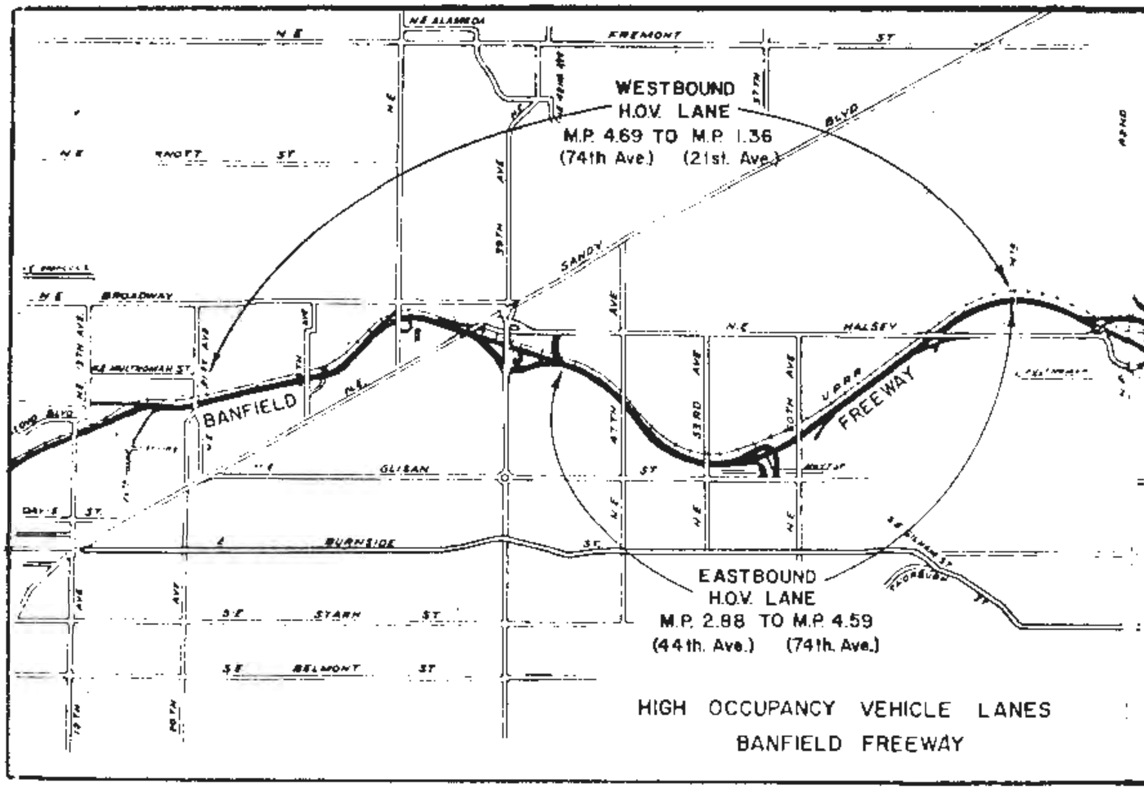
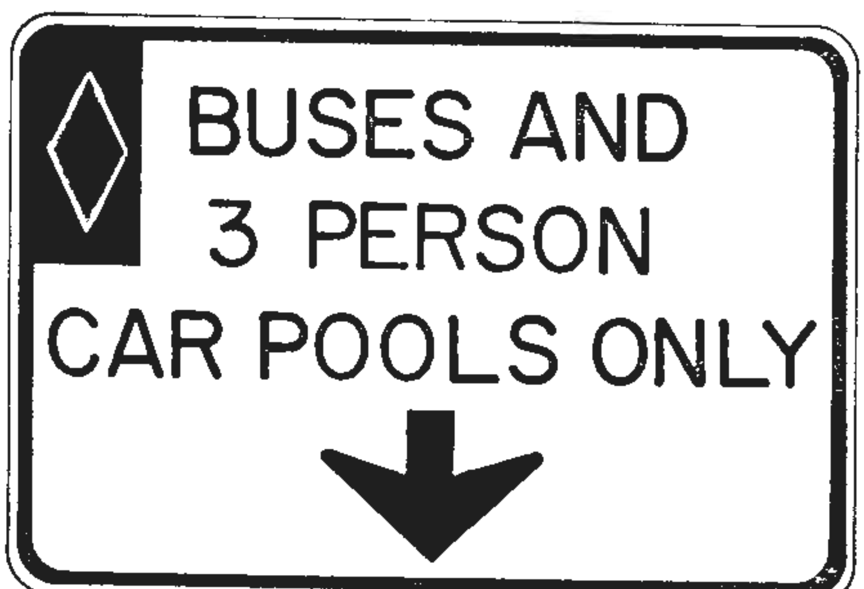
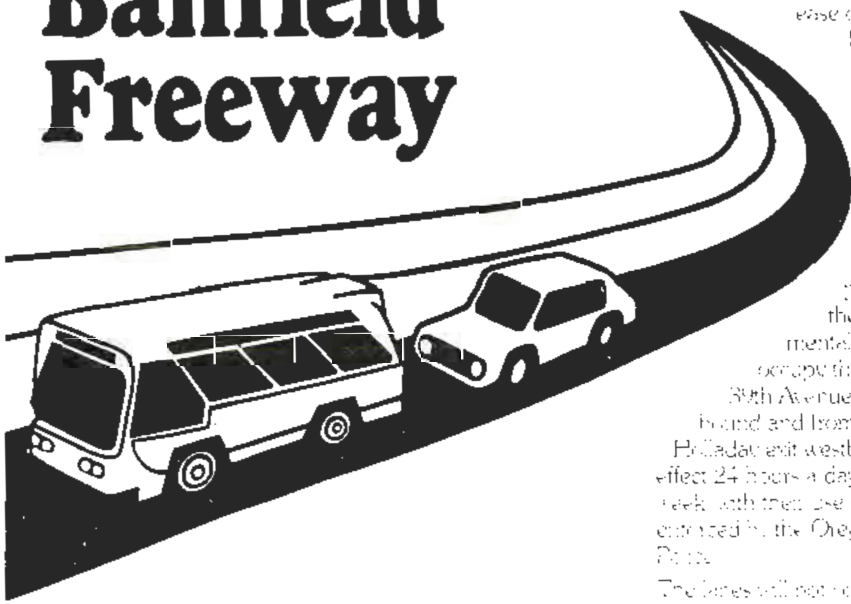


Figure 5



Express yourself on the new Banfield Freeway



Since the Banfield Freeway was already scheduled for resurfacing, the State Highway Division decided it would be a good time to also try to do something about the congestion problems.

There were several options. Among those considered was a conventional third lane, but this would have only filled to capacity, further increasing congestion. The most logical solution was a restricted lane for express buses and carpools, which would move more people more efficiently using the already existing roadway. In each direction, a third lane has been added to ease congestion on the two normal lanes.

The project is nearly finished, so it's time to start planning how you can make the best use of the new Banfield. Beginning December 1, Tri-Met's new Banfield Flyer Buses and carpools with three or more people will have exclusive use of their own lane. These experimental restricted lanes will occupy the inside lanes from 39th Avenue to 82nd Avenue eastbound and from 82nd Avenue to the Holladay exit westbound. They will be in effect 24 hours a day, seven days a week, with their use strictly enforced by the Oregon State Police.

The lanes will not only help trim minutes from morning and evening commuter time, but may [illegible] great value during the rest of the day to shoppers, groups of skiers on their way to the mountain, people on their way to the airport, or families on outings.

It's a new program. You can help make it work.

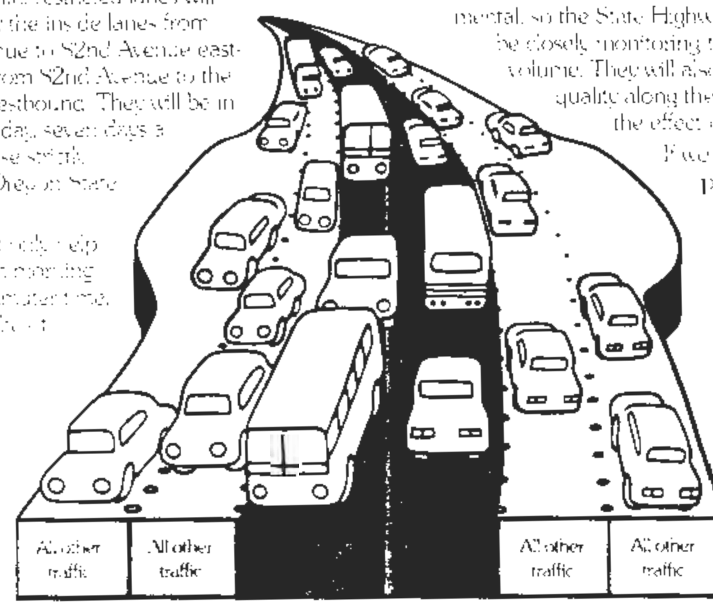
These restricted bus and carpool lanes will be new to most metro area residents. However, restricted lanes have been tried successfully in other parts of the country.

In Washington, D.C., special bus and carpool lanes on the Shirley Highway have allowed travelers to reduce their commuting time. Bus ridership has increased by 400 percent and carpools are up 500 percent in just one year.

Carpoolers and bus riders on the San Francisco Oakland Bay Bridge avoid long lines at the toll plaza by using exclusive lanes. Over 20,000 bus riders and 5,400 carpoolers take advantage of this service daily.

The lanes on the Banfield Freeway are experimental, so the State Highway Division will be closely monitoring traffic flow, speed and volume. They will also be testing the air quality along the roadway to determine the effect of reduced traffic.

If we all try to make this new program work, it will. And we can then look forward to similar lanes being developed in other high density traffic areas.



beginning December First.

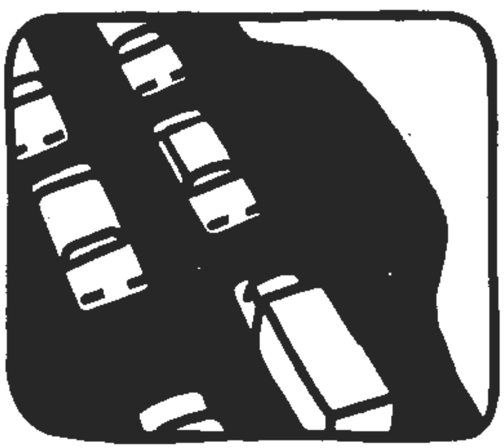
FIGURE 6

For safety's sake

The restricted lanes can help everyone move more easily on the Banfield. By putting express buses and carpools in one lane, the other two lanes will also be less crowded for regular bus lines and those who simply can't ride the bus or carpool.

For this reason, it is to everyone's benefit to allow people to move across traffic to enter and exit from the special lane. Since traffic in the express lane may also be moving faster, drivers should be extremely careful when getting into or out of the lane.

Another important point about safety: Since we've eliminated the shoulder, please make sure your car is in good operating condition before you enter the freeway. It is impossible to always predict when you are going to have car problems, but a properly maintained car is much less likely to break down. If you do have trouble, emergency turnouts have been provided approximately every 2,000 feet and special phones are being installed with a direct line to the state police. Since the police will be patrolling the Banfield more frequently, it shouldn't take long to get assistance to you.



Don't overlook these other Banfield Improvements.

The ruts are gone. The Highway Division has applied a quieter new resurfacing material which is also more porous, allowing the rain to run through it and more. This will eliminate dangerous puddles and night-time glare from standing water.

The lanes are clearly marked. White lines wear off easily, so new reflector buttons have been installed to clearly light the way. They also help keep you alert because they make a noise when you drive across them. The restricted lanes will be identified by a white diamond painted on the roadway.

Cars will be guided away from bridge abutments. Safety barriers now extend around the base of all overpasses shielding you from would-be obstacles.

The potential for head-on collisions has been eliminated. New concrete safety dividers have been placed between the east and west bound lanes to keep everyone on their side of the freeway.

Our hat's off to you. Happy traveling!

Thank you for your patience while the new Banfield was being completed. We hope you'll now be able to get where you want to go more easily and with greater safety.

State Highway Division
238-8226

Tri Met
233-3511

CARPOOL
227-7665

I would like to be included in CARPOOL's free matching service.

Mail to: CARPOOL
520 S.W. Yamhill
Portland, Oregon 97204

Name ____________________

Home Address ____________________

Work Address ____________________

Phone: Work __________ Home __________

Hours you work From ______ AM / PM to ______ AM / PM

I will: Ride only   Drive only   Do either

A strong selling point of the project was that the HOV provided a means for the receptive commuter to avoid congestion and shorten travel time. Additionally, use of the HOV lane would correspondingly decrease the volume of traffic in the normal travel lanes, thereby reducing congestion.

To provide a further incentive, and to facilitate the success of the HOV lane, the regional transit agency, Tri-Met, provided 10 express buses (Banfield Flyers), in addition to 19 normal runs, that operate on the Banfield during the morning and evening peak periods.

Throughout the development of this project, public criticism generally focused on two main concerns:

1. The increased driving hazard created by narrower lanes, potential weaving, and lack of shoulders; and
2. Encroachment on the freedom of the individual taxpayer by placing restrictions on what lane may be used.

Perceiving and attending to these concerns was a principal objective of the public relation effort and marketing program.

Project Evaluation

An extensive two-year monitoring program is underway to evaluate the operational effectiveness of the HOV lanes in meeting the project objectives. The program is functionally divided into two parts--air monitoring and traffic monitoring.

The air monitoring program includes: (1) sampling of carbon monoxide, using a sequential bag sampling technique; (2) sampling lead, using a hi-volume particulate sampler; (3) sampling oxides of nitrogen, using a continual chemiluminescent analyzer; and (4) sampling wind speed and direction through the use of mechanical weather stations.

The traffic monitoring program includes:

1. Periodic traffic counts on all freeway ramps on the project;
2. A continual traffic count of all traffic at the western terminus of the project, (CBD);
3. Periodic traffic counts on arterial streets paralleling the Banfield;
4. Periodic lane and vehicle occupancy counts at two selected locations on the Banfield; and
5. Periodic traffic speed monitoring, on both the freeway and arterial streets, through the use of floater cars.

The program includes monitoring of bus ridership, bus travel time, and traffic accidents on the freeway.

Preliminary Evaluation Data

The following evaluation of the Banfield HOV lane is based upon data taken during the first thirty days of operation:

The average weekday traffic volumes in the corridor indicate no diversion of traffic from the freeway to adjacent boulevards. This information is inconclusive to ascertain whether any traffic has been diverted from the boulevards to the freeway.

Corridor Average Weekday Volumes

	Freeway	Adjacent Arterial Boulevards (Sandy, Broadway, Burnside)
January 1975	96,000	- -
February	97,000	- -
March	102,000	- -
April	102,000	- -
May	104,000	- -
June	108,000	- -
July	106,000	- -
August	106,000	- -
September	101,000	73,000
October	102,000	- -
November	98,000	69,000
December	100,000	75,000
January 1976	98,000	72,000

A substantial improvment in the speed in the peak hours over the entire five-mile section has occurred since initiation of the HOV lane project.

Average peak-hour speeds for 5-mile project

Before (Six months)	a.m.	38 m.p.h.	p.m.	29 m.p.h.
After (One month)	a.m.	40 m.p.h.	p.m.	40 m.p.h.

The peak-hour auto occupancy has increased 2 per cent since initiation of the project, the percentage of carpool, or three-or-more-occupant vehicles has increased from 3 per cent to 5 per cent of the total number of vehicles on the freeway. The occupancy rate in the HOV lanes is 2.507. The violation rate is 30 per cent of those vehicles using the HOV lane. The percentage of violation of the total vehicles on the freeway is small.

Peak-hour auto occupancy

Occupancy rate for freeway	a.m.			p.m			average		
Before (3 months)	1.215			1.302			1.265		
After	1.239			1.319			1.287		
% 1-2-3-occupants/auto for fwy.	1	2	3	1	2	3	1	2	3
Before	80	18	2	73	23	4	76	21	3
After	80	16	4	74	21	5	76	19	5
% 1-2-3-occupants/auto HOVL only									
After	27	12	61	15	8	77	20	9	71

The total utilization of the HOVL during the first month has been nominal. Average peak-hour usage in the a.m. is 23 buses and 121 vehicles. The p.m. usage has reached 32 buses and 199 vehicles.

The "Banfield Flyers" are carrying 153 passengers in the a.m. and 143 passengers in the p.m. peak hours. The total bus ridership in the a.m. is 447 and the p.m. peak hour is 571.

HOVL vehicles are carrying 461 occupants in the a.m. and 661 occupants in the p.m. peak hour.

The HOVLs are carrying 808 persons in the a.m. and 1232 persons in the p.m. peak hour. The auto lanes are carrying 4333 persons in the a.m. and 4668 persons in the p.m. peak hour.

The HOVL is carrying 18 per cent of the person trips.

Addendum (April 1976)

Initially, the Banfield Freeway HOV lanes were reserved for buses and carpools on a 24-hour basis. Beginning March 28, 1976, the lane restriction was changed to peak periods only. Buses and carpools now have exclusive use of the westbound HOV lane from 6-10 a.m. and the eastbound HOV lane from 3-7 p.m., Monday through Friday.

INTERSTATE 95 EXCLUSIVE BUS/CARPOOL LANES DEMONSTRATION PROJECT*

Bob Deuser, Project Engineer
Florida Department of Transportation
March 1976

I. Project Overview

The I-95 Exclusive Bus/Carpool Lanes Demonstration Project is perhaps the Florida Department of Transportation's most innovative method of addressing the peak-period transportation problem facing Dade County. This demonstration project has two primary objectives: (1) to partially alleviate the daily peak-period traffic congestion on Interstate 95 by increasing the "people-moving" capacity of this facility; and (2) to demonstrate and evaluate the exclusive lane operation which provides priority treatment to high occupancy vehicles.

There are several important elements included in this demonstration project. Each element is designed to encourage the use of transit and/or the formation of carpools. These elements are: (See Figures 1 and 2).

1. The establishment of two exclusive lanes, one in each direction, on Interstate 95 for use in the peak-period, peak-direction by high-occupancy vehicles. These lanes are 7 1/2 miles in length located between the Golden Glades Interchange and Airport Expressway Interchange.

2. The establishment of two commuter park 'n' ride facilities (total capacity of 2200+ parking spaces) located within the Golden Glades Interchange in north Dade County.

3. The establishment of a flyover ramp providing direct access between the Interstate 95 exclusive lanes and the park'n' ride lots within the Golden Glades Interchange.

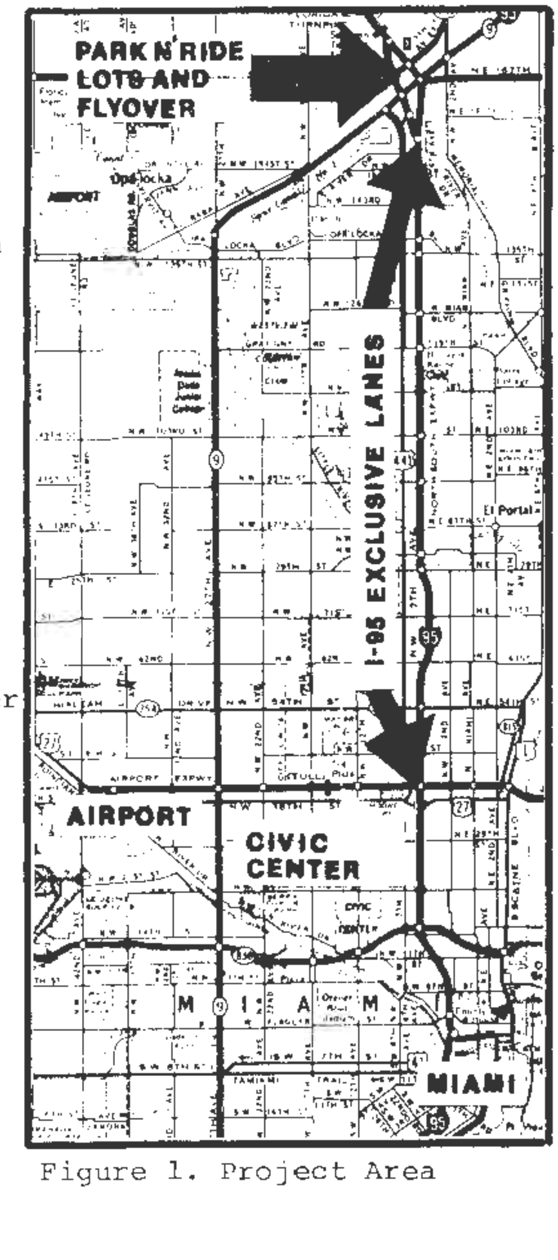


Figure 1. Project Area

*Project sponsored by U.S. Department of Transportation, Florida Department of Transportation, and Metropolitan Dade County.

4. The operation of a commuter express bus service, which is marketed locally as the Orange Streaker, that provides non-stop travel between the park'n'ride facilities and the employment areas which it serves - downtown Miami, the Civic Center and Miami International Airport complex.

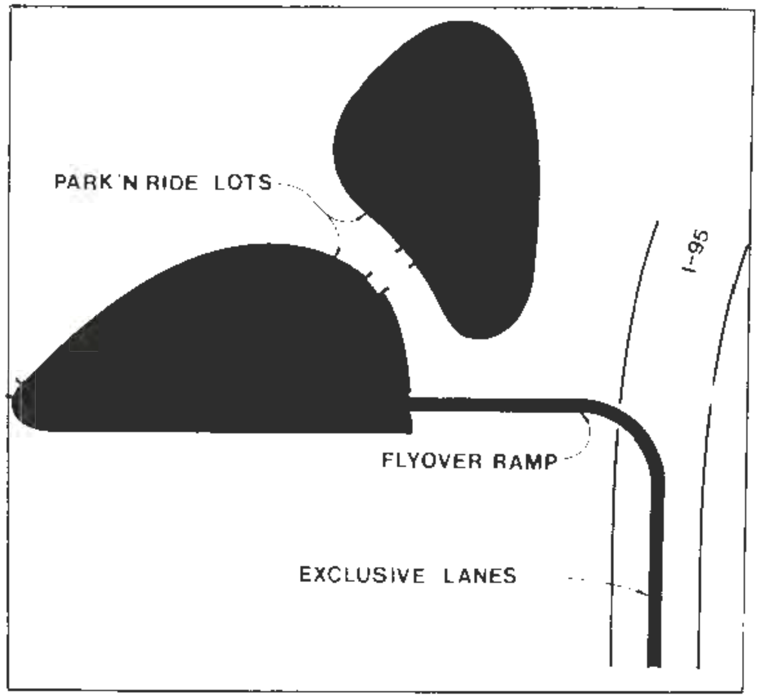


Figure 2. Layout of Park and Ride Lots

By reserving the exclusive lanes to buses and other high-occupancy vehicles, these vehicles will be the recipient of substantially reduced travel-time (as much as 15-20 minutes) through congested Interstate 95. This inducement of reduced traveltime, as well as other benefits, should encourage the use of transit and the formation of carpools. The results will be an improved "people-mover" capacity for Interstate 95.

Certainly, exclusive lanes have been tried successfully in many other locations. However, the design of the I-95 Exclusive Bus/Carpool Lanes is an unique one, since the exclusive lane is not physically separated from the general traffic lanes. Because of the significance of this design treatment, a detailed evaluation program is being undertaken for the demonstration project. This evaluation program is exploring such matters relating to Interstate 95 travel as traveltime, auto occupancy, modal split, passenger-carrying capability, traffic operations, transit operations and carpool formation.

II. Interstate 95 Exclusive Lanes Operation

The Interstate 95 Exclusive Lanes have been designed for a simple operation. The exclusive lanes operate in a peak-period, peak-direction manner. The inbound (southbound) median lane is reserved from 6 to 10 AM, Monday through Friday for vehicles carrying three or more persons. Likewise, the outbound (north-bound) median lane is reserved from 3 to 7 PM, Monday through Friday for vehicles carrying three or more persons. During the other 20 hours of the day, these lanes are available for general traffic. Overhead signing located throughout this section of Interstate 95 specifies the reserved nature of the two median lanes. (See Figure 3).

Figure 3. Operation of I-95 Exclusive Lane

During the stated times of exclusive lane operation, a qualifying vehicle (three persons or more in the vehicle) needs only to enter and exit the exclusive lane at the locations the driver chooses. Only a painted solid white line separates the exclusive lane from the general lanes. The fact that the exclusive lanes are not physically separated from the general traffic lanes enables many more qualifying vehicles to have accessibility to the use of the exclusive lanes.

In designing the exclusive lane operation certain decisions had to be made regarding the occupancy requirement, the hours of operation and the violation activity for the exclusive lane.

The purpose of establishing the occupancy requirement for the exclusive lane at a level of three is to ensure a free flowing exclusive lane and to encourage carpool formation. For each three-person carpool formed on Interstate 95, generally two cars will be removed from the roadway. The question of establishing the occupancy requirement at a level of two was previously studied. However, traffic counts on Interstate 95, a facility with three or four directional general traffic lanes, reveal that 26 to 29 percent of the vehicles have an occupancy of two or more persons. Such a large percentage means that the exclusive lane could easily become congested under an occupancy requirement of two and certainly would have only slight potential for future growth. The same traffic counts reveal that at the time of the exclusive lane opening only five to seven percent of the total Interstate 95 volume had an occupancy of three or more persons.

The exclusive lanes are essentially for the peak-period of traffic on Interstate 95 when the general traffic lanes are congested. During the off-peak periods, traffic on Interstate 95 is free-flowing and the additional lane is not necessary for travel. The four hour time span (6-10 AM for the inbound exclusive lane and 3-7 PM for the outbound exclusive lane) established for the exclusive lane operation ensures that the exclusive lane will be in operation when it is needed - during the peak periods of traffic congestion, which are historically getting longer in length.

As stated earlier, the Interstate 95 exclusive lane design is unique in that the exclusive lane is not physically separated from the general traffic lanes. This design permits greater accessibility to the exclusive lane by both eligible and non-eligible vehicles. Unfortunately, because of limited available right-of-way and design considerations, a storage facility in the median area could not be provided. This design does assuredly put greater emphasis on enforcement. The Florida Highway Patrol can apprehend a violator of the exclusive lane restriction in two ways: (1) force the violator over 3 to 4 lanes of generally heavily congested traffic to the right shoulder; or (2) follow the violator to a point where a left shoulder or uncongested traffic occurs. The first enforcement procedure is considered to be a less than safe manuever, while the latter procedure entails extra attention that is time-consuming.

III. Project Performance

The scheduling of the elements of the Interstate 95 Exclusive Bus/Carpool Lanes Demonstration Project has occurred/or will occur as follows:

- The first segment of the Interstate 95 Exclusive Bus/Carpool Lanes (one-half of the complete length of the outbound lane) became available in July 1975.
- The remaining segments of the exclusive lanes became available on December 2, 1975.
- The flyover ramp will not be readied until June 1976.
- One park'n'ride facility (capacity of 967 spaces) has been in operation since April 1974, while the second park'n'ride facility will not be readied until September 1976. Interstate 95 is accessible from the present facility.
- The Orange Streaker express bus service, presently consisting of 30 peak-period trips, began using the Interstate 95 exclusive lanes on March 15, 1976.

The main thrust of the evaluation program did not commence until the exclusive lanes opened completely in December 1975 and thus operational data is limited. However, since the first opening of the exclusive lanes in July 1975, periodical surveys of the PM exclusive lane operation have been undertaken. The results are shown in Figure 4.

INTERSTATE 95 EXCLUSIVE LANE OPERATION
OUTBOUND 4:30 - 5:30 PM

Month \ Item	Total Vehicles in Lane	Average Auto Occupancy	Violation Rate
July	315	2.28	56%
August	300	2.12	66%
September	316	2.08	64%
October	367	2.10	64%
November	389	2.15	64%
December	437	2.35	52%
January	468	2.52	48%
February	693	2.39	53%
March	-	2.63	40%

Figure 4

The exclusive lanes have commenced operations by achieving an underutilization of the lane, a low average occupancy level and a high violation rate. This performance was to some extent expected for the following reasons:

1. Only five to seven percent of the total Interstate 95 traffic volume was eligible to initially use the exclusive lanes.

2. Only since December 1975 have the exclusive lanes been fully operational.

3. For the first several months (July - September 1975), it was publicly known that the Florida Highway Patrol was providing a grace period from ticket-writing for an exclusive lane violation.

4. The visibility of buses in the exclusive lane was absent.

What is encouraging in this set of data is the evolving trends. Each month the exclusive lane operation experiences a greater utilization of the lane, a higher average occupancy level and a lower violation rate. In short, more vehicles are being attracted to the exclusive lane and these vehicles are overwhelmingly ones with three persons or more. The full impact of the exclusive lane operation is certainly not expected to be visible immediately as it takes time for travel habits to change.

If the Interstate 95 Exclusive Bus/Carpool Lanes Demonstration Project provides for a successful operation, then undoubtedly other urban areas will undertake similar designs for exclusive lane operation in appropriate situations.

CONNECTICUT'S CARPOOL PROGRAMS

Nicholas A. Artimovich II, Highway Engineer
Federal Highway Administration
January 1976

Abstract

This report presents the history, current status, and estimated annual savings realized by commuters for all phases of Connecticut's carpool program (carpool lots, commuter buses, reduced tolls, and statewide and industry-wide promotion of pooling. The annual savings by commuters using the carpool program is estimated at just under $3 1/2 million.

History

The State of Connecticut's involvement in carpool parking lots began in the summer of 1969 with an inventory of existing interchange parking. Approximately 900 autos were found parked at 69 interchanges along Connecticut's expressways. The parked vehicles were left unoccupied while their drivers went to work by carpool or bus. Based on this initial survey, three recommendations were made: 1) that improvements be made to three existing areas where commuter vehicles were parked; 2) that four lots be constructed on new locations; and 3) that additional lots be considered for future development.

In 1973, the energy crisis prompted the Governor of Connecticut to issue a three-point program to alleviate the gasoline shortage. This program involved commuter bus service, carpool parking lots, and carpooling by industry employees. In that year, the number of carpool lots was increased to 11, making a total capacity of 720 autos.

During 1974, 66 gravel parking facilities were constructed. The number of paved facilities increased from 11 to 21. As a result of this expansion, the overall number of parking spaces increased to 3,800.

In observance of the first point of the Governor's program, express commuter bus routes were established to serve the cities of Hartford and New Haven. These routes originate at commuter lots and end in the Central Business District of the city. By September 1974, seven routes served Hartford and two operated to and from New Haven.

Connecticut's efforts to promote carpooling through organizations began in 1972. At that time, the Connecticut Department of Transportation developed a computer program for carpool matching. It provides carpool matching services to any public or private employer in the State who wishes to participate.

Initially, over 7,000 employees from 45 State agencies in Hartford submitted data forms for matching. As a result, over 1,000 employees ride in carpools, most parking in spaces reserved for carpools with three or more occupants. In addition, about 100 companies from across the State sponsored programs in the spirit of conserving energy. With 80 to 90 percent of the employees participating, many through the use of personnel records, 70,000 questionnaires were returned by the first 31 firms.

Present

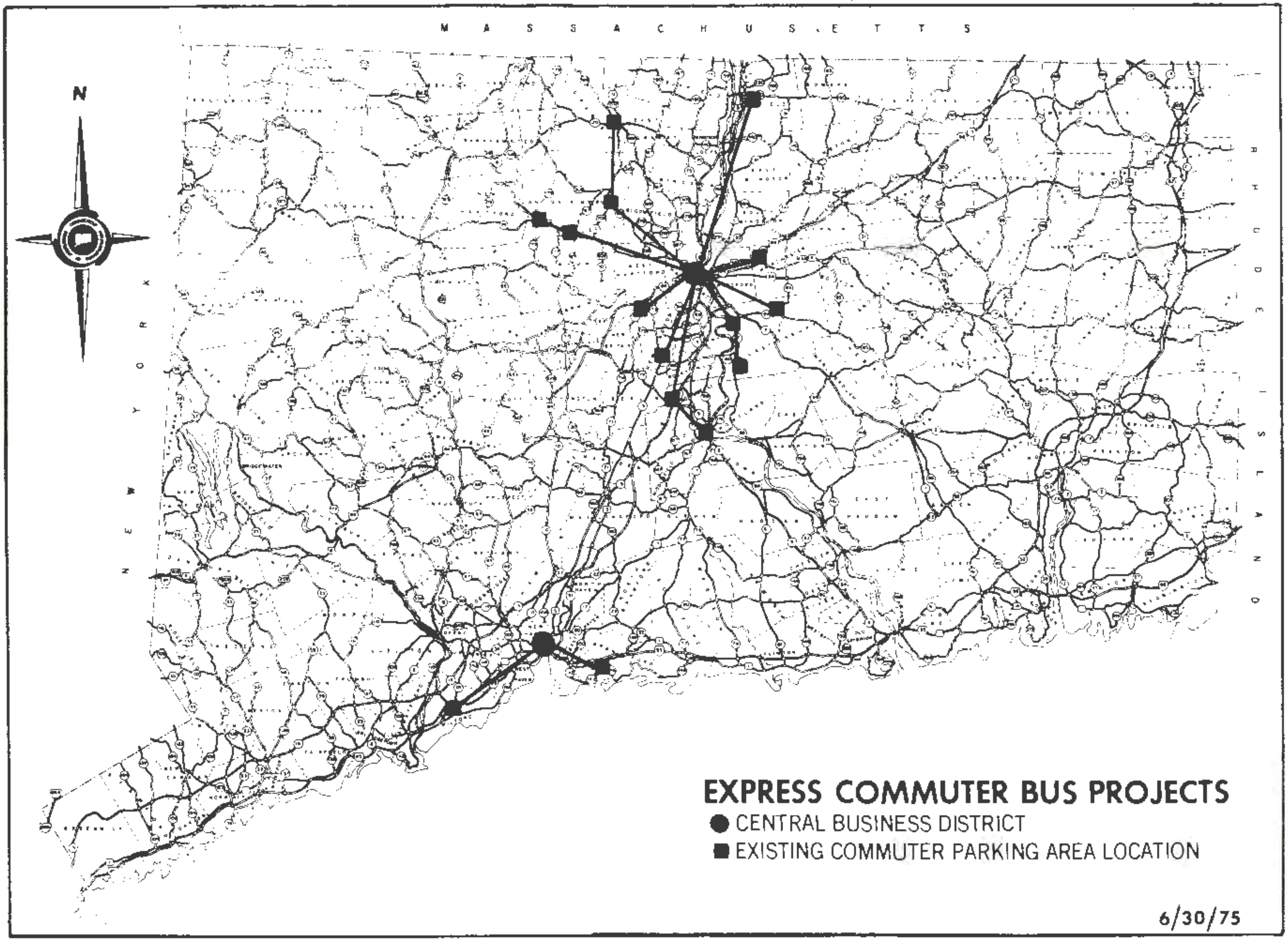
Currently, Connecticut's carpooling program has been expanded to encompass more than 100 carpool parking lots. Of these, 16 are served by commuter bus runs. The lots have a capacity of 7,000 vehicles and are being used at a rate of 63 percent. A few of the lots are not used at all while several are handling more than their stated capacity. (Six of the lots which were consistently unoccupied have been closed as commuter parking lots.) Some lots show heavy use even at night and on weekends when they are used by night shift workers and shoppers. Reasons for the different occupancy rates are discussed later.

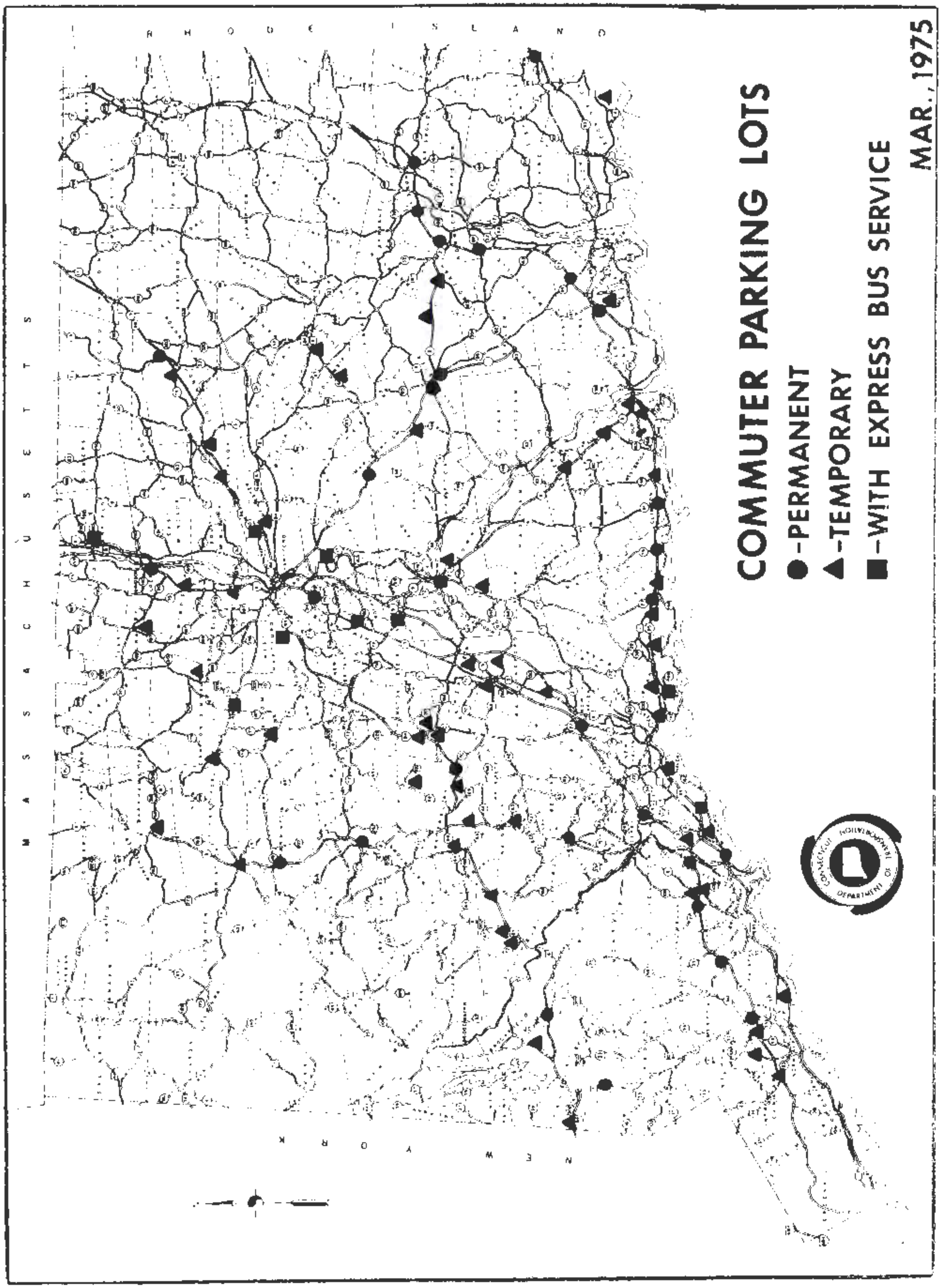
A most successful aspect of the energy conservation project has been the commuter bus program. Presently, there are 15 routes serving over 25,000 passengers weekly. Ten of these are express runs (originating at one lot and proceeding directly to the CBD). There are 12 routes (10 express) in Hartford and three (all express) in New Haven. Each route originates at one (or more) of the commuter parking lots and ends in the CBD. In addition to the New Haven routes, there is a special route called the "clamdigger" which follows the Connecticut Turnpike (I-95) from Old Saybrook to New Haven and stops at many of the carpool lots along the way. This route was instituted to replace a discontinued commuter rail line which was not financially self-sufficient.

The number of bus trips per week varies from 45 trips per week for the Simsbury parking lot, to 150 trips for the Manchester lot.

Increased pooling through organizations has been worthwhile. During fiscal year 1975, 13 additional private employers with approximately 9,600 employees were matched for carpooling by the Connecticut DOT bringing the total number of private employers matched to 44 with approximately 78,400 employees.

The most recent innovation in Connecticut's carpooling program is the policy of sending computer applications with automobile registrations. Of 330,000 applications sent out since October, 3,500 applications were returned. When the applicants from this program are successfully matched, they will probably be using the existing carpool lots. So far, 1,900 matches have been prepared by the State.


N
M A S S A C H U S E T T S
N E W Y O R K
R H O D E I S L A N D
EXPRESS COMMUTER BUS PROJECTS
CENTRAL BUSINESS DISTRICT
EXISTING COMMUTER PARKING AREA LOCATION
6/30/75


COMMUTER PARKING LOTS
●-PERMANENT
▲-TEMPORARY
■-WITH EXPRESS BUS SERVICE
MAR., 1975
M A S S A C H U S E T T S
R H O D E I S L A N D
N E W Y O R K

Typical trailblazer sign.

Paved commuter bus lot with shelter.

Commuter bus lot at shopping center.

Lot within interchange.

Sign used at larger lots.

Roadside lot.

Gravel lot near I-86.

Another program developed in support of carpooling activities is the reduced toll fees program on the Connecticut Turnpike. A carpool of three or more people may purchase a 42-ticket booklet for $1, a savings of $2.50. Carpool ticket book sales were averaging approximately 1,200 books a month by the fall of 1974.

In conjunction with the State's program, informational pamphlets and maps are given to those requesting them.

Factors Affecting Usage

As previously stated, overall usage of Connecticut's carpool parking lots is 63 percent of capacity. The usage is somewhat higher for the 27 paved (bituminous surface) facilities, these being, on the average, three-quarters full, while the remaining gravel lots are only half-full. When given a choice, a driver will almost always prefer the paved lot: in six out of eight locations around the State where a paved lot is close to a gravel lot, the paved facility is utilized to a greater extent. The gravel lots are officially termed "temporary" or "emergency" lots, but many are being upgraded to permanent status.

The presence of a commuter bus stop is a big drawing card for some of the lots. Of the eight lots across the State which show more than 100 vehicles, six are served by commuter buses. Overall, the lots which are on commuter bus routes show an occupancy rate of 81 percent.

An interesting conclusion can be drawn from observing data on some of the lots served by commuter buses. Several lots have been at or over capacity for some time now, yet the bus ridership continues to increase. This means that commuters are carpooling from their homes to get to the bus lots. Apparently, this service is very attractive and some people are really getting accustomed to ride-sharing.

The vast majority of lots are well signed, with at least a one-post sign at the lot, and usually one or more in advance locations. The larger lots have the larger displays. In addition, the commuter bus lots have large advance signs indicating express buses in operation to either Hartford or New Haven. In at least two instances, there are no signs at all indicating the availability of commuter parking; not surprisingly, no cars were found using the lots.

Cost Savings

To determine precisely the money saved by users of carpool parking lots, extensive survey and computer oprations would be necessary. One would need to know the exact origin and destination of each commuter. Also, operating costs for all automobiles would be required. To simplify this, the following assumptions were made:

1. All motorists whose autos are parked at a particular lot have a common destination.

2. Eight major cities in Connecticut attract all trips: Hartford (including East Hartford), New Haven, New London (including Groton), Norwalk, Norwich, Waterbury. Distances from each lot to its respective attractor were scaled using a (1" = 3 1/2 miles) highway map.

3. Operating costs for automobiles vary with vehicle size. These costs were estimated using figures published by the Highway Statistics Division of the Federal Highway Administration.

About half of the carpool lots were inspected in October and November 1975. Vehicles present were counted and classified by subcompact, compact, or standard. For the lots which were not visited, the most recent weekly counts (August 1975) from the Connecticut Department of Transportation were used. To account for the seasonal variation in usage between August and November, the ConnDOT figures were adjusted. Both August and November counts were available for half of the lots, and it was found that the November figures were 20 percent higher. Therefore, the August counts were increased by 20 percent to reflect the variation.

The cost savings were determined by multiplying the number of vehicles of each classification at a lot by the distance to the appropriate CBD. This was then multiplied by the cost per mile per year for this class of vehicle. Results for all classes at all lots were summed. This yielded a figure of slightly under $3 1/2 million which Connecticut drivers save annually by using these carpool lots.

Conclusion

Commuter programs are continually being expanded. For example, some commuter bus lines will increase daily trips, and new and enlarged carpool lots are proposed. Connecticut has not yet reached the point of saturation for the demand of its carpool lots. More will be needed, even in locations where the supply is currently adequate, especially if economic and energy situations continue to worsen.

To keep these programs as productive as possible, the current public relations efforts, including radio and television, should be continued. As drivers recognize the availability of these services, and the adversity of economic affairs, they may realize that carpooling or riding commuter buses is the easiest answer to their commuting (or transportation) needs.

BOSTON I-93 CARPOOL LANE

Peter Hatzi, Highway Engineer
Federal Highway Administration
April 1976

On February 26, 1974, in Boston, Massachusetts, a carpool priority lane, 0.2 mile in length, was opened for Interstate 93 southbound traffic. The intent of the preferential lane is to give head-of-the-line privileges to carpools headed for downtown Boston during the morning rush hours. In late August 1974, the lane was extended to more than 3/4 mile to further encourage the formation of carpools and the use of bus transit.

Only recently have such traffic engineering strategies been implemented nationwide. These projects support the new concept of transportation system management, that is, using our present highway system more efficiently by placing more emphasis on the people-moving capacity of existing highways rather than continually providing additional vehicle-moving capacity.

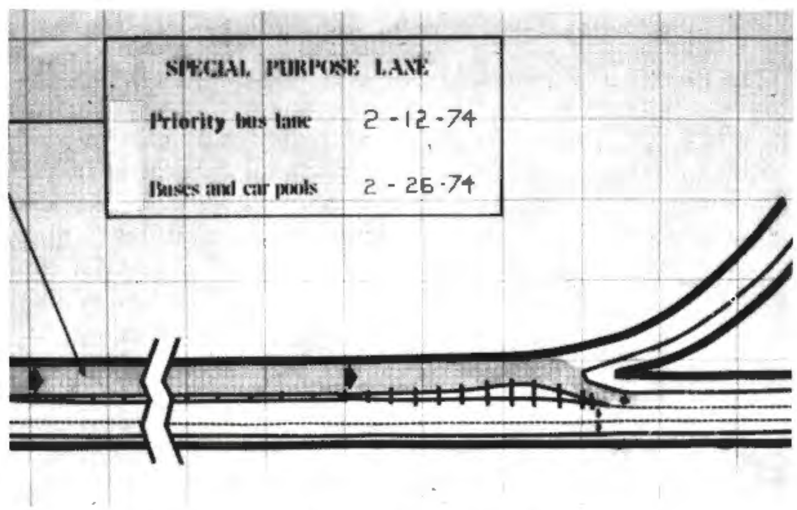


Diagram of I-93 priority lane.

The I-93 carpool lane is located on the lower level (southbound roadway) of a two-level bridge in Charlestown, Massachusetts. The lane provides preferential treatment to buses and carpools on weekdays from 6:30-9:30 a.m. The left lane of the four-lane southbound roadway is reserved for high occupancy vehicles with three or more occupants. The carpool lane also serves as a left exit ramp for northbound traffic to Charlestown. The third

Carpool entering priority lane. Bituminous curb in adjacent lane separates buses and carpools from the regular traffic lanes.

lane serves as a barrier lane separating the carpool lane from the two regular traffic lanes. A bituminous concrete curb in the third lane physically separates the carpool lane from the regular traffic lanes. Pavement markings and signs are also used to help direct the carpools to the priority lane and then back into the regular traffic lanes at a merge point just before the gore of I-93 and the northbound ramp to Charlestown.

A State trooper enforces the three-occupant rule at the merge of the carpool and regular lanes. When he identifies a vehicle with fewer than three occupants, he does not allow it to merge with the regular traffic. Instead he directs its operator to take the northbound connector to Charlestown. If the vehicle operator is destined to the CBD, or a point further South, his traveltime is increased by 20 minutes.

The preferential treatment for buses and carpools on I-93 has encouraged increased carpooling in the I-93 corridor, and has produced significant traveltime savings to commuters using the carpool lane. On a normal day the preferential lane saves commuters 4 1/2 minutes in traveltime, and up to 10 minutes depending on traffic conditions. In fact, during the morning rush hours, approximately 500 carpools and 32 buses use the lane; thus it moves an additional 2,620 commuters. The safety record of this lane has been excellent. There have been three reported accidents involving only minor property damage to date.

Buses and carpools reenter the regular traffic lanes at the head of the queue. Violators are directed onto the exit ramp heading away from the CBD.

BUS AND CARPOOL LANES IN HONOLULU

Stephen Baluch, Highway Engineer
Federal Highway Administration
April 1976

In the Honolulu metropolitan area, two projects providing preferential treatment for high occupancy vehicles are now in operation. One of these is a reserved lane along the Moanalua Freeway to the northwest of the CBD. The other project is a reserved arterial lane along the Kalanianaole Highway to the east of the downtown area.

Moanalua Freeway

On October 1, 1974, the inbound median lane along the Moanalua Freeway was opened to vehicles with four or more occupants. Almost immediately, it became evident that the reserved lane could easily accommodate more vehicles and the occupancy requirement was reduced to three persons.

Initially, the median lane was opened only to inbound buses and carpools during the morning peak period, 6-8 a.m. However, after all constuction work along the newly widened freeway had been completed, the median lane in each direction was reserved for vehicles with three or more persons on a 24-hour basis. The reserved median lane extends nearly 2.7 miles inbound and 1.4 miles in the outbound direction.

The additional freeway lanes were originally constructed for general traffic use, but were designated as preferential lanes, on an experimental basis, when construction work was nearly completed. The intent of the preferential designation was to encourage the increased use of carpools and public transportation to alleviate the growing congestion of inbound commuter traffic. The lane was never in fact opened for ordinary traffic. The initial success of the preferential lane operation led to permanent continuation of the special use on a 24-hour basis.

Reserved bus and carpool lane along the Moanalua Freeway

The cost of converting the lane to preferential use is estimated at $36,500 including signs, markings, and delineators. Only a dotted white line (similar to a guide line) separates the preferential lane from the normal traffic lanes. High occupancy vehicles can enter or exit at any point throughout the length of the lane.

Carpools and buses in the reserved lane can save as much as 10 minutes in traveltime along the 2.7-mile inbound section. Even though express bus service on the reserved lanes did not begin for at least a month after the lanes opened, carpool use of the lane grew rapidly. Initially, about 530 carpools of three or more persons were using the reserved lane daily during the morning peak period. By February 1975 that number had increased to over 1,300 carpools and 11 buses.

The fact that the reserved lane had never been open to regular traffic is believed to have made public acceptance easier. During the first month of operation, compliance with the carpool lane restriction was voluntary. As the use of the carpool lane increased, enforcement became necessary. In fact, many of the complaints about the special lane concerned the need to enforce the restrictions. Enforcement of the three person occupancy restriction began in November 1974. By January 1975, violators had been reduced to about 10 percent of the total vehicles in the special lane.

Buses and carpools use the reserved lanes on a 24-hour basis.

Kalanianaole Highway

In conjunction with the development of new express bus service to the Hawaii Kai area, a rapidly-growing residential suburb of Honolulu, an exclusive bus lane was designated along a congested arterial highway. Kalanianaole Highway provides the only route connecting Hawaii Kai and the major activity centers in Honolulu. The peak hour congestion along this route prompted the Honolulu Traffic Department to propose the

Bus entering reversible bus/carpool lane on Kalanianaole Highway.

express bus system including bus service to the University of Hawaii and the Honolulu CBD, and the exclusive bus lane through the congested portion of the corridor.

The exclusive bus lane, 2.5 miles in length, was designed to allow buses to bypass the most congested area along the Kalanianaole Highway. The first segment of the exclusive lane, about 2 miles in length, is located along a 4-lane undivided section of roadway. During the morning peak period (from about 6-8 a.m.) one of the two outbound lanes is reserved for inbound buses. This provides two lanes for regular inbound traffic, one lane for inbound buses, and one lane for outbound traffic in a three-one configuration. Cones are placed along the bus lane to separate the inbound buses from opposing outbound traffic. Beyond this section the roadway widens to a six-lane divided arterial. The recently completed third inbound lane, adjacent to the median, is reserved for buses for an additional 1/2 mile. Thereafter, the buses travel in mixed traffic to the final destinations.

On September 15, 1975, the express bus lane was opened to carpools on an experimental basis. The experiment has been so successful that carpools and buses will share the reserved lane on a permanent basis. The exclusive lane will continue to operate only during the morning peak period.

Priority lane for buses and carpools of three or more continues for another 1/2 mile in the median lane of this divided section.

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