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PRIORITY TREATMENT FOR HIGH OCCUPANCY VEHICLES: PROJECT STATUS REPORT

March 1977

Interim Report

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Prepared for FHWA:

FEDERAL HIGHWAY ADMINISTRATION
Offices of Research & Development
Washington, D. C. 20590

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This report will be of particular interest to urban planners, traffic engineers, and highway designers who are involved with the planning, design, and/or operation of highway facilities which provide incentives for encouraging drivers to switch to carpools or buses. The report provides a brief summary of 14 projects which provide priority techniques for high occupancy vehicles. Some useful observations and guidelines are noted as a result of these studies.

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16. Abstract

This report discusses the current status of 14 preferential treatment projects for buses and carpools in the United States. The range of projects covered include bus and carpool lanes physically separated from the flow of other traffic, contra-flow lanes, exclusive median with-flow lanes, bypasses of metered freeway ramps, and toll reductions for carpools. Key historical events in the development of each project are cited and observations are made on the effectiveness of each. This report is part of FHWA's Federally Coordinated Program (FCP) research project 2D, which is titled "Research on Priority Techniques for High Occupancy Vehicles." Several of the 14 projects discussed herein as well as other additional projects will be given detailed evaluation in the near future.

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SUMMARY

Priority treatment for High Occupancy Vehicles (HOV's) is no longer a new concept. It has been implemented on individual freeways, arterials, and city streets for over a decade, although it took the energy crisis of 1974 to awaken the American public to the realization that the single occupant automobile is an inefficient transportation mover. Since 1974, a large number of priority treatment projects have been initiated with varying degrees of success. The experience to date of these facilities shows the following:

Freeways - Separate and exclusive freeway lanes for high occupancy vehicles both "with-flow" or "contra-flow" will attract an increased number of carpools or transit users providing that there is a significant travel time saving (10 minutes or more) over the normal vehicle flow. Travel time savings (including travel time reliability) and reduced costs are the most important factors that people consider in choosing their travel mode.

Physically separate or contra-flow freeway priority lane treatments have low violations rates (under 5%) since violators are conspicuous and enforcement can be carried out at a few selected locations.

Freeway treatments that remove lanes from normal use will be highly controversial as will any treatment that appears to discriminate against a particular area or impact another jurisdiction. Ramp bypasses by themselves appear to create little incentive for HOV's unless the ramp queues are excessive (3 minute delays).

With-flow priority freeway treatments that do not provide physical separation have high violations rates (15-60%) which, regardless of the travel time savings, cannot be considered a desirable situation.

Arterials and City Streets - Experience on arterials and city streets is more limited, conditions vary considerably from project to project and travel time savings are generally less for individual trips. The largest increase in bus and carpool use has occurred where travel time savings are significant. Travel time savings are greatest with contra-flow or with-flow median lanes or contra-flow curb lanes

as opposed to with-flow curb lanes. Violation rates are high on non-separated with-flow projects since enforcement is difficult.

Safety and operational problems are critical, especially at intersections and need to be carefully planned for. Signs and markings need attention if they are not to confuse both priority and non-priority users.

Priority treatment for high occupancy vehicles is in its infancy as a major traffic system management tool. Concepts which present unresolvable safety and operational problems and which result in unacceptable violations rates have little opportunity of becoming permanent or long term solutions to urban problems although they may provide limited relief at selected locations.

Priority treatments which are limited to portions of individual facilities serve only a small percentage of an urban area's mobility needs; a situation which can only be improved by the application of systems of priority treatment either by corridor or throughout the urban area.

The most successful and the least controversial priority treatments are among the costliest and require substantial physical improvements (i.e. San Bernardino Busway and Shirley Highway Bus and Carpool exclusive lanes). This implies that the future of priority treatment may lie with a major reconstruction program of urban freeways and arterials to provide a physically separated, high capacity system for high occupancy vehicles.

INTRODUCTION

FCP PROJECT 2D, "PRIORITY TECHNIQUES FOR HIGH OCCUPANCY VEHICLES

The Federal Highway Administration (FHWA) is responsible for developing a highway transportation system that effectively satisfies national, regional, and local needs. This mission involves a high degree of cooperation with State and local highway agencies in addressing the problems related to moving people and goods more efficiently and at less cost to both the user and non-user.

The FHWA has initiated, as one of its action strategies, the Federally Coordinated Program of Research and Development in Highway Transportation (FCP), an applied research and development program designed to initiate, analyze, and implement innovative solutions to major transportation problems. FCP serves as a guide for integrating highway research by all participants so that common objectives can be achieved within the shortest possible time at the lowest possible cost. It is a cooperative enterprise utilizing the talents not only of the research community but also those of FHWA field and operating offices, State highway departments, and others.

As urban areas continue to grow, the need to move more people into and out of the central business area and throughout the region steadily increases. However, it is not practical to continuously provide additional highway transportation facilities to match the increase in trip demands. Instead, it is necessary to maximize the efficiency of the existing facilities to move as many people as possible in a reasonable period of time. One of the most cost-effective approaches to maximizing the people carrying capacity of existing highway facilities is to provide preferential treatment for high occupancy vehicles.

In order to study the possible approaches to maximizing the use of existing facilities, the Federal Highway Administration in 1974 established the 2D Project. Under this project, research is being conducted on priority techniques for high occupancy vehicles. The objective of the 2D Project is to increase the people moving efficiency of the highway system by: (1) applying a variety of techniques for the preferential treatment of high occupancy vehicles (buses, vanpools, carpools), (2) thoroughly evaluating the techniques considering benefits, costs, environmental impacts, and institutional and public acceptance, and (3) providing all information necessary to facilitate wider implementation of the most promising techniques.

In recognition of the need to make better use of existing facilities, FHWA and UMTA have issued new rules and regulations (U.S.C. Title 23, Chapter I, Part 450) governing urban transportation planning. One of the new requirements of the planning process is a Transportation System Management (TSM) element. One of the specific kinds of actions cited in these regulations which should be considered in the TSM element is "Preferential treatment for transit and other high occupancy vehicles such as:

- Reserved or preferential lanes on freeways and city streets,
- Exclusive lanes to bypass congested points,
- Exclusive lanes at toll plazas with provision for non-stop toll collection...,
- Exclusive access ramps to freeways," etc.

The scope of the 2D research project includes evaluation of a variety of techniques which would fall into the categories of actions required by the new regulations.

At this time in the project, a number of preferential treatment projects have been implemented and are being evaluated. Several others have been in operation for some time and their impacts can be determined. This report is meant to provide a brief summary of several of the projects with an assessment of their operation. More detailed information on each project is available from the individual sponsoring agencies, and individual evaluation reports will also be available in the future.

A total of 14 projects are summarized. They are:

1. I-95/7th Avenue, Miami, Florida
2. Freeway Ramp Bypasses, Los Angeles, California
3. Connecticut Turnpike
4. Banfield Freeway, Portland, Oregon
5. CBD Carpool Ramps, Minneapolis, Minnesota
6. Shirley Highway, Northern Virginia
7. U.S. 101, Marin County, California

8. San Bernardino Freeway Express, Los Angeles, California

9. I-93, Boston, Massachusetts

10. U.S. 1/South Dixie Highway, Miami, Florida

11. Moanalua Freeway, Honolulu, Hawaii

12. Santa Monica Freeway Diamond Lanes, Los Angeles, California

13. Kalanianaole Highway, Honolulu, Hawaii

14. I-495/Lincoln Tunnel, New York City

The locations of these projects are shown on Figure 1 below.

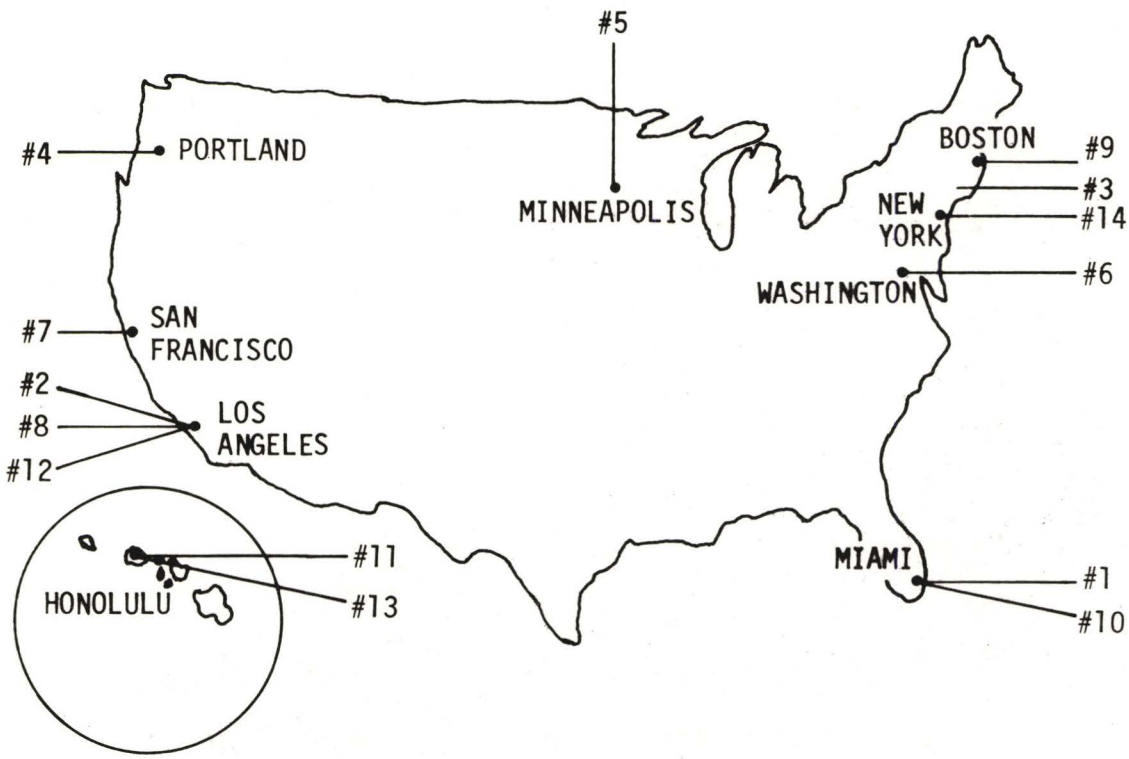

Figure 1. Location of preferential treatment projects.

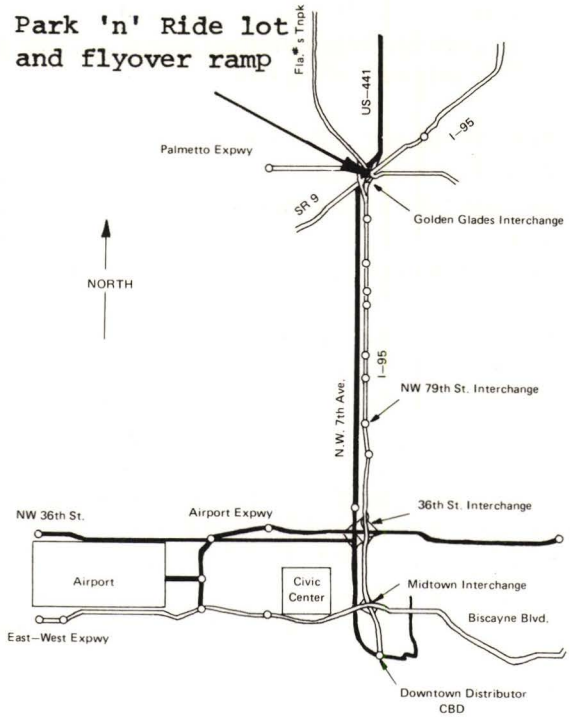

Figure 2. Project corridor, I-95/N.W. 7th Avenue, Miami, Florida.

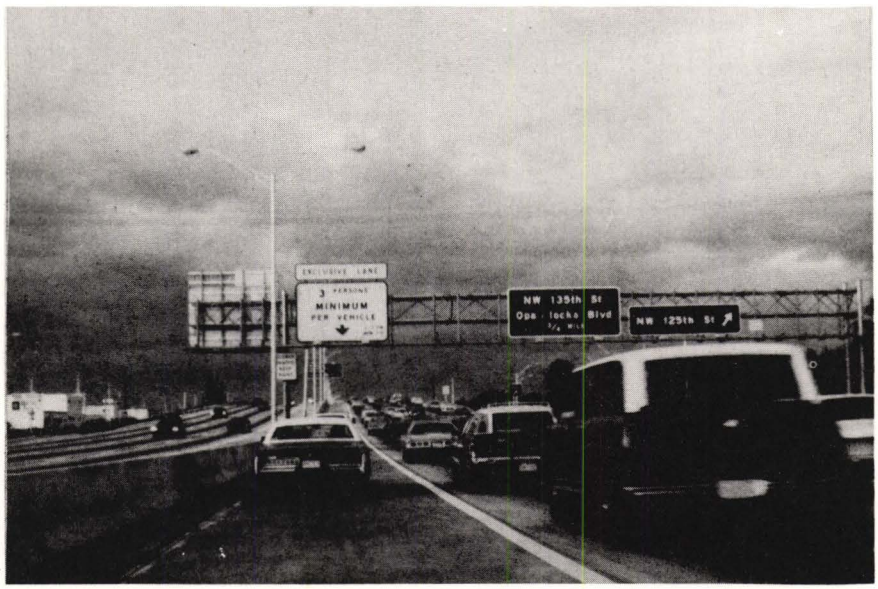

Figure 3. Exclusive lane, I-95, Miami, Florida.

Summary of Project Status
I-95/7th Avenue
Miami, Florida

Project Description: The median shoulder of I-95 in the Miami area has been reserved and converted for the exclusive use of carpools of two or more persons and buses. The project operates from 7 a.m. to 9 a.m. southbound and 4 p.m to 6 p.m. northbound on weekdays. Lanes are open to general use at other times. "Orange Streaker" buses which previously used the 7th Avenue preferential lane now operate on I-95. Also included is a 2200 space park n' ride lot at the north end of the project with a direct connection to I-95.

Project Location: On I-95 from the Golden Glades interchange south along N.W. 7th Avenue and I-95 to downtown Miami, the Airport, Civic Center, and N.W. 36th Street, a distance of 7½ miles.

Project Started: The first segment became available in July, 1975. On December 2, 1975, the exclusive lanes were fully opened in both directions. The fly over ramp providing a direct connection to the park n' ride lot was opened Feb. 1977.

Project Events: Average auto occupancy in the corridor has not undergone a substantial change. Carpools were initially defined as three or more persons and hours of operation were 6 a.m. to 10 a.m. and 3 p.m. to 7 p.m. These were changed to present status on January 10, 1977. In the first stages of the project, bus signal preemption on 7th Avenue increased operating speed approximately 20%. An additional 10% increase was a result of implementing the 7th Avenue exclusive bus lane, resulting in a total travel time savings of 6 minutes. Travel time savings after the switch over to I-95 has ranged up to 15 minutes. No decrease in speeds has resulted from allowing two-person carpools to use the facility.

Persons Accommodated: 1650 daily passengers on 52 buses, and approximately 2600 persons in 1250 automobiles in the p.m. peak hour, including 22% violators. Prior to lowering the permissible carpool size to two persons, ridership peaked at approximately 1700 persons in 700 automobiles. Almost half of the automobiles were violators.

Observations: The "Orange Streaker" bus service has been well received and has significantly increased transit service in the project corridor. There has been a relatively high number of violators and need is seen for new enforcement techniques. Several major accidents have occurred on the reserved lanes during off-peak period operation.

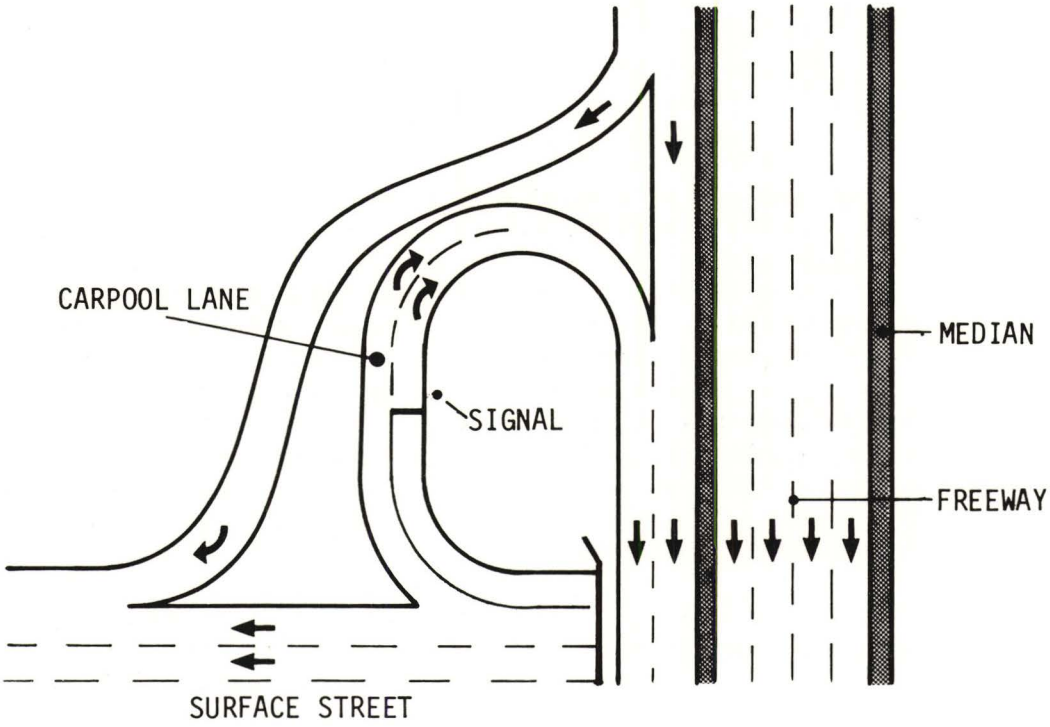

Figure 4. Ramp bypass concept, Los Angeles.

Figure 5. Bus and carpool bypass lane, Los Angeles.

(photo courtesy of Bob Goodell, California Dept. Transportation)

Summary of Project Status
Freeway Ramp Bypasses
Los Angeles, California

Project Description: Buses and two or more person carpools are given preferential bypass treatment at metered freeway on-ramps. Eligible vehicles may bypass single occupant vehicles being metered on freeway entrance ramps. Initially, 13 ramps were equipped with the bypass feature. At present, 24 such ramps are operating in either the a.m. or p.m. peak period, and there are plans to open additional ramps.

Project Location: Twenty-four metered on-ramps on freeways in the Los Angeles area.

Project Started: June 1973.

Project Events: Minor operating problems occurred upon opening, but were ironed out with the elimination of ramp signals for the carpool lane. The initial 13-ramp phase of the project resulted in a large increase in carpools on the ramps (sometimes doubling and tripling). This increase is partially due to the shifting of some carpools from surface streets or from ramps with no bypass lanes to the ramps with the free entry. The opening of the 11 additional ramps has produced less of an increase. A full evaluation of the 24-ramp system is currently underway.

Persons Accommodated: In the initial 13-ramp stage there was an average 50% increase in the number of carpools using the bypass ramps since the bypasses were installed. There were an average of 1850 carpools and 105 buses using the bypasses in the a.m. peak period, carrying 4270 and 4200 persons respectively. The average vehicle occupancy at these bypass ramps has increased from 1.24 to 1.33. There have been few operational problems but occasional enforcement problems. Enforcement has been found to be more of a problem with the additional ramps to patrol. The bypass lanes result in an average of 1-3 minutes of time saved.

Observations: Although there have been significant increases in carpool usage of the on-ramps, much of the increase may be due to a shift in route of existing carpools rather than the formation of new carpools. Providing too many ramp bypasses may make regular enforcement difficult. Ramps should provide an area, normally on the shoulder, for observing and apprehending violators. It is usually better to use the left lane as the bypass lane so that queues of regular traffic will not block the bypass lane entrance.

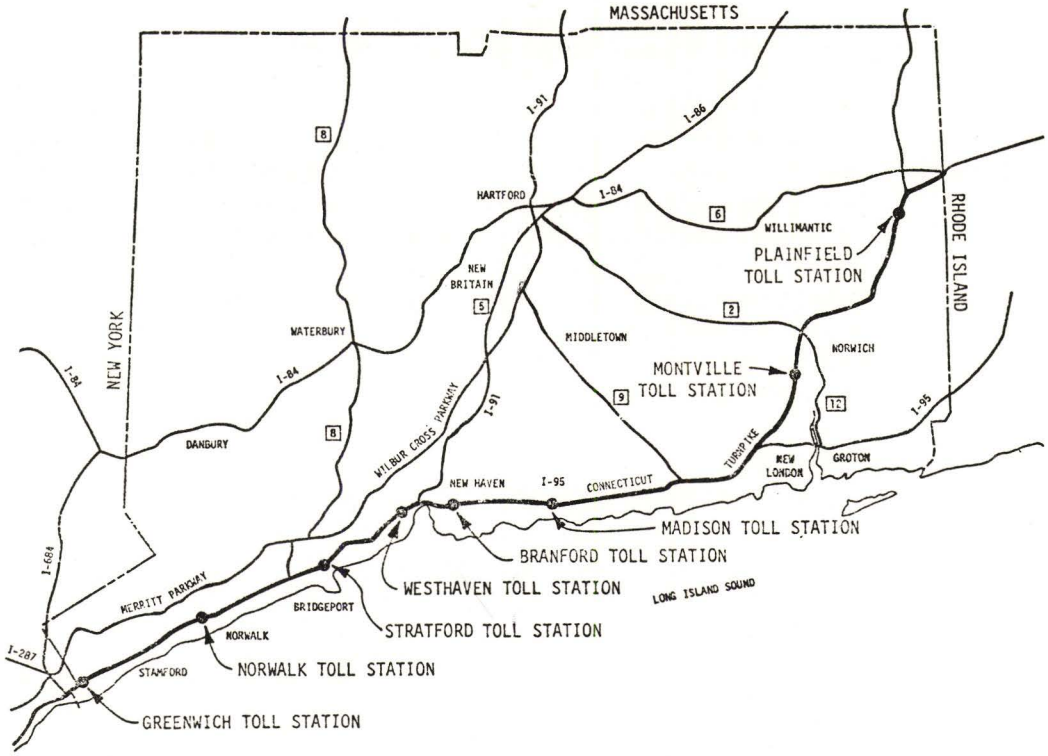

Figure 6. Location of Connecticut Turnpike.

Figure 7. Toll station, Connecticut Turnpike.

Summary of Project Status
Connecticut Turnpike

Project Description: Commutation tickets on the Connecticut Turnpike were reduced from $3,50 to $1,00 for a book of 42 tickets for three person carpools. Use is limited to a series of three consecutive toll (barrier) stations over a 60 day period. At the same time the regular $3.50 commutation ticket was also expanded from permitted use at only one toll booth over a 30-day period to use at a series of three consecutive toll stations over a 60 day period.

Project Location: Along the entire 129 miles of the Turnpike but valid for only three consecutive toll stations out of the total of eight.

Project Started: March 1974.

Project Events: A survey of carpool ticket users conducted by ConnDOT in January, 1975, showed that nearly half of the 925 daily carpools were formed and using the Turnpike prior to the toll reduction. A second survey was conducted in November, 1976, showing that in comparison to first year sales, carpool ticket sales have increased by approximately 18 percent. However, as a result of the 37 percent growth in regular commuter tickets over the same time span, carpool ticket sales represent only approximately 2.5 percent of total ticket sales. The number of carpools utilizing the program has increased to approximately 1100. The average one-way carpool trip length is 30 miles, passing through an average of 1.5 toll stations, Over 96 percent of the carpool trips are for the purposes of work or school. Approximately 36 percent of the survey respondents indicated that they were carpooling prior to the revised toll plan.

Persons Accommodated: Approximately 5000 per day or 110,000 per month.

Observations: There has not been a major shift to carpools because the monetary savings on a per capita basis are not large enough to attract a significant number from single occupant vehicles. The revised toll plan has encouraged the use of regular commuter tickets.

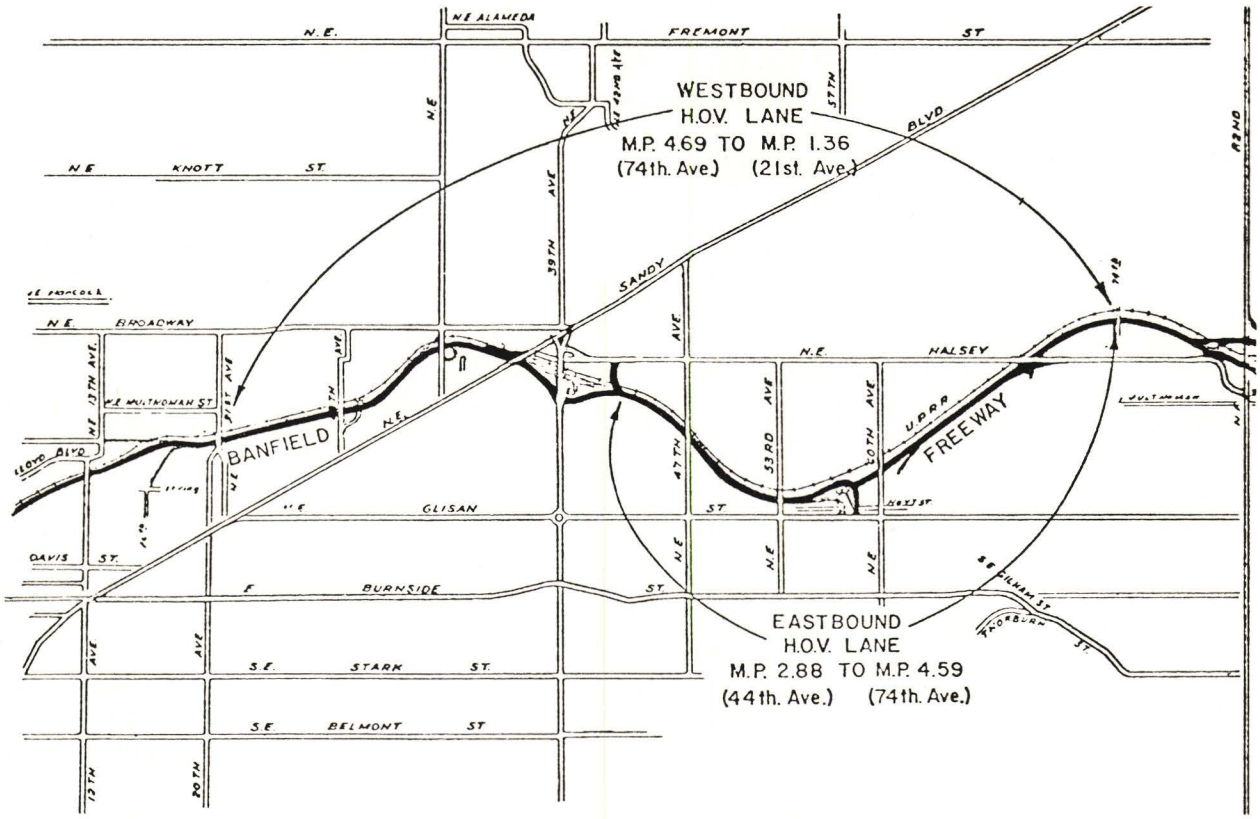

Figure 8. Location of high occupancy vehicle lanes, Banfield Freeway.

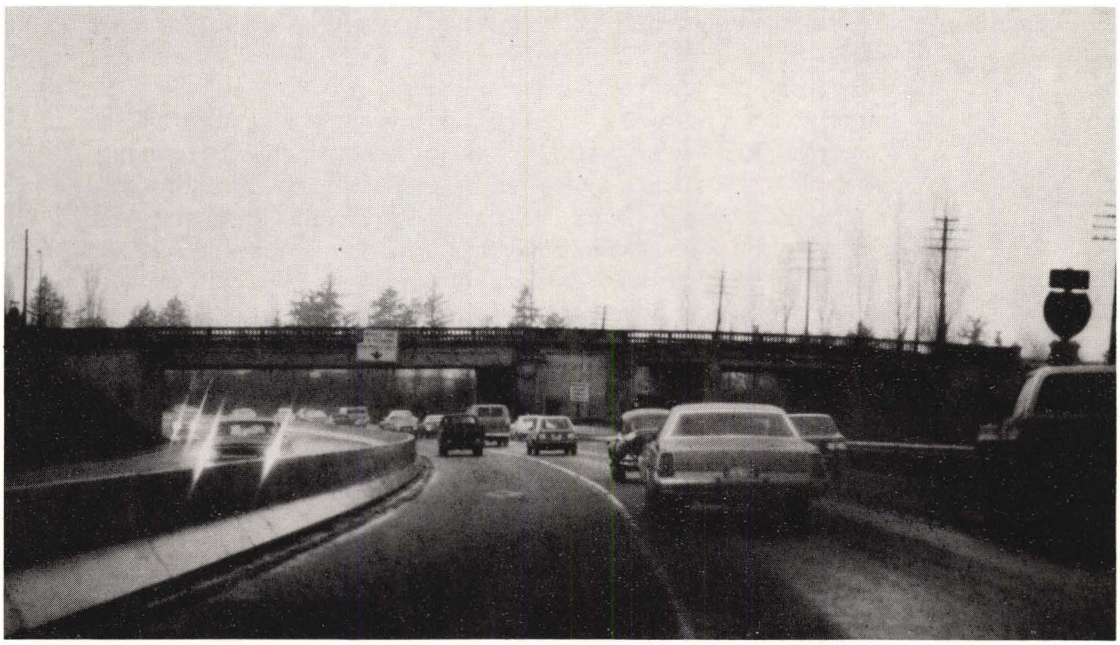

Figure 9. HOV lane, Banfield Freeway.

Summary of Project Status
Banfield Freeway
Portland, Oregon

Project Description:	A four and six lane divided freeway was resurfaced to remove the shoulder and add a median with-flow HOV lane. A Jersey barrier was used as a median and the lanes narrowed to 11 feet with the exception of the 12 foot median lanes. The facility is restricted to buses and three or more person carpools 6:30 to 9:30 a.m. westbound and 3:30 to 6:30 p.m. eastbound.
Project Location:	On the east side of Portland in the east-west corridor leading toward the downtown area.
Project Started:	December 15, 1975, originally restricted to HOV's 24 hours per day. The restrictions were changed to 6:00 to 10:00 a.m. westbound and 3:00 to 7:00 p.m. eastbound in April, 1976 and to the current status on Oct. 11, 1976.
Project Events:	Prior to opening the HOV lanes, the Banfield was carrying 100,000 vehicles during a 24-hour period, with an average vehicle occupancy of 1.26. Single or two occupant vehicles accounted for over 98% of all peak hour traffic. An extensive promotional effort was carried out prior to opening the HOV lanes. The lanes currently carry 20% of the persons using the Banfield Freeway in 6% of the vehicles. The initial violation rates of 30% or more have decreased to less than 20 percent following saturation enforcement by police. Carpool usage nearly tripled immediately after opening but has remained fairly stable since that time. Bus ridership is increasing steadily, having more than doubled within one year after the opening of the HOV lanes. Speeds in the HOV lane have averaged between 3 and 13 miles per hour faster than normal traffic. Continued publicity and a carpool forming program are underway in an effort to increase HOV lane usage.
Persons Accommodated:	Average a.m. peak hour usage westbound is 16 buses and 140 autos, carrying a total of 925 occupants. Average p.m. usage eastbound is 17 buses and 262 autos carrying 1325 persons.
Observations:	Although an improvement in peak hour speeds has occurred since the initiation of the HOV lane project, average auto occupancy has increased only 2%. The HOV lane will need to show continued increase in usage if the project is to be judged successful in encouraging the use of high occupancy vehicles.

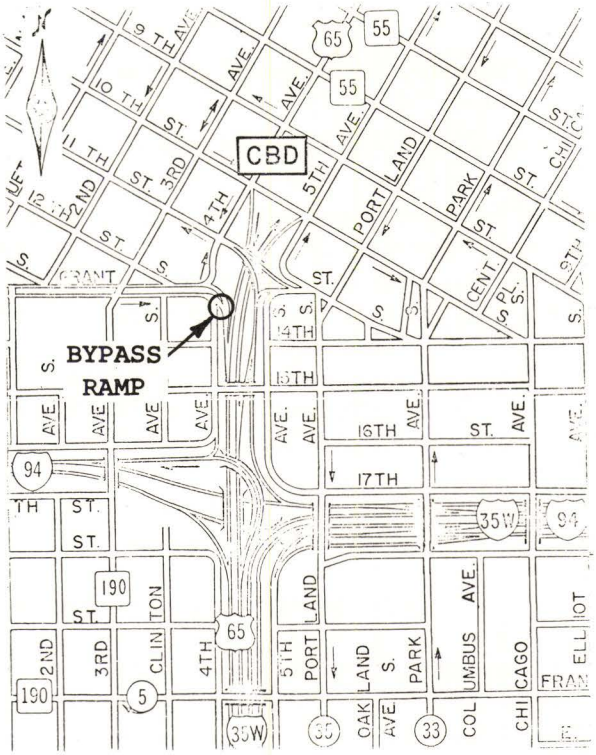

Figure 10. Location of Grant Street bypass ramp.

Figure 11. Grant Street ramp.

Summary of Project Status
Grant Street Carpool Ramp
Minneapolis, Minnesota

Project Description:	The I-35 Urban Corridor Demonstration project established nine bypass ramps for buses. The Grant Street project permits carpools of three or more people to share the use of the bypass ramp in downtown Minneapolis.
Project Location:	The Grant Street ramp in downtown Minneapolis which serves much of the CBD. Its use is limited to the evening rush peak period outbound from the CBD.
Project Started:	November 18, 1975.
Project Events:	An average of 70 carpools in the 3-hour evening peak period were handled during one week of data collection 6 months after the ramp was opened to carpools. This is slightly higher than the 55 on opening day but lower than mid-winter high of 79. Usage has been below that hoped for. Violation rates have been as high as 15-20% and as low as 6-10% depending upon the level of enforcement. There are no operational problems. The travel time savings for those who can most conveniently use the ramp is less than two minutes. The delays at other metered ramps are very minor. A questionnaire was distributed to users, with the results indicating only limited potential for increasing average auto occupancy on I-35.
Persons Accommodated:	Average occupancy of carpools is 3.6 persons serving approximately 240 persons per peak period.
Observations:	The project is operationally sound. However, the limited travel time savings has resulted in a negligible modal shift to high occupancy vehicles.

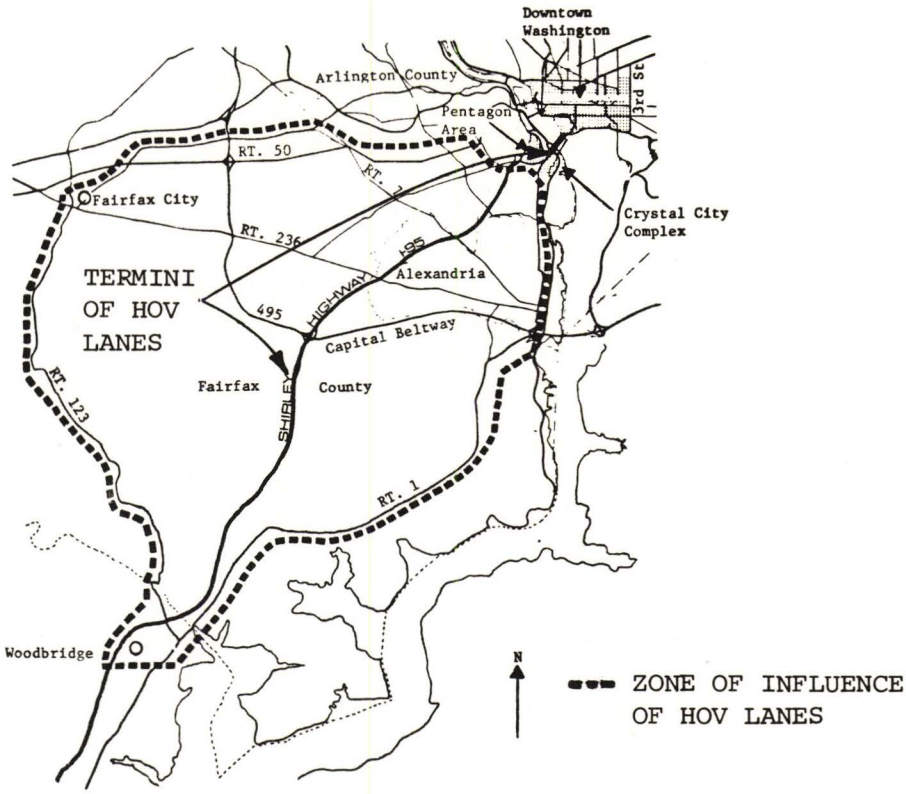

Figure 12. Location of Shirley Highway HOV lanes.

Figure 13. Shirley Highway HOV lanes and ramp.

Summary of Project Status
Shirley Highway (I-95)
Northern Virginia

Project Description:	Buses and four or more person carpools are allowed the exclusive use of a physically separated two lane reversible section in the median of I-95. The Shirley Highway is a major commuter route which serves the Northern Virginia and Washington, D.C. area. The buses and carpools enter and exit on exclusive ramps.
Project Location:	The facility extends from the Springfield area of Northern Virginia to the Washington, D.C. side of the Potomac River via the 14th Street Bridge, a distance of 12 miles.
Project Started:	Initial bus-only operation on a part of the exclusive lanes began in September 1969. Carpools were allowed partial use in December 1973. Additional access points were opened to carpools in October, 1975 and February, May and October, 1976.
Project Events:	Project works quite satisfactorily. The physically separate system makes enforcement straightforward. Violation rates are less than 3 percent. Opening of the additional access has greatly increased use by carpools, and the growth in the number of carpools is continuing. There is a growing concern that the capacity of the two lanes may be exceeded in the near future. The decision was made not to allow three person carpools because of capacity considerations. Time savings of between 15 and 20 minutes are realized over the length of the project.
Persons Accommodated:	During the a.m. peak period (6:00 a.m. to 9:30 a.m.) 2900 carpools and 450 buses carry 13,000 and 18,000 persons respectively. Approximately 65% of the use (or 20,000 persons) occurs in a single hour.
Observations:	The project has been very successful, producing a significant shift in modal split favoring high occupancy vehicles. The single facility serves a wide area which results in considerable circuity for some carpoolers. Evidence exists of need for a system of high type preferential facilities in the region.

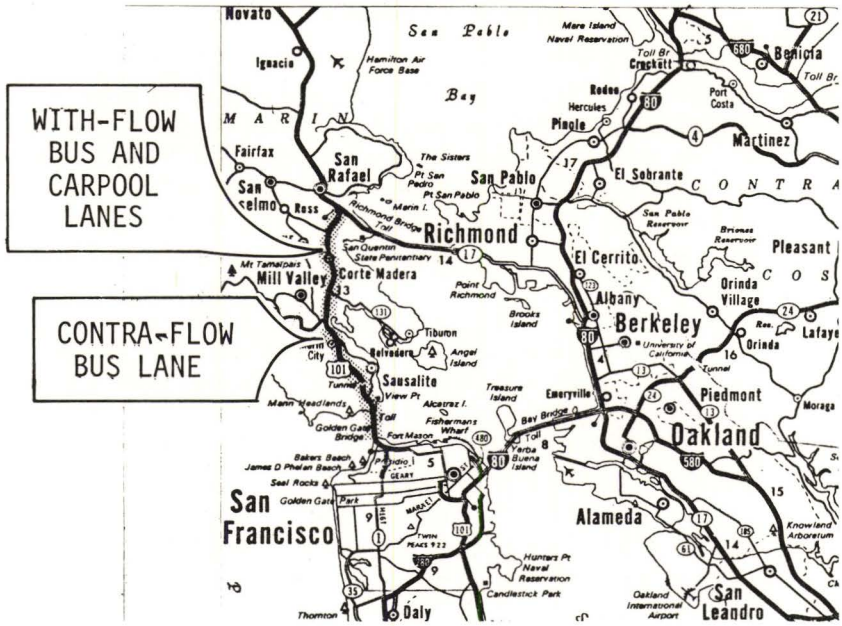

Figure 14. Location of HOV lanes, U.S. 101, Marin County, California.

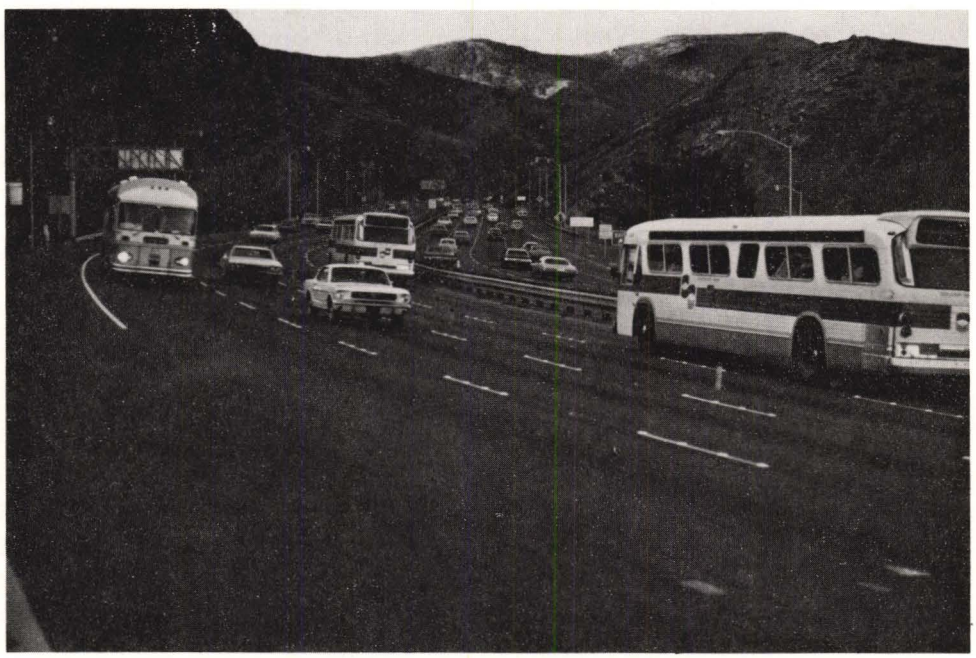

Figure 15. Contra-flow bus lane, U.S. 101, Marin County.

Summary of Project Status
U.S. 101
Marin County, California

Project Description:	Contra-flow bus lane in one direction, and with-flow bus and carpool lanes in both directions, in two separate segments on an eight lane divided facility. The contra-flow bus lane operates during afternoon peak periods and use is limited to buses with a permit. The with-flow lanes are used for buses and three or more person carpools southbound between 6 a.m. and 9 a.m., and northbound between 4 p.m. and 7 p.m.
Project Location:	The contra-flow lane is a 4 mile long facility from just north of the Golden Gate Bridge to just south of the Richardson Bay Bridge. The with-flow lane continues from the Richardson Bay Bridge to Sir Francis Drake Boulevard, a distance of 3.8 miles.
Project Started:	Contra-flow, September, 1972. With-flow (bus only), December, 1974. With-flow (buses and carpools), June, 1976.
Project Events:	Buses on the contra-flow lane save relatively little time when compared to autos, but are unaffected by congestion caused by incidents in the auto lanes. There has been little problem with enforcement on this lane. Pressure to open the with-flow bus-only lane to carpools came during the transit strike of Spring, 1976, after which carpools were allowed to remain on the lane. A no-fare policy for the carpools on the Golden Gate Bridge was also instituted as a further incentive for carpools. On the bus and carpool lane there is a 2-5 minute time savings, and reliability of travel time is also improved. Violation rates range between 10 and 20 percent.
Persons Accommodated:	The number of carpools on U.S. 101 rose sharply immediately after opening due to the transit strike. Following the strike, the number of legitimate carpools dropped down to the current levels of slightly over 400 for each peak period. There are approximately 150 buses on the facility during each peak period.
Observations:	Both the contra-flow and bus/carpool lanes operate very well. Carpool use in the corridor has increased, but part of this increase is likely due to factors other than the institution of the carpool lane such as the bus strike and the no-fare policy for carpools at the Golden Gate Bridge. Travel time savings are minimal.

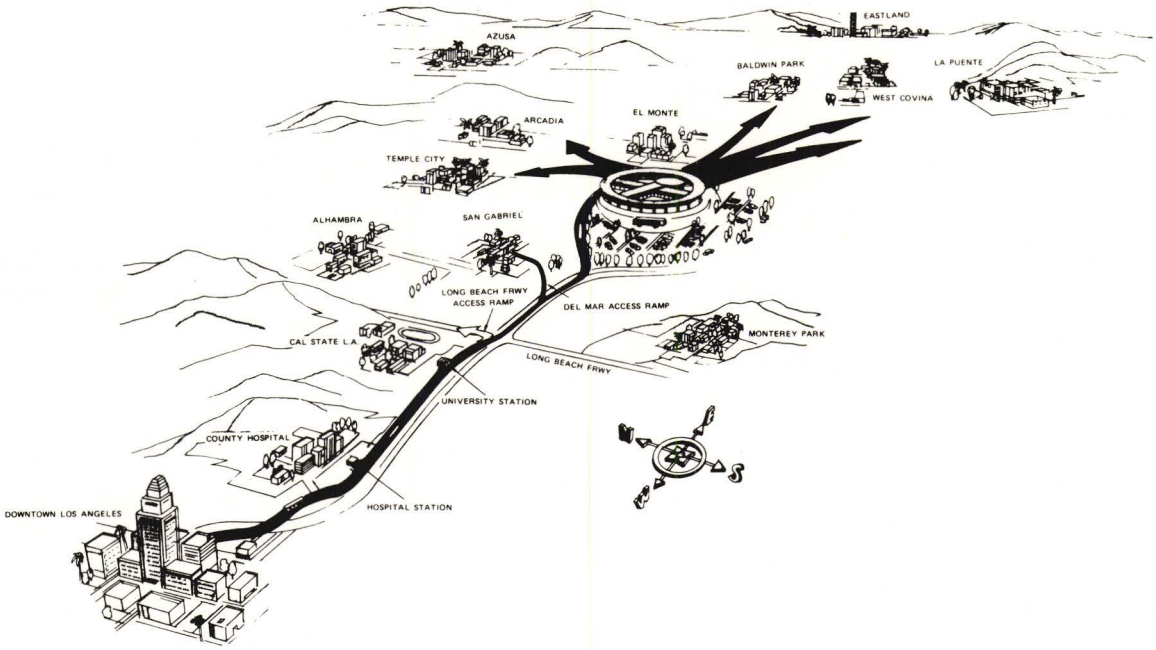

Figure 16. Express Lanes, San Bernardino Freeway, Los Angeles, California.

Figure 17. Express Lane, San Bernardino Freeway, Los Angeles California.

Summary of Project Status
San Bernardino Freeway Express Lanes
Los Angeles, California

Project Description: The express lane facility is a two-lane exclusive roadway in the center and along side of the freeway, one lane in each direction. It is complete with three off-line stations with 1400 parking spaces at El Monte. The section from El Monte to the Long Beach Freeway was opened to three or more person carpools in October, 1976.

Project Location: San Bernardino Freeway, between El Monte and Los Angeles.

Project: January 1973; full length opened to buses only in January 1974.

Project Events: There was sparse usage on the first phase, as few new transit passengers were attracted. Ridership increased dramatically after the facility was completed. Beginning in April 1975, two German Neoplan double decker buses with a capacity of 84 seated passengers plus standees were substituted for conventional buses on some of the runs. The express lanes have recently been opened, on an experimental basis, to 3 or more person carpools. An evaluation to determine the express lane's future use will be made in 1978. The project results in 10 minutes or more travel time savings over its 11 mile length.

Persons Accommodated: On the first phase of the project, about 4,000 passengers daily rode the express buses, but nearly 50% of these were already utilizing buses. Since the completion of the busway, patronage has grown continually to almost 18,000 daily round trip passengers hitting a peak of 19,000 before the bus strike in Summer, 1976. Surveys have shown that 75 percent of the commuters using it formerly drove automobiles. Use of the facility by carpools has been increasing with traffic counts indicating 760 carpools westbound in the a.m. peak 4-hour period and 850 in the p.m. peak period. Violation rates are between 6 and 8 percent of legitimate carpools.

Observations: The project to date has been successful with few operational problems. With increasing patronage, the express lanes may be converted to a rapid-rail transit line when passenger traffic warrants. Quote from a rapid transit district official: "We are extremely gratified by the enthusiastic response. More and more people are seeing the wisdom of using this form of public transportation."

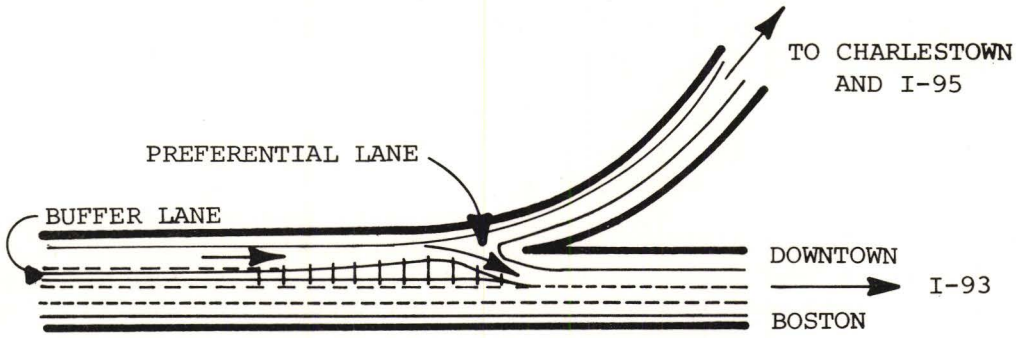

Figure 18. Preferential lane, I-93, Boston Massachusetts.

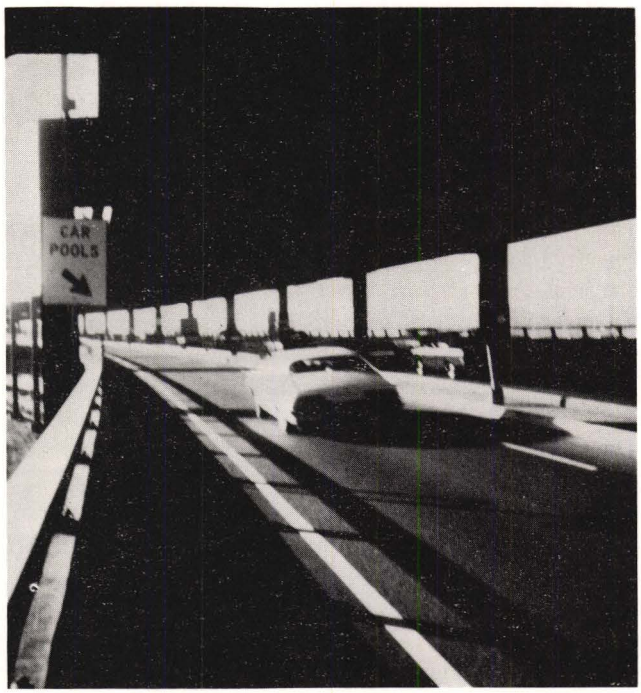

Figure 19. Preferential lane, I-93, Boston.

Summary of Project Status
I-93
Boston, Massachusetts

Project Description:	A preferential lane is located in the far left lane of a four-lane roadway. The lanes are reserved for buses and carpools of three or more persons. There is a buffer lane between the preferential lane and the two regular travel lanes. The intent of the preferential lane is to give head-of-the-line privileges to carpools for downtown Boston during the morning rush hours.
Project Location:	A 3/4 mile section of I-93 southbound in Charlestown, Massachusetts.
Project Started:	Stage 1, a 1925 foot section was opened on February 26, 1974. A second stage later increased the length of the lane to 4212 feet.
Project Events:	The facility operates weekdays between 6:30 to 9:30 a.m. and saves 4-10 minutes in travel time. Auto occupancy has increased from 1.35 to 1.44 and there has been an estimated reduction of 500 vehicles per day between 7 a.m. and 9 a.m. because of carpools. Enforcement consists of stationing a police officer in the gore area of the I-95 direct connector. Violators are directed to the I-95 connector to Charlestown, which increases travel time to the CBD as much as 20 minutes. Violation rates are very low. The safety record of the facility has been excellent.
Persons Accommodated:	An average of 32 buses and in excess of 500 carpools per day, carrying a total of 2620 passengers.
Observations:	The preferential lane operates very successfully and creates a significant incentive for high occupancy vehicle use. The enforcement method is effective in discouraging violations.

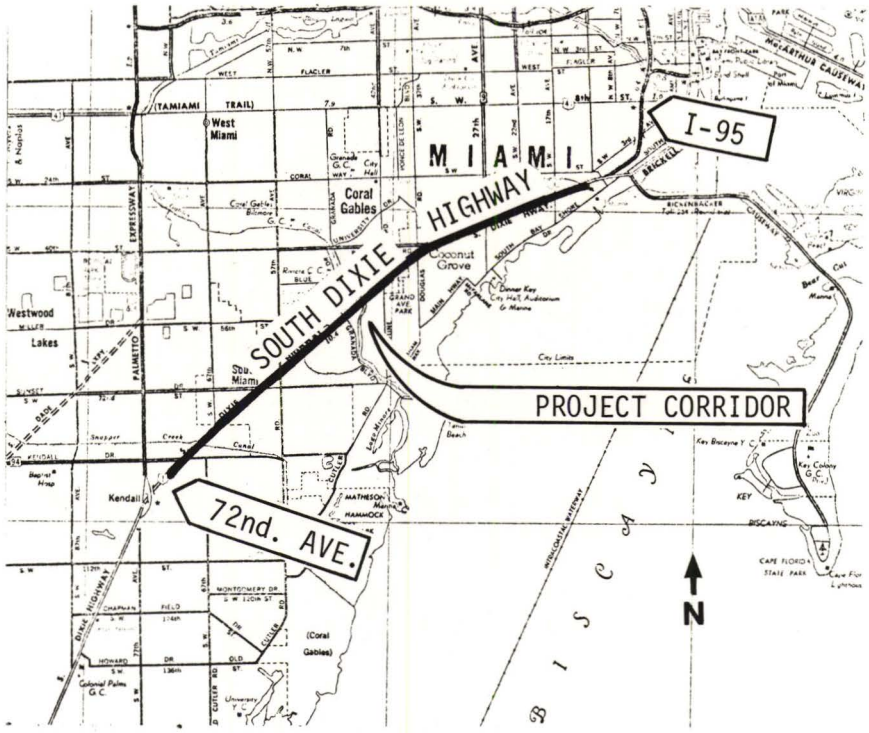

Figure 20. Location of HOV lane, U.S. 1/South Dixie Highway, Miami, Florida.

Figure 21. South Dixie Highway HOV lane.

Summary of Project Status
U.S. 1/South Dixie Highway
Miami, Florida

Project Description:	The project consists of a median with-flow bus and carpool lane, and traffic signal improvements on a 5.5 mile segment of South Dixie Highway, a six lane arterial. Initially, buses were carried on a contra-flow lane, but this was dropped in favor of joint use of the median lane with carpools of two or more persons. The project operates from 7 to 9 a.m. and 4 to 6 p.m. on weekdays.
Project Location:	South Dixie Highway between S.W. 72nd Avenue in South Miami to the entrance to I-95 south of the Miami central business district.
Project Started:	July 22, 1974. Contra-flow lane dropped April 1, 1976.
Project Events:	The project began operation in 1974, operating from 6 to 9 a.m. and 4 to 7 p.m. Operation was changed to the current hours on April 21, 1975. Express buses, designated as the "Blue Dash" utilize the reserved lane and carry about 7,100 passengers per day. Since the implementation of the project, the highway now carries 2,400 more persons in 345 fewer autos than prior to the beginning of the project. The auto occupancy rate has risen from 1.38 to 1.60. Bus and carpool travel time has decreased 5-10 minutes.
Persons Accommodated:	Average daily bus ridership has stabilized at about 2100 per day on 61 buses, representing a 100% increase in ridership. The bus and carpool lane carries about 40% of all persons on the highway during the peak hour. This represents approximately 1200 autos, carrying 2600 passengers during the peak hour.
Observations:	The project is considered successful and has resulted in increased vehicle occupancy, decreased travel time, increased speeds, a significant increase in corridor transit usage, and a reduction in the total number of vehicles using the facility. The cost of manually placing cones for the contra-flow bus lane was not felt to be cost-effective resulting in that portion of the project being terminated.

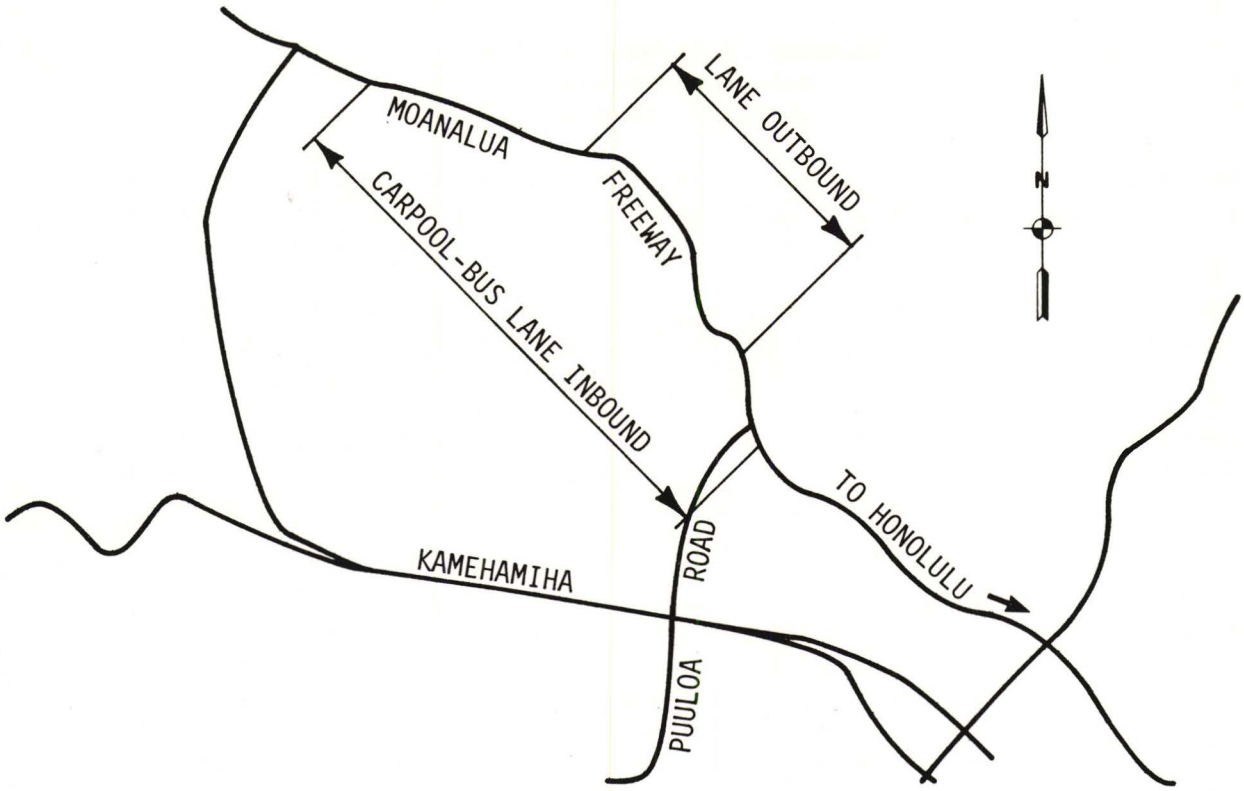

Figure 22. Location of Moanalua Freeway Carpool/Bus Lane.

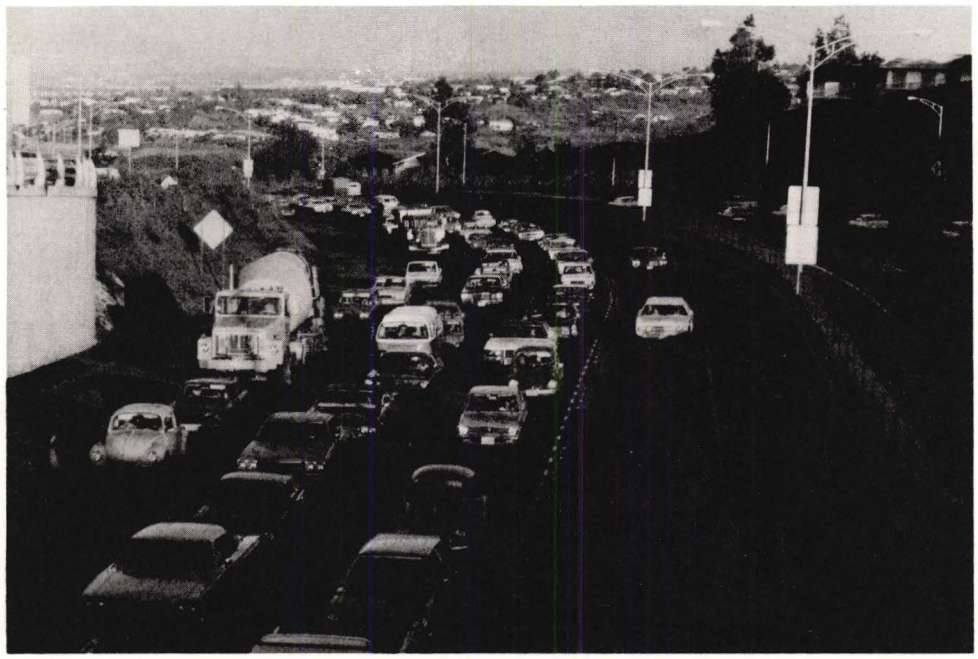

Figure 23. Carpool and bus lane, Moanalua Freeway.

Summary of Project Status
Moanalua Freeway
Honolulu, Hawaii

Project Description:	The median lane in each direction is reserved for buses and three person carpools. The lanes are in operation 24 hours a day, and operate as a with-flow facility.
Project Location:	Reserved lanes are on a 2.7 mile inbound and 1.4 mile outbound portion of Moanalua Freeway, from north of Honolulu toward the central business district.
Project Started:	October 1974. The reserved lanes were originally constructed as new lanes for general use but were designated as preferential lanes on an experimental basis when construction was completed.
Project Events:	The project was begun by permitting 4 or more person carpools and buses to use the reserved lanes, but was later modified to allow three or more person carpools and buses. A dotted white line is used to separate the reserved lane from the regular lanes, and the lanes are marked as well. As much as 10 minutes in travel time is saved along the inbound section.
Persons Accommodated:	During the morning peak two-hour period, approximately 1500 carpools use the reserved lanes, carrying a total of about 5100 persons. Initial carpool use during the a.m. period was 530 vehicles, indicating a significant increase in carpool usage since the opening of the facility. Travel time savings vary substantially, ranging up to 5 minutes. Typical peak period bus usage of the preferential lanes is six buses with approximately 300 passengers. Violations have been reduced to the 10% level.
Observations:	There are few operational problems, and the project works quite well. Violation rates appear tolerable and there is generally public acceptance of the project perhaps because the lanes were never in general use. Over half of legitimate carpools include school children being driven to public or private schools.

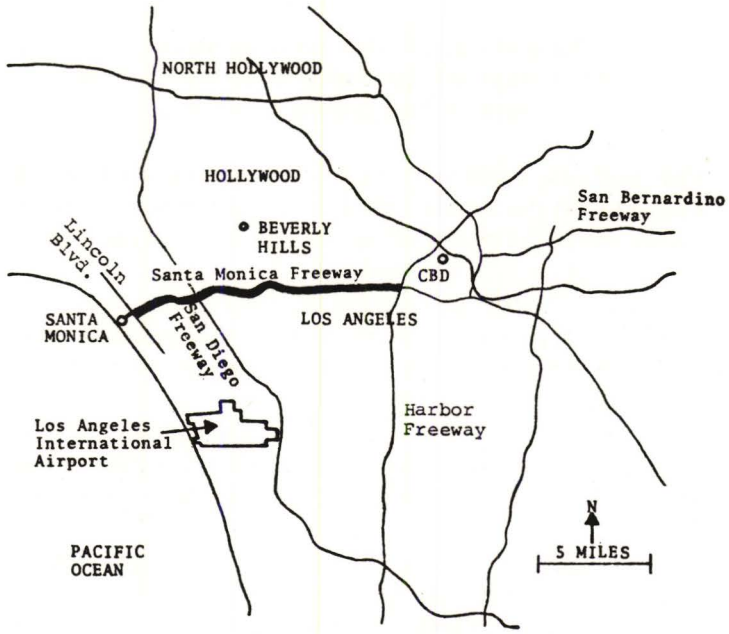

Figure 24. Location,Santa Monica Freeway, Los Angeles, California.

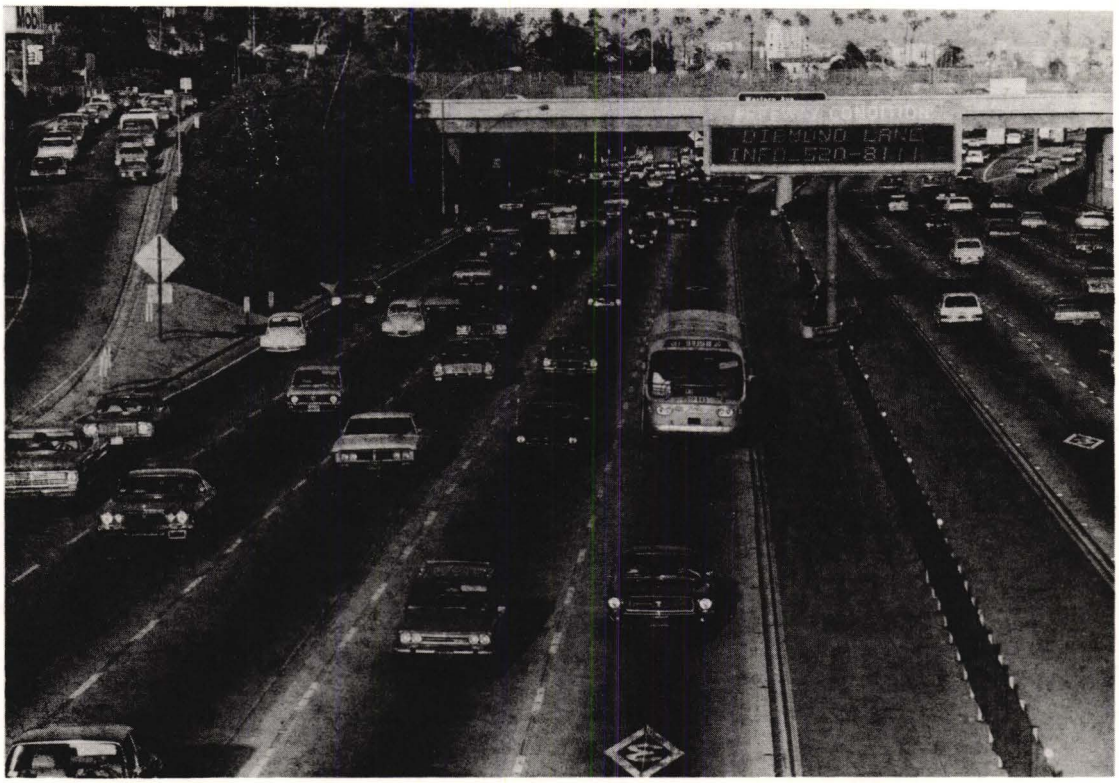

Figure 25. Santa Monica Freeway Diamond Lane.

Summary of Project Status
Santa Monica Freeway Diamond Lanes
Los Angeles, California

Project Description:	The median lanes in both directions of a 10 lane divided freeway were reserved for buses and 3-person carpools between the hours of 6:30 to 9:30 a.m. and 3 to 7 p.m., Mondays through Fridays.
Project Location:	A 12.6 mile section of the Santa Monica Freeway between Lincoln Boulevard in Santa Monica and the Harbor Freeway in Los Angeles, California.
Project Started:	March 15, 1976. Was terminated by court order on August 9, 1976, pending further environmental review.
Project Events:	During the first day of operation, extreme congestion and a large number of accidents occurred. The situation improved significantly the second day and thereafter, but the accident rate for the 21 weeks of the project was approximately three times the 1975 average. By the end of its life, the project had shown high potential for increasing the use of high occupancy vehicles. The number of carpools increased to 2½ times pre-project levels, bus ridership more than tripled, and 3 percent more people were traveling on the Freeway in 7 percent fewer vehicles. By the eleventh week after the project was terminated, vehicle occupancy rates for the freeway had dropped to 1.27 from a project high of 1.36. Carpools saved approximately four minutes for the complete trip. Violations were in the 10-20% range and higher near the beginning and end of the peak period.
Persons Accommodated:	The highest volumes were achieved in the 15th week of the project, in which over 4200 persons rode the buses daily compared to pre-project levels of 1300 and 3150 three months after the project's termination. The Diamond Lane accommodated a peak of nearly 4400 carpools during the seven hour peak period as compared to approximately 2000 on the Santa Monica Freeway before the project. The major increases in carpool and bus usage occurred during the first month of operation, and gradually increased thereafter. Usage was highly peaked within the peak period.
Observations:	From its outset the project created heated controversy. Although the potential for increasing high occupancy vehicle use has been demonstrated, there have been significant safety and enforcement problems associated with the project.

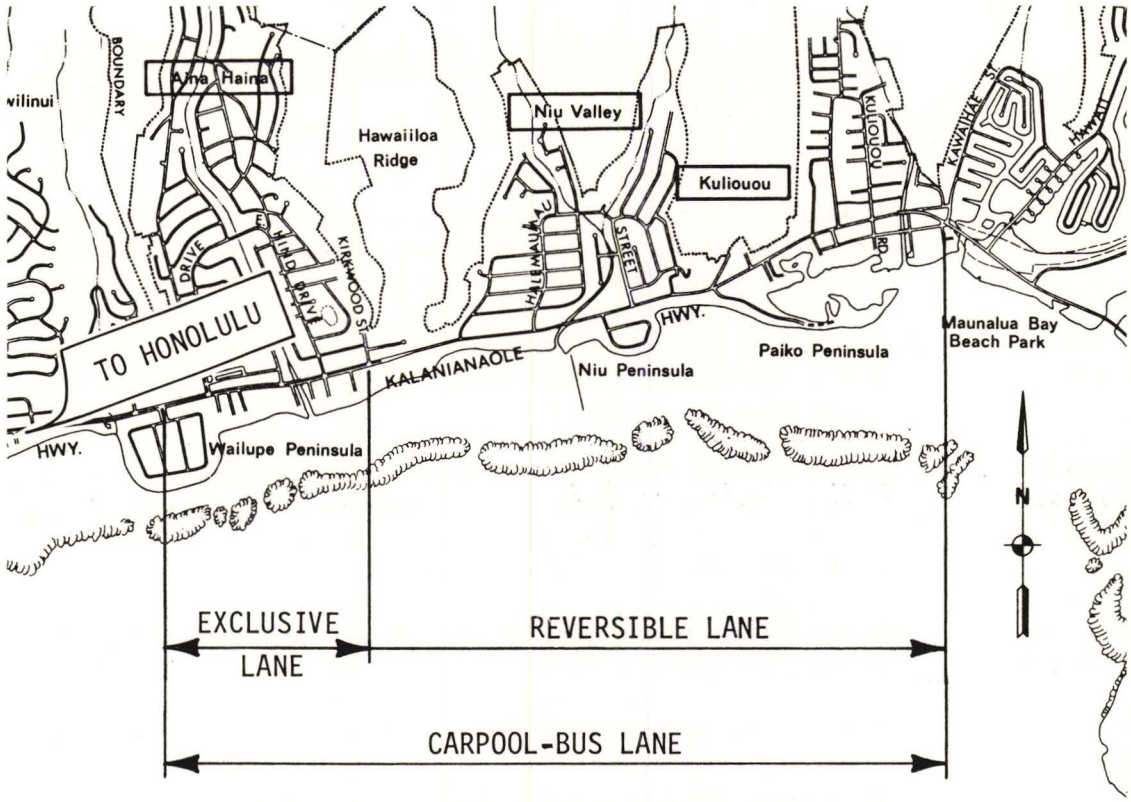

Figure 26. Location of Kalanianaole Highway carpool/bus lane.

Figure 27. Carpool and bus lane, Kalanianaole Highway.

Summary of Project Status
Kalanianaole Highway
Honolulu, Hawaii

Project Description:	The project operates as a reversible exclusive lane for buses and 3-person carpools on a 4-lane undivided street for 2.0 miles and on a 6-lane divided arterial for an additional one-half mile. The facility operates only from 6:00 to 8:00 a.m. with 2 or 3 regular inbound lanes, the reversible inbound reserved lane, and one or two regular lanes outbound.
Project Location:	Kalanianaole Highway from the Hawaii Kai area to Aina Haina, Honolulu, Hawaii, a distance of 2.5 miles. The highway leads to the University of Hawaii and the Honolulu CBD.
Project Started:	Lane opened to buses August, 1973. Lane opened to carpools, September, 1975.
Project Events:	The carpool-use phase of the project was initiated on a 30-day trial basis, but has now been extended to permanent status. The reversible lane currently carries approximately 16 buses with a total of 660 passengers and 1200 autos with 3600 passengers during the two hours of operation. The use of the facility immediately after its opening to carpools was approximately 600 autos, indicating a doubling of carpool patronage since that time. Consideration is being given to raising the carpool occupancy from 3 to 4 persons per vehicle if the lane becomes congested and causes delay to the express bus operation. Cones are used to separate the reserved lane from the opposing flow. Travel time savings range between 3 and 5 minutes. Violation rates are low.
Persons Accommodated:	1200 autos and 16 buses carrying 3600 and 660 passengers respectively during the morning peak two-hour period.
Observations:	The project appears successful and is well received by the public. The continuing growth in the number of carpools indicates that this incentive for use of high occupancy vehicles is effective. However, over two-thirds of the legitimate carpools include school children being driven to public or private schools.

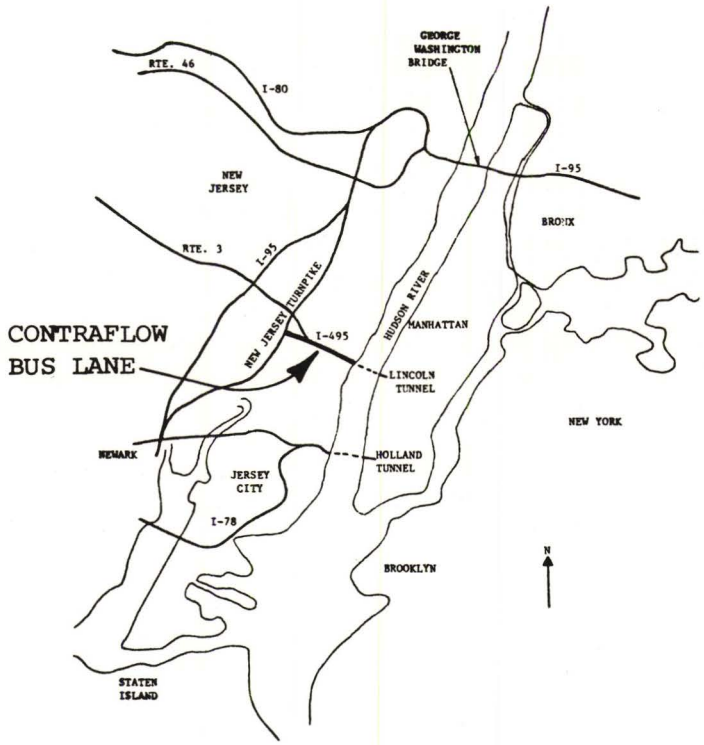

Figure 28. Location of I-495 contra-flow bus lane to New York City.

Figure 29. I-495 contra-flow bus lane to New York City.

Summary of Project Status
I-495/Lincoln Tunnel
New York, New York

Project Description:	The project consists of an inbound contra-flow bus lane operating on a six lane freeway. The lane is separated from the two outbound lanes by the use of cones, and operates during the morning peak period only.
Project Location:	A 2½ mile segment of I-495 between the New Jersey Turnpike and the Lincoln Tunnel going into New York City.
Project Started:	December 1970.
Project Events:	Bus ridership on the I-495 contra-flow lane has not undergone significant change compared with pre-project levels. However, it has been credited with arresting a downward trend in patronage. Bus ridership has been maintained at approximately the level of 40,000 persons in the three-hour peak period, with occasional fluctuations. The lane has significantly increased inbound vehicle capacity, as the inbound vehicle flow in the peak period has increased 40%. During the initial six-month period, auto occupancy decreased from 1.6 to 1.54 and the use of the Lincoln Tunnel park-and-ride lot increased 10%. Bus time on I-495 has been reduced by an average of 44% and the time all vehicles spent on I-495 decreased by 23%. The contra-flow lane operates smoothly and ties in with other preferential treatment strategies at the Lincoln Tunnel.
Persons Accommodated:	Approximately 960 buses carrying 40,400 passengers in the peak period. During the peak hour, there are approximately 450 buses with 22,000 passengers.
Observations:	Although the contra-flow lane has not produced a significant diversion of trips to transit, it has substantially improved capacity and travel times into New York City for both buses and autos. It is operationally sound and has proven extremely valuable in situations of unusually high demand, such as the 1971 rail strike.

PROJECT 2D DURING THE COMING YEARS

During the coming years, a number of new evaluation studies will be initiated. Current projects will continue to be monitored and the results will be transmitted to the FHWA operating offices as they become available. Several related studies are being initiated in other projects as well. These studies are: (1) Safety Evaluation of Priority Techniques for High Occupancy Vehicles from Project 1A, and (2) Signing and Delineation for Special Use Lanes from Project 2K. A special study on Enforcement Requirements for High Occupancy Vehicle Facilities is also funded from Project 2D.

Several additional projects are proposed to be evaluated in the near future. These include:

- Brooklyn - Queens Expressway, New York
- Arlington and Wilson Blvds., Arlington, Virginia
- Northeast Highway, Oklahoma City
- Bus lanes, Chicago CBD
- Bus stop preempt, Minneapolis and Washington, D.C.
- Carpool lanes, Denver, Colorado
- Bus priority, Santa Cruz, California
- Carpool pricing incentives, Port Authority, N.Y. - N. J.
- CBD Parking, San Francisco, California
- Several other projects will be monitored

Emphasis during the next few years will also shift from freeway type projects to projects on urban arterial and city streets. In addition, greater attention will be given to the functioning of systems of preferential treatment rather than individual projects. During 1978 it is expected that a Handbook of Priority Treatment will be developed aimed at providing guidance to the transportation engineer who bears the responsibility for operating the urban transportation system.