South Dixie Highway Contraflow Bus and Car-Pool Lane Demonstration Project

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This paper describes a series of improvements planned and implemented by the Florida Department of Transportation and Metropolitan Dade County, Florida, to increase the peak-hour people moving capacity of an 8.8-km (5.5-miles) section of US-1 (South Dixie Highway) that links the suburbs of South Dade County with the Miami central business district. One of the improvements, the contraflow bus lane, improved travel times for transit riders by 10 to 16 min and induced over 1700 more riders per day to use transit. The car-pool lane, another part of the project, improved travel times for the nearly 900 car poolers per day by 6 to 8 min. These results and other effects of the project such as automobile occupancy, traffic volume changes, enforcement, and safety are discussed. A profile of the transit user is presented, and car-pool and general lane riders compared.

Much attention has recently been given to the possibility of increasing the use of public transportation by the development of preferential lanes in and around urban areas. Similar attention has been given to the increased efficiency of the automobile when preferential treatment is given to the regular car pooler. A combination of these two approaches, the South Dixie Highway Transportation Demonstration Project, has been in operation in Dade County, Florida, since July 1974. The project was sponsored jointly by the Florida Department of Transportation and Metropolitan Dade County for the first year, after which the county assumed all financial and operational responsibilities.

The project was planned and executed by the Mass Transit Division of the Florida Department of Transportation, the Metropolitan Dade County Office of Transportation Administration, the Dade County Metropolitan Transit Agency, the Dade County Department of Traffic and Transportation, the Dade County Public Works Department, the police departments of Dade County, and the municipalities of South Miami, Coral Gables, and Miami. These agencies met for approximately 6 months and negotiated an interlocal agreement between the state and the county. The funding formula called for a 50 percent contribution by the state with the operating costs to be spent on a sliding scale over the four quarters of the demonstration. This ad hoc committee continued to meet throughout the life of the demonstration phase constantly reviewing project data and operational problems.

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DESCRIPTION OF THE PROJECT

The contraflow bus and car-pool lanes extend 8.8 km (5.5 miles) from Sunset Drive in South Miami to just south of I-95 (Figure 1). The signalization improvements extend farther to the south. The project is in effect from 7 to 9 a.m. and 4 to 6 p.m. on weekdays, excluding holidays. Left turns are prohibited from the highway during these hours; cross-highway movements are made possible through a series of ground loops marked by signs.

The transit element of the project uses the inside, off-peak lane as a bus-only contraflow lane in the peak direction. During the morning peak, the median lane (inside lane) in the outbound direction is separated from the normal flow by removable safety posts and used by Metropolitan Transit Agency (MTA) buses proceeding in the inbound direction (Figure 2). The procedure is reversed in the afternoon. Notice of these lane configuration changes is provided by overhead variable message signs displaying MTA BUS ONLY in the bus direction and LANE CLOSED in the normal traffic direction.

At the beginning of the project, the MTA developed five new routes and expanded an existing one to make a total of 42 runs each in the morning and afternoon (5). This was later reduced to 31 morning and 30 afternoon routes as ridership patterns changed and the project hours were shortened (the original project hours were 6 to 9 a.m. and 4 to 7 p.m.). The buses are known as Blue Dash and have a logo designed specifically for them. A number of park-and-ride locations, primarily in shopping center parking lots, have been designated. One lot, located near Dadeland (a regional shopping center) and convenient to numerous suburban developments, was specifically constructed for the project. This lot is filled to its 200-car capacity nearly every day. Amenities such as shelters and schedule information are provided at all major locations and most walk-up bus stops along the Blue Dash route. The one-way fare is 50 or 60 cents depending on the loading point. An extensive feeder system provides convenient localized pickup points in the market area. From

this area the buses all pass through the Dadeland park-and-ride lot before entering the contraflow lane.

The unsignalized median cuts along the corridor are blocked by safety cones to prevent left turns and NO LEFT TURN signs are placed in the left-turn storage bays at signalized intersections. Left turns are permitted onto the highway at signalized intersections, and road striping is designed to keep motorists from entering the buse lane inadvertently. In addition to these precautions, six police officers patrol the project corridor during the peak period. These officers use the blocked left-turn bays to ticket violators and to remove disabled vehicles from the roadway. The buses cross to the right side of the median at S.W. Sixteenth Avenue, where a special traffic signal holds traffic in the peak direction. From there the buses proceed in mixed mode either downtown to the Brickell Avenue office building area or to the Civic Center. In the afternoon the process is reversed, except that the buses enter the contraflow lane via a paved crossover about 0.8 km (0.5 mile) closer to the CBD than Sixteenth Avenue. The entire bus trip requires 9 min (versus about 20 min for single-occupant vehicles).

The car-pool lane uses the inside peak-direction lane for passenger vehicles having two or more occupants. At the outset of the project this lane was separated by yellow safety posts. However, the problems of vehicles attempting to enter or exit the lane as well as maintenance costs forced the elimination of this feature, leaving the lane open but clearly marked by overhead signs. A motorist (with at least one passenger) may enter or exit the lane at any point. The violation rate of the car-pool lane has averaged about 8 percent over the duration of the project, with most of these infractions occurring after dark. The enforcement effort has been focused on maintaining the viability of the lane by apprehending and ticketing violators (4).

In order to further induce the formation of car pools, a car-pool parking lot having a minimal daily charge was established in the CBD. This lot, opened in January 1975, increased in use from 35 to 100 percent daily within 2 months.

The signalization improvements were designed to improve the traffic flow along a 29.8-km (18.5-mile) portion of the highway. Three basic changes were made.

1. The off-set relationships were changed to reference each signal to the green rather than the yellow indication. This improved the green time use by vehicle platoons by providing progression for the beginning of each platoon instead of the end.
2. The cycle length of the signal system was extended from 90 to 114 s, giving extra time to traffic flow along the corridor.
3. Certain multiphase signals were reduced to two phases by eliminating or restricting left turns at some intersections and providing ground loop patterns as alternatives.

These changes have resulted in more efficient movement of highway traffic and had minimal effect on cross-street traffic.

A final element of the project was to build a downtown bus terminal that funnels not only Blue Dash buses but all buses coming into downtown through one facility.

EVALUATION OF THE PROJECT

The evaluation program was based on a predetermined set of criteria established as part of the overall goal of the project. Dade County was responsible for the program and developed the document outlining each task and its expected outputs (2). Numerous surveys were designed to determine the effect of the project on all the users of the highway. Travel times, vehicle counts, accident counts, delay studies, and enforcement studies were made in an effort to measure any operational changes that occurred on the highway as a result of the project.

The six criteria used were project objectives, system usage, service quality, local objectives, national objectives, and operator cost. These criteria were also used to measure, on a coarse level, a number of alternative configurations to determine whether the project as it currently exists is the most efficient, safe, and equitable method to increase the people-moving capacity of the highway.

Effectiveness, in the context of the evaluation, was defined as the degree to which the project increased the people-moving capacity of the highway while providing incentives for the appropriate use of this increased capacity in such a way as to improve the next service quality level provided by the facility. Effectiveness also included the degree to which other beneficial impacts relating to predetermined local and national objectives were achieved. The project's objectives, together with related impacts, were also weighed against cost to determine the cost-effectiveness of the project.

The evaluation continued over 1 year in which various vehicle and occupancy counts were taken. The occupancy counts of the Blue Dash buses were (and still are) conducted on a daily basis. MTA personnel check each bus at the last loading point in the morning and the first loading point in the afternoon. Vehicle and occupancy counts for all other users of the highway were taken on a monthly basis, for durations of 1 week, during 8 of the 12 months of the demonstration. Comparison data had been collected 6 months, 3 months, and 1 month prior to implementation of the project. Mail-back surveys, a telephone survey, and a direct return survey were conducted during the demonstration. A full-scale home interview survey was not conducted because of time and cost limitations. The telephone survey, given to a random sample of business people on and around US-1, contained questions relating to the effect of the project on their business volume. For control purposes the survey was also administered to businesses in other areas.

Only the pertinent data base will be discussed in this report in order to describe the operational and attitudinal performance of the project.

Project Evaluation Data

The initial 1-year evaluation of the project was based on data gathered prior to and following the beginning of the project in July 1974 (1). The post start-up information presented in this paper applies mainly to the first 9 months of project operation.

At the beginning of the project the number of peak-period bus trips in the corridor was increased from 10 to 84, and because of the contraflow lane, transit travel times decreased by 15 to 20 min. These improvements resulted in a corridor transit ridership level, now 2100 and steadily increasing, over five times the level that existed prior to the project. Survey results show that the great majority of these new riders diverted from their automobiles and not from adjacent routes. Service cutbacks in October and February (Figure 3), which were necessary to keep the average load factor at an acceptable level, had little lasting impact on ridership.

The implementation of the car-pool priority lane reduced automobile travel times by 6 to 8 min for users. This time saving, together with the advantage of the car-pool parking lot in downtown Miami, was effective in increas-

Figure 1. Project corridor.

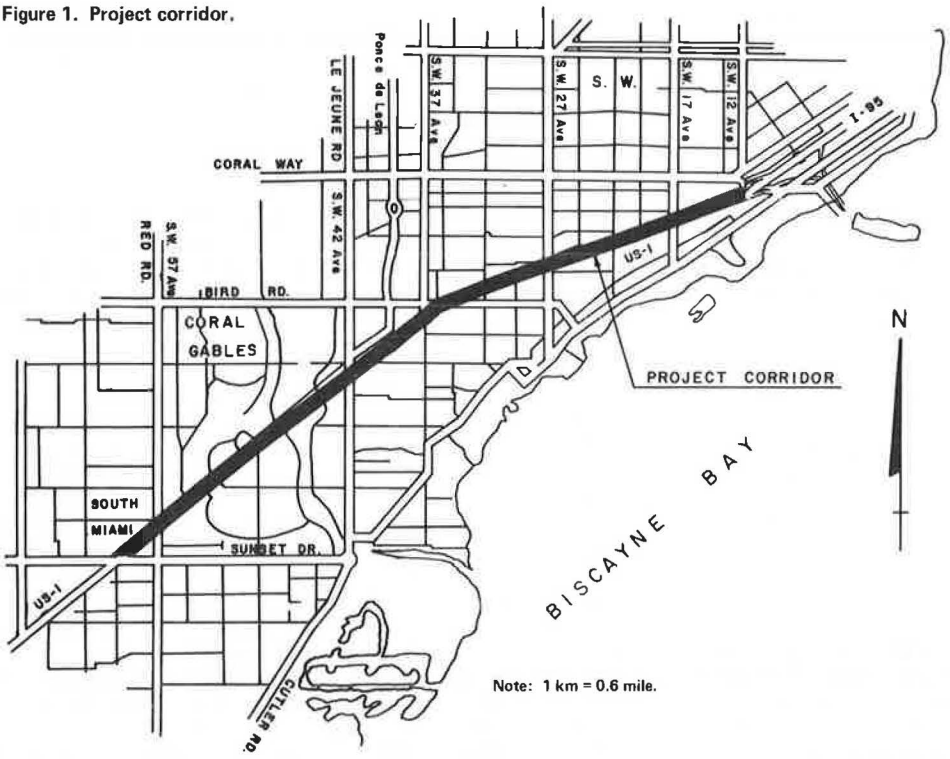


Figure 2. Lane configuration.

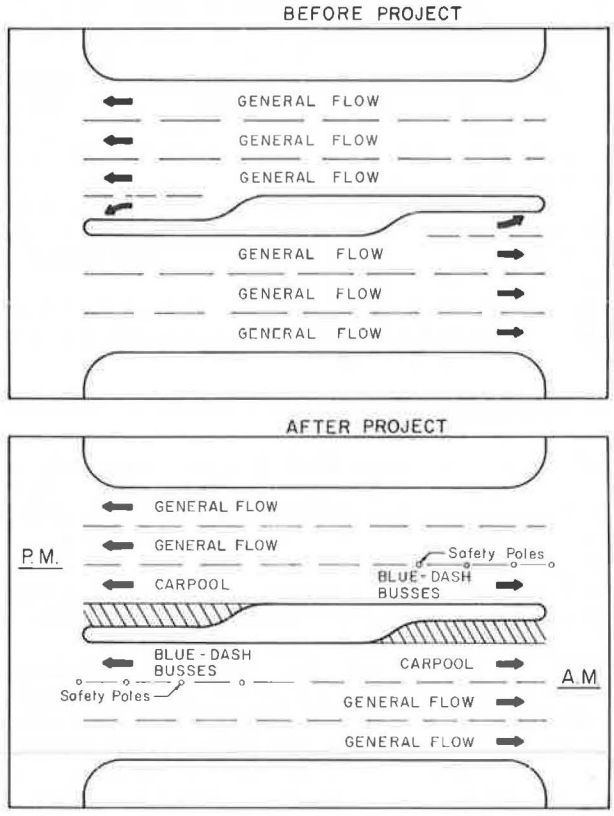


Figure 3. Monthly total ridership.

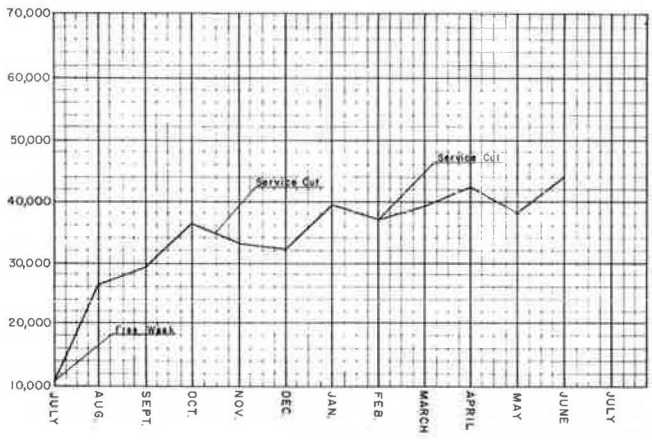
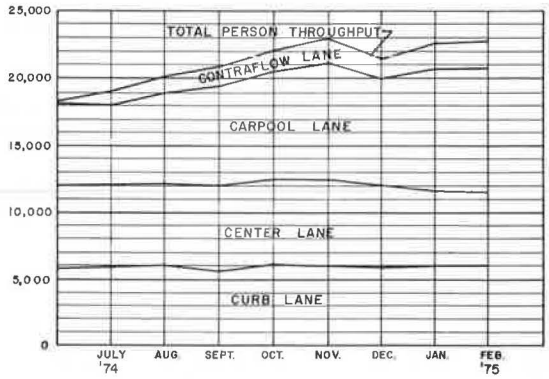


Figure 4. Cumulative lane use (persons), US-1-South Dixie Highway demonstration project.



ing the average automobile occupancy rate for all lanes from 1.30 to 1.45 during the initial 6 months of project operation. At that point, the car-pool lane was carrying up to 40 percent (representing 9000 people/day) of the peak-direction person-trips during project hours (Figure 4). Those persons using the general (center and curb) lanes in the peak direction lost an average of 15 min because of the slight increase in volume. This situation, which was compounded by a greater number of right turns from the curb lane, has since improved slightly.

These increases in transit ridership and automobile occupancy levels have improved the people-moving efficiency of South Dixie Highway in the project area to the extent that the highway now carries 2400 more persons in 350 fewer vehicles/day.

The improved people-moving capacity of the highway was reflected in substantial savings in user travel times (approximately 1000 person-h/day). This figure was based on slightly modified travel speeds and system use values that were necessary to place the before-and-after data into similar reference frames as a result of the fact that total peak-period person-trip demand on the highway increased by about 10 percent during the project time. These travel time savings accrued mainly to those persons who diverted from single-occupant vehicles in the slower general lanes to car-pool vehicles in the faster car-pool priority lane. In addition, users of the project realized savings of more than $3600/day in direct out-of-pocket costs because of the effects of shared travel expenses associated with car pooling and, to a lesser extent, of the relatively inexpensive bus travel.

The car-pool lane, which was the main factor in the travel time and cost savings, is thus a very valuable priority treatment in terms of cost-effectiveness. One key element that ensured the success of the Dade County car-pool lane was the enforcement procedure used. A total of six police officers patrolled the project area during the peak periods creating the high level of enforcement deemed necessary to enforce the left-turn prohibitions and bus and car-pool lane restrictions, as well as control the other problems normally associated with a highly congested arterial highway during peak hours.

One characteristic of the roadway that is extremely important in allowing effective enforcement, particularly of the car-pool lane, is the existence of a median separator with vacant left-turn storage bays during the peak periods. This feature allows high visibility of police officers and permits the use of direct apprehension techniques. The advantage of this situation over that of expressways or arterials with no median separation is obvious.

One aspect of bus and car-pool priority projects (especially those having contraflow bus lanes) that has received attention in recent years is the problem of safety. South Dixie Highway, which contains 15 signalized intersections and numerous curb access points within the project corridor, could be considered one of the most difficult challenges in respect to the implementation of a safe contraflow bus lane. Safety measures used include removable safety posts separating the contraflow lane from the adjacent automobile lane, elimination of left turns, and strict and highly visible enforcement of these and all other traffic regulations.

The number of accidents in the initial 9-month period of project operation was 245 (compared with 148 in the same 9-month period in the preceding year). This increase was shown to be significant at the 95 percent confidence level by the use of nonparametric statistical techniques. Of the increased accidents, many were rear-end collisions; much of the remainder were small increases in left-turn accidents and accidents that involved hitting fixed objects. The rate of bus-related accidents initially increased dramatically but then leveled off at a rate of about 2 accidents/month. On balance, the accident rate has increased, but, in the opinion of local policy makers, not so much as to offset the significant benefits derived from the project.

Transit User Profile

The three user surveys conducted during the evaluation period were the Blue Dash rider survey, the car-pool survey, and the general lanes survey. The transit survey cards were distributed by the bus operators and designed to be either mailed back or returned to the operator. Of the 960 morning riders on survey day, 77 percent returned the cards.

The great majority (94 percent) of transit riders use the service to go to and from work. This was expected because of the nature of the service and the market area. The modal shift to transit was surprisingly high for an automobile-oriented area such as Dade County: Nearly two-thirds of all patrons had driven to work by themselves before the project, and overall 77 percent had used automobiles for their trips prior to the project.

Previous Transit Mode	Bus Riders (%)	Previous Transit Mode	Bus Riders (%)
Automobile with single occupant	65.1	Bus	17.1
Car pool	12.5	Bicycle	3.5
		Other	2.8

Most riders had changed to transit because of the convenience of the service.

Reason for Change to Bus	Bus Riders (%)	Reason for Change to Bus	Bus Riders (%)
Low cost	49.1	Convenience	77.4
Speed	47.4	Other	14.9

The total in the above and later tabulations is greater than 100 percent because of multiple-response counts. It is obvious that speed, though important, is not the overriding factor in shifting to transit, but convenience may have been perceived as a combination of speed, low cost, and other considerations.

Park-and-ride is the most popular mode of access to the transit system and convenient bus stops are second most popular.

Mode of Access to Bus	Bus Riders (%)	Mode of Access to Bus	Bus Riders (%)
Walk	36.5	Bus	1.5
Automobile	45.0	Bicycle	0.7
Automobile passenger	15.8	Other	0.5

The Dadeland park-and-ride lot is the most heavily used facility with 16.3 percent of the riders boarding at that location and some driving over 16 km to reach it.

Six of every 10 riders are female (compared to 7 out of 10 for the MTA system as a whole). The age of the average user is lower than that for the system as a whole (39 percent fall in the 20 to 29 age group). Income ranges are much higher than the county average for bus riders. Nineteen percent reported a family income between $10 000 and $15 000/year and 22 percent between $15 000 and $20 000 or more.

The car-pool and general lanes surveys were of the mail-back variety and were distributed on one day during the afternoon peak period. The general lanes in this context are the two nonpriority lanes in the peak direction.

Twenty percent of the cards given to car poolers and 41 percent of those given to the general lane users were returned.

The CBD generates the largest number of car-pool trips in the afternoon, whereas the South Miami area generates the largest number of morning trips. This origin and destination split also holds true for single-occupant vehicles. The South Miami area is approximately 19 km (12 miles) from the CBD, but car-pool activity also originates as far south as Homestead, 56 km (35 miles) from the CBD. The great acceptance of the car-pool lane makes it important to ascertain why people arrange to double up.

Reason for Car Pooling	Car Poolers (%)	Reason for Car Pooling	Car Poolers (%)
Time advantage	58.7	Companionship	37.4
Monetary reasons	14.2	Other	15.5
Fuel savings	62.6		

The most commonly given reasons were fuel and time savings. Thus, with increasing fuel prices, the use of the car-pool lane will increase and it will gradually lose the time advantage. Future study of this phenomenon will take place as vehicle counts warrant it.

Fifty percent of general lane users do not use the buses because they need their cars during the day, 30 percent complain of inconvenient routes, and 10 percent complain of inconvenient schedules. The same basic question was also asked of this group as to why they do not car pool. Again, the most frequently mentioned reason was need of the car during the day. The second most frequently mentioned reason was inability to find car poolers. Only 17 percent indicated that they would want to help in forming car pools despite the fact that this would remove nearly 200 vehicles from the highway each day. Since all of the car pools were formed through the users' own initiative, and only a small percentage of those not car pooling desire help, the county has not planned to provide an organized car-pool matching service.

In both the car-pool and general lanes, males outnumber females two to one. However, the income distribution of car poolers is not so broad as that of general lanes users.

Income Distribution ($)	Car Poolers (%)	General Lane Users (%)
0 to 3000	2.2	2.4
3000 to 6000	5.0	2.4
6000 to 10 000	9.4	13.5
10 000 to 15 000	12.2	27.1
15 000 to 20 000	18.0	16.4
20 000 and over	53.2	38.2

CONCLUSION

The South Dixie Highway Project was designed to give south Dade County commuters a choice of transit mode. It introduced the public to alternatives to the one-person, one-car philosophy prevalent in this country for many years. For the Blue Dash bus riders, a fast inexpensive alternative to the car was provided; for car poolers, the car-pool lane provided shorter travel times and lower costs than the single-occupant vehicle but maintained the convenience of the private automobile. By the criteria established, the project was successful in fulfilling its goal of moving more people in fewer vehicles.

REFERENCES

1. US-1/South Dixie Highway Transportation Demonstration Project: Evaluation Report. Dade County Office of Transportation Administration, April 1975.
2. Evaluation Design. Dade County Office of Transportation Administration, Aug. 1974.
3. Traffic Operations Manual. Dade County Department of Traffic and Transportation, July 1974.
4. Police Patrol Manual of Operations. Dade County Office of Transportation Administration, July 1974.
5. Bus Operations Manual. Dade County Metropolitan Transit Agency, July 1974.