



**analysis of preferential bus
treatment on arlington
boulevard and columbia pike**

ANALYSIS
OF
PREFERENTIAL BUS TREATMENT
ON
ARLINGTON BOULEVARD AND COLUMBIA PIKE

APRIL 1977



NORTHERN VIRGINIA TRANSPORTATION COMMISSION
2009 NORTH 14th STREET
ARLINGTON, VIRGINIA 22201

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	1
II. SUMMARY OF FINDINGS AND CONCLUSIONS	5
III. ARLINGTON BOULEVARD ROUTE ANALYSIS	7
EXISTING CONDITIONS	7
POTENTIAL BENEFITS	9
EVALUATION OF ALTERNATIVES	14
FINDINGS AND IMPLEMENTATION	21
IV. COLUMBIA PIKE ROUTE ANALYSIS	23
EXISTING CONDITIONS	23
EVALUATION OF ALTERNATIVES	26
FINDINGS AND IMPLEMENTATION	29

APPENDICES

I. Analysis of Time Savings on Arlington Boulevard Bus Lanes	A-1
II. Representative Bus Schedules	
Arlington Boulevard Route 20K, S, W	A-3
Columbia Pike Route 16	A-5
III. Metropolitan Washington Council of Governments Vehicle and Person Counts	
Arlington Boulevard	A-7
Columbia Pike	A-8

LIST OF FIGURES

	<u>Page</u>
Figure 1 Location of Routes Under Analysis	2
Figure 2 Portion of Arlington Boulevard Proposed for Bus Improvements	8
Figure 3 Existing and Proposed A.M. Peak Period Bus Movements on Arlington Boulevard	13
Figure 4 Proposed Counterflow Traffic Operator's Plan	17
Figure 5 Portion of Columbia Pike Analyzed for Bus Improvements	24
Figure 6 A.M. Peak Period Transit Usage on Columbia Pike	27
Table 1 Daily Vehicular Traffic Volumes - Columbia Pike	25

I. INTRODUCTION

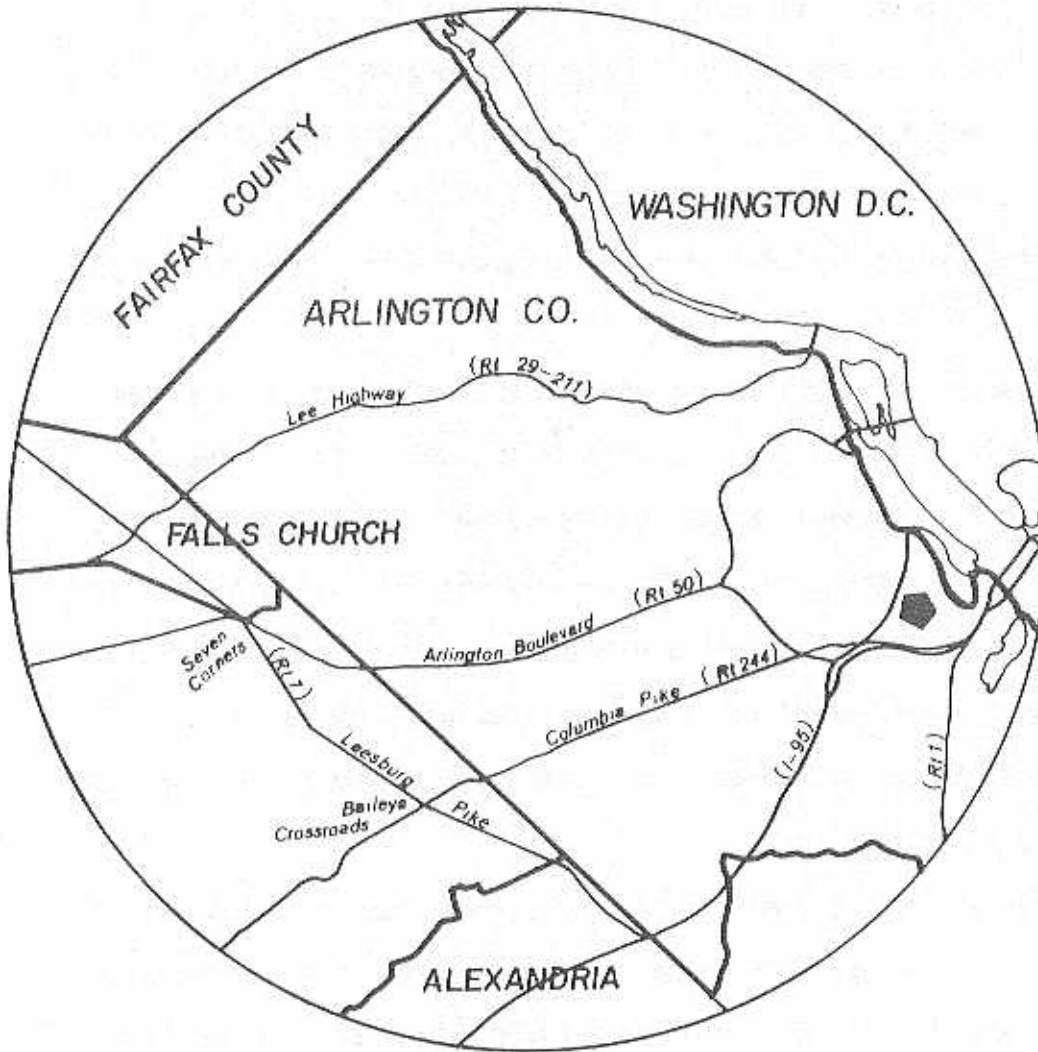
Two of the major transportation problems facing Northern Virginia are the heavy traffic congestion and travel delay on major arterial routes during peak travel periods. Congestion and long travel times are particularly acute on radial arterials leading to centers of concentrated employment, such as Rosslyn and the downtown Washington employment centers. One of the principal causes of this congestion is the predominant reliance upon the automobile for journey-to-work travel.

Since the only mass transportation currently available in the Northern Virginia region is provided by the bus system, travel by mass transit is subject to the same congested and slow conditions as the automobile (except in the Shirley Highway Corridor where preferential treatment for buses is provided). By being in the same travel stream over their entire trips as the automobile, buses operate at slower overall travel speeds, since time is required to pick up and discharge passengers.

Longer overall travel times by buses, as compared to automobiles, seriously decrease the convenience of transit to existing and new users. This significantly reduces the attractiveness and potential of transit as an alternative to the automobile, particularly during peak travel periods.

Awareness of the impact of automobiles and highways upon the environment, concerns over energy, pollution, noise, and community

Figure 1
LOCATION OF ROUTES UNDER ANALYSIS



disruption all emphasize the importance and urgency of developing and continuing a viable and convenient alternative to the automobile during peak travel periods. The tool that potentially is available, and that can be implemented quickly, is improved bus service. The resources to improve bus service include the existing highway and bus systems, and bus flow improvements such as construction within existing rights-of-way. It is from this perspective that this study of ways to provide preferential treatment for bus movements along Arlington Boulevard (U.S. Route 50) and Columbia Pike (Va. Route 244) was developed.

Positive actions to improve bus movements through preferential lanes have already been taken by the Virginia Department of Highways and Transportation and the Northern Virginia Transportation Commission, in cooperation with a number of other governmental agencies, in the Shirley Highway Corridor. This project has received national recognition and acclaim, and provides proof that leadership, innovation, and adequate resources can provide a significant improvement in bus service, and lead to increased ridership.

Because of the advantages of preferential movement to buses, and the existing congestion and delays in these corridors, Arlington Boulevard and Columbia Pike were logical candidates for study. Other radial routes in Northern Virginia do experience similar congestion, but were not studied under this project. As can be seen in the findings and recommendations, only Arlington Boulevard proved to need preferential bus treatment. Here a plan was agreed upon, designed, and lanes

implemented during the course of this study. Columbia Pike has benefited from Shirley Highway improvements, and an unbalanced flow plan, so detailed design and implementation of bus lanes was not warranted.

This paper details the existing conditions on the routes at the time of study, describes the alternatives for preferential treatment evaluated, and outlines findings and implementation. It is part of an on-going effort in Northern Virginia to identify Transportation System Management-type improvement that would result in improved transit ridership and efficiency.

II. SUMMARY OF FINDINGS AND RECOMMENDATIONS

The two routes, Arlington Boulevard (U.S. Route 50) and Columbia Pike (Va. Route 244) were analyzed separately, from a viewpoint of possible preferential treatment. In each case the existing levels of bus service and delays were considered along with the plans for both bus service and highway upgrading. The following summarizes the findings in each case.

Arlington Boulevard showed considerable potential for preferential bus movement. Several alternatives were considered including

1. Connection and upgrading of the discontinuous parallel service roads into bus lanes.
2. Creation of an unbalanced flow by using one lane in the off-peak direction as a "contra-flow" bus lane.
3. Strengthen and upgrade the shoulders along the existing roadway, to use as bus lanes.

Public hearings on these alternatives were held, along with many discussions with representatives of the Virginia Department of Highways and Transportation, and Arlington County Board and staff. The result was a plan that included construction of bus lanes on the then-existing shoulders, as well as an adjacent bike path. The project was funded by the State, construction took place, and the lanes and path are now in use. They have resulted in improved operation for buses and other traffic, and can certainly be termed a success (see Appendix I for analysis of time savings). It is recommended that continued and expanded

use be made of the lanes, and the benefits of further extension into Fairfax be evaluated.

Columbia Pike presented a different situation. While the study progressed, events took place which made the need for bus lanes much less immediate than previously envisioned. The completion of major improvements to the nearby Shirley Highway, and implementation of an unbalanced lane flow system have resulted in alleviation of much of the previous bus delays on this route. Consequently, it was determined that priority bus lanes were not necessary at the present time. A program of installing shelters, and adding service along the route was recommended. After implementation of Metrorail Phase II into Virginia, further analysis by concerned agencies such as Arlington County or the Northern Virginia Transportation Commission oriented toward preferential treatment of feeder buses should be considered.

III. ARLINGTON BOULEVARD ROUTE ANALYSIS

EXISTING CONDITIONS

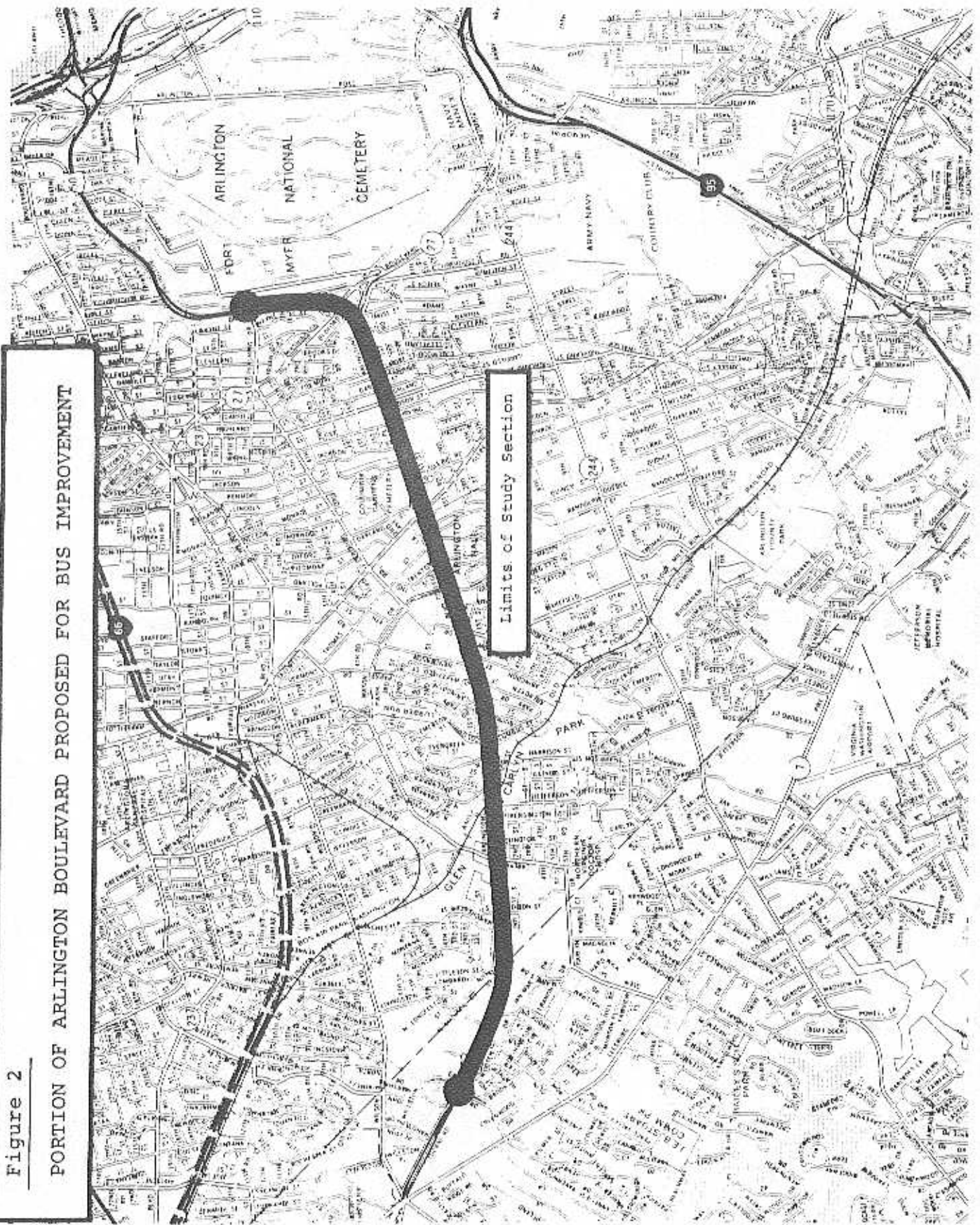
The portion of Arlington Boulevard under analysis is between the Seven Corners area in Fairfax County and the Potomac River in Arlington County as shown in Figure 2. Throughout most of this section, Arlington Boulevard has four 11-foot lanes with stabilized shoulders. Some sections are separated by a median varying between 4' and 20' in width. Parallel frontage roads exist on both sides of the roadway but are not continuous on either side. This section contains about 30 intersections, ten of which are signalized, six being inter-connected into a semi-actuated system. During peak travel periods Arlington Boulevard is allotted a predominant portion of green flow time by the signal cycles.

Arlington Boulevard is on the Federal-aid and State Primary Systems of Highways. Three of the intersections are presently grade-separated, permitting sections of roadway to be classified as an expressway (the upper level of the arterial system). The grade-separated intersections are: 1) Washington Boulevard, 2) Glebe Road, and 3) Carlyn Springs Road. A grade separated interchange at George Mason Drive is currently under construction.

Peak hour traffic volumes are about 3,500 vehicles per hour, or approximately 8% of the total daily volume of 42,000 vehicles. A heavily predominant movement occurs each weekday morning in the eastbound direction (towards the District of Columbia) and a corresponding and reverse

Figure 2

PORTION OF ARLINGTON BOULEVARD PROPOSED FOR BUS IMPROVEMENT



movement occurs each weekday evening. This direction distribution of the traffic flow is about 70% - 30% during each peak period.

Arlington Boulevard presently carries several bus routes. Metro routes 4, 20, 24, 25 use portions of the roadway during peak periods. Daily weekday A.M. peak period (2½ hours) bus volumes are about 40 buses, carrying approximately 1,400 passengers, with a similar evening peak. At the beginning of the Study peak period travel speeds were generally less than 20 mph for autos and somewhat slower for buses.

POTENTIAL BENEFITS

The Northern Virginia TOPICS Study that was conducted for the Virginia Department of Highways and Transportation (VDH&T) recommended several major improvements on Arlington Boulevard. These improvements included widening the route to six lanes, constructing a concrete median for the entire route, and reconstruction of several major intersections. Additionally, it was recommended that the "missing links" of the service roads be constructed to provide continuous preferential bus lanes. The Northern Virginia Thoroughfare Plan also recommended construction of the continuous service roads. Accordingly, a study was undertaken to determine the feasibility of constructing the "missing links" to provide continuous one-way service roads paralleling Arlington Boulevard from Seven Corners to Washington Boulevard, or some other plan for preferential movement of express and local buses during peak hours.

The benefit analysis considered two main issues: 1) Travel time studies on Arlington Boulevard and Lee Highway (Rt. 29/211) to determine potential time savings, and 2) analysis of bus ridership in the corridor to evaluate means of increasing bus usage of the lanes.

Travel Time Studies

These studies consisted of time travel during the A.M. and P.M. peaks on Arlington Boulevard and Lee Highway for the purpose of estimating the time savings that would result from the use of preferential bus lanes. Time runs were made on Arlington Boulevard in order to estimate the time savings for local and express buses presently traveling on the facility, while time runs were made on Lee Highway to estimate the time savings for possible diverted express buses.

For purposes of estimating the time savings, 30 mph and 35 mph average speeds were assumed for the completed continuous bus lanes. Since the speed limit on Arlington Boulevard is 45 mph in this section, the assumed speeds should take into account possible signal and traffic delays on the improvement. The lower speed was felt to be indicative of local bus service, with 35 mph being appropriate for express service on the improvement.

The time savings range from approximately 3 minutes to 9 minutes, or 13 to 43% of the total travel time, depending on the assumed speed, routing, and peak period.

To take advantage of these estimated time savings, it was proposed to reroute to Arlington Boulevard a number of bus trips from other routes operating on conventional streets. This would also increase the utilization of the bus priority lane. Bus service to such destinations as the Navy Annex, the Pentagon, and Crystal City could be routed along Arlington Boulevard to Washington Boulevard to expedite their movement.

Supplemental to and coordinated with all the bus lane proposals will be the effort to obtain preferential treatment for the movements of buses between Arlington Boulevard and Key Bridge in Virginia, and on connecting streets in the District of Columbia. The Arlington County government has taken action to expedite bus movements through Rosslyn, and these time savings are additional to the benefits to be derived from implementation of the NVTC proposal. Discussions are currently under way with the District of Columbia Department of Highways and Traffic relative to the preferential treatment of bus movements along M Street and/or the Whitehurst Freeway. Time savings that would be made possible by providing preferential treatment for the bus movements through Rosslyn, and on streets in the District of Columbia would be in addition to the travel time savings estimated, and would make those estimates represent a minimum.

The value of the time savings occurring to new riders of the improved bus service have also not been included in the benefits. Likewise, benefits resulting from the diversion of travelers from automobiles to the bus, such as decreased air pollution and decreased congestion, have not been quantified and included in the estimates.

Analysis of Bus Ridership

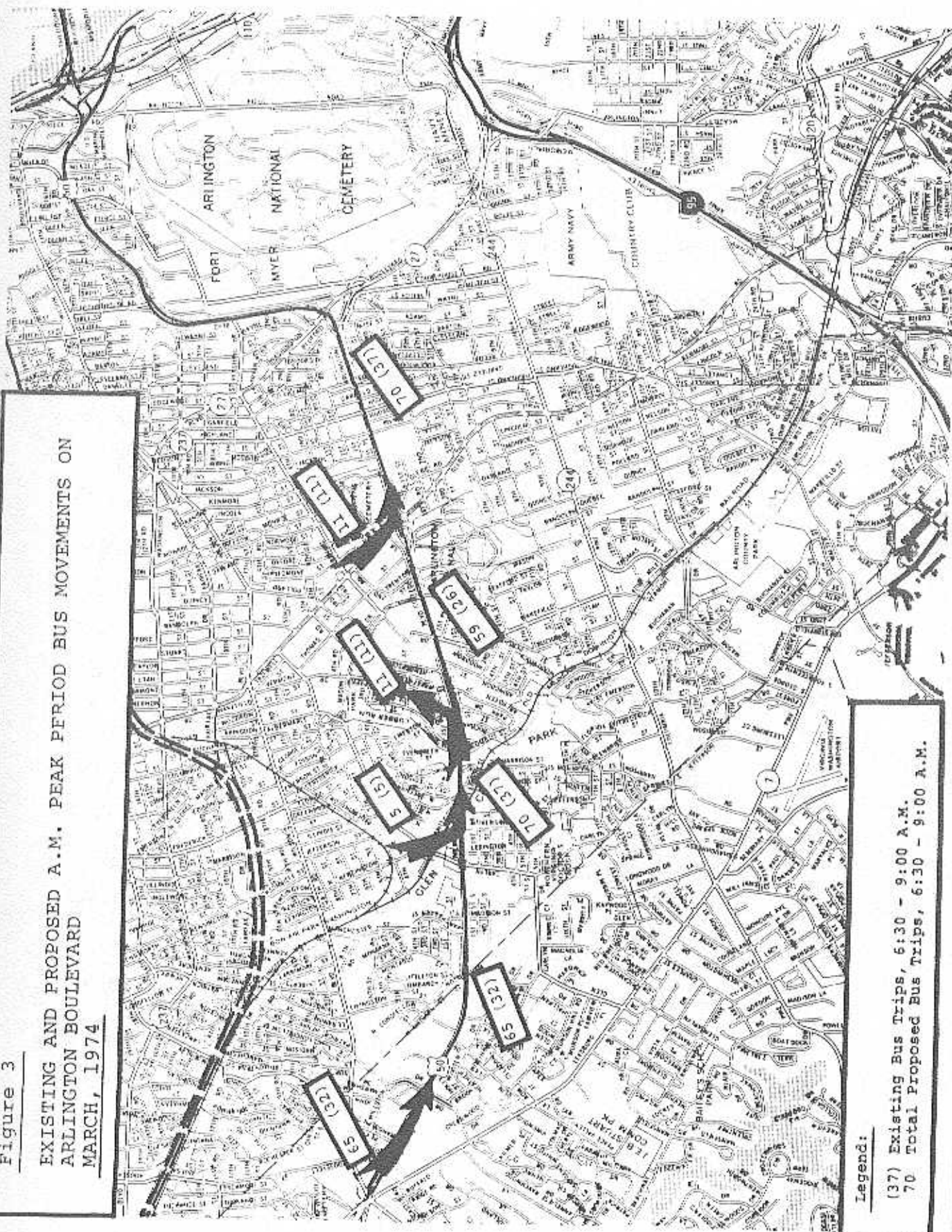
The purpose of this analysis was to determine how many peak period buses presently traveling on Lee Highway, Wilson Boulevard, and Washington Boulevard might be rerouted to the proposed preferential busways. Bus lines originating further out were also considered for possible diversion. Existing and proposed bus flows are shown in Figure 3.

By assuming that loaded or nearly loaded buses entering the corridor would be diverted, and that buses serving the passengers within the corridor would not be diverted, an estimate of the number of potential buses and ridership on the proposed improvement was determined. The estimates indicated a total peak period usage of 70 buses with 2,750 riders. Approximately 60% of this usage would occur in the peak hour, with the remaining 40% during the transitional periods before and after the peak hour.

Knowing the ridership and the time savings from the previous travel time studies, the passenger-hour savings were computed. Further, by assuming a value of time as 5 cents per passenger-minute (or \$3.00 per passenger hour), the cost savings were estimated. The total daily saving was 402 passenger-hours if the assumed speed on the improvement was 30 mph and 465 passenger-hours at 35 mph. The daily cost savings were \$1,206 and \$1,395 at 30 and 35 mph, respectively. On an annual basis (260 weekdays per year) the savings were approximately 105,000 passenger-hours or 121,000 passenger hours, depending on the speed, or an annual cost savings of approximately \$314,000 and \$363,000 at 30 and 35 mph, respectively.

Figure 3

EXISTING AND PROPOSED A.M. PEAK PERIOD BUS MOVEMENTS ON
ARLINGTON BOULEVARD
MARCH, 1974



Legend:
(37) Existing Bus Trips, 6:30 - 9:00 A.M.
70 Total Proposed Bus Trips, 6:30 - 9:00 A.M.

EVALUATION OF ALTERNATIVES

There were originally two alternative proposals for giving buses preferential treatment along Arlington Boulevard. Basically they were:

1. Connect and upgrade where needed the now uncontinuous service roads that parallel Route 50, and use the resulting roads for bus movement. This would probably require the buses returning to the main roadway at the grade-separated interchanges, and the construction of additional lanes at the Four Mile Run Bridge.
2. Create an unbalanced-flow situation by using one lane in the "off-peak" direction for peak-directional auto traffic, and reserve the right-hand lane for buses. Some additional lanes would have to be constructed where medians exist, if peak traffic is to be kept on the right-hand side of the median.

This study initially attempted to evaluate these two proposals in terms of the benefits, costs, and community problems involved with each, and arrive at an implementable solution. However, out of the two proposals above, discussions developed a third plan.

3. Strengthen and upgrade the shoulders along the existing roadway, to use as a preferential bus lane. As the shoulders exist along most of the roadway this could be accomplished at low cost, and without the adverse safety aspects of the other two plans. Consequently this proposal received evaluation also.

Analysis of Access Road Connection Alternative

The cost analysis was developed assuming continuous one-way service roads from Seven Corners to Washington Boulevard, except through existing or proposed interchanges, and across Four Mile Run. Through these areas the buses would use the outside lane of a six-lane facility. An assumed width of 24 feet was used for new service roads, but existing roadways were considered adequate with a 20-foot width.

The most costly item would be a new structure at Four Mile Run. A cost estimate of \$828,000 was used for this bridge. The total estimated project cost of \$1,917,000 includes improvements needed for the busway only, and no costs were included for right-of-way, or the TOPICS recommendations such as channelization at major intersections, or interchanges at Carlyn Springs Road and George Mason Drive.

This plan was recommended by the Northern Virginia TOPICS study. However, discussions with the Virginia Department of Highways and Transportation, Arlington County representatives, and other agencies revealed a strong community concern, and adverse reaction to the proposal to use the service roads for express bus movements. The major objection to this plan by Arlington County centered on the questionable safety. The service roads front directly on a number of residences, and the problems of safe entrance and exits from driveways or hazards to children from the buses were apparent. The additional noise created by the buses to the residents was also raised.

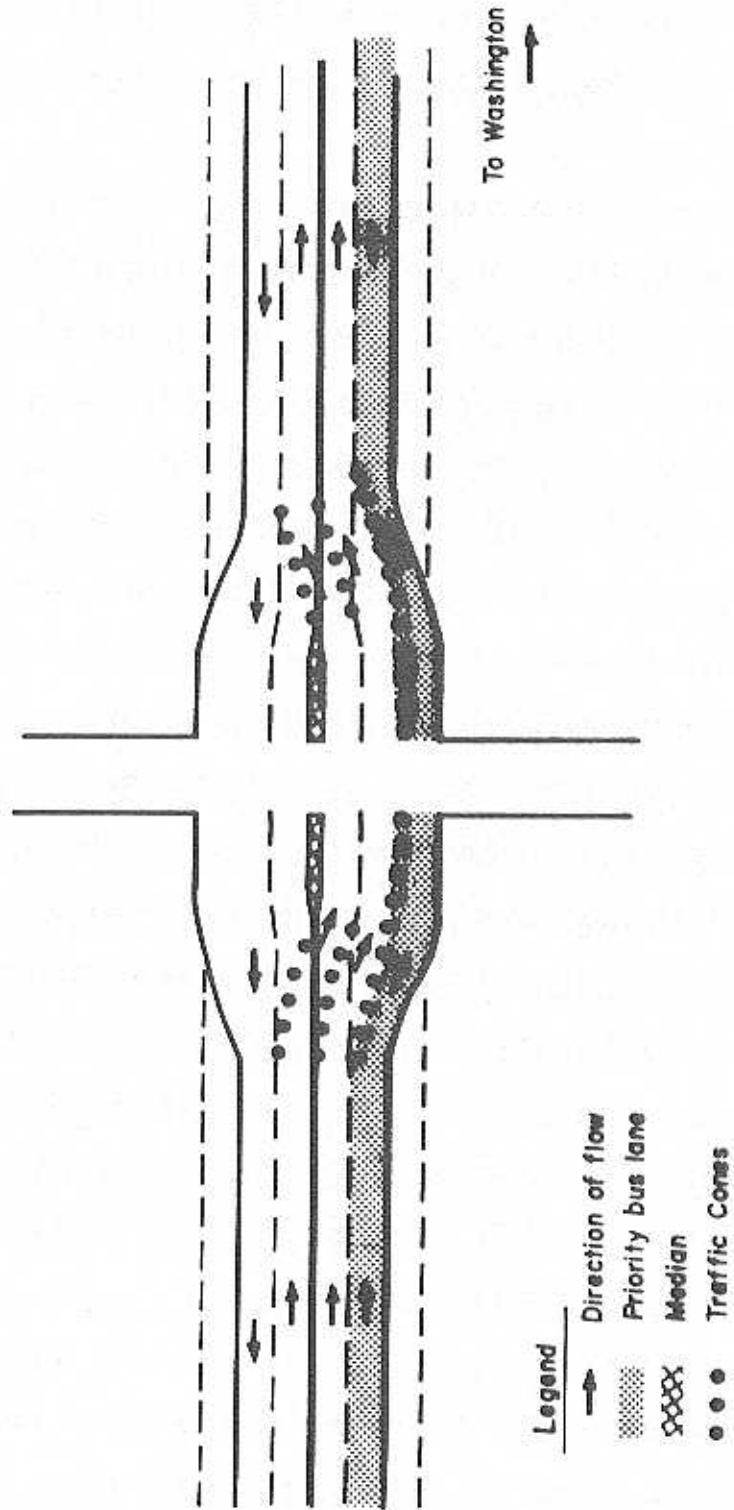
The proposal would require a considerable amount of construction, as the service lanes are disconnected at a number of places. Upgrading to a standard that would allow safe, reasonably rapid bus movements would be necessary. This construction would be time-consuming and not easily implementable.

Analysis of Unbalanced Lane Alternative

Between a point several hundred feet east of Patrick Henry Drive in Fairfax County (where the undivided roadway section begins) and the intersection with Fillmore Street in Arlington County, the main-line roadway has a four-lane undivided cross-section, except for three short sections of raised median: At Manchester Street, at Park Drive, and at Glebe Road. Over this same section, two lanes would be provided for eastbound vehicular traffic during the A.M. rush period and two lanes provided for westbound traffic during the P.M. peak period. The remaining traffic lane would be provided for counterflow movements. (See Figure 4).

Traffic volume counts taken by the Virginia Department of Highways and Transportation indicate that about 800 vehicles are traveling in the non-peak (outbound) direction during the A.M. rush hour and about 1,000 vehicles in the inbound direction during the P.M. peak hour. To restrict this volume to one lane would produce a flow of 800 - 1,000 vehicles per hour per lane for the peak direction flows, assuming two lanes are used for automobiles during the peak periods. In other words,

Figure 4
PROPOSED COUNTERFLOW TRAFFIC OPERATIONS PLAN
 A.M. PEAK PERIOD



the proposed operating scheme would result in about the same congestion for non-peak direction traffic as existed for peak-direction traffic.

At the three locations where a median exists it was proposed that the shoulder be upgraded immediately to a full-strength traffic lane for the length of the median, plus adequate taper. Since three lanes in each direction already exist on Arlington Boulevard through the Glebe Road interchange, only relatively minor construction is required, and all within the existing mainline right-of-way. This minor construction will permit traffic to stay to the right of the median at all times by providing three lanes of traffic for each direction of travel through these short sections of roadway.

The bus travel time savings and the rider and community benefits that are possible under the unbalanced lane concept were estimated to be considerably higher than the value of benefits obtained by connecting the access roads. However, the estimated annual benefits of \$300,000 seems so high in relation to the probable construction and operating costs of unbalanced lanes that it was not felt necessary to do an elaborate benefit analysis to justify the proposal. The total cost of the initial stages of this proposal should not exceed \$200,000. Highway Department funding is proposed.

In addition to these bus travel time and service improvements, it was proposed to provide for the installation of bus rider shelters at selected bus stops in the inbound direction along Arlington Boulevard. Also, additional traffic signal faces must be installed at all existing

locations to provide a signal indication for each lane, and especially for each of the two lanes that will become reversible lanes under this alternative.

As a second stage of development, bus pull-outs should be constructed at all bus stops along Arlington Boulevard. During this stage a third traffic lane would be added for each direction of travel between Fillmore Street and the east intersection of Pershing Drive, and these lanes be reserved for bus priority movements during the rush hours. Since three lanes in each direction already exist between Pershing Drive and Rosslyn, construction of these lanes will permit the extension of bus priority lanes all the way to the Rosslyn area. This construction could represent the ultimate development of Arlington Boulevard through the Washington Boulevard interchange.

At the present time the volume of traffic using Arlington Boulevard warrants, and is assigned, a predominant portion of the "green" time for each signal cycle. It is probable that the amount of "green" time presently assigned to Arlington Boulevard will permit buses to move expeditiously along the street. However, based on the experience gained during the first phase of operations, consideration could be given to equipping the buses and traffic signals along the route with driver-actuated signaling devices that would permit expedited movement of buses through traffic signals.

Additional Lanes Alternative

The alternatives outlined previously furnished the basis for extensive discussions between NVTC, VDH&T, and Arlington County. Out of these discussions another proposal evolved. This plan would combine most aspects of the first and second stages of the initial NVTC proposal, but without any contra-flow lanes. As a substitute, a third lane would be created on both sides of the roadway, along almost the entire length of the segment from Patrick Henry Drive to Pershing Drive, by paving of existing shoulders. This would create a six-lane roadway that would allow the curb lane in the peak direction to be used exclusively by buses and right-turning vehicles, without the problems involved in using contra-flow lanes. The roadway would narrow to four lanes at two points: Between the bridge over Carlyn Springs Road and Granada Street, and at George Mason Drive. These are necessary because of the narrowness of the bridges in the first section, that would otherwise require expensive replacement of them, and the restricted area available at the George Mason intersection for improvement. A grade separated interchange has been proposed here previously, and is currently being constructed.

Buses would have access to the lane at any existing intersection. However, they could merge easily into and out of them from access roads adjacent to the highway at Patrick Henry Drive. Pedestrian access across Arlington Boulevard would be by way of existing pedestrian-controlled signals on the Boulevard, which would stop the bus lane as well.

Construction would include some minor widening and upgrading of the shoulders and drainage areas, paving, installation of signals for the bus lanes, signing, and striping. Bus turnouts would be provided at most stop locations, so that stopped buses would not interrupt movement in the lane. Additionally, bus shelters would be placed along the inbound route side.

FINDINGS AND IMPLEMENTATION

A technical committee composed of the NVTC, VDH&T, and Arlington County studied the three proposals, and recommended that a public hearing be held. At that hearing, the two refined plans dealing with 1) paving the shoulders and 2) connecting the access roads, would be presented. It was felt that the contra-flow proposal was the least desirable, and so should not be studied further.

The two plans were presented at a public informational meeting, sponsored by NVTC, held in Arlington on August 1, 1973. About 100 citizens attended, and a large majority of the seventeen persons who spoke supported the proposal for strengthening and paving the shoulders. The major objection to the connected access road proposal centered on the safety hazards, and residential area disruption that would be caused. Also, several requests for bike paths as part of the project were made.

On the strength of this hearing, and the recommendation of the staff and technical committee, NVTC endorsed the proposal to strengthen and pave the shoulders, and also requested VDH&T to provide bike paths where feasible.

Based on this, VDH&T designed the bus lanes using the shoulders as outlined above, and construction began in October 1973. The construction included exclusive bike paths along some two miles of the roadway, merging into the existing service roads to form a continuous bike trail. Construction of the bike and bus lanes was completed in November, 1974. The total construction costs were approximately \$1,315,000, all of which was paid by Virginia State highway funds. The bus lanes are restricted for use by buses and right-turning vehicles in the peak direction during rush hours, and are open for use by all vehicles during other times.

As can be seen in the March 1975 follow-up survey, the lanes have resulted in considerable time savings for bus users. Additionally, informal counts show all traffic moving better with buses removed from the flow. This project shows local, regional and State cooperation at its best, and the resulting facility will be of great benefit to the citizens of Northern Virginia throughout the foreseeable future. It is recommended that continued use be made of the lanes, and when opportunities for rerouting of buses become available, the maximum use of them be obtained. Additionally, study of the cost and benefits of extending the lanes further into Fairfax County should be undertaken.

IV. COLUMBIA PIKE ROUTE ANALYSIS

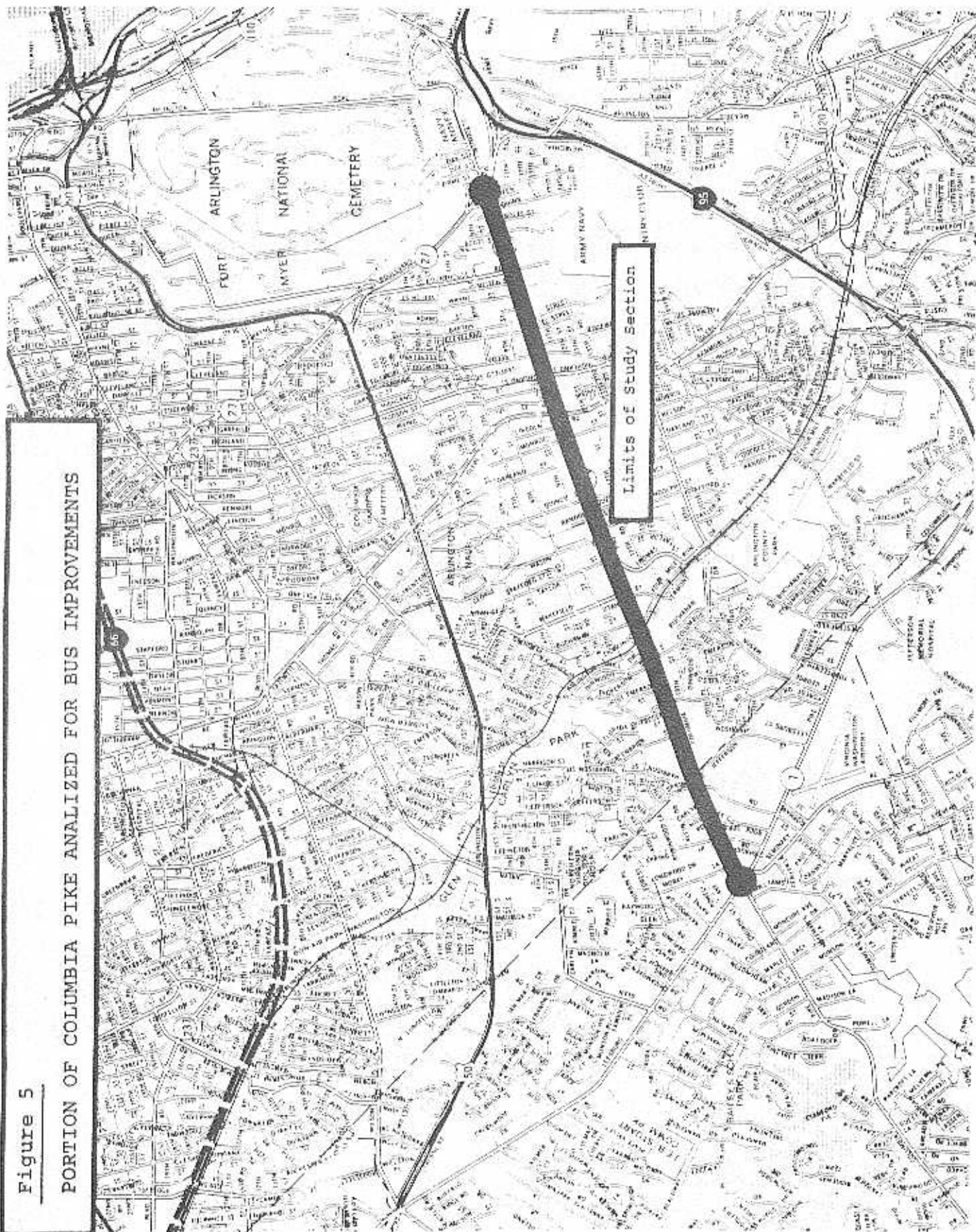
EXISTING CONDITIONS

Columbia Pike (Va. Route 244) is a major east-west highway which serves central Fairfax County and south-central Arlington County. It is included in the Federal-aid and State Primary systems of highways, and is functionally classified as a primary arterial. The portion of Columbia Pike which is included in the study extends 3.3 miles east from Leesburg Pike (Va. Route 7) in Fairfax County to Washington Boulevard in Arlington County, as shown in Figure 5.

Throughout this section, Columbia Pike has four travel lanes with additional parking and turning lanes provided at selected locations. Between South Wayne Street and Washington Boulevard, the Virginia Department of Highways and Transportation has implemented a three lane/one lane configuration during peak hours, with three lanes serving the heavier direction traffic flow. The abutting land use is a mixture of high density residential and commercial. At the eastern end of Columbia Pike are the major employment areas of Washington, D.C., the Pentagon and the Navy Annex in Arlington County. This combination of relatively dense residential development, and major employment centers has resulted in high transit ridership. The Columbia Pike Corridor has more daily transit passengers than any other in Northern Virginia except Shirley Highway.

Figure 5

PORTION OF COLUMBIA PIKE ANALYZED FOR BUS IMPROVEMENTS



There are approximately 38 intersections in the study area, of which 18 are signalized in an interconnected system. A grade separated interchange exists at Washington Boulevard and one is under construction at the Leesburg Pike (Route 7) intersection in Baileys Crossroads.

In 1973 the section of Columbia Pike between Leesburg Pike and Glebe Road carried an Average Daily Traffic (ADT) volume of 29,300 vehicles and between Glebe Road and Washington Boulevard the ADT was slightly less at 27,300 vehicles. However, the opening of the Shirley Highway "Mixing Bowl" project in May 1973 decreased the traffic volume along Columbia Pike to the point where improved traffic operations resulted. Additional smaller traffic flow improvements in the Columbia Pike corridor have resulted from subsequent periodic additions to the permanent construction along the Shirley Highway corridor. These traffic flow changes can be seen in the following table:

TABLE ONE
DAILY VEHICULAR TRAFFIC VOLUMES
COLUMBIA PIKE

<u>Intersection with:</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>
Glebe Road (Rt.120)	29,335	26,815	25,125
Washington Boulevard (Rt.237) East side	24,230	22,910	20,570

The A.M. Peak Hour traffic volumes range up to 2,000 vehicles in the major flow (eastbound) direction and 500 vehicles in the counter-flow (westbound) direction. Vehicular travel speeds in the peak hour are in the 15-20 mile per hour range.

Primarily radial bus service on Columbia Pike is provided by Metrobus Route 16 with Routes 21, and 22 also serving the eastern portion. Ridership and bus volumes for the eastbound direction in the A.M. peak period taken in March, 1975, are shown in Figure 6. During the A.M. peak hour, approximately 2,000 bus riders in 41 buses pass the peak load point at Washington Boulevard (based on Spring 1976 counts). NVTC field counts show bus travel speeds in the peak hour average 12-14 miles per hour.

EVALUATION OF ALTERNATIVES

In the process of analyzing the traffic flow, travel speed, and operating conditions along Columbia Pike during the initial stages of this study, several potential strategies for providing preferential treatment for bus movement were studied and reviewed with the Virginia Department of Highways and Transportation and Arlington County staffs. Following is a discussion of each of these alternatives and the conclusions reached.

Initiate unbalanced lane flow between approximately Four Mile Run Drive and the end of the existing unbalanced lanes at South Wayne Street, and create a curb bus lane. One problem is that the outbound A.M. traffic at several locations is over 500 vehicles per hour, and so could create congested and unstable flow conditions. There are many more intersections along this western part and traffic counts of westbound-flow left turns at several intersections measured 30 to 40 vehicles per hour. This would

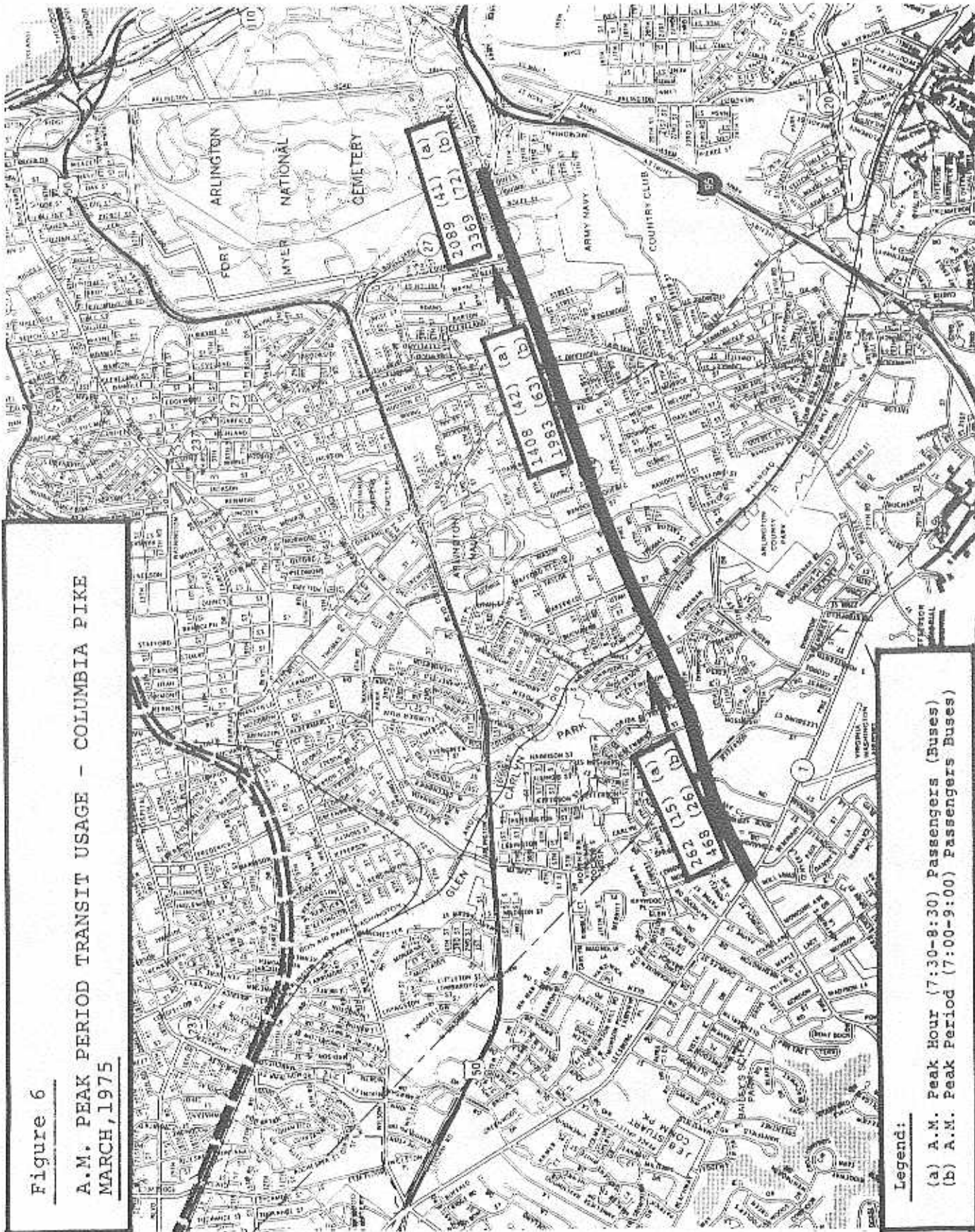


Figure 6
 A.M. PEAK PERIOD TRANSIT USAGE - COLUMBIA PIKE
 MARCH, 1975

Legend:
 (a) A.M. Peak Hour (7:30-8:30) Passengers (Buses)
 (b) A.M. Peak Period (7:00-9:00) Passengers Buses

cause severe delays if outbound traffic were restricted to one lane. These volumes indicate that it would be very difficult to maintain an unbalanced lane operation beyond that currently in place. Taking one lane of the existing unbalanced configuration for buses also concerned Arlington County, as it would probably create auto capacity problems in the remaining lanes.

This same result could be accomplished by increasing bus service to the point where bus activity in the curb lane would in effect preempt the lane from automobiles, thereby creating a bus priority lane. The "local" nature of the present Metrobus Route 16 service, which stops frequently to serve the residential centers along Columbia Pike, has in some part done this. The financial constraints of the Northern Virginia jurisdictions require, however, that additional service be carefully analyzed and justified before implementation. With the planned July 1, 1977, opening of the Rosslyn to National Airport Metrorail line, the opportunity to decrease bus headways without increasing the number of buses required by utilizing "turnback" routes at the rail stations becomes available. Subsequent expansions of the system will make more destinations accessible, and rail ridership may result in justification for increased bus service. The buses will still be subject to traffic signal and other delays, however, and the time savings over normal traffic speeds would be minimal.

Initiate unconventional bus operations. It may be possible to save bus travel time by having buses move in a "counterflow" lane along the

eastern end of Columbia Pike, then be routed over Four Mile Run Drive, and through the Shirlington Interchange entrance to the Shirley Highway busway. It has been suggested that routing buses in this manner from approximately Glebe Road would provide faster service than establishing a priority lane all the way to the Navy Annex, as in the previous alternative. Initial analysis showed that the out-of-direction travel required by this routing was too long to result in more than a very marginal time savings, and that additional buses would then be required to provide local service to Arlington County along the remainder of Columbia Pike east of Four Mile Run.

Recently the Arlington County staff has suggested that "long distance" buses from Fairfax, operating as express or limited stop, might benefit from this scheme. A "shuttle" service between Four Mile Run Drive and the Navy Annex, or Pentagon, could be instituted with a small number of buses, to serve Arlington and connect with the Metrorail system. This operation would not necessarily require preferential bus treatment, and will be evaluated by NVTC and WMATA as a rerouting alternative.

FINDINGS AND IMPLEMENTATION

Review of the operating situation on Columbia Pike indicates that the decrease in traffic volumes due to Shirley Highway improvements, and the existing unbalanced lane operations on the eastern

portion are providing bus movements that would not be materially aided by any of the preferential treatment alternatives analyzed. There are, however, transit service improvements that would be worthwhile, and planning that should continue. It must be noted that traffic volumes have begun to rise in the 1976-77 period, so that the transit improvement efforts outlined below are important.

It appears desirable to carry out the following program of transit ridership, bus flow improvements, and planning along Columbia Pike:

1. Improve transit passenger conveniences immediately.
 - a. Install up to 16 bus rider shelters at the major bus stops along the route.
 - b. Install improved bus stop signs or an information panel in the shelters.
 - c. Make an extensive distribution of specially designed timetables to the residential areas along Columbia Pike.
2. Improve bus service along Columbia Pike.

With the opening of Phase II Metrorail, the opportunity for extensive bus service improvements will be available. Buses originating from Fairfax County could be operated express or limited stop along Columbia Pike, or rerouted to Shirley Highway to reduce travel times. Turning back buses at the Northern Virginia rail stations will make additional trips possible, especially around the early and late "edges" of the peak periods. These buses could be used for short trips, perhaps beginning at Route 7, to replace Fairfax routes diverted or operated "closed door".

3. In a similar manner investigate the feasibility of providing neighborhood feeder buses from the residential areas along Columbia Pike to the Metrorail stations. This feature could substantially increase the convenience of transit by increasing the area covered by bus service without requiring major redesign of the routes along Columbia Pike.
4. Study under normal staff efforts the feasibility of longer range improvements for bus or rapid rail transit movements, including such operations as:
 - a. A bus priority lane on Columbia Pike after Shirley Highway construction is complete, and experience has been gained with Metrorail operations.
 - b. Desirability of a Metrorail extension in this corridor, or provision of other transit exclusive priority measures requiring major construction, such as a busway.

The immediate and short range features of the shelter, bus stop, information programs, and service improvements must be carried out through WMATA by Arlington County and NVTC. The Virginia Department of Highways and Transportation could also be of great assistance with the shelters. Service improvements in conjunction with the Metrorail station at the Pentagon may be very worthwhile. These should be part of the on-going Transportation Systems Management (TSM) element in the region.

For longer range improvements, such as a priority lane for feeder buses, a cooperative effort again including Arlington County, NVTC and VDH&T would be needed. This would be an appropriate element in the Unified Work Program at some later date.

APPENDICES

MEMORANDUM TO: Irving G. McNayr

DATE: March 5, 1975

FROM: David F. Erion *DFE*SUBJECT: Analysis of Time Savings on Arlington
Boulevard Bus Lanes.

The Arlington Boulevard priority bus lanes began operation on November 18, 1974. The lanes extend a distance of 4.3 miles from Patrick Henry Drive in Fairfax County to Pershing Drive at the Fort Myer gate in Arlington County. The operating hours are 6:30 A.M. - 9:00 A.M. for inbound buses and 4:00 P.M. - 6:30 P.M. for outbound buses.

Tabulated below are travel time and ridership statistics for the A.M. peak period before and after opening of the bus lanes. The travel time statistics represent a two-day average (November 5 and 6, 1974) before opening and a one day count (March 3, 1975) after opening the lanes. The ridership statistics represent a two-day average before (October, 1974) and after (January, 1975) opening the lanes.

Time Period	No. of Bus Trips	Average Bus Travel Time Comparison for the section of Arlington Blvd. between Patrick Henry & Pershing Drs.		% Change
		Before Bus Lanes were opened.	After Bus Lanes were opened	
6:30-7:00 AM	5	12.0 minutes	11.0 minutes	(8%)
7:00-7:30 AM	6	12.7 "	10.2 "	(20%)
7:30-8:00 AM	7	15.7 "	12.4 "	(21%)
8:00-9:00 AM	6	15.3 "	12.6 "	(18%)
Total Peak Period 6:30 - 9:00 AM	24	14.0 minutes	11.6 minutes	(17%)
Average Speed	24	18.4 mph	22.2 mph	21%

Route	Destination	No. of Bus Trips	Peak Load Point Ridership Comparison for Arlington Blvd. Bus Routes		% Change
			Before Bus Lanes were opened.	After Bus Lanes were opened	
20K & S	11th & E, NW	9	400	423	6%
20, 24	SW Mall	13	552	632	13%
25	Pentagon	2	47	47	0
Total Peak Period 6:30-9:00 AM		24	999	1,102	10%
Average Riders/Trip		24	41.6	45.9	10%

Based on the above statistics, the average bus travel time has decreased by almost $2\frac{1}{2}$ minutes during the morning peak period since the bus lanes have been in operation. While travel time checks have not been made during the P.M. peak period, travel time savings are probably in the same range as for the A.M. period.

In addition to the 24 bus trips referred to in the above tables, 13 other bus trips operate over a portion of the bus lanes in the A.M. peak period. However, only those buses which travel the entire 4.3 mile length of the bus lanes have been used in the travel time and ridership comparisons.

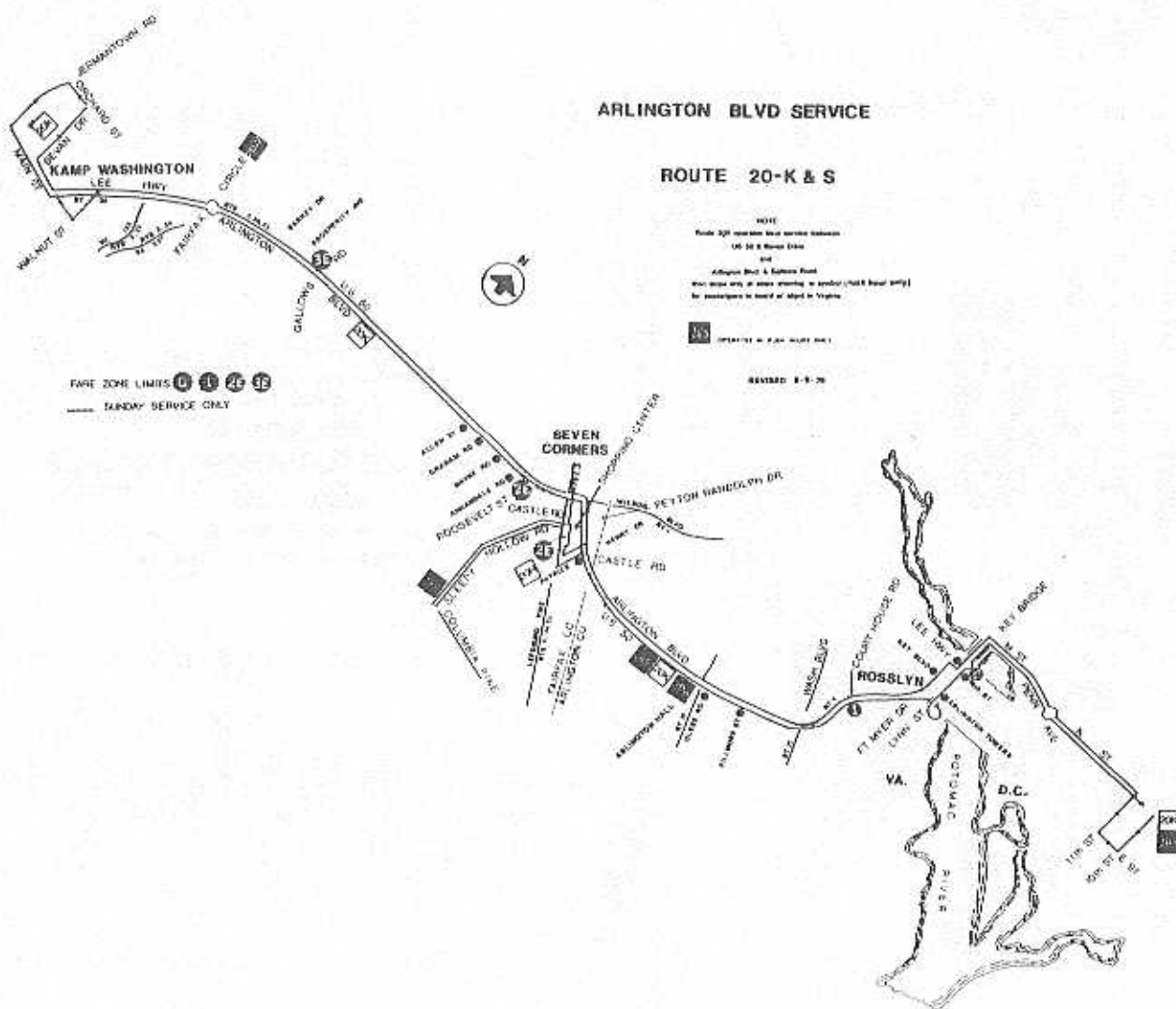
While the travel time savings and ridership increases for Arlington Boulevard are not as dramatic as on Shirley Highway, they do indicate positive trends toward improving transit in this corridor.

DFE:clg

FROM WASHINGTON							
Leave 11th & E. St.	Conn. & K. N.W.	Ft. Myer & Key Blvd	Circle Rd.	Seven Corners	Arif. Blvd. & Arif. Rd.	Outlook Rd.	Beulah Lodge
6:50	6:55	7:05	7:13	7:29	7:23	7:32	7:38
7:50	7:55	8:05	8:13	8:29	8:23	8:32	8:38
8:50	8:55	9:05	9:13	9:29	9:23	9:32	9:38
9:50	9:55	10:05	10:13	10:29	10:23	10:32	10:38
10:50	10:55	11:05	11:13	11:29	11:23	11:32	11:38
11:50	11:55	12:05	12:13	12:29	12:23	12:32	12:38
12:50	12:55	1:05	1:13	1:29	1:23	1:32	1:38
1:50	1:55	2:05	2:13	2:29	2:23	2:32	2:38
2:50	2:55	3:05	3:13	3:29	3:23	3:32	3:38
3:50	3:55	4:05	4:13	4:29	4:23	4:32	4:38
4:50	4:55	5:05	5:13	5:29	5:23	5:32	5:38
5:50	5:55	6:05	6:13	6:29	6:23	6:32	6:38
6:50	6:55	7:05	7:13	7:29	7:23	7:32	7:38
7:50	7:55	8:05	8:13	8:29	8:23	8:32	8:38
8:50	8:55	9:05	9:13	9:29	9:23	9:32	9:38

TO WASHINGTON							
Leave Circle	Outlook Rd.	Arif. Blvd. & Arif. Rd.	Seven Corners	Circle Rd.	11th & Lynn	Conn. & K. N.W.	Arrive 11th & E. St.
7:00	7:05	7:10	7:16	7:23	7:31	7:39	7:45
8:00	8:05	8:10	8:16	8:23	8:31	8:39	8:45
9:00	9:05	9:10	9:16	9:23	9:31	9:39	9:45
10:00	10:05	10:10	10:16	10:23	10:31	10:39	10:45
11:00	11:05	11:10	11:16	11:23	11:31	11:39	11:45
12:00	12:05	12:10	12:16	12:23	12:31	12:39	12:45
1:00	1:05	1:10	1:16	1:23	1:31	1:39	1:45
2:00	2:05	2:10	2:16	2:23	2:31	2:39	2:45
3:00	3:05	3:10	3:16	3:23	3:31	3:39	3:45
4:00	4:05	4:10	4:16	4:23	4:31	4:39	4:45
5:00	5:05	5:10	5:16	5:23	5:31	5:39	5:45
6:00	6:05	6:10	6:16	6:23	6:31	6:39	6:45
7:00	7:05	7:10	7:16	7:23	7:31	7:39	7:45
8:00	8:05	8:10	8:16	8:23	8:31	8:39	8:45
9:00	9:05	9:10	9:16	-	-	-	-

Light Figures Indicate A. M., Dark Figures Indicate P. M.



(SUBJECT TO CHANGE WITHOUT NOTICE) WEEKDAY SCHEDULE

TO WASHINGTON

Table with columns for route number, carrier, aircraft type, departure times, and arrival times for various destinations including Chicago, St. Louis, Kansas City, and Denver.

FROM WASHINGTON

Table with columns for route number, carrier, aircraft type, departure times, and arrival times for various destinations including Chicago, St. Louis, Kansas City, and Denver.

SPRING 1976

APPENDIX III

VEHICLE AND PERSON VOLUMES (INBOUND)

RING 1 (BY SITE)
BY TIME OF DAY

STATION LOCATION	AUTO		On Arlington Boulevard @ North of Queen Street							
	TRANSIT		On Arlington Boulevard @ Meade Street							
PERIOD ENDING	TRANSIT		AUTO AND TAXIS			OTHER VEHICLES				TOTAL $\frac{1}{2}$ VEHICLES
	NO. OF PASSEN- GERS	NO. OF BUSES	NO. OF PASSEN- GERS	NO. OF VEHICLES	AVERAGE OCCU- PANCY	TRUCKS	MOTOR- CYCLES	BICY- CLES	OTHER BUSES	
6:30	18	1	587	460	1.28	4	5	0	0	470
7:00	109	6	1257	996	1.26	9	11	1	2	1024
7:30	357	11	2388	1762	1.36	5	26	3	6	1810
8:00	667	12	3029	2192	1.38	3	10	2	0	2217
8:30	698	15	3122	2330	1.34	7	20	1	0	2372
9:00	357	10	2812	2124	1.32	17	9	0	0	2160
9:30	115	3	1888	1404	1.34	15	11	0	3	1436
10:00	37	1	1264	940	1.34	10	7	0	3	961
11:00	96	4	2027	1440	1.41	31	14	0	0	1489
12:00	34	4	1760	1295	1.36	23	19	0	0	1341
1:00	42	4	1730	1278	1.35	27	16	1	0	1325
2:00	39	4	1742	1239	1.41	23	15	0	0	1281
3:00	33	4	1611	1169	1.38	17	9	0	0	1199
4:00	55	6	1763	1336	1.32	15	9	0	16	1382
5:00	41	7	2062	1526	1.35	14	11	1	52	1610
6:00	39	4	1731	1360	1.27	3	7	0	0	1374
7:00	21	4	1627	1164	1.40	3	10	1	0	1181
A.M. PEAK HOUR 7:30-8:30	1365	27	6151	4522	1.36	10	30	3	0	4589
A.M. RUSH PERIOD 6:30-9:30	2303	57	14,496	10,808	1.34	56	87	7	11	11,019
13-HOUR TOTALS	2758	100	32,400	24,015	1.35	226	209	10	82	24,632

RING 1 (BY SITE)
BY TIME OF DAY

STATION LOCATION		AUTO		On Columbia Pike @ W. of Scott Street							
		TRANSIT		On Columbia Pike @ Scott Street							
13E		TRANSIT		AUTO AND TAXIS			OTHER VEHICLES				TOTAL VEHICLES 1/
PERIOD ENDING	NO. OF PASSEN- GERS	NO. OF BUSES	NO. OF PASSEN- GERS	NO. OF VEHICLES	AVERAGE OCCU- PANCY	TRUCKS	MOTOR- CYCLES	BICY- CLES	OTHER BUSES		
6:30	67	3	421	315	1.34	0	3	1	0	321	
7:00	323	10	601	439	1.37	5	2	0	0	456	
7:30	914	23	1,310	850	1.54	2	13	1	0	888	
8:00	959	18	1,481	982	1.51	10	13	2	8	1031	
8:30	1130	23	998	654	1.53	11	4	1	0	692	
9:00	366	8	544	409	1.33	8	4	1	4	433	
9:30	139	6	503	349	1.44	12	2	1	4	373	
10:00	139	4	338	233	1.45	8	1	0	2	248	
11:00	122	9	746	519	1.44	23	1	5	5	557	
12:00	55	5	836	562	1.49	16	7	2	7	597	
1:00	71	7	1,249	788	1.58	29	8	1	7	839	
2:00	57	9	1,216	768	1.58	24	7	1	2	810	
3:00	42	6	818	560	1.46	16	5	4	7	594	
4:00	72	8	806	590	1.37	27	6	6	8	639	
5:00	74	10	960	681	1.41	17	4	3	5	717	
6:00	46	7	865	628	1.38	6	12	1	5	658	
7:00	21	5	1,018	658	1.55	1	3	1	1	668	
N.H. PEAK HOUR (7:30-8:30)	2089	41	2,479	1636	1.51	34	17	3	8	1736	
A.M. RUSH PERIOD (6:30-9:30)	3831	88	5,437	3683	1.48	61	38	6	16	3886	
13-HOUR TOTALS	4597	161	14,710	9985	1.47	215	95	31	65	10521	