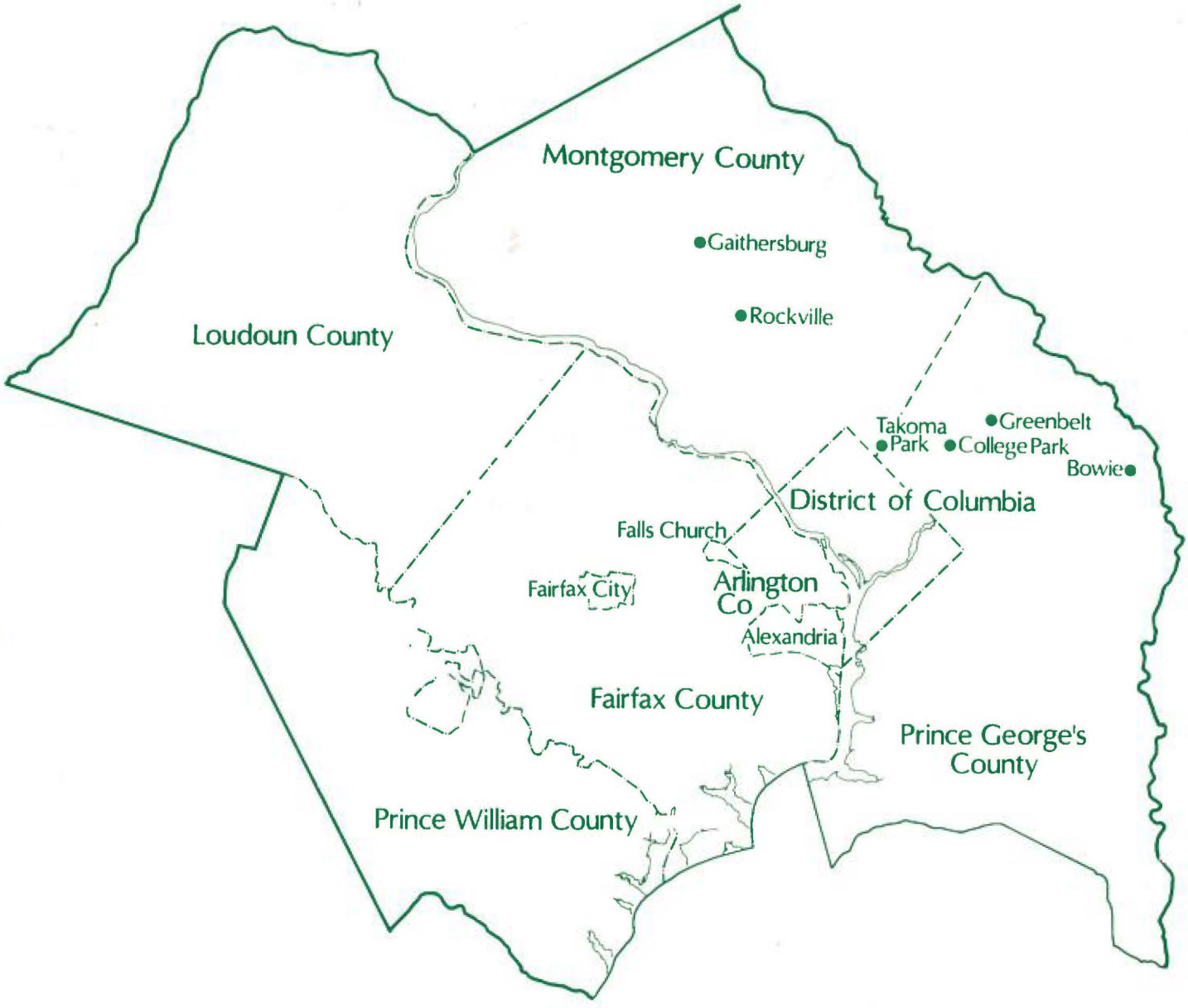
TRAVEL FINDINGS REPORT UPDATE:
CHANGES IN TRAVEL BEHAVIOR

Metropolitan Washington Council of Governments

September 1983



METROPOLITAN WASHINGTON REGION

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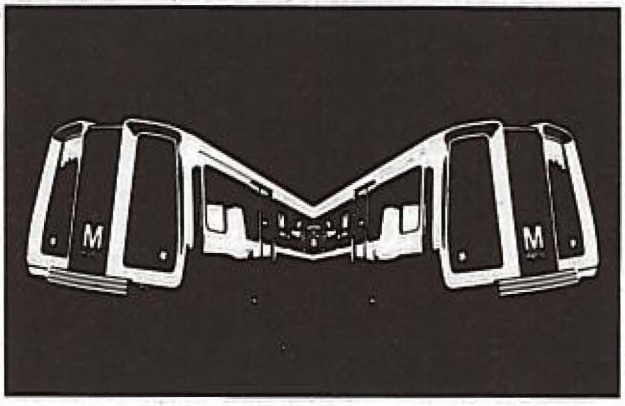

TRAVEL FINDINGS REPORT UPDATE: CHANGES IN TRAVEL BEHAVIOR

METRORAIL BEFORE AND AFTER STUDY

SEPTEMBER 1983

METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS

NATIONAL CAPITAL REGION TRANSPORTATION PLANNING BOARD

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AGENCY:

The Metropolitan Washington Council of Governments is the regional organization of the Washington area's major local governments and their governing officials. COG works toward solutions to such regional problems as growth, transportation, inadequate housing, air pollution, water supply, water quality, economic development and noise, and serves as the regional planning organization for Metropolitan Washington.

REPORT ABSTRACT:

The first segment of Metrorail, Metropolitan Washington's rapid rail transit system, opened in 1976. The system has grown in increments since then. In September 1981, COG published an initial report describing changes in travel behavior related to the first four years of operation of the Metrorail system. This report is an update of the analyses conducted for the first travel findings report, focusing on the subsequent three years of rail operations, and providing current information on the ridership characteristics by operating phase, changes in total transit travel, and changes in travel to the central employment area. Also, a series of quantitative indicators, developed to monitor and compare transit service, use and impacts over time, are computed and presented. This report is produced as part of the Metrorail Before-and-After Study conducted by the Council of Governments.

SUBJECT:

Urban Rapid Transit, Mass Transportation Bus Transit, Journey to Work, Transit Performance Indicators, Central Business District.

PRECEDING REPORTS:

More Than A Subway: A Chronicle of Transit Goals for The Nation's Capital	Apr 1979
The First Four Years of Metrorail: Travel Changes	Sept 1981
Trends Before Metrorail	July 1982
Metrorail Area Planning	Aug 1983

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SUMMARY

This report is an update of the analyses conducted for an earlier report describing the changes in travel behavior related to the first four years of operation of the Metrorail rapid transit system. Since the publication of that first report, in September 1981, Metrorail has extended further into the Virginia and Maryland suburbs and has penetrated the heavily residential areas of Northwest Washington. The nature of these extensions has provided enhanced opportunity for transit use, both work and non-work trip making.

This report contains current information on ridership for rail transit as well as bus and selected auto trips. It describes the growth of transit ridership by operating phase, the effects of change in Metrorail travel on the total transit system, and the extent to which changes in Metrorail travel affect travel to the central employment area. In addition, a series of quantitative indicators, developed earlier to monitor and compare Metrorail and Metrobus service, use and impacts over time, have been computed and the results are presented.

This is one in a series of reports to be produced by the Metropolitan Washington Council of Governments' Metrorail Before and After Program. This program has been supported since 1976 by grants from the Urban Mass Transportation Administration. The program was established to measure the Metrorail system's effects on the Washington region, both direct travel changes, and indirect effects, such as land development.

By 1982, with 39 miles and 43 stations in operation, Metrorail was carrying close to one-half of all weekday transit trips and had become an important fixture in the regional transportation network. It is appropriate to step back at this time, analyze the effects of Metrorail, and to develop information that may allow improvements in future Metro operations and may provide useful experiences to other cities. This study, conducted by the Metropolitan Washington Council of Governments, describes successive evaluations before and after each segment of the rail system became operational between 1979 and 1982.

It is important to note in this analysis that the year 1980, and particularly the summer of that year, represented an anomaly for transit throughout the country. Due in most part to the gasoline shortage, there was a substantial growth in transit ridership during this year. However, it was only a temporary surge in transit ridership, which declined when the gasoline crisis was eased. Although WMATA retained around 90 percent of the ridership increase that occurred in 1980, there was a decrease in ridership after the summer of 1980. Both the growth in transit ridership that was experienced that year and the subsequent decrease must be viewed with this in mind.

CHARACTERISTICS OF METRORAIL TRAVEL

The most celebrated achievement of Metrorail during the first four years of operations was the high level of ridership. The analysis of Metrorail ridership during this time revealed a pattern of continuing growth, even during periods when transit ridership traditionally declines. This

steady growth was evident not only for the total system, but for individual line segments and for interline transfers as well.

The steady growth in average weekday Metrorail ridership continued into the summer of 1979, when a pattern emerged of seasonal fluctuations that transit traditionally displays (summer peaks, winter valleys). No single factor was found that could be responsible for this fluctuating Metrorail ridership pattern, but rather a combination of traditional fluctuations, fare increases and service improvements and expansions, factors that have a strong impact on transit ridership.

Unlike the first four years of rail service, which displayed continuous growth, not only had this fluctuating pattern emerged, but average weekday rail ridership had stabilized at just under 300 thousand passengers per average weekday since the summer of 1980. The decline from the 300 thousand plus peak can be attributed to a combination of factors, such as gasoline price and availability, effects of the economic recession on core area employment, and concern over rail reliability.

Rail ridership during this second period of analysis can be characterized as follows:

- A pattern of seasonal fluctuations emerged, similar to that of traditional transit ridership, attributable to a combination of factors;

- Overall rail ridership has declined from the 'peak' year of 1980 and levelled off, also due to a combination of factors; and,

- These changes have occurred in the context of an expanding rail system, and are therefore incremental in nature as well.

Other areas of interest regarding Metrorail travel are alternative mode of travel for Metrorail riders, and AM peak period modes of access and egress to and from Metrorail stations. These areas were analyzed for each phase of the rail system as it opened, and the results are as follows:

- The major changes in alternative mode of travel of Metrorail riders were a decrease in the percentage of those who would have taken a bus (from 54% to 50%) and increases of almost 3 percent in those who would have been auto passengers, and almost one percent in new trips;

- The AM peak period mode of access to Metrorail stations showed significant changes in bus users (a decrease of 7 percentage points between 1979 and 1982) and those who walk to the station (an increase of 5 percentage points); and

- AM peak period mode of egress from Metrorail stations showed very little change during this time, with close to 90 percent of morning riders walking to their ultimate destination, and most of the rest taking a bus.

Purpose of trips made on Metrorail was closely examined in this report, and a definite pattern was found to have developed. The dominant purpose at the destination end of the Metrorail trip was work, accounting for about two-thirds of all trips made. All other trip purpose categories ac-

counted for less than 10 percent of trips made, each. In addition, better than one in four trips made (28%) were non-home based, indicative of the high level of midday service and use on rail.

Other significant trip purpose conclusions are as follows:

- For the most part, the number of trips made in each purpose category other than work remained fairly constant between 1980 and 1982. Total rail ridership, however, declined by over 7 thousand trips per day during this time. This decline in total rail ridership was due to a major decrease in the work trip category;

- Trips beginning or ending on the new rail extensions primarily are to or from home, rather than trips to work or commercial trips to areas with new rail service;

- A directional imbalance continues to exist in peak period ridership, with only one out of seven passengers travelling in the 'reverse' direction; and,

- Preliminary indications are that Metrorail has had an impact on non-work travel in the Van Ness-UDC corridor, with an increase of 2.1 percent after the extension of rail service.

By the spring of 1982, the 43 stations in operation were generally found to have strong differences in the hours of predominant use, the predominant destination purpose, and the predominant mode of access to the stations:

- Twelve stations, representing just over one-quarter of the stations in operation were used by over 57 percent of all daily Metrorail passengers;

- Over two-thirds of the stations can be identified as peak period stations, with the majority of passengers entering during either AM or PM peak period;

- Better than half of the stations have home as the destination for a majority of the trips to those stations. Of the remaining trips destined to these stations, the majority are for purposes other than work; and,

- Sixty-five percent of weekday passengers walk to the stations. All of the stations located in downtown Washington are classified as work dominant and have almost 80 percent of their users walking to them.

CHANGES IN BUS RIDERSHIP AND THE BUS SYSTEM

As with Metrorail ridership, beginning in the summer of 1979, the pattern of total transit ridership (bus and rail) began to display the historic trend of seasonal fluctuation that characterizes bus only transit. In addition, total transit ridership has experienced a slight but steady decrease since the summer of 1980, which peaked at around 650 thousand riders per day. The fluctuating pattern and the decline in ridership can both be seen in bus ridership as well as rail-related ridership during

this time. The decreasing trend can also be attributed to a combination of factors, such as gasoline prices and employment in the core area, and is similar to the patterns in large transit systems in other U.S. cities.

While the rail system predominantly carries transit riders to and from the central employment area, the focus of the Metrobus system has increasingly shifted from carrying commuters into the city in a line-haul capacity, to serving trips made entirely within the suburbs or entirely within the city. These changes can be summarized as follows:

- Bus trips between suburban jurisdictions and the D.C. core have decreased dramatically between 1979 and 1982;

- Intrajurisdictional bus trips have continued to increase since 1979; and,

- Although wide fluctuations occurred each year in between, annually scheduled bus miles in 1982 were virtually the same in number as 1978, indicating that the decrease in bus miles attributable to the decline in trips to the D.C. core during this time has been offset by an increase in the number of bus miles being travelled within the suburban jurisdictions.

The introduction of rail service into major travel corridors has led to the integration of the bus and rail systems into a single regional transit system. Changes that have been made in Metrobus service since the takeover of the four bus companies (due largely to the opening of Metrorail) have resulted in fewer bus miles being operated than before Metrorail opened in 1976, and more bus passengers being carried. This higher ratio of passengers per bus mile indicates a more efficient bus system is now being operated.

CHANGES IN AUTO TRAVEL

The focus of Metrorail service and ridership to the central employment area makes the D.C. core area the most important area in which to measure the effects of Metrorail on travel behavior. As reported in the first travel findings report, Metrorail allowed substantial increases in travel to the central employment area, thereby increasing capacity in both the highway network and the transit system.

In the first three years of Metrorail operations, auto travel entering the D.C. core decreased substantially, which was thought to be indicative of a downward trend. This trend, however, did not continue. The changes in auto travel since 1979 can be summarized as follows:

- After the decline recorded through 1979, inbound auto trips increased in 1980 and decreased slightly in 1981. The overall effect has been only a small decrease in combined auto driver and passenger trips, 3.4 percent, between 1977 and 1981;

- AM peak period auto travel entering the D.C. core increased by 5.7 percent, almost equally divided between drivers and passengers, between 1977 and 1982; and,

- Similar trends in overall auto travel crossing the D.C. cordon line and in AM peak period auto travel are found in the four major travel corridors.

METRORAIL AND METROBUS INDICATORS

One of the earlier projects associated with the Metrorail Before and After Program identified a series of quantitative indicators which could be used to measure the impact of Metrorail and Metrobus in the region, to compare the different operating segments of the Metrorail system, and to compare the service provided by WMATA to service provided in other U.S. cities.

The results of the computation of the Metrorail and Metrobus indicators are as follows:

- Systemwide indicators show that, as the rail system expanded, the number of scheduled rail trips increased dramatically, while the number of annually scheduled bus miles per transit zone resident decreased.

- Also, as the rail system expanded into less densely populated areas, the number of rail passengers per rail car mile has decreased, and the number of passengers per bus mile has increased;

- The Red Line between Metro Center and Silver Spring is the most heavily used segment, maintaining a higher average of passengers per peak period rail car, and a higher ratio of peak hour passengers to seating capacity than the other Red Line segment, and any of the Blue/Orange Line segments;

- Metrobus indicators show fewer vehicle trips entering the D.C. core area, a constant number of total annually scheduled bus miles, and an increase in bus ridership, resulting in an increase in the ratio of passengers per bus mile; and,

- Total transit system indicators computed show that the WMATA system is in good standing when compared to systems in other major U.S cities, with substantial increases in ridership plus performance indicators for bus and rail that are near or better than average.

PREFACE

This report is an update of the first compilation of the travel findings of the Metrorail Before and After Program. It analyzes the changes in travel behavior that have occurred since the publication of the first report, from the first full year of Phase III operations (1979) through Metrorail's Phase V operations, during 1982. As such, it is an "event" report which documents the findings for the 'next three years' of Metrorail operations and compares them to the earlier findings, as part of the multi-year program sponsored by the U.S. Department of Transportation.

The Metrorail Before and After Program is being conducted by the Metropolitan Washington Council of Governments. Many individuals and organizations have provided invaluable advice, assistance and information to this program. The most critical of these has been the Washington Metropolitan Area Transit Authority, which is responsible for the planning, design, construction and operation of the Metrorail system and the regional Metrobus system. Among WMATA staff who have contributed to this report are Mr. Robert Codding, who has served as the official transit authority liaison for this program, Mr. Robert Pickett and Mr. Warren Shindle.

The program has received guidance from the Transit Planning Subcommittee of the National Capital Region Transportation Planning Board's Technical Committee. This subcommittee is currently chaired by Mr. Frank Derro of the Maryland-National Capital Park and Planning Commission, Prince George's County.

The many contributions of all these individuals are gratefully acknowledged. However, responsibility for the contents of this report and any errors contained therein rests with the Metropolitan Washington Council of Governments. Among MWCOG staff who contributed to this report are members of the Metrorail Before and After Study Management Team: Mr. Robert Dunphy, Project Manager; Mr. George Wickstrom; Mr. Ronald Sarros; Mr. Phillip Shapiro; and, Mr. Robert Griffiths.

The report was authored and prepared by Mr. Kenneth Flick, Senior Transportation Engineer, with assistance from Mr. Christopher Neumann. Ms. Dolores Brandow prepared the graphics and Mr. Mark Pfoutz supervised report publication.

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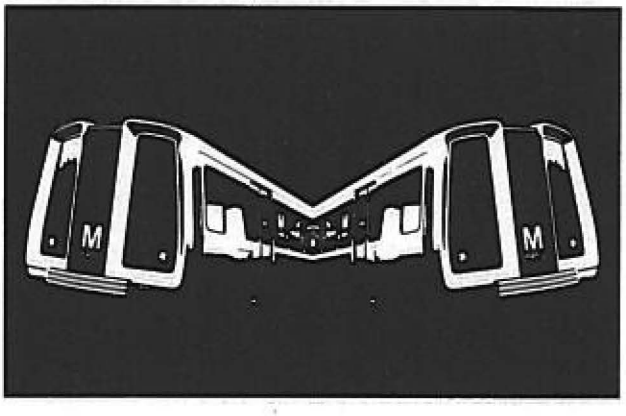
INTRODUCTION



CHAPTER I

INTRODUCTION

BACKGROUND

THE FIRST FOUR YEARS OF METRORAIL: TRAVEL CHANGES

In September 1981, the Metropolitan Washington Council of Governments published a report describing changes in travel behavior related to the first four years of operation of the Metrorail rapid transit system, as part of the Metro Before and After study. That report described travel changes resulting from the initial opening of the downtown subway spur through one full year of operations of the first completed route, to New Carrollton, Maryland which opened in November 1978. Characteristics of rail passengers and stations, bus travel auto travel and travel to the central employment area were analyzed, as well as the effects of rapid transit on a major suburban employment center.

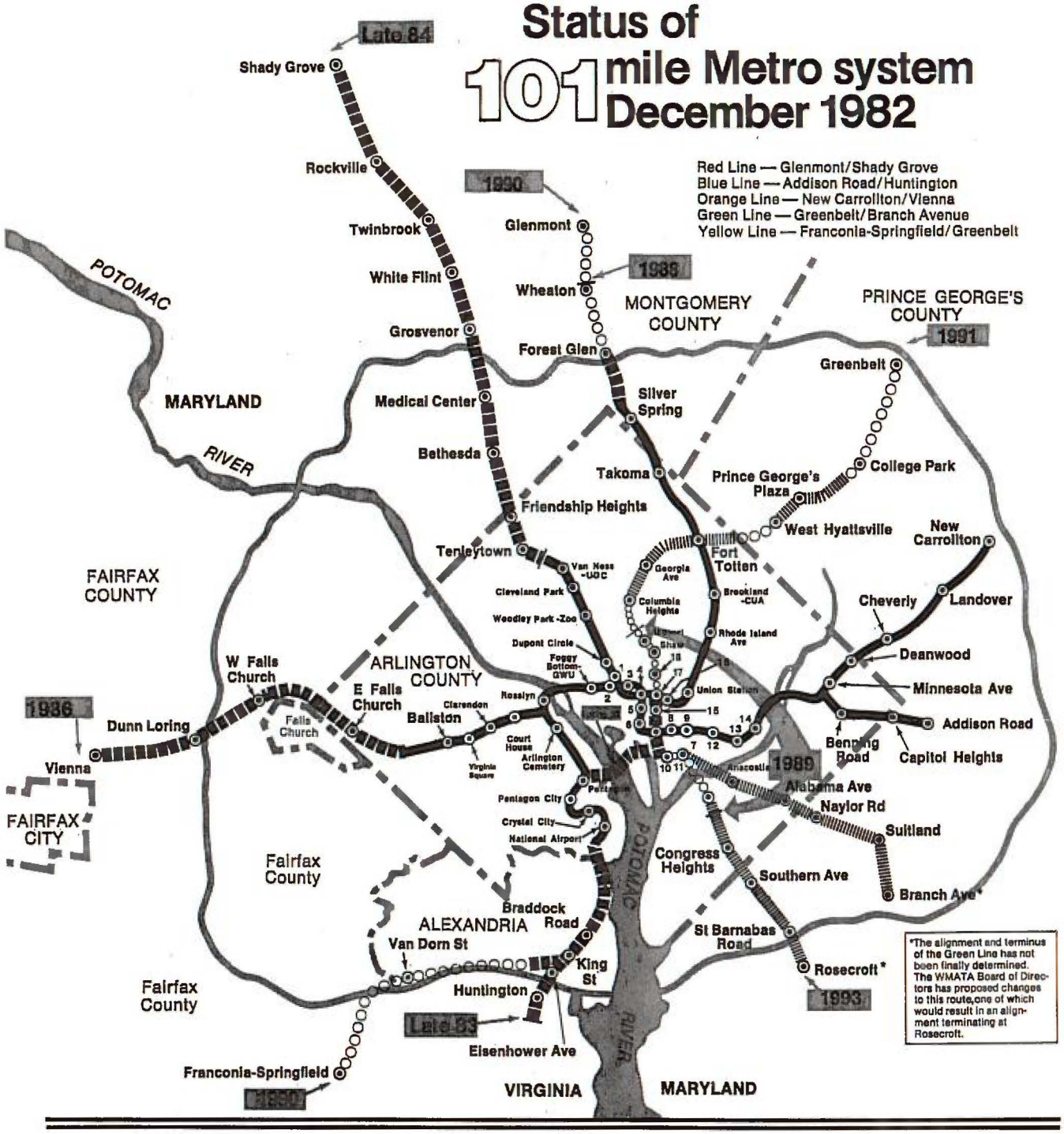
Since the analysis conducted for the first travel findings report, Metrorail has extended further into the Maryland and Virginia suburbs and has penetrated the urban residential areas of Northwest Washington. The nature of these extensions has provided enhanced opportunity for transit use, for both work and non-work trip making.

This report is an update of the analyses conducted for the first travel findings report, providing the most current information on ridership for rail transit as well as bus transit and selected auto trips. It describes the growth of transit ridership by operating phase, the effects of changes in Metrorail travel on the total transit system, and the extent to which changes in Metrorail travel affect travel to the central employment area. Particular attention is given to changes in the purpose of trips made on Metrorail and to the impacts of rail extensions on non-work travel. In addition, a series of quantitative indicators, developed as an earlier task in the Metro Before and After Study, to monitor and compare Metrorail and Metrobus service, use and impacts over time, have been computed and the results are presented.

THE METRORAIL SYSTEM

The Washington Metropolitan Area Transit Authority (WMATA) has opened the Metrorail system in a series of operating phases, beginning with Phase I in 1976. At present, the system is expected to be completed in 1993. A map of the planned 101-mile, 86-station rapid rail system is shown in Figure 1.1. Current operations cover 39.1 miles and 43 stations on three lines: the Red Line from Van Ness-UDC in Upper Northwest Washington to Silver Spring in Montgomery County, Maryland; the Blue Line from National Airport in Northern Virginia to Addison Road in Prince George's County, Maryland; and, the Orange Line from Ballston in Arlington County, Virginia to New Carrollton in Prince George's County. The sequence of actual openings to date and the current schedule of planned openings of the remaining segments of the rail system is as follows:

ADOPTED 101-MILE METRORAIL SYSTEM



LEGEND

- Operating Lines 39.12 miles 44 stations
- Under Construction or Substantially Complete 32.4 miles 22 stations
- Under Final Design 19.78 miles 12 stations
- Remainder of System 9.88 miles 8 stations
- 1988 — Projected start of operations for this segment based on approved schedule. Applies to all stations inbound from this point.

Total mileage—101.18

Total stations—86

1. Farragut North
2. Farragut West
3. McPherson Square
4. Metro Center
5. Federal Triangle
6. Smithsonian
7. L'Enfant Plaza
8. Federal Center SW
9. Capitol South
10. Waterfront
11. Navy Yard
12. Eastern Market
13. Potomac Ave
14. Stadium-Armory
15. Archives
16. Judiciary Square
17. Gallery Place
18. Mt Vernon Sq-UDC

Washington Metropolitan Area Transit Authority
600 Fifth Street, N.W., Washington, D.C. 20001

Department of Public Services: Office of Public Affairs
Paul Willis, Editor
637-1047

SEQUENCE OF METRORAIL OPENINGS

LINE	OPERATING SEGMENT	DATE
	(In operation as of January 1, 1983)	
Red	Farragut North to Rhode Island Avenue	March 1976
Red	Gallery Place Station	December 1976
Red	Farragut North to Dupont Circle	January 1977
Blue	National Airport to Stadium-Armory	July 1977
Red	Rhode Island Avenue to Silver Spring	February 1978
Orange	Stadium-Armory to New Carrollton	November 1978
Orange	Rosslyn to Ballston	December 1979
Blue	Stadium-Armory to Addison Road	November 1980
Red	Dupont Circle to Van Ness-UDC	December 1981
	(For planning purposes only)	
Yellow	Gallery Place to National Airport via Potomac River Bridge	Spring 1983
Blue	National Airport to Huntington	Late 1983
Red	Van Ness-UDC to Shady Grove	Late 1984
Orange	Ballston to Vienna	Early 1986
Red	Silver Spring to Wheaton	Mid 1988
Green	Anacostia to U Street	Mid 1989
Yellow	King Street to Franconia-Springfield	Mid 1990
Red	Wheaton to Glenmont	Mid 1990
Green	U Street to Greenbelt	Mid 1991
Green	Anacostia to Rosecroft	Mid 1993

Hours of operation are from 6 a.m. to midnight Monday through Friday, 8 a.m. to midnight on Saturdays and 10 a.m. to 6 p.m. on Sundays. Trains operate on a 3 to 6 minute headway (the length of time between trains, a measure of frequency of service) during the rush hours and on a 6 to 12 minute headway at all other times. Trains consist of between 2 and 8 cars

(even numbers only) depending on the day of the week and on the time of day.

The initial travel changes report focused on the first three operating phases of the Metrorail System - through the opening of the Orange Line from Stadium-Armory to New Carrollton. This update concentrates on the additional operating phases that have opened since 1978: Phase IV - the Orange Line from Rosslyn to Ballston in Northern Virginia; Phase IVA - the Blue Line from Stadium-Armory to Addison Road in Southeast Washington and Prince George's County, Maryland; and Phase V - the Red Line from Dupont Circle to Van Ness-UDC in upper northwest Washington.

WMATA practice has been to follow the extension of Metrorail service into a major travel corridor with the revision of existing bus service in that corridor, to reduce operating costs and to eliminate, as much as possible, duplicative transit service. A chronology of Metrorail operations for the newly opened phases, and the attendant changes to Metrobus service with each rail extension is contained in Table 1.1.

STUDY PURPOSE

The Metrorail system in the Washington Metropolitan area represents the single most costly civil construction project in United States history, and only the second rail rapid transit system to be built in this country since the Depression. Due to the magnitude of capital funds being expended to build a relatively short system, the Metrorail Before and After Study was designed to assess the impacts of such a major transportation investment.

In a number of ways, construction of the Metrorail system represents a major experiment in whether or not building a rapid rail system in a region which experienced most of its growth in the automobile era would have effects similar to those experienced in older cities such as New York, Boston and Philadelphia where growth followed the rail lines.

The Metropolitan Washington Council of Governments (COG) initiated the Metrorail Before and After Program to provide a formal record of the effects of Washington's rail system for local planners, Federal and State transportation policy makers, and the transportation profession at large. Federal officials could find such an analysis useful in dealing with other cities, and local planners could learn much to help deal with future stages of Metrorail. A similar study of the Bay Area Rapid Transit (BART) System in San Francisco was conducted, and a concurrent study of the Metropolitan Atlanta Rapid Transit Authority (MARTA) System is now underway. The Metrorail Before and After Program began with an initial planning grant from the Urban Mass Transportation Administration in 1976 for the design of a multi-year program to observe and document the influence of Metrorail on the National Capital Region.

The report, The First Four Years of Metrorail: Travel Changes, summarized the findings of the Metrorail Before and After Study on travel impacts during the first years of rail operations. As a continuing part of that study, this report updates the analyses conducted for the first travel findings report, providing current information on ridership, transit

travel, individual Metrorail station characteristics, and the effectiveness of Metrorail as a transit system.

TABLE 1.1

CHRONOLOGY OF METRORAIL AND METROBUS OPERATIONS

PHASE	MILEAGE	STATIONS	OPENING DATE
Phase I	4.6 mi.	5-6 Stations	March 26, 1976
Phase IA	5.7 mi.	7 Stations	January 17, 1977
Phase II	17.6 mi.	24 Stations	July 1, 1977
Phase IIA	23.3 mi.	28 Stations	February 6, 1978
Phase III	30.8 mi.	33 Stations	November 20, 1978
Phase IV	33.6 mi.	37 Stations	December 1, 1979
Phase IVA	37.1 mi.	40 Stations	November 22, 1980
Phase V	39.1 mi.	43 Stations	December 5, 1981

March 26, 1976	PHASE I	Red Line Opens 4.6 mi. & 5 Sta.
December 15, 1976		Gallery Place Sta. opens
January 17, 1977		Dupont Circle Sta. & 1.1 mi. opens
July 1, 1977	PHASE II	Blue Line Opens 11.9 mi. & 17 Sta.
August 1, 1977		Partial Metrobus turnbacks (All except Bladensburg and Alexandria garages)
September 4, 1977		Complete Metrobus turnbacks
February 6, 1978	PHASE IIA	Red Line Opens 5.7 mi. & 4 Sta.
February 21, 1978		Complete Metrobus turnbacks
September 25, 1978		Rail service extended from 8 p.m. to midnight on weekdays
September 30, 1978		Saturday rail service initiated from 8:00 a.m. to midnight
November 20, 1978	PHASE III	Orange Line Opens 7.5 mi. & 5 Sta.
December 4, 1978		Complete Metrobus turnbacks
September 1, 1979		Sunday rail service initiated from 10:00 a.m. to 6:00 p.m.
December 1, 1979	PHASE IV	Orange Line Opens 2.8 mi. & 4 Sta.
January 6, 1980		Complete Metrobus turnbacks
November 22, 1980	PHASE IVA	Blue Line Opens 3.5 mi. & 3 Sta.
January 4, 1981		Complete Metrobus turnbacks
December 5, 1981	PHASE V	Red Line Opens 2.0 mi. & 3 Sta.
January 31, 1982		Partial Metrobus turnbacks
June 20, 1982		Complete Metrobus turnbacks (Van Ness-UDC Station off-street bus facilities opened)

REPORT FORMAT

The initial travel findings report was intended to be an "event" report which summarized travel impacts of Metrorail through the operation of Phase III, the first completed route, to New Carrollton, Maryland. Similarly, this report is an "event" report which documents the travel findings through Phase V, for the extensions of service on the Orange Line to Ballston (into the heavily residential section of Arlington County), on the Blue line to Addison Road (into the residental communities of Prince George's County), and on the Red line to Van Ness-UDC (into the residential sections of upper Northwest Washington). Figure 1.2 schematically displays the geographic locations of each of the three new extensions.

The results of the Metrorail Before and After Study up to this point provide a great deal of descriptive analysis of the ongoing effects of Metrorail. The data used in the analysis include Metrorail passenger surveys (as reported by WMATA and special tabulations of those surveys by COG), miscellaneous bus and rail operating characteristics reported by WMATA, COG surveys of central area commuters, and COG cordon counts of travel by mode. Each of these data sources provides a different prospective on the impacts of Metrorail, and each has certain limitations. Combining these data sources provides insight into the effects of Metrorail travel impacts which would not be possible using each of these data sources independently.

The purpose of each of the remaining chapters of this report is as follows:

Chapter II: Changes in Metrorail Ridership

An overview of trends in Metrorail ridership since operations began in 1976; mode of access to and mode of egress from the system; changes in the alternative modes of travel of Metrorail users; incremental changes at each stage.

Chapter III: Purpose of Trips Made on Metrorail

Analysis of the extent to which the composition of trip purpose has changed; trip purpose based on different operating phases of Metrorail; changes in use of transit for commuting to work; effects of Phase V rail operations on non-work travel.

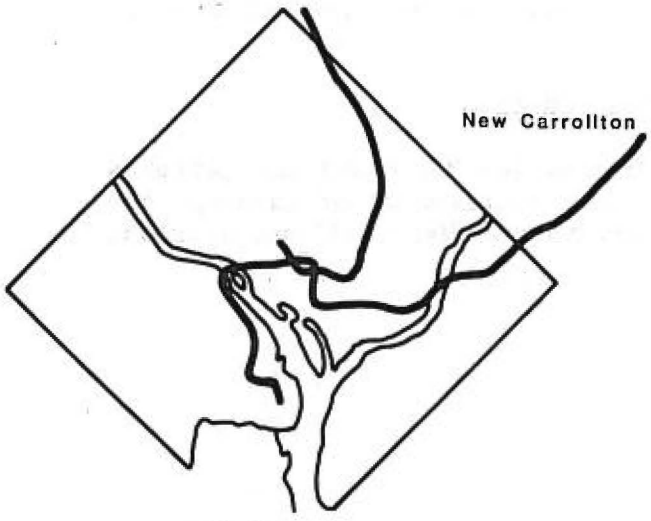
Chapter IV: The Effects of Metrorail on the Total Transit System

Growth in total transit ridership over time; the extent to which changes in Metrorail travel affected bus travel (diverted transit trips); the effect of Metro on total transit travel; accompanying changes in bus service and use.

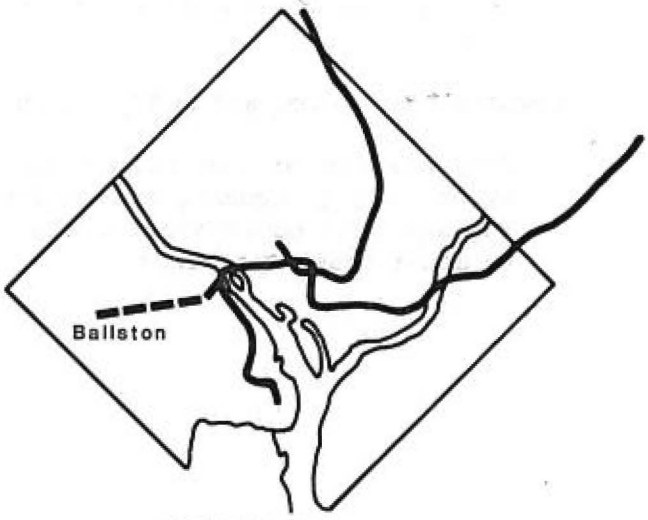
Chapter V: Travel to the Core

The extent to which changes in Metro travel resulted in changes in auto travel (diverted auto trips) to the core; changes in central area travel by time of day; differential growth in auto, bus, and rail ridership by corridor.

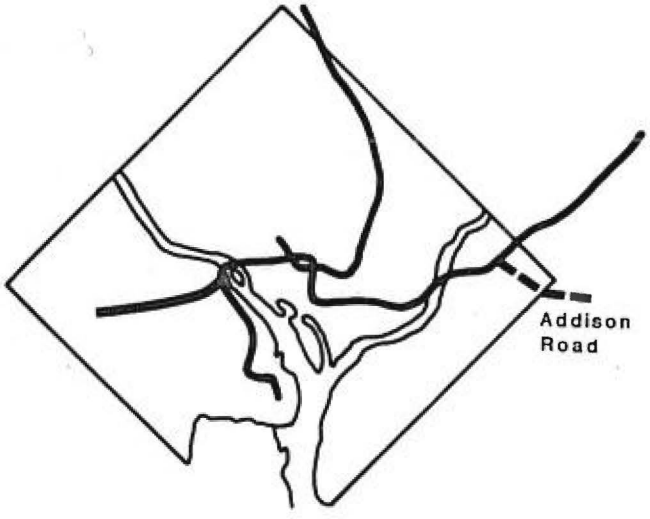
METRORAIL PHASES 1979-1982



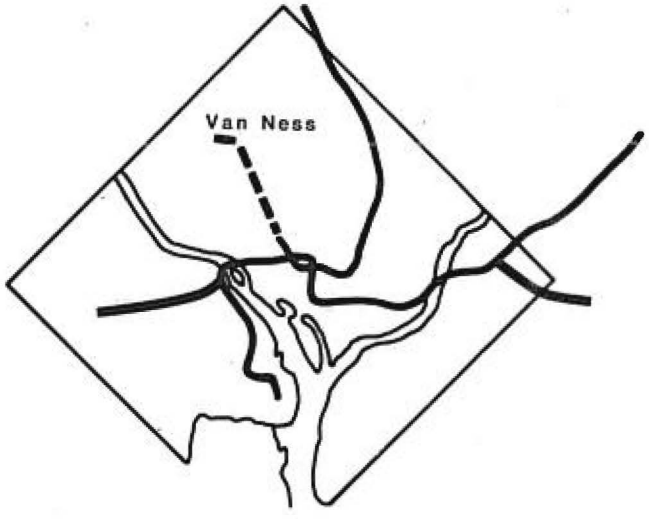
PHASE III



PHASE IV



PHASE IV-A



PHASE V

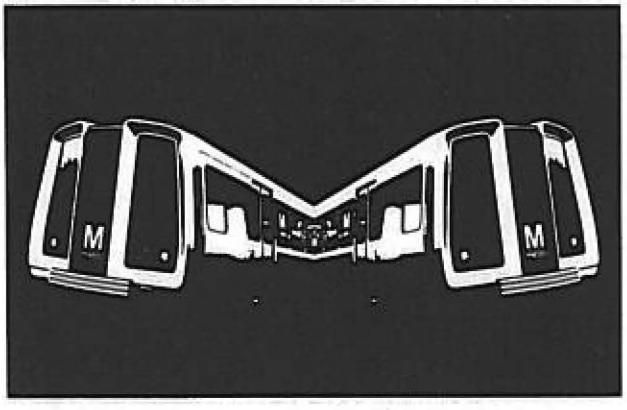
Chapter VI: Metrorail Station Characteristics

Analysis of the geographical distribution of Metrorail travel at the station level; classification of Metrorail stations by arrivals by time of day, by trip purpose at the destination, and by mode of access; examination of how different Metrorail stations are used by transit riders.

Chapter VII: Metrorail and Metrobus System Indicators

Presentation of the indicators calculated for Metrorail and Metrobus by operating segment; evaluation of the effectiveness of each operating segment; comparison of the effectiveness of Metrorail and Metrobus to other transit systems.

CHAPTER 2
CHANGES IN METRORAIL RIDERSHIP



CHAPTER II

CHANGES IN METRORAIL RIDERSHIP

EARLY GROWTH IN METRORAIL RIDERSHIP (1976-1979)

The early history of Metrorail ridership, during the first three and one-half years of operation, was one of spurts in growth with the opening of each additional segment and each expansion of service hours, which continued during the interim periods between these events. This strong pattern of continuous growth stood in contrast to typical bus ridership patterns, which display seasonal peaks in early summer, declines through the fall to a low, usually in January, and then growth again in the spring months to another early summer peak. Early Metrorail ridership continued its growth during the periods between service extensions, and between what would have been the seasonal peaks.

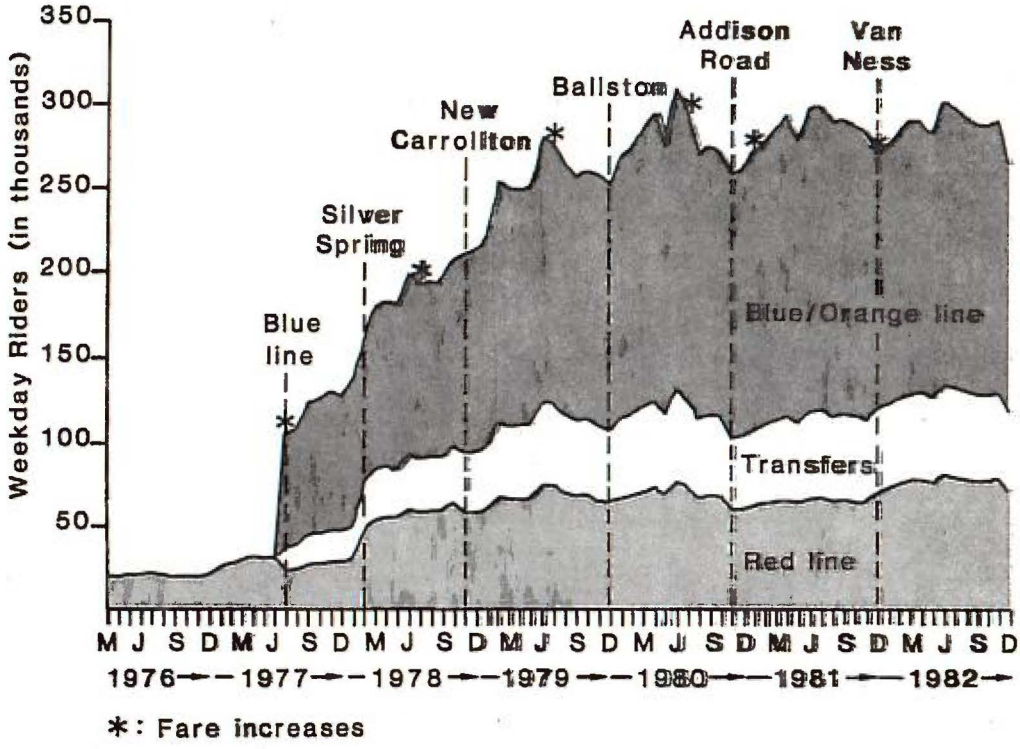
This trend is illustrated in Figure 2.1, which displays average weekday ridership on a monthly basis for the total Metrorail system, and broken down by line segment - for the Red Line, for interline transfers, and for the Blue/Orange Line. After a pattern of somewhat constant ridership, from the opening of the initial Red Line segment in March 1976 to June 1977, substantial increases in total ridership can be traced to when the initial Blue Line segment opened (July 1977), and further increases when service was extended to Silver Spring (February 1978) and to New Carrollton (November 1978). This steady growth continued after the Phase III, New Carrollton opening until reaching a peak in the summer months of 1979. In the breakdown of ridership by line segment, the bottom graph in Figure 2.1 showing ridership patterns on both lines plus interline transfers, it can be seen that, with minor fluctuations, ridership on both lines, and transfers as well, continued the steady increase during the 1976 - 1979 period.

The analysis of Metrorail ridership during the first three years of rail operations, then, revealed this pattern of continuing growth, even during periods when transit ridership traditionally declines. This steady growth was evident not only for the total system, but for the individual line segments and for interline transfers as well.

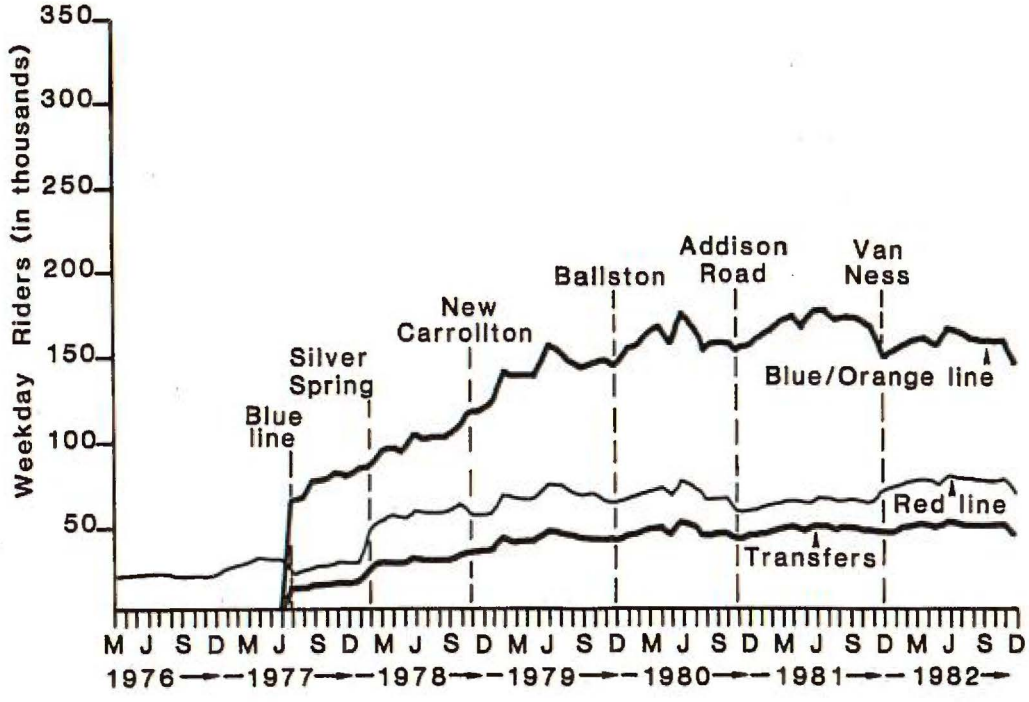
SUBSEQUENT CHANGES IN METRORAIL RIDERSHIP (1979-1982)

The steady growth in average weekday Metrorail ridership continued into the summer of 1979, when a pattern began to develop that is very much like the seasonal fluctuations historically experienced in bus ridership. Each year since 1979, Metrorail ridership has experienced a trend of peaking in the summer, usually in June, steady declines through the fall to a low, usually in January, and then growth again through the spring to another summer peak. The breakdown of Metrorail ridership by line segment in Figure 2.1 displays some insight into the pattern of fluctuation that has appeared. While riders transfering between the two lines have remained somewhat constant since 1979, and Red Line ridership, although displaying slight fluctuations, has held its own during these three and

TOTAL METRORAIL RIDERSHIP
1976-1982



METRORAIL RIDERSHIP BY LINE SEGMENT
1976-1982



one-half years, major fluctuations appear in the Blue/Orange Line ridership. Starting in the summer of 1979, the same peaks and valleys that appear in total ridership also appear, to a somewhat lesser degree, in Blue/Orange Line ridership. Table 2.1 contains a comparison of average weekday Metrorail ridership since 1979, which shows the fluctuating ridership by month, as a percentage of the yearly average.

TABLE 2.1

COMPARISON OF AVERAGE WEEKDAY METRORAIL RIDERSHIP

BY MONTH

	1979	1980	1981	1982	Avg.
	(Percentages of Yearly Average)				
Jan	.86	.97	.96	.96	.94
Feb	.99	.98	.97	.99	.98
Mar	.97	1.03	1.00	1.01	1.00
Apr	.97	1.06	1.03	1.01	1.02
May	.98	.99	.98	.98	.98
Jun	1.09	1.11	1.04	1.05	1.07
Jul	1.08	1.06	1.05	1.04	1.06
Aug	1.03	.97	1.01	1.02	1.01
Sep	1.00	.99	1.02	1.02	1.01
Oct	1.02	.98	1.01	1.00	1.00
Nov	1.01	.93	.99	1.00	.98
Dec	.98	.94	.95	1.01	.97
Avg.	257,176	279,882	286,830	288,585	278,118

It is, however, difficult to attribute this pattern solely to seasonal fluctuations. Other factors which traditionally have similar effects on

transit ridership were present during these three years as well. Fare increases on Metrorail, which, in the past, have been the primary factor in as much as a 10% decrease in ridership, were put into effect on July 1, 1979 and June 28, 1980. These fare increases, roughly 12% and 22% respectively, are thought to have contributed to the ridership declines. However, subsequent fare increases, taking place on January 4, 1981 and December 5, 1981, became effective during periods of ridership growth. Therefore, fare increases cannot be found solely responsible for these fluctuating ridership patterns.

As was evident in the early growth in Metrorail ridership, each of the later extensions of rail service contributed to substantial increases in rail ridership, systemwide and on the individual segments as well. The openings of the three extensions since 1979, as seen in Figure 2.1, are most definitely contributing factors to the fluctuating pattern of rail ridership. The extensions to Ballston, Addison Road, and Van Ness-UDC were opened in December 1979, November 1980 and December 1981, respectively. In each case, rail ridership began its growth toward the following summer peak shortly after the rail extension opened. However, this factor is not solely attributable for the ridership pattern either, since approximately six months after each opening, there is a substantial drop in ridership that did not appear as sharply after the previous extensions of service.

No single factor has been found, then, that seems to be responsible for the fluctuating Metrorail ridership pattern that has appeared since the summer of 1979, but rather a combination of seasonal fluctuations, fare increases, and service expansions - factors that traditionally have a strong impact on transit ridership.

It is also important to note that, unlike the first three and one-half years of rail service, which enjoyed continuous growth, not only has this fluctuating pattern of rail ridership appeared, but average weekday ridership, systemwide, has stabilized since the peak reached in the summer of 1980. The reason for this is certain to be a combination of factors, such as gasoline price and availability, effects of the economic recession, or concern regarding rail reliability. A thorough analysis of all of the possible factors is beyond the scope of this report.

INCREMENTAL CHANGES IN RIDERSHIP

Since the fluctuating pattern of Metrorail ridership that developed after the summer of 1979 has occurred against a background of new segments being put into operation, an analysis of the incremental changes in ridership between each operating phase might provide more insight than measuring yearly increases alone. A particular analysis from the annual Metrorail passenger surveys makes it possible to classify rail trips by line, identify transfers and separate those trips having one end on a new extension of an existing line. Table 2.2 shows the daily Metrorail ridership by line segment as each of the new phases of rail operations has opened, comparing the numbers of riders that used prior segments of the system with those using the new segments. This table shows the changes in ridership for both lines in operation as well as transfers between the two, since the beginning of rail service in May 1976. The analysis in this section will focus on those changes that occurred between May 1979 and May 1982.

TABLE 2.2

DAILY METRORAIL RIDERSHIP BY LINE SEGMENT

(In 1,000's)

LINE:	May 1976	Nov 1977	May 1978	May 1979	May 1980	May 1981	May 1982
RED:							
Prior[1]	--	29.8	30.8	68.9	75.7	65.8	56.8
New[1]	21.3	--	24.6	--	--	--	21.7
Total	21.3	29.8	55.4	68.9	75.7	65.8	78.5
BLUE/ORANGE:							
Prior	--	--	95.9	117.1	143.7	166.2	166.2
New	--	82.9	--	24.9	28.9	11.7	--
Total	--	82.9	95.9	142.0	172.6	177.9	166.2
TRANSFERS:							
Prior	--	--	20.8	40.9	48.4	49.3	44.1
New	--	18.5	9.5	3.7	4.3	1.6	8.9
Total	--	18.5	30.3	44.6	52.7	50.4	53.0
UNKNOWN:	--	3.3	4.4	4.4	4.4	1.9	0.6
TOTAL	21.3	134.5	186.0	259.9	305.4	296.0	298.3

SOURCE: Metrorail Passenger Surveys; WMATA

It can be seen from this table that the increase in total daily rail ridership between Phase III rail operations (May 1979) and Phase IV operations (May 1980) was approximately 17.5 percent - from 259,900 to 305,400. Examining the breakdown by line segment, we see that about two-thirds of the increase is attributed to 'new' ridership on the Blue/Orange Line. Almost 29 thousand passengers per day were using the new Orange Line segment from Ballston to Rosslyn, which opened in December

[1] Figures for 'Prior' ridership refer to passengers travelling over segments which were in operation prior to the latest opening, while figures for 'New' ridership refer to passengers travelling over the latest segment to open (e.g. May 1981 'New' ridership refers to passengers using the Blue Line extension to Addison Road, opened in November, 1980).

1979. The remainder of the increase in ridership was split between the Red Line (an increase of 6,800 passengers or 9.8%) and interline transfers (an increase of 8,100 passengers, of which 4,300 were 'new' transfers).

The slight decrease (9,400 passengers or 3%) in ridership between Phase IV (May 1980) and Phase IVA (May 1981) must be viewed in terms of 'new' versus 'prior' ridership. The Addison Road extension of the Blue Line, opened in November 1980, resulted in 11,700 'new' riders on the Blue/Orange Line and 1,600 'new' transfers. A decrease of 9,400 passengers in total ridership viewed against the 13,300 'new' riders points to a loss in passengers using rail segments that were in operation prior to the opening of Addison Road. This loss in 'prior' ridership is seen on both the Red Line (from 75,700 to 65,800) and the Blue/Orange Line (from 172,600 to 166,200), as well as in transfers (from 52,700 to 49,300).

Phase V ridership on the Red Line (May 1982) showed an increase of 12,700 passengers per day over Phase IVA ridership (May 1981). However, there was a decrease in the number of 'prior' riders, using the line from Dupont Circle to Silver Spring. This decrease (9,000) was more than offset by nearly 22,000 passengers entering the system on the new Red Line segment from Van Ness-UDC to Dupont Circle. This, plus the restructured bus service in the Connecticut Avenue corridor, suggests that a number of trips that once began at Dupont Circle or further south on the Red Line, perhaps transferring from bus, now originate along the new extension.

Also, in Table 2.2, there is an increase in total daily ridership between Phase IVA operations (May 1981) and Phase V operations (May 1982) of just over two thousand passengers per day. Looking at the breakdown by line, however, we see that interline transfers showed a slight increase during this period, and that Red Line ridership, as discussed before, experienced a larger increase. Therefore, a substantial loss in ridership must have occurred on the Blue/Orange Line. Table 2.2 shows a decrease in Blue/Orange Line total ridership of just less than 12 thousand passengers per day. Further analysis of this decrease in Blue/Orange Line ridership indicates a loss of passengers on almost all segments of the line. The Virginia segments of this line (National Airport to Rosslyn and Ballston to Rosslyn) experienced a total decrease of 8.7 percent. The Maryland segments (New Carrollton to Stadium-Armory and Addison Road to Stadium-Armory) were just about even. And, the District of Columbia segments (Rosslyn to Metro Center and Stadium-Armory to Metro Center) experienced a total decrease of 6.7 percent. In absolute numbers, the ridership loss on the D.C. segments of the Blue/Orange Line was almost twice the loss in ridership on the Virginia segments. This lends credence to the theory that employment within the District of Columbia, which experienced a 1.1 percent decline during this period of time, is an important factor in determining Metrorail ridership. Another important factor is the resident labor force in the District, which decreased by a total of 37,000 persons in the decade 1970 to 1980, and decreased by an additional 12,000 persons between 1980 and 1982.

Other Metrorail related areas of interest to planners and Federal, State and local transportation policy makers have also experienced changes as each new segment becomes operational. In the next few sections of this chapter, analyses regarding changes in alternative modes of travel of Metrorail riders, and changes in AM peak period modes of access and egress

to and from Metrorail stations that were experienced as each additional segment was opened, are presented.

PHASE III OPERATING SYSTEM (May 1979)

The initial travel findings report summarized the impacts of Metrorail on travel behavior through the operation of Phase III, which extended service to the first station planned as a terminus, at New Carrollton, Maryland. This updated report will use the Phase III operating system as a base and will examine changes that have occurred as each new extension became operational since that time. The New Carrollton extension opened in November 1978, bringing the system to 33 stations and 31 miles of rail. Analysis of the passenger survey conducted in May 1979 gives an overview of the effect of Metrorail on travel behavior through Phase III. This section will present the findings of the May 1979 Metrorail passenger survey, which will be used as a base for further comparisons.

To determine alternative mode of travel, the passenger surveys asked, "How would you have made this trip if Metrorail were not available?" By the end of the third year of rail operations, a majority (54%) of the respondents answered that they would have taken a bus as an alternative to Metrorail. Out of approximately 260,000 passengers, almost 141,000 could be considered to have been diverted from bus. Figure 2.2 displays the breakdown, in absolute numbers, of alternative mode of travel of the average weekday ridership on Metrorail. The second most frequent alternative mode was auto - 61,000 or 23% would have been auto drivers and 11,000 (4.5%) would have been auto passengers. About 8 percent of the passengers reported that a taxi was their alternative, while one out of twenty would not have made the trip (new trips). The remaining 5 percent of the passengers responded 'other' modes, such as commuter rail and walk.

With rail operations through Phase III, the systemwide mode of access to the Metrorail stations in the AM peak period showed wide diversity. Figure 2.3 displays the mode split in absolute numbers as of May 1979. While 43% of Metro riders arrived at the station by bus, those walking to the station and those arriving by car (combining auto drivers with auto passengers) were virtually equal, with 26% and 27% respectively. Those using 'other' modes to arrive at the station, including commuter rail, bicycles, etc., were at 4% of the AM peak period ridership.

In contrast to the AM peak period mode of access figures, the morning peak period mode of egress at the destination end of the Metrorail trip shows a remarkably different pattern. Figure 2.4 shows that almost 90 percent of the morning Metro riders walked from the last station to their ultimate destination. The second most common mode of egress was bus, which accounted for fewer that one in ten riders. The remainder of the riders were evenly split between the auto and 'other' modes, however, their numbers were very small. This highlights the importance of employment sites being within walking distance of a Metrorail station.

PHASE IV OPERATING SYSTEM (May 1980)
(The Virginia Orange Line Segment)

The opening of Phase IV, the Orange Line extension to Ballston, in December 1979, marked the initiation of service into the heavily residential

ALTERNATIVE MODE OF TRAVEL OF METRORAIL RIDERS SYSTEMWIDE
(MAY 1979)

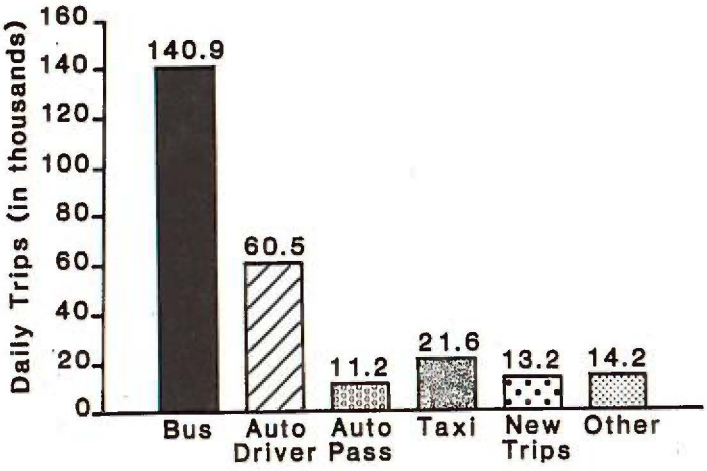


Figure 2.3

AM PEAK PERIOD MODE OF ACCESS SYSTEMWIDE (MAY 1979)

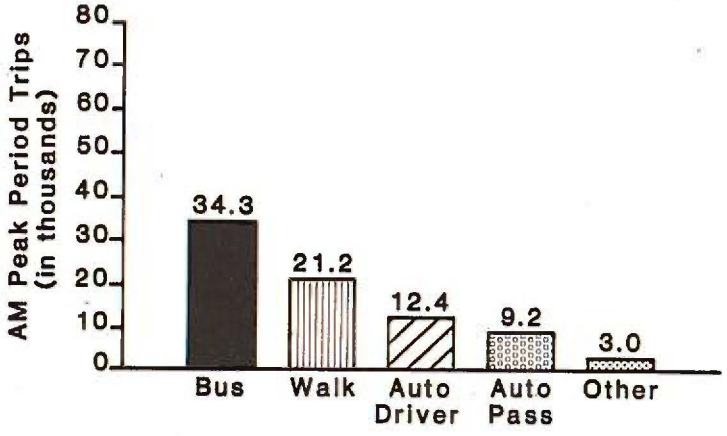
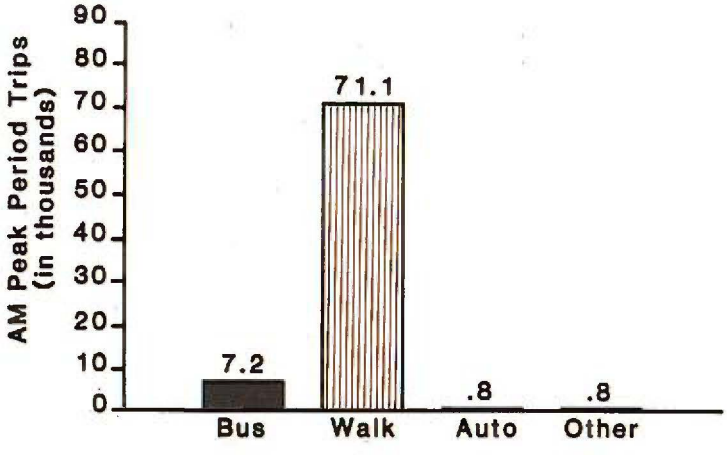


Figure 2.4

AM PEAK PERIOD MODE OF EGRESS SYSTEMWIDE (MAY 1979)



and commercial sections of Arlington County, Virginia. The Orange Line travels from Ballston to Rosslyn, where it joins the Blue Line and shares the tracks through downtown Washington. The opening of Phase IV added four stations and 2.8 miles of rail to the system. As discussed earlier, following this extension, ridership entirely within the Blue/Orange Line increased by over 19 percent, an increase of almost 29 thousand passengers per day, while there was a 9.5 percent increase in rail transfers attributable to this extension.

The breakdown in absolute numbers of alternative mode of travel of Metrorail riders through the Phase IV operating system (May 1980) is shown in Figure 2.5. Although the number of riders responding that they would have taken a bus as an alternative to Metrorail increased by over 14,000, the percentage of total rail ridership that was diverted from bus slightly decreased, from 54 percent to 52 percent. Substantial increases were also experienced in those diverted from auto, both drivers (12,600) and passengers (over 3,900), those who would not have made the trip (3,800) and those diverted from taxi (about 3,000). However, the relative percentages for these categories remained within one point of the May 1979 figures.

The AM peak period mode of access figures for operations through Phase IV differ very little from those for the previous year. Although the numbers of riders increased, corresponding to the increase in total ridership, the percentages for the various modes changes little. As Figure 2.6 shows, bus still led as the highest percentage mode of access from home to Metro with 44 percent. Those walking and those arriving by car remained virtually equal with 27 percent and 26 percent respectively, and 'other' modes made up the remaining 3 percent of the morning riders.

Similarly, AM peak period mode of egress from Metrorail to the final destination in May 1980 was dominated by those riders who walk, with 89 percent, and bus riders making up virtually all of the rest. Figure 2.7 displays the absolute numbers for each egress mode.

PHASE IVA OPERATING SYSTEM (May 1981)
(The Blue Line Branch to Addison Road)

Phase IVA operations began in November 1980, extending rail service on the Blue Line into the residential communities in central Prince George's County. This branch line travels from Addison Road to Stadium-Armory, joining the Orange Line to share tracks through downtown Washington, and added only 3 stations and 3.5 miles of rail to the system. When Phase IVA opened, Metrorail ridership was stabilizing after reaching a peak of over 300 thousand average weekday passengers (summer 1980). By May 1981, initiation of this service was responsible for a slight increase in ridership entirely within the Blue/Orange Line (3%). However, this increase was more than offset by losses on the Red Line (13.1%) and in interline transfers (3.4%), for a systemwide loss of approximately 6,400 passengers per day.

The alternative mode of travel of Metrorail riders through Phase IVA, shown in Figure 2.8, represents the first time since the initial line segment opened in 1976 that the numbers of riders diverted from bus had fallen below 50 percent of the total. The 146 thousand riders that would have taken the bus equals 49 percent of the total in the May 1981 passenger

ALTERNATIVE MODE OF TRAVEL OF METRORAIL RIDERS SYSTEMWIDE
(MAY 1980)

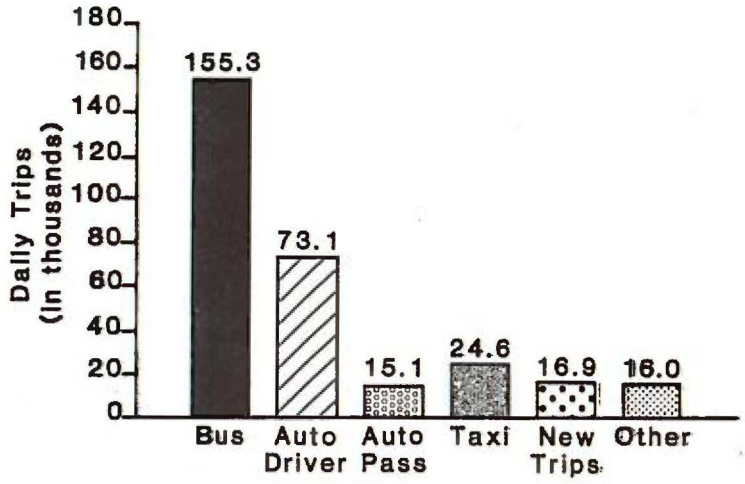


Figure 2.6

AM PEAK PERIOD MODE OF ACCESS SYSTEMWIDE (MAY 1980)

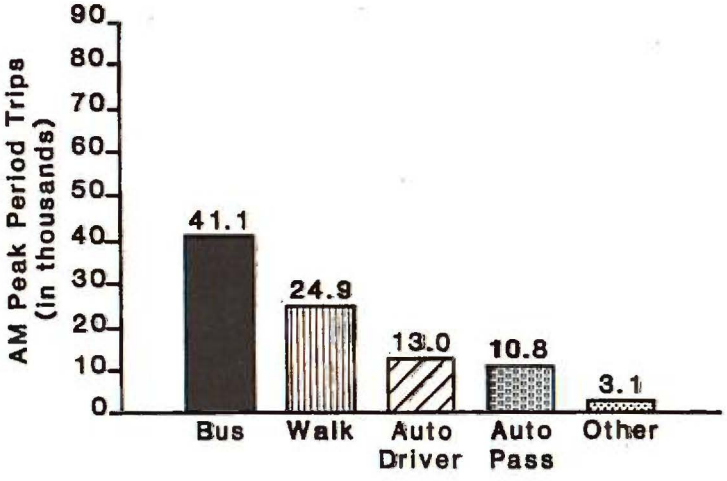
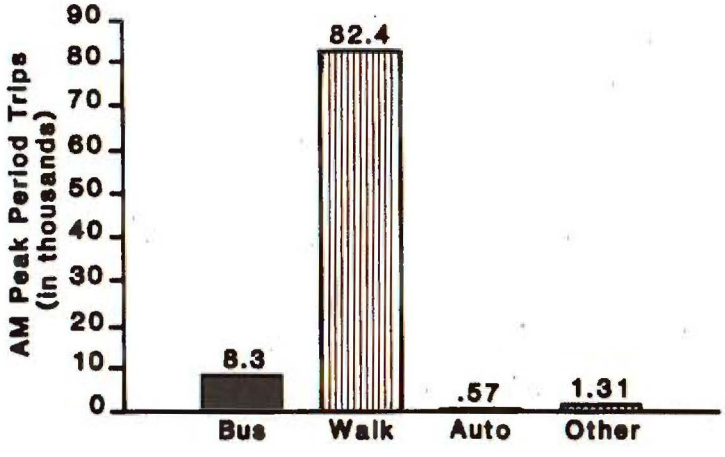


Figure 2.7

AM PEAK PERIOD MODE OF EGRESS SYSTEMWIDE (MAY 1980)



survey. The number of auto users (drivers plus passengers) grew to 31 percent of the total. The remaining modes - taxi, 'other' and new trips - were somewhat constant in terms of relative percentage of total ridership during this period.

Phase IVA operations marked a substantial change in AM peak period mode of access to Metrorail stations. By May 1981, passengers arriving at the station by bus, which accounted for over 53 percent of morning riders when Phase II opened (1977), had fallen to only 40 percent of the total. Figure 2.9 shows that the second most frequent mode of access, walk, had picked up much of the slack from bus, while both combined auto, and 'other' increased only slightly.

AM peak period mode of egress figures, while remaining remarkably different from mode of access, showed a minor change through Phase IVA. Those who walked to their final destination still remain in the vast majority of Metrorail riders, however, they represent slightly less than the relative percentages in the past, dropping to 86 percent of the total. In May 1981, bus remained at about 10 percent, as seen in Figure 2.10. The increase corresponding to the decline in the walk mode is found in 'other' modes (3%).

PHASE V OPERATING SYSTEM (May 1982)
(The Red Line in Northwest Washington)

The opening of Phase V, from Van Ness-UDC to Dupont Circle in December 1981, marked the first service extension on the Red Line in almost four years. Adding two miles of rail and three stations to the system this extension brought service to the heavily urban and residential area of upper Connecticut Avenue in Northwest Washington. Systemwide ridership had dropped slightly when the effects of opening this segment were measured (the May 1982 Metrorail passenger survey), however, this short segment accounted for over 27 percent of all Red Line ridership, and almost 17 percent of all transfers (Table 2.2).

The breakdown in absolute numbers of daily trips that would have used alternative modes of travel had Metrorail not been available in May 1982 is shown in Figure 2.11. Comparing these numbers to those for May 1981, an increase is seen in bus, auto driver and taxi, while auto passenger, new trips and 'other' trips decreased. Passengers diverted from bus climbed back to just above 50 percent of the total and the percentage for new trips increased to 6 percent, while the percentages for those diverted from auto, taxi and 'other' modes each decreased slightly.

The trend that appeared with Phase IVA ridership regarding AM peak period mode of access from home to Metrorail continued with Phase V. Figure 2.12 shows the mode split in absolute numbers from May 1982. We again see a decrease in the number of passengers arriving at Metrorail stations by bus. The bus figure translates into 36 percent of the total morning riders. At the same time, the combined auto mode levelled off at about 28 percent of the total and 'other' modes remained at 4 percent. There is a significant increase in morning Metrorail passengers who walk to the station, averaging more than 29 thousand, or 32 percent, of the total AM peak period ridership. A number of reasons have been advanced to explain the change in mode of access to Metrorail, including the residential nature of the

ALTERNATIVE MODE OF TRAVEL OF METRORAIL RIDERS
SYSTEMWIDE (MAY 1981)

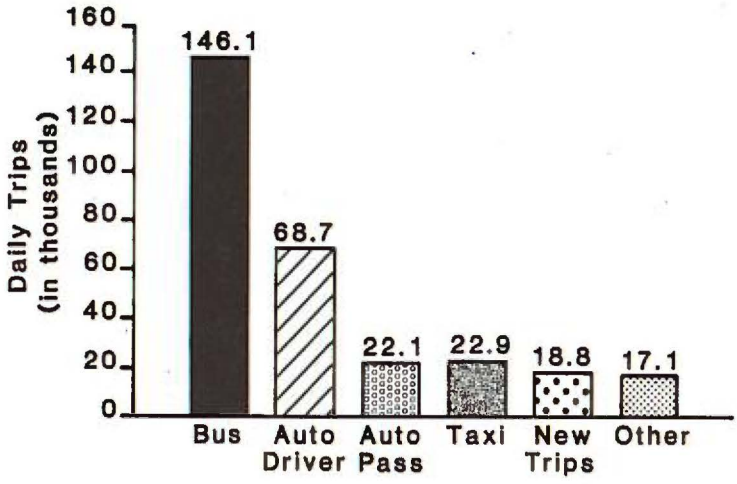


Figure 2.9

AM PEAK PERIOD MODE OF ACCESS SYSTEMWIDE (MAY 1981)

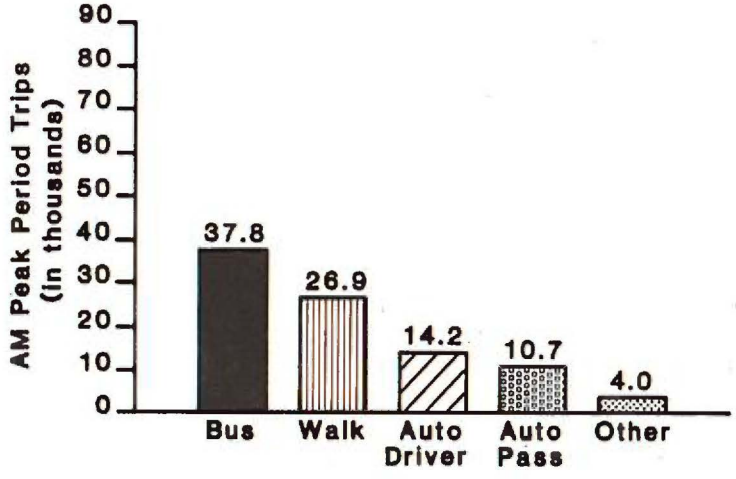
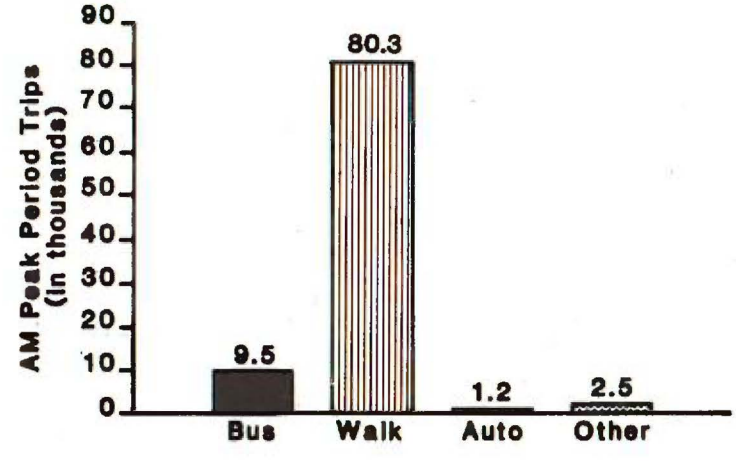


Figure 2.10

AM PEAK PERIOD MODE OF EGRESS SYSTEMWIDE (MAY 1981)



ALTERNATIVE MODE OF OF TRAVEL OF METRORAIL RIDERS SYSTEMWIDE (MAY 1982)

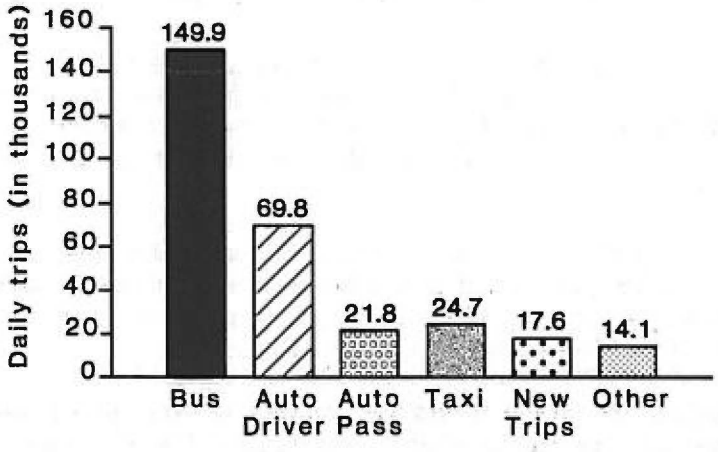


Figure 2.12

AM PEAK PERIOD MODE OF ACCESS SYSTEMWIDE (MAY 1982)

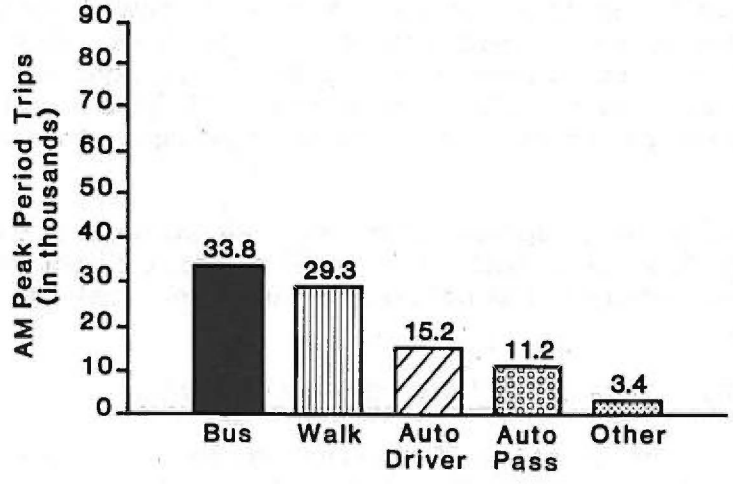
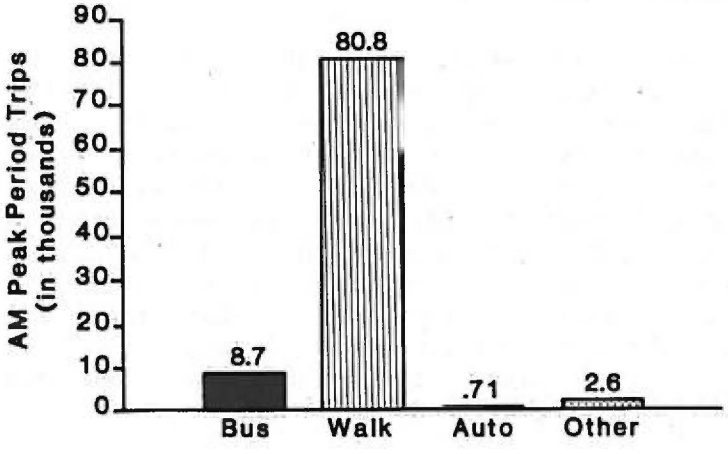


Figure 2.13

AM PEAK PERIOD MODE OF EGRESS SYSTEMWIDE MAY 1982)



latest extensions, a growing resistance to bus-to-rail transfers, and Metrorail riders relocating to be closer to their home stations.

AM peak period mode of egress from Metrorail, shown in Figure 2.13, differs very little from the last few years, with 9 percent of morning riders leaving the station and taking a bus to their ultimate destination, 87 percent walking, 1 percent taking an automobile, and 3 percent using 'other' modes.

The figures on the following page summarize the changes in absolute numbers that occurred between 1979 and 1982 for alternative mode of travel of Metrorail riders (Figure 2.14), AM peak period mode of access (Figure 2.15), and AM peak period mode of egress (Figure 2.16).

The major changes in the alternative modes of travel of Metrorail riders were a decrease in the percentage that would have taken the bus (from 54% to 50%), and increases in those who would have been auto passengers (from 4.5% to 7.3%) and those who would not have made the trip (from 5% to 5.9%).

The AM peak period mode of access to Metrorail showed significant changes in bus riders and those who walk during this time. Bus accounted for 43 percent of Metrorail riders arriving at the stations in 1979, and had declined to 36 percent in 1982. Those who walk to the stations showed a corresponding increase from 27 percent to 32 percent of total morning ridership.

AM peak period mode of egress from Metrorail stations showed very little change during this time, with close to 90 percent of the morning riders walking to their ultimate destination and bus riders making up the majority of the rest.

ALTERNATIVE MODE OF TRAVEL OF 'NEW' METRORAIL RIDERS

The responses to the question of alternative mode of travel to Metrorail between Phase III operations (May 1979) and Phase V operations (May 1982), although fluctuating slightly during this time period, remained within a few percentage points of one another as each of the new segments opened. It is interesting to note, however, that this same information for riders on each new segment (the 'new' ridership delineated in Table 2.2) reveals strikingly different patterns.

Figure 2.17 compares the percentages for alternative mode of travel of Metrorail riders on the entire system as of May 1982, with the percentages for riders on each new segment as it opened since 1979. Systemwide, we see that 50 percent of the May 1982 average weekday ridership would have taken a bus as an alternative to Metrorail. This is followed by 30 percent for the combined auto mode (drivers plus passengers), 8 percent for taxi, 6 percent new trips (those who would not have made the trip), and 5 percent 'other' modes. When the extension to Ballston opened in 1979, however, higher percentages of trips could be considered to have been diverted from bus (56%) and from the combined auto mode (35%), while taxi trips that were diverted almost disappeared (1%). New trips and trips from 'other' modes were slightly reduced as well.

ALTERNATIVE MODE OF TRAVEL OF METRORAIL RIDERS
SYSTEMWIDE (1979-1982)

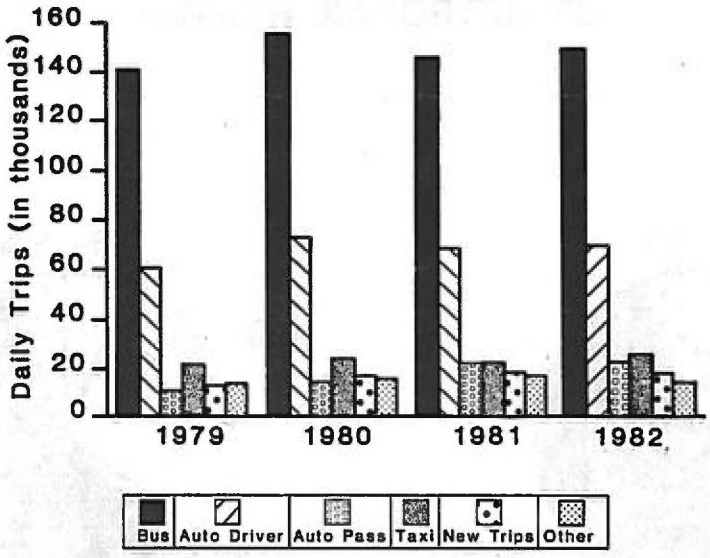


Figure 2.15

AM PEAK PERIOD MODE OF ACCESS SYSTEMWIDE (1979-1982)

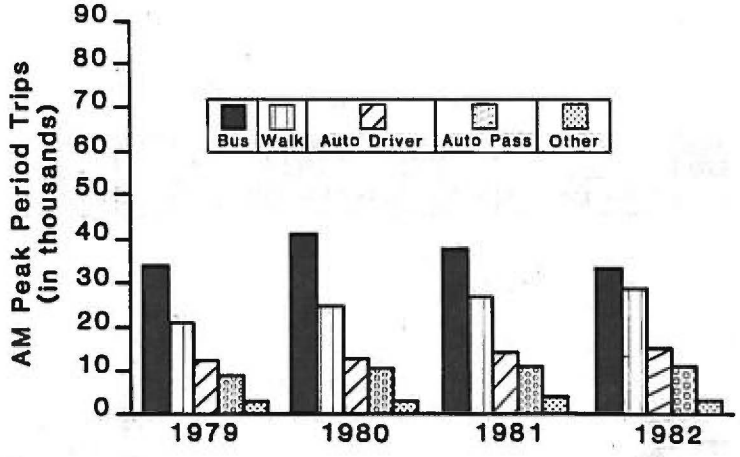


Figure 2.16

AM PEAK PERIOD MODE OF EGRESS SYSTEMWIDE (1979-1982)

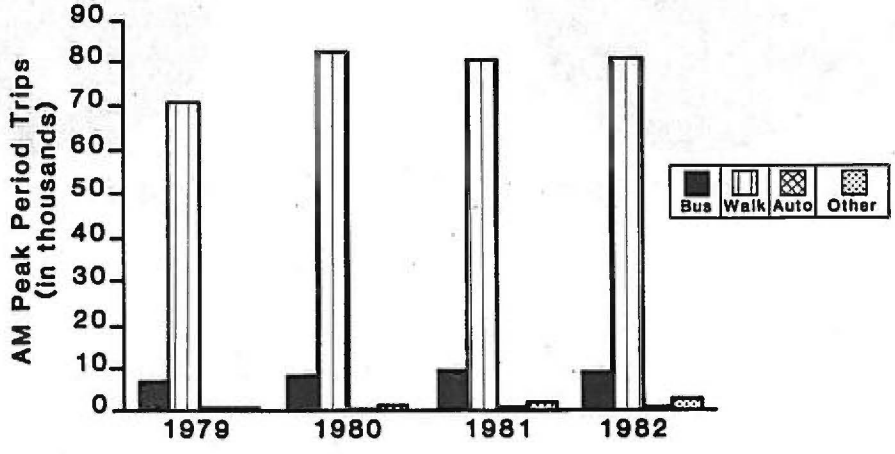
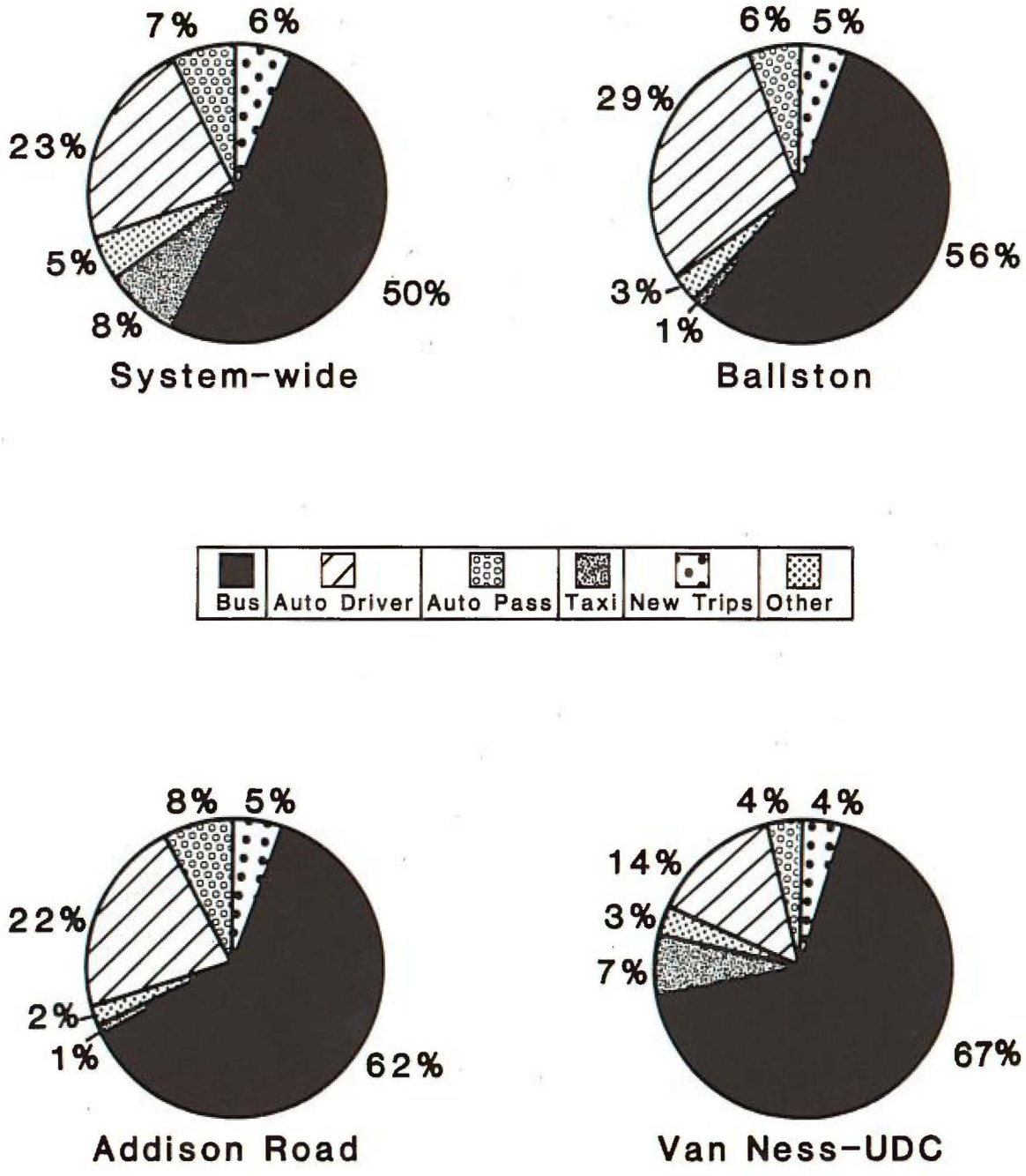


Figure 2.17

ALTERNATIVE MODE OF TRAVEL OF METRORAIL RIDERS



Even higher percentages of trips that could be considered to have been diverted from bus become evident when examining ridership on the Phase IVA and Phase V operating systems. When Addison Road opened in 1980, diverted bus riders comprised 62 percent of the passengers using that extension. The combined auto mode was the same as the 1982 systemwide level (30%), and the taxi and 'other' modes were dramatically reduced (1% and 2% respectively).

On the Van Ness-UDC extension, the figure for diverted bus trips climbs to 67 percent, while the figure for diverted auto trips, drivers and passengers combined, falls to a total of only 18 percent. Diverted taxi trips rises almost to the 1982 systemwide level (7%), while new trips (4%) and trips diverted from 'other' modes (4%) drop slightly. This data is consistent with the nature of the upper Connecticut Avenue area, which is urban and heavily residential, and was previously well served by bus transit. It is also very important to note that WMATA's practice of following the extension of Metrorail service into a major travel corridor with the revision of existing bus service "forces" transfers from bus to rail and eliminates bus routes that duplicate rail service. Thus, passengers who would have otherwise taken a bus are not always "diverted" to rail, but in some cases have no choice.

TABLE 2.3

ALTERNATIVE MODE OF TRAVEL OF METRORAIL RIDERS ON EACH SEGMENT
(Percentage of Riders)

	New Trip	Bus	Auto Driver	Auto Passenger	Taxi	Walked	Other
Initial Red Line (21,300 Riders)	12.8	40.7	17.6	2.2	19.1	5.9	1.7
Initial Blue Line (103,600 Riders)	3.6	66.9	13.7	2.4	9.5	2.0	1.8
Silver Spring Ext (34,500 Riders)	4.0	58.0	28.6	4.4	1.7	.2	3.0
New Carrollton Ext (29,100 Riders)	4.6	47.2	38.1	6.3	.7	.7	2.2
Ballston Ext (15,700 Riders)	4.5	55.5	29.2	6.1	1.3	1.1	2.3
Addison Road Ext (6,800 Riders)	4.9	61.9	21.5	8.2	1.0	.5	2.0
Van Ness-UDC Ext (14,550 Riders)	4.1	67.1	14.0	4.1	7.3	1.9	1.5
Systemwide Average (May 1982)	5.9	50.3	23.4	7.3	8.3	2.4	2.3

SOURCE: Metrorail Passenger Surveys; WMATA

In general, the newer Metrorail extensions appear to capture higher percentages of riders who would have used the bus and lower percentages of riders who would have used a car than was true for the earlier extensions, which corresponds to the fact that the earlier extensions included a good number of parking spaces at most of the stations, while the later extensions had less parking, if any at all. Table 2.3 displays the percentages for alternative mode of travel of riders on the Metrorail extensions as each opened, since 1976.

It can be seen that higher percentages for those passengers who otherwise would have been auto drivers are found for the suburban extensions of service (Silver Spring, New Carrollton, Ballston and Addison Road) than for the segments that are in urban areas (initial Red Line, initial Blue Line, Van Ness-UDC extension). The last two operating phases appear to have captured the highest percentages of trips diverted from bus since the initial Blue Line segment opened. The Van Ness-UDC extension, the first "in-city" expansion of service in over four years, captured higher percentages of taxi trips and walk trips and lower percentages of 'other' mode trips, auto passengers and new trips than any of the four prior suburban extensions.

CONCLUSIONS

Analysis of Metrorail ridership during the 'second three years' of rail operations reveals a fluctuating pattern, somewhat like the traditional seasonal fluctuations found in bus ridership. This is in contrast to the pattern of continuous growth that characterized the first three years of Metrorail ridership. It should also be noted that, during this time, the rail openings were short extensions of existing lines and no new rail corridors were tapped.

This fluctuating pattern of rail ridership, which began in the summer of 1979, appears to be the result of a number of factors, such as fare increases, extensions of rail service and seasonal adjustments. In addition to this new pattern of ridership, total average weekday rail ridership has levelled off after reaching the 300 thousand plus peak in the summer of 1980. Reasons for this decline, again, appear to be a combination of factors such as gasoline price and availability, the status of employment in the central core area, and concern over rail reliability.

As of May 1982, with 43 stations and over 39 miles of rail in operation, certain characteristics of Metrorail had established patterns that are expected to remain constant throughout the rest of the system's growth.

At the destination end of the morning Metrorail trip, which was usually work or work-related, virtually everyone (almost 90%) walked from the Metrorail station to their ultimate destination, and nearly all of the remainder took a bus. This pattern of mode of egress was established very early in the operation of the system, and the figures for each mode have remained within a few percentage points each year through 1982.

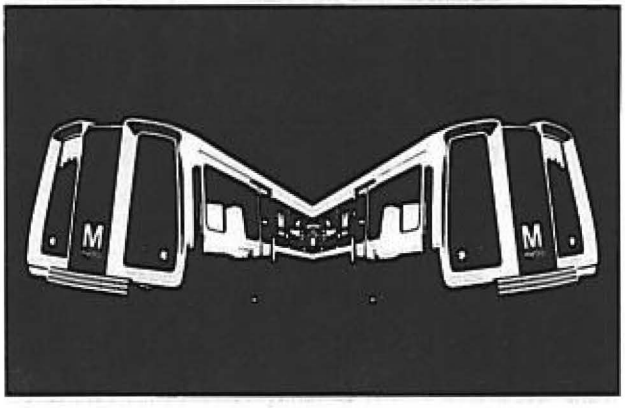
The AM peak period mode of access, however, developed a pattern that was both distinct from the mode of egress pattern, and changing over time. The systemwide morning mode of access to Metrorail in May 1979 was dominated by bus (43%), followed by walk and auto (both at 27%) and 'other'

modes (4%). By May 1982, however, the bus mode had dropped to 36 percent of the morning riders, while auto and 'other' remained roughly the same. The major increase offsetting the decline in bus access was found in those who walk to the station, which grew to 32 percent of the total. These changes appear to reflect the changing nature of the rail system as each extension has opened (with more stations within walking distance) and are expected to continue to change as the remainder of the system becomes operational.

Following the initiation of Phase III rail operations to New Carrollton, the majority (54%) of Metrorail passengers claimed that they would have taken a bus to make their particular trip if Metrorail were not available, while 28 percent would have taken an auto. Only 5 percent of the total weekday riders would not have made their trip. Through Phase V operations (May 1982) the relative figures had changed very little: 50 percent diverted from bus; 30 percent diverted from auto; and, 6 percent new trips. The levels of these figures are indicative of several factors, most notably the practice of truncating bus routes at rail stations where possible thereby forcing former bus riders onto rail, and that Metrorail provides a much faster alternative to bus in the corridors it now serves.

Although the relative percentages for systemwide ridership have changed only slightly since 1979, the breakdowns for alternative mode of travel on each service extension as it opened display different patterns. All three of the extensions seem to capture a higher percentage of riders who would otherwise take a bus than the system as a whole, the suburban extensions, where some parking is provided at the stations, attracted more auto users and fewer 'other' mode users. The urban extension drew an even higher percentage from bus, more taxi users, and a much lower percentage of auto users. In general, these newer segments seem to reflect the nature of the area into which they were extended quite well.

CHAPTER 3
PURPOSE OF TRIPS MADE ON METRORAIL



CHAPTER III

PURPOSE OF TRIPS MADE ON METRORAIL

As will be seen, a definite pattern had developed as early as 1979 in the purpose of trips made on Metrorail. By far, the dominant purpose at the destination end of the Metrorail trip was the workplace, accounting for approximately two-thirds of all trips made. The second most frequent category of trip purpose was 'other' (recreation, sightseeing, etc.) with about 9 percent of the total, and this was followed by personal business and job-related trips, each with almost 7 percent, school trips with 6 percent, and shopping trips with around 5 percent of the total trips per day. This pattern was established early in the history of Metrorail, and remained at or near these figures through 1982. Figure 3.1 displays this pattern, in absolute numbers, from 1979 through 1982.

By May 1982, Metrorail had extended service into four major travel corridors in the region - Northern Virginia, Silver Spring, New Carrollton, and Wisconsin/Connecticut Avenues. In addition, the initial Red Line, combined with the initial Blue Line provided an excellent downtown distribution and circulation system. Thus the extensive use of Metrorail for the commute to work was not unexpected. However, the extent to which non-home based trips are being made on Metrorail was not altogether predicted. Better than one in four of the trips made on Metrorail in May 1982 (28%) were made either for personal business, job-related business, shopping or 'other' purposes. This is indicative of the high level of midday service that is provided on rail transit.

Trip purpose, then, can provide important information on the changes in travel behavior resulting from the introduction of Metrorail service. This chapter will closely examine the destination purpose of Metrorail trips, for both work and non-work travel.

COMPOSITION OF TRIP PURPOSE (1976-1982)

The historical trend of the composition of the purpose of trips made on Metrorail since its opening is illustrated in Figure 3.2. This graph displays the total number of trips made for each category since 1976. As can be seen, the work trip category (the dark shaded section at the bottom of the chart) has been the principal purpose of trips made on Metrorail since the start of rail operations. This graph also reflects the trends in total rail ridership discussed in Chapter 2. After reaching a peak of over 300 thousand average weekday riders in 1980, the total number of daily trips made on Metrorail declined slightly, and has levelled off.

For the most part, the number of trips made in each trip purpose category, other than work, remained fairly constant between 1980 and 1982, with slight increases in personal business and school trips. Total rail ridership, however, declined by over 7 thousand trips per day during this period. This decrease in total rail ridership was caused by a major decrease in the work trip category.

PURPOSE OF TRIPS MADE ON METRORAIL SYSTEMWIDE (1979-1982)

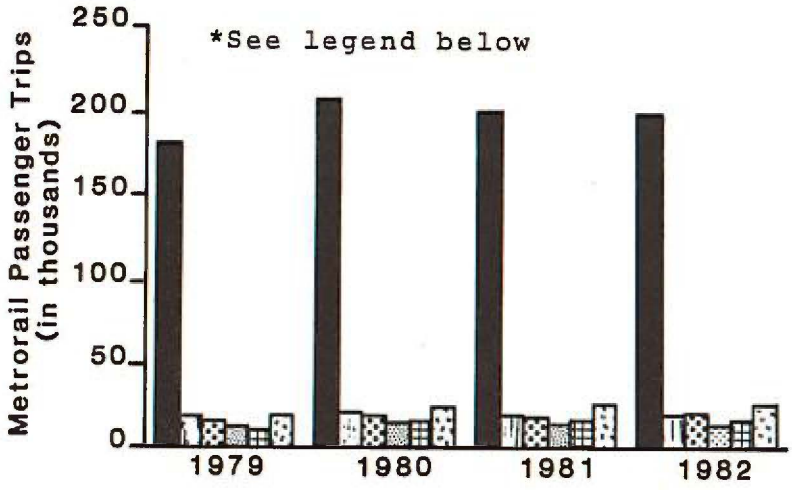


Figure 3.2

PURPOSE OF TRIPS MADE ON METRORAIL (NUMBER OF DAILY TRIPS)

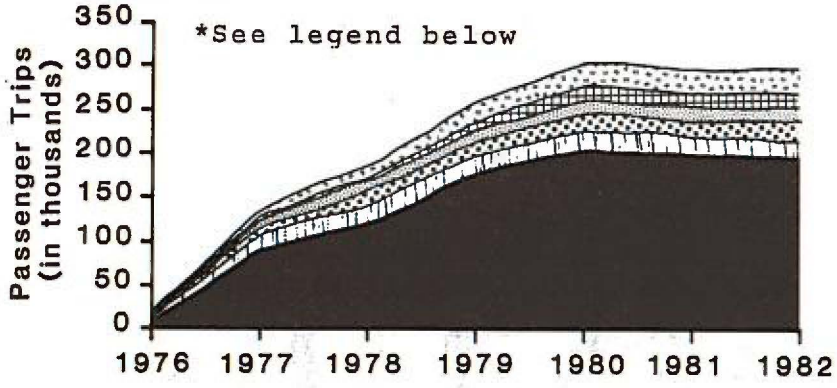


Figure 3.3

PURPOSE OF TRIPS MADE ON METRORAIL (PERCENTAGE OF DAILY TRIPS)

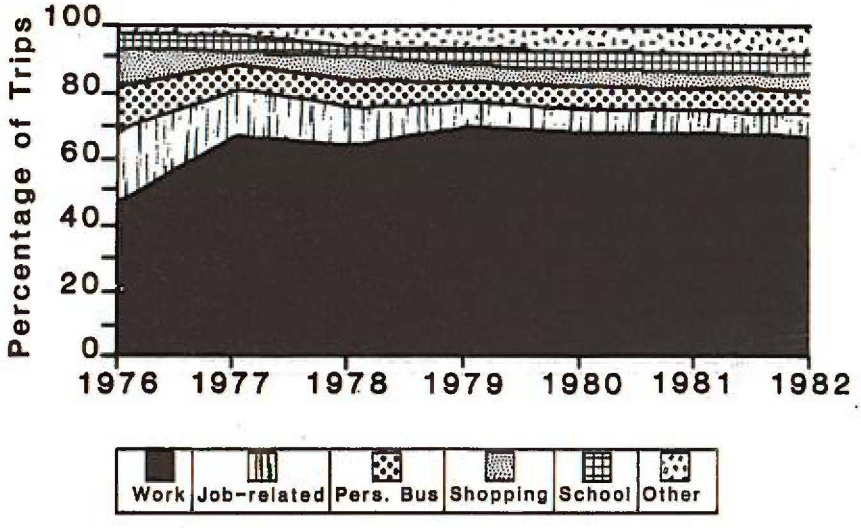


Figure 3.3 translates the absolute numbers of trips in each category of trip purpose into a percentage of the total. This graph shows wide diversity in the early years of service, which subsequently settled into a pattern of a high percentage for work trips (approximately two-thirds) with fairly constant percentages for the remaining categories. The percentages for school trips and 'other' trips (the top two areas on the graph) seem to have increased steadily since 1979. And, although a decrease in absolute numbers of almost 10 thousand passengers per day was experienced in work trips between 1980 and 1982, the relative percentage for this trip purpose category remains at roughly two-thirds of the total.

The numerical data on which Figure 3.2 and Figure 3.3 are based is contained in Table 3.1.

TABLE 3.1

PURPOSE OF TRIPS MADE ON METRORAIL

(Numbers in 1,000's)

	Work	Job Related	Personal Business	Shopping	School	Other	Total
1976: No.	10.0	4.9	2.6	2.3	.9	.6	21.3
%	46.5	22.8	12.6	11.2	4.2	2.7	
1977: No.	90.3	18.2	9.7	5.0	6.3	5.0	134.5
%	67.3	13.5	7.2	3.7	4.6	3.7	
1978: No.	119.9	20.9	14.9	12.9	5.5	11.9	186.0
%	64.3	11.3	8.0	7.0	3.0	6.4	
1979: No.	181.0	19.0	16.0	13.0	10.9	20.0	259.9
%	69.3	7.3	6.2	5.0	4.2	7.7	
1980: No.	207.5	20.9	20.2	14.9	17.0	24.9	305.4
%	68.0	6.8	6.6	4.9	5.5	8.2	
1981: No.	201.0	20.0	18.8	13.8	16.1	26.3	296.0
%	68.0	6.8	6.3	4.7	5.4	8.8	
1982: No.	198.1	20.4	21.1	14.3	17.8	26.6	298.3
%	66.4	6.9	7.1	4.8	5.9	8.9	

SOURCE: Metrorail Passenger Surveys; WMATA

The trends discussed above can again be seen in this data: wide fluctuations in the percentages for the first years and a levelling off to fairly constant amounts thereafter; and, a substantial decrease in work trips between 1980 and 1982 while the remaining categories remain relatively constant. An analysis of the geographic distribution of the decrease in AM peak period work trips provides some interesting results. Morning ridership on the Blue/Orange Line that approaches the central employment area from the east (New Carrollton, Addison Road) increased slightly between 1980 and 1982. Blue/Orange Line ridership approaching from the west (National Airport, Ballston) declined by 9.5 percent. This is fairly consistent with the discussion of the losses in Blue/Orange Line ridership in Chapter 2. However, unlike the findings in Chapter 2, morning work-bound ridership on the Red Line from Silver Spring declined by over 5,000 passengers, while like ridership on the other end of the Red Line increased by 4,450 passengers (most likely due to the extension from Dupont Circle to Van Ness-UDC). Since the earlier findings showed an increase in total Red Line ridership during this time, the total decrease in AM work trips had to be offset by increases in trips made for other purposes and/or trips made during other times of the day.

TRIP PURPOSE SERVED BY NEW RAIL SEGMENTS

By separating the Metrorail system into segments, it is possible to analyze the purpose at each end of the trip, rather than at the destination end, as described earlier. Analyzing trip purpose in this manner, the most common categories of systemwide Metrorail trips in May 1982 were home trips, since a good number of trips either began or ended there, and work trips, both of which accounted for 38 percent of all systemwide trips made in 1982. Job-related trips, personal business trips, and shopping trips account for the remaining systemwide trips, each with five percent or less of the total. However, when individual segments are examined, the distribution for trip purpose varies sharply from the systemwide average.

Table 3.2 illustrates this analysis of trip purpose. Trips to home, which account for 38 percent of the systemwide total, are dramatically more dominant on the rail extensions, accounting for between 61 percent and 85 percent of each extension's total. The other most frequent trip purpose systemwide was work, accounting for 38 percent of the total. With the exception of the Van Ness-UDC extension, work is also the second most frequent trip purpose on the extensions. However, it is no more than 11 percent of all trips on any of the segments. Again, with the exception of the Van Ness-UDC extension, the remaining trip purpose catogories - job-related, personal business, shopping and 'other' - each accounts for five percent or less of any segment's total, similar to the systemwide figures.

Several other interesting facts can be seen in Table 3.2. The Van Ness-UDC extension, as mentioned above, is unique among the rail service extensions, in that 'other' is the second most frequent category of trip purpose, accounting for 19 percent of all trips on this segment. This can most likely be explained by the presence of the National Zoological Park and the University of the District of Columbia, both located along this extension, as well as the number of hotels in this area. Although not the primary trip purpose on any of the extensions, work trips are more dominant on the Silver Spring extension (10%), the Ballston extension (11%),

and the Van Ness-UDC extension (9%), than on the New Carrollton and Addison Road extensions (5% each). This is also reflective of the areas served by each extension, of which the New Carrollton and Addison Road areas are more predominantly residential than the other three.

TABLE 3.2

DISTRIBUTION OF METRORAIL TRIPS BY PURPOSE AT DESTINATION AND SEGMENT[1]

(Percentage of Daily Trips)

	Home	Work	Job Related	Shopping	Personal Business	Other
Systemwide Average (May 1982)	38	38	5	4	5	10
Silver Spring Ext	77	10	2	2	4	5
New Carrollton Ext	85	5	1	1	4	4
Ballston Ext	76	11	1	2	5	5
Addison Road Ext	84	5	1	2	4	4
Van Ness-UDC Ext	61	9	4	3	4	19

SOURCE: Metrorail Passenger Surveys; WMATA

It is clear, then, that each of the extensions primarily serves trips beginning or ending at homes near the new stations, rather than trips to work or commercial trips to areas with new rail service.

COMMUTING AND REVERSE COMMUTING

Since home is the predominant trip purpose on the rail extensions, and most work and 'other' destinations are largely concentrated in the central core area, a directional imbalance in average weekday Metrorail trips is created during the morning and evening peak periods. By analyzing the inbound and outbound movement on several key links in the Metrorail system, we can determine the magnitude of this directional imbalance. (A system link is defined as that part of the rail line between and including two stations.) Table 3.3 identifies the key links on each of the rail segments, and displays the inbound and outbound trip volumes for a typical weekday AM peak period.

[1] Figures describe the purpose of trips made to those stations which opened in conjunction with each extension.

In May 1982 during the morning peak period, there was a total of over 62,000 riders travelling toward the central employment area on all of the rail segments. However, outbound ridership during the morning peak period totaled only 10,300 on all segments, or only one out of every seven passengers was travelling in the 'reverse' direction.

The heaviest outbound ridership was found on the route to National Airport (5,000) which accounted for approximately 27 percent of the morning ridership on this line. The least number of AM outbound passengers (150) were riding toward Addison Road, although the routes to New Carrollton and Ballston carried fewer than 1,000 AM outbound riders as well. In 1982, the most severe directional imbalances, in absolute numbers, were found on the Ballston and Silver Spring segments, where, respectively, 10,300 and 15,600 more riders travelled inbound than outbound.

TABLE 3.3

DIRECTIONAL IMBALANCE OF METRORAIL TRIPS

AM PEAK PERIOD

(May 1982)

Segment (From)	Key Link	Inbound	Outbound
National Airport	Arlington Cemetery to Rosslyn	13,800	5,000
Ballston	Courthouse to Rosslyn	11,100	800
Van Ness-UDC	Woodley Park-Zoo to Dupont Circle	6,100	1,750
Silver Spring	Rhode Island Ave. to Union Station	17,750	2,150
New Carrollton	Minnesota Ave. to Stadium-Armory	8,300	500
Addison Road	Benning Road to Stadium-Armory	5,000	150
	Totals	62,050	10,350

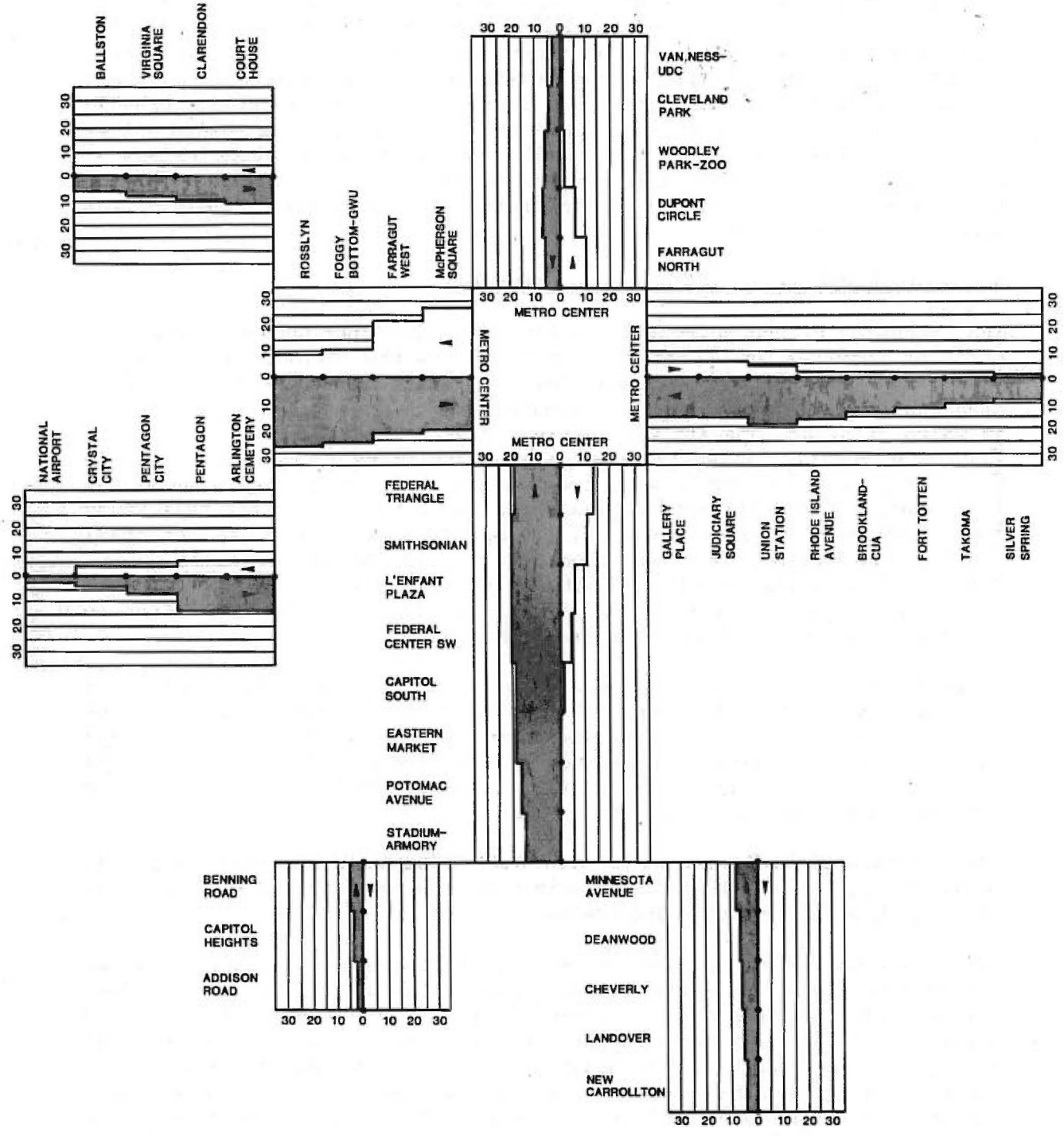
SOURCE: 1982 WMATA Passenger Survey

Figure 3.4 is a schematic treatment of the Metrorail system through Phase V, showing the relative inbound and outbound volumes on the links on the various line segments.

The analysis of the Phase III operating system, contained in the initial travel findings report, showed that, in May 1979, a significant directional imbalance in AM peak period ridership existed, with almost 20,000 riders per line entering the central employment area, and a total of just

Figure 3.4

METRORAIL RIDERSHIP AM PEAK PERIOD (IN THOUSANDS)



under 7,200 riders travelling outbound. An examination of the net change in ridership between 1979 and 1982 on these lines reveals further information on reverse commuting. With the exception of the Arlington Cemetery to Rosslyn link, which saw an increase of only 125 passengers, a decrease in AM peak period inbound ridership is found on the key links analyzed above - 2,075 riders on the Minnesota Avenue to Stadium-Armory link, and 750 riders on the Rhode Island Avenue to Union Station link. This reflects the decrease in work purpose trips previously discussed. The changes in AM peak period inbound ridership were combined with increases in outbound riders on all three lines during this period (a 1,625 rider increase toward National Airport, an increase of over 150 riders travelling toward New Carrollton, and almost 400 more riders going toward Silver Spring). These figures are too small upon which to draw conclusions at this time. However, this analysis should be continued with future ridership data to determine whether Metrorail has an effect on employment location in the region.

NON-WORK TRAVEL ON THE VAN NESS-UDC EXTENSION

The extension of the Metrorail Red Line into the upper Connecticut Avenue corridor provides an opportunity to study how the introduction of Metro into a heavily residential urban setting affects non-work travel. This area was already highly transit oriented and one of the few in the region in which existing capacity was severely constrained by demand. An analysis of Metrorail-related changes in non-work transit trip generation in this corridor is currently being conducted as a separate project under the Metro Before and After Study. The principal data sources for this study are telephone surveys of residents living near the Van Ness-UDC Metrorail station, conducted before and after the system extension became operational. One of the primary objectives of this study is to measure the amount of non-work travel on Metrorail, and to determine the extent to which these trips are diversions from other modes.

Preliminary tabulations for trips by purpose from the before and after surveys show a total increase of 2.1 percent in non-work trips after the Metrorail extension was opened. The survey data shows that non-work trips that are made on transit increased by 34.8 percent, non-work auto trips declined by 2.6 percent, non-work taxi trips increased by 8.3 percent and non-work trips made on 'other' modes decreased by 10.6 percent.

The increase of 34.8 percent for non-work trips made on transit is an impressive figure, indicating that the introduction of Metrorail in this corridor had an effect on non-work travel.

Additional data from the surveys is shown in Table 3.4. This table shows the percentages of all non-work trips made for each of the five modes listed. The increase of 6.1 percentage points in transit in the after survey is offset, for the most part, by decreases in the percentages for auto and 'other' modes, thus indicating diversions from these modes to transit. A further breakdown of the transit figures in this table shows that the bus mode decreased from 18.6 percent of all non-work trips to 15.8 percent, while rail increased from less than one percent before to 9.5 percent in the after survey. Thus, the decrease of 3.2 percentage points on bus and the increase of 8.9 percentage points on rail indicate

that non-work trips formerly made on bus, as well as auto and 'other' modes, are now being diverted to rail in this corridor.

TABLE 3.4

NON-WORK TRIP GENERATION
VAN NESS-UDC EXTENSION
(Percentages)

Mode	Before	After	Change
Transit	19.3	25.3	6.1
Auto	68.5	65.3	-3.2
Taxi	3.3	3.5	0.2
Other	6.5	5.7	-0.8
Unknown	2.5	0.1	-2.4
Total	100.0	100.0	0.0

CONCLUSIONS

The trends seen in the composition of trip purpose on Metrorail have been fairly consistent since the second year of rail operations, in 1977. While work trips have remained the dominant trip purpose, at roughly two-thirds of the total trips made, the absolute numbers of work trips has decreased substantially since 1980. The percentages for all categories of trip purpose fluctuated widely in the first few years, but have levelled off to fairly constant amounts since 1977/1978.

On each of the rail extensions, purpose at each end of the trip can be analyzed. The most common purpose on each of the rail extensions opened since 1978 has been trips to home, accounting for between 61 and 85 percent of all trips made on the individual segment. Trip purpose on the rail segments is also reflective of the areas served by each segment, with 19 percent of trips made on the Van Ness-UDC extension being for 'other' purposes (i.e. recreational trips to the National Zoo), and higher percentages of work purpose trips on the extensions that also serve commercial areas (Silver Spring, Ballston) than on those that serve predominantly residential areas.

Commuting and reverse commuting on Metrorail in May 1982 display the same extent of directional imbalance that was evident in 1979. On key links of the six rail segments during the AM peak period, over 62,000 riders are travelling inbound (toward the central employment area) on an average weekday, while only about 10,300 are travelling outbound. This directional imbalance creates a tremendous excess capacity on outbound trains, necessary to carry inbound riders.

Preliminary indications are that Metrorail has had an impact on non-work travel in the Van Ness-UDC corridor, with an increase of 2.1 percent in

non-work trips made after the extension of service. These trips have been found, for the most part, to have been diverted from bus, auto and 'other' modes of travel.

CHAPTER 4
THE EFFECTS OF METRORAIL ON THE TOTAL TRANSIT SYSTEM

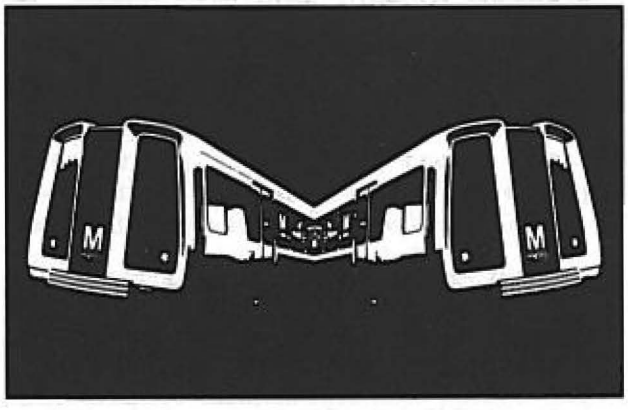
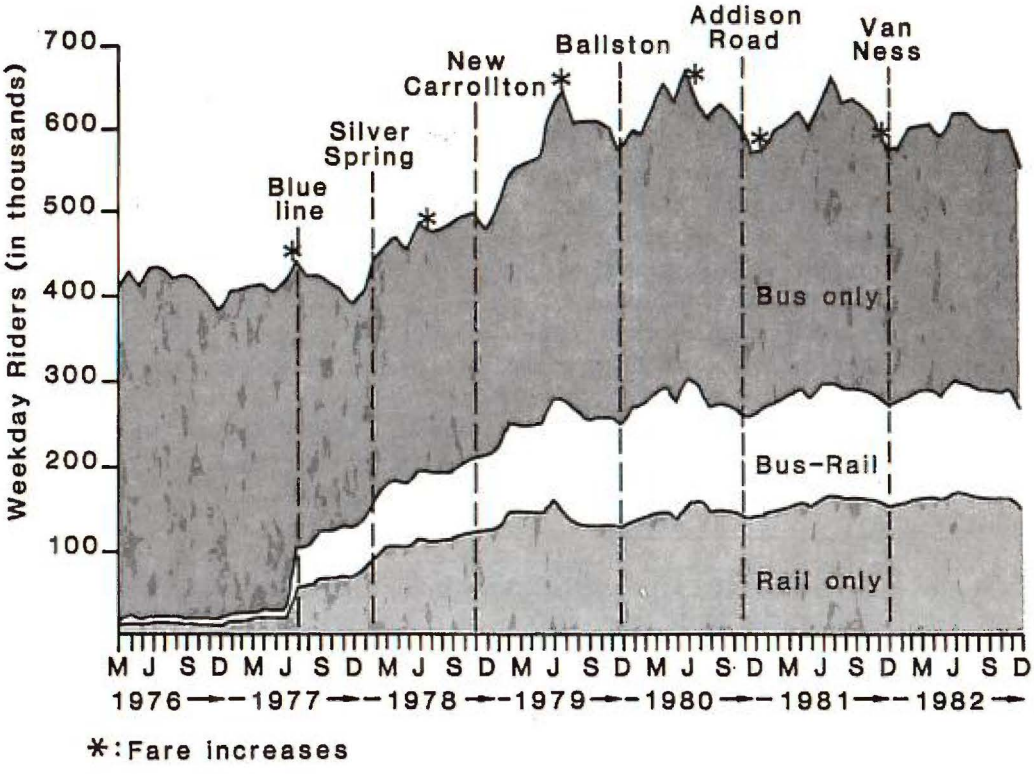
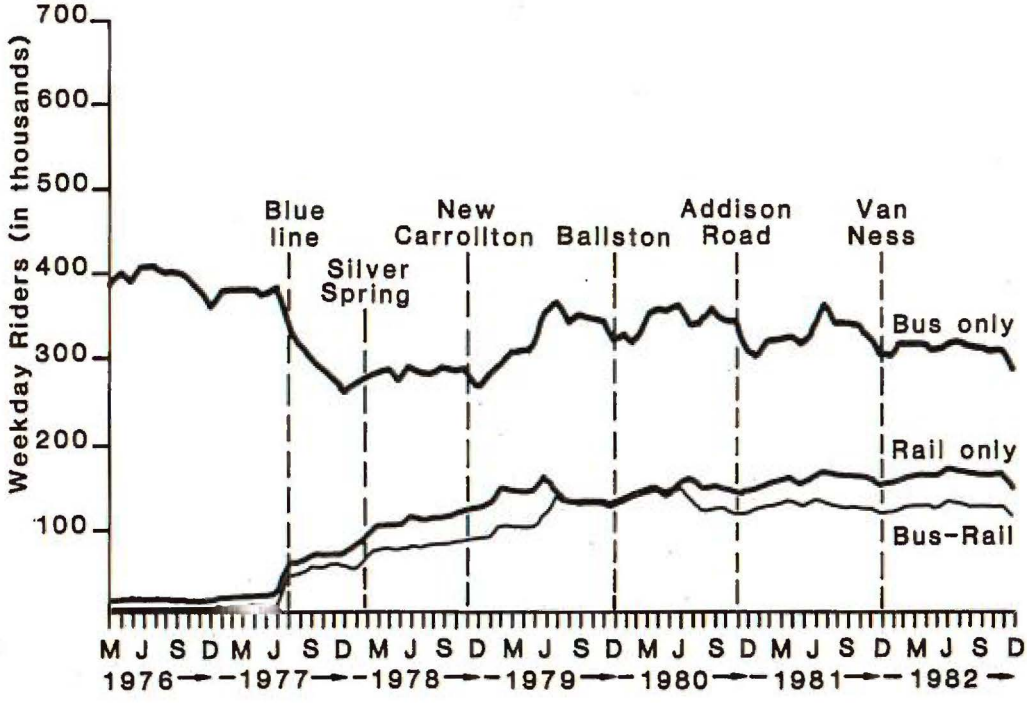


Figure 4.1

TOTAL WMATA RIDERSHIP
1976-1982



TOTAL WMATA RIDERSHIP BY MODE
1976-1982



displays summer peaks, declines through the fall to a winter low, and increases through the spring to another summer peak. This pattern is evident from the summer of 1979 through December 1982.

In addition to this fluctuating pattern, total transit ridership has experienced a slight decrease and stabilization since the summer of 1980, when a peak of around 650 thousand riders per day was attained. This trend is seen in bus ridership as well as rail-related ridership during this period of time. The reason for this trend in total ridership, as with rail ridership, is a combination of factors, such as price of gasoline, bus and rail reliability, and employment in the core area, and appears to be similar to that of large transit systems in other U.S. cities.

COMPARING BUS AND RAIL RIDERSHIP BY PHASE

An analysis of total transit and bus ridership changes that occur due to the opening of new Metrorail service is complicated by the seasonal fluctuations previously discussed, plus the fact that the Metrorail operating phases opened at different times of the year. It is therefore necessary to analyze ridership statistics over a period in which ridership is least effected by seasonal fluctuations.

TABLE 4.1

WMATA TRANSIT RIDERSHIP BY PHASE
(Average Weekday Trips: July - October)

	RAIL ONLY	BUS-RAIL	RAIL-RELATED	BUS ONLY	TOTAL TRANSIT
PRE-METRO (1975)	0	0	0	396,000	396,000
PHASE I (1976)	16,000	6,000	22,000	403,000	425,000
PHASE II (1977)	64,000	52,000	116,000	311,000	427,000
PHASE IIA (1978)	115,000	83,000	198,000	286,000	484,000
PHASE III (1979)	134,000	132,000	266,000	353,000	619,000
PHASE IV (1980)	152,000	127,000	279,000	346,000	625,000
PHASE IVA (1981)	165,000	128,000	293,000	347,000	640,000
PHASE V (1982)	165,000	128,000	293,000	314,000	607,000

SOURCE: WMATA Quarterly Ridership Reports
(All figures rounded to nearest thousand.)

Table 4.1 displays the rail-related, bus only and total transit ridership for the months of July through October as each phase of Metrorail operations was opened. These months are used in this comparative analysis as they are both relatively stable months for transit ridership and common to all Metrorail operating phases. Since these figures represent the average weekday ridership for these months only, the numbers may differ from average weekday ridership figures discussed elsewhere in this report.

TABLE 4.2

WMATA RIDERSHIP CHANGES BY PHASE
(Average Weekday Trips: July - October)

	RAIL ONLY		BUS-RAIL		RAIL-RELATED		BUS ONLY		TOTAL TRANSIT	
	NUMBER	%	NUMBER	%	NUMBER	%	NUMBER	%	NUMBER	%
PRE-METRO TO PHASE I	+16,000	-	+6,000	-	+22,000	-	+7,000	2%	+29,000	7
PHASE I TO PHASE II	+49,000	306%	+45,000	750%	+94,000	427%	-92,000	-23%	+2,000	NC
PHASE II TO PHASE IIA	+51,000	80%	+31,000	62%	+82,000	72%	-25,000	-8%	+57,000	13%
PHASE IIA TO PHASE III	+19,000	17%	+49,000	59%	+68,000	34%	+67,000	23%	+135,000	28%
PHASE III TO PHASE IV	+18,000	13%	-4,000	-3%	+14,000	5%	-7,000	-2%	+7,000	1%
PHASE IV TO PHASE IVA	+13,000	9%	+1,000	1%	+14,000	5%	+1,000	NC	+15,000	2%
PHASE IVA TO PHASE V	0	NC	0	NC	0	NC	-33,000	-10%	-33,000	-5%

SOURCE: WMATA Quarterly Ridership Reports (All figures rounded)

Table 4.2 displays the changes in ridership between phases of Metrorail operations since 1976. The analyses in the following sections will focus on those changes that have occurred between Phase III operations and Phase V operations.

PHASE III: The Completion of the New Carrollton Route

The analysis of WMATA ridership changes by phase in the initial travel findings report carried through Phase III rail operations. Total average weekday transit ridership for the July to October period during Phase III increased by an unprecedented 135 thousand, or a 28 percent increase over the comparable period a year earlier. This increase was apparently due not only to the extension of rail service on the Orange Line to New Carrollton, but also to the severe gasoline shortages of the summer of 1979.

The impact of the gas shortage on total transit ridership was most significant in the growth of bus only ridership, which grew by an average of 67 thousand daily trips, almost half of the total increase in transit patronage. This was the first time bus only ridership had increased since Phase I operations. Bus-rail and rail only ridership grew as well during Phase III, with bus-rail trips accounting for nearly three-quarters of the total increase in rail-related ridership. This strong growth in bus-rail ridership indicated that transit riders were willing to use a bus to reach the rail system, if good bus access is provided.

In the Phase III comparison between bus and rail ridership, the initial travel findings report questioned whether the growth in bus only and bus-rail ridership during this phase reflected a temporary aberration due to the gasoline shortage, and suggested that future data might answer this question.

PHASE IV: The Virginia Orange Line Extension

During Phase IV, the trend of substantially increasing total transit ridership for these months tapered off significantly, displaying only a one percent increase over the comparable period for Phase III. This time period included the extension of rail service on the Orange Line from Rosslyn to Ballston in Arlington County, as well as the easing of the gasoline crisis of the previous summer.

The effect of the lessening of the gas crisis on total transit ridership appears to be most significant in the decrease in bus only ridership during this period. Although only decreasing by 2 percent (seven thousand riders), this was a significant reversal from the 23 percent increase during Phase III. However, the extension of the Orange Line to Ballston was accompanied by a significant revision to the bus service in this corridor. The seven thousand passenger decrease in bus only ridership might also be attributed to the bus turnbacks. In addition, bus-rail ridership fell off during this period as well. Passengers who once rode the bus to the rail station decreased by four thousand, or 3 percent, during Phase IV.

It would appear, then, that the substantial growth in bus only and bus-rail ridership during Phase III was, indeed, a temporary aberration due to the gasoline shortage. However, even with the 11 thousand decrease in bus-related ridership during Phase IV, WMATA retained better

than 90 percent of the ridership increase that resulted from the gas crisis.

The decrease in bus-related ridership was offset by an increase in rail only ridership of 18 thousand (13%), resulting in a seven thousand rider increase in total transit ridership during Phase IV. This growth seems to be consistent with the increase in rail only ridership experienced when the New Carrollton extension was opened. Rail-related ridership (rail only plus bus-rail) increased to 45 percent of the total transit ridership.

PHASE IVA: The Blue Line Branch to Addison Road.

The tapering off of the increasing trend in total transit ridership seen during Phase IV continued through Phase IVA, with an increase in total transit ridership of only two percent occurring. The extension of rail service on the Blue Line to Addison Road and the attendant truncation of bus service in this area, plus a fare increase of almost 20 percent were the major events that occurred during this period.

The growth in total transit ridership of 15 thousand daily trips occurred primarily in rail only trips. While bus only and bus-rail trips did increase (by approximately one thousand each), these increases were less than one percent of the respective totals for the comparable period for the previous year. Phase IVA rail only trips, on the other hand, increased by 13 thousand, or 9 percent, over rail only trips for the previous phase. The increase in rail only ridership was facilitated by the addition of over 800 parking spaces to the system total, at the Capitol Heights and Addison Road Stations. Rail-related ridership continued to account for 45 percent of the total transit ridership.

PHASE V: The Red Line Extension in Northwest Washington

Total average weekday transit ridership for the July to October period during Phase V showed a decrease for the first time since the days prior to Metrorail. This unprecedented decrease totalled five percent of the amount for the comparable period the year earlier, or 33 thousand riders per day, attributable entirely to a decline in bus only ridership. Phase V included the extension of Red Line rail service from Dupont Circle to Van Ness-UDC in upper northwest Washington, plus a major revision to bus service in the Connecticut Avenue travel corridor.

Rail only and bus-rail ridership remained at the exact same levels found during Phase IVA. This is unlike the past three extensions of service, which accounted for increases in rail-related ridership from 14 thousand to 68 thousand passengers per day. As indicated earlier, the increase in Red Line ridership resulting from this extension was offset by a sharp decline in daily ridership on the Blue/Orange Line.

Consequently, the entire decrease in total transit ridership is due to the decrease in bus only ridership. The 33 thousand rider decrease was 10 percent of the bus only ridership during Phase IVA operations. Aside from the major revision in the bus service which resulted in the highest diversion to date of bus trips to rail, the bus only ridership decrease can also be partly attributed to the price of gasoline, which decreased by an average of five percent from the price during the same period a year ear-

lier, and to serious bus reliability problems that were experienced at this time.

Since rail-related ridership remained at the previous year's level and bus only ridership decreased, the percentage of the total transit ridership that was rail-related grew to 48 percent during Phase V.

GEOGRAPHIC DISTRIBUTION OF RAIL TRAVEL

The focus of the Metrorail system is on downtown Washington, where construction began and where all lines of the system converge. This area is the subject of extensive historical data on transportation and development. For transportation planning purposes, it is described as the D.C. core. Figure 4.2 displays the boundary of the D.C. core, and which portions of the Metrorail system, as it exists through Phase V operations, lie within the core.

In order to more thoroughly understand the location of the Metrorail transit market, an analysis of the geographic distribution of rail trips and how they changed between Phase III and Phase V operations is presented. The distribution of Metrorail travel with respect to this central area is shown in Table 4.3.

TABLE 4.3

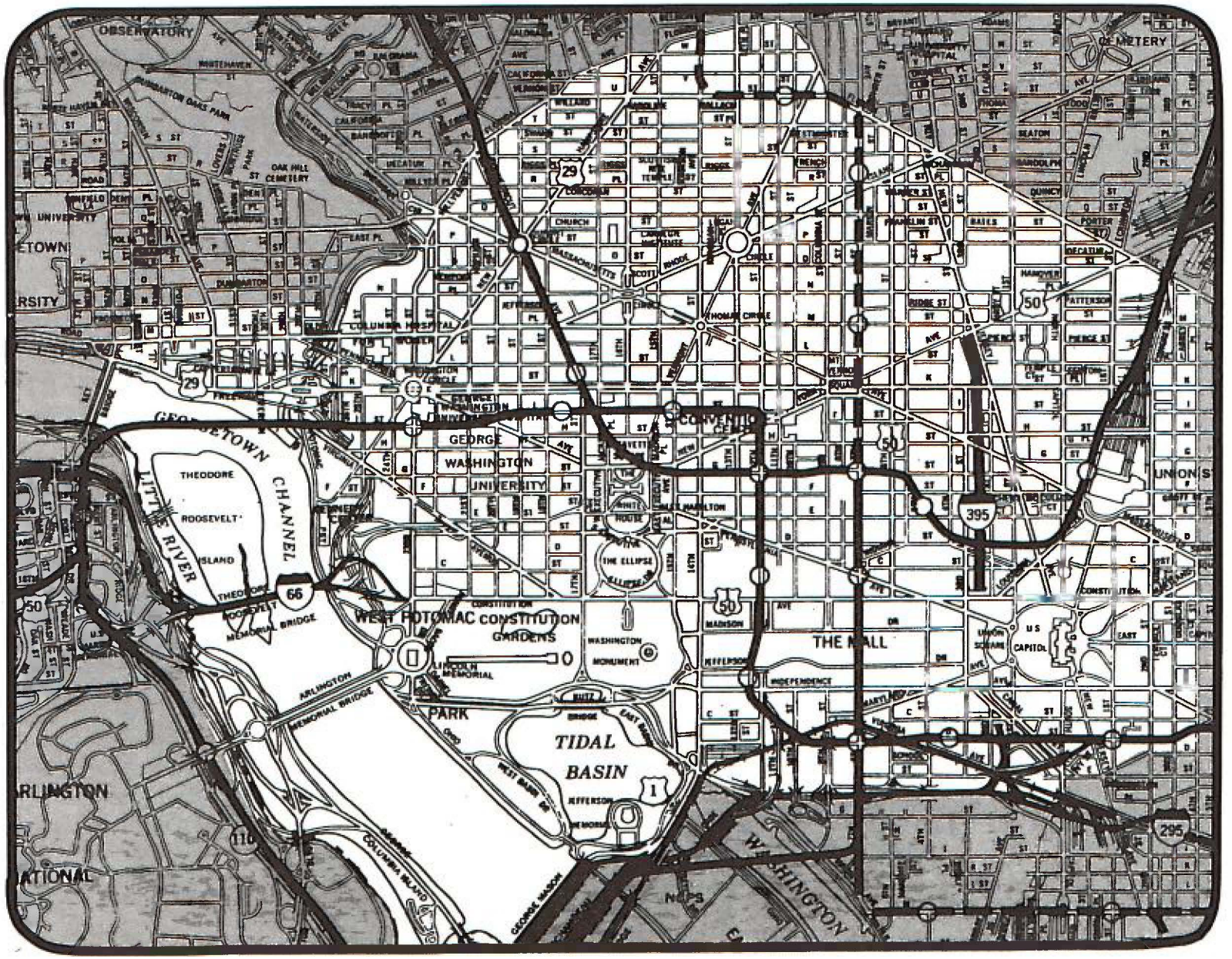
GEOGRAPHIC DISTRIBUTION OF RAIL TRAVEL
(1976-1982)

Systemwide	Trips Within DC Core		Trips To/From DC Core		Trips Through DC Core		Trips Not Crossing DC Core Cordon		Total Trips
	NO.	%	NO.	%	NO.	%	NO.	%	NO.
PHASE I	15,100	70.7	6,000	28.4	--	-	200	0.9	21,300
PHASE II	58,000	43.1	67,400	50.1	1,700	1.3	7,400	5.5	134,500
PHASE IIA	62,900	33.8	105,200	56.6	4,900	2.6	13,000	7.0	186,000
PHASE III	62,600	24.1	171,800	66.1	12,500	4.8	13,000	5.0	259,900
PHASE IV	73,000	23.9	198,500	65.0	13,700	4.5	20,200	6.6	305,400
PHASE IVA	62,200	21.0	198,600	67.1	15,700	5.3	19,500	6.6	296,000
PHASE V	57,100	19.1	201,300	67.5	21,200	7.1	18,700	6.3	298,300

SOURCE: Metrorail Passenger Surveys; WMATA

Figure 4.2

D.C. CORE



By the end of the first three years of Metrorail operations, several trends had developed in the geographic distribution of rail travel. Through Phase III operations, trips within the D.C. core had quadrupled in number since the opening of Phase I, and accounted for just over 24 percent of the total trips made. In terms of absolute numbers, trips to and from the D.C. core had shown the most dramatic changes, increasing by as many as 66,000 trips per day as the various rail extensions were opened, and had attained a level of nearly two-thirds of all trips made during Phase III. Trips through the core, most of which were trips from the New Carrollton and Silver Spring extensions to stations in Northern Virginia, showed substantial increases as well, though not in the same magnitude as travel to and from the core. By Phase III, these trips had grown to approximately five percent of total trips, as had trips not crossing the D.C. core cordon. Travel outside of the core had begun at less than one percent of all travel in Phase I, and had grown to 13 thousand trips per day by Phase III.

The growth in rail travel within the D.C. core was primarliy due to the opening of the second downtown segment, the initial Blue Line, and the extension of the Red Line to Silver Spring. The level of trips within the core during Phase IIA operations was virtually the same level as during Phase III. The initial travel findings report suggested that, since there was no absolute growth in trips within the core during Phase III, this travel market may be saturated until a new downtown rail line is opened, or until there is additional growth in downtown employment. Table 4.3 appears to verify this observation. Although there was an increase in the absolute number of trips within the core during Phase IV operations, due to the overall increase in total rail trips to over 300 thousand per day, the proportion for this type of travel fell to under 24 percent. Phases IVA and V saw further decreases in both absolute numbers and proportions for these trips, with only 19 percent of all trips made being within the D.C. core during Phase V. The relationship, discussed earlier, between rail ridership and employment within D.C. can again be seen. From Phase III to Phase V, trips within the D.C. core decreased by 8.8 percent, while D.C. employment experienced an overall decline of 1.8 percent.

As each of the rail extensions after Phase III came into operation, the effects, in terms of geographic distribution of rail travel, were most significant on the trips to and from the D.C. core. The trend established through Phase III, of significant growth with each new service extension, continued with Phase IV. An additional 26,700 daily trips were made to and from the core, an increase of 15.5 percent over Phase III ridership. It is possible that part of this large growth in core-oriented ridership may have been due to gasoline prices in the Washington area, which increased most dramatically, by over 50 percent, during this time period. Following Phase IV, trips to and from the D.C. core remained virtually the same during Phase IVA, and increased again (by 2,700) during Phase V. In terms of total rail trips made, this type of trip maintained a high percentage (around two-thirds) through Phase V.

Trips through the D.C. core increased slightly with each extension of rail service between Phase III and Phase IVA, maintaining a level of roughly five percent of total trips each year. However, between Phase IVA and Phase V, this category of trip increased by over 35 percent, or 5,500

trips per day. The majority of this increase is attributed to trips being made from the Red Line extension stations to Northern Virginia.

After Phase III, rail trips not crossing the D.C. core cordon increased somewhat substantially. Between Phase III and Phase IV, an increase of over 55 percent occurred in this trip category, raising the proportion to 6.6 percent of the total number of trips made, a level which was roughly maintained through Phase V. This increase during Phase IV is attributed to the nature of the Orange Line extension to Ballston, lying entirely outside of the D.C. core area. Of the Phase IV rail trips not crossing the core cordon, a majority are trips made entirely within Virginia. Further analysis of these intra-Virginia trips is presented in Table 4.4.

TABLE 4.4

DISTRIBUTION OF RAIL TRAVEL WITHIN VIRGINIA

(1980-1982)

Trips Within VA	Trips Crossing VA Core Cordon		Trips Not Crossing VA Core Cordon	
	NO.	%	NO.	%
PHASE IV	4,000	28.4	10,100	71.6
PHASE IVA	3,500	27.1	9,400	72.9
PHASE V	3,100	27.4	8,200	72.6

SOURCE: Metrorail Passenger Surveys; WMATA

The pattern of high density employment found in the D.C. core area extends into Virginia, to form a single continuous regional core. The Virginia core boundary crosses the Rosslyn-Ballston corridor just to the west of the Rosslyn Metrorail Station, between that station and the Court House Station. This effectively separates the Virginia Metrorail service in two: the Blue Line to National Airport lies entirely within the Virginia core, and the Orange Line to Ballston lies entirely outside of the Virginia core. In Table 4.4, then, trips that cross the Virginia core cordon are those that have an origin on either Blue or Orange Line, and a destination on the other line. Trips that do not cross the core cordon are made entirely within the Orange Line or entirely within the Blue Line. Although the absolute numbers for each category within Virginia decreased between each phase of rail service, the relative percentages of the total number of intra-Virginia trips remained somewhat constant during these three years. It is important to note that, for each of these years, rail trips made entirely within Virginia were the majority of all trips not crossing the D.C. core cordon.

CHANGES IN THE GEOGRAPHIC DISTRIBUTION OF BUS RIDERSHIP

The analysis of the geographic distribution of rail travel is complemented by an analysis of changes in bus ridership patterns in the region. Unlike rail ridership, bus ridership is generally reported by jurisdiction, focusing on bus travel within each jurisdiction and between jurisdictions. A bus ridership survey taken in 1972, prior to WMATA's takeover of four private bus companies, reported the geographic pattern of bus ridership observed at that time. Since the WMATA takeover, surveys have been conducted annually for the purpose of allocating bus revenues that are attributable to the various jurisdictions. Table 4.5 displays bus passenger trips within and between the jurisdictions for the 1972 survey and the revenue allocation surveys that have been conducted since the introduction of Metrorail.

TABLE 4.5

BUS PASSENGER TRIPS BETWEEN JURISDICTIONS

(In 1,000's)

	Fall[1] 1972	Fall[2] 1976	Fall[2] 1977	Fall[2] 1978	Spring[3] 1979	Spring[3] 1980	Spring[3] 1981	Spring[3] 1982
DC - DC	218.0	227.3	197.1	213.6	259.8	266.7	254.8	245.4
MC - MC	4.6	9.3	10.4	11.6	21.0	23.3	20.5	22.8
PG - PG	2.6	4.2	5.8	5.9	12.4	11.4	13.7	16.3
VA - VA	20.9	23.5	48.6	53.3	63.1	75.2	61.2	66.9
DC - MC	35.8	22.0	22.9	14.8	20.7	23.8	18.1	16.8
DC - PG	32.4	20.1	17.0	16.7	21.0	24.2	19.7	18.9
DC - VA	59.0	69.9	31.0	29.6	23.4	26.1	19.4	16.2
MC - PG	1.4	1.9	2.1	1.8	2.1	2.9	2.6	2.9
MC - VA	.7	.6	.4	.3	.1	.1	.1	--
PG - VA	1.0	.8	.3	.5	.2	.2	.2	.3
TOTALS	376.4	379.6	335.6	348.2	423.7	453.9	410.2	406.5

SOURCE: Metrobus Revenue Allocation Surveys

It is important to note that some of the figures in Table 4.5 are not directly comparable. While the 1972 survey included D.C. school trips in the bus ridership, those who used school tokens as fares are specifically excluded in the later surveys. The allocation surveys are conducted in

[1] All bus trips including D.C. school trips.
[2] Did not include rail to bus transfers in D.C., Montgomery and Prince George's Counties.
[3] Includes all passengers except WMATA, police, postal, school token and Metrobus transfers.

order to divide the Metrobus revenue among jurisdictions. Therefore, non-revenue ridership, i.e. rail-to-bus transfers in D.C. and Maryland prior to 1979 or bus-to-bus transfers in which no fare is collected, are not included in these counts. Meaningful comparisons can be made from this data if care is taken to analyze like figures for each year.

The extension of rail service can be seen to affect the geographical patterns of bus travel.

With the opening of the initial Blue Line in 1977, which provided extensive rail service in Northern Virginia, bus travel between the District of Columbia and Northern Virginia declined by more than 50 percent. In the fall of 1976, almost 70 thousand weekday trips were made between these two areas. One year later, after the Blue Line opened, this type of bus ridership had dropped to 31 thousand. Of course, some of this decline is due to the turnback of buses at rail stations, but the continuation of this decline in D.C./Virginia ridership suggests that it is largely due to Metrorail. At the same time, Metrobus trips made entirely within Virginia increased substantially, from 23,500 in the fall of 1976 to just under 67,000 in 1982. Again, much of this increase can be attributed to the shift from all bus trips into D.C. to bus-rail trips.

Similar patterns can be seen in the ridership between D.C. and the Maryland jurisdictions. While trips between D.C. and Montgomery County and between D.C. and Prince George's County have generally decreased since the introduction of Metrorail in each of these jurisdictions, the intra-county trips for both jurisdictions have steadily increased.

TABLE 4.6

CHANGES IN BUS PASSENGER TRIPS BETWEEN JURISDICTIONS

(In 1,000's)

	1972-1976	1976-1979	1979-1982
DC - DC	+49.3	+32.5	-14.4
MC - MC	+ 4.7	+11.7	+ 1.8
PG - PG	+ 1.6	+ 8.2	+ 3.9
VA - VA	+ 2.6	+39.6	+ 3.8
DC - MC	-13.8	- 1.3	- 3.9
DC - PG	-12.3	+ .9	- 2.1
DC - VA	+10.9	-46.5	- 7.2
MC - PG	+ .5	+ .2	+ .8
MC - VA	- .1	- .5	- .1
PG - VA	- .2	- .6	+ .1
TOTALS	+43.2	+44.1	-17.2

A comparison of the changes in bus ridership patterns between the period prior to Metrorail operations (1972-1976), the initial operating period of Metrorail (1976-1979) and the latest years of Metrorail operations (1979-1982) is contained in Table 4.6. To make the figures comparable, D.C. school trips have been eliminated from the 1972 survey figures.

Table 4.6 shows that, between 1972 and 1976, during the time WMATA acquired the bus companies and began to improve equipment, add service and integrate routes, bus ridership within each jurisdiction increased. Bus trips between D.C. and Northern Virginia also increased substantially during this time. However, trips between D.C. and the Maryland suburbs showed considerable declines, with a drop of almost 14,000 weekday trips between Montgomery County and the District, and more than 12,000 weekday trips between Prince George's County and the District.

During the initial three years of Metrorail operations, from 1976 to 1979, bus trips within each jurisdiction continued to increase. The dramatic increases within the suburban jurisdictions indicate the increased use of bus-to-rail transfers for commuting to work that was discussed previously. The increase of almost 40,000 weekday trips in intra-Virginia bus travel can be compared to the 46,500 decrease in weekday trips between the District of Columbia and Northern Virginia, indicating a high correlation between the extension of rail service in this area and the diversion of bus trips.

The same situation is not evident in bus travel between Maryland and the District. Here, the increase in intrajurisdictional bus travel from 1976 to 1979 is not offset by a corresponding decline in interjurisdictional travel. In the previous discussion of total transit use, it was indicated that the total transit market increased after the Metrorail extensions into Maryland. This is supported by the data on changes in bus travel. Intra-Montgomery County bus travel increased by almost 12,000 weekday trips while bus travel between Montgomery County and D.C. decreased only slightly. It should also be noted that Montgomery County began operations of its RIDE-ON bus service during this time, providing additional intra-County bus service that was essentially a feeder service to the Silver Spring Metrorail Station. In Prince George's County, weekday bus trips within the County show an increase of over 8,000 trips and only minor changes in interjurisdictional bus travel to and from the County. It appears, then, that the initial extensions of rail service into the Maryland suburbs added new transit riders while retaining the previous bus users.

The data on bus passenger trips between jurisdictions for the 1979 to 1982 period indicate some significant changes. The pattern established in Northern Virginia during the initial operation of Metrorail (high correlation of rail service with bus trip diversion) begins to appear in the Maryland suburbs. Intrajurisdictional trips in Northern Virginia, as well as Montgomery and Prince George's Counties, continued to increase. However, during this period, trips between these jurisdictions and the District decreased in corresponding fashion. Also during this period, bus travel within the District decreased considerably, further reflecting the relationship between transit use and the state of employment within D.C. that was discussed previously.

CHANGES IN BUS SERVICE

As discussed earlier, WMATA policy is to revise bus service in major travel corridors following the introduction of rail service. Since the beginning of Metrorail service, extensive changes have been made in the regional bus system, most of which were intended to integrate bus and rail into a single regional transit system. Additional adjustments have been made to individual bus routes, at the request of the jurisdiction in which the service is located, in order to improve the bus system itself.

The changes made in bus service in individual travel corridors is complex to measure, not only because of the extent of the changes made, but also because many of them were unrelated to the rail system. Therefore, this section will analyze the total annual amount of Metrobus service in the Washington metropolitan region, and the overall changes that have been made since the opening of Metrorail.

TABLE 4.7

TRENDS IN BUS SERVICE AND RIDERSHIP

FISCAL YEAR[1]	ANNUAL BUS MILES	ANNUAL BUS PASSENGERS[2]	PASSENGERS PER BUS MILE
FY 76	55,400,000	126,806,000	2.29
FY 77	55,422,000	127,000,000	2.29
FY 78	52,356,000	112,599,000	2.15
FY 79	50,990,000	119,848,000	2.35
FY 80	54,459,000	149,224,000	2.74
FY 81	53,942,000	141,411,000	2.62
FY 82	52,556,000	135,960,000	2.59

Table 4.7 displays the trends in bus service and ridership that have occurred each year (on a fiscal year basis) since the initial Red Line opened. Prior to the opening of this segment, the total for annual bus miles of service was 55.4 million, an amount which slightly increased when the Red Line segment opened in March 1976. From fiscal year 1977 through fiscal year 1979, when Metrorail was operating the Phase III system, including service to New Carrollton, the total annual amount of bus service

[1] Figures are reported on a July-June fiscal year basis.
[2] Includes bus-rail transfers as well as bus only passengers.

declined from 55.4 million miles to just under 51.0 million miles. This represented an eight percent reduction in bus service.

During the summer of 1979 (beginning of fiscal year 1980) the gasoline shortages appeared in the Washington Metropolitan area. The result of the gas crisis, as has been discussed, was an increase in bus ridership (by over 29 million passengers) which was accompanied by an increase in bus service. Between fiscal year 1979 and fiscal year 1980, the total amount of bus service increased almost as much as it had declined during the three previous years. The 54.4 million total annual bus miles for fiscal year 1980 represented a seven percent increase over fiscal year 1979.

Following fiscal year 1980, however, service adjustments again began to decrease the total annual bus miles, but not as dramatically as in prior years. Fiscal year 1981 saw a 5.2 percent decline in bus passengers and a decrease in service provided of just under one percent (517,000 bus miles less). In fiscal year 1982, bus passengers again decreased (by 3.9 percent) as did the total number of bus miles (1,386,000 miles, or a decrease of just over 2.5 percent).

The relationship between bus service supply and demand can be measured through the ratio of bus passengers per mile. Although this ratio remained relatively constant between 1976 and 1979, it reached a peak in fiscal year 1980, along with demand and service provided, and similarly declined in fiscal years 1981 and 1982. However, the ratio for the last two reporting periods are higher than the earlier years, when fewer passengers were carried and more miles of service were operated. Metrobus now carries more passengers and operates fewer bus miles, indicating that the adjustments made in recent years have led to more efficient bus service.

CONCLUSIONS

In Chapter 2, the changes in ridership on the Metrorail system between its opening in 1976 and Phase V operations in 1982 were discussed. This system has been constructed, however, in a region that was already served by one of the largest regional bus systems in the country. As cited earlier, the majority of rail passengers would have taken a bus as an alternative mode of travel if Metrorail were not available. For the most part, as the rail network was expanded, increases in rail ridership were matched by losses in bus trips. To some extent, the reduction in bus travel was attributable to a choice by passengers to take the faster mode, while in other cases, WMATA terminated bus routes at rail stations, or eliminated parallel bus service, thereby forcing bus passengers onto rail.

Total WMATA ridership, both bus and rail, fluctuated widely after the first three years of rail operations. The first-time increase in total transit ridership that followed the Red Line extension to Silver Spring in 1978 continued through the summer of 1980. During this time, the historic trend of seasonal fluctuations that characterizes bus transit became evident in total transit usage in this region. Since the summer of 1980, total transit ridership has declined from its peak and levelled off, affecting bus ridership and rail-related ridership as well.

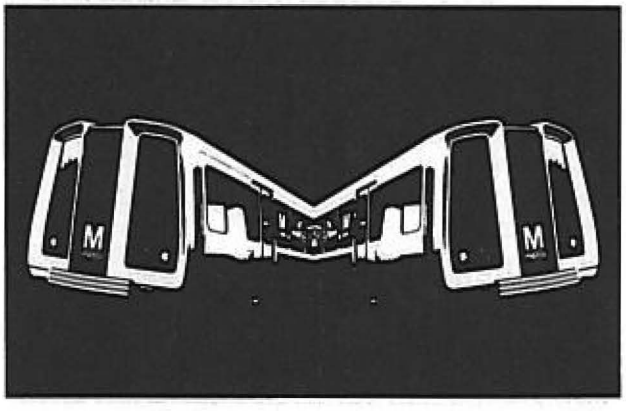
The geographic distribution of rail travel between 1979 and 1982 generally maintained the patterns established in the first three years of Metrorail operations. Approximately two-thirds of all trips made were oriented to or from the central employment area of the District, a level that remained fairly constant through 1982. Trips within the D.C. core continued to decline during this period, indicating that this travel market may be saturated until a new downtown rail line is opened. The remaining categories of geographic distribution of rail travel - trips through the D.C. core and trips not crossing the D.C. core - continued their steady, though small, increases through 1982.

The overall decline in rail trips between 1980 and 1982 occurred initially in trips within the D.C. core, but between 1981 and 1982 it was divided almost equally between trips within and trips to and from the core.

While the rail system predominantly carries transit riders to and from the D.C. core area, the focus of the Metrobus system has increasingly shifted from carrying commuters into the city, in a line-haul capacity, to serving trips made entirely within the suburbs or the city. Bus trips between suburban jurisdictions and the D.C. core have decreased dramatically, while intrajurisdictional trips have continued to increase since 1979. For the most part, growth in bus travel continues to represent travel to and from rail stations within the same jurisdiction. This is most clearly seen in Northern Virginia, where bus operations are closely linked to the rail system in all major travel corridors.

The introduction of rail service into major travel corridors has led to the integration of the bus and rail systems into a single regional transit system. Changes that have been made in Metrobus service since the opening of Metrorail have resulted in fewer bus miles being operated and more bus passengers being carried. This higher ratio of passengers per bus mile indicates a more efficient bus system is now in operation than prior to Metrorail.

CHAPTER 5
TRAVEL TO THE CORE



CHAPTER V

TRAVEL TO THE CORE

In the previous chapters, it has been noted that the focus of the Metrorail system is on downtown Washington, and that extensive use is made of Metrorail for the commute to and from work in the central employment area. By Phase V operations, in 1982, over two-thirds of all rail ridership represented travel to and from the D.C. core. Thus, any changes in travel behavior that might be the result of the introduction of Metrorail would most likely occur first in travel to and from the D.C. core.

The D.C. core, as discussed in Chapter 4, is the subject of extensive historical data on transportation and development. Over the past several years, the Transportation Planning Board of the Metropolitan Washington Council of Governments has collected extensive data on passengers and vehicles entering the central employment area of the region. This COG/TPB program monitors all persons and vehicles crossing a core cordon line which encompasses the central employment area. This counting program provides a unique opportunity to isolate the geographic region most affected by Metrorail and to obtain directly comparable empirical information on auto, bus and Metrorail traffic crossing the heaviest travel cordon line in the region. Within this central cordon line, the existing highway network and bus system were operating close to capacity. Metrorail, in its initial three years of operation, allowed substantial increases in travel to the central employment area, thereby increasing the capacity of both the highway network and transit system.

CHANGES IN TRANSIT TRAVEL TO THE D.C. CORE

The Metro Core Cordon Count program measures traffic entering the central employment area during the 13 hour period between 6:00 A.M. and 7:00 P.M. Until 1981, this data was collected on an annual basis. Thereafter, agreement was reached to conduct the program every other year, with the next count scheduled to be taken in the spring of 1983. Thus, the analyses in this and the next section will be based on the data collected through 1981.

Total transit ridership crossing the D.C. core cordon line increased from 160,600 inbound riders per day in 1977 to a peak of 235,600 inbound riders in the spring of 1980 (the overall peak year for transit in the region), and then declined to 218,600 in the spring of 1981. Figure 5.1 graphically displays this trend. The proportion of this total transit ridership that used the rail system increased substantially during this time.

In the spring of 1977, with only the Rhode Island Avenue Station lying outside of the core cordon, 2.7 percent of total transit ridership entering the core was on the rail system. By 1981, with 37.1 miles of the system in operation, the majority of which was located in the core area, almost half of all transit ridership entering the D.C. core was on the rail system.

Figure 5.1

CHANGE IN TRANSIT TRAVEL TO THE D.C. CORE
(6:00 AM–7:00 PM)

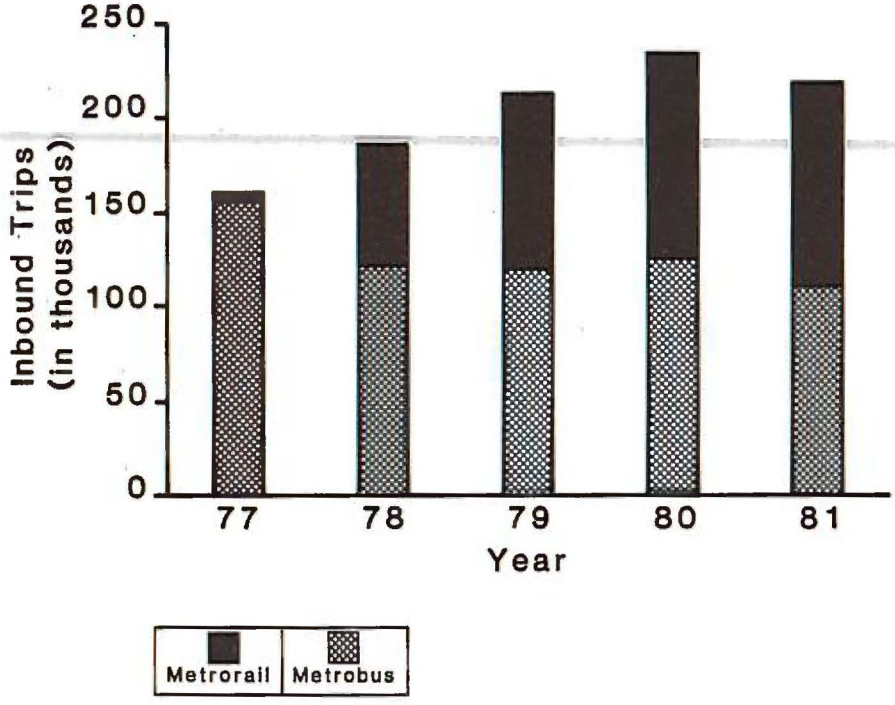
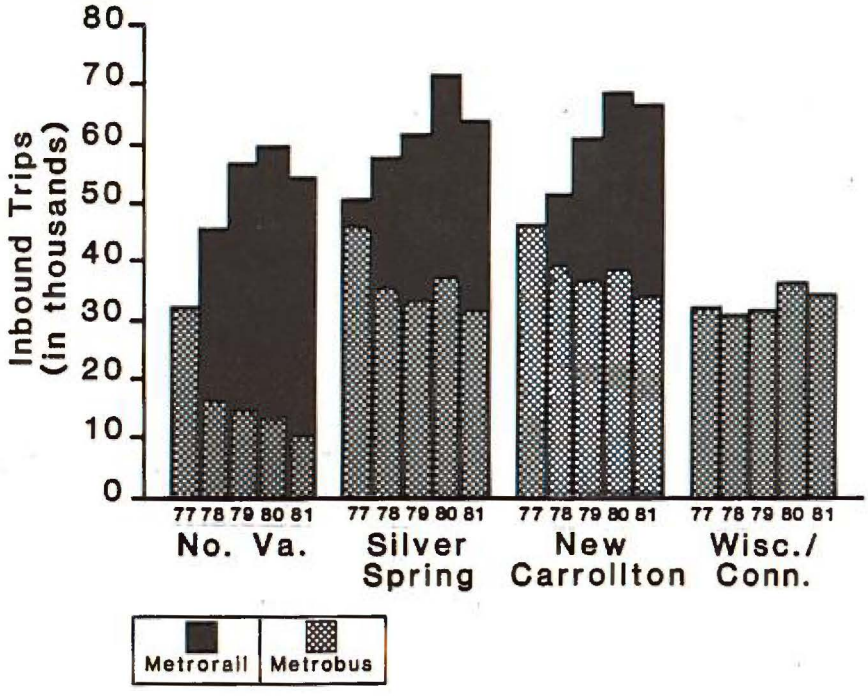


Figure 5.2

TRANSIT TRAVEL TO THE D.C. CORE
13 HOUR PERIOD
(6:00 AM–7:00 PM)



The decrease in the bus share of total transit ridership between 1977 and 1981 was from 97.3 percent to 50.7 percent of total transit ridership entering the core. The expansion of rail service during this period, then, accounts for a net reduction of just under 45,500 core area bus trips, or a decrease of 29 percent over the 1977 total. Although there was a slight increase in bus ridership entering the core between 1979 and 1980, corresponding to the overall increase in transit usage in 1980, the net effect of Metrorail on bus ridership entering the core was a reduction.

The observations regarding traffic entering the D.C. core reveal the same patterns observed in the analysis of the regional bus and rail survey data. As each new rail line has become operational, the role of Metrorail in carrying passengers to and from the central employment area has increased, while at the same time, the role of Metrobus in providing line-haul D.C. core area service has diminished. This is consistent with the goal of an integrated transit system in the Washington region.

The changes in core area transit use between 1977 and 1981 are even more dramatic when the individual transit corridors in which Metrorail service is provided, are examined. Figure 5.2 displays the changes in transit travel to the D.C. core during the 6:00 A.M. to 7:00 P.M. period, for the three major travel corridors which had Metrorail service by 1981, plus one corridor that historically has been well served by bus transit.

The overall trends in core area transit travel are very well illustrated in Northern Virginia. Total transit ridership increased dramatically between 1977 and 1980, and then declined in 1981. Between 1977 and 1979, total ridership nearly doubled while bus ridership was cut in half. Total bus trips to the D.C. core from the Northern Virginia corridor declined by almost 55 percent. This trend continued through 1981. The proportions of total transit ridership travelling from Northern Virginia to the D.C. core via Metrorail continued to increase, from 74 percent in 1979 to 77 percent in 1980, and to over 81 percent in 1981.

This same general pattern of change in transit ridership to the D.C. core can also be seen in the Silver Spring corridor. Total ridership showed an increase of over 20 percent, almost 11,000 trips daily, between 1977 and 1979. This amount was nearly matched in 1980 alone (a 10,200 increase) which was then followed by an 11 percent decrease in 1981. Bus ridership showed a significant decrease between 1977 and 1979, of 27 percent, while rail and total ridership showed substantial increases. After a minor increase in 1980, bus ridership entering the core area from the Silver Spring corridor decreased an additional four percentage points, so that, by 1981, it had declined 31 percent from the 1977 total. Rail ridership, in contrast, showed dramatic increases during this period. Beginning with only nine percent of the total in 1977 (passengers entering the Metrorail system at Rhode Island Avenue and travelling downtown), rail grew to 45 percent in 1979, and then to just under 50 percent of the total in 1981.

For the purpose of this analysis, the New Carrollton corridor has been defined to include all traffic entering the core between New York Avenue, NW, and 14th Street, SW, a rather broad area. For this reason, the changes observed in transit travel in this corridor, although following the same general trend as noted for the other two travel corridors, are not quite as dramatic or substantial in extent. The decrease in bus trips be-

tween 1977 and 1979 totalled just under 20 percent, and grew by five percentage points, to just under 25 percent in 1981. Total transit trips entering the D.C. core increased by over 49 percent between 1977 and 1980, but decreased by only three percent in 1981. Thus, Metrorail is capturing an increasing share of this total transit in the New Carrollton corridor. With a share of 23 percent of total transit ridership in 1978, rail grew to 39 percent in 1979, after the Orange Line extension to New Carrollton, and to 48 percent in 1981, after the Blue Line extension to Addison Road.

In the Wisconsin/Connecticut Avenue travel corridor, the pattern of transit ridership to the core area is markedly different from that seen in the other corridors. The Wisconsin/Connecticut Avenue corridor, although well served by bus transit, was not directly served by rail transit during the spring 1977 to spring 1981 period (the Red Line extension to Van Ness-UDC did not open until December 1981). The data for this corridor shown in Figure 5.2 display very little change in total transit use to the core, in contrast to those corridors with Metrorail service. Metrobus ridership in this corridor (which would also be total transit ridership here) fluctuated at around 31 thousand daily inbound riders between 1977 and 1979. There was a slight increase (4,500 riders) in 1980, followed by a decrease in 1981. Between 1977 and 1981, total transit ridership to the core increased by only eight percent.

Comparing the Wisconsin/Connecticut Avenue corridor to the Northern Virginia corridor, we can see that total transit ridership in 1977 for both corridors was roughly equivalent. The introduction of Metrorail service in Northern Virginia spurred a substantial increase in transit travel to the core. By 1981, ridership in the Northern Virginia corridor showed an increase of over 63 percent, while in the Wisconsin/Connecticut Avenue corridor, the increase in total transit travel to the core was only eight percent. It will be important to track ridership in the Wisconsin/Connecticut Avenue corridor after the December 1981 opening of the Red Line extension, to see how closely it relates to the increases that were experienced in Northern Virginia.

CHANGES IN AUTO TRAVEL TO THE D.C. CORE

The effect of Metrorail on travel to and from downtown Washington was expected to be felt not only in transit, but in auto travel as well. The initial travel findings report analyzed changes in auto travel to the core between 1977 and 1979. That report concluded that it was not until 1979 that Metrorail's effect on auto travel was observed. The Metro Core Cordon Count taken in the spring of 1979 was the first in which the full effects of the suburban rail extensions (to Silver Spring and to New Carrollton) could be seen. The results were an 8.3 percent reduction in inbound auto trips (48,400) and a 7.6 percent reduction in the number of autos entering the core (30,800). These trends, however, did not continue as expected. Figure 5.3 shows the change in auto travel to the D.C. core, measured for the 13 hour period, between 1977 and 1981.

After the decline recorded through 1979, inbound auto trips increased in 1980, and then decreased almost imperceptibly in 1981. The overall effect has been only a slight decrease in both auto driver travel, down 14,700 or 3.6 percent, and auto passenger travel, down almost 5,000 or 3 percent on a daily basis since 1977.

CHANGE IN AUTO TRAVEL TO THE D.C. CORE
(6:00 AM–7:00PM)

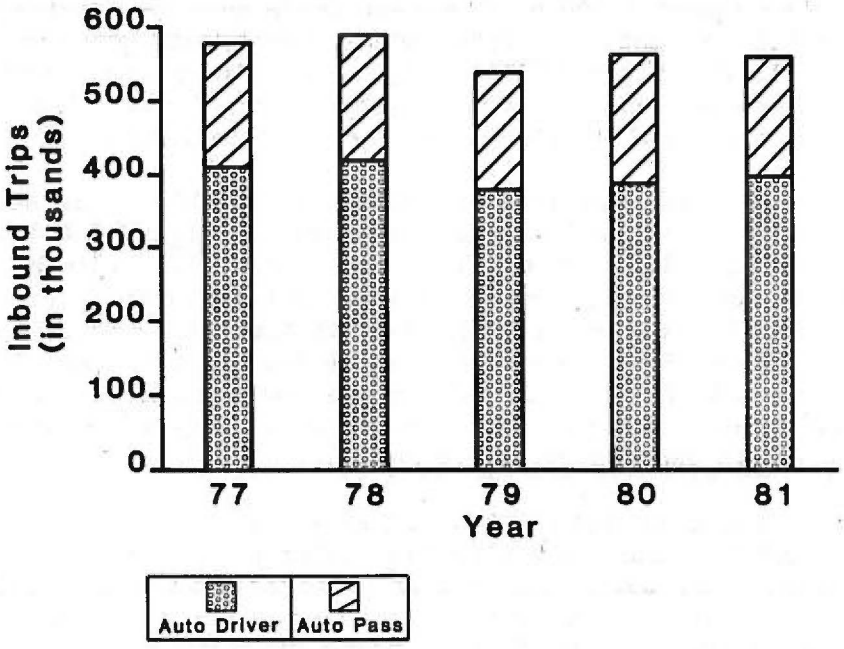
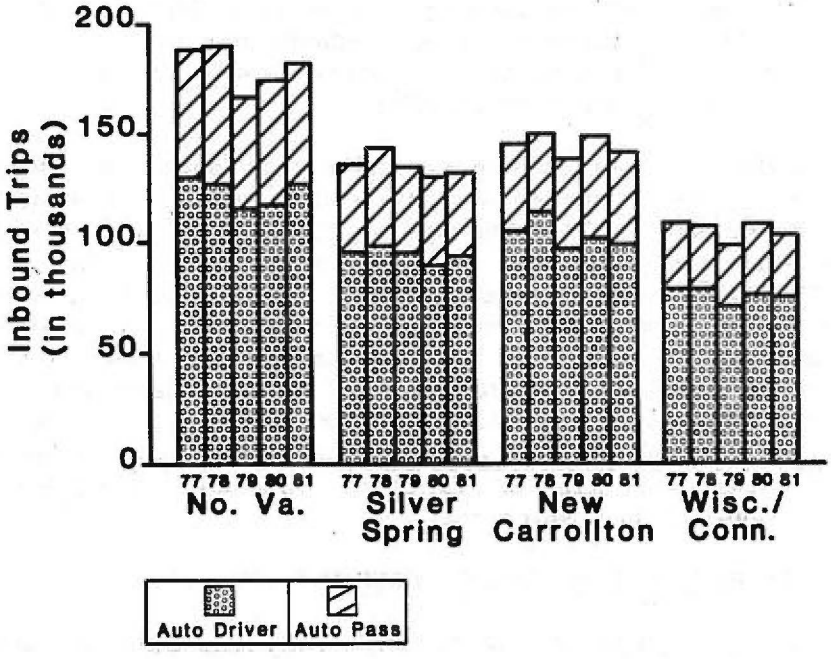


Figure 5.4
AUTO TRAVEL TO THE D.C. CORE
13 HOUR PERIOD
(6:00 AM–7:00 PM)



One note regarding the auto increases since 1979 is that, in 1980 (the first count to measure the effects of the gasoline shortages), auto drivers increased by almost 7,500 or 2 percent while auto passengers increased by 15,000 or 9.5 percent. In 1981, while total auto persons trips remained within 1,000 of the 1979 total, auto drivers increased by 9,000 (2.3%) while auto passengers decreased by 9,800 (5.6%). The effects of the gas crisis on carpooling did not appear to be long lasting.

Again, changes in core area auto travel can be further illustrated by examining each of the four major travel corridors. Figure 5.4 displays the changes in each corridor. In the Northern Virginia corridor between 1977 and 1979, there was a significant reduction in total auto travel (9.8 percent), corresponding to the large increase in Metrorail ridership. However, between 1979 and 1981, there were increases in both auto drivers and auto passengers. By 1981, total auto travel to the core in this corridor had decreased by only 2.9 percent, auto drivers decreasing by 2.6 percent and auto passengers decreasing by 3.6 percent.

The overall decrease in total auto travel in the Silver Spring corridor between 1977 and 1981 was only slightly higher than in Northern Virginia, just 3.1 percent. The pattern of change, however, was somewhat different. Rather than recording a substantial decrease in 1979 followed by steady increases, auto travel in the Silver Spring corridor decreased by 6 percent in 1979 and decreased by another 4.1 percent in 1980. In 1981, there was only a 1.7 percent increase in auto travel to the core. Also, during these five years, the proportions of auto drivers and auto passengers remained within two percentage points for each year.

The New Carrollton corridor similarly experienced a small decrease in total auto travel to the core of only 2.8 percent. There was a widely fluctuating pattern in this corridor, with an increase of 3.1 percent in 1978, followed by a decrease of 8.5 percent in 1979, followed by an increase of 8.5 percent in 1980, and followed by a 5 percent decrease in 1981. Even the proportions of auto drivers and auto passengers fluctuated more widely in this corridor, with a high of 75.3 percent auto drivers in 1978 and a low of 68.5 percent auto drivers in 1980.

The Wisconsin/Connecticut Avenue corridor represents an anomaly in the trend in auto travel to the core. Since this corridor was not served by Metrorail between spring 1977 and spring 1981, one would expect a smaller decrease in auto travel to the core, or none at all. However, between 1977 and 1981, the Wisconsin/Connecticut Avenue corridor experienced a larger decrease in total auto travel, in terms of both absolute numbers and percentages, than in any of the three travel corridors in which Metrorail service was provided. There was a 5.3 percent decrease in total auto travel to the D.C. core, most of which were auto drivers. Again, it will be important to track this trend after the Red Line extension to Van Ness-UDC to discern what kind of effect the introduction of Metrorail will have on auto travel in this corridor.

IMPACTS OF METRORAIL ON PEAK PERIOD TRAFFIC

One of the primary goals of the Metrorail system was to reduce traffic congestion by providing an alternative to commuting to and from the cen-

tral employment area by private automobile. By isolating the travel to the D.C. core between 6:30 and 9:30 A.M., an analysis can be conducted on the impact of Metrorail on peak period commuting trips. This period corresponds to the time when travel capacities on the major approaches to downtown are most strained.

TABLE 5.1

PEAK PERIOD TRAVEL TO THE D.C. CORE
(6:30 - 9:30 A.M. Inbound)

(In 1,000's)

AUTO PERSON TRIPS	1977	1978	1979	1980	1981	1982
Auto Drivers	152.3	154.5	145.9	141.7	147.6	158.5
Auto Passengers	73.0	75.4	68.7	72.1	68.8	79.6
Total Auto Trips	225.3	229.9	214.6	213.8	216.4	238.1
Avg. Auto Occupancy	1.48	1.49	1.47	1.51	1.47	1.50
WMATA TRANSIT TRIPS						
Metrobus	91.5	68.2	63.7	68.9	59.6	55.1
Metrorail	2.6	38.8	57.7	68.8	64.2	68.4
Total WMATA Trips	94.1	107.0	121.4	137.7	123.8	123.5
Total Person Trips	319.4	336.9	336.0	351.5	340.2	361.6
Percent Transit	29%	32%	36%	39%	36%	34%

CHANGES	1977-1979	1979-1982	1977-1982
Auto Driver	- 6.4	+12.6	+ 6.2
Auto Passenger	- 4.3	+10.9	+ 6.6
TOTAL AUTO	-10.7	+23.5	+12.8
Metrobus	-27.8	- 8.6	-36.4
Metrorail	+55.1	+10.7	+65.8
TOTAL WMATA	+27.3	+ 2.1	+29.4
TOTAL TRIPS	+16.6	+25.6	+42.2

SOURCE: TPB Cordon Counts

Table 5.1 displays the total morning peak period travel entering the D.C. core, broken into auto person trips and WMATA transit trips, plus the changes that have been experienced in this travel between 1977 and 1982. Due to a special morning peak period core cordon count that was taken, we can also incorporate 1982 travel into this analysis. (Total auto trip figures used may vary slightly from that core cordon count due to factoring differences.)

The initial travel findings report, which sought to establish the trends of Metrorail's impact on rush hour traffic through 1979, concluded that the data for total auto trips between 1977 and 1979 was indicative of a downward trend, decreasing by 10,700 inbound trips. However, between 1979 and 1982, a complete reversal of this trend occurred, with total inbound auto trips increasing by 23,500. Better than half of this increase was due to an increase in auto drivers. The cumulative change for total auto trips to the D.C. core between 1977 and 1982 was an increase of 12,800, which was split almost evenly between auto drivers and auto passengers.

The changes that occurred in peak period transit ridership are significant as well. From 1977 to 1979, there was an increase of 27,300 inbound peak period transit riders crossing the D.C. core cordon. This represented a 30 percent increase in transit ridership in just two years. This increase continued into 1980 (the 'peak' year for transit in the Washington region) with a further increase of 16,300 riders. As with auto trips, however, the trend in transit trip making was reversed between 1980 and 1982, with a total transit ridership loss of 14,200 peak period riders occurring. This decrease in morning transit ridership affected not only Metrobus (declining by a total of 13,800 riders), but also Metrorail (which lost 4,600 morning riders between 1980 and 1981 before regaining the loss in 1982).

The net change in transit ridership between 1977 and 1982 is substantial. The total transit ridership figure represents 36,400 bus riders that have been diverted to rail, plus an increase of 29,400 'new' peak period Metrorail riders entering the D.C. core.

There was a net increase of 42,200 A.M. peak period trips (auto plus transit) entering the D.C. core between 1977 and 1982. This growth was partially made possible by the expansion of Metrorail, which increased the capacities of both the transit system and the highway network. By removing almost 800 bus trips from congested downtown streets and replacing them with over 1000 rail car trips with more than twice the capacity, Metrorail has allowed the highway network to carry more inbound auto trips and the transit system to carry more passengers.

CHANGES IN MORNING PEAK PERIOD TRAVEL BY TRAVEL CORRIDOR

The cumulative effects of Metrorail on the highway network and transit system capacities were shown in Table 5.1. Analysis of travel to the regional core by travel corridor uncovers patterns that are similar to that found for total daily travel.

In Table 5.2, the Northern Virginia corridor A.M. peak period travel to the core is displayed. Total auto trips from Virginia in the 1977 to 1979 period decreased by six percent while transit trip making increased by 44 percent. Total trips made to the D.C. core in this period increased by a

total of 6.5 percent. These trends were completely reversed in the period from 1979 to 1982. Auto trips entering the core increased by over 18 percent while transit trips declined by almost 5 percent. The overall effect of Metrorail in Northern Virginia from 1977 to 1982 was an increase in capacities to handle 7,800 new auto trips to the core and 8,900 new transit trips. The transit proportion of total person trips from Northern Virginia rose from 25 percent in 1977 to 29 percent in 1982.

TABLE 5.2

PEAK PERIOD TRAVEL TO THE D.C. CORE: NORTHERN VIRGINIA CORRIDOR
(6:30 - 9:30 A.M. Inbound)

(In 1,000's)

AUTO PERSON TRIPS	1977	1978	1979	1980	1981	1982
Auto Drivers	46.0	46.7	43.3	43.3	46.8	50.4
Auto Passengers	25.5	29.8	23.8	26.6	26.3	28.9
Total Auto Trips	71.5	76.5	67.1	69.9	73.1	79.3
Avg. Auto Occupancy	1.55	1.64	1.55	1.61	1.56	1.57
WMATA TRANSIT TRIPS						
Metrobus	24.1	12.8	11.2	10.7	8.9	7.2
Metrorail	--	15.6	23.5	26.6	23.3	25.8
Total WMATA Trips	24.1	28.4	34.7	37.3	32.1	33.0
Total Person Trips	95.6	104.9	101.8	107.2	105.2	112.3
Percent Transit	25%	27%	34%	35%	31%	29%

CHANGES	1977-1979	1979-1982	1977-1982
Auto Driver	- 2.7	+ 7.1	+ 4.4
Auto Passenger	- 1.7	+ 5.1	+ 3.4
TOTAL AUTO	- 4.4	+12.2	+ 7.8
Metrobus	-12.9	- 4.0	-16.9
Metrorail	+23.5	+ 2.3	+25.8
TOTAL WMATA	+10.6	- 1.7	+ 8.9
TOTAL TRIPS	+ 6.2	+10.5	+16.7

Table 5.3 similarly indicates the changes in inbound A.M. peak period travel in the Silver Spring corridor. In the first three years of Metrorail, total transit trips entering the D.C. core increased by 25 percent while morning peak auto use decreased by only two percent. The changes experienced in the Silver Spring corridor between 1979 and 1982 are insignificant. Total auto trips continued to decrease slightly and total WMATA trips continued with a slight increase.

TABLE 5.3

PEAK PERIOD TRAVEL TO THE D.C. CORE: SILVER SPRING CORRIDOR
(6:30 - 9:30 A.M. Inbound)

(In 1,000's)

AUTO PERSON TRIPS	1977	1978	1979	1980	1981	1982
Auto Drivers	33.7	33.5	35.0	31.8	31.5	33.5
Auto Passengers	17.2	17.0	14.8	14.1	12.5	15.1
Total Auto Trips	50.9	50.5	49.8	45.9	44.0	48.6
Avg. Auto Occupancy	1.51	1.51	1.42	1.44	1.40	1.45
WMATA TRANSIT TRIPS						
Metrobus	24.2	16.8	15.8	16.9	15.1	15.8
Metrorail	2.6	14.7	17.6	21.9	19.3	18.3
Total WMATA Trips	26.8	31.4	33.4	38.8	34.4	34.1
Total Person Trips	77.7	81.9	83.2	84.7	78.4	82.7
Percent Transit	34%	38%	40%	46%	44%	41%

CHANGES	1977-1979	1979-1982	1977-1982
Auto Driver	+ 1.3	- 1.5	- 0.2
Auto Passenger	- 2.4	+ 0.3	- 2.1
TOTAL AUTO	- 1.1	- 1.2	- 2.3
Metrobus	- 8.4	--	- 8.4
Metrorail	+15.0	+ 0.7	+15.7
TOTAL WMATA	+ 6.6	- 0.7	+ 7.3
TOTAL TRIPS	+ 5.5	- 0.5	+ 5.0

There was an overall decline of 2,300 auto trips in this corridor from 1977 to 1982, while total transit trips increased by 7,300. In addition, the proportion for transit of total person trips rose from 34 percent in 1977 to 41 percent in 1982.

TABLE 5.4

PEAK PERIOD TRAVEL TO THE D.C. CORE: NEW CARROLLTON CORRIDOR
(6:30 - 9:30 A.M. Inbound)

(In 1,000's)

AUTO PERSON TRIPS	1977	1978	1979	1980	1981	1982
Auto Drivers	42.6	43.5	40.2	39.0	41.1	46.0
Auto Passengers	19.5	17.1	19.3	19.8	19.4	24.8
Total Auto Trips	62.1	60.6	59.5	58.8	60.5	70.8
Avg. Auto Occupancy	1.46	1.39	1.48	1.51	1.47	1.54
WMATA TRANSIT TRIPS						
Metrobus	27.6	23.0	20.4	22.1	19.6	19.7
Metrorail	--	8.5	16.6	20.3	21.7	18.6
Total WMATA Trips	27.6	31.5	37.0	42.4	41.3	38.3
Total Person Trips	89.7	92.1	96.5	101.2	101.8	109.1
Percent Transit	31%	34%	38%	42%	41%	35%

CHANGES	1977-1979	1979-1982	1977-1982
Auto Driver	- 2.4	+ 5.8	+ 3.4
Auto Passenger	- .2	+ 5.5	+ 5.3
TOTAL AUTO	- 2.6	+11.3	+ 8.7
Metrobus	- 7.2	- 0.7	- 7.9
Metrorail	+16.6	+ 2.0	+18.6
TOTAL WMATA	+ 9.4	+ 1.3	+10.7
TOTAL TRIPS	+ 6.8	+12.6	+19.4

Similar data for the New Carrollton corridor is shown in Table 5.4. Between 1977 and 1979, total auto trips entering the D.C. core in this cor-

ridor decreased by just over four percent. Also during this time, transit trips in this corridor increased substantially, by 34 percent. The reversal in these trends between 1979 and 1982 was quite dramatic. Total auto travel increased by almost 19 percent while transit trips to the core increased by only 4 percent. The cumulative figures in this corridor (1977-1982) show an increase in A.M. peak period auto trip making of 8,700

TABLE 5.5

PEAK PERIOD TRAVEL TO THE D.C. CORE: WISCONSIN/CONNECTICUT CORRIDOR
(6:30 - 9:30 A.M. Inbound)

(In 1,000's)

AUTO PERSON TRIPS	1977	1978	1979	1980	1981	1982
Auto Drivers	30.1	31.0	27.5	27.8	28.1	28.6
Auto Passengers	10.7	11.4	10.8	11.7	10.7	10.9
Total Auto Trips	40.8	42.4	38.3	39.5	38.8	39.5
Avg. Auto Occupancy	1.36	1.37	1.39	1.42	1.38	1.38
WMATA TRANSIT TRIPS						
Metrobus	15.5	15.6	16.2	19.3	16.1	12.4
Metrorail	--	--	--	--	--	5.6
Total WMATA Trips	15.5	15.6	16.2	19.3	16.1	18.0
Total Person Trips	56.3	58.0	54.5	58.8	54.9	57.5
Percent Transit	28%	27%	30%	33%	29%	31%

CHANGES	1977-1979	1979-1982	1977-1982
Auto Driver	- 2.6	+ 1.1	- 1.5
Auto Passenger	+ 0.1	+ 0.1	+ 0.2
TOTAL AUTO	- 2.5	+ 1.2	- 1.3
Metrobus	+ 0.7	- 3.8	- 3.1
Metrorail	--	+ 5.6	+ 5.6
TOTAL WMATA	+ 0.7	+ 1.8	+ 2.5
TOTAL TRIPS	- 1.8	+ 3.0	+ 1.2

weekday trips, plus an increase of 10,700 weekday A.M. peak period transit trips. The percentage of total person trips made on transit in the New Carrollton corridor grew from 31 percent in 1977 to as high as 42 percent in 1980 before settling at 35 percent in 1982.

In the Wisconsin/Connecticut Avenue corridor, shown in Table 5.5, the changes in auto person trips and WMATA transit trips were not as considerable as in the other corridors. Between 1977 and 1979, total inbound A.M. auto trips decreased by six percent while transit trip making (in this corridor, bus only at this time) increased by 4.5 percent. Between 1979 and 1982, total auto trips and total WMATA trips both continued with very small increases. The first year of Metrorail operations in this corridor (1982) showed 3,700 fewer bus trips entering the D.C. core, compared to 5,600 Metrorail riders, implying an increase of 1,900 peak period rail riders who were 'new' to transit.

Figures 5.5 and 5.6 show the A.M. peak period data for each of these corridors for transit travel to the core, broken down by rail and bus, and for auto travel to the core, broken down by auto drivers and passengers, respectively.

CONCLUSIONS

The focus of Metrorail service and ridership to the central employment area makes the D.C. core the most important area in which to measure the effects of Metrorail on travel behavior. As reported in the initial travel findings report, Metrorail allowed substantial increases in travel to the central employment area, thereby increasing the capacities of both the highway network and the transit system.

By 1981, total transit ridership entering the D.C. core had increased by 36 percent, from 160,600 in 1977 to 218,600. With 37.1 miles of the Metrorail system in operation, the proportion of transit ridership crossing the core cordon on the rail system had grown to 49.3 percent. Expansion of rail service accounted for a net reduction of just under 45,500 core area bus passenger trips. As each new rail line became operational, the role of Metrorail in carrying passengers to and from the core area increased, while the role of Metrobus diminished. Parallel trends were observed in each of the three major travel corridors served by Metrorail as of 1981, with the changes in Northern Virginia being more dramatic than those in the Silver Spring or New Carrollton corridors. In the Wisconsin/Connecticut Avenue corridor, which did not yet have an operating rail line, there was very little change shown in transit ridership to the core.

In the first three years of Metrorail operations, auto travel to the D.C. core decreased substantially, which was thought to be indicative of a downward trend. However, after 1979, total auto travel to the core increased, resulting in an overall decrease of only 19,600 or 3.4 percent between 1977 and 1981. Similar trends in auto travel crossing the D.C. cordon line were experienced in the four major travel corridors.

The increase in transit ridership entering the D.C. core during the morning peak period was 31 percent between 1977 and 1982. This increase was accompanied by a surprising increase in peak period auto travel of 6,200

Figure 5.5

TRANSIT TRAVEL TO THE D.C. CORE
AM PEAK PERIOD
(6:30-9:30)

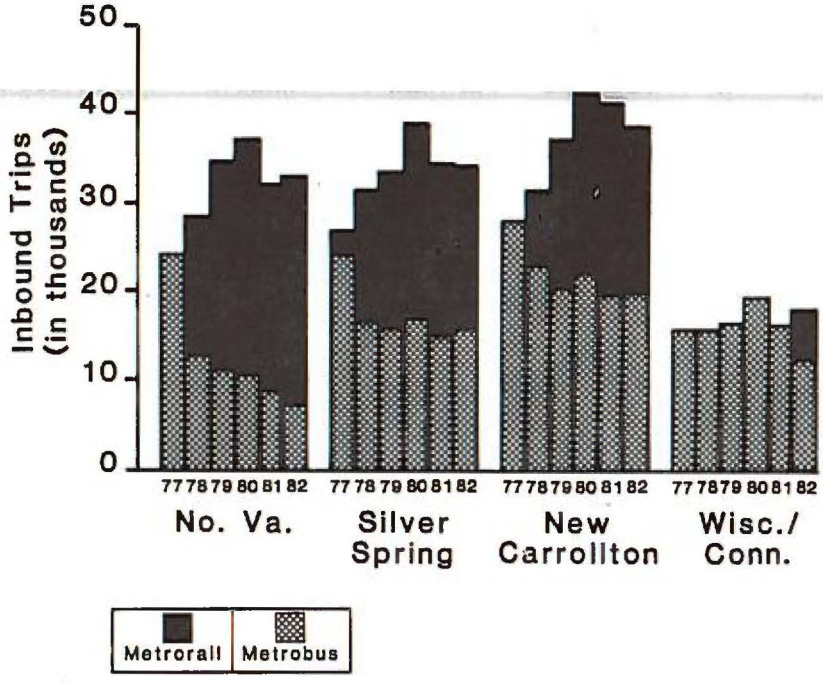
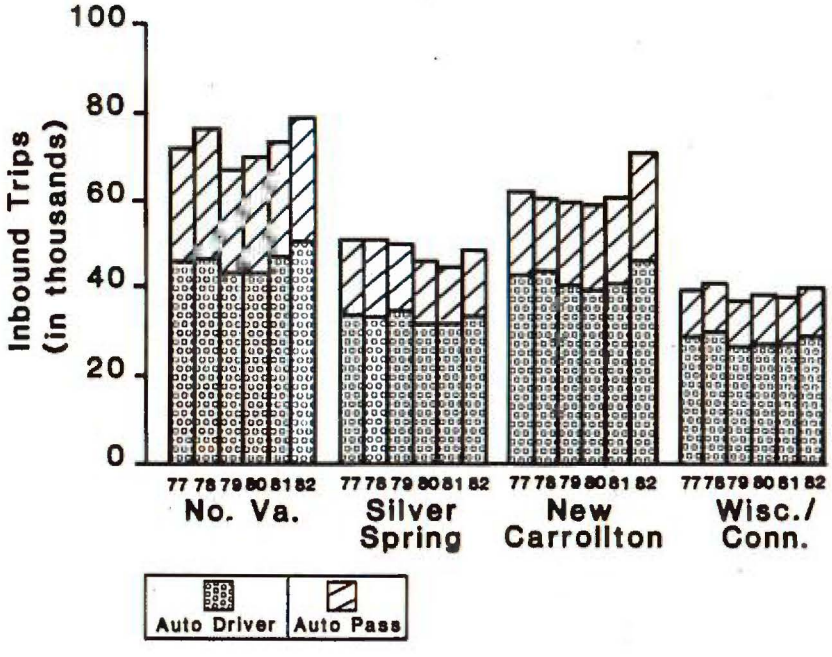


Figure 5.6

AUTO TRAVEL TO THE D.C. CORE
AM PEAK PERIOD
(6:30-9:30 AM)



auto drivers and 6,600 auto passengers, a 5.7 percent increase over the 1977 figures. The expansion of Metrorail, which increased the capacity of the highway network by removing a number of buses from congested downtown streets, and increased the capacity of the transit system by more than doubling the capacity of the buses removed, has allowed for this substantial growth in travel to the core.

Changes in peak period travel to the core by travel corridor show an interesting diversity. While all four of the major travel corridors show an overall increase in morning trips to the core between 1977 and 1982, only two corridors, Silver Spring and Wisconsin/Connecticut Avenue, show a decrease in total auto trips. The decrease in auto trips in these corridors was accompanied by an increase in transit entirely attributable to Metrorail (in fact Metrobus lost riders in each corridor). In the Northern Virginia and New Carrollton corridors, substantial increases were recorded in all trip making categories except Metrobus. However, the significant increases in AM peak period trips to the core were still over 50 percent attributable to transit in general.

CHAPTER 6
METRORAIL STATION CHARACTERISTICS

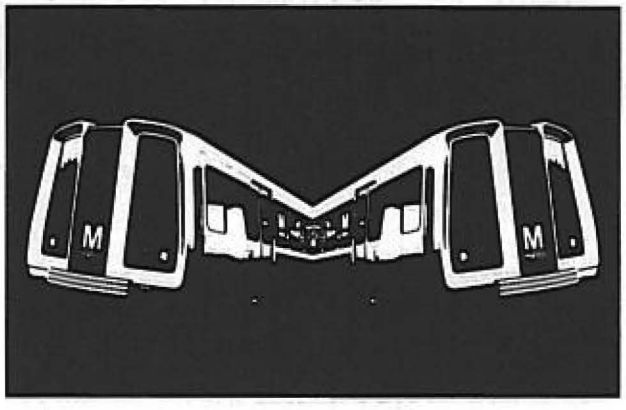
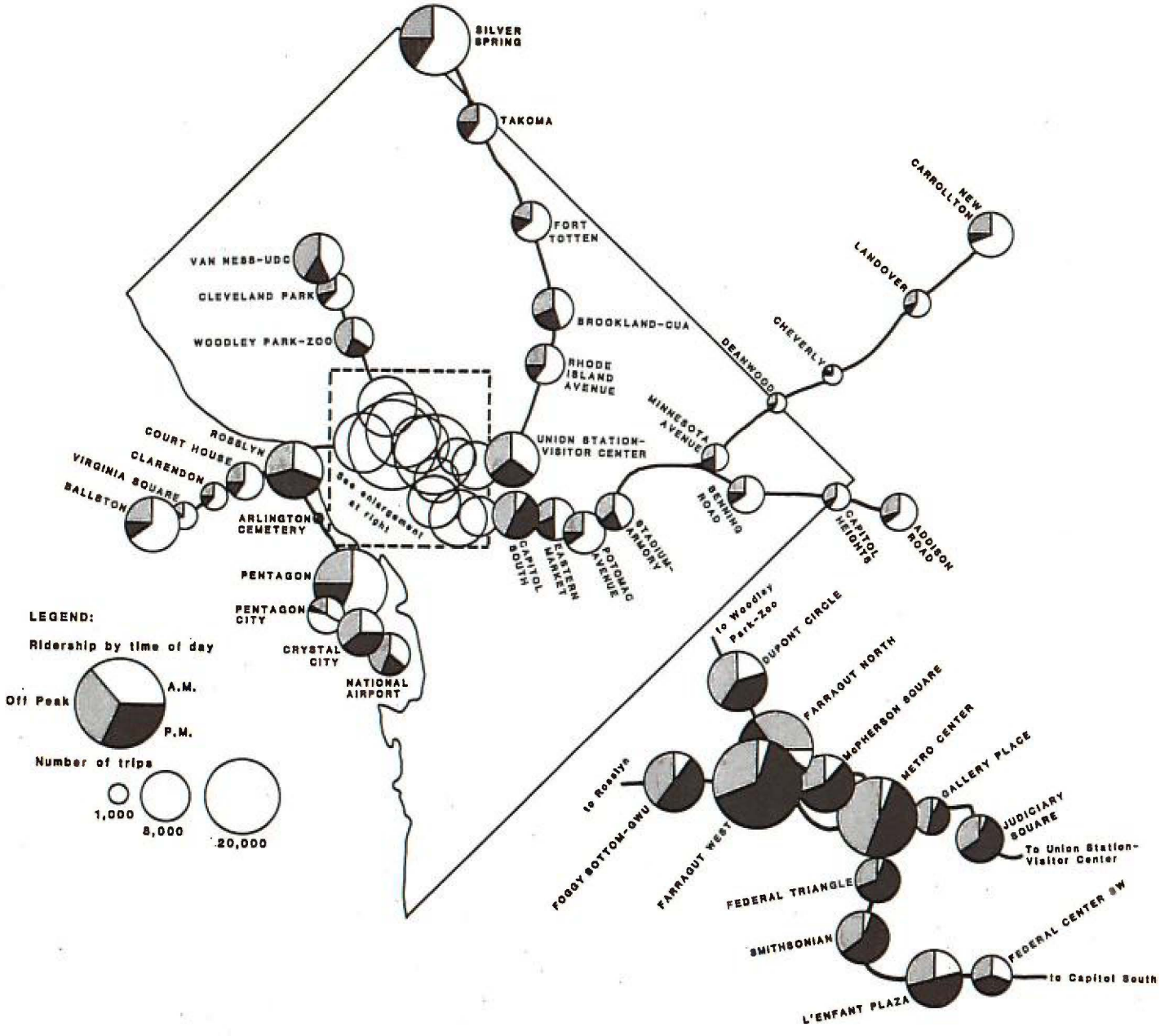


Figure 6.1

METRORAIL STATION ARRIVALS BY TIME OF DAY



CHAPTER VI

METRORAIL STATION CHARACTERISTICS

The analyses thus far in this report have concentrated on regional trends in the level and composition of transit trips. However, the effects of a major transit system such as Metrorail are not as sharply felt at the regional level, as they are at a more specific level - the transit station areas. This chapter, then, will analyze the geographical distribution of Metrorail travel at the station area level, and examine how transit riders use the different stations. The focus of this analysis will be the changes that occurred in those characteristics that were evident after the first three years of rail operations (spring 1979) and through the extension of Phase V service (spring 1982).

STATION ARRIVALS BY TIME OF DAY

When the initial Red Line opened in 1976, one of the differences observed between Metrorail and traditional transit systems was that trips were much less concentrated in the peak hours than would be expected. However, as the system expanded and the extensions provided rail service to suburban locations, ridership became more traditionally patterned, and was more concentrated during the morning and evening peak periods.

In the spring of 1979, slightly fewer than one-third of all Metrorail passengers travelled during the morning peak period (6:30 to 9:30 A.M.), and more than one-third travelled during the evening peak period (3:30 to 6:30 P.M.). By the spring of 1982, these figures had not changed. Morning peak period ridership was 31 percent of the daily total and evening peak period ridership was 36 percent. Thus, two out of every three passengers travelled during the peak periods. Of the remaining, non-work trips, most (24 percent of the daily total) were carried during the midday, and the rest (9 percent of the total) were evening trips.

Figure 6.1 shows the relative number of passengers boarding at each Metrorail station during the different times of the day in 1982. The wide variation in station volumes and usage by time of day can be clearly seen. The station carrying the highest daily volume was Farragut West (25,400) and the one carrying the lowest volume was Arlington Cemetery (215). Other high volume stations were Metro Center, Farragut North, Pentagon, Silver Spring, Foggy Bottom, McPherson Square, L'Enfant Plaza, Dupont Circle, Rosslyn, Union Station and Ballston. These high volume stations can all be classified as either within the central employment area (the Farraguts, Metro Center), major transfer points (Pentagon, Rosslyn) or current end-of-the-line stations (Silver Spring, Ballston).

These 12 stations represent just over one-quarter of the 43 stations in operation as of 1982, and were used by over 57 percent of all daily Metrorail passengers. This pattern is similar to the one displayed in 1979, when 8 of the 33 stations in operation carried over 50 percent of the daily passengers. This 1982 station list is the same as in 1979, plus Ballston, Union Station, L'Enfant Plaza and Foggy Bottom.

TABLE 6.1
CLASSIFICATION OF METRORAIL STATIONS BY TIME OF ARRIVAL

PERCENTAGE OF ARRIVALS IN:	AM PEAK	PM PEAK	OFF PEAK
PEAK MORNING-PEAK (More than 65 Percent of Arrivals in AM Peak)			
Pentagon City	79	6	15
Cheverly	74	9	17
Virginia Square	70	9	21
New Carrollton	67	7	26
Potomac Avenue	67	11	22
Ballston	65	11	24
MORNING-PEAK (From 50 to 64 Percent of Arrivals in AM Peak)			
Addison Road	64	8	28
Benning Road	64	10	26
Fort Totten	63	14	23
Capitol Heights	62	10	28
Court House	62	15	23
Clarendon	61	13	26
Landover	61	11	28
Rhode Island Avenue	59	15	26
Takoma	59	13	28
Silver Spring	59	13	28
Deanwood	58	12	30
Cleveland Park	58	11	31
Pentagon	56	18	26
Minnesota Avenue	50	18	32
EVENING-PEAK (More than 50 Percent of Arrivals in PM Peak)			
Federal Triangle	4	64	32
Farragut West	4	63	33
Smithsonian	4	60	36
McPherson Square	11	60	29
Judiciary Square	7	58	35
Farragut North	11	55	34
Arlington Cemetery	10	54	36
L'Enfant Plaza	19	50	31
Gallery Place	7	50	43
Metro Center	7	50	43
OFF-PEAK (Less than 50 Percent of Arrivals in Either Peak Period)			
National Airport	34	20	46
Woodley Park-Zoo	32	23	45
Capitol South	12	45	43
Dupont Circle	19	39	42
Van Ness-UDC	43	16	41
Foggy Bottom	12	49	39
Union Station	33	32	35
Rosslyn	29	36	35
Crystal City	25	41	34
Brookland	44	22	34
Stadium-Armory	48	19	33
Eastern Market	48	20	32
Federal Center SW	28	41	31
SYSTEM AVERAGE (May 1982)	31%	36%	33%

Table 6.1 displays an analysis of the pattern of arrivals by time of day at each station, showing that, at most stations, sharp differences in peaking characteristics occur. There are only a few stations (i.e. Rosslyn, Union Station, Federal Center, SW) that display 'average' characteristics for arrivals by time of day.

Over two-thirds of the stations can be identified as peak period stations with the majority of passengers entering during either A.M. or P.M. peak period. Of these peak period stations, 20 are morning peak stations and 10 are evening peak stations. Further analysis of the morning peak stations shows that 6 of these stations can be classified as almost exclusively morning peak stations, with about 7 out of every 10 daily passengers arriving at this time.

This pattern is, again, very similar to the station classification pattern displayed in 1979. Almost all of the stations opened since 1979 were classified as A.M. peak period stations, with the exceptions being the Van Ness-UDC and Woodley Park-Zoo stations, which are off peak stations. From the 1979 classification, four stations (Stadium-Armory, Brookland, Eastern Market and Rosslyn) shifted from morning peak to off peak stations, and two (Metro Center and Arlington Cemetery) shifted from off peak to evening peak stations. The major change occured at the Rosslyn Station. The previous distribution of arrival was 50 percent A.M. peak, 22 percent P.M. peak and 28 percent off peak. By 1982, the distribution had changed to 29 percent A.M. peak, 36 percent P.M. peak and 35 percent off peak. This change was a result of the extension of the Orange Line, which diverted many of the Rosslyn boardings to the new stations.

The classification of Metrorail stations into these categories is shown in Figure 6.2. Almost all of the stations having evening peak dominance are in downtown Washington, extending from Farragut West to L'Enfant Plaza on the Blue/Orange Line and from Farragut North to Judiciary Square on the Red Line. The other station with over 50 percent of arrivals in the P.M. peak is Arlington Cemetery. The morning peak dominant stations, for the most part, are concentrated around the current ends of each line segment. The exceptions are the Blue Line in Virginia, which shows the Crystal City and National Airport Stations as having 'day-long' trip arrival patterns (not having a majority of trips during either peak period) and the Red Line extension from Dupont Circle, which also shows two stations, Van Ness-UDC and Woodley Park-Zoo, as having 'day-long' patterns.

STATIONS BY TRIP PURPOSE AT DESTINATION

It can be inferred from the analysis of arrival times that certain stations serve primarily residential areas, other stations serve employment areas, and others may serve a mixture of both, as well as shopping and other types of travel. As was discussed in Chapter 4, on an average weekday, almost 40 percent of all Metrorail trips in 1982 were destined to work, another 40 percent were destined to home, and the remaining trips were for job-related, personal business, shopping or 'other' purposes.

When the system is broken down by individual stations, however, there are no stations which conform exactly to the regional average (Union Station is the closest). Figure 6.3 displays the relative number of passengers leaving each Metrorail station, by trip purpose, in 1982. The stations

Figure 6.2

CLASSIFICATION OF METRORAIL STATIONS BY TIME OF ARRIVAL–MAY 1982

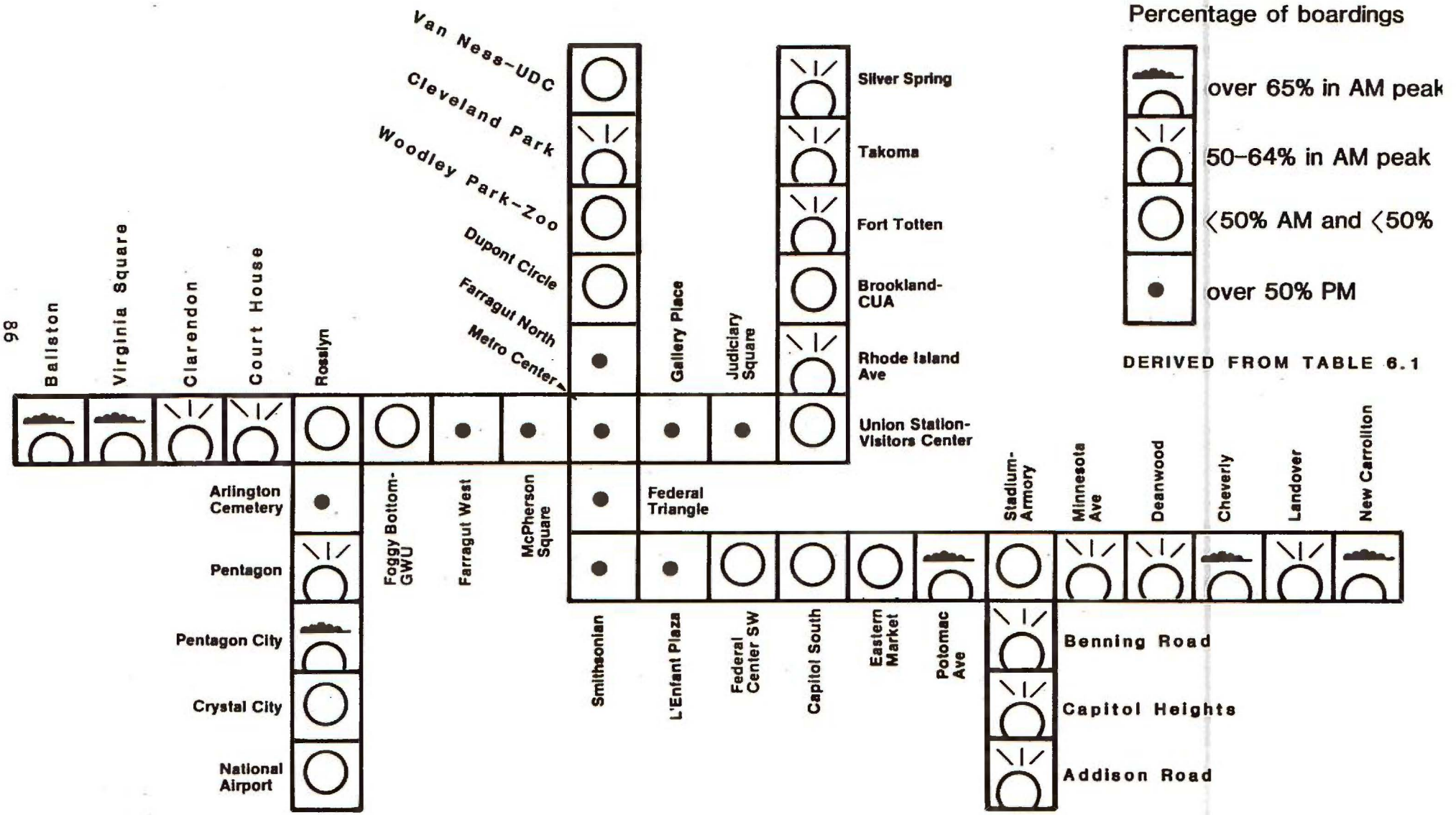


Figure 6.3

METRORAIL STATIONS BY TRIP PURPOSE AT DESTINATION

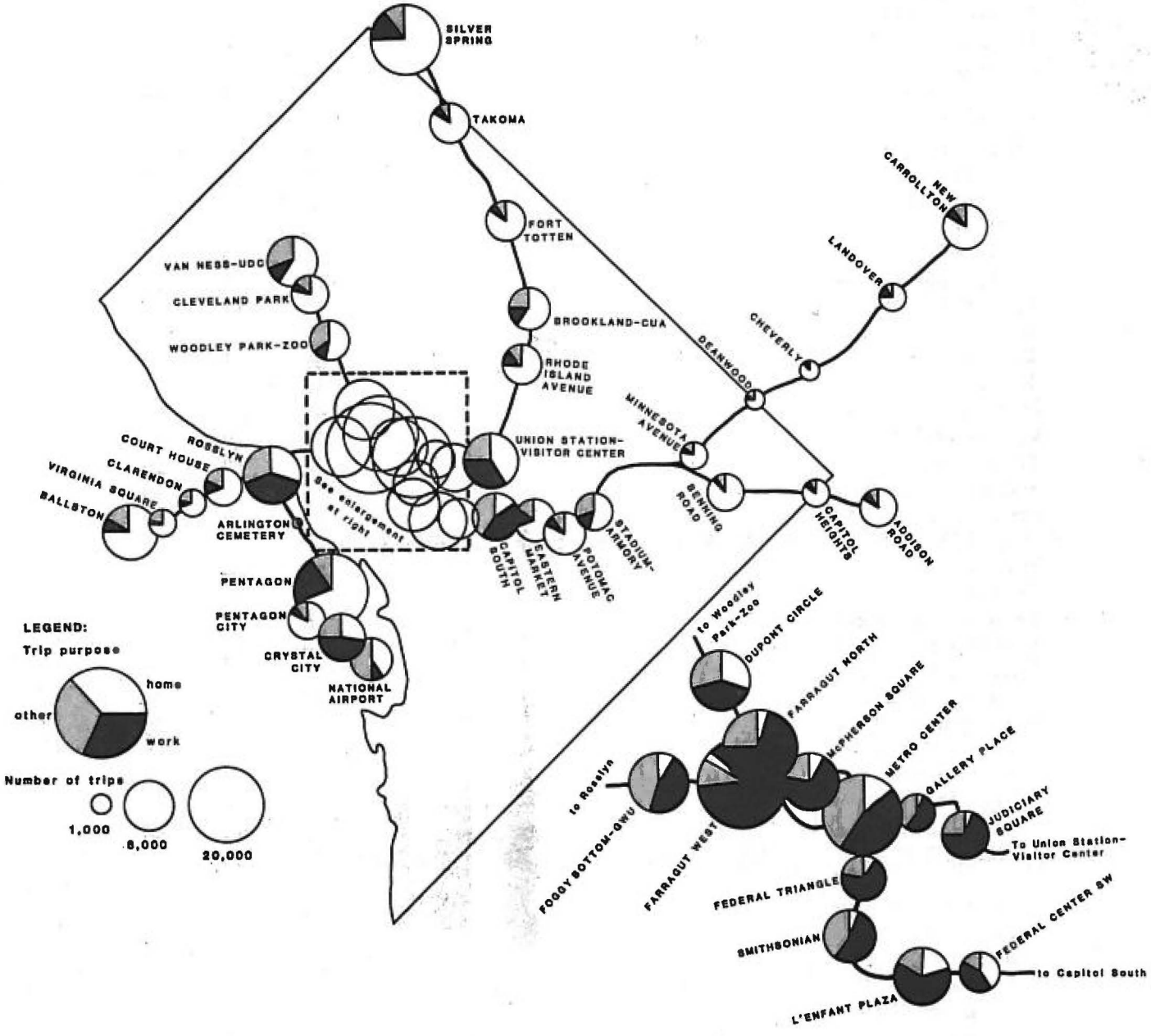


TABLE 6.2

CLASSIFICATION OF METRORAIL STATIONS BY TRIP PURPOSE AT DESTINATION

PERCENTAGE OF TRIP ENDS BY PURPOSE:	HOME	WORK	OTHER
HOME DOMINANT (More than 50% of Trips to Home)			
Benning Road	91	1	8
Cheverly	90	6	4
Capitol Heights	85	2	13
Potomac Avenue	84	6	10
New Carrollton	84	6	10
Addison Road	83	6	11
Takoma	83	6	11
Pentagon City	83	4	13
Fort Totten	82	7	11
Minnesota Avenue	78	8	14
Cleveland Park	78	5	17
Ballston	77	9	14
Virginia Square	76	3	21
Landover	75	9	16
Deanwood	73	9	18
Rhode Island Avenue	73	9	18
Silver Spring	72	13	15
Eastern Market	69	13	18
Clarendon	69	11	20
Court House	68	17	15
Pentagon	67	22	11
Van Ness-UDC	59	10	31
Brookland	58	13	29
Stadium-Armory	57	14	29
Woodley Park-Zoo	52	9	39
WORK DOMINANT (More than 40% Work, Less than 25% Home)			
Farragut West	5	74	21
Farragut North	4	72	24
Federal Triangle	8	71	21
McPherson Square	9	70	21
Judiciary Square	2	70	28
L'Enfant Plaza	20	63	17
Smithsonian	4	56	40
Gallery Place	7	53	40
Metro Center	13	46	41
Foggy Bottom	12	46	45
Capitol South	17	45	38
WORK DOMINANT WITH HIGH PERCENT HOME (More than 40% Work, 25-40% Home)			
Federal Center SW	38	47	15
Crystal City	29	45	26
Dupont Circle	30	42	28
Rosslyn	29	42	29
OTHER (More than 40% 'Other', or evenly distributed)			
Arlington Cemetery	14	18	68
National Airport	43	12	45
Union Station	36	38	26
SYSTEM AVERAGE (May 1982)	38%	38%	24%

are classified into three trip purpose categories (home, work and other), which are further displayed in Table 6.2.

Similar to the pattern displayed in 1979, better than half of the stations (25 of 43) have a majority of their destinations as home. As would be expected, the ten stations that have opened since 1979, all of which are either suburban stations or heavily residential urban stations, are classified as home dominant stations.

The major change between the 1979 and 1982 classifications is that a fourth category has been established, 'Other', into which three stations fall. Defined as either having more than 40 percent 'other' for trip purpose, or being evenly distributed among the three categories (no dominant category), we find National Airport, Union Station and Arlington Cemetery, each of which is a unique generator.

For the most part, the majority of the remaining trips destined to the home dominant stations are for purposes other than work (exceptions are Pentagon, Court House and Cheverly). There is a one-to-one correspondence between stations that were classified as morning peak period stations in 1982 (Table 6.1), and stations that are home dominant. The other home dominant stations, Eastern Market, Van Ness-UDC, Brookland, Stadium-Armory and Woodley Park-Zoo, were classified as off peak stations, probably due to considerable midday use by local residents.

The stations dominated by work purposes in 1982 fall into two categories: those with relatively few trips to home (less than 25 percent) and those having a significant percentage of home trips (25 to 40 percent). With the exception of Arlington Cemetery, which is appearing more and more as a unique station, all of the stations that were classified as evening peak stations (Table 6.1) fall into the first category of work dominant stations. In addition, two stations at which arrivals were concentrated in the off peak, Capitol South and Foggy Bottom, also fall into this category. Both of these stations have only 46 percent work trips, although the percentage of trips to home is relatively low and the percentage of non-work ('other') trips is high. In fact, the Foggy Bottom Station has the highest percentage of 'other' trips (45 percent) of all work dominant stations.

The four stations that fall into the final category of trip purpose, Federal Center SW, Crystal City, Dupont Circle and Rosslyn, were previously classified as off peak stations; a high percentage of arrivals were during midday. Although work dominant, the number of trips destined to home from these stations exceeded the number of non-work trips.

STATIONS BY MODE OF ACCESS

In Chapter 2, this area of analysis was separated into mode of access and mode of egress systemwide, due to the sharp differences between mode of arrival at the boarding Metrorail station and the mode of departure from the destination station. However, at the individual station level, this problem no longer exists, since most passengers are likely to use the same mode to reach the station and to leave the station.

Table 6.3 shows the mode of access classification of Metrorail stations,

TABLE 6.3
CLASSIFICATION OF METRORAIL STATIONS BY MODE OF ACCESS

PERCENTAGE OF TRIPS BY MODE OF ACCESS:	WALK	TRANSIT	AUTO	OTHER
WALK DOMINANT (More than 40% Walk)				
Farragut West	92	5	1	2
Farragut North	92	4	3	1
Woodley Park-Zoo	92	3	3	2
Capitol South	92	1	5	2
Federal Triangle	91	4	3	2
Judiciary Square	91	2	5	2
Smithsonian	88	2	6	4
Foggy Bottom	86	9	3	2
McPherson Square	85	11	2	2
Crystal City	84	4	8	4
Dupont Circle	83	13	3	1
Gallery Place	83	11	5	1
Metro Center	82	10	3	5
Cleveland Park	82	7	10	1
L'Enfant Plaza	78	13	6	3
Rosslyn	74	11	11	4
Court House	74	1	22	3
Federal Center SW	72	24	3	1
Eastern Market	71	16	12	1
Union Station	66	24	7	3
Van Ness-UDC	65	24	9	2
Deanwood	56	9	32	3
Stadium-Armory	54	9	34	3
Clarendon	54	3	41	2
Arlington Cemetery	54	0	32	14
Benning Road	52	22	26	0
Minnesota Avenue	42	33	22	3
TRANSIT DOMINANT (More than 45% Transit)				
Pentagon	20	67	8	5
Potomac Avenue	24	55	18	3
Rhode Island Avenue	25	51	22	2
Ballston	22	47	29	2
Silver Spring	25	45	28	2
AUTO DOMINANT (More than 45% Auto)				
Cheverly	15	8	73	4
New Carrollton	6	24	67	3
Pentagon City	35	3	59	3
Landover	18	21	56	5
Addison Road	12	36	49	3
MIXED-MODE (No Single Mode Clearly Dominates)				
Fort Totten	25	41	32	2
National Airport	35	35	8	22
Takoma	37	36	25	2
Brookland	39	38	22	1
Capitol Heights	39	17	42	2
Virginia Square	46	1	50	3
SYSTEM AVERAGE (May 1982)	65%	19%	13%	3%

differentiating the stations according to the percentage of passengers walking, taking transit, arriving by car or using some 'other' mode to reach the station.

Unlike 1979, when transit was the predominant mode of access to the individual stations (45 percent), the 1982 figures show that 65 percent of weekday passengers walk to the stations. By 1982, transit had fallen to 19 percent of the total, while auto provided access for 13 percent and 'other' modes, which were not differentiated in 1979, accounted for three percent. However, further analysis of mode of access at the home end of work trips (which is a better indicator of the needed support facilities at Metrorail stations, i.e. feeder bus or parking) shows walk at about 30%, transit at 39% and auto at around 29% of home to work trips.

It can be seen from this table, and from Figure 6.4, that most stations are pedestrian oriented. In fact, 27 of the 43 stations in operation in 1982 had more than 40 percent of their users walking to them. It should not be surprising that all 15 of the stations previously classified as work dominant (Table 6.2) were pedestrian oriented. All of the stations in downtown Washington, seen in Figure 6.4, are walk dominant, extending from Foggy Bottom to Eastern Market on the Blue/Orange Line and from Van Ness-UDC to Union Station on the Red Line. In addition, 10 stations which were classified as serving mostly home trips are also pedestrian oriented, being located primarily within the District of Columbia or in the Ballston corridor in Northern Virginia.

There are five stations for which the dominant access mode was transit and five stations for which the dominant mode was auto. All ten of these stations were previously classified as serving mostly home purposes. The five transit dominant stations are also, not surprisingly, stations at which major bus turnbacks are concentrated. Of the auto dominant stations, four are located in Prince George's County (on the New Carrollton extension and the Addison Road extension) and have considerable amounts of parking.

The remaining category, mixed mode, for which no single mode clearly dominates, contains six stations. Takoma and Brookland have almost equal percentages of walk and transit, with high levels of auto as well. Capitol Heights and Virginia Square have high and nearly equal distributions of walk and auto and much lower levels of transit (Virginia Square has almost no transit access). Fort Totten has relatively high transit access and equal percentages of walk and auto. The remaining station, National Airport, is again unique. This station has the highest proportion (22 percent) of passengers using 'other' modes of access, which includes taxi and airport limos, plus relatively high and equal proportions of walk and transit, and a much lower level of auto access.

CHANGES IN STATION VOLUMES

An analysis of the changes in station volumes, or the number of boardings at each Metrorail station, provides some interesting insights into the changing nature of the Metrorail system itself. Table 6.4 displays the boardings by station of origin from the 1979 Metrorail survey and the 1982 Metrorail survey, and also shows the change in station volumes, in absolute numbers and in percentages, between these two years.

Figure 6.4

CLASSIFICATION OF METRORAIL STATIONS BY MODE OF ACCESS–MAY 1982

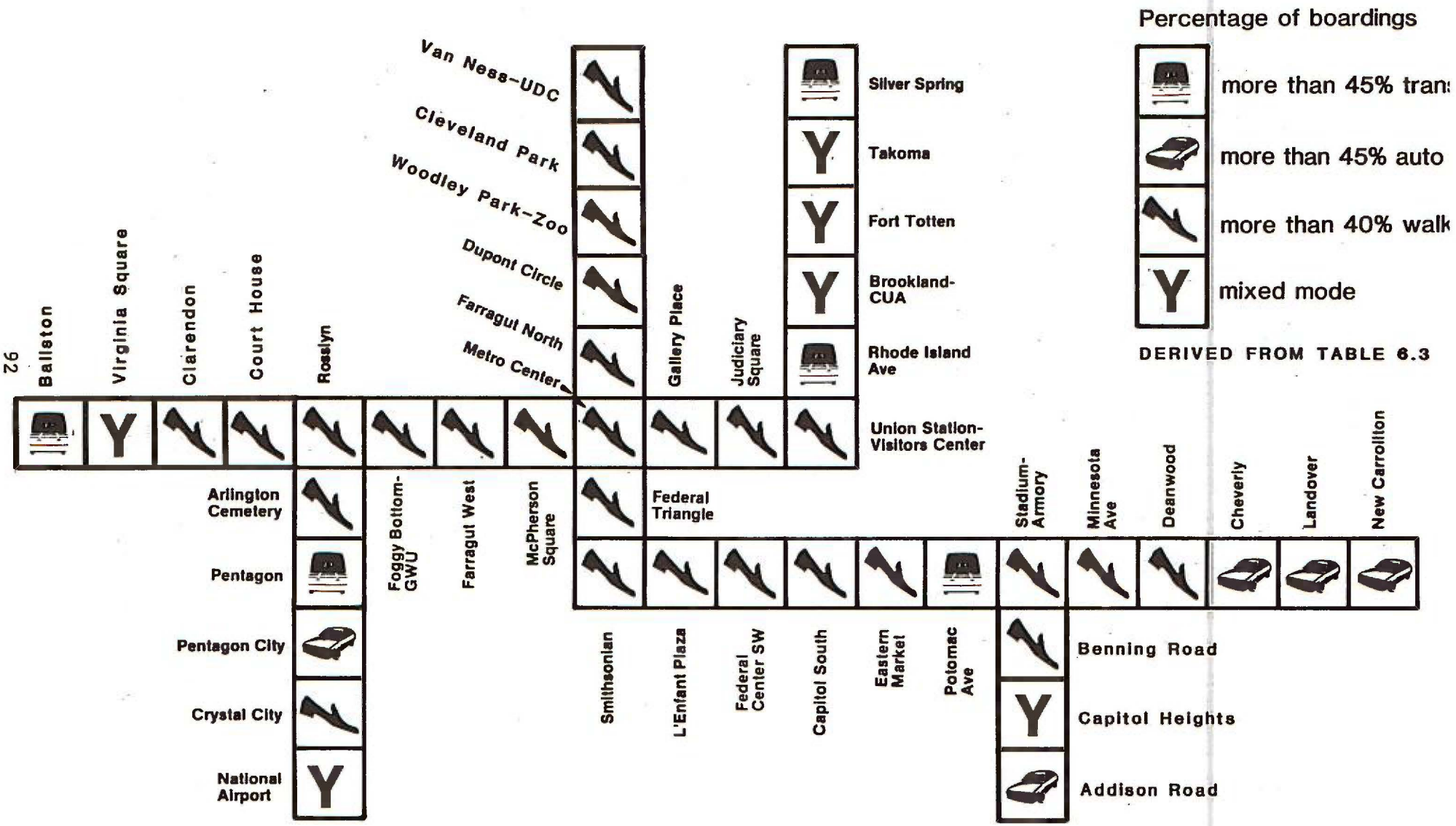


TABLE 6.4
CHANGES IN STATION VOLUMES

STATION	1979	1982	CHANGE	% CHANGE
National Airport	5,088	4,881	- 207	- 4.1
Crystal City	7,553	7,667	+ 114	+ 1.5
Pentagon City	3,325	3,210	- 115	- 3.5
Pentagon	14,443	15,310	+ 867	+ 6.0
Arlington Cemetary	384	215	- 169	-44.0
Rosslyn (E)	17,157	11,406	-5,751	-33.5
Foggy Bottom	9,818	12,644	+2,826	+28.8
Farragut West	23,390	25,396	+2,006	+ 8.6
McPherson Square	12,837	13,218	+ 381	+ 3.0
Metro Center	19,401	17,635	-1,766	- 9.1
Federal Triangle	5,660	5,960	+ 300	+ 5.3
Smithsonian	8,313	9,711	+1,398	+16.8
L'Enfant Plaza	11,417	11,990	+ 573	+ 5.0
Federal Center SW	4,775	4,024	- 751	-15.7
Capitol South	5,392	7,429	+2,037	+37.8
Eastern Market	4,201	4,468	+ 267	+ 6.4
Potomac Avenue	4,926	5,095	+ 169	+ 3.4
Stadium-Armory (E)	4,316	2,887	-1,429	-33.1
Minnesota Avenue	3,690	2,305	-1,385	-37.5
Deanwood	2,535	1,851	- 684	-27.0
Cheverly	1,344	1,162	- 182	-13.5
Landover	2,380	2,219	- 161	- 6.8
New Carrollton	5,715	5,889	+ 174	+ 3.0
Silver Spring	13,861	14,478	+ 617	+ 4.5
Takoma	3,873	4,137	+ 264	+ 6.8
Fort Totten	4,895	4,150	- 745	-15.2
Brookland	5,204	5,538	+ 334	+ 6.4
Rhode Island Avenue	4,307	4,073	- 234	- 5.4
Union Station	11,386	10,836	- 550	- 4.8
Judiciary Square	7,955	7,175	- 780	- 9.8
Gallery Place	3,937	3,753	- 84	- 2.1
Farragut North	12,791	16,049	+3,258	+25.5
Dupont Circle (E)	13,617	11,628	-1,989	-14.6
Ballston	--	10,173	--	--
Virginia Square	--	2,212	--	--
Clarendon	--	2,064	--	--
Court House	--	2,860	--	--
Addison Road	--	2,964	--	--
Capitol Heights	--	1,965	--	--
Benning Road	--	3,078	--	--
Van Ness-UDC	--	7,651	--	--
Cleveland Park	--	2,443	--	--
Woodley Park-Zoo	--	4,456	--	--

(E) End-of-the-line station in 1979, line extended by 1982.

Significant decreases in boardings can be seen at those stations which served as end-of-the-line stations or major bus-rail interface stations in 1979, but which no longer had those functions in 1982. The Rosslyn Station experienced a 33.5 percent decrease after the Orange Line was extended to Ballston; the Stadium-Armory Station showed a 33.1 percent decrease once to the Blue Line extension to Addison Road opened (the Minnesota Avenue and Deanwood Stations experienced decreased boardings, possibly due to this extension as well); and, the Dupont Circle Station saw a 14.6 percent decrease following the Red Line extension to Van Ness-UDC.

About 50 percent of the 33 stations in operation in 1979 (16) showed increases in the number of passengers boarding by 1982. Of these stations, significant changes were seen at the Capitol South Station (+37.8 percent), the Foggy Bottom Station (+28.8 percent), the Farragut North Station (+25.5 percent) and the Smithsonian Station (+16.8 percent). These increases are most likely due to increased development in the station areas, both residential development (Foggy Bottom) and increased employment (Capitol South).

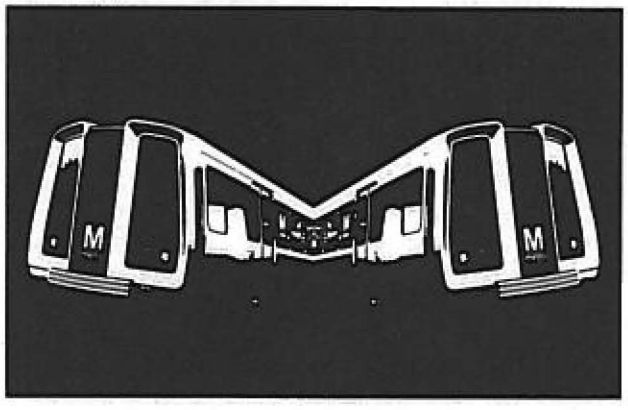
CONCLUSIONS

This analysis of Metrorail station characteristics shows sharp differences between stations, based on the primary destination purpose: whether the stations primarily serve work or home trips. There is a high correlation between the primary purpose and whether the station serves a residential or an employment area. Those stations classified as residential, serving mostly trips to home, are also those stations at which most of the trip arrivals are during the morning peak period. The most varied characteristic of residential stations is the mode of access from home to the station, fluctuating among walking, transit and auto. This is primarily dependent on the population concentrated within walking distance of the station, the number of parking spaces provided at the station or in the immediate vicinity and the availability of good transit, generally bus, to the station.

The stations classified as work dominant, or commercial stations, are those with the highest percentage of daily boardings in the evening peak period. They are almost exclusively pedestrian oriented in terms of mode of access. The remaining stations, other than those that are primarily residential or commercial, generally have a higher percentage of 'other' and home trips, have a more evenly balanced distribution of arrivals throughout the day, and, since they are mostly downtown stations, the predominant mode of access is walking.

The analysis of Metrorail station volumes showed some changes in ridership at all stations that were operating in 1979. The most substantial growth was registered at four stations, each in a different sector of the downtown employment core. Substantial decreases were experienced at the three stations that were functioning as end-of-the-line stations until the extensions to Ballston, Addison Road and Van Ness-UDC became operational, plus several other stations that appear to have lost ridership to the new stations.

CHAPTER 7
METRORAIL AND METROBUS SYSTEM INDICATORS



CHAPTER VII

METRORAIL AND METROBUS SYSTEM INDICATORS

One of the earlier projects associated with the Metrorail Before and After Study identified a series of quantitative indicators which could be used to monitor and compare Metrorail and Metrobus service, usage and impacts over time. This set of quantitative indicators were intended to be used not only to determine the impact of the Metrorail system in the Washington Metropolitan Area and to compare it to other comparable transit systems (i.e. BART, MARTA), but also to compare the different operating segments of the system and develop measures of their effectiveness.

The indicators identified were related to four different perspectives on transit: the community as a whole, the non-user, the transit user, and the transit system operator. Sources providing data for these indicators and methods for computing the quantitative values, were also determined as part of the earlier work.

The focus of this chapter is to compute and compare selected Metrorail and Metrobus system indicators. We have been primarily concerned with the indicators that provide data on the amount and quality of transit service provided, the cost of providing this service, the extent to which the transit system is used and the manner in which the system is used. These indicators relate to the community's perspective, the user's perspective and the transit operator's perspective. They are compared over time between rail operating phases, between rail segments and among different transit systems in other U.S. cities.

SYSTEMWIDE INDICATORS

Table 7.1 provides data for Metrorail and Metrobus system indicators, which are divided into five categories: the amount and quality of transit service provided; costs of providing this service; the total use and per unit use of the transit system; how the transit system is used; and the alternative mode of travel for Metrorail users. The data is reported on a July to June fiscal year basis, and covers rail operations from Phase IA (the Red Line to Dupont Circle) through Phase V.

The first category of indicators deals with service provided on bus and rail, measuring the number of scheduled rail trips during both peak and off peak periods, the annual scheduled bus miles per resident of the transit zone, and the ratio of Metrorail riders to seating capacity of a rail car in the peak hour and in the peak direction.

Table 7.1 shows that the number of scheduled rail trips increased between FY 1977 and FY 1980, by 250 percent during the peak and by 212 percent in the off peak. After 1980, however, the number remained somewhat constant, due mainly to the fact that all currently available rail cars were in service. The number of annually scheduled bus miles per transit zone resident showed a good deal of fluctuation during this time period. Al-

TABLE 7.1

METRORAIL AND METROBUS SYSTEM INDICATORS

Metrorail Phase	FY77 IA	FY78 IIA	FY79 III	FY80 IV	FY81 IVA	FY82 V
A. Amount and Quality of Service Provided						
1. Number of Rail Trips Scheduled per Weekday (Peak/Off Peak)	116/ 108	274/ 185	304/ 252	405/ 337	397/ 340	399/ 335
2. Annual Scheduled Bus Miles per Resident (of Transit Zone)[1]	20.1	18.9	18.5	19.7	19.5	19.0
3. Ratio of Rail Riders to Seat Capacity (Peak Hour, Peak Direction)	N/A	N/A	1.67	1.44	1.47	1.47
B. Cost of Providing Service (In 1977 Constant Dollars)						
1. Subsidy per Rail Passenger[2]	.272	.483	.308	.297	.372	.370
2. Subsidy per Bus Passenger	.439	.510	.517	.456	.453	.525
3. Subsidy per Rail Passenger Mile	N/A	N/A	.067	.059	.064	.073
4. Subsidy per Bus Passenger Mile	N/A	N/A	.104	.087	.092	.118
5. Operating Cost per Rail Passenger	.700	.865	.764	.735	.816	.897
6. Operating Cost per Rail Passenger Mile	N/A	N/A	.167	.149	.163	.176
7. Operating Cost per Bus Passenger	.960	1.032	.949	.810	.843	.930
8. Operating Cost per Bus Passenger Mile[3]	N/A	N/A	.192	.156	.171	.209

TABLE 7.1

METRORAIL AND METROBUS SYSTEM INDICATORS

METRORAIL PHASE	FY77 IA	FY78 IIA	FY79 III	FY80 IV	FY81 IVA	FY82 V
C. Total and Per Unit of System						
1. Average Weekday Total Ridership (000's)	413.5	435.7	524.1	621.8	609.9	613.6
2. Metrorail Passengers per Car Mile	5.77	5.85	4.82	4.52	4.21	4.50
3. Metrobus Passengers per Bus Mile	2.29	2.15	2.35	2.74	2.62	2.59
4. Fringe Lot Use at Rail Stations	-- N/A	Sep 77 1037	Apr 79 5832	Apr 80 6514	Apr 81 7090	Apr 82 N/A
D. How System is Used						
1. Mode of Access: Transit (All Day)[4]	30.2%	27.5%	22.1%	21.8%	21.3%	18.5%
Auto	9.9%	12.3%	12.0%	11.5%	12.1%	13.0%
Walked	58.1%	58.6%	62.9%	64.6%	62.5%	65.1%
2. Percent of Total Annual Trips Transferring Between Bus and Rail	1.5%	12.0%	16.0%	20.0%	18.9%	19.0%
E. Alternative Mode of Travel						
1. Percent Diverted from Auto to Metrorail[4]	15.8%	22.4%	27.6%	29.1%	30.7%	30.7%
2. Percent Diverted from Bus to Metrorail[4]	64.3%	57.2%	54.2%	51.8%	49.5%	50.3%

though showing only a 5.5 percent decline overall, this figure declined by 8 percent between FY 1977 and FY 1979, rose by 6 percent between FY 1979 and FY 1980 and has declined 3.5 percent since FY 1980. The ratio of rail riders to seat capacity in the peak hour declined between FY 1979

[1] Based on 1980 Census Population for the Transit Zone of 2,763,397

[2] Subsidy based on Net Costs = Actual Costs - Capitalized Costs: $21,894,000 (Actual) - $17,362,000 (Capitalized) = $4,622,000 (Net)

[3] Metrobus Passenger Miles: FY79: 595,460,397; FY80: 778,674,833 FY81: 696,795,470; FY82: 604,996,514.

[4] Data based on Metrorail Passenger Surveys conducted in Nov 77, May 78, May 79, May 80, May 81, and May 1982.

and FY 1980, and has remained about the same since then. The 13.8 percent decrease in FY 1980 is likely due to the increase in the number of scheduled peak period trips.

The second category contains eight indicators related to subsidies and operating costs for Metrorail and Metrobus. In order to examine the costs of providing transit service, trends in subsidies and operating costs, per passenger and per passenger mile, are shown for both bus and rail, in 1977 constant dollars. As would be expected, the trend for each of these indicators is a general increase between FY 1977 and FY 1982, with a slight downward fluctuation in FY 1980 due to the substantial increase in ridership experienced at that time. The exception to this trend is operating cost per bus passenger, which showed a slight decrease during this time. The largest non-inflation related increases were seen in the subsidy per rail passenger (+36.0%) and the corresponding operating cost per rail passenger (+28.1%). A similar increase is seen in the subsidy per bus passenger (+19.6%), however the corresponding operating cost per bus passenger is the one indicator that, although fluctuating widely during this time, actually decreased.

Data on total use of the transit system and 'per unit' use is shown in the third category. As has been discussed in previous chapters, average weekday total ridership, both bus and rail, increased dramatically between FY 1977 and FY 1980, and has decreased since that time. Even with this increase in ridership, the expansion of the rail system and the increase in the number of scheduled rail trips have led to a decrease in the ratio of Metrorail passengers per car mile of 22 percent between FY 1977 and FY 1982. This figure did increase, however, between FY 1981 and FY 1982, due to a decrease in the number of car miles operated. Unlike rail, the ratio of bus passengers per bus mile has increased since FY 1977, by 13 percent overall. This ratio increased more dramatically between FY 1977 and FY 1980, by almost 20 percent, but declined between FY 1980 and FY 1982 due to the decrease in bus ridership during that time. The last indicator in this category, use of fringe parking lots at rail stations, increased substantially between FY 1978 and FY 1981, due to the opening of additional rail stations with parking facilities.

The breakdown of the mode of access to Metrorail, measured all day, and the percent of total annual transit passengers that transfer between bus and rail are the indicators measured to assess the fourth category in Table 7.1. This category shows that a lower proportion of passengers accessed the rail system by transit in FY 1982 (18.5 percent), and higher proportions used auto (13 percent) and walked to the stations (65.1 percent) than the respective figures for FY 1977. A most dramatic increase can be seen in the percentage of passengers whose trip required a transfer between bus and rail between FY 1977 and FY 1980, from 1.5 percent of the total to 20 percent. This was most likely due to the extensive turnbacks in bus service that occurred as the Metrorail system was expanded. The turnaround between FY 1980 and FY 1982, a decline of 5 percent, may indicate some resistance to forced transfer from bus to rail.

The last category in Table 7.1 measures the alternative mode of travel that would have been used if Metrorail were not available. It can be seen that the percentage of total rail ridership diverted from auto increased between FY 1977 (15.8 percent) and FY 1980 (30.7 percent) while the corre-

sponding percentage of riders diverted from bus decreased (64.3 percent versus 50.3 percent). It should also be noted that, although the general trends show an increase in trips diverted from auto and a decrease in trips diverted from bus, the respective figures for the last three fiscal years, for both categories, have become relatively constant.

INDICATORS FOR METRORAIL LINE SEGMENTS

While the five categories of indicators discussed above help in an analysis of the total bus-rail transit system, other indicators identified allow for comparisons to be made between the segments that make up the Metrorail system itself. Table 7.2 illustrates such an indicator, average number of passengers per rail car, based on the different system segments. These counts are based on the average of the passenger counts for both peak periods taken at the maximum load points on each of the segments divided by the number of scheduled rail cars on each of the segments.

TABLE 7.2

AVERAGE PASSENGERS PER RAIL CAR BY RAIL SEGMENT

(Peak Period in Peak Direction)

	1979	1980	1981	1982
Metro Center-National Airport	68.09	80.77	78.02	74.89
Metro Center-New Carrollton	59.69	49.73	57.26	65.10
Metro Center-Van Ness[1]	45.69	52.71	46.07	49.88
Metro Center-Silver Spring	85.58	91.86	86.78	81.90
Rosslyn-Ballston	---	55.62	59.67	56.97
Stadium-Armory-Addison Road	---	---	24.74	30.88
Total System	64.76	66.14	58.76	59.94
System Ridership	259,900	305,400	296,000	298,300
System Passenger Miles	1,245,111	1,450,234	1,371,591	1,336,988
System Rail Car Miles	49,713	56,892	58,556	60,882
System Operating Miles[2]	28.11	30.74	35.74	38.37

It can be seen from this table that the most heavily used rail segments are Metro Center to Silver Spring, averaging 86.52 passengers per peak period rail car over four years, and Metro Center to National Airport, averaging 75.44 passengers per peak period car. The most lightly used segment is Stadium-Armory to Addison Road, averaging only 27.81 passengers per peak period car during its two years of operation. The trends in average

[1] Operated only as far as Dupont Circle in 1979, 1980 and 1981.
[2] Operating mileage is measured from center line of station to center line of station. Does not include non-revenue portions of system.

passengers per peak period rail car that can be seen in the total system average are generally true for each of the segments. Since 1980, the total system average has declined by almost 10 percent. This is due to a decrease in both system ridership and passenger miles, coupled with an increase in system rail car miles, experienced with the expansion of the system.

Another indicator by which to compare individual Metrorail lines is the ratio of riders to seating capacity. The disaggregated data shown in Table 7.3 is a breakdown, for the peak hour, of the measure of rail service quality seen systemwide in Table 7.1. **This table shows that, since 1980, the Red Line extension to Silver Spring has consistently maintained a higher ratio of peak hour rail riders to seat capacity than the other Red Line segment, and higher than the Blue/Orange Line segments as well.**

TABLE 7.3

RATIO OF RAIL RIDERS TO SEAT CAPACITY BY LINE

(Peak Hour in Peak Direction)

	1979	1980	1981	1982
RED LINE:				
Union Station (AM)	1.73	1.72	1.61	1.69
Judiciary Square (PM)	1.64	1.72	1.63	1.71
BLUE/ORANGE LINE:				
Rosslyn (AM)	1.85	1.49	1.59	1.59
Foggy Bottom (PM)	1.90	1.45	1.55	1.47
Federal Center SW (AM)	1.42	1.05	1.18	1.13
L'Enfant Plaza (PM)	1.48	1.21	1.28	1.24
TOTAL SYSTEM:				
System Average (AM)	1.67	1.42	1.46	1.47
System Average (PM)	1.67	1.46	1.49	1.47

On the Blue/Orange Line , the measurements taken at Rosslyn and Foggy Bottom, on the western edge of the D.C. core, are higher than those taken at Federal Center SW and L'Enfant Plaza on the eastern edge. This data corresponds to the findings from Table 7.2, that the most heavily used rail segments are those between Metro Center and Silver Spring, and Metro Center and National Airport.

METROBUS SYSTEM INDICATORS

Indicators helpful in analyzing the Metrobus element of the transit system are shown in Table 7.4. Viewed together, these nine indicators provide an excellent overview of what bus service is provided and how that service is being used.

TABLE 7.4

TRENDS IN BUS SERVICE PROVIDED AND USED

FISCAL YEAR	ANNUAL SCHEDULED BUS MILES	TOTAL OPERATOR PAY HOURS	BUS MILES PER PAY HOUR	AVERAGE # FULL TIME OPERATORS	AVERAGE # PART TIME OPERATORS	AVERAGE # TOTAL OPERATORS	# OF VEHICLE TRIPS ENTERING D.C. CORE 1/	TOTAL BUS RIDERSHIP 2/	PASSENGERS PER BUS MILE
1976	55,400,000	---	---	---	---	---	2,375	126,806,000	--
1977	55,422,000	---	---	---	---	---	2,417	127,000,000	2.29
1978	52,356,000	6,890,400	7.6	2,927	---	2,927	1,919	112,599,000	2.15
1979	50,990,000	6,740,400	7.6	2,750	101	2,851	1,823	119,848,000	2.35
1980	54,459,000	6,895,200	7.9	2,858	154	3,012	1,802	149,224,000	2.74
1981	53,942,000	6,784,800	8.0	2,789	215	3,004	1,671	141,411,000	2.62
1982	52,633,000	6,250,800	8.4	2,594	250	2,844	1,634	135,960,000	2.59
CHANGE 78-82	+0.5%	-9.3%	+10.5%	-11.4%	---	-2.8%	-14.9%	+20.7%	+20.5%

SOURCES: Metrobus and Metrorail Performance Indicators and Measures Quarterly Reports, WMATA
Metrobus and Metrorail Quarterly Ridership Reports, WMATA
Metro Core Cordon Counts of Vehicular and Passenger Vehicles, COG/TPB.

NOTES: 1/During AM Peak Period, as measured in the spring Ring 1 Cordon Counts.

2/Includes passengers transferring to and from Metrorail, as well as those using buses only.

The indicator displaying the largest decline between FY 1978 and FY 1982 is the number of bus vehicle trips entering the D.C. core. This decline of 14.9 percent is the result of the turnback of bus service in various travel corridors at rail stations as they became operational. At the same time, however, the number of annually scheduled bus miles remained virtually unchanged between FY 1978 and FY 1982. This would indicate that the decreases in bus miles attributable to the decline in bus trips to the D.C. core has been offset by an increase in the number of bus miles being travelled in the suburban jurisdictions.

Another interesting point to be made from this table regards the decrease in the total number of operator pay hours. This 9.3 percent decline in total pay hours, which resulted in a substantial increase in bus miles per pay hour, was, itself, the result of the decrease in the number of full time operators and the increase in the number of part time operators. This recent concession in WMATA's labor contract with the transit unions allows the transit system to pay straight time to part time operators who work peak period 'trippers' when previously, a full time operator would have been paid overtime for the same work.

Total bus ridership, which includes passengers transferring to and from Metrorail as well as those using buses only, experienced an overall increase of better than 20 percent between FY 1978 and FY 1982. This overall increase resulted, even though there were declines in FY 1981 and FY 1982 from the 1980 'peak' year for transit in this region. This fact, coupled with the minor increases in annual scheduled bus miles resulted in a corresponding increase in passengers per bus mile. This overall increase, which also has declined since FY 1980, was just over 20 percent as well.

WMATA VERSUS OTHER TRANSIT SYSTEMS

One of the major objectives behind the identification of these indicators was to develop a system whereby WMATA (both Metrorail and Metrobus) could be compared to transit systems in other U.S. cities, to ascertain its effectiveness. Table 7.5 compares the Metrorail system to six other U.S. rail systems with respect to three indicators: passengers per vehicle mile; operating expenses per vehicle mile; and, operating expenses per passenger. All expense figures are standardized to account for differing fiscal years.

In terms of total passengers per vehicle mile, Metrorail, with a total of 4.8, falls just below the average of the seven systems. Metrorail's total operating expenses per vehicle mile, $4.87, are also slightly higher than the average. Coupling these two indicators, we derive the third, operating expenses per passenger, for which Metrorail is slightly below the average at $1.01.

Comparing the Metrorail system to BART in San Francisco, we see that, while operating only two-thirds as many rail cars (296 versus 439) and slightly more than half of the system mileage (39 versus 75), Metrorail fairs quite favorably. Although the total operating expenses per vehicle mile are higher ($4.87 versus $3.70) for Metrorail, the greater number of passengers per vehicle mile (4.8 versus 1.8) results in WMATA spending

TABLE 7.5

TRANSIT PERFORMANCE INDICATORS: RAPID RAIL SYSTEMS

CITY 1/	TRANSIT SYSTEM	TOTAL PASSENGERS PER VEHICLE MILE			TOTAL OPERATING EXPENSES PER VEHICLE MILE (IN $)			TOTAL OPERATING EXPENSES PER PASSENGER (IN $)			RAIL CARS
		FY 79	FY 80	FY 81	FY 79	FY 80	FY 81	FY 79	FY 80	FY 81	FY 81 TOTAL
NEW YORK	NYCTA	---	3.8	5.1	3.82	4.21	4.57	---	1.12	.89	6,303
CHICAGO	CTA	3.3	3.0	3.1	2.85	3.33	2.90	.86	1.09	.95	1,100
SAN FRANCISCO	BART	---	---	1.8	---	---	3.70	---	---	2.05	439
PHILADELPHIA	SEPTA	6.7	7.1	6.5	3.57	4.37	4.82	.53	.61	.74	430
BOSTON	MBTA	13.3	10.2	7.6	11.93	8.20	8.74	.90	.80	1.14	385
WASHINGTON	WMATA	---	5.6	4.8	3.02	4.73	4.87	---	.85	1.01	296
ATLANTA	MARTA	11.8	---	5.5	.37	2.90	3.62	.03	---	.66	99
AVERAGE		8.7	4.6	4.9	4.26	4.62	4.75	.58	.89	1.06	

SOURCE: National Urban Mass Transportation Statistics, Section 15 Reports, UMTA

NOTE: Includes entire transit zone, which usually includes most of the metropolitan area.

TABLE 7.6

TRANSIT PERFORMANCE INDICATORS: MOTOR BUS SYSTEMS

CITY 1/	TRANSIT SYSTEM	TOTAL PASSENGERS PER VEHICLE MILE			TOTAL OPERATING EXPENSES PER VEHICLE MILE (IN $)			TOTAL OPERATING EXPENSES PER PASSENGER (IN $)			MOTOR BUSES
		FY 79	FY 80	FY 81	FY 79	FY 80	FY 81	FY 79	FY 80	FY 81	FY 81 TOTAL
NEW YORK	NYCTA	10.5	10.5	11.4	4.51	4.68	6.07	.43	.45	.53	4,568
LOS ANGELES	SCRTD	3.8	3.8	3.6	2.35	2.56	3.05	.63	.67	.84	3,362
CHICAGO	CTA	5.6	6.8	6.4	2.62	3.61	3.69	.47	.53	.58	2,420
NEWARK	TRANSP. OF NJ	1.8	2.0	1.9	1.87	2.06	2.24	1.01	1.04	1.19	1,931
WASHINGTON	WMATA	3.4	3.8	3.6	2.71	3.02	3.46	.81	.79	.95	1,767
PHILADELPHIA	SEPTA	6.1	6.1	6.6	2.59	3.01	3.38	.43	.49	.51	1,622
DETROIT	SEMTA	1.4	2.9	2.1	----	2.92	2.86	---	1.00	1.37	1,317
BOSTON	MBTA	---	3.6	4.5	----	3.72	4.03	---	1.02	.90	1,137
BALTIMORE	MTA	4.0	4.4	4.2	2.24	2.79	3.12	.56	.63	.75	1,069
ST. PAUL	MTC	3.5	3.6	---	2.08	2.41	----	.60	.66	---	1,048
SEATTLE	METRO	2.4	2.5	2.3	2.02	2.27	2.56	.83	.93	1.13	1,028
ST. LOUIS	BI-STATE	2.8	2.9	2.6	2.30	2.78	3.07	.82	.95	1.20	1,004
OAKLAND	AC TRANSIT	3.2	3.6	3.3	1.98	2.37	2.56	.62	.66	.78	997
ATLANTA	MARTA	2.5	3.6	3.7	1.82	2.26	2.27	.73	.62	.61	990
PITTSBURGH	PAT	3.1	3.0	2.9	2.24	2.55	2.81	.72	.86	.98	965
AVERAGE		3.9	4.2	4.2	2.41	2.87	3.23	.67	.75	.88	

SOURCE: National Urban Mass Transportation Statistice, Section 15 Reports, UMTA

NOTE: Includes entire transit zone, which usually includes most of the metropolitan area.

TABLE 7.7

RIDERSHIP TRENDS IN U.S. CITIES

(UNLINKED PASSENGER TRIPS, IN THOUSANDS)

CITY	SYSTEM TYPE	1977	1978	1979	1980	1981	1982	% CHANGE 1977-80	% CHANGE 1980-82
ATLANTA	TOTAL	79,437	82,356	86,316	108,789	105,404	109,220	+ 37.0	+ 0.4
	SURFACE	----	----	----	88,379	84,854	85,752	--	- 3.0
	RAPID	----	----	----	20,410	20,550	23,468	--	+ 15.0
BALTIMORE	BUS	107,553	111,081	115,431	116,572	104,300	91,817	+ 8.4	- 21.2
CHICAGO	TOTAL	646,228	673,272	712,621	696,637	643,280	616,068	+ 7.8	- 11.6
	SURFACE	514,132	533,413	562,599	541,083	492,697	468,899	+ 5.2	- 13.3
	RAPID	132,096	139,859	150,021	155,554	150,583	147,169	+ 17.8	- 5.4
DETROIT	BUS	9,054	10,208	12,890	12,836	13,610	12,249	+ 29.5	- 4.6
LOS ANGELES	BUS	---	---	338,100	392,000	385,230	366,500	--	- 6.5
PHILADELPHIA	TOTAL	272,695	318,629	333,905	330,254	286,432	324,075	+ 17.4	- 1.9
	SURFACE	194,683	222,634	235,035	233,704	201,932	227,754	+ 20.0	- 2.5
	RAPID	78,013	95,995	98,870	96,550	84,500	96,312	+ 23.8	- 0.2
SAN FRANCISCO	RAPID	44,565	38,234	34,636	48,936	54,030	58,211	+ 9.8	+ 18.9
ST. LOUIS	BUS	---	---	74,193	69,806	60,669	53,606	--	- 23.2
WASHINGTON	TOTAL	137,790	159,190	262,487	283,996	275,551	266,262	+106.1	- 6.2
	SURFACE	118,780	111,098	179,481	191,895	182,112	171,896	+ 61.6	- 10.4
	RAPID	19,010	48,092	83,006	92,100	93,439	94,366	+384.5	+ 2.5
AVERAGE CHANGE	TOTAL							+ 30.9	- 6.2
	BUS/SURFACE							+ 29.9	- 10.6
	RAPID							+109.0	+ 6.2

SOURCE: Monthly Transit Ridership Reports, American Public Transit Association.

less than half the amount that BART does in operating expenses per passenger ($1.01 versus $2.05).

Table 7.6 displays a similar comparison between Metrobus and fourteen other bus transit systems in the U.S. With regard to the FY 81 averages for these fifteen systems, Metrobus carries slightly less than the average number of passengers per vehicle mile (3.6). In addition, the total operating expenses per vehicle mile for Metrobus ($3.46) and the total operating expenses per passenger ($.95) are slightly above the averages as well. All expense figures are standardized to account for differing fiscal years.

Table 7.7 compares ridership trends among nine transit systems in the U.S., four bus-rail systems, four all bus systems and one rail only system. Between 1977 and 1980 WMATA's total ridership, bus and rail, experienced the largest increase (106.1 percent) among those transit systems measured. The decrease in WMATA's total ridership during the following two years (6.2 percent) was equal to the average decline. Broken down, these figures displayed a bus ridership decline that was almost the same as the average (10.4 percent versus 10.6 percent) and a rail ridership increase that was below the average increase (2.5 percent versus 6.2 percent). **The overall increase in total ridership for WMATA between 1977 and 1982 (93.2 percent) is almost two and a-half times the percentage increase for the next highest transit system.**

This increase in ridership, coupled with the showings for Metrorail and Metrobus with regard to passengers and operaring expenses per vehicle mile, plus operating expenses per passenger, put WMATA in good standing when comparing major transit systems in the U.S.

CONCLUSIONS

The series of quantitative indicators developed as an earlier part of the Metrorail Before and After Study were computed and presented in this chapter. These indicators can be used to determine the impact of the Metrorail and Metrobus system in the Washington region, to compare the different operating segments of the Metrorail system, and to compare the service WMATA provides in the Washington Metropolitan Area to the service provided in other U.S. cities.

Systemwide indicators for both Metrorail and Metrobus show that the amount and quality of service provided has changed dramatically since 1977. As the rail system has expanded, the number of rail trips scheduled each weekday has increased by as much as 250 percent, while annual scheduled bus miles per transit zone resident has decreased. The non-inflation related costs of providing this service have, for the most part, increased since 1977, ranging from a 3.1 percent decrease in operating cost per bus passenger to a 36 percent increase in subsidy per rail passenger. In addition, the total use of the system has increased by over 200 thousand passengers per day. The number of Metrorail passengers per car mile has decreased, as would be expected as the system expands, while the number of passengers per bus mile has increased.

Indicators for the Metrorail line segments show that the Red Line between Metro Center and Silver Spring is the most heavily used rail segment dur-

ing the peak periods, and has maintained a high peak hour ratio of passengers to seating capacity, higher than the other Red Line segment and the segments of the Blue/Orange Line as well.

The Metrobus indicators highlight the changing nature of the bus network as the rail system expands, with fewer vehicle trips entering the D.C. core, yet close to the same number of annually scheduled bus miles. Major increases in bus ridership between 1976 and 1982 coupled with the same number of annually scheduled bus miles resulted in a 20 percent increase in the ratio of passengers per bus mile.

Total transit system indicators computed show that the WMATA system is in good standing when compared to systems in other major U.S. cities, with a substantial increase in total transit ridership between 1977 and 1982 plus performance indicators for both Metrorail and Metrobus that are near or better than average.