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December 26, 2006

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VIA HAND DELIVERY

Ms. Carol Mitten, Chairperson
District of Columbia Zoning Commission
Office of Zoning
441 4th Street, NW, Room 210
Washington, DC 20001

Re: Zoning Commission Case No. 06-27, Square 54

Dear Ms. Mitten:

Pursuant to the Commission's requests during the November 20, 2006 hearing, the Applicant submits the WMATA's 2005 Development-Related Ridership Survey for the record in the above-referenced case.

Sincerely yours,

Phil T. Feola

Samantha L. Mazo

Enclosure

CERTIFICATE OF SERVICE

I hereby certify that copies of this submission were hand delivered to the persons listed below on December 26, 2006.

Phil Feola

ANC 2A
St. Mary's Court
725 24th Street, NW
Washington, D.C. 20037

Vincent Micone
Chair, ANC 2A
1099 22nd Street, NW #1005
Washington, DC 20037

West End Citizens Association
c/o Barbara Kahlow
800 25th St NW
Apart. # 704
Washington, DC 20037-2208

Foggy Bottom Association
Cornish F. Hitchcock,
5301 Wisconsin Avenue, NW,
Suite 350, Washington, DC 20015

DEVELOPMENT-RELATED RIDERSHIP SURVEY II

Prepared for

Washington Metropolitan Area Transit Authority

Prepared by

JHK & Associates

December 1989

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ACKNOWLEDGEMENTS

The study was sponsored by the Washington Metropolitan Area Transit Authority (WMATA). The project managers for WMATA were Mr. Richard Miller and Mr. John Green. The project manager for JHK & Associates (JHK) was Mr. James Curren. Mr. Dan Hardy served as JHK's project engineer, Ms. Joan Jenkins served as Field Supervisor, and Mr. Morris Rothenberg was the Responsible Officer.

JHK & Associates and WMATA would like to acknowledge and thank the many individuals and organizations that contributed to this study. This especially includes the building owners and managers who assisted JHK in granting permission for and setting up the surveys. A listing of the sites studied can be found in the text of the report. Thanks are also expressed to other WMATA staff.

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EXECUTIVE SUMMARY

This study, the Development - Related Ridership Survey II, is the second in a series sponsored by the Washington Metropolitan Area Transit Authority (WMATA). The first study conducted by JHK & Associates was completed in March 1987. The data collection for this study was collected during March and April 1989. The purposes of the studies were to study travel behavior of persons travelling to and from residential and commercial developments around Metrorail stations and to establish relationships among travel characteristics, distance, and the nature of development at each site. The studies consisted of surveys of persons travelling to and from office buildings, residential developments, retail sites and hotels near Metrorail stations. The first study surveyed 34 building sites, this study surveyed 38 buildings, 13 of which were repeated from the first study.

This executive summary highlights the key findings and conclusions from the Development-Related Ridership Surveys. The details of the procedures and results are discussed in the body of the report. A summary of observations is presented below, beginning first with general observations, followed by conclusions relating to each of the land use types.

General Observations

The choice of mode for trips to and from any type of land use is influenced by many factors. This study confirmed the findings of the first study, that the most significant and readily used factors for planning purposes are:

- The location of the site within Metropolitan Washington.
- The proximity of a building to a Metrorail station entrance.

Significant transit mode shares were recorded for all land uses.

Transit users reported almost as many linked trips as auto users.

Origin destination pairs heavily influence the propensity to take transit. Poor transit accessibility at either end of the trip results in poor transit ridership between those pairs.

Based on the response to attitudinal questions an average of 28% of all respondents hold the perception that information regarding the transit system (rail and bus) and schedules is not readily available.

Observations on Office Development

Transit mode share for offices ranged from under 10% in some suburban settings to over 50% in the downtown. In general it was found that the residences of employees was spread throughout the region, with employees who cross jurisdictional lines more inclined to use transit than those who live and work within the same jurisdiction.

Residential Buildings

The transit mode share for residential buildings surveyed in this study ranged from 30 to over 70%. The sites surveyed included both rented and owner occupied. Auto ownership was found to be significantly lower at all sites surveyed as compared to the regional average, which is 1.93 autos per household.

Retail Uses

All of the retail sites surveyed had significant transit mode share. In general, it appears that transit mode share to retail sites has increased over the two year period between studies. In contrast to the first study, this study found that transit mode share to retail sites was often higher at a given metrorail station than the transit mode share to office buildings at that station.

Hotels

Like retail sites, hotels showed a significant increase in the transit mode share when compared to the first study. Hotel trip generation rates vary from day to day more so than other land uses.

Conclusions

Several land use and transportation factors are critical to making the best possible use of the transit system. These include:

- Locating the types of uses that tend to generate the most transit trips in the Metrorail station areas.

- Locating these land uses in close proximity to stations with good access to the station portals.
- Providing high density land development around Metrorail stations, including suburban stations.
- Providing convenient walk and feeder bus access to the stations to expand the transit market.

In general mixed development at each station area is the most desirable in terms of reducing overall vehicle trips. However, the development in a corridor as a whole should be considered, as well as development at individual stations. Variations from station to station along a rail line appear to maximize ridership on a daily basis. The study also found that in general sensitivity to the distance from the station portal varies by land use, office developments being the most sensitive and residential developments the least sensitive. This suggests that office development is best suited to areas immediately adjacent to the station. However, exceptions to this may occur for specific uses such as destination retail.

Development of the station areas is only one component of overall planning that is required in order to maximize transit ridership. Transit service and station access to and from lower density development is also critical.

Adequate road networks must be constructed in conjunction with the development of station areas. Poor road networks not only create a negative image of station areas but also restrict the transit market to relatively tight areas surrounding the station. People will not use Metrorail if they must fight congestion to reach the station.

Marketing must be targeted at individual station areas to provide those who live, work, or shop in these areas specific information about the system and how they can use it.

Development of any type tends to be controversial. There are pros and cons that must be weighed. It is clear, however, that the limited supply of developable land and the fixed nature of the Metrorail system make development decisions around rail stations particulary critical. These decisions must be lived with for years to come and therefore must be made with a long-term view. One locational benefit, for example, is that a 200,000 square foot office being considered for development in the suburbs could achieve an annual reduction of some 500,000 vehicle miles of travel by locating near a Metrorail Station.

It is inevitable that the Washington area will grow. Careful attention to how it grows, particulary in areas served by Metrorail, will reap major benefits in optimizing

the use of the existing and future regional transportation system.

INTRODUCTION

This is the Final Report for the Development-Related Ridership Survey II, prepared for the Washington Metropolitan Area Transit Authority (WMATA). Like the first Ridership Survey completed in March 1987[1], the purpose was to study the travel behavior of persons travelling to and from residential and commercial developments around Metrorail stations. The data collected was used to establish relationships between travel characteristics and the nature of development at each site. The sites chosen for this survey were carefully selected to provide expansion of the existing database, and to permit long-term trend analysis. In addition, a more extensive examination of mid-day travel characteristics was conducted in this survey than in the original effort. This information will provide WMATA and other local agencies with better information on the accessibility benefits of locating buildings near Metrorail stations.

The purpose of this study is to present findings from the survey data, mathematical relationships developed between travel characteristics and site development factors, and trip generation characteristics and site development factors.

STUDY APPROACH

The basic approach to the study involved the development of data on a building by building basis. Each building was considered to constitute an observation with which a distinct set of travel characteristics could be associated. The travel characteristics were expected to vary among buildings based on a number of factors including, type of land use, location within the metropolitan area, proximity to Metrorail stations, type of employers within a building, cost and availability of parking. Also, factors not directly related to sites also influence travel characteristics. Examples of these include average income, auto ownership, and the quality of Metrorail service at each end of the trip.

Data on travel characteristics was collected through a series of questionnaires, interviews, and "cordon counts" conducted at each of the 38 buildings surveyed. The type of survey conducted depended primarily on the type of land use. The four land use types and associated survey approach were as follows:

---

[1] Development-Related Ridership, JHK & Associates, March 1987.

- Office Buildings - several techniques were employed including self-administered questionnaires for employees, pedestrian intercept surveys for visitors, and cordon counts of persons entering the office for specified periods.

- Residential Buildings - self-administered surveys were distributed to each unit and cordon counts were conducted at all sites to determine actual trip generation rates for each site.

- Retail Establishments - personal interviews were conducted at the store entrances or within the store itself depending on the characteristics of the site. In addition cordon counts were conducted at most sites.

- Hotels - as with the retail sites, personal interviews were conducted combined with cordon counts of the site.

Chapter 2 of this study discusses the specific approach and survey procedures for each land use type as well as unique characteristics of specific sites, the analysis procedure, and a summary of results. Important considerations in the design of the data collection program were the development of unbiased sampling techniques, the ability to cross-check data, and compatibility with the previous surveys. Although any survey is subject to sampling error, careful design of the data collection program can reduce the chances of any biasing of the results. For example, no direct reference was made to WMATA in the self administered surveys. The surveys were cast as general transportation surveys, thereby providing the best chance of obtaining unbiased estimates of mode choice. The ability to detect any bias that may occur is also important. For example, cordon counts can provide the actual trip generation rate and in many cases the mode split, thus acting as a cross-check. Where interviews were conducted, counts allow sample size by entrance to be determined. The total number of survey responses for all land uses studied exceeded 6,600, plus cordon counts for all but three sites. A summary of response rates for mail-back surveys is given in the appendix.

Chapter 3 focuses on quantitative relationships between travel characteristics at the buildings surveyed and the factors that influence travel behavior. This includes the development of regression equations that can be used to predict transit[1] mode share for newly planned development. These equations are compared to previous findings in other studies and their limitations discussed. When properly applied within the context of their limitations, the equations provide an excellent planning tool for developments being considered in close proximity to an urban rail station.

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[1] The term "transit" is used in this report to refer to rail and bus services unless otherwise specified.

Finally, Chapter 4 presents a summary of our conclusions and recommendations. Techniques and strategies to improve transit ridership are suggested based on the findings of the study.

SITE SELECTION

Site selection procedures considered the location of the Metrorail station, the location and type of building, and the previous study (Figure 1 shows the station areas selected and Table 1 the number of land uses surveyed at each station). The surveyed sites were selected from an initial list of candidate Metrorail stations and sites by the following criteria:

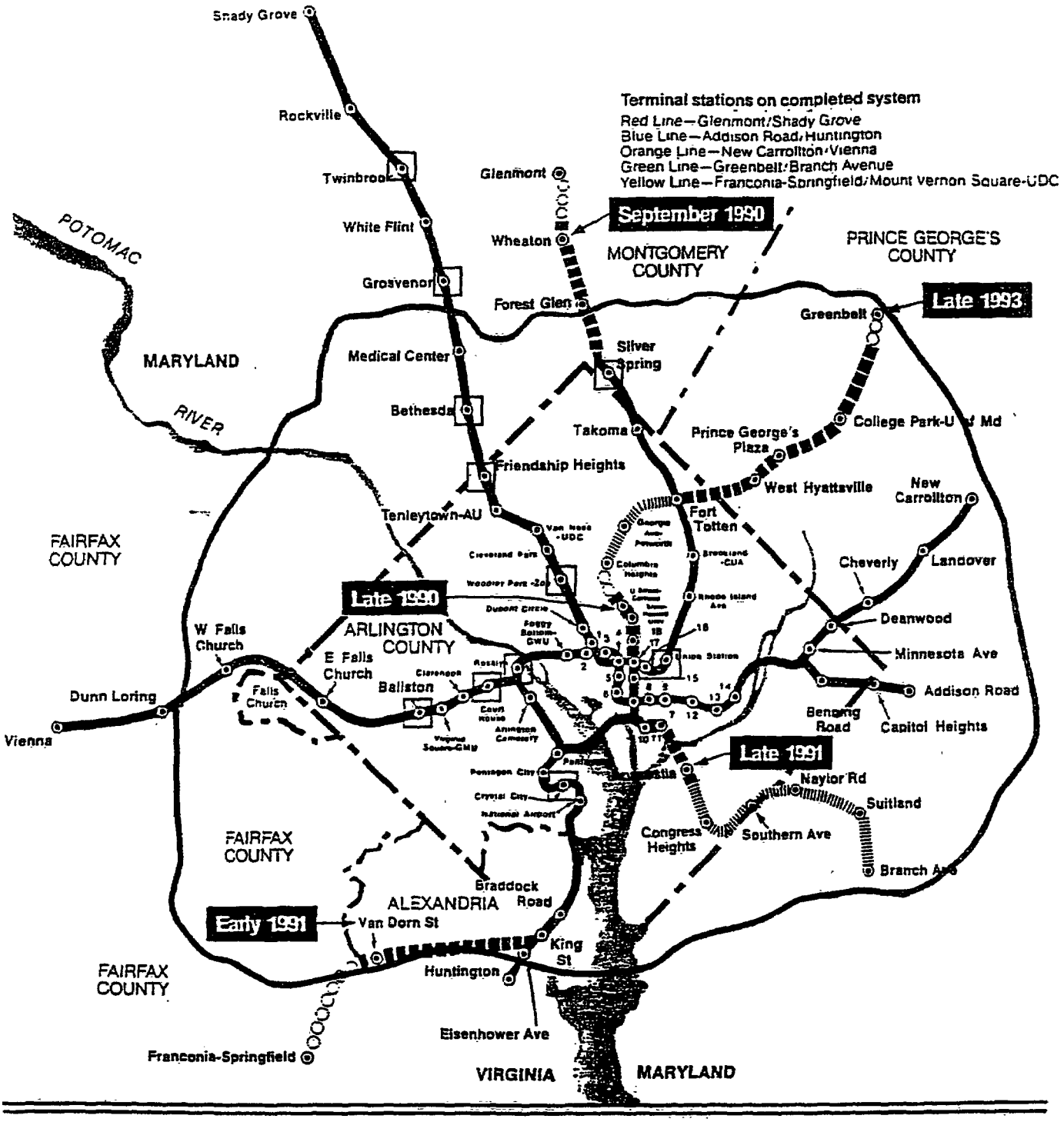
- A range of stations reflecting different development patterns and varying locations within the metropolitan area. (i.e. inside the Beltway vs. outside the Beltway):

- Station areas had to have building developments that were constructed, rehabilitated or converted within more recent years. Unlike the first study, individual sites that were older were selected in order to broaden the database.

- The expansion of the database was an important consideration. A similar study " Development Related Ridership Survey" was completed for WMATA by JHK & Associates in March of 1987. Additional station areas and sites were added while at the same time a deliberate effort was made to repeat a significant number of sites in order to begin the development of time series data.

- The developments were to be of the following minimum sizes; office buildings - 100,000 square feet, residential buildings - 75 dwelling units, hotels - 200 rooms, retail - no minimum square footage or number of establishments.

- Another major criterion involved the nature of the building tenants. In an effort to develop a data base that covers the full range of tenants, buildings were chosen to include both public and private employers. Government agencies tend to be large employers and have operational characteristics that significantly impact travel habits of employees. For example, the large employment base and fairly regular work hours enable extensive participation in ridesharing programs. Building sites with public employers were not chosen in the first study as it was felt that the data base was not large enough to allow the isolation of other factors. With the growing data base it was felt that government agencies should now be included. As well, there is a growing trend for government employers to locate adjacent to a Metrorail station, therefore it is important to include the trip making characteristics of public agencies in the data base.



LEGEND

Operating Lines	69 57 miles	64 stations	Total Mileage—102.99
Under Construction	19 24 miles	13 stations	Total Stations—87
Under Final Design	5 47 miles	3 stations	
Remainder of System	8.71 miles	7 stations	

Early 1991 — Projected start of operations for this segment based on approved schedule. Applies to all stations inbound from this point.

Stations Studied

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-Navy Mem'l
16. Judiciary Square
17. Gallery Pl-Chinatown
18. Mt Vernon Sq-UDC

Washington Metropolitan Area Transit Authority
600 Fifth Street, N.W., Washington, D.C. 20001
Office of Public Affairs

Figure 1 Metrorail System Map and Stations Studied

Table 1. Site Survey
Building Inventory Summary

	Office	Retail	Residential	Hotel	TOTAL
Metro Center		2		2	4
Farragut West	1				1
Crystal City	1	2	3	2	8
Courthouse	1				1
Silver Spring	1		2	1	4
Ballston	1	1	1		3
Bethesda	3	1		1	5
Friendship Heights		1			1
Twinbrook	2		1	1	4
Grosvenor			3		3
Union Station		1		1	2
Rosslyn				1	1
Woodley Park/Zoo				1	1
TOTAL	10	8	10	10	38

The sites selected are illustrated in Figures 2 to 13. These maps illustrate the varying distances the selected sites are from the stations. In addition, tables containing brief descriptions of the selected sites, with the numbers corresponding to the numbers shown on each map are included with the discussion for each land use. Numbers were assigned sequentially based on initial selections.

Contacting the building managers or leasing agents was the next step in the survey process. During the initial site inventory, basic information on each site (e.g. an estimate of size, proximity to Metro, etc.) was collected. Occasionally, management companies were reluctant to grant permission, stating they would not like to inconvenience their tenants or patrons. However, a thorough explanation of the study stressing that participation was voluntary on the part of each tenant or patron usually satisfied most building managers. Some managers preferred to have the request to conduct the survey in writing. The letter developed to give those building managers who requested additional information is contained in the appendix.

Unfortunately, not all of the initially selected sites were willing to participate in the survey. Replacement sites were chosen on an individual basis to provide the necessary balance in site characteristics. These sites were chosen in conjunction with WMATA. All data was collected during March and April 1989.

Sites were not re-numbered when alternate sites were chosen. All sites are shown on the maps including those that were dropped.

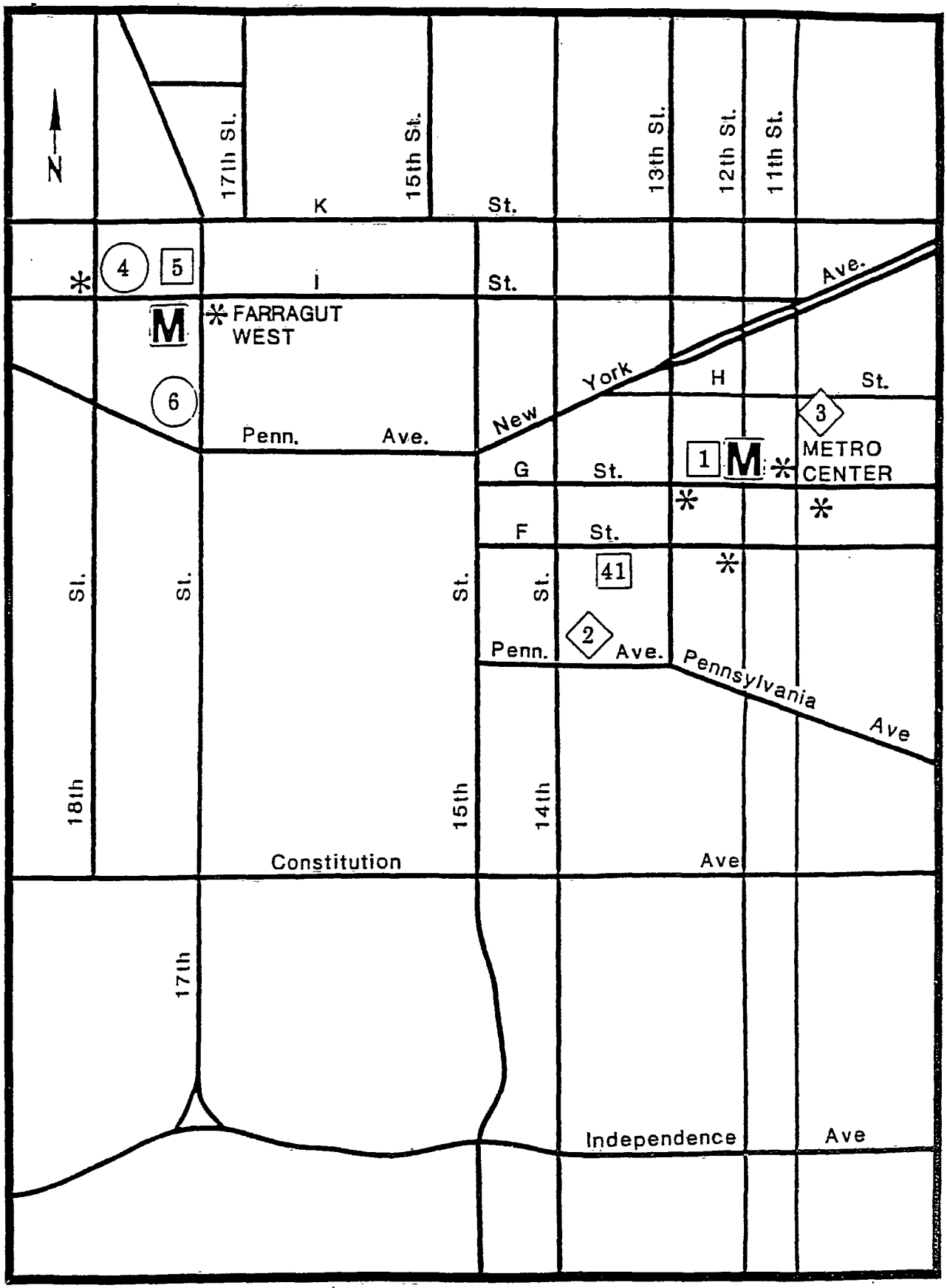


Figure 2. Farragut West/Metro Center

○ office
□ retail
✳ entrance location
△ residential
◇ hotel

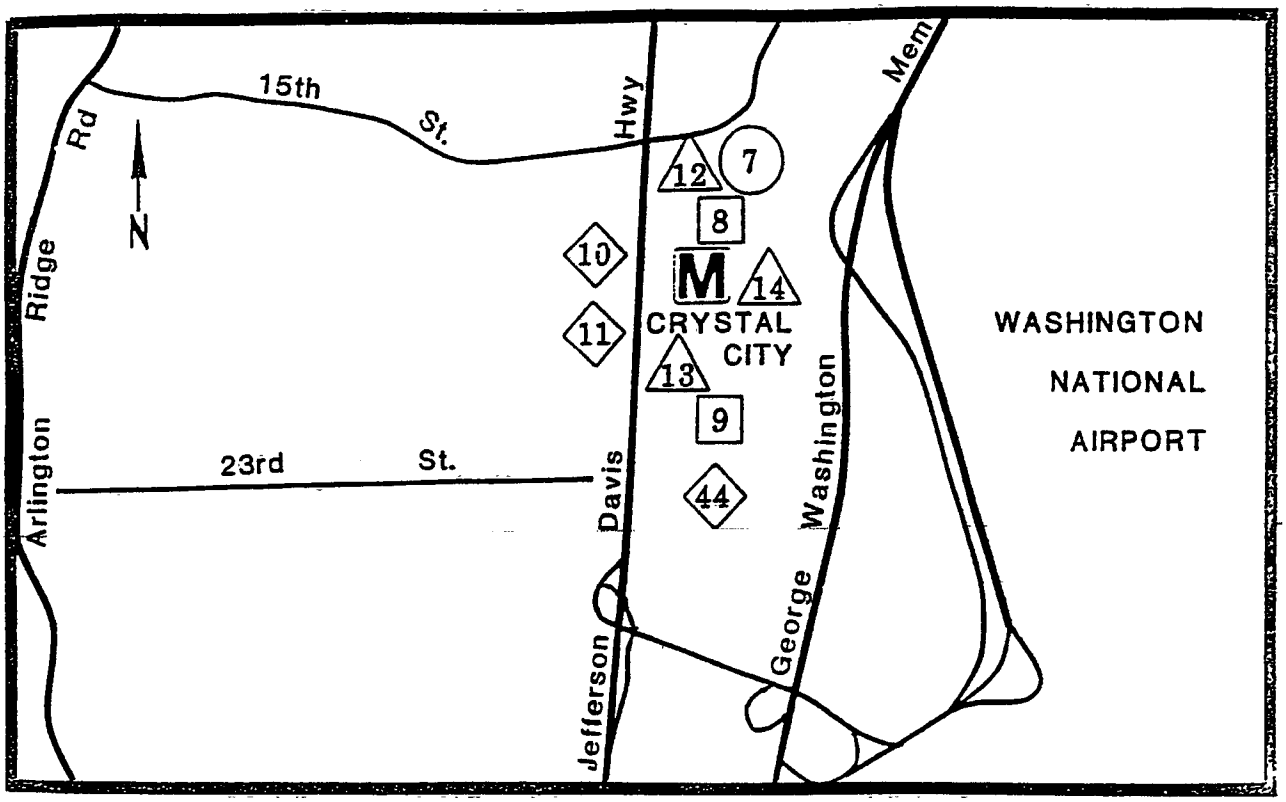


Figure 3. Crystal City

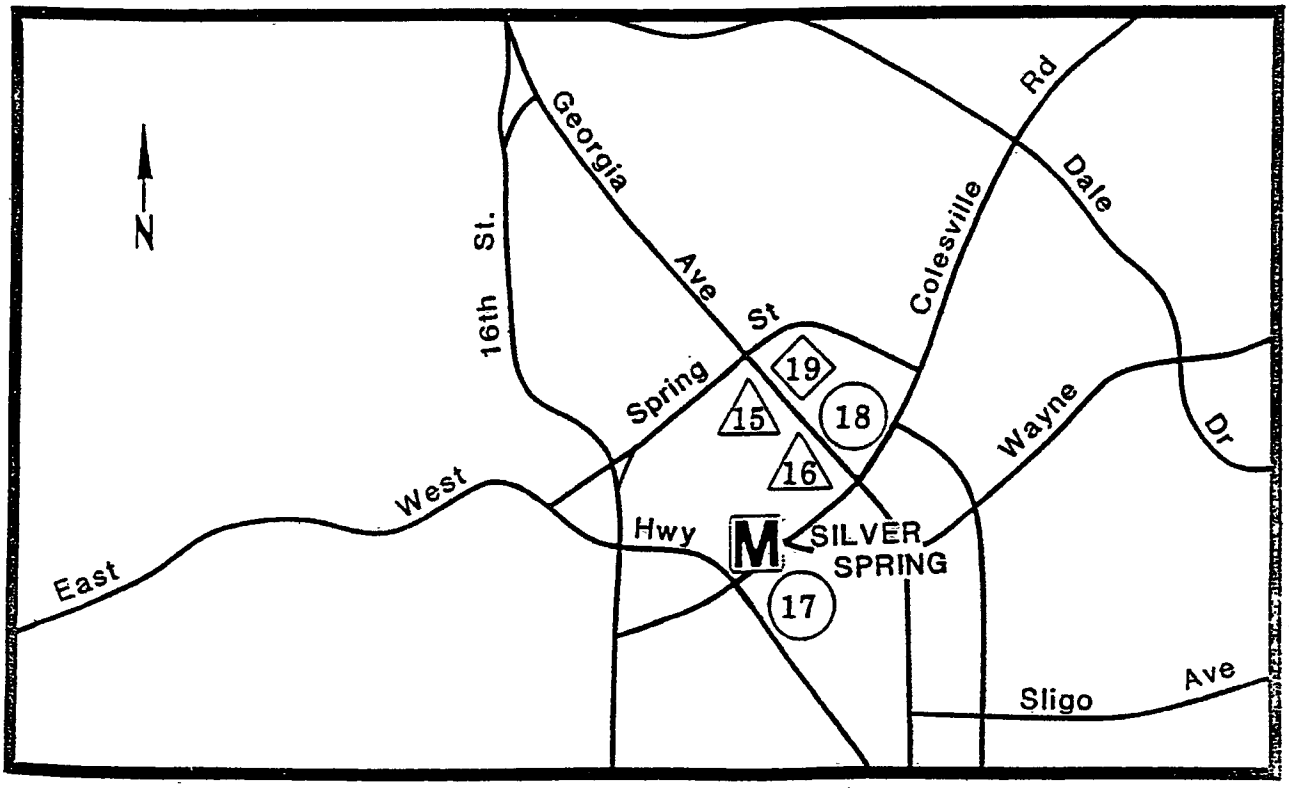


Figure 4. Silver Spring

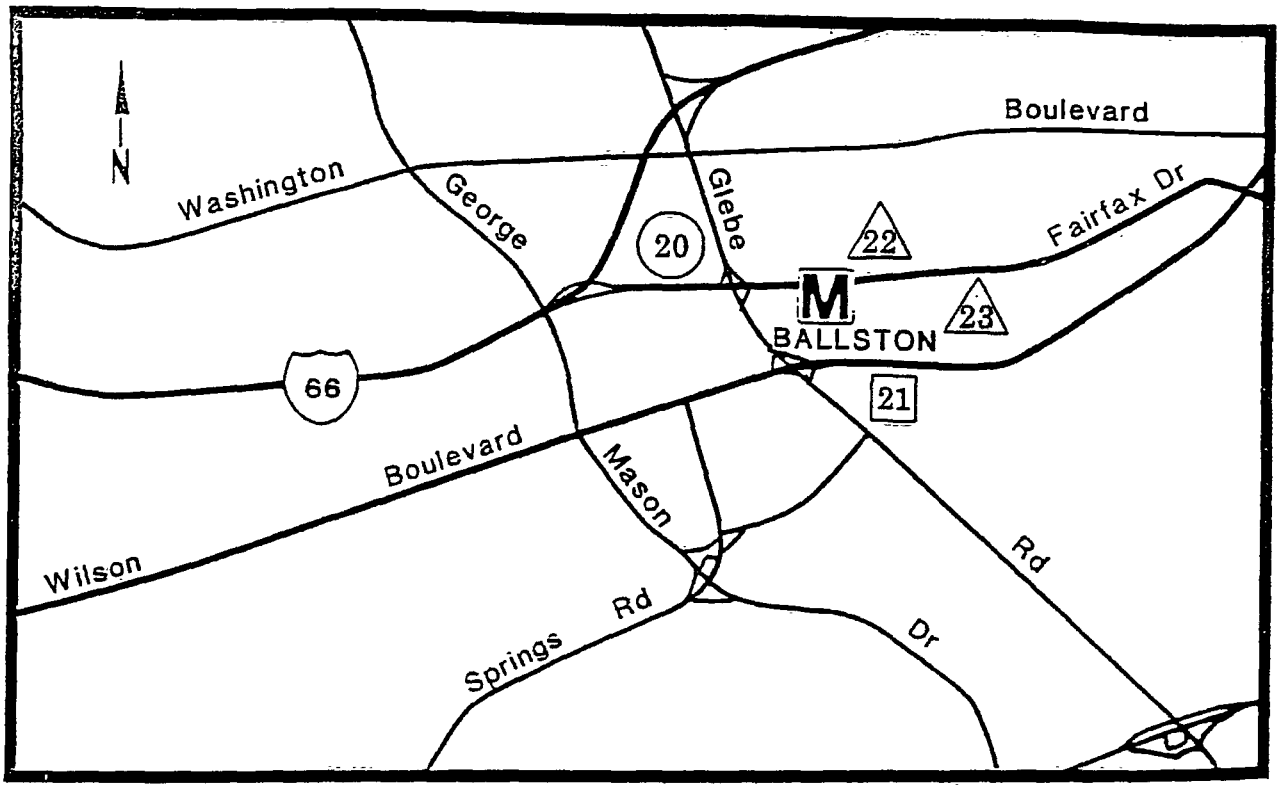


Figure 5. Ballston

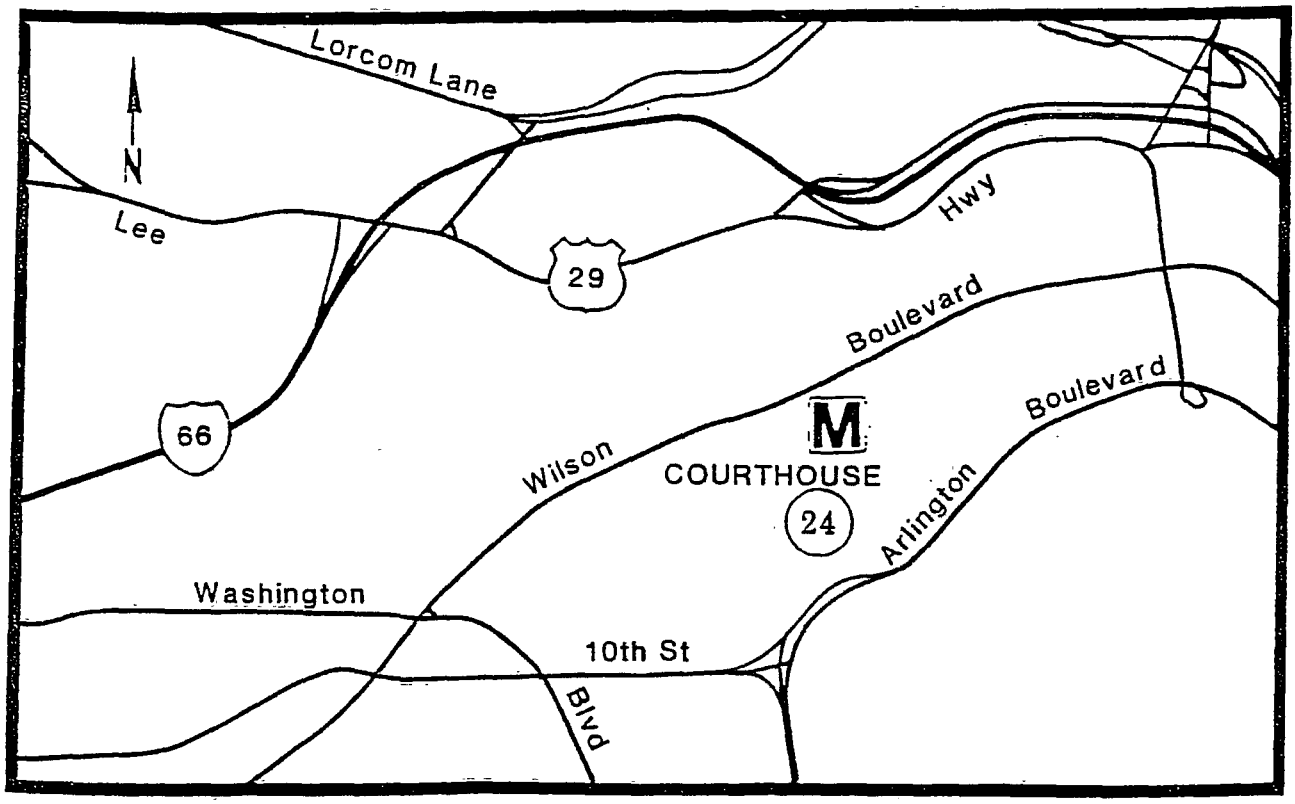


Figure 6. Courthouse

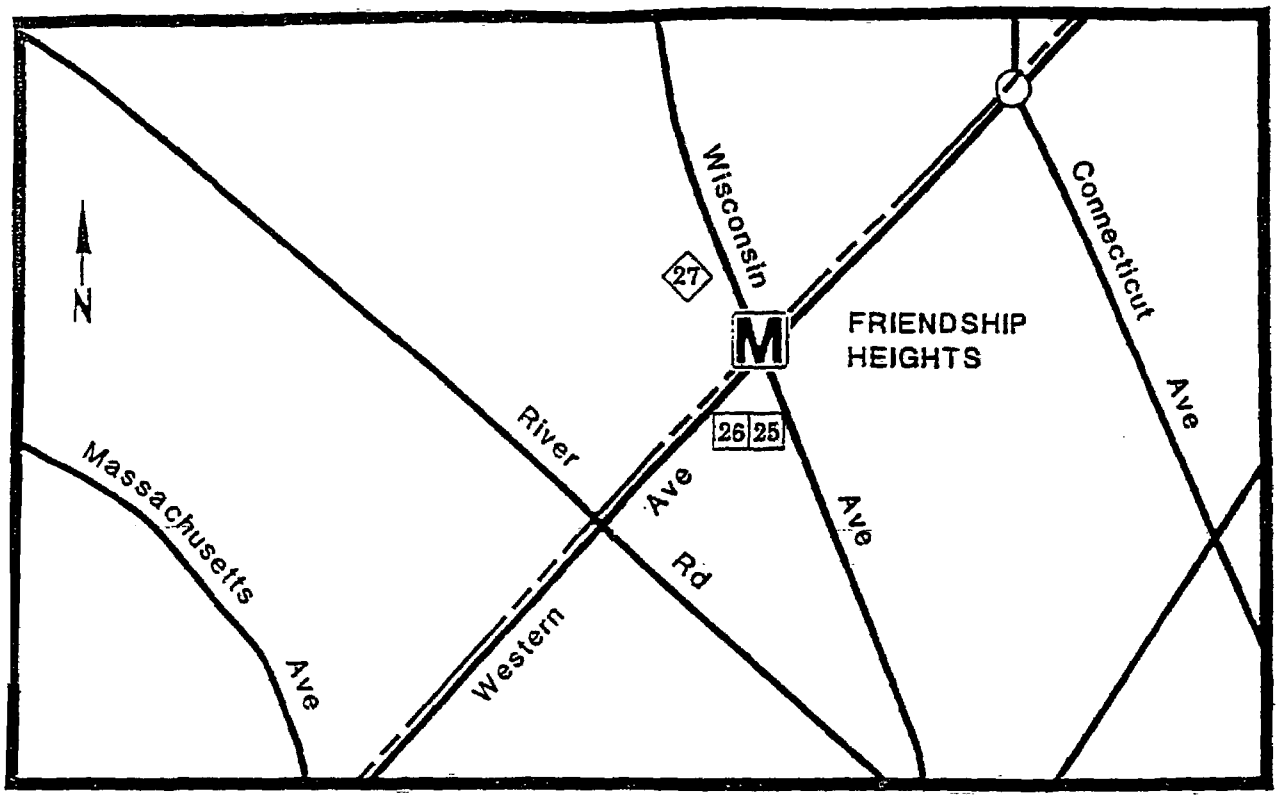


Figure 7. Friendship Heights

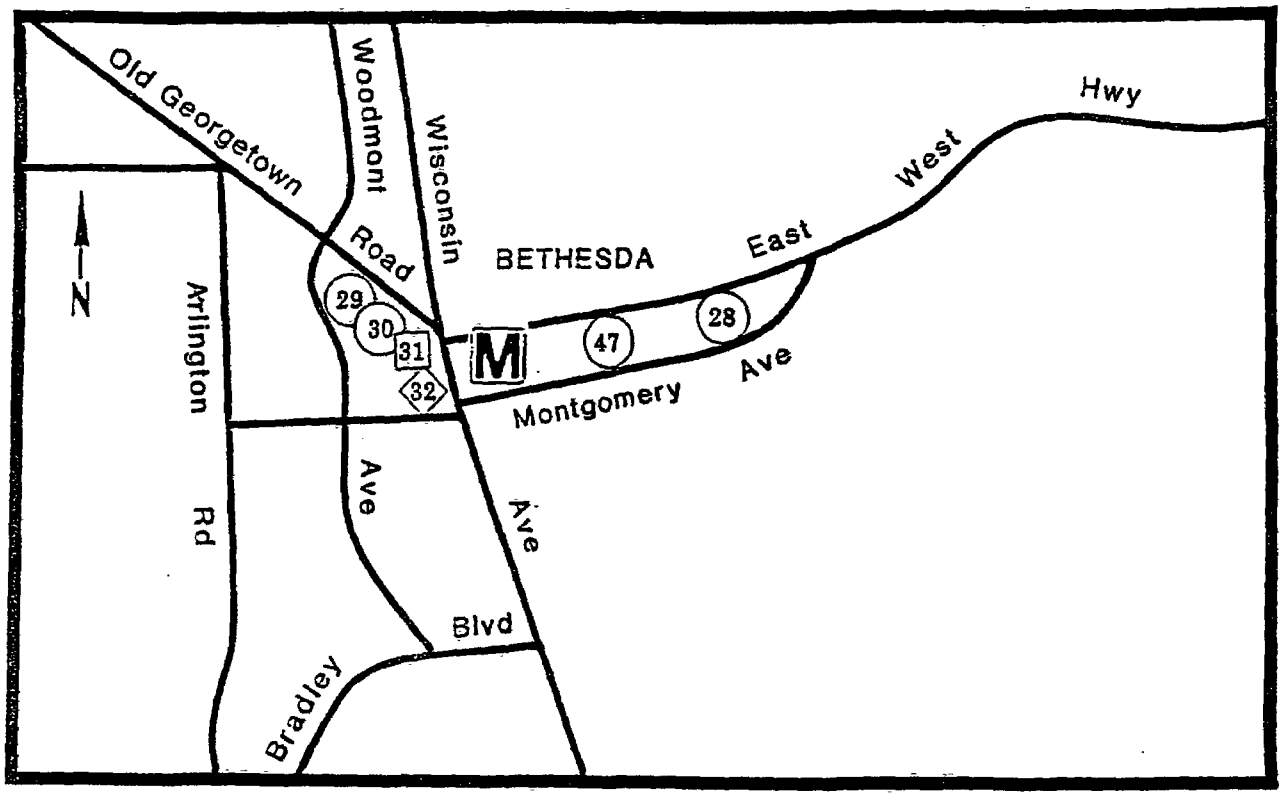


Figure 8. Bethesda

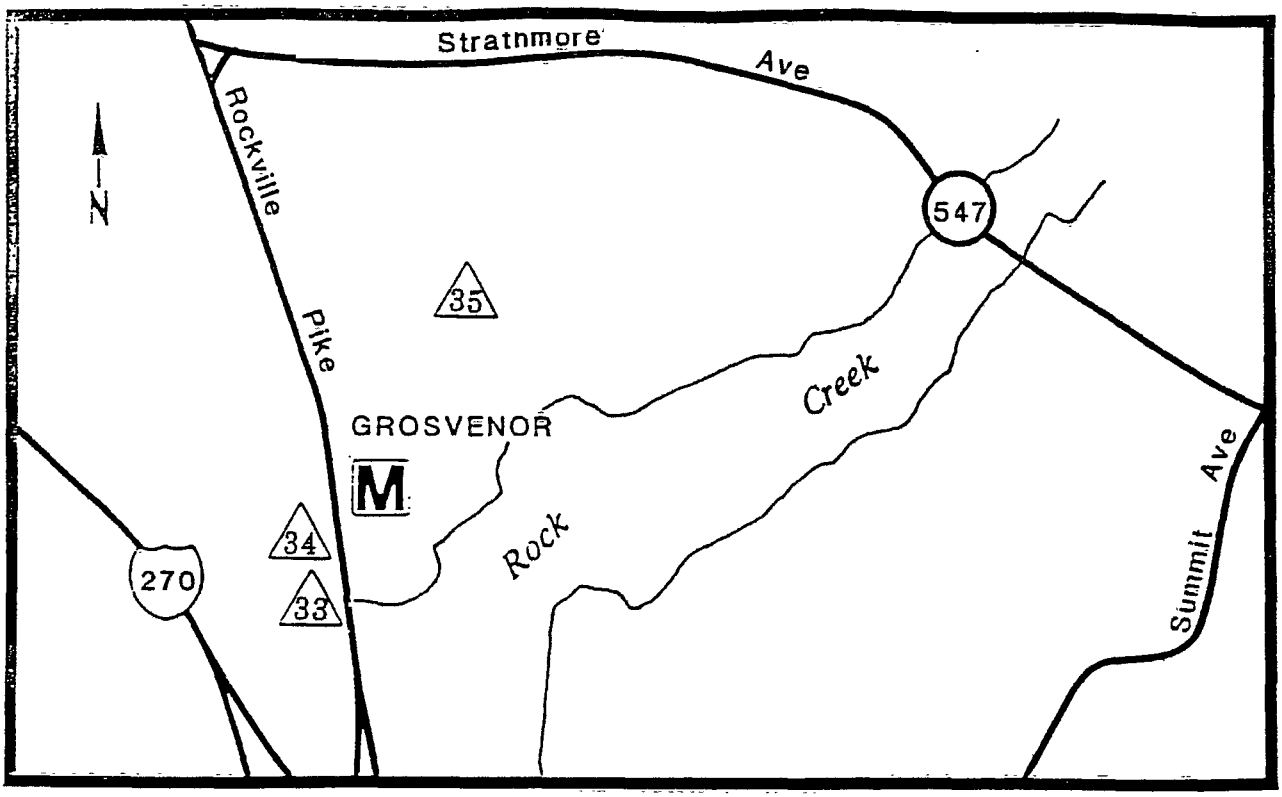


Figure 9. Grosvenor

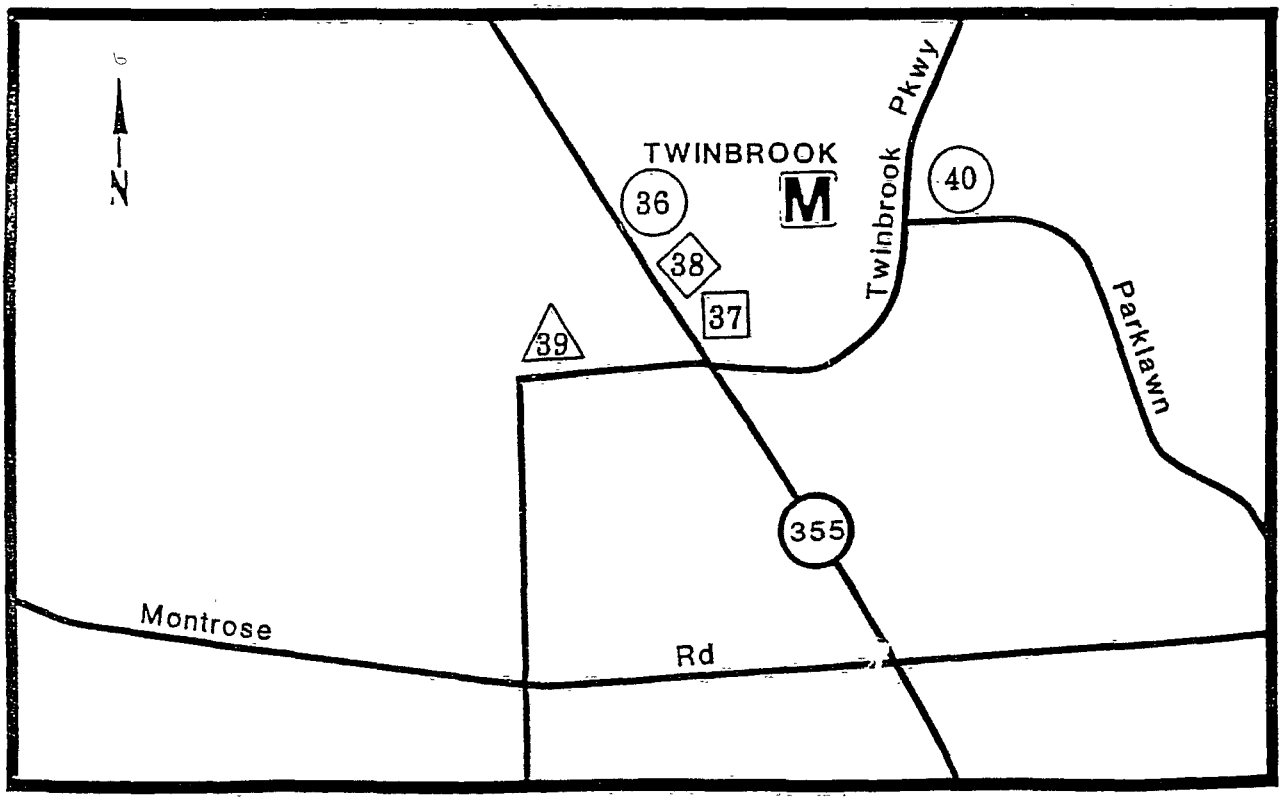


Figure 10. Twinbrook

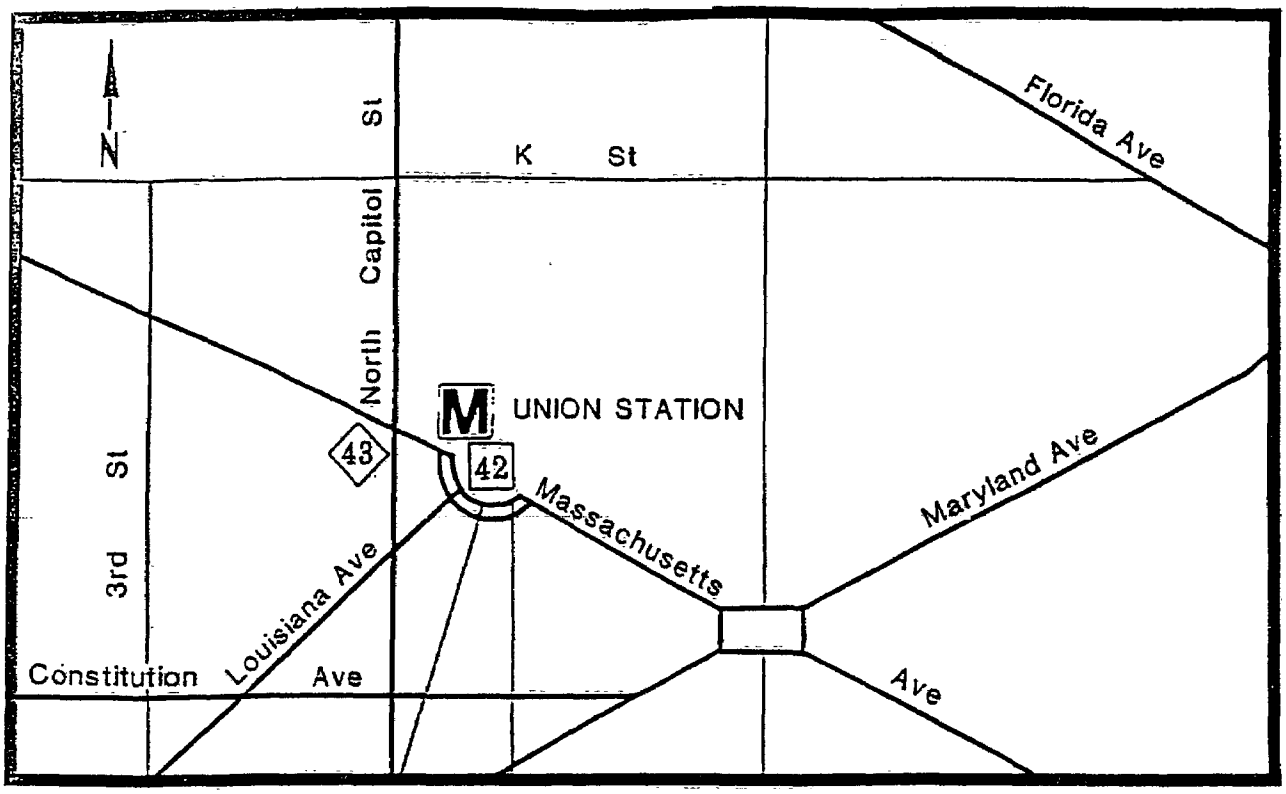


Figure 11. Union Station

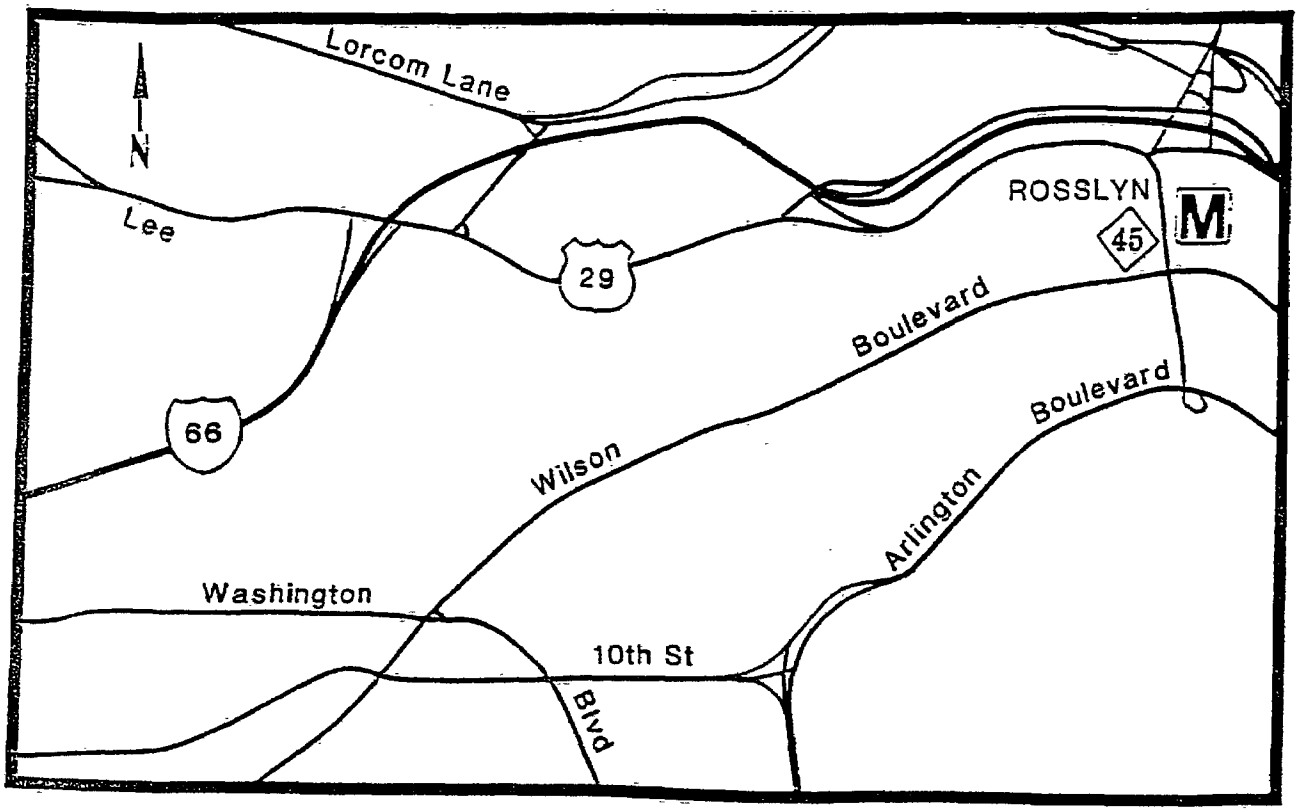


Figure 12. Rosslyn

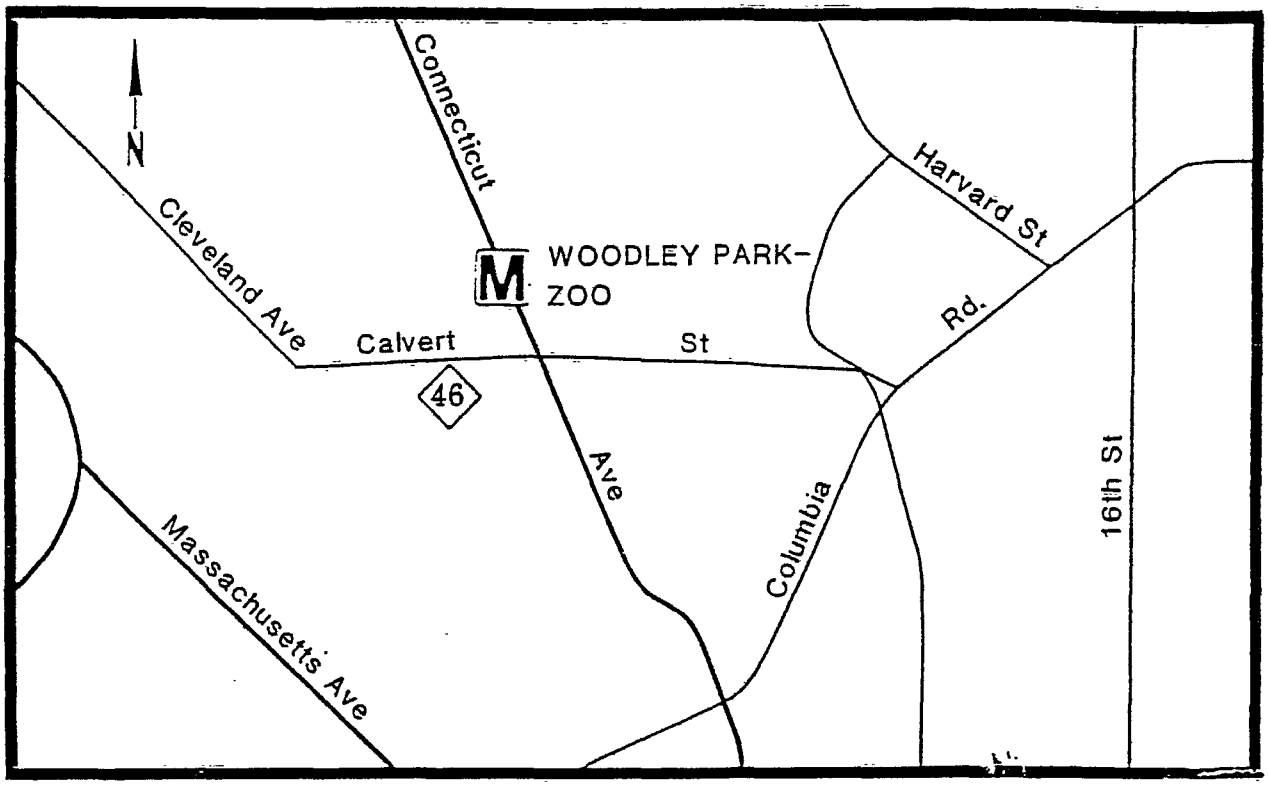


Figure 13. Woodley Park-Zoo

SURVEY PROCEDURES AND RESULTS

The survey procedures are described below for office, residential, retail, and hotel sites. A critical element of the study involved consistency with the first set of data in order that the testing and validity of the data could be accomplished without introducing any inconsistencies. The survey forms for this study were modified only slightly from those used in the 1987 study. The most significant additions in this survey were questions relating to linked trips (trips that have an indeterminate destination) and attitudes towards transit. Also, significantly more pedestrian counts were undertaken in this study with cordon counts completed at most sites.

OFFICE

Ten office buildings, varying from 100 to 2,000 feet in distance from the various Metrorail station entrances were selected for study. Table 2 provides the characteristics for each office building. At these offices, approximately 9,500 workplace surveys were distributed with slightly less than one third responding.

Data Collection

In order to determine the travel characteristics of office employees, a survey form was developed for distribution in the workplace. The objective of the survey was to determine the mode split and other travel characteristics of office employees. A sample workplace questionnaire is contained in the appendix. Demographic data were acquired first, followed by information on trips to and from the building, and then respondents' attitudes toward transit.

The questionnaires were delivered to individual employers by project staff. The staff personally visited each office to explain the survey procedure and distribute enough forms for each employee to respond. Also, a letter from WMATA explaining the purpose of the survey was left with the employer's contact person. A copy of the letter is contained in the appendix. In several cases, the building manager distributed a memo to inform tenants that the survey was to be conducted. After the surveys were distributed, the employees were asked to return them to the employer's contact person within two days. On approximately the third day the completed questionnaires were picked up by project staff. This procedure was altered at the Bell Atlantic and Parklawn buildings at the request of their management. At both buildings the survey

Table 2. Site Characteristics of Office Buildings

Metrorail Station	Office Building	Distance[1] to Station (ft.)	Gross Square Feet (1000)	Leasable Square Feet (1000)	Percent Occupied	Number of Employees	Number of Parking Spaces	Parking Cost per Month[2]	Year Constructed	Cost/sq ft
Farragut West	1701 Pennsylvania (6)[3]	700	175	175	85	680	175	$120	1963	3.87
Crystal City	Crystal Square 2 (7)	1000	490[4]	414	98	1550	550	$40-70	1980	3.75
Bethesda	East-West Towers, North Building (28)	2000	180	180	100	700	1600	$75	1978	3.89
	Bethesda Office Ctr. (47)	800	168	168	98	600	--	--	1980	3.57
	Bethesda Metro Ctr. (30)	100	378	377	99	1500	1400[5]	--	1985	3.98
Ballston	Ballston One (20)	2000	240	238	78	1000	450	$60	1986	4.20
Courthouse	Bell Atlantic (24)	1500	353	--	100	1300	690	--	1982	3.48
Twinbrook	Parklawn (40)	2000	1035[6]	--	--	6800	362 in Bldg 2650 outside	--	1969	
	Twinbrook Office Center (36)	800	165	--	75	700	--	--	1980	
Silver Spring	Silver Spring Metro Center (17)	200	150	--	60	300	26	(7)	1986	2.00

[1] Distance to station is defined as the walking distance from the surveyed building to the nearest Metrorail station portal.

[2] Monthly parking cost refers to cost at garage.

[3] Numbers in parentheses refer to location maps in Figures 2 to 13.

[4] Based on LSF = 0.85 x GSF.

[5] Total parking for project.

[6] Government offices only -- does not include retail.

[7] $30/2 pers; $25/30--4; free-5 or more.

was distributed through the internal mail systems. At the Bell Atlantic building a mail back survey was used and at Parklawn, surveys were deposited in containers provided in the lobbies.

The surveys were distributed on Tuesdays, Wednesdays and Thursdays to maximize the chances of receiving responses for the most typical travel days.

Data on visitors to office buildings was collected by intercepting persons as they entered the building. If persons were employees no questions were asked; if persons were visitors, they were asked questions concerning their trip. This approach, combined with the cordon counts, allowed not only the trip characteristics of visitors to be determined but also the establishment of a relationship between the number of employees entering and the number of visitors. The number of persons intercepted was recorded to allow the percent of visitors to be determined and then factored by the total count to determine the percent of visitors interviewed.

Analysis

The workplace survey form was designed to request information about the respondent, trips to and from the building, parking or transit costs, linked trips,[1] and the respondent's attitude towards transit. The completed survey forms were keypunched on microcomputer diskettes using a database program (dBase III Plus). The microcomputer version of the statistical package, SPSS, was then used to compute frequencies and/or means for each variable and crosstabs of selected variables. Many frequencies and crosstabs were created and are available as an appendix, contained in a separate volume.

The following summary tables were derived from the dBase III and SPSS outputs:

Work trip mode shares[2]

Work trip mode share by location of residence

Mode share by gender

Mode share by age

Mode share for non-walk, mid-day trips by destination

---

[1] Linked trips refer to trips with intermediate destinations.

[2] Mode share refers to the percent of persons using that particular mode of travel for the trip in question.

Mode share for non-walk, mid-day trips by purpose

Mode share for mid-day trips by destination

Mode share for mid-day trips by purpose

Mode share for visitors

It is important to understand the statistical limitations of the data prior to discussing the results. Because the surveys only represent a sample of all trips to and from a building, there is a degree of error associated with the results. Assuming a distribution of the data and knowing the sample size, estimates of this error can be made. Appendix A explains the statistical aspects in more detail and provides a table indicating the 95 percent confidence limits that can be placed on various values and sample size combinations. The smaller the sample, the wider the confidence. Particular caution is needed in interpreting cross-tabulated data as the number of responses for one variable may be very small. Sample size varies question by question since not all respondents answered every question.

Results

The first several questions on the survey form asked for information regarding the individual respondent. The tabulation of these questions reveals several factors that influence mode share although they are not the prime factors in determining ridership.

Table 3 summarizes mode share for trips to and from work by location of employee's residence. Examination of the residence locations indicate that at least a third of employees for an individual office come from outside the jurisdiction in which the office is located. Further study indicates that employees who cross jurisdictional lines are more likely to use transit than those who live and work within the same jurisdiction. This is illustrated in Figure 14 which shows the transit mode share at 11.4% within a jurisdiction and 23.6% when jurisdictional lines are crossed. As with the first study, the responses to this question imply that Metrorail accessibility opens up a substantial labor pool that might not otherwise be available.

Figure 15 shows the location of residence for Bell Atlantic employees, examination of these pie charts illustrates how employees are distributed throughout the metropolitan region. This widespread distribution of employees' residences throughout the metropolitan area is typical of most buildings surveyed.

Table 3. Mode by Location of Residence Trip to and from Work by Percents

Location	Mode	D.C.	Fairfax County	Arl.	Alex.	Va. Other	P.G. County	Montg. County	Md. Other	Other	Subtotal	Percent Auto	Percent Transit
1701 Penn	Auto	38.0%	61.3%	43.8%	23.5%	100.0%	60.9%	34.0%	60.0%	100.0%	44.6%		
	Transit	48.0	38.7	50.0	70.6	0.0	39.1	66.0	20.0	0.0	50.0		
	Other	14.0	0.0	6.3	5.9	0.0	0.0	0.0	20.0	0.0	5.4		
	Total	24.5	15.2	7.8	8.3	1.0	11.3	26.0	4.9	1.0	100.0	44.6%	50.0%
Silver Spring Metro Center	Auto	39.4	77.8	72.7	—	—	66.7	65.9	85.7	100.0	63.8		
	Transit	51.5	22.2	27.3	—	—	22.2	9.8	0.0	0.0	24.6		
	Other	9.1	0.0	0.0	—	—	11.1	24.4	14.3	0.0	11.5		
	Total	25.4	20.8	8.5	0.0	0.0	6.9	31.5	5.4	1.5	100.0	63.8	24.6
Ballston One	Auto	81.8	89.8	63.0	93.3	70.3	64.9	87.5	100.0	66.7	78.5		
	Transit	18.2	6.5	14.8	6.7	0.0	35.1	12.5	0.0	0.0	13.2		
	Other	0.0	3.7	22.2	0.0	29.7	0.0	0.0	0.0	33.3	8.3		
	Total	9.5	30.9	15.5	4.3	10.6	16.3	9.2	2.0	1.7	100.0	78.5	13.2
Bell Atlantic	Auto	66.7	83.1	78.9	94.7	82.9	92.3	93.2	100.0	100.0	85.2		
	Transit	26.7	14.8	11.3	5.3	4.9	7.7	6.8	0.0	0.0	11.4		
	Other	6.7	2.1	9.9	0.0	12.2	0.0	0.0	0.0	0.0	3.4		
	Total	5.4	43.4	12.7	3.4	7.3	11.6	10.5	5.2	0.5	100.0	85.2	11.4
East West Towers	Auto	66.7	100.0	—	—	—	100.0	77.8	100.0	—	83.3		
	Transit	0.0	0.0	—	—	—	0.0	22.2	0.0	—	13.3		
	Other	33.3	0.0	—	—	—	0.0	0.0	0.0	—	3.3		
	Total	10.0	6.7	0.0	0.0	0.0	10.0	60.0	13.3	0.0	100.0	83.3	13.3

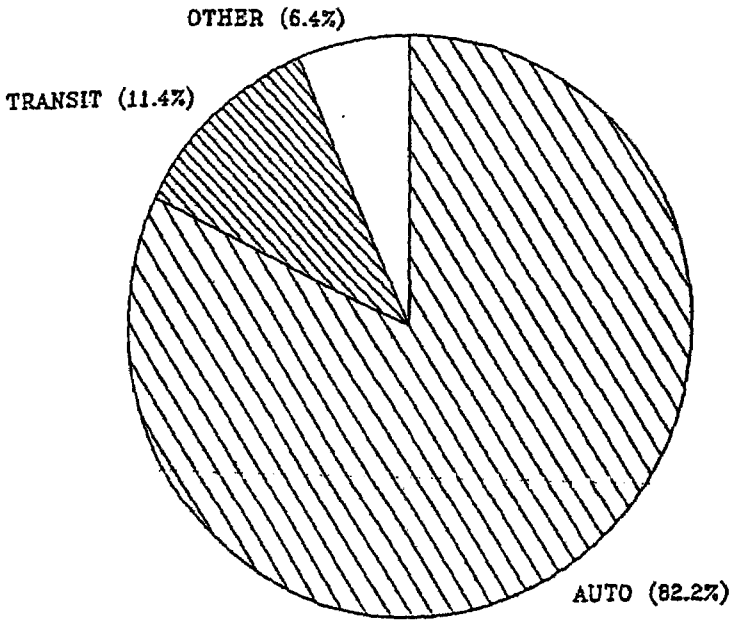
Table 3. Mode by Location of Residence Trip to and from Work by Percents (Continued)

Location	Mode	D.C.	Fairfax County	Arl.	Alex.	Va. Other	P.G. County	Montg. County	Md. Other	Other	Subtotal	Percent Auto	Percent Transit
Bethesda Metro Center	Auto	70.6	88.9	100.0	100.0	100.0	70.4	84.4	81.0	33.3	82.3		
	Transit	29.4	11.1	0.0	0.0	0.0	29.6	12.3	4.8	66.7	14.6		
	Other	0.0	0.0	0.0	0.0	0.0	0.0	3.2	14.3	0.0	3.1		
	Total	6.7	7.1	2.4	2.0	1.2	10.6	60.6	8.3	1.2	100.0	82.3	14.6
Twinbrook	Auto	40.0	100.0	88.9	100.0	100.0	95.7	90.8	100.0	50.0	90.1		
	Transit	60.0	0.0	0.0	0.0	0.0	4.3	9.2	0.0	50.0	9.3		
	Other	0.0	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5		
	Total	5.5	9.3	4.9	2.2	3.3	12.6	53.8	7.1	1.1	100.0	90.1	9.3
Parklawn	Auto	68.4	97.4	83.3	100.0	87.5	94.0	87.3	88.3	50.0	87.2		
	Transit	21.1	2.6	16.7	0.0	12.5	6.0	7.7	5.2	0.0	7.8		
	Other	10.5	0.0	0.0	0.0	0.0	0.0	4.9	6.5	50.0	4.9		
	Total	5.5	5.7	0.9	0.3	1.2	7.2	67.5	11.2	0.6	100.0	87.2	7.8
Crystal Square 2	Auto	100.0	73.4	37.5	77.3	94.6	94.1	68.2	88.2	—	75.8		
	Transit	0.0	21.5	37.5	13.6	0.0	5.9	31.8	11.8	—	17.8		
	Other	0.0	5.1	25.0	9.1	5.4	0.0	0.0	0.0	—	6.4		
	Total	0.5	36.1	11.0	10.0	16.9	7.8	10.0	7.8	0.0	100.0	75.8	17.8
Bethesda Office Center	Auto	56.3	100.0	66.7	50.0	—	87.5	79.7	77.8	—	79.3		
	Transit	43.8	0.0	33.3	50.0	—	12.5	12.2	0.0	—	14.3		
	Other	0.0	0.0	0.0	0.0	—	0.0	8.1	22.2	—	6.5		
	Total	7.4	8.3	2.8	1.8	0.0	7.4	68.2	4.1	0.0	100.0	79.3	14.3

Note: This table presents the mode share by jurisdiction for each office building and the distribution of employee residences by jurisdiction. For each jurisdiction, the percentage of trips by mode are indicated in the rows labeled "Auto," "transit," and "other." These three totaled vertically for each building equal 100%. For each office location, the row labeled "total" indicates the percentage of trips from each jurisdiction. Totaled horizontal this row equals 100%.

OFFICE COMMUTE BY JURISDICTION

TRIPS WITHIN JURISDICTION



OFFICE COMMUTE BY JURISDICTION

TRIPS BETWEEN JURISDICTIONS

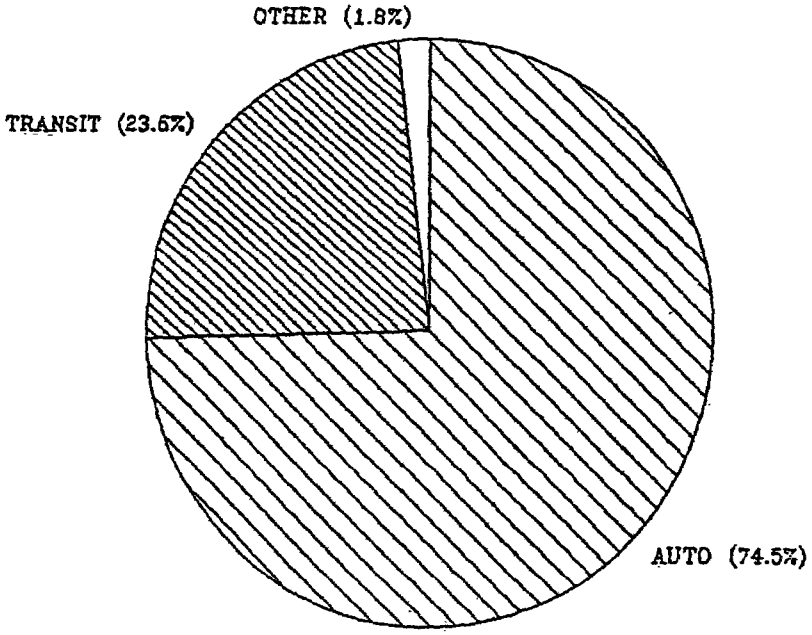


Figure 14.

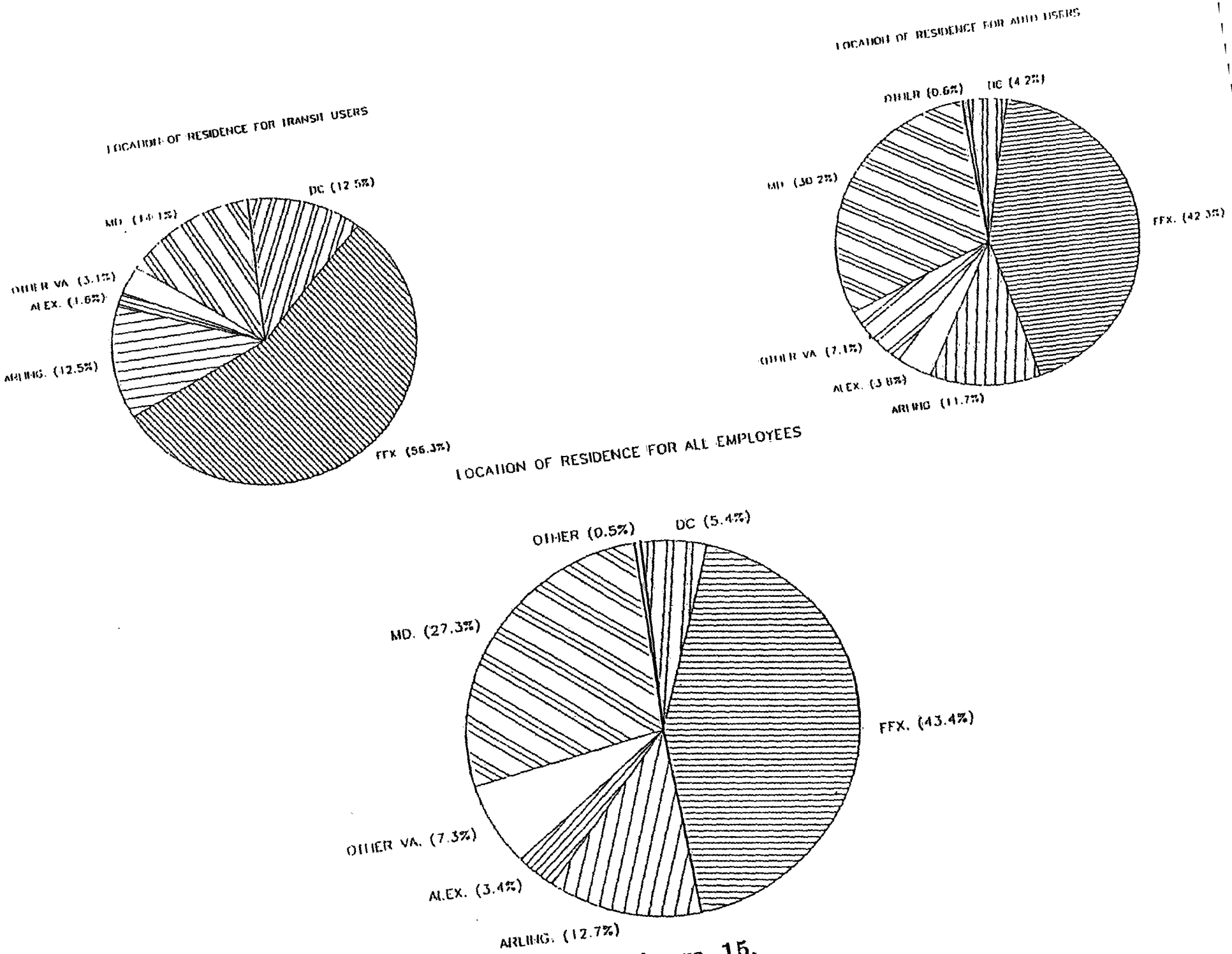

LOCATION OF RESIDENCE FOR TRANSIT USERS
DC (12.5%)
MD. (14.1%)
OTHER VA. (3.1%)
ALEX. (1.6%)
ARLING. (12.5%)
FFX. (56.3%)
LOCATION OF RESIDENCE FOR AUTO USERS
OTHER (0.6%)
DC (4.2%)
MD. (30.2%)
FFX. (42.3%)
OTHER VA. (7.1%)
ALEX. (3.8%)
ARLING. (11.7%)
LOCATION OF RESIDENCE FOR ALL EMPLOYEES
OTHER (0.5%)
DC (5.4%)
MD. (27.3%)
FFX. (43.4%)
OTHER VA. (7.3%)
ALEX. (3.4%)
ARLING. (12.7%)

Figure 15.

Based on the responses to question 4 the auto ownership per household is 2.05. This is above the regional average of 1.93. Auto availability by building and mode of travel is shown in Table 4. The results confirm that auto users generally have more cars available.

Figure 16 summarizes the responses by gender. The result indicates that there is almost no difference in mode share by gender. This is in contrast to some previous studies which have indicated that women are more likely to use transit than men (studies in other cities have indicated that this is changing). The response rate to the survey by females was higher compared to males with approximately 57% of all replies made by women. The results of this analysis indicates the higher response by females does not bias the overall findings of this survey.

Examining the mode share by age indicates that transit usage declines with age from 27% by people in their twenties to approximately 15% for people in their forties and fifties (Table 5). This is probably a reflection of several factors: older people generally hold positions that require a greater use of their auto during the day; they perhaps have more disposable income and can afford more cars per household; parking provided by employers tends to be by rank thus more people in the older age groups have parking provided; and people in older age brackets developed their commuting practices before Metrorail was in place and old habits die hard.

While this relationship will probably hold true for some time to come, it does indicate that WMATA should consider strategies to expand the 35 and up market. This could become increasingly important as the average age of the work force increases.

The impact of occupation on mode share appears to be insignificant with the exception of clerical jobs which report greater transit usage. However, it should be kept in mind that the data base for this study is limited to primarily white collar office buildings and occupations are classified based on respondents information.

Based on the responses, the peak hour for the AM is between 7:30 and 8:30 and the PM is between 4:30 and 5:30. Examination of the data also reveals that in most cases the number of people arriving in the peak hour is not significantly greater than the hour immediately before and after. Instead there is a peak period that lasts for about 2 1/2 hours. This is true for all buildings, perhaps indicating that employees are taking advantage of flexible work hours allowed by their employers to avoid the peak hours. Over 50% of respondents reported that their employers allowed flexible working hours.

The mode share (auto vs transit) for the commute trip to each office building is given in Table 6 and illustrated in Figure 17. The cordon count conducted at each

Table 4. Workplace Surveys

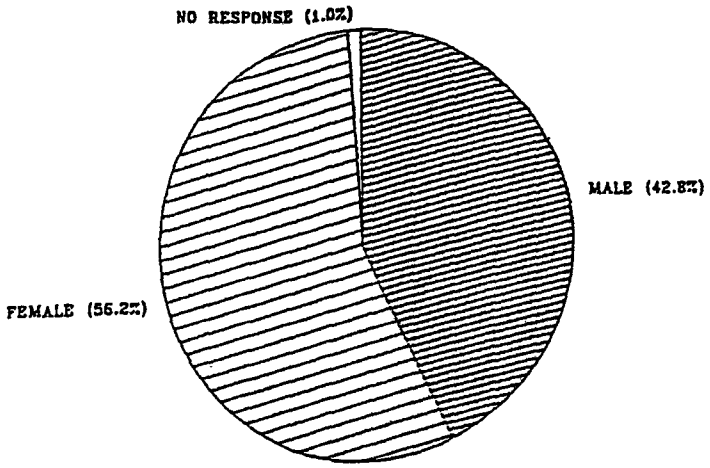
Number of Vehicles Available by Mode to Work

Average Number of Vehicles Per Household

Building	MODE				All Modes	Transit Mode Shares
	Auto	Transit	Walk	Other		
Olmstead Building	2.04	1.51	0.80	NA	1.67	50.0%
Silver Spring Metro Center	2.01	1.53	1.00	1.78	1.83	24.6
Ballston One	2.11	1.18	1.50	2.17	1.95	13.2
Bell Atlantic	2.21	1.82	1.00	2.00	2.13	11.4
East West Towers	1.90	2.00	1.00	NA	1.88	16.7
Bethesda Metro Center	2.20	1.71	3.00	1.67	2.14	14.6
Twinbrook	2.18	0.92	NA	1.00	2.09	9.3
Parklawn	2.23	1.45	1.79	1.67	2.14	7.8
Crystal Square II	2.35	2.03	1.00	1.50	2.21	17.8
Bethesda Office Center	2.11	1.10	2.63	0.00	1.95	14.3
Averages	2.18	1.54	1.61	1.70	2.05	17.6

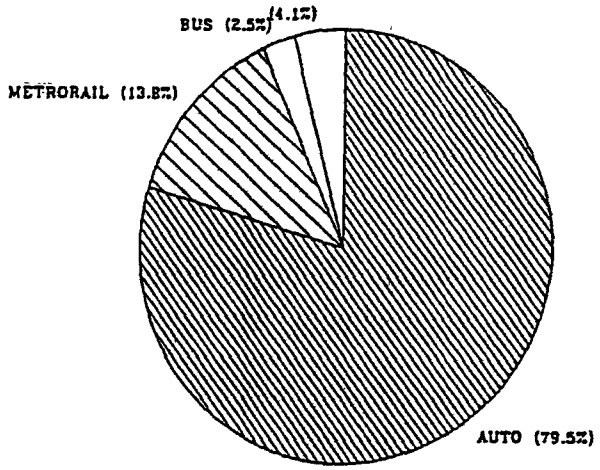
Note: This table shows the auto availability by building and by mode of travel. For example, at the Bell Atlantic building, the average number of vehicles per household among transit users is 1.82.

OFFICE BUILDINGS



MODE SPLIT FOR OFFICE BUILDINGS

MALE EMPLOYEES



MODE SPLIT FOR OFFICE BUILDINGS

FEMALE EMPLOYEES

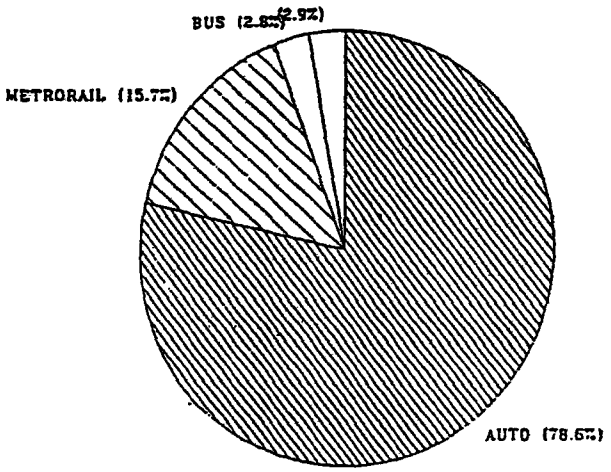


Figure 16.

Table 5. Workplace Surveys

Age By Mode By Office

Sites 1 - 10: All Surveyed Offices

	Auto	Transit	Walk	Other	Total
<18	5	3	0	0	8
19 - 24	158	65	5	2	230
25 - 34	498	134	20	7	659
35 - 44	563	91	12	11	677
45 - 54	404	84	9	4	501
55 - 64	158	25	4	3	190
>65	24	3	1	0	28
Missing Values	19	3	0	1	23
Totals	1829	408	51	28	2316

Note: "Missing Values" refer to people who answered the question but did not specify their mode of travel.

Table 6. Mode Share for Trips to and from Work

Location	Mode					Summary	
	Auto	Rail	Bus	Walk	Other	Subtotal	% Auto	% Transit
Olmstead Building	44.0%	43.5%	7.2%	3.9%	1.4%	100.0%	44.0%	50.7%
Silver Spring Metro Center	64.4	19.7	4.5	5.3	6.1	100.0	64.4	24.2
Ballston One	78.6	12.0	1.1	3.1	5.1	100.0	78.6	13.1
Bell Atlantic	85.1	11.0	0.5	1.9	1.4	100.0	85.1	11.5
East Wet Towers	83.3	13.3	3.3	0.0	0.0	100.0	83.3	16.7
Bethesda Metro Center	82.4	14.5	0.0	1.6	1.6	100.0	82.4	14.5
Twinbrook	90.3	7.6	1.1	0.5	0.5	100.0	90.3	8.6
Parklawn	87.4	4.7	3.0	3.4	1.4	100.0	87.4	7.8
Crystal Square II	75.8	16.4	1.4	2.7	3.7	100,0	75.8	17.8
Bethesda Office Center	79.5	10.0	4.1	5.0	1.4	100.0	79.5	14.2

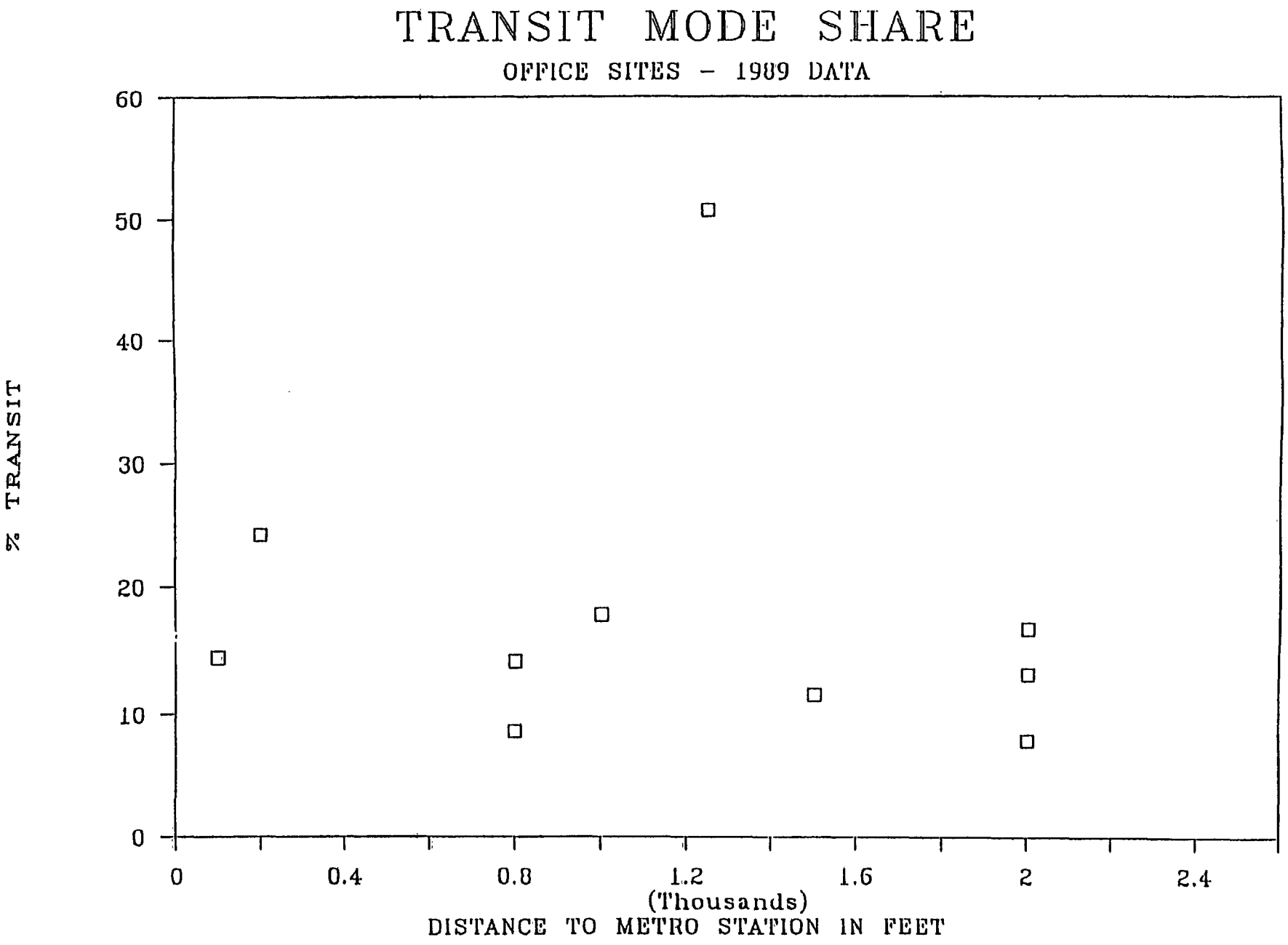

TRANSIT MODE SHARE
OFFICE SITES - 1989 DATA
% TRANSIT
60
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 17.

Table 7. Summary of Transit Mode Share - Office

	Number of Sites	Percent Transit Range	Percent Transit Average
CBD Locations	1	50.0%	50.0%
Suburban Locations Inside Beltway	7	11.4% - 24.6%	15.6%
Suburban Locations Outside Beltway	2	7.8% - 9.3%	8.5%
All Office Locations	10	7.8% - 50.0%	17.6%

Table 8. Workplace Surveys
Auto Availability

If you took transit, was a car available?

Building	Yes	No	Not Answered	Total	Percent Available
1701 Pennsylvania	62	17	4	83	74.7%
Silver Spring Metro Center	22	14	2	38	57.9
Ballston One	16	25	5	46	34.8
Bell Atlantic	53	18	3	74	71.6
East West Towers	2	4	1	7	28.5
Bethesda Metro Center	19	8	3	30	63.3
Twinbrook	7	7	0	14	50.0
Parklawn	28	25	3	56	50.0
Crystal Square II	20	11	0	31	64.5
Bethesda Office Center	17	10	2	29	58.6
TOTALS	246	139	23	408	60.3

Table 9. Average Travel Times

Auto Users	(Minutes)
Drive from home to office parking	31.6
Walk from office parking to office	3.2
Total trip time, home to office	36.2
Transit Users	
Trip from home to transit	9.6
Time on transit vehicle(s)	31.3
Trip from last transit vehicle to office	7.0
Total trip time, home to office	43.9

Table 10. Workplace Surveys
Respondents Opinions By Mode of Travel
(Continued)

Q12C: Metrorail is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	1543	(84.4%)	379	(92.9%)	51	(100.0%)	23	(82.1%)	1996	(86.2%)	30	(71.4%)	2026	(85.9%)
Disagree	58	(3.2)	9	(2.2)	0	(0.0)	1	(3.6)	68	(2.9)	3	(7.1)	71	(3.0)
No Opinion	202	(11.0)	6	(1.5)	0	(0.0)	1	(3.6)	209	(9.0)	6	(14.3)	215	(9.1)
Not Answered	26	(1.4)	14	(3.4)	0	(0.0)	3	(10.7)	43	(1.9)	3	(7.1)	46	(2.0)
Total	1829	(100.0)	408	(100.0)	51	(100.0)	28	(100.0)	2316	(100.0)	42	(100.0)	2358	(100.0)

Q12D: Metrobus is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	521	(28.5%)	142	(34.8%)	15	(29.4%)	3	(10.7%)	681	(29.4%)	10	(23.8%)	691	(29.3%)
Disagree	358	(19.6)	93	(22.8)	9	(17.6)	11	(39.3)	471	(20.3)	7	(16.7)	478	(20.3)
No Opinion	917	(50.1)	154	(37.7)	27	(52.9)	11	(39.3)	1109	(47.9)	22	(52.4)	1131	(48.0)
Not Answered	33	(1.8)	19	(4.7)	0	(0.0)	3	(10.7)	55	(2.4)	3	(7.1)	58	(2.5)
Total	1829	(100.0)	408	(100.0)	51	(100.0)	28	(100.0)	2316	(100.0)	42	(100.0)	2358	(100.0)

Note: Not answered refers to people who specified their mode of travel but do not answer the question. Missing values refer to people who answered the question but did not specify their mode of travel.

Table 11. Mode by Location of Residence Trip to and from Work by Percent

Location	Mode	D.C.	Fairfax County	Arl.	Alex.	Va. Other	P.G. County	Montg. County	Md. Other	Other	Subtotal	Percent Auto	Percent Transit
1701 Penn	Auto	38.0%	61.3%	43.8%	23.5%	100.0%	60.9%	34.0%	60.0%	100.0%	44.6%		
	Transit	48.0	38.7	50.0	70.6	0.0	39.1	66.0	20.0	0.0	50.0		
	Other	14.0	0.0	6.3	5.9	0.0	0.0	0.0	20.0	0.0	5.4		
	Total	24.5	15.2	7.8	8.3	1.0	11.3	26.0	4.9	1.0	100.0	44.6%	50.0%
Silver Spring Metro Center	Auto	39.4	77.8	72.7	—	—	66.7	65.9	85.7	100.0	63.8		
	Transit	51.5	22.2	27.3	—	—	22.2	9.8	0.0	0.0	24.6		
	Other	9.1	0.0	0.0	—	—	11.1	24.4	14.3	0.0	11.5		
	Total	25.4	20.8	8.5	0.0	0.0	6.9	31.5	5.4	1.5	100.0	63.8	24.6
Ballston One	Auto	81.8	89.8	63.0	93.3	70.3	64.9	87.5	100.0	66.7	78.5		
	Transit	18.2	6.5	14.8	6.7	0.0	35.1	12.5	0.0	0.0	13.2		
	Other	0.0	3.7	22.2	0.0	29.7	0.0	0.0	0.0	33.3	8.3		
	Total	9.5	30.9	15.5	4.3	10.6	16.3	9.2	2.0	1.7	100.0	78.5	13.2
Bell Atlantic	Auto	66.7	83.1	78.9	94.7	82.9	92.3	93.2	100.0	100.0	85.2		
	Transit	26.7	14.8	11.3	5.3	4.9	7.7	6.8	0.0	0.0	11.4		
	Other	6.7	2.1	9.9	0.0	12.2	0.0	0.0	0.0	0.0	3.4		
	Total	5.4	43.4	12.7	3.4	7.3	11.6	10.5	5.2	0.5	100.0	85.2	11.4
East West Towers	Auto	66.7	100.0	—	—	—	100.0	77.8	100.0	—	83.3		
	Transit	0.0	0.0	—	—	—	0.0	22.2	0.0	—	13.3		
	Other	33.3	0.0	—	—	—	0.0	0.0	0.0	—	3.3		
	Total	10.0	6.7	0.0	0.0	0.0	10.0	60.0	13.3	0.0	100.0	83.3	13.3

Note: This table presents the mode share by jurisdiction for each office building and the distribution of employee residences by jurisdiction. For each jurisdiction, the percentage of trips by mode are indicated in the rows labeled "Auto," "transit," and "other." These three totaled vertically for each building equal 100%. For each office location, the row labeled "total" indicates the percentage of trips from each jurisdiction. Totaled horizontal this row equals 100%.

Table 12. Mode Share for Midday Trips by Purpose

Location	Mode	Work Related	Personal Business	Meal/ Snack	Shopping	Educa-tional	Recrea-tional	Other	Total	Summary: Percent Auto	Summary: Percent Transit
1701	Auto	22.2%	0.0%	0.0%	0.0%	—%	33.3%	—%	8.6%		
Penn	Transit	11.1	20.0	0.0	25.0	—	33.3	—	14.3		
	Other	66.7	80.0	100.0	75.0	—	33.3	—	77.1		
	Total	25.7	28.6	25.7	11.4	0.0	8.6	0.0	100.0	8.6%	14.3%
Silver	Auto	45.5	33.3	44.4	100.0	—	—	—	44.4		
Spring	Transit	54.5	0.0	0.0	0.0	—	—	—	22.2		
Metro	Other	0.0	66.7	55.6	0.0	—	—	—	33.3		
Center	Total	40.7	22.2	33.3	3.7	0.0	0.0	0.0	100.0	44.4	22.2
Ballston	Auto	81.3	90.0	78.3	85.7	100.0	100.0	0.0	81.7		
One	Transit	12.5	10.0	0.0	0.0	0.0	0.0	0.0	5.0		
	Other	6.3	0.0	21.7	14.3	0.0	0.0	100.0	13.3		
	Total	26.7	16.7	38.3	11.7	1.7	3.3	1.7	100.0	81.7	5.0
Bell	Auto	73.1	78.3	64.4	83.3	50.0	40.0	83.3	71.9		
Atlantic	Transit	15.4	4.3	5.1	3.3	33.3	0.0	0.0	6.7		
	Other	11.5	17.4	30.5	13.3	16.7	60.0	16.7	21.3		
	Total	14.6	25.8	33.1	16.9	3.4	2.8	3.4	100.0	71.9	6.7
East	Auto	25.0	0.0	—	—	—	—	—	20.0		
West	Transit	50.0	100.0	—	—	—	—	—	60.0		
Towers	Other	25.0	0.0	—	—	—	—	—	20.0		
	Total	80.0	20.0	0.0	0.0	0.0	0.0	0.0	100.0	20.0	60.0

Note: For each purpose, the percentage of trips by mode are indicated in the rows labeled "auto", "transit", and "other". These vertically total to 100% for each purpose. For each office location the row labeled "total" indicates the percentages of trips by purpose. This row totals horizontally to 100%.

The results for this study were very similar to the first study. Approximately two thirds of the mid-day trips were made for job-related business or for a meal or snack. Job-related business accounted for approximately one third of the total mid-day trips. The actual percentages varied considerably. The Parklawn Building was at the low end with 12.5% reporting a mid-day trip, while East-West Towers was at the high end with 80% of respondents reporting a mid-day trip.

In contrast to the first study, office buildings were located in areas with varying density. For the meal or snack category, transit ridership was low. Transit ridership ranged from 0 to 6.7% and the percentage for auto usage ranged from 0 to 85%, with the higher auto use at the Parklawn Building (see Table 12). Transit mode share for non-walk mid-day trips by purpose is shown in Table 13.

The job-related business trip percentage increases when walk trips are removed from the data base while the percent of meal snack decreases significantly. One implication is that work related business is the least likely to be by transit. It should be noted that the sample sizes for the non-walk mid-day trips become very small in some cases and may not be representative of what actually happens.

Table 14 contains information on the percent of mid-day trips to each destination by office building and the mode share for each destination. Table 15 was prepared utilizing only non-walk mid-day trips. Eliminating these walk trips essentially removed the short localized trips. For example, a large percentage of the trips from 1701 Pennsylvania Avenue were walk trips. Removing the walk trips dramatically increased the percentage of trips to Virginia or Maryland. Generally trips from the offices outside the CBD to other offices in Maryland or Virginia exhibit a very low transit mode share. However, trips to or from the District of Columbia, where Metrorail access is the greatest, are expected to exhibit a larger transit ridership percentage. It is interesting to note that Silver Spring Metro Center and Crystal Square 2 both have a significant transit mode share. The implication is that a high percentage of mid-day office to office trips will take place on Metrorail as long as rail access is good at both ends. Locating office buildings at suburban stations should have the effect of increasing mid-day transit ridership through job-related interchange between that location and other Metrorail stations. An indirect effect of making mid-day job-related trips accessible by transit is the greater possibility of suburban employees commuting to their offices by transit, since their car would be needed less frequently for mid-day travel.

Table 13. Mode Share for Midday Trips by Purpose
Only Non-Walk Trips Included
(Continued)

Mode	Work Related	Personal Business	Meal/ Snack	Shopping	Educa-tional	Recrea-tional	Other	Total	Summary Percent Auto	Summary Percent Transit
Auto	79.3	89.5	100.0	100.0	—	100.0	—	87.7		
Transit	20.7	10.5	0.0	0.0	—	0.0	—	12.3		
Other	0.0	0.0	0.0	0.0	—	0.0	—	0.0		
Total	44.6	29.2	12.3	12.3	0.0	1.5	0.0	100.0	87.7	12.3
Auto	92.9	92.9	100.0	100.0	100.0	—	100.0	95.7		
Transit	7.1	7.1	0.0	0.0	0.0	—	0.0	4.3		
Other	0.0	0.0	0.0	0.0	0.0	—	0.0	0.0		
Total	29.8	29.8	21.3	12.8	4.3	0.0	2.1	100.0	95.7	4.3
Auto	64.3	95.7	100.0	100.0	100.0	100.0	100.0	93.9		
Transit	35.7	4.3	0.0	0.0	0.0	0.0	0.0	6.1		
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total	13.1	32.9	31.9	16.4	1.4	1.4	2.8	100.0	93.9	6.1
Auto	66.7	84.2	85.7	—	0.0	—	100.0	74.2		
Transit	33.3	15.8	14.3	—	100.0	—	0.0	25.8		
Other	0.0	0.0	0.0	—	0.0	—	0.0	0.0		
Total	53.2	30.6	11.3	0.0	1.6	0.0	3.2	100.0	74.2	25.8
Auto	93.3	80.0	100.0	80.0	—	50.0	—	85.3		
Transit	6.7	20.0	0.0	20.0	—	50.0	—	14.7		
Other	0.0	0.0	0.0	0.0	—	0.0	—	0.0		
Total	44.1	29.4	5.9	14.7	0.0	5.9	0.0	100.0	85.3	14.7

r each purpose, the percentage of trips by mode are indicated in the rows labeled "auto", "transit", and "other". These vertically
00% for each purpose. For each office location the row labeled "total" indicates the percentages of trips by purpose. This row
izontally to 100%.

Table 14. Mode Share for Midday Trips by Destination

Location	Mode	Within 1/2 mi	D.C.	Ffx. County	Arl.	Alex.	Va Other	P.G. County	Mont. County	Md Other	Other	Subtotal	Summary Percent Auto	Summary Percent Transit
1701	Auto	0.0%	0.0%	—%	0.0%	0.0%	—%	—%	—%	—%	—%	0.0		
Penn	Transit	0.0	46.7	—	100.0	0.0	—	—	—	—	—	22.9		
	Other	100.0	53.3	—	0.0	100.0	—	—	—	—	—	77.1		
	Total	51.4	42.9	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	22.9
Silver	Auto	0.0	42.9	—	—	—	—	—	52.9	—	—	44.4		
Spring	Transit	0.0	57.1	—	—	—	—	—	11.8	—	—	22.2		
Metro	Other	100.0	0.0	—	—	—	—	—	35.3	—	—	33.3		
Center	Total	11.1	25.9	0.0	0.0	0.0	0.0	0.0	63.0	0.0	0.0	100.0	44.4	22.2
Ballston	Auto	25.0	80.0	90.9	84.6	100.0	100.0	—	100.0	100.0	100.0	80.0		
One	Transit	0.0	20.0	9.1	7.7	0.0	0.0	—	0.0	0.0	0.0	6.7		
	Other	75.0	0.0	0.0	7.7	0.0	0.0	—	0.0	0.0	0.0	13.3		
	Total	13.3	8.3	18.3	43.3	5.0	5.0	0.0	3.3	1.7	1.7	100.0	80.0	6.7
Bell	Auto	18.2	61.9	100.0	75.0	100.0	—	100.0	100.0	—	100.0	72.4		
Atlantic	Transit	0.0	33.3	0.0	5.7	0.0	—	0.0	0.0	—	0.0	6.9		
	Other	81.8	4.8	0.0	19.3	0.0	—	0.0	0.0	—	0.0	20.7		
	Total	12.6	12.1	14.4	50.6	5.2	0.0	1.1	3.4	0.0	0.6	100.0	72.4	6.9
East	Auto	0.0	—	—	—	—	—	—	33.3	—	—	20.0		
West	Transit	0.0	—	—	—	—	—	—	33.3	—	—	60.0		
Towers	Other	0.0	—	—	—	—	—	—	33.3	—	—	20.0		
	Total	40.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	100.0	20.0	60.0

Table 14. Mode Share for Midday Trips by Destination
(Continued)

Location	Mode	Within 1/2 mi	D.C.	Fix. County	Arl.	Alex.	Va Other	P.G. County	Mont. County	Md Other	Other	Subtotal	Summary Percent Auto	Summary Percent Transit
Bethesda	Auto	38.5	44.4	100.0	50.0	—	—	100.0	77.5	100.0	100.0	70.1		
Metro	Transit	0.0	55.6	0.0	50.0	—	—	0.0	5.0	0.0	0.0	10.4		
Center	Other	61.5	0.0	0.0	0.0	—	—	0.0	17.5	0.0	0.0	19.5		
	Total	16.9	11.7	6.5	2.6	0.0	0.0	3.9	51.9	5.2	1.3	100.0	70.1	10.4
Twinbrook	Auto	72.7	100.0	—	—	100.0	—	100.0	78.1	100.0	100.0	81.8		
	Transit	0.0	0.0	—	—	0.0	—	0.0	6.3	0.0	0.0	3.6		
	Other	27.3	0.0	—	—	0.0	—	0.0	15.6	0.0	0.0	14.5		
	Total	20.0	9.1	0.0	0.0	3.6	0.0	3.6	58.2	3.6	1.8	100.0	81.8	3.6
Parklawn	Auto	61.5	50.0	100.0	100.0	—	—	100.0	91.8	100.0	—	86.0		
	Transit	0.0	50.0	0.0	0.0	—	—	0.0	3.3	0.0	—	5.7		
	Other	38.5	0.0	0.0	0.0	—	—	0.0	4.9	0.0	—	8.3		
	Total	11.4	6.1	0.4	0.4	0.0	0.0	0.9	79.5	1.3	0.0	100.0	86.0	5.7
Crystal	Auto	0.0	35.7	93.3	71.4	100.0	100.0	100.0	—	100.0	100.0	63.9		
Square 2	Transit	20.0	64.3	6.7	19.0	0.0	0.0	0.0	—	0.0	0.0	22.2		
	Other	80.0	0.0	0.0	9.5	0.0	0.0	0.0	—	0.0	0.0	13.9		
	Total	13.9	19.4	20.8	29.2	2.8	2.8	5.6	0.0	4.2	1.4	100.0	63.9	22.2
Bethesda	Auto	9.1	50.0	100.0	—	—	100.0	100.0	65.5	100.0	—	54.7		
Office	Transit	0.0	50.0	0.0	—	—	0.0	0.0	3.4	0.0	—	9.4		
Center	Other	90.9	0.0	0.0	—	—	0.0	0.0	31.0	0.0	—	35.8		
	Total	20.8	15.1	1.9	0.0	0.0	3.8	1.9	54.7	1.9	0.0	100.0	54.7	9.4

Note: For each destination, the percentage of trips of trips by mode are indicated in the rows labeled "auto", "transit", and "other". These total vertically to 100%. For office location, the row labeled "total" indicates the percentage of trips made to each destination. This row totals horizontally t 100%.

Table 15. Mode Share for Midday Trips by Destination
Only Non-Walk Trips Included

Location	Mode	Within 1/2 mi	D.C.	Ffx. County	Arl.	Alex.	Va Other	P.G. County	Mont. County	Md Other	Other	Subtotal	Summary Percent Auto	Summary Percent Transit
1701	Auto	—%	0.0%	—%	0.0%	0.0%	—%	—%	—%	—%	—%	0.0%		
Penn	Transit	—	77.8	—	100.0	0.0	—	—	—	—	—	72.7		
	Other	—	22.2	—	0.0	100.0	—	—	—	—	—	27.3		
	Total	0.0	81.8	0.0	9.1	9.1	0.0	0.0	0.0	0.0	0.0	100.0	0.0	72.7
Silver	Auto	—	42.9	—	—	—	—	—	81.8	—	—	66.7		
Spring	Transit	—	57.1	—	—	—	—	—	18.2	—	—	33.3		
Metro	Other	—	0.0	—	—	—	—	—	0.0	—	—	0.0		
Center	Total	0.0	38.9	0.0	0.0	0.0	0.0	0.0	61.1	0.0	0.0	100.0	66.7	33.3
Ballston	Auto	100.0	80.0	90.9	91.7	100.0	100.0	—	100.0	100.0	100.0	92.3		
One	Transit	0.0	20.0	9.1	8.3	0.0	0.0	—	0.0	0.0	0.0	7.7		
	Other	0.0	0.0	0.0	0.0	0.0	0.0	—	0.0	0.0	0.0	0.0		
	Total	3.8	9.6	21.2	46.2	5.8	5.8	0.0	3.8	1.9	1.9	100.0	92.3	7.7
Bell	Auto	100.0	61.9	100.0	93.0	100.0	—	100.0	100.0	—	100.0	90.6		
Atlantic	Transit	0.0	33.3	0.0	7.0	0.0	—	0.0	0.0	—	0.0	8.6		
	Other	0.0	4.8	0.0	0.0	0.0	—	0.0	0.0	—	0.0	0.7		
	Total	2.9	15.1	18.0	51.1	6.5	0.0	1.4	4.3	0.0	0.7	100.0	90.6	8.6
East	Auto	0.0	—	—	—	—	—	—	50.0	—	—	25.0		
West	Transit	100.0	—	—	—	—	—	—	50.0	—	—	75.0		
Towers	Other	0.0	—	—	—	—	—	—	0.0	—	—	0.0		
	Total	50.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	100.0	25.0	75.0

Table 15. Mode Share for Midday Trips by Destination
Only Non-Walk Trips Included
(Continued)

Location	Mode	Within 1/2 mi	D.C.	Ffx. County	Arl.	Alex.	Va Other	P.G. County	Mont. County	Md Other	Other	Subtotal	Summary: Percent Auto	Summary: Percent Transit
Bethesda	Auto	100.0	44.4	100.0	50.0	—	—	100.0	93.9	100.0	100.0	87.1		
Metro	Transit	0.0	55.6	0.0	50.0	—	—	0.0	6.1	0.0	0.0	12.9		
Center	Other	0.0	0.0	0.0	0.0	—	—	0.0	0.0	0.0	0.0	0.0		
	Total	8.1	14.5	8.1	3.2	0.0	0.0	4.8	53.2	6.5	1.6	100.0	87.1	12.9
Twinbrook	Auto	100.0	100.0	—	—	100.0	—	100.0	92.6	100.0	100.0	95.7		
	Transit	0.0	0.0	—	—	0.0	—	0.0	7.4	0.0	0.0	4.3		
	Other	0.0	0.0	—	—	0.0	—	0.0	0.0	0.0	0.0	0.0		
	Total	17.0	10.6	0.0	0.0	4.3	0.0	4.3	57.4	4.3	2.1	100.0	95.7	4.3
Parklawn	Auto	100.0	50.0	100.0	100.0	—	—	100.0	96.5	100.0	—	93.8		
	Transit	0.0	50.0	0.0	0.0	—	—	0.0	3.5	0.0	—	6.2		
	Other	0.0	0.0	0.0	0.0	—	—	0.0	0.0	0.0	—	0.0		
	Total	7.6	6.7	0.5	0.5	0.0	0.0	1.0	82.4	1.4	0.0	100.0	93.8	6.2
Crystal	Auto	0.0	35.7	93.3	78.9	100.0	100.0	100.0	—	100.0	100.0	74.2		
Square 2	Transit	100.0	64.3	6.7	21.1	0.0	0.0	0.0	—	0.0	0.0	25.8		
	Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—	0.0	0.0	0.0		
	Total	3.2	22.6	24.2	30.6	3.2	3.2	6.5	0.0	4.8	1.6	100.0	74.2	25.8
Bethesda	Auto	100.0	50.0	100.0	—	—	100.0	100.0	95.0	100.0	—	85.3		
Office	Transit	0.0	50.0	0.0	—	—	0.0	0.0	5.0	0.0	—	14.7		
Center	Other	0.0	0.0	0.0	—	—	0.0	0.0	0.0	0.0	—	0.0		
	Total	2.9	23.5	2.9	0.0	0.0	5.9	2.9	58.8	2.9	0.0	100.0	85.3	14.7

Note: For each destination, the percentage of trips of trips by mode are indicated in the rows labeled "auto", "transit", and "other". These total vertically to 100%. For office location, the row labeled "total" indicates the percentage of trips made to each destination. This row totals horizontally 100%.

Office Visitors

Office visitors were interviewed rather than given a self administered survey. This resulted in a higher response rate than was achieved in the first study. When conducting the interviews each person approached was asked if they were a visitor or an employee. If they were an employee, no further questions were asked; if they were a visitor the questions concerning their trip were asked. The number of each (employee or visitor) approached was recorded by time period. This allowed the percent of visitors to be determined at each office by time of day. For the most part visitors accounted for about 10% to 15% of all persons entering an office. The mode share for visitors is shown in Table 16. No relationship to distance from the station could be determined. Most buildings averaged about a 10% transit mode share. This agrees with the findings of the office surveys in relation to the mid-day trip information.

RESIDENTIAL

Ten residential sites were chosen for study. Data was collected via a self-administered mail-back survey forms and by conducting cordon counts at each site for selected hours during the day. The primary objective was to determine the trip making characteristics for residential developments in close proximity of a Metrorail station. A variety of housing types were chosen that included both rental accommodations and owner occupied units. Site characteristics of each building are contained in Table 17. The average response rate for the home-based surveys was 12.6%.

Data Collection

The primary objective of the home-based survey was to obtain information on the trip making characteristics of residents. A sample home-based survey is contained in the appendix. The primary changes to the survey as compared to the first study were an attempt to gather information concerning linked trips and the addition of questions to determine residents' attitude towards transit. Mail-back surveys were mailed to each unit of a building on a Monday or Tuesday in an attempt to have residents receive the survey on a Tuesday, Wednesday, or Thursday.

In addition to the surveys, cordon counts were conducted at all ten sites and in most cases occupancy counts were conducted for vehicles leaving the buildings during the peak periods.

Table 16. Mode Share of Office Visitors

Office Site	Mode						Summary	
	Auto	Rail	Bus	Walk	Taxi	Other	Subtotal	% Auto	% Transit
1701 Penn	61.0%	11.0%	0.0%	19.5%	0.0%	8.5%	100.0%	61.0%	11.0%
Silver Spring Metro Center	79.3	13.8	0.0	6.9	0.0	0.0	100.0	79.3	13.8
Ballston One	61.2	5.0	0.0	24.0	0.0	9.9	100.0	61.2	5.0
Bell Atlantic	52.8	10.4	0.0	29.6	4.8	2.4	100.0	52.8	10.4
East West Towers	83.8	10.3	0.0	5.9	0.0	0.0	100.0	83.8	10.3
Bethesda Metro Center	34.0	33.3	4.1	27.9	0.0	0.7	100.0	34.0	37.4
Twinbrook	84.6	7.7	0.0	7.7	0.0	0.0	100.0	84.6	7.7
Parklawn	75.5	9.1	2.1	11.2	1.4	0.7	100.0	75.5	11.2
Crystal Square II	11.1	8.9	1.6	78.4	0.0	0.0	100.0	11.1	10.5
Bethesda Office Center	80.0	6.3	0.0	13.8	0.0	0.0	100.0	80.0	6.3

Table 17. Site Characteristics of Residential Developments

	Residential	Distance to Station (ft)	No. Units	Effi-ciencies	One Bdrm.	Two Bdrm.	Three Bdrm.	Percent Occupied	Number Parking Spaces	Parking Cost per Month	Year Constructed
Crystal City	Crystal Square Apts. (12)[1]	500	378	58	247	58	15	99	(2)	1 space included in rent, additional space $45	1976
	Crystal Plaza Apts. (13)	1500	540	94	184	214	48	100	570[3]	1 space included in rent, additional space $45	1966
	Crystal Park Condos (14)	2000	180	--	--	--	--	--	--	--	--
Silver Spring	Twin Towers (16)	900	315	--	--	--	--	99	320[4]	$50	1965
	Georgian Towers (15)	1400	858	--	--	--	--	99	550	$55 reserved $40 unreserved	1969
Ballston	Randolph Towers (23)	500	507	--	--	--	--	--	--	--	--
Twinbrook	Bethany House (39)	2400	276	--	--	--	--	100	69	$12	1968
Grosvenor	Grosvenor House Apts. (33)	2300	404	--	--	--	--	--	--	--	--
	Grosvenor Park I (34)	1850	399	--	--	--	--	--	--	--	--
	Stoneybrook (35)	2000	109	--	--	--	--	--	--	N/A	--

[1] Numbers in parentheses refer to location maps in Figures 2 to 13.

[2] Shared parking with entire Crystal Square complex, tenants are guaranteed one space/dwelling unit, no waiting list at present time.

[3] Approximately 218 spaces rented out to area workers on a monthly basis, these employees must be out of garage by 5:30-6:00 PM.

[4] Includes parking for 50 hotel rooms.

Analysis

Residential surveys were designed to obtain socioeconomic, demographic, and trip making characteristics. As with previous studies the response rate was not as good as with the workplace surveys, therefore caution must be exercised when interpreting the data at buildings with a small sample size. The data structure is included in the appendix. Crosstabs are also included in the appendix.

Similar to the office surveys, summary tables were produced based on the analysis. Mid-day trip information was found to be unreliable as a significant number of respondents reported on all trips they made during the day rather than just trips that began or ended at their building.

Results

Table 18 summarizes the socioeconomic and demographic data collected for each site. As with the office surveys more respondents were female and they tended to be older. Based on observation during site selection and while conducting the counts, it is felt that the average age as determined by the survey tends to be high although we are unable to verify this. Based on the cordon counts it appears that there is an under reporting of commute trips. This could be partially explained by the number of older retired respondents. Examining the counts (contained in the technical appendix) it appears that the transit mode share may be slightly higher than determined by the survey. The data suggests that the typical resident falls into three categories: single person households, couples without children and older people. Families tend to live in areas further away from the Metro station in lower density neighborhoods. The implication is that while families tend to generate more trips per household, the likelihood of this group increasing their transit usage cannot be influenced to a great degree by the nature of the development in the area of Metrorail stations. Increasing transit patronage by this segment of the population is influenced by access to the Metrorail station either by car or by feeder bus.

Table 19 presents mode share of each building by destination for the commute trips and a summary is presented in Table 20. Transit mode share ranges from 30.2% at Grosvenor Park I to 73.7% at Twin Towers with an overall average 46.2% Bethany House was excluded from the data base due to the small sample size. The trip generation from Bethany House was low as would be expected at a retirement home.

Table 18. Demographic Data for Residential Developments

Location	Mean Age	Mean Number of Vehicles per DU	Mean Number of Residents per DU
Crystal Plaza	52.0	0.98	1.53
Crystal Park	44.9	1.20	1.57
Crystal Square West	48.1	1.05	1.63
Georgian Towers	39.4	0.76	1.27
Randolph Towers	43.0	0.97	1.58
Grosvenor House	41.1	1.19	1.44
Stoneybrook	43.7	1.56	2.06
Bethany House	72.7	0.25	1.09
Twin Towers	43.3	0.50	1.30
Grosvenor Park I	59.3	1.24	1.35
Averages	**47.8**	**1.01**	**1.49**

Table 19. Mode Share by Destination of Trip

Location	Mode	Within Half Mile	D.C.	Fairfax County	Arling. County	Alex.	Other Va.	Mont. County	P.G. County	Other Md.	Elsewhere	Total
Crystal	Auto	40.0	20.0	100.0	27.3	0.0	100.0	75.0	100.0	—	—	33.3%
Plaza	Transit	0.0	80.0	0.0	50.0	100.0	0.0	25.0	0.0	—	—	57.5
	Other	60.0	0.0	0.0	22.7	0.0	0.0	0.0	0.0	—	—	9.2
	Total	5.7	51.7	5.7	25.3	2.3	2.3	4.6	2.3	0.0	0.0	100.0
Crystal Park	Auto	0.0	9.1	100.0	14.3	50.0	—	50.0	100.0	—	—	24.2
	Transit	14.3	90.9	0.0	42.9	50.0	—	50.0	0.0	—	—	48.5
	Other	85.7	0.0	0.0	42.9	0.0	—	0.0	0.0	—	—	27.3
	Total	21.2	33.3	9.1	21.2	6.1	0.0	6.1	3.0	0.0	0.0	100.0
Crystal	Auto	0.0	8.2	66.7	25.0	83.3	—	0.0	0.0	—	—	15.6
Square West	Transit	16.7	91.8	33.3	41.7	16.7	—	100.0	0.0	—	—	62.2
	Other	83.3	0.0	0.0	33.3	0.0	—	0.0	100.0	—	—	22.2
	Total	20.0	54.4	3.3	13.3	6.7	0.0	1.1	1.1	0.0	0.0	100.0
Georg'n	Auto	33.3	30.0	66.7	0.0	33.3	100.0	52.6	75.0	66.7	100.0	42.3
Towers	Transit	33.3	70.0	33.3	100.0	66.7	0.0	31.6	25.0	33.3	0.0	52.6
	Other	33.3	0.0	0.0	0.0	0.0	0.0	15.8	0.0	0.0	0.0	5.1
	Total	3.8	51.3	3.8	1.3	3.8	1.3	24.4	5.1	3.8	1.3	100.0
Rand'ph	Auto	0.0	9.8	50.0	9.1	100.0	100.0	80.0	—	—	—	20.6
Towers	Transit	66.7	87.8	33.3	54.5	0.0	0.0	20.0	—	—	—	69.1
	Other	33.3	2.4	16.7	36.4	0.0	0.0	0.0	—	—	—	10.3
	Total	4.4	60.3	8.8	16.2	1.5	1.5	7.4	0.0	0.0	0.0	100.0

Note: For each jurisdiction, the percentage of trips by mode are indicated in the rows labeled "auto", "transit", and "other". The overall mode share for each location is given in the column labeled "total". For each residential location, the row labeled "total" indicates the percentage of trips from each jurisdiction.

Table 19. Mode Share by Destination of Trip
(Continued)

Location	Mode	Within Half Mile	D.C.	Fairfax County	Arling. County	Alex.	Other Va.	Mont. County	P.G. County	Other Md.	Elsewhere	Total
Grosv'r	Auto	0.0	25.0	—	33.3	100.0	0.0	88.9	100.0	0.0	—	60.0%
House	Transit	0.0	75.0	—	33.3	0.0	100.0	11.1	0.0	100.0	—	35.0
	Other	100.0	0.0	—	33.3	0.0	0.0	0.0	0.0	0.0	—	5.0
	Total	2.5	30.0	0.0	7.5	2.5	2.5	45.0	7.5	2.5	0.0	100.0
Stoneybrook	Auto	—	30.0	100.0	0.0	—	0.0	66.7	100.0	100.0	—	57.6
	Transit	—	60.0	0.0	100.0	—	100.0	20.0	0.0	0.0	—	33.3
	Other	—	10.0	0.0	0.0	—	0.0	13.3	0.0	0.0	—	9.1
	Total	0.0	30.3	9.1	3.0	0.0	3.0	45.5	3.0	6.1	0.0	100.0
Beth'y	Auto	—	—	—	—	—	—	0.0	—	—	—	0.0
House	Transit	—	—	—	—	—	—	100.0	—	—	—	100.0
	Other	—	—	—	—	—	—	0.0	—	—	—	0.0
	Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Twin Towers	Auto	—	8.3	—	—	—	—	20.0	0.0	—	—	10.5
	Transit	—	91.7	—	—	—	—	40.0	50.0	—	—	73.7
	Other	—	0.0	—	—	—	—	40.0	50.0	—	—	15.8
	Total	0.0	63.2	0.0	0.0	0.0	0.0	26.3	10.5	0.0	0.0	100.0
Grosv'r	Auto	100.0	15.4	100.0	—	—	—	87.0	100.0	100.0	—	67.4
Park I	Transit	0.0	84.6	0.0	—	—	—	8.7	0.0	0.0	—	30.2
	Other	0.0	0.0	0.0	—	—	—	4.3	0.0	0.0	—	2.3
	Total	4.7	30.2	7.0	0.0	0.0	0.0	53.5	2.3	2.3	0.0	100.0

Note: For each jurisdiction, the percentage of trips by mode are indicated in the rows labeled "auto", "transit", and "other". The overall mode share for each location is given in the column labeled "total". For each residential location, the row labeled "total" indicates the percentage of trips from each jurisdiction.

Table 20. Summary of Transit Mode Share - Residential

	Number of Sites	Percent Transit Range	Percent Transit Average
CBD Locations	---	---	---
Suburban Locations Inside Beltway	6	48.5% - 73.7%	60.0%
Suburban Locations Outside Beltway	3	30.2% - 35.0%	32.8%
All Residential Locations	9	30.2% - 73.7%	46.2%

Note: Bethany House excluded from table because sample size = 1.

The transit mode share vs distance is plotted in Figure 20. The results were generally consistent, with higher transit ridership typically occurring at residential buildings closer to a rail station. Stoneybrook, an expensive ($250,000.00 per unit) town-home development near the Grosvenor station had a transit mode share of 33% indicating that even though higher income developments are more likely to have more autos available per household, substantial transit mode shares will be realized if convenient access to a rail station is available.

Average auto ownership for all residential sites was 1.01 per unit, less than half the average reported by respondents to the workplace survey which could be taken to represent the general population. It can be debated as to whether households without cars seek to locate near a rail station or whether their location influences their decision to buy a second or third car. In order to get some feel for this, the average auto ownership for areas with similar mid to high density development were examined. While auto ownership was found to be substantially lower, approximately 1.6 cars per household vs about 2.2 for single family neighborhoods, for mid to high density areas the building sites studied are well below comparable sites away from rail stations. The implication here is that locating residential developments near Metrorail stations has significant impact in terms of reducing auto ownership and hence vehicle trips. This has a greater impact than just replacing vehicle work trips with transit work trips. Second and third cars, once purchased, are usually used for more than just commuting, so if the proximity to a rail station tips the decision to buy or not to buy a car against buying, it reduces the auto availability for other trips as well, indirectly reducing the overall trip generation rate.

Table 21 presents the results of the attitudinal questions for the residential data base. In general the findings are similar to those for the office surveys. The most significant finding is the number of respondents who feel that adequate schedule information is not available for transit. This is further illustrated by Figure 21 which shows the results for Crystal Plaza apartments, where over 40% of respondents feel that they do not have adequate information. As mentioned earlier, this suggests that market strategies for station areas should be developed that provide residents, patrons, or office workers information concerning the transit options available.

The attempt to collect information on linked trips was not particularly successful as many respondents were confused and responded with information about all trips, whether or not they began or ended at the building.

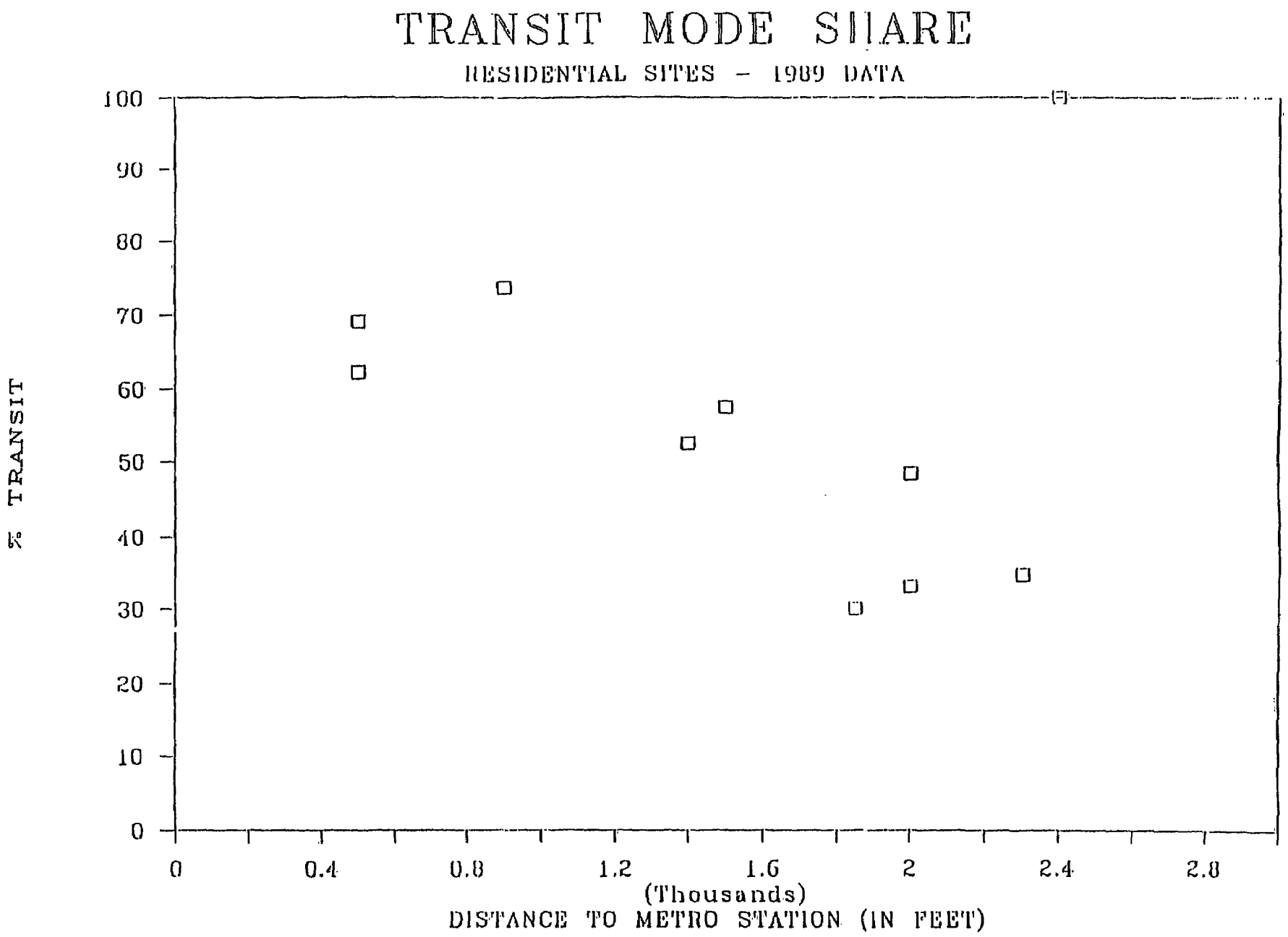

TRANSIT MODE SHARE
RESIDENTIAL SITES - 1989 DATA
% TRANSIT
100
90
80
70
60
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
2.8
(Thousands)
DISTANCE TO METRO STATION (IN FEET)

Figure 20.

Table 21. Residential Surveys
Respondents Opinions By Mode of Travel

Q8A: People should be encouraged to use transit.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	164	(88.6%)	274	(94.6%)	44	(84.6%)	2	(100.0%)	457	(91.4%)	158	(87.3%)	615	(90.3%)
Disagree	5	(2.7)	1	(0.4)	1	(1.9)	0	(0.0)	7	(1.4)	4	(2.2)	11	(1.6)
No Opinion	11	(5.9)	9	(3.4)	5	(9.6)	0	(0.0)	25	(5.0)	11	(6.1)	36	(5.3)
Not Answered	5	(2.7)	4	(1.5)	2	(3.8)	0	(0.0)	11	(2.2)	8	(4.4)	19	(2.8)
Total	185	(100.0)	261	(100.0)	52	(100.0)	2	(100.0)	500	(100.0)	181	(100.0)	681	(100.0)

Q8B: Schedule information for transit is readily available.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	88	(47.6%)	171	(65.5%)	31	(59.6%)	1	(50.0%)	291	(58.2%)	94	(51.9%)	385	(56.5%)
Disagree	75	(40.5)	66	(25.3)	13	(25.0)	0	(0.0)	154	(30.8)	49	(27.1)	203	(29.8)
No Opinion	18	(9.7)	21	(8.0)	6	(11.5)	1	(50.0)	46	(9.2)	26	(14.4)	72	(10.6)
Not Answered	4	(2.2)	3	(1.1)	2	(3.8)	0	(0.0)	9	(1.8)	12	(6.6)	21	(3.1)
Total	185	(100.0)	261	(100.0)	52	(100.0)	2	(100.0)	500	(100.0)	181	(100.0)	681	(100.0)

Table 21. Residential Surveys
Respondents Opinions By Mode of Travel
(Continued)

Q8C: *Metrorail is clean and reliable.*

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	177	(95.7%)	257	(98.5%)	49	(94.2%)	2	(100.0%)	485	(97.0%)	160	(88.4%)	645	(94.7%)
Disagree	3	(1.6)	0	(0.0)	1	(1.9)	0	(0.0)	4	(0.8)	3	(1.7)	7	(1.0)
No Opinion	1	(0.5)	1	(0.4)	0	(0.0)	0	(0.0)	2	(0.4)	9	(5.0)	11	(1.6)
Not Answered	4	(2.2)	3	(1.1)	2	(3.8)	0	(0.0)	9	(1.8)	9	(5.0)	18	(2.6)
Total	185	(100.0)	261	(100.0)	52	(100.0)	2	(100.0)	500	(100.0)	181	(100.0)	681	(100.0)

Q8D: Metrobus is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	42	(22.7%)	62	(23.8%)	17	(32.7%)	1	(50.0%)	122	(24.4%)	68	(37.6%)	190	(27.9%)
Disagree	35	(18.9)	51	(19.5)	4	(7.7)	0	(0.0)	90	(18.0)	20	(11.0)	110	(16.2)
No Opinion	104	(56.2)	140	(53.6)	29	(55.8)	0	(0.0)	273	(54.6)	80	(44.2)	353	(51.8)
Not Answered	4	(2.2)	8	(3.1)	2	(3.8)	1	(50.0)	15	(3.0)	13	(7.2)	28	(4.1)
Total	185	(100.0)	261	(100.0)	52	(100.0)	2	(100.0)	500	(100.0)	181	(100.0)	681	(100.0)

Note: Not answered refers to people who specified their mode of travel but do not answer the question. Missing values refer to people who answered the question but did not specify their mode of travel.

CRYSTAL PLAZA APARTMENTS

OPINIONS REGARDING TRANSIT

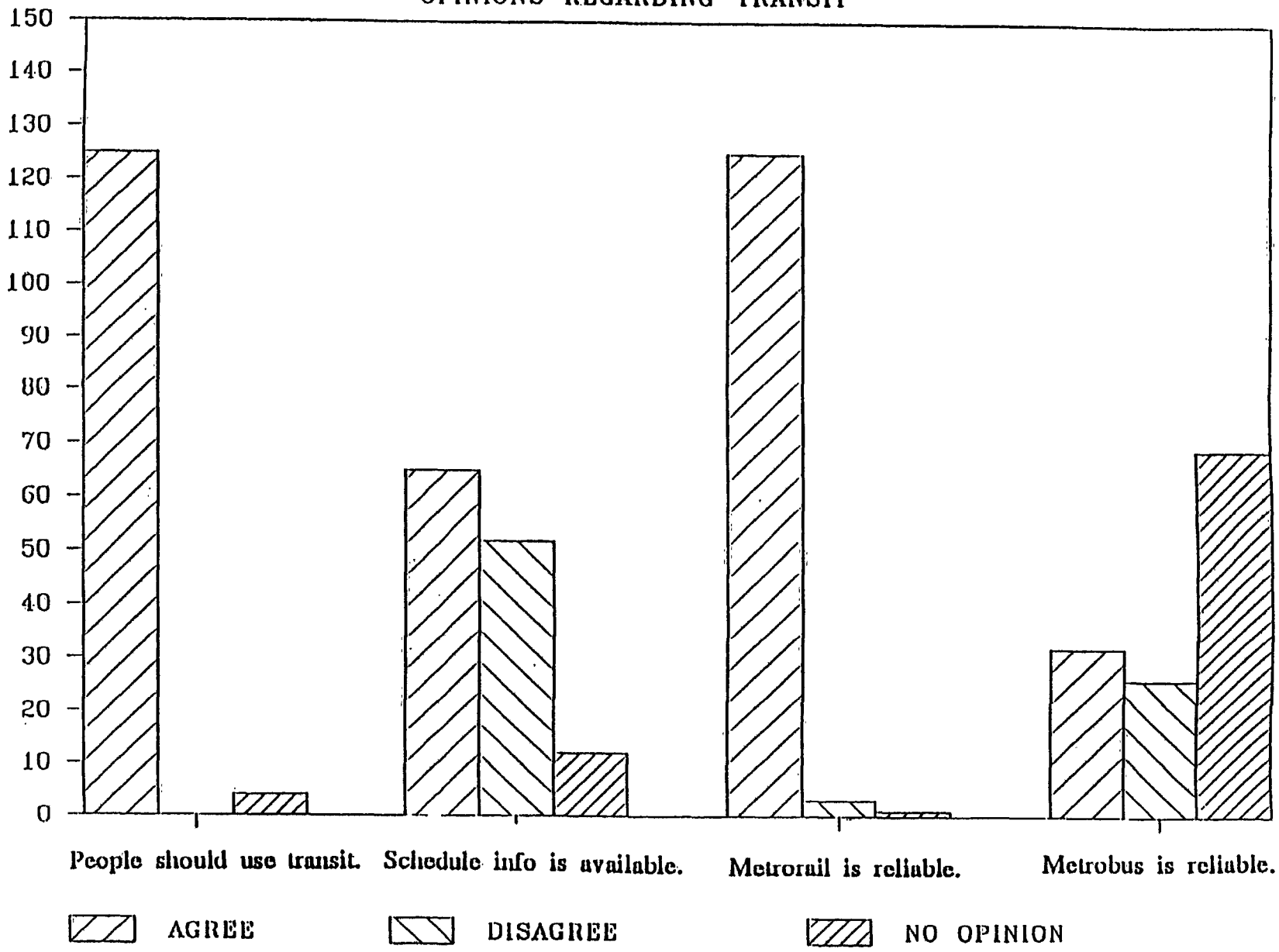


Figure 21.

RETAIL

Eight retail sites were surveyed. Site characteristics are summarized in Table 22. These sites varied in the types of tenants, as well as in size, from 200,000 to 550,000 gross square feet (GSF) of floor area. For example, the Underground and Crystal Plaza in Crystal City both with direct access to the Metro station, cater primarily to the occupants of the office buildings adjacent to the retail centers. These locations are convenient for those who walk through the building to get to the Metrorail station, residence or parked car. Neither establishment has an anchor tenant. The second type of establishment surveyed was the single tenant building. This site, Hecht's at Metro Center was a repeat from the first survey. Ballston Common shopping mall, also a repeat site, has two large anchor tenants and Union Station represents a multi-mode transfer point, a shopping area, and a tourist attraction.

Data Collection

The pedestrian-based survey was designed to gather information on particular trip characteristics, such as trip purpose, trip mode, and trip origin-destination. A sample retail patron interview form is contained in the appendix. The interview was conducted in person by reading the questions from left to right and marking the answers in a single row for each respondent.

For most sites interviews were conducted at random throughout the common areas. At Hecht's Metro Center, The Shoppes and Mazza Gallerie, interviews were conducted at the entrances. Pedestrian counts were also conducted at these locations, as well as determining person trip generation. These counts also allowed for any bias to be detected and weighting factors to be developed for those sites where interviews were conducted at the entrances. For instance if a higher percentage of persons were interviewed at an entrance that is utilized by transit users, the results would be biased in favor of transit.

The interviews were conducted from the time the establishments opened until six o'clock PM on a Tuesday, Wednesday or Thursday. At Ballston Common and Mazza Gallerie interviews were conducted until nine o'clock PM.

Table 22. Site Characteristics of Retail Establishments

Metrorail Station	Retail Establishment	Distance to Station	Gross Square Feet (1000)	Selling Square Feet (1000)	No. Parking Spaces	Year Constructed
Metro Center	The Hecht Company (1)[1]	100	270	204	none	Oct. '85
	The Shops (41)	450	125			1984
Crystal City	The Underground (8)	100	150		200[2]	1979
	Crystal Plaza Shops (9)	2000	150			1985
Ballston Common	Ballston Common (21)	1000	530	530	2,900[3]	Oct.'86
Friendship Heights	Mazza Gallerie (25)	50	--	--	--	--
Bethesda	Bethesda Metro Center (31)	100	60	--	1400[4]	1985
Union Station	Union Station (42)	50	Total 750 Retail 210			Sept.'88

[1] Numbers in parentheses refer to location maps in Figures 2 to 13.

[2] 200 commercial parking spaces (at any one time not more than 50 percent are used by The Underground.

[3] Arlington County owns the parking structure.

[4] Total parking for project.

Analysis

As with office and residential sites, summary tables and figures were prepared including: mode share by retail establishment, transit/auto mode share by trip purpose, and transit/auto mode share by the location of the last stop for the retail patron. Due to the unique character of Union Station a more detailed analysis was undertaken and is presented here.

Results

Mode share for each of the retail establishments by location of the last stop is presented in Table 23. Table 24 summarizes transit mode share for retail sites. These are graphed on Figure 22. Transit mode share ranged from approximately 34% to 55%. This is significantly better than was found when the first study was conducted. Also, it is important to note that transit accounts for the biggest share at most sites ahead of auto. As expected the lower mode shares are found at the suburban sites. However, impressive mode shares were reported at these sites.

Several sites were repeated from the first study allowing a direct comparison with the two studies. In the first study The Underground at Crystal City had a disappointing transit mode share (13.6%), in this survey the transit mode share was found to be just over 40%. The transit mode share at Ballston Common increased from approximately 12% to 27%, although it is important to note that transit mode share varies considerably by the time of day from a peak of over 50% midday to approximately 20% in the evening. At Hecht's Metro Center transit mode share increased slightly from 40.8% to 44.4%.

An increase in the transit mode share at one particular location could be dismissed as just another data point due to the fact that mode shares are likely to vary more from day to day than for office sites based on a number of factors such as the weather, time of year, and hours surveyed. However, given the substantial mode share at all sites and the increases at all three sites that were repeated it can be concluded that Metrorail is becoming an accepted transportation mode for retail sites that are conveniently located near a Metrorail station.

Another important finding is that the retail sites appear to be attracting higher transit mode shares than office sites at the same Metrorail station. This is different than in the first study which found that transit mode share was consistent within a station area. This possibly indicates that it takes longer for retail sites to mature than

Table 23. Mode Share by Location of Last Stop

Retail Location	Mode	D.C.	Fairfax County	Arling. County	Alex.	Other Virginia	P.G. County	Mont. County	Other Maryland	Other	Totals
The	Auto	37.0%	45.5%	19.6%	62.5%	42.9%	57.1%	25.0%	58.8%	38.5%	33.7%
Under-	Transit	59.3	54.5	33.6	37.5	28.6	28.6	66.7	35.3	30.8	42.4
Ground	Other	3.7	0.0	46.7	0.0	28.6	14.3	8.3	5.9	30.8	23.9
	Total	21.2	8.6	42.0	6.3	2.7	2.7	4.7	6.7	5.1	100.0
Crystal	Auto	29.3	84.6	32.1	37.5	71.4	100.0	36.4	56.3	62.5	47.7
Plaza 2000	Transit	65.9	15.4	32.1	50.0	14.3	0.0	63.6	43.8	33.3	42.5
Shops	Other	4.9	0.0	35.7	12.5	14.3	0.0	0.0	0.0	4.2	9.8
	Total	26.8	8.5	18.3	5.2	4.6	3.3	7.2	10.5	15.7	100.0
Ballston	Auto	32.1	68.8	57.6	68.8	56.8	75.0	66.7	53.3	71.4	53.3
Common	Transit	64.1	18.8	31.2	25.0	18.9	25.0	33.3	46.7	14.3	36.6
	Other	3.8	12.5	11.2	6.3	24.3	0.0	0.0	0.0	14.3	10.1
	Total	24.6	10.1	39.4	5.0	11.7	1.3	0.9	4.7	2.2	100.0
Bethesda	Auto	27.5	100.0	16.7	100.0	100.0	33.3	41.4	48.0	12.5	38.6
Metro	Transit	70.6	0.0	50.0	0.0	0.0	66.7	25.7	44.0	37.5	42.7
Center	Other	2.0	0.0	33.3	0.0	0.0	0.0	32.9	8.0	50.0	18.7
	Total	29.8	1.2	3.5	1.2	2.3	1.8	40.9	14.6	4.7	100.0
Mazza	Auto	31.9	100.0	25.0	100.0	100.0	100.0	44.4	34.5	56.3	39.6
Gallerie	Transit	61.1	0.0	75.0	0.0	0.0	0.0	55.6	37.9	12.5	48.7
	Other	6.9	0.0	0.0	0.0	0.0	0.0	0.0	27.6	31.3	11.7
	Total	46.8	1.3	2.6	0.6	1.3	0.6	17.5	18.8	10.4	100.0

Table 23. Mode Share by Location of Last Stop
(Continued)

Retail Location	Mode	D.C.	Fairfax County	Arling. County	Alex.	Other Virginia	P.G. County	Mont. County	Other Maryland	Other	Totals
Hecht's	Auto	12.2	0.0	0.0	33.3	100.0	100.0	0.0	37.5	0.0	13.3
Metro	Transit	45.9	100.0	100.0	66.7	0.0	0.0	100.0	62.5	66.7	49.5
Center	Other	42.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	37.1
	Total	86.2	1.0	1.9	1.4	0.5	0.5	1.9	3.8	2.9	100.0
Union	Auto	19.7	55.6	12.5	50.0	54.5	100.0	22.7	26.5	16.7	23.4
Station	Transit	48.6	44.4	50.0	25.0	45.5	0.0	68.2	58.8	73.3	53.5
	Other	31.7	0.0	37.5	25.0	0.0	0.0	9.1	14.7	10.0	23.0
	Total	52.8	3.3	5.9	1.5	4.1	0.4	8.2	12.6	11.2	100.0
The Shops	Auto	12.7	50.0	0.0	—	50.0	0.0	0.0	25.0	20.0	14.4
	Transit	45.3	0.0	87.5	—	50.0	100.0	100.0	75.0	70.0	50.3
	Other	42.0	50.0	12.5	—	0.0	0.0	0.0	0.0	10.0	35.3
	Total	80.2	1.1	4.3	0.0	4.3	0.5	2.1	2.1	5.3	100.0

Note: For each jurisdiction, the percentage of trips by mode share is indicated in the rows labeled "auto," "transit," and "other." These total vertically to 100%. The overall mode for each retail location is shown in the columns labeled "total." For each retail location, the row labeled "total" indicates the percentage of trips from each jurisdiction. This row totals horizontally.

Table 24. Summary of Transit Mode Share - Retail

	Number of Sites	Percent Transit Range	Percent Transit Average
CBD Locations	4	45.3% - 55.8%	49.5%
Suburban Locations Inside Beltway	4	34.4% - 40.7%	38.9%
Suburban Locations Outside Beltway	0	---	---
All Retail Locations	8	34.4% - 55.8%	44.2%

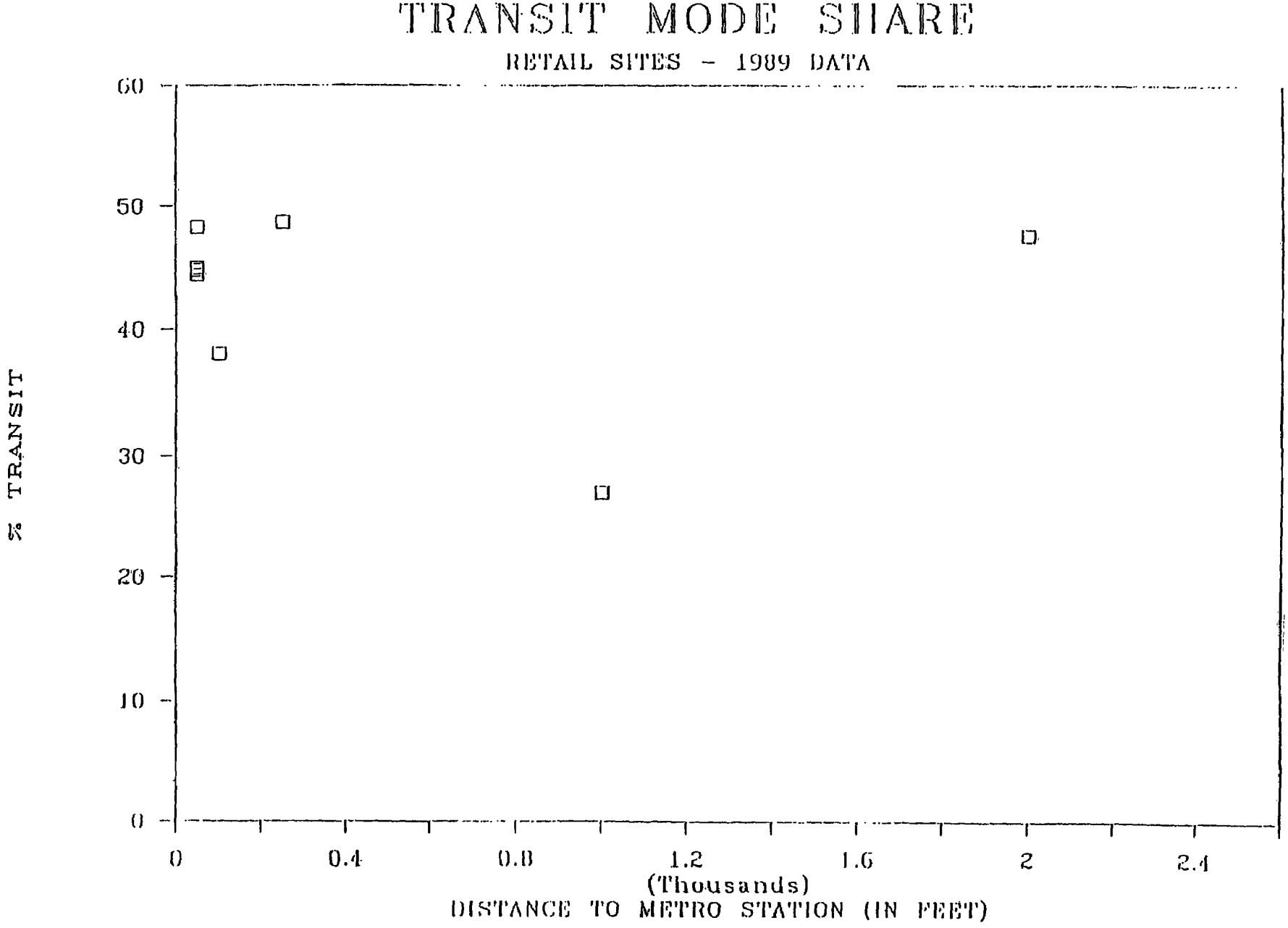

TRANSIT MODE SHARE
RETAIL SITES - 1989 DATA
% TRANSIT
60
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
(Thousands)
DISTANCE TO METRO STATION (IN FEET)

Figure 22.

Table 25. Mode Share by Purpose for Trips to and from Retail Sites

Retail Site	Purpose	Auto	Rail	Bus	Walk	Taxi	Amtrak	Other Mode	Total	Summary % Auto	Summary % Transit
The Under-Ground	Shopper	27.9%	37.2%	7.6%	22.1%	1.2%	0.0%	4.1%	100.0%	27.9%	44.8%
	Employee	44.2	35.1	5.8	14.3	0.0	0.0	0.6	100.0	44.2	40.9
	Restaurant	30.8	46.2	7.7	15.4	0.0	0.0	0.0	100.0	30.8	53.8
	Other	32.9	27.1	5.8	27.7	2.6	0.0	3.9	100.0	32.9	32.9
Crystal Plaza Shops Center	Shopper	33.3	47.6	0.0	16.7	0.0	0.0	2.4	100.0	33.3	47.6
	Employee	47.5	39.4	6.9	6.3	0.0	0.0	0.0	100.0	47.5	46.3
	Restaurant	54.5	27.3	0.0	18.2	0.0	0.0	0.0	100.0	54.5	27.3
	Other	42.4	30.5	0.0	23.7	0.0	0.0	3.4	100.0	42.4	30.5
Ballston Common	Shopper	64.4	21.7	5.3	8.0	0.6	0.0	0.0	100.0	64.4	26.9
	Employee	47.1	33.7	4.8	10.6	0.0	0.0	3.8	100.0	47.1	38.5
	Restaurant	50.0	18.4	3.9	27.6	0.0	0.0	0.0	100.0	50.0	22.4
	Other	34.4	56.3	0.8	7.0	0.0	0.0	1.6	100.0	34.4	57.0
Bethesda Metro Center	Shopper	61.9	35.7	2.4	0.0	0.0	0.0	0.0	100.0	61.9	38.1
	Employee	59.1	31.8	4.5	4.5	0.0	0.0	0.0	100.0	59.1	36.4
	Restaurant	29.6	29.1	8.4	31.8	0.0	0.0	1.1	100.0	29.6	37.4
	Other	32.9	42.1	7.9	13.2	3.9	0.0	0.0	100.0	32.9	50.0
Mazza Gallerie	Shopper	43.9	40.4	4.7	11.1	0.0	0.0	0.0	100.0	43.9	45.0
	Employee	30.0	56.7	10.0	0.0	3.3	0.0	0.0	100.0	30.0	66.7
	Restaurant	18.8	43.8	18.8	28.8	0.0	0.0	0.0	100.0	18.8	62.5
	Other	37.5	37.5	2.8	19.4	0.0	0.0	2.8	100.0	37.5	40.3

Table 25. Mode Share by Purpose for Trips to and from Retail Sites (Continued)

Retail Site	Purpose	Auto	Rail	Bus	Walk	Taxi	Amtrak	Other Mode	Total	Summary % Auto	Summary % Transit
Hecht's	Shopper	12.5	25.9	18.5	40.7	2.3	0.0	0.0	100.0	12.5	44.4
Metro	Employee	20.0	60.0	20.0	0.0	0.0	0.0	0.0	100.0	20.0	80.0
Center	Restaurant	12.5	87.5	0.0	0.0	0.0	0.0	0.0	100.0	12.5	87.5
	Other	4.0	26.0	12.0	54.0	2.0	0.0	2.0	100.0	4.0	38.0
Union	Shopper	24.6	39.8	5.9	18.6	5.1	2.5	3.4	100.0	24.6	48.3
Station	Employee	31.3	31.3	25.0	6.3	0.0	6.3	0.0	100.0	31.3	62.5
	Restaurant	32.1	22.6	17.9	25.0	0.0	2.4	0.0	100.0	32.1	42.9
	Other	18.5	23.5	18.1	12.1	5.0	20.1	2.7	100.0	18.5	61.7
The Shops	Shopper	20.9	34.8	13.9	24.1	4.4	0.0	1.9	100.0	20.9	48.7
	Employee	13.2	55.3	28.9	0.0	2.6	0.0	0.0	100.0	13.2	84.2
	Restaurant	0.0	21.2	6.1	69.7	3.0	0.0	0.0	100.0	0.0	27.3
	Other	8.3	22.0	27.5	34.9	6.4	0.0	0.9	100.0	8.3	49.5

Note: For each retail location, the mode split is given for each trip purpose. In the columns labeled "summary," transit includes rail, bus, and Amtrak.

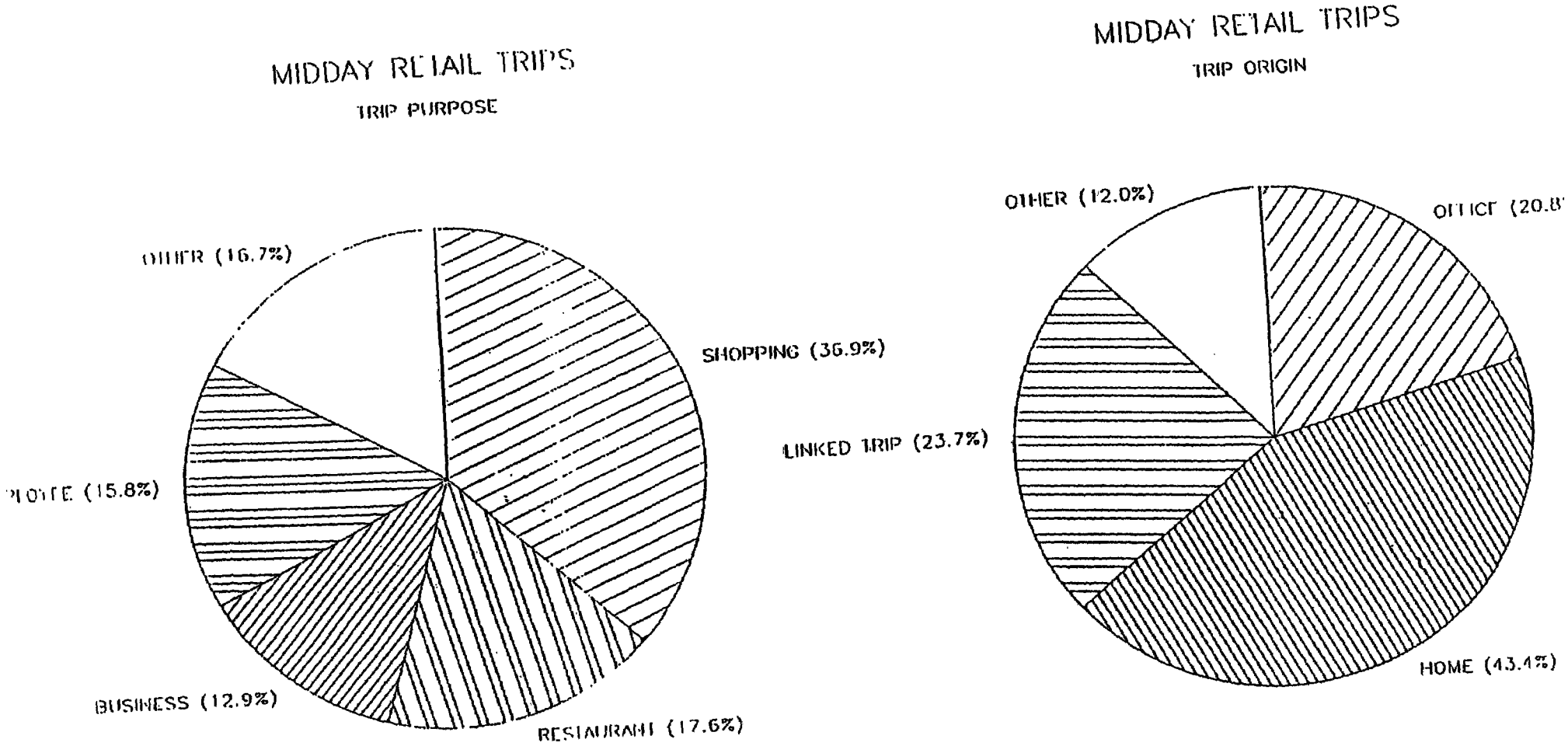

MIDDAY RETAIL TRIPS
TRIP PURPOSE
OTHER (16.7%)
SHOPPING (36.9%)
HOME (15.8%)
BUSINESS (12.9%)
RESTAURANT (17.6%)
MIDDAY RETAIL TRIPS
TRIP ORIGIN
OTHER (12.0%)
LINKED TRIP (23.7%)
HOME (43.4%)

Figure 23.

Table 26. Retail Surveys
Respondents Opinions by Mode of Travel

Q15: People should be encouraged to use transit.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	544	(88.9%)	702	(92.9%)	265	(90.4%)	26	(92.9%)	1537	(91.0%)	24	(88.9%)	1561	(91.0%)
Disagree	30	(4.9)	15	(2.0)	9	(3.1)	0	(0.0)	54	(3.2)	1	(3.7)	55	(3.2)
No Opinion	36	(5.9)	35	(4.6)	18	(6.1)	2	(7.1)	91	(5.4)	1	(3.7)	92	(5.4)
Not Answered	2	(0.3)	4	(0.5)	1	(0.3)	0	(0.0)	7	(0.4)	1	(3.7)	8	(0.5)
Total	612	(100.0)	756	(100.0)	293	(100.0)	28	(100.0)	1689	(100.0)	27	(100.0)	1716	(100.0)

Q16: Schedule information is readily available for transit.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	425	(69.4%)	601	(79.5%)	209	(71.3%)	22	(78.6%)	1257	(74.4%)	23	(85.2%)	1280	(74.6%)
Disagree	113	(18.5)	117	(15.5)	59	(20.1)	2	(7.1)	291	(17.2)	1	(3.7)	292	(17.0)
No Opinion	70	(11.4)	35	(4.6)	24	(8.2)	4	(14.3)	133	(7.9)	2	(7.4)	135	(7.9)
Not Answered	4	(0.7)	3	(0.4)	1	(0.3)	0	(0.0)	8	(0.5)	1	(3.7)	9	(0.5)
Total	612	(100.0)	756	(100.0)	293	(100.0)	28	(100.0)	1689	(100.0)	27	(100.0)	1716	(100.0)

Table 26. Retail Surveys
Respondents Opinions by Mode of Travel
(Continued)

Q17: Metrorail is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	544	(88.9%)	701	(92.7%)	268	(91.5%)	22	(78.6%)	1535	(90.9%)	21	(77.8%)	1556	(90.7%)
Disagree	18	(2.9)	13	(1.7)	7	(2.4)	0	(0.0)	38	(2.2)	0	(0.0)	38	(2.2)
No Opinion	47	(7.7)	39	(5.2)	16	(5.5)	6	(21.4)	108	(6.4)	5	(18.5)	113	(6.6)
Not Answered	3	(0.5)	3	(0.4)	2	(0.7)	0	(0.0)	8	(0.5)	1	(3.7)	9	(0.5)
Total	612	(100.0)	756	(100.0)	293	(100.0)	28	(100.0)	1689	(100.0)	27	(100.0)	1716	(100.0)

Q18: Metrobus is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	251	(41.0%)	325	(43.0%)	122	(41.6%)	10	(35.7%)	708	(41.9%)	9	(33.3%)	717	(41.8%)
Disagree	115	(18.8)	210	(27.8)	72	(24.6)	3	(10.7)	400	(23.7)	0	(0.0)	400	(23.3)
No Opinion	242	(39.5)	218	(28.8)	99	(33.8)	15	(53.6)	574	(34.0)	17	(63.0)	591	(34.4)
Not Answered	4	(0.7)	3	(0.4)	0	(0.0)	0	(0.0)	7	(0.4)	1	(3.7)	8	(0.5)
Total	612	(100.0)	756	(100.0)	293	(100.0)	28	(100.0)	1689	(100.0)	27	(100.0)	1716	(100.0)

Note: Not answered refers to people who specified their mode of travel but do not answer the question. Missing values refer to people who answered the question but did not specify their mode of travel.

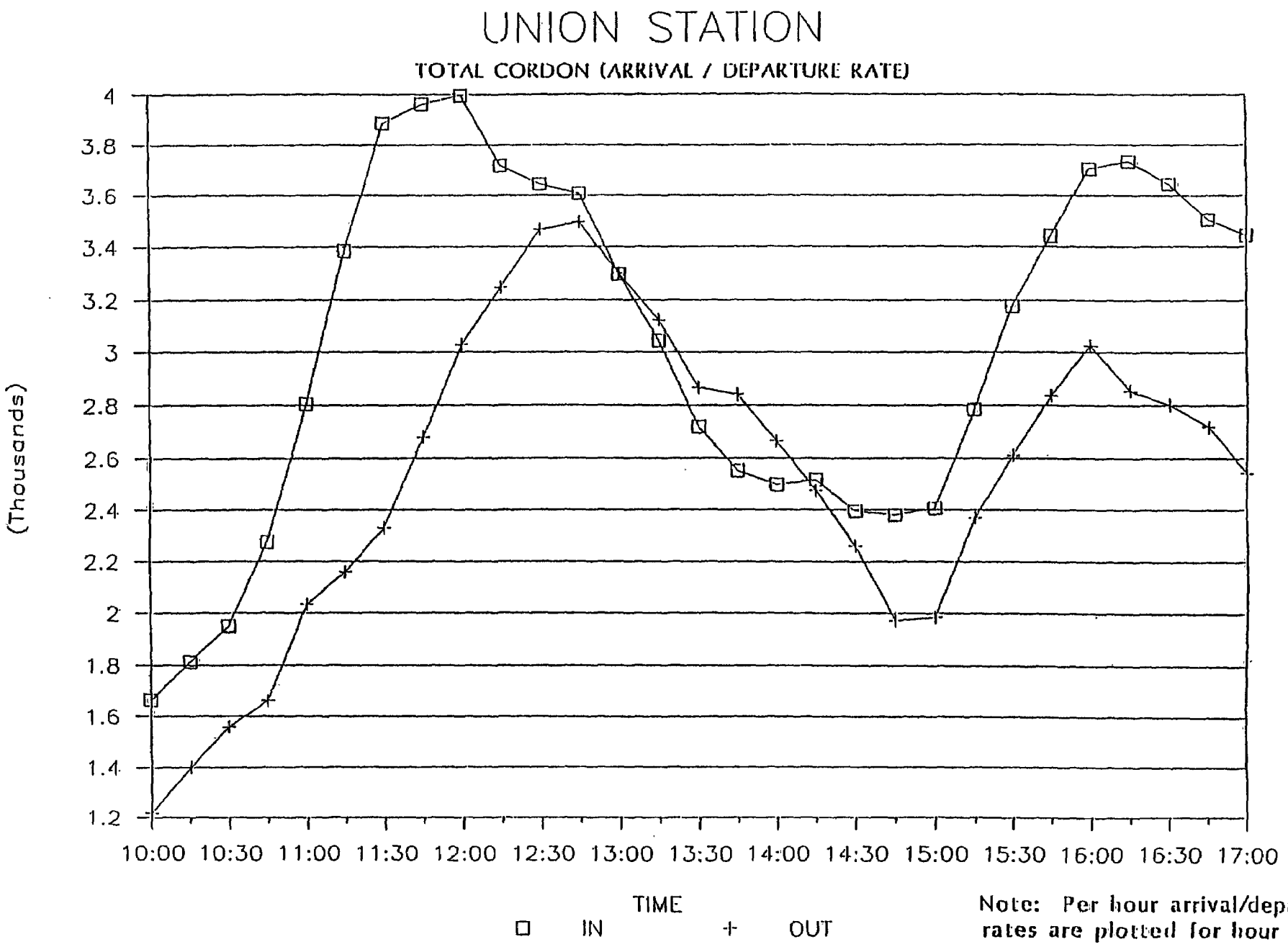

UNION STATION
TOTAL CORDON (ARRIVAL / DEPARTURE RATE)
(Thousands)
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
10:00 10:30 11:00 11:30 12:00 12:30 13:00 13:30 14:00 14:30 15:00 15:30 16:00 16:30 17:00
TIME
IN
OUT
Note: Per hour arrival/departur
rates are plotted for hour
beginning by 15 minute interv

Figure 24.

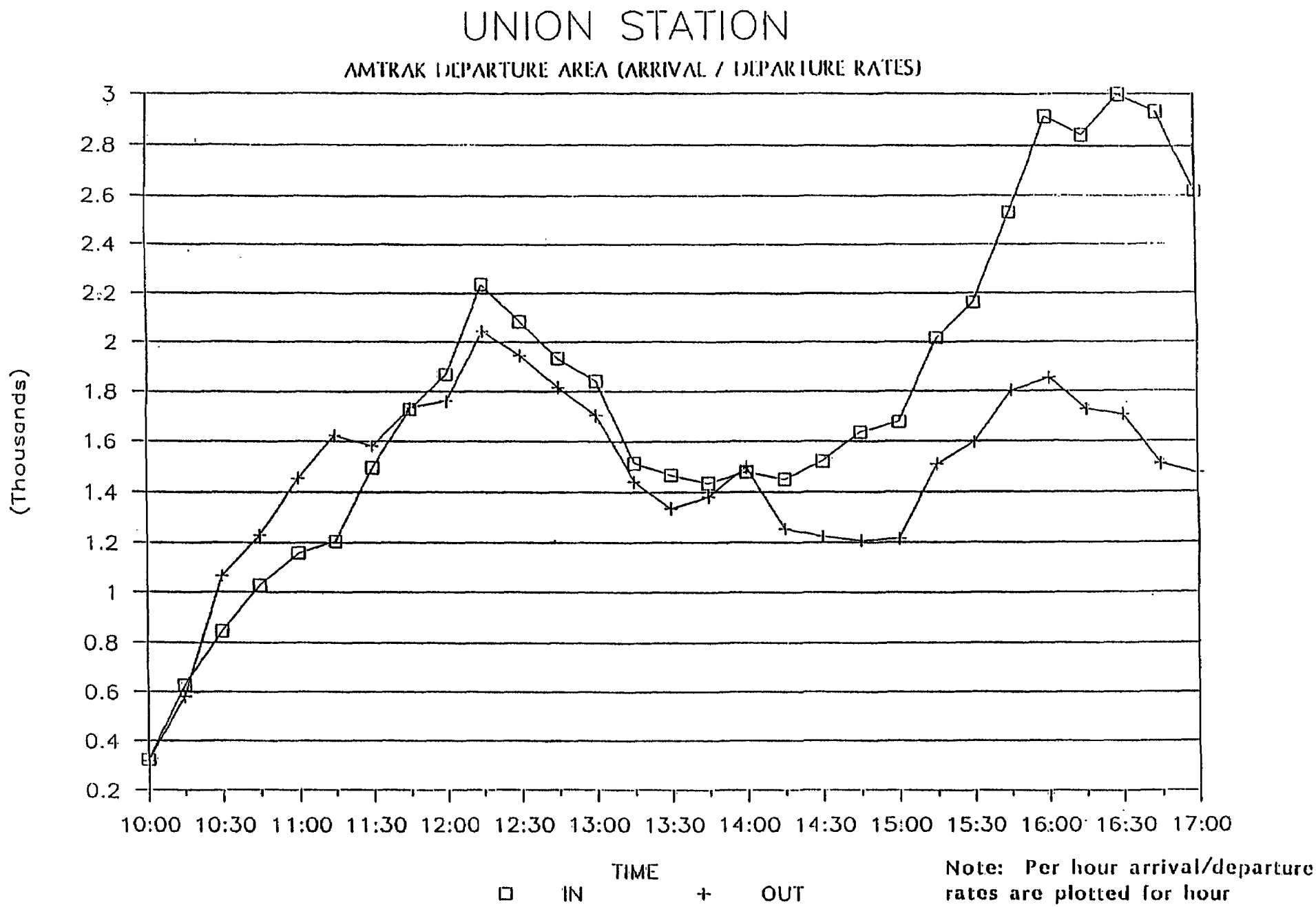

UNION STATION
AMTRAK DEPARTURE AREA (ARRIVAL / DEPARTURE RATES)
(Thousands)
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
10:00 10:30 11:00 11:30 12:00 12:30 13:00 13:30 14:00 14:30 15:00 15:30 16:00 16:30 17:00
TIME
□ IN + OUT
Note: Per hour arrival/departure rates are plotted for hour beginning by 15 minute intervals

Figure 25.

office sites. As more studies are completed in the future, trend analysis may define this relationship better.

Mode share is presented by purpose in Table 25. The transit mode share for employees is higher than the transit mode share found at the office sites in the corresponding station area. A similar geographic distribution of patrons was found as compared to the office sites. This suggests that people chose their shopping location in areas they are familiar with based on their daily work trips.

Figure 23 illustrates the purpose of mid-day transit trips to the retail areas as well as the origin of trips based on the last stop reported. It is interesting to note that only a little over a third of trips are for the purpose of shopping. This is considerably lower than in the evenings or on a weekend. Less than half the reported trips originate at the patrons home with 23.7% reported as linked trips. This is about the same magnitude of linked trips as found among auto users which is somewhat contradictory to the excuse given by many auto users for not using transit. That is, if they use transit they cannot stop off or make multi-purpose trips.

Responses to the attitudinal questions were similar to those for office and residential sites and are presented in Table 26.

Union Station

One of the retail sites chosen was the retail area at Union Station. This site is unique in the metropolitan area acting as a multi-modal transfer point for trips up and down the east coast via Amtrak, commuter rail (MARC), a Metrorail station, a retail area with 210,000 square feet of shops, 100,000 square feet of office, and a tourist attraction. There were three components to the data collection at Union Station. First, the entire building was cordoned off and pedestrians entering and exiting the building were counted by 15 minute intervals for each entrance. Second, a secondary cordon recorded pedestrians entering or exiting the Amtrak arrival/ departure lounge area. Finally interviews were conducted for the full counting period of 10:00 AM to 6:00 PM. The tables and figures in this section highlight mode share, trip generation, trip purpose and other trip characteristics for trips made to and from Union Station.

Over the eight hour count period approximately 43,600 persons were seen to enter or exit Union Station, the hourly arrival and departure rates by 15 minute increments is shown in Figure 24. Figure 25 shows the arrival and departure rates for the Amtrak arrival/departure area. Approximately 57% of all persons entering Union Station enter

the Amtrak arrival departure area, or putting it the other way around, 43% are visitors, for reasons such as shopping, lunch, or just plain sight seeing.

The Union Station Metrorail stop had approximately 26,000 patrons for the same time period. Of these it is estimated that approximately one-half entered Union Station. The arrival and departure rates for the Metrorail station are shown in Figure 26. The Metrorail station was considered outside of Union Station, therefore, it was counted separately. Of the 26,000 patrons it is estimated that approximately 8,000 enter or exit Union Station.

Figure 27 shows the jurisdiction of origin by mode. Just over half of all trips to Union Station originated in DC. Figure 28 shows mode share by trip purpose. It is interesting to note that arrival by car accounts for less than one third of all trips to or from Union Station.

Figure 29 illustrates the expenditures by patrons at Union Station. The average or mean expenditure is $22.00 and the median expenditure is $6.00. Finally Table 27 summarizes some of the information discussed above.

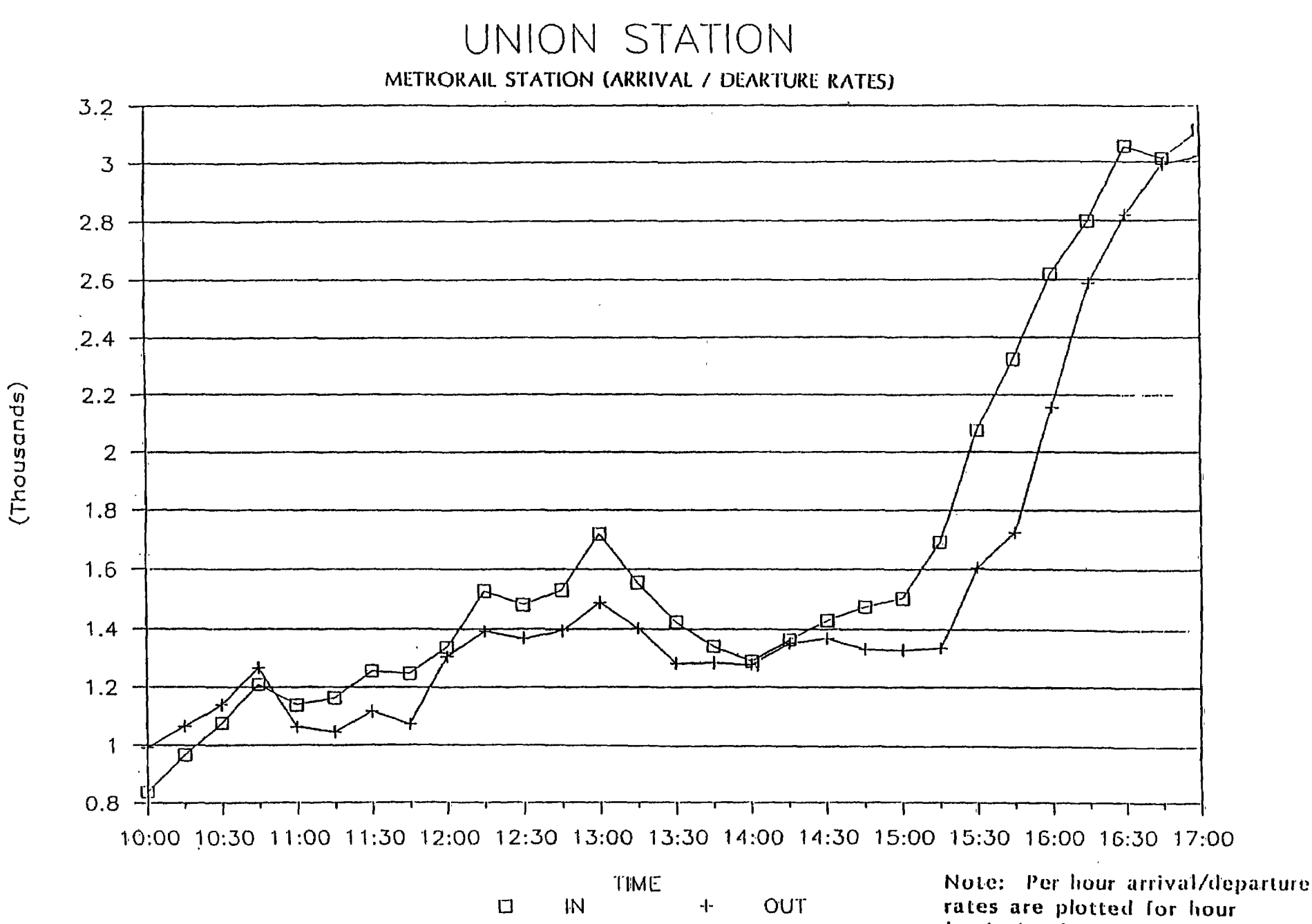
In summary Union Station generates over 4000 trips per hour for most of the day, with the absolute peak occurring at noon hour. The majority of trips to and from Union Station are made by transit or on foot. Union Station generates considerable revenue for WMATA throughout the day, not just the peak periods and represents a mixed use development that appears to encourage transit ridership to a greater extent than these uses would, located on their own.

HOTEL

The ten hotels chosen for study were full service hotels ranging in size from 88 to 907 guest rooms. The characteristics for each hotel were given in Table 28. Conference/meeting space varied from 10,000 to 50,000 gross square feet. A wide range of distances from Metrorail stations was studied. As well, four of the five hotels surveyed in the first study were repeated in this study.

Data Collection

Data were collected at hotel sites using a pedestrian-based survey to gather information from patrons and cordon counts were conducted to determine actual trip generation rates. The format and procedures employed were very similar to those used for retail sites. The objectives were:

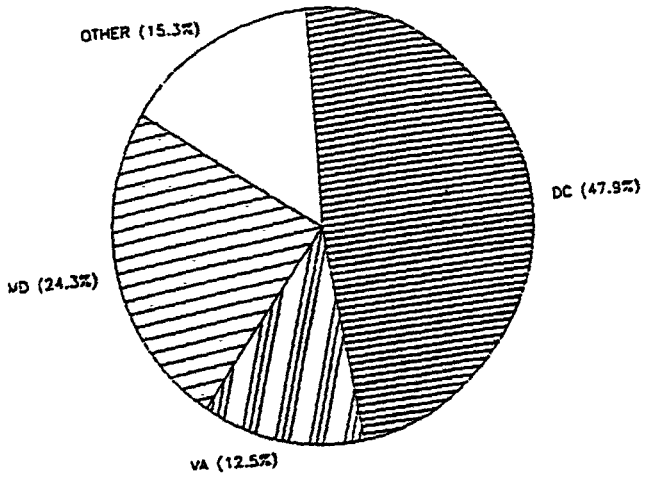


Note: Per hour arrival/departure rates are plotted for hour beginning by 15 minute intervals

Figure 26.

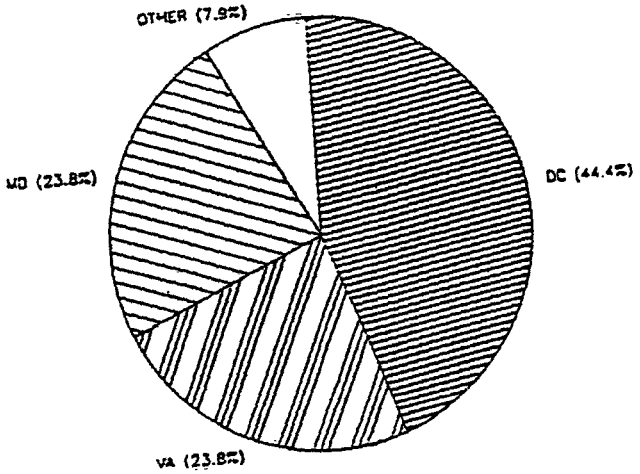
UNION STATION

LOCATION OF LAST STOP FOR TRANSIT USERS



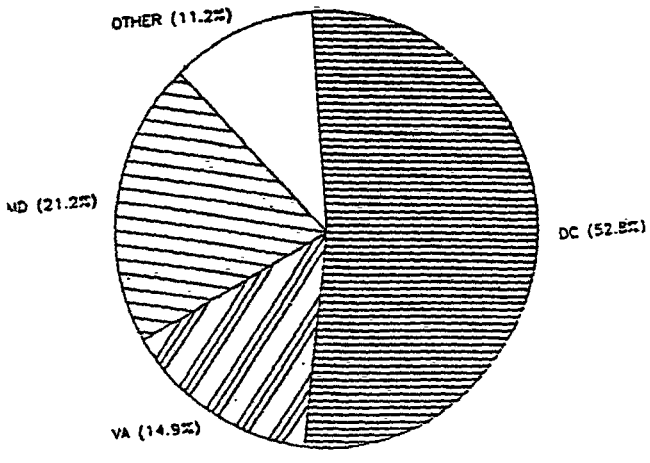
UNION STATION

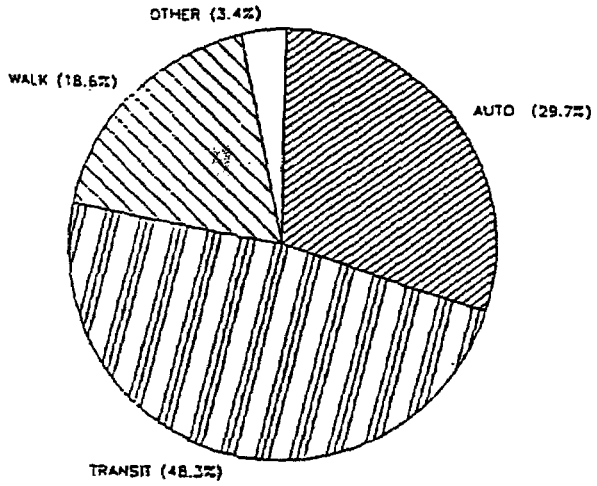
LOCATION OF LAST STOP FOR AUTO USERS



UNION STATION

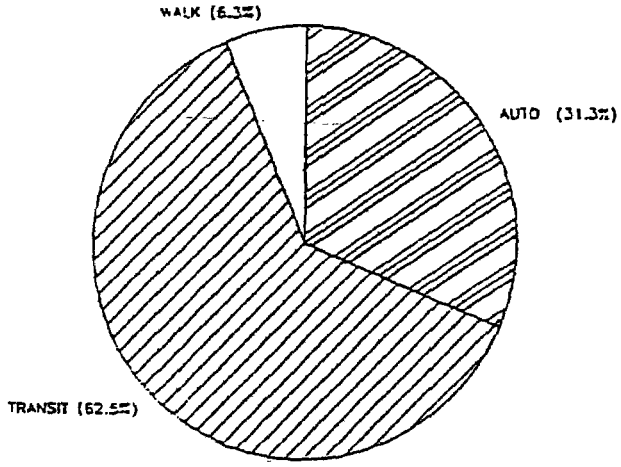
LOCATION OF LAST STOP FOR ALL PERSONS





UNION STATION

MODE SPLIT FOR EMPLOYEES



UNION STATION

MODE SPLIT FOR RESTAURANT PATRONS

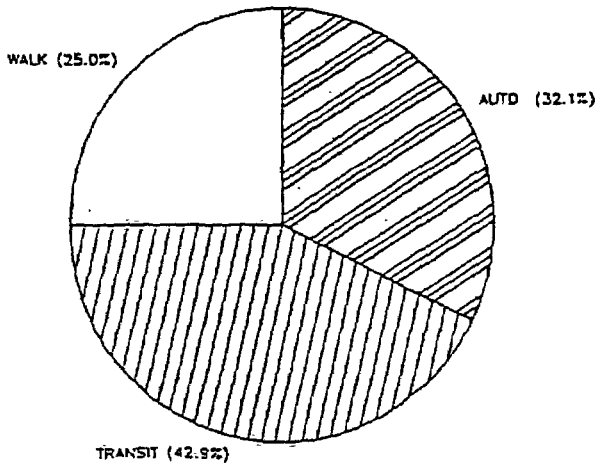


Figure 28.

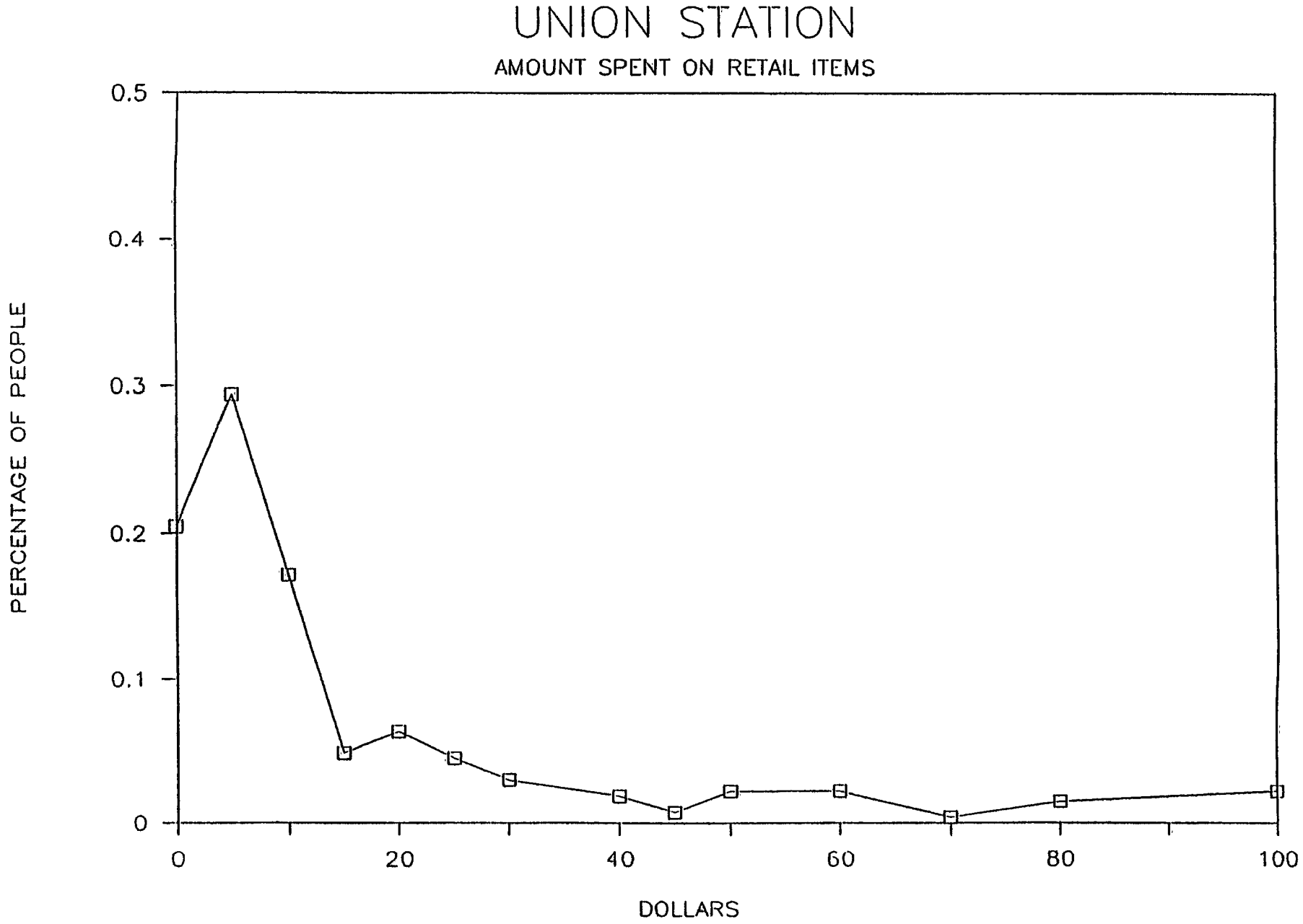

UNION STATION
AMOUNT SPENT ON RETAIL ITEMS
PERCENTAGE OF PEOPLE
0.5
0.4
0.3
0.2
0.1
0
0
20
40
60
80
100
DOLLARS

Figure 29.

Table 27. Union Station

Counting Period: 10:00 AM - 6:00 PM

Peak Hour: 12:30 PM - 1:30 PM
(Metrorail: 4:30 PM - 5:30 PM)

Total Number of Persons:

	IN	OUT
Counting Period		
Union Station	23,817	19,799
Amtrak	13,876	11,279
Metrorail	13,561	12,634

- Approximately 9% of visitors park in the parking structure
- Approximately 57% of visitors enter the Amtrak arrival/departure area

Average (mean) Expenditure: $22.00

Parking Costs: $1.50/hour $7.50/day

Table 28. Site Characteristics of Hotels

Metrorail Station	Hotel	Distance to Station (ft.)	No. Guest Rooms	GSF Conf. Space	Rest./ Lounge Seats	No. Parking Spaces	Parking Costs	Year Constructed
Metro Center	JW Marriott (2)[1]	1300	773	28,360	450			1983
	Hyatt Grand (3)	500	907	50,000				1987
Rosslyn	Hyatt Arlington (45)	300	303	6,020	330	290	guests free conf. varies	1976
Crystal City	Crystal Gateway (10)	100	702	14,800	350	320	guest/conf. pay for parking	1982
	Crystal Hyatt (11)	3800	685	31,900	594	330	guest $7.50/day rest. validates weekend guests free	1982
Woodley Park/Zoo	Omni Shoreham (46)	1050	770					
Bethesda	Hyatt Regency (32)	300	380			1400[2]		
Twinbrook	Holiday Inn--Crowne Plaza (38)	400	315	850[3]				
Union Station	Phoenix Park (43)	900	88	150[3]				
Silver Spring	Holiday Inn (19)	2500	227					

[1] Numbers in parentheses refer to location maps in Figures 2 to 13.

[2] Total parking for project.

[3] Capacity of conference area.

- to determine the purpose of the trip to the hotel
- to determine mode of travel used to get to or from the hotel on the survey day.
- to determine where the trips originated
- to determine trip generation rates

The pedestrian surveys contained in the Appendix were conducted at the entrances of the hotel or in the lobby area. Interviews were conducted for a minimum of 6 hours at each site covering both peak periods and portions of the mid-day. Cordon counts were conducted throughout this time and in the suburban locations auto occupancy counts were conducted.

Analysis

As with the other land use categories the responses to each question were tabulated and the person trips by 15 minute period tabulated. Summary tables presenting mode share by site and trip purpose are presented in this section.

Results

As with the retail sites transit mode share (Table 29) was found to be considerably higher than that found in the first study with all four repeat sites showing increase in transit mode share. The highest transit mode share was 37.7% at the Holiday Inn Crowne Plaza near the Twinbrook station, while the lowest was found at the Phoenix Park Hotel near Union Station. Of all the land uses surveyed, hotels can be expected to have the greatest variability in transit mode share.

The expansion of the mode share table to include trip purpose is shown in Table 30. Figure 30 graphs the relationship between transit mode share and distance for hotel sites. The table reveals that as was the case in the first study, overnight guests consistently had a lower transit ridership than meeting/conference attendees. Many factors influence transit ridership. For instance, lack of familiarity with the system may result in fewer overnight guests or out of town conference attendees choosing to take transit. Also, the reason the overnight guest is in town may influence their mode choice. For instance, an overnight guest visiting the area for pleasure rather than

Table 29. Summary of Transit Mode Share - Hotel

	Number of Sites	Percent Transit Range	Percent Transit Average
CBD Locations	4	10.8% - 35.9%	25.0%
Suburban Locations Inside Beltway	5	12.4% - 29.8%	19.3%
Suburban Locations Outside Beltway	1	37.7%	37.7%
All Hotel Locations	10	10.8% - 35.9%	25.2%

Table 30. Mode Share by Purpose for Trips to and from Hotel Sites

Hotel	Purpose	Auto	Rail	Bus	Walk	Taxi/Limo	Shuttle	Total	Summary % Auto	Summary % Transit
Hyatt Regency Bethesda	Overnight Guest	48.7%	33.3%	2.6%	5.1%	10.3%	0.0%	100.0%	48.7%	35.9%
	Meeting/Conf.	48.4	29.0	0.0	9.7	9.7	3.2	100.0	48.4	29.0
	Restaurant	28.6	14.3	7.1	21.4	21.4	7.1	100.0	28.6	21.4
	Other	50.0	20.0	0.0	20.0	0.0	10.0	100.0	50.0	20.0
Holiday Inn Silver Spring	Overnight Guest	54.2	16.7	4.2	20.8	4.2	0.0	100.0	54.2	20.8
	Meeting/Conf.	0.0	0.0	0.0	0.0	100.0	0.0	100.0	0.0	0.0
	Restaurant	—	—	—	—	—	—	—	—	—
	Other	—	—	—	—	—	—	—	—	—
Hyatt Grand	Overnight Guest	23.1	30.8	1.9	23.1	21.2	0.0	100.0	23.1	32.7
	Meeting/Conf.	14.3	39.3	0.0	14.3	28.6	3.6	100.0	14.3	39.3
	Restaurant	36.4	9.1	0.0	54.5	0.0	0.0	100.0	36.4	9.1
	Other	19.2	38.5	7.7	26.9	7.7	0.0	100.0	19.2	46.2
Holiday Inn Crowne Plaza	Overnight Guest	61.7	33.3	0.0	1.7	3.3	0.0	100.0	61.7	33.3
	Meeting/Conf.	26.8	56.1	9.8	0.0	7.3	0.0	100.0	26.8	65.9
	Restaurant	100.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0
	Other	83.3	16.7	0.0	0.0	0.0	0.0	100.0	83.3	16.7
J.W. Marriott	Overnight Guest	34.4	18.5	2.1	12.8	30.3	2.1	100.0	34.4	20.5
	Meeting/Conf.	26.7	20.0	20.0	20.0	13.3	0.0	100.0	26.7	40.0
	Restaurant	61.9	23.8	0.0	0.0	14.3	0.0	100.0	61.9	23.8
	Other	41.7	23.3	6.7	13.3	15.0	0.0	100.0	41.7	30.0

Note: For each hotel location, the mode split is given for each trip purpose. In the columns labeled "summary," transit includes rail and bus.

Table 30. Mode Share by Purpose for Trips to and from Hotel Sites
(Continued)

Hotel	Purpose	Auto	Rail	Bus	Walk	Taxi/Limo	Shuttle	Total	Summary % Auto	Summary % Transit
Crystal Gateway Marriott	Overnight Guest	33.6	28.0	0.9	14.0	11.2	12.1	100.0	33.6	29.0
	Meeting/Conf.	53.8	19.2	0.0	7.7	15.4	3.8	100.0	53.8	19.2
	Restaurant	0.0	50.0	0.0	50.0	0.0	0.0	100.0	0.0	50.0
	Other	45.8	16.7	2.1	29.2	0.0	6.3	100.0	45.8	18.8
Hyatt Arlington	Overnight Guest	23.0	28.0	2.0	21.0	19.0	7.0	100.0	23.0	30.0
	Meeting/Conf.	30.4	52.2	0.0	13.0	4.3	0.0	100.0	30.4	52.2
	Restaurant	78.6	7.1	0.0	7.1	7.1	0.0	100.0	78.6	7.1
	Other	66.7	7.7	2.6	23.1	0.0	0.0	100.0	66.7	10.3
Phoenix Park Hotel	Overnight Guest	17.4	8.7	0.0	21.7	52.2	0.0	100.0	17.4	8.7
	Meeting/Conf.	33.3	0.0	0.0	16.7	50.0	0.0	100.0	33.3	0.0
	Restaurant	100.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0
	Other	16.7	16.7	16.7	33.3	16.7	0.0	100.0	16.7	33.3
Hyatt Regency Crystal City	Overnight Guest	23.3	4.1	1.4	8.2	8.2	54.8	100.0	23.3	5.5
	Meeting/Conf.	10.8	27.0	0.0	0.0	37.8	24.3	100.0	10.8	27.0
	Restaurant	100.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0
	Other	100.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0
Omni Shoreham	Overnight Guest	15.7	25.1	0.5	7.9	46.6	4.2	100.0	15.7	25.7
	Meeting/Conf.	43.5	36.5	1.2	8.2	10.6	0.0	100.0	43.5	37.6
	Restaurant	100.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0
	Other	45.0	20.0	15.0	10.0	10.0	0.0	100.0	45.0	35.0

Note: For each hotel location, the mode split is given for each trip purpose. In the columns labeled "summary," transit includes rail and bus.

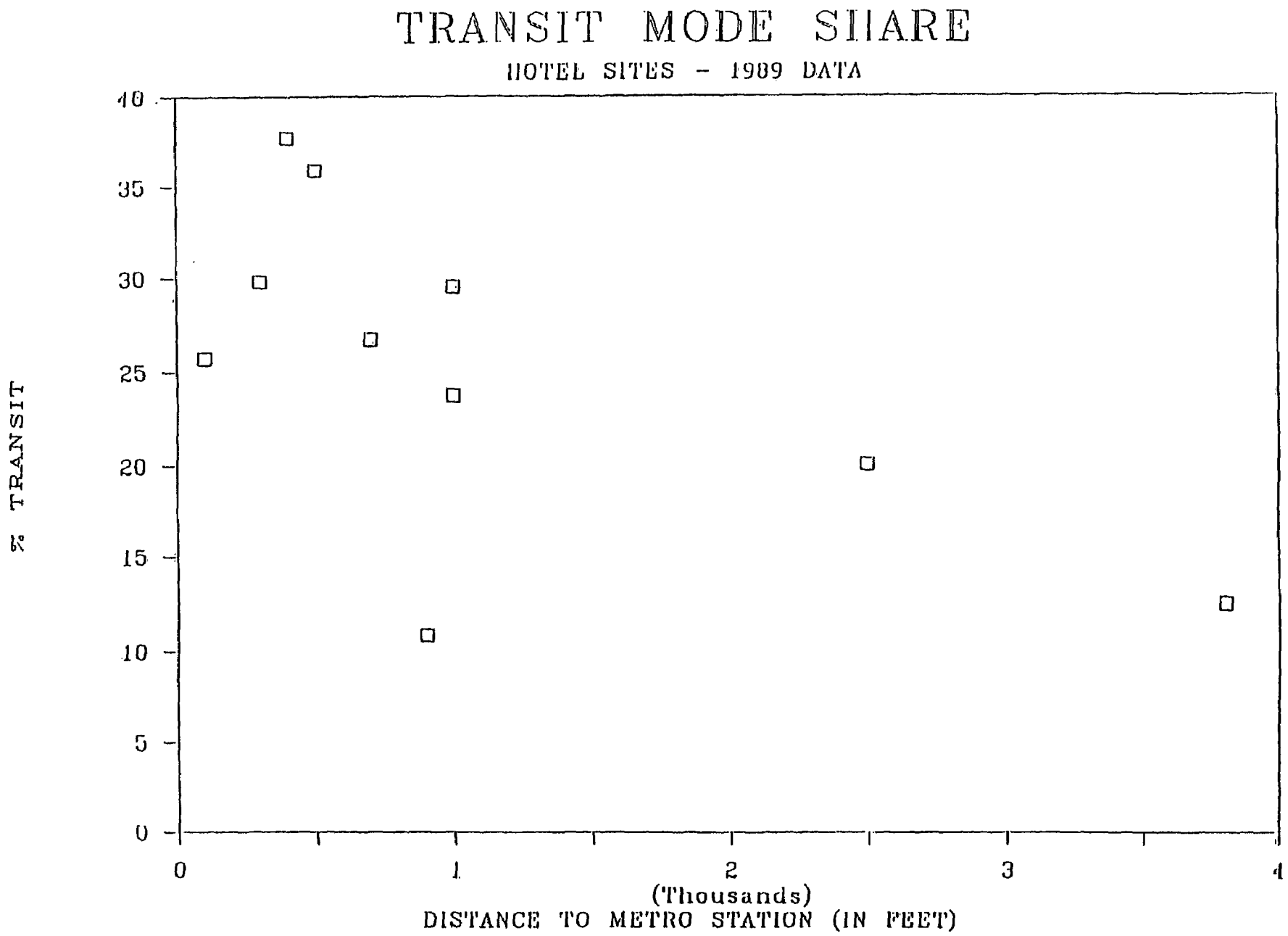

TRANSIT MODE SHARE
HOTEL SITES - 1989 DATA
% TRANSIT
40
35
30
25
20
15
10
5
0
0
1
2
3
4
(Thousands)
DISTANCE TO METRO STATION (IN FEET)

Figure 30.

business may choose transit more often than the business person on a travel expense account. During the interviews common observations from overnight guests from out of town were that they did not know that Washington had a rail system or that it took them 2 or 3 days to discover the system. While this is admittedly a subjective statement, it again suggests that a marketing strategy targeted at individual station areas may be appropriate. Responses to the attitudinal questions from the hotel surveys are presented in Table 31.

DATA FROM OTHER SOURCES

There are several other sources of data, similar to that collected in this study, that provide insight into travel behavior at sites near Metrorail stations. The first study which has been referred to throughout this report provided data on 34 sites. Another study completed by JHK & Associates for the Maryland-National Capital Park and Planning Commission involved the collection of mode split and trip generation data at sites along the Metrorail Red Line in Montgomery County. The Council of Governments (COG) has also conducted studies at several sites in the downtown and at the Van Ness-UDC station. Mode share and trip generation data has been collected over the past year and half at the NRC Building near the White Flint station.

Data from a number of other sites in these studies has been included in the appendix B of this report. This data can be used for comparative purposes or for additional points of reference at rail stations other than those included in this study. In general, the data from the several studies support one another. Data from the downtown sites, collected by COG suggest a high transit mode share, as would be expected. Several tables of data from these studies are provided in Appendix B.

Table 31. Hotel Surveys
Respondents Opinions by Mode of Travel

Q12: People should be encouraged to use transit.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	308	(89.8%)	149	(93.7%)	49	(92.5%)	78	(94.0%)	584	(91.5%)	520	(87.5%)	1104	(89.6%)
Disagree	9	(2.6)	2	(1.3)	1	(1.9)	1	(1.2)	13	(2.0)	12	(2.0)	25	(2.0)
No Opinion	23	(6.7)	6	(3.8)	3	(5.7)	4	(4.8)	36	(5.6)	59	(9.9)	95	(7.7)
Not Answered	3	(0.9)	2	(1.3)	0	(0.0)	0	(0.0)	5	(0.8)	3	(0.5)	8	(0.6)
Total	343	(100.0)	159	(100.0)	53	(100.0)	83	(100.0)	638	(100.0)	594	(100.0)	1232	(100.0)

Q13: Schedule information is readily available for transit.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	219	(63.8%)	123	(77.4%)	40	(75.5%)	64	(77.1%)	446	(69.9%)	354	(59.6%)	800	(64.9%)
Disagree	61	(17.8)	21	(13.2)	10	(18.9)	11	(13.3)	103	(16.1)	118	(19.9)	221	(17.9)
No Opinion	60	(17.5)	13	(8.2)	3	(5.7)	8	(9.6)	84	(13.2)	120	(20.2)	204	(16.6)
Not Answered	3	(0.9)	2	(1.3)	0	(0.0)	0	(0.0)	5	(0.8)	2	(0.3)	7	(0.6)
Total	343	(100.0)	159	(100.0)	53	(100.0)	83	(100.0)	683	(100.0)	594	(100.0)	1232	(100.0)

Table 31. Hotel Surveys
Respondents Opinions by Mode of Travel
(Continued)

Q14: Metrorail is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	264	(77.0%)	144	(90.6%)	47	(88.7%)	65	(78.3%)	520	(81.5%)	424	(71.4%)	944	(76.6%)
Disagree	3	(0.9)	3	(1.9)	1	(1.9)	2	(2.4)	9	(1.4)	2	(0.3)	11	(0.9)
No Opinion	74	(21.6)	10	(6.3)	5	(9.4)	16	(19.3)	105	(16.5)	166	(27.9)	271	(22.0)
Not Answered	2	(0.6)	2	(1.3)	0	(0.0)	0	(0.0)	4	(0.6)	2	(0.3)	6	(0.5)
Total	343	(100.0)	159	(100.0)	53	(100.0)	83	(100.0)	683	(100.0)	594	(100.0)	1232	(100.0)

Q15: Metrobus is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	128	(37.3%)	61	(38.4%)	19	(35.8%)	26	(31.3%)	234	(36.7%)	188	(31.6%)	422	(34.3%)
Disagree	26	(7.6)	16	(10.1)	6	(11.3)	3	(3.6)	51	(8.0)	23	(3.9)	74	(6.0)
No Opinion	181	(52.8)	77	(48.4)	28	(52.8)	53	(63.9)	339	(53.1)	380	(64.0)	719	(58.4)
Not Answered	8	(2.3)	5	(3.1)	0	(0.0)	1	(1.2)	14	(2.2)	3	(0.5)	17	(1.4)
Total	343	(100.0)	159	(100.0)	53	(100.0)	83	(100.0)	683	(100.0)	594	(100.0)	1232	(100.0)

Note: Not answered refers to people who specified their mode of travel but do not answer the question. Missing values refer to people who answered the question but did not specify their mode of travel.

ANALYSIS OF TRENDS AND RELATIONSHIPS

This chapter discusses the development of mathematical relationships between transit ridership and the characteristics of building sites, and provides peak hour generation rates for the buildings based on cordon counts and/or estimates made based on the survey results. Data from the previous study has been included in this analysis and the differences are highlighted. The primary objective of these analyses was to refine and if possible, expand the tools developed in the first study for use in land use and transportation planning in the vicinity of Metrorail stations. The development of mathematical relationships is presented first, followed by summaries of trip generation rates.

MATHEMATICAL RELATIONSHIPS BETWEEN TRANSIT RIDERSHIP AND SITE CHARACTERISTICS

- What type of development is most appropriate?
- What percent of employees, residents, or patrons will come by transit?
- How many vehicle trips will be generated?
- How can vehicle trips be minimized while transit ridership is encouraged?

The answer to these questions and others has implications on the roadway facilities required, on the amount of parking needed, and on the utilization of the transit system.

There is no foolproof method of predicting what transit mode share will be. Each building and its occupants are unique, in terms of the travel habits and O/D characteristics of its employees, the cost and supply of parking, age, sex, income etc. For example, a building that houses primarily real estate and insurance personnel will be different than for a building that houses primarily medical professionals. However, trends and typical relationships between transit ridership and certain site factors can be developed. In this study and the previous WMATA study the technique applied was multiple regression analysis. Regression analysis enables the development of mathematical equations that best explain the variation in a dependent variable (transit mode share in this case) on the basis of one or more independent variables such as distance to a metrorail station, number of employees, size of building etc. The resulting equations provide a reliable estimate of the transit mode share. It must be understood, however, that these are not perfect predictors but only tools to be used for general

planning purposes. Individual sites may have transit ridership characteristics that vary widely from the norm. This study has focused on site characteristics that influence transit ridership. However, characteristics of the transit system and the road network also influence transit ridership along with land use characteristics of the general area. Other studies have developed tools based on these and other characteristics. The tools developed in this study must be used in conjunction with the other planning tools available.

The data collection for this study was designed to collect data related to site characteristics, however some of the data collected relates to characteristics of the system and the region as a whole. The implications of these data are discussed where possible. However, to gain the full benefit of the data it must used to supplement other data sources such as demographic and socioeconomic data provided by COG.

The analysis of the data was undertaken in three steps. The first step was to tabulate the data and perform a comparison between this study and the first WMATA study. The data from this survey was in general very similar to that of the first study with the exceptions noted previously. The first study undertook a stepwise regression and produced correlation matrices between pairs of dependent and independent variables. The second step verified correlations between selected variables developed in the first WMATA study based on the survey results and then equations were developed that were practical for planning purposes. The final step involved the merging of the results from the two studies and other data sources where possible to produce a composite set of equations based on the total data available. While some variables that are highly correlated are not practical for inclusion in the equations, their possible implications are discussed.

The candidate dependent and independent variables considered throughout the two studies are discussed below. Suggested planning equations are presented, and the equations are portrayed graphically.

Office

The following candidate dependent and independent variables were identified in the office regression analysis:

Candidate dependent variables

- percent of work trips by auto

- percent of work trips by transit
- percent of work trips by walking
- percent of all mid-day trips by auto
- percent of all mid-day trips by transit
- percent of all mid-day trips by walking
- percent of non-walk mid-day trips by auto
- percent of non-walk mid-day trips by transit
- average auto occupancy

Candidate independent variables

- auto availability
- distance from the DC core, measured in airline miles between the Metrorail station and the closet edge of the DC core area. This distance was considered to be 0 for Farragut West, Metro Center, and Union stations.
- development setting: downtown DC, inside the Beltway, outside the Beltway
- employer type: multiple tenant, single tenant, private sector, government
- number of employees
- employees per 1000 square feet
- GSF gross square feet of building floor area
- percent of those residing in the same state as they work
- distance of the building from the station portal
- percent of drivers with free parking
- cost of parking
- parking spaces per 1000 GSF
- cost for transit users (dollars per day for round trip)
- household size

The philosophy in developing the candidate variables was to include all possible factors that could explain variations in travel characteristics and for which data were available. There are very fine differences between some of the variables (e.g., those

related to cost). Others, such as the auto and transit variables, are complements of one another. Emphasis was placed primarily on developing equations to explain the variations in transit mode share, both for work trips and mid-day trips. Experimenting was also done with several of the other candidate dependent variables.

Factors were only included in an equation if they added significantly to the explanatory power of the equation as a whole. The explanatory power is summarized in the R-squared statistic and is the proportion of the variance in the dependent variable that can be "explained" by the independent variables. If all the variance could be explained, the R-squared value would be 1.0. Several other tests also need to be conducted to determine the extent to which the given equation is valid. Several observations from the regression analysis are discussed below:

When all sites from both studies are included in the data set, the development type is the most correlated with the percent of work trips by transit. This is because of the dramatic difference between the transit mode share for downtown and suburban sites.

When broken into groups by location within the metropolitan area, the most important variable is the distance from the building to the Metrorail station portal.

Including other variables such as auto availability, transit costs, parking, costs, etc. does not significantly increase the R-squared value and are not as easily used in planning applications.

Considered on their own several other non-site factors (household size, auto availability, transit availability) do exhibit mathematical relationships which can be used if information is available to confirm predictions based on site factors.

The expanded data set was used to refine the two sets of equations developed in the first study, one for downtown sites and another for suburban sites. Equations were developed to predict transit mode share for commute trips and for non walk midday trips.

Equations for Downtown Offices

Only one building was surveyed in downtown Washington for this study. The addition of this site to the data base resulted in only a slight change to the suggested equation. The suggested equation is:

$$T = 61.37 - 0.76 * (M)$$

(T = Transit Mode Share)
(M = distance from Metro)

The R-squared value for this equation is a moderate .57, only a slight improvement over the original equation. The equation is graphed in Figure 31. The equation indicates that the transit mode share for a building directly adjacent to a station portal would be slightly over 60 percent. This would decrease by 0.76 percent for each 100 feet distance from the station portal. Intuitively one would not expect the relationship between transit mode share and Metro to be linear. It is more likely that the transit mode share would stay fairly level up until a certain distance is from Metro and then begin to fall off more dramatically as the distance from the station is increased and then leveling off again at the farthest distances. Testing of a non linear relationship with the current data resulted in a curve that dropped off quicker near the station portal and than leveled off similar to the relationship found in two Canadian cities as illustrated in Figure 32. The R^2 of a non-linear equation was slightly better, however, it was felt that without more data the linear relationship was the most appropriate and would suffice as an approximate planning tool producing similar results for distances between 200 and 2,000 feet. Based on the available data from these studies and similar studies elsewhere the proposed equation probably underestimates transit mode share for building sites near a rail station and overestimates transit mode share at more distant sites. This equation should not be considered to be the final answer, but should be modified as the system and the land around it develops. More data is required to better define the equation and improve its validity.

The following equation is suggested to explain the transit mode share for mid-day non-walk trips:

$$T = 62.76 - 1.12 * (M)$$

(T = Transit Mode Share)
(M = distance from Metro)

The R-squared for this equation is 0.33 which is relatively poor. The fact the addition of one site reduced the R-squared from 0.52 to 0.33 illustrates the need for a larger database to improve validity.

The mid-day equation is shown in Figure 33. It is important to note that the equations should not be extended beyond the limits of the available data without more data collection.

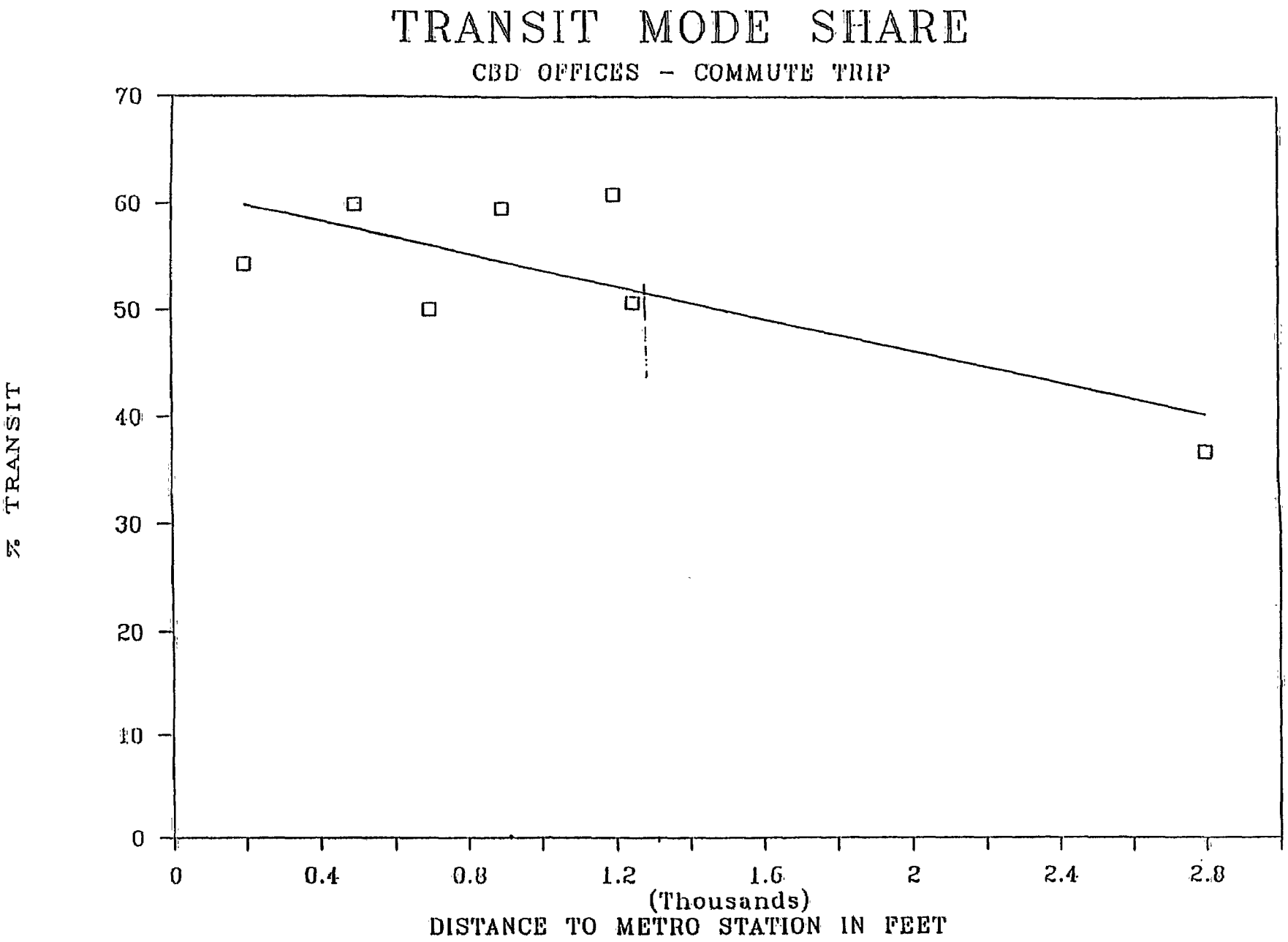
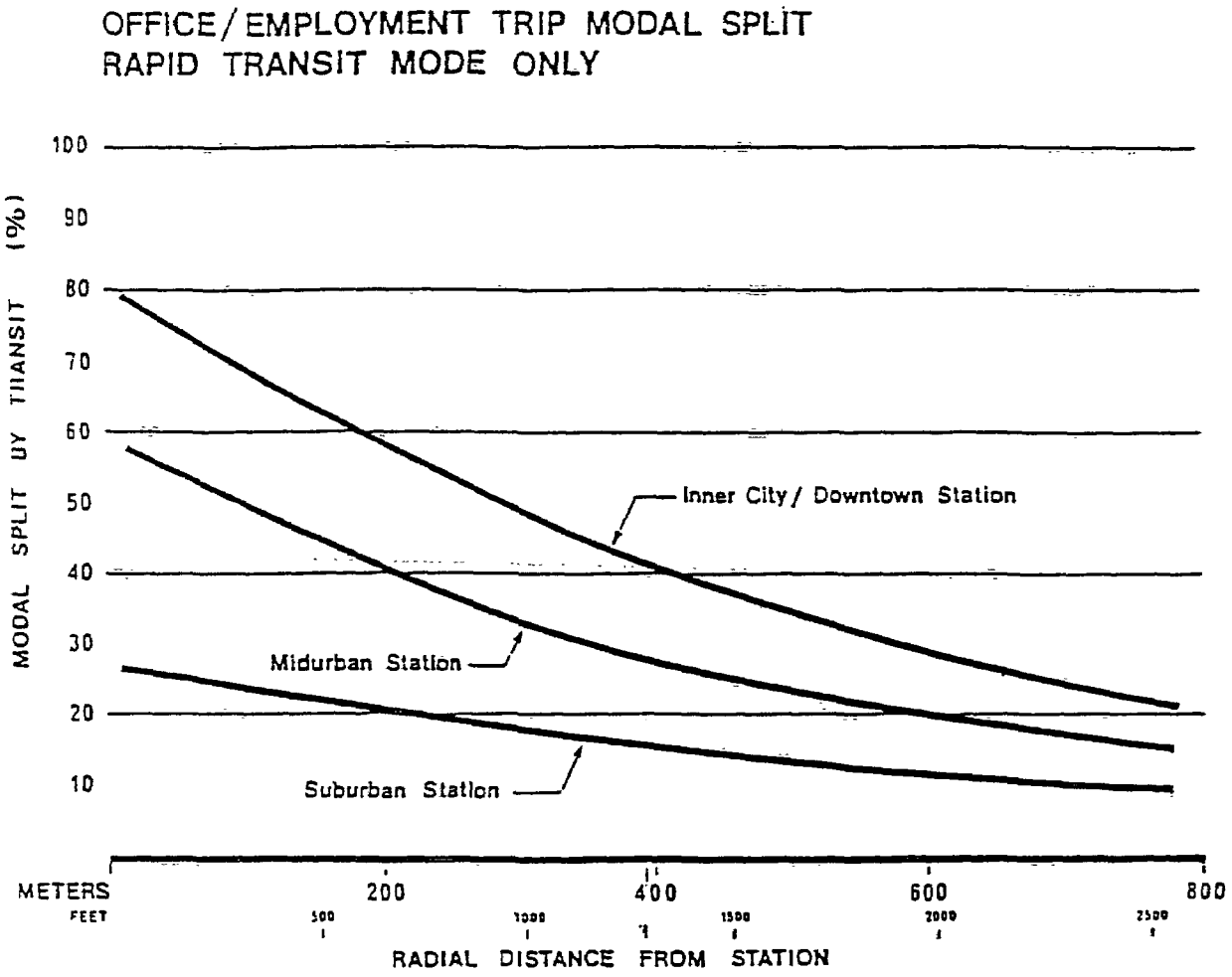

TRANSIT MODE SHARE
CBD OFFICES - COMMUTE TRIP
% TRANSIT
70
60
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
2.8
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 31.

RAPID TRANSIT MODE SPLIT FOR OFFICE WORK TRIPS
VERSUS WALK DISTANCE TO STATION



Source: Stringham 1983

Figure 32.

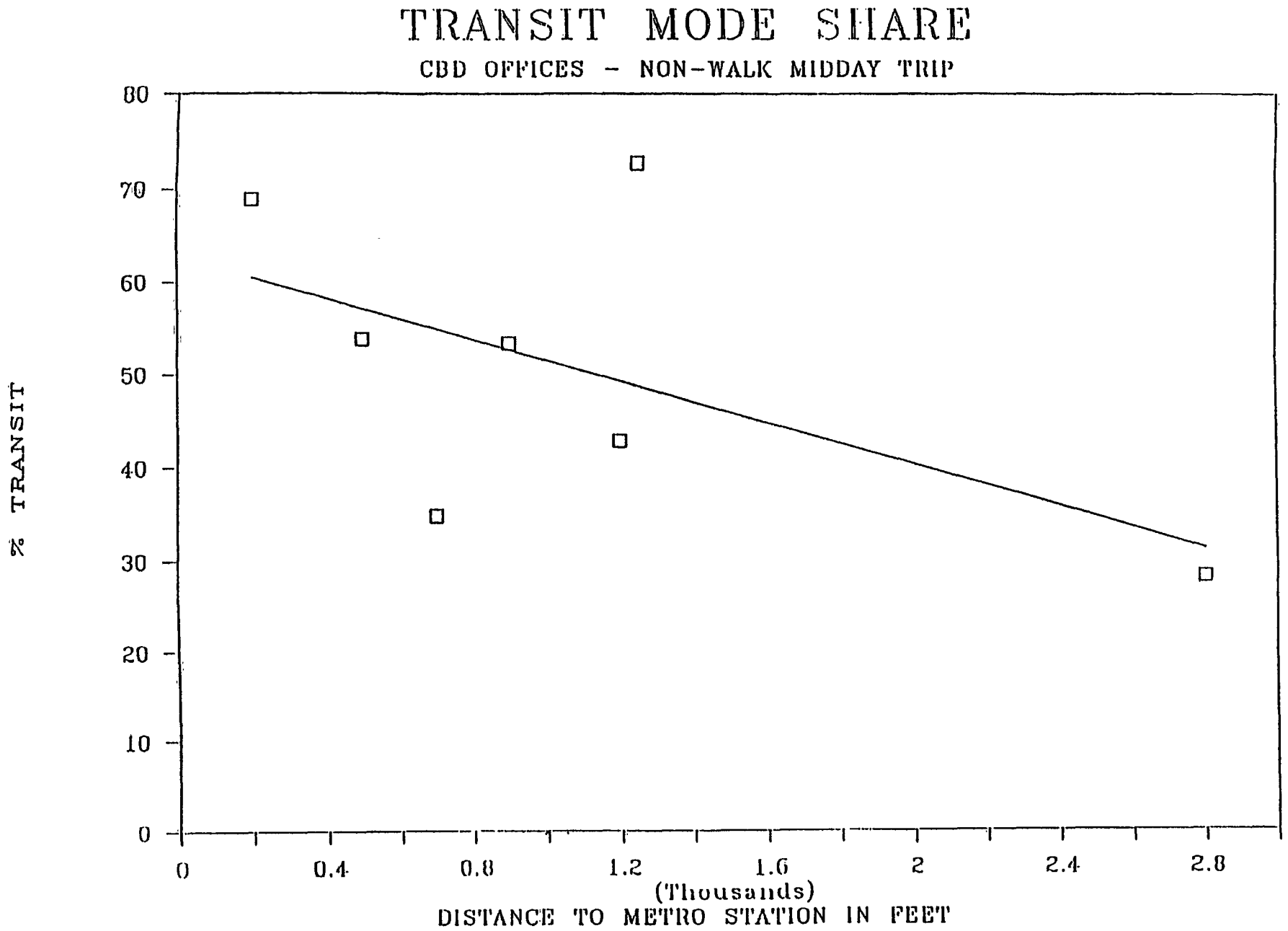

TRANSIT MODE SHARE
CBD OFFICES - NON-WALK MIDDAY TRIP
% TRANSIT
80
70
60
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
2.8
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 33.

Equations for Suburban Offices

For suburban offices, the following equations are suggested incorporating two independent variables - distance from the DC core, and distance from Metro. Equations that incorporate all applicable data from the first study, the Red Line study and this study are recommended. The equation for the [redacted] is:

$$T = 27.16 - 0.61(M) - 0.84(D)$$

(T = Transit Mode Share)
(M = distance from Metro) — hundred feet
(D = distance to ~~downtown~~ core or metro center) — airplane miles

The R-squared is 0.57. The equation for [redacted] non-walk trip is:

$$T = 33.31 - 0.86(M) - 1.63(D)$$

The R-squared for this equation is 0.47.

These equations are considered to be more valid as they include 40 sites for the commute trip and 18 sites for the mid-day trips. This is considerably more than in the first study. As well there are buildings covering the full range of distances. As indicated by the R-squared values there is a better relationship for the commute trip. The two equations are graphed on Figures 34 and 35 respectively.

Residential

The candidate variables for residential sites were as follows:

Candidate dependent variables

- percentage of all trips by auto
- percentage of work trips by auto
- percentage of all trips by transit
- percentage of work trips by walking

Candidate independent variables

- average age of residents
- distance from the DC core

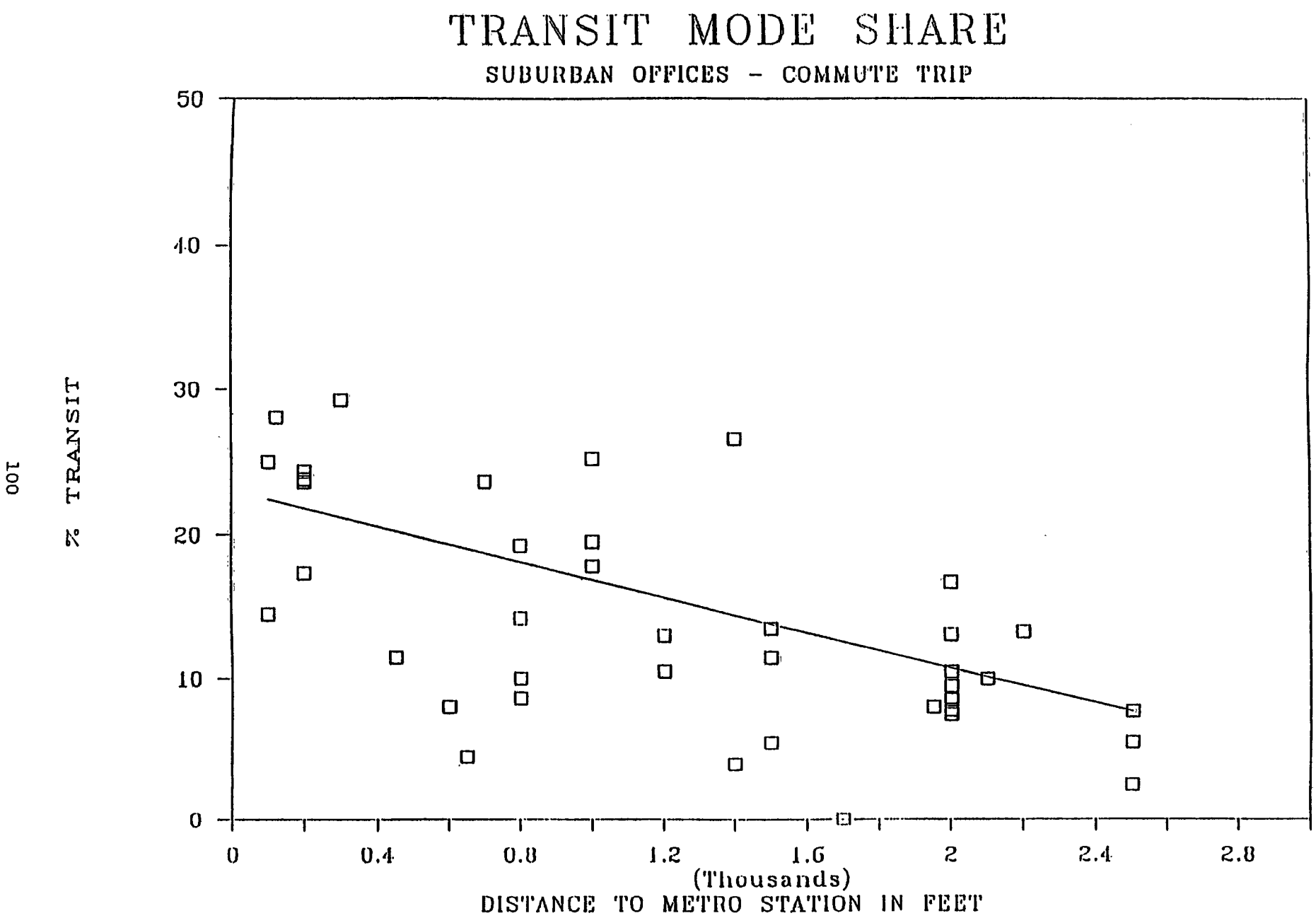

TRANSIT MODE SHARE
SUBURBAN OFFICES - COMMUTE TRIP
% TRANSIT
100
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
2.8
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 34.

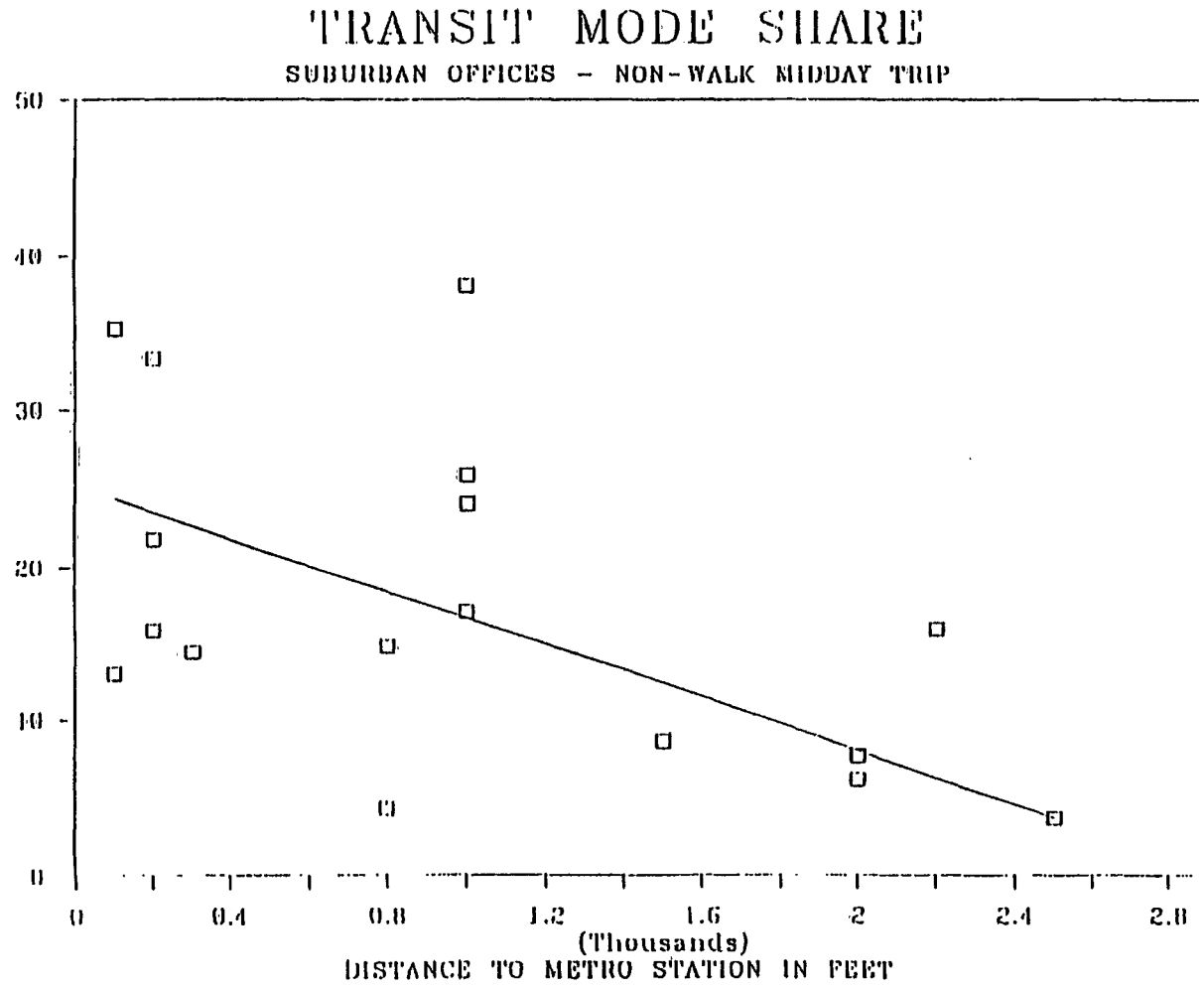

TRANSIT MODE SHARE
SUBURBAN OFFICES - NON-WALK MIDDAY TRIP
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
2.8
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 35.

- percentage of those employed
- distance from the station portal
- average number of residents per dwelling unit
- number of parking spaces per dwelling unit
- monthly parking cost per vehicle
- number of dwelling units
- average number of vehicles per dwelling unit

Based on the expansion of the data base the equation was modified to the following:

RESIDENTIAL

$$T = 66.52 - 1.56\ (M)$$

(T = Transit Mode Share)
(M = distance from Metro)

The R-squared of 0.40 is slightly improved over the original equation but is still relatively poor. The database has been expanded to include 18 buildings. Sites further than half a mile from the station and those sites outside the Beltway were excluded. If these sites are included the R-squared is reduced noticeably. Due to limitations in the data collected for this study the equation for all trips from residential studies remains unchanged:

$$T = 51.5 - 0.66 * (M)$$

(T = Transit Mode Share)
(M = distance from Metro)

The R-squared for this equation is 0.34. The new equation is graphed in Figure 36.

Retail

The candidate variables for the retail analysis included:

Candidate dependent variables

- percentage of shopping trips by auto
- percentage of shopping trips by transit

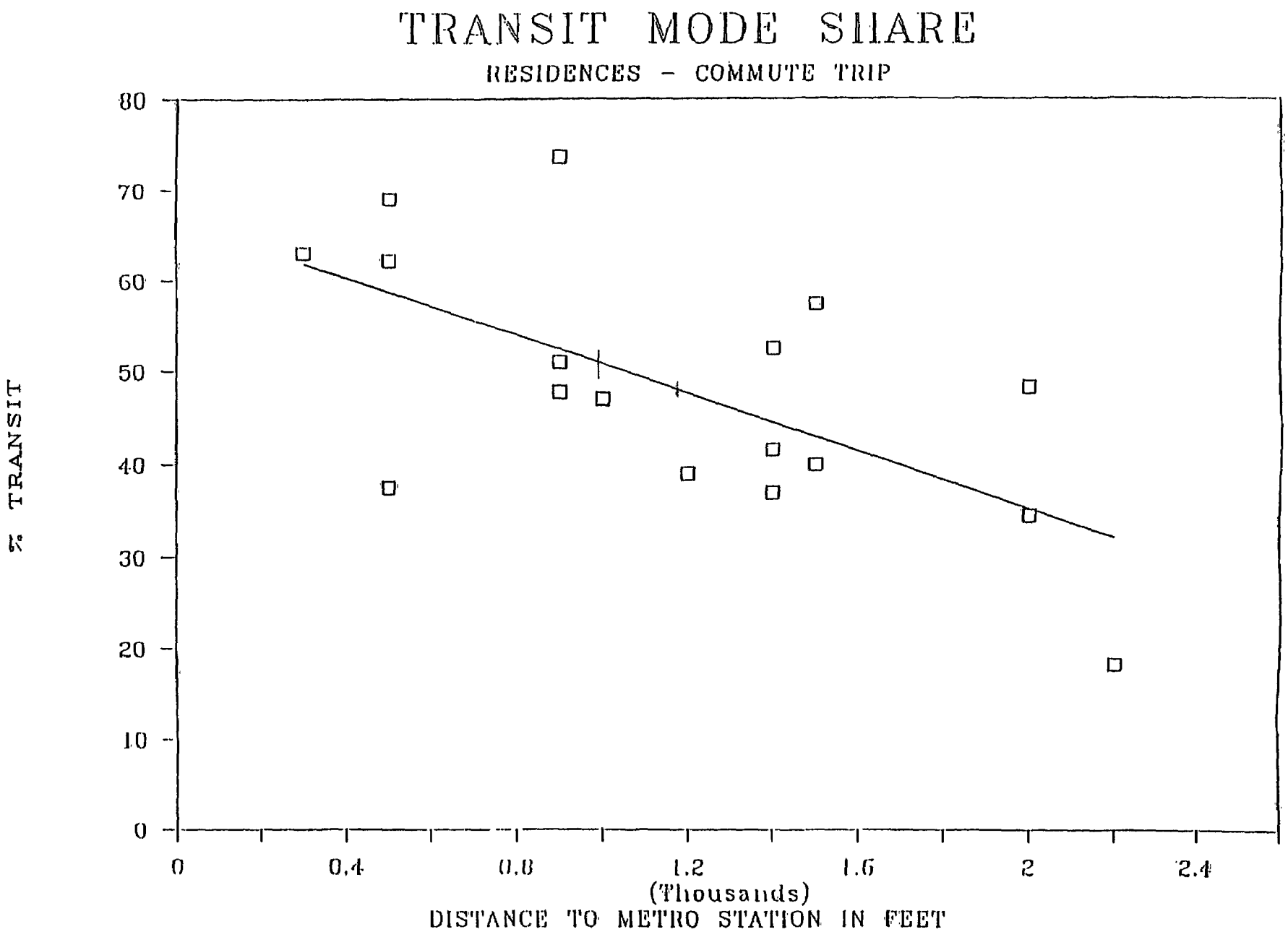

TRANSIT MODE SHARE
RESIDENCES - COMMUTE TRIP
% TRANSIT
80
70
60
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 36.

Candidate independent variables

- development setting (downtown or suburban)
- distance from the DC core
- GSF gross square feet in 1000's
- distance from a Metrorail station
- Market draw (regional or local)[1]

With the expanded database available it was possible to include both distance to DC and distance to a Metro station in the proposed equation. The equation when based on data from this study is:

$$T = 49.18 - 0.15(M) - 2.16(D)$$

(T = Transit Mode Share)
(M = distance from Metro)
R-squared = 0.50

When an equation using the most recent data available from all studies is developed the equation is as follows:

[redacted]

(T = Transit Mode Share)
(M = distance from Metro)
R-squared = 0.64

This equation includes 28 sites covering the full range of distances. The R-squared values are lower than for the first study but represent a much bigger database and should therefore be considered more valid. Caution should be exercised when using these equations as one of the findings of this study is that transit mode share to retail sites has increased from the time of the first WMATA study. This emphasizes the fact that these equations must be reviewed over time as the system and the areas it serves develop. These equations are graphed in Figures 37 and 38 respectively.

[1] Market draw refers to the target market of the establishment. An example of a retail site with local draw would be a shopping center with tenants such as a bank, a 7-11 store, dry cleaners, etc. A retail site with regional draw would be a larger shopping center with major anchor tenants. An example would be Ballston Common.

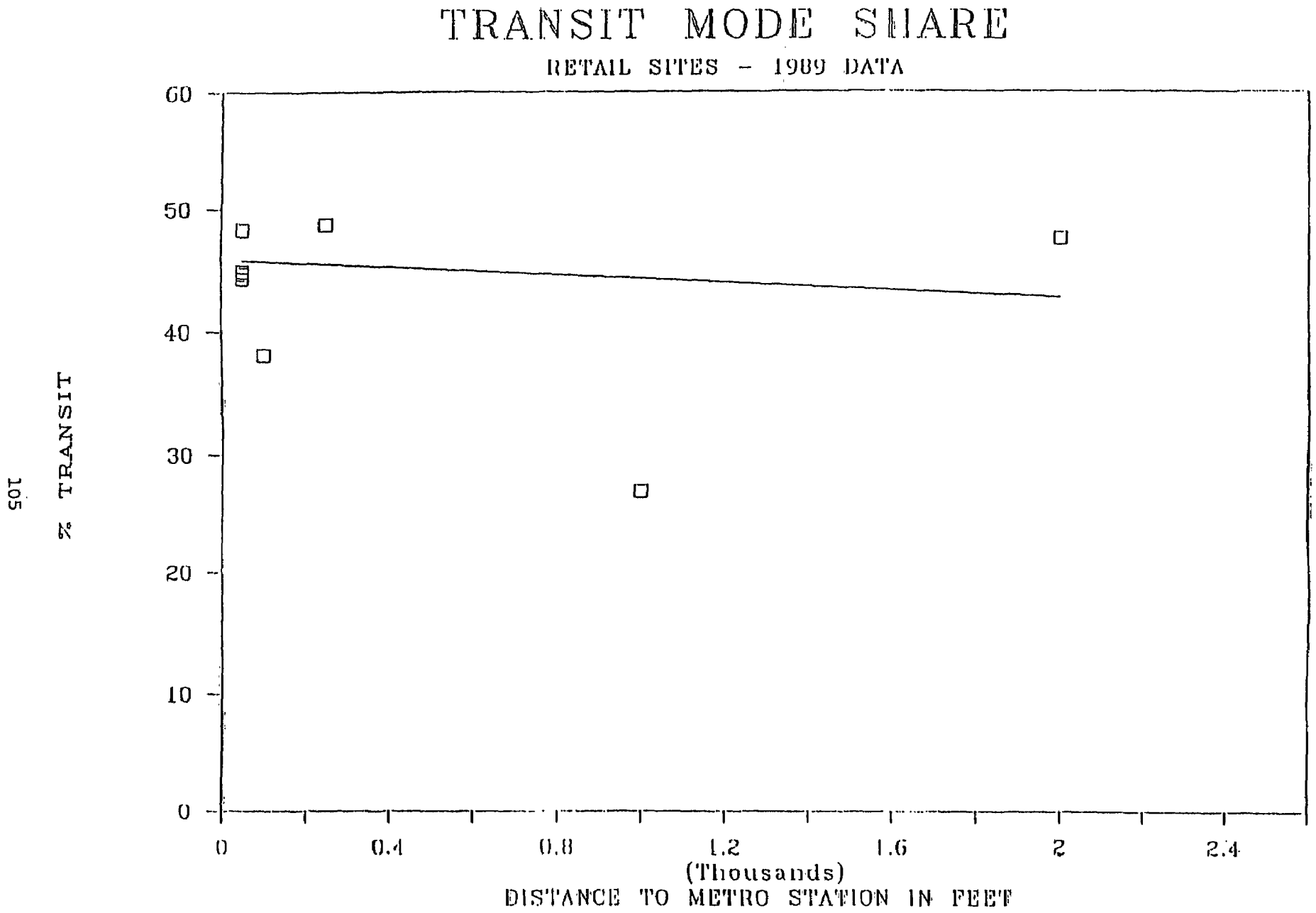

TRANSIT MODE SHARE
RETAIL SITES - 1989 DATA
60
50
40
30
20
10
0
% TRANSIT
0
0.4
0.8
1.2
1.6
2
2.4
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 37.

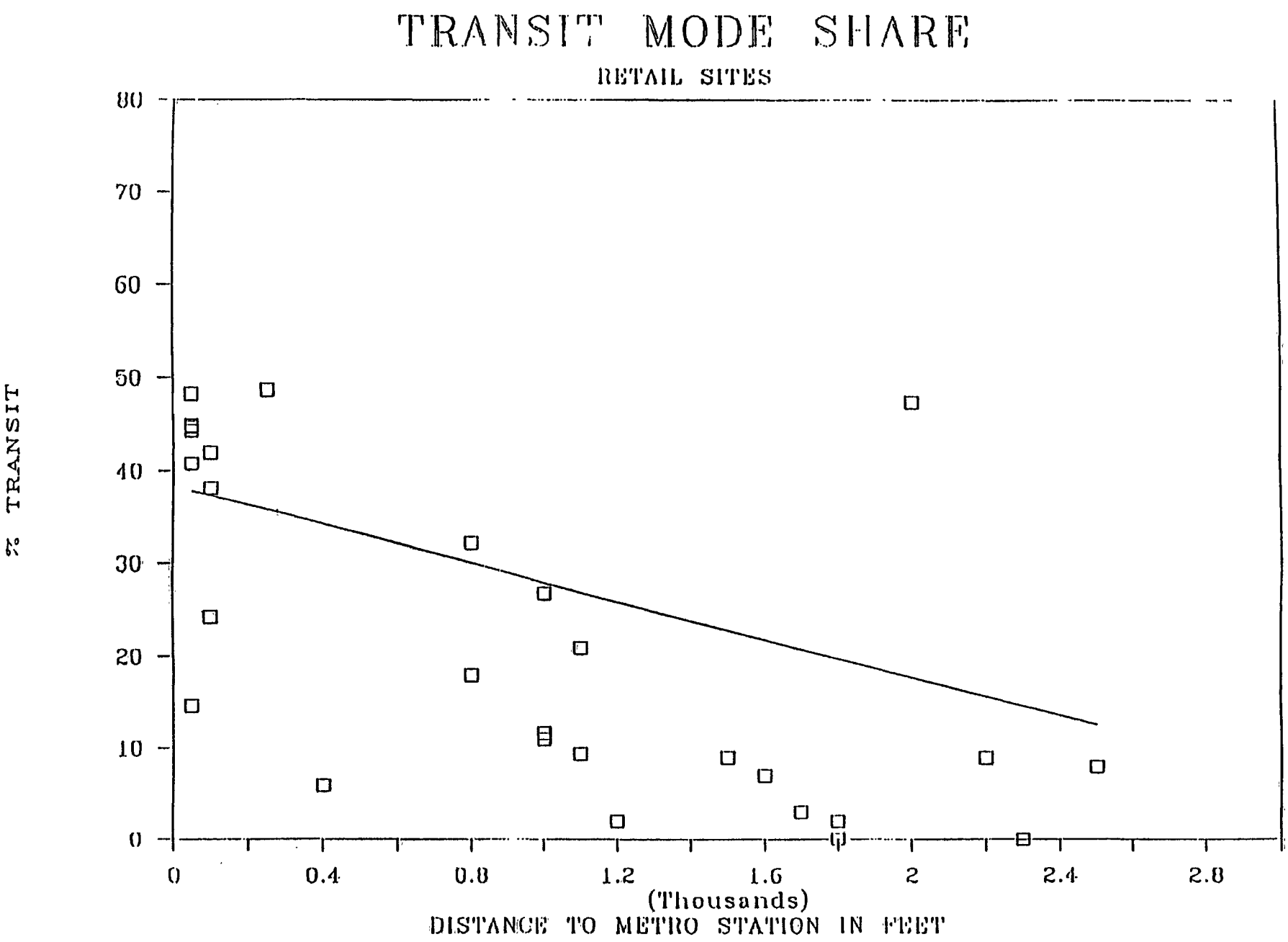

TRANSIT MODE SHARE
RETAIL SITES
% TRANSIT
80
70
60
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
2.8
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 38.

Hotel

The candidate variables for the hotel regression analysis included:

Candidate dependent variables

- percent of trips by transit for conference attendees
- percent of transit by overnight guests

Candidate independent variables

- development setting
- distance from DC core
- distance from a Metro Station
- number of parking spaces
- number of guest rooms

Due to the wide variance in results between the two studies the results were not combined. Unlike the first study there was no apparent relationship between transit mode share and the distance to DC. No correlation was apparent for conference attendees. For hotel guests there was a correlation between transit mode share and the distance to a Metro station portal. The equation suggested for hotel guests is:

$T = 34.09 - 0.77(M)$	R-squared 0.87	(T = Transit Mode Share)
$LN(T) = 3.20 - 0.038(M)$	$R^2 = 0.63$	(M = distance from Metro)

This equation is graphed on Figure 39.

As with the retail sites the fact that the results differ substantially from the first study indicates that caution must be exercised when attempting to use the results and the equation developed herein. As was discussed previously transit mode share for hotels is no doubt subject to more variability from day to day than for any of the other land uses and the data from hotels to date does not allow any "average" or "typical" transit mode share to be established with any degree of confidence.

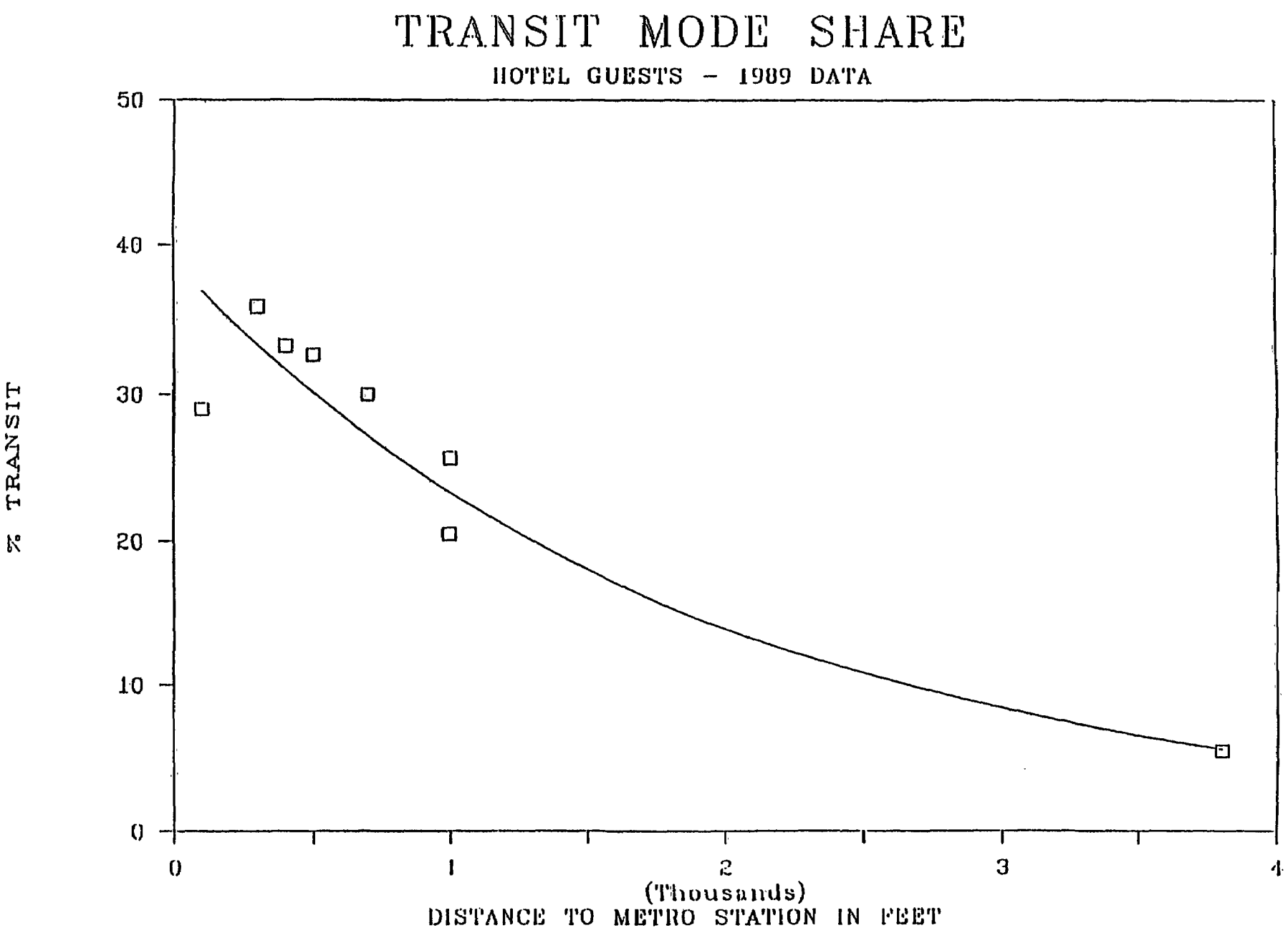

TRANSIT MODE SHARE
HOTEL GUESTS - 1989 DATA
% TRANSIT
50
40
30
20
10
0
0
1
2
3
4
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 39.

Relationships for Non-Site Factors

As discussed earlier in this report other factors also influence transit mode share. Distance to a Metrorail station or the distance from DC can only be used to predict transit mode share and ridership assuming these other factors remain constant from site to site. Of course this is not true, and despite the fact that specific information concerning many of these other factors is often not available during the planning for many developments, an effort should be made to estimate their impact. It should be noted that while individual factors may be well correlated with transit mode, they are not necessarily well correlated with the distance to a Metrorail station. Thus a combined equation will not always produce a higher R^2. However, the relationship between a number of these factors is well correlated with transit mode share and should be considered, at least in a subjective manner.

Transit mode share decreases as average household size increases. This relationship is due to a number of factors such as the fact that larger households prefer single family or lower density housing which is often located further from rail stations and transit is not considered an alternative. If the distribution of household size is known for potential "origin stations," estimates of transit mode share by distance can be modified up or down. The equation suggested by the data from the workplace surveys is:

$$T = 201.6 - 67.7 \text{ (persons/household)} \qquad R^2 = 0.73$$

This is graphed on Figure 40.

Another relationship with a relatively good correlation is that of transit availability. The suggested equation is:

$$T = 35.6 + 1.23 \text{ (\% surveyed with convenient transit connections)} \qquad R^2 = 0.54$$

This is graphed on Figure 41. The fact that some sites with low transit mode share were close to a Metrorail station are explained to a large extent by examining the data concerning transit availability. Respondents at these offices reported poor transit availability, since the availability is known at the site this indicates the problem is at the origin end. In summary this relationship illustrates the somewhat obvious fact that good transit connections are required at both ends. As with household size there


WORKPLACE SURVEYS
HOUSEHOLD POPULATION/TRANSIT USE
Percent Transit for Office Sites
55
50
45
40
35
30
25
20
15
10
5
0
2.3
2.5
2.7
2.9
Persons per Household

Figure 40.

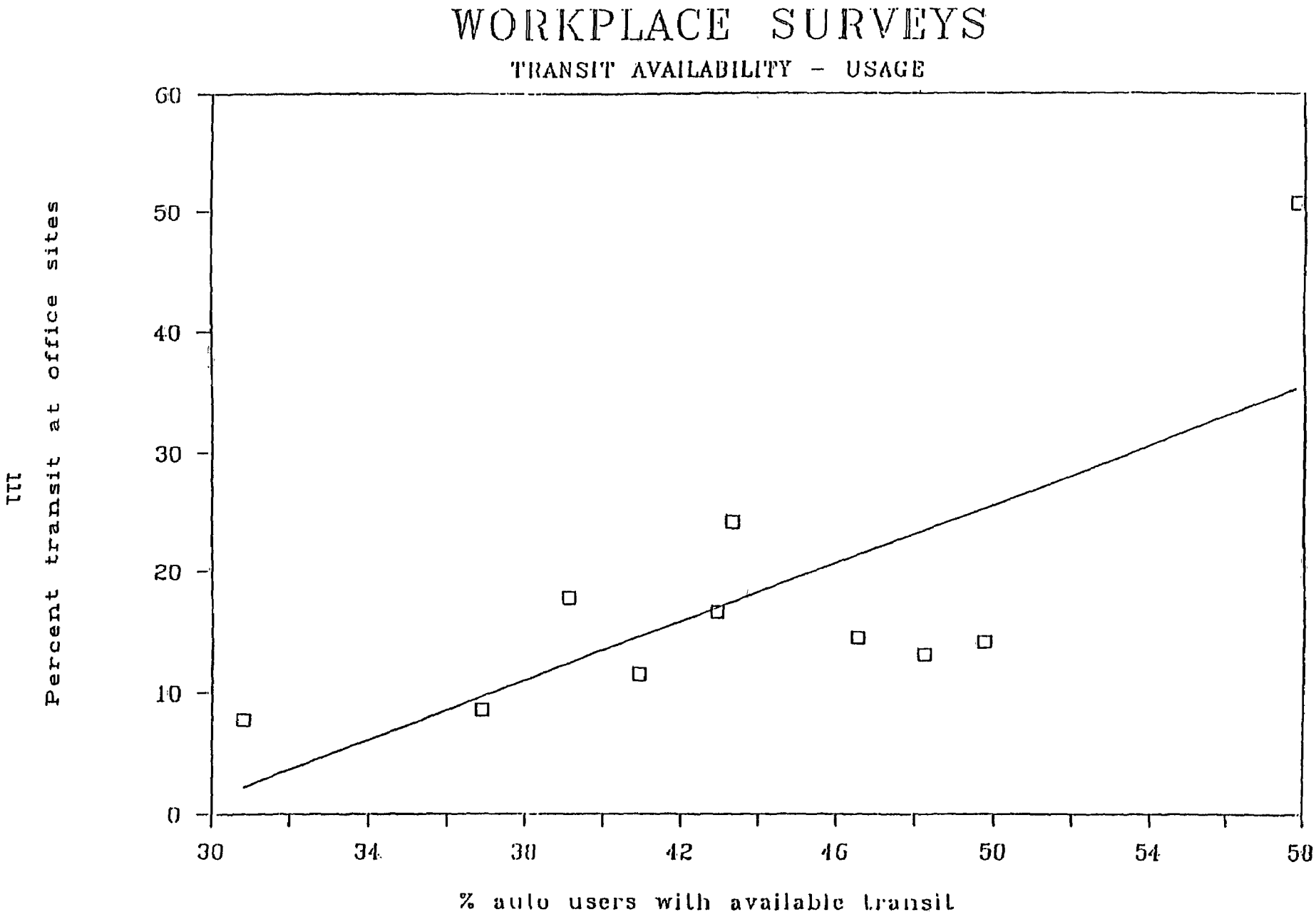

WORKPLACE SURVEYS
TRANSIT AVAILABILITY - USAGE
Percent transit at office sites
60
50
40
30
20
10
0
30
34
38
42
46
50
54
58
% auto users with available transit

Figure 41.

is often not enough information available at planning level to justify incorporating this in planning equations but is a relationship that can be used to modify results.

Finally as discussed previously autos per household is well correlated with transit mode share. The equation suggested is:

$$T = 130.1 - 56.1 \text{ (autos/household)} \qquad R^2 = 0.60$$

If a planner knows the average auto ownership for the labor market surrounding a proposed office development, transit mode share estimate based on distance can be refined. This relationship is graphed in Figure 42.

Summary of Regression Analysis

The equations presented in the above sections represent an updated version of equations developed in the first study reflecting both an increased database and to the degree possible the current development level of both the system and the station areas. As has been stated previously, however, it is important to recognize the limitations of the data, such as the limited sample sizes and ranges of independent variables and the variability of mode share for land uses such as hotels when considering an application of the equations. Well correlated relationships between independent and transit mode share often provide contradictory results for any specific site. The planner/engineer must exercise professional judgment in interpreting results for a specific site. As has been illustrated by changes between the two studies, it must be recognized that these relationships will change over time, based on the extent of the transit system and development trends in the urban area. With these cautions in mind, the suggested equations should be reasonable approximations of average transit mode shares for the next several years.

TRANSIT TRIP GENERATION RATES

Knowledge of the transit trip generation potential of various development types would significantly assist in land use planning decisions to optimize the development of land around each Metrorail station area. With this in mind cordon counts were conducted for extensive periods at most sites. The only sites excluded were those sites where through trips were impossible to keep track of or where it was difficult to cordon

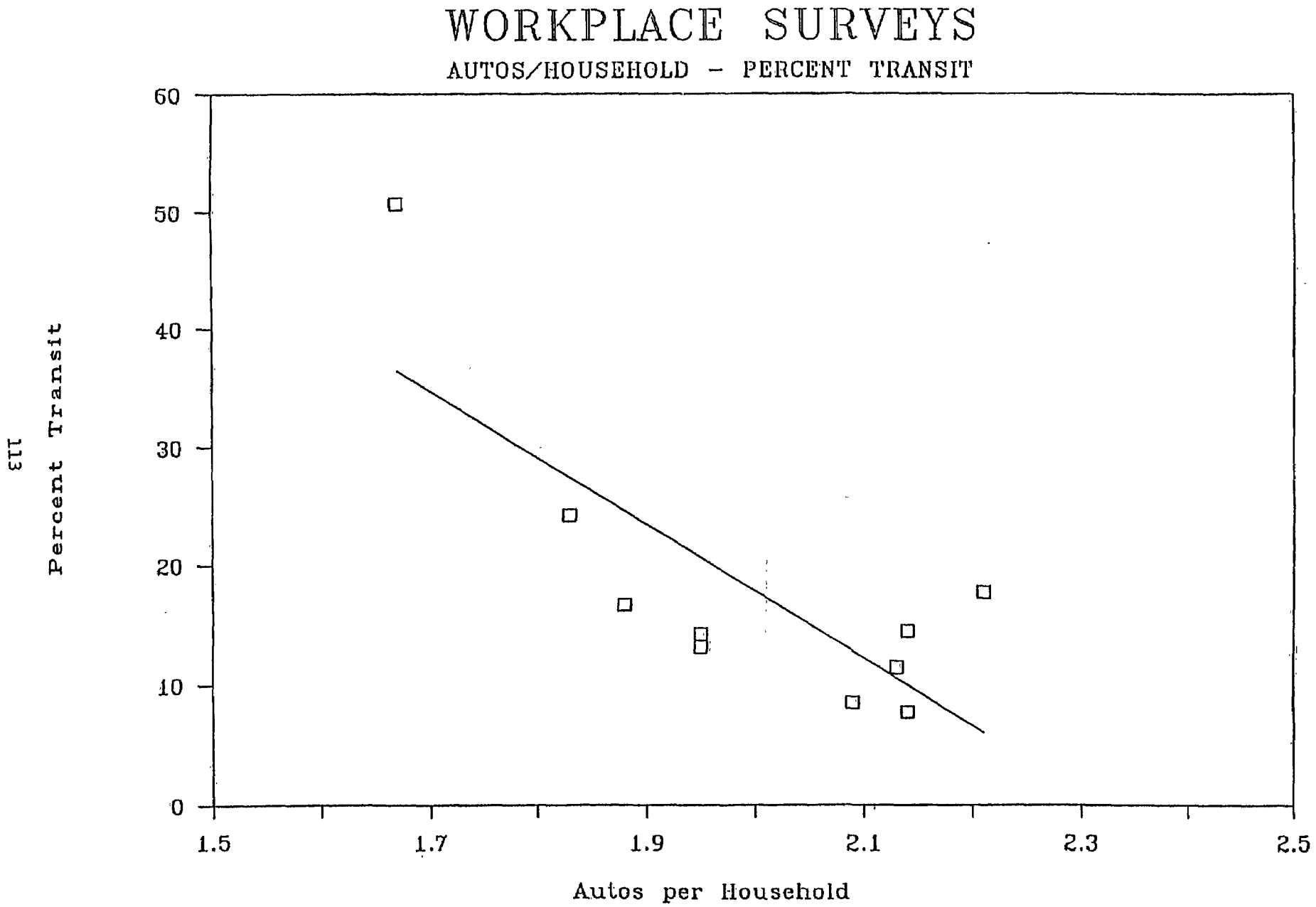

WORKPLACE SURVEYS
AUTOS/HOUSEHOLD - PERCENT TRANSIT
Percent Transit
60
50
40
30
20
10
0
1.5
1.7
1.9
2.1
2.3
2.5
Autos per Household

Figure 42.

off. The counts are expressed in terms of person trips and where possible vehicle trips. Although it must be noted that the vehicle trips represent only those trips from the site itself. At many locations, particularly offices, there is considerable off-site parking. At residential sites the counts do accurately represent the auto trip generation. Combined with the results of the surveys, transit trips can be estimated.

Tables 32 to 35 summarize the results of the cordon counts. Copies of the cordon counts are contained in the technical appendix. In general, the daily person trip generation rate is consistent with rates found in other literature. However, the peak hour trip generation rates are lower than average. This is explained by the flatness of the peak, there are 2 to 3 hours of almost equal trip generation for most sites.

A summary analysis similar to that undertaken in the first study was conducted to bring together the results in a form that could be interpreted for land use and transportation planning purposes. Table 36 presents a comparison of the transit trip generation rates for the four land use types on a consistent basis of trips per 1000 GSF of floor space. Residential and hotel rates are not normally expressed this way, and assumptions had to be made regarding the ratio of square footage to dwelling units and the number of hotel rooms. Exact figures were not available for the buildings studied. To allow comparison between the two studies the same assumptions were made this time. For residential units, 750 square feet per unit was assumed. For hotel, 750 square feet per unit was assumed. Although the actual size of guest rooms for hotels is much smaller, the factor incorporates the large conference, dining and lobby areas associated with the hotels of the type surveyed. Based on this analysis the trip generation rates derived in the first study were revised to reflect to some extent the increased transit mode share for retail and hotel sites. It was felt that the rates should be conservatively increased considering all data available. Previous values are shown in brackets where revisions were made.

As was the case in the first study, retail sites generate two to six times the number of person trips as other land uses. In all likelihood this applies only to those retail sites having a regional market draw. Convenience oriented retail or those attracting only local trips, will have a small transit trip generation rate.

In conclusion, office transit trip generation rates have remained relatively constant over the last two years, hotel and retail appear to be improving thus providing increased potential for off peak usage. All four land uses have significant potential for transit trip generation. At the risk of stating the obvious, this study reinforces past findings that transit is highly dependent on convenient walk access and, therefore,

Table 32. Office Trip Generation

Site	Count Period	Total Ped. In	Total Ped. Out	Peak Hours Hr. Beg.	Peak Hour Trips: Pedestrians In	Pedestrians Out	Vehicles In	Vehicles Out	Auto Occ.	Mode Share: Auto	Mode Share: Non-Auto	Peak Hour Trip Gen. Rate Persons
1701 Penn.	7 am-10 am	266	58	8:45	153	36	--	--	--	--	--	1.08 per 1000 sq.ft.
	3 pm-6 pm	145	240	3:15	64	63	--	--	--	--	--	.72
Ballston One	8 am-10 am	245	72	8:30	159	37	91	9	1.00	51%	49%	.81
	3 pm-6 pm	73	414	4:15	7	258	4	78	1.00	31%	69%	1.10
Silver Spring	7 - 10	265	47	7:00	136	9	18	4	1.00	13%	87%	.97
Metro Center	3 - 6	46	196	4:00	8	123	0	13	1.3	9%	91%	.87
Bell Atlantic	6 - 9	1059	106	7:30	654	55	284	12	1.16	42%	58%	2.01
	3 - 6	191	928	4:30	66	516	10	240	1.10	43%	57%	1.65
East West	7 - 10	602	94	8:15	325	37	--	--	--	--	--	2.01
Towers	3 - 6	299	599	4:45	159	414	--	--	--	--	--	3.18
Bethesda	6:30-9:00	267	91	8:00	204	54	--	--	--	--	--	.86
Metro Center	3 - 6	481	659	3:00	192	267	--	--	--	--	--	1.53
Twinbrook Office Center	1:00 - 6:00 pm	369	354	4:15	78	80	--	--	--	--	--	.95
Parklawn	6:00 - 9:00	3253	311	7:15	1637	129	250	5	1.26	--[1]	--[1]	1.71
Building	3:00 - 6:00	611	4345	4:00	902	2168	40	483	1.43	--	--	2.97
Crystal	7 - 10	1652	843	7:30	659	260	--	--	--	--	--	2.16
Square II	3 - 6	745	1243	3:45	306	469	--	--	--	--	--	1.82
Bethesda	6:30 - 9:30	541	115	8:30	285	65	123	5	1.00	36%	64%	2.08
Office Ctr.	3:00 - 6:00	327	579	5:00	108	319	11	121	1.00	31%	69%	2.54
										30%	68%	

[1] Mode share for site only.

Table 33. Residential Trip Generation

Site	Count Period	Total Ped. In	Total Ped. Out	Peak Hours Hr. Beg.	Peak Hour Trips: Pedestrians In	Peak Hour Trips: Pedestrians Out	Peak Hour Trips: Vehicles In	Peak Hour Trips: Vehicles Out	Auto Occ.	Mode Share: Auto	Mode Share: Non-Auto	Peak Hour Trip Gen. Rate[1]: Persons	Peak Hour Trip Gen. Rate[1]: Vehicles
Crystal Plaza	6:00 - 10:00 AM	245	636	7:45	56	129	22	55	1.32	35%	65%	.34	.14
	2:00 - 6:00 PM	658	671	4:00	155	79	39	87	1.33	42%	58%	.44	.23
Crystal Park Condo	6:00 - 10:00	204	201	7:45	48	45	10	8	1.28	21%	79%	.52	.10
	2:00 - 6:00	228	199	4:45	59	42	11	8	1.26	19%	81%	.56	.11
Crystal Square West	6:00 - 10:00	140	383	7:15									
	2:00 - 6:00	460	382	4:45									
Georgian Towers	6:00 - 10:00	264	763	8:00	48	236	65	69	1.21	24%	76%	.33	.16
	2:00 - 6:00	664	499	4:45	210	98	48	92	1.15	34%	66%	.36	.17
Randolph Towers	6:00 - 10:00	142	414	7:45	34	148	27	42	1.26	32%	68%	.36	.14
	2:00 - 6:00	561	302	5:00	167	93	46	23	1.04	22%	78%	.51	.14
Grosvenor House	6:45 - 10:00	423	384	7:45	41	48	98	79	1.28	72%	18%	.22	.45
	2:00 - 6:00	355	347	4:00	28	29	70	54	1.21	72%	18%	.11	.31
Stoneybrook	7:00 - 10:00	50	224	7:45	2	33	19	63	1.32	79%	21%	.32	.75
	2:00 - 6:00	152	96	4:45	19	0	35	24	1.20	75%	25%	.04	.54
Bethany House	7:00 - 10:00	46	72	9:10	31	47	--	--	--	--	--	.28	--
	2:00 - 6:00	162	182	3:15	51	63	--	--	--	--	--	.41	--
Twin Towers	6:00 - 10:00	300	326	8:15	87	98	87	29	1.05	50%	50%	.59	.37
	2:00 - 6:00	284	269	4:30	75	56	16	53	1.00	31%	69%	.42	.22
Grosvenor Park I	6:00 - 10:00	55	181	7:15	7	18	13	49	1.10	27%	73%	.06	.16
	2:00 - 6:00	148	104	3:30	3	9	27	19	1.13	19%	81%	.03	.12

[1] Trip generation rates are expressed as persons or vehicles per hour per unit.

Table 34. Retail Trip Generation

Site	Count Period	Total In	Total Out	Peak Hours Hr. Beg.	Peak Hour In	Peak Hour Out	Peak Hour Trip Generation Rate[1]	Size 1000 Sq. Ft.
Ballston Common	10:00 AM 6:00 PM	10036	9838	5:00	1817	1944	7.1	530,000
Hecht's Metro Center	10:00 - 6:00	4603	4070	12:30	936	903	3.34	270,000
Union Station	10:00 - 6:00	23817	19799	12:30	3645	3465	9.48	750,000*

[1] per 1,000 square feet.

* Total Development

Table 35. Hotel Trip Generation

Site	Count Period	Total In	Total Out	Peak Hours Hr. Beg.	Peak Hour In	Peak Hour Out	Peak Hour Trip Generation Rate (per room)	No. Rooms
Hyatt Regency	7:00 - 10:00 AM	358	467	8:00	173	245	1.10	380
Bethesda	3:00 - 6:00 PM	492	378	4:00	158	146	.80	
Holiday Inn	7:00 - 10:00	333	305	7:00	148	132	1.23	227
Silver Spring	3:00 - 6:00	393	231	5:00	237	108	1.52	
Hyatt Grand	7:00 - 10:00	620	629	8:30	412	438	.94	
	11:00 - 2:00	1266	1265	12:30	525	522	1.15	907
	3:00 - 6:00	1290	1095	4:45	603	475	1.19	
Holiday Inn	7:00 - 10:00	313	265	8:15	169	128	.94	315
Crowne Plaza	3:00 - 6:00	337	374	3:45	121	160	.89	
JW Marriott	7:00 - 10:00	2132	2094	7:45	831	877	2.21	
	11:00 - 2:00	4965	4653	12:15	2073	1790	5100	773
	3:00 - 6:00	3230	2360	6:45	1635	886	3.26	
Crystal Gateway	7:00 - 10:00	1269	1665	7:45	549	674	1.74	702
Marriott	3:00 - 6:00	1653	1112	5:00	713	482	1.7	
Hyatt Arlington	7:00 - 10:00	251	473	7:15	130	189	1.05	303
	3:00 - 6:00	384	177	5:00	165	87	.83	
Phoenix Park	7:00 - 10:00	107	164	8:45	52	84	1.55	88
Hotel	3:00 - 6:00	76	48	5:00	32	30	.70	
Hyatt Regency	7:00 - 10:00	510	619	7:45	242	369	.89	685
Crystal City	3:00 - 6:00	727	485	5:00	356	170	.77	
Omni Shoreham	7:00 - 10:00	778	774	8:45	399	457	1.11	770
	3:00 - 6:00	842	806	5:00	391	307	.91	

Near Metrorail Stations, by Land Use Type

Land Use	Typical Daily Person-Trip Generation Rate (per 1,000 S.F. GFA)	Typical Daily Transit Mode Share[1]	Estimated Transit Trip Generation Potential (per 1,000 S.F. GFA)
Office			
Downtown	15	35%	5.3
Close-in suburban stations	15	15	2.3
Residential[2]			
Close-in suburban stations	5	40 (35)[3]	2 (1.8)
Retail (major complex)			
Downtown	30	40 (35)	12 (10.5)
Close-in suburban stations	30	25 (15)	7.5 (4.5)
Hotel[4]			
Downtown	14	20 (15)	2.8 (2.1)
Close-in suburban stations	14	15 (10)	2.1 (1.4)

[1] Transit as a percentage of all trips, including walk trips. Transit mode shares as a percentage of non-walk trips would be substantially higher, especially for office and retail uses.

[2] Assumes 750 square feet of building floor space per dwelling unit.

[3] ( ) - values derived as part of Development Related Ridership Survey, 1987.

[4] Assumes 750 square feet of hotel floor space per guest room.

Note: Person-trip generation rates are "typical" rates, derived from a combination of sources, inlcuding data collected in this study, data from the M-NCPPC study of the Metrorail Red Line, and data from the Institute of Transportation Engineers' Trip Generation Manual. Rates for any individual site could vary widely from

relatively dense, compact land use arrangements are essential within most station areas. This development philosophy is good for the metropolitan region as a whole. By locating sizable developments near Metrorail stations transit ridership is increased, thus reducing the overall number of trips in the metropolitan region as a whole. While relatively dense compact development in the station areas can have a dramatic effect in terms of reducing the number of vehicle trips in the region as a whole, local traffic often increases. This can have the effect of increasing the resistance of the surrounding communities towards higher densities. To avoid or minimize this, WMATA must work with the local jurisdictions and various planning agencies to ensure that road network in the station area is adequate. Strategies must be devised to ensure that traffic resulting from station area development does not infiltrate the surrounding communities.

Land use decisions around rail stations are crucial to the continued optimization of available transportation resources. It is difficult to overstate the importance of these decisions and possible benefits of rational land use planning around the stations. For example, a 200,000 square foot office building being considered for development in the suburbs could achieve an annual reduction of some 500,000 vehicle miles of travel by locating near a Metrorail station. This study has expanded the database and refined the planning tools developed in the first study. Hopefully this will increase their usefulness in planning for growth in the areas surrounding Metrorail stations.

OBSERVATIONS AND CONCLUSIONS

There has been a large volume of data generated in this project, requiring a substantial amount of time to assimilate and interpret. WMATA and other agencies will be able to draw their own conclusions directly from the data. However, a number of conclusions and observations have been derived from the analysis of the data. A summary of these observations is presented below, beginning first with general observations, followed by conclusions relating to each of the land use types. Many of these observations were originally made as part of the first study and are worth repeating; others reflect the expanded database.

General Observations

Many factors influence the choice of mode for trips to and from any type of land use. This study confirmed that the most significant and readily used factors for planning purposes are: 1) the location of the site within the urban area, (downtown sites have the highest transit mode shares, sites within the Beltway have significant transit mode shares, and sites outside the Beltway have relatively low transit mode shares); and 2) the proximity of a building to a Metrorail station entrance. Other factors influence transit ridership such as parking, cost, travel times, connectivity of the transit system, distance from transit connections at the other end of the trip, auto ownership etc. However, the location of the site within the metropolitan area and the proximity of a building to a Metrorail station entrance are well correlated and provide an easily used planning tool.

In contrast to the first study significant transit mode shares were recorded for all land uses. This indicates that while the commute trip is typically the first to be taken by transit, other trips will be increasingly taken by transit as the system and surrounding development mature. Transit users reported almost as many linked trips as auto users indicating that the general level of development along the transit line as a whole influences the propensity to use transit.

Origin destination pairs heavily influence the propensity to take transit. Poor transit accessibility at either end of the trip results in poor transit ridership between those pairs.

Responses to attitudinal questions are similar for surveys conducted at all land use types. Metrorail in general receives very good ratings. The most significant finding from these questions is that even among these groups who live, work, or shop in these

areas that are well served by transit in a visible way, an average of 28% of respondents hold the perception that information regarding the system and schedules is not readily available. At some sites over 40% of the respondents believe that information is not readily available.

Observations on Office Development

Transit mode share for work trips to downtown office buildings is in excess of 50% for offices located near Metrorail stations.

The distribution of residence location for office employees indicates that the transit commuters to any given office building are drawn from throughout the region.

A much higher percentage of work trips occurs by transit where the trip crosses jurisdictional boundaries. (e.g. a site in Virginia from either the District or Maryland). This is probably due to both the length of the trip and the accessibility at the origin end. It is difficult for transit to compete on relatively short trips where wait times make up a significant percentage of the total. As well, connectivity of the trip is important. There is a strong propensity to take transit from either Maryland or Virginia to the District but transit mode share is much lower between Montgomery County and Fairfax County despite competitive travel times. The data from both studies indicate that there is considerable trip interchange between Montgomery County and Virginia.

Most mid-day trips by employees at office buildings near Metrorail stations are walk trips. Of the non-walk mid-day trips, a significant number of the trips to and from the District are made by transit.

The regression analysis of office sites indicates that the work trip transit mode share decreases by 0.76 percent for each 100 foot increase in distance of the site from the station portal. Although this relationship was found to be valid for the sites studied, it is expected that the actual relationship is not linear. The percentage of mid-day non walk trips captured by transit decreases by approximately 1.12% for each 100 foot increase in distance from the station.

Transit mode share for trips by visitors to office buildings was relatively low. The data indicates that between 10% and 15% of visitor trips are by transit. The difference between this study and the first study is probably explained by the fact that all but one of the buildings in this study are located outside of the downtown.

Residential Buildings

A high percentage of trips to and from multi-family residential buildings near Metrorail stations are via transit. The transit mode share for this study ranged from 30 to over 70 percent. The ten sites studied included both rental and owner occupied developments over a range of income levels. Relationships based on the type and cost of the unit could not be correlated with transit mode shares probably due to the limitations of the sample size.

Auto ownership was found to be significantly lower at all sites surveyed, as compared to the regional average and even when compared to areas with similar development located away from a Metrorail station. The implication is that convenient connections to Metrorail influence the tendency to purchase second or third cars. With fewer cars available overall trip generation will be lower, as many trips will simply not be taken.

The percentage of trips by transit decreases by approximately 0.66% for each 100 foot increase in distance of a residential site from a station portal.

Retail Uses

All of the retail sites surveyed had significant transit mode shares. Those sites repeated from the first study showed significant increases in the transit mode share. The transit mode share, particularly at the suburban sites, varies by time of day. For instance at Ballston Common Mall transit mode share drops to less than a third of its midday value in the evenings.

The percentage of trips by transit decreases by approximately 2.0% for each 100 feet of distance from a station portal.

Hotels

Like the retail areas, hotels showed a significant increase in the transit mode share when compared to the first study. Conference attendees are more likely to take transit than overnight guests but there is no correlation with distance from a Metrorail station. Hotel trip generation rates vary from day to day more so than other land uses. Data should be collected for several days at a site to establish an average trip generation rate.

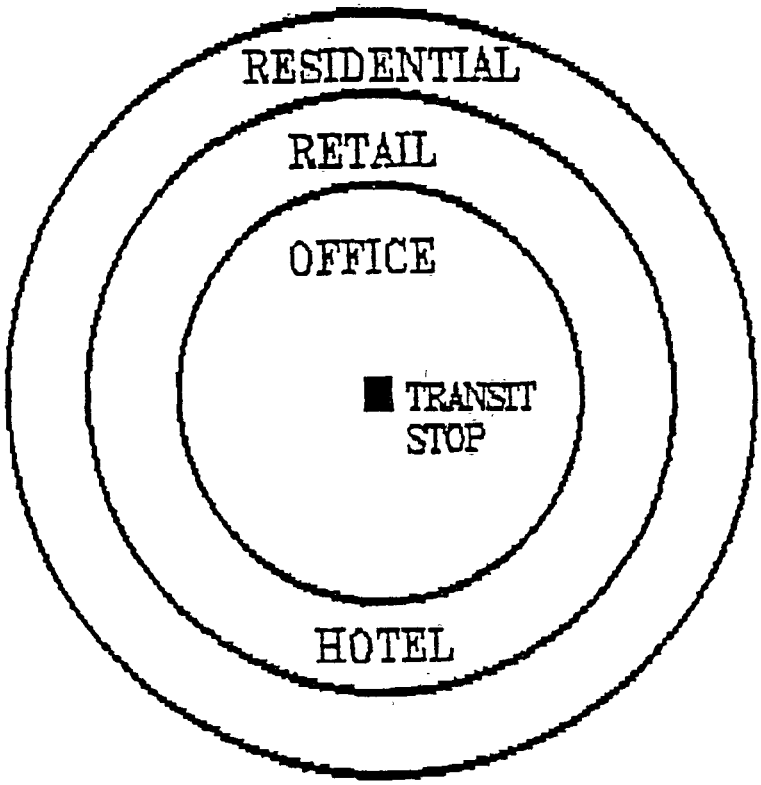
Conclusions

The results of these studies and the analysis of the growing database have a number of significant implications on land use and transportation planning in the Washington Metropolitan area. Metrorail is increasingly a major factor in transporting persons not only to and from the downtown but also to and from suburban sites. However, despite the relationships to distance from the sites, the propensity to take transit is dependent on origin destination relationships. Several land use and transportation factors are critical to making the best possible use of the transit system. These include:

- Locating the types of uses that tend to generate the most transit trips in Metrorail station areas.
- Locating these land uses in close proximity to the station portals.
- Providing high density land development around Metro stations, including suburban stations.
- Providing convenient walk and feeder bus access to the stations to expand the transit market.

Adequate road networks must be constructed in conjunction with the development of station areas. Poor road networks not only will create a negative image of station areas but will restrict the transit market to relatively tight areas surrounding the station. People will not use Metrorail if they must fight congestion to reach the station.

The suburban transit stations and the areas surrounding them are critical to gaining the maximum benefit from the Metrorail system. Figure 43 illustrates a general concept for development surrounding a typical station. Office uses with the associated convenience retail should be located closest to the station entrances since they are the most sensitive to distance from the station. The distance people are willing to walk can be increased by careful planning of the pedestrian systems. For example utilizing underground walkways or skywalks between buildings can be used to separate pedestrians from vehicle traffic. Major retail and hotel uses could occupy the next ring. Mid to high density residential developments would occupy the outer ring. The highest densities would be located closer to the station, transitioning down to single family residential as distance from the station increases. This is a generalized concept only and could be varied from station to station along a corridor.



GENERAL HIERARCHY OF PROXIMITY OF LAND USES TO A TRANSIT STATION

Figure 43.

The data suggests that linked trips increase as the system matures. This encourages the use of the system for non work trips. To maximize this, development in the corridor must provide a variety of facilities allowing the patron to complete many of the day to day errands that have been done by car (i.e. shopping, banking etc.) This suggests that slightly different emphasis could be placed on development around different stations, for instance major destination type retail development will not be located at each station. However, it appears to be desirable to have this type of development within each corridor. Where destination retail is planned it should be as close as possible to the station. While the emphasis of each station area should be varied, mixed-use development surrounding each station is the most desirable in terms of reducing vehicle trips.

Land use planning beyond the station areas of these four rings of development is also critical. Feeder bus routes to and from the stations need to be considered during the planning for lower density developments. For instance bus only connections can be used to provide more direct bus routes through subdivisions that are planned to discourage through traffic. In short, transit operations should be considered in conjunction with all land use planning in the region.

In addition to development at the station areas, marketing must be targeted at individual station areas providing those who live, work, or shop in these areas specific information about the system and how they can use it.

The data collected by the Development-Related Ridership Surveys provides WMATA and other local agencies with information that can be used in comparing alternate development scenarios for station areas.

APPENDIX A
DETERMINING CONFIDENCE LIMITS FROM SURVEY DATA

A sample drawn from a given population is not likely to be an exact representation of the true characteristics of the population. However, it is possible to estimate the likelihood that the true value lies within a certain a range about the estimated value derived from the data. This range, or "confidence limit," can be determined assuming that the data correspond to an appropriate statistical distribution. This appendix provides the reader with a simple means of establishing confidence limits for the survey results, based on sample size and the travel characteristics being examined.

Table A has been prepared to permit the direct determination of 95 percent confidence limits for all data based on percentages. The typical way of expressing the statistical accuracy is that the percentage derived from the data is within plus or minus X percentage points with 95 percent confidence. The use of the 95th percentile is common, but other percentiles could also be used.

In Table A-1, the sample size for the value being investigated is located on the left side of the table. The percentage of respondents specifying a given answer is located in the column headings. If the percent frequency in the column heading is termed "p," it can be seen that both p and 1-p yield the same results for a given sample size. The 95 percent confidence limit is identified by the intersection of the appropriate sample size row and percent frequency columns. For example, if the percentage of trips by transit is 10 percent and the sample size upon which that estimate is based is 100, it could be said that the estimate is within 5.6 percent of the true value with 95 percent confidence. The equation used to derive Table A-1 can also be used directly, if desired.

Table A-1. Confidence Limits (±%) for 95% Significance Level

Actual Sample Size	Percent Frequency											
	1 or 99	2 or 98	3 or 97	4 or 96	5 or 95	7 or 93	10 or 90	15 or 85	20 or 80	30 or 70	40 or 60	50
10	±6.2%	8.7	10.6	12.1	13.5	15.0	17.0	22.1	24.0	20.4	30.4	31.0
25	3.9	5.5	6.7	7.7	8.5	10.0	11.2	14.0	15.7	18.0	19.2	19.6
50	2.8	3.8	4.7	5.4	6.0	7.1	7.9	9.9	11.1	12.7	13.6	13.9
75	2.3	3.2	3.9	4.4	4.9	5.8	6.5	8.1	9.1	10.4	11.1	11.3
100	1.9	2.7	3.3	3.8	4.3	5.0	5.6	7.0	7.8	9.0	9.6	9.8
150	1.6	2.2	2.7	3.1	3.5	4.1	4.6	5.7	6.4	7.3	7.8	8.0
200	1.4	1.9	2.4	2.7	3.0	3.5	4.0	4.9	5.5	6.3	6.8	6.9
300	1.1	1.6	1.9	2.2	2.5	2.9	3.2	4.0	4.5	5.2	5.5	5.7
400	1.0	1.4	1.5	1.9	2.1	2.5	2.8	3.5	3.9	4.5	4.8	4.9
500	0.9	1.2	1.5	1.7	1.9	2.2	2.5	3.1	3.5	4.0	4.3	4.4
700	0.7	1.0	1.3	1.5	1.6	1.9	2.1	2.6	3.0	3.4	3.6	3.7
900	0.6	0.9	1.1	1.3	1.4	1.7	1.9	2.3	2.6	3.0	3.2	3.3
1200	0.6	0.8	1.0	1.1	1.2	1.4	1.6	2.0	2.3	2.6	2.8	2.8
1500	0.5	0.7	0.9	1.0	1.1	1.3	1.5	1.8	2.0	2.3	2.5	2.5
2000	0.4	0.6	0.7	0.9	1.0	1.1	1.3	1.6	1.8	2.0	2.1	2.2
2500	0.4	0.5	0.7	0.8	0.9	1.0	1.1	1.4	1.6	1.8	1.9	2.0
3000	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.3	1.4	1.6	1.8	1.8

Equation:

$$\text{Confidence Limits} \quad (d) = \sqrt{\frac{(\%\text{Freq.})(1-\%\text{Freq.})(1.96^2)}{\text{Sample Size}}}$$

APPENDIX B

Relevant Data from Other Sources

Table B-1. Residential/Retail/Hotel Data from Additional Sources[1/]

esidential Development	Station Location	Distance to Station (feet)	Distance to DC Core (miles)	AM Peak Hour[2/] Percent Transit and Walk	Number of Dwelling Units
he Willoughby	Friendship Heights	1,200	5.0	53	804
opaz House	Bethesda	2,000	6.9	50	365
toneybrook	Grosvenor	1,000	10.3	24	200
arkside	Grosvenor	2,000	10.3	8	340
he Forum	White Flint	1,000	12.0	14	227
mericana	Rockville	500	16.0	34	425

etail Development	Station Location	Distance to Station (feet)	Distace to DC Core (miles)	Mid-day[3/] Peak Hour Percent Transit	GSF (x 1,000)
Woodward & Lothrop	Friendship Heights	100	5.0	39	180
aks Fifth Avenue	Friendship Heights	1,600	5.0	4	103

Hotel	Station Location	Distance to Station (feet)	Distance to DC Core (miles)	AM I eak Hour[4/] Percent Transit	Number of Rooms
oliday Inn	Friendship Heights	1,800	5.0	9	227
yatt (Metro Center)	Bethesda	100	6.9	11	380

/ Additional sources include: The Maryland-National Capital Park and Planning Commission study of the Metrorail Red Line (1986).

/ AM Peak hour percentage includes transit plus walk.

/ Transit percentage includes all persons to the retail developments.

/ Transit percentage includes all persons to the hotels.

Table B-2. Office Building Data from Additional Sources[1/]

Office Building	Station Location	Distance to Station (feet)	Distance to DC Core (miles)	AM Peak Hour Percent Transit	GSF (x1,000)
National Place/ National Press Bldg.	Metro Center	100	0.0	59.3	409
1920 L Street	Farragut North	1,000	0.0	53.0	74.8
Van Ness Center	Van Ness-UDC	100	2.9	32.0	182.6
7500 Old Georgetown Road	Bethesda	100	6.9	13.3	
The Barlow Bldg.	Friendship Heights	700	5.0	23.5	240
Chevy Chase Bldg.	Friendship Heights	1,500	5.0	13.5	250
One Park North	Friendship Heights	2,000	5.0	9.0	132
Montgomery Bldg.	Bethesda	450	6.9	12.0	82.5
7315 Wisconsin	Bethesda	600	6.9	30.6	
Fairmont Bldg.	Bethesda	1,400	6.9	27.0	136
Landow Bldg.	Bethesda	2,000	6.9	9.0	225
7101 Wisconsin	Bethesda	2,000	6.9	17.8	
NRC Building	Bethesda	2,100	6.9	10.0	134

1/ Additional sources include: The Maryland-National Capital Park and Planning Commission study of the Metrorail Red Lir (1986), and the National Capital Region Transportation Planning Board Trip Generation Studies of the National Place (198 and the Van Ness Office Building (1985).

APPENDIX C

Survey Instruments

WASHINGTON METROPOLITAN AREA WORK PLACE SURVEY

This survey is part of a continuing effort, approved by Regional Transportation Authorities, to plan for the transportation needs of employees within the Washington Region. We would appreciate your help in this effort by filling out this questionaire. The information obtained from this survey is completely confidential and will only be documented in summary form. Please complete this questionaire and return it to the person who gave it to you as soon as you can.

THANK YOU FOR YOUR TIME AND COOPERATION.

Today's Date ___/___/89

RESPONDENT INFORMATION

1. What is the name and address of the place where you report for work?

_____
Name of Employer

_____
Street Address

2. Where do you live?

1. District of Columbia
2. Fairfax County
3. Arlington County
4. Alexandria
5. Falls Church
6. Fairfax City
7. Prince Georges County
8. Rockville
9. Bethesda
10. Silver Spring
11. Elsewhere in Montgomery County
12. Elsewhere in Virginia
13. Elsewhere in Maryland
14. Other

3. What is the intersection nearest your home? _____
Zip Code? _____

4. How many autos, pickups, vans and motorcycles are available for use by members of your household? _____

5. Your sex? (circle one)
1. Male
2. Female

6. Your age on your last birthday? (circle one)
1. 18 years or under
2. 19 to 24 years
3. 25 to 34 years
4. 35 to 44 years
5. 45 to 54 years
6. 55 to 64 years
7. 65 years or over

7. Including yourself, how many people live in your household?

Total number of people ____
Number under 16 years of age ____
How many work full time? ____
How many work part time? ____

8. What is your occupation? (circle one)

1. Professional/technical	5. Craftsman (mechanic, etc)
2. Manager/administrator	6. Equipment operator
3. Sales worker	7. Laborer
4. Clerical	8. Service worker
	9. Other

9. At what time did you start work today, even if atypical. _____:_____ AM PM
At what time did you leave work yesterday even if atypical. _____:_____ AM PM
(Please fill in time and circle AM or PM)

9. What means of travel did you use to get to work today? (circle one)

1. Drove alone	4. Metrorail only	9. Walked all the way
2. Drove others (how many others, excluding yourself ___)	5. Metrorail and bus	10. Taxi
	6. Metrorail and auto	11. Bicycle
	7. Metrorail and other combination (specify) _____	12. Other (specify) _____
3. Rode as a passenger (how many total were in the vehicle ___)	8. Bus only	

COMMUTE CHARACTERISTICS

10. Answer these questions if you rode transit for any portion of your trip to work today, otherwise skip to 11.

10a. Was a privately owned vehicle available for your trip to work today? (circle one) 1. Yes 2. No

10b. Do you normally ride transit? (circle one) 1. Yes 2. No

10c. How long did it take you to travel from your home to work today?

From your house to transit?	___ Min.
From last transit vehicle to your building entrance	___ Min.
Total (including time on transit)	___ Min.

10d. What is your estimated round-trip cost to and from work?
Please include all transit fares and parking charges. (Fill in amount)

$ __.__

10e. Does your employer: (circle one)

Subsidize your transit costs?	1. Yes 2. No
Provide a car for business purposes during the day?	1. Yes 2. No
Have a program to encourage car or vanpooling?	1. Yes 2. No
Allow flexible working hours?	1. Yes 2. No

11a. Are there convenient transit connections available for your trip to work? (circle one) 1. Yes 2. No 3. Don't know

11b. Do you normally drive to work? (circle one) 1. Yes 2. No

11c. Did you require your car during the day TODAY? (circle one) 1. Yes 2. No

11d. How long did it take you to travel to work TODAY?
To drive from your residence to the parking lot? ___ min.
To walk from the parking lot to your building entrance? ___ min.

11e. Does your employer: (circle one)
Subsidize your automobile expenses or parking costs? 1. Yes 2. No
Have a program to encourage car or van-pooling? 1. Yes 2. No
Allow flexible working hours? 1. Yes 2. No

12. Do you agree, disagree, or have no opinion with respect to the following statements? (circle one)

People should be encouraged to use transit. 1. Agree 2. Disagree 3. No opinion

Schedule information for transit services is readily available. 1. Agree 2. Disagree 3. No opinion

Metrorail is clean and reliable. 1. Agree 2. Disagree 3. No opinion

Metrobus is clean and reliable. 1. Agree 2. Disagree 3. No opinion

TRIP MAKING CHARACTERISTICS

We would like to find out about all the trips you made on the way to work TODAY, as well as the trips you made during the day and on the way home from work yesterday (or your last weekday at work). For each trip write in the corresponding code numbers from the lists below for Purpose of Trip and Means of Travel and Destination of Trip.

Purpose of Trip
1. Work related
2. Personal business
3. Meal or snack
4. Shopping
5. Educational
6. Recreational
7. Other (specify)

Means of Travel
1. Drove a car
2. Rode in a car
3. Metrorail and walk
4. Metrorail and drive
5. Metrorail and bus
6. Bus only
7. Walk
8. Bicycle
9. Other (specify)

Destination
1. Within half a mile
2. District of Columbia
3. Fairfax County
4. Arlington
5. Alexandria
6. Falls Church
7. Fairfax City
8. Prince Georges County
9. Bethesda
10. Silver Spring
11. Rockville
12. Elsewhere in Montgomery County
13. Elsewhere in Maryland
14. Elsewhere in Virginia
15. Other (specify)

The example indicates a work related trip (1) made from Rockville to the District of Columbia (2) by Metrorail and walking (3) with a shopping stop over in Bethesda (9).

	Example	Trip to Work	Midday Trip	Midday Trip	Trip Home
Time you left	10 30 (AM) PM	__:__ AM PM	__:__ AM PM	__:__ AM PM	__:__ AM PM
	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd
Purpose	4 1 __	____	____	____	____
Means of Travel	3 3 __	____	____	____	____
Destination	9 2 __	____	____	____	____
And then to work	1. (1) 1.	1. 1. 1.	1. 1. 1.	1. 1. 1.	1. 1. 1.
to next stop	(2) 2. 2.	2. 2. 2.	2. 2. 2.	2. 2. 2.	2. 2. 2.
Arrival time	12:00				
Length of Trip	10 miles	___ miles	___ miles	___ miles	___ miles

WASHINGTON METROPOLITAN AREA TRAVEL SURVEY

This survey is part of a continuing effort, approved by the Washington Metropolitan Area Transit Authority, to plan for the transportation needs of employees within the Washington Region. We would appreciate your help in this effort by filling out this questionaire. The information obtained from this survey is completely confidential and will only be documented in summary form. Please complete this questionaire and drop it in any mailbox. No postage is required. If you have further questions about this survey, please contact Joan Jenkins, JHK & Associates, at (703) 370-2411.

THANK YOU FOR YOUR TIME AND COOPERATION.

One person may fill in the responses for all persons 16 years of age or older who are currently living in the household:

	Person 1	Person 2	Person 3
1. Date for reporting information - please use a weekday.	/ /89	/ /89	/ /89
2. Sex 1. Male 2. Female Enter one code number for each person.	_____	_____	_____
3. Age 1. 16-25 2. 26-35 3. 36-45 4. 46-55 5. 56-65 6. over 65 Enter code number.	_____	_____	_____
4. Does this person work outside this residence? 1. Yes, Full-time 2. Yes, Part-time 3. No Enter a code(s) number for each person.	_____	_____	_____
5. Does this person have a current drivers License? 1. Yes 2. No Enter one code number for each person.	_____	_____	_____

6. Including yourself, how many people live in your household?

Total number of people	____
Number under 16 years of age	____
How many work full time?	____
How many work part time?	____

7. How many autos, pickups, vans and motorcycles are available for use by members of your household? _____

TRIP MAKING CHARACTERISTICS

We would like to find out about all the trips you made to and from your building today. For each trip write in the corresponding code numbers from the lists below for Purpose of Trip and Means of Travel and Destination of Trip.

1. Work related
2. Personal business
3. Meal or snack
4. Shopping
5. Educational
6. Recreational
7. Other (specify)

1. Drove a car
2. Rode in a car
3. Metrorail and walk
4. Metrorail and drive
5. Metrorail and bus
6. Bus only
7. Walk
8. Bicycle
9. Other (specify)

1. Within half a mile
2. District of Columbia
3. Fairfax County
4. Arlington
5. Alexandria
6. Falls Church
7. Fairfax City
8. Prince Georges County
9. Bethesda
10. Silver Spring
11. Rockville
12. Elsewhere in Montgomery Co.
13. Elsewhere in Maryland
14. Elsewhere in Virginia
15. Other (specify)

The example indicates a midday trip made to the District of Columbia by Metrorail for the purpose of shopping with a stop over in Bethesda.

PERSON 1	Example	Trip to Work	Midday Trip	Midday Trip	Trip Home
Time you left	__:__ AM PM	__:__ AM PM	__:__ AM PM	__:__ AM PM	__:__ AM PM
	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd
Purpose	_____	_____	___ ___ ___	___ ___ ___	___ ___ ___
Means of Travel	_____	_____	___ ___ ___	___ ___ ___	___ ___ ___
Destination	_____	_____	___ ___ ___	___ ___ ___	___ ___ ___
And then: to work	1. 1. 1.	1. 1. 1.	1. 1. 1.	1. 1. 1.	1. 1. 1.
to next stop	2. 2. 2.	2. 2. 2.	2. 2. 2.	2. 2. 2.	2. 2. 2.
Arrival time					
Length of Trip	___ miles	___ miles	___ miles	___ miles	___ miles

PERSON 2	Trip to Work	Midday Trip	Midday Trip	Trip Home
Time you left	__:__ AM PM	__:__ AM PM	__:__ AM PM	__:__ AM PM
	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd
Purpose	_____	___ ___ ___	___ ___ ___	___ ___ ___
Means of Travel	_____	___ ___ ___	___ ___ ___	___ ___ ___
Destination	_____	___ ___ ___	___ ___ ___	___ ___ ___
And then: to work	1. 1. 1.	1. 1. 1.	1. 1. 1.	1. 1. 1.
to next stop	2. 2. 2.	2. 2. 2.	2. 2. 2.	2. 2. 2.
Arrival time				

PERSON 3	Trip to Work	Midday Trip	Midday Trip	Trip Home
Time you left	__:__ AM PM	__:__ AM PM	__:__ AM PM	__:__ AM PM
	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd	Stop 1st 2nd 3rd
Purpose	_____	___ ___ ___	___ ___ ___	___ ___ ___
Means of Travel	_____	___ ___ ___	___ ___ ___	___ ___ ___
Destination	_____	___ ___ ___	___ ___ ___	___ ___ ___
And then: to work	1. 1. 1.	1. 1. 1.	1. 1. 1.	1. 1. 1.
to next stop	2. 2. 2.	2. 2. 2.	2. 2. 2.	2. 2. 2.
Arrival time				

8. Do you agree, disagree, or have no opinion with respect to the following statements? (circle one)

People should be encouraged to use transit.	1. Agree 2. Disagree 3. No opinion
Schedule information for transit services is readily available.	1. Agree 2. Disagree 3. No opinion
Metrorail is clean and reliable.	1. Agree 2. Disagree 3. No opinion
Metrobus is clean and reliable.	1. Agree 2. Disagree 3. No opinion

(Please seal here)

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

Business Reply Mail

First Class Permit No. 8224 Alexandria, VA

Postage Will Be Paid By Addressee

Washington Metropolitan Area Travel Survey
4660 Kenmore Ave., Suite 1200
Alexandria, VA 22304

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

Pedestrian Survey for Retail Sites

Excuse me, I am conducting a travel survey for the Washington Metropolitan Area Transit Authority. Could I ask you a few brief questions?

Site Name: ____________________ Location of Interview: ____________________ Begin Time: __________ End Time: __________

Observer: ____________________ Weather: ____________________ Date: ____________________

Do you agree, disagree or have no opinion with respect to the following statements?

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Arrival Time	Are you: 1. Shopping 2. Eating 3. Business 4. Employee 5. Banking 6. Other	What is your home zip code?	How did you get to _____ Auto: 1. Driver 2. Passenger 3. Drop off 4. Walk 5. Metrorail 6. Bus 7. Taxi 8. Other	Did you have a car available for your trip? 1. Yes 2. No	How many people came in your group?	Where was your last stop before coming here? City, name of building or nearest intersection	Was this 1. An office 2. Your home 3. Friend's home 4. Store 5. Bank 6. Restaurant 7. School 8. Pickup/drop-off 9. Hotel 10. Medical 11. Health club 12. Other	How far is that from here? (miles)	What time do you expect to leave?	Where will your next stop be after leaving here? City, building name or nearest intersection	Is this 1. An office 2. Your home 3. Friend's home 4. Store 5. Bank 6. Restaurant 7. School 8. Pickup/drop-off 9. Hotel 10. Medical 11. Health club 12. Other	How will you be getting there? Auto: 1. Driver 2. Passenger 3. Dropoff 4. Walk 5. Metrorail 6. Bus 7. Taxi 8. Other	How far is that from here? (miles)	People should be encouraged to use transit. 1. Agree 2. Disagree 3. No opinion	Schedule information is readily available for public transit. 1. Agree 2. Disagree 3. No opinion	Metrorail is clean and reliable. 1. Agree 2. Disagree 3. No opinion	Metrobus i[s] clean and reliable. 1. Agree 2. Disagre[e] 3. No opin[ion]

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

Visitor Survey for Office Sites

I am conducting a travel survey for the Washington Metropolitan Area Transit Authority. Could I ask you a few brief questions?

____________________ Location of Interview: ____________________ Begin Time: __________ End Time: ______

____________________ Weather: ____________________ Date: ____________________

Do you agree, disagre[e]
with respect to the foll[owing]

(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
...ur work ... ...ng? ...nployee ...ator ...ang ...rking ...nuler ...uide ...her ...ployee – ...nd	How did you get to this building? Auto: 1. Driver 2. Passenger 3. Drop off 4. Walk 5. Metrorail 6. Bus 7. Taxi 8. Other	Auto drivers only: How many people came in your car including yourself?	Did you have a car available for your trip to the office? 1. Yes 2. No	Where was your last stop before coming here? City, building name or nearest intersection	Was this 1. An office 2. Your home 3. Friend's home 4. Store 5. Bank 6. Restaurant 7. School 8. Pickup/drop-off 9. Hotel 10. Medical 11. Health club 12. Other	How far is that from here? (miles)	Would you have driven by this office building if you did not stop? 1. Yes 2. No	What time do you expect to leave?	Where will your next stop be after leaving here? City, building name or nearest intersection	Is this 1. An office 2. Your home 3. Friend's home 4. Store 5. Bank 6. Restaurant 7. School 8. Pickup/drop-off 9. Hotel 10. Medical 11. Health club 12. Other	How will you be getting there? Auto: 1. Driver 2. Passenger 3. Dropoff 4. Walk 5. Metrorail 6. Bus 7. Taxi 8. Other	How far is that from here? (miles)	People should be encouraged to use transit. 1. Agree 2. Disagree 3. No opinion	Schedule information is readily available for public transit. 1. Agree 2. Disagree 3. No opinion

Survey for Hotel Sites

Excuse me, I am conducting a travel survey for the Washington Metropolitan Area Transit Authority. Could I ask you a few brief questions?

Site Name: ______________________ Location of Interview: ______________________ Begin Time: __________ End Time: __________

Observer: ______________________ Weather: ______________________ Date: ______________________

Do you agree, disagree or have no opinion with respect the following statements?

(1)	(2)	(3)	(4)	(5)	If person used Metrorail or bus; (6)	All: (7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Arrival Time	Are you 1. An employee 2. An overnight guest 3. Attending Mtg./Conf. 4. Both 2&3 5. Going to restaurant-lounge 6. Other	Have you been outside this hotel earlier TODAY? 1. Yes 2. No - Go to Question 7	What time did you get here? How many people in your group?	How did you get here? 1. Own car 2. Rental car 3. Walked 4. Metrorail 5. Bus 6. Taxi/limo 7. Hotel shuttle 8. Other	Did you have a car available for your trip to the hotel?	Where were you coming from? City, building name or nearest intersection What was the purpose of your trip? 1. Work related 2. Shopping 3. Sightseeing 4. Other	Will you be going outside this hotel later today? 1. Yes 2. No - Go to Question 12	What time do you expect to leave? How many people will be in your group?	Where will you be going? City, Building name or nearest intersection What was the purpose of your trip? 1. Work related 2. Shopping 3. Sightseeing 4. Other	How will you be getting there? 1. Own car 2. Rental car 3. Walked 4. Metrorail 5. Bus 6. Taxi/limo 7. Hotel Shuttle 8. Other	People should be encouraged to use transit. 1. Agree 2. Disagree 3. No opinion	Schedule information is readily available for public transit. 1. Agree 2. Disagree 3. No opinion	Metrorail is clean and reliable. 1. Agree 2. Disagree 3. No opinion	Metrobus is clean and reliable. 1. Agree 2. Disagree 3. No opinion
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Washington Metropolitan Area Transit Authority

600 Fifth Street, N.W., Washington, D.C. 20001
(202) 962-1234

FEB 17 1989

Dear Washington Metropolitan Area Building Owner or Manager:

The Washington Metropolitan Area Transit Authority (WMATA) has enlisted the services of JHK & Associates, a transportation engineering consulting firm, to conduct a study of travel characteristics around several Metrorail stations in the Washington region. Essential to this study is development of a data base of travel characteristics at existing offices, shopping areas, hotels and residential dwellings. This information will assist in providing better planning information for WMATA and for other local agencies. Some of you may recall that your assistance in this type of survey endeavor was also requested in 1986. The results in that year provided valuable information to transportation planners in understanding relationships among land uses, transit and distances between the two. This second round of survey work, in 1989, will provide for expanded understanding of these relationships over time.

The enclosed questionnaires request information from various persons in your building about their daily travel patterns. We are seeking your assistance in distributing the questionnaires to these persons and collecting them once they have been filled out completely. We realize that this may be a slight inconvenience to you, however, we believe that the investment of this short amount of time on your part (approximately four minutes per person) will be worth the effort in our planning for better transportation in the Washington Metropolitan Area.

A representative from JHK & Associates will return to collect the surveys in approximately three days unless you have made other arrangements. We greatly appreciate your cooperation. If you have any questions concerning the survey you may contact James Curren of JHK & Associates at (703) 370-2411.

Very truly yours,

Robert A. Pickett

Robert A. Pickett
Acting Director
Office of Planning

Washington Metropolitan Area Transit Authority

600 Fifth Street, N.W., Washington, D.C. 20001
(202) 962-1234

FEB 17 1989

Dear Washington Metropolitan Area Employer:

The Washington Metropolitan Area Transit Authority (WMATA) has enlisted the services of JHK & Associates, a transportation engineering consulting firm, to conduct a study of travel characteristics around several Metrorail stations in the Washington region. Essential to this study is development of a data base of travel characteristics at existing offices, shopping areas, hotels and residential dwellings. This information will assist in providing better planning information for WMATA and for other local agencies. Some of you may recall that your assistance in this type of survey endeavor was also requested in 1986. The results in that year provided valuable information to transportation planners in understanding relationships among land uses, transit and distances between the two. This second round of survey work, in 1989, will provide for expanded understanding of these relationships over time.

The enclosed questionnaires request information from each employee in your office about their daily travel patterns. We are seeking your assistance in distributing the questionnaires to each of your employees and collecting them once they have been filled out completely. We realize that this may be a slight inconvenience to you, however, we believe that the investment of this short amount of time on your part (approximately four minutes per employee) will be worth the effort in our planning for better transportation in the Washington Metropolitan Area.

A representative from JHK & Associates will return to collect the surveys in approximately three days unless you have made other arrangements. We greatly appreciate your cooperation. If you have any questions concerning the survey you may contact James Curren of JHK & Associates at (703) 370-2411.

Very truly yours,

Robert A. Pickett

Robert A. Pickett
Acting Director
Office of Planning

Appendix D: Response Rates for Self Administered Surveys

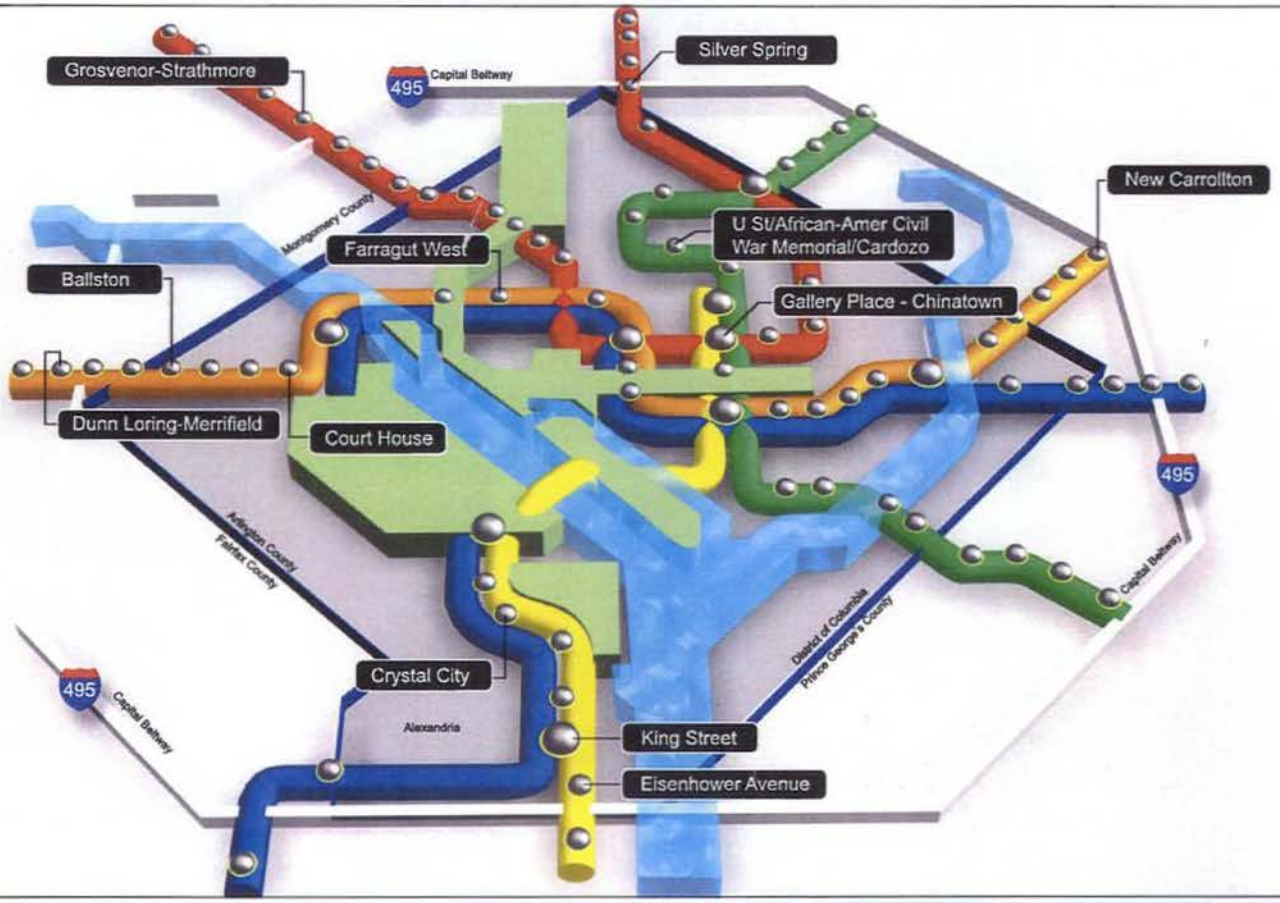
SITE LIST

Offices	Survey/ Count Date	No. Surveys Distributed	No. Surveys Returned	No. Complete Surveys	No. Rec'd Late	Complete % Return	Overall % Return
1701 Pennsylvania Ave.	3/30/89	388	146	140		36.08	37.63
Silver Spring Metro Ctr.	3/22/89	300	122	122		40.67	40.67
Ballston One	3/23/89	827	301	301		36.40	36.40
Bell Atlantic	3/16/89	1300	477	456	2	35.08	36.85
East West Towers - North	4/26/89	95	33	33		34.74	34.74
Bethesda Metro Center	4/05/89	940	228	225		23.94	24.26
Twinbrook Office Center	3/15/89	302	158	158		52.32	52.32
Parklawn	4/13/89	3500	588	573		16.37	16.80
Crystal Square 2	4/18/89	1200	156	155		12.92	13.00
Bethesda Office Center	5/11/89	663	401	195		29.41	60.48
TOTALS		9515	2610	2358		24.78	27.43

Residential	Survey/ Count Date	No. Surveys Distributed	No. Surveys Returned	Percent Returned	No. Vacant	Other	Rec'd Late	Adjusted Percent
Crystal Square West Apts.	4/18/89	379	82	21.64	22	1		23.03
Georgian Towers	3/21/89	864	73	8.45	11	14		8.70
Twin Towers	3/22/89	315	20	6.35				6.35
Randolph Towers	3/23/89	507	61	12.03	61	3	1	13.80
Grosvenor House Apts.	3/14/89	408	36	8.82	50			10.06
Grosvenor Park I	4/04/89	399	67	16.79				16.79
Stoneybrook	3/14/89	109	18	16.51	1			16.67
Bethany House	3/28/89	276	12	4.35	5			4.43
Crystal Park Condos	4/12/89	180	34	18.89	1			18.99
Crystal Plaza Apartments	4/12/89	536	94	17.54	22	4	1	18.47
TOTALS		3973	497	12.51	173	22	2	13.16

March 2006

2005 DEVELOPMENT-RELATED
Ridership Survey
FINAL REPORT



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District of Columbia
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EXHIBIT NO. 57 (3 of 3)

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Washington Metropolitan Area Transit Authority

Executive Summary

S.1 Study Purpose

The purpose of the 2005 Development Related Ridership Survey was to update a 16-year old study conducted by the Washington Metropolitan Area Transit Authority (WMATA) that surveyed the travel behavior of persons traveling to and from office, residential, hotel and retail sites near Metrorail stations. The 2005 effort sought to determine if modal splits for these land uses have changed over time and whether certain physical site characteristics still impact transit ridership. In 2005, 49 sites of the land uses listed above plus entertainment venues near 13 Metrorail stations participated in the study, which was designed to mimic the earlier efforts as a way to provide some context for comparison.

S.2 Background

In the 16 years since WMATA last surveyed development around its rail stations to determine how much transit ridership certain land uses generate when placed near rail stations, much has changed in the Washington metropolitan region in terms of population growth, the regional economy and the built environment. Given these changes, WMATA determined that the time was right to conduct a new survey, modeled on the 1989 survey, to evaluate whether this changed environment had affected modal splits at certain types of land uses in Metrorail station areas and to determine if certain physical attributes of these land uses impact transit ridership.

In 1989, stations were organized into three typologies: CBD location, Suburban-Inside the Beltway and Suburban-Outside the Beltway. The 2005 effort was designed to update these figures based on the changed environment and has generally organized data based upon the same typologies.

The 1989 study and an earlier 1987 study[1] identified a set of statistical relationships between the distance at which a building (office, residential, retail or hotel) is sited from the rail station and the amount of transit ridership it generates. The 2005 effort aimed to assess to what degree these relationships were still valid and whether additional variables might also show a strong relationship with transit ridership. Some of the additional variables tested include: quality of the pedestrian environment; housing density in the station area; job density in the station area; attractiveness of automobile access; and the availability of transit subsidies.

As in the earlier studies, the 2005 survey targeted high-density commercial office and residential sites, retail and hotel sites, as well as a new use, "entertainment" (which for this study's purposes was defined as movie theaters), as these are the types of land uses typically proposed in joint development projects. The 2005 study secured participation from 49 sites distributed as shown in Table S-1.

[1] In addition to the 1989 Survey, WMATA also conducted a similar survey in 1987.

Table S-1
Final Distribution of Survey Sites by Land Use Type and Station Location

Station Area	Classification[1]	Office	Residence	Retail	Hotel	Enter.	Total
Ballston	I	2	2	1	1	1	7
Court House	I	2	2	--	--	--	4
Crystal City	I	2	2	2	2	--	8
Dunn-Loring	O	--	1	--	--	--	1
Eisenhower Avenue	I	--	--	--	--	1	1
Farragut West	C	2	--	--	--	--	2
Friendship Heights	I	2	2	--	1	--	5
Gallery Place	C	--	2	--	--	--	2
Grosvenor	O	--	4	--	--	--	4
King Street	I	2	--	--	--	--	2
New Carrollton	O	1	--	--	--	--	1
Silver Spring	I	3	2	1	1	2	9
U Street/African-Amer Civil War Memorial/Cardozo	I	1	1	1	--	--	4
Total		**17**	**18**	**5**	**5**	**4**	**49**

[1] C = CBD; I=Inside Beltway; O=Outside Beltway

S.3 Summary of Findings

It is important to note that response rates varied considerably from site to site, and particularly with the office surveys. In addition to changes in the physical environment (e.g., greater urbanization in rail station areas, increasing suburbanization of outer jurisdictions) over the last 16 years, the region, like the rest of the nation and even the world, has experienced a change in attitude with respect to security (especially in light of the September 11, 2001, attacks) and to providing personal information to outside entities. The project team anticipated that potential respondents might be reluctant to answer the survey and that property managers might also refuse to allow survey efforts to be conducted at their locations.

These expectations seem to have been borne out in the low response rates at some buildings, offices in particular, as well as in the final number of sites agreeing to participate. For the most part, at office sites where there was a 'champion' from building management or on-site staff, response rates were fairly high. However, without the 'insider assistance,' response rates faltered. The project team also found a resistance on the residential side to the hand-delivery of survey forms, and on the office management side to even approaching tenants with survey forms. Lastly, the project team attempted to secure some federal participation at stations, but was unable to do so for a variety of reasons, namely security concerns. For these reasons, the 2005 effort faced a number of challenges that only performing the study could have revealed. In the end, the process itself yielded a wealth of information to be incorporated into subsequent study efforts.

Nonetheless, the information gleaned from these sites does provide a good look into the current state of travel at sites around rail stations and offer some explanation as to cause and effect. That

said, there also is sufficient reason for additional, more targeted research to be conducted in certain areas to delve more deeply into the reasons for certain modal splits.

S.3.1 General Observations

1. 2005 survey results confirmed previous findings that the walking distance between a site and the Metrorail station affects transit ridership (see Table S-2). In general, the closer a site is to the station, the greater likelihood those traveling to/from or within a site choose Metrorail as their travel mode. Based on the survey results, this relationship was stronger for residential sites than for office sites.

Table S-2
Regression Equation Summary for Office Commute and Residential Trips by Distance from Station

Distance (Mile)	Metrorail Mode share		All Transit[1] Mode Share		Auto Mode Share	
	Office Commute	Residential	Office Commute	Residential	Office Commute	Residential
0	35%	54%	46%	55%	48%	29%
1/4	23%	43%	30%	45%	66%	41%
1/2	10%	31%	13%	36%	83%	54%

Notes: [1] Includes Metrorail, Metrobus, commuter rail and other transit options.

2. In urban fringe or outlying locations, residential uses may be more reliable in boosting Metrorail ridership than office uses (see Table S-3). Based on the results of the survey, outlying office sites tended to produce trips connected with areas outside the core, which typically are not well served by transit.

3. At the overall site level, survey results showed that high-density, mixed-use environments with good transit access generated higher shares of transit and walk trips—especially midday trips from and visitor trips to office sites, than those areas dominated by a single use.

4. Metrorail continues to remain competitive with the automobile in markets where it provides good access and service and has increased its mode share in the core since 1989. In each surveyed land use category, those trips recorded to or from the District, the jurisdiction with the greatest number of rail stations and a comprehensive bus network, showed the highest rates of Metrorail and transit use.

5. Overall, when compared to the results of the 1989 Survey, the 2005 results suggest that land uses surrounding Metrorail stations are supporting higher transit use than in 1989 (see Table S-4). For office sites, the overall average transit share among the sites was about 93 percent greater than the overall average transit share among the 1989 sites. For residential sites, transit shares appeared to have changed little.

Table S-3
Office Commute and Residential Mode Share
by Concentric Location Typology

Mode Share	CBD	Inside the Beltway	Outside the Beltway
Office Site Commute			
Metrorail	63%	21%	8%
Metrobus & Other Transit	12%	9%	3%
Auto	21%	66%	89%
Walk & Other	5%	6%	0%
Residential Sites			
Metrorail	50%	43%	31%
Metrobus & Other Transit	6%	6%	1%
Auto	18%	39%	62%
Walk & Other	26%	14%	6%

Table S-4
Comparison of Transit Share Results from 2005 & 1989 Surveys

Land Use Type	Transit[1] Share Range		Transit Share Average		
	2005 Survey	1989 Survey	2005 Survey	1989 Survey	% Change
Office: Commute	8% - 76%	8% - 50%	34% (17 locations)	17.6% (10 locations)	93%
Residential	17%[2] - 67%	30% - 74%	45% (18 locations)	46.2% (10 locations)	-3%[3]
Retail	19% - 57%	34% - 56%	37% (5 locations)	44.2% (8 locations)	-16%
Hotel	12% - 51%	11% - 38%	31% (5 locations)	25.2% (10 locations)	23%
Entertainment	13% - 44%	N/A	32% (4 locations)	N/A	N/A

Notes: [1] Transit mode share includes Metrorail, Metrobus and Other Transit.
[2] The 17% figure is from a site converting its apartments to condominiums, and is an outlier. The next lowest end of the range is 32%.
[3] This figure may be skewed due to the low figure reported from the site converting its apartments to condominiums.

S.3.2 Land Use Specifics

For each land use type, survey results were tabulated to display frequencies and regression analyses were performed to test the strength of relationships between transit ridership and certain independent variables. A summary of the frequency results follows:

Office (17 sites; 15 percent response rate)

- 25 percent of all workplace survey respondents use Metrorail to commute to work.
- 44 percent of District residents responding to the workplace survey used Metrorail to commute to work. This figure exceeds the auto mode share for District residents, which was 41 percent. District residents accounted for only 14 percent of all survey responses, but accounted for more than 25 percent of all Metrorail commute trips.

- 16 percent of Arlington County residents responding to the workplace survey reported using the 'walk or other' mode to commute to and from work.
- 76 percent of workplace survey respondents who have no vehicle at their disposal use transit to commute; 63 percent of those used Metrorail. 31 percent of single-vehicle households use transit to commute; 28 percent of those use Metrorail.
- The sites with the highest midday Metrorail and walk trips are sites located in areas with a solid mix of office, retail and eating establishments.
- Visitors to the 13 office sites that allowed interviews used Metrorail 15 percent of the time and used the 'walk/other' mode 22 percent of the time.
- Office sites on the low end of the transit share scale in 2005 are located in areas with good auto access and ample parking. On the high end, survey results show that transit mode shares have grown in the inner areas—where traffic congestion is high, highway access limited and parking is constrained.

Residential (18 sites; 12 percent response rate)

- On average, 45 percent of all trips from these sites used transit.
- 55 percent of all work or school trips used Metrorail.
- 67 percent of trips to the District were made on Metrorail.
- 73 percent of zero-vehicle households and 42 percent of single-vehicle households used transit for their reported trips; 66 percent of zero-vehicle households and 40 percent of single-vehicle households used Metrorail as their travel mode.
- Residents living in areas with comparatively higher density housing and dense street networks are less likely to use their car, and more likely to use transit and Metrorail.

Retail (5 sites)

- 1,300 survey respondents.
- 36 percent of retail site patron and employee respondents used transit to access the site; 28 percent of those used Metrorail.
- 28 percent used the walk/other mode

Hotel (5 sites)

- 167 survey respondents.
- 35 percent of respondents used transit to access the site; 30 percent of those used Metrorail.

Entertainment (Movie Theaters) (4 sites)

- 974 survey respondents
- 28 percent used transit; 20 percent of those used Metrorail

S.4 Conclusions and Policy Considerations

The 2005 Development Related Ridership Survey effort provides a starting point for renewed efforts to analyze the travel characteristics of development around Metrorail stations. Despite some challenges related to privacy and security, this latest study provides a useful update to the past work, confirming some historic findings and pointing to some new findings regarding transit ridership. However, study findings also bring to light some areas where the process and data could be improved, and raise some questions as to the considerations and implications of

WMATA joint development opportunities. These are presented below. That said, the base provided herein gives WMATA a place from which to determine its next steps.

S.4.1 Potential Study Improvements

Increased Sample Size – Greater Statistical Significance

The findings from this study should help guide WMATA decision-making with respect to its joint development program and overall station-area planning. However, given that the unit of analysis for this study is at the site level, the survey sample size is admittedly small. Collecting more detailed data for station areas throughout the WMATA system could result in effective increases in the sample size and could create a more robust data set. In particular, a program focusing on federal sites might prove useful as the region supports an extensive federal workforce, but this study was unable to attract specific federal participation.

Weekend Data

Local jurisdictions already have suggested that having weekend ridership data would be useful. There has been a noticeable increase in transit ridership on weekends. Collecting weekend station area transit use data could help WMATA assess the implications of increased weekend service on operations and service planning, maintenance programs and capital spending.

Parking Pricing

Additionally, this effort was unable to adequately address the issue of parking pricing as it relates to workplace transit ridership in Metrorail station areas, as so many variables must be evaluated. For example, at the site level, each employer may have a different parking subsidy policy; at the station level, parking of varying price levels, availability and distance may be available to employees. Research focusing on this issue may also add to the tools at WMATA's disposal.

S.4.2 Questions Raised

Finally, the current study findings raise questions for WMATA with respect to a number of interesting and potentially important policy matters. For example, WMATA has significant unused capacity on outbound railcars in the peak-period. The system as a whole would benefit from increased utilization of this essentially "free" capacity, and office uses at suburban stations could help achieve this goal. To that end, there may be public policy benefits to encouraging office development at suburban rail stations as a complement to residential development, striking a balance between uses. The question raised is, what steps must be taken to raise the transit mode share for transit-proximate office space in suburban settings? More detailed survey information linked to site design and transit use characteristics of different office labor markets (e.g., federal, IT, financial services, biotechnology, back-office support, etc.) could help WMATA and others better understand the implications and opportunities presented by alternative development scenarios, and what steps could be taken to raise transit mode shares in suburban office settings.

Additionally, the 2005 Development Related Ridership Survey data continue to point to the question of how WMATA best meets the access needs of those residents who wish to use

Metrorail but are located in outlying or low-density areas, while maximizing the use of its station areas. For example, can bus service improvements, car-sharing arrangements or bicycle facility enhancements offer alternatives to those who currently drive to a rail station, freeing up some demand for parking? Additional research could tease out the variety of reasons why some Metrorail riders drive to stations and begin to classify those reasons and address them through targeted planning efforts.

These and other questions merit additional research and analysis. It is possible that WMATA's ongoing planning work program could provide opportunities to incrementally address these and related questions. Refinements and supplements to the findings from this study will be presented as they are developed through this work program.

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The 2005 Development-Related Ridership Survey was sponsored by the Washington Metropolitan Area Transit Authority (WMATA). The project manager for WMATA was Kristin Haldeman. The prime consultant was Parsons Brinckerhoff (PB). The project manager for PB was Phil Braum. He was assisted by Jason Yazawa and Robert Donnelly. Diversity Services, Inc. conducted the data collection. Its project manager was Ellen DeBremond, and the field supervisor was Salvador Cortes.

WMATA wishes to acknowledge and thank the many people who provided their time and assistance to make this survey effort a success. These included local jurisdiction staff, property and site managers and local community and business groups. Without their cooperation and support, conducting this study would not have been possible.

1. Introduction

It has been 16 years[1] since the Washington Metropolitan Area Transit Authority (WMATA) last surveyed development around its rail stations to determine how much transit ridership certain land uses generate when placed near rail stations. Since that time much has changed in the Washington metropolitan region in terms of population growth, the regional economy and the built environment. Given these changes, WMATA determined that the time was right to conduct a new survey, modeled on the 1989 survey, to evaluate whether this changed environment had affected modal splits at development around rail stations and to determine if any factors related to the nature of development at a station impacts ridership. Accordingly, WMATA enlisted the services of Parsons Brinkerhoff to conduct the survey and prepare the report.

In 1989, stations were organized into three typologies based on their concentric locations from the Metropolitan urban core: (1) central business district (CBD) location; (2) suburban-inside the Beltway; and (3) suburban-outside the Beltway. Transit mode shares for office sites near rail stations ranged from an average high of 50 percent at CBD locations to an average low of 8.5 percent at Suburban-Outside the Beltway locations. Residential sites showed mode shares ranging from an average high of 60 percent at Suburban-Inside locations and an average low of 33 percent at Suburban-Outside locations. The 2005 effort was designed to update these figures using the same typologies. Since 1989, however, the urban environment has changed. There has been a notable increase in densities surrounding a number of Metrorail stations, as well as an increase in suburb-to-suburb commuting.

The 1987 and 1989 studies also found a relationship between the distance at which a building (office, residential, retail or hotel) is sited from the rail station and the amount of transit ridership it generates. The 2005 effort sought to determine if this relationship still bears out and if there are additional variables that also might show a strong relationship to transit ridership. Some of the additional variables tested include: quality of the pedestrian environment, housing density in the station area, job density in the station area, attractiveness of automobile access, and the availability of transit subsidies.

Similar to the earlier studies, the 2005 survey targeted high-density commercial office and residential, retail and hotel sites, as well as a new use, "entertainment" (which for this study's purposes was defined as movie theaters), as these are the types of land uses typically proposed in joint development projects. The 2005 study secured participation from 49 sites distributed as shown in Table 1.

It is important to note that response rates varied considerably, particularly with the office surveys. One possible reason is that many in the Washington Metropolitan region, like the rest of the nation and even the world, have experienced a change in attitude with respect to security (especially in light of the September 11, 2001 attacks) and to providing personal information to outside entities. The project team anticipated reluctance from potential respondents vis à vis answering the survey questions as well as possible refusal to participate on the part of building management. These expectations seem to have been borne out in the low response rates at some

[1] WMATA conducted two studies, the first in 1987 and the second in 1989, examining how certain development near Metrorail stations affect Metrorail ridership and other mode share characteristics.

buildings, offices in particular, and in the final number of sites agreeing to participate. For the most part, at office sites where there was a 'champion' from building management or on-site staff, response rates were fairly high. However, without the 'insider assistance,' response rates faltered. The project team also found a resistance on the residential side to the hand-delivery of survey forms, and on the office management side to approaching tenants with survey forms. Lastly, the project team attempted to secure some federal participation at stations, but was unable to do so for a variety of reasons, namely security concerns. For these reasons, the 2005 effort faced a number of challenges that only performing the study could have revealed. In the end, the process itself yielded a wealth of information to be incorporated into subsequent study efforts.

Table 1
Final Distribution of Survey Sites by Land Use Type and Station Location

Station Area	Typology Classification	Office	Residence	Retail	Hotel	Enter.	Total
Ballston	I	2	2	1	1	1	7
Court House	I	2	2				4
Crystal City	I	2	2	2	2		8
Dunn-Loring	O		1				1
Eisenhower Avenue	I					1	1
Farragut West	C	2					2
Friendship Heights	I	2	2		1		5
Gallery Place	C		2				2
Grosvenor	O		4				4
King Street	I	2					2
New Carrollton	O	1					1
Silver Spring	I	3	2	1	1	2	9
U Street/African-Amer Civil War Memorial/Cardozo	I	1	1	1			4
Total		**17**	**18**	**5**	**5**	**4**	**49**

Notes: C: CBD location
I: Inside the Beltway
O: Outside the Beltway

Nonetheless, the information gleaned from the office sites agreeing to participate in the study, as well as the residential sites, does provide valuable information about the current state of travel at sites around rail stations and offer some explanation as to cause and effect. That said, there also is sufficient reason for additional, more targeted research to be conducted in certain areas to delve more deeply into the reasons for certain modal splits.

2. Survey Site Selection

The project team guiding the study process included members from WMATA's Offices of Business Planning & Project Development, Property Development & Management and Financial Management, as well as planners and staff from Parsons Brinkerhoff and its sub-contractor, Diversity Services, Inc. The team first identified Metrorail station areas for study, then identified actual sites to survey. The project team then worked to secure permission from the selected office, residential, retail, hotel and entertainment sites to conduct the surveys.

Metrorail stations were selected based on certain characteristics of their surrounding environment and land uses. One important consideration for the study was to include some stations located in areas with densities, mix, urban design and streetscape similar to expected future joint, private, or government developments near Metrorail stations. Therefore, some stations were selected specifically because they are located in areas thought to be good examples of transit-oriented development (TOD)[2]. However, for comparative purposes, several other station types also were examined and included stations in metropolitan fringe, midpoint or outlying locations. In addition, all five Metrorail lines and six political jurisdictions containing rail stations were represented among the selected stations. Lastly, in order to make possible some longitudinal comparison with the earlier studies, the project team also considered whether the station area was surveyed in the 1989 study.

Survey sites were selected using criteria consistent with the earlier studies and distributed to ensure adequate response rates. In addition to those criteria, certain principles were developed to guide decisions about the distribution and selection of survey buildings and sites for the study. For instance, because joint development proposals tend to be weighted toward office and residential uses, a greater number of these sites were selected at the expense of retail, hotel and entertainment sites. Also, where there was a choice, sites located in station areas with TOD characteristics, or areas with designs and densities that WMATA would like to replicate with its joint development projects were chosen instead of sites without TOD characteristics. Local jurisdiction staff and other local organizations provided building/site candidate lists to project staff, who then contacted site managers to ask if they would be willing to participate in the study. A number of site managers declined to participate and project staff then contacted managers at other sites in the same station area. Initially, the plan was to survey a total of 55 sites, but due to such refusals, only 49 sites participated in the project.

These 49 sites were distributed among 13 station areas (see Figure 1). Figures 2 through 13 show the locations of these sites relative to the stations. An asterisk appears next to those sites that were surveyed in 1989.

[2] Although there is no one definition of TOD, WMATA defines it as "projects near transit stops which incorporate the following smart-growth principles: reduce automobile dependence; encourage high shares of pedestrian and bicycle access trips to transit; help to foster safe station environments; enhance physical connections to transit stations from surrounding areas; and provide a vibrant mix of land-use activities."

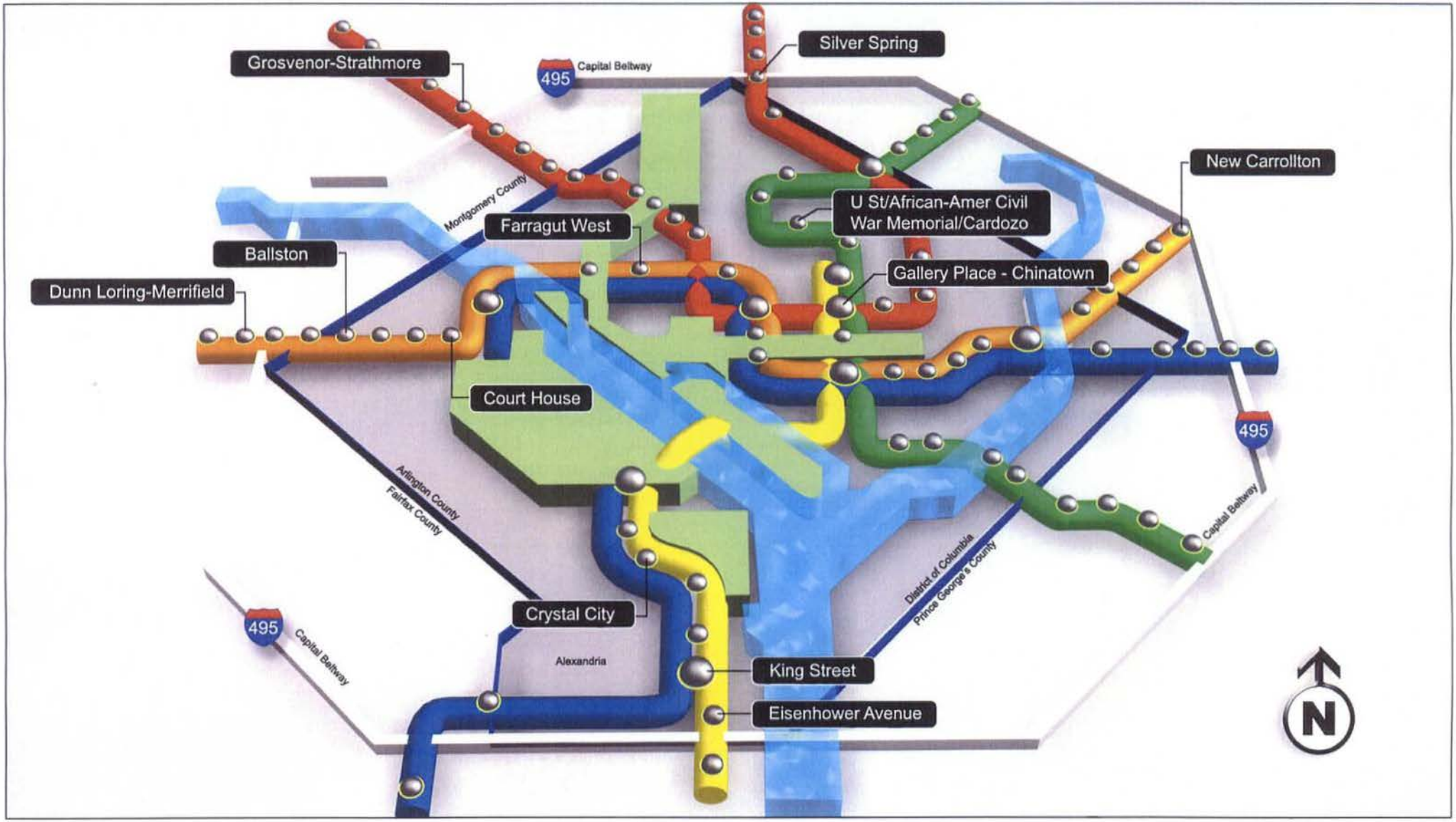

Figure 1: Stations included in survey

Ballston (7 sites) —see Figure 2

- Ballston One (office)*
- 3 Ballston Plaza (office)
- Randolph Towers (residential)*
- Lincoln Towers (residential)
- Ballston Common (retail)*
- Holiday Inn Arlington (hotel)
- Regal Cinemas (entertainment)

Court House (4 sites) —see Figure 3

- 2100 & 2200 Clarendon Drive (office)
- Courthouse Tower (office)
- Arlington Courthouse Plaza (residential)
- Courtland Towers (residential)

Crystal City (8 sites) —see Figure 4

- Crystal Park Four (office)
- Crystal Square 2 (office)*
- Crystal Square Apartments (residential)*
- Crystal Plaza Apartments (residential)*
- Crystal Plaza Shops (retail)*
- Crystal City Shops North (Underground) (retail)*
- Crystal Hyatt Regency (hotel)*
- Crystal Gateway Marriott (hotel)

Dunn-Loring-Merrifield (1 site) —see Figure 5

- Merrifield Village (residential)

Eisenhower Avenue (1 site) —see Figure 6

- AMC Hoffman Theaters (entertainment)

Farragut West (2 sites) —see Figure 7

- 1701 Pennsylvania Avenue (office)*
- 1634 I Street (office)

Friendship Heights (5 sites) —see Figure 8

- 2 Wisconsin Circle (office)
- Chevy Chase Plaza (office)
- Highland House West (residential)
- North Park Apartments (residential)
- Embassy Suites Chevy Chase Pavilion (hotel)

Gallery Place-Chinatown (2 sites) —see Figure 9

- The Lansburgh (residential)
- Meridian at Gallery Place (residential)

Grosvenor-Strathmore (4 sites)—see Figure 10

- Avalon at Grosvenor Station (residential)
- Grosvenor House Apartments (residential)*
- Grosvenor Park I (residential)*
- Stoneybrook (residential)*

King Street (2 sites) —see Figure 6

- King Street Station (office)
- 333 John Carlyle (office)

New Carrollton (1 site) —see Figure 11

- 8400 Corporate Drive (office)

Silver Spring (9 sites) —see Figure 12

- 8720 Georgia Avenue (office)
- Metro Plaza 1 (office)
- 8380 Colesville Road (office)
- Twin Towers (residential)*
- Georgian Towers (residential)*
- Silver Spring Plaza Neighborhood Center (retail)
- Holiday Inn Silver Spring (hotel)*
- The Majestic 20 (entertainment)
- AFI Silver Theater (entertainment)

U Street/African American Civil War Memorial/Cardozo (3 sites) —see Figure 13

- Reeves Center (office)
- Summit Roosevelt (residential)
- U Street (12th to 15th Street) (retail)

More detailed information about the station and site selection process can be found in Appendix A.