EXISTING AND FUTURE LAND USE

The initial phase of the study allocated pedestrian trips to and from the existing and proposed entrances to the Bethesda Metrorail station and proposed Bi-County Transitway station based on the surrounding land use. The future land use in the Bethesda station area was determined based on MWCOG Round 6.4 forecasts for jobs and dwelling units. The data was examined at the Traffic Analysis Zone (TAZ) level for the year 2030.

The MWCOG TAZ data was further refined based on information provided by M-NCPPC. The additional data included smaller geographic increments, approaching the block level, for three TAZs in the Bethesda central business district (CBD) area. The M-NCPPC block data provided a more accurate forecast of the distribution of jobs and dwelling units within the TAZs located closest to the existing and proposed entrances. Figure 4 illustrates the location of TAZs and M-NCPPC blocks in the Bethesda area. Complete details about the existing and future land use forecast are included in Appendix A.

The primary access point to the proposed south entrance of the Bethesda station would be the elevators on Elm Street just west of Wisconsin Avenue. However, if the Bi-County Transitway is constructed, these elevators would also stop at the Bi-County Transitway level 24.5 feet below street level. This is also the same level as the current interim Capital Crescent Trail, which would serve as a secondary access point to the elevators and the Bi-County Transitway. The trail access point would shorten the walking distance from some blocks and eliminate the need for patrons to use the elevator to access the Bi-County Transitway. For this report, the primary street-level access is referred to as the east access point, and the secondary transitway-level access is referred to as the west access point.

Although there is a mix of uses in the station area, the higher density uses are concentrated around the station and consist of predominantly office space and supporting retail. As the distance from the station increases, so does the percentage of residential uses, which occur at lower intensities. Adding a south entrance to the Metrorail station would expand the catchment area for pedestrian trips in the Bethesda area as illustrated Figure 5 and Table 3.

Dwelling units within the station's catchment area increase by a relatively high 27 percent—larger than the 9 to 11 percent increase in employment. The percent increase in dwelling units is larger than for employment because of the concentration of employment near the existing station, whereas the expanded catchment area captures large residential areas. However, the number of new trips is much larger from employment land uses because the density of the residential uses is much lower, attracting far fewer trips per unit area.

Figure 4: Bethesda Area TAZs and M-NCPPC Blocks

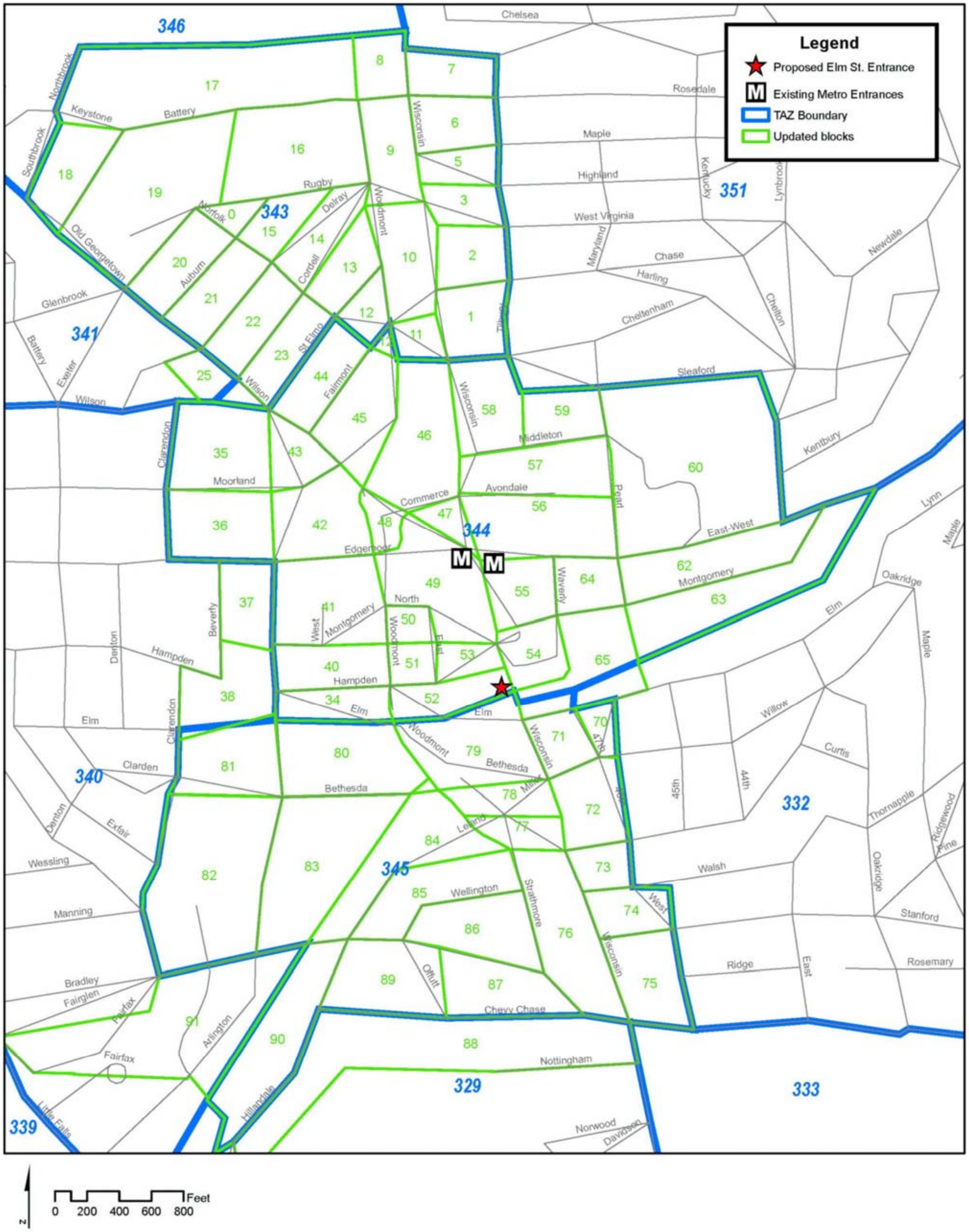


Figure 5: Expansion of Service Areas Caused by South Entrance

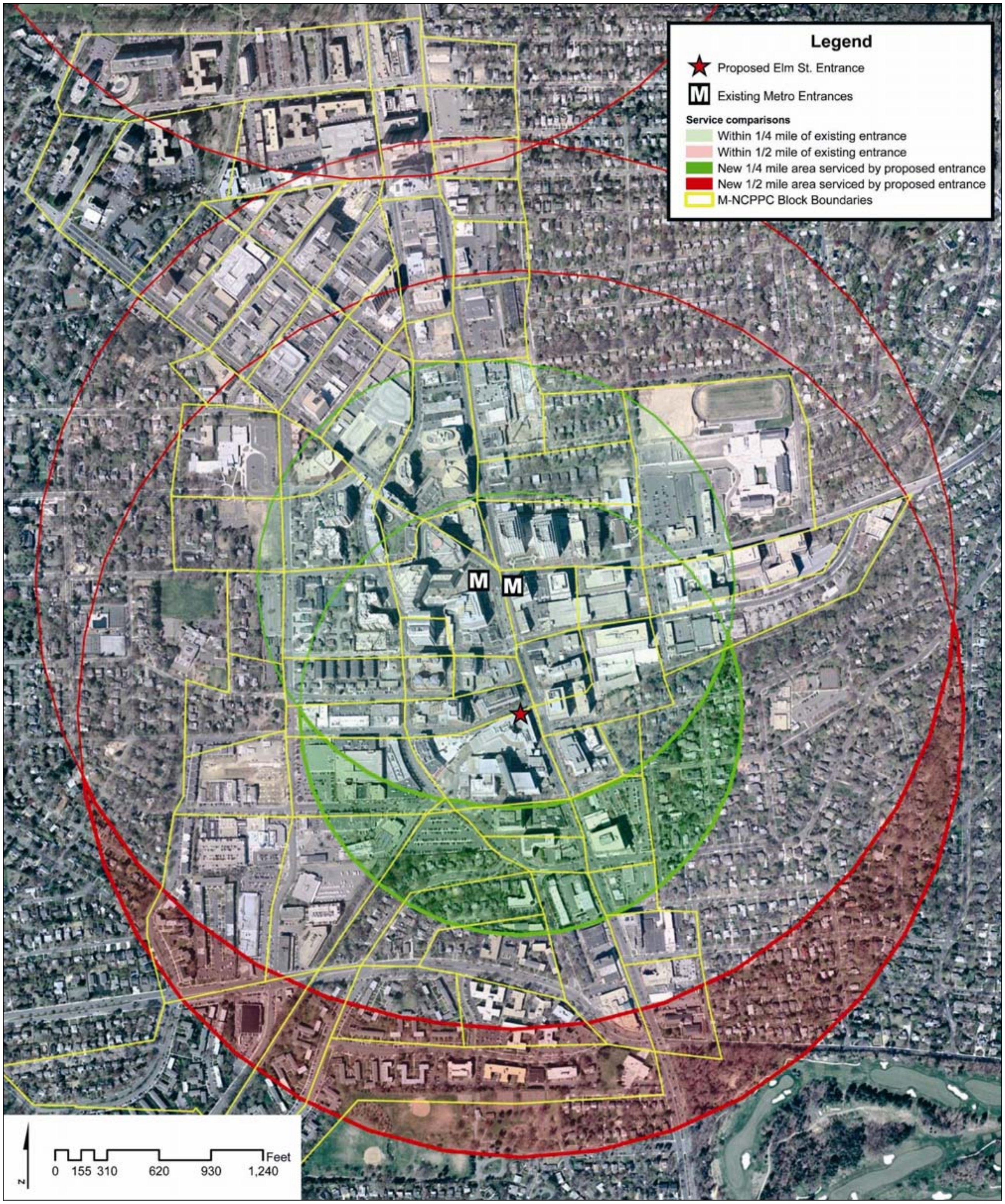


Table 3: Change in Area, Dwelling Units and Employment near Station Entrances

		Land Area (acres)	Dwelling Units		Employment	
			Existing	2030	Existing	2030
¼ mile radius	Within ¼ mile of existing entrance	12.77	1,349	2,891	21,096	29,104
	Within ¼ mile of existing or proposed entrance	16.75	2,261	3,680	23,509	32,296
	Increase Due to South Entrance	**3.98**	**912**	**789**	**2,413**	**3,192**
		31%	**68%**	**27%**	**11%**	**11%**
½ mile radius	Within ½ mile of existing entrance	48.78	3,869	6,237	33,282	45,267
	Within ½ mile of existing or proposed entrance	56.68	5,253	7,931	36,211	49,167
	Increase Due to South Entrance	**7.9**	**1,384**	**1,694**	**2,929**	**3,900**
		16%	**36%**	**27%**	**9%**	**9%**

Source: MWCOG Round 6.4

The allocation of Metrorail boardings in the morning peak period was determined based on the distribution of dwelling units in the station area and assumes that most morning trips are from home to work. The morning alightings were allocated based on the distribution of jobs in the station area, based on a similar assumption that most people exiting the station in the morning are on their way to their place of employment. The allocation of Metrorail trips in the afternoon peak period was the reverse of the morning, such that alightings in the afternoon follow the same pattern as boardings in the morning, and boardings in the afternoon follow the same pattern as alightings in the morning. The morning and afternoon allocation of Metrorail boardings and alightings between the north and south entrances are presented in Table 4.

Table 4: Allocation of Trips to Bethesda Metrorail Station Entrances by TAZ

TAZ	AM Boardings and PM Alightings		PM Boardings and AM Alightings	
	North Entrance	South Entrance	North Entrance	South Entrance
329	0%	100%	0%	100%
332	30%	70%	30%	70%
340	50%	50%	50%	50%
343	100%	0%	100%	0%
344	87%	13%	77%	23%
345	0%	100%	0%	100%
351	100%	0%	100%	0%

Source: Based on MWCOG Round 6.4 population and employment for 2030.

If a south entrance were constructed, all or most of the boardings and alightings from TAZs 329, 332, and 345 would use that entrance. All or most of the boardings and alightings from TAZs 343, 344, and 351 would use the existing north entrance. TAZ 340 would be split fairly evenly between the two entrances.

If the Bi-County Transitway is constructed, all Bi-County Transitway passengers are assumed to use the south entrance. Use of the north entrance would require a long trip through the Metrorail Station, including vertical circulation down the long north escalators and back up the south elevators, passing through the faregates and along the platform. This route would be unattractive to Bi-County passengers; the street-level route would require much less time.

However, if the Bi-County Transitway is constructed, both Metrorail passengers and Bi-County Transitway passengers may choose to use either the east or west access points to the south entrance. (The locations of the east and west access points are included on Figure 3.) The allocation of boardings and alightings by south entrance access point was determined based on the same method previously described for the Metrorail station entrances. The morning and afternoon allocations between the west and east access points are presented in Table 5.

It was assumed that the elevators would not stop at the Capital Crescent Trail if the south entrance were constructed without the Bi-County Transitway (under Option 2), to improve elevator operations.

Table 5: Allocation of Trips to South Entrance Access Points by TAZ

TAZ	AM Boardings/PM Alightings		PM Boardings/AM Alightings	
	West Access	East Access	West Access	East Access
329	100%	0%	100%	0%
332	0%	100%	0%	100%
340	50%	50%	50%	50%
343	0%	100%	0%	100%
344	0%	100%	0%	100%
345	89%	11%	44%	56%
351	0%	100%	0%	100%

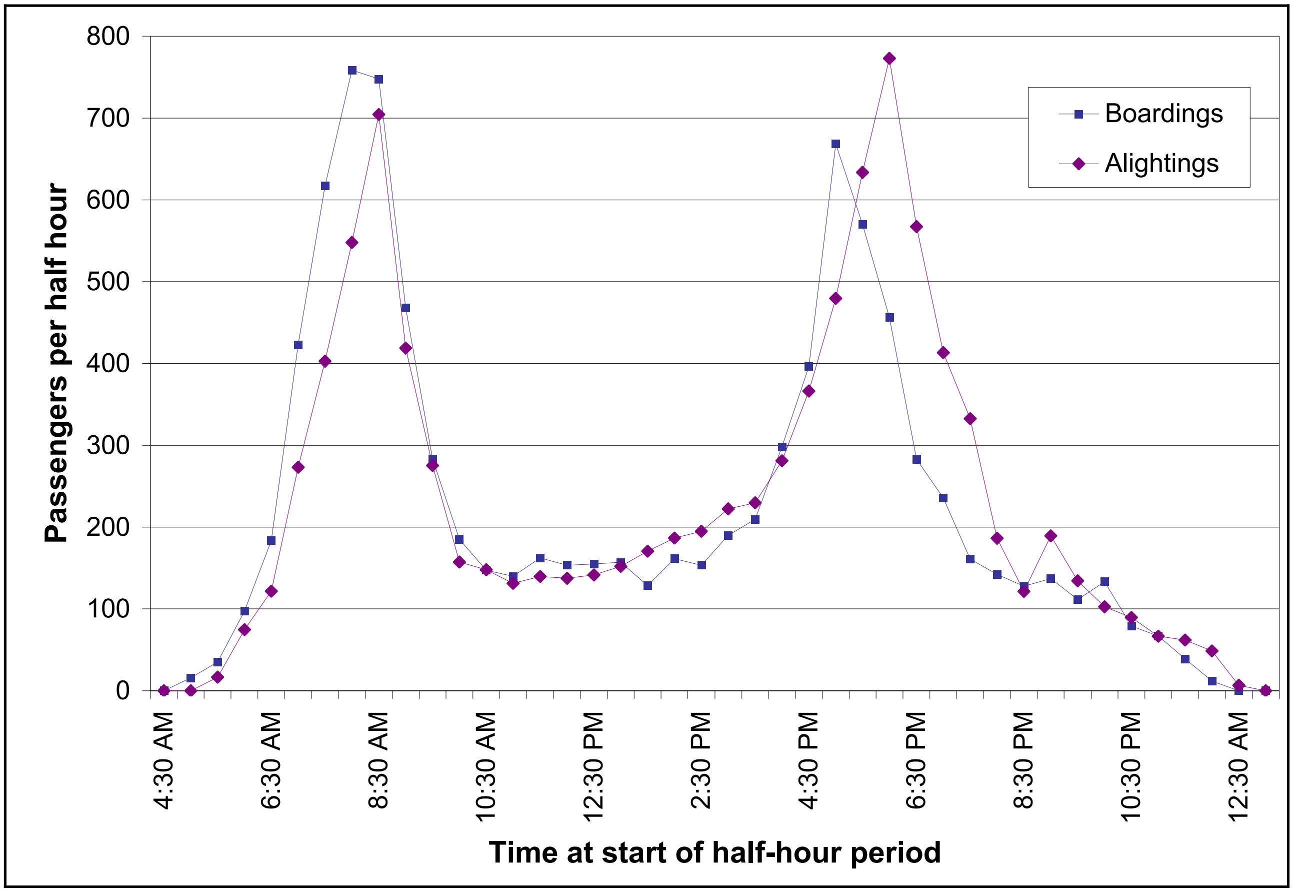
Note: Applies only to trips that are determined to use the South Entrance.
Source: Based on MWCOG Round 6.4 population and employment for 2030.

All or most of the boardings and alightings from TAZs 329 and 345 would use the west access point. All or most of the boardings and alightings from TAZs 332, 343, 344, and 351 would use the east access point. TAZ 340 would be split fairly evenly between the two access points.

EXISTING METRORAIL RIDERSHIP

Existing Metrorail ridership was determined from three mid-week days in May 2004, generally taken to be an average, representative period. May ridership levels were used as the baseline for computations of future ridership in this report; however, it is noted that ridership often surges above May levels, particularly during the summer. Figure 6 graphically presents the existing boarding and alighting patterns at the Bethesda station in 30-minute increments. Table 6 documents existing boardings and alightings during peak periods of various lengths and on a daily basis.

Figure 6: Existing Bethesda Metrorail Station Boardings and Alightings



Source: WMATA Faregate data, May 2004

The WMATA 2002 Metrorail Passenger Survey was used to determine the modes of access for Metrorail trips with origins at the Bethesda Station. The relevant results of the survey are presented in Table 7 and graphically in Figure 7.

Table 6: Existing Boardings and Alightings, Peak Periods and Daily

		Boardings	Alightings
AM Peak Period	30-min peak	759	704
	1-hr peak	1506	1252
	3-hr peak	3298	2622
PM Peak Period	30-min peak	668	773
	1-hr peak	1239	1407
	3-hr peak	2672	3233
Daily		9490	9701

Table 7: Access Modes for Metrorail Trips with origins at Bethesda

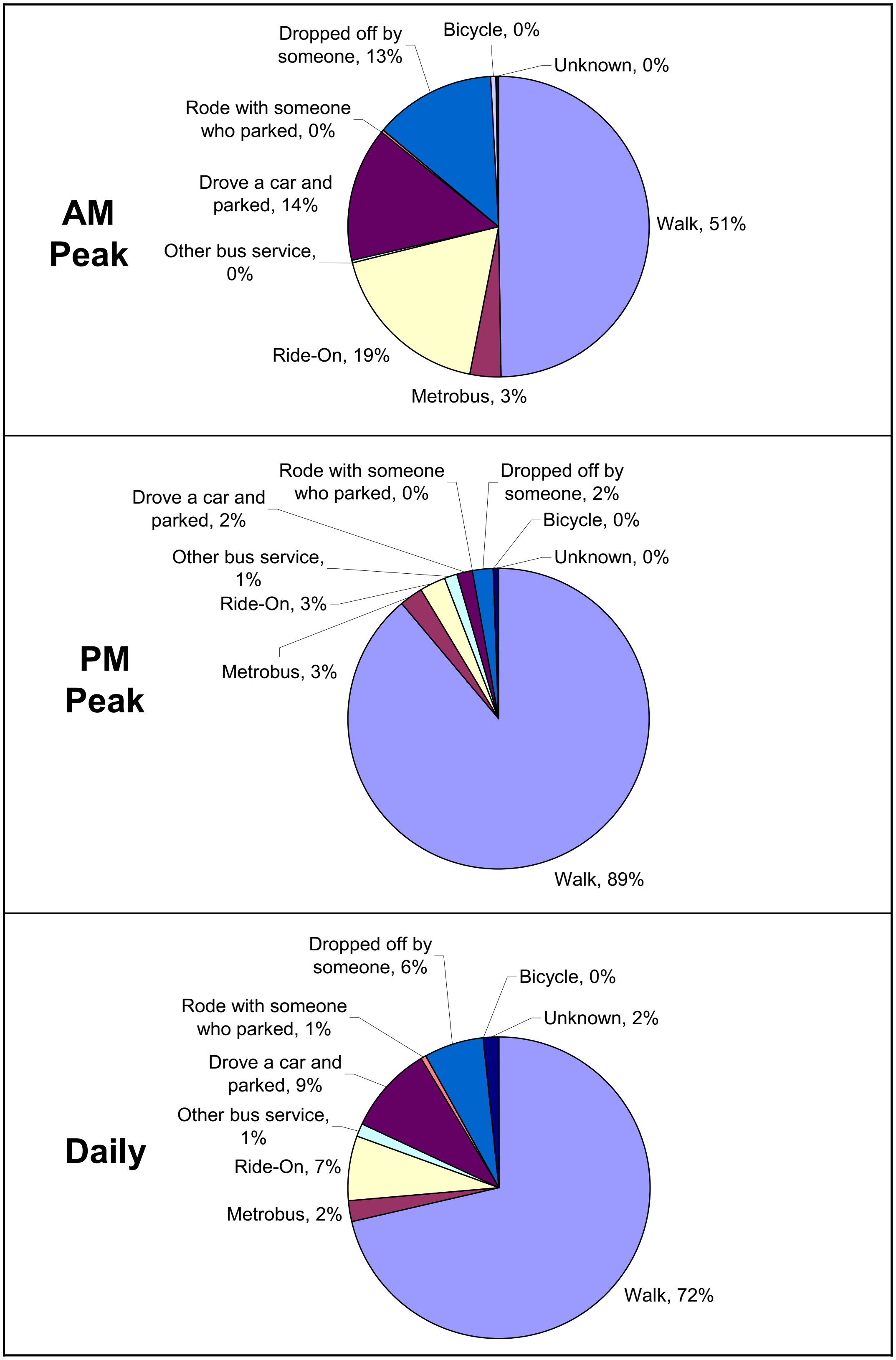
Access Mode	AM Peak		AM Off Peak		PM Peak		PM Off Peak		Daily	
	no.	pct.	no.	pct.	no.	pct.	no.	pct.	no.	pct.
Walk	1,464	49.8%	1,955	72.9%	1,561	88.8%	1,900	84.3%	6,880	71.4%
Metrobus	96	3.3%	0	0.0%	47	2.7%	63	2.8%	206	2.1%
Ride-On	528	18.0%	45	1.7%	47	2.7%	63	2.8%	683	7.1%
Other bus service	12	0.4%	45	1.7%	24	1.3%	42	1.9%	123	1.3%
Drove a car and parked	420	14.3%	409	15.3%	31	1.8%	42	1.9%	902	9.4%
Rode with someone who parked	12	0.4%	45	1.7%	0	0.0%	0	0.0%	57	0.6%
Dropped off by someone	384	13.1%	45	1.7%	39	2.2%	146	6.5%	615	6.4%
Bicycle	12	0.4%	0	0.0%	0	0.0%	0	0.0%	12	0.1%
Unknown	12	0.4%	136	5.1%	8	0.5%	0	0.0%	156	1.6%
Total	**2,941**	**100.0%**	**2,682**	**100.0%**	**1,757**	**100.0%**	**2,255**	**100.0%**	**9,635**	**100.0%**

Source: WMATA 2002 Metrorail Passenger Survey
Note: Rounding may affect sums.

Walking is the dominant access mode for Bethesda passengers. About half of passengers in the morning peak period walk to the station, increasing to nearly 90 percent in the afternoon peak period. Ride On Bus service is about six times more popular than Metrobus service as an access mode; Ride On is the second most frequent mode of access in the morning peak. About 14 percent of morning-peak passengers drove and parked, accounting for over 400 parked vehicles in the vicinity of the station.

A review of egress mode data from the Metrorail Passenger Survey shows patterns that are largely symmetric with the access mode data presented in Table 7 and Figure 7.

Figure 7: Access Modes for Metrorail Trips with origins at Bethesda



Source: WMATA 2002 Metrorail Passenger Survey

RIDERSHIP DEMAND ANALYSIS

Two methodologies were used to forecast future ridership. First, the MWCOG travel forecasting model was used to compare ridership under existing, No-build, and Bi-County Transitway scenarios. However, the model is not the best way to predict new Metrorail demand that would be induced by providing better access through a south entrance. As such, the south entrance was evaluated using the methodology outlined in WMATA's *Development-Related Ridership Survey* (1987, 1989), coupled with the land use forecast discussed earlier. Each of these methods is outlined in further detail below.

MWCOG Travel Forecasting Model

WMATA provided a copy of the MWCOG Version 2.1 D/TP+#50 travel forecasting model with Round 6.4A of the MWCOG Cooperative Forecasts on demographic data, and it was initially expected that this Version D model would be used exclusively in the study. However, the Version D model does not include the Bi-County Transitway, which is the most critical component of this study. In the earlier Georgetown Branch Transitway study, the Bi-County Transitway and its supplementary network of feeder buses were coded and tested as one of the alternatives under the MWCOG Version 2.1 C model with Round 6.2 Cooperative Forecasts. Modeling assumptions used in the earlier study and carried forward to this study are presented in Appendix B.

It was initially expected that this earlier coding of the Bi-County Transitway could be easily adapted into the new MWCOG Version D model. However, a review of the Version D model indicated that the Bi-County Transitway coding could not be readily converted from Version C model because of significant changes in the structure and algorithms of the Version D model.

Because of these constraints, the Version C model that includes the Bi-County Transitway was selected for use in this study, with the following refinements to reflect the needed updates:

- Metrorail service in the Version 2.1 C model was replaced with the service from the "Dulles Corridor Final EIS Full Build after 2015" plan. Appendix C compares Metrorail service assumptions between the original 2025 Constrained Long Range Plan (CLRP) transit network and the updated 2030 plan used in this study.
- Round 6.4A land use input data for the year 2030 replaced the Round 6.2 data from 2025 used in the Version C model. As such, the impacts of the most recent land use assumptions on Bi-County Transitway ridership were assessed. Appendix D further illustrates the differences among land use forecasts for TAZs in the Bethesda CBD.
- A separate node was added to represent the Bethesda Bi-County Transitway station to document transfers between the transitway and Metrorail.

Because the Version D model was not used in the study, a sensitivity analysis was undertaken to document the differences in model results attributable to the use of the Version C model. The results of this analysis are discussed later in this section.

In the model, the transit vehicle mode was coded as light rail. Because BRT and LRT are expected to have only minor operational differences, this study does not directly consider changes to transit vehicle mode.

To develop ridership forecasts for the Bethesda Station based on the demand analysis from the MWCOG travel forecasting model, prior to adding a new south station entrance, the following three scenarios were studied:

- Existing 2005 conditions
- Future 2030 No-build (does not include Bi-County Transitway)
- Future 2030 Build (includes Bi-County Transitway)

The results of the existing conditions scenario were compared to actual ridership, forming a basis for adjusting future ridership forecasts from the model.

The MWCOG model is only able to simulate the morning peak and off-peak periods. Afternoon peak-period data was synthesized by assuming that trip distribution is symmetric to the morning peak, and by assigning afternoon trips to times of the day that are consistent with existing patterns.

The raw model outputs and adjusted results for these three scenarios were summarized into three categories: regional transit demand, Bethesda Station demand, and Bethesda local access demand. Each of these categories is discussed further as follows.

Regional Transit Demand

Part I of Appendix E presents the differences in regional transit demand among the scenarios. Regional transit demand accounts for changes in transit trip patterns on a regional basis, including the following elements:

- Modeled transit person trips by trip purpose, time period and access mode
- Modeled rail trips by time period and access mode
- Observed rail trips by time period from May 2004
- Future adjusted rail trips by time period based on observed rail trips and the relationship between modeled rail trips of different scenarios

Bethesda Station Demand

Bethesda Station demand, as shown in Appendix E, Part II, accounts for transit trip patterns at the Bethesda station, including the following elements:

- Metrorail and Bi-County Transitway boardings and alightings by time period, access mode, and direction of travel
- Observed rail boarding and alighting by time period from May 2004
- Modeled rail transfers between Metrorail and the Bi-County Transitway by time period and access mode
- Future adjusted boarding and alighting, adjusted transfers between Metrorail and the transitway, and local (non-transfer) access demand by time period based on observed boarding and alighting data and the relationship between modeled rail boarding and alighting data of different scenarios

Bethesda Station Local Access Demand

Bethesda local access demand, as shown in Appendix E, Part III, represents direct access and egress from the Bethesda area to Metrorail and the Bi-County Transitway. It differs from station demand in that it excludes passengers transferring between Metrorail and the transitway, focusing only on those passengers who access the Bethesda Station by other modes. The following elements are included:

- Modeled local boarding and alighting rail demand by time period, access mode, and direction to and from station
- For passengers who walk to the station, the boarding and alighting demand was further segregated by origin and destination TAZ.
- Future adjusted local rail demand by time period, access mode, and direction

The rail ridership estimates derived from the above modeling procedure represented the basic demand without the new south entrance, with and without Bi-County Transitway.

South Entrance

A new south entrance would provide significant benefits for current Metrorail users and would attract new riders because of the shorter walking access time for areas south of the station. The increase in Bethesda Metrorail demand due to the addition of a south entrance was computed by calculating the reduction in walking distance for individual M-NCPPC blocks south of the station. The differences in walking distances were converted to differences in mode share using the *Development-Related Ridership Survey*.

The use of the M-NCPPC block land use forecasts allows more accurate forecasting than would be possible in the MWCOG model, because the model's land use forecast does not have nearly as much detail about the Bethesda area.

Appendix F presents the calculations and results of the south entrance analysis for each M-NCPPC block. For blocks where a reduction in walking distance can be achieved, the resulting difference in transit mode share was applied to the block's 2030 population and employment forecast to determine the likely percent increase that the south entrance would cause in 2030 Metrorail ridership levels among patrons who access the station on foot. (The south entrance is not expected to increase ridership among patrons who access the station by other modes, such as by bus or car, because it would not significantly change riders' access times.)

The results show that the south entrance would induce a 3.2 percent increase in pedestrian-based Metrorail ridership generated by residential areas, and a 7.5 percent increase in pedestrian-based ridership generated by employment areas. Overall, the weighted average of both land uses shows that the south entrance could be expected to increase pedestrian-based Metrorail ridership by 6.2 percent.

The magnitude of the mode share increase, 6.2 percent, is much smaller than would be suggested by Figure 5 and Table 3. Although the population of the ¼-mile and ½-mile transit catchment areas increases by 27 percent with a south entrance, individual households observe relatively small reductions in walking distance—never exceeding the distance between the entrances of about 800 feet.

Model Version Sensitivity

As discussed earlier, the most recent version of the MWCOG model (Version D) was not able to be used in the current study because of difficulties with coding the Bi-County Transitway. Instead, this study used the Version C model, in which the Bi-County Transitway had been coded as part of an earlier project.

Version D includes several changes to transportation facilities in the region that are not included in Version C. Among these changes are the additions of the Inter-County Connector and the Corridor Cities Transitway. A sensitivity analysis was conducted to determine whether these facility changes would significantly affect ridership levels in the Bethesda area. The sensitivity analysis compared transit person trip-table patterns from this study's 2030 No-build scenario with the 2030 CLRP Version 2.1 D model. By using the total boardings and alightings for the Bethesda area and total regional transit person trips as measures for computing quantitative effects on local access and transfer rail trips respectively, the results are summarized in Part IV of Appendix E.

The sensitivity analysis showed only minor changes in forecast ridership levels, both in the Bethesda area and region-wide.

Ridership Summary

The final ridership forecasts, presented in Table 8 and Figure 8, were computed by combining the results of the MWCOG methodology with the results of the South Entrance methodology. Results for the No-build Option (Option 1) are identical to those in the MWCOG forecast. The South Entrance Option (Option 2) was computed by applying the mode share increase caused by the south entrance to the appropriate time period, land use, and travel access modes of Option 1.

The Bi-County Transitway Option (Option 3) was computed by applying the south entrance mode share increase to the MWCOG scenario with the Bi-County Transitway in place.

The ridership in Table 8 was assigned to the closer station entrance, according to the allocations developed for Table 4. However, it was assumed that all passengers using the Bi-County Transitway would use the south entrance, because using the north entrance would require traveling through the Bethesda Metrorail Station, an awkward trip because of the large amount of vertical travel.

Table 8: Adjusted Ridership Summary, 2030

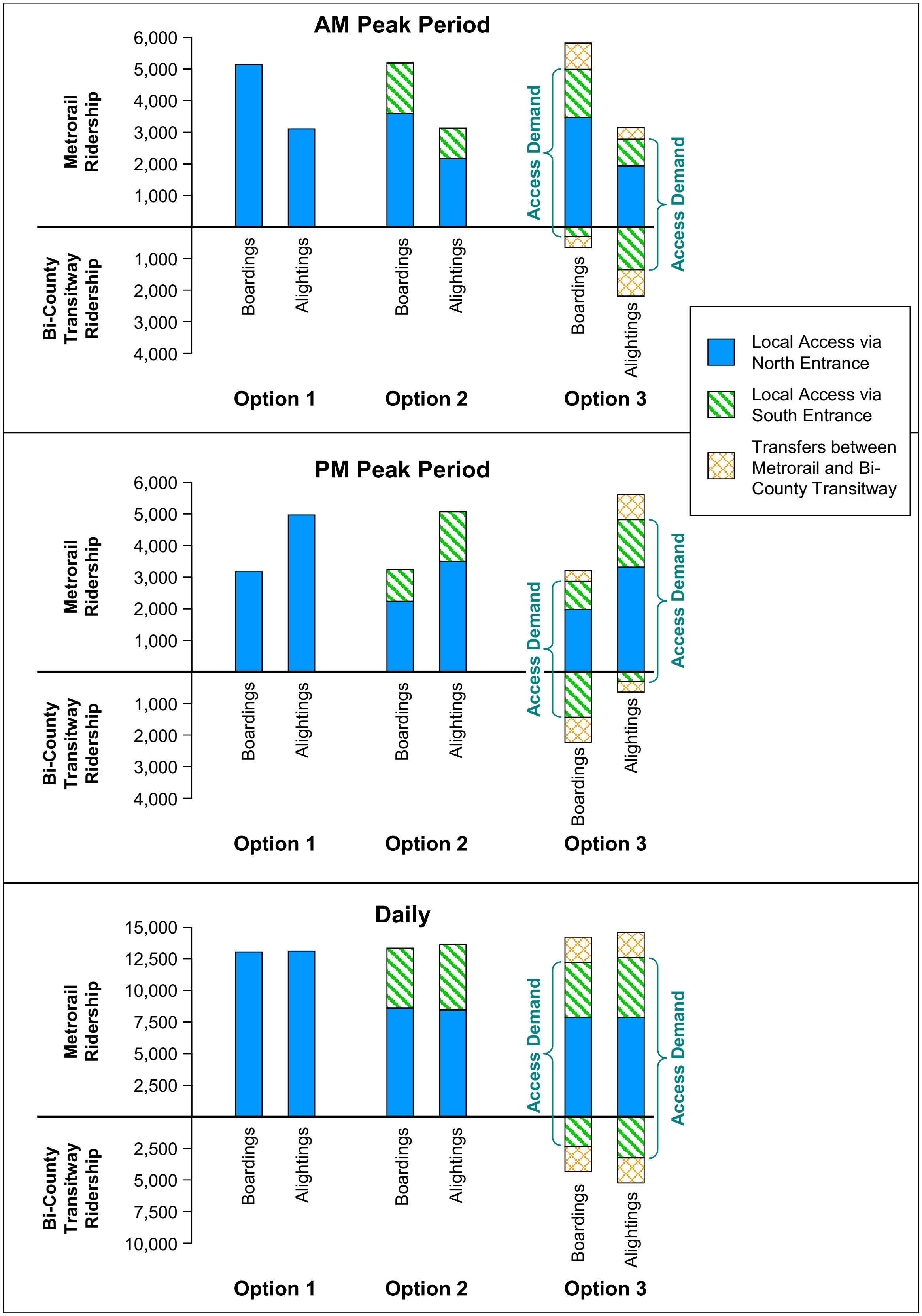
AM Peak Period		*Metrorail Bethesda Station*		*Bi-County Transitway Bethesda Station*		*Transfers between Metrorail and Bi-County*		***Total Access Demand (excludes transfers)***	
	Entrance	*Boardings*	*Alightings*	*Boardings*	*Alightings*	*From Metro to Bi-County*	*From Bi-County to Metro*	***Boardings***	***Alightings***
Option 1: No-Build	North	5,100	3,100	0	0	0	0	**5,100**	**3,100**
	South	0	0	0	0	0	0	**0**	**0**
	Total	**5,100**	**3,100**	**0**	**0**	**0**	**0**	**5,100**	**3,100**
Option 2: South Entrance without Bi-County	North	3,600	2,200	0	0	0	0	**3,600**	**2,200**
	South	1,600	1,000	0	0	0	0	**1,600**	**1,000**
	Total	**5,200**	**3,200**	**0**	**0**	**0**	**0**	**5,200**	**3,200**
Option 3: South Entrance with Bi-County	North	3,500	1,900	0	0	0	0	**3,500**	**1,900**
	South	1,500	900	300	1,400	400	800	**1,900**	**2,200**
	Total	**5,000**	**2,800**	**300**	**1,400**	**400**	**800**	**5,300**	**4,200**

PM Peak Period		*Metrorail Bethesda Station*		*Bi-County Transitway Bethesda Station*		*Transfers between Metrorail and Bi-County*		***Total Access Demand (excludes transfers)***	
	Entrance	*Boardings*	*Alightings*	*Boardings*	*Alightings*	*From Metro to Bi-County*	*From Bi-County to Metro*	***Boardings***	***Alightings***
Option 1: No-Build	North	3,100	5,000	0	0	0	0	**3,100**	**5,000**
	South	0	0	0	0	0	0	**0**	**0**
	Total	**3,100**	**5,000**	**0**	**0**	**0**	**0**	**3,100**	**5,000**
Option 2: South Entrance without Bi-County	North	2,200	3,500	0	0	0	0	**2,200**	**3,500**
	South	1,000	1,600	0	0	0	0	**1,000**	**1,600**
	Total	**3,200**	**5,100**	**0**	**0**	**0**	**0**	**3,200**	**5,100**
Option 3: South Entrance with Bi-County	North	2,000	3,300	0	0	0	0	**2,000**	**3,300**
	South	900	1,500	1,400	300	800	300	**2,300**	**1,800**
	Total	**2,900**	**4,800**	**1,400**	**300**	**800**	**300**	**4,300**	**5,100**

Daily		*Metrorail Bethesda Station*		*Bi-County Transitway Bethesda Station*		*Transfers between Metrorail and Bi-County*		***Total Access Demand (excludes transfers)***	
	Entrance	*Boardings*	*Alightings*	*Boardings*	*Alightings*	*From Metro to Bi-County*	*From Bi-County to Metro*	***Boardings***	***Alightings***
Option 1: No-Build	North	13,000	13,100	0	0	0	0	**13,000**	**13,100**
	South	0	0	0	0	0	0	**0**	**0**
	Total	**13,000**	**13,100**	**0**	**0**	**0**	**0**	**13,000**	**13,100**
Option 2: South Entrance without Bi-County	North	8,500	8,400	0	0	0	0	**8,500**	**8,400**
	South	4,700	5,100	0	0	0	0	**4,700**	**5,100**
	Total	**13,300**	**13,500**	**0**	**0**	**0**	**0**	**13,300**	**13,500**
Option 3: South Entrance with Bi-County	North	7,900	7,800	0	0	0	0	**7,900**	**7,800**
	South	4,400	4,800	2,400	3,200	2,000	2,000	**6,700**	**8,000**
	Total	**12,200**	**12,600**	**2,400**	**3,200**	**2,000**	**2,000**	**14,600**	**15,800**

Note: Figures are rounded to the nearest 100 riders, which may affect sums.

Figure 8: Adjusted Ridership Summary, 2030



ANALYSIS OF CAPACITY CONSTRAINTS

The infrastructure requirements at each entrance to the Bethesda Station were evaluated based on the forecasted ridership levels. At each point of access, each of the following station elements were analyzed:

- Vertical circulation: elevators, escalators and stairways
- Fare gate aisles
- Farecard vendors

The design criteria used for the capacity analysis are presented in Table 9, sourced to their use in other recent WMATA studies.

Table 9: Assumed Metrorail Station Capacity Criteria

Item		***Source***
Peaking factor for alighting passengers	1.28	Convention Center Metrorail Expansion Program, page 2
Escalator flow rate	83 ppm*	Technical Report and Program for the Mount Vernon Square-UDC Station to Complement the New Washington Convention Center, 1997.
Up stair flow rate	55 ppm	Core Capacity Study, table on page 21, modified per Convention Center Program
Down stair flow rate	55 ppm	Core Capacity Study, table on page 21
Percent of passengers using farecard vendor	30%	Convention Center Metrorail Expansion Program, page 2
Farecard vendor peaking factor	1.1	Convention Center Metrorail Expansion Program, page 2
Farecard vendor transactions per minute	2.5	Concurrence among Core Capacity Study and Convention Center Program
Fare gate aisle flow rate	32 ppm	Average for the range (25 to 40 ppm) as cited in the Transit Capacity and Quality of Service Manual
Ascent/descent rate of high-speed elevator	350 ft/min	Courthouse Metrorail Station Access Study, Appendices I, IV
Elevator acceleration and deceleration time	2 sec	Courthouse Metrorail Station Access Study, Appendices I, IV
Elevator load and unload time per passenger	1 sec	Courthouse Metrorail Station Access Study, Appendices I, IV
Elevator door cycle time	6.22 sec	Courthouse Metrorail Station Access Study, Appendices I, IV
Elevator cab passenger capacity	9.6 passengers	Courthouse Metrorail Station Access Study, Appendices I, IV

*ppm = passengers per minute

South Entrance

At the south entrance, passenger demand predicted according to the ridership forecast was allocated to the east and west access points in accordance with Table 5.

Elevators

Of particular concern at the south entrance is the new bank of elevators that would connect street level with the Metrorail Station and, in the case of Option 3, the transitway station. Because the elevators would stop at three levels under this latter option, they were evaluated using an iterative approach to determine the cycle length and number of passengers per elevator cab. The analysis considered the peak 30-minute ridership during both morning and afternoon peaks.

The results of the analysis show that three elevator cabs are required to serve passenger demand under Option 2 and five cabs are required under Option 3. The elevator requirement is higher when the Bi-County Transitway is in place not only because the passenger load increases, but also because the elevators are required to serve an additional level, increasing travel times.

One additional cab should be considered under both options so that service can continue when one cab is taken out of service for maintenance or repair.

Elevator capacity could be increased using several methods, such as increasing speed or enlarging the cabs to accommodate more passengers. These or other similar capacity improvements may reduce the number of elevator cabs required.

Under Option 3, other studies have suggested that escalators or stairways be provided between street level and Bi-County Transitway level, in addition to elevators. Escalators or stairs would improve vertical circulation, but they would not reduce the number of elevator cabs required. Elevator cabs would carry their maximum loads between Bi-County Transitway level and Metrorail level, so providing additional circulation between the transitway and street levels does not significantly reduce the need for elevator capacity. (Additional vertical circulation is also not expected to be needed for emergency egress of the Bi-County Transitway platform because of its high-capacity at-grade egress to the west.)

Detailed results of the elevator analysis are presented in Appendix H.

Infrastructure

Aside from the elevator access, the infrastructure required to serve the south entrance is not extensive. Again, peak 30-minute flows were evaluated during morning and afternoon periods to determine the infrastructure needs.

In both Option 2 and Option 3, vertical circulation between the platform and mezzanine could be served easily by one pair of escalators. This system would operate at well below half of its capacity, even during peak times. It would remain below capacity even if one or both of the escalators were replaced with a static stairway of similar width. (Including a stairway offers emergency egress advantages as well.) To comply with the Americans with Disabilities Act (ADA), it is also recommended that elevator access be provided between mezzanine and platform.

A minimum of two elevators is recommended so that service can continue during maintenance or repair.

Two fare card vendors would be sufficient to serve demand in Option 2, increasing to three in Option 3.

Passenger volume suggests that two standard fare gate aisles would be required to serve demand in Option 2 and three would be required in Option 3. In both options, two additional ADA-accessible aisles are recommended, as is one additional standard aisle as a spare. This results in a total of five aisles in Option 2 and six aisles in Option 3.

Further details about the infrastructure analysis are included in Appendix I.

North Entrance

Passenger volume at the north entrance is highest in Option 1. It drops significantly in Option 2, as many existing passengers switch to the south entrance, and it drops further in Option 3 when Bi-County Transitway passengers shift to the south entrance.

Infrastructure

The existing bank of three escalators from street level to mezzanine level is expected to remain below capacity, even in the highest-volume Option 1. The single elevator between street and mezzanine provides ADA access, but a second elevator would be desirable, particularly in Option 1, when elevator access is not provided in a new south entrance.

Vertical circulation between mezzanine and platform, provided by two escalators and a single elevator, is expected to be about 7 percent over capacity in Option 1. An additional unit of exit is recommended in Option 1 to offset this capacity shortfall; a static stairway is the most effective way to increase capacity because of its emergency egress advantages.

In Options 2 and 3, the existing platform-to-mezzanine circulation remains below capacity, but the bank of two escalators does not provide for redundant service. When one escalator is removed from service, congestion is expected to result. In all options, a second platform elevator would be desirable to provide redundant ADA accessibility.

The existing seven fare card vendors at the north entrance are predicted to be sufficient in Option 1. The farecard vendor requirement drops to five in Options 2 and 3.

The north entrance features seven standard fare gate aisles and one ADA-accessible aisle. Under Option 1, only five standard aisles are needed to serve peak demand, with a sixth aisle as a spare. A second ADA aisle would be desirable; sufficient space exists to add an ADA aisle to the existing fare gate array without reconfiguring the kiosk or existing fare gate aisles. Under Options 2 and 3, three standard fare gate aisles are needed to serve peak demand, two fewer than under Option 1. In both Options 2 and 3, an additional ADA aisle would be desirable.

Further details about infrastructure elements at the north entrance are presented in Appendix I.

Infrastructure Summary

Table 10 provides a summary of the existing and required infrastructure elements for both north and south entrances for the three options under consideration.

If a south entrance is constructed, it would reduce the passenger load at the north entrance, which has ample reserve capacity. As such, it is recommended that bus-to-Metrorail transfers remain focused near the north entrance, rather than shifting some to the south entrance, where the elevator access point will have less reserve capacity to handle additional traffic.

Table 10: Summary of Bethesda Station Infrastructure Requirements

<table>
<tr><th colspan="3" rowspan="2">Infrastructure Element</th><th colspan="4">North Entrance</th><th colspan="2">South Entrance</th></tr>
<tr><th>Existing</th><th>Option 1</th><th>Option 2</th><th>Option 3</th><th>Option 2</th><th>Option 3</th></tr>
<tr><td rowspan="6">Vertical Circulation</td><td rowspan="3">Street to mezzanine</td><td>Escalators</td><td>3</td><td>3</td><td>2</td><td>2</td><td>0</td><td>0</td></tr>
<tr><td>Elevators*</td><td>1</td><td>2</td><td>2</td><td>2</td><td>3**</td><td>5**</td></tr>
<tr><td>Stairs</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td rowspan="3">Mezzanine to platform</td><td>Escalators</td><td>2</td><td>2</td><td>2</td><td>2</td><td>1</td><td>1</td></tr>
<tr><td>Elevators*</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Stairs</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="3">Farecard Vendors</td><td>7</td><td>7</td><td>5</td><td>5</td><td>2</td><td>3</td></tr>
<tr><td colspan="2" rowspan="4">Fare Gate Aisles</td><td>Standard</td><td>7</td><td>5</td><td>3</td><td>3</td><td>2</td><td>3</td></tr>
<tr><td>ADA</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Spare</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Total</td><td>8</td><td>8</td><td>6</td><td>6</td><td>5</td><td>6</td></tr>
</table>

* A minimum of two elevators is recommended for redundancy.
** One additional elevator should be considered for redundancy.

Emergency Egress

Emergency egress requirements for transit stations are set forth in *NFPA-130: Standard for Fixed Guideway Transit and Passenger Rail Systems,* published by the National Fire Protection Association most recently in 2003. As per section 1.3.1 of NFPA-130, the standard only applies "to new fixed guideway transit and passenger rail systems and to extensions of existing systems." Therefore, it is WMATA's position that the standard does not apply to stations within the original Metrorail system, but only to new stations on extensions of that system. As such, adding a new entrance to the Bethesda Station would not require the station to comply with NFPA-130.

In order to assess the potential benefits of a new entrance, an emergency egress analysis of the Bethesda Station was conducted, using the parameters specified by NFPA-130. The analysis showed the following:

- The time required to evacuate the station platform at the existing Bethesda Station is 15.3 minutes in the morning peak period and 14.9 minutes in the afternoon peak. Under Option 1 (future No-build scenario), platform evacuation times would increase to 20.9 minutes in the morning peak and 19.6 minutes in the afternoon peak.

- At the Bethesda Station, the time required to evacuate from the most remote point on the platform to a point of safety is 18.6 minutes during the morning peak and 18.2 minutes in the afternoon peak. Under Option 1, the station evacuation times would increase to 24.2 minutes in the morning peak and 23.0 minutes in the afternoon peak.

Adding a south entrance improves egress times dramatically. If the station elements in Table 10 are provided, the platform evacuation times under Option 2 decrease to 7.0 minutes in the morning peak hour and 6.6 minutes in the afternoon peak hour. Station evacuation times decrease to 10.4 minutes in the morning peak hour and 10.0 minutes in the afternoon peak hour. Both of these times are significant improvements over conditions in Option 1.

Conditions in Option 3 are very similar to Option 2, with identical platform evacuation times and only slightly longer station evacuation times during the morning peak period.

Detailed calculations of emergency egress features are presented in Appendix J for the Metrorail Station with the infrastructure as shown in Table 10.

In Option 3, the Bethesda Bi-County Transitway Station is expected to satisfy NFPA requirements easily, because patrons can exit that station to a point of safety via the west access, along the Capital Crescent Trail, without using any vertical circulation features and without passing through fare gates.