DEPARTMENT OF MANAGEMENT & FINANCIAL SERVICES

MEMORANDUM

DATE: April 13, 2012

TO: Board of Supervisors

THRU: Tim Hemstreet, County Administrator

FROM: Mark Adams, Director, Department of Management & Financial Services

RE: Metrorail Parking Demand Study

Background. On November 15, 2011, the Board of Supervisors agreed to sign a Memorandum of Agreement between the United States Department of Transportation, the Commonwealth of Virginia, Loudoun and Fairfax Counties, the Metropolitan Washington Airports Authority (MWAA) and the Washington Metropolitan Area Transit Authority (WMATA) that described the terms and conditions agreed to by each of the parties for construction and financing Phase II of the Dulles Corridor Metrorail Project. Within the terms of the agreement, Loudoun County would utilize best efforts to separately fund the Phase II construction costs for the parking garage at the 606 station and the two parking garages at the 772 station. If the County is unable to fund any of these elements, then the funding and costs would stay with the project. The intent is to secure private funding for these elements.

Since that meeting, staff retained DESMAN Associates to prepare a comprehensive demand analysis for construction of three Metrorail parking facilities in Loudoun County, with the main objective being to determine whether the County could build and operate the garages with separate funding (from the cost of the Dulles Rail, Phase 2 project) that would require no additional local tax funding, on the basis of projected demand. The variables that DESMAN evaluated were:

1) future parking demand and utilization during peak and off-peak hours for the three proposed facilities through year 2040;
2) parking elasticities of demand for several variables included toll road fees, rail fares, parking rates and gas prices at the three garages;
3) parking alternatives on demand, and
4) potential parking options should the facilities be found inadequate to accommodate future parking demand.

Methodology.

1) Determine what changes in land use had occurred since the Dulles Corridor Rapid Transit Project Final Environmental Impact Statement (FEIS) was released in 2004. Determine how significant the change would be to calculate station parking demand.
2) Assume 83% of daily boardings would be comprised of home-based commute trips.
3) Determine the ratios between the number of average daily boardings and occupied parking spaces to lessen by 7% from opening year to year 2040 due to level of sophistication of the transit system and the various parking station arrival mode options available to the Metrorail rider

Findings.

1) The impact of change in daily trip costs (tolls, fares, fuel, parking fees) will not significantly change parking demand.
    - 1% increase in the daily costs to ride Metrorail reduces the parking demand by 0.08%.
    - 1% increase in the daily costs to commute by auto increases parking demand by 0.08%.

2) The impact of change in parking prices will not significantly change parking demand.
    - 3% annual parking price increase after the opening year would only deter current users who would find an alternative way to arrive and park at the station. The increase in population, the number of households and other factors (new riders), however, would offset the decrease in

demand from current users, and cause a slight increase in parking demand at the three stations despite the 3% annual parking price increase.

- 15% annual parking price increase results in a modeled decrease in parking by 7% in year 2040.

3) The impact of competing facilities would have minimal effect on parking demand.
   - The garages are located in the most convenient sites relative to the stations.
   - There are currently no other commuter parking facilities planned within the existing zoning districts, but zoning regulations do allow for them.

4) Significant revenues could be projected from the level of demand at the garages.
   - Even by increasing the parking prices of the garages, there would be little impact on parking demand, and revenue sources could remain strong.

Conclusion. DESMAN has found that the three proposed parking garages are adequately sized to accommodate the peak daily parking demand estimated for the Route 606 and Route 772 Stations, and that parking demand is relatively inelastic despite many variables. Therefore, if Loudoun County remains in the project, it is projected that Loudoun County can conform to the Memorandum of Agreement whereby the County could assume responsibility of the three garages without impact on debt ratios or local tax funding.

DESMAN staff will present the findings of this report to the Board of Supervisors on May 16. Staff will be available to brief the Board members if desired prior to DESMAN's formal presentation or after the presentation on this analysis.

The report will be loaded in PDF format on the Dulles Corridor Metrorail Project website: www.loudoun.gov/dullesrail.

CC: Linda Neri, Deputy County Administrator
Charles Yudd, Assistant County Administrator
John Sandy, Assistant County Administrator
Julie Withrow, Assistant County Administrator
Danny Davis, Chief of Staff
John R. Roberts, County Attorney
Ben Mays, Deputy Chief Financial Officer
Andy Beacher, Director of Transportation
Julie Pastor, Director of Planning

MEMORANDUM

TO: Martina Williams, Department of Management & Financial Services
Loudoun County

FROM: Chris Luz, DESMAN Associates

DATE: April 12, 2012

RE: Metrorail Parking Demand Study
Route 606 and 772 Station Commuter Parking Demand Forecast
Project 10-11148-3

DESMAN Associates (DESMAN) has been retained to prepare a parking demand analysis associated with the construction of three proposed Metrorail parking facilities in Loudoun County, Virginia. One garage is proposed at the Route 606 Station with 1,965 spaces and two garages at the Route 772 Station with 1,433 spaces on the north side of the Greenway and 1,540 spaces on the south side. The objective of the analysis is to assist Loudoun County in studying whether it can build and operate these garages with separate funding through a private sector partnership that would require no additional local tax funding.

Peak parking demand has been estimated based on a review of past studies and land use model forecasts and incorporation of the most recently available data.

Overview

The Toll Road Plan (TRP) adopted in 1995, first established location criteria, design, and development policies for potential high density mixed-use transit nodes in the Dulles Greenway. The TRP identified the first two nodes as being located to the west of the Route 606 interchange and between the Route 607 and 772 interchanges. In 2001, the Revised General Plan and the Revised Countywide Transportation Plan were adopted refining the land development polices for a Transit-Oriented Development (TOD) at the Route 772 Station area on both sides of the Greenway and a Transit Related Employment Centre (TREC) for the Route 606 Station area north of the Greenway. The TOD is planned as a pedestrian-scale development with a mix of residential, commercial, public, and employment uses while the TREC, which does not include a residential component, is planned for concentrated compact employment uses. In 2002 the Planned Development – Transit Related Center (PD-TRC) zoning district was amended implementing the policies of the Revised General Plan for the Route 772 Station. Subsequently, in 2003 the Planned Development – Transit Related Employment Center (PD-TREC) zoning district was developed to implement the Plan policies for the Route 606 Station location.

The County has approved three TOD projects for the Route 772 station area ensuring a dense, urban character with residential and pedestrian oriented urban amenities, unlike most other similarly positioned stations. While original plans for the rail project included only minimal parking at this station, the Loudoun County Board of Supervisors later advocated for the existing parking allocations to be split between the north and south sides of the station.

The Dulles Corridor Rapid Transit Project Final Environmental Impact Statement (FEIS) for the full Locally Preferred Alternative (LPA)[1], was published in 2004, using the Northern Virginia Major Investment Study Model with inputs from the Metropolitan Washington Council of Governments (MWCOG) Round 6.3 Cooperative Land Use Forecasts representing year 2003, as well as future highway and transit networks, transit operating plans developed for the project and operating characteristics of the Dulles Toll Road.[2]

At the outset of the parking demand study both Loudoun County and DESMAN anticipated that detailed daily boardings projections – which are critical to forecasting parking demand - would be available from Washington Metropolitan Area Transit Authority (WMATA) or Metropolitan Washington Airports Authority (MWAA) to supplement the limited summary daily boardings projection provided for year 2025 in Table 6.1-4 of the FEIS. Unfortunately, after consulting with the Virginia Department of Rail and Public Transportation, WMATA, the Dulles Rail Project Office and MWCOG, it was determined that additional boardings information was not available for use in this analysis. As a result, DESMAN developed proxy measures in order to develop its own forecasts for the planning timeline of 2018 through 2040. This is described in more detail in the next section.

Methodology for Estimating Parking Demand

As noted earlier, ridership forecasts for the Route 606 and Route 772 stations exist only for a single year (2025). These forecasts were developed in 2004, in part based on MWCOG Round 6.3 Cooperative Land Use Forecasts from 2003. MWCOG has developed several new forecasts since Round 6.3, with Round 8.0 representing the most current forecast. In addition, Loudoun County retained Robert Charles Lesser & Company (RCLCO study)[3] to further refine the Round 8.0 forecast, particularly for the Route 606 and Route 772 Stations under the Phase II full LPA extension.

The following is a discussion of the Round 6.3 population and land use assumptions used in the FEIS with a comparison of the Round 6.3 and Round 8.0 forecasts to the RCLCO study, which includes refinements made to the Round 8.0 forecasts. (For clarification, Round 6.3 includes

[1] Locally Preferred Alternative (LPA) includes the Phase 2 extension into Loudoun County and the Route 606 and 772 Stations.
[2] Dulles Corridor Rapid Transit Project FEIS, Chapter 6. Transportation Effects, Section 6.1.1 Methodology. 2004.
[3] Market and Fiscal Impact Analysis of the Phase 2 Metrorail Extension to Loudoun County, RCLCO, April 2012.

forecasts through year 2030, while Round 8.0 and the RCLCO study data include forecasts through year 2040.)

Comparison of the Round 6.3 and Round 8.0 Forecasts to the RCLCO Study Refinements

The MWCOG transportation planning model (model) covers 22 jurisdictions comprised of Washington, DC, 12 cities and counties in Maryland and seven cities and counties in Virginia, including Loudoun County. Population and land use data is summarized within geographical areas referred to as traffic analysis zones (TAZs) for each jurisdiction. The Round 6.3 model incorporates 126 TAZs for Loudoun County that include the following data summarized in five year increments from 2000 through 2030:

- Number of Households;
- Household population;
- Group quarters population;
- Total employment;
- Industrial employment;
- Retail employment;
- Office employment; and
- Other employment.

The Round 8.0 model for Loudoun County includes a number of updates since the Round 6.3 model was prepared including a refinement of the TAZs from 126 to 282 zones. The overall geographic area covered by the TAZs in Loudoun County remained identical from Round 6.3 to 8.0. The Round 8.0 population and land use data is also summarized into five year increments from 2005 through 2040, rather than 2030 as in Round 6.3. The RCLCO study includes a more detailed approach specifically directed at how Loudoun County might grow as a result of the full LPA. The land use forecasts included in the RCLCO study used the same assumptions that Loudoun County used in the Round 8.0 forecast with the addition of taking into account the Route 28 Comprehensive Plan Amendment and rezonings in the Route 28 corridor which were approved after the Round 8.0 forecasts were prepared[4].

A comparative analysis was conducted for the Round 6.3 population and land use forecast, the Round 8.0 forecast and the RCLCO study forecasts to determine what changes had occurred in land use since the FEIS was prepared and if the change was significant relative to calculating station parking demand. The common basis for analysis was at the county level and therefore, a comparative analysis between the three data sets was conducted on a countywide basis.

There are two sets of data that are particularly important for comparative purposes in this study across the three forecasts: number of households and total employment. Table 1 provides a comparison of the number of households forecast by each data set countywide.

[4] Market and Fiscal Impact Analysis of the Phase 2 Metrorail Extension to Loudoun County, RCLCO, March 2012.

Also included for reference is Loudoun County's September 2011 forecast through 2040, which incorporates the U.S. Census Bureau data for 2010.

The RCLCO study identified household data annually from 2010 through 2040 for both the Round 8.0 data and for the refined RCLCO data[5]. Year 2018 was added to the tables listing boardings and parking demand since it is the estimated opening year for the Route 606 and 772 Stations (according to informal discussions with Loudoun County, Department of Management & Financial Services). As discussed, interim year data is not available for Round 6.3 and 8.0, but the RCLCO study does include annual forecasts, including year 2018 as shown in the following tables.

Table 1 – Household Forecasts

	Year								
Source	**2010**	**2011**	**2015**	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**
Round 6.3	106,572	n/a	124,553	n/a	139,608	149,985	156,697	n/a	n/a
Round 8.0	102,331	n/a	112,669	n/a	127,409	141,848	150,209	154,978	158,299
RCLCO	104,583	106,591	121,101	131,504	137,588	146,826	152,911	157,600	160,234
Current Loudoun County Forecasts[1]	104,583	106,951	117,481	126,179	132,482	146,623	154,475	159,427	163,298

[1] www.loudoun.gov/researchunit. "2000 - 2040 Annual Series of Population, Households, and Housing Units," Loudoun County Department of Management and Financial Services, September 19, 2011. The 2010 figure matches U.S. Census Bureau decennial census data.

As opposed to the Round 8.0 data, the number of households included in the RCLCO study forecasts is higher than the Round 8.0 forecast and similar to the Round 6.3 forecast through year 2030. The RCLCO study anticipates more aggressive growth than Round 8.0 in the earlier years while the Round 8.0 anticipates more aggressive growth than the RCLCO in the later years. The current Loudoun County forecasts are lower than the RCLCO data until after year 2025 when the forecasts are slightly higher resulting in a higher forecast for the County in year 2040. The RCLCO study forecast 160,234 households in 2040 versus the County at 163,298 and Round 8.0 at 158,299 households.

The number of households projected by Round 6.3 (used in the FEIS) is close to the number forecasted by the RCLCO refinements and the Loudoun County Department of Management and Financial Services forecasts which reflect the most recent Census data. The Round 8.0 data does not correlate as well with Round 6.3, the RCLCO refinements or the current Loudoun County forecasts.

[5] Exhibit II-13, Market and Fiscal Impact Analysis of the Phase 2 Metrorail Extension to Loudoun County, RCLCO, April 2012.

Table 2 – Employment

	Year								
Source	**2010**	**2011**	**2015**	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**
Round 6.3	137,083	n/a	166,214	n/a	195,338	224,453	253,575	n/a	n/a
Round 8.0	143,736	n/a	167,570	n/a	206,458	236,327	257,195	271,462	285,415
RCLCO	143,736	147,209	178,686	204,768	221,904	255,556	280,606	300,114	315,108

Table 2 lists the total employment from the Round 6.3 and Round 8.0 TAZs, as well as, the RCLCO study. Although insufficient information exists for DESMAN to quantify the differences in square footage of development, by type, between the Round 6.3 and Round 8.0 TAZs or the RCLCO study, it is apparent that the number of jobs has increased significantly in the RCLCO study forecasts. As shown, the differences between the Round 6.3 FEIS employment data and the RCLCO study data is 12,472 jobs in 2015 to 26,566 jobs in 2020, 31,103 in 2025 and 27,031 in 2030.

Based on the household and employment differences shown in Tables 1 and 2, the following conclusions can be made:

- The number of households in the RCLCO study and Round 6.3 data is similar through year 2030, the last year available for Round 6.3 data. At that time and through 2040, the number of households in the RCLCO study continue to grow but at a lower growth rate than preceding years; and
- The employment data for the RCLCO study is significantly greater than the Round 8.0 and the Round 6.3 data. The higher employment numbers in the RCLCO study data are interpreted herein, to result in attracting employees from outside the county. This would also potentially increase the number of passengers from outside the county using Metrorail to commute to jobs in the county. While this may increase ridership at the Route 606 and 772 Stations, it would have no impact on parking demand since the trips are inbound to the stations.

Proxy Methodology

As discussed earlier, the detailed model assumptions used to develop the FEIS forecasts were not available for this analysis. As a result it was necessary to develop a proxy methodology for forecasting daily boardings using the data that was available. As a commuter transit link, it is reasonable to assume that the majority of daily boardings (83%) will be typically comprised of home-based commute trips[6] and will in turn be directly related to the number of households producing those home-based work trips. As a result, a mathematical relationship can be drawn between number of households and boardings, and used to forecast boardings for other years.

[6] Transit Ridership Trends and Markets, Table 4. Metrorail Trip Purpose, WMATA, 2009.

Route 606 and 772 Station Boardings

As discussed earlier, the FEIS included only a single forecast year of boardings for the new stations, as excerpted in Table 3 below. Also shown is the total number of households in Loudoun County for year 2025 included in the Round 6.3 transportation model (used for the FEIS).

Table 3 - Forecast Daily Station Boardings

Station	Full LPA 2025 Boardings[1]	No. of Households[2]	Boardings per Household[3]
Route 606	4,485	149,985	0.030
Route 772	6,961	149,985	0.046

[1] Dulles Corridor Rapid Transit Project FEIS, Chapter 6, Table 6.1-4.
[2] Round 6.3 MWCOG household data for 2025.
[3] Ratios are rounded.

As discussed in the proxy methodology, a mathematical relationship was established between the number of station boardings and households as shown in the above table under "boardings per household". The Route 606 (0.030) and the Route 772 (0.046) ratios were then applied to the annual household forecasts in the Round 6.3 data, Round 8.0 data and RCLCO study (shown in Table 1) to solve for average daily boardings for each station for opening year (RCLCO), 2020, 2025, 2030, 2035 (RCLCO and Round 8.0) and 2040 (RCLCO and Round 8.0).

Table 4 - Route 606 Station Estimated Boardings

	Year				
Source[1]	2018	2020	2025	2030	2035	2040
Round 6.3	n/a	4,175	4,485	4,686	n/a	n/a
Round 8.0	n/a	3,810	4,242	4,492	4,634	4,734
RCLCO	3,932	4,114	4,391	4,572	4,713	4,791

[1] The boarding calculations are based on the actual mathematical calculations rather than the rounded ratios listed in Table 4.

Table 5 - Route 772 Station Estimated Boardings

	Year				
Source[1]	2018	2020	2025	2030	2035	2040
Round 6.3	n/a	6,479	6,961	7,273	n/a	n/a
Round 8.0	n/a	5,913	6,583	6,971	7,193	7,347
RCLCO	6,103	6,386	6,814	7,097	7,314	7,437

[1] The boarding calculations are based on the actual mathematical calculations rather than the rounded ratios listed in Table 4.

There is little difference in boardings between Round 6.3 and the RCLCO study for both Route 606 and Route 772 in 2020, 2025 and 2030, because the number of households is similar in both sets of data. The RCLCO study boardings continue to grow relative to the number of households resulting in 4,791 boardings in 2040 for Route 606 and 7,437 boardings for Route 772. While the 2025 data is similar to what was in the FEIS, the 2035 and 2040 forecasts in boardings for the RCLCO study data will provide a means to estimate the parking demand through the horizon year of 2040.

Metrorail Station Access

As discussed in the preceding section, Metrorail boardings are projected to increase over time as households come online. It would be expected that as boardings increase, parking demand would increase proportionately, but this is not necessarily the case. Driving and parking in a park-and-ride facility at a station is just one of several arrival modes which also include walk/bike, local bus service and kiss and ride (drop-offs). The percentage of passengers who walk/bike to a station is related to the number of households within the TOD area and the level of service of the surrounding pedestrian and bicycle network. As the number of households increase in the TOD area, so does the potential to increase the percentage of passengers walking/biking to the station. Similarly, as the population grows in the areas served by local transit, the potential for passengers to ride the bus to the station also increases. These factors can shift passengers away from park-and-ride to an alternate mode of travel.

Little information was available in the FEIS on the various types of arrival modes, or changes in mode type, at the stations. As a result, DESMAN felt it was necessary to factor the parking demand calculations to reflect reasonable changes in mode arrival patterns over time. The factored parking demand is expressed as a parking ratio and is discussed in more detail later in this report. The parking ratio, as discussed herein, is the percentage of boarding passengers who use the station park-and-ride facility.

The parking ratios that were selected were based on several assumptions, including:

- The number of households in the Route 772 Station TOD will increase to nearly 9,000 households at full development capacity[7];
- Loudoun County continues to plan and expand transit services per updates to the Loudoun County Transit Development Plan[8];
- Commute costs remain relatively consistent with historic trends including programmed increases in toll road fares[9]; and
- Development consistency with the RCLCO study and the Revised General Plan.

A model was used to project parking demand incorporating the assumptions listed above by reducing the parking ratio, over time, to account for increased urbanization of Loudoun County and continued expansion of the local transit system.

Commuter Parking Demand

WMATA has collected data on parking occupancy and average daily boardings at Metrorail stations for 2010. The data has been summarized in a table in the appendix. The appendix table lists the station location, information as to where the location is on the line (depth), the WMATA line, whether the station was inside or outside the beltway, the average daily boardings for that station, the parking supply, occupancy of the spaces during the peak period and total number of spaces occupied. The parking occupancy is listed for both the month of January 2010 as well as the total year to date occupancy from July through January 2010.

Also shown is the parking ratio, which is calculated by dividing the number of occupied parking spaces (demand) by the number of average daily boardings at that station. The parking ratio represents the parking demand per passenger boarding and is the key factor that will be used to estimate parking demand for the Route 606 and 772 Stations.

The parking demand data is listed for January 2010 as well as the year-to-date total from July through January, which provides a seven month average. The average daily boardings represent May 2010 data. To better understand the boarding data and ensure it represented typical conditions, DESMAN conducted research to determine if the "average weekday" boardings data obtained from WMATA actually represented a typical weekday during a typical month (average annual weekday) or if the May data was atypical (higher or lower) than the average annual weekday. The most recent information obtained from WMATA for Metrorail monthly ridership indicates that from 2006 through 2009, the number of boardings for the

[7] Market and Fiscal Impact Analysis of the Phase 2 Metrorail Extension to Loudoun County, RCLCO, April 2012.
[8] Loudoun County Transit Development Plan, Fiscal Years: 2012–2017, October, 2011.
[9] MWAA, Official Statement Dulles Toll Road Revenue Bonds, Series 2009 (Dulles Metrorail and Capital Improvement Projects).

month of May is within 0 to 3% of the average annual monthly boardings and as a result, was determined to be representative of an average condition[10]. As a result, the May boardings data and the seven month average parking occupancy data was considered typical and were used as is and not adjusted.

One of the noticeable characteristics in the data is that the parking ratio tends to be highest at the end line stations and lowest in the more urban and densely developed areas. The end of the line stations have a higher parking ratio associated with them because they are drawing not only from the area surrounding the station but also park-and-ride commuters from the regional and rural areas. (Terminus stations of the Metrorail system are known to have consistently high park-and-ride demand[11]). The more urban station locations typically have a lower parking ratio as a result of several factors including increased density of development, particularly residential development, a resultant higher percentage of passengers who walk/bike, and a higher level of transit service providing access to the station. At the end line stations, the parking ratios average about 40% with the highest at 47%. This translates to a parking demand of 40 spaces and 47 spaces, respectively, for every 100 boardings.

Based on a review by DESMAN of the station parking data along with the characteristics of the Route 606 and Route 772 Stations, a parking ratio of 47% was assumed for 2018 through 2020, stepping down to 43% by 2025 through 2030 and 40% by 2035 through 2040. The opening and year 2020 parking ratio (47%) is about the same as the highest end line station (47.3%) and assumes that in the first several years of operation that most Metrorail passengers will drive or share rides to the station. By year 2025 through 2030, the transit system serving the area is assumed to provide an increased level of service, the area becomes more urban, and passengers become more knowledgeable about their travel mode options, thereby reducing the parking ratio (43%) consistent with, but still somewhat higher than, the average for end line stations. Beginning in 2035 through 2040, it was assumed the transit systems serving the area becomes even more sophisticated, as do the Metrorail users, and that urbanization continues, thereby reducing the parking ratio to about the average (40%) of the end line stations. Tables 6 and 7 list the forecast boardings, the assumed parking ratios and resultant parking demand estimated for the Route 606 and 772 Stations.

Table 6 - Route 606 Station Parking Demand

	Year					
	2018	**2020**	**2025**	**2030**	**2035**	**2040**
Boardings	3,932	4,114	4,391	4,572	4,713	4,791
Parking Ratio	47%	47%	43%	43%	40%	40%
Parking Demand (spaces)	1,848	1,934	1,888	1,966	1,885	1,917

[10] http://www.wmata.com/pdfs/planning/Metrorail%20Metrobus%20Ridership%20By%20Month.pdf, Metrobus and Metrorail Average Monthly Boardings, WMATA, 3/4/2010.
[11] Vienna Station Parking and Improvement Studies, WMATA, February, 2006.

Table 7 - Route 772 Station Parking Demand

	Year					
	2018	**2020**	**2025**	**2030**	**2035**	**2040**
Boardings	6,103	6,386	6,814	7,097	7,314	7,437
Parking Ratio	47%	47%	43%	43%	40%	40%
Parking Demand (spaces)	2,869	3,001	2,930	3,052	2,926	2,975

Tables 6 and 7 represent the parking demand for the two stations (three garages) given the information currently available and based on the assumptions stated herein. The number of boardings for each station increases by about 22% through 2040 as Loudoun County continues to develop and the number of home-based work trips increase. At the same time, the parking ratio decreases over time as travel options to the station other than park-and-ride become more viable and accessible. As shown in Table 6, the Route 606 Station estimated parking demand is relatively stable at just under 2,000 spaces. Like the Route 606 Station, the Route 772 Station parking demand is also relatively stable ranging from about 2,870 spaces to just over 3,050 spaces. Since Route 772 has both a north and a south station, each with its own garage, the parking demand would be split between the two stations.

The parking demand has been calculated by station for each year from 2018 through 2040 based on boardings and parking ratios and is shown in detail in Appendix Table 2, Annual Base Case Parking Demand. After the opening year (2018), the total parking demand (for both stations) varies from a low of 4,717 spaces to a high of 5,018 spaces in 2030. In comparison, the number of parking spaces proposed at the stations based on the FEIS[12], includes 1,965 spaces in one garage at the Route 606 Station and 2,974 spaces in two garages at the Route 772 Station for a total of 4,939 spaces.

The parking demand projections calculated in this section will be referred to as the Base Case scenario. The Base Case parking demand projections were then adjusted to reflect changes anticipated in the trip costs for both Metrorail and auto commuters through 2040. This scenario is referred to as the Base Case Adjusted and represents the final parking demand projections. In addition, a sensitivity analysis was prepared to determine the impact of changes in parking prices on parking demand. The Base Case Adjusted and two pricing alternatives are discussed in the next section.

Parking Elasticity

The elasticity of parking at Metrorail stations is primarily a function of the travel cost to use Metrorail and the comparative travel cost to commute by auto or other mode. Logically, as travel costs for park-and-ride users of Metrorail increase, including parking rates, parking demand should decrease as some drivers shift to other modes as other commute options

[12] Current proposed capacity of the garages as stated in the MOU under negotiation by the funding partners.

become more financially viable. Conversely, as costs for commuting by auto increase, including gas prices or tolls, parking demand at the stations should increase as some people shift to Metrorail to avoid the increased cost. There are always multiple cost factors working against one another, such as increases in both parking rates and the cost of fuel, occurring simultaneously creating a push/pull phenomenon on demand that is difficult to forecast.

The primary purpose for evaluating elasticity in this study is to determine the sensitivity of station parking demand relative to changes in commute travel costs. Ultimately, the County's goal is to ascertain not only the estimated parking demand for the Route 606 and 772 Stations, but more importantly, the potential revenue generation. An evaluation of elasticity in a financial feasibility pro forma would likely be conducted in a more detailed manner with variables adjusted to model a range of outcomes. The elasticity evaluation conducted herein is focused on obtaining a level of confidence that the projected parking demand is reasonable. This section of the report discusses an approach to determining the elasticity of parking relative to costs, including parking rates, at the Route 606 and Route 772 Stations.

While parking elasticity is relatively easy to understand, there is little research that provides applicable models for use in estimating the impact of pricing changes. The most commonly used and referenced elasticity model states that a 1% increase in commuter parking prices will decrease parking demand by 0.08%[13]. This will be referred to herein as the TRACE model and it indicates that parking is quite inelastic. As an example, if 2,000 cars are parked in a daily parking lot and the parking rate increases by 20%, from $5 to $6 per day, the demand would be expected to decrease by 1.6% or about 32 cars. More importantly, even though parking demand decreases by 32 parkers, the revenue generation increases dramatically. At $5 per day, 2,000 cars generate $10,000 per day, at $6 per day, 1,968 cars generate $11,808 per day, an increase of about 18% in daily revenue.

Although the TRACE model specifically refers to the price of station parking, the impact on parking demand cannot be measured in isolation at Metrorail stations since other costs are increasing at the same time. Therefore, to address this, the elasticity analysis conducted herein extrapolates the TRACE model to assume that a 1% increase in the *daily costs* to ride Metrorail *reduces* the parking demand by 0.08% and a 1% increase in the *daily costs* to commute by auto *increases* parking demand by 0.08%.

Base Case Adjusted Parking Demand

There are an unlimited number of scenarios and variables that could be evaluated in an elasticity analysis. The level of sophistication and accuracy of the analysis is intended to provide a level of confidence that if certain price changes occur, then, a related change in parking demand should also occur. Elasticity is by no means an exact science and consequently,

[13] TRACE, 1999, Tables 32, 33.

each analysis should be treated as an indicator of anticipated changes, trends and patterns in parking demand. The cost variables that are used represent the most current and accurate information available given the scope of services and objective of the analyses.

It can be argued that the Base Case parking demand estimates assume no impact from changes in travel costs related to commute options and only reflect increases in parking demand related to the growth in households. Therefore, the Base Case estimates were adjusted to account for increases in travel cost and to test the application of the TRACE elasticity model. Travel costs vary depending on the destination of the trip, longer trips use more fuel, and trips to downtown may pay more in tolls and for parking while other destinations may have fewer tolls and free parking. Since there are numerous potential trip purposes and destinations possible for passengers using the Route 606 and 772 Stations and since no trip origin/destination information was available for use in this analysis, DESMAN incorporated the following assumptions into the elasticity model:

- The station Base Case parking demand represents passengers who drive and park at the station for work-related commute trips;
- ½ of the work-related commute trips by Metrorail passengers were destined to Tysons Corner; and
- ½ of the work-related commute trips by Metrorail passengers were destined to downtown Washington, DC.

There are many origin/destination trips that are possible along the Dulles Corridor and the assumption that ½ of the commuters travel from either Route 606 or 772 to Tysons Corner and ½ the commuters travel to DC is not intended to represent actual trip pairs, but to provide a basis to evaluate the elasticity of parking demand relative to price (cost).

Two cost tables were developed for the analysis and two elasticity analyses were prepared, one for trips to Tysons Corner, and the other to Washington, DC. The parking demand estimates resulting from the elasticity analyses were averaged to represent the final parking demand estimates, hereafter referred to as the Base Case Adjusted parking demand.

Table 8 lists the major variables comprising travel costs. Historic data was obtained for specific travel costs from 2005 through 2011 from various sources. As shown, travel costs have increased at varying annual rates ranging from 4.5% per year for downtown parking to 11.0% per year for the Greenway tolls. With the exception of the toll road rates, the average annual rate of increase was used to estimate the travel costs associated with commute trips to both Washington, DC and Tysons Corner for the analysis period, 2018 through 2040. Specific calculations were developed for projecting toll road costs and are discussed below.

Table 8 - Historic Growth in Commute Trip Costs

	2005	2006	2007	Year 2008	2009	2010	2011	Avg Annual Increase
Metrorail Commuter								
Station Parking Rates[1]	$2.25	$2.25	$2.25	$2.75	$2.75	$3.25	$3.25	6.3%
One-way Max. Rail Fare[2]	$3.90	$3.90	$3.90	$4.50	$4.50	$4.60	$5.20	4.9%
Auto Commuter								
Fuel ($/gal)[3]	$2.35	$2.68	$2.86	$3.35	$2.44	$2.86	$3.63	7.5%
Greenway Tolls[4]	$2.40	$2.70	$3.00	$4.00	$4.00	$4.50	$4.50	11.0%
Dulles Tolls[5]	$0.75	$0.75	$0.75	$0.75	$0.75	$1.00	$1.25	8.9%
Downtown Parking[6]	$10.00	$10.30	$10.50	$10.85	$11.50	$12.25	$13.00	4.5%

[1] http://www.wmata.com/about_metro/public_rr.cfm?
[2] http://www.wmata.com/about_metro/docs/Fare_History_06Jun11.pdf. Fare shown represents peak fare.
[3] http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMM_EPM0_PTE_R1Y_DPG&f=A
[4] E. Thomas Sines, Chief Executive Officer, Toll Road Investors Partnership II, L.P.
[5] Draft Dulles Toll Road Traffic & Revenue Study Update, Table ES-1, CDM Smith, January, 2012.
[6] Collier International & DESMAN experience

Table 9 summarizes the projected travel costs for a commuter originating in Loudoun County destined to downtown DC. The travel costs listed in Table 8 for 2011 were adjusted using the annual rate of increase to obtain future year costs for 2018 through 2040. In the case of the Dulles tolls, the programmed future year tolls through 2040 were obtained from a study completed by CDM Smith for the MWAA[14]. The other exception is the annual rate of increase projected for the Greenway Toll Road (Greenway). The State Corporation Commission authorized annual toll increases between 2013 and 2020 at the greater of growth in CPI plus one percent, GDP growth, or 2.8%, with additional increases if necessary to offset more rapid growth in property taxes or to ensure that the Toll Road Investors Partnership II, L.P., owner of the Dulles Greenway, has sufficient revenues to achieve debt service coverage ratios[15]. As a result, DESMAN estimated the rate of increase for the Greenway tolls at 4.0% per year beginning in year 2012. The Greenway toll implemented in January 2012 for the a.m. and p.m. peak hour in the peak direction (which includes a 20% premium for congestion management) is $4.80. This rate was increased by 4.0% per year through 2040.

[14] Draft Dulles Toll Road Traffic & Revenue Study Update, Table ES-1, CDM Smith, January 2012.
15 http://dullesgreenway.com/future-toll-rates-approved/. SCC Order #PUE-2006-00081, Dulles Greenway Future Toll Schedule.

Also listed is the approximate daily trip cost for a roundtrip Metrorail commute and an auto commuter to Washington, DC which for 2018 incorporates:

- the station parking fee ($5.00) plus the maximum peak ticket price for a roundtrip rail fare[16] ($14.54) resulting in a daily trip cost of $19.54 for a Metrorail passenger; and
- the cost of three gallons of fuel ($18.06) plus the maximum roundtrip toll road fare ($20.15) in addition to the cost to park downtown ($17.66) for a total daily trip cost of $55.86 for an auto commuter.

Table 9 – Illustrative Commute Costs to Downtown DC[17]

	Year						Avg.
Metrorail Commute	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**	**Annual**
Station Parking Rates	$5.00	$5.64	$7.67	$10.41	$14.15	$19.22	n/a
Round Trip Max. Rail Fares	$14.54	$16.02	$20.34	$25.86	$32.86	$41.76	n/a
Approx. Daily Trip Cost	$19.54	$21.66	$28.01	$36.27	$47.01	$60.98	5.3%
Auto Commute							
Fuel Costs	$18.06	$20.87	$29.95	$42.99	$61.70	$88.57	n/a
Round Trip Greenway Tolls	$12.15	$13.14	$15.98	$19.45	$23.66	$28.79	n/a
Round Trip Dulles Tolls	$8.00	$8.00	$10.00	$12.00	$14.00	$16.00	n/a
Downtown Parking	$17.66	$19.27	$23.98	$29.84	$37.13	$46.20	n/a
Approx. Daily Trip Cost	$55.86	$61.27	$79.91	$104.27	$136.49	$179.56	5.5%

Table 10 summarizes the projected travel costs for a commuter originating in Loudoun County destined to Tysons Corner rather than downtown DC. As before, the travel costs reflect the 2011 costs listed in Table 8, escalated to represent future years 2018 through 2040. Similarly, the exception is the costs for the toll roads which were modified as discussed previously. Also listed is the 2018 approximate daily trip cost for a roundtrip commute to Tysons Corner which includes:

- the station parking fee ($5.00) plus the cost of a roundtrip Metrorail maximum fare pass to Tysons Corner ($14.54) for a daily trip cost of $19.54[18]; and
- the cost for two gallons of fuel ($12.04) in addition to the maximum toll road fares ($20.15) for a total daily trip cost for an auto commuter $32.19. This is a lower cost than the DC trip by the cost for a gallon of fuel and the cost to park downtown.

[16] http://www.wmata.com/about_metro/public_rr.cfm? , History of Metrorail Fare Increases, 2010.
[17] Rates would be rounded to user-friendly amounts for actual implementation, but herein reflect actual calculations.
[18] The trip length from the Loudoun County stations to Tysons Corner exceeds 14 miles which results in the maximum rail fare.

As discussed previously, the TRACE elasticity model is used to estimate changes in parking demand relative to the percent increase in one or more cost variables. Although the approximate daily trip costs are different for an auto commute trip to downtown DC and a trip to Tysons Corner, the annual rate of increase in costs is the same in both examples (5.5% per year). In both examples, the annual rate of increase for the auto commute costs is slightly higher than the rate of increase for the Metrorail commuter (at 5.3% per year). As a result, application of the TRACE model should result in a slight increase in parking demand over the Base Case.

Table 10 - Illustrative Commute Costs to Tysons Corner[19]

	Year						Avg.
Metrorail Commute	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**	**Annual**
Station Parking Rates	$5.00	$5.64	$7.67	$10.41	$14.15	$19.22	n/a
Round Trip Max. Rail Fares	$14.54	$14.54	$20.34	$25.86	$32.86	$41.76	n/a
Approx. Daily Trip Cost	$19.54	$20.18	$28.01	$36.27	$47.01	$60.98	5.3%
Auto Commute							
Fuel Costs	$12.04	$13.91	$19.97	$28.66	$41.14	$59.04	n/a
Round Trip Greenway Tolls	$12.15	$13.14	$15.98	$19.45	$23.66	$28.79	n/a
Round Trip Dulles Tolls	$8.00	$8.00	$10.00	$12.00	$14.00	$16.00	n/a
Downtown Parking	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	n/a
Approx. Daily Trip Cost	$32.19	$35.05	$45.95	$60.11	$78.80	$103.83	5.5%

The cost variables listed in Tables 9 and 10 were used in the TRACE model and applied to the Base Case parking demand to develop two sets of parking demand estimates, one for the DC scenario and one for the Tysons Corner scenario. The opening year for the station and first year of the parking demand estimates is 2018. Therefore, for each of the trip scenarios, the rate/cost structure in Tables 9 and 10 was considered in-place in 2018 and the impact of cost increases was calculated for each of the following years from 2019 through 2040. Finally, the two sets of parking demand estimates were then averaged to reflect the assumption that ½ the trips are to downtown DC and ½ the trips are to Tysons Corner. The resultant parking demand is the Base Case Adjusted parking demand and represents the final parking demand estimates for this study.

Table 11 shows a slight increase in parking demand for the Base Case Adjusted which was expected since the annual rate of increase in costs for the auto commute were slightly higher than for the Metrorail commute. However, the difference in parking demand between the Base Case to the Base Case Adjusted is nominal when considered within the rigors of this analysis. The similarity in the two sets of estimates does indicate that the continuation of past trends and future anticipated increases in travel cost associated both Metrorail and auto commuters is not expected to significantly change the parking demand.

[19] Ibid.

Table 11 - Parking Demand and Elasticity

	Year					
Scenario	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**
Base Case	4,717	4,935	4,818	5,018	4,811	4,891
Base Case Adjusted	4,717	4,930	4,821	5,032	4,843	4,947

Since the individual contribution of each cost component is included in the TRACE model methodology, a single cost item, such as parking rates can be modified and the impact on parking demand measured. To help bracket and illustrate the relative inelasticity of parking demand relative to parking pricing, two pricing alternatives were tested. A "low end" increase of 3% per year in parking rates was tested along with a "high end" increase in parking rates of 15% per year as compared to the 6.3% per year increase used in the Base Case Adjusted scenario. All other cost components increases were included as listed in the cost tables.

Alternative 1 – Increase Parking Rates by 3% per year

A 3% annual increase in parking rates was modeled to represent the "low end" of a parking rate increase near or at about the same rate as inflation. This alternative was included to illustrate the change in parking demand and the impact on revenue. A 3% per year increase in daily parking rates was applied the year after opening and results in a 2020 parking rate of about $5.30, a 2025 rate of just over $6.00, a 2030 rate of just over $7.00, a 2035 rate of about $8.25 and a daily parking rate of about $9.50 in 2040. The cost for auto commuters was maintained at the rates established in the Base Case Adjusted scenario.

Table 12 - Alternative 1; Increase Metrorail Station Parking Rates by 3% per year

			Year				Avg. Annual
Metrorail Commute	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**	**Rate of Increase**
Station Parking Rates	$5.00	$5.29	$6.15	$7.12	$8.26	$9.56	3.0%
Round Trip Max. Rail Fares	$14.54	$16.02	$20.54	$25.86	$32.86	$41.78	4.9%
Approx. Daily Trip Cost	$19.54	$21.31	$26.49	$32.98	$41.12	$51.34	4.5%

As an outcome of the decrease in parking rates from 6.4% to 3%, the daily trip cost also decreases as does the daily trip costs annual increase in rates. The annual rate of increase is now 4.5% rather than the 5.3% in the Base Case Adjusted scenario. The auto commute annual rate of increase remains the same as the Base Case Adjusted scenario at 5.7%.

According to the TRACE model, as the relative cost for the Metrorail commute decreases, the parking demand would be expected to increase as more riders are attracted to the system. As shown in Table 13, the net result is a modeled increase in parking demand for 2040 by about 65 spaces (compared to the Base Case Adjusted). The changes in demand due to the application of the TRACE model cannot be ascertained from the information in the tables. The calculation of

the elasticity has several parts associated with it. The reduction in demand due to increases in rate only applies to users already in the system who choose to find a new mode of travel other than driving to and parking at the station. New parking demand generated by increases in ridership is assumed as electing to enter the system and pay the prevailing rate.

Table 13 - Alternative 1; Parking Demand Estimates

	Year					
Scenario	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**
Base Case Adjusted	4,717	4,930	4,821	5,032	4,843	4,947
Alternative 1 - 3%	4,717	4,936	4,843	5,070	4,894	5,012

Alternative 2 – Increase Parking Rates by 15% per year

While parking rates could increase in any given year by 15% or more, it is highly unlikely to assume rates would increase by 15% every year until 2040. However, it is modeled herein to illustrate the relative inelasticity of parking demand and the theoretical impact on revenue in an extreme condition. This alternative provides the high end of the "bracketed" conditions as an illustrative example to test the market's reaction to the rate increases, measured in parking demand. A 15% per year increase in daily parking rates was applied the year after opening and result in a 2020 rate of about $6.60, a 2025 rate of about $13.30, a 2030 rate of about $26.70, a 2035 rate of about $53.70 and a daily parking rate of about $108.00 in 2040. Table 14 also provides a summary of the parking rates used in this alternative.

To simplify the analysis, the 15% annual increase in parking rates also assumes that the costs for the Metrorail and auto commuter are adjusted annually based on the preceding cost tables. In addition, since the difference in the annual rate of increase between the trip costs for downtown DC and Tysons Corner was determined insignificant, it was arbitrarily assumed that the elasticity analysis incorporates the cost for the downtown DC trip rather than the Tysons Corner trip. The results of evaluation would be nearly exact if the Tysons Corner trip costs were used instead.

Table 14 – For Illustrative Purposes
Alternative 2; Increase Metrorail Station Parking Rates by 15% per year

	Year						Avg.
Metrorail Commute	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**	**Annual**
Station Parking Rates	$5.00	$6.60	$13.28	$26.70	$53.71	$108.03	15.0%
Round Trip Max. Rail Fare	$14.54	$16.02	$20.34	$25.86	$32.86	$41.78	4.9%
Approx. Daily Trip Cost	$19.54	$22.62	$33.62	$52.56	$86.57	$149.81	9.7%

As an outcome of the parking rate increase to 15% per year, the daily trip cost and the rate of increase for the daily trip costs increases significantly. The annual rate of increase is now 9.7% rather than the 5.3% in the Base Case Adjusted scenario or 4.3% in Alternative 1. According to

the TRACE model, as the cost for the Metrorail commuter increase relative to the auto commute, the parking demand should decrease. As shown in Table 15, the net result is a modeled decrease in parking demand for 2040 by about 334 spaces or by about 7% (compared to the Base Case Adjusted). So even though the parking rate increases from $5.00 to about $108.00, the demand only changes by 7%.

Table 15 - Parking Demand Estimates

	Year					
Scenario	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**
Base Case Adjusted	4,717	4,930	4,821	5,032	4,843	4,947
Alternative 1 - 3%	4,717	4,936	4,843	5,070	4,894	5,012
Alternative 2 - 15%	4,717	4,912	4,747	4,886	4,608	4,613

Table 16 was prepared to show the relative differences in parking revenue associated with changes in the parking rates. A financial feasibility proforma analysis would incorporate a detailed revenue generation model, but for purposes of this study, a simple comparative model was used. The annual revenue (in 000's) shown in Table 16 was calculated by multiplying the daily parking rate by the Base Case Adjusted parking demand and adjusted to represent annual revenue.

Table 16 - Illustrative Annual Revenue Generation (000's)

	Year					
Scenario	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**
Base Case Adjusted	$5,226	$6,174	$8,203	$11,634	$15,210	$21,108
Alternative 1 - 3%	$5,226	$5,802	$6,600	$8,009	$8,964	$10,641
Alternative 2 - 15%	$5,226	$7,198	$13,992	$28,968	$54,946	$110,639

The revenue generation in 2018 is the same since the three scenarios assume the same starting point in the opening year. The Base Case Adjusted scenario assumes that parking rates continue to increase at 6.4% per year through 2040. Alternative 1 includes the revenue impact of a 3% increase in parking rates through 2040 and Alternative 2 represents the modeled revenue as a result of a 15% per year increase in parking rates. Because parking demand is so highly inelastic, the modeled revenue is far more a function of the rates charged for parking and less a function of elasticity. The annual rate increase assumed for parking in the Base Case Adjusted scenario is more representative of a practical application than either Alternative 1 or 2. Alternative 1 illustrates that setting the annual increase in parking rates at 3% (rather than 6.3% in the Base Case Adjusted), would result in a nominal increase in the parking demand for year 2040 compared to the Base Case Adjusted. However, the most significant impact is that the revenue generated is less than ½ of the Base Case Adjusted scenario in year 2040.

Alternative 2 illustrates that in the extreme case of increasing rates at 15% per year or roughly doubling the parking rates every three to four years, the predicted decrease in parking demand is about 7% in year 2040. Once again, the most significant impact is that the parking revenue would be expected to increase significantly from a hypothetical value of about $21,000 to over $110,000. In summary, parking demand is highly inelastic and market driven rate increases will provide an opportunity for significant revenue increases with little impact on parking demand.

Competing Parking Facilities

The parking demand estimates herein assume that Metrorail passengers drive to either the Route 606 or 772 Stations, park in one of the station garages and ride the train to work. However, this may not be a valid assumption. The potential could exist for a competing parking facility to capture a portion of the station parking demand by providing a more attractive alternative. Since the station garages will be located in the most convenient sites relative to the station the only other factor that could attract parkers to another facility is lower cost. Understanding the risk of competition is important as it relates directly to properly sizing a garage and more importantly, analyzing the ability of a garage to generate revenue.

The first question to address is whether current zoning regulations allow the development or operation of commuter parking within the inner or outer core of either station area. To determine this, the Revised 1993 Loudoun County Zoning Ordinance was reviewed. The County has been proactively planning the Route 606 and 772 Station areas for over a decade. Three developments (Moorefield Station, Loudoun Station, and Dulles Parkway Center II) proximate to the Route 772 Station have received zoning approval to the Planned Development –Transit Related Center (PD-TRC) zoning district. To date, the County has not received any rezoning requests for the Planned Development – Transit Related Employment Center (PD-TREC) zoning district. The inner and outer core for both the Route 772 and 606 Station locations is established through the approval of a Concept Development Plan.

Based on DESMAN's review of the ordinance and from discussions with County staff, commuter parking facilities are only permitted within the outer core of the PD-TRC zoning district by special exception. Additionally, commuter parking facilities within the outer core of the PD-TRC zoning district must either be structured or planned to be structured. Commuter parking facilities, structured or surface are permitted by special exception within the Transit Supportive Area (TSA) of the PD-TRC zoning district as well. Park-and-ride (commuter parking) facilities are permitted by SPEX in the outer core of PD-TREC.

It should be noted that parking facilities are permitted in other zoning districts, such as PD-CC-SC or PD-OP which are located proximate to the stations. So there is a possibility that commuter parking could be developed on land parcels that have not been rezoned into the PD-TRC or PD-TREC zoning districts. It is likely that commuter parking in this instance would be

limited to smaller lots and as an interim use and not have a significant impact on the park-and-ride station demand.

Conclusion

DESMAN has prepared an estimate of parking demand for the Route 606 and 772 Stations in Loudoun County. The parking demand estimates were based on the number of boarding passengers listed for the two stations reported in the FEIS for year 2025. Unfortunately, after consulting with the Virginia Department of Rail and Public Transportation, WMATA, the Dulles Rail Project Office and MWCOG, it was determined that additional boardings information was not available for use in this analysis. As a result, DESMAN developed proxy measures in order to develop its own forecasts. DESMAN projected boardings for the planning timeline, 2018 through 2040, based on number of households contained in the RCLCO study. Year 2018 was considered the opening year for the two stations.

Once boardings were projected through 2040, DESMAN used a series of parking ratios representing the number of parking spaces occupied divided by the number of boarding passengers to estimate parking demand. The station boarding and parking demand data was obtained from WMATA for various stations and varied from over 47% at the end line stations to less than 20% for stations located in highly urbanized areas. DESMAN multiplied the projected annual boardings by the parking ratios shown in Table 17 to estimate peak daily parking demand.

Table 17 - Parking Demand Calculations

	Year					
	2018	**2020**	**2025**	**2030**	**2035**	**2040**
Projected Boardings						
Route 606 Station	3,932	4,114	4,391	4,572	4,713	4,791
Route 772 Station	6,103	6,386	6,814	7,097	7,314	7,437
Total	10,036	10,500	11,205	11,669	12,027	12,228
Parking Ratio	47%	47%	43%	43%	40%	40%
Base Case Parking Demand						
Route 606 Station	1,848	1,934	1,888	1,966	1,885	1,917
Route 772 Station	2,869	3,001	2,930	3,052	2,926	2,975
Total	4,717	4,935	4,818	5,018	4,811	4,891
Base Case Adjusted Parking Demand						
Route 606 Station	1,848	1,932	1,889	1,972	1,898	1,938
Route 772 Station	2,869	2,998	2,932	3,060	2,945	3,008
Total	4,717	4,930	4,821	5,032	4,843	4,947

Table 17 summarizes intermediate year projections for passenger boardings, the parking ratio used to calculate parking demand and an initial estimate of parking demand, referred to as the Base Case scenario. Also shown in the table is an estimate of the parking demand adjusted to reflect changes in commute travel costs (Base Case Adjusted). The Base Case Adjusted reflects commute costs associated for both Metrorail and auto commuters assuming a continuation of historic trends and rate adjustments from 2005 through 2011 and incorporation of data obtained on future toll road charges for the Dulles tolls. The Base Case Adjustment also reflects the relative inelasticity of parking as predicted by the TRACE model, defined as a 1% increase in parking demand will reduce parking demand by 0.08% (less than 1/10th of a percent).

FEIS Proposed Parking Garages

Loudoun County identified three proposed garages at the stations including a 1,965 space garage at the Route 606 Station, and two garages totaling 2,974 spaces at the Route 772 Station for a total of 4,939 spaces in three garages as listed in below in Table 18.

Table 18 - FEIS Parking Garages

Location	No. of Spaces	2030 Parking Demand	Surplus/ (Shortfall)	Percent of Demand Met
Route 606 Station	1,965	1,972	(7)	99.7%
Route 772 Station - North	1,434	1,530	(96)	93.7%
Route 772 Station - South	1,540	1,530	10	100.6%
Total	4,939	5,032	(93)	98.1%

The parking demand listed in Table 18 is for 2030 and represents the highest parking demand estimated throughout the planning term. The estimated parking demand for all other years remain within 5% of the 2030 estimate with the exception of the opening year, which is about 8% less. When the proposed garages are compared to the 2030 estimates, there is an estimated shortfall in the supply of about 2%. However, given the methodology, objectives and the 28 year framework of this parking study, it is the finding of DESMAN that the three garages as proposed are adequately sized to accommodate the peak daily parking demand estimated for the Route 606 and Route 772 Stations in the Base Case Adjusted scenario.

Appendix Tables

Appendix Table 1 – WMATA Data

Metro Station	Depth [1]	Line	State	No. of Parking Spaces [3]	May 2010 Avg Wkday Boardings [2]	YTD FY 2010 [4] Peak Occupancy [3]	Spaces Occupied	Parking Ratio
Branch Ave.	1	Green	MD	3,072	6,868	99.5%	3,057	44.5%
Glenmont	1	RED	MD	1,781	5,857	92.6%	1,649	28.2%
Greenbelt	1	Green	MD	3,399	7,294	89.6%	3,046	41.8%
Largo Town Center	1	Blue	MD	2,200	5,283	90.4%	1,989	37.6%
New Carrollton	1	Orange	MD	3,519	10,287	93.8%	3,301	32.1%
Shady Grove	1	RED	MD	5,745	13,945	91.7%	5,268	37.8%
College Park	2	Green	MD	1,820	4,720	66.4%	1,208	25.6%
Landover	2	Orange	MD	1,866	2,570	57.1%	1,065	41.5%
Morgan Boulevard	2	Blue	MD	608	1,674	92.5%	562	33.6%
Rockville	2	RED	MD	524	4,927	102.9%	539	10.9%
Suitland	2	Green	MD	1,890	6,668	86.5%	1,635	24.5%
Wheaton	2	RED	MD	977	4,543	48.2%	471	10.4%
Addison Rd.	3	Blue	MD	1,268	3,759	60.3%	765	20.3%
Cheverly	3	Orange	MD	500	1,571	92.7%	464	29.5%
Forest Glen	3	RED	MD	596	2,366	95.3%	568	24.0%
Twinbrook	3	RED	MD	1,097	4,587	74.2%	814	17.7%
Franconia/Springfield	1	Blue	VA	5,069	9,665	90.1%	4,567	47.3%
Huntington	1	Yellow	VA	3,617	8,760	84.6%	3,060	34.9%
Vienna	1	Orange	VA	5,169	13,987	101.0%	5,221	37.3%
Dun Loring	2	Orange	VA	1,326	5,371	103.6%	1,374	25.6%
Van Dorn St.	2	Blue	VA	361	3,792	110.8%	400	10.5%
West Falls Church	3	Orange	VA	2,009	10,836	98.0%	1,969	18.2%

[1] Last stop on line = 1, Second to last stop on line = (2) and third to last stop on line = 3

[2] http://www.wmata.com/pdfs/planning/FY11_Rail_Ridership_By_Station.pdf

[3] http://www.scribd.com/doc/31302774/Parking-Occupancy-Jan-2010, WMATA Parking Facility Usage, January, 2010.

[4] YTD FY2010 is a monthly average for a partial year from July 2009 through January 2010.

Appendix Table 2 – Annual Base Case Parking Demand

	Year																						
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Number of Households[1]	131,504	134,672	137,588	140,139	142,193	143,946	145,447	146,826	148,111	149,373	150,640	151,819	152,911	153,918	154,906	155,877	156,775	157,600	158,333	159,021	159,579	159,960	160,234
Number of Boardings[2]																							
Route 606 Boardings	3,932	4,027	4,114	4,191	4,252	4,304	4,349	4,391	4,429	4,467	4,505	4,540	4,572	4,603	4,632	4,661	4,688	4,713	4,735	4,755	4,772	4,783	4,791
Route 772 Boardings	6,103	6,250	6,386	6,504	6,599	6,681	6,750	6,814	6,874	6,933	6,991	7,046	7,097	7,144	7,189	7,234	7,276	7,314	7,348	7,380	7,406	7,424	7,437
Total Boardings	10,036	10,277	10,500	10,695	10,851	10,985	11,100	11,205	11,303	11,399	11,496	11,586	11,669	11,746	11,822	11,896	11,964	12,027	12,083	12,136	12,178	12,207	12,228
Parking Ratio	47%	47%	47%	46%	45%	44%	44%	43%	43%	43%	43%	43%	43%	42%	42%	41%	41%	40%	40%	40%	40%	40%	40%
Base Case Parking Demand																							
Route 606 Pking	1,848	1,893	1,934	1,928	1,913	1,894	1,914	1,888	1,904	1,921	1,937	1,952	1,966	1,933	1,946	1,911	1,922	1,885	1,894	1,902	1,909	1,913	1,917
Route 772 Pking	2,869	2,938	3,001	2,992	2,970	2,940	2,970	2,930	2,956	2,981	3,006	3,030	3,052	3,000	3,020	2,966	2,983	2,926	2,939	2,952	2,963	2,970	2,975
Total	4,717	4,830	4,935	4,920	4,883	4,833	4,884	4,818	4,860	4,902	4,943	4,982	5,018	4,933	4,965	4,877	4,905	4,811	4,833	4,854	4,871	4,883	4,891

[1] Number of Household taken from RCLCO Study.

[2] Number of boardings calculated by multiplying households by 0.030 for Route 606 or 0.046 for Route 772.

Appendix Table 3 – Base Case Adjusted Parking Demand

	Year																						
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Base Case Adjusted Parking Demand																							
Route 606 Station	1,848	1,892	1,932	1,925	1,910	1,896	1,915	1,889	1,905	1,921	1,943	1,958	1,972	1,939	1,952	1,922	1,934	1,898	1,907	1,917	1,928	1,934	1,938
Route 772 Station	2,869	2,936	2,998	2,987	2,964	2,943	2,973	2,932	2,957	2,982	3,015	3,038	3,060	3,010	3,030	2,983	3,001	2,945	2,960	2,975	2,992	3,001	3,008
Total	4,717	4,828	4,930	4,912	4,874	4,839	4,888	4,821	4,862	4,903	4,958	4,996	5,032	4,949	4,982	4,905	4,935	4,843	4,868	4,891	4,920	4,935	4,947