Task Report 10-3

A Glance at Priced Roadways in the Baltimore Region through the Transportation Model

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Baltimore Metropolitan Council

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INTRODUCTION

The Baltimore Region Travel Demand Model is a four-step trip-based model. This model runs under Cube software, published by Citilabs. The model simulates travel by persons, passenger auto, trucks, and transit users in the Baltimore region as well as portions of adjoining jurisdictions in the Washington region. The current version of the model was updated in 2006 with a base year of 2000 and is known as the BMC Travel Choice Model Version 3.3. As a part of BMC's constant transportation model enhancement, in FY 2010, a toll choice model component was included in the regional modeling framework.

The toll choice model component introduced new tolling capabilities to the Version 3.3 model. These included Harbor Crossings toll roads (Fort McHenry Tunnel, Harbor Tunnel and Key Bridge) and mixed toll/ non-toll facilities such as the I-95 Express Toll Lanes northeast of Baltimore. This report intends to explain toll model strengths, weaknesses, and provides a quick look at priced facilities in Baltimore region.

The report has two major sections. The first section summarizes the properties of the toll model, particularly the influence of model variables such as toll cost and average annual household income on the toll choice estimates. A change in toll choice with respect to one percentage increase in toll users travel time savings, toll cost and household income were evaluated. Understanding the model elasticity will help the analyst to evaluate how policy changes would affect toll choice estimates.

The second section of this report documents both system wide and project level toll estimates. Toll origins and toll traffic routing pattern are analyzed for the years 2000 and 2020. Toll user's origin was identified to establish the toll choice area. Similarly, toll traffic on non-tolled roadways was isolated to understand the toll traffic routing pattern. The analysis utilizes select link analysis techniques for toll traffic evaluation. These two analysis years were selected because the year 2000 is the Travel Demand Model's base year and, in the year 2020, a significant number of transportation projects – tolled and non-tolled – are projected to be complete (see Exhibit 8).

TOLL MODEL PROPERTIES

I. MODEL DESIGN AND ASSUMPTION

The BMC toll choice model is a toll diversion model that separates vehicle trips between the toll and non-toll users before the Traffic Assignment step of the sequential four-step model. The model is based on the assumption that toll choice depends on the competition between the best tolled route and the best non-tolled route. In the model computational framework, the toll system does not directly compete with the public transit system. Toll choice is a part of total vehicle choice.

The BMC toll diversion model is a binary logit model. The probability of a driver (SOV, HOV and Truck) selecting a toll road depends on the tradeoff between travel time savings with the toll facility and the associated toll costs. The driver's characteristics such as income, discount rates and electronic transponder ownership are considered to estimate toll choice. Mathematically,

Toll Share = $1/ (1 + e^{\alpha}*\Delta T + b*Cost/\ln(Inc) + c + etcbias)$

Where

e = Base of natural logarithm (ln)

ΔT = time saving between toll road and non-toll road travel, in minutes

Cost = toll cost in dollars

Inc = median zonal household annual income (in thousands)

α = time coefficient

b = cost coefficient

c = toll road bias constant

etcbias = bias towards selecting toll routes with ETC payment

Influence of model variables (time, cost and income) on toll share estimate are discussed in the following section.

II. MODEL ELASTICITY

The next part of the analysis looks at the influence of model variables on the toll choice model utilized in the BMC travel choice model. In general, elasticity is defined as the percentage change in the response variable with respect to a one percentage change in an explanatory variable[1].The analysis focuses on evaluating the percentage change in toll choice with one percentage increase in toll road user's time saving, toll cost, and average TAZ household income. For this analysis, model elasticity is categorized:

- Highly Elastic: Change in toll choice greater than 1%
- Elastic: Change in toll choice is between 0.8% - 1.0%
- Moderately Elastic: Change in toll choice 0.5% - 0.8%
- Low Elastic: Change in toll choice is less than 0.5%

Exhibits 1, 2 and 3 illustrate the elasticity of toll model with respect to toll users travel time saving, toll cost and average household income respectively. The measurement is based on assumption of $2 toll cost and $62,500 Transportation Analysis Zone

(TAZ) average household income that save from 1 minute to 30 minutes travel time utilizing toll facility.

Exhibit 1 displays the model elasticity with an one percentage increase in toll users travel time saving on the toll choice estimate by trip purpose and vehicle class. The X-axis represents thirty different types of origin-destination pairs that save from 1 minute to 30 minutes of travel time utilizing toll facility. The Y-axis represents the percentage change in toll choice estimate for 1% improvement in toll travel time savings. Both toll cost and household income remain constant in this scenario. As shown in exhibit:

- model is low to moderately elastic
- HBW trips considered to have both maximum and minimum elasticity
- truck and commercial trips are considered as low elastic

Illustrated in Exhibit 1, Home-Based Work (HBW) trips within 5-12 minutes time savings are moderately elastic to toll travel time savings. HBW trips with 8 minutes toll travel time saving show most elasticity. In this case, with 1% improvement in toll time saving (time saving from 8 minutes to 8.08 minutes), toll choice would potentially increase from 59.3% to 59.6% and has model elasticity 0.66%. All other trips have low elasticity, except Non-Home Based (NHB) trips with 9-16 minutes travel time saving and Home Base Non Work (HBNW) trips with 13 to 19 minutes travel time saving.

Exhibit 1

Change in Toll Choice with 1% Increase in Toll User's Time Saving

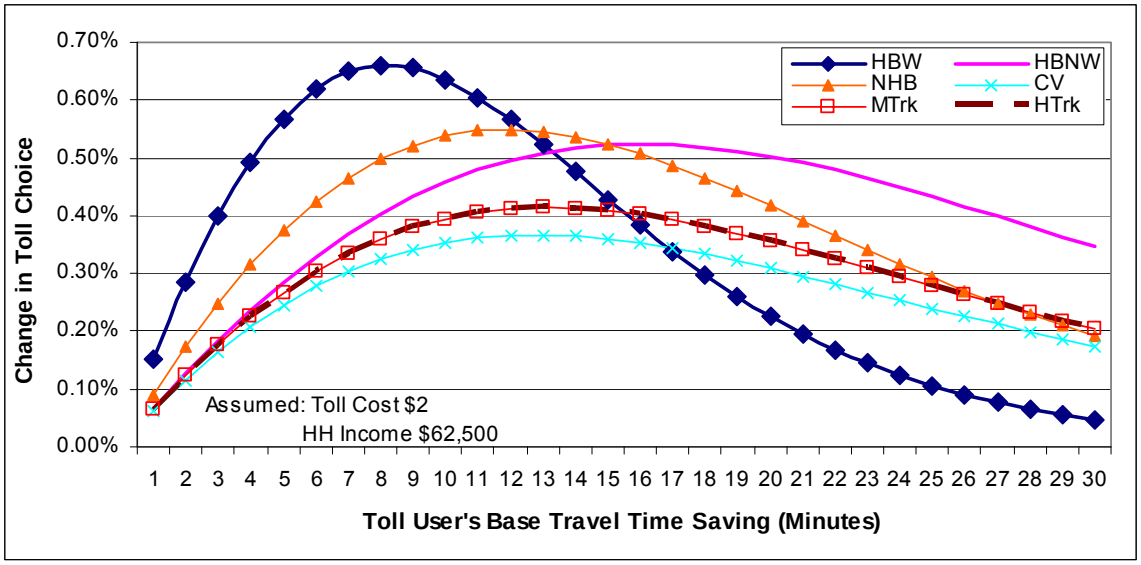


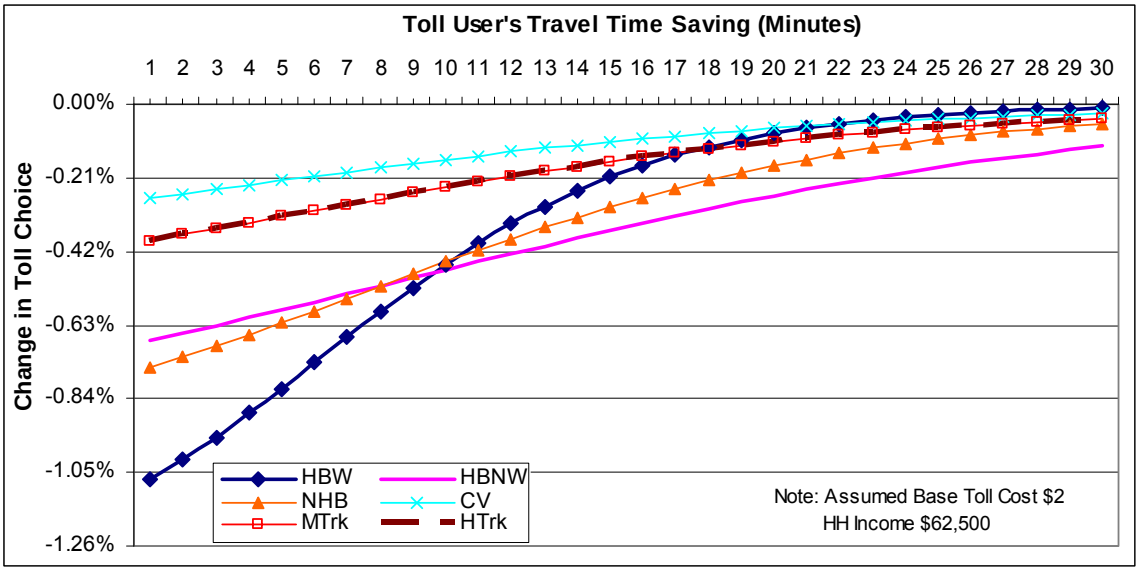
Exhibit 2 illustrates the toll model cost elasticity property with an one percentage increase in toll cost ($2 to $2.02).. Both toll users travel time saving and household income remain constant in this scenario. As shown in exhibit:

- model elasticity ranges from low to high elastic
- HBW trips considered to have both maximum and minimum elasticity
- truck and commercial trips are considered as low elastic

With 1% increase in toll cost, Home-Based Work trips with 1-minute travel time saving shows the highest negative elasticity. The toll choice in this case decreases from 26% to 25.7% with toll cost elasticity -1.12%. In other words, these trips are most likely to choose free alternate route over continue usage of toll roads with the increased toll cost. On the other hand, HBW trips toll users with 30 minutes time saving are most likely continue using toll roads despite 1% increase in toll cost. Home-Based Work trips with 2-5 minutes travel time savings have high elasticity and Home-Based Work trips within 5-9 minutes travel time savings are moderately elastic to toll cost. All other trips types have a low elasticity except; Home-Base Other and Non-Home Base trip with travel time saving range less than 9 minutes.

Exhibit 2

Change in Toll Choice with 1% Increase in Toll Cost ($2 to $2.02)



Similarly, Exhibit 3 illustrates the potential changes in toll choice with one percentage increase in TAZ average household income. Both toll users travel time saving and toll cost remain constant in this scenario. Unlike travel time savings and toll cost, the model elasticity for all trips have a low elasticity with less than 0.1%. This is well below the defined upper bound of low elastic range 0.5%. As shown in the exhibit:

- model is low elastic for all trips
- truck trips and commercial vehicle are insensitive to household income

Exhibit 3

Change in Toll Choice with 1% Increase in Household Income (62,500 to $63,125)

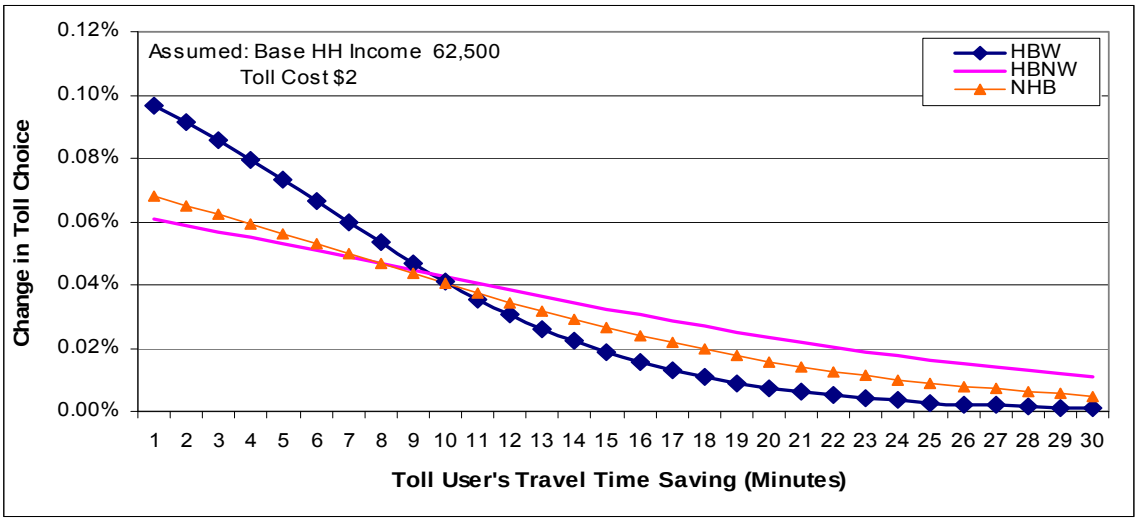
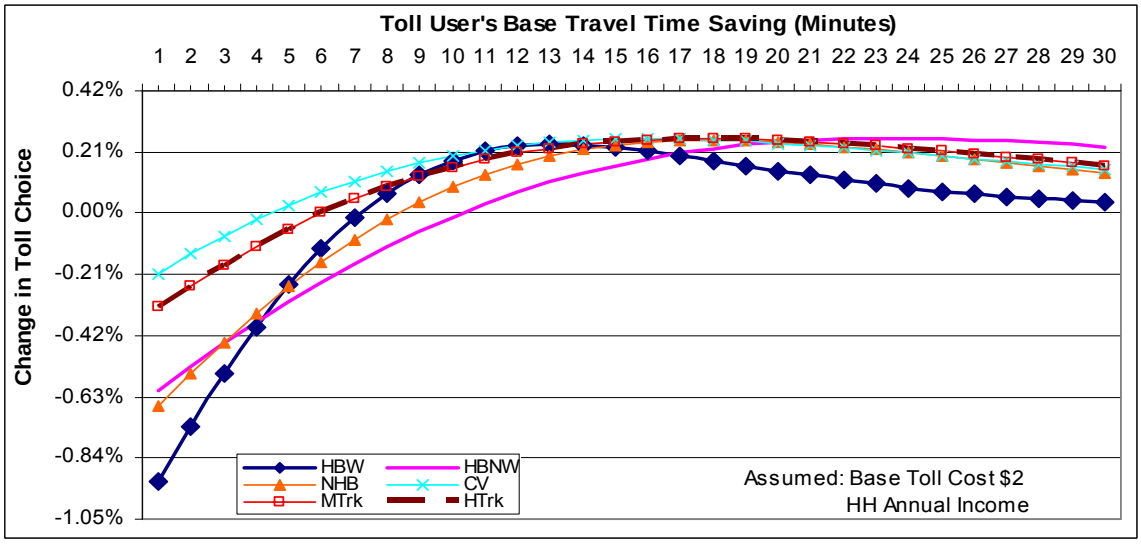


Exhibit 4 displays toll model property of estimating change in toll choice in response to improved toll travel time and increased toll cost scenario. The X-axis represents toll travel time saving without improvement. The Y-axis represents the change in toll choice with a 1% increment in both toll time saving and toll cost. Except for Home Based Non Work (HBNW) trips, all trip types with at least 8 minutes travel time saving in base year shows an increase in toll choice in this scenario. Toll choice with less than 8 minutes of toll route travel time saving will decrease. The maximum toll choice decrease of 0.92% is for Home-Based Work trips with one minute saving. Trucks trips toll choice with at least 5 minutes travel time saving with toll route in base scenario shows an increase in the toll choice.

Exhibit 4

Change in Toll Choice with 1% Increase in Toll Cost and Time Saving



Examples of variation in toll choice changes due to a change in model variables are summarized in Table 1. Household income of $62,500 is assumed constant for all scenarios. Toll cost and travel time saving from toll route vary by scenarios. However, toll cost within the same scenario is equal for both cases Type I and Type.

In the base case scenario with toll cost of $2, for the first case Type I, 59.3% of all Home Based trips that could save 8 minutes will choose toll facility. For the second case, Type II, only 34.5% of all Home Based trips that would save 3 minutes utilize toll facilities. This 139% reduction in toll choice with 160% reduction in toll time saving shows the nonlinear relationship between toll travel time saving and toll choice. Outlined below are the summary of the toll choice variations for three other scenarios

Scenario 1: No change in toll time saving but 1% increase in toll cost

- Decline in toll choice from both cases (Type I and Type II)

Scenario 2: 1% improvement in toll time saving and 1% increase in toll cost

- No change in toll choice from Type I
- Decline in toll choice from Type II

Scenario 3: 1% reduction in toll time saving and 1% increase in toll cost

- Decline in toll choice from both area types (Type I and Type II)

Table 1

Change Toll Choice by Model Scenario

Trip Types	Model Scenario	Toll Users Travel Time Saving (minutes)	Toll Cost ($)	Toll Demand
Home-Based Work (Type I)	Base	8.00	2.00	59.3%
	1% Toll cost increase	8.00	2.02	58.9%
	1% Increase in both time saving and toll cost	8.08	2.02	59.3%
	1% Decrease in time saving and 1% increase in toll cost	7.92	2.02	58.5%
Home-Based Work (Type II)	Base	3.00	2.00	34.5%
	1% Toll cost increase	3.00	2.02	34.2%
	1% Increase in both time saving and toll cost	3.03	2.02	34.3%
	1% Decrease in time saving and 1% increase in toll cost	2.97	2.02	34.0%

III. MODEL PROPERTY SUMMARY

An understating of the toll model elasticity will allow the analyst to evaluate model results through the understating of toll modeling capabilities and limitations. BMC's toll choice calculations are based on travel time savings between a toll route and free alternate route. The model has shown more responsive to changes in toll cost than changes in travel time savings. The analysis also indicates that toll choice model has the lowest income elasticity.

Quantitatively, with the base assumption of $2 toll cost and a $62,500 TAZ average household income, the maximum elasticity with one percentage increase in:

- **Toll Travel Time Saving** is 0.7% for Home-Based Work auto trips that save 8 minutes with toll route
- **Toll Cost** is 1.07% for Home Based Work auto trips that save 1 minute with toll route
- **Household Income** is 0.1% for Home Based Work auto trips that save 1 minute with toll route

Under the above mentioned analysis assumption, toll choice model assumes that trips that save more than 15 minutes are less likely to change toll choice in response to the change in toll travel time, toll cost and household income. In comparison to other trip types, Home-Based trips shows more response to the change in tolling policies. The analysis also shows that increasing toll cost without improving travel time would decrease toll choice in a similar way.

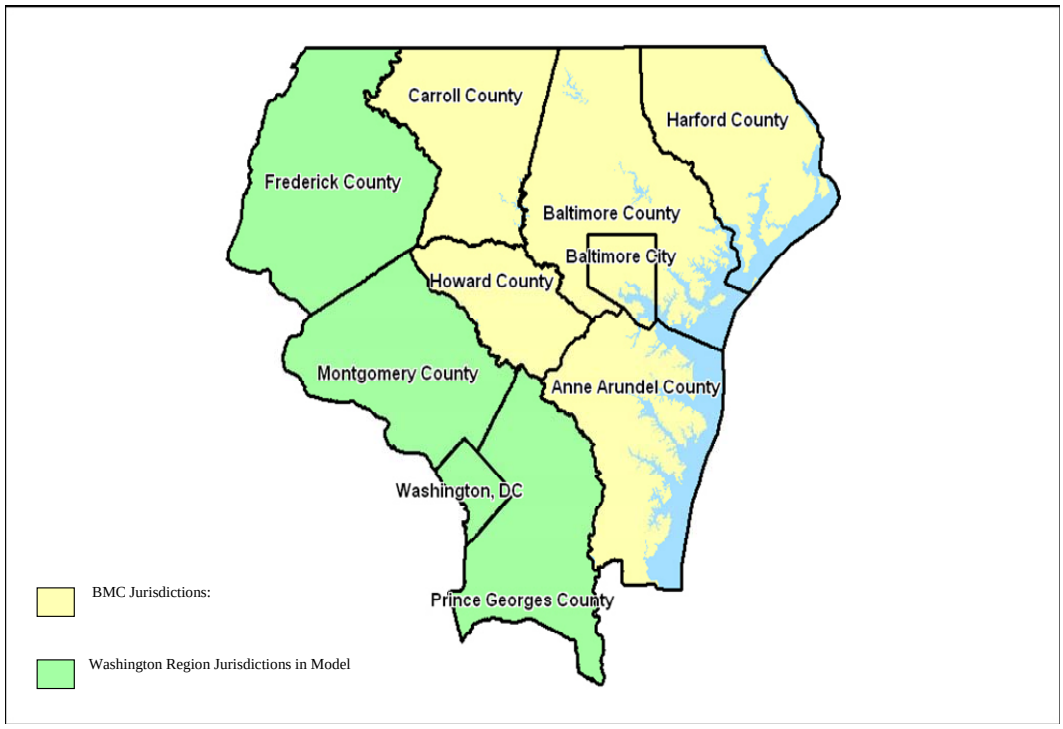
TOLL TRAFFIC ANALYSIS

I. STUDY AREA

The study area for this analysis includes all TAZs in the BMC Travel Choice Model, which includes Baltimore City and Anne Arundel, Baltimore, Carroll, Harford and Howard counties. In addition to the Baltimore metropolitan area, the travel model also includes four additional jurisdictions in the Washington region: Washington, DC, Montgomery County, Prince George's County and Frederick County in Maryland (see Exhibit 5).

Exhibit 5

BMC Transportation Model Area



II. STUDY METHODOLOGY

This study was conducted utilizing a select link analysis technique and the BMC regional travel demand model. Select link analysis is a traffic assignment modeling technique that identifies the origins and destinations of all trips utilizing selected roadway segments in the modeled roadway network.

The results from this analysis identify the aggregated number of trips within a Traffic Analusis Zone (TAZ) rather than the number of trips originating from a specific category of households within the TAZ. Trips that utilize toll roads originating from the identified TAZ include trips starting at locations other than home. This situation could mislead the interpretation of the analysis results, particularly for TAZs with little or no residents but with employment. Examples of such areas are a central business district/downtown, airport, major industrial park or a large institution such as colleges and hospitals.

For this analysis, a comparison between model years 2000 and 2020 was completed. Toll roads open to traffic in each analysis year were included in the select link analysis. Table 2 lists the roadway segments included for the project level analysis. Select link analysis was computed using four time-periods (AM Peak, Mid Day, PM peak and Night Time) and results obtained from each period were aggregated for reporting purpose.

Table 2

Selected Toll Roadway

Facility Name	Route	Facility Type	Description	Analysis Network Year	Total Tolled Lanes	AADT (2008)
Fort McHenry Tunnel	I-95	Harbor Crossing Bridge Tunnel	Crosses Baltimore Harbor connecting Canton and Locust Point	2000 & 2020	8	120,000
Harbor Tunnel	I-895	Harbor Crossing Bridge Tunnel	Crosses Baltimore Harbor connecting Canton and Brooklyn	2001 & 2020	4	70,000
Key Bridge	I-695	Harbor Crossing Bridge Tunnel	Crosses Baltimore Harbor connecting Sparrows Point and Glen Burnie	2002 & 2020	4	33,000
I-95 Express Toll Lanes	I-95	Managed Lane within General Purpose Lanes	Connects north of MD 43 in White marsh to I-895 in East Baltimore	2020	4	N/A

III. Model Roadway Network

Exhibits 6 and 7 illustrate the toll system difference between the year 2000 and 2020. The 2000 scenario highway network includes three harbor crossings toll roads: the Fort McHenry Tunnel, the Harbor Tunnel (I-895) and the Key Bridge (I-695). I-95 Express Toll Lanes is included in the 2020 scenario. In addition to this new toll facility, year 2020 model transportation network includes all planned road and transit improvements considered in the region's long-range transportation plan, Transportation Outlook 2035. Exhibit 8 summarizes the highway network difference between the years 2000 and 2020.

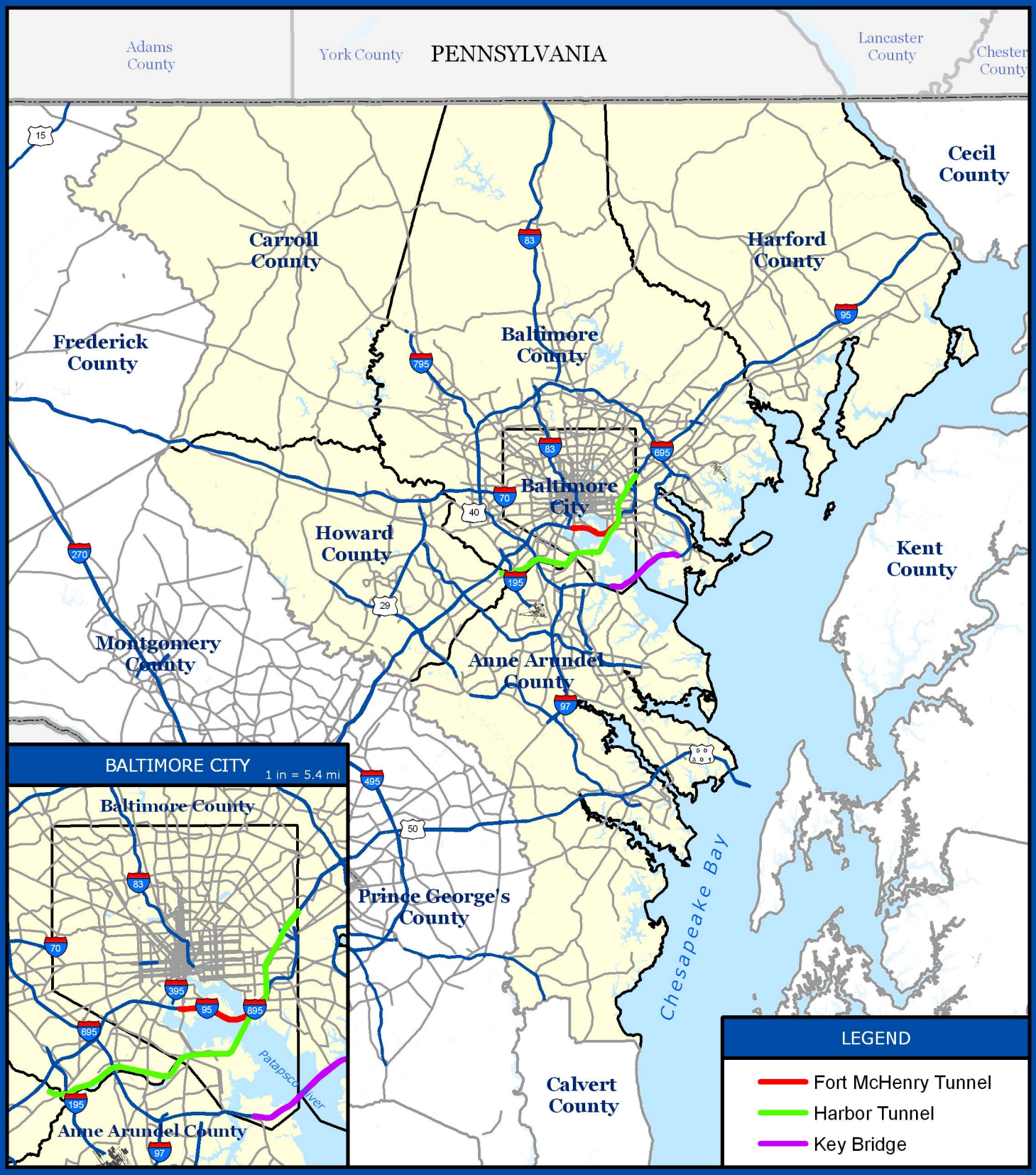
Table 3 presents the system wide summary of the highway network. By the year 2020, about 180 lane-miles of new toll facilities would be open for traffic. This is a 180% increase in toll lanes miles. At the same time, 330 lane-miles of additional freeway capacity would be added to the roadway system. By 2020, a toll system would provide 7.7% of the region's lane-miles that are equivalent to freeway/interstate standard. The roadway network system would grow by 5% to 16,620 lane-miles by 2020.

Table 3

Model Area Roadway Network Summary

Roadway Classification	Model Year 2000		Model Year 2020	
	Roadway Lane-Miles	% Tolled	Roadway Lane-Miles	% Tolled
Freeways	3,120	3.20%	3,630	7.70%
Principal Arterials	4,460		4,590	
Minor Arterials	3,940		4,100	
Collectors	4,310		4,300	
Total	**15,830**		**16,620**	

Exhibit 6: Year 2000 Toll System



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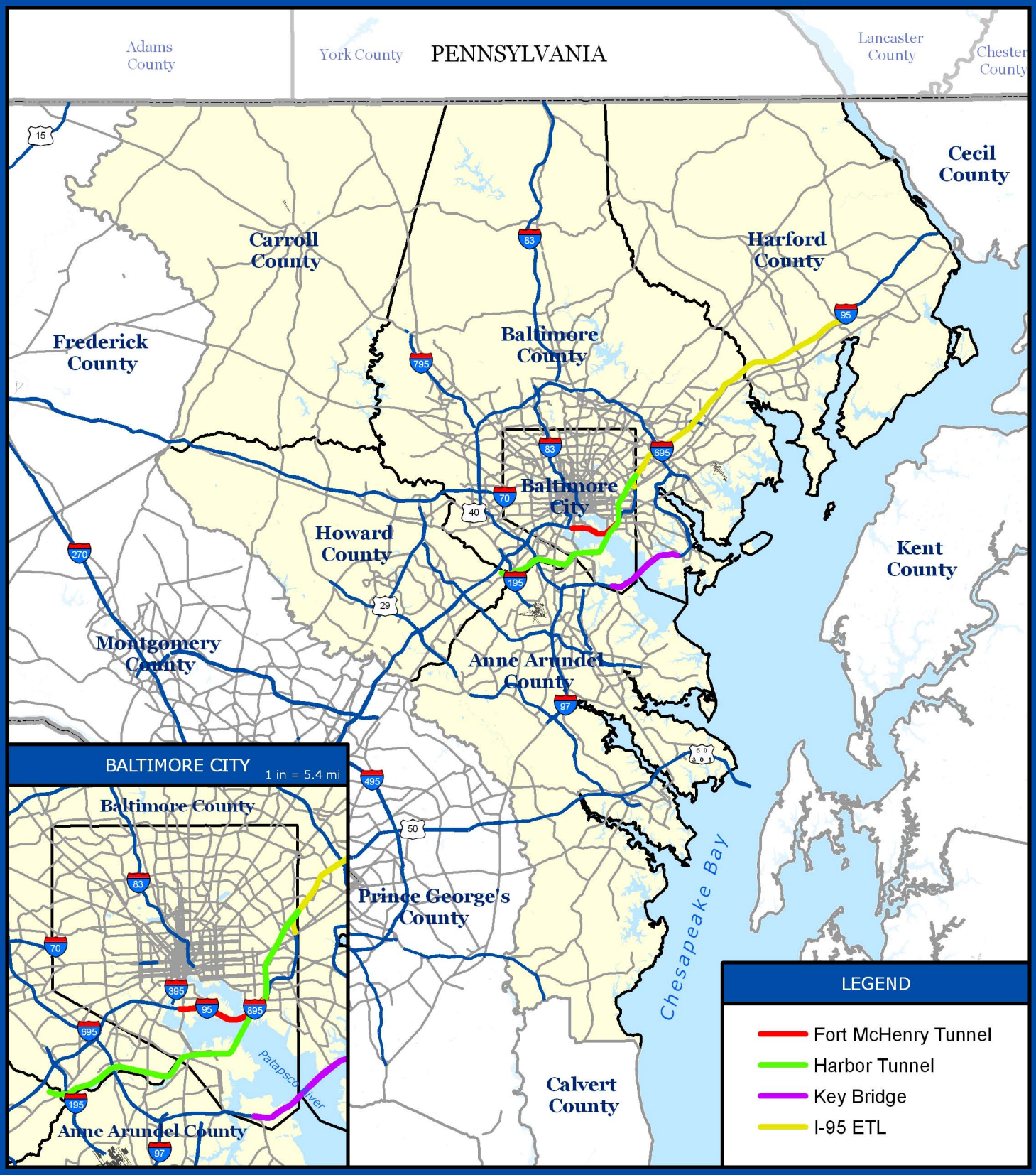
N W E S

1:633,600

0 10 Miles

1 in = 10 miles

Exhibit 7: Planned Year 2020 Toll System



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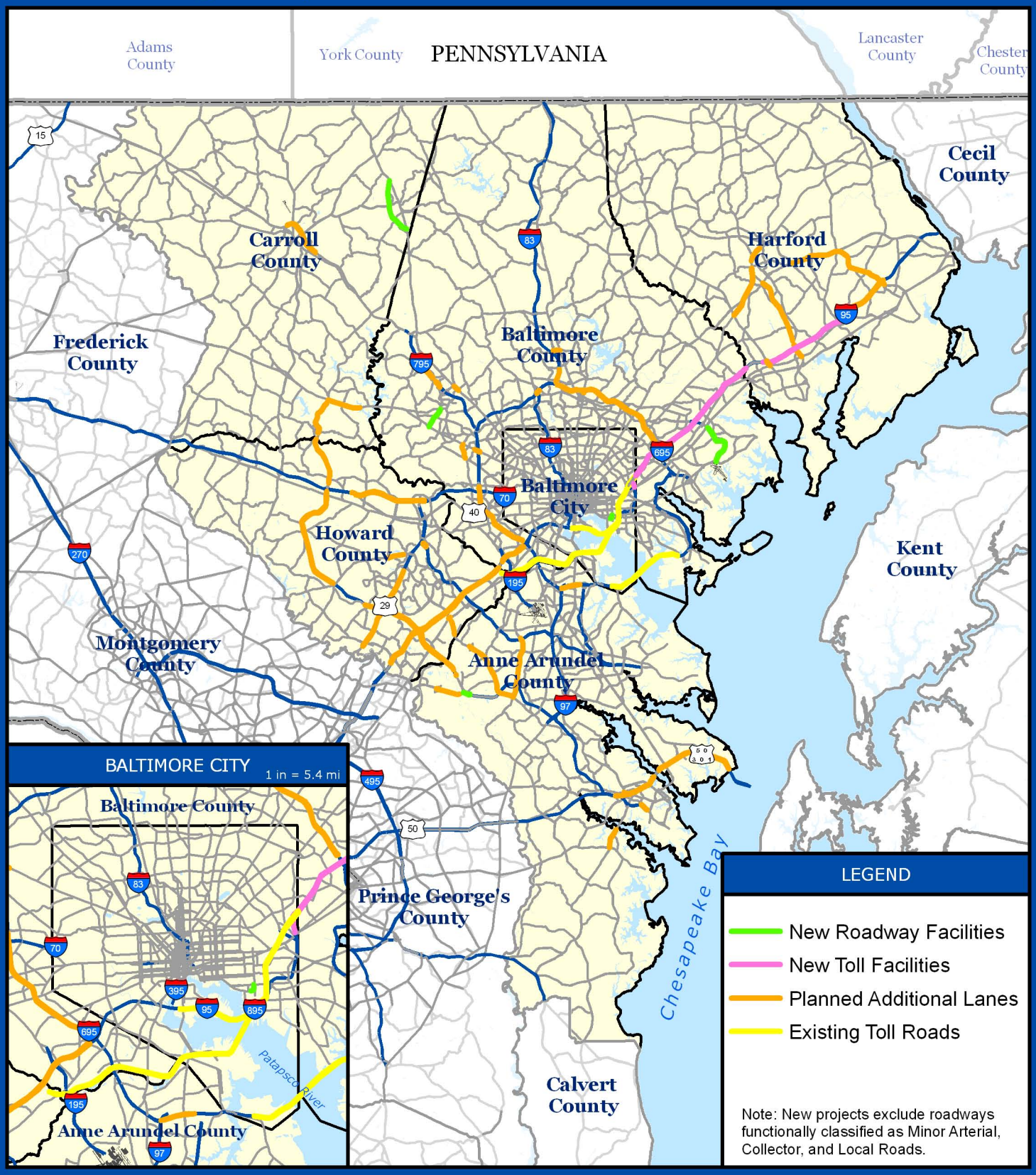
N W E S

1:633,600

0 10 Miles

1 in = 10 miles

Exhibit 8:
Model Highway Network Difference: 2000 vs. 2020



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N W E S

1:633,600

0 10 Miles

1 in = 10 miles

IV. Analysis Results

Exhibit 9 illustrates the percentage increase in toll system capacity, toll market and toll choice estimates. For this analysis, all trips between an origin-destination pair are considered toll market if at least one trip from that origin-destination pair chooses a toll facility. Toll choice represents all toll road users. In comparison to year 2000, in the year 2020:

- toll market increase is higher than toll system capacity expansion
- toll choice increase is lower than toll system capacity expansion

Exhibit 9

System-wide Toll Comparison: Years 2020 and 2000

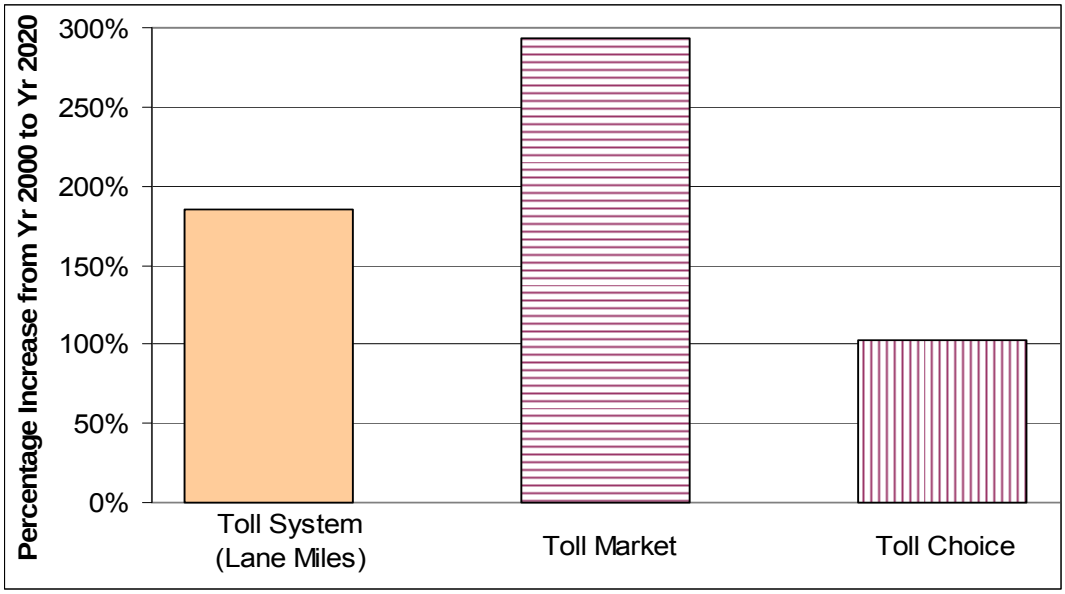


Table 4

System-wide Toll Market and Toll Choice

Description	Year 2000			Year 2020		
	Auto Trips	Truck Trips	Vehicle Trips	Auto Trips	Truck Trips	Vehicle Trips
Daily Total Trips in Model Area	12,251,000	655,000	12,906,000	14,574,000	779,000	15,352,000
Total Toll Market	249,000	42,000	291,000	1,024,000	120,000	1,144,000
Total Toll Choice	173,000	26,000	199,000	345,000	58,000	403,000
Percentage Choosing Toll Facility	69%	62%	68%	34%	48%	35%
Percentage of Toll Market to Total Model Area Trips	2%	6%	2%	7%	15%	7%

System-wide toll choice summary estimates for the year 2000 and 2020 are in Table 4. Daily toll market share to regional total is anticipated to reach 7% in year 2020 from 2% in year 2000. With the expansion of toll market to 1,144,000 daily vehicle trips in the year 2020 from 291,000 in the year 2000, toll choice is estimated to double to 403,000 daily vehicle trips. However, toll choice percentage to total toll market reduces to 35% in comparison to 68% share in the year 2000.

Tables 5 and 6 illustrate the details of toll utilization by toll facilities for years 2000 and 2020. In both years, more than 45% of TAZs generate at least one-vehicle trip that utilize toll facilities on an average weekday. Of the toll-system auto toll choice (173,000) in the year 2000, 43% of the trips utilize the Fort McHenry, 42% pass through the Harbor Tunnel and 15% utilize the Key Bridge. However, in the year 2020, only 28% of the total auto choice passes through the Fort McHenry Tunnel, 22% utilize the Harbor Tunnel and 10% pass through the Key Bridge.

Among harbor crossings, the Key Bridge auto market grew by 60% (68,000 to 110,000) in the year 2020 in comparison to 40% market increase for the Fort McHenry and the Harbor Tunnel. Exhibit 10 shows the facility specific change in percentage of vehicle toll choice to vehicle toll market between two scenarios. Toll choice share to its toll market is highest for the Harbor Tunnel in both years 2000 and 2020.

Exhibit 10

Estimated Vehicle Toll Choice Share to Toll Markets

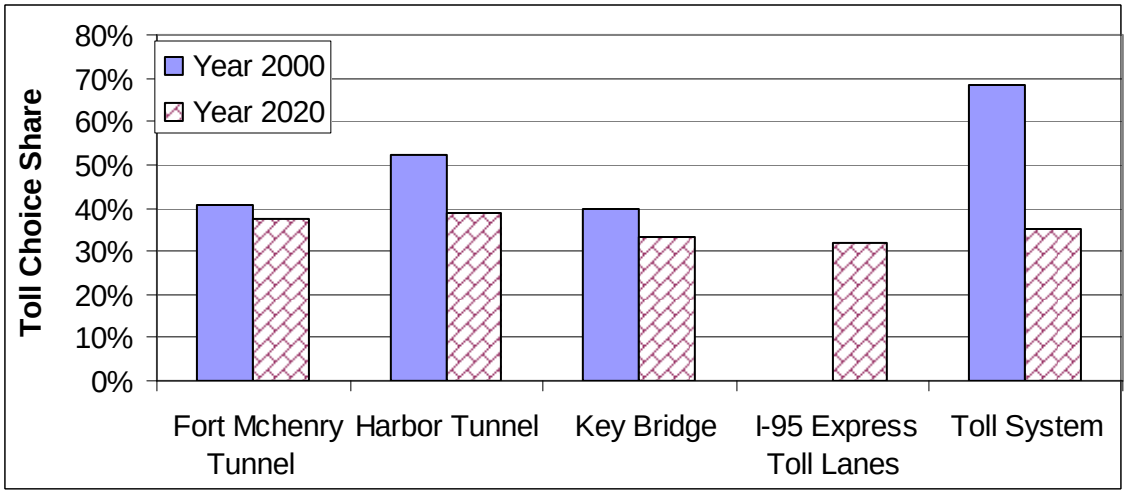


Table 5

Year 2000 Toll Utilization by Toll Facility

Description	Toll Roadways		
	Fort Mchenry	Harbor Tunnel	Key Bridge
Total TAZs Utilizing (Model Area TAZs 2973)	1,406	1,305	1,380
Daily Auto Trips Toll Market	191,000	134,000	68,000
Daily Auto Trips Utilizing	75,000	72,000	26,000
Pct Share to Total Auto Toll Choice (Total Choice 173000)	43%	42%	15%
Daily Auto Trips Utlizing Free Alternate*	116,000	62,000	42,000
Percentage Auto Utilizing Toll	**39%**	**54%**	**38%**
Daily Truck Trips Toll Market	31,000	15,000	10,000
Daily Truck Trips Utilizing	15,000	6,000	5,000
Pct Share to Total Truck Toll Choice (Total Choice 26000)	58%	23%	19%
Daily Truck Trips Utlizing Free Alternate *	16,000	9,000	5,000
Percentage Truck Utilizing Toll	**48%**	**40%**	**50%**
Daily Vehicles Toll Market	222,000	149,000	78,000
Daily Vehcile Utilizing	90,000	78,000	31,000
Daily Vehicle Trips Utlizing Free Alternate *	132,000	71,000	47,000
Percentage Vehicle Utilizing Toll	**41%**	**52%**	**40%**

* Excludes TAZs that do not ulilize toll road

Table 6

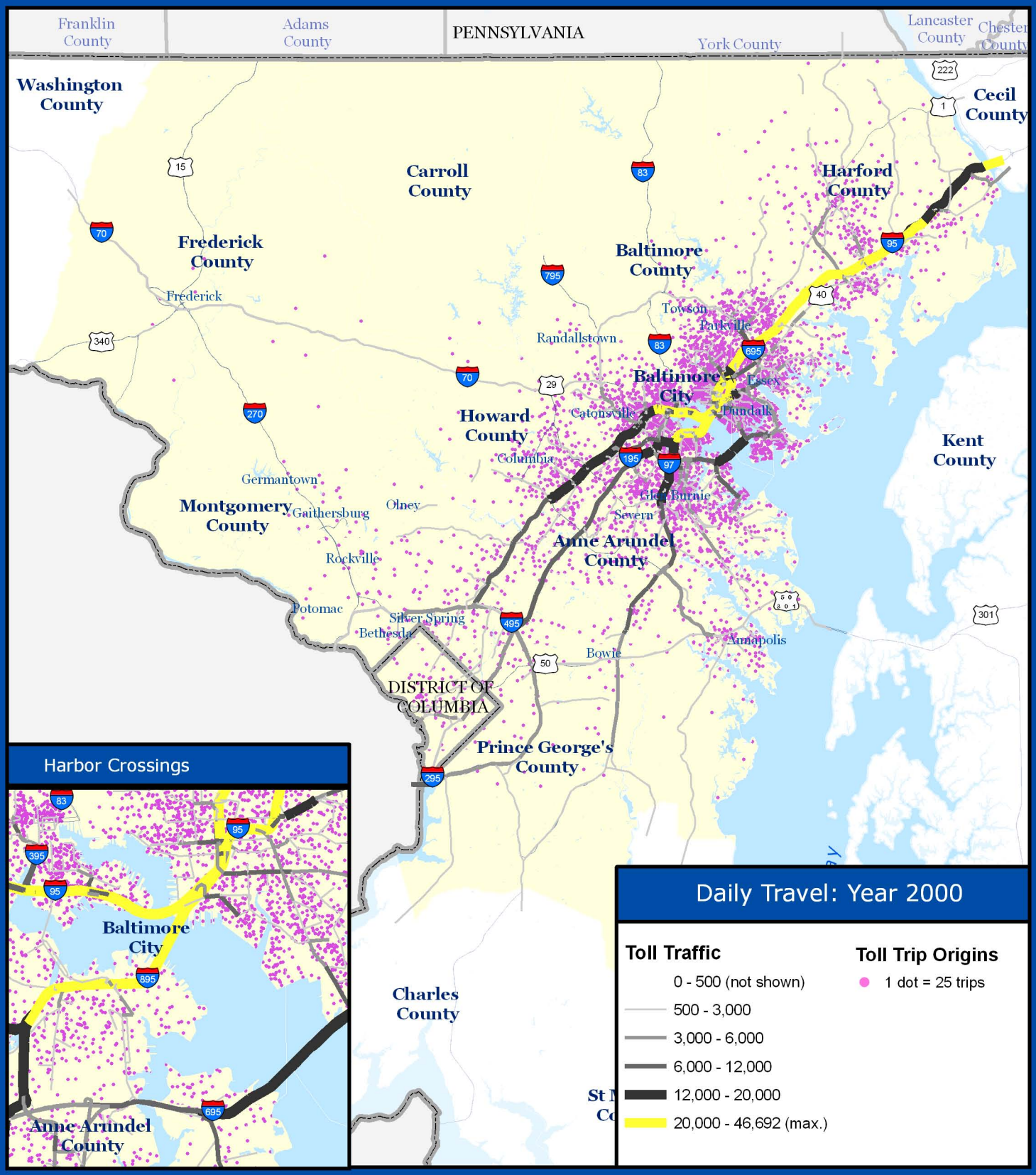
Year 2020 Toll Utilization Rate by Toll Facility

Description	Toll Roadways			
	Fort Mchenry	Harbor Tunnel	Key Bridge	I-95 Express Toll Lanes
Total TAZs Utilizing (Model Area TAZs 2973)	1,426	1,316	1,398	1,453
Daily Auto Trips Toll Market	272,000	192,000	110,000	223,000
Daily Auto Trips Utilizing	98,000	76,000	35,000	70,000
Pct Share to Total Auto Toll Choice (Total Choice 345075)	28%	22%	10%	20%
Daily Auto Trips Utlizing Free Alternate*	174,000	116,000	75,000	153,000
Percentage Auto Utilizing Toll	**36%**	**40%**	**32%**	**31%**
Daily Truck Trips Toll Market	42,000	25,000	14,000	37,000
Daily Truck Trips Utilizing	19,000	8,000	6,000	13,000
Pct Share to Total Truck Toll Utilization (Total Utilization 57848)	33%	14%	10%	22%
Daily Truck Trips Utlizing Free Alternate*	23,000	17,000	8,000	24,000
Percentage Truck Utilizing Toll	**45%**	**32%**	**43%**	**35%**
Daily Vehicles Toll Market	314,000	217,000	124,000	260,000
Daily Vehcile Utilizing	117,000	84,000	41,000	83,000
Daily Vehicle Trips Utlizing Free Alternate*	197,000	133,000	83,000	177,000
Percentage Vehicle Utilizing Toll	**37%**	**39%**	**33%**	**32%**

* Excludes TAZs that do not ulilize toll road

Series of exhibits are prepared to analyze toll traffic roadway routing patterns to isolate major roadways that feed traffic to the toll facilities and to display toll trip choice origins. Exhibits 11 and 12 illustrate model estimated toll system users' daily traffic pattern for the years 2000 and 2020. Exhibits 13, 15 and 17 depict the year 2000 model estimated daily traffic route and the trip origins of traffic that utilize the Fort McHenry, the Harbor Tunnel and the Key Bridge, respectively. Exhibits 14, 16 and 18 present model estimated toll users' pattern for each harbor crossing for the year 2020. The toll model estimated I-95 Express Toll lanes users in the year 2020 are presented in Exhibits 19.

Exhibit 11
Estimated Daily Travel Pattern - Toll System



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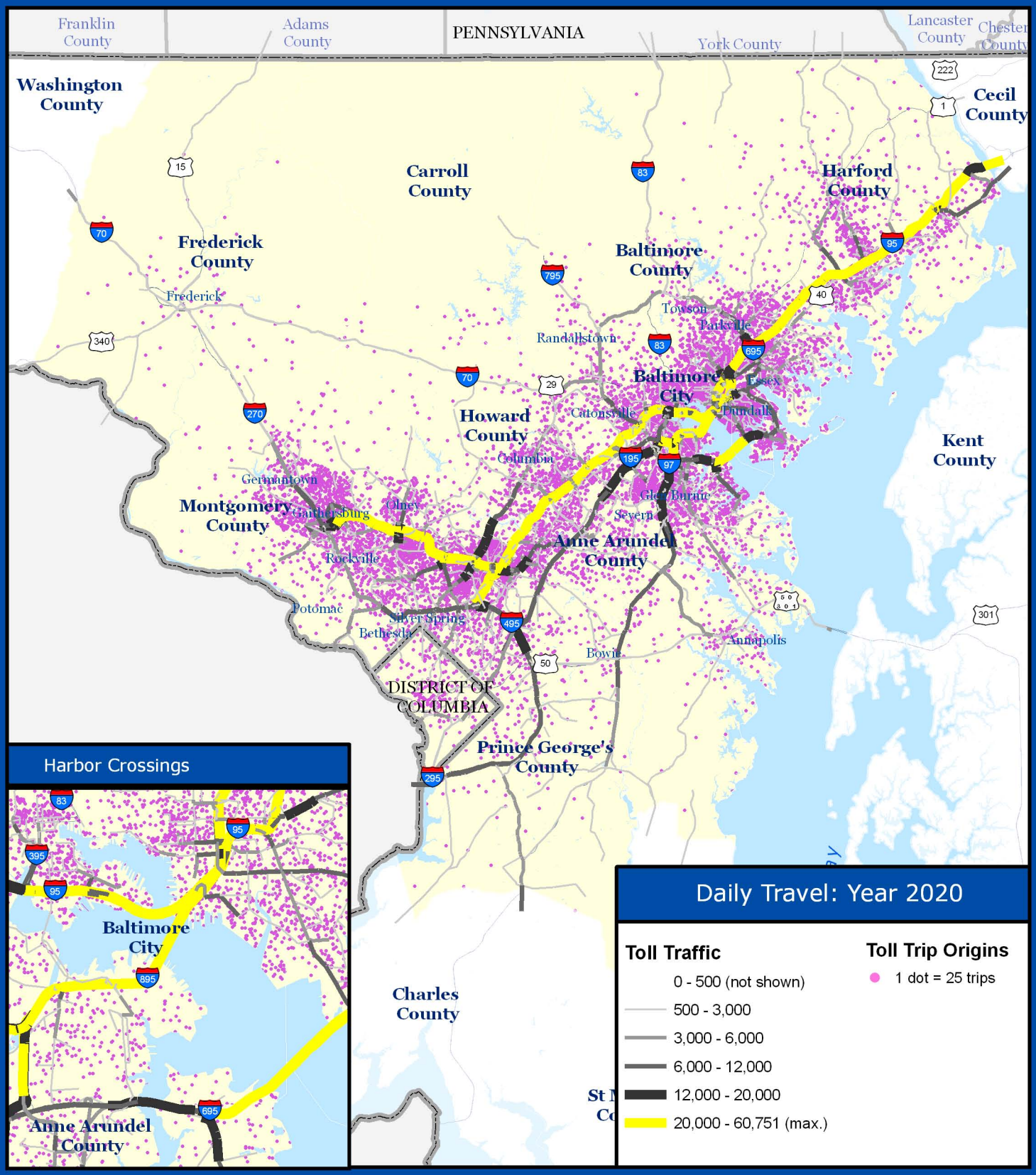
N W E S

1:760,320

0 12 Miles

1 in = 12 miles

Exhibit 12
Projected Daily Travel Pattern - Toll System



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N W E S

1:760,320

0 12 Miles

1 in = 12 miles

The higher dot density represents the area anticipated for higher toll trip origins. In comparison to the Key Bridge, the other two harbor crossings show a larger drive shed for toll trip origins and have a similar spatial pattern for both analysis years. Following toll facility orientation, the toll trip origins show heavy concentration along the I-95 corridor throughout the model area. The Key Bridge shows a higher localization of trip origins within the Dundalk and Glen Burnie areas..

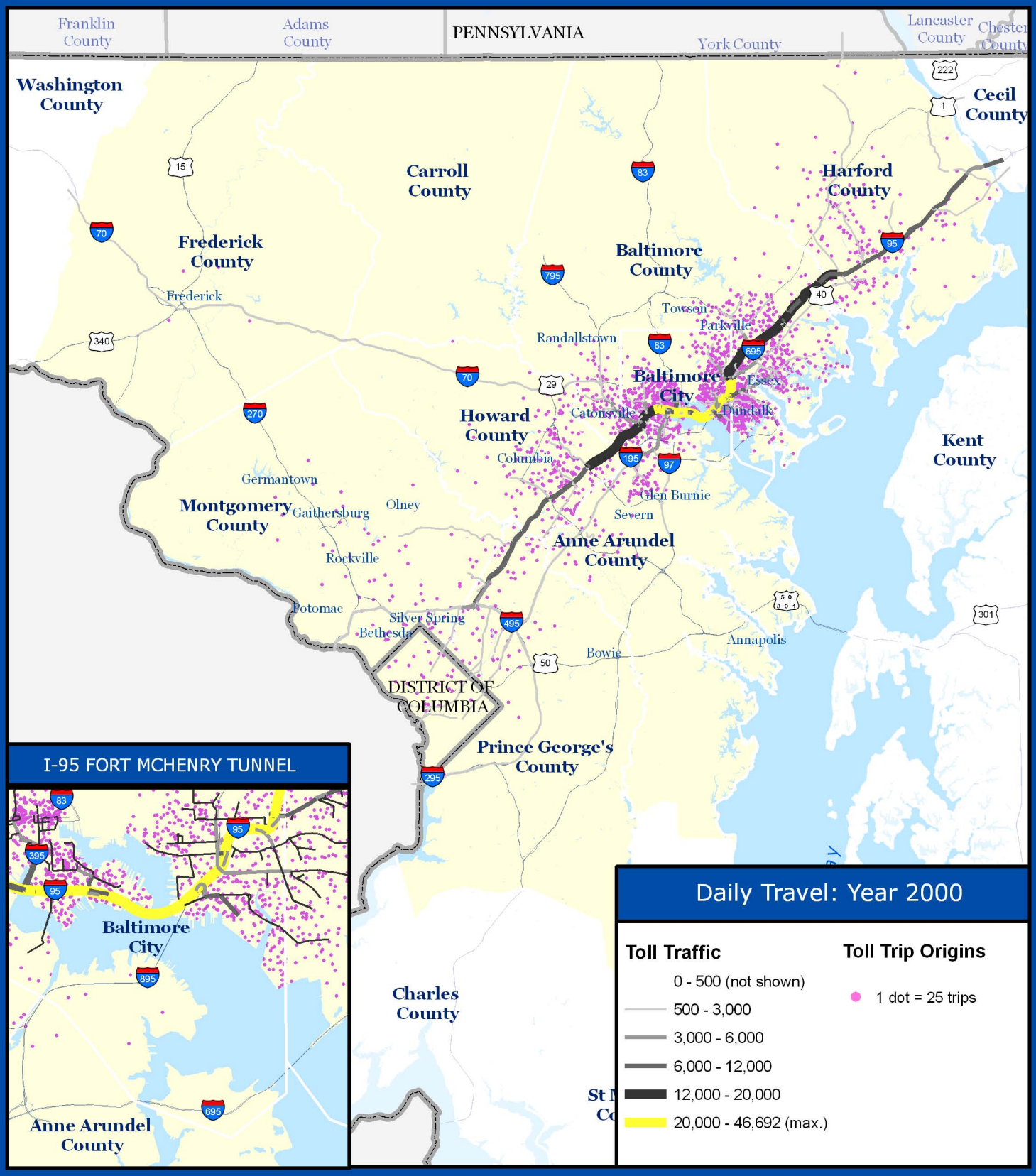
For both analysis years, estimated traffic that utilizes the Fort McHenry or the Harbor Tunnels has similar origins in the area north of the harbor crossings. Toll trips originating from Baltimore City and Parkville are likely to utilize the Fort McHenry Tunnel more than the Harbor Tunnel. The estimated trip origin patterns of the Fort McHenry Tunnel toll users and I-95 Express Toll facility users are comparable.

For each toll facility, the model shows different trip origin patterns for the area south of the harbor crossings. For both analysis years 2000 and 2020, traffic anticipated to utilize the Fort McHenry Tunnel originates along the I-95 corridor, under the area of Catonsville, Ellicott City and Columbia. Although minimal, the Fort McHenry Tunnel's estimated market extends northwest to the City of Frederick in Fredrick County. By the year 2020, the model estimated Fort McHenry Tunnel's market is likely to expand along I-70 corridor in Howard and Frederick counties. In case of the Harbor Tunnel, higher number trips are estimated to originate from the area along and between the Baltimore Washington Parkway and the I-97 corridor to Fort Meade. Between the years 2000 and 2020, toll trip markets south of harbor crossings is estimated to remain unchanged for the Harbor Tunnel and the Key Bridge. Model estimated trips originating in Fort Meade area are more likely to utilize the Harbor Tunnel than the Fort McHenry Tunnel.

Illustrated in Exhibits 13 and 14, Interstate I-95 serves as a major feeder roadway to traffic that utilize the Fort McHenry Tunnel. Similar to the Fort McHenry Tunnel, I-95 north of harbor crossings also serves as a major feeder roadway for traffic that utilize the Harbor Tunnel. However, in the area south of harbor crossings, several roadways (I-95, MD 295, I-97 and MD 3) operate as major feeder roadways for traffic that passes through the Harbor Tunnel. The model estimated results show that south of the harbor crossings - Bowie, Annapolis and Laurel - are the other major markets for the Harbor Tunnel.

As depicted in Exhibits 13 and 14, I-95 between US 40 and MD 295 estimated to carry more than 20,000 daily of Fort McHenry toll traffic in each direction. Similarly, I-95 from MD 295 to MD 100, and from US 40 to MD 24 in Harford County carries about 12,000-20,000 daily Fort McHenry toll traffic in each direction. Remaining portions of I-95 in Maryland is estimated to carry at least 6,000 vehicles for each of the Fort McHenry Tunnel and Harbor Tunnel.

Exhibit 13
Estimated Daily Travel Pattern - Fort McHenry Tunnel



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1:760,320
0 12 Miles
1 in = 12 miles

Exhibit 14
Projected Daily Travel Pattern - Fort McHenry Tunnel

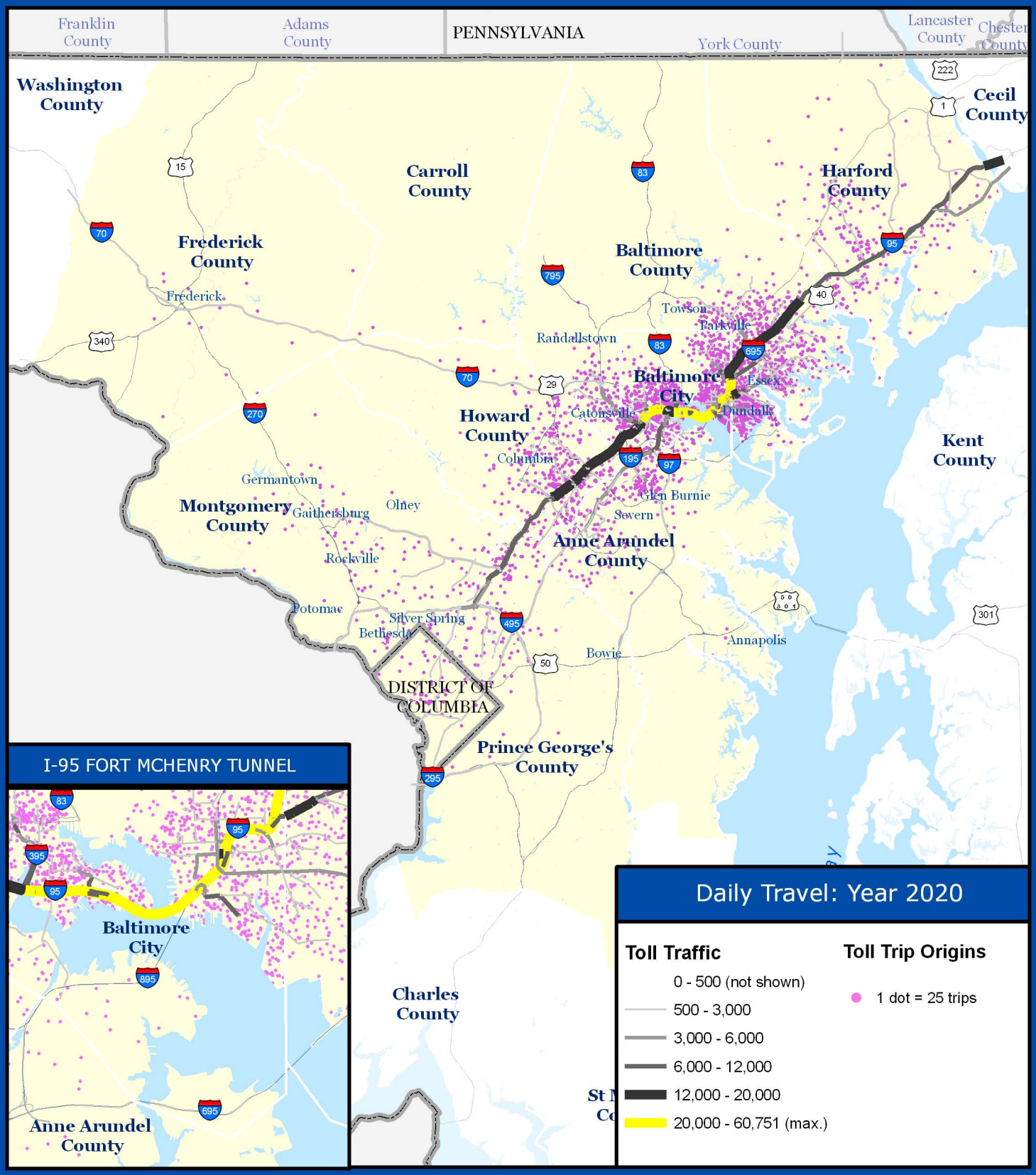

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Exhibit 15
Estimated Daily Travel Pattern - Harbor Tunnel

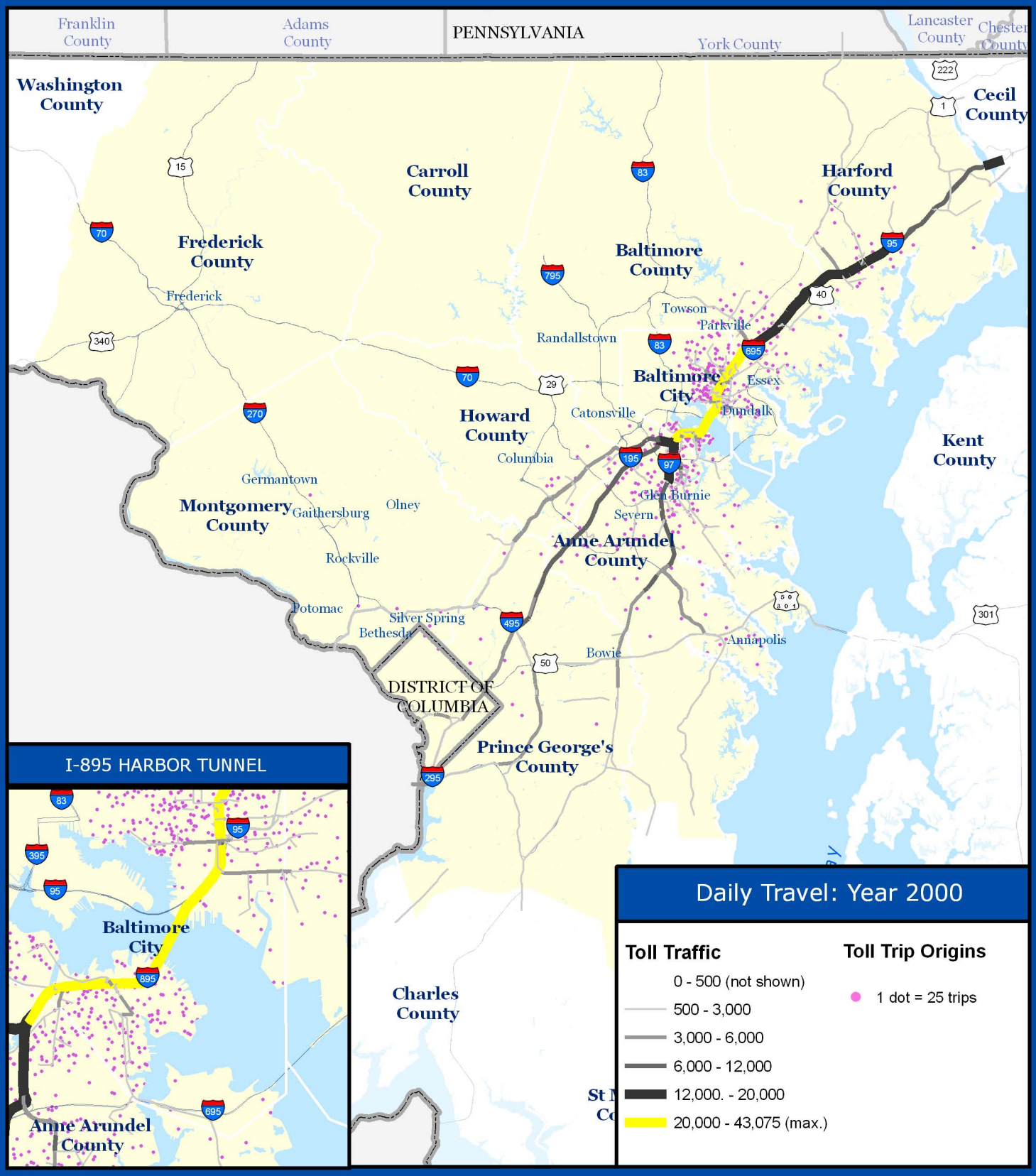

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Exhibit 16
Projected Daily Travel Pattern - Harbor Tunnel

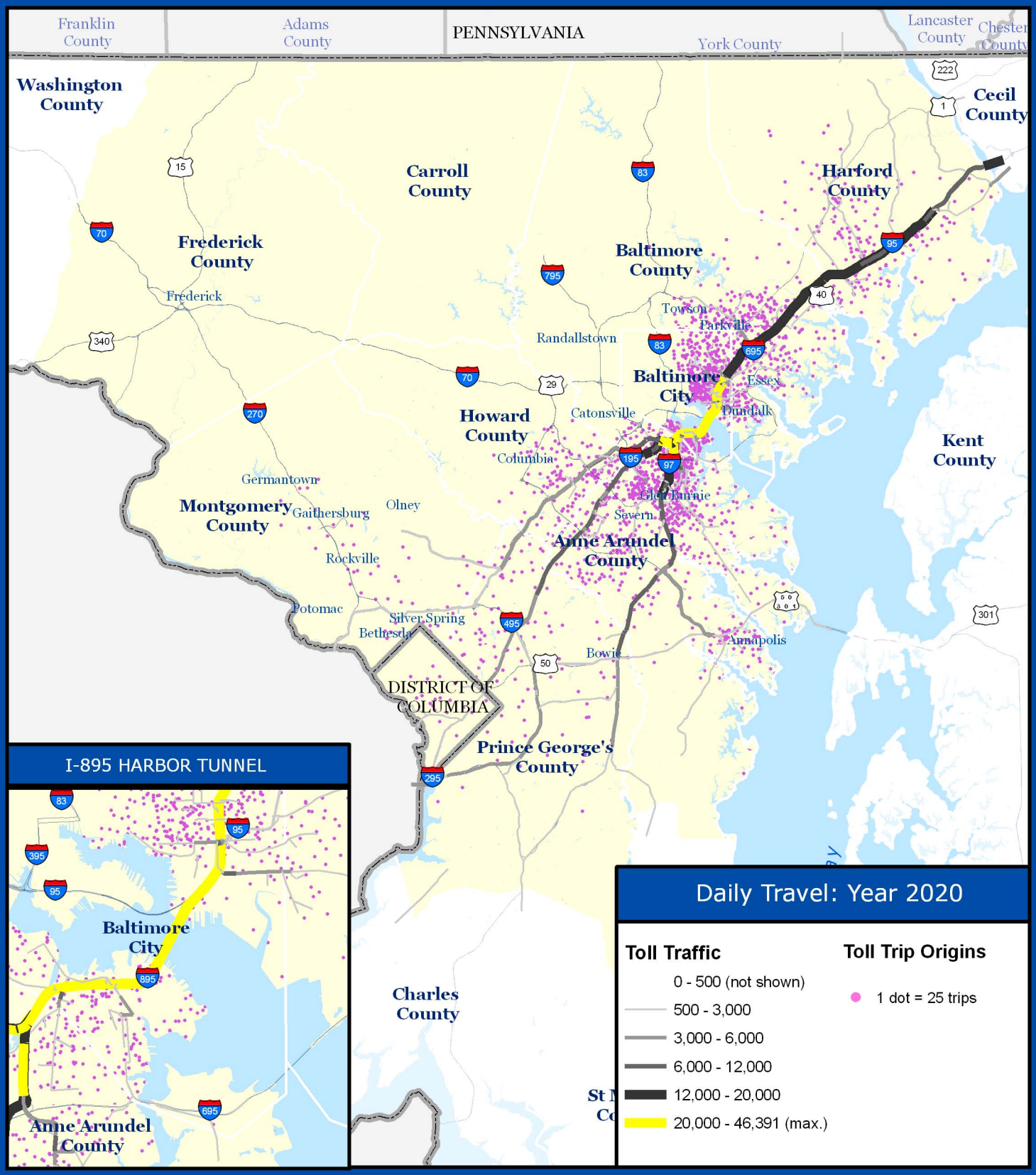

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Exhibit 17
Estimated Daily Travel Pattern - Key Bridge

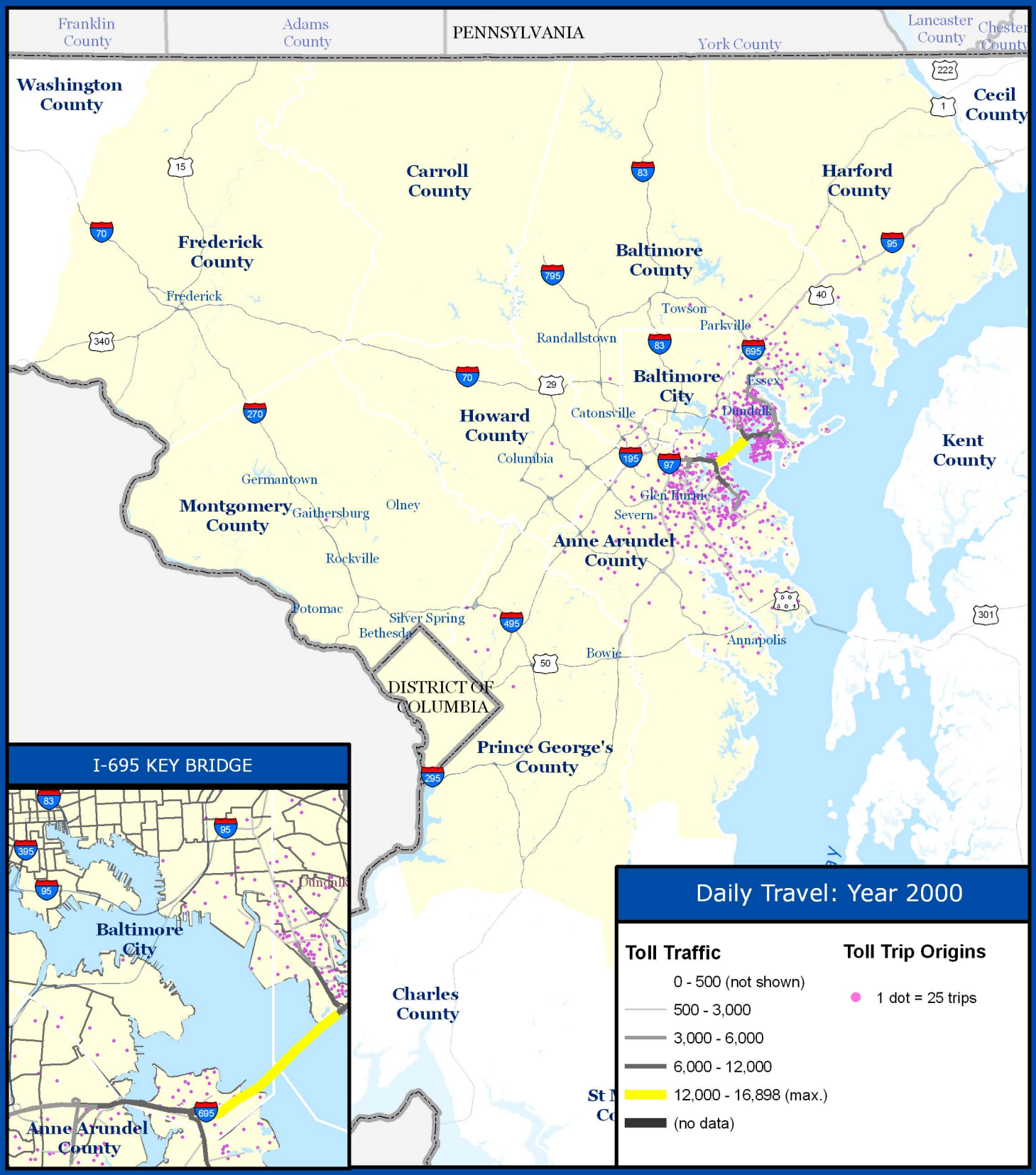

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Exhibit 18
Projected Daily Travel Pattern - Key Bridge

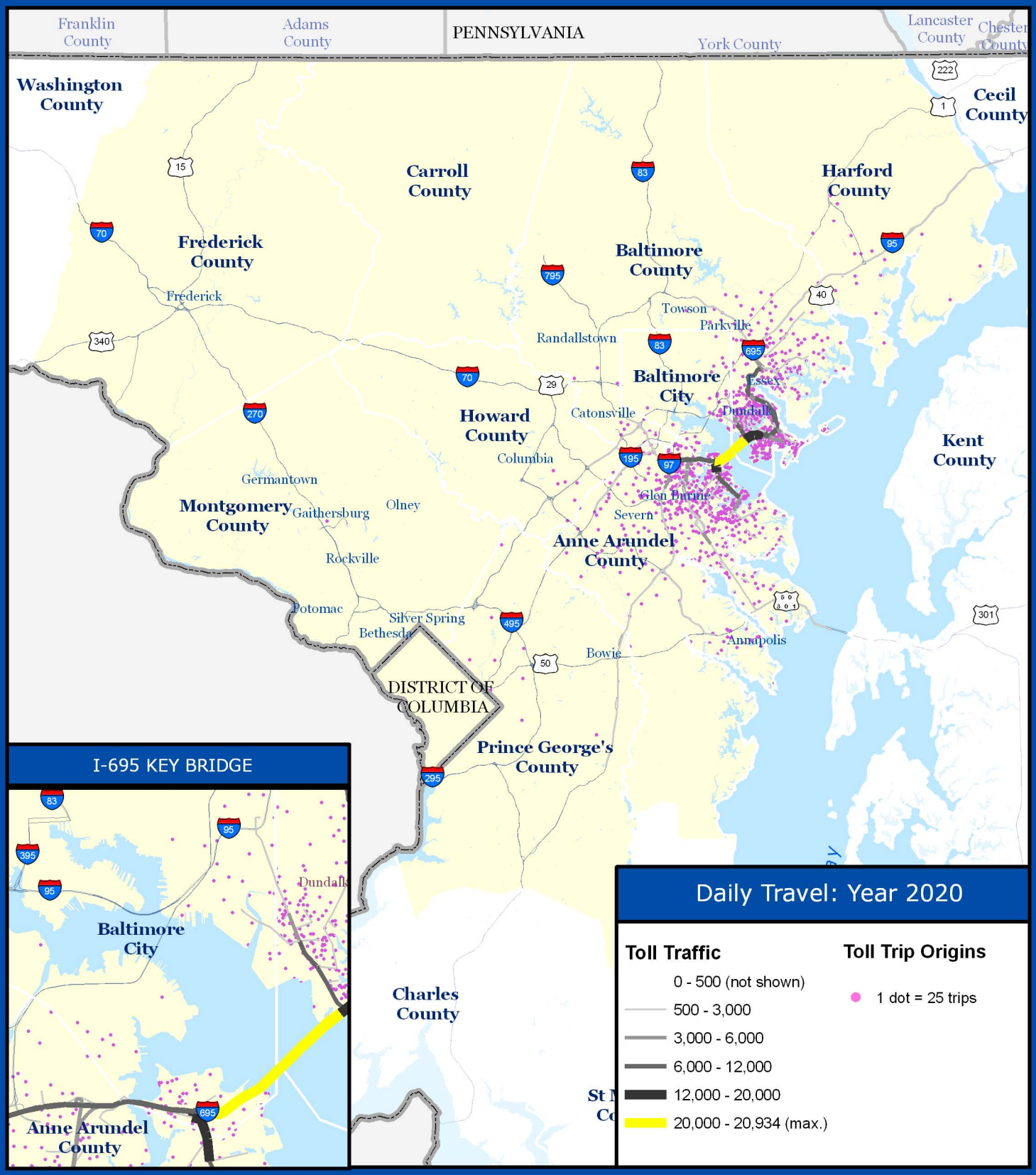

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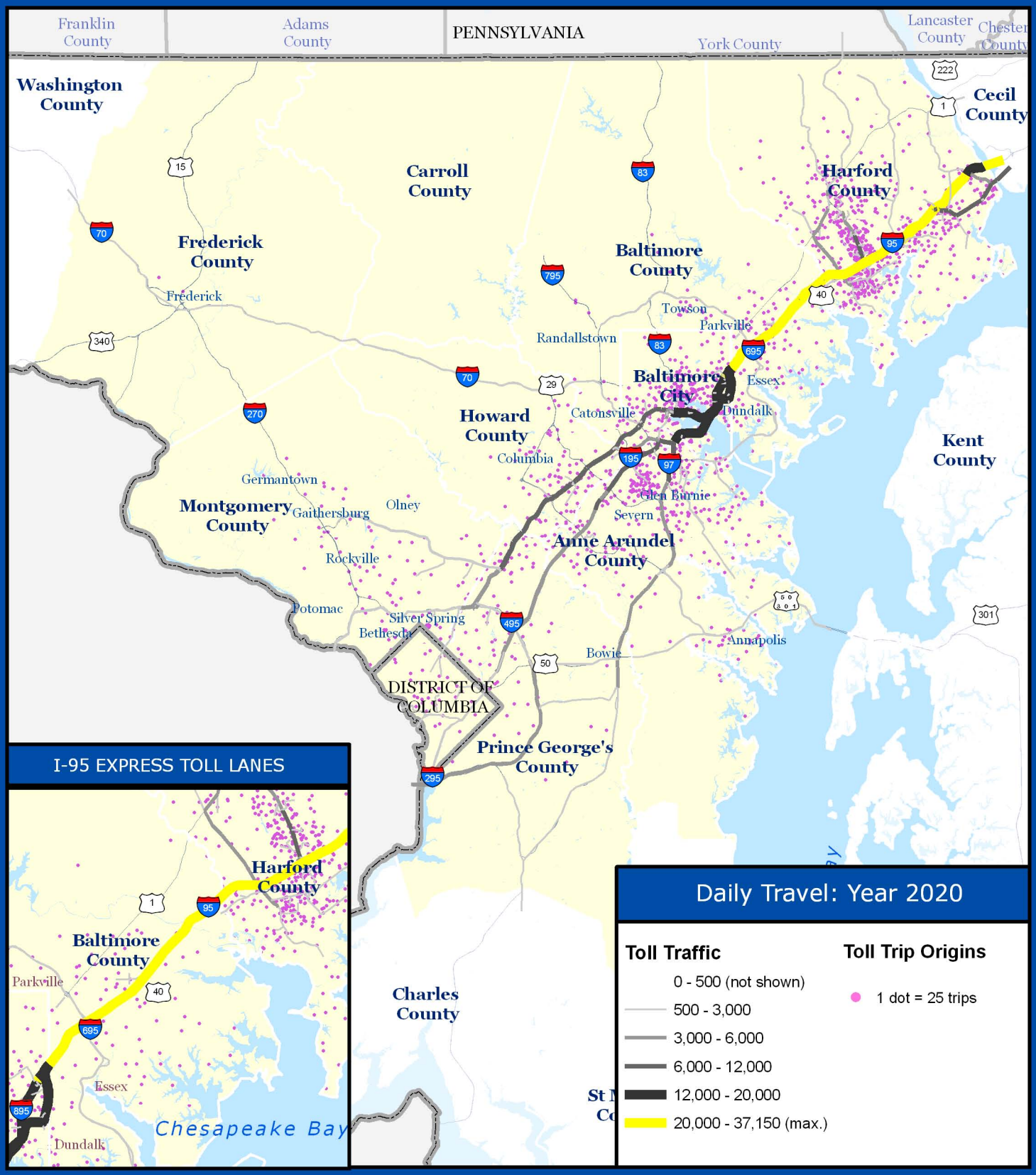
Exhibit 19
Projected Daily Travel Pattern - I-95 Express Toll Lanes



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0 12 Miles
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Traffic estimates on the segment of I-95 between I-895 and I-695 show the usage of non-tolled I-95 and I 95 Express Toll lanes and its relationship with the harbor crossings. Tables 7 and 8 summarize the model estimated number of trips that pass through the harbor crossings but with/without using the above-mentioned express tolled I-95 section. By the year 2020, the total daily traffic is anticipated to increases by 33% to 200,000. However, daily traffic that is expected to utilize the harbor crossings increases by only 21%, from 80,000 to 98,000 in year 2020. A very few traffic utilizing this segment is expected to utilize the Key Bridge. The estimated daily total traffic on I-95 between I-895 & I-695 increases at a slightly higher rate than the total traffic that uses both this segment and the harbor crossings.

Of the total corridor traffic, only 49% (98,000) utilize the harbor crossings in the year 2020 whereas 54% (80,000) of the corridor traffic is estimated to utilize the harbor crossings in the year 2000. The analysis also estimates that 65% of traffic passing through the harbor crossings are likely to utilize express tolled lanes on I-95 segment of the corridor. Similarly, about 61% of traffic utilizing the Fort McHenry Tunnel and about 69% of traffic utilizing the Harbor Tunnel is estimated to utilize the express tolled lanes on I-95 section of the corridor.

Table 7

Traffic on I-95 between I-895 and I-695

Roadway Corridor	Utilize Harbor Crossings		Do not Utilize Harbor Crossings		Total Vehicle	
	2000	2020	2000	2020	2000	2020
Non-tolled I-95	80,000	34,000	69,000	96,000	149,000	130,000
I-95 Express Toll Lanes	NA	64,000	NA	6,000	0	70,000
Total	**80,000**	**98,000**	**69,000**	**102,000**	**149,000**	**200,000**

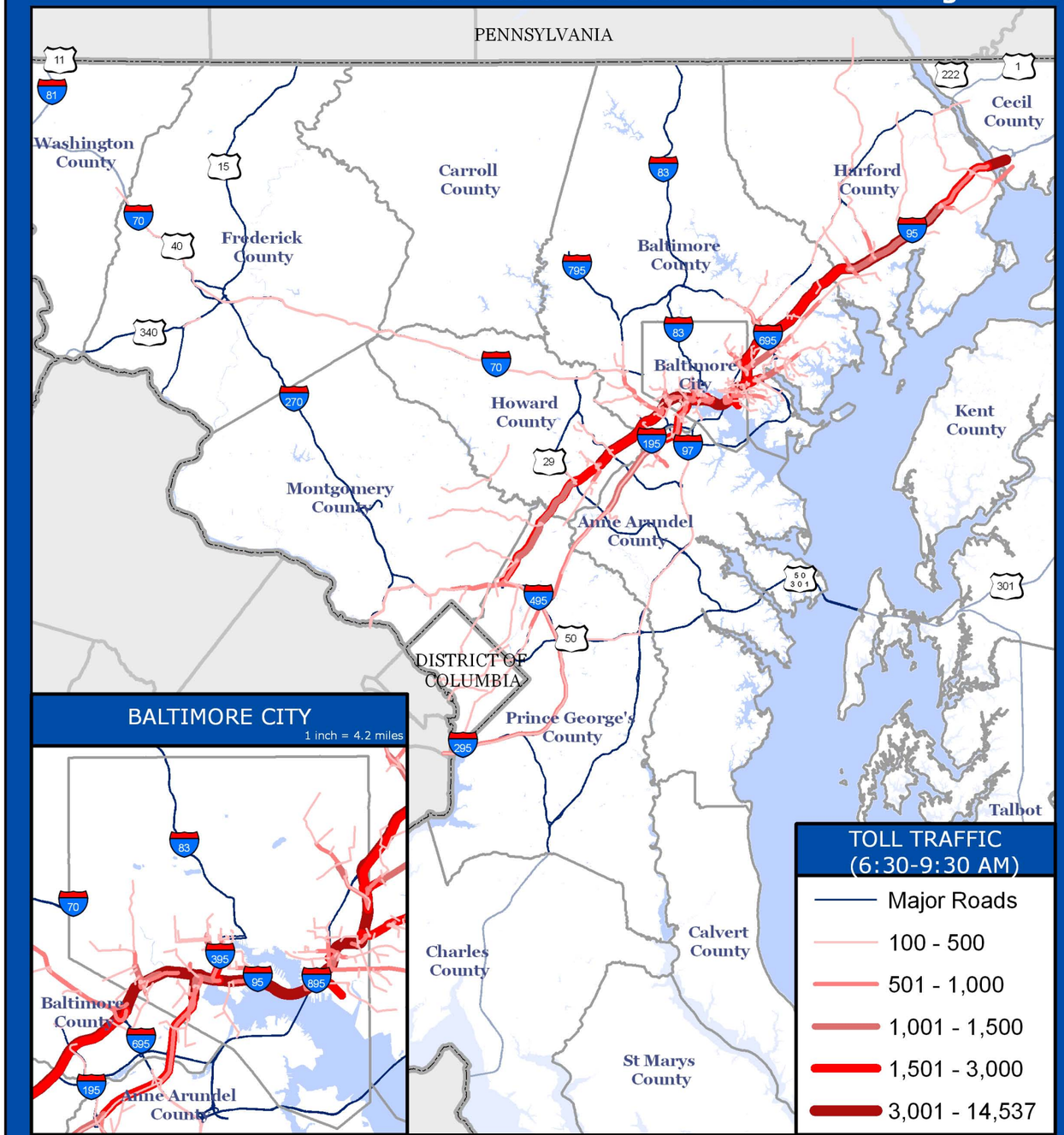
Table 8

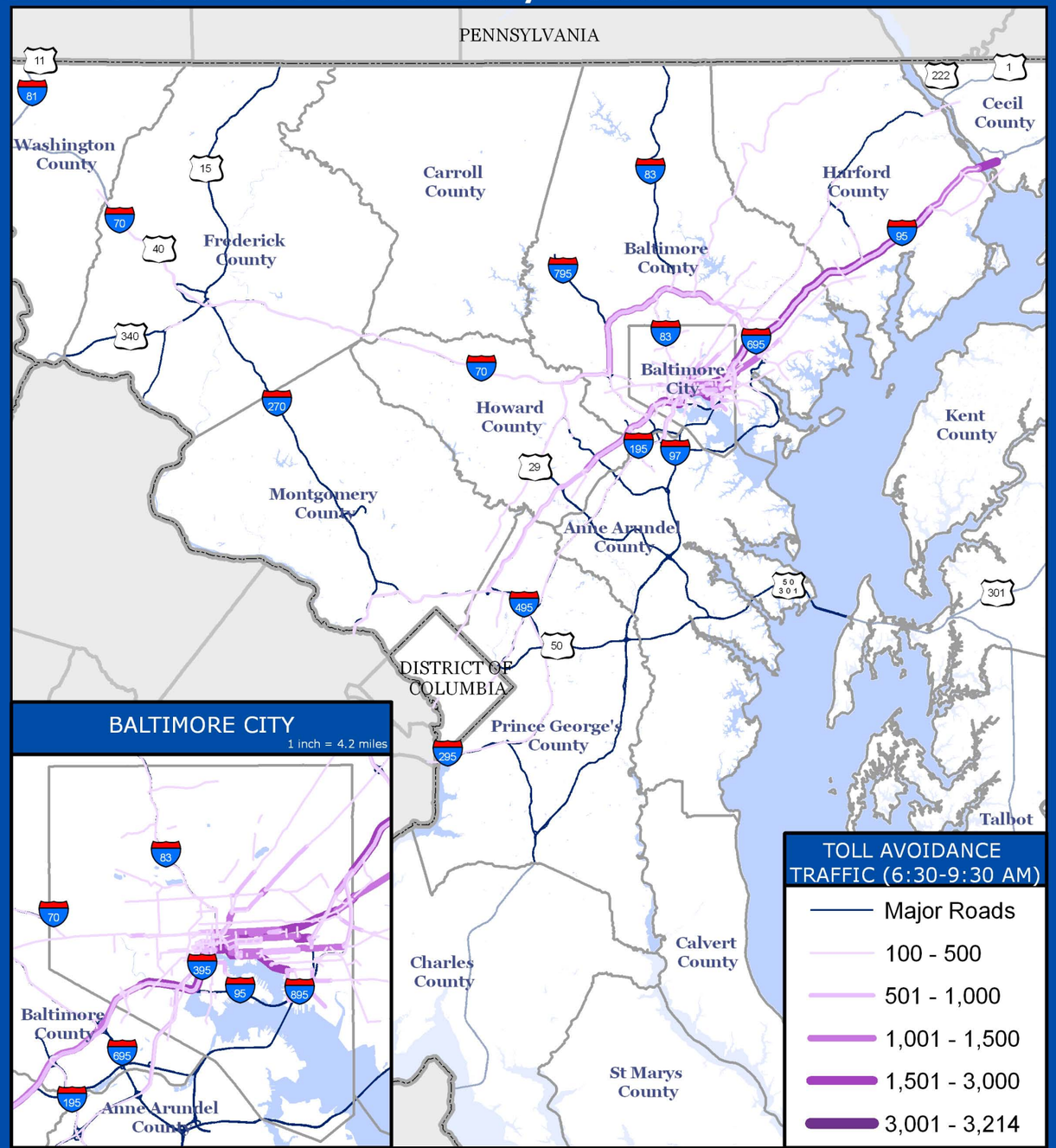
Details of Toll Traffic on I-95 Corridor between I-895 and I-695

Roadway Corridor	Utilize FortMcHenry		Utilize Harbor Tunnel		Utilize Key Tunnel		Utilize Other Toll Facility	
	2000	2020	2000	2020	2000	2020	2000	2020
Non-tolled I-95	33,000	18,000	47,000	16,000	0	0	NA	480
I-95 Express Toll Lanes	NA	29,000	NA	35,000	NA	78	NA	6,000
Total	**33,000**	**47,000**	**47,000**	**51,000**	**0**	**78**	**0**	**6,000**

Exhibit 21 illustrates the model estimated morning peak (6:30-9:30 AM) traffic pattern of traffic that utilizes the Fort McHenry Tunnel and the traffic that avoids the tunnel to travel the same origin-destination. As depicted in the exhibit, I-695 north of I-70 to I-95 and US 40 in Baltimore City stands out as free alternate options as opposed to the Fort McHenry Tunnel.

Exhibit 20:
Year 2000 Estimated Moring Travel Pattern - Fort McHenry Tunnel





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1:760,320

0 12 24 Miles

1 in = 12 miles

V. Summary

From the years 2000 to 2020, regional daily auto and truck trips is estimated to increase by 19% to 14.5 million trips and 779,000 trips, respectively. At the same, time toll system capacity (lane-miles) increases by 180%. Similarly, by the year 2020, the regional toll market share of auto trips is anticipated to increase from 2% to 7% and from 6% to 15% for truck.

In response to the toll system expansion, model estimated toll market and toll choice increase by 293% and 103%, respectively. However, the systemwide diversion to toll road is likely to decreases to 35% in the year 2020 from 68% in the year 2000. Toll choice rates for the Harbor Tunnel are highest in both 2000 and 2020.

Toll origin markets in the area north of the Harbor crossings is estimated to remain unchanged for traffic that utilize the Fort McHenry or the Harbor Tunnels in both analysis years. Model estimated toll trips originating from Baltimore City and Parkville areas are more likely to utilize the Fort McHenry Tunnel than the Harbor Tunnel. Trip origins pattern of the Fort McHenry Tunnel toll users and I-95 Express Toll lanes users are comparable.

Estimated trip origin patterns in the area south of harbor crossings are different for each toll facility. For both analysis years 2000 and 2020, traffic utilizing the Fort McHenry Tunnel mostly originates along the I-95 corridor, Catonsville, Ellicott City and Columbia. In year 2020, Fort McHenry Tunnel's toll market is anticipated to expand along I-70 corridor in Howard and Frederick counties. The Harbor Tunnel shows a higher number of trips originating from the area along and between the MD 295 and I-97 corridor to Fort Meade.

On the either side of the Harbor crossings, I-95 serves as a major feeder roadway to traffic that utilize the Fort McHenry Tunnel and the Harbor Tunnel. In addition to the I-95 facility, in the area south of Harbor crossings, several roadways (I-95, MD 295, I-97 and MD 3) are the major roadways that feed traffic to the Harbor Tunnel. Bowie, Annapolis and Laurel are among the Harbor Tunnel's major markets south of Harbor crossings.