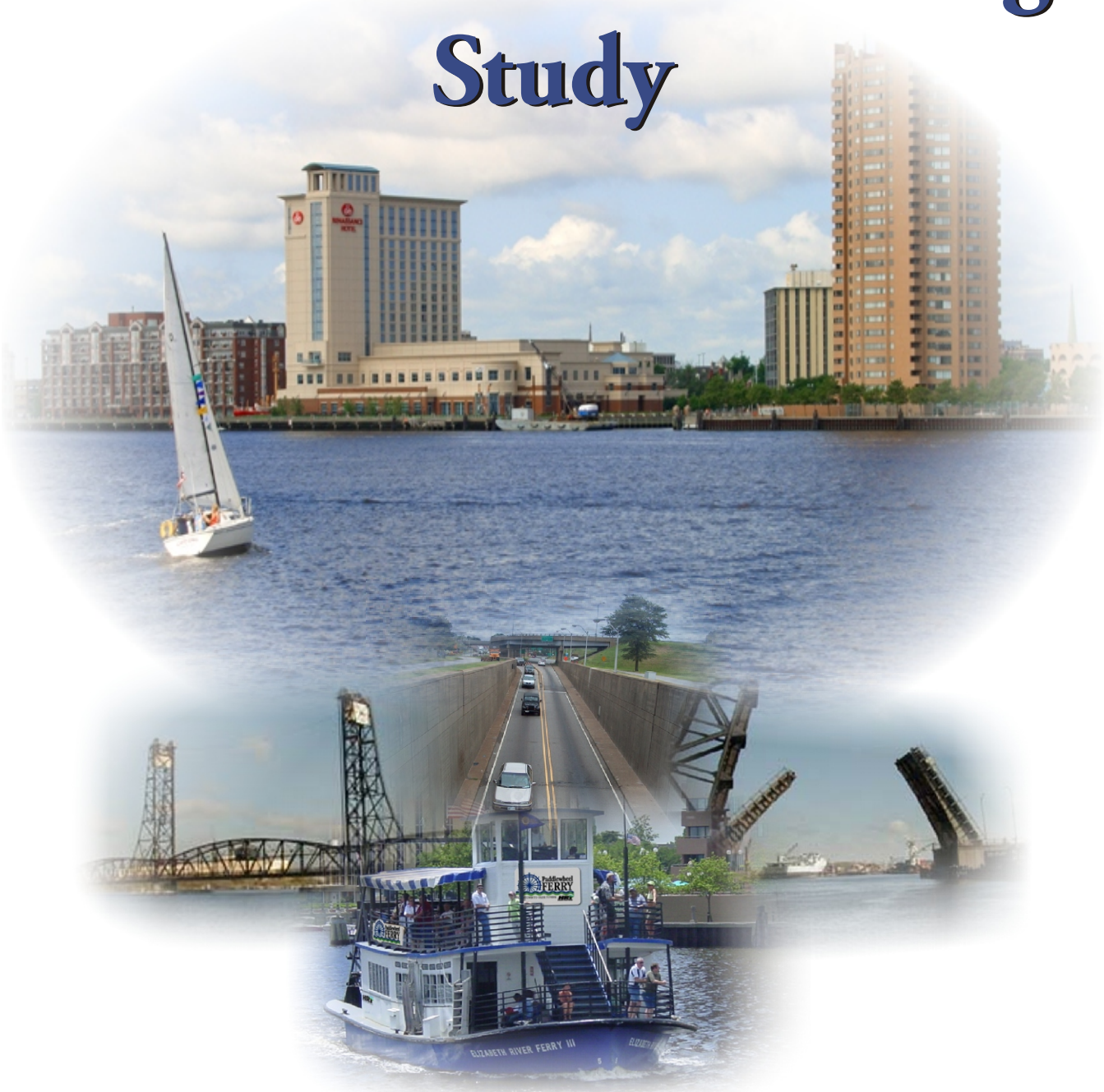
Elizabeth River Crossings Study



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T08-07

June 2008

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ELIZABETH RIVER CROSSINGS STUDY

This report was included in the Work Program for Fiscal Year 2007-2008, which was approved by the Commission and the Metropolitan Planning Organization at their meetings of March 21, 2007.

PREPARED BY
HAMPTON ROADS METROPOLITAN PLANNING ORGANIZATION

JUNE 2008

T08-07

REPORT DOCUMENTATION

TITLE
Elizabeth River Crossings Study

REPORT DATE
June 2008

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ABSTRACT
The City of Portsmouth requested a comprehensive study to identify the present and long-term (2030) demand for crossing the Elizabeth River between the Midtown Tunnel and the High Rise Bridge. An estimate of the latent crossing demand in the study area and the ability of present and proposed facilities to accommodate this demand are reviewed. Two alternative crossings not included in the region's 2030 Long-Range Transportation Plan were analyzed. Public transportation, bicycle, and pedestrian modes for crossing this portion of the Elizabeth River were also reviewed.

ACKNOWLEDGEMENTS
Prepared in cooperation with the U.S. Department of Transportation (USDOT), the Federal Highway Administration (FHWA), and the Virginia Department of Transportation (VDOT). The contents of this report reflect the views of the Hampton Roads MPO. The Commission is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the FHWA, VDOT, or the Commission. This report does not constitute a standard, specification, or regulation. FHWA or VDOT acceptance of this report as evidence of fulfillment of the objectives of this planning study does not constitute endorsement/approval of the need for any recommended improvements nor does it constitute approval of their location and design or a commitment to fund any such improvements. Additional project level environmental impact assessments and/or studies of alternatives may be necessary.

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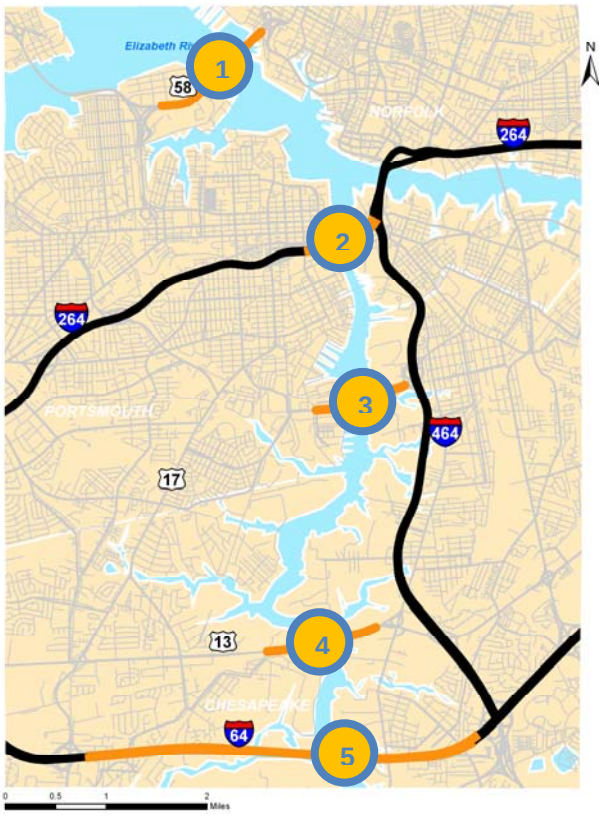
EXECUTIVE SUMMARY

The Elizabeth River corridor between the Midtown Tunnel on the north and the High Rise Bridge (I-64) on the south currently serves over a quarter-million vehicle trip crossings each weekday. It boasts the tunnel with the highest weekday usage of the six tunnels in the region (the Downtown Tunnel), three of the region's five interstates (I-64, I-264, and I-464), one of the region's four toll facilities (Jordan Bridge), and one of the region's two commuter ferries (Elizabeth River Ferry).[1] Unfortunately, four of the five crossings are also currently severely congested and the Jordan Bridge has a weight restriction of only three tons.

Figure I. Elizabeth River Crossings Study Area

1: Midtown Tunnel (U.S. Route 58)
2: Downtown Tunnel (Interstate 264)
3: Jordan Bridge (State Route 337)
4: Gilmerton Bridge (U.S. Route 13)
5: High Rise Bridge (Interstate 64)



Service across this portion of the Elizabeth River began with rowboat crossings in 1636.[2] Ferry service then continued until 1955 and started up again in 1983. Highway crossings began with the construction of the Jordan Bridge in 1928, with new crossings being added every ten to fifteen years through 1987. Since 1987, no additional crossings have been constructed. The region's 2030 Long-Range Transportation Plan

[1] Interstates: I-64, I-264, I-464, I-564, and I-664. Toll facilities: Jordan Bridge, Coleman Bridge, Chesapeake Bay Bridge Tunnel, Chesapeake Expressway. Commuter ferries: Elizabeth River Ferry and Jamestown-Scotland Ferry.
[2] Source: HRT staff and article "Ferries Have Long Run the Elizabeth River," The Virginian Pilot, Oc. 6, 1996.

includes an expansion of the Midtown Tunnel. Though the date of construction of the expansion is uncertain, one can be sure that the expansion will follow a gap greatly exceeding the historical trend of adding crossing capacity every ten to fifteen years.

Socioeconomic projections indicate that the area to the east of the Elizabeth River crossings has an expected growth between 2000 and 2030 of 177,000 in population and 102,000 in employment. The area to the west has an expected growth between 2000 and 2030 of 106,000 in population and 53,000 in employment. This is an indication that the crossings of the Elizabeth River corridor will continue to see increased pressure as population and employment grow on either side of the crossings.

The demand for the crossings measures how many vehicles per day would *like* to use the given facility. This information can be useful for better placing future capacity improvements at locations where people *want* to travel. This differs from the forecast volume in that the forecast is an estimate of the number of vehicles that will use the given facility under actual capacity and toll conditions. There is a total growth in demand (desired, as opposed to actual trips) across this corridor of 79,000 vehicles each day between 2007 and 2030. The demand for individual facilities tracks the traffic volume, with the highest demand being for the Downtown Tunnel and the lowest being for the Jordan Bridge. The largest growth in demand between 2007 and 2030 is expected for the High Rise Bridge with an increase of 29,000 more vehicles, followed by the Downtown Tunnel with an increase of 24,000.

Two alternative locations for capacity expansions were evaluated for the year 2030 as a part of this study. Both alternatives assume the projects in the region's 2030 Long-Range Transportation Plan are in place. See **Maps I, II, and III**. The alternatives evaluated were:

- **Alternative A**: Creation of a partial downtown loop from the Midtown Tunnel to I-464 via the MLK Freeway and a new Jordan Bridge with tolls. [3]
- **Alternative B**: A widening of Military Highway to six through lanes from Battlefield Blvd to Bowers Hill, with tolls on the Gilmerton Bridge.[4] This alternative assumes that the Jordan Bridge is no longer in service.

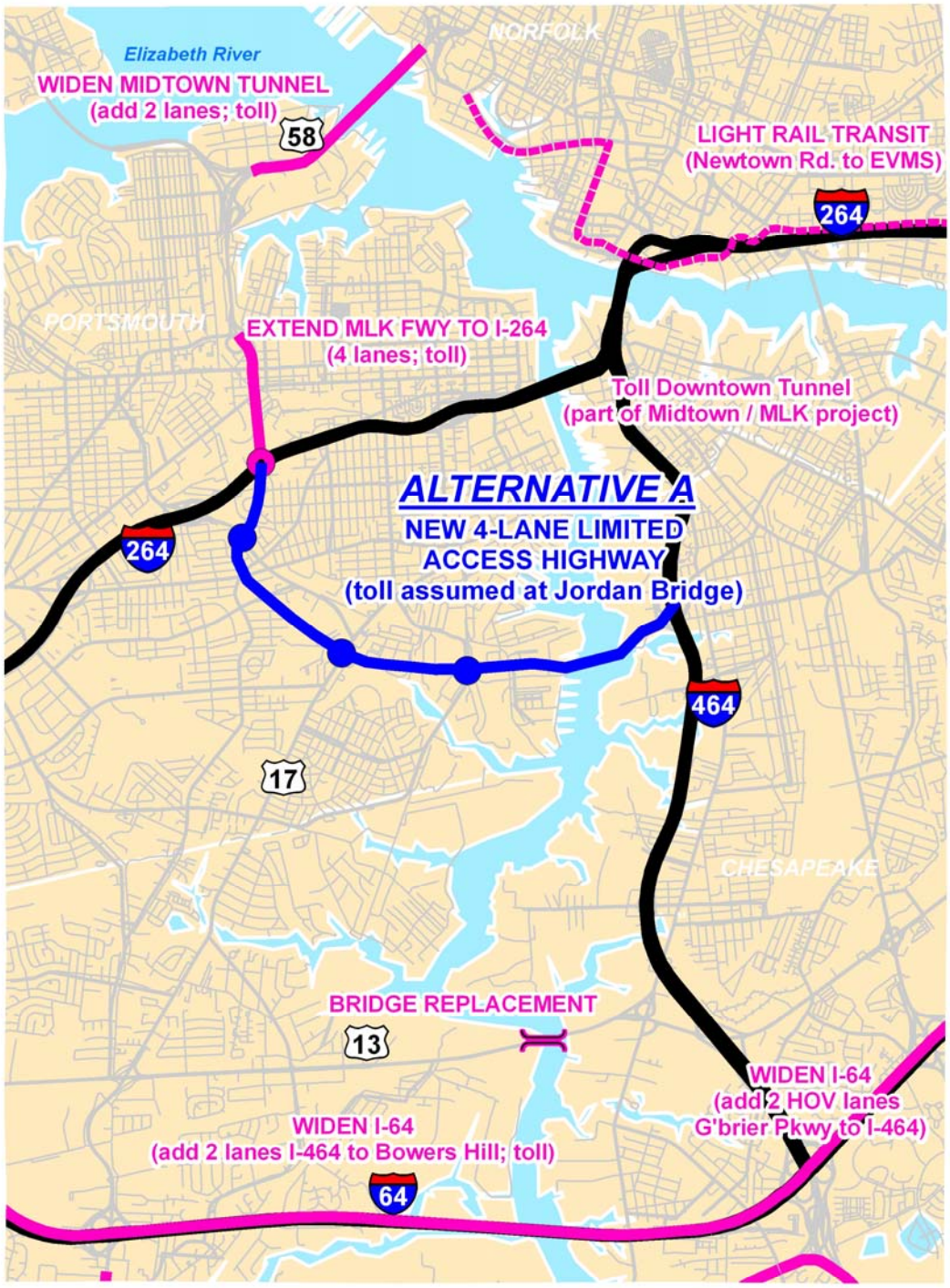
[3] Assumes a fixed toll of $0.60 in year 2007 dollars across the improved Jordan Bridge in the interest of including an extended analysis of one toll rate scenario. Further analysis would be required to determine an acceptable rate given the cost of each project and striking a balance between toll rate and use of the facility.

[4] Assumes a fixed toll of $0.60 in year 2007 dollars across the improved Gilmerton Bridge in the interest of including an extended analysis of one toll rate scenario. Further analysis would be required to determine an acceptable rate given the cost of each project and striking a balance between toll rate and use of the facility.

Map I. 2030 Long-Range Transportation Plan Projects in Study Area

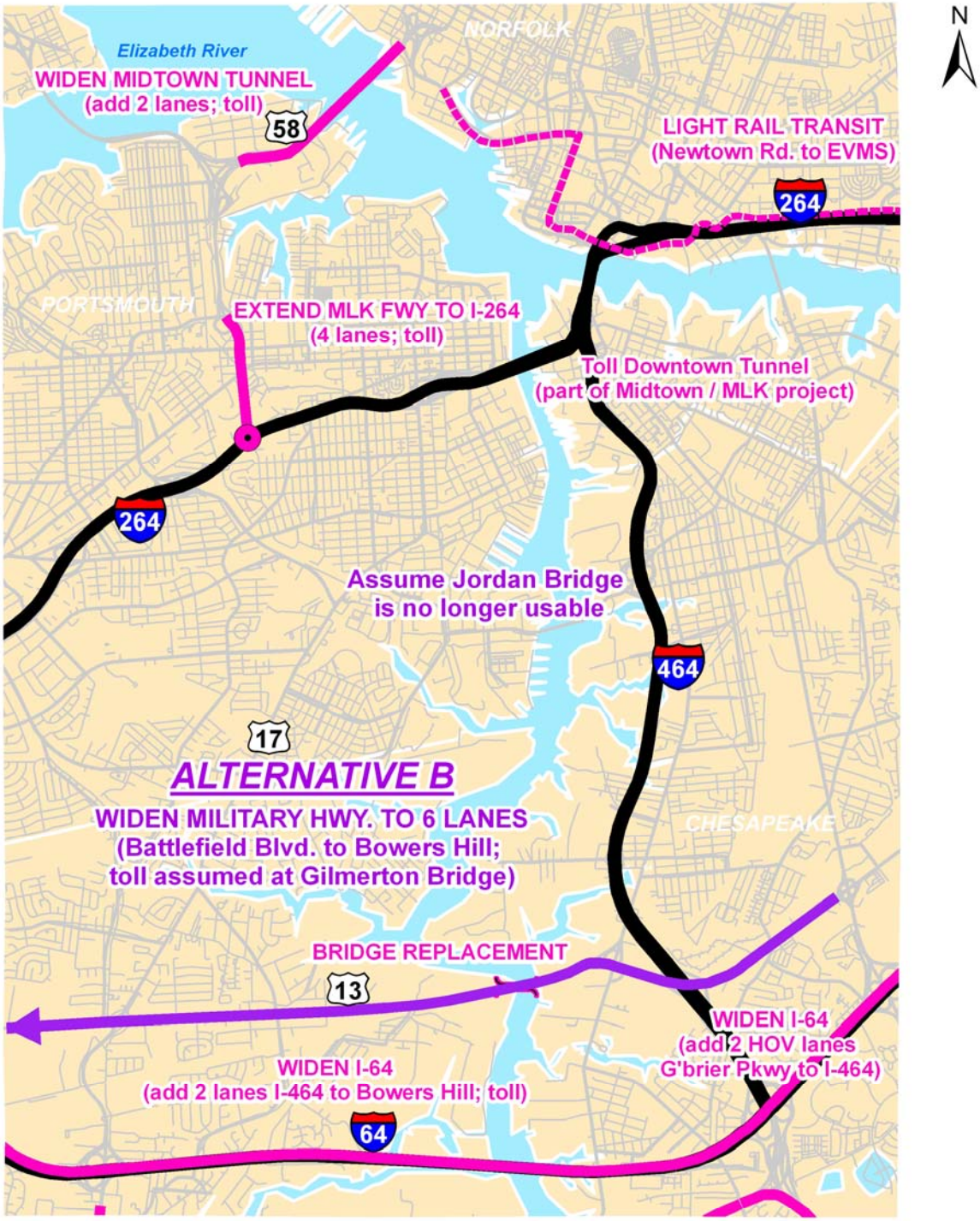
Note: The alignment of any project is not set until the final design is completed.

Map II. Elizabeth River Crossings Study Alternative A: Creation of a New Loop Road from I-264 to I-464



Note: The alignment of any project is not set until the final design is completed.

Map III. Elizabeth River Crossings Study Alternative B:
Widen Military Highway and Assume Jordan Bridge Is No Longer in Service



Note: The alignment of any project is not set until the final design is completed.

Figures II and III on the following pages show a summary of the impact on traffic volumes and volume to capacity ratios of Alternatives A and B. More total vehicle trips are served with Alternative A in comparison to Alternative B (277,000 versus 224,000) and in comparison to the 2030 Long-Range Transportation Plan (277,000 versus 274,000). Alternative A also has a significant impact on the Downtown Tunnel, reducing its volume by 17,000 vehicles per day and reducing its v/c ratio to below 1.00. This is due to the significant quantity of traffic (56,000) attracted to the new four-lane replacement for the Jordan Bridge as part of the new limited-access loop road from I-264 to I-464.

The most significant impact of Alternative B is the better quality of traffic flow on the Gilmerton Bridge, as the quantity of traffic actually declines across the bridge with the assumption of a fixed $0.60 toll (year 2007 dollars). Alternative B has a minor impact on the Downtown Tunnel, reducing its volume by 4,000 vehicles per day but leaving the tunnel over capacity.

Future studies that may further evaluate the previously described two alternatives should include an evaluation of transit service as a complement to the added vehicle capacity. As already noted, public transportation has had a role in the crossing of the Elizabeth River since 1636. Until the summer of 2008 there were four Hampton Roads Transit services for crossing the Elizabeth River in the study area (three bus routes and a ferry). Boardings for these routes were analyzed from FY2003 to FY2007.[5] The combined total boardings for the subject routes grew from 793,000 in FY03 to 1,025,000 in FY07, representing an annual growth rate of 6.6%. In the summer of 2008, an additional two commuter bus routes were added in the study area (routes 962 and 967).

There are currently limited options for crossing the Elizabeth River via bicycle or on foot. Only two of the five crossings in the study area have any accommodations for pedestrians. The Jordan Bridge and Gilmerton Bridge have sidewalks on one side of each bridge (the north side). No toll is collected at the Jordan Bridge from bicyclists or pedestrians. These bridges, however, do not have bicycle facilities leading to the bridges. Transit can also serve to assist bicyclists and pedestrians in their travels. All of HRT's buses, except for the replica trolleys, have bicycle racks. In addition, the ferry between downtown Portsmouth and downtown Norfolk serves the needs of both pedestrians and bicyclists.

[5] Boarding totals are for the entire route, not just persons using HRT service to cross the Elizabeth River.

Figure II. Comparison of 2030 Average Weekday Volumes

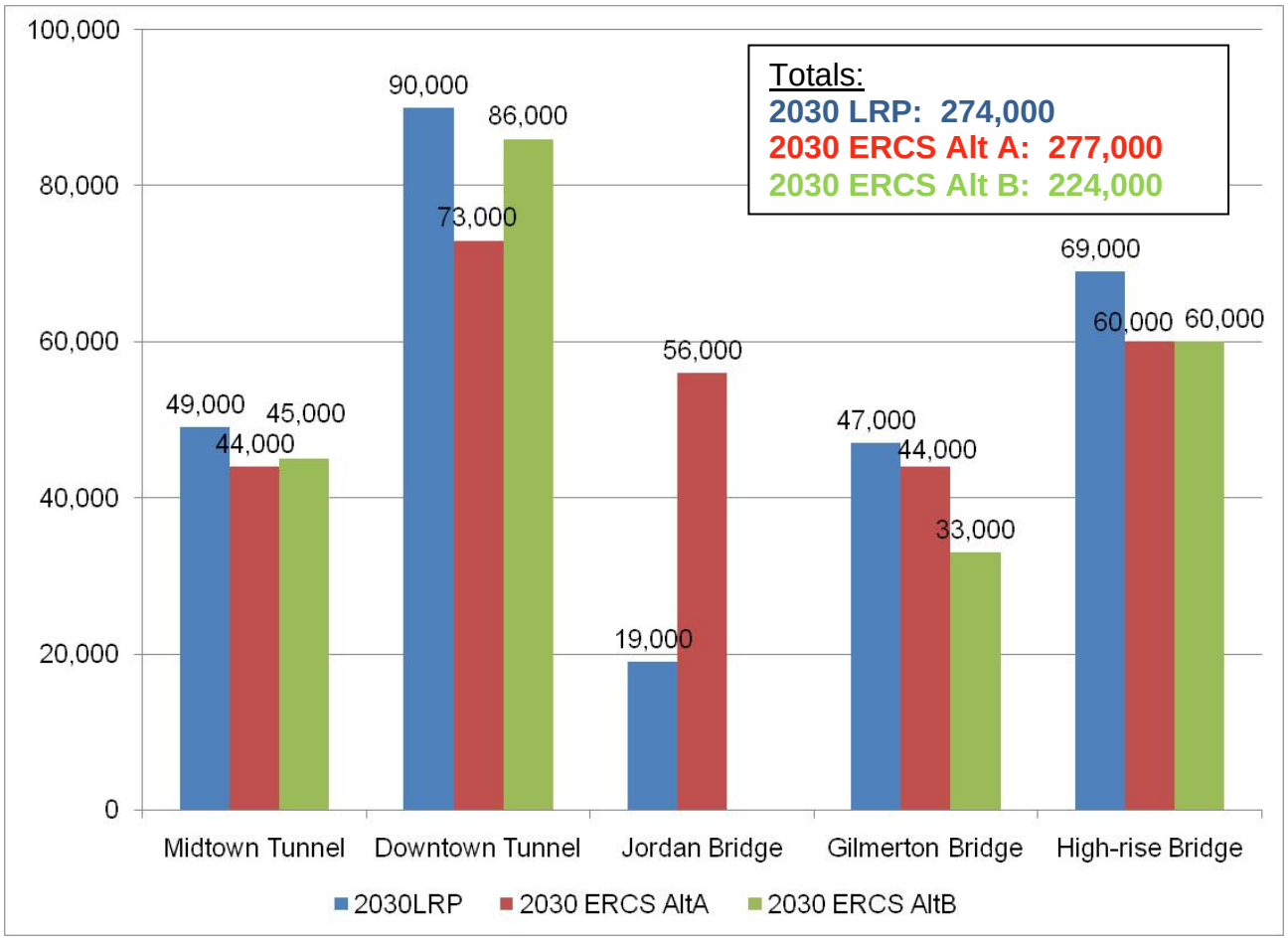
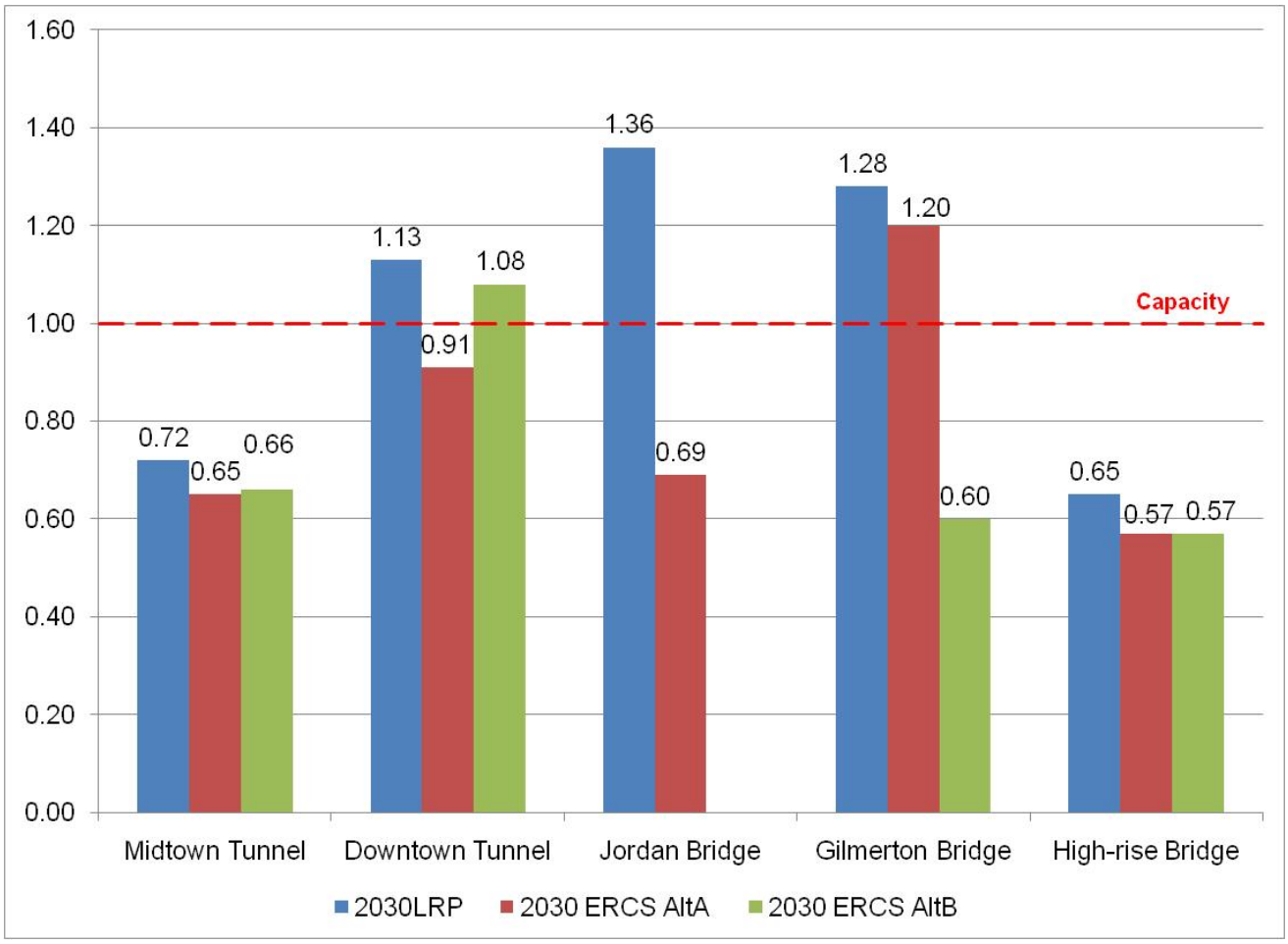


Figure III. Comparison of 2030 Volume to Capacity Ratio



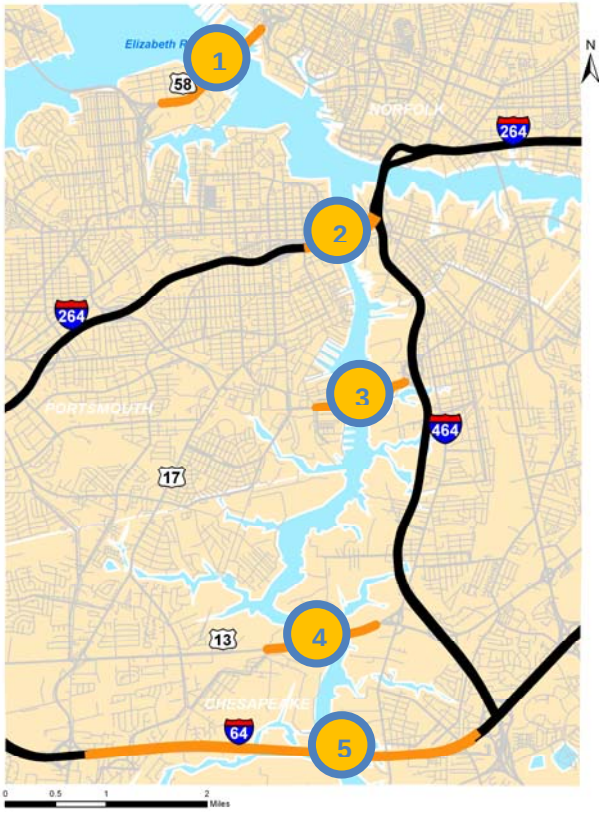
STUDY AREA

This study is focused on the crossings of the Elizabeth River from the Midtown Tunnel on the north to the High Rise Bridge (I-64) on the south. The existing facilities included in this area include, from north to south (numbers refer to **Map 1** below):

- 1: Midtown Tunnel (U.S. Route 58)
- 2: Downtown Tunnel (Interstate 264)
- 3: Jordan Bridge (State Route 337)
- 4: Gilmerton Bridge (U.S. Route 13)
- 5: High Rise Bridge (Interstate 64)

The corridor boasts the tunnel (the Downtown Tunnel) with the highest weekday usage of the six tunnels in the region, three of the region's five interstates (I-64, I-264, and I-464), one of the region's four toll facilities (Jordan Bridge), and one of the region's two commuter ferries (Elizabeth River Ferry).[6]

Map 1. Elizabeth River Crossings Study Area



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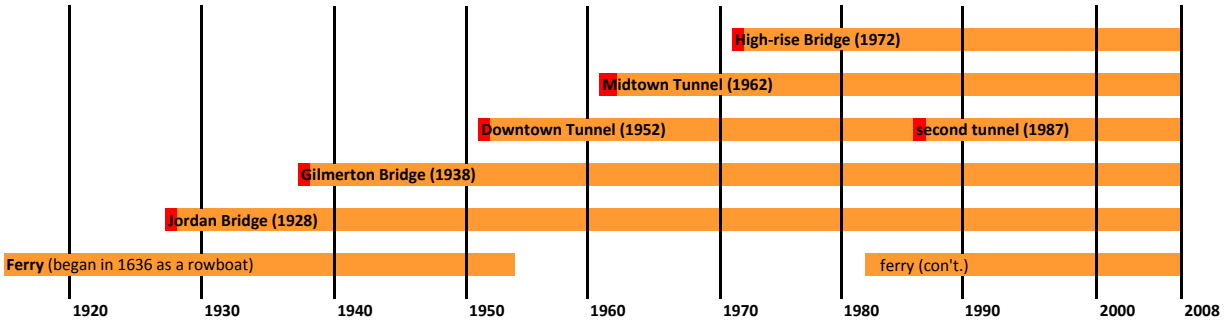
[6] Interstates: I-64, I-264, I-464, I-564, and I-664. Toll facilities: Jordan Bridge, Coleman Bridge, Chesapeake Bay Bridge Tunnel, Chesapeake Expressway. Commuter ferries: Elizabeth River Ferry and Jamestown-Scotland Ferry.

HISTORY

A timeline of the construction of crossings in the study area is presented in **Figure 1**. It began with rowboat crossings in 1636.[7] Ferry service then continued until 1955 and started up again in 1983. Highway crossings began with the construction of the Jordan Bridge in 1928, with new crossings being added every ten to fifteen years through 1987. Since 1987, no additional crossings have been constructed. The region's 2030 Long-Range Transportation Plan includes an expansion of the Midtown Tunnel. Though the date of construction of the expansion is uncertain, one can be sure that the expansion will follow a gap greatly exceeding the historical trend of adding crossing capacity every ten to fifteen years.

Figure 1. Timeline of Elizabeth River Study Area Crossings



BRIDGE AND TUNNEL SPECIFICATIONS

A summary of the characteristics of each bridge and tunnel in the study area is included in **Figure 2** on the following page. Over 260,000 vehicles crossed the river on an average weekday in 2007. Most of these vehicles experienced significant congestion at the peak hour, with four of the five crossings having severe congestion.[8] **Map 2** shows the level-of-service based on the most recent counts available.

The Jordan Bridge

The Jordan Bridge is a unique facility among the highway crossings in the study area. It is the oldest movable span bridge in Virginia, having been built in 1928. With this age comes a significant weight limit of three tons and a sufficiency rating of 4 (on a scale of 1 to 100). Three tons is not a very high threshold; many large SUV's approach or can exceed this weight.[9] In addition to its weight restrictions, the Jordan Bridge is unique as it is the only one of the four toll facilities in the region that does not accept EZ-Pass. Instead, tolls are collected manually at a toll booth, increasing the time it takes to cross the bridge.[10]

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[7] Source: Source: HRT staff and article "Ferries Have Long Run the Elizabeth River," The Virginian Pilot, Oc. 6, 1996.

[8] "Severe congestion" is considered level-of-service E and F in this study.

[9] As an example, a 2008 Chevrolet Tahoe 4x4 has a curb weight of 5,527 pounds. Curb weight is the weight of the vehicle without occupants or payload.

[10] Observations indicate vehicles are processed at a rate of every 5 to 6 seconds during the peak period.

Figure 2. Summary of Bridge and Tunnel Specifications

	MIDTOWN TUNNEL
YEAR BUILT	1962
# EXISTING LANES	2
BRIDGE TYPE	na
WT LIMIT	no limit
SUFFICIENCY RATING	na
PED FACILITIES	N
TOLL	N
EXISTING WEEKDAY VOL.	41,000
EXISTING LOS	F

	DOWNTOWN TUNNEL
YEAR BUILT	1952
# EXISTING LANES	4
BRIDGE TYPE	na
WT LIMIT	no limit
SUFFICIENCY RATING	na
PED FACILITIES	N
TOLL	N
EXISTING WEEKDAY VOL.	101,000
EXISTING LOS	F

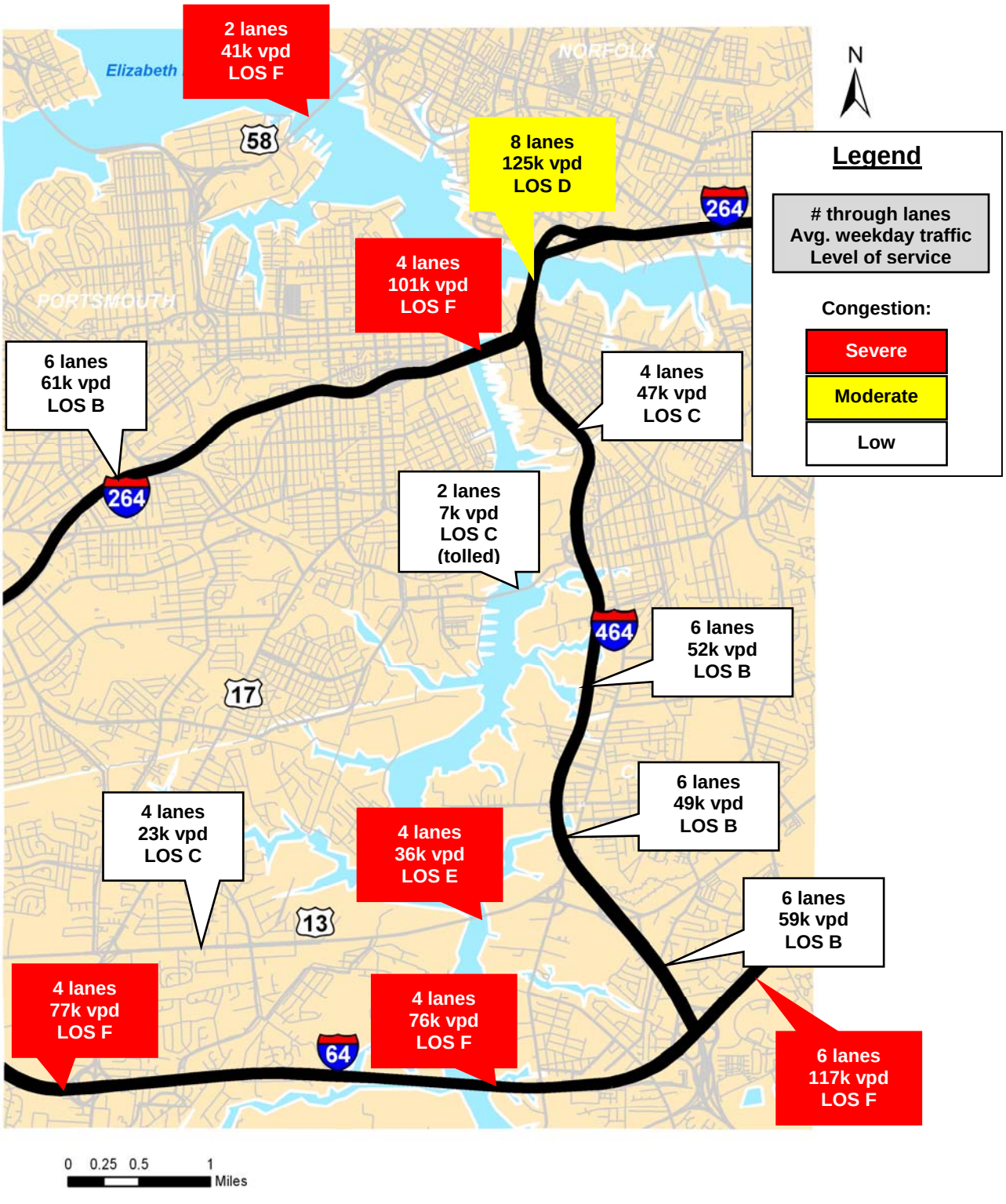
	JORDAN BRIDGE
YEAR BUILT	1928 (oldest movable span bridge in state)
# EXISTING LANES	2
BRIDGE TYPE	Movable bascule
WT LIMIT	3 tons
SUFFICIENCY RATING	4
PED FACILITIES	Y
TOLL	$0.75 for two-axle veh
EXISTING WEEKDAY VOL.	7,200
EXISTING LOS	C

	GILMERTON BRIDGE
YEAR BUILT	1938
# EXISTING LANES	4
BRIDGE TYPE	Movable bascule
WT LIMIT	14 tons (SU trucks) ; 20 tons (ST trucks)
SUFFICIENCY RATING	3
PED FACILITIES	Y
TOLL	N
EXISTING WEEKDAY VOL.	36,000
EXISTING LOS	E

	HIGH-RISE BRIDGE
YEAR BUILT	1972
# EXISTING LANES	4
BRIDGE TYPE	Movable bascule
WT LIMIT	no limit
SUFFICIENCY RATING	61
PED FACILITIES	N
TOLL	N
EXISTING WEEKDAY VOL.	76,000
EXISTING LOS	F

Sources: "Hampton Roads Regional Bridge Study", HRPDC, August 2008; plus additional staff calculations.

Map 2. Recent Traffic Volumes and Congestion



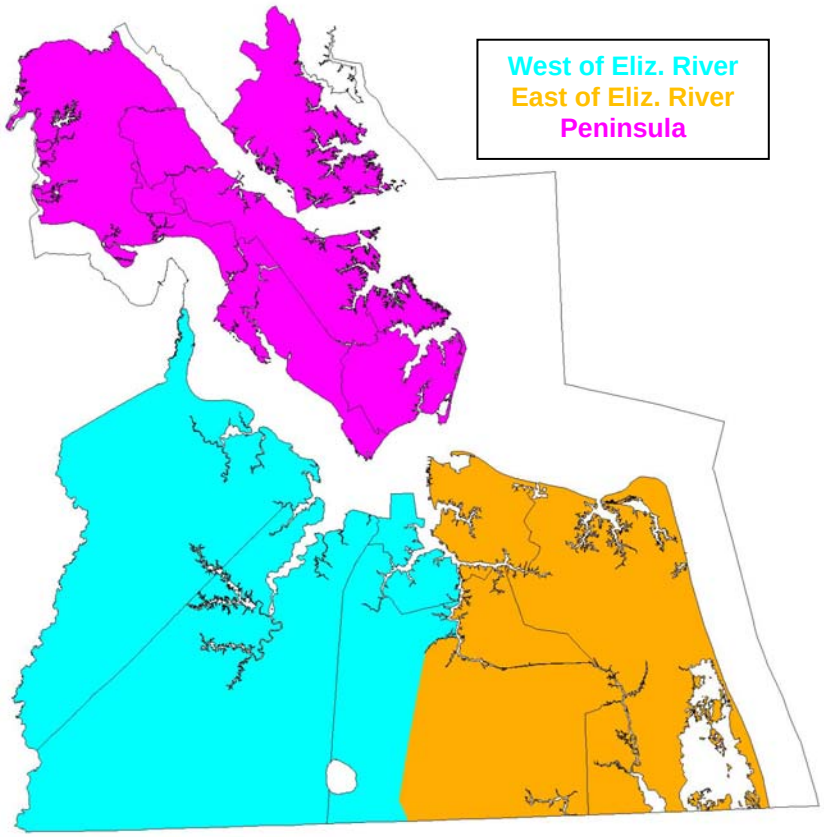
vpd is vehicles per day

base_scale_arrow4.jpg

SOCIOECONOMIC DATA

To gain a broad understanding of the users of the crossings, the population and employment for the areas to the east and west of the Elizabeth River crossings were reviewed. **Map 3** indicates the division of the region for this analysis of socioeconomic growth.

Map 3. Areas of Region



Areas.jpg

Table 1 below shows the growth in the population and employment for the region between 2000 and 2030. The area to the east of the Elizabeth River crossings has the largest quantity of growth with an increase of 177,000 in population and 102,000 in employment expected between 2000 and 2030. However, the area to the west has the largest percentage growth – about double that of the area to the east of the Elizabeth River. This is an indication that the crossings of the Elizabeth River corridor will continue to see increased pressure as population and employment continue to grow on both sides of the crossings.

Table 1. Population and Employment By Area of Region

	Population						Employment					
Area	2000	%	2030	%	Chg.	% Chg.	2000	%	2030	%	Chg.	% Chg.
EAST	805,545	53%	982,476	50%	176,931	40%	22%	551,155	58%	653,202	54%	102,047	42%	19%
WEST	247,269	16%	353,024	18%	105,755	24%	43%	117,761	12%	171,098	14%	53,337	22%	45%
PENINSULA	478,059	31%	637,750	32%	159,691	36%	33%	287,093	30%	374,475	31%	87,382	36%	30%
TOTAL	1,530,873	100%	1,973,250	100%	442,377	100%	29%	956,009	100%	1,198,775	100%	242,766	100%	25%

DEMAND FOR THE CROSSINGS

The demand for the crossings measures how many vehicles per day would *like* to use the given facility. This information can be useful for better placing future capacity improvements at locations where people *want* to travel. This differs from the forecast volume in that the forecast is an estimate of the number of vehicles that will use the given facility under actual capacity and toll conditions. Demand was estimated by running the regional travel model with unlimited capacity and no tolls across the Elizabeth River crossings. The development of the demand analysis is further discussed in **Appendix A**.

Table 2. Estimated Demand for the Elizabeth River Crossings

	2007 Count		2007 Demand	Diff	% Diff	2030 LRP Vol		2030 Demand	Diff	% Diff	Demand growth
Midtown Tunnel	41,000		45,000	4,000	10%	49,000	*	54,000	5,000	10%	**9,000**
Downtown Tunnel	101,000		100,000	-1,000	-1%	90,000	*	124,000	34,000	38%	**24,000**
Jordan Bridge	7,200	*	18,000	10,800	150%	19,000	*	31,000	12,000	63%	**13,000**
Gilmerton Bridge	36,000		37,000	1,000	3%	47,000		41,000	-6,000	-13%	**4,000**
High-rise bridge	76,000		68,000	-8,000	-11%	69,000	*	97,000	28,000	41%	**29,000**
	261,200		**268,000**	**6,800**	**3%**	**274,000**		**347,000**	**73,000**	**27%**	**79,000**

* indicates presence of a toll.

As shown in **Table 2**, there is a total growth in demand across this corridor of 79,000 vehicles each day between 2007 and 2030. The demand for individual facilities does track the traffic volume, with the highest demand being for the Downtown Tunnel and the lowest being for the Jordan Bridge. The largest growth in demand between 2007

and 2030 would be expected for the High Rise Bridge with an increase of 29,000 more vehicles, followed by the Downtown Tunnel with an increase of 24,000.

Although the Jordan Bridge has the lowest demand of the five crossings, the percentage difference between the volume being served and the quantity that would like to use this route (in the absence of toll and capacity restrictions) is significant at 150% in 2007 and 63% in 2030.

EVALUATION OF ALTERNATIVE CROSSINGS

Two alternative locations for capacity expansions were evaluated as a part of this study. They were:

- Creation of a partial downtown loop from the Midtown Tunnel to I-464 via the MLK Freeway and a new Jordan Bridge with tolls. (see **Map 6**)
- A widening of Military Highway (including the Gilmerton Bridge) to six through lanes from Battlefield Blvd to Bowers Hill with tolls on the Gilmerton Bridge. This alternative assumes that the Jordan Bridge is no longer in service. (see **Map 8**)

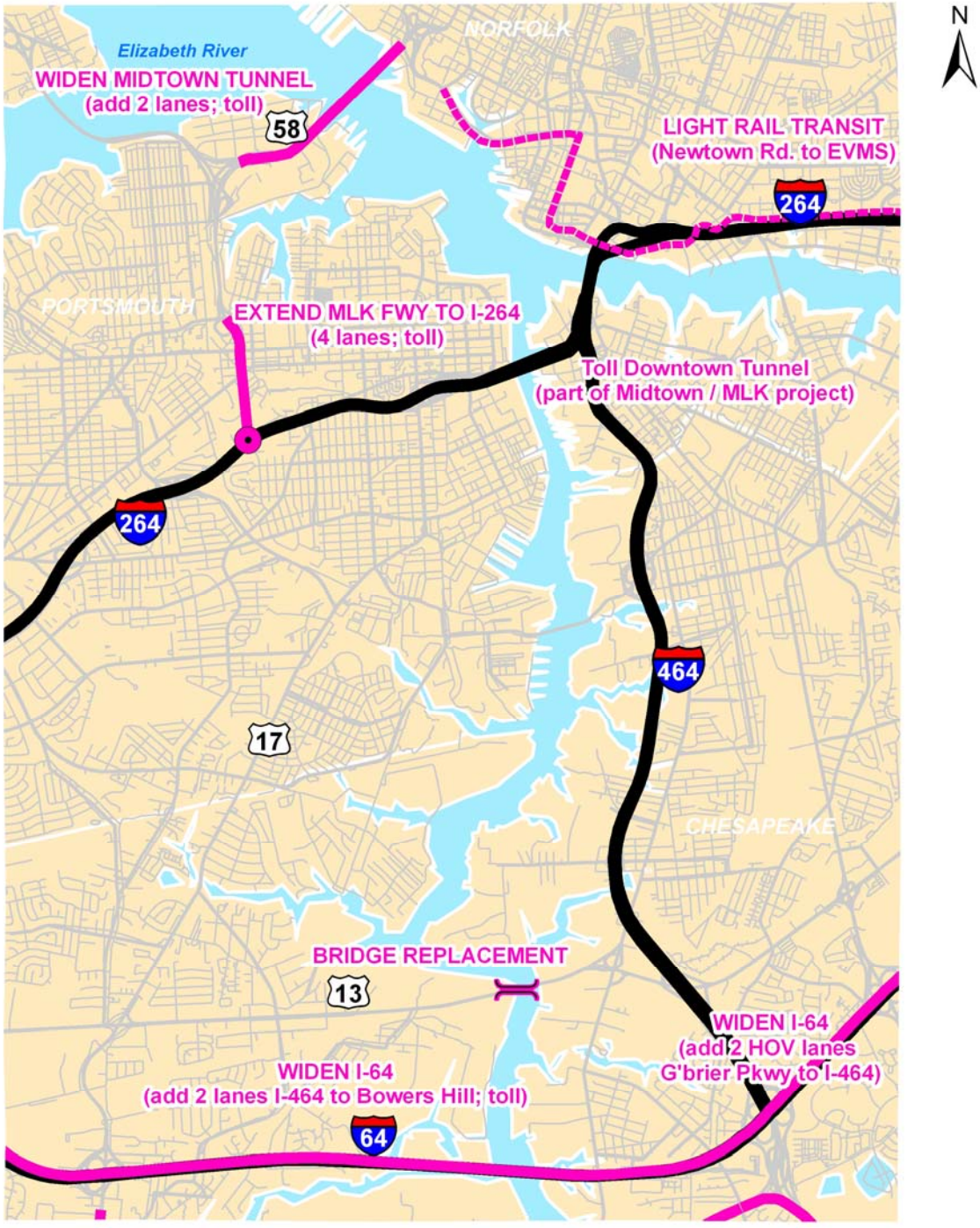
The evaluation of these alternatives was made under the assumption that the 2030 landuse and the projects contained in the region's 2030 Long-Range Transportation Plan (LRP) were in place.[11] **Map 4** shows those projects contained in the 2030 LRP that are located in the study area. It should also be noted that tolls are assumed to be used extensively for the funding of projects in the 2030 LRP. The toll rates are shown in **Table 3**.

While these alternatives are highway expansions, it should be noted that in this document can be found an analysis of existing transit routes (page 25), light-rail transit (page 27), and bicycle and pedestrian accommodations (page 28). Future studies that may further evaluate these two alternatives should include an evaluation of transit service as a complement to the added vehicle capacity.

Map 5 shows the traffic volumes and congestion expected in 2030, with the projects in the 2030 LRP in place. The Midtown Tunnel and High Rise Bridge are the only two facilities of the crossings without a level-of-service of F. This is due to a combination of the additional lanes added to these two locations and the presence of tolls, which will deter some drivers from using these routes.

[11] "Hampton Roads 2030 Long-Range Transportation Plan," HRPDC, December 2007.

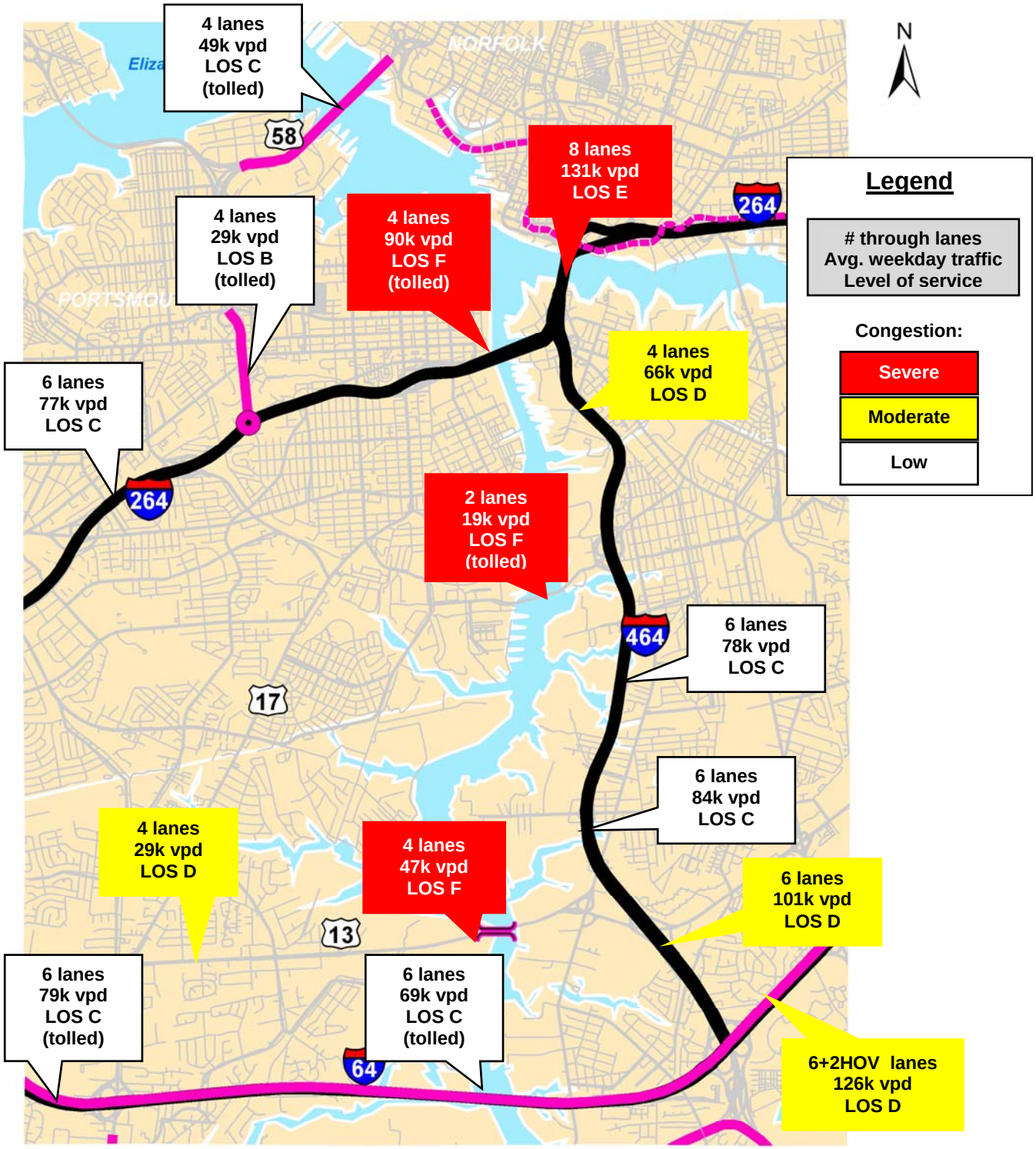
Map 4. 2030 Long-Range Transportation Plan Projects in Study Area



Note: The alignment of any project is not set until the final design is completed.

2030lrptext2.jpg

Map 5. 2030LRP Traffic Volumes and Congestion



vpd is vehicles per day

Note: The alignment of any project is not set until the final design is completed.

2030lrp2.jpg

Table 3: Toll Details of MPO Package of Toll Projects[12]

Project Funding

Tolls are projected to cover about 30% of total project costs.
The toll rates are:

Toll Rates for 2030 Plan Package, Approved by MPO June '05

Off-Peak Tolls[6] Year 2004 $	Project [8]		Toll/Trip on Existing Bridges/Tunnels [7]			
Projects - Length	Toll Rate per Mile	Typical Trip Length Toll	JRB[2]	MMBT[3]	HRBT[4]	DTT[5]
Third Crossing[10] - 30 miles	$0.06	$1.20 [1]	$0.80	$0.80	$0.80	-
Midtown Tunnel - 1.0 mile	$0.61	$0.61	-	-	-	$0.65
MLK Extension - 0.6 mile	$0.20	$0.12	-	-	-	-
SE Parkway - 18 miles	$0.07	$0.49	-	-	-	-
Dominion Blvd.[11] - 3 miles	$0.07	$0.21	-	-	-	-
Oak Grove Connector - 2 miles	$0.07	$0.14	-	-	-	-
US 460[12] - 56 miles	$0.02	$1.00 [9]	-	-	-	-
I-64 Peninsula - 12 miles	$0.18	$1.00	-	-	-	-
I-64 Southside - 9 miles	$0.15	$1.00	-	-	-	-

Notes

[1] Trip from central Southside to Peninsula (Bowers Hill to Hampton Coliseum); typical trip using one or more of the 5 tolled segments of the Third Crossing would be considerably shorter.
[2] James River Bridge
[3] Monitor Merrimac Bridge Tunnel
[4] Hampton Roads Bridge Tunnel
[5] Downtown Tunnel
[6] Peak Periods: 3 hours during morning rush and 3 hours during afternoon rush; peak tolls approx. 50% higher than off-peak.
[7] Tolls on existing facilities will be instituted during engineering phase of project; after project opens to traffic, tolls on parallel facilities will be continued.
[8] Tolls on project will be instituted at project completion.
[9] Trip from Hampton Roads to I-295 and beyond; typical trip on 460 would be considerably shorter.
[10] Segments 1 thru 5 are tolled; segment 6 (I-564) is not tolled.
[11] Segment north of Cedar Rd. is tolled; segment south of Cedar Rd. is not tolled.
[12] Segment from Suffolk Bypass to I-295 is tolled; segment from Bowers Hill to Suffolk Bypass is not tolled.

toll insert-2.jpg

Note: Only Phase I of the Third Crossing is in the 2030 LRP.

Alternative A: Creation of a New Loop Road

This alternative would create a partial loop road from the Midtown Tunnel to I-464 via the Martin Luther King Freeway and the Jordan Bridge. A portion of this alternative is already planned to be constructed, with the expansion of the Midtown Tunnel and the extension of the Martin Luther King Freeway to I-264 included in the region's 2030 LRP. The additional component is:

- A new four-lane, limited access highway from I-264 at the extended Martin Luther King Freeway to the I-464/Poindexter St. interchange.

Map 6 shows the approximate location of the alternative.

[12] To convert year 2004 dollars to year 2007 dollars, multiply by 1.097. Calculated using Consumer Price Index values of 188.9 for 2004 and 207.3 for 2007.

Map 6. Elizabeth River Crossings Study Alternative A: Creation of a New Loop Road from I-264 to I-464

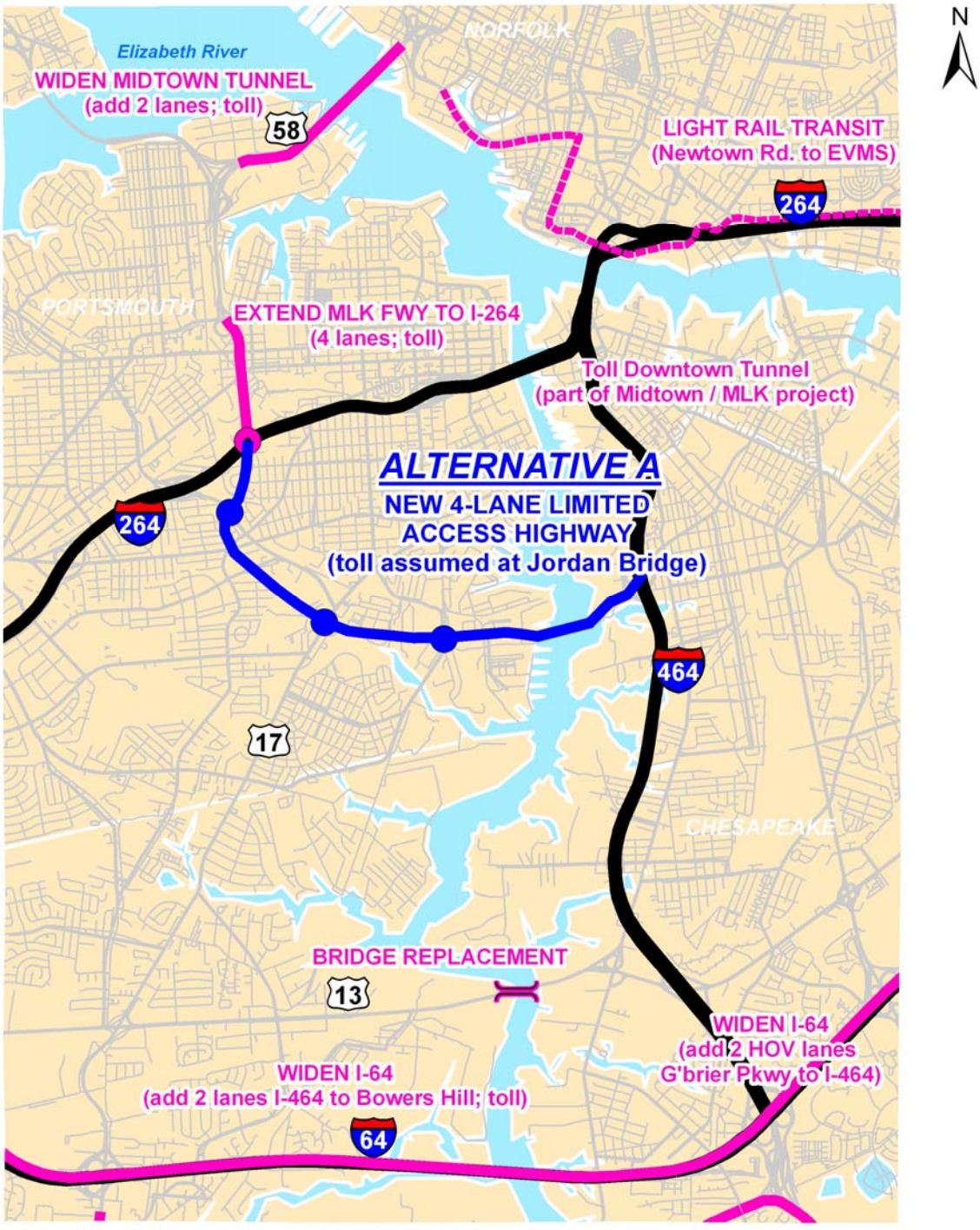


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Table 4 and **Map 7** below shows the results of the analysis. An analysis of model sensitivity to toll rates across the widened Jordan Bridge was conducted and is discussed later in this report. However, in the interest of including an extended analysis of one toll rate scenario, a moderate toll rate of $0.60 (in year 2007 dollars) across the Jordan Bridge will be analyzed in greater detail.

The results of Alternative A show that travel conditions across all of the study area crossings improves. The greatest improvement is in the center of the corridor, at the Downtown Tunnel and Jordan Bridge. The quantity of traffic across the Downtown Tunnel decreases by 17,000 vehicles per day, resulting in an improved level-of-service from F to D. The improved Jordan Bridge serves both a greater quantity of vehicles (an increase of 37,000) and at a better level-of-service. However, an increase in volume of up to 10,000 and a slight decrease in level-of-service does occur for those sections of I-464 to the south of the improved Jordan Bridge.

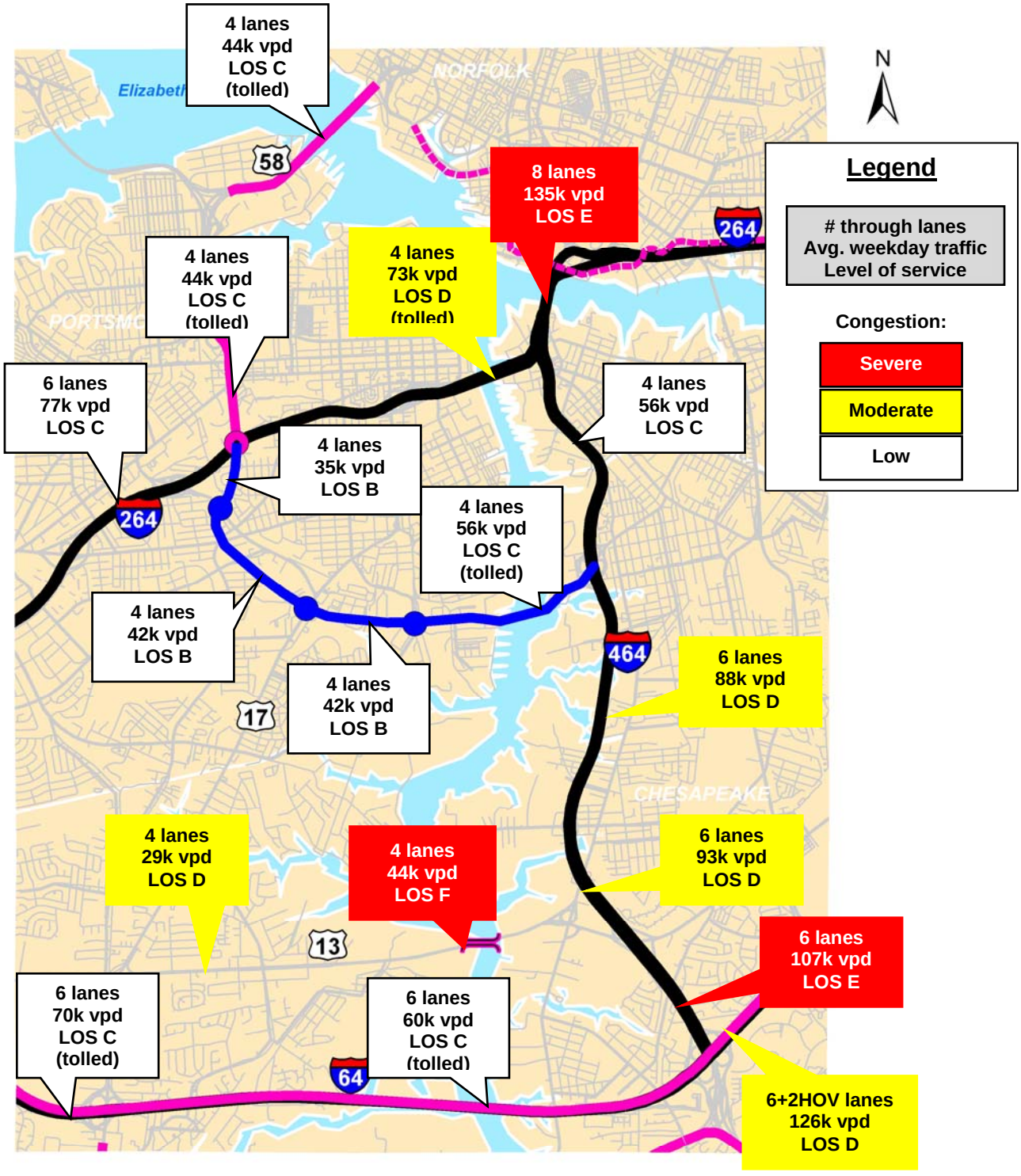
Table 4. Change in 2030 Average Weekday Volume, Alternative A Compared to 2030 LRP

Orange indicates significant changes to this segment.

Road	From	To	2030 LRP Forecast	V/C	LOS	2030 ERCS Alt A Forecast	V/C	LOS	Chg. V/C	Chg. Vol.
Midtown Tunnel	na	na	49,000	0.72	C	44,000	0.65	C	-0.07	-5,000
Downtown Tunnel	na	na	90,000	1.13	F	73,000	0.91	D	-0.22	-17,000
Jordan Bridge	na	na	19,000	1.36	F	56,000	0.69	C	-0.67	37,000
Gilmerton Bridge	na	na	47,000	1.28	F	44,000	1.20	F	-0.08	-3,000
High Rise Bridge	na	na	69,000	0.65	C	60,000	0.57	C	-0.08	-9,000
MLK Fwy	Midtown Tunnel	London Blvd	44,000	0.37	B	51,000	0.43	B	0.06	7,000
MLK Fwy	London Blvd	High St	33,000	0.44	B	44,000	0.59	C	0.15	11,000
MLK Fwy	High St	I-264	29,000	0.38	B	44,000	0.57	C	0.19	15,000
Military Hwy	Battlefield Blvd	Campostella Rd	32,000	1.09	F	33,000	1.13	F	0.03	1,000
Military Hwy	Campostella Rd	I-464	35,000	1.11	F	36,000	1.14	F	0.03	1,000
Military Hwy	I-464	Bainbridge Blvd	35,000	1.03	F	33,000	0.97	E	-0.06	-2,000
Military Hwy	Canal Dr	GW Hwy	29,000	0.87	D	29,000	0.87	D	0.00	0
Military Hwy	GW Hwy	Cavalier Blvd	26,000	0.83	D	26,000	0.83	D	0.00	0
Military Hwy	Cavalier Blvd	I-64	25,000	0.79	C	24,000	0.76	D	-0.03	-1,000
Military Hwy	I-64	Airline Blvd	27,000	0.68	C	27,000	0.68	C	0.00	0
I-64	Bowers Hill	Military Hwy	63,000	0.57	C	56,000	0.50	B	-0.06	-7,000
I-64	Military Hwy	GW Hwy	79,000	0.73	C	70,000	0.65	C	-0.08	-9,000
I-64	I-464	Battlefield Blvd	126,000	0.82	D	126,000	0.82	D	0.00	0
I-64	Battlefield Blvd	Greenbrier Pkwy	147,000	0.94	E	147,000	0.94	E	0.00	0
I-264	I-664	Greenwood Dr	58,000	0.80	D	58,000	0.80	D	0.00	0
I-264	Greenwood Dr	Victory Blvd	64,000	0.85	D	64,000	0.85	D	0.00	0
I-264	Victory Blvd	Portsmouth Blvd	76,000	0.66	C	76,000	0.66	C	0.00	0
I-264	Portsmouth Blvd	Frederick Blvd	77,000	0.68	C	77,000	0.68	C	0.00	0
I-264	Frederick Blvd	MLK Fwy	88,000	0.75	D	80,000	0.68	C	-0.07	-8,000
I-264	MLK Fwy	Des Moines Ave	95,000	0.81	D	89,000	0.76	D	-0.05	-6,000
I-264	Des Moines Ave	Effingham St	87,000	0.74	C	83,000	0.71	C	-0.03	-4,000
I-264	I-464	Tidewater Dr	131,000	0.94	E	135,000	0.96	E	0.03	4,000
I-264	Tidewater Dr	Campostella Rd	127,000	0.78	D	127,000	0.78	D	0.00	0
I-464	I-64	Military Hwy	101,000	0.89	D	107,000	0.95	E	0.05	6,000
I-464	Military Hwy	Freeman Ave	84,000	0.73	C	93,000	0.81	D	0.08	9,000
I-464	Freeman Ave	Poindexter St	78,000	0.68	C	88,000	0.77	D	0.09	10,000
I-464	Poindexter St	South Main St	66,000	0.84	D	56,000	0.72	C	-0.13	-10,000
I-464	South Main St	I-264	61,000	0.82	D	51,000	0.69	C	-0.14	-10,000
Western Fwy	Midtown Tunnel	West Norfolk Rd	58,000	0.78	D	62,000	0.83	D	0.05	4,000
New Alt A road	I-264	Frederick Blvd	na	na	na	35,000	0.45	B	na	na
New Alt A road	Frederick Blvd	GW Hwy	na	na	na	42,000	0.54	B	na	na
New Alt A road	GW Hwy	Elm Ave	na	na	na	42,000	0.54	B	na	na

Note: A toll rate of $0.60 (year 2007 dollars) is assumed for travel across the improved Jordan Bridge in the "Alt. A" scenario.

Map 7. 2030 ERCS Alternative A Traffic Volumes and Congestion



Note: The alignment of any project is not set until the final design is completed.

vpd is vehicles per day

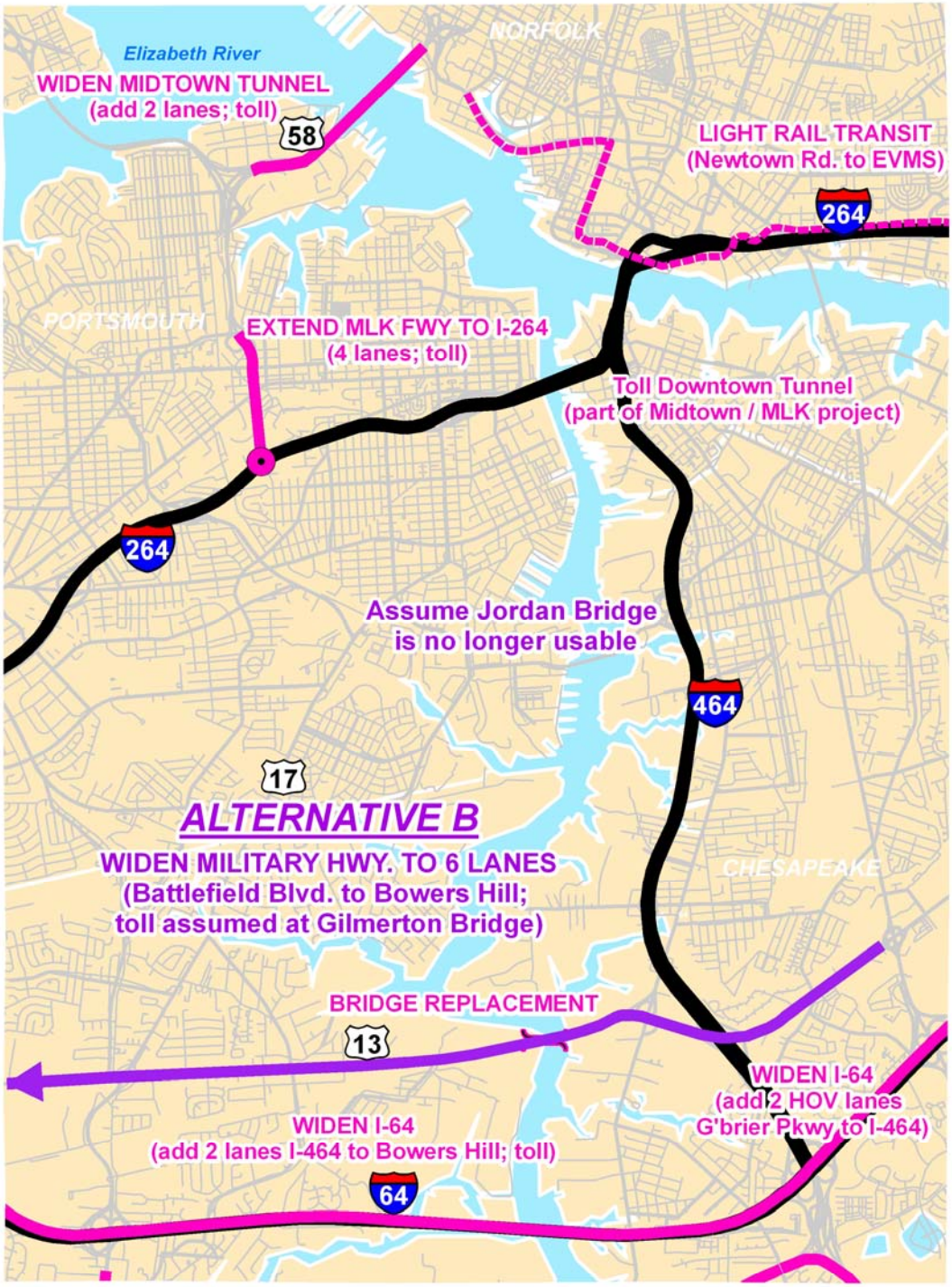
Alternative B: Widening of Military Highway

This alternative would increase the capacity at the southern end of the study area by increasing the number of through lanes on Military Highway by two, for a total of six lanes between Battlefield Blvd. and Bowers Hill, including expansion of the Gilmerton Bridge. Because of the age and replacement cost of the Jordan Bridge, the bridge is assumed to be closed in this 2030 scenario. **Map 8** shows the location of this alternative.

Table 5 and **Map 9** below shows the results of the analysis. An analysis of model sensitivity for toll rates across the widened Gilmerton Bridge was conducted and is discussed later in this report. However, in the interest of including an extended analysis of one toll rate scenario, a moderate toll rate of $0.60 (in year 2007 dollars) across the Gilmerton Bridge will be analyzed in greater detail.

Volumes at both the Midtown and Downtown Tunnels decrease by only 4,000, yet the volume at the High Rise bridge decreases by 9,000. The toll on the Gilmerton Bridge results in a decrease of traffic as compared to the 2030 LRP scenario. The decreased volume, combined with a widening, results in a LOS of C across the improved Gilmerton Bridge.

Map 8. Elizabeth River Crossings Study Alternative B:
Widen Military Highway and Assume Jordan Bridge Is No Longer in Service



Note: The alignment of any project is not set until the final design is completed.

AltBtext2.jpg

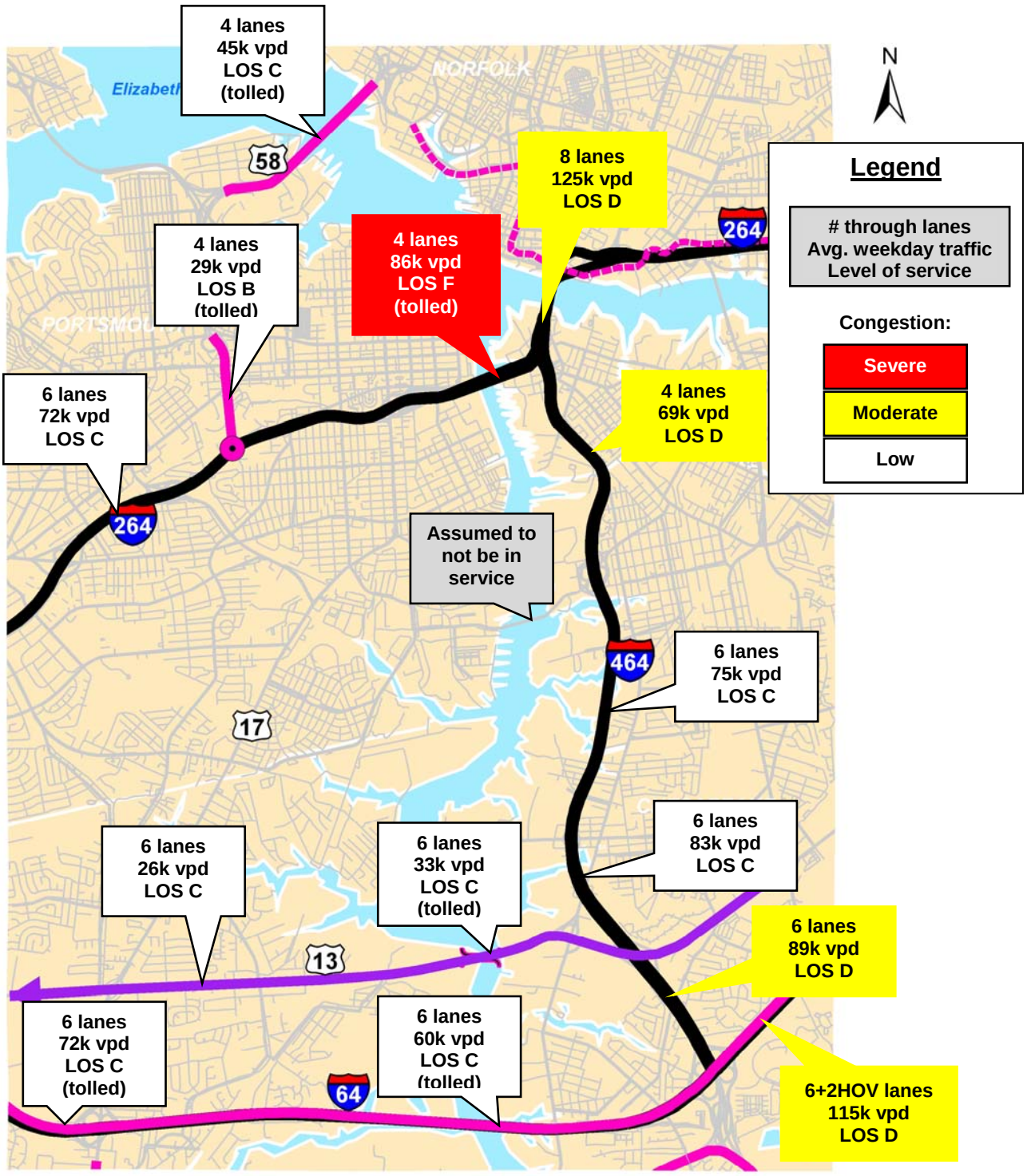
Table 5. Change in 2030 Average Weekday Volume, Alternative B Compared to 2030 LRP

Orange indicates significant changes to this segment.

Road	From	To	2030 LRP Forecast	V/C	LOS	2030 ERCS Alt B Forecast	V/C	LOS	Chg. V/C	Chg. Vol.
Midtown Tunnel	na	na	49,000	0.72	C	45,000	0.66	C	-0.06	-4,000
Downtown Tunnel	na	na	90,000	1.13	F	86,000	1.08	F	-0.05	-4,000
Jordan Bridge	**na**	**na**	**19,000**	**1.36**	**F**	**na**	**na**	**na**	**na**	**na**
Gilmerton Bridge	**na**	**na**	**47,000**	**1.28**	**F**	**33,000**	**0.60**	**C**	**-0.68**	**-14,000**
High-rise Bridge	na	na	69,000	0.65	C	60,000	0.57	C	-0.08	-9,000
MLK Fwy	Midtown Tunnel	London Blvd	44,000	0.37	B	45,000	0.38	B	0.01	1,000
MLK Fwy	London Blvd	High St	33,000	0.44	B	33,000	0.44	B	0.00	0
MLK Fwy	High St	I-264	29,000	0.38	B	29,000	0.38	B	0.00	0
Military Hwy	**Battlefield Blvd**	**Campostella Rd**	**32,000**	**1.09**	**F**	**33,000**	**0.75**	**C**	**-0.34**	**1,000**
Military Hwy	**Campostella Rd**	**I-464**	**35,000**	**1.11**	**F**	**35,000**	**0.74**	**C**	**-0.37**	**0**
Military Hwy	**I-464**	**Bainbridge Blvd**	**35,000**	**1.03**	**F**	**28,000**	**0.55**	**C**	**-0.48**	**-7,000**
Military Hwy	Canal Dr	GW Hwy	29,000	0.87	D	26,000	0.52	C	-0.35	-3,000
Military Hwy	GW Hwy	Cavalier Blvd	26,000	0.83	D	27,000	0.57	C	-0.25	1,000
Military Hwy	Cavalier Blvd	I-64	25,000	0.79	C	20,000	0.42	C	-0.37	-5,000
Military Hwy	I-64	Airline Blvd	27,000	0.68	C	29,000	0.49	C	-0.19	2,000
I-64	Bowers Hill	Military Hwy	63,000	0.57	C	56,000	0.50	B	-0.06	-7,000
I-64	Military Hwy	GW Hwy	79,000	0.73	C	72,000	0.67	C	-0.06	-7,000
I-64	I-464	Battlefield Blvd	126,000	0.82	D	115,000	0.75	D	-0.07	-11,000
I-64	Battlefield Blvd	Greenbrier Pkwy	147,000	0.94	E	142,000	0.91	D	-0.03	-5,000
I-264	I-664	Greenwood Dr	58,000	0.80	D	54,000	0.75	D	-0.06	-4,000
I-264	Greenwood Dr	Victory Blvd	64,000	0.85	D	61,000	0.81	D	-0.04	-3,000
I-264	Victory Blvd	Portsmouth Blvd	76,000	0.66	C	72,000	0.63	C	-0.03	-4,000
I-264	Portsmouth Blvd	Frederick Blvd	77,000	0.68	C	72,000	0.64	C	-0.04	-5,000
I-264	Frederick Blvd	MLK Fwy	88,000	0.75	D	83,000	0.71	C	-0.04	-5,000
I-264	MLK Fwy	Des Moines Ave	95,000	0.81	D	90,000	0.77	D	-0.04	-5,000
I-264	Des Moines Ave	Effingham St	87,000	0.74	C	83,000	0.71	C	-0.03	-4,000
I-264	I-464	Tidewater Dr	131,000	0.94	E	125,000	0.89	D	-0.04	-6,000
I-264	Tidewater Dr	Campostella Rd	127,000	0.78	D	121,000	0.74	C	-0.04	-6,000
I-464	I-64	Military Hwy	101,000	0.89	D	89,000	0.79	D	-0.11	-12,000
I-464	Military Hwy	Freeman Ave	84,000	0.73	C	83,000	0.72	C	-0.01	-1,000
I-464	Freeman Ave	Poindexter St	78,000	0.68	C	75,000	0.66	C	-0.03	-3,000
I-464	Poindexter St	South Main St	66,000	0.84	D	69,000	0.88	D	0.04	3,000
I-464	South Main St	I-264	61,000	0.82	D	63,000	0.85	D	0.03	2,000
Western Fwy	Midtown Tunnel	West Norfolk Rd	58,000	0.78	D	56,000	0.75	D	-0.03	-2,000

Note: A toll rate of $0.60 (year 2007 dollars) is assumed for travel across the improved Gilmerton Bridge in the "Alt. B" scenario.
Note also that this alternative assumes that the Jordan Bridge is no longer in service.

Map 9. 2030 Alternative B Traffic Volumes and Congestion



vpd is vehicles per day

Note: The alignment of any project is not set until the final design is completed.

AltB2.jpg

Comparison of Alternatives

Figures 3 and 4 show a summary of the impact on traffic volumes and volume to capacity ratios of Alternatives A and B. More total vehicle trips are served with Alternative A in comparison to Alternative B (53,000 more) and in comparison the 2030 Long-Range Transportation Plan (3,000 more). Alternative A also has a significant impact on the Downtown Tunnel, reducing its volume by 17,000 vehicles per day and reducing its v/c ratio to below 1.00.

The most significant impact of Alternative B is the better quality of traffic flow on the Gilmerton Bridge, as the quantity of traffic actually declines across the bridge with the assumption of a $0.60 toll (year 2007 dollars). Alternative B has a minor impact on the Downtown Tunnel, reducing its volume by only 4,000 vehicles per day which leaves the tunnel over capacity.

Figure 3. Comparison of 2030 Average Weekday Volumes

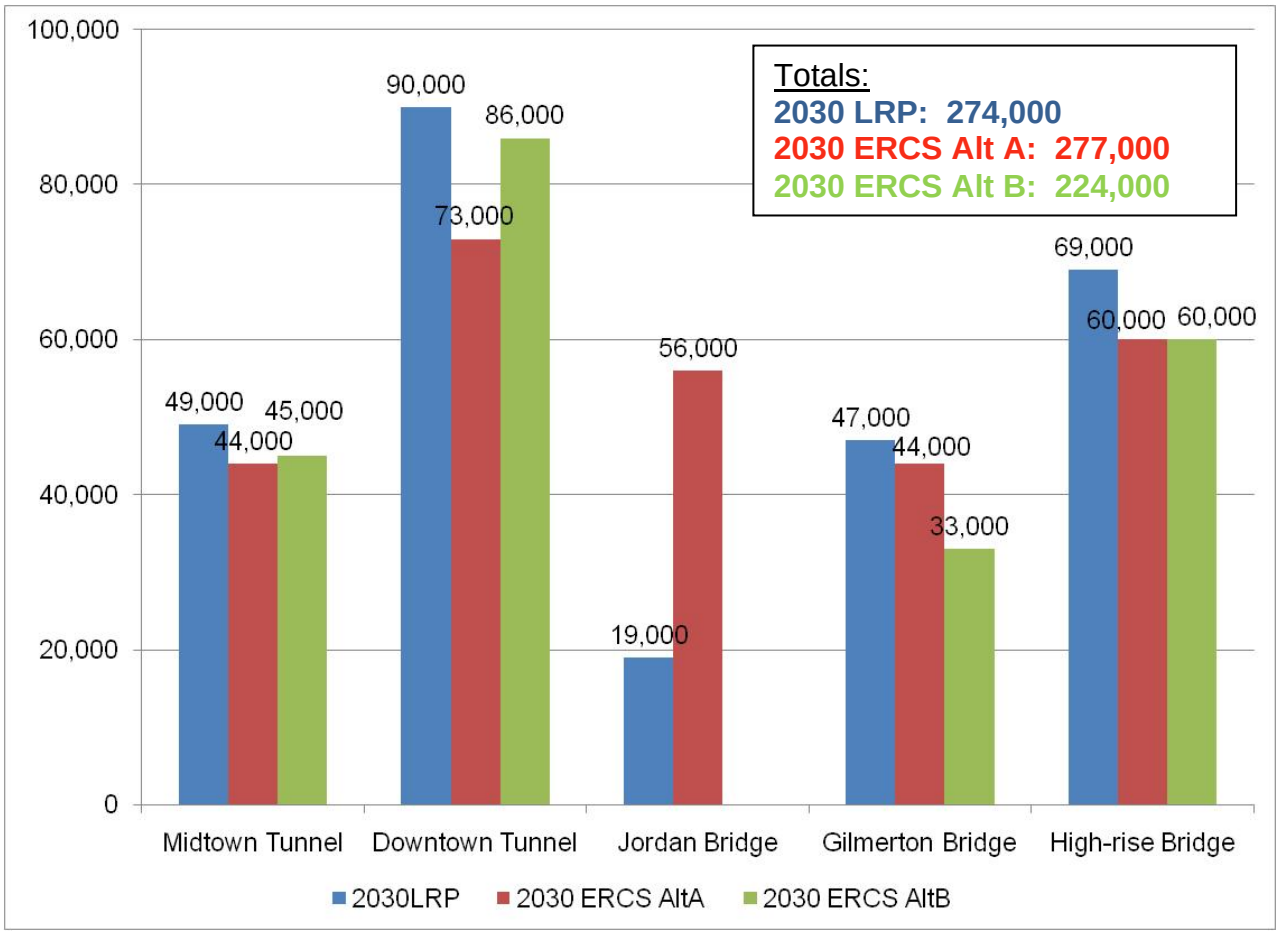
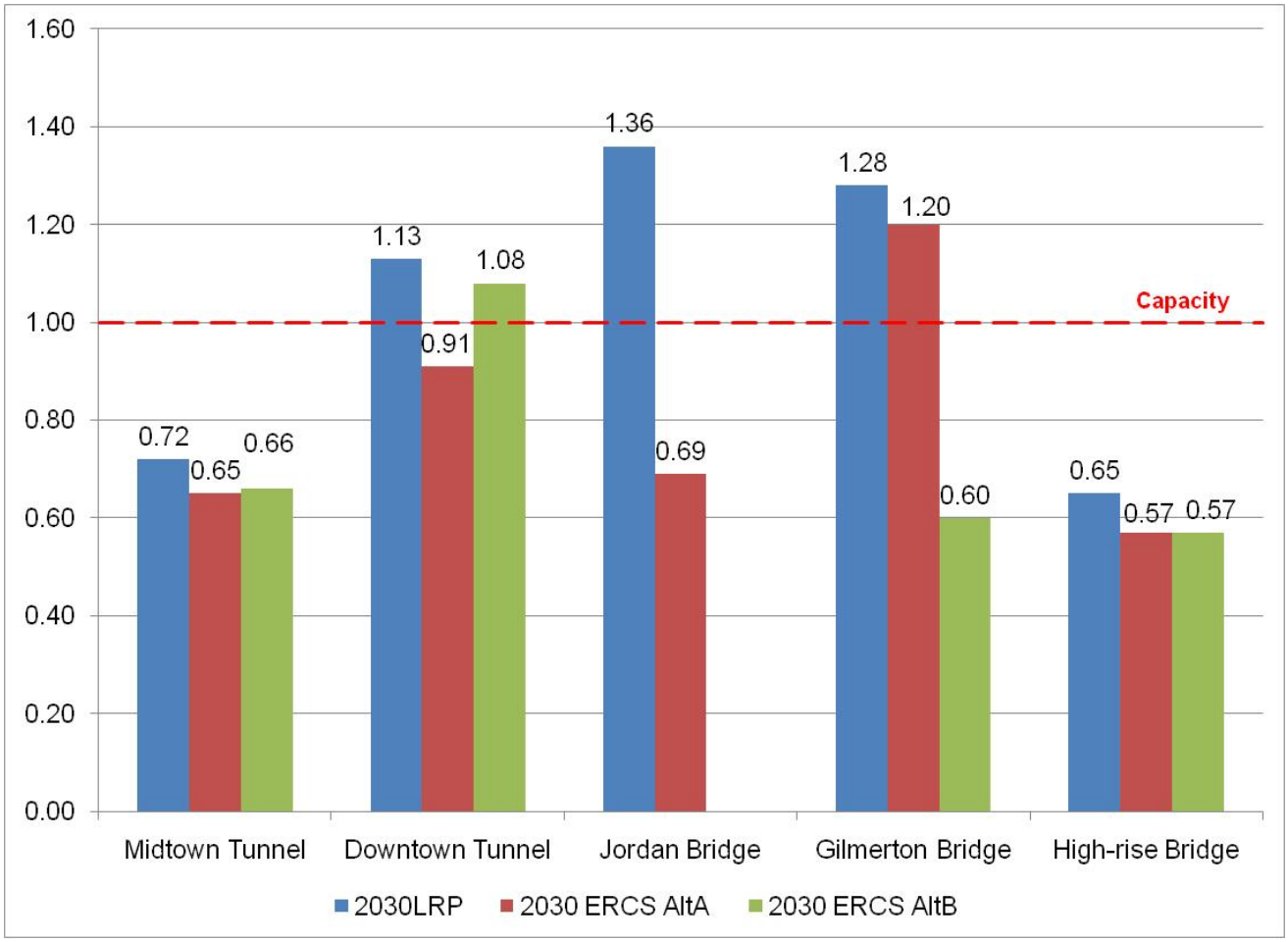


Figure 4. Comparison of 2030 Volume to Capacity Ratio



MODEL SENSITIVITY TO TOLLS

The previous analysis of alternatives used a single toll rate. However, further analysis would be required to determine what would be an acceptable toll rate given the cost of each project and striking a balance between toll rate and use of the facility. Given the uncertainty of the toll rates and to assist with any future analysis of these alternatives, a toll sensitivity analysis was conducted for the two alternatives. The travel demand forecast model was run for the year 2030 with toll levels of $0.24, $0.48, $0.60, $0.72, and $0.96 (in year 2007 dollars) for both the Jordan Bridge (for the loop alternative; Alternative A) and for the Gilmerton Bridge (for the widening of Military Highway alternative and no Jordan Bridge; Alternative B).[13] All other variables (toll rates, projects, and land use) were held constant at their 2030 LRP values.

The improved Jordan Bridge shed an average of twice the traffic per ten-cent toll increase as the improved Gilmerton Bridge (8,200 decrease versus 4,100) as shown in **Table 6**. However, both the Jordan Bridge and Gilmerton Bridge responded in a similar manner in terms of elasticity, as shown in **Table 7**. [14] Both are relatively inelastic in the $0.24 to $0.48 toll range and are elastic (elasticity value > 1.0) when a toll of $0.60 is exceeded. However, the sensitivity to tolls may still be greater than expected across the whole range of tolls analyzed.

[13] Appendix B includes factors used in converting among 2000, 2004, and 2007 toll values.
[14] Elasticity calculated as (% Change in Volume / % Change in Toll). The curves used are generalized and elasticity would actually differ at each point along the toll-volume curve.

Figure 5. Difference in 2030 Volume Relative to $0.60 Toll on Jordan Bridge for ERCS Alternative A

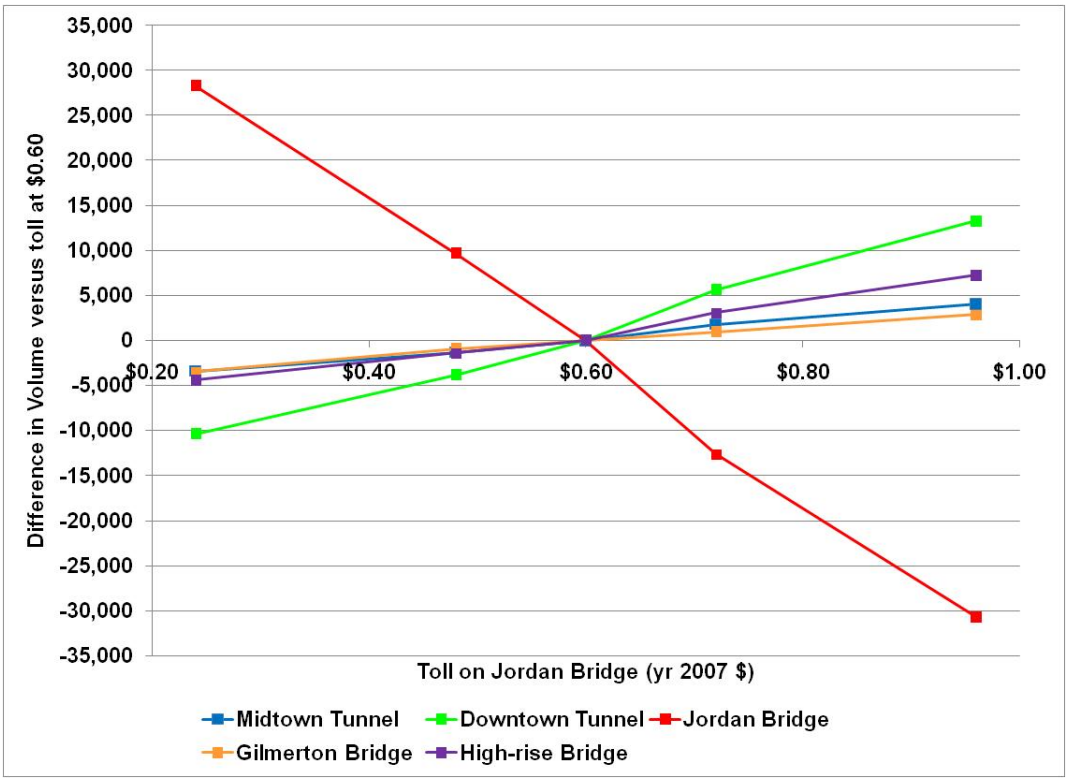


Figure 6. Difference in 2030 Volume Relative to $0.60 Toll on Gilmerton Bridge for ERCS Alternative B

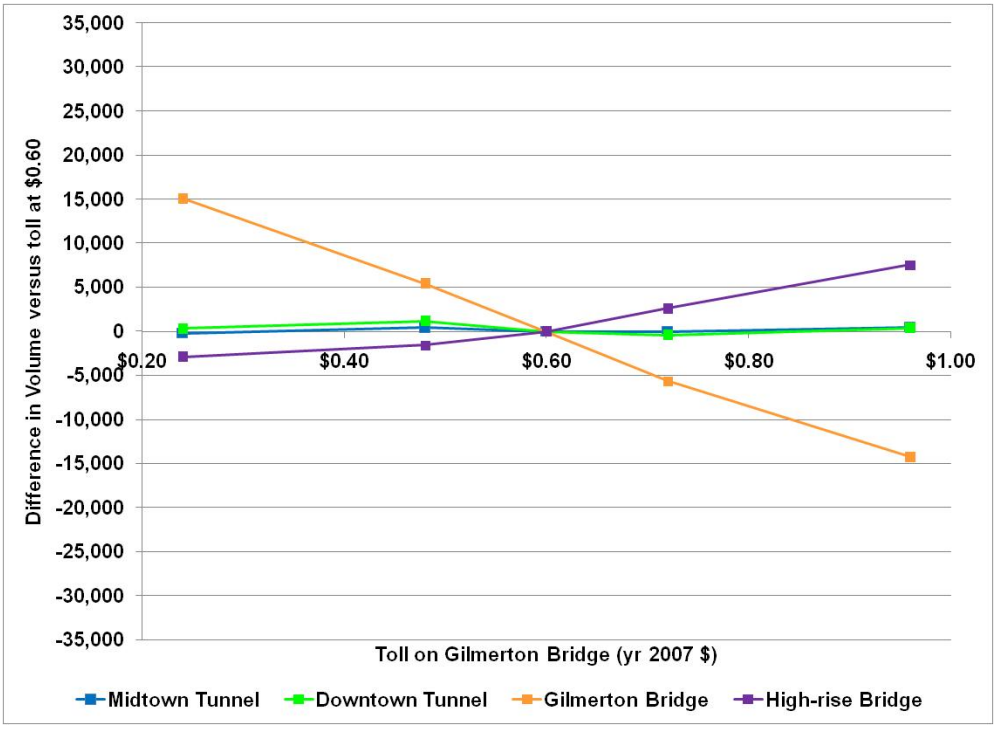


Table 6. Change in 2030 Volume Per Ten Cent Increase in Toll

(Toll on the Jordan Bridge for ERCS Alt. A and Toll on the Gilmerton Bridge for ERCS Alt. B)

	ERCS Alternative A					ERCS Alternative B				
Road	**$0.24-$0.48**	**$0.48-$0.60**	**$0.60-$0.72**	**$0.72-$0.96**	**Avg. ***	**$0.24-$0.48**	**$0.48-$0.60**	**$0.60-$0.72**	**$0.72-$0.96**	**Avg. ***
Midtown Tunnel	900	1,100	1,500	900	1,000	300	-400	400	200	100
Downtown Tunnel	2,700	3,200	4,700	3,200	3,300	300	-1,000	700	300	0
Jordan Bridge	**-7,800**	**-8,100**	**-10,500**	**-7,600**	**-8,200**	na	na	na	na	na
Gilmerton Bridge	1,100	800	800	800	900	**-4,000**	**-4,500**	**-7,200**	**-3,600**	**-4,100**
High-rise Bridge	1,300	1,100	2,600	1,700	1,600	600	1,300	4,100	2,100	1,500

*Note: Toll is year 2007 dollars. "Average" is the change in volume per 10-cent toll increase for a toll range of $0.24 to $0.96.

Table 7. Elasticity of 2030 Volumes

(Toll on the Jordan Bridge for ERCS Alt. A and Toll on the Gilmerton Bridge for ERCS Alt. B)

	ERCS Alternative A				ERCS Alternative B			
Road	**$0.24-$0.48**	**$0.48-$0.60**	**$0.60-$0.72**	**$0.72-$0.96**	**$0.24-$0.48**	**$0.48-$0.60**	**$0.60-$0.72**	**$0.72-$0.96**
Midtown Tunnel	0.05	0.11	0.18	0.13	0.01	-0.04	0.00	0.03
Downtown Tunnel	0.10	0.22	0.38	0.29	0.01	-0.05	-0.02	0.03
Jordan Bridge	**-0.23**	**-0.61**	**-1.16**	**-1.31**	na	na	na	na
Gilmerton Bridge	0.07	0.10	0.12	0.15	**-0.23**	**-0.66**	**-1.01**	**-1.18**
High-rise Bridge	0.07	0.12	0.33	0.24	0.03	0.14	0.27	0.30

Note: Toll is year 2007 dollars. Elasticity calculated as (% Change in Volume / % Change in Toll). Elasticity will differ at various points along the toll-volume curve.

PUBLIC TRANSPORTATION

Existing Bus and Ferry

Public transportation has had a role in the crossing of the Elizabeth River since 1636, as noted earlier in the history of the Elizabeth River crossings. There are currently six Hampton Roads Transit services for crossing the Elizabeth River in the study area. They are:

- Elizabeth River Ferry
- Route 44 (crosses Midtown Tunnel)
- Route 45 (crosses Downtown Tunnel)
- Route 57 (crosses Gilmerton Bridge)
- Route 962 (crosses Downtown Tunnel)
- Route 967 (crosses High Rise Bridge)

See **Map 10** for a map of the routes.

Commuter routes 962 and 967 started service in summer of 2008. Prior to the summer of 2008 there were four Hampton Roads Transit services for crossing the Elizabeth River in the study area (three bus routes and a ferry). Boardings for these routes were analyzed from FY2003 to FY2007, as shown in **Figure 7**.[15] The combined total boardings for the subject routes grew from 793,000 in FY03 to 1,025,000 in FY07, representing an annual growth rate of 6.6%. Among the individual routes, Route 45 grew the most in quantity of boardings from FY03 to FY07, growing by 95,000 boardings. In percentage terms, Route 57 grew the most, from 22,000 boardings in FY03 to 92,000 boardings in FY07, or a change of over 300%. The ferry showed notable growth from just over 315,000 boardings in FY03 to 390,000 boardings in FY07, or a change of 23%. Route 44 stayed consistently in the range of approximately 150,000 to 160,000 boardings per year during this time.

[15] Boarding totals are for the entire route, not just persons using HRT service to cross the Elizabeth River.

Map 10. Existing Hampton Roads Transit Routes

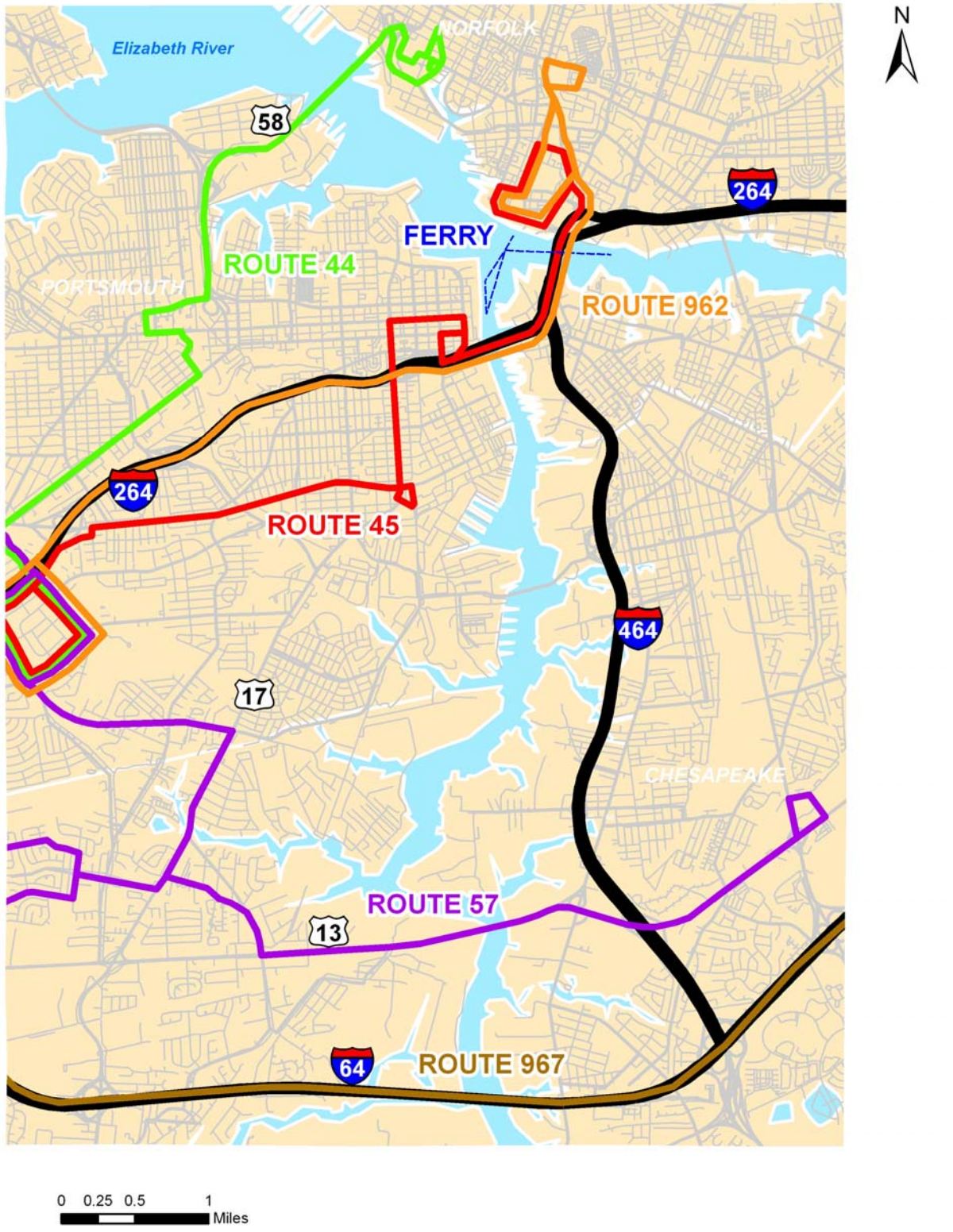


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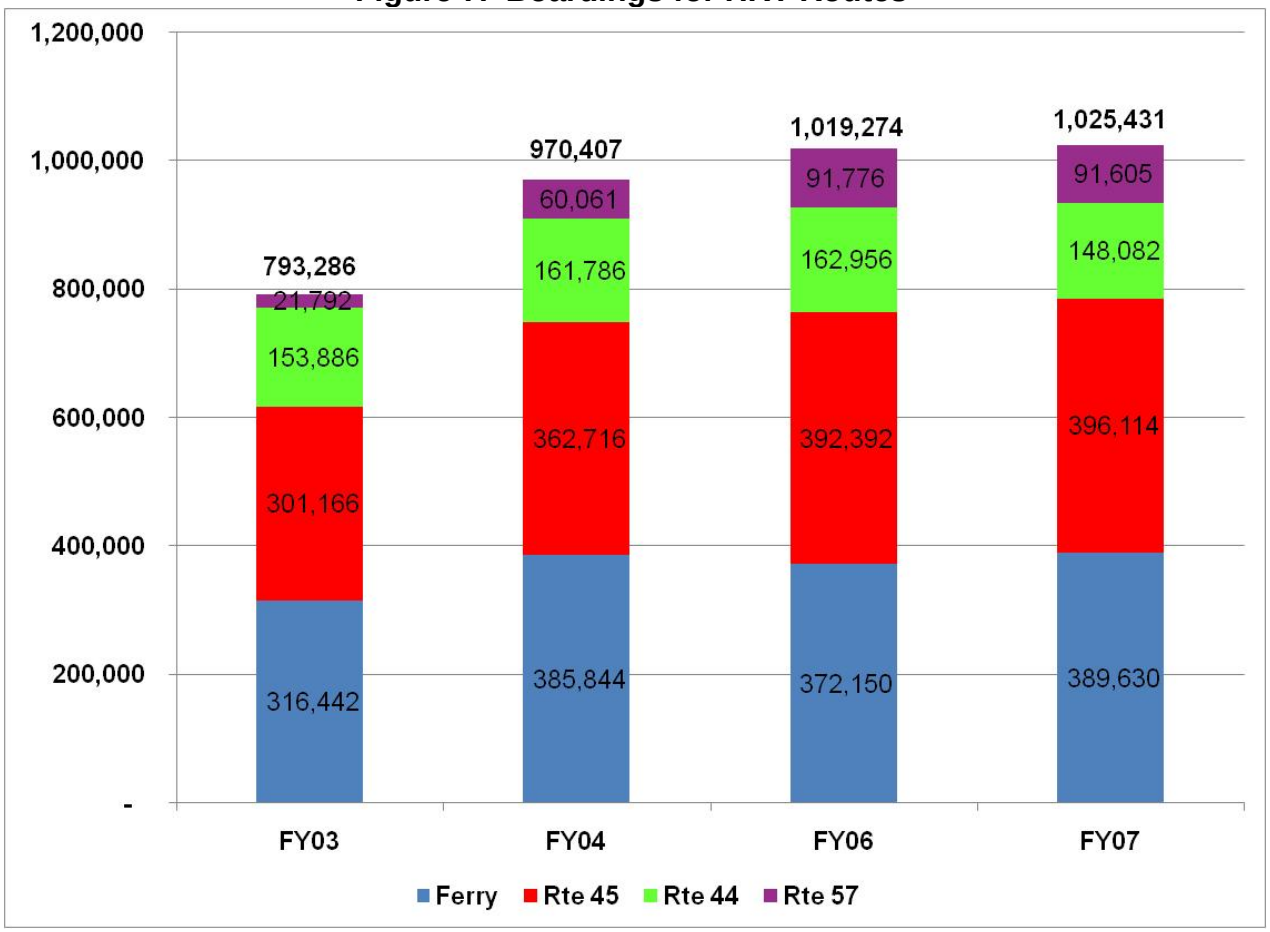
Figure 7. Boardings for HRT Routes



Note: Complete FY05 data not available due to a change in the HRT fiscal year calendar at that time. Commuter routes 962 and 967 did not begin service until summer of 2008.

Light Rail Corridors

VDOT has recently been exploring Public-Private Partnerships (PPP's) as a means of constructing a widening of the Midtown Tunnel and an extension of the Martin Luther King Freeway to I-264. The current call for proposals includes the statement that

> "The design and construction of the proposed new Midtown Tunnel shall not preclude the development of future facilities dedicated to providing multi-modal transportation alternatives."[16]

Prior to these recent efforts, expansion of the Norfolk light-rail system across the southern branch of the Elizabeth River was last studied in 1999 in the "Portsmouth and Chesapeake Corridor Planning Study".[17] There were four corridors for crossing the

[16] Source: "Downtown Tunnel / Midtown Tunnel / MLK Freeway Extension Solicitation for Proposals," VDOT, May 30, 2008, p. 13. Accessed via VDOT website on 6/30/08.
[17] "Portsmouth and Chesapeake Corridor Planning Study for the Hampton Roads Regional Light Rail Transit System," July 1999, Parsons Brinckerhoff and BRW.

southern branch under consideration at that time (and their approximate lengths) are listed below.

Cross at the Midtown Tunnel:

- MLK / CSX corridor (12.8 miles)

Cross at the Downtown Tunnel:

- CSX corridor (9.0 miles)
- I-264 corridor (8.4 miles)

Cross via the ferry:

- High Street Corridor to Churchland (7.7 miles)
- High Street / Airline Blvd. corridor (7.4 miles)
- CSX railroad corridor (7.0 miles)

Cross via a new LRT tunnel near the Naval Hospital:

- CSX railroad corridor (11.5 miles)

BICYCLE AND PEDESTRIAN FACILITIES

There are currently limited options for crossing the Elizabeth River via bicycle or on foot. Only two of the five crossings in the study area have any accommodations for pedestrians. The Jordan Bridge and Gilmerton Bridge have sidewalks on one side of the bridge (the north side). No toll is collected at the Jordan Bridge from bicyclists or pedestrians. These bridges, however, do not have bicycle facilities leading to the bridges.

Figure 8. Sidewalks on the Jordan and Gilmerton Bridges

Sidewalks are only on the north side of the Jordan Bridge (left) and Gilmerton Bridge (right).

Transit can also serve to assist bicyclists and pedestrians in their travels. All of HRT's buses, except for the replica trolleys, have bicycle racks. In addition, the ferry between downtown Portsmouth and downtown Norfolk serves the needs of both pedestrians and

bicyclists. As noted in the preceding "Public Transportation" section, HRT serves this corridor with three bus routes and a ferry. **Table 7** summarizes the options for bicyclists and pedestrians for crossing the Elizabeth River in the study area.

Table 8. Summary of Bicycle and Pedestrian Facilities

Road	Bike or Ped Facility	Bus Route
Midtown Tunnel	no	yes
Downtown Tunnel	no	yes
Jordan Bridge	sidewalk on one side	no
Gilmerton Bridge	sidewalk on one side	yes
High-rise Bridge	no	yes

All bus routes have bike racks on the fronts of buses.
The Downtown Tunnel vicinity is additionally served by the HRT ferry, which provides travel for pedestrians and bicyclists.

ADDITIONAL RESOURCES

The issues involved with the expansion of the capacity across the Elizabeth River are many and complex. This study was designed as a starting point for further analysis of the options available. There have also been related studies performed in the past that may be of interest. These additional studies are listed below.

- "Downtown Tunnel Traffic Management Plan", HRPDC, November 2003.
- "Midtown Tunnel Closure Traffic and Transit Analysis", HRPDC, June 2004.
- "Toll Feasibility Study", Michael Baker Corp. for HRPDC, VDOT, and FHWA. October 28, 2005.
- "Regional Bridge Study", HRPDC, August 2008.

APPENDICES

APPENDIX A
Development of Demand Quantities

Despite its designated name of "travel demand forecasting model," the model is typically used to forecast traffic volumes, given the restraints of capacities and the impact of tolls. Demand, however, is quite different. It is a measure of what route people would *like* to take. Demand is a difficult concept to forecast, as there are no real-world "checks" available, unlike forecast volumes where ground counts are a useful comparison.

Three methods were used for estimating the demand for the Elizabeth River crossings. The approaches used were:

- **Network-wide** unrestricted capacity and no tolls (one model run)
- Unrestricted capacity and no tolls just for the **Elizabeth River corridor** (one model run)
- Unrestricted capacity and no tolls for **each of the five crossings of the corridor individually** (one model run for each crossing; five runs total)

The results are shown in **Table A1** below.

Table A1. Estimates of 2030 Demand

Eliz. River Crossings:

Road	Network-wide (1 run)	Eliz River corridor (1 run)	Individual facility (5 runs; 1 each xing)
Midtown Tunnel	66,000	54,000	64,000
Downtown Tunnel	119,000	124,000	128,000
Jordan Bridge	44,000	31,000	37,000
Gilmerton Bridge	60,000	41,000	64,000
High-rise bridge	22,000	97,000	121,000
	311,000	347,000	n.a.

Other Facilities:

Cedar Rd	8,000	9,000	did not run
Moses Grandy Trl	50,000	23,000	did not run
	58,000	32,000	-

The network-wide run produced results that approximate a free-flowing interstate throughout the region. The most notable result of this run was the very low volume on the High Rise Bridge (22,000) and the very high volume on Moses Grandy Trail (50,000). It is clear that this is just a reflection of where people live (no one lives right next to the High Rise Bridge). This definition of demand did not seem to have any measure of reality, and so it was not used.

At the other end of the spectrum, scenarios were run where each crossing was the only unrestricted facility in the network. The results of this scenario did not seem unreasonable on an individual basis; those with the highest actual traffic volume had the

highest demand. The issue with this method was that the total quantity of crossings (414,000) was then higher than the actual number of trips that the trip table indicated crossed through the corridor. For this reason, this method was not chosen.

The method settled on struck a balance between all facilities being unrestrained and one facility being unrestrained at a time. The method used applied an unrestricted capacity and no tolls to the components of the Elizabeth River corridor (the five facilities from the Midtown Tunnel to the High Rise Bridge) at the same time, while the rest of the network remained with their "real" capacities and tolls. The results struck a balance between the previous two methods and produced reasonable results.

APPENDIX B
Converting Among 2000, 2004, and 2007 Dollars

Toll rates for three different years were used by sources for this document: 2000 (as used within the regional travel demand model), 2004 (as cited in the "Toll Feasibility Study" rates in Table 3), and 2007, which is the most recent full calendar year and the most recent full year for which Consumer Price Index (CPI) data is available. Toll rates were converted to year 2007 dollars when appropriate, using the data below.

	2000	2004	2007
CPI	172.2	188.9	207.3
Toll Rate	$ 0.20	$ 0.22	$ 0.24
	$ 0.40	$ 0.44	$ 0.48
	$ 0.50	$ 0.55	$ 0.60
	$ 0.60	$ 0.66	$ 0.72
	$ 0.80	$ 0.88	$ 0.96

"CPI" is Consumer Price Index

Convert from 2000 to 2004: 188.9 / 172.2 = 1.097 = 2.3% annual growth rate
Convert from 2000 to 2007: 207.3 / 172.2 = 1.204 = 2.7% annual growth rate
Convert from 2004 to 2007: 207.3 / 188.9 = 1.097 = 3.1% annual growth rate