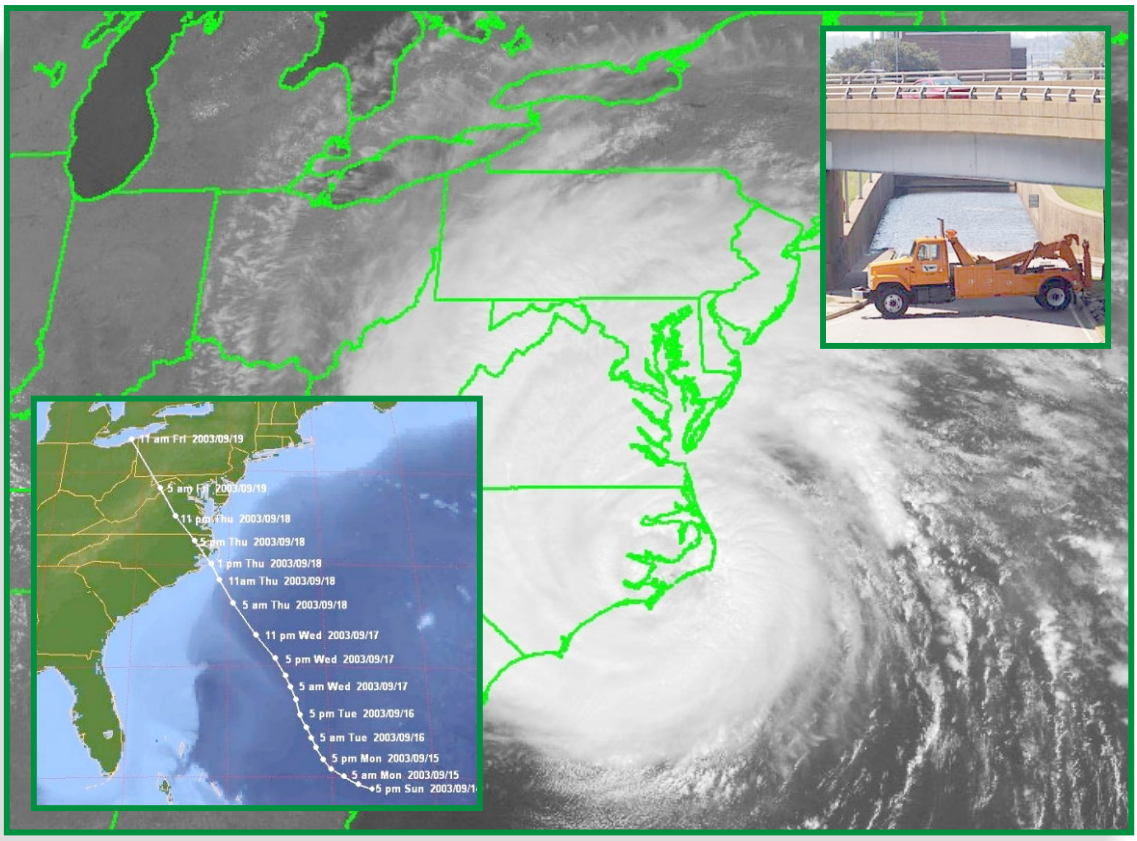
MIDTOWN TUNNEL CLOSURE TRAFFIC AND TRANSIT ANALYSIS



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T04-08

JUNE 2004

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MIDTOWN TUNNEL CLOSURE
TRAFFIC AND TRANSIT ANALYSIS

This report was included in the Work Program for Fiscal Year 2003-2004, which was approved by the Commission and the Metropolitan Planning Organization at their meetings of March 19, 2003.

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HAMPTON ROADS PLANNING DISTRICT COMMISSION

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Traffic and Transit Analysis

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ABSTRACT
During the week of September 14, 2003, Hurricane Isabel approached the East Coast of the United States, eventually passing through Hampton Roads on Thursday, September 18, 2003. Among the damage that Isabel left behind was a flooded Midtown Tunnel. The tunnel would remain closed for almost four weeks, re-opening on October 15, 2003. This study is an analysis of traffic volumes and transit ridership during the tunnel closure. It provides information on the role that the Midtown Tunnel has in the region's transportation system.

ACKNOWLEDGEMENTS
This report was prepared in cooperation with the U.S. Department of Transportation, the Federal Highway Administration, the Virginia Department of Transportation, and the cities of Hampton Roads. The contents of this report reflect the views of the staff of the Hampton Roads MPO. The MPO staff 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 Hampton Roads Planning District Commission or cooperating bodies. The 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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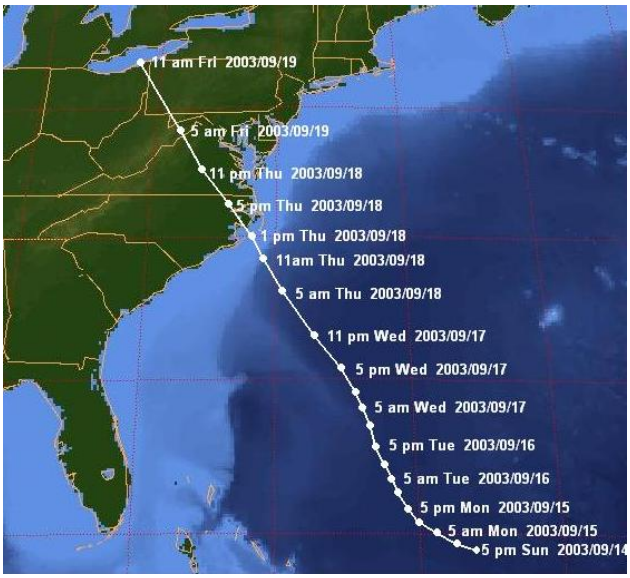
FIGURES, MAPS AND TABLES

THE EVENTS OF HURRICANE ISABEL

The week of September 14, 2003 will long be remembered by the residents of Hampton Roads. It was during this week that the path of Hurricane Isabel was carefully followed as it closed in on the East Coast of the United States. On Thursday of that week (September 18, 2003), Isabel made landfall in the Outer Banks of North Carolina, passed through Hampton Roads, and continued on through Virginia.

FIGURE 1. Path of Hurricane Isabel



Isabel.hurricane.track.jpg

FIGURE 2. Events Timeline

Sunday, September 14, 2003: Hurricane Isabel approaching east coast of the United States.

Monday, September 15, 2003: Isabel begins turning towards Mid-Atlantic states.

Thursday, September 18, 2003: Isabel makes landfall in the Outer Banks of North Carolina, and continues on a northwest path through Hampton Roads. Midtown Tunnel floods and is closed. Tolls on Jordan Bridge are removed ($0.75 for a two-axle vehicle).

Wednesday, October 15, 2003: Midtown Tunnel re-opens at approximately 3:00 p.m.

Friday, October 17, 2003: Tolls resumed on Jordan Bridge at approximately 5:30 a.m.

Isabel left significant damage in its wake. This included countless downed trees, wind damage, erosion, and significant flooding in some areas. Flooding was a particular problem for the Midtown Tunnel. A stuck plate kept the tunnel's flood-gate

open. The tunnel filled with 44 million gallons of water and remained closed for nearly four weeks[1].

FIGURE 3. A Flooded Midtown Tunnel

Tunnelflood0920n.jpg

BACKGROUND ON THE MIDTOWN TUNNEL

The Midtown Tunnel is a significant regional gateway, providing one of the primary access points to and from Norfolk and Portsmouth across the Elizabeth River. Norfolk is home to a thriving downtown area and the world's largest Navy base. Norfolk had 15% of the region's population and 24% of the region's employment in 2000, while Portsmouth accounted for 7% of the 2000 population and 6% of the region's employment. In addition to serving commuters and shoppers, approximately 4.2% of its daily traffic volume is truck traffic.[2] **Appendices B and C** have regional and Midtown Tunnel location maps for those not familiar with the facility.

ANALYSIS OF HIGHWAY TRAFFIC VOLUMES

One of the usual tools for analyzing the impact of a transportation facility is the region's travel demand forecasting model. This study is unique in that an extensive set of actual traffic counts were used instead of estimates from the model. The extended closing of the Midtown Tunnel provided this rare opportunity. However, in the interest of seeing how well the regional travel demand forecasting model performs, a brief comparison of the model versus the actual counts is included in **Appendix D**.

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[1] "September-October 2003 Bulletin", Virginia Department of Transportation.

[2] "Intermodal Management System for Hampton Roads, Virginia". Hampton Roads Planning District Commission, December 2001.

Inventory of Traffic Counts

Daily traffic counts were gathered for the study period of 8/4/2003 through 11/30/2003. This is seventeen weeks (Monday through Sunday), or 119 days of data. The Study Period was divided into six parts:

1. **Summer**: 8/4/2003 through 9/1/2003
2. **Pre-Isabel**: 9/2/2003 through 9/14/2003
3. **Isabel**: 9/15/2003 through 9/21/2003
4. **Midtown Closed**: 9/22/2003 through 10/15/2003
5. **Post-Reopening A**: 10/16/2003 through 11/2/2003
6. **Post-Reopening B**: 11/3/2003 through 11/30/2003

The "Midtown Closed" period was defined to start on 9/22/03 to coincide with the first workday following Hurricane Isabel. The tunnel actually closed on Thursday, 9/18/03, the day Isabel passed through the region.

Forty count locations were obtained from the Virginia Department of Transportation's (VDOT) monthly tunnel reports, VDOT continuous count stations, and from the City of Chesapeake. All available continuous counts were considered for this study. The number of counts for each of the forty count locations ranged from 119 (100% coverage) to 101 (85% coverage), with the average being 115 (97% coverage). See **Table 1** for the inventory of counts used.

The counts used were located throughout the region, with nine localities represented. The distance of the counts from the Midtown Tunnel ranged from 2 miles to 41 miles, with the average being 14 miles. See **Maps 1 and 2** for maps of count locations.

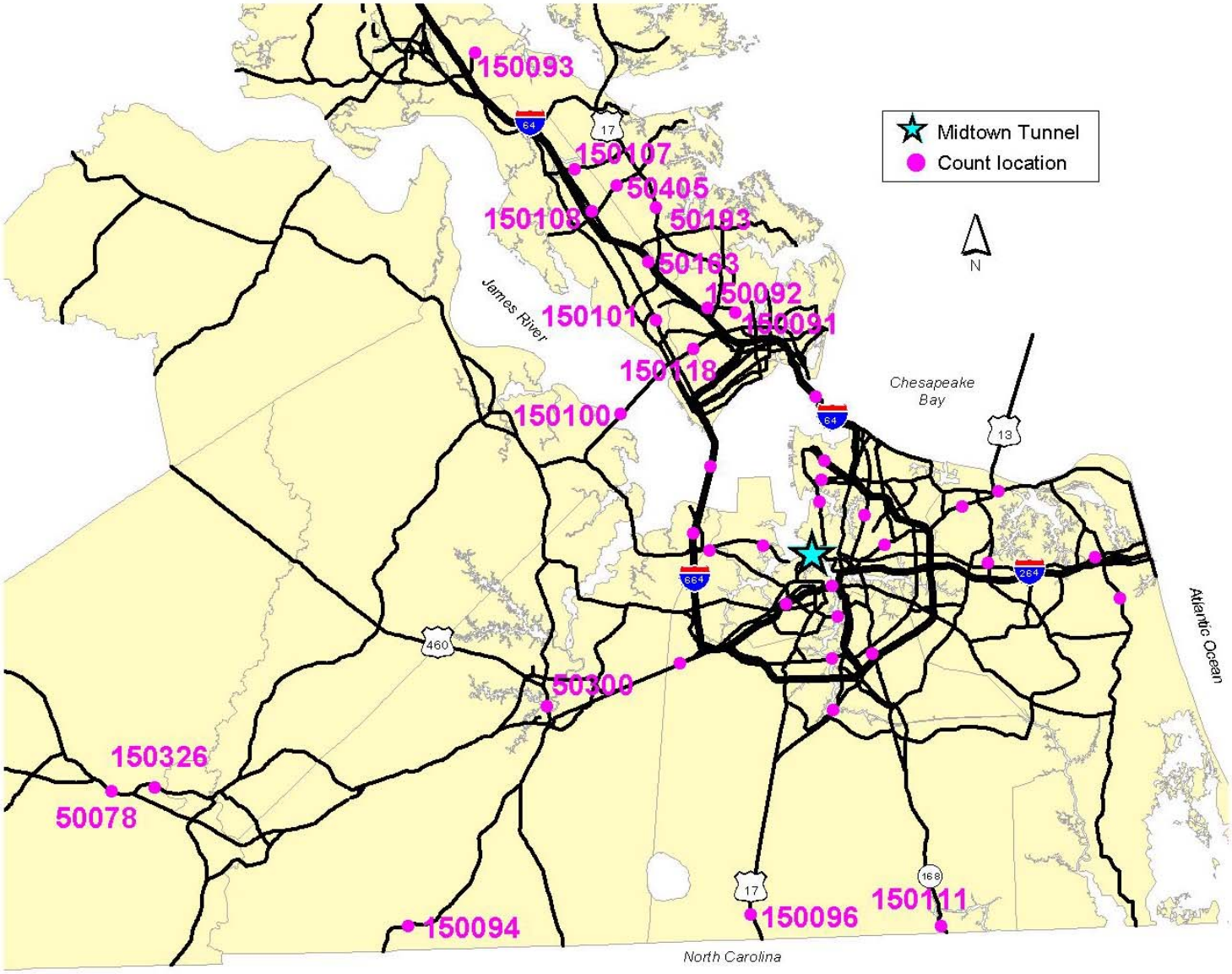
Data was also desired for the High-rise Bridge (I-64 from I-464 to G. Washington Hwy. in Chesapeake), and Campostella Bridge. However, there was not a counter at these locations during the study period. The High-rise Bridge in particular was likely impacted by the Midtown Tunnel closure. A permanent counter has since been installed for the High-rise Bridge. Traffic counts for additional interstate locations were also available via the VDOT Smart Travel Lab. A cursory review of these counts revealed that the quality of the counts was too inconsistent for including in an analysis of a 119-day period.

TABLE 1. Inventory of Traffic Count Locations

COUNT SOURCE	ID1	ID2	LOCALITY	ROUTE	ROAD	FROM	TO	NUMBER OF COUNTS	%	DIST.	LOS	LANES
VDOT Monthly Tunnel Report	MT		Norf / Port	58	**Midtown Tunnel**	Norfolk	Portsmouth	119	100%	0.0	E	2
VDOT Monthly Tunnel Report	DT		Norf / Port	264	**Downtown Tunnel**	Norfolk	Portsmouth	119	100%	2.0	F	4
City of Chesapeake	JB		Ches / Port	337	**Jordan Bridge**	Chesapeake	Portsmouth	101	85%	3.7	C	2
VDOT Continuous Count	150123		Ches	13 / 460	**Military Hwy (Gilmerton Bridge)**	Canal Dr	Bainbridge Blvd	119	100%	5.8	E	4
VDOT Monthly Tunnel Report	HRBT		Hamp / Norf	64	**Hampton Roads Bridge Tunnel**	Hampton	Norfolk	119	100%	8.8	F	4
VDOT Monthly Tunnel Report	MMBT		NN / Suff	664	**Monitor Merrimac Memorial Bridge Tunnel**	Suffolk	Newport News	119	100%	7.4	D	4
VDOT Continuous Count	150111		Chesapeake	168	**Battlefield Blvd**	N. Carolina state line	Ballahack Rd	117	98%	21.7	C	4
VDOT Continuous Count	150121		Chesapeake	168	**Battlefield Blvd**	I-64	Military Hwy	113	95%	6.3	C	6
VDOT Continuous Count	150098		Chesapeake	17	**Bridge Rd.**	Churchland Blvd	ECL Suffolk	118	99%	5.7	C	4
VDOT Continuous Count	150106		Chesapeake	17	**Dominion Blvd**	Cedar Rd	Bainbridge Blvd	116	97%	8.7	F	2
VDOT Continuous Count	150095		Chesapeake	13 / 58 / 460	**Military Hwy**	ECL Suffolk	I-664	117	98%	10.0	C	6
VDOT Continuous Count	150096		Chesapeake	17	**Rte 17**	N. Carolina state line	Ballahack Rd	116	97%	20.3	C	2
VDOT Continuous Count	150091		Hampton	n.a.	**Armistead Ave**	Tidemill Ln	Hampton Roads Center Pkwy	118	99%	14.1	C	4
VDOT Continuous Count	150092		Hampton	n.a.	**Hampton Roads Center Pkwy**	I-64	Magruder Blvd	118	99%	14.8	C	4
VDOT Continuous Count	150118		Hampton	258	**Mercury Blvd**	Chestnut Ave	Big Bethel Rd	106	89%	13.1	C	8
VDOT Continuous Count	150100		Isle of Wight Co.	17	**James River Bridge**	na	na	102	86%	12.0	C	4
VDOT Continuous Count	150107		Newport News	105	**Ft. Eustis Blvd**	Jefferson Ave	NCL Newport News	119	100%	25.1	D	2
VDOT Continuous Count	50163	150051	Newport News	64	**I-64**	Oyster Point Rd	J. Clyde Morris Blvd.	104	87%	18.9	D	6
VDOT Continuous Count	150101		Newport News	143	**Jefferson Ave**	Main St	Harpersville Rd	119	100%	15.6	D	6
VDOT Continuous Count	150108		Newport News	143	**Jefferson Ave**	Denbigh Blvd	Richneck Rd	117	98%	22.7	D	4
VDOT Continuous Count	150119		Norfolk	337	**Hampton Blvd**	Lafayette River bridge	Lexan Ave.	113	95%	3.0	C	6
VDOT Continuous Count	150036	150037	Norfolk	564	**I-564**	Int'l Terminal Blvd	Admiral Taussig Blvd	116	97%	5.5	E	4
VDOT Continuous Count	150120		Norfolk	406	**International Terminal Blvd**	Hampton Blvd	Ruthven Rd	115	97%	4.2	C	4
VDOT Continuous Count	150110		Norfolk	166	**Princess Anne Rd**	Ballentine Blvd	Azalea Garden Rd	103	87%	4.2	C	4
VDOT Continuous Count	150114		Norfolk	168	**Tidewater Dr**	Norview Ave	Cromwell Dr	114	96%	3.9	D	4
VDOT Continuous Count	150010	150079	Portsmouth	264	**I-264**	Victory Blvd	Portsmouth Blvd	119	100%	3.0	C	6
VDOT Continuous Count	150109		Portsmouth	164	**Western Freeway**	Cedar Ln	West Norfolk Rd	118	99%	3.6	C	4
VDOT Continuous Count	50078		Southampton	58	**Rte 58**	Bus 58 e. Courtland	Bus 58 w. Franklin	118	99%	41.0	na	4
VDOT Continuous Count	150326		Southampton	Bus 58	**Rte 58 Bus**	Rte 58	w. corp. limit Franklin	117	98%	38.6	na	4
VDOT Continuous Count	150012	150022	Suffolk	664	**I-664**	College Dr	Western Fwy	114	96%	6.6	B	6
VDOT Continuous Count	150094		Suffolk	13	**Rte 13**	N. Carolina state line	Rte 616	115	97%	29.2	C	2
VDOT Continuous Count	50300		Suffolk	Bus 460	**Main St**	Nansemond River brid	Godwin Blvd	119	100%	18.6	D	4
VDOT Continuous Count	677732		Va. Beach	225	**Independence Blvd**	Va. Beach Blvd	Pembroke Blvd	119	100%	9.8	E	8
VDOT Continuous Count	150103		Va. Beach	58	**Laskin Rd**	Va. Beach Blvd	First Colonial Rd	119	100%	15.8	D	4
VDOT Continuous Count	677768		Va. Beach	13	**Northampton Blvd**	Diamond Springs Rd	Independence Blvd	113	95%	8.8	C	6
VDOT Continuous Count	150105		Va. Beach	615	**Oceana Blvd**	Credle Rd	First Colonial Rd	119	100%	17.4	B	4
VDOT Continuous Count	150104		Va. Beach	60	**Shore Dr**	Northampton Blvd	Bay Lake Rd	111	93%	11.0	F	4
VDOT Continuous Count	50405		York	173	**Denbigh Blvd**	Newport News CL	Rte 17	119	100%	23.3	D	2
VDOT Continuous Count	50193		York	17	**GW Memorial Hwy**	Hampton Hwy	Dare Rd	110	92%	20.2	F	4
VDOT Continuous Count	150093		York	641	**Penniman Rd**	Rte 199	Colonial Pkwy	115	97%	33.1	C	2
							AVG:	**115**	**97%**	**13.4**		

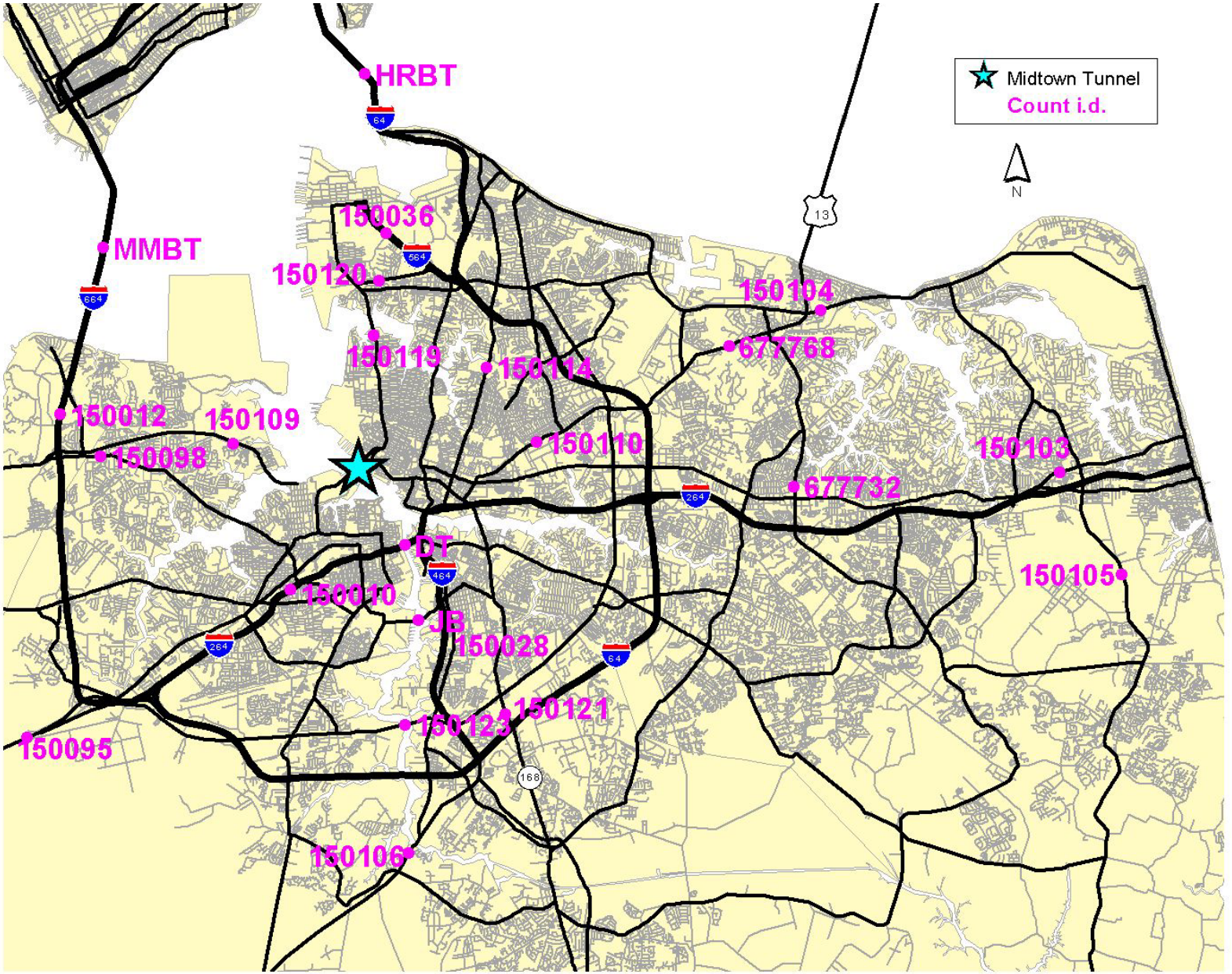
"Number of Counts" refers to the number of daily counts available during the study period of 8/4/03 through 11/30/03 (119 days).
119 counts equals 100%.
"Dist." is the euclidean distance in miles from the Midtown Tunnel.
"LOS" is the lower of the AM or PM LOS based on typical weekday counts from 1997 to 2000; it is from "Congestion Management System for Hampton Roads, Virginia 2001 - Technical Appendix", HRPDC, June 2001.
Gilmerton Bridge LOS was updated to reflect more recent traffic counts.
"na" - not available.

MAP 1. Traffic Count Locations, Regional



Count-region.jpg

MAP 2. Traffic Count Locations, South Hampton Roads



Count-local2.jpg

Analysis of Traffic Counts

The primary purpose of this study is to determine the impact that closing the Midtown Tunnel had on the transportation system of Hampton Roads. Traffic patterns vary greatly for weekdays versus weekends, and so they will be analyzed separately. Detailed profiles for each of the count locations can be found in **Appendix A**.

One caveat to be considered is that the Jordan Bridge was not collecting its usual $0.75 toll (for two-axle vehicles) during the closure of the Midtown Tunnel. The removal of this disincentive would certainly have an impact on the use of the Jordan Bridge. However, the data required to determine the magnitude of the toll's impact is not available.

Weekdays

Table 2 and **Map 3** illustrate the change in average weekday traffic volume during the closure of the Midtown Tunnel. The road segments with the largest increase in average weekday traffic were the other Elizabeth River crossings (the Jordan Bridge without a toll, Downtown Tunnel and Gilmerton Bridge). Some less-expected locations with increases were I-564 (alternate route to the Navy base), Battlefield Blvd. north of I-64, Mercury Blvd., and the HRBT. The largest declines in weekday traffic were I-664, Western Freeway, Hampton Blvd., and Military Highway at Bower's Hill. Some of these locations (e.g. Oceana Blvd.) may have had changes in traffic volumes that were not the direct result of the Midtown Tunnel closure. Other factors (possibly military-related activities in the case of Oceana Blvd. for example) may have played a role in traffic growth or decline.

When the increases and decreases in traffic are logically connected, we can determine those corridors that are the most sensitive to changes at the Midtown Tunnel:

- **Other Elizabeth River crossings** (Jordan Bridge, Downtown Tunnel, Gilmerton Bridge)
- **Hampton Roads crossings** (HRBT, MMMBT)
- **extensions of Midtown Tunnel** (Hampton Blvd., Western Fwy.)
- **I-564**
- **Other local roads**

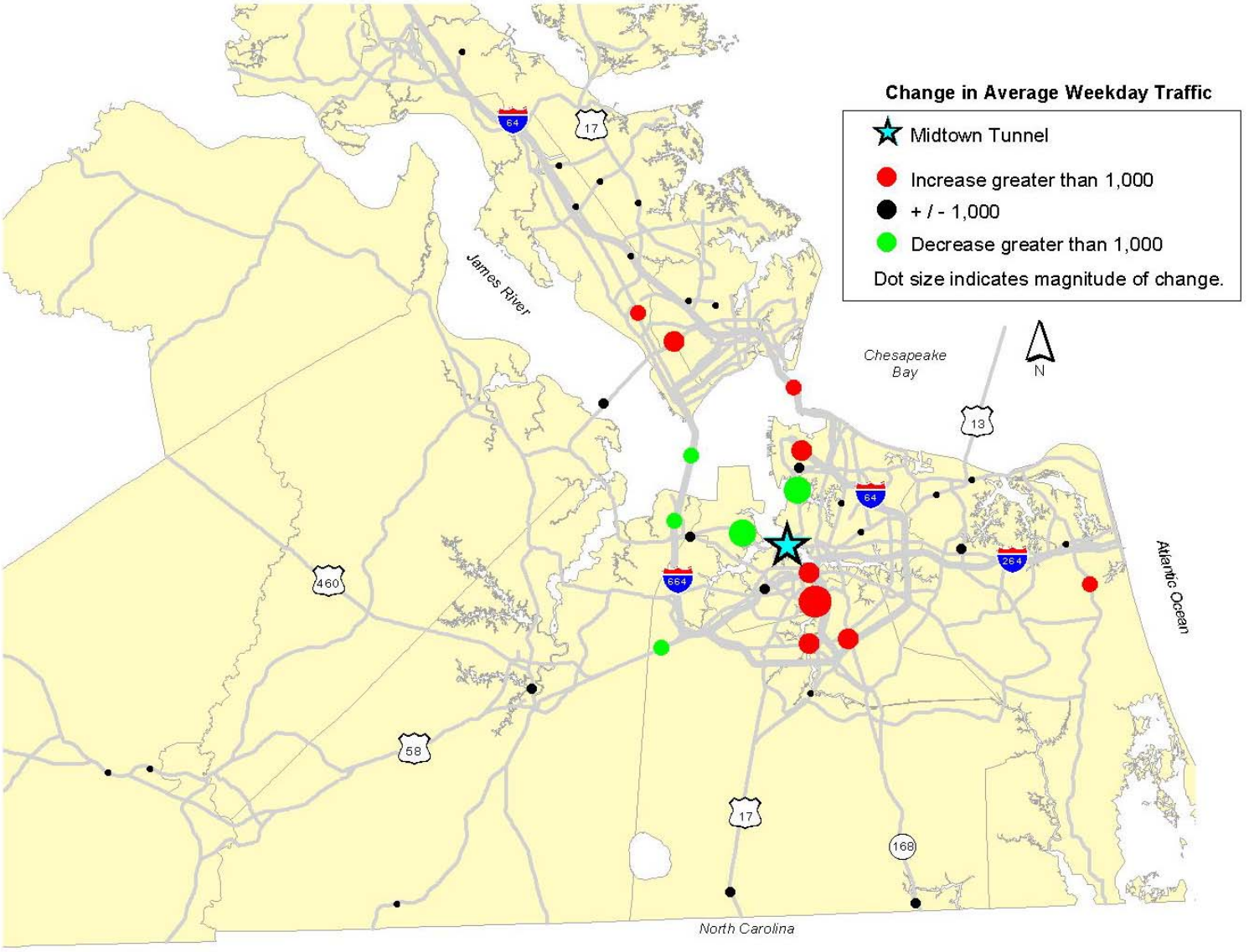
TABLE 2. Traffic Volumes for Typical Weekday vs. Midtown Tunnel Closed Weekday

ID	LOCALITY	ROAD	FROM	TO	TYPICAL WEEKDAY VOLUME	M'TOWN CLOSED WEEKDAY VOLUME	CHANGE VOLUME	% CHANGE
MT	Norf / Ports	**Midtown Tunnel**	Norfolk	Portsmouth	37,631	0	**-37,631**	**-100.0%**
JB	Ches / Ports	**Jordan Bridge**	Chesapeake	Portsmouth	6,718	20,252	**13,535**	**201.5%**
DT	Norf / Ports	**Downtown Tunnel**	Norfolk	Portsmouth	103,859	108,629	**4,771**	**4.6%**
150123	Ches	**Gilmerton Bridge**	Canal Dr	Bainbridge Blvd	36,548	41,200	**4,652**	**12.7%**
150121	Chesapeake	**Battlefield Blvd**	I-64	Military Hwy	42,987	46,591	**3,604**	**8.4%**
150118	Hampton	**Mercury Blvd**	Chestnut Ave	Big Bethel Rd	49,307	52,765	**3,459**	**7.0%**
150036 / 150037	Norfolk	**I-564**	Int'l Terminal Blvd	Admiral Taussig Blvd	49,871	53,266	**3,395**	**6.8%**
HRBT	Hamp / Norf	**I-64 (HRBT)**	Hampton	Norfolk	93,427	95,160	**1,733**	**1.9%**
150105	Va. Beach	**Oceana Blvd**	Credle Rd	First Colonial Rd	35,416	36,691	**1,276**	**3.6%**
150101	Newport News	**Jefferson Ave**	Main St	Harpersville Rd	53,687	54,775	**1,089**	**2.0%**
150120	Norfolk	**Int'l Terminal Blvd**	Hampton Blvd	Ruthven Rd	31,901	32,839	**938**	**2.9%**
150098	Chesapeake	**Bridge Rd**	Churchland Blvd	ECL Suffolk	22,825	23,683	**859**	**3.8%**
150100	Isle of Wight Co.	**James River Bridge**	na	na	28,450	29,302	**852**	**3.0%**
50300	Suffolk	**Main St**	Nansemond River bridge	Godwin Blvd	29,357	30,121	**765**	**2.6%**
677732	Va. Beach	**Independence Blvd**	Va. Beach Blvd	Pembroke Blvd	55,391	56,148	**758**	**1.4%**
150103	Va. Beach	**Laskin Rd**	Va. Beach Blvd	First Colonial Rd	30,493	30,986	**494**	**1.6%**
150091	Hampton	**Armistead Ave**	Tidemill Ln	Hampton Roads Center Pkwy	36,726	37,169	**443**	**1.2%**
150114	Norfolk	**Tidewater Dr**	Norview Ave	Cromwell Dr	40,772	41,177	**405**	**1.0%**
150092	Hampton	**HRCP**	I-64	Magruder Blvd	55,494	55,841	**346**	**0.6%**
150108	Newport News	**Jefferson Ave**	Denbigh Blvd	Richneck Rd	38,039	38,384	**345**	**0.9%**
150110	Norfolk	**Princess Anne Rd**	Ballentine Blvd	Azalea Garden Rd	24,236	24,379	**143**	**0.6%**
50193	York	**GW Mem Hwy**	Hampton Hwy	Dare Rd.	57,241	57,382	**141**	**0.2%**
150326	Southampton	**Rte 58 Bus**	Rte 58	w. corp. limit Franklin	3,446	3,554	**109**	**3.2%**
50405	York	**Denbigh Blvd**	Newport News CL	Rte 17	16,445	16,504	**59**	**0.4%**
150104	Va. Beach	**Shore Dr**	Northampton Blvd	Bay Lake Rd	42,084	42,080	**-4**	**0.0%**
150093	York	**Penniman Rd**	Rte 199	Colonial Pkwy	4,605	4,459	**-145**	**-3.2%**
677768	Va. Beach	**Northampton Blvd**	Diamond Springs Rd	Independence Blvd	40,894	40,712	**-182**	**-0.4%**
150107	Newport News	**Ft Eustis Blvd**	Jefferson Ave	NCL Newport News	16,725	16,487	**-237**	**-1.4%**
150094	Suffolk	**Rte 13**	N. Carolina state line	Rte 616	5,382	5,121	**-261**	**-4.8%**
150106	Chesapeake	**Dominion Blvd**	Cedar Rd	Bainbridge Blvd	29,975	29,684	**-291**	**-1.0%**
50078	Southampton	**Rte 58**	Bus 58, e. of Courtland	Bus 58, w. of Franklin	20,002	19,708	**-294**	**-1.5%**
50163 / 150051	NN	**I-64**	Oyster Point Rd.	J. Clyde Morris Blvd.	128,339	128,010	**-329**	**-0.3%**
150111	Chesapeake	**Battlefield Blvd**	N. Carolina state line	Ballahack Rd	19,876	19,357	**-519**	**-2.6%**
150096	Chesapeake	**Rte 17**	N. Carolina state line	Ballahack Rd	10,478	9,906	**-571**	**-5.5%**
150010 / 150079	Portsmouth	**I-264**	Victory Blvd.	Portsmouth Blvd.	66,333	65,400	**-933**	**-1.4%**
150095	Chesapeake	**Military Hwy**	ECL Suffolk	I-664	68,013	66,967	**-1,045**	**-1.5%**
MMBT	Suff / NN	**I-664 (MMMBT)**	Suffolk	Newport News	54,334	52,186	**-2,149**	**-4.0%**
150012 / 150022	Suffolk	**I-664**	College Dr	Western Fwy	57,117	54,724	**-2,393**	**-4.2%**
150119	Norfolk	**Hampton Blvd**	Lafayette River bridge	Lexan Ave.	44,925	39,378	**-5,548**	**-12.3%**
150109	Portsmouth	**Western Fwy**	Cedar Ln	West Norfolk Rd	25,044	18,893	**-6,152**	**-24.6%**

Typical Weekday is average of T, W, TH from 9/2/03 - 9/14/03 and 11/3/03 - 11/26/03, not including Veteran's Day.
Midtown Closed Weekday is average of T, W, TH from 9/22/03 - 10/14/03.

Source of counts: VDOT and City of Chesapeake.

MAP 3. Change in Weekday Traffic Volumes With Midtown Tunnel Closed



chg-week day.jpg

Prepared by HRPDC, May 2004.

Saturdays

The changes in traffic patterns are more difficult to determine for weekend versus weekday traffic. This is due to the greater variety and sensitivity of activities that people get involved with during their weekends, as opposed to weekday activities being largely repetitive and predictable. For example, the weather could have an impact on discretionary shopping or outdoor activities during a weekend. Also, many special events are held during weekends. Because of the complexities of weekend traffic, few conclusions are made, with the remaining data being informational.

Map 4 and **Table 3** illustrate the change in average Saturday traffic volumes during the closure of the Midtown Tunnel. Many of the changes in traffic patterns are similar to those seen for the weekday traffic. There is increased traffic along the Elizabeth River routes of the Downtown Tunnel, Jordan Bridge, and Gilmerton Bridge. There are also increases in traffic on the HRBT and I-564. Likewise, there were decreases at the MMMBT, Western Fwy., and Hampton Blvd. There were also many other roads (e.g., Northampton Blvd., Dominion Blvd., several roads on the Peninsula) with increases in volume. They may or may not have been impacted by the Midtown Tunnel closing. For example, those living on the Peninsula may have chosen to not travel to South Hampton Roads on weekends while the Midtown Tunnel was closed, instead staying closer to home, with the result being an increase in volume on the Peninsula roads. This explanation is speculative, however.

Elizabeth River and Peninsula-South Hampton Roads Crossings

It appears that the total volume of traffic using the Elizabeth River crossings declined during the Midtown Tunnel closure. See **Table 4.** Two important continuous traffic count locations were unavailable, however – the I-64 High-Rise Bridge and the Campostella Bridge. This prevents making a definitive calculation of all Elizabeth River Crossings. These two missing facilities would had to have increased in traffic volume by almost 15,000 vehicles per day to help make up for the loss of traffic at the Midtown Tunnel. The Jordan Bridge (without a toll) was the most desirable alternate to the Midtown Tunnel during the week while the Downtown Tunnel was the most desirable alternate on the weekend.

The volume of traffic crossing from the Peninsula to South Hampton Roads was not impacted as greatly by the Midtown Tunnel closure as the Elizabeth River crossings. The most noticeable impact was a shift of users from the MMMBT to the HRBT. During the week, the net effect was almost negligible, with a change of only a little over 400 in total Hampton Roads crossings. On Saturdays, there was an average increase of about 3,000 in total Hampton Roads crossings, possibly due to truck and personal trips involved with continued clean-up following Isabel.

TABLE 4. Elizabeth River and Peninsula-South Hampton Roads Crossings

	ID	Road	From	To	Avg. Weekday Change	Portion of M.T. Vol.	Avg. Saturday Change	Portion of M.T. Vol.
	MT	**Midtown Tunnel**	Norfolk	Portsmouth	**- 37,631**	100%	**- 22,158**	100%
ELIZABETH RIVER CROSSINGS	JB	Jordan Bridge	Chesapeake	Portsmouth	+ 13,535	36%	+ 6,546	30%
	DT	Downtown Tunnel	Norfolk	Portsmouth	+ 4,771	13%	+ 10,491	47%
	150123	Gilmerton Bridge	Canal Dr.	Bainbridge Blvd.	+ 4,652	12%	+ 1,462	7%
				SUBTOTAL	**- 14,673**	**61%**	**- 3,659**	**83%**
		I-64 High-rise bridge	I-464	G.W. Hwy.	n.a.	n.a.	n.a.	n.a.
		Campostella bridge	I-264	Wilson Rd.	n.a.	n.a.	n.a.	n.a.
HAMPTON ROADS CROSSINGS	HRBT	I-64 (HRBT)	Hampton	Norfolk	+ 1,733	5%	+ 2,604	12%
	MMBT	I-664 (MMMBT)	Suffolk	Newport News	- 2,149	6%	- 1,389	6%
		James River Bridge	Newport News	Isle of Wight Co.	+ 852	2%	+ 1,814	8%
				SUBTOTAL	**+ 436**	**1%**	**+ 3,029**	**14%**

Change is avg. volume with Midtown Tunnel closed minus avg. volume with M.T. open.
n.a. = not available

MAP 4. Change in Saturday Traffic Volumes With Midtown Tunnel Closed

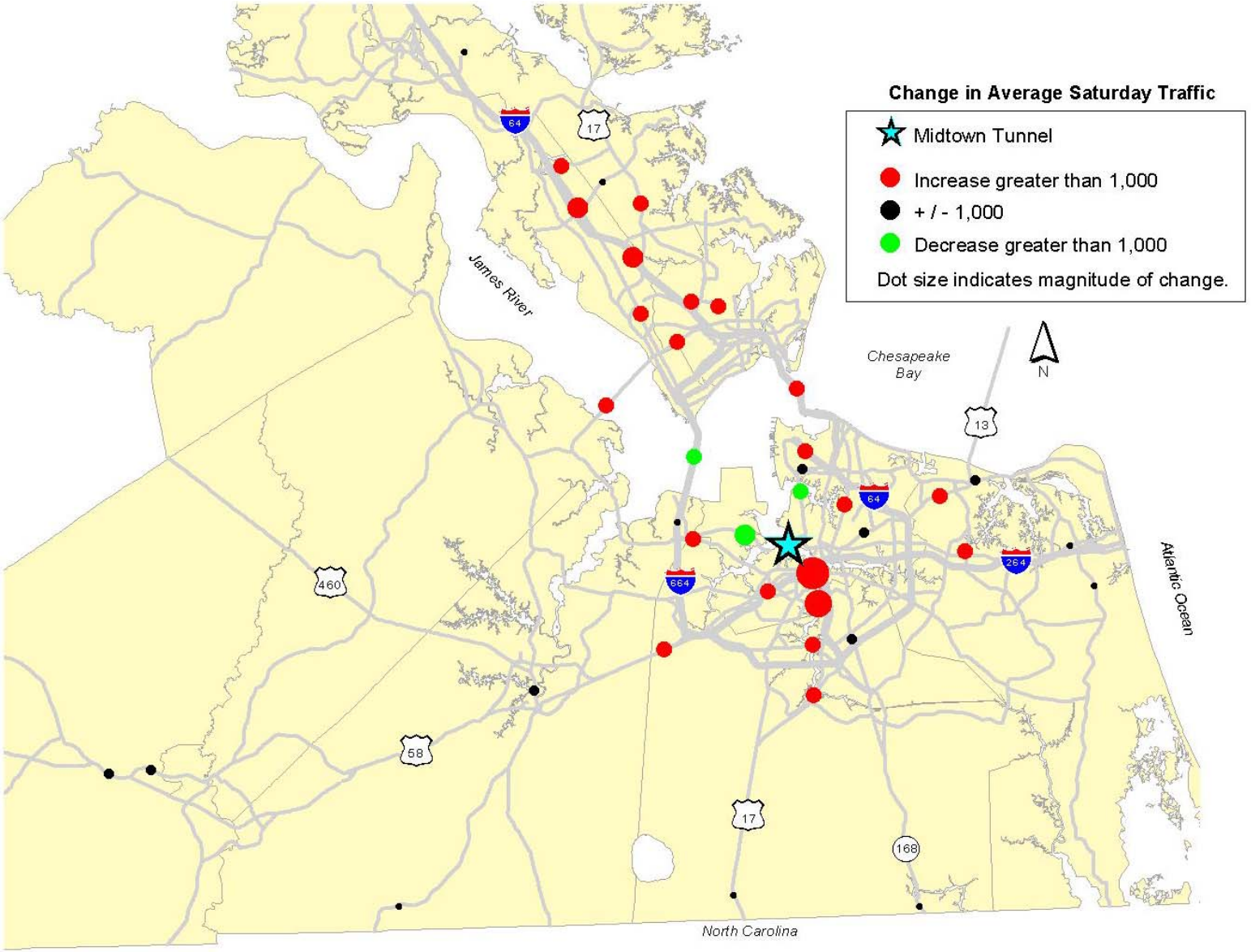


TABLE 3. Traffic Volumes for Typical Saturday vs. Midtown Tunnel Closed Saturday

ID	LOCALITY	ROAD	FROM	TO	TYPICAL SATURDAY VOLUME	M'TOWN CLOSED SATURDAY VOLUME	CHANGE VOLUME	% CHANGE
MT	Norf / Ports	**Midtown Tunnel**	Norfolk	Portsmouth	22,158	0	**-22,158**	**-100%**
DT	Norf / Ports	**Downtown Tunnel**	Norfolk	Portsmouth	89,529	100,021	**10,491**	**11.7%**
JB	Ches / Ports	**Jordan Bridge**	Chesapeake	Portsmouth	3,309	9,855	**6,546**	**197.8%**
50163 / 150051	NN	**I-64**	Oyster Point Rd.	J. Clyde Morris Blvd.	118,684	123,645	**4,960**	**4.2%**
150108	Newport News	**Jefferson Ave**	Denbigh Blvd	Richneck Rd	34,031	37,743	**3,712**	**10.9%**
HRBT	Hamp / Norf	**I-64 (HRBT)**	Hampton	Norfolk	86,491	89,095	**2,604**	**3.0%**
150010 / 150079	Portsmouth	**I-264**	Victory Blvd.	Portsmouth Blvd.	53,824	56,233	**2,409**	**4.5%**
677732	Va. Beach	**Independence Blvd**	Va. Beach Blvd	Pembroke Blvd	48,065	50,441	**2,376**	**4.9%**
677768	Va. Beach	**Northampton Blvd**	Diamond Springs Rd	Independence Blvd	35,537	37,817	**2,280**	**6.4%**
150114	Norfolk	**Tidewater Dr**	Norview Ave	Cromwell Dr	33,484	35,707	**2,222**	**6.6%**
150101	Newport News	**Jefferson Ave**	Main St	Harpersville Rd	44,265	46,433	**2,168**	**4.9%**
150092	Hampton	**HRCP**	I-64	Magruder Blvd	41,975	43,910	**1,935**	**4.6%**
150107	Newport News	**Ft Eustis Blvd**	Jefferson Ave	NCL Newport News	13,154	15,049	**1,894**	**14.4%**
150098	Chesapeake	**Bridge Rd**	Churchland Blvd	ECL Suffolk	21,738	23,605	**1,867**	**8.6%**
150095	Chesapeake	**Military Hwy**	ECL Suffolk	I-664	61,254	63,116	**1,862**	**3.0%**
150091	Hampton	**Armistead Ave**	Tidemill Ln	Hampton Roads Center Pkwy	28,446	30,276	**1,830**	**6.4%**
150100	Isle of Wight Co.	**James River Bridge**	na	na	25,780	27,594	**1,814**	**7.0%**
50193	York	**GW Mem Hwy**	Hampton Hwy	Dare Rd.	50,389	52,120	**1,731**	**3.4%**
150123	Ches	**Gilmerton Bridge**	Canal Dr	Bainbridge Blvd	27,195	28,657	**1,462**	**5.4%**
150118	Hampton	**Mercury Blvd**	Chestnut Ave	Big Bethel Rd	53,230	54,632	**1,402**	**2.6%**
150106	Chesapeake	**Dominion Blvd**	Cedar Rd	Bainbridge Blvd	25,852	26,938	**1,086**	**4.2%**
150036 / 150037	Norfolk	**I-564**	Int'l Terminal Blvd	Admiral Taussig Blvd	25,693	26,714	**1,021**	**4.0%**
150120	Norfolk	**Int'l Terminal Blvd**	Hampton Blvd	Ruthven Rd	21,804	22,789	**985**	**4.5%**
150104	Va. Beach	**Shore Dr**	Northampton Blvd	Bay Lake Rd	36,812	37,765	**953**	**2.6%**
50078	Southampton	**Rte 58**	Bus 58, e. of Courtland	Bus 58, w. of Franklin	18,268	19,207	**939**	**5.1%**
150110	Norfolk	**Princess Anne Rd**	Ballentine Blvd	Azalea Garden Rd	18,396	19,332	**936**	**5.1%**
50300	Suffolk	**Main St**	Nansemond River bridge	Godwin Blvd	27,049	27,957	**908**	**3.4%**
150121	Chesapeake	**Battlefield Blvd**	I-64	Military Hwy	37,388	38,140	**752**	**2.0%**
150326	Southampton	**Rte 58 Bus**	Rte 58	w. corp. limit Franklin	2,321	2,835	**514**	**22.1%**
150093	York	**Penniman Rd**	Rte 199	Colonial Pkwy	3,139	3,368	**229**	**7.3%**
150012 / 150022	Suffolk	**I-664**	College Dr	Western Fwy	43,034	43,242	**208**	**0.5%**
50405	York	**Denbigh Blvd**	Newport News CL	Rte 17	15,699	15,759	**60**	**0.4%**
150096	Chesapeake	**Rte 17**	N. Carolina state line	Ballahack Rd	10,554	10,526	**-28**	**-0.3%**
150111	Chesapeake	**Battlefield Blvd**	N. Carolina state line	Ballahack Rd	24,404	24,296	**-108**	**-0.4%**
150094	Suffolk	**Rte 13**	N. Carolina state line	Rte 616	6,274	6,128	**-146**	**-2.3%**
150105	Va. Beach	**Oceana Blvd**	Credle Rd	First Colonial Rd	27,342	27,158	**-184**	**-0.7%**
150103	Va. Beach	**Laskin Rd**	Va. Beach Blvd	First Colonial Rd	30,845	30,605	**-241**	**-0.8%**
MMBT	Suff / NN	**I-664 (MMMBT)**	Suffolk	Newport News	45,261	43,872	**-1,389**	**-3.1%**
150119	Norfolk	**Hampton Blvd**	Lafayette River bridge	Lexan Ave.	28,984	27,466	**-1,519**	**-5.2%**
150109	Portsmouth	**Western Fwy**	Cedar Ln	West Norfolk Rd	19,542	15,098	**-4,444**	**-22.7%**

Typical Saturday is average from 9/2/03 - 9/14/03 and 11/3/03 - 11/26/03.
Midtown Closed Saturday is average from 9/22/03 - 10/14/03, not including Columbus Day weekend.

Source of counts: VDOT and City of Chesapeake.

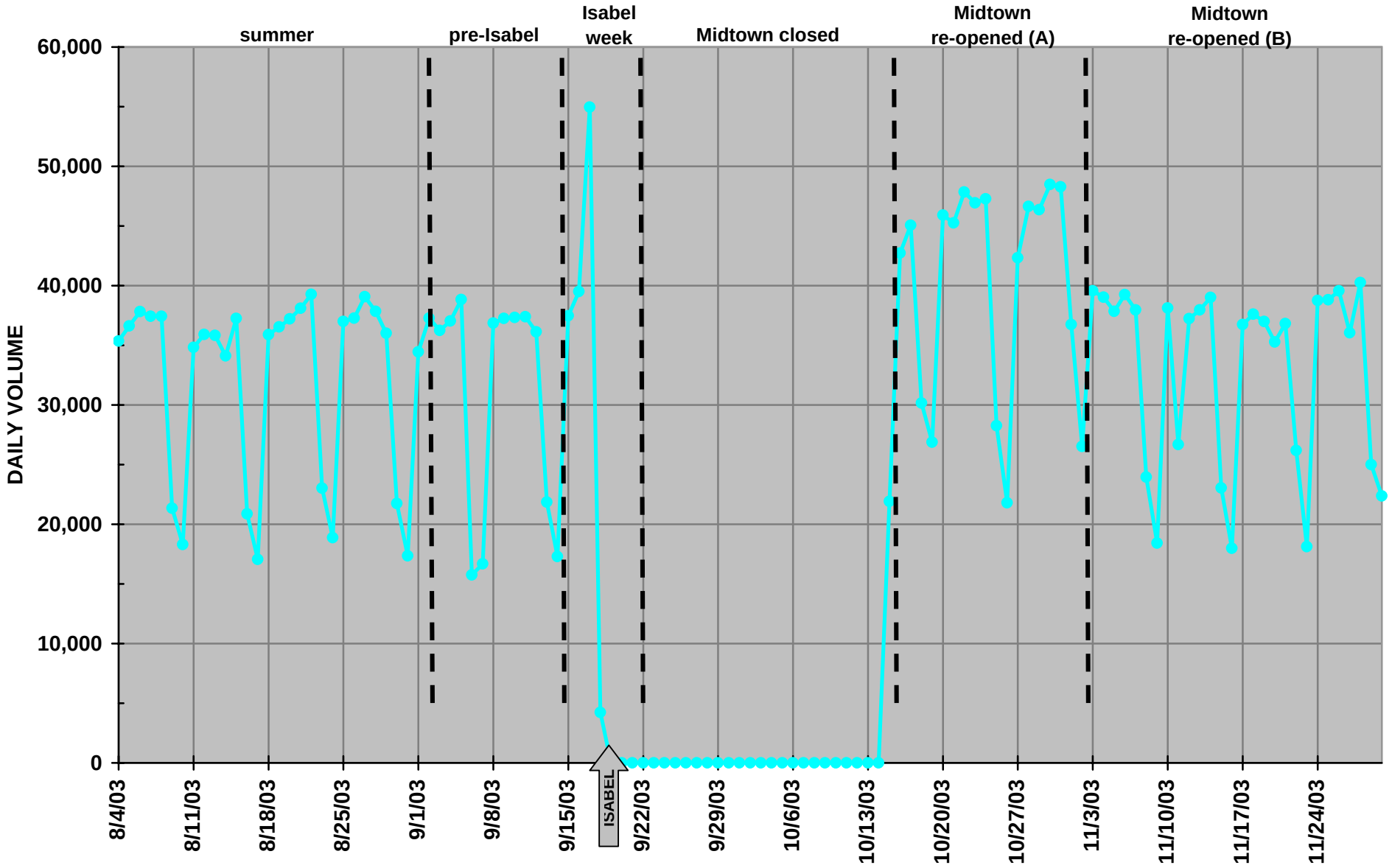
Response to the Midtown Tunnel Re-opening

The Midtown Tunnel had a noticeable increase in traffic volume immediately following its re-opening (time period Post-Reopening A – 10/16/2003 to 11/2/2003). See **Figure 4**. Additional profiles for all other facilities are in **Appendix A**.

The Midtown Tunnel weekday volumes were up about 9,000 vehicles per day during this time period versus "typical" volumes (weekdays: 46,322 vs. 37,631; Saturdays: 31,713 vs. 22,158). The possible reasons for this marked rise during this time period are varied. It could have been simply a reaction to the tunnel finally re-opening, where the media coverage of the re-opening drew new users to the facility for a short time. It could also have been due to increased demand for supplies related to Hurricane Isabel recovery and re-stocking of other goods. Truck trips across the Midtown Tunnel and to the port terminals along Hampton Blvd. would be affected by this demand, although the Hampton Blvd. and Western Fwy. did not rise as much as the Midtown Tunnel volumes.

FIGURE 4. Midtown Tunnel Traffic Volume Profile

Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT monthly tunnel reports.
Prepared by HRPDC, March 2004.

TRANSIT ANALYSIS

Hampton Roads Transit (HRT) provided daily ridership data for the Elizabeth River Ferry and monthly ridership for the entire system. Year 2002 system ridership is included as a reference, to better understand what ridership in September and October 2003 might have looked like if Isabel hadn't occurred. See **Figures 5 and 6** and **Table 5**. The Elizabeth River Ferry did show a change in ridership during the closing of the Midtown Tunnel. Weekdays increased by an average of over 300 riders and Saturdays increased by over 1,000 riders. There was also a drop in systemwide ridership due to Isabel in September 2003 followed by a recovery in ridership level in October.

TABLE 5. Elizabeth River Ferry Daily Ridership

TIME	WEEKDAY			SATURDAY		
PERIOD	Min	Max	Avg	Min	Max	Avg
Typical	474	1,040	687	638	1,718	1,167
Midtown Tunnel Closed	833	1,376	1,052	2,029	2,451	2,240
CHANGE	**359**	**336**	**365**	**1,391**	**733**	**1,073**

Weekday is T/W/TH.
Typical is based on ridership for 9/2/03-9/14/03 and 11/3/03-11/26/03, not including 11/11 and 11/22/03.

RELIABILITY OF ALTERNATE CHOICES

The alternate routes chosen by commuters during the closing of the Midtown Tunnel each have their own difficulties with accommodating the additional traffic. **Table 6** is a summary of the primary alternate routes studied and their existing and future status.

TABLE 6. Status of Alternate Routes

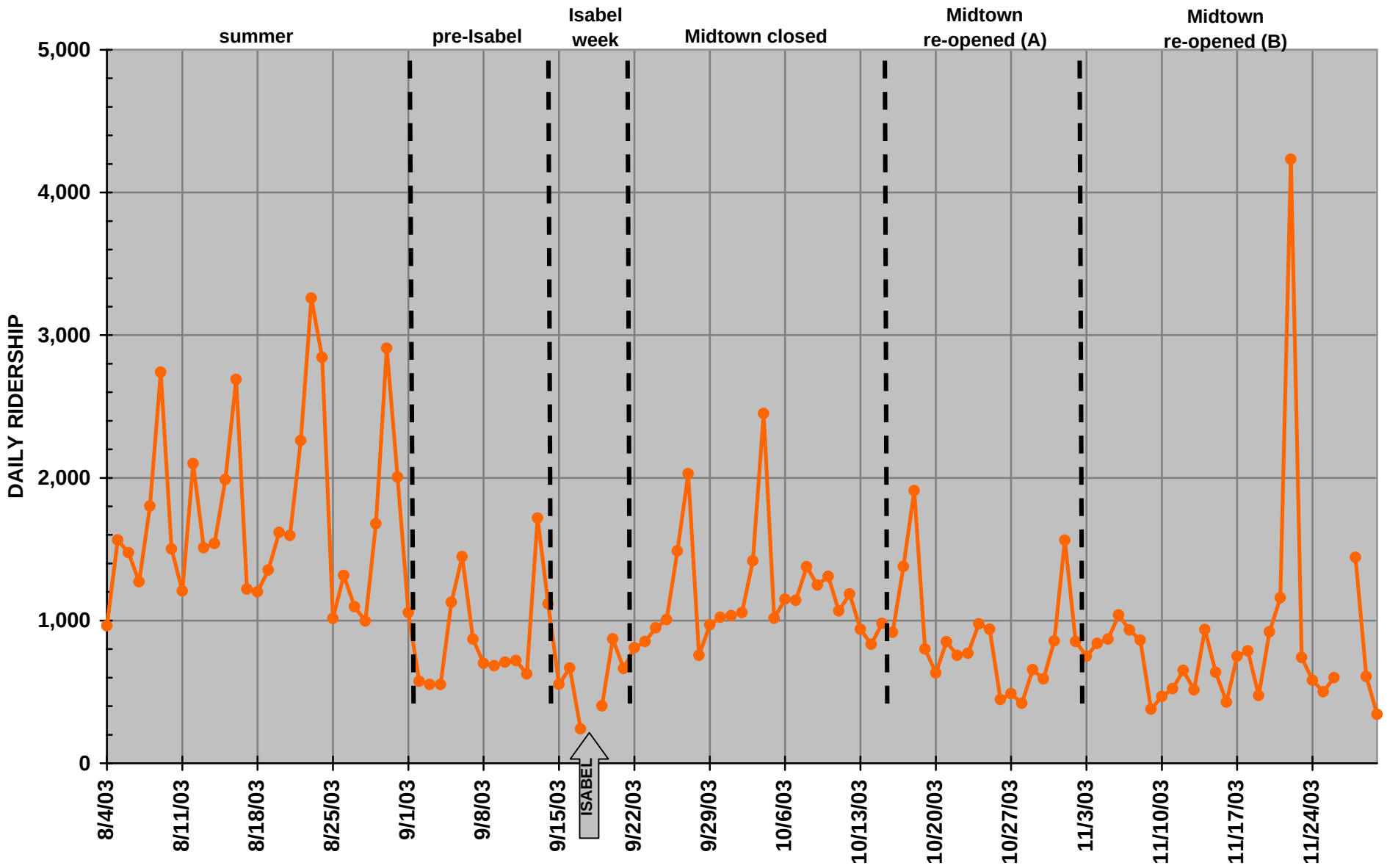
Road	Lanes	Current LOS	Typical Weekday Volume	Current Status	2026 Plan Projects
Midtown Tunnel	2	E	38,000	Long queues at am and pm peaks	No project in Plan.
Downtown Tunnel	4	F	104,000	Long queues at am and pm peaks	No project in Plan.
Jordan Bridge	2	C	7,000	Toll. Weight restriction of 3 tons.	No project in Plan.
Gilmerton Bridge	4	E	37,000	Primary alternate to High-rise Bridge.	Bridge replacement project. No additional capacity.
High-rise Bridge	4	F	88,000	Long queues several days of the week.	No project in Plan.
Total	16		274,000		

"LOS" is the lower of the AM or PM LOS based upon typical weekday counts from 1997 to 2000; it is from the "Congestion Management System for Hampton Roads, Virginia 2001 – Technical Appendix", HRPDC, June 2001. Gilmerton Bridge and High-rise Bridge counts and LOS were updated to reflect recent traffic counts.

When considering the current congestion and desirability of each of the alternate routes to the Midtown Tunnel to get across the Elizabeth River, we can see that the reliability of these routes is already delicate. A breakdown of any one of these individual routes for any time period will have an impact on the other routes. The current Regional Transportation Plan includes no capacity improvements for this whole corridor.

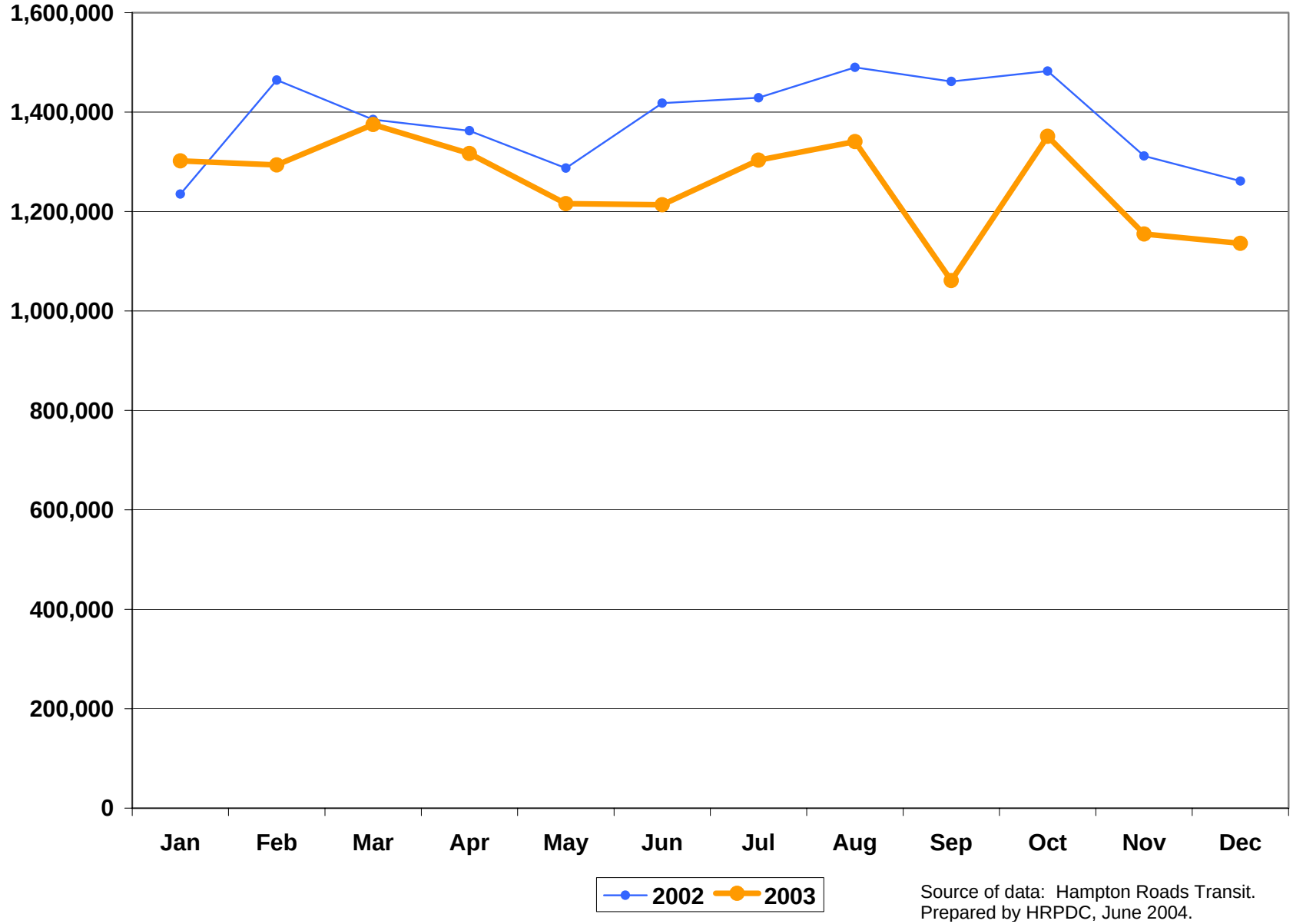
FIGURE 5. Elizabeth River Ferry

Daily Ridership: 8/4/03 to 11/30/03



Source of data: Hampton Roads Transit.
Prepared by HRPDC, June 2004.

FIGURE 6. Hampton Roads Transit Systemwide Monthly Ridership



Source of data: Hampton Roads Transit.
Prepared by HRPDC, June 2004.

COSTS OF HURRICANE ISABEL

The costs associated with Hurricane Isabel's impact are steep. **Table 7** includes cost estimates from a few sectors of the economy. The cost estimates continue to change but do provide an idea of the magnitude of expenses involved with a hurricane.

TABLE 7. Costs Associated With Hurricane Isabel

	SECTOR	GEOGRAPHY	COST ESTIMATE
1	**VDOT**	Virginia	$100 million
2	**Insurance**	Virginia	$500 million
		All areas	Over $2 billion
3	**Red Cross**	All areas	$14 million to $17 million
4	**Military base repairs**	All areas	Over $442 million
5	**Taxable sales**	Hampton Roads	$422 million increase
6	**All sectors**	Hampton Roads	$1.6 billion

Source:

1 - Virginia Department of Transportation

2 - House Subcommittee on Economic Development, Public Buildings, and Emergency Management

3 - American Red Cross

4 - Peter Hardin, Richmond Times-Dispatch

5 - Old Dominion University College of Business and Public Administration

6 - Christopher Schnaars, Daily Press.

CONCLUSIONS AND RECOMMENDATIONS

Hurricane Isabel had a tremendous impact on every community in its path, with the Outer Banks and Hampton Roads being among the hardest hit. One of the most significant events for Hampton Roads was the flooding and subsequent closure of the Midtown Tunnel for nearly four weeks. This is a critical highway in the region, serving an average of over 37,000 vehicles each weekday. An analysis of the transportation system during the closing of the Tunnel reveals useful information about the Midtown Tunnel and the region's transportation system:

- The most desirable alternate routes to the Midtown Tunnel were the Elizabeth River crossings (Jordan Bridge, Downtown Tunnel, and Gilmerton Bridge; data was not available for the High-rise Bridge). The most desirable alternate route for weekday travel was the Jordan Bridge (without a toll). The Downtown Tunnel was the most desirable alternate on Saturdays. Other important alternates were the Hampton Roads Bridge Tunnel, I-564, and the Elizabeth River Ferry.

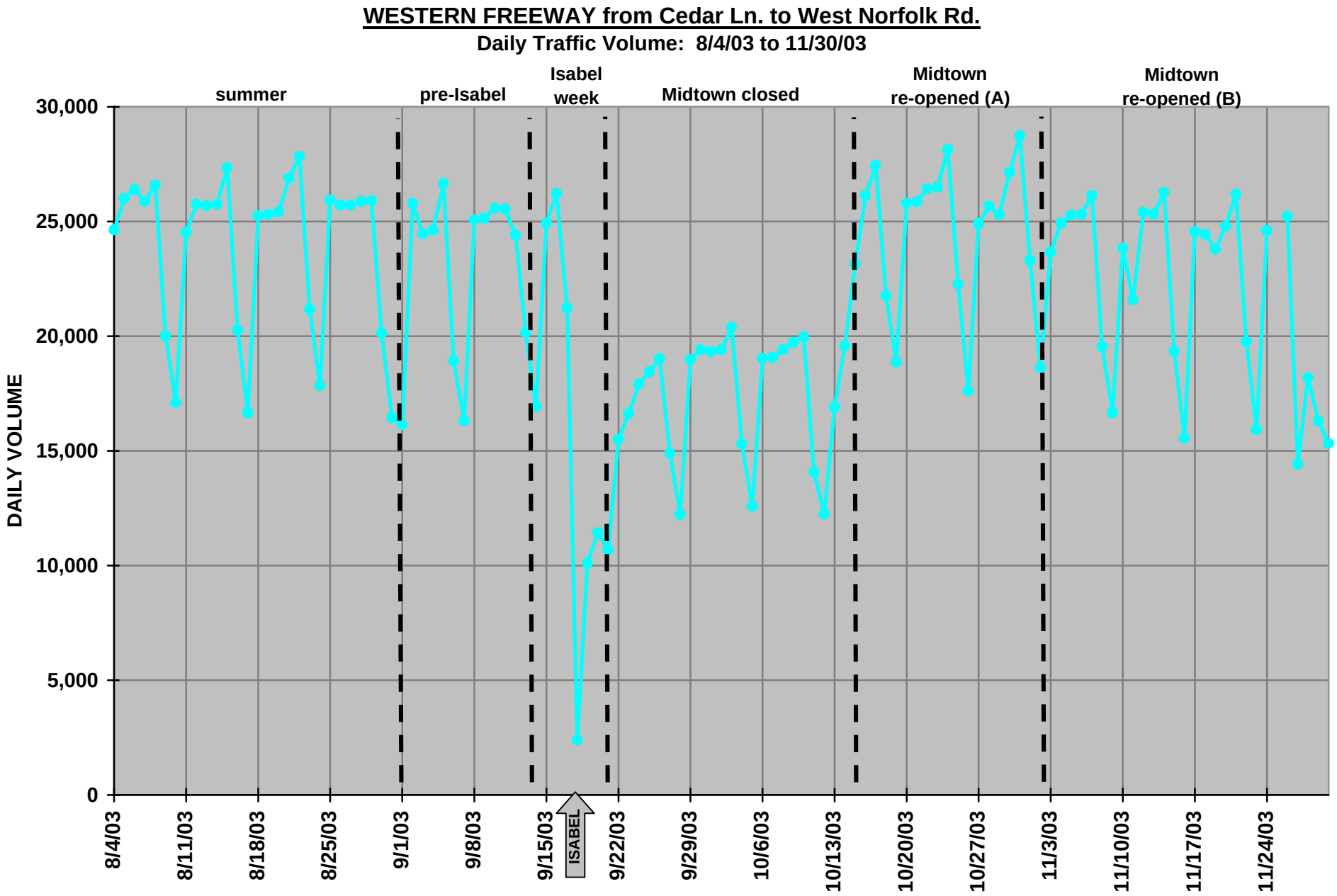
- The 2026 Regional Transportation Plan includes no capacity improvements to the Elizabeth River Crossings.

- A newly re-opened highway may attract a significant number of new users for a period of time.

- Improved data resources are needed for monitoring use of the region's traffic and transit systems, for both typical days and as unique events occur (e.g., natural disasters, accidents, completion of new road projects, etc.). This will greatly assist with timely operational analyses.

- The VDOT Smart Traffic Center and the local media are in the position of dispensing "real time" information on traffic conditions and alternate routes during natural disasters and other extraordinary events. Improvement of an action plan to provide this array of information to the public in a useful and timely manner is needed.

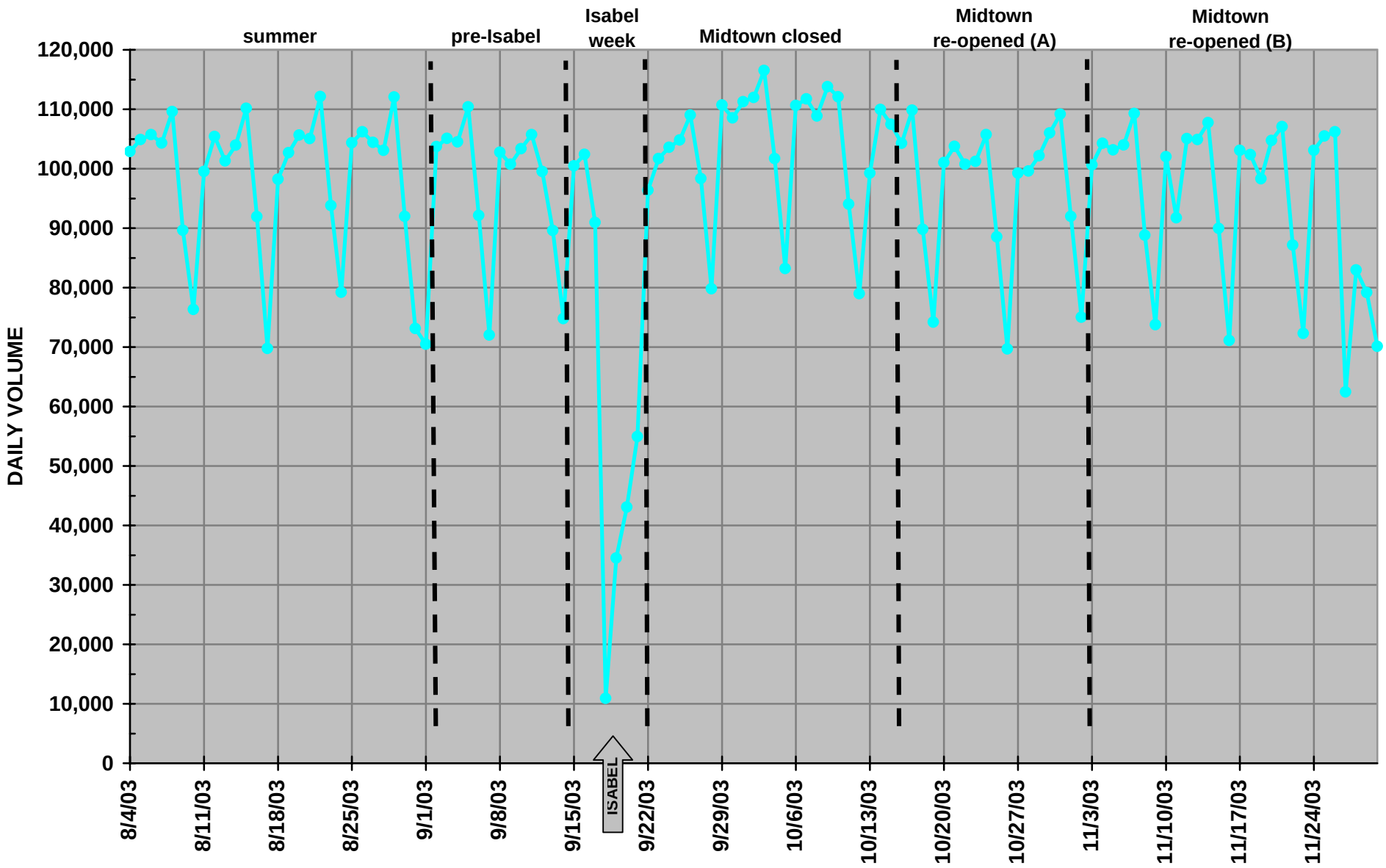
Appendix A. Traffic Volume Profiles



Source of data: VDOT, count ID 150109.
Prepared by HRPDC, March 2004.

DOWNTOWN TUNNEL (I-264)

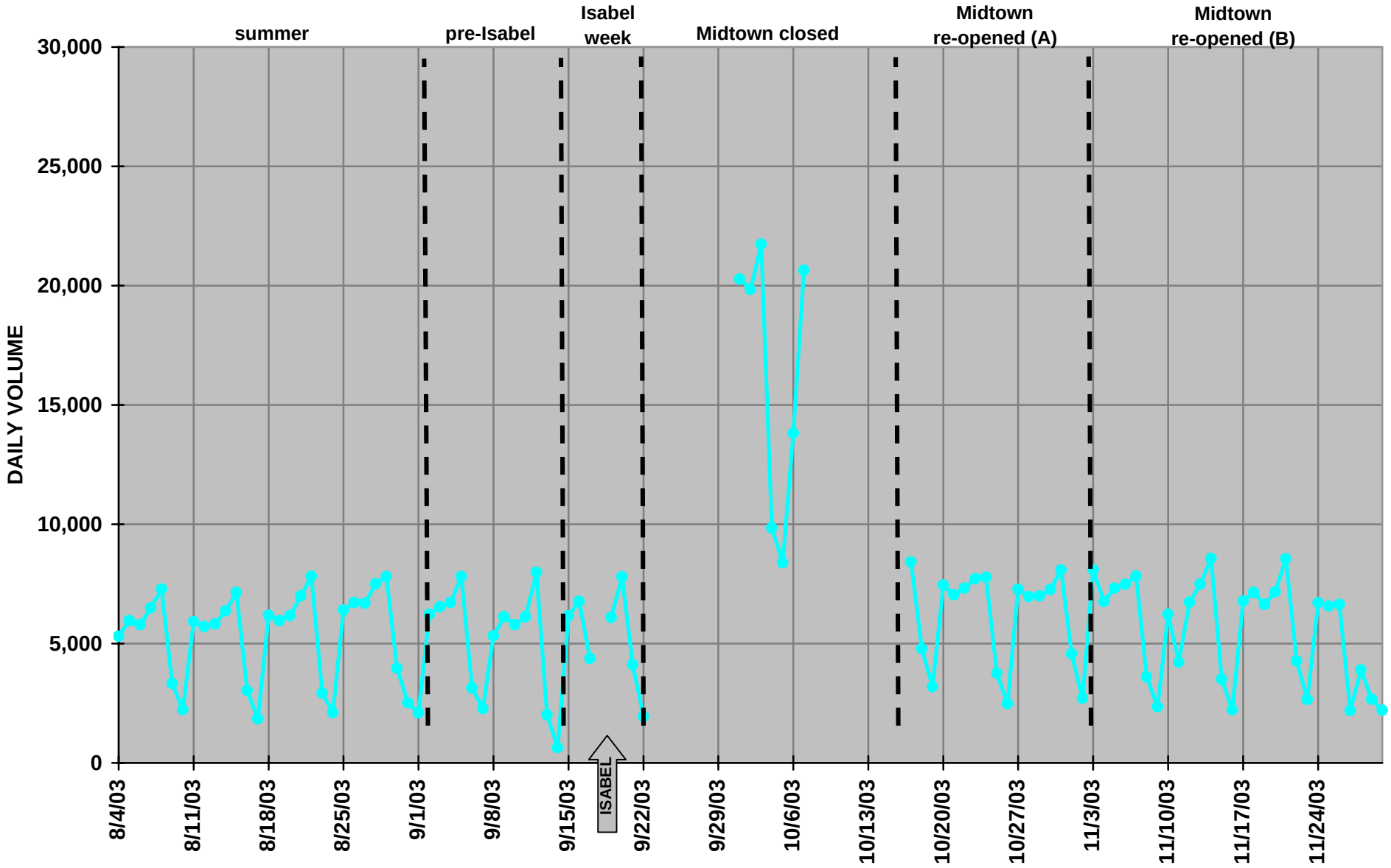
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT monthly tunnel reports.
Prepared by HRPDC, March 2004.

JORDAN BRIDGE

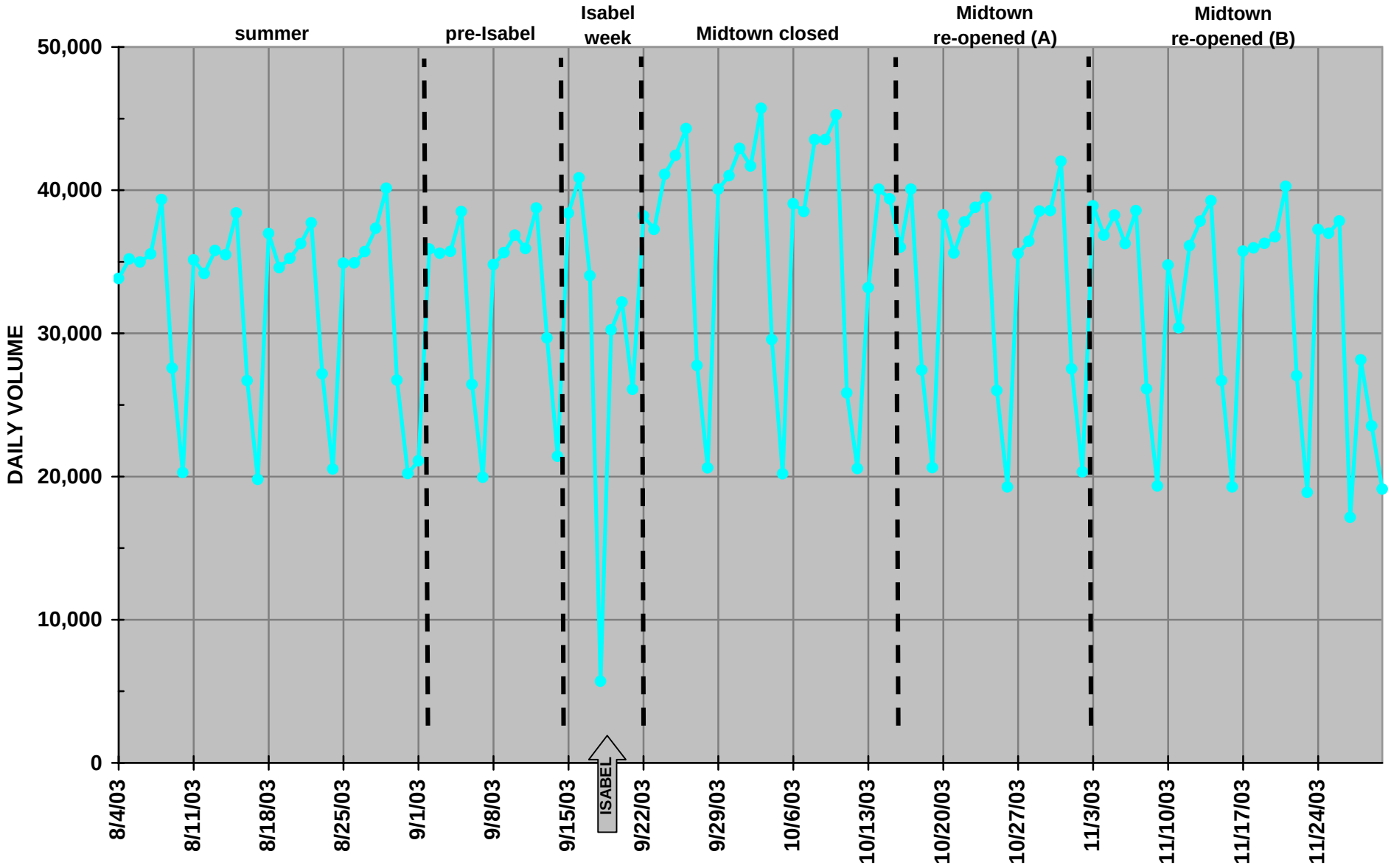
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: City of Chesapeake.
Prepared by HRPDC, March 2004.

MILITARY HIGHWAY from Canal Dr. to Bainbridge Blvd.

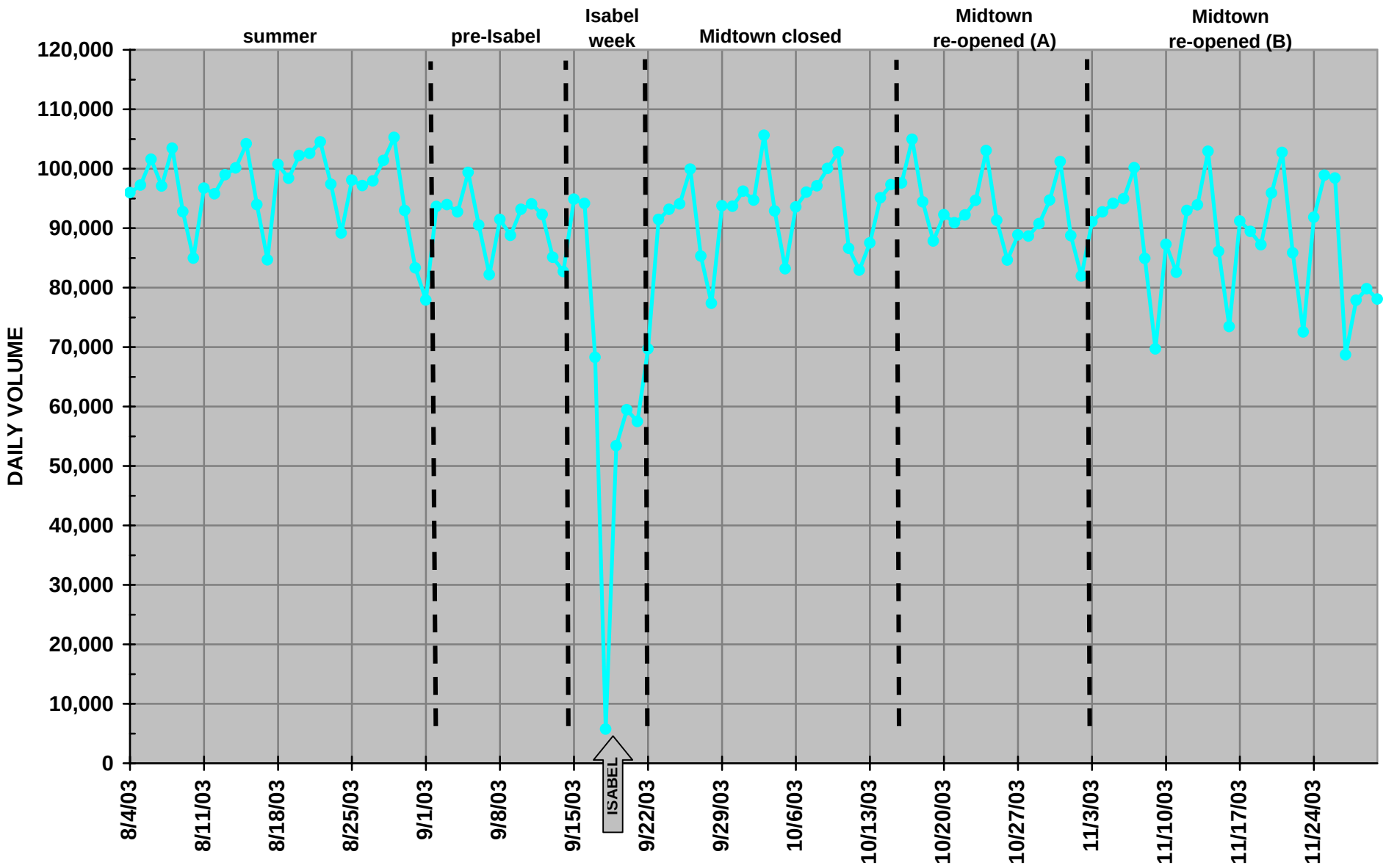
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150123.
Prepared by HRPDC, March 2004.

HAMPTON ROADS BRIDGE-TUNNEL (I-64)

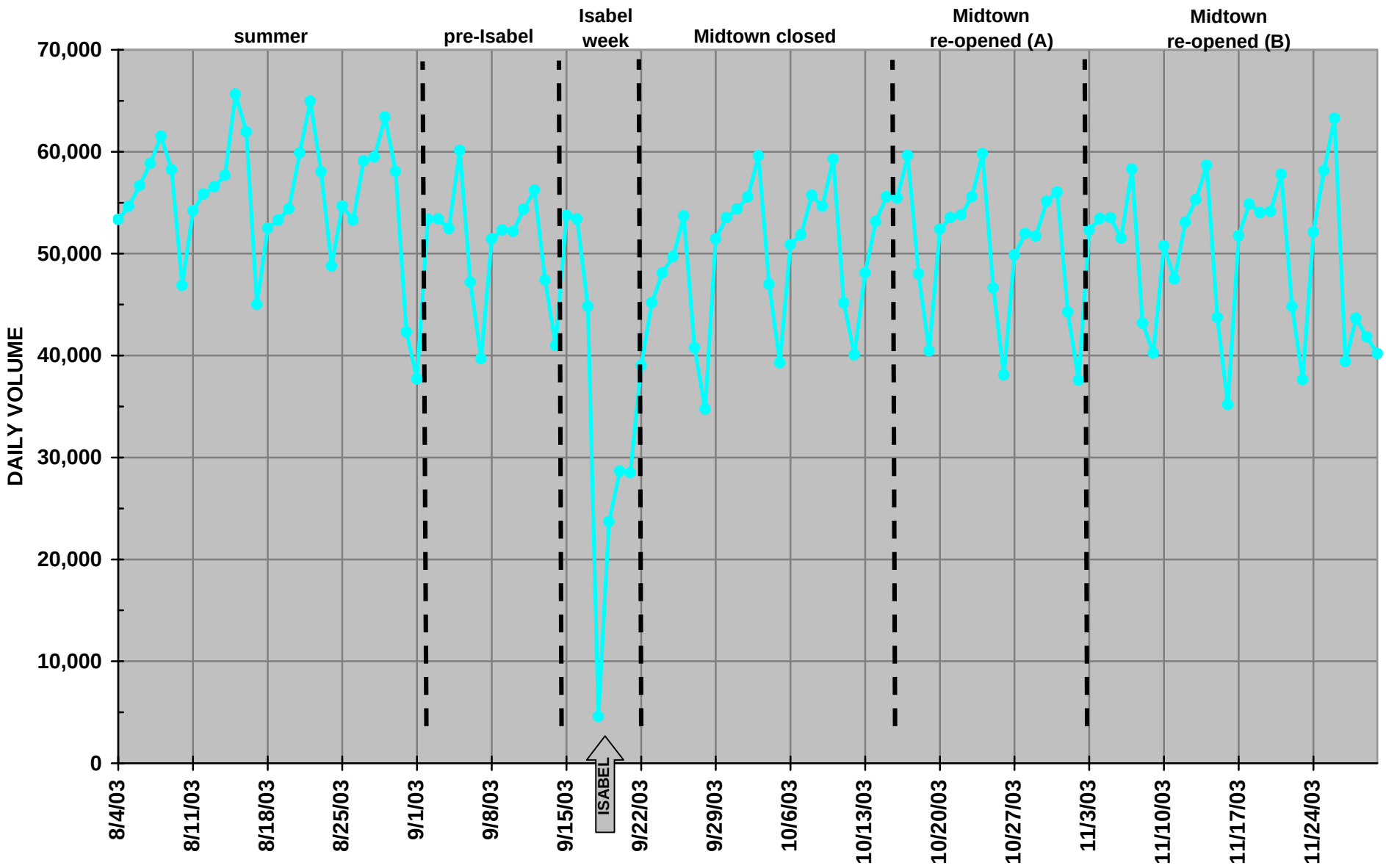
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT monthly tunnel reports.
Prepared by HRPDC, March 2004.

MONITOR MERRIMAC MEMORIAL BRIDGE-TUNNEL (I-664)

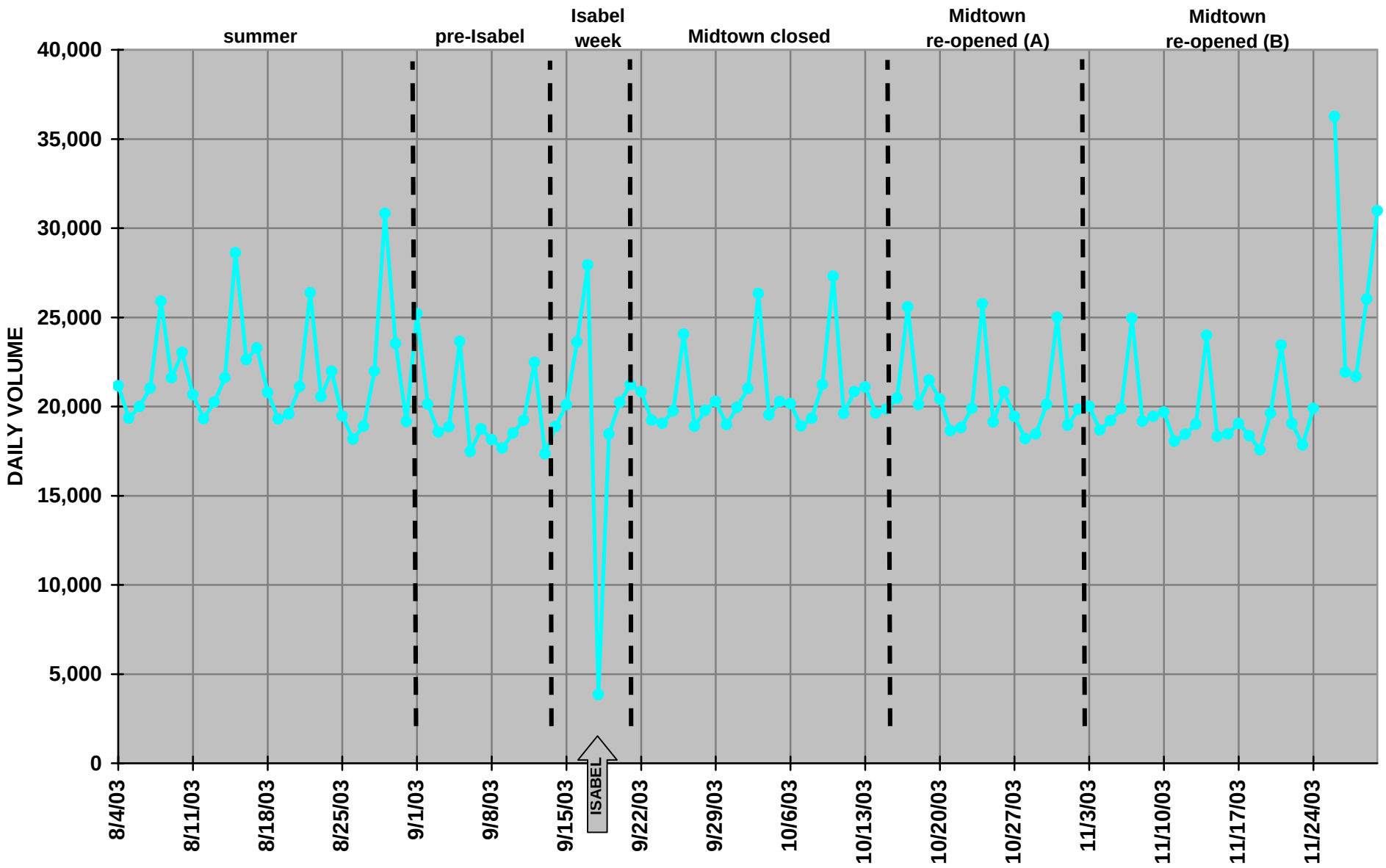
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT monthly tunnel reports.
Prepared by HRPDC, March 2004.

RTE 58 from Bus. 58 e. of Cortland to Bus. 58 w. of Franklin

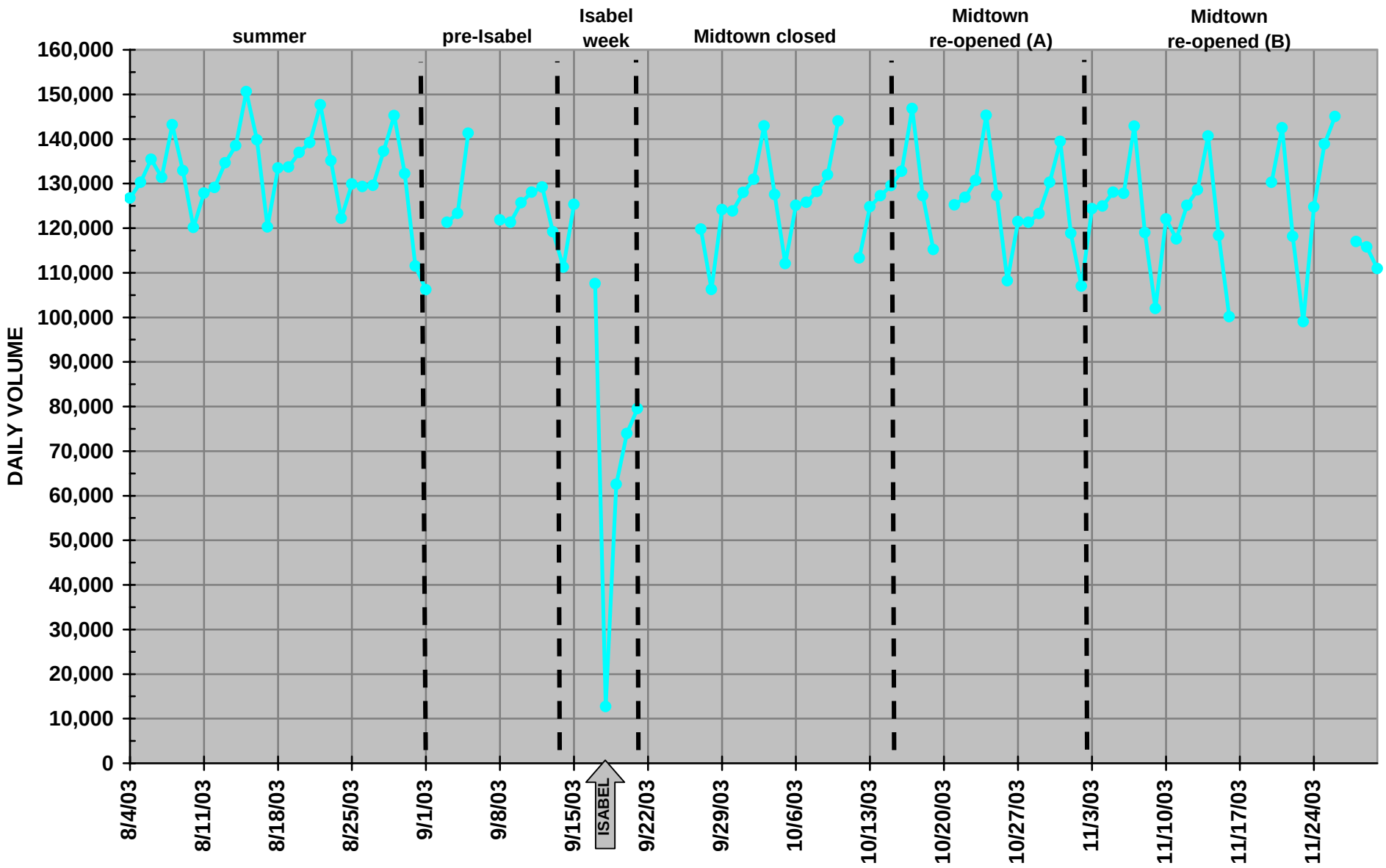
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 50078.
Prepared by HRPDC, March 2004.

I-64 from Oyster Point Rd. to J. Clyde Morris Blvd.

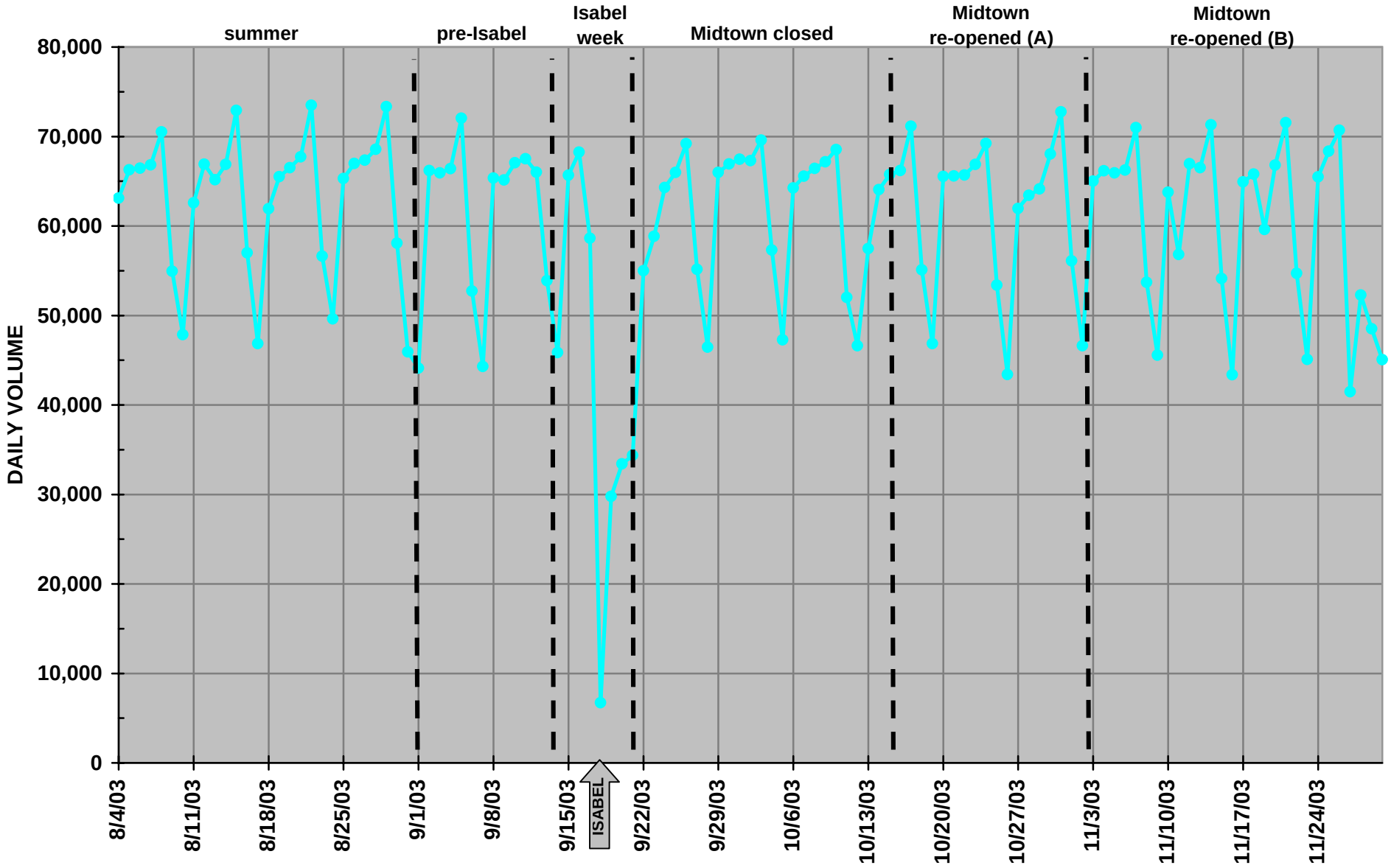
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 50163 and 150051.
Prepared by HRPDC, March 2004.

I-264 from Victory Blvd. to Portsmouth Blvd.

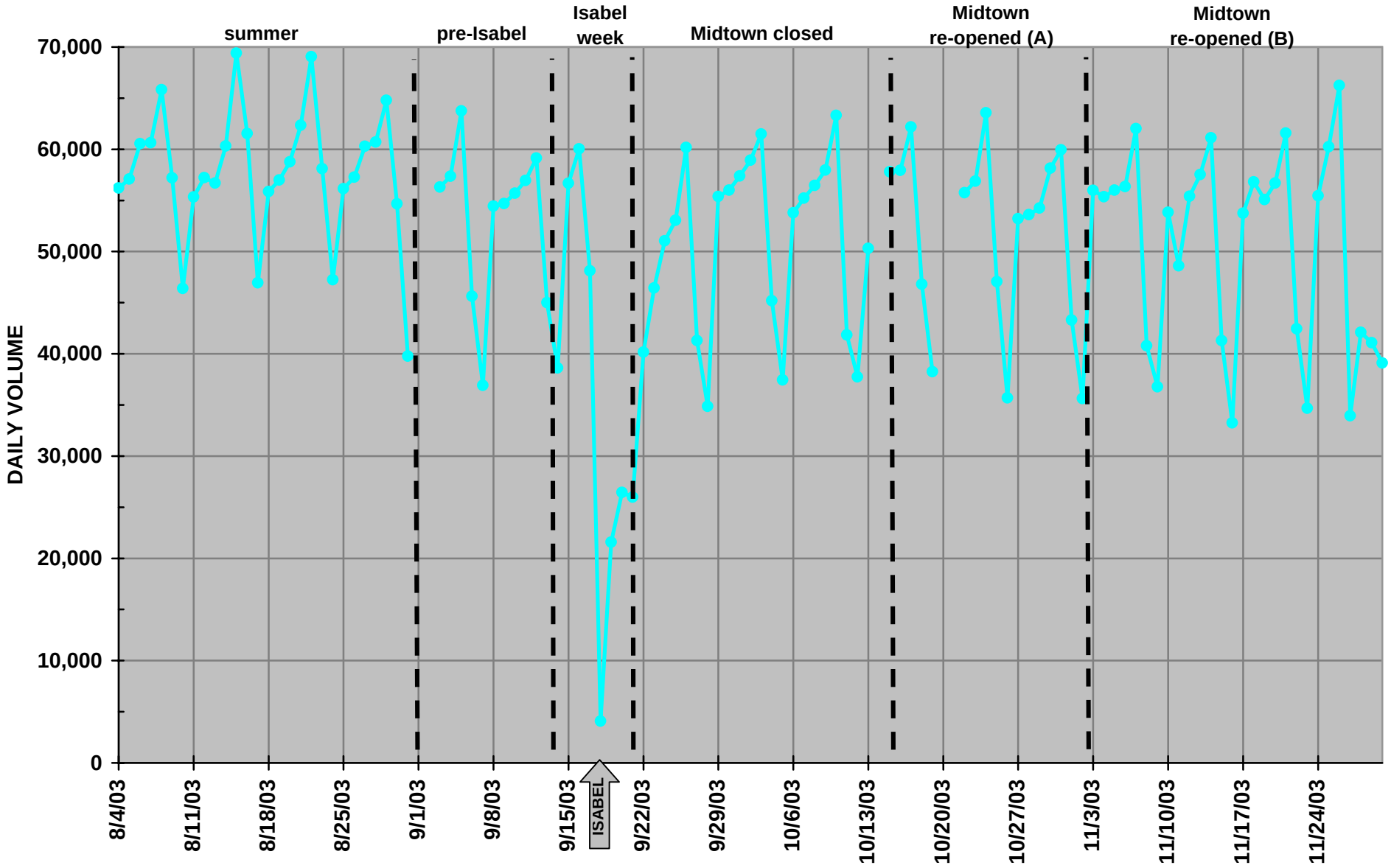
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150010 and 150079.
Prepared by HRPDC, March 2004.

I-664 from College Dr. to Western Fwy.

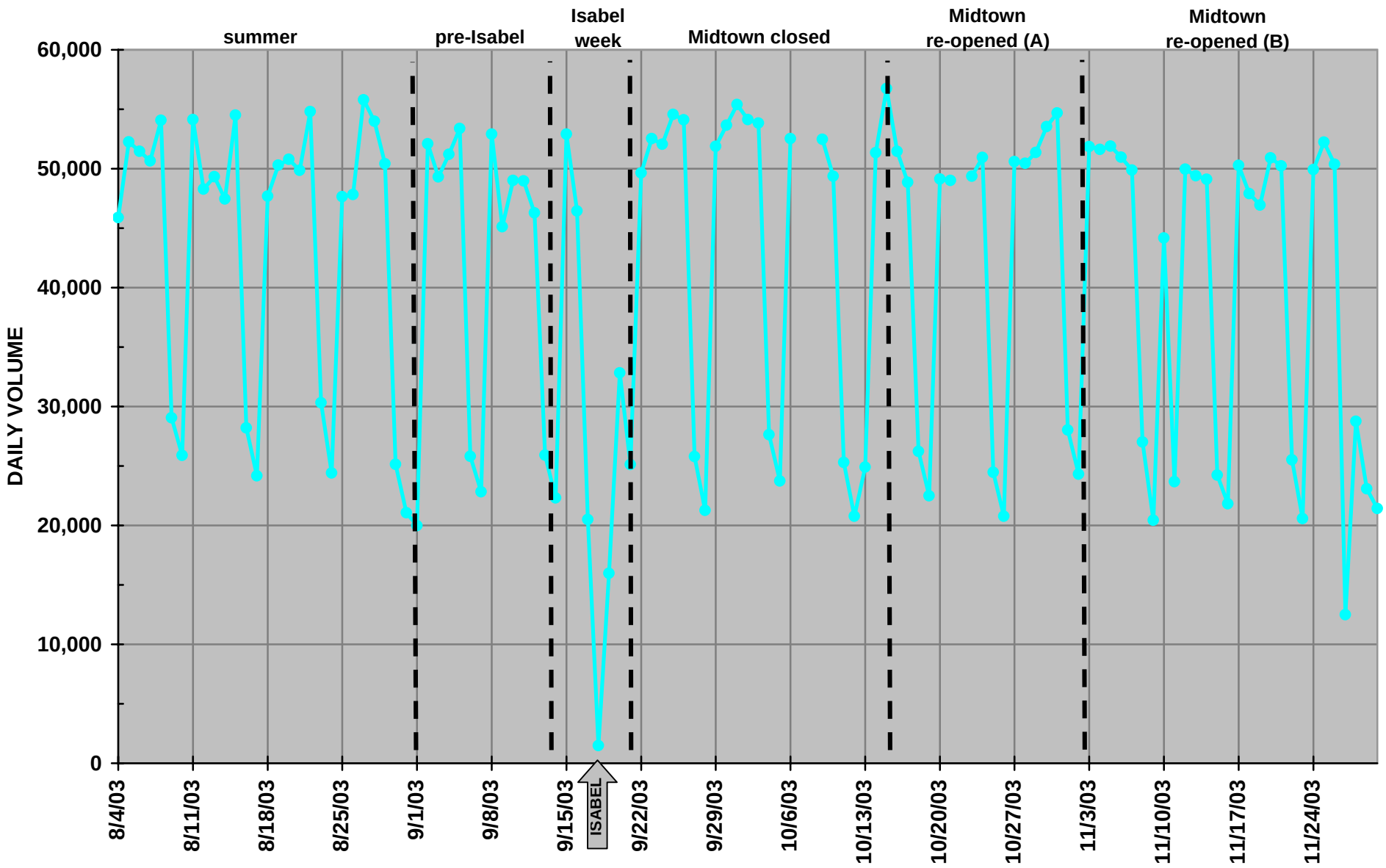
Daily Traffic Volume: 8/4/03 to 11/30/03



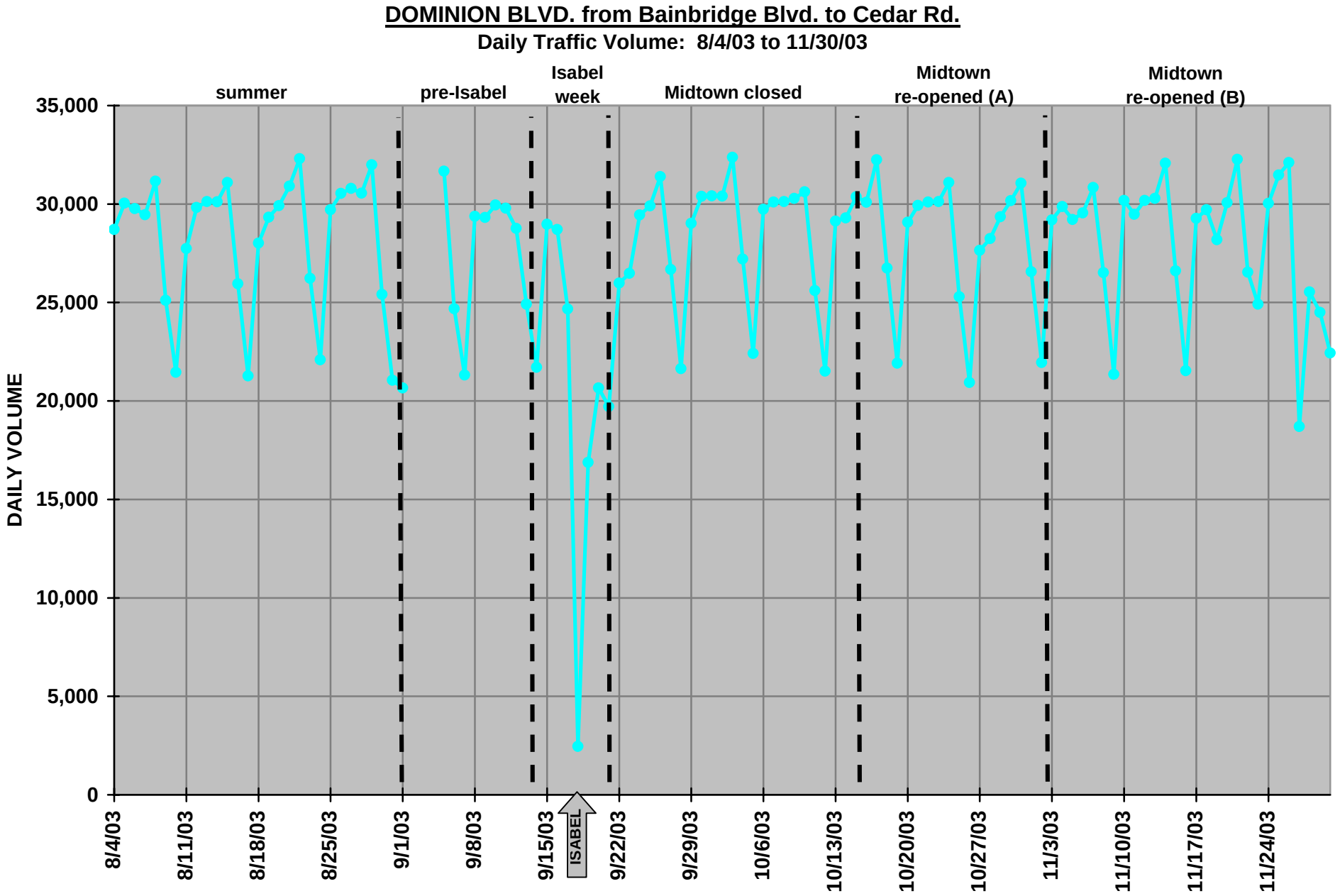
Source of data: VDOT, count ID 150012 and 150022.
Prepared by HRPDC, March 2004.

I-564 from International Terminal Blvd. to Hampton Blvd.

Daily Traffic Volume: 8/4/03 to 11/30/03



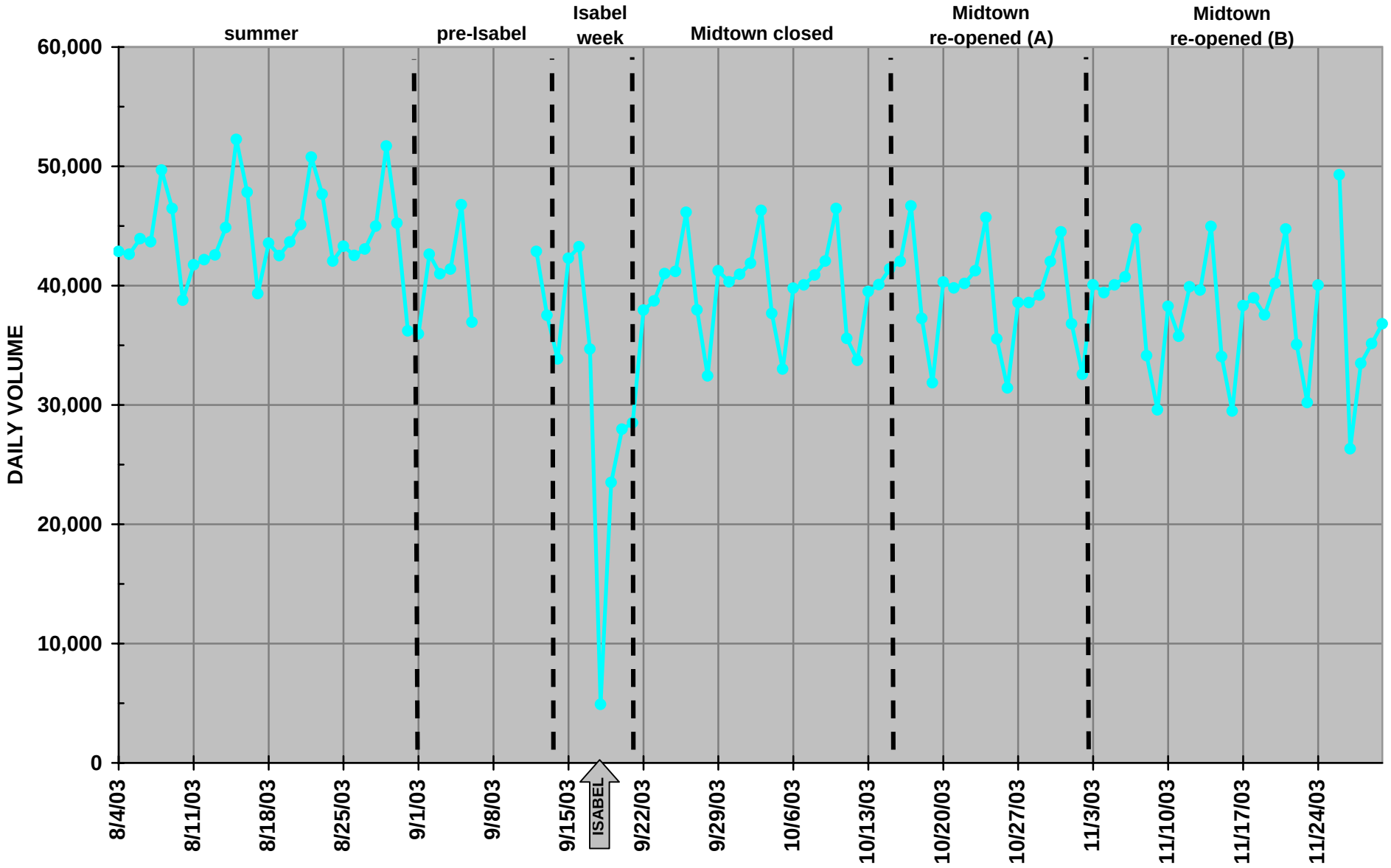
Source of data: VDOT, count ID 150036 and 150037.
Prepared by HRPDC, March 2004.



Source of data: VDOT, count ID 150106.
Prepared by HRPDC, March 2004.

NORTHAMPTON BLVD. from Diamond Springs Rd. to Independence Blvd.

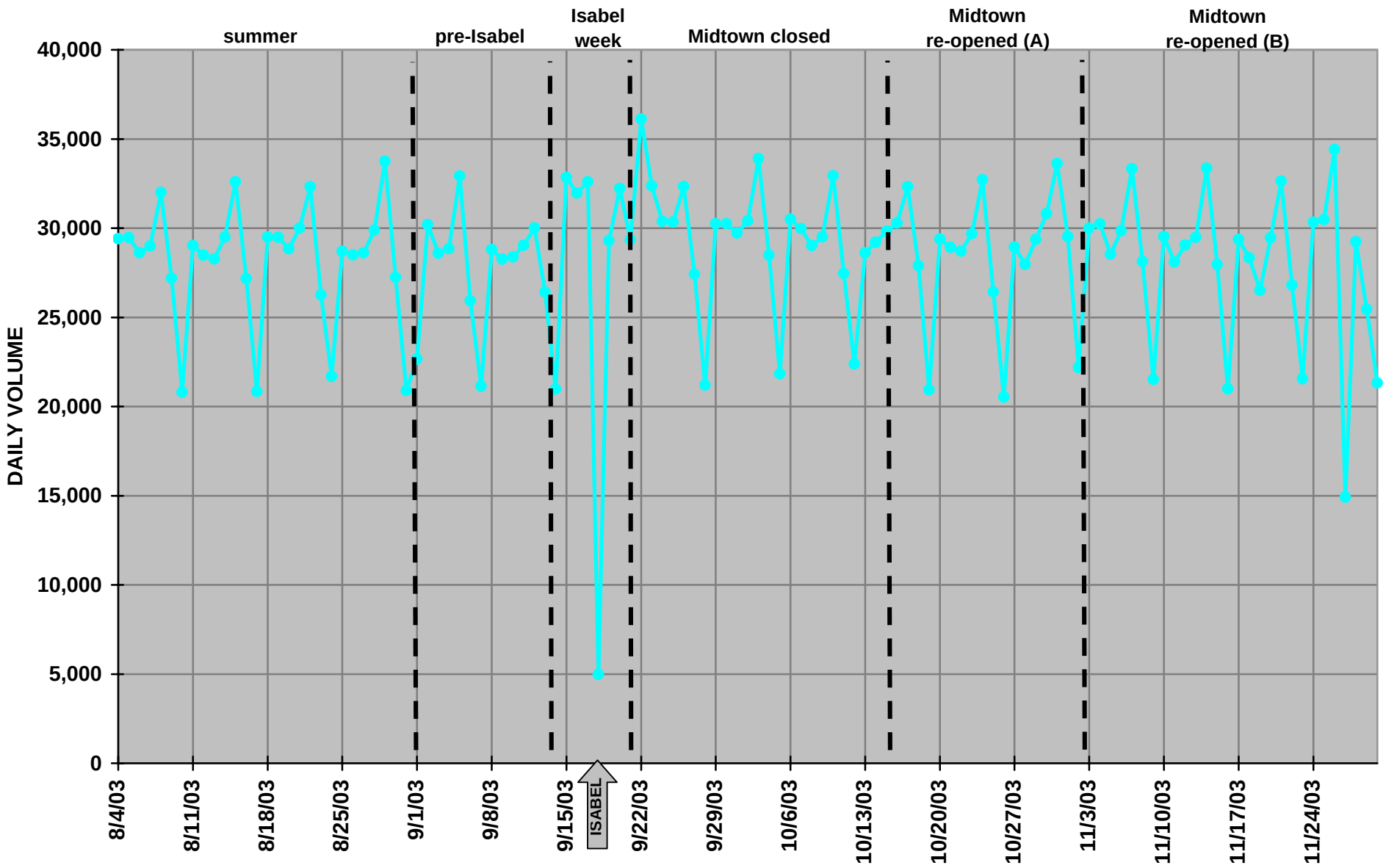
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 677768.
Prepared by HRPDC, March 2004.

MAIN STREET from Nansemond River bridge to Godwin Blvd.

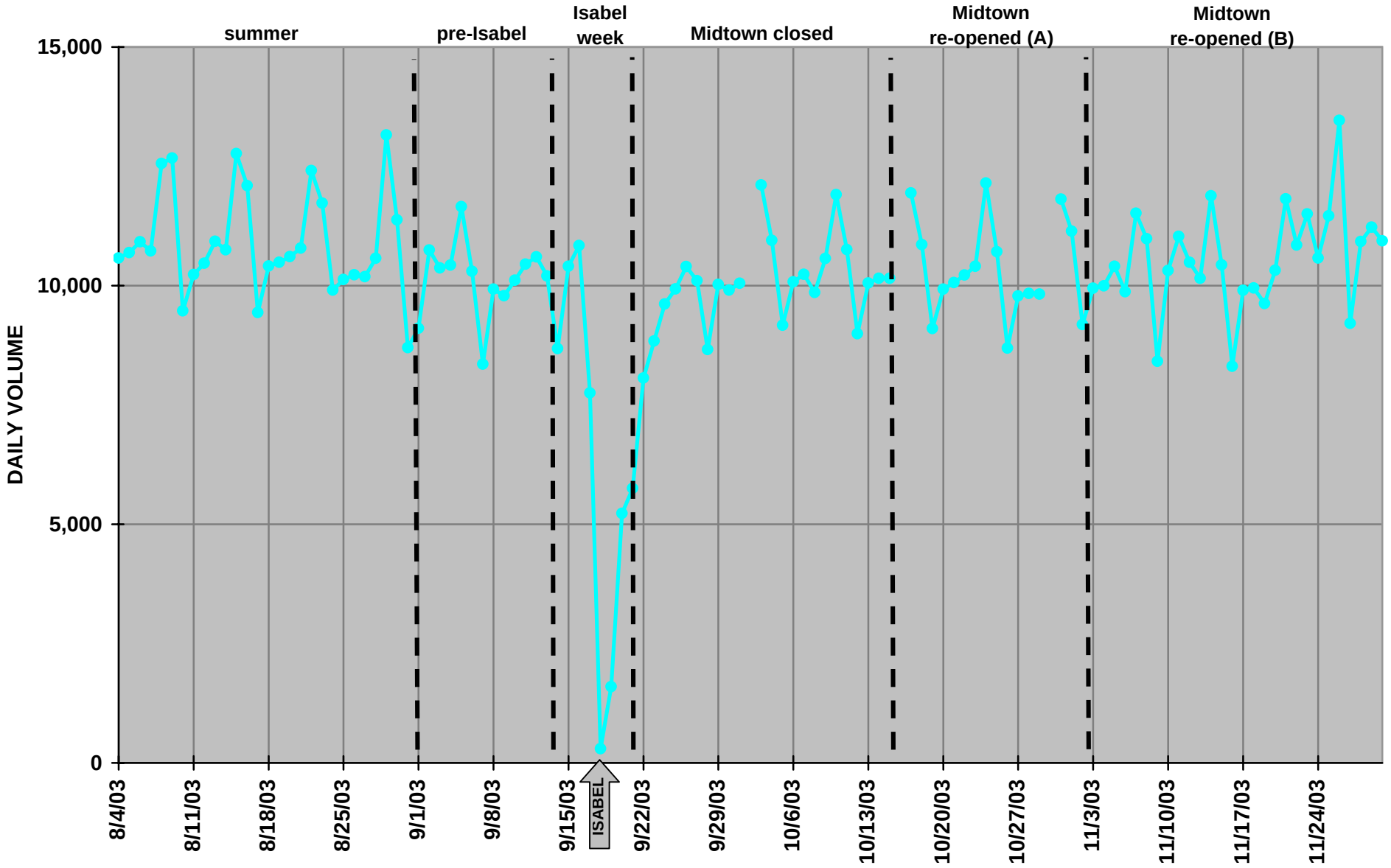
Daily Traffic Volume: 8/4/03 to 11/30/03



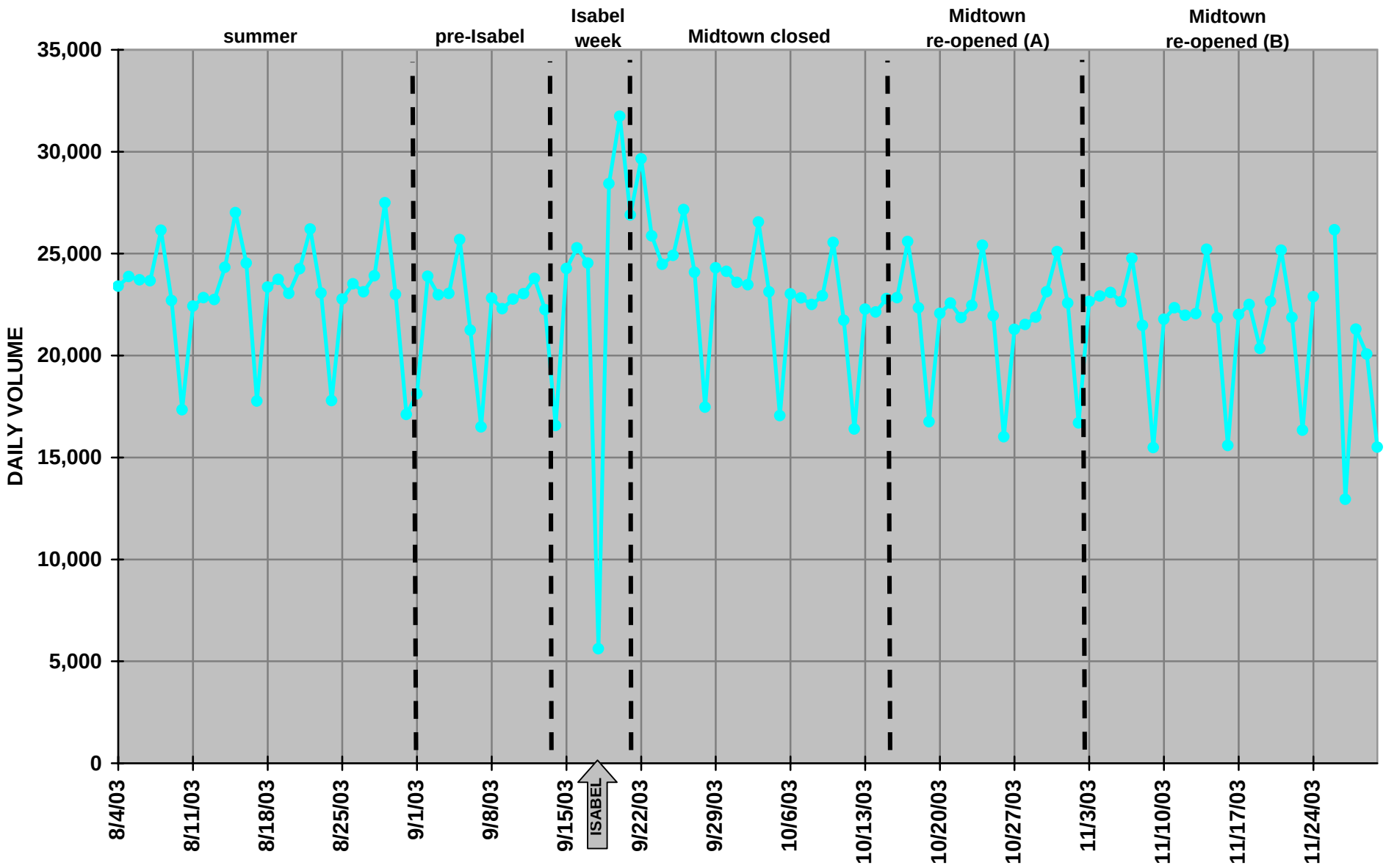
Source of data: VDOT, coutn ID 50300.
Prepared by HRPDC, March 2004.

ROUTE 17 from North Carolina state line to Ballahack Rd.

Daily Traffic Volume: 8/4/03 to 11/30/03



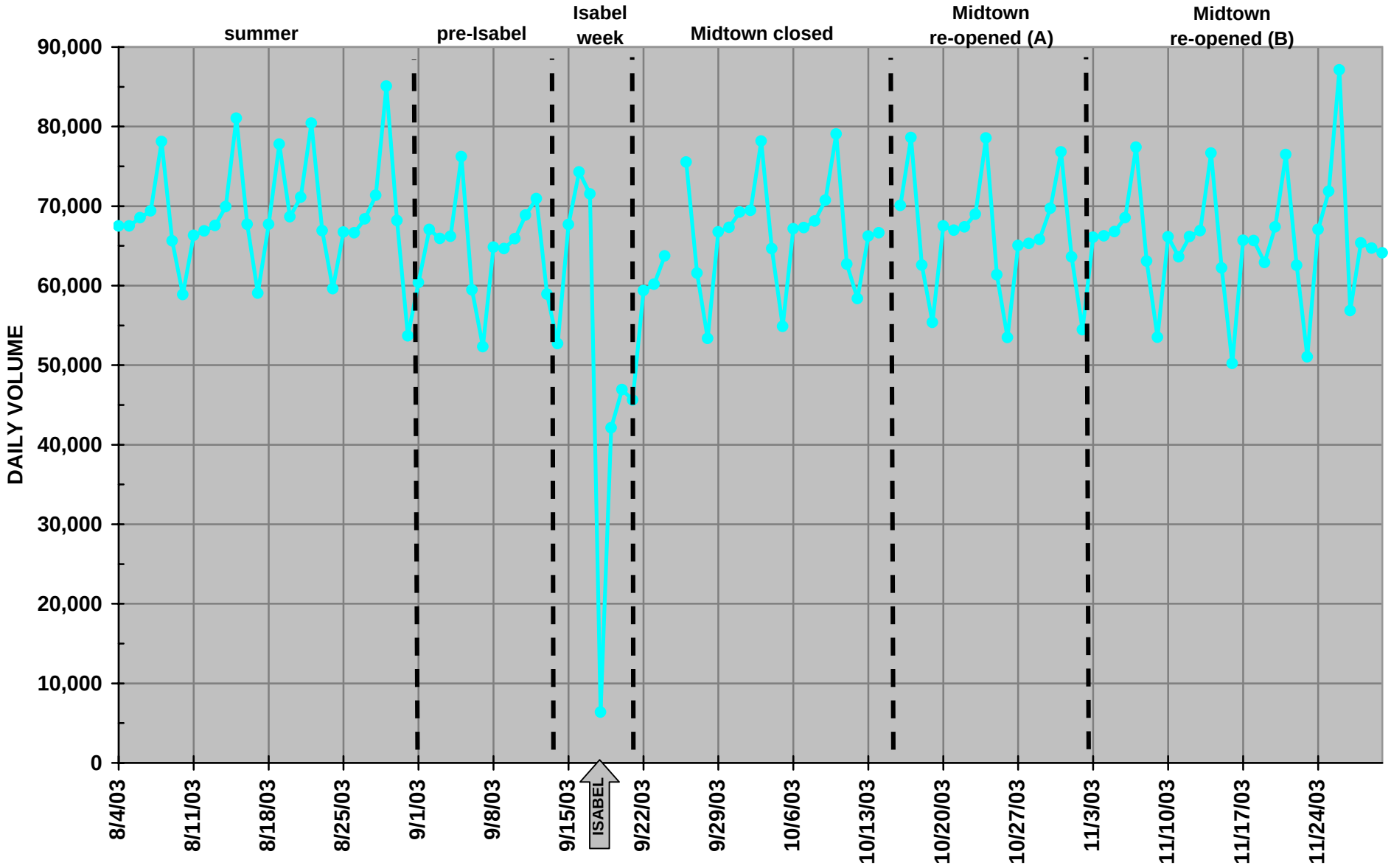
Source of data: VDOT, count ID 150096.
Prepared by HRPDC, March 2004.



Source of data: VDOT, count ID 150098.
Prepared by HRPDC, March 2004.

MILITARY HIGHWAY from I-664 to Suffolk corporate limits

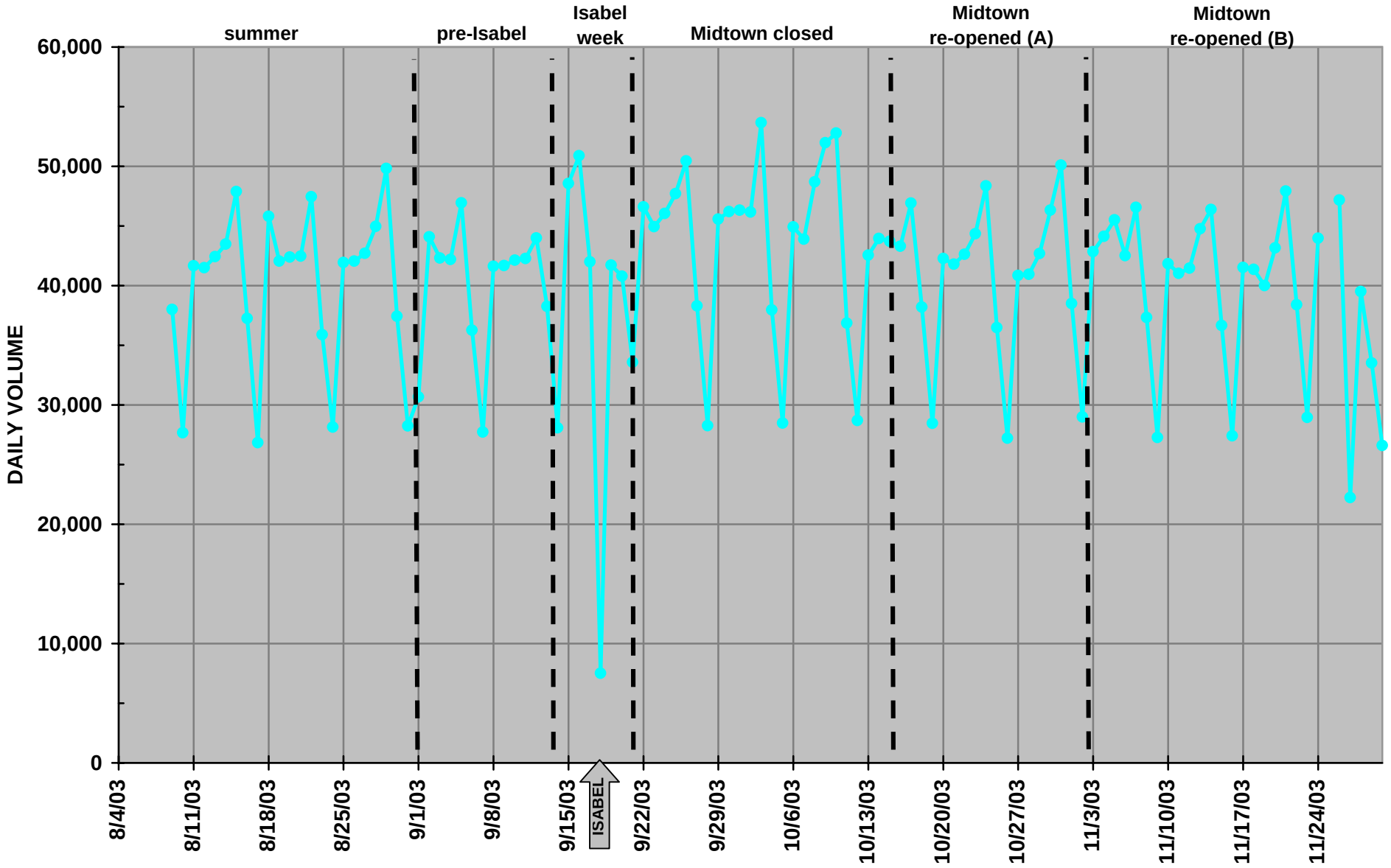
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150095.
Prepared by HRPDC, March 2004.

BATTLEFIELD BOULEVARD from I-64 to Military Hwy.

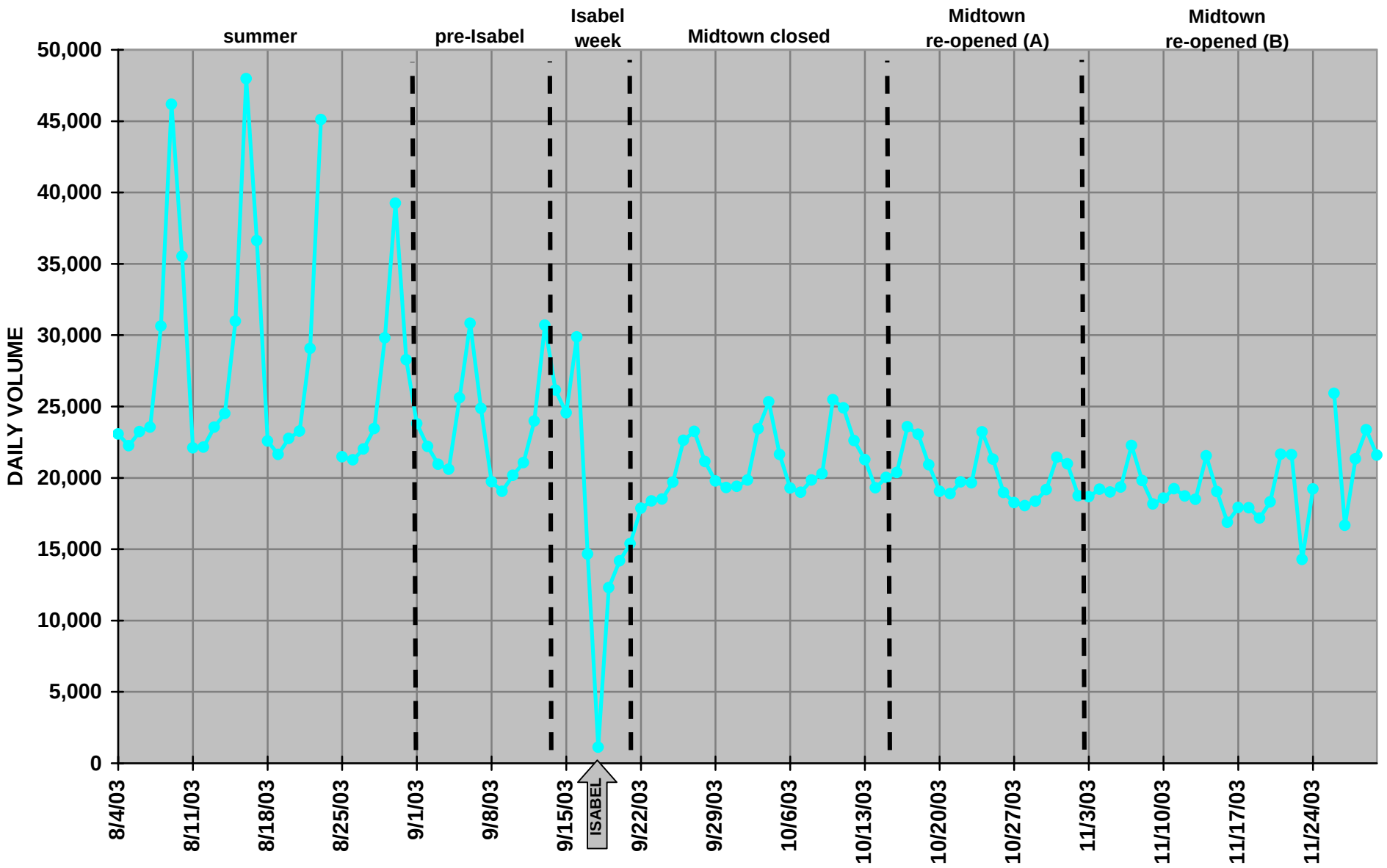
Daily Traffic Volume: 8/4/03 to 11/30/03



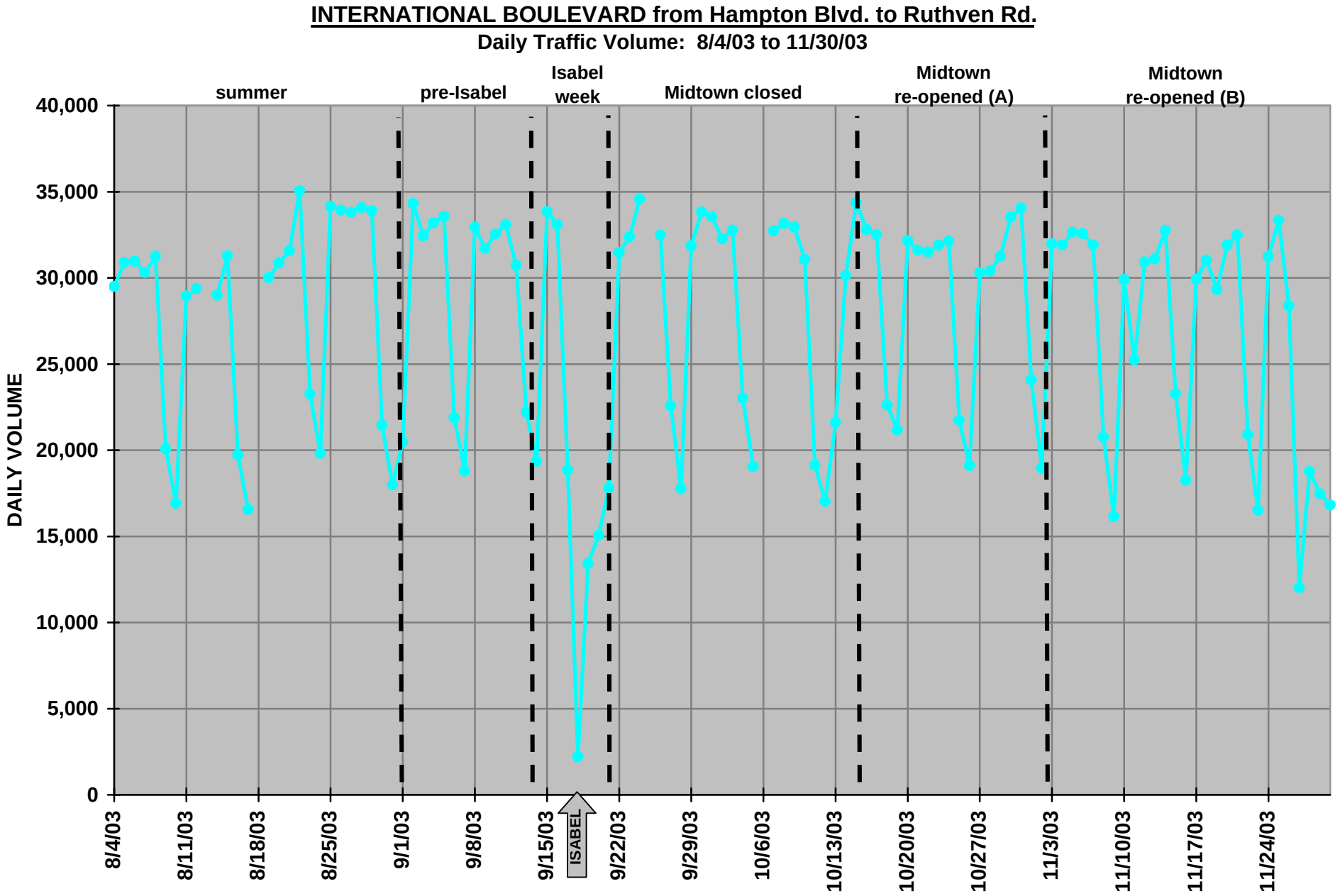
Source of data: VDOT, count ID 150121.
Prepared by HRPDC, March 2004.

BATTLEFIELD BOULEVARD from North Carolina state line to Ballahack Rd.

Daily Traffic Volume: 8/4/03 to 11/30/03



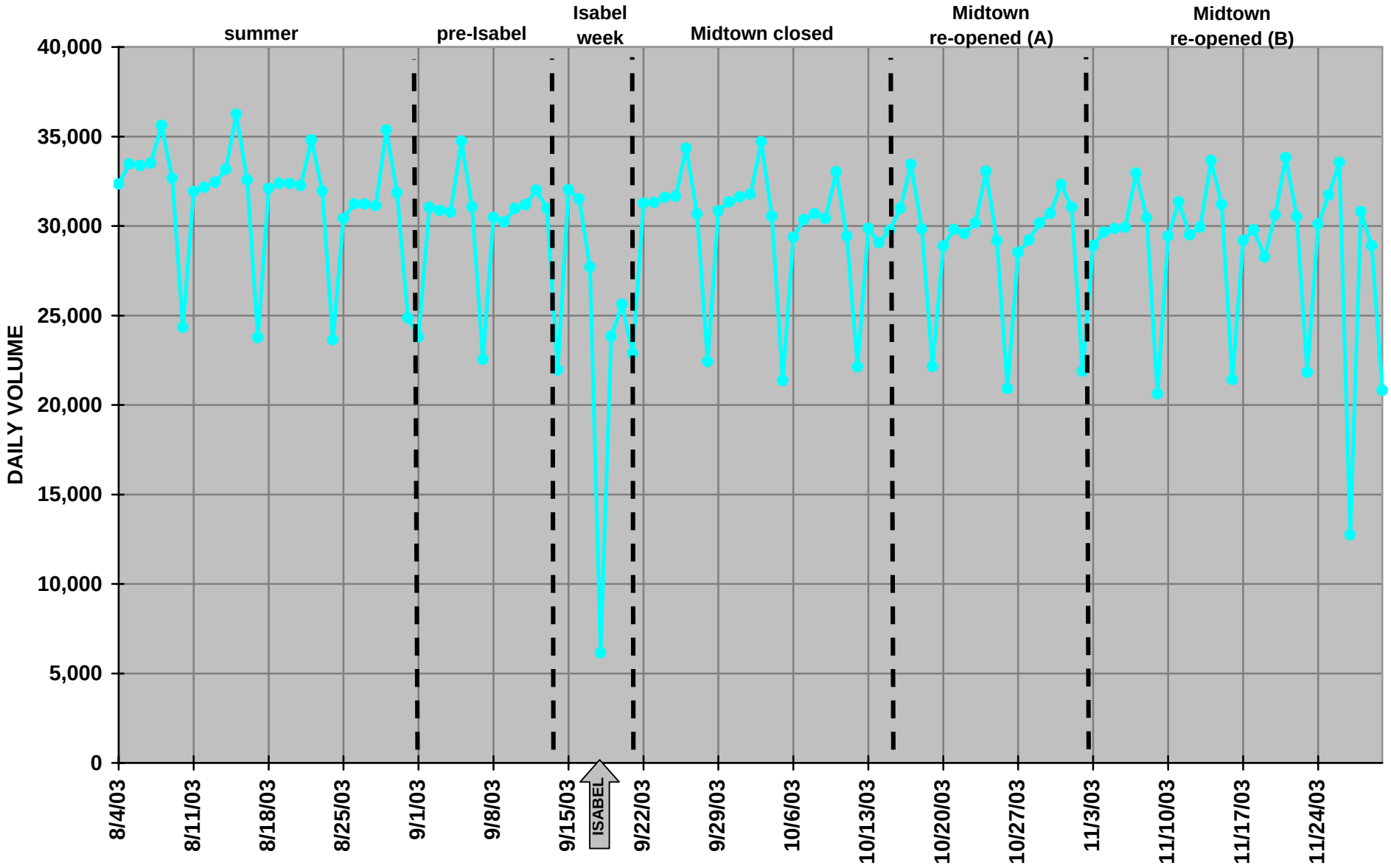
Source of data: VDOT, count ID 150111.
Prepared by HRPDC, March 2004.



Source of data: VDOT, count ID 150120.
Prepared by HRPDC, March 2004.

LASKIN ROAD from Virginia Beach Blvd. to First Colonial Rd.

Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150103.
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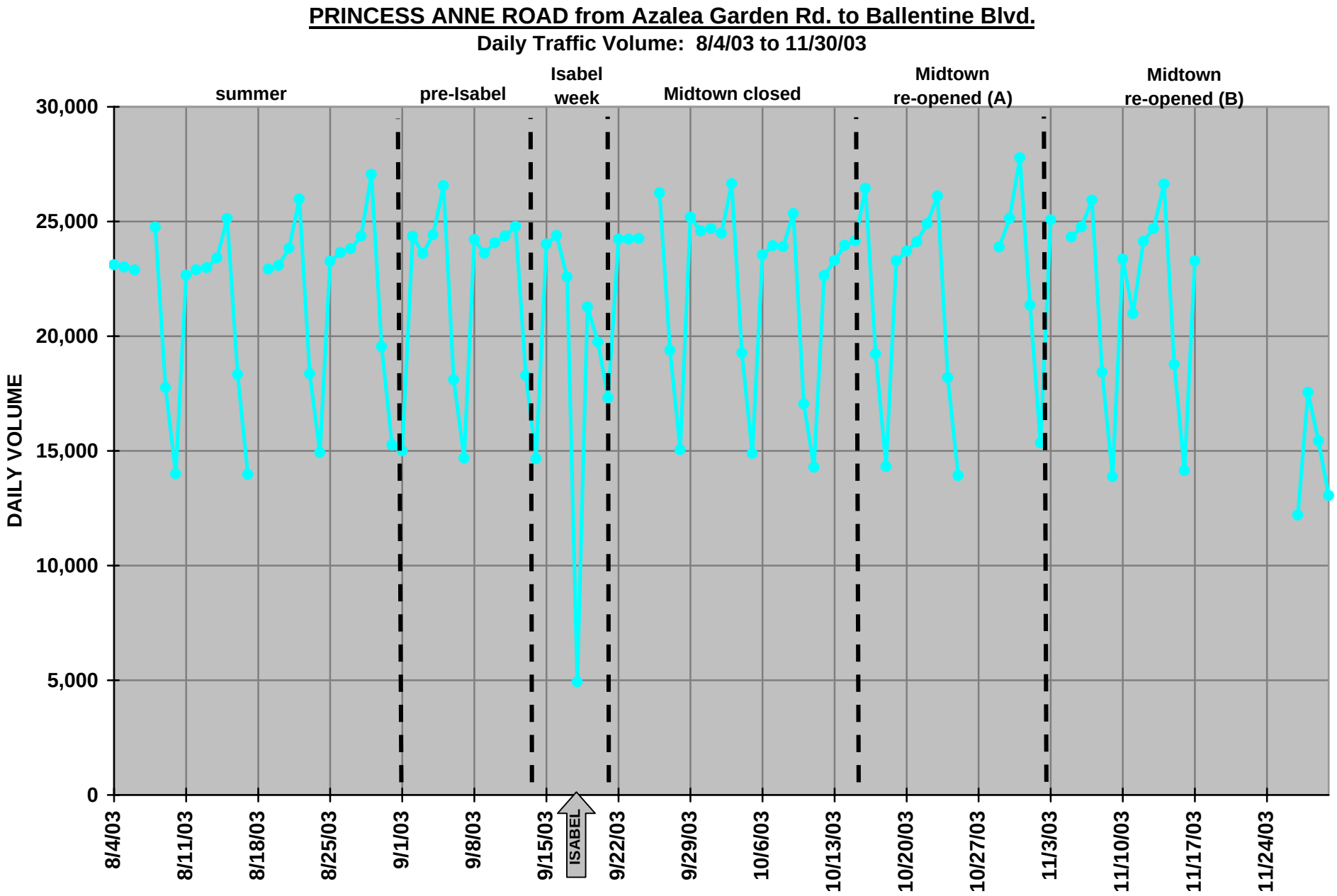
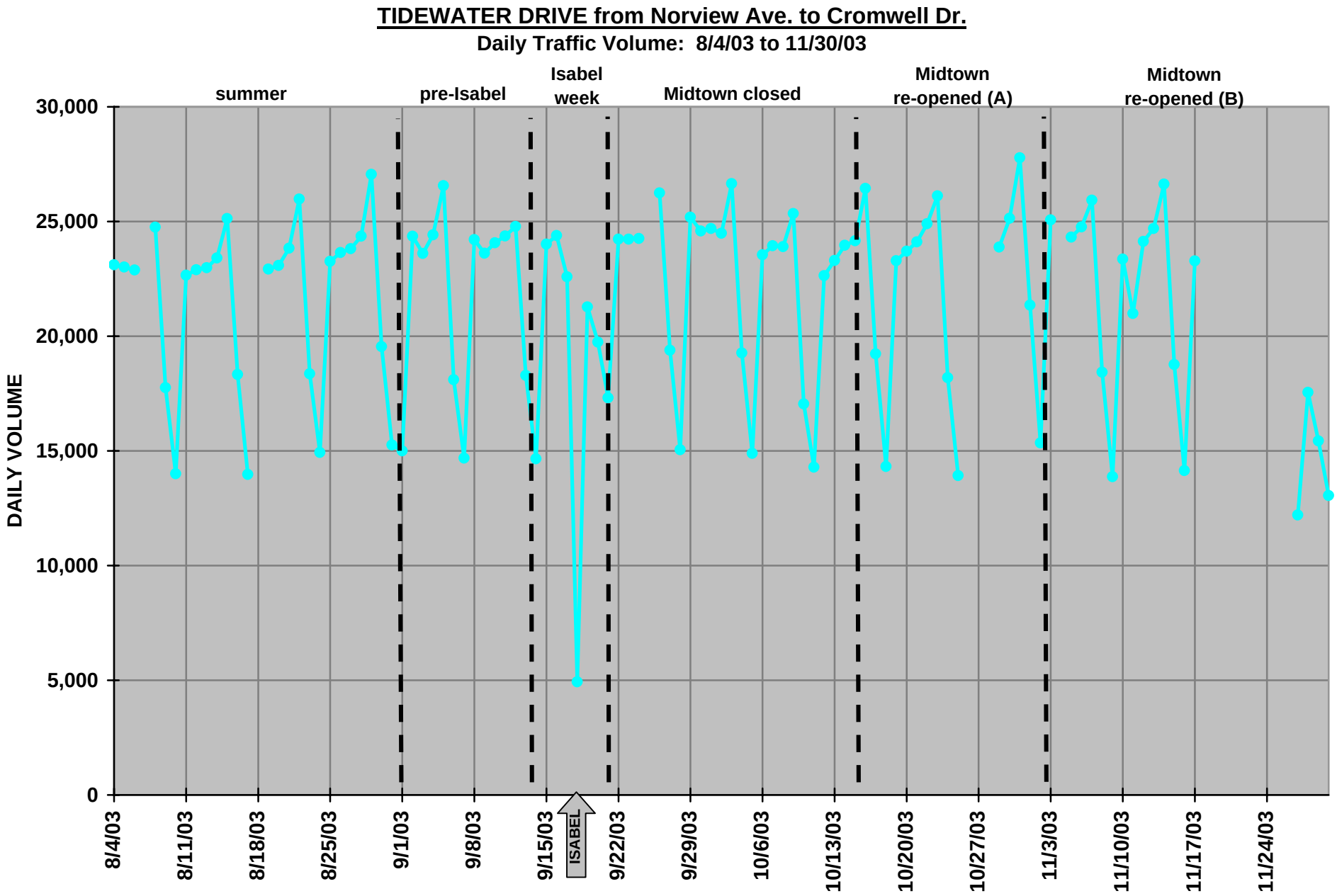


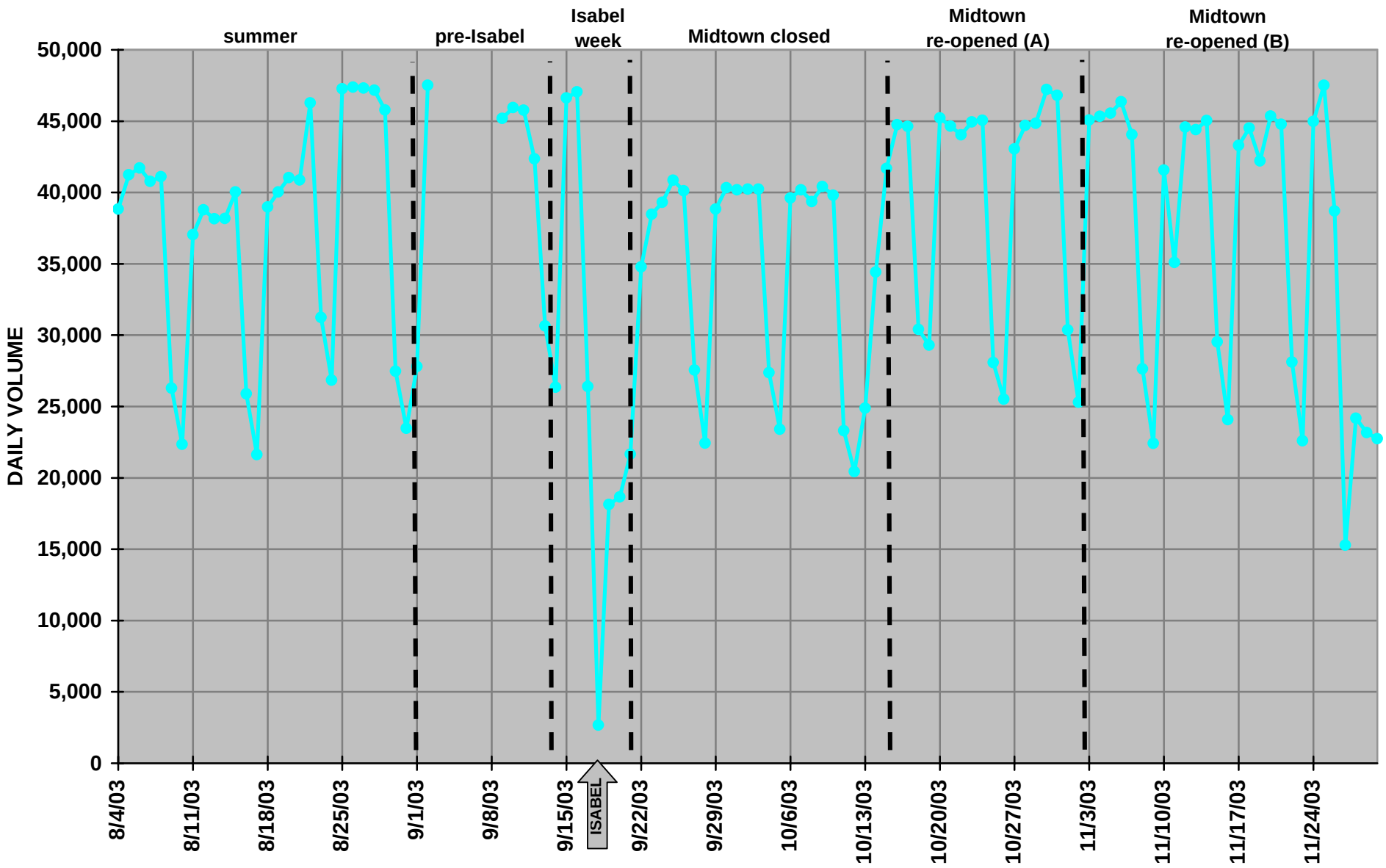
Source of data: VDOT, count ID 150110.
Prepared by HRPDC, March 2004.



Source of data: VDOT, count ID 150114.
Prepared by HRPDC, March 2004.

HAMPTON BOULEVARD from Lafayette River bridge to Lexan Ave.

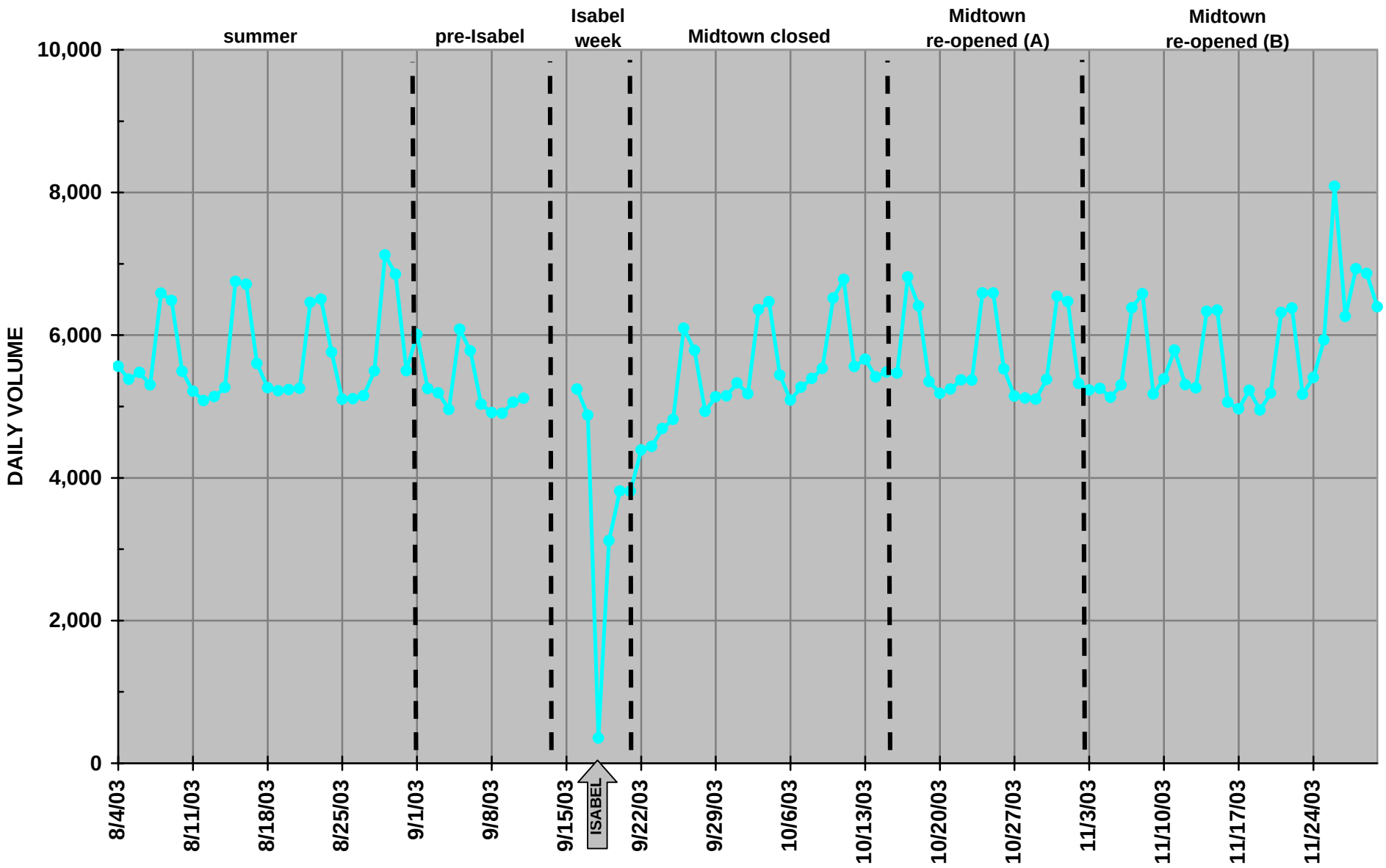
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150119.
Prepared by HRPDC, March 2004.

ROUTE 13 from North Carolina state line to Route 616

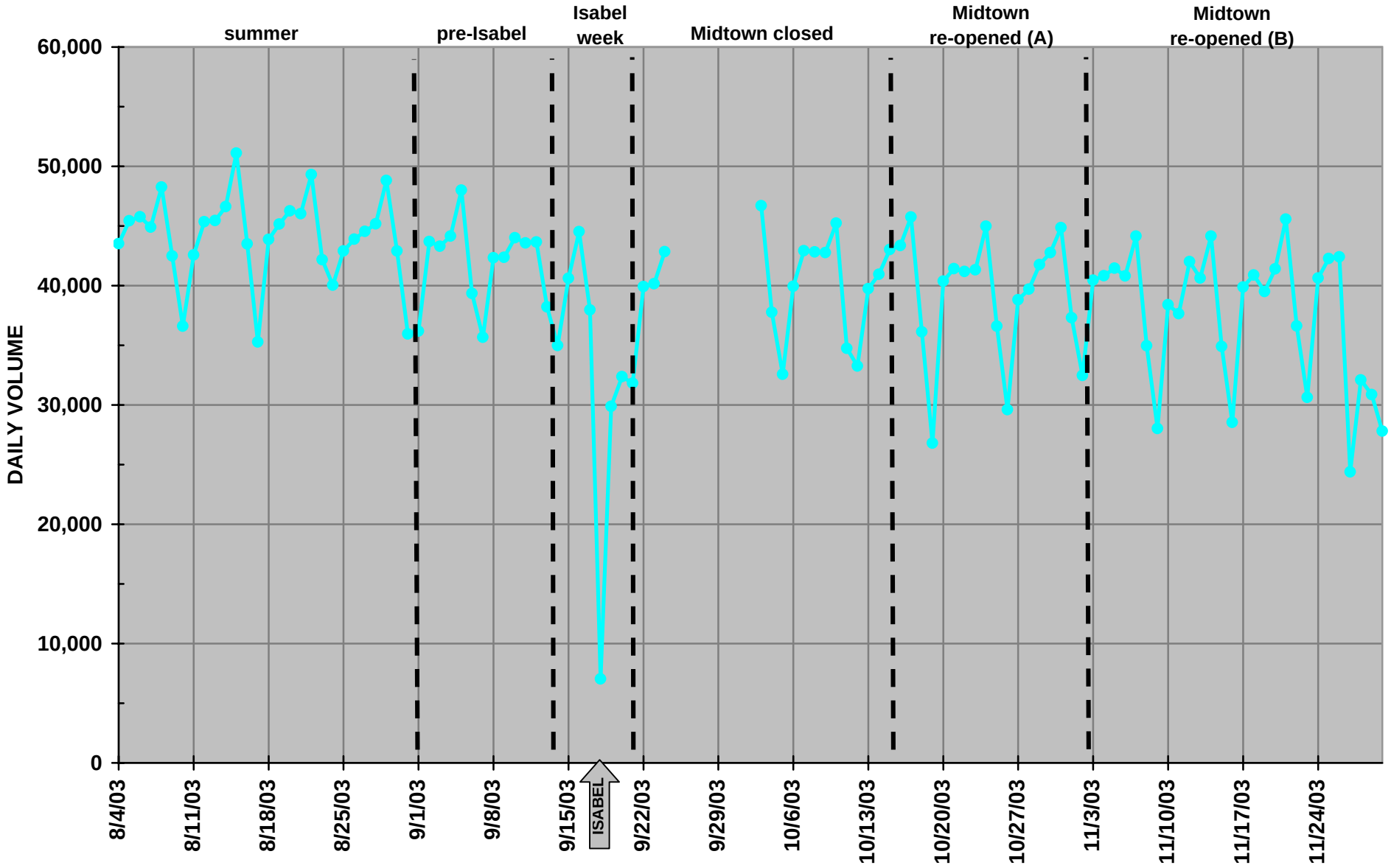
Daily Traffic Volume: 8/4/03 to 11/30/03



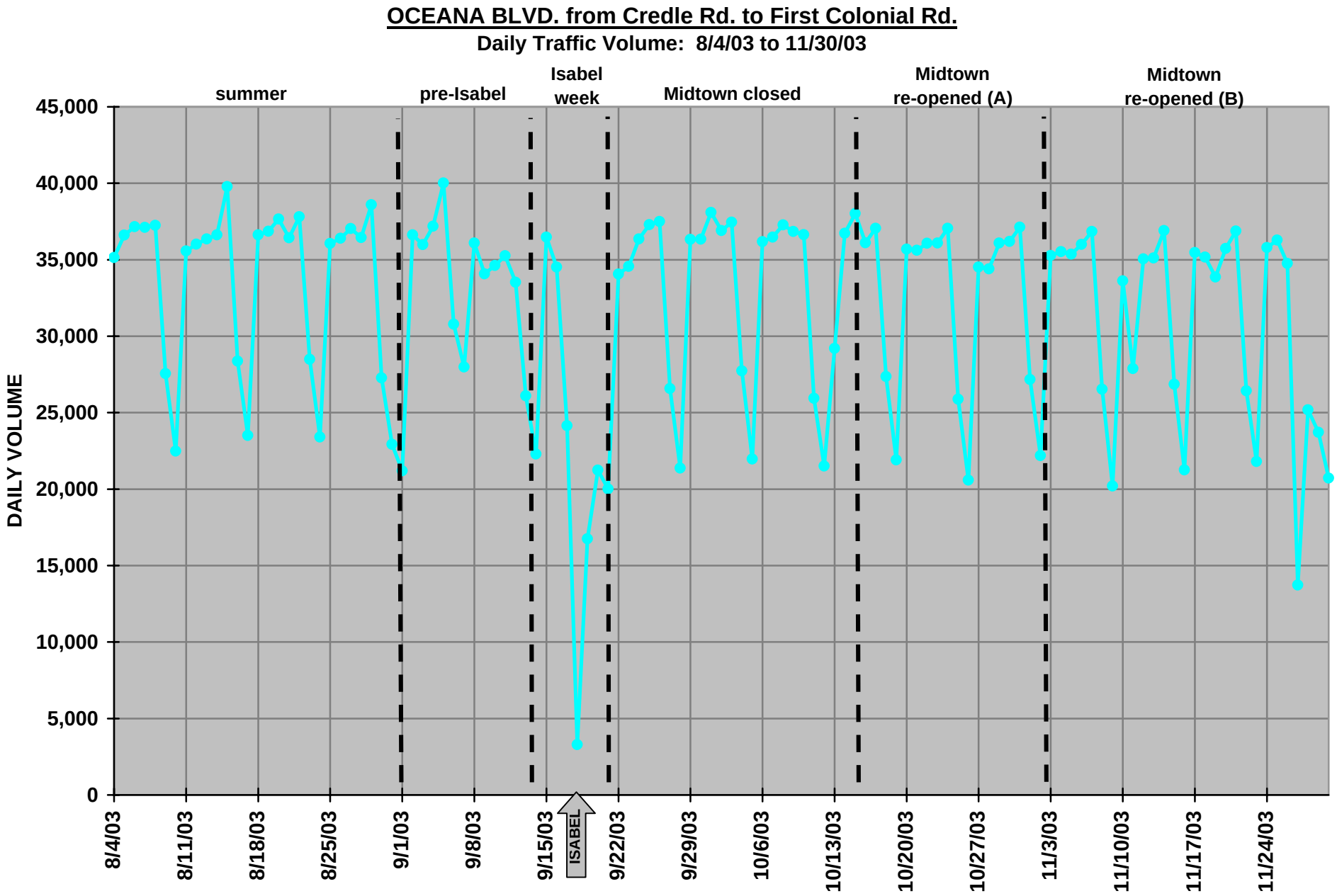
Source of data: VDOT, count ID 150094.
Prepared by HRPDC, March 2004.

SHORE DRIVE from Northampton Blvd. to Bay Lake Rd.

Daily Traffic Volume: 8/4/03 to 11/30/03



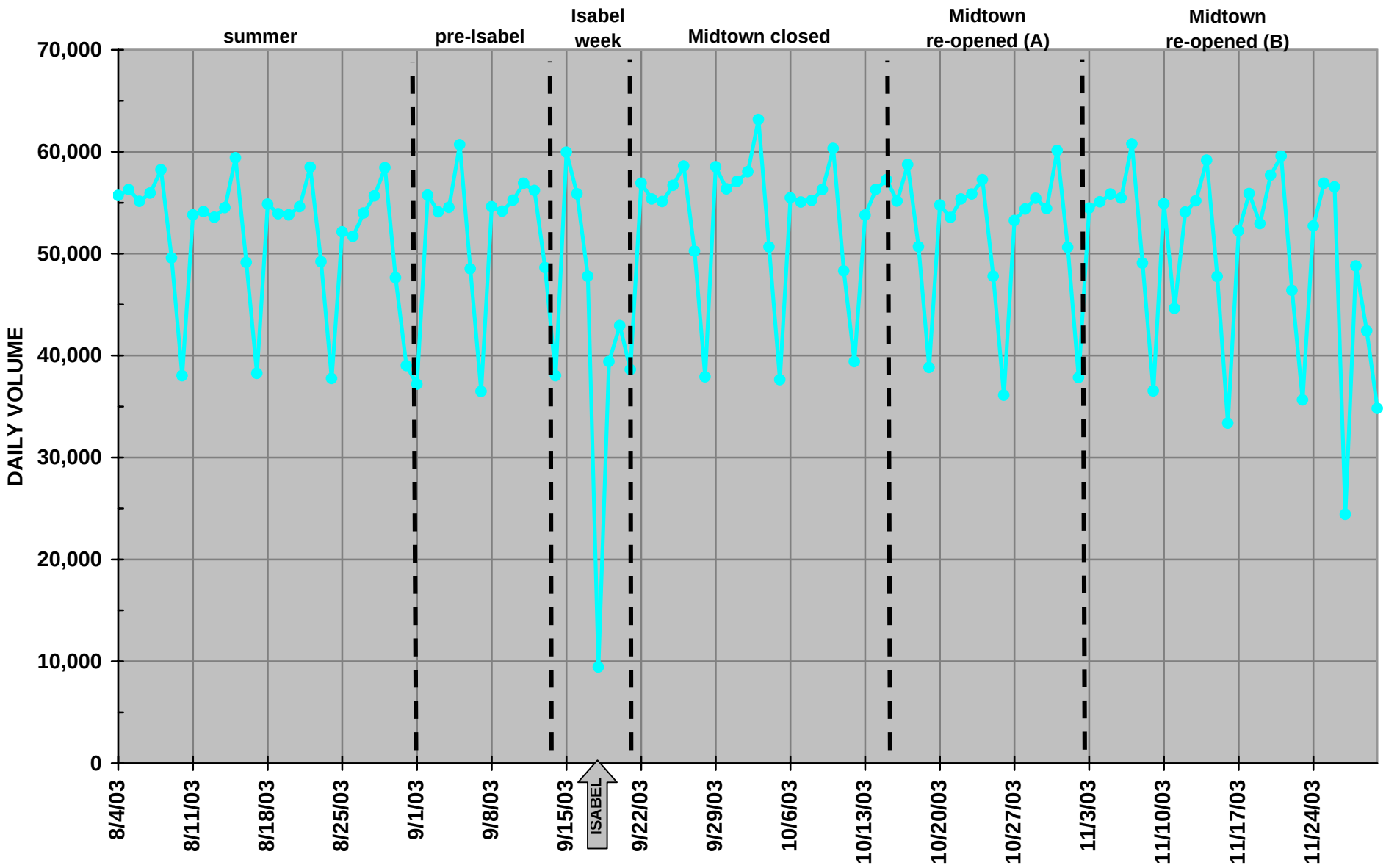
Source of data: VDOT, count ID 150104.
Prepared by HRPDC, March 2004.



Source of data: VDOT, count ID 150105.
Prepared by HRPDC, March 2004.

INDEPENDENCE BLVD. from Pembroke Blvd. to Virginia Beach Blvd.

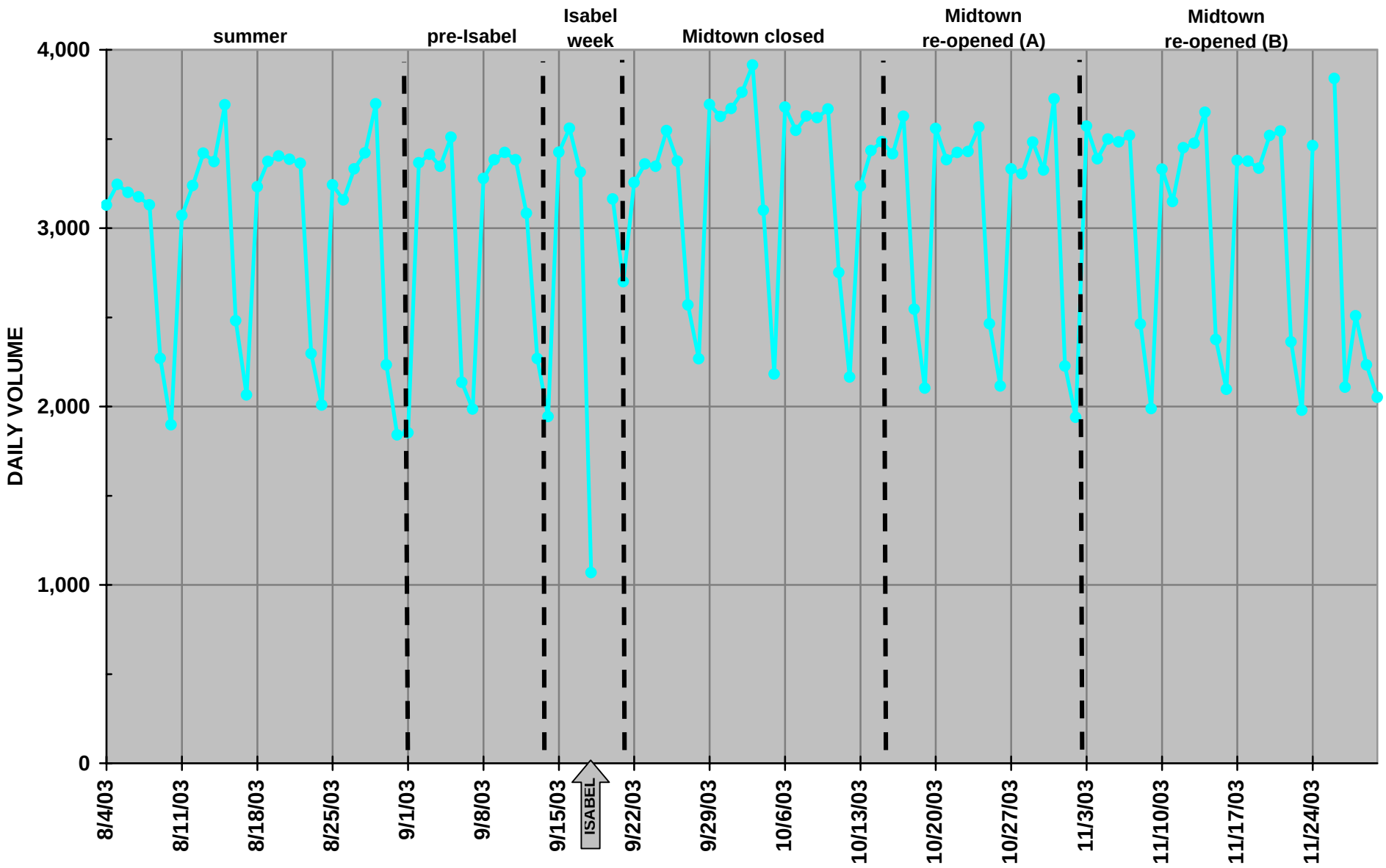
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 677732.
Prepared by HRPDC, March 2004.

BUSINESS ROUTE 58 from Rte. 58 to w. corporate limits of Franklin

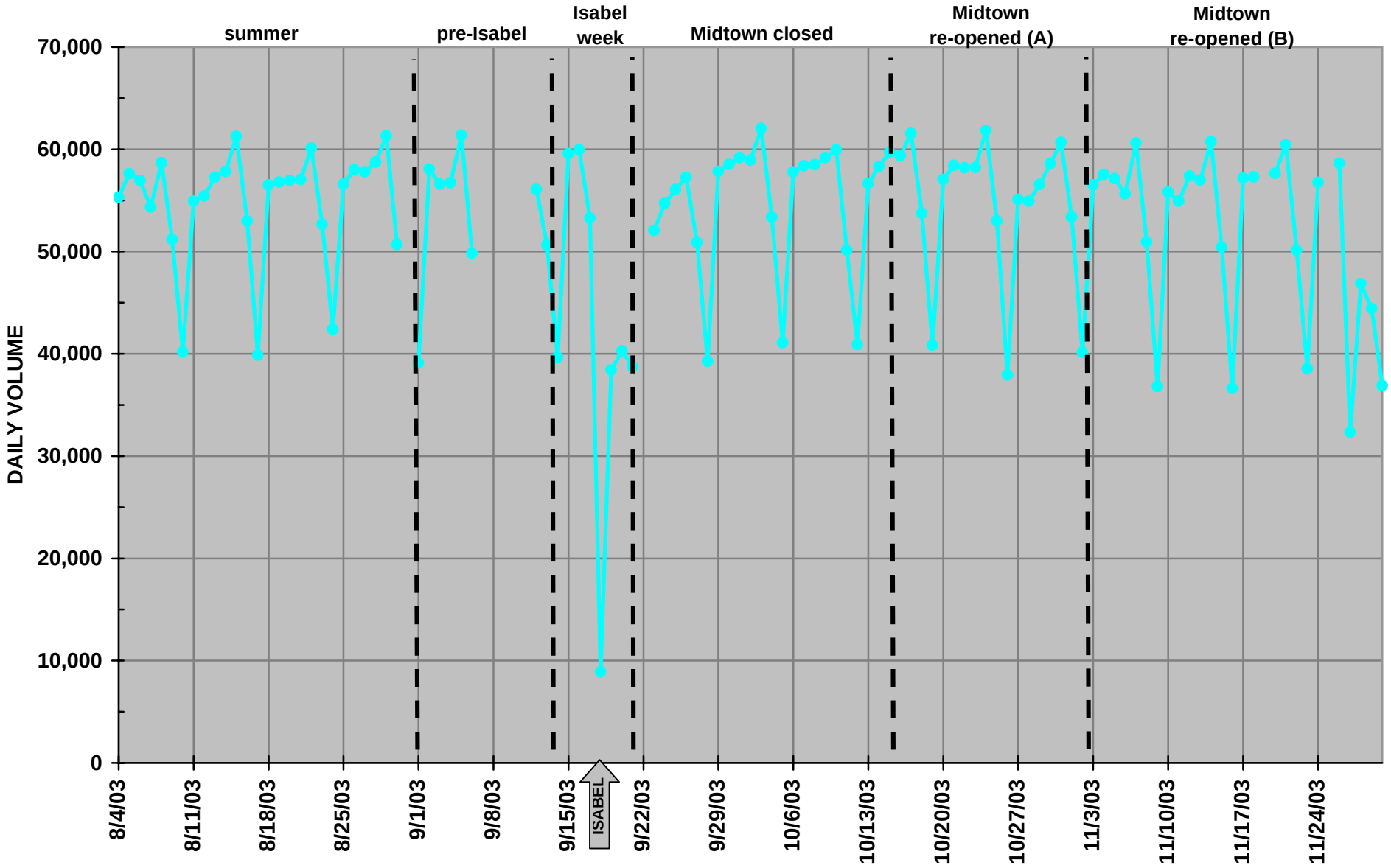
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150326.
Prepared by HRPDC, March 2004.

ROUTE 17 from Hampton Hwy. to Dare Rd.

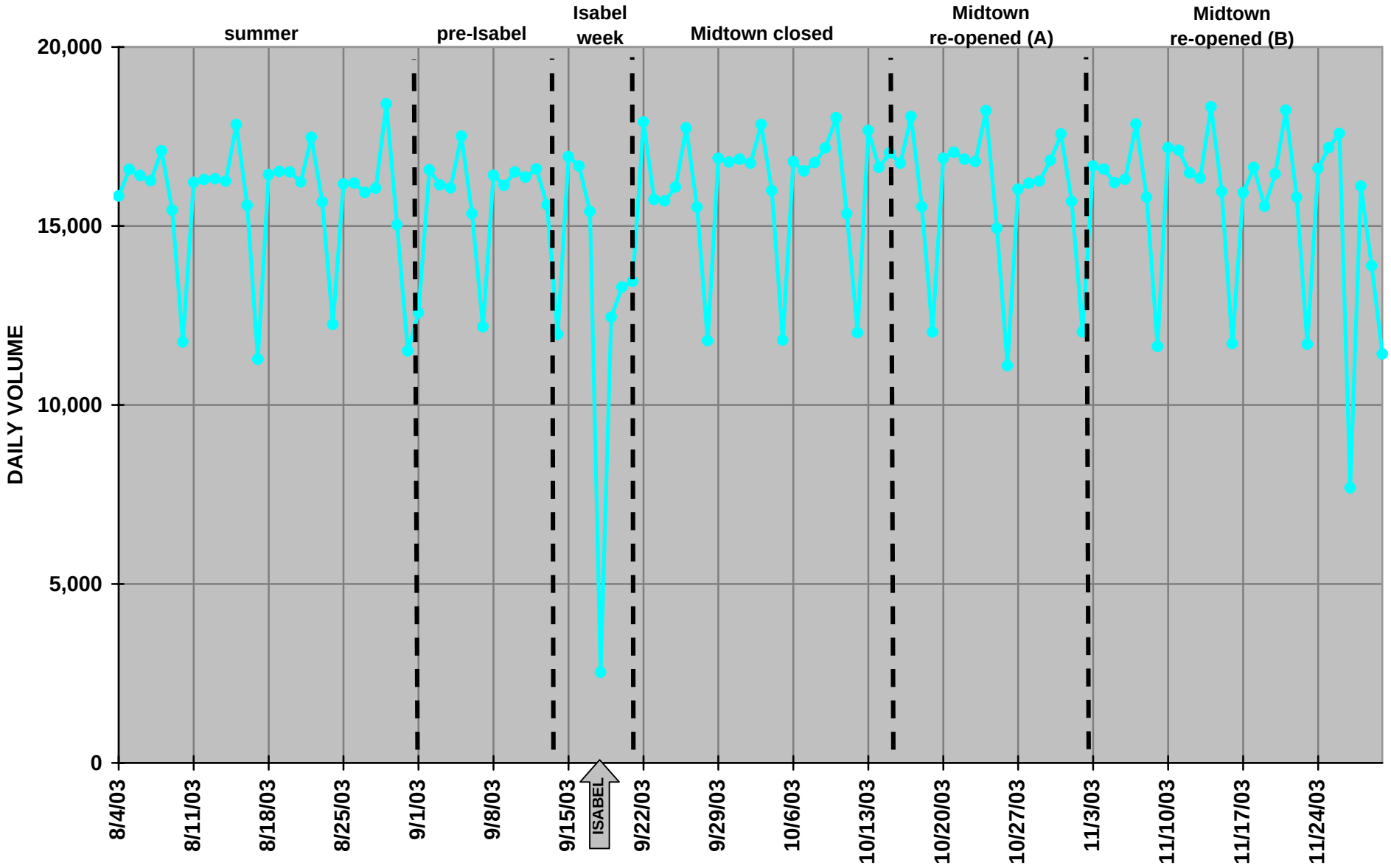
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 50193.
Prepared by HRPDC, March 2004.

DENBIGH BOULEVARD from Newport News corporate limit to Route 17

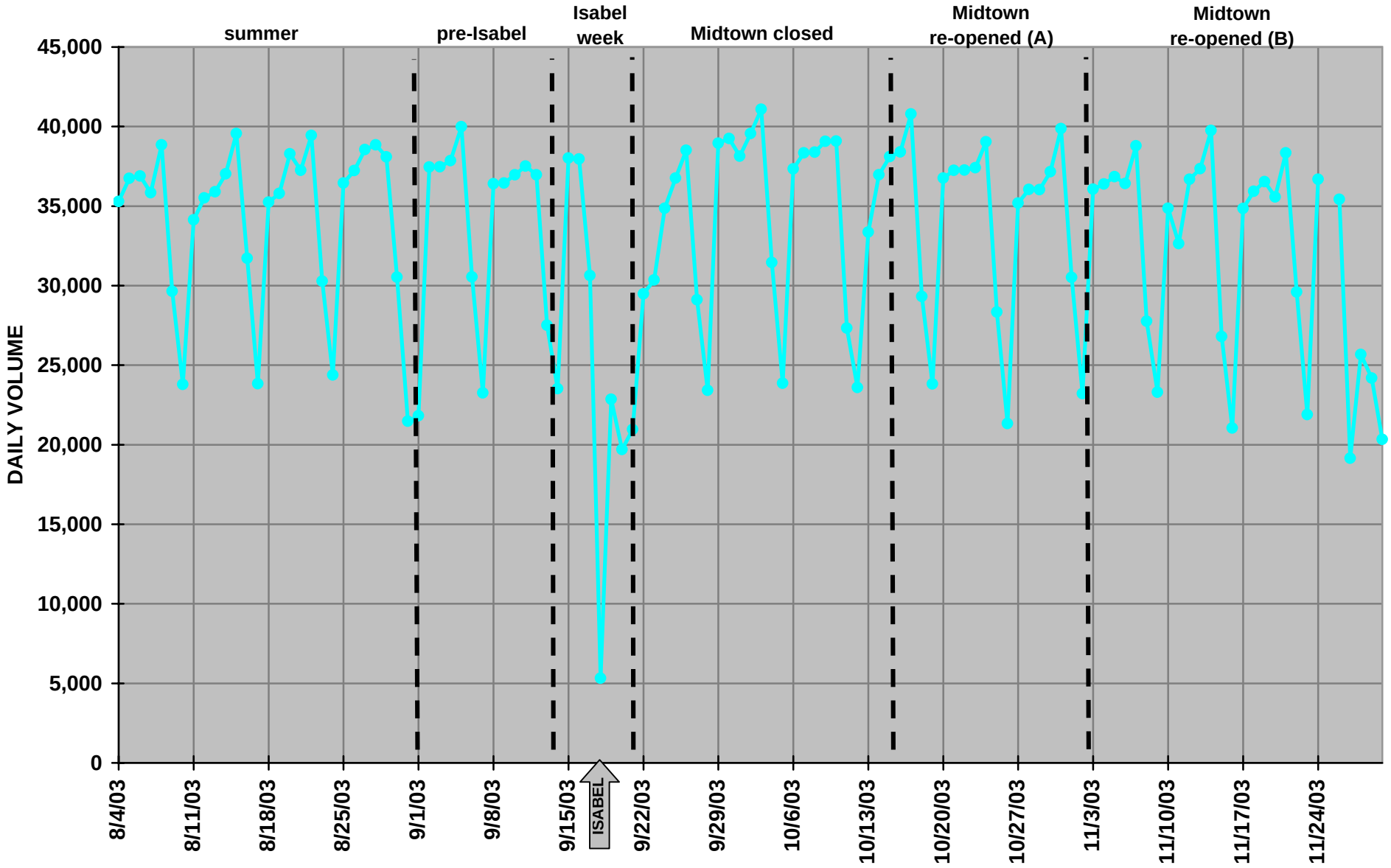
Daily Traffic Volume: 8/4/03 to 11/30/03



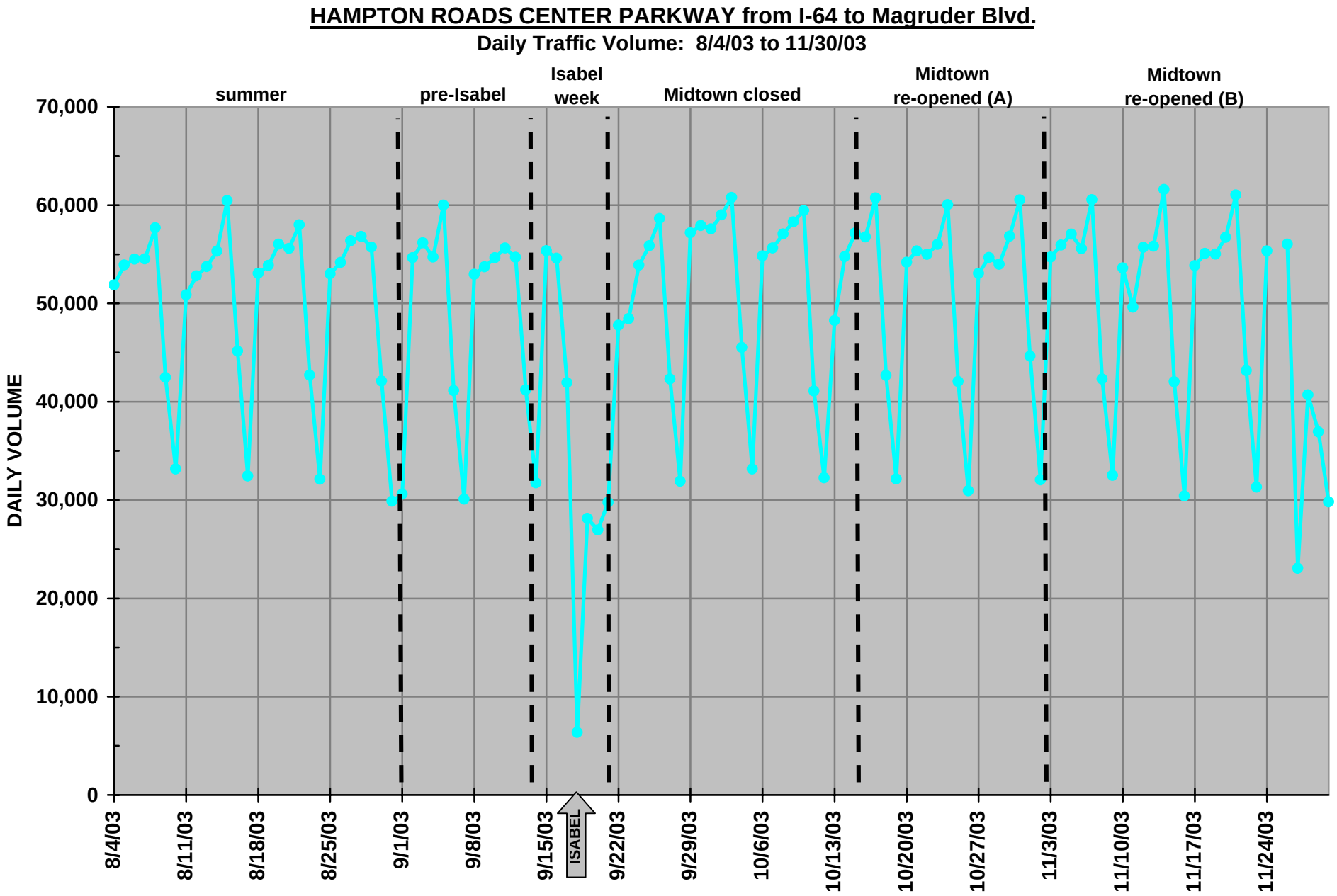
Source of data: VDOT, count ID 50405.
Prepared by HRPDC, March 2004.

ARMISTEAD AVENUE from Tidemill Ln. to Hampton Roads Center Pkwy.

Daily Traffic Volume: 8/4/03 to 11/30/03



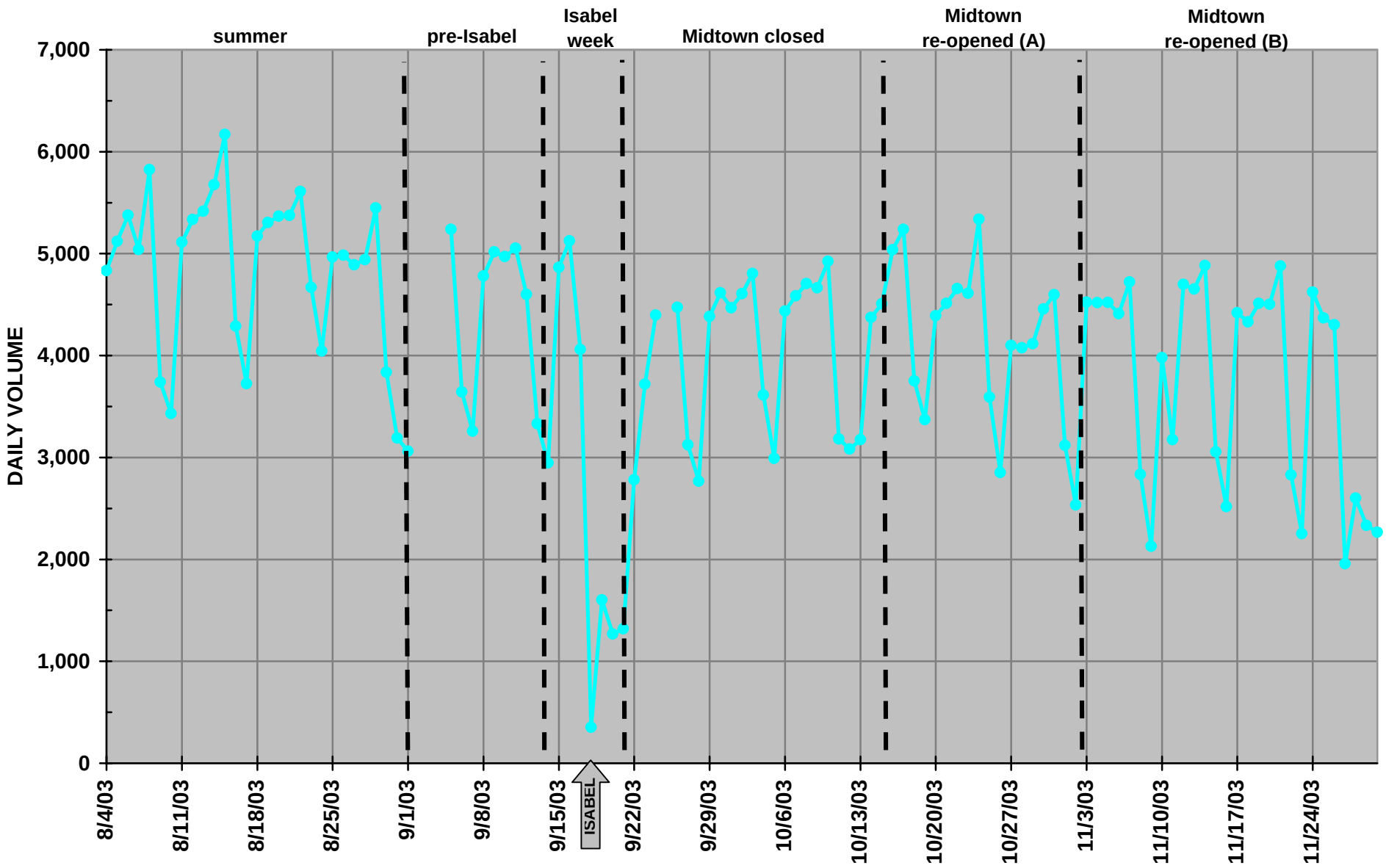
Source of data: VDOT, count ID 150091.
Prepared by HRPDC, March 2004.



Source of data: VDOT, count ID 150092.
Prepared by HRPDC, March 2004.

PENNIMAN ROAD from Route 199 to Colonial National Historical Pkwy.

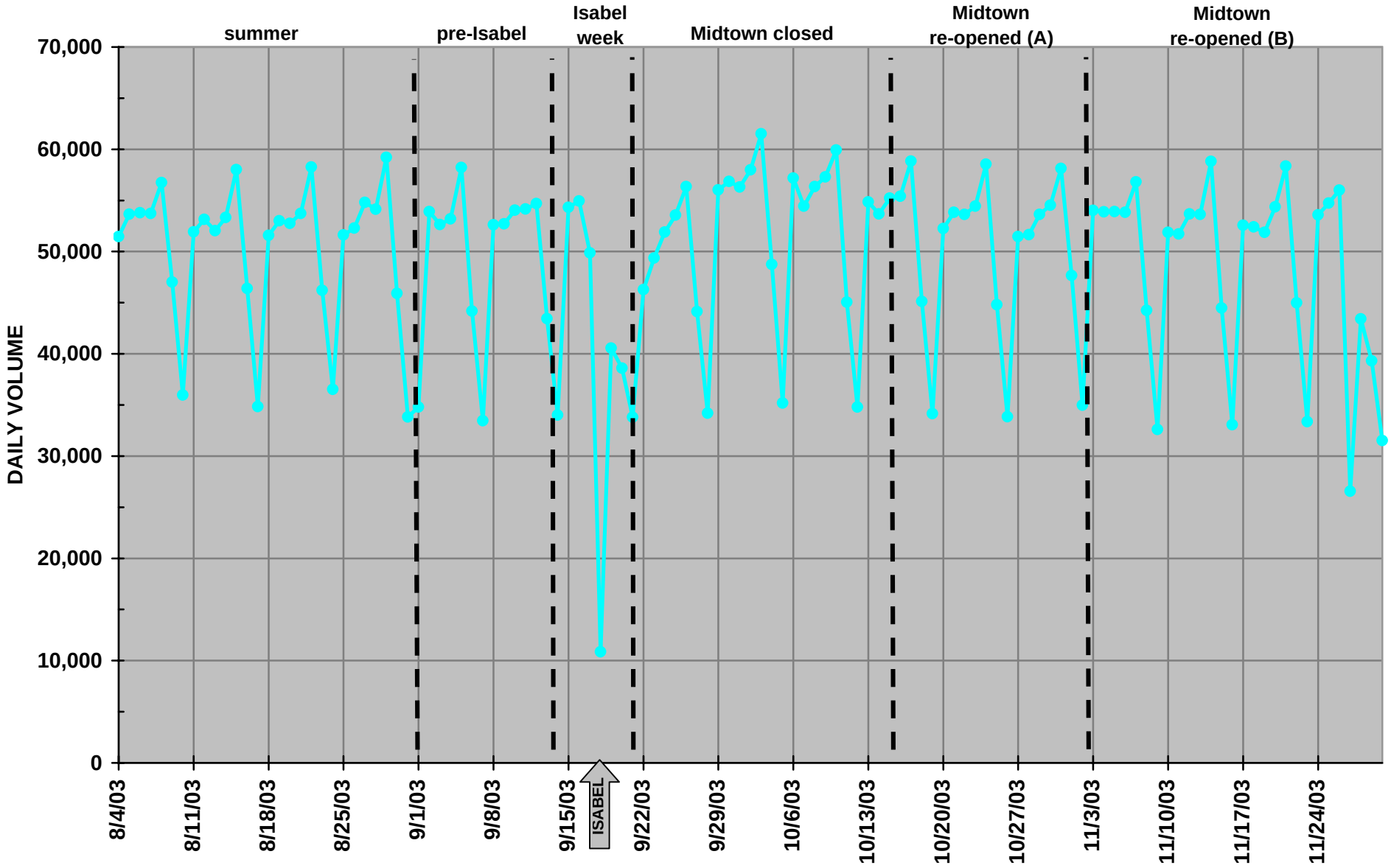
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150093.
Prepared by HRPDC, March 2004.

JEFFERSON AVENUE from Main St. to Harpersville Rd.

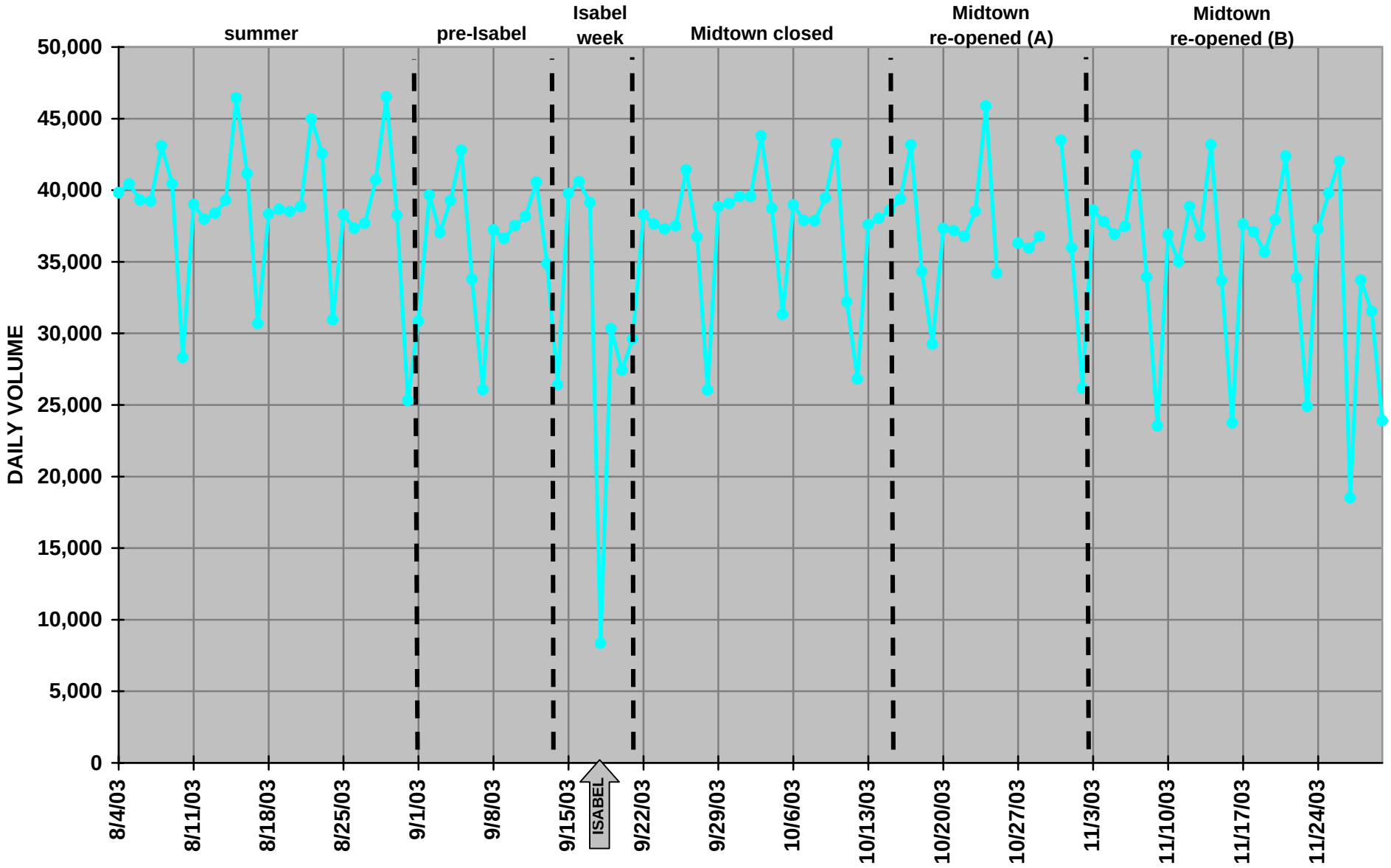
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150101.
Prepared by HRPDC, March 2004.

JEFFERSON AVENUE from Denbigh Blvd. to Richneck Rd.

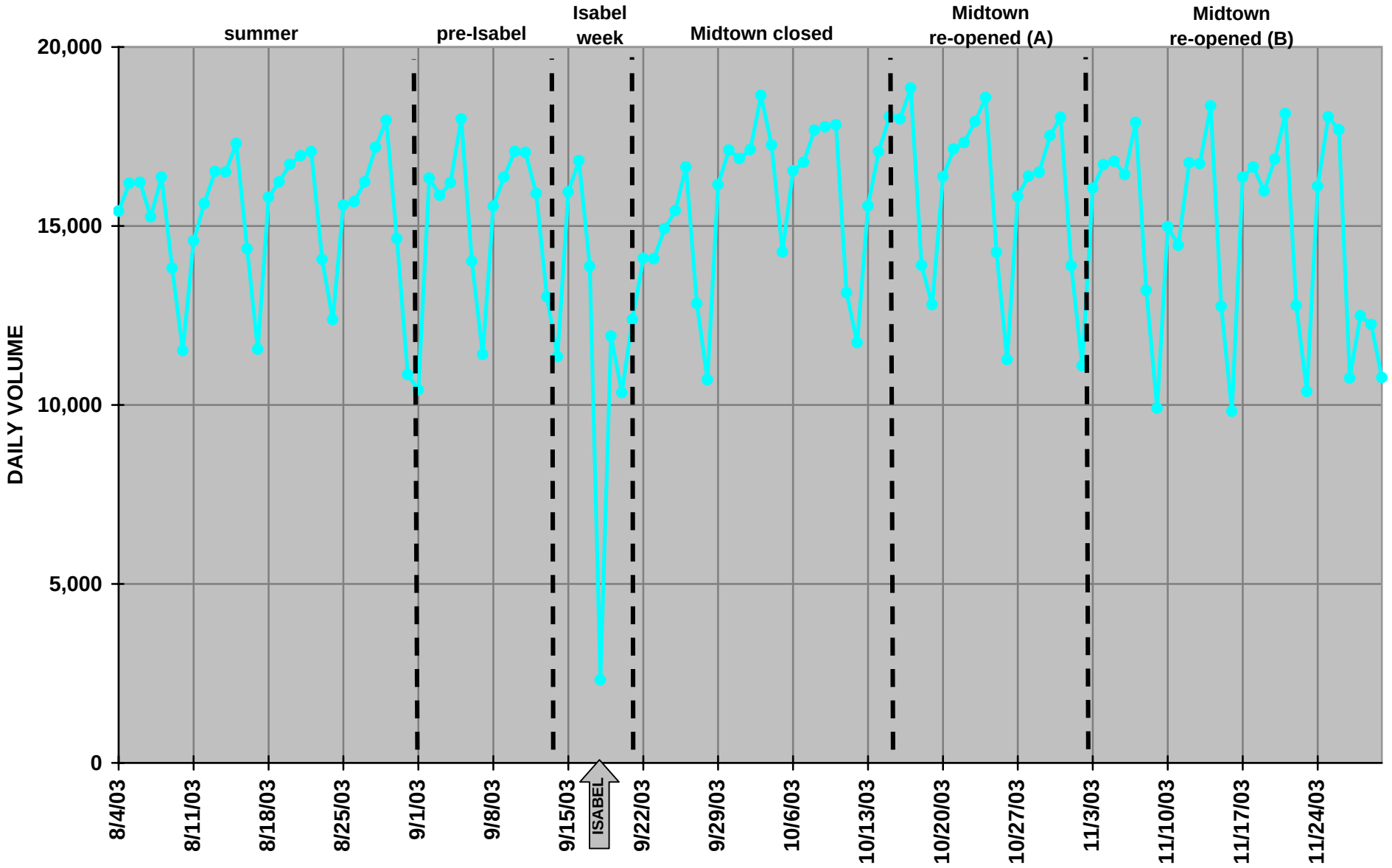
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150108.
Prepared by HRPDC, March 2004.

FORT EUSTIS BOULEVARD from Jefferson Ave. to n. corporate limits of Newport News

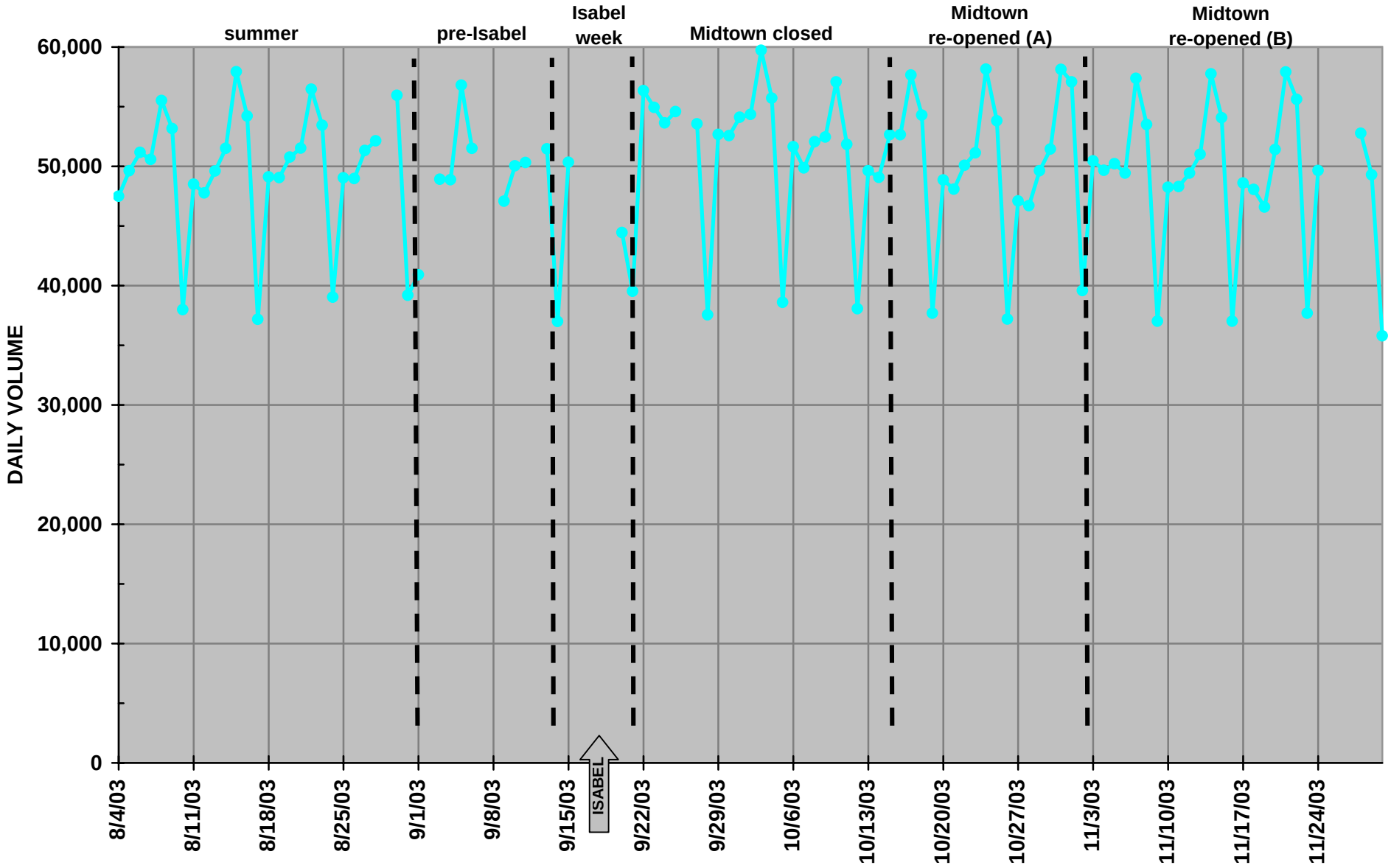
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150107.
Prepared by HRPDC, March 2004.

MERCURY BOULEVARD from Chestnut Ave. to Big Bethel Rd.

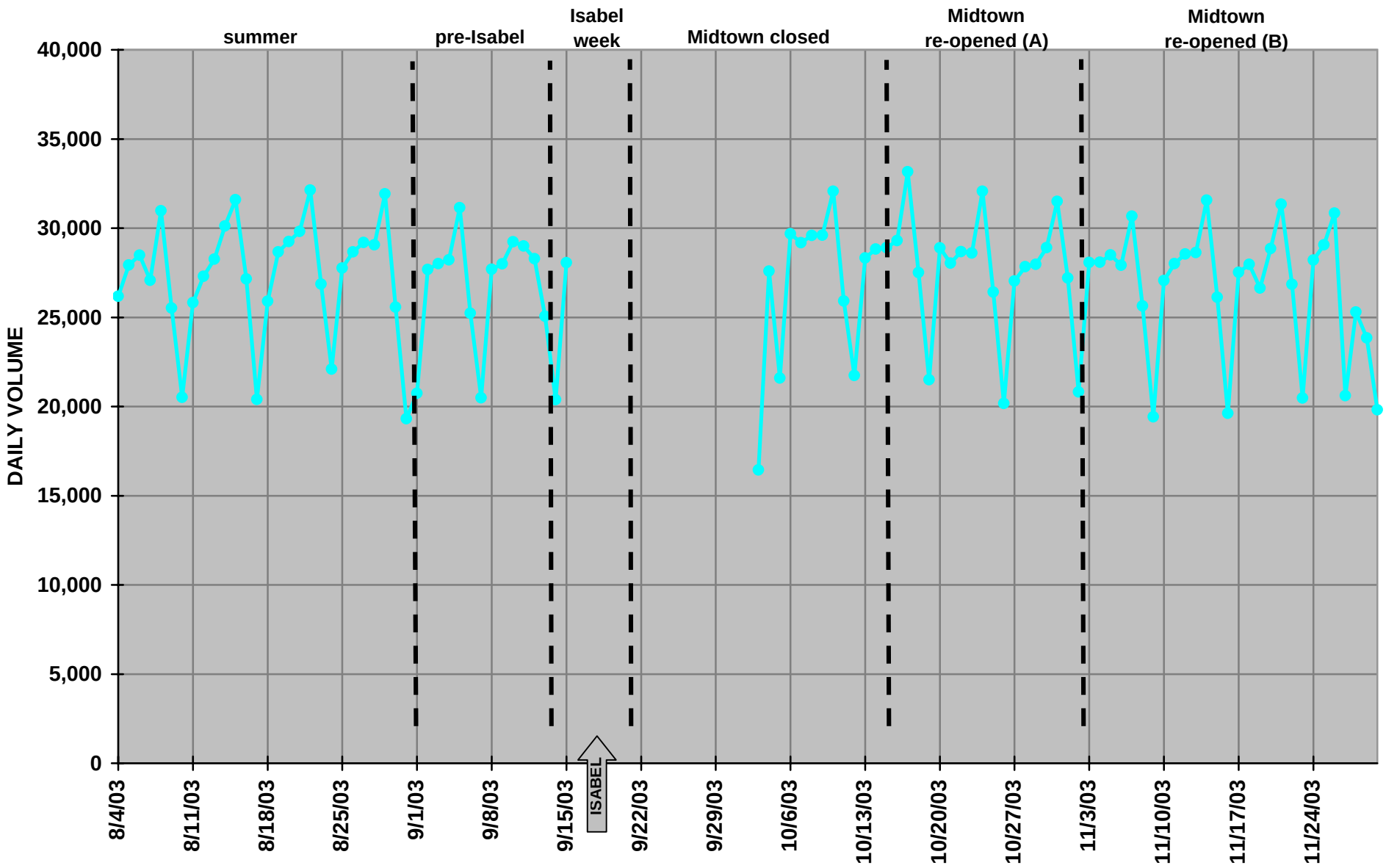
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150118.
Prepared by HRPDC, March 2004.

JAMES RIVER BRIDGE

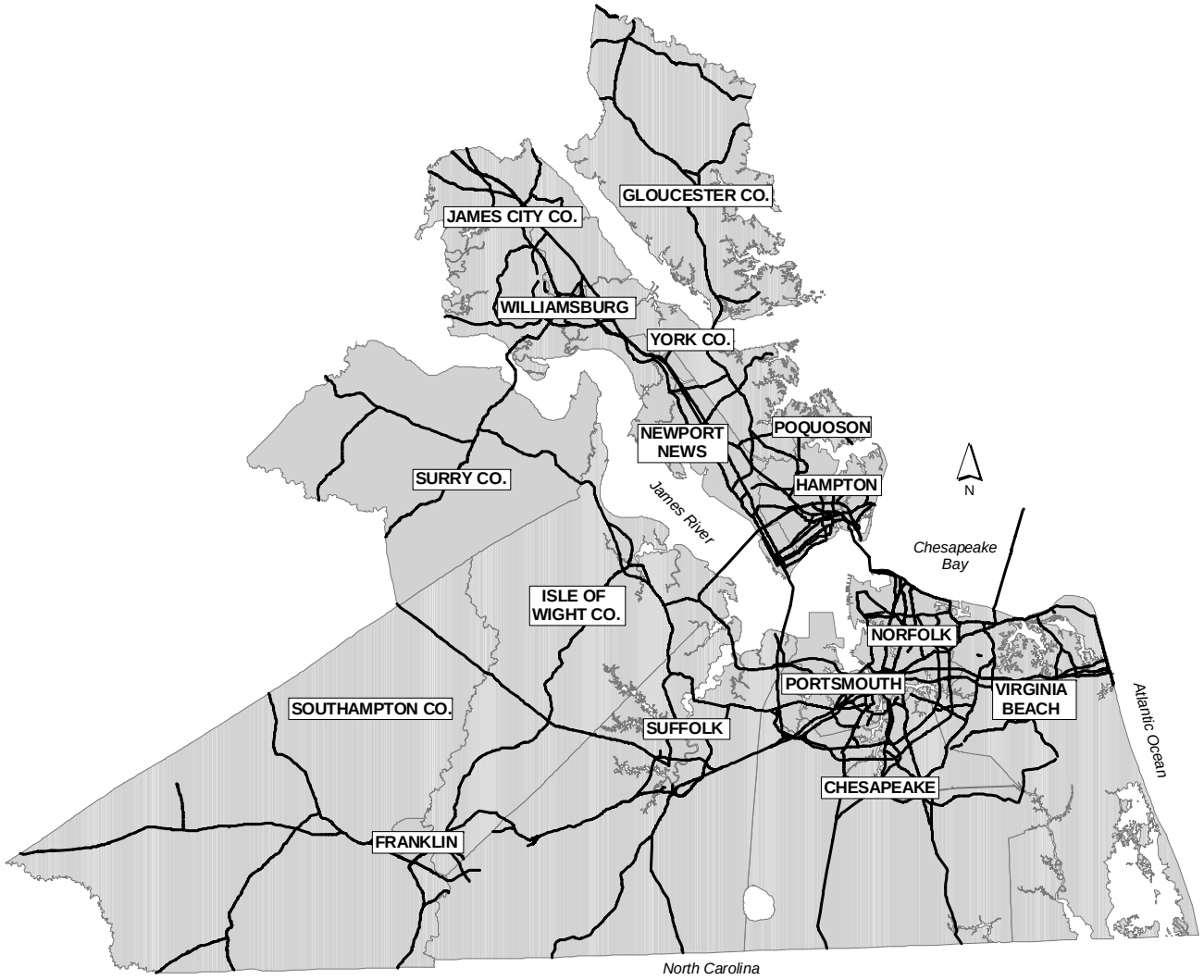
Daily Traffic Volume: 8/4/03 to 11/30/03



Source of data: VDOT, count ID 150100.
Prepared by HRPDC, June 2004.

Appendix B. Map of Hampton Roads

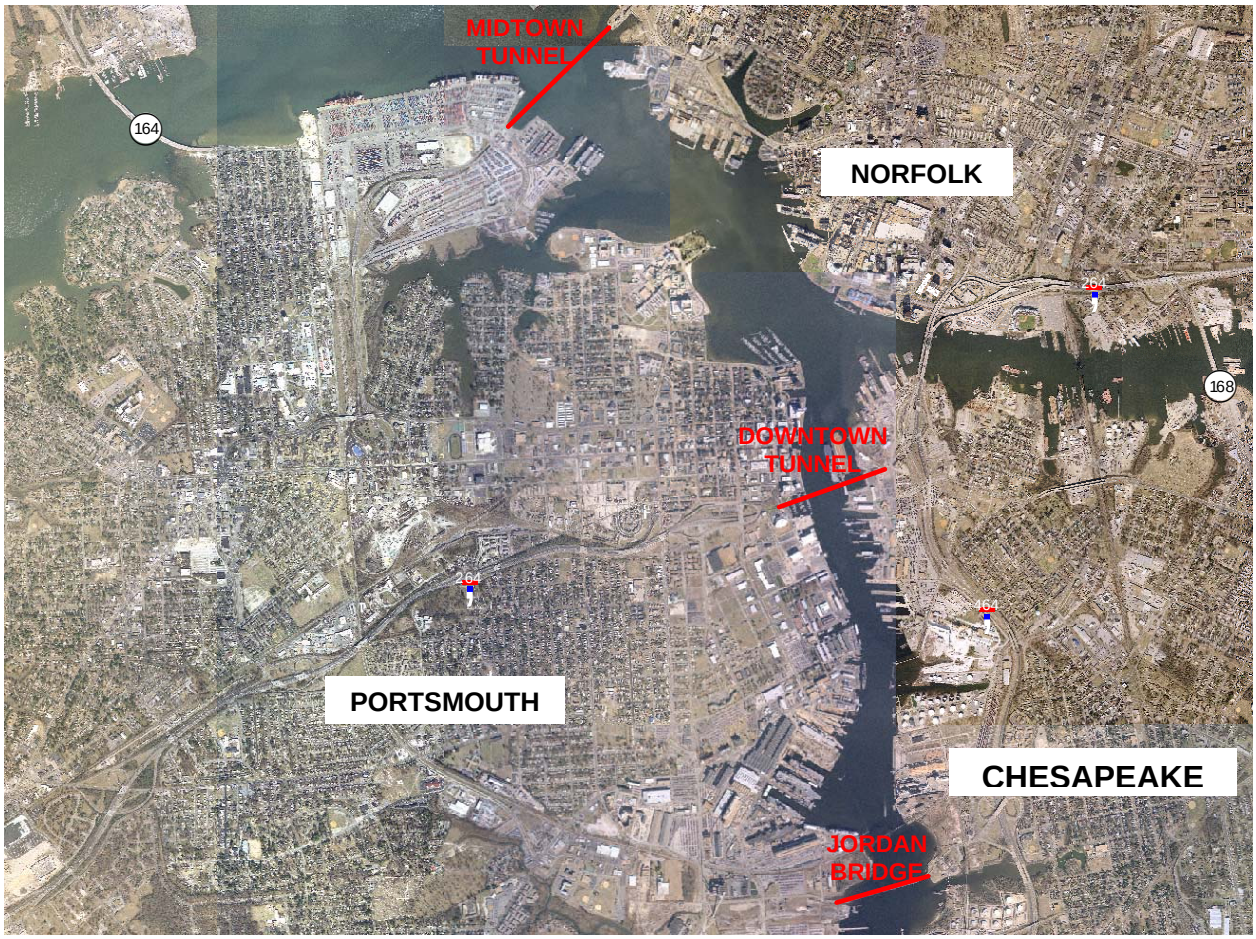
MAP B1. Map of Hampton Roads



regionalmap.wmf

Appendix C. Aerial View of the Midtown Tunnel

FIGURE C1. Aerial View of the Midtown Tunnel



Aerial imagery © Commonwealth of Virginia

mtaerial4.wmf

Appendix D. Travel Demand Forecasting Model Analysis

The extensive data collected for the analysis of the Midtown Tunnel closure also provides a very rare opportunity to test the ability of the regional travel demand forecasting (TDF) model. The model is used for a variety of transportation planning activities, including analyzing the impact of highway improvements, examining traffic patterns in the region, and as a part of the air quality conformity process.

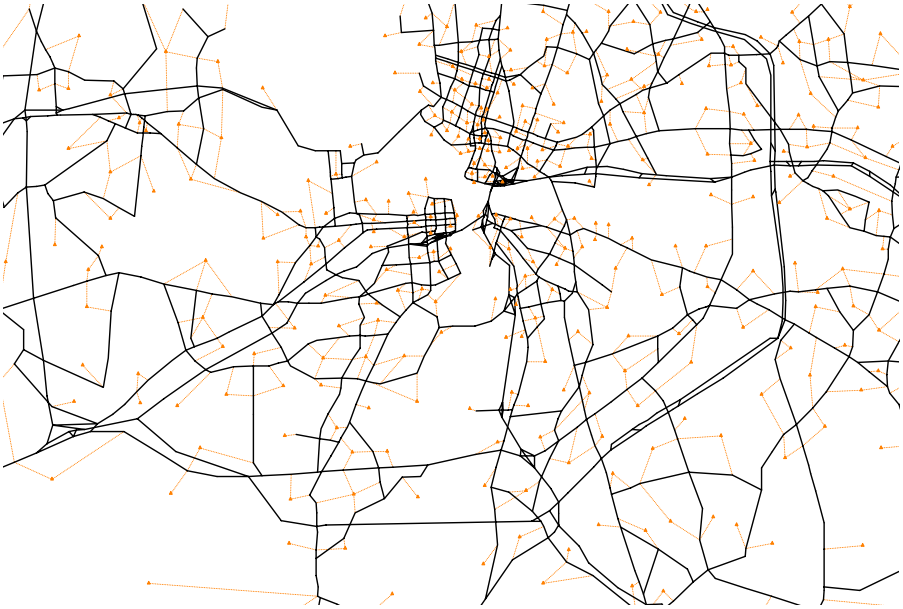
Highway alternatives tested with the TDF model are usually widenings of an existing road or the construction of a new highway. Use of the Midtown Tunnel closure data is a somewhat unconventional test because it is a check of how the model responds to the removal of an existing facility. However, this shouldn't lower the expectations of how well the model performs.

Table D1 compares the change in average weekday volume as estimated by the TDF model (with no Midtown Tunnel and no Jordan Bridge toll) versus the actual change in volume. The difference between the model volume change and the actual volume change ranged from +16,431 to –4,968. Over half of the segments had a difference of less than 1,000, and over 80% had a difference of 3,000 or less. See **Figure D2.** A scatter plot of model volumes versus actual volumes shows a good fit at a macro level both with the Midtown Tunnel open and after it is closed. See **Figure D3.**

The model had the most difficulty with allocating the change in traffic to the Elizabeth River crossings. The model overestimated the increase on the Downtown Tunnel and underestimated the increase on the Jordan Bridge and Gilmerton Bridge. It also underestimated the decrease in volume on I-664, Western Fwy., and Hampton Blvd.

correctly predicted an increase or decrease in volume, the model was correct 64% of the time (23 of 36 segments).

FIGURE D1. Travel Demand Forecasting Network Near Midtown Tunnel



samplenet.emf

TABLE D1. Travel Demand Forecasting Model Estimate of Midtown Tunnel Closure

ID	LOCALITY	ROAD	FROM	TO	ACTUAL CHANGE VOLUME	MODEL WITH MIDTOWN VOLUME	MODEL M.T. CLOSED VOLUME	MODEL CHANGE VOLUME	% CHANGE	DIFF MODEL CHG vs ACTUAL CHG
MT	Norf / Ports	**Midtown Tunnel**	Norfolk	Portsmouth	-37,631	40,024	0	-40,024	-100%	**-2,393**
DT	Norf / Ports	**Downtown Tunnel**	Norfolk	Portsmouth	4,771	99,066	120,268	**21,202**	**21.4%**	**16,431**
JB	Ches / Ports	**Jordan Bridge**	Chesapeake	Portsmouth	13,535	10,331	18,898	**8,567**	**82.9%**	**-4,968**
HRBT	Hamp / Norf	**I-64 (HRBT)**	Hampton	Norfolk	1,733	84,312	86,275	**1,963**	**2.3%**	**230**
150123	Ches	**Gilmerton Bridge**	Canal Dr	Bainbridge Blvd	4,652	23,506	24,602	**1,096**	**4.7%**	**-3,556**
150036 / 150037	Norfolk	**I-564**	Int'l Terminal Blvd	Admiral Taussig Blvd	3,395	60,901	61,752	**851**	**1.4%**	**-2,544**
150100	Isle of Wight Co.	**James River Bridge**	na	na	852	25,931	26,283	**352**	**1.4%**	**-500**
150105	Va. Beach	**Oceana Blvd**	Credle Rd	First Colonial Rd	1,276	25,070	25,324	**254**	**1.0%**	**-1,022**
150106	Chesapeake	**Dominion Blvd**	Cedar Rd	Bainbridge Blvd	-291	22,488	22,712	**225**	**1.0%**	**516**
150091	Hampton	**Armistead Ave**	Tidemill Ln	Hampton Roads Center Pkwy	443	32,380	32,594	**214**	**0.7%**	**-229**
150095	Chesapeake	**Military Hwy**	ECL Suffolk	I-664	-1,045	75,446	75,571	**125**	**0.2%**	**1,170**
150092	Hampton	**HRCP**	I-64	Magruder Blvd	346	39,502	39,621	**119**	**0.3%**	**-227**
150118	Hampton	**Mercury Blvd**	Chestnut Ave	Big Bethel Rd	3,459	43,314	43,424	**110**	**0.3%**	**-3,349**
50193	York	**GW Mem Hwy**	Hampton Hwy	Dare Rd.	141	44,423	44,488	**65**	**0.1%**	**-76**
150107	Newport News	**Ft Eustis Blvd**	Jefferson Ave	NCL Newport News	-237	16,978	17,015	**37**	**0.2%**	**274**
150093	York	**Penniman Rd**	Rte 199	Colonial Pkwy	-145	2,795	2,832	**37**	**1.3%**	**182**
150108	Newport News	**Jefferson Ave**	Denbigh Blvd	Richneck Rd	345	29,267	29,303	**36**	**0.1%**	**-309**
150103	Va. Beach	**Laskin Rd**	Va. Beach Blvd	First Colonial Rd	494	26,369	26,402	**34**	**0.1%**	**-460**
150104	Va. Beach	**Shore Dr**	Northampton Blvd	Bay Lake Rd	-4	41,556	41,589	**33**	**0.1%**	**36**
677732	Va. Beach	**Independence Blvd**	Va. Beach Blvd	Pembroke Blvd	758	43,466	43,486	**20**	**0.0%**	**-738**
50300	Suffolk	**Main St**	Nansemond River bridge	Godwin Blvd	765	13,070	13,083	**13**	**0.1%**	**-752**
150094	Suffolk	**Rte 13**	N. Carolina state line	Rte 616	-261	5,400	5,397	-3	0.0%	**258**
150111	Chesapeake	**Battlefield Blvd**	N. Carolina state line	Ballahack Rd	-519	20,943	20,936	-7	0.0%	**512**
150096	Chesapeake	**Rte 17**	N. Carolina state line	Ballahack Rd	-571	9,999	9,991	-8	-0.1%	**563**
150114	Norfolk	**Tidewater Dr**	Norview Ave	Cromwell Dr	405	39,324	39,186	-139	-0.4%	**-544**
150119	Norfolk	**Hampton Blvd**	Lafayette River bridge	Lexan Ave.	-5,548	42,056	41,905	-152	-0.4%	**5,396**
50163 / 150051	NN	**I-64**	Oyster Point Rd.	J. Clyde Morris Blvd.	-329	138,264	138,015	-249	-0.2%	**80**
150121	Chesapeake	**Battlefield Blvd**	I-64	Military Hwy	3,604	26,746	26,483	-264	-1.0%	**-3,868**
150012 / 150022	Suffolk	**I-664**	College Dr	Western Fwy	-2,393	58,883	58,614	-269	-0.5%	**2,124**
150120	Norfolk	**Int'l Terminal Blvd**	Hampton Blvd	Ruthven Rd	938	19,431	19,012	-419	-2.2%	**-1,357**
150098	Chesapeake	**Bridge Rd**	Churchland Blvd	ECL Suffolk	859	10,850	10,124	-726	-6.7%	**-1,585**
150110	Norfolk	**Princess Anne Rd**	Ballentine Blvd	Azalea Garden Rd	143	29,817	28,814	-1,003	-3.4%	**-1,146**
MMBT	Suff / NN	**I-664 (MMMBT)**	Suffolk	Newport News	-2,149	63,519	62,477	-1,042	-1.6%	**1,107**
150101	Newport News	**Jefferson Ave**	Main St	Harpersville Rd	1,089	54,032	52,612	-1,419	-2.6%	**-2,508**
150010 / 150079	Portsmouth	**I-264**	Victory Blvd.	Portsmouth Blvd.	-933	59,332	56,349	-2,983	-5.0%	**-2,050**
150109	Portsmouth	**Western Fwy**	Cedar Ln	West Norfolk Rd	-6,152	37,162	33,053	-4,109	-11.1%	**2,043**

FIGURE D2. Difference Between Model Volume Change and Actual Volume Change

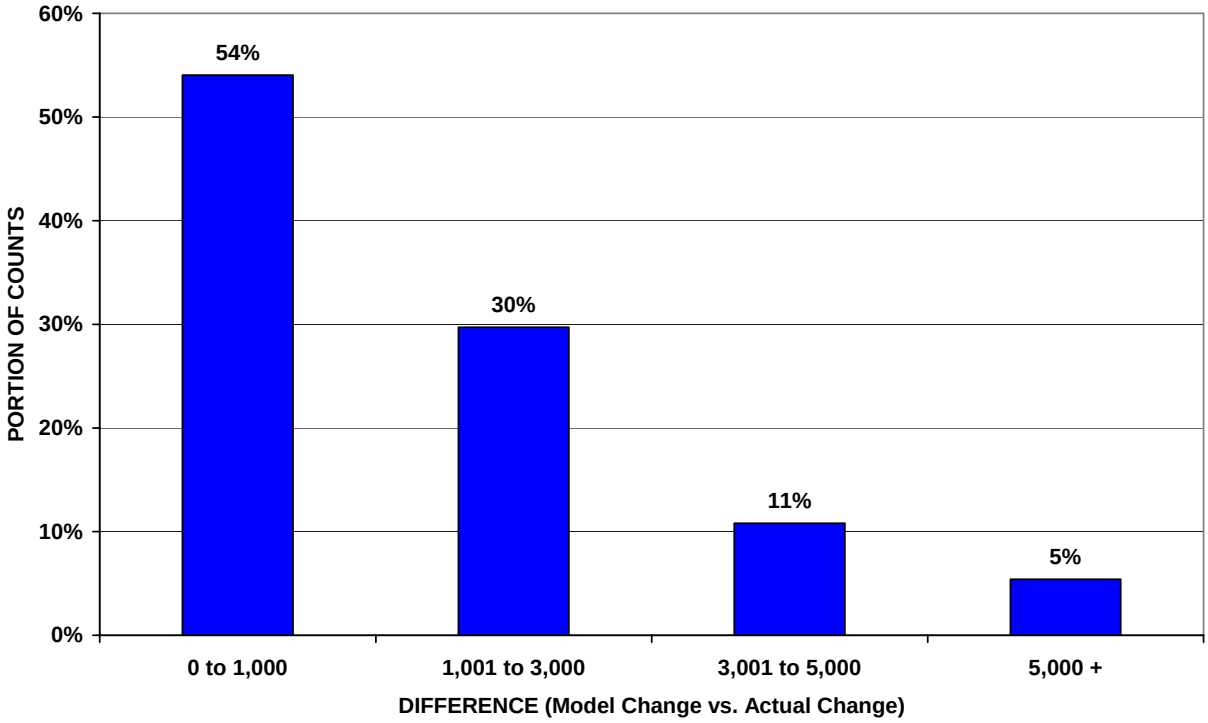
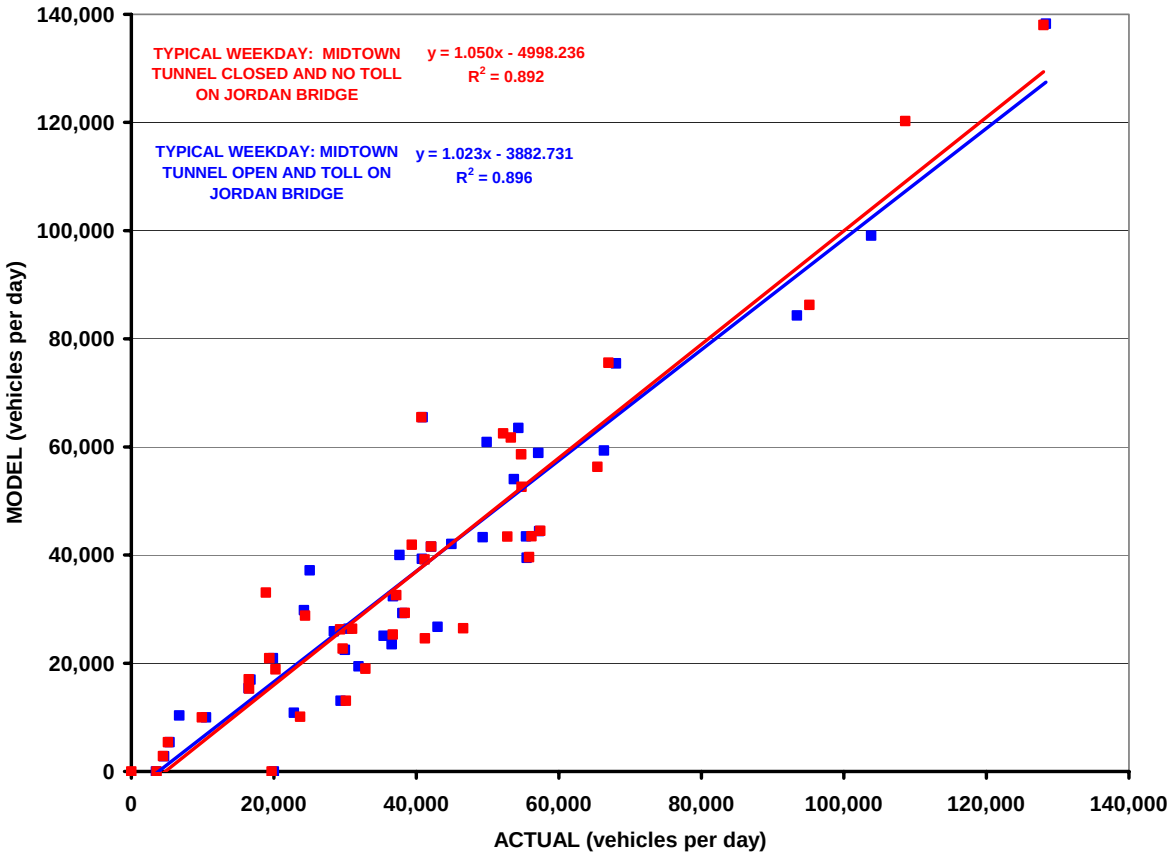


FIGURE D3. Model Volume vs. Actual Volume



Appendix E. VDOT Newsletter on Hurricane Isabel

S E P T E M B E R - O C T O B E R 2 0 0 3

bulletin

Isabel blusters; VDOT not bullied

More than 1,000 roads were shut down by the hurricanes' onslaught. Within a week, most were clear of debris for motorists to travel again.

Hurricane Isabel blustered and flooded across Virginia Sept. 18, ripping roofs, knocking over silo-sized trees, turning off millions of lights, and shutting down 1,000 of Virginia's roads from Hampton Roads to the Shenandoah Valley to the Washington suburbs. Coming ashore as barely a "Category 2," the damage she caused put her, in many Virginians' minds, in the category of "catastrophic."

VDOT employees, on the ready as the storm made its destructive way into the state, were deployed everywhere, clearing roads and giving assistance to stranded motorists. Fallen trees, water, accidents, debris, washouts, and shattered telephone poles confronted hundreds of crews from the department. Electric power complicated the recovery — whether on or off — as the lack of power darkened 351 traffic signals in Fairfax

County alone, and the presence of power in downed lines and trees inhibited VDOT's work force.

Then, a tornado crashed through Southside and Central Virginia Sept. 23, closing another 200 roads. But despite the tornado's added insult, by Sept. 26 VDOT crews had reopened all but 72 roads closed by the storm and 32 roads hit by the tornado.

Marty Frederick, Electronics Technician II with the Richmond District traffic signal staff, gets set to work on a signal at the intersection of Route 60 and Wadsworth Drive in Chesterfield County that was damaged by Hurricane Isabel.

It wasn't without the work of almost 4,000 VDOTers, some of them performing near-Herculean efforts. While employees in the field struggled to make road repairs, VDOT office staffs strived to serve them, as well as the public. The Transportation Emergency Operations Center, to mention just one example, handled 35,136 calls from concerned citizens from Sept. 16-22.

Commissioner Philip Shucet commended every one of them: "No matter your job; no matter whether you're in the field or in the central office, all of you contributed in a positive way to our efforts over the past several days. From the people behind the desks to the people in the field with chain saws, it takes all of us to make this department work. And work it did."

Unfortunately, two VDOTers experienced serious injuries (see accompanying story).

Damages were not so light. The current estimate for all of VDOT's costs associated with Hurricane Isabel is $100 million, including damages to roads and other infrastructure.

Heroic effort at Midtown Tunnel

Stealing early into Hampton Roads with an advance thrust, Hurricane Isabel reached ruthlessly for the lives of VDOT employees trying to protect the Midtown Tunnel between Norfolk and Portsmouth. Risking their lives to put the tunnel's foot-thick

Opening in which the steal plate was locked at Midtown Tunnel

floodgate in place before the hurricane hit, the tunnel team had to stop to rescue each other as the Elizabeth River poured in on them.

A steel plate, which had to be removed from the pavement before the floodgate could be locked, stayed stuck despite employees' mighty efforts to pull it loose. **David Kurtich**, one of the first workers to arrive, removed four bolts that helped hold the plate down, but neither he nor others arriving could knock loose the temporary welds on the plate, which normally are broken with a small hammer. As they grappled with the plate, now under the rising water, the flood began to engulf them.

VDOTers began rushing to the scene as they heard of the struggle. **Darrell Southerland** drove a truck through three-feet of water from the Portsmouth side, and Facility Manager Bruce Wilkerson tried to do the same in his car, but was stalled by the rising flood. **Robert Hewitt** left his stalled pickup in the tunnel and scurried along a handrail on top of the catwalk to get to the Norfolk side with a big pry bar. Meanwhile, Robert Huffman drove a hefty tow truck from the Norfolk side to the tunnel entrance to haul the men out if necessary. After jumping out of the truck and trying to help with the plate, Huffman was swept into the tunnel. He was rescued only after a human chain of workers was formed to pull him back.

Finally, after Southerland phoned to say, "It's dangerous. We're losing it," facility manager Wilkerson told him to "Pull 'em." The men scrambled onto two trucks and drove out of the deepening storm surge.

After their defeat by the watery assault, tunnel employees were

Citizens, leaders praise VDOT

"Please pass along to the entire 'storm team' my deepest appreciation and respect for the tremendous job that is being done. I have been proactively calling localities and asking their needs. The most frequent compliment I get is about VDOT's initiative and work ethic. Do not allow a few sporadic complaints, that will always find their way into the press, deter you from understanding of how grateful Virginians, and this Governor, are for your service."

- William H. Leighty, chief of staff, Office of the Governor.

downcast. Some called Wilkerson and offered to resign. Wilkerson said, "What for?" Responding to questions from the media, Commissioner Philip Shucet said, "There was no failure. There was no human error. Nature won."

Within the next week, the men's heroic stand had been praised not only by Commissioner Shucet, who called them gallant; but also by Gov. Mark Warner, who said the men had gone above and beyond the call of duty; and by President George Bush, who recognized them in a stop in Richmond for reports on storm recovery efforts.

The tunnel, which completely filled with 44 million gallons of water, has been pumped dry, and an assessment of damage from flooding to the tunnel systems is under way. Meanwhile, the tunnel team was planning temporary repairs that would allow motorists to use the Midtown tunnel during drive-time.

Two in Staunton seriously hurt

Two Staunton District employees, **Garland F. Presgraves** and **Randal W. Vorous**, felt the punch of a treacherous Hurricane Isabel as they worked to clear roads in Clarke County during the night of the storm.

As they intently cut up trees blocking Route 50, another tree, unseen by them, succumbed to the winds and fell with all its force on them. Vorous was able to crawl out from under the pressure of the fallen limbs, but he could not see Presgraves or get him to answer his call. After a desperate search of the flattened foliage, he found his workmate unconscious. After signaling for emergency help, Vorous sawed a path into where Presgraves lay. When emergency workers arrived, they were able to go right to Pregraves and lift him onto a stretcher.

Pesgraves was in serious condition at last report. Vorous had been treated and released from the hospital. They represent the commitment, in the face of danger, that VDOT

"You've got to hand it to VDOT. Battered by snow all winter, then taunted by rains and harangued by complaints of unmowed grass all summer, department workers have been out busting their humps 24-7."

- Chris Dovi, Street Beat columnist, Richmond-Times Dispatch

"Just wanted to say 'thanks' to all the hard-work during (the) hurricane. As a 911 officer, I know it was a busy time for us all. Thanks for the road work and more, Virginia DOT."

- Stuart, Hanover County

"I was super-pleased to see the work that was done during the storm to clear the roads of trees and put the lights back on in Pittsylvania County by 3 a.m. (Sept. 19)…. Please pass on… praise…(to) those who brave the storm to keep us safe."

-Dexter L. Smith, Sgt. Maj., U.S. Army, retired.

workers show every time a disaster touches the Commonwealth.

Appendix F. References

hurr-isabel-20030918-1715-g122kmvs.jpg (black and white cover photo) downloaded from www1.ncdc.noaa.gov/pub/data/images/hurr-isabel-20030918-1715-g122kmvs.jpg, downloaded 2/24/04

Isabel.hurricane.track.jpg downloaded from www2.ncsu.edu/eos/service/pams/meas/sco/research/nws/cases/20030918/isabel.hurricane.track.jpg on 2/24/04

Tunnelflood0920n.jpg downloaded from www.hamptonroads.com/images/temp/tunnelflood0920n.jpg on 4/14/04

Belfield, Samuel S., Joseph L. Lewis, and Keith M. Nichols. "Congestion Management System for Hampton Roads, Virginia 2001 - Technical Appendix". Hampton Roads Planning District Commission, June 2001.

Belfield, Samuel S., John A. Bishop, and Keith M. Nichols. "Intermodal Management System for Hampton Roads, Virginia". Hampton Roads Planning District Commission, December 2001.

Virginia Department of Transportation. "September-October 2003 Bulletin". Downloaded from www.virginiadot.org/bulletin/2003 sept/hurricane_feature_story.asp on 4/14/2004.

House Subcommittee on Economic Development, Public Buildings, and Emergency Management. "The Federal Response to Hurricane Isabel", October 7, 2003. Downloaded from www.house.gov/transportation/pbed/10-07-03/10-07-03memo.html on 5/3/2004.

American Red Cross. "Red Cross Cost of Hurricane Isabel Relief Efforts Outpacing Disaster Relief Fund Resources". October 2, 2003. Downloaded from www.redcross.org/pressrelease/0,1077,0_314_1722,00.html on 5/3/2004.

Hardin, Peter. "Congress Approves Money to Fix Damage By Hurricane Isabel". Richmond Times-Dispatch, November 1, 2003. Downloaded from www.timesdispatch.com/servlet/Satellite?pagename=RTD%2FMGArticle%2FRTD_BasicArticle&c=MGArticle&cid=1031771868929&path=%21news%21special%21generic1&s=1058750351796 on 5/3/2004.

Old Dominion University College of Business and Public Administration. "2004 Annual Economic Forecast for Hampton Roads MSA". January 21, 2004. Downloaded from www.odu.edu/bpa/forecasting/forecast_hryearlyanalysis_04.shtml on 5/3/2004.

Schnaars, Christopher. "Tallying Isabel's Cost: Computer Analysis Compares Damage Across Area". Daily Press. April 18, 2004. Downloaded from www.dailypress.com/news/dp-93013sy0apr18,0,2199003.story?coll=dp-headlines-topnews on 5/3/2004.