



MEMORANDUM

One Riverwalk Center
110 S. Poplar Street, Suite 102
Wilmington, DE 19801
Phone 302.468.4880
Fax 877.421.7265
www.rkk.com

Date: September 12, 2014

To: Rich Vetter, PE, AICP
Executive Director
The Dover/ Kent County Metropolitan Planning Organization

From: Shilpa Mallem, PE

Re: West Street Traffic Study

Introduction

The Dover/Kent County Metropolitan Planning Organization (Dover/Kent MPO) requested that RK&K evaluate the traffic impacts of converting a section of South West Street into a one-way, southbound street between North Street and Queen Street.

RK&K conducted a traffic study to determine the feasibility of converting a section of South West Street into a one-way street before and after the completion of the West Dover Connector (WDC). This Technical Memorandum summarizes the data collection, safety analysis, traffic forecasting process and potential impacts associated with each of the proposed options.

Existing Conditions:

South West Street (West Street) is a two lane roadway connecting North Street, Water Street and Queen Street in downtown Dover, Delaware. West Street intersects North Street as a T-intersection, with West Street forming the south leg of the intersection. Norfolk Southern Railroad, runs parallel to West Street between North Street and Water Street, and crosses the west leg of the intersection. Figure 2 shows details of the study area.

The eastbound approach of North Street carries one through lane and one right turn lane. These two lanes are separated by a concrete channelization island that houses the railroad crossing assembly. Figure 1 is a photograph of this approach. As a result, northbound traffic on West Street has to cross a wide stretch of roadway (approximately 35' - see Appendix A) to access westbound North Street. Additionally, the location of the right turn lane restricts the ability of the northbound traffic to identify gaps in the through traffic on eastbound North Street (see Figure 2 below). This sight distance limitation combined with location of the

railroad tracks currently creates an unsafe situation for West Street traffic making a left turn at this unsignalized intersection.

The Dover Transit Center is located at the intersection of Water Street and West Street. The main entrance for all buses accessing the Transit Center is located on West Street between Water Street and Queen Street, and the main exit is on Water Street between West Street and Queen Street. According to the Transit Maps shown on DART First State’s website for the Central Dover area, the portion of West Street between North Street and Water Street is currently utilized by buses on two routes (113 and 103).

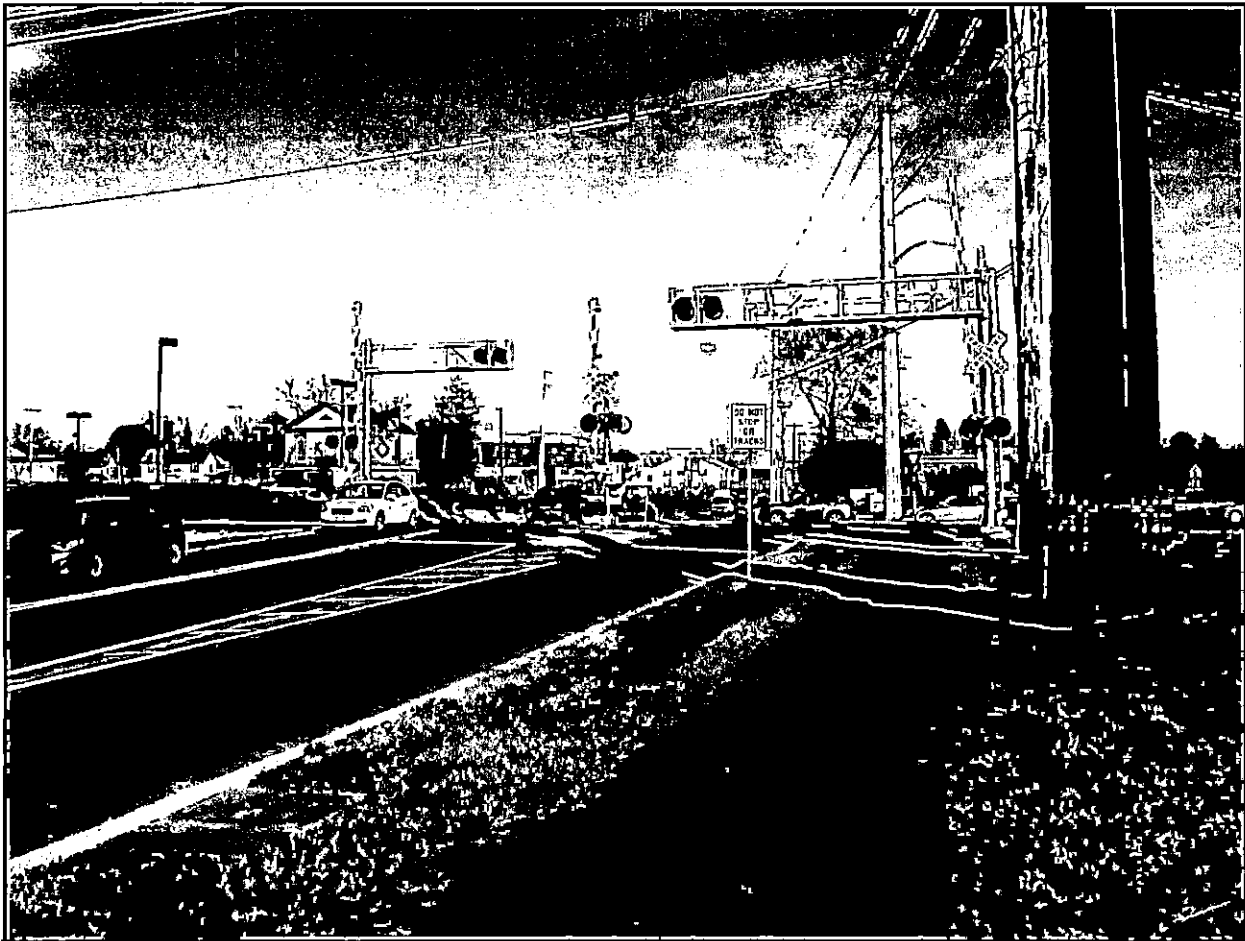


Figure 1: North Street at West Street intersection: Eastbound North Street approach showing the through and right turn lanes, and the channelization island.



DOVER KENT MPO WEST STREET STUDY STUDY AREA			
SCALE 0' 100' 200' 	JULY 2014	DRAWN BY GBP	FIGURE 2

Data Collection

The conversion of West Street into a one-way, southbound street would result in existing northbound traffic diverting to other roadways in the area. For the purpose of this study, it is assumed that all diverted traffic would use Queen Street to access North Street. In order to determine the impacts of this diverted traffic on adjacent roadways, the following intersections were included for analysis:

- Saulsbury Road (SR 15) at North Street (Signalized)
- North Street at West Street
- North Street at Queen Street (Signalized)
- Queen Street at Bank Lane
- Queen Street at Water Street (Signalized)
- Queen Street at West Street
- West Street at Water Street
- North Street at New Street (Signalized)
- Banning Street at North Street (Signalized) and
- Entrance to the Dover Transit Center’s Park & Ride on Water Street

Turning Movement Counts: RK&K and Dover Kent MPO collected peak hour turning movement counts at all of the above mentioned intersections (except Saulsbury Road at North Street) on Wednesday, November 5, 2013 and Thursday, November 6, 2013. Figure 3 shows the existing traffic volumes obtained from the turning movement counts.

Saulsbury Road (SR 15) at North Street intersection: A July 2011 Traffic Impact Study developed by Duffield Associated for the property located at the northeast corner of SR 15 and North Street intersection determined the impacts resulting from additional traffic generated by the construction of a new gas station with a convenience store, and a drive-in branch bank. Turning movement count volumes at the intersection of Saulsbury Road and North Street were obtained from this report (Please see Appendix A for details at this intersection).

Tube Counts: RK&K also collected 24-hour tube counts during the week of November 3-7, 2013 at two locations along West Street. The tubes were installed on West Street between North Street and Water Street and between Water Street and Queen Street, adjacent to the Dover Transit Center. Table 1 shows the volume and speed data obtained from the tube counts.

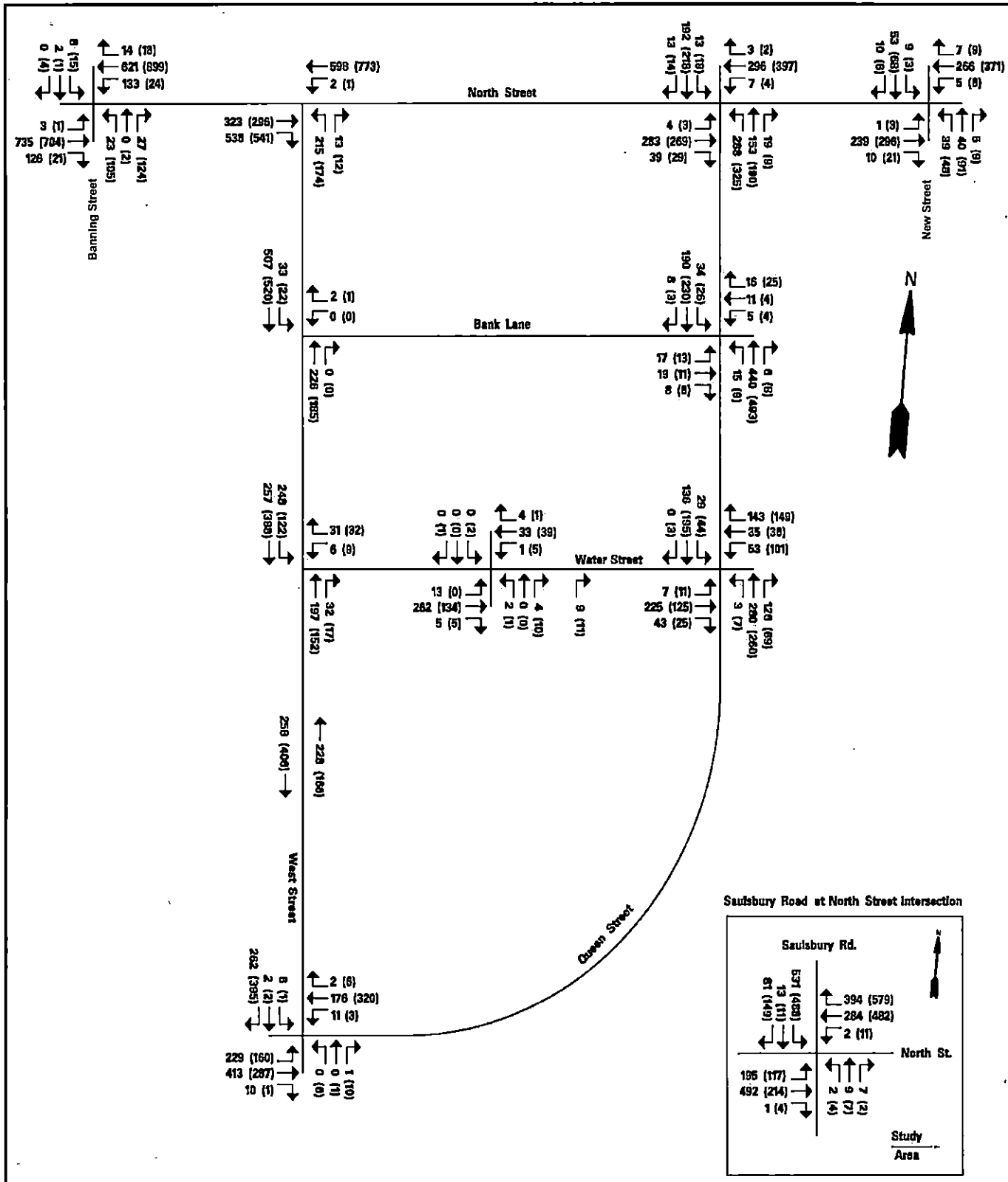
Table 1: Tube Counts – Volume and Speed data on West Street

Location 1: West Street – north of Water Street						
	ADT (vpd.)		Average Speed (mph.)		85 th percentile speed (mph.)	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
NB	3,390	2,650	29	29	34	34
SB	6,060	3,725	28	29	33	34

Location 2: West Street – south of Water Street						
	ADT (vpd.)		Average Speed (mph.)		85 th percentile speed (mph.)	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
NB	2,935	2,265	32	32	37	37
SB	4,460	3,015	31	32	35	37

Notes: vpd. – vehicles per day;
mph. – miles per hour

Figure 3: Existing 2013 AM(PM) Peak Hour Turning Movement Volumes



Traffic Analyses

Existing Conditions:

Turning Movement volumes shown in Figure 3 were used to develop a Synchro Model to analyze existing traffic conditions in the study area. The signal timings at each intersection were provided by DelDOT and verified in the field. Existing traffic conditions were analyzed using Simtraffic to obtain the 95th percentile queue lengths along each of the approaches. Table 2 shows the Level of Service (LOS), intersection delay and critical queue length values, including approaches where the 95th percentile queues are greater than the available storage lengths (shown in red), for each of the study intersections.

Table 2: Existing Conditions - Level of Service, Delay and Queuing Information

		North Street Intersections					Queen Street Intersections			West St. Intersections	
		SR 15	Banning Street	West Street	Queen Street	New St	West Street	Water Street	Bank Lane	Water Street	Bank Lane
AM Peak	LOS / Delay (sec) ¹	D / 39.7	D / 53.6	D / 34.9	C / 20.5	B / 13.6	A / 5.7	B / 11.8	A / 2.8	A / 4.5	A / 1
	Critical Queues - Queue Length/ Link Distance (ft.) ²	SBL SR 15 - 250/200	WB North - 191/181	-	NBL Queen - 121/100	-	-	NBR Queen - 183/130	-	-	-
PM Peak	LOS / Delay	D / 37	C / 26.6	C / 20.9	C / 23.6	B / 17.3	B / 10.8	B / 12.9	A / 2.5	A / 2.9	A / 1
	Critical Queues - Queue Length/ Link Distance (ft.)	SBL SR 15 241/200	WB North 268/181	-	NBL Queen - 119/100	-	-	-	-	-	-

1. Obtained from Synchro, Version 8.
2. 95th percentile queue length values obtained from Simtraffic, Version 8. Only queue lengths that exceed existing storage lengths are shown. For left and right turn movements, storage lengths were used in place of link distances. See Appendix C for the complete Simtraffic report on queue lengths.

The analyses show that:

- The intersection of SR 15 and North Street currently operates at LOS D during the AM and PM peak hours, with the southbound left turn queues exceeding the existing storage lengths.
- Queue lengths along stop controlled NB West Street are considerably long and occasionally back up to the intersection of Bank Lane and West Street. According to the Synchro Model, this approach currently operates at LOS F.
- The queue for the NB left turn approach at the intersection of North Street and Queen Street occasionally blocks the through lane during the AM and PM peak hours.
- The queue for the NB right turn approach at the intersection of Queen Street and Water Street also occasionally blocks the through lane during the AM peak hour.
- At all intersections, the queue lengths from the model were consistent with field observations.

Option 1: No Build

West Dover Connector

DelDOT is currently finalizing the design documents for the West Dover Connector (WDC) that will connect Saulsbury Road and US 13. Construction is anticipated to start in Winter 2014 with an anticipated duration of approximately 30 months. It is expected that this new roadway will divert a portion of the traffic from West Street away from the study area.

Traffic redistribution

DelDOT provided RK&K with the traffic redistribution assumptions used for the WDC project. According to the redistribution percentages used for the WDC project, 40% and 50% of the traffic will divert from Queen Street to the WDC in the AM and PM peak hours, respectively (see Appendix B), and 25% and 55% of traffic from eastbound North Street will divert to WDC during the AM and PM peak hours, respectively. This diverted traffic is expected to use the intersection of North Street and SR 15 to access other areas in the City of Dover.

RK&K developed no-build traffic volumes in the study area utilizing the redistribution percentages used for the WDC project. A Synchro Model was developed with these volumes to determine how the WDC will affect existing traffic flow in the study area. The redistribution assumptions and updated turning movement volume calculations are shown in Appendix B. The updated turning movement counts are shown in Figure 4.

Table 3 shows the Level of Service (LOS), intersection delay and critical queue length values, including approaches where the 95th percentile queues are greater than the available storage lengths (shown in red), for each of the study intersections.

The analyses show that, with no modifications to West Street:

- Reduced volumes along Queen Street and North Street due to the WDC eliminate the queuing issues at these intersections.
- The intersection of North Street and SR 15 operates at LOS F, and the northbound and southbound approaches experience very long queues due to the significant amount of traffic diverted by the WDC to this location. The signal timings at this intersection need to be adjusted to accommodate the increased traffic.
- The queues at the intersection of North Street and Banning Street are slightly shorter than existing conditions.

Figure 4: Option 1
AM(PM) Peak Hour Turning Movement Volumes

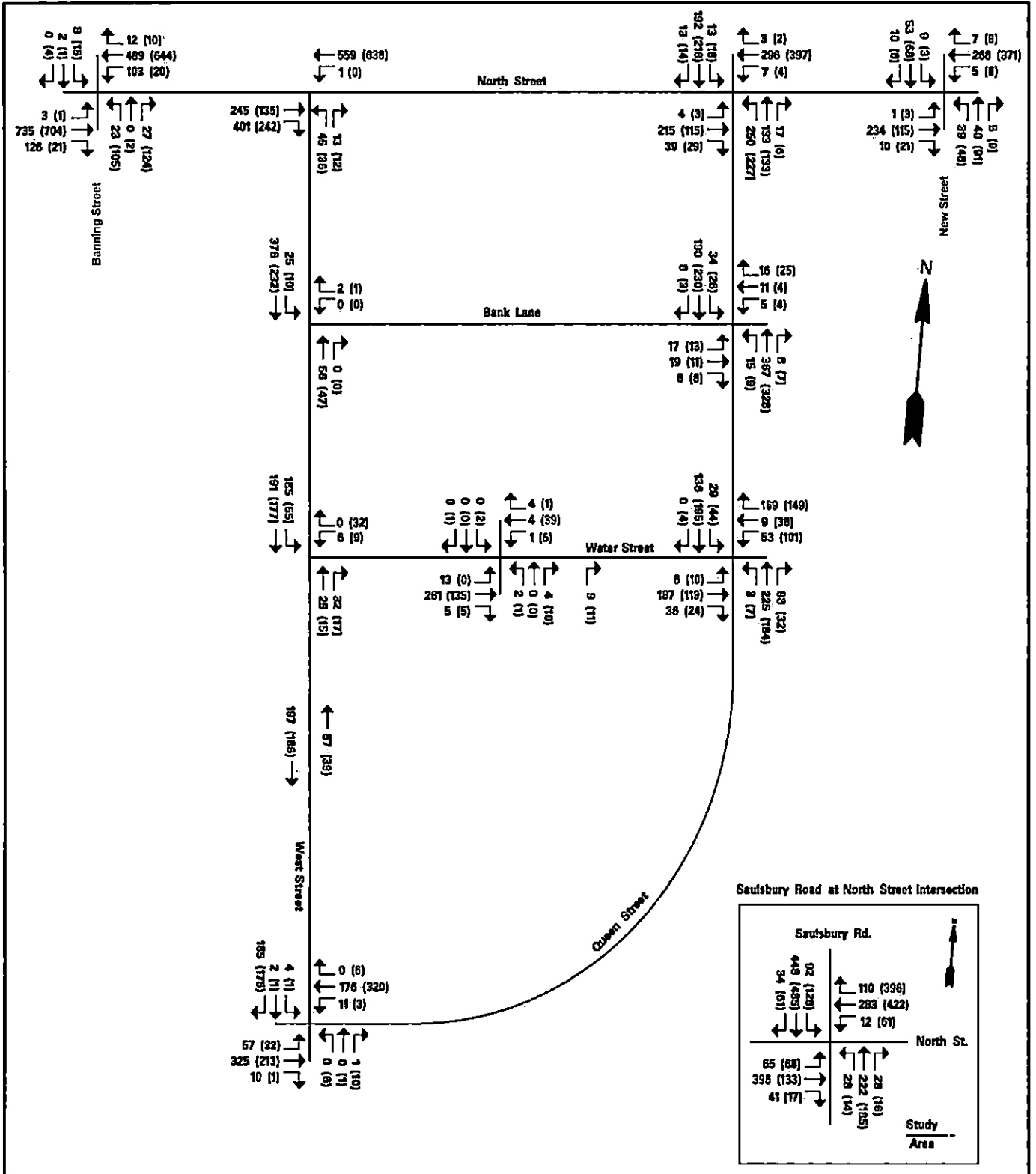


Table 3: Option 1 – No Build

Level of Service, Delay and Queueing Information

		North Street Intersections					Queen Street Intersections			West St. Intersections	
		SR 15	Banning Street	West Street	Queen Street	New St	West Street	Water Street	Bank Lane	Water Street	Bank Lane
AM Peak	LOS / Delay (sec) ¹	F/108.8	D / 39.8	A / 1.1	C / 20.6	B / 14.3	A / 3.7	B / 11.8	A / 2.8	A / 4.2	A / 1
	Critical Queues - Queue Length/ Link Distance (ft.) ²	NB 15-1183/940 SB 15-866/858	WB 192/181 EBR 190/130	-	NBL Queen 120/100	-	-	NBR Queen – 116/130	-	-	-
PM Peak	LOS / Delay	F / 98.6	C / 21.1	A / 1	C / 24.2	B / 17.2	A / 3.7	B / 13	A / 2.7	A / 3.1	A / 1
	Critical Queues - Queue Length/ Link Distance (ft.)	NB 15 – 1163/940 SB 15 – 1176/858	WB North 205/181	-	NBL Queen 111/100	-	-	NBR Queen – 6/130	-	-	-

1. Obtained from Synchro, Version 8.
2. 95th percentile queue length values obtained from Simtraffic, Version 8. Only queue lengths that exceed existing storage lengths are shown. For left and right turn movements, storage lengths were used in place of link distances. See Appendix C for the complete Simtraffic report on queue lengths.

Option 2: Convert West Street into a one-way southbound street between North Street and Water Street prior to the construction of the West Dover Connector

RK&K generated turning movement volumes for each of the intersections in the project area based on the conversion of West Street to a one-way, southbound street between North Street and Water Street. It was assumed that all northbound traffic along this section of West Street would use Queen Street to access North Street. The redistribution percentages and updated turning movement volume calculations based on this assumption are shown in Appendix B. The updated turning movement volumes are shown in Figure 5. Table 4 shows the Level of Service (LOS), intersection delay and critical queue length values, including approaches where the 95th percentile queues are greater than the available storage lengths (shown in red), for each of the study intersections.

Table 4: Option 2 - Level of Service, Delay and Queuing Information

		North Street Intersections					Queen Street Intersections			West St. Intersections	
		SR 15	Banning Street	West Street	Queen Street	New St	West Street	Water Street	Bank Lane	Water Street	Bank Lane
AM Peak	LOS / Delay (sec) ¹	D / 39.7	D / 53.9	A / 0	D / 53.9	B / 14	A / 3.9	B / 14.8	A / 3.5	A / 4.8	A / 1
	Critical Queues - Queue Length/ Link Distance (ft.) ²	SBL SR 15 - 248/200	WB North - 266/181	-	NB Queen - 451/358	-	-	NBR Queen - 221/130	-	-	-
PM Peak	LOS / Delay (sec)	D / 37	C / 26	A / 1	D / 43.8	B / 17.7	A / 9	B / 13.6	A / 3	A / 3	A / 1
	Critical Queues - Queue Length/ Link Distance (ft.)	SBL SR 15 250/200	WB North 281/181	-	NB Queen - 413/358	-	-	NBR Queen - 161/130	-	-	-

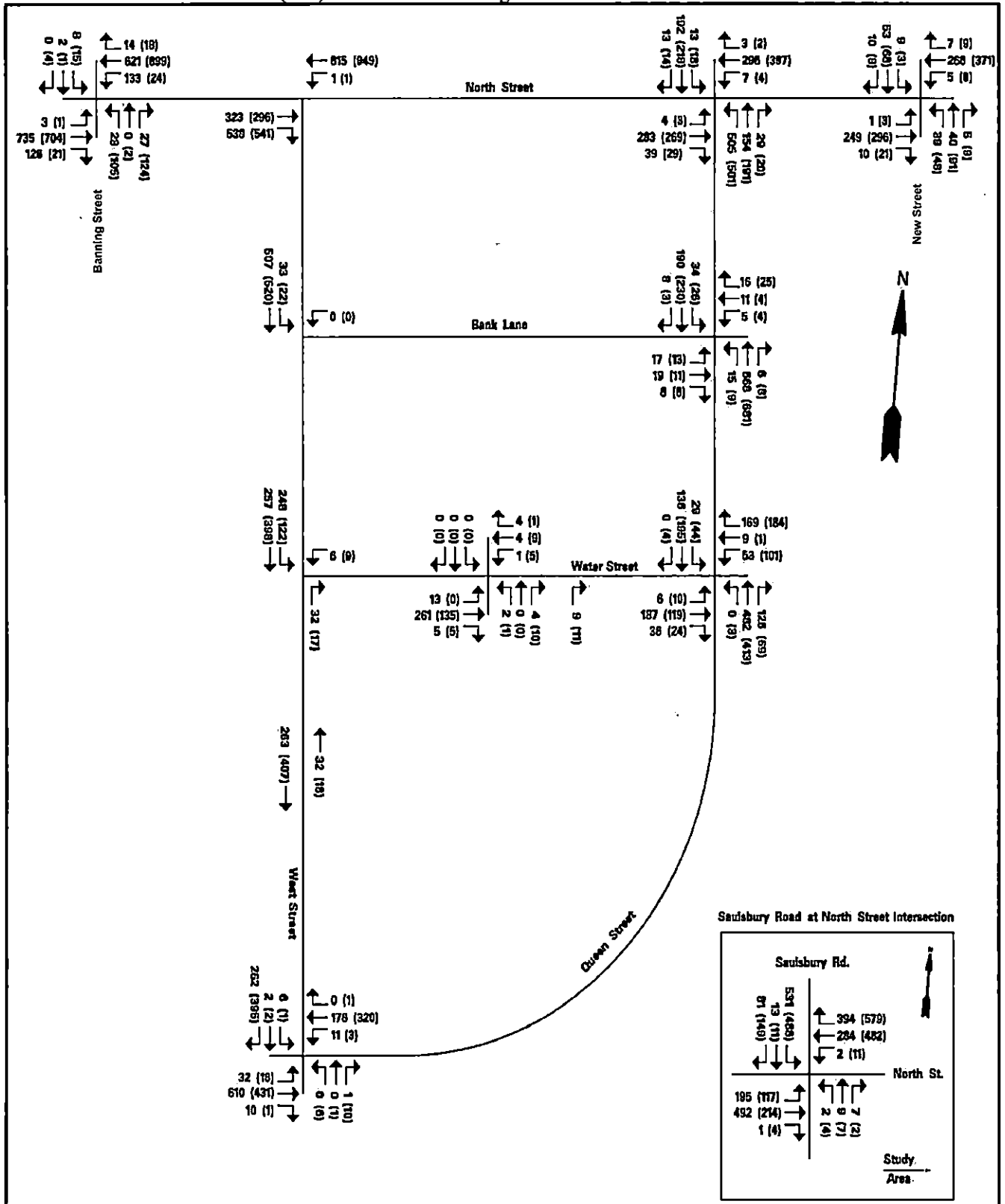
1. Obtained from Synchro, Version 8.
2. 95th percentile queue length values obtained from Simtraffic, Version 8. Only queue lengths that exceed existing storage lengths are shown. For left and right turn movements, storage lengths were used in place of link distances. See Appendix C for the complete Simtraffic report on queue lengths.

The analyses show that:

- The SR 15 and North Street intersection operates at LOS D during the AM and PM peak hours with SB SR 15 queues exceeding the existing storage lengths, similar to existing conditions.
- The additional volume on Queen Street will cause queuing issues along the NB approach of Queen Street at the intersections of North Street and Water Street, during the AM and PM peak hours.

The section of Queen Street in the study area has on-street parking lanes in both directions. Field observations indicate that these parking lanes are seldom used and rarely reach capacity. At the intersection of Queen Street and North Street, it is possible to extend the right and left turn lanes by reducing the designated parking lane lengths to reduce the possibility of the NB queue impacting the Bank Lane intersection. The access points for the property located at the southeast corner of Queen Street and Water Street (see Figure 2) prevents the extension of the right turn lanes at this location.

Figure 5: Option 2
AM (PM) Peak Hour Turning Movement Volumes



Option 3: Convert West Street into a one-way street between North Street and Water Street after construction of the West Dover connector:

RK&K generated turning movement volumes for each of the intersections in the project area based on the conversion of West Street into a southbound, one-way street between North Street and Water Street after the WDC is open to traffic. Similar to Option 2, it was assumed that all northbound traffic along this section would use Queen Street to access North Street. The redistribution percentages and updated turning movement volume calculations are shown in Appendix B and updated turning movement counts are shown in Figure 6. Table 5 shows the Level of Service (LOS), intersection delay and critical queue length values, including approaches where the 95th percentile queues are greater than the available storage lengths (shown in red), for each of the study intersections.

Table 5: Option 3 - Level of Service, Delay and Queuing Information

		North Street Intersections					Queen Street Intersections			West St. Intersections	
		SR 15	Banning Street	West Street	Queen Street	New St	West Street	Water Street	Bank Lane	Water Street	Bank Lane
AM Peak	LOS / Delay (sec)	F / 108.8	B / 18.5	A / 0	C / 21.3	B / 14.5	A / 3.5	B / 11.9	A / 2.8	A / 4.4	A / 1
	Critical Queues - Queue Length/ Link Distance (ft.)	NB 15 – 1183/940 SB 15 – 1036/858	EBR 160/130 WB 185/181		NBL Queen – 119/100	-	-	NBR Queen – 160/130	-	-	-
PM Peak	LOS / Delay	F / 99.2	B / 18.6	A / 0	C / 24.3	B / 18.2	A / 3.6	B / 13.2	A / 2.6	A / 2.5	A / 1
	Critical Queues - Queue Length/ Link Distance (ft.)	NB 15 – 1154/940 SB 15 – 951/858	WB North 192/181		NBL Queen – 113/100	-	-		-	-	-

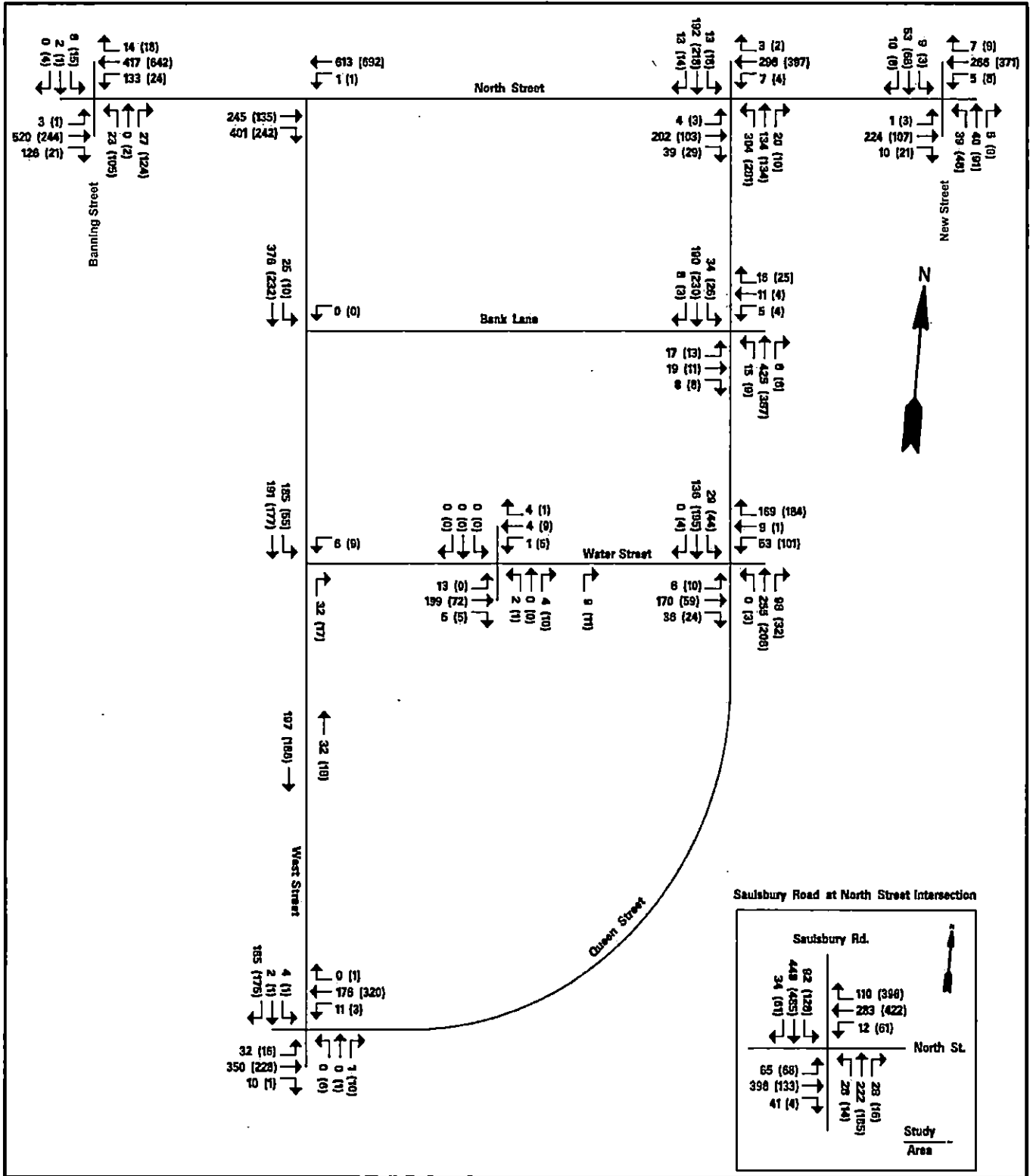
1. Obtained from Synchro, Version 8.
2. 95th percentile queue length values obtained from Simtraffic, Version 8. Only queue lengths that exceed existing storage lengths are shown. For left and right turn movements, storage lengths were used in place of link distances. See Appendix C for the complete Simtraffic report on queue lengths.

The analyses show that:

- The increase in traffic along Queen Street will cause minor queuing issues along approaches to the Queen Street intersections.
- The northbound right turn queue at the intersection of Queen Street and Water Street would still exceed storage capacity, but is much shorter than the queue length shown under Option 2.
- The intersection of North Street and SR 15 operates at LOS F and the northbound and southbound approaches experience very long queues due to the significant amount of traffic diverted by the WDC to this location. The signal timings at this intersection need to be adjusted to accommodate the increased traffic.

Similar to Option 2, the right turn and left turn storage lanes at the intersection of Queen Street and North Street can be extended to reduce the potential for NB queues to impact the Bank Lane intersection.

Figure 6: Option 3
AM(PM) Peak Hour Turning Movement Volumes



All Options - Comparison

Table 6: All options - Level of Service, Delay and Queueing Information

		Existing				Option 1: No Build - West Dover Connector (WDC)				Option 2: West St – One Way/ Prior to WDC				Option 3: West St – One Way/ after WDC is complete			
		AM		PM		AM		PM		AM		PM		AM		PM	
		LOS/ Delay (sec) ¹	Critical Queue Lengths ²	LOS/ Delay (sec) ¹	Critical Queue Lengths ²	LOS/ Delay (sec) ¹	Critical Queue Lengths ²	LOS/ Delay (sec) ¹	Critical Queue Lengths ²	LOS/ Delay (sec)	Critical Queue Lengths ²	LOS/ Delay (sec) ¹	Critical Queue Lengths ²	LOS/ Delay (sec) ¹	Critical Queue Lengths ²	LOS/ Delay (sec) ¹	Critical Queue Lengths ²
North St. Intersections (from west to east)	SR 15	D/ 39.7	SBL 250/200	D/37	SBL 241/200	F/ 108.8	NB 1183/940 SB 866/858	F/ 98.6	NB 1163/940 SB 1076/858	D/ 39.7	SBL 248/200	D/37	SBL 250/200	F/ 108.8	NB 1183/940 SB 1036/858	F/ 99.2	NB 1154/940 SB 951/858
	Banning St.	D/ 53.6	WB 191/181; EBR 212/130	C/ 26.6	WB 268/181	D/ 39.8	WB 192/181 EBR 190/130	C/ 21.2	WB 205/181	D/ 53.9	WB 266/181	C/26	WB 281/181	B /18.5	EBR 160/130 WB – 185/181	B/ 18.6	WB – 192/181
	West St.	D/ 34.9	-	C/ 20.9	-	A/1.1	-	A/1	-	A/0	-	A/1	-	A/0	-	A/0	-
	Queen St.	C/20. 5	NBL 121/100	C/23. 6	NBL 119/100	C/20. 6	NBL 10/100	C/23. 9	NBL 111/100	D/53. 9	NB 451/358	D/ 43.8	NB 413/358	C/ 21.3	NBL 119/100	C/ 24.7	NBL 113/100
	New St.	B/ 13.6	-	B/ 17.3	-	B/ 14.3	-	B/ 17.7	-	B/14	-	B/ 17.7	-	B/ 14.5	-	B/ 17.5	-
Queen St. Intersections (from south to north)	West St.	A/5.7	-	B/ 10.8	-	A/3.7	-	A/3.7	-	A/3.9	-	A/9	-	A/3.5	-	A/3.6	-
	Water St.	B/ 11.8	NBR 183/130	B/ 12.9	NBR 80/130	B/ 11.8	NBR 116/130	B/13	NBR 6/130	B/ 14.8	NBR 221/130	B/ 13.6	NBR 161/130	B/ 11.9	NBR 160/130	B/ 13.2	NBR 55/130
	Bank Ln.	A/2.8	-	A/2.5	-	A/2.8	-	A/2.7	-	A/3.5	-	A/3	-	A/2.8	-	A/2.6	-
West St. Intersections (from south to north)	Water St.	A/4.5	-	A/2.9	-	A/4.2	-	A/3.1	-	A/4.8	-	A/3	-	A/4.4	-	A/2.5	-
	Bank Ln.	A/1	-	A/1	-	A/1	-	A/1	-	A/1	-	A/1	-	A/1	-	A/1	-

1. Obtained from Synchro, Version 8.
 2. 95th percentile queue length values obtained from Simtraffic, Version 8. Only queue lengths that exceed existing storage lengths are shown. For left and right turn movements, storage lengths were used in place of link distances. See Appendix C for the complete Simtraffic report on queue lengths.

Table 6 shows a comparison of LOS, intersection delay, and queue lengths for all alternatives and intersections in the study area.

Additional Options

The following additional Options were also evaluated as part of this study:

- Convert West Street into a one-way street from North Street to Queen Street before construction of the West Dover connector.
- Convert West Street into a one-way street from North Street to Queen Street after construction of the West Dover connector.

However, these alternatives would restrict access to businesses along West Street located between Water Street and Queen Street; therefore, they were dropped from further consideration.

Summary of Findings:

The northbound approach of West Street at its intersection with North Street currently experiences a significant amount of delay (over 200 seconds) and operates at LOS F. Field observations indicate this is a result of the high traffic volumes along North Street combined with sight distance limitations for the stop controlled, northbound leg of West Street.

If West Street is converted into a one-way, southbound street from North Street to Water Street., the northbound traffic on this section of West Street would most likely use Queen Street to access North Street. The study area intersections on Queen Street currently experience occasional queueing issues during the peak hours, which would worsen with the addition of the traffic diverted from West Street, as shown in the Synchro/ Simtraffic analyses.

The West Dover Connector is scheduled to be constructed just west of the project area in the near future, and this roadway is expected to divert a significant amount of traffic from West Street, Queen Street and other major roadways in the vicinity of the study area. This diversion of traffic will significantly reduce the queueing issues at the Queen Street intersections as compared to existing conditions.

Queen Street has existing parking lanes between West Street and North Street that are rarely used. Therefore, under Options 2 and 3, these parking lanes could be reduced or eliminated to provide additional storage capacity for left and right turn movements at these intersections.

Option 1

Under Option 1 (No Build), the intersections in the study area will experience a reduction in traffic volumes due to the construction of the WDC in the near future. This would result in shorter queue lengths at all study area intersections along Queen Street and West Street.

Option 2

If West Street is converted into a one-way, southbound Street between North Street and Water Street, prior to the construction of the WDC, it would improve safety for the northbound West Street traffic at the intersection of North Street and West Street, since this movement would be eliminated. However, it would result in an increase in queue lengths at all Queen Street study intersections during the peak hours.

Option 3

If West Street is converted into a one-way, southbound Street between North Street and Water Street, after the construction of the WDC, it would improve safety for the northbound West Street traffic at the intersection of North Street and West Street, since this movement would be eliminated. The construction of the WDC will also divert a significant amount of traffic from North Street, West Street and Queen Street. Certain approaches to the Queen Street study intersections will still experience long queues; however, these queue lengths will not be as long as the queues under existing conditions or Option 2.

Conclusion:

All three options analyzed in this study are feasible options. The diversion of northbound traffic from West Street to Queen Street will cause an increase in queue lengths at Queen Street intersections in the study area, particularly in the northbound direction. This increase can be mitigated by reducing/ eliminating the parking lanes on Queen Street, and extending the left and right turn lanes at intersections.

The construction of WDC would decrease the amount of traffic in the study area, which helps improve the LOS, delay and queue lengths along Queen Street and West Street study intersections.

The conversion of West Street into a one-way, southbound street between North Street and Water Street will improve safety for northbound West Street traffic at the intersection of North Street and West Street since this movement would be eliminated. It could also provide the Dover/Kent MPO and the City of Dover with additional Right-of-way (ROW) to provide a continuous bicycle/pedestrian pathway to connect the existing bicycle and pedestrian facilities located on North Street and the Dover Transit Center.

The analyses show that construction of the West Dover Connector will significantly increase the amount of traffic at the intersection of North Street and Saulsbury Road (SR 15). This intersection will operate at LOS F during the AM and PM peak hours when analyzed using existing lane configurations signal timings. In order to accommodate future traffic at this intersection, the signal timings need to be optimized, in addition to geometric improvements that are proposed as part of the WDC alternative.

The conversion of West Street into a one-way, southbound street will require coordination between the Dover/ Kent MPO, DelDOT, City of Dover, DART First State, Emergency Services in the area, the Kent General Hospital and all other stakeholders who would likely be impacted by the change.

cc: Carolann Wicks, PE, RK&K
Jim Burnett, PE, PTOE, RK&K

APPENDIX A
Existing Conditions Diagrams

APPENDIX B
West Dover Connector Volumes and
Traffic Volume Redistribution

APPENDIX C
Synchro/Simtraffic Reports