MEMORANDUM

URBAN systems

Date:	November 30, 2016
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From:	Jayson Walker, Niraj Sunuwar
File:	1862.0006.02
Subject:	Shelbourne Street – Option Analyses and Comparison

1. INTRODUCTION

As part of the work for the Shelbourne Valley Action Plan, Urban Systems was retained by the District of Saanich in 2012 to undertake a transportation study to explore optional configurations for the 4.0 kilometre section of the Shelbourne Street corridor between Feltham Road and North Dairy Road. The 2012 transportation study included the development and evaluation of several corridor configurations including a 4 lane, 3 lane reversible and 2 lane option.

Subsequent to that work, District staff has developed an additional configuration, Option 2, for Shelbourne Street as an interim option. In the fall of 2015, Urban Systems analyzed the traffic implications of Option 2. After receiving feedback through the public consultation, further refinements were made to Option 2 to create Option 3. To fully understand the traffic impacts each option would have on Shelbourne Street and other parallel routes, the District has requested further technical analyses on Shelbourne Street with an expanded road network including Cedar Hill Road, Richmond Road, and Gordon Head Road.

This technical memorandum provides an overview of the traffic assessment, including key assumptions and summary of findings, which will guide the District's decision on the implementation on Shelbourne Street.

Note: Urban Systems previously completed analysis for Option 2 in September 2015, which is similar to the Option 2 being analyzed in this memo. However, several changes to the lane and intersection configurations were later explored that were not included in the initial analysis. In particular, changes to the number of southbound travel lanes between Feltham Road and McKenzie Avenue and between Christmas Avenue and Garnet Road were not captured in the analysis. Additionally, the analyses assumed no lane configuration changes to the side streets, particularly Feltham Road and Cedar Hill Cross Road. The analyses undertaken in this memo include the modifications made to the original Option 2 configuration.

2. OPTIONS OVERVIEW

Since the completion of Shelbourne Valley Action Plan, three short term improvement options have been developed for consideration. Any of these options, if chosen, could be implemented within the next five years.

Option 1 maintains the existing four travel lanes configuration along the corridor. This option focuses on improvements to pedestrian and cycling facilities by providing cycle track on the southern section of the corridor and upgrading the existing sidewalks and bikeways. The configuration of Garnet Road and Broadmead/Kisber Avenue are proposed to operate as right-in and right-out only. However, the travel time and delays along the corridor is expected to remain unchanged from existing conditions.

Option 2 proposes reduction in the number of travel lanes along different sections of the corridor, with a focus on maintaining capacity at major intersections. Furthermore, minor streets such as Broadmead/Kisber Avenue, Church Avenue, and Cedar Avenue are restricted to right-in/right-out operation. However, this option allows bike lane to be implemented for the entire length of Shelbourne Street. The sidewalk and transit improvements are consistent with Option 1. The reduction in travel lanes would reduce the vehicle carrying capacity and cause diversion of vehicles onto parallel streets. The travel times during the peak periods are expected to worsen due to these changes.

Option 3 also proposes lane reductions at different sections of Shelbourne Street. The notable difference between Option 2 and Option 3 is that Shelbourne Street is proposed to maintain the existing four travel lanes between North Dairy Road and Cedar Hill Cross Road. Although this south portion of the corridor is expected to maintain the vehicle carrying capacity, the constraint is expected north of Cedar Hill Cross Road causing vehicles to divert to parallel streets. Additionally, the right-in/right-out restrictions proposed in Option 2 are reverted to allow all turn movements (except left turns) from Broadmead/Kisber Avenue, Church Avenue, and Cedar Avenue.

Table 1 summarizes the number of travel lanes at different roadway segment along the corridor for each option.

Table 1 – Travel Lanes Comparison

Roadway Segment			Existing Configuration	Option 2	Option 3
Feltham Road	-	Blair Avenue	4	2	2
Blair Avenue	-	McKenzie Avenue	4	varies	varies
McKenzie Avenue	-	Garnet Road	4	4	4
Garnet Road	-	Stockton Crescent	4	3	3
Stockton Crescent	-	Mortimer Street	4	2	2
Mortimer Street	-	Broadmead Avenue	4	2	2
Broadmead Avenue	-	Cedar Hill Cross Road	4	4	4
Cedar Hill Cross Road	-	Pear Street	4	4	4
Pear Street	-	Rowan Street	4	3	4
Rowan Street	-	Cedar Avenue	4	2	4
Cedar Avenue	-	Derby Road	4	2	4
Derby Road	-	Freeman Avenue	4	2	4
Freeman Avenue	-	Knight Avenue	4	2	4
Knight Avenue	-	McRae Avenue	4	2	4
McRae Avenue	-	North Dairy Road	4	3	4

3. EXISTING CONDITIONS (2015)

This section of the document highlights the existing corridor and intersection characteristics primarily along Shelbourne Street and on parallel routes along Cedar Hill Road, Richmond Road, and Gordon Head Road, including corridor laning, intersection geometry and overall network connections. As noted, Option 1 reflects a similar corridor configuration when compared with the existing corridor and the existing conditions should reflect the operational conditions for Option 1.

3.1 Corridor Context

The Shelbourne corridor is a 4 kilometre long segment supporting a larger network within the Capital Regional District. Shelbourne Street is one of the primary north-south routes in the municipal transportation network. At a regional level, it is a critical route that moves people and goods to and from other areas of the Capital Region District (CRD). Residents living within the corridor study area, and those to the north and east of Shelbourne, have few options when it comes to travelling south. The road network surrounding Shelbourne Street is somewhat discontinuous and does not contain many parallel routes aside from Cedar Hill Road and Richmond Road. The long blocks adjacent to the corridor inhibit connectivity, particularly for cyclists and pedestrians. The transportation infrastructure available on the Shelbourne corridor influences the attractiveness of each mode and ultimately, will determine people's travel choices.

Shelbourne Street is designated in the Official Community Plan as a major transit route, auto and truck route, and commuter bikeway. In the north, it connects road users to Gordon Head, Mt. Douglas Park, and Cordova Bay. For commuters from the south (i.e. Oak Bay and Victoria), Shelbourne is a major arterial for those headed to major institutional destinations such as Camosun College and the University of Victoria. Further, the route is a key spine for east-west collector roads that route commuters to downtown Victoria, Oak Bay, Cadboro Bay, and the Patricia Bay and TransCanada Highway.

3.2 Corridor and Intersection Characteristics

Shelbourne Street is primarily a four lane, undivided, major road with auxiliary turn lanes at select intersections. There are eight traffic signals throughout the length of the study area; two of which are pedestrian controlled signals (Cedar Avenue and McRae Avenue). The corridor includes several accesses along its length, serving everything from single family to commercial centres. Accesses are, for the most part, unrestricted and allow for full vehicle turning movements in and out. There is no on-street parking along the corridor. Three bus routes currently operate on Shelbourne Street.

Several parallel routes within 500m to 1.0 kilometre of Shelbourne Street serve as major or collector roads in the larger network. The corridor characteristics for the parallel routes are described below:

Cedar Hill Road – Feltham Road to North Dairy Road. Cedar Hill Road is a two lane north-south collector road providing access for local traffic connecting to the major roads and other

collector streets. The area is characterized by primarily single-family residential housing, with notable destinations such as Cedar Hill Middle School and Cedar Hill Recreation Centre. Three of the four study intersections along Cedar Hill Road are signalized. On-street bike lanes/shoulder bikeways are located between Feltham Road and north of McKenzie Ave, and between Cedar Hill Cross Road and Rowan. One local bus route operates along Cedar Hill Road.

Richmond Road – Cedar Hill Cross Road to Lansdowne Road. Richmond Road is a two lane north-south collector providing access for local traffic connecting to the major roads and other collector streets. Notable institutions along the corridor include the Camosun College Lansdowne Campus and St Michaels University School. Land use within the area is predominantly single-family residential, with the exception of the north end of the corridor, where there are low-medium rise apartment buildings. The intersection at Lansdowne Road is signalized, while the intersection at Cedar Hill Cross Road is stop controlled on Richmond Road. One frequent bus route operates along Richmond Road.

Gordon Head Road – McKenzie Road to Cedar Hill Cross Road. Gordon Head Road is a two lane north-south major road along the west edge of the University of Victoria campus, providing access to the University, as well as Campus View Elementary School. In addition, the area is primarily made up of single-family residential housing. Both study intersections for this corridor are signalized. No bus services run on Gordon Head Road.

3.3 Existing Traffic Conditions

Shelbourne Street serves as a key north-south link within Saanich. Existing traffic volumes, provided by the District of Saanich and the Capital Regional District, are in the order of 1,000 to 1,200 vehicles per hour in the peak direction. Comparing the most recent intersection count data to the volumes from the 2012 study, volumes along the corridor have remained relatively unchanged. Existing traffic volumes for the AM and PM peak hour turning movements and corridor volumes at each major study intersection along Shelbourne Street are highlighted in **Figure 2**. Traffic volumes are highest along the southern portion of the corridor, with dominant network connections occurring at Cedar Hill Cross Road and McKenzie Avenue.

The overall performance of an urban roadway is typically measured by the delays experienced at major intersections, also referred to as Level of Service (LOS). The LOS assigned to a signalized intersection can range between LOS A and F. LOS A through C generally indicates that the intersection experiences very few delays during the peak hour whereas LOS F suggests the delays are significant (greater than 80 seconds / vehicle) and that the intersection is failing. For planning purposes, signalized intersections LOS D or better are generally acceptable, with no left-turn movement operating below LOS E. For unsignalized intersections, the level of service is measured for the critical movements that cross free flow traffic, such as from the minor street or turning left on the main street. LOS E or better is generally acceptable for these critical movements at unsignalized intersections. **Table 3** below summarizes the intersection delay associated with each intersection LOS:

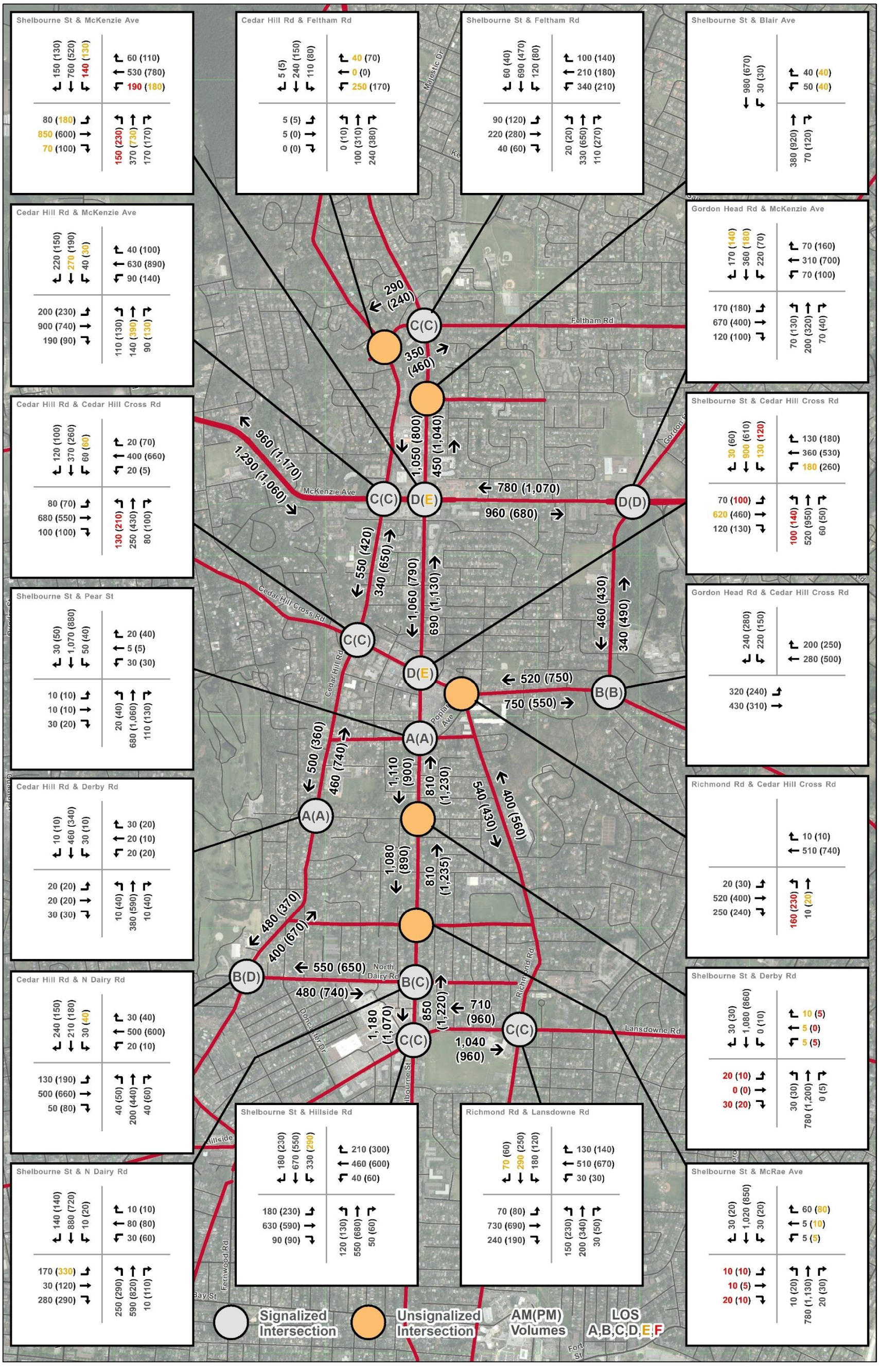
Table 3 – Intersection LOS and delay

LOS	Signalized Intersection	Unsignalized Intersection
A	≤10 sec	≤10 sec
B	10–20 sec	10–15 sec
C	20–35 sec	15–25 sec
D	35–55 sec	25–35 sec
E	55–80 sec	35–50 sec
F	≥80 sec	≥50 sec

The AM and PM peak hour levels of service for each of the signalized and unsignalized intersections with available traffic data are summarized in **Figure 2**. In general, most intersections along Shelbourne Street perform within acceptable levels, however the intersections at Cedar Hill Cross Road and McKenzie Avenue are noted to experience failing levels of service on some movements. Side street traffic movements at unsignalized locations were noted to have poor performance as a result of the traffic volumes on Shelbourne Street. All existing levels of service throughout the parallel routes perform within acceptable levels at LOS D or better.

Peak directional travel times along the corridor are observed to be 9 to 10 minutes in the peak hours. The notable intersections contributing to the overall corridor delay are North Dairy Road, Hillside Road, Cedar Hill Cross Road, McKenzie Avenue, and Feltham Road.

Figure 2 – Existing Base Traffic Volumes

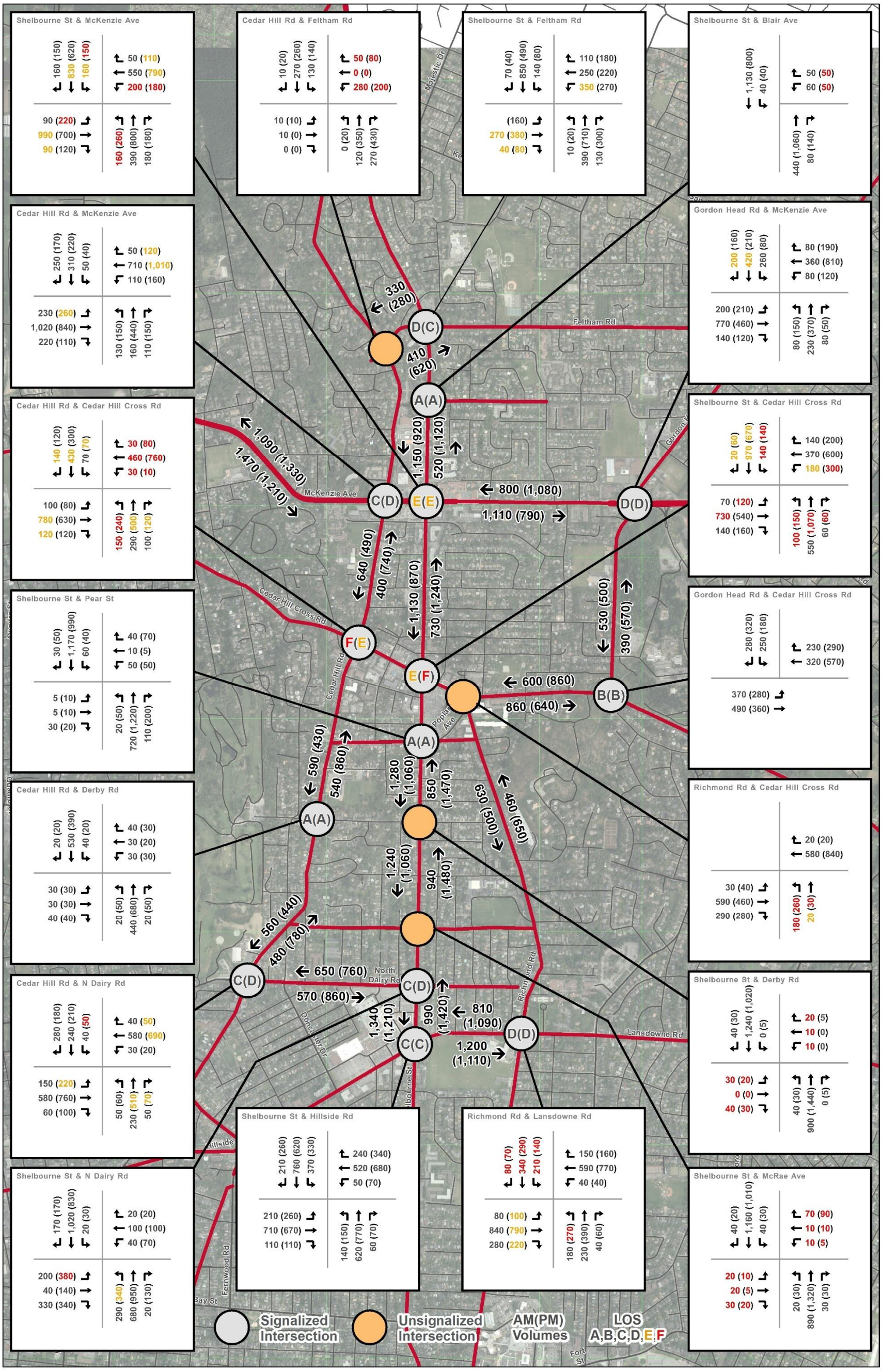


4. FORECAST CONDITIONS

Future traffic forecast volumes for 2038 were estimated using growth rates derived from the CRD's TransCAD model completed as part of previous planning work prepared for the Shelbourne Valley Action Plan Transportation Study. The relative changes to existing traffic volumes were applied to the observed patterns previously described and are summarized in Figure 3. Average corridor traffic growth is estimated to be 0.5% per year, using a linear growth rate. It is noted that historical growth rates have been relatively flat, therefore the 0.5% growth rate estimated may be slightly conservative.

The forecast levels of service throughout Shelbourne Street reflect a modest change from the existing conditions. All intersections are noted to perform within acceptable ranges with the exception of the intersections at McKenzie Avenue and Cedar Hill Cross Road, where some movements continue to operate under failing levels of service. Similar to the existing conditions, side street traffic movements at unsignalized locations were noted to have poor performance as a result of the traffic volumes on Shelbourne Street. All forecast levels of service throughout the parallel routes perform within acceptable levels, with the exception of Cedar Hill Road at Cedar Hill Cross Road, which will experience failing levels of service. Intersection and movement levels of service are summarized in **Figure 3**.

Figure 3 – Forecast Base Traffic Volumes



5. OPTION 2 EVALUATION

5.1 Option 2 Concept

Option 2 concept consists of some travel lane reductions between Feltham Road and North Dairy Road and reallocation of existing road space to provide curbside bike lanes in each direction. From Feltham Road to north of McKenzie Avenue, the existing four travel lanes are reduced to one northbound and one southbound travel lanes with two-way left turn lane in the centre. Four travel lanes are preserved from the Home Depot Access and Garnet Road. The travel lanes are reduced to one northbound and one southbound lane between Garnet Road and Stockton Crescent. Between Stockton Crescent and Mortimer Street, a two-way left turn lane is available between the northbound and southbound travel lanes. South of Mortimer Street, only the section between Pear Street and Broadmead/Kisber Avenue maintain the existing four lane travel lanes. Existing auxiliary lanes are maintained at major intersections. Bus bays are added at most bus stop locations to allow passing of general purpose traffic.

In order to understand the traffic implications on Shelbourne Street and on adjacent parallel routes, intersection analysis was conducted using adjusted volumes based on anticipated diversions with Option 2. Network traffic changes from the TransCAD model for the previous 2-lane configuration examined in the Shelbourne Valley Action Plan Transportation Study were used to estimate diversions in the network for Option 2.

5.2 Anticipated Diversion Assumptions

General assumptions used in the analysis for reflecting the anticipated diversions include:

- Based on the laning assumed, corridor volumes along Shelbourne Street can be assumed to remain in the range of 1,000 to 1,200 vehicles per hour
- Diversions will generally occur in the peak direction only, as there is sufficient capacity in the non-peak direction, with the exception of the forecast scenarios, where some diversions are expected in the off-peak direction.
    - The approximate diversions are in the magnitude of 200 to 300 vehicles per hour in the existing scenarios, and 300 to 400 vehicles per hour in the forecast scenarios.
- Since the new Option 2 maintains additional laning at key intersections along Shelbourne Street, the approximate diversions are expected to be less than the previously modelled 2-lane scenario. Using the previous TransCAD model results, it is assumed that the majority of the traffic volume diversions will be to the adjacent parallel routes of Cedar Hill Road and Richmond Road. A small proportion would be anticipated to utilize other network connections.
- It is anticipated that the reduction in capacity along the Shelbourne Street corridor would result in approximately 10% to 15% growth in peak directional traffic on Cedar Hill Road, 6-7% on Richmond Road, and 15 to 20% on Gordon Head Road.

5.3 Traffic Volumes & Operations

5.3.1 Existing Conditions

Most intersections along Shelbourne Street perform within acceptable levels with the Option 2 configuration. Similar to the existing base scenario, the intersections at McKenzie Avenue and Cedar Hill Cross Road is noted to experience failing levels of service on some movements. However, the overall intersection levels of service are either relatively unchanged or improved with the anticipated diversions. Side street traffic movements at unsignalized locations were noted to have poor performance as a result of the traffic volumes on Shelbourne Street.

Even with the anticipated diversions, the existing levels of service throughout the parallel routes perform within acceptable levels. The AM and PM peak hour levels of service for Option 2 are summarized in **Figure 4**.

5.3.2 Forecast Conditions

In the forecast scenario for Option 2, all signalized intersections are noted to perform within acceptable ranges with the exception of the intersections at McKenzie Avenue and Cedar Hill Cross Road which experience deteriorated and failing levels of service on some movements. This is consistent with the forecast results for the existing base. However, similar to the existing condition for Option 2, overall intersection levels of service is either relatively the same or improved with the anticipated diversions.

For the parallel routes, several intersections operate at or close to failing levels of service with the anticipated diversions. Notable intersections impacted include Cedar Hill Road and McKenzie Avenue, Cedar Hill Road and Cedar Hill Cross Road, and Richmond Road and Lansdowne Road. Intersection and movement levels of service for the forecast scenario are summarized in **Figure 5**.

Figure 4 – Option 2 Existing Traffic Volumes

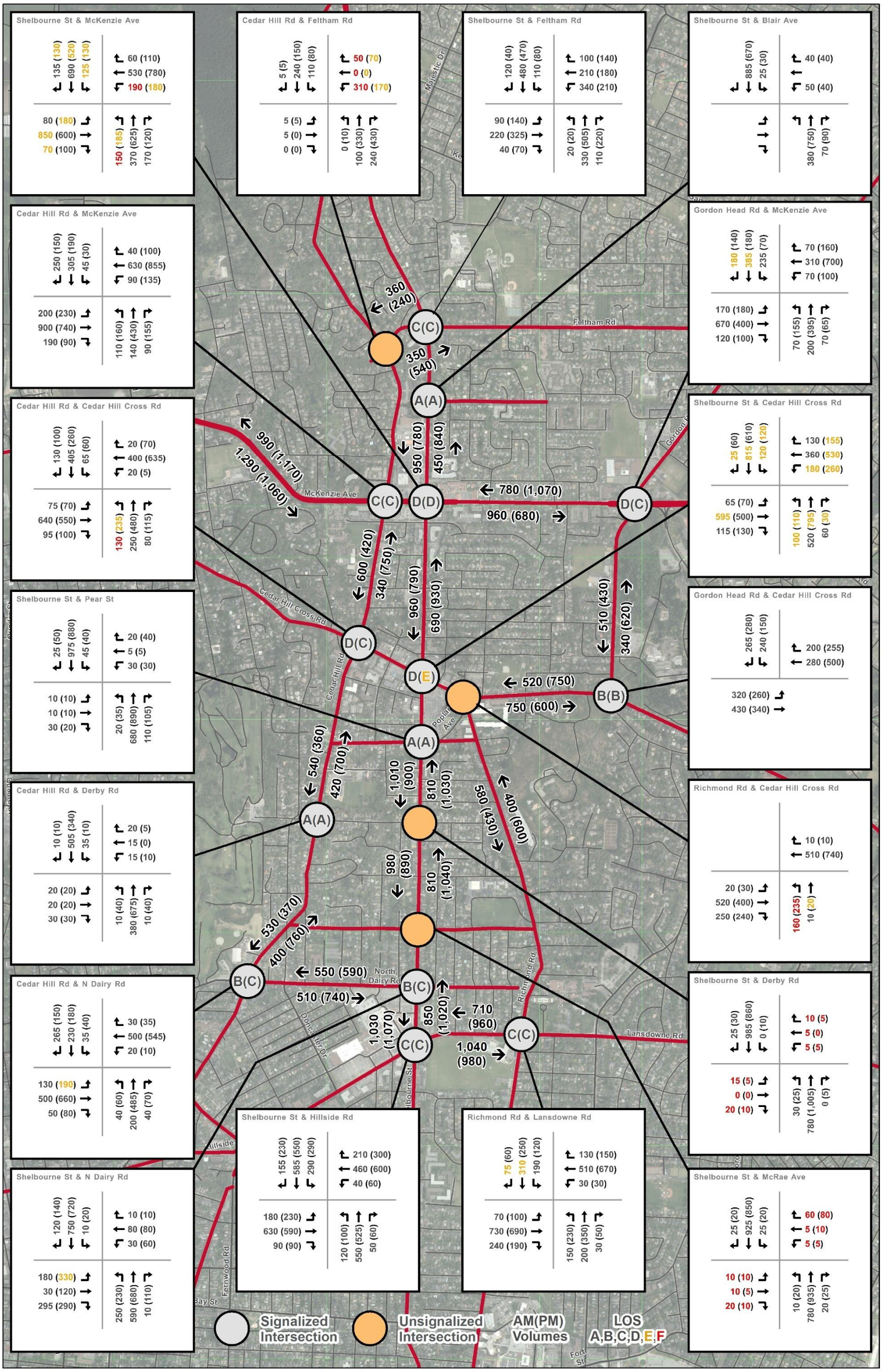
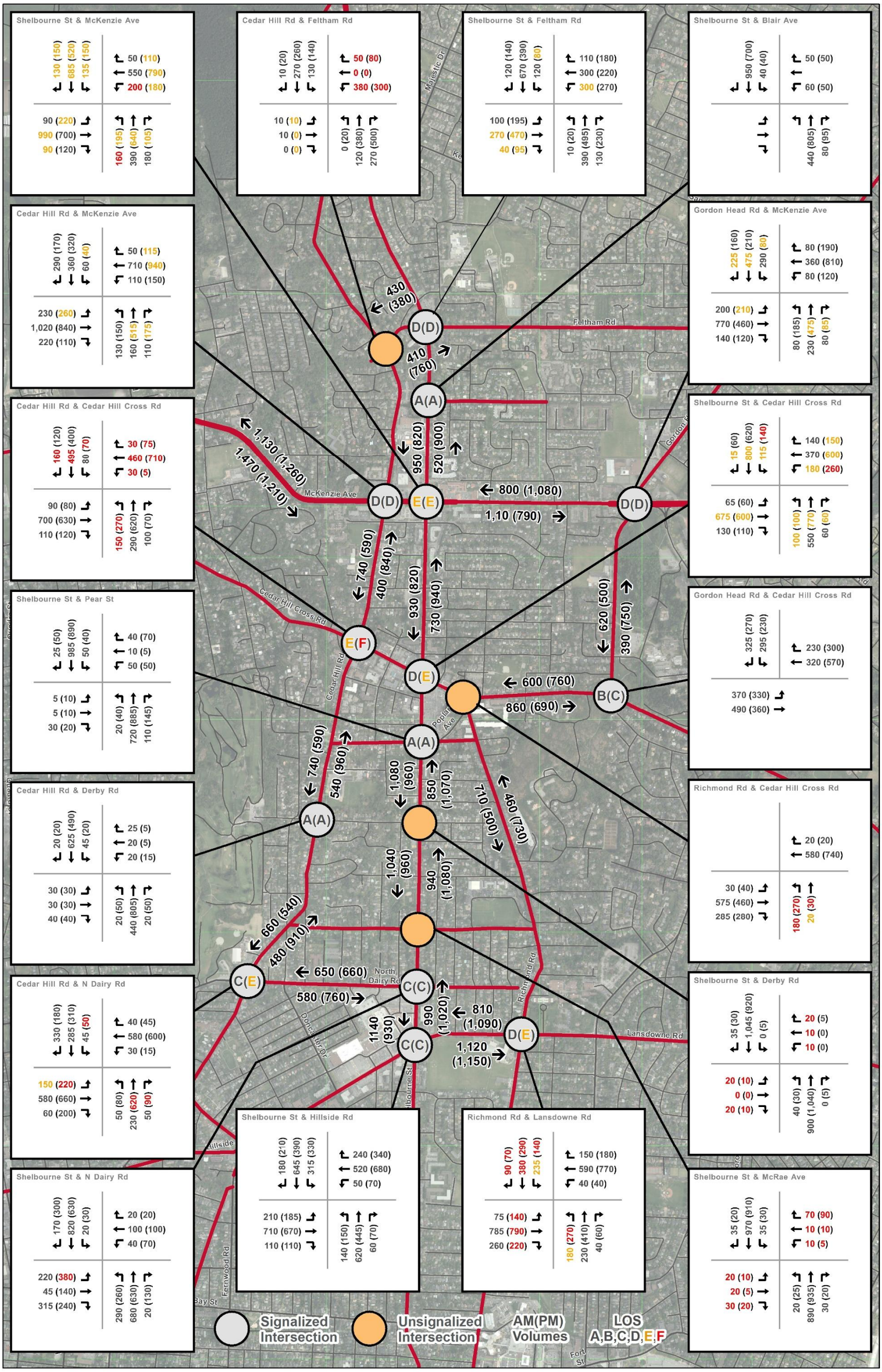


Figure 5 – Option 2 Forecast Traffic Volumes



5.4 Total Corridor Travel Time Delays

Table 4 below summarizes the average travel time in the peak direction for the base and Option 2 scenarios on Shelbourne Street from Feltham Road to Hillside Avenue.

Table 4 – Option 2 Average Travel Time (minutes) in Peak Direction

Scenario	Existing		Forecast	
	AM Southbound	PM Northbound	AM Southbound	PM Northbound
Base Conditions	9.0	10.0	10.7	12.7
Option 2	11.0	12.8	14.8	12.7
Difference	+2.0	+2.8	+4.1	0

As previously noted, current peak directional travel time on the corridor are observed to be between 9 and 10 minutes during the peak periods. Under existing conditions, the implementation of Option 2 is expected to increase peak directional travel times across the corridor by 2.0 minute and 2.8 minutes in the AM and PM peak hour, respectively.

Notably, the increase in delay in the southbound direction is primarily caused by additional queueing from Hillside Avenue to McRae Avenue as well as due to the congestion at McKenzie Avenue. In the northbound direction, the notable point of congestion was observed to be at Cedar Hill Cross Road.

In the forecast scenario, overall corridor travel time in the peak direction is expected to increase by 4.1 minutes in the AM peak with the implementation of Option 2.

Table 5 below summarizes the average travel time in the peak direction for the Option 2 and base scenarios for the segment of Shelbourne Street between McKenzie Avenue and North Dairy Road.

Table 5 – Option 2 Average Travel Time (minutes) in Peak Direction – McKenzie Ave to North Dairy Road

Scenario	Existing		Forecast	
	AM Southbound	PM Northbound	AM Southbound	PM Northbound
Base Conditions	6.0	7.0	7.3	9.6
Option 2	7.9	9.7	10.6	9.6
Difference	+1.9	+2.7	+3.3	+0

Similar increases in delay in the peak direction are expected between McKenzie Avenue and North Dairy Road. As noted above, the increase in delay in the southbound direction is primarily caused by queuing at North Dairy Road, backing up to McRae Avenue. In the southbound direction, McKenzie Avenue is another notable point of congestion. In the northbound direction, Cedar Hill Cross Road is the notable point of congestion.

6. OPTION 3 EVALUATION

6.1 Option 3 Concept

Option 3 was developed by the District as a result of public consultation feedback provided on Option 2. The concept generally consists of four-lane cross section with cycle tracks between North Dairy Road and Cedar Hill Cross Road and travel lane reductions between Cedar Hill Cross Road and Feltham Road with reallocation of existing road space to provide curbside bike lanes in each direction. From Feltham Road to Blair Avenue, the existing four travel lanes are reduced to one lane in each direction with a two-way left turn lane. From Blair Avenue to Garnet Road, the travel lanes are reduced to one northbound and two southbound travel lanes. The travel lanes are reduced to one in each direction, with a two-way left turn lane, between Garnet Road and Broadmead Avenue. Four travel lanes are preserved from Broadmead Avenue to North Diary Road. Existing auxiliary lanes are maintained at major intersections. Bus bays are added at bus stop locations to allow passing of general purpose traffic.

Due to the changes in the lane configurations from Option 2, intersection analysis was conducted once again using adjusted volumes based on anticipated diversions. Similar to analysis carried out for Option 2, network traffic changes from the TransCAD model for the previous 2-lane configuration examined in the Shelbourne Valley Action Plan Transportation Study were used to estimate diversions in the network for Option 3.

6.2 Anticipated Diversion Assumptions

General assumptions used in the analysis for reflecting the anticipated diversions include:

- Based on the laning assumed, corridor volumes along Shelbourne Street can be assumed to remain in the range of 1,000 to 1,200 vehicles per hour south of Cedar Hill Cross Road and 700 to 1,000 vehicles per hour north of Cedar Hill Cross Road. The reduction in travel lanes north of Cedar Hill Cross Road would make it less desirable for the non-local traffic to travel through that segment of the roadway.
- Less diversions are expected south of Cedar Hill Cross Road due to the availability of four travel lanes. However, diversions from Shelbourne Street to Cedar Hill Road is expected to be in similar magnitude to that of Option 2 north of Cedar Hill Cross Road. This will also generally occur in the peak direction only, as there is sufficient capacity in the non-peak direction, with the exception of the forecast scenarios, where some diversions are expected in the off-peak direction.
    - The approximate diversions are in the magnitude of 100 to 200 vehicles per hour in the existing scenarios, and 300 to 400 vehicles per hour in the forecast scenarios.
- Due to the auxiliary lanes still being maintained at key intersections along Shelbourne Street, the approximate diversions expected to the adjacent parallel routes of Cedar Hill Road and Richmond Road are in the same magnitude as estimated for Option 2.
- It is anticipated that the reduction in capacity along the Shelbourne Street corridor would result in approximately 10% to 15% growth in peak directional traffic on Cedar Hill Road, 3-4% on Richmond Road, and 15 to 20% on Gordon Head Road.

6.3 Traffic Volumes & Operations

6.3.1 Existing Conditions

Most intersections along Shelbourne Street perform within acceptable levels with the Option 3 configuration. Similar to the existing base scenario, the intersections at McKenzie Avenue and Cedar Hill Cross Road are noted to experience failing levels of service on some movements. However, the overall intersection levels of service are relatively unchanged with the anticipated diversions. Side street traffic movements at unsignalized locations were noted to have poor performance as a result of the traffic volumes on Shelbourne Street.

Even with the anticipated diversions, the existing levels of service throughout the parallel routes perform within acceptable levels. The AM and PM peak hour levels of service for Option 3 are summarized in **Figure 6**.

6.3.2 Forecast Conditions

In the forecast scenario for Option 3, all signalized intersections are noted to perform within acceptable ranges with the exception of the intersections at McKenzie Avenue and Cedar Hill Cross Road which experience deteriorated and failing levels of service on some movements. This is consistent with the forecast results for the base conditions. However, similar to the existing condition for Option 3, overall intersection levels of service are relatively the same with the anticipated diversions.

For the parallel routes, several intersections operate at or close to failing levels of service with the anticipated diversions. Notable intersections impacted include Cedar Hill Road/McKenzie Avenue, Cedar Hill Road/Cedar Hill Cross Road, and Richmond Road/ Lansdowne Road. The localized intersection improvements at these locations may be required in future to ensure acceptable levels of operation. Intersection and movement levels of service for the forecast scenario are summarized in **Figure 7**.

Figure 6 – Option 3 Existing Traffic Volumes

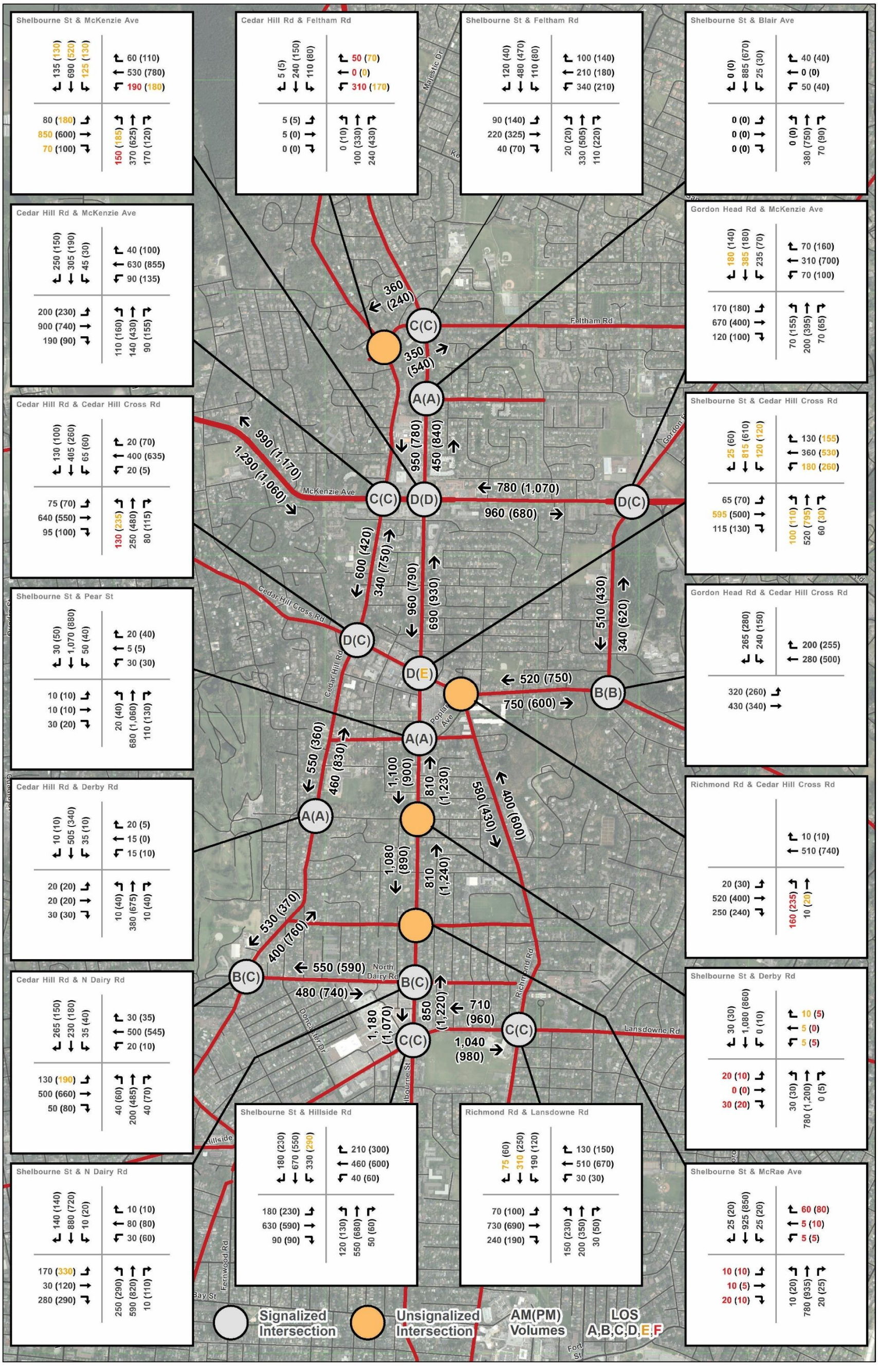
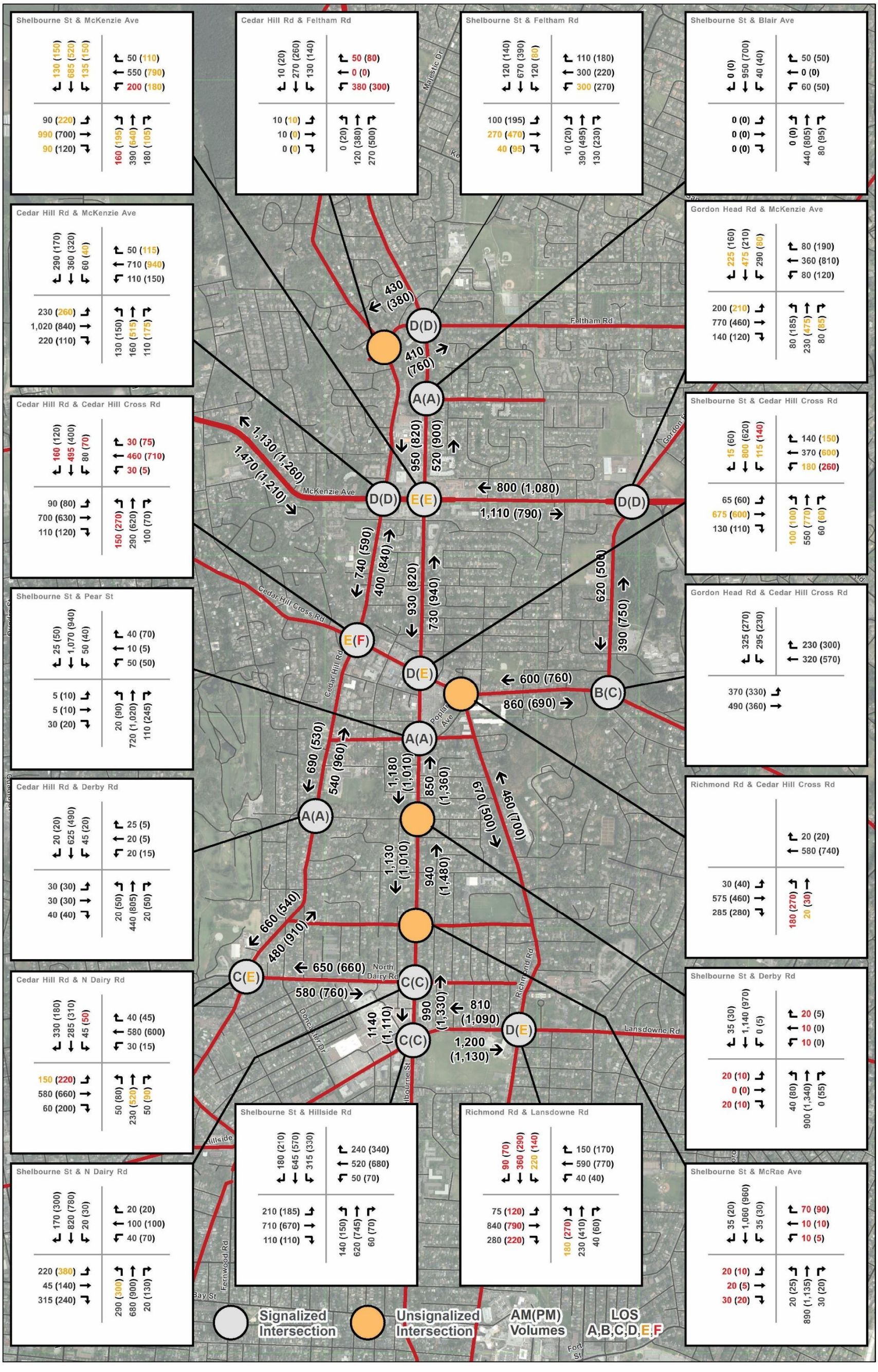


Figure 7 – Option 3 Forecast Traffic Volumes



6.4 Total Corridor Travel Time Delays

Table 6 below summarizes the average travel time in the peak direction for the base and Option 3 scenarios on Shelbourne Street from Feltham Road to Hillside Avenue.

Table 6 – Option 3 Average Travel Time (minutes) in Peak Direction

Scenario	Existing		Forecast	
	AM Southbound	PM Northbound	AM Southbound	PM Northbound
Base Conditions	9.0	10.0	10.7	12.7
Option 3	10.6	12.6	14.5	13.1
Difference	+1.6	+2.6	+3.8	+0.4

As previously noted, current peak directional travel time on the corridor are observed to be between 9 and 10 minutes during the peak periods. Under existing conditions, the implementation of Option 3 is expected to increase peak directional travel times across the corridor by 1.6 minutes in the AM peak and 2.6 minutes in the PM peak. In the forecast horizon, the peak directional travel times increases by 3.8 minutes in the AM peak and 0.4 minutes in the PM peak.

McKenzie Avenue and Hillside Avenue are the notable points of congestion in the southbound direction. In the northbound direction, the notable point of congestion was observed to be at Cedar Hill Cross Road.

Table 7 below summarizes the average travel time in the peak direction for Option 3 and base scenarios for the segment of Shelbourne Street between McKenzie Avenue and North Dairy Road.

Table 7 – Option 3 Average Travel Time (minutes) in Peak Direction – McKenzie Ave to North Dairy Road

Scenario	Existing		Forecast	
	AM Southbound	PM Northbound	AM Southbound	PM Northbound
Base Conditions	6.0	7.0	7.3	9.6
Option 3	7.1	9.6	11.1	9.7
Difference	+1.1	+2.6	+3.8	+0.1

Similar increases in delay in the peak direction are expected between McKenzie Avenue and North Dairy Road. The increase in delay in the southbound direction is primarily caused by queuing at Mckenzie Road. In the northbound direction, Cedar Hill Cross Road is the notable point of congestion.

7. IMPACTS TO TRANSIT

Transit vehicles travelling along Shelbourne Street are susceptible to same delays and congestion experienced by the passenger cars. The notable intersections contributing to the overall corridor delay are North Dairy Road, Hillside Road, Cedar Hill Cross Road, McKenzie Avenue, and Feltham Road. Additionally, the southbound direction experiences more delays in

the morning peak and the northbound direction experiences more delays in the PM peak. Transit would be expected to experience an increase in travel time of 1 to 3 minutes during the peak periods in both Option 2 and Option 3. It is noted that the corridor is observed to generally have a variability of travel time of approximately 1 to 2 minutes during peak periods. As schedules for transit need to remain active, it would be assumed that transit schedules may need to increase by approximately 3-5 minutes during the morning and afternoon peak periods to accommodate the revised corridor configuration.

It is also noted, however, that the current plan anticipates reducing the number of transit stops through the corridor. There are currently 24 transit stops in the corridor – 12 northbound and 12 southbound. Both Option 2 and 3 consolidate the number of bus stops with three less bus-stops in the northbound direction and two less in the southbound direction. Travel time savings resulting from consolidating stops can vary, but are typically in the order of 20 seconds per transit stop removed. As a result, it would be expected that this change would provide an improvement to transit travel times for all routes no longer using the removed stops, thereby reducing the net change required in scheduling previously noted. **Table 8** summarizes estimated transit travel time savings and delays due to the planned changes on the corridor in the peak periods.

Table 8 – Transit Travel Time Impacts on the Corridor during Peak Periods

	Northbound (PM Peak)	**Southbound (AM Peak)**
Estimated transit schedule impact – Option 2 (corridor delay and variability)	+2 to 3 minutes	+2 to 3 minutes
Estimated transit schedule impact – Option 3 (corridor delay and variability)	+2 to 3 minutes	+1 to 2 minutes
Bus Stop Removals	-1 minute[1]	-0.7 minutes
Potential Revised Transit Schedule Change	+1 to 2 minutes	+1.3 to 2.3 minutes

As seen in Table 8, the transit travel time will be impacted by the delays along the corridor experienced by the passenger cars. Travel time benefits due to other improvements such as bus stop removals are possible. It is noted that removal of cyclists from current travel lanes may also provide some additional travel time benefit, but are expected to be small in when compared with the overall delays along the corridor. As a result of these additional changes, transit travel times, and schedules, could potentially be improved by up to a minute in the peak periods if these additional benefits are realized.

[1] Based on 20 seconds delay savings per transit stop.

8. SUMMARY OF FINDINGS & RECOMMENDATIONS

Shelbourne Street currently accommodates peak directional traffic volumes that are within the capacity of a major roadway (1,000 to 1,200 vehicles per hour). The signalized intersections at Cedar Hill Cross Road and McKenzie Avenue are noted to experience failing levels of service on some movements in the existing condition, while the side street traffic movements at unsignalized intersections along the corridor currently operate with notable delays as a result of the higher traffic volumes on Shelbourne Street.

Currently, approximately 40% of the peak period traffic along Shelbourne Street is considered local in that they have an origin or destination located along the corridor or in the immediate area. In other words, 60% of vehicle trips are regional or district-wide in nature. The proposed Option 2 and Option 3, both, will make Shelbourne Street less attractive to commuter traffic, meaning a larger proportion of trips will be made up of local area and neighbourhood traffic. Approximately 60% and 50% of peak period traffic is estimated to be local in Option 2 and Option 3 respectively.

With the laning proposed in the Option 2 scenario, it is expected that Shelbourne Street would operate within the range of 1,000 vehicles per hour in the peak direction. Although overall intersection levels of service would remain relatively the same or slightly improved with Option 2 as compared to current conditions, an increase in corridor delay is expected. Notable factors attributing to the increases in delay include increases in queue lengths with the reduced corridor capacity, specifically at merge points after the intersections. Additional queuing would be anticipated at intersections throughout the corridor which exceeding those observed today. Notable locations of additional queueing include the southbound direction between Hillside Avenue and McRae Avenue in the AM peak scenarios, and northbound at Cedar Hill Cross Road in the PM peak scenarios.

The delay and congestion patterns for Option 3 are consistent with Option 2. Although Option 3 provides the four lane cross sections south of Cedar Hill Road compared to Option 2's three lane cross section, the left turn movements at the intersections impede the flow of the through movements. However, if queues are observed to become longer due to left turn vehicles hindering through movements, the operation could be improved by restricting left turn movements during the peak hours.

The additional traffic onto the parallel routes is expected to have impacts to the intersection performance of Cedar Hill Road and McKenzie Avenue, Cedar Hill Road and Cedar Hill Cross Road, and Richmond Road and Lansdowne Road, causing these intersections to perform at or close to failing levels of service in the forecast conditions. Intersection improvements such as additional laning and/or signal phasing changes may be required at these intersections to improve performance in future.

Table 9 provides a summary comparison of corridor volumes along Shelbourne Street between the existing configuration, Option 2, and Option 3.

Table 9 – Corridor Option Comparisons

	Existing Configuration	Option 2	Option 3
Existing Traffic Volume			
AM (peak/off-peak dir)			
North of McKenzie	1,050/450	950/450	950/450
Between Mckenzie and Cedar Hill Cross Road	1,060/690	960/690	960/690
South of Cedar Hill Cross Road	1,110/810	1,010/810	1,100/810
PM (peak/off-peak dir)			
North of McKenzie	1,040/780	840/780	840/780
Between Mckenzie and Cedar Hill Cross Road	1,130/790	930/790	930/790
South of Cedar Hill Cross Road	1,230/900	1,030/900	1,230/900
% Local Traffic	40%	60%	50%
Forecast Traffic 2038			
AM (peak/off-peak dir)			
North of McKenzie	1,150/520	950/520	950/520
Between Mckenzie and Cedar Hill Cross Road	1,130/730	930/730	930/730
South of Cedar Hill Cross Road	1,280/850	1,080/850	1,180/850
PM (peak/off-peak dir)			
North of McKenzie	1,200/920	940/900	900/820
Between Mckenzie and Cedar Hill Cross Road	1,240/870	940/820	940/820
South of Cedar Hill Cross Road	1,470/1,060	1,070/960	1,360/1,010
Traffic Diversion	No diversion	10 - 15% increase on Cedar Hill Rd; 6 - 7 % on Richmond Rd; 15 - 20% on Gordon Head Rd	10 - 15% increase on Cedar Hill Rd north of Cedar Hill Cross Road; 3 – 4% on Richmond Rd; 15 - 20% on Gordon Head Rd

As seen in Table 9, both options increase the share of local traffic on Shelbourne Street by diverting the regional traffic on parallel roads. McKenzie Avenue and Cedar Hill Cross Road are the critical intersections where the carrying capacity of the corridor changes in both options. In Option 2, the roadway capacity reduces south of Cedar Hill Cross Road whereas in Option 3, the notable change in capacity occurs between McKenzie Avenue and Cedar Hill Cross Road.

Table 10 provides a comparison in average travel time between Option 2 and Option 3.

Table 10 – Average Travel Time (minutes) in Peak Direction

Scenario	Existing		Forecast	
	AM Southbound	PM Northbound	AM Southbound	PM Northbound
Base Conditions	*9.0*	*10.0*	*10.7*	*12.7*
Option 2	11.0	12.8	14.8	12.7
Option 3	10.6	12.6	14.5	13.1
Difference	-0.4 (-4%)	-0.2 (-2%)	-0.3 (-2%)	+0.4 (+3%)

As seen in Table 10, Option 3 shows some improvement in travel time when compared to Option 2. Improvements in travel times are expected from Option 3 in both existing and forecast horizons with exception to the northbound direction in the forecast PM peak. The northbound travel time along the corridor in the forecast PM peak shows a slight increase, however is noted to be carrying approximately 300 more vehicles per hour than Option 2 through the segment between Cedar Hill Cross Road and North Dairy Road.

Based on the evaluation of both concepts and with consideration that Option 3 is the preferred choice, the following considerations to the design are provided:

- As the Ultimate Concept for Shelbourne Street is implemented through redevelopment, **consider re-implementing four travel lanes between Cedar Hill Cross Road and McKenzie Avenue.** As corridor redevelops and traffic demands increase, re-implementing a four lane configuration will improve corridor capacity and reduce potential diversions to other parallel routes. **Optimize signal coordination for Shelbourne Street** at Hillside Avenue and North Dairy Road to alleviate additional queuing in the southbound direction particularly during the AM peak period.
- **Optimize signal timings and coordination** at minor intersections along parallel roadways, particularly at the intersection of Cedar Hill Road/McKenzie Avenue and Cedar Hill Road/Cedar Hill Cross Road.
- **Consider localized improvements** on Cedar Hill Road, Richmond Road, and Gordon Head Road as budget permits.
- **Consider implementing Transit Signal Priority** on the Shelbourne Street corridor including pre-emptive traffic signals and revised timing to further prioritize north-south movements.

Sincerely,
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/ns
Enclosure
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