Parkside Drive Class Environmental Assessment

Transportation Assessment

November 2011
1.0 Introduction and Background

Delcan was retained by the City of Hamilton to undertake a Class Environmental Assessment (Class EA) for Parkside Drive (Phases 3 and 4 of the Municipal Class EA process), from Highway 6 to 500m east of Churchill Avenue (see map below). The need for improvements along this corridor was previously established through the City of Hamilton’s Transportation Master Plan in 2007 (Phases 1 and 2 of the Municipal Class EA process) and was reconfirmed through this study.

Parkside Drive is a two-lane minor arterial roadway under the jurisdiction of the City of Hamilton, within the community of Waterdown. In addition to Parkside Drive, Waterdown is also served by another east-west arterial road to the south of Parkside Drive, Dundas Street. The City of Hamilton is planning on introducing a third east-west arterial road north of Parkside Drive that would serve as a key east-west roadway within the community.

Within the study area, a number of new developments are planned for the lands located to the north of Parkside Drive and west of Hamilton Street/Centre Road. In order to assess the impacts of these developments on the arterial road network, Paradigm Transportation Solutions Limited completed the Waterdown North Coordinated Traffic Impact Study in 2009 (TIS). The horizon year for this study was 2016 and did not include the planned East-West road in its analysis.

In order to assess the impacts of the planned developments and the new East-West road on the transportation network, as well as determine the appropriate improvements to develop Parkside Drive as a multi-modal corridor (which will consider the needs of not only vehicle, but pedestrians and cyclists as well), a comprehensive review of the analysis completed in the TIS as well as a review of the City of Hamilton’s EMME/2 model was undertaken. Additionally, the analysis undertaken and the subsequent recommendations made in the 2008 Waterdown-Aldershot Transportation Master Plan have been thoroughly reviewed, and a review of the recommendations made in the 2007 Hamilton Transportation Master Plan was completed.
For the purpose of this review, Delcan has also analyzed traffic operations within the corridor using current 2012 traffic volume data provided by the City of Hamilton in May and June 2012.

The intersection of Highway 6 and Parkside Drive is under the jurisdiction of The Ministry of Transportation (MTO). The Ministry has recently completed a design for the intersection which will be implemented by the Ministry as part of their capital improvements along Highway 6. As such, the Ministry’s recommended intersection design should be incorporated with the existing roadway design.
2.0 Existing Conditions (2012)

In establishing the existing traffic conditions, Delcan reviewed the 2009 TIS report which analyzed transportation conditions along Parkside Drive for the Weekday AM and PM peak hours. The results documented indicate that the intersections along Parkside Drive during the weekday AM and PM peak hours were operating satisfactorily with an overall Level of Service (LOS) of B or better. Delcan also reviewed the Synchro analysis (Synchro files) provided by the City of Hamilton to confirm the results of the 2009 TIS. As this report is an approved document, and based on a review of the analysis, Delcan agrees with the findings.

In addition to the 2009 TIS review, Delcan have undertaken a comprehensive corridor traffic operations analysis utilizing 2012 traffic count data and current signal timing plans provided by the City. The 2012 Weekday AM and PM traffic volumes are included in Figure 2-1.
2.1 Existing Traffic Analysis (2012)

Using current traffic volumes and signal timings, Delcan completed capacity analyses for the signalized and unsignalized intersections within the corridor using Synchro/SimTraffic (Version 8). The Synchro modelling assumptions and analysis parameters used were consistent with those from the approved 2009 TIS report.

The intersection capacity analysis completed for the signalized and unsignalized intersections during the weekday AM and PM peak hours under existing traffic conditions is summarized in Table 2-1, 2-2 and 2-3. Synchro output sheets can be found in Appendix A.

**Table 2-1 – Existing 2012 Weekday AM and PM Peak Hour Signalized Operational Performance (Existing Timings)**

<table>
<thead>
<tr>
<th>Signalized Intersections</th>
<th>Overall LOS</th>
<th>Delay/Veh (sec.)</th>
<th>Overall V/C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM PEAK HOUR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkside Dr. &amp; YMCA/Keewaydin St.</td>
<td>B</td>
<td>13.3</td>
<td>0.44</td>
</tr>
<tr>
<td>Parkside Dr. &amp; Hamilton Street</td>
<td>B</td>
<td>17.3</td>
<td>0.57</td>
</tr>
<tr>
<td><strong>PM PEAK HOUR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkside Dr. &amp; YMCA/High School</td>
<td>B</td>
<td>12.9</td>
<td>0.50</td>
</tr>
<tr>
<td>Parkside Dr. &amp; Hamilton Street</td>
<td>C</td>
<td>24.7</td>
<td>0.68</td>
</tr>
</tbody>
</table>

As illustrated in Table 2-1, all signalized intersections within the study area operate satisfactorily with a level of service ‘C’ or better with no critical movements or delay under the Weekday AM and PM peak hours. Upon further review of the analysis, Delcan has recognized that several intersections could benefit from introducing advanced left turn phases. Those intersections are as follows:

- Southbound advanced left during the Weekday AM and PM peak hour at Parkside Drive and YMCA/Keewaydin Street;
- Westbound and northbound advanced left during the Weekday AM and PM peak hours and eastbound advanced left during the PM peak hour at Parkside Drive and Hamilton Street.

To illustrate the resulting intersection performance, additional capacity analysis with the introduction of the advanced left turn phases was performed at the intersections for both the Weekday AM and PM peak hours. The results of that analysis are provided in Table 2-2.
Table 2-2 – Existing 2012 Weekday AM and PM Peak Hour Signalized Operational Performance (Optimized)

<table>
<thead>
<tr>
<th>Signalized Intersections</th>
<th>Overall LOS</th>
<th>Delay/Veh (sec.)</th>
<th>Overall V/C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM PEAK HOUR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkside Dr. &amp; YMCA/Keewaydin St.</td>
<td>B</td>
<td>13.2</td>
<td>0.51</td>
</tr>
<tr>
<td>Parkside Dr. &amp; Hamilton Street</td>
<td>C</td>
<td>25.3</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>PM PEAK HOUR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkside Dr. &amp; YMCA/High School</td>
<td>B</td>
<td>13.3</td>
<td>0.57</td>
</tr>
<tr>
<td>Parkside Dr. &amp; Hamilton Street</td>
<td>C</td>
<td>33.0</td>
<td>0.77</td>
</tr>
</tbody>
</table>

As presented above, with the introduction of the left turn phases, all intersections continue to operate satisfactorily with no critical movements or delay with improved levels of service for left turning vehicles.

The existing unsignalized intersection analysis is presented in Table 2-3.

Table 2-3 – Existing 2012 Weekday AM and PM Peak Hour Unsignalized Operational Performance

<table>
<thead>
<tr>
<th>Unsignalized Intersections</th>
<th>Highest Movement Lane LOS</th>
<th>Delay (s)</th>
<th>V/C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM PEAK HOUR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkside Dr. &amp; Hollybush Dr.</td>
<td>EBLTR=A</td>
<td>0.3</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>WBLTR=A</td>
<td>3.1</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>NBL=C</td>
<td>19.6</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>NBTR=B</td>
<td>11.6</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>SBLTR=C</td>
<td>22.9</td>
<td>0.11</td>
</tr>
<tr>
<td>Parkside Dr. &amp; Duncan Ave.</td>
<td>EBTR=A</td>
<td>0.0</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>WBTL=A</td>
<td>0.5</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>NBLR=B</td>
<td>12.0</td>
<td>0.10</td>
</tr>
<tr>
<td>Parkside Dr. &amp; Braheid Ave.</td>
<td>EBLTR=A</td>
<td>0.3</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>WBLTR=A</td>
<td>1.8</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>NBLTR=C</td>
<td>16.8</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>SBLTR=C</td>
<td>17.2</td>
<td>0.19</td>
</tr>
<tr>
<td><strong>PM PEAK HOUR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkside Dr. &amp; Hollybush Dr.</td>
<td>EBLTR=A</td>
<td>0.1</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>WBLTR=A</td>
<td>4.2</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>NBL=C</td>
<td>22.5</td>
<td>0.09</td>
</tr>
</tbody>
</table>
Unsignalized Intersections

<table>
<thead>
<tr>
<th>Unsignalized Intersections</th>
<th>Highest Movement Lane LOS</th>
<th>Delay (s)</th>
<th>V/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parkside Dr. &amp; Duncan Ave.</td>
<td>NBTR=B SBLTR=C</td>
<td>10.6</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18.5</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>EBTR=A WBLT=A</td>
<td>0.0</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.2</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>NBLR=B</td>
<td>13.2</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>EBLTR=A WBLTR=A</td>
<td>0.9</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.1</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>NBLTR=C SBLTR=C</td>
<td>19.0</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4</td>
<td>0.17</td>
</tr>
</tbody>
</table>

As is presented above, all unsignalized intersections operate satisfactorily under existing traffic conditions with no critical movements, delay or v/c ratios. However, roadway users will experience some delay as they wait for suitable gaps in traffic to complete their traffic manoeuvres. This is not uncommon for two-way stop controlled intersections. The issue of delay at these unsignalized intersections was raised by residents at public meetings with a request to consider signalization. Delcan has completed traffic signal warrant analysis to determine if any of these intersections may require a traffic signal. The analysis shows that traffic signals are not warranted at any of these unsignalized intersections. The signal warrant sheets are included in Appendix B.

2.2 Left Turn Lane Warrant Analysis

Due to concerns raised during technical agency meetings, left turn lane warrant analysis was completed at several intersections along Parkside Drive to determine if dedicated left turn storage lanes are required to accommodate left turning vehicles. Delcan performed these warrants on the intersections of Parkside Drive and Churchill Avenue, Parkside Drive and Mill Street North and Parkside Drive and Victoria Street. The warrants were completed using 2012 turning movement count data provided by the City of Hamilton. The results of the left turn lane warrant analysis indicate that left turn lanes are recommended at the following intersections:

- 15 meter westbound left turn lane at Parkside Drive and Mill Street North.
- 15 meter westbound and eastbound left turn lanes at the intersection of Parkside Drive and Victoria Street.

The left turn lane warrant sheets are included in Appendix C.
3.0 Future Conditions (2016)

The 2009 TIS report analysed the impacts that the planned developments (including infill) within Waterdown would have on Parkside Drive, utilizing a horizon year of 2016 (when all developments are assumed to be completed). These developments include the following 5 residential developments as well as 2 commercial developments:

- Silverwood
- Waterdown Bay
- Upcountry Estates
- MC2 Homes
- Parkside Hills
- Flamborough Power Centre
- Trinity/Krpan Development

The projected travel demands were calculated based on these future developments and utilized a 1.5% growth rate from the 2009 traffic volumes as well as a 2.0% reduction for public transit use. Since 2009 some of the planned development has occurred and the associated traffic is part of the 2012 traffic volumes. Also, since not all planned roadways and accesses are implemented (to 2016 levels); traffic distribution is not at its final state. As such, we would expect some moderate anomalies between 2012 counts and the 2016 forecasts. In reviewing this data the majority of the 2012 volumes were found to be representative. However, we did identify some anomalies (existing 2012 volumes higher than 2016 volumes) within the volumes. In order to be conservative and ensure that the intersections would operate as an acceptable level of service, Delcan has increased the 2012 volume anomalies by 1.5% per annum to account for confirmed growth.

The resulting future 2016 total traffic volumes for the Weekday AM and PM peak hours are illustrated in Figure 3-1.
Figure 3-1

Future 2016 Traffic Volumes

AM Peak Hour

PM Peak Hour
### 3.1 Geometric Modifications

Between Main Street and Hollybush Drive there are a number of existing and proposed municipal roadway intersections and a considerable number of private residential accesses. Currently there are left turn lanes at all major intersections within this section. Given the number of accesses and close spacing, the introduction of a continuous centre two-way left turn lane would provide enhanced roadway operations, improved safety for turning traffic and reduce delay for residential driveways through the introduction of two-way left turning. This recommendation is consistent with and supported by the approved 2009 TIS report. This modification is included in future traffic analysis presented below.

### 3.2 Future Traffic Analysis (2016)

The 2016 traffic capacity analysis completed for the signalized and unsignalized intersections during the Weekday AM and PM peak hours, under 2016 traffic conditions is summarized in **Table 3-1** and **Table 3-2**. The following analysis was completed utilizing the previously mentioned geometric and planned improvements (left turn phases and two-way left turn lanes). Synchro output sheets are provided in **Appendix D**.

**Table 3-1 – Future 2016 Weekday AM and PM Peak Hour Signalized Operational Performance (with improvements)**

<table>
<thead>
<tr>
<th>Signalized Intersections</th>
<th>Overall LOS</th>
<th>Delay/Veh (sec.)</th>
<th>Overall V/C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM PEAK HOUR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkside Dr. &amp; YMCA/Keewaydin St.</td>
<td>C</td>
<td>19.3</td>
<td>0.81</td>
</tr>
<tr>
<td>Parkside Dr. &amp; Hamilton Street</td>
<td>C</td>
<td>34.8</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>PM PEAK HOUR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkside Dr. &amp; YMCA/High School</td>
<td>B</td>
<td>15.9</td>
<td>0.73</td>
</tr>
<tr>
<td>Parkside Dr. &amp; Hamilton Street</td>
<td>D</td>
<td>41.6</td>
<td>0.86</td>
</tr>
</tbody>
</table>

As presented above, with the optimization of the traffic signal timings, all signalized intersections are forecast to operate satisfactorily with a level of service of ‘D’ or better under the future 2016 traffic conditions.

**Table 3-2** below presents the results of the future 2016 unsignalized capacity analysis.
### Table 3-2 – Future 2016 Weekday AM and PM Peak Hour Unsignalized Operational Performance (with improvements)

<table>
<thead>
<tr>
<th>Unsignalized Intersections</th>
<th>Highest Movement Lane LOS</th>
<th>AM PEAK HOUR</th>
<th>PM PEAK HOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delay (s)</td>
<td>V/C</td>
<td>Delay (s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkside Dr. &amp; Hollybush Dr.</td>
<td>EBLTR=A</td>
<td>0.4</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>WBL=A</td>
<td>8.5</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>WBTR=A</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>NBL=D</td>
<td>34.1</td>
<td>79.7</td>
</tr>
<tr>
<td></td>
<td>NBTR=B</td>
<td>12.7</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td>SBL=F</td>
<td>81.9</td>
<td>166.6</td>
</tr>
<tr>
<td></td>
<td>SBTR=B</td>
<td>14.0</td>
<td>18.6</td>
</tr>
<tr>
<td></td>
<td>EBL=A</td>
<td>8.2</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>EBTR=A</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>WBL=A</td>
<td>8.9</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>WBTR=A</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>NBL=E</td>
<td>38.8</td>
<td>40.6</td>
</tr>
<tr>
<td></td>
<td>NBTR=B</td>
<td>13.8</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>SBLTR=D</td>
<td>27.7</td>
<td>93.6</td>
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<tr>
<td></td>
<td>SBL=F</td>
<td>79.7</td>
<td>166.6</td>
</tr>
<tr>
<td></td>
<td>SBTR=C</td>
<td>18.6</td>
<td>18.6</td>
</tr>
<tr>
<td></td>
<td>EBL=A</td>
<td>1.1</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>EBTR=A</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>WBL=A</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>WBTR=A</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>NBL=F</td>
<td>50.9</td>
<td>50.9</td>
</tr>
<tr>
<td></td>
<td>NBTR=B</td>
<td>12.0</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td>SBLTR=D</td>
<td>25.1</td>
<td>25.1</td>
</tr>
<tr>
<td></td>
<td>EBL=B</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>EBTR=A</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>WBL=A</td>
<td>8.4</td>
<td>8.4</td>
</tr>
<tr>
<td></td>
<td>WBTR=A</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
### Unsignalized Intersections

<table>
<thead>
<tr>
<th>Highest Movement Lane LOS</th>
<th>Delay (s)</th>
<th>V/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBL=F</td>
<td>120.6</td>
<td>0.37</td>
</tr>
<tr>
<td>NBTR=C</td>
<td>23.8</td>
<td>0.25</td>
</tr>
<tr>
<td>SBL=F</td>
<td>428.0</td>
<td>1.43</td>
</tr>
<tr>
<td>SBTR=C</td>
<td>19.5</td>
<td>0.24</td>
</tr>
</tbody>
</table>

As illustrated above, all unsignalized intersections are forecast to operate satisfactorily under the future total 2016 traffic conditions. Several left turn movements experience delay which is not uncommon however, traffic signal warrant analysis was completed at these intersection using 2016 traffic volumes to determine if traffic signals are required. The results of this analysis indicate that traffic signals are not warranted at any of the intersections. The signal warrant results sheets are included in Appendix E.

#### 3.3 Future Conditions (2031)

By 2031 it is assumed that the new East-West road will be constructed. In order to assess the impacts that this will have on the travel demands on Parkside Drive, Delcan reviewed the City’s EMME/2 model for existing (2008), 2021 and 2031 scenarios within, and adjacent to, the study area. The City’s model however does not appear to be properly calibrated and does not reflect the anticipated traffic likely to use this new east-west roadway facility. This can be confirmed from the model plot indicating that only 1 (one) trip is attracted to the new east-west roadway in 2021 in the eastbound direction. Additionally, by 2031, only 408 trips have been assigned to this new roadway in the eastbound direction and none in the westbound direction. Despite the fact that the City’s travel demand forecasting model was unable to realistically assign traffic on to this new facility, it is our understanding for the City’s Transportation Plan that this new east west roadway is proposed to be a key east-west link in the City’s transportation network.

This roadway located west of Parkside Drive will provide the required additional capacity and connectivity of Highway 6 to support the build out of the greater Waterdown area. As such, this roadway will mostly take on new trips but is anticipated to attract trips currently utilizing Parkside Drive to access Highway 6.

Therefore, in the future Parkside Drive will predominantly be utilized by the traffic from the surrounding developments. The 2016 forecast traffic assumed that a significant amount of the planned development in the immediate area will be in place. Based on these travel demands the analysis presented above indicated that this demand can be accommodated and the intersections will still contain some reserve capacity.

In summary, by 2031 with the east-west roadway in place and the associated traffic redistribution, it is reasonable to consider traffic levels on Parkside Drive will be at a level
below 2016. Therefore, 2016 traffic forecast can be considered a 2031 worst case scenario for Parkside Drive. Based on this assumption, no further geometric improvements are required however, the city should continue to monitor intersection traffic levels and adjust signal timings and traffic control as necessary.
4.0 Supporting Policies

In 2007, the City of Hamilton completed their Road Network Strategy as a part of their Transportation Master Plan (TMP). As a part of this TMP, Parkside Drive was recommended for a number of improvements. These included:

- Road widening from Hwy 6 to Braeheid Avenue
- A two-way left-turn from Braeheid Avenue to the east part of industrial section

As a part of the TMP’s Cycling Network Strategy, Parkside Drive was recommended for the following improvement:

- Bike Lane/Paved shoulder/Shared Lane from Hollybush Drive to east of Churchill Avenue

As a part of the TMP’s Pedestrian Network Strategy, Parkside Drive was recommended for the following improvement:

- Off Road Multi-Use Paths from Borer’s Creek to Hamilton Street/Centre Avenue.
5.0 Recommendations

Based on the results of the analysis and the recommendations made in the previously approved 2009 TIS and 2007 TMP, and the completed existing and future traffic analysis by Delcan, the recommended improvements to be made to Parkside Drive, from Highway 6 to 500m east of Churchill Avenue are as follows:

- Provide a 1.5m wide dedicated bike lanes along both sides of Parkside Drive throughout the study area.

- Provide a continuous sidewalk on both the north and south side of Parkside Drive within the study area. Between Hollybush Drive and Centre Street which experiences greater pedestrian demand. It is recommended that a wider (2.0 meter) sidewalk be provided on both the north and south sides.

- Incorporate the MTO preliminary design of the Highway 6 intersection into the design of Parkside Drive.

- Provide a continuous 4.0m two-way left-turn lane from Hollybush Drive to Main Street. The intersections at Braeheid Avenue, Keewaydin Street and Hamilton Street/Centre Road currently include left turn lanes. As a number of properties in this area fronting on Parkside Drive, the inclusion of a two-way-left-turn lane would aid in facilitating the smooth operation of Parkside Drive. Also, providing a consistent cross section over a longer distance is preferable to having a number of shorter, differing cross sections.

- Upgrade Parkside Drive to an urban cross section from Highway 6 to Hollybush Drive. As the Urban Area Boundary runs along Parkside Drive on this section, the north side will require a curb and gutter, with an open ditch for drainage, while the south side will require curb and gutter with a storm sewer system for storm drainage.

- Upgrade Parkside Drive to an urban cross section from Main Street to 500m East of Churchill Drive. This section of Parkside Drive is entirely within the Urban Area Boundary and as such, curb and gutter with a storm sewer system are required.

- 15 meter left turn storage lanes are required (as per the left turn warrant analysis) at the following intersections:
  - Parkside Drive and Mill Street North (eastbound and westbound directions)
  - Parkside Drive and Victoria Street (eastbound and westbound directions)

- Advanced left turn phases should be implemented at the intersections of Parkside and Keewaydin Street and Parkside and Hamilton Street to mitigate the delay to left turning vehicles.
• Traffic signal warrants not met for the intersection of Parkside Drive and Hollybush Drive and Parkside Drive and Braheid Avenue; however the City should consider signalizing these intersections to allow for suitable gaps in the traffic stream which would provide opportunities for vehicles exiting at unsignalized intersections to enter Parkside Drive.
## Existing AM Traffic Volumes
### 5: YMCA / High School & Parkside Drive
#### AM Peak Hour

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## Intersection Summary

- **HCM 2000 Control Delay**: 13.3
- **HCM 2000 Level of Service**: B
- **HCM 2000 Volume to Capacity ratio**: 0.44
- **Actuated Cycle Length (s)**: 70.7
- **Sum of lost time (s)**: 15.0
- **Intersection Capacity Utilization**: 67.3%
- **ICU Level of Service**: C
- **Analysis Period (min)**: 15

**Critical Lane Group**

---

Delcan
HCM Signalized Intersection Capacity Analysis

Synchro 8 Report
2/4/2013

Appendix G - Page 19
### Movement

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### Intersection Summary

- **HCM 2000 Control Delay**: 17.3
- **HCM 2000 Level of Service**: B
- **HCM 2000 Volume to Capacity ratio**: 0.57
- **Actuated Cycle Length (s)**: 70.0
- **Sum of lost time (s)**: 11.5
- **Intersection Capacity Utilization**: 80.7%
- **ICU Level of Service**: D
- **Analysis Period (min)**: 15

**Parkside Drive Class EA**

**Delcan**

**HCM Signalized Intersection Capacity Analysis**

**Synchro 8 Report**

**2/4/2013**
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### Actuated Green, G (s)

| Actuated Green, G (s) | 48.4 | 48.4 | 40.0 | 40.0 | 40.0 | 40.0 | 12.4 | 12.4 | 12.4 | 12.4 | 12.4 | 12.4 |

### Effective Green, g (s)

| Effective Green, g (s) | 48.4 | 48.4 | 40.0 | 40.0 | 40.0 | 40.0 | 12.4 | 12.4 | 12.4 | 12.4 | 12.4 | 12.4 |

### Actuated g/C Ratio

| Actuated g/C Ratio | 0.66 | 0.66 | 0.55 | 0.55 | 0.55 | 0.55 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |

### Clearance Time (s)

| Clearance Time (s) | 3.0  | 6.0  | 6.0  | 6.0  | 6.0  | 6.0  | 6.0  | 6.0  | 6.0  | 6.0  | 6.0  | 6.0  |

### Vehicle Extension (s)

| Vehicle Extension (s) | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  |

### Lane Grp Cap (vph)

| Lane Grp Cap (vph) | 551  | 1206 | 529  | 1003 | 878  | 215  | 284  | 235  | 286  |

### v/s Ratio Prot

| v/s Ratio Prot | 0.01 | c0.24 | 0.03 | 0.01 | c0.09 |

### v/c Ratio

| v/c Ratio | 0.14 | 0.36 | 0.11 | 0.50 | 0.06 | 0.07 | 0.05 | 0.54 | 0.18 |

### Uniform Delay, d1

| Uniform Delay, d1 | 5.0  | 5.4  | 7.9  | 10.2 | 7.6  | 25.4 | 25.3 | 27.6 | 25.9 |

### Progression Factor

| Progression Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

### Incremental Delay, d2

| Incremental Delay, d2 | 0.1  | 0.9  | 0.4  | 0.1  | 0.1  | 0.1  | 0.1  | 0.1  | 0.1  |

### Delay (s)

| Delay (s) | 5.1  | 6.2  | 8.3  | 12.0 | 7.8  | 25.5 | 25.4 | 29.9 | 26.2 |

### Level of Service

| Level of Service | A    | A    | A    | A    | A    | A    | C    | C    | C   |

### Approach Delay (s)

| Approach Delay (s) | 6.1  | 11.1 | 25.4 | 27.9 |

### Approach LOS

| Approach LOS | A    | B    | C    | C    |

### Intersection Summary

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### Analysis Period (min)

| Analysis Period (min) | 15 |

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*Delcan*

HCM Signalized Intersection Capacity Analysis

*Synchro 8 Report*

*2/4/2013*
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### Peak-hour factor, PHF

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### Lane Group Flow (vph)

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#### Turn Type

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#### Intersection Summary

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c Critical Lane Group

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Delcan  
HCM Signalized Intersection Capacity Analysis  
Synchro 7 - Report  
2/4/2013
### Movement

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<th>SBL</th>
<th>SBT</th>
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<tr>
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Delcan

HCM Signalized Intersection Capacity Analysis

Synchro 7 - Report

2/4/2013
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<td>B</td>
<td>D</td>
<td>B</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>D</td>
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<tr>
<td>Approach LOS</td>
<td>D</td>
<td>C</td>
<td>C</td>
<td>D</td>
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</table>

### Intersection Summary

- **HCM 2000 Control Delay**: 33.0
- **HCM 2000 Volume to Capacity ratio**: 0.77
- **Actuated Cycle Length (s)**: 90.0
- **Intersection Capacity Utilization**: 81.5%
- **Analysis Period (min)**: 15

---

Delcan
HCM Signalized Intersection Capacity Analysis

Synchro 7 - Report
2/4/2013
### Existing AM Traffic Volumes

#### 2: Hollybush Drive & Parkside Drive

**AM Peak Hour**

| Movement          | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| **Lane Configurations** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **Volume (veh/h)** | 10  | 296 | 13  | 96  | 193 | 25  | 33  | 1   | 146 | 15  | 4   | 5   |     |
| **Sign Control**   | Free| Free|     |     |     | Stop|     |     | Stop|     |     |     |     |
| **Grade**          | 0%  | 0%  |     |     |     | 0%  |     |     | 0%  |     |     |     |     |
| **Peak Hour Factor** | 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92|     |
| **Hourly flow rate (vph)** | 11  | 322 | 14  | 104 | 210 | 27  | 36  | 1   | 159 | 16  | 4   | 5   |     |

**Pedestrians**

- **Walking Speed (m/s)**
- **Percent Blockage**
- **Right turn flare (veh)**
- **Median type**
- **Median storage veh**
- **Upstream signal (m)**
- **pX, platoon unblocked**
  - vC, conflicting volume | 237 | 336 | 790 | 796 | 329 | 942 | 790 | 223 |
  - vC1, stage 1 conf vol  |     |     |     |     |     |     |     |     |
  - vC2, stage 2 conf vol  |     |     |     |     |     |     |     |     |
  - vCu, unblocked vol     | 237 | 336 | 790 | 796 | 329 | 942 | 790 | 223 |
  - tC, single (s)         | 4.1 | 4.2 | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
  - tC, 2 stage (s)        |     |     |     |     |     |     |     |     |
  - tf (s)                 | 2.2 | 2.3 | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
  - p0 queue free %        | 99  | 91  | 87  | 100 | 78  | 91  | 99  | 99  |
  - cM capacity (veh/h)    | 1330| 1201| 283 | 290 | 710 | 175 | 292 | 816 |

**Direction, Lane #**

<table>
<thead>
<tr>
<th>Direction, Lane #</th>
<th>EB 1</th>
<th>WB 1</th>
<th>NB 1</th>
<th>NB 2</th>
<th>SB 1</th>
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<td>36</td>
<td>0</td>
<td>16</td>
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<tr>
<td>Volume Right</td>
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<td>27</td>
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<td>159</td>
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<td>5</td>
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<tr>
<td>cSH</td>
<td>1330</td>
<td>1201</td>
<td>283</td>
<td>703</td>
<td>175</td>
<td>454</td>
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<td>0.09</td>
<td>0.13</td>
<td>0.23</td>
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<td>3.4</td>
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<td>B</td>
<td>D</td>
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<td>B</td>
<td>C</td>
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**Intersection Summary**

- **Average Delay**: 4.7
- **Intersection Capacity Utilization**: 56.4%
- **ICU Level of Service**: B
- **Analysis Period (min)**: 15

---

Delcan
HCM Unsignalized Intersection Capacity Analysis

Synchro 8 Report
2/4/2013

Appendix G - Page 27
<table>
<thead>
<tr>
<th>Movement</th>
<th>EBT</th>
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<th>WBL</th>
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<td>0%</td>
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<td>Peak Hour Factor</td>
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<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
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<tr>
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<td>358</td>
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Pedestrians
Lane Width (m)
Walking Speed (m/s)
Percent Blockage
Right turn flare (veh)
Median type
Upstream signal (m)
pX, platoon unblocked
vC, conflicting volume
vC1, stage 1 conf vol
vC2, stage 2 conf vol
vCu, unblocked vol
tC, single (s)
tC, 2 stage (s)
tF (s)
p0 queue free %
cM capacity (veh/h)

Direction, Lane #
Volume Total
Volume Left
Volume Right
cSH
Volume to Capacity
Queue Length (m)
Control Delay (s)
Lane LOS
Approach Delay (s)
Approach LOS

Intersection Summary
Average Delay
Intersection Capacity Utilization
Analysis Period (min)

ICU Level of Service A
## Existing AM Traffic Volumes

### AM Peak Hour

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<tr>
<th>Movement</th>
<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
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<th>WBT</th>
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<th>NBL</th>
<th>NBT</th>
<th>NBR</th>
<th>SBL</th>
<th>SBT</th>
<th>SBR</th>
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</thead>
<tbody>
<tr>
<td>Volume (veh/h)</td>
<td>10</td>
<td>408</td>
<td>20</td>
<td>51</td>
<td>245</td>
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<td>29</td>
<td>1</td>
<td>72</td>
<td>23</td>
<td>4</td>
<td>37</td>
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<tr>
<td>Sign Control</td>
<td>Free</td>
<td>Free</td>
<td>Stop</td>
<td>Stop</td>
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<td></td>
<td></td>
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<td>0%</td>
<td>0%</td>
<td>0%</td>
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<td></td>
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<td>Peak Hour Factor</td>
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<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
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<td>Hourly flow rate (vph)</td>
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<td>443</td>
<td>22</td>
<td>55</td>
<td>266</td>
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<td>32</td>
<td>1</td>
<td>78</td>
<td>25</td>
<td>4</td>
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### Pedestrians

- Lane Width (m)
- Walking Speed (m/s)
- Percent Blockage
- Right turn flare (veh)

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<thead>
<tr>
<th>Median type</th>
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<th>None</th>
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<td>None</td>
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<td>Upstream signal (m)</td>
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</tr>
<tr>
<td>pX, platoon unblocked</td>
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<td></td>
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</table>

<table>
<thead>
<tr>
<th>VC, conflicting volume</th>
<th>272</th>
<th>465</th>
<th>896</th>
<th>859</th>
<th>454</th>
<th>924</th>
<th>867</th>
<th>269</th>
</tr>
</thead>
<tbody>
<tr>
<td>VC1, stage 1 conf vol</td>
<td>4.1</td>
<td>4.1</td>
<td>7.1</td>
<td>6.5</td>
<td>6.2</td>
<td>7.1</td>
<td>6.5</td>
<td>6.2</td>
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<tr>
<td>VC2, stage 2 conf vol</td>
<td>2.2</td>
<td>2.2</td>
<td>3.5</td>
<td>4.0</td>
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<td>4.0</td>
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<th>VCu, unblocked vol</th>
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<th>465</th>
<th>896</th>
<th>859</th>
<th>454</th>
<th>924</th>
<th>867</th>
<th>269</th>
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<tbody>
<tr>
<td>tC, single (s)</td>
<td>4.1</td>
<td>4.1</td>
<td>7.1</td>
<td>6.5</td>
<td>6.2</td>
<td>7.1</td>
<td>6.5</td>
<td>6.2</td>
</tr>
<tr>
<td>tC, 2 stage (s)</td>
<td>2.2</td>
<td>2.2</td>
<td>3.5</td>
<td>4.0</td>
<td>3.3</td>
<td>3.5</td>
<td>4.0</td>
<td>3.3</td>
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<table>
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<th>95</th>
<th>87</th>
<th>100</th>
<th>87</th>
<th>88</th>
<th>98</th>
<th>95</th>
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<td>95</td>
<td>87</td>
<td>100</td>
<td>87</td>
<td>88</td>
<td>98</td>
<td>95</td>
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<tr>
<td>cM capacity (veh/h)</td>
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<td>1107</td>
<td>236</td>
<td>277</td>
<td>610</td>
<td>208</td>
<td>274</td>
<td>770</td>
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### Direction, Lane #

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<th>465</th>
<th>55</th>
<th>272</th>
<th>32</th>
<th>79</th>
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<td>0</td>
<td>32</td>
<td>0</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Volume Right</td>
<td>0</td>
<td>22</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>78</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>cSH</td>
<td>1292</td>
<td>1700</td>
<td>1107</td>
<td>1700</td>
<td>236</td>
<td>600</td>
<td>208</td>
<td>654</td>
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### Queue Length 95th (m)

<table>
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<th>Control Delay (s)</th>
<th>7.8</th>
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<th>8.4</th>
<th>0.0</th>
<th>22.6</th>
<th>11.9</th>
<th>24.7</th>
<th>10.9</th>
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<tr>
<td>Lane LOS</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>B</td>
<td>C</td>
<td>B</td>
<td>C</td>
<td>B</td>
</tr>
<tr>
<td>Approach Delay (s)</td>
<td>0.2</td>
<td>1.4</td>
<td>15.0</td>
<td>15.9</td>
<td></td>
<td></td>
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<tr>
<td>Approach LOS</td>
<td>B</td>
<td>C</td>
<td>C</td>
<td>B</td>
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### Intersection Summary

- Average Delay | 3.4 |
- Intersection Capacity Utilization | 44.3% |
- ICU Level of Service | A |
- Analysis Period (min) | 15 |
## Existing AM Traffic Volumes

### 51: Churchill Avenue & Parkside Drive

#### AM Peak Hour

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<th>EBT</th>
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<td>231</td>
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<td>Sign Control</td>
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<td>Stop</td>
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<tr>
<td>Grade</td>
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<td>0%</td>
<td>0%</td>
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<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
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<td>4</td>
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#### Pedestrians

<table>
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<th>Lane Width (m)</th>
<th>Walking Speed (m/s)</th>
<th>Percent Blockage</th>
<th>Right turn flare (veh)</th>
<th>Median type</th>
<th>Median storage veh</th>
<th>Upstream signal (m)</th>
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<tbody>
<tr>
<td></td>
<td></td>
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<td>None</td>
<td>None</td>
<td>pX, platoon unblocked</td>
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<td>vC, conflicting volume</td>
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<td>722</td>
<td>462</td>
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<td></td>
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<td>vC1, stage 1 conf vol</td>
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<td>vC2, stage 2 conf vol</td>
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<td></td>
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<tr>
<td>vCu, unblocked vol</td>
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<td>722</td>
<td>462</td>
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#### Direction, Lane #

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<th>NB 1</th>
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<td>Volume Right</td>
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<tr>
<td>cSH</td>
<td>1700</td>
<td>1097</td>
<td>516</td>
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| Volume to Capacity | 0.27 | 0.00 | 0.03 |
| Queue Length 95th (m) | 0.0 | 0.1 | 0.7 |
| Control Delay (s) | 0.0 | 0.2 | 12.2 |
| Lane LOS | A | B |
| Approach Delay (s) | 0.0 | 0.2 | 12.2 |
| Approach LOS | | B |

#### Intersection Summary

| Average Delay | 0.3 |
| Intersection Capacity Utilization | 32.5% |
| ICU Level of Service | A |
| Analysis Period (min) | 15 |
## Movement

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<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
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<th>NBT</th>
<th>NBR</th>
<th>SBL</th>
<th>SBT</th>
<th>SBR</th>
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### Lane Configurations

<table>
<thead>
<tr>
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<th>158</th>
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<th>1</th>
<th>75</th>
<th>13</th>
<th>0</th>
<th>13</th>
</tr>
</thead>
</table>

### Sign Control

- Free
- Stop

### Grade

- 0%

### Peak Hour Factor

- 0.92

### Hourly flow rate (vph)

<table>
<thead>
<tr>
<th>4</th>
<th>258</th>
<th>64</th>
<th>172</th>
<th>248</th>
<th>10</th>
<th>20</th>
<th>1</th>
<th>82</th>
<th>14</th>
<th>0</th>
<th>14</th>
</tr>
</thead>
</table>

### Pedestrians

- Lane Width (m)
- Walking Speed (m/s)
- Percent Blockage
- Right turn flare (veh)

### Median type

- None

### Median storage veh

- None

### Upstream signal (m)

- pX, platoon unblocked

### vC, conflicting volume

<table>
<thead>
<tr>
<th>258</th>
<th>322</th>
<th>909</th>
<th>899</th>
<th>290</th>
<th>977</th>
<th>927</th>
<th>253</th>
</tr>
</thead>
</table>

### vC1, stage 1 conf vol

<table>
<thead>
<tr>
<th>4.1</th>
<th>4.2</th>
<th>7.1</th>
<th>6.5</th>
<th>6.2</th>
<th>7.1</th>
<th>6.5</th>
<th>6.2</th>
</tr>
</thead>
</table>

### vC2, stage 2 conf vol

<table>
<thead>
<tr>
<th>2.2</th>
<th>2.3</th>
<th>3.5</th>
<th>4.0</th>
<th>3.3</th>
<th>3.5</th>
<th>4.0</th>
<th>3.3</th>
</tr>
</thead>
</table>

### vCu, unblocked vol

<table>
<thead>
<tr>
<th>1307</th>
<th>1216</th>
<th>225</th>
<th>727</th>
<th>182</th>
<th>786</th>
</tr>
</thead>
</table>

### tC, single (s)

<table>
<thead>
<tr>
<th>2.2</th>
<th>2.3</th>
<th>3.5</th>
<th>4.0</th>
<th>3.3</th>
<th>3.5</th>
<th>4.0</th>
<th>3.3</th>
</tr>
</thead>
</table>

### tC, 2 stage (s)

<table>
<thead>
<tr>
<th>0.1</th>
<th>4.2</th>
<th>12.9</th>
<th>18.1</th>
</tr>
</thead>
</table>

### p0 queue free %

<table>
<thead>
<tr>
<th>100</th>
<th>86</th>
<th>91</th>
<th>89</th>
<th>92</th>
<th>100</th>
<th>98</th>
</tr>
</thead>
</table>

### cM capacity (veh/h)

<table>
<thead>
<tr>
<th>1307</th>
<th>1216</th>
<th>225</th>
<th>727</th>
<th>182</th>
<th>786</th>
</tr>
</thead>
</table>

### Direction, Lane #

<table>
<thead>
<tr>
<th>Volume Total</th>
<th>EB 1</th>
<th>WB 1</th>
<th>NB 1</th>
<th>NB 2</th>
<th>SB 1</th>
<th>SB 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>326</td>
<td>429</td>
<td>20</td>
<td>83</td>
<td>14</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

### Volume Left

<table>
<thead>
<tr>
<th>4</th>
<th>172</th>
<th>20</th>
<th>0</th>
<th>14</th>
</tr>
</thead>
</table>

### Volume Right

<table>
<thead>
<tr>
<th>64</th>
<th>10</th>
<th>0</th>
<th>82</th>
<th>0</th>
<th>14</th>
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</table>

### cSH

<table>
<thead>
<tr>
<th>1307</th>
<th>1216</th>
<th>225</th>
<th>727</th>
<th>182</th>
<th>786</th>
</tr>
</thead>
</table>

### Volume to Capacity

<table>
<thead>
<tr>
<th>0.00</th>
<th>0.14</th>
<th>0.09</th>
<th>0.11</th>
<th>0.08</th>
<th>0.02</th>
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</thead>
</table>

### Queue Length 95th (m)

<table>
<thead>
<tr>
<th>0.1</th>
<th>3.9</th>
<th>2.3</th>
<th>3.1</th>
<th>2.0</th>
<th>0.4</th>
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</thead>
</table>

### Control Delay (s)

<table>
<thead>
<tr>
<th>0.1</th>
<th>4.2</th>
<th>22.5</th>
<th>10.6</th>
<th>26.5</th>
<th>9.7</th>
</tr>
</thead>
</table>

### Lane LOS

<table>
<thead>
<tr>
<th>A</th>
<th>A</th>
<th>C</th>
<th>B</th>
<th>D</th>
<th>A</th>
</tr>
</thead>
</table>

### Approach Delay (s)

<table>
<thead>
<tr>
<th>0.1</th>
<th>4.2</th>
<th>12.9</th>
<th>18.1</th>
</tr>
</thead>
</table>

### Approach LOS

<table>
<thead>
<tr>
<th>B</th>
<th>C</th>
</tr>
</thead>
</table>

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**Intersection Summary**

<table>
<thead>
<tr>
<th>Average Delay</th>
<th>4.2</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Intersection Capacity Utilization</th>
<th>55.2%</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ICU Level of Service</th>
<th>B</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Analysis Period (min)</th>
<th>15</th>
</tr>
</thead>
</table>
### Movement

<table>
<thead>
<tr>
<th>Movement</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>NBL</th>
<th>NBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Configurations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume (veh/h)</td>
<td>342</td>
<td>14</td>
<td>42</td>
<td>414</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Sign Control</td>
<td>Free</td>
<td>Free</td>
<td>Stop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Hour Factor</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
</tr>
<tr>
<td>Hourly flow rate (vph)</td>
<td>372</td>
<td>15</td>
<td>46</td>
<td>450</td>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>

### Pedestrians

|   | Lane Width (m) | Walking Speed (m/s) | Percent Blockage | Right turn flare (veh) | Median type | Median storage veh | Upstream signal (m) | pX, platoon unblocked | vC, conflicting volume | vC1, stage 1 conf vol | vC2, stage 2 conf vol | vCu, unblocked vol | tC, single (s) | tC, 2 stage (s) | tF (s) | p0 queue free % | cM capacity (veh/h) | Direction, Lane # | Volume Total | Volume Left | Volume Right | cSH | Volume to Capacity | Queue Length 50th (m) | Control Delay (s) | Lane LOS | Approach Delay (s) | Approach LOS | Intersection Summary | Average Delay | Intersection Capacity Utilization | ICU Level of Service | Analysis Period (min) |
|---|----------------|--------------------|------------------|--------------------|----------------------|---------------|-------------------|---------------------|---------------------|------------------|------------------|----------------|-------------|----------------|----------|-----------------|----------------|----------------|----------------|---------------|----------------|----------------|-------------------|----------------------|------------------------|
|   |                |                    |                  |                    |                      |               |                   |                     |                     |                  |                  |                |             |              |           |                 |                |                |                |               |                |                 |                   |                        |                        |                  |                |
|   |                |                    |                  |                    |                      |               |                   |                     |                     |                  |                  |                |             |              |           |                 |                |                |                |               |                |                 |                   |                        |                        |                  |                |
|   |                |                    |                  |                    |                      |               |                   |                     |                     |                  |                  |                |             |              |           |                 |                |                |                |               |                |                 |                   |                        |                        |                  |                |
|   |                |                    |                  |                    |                      |               |                   |                     |                     |                  |                  |                |             |              |           |                 |                |                |                |               |                |                 |                   |                        |                        |                  |                |

### Analysis Period (min)

- Delcan
- HCM Unsignalized Intersection Capacity Analysis
- Synchro 8 Report
- 2/4/2013
### Movement

<table>
<thead>
<tr>
<th>Movement</th>
<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>WBR</th>
<th>NBL</th>
<th>NBT</th>
<th>NBR</th>
<th>SBL</th>
<th>SBT</th>
<th>SBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (veh/h)</td>
<td>27</td>
<td>308</td>
<td>25</td>
<td>87</td>
<td>425</td>
<td>31</td>
<td>15</td>
<td>9</td>
<td>45</td>
<td>13</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Sign Control</td>
<td>Free</td>
<td>Free</td>
<td>Stop</td>
<td>Stop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Peak Hour Factor</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
<td>0.92</td>
</tr>
<tr>
<td>Hourly flow rate (vph)</td>
<td>29</td>
<td>335</td>
<td>27</td>
<td>95</td>
<td>462</td>
<td>34</td>
<td>16</td>
<td>10</td>
<td>49</td>
<td>14</td>
<td>7</td>
<td>22</td>
</tr>
</tbody>
</table>

### Pedestrians

| Pedestrians | Lane Width (m) | Walking Speed (m/s) | Percent Blockage | Right turn flare (veh) | Median type | Median storage veh | Upstream signal (m) | pX, platoon unblocked | vC, conflicting volume | vC1, stage 1 conf vol | vC2, stage 2 conf vol | vCu, unblocked vol | tC, single (s) | tC, 2 stage (s) | tf (s) | p0 queue free % | cM capacity (veh/h) | Direction, Lane # | Volume Total | Volume Left | Volume Right | cSH | Volume to Capacity | Queue Length 95th (m) | Control Delay (s) | Lane LOS | Approach Delay (s) | Approach LOS |
|-------------|----------------|--------------------|------------------|------------------------|-------------|-----------------|-------------------|-------------------|----------------------|---------------------|-------------------|---------------|---------------|----------------|--------|----------------|----------------|------------------|-----------|----------------|-------------|
|             |                |                    |                  |                        | None        | None            | 328               | 0.96              | 496                  | 1083               | 1092              | 348            | 1088          | 1098          | 409              |
|             |                |                    |                  |                        |             |                 |                   | 362               | 1063                 | 1073               | 348              | 1098          | 1070          | 432            |
|             |                |                    |                  |                        |             |                 |                   |                   |                       |                     |                  |               |               |                |
|             |                |                    |                  |                        |             |                 |                   |                   |                       |                     |                  |               |               |                |
|             |                |                    |                  |                        |             |                 |                   |                   |                       |                     |                  |               |               |                |
|             |                |                    |                  |                        |             |                 |                   |                   |                       |                     |                  |               |               |                |
|             |                |                    |                  |                        |             |                 |                   |                   |                       |                     |                  |               |               |                |

### Intersection Summary

<table>
<thead>
<tr>
<th>Intersection Summary</th>
<th>Average Delay</th>
<th>Intersection Capacity Utilization</th>
<th>ICU Level of Service</th>
<th>Analysis Period (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.9</td>
<td>45.1%</td>
<td>A</td>
<td>15</td>
</tr>
</tbody>
</table>

---

Delcan
HCM Unsignalized Intersection Capacity Analysis

Synchro 8 Report
2/4/2013

Appendix G - Page 33
## Signalization Warrant

**Parkside Drive and Braehide Avenue**

Existing 2012 Peak Hour

<table>
<thead>
<tr>
<th>WARRANT</th>
<th>DESCRIPTION</th>
<th>MINIMUM REQUIREMENT FOR 2 LANE HIGHWAYS</th>
<th>COMPLIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>A. VEHICLE VOLUME, ALL APPROACHES PER HOUR FOR 8 HOURS, AND B. VEHICLE VOLUME, ALONG MINOR STREETS, PER HOUR FOR SAME, 8 HOURS.</td>
<td>720</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td></td>
<td>170</td>
<td>376</td>
</tr>
<tr>
<td>1b</td>
<td>A. VEHICLE VOLUME, ALONG ARTERY. PER HOUR FOR 8 HOURS, AND B. COMBINED VEHICLE AND PEDESTRIAN TRAFFIC VOLUME CROSSING ARTERY FROM MINOR STREETS, PER HOUR FOR SAME 8 HOURS.</td>
<td>720</td>
<td>688</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75</td>
<td>291</td>
</tr>
<tr>
<td>2a</td>
<td>A. TOTAL REPORTED ACCIDENTS OF TYPES SUSCEPTIBLE TO CORRECTION BY A TRAFFIC SIGNAL WITHIN A 12 MONTH PERIOD, AND B. ADEQUATE TRIAL OF LESS RESTRICTIVE REMEDIES, WHERE SATISFACTORY OBSERVANCE AND ENFORCEMENT HAVE FAILED TO REDUCE THE NUMBER OF ACCIDENTS, AND C. FULFILLMENT OF EITHER OF THE ABOVE WARRANTS Minimum Vehicular Volume or Delay to Cross Traffic to the Extent of 80% or more</td>
<td>No. accidents</td>
<td>Warrant Value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2b</td>
<td>TWO OR MORE OF ABOVE WARRANTS (NUMBERS 1, 2, 3, OR 4) SATISFIED TO THE EXTENT OF 80% OR MORE.</td>
<td>YES or NO</td>
<td></td>
</tr>
</tbody>
</table>
### Signalization Warrant

**Parkside Drive and Duncan Avenue**

**Existing 2012 Peak Hour**

<table>
<thead>
<tr>
<th>Warrant</th>
<th>Description</th>
<th>Minimum Requirement for 2 Lane Highways</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>A. Vehicle volume, all approaches per hour for 8 hours, and</td>
<td>720</td>
<td>SECTIONAL</td>
</tr>
<tr>
<td></td>
<td>B. Vehicle volume, along minor streets, per hour for same, 8 hours.</td>
<td>170</td>
<td>(4) ENTIRE</td>
</tr>
<tr>
<td>1b</td>
<td>A. Vehicle volume, along artery. Per hour for 8 hours, and</td>
<td>720</td>
<td>% NUMERICAL</td>
</tr>
<tr>
<td></td>
<td>B. Combined vehicle and pedestrian traffic volume crossing artery from minor streets, per hour for same 8 hours.</td>
<td>75</td>
<td>% ENTIRE</td>
</tr>
<tr>
<td>1b</td>
<td>A. Total reported accidents of types susceptible to correction by a traffic signal within a 12 month period, and</td>
<td>0</td>
<td>Yes OR No</td>
</tr>
<tr>
<td></td>
<td>B. Adequate trial of less restrictive remedies, where satisfactory observance and enforcement have failed to reduce the number of accidents, and</td>
<td>5</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>C. Fulfillment of either of the above warrants: Minimum vehicular volume or delay to cross traffic to the extent of 80% or more</td>
<td>0</td>
<td>Yes OR No</td>
</tr>
<tr>
<td>2a</td>
<td>Two or more of above warrants (numbers 1, 2, 3, or 4) satisfied to the extent of 80% or more.</td>
<td>0</td>
<td>Yes OR No</td>
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</tbody>
</table>
## Signalization Warrant
### Parkside Drive and Hollybush Drive
#### Existing 2012 Peak Hour

<table>
<thead>
<tr>
<th>Warrant</th>
<th>Description</th>
<th>Minimum Requirement for 2 Lane Highways</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FLOW RATE</td>
<td>SECTIONAL</td>
<td>ENTIRE</td>
</tr>
<tr>
<td></td>
<td>NUMERICAL</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>1</td>
<td>MINIMUM VEHICULAR VOLUME</td>
<td>720</td>
<td>641</td>
</tr>
<tr>
<td></td>
<td>A. VEHICLE VOLUME, ALL APPROACHES PER HOUR FOR 8 HOURS, AND</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. VEHICLE VOLUME, ALONG MINOR STREETS, PER HOUR FOR SAME, 8 HOURS.</td>
<td>170</td>
<td>419</td>
</tr>
<tr>
<td>2</td>
<td>DELAY TO CROSS TRAFFIC</td>
<td>720</td>
<td>545</td>
</tr>
<tr>
<td></td>
<td>A. VEHICLE VOLUME, ALONG ARTERY. PER HOUR FOR 8 HOURS, AND</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. COMBINED VEHICLE AND PEDESTRIAN TRAFFIC CROSSING ARTERY FROM MINOR STREETS, PER HOUR FOR SAME 8 HOURS.</td>
<td>75</td>
<td>256</td>
</tr>
<tr>
<td>3</td>
<td>ACCIDENT HAZARD</td>
<td>No. accidents</td>
<td>Warrant Value</td>
</tr>
<tr>
<td></td>
<td>A. TOTAL REPORTED ACCIDENTS OF TYPES SUSCEPTIBLE TO CORRECTION BY A TRAFFIC SIGNAL WITHIN A 12 MONTH PERIOD, AND</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. ADEQUATE TRIAL OF LESS RESTRICTIVE REMEDIES, WHERE SATISFACTORY OBSERVANCE AND ENFORCEMENT HAVE FAILED TO REDUCE THE NUMBER OF ACCIDENTS, AND</td>
<td>yes OR no</td>
<td>yes</td>
</tr>
<tr>
<td>2a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. FULFILLMENT OF EITHER OF THE ABOVE WARRANTS Minimum Vehicluar Volume or Delay to Cross Traffic to the Extent of 80% or more</td>
<td>yes OR no</td>
<td>yes</td>
</tr>
<tr>
<td>2b</td>
<td>COMBINATION WARRANT</td>
<td>TWO OR MORE OF ABOVE WARRANTS (NUMBERS 1, 2, 3, OR 4) SATISFIED TO THE EXTENT OF 80% OR MORE.</td>
<td>YES or NO</td>
</tr>
</tbody>
</table>
LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED

\(\% \text{ LEFT TURNS IN } V_A = 5\%\)
\(S = \text{STORAGE LENGTH}\)

DESIGN SPEED = 60 km/h

\(V_A = 292\)
\(V_o = 640\)
\(V_L = 6\)
\(\frac{6 \times 100}{292} = 2\%\)

TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW

TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED

\(\% \text{ LEFT TURNS IN } V_A = 10\%\)
\(S = \text{STORAGE LENGTH}\)

DESIGN SPEED = 60 km/h

Figure EA-6

94-06

EA-7
LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED

% LEFT TURNS IN \( V_A \) = 5%

\( S \) = STORAGE LENGTH

DESIGN SPEED = 60 km/h

Traffic signals may be warranted in rural areas or urban areas with restricted flow.

Traffic signals may be warranted in "free flow" urban areas.

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED

% LEFT TURNS IN \( V_A \) = 10%

\( S \) = STORAGE LENGTH

DESIGN SPEED = 60 km/h

Figure EA-6

EA-7
LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED

% LEFT TURNS IN $V_A = 5\%$

S = STORAGE LENGTH

DESIGN SPEED = 60 km/h

TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW

TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS

Figure EA-6

94-06

EA-7
LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED

% LEFT TURNS IN $V_A = 5\%$

$S = \text{STORAGE LENGTH}$

DESIGN SPEED = $60 \text{ km/h}$

---

TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW

---

TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS
### Lane Configurations

<table>
<thead>
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### Peak-hour factor, PHF

| Adj. Flow (vph) | 179  | 703  | 35  | 14  | 249 | 341 | 23  | 122 | 112 | 186 | 1198 | 198 |
| RTOR Reduction (vph) | 0    | 2    | 0   | 0   | 0   | 214 | 0   | 48  | 0   | 0   | 97   | 0   |
| Lane Group Flow (vph) | 179  | 736  | 0   | 14  | 249 | 127 | 23  | 186 | 0   | 198 | 0    | 0   |
| Heavy Vehicles (%) | 0%   | 4%   | 0%  | 0%  | 4%  | 1%  | 0%  | 0%  | 0%  | 0%  | 0%   | 0%  |
| Turn Type | pm+pt | NA  | Perm | NA  | Perm | Perm | NA  | pm+pt | NA  |
| Protected Phases | 1    | 6    | 2   | 8   | 4   |
| Permitted Phases | 6    | 2    | 2   | 8   |
| Actuated Green, G (s) | 34.6 | 34.6 | 25.6 | 25.6 | 25.6 | 12.5 | 12.5 | 12.5 | 21.9 | 21.9 |
| Effective Green, g (s) | 34.6 | 34.6 | 25.6 | 25.6 | 25.6 | 12.5 | 12.5 | 12.5 | 21.9 | 21.9 |
| Actuated g/C Ratio | 0.51 | 0.51 | 0.37 | 0.37 | 0.37 | 0.18 | 0.18 | 0.18 | 0.32 | 0.32 |
| Clearance Time (s) | 3.0  | 6.0  | 6.0  | 6.0  | 6.0  | 6.0  | 3.5  | 6.0  |
| Vehicle Extension (s) | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  |
| Lane Grp Cap (vph) | 572  | 917  | 182 | 682 | 597 | 217 | 321 | 327 | 544 |
| v/s Ratio Prot | 0.03 | c0.40 | 0.14 | 0.11 | c0.05 | 0.06 |
| v/s Ratio Perm | 0.13 | 0.03 | 0.08 | 0.02 | c0.14 |
| v/c Ratio | 0.31 | 0.80 | 0.08 | 0.37 | 0.21 | 0.11 | 0.58 | 0.61 | 0.20 |
| Uniform Delay, d1 | 9.4  | 14.1 | 13.8 | 15.6 | 14.6 | 23.3 | 25.6 | 18.1 | 17.0 |
| Progression Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 0.3  | 7.3  | 0.8  | 1.5  | 0.8  | 2.5  | 3.2  | 0.2  |
| Delay (s) | 9.8  | 21.5 | 14.7 | 17.1 | 15.4 | 23.6 | 28.1 | 21.3 | 17.1 |
| Level of Service | A    | C    | B    | B    | B    | C    | C    | B    |
| Approach Delay (s) | 19.2 | 16.1 | 27.7 | 19.2 |
| Approach LOS | B    | B    | C    | B    |

### Intersection Summary

- HCM 2000 Control Delay: 19.3
- HCM 2000 Volume to Capacity ratio: 0.81
- Actuated Cycle Length (s): 68.5
- Intersection Capacity Utilization: 93.3%
- Analysis Period (min): 15
## Parkside Drive EA
### 6: Hamilton Street & Parkside Drive
#### Future 2016 AM Traffic Analysis
##### AM Peak Hour

**Lane Configurations**

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**Turn Type**

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**Intersection Summary**

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**Delcan**

HCM Signalized Intersection Capacity Analysis

Synchro 7 - Report

2/4/2013
## Movement

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### Intersection Summary

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c Critical Lane Group
## Parkside Drive EA
### Future 2016 PM Traffic Analysis
#### 6: Hamilton Street & Parkside Drive
##### PM Peak Hour

### Delcan
#### HCM Signalized Intersection Capacity Analysis
Synchro 7 - Report
2/4/2013

### Appendix G - Page 47

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## Movement Capacity Analysis

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### Pedestrians

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### Intersection Summary

<p>| Average Delay | 8.4 |
| Intersection Capacity Utilization | 67.1% |
| ICU Level of Service | C |
| Analysis Period (min) | 15 |</p>
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**Pedestrians**

| Lane Width (m) | Walking Speed (m/s) | Percent Blockage | Right turn flare (veh) | Median type | Median storage veh | Upstream signal (m) | pX, platoon unblocked | vC, conflicting volume | vC1, stage 1 conf vol | vC2, stage 2 conf vol | vCu, unblocked vol | tC, single (s) | tC, 2 stage (s) | tF (s) | p0 queue free % | cM capacity (veh/h) | Direction, Lane # | Volume Total | Volume Left | Volume Right | cSH | Volume to Capacity | Queue Length 95th (m) | Control Delay (s) | Lane LOS | Approach Delay (s) | Approach LOS |
|----------------|--------------------|------------------|------------------------|-------------|-------------------|---------------------|----------------------|------------------------|----------------------|----------------------|-----------------|--------------|------------------|-------|-----------------|------------------|-------------------|---------|-------------|--------------|-------------|
|                |                    |                  |                        | None        | None              |                     |                      | 403                    | 587                  | 1192                 | 1139           | 571          | 1218            | 1151  | 399            |                    | EB 1  | 20         | 0            | 20            | 0   | 0.02         | 0.4              | 8.2              | A       | 0.3          | C             |
|                |                    |                  |                        |             |                   |                     |                      | 1155                  | 983                   | 1700                 | 1700           | 135          | 509             | 252              |                    | EB 2  | 587        | 63          | 0             | 29  | 0.35         | 0.0             | 0.0               | A       | 1.2          | D             |
|                |                    |                  |                        |             |                   |                     |                      | 1700                  | 983                   | 1700                 | 135            | 509          | 252             |                    |                    | WB 1 | 63         | 0            | 0             | 29  | 0.06         | 1.6             | 8.9              | E       | 19.5         |              |
|                |                    |                  |                        |             |                   |                     |                      | 1700                  | 983                   | 1700                 | 135            | 509          | 252             |                    |                    | WB 2 | 63         | 0            | 0             | 29  | 0.24         | 0.0             | 8.9              | B       | 27.7         |              |
|                |                    |                  |                        |             |                   |                     |                      | 135                   | 509                   | 252                  |                |              |                 |                    |                    | NB 1 | 0          | 63            | 0             | 0   | 0.22         | 0.6             | 8.9              |                    |              |
|                |                    |                  |                        |             |                   |                     |                      | 509                   | 252                  | 135                  |                |              |                 |                    |                    | NB 2 | 0          | 63            | 0             | 0   | 0.20         | 0.6             | 8.9              |                    |              |
|                |                    |                  |                        |             |                   |                     |                      | 252                  | 135                  | 509                  |                |              |                 |                    |                    | SB 1 | 96         | 100          | 20            | 0   | 0.38         | 5.8             | 13.5             |                    |              |

**Intersection Summary**

- Average Delay: 4.5
- Intersection Capacity Utilization: 53.9%
- Analysis Period (min): 15
- ICU Level of Service: A

Delcan
HCM Unsignalized Intersection Capacity Analysis

Synchro 7 - Report
2/4/2013
## Movement

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### Pedestrians

- **Lane Width (m):**
  - None
- **Walking Speed (m/s):**
  - None
- **Percent Blockage:**
  - None
- **Right turn flare (veh):**
  - None
- **Median type:**
  - None
- **Median storage veh:**
  - None
- **Upstream signal (m):**
  - 328
- **pX, platoon unblocked:**
  - vC, conflicting volume: 359, 645, 1220, 1147, 636, 1228, 1141, 345
- **vC1, stage 1 conf vol:**
  - vC2, stage 2 conf vol: 359, 645, 1220, 1147, 636, 1228, 1141, 345
- **tC, single (s):**
  - 4.1, 4.1, 7.1, 6.5, 6.2, 7.1, 6.5, 6.2
- **tC, 2 stage (s):**
  - 2.2, 2.2, 3.5, 4.0, 3.3, 3.5, 4.0, 3.3
- **tF (s):**
  - 97, 95, 80, 99, 79, 28, 97, 86
- **p0 queue free %:**
  - 97, 95, 80, 99, 79, 28, 97, 86
- **cM capacity (veh/h):**
  - 1200, 950, 126, 466, 114, 611
- **Direction, Lane #**
  - **Volume Total:**
  - **Volume Left:**
    - EB 1: 33, WB 1: 0, NB 1: 0, EB 2: 43, WB 2: 0, NB 2: 25, SB 1: 83, SB 2: 0
  - **Volume Right:**
    - EB 1: 0, WB 1: 17, NB 1: 0, EB 2: 0, WB 2: 28, NB 2: 0, SB 1: 103, SB 2: 0
  - **cSH:**
    - 1200, 1700, 950, 1700, 126, 466, 114, 611
  - **Volume to Capacity:**
    - 0.03, 0.38, 0.05, 0.21, 0.20, 0.23, 0.72, 0.17
  - **Queue Length 50th (m):**
    - 0.7, 0.0, 1.1, 0.0, 5.6, 6.9, 31.5, 4.9
  - **Control Delay (s):**
    - 8.1, 0.0, 9.0, 0.0, 40.6, 15.0, 93.6, 12.1
  - **Lane LOS:**
    - A, A, E, B, F, B
  - **Approach Delay (s):**
    - 0.4, 1.0, 19.9, 48.1
  - **Approach LOS:**
    - C, E

### Intersection Summary

<p>| Average Delay | 8.8 |
| Intersection Capacity Utilization | 50.8% |
| ICU Level of Service | A |
| Analysis Period (min) | 15 |</p>
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**Direction, Lane #**

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**Intersection Summary**

| Average Delay | 9.4 |
| Intersection Capacity Utilization | 75.9% |
| ICU Level of Service | D |
| Analysis Period (min) | 15 |
| Movement      | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|--------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| **Volume (veh/h)** | 62  | 452 | 24  | 42  | 535 | 31  | 24  | 0   | 40  | 16  | 0   | 37  |     |
| **Sign Control** | Free| Free|     |     |     |     |     |     |     |     |     |     |     |
| **Grade**      | 0%  | 0%  |     |     |     |     |     |     |     |     |     |     |     |
| **Peak Hour Factor** | 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92| 0.92|     |
| **Hourly flow rate (vph)** | 67  | 491 | 26  | 46  | 582 | 34  | 26  | 0   | 43  | 17  | 0   | 40  |     |
| **Pedestrians** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **Lane Width (m)** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **Walking Speed (m/s)** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **Percent Blockage** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **Right turn flare (veh)** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **Median type** | None| None|     |     |     |     |     |     |     |     |     |     |     |
| **Median storage veh)** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **Upstream signal (m)** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **pX, platoon unblocked** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **vC, conflicting volume** | 615 | 517 | 1352| 1346| 504 | 1359| 1342| 598 |     |     |     |     |     |
| **vC1, stage 1 conf vol** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **vC2, stage 2 conf vol** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **vCu, unblocked vol** | 615 | 517 | 1352| 1346| 504 | 1359| 1342| 598 |     |     |     |     |     |
| **tC, single (s)** | 4.1 | 4.1 | 7.2 | 6.5 | 6.3 | 7.1 | 6.5 | 6.2 |     |     |     |     |     |
| **tC, 2 stage (s)** |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **tF (s)** | 2.2 | 2.2 | 3.6 | 4.0 | 3.4 | 3.5 | 4.0 | 3.3 |     |     |     |     |     |
| **p0 queue free %** | 93  | 96  | 75  | 100 | 92  | 84  | 100 | 92  |     |     |     |     |     |
| **cM capacity (veh/h)** | 964 | 1043| 104 | 135 | 556 | 106 | 135 | 502 |     |     |     |     |     |
| **Direction, Lane #** | EB 1| EB 2| WB 1| WB 2| NB 1| NB 2| SB 1|     |     |     |     |     |     |
| **Volume Total** | 67  | 517 | 46  | 615 | 26  | 43  | 58  |     |     |     |     |     |     |
| **Volume Left** | 67  | 0   | 46  | 0   | 26  | 0   | 17  |     |     |     |     |     |     |
| **Volume Right** | 0   | 26  | 0   | 34  | 0   | 43  | 40  |     |     |     |     |     |     |
| **cSH** | 964 | 1700| 1043| 1700| 104 | 556 | 236 |     |     |     |     |     |     |
| **Volume to Capacity** | 0.07| 0.30| 0.04| 0.36| 0.25| 0.08| 0.24|     |     |     |     |     |     |
| **Queue Length 95th (m)** | 1.8 | 0   | 1.1 | 0.0 | 7.3 | 2.0 | 7.4 |     |     |     |     |     |     |
| **Control Delay (s)** | 9.0 | 0   | 8.6 | 0.0 | 50.9| 12.0| 25.1|     |     |     |     |     |     |
| **Lane LOS** | A   | A   | F   | B   | D   |     |     |     |     |     |     |     |     |
| **Approach Delay (s)** | 1.0 | 0.6 | 26.6| 25.1|     |     |     |     |     |     |     |     |     |
| **Approach LOS** | D   |     |     |     |     |     |     |     |     |     |     |     |     |

**Intersection Summary**
- **Average Delay**: 3.1
- **Intersection Capacity Utilization**: 53.3%
- **ICU Level of Service**: A
- **Analysis Period (min)**: 15

---

Delcan
HCM Unsignalized Intersection Capacity Analysis

Synchro 7 - Report
2/4/2013
<table>
<thead>
<tr>
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<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>WBR</th>
<th>NBL</th>
<th>NBT</th>
<th>NBR</th>
<th>SBL</th>
<th>SBT</th>
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<tr>
<td><strong>Volume (veh/h)</strong></td>
<td>114</td>
<td>363</td>
<td>25</td>
<td>87</td>
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<td>105</td>
<td>15</td>
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<td><strong>Sign Control</strong></td>
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<td>0%</td>
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<td>0.92</td>
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<td><strong>Walking Speed (m/s)</strong></td>
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<td>1559</td>
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<td><strong>cM capacity (veh/h)</strong></td>
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<td>1147</td>
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<table>
<thead>
<tr>
<th>Direction, Lane #</th>
<th>EB 1</th>
<th>EB 2</th>
<th>WB 1</th>
<th>WB 2</th>
<th>NB 1</th>
<th>NB 2</th>
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<td><strong>Volume Total</strong></td>
<td>124</td>
<td>423</td>
<td>100</td>
<td>702</td>
<td>17</td>
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<td>0</td>
<td>17</td>
<td>0</td>
<td>64</td>
<td>0</td>
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<td><strong>Volume Right</strong></td>
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<td>114</td>
<td>0</td>
<td>52</td>
<td>0</td>
<td>73</td>
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<td><strong>cSH</strong></td>
<td>841</td>
<td>1700</td>
<td>1147</td>
<td>1700</td>
<td>47</td>
<td>253</td>
<td>45</td>
<td>329</td>
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<td><strong>Volume to Capacity</strong></td>
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<td>0.09</td>
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<td>0.25</td>
<td>2.3</td>
<td>0.0</td>
<td>10.3</td>
<td>7.5</td>
<td>50.0</td>
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<td><strong>Control Delay (s)</strong></td>
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<td>0.0</td>
<td>8.4</td>
<td>0.0</td>
<td>120.6</td>
<td>23.8</td>
<td>428.0</td>
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<td>A</td>
<td>C</td>
<td>C</td>
<td>F</td>
<td>F</td>
<td>C</td>
<td>F</td>
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<td>E</td>
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**Intersection Summary**

- **Average Delay**: 22.0
- **Intersection Capacity Utilization**: 61.1% (ICU Level of Service: B)
- **Analysis Period (min)**: 15
APPENDIX E
# Signalization Warrant

**Parkside Drive and Braehide Avenue**

**Future 2016 Peak Hour**

## 1a Warrant Description

<table>
<thead>
<tr>
<th>Warrant</th>
<th>Description</th>
<th>Flow Rate</th>
<th>Minimum Requirement for 2 Lane Highways</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM VEHICULAR VOLUME</td>
<td>A. Vehicle Volume, All Approaches Per Hour for 8 Hours, and B. Vehicle Volume, Along Minor Streets, Per Hour for Same 8 Hours.</td>
<td>720</td>
<td>800</td>
<td>100%</td>
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<td></td>
<td></td>
<td>170</td>
<td>661</td>
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### 1b Warrant Description

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<th>Flow Rate</th>
<th>Minimum Requirement for 2 Lane Highways</th>
<th>Compliance</th>
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</thead>
<tbody>
<tr>
<td>DELAY TO CROSS TRAFFIC</td>
<td>A. Vehicle Volume, Along Artery, Per Hour for 8 Hours, and B. Combined Vehicle and Pedestrian Traffic Volume Crossing Artery from Minor Streets, Per Hour for Same 8 Hours.</td>
<td>720</td>
<td>800</td>
<td>100%</td>
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<td></td>
<td></td>
<td>75</td>
<td>641</td>
<td>80%</td>
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### 1b Warrant Description

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<th>Minimum Requirement for 2 Lane Highways</th>
<th>Compliance</th>
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<tbody>
<tr>
<td>ACCIDENT HAZARD</td>
<td>A. Total Reported Accidents of Types Susceptible to Correction By a Traffic Signal Within a 12 Month Period, and B. Adequate Trial of Less Restrictive Remedies, Where Satisfactory Observance and Enforcement Have Failed to Reduce the Number of Accidents, and C. Fulfillment of Either of the Above Warrants Minimum Vehicle Volume or Delay to Cross Traffic to the Extent of 80% or More.</td>
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### 2a Warrant Description

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### 2b Warrant Description

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<th>Compliance</th>
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### 3 Comb. Warrant

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<th>Description</th>
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<th>Compliance</th>
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<tbody>
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### 4 Comb. Warrant

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<th>Compliance</th>
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### Signalization Warrant

**Parkside Drive and Duncan Avenue**  
**Future 2016 Peak Hour**

<table>
<thead>
<tr>
<th>1a WARRANT</th>
<th>DESCRIPTION</th>
<th>MINIMUM REQUIREMENT FOR 2 LANE HIGHWAYS</th>
<th>COMPLIANCE</th>
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<td>FLOW RATE</td>
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<tr>
<td>1</td>
<td>MINIMUM VEHICULAR VOLUME</td>
<td>A. VEHICLE VOLUME, ALL APPROACHES PER HOUR FOR 8 HOURS, AND</td>
<td>720</td>
</tr>
<tr>
<td></td>
<td>B. VEHICLE VOLUME, ALONG MINOR STREETS, PER HOUR FOR SAME, 8 HOURS.</td>
<td>170</td>
<td>408</td>
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<tr>
<td>2</td>
<td>DELAY TO CROSS TRAFFIC</td>
<td>A. VEHICLE VOLUME, ALONG ARTERY. PER HOUR FOR 8 HOURS, AND</td>
<td>720</td>
</tr>
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<td></td>
<td>B. COMBINED VEHICLE AND PEDESTRIAN TRAFFIC VOLUME CROSSING ARTERY FROM MINOR STREETS, PER HOUR FOR SAME 8 HOURS.</td>
<td>75</td>
<td>316</td>
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| 1b | MINIMUM VEHICULAR VOLUME | A. VEHICLE VOLUME, ALONG MINOR STREETS, PER HOUR FOR SAME 8 HOURS. | 106 | 188 |

| 3 | ACCIDENT HAZARD | A. TOTAL REPORTED ACCIDENTS OF TYPES SUSCEPTIBLE TO CORRECTION BY A TRAFFIC SIGNAL WITHIN A 12 MONTH PERIOD, AND | No. accidents | Warrant Value | Avg. No. Accidents |
|   |                | 0 | 5 | 0.00 | 0 |

| 2a | ADEQUATE TRIAL OF LESS RESTRICTIVE REMEDIES, WHERE SATISFACTORY OBSERVANCE AND ENFORCEMENT HAVE FAILED TO REDUCE THE NUMBER OF ACCIDENTS, AND | yes OR no | yes | 100 |

| 2b | FULFILLMENT OF EITHER OF THE ABOVE WARRIORS Minimum Vehicular Volume or Delay to Cross Traffic to the Extent of 80% or more | yes OR no | yes | 100 |

| 4 | COMBINATION WARRANT | TWO OR MORE OF ABOVE WARRANTS (NUMBERS 1, 2, 3, OR 4) SATISFIED TO THE EXTENT OF 80% OR MORE. | YES or NO |
### Signalization Warrant

#### Parkside Drive and Hollybush Drive

**Future 2016 Peak Hour**

<table>
<thead>
<tr>
<th>Warrant</th>
<th>Description</th>
<th>Minimum Requirement for 2 Lane Highways</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Minimum Vehicular Volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. Vehicle Volume, All Approaches Per Hour for 8 Hours, and</td>
<td>720</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>B. Vehicle Volume, Along Minor Streets, Per Hour for Same, 8 Hours.</td>
<td>170</td>
<td>628</td>
</tr>
<tr>
<td>1b</td>
<td>Delay to Cross Traffic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. Vehicle Volume, Along Artery, Per Hour for 8 Hours, and</td>
<td>720</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>B. Combined Vehicle and Pedestrian Traffic Volume Crossing Artery From Minor Streets, Per Hour for Same 8 Hours.</td>
<td>75</td>
<td>595</td>
</tr>
<tr>
<td>3</td>
<td>Accident Hazard</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. Total Reported Accidents of Types Susceptible to Correction By a Traffic Signal Within a 12 Month Period, and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Adequate Trial of Less Restrictive Remedies, Where Satisfactory Observance and Enforcement Have Failed to Reduce the Number of Accidents, And</td>
<td>yes or no</td>
<td>yes</td>
</tr>
<tr>
<td>2a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Combination Warrant</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two or More of Above Warrants (Numbers 1, 2, 3, or 4) Satisfied to the Extent of 80% or More.</td>
<td>yes or NO</td>
<td></td>
</tr>
</tbody>
</table>