

Watersand Development Phase 2 North Residential

City of Barrie

Traffic Impact Study for Watersand Construction Ltd.

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John Northcote, P.Eng.
Professional License #: 100124071



ENGINEERING

JD Northcote Engineering Inc.
86 Cumberland Street
Barrie, ON
705.725.4035
www.JDEngineering.ca

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Executive Summary

This report summarizes the traffic impact study prepared for the residential subdivision (referred to in this analysis as the Watersand Development), located generally west of Veteran's Drive in the Salem Secondary Plan Area [SSPA] in the City of Barrie [City]. The report assesses the impact of traffic related to the development on the adjacent roadway and provides recommendations to accommodate this traffic in a safe and efficient manner.

Phase 2 North of the Watersand Development includes the development of 47.9 hectares, including 319 single detached residential units, 117 townhouse units and a mixed use node with 361 residential units. The scope of this study is limited to the low-density residential component (i.e. excluding the mixed-used node) of Phase 2 North of the Watersand Development. A subsequent study will be provided for the mixed use node of Phase 2 South of the Watersand Development.

Phase 2 North of the Watersand Development will include three municipal roads [Streets 1,2 and 3] onto Salem Road. Phase 2 North of the Watersand Development will also include three internal connections to the road network proposed as a part of the H&H Development.

The scope of this analysis includes a review of the following intersections:

- McKay Road West / Reid Drive;
- Salem Road / Street 1;
- Salem Road / Street 2; and
- Salem Road / Street 3.

Conclusions

1. The proposed development is expected to generate a total of 272 AM and 361 PM peak hour trips.
2. Traffic projections for the 2031 and 2041 year for the McKay Road West / Reid Drive intersection were obtained from the Watersand TA and traffic projections for the 2031 and 2041 year for Salem Road adjacent to Street 1, Street 2 and Street 3 were obtained from the EMME travel demand model used in the City TMP.
3. An estimate of the amount of traffic that would be generated by the proposed development was prepared and assigned to the study area streets and intersections.
4. An intersection operation analysis was completed at the McKay Road West / Reid Drive intersection and functional review was completed at the remaining study area intersection, using the total (2031 and 2041) traffic volumes, with the proposed development operational. The following geometric lane improvements and traffic signal improvements are recommended within the study area:

At Opening

McKay Road West

- Reduce the speed limit on McKay Road West to 60 km/h to the west end of the Watersand Development.

Salem Road / Street 1 (east and west intersections)

- Westbound left turn auxiliary lane with a 25 metre storage and 85 metre taper length.

Salem Road / Street 2

- Westbound left turn auxiliary lane with a 25 metre storage and 85 metre taper length.

Salem Road / Street 3

- Westbound left turn auxiliary lane with a 25 metre storage and 85 metre taper length.

5. It is recommended that McKay Road West is monitored closer to the 2041 horizon year to determine if further improvements on McKay Road West are required.
6. It is recommended that active transportation infrastructure is prioritized within the Salem Secondary Plan Area.
7. In summary, the residential component of Phase 2 North of the Watersand Development will not cause any operational issues and will not add a notable delay or congestion to the local roadway network.

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1 Introduction

1.1 Background

Watersand Construction Ltd. [The Developer] is proposing to develop a 119 hectare property (referred to in this analysis as the Watersand Development), located generally west of Veteran's Drive in the Salem Secondary Plan Area [SSPA] in the City of Barrie [City].

Phase 2 North of the Watersand Development includes the development of 47.9 hectares, including 319 single detached residential units, 117 townhouse units and a mixed use node with 361 residential units.

Phase 2 North of the Watersand Development will include three municipal roads [Streets 1¹, 2 and 3] onto Salem Road. Phase 2 North of the Watersand Development will also include three internal connections to the road network proposed as a part of the H&H Development.

The City has indicated that they would prefer to have right-in-right-out [RIRO] access restrictions on all future local roads along Salem Road.

The Developer has retained **JD Northcote Engineering Inc.** [JD Engineering] to prepare this traffic impact study in support of Phase 2 North of the Watersand development.

1.2 Study Area

Figure 1 shows the location of the proposed development and study area intersections, in relation to the surrounding area. The Draft Plan of Subdivision by KLM Planning Partners Inc. is provided in **Appendix A**.

Phase 2 North of the Watersand Development is bound by Essa Road and additional lands to be redeveloped as a part of the SSPA to the west, Salem Road to the north and additional lands to be redeveloped as a part of the SSPA to the south and east.

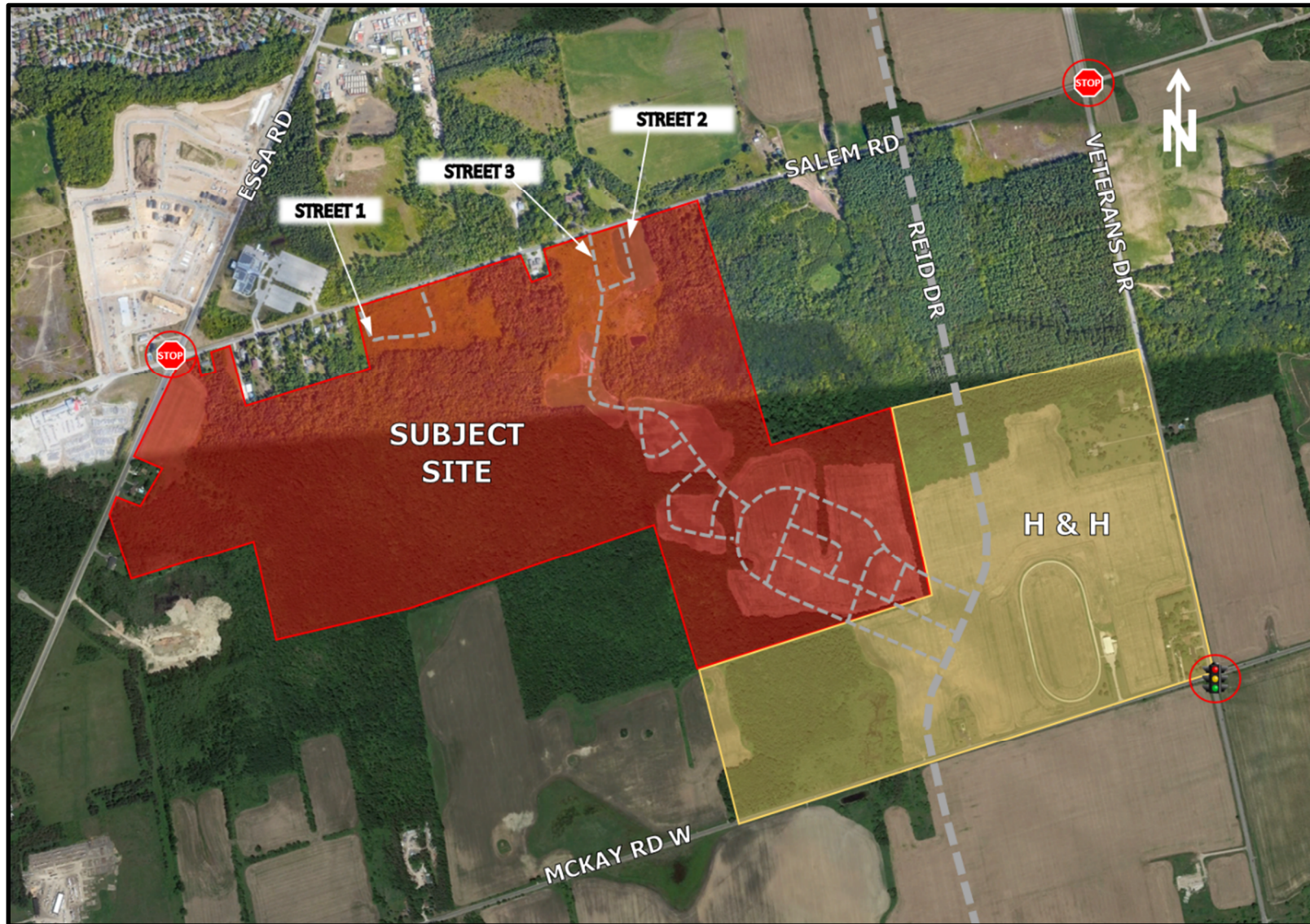
The following intersections will be analysed as part of the study:

- McKay Road West / Reid Drive;
- Salem Road / Street 1 (functional review only);
- Salem Road / Street 2 (functional review only); and
- Salem Road / Street 3 (functional review only).

The scope of this study is limited to the low-density residential component (i.e. excluding the mixed-used node) of Phase 2 North of the Watersand Development. A subsequent study will be provided for the mixed use node of Phase 2 South of the Watersand Development.

¹ Street 1 includes two connections onto Salem Road; however, for the purpose of this study and in order to be conservative, we have analyzed Street 1 with only one connection onto Salem Road.

Figure 1 – Proposed Site Location and Study Area



1.3 Study Scope and Objectives

The purpose of this study is to identify the potential impacts to traffic flow at the site access and on the surrounding roadway network. The study analysis includes the following tasks:

- Consult with the City to address any traffic-related issues or concerns they have with the proposed development;
- Estimate future traffic volumes if the proposed development was not constructed, including the impact of additional proposed developments in the area;
- Estimate the amount of traffic that would be generated by the proposed development and assign to the roadway network;
- Complete LOS analysis of horizon year (with the proposed development) traffic conditions and identify additional operational deficiencies;
- Identify improvement options to address operational deficiencies; and
- Document findings and recommendations in a final report.

1.4 Horizon Year and Analysis Periods

Traffic scenarios for the planning horizon years (2031 and 2041) were selected for analysis of traffic operations in the study area. The weekday morning [AM] and weekday afternoon [PM] peak hours have been selected as the analysis periods for this study.

2 Information Gathering

2.1 Street and Intersection Characteristics

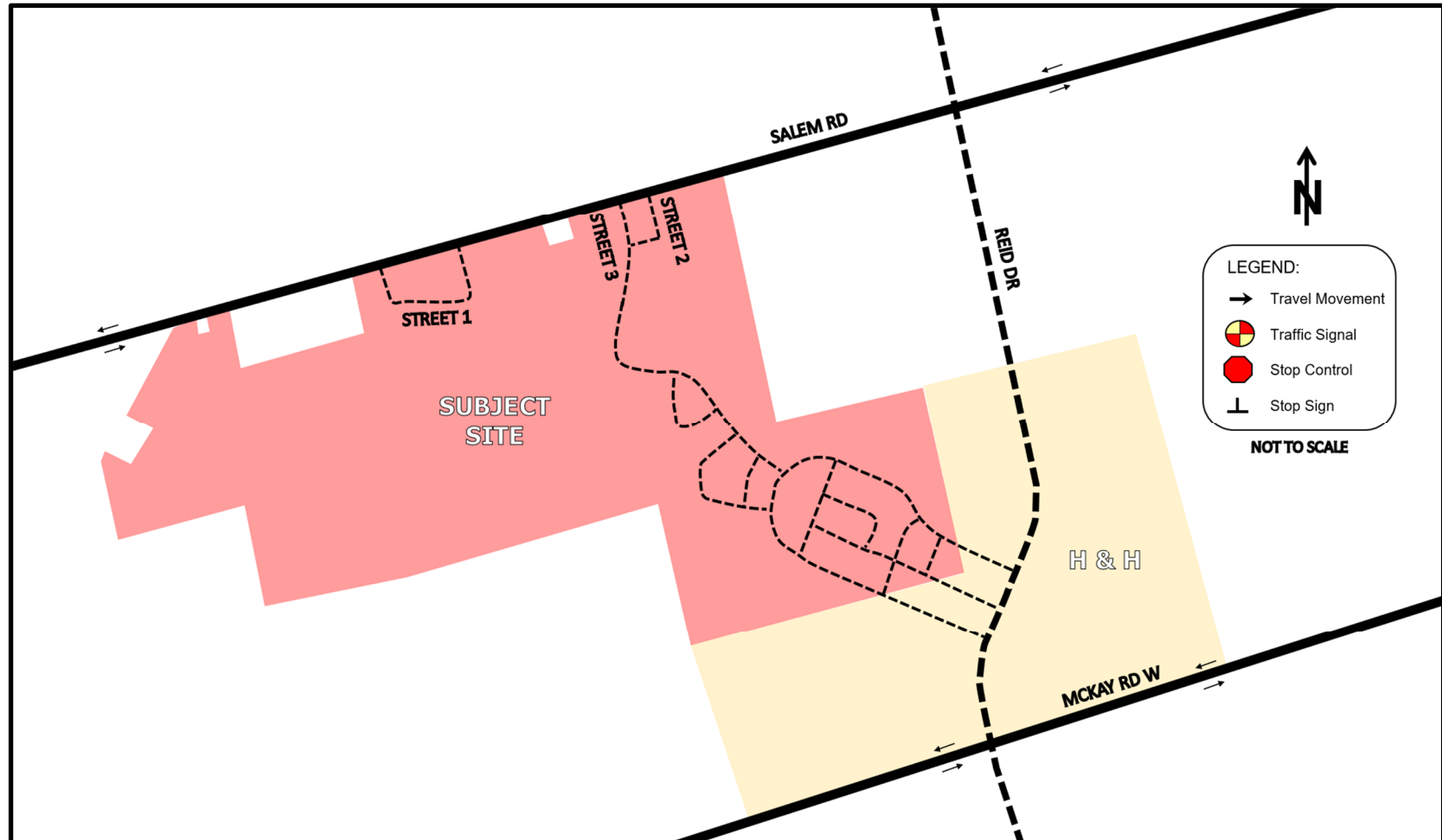
McKay Road West is a two-lane arterial road with a rural cross section and no sidewalks. McKay Road West has a posted speed limit of 80km/h² and is under the jurisdiction of the City within the study area.

Salem Road is a two-lane arterial road with a rural cross section and no sidewalks. Salem Road has a posted speed limit of 80km/h and is under the jurisdiction of the City within the study area.

The existing lane configuration within the study area is illustrated in **Figure 2**.

² Based on our correspondence with the City, it is our understanding that the speed limit on McKay Road West will be reduced to 60km/h as development occurs within the study area.

Figure 2 – Existing Lane Configuration within Study Area



2.2 Local Transportation Infrastructure Improvements

Based on a review of the City's Transportation Master Plan [TMP] and the conclusions and recommendations from the traffic analysis in support of the Watersand Development (dated March 7, 2018) and traffic analysis addendums (dated February 15th, 2019 and September 3rd, 2022) [collectively, Watersand TA] as prepared by JD Engineering, the following infrastructure improvements are anticipated to be completed within the study area:

- McKay Road West (within the study area)
 - o Widening of road to a 3-lane cross section (by 2031)
 - o Widening of road to a 5-lane cross section (by 2041)
 - o Construction of the McKay Road West / Reid Drive intersection including signalization. Lane configuration in all directions anticipated to include one through-right turn lane and an auxiliary left turn lane at time of construction. (by 2031)
- Salem Road
 - o Widening of road to a 3-lane cross section (by 2031)

The future lane configuration within the study area is illustrated in **Figure 3 and 4**.

Figure 3 – Future Lane Configuration within Study Area (2031)

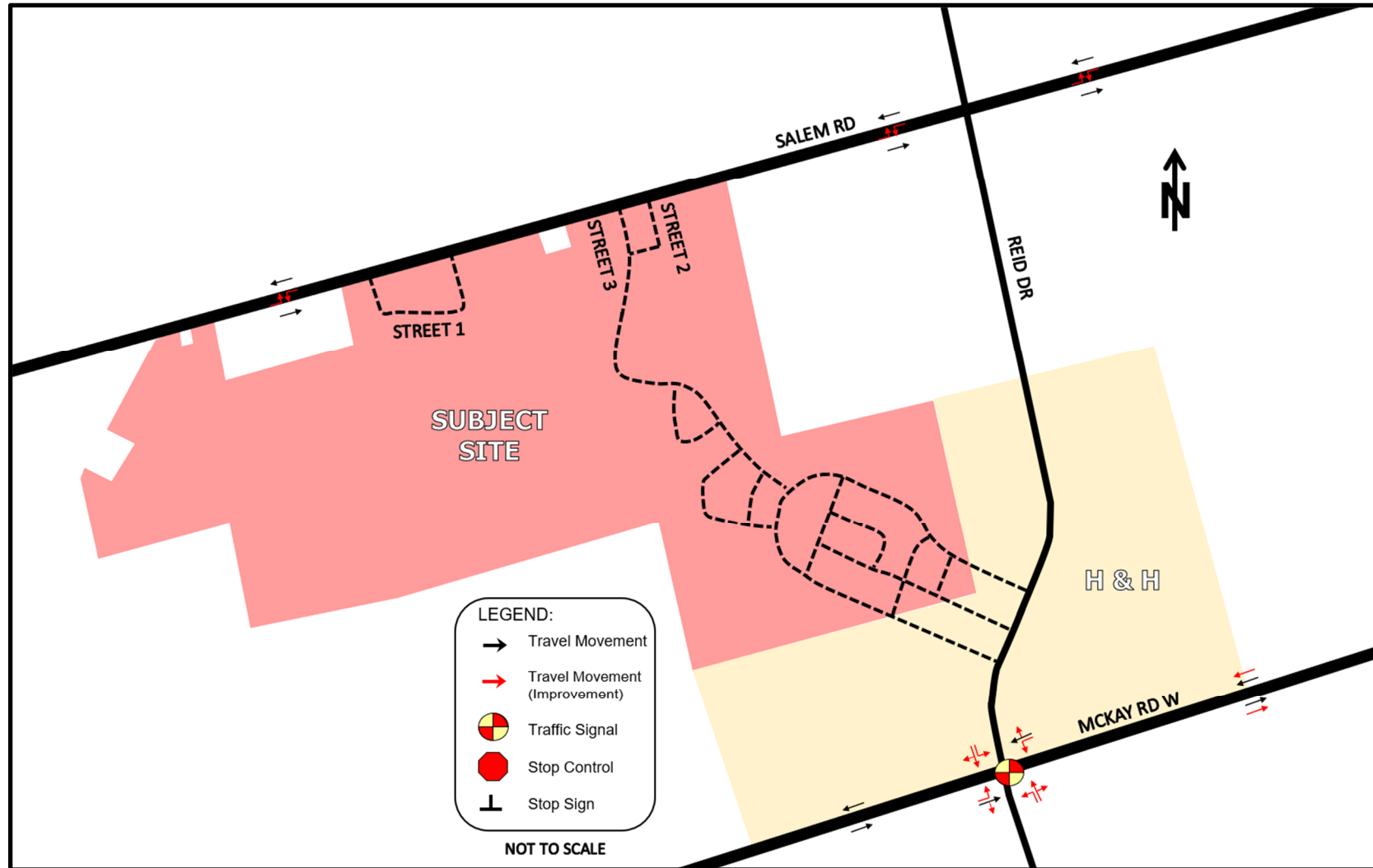
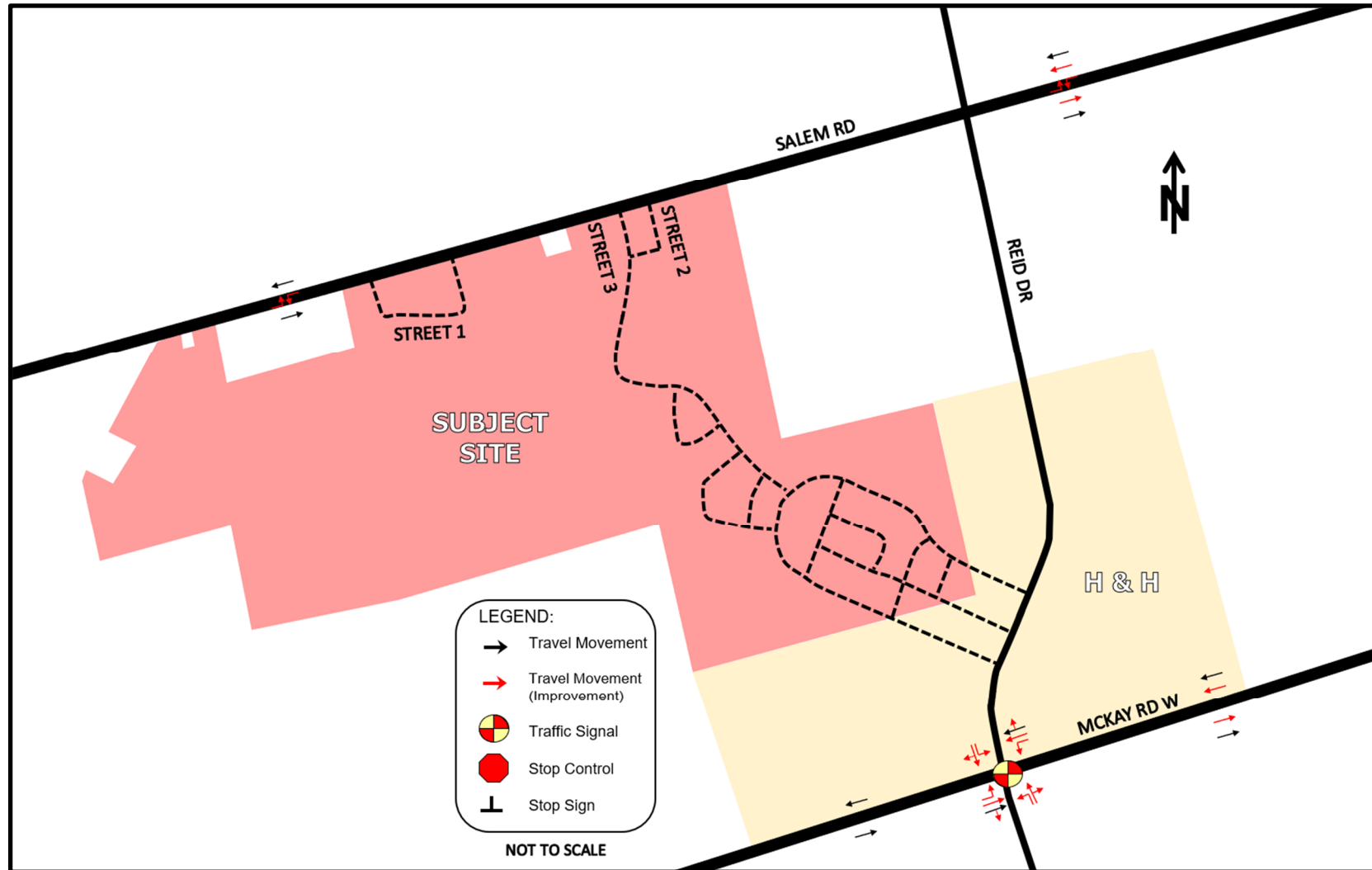


Figure 4 – Future Lane Configuration within Study Area (2041)



2.3 Transit Access

There is currently no municipal transit service within the study area; however, the City's TMP identifies one bus route adjacent to the proposed development on the future Reid Drive prior to the 2041 horizon year, which would service the proposed development and provide branching service throughout the City.

2.4 Horizon Year Traffic Volumes

The background (2031 and 2041) traffic volumes at McKay Road West / Reid Drive intersection have been estimated based on the Watersand TA (excerpts provided in **Appendix B**). It is noted that these traffic volumes include the development of all units within Phase 1 of the SSPA, per the forecasted Unit Projections' table issued on May 11, 2020 by KLM Planning Partners Inc. While it is anticipated that there may be some variation in the current unit count compared to the unit count at the time of the Watersand TA (May 11, 2020), the Watersand TA is based on a conservative assumption that all units in Phase 1 of the SSPA will be occupied by 2031. Based on our review, this conservative assumption would offset any minor increase in the unit count for the developments that will be occupied by 2031.

The background (2031 and the 2041) traffic volumes on Salem Road adjacent to Street 1, Street 2 and Street 3 were obtained from the EMME travel demand model used in the City TMP. The future traffic projections from the EMME model were utilized as the Watersand TA did not estimate traffic volumes on Salem Road for the 2031 and 2041 horizon years. The EMME travel demand model provides the best estimate of the long term traffic growth and distribution patterns on Salem Road, as they account for the impact of the planned infrastructure improvements and future development in and around the City.

Figures 5 and 6 illustrate the background (2031 and 2041) horizon year AM and PM peak hour traffic volumes in the study area.

3 Proposed Development Traffic Generation and Assignment

3.1 Traffic Generation

The traffic generation for the proposed development has been based on the Institute of Transportation Engineers [ITE] *Trip Generation Manual* (11th Edition) [ITE Trip Generation Manual]. The following ITE land uses have been applied to estimate the traffic from the proposed development:

- ITE land use 210 (Single-Family Detached Housing) – General Urban / Suburban Setting; and
- ITE land use 220 (Multifamily Housing (Low-Rise)) – General Urban / Suburban Setting.

The estimated trip generation of the proposed development is illustrated below in **Table 1**. The AM and PM peak traffic generation for the proposed development is not expected to exactly align with the AM and PM peak hour in the traffic data; consequently, we have applied the peak hour of adjacent street traffic values provided in the ITE Trip Generation Manual.

Table 1 – Estimated Traffic Generation of Proposed Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Single-Family Detached Housing ITE Land Use: 210	319 units	58	167	225	189	112	301
Multifamily Housing (Low-Rise) ITE Land Use: 220	117 units	11	36	47	38	22	60
TOTAL TRIP GENERATION		69	203	272	227	134	361

No transportation modal split has been applied to the above-noted traffic generation calculation.

3.2 Traffic Assignment

For the purposes of this study, it has been assumed that all traffic generated by proposed development will be new traffic and would not be in the study area if the development was not constructed.

In Section 3.1, the anticipated percentage of new traffic entering and exiting during the peak hour was established. The distribution of traffic entering at each access location is based on our review of the internal road network, in conjunction with the external traffic distribution. Two different distributions have been calculated for the proposed development; one for units on the north end of Phase 2 North of the Watersand development that will primarily use Salem Road to connect to the external road network and one for units on the south end of Phase 2 North of the Watersand development that will primarily use McKay Drive West via Reid Drive to connect into the external road network.

The distribution of traffic for units on the north side of Phase 2 North the Watersand Development is based on the City's EMME travel demand model and the distribution of traffic for units on the south side of Phase 2 North the Watersand Development is based on the traffic distribution calculated in the Watersand TA, illustrated in **Tables 2 and 3**.

Table 2 – Proposed Development Traffic Distribution (North Side) – via Salem Road

Travel Direction (to / from)	AM Peak Hour		PM Peak Hour	
	Ingress	Egress	Ingress	Egress
East via Salem Road	40%	60%	55%	45%
West via Salem Road	60%	40%	45%	55%
TOTAL	100%	100%	100%	100%

Table 3 – Proposed Development Traffic Distribution (South Side) – via McKay Road West

Travel Direction (to / from)	Percentage of Total Traffic Generation
East via McKay Road West	90%
West via McKay Road West	10%
TOTAL	100%

Using the traffic distributions pattern noted above, the traffic assignment for the proposed development was calculated for the AM and PM peak hour and is illustrated in **Figure 7**.

3.3 Total Horizon Year Traffic Volumes with the Proposed Development

For the total (2031 and 2041) horizon year traffic volumes, the proposed development traffic was added to the background (2031 and 2041) traffic volumes. The resulting total (2031 and 2041) horizon year traffic volumes for the AM and PM peak hour are illustrated in **Figures 8 and 9**.

4 Intersection Operation with Proposed Development

4.1 Introduction

Traffic operations within the study area were evaluated with the future road configuration and traffic control. The intersection performance was measured using the traffic analysis software, Synchro 11, a deterministic model that employs Highway Capacity Manual and Intersection Capacity Utilization methodologies for analyzing intersection operations. These procedures are accepted by provincial and municipal agencies throughout North America.

Synchro 11 enables the study area to be graphically defined in terms of streets and intersections, along with their geometric and traffic control characteristics. The user is able to evaluate both signalized and unsignalized intersections in relation to each other, thus not only providing level of service for the individual intersections, but also enabling an assessment of the impact the various intersections in a network have on each other in terms of spacing, traffic congestion, delay, and queuing.

4.2 Intersection Capacity Analysis Criteria

Individual turning movements with a volume-to-capacity [V/C] ratio of 0.85 or greater are considered to be critical movements and have been highlighted in the LOS tables.

The intersection operations were also evaluated in terms of the LOS. LOS is a common measure of the quality of performance at an intersection and is defined in terms of vehicular delay. This delay includes deceleration delay, queue move-up time, stopped delay, and acceleration delay. LOS is expressed on a scale of A through F, where LOS A represents very little delay (i.e. less than 10 seconds per vehicle) and LOS F represents very high delay (i.e. greater than 50 seconds per vehicle for a stop sign controlled intersection and greater than 80 seconds per vehicle for a signalized intersection).

The LOS criteria for signalized and stop sign controlled intersections are shown in **Table 4**. A description of traffic performance characteristics is included for each LOS.

Table 4 – Level of Service Criteria for Intersections

LOS	LOS Description	Control Delay (seconds per vehicle)	
		Signalized Intersections	Stop Controlled Intersections
A	Very low delay; most vehicles do not stop (Excellent)	less than 10.0	less than 10.0
B	Higher delay; more vehicles stop (Very Good)	between 10.0 and 20.0	between 10.0 and 15.0
C	Higher level of congestion; number of vehicles stopping is significant, although many still pass through intersection without stopping (Good)	between 20.0 and 35.0	between 15.0 and 25.0
D	Congestion becomes noticeable; vehicles must sometimes wait through more than one red light; many vehicles stop (Satisfactory)	between 35.0 and 55.0	between 25.0 and 35.0
E	Vehicles must often wait through more than one red light; considered by many agencies to be the limit of acceptable delay	between 55.0 and 80.0	between 35.0 and 50.0
F	This level is considered to be unacceptable to most drivers; occurs when arrival flow rates exceed the capacity of the intersection (Unacceptable)	greater than 80.0	greater than 50.0

4.3 Total (2031) Intersection Operation

The results of the LOS analysis under total (2031) traffic volumes during the AM and PM peak hour can be found below in **Table 5**. The anticipated future intersection geometry and traffic control identified in Section 2.2 has been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix C**.

Table 5 – Total (2031) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95% Queue (m)		V/C	Delay (s)	LOS	95% Queue (m)	
				Storage	Model				Storage	Model
Reid Road / McKay Road West (signalized)	0.91	31.8	C	-	-	0.96	32.2	C	-	-
EBL	0.03	9.8	A	15	4	0.45	16.7	B	15	19
EBTR	0.94	35.0	C	-	204	0.80	22.2	C	-	162
WBL	0.33	14.2	B	25	7	0.67	16.7	B	25	28
WBTR	0.44	8.2	A	-	52	1.00	41.3	D	-	271
NBL	0.15	23.7	C	25	15	0.37	30.5	C	25	30
NBTR	0.07	22.7	C	-	13	0.09	25.8	C	-	13
SBL	0.97	74.1	E	45	96	0.68	41.8	D	45	57
SBTR	0.02	22.2	C	-	-	0.01	25.0	C	-	-

The results of the LOS analysis indicate that the Reid Road / McKay Road West intersection is operating outside the design limits outlined in Section 4.2 during the AM and PM peak hours; however, no improvements are recommended as the intersection is operating within the theoretical capacity and due to the anticipated McKay West Road widening to a five-lane cross-section as outlined in Section 2.2.

The anticipated 95th percentile queue length for the westbound left, northbound left and southbound left turn movements at the Reid Drive / McKay Road West intersections exceed the existing storage

lengths; however, no improvements are recommended as the turning movements are accommodated within the proposed taper lengths and due to the anticipated McKay West Road widening to a five-lane cross-section as outlined in Section 2.2. The anticipated 95th percentile queue length for the eastbound and westbound through movements at the Reid Drive / McKay Road West intersection exceed the existing storage length for the associated left turn movement; however, no improvements are recommended due to the anticipated McKay West Road widening to a five-lane cross-section as outlined in Section 2.2. The anticipated 95th percentile queues for all other turning movements can be accommodated by the proposed auxiliary lane storage lengths.

The results of the Synchro analysis indicate that there is excess capacity for all other movements; consequently, an auxiliary right turn lane is not recommended.

It is recommended that the speed limit on McKay Road West is reduced from 80km/h to 60 km/h across the frontage of the subject site, prior to occupancy in Phase 2 North of the Watersand Development.

No additional infrastructure improvements are recommended within the study area.

4.4 Total (2041) Intersection Operation

The results of the LOS analysis under total (2041) traffic volumes during the AM and PM peak hour can be found below in **Table 6**. The anticipated future intersection geometry and traffic control identified in Section 2.2 has been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix C**.

Table 6 – Total (2041) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95% Queue (m)		V/C	Delay (s)	LOS	95% Queue (m)	
				Storage	Model				Storage	Model
Reid Road / McKay Road West (signalized)	0.83	24.4	C	-	-	0.79	22.9	C	-	-
EBL	0.06	13.6	B	15	5	0.51	23.4	C	15	22
EBTR	0.91	29.8	C	-	141	0.85	28.1	C	-	114
WBL	0.31	13.7	B	25	10	0.68	18.4	B	25	37
WBTR	0.39	10.7	B	-	40	0.87	19.9	B	-	134
NBL	0.11	18.2	B	25	13	0.26	21.5	C	25	27
NBTR	0.07	17.7	B	-	11	0.07	19.1	B	-	12
SBL	0.82	40.0	D	45	93	0.55	27.4	C	45	52
SBTR	0.03	17.3	B	-	-	0.02	18.6	B	-	-

The results of the LOS analysis indicate that the V/C ratio for the eastbound and westbound through movements at the Reid Drive / McKay Road West intersection is operating marginally outside the typical design limits noted in Section 4.2; however, no improvements are recommended as the intersection is operating within the theoretical capacity. It is recommended that McKay Road West is monitored closer to the horizon year to determine if further improvements are required.

The anticipated 95th percentile queue length for the westbound left and northbound left turn movements at the Reid Drive / McKay Road West intersections exceed the existing storage lengths; however, no improvements are recommended as the turning movements are accommodated within the proposed taper lengths.

The anticipated 95th percentile queue length for the eastbound and westbound through movements at the Reid Drive / McKay Road West intersection exceed the existing storage length for the associated

left turn movement. It is recommended that the City continue to prioritize active transportation infrastructure within the study area to manage transportation demands, rather than providing additional road widening.

The anticipated 95th percentile queue length for the southbound left turn movement at the Reid Drive / McKay Road West intersection also exceeds the existing storage length; however, no further improvements are recommended as the storage and taper length is restricted by the east-west local road north of McKay Road West.

The anticipated 95th percentile queues for all other turning movements can be accommodated by the proposed auxiliary lane storage lengths.

The results of the Synchro analysis indicate that there is excess capacity for all other movements; consequently, an auxiliary right turn lane is not recommended.

No additional infrastructure improvements are recommended within the study area.

4.5 Traffic Impact Analysis – Salem Road Intersections

Based on our review of the projected volume of traffic at the Salem Road / Street 1, Salem Road / Street 2 and Salem Road / Street 3 intersections, it is anticipated that there will be sufficient capacity in the road network to accommodate the traffic generated by the proposed development. No improvements are recommended within the study area as a result of the proposed development.

Based on the Ontario Traffic Manual Book 12 *Signal Justification*, traffic signals are not warranted at the Street 1 / Salem Road, Street 2 / Salem Road and Street 3 / Salem Road intersections (results are provided in **Appendix D**).

An analysis with left-ins permitted at local roads has been completed in Section 5.

4.6 Construction Parking

Based on our correspondence with the Developer, the Developer is committed to the following arrangement for construction parking:

The parking of construction vehicles and vehicles owned by staff and subcontractors employed by the Developer will be formally directed (in writing where possible) to avoid parking on municipal streets surrounding the subject site and avoid parking within private parking lots surrounding the subject site, without consent from the owner of the parking lots.

5 Supplemental Analysis – Site Accesses Left-In Permitted

The City has requested all future local roads (including Street 1, Street 2 and Street 3) to be limited to RIRO on Salem Road. This supplemental analysis has been provided to assess the impact of permitting left-in [LI] movements from Salem Road onto Street 1, 2 and 3.

5.1 Total (2041) Traffic Volumes – LI Permitted

5.1.1 Proposed Development Traffic Assignment – LI Permitted

The overall traffic distribution calculated in Section 3.2 will remain unchanged with the LI movements permitted at local roads; however, the distribution of traffic entering at each access location changes.

Using the traffic distribution patterns outlined in Section 3.2, the site traffic assignment for the subject site was recalculated for the AM and PM peak hour with LI movements permitted at Street 1, Street 2 and Street 3 on Salem Road and is illustrated in **Figure 10**.

5.1.2 Total (2041) Traffic Volumes – LI Permitted

For the total (2041) horizon year traffic volumes with LI movements permitted at the at the Salem Road / Street 1, Salem Road / Street 2 and Salem Road / Street 3 intersections, the proposed development traffic with LI movements permitted at Street 1, 2 and 3 were added to the background (2041) traffic volumes. The resulting total (2041) horizon year traffic volumes with LI movements permitted at Street 1, 2 and 3 for the AM and PM peak hour is illustrated in **Figure 11**.

5.2 Total (2041) Intersection Operation – LI Permitted

Based on our review of the projected volume of traffic at the Salem Road / Street 1, Salem Road / Street 2 and Salem Road / Street 3 intersections with left ins permitted, there is a notable redistribution of traffic; however, the impact on intersection operation is anticipated to be generally negligible. No improvements are recommended within the study area as a result of the proposed development. Based on this review, we recommend the City permit left-in movements on Salem Road at Street 1, 2 and 3.

An analysis was completed for left turn movements at the Street 1 / Salem Road, Street 2 / Salem Road and Street 3 / Salem Road intersections, based on the criteria outlined in Appendix 9A of the Ontario Ministry of Transportation Design Supplement for TAC Geometric Design Guide for Canadian Roads June 2017 [MTO DS]. According to the above-noted criteria a left turn lane is warranted at all intersections (results are provided in **Appendix E**). A 25 metre storage and 85 metre taper length is recommended for the westbound left turn movements at the Street 1 / Salem Road (east and west intersections), Street 2 / Salem Road and Street 3 / Salem Road intersections.

6 Transportation Demand Management

The study area has and will continue to experience a significant transformation with respect to land-use and transportation. A number of infrastructure initiatives currently in the design, planning or concept phase, will help to address the transportation capacity challenges in the area. However, the construction of new roads will not be enough to accommodate the projected future travel demand. The following section provides additional existing and planned techniques incorporated in the design for the subject site which will help to address the transportation demand in the study area.

6.1 Transit Network

The subject site is not adjacent to any existing Barrie Transit bus routes; however, the subject site is adjacent to a future Barrie Transit bus route (proposed route on the future Reid Drive) as identified in the City TMP. The above noted future bus route is anticipated to connect into the City's downtown bus terminal. It is recommended that the City implement the future transit route as close to occupancy of the proposed development as is feasible, to provide transit service within the study area.

6.2 Pedestrian and Cycling Network

According to the City's TMP, the existing cycling network in the City includes approximately 70 kilometers of bike lanes, 80 kilometers of Buffered bike lanes, 45 kilometers of cycling tracks and 36 kilometers of In-boulevard pathways. While there is no existing direct cycling infrastructure on McKay Road West and Salem Road at this time, the proposed cycling network in the City's TMP and SSPA development plans include bicycle infrastructure along McKay Road West, Salem Road and Reid Drive which will connect into the City's planned cycling network.

There is also no existing sidewalk infrastructure within the study area; however, based on the city TMP, the City proposes approximately 143 kilometers of sidewalk network. The City's TMP and SSPA development plans propose a sidewalk on McKay Road West and Salem Road. All proposed local roads within the Watersand Development will also include sidewalk, which will provide access into the City's existing and planned sidewalk network.

Furthermore, a variety of additional active transportation infrastructure is proposed within the City's TMP, including:

- Proposed additional 485 kilometers of active transportation infrastructure within the City;
- A direct, connected and continuous network of different active transportation options to be established that accommodates safe walking, cycling, hiking and other active modes of transportation;
- Provide and prioritize connections to key destinations within the City and to public transit;
- Enhance opportunities for people to walk and bike for short trips;
- Allocate an appropriate annual maintenance budget to monitoring and maintain pedestrian and cycling facilities once they have been constructed;
- Establish a winter maintained network consisting of spine routes in order for walking and cycling to be viable modes of transportation year-round; and
- Developing and implementing programs aimed at encouraging and promoting a culture of active transportation.

6.3 Local Development

The following is a list of transportation demand management techniques that are recommended for the proposed development:

- \$25 transit pass for the first owner of each residential unit, to encourage transit use among residents; and
- Preparation and distribution of transit information packages to new residents, including bicycle maps, local transit map/schedule, information on transit incentives and any other relevant information related to active transportation, at time of distribution.

7 Summary

Watersand Construction Ltd. retained **JD Engineering** to prepare this traffic impact study in support of the residential component of Phase 2 North of the Watersand Development located generally west of Veteran's Drive in the Salem Secondary Plan Area [SSPA] in the City of Barrie [City]. The proposed Draft Plan of Subdivision is shown in **Appendix A**. This chapter summarizes the conclusions and recommendations from the study.

Phase 2 North of the Watersand Development includes the development of 47.9 hectares, including 319 single detached residential units, 117 townhouse units and a mixed use node with 361 residential units. The scope of this study is limited to the low-density residential component (i.e. excluding the mixed-used node) of Phase 2 North of the Watersand Development.

1. The proposed development is expected to generate a total of 272 AM and 361 PM peak hour trips.
2. Traffic projections for the 2031 and 2041 year for the McKay Road West / Reid Drive intersection were obtained from the Watersand TA and traffic projections for the 2031 and 2041 year for Salem Road adjacent to Street 1, Street 2 and Street 3 were obtained from the EMM travel demand model used in the City TMP.
3. An estimate of the amount of traffic that would be generated by the proposed development was prepared and assigned to the study area streets and intersections.
4. An intersection operation analysis was completed at the McKay Road West / Reid Drive intersection and functional review was completed at the remaining study area intersection, using the total (2031 and 2041) traffic volumes, with the proposed development operational. The following geometric lane improvements and traffic signal improvements are recommended within the study area:

At Opening

McKay Road West

- Reduce the speed limit on McKay Road West to 60 km/h to the west end of the Watersand Development.

Salem Road / Street 1 (east and west intersections)

- Westbound left turn auxiliary lane with a 25 metre storage and 85 metre taper length.

Salem Road / Street 2

- Westbound left turn auxiliary lane with a 25 metre storage and 85 metre taper length.

Salem Road / Street 3

- Westbound left turn auxiliary lane with a 25 metre storage and 85 metre taper length.

5. It is recommended that McKay Road West is monitored closer to the 2041 horizon year to determine if further improvements on McKay Road West are required.
6. It is recommended that active transportation infrastructure is prioritized within the Salem Secondary Plan Area.
7. In summary, the residential component of Phase 2 South of the Watersand Development will not cause any operational issues and will not add a notable delay or congestion to the local roadway network.

Figure 5 – Background (2031) Traffic Volumes

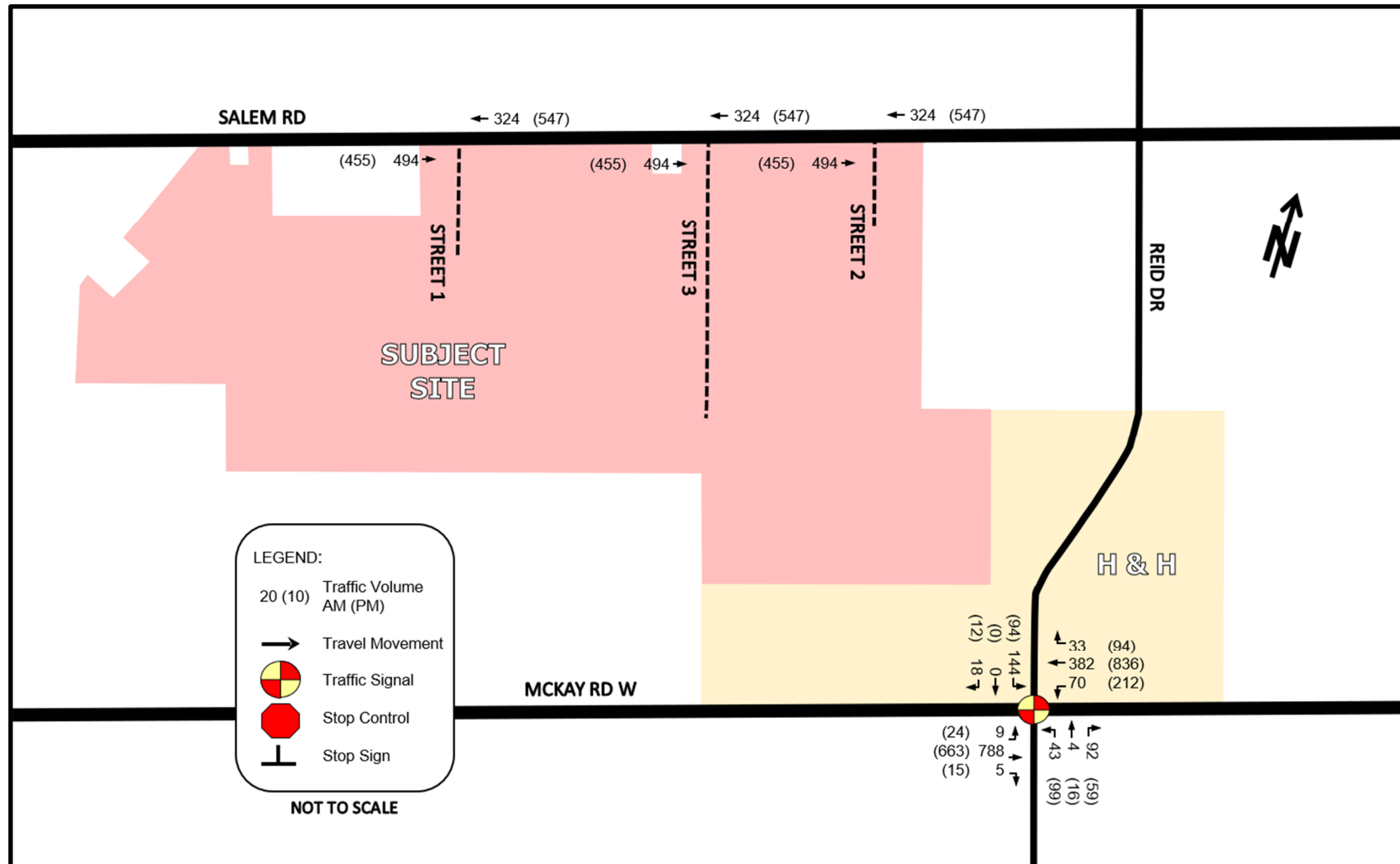


Figure 6 – Background (2041) Traffic Volumes

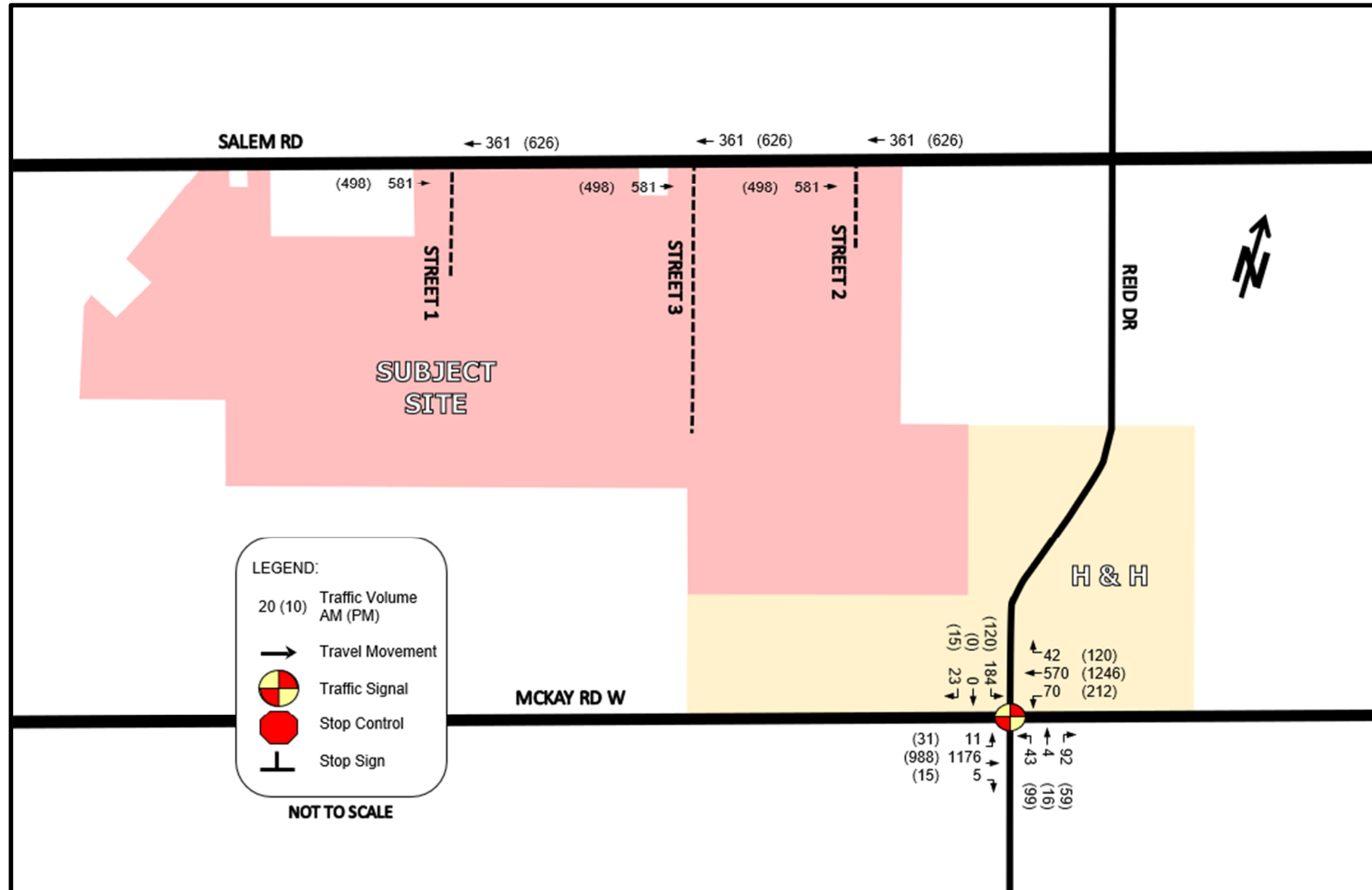


Figure 7 – Proposed Development Traffic Assignment

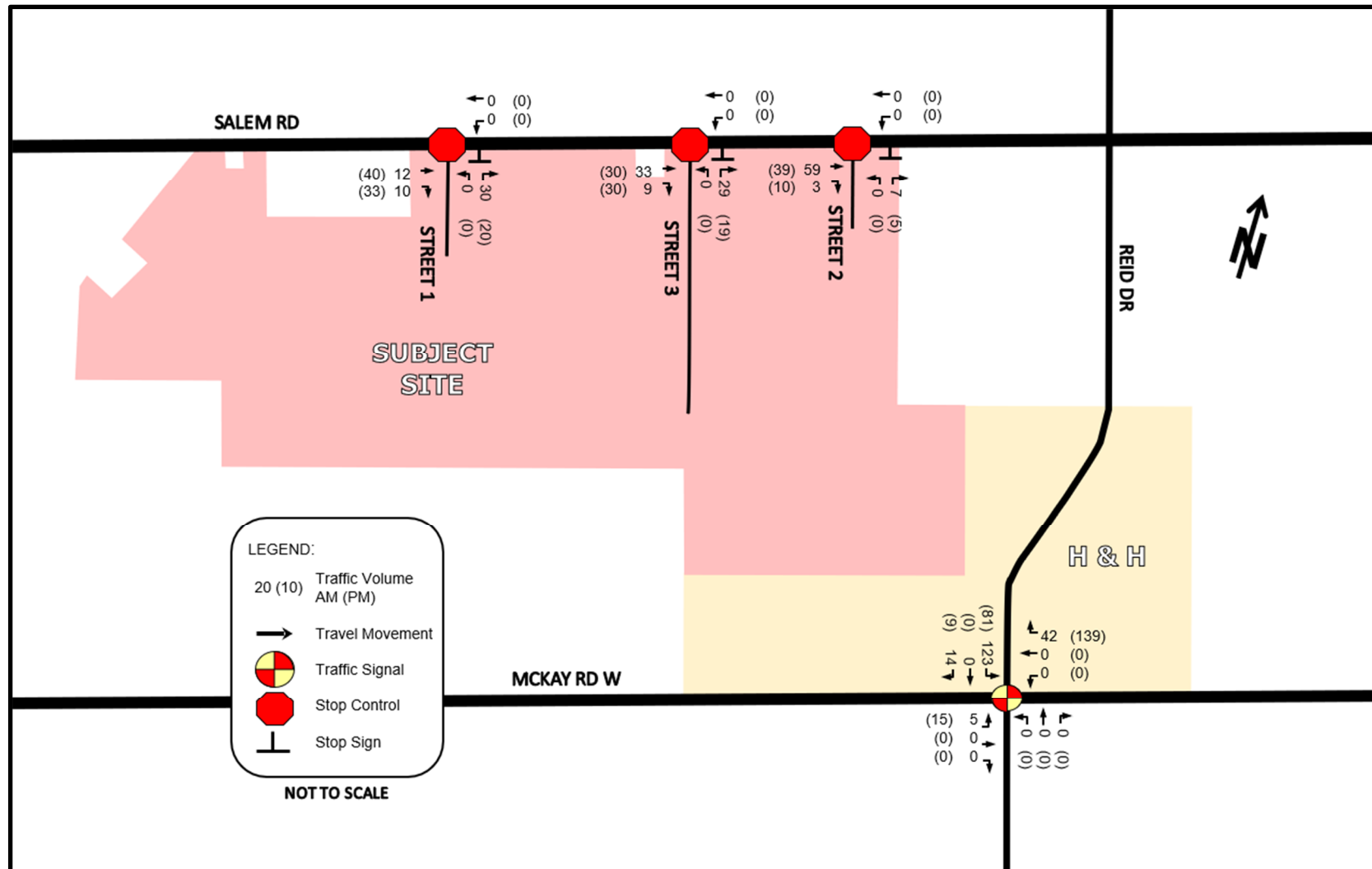


Figure 8 – Total (2031) Traffic Volumes

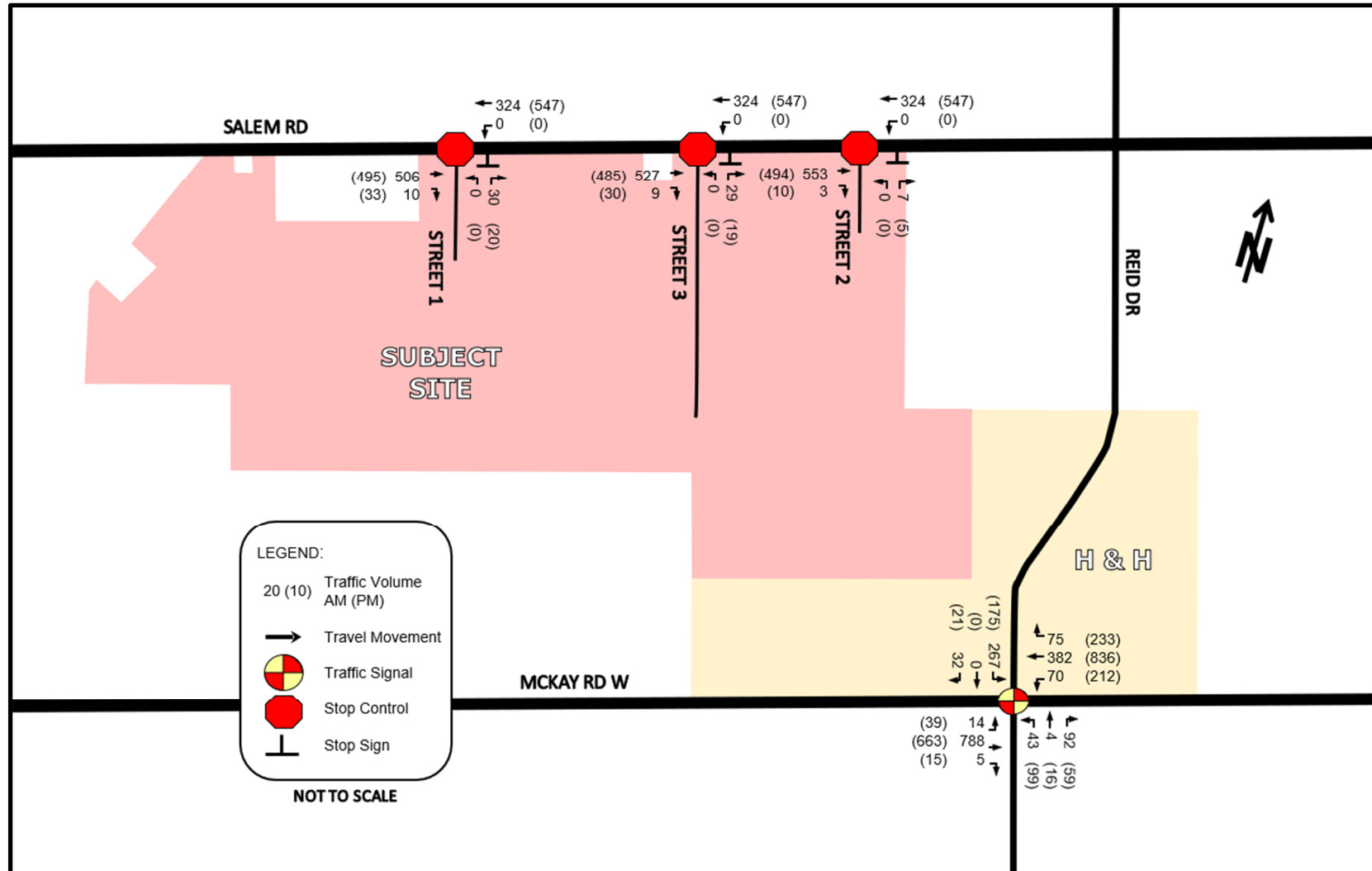


Figure 9 – Total (2041) Traffic Volumes

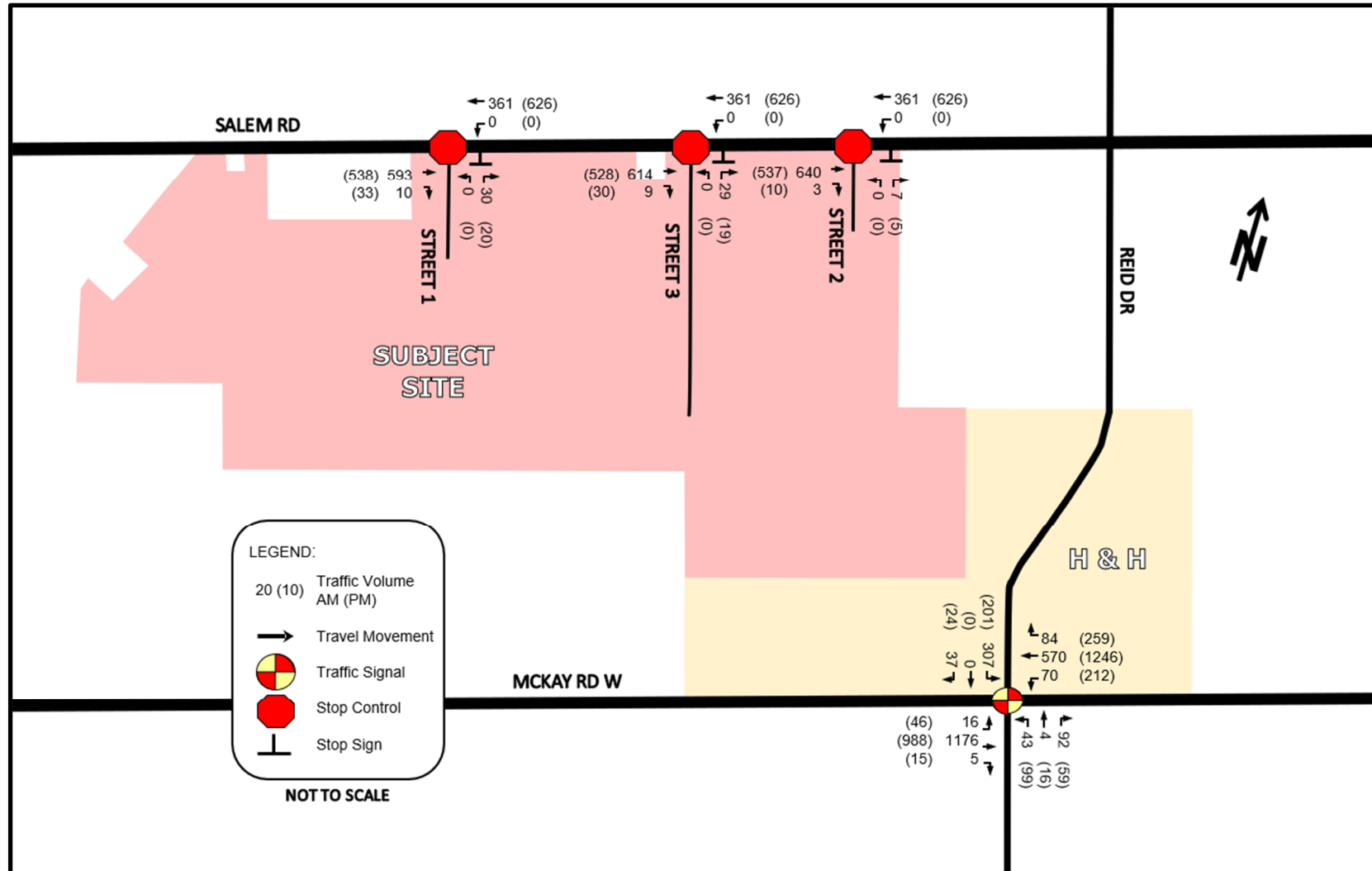


Figure 10 – Proposed Development Traffic Assignment – LI Permitted

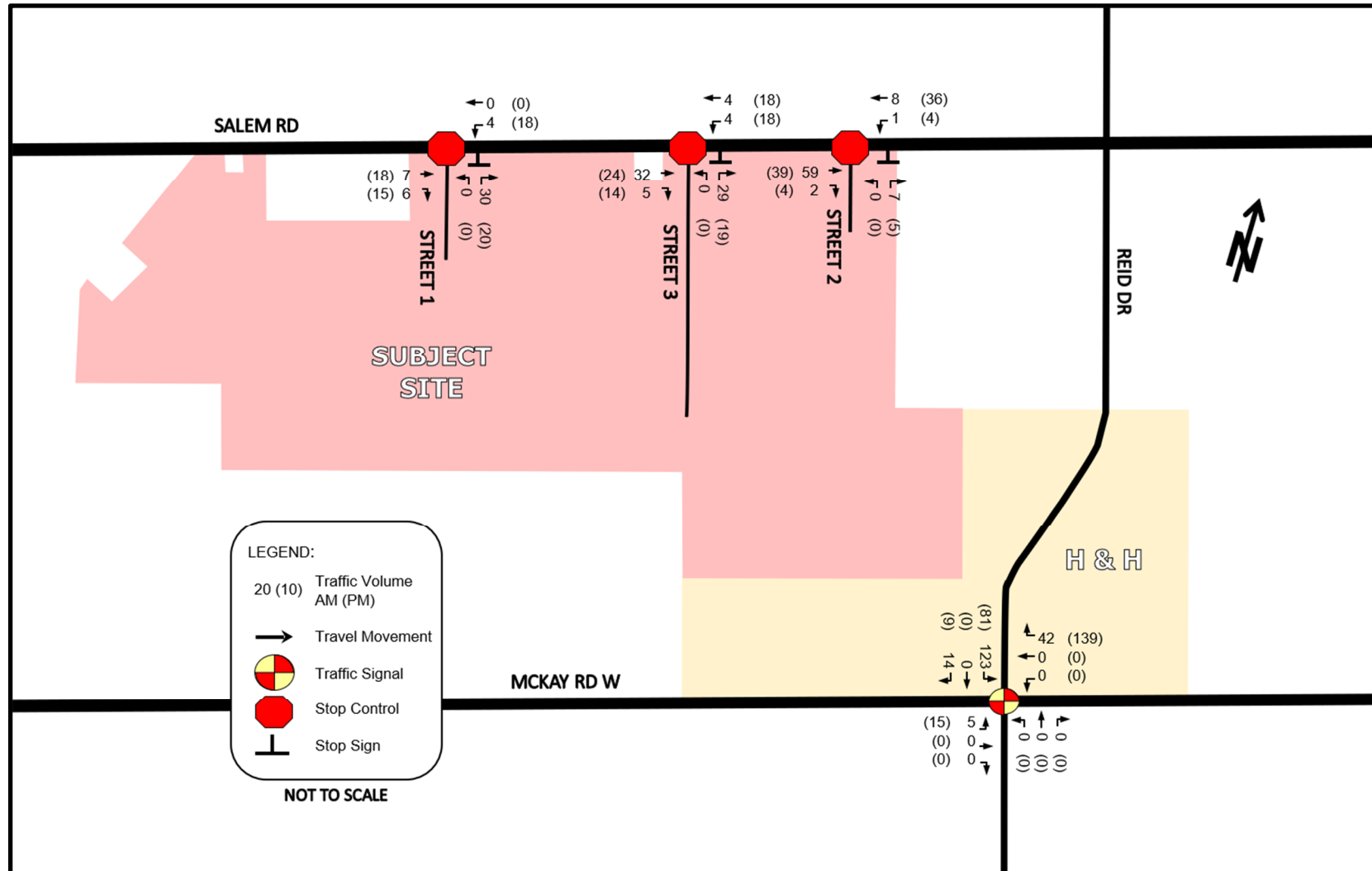
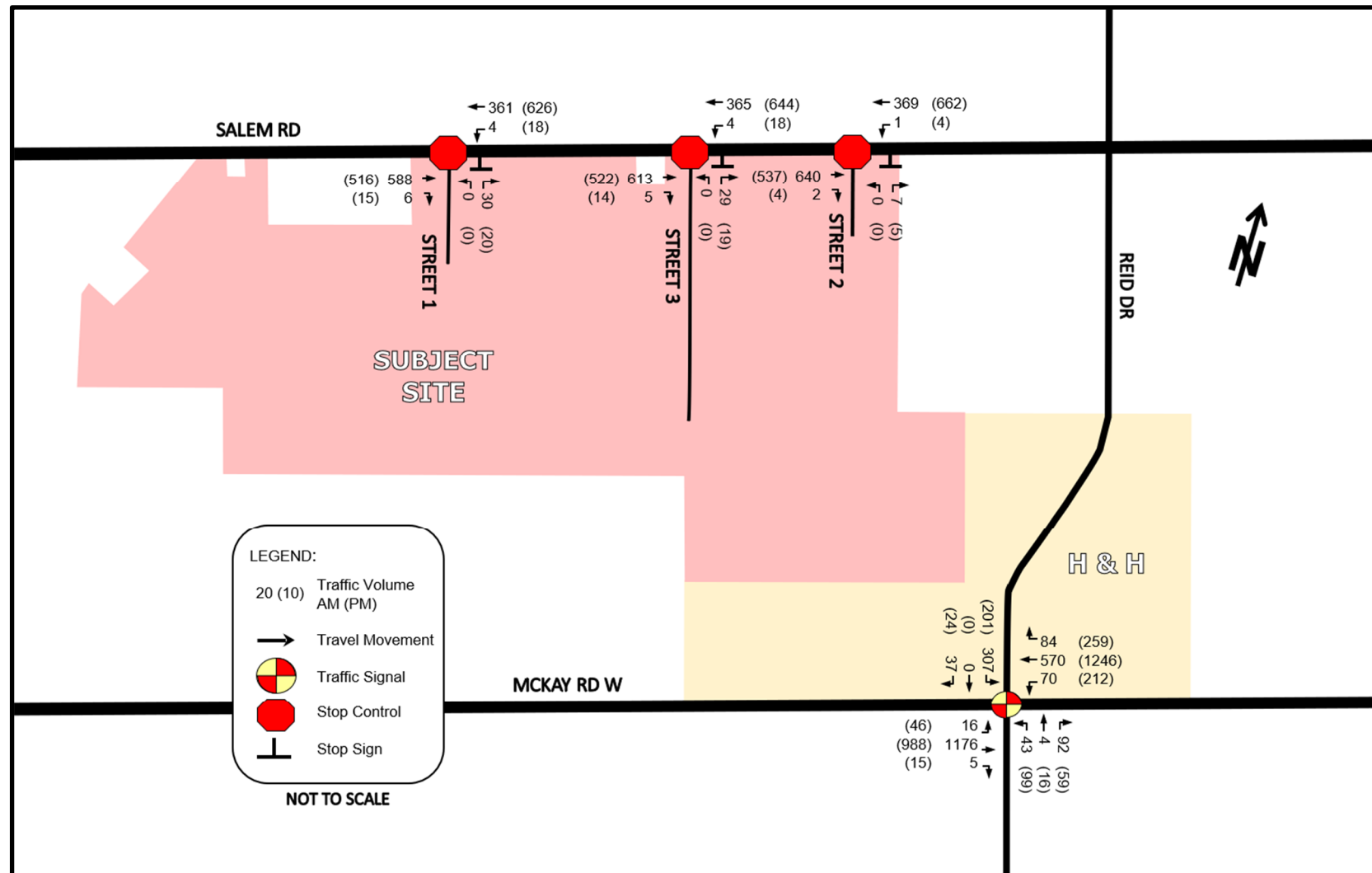


Figure 11 – Total (2041) Traffic Volumes – LI Permitted

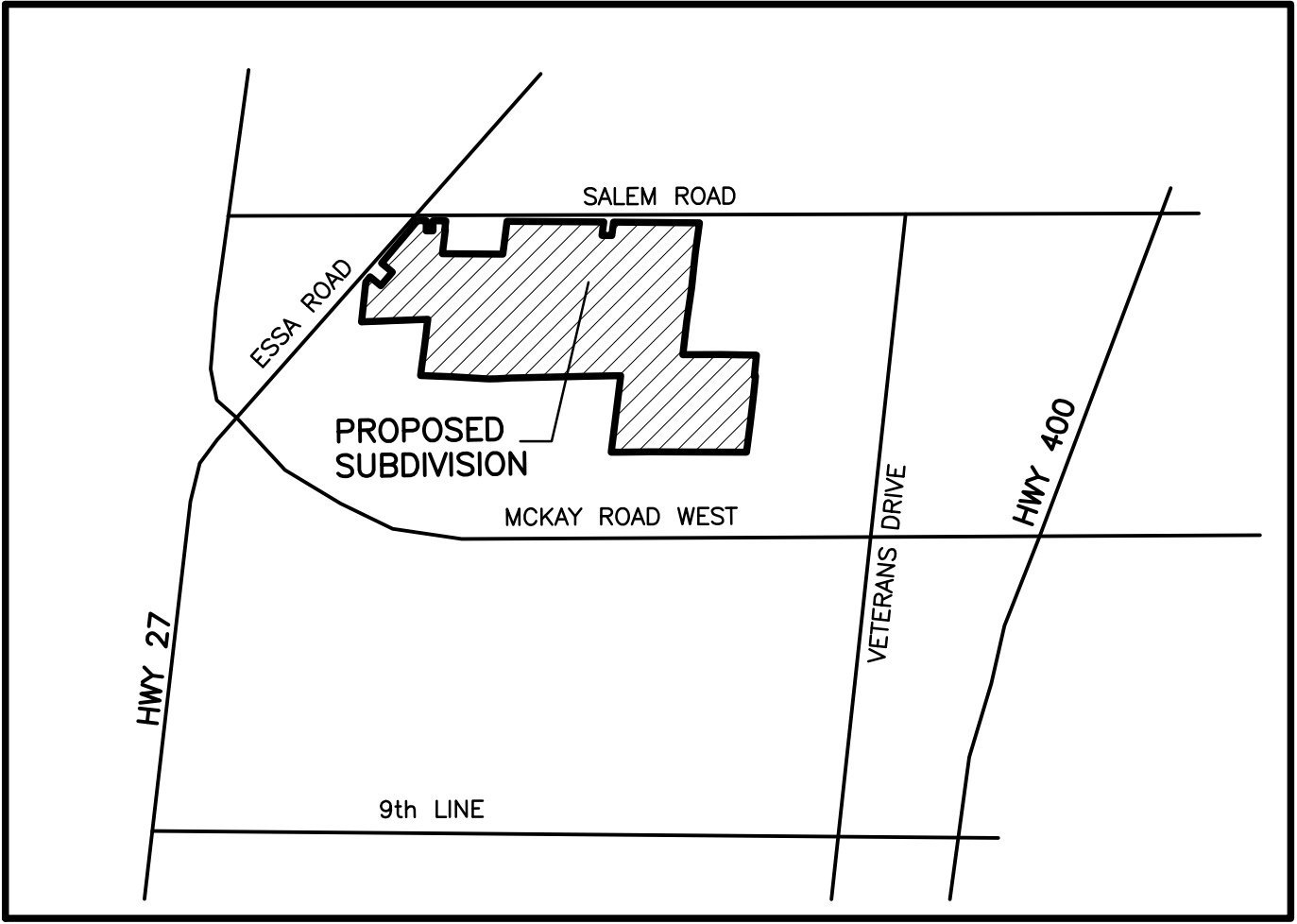


Appendix A – Site Plan

DRAFT PLAN OF SUBDIVISION
PART OF LOTS 2 AND 3
PART OF THE NORTH HALF OF LOT 4
PART OF THE SOUTH HALF OF LOT 4
CONCESSION 10
(GEOGRAPHIC TOWNSHIP OF INNISFIL)
CITY OF BARRIE
COUNTY OF SIMCOE

SCALE 1:2500

DRAFT PLAN T-



KEY PLAN

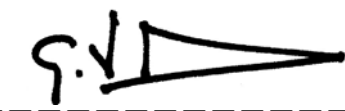
SECTION 51, PLANNING ACT,
ADDITIONAL INFORMATION

- A. AS SHOWN ON DRAFT PLAN
- B. AS SHOWN ON DRAFT PLAN
- C. AS SHOWN ON DRAFT PLAN
- D. SEE SCHEDULE OF LAND USE
- E. AS SHOWN ON DRAFT PLAN
- F. AS SHOWN ON DRAFT PLAN
- G. AS SHOWN ON DRAFT PLAN
- H. MUNICIPAL PIPED WATER AVAILABLE AT TIME OF DEVELOPMENT
- I. CLAY-LOAM
- J. AS SHOWN ON DRAFT PLAN
- K. SANITARY AND STORM SEWERS, GARBAGE COLLECTION, FIRE PROTECTION
- L. AS SHOWN ON DRAFT PLAN

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE
SUBDIVIDED AS SHOWN ON THIS PLAN, AND THEIR RELATIONSHIP TO
THE ADJACENT LAND ARE ACCURATELY AND CORRECTLY SHOWN.

DATE DECEMBER 15, 2022



GARY B. VANDERVEEN
ONTARIO LAND SURVEYOR

HOLDING JONES VANDERVEEN INC.

OWNER'S CERTIFICATE

I AUTHORIZE KLM PLANNING PARTNERS INC. TO PREPARE AND SUBMIT
THIS DRAFT PLAN OF SUBDIVISION TO THE CITY OF BARRIE FOR APPROVAL.

OWNER

WORMWOOD DEVELOPMENTS INC.

C/O

DC GROUP
30 FLORAL PARKWAY
SUITE 300
CONCORD, ONTARIO
L4K 4R1

ROBERT DE GASPERIS
S.O.

SCHEDULE OF LAND USE

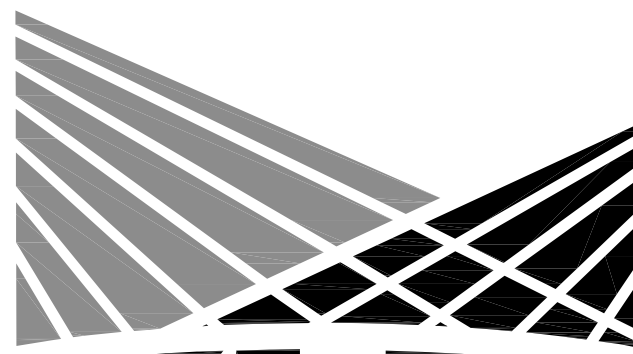
TOTAL AREA OF LAND = 114.681±Ha. (283.382±Acs.)

LOTS FOR SINGLE FAMILY DWELLINGS		BLOCKS	LOTS	UNITS	±Ha.	±Acs.	
LOTS 130-131, 135-146, 150 and 164-179 MIN. LOT FRONTAGE=15.3m. MIN. AREA=420.75sq.m.			31	31	1.848	4.566	
LOTS 1-5, 36, 45-48, 56, 60-72, 75-83, 92-94, 100-104, 114-115, 117-125, 127-159, 132, 147-149, 151-154, 160-163, 180-184, 188- 189, 191-196, 200-202, 204-205, 207-209, 227-235 and 312 MIN. LOT FRONTAGE=13.7m. MIN. AREA=376.75sq.m. plus BLOCKS 327-330 and 332-334			98	98	4.640	11.466	
LOTS 6-35, 37-44, 49-55, 57-59, 73-74, 84-91, 95-99, 105-113, 116, 126, 133-134, 158- 159, 185-187, 190, 197-199, 203, 206, 210- 226, 236-240, 246-248, 259-261, 266-268, 274, 276-278, 285-287, 295-296, 311 and 313-326 MIN. LOT FRONTAGE=11.6m. MIN. AREA=319.0sq.m. plus BLOCKS 335-347			142	142	6.559	16.209	
LOTS 155-157, 241-243, 249-253, 258, 263-265, 271-273, 279-281, 283-284, 288-290, 293- 294, 297-298 and 303-310 MIN. LOT FRONTAGE=10.0m. MIN. AREA=275.0sq.m.			38	38	1.224	3.025	
STREET TOWNHOUSES BLOCKS 244-245, 254-257, 262, 269-270, 275, 282, 291-292, 299-302 and 331 MIN. UNIT FRONTAGE=6.3m.			18	114.5	2.088	5.159	
MIXED USE NODE BLOCKS 348-349			2	361 *	3.006	7.427	
SUBTOTAL			40	309	794.5 *	19.365	47.852
BLOCK 350 - PARK			1		1.208	2.985	
BLOCK 351 - S.W.M.			1		1.279	3.160	
BLOCK 352 - UNDERGROUND STORAGE TANK			1		0.345	0.853	
BLOCKS 353-354 - NATURAL HERITAGE SYSTEM			2		84.325	208.372	
BLOCKS 355-360 - OPEN SPACE			6		0.224	0.553	
BLOCKS 361-365 - ROAD WIDENING			5		0.751	1.856	
BLOCKS 366-372 - 0.3m. RESERVE			7		0.005	0.012	
STREETS					7.179	17.739	
24.0m. WIDE TOTAL LENGTH= 282.8m. AREA= 0.677Ha.							
18.0m. WIDE TOTAL LENGTH= 3612.1m. AREA= 6.502Ha.							
TOTAL TOTAL LENGTH= 3894.9m. AREA= 7.179Ha.							

TOTAL	63	309	794.5*±114.681	283.382
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NOTE - ELEVATIONS RELATED TO
CANADIAN GEODETIC DATUM

NOTE - @ SPECIAL DESIGN UNITS



PROJECT No. P-3158

SCALE 1:2500 DEC 16, 2022

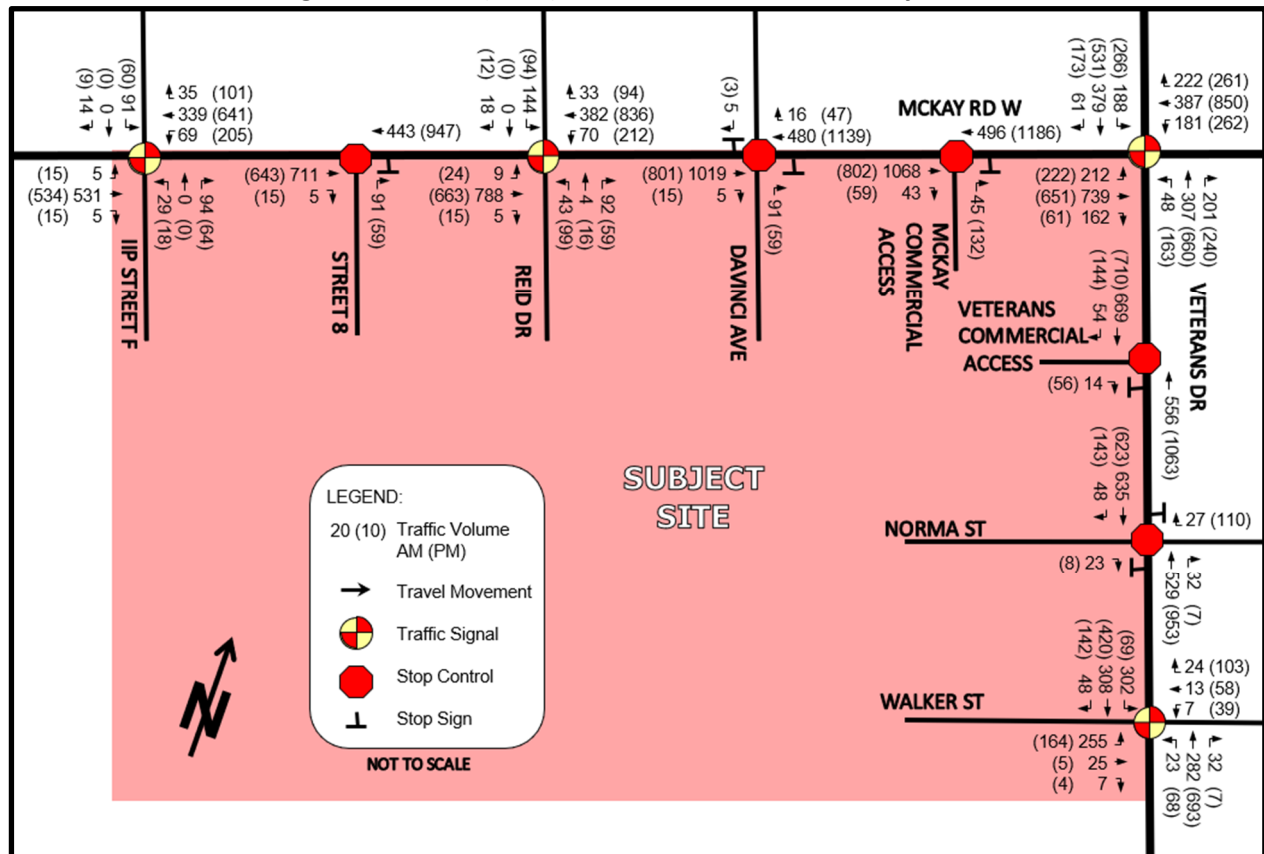
(3158DES5) X-REF: (3158MAS2 & 3158TOPO)

KLM DWG. No. - 22:3
PLANNING PARTNERS INC. 64 JARDIN DRIVE - UNIT 1B, CONCORD ONTARIO L4K 3P3
TEL: (905) 669-4055 FAX: (905) 669-0097 design@klmplanning.com

Planning • Design • Development

Appendix B – Watersand TA Excerpts

Figure 11 –Total (2031) Traffic Volumes within Study Area



4.3.3 TOTAL (2036 AND 2041) HORIZON YEAR TRAFFIC VOLUMES

In order to calculate the Total (2036 and 2041) traffic volumes, a background traffic growth rate of 2.46% / year on Veteran's Drive and 4.08% / year on McKay Road West has been applied to the Total (2031) traffic volumes. The background growth rate was applied to the total (2031) traffic volumes, rather than the background (2031) traffic volumes, in order to account for the future development and intensification of these corridors. While this methodology results in larger traffic volumes than the 2041 EMME model output, we believe this provides a reasonable, yet somewhat conservative estimate of the future traffic volume, based on our review of the Phase 1 traffic volumes and the planned future development in Phase 2 and 3 of the Salem Secondary Plan.

The annual background traffic growth rates outlined above have been calculated using the City's EMME transportation model output. The 2031 and 2041 EMME models were compared for Veteran's Drive and McKay Road West during AM and PM peak hour.

It is noted that a 2.46% / year background growth rate has also been applied to the IIP Street F and Reid Drive (north leg) total (2031) traffic volumes, to account for future development in Phase 2 that will be serviced by IIP Street F and the north leg of Reid Drive as well as additional traffic anticipated within the study area as a result of the Reid Drive extension.

6.0 SUPPLEMENTAL ANALYSIS – LOCAL ROADS AND COMMERCIAL ACCESSES LEFT-IN

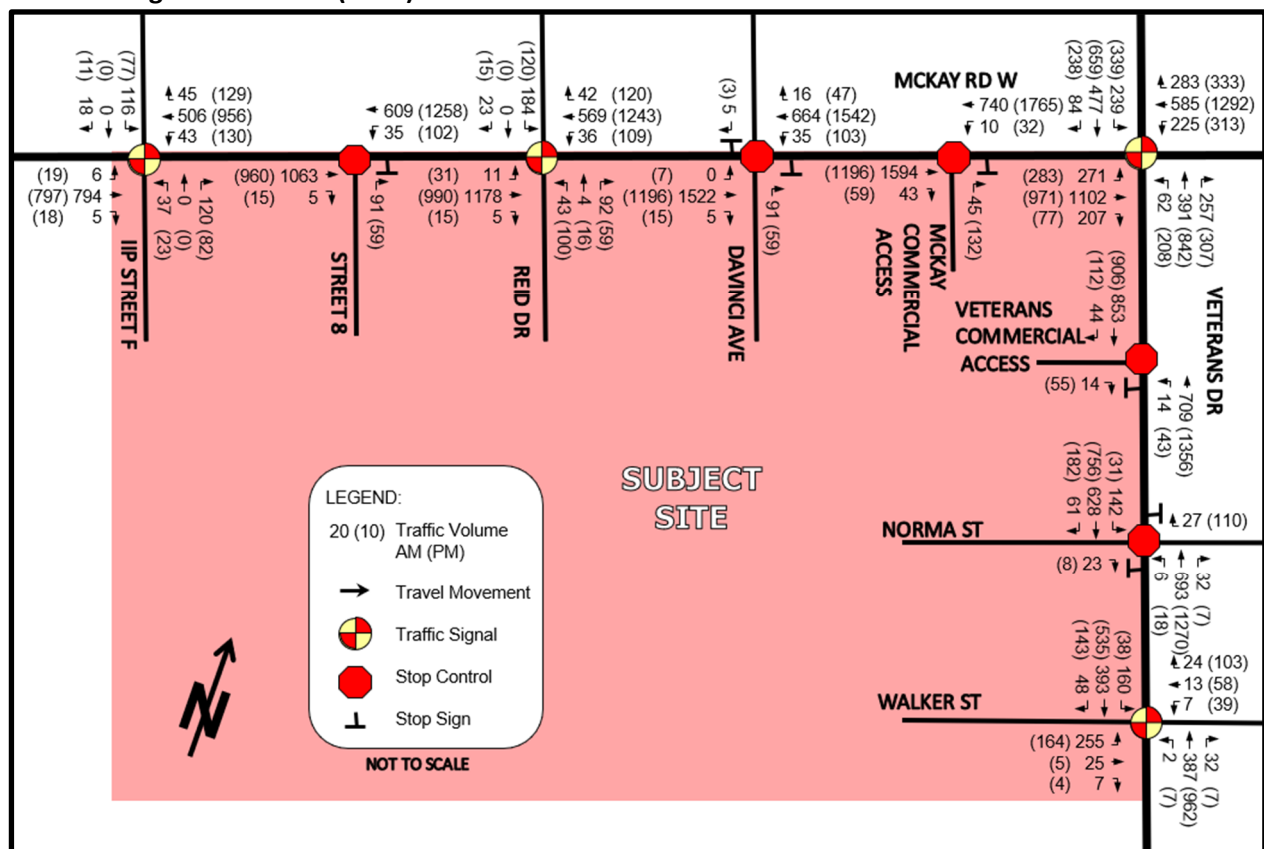
The City has requested all local roads and future commercial accesses from McKay Road West and Veteran's Drive to be limited to right-in-right-out accesses. This supplemental analysis has been provided to assess the impact of permitting left-in [LI] movements to the commercial accesses from McKay Road West and Veteran's Drive in addition to LI movements being permitted from McKay Road West and Veteran's Drive onto local roads Street 8, DaVinci Drive and Norma Street. The intent is to improve access into the Commercial Block while minimizing the impact on the local roads in the Watersand Development.

6.1 TOTAL (2041) TRAFFIC VOLUMES – LIs PERMITTED

The overall traffic assignment calculated in Table 9 in Section 4.2 will remain unchanged with the LI movements permitted at the commercial access and local roads; however, the distribution of traffic entering at each access location changes.

Using the traffic distribution patterns outlined in Table 9 in Section 4.2, the site traffic assignment for the subject site was recalculated for the AM and PM peak hour with LI movements permitted at the commercial accesses and local roads. **Figure 14** illustrates the revised traffic assignment.

Figure 14 – Total (2041) Traffic Volumes – Commercial and Local Road LI Permitted



Appendix C – Synchro Analysis Output – Total Traffic Volumes

Watersand Development - Phase 2 North
9: Reid Drive & McKay Road West

Queues
Total (2031) AM Peak Hour

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	14	788	70	382	43	4	267	0
Future Volume (vph)	14	788	70	382	43	4	267	0
Lane Group Flow (vph)	15	862	76	497	47	104	290	35
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		4	3	8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	3	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	22.0	22.0	11.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	45.0	45.0	12.0	57.0	23.0	23.0	23.0	23.0
Total Split (%)	56.3%	56.3%	15.0%	71.3%	28.8%	28.8%	28.8%	28.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	0.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	3.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.03	0.93	0.27	0.45	0.15	0.23	0.97	0.05
Control Delay	10.5	37.0	7.0	8.7	26.5	8.1	78.4	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.5	37.0	7.0	8.7	26.5	8.1	78.4	0.1
Queue Length 50th (m)	1.1	117.6	3.5	32.8	6.0	0.5	~49.4	0.0
Queue Length 95th (m)	4.2	#204.0	7.6	51.8	15.0	12.6	#97.5	0.0
Internal Link Dist (m)		1652.9		2295.5		209.9		473.4
Turn Bay Length (m)	15.0		25.0		25.0		45.0	
Base Capacity (vph)	480	998	316	1280	319	449	300	731
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.86	0.24	0.39	0.15	0.23	0.97	0.05

Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 74

Natural Cycle: 90

Control Type: Semi Act-Uncoord

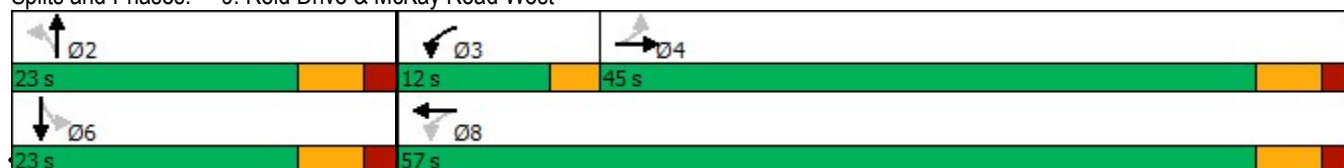
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 9: Reid Drive & McKay Road West



Watersand Development - Phase 2 North
9: Reid Drive & McKay Road West

HCM Signalized Intersection Capacity Analysis

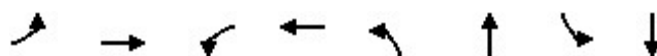
Total (2031) AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	788	5	70	382	75	43	4	92	267	0	32
Future Volume (vph)	14	788	5	70	382	75	43	4	92	267	0	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		3.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	0.98		1.00	0.86		1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1861		1770	1817		1770	1594		1770	1583	
Flt Permitted	0.48	1.00		0.10	1.00		0.73	1.00		0.69	1.00	
Satd. Flow (perm)	897	1861		188	1817		1368	1594		1285	1583	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	857	5	76	415	82	47	4	100	290	0	35
RTOR Reduction (vph)	0	1	0	0	10	0	0	77	0	0	27	0
Lane Group Flow (vph)	15	861	0	76	487	0	47	27	0	290	8	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	36.7	36.7		45.2	45.2		17.3	17.3		17.3	17.3	
Effective Green, g (s)	36.7	36.7		45.2	45.2		17.3	17.3		17.3	17.3	
Actuated g/C Ratio	0.49	0.49		0.61	0.61		0.23	0.23		0.23	0.23	
Clearance Time (s)	6.0	6.0		3.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	441	916		230	1102		317	370		298	367	
v/s Ratio Prot		c0.46		0.02	c0.27			0.02			0.01	
v/s Ratio Perm	0.02			0.18			0.03			c0.23		
v/c Ratio	0.03	0.94		0.33	0.44		0.15	0.07		0.97	0.02	
Uniform Delay, d1	9.8	17.9		13.4	7.9		22.7	22.3		28.4	22.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.0	17.1		0.8	0.3		1.0	0.4		45.7	0.1	
Delay (s)	9.8	35.0		14.2	8.2		23.7	22.7		74.1	22.2	
Level of Service	A	C		B	A		C	C		E	C	
Approach Delay (s)		34.6			9.0			23.0			68.5	
Approach LOS		C			A			C			E	
Intersection Summary												
HCM 2000 Control Delay			31.8			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.91									
Actuated Cycle Length (s)			74.5			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			82.4%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

Watersand Development - Phase 2 North

9: Reid Drive & McKay Road West

Queues
Total (2031) PM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	39	663	212	836	99	16	175	0
Future Volume (vph)	39	663	212	836	99	16	175	0
Lane Group Flow (vph)	42	737	230	1162	108	81	190	23
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		4	3	8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	3	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	22.0	22.0	11.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	45.0	45.0	12.0	57.0	23.0	23.0	23.0	23.0
Total Split (%)	56.3%	56.3%	15.0%	71.3%	28.8%	28.8%	28.8%	28.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	0.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	3.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.46	0.80	0.65	1.00	0.37	0.20	0.68	0.05
Control Delay	33.6	25.7	15.7	43.1	31.2	11.4	43.5	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.6	25.7	15.7	43.1	31.2	11.4	43.5	0.2
Queue Length 50th (m)	4.2	94.9	11.7	~162.3	14.9	2.2	28.1	0.0
Queue Length 95th (m)	#19.3	#162.3	27.8	#271.3	29.8	13.2	#57.0	0.0
Internal Link Dist (m)		1652.9		2295.5		209.9		473.4
Turn Bay Length (m)	15.0		25.0		25.0		45.0	
Base Capacity (vph)	92	918	364	1160	293	399	278	468
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.80	0.63	1.00	0.37	0.20	0.68	0.05

Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 80

Natural Cycle: 90

Control Type: Semi Act-Uncoord

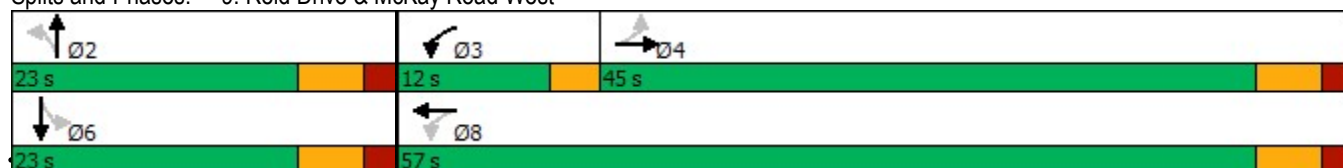
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 9: Reid Drive & McKay Road West



Watersand Development - Phase 2 North
9: Reid Drive & McKay Road West

HCM Signalized Intersection Capacity Analysis

Total (2031) PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	39	663	15	212	836	233	99	16	59	175	0	21
Future Volume (vph)	39	663	15	212	836	233	99	16	59	175	0	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		3.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	0.97		1.00	0.88		1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1857		1770	1802		1770	1642		1770	1583	
Flt Permitted	0.10	1.00		0.16	1.00		0.74	1.00		0.70	1.00	
Satd. Flow (perm)	189	1857		294	1802		1383	1642		1312	1583	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	42	721	16	230	909	253	108	17	64	190	0	23
RTOR Reduction (vph)	0	1	0	0	13	0	0	50	0	0	18	0
Lane Group Flow (vph)	42	736	0	230	1149	0	108	31	0	190	5	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	39.5	39.5		51.0	51.0		17.0	17.0		17.0	17.0	
Effective Green, g (s)	39.5	39.5		51.0	51.0		17.0	17.0		17.0	17.0	
Actuated g/C Ratio	0.49	0.49		0.64	0.64		0.21	0.21		0.21	0.21	
Clearance Time (s)	6.0	6.0		3.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	93	916		344	1148		293	348		278	336	
v/s Ratio Prot		0.40		0.07	c0.64			0.02			0.00	
v/s Ratio Perm	0.22			0.35			0.08			c0.14		
v/c Ratio	0.45	0.80		0.67	1.00		0.37	0.09		0.68	0.01	
Uniform Delay, d1	13.2	17.0		11.8	14.5		26.9	25.3		29.0	24.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.5	5.2		4.9	26.8		3.5	0.5		12.8	0.1	
Delay (s)	16.7	22.2		16.7	41.3		30.5	25.8		41.8	25.0	
Level of Service	B	C		B	D		C	C		D	C	
Approach Delay (s)		21.9			37.3			28.5			40.0	
Approach LOS		C			D			C			D	
Intersection Summary												
HCM 2000 Control Delay			32.2			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.96									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			95.4%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

Watersand Development - Phase 2 North
9: Reid Drive & McKay Road W

Queues
Total (2041) AM Peak Hour

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	16	1176	70	570	43	4	307	0
Future Volume (vph)	16	1176	70	570	43	4	307	0
Lane Group Flow (vph)	17	1283	76	711	47	104	334	40
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		4	3	8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	3	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	22.0	22.0	11.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	35.0	35.0	16.0	51.0	29.0	29.0	29.0	29.0
Total Split (%)	43.8%	43.8%	20.0%	63.8%	36.3%	36.3%	36.3%	36.3%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	0.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	3.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.06	0.90	0.27	0.39	0.11	0.18	0.82	0.06
Control Delay	15.3	31.9	9.6	10.7	19.5	5.9	42.4	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.3	31.9	9.6	10.7	19.5	5.9	42.4	0.2
Queue Length 50th (m)	1.5	91.8	4.6	28.6	4.9	0.4	45.2	0.0
Queue Length 95th (m)	5.7	#141.2	10.0	40.2	12.7	10.8	#92.7	0.0
Internal Link Dist (m)		1652.9		2295.5		209.9		473.4
Turn Bay Length (m)	15.0		25.0		25.0		45.0	
Base Capacity (vph)	285	1422	406	2179	434	576	409	682
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.90	0.19	0.33	0.11	0.18	0.82	0.06

Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 72.4

Natural Cycle: 80

Control Type: Semi Act-Uncoord

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 9: Reid Drive & McKay Road W



Watersand Development - Phase 2 North
9: Reid Drive & McKay Road W

HCM Signalized Intersection Capacity Analysis
Total (2041) AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	1176	5	70	570	84	43	4	92	307	0	37
Future Volume (vph)	16	1176	5	70	570	84	43	4	92	307	0	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		3.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	0.98		1.00	0.86		1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3537		1770	3471		1770	1594		1770	1583	
Flt Permitted	0.38	1.00		0.12	1.00		0.73	1.00		0.69	1.00	
Satd. Flow (perm)	710	3537		232	3471		1362	1594		1285	1583	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	17	1278	5	76	620	91	47	4	100	334	0	40
RTOR Reduction (vph)	0	1	0	0	16	0	0	68	0	0	27	0
Lane Group Flow (vph)	17	1282	0	76	695	0	47	36	0	334	13	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	29.1	29.1		37.9	37.9		23.1	23.1		23.1	23.1	
Effective Green, g (s)	29.1	29.1		37.9	37.9		23.1	23.1		23.1	23.1	
Actuated g/C Ratio	0.40	0.40		0.52	0.52		0.32	0.32		0.32	0.32	
Clearance Time (s)	6.0	6.0		3.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	283	1409		242	1802		430	504		406	500	
v/s Ratio Prot		c0.36		0.02	c0.20			0.02			0.01	
v/s Ratio Perm	0.02			0.14			0.03			c0.26		
v/c Ratio	0.06	0.91		0.31	0.39		0.11	0.07		0.82	0.03	
Uniform Delay, d1	13.5	20.7		12.9	10.6		17.7	17.4		23.1	17.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	9.1		0.7	0.1		0.5	0.3		17.0	0.1	
Delay (s)	13.6	29.8		13.7	10.7		18.2	17.7		40.0	17.3	
Level of Service	B	C		B	B		B	B		D	B	
Approach Delay (s)		29.6			11.0			17.9			37.6	
Approach LOS		C			B			B			D	
Intersection Summary												
HCM 2000 Control Delay	24.4			HCM 2000 Level of Service			C					
HCM 2000 Volume to Capacity ratio	0.83											
Actuated Cycle Length (s)	73.0			Sum of lost time (s)			15.0					
Intersection Capacity Utilization	75.5%			ICU Level of Service			D					
Analysis Period (min)	15											
c Critical Lane Group												

Watersand Development - Phase 2 North
9: Reid Drive & McKay Road W

Queues
Total (2041) PM Peak Hour

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	46	988	212	1246	99	16	201	0
Future Volume (vph)	46	988	212	1246	99	16	201	0
Lane Group Flow (vph)	50	1090	230	1636	108	81	218	26
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		4	3	8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	3	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	22.0	22.0	11.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	35.0	35.0	16.0	51.0	29.0	29.0	29.0	29.0
Total Split (%)	43.8%	43.8%	20.0%	63.8%	36.3%	36.3%	36.3%	36.3%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	0.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	3.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.52	0.85	0.66	0.87	0.26	0.15	0.55	0.05
Control Delay	42.3	30.6	20.6	21.0	23.7	9.1	29.6	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.3	30.6	20.6	21.0	23.7	9.1	29.6	0.2
Queue Length 50th (m)	5.8	77.5	15.3	101.9	13.2	1.9	29.4	0.0
Queue Length 95th (m)	#22.3	#113.5	36.9	134.8	26.7	11.8	52.6	0.0
Internal Link Dist (m)		1652.9		2295.5		209.9		473.4
Turn Bay Length (m)	15.0		25.0		25.0		45.0	
Base Capacity (vph)	105	1377	403	2069	419	543	398	538
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.79	0.57	0.79	0.26	0.15	0.55	0.05

Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 76.1

Natural Cycle: 60

Control Type: Semi Act-Uncoord

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 9: Reid Drive & McKay Road W



Watersand Development - Phase 2 North
9: Reid Drive & McKay Road W

HCM Signalized Intersection Capacity Analysis
Total (2041) PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	46	988	15	212	1246	259	99	16	59	201	0	24
Future Volume (vph)	46	988	15	212	1246	259	99	16	59	201	0	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		3.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	0.97		1.00	0.88		1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3531		1770	3448		1770	1642		1770	1583	
Flt Permitted	0.15	1.00		0.13	1.00		0.74	1.00		0.70	1.00	
Satd. Flow (perm)	271	3531		244	3448		1379	1642		1312	1583	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	50	1074	16	230	1354	282	108	17	64	218	0	26
RTOR Reduction (vph)	0	1	0	0	23	0	0	45	0	0	18	0
Lane Group Flow (vph)	50	1089	0	230	1613	0	108	36	0	218	8	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	27.5	27.5		40.9	40.9		23.1	23.1		23.1	23.1	
Effective Green, g (s)	27.5	27.5		40.9	40.9		23.1	23.1		23.1	23.1	
Actuated g/C Ratio	0.36	0.36		0.54	0.54		0.30	0.30		0.30	0.30	
Clearance Time (s)	6.0	6.0		3.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	98	1277		340	1855		419	499		398	481	
v/s Ratio Prot		0.31		0.09	c0.47			0.02			0.00	
v/s Ratio Perm	0.18			0.27			0.08			c0.17		
v/c Ratio	0.51	0.85		0.68	0.87		0.26	0.07		0.55	0.02	
Uniform Delay, d1	19.0	22.4		13.1	15.2		20.0	18.8		22.1	18.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.4	5.7		5.3	4.6		1.5	0.3		5.3	0.1	
Delay (s)	23.4	28.1		18.4	19.9		21.5	19.1		27.4	18.6	
Level of Service	C	C		B	B		C	B		C	B	
Approach Delay (s)		27.9			19.7			20.5			26.5	
Approach LOS		C			B			C			C	
Intersection Summary												
HCM 2000 Control Delay			22.9			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			76.0			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			81.3%			ICU Level of Service			D			
Analysis Period (min)			15									
c Critical Lane Group												

Appendix D – OTM Signal Justification Sheets

Justification No. 7 - 2041 Total Traffic (Critical Case)

Street 1 / Salem Road

Justification	Description	Rest. Flow	Compliance			Signal Warrant	Underground Provisions Warrant
			Sectional		Entire %		
			Numerical	%			
1. Minimum Vehicluar Volume	A. Vehicle volume, all aproaches (average hour)	900	555	62%	3%	NO	NO
	B. Vehicle volume, along minor streets (average hour)	255	13	5%		NO	NO
2. Delay to cross traffic	A. Vehicle volume, major street (average hour)	900	532	59%	0%	NO	NO
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	170	0	0%		NO	NO

Justification No. 7 - 2041 Total Traffic (Critical Case)

Street 2 / Salem Road

Justification	Description		Compliance			Signal Warrant	Underground Provisions Warrant
			Sectional		Entire %		
			Rest. Flow	Numerical			
1. Minimum Vehicluar Volume	A. Vehicle volume, all aproaches (average hour)	900	558	62%	4%	NO	NO
	B. Vehicle volume, along minor streets (average hour)	255	14	5%		NO	NO
2. Delay to cross traffic	A. Vehicle volume, major street (average hour)	900	533	59%	0%	NO	NO
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	170	0	0%		NO	NO

Justification No. 7 - 2041 Total Traffic (Critical Case)

Street 2 / Salem Road

Justification	Description		Compliance			Signal Warrant	Underground Provisions Warrant
			Sectional		Entire %		
			Rest. Flow	Numerical			
1. Minimum Vehicluar Volume	A. Vehicle volume, all aproaches (average hour)	900	550	61%	1%	NO	NO
	B. Vehicle volume, along minor streets (average hour)	255	3	1%		NO	NO
2. Delay to cross traffic	A. Vehicle volume, major street (average hour)	900	543	60%	0%	NO	NO
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	170	0	0%		NO	NO

Appendix E – MTO Left Turn Warrant Analysis

Exhibit 9A-22

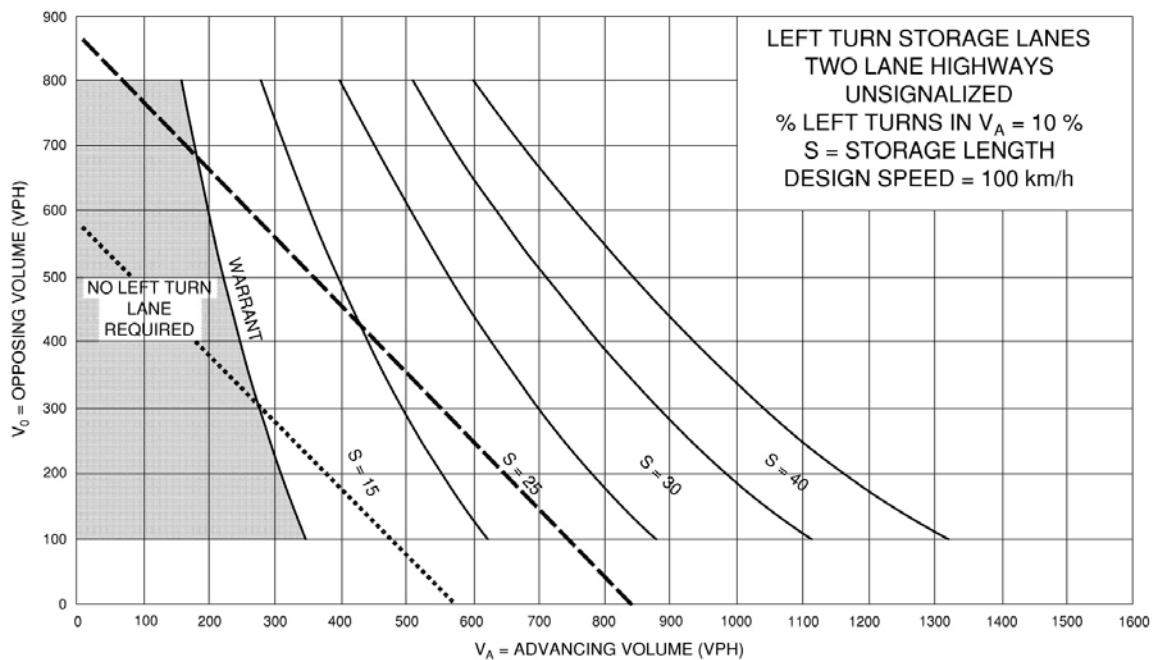
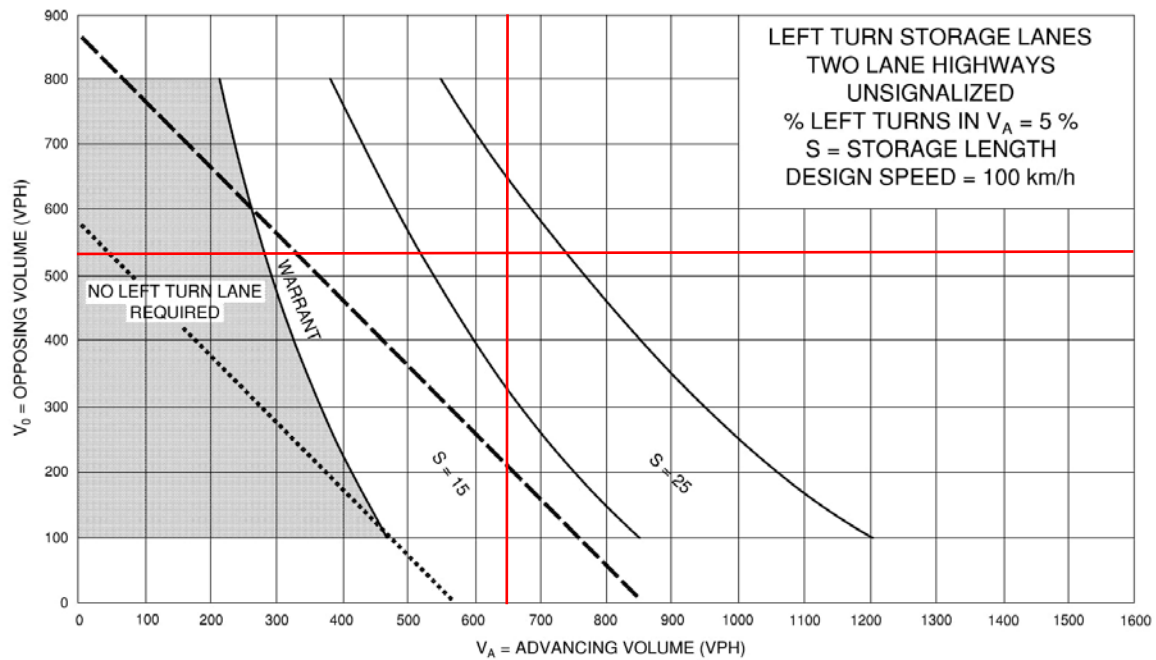
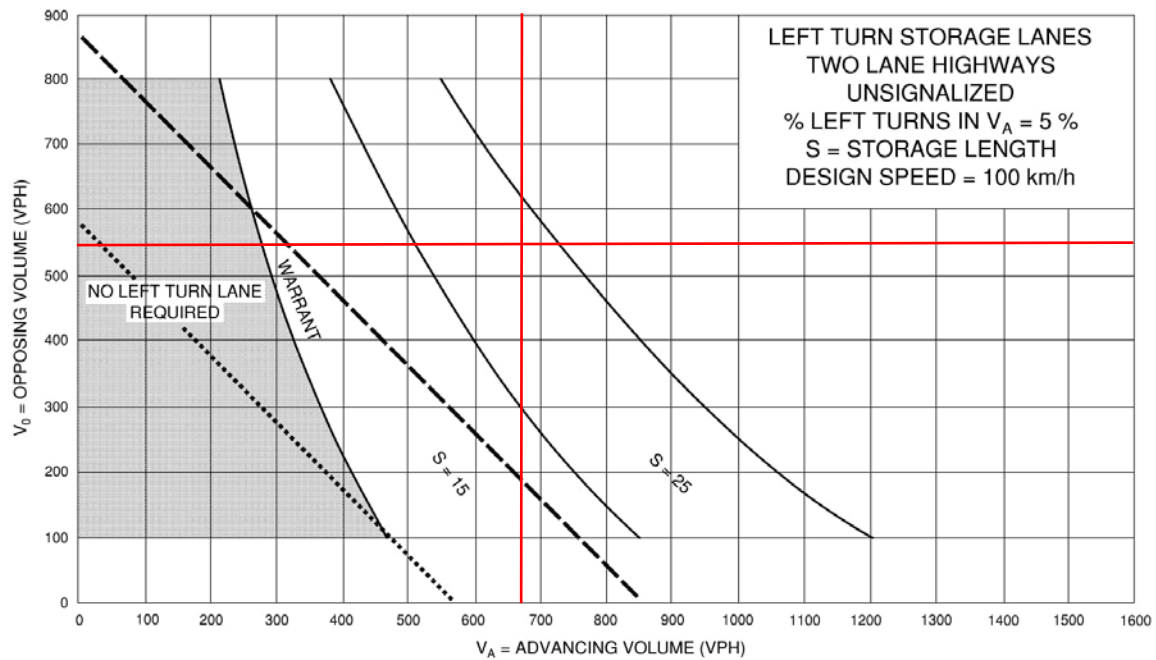


Exhibit 9A-22



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

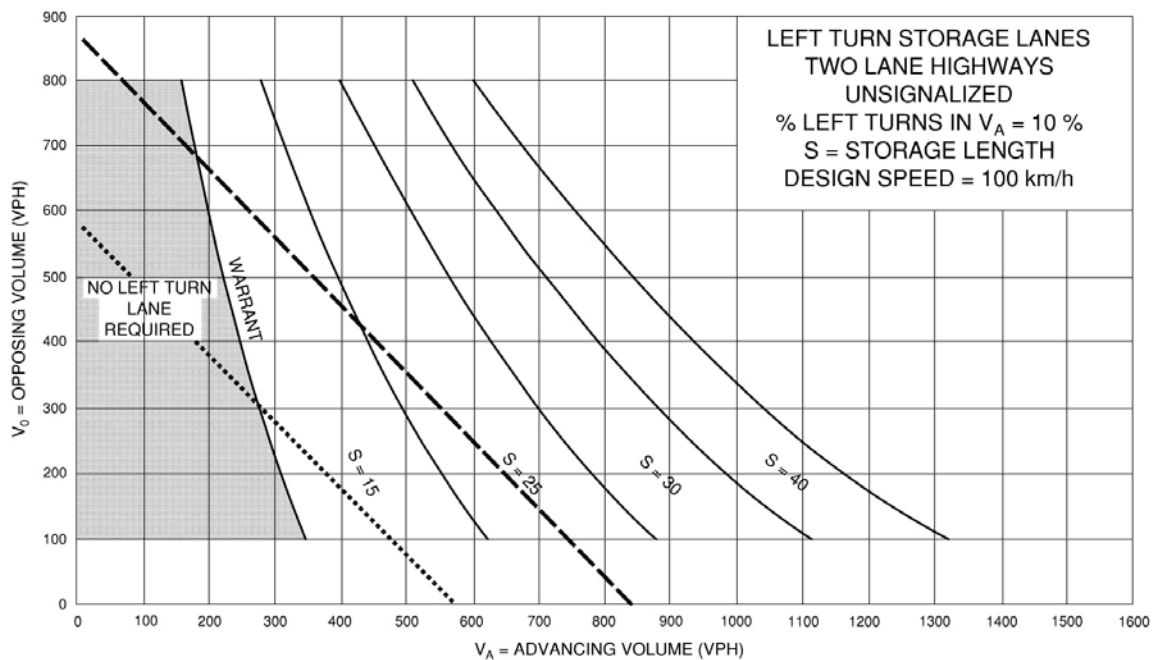


Exhibit 9A-22

