City of Hamilton

PLANNING COMMITTEE ADDENDUM

Meeting #: 19-008
Date: May 14, 2019
Time: 9:30 a.m.
Location: Council Chambers, Hamilton City Hall
71 Main Street West

Lisa Chamberlain, Legislative Coordinator (905) 546-2424 ext. 4605

Pages

6. DELEGATION REQUESTS

7. CONSENT ITEMS

*7.3.b Written Submissions:

1. George McCowan
2. Surabhi Patel
3. Anna Roberts
4. Stan and Renee Kurak
5. Zita Petozzi
6. Tabatha Morris
7. Joan Whitson
8. Russell and Janet Pape
9. Larry Birch
10. Eleanor Boyle
11. Ron and Rae Wilcox
12. Linda McEneny
13. Sherry Hayes

8. PUBLIC HEARINGS / DELEGATIONS

8.3 Applications for an Amendment to the Rural Hamilton Official Plan and the City of Hamilton Zoning By-law No. 05-200 for Lands Located at 1633, 1649 and 1653 Highway No. 6 North, Flamborough (PED19076) (Ward 13)

*8.3.a Staff Presentation: *380*

Form: Request to Speak to Committee of Council
Submitted on Wednesday, May 8, 2019 - 9:40 am

==Committee Requested==
Committee: Planning Committee

==Requestor Information==
Name of Individual: Viv Saunders

Name of Organization: Lakewood Beach Community Council

Contact Number:

Email Address:

Mailing Address:

Reason(s) for delegation request: Request permission to have community input (contest) on renaming a local Street and Council's direction to waive $7,000 fee upon filing the Street Renaming form.

Will you be requesting funds from the City? No

Will you be submitting a formal presentation? No

Form: **Request to Speak to Committee of Council**
Submitted on Thursday, May 9, 2019 - 1:38 pm

==Committee Requested==
Committee: Planning Committee

==Requestor Information==
Name of Individual: Debbie Martin

Name of Organization: Community Group for Stop the Triple Towers at 310 Francis Ave.

Contact Number:

Email Address:

Mailing Address:

Reason(s) for delegation request: Will need to present community input re 3 Towers development project and its affect on my community and Stoney Creek.

Will you be requesting funds from the City? No

Will you be submitting a formal presentation? No

Form: **Request to Speak to Committee of Council**
Submitted on Thursday, May 9, 2019 - 9:15 pm

==Committee Requested==
Committee: Planning Committee

==Requestor Information==
Name of Individual: Viv Saunders

Name of Organization: Lakewood Beach Community Council

Contact Number:

Email Address:

Mailing Address:

Reason(s) for delegation request: Speak to Item 7.3 - 310 Frances Avenue

Will you be requesting funds from the City? No

Will you be submitting a formal presentation? No

Form: Request to Speak to Committee of Council
Submitted on Friday, May 10, 2019 - 8:55 am

==Committee Requested==
Committee: Planning Committee

==Requestor Information==
Name of Individual: Brian McRae

Name of Organization: Ontario Federation of Anglers and Hunters

Contact Number:

Email Address:

Mailing Address:

Reason(s) for delegation request: To speak to the proposed Discharge of Firearms By-law being presented and discussed.

Will you be requesting funds from the City? No

Will you be submitting a formal presentation? No

Form: **Request to Speak to Committee of Council**
Submitted on Monday, May 13, 2019 - 11:06 am

==Committee Requested==
Committee: Planning Committee

==Requestor Information==
Name of Individual: Mark Victor

Name of Organization:

Contact Number:

Email Address:

Mailing Address:
Hamilton, ON

Reason(s) for delegation request:
Item 7.3 of May 14th Planning Committee Meeting. Staff Report PED19115 on Site Plan Control Application for 310 Frances Avenue

Will you be requesting funds from the City? No

Will you be submitting a formal presentation? No

Mark P. Victor

May 13, 2019

To: 1. Planning Committee, City of Hamilton
2. Councilor Maria Pearson for Ward 10

From: Mark Victor, CET

Hamilton, ON

Re: ITEM 7.3 of PLANNING COMMITTEE MEETING
Staff Report PED19115 on Site Plan Control Application for 310 Frances Avenue

Via: Email to: clerk@hamilton.ca

Following my presentation to the Planning Committee on April 16, 2019 it was reported that only 7 people were opposed to the proposal to build 3 of the tallest towers in all of Hamilton City at 310 Frances Avenue.

This reported perception of meager opposition is totally inaccurate; in fact, I have received up to this point in time, 95 individual signatures of residents, in The Bayliner condominium building, directly across the street from the 310 Frances Avenue tower site, who are vehemently opposed to the proposed tower development.

For inspection of this petition please contact the writer.

Respectfully submitted,

Mark Victor, CET

CITY OF HAMILTON
PLANNING AND ECONOMIC DEVELOPMENT DEPARTMENT
Planning Division

TO:	Chair and Members Planning Committee
COMMITTEE DATE:	May 14, 2019
SUBJECT/REPORT NO:	Site Plan Control Application for 310 Frances Avenue (PED19115) (Ward 10)
WARD(S) AFFECTED:	Ward 10
PREPARED BY:	Melanie Schneider (905) 546-2424 Ext. 1224
SUBMITTED BY: **SIGNATURE:**	Steve Robichaud Director, Planning and Chief Planner Planning and Economic Development Department

RECOMMENDATION

(a) That Report PED19115 (Site Plan Control Application DA-19-020 for lands located at 310 Frances Avenue) be received;

(b) That Site Plan Control Application DA-19-020 for the proposed development of three tall buildings having heights of 48, 54, and 59 storeys and a total of 1,836 residential units be referred back to the Applicant for revisions to the proposal on the following basis:

i) The proposal does not implement the policies of the Urban Hamilton Official Plan related to Urban Design;

ii) Insufficient information has been provided to determine sanitary and watermain services are available to accommodate the proposed development proposed at a density greater than 250 persons per hectare;

iii) The proposal does not address concerns related to shadow, overlook and privacy for adjacent townhouse dwellings on Frances Avenue;

iv) The proposal has not demonstrated appropriate transitions in building massing and height; and,

v) The proposal does not provide satisfactory transitions in the form of intervening land uses, visual barriers or separation distance.

EXECUTIVE SUMMARY

This Report is in response to Delegation requests made at the April 16, 2019 Planning Committee with respect to Site Plan Control Application DA-19-020 for lands located at 310 Frances Avenue, Stoney Creek (see Appendix "A" to Report PED19115). Based on discussions at the Planning Committee meeting, Council adopted the following motion on April 24, 2019:

(a) That staff be directed to report back to the Planning Committee on the proposed developments on the subject property, 310 Frances Avenue, with the Minutes of the Design Review Panel, and any studies required for future Site Plan approval, with staff recommendations for consideration by the Planning Committee; and,

(b) That staff consult with the Ward Councillor to provide proper public notice.

The purpose of this Report is to:

- Provide a status update on the file, including a summary of all comments made to date by applicable City and regulatory agencies.

- Summarize all comments made on the development application by the Design Review Panel (DRP) at their meeting of April 11, 2019.

- Provide public access to Studies provided by the applicant in support of the proposed development in digital format to the public and Planning Committee.

- Provide a brief history and relevant background information regarding the subject lands.

HISTORICAL BACKGROUND

Background History

Development Applications OPA-08-019, ZAC-08-079

On February 10, 2010, City Council approved Official Plan Amendment and Zoning By-law Amendment applications for a change in zoning from the Residential Multiple "RM5-7" Zone, Modified, to the Mixed Use Commercial "MUC-4" Zone, Modified on the subject lands. The Official Plan Amendment was made under the Stoney Creek Official Plan as the UHOP was not in force and effect at that time. The policy modifications allowed for a mixed use development with the following key site-specific provisions:

- No maximum building height;
- Minimum 585 dwelling units; and,
- No maximum lot coverage.

These modifications are consistent with the policy framework established through the South Shore Estates Draft Plan of Subdivision from the 1970's, which anticipated a total of 2,222 units within the subdivision. Through the 2010 approval, the Green Millen Shores Draft Plan of Subdivision anticipated 233 dwelling units, with the balance of undeveloped units to be accommodated on the subject lands, by establishing the minimum 585 dwelling unit zoning requirement.

Site Plan Control Application DA-19-020

On December 20, 2018, the owner of 310 Frances Avenue submitted Site Plan Control Application DA-19-020, which proposes to construct a tall building composed of three towers being 48, 54, and 59 storeys in height, 2,409 parking spaces within a four storey podium and two levels of underground parking, 400 sq m of commercial space, and a total of 1,836 dwelling units, eight of which are proposed as ground-related units (see Appendix "B" to Report PED19115). Driveway accesses are proposed from Frances Avenue and a common rooftop amenity space above the podium structure has been proposed.

As part of the submission, the following studies and plans were received (see Appendix "C" to Report PED19115):

- Grading Plan;
- Servicing Plan;
- Erosion and Siltation Control Plan;
- Stormwater Management Brief;
- Water / Wastewater Generation Report;
- Shadow Impact Analysis;
- Traffic Impact Study;
- Wind Assessment; and,
- Environmental Noise Impact Study.

Staff have conducted a review of these studies, which is outlined in Appendix "D" to Report PED19115.

POLICY IMPLICATIONS AND LEGISLATED REQUIREMENTS

Provincial Planning Policy Framework

The Provincial Planning Policy Framework is established through the *Planning Act* (Section 3) and the Provincial Policy Statement (PPS 2014). Section 41(6) of the *Planning Act* states that "nothing in this section shall be deemed to confer on the council of the municipality power to limit the height or density of buildings to be erected on the land."

Based on the above established parameters, the focus of the Site Plan Control Application is directed towards the design of the development as it implements the intent of the applicable Official Plan policies, Zoning By-law, and Site Plan Guidelines.

The *Planning Act* requires that all municipal land use decisions affecting planning matters be consistent with the PPS.

The mechanism for the implementation of the Provincial plans and policies is through the Official Plan. Through the preparation, adoption and subsequent Local Planning Appeal Tribunal approval of the City of Hamilton Official Plans, the City of Hamilton has established the local policy framework for the implementation of the Provincial planning policy framework. As such, matters of provincial interest (e.g. efficiency of land use, balanced growth, environmental protection and sensitive land uses) are reviewed and discussed in the Official Plan analysis that follows.

As the Site Plan Control application complies with the Official Plan and the relevant policies in the PPS, 2014, it is staff's opinion that the application is:

- Consistent with Sections 3 and 41(6) of the *Planning Act*; and,
- Consistent with the Provincial Policy Statement.

Growth Plan for the Greater Golden Horseshoe (2017)

The proposal conforms to the Guiding Principles, Section 1.2.1 of the Growth Plan, as it is designed to prioritize intensification and higher densities. In addition, the Growth Plan provides direction for residential uses under the following policies:

"2.2.1.2. Forecasted growth to the horizon of this Plan will be allocated based on the following:

c) within settlement areas, growth will be focused in:

i. delineated built-up areas;

ii. strategic growth areas;

iii. locations with existing or planned transit, with a priority on higher order transit where it exists or is planned; and

iv. areas with existing or planned public service facilities;

d) development will be directed to settlement areas, except where the policies of this Plan permit otherwise;

2.2.1.4. Applying the policies of this Plan will support the achievement of complete communities that:

a) feature a diverse mix of land uses, including residential and employment uses, and convenient access to local stores, services, and public service facilities;

2.2.1.7 New development taking place in designated greenfield areas will be planned, designated, zoned and designed in a manner that:

a) supports the achievement of complete communities;

b) supports active transportation; and

c) encourages the integration and sustained viability of transit services.

2.2.1.2. The designated greenfield area of each upper- or single-tier municipality will be planned to achieve within the horizon of this Plan a minimum density target that is not less than 80 residents and jobs combined per hectare.

The subject lands are identified outside of the Built Boundary, as shown on Appendix "G" of the UHOP. The proposed development will contribute residential growth needed to support complete communities with an approximate density of 1,376 residents and jobs per hectare.

Based on the foregoing, the proposal conforms to the Growth Plan for the Greater Golden Horseshoe (2017).

Urban Hamilton Official Plan

The subject lands are identified as "Neighbourhood" on Schedule "E" – Urban Structure and designated "Neighbourhoods" on Schedule "E-1" – Urban Land Use Designations in the Urban Hamilton Official Plan (UHOP). The following policies, amongst others, apply to the application:

Neighbourhoods

"E.3.6.3 Local commercial uses may also be permitted on the ground floor of buildings containing multiple dwellings, provided the provisions of Section E.3.8 – Local Commercial are satisfied.

E.3.6.4 High density residential uses shall be located within safe and convenient walking distance of existing or planned community facilities/services, including public transit, schools, and active or passive recreational facilities.

E.3.6.7 Development within the high density residential category shall be evaluated on the basis of the following criteria:

a) Development should have direct access to a collector or major or minor arterial road. If direct access to such a road is not possible, the development may be permitted indirect access to a collector or major or minor arterial roads from a local road upon which only a small number of low density residential dwellings are fronting on the local road.

b) High profile multiple dwellings shall not generally be permitted immediately adjacent to low profile residential uses. A separation distance shall generally be required and may be in the form of a suitable intervening land use, such as a medium density residential use. Where such separations cannot be achieved, transitional features such as effective screening and/or design features shall be incorporated into the design of the high density development to mitigate adverse impact on adjacent low profile residential uses.

d) Development shall:

i) provide adequate landscaping, amenity features, on-site parking, and buffering where required;

ii) be compatible with existing and future uses in the surrounding area in terms of heights, massing, and an arrangement of buildings and structures; and,

iii) provide adequate access to the property, designed to minimize conflicts between traffic and pedestrians both on-site and on surrounding streets."

The current design of the development provides 400 sq m of commercial use on the ground floor of the proposed podium structure. The development is not located within convenient walking distance of community facilities and services, public transit, or schools. The lands are, however, within walking distance of passive recreational facilities including Edgelake Park to the west and the Waterfront Trail to the north. The Hamilton Street Railway (HSR) has provided comments on the development application which identify that the area is currently serviced by Trans Cab with monitoring to determine if improved public transit should be extended to this area.

The subject lands are located adjacent to North Service Road, which is designated as a Minor Arterial Road on Schedule "C" – Functional Road Classification of the UHOP. Access to North Service Road is provided by Green Road, which is designated as a Local Road. This portion of Green Road does not contain low density residential dwellings which ensures Policy E.6.7 is met.

Two storey block townhouses and two storey street townhouse dwellings are located to the north and west of the subject lands, respectively. The current design of the development does not provide an intervening land use to transition from the high profile building to the adjacent low profile residential uses and has not demonstrated that the height and massing of the development is compatible with existing uses in the area. In addition, adequate buffering and landscaping has not been provided at the ground level. Extensive amenity features have been proposed above the four storey podium.

The proposed development is seeking a reduction of parking from 2,763 spaces to 2,409 spaces (2,387 residential spaces and 22 commercial parking spaces). The applicants have provided a Parking Justification Study as part of the Traffic Impact Study (TIS) prepared by Paradigm Transportation Solutions Ltd, dated December 2018, in support of the parking reduction. The rationale provided by the applicant is not supported by staff and revisions are required to the study before staff can evaluate a request for parking reduction. Additional comments regarding the Parking study have been outlined in Appendix "D" to Report PED19115.

Further, a preliminary review of the TIS has been conducted by staff which identifies that additional information is required in support of the development. Additional details regarding traffic infrastructure such as turn lanes, traffic signals, and configuration of site access is required to ensure the development minimizes conflicts between pedestrians and traffic.

<u>Urban Design</u>

Section B.3.3 of the UHOP provides Urban Design direction for new development. Some of the key policies, amongst others, include the following:

"B.3.3.1.3 Create pedestrian oriented places that are safe, accessible, connected, and easy to navigate for people of all abilities.

B.3.3.1.4 Create communities that are transit-supportive and promote active transportation.

B.3.3.1.5 Ensure that new development is compatible with and enhances the character of the existing environment and locale.

B.3.3.2.4 Quality spaces physically and visually connect the public and private realms. Public and private development and redevelopment should create quality spaces by:

a) organizing space in a logical manner through the design, placement, and construction of new buildings, streets, structures, and landscaping;

b) recognizing that every new building or structure is part of a greater whole that contributes to the overall appearance and visual cohesiveness of the urban fabric;

c) using materials that are consistent and compatible with the surrounding context in the design of new buildings;

d) creating streets as public spaces that are accessible to all;

e) creating a continuous animated street edge in urban environments;

f) including transitional areas between the public and private spaces where possible through use of features such as landscaping, planters, porches, canopies, and/or stairs;

g) creating public spaces that are human-scale, comfortable, and publicly visible with ample building openings and glazing;

h) creating, reinforcing, and emphasizing important public vistas and view corridors; and,

i) minimizing excessive street noise and stationary noise source levels through the design, placement, and construction of buildings and landscaping."

The development proposes pedestrian oriented uses at the ground level of the development including eight ground related units along Green Road and 400 sq m of commercial floor area at the intersection of Green Road and Frances Avenue. The

proposed 1,836 units will provide for population needed to support transit infrastructure. However, additional information is required from the applicant to demonstrate compatibility between the existing uses and the proposed development, including the design and placement of tower component.

"B.3.3.2.6 Where it has been determined through the policies of this Plan that compatibility with the surrounding areas is desirable, new development and redevelopment should enhance the character of the existing environment by:

a) complementing and animating existing surroundings through building design and placement as well as through placement of pedestrian amenities;

B.3.3.3.2 New development shall be designed to minimize impact on neighbouring buildings and public spaces by:

a) creating transitions in scale to neighbouring buildings;

b) ensuring adequate privacy and sunlight to neighbouring properties; and,

c) minimizing the impacts of shadows and wind conditions."

The applicant is required through the Site Plan Control process to ensure the above noted policies have been met. In support, the applicant has submitted a Shadow Impact Analysis prepared by KNYMH Inc., dated December 19, 2018 and a Pedestrian Wind Assessment, prepared by RWDI, dated June 7, 2018 to demonstrate that the objectives of the Urban Design policies have been met (see Appendix "C" to Report PED19115). Additionally, the proposal was presented to the Design Review Panel on April 11, 2019 for feedback in context of how to best address these policies (see Appendix "E" to Report PED19115). A summary of staff's comments, which state that insufficient details have been provided for both documents, has been outlined in Appendix "D" to Report PED19115. Additional information such as specific mitigation measures to wind impacts, and existing shadows within the neighbourhood, have not been provided to ensure that the development minimizes shadow and wind conditions.

Road and Railway Traffic Noise and Vibration

"B.3.6.3.7 A noise feasibility study, or detailed noise study, or both, shall be submitted as determined by the City prior to or at the time of application submission, for development of residential or other noise sensitive land uses on lands in the following locations:

a) 100 metres of a minor arterial road, as identified on Schedule C – Functional Road Classification;

c) 400 metres of a truck route;

d) 400 metres of an existing or proposed parkway or provincial highway (controlled access), as identified on Schedule C – Functional Road Classification;"

The subject lands are adjacent to North Service Road, which is identified as a minor arterial road on Schedule "C" – Functional Road Classification of the UHOP and is approximately 25 metres from the QEW, a Provincial Highway and a truck route. An Environmental Noise Impact Study has been submitted for staff's review as part of the application (see Appendix "C" to Report PED19115). A summary of staff's comments, which require additional clarification from the applicant, has been outlined in Appendix "D" to Report PED19115.

Natural Heritage System – Core Areas

C.2.3 It is the intent of this policy to preserve and enhance Core Areas and to ensure that any development or site alteration within or adjacent to them shall not negatively impact their natural features or their ecological functions.

The subject property is located within the boundaries of the Urban Hamilton Official Plan (UHOP). Based on Schedule B (Natural Heritage System) of the UHOP, Core Areas have been identified adjacent to the subject property. In this case, the Core Areas have been identified as Stoney Creek Watercourse 1 (regulated by the Hamilton Conservation Authority; HCA), Community Beach Ponds Environmentally Significant Area (ESA) and Lake Ontario.

Due to the size of the proposed development and the amount of glass/window surface there is concern that the function of the adjacent Core Areas may be impacted per Policy C.2.3 of the UHOP. These impacts include bird-window collisions, potential predation of local wildlife by pets, dumping and the introduction of invasive species within the ESA. Staff have requested that the owner demonstrate that the development meets bird friendly design best practices. A Bird Impact Assessment discussing the direct and indirect impacts on birds as well as implementation of specific bird-friendly design elements that will be incorporated into the development is required to address this comment (see Appendix "D" to Report PED19115). The Assessment will be required with the next comprehensive submission from the applicant.

Traffic Management

C.4.5.12 The City shall require transportation impact studies to assess the impact of proposed developments on current travel patterns and/or future transportation requirements. These studies shall be submitted as part of

applications for Official Plan amendments, subdivision approvals, major rezoning and major site plan approvals.

C.4.5.19 New development on properties adjacent to major arterial and minor arterials and where necessary, collector roads, shall include provisions for sufficient parking, loading, manoeuvring and off-street parking."

The applicant has submitted a Traffic Impact Study (TIS) prepared by Paradigm Transportation Solutions Ltd., dated December 2018, in support of the proposed development. A copy of the report has been included in Appendix "C" to Report PED19115. Preliminary staff comments note that revisions to the TIS are required to meet Ministry of Transportation terms of reference.

A Parking Justification Study has been provided to support a reduction in parking from 1.5 parking spaces per unit to 1.3 parking spaces, which includes visitor parking. The rationale provided by the applicant is not supported by staff and revisions are required to the study before staff can evaluate a request for a parking reduction. Additional comments have been outlined in Appendix "D" to Report PED19115.

Based on the foregoing, the proposal, as currently proposed, does not comply with the UHOP.

Stoney Creek Zoning By-law No. 3692-92

The subject lands are zoned Mixed Use Commercial "MUC-4" Zone, modified in the former City of Stoney Creek Zoning By-law No. 3692-92. This zone permits mixed use developments in the form of commercial uses on the ground floor with residential uses above.

Through review of the application, staff have identified the following non-conformities to the "MUC-4" Zone, modified:

- Minimum rear yard setback of 0.681 m to Tower 1, whereas a minimum setback of 3.0 m is required;
- Minimum amenity space of 33,169.3 sq m, of which 1,806 sq m is proposed as a combined indoor amenity area, whereas 55,031 sq m of amenity area is required;
- Minimum landscaped open space of 20%, whereas 50% landscaped open space is required;
- Minimum 1.1 m landscaped strip along Frances Avenue and 0.6 m wide landscaped strip, whereas a minimum 5.0 m wide landscaped strip adjacent to a street is required;
- Minimum 3.6 m landscaped strip adjacent to another lot, whereas a minimum 9.0 m landscaped strip adjacent to another lot is required;

- Minimum 2,387 residential parking spaces and 22 commercial parking spaces, whereas 2,763 residential parking spaces and 1 parking space for every 28 sq m of commercial parking spaces is required;
- To permit consolidated residential and commercial driveway access whereas commercial and residential parking shall be separate with separate points of ingress and egress; and,
- To permit residential uses, including associated amenity areas on the ground floor, whereas residential uses shall be located above the ground floor.

The scope of these non-conformities could be considered by the Committee of Adjustment through a Minor Variance application, given the variances meet the following tests under Section 45(1) of the *Planning Act*:

- The variance meets the general intent and purpose of the Official Plan;
- The variance meets the general intent and purpose of the Zoning By-law;
- The variance is desirable for the appropriate use of the land; and,
- The variance is considered minor in nature.

The impact of the variances is integral to the evaluation of the above noted tests. Accordingly, the scale of these variances may not be appropriate for this site but may be appropriate for another development. Staff have not indicated whether these variances can be supported from a Planning perspective as revisions and further evaluation is needed to address some of the other issues that been identified through the review process. Once the list of all variances has been finalized, staff will be coordinating with the local Ward Councillor and the applicants to determine how best to engage with the public. This engagement may be in the form of an information letter, or a public open house hosted by the Ward Councillor and / or the applicant.

RELEVANT CONSULTATION

Design Review Panel

The proposal was presented by the applicants to the DRP on April 11, 2019. DRP provided technical feedback from a design perspective which encouraged breaking up the main podium into separate towers and providing additional uses at the ground level. A full copy of the meeting minutes has been included in Appendix “E” to Report PED19115. The applicant has not formally submitted a revised proposal and continues to dialogue with staff on the design of the proposal.

Public Input

Several delegations were made at the April 16, 2019 Planning Committee in response to the proposed development. Overall, the following concerns were raised by the delegations:

- Departure from the original approved development concept, approved on February 10, 2010;
- Opposition to proposed density;
- Opposition to proposed height;
- Development out of scale with the surrounding neighbourhood;
- Reduction of provided parking as on-street parking in the neighbourhood cannot be accommodated;
- Adjacent properties will be negatively impacted by shadow;
- Stormwater management impacts;
- Impacts on migratory bird patterns; and,
- Traffic congestion.

Section 41(6) of the *Planning Act* does not give City Council, or its designates, the authority to limit the height and density of proposed buildings through the Site Plan application process. The intent of the Site Plan Control process is to evaluate the details of development as it implements applicable Official Plan policies, the Zoning By-law, and meets appropriate design guidelines not limited to planning, engineering and transportation perspectives. The concerns noted above will be addressed through the technical review of the Site Plan Control Application based on this lens.

Two of the delegations submitted materials in support of the development per the following items:

- Suburban neighbourhoods can function in harmony with high rise developments;
- Development will provide condo ownership and rental opportunities;
- Encourage affordable home ownership;
- Development will encourage job growth;
- Encourage transit services in the area; and,
- Development includes high quality landscaping.

All of the comments above will be considered as part of the final approved Site Plan process.

Development Review Team Meeting

On April 24, 2019, the Ward Councillor and City staff met with the applicants to discuss the technical review of the application. A summary of staff's comments, which include all commenting agencies and departments, has been included in Appendix "D" to Report PED19115. The following key issues have been raised by staff as concerns for the development:

- Site servicing (sanitary sewers, watermain capacity and stormwater management, see Appendix "D" to Report PED19115);

- Traffic Impact;
- Parking;
- Site Design;
- Bird Friendly Design;
- Shadow Impact;
- Wind Impact; and,
- Noise Impact.

Based on the above, the development has been referred back to the applicant for revisions to the site design and adjustments to the technical studies. Staff have scheduled meetings with the applicants to address these concerns. A revised proposal that addresses these comments has not been received to date.

Next Steps

Based on the concerns from staff and commenting agencies, as well as feedback from the public, staff are not in a position to issue Conditional Approval of the proposal in its current form. The applicant will be working with staff to refine the development proposal per applicable policies and guidelines. Once the development has been adjusted, detailed revisions to the supporting studies will be requested for staff's review. Staff will again coordinate with the local Ward Councillor regarding on-going public engagement as part of subsequent submissions.

ALIGNMENT TO THE 2016 – 2025 STRATEGIC PLAN

Community Engagement & Participation
Hamilton has an open, transparent and accessible approach to City government that engages with and empowers all citizens to be involved in their community.

Healthy and Safe Communities
Hamilton is a safe and supportive city where people are active, healthy, and have a high quality of life.

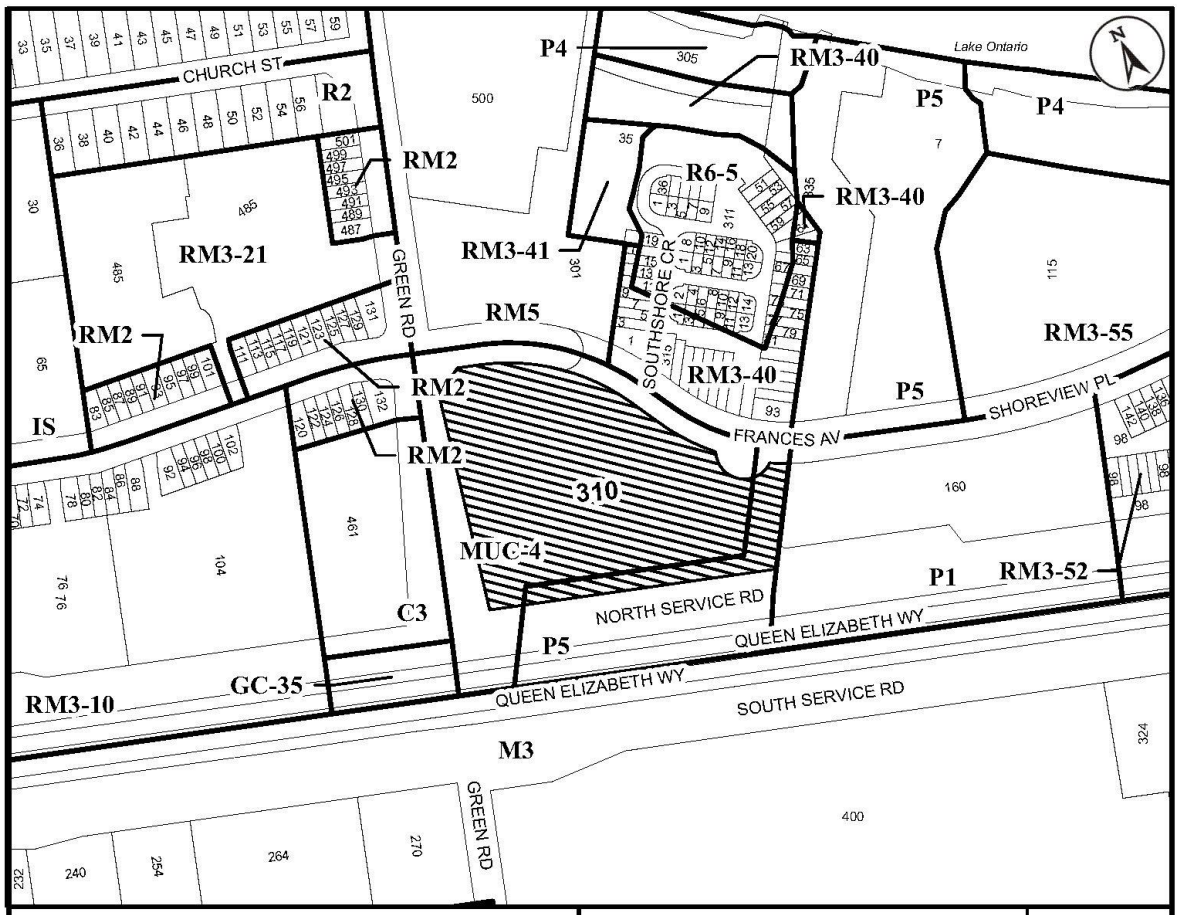
Clean and Green
Hamilton is environmentally sustainable with a healthy balance of natural and urban spaces.

Built Environment and Infrastructure
Hamilton is supported by state of the art infrastructure, transportation options, buildings and public spaces that create a dynamic City.

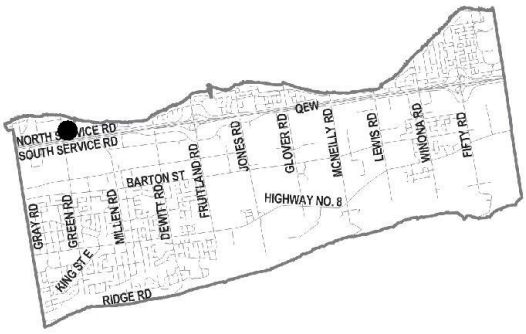
Our People and Performance
Hamiltonians have a high level of trust and confidence in their City government.

APPENDICES AND SCHEDULES ATTACHED

Appendix “A” – Location Map
Appendix “B” – Site Plan & Elevations
Appendix “C” – Technical Studies
Appendix “D” – Comment Summary
Appendix “E” – DRP Minutes



● Site Location



Key Map - Ward 10

Location Map

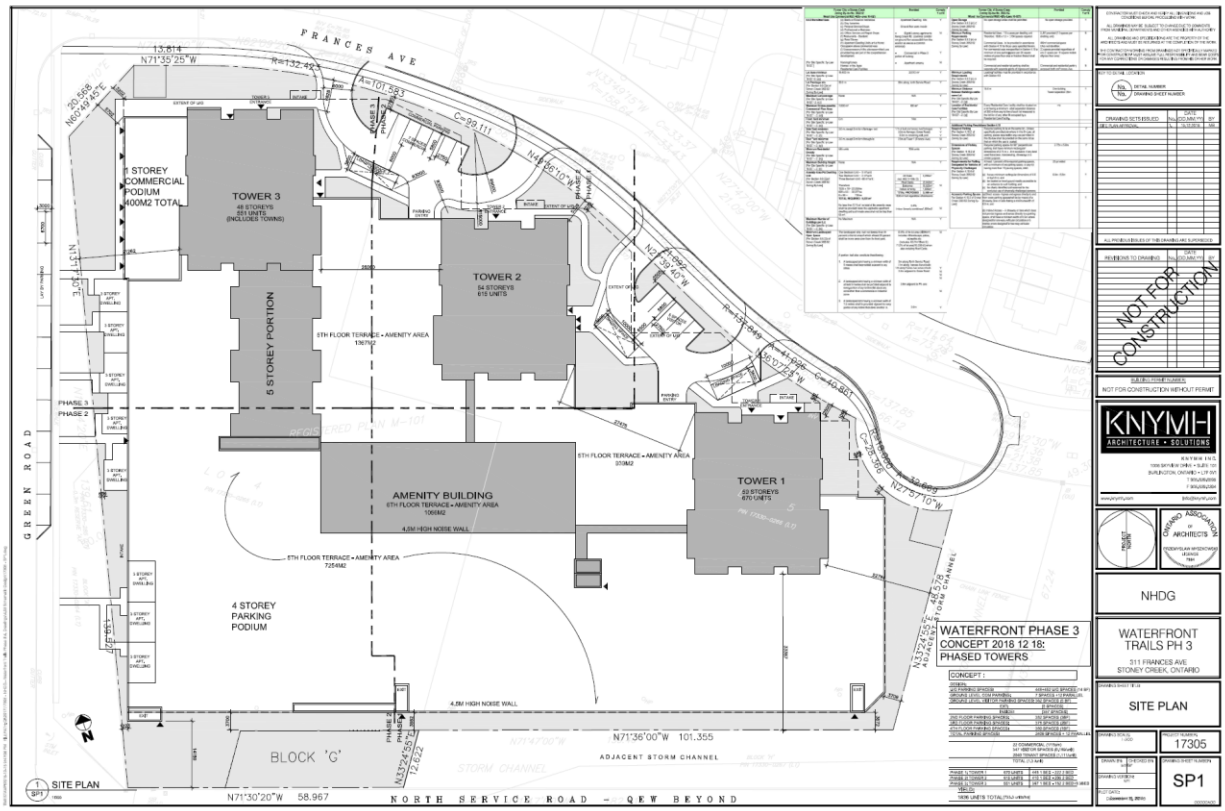
Hamilton

PLANNING AND ECONOMIC DEVELOPMENT DEPARTMENT

File Name/Number: DA-19-020		Date: May 2, 2019
Appendix "A"	Scale: N.T.S	Planner/Technician: MS/NB

Subject Property

310 Frances Avenue, Stoney Creek (Ward 10)


FRANCES AVE
TOWER 3
48 STOREYS
551 UNITS
(INCLUDES TOWNS)
1 STOREY COMMERCIAL PODIUM
400M2 TOTAL
TOWER 2
54 STOREYS
618 UNITS
6 STOREY PORTION
5TH FLOOR TERRACE - AMENITY AREA
1367M2
AMENITY BUILDING
6TH FLOOR TERRACE - AMENITY AREA
1060M2
4.6M HIGH NOISE WALL
TOWER 1
59 STOREYS
670 UNITS
5TH FLOOR TERRACE - AMENITY AREA
370M2
5TH FLOOR TERRACE - AMENITY AREA
724M2
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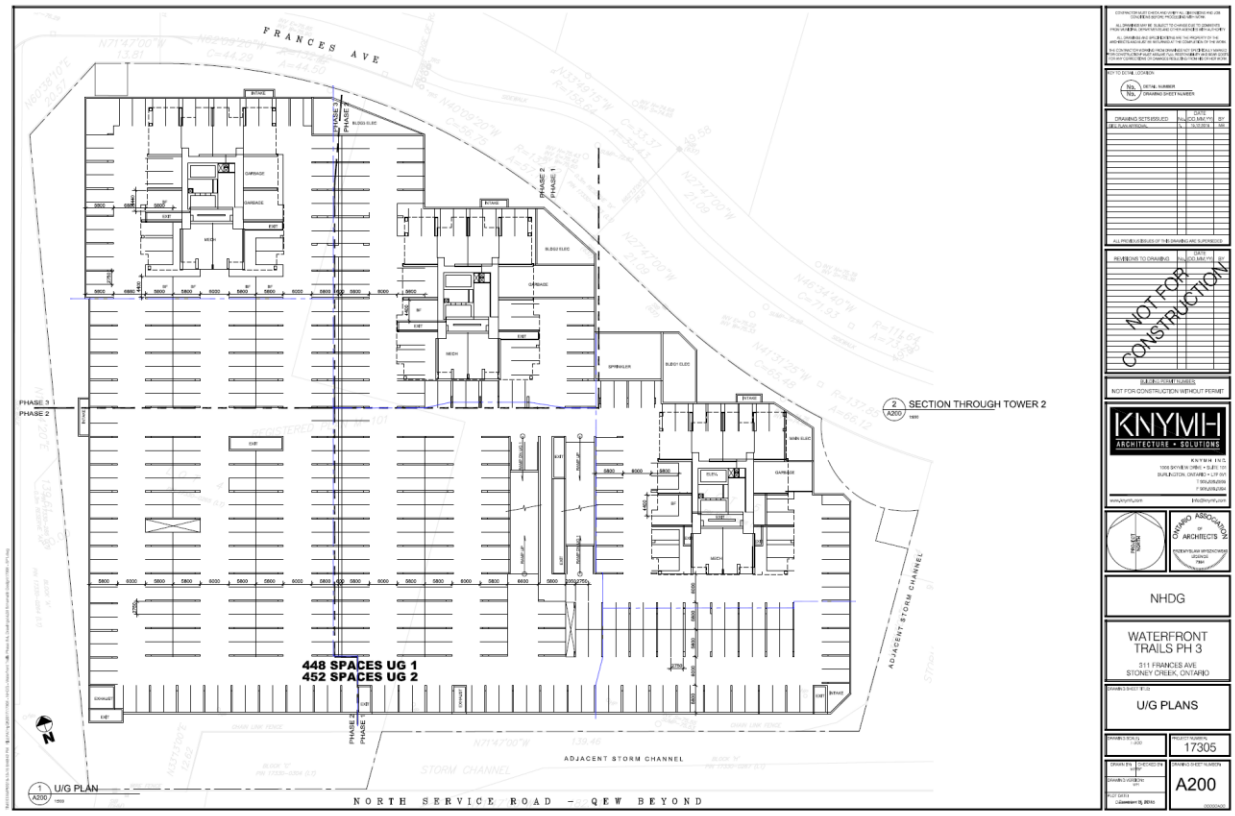
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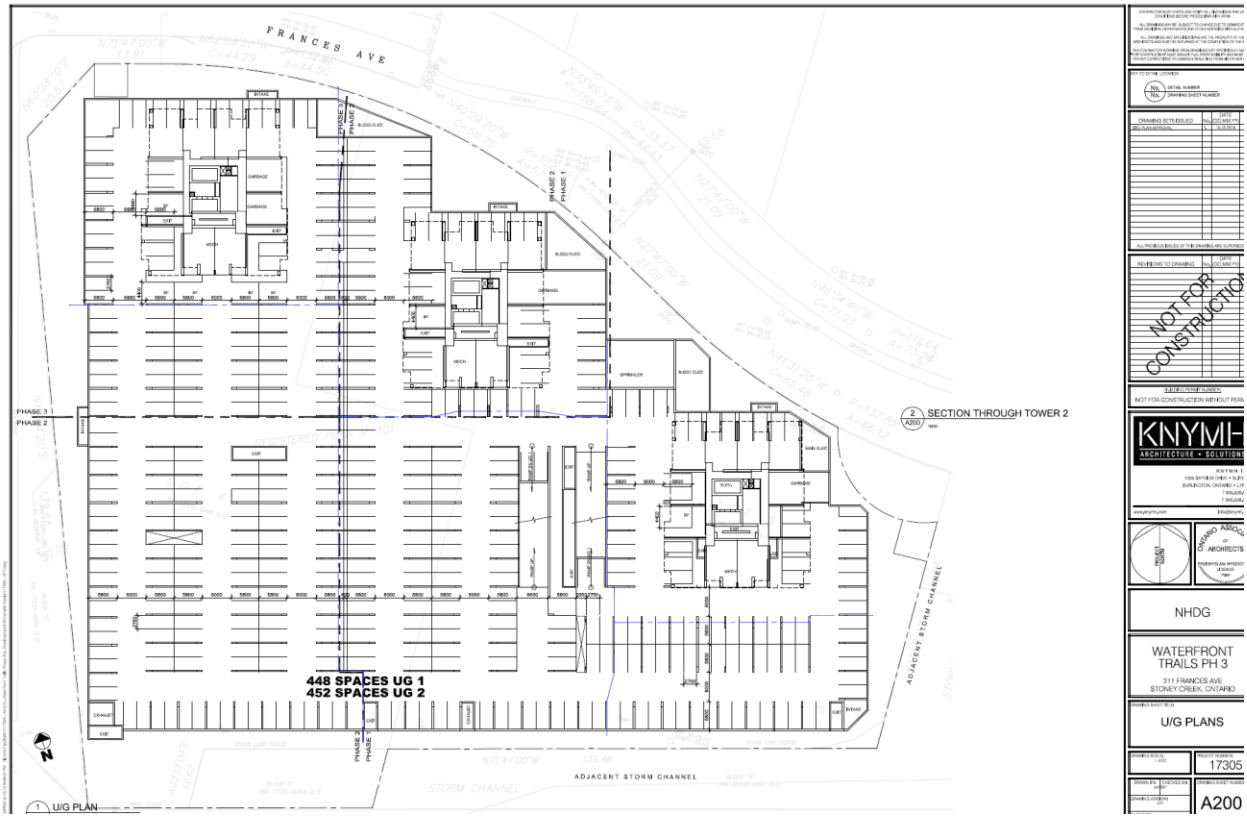
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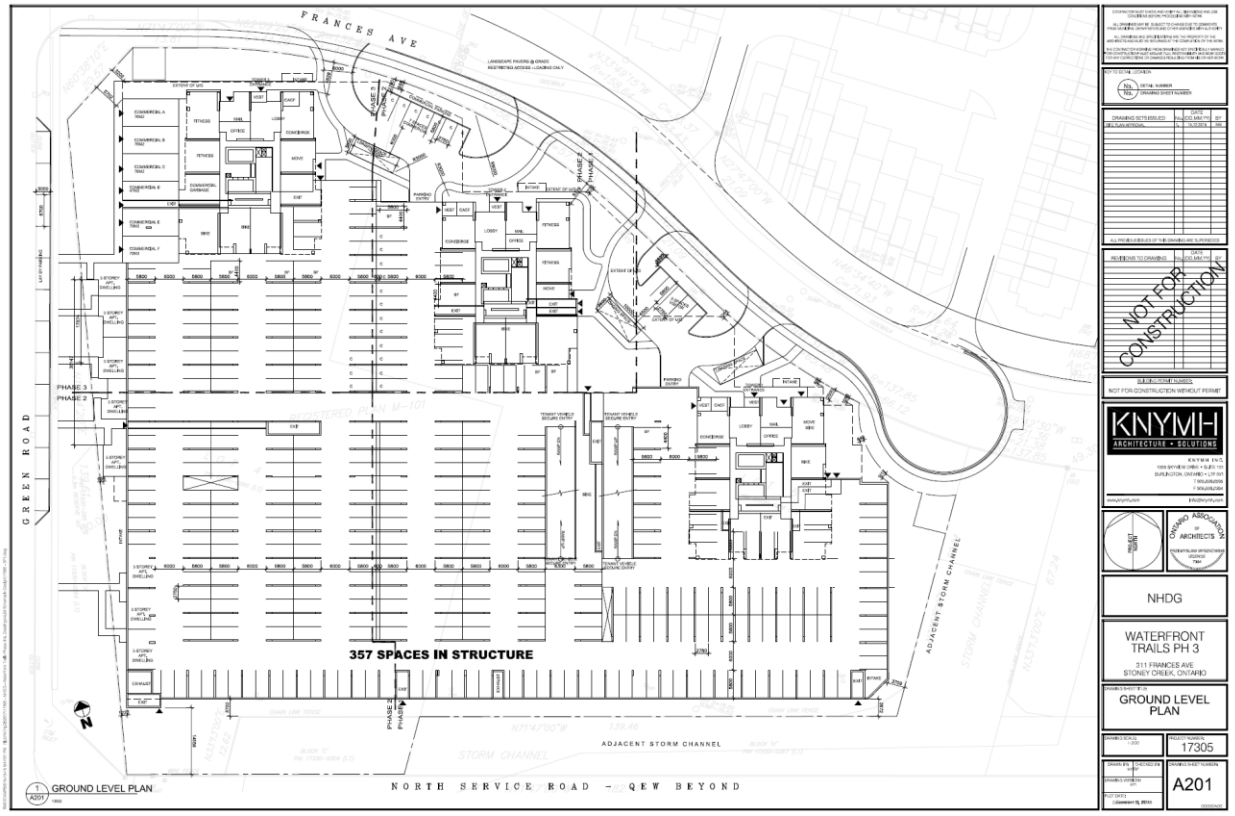
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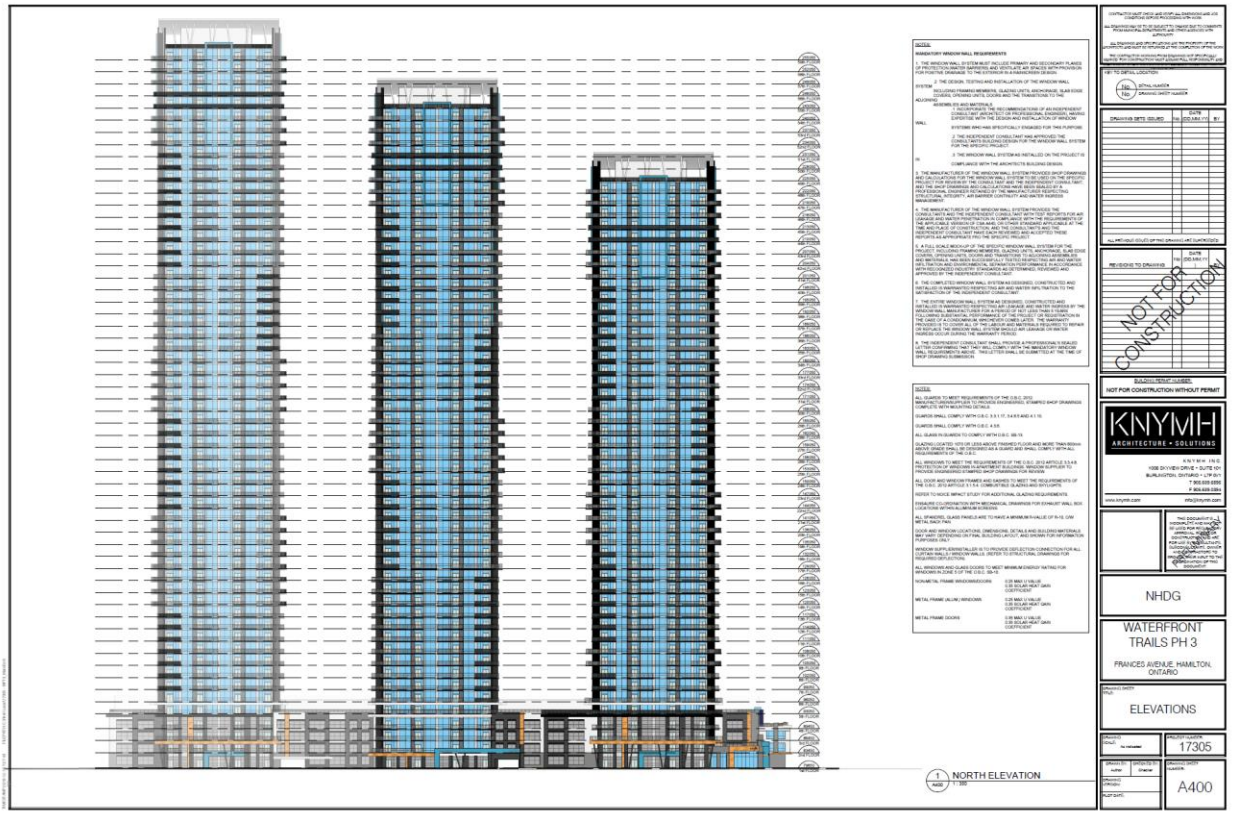
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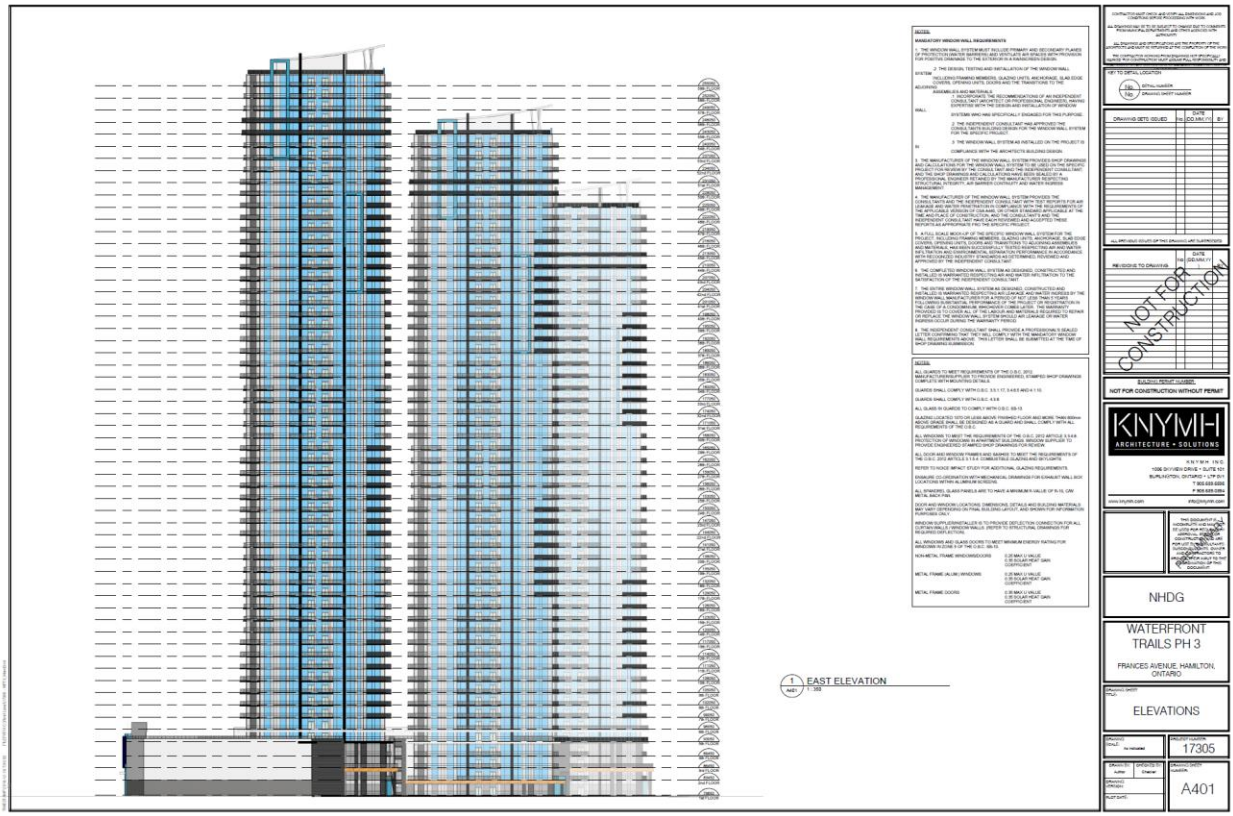
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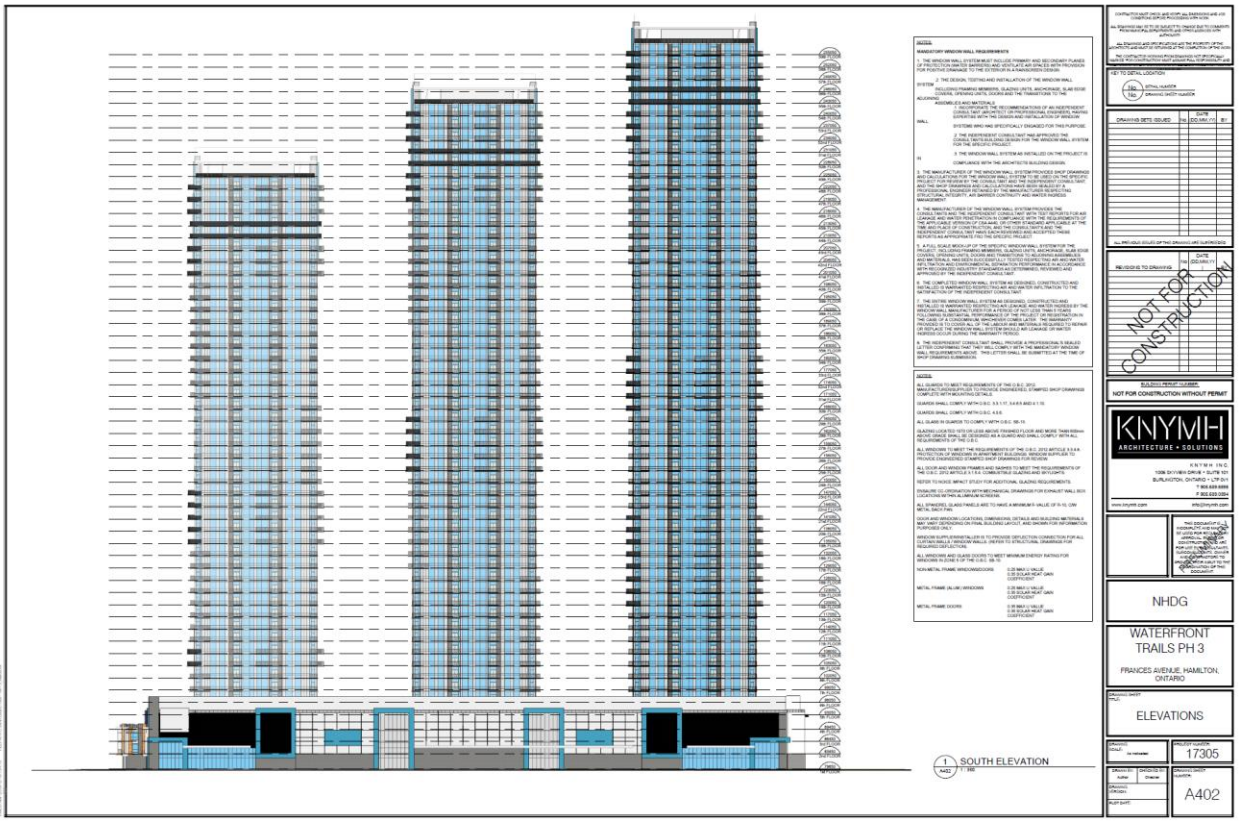
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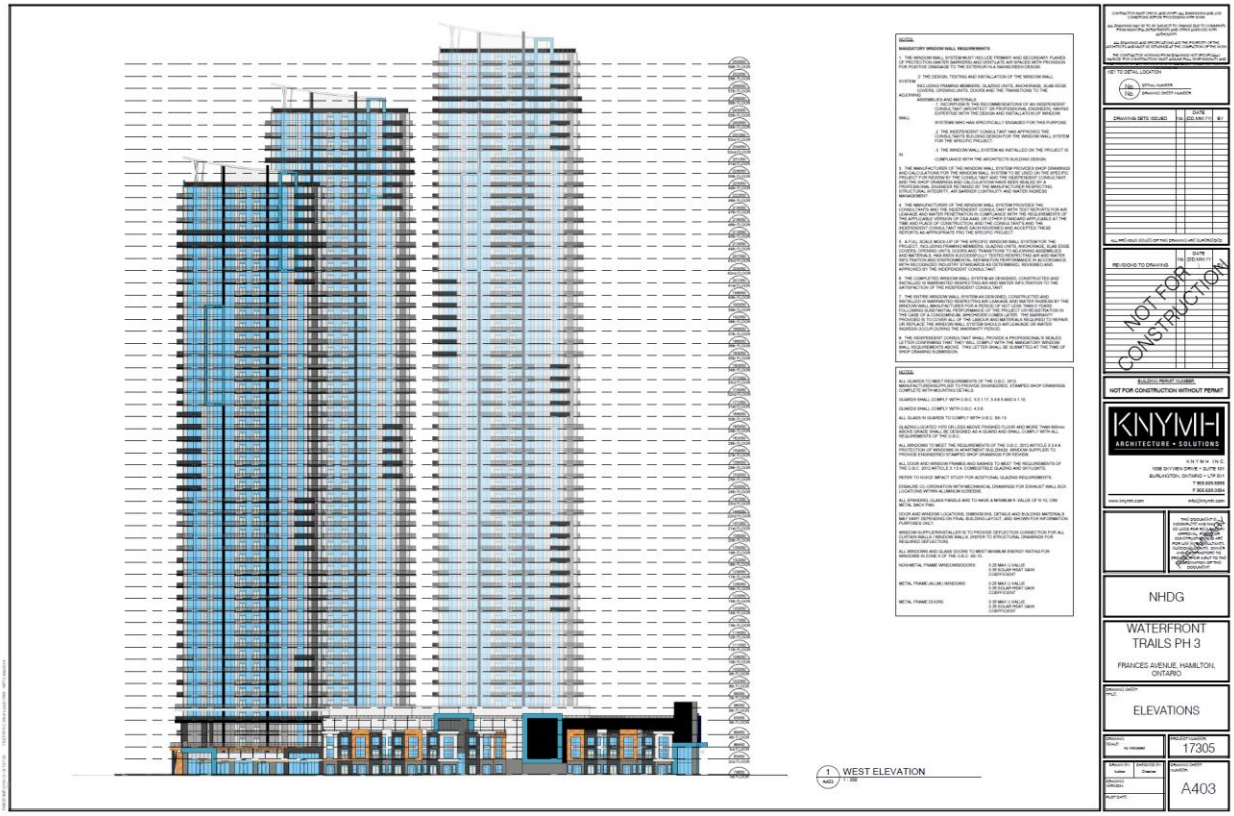
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ELEVATIONS
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TRANSPORTATION SOLUTIONS LIMITED

Waterfront Trails Transportation Impact, Parking Justification & TDM Options Study

Paradigm Transportation Solutions Limited

December 2018

Project Number
180010

December 2018

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Waterfront Trails Transportation Impact, Parking Justification & TDM Options Study

Signatures and Seals

Signature

Engineer's Seal

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Executive Summary

Content

Paradigm Transportation Solutions Limited (Paradigm) was retained by New Horizon Development Group (Sapphire) Inc. to conduct this Transportation Impact, Parking Justification and TDM Options Study for the proposed residential and commercial development to be located at 310 Frances Avenue in the City of Hamilton, Ontario.

This study includes an analysis of existing traffic conditions, a description of the proposed development, traffic forecasts for each phase of development, a parking assessment, transportation demand management assessment and recommendations for any required roadway improvements to accommodate future traffic conditions.

Development Concept

The proposed commercial development is located on the south side of Frances Avenue east of Green Road. The property is currently vacant land bordered by residential dwellings to the north and a small commercial development to the west.

The subject site is proposed to include a total of 1,836 residential units in three high-rise buildings with a total of 400 square metres (4,306 square feet) of ground-floor commercial retail space. An on-site parking supply of 2,438 spaces is proposed to service the residential component of the site, including 20 barrier free spaces. Seven (7) parking spaces are proposed for the commercial component. All parking spaces are provided in an above-grade parking structure.

The development will be constructed in three phases with one building completed every two years from 2021 (Phase 1) to 2025 (full build-out). Vehicular access to the site is proposed via four (4) all-turns driveway connections to Frances Avenue. These driveways (herein referred to as “Site Access”) are planned to be stop-controlled on the minor road (driveway) approach.

Conclusions

Based on the investigations carried out, it is concluded that:

Existing Traffic Operations

Under existing traffic conditions, all intersections within the study area are operating at acceptable levels of service (LOS) during the AM and PM peak hours. The following critical movement is noted:

- North Service Road and Green Road:

- Southbound left-turn movement – LOS D during the PM peak hour with a v/c ratio of 0.28. The low v/c ratio on this movement indicates the delay is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

Development Generated Traffic

At full build-out, the development is forecast to generate 556 and 666 trips during the AM and PM peak hours, respectively.

2021 Background Traffic Operations

Under 2021 background traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movement is noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS D with a v/c of 0.32 during the AM peak hour and LOS F with a v/c of 0.57 during the PM peak hour. The low to moderate v/c ratios indicate the delay is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

2021 Total Traffic Operations (Phase 1)

Under 2021 total traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS E with a v/c ratio of 0.58 during the AM peak hour and LOS F with a v/c ratio of 1.25 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 11 metres during the PM peak hour;
  - Southbound right-turn movement – LOS D with a v/c ratio of 0.59 during the AM peak hour; and
  - The moderate v/c ratios during the AM peak hour indicate the delay is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

2023 Background Traffic Operations

Under 2023 background traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 0.62 during the AM peak hour and LOS F with a v/c ratio of 1.40 during the PM peak hour. The95th percentile queue is forecast to exceed the available storage by 16 metres during the PM peak hour;
  - Southbound right-turn movement – LOS D with a v/c ratio of 0.62 during the AM peak hour; and
  - The moderate v/c ratios during the AM peak hour indicate the delay is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

2023 Total Traffic Operations (Phase 2)

Under 2023 total traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS E with a v/c ratio of 0.93 during the AM peak hour and LOS F with a v/c ratio of 2.66 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 15 metres during the AM peak hour and 51 metres during the PM peak hour;
  - Southbound right-turn movement – LOS D with a v/c ratio of 0.95 during the AM peak hour; and
  - Overall intersection – LOS E during the PM peak hour.

2025 Background Traffic Operations

Under 2025 background traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 1.0 during the AM peak hour and LOS F with a v/c ratio of 2.97 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 21 metres during the AM peak hour and 55 metres during the PM peak hour;
  - Southbound right-turn movement – LOS F with a v/c ratio of 1.01 during the AM peak hour; and
  - Overall intersection – LOS D during the AM peak hour and LOS F during the PM peak hour.

2025 Total Traffic Operations (Full Build-Out)

Under 2025 total traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- Green Road and Frances Avenue:
  - Westbound left-turn/through/right-turn movement – LOS D with a v/c ratio of 0.79 during the AM and 0.74 during the PM peak hour.
- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 1.40 during the AM peak hour and a v/c ratio of 5.47 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 59 metres during the AM peak hour and 55+ metres during the PM peak hour;
  - Southbound right-turn movement – LOS F with a v/c ratio of 1.33 during the AM peak hour; and
  - Overall intersection – LOS F during the AM and PM peak hours.

Remedial Measures

The following remedial measures are required to provide acceptable levels of service at the study area intersections:

- Traffic signals at the intersection of North Service Road and Green Road. Although not warranted until 2025, the signals should be installed as part of Phase 1 of the development (2021) to provide acceptable levels of service on all approaches;
- A separate westbound right-turn lane should be provided at the intersection of North Service Road and Green Road at the 2025 horizon. This lane warrants 7.5 metres of storage and 120 metres of taper and parallel lane; however, due to environmental constraints, only 10 metres of storage and 15.8 metres of taper can be provided within the right-of-way without significant reconstruction;
- A separate westbound left-turn lane should be provided at the intersection of Green Road and Frances Avenue at the 2025; and
- The southbound left-turn lane at North Service Road and Green Road should be increased by 15 metres by the 2025 horizon.

These improvements are directly related to the increase in traffic due to development of the subject site.

Parking Assessment

City of Stoney Creek By-law Parking Requirements

Based on the City of Stoney Creek Zoning By-law 3692-92, a total of 3,090 parking spaces will be required to service the residential component of the site. A total of 2,438 spaces are proposed. This is a deficiency of 652 spaces or 21% of the By-law parking requirement.

Proxy Site Survey Data

Parking utilization surveys were undertaken at a proxy site in Burlington, Ontario (3060/3070 Rotary Way). Based on the maximum observed demand at the proxy sites, a total of 2,295 spaces would be required to service the site during the peak weekday period. A total of 2,438 spaces are proposed. This is a surplus of 143 spaces or 106% of the proxy site parking requirement.

Overall Findings

The Zoning By-law results in a deficiency in parking of 652 spaces and the proxy site data results in a surplus of 143 spaces. The proxy site data provides an accurate representation of the parking demands for the site as they are based on area-specific data and not a general Zoning By-law. Additionally, it further supports a reduction in parking requirements for the site. Therefore, the proposed parking supply should adequately accommodate the parking demands of the site.

TDM Options

The proposed site with nearby connections to bicycle facilities and transit routes has the potential to be an accessible development. Further enhancing these elements inside and outside the boundaries of the development will ensure these opportunities do not go unused.

By incorporating the TDM options contained in this report, such as improving walking and cycling facilities, reducing the parking supply and developing individualized travel plans for residents (alternative mode trip planning, carpool arrangements, etc.), the site will set the tone for the surrounding area in helping to achieve the City's long-term transportation goals.

Recommendations

Based on the findings of this study, it is recommended that:

- The City of Hamilton recognize the conclusions drawn above;
- The site be allowed to be developed as planned;
- The site driveway connections operate under stop sign control;
- The City install traffic signals at the intersection of North Service Road and Green Road by buildout of Phase 1 in 2021. The signal timing and phasing should be optimized as required;

- A separate westbound right-turn lane with 10 metres of storage and 15.8 metres of taper should be provided at the intersection of North Service Road and Green Road at the 2025 horizon;
- A separate westbound left-turn lane with 45 metres storage should be provided at the intersection of Green Road and Frances Avenue at the 2025 horizon. This can be accomplished through pavement markings;
- The southbound left-turn lane at North Service Road and Green Road should be extended by 15 metres by the 2025 horizon. This can be accomplished through pavement markings; and
- The applicant should ensure proper pedestrian and cyclist connections from the surrounding roads to the buildings' main entrances;
- Current bus schedules are provided within the lobby of each building to further promote the use of transit; and
- The buildings' management should work with the buildings' residents to form a travel planning committee/team that will help develop individualized travel plans (alternative mode trip planning, carpool arrangements, etc.) for interested residents. To assist the committee/team, the applicant should consider providing a kiosk within the lobby of each building for use by the committee/team.

Contents

Appendices

Figures

Tables

1 Introduction

1.1 Overview

Paradigm Transportation Solutions Limited (Paradigm) was retained by New Horizon Development Group (Sapphire) Inc. to conduct this Transportation Impact, Parking Justification and TDM Options Study for the proposed mixed-use development located at 310 Frances Avenue in Hamilton, Ontario. **Figure 1.1** details the study area and location of the subject site.

The development is proposed to be constructed in three (3) phases to include three (3) high-rise apartment buildings with a total of 1,836 units and 400 square metres (4,306 square feet) of commercial space. A total of 2,438 parking stalls are proposed to service the residential component of the site, including 20 barrier free spaces. Seven (7) parking spaces are proposed for the commercial component. Vehicular access to the site is proposed via four (4) all-turns driveway connections to Frances Avenue. The site is expected to be fully built and occupied by 2025.

1.2 Purpose and Scope

The purpose of this study is to assess the impacts of the subject site on the adjacent roadway network, to determine the improvements necessary (if any) to mitigate impacts and to assess the adequacy of the proposed parking supply.

The scope of the study includes the following:

- Determination and assessment of the current traffic conditions in the vicinity of the site;
- Determination and assessment of the additional traffic that will be generated by the proposed development;
- Analyses of the impacts of the additional traffic;
- Assessment of the adequacy of the proposed parking supply;
- Assessment of the transportation demand management measures integrated into the site plan; and
- Recommendations on the measures required to accommodate the traffic in a satisfactory manner.

This report has been prepared to meet the City of Hamilton Traffic Impact Study (TIS) Guidelines[1]. This report assesses traffic conditions corresponding to the 2021 (Phase 1 opening year), 2023 horizon (Phase 2 opening year) and 2025 horizon (Phase 3 Full Build-Out), as required under the City of Hamilton Guidelines.

[1] City of Hamilton, *Traffic Impact Study Guidelines*, July 2009

Denotes Study Area Intersection

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Study Area and Subject Development Location

Waterfront Trails Transportation Impact, Parking Justification and TDM Options Study
180010

Figure 1.1

Appendix A contains the pre-study consultation correspondence with the City of Hamilton staff.

1.3 Study Area Intersections

The following intersections were investigated in this study:

- Green Road and Frances Avenue (two-way stop control);
- North Service Road and Green Road (two-way stop control);
- North Service Road and Millen Road (two-way stop control); and
- The four (4) proposed site driveway connections to Frances Avenue (two-way stop control).

2 Existing Conditions

This section documents current traffic conditions, operational deficiencies and constraints experienced by the public travelling at the intersections within the study area. The operational deficiencies and constraints identified at this stage will be fundamental to the process of defining the required remedial measures.

2.1 Road Network

The characteristics of the roadways in the study area are described below. Reference was made to the City of Hamilton's Official Plan[2]. All intersections within the study area are stop-controlled.

- **North Service Road** is an east-west minor arterial roadway between Centennial Parkway and Fruitland Road. North Service Road has an urban cross-section on the north side and rural cross-section on the south side in the westerly portion of the study area. North Service Road is designated as a full-time truck route by the City of Hamilton. Within the study area, the posted speed limit is 80 kilometres per hour. Parking restrictions are not posted; therefore, parking is subject to City of Hamilton Parking By-law regulations. The surrounding land uses are mainly public park lands and residential development.
- **Green Road** is north-south local roadway running from Lake Ontario in the north to North Service Road/Queen Elizabeth Way (QEW). Green Road continues south of the QEW; however, a direct connection is not provided across the highway. Within the study area, Green Road has a four-lane urban cross-section consisting of one travel lane and one parking "lane" in each direction. The speed limit is not posted; therefore, it is assumed to be 50 kilometres per hour. North of Frances Avenue, parking is permitted on the east side of the roadway and on the west side of the roadway in the vicinity of Church Street. South of Frances Avenue, parking restrictions are not posted; therefore, parking is subject to City of Hamilton Parking By-law regulations. The surrounding land use is mainly residential in nature.
- **Millen Road** is a two-lane minor arterial roadway with an urban cross-section that provides a continuous and direct connection from North Service Road to South Service Road and points further south across the QEW. Millen Road is designated as a full-time truck route by the City of Hamilton. The speed limit is not posted; therefore, it is assumed to be 50 kilometres per hour. Parking is prohibited on the south side of the roadway on the section parallel to Lake Ontario and stopping is prohibited on the west side of the roadway over the QEW.

[2] City of Hamilton. *Urban Hamilton Official Plan Schedule C – Functional Road Classification.* January 2017.

The surrounding land use is residential in nature north of the QEW and light industrial in nature south of the QEW.

- **Frances Avenue** is an east-west two-lane local roadway running from Grays Road in the west ending in a cul-de-sac east of Green Road. Within the study area, Frances Avenue has a two-lane urban cross-section. The speed limit is not posted; therefore, it is assumed to be 50 kilometres per hour. Parking restrictions are not posted; therefore, parking is subject to City of Hamilton Parking By-law regulations. The surrounding land use is mainly residential in nature.

On-street parking on the study area roads is regulated by the City of Hamilton On-Street Parking By-law No. 01-218[3]. The By-law prohibits vehicles from parking for longer than 12 hours at any given time.

Figure 2.1 illustrates the existing lane configurations and traffic control at the study area intersections.

2.2 Existing Transit Service

The City of Hamilton and GO Transit do not currently provide fixed route transit service within 400 metres of the subject site. The nearest fixed transit route in the study area is Route 56 – Centennial, which travels north - south from Eastgate Terminal Platform #3 to Lakeland Community Centre. Service runs daily from 10:00 AM to 6:10 PM on 45- minute headways. The nearest transit stop for Route 56 is located 1.9 kilometres west of the subject site.

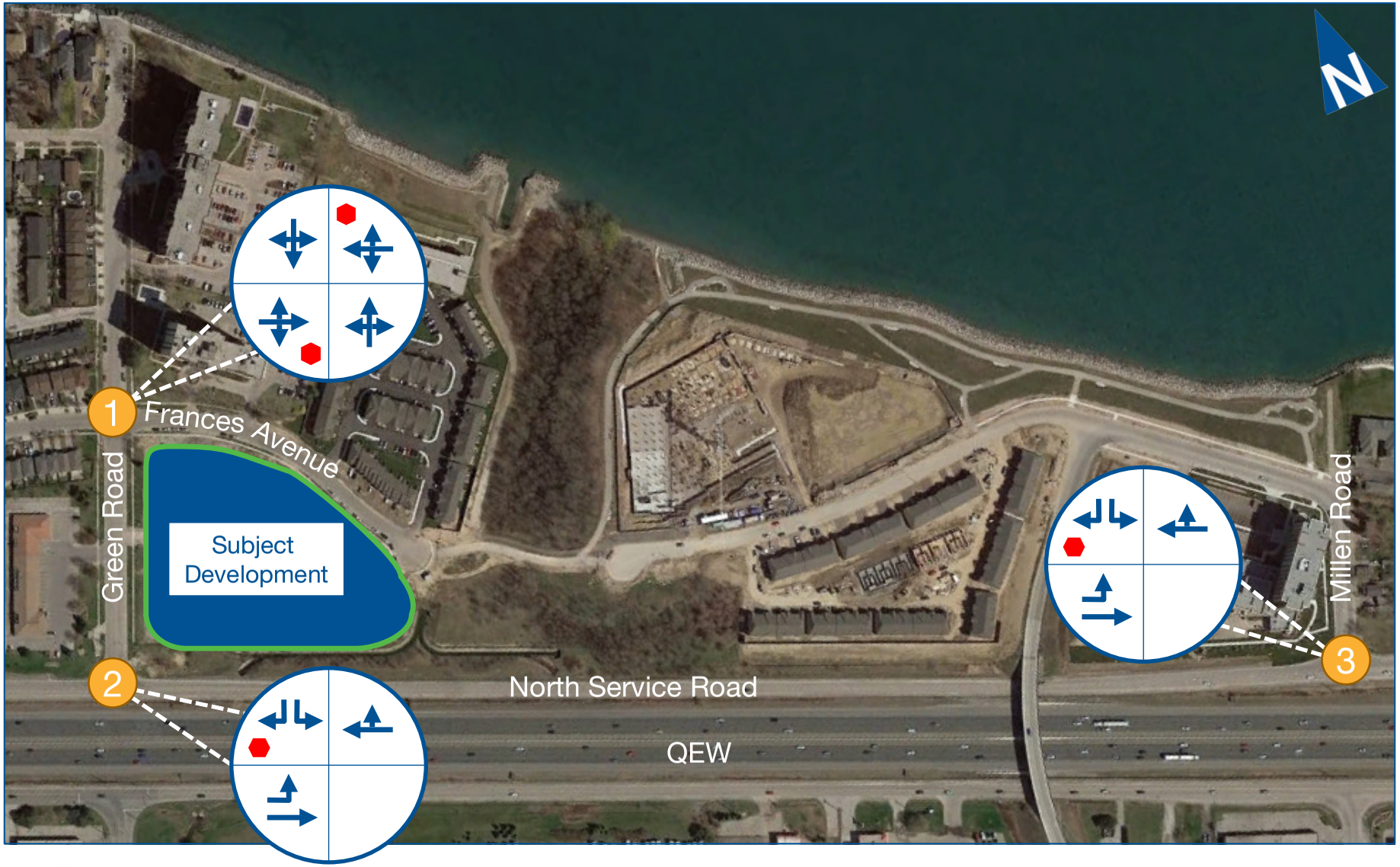
However, the site is located within an area where Trans-Cab service is provided. Trans-Cab is a shared ride taxi service between Hamilton Street Railway (HSR) and Hamilton Cab. It is available to all passengers in Stoney Creek where buses do not currently provide service. The subject site is located within the Bell Manor and Levi-Loop Trans-Cab service area. This service picks up passengers and transports to the nearest bus stop transfer point:

- Confederation Parkway and North Service Road (2.7 kilometres from the subject site); or
- Grays Road and Barton Street (2.0 kilometres from the subject site).

Trans-Cab service is provided Monday through Saturday from 6:00 AM to 7:00 PM. This service costs $0.50 in addition to the standard bus fare ($3.00 or less depending on method of payment).

Figure 2.2 shows the location of the fixed transit routes and Trans-Cab area.

[3] City of Hamilton. *On-Street Parking By-law No. 01-218*.



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Existing Lane Configuration and Traffic Control

Source: City of Hamilton

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Existing Transit Routes

Figure 2.2

2.3 Active Transportation

2.3.1 Walkability

Pedestrian sidewalks are provided throughout the study area as follows:

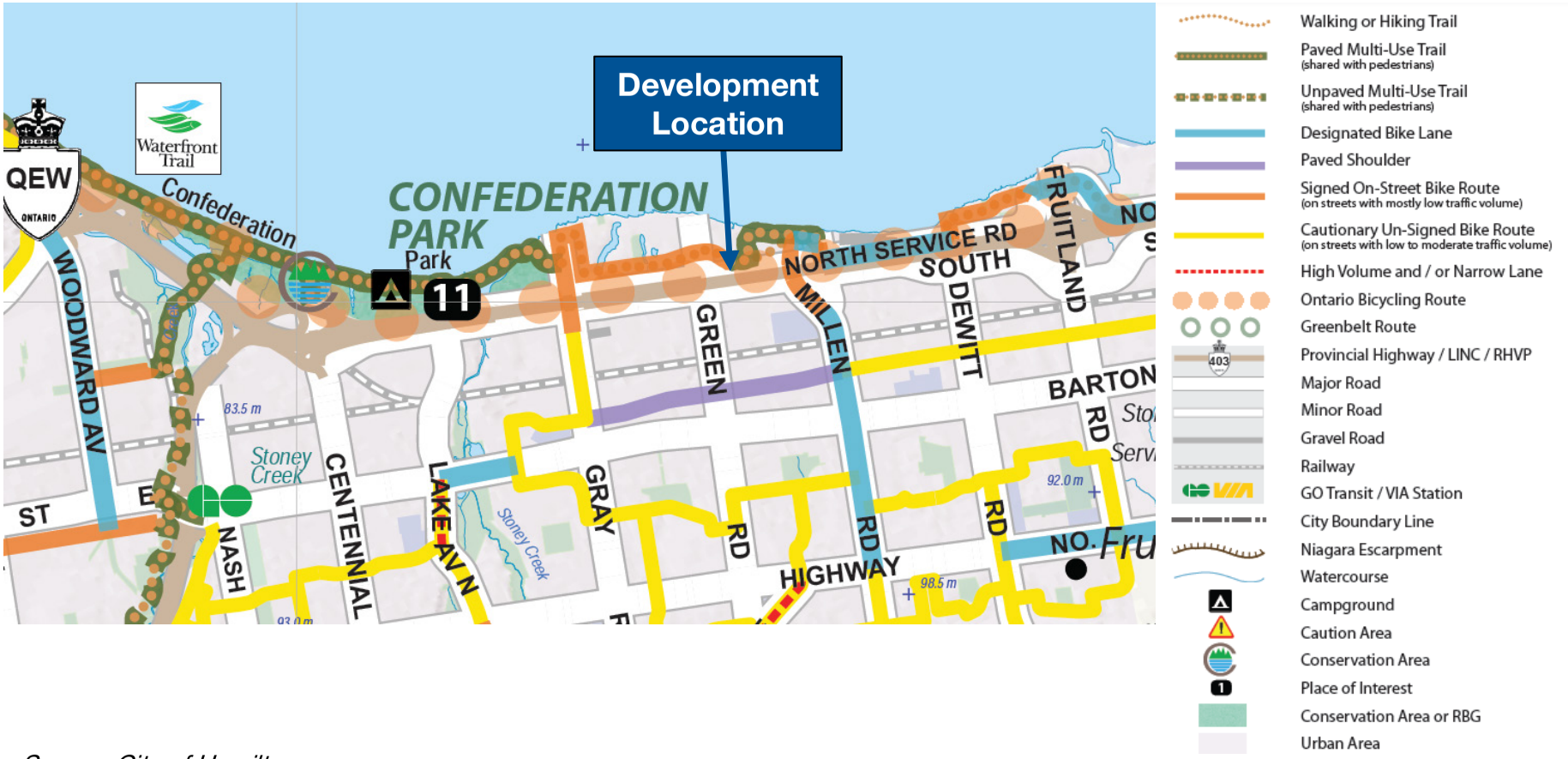
- Green Road
  - Sidewalks are provided on both sides of the roadway.
- Millen Road
  - A sidewalk is provided on the north side of the roadway on the section that runs parallel to Lake Ontario.
- Frances Avenue:
  - Sidewalks are provided along both sides of the roadway.

2.3.2 Cycling

Several roadways within the study area are designated cycling/trail routes. The details of each are as follows:

- **Frances Avenue** from Grays Road to east of Green Road is identified on the City of Hamilton's Rural Cycling Map as an on-street bike route and a walking or hiking trail. East of Green Road, the trail continues eastward through the undeveloped lands as the extension of Frances Avenue and is designated as a paved multi-use trail (shared with pedestrians). This trail is also part of the Waterfront Trail system;
- **North Service Road** is designated as part of the Ontario Bicycle Route. The route is an "inter-regional cycling network of provincially and regionally important links that fill an existing gap needed for cycling routes between regions and extends to all provincial and international boundaries"; and
- **Millen Road/Frances Avenue/Shoreview Place** is designated as a signed on-street bike route throughout the study area. The portion of Millen Road that runs parallel to Lake Ontario (Shoreview Place) is designated as a paved multi-use trail that is part of the Waterfront Trail system. Parking is available on the north side of Shoreview Place.

Figure 2.3 shows the City of Hamilton's cycling and trail map, including the location of the subject site.



Source: City of Hamilton

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Existing Cycling and Trail Network

2.4 Existing Traffic Volumes

The weekday AM and PM peak hour traffic counts for the study area intersections were provided as follows:

- Green Road and Frances Avenue: collected by Paradigm staff on June 24, 2015;
- Green Road and North Service Road: collected by Paradigm staff on May 2, 2017; and
- Millen Road and North Service Road: collected by the City of Hamilton on May 6, 2016.

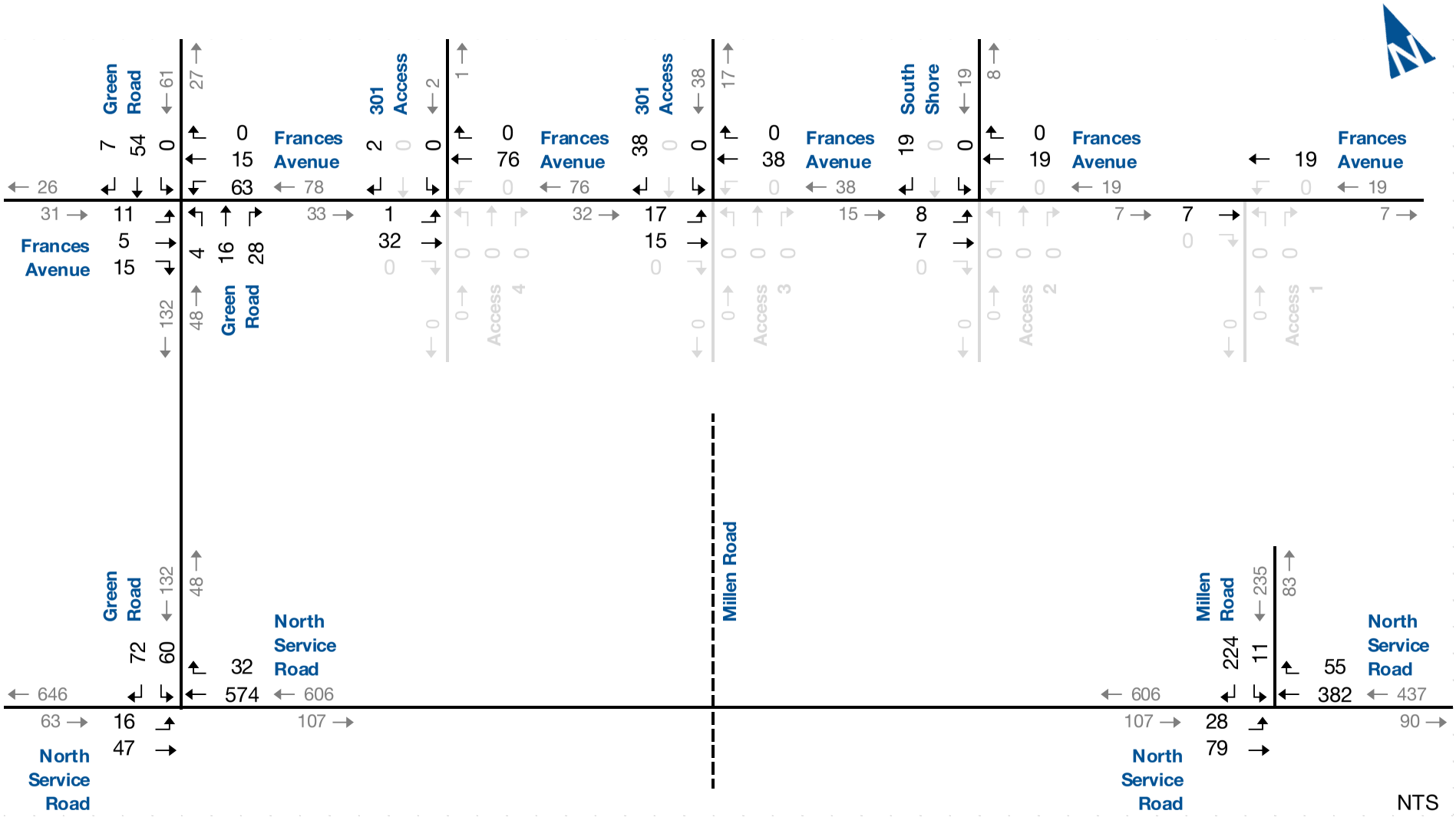
A growth rate of 2% per annum compounded was applied to all intersection volumes for the respective number of years to reflect 2018 conditions. This growth rate is also reflective of the yearly growth in average annual daily traffic (AADT) on the QEW between Fruitland Road and Centennial Parkway from 2005 to 2010[4].

To ensure consistency, network traffic volumes on Green Road and North Service Road were balanced using the higher volume intersection. Any further resultant traffic volume discrepancies were equalized based on percent distribution.

Waterfront Trails is located in the Green Millen Shores Estates (GMSE) development area. Over the past couple of years, Paradigm has completed extensive analysis for a number of development applications within this area. The most recent study was completed in June 2017[5] and included traffic forecasts for the AM and PM peak hours for the 2021 and 2026 horizon years. These forecasts include general traffic growth, the traffic generated by full development of the GMSE lands (not including the subject site) and the planned improvements to Confederation Park. It is noted that Paradigm assumed the developments at 311 and 321 Frances Avenue and 98 Shoreview were completed and fully occupied at the time of that study.

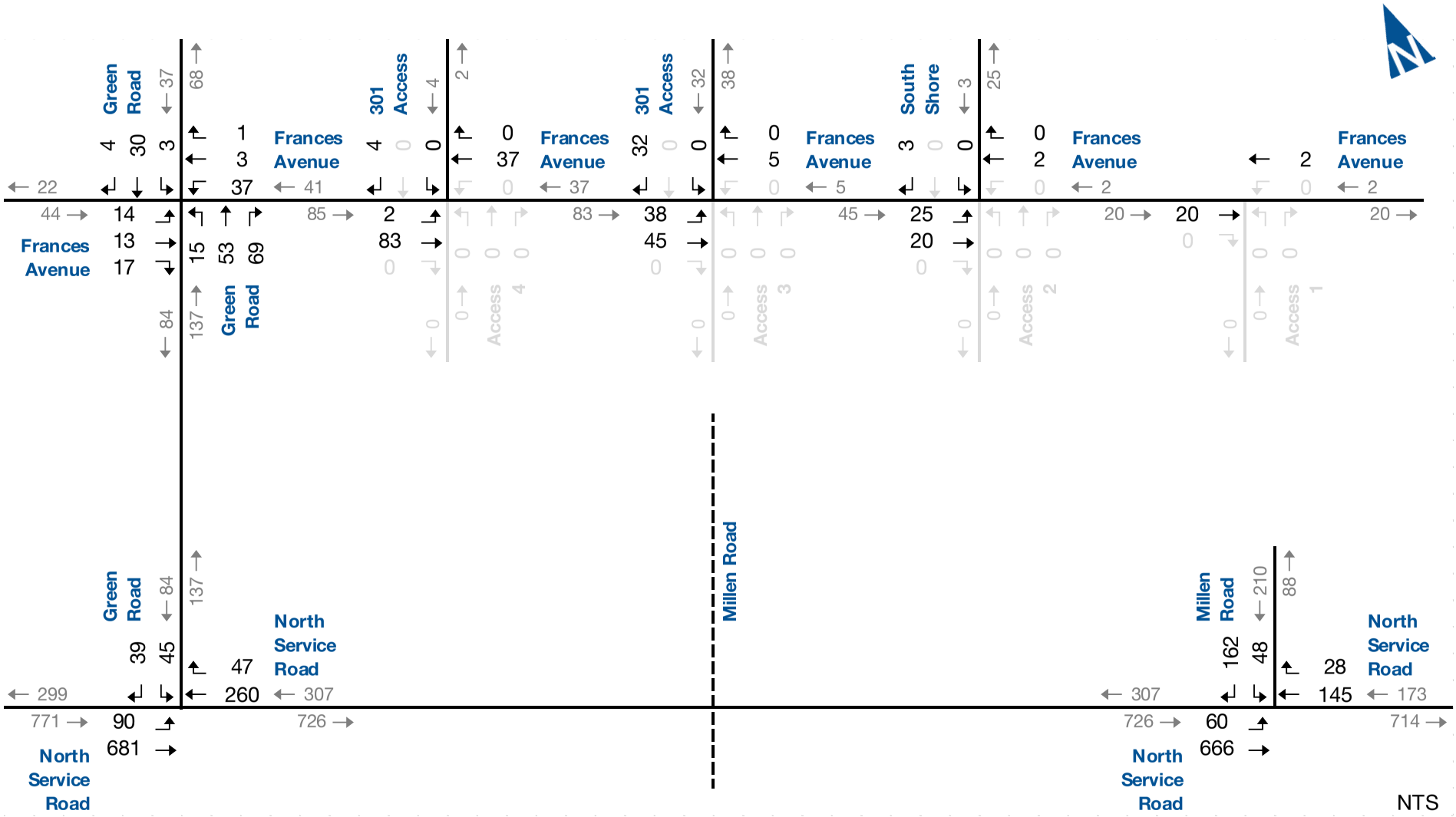
Figure 2.4 and **Figure 2.5** summarize the base year (2018) AM and PM peak hour traffic volumes, respectively. **Appendix B** contains the detailed count data.

[4] Provincial Highways Traffic Volumes 1988-2010, Ministry of Transportation
[5] Paradigm Transportation Solutions Limited. *101 Shoreview Place, City of Hamilton Transportation Impact Study*. June 2017.



Base Year (2018) AM Traffic Volumes

Figure 2.4



Base Year (2018) PM Traffic Volumes

Figure 2.5

2.5 Traffic Operations

Intersection level of service (LOS) is a recognized method of quantifying the delay experienced by drivers at intersections. The term “Level of Service” denotes how well a traffic movement operates under given traffic demands, lane arrangements, and traffic controls. Each level is determined by the average amount of control delay per vehicle. Control delay is the total delay associated with stopping for a signal or stop sign, and includes four components: deceleration delay, stopped delay, queue move up time and final acceleration delay.

Table 2.1 contains the level of service criteria for signalized and stop-controlled intersections. As shown, LOS A indicates small average control delays (less than 10 second per vehicle) whereas LOS F indicates intersection failure, which results in extensive vehicular queues and long delays (over 50 seconds per vehicle at an unsignalized intersection, and over 80 seconds per vehicle at a signalized intersection). LOS D is typically considered acceptable peak-hour performance in an urban setting, and lower LOS values are tolerable for short-term time periods during peak hours when heavier traffic volumes are expected.

TABLE 2.1: VEHICLE LEVEL OF SERVICE DEFINITIONS

Level of Service	Signalized Intersections Average Total Delay (sec/veh)	Unsignalized Intersections Average Total Delay (sec/veh)
A	< = 10	< = 10
B	> 10 & < = 20	> 10 & < = 15
C	> 20 & < = 35	> 15 & < = 25
D	> 35 & < = 55	> 25 & < = 35
E	> 55 & < = 80	> 35 & < = 50
F	> 80	> 50

As per the City of Hamilton TIS Guidelines, the following defines critical movements for intersections:

- Volume to capacity ratios for through movements or shared through/turning movements that operate at 0.85 or greater for signalized intersections;
- Volume to capacity ratios for exclusive turning movements that operate at 0.90 or greater for signalized intersections;
- Level of service based on average delay per vehicle or individual movement is LOS D or greater for unsignalized intersections; and
- Estimated 95th percentile queue lengths exceed available turning lane storage.

The operations of the study intersections under existing, or base year (2018), traffic conditions were evaluated using Synchro 9 with HCM 2000 procedures. The intersection analysis considered three separate measures of performance:

- The LOS for each turning movement;
- The volume to capacity (v/c) ratio for each turning movement; and
- The 95th percentile queue lengths.

Table 2.2 summarizes the existing intersection operations, indicating the existing levels of service (LOS), volume to capacity ratios (V/C) and 95th percentile queues experienced within the study area for the AM and PM peak hours, respectively.

The analyses indicate that all intersections and movements within the study area currently operate at overall acceptable levels of service, with the following exception:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS D during the PM peak hour with a v/c ratio of 0.28. The low v/c ratio on this movement indicates the delay is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

Appendix C provides the detailed Synchro 9 reports.

TABLE 2.2: BASE YEAR (2018) AM PEAK HOUR TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	9	>	9	<	10	>	10	<	1	>	1	<	0	>	0	5
			V/C	<	0.04	>		<	0.10	>		<	0.00	>		<	0.00	>		
			Q	<	1	>		<	3	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	A	A		A		A	>	A					C		B	C	A
			Delay	9	0		2		0	>	0					16		14	15	3
			V/C	0.02	0.03				0.39	>						0.17		0.16		
			Q	1	0				0	>						5		5		
			Ex	125	-				-	>						40		-		
			Avail.	125	-				-	>						35		-		
	3 - North Service Road & Millen Road	TWSC	LOS	A	A		A		A	>	A					B		B	B	A
			Delay	9	0		2		0	>	0					15		15	15	5
			V/C	0.03	0.05				0.28	>						0.40		0.40		
			Q	1	0				0	>						15		15		
			Ex	90	-				-	>						-		25		
			Avail.	89	-				-	>						-		10		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

TABLE 2.3: BASE YEAR (2018) PM PEAK HOUR TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	A	>	A	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	10	>	10	<	1	>	1	<	1	>	1	4
			V/C	<	0.06	>		<	0.06	>		<	0.01	>		<	0.00	>		
			Q	<	2	>		<	2	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	A	A		A		A	>	A					D		B	C	A
			Delay	8	0		1		0	>	0					33		10	22	2
			V/C	0.08	0.44				0.20	>						0.28		0.06		
			Q	2	0				0	>						9		1		
			Ex	125	-				-	>						40		-		
			Avail.	123	-				-	>						31		-		
	3 - North Service Road & Millen Road	TWSC	LOS	A	A		A		A	>	A					B		B	B	A
			Delay	8	0		1		0	>	0					13		13	13	3
			V/C	0.05	0.43				0.11	>						0.21		0.21		
			Q	1	0				0	>						6		6		
			Ex	90	-				-	>						-		25		
			Avail.	89	-				-	>						-		19		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

3 Development Concept

3.1 Development Description

The proposed development is located at 310 Frances Avenue and is bordered by Frances Avenue to the north, Green Road to the east and North Service Road to the south.

The subject site is proposed to be developed in three (3) phases:

- Phase 1 (Tower 1) – Completed and occupied in 2021:
  - 59 storey residential apartment building with 670 units, comprising 448 one-bedroom units and 222 two-bedroom units;
  - A total of 889 parking spaces; and
  - Vehicular access via one (1) all-turns driveway connection to Frances Avenue (Site Access 1).
- Phase 2 (Tower 2) – Completed and occupied in 2023:
  - 54 storey residential apartment building with 615 units, comprising 410 one-bedroom units and 205 two-bedroom units;
  - A total of 817 parking spaces; and
  - Vehicular access via two (2) all-turns driveway connections to Frances Avenue (Site Access 2 and Site Access 3).
- Phase 3 (Tower 3) – Completed and occupied in 2025:
  - 48 storey residential apartment building with 551 units, comprising 369 one-bedroom units and 182 two-bedroom units;
  - 400 square metres (4,306 square feet) of commercial retail space;
  - A total of 739 parking spaces; and
  - Vehicular access via one (1) all-turns driveway connection to Frances Avenue (Site Access 4).

The development will also include an amenity building that will be available for all residents of the site by the conclusion of construction. The four (4) all-turns driveway connections to Frances Avenue (herein referred to as “Access”) are planned to be stop-controlled on the minor road (driveway) leg.

Figure 3.1 shows the proposed site plan.

Development Site Plan

Figure 3.1

3.2 Development Trip Generation

Trip generation information is used to forecast the anticipated level of traffic activity to occur as a result of the development of the site.

The Institute of Transportation Engineers (ITE) Trip Generation Manual 10th Edition[6] provide rates and equations to estimate the constituent component development peak hour traffic volumes. The following Land Use Codes (LUC) were utilized in this study:

- **LUC 222 – Multifamily Housing (High-Rise)**: Includes apartments, townhouses, and condominiums that have more that 10 levels; and
- **LUC 820 – Shopping Centre**: Integrated group of commercial establishments that is planned, developed, owned and managed as a unit. The composition is related to its market area in terms of size, location and type of store. Provides on-site parking facilities sufficient to serve its parking demands.

The regression equations were utilized for the residential component of the development as all criteria for their use were met. Average rates were used for the commercial component estimates as all criteria for use of the equation rates were not met.

Note that in order to remain conservative in the trip generation estimates, reductions were not applied to account for the synergy between the residential and commercial components of the development. This decision was largely based on the small size of commercial retail space planned for the site and that it will not be constructed until the final phase of development.

Table 3.1 summarizes the resulting base trip generation and indicates that the site will generate a total of 556 AM peak hour trips and 666 PM peak hour trips upon full build-out.

[6] Institute of Transportation Engineers. *Trip Generation Manual, 10th Edition*. 2017.

TABLE 3.1: TRIP GENERATION

Land Use		Unit of Measure	Units/ GFA	AM Peak Hour				PM Peak Hour			
				Rate	In	Out	Total	Rate	In	Out	Total
PHASE 1	LUC 222 - Multifamily Housing (High-Rise)	Units	670	FCE[1]	48	152	200	FCE[2]	144	92	236
Total Phase 1					**48**	**152**	**200**		**144**	**92**	**236**
PHASE 2	LUC 222 - Multifamily Housing (High-Rise)	Units	615	FCE[1]	44	141	185	FCE[2]	133	85	218
Total Phase 2					**44**	**141**	**185**		**133**	**85**	**218**
PHASE 3	LUC 222 - Multifamily Housing (High-Rise)	Units	551	FCE[1]	40	127	167	FCE[2]	120	76	196
	LUC 820- Shopping Centre	GFA	4,305	0.94	2	2	4	3.81	8	8	16
Total Phase 3					**42**	**129**	**171**		**128**	**84**	**212**
Total New Trips					**134**	**422**	**556**		**405**	**261**	**666**

[1] T = 0.28(x) + 12.86 [2] T = 0.34(x) + 8.56

3.3 Development Trip Distribution and Assignment

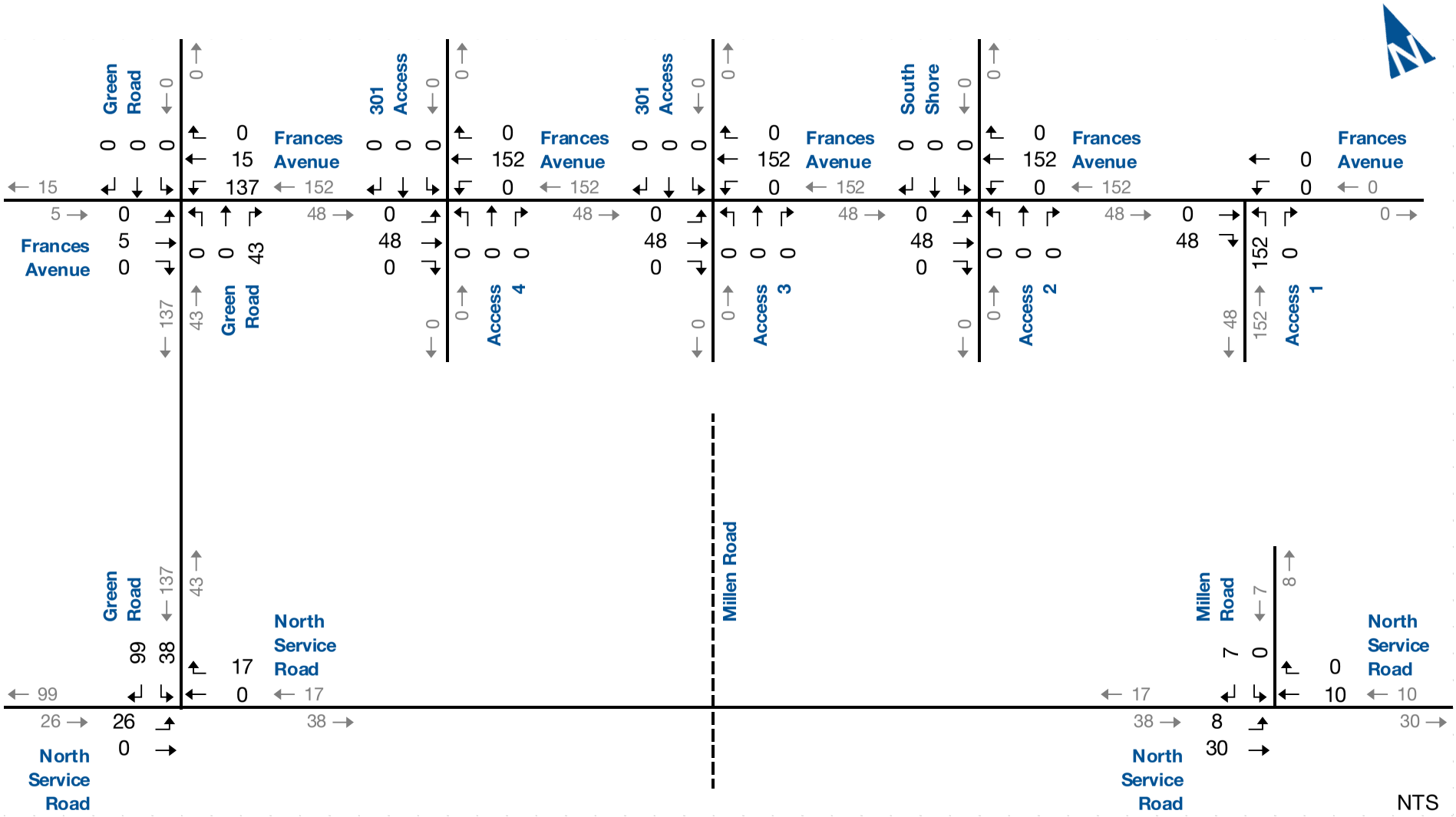
The estimated site generated trips were assigned to the roadway network based on the existing distribution of traffic within the study area as calculated in the June 2017 Paradigm study. The 2016 Transportation Tomorrow Survey (TTS) was not utilized to determine trip distribution data as much of the study area had not yet been fully developed when the TTS data was collected. **Table 3.2** details the estimated trip distribution for the development.

TABLE 3.2: TRIP DISTRIBUTION

Origin/Destination	IN	OUT
West via Frances Avenue	10%	10%
East via North Service Road	20%	20%
West via North Service Road	55%	65%
South via Millen Road	15%	5%
Total	**100%**	**100%**

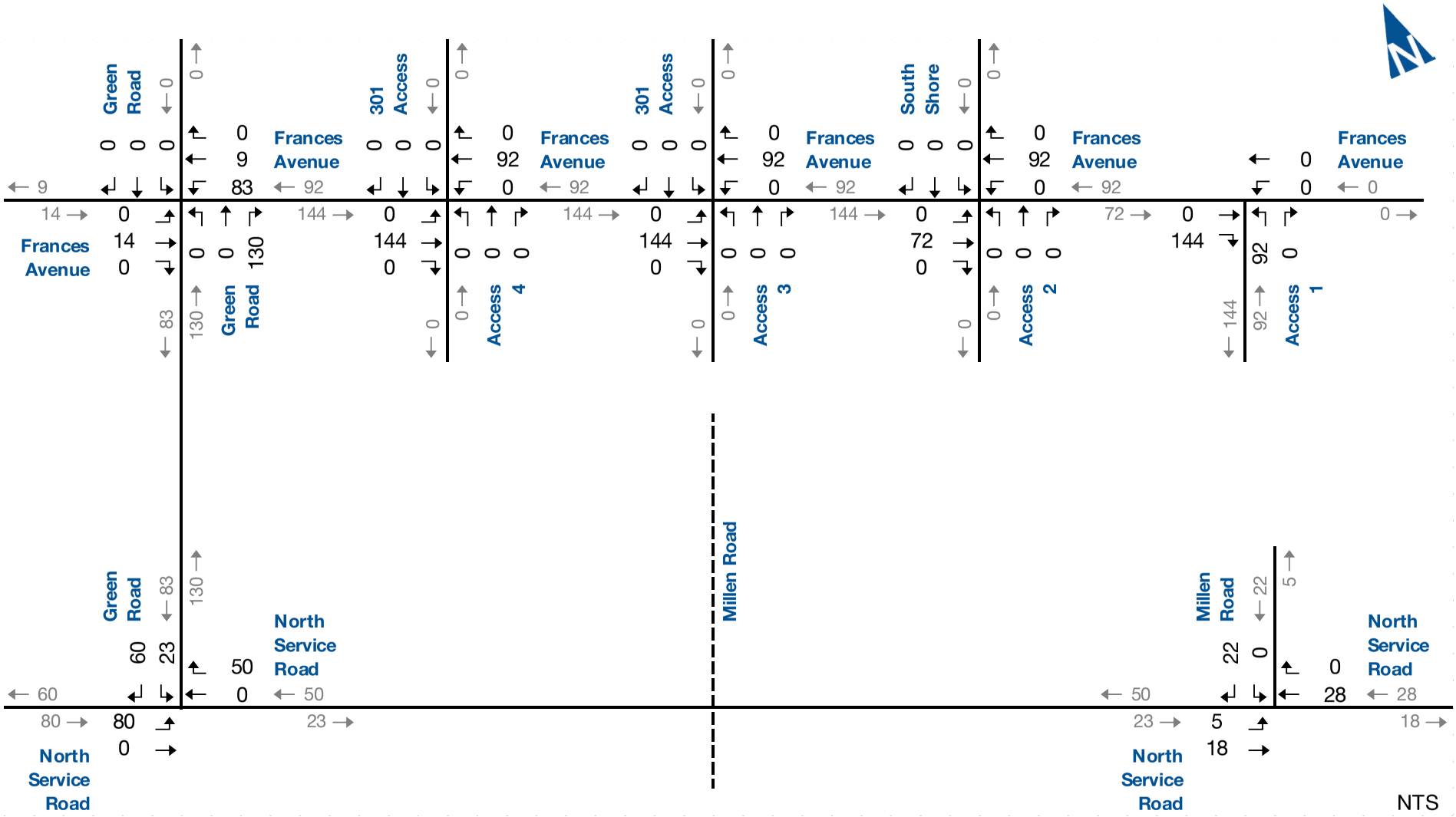
Using the trip generation and trip distribution estimates, the site traffic was assigned to the road network. The site traffic is illustrated as follows:

- **Figure 3.2** and **Figure 3.3** - Phase 1;
- **Figure 3.4** and **Figure 3.5** - Phase 2; and
- **Figure 3.6** and **Figure 3.7** - Phase 3 (Full Build-Out)



Phase 1 AM Development Traffic Assignment

Figure 3.2



Phase 1 PM Development Traffic Assignment

Figure 3.3

Appendix "C" to Report PED19115
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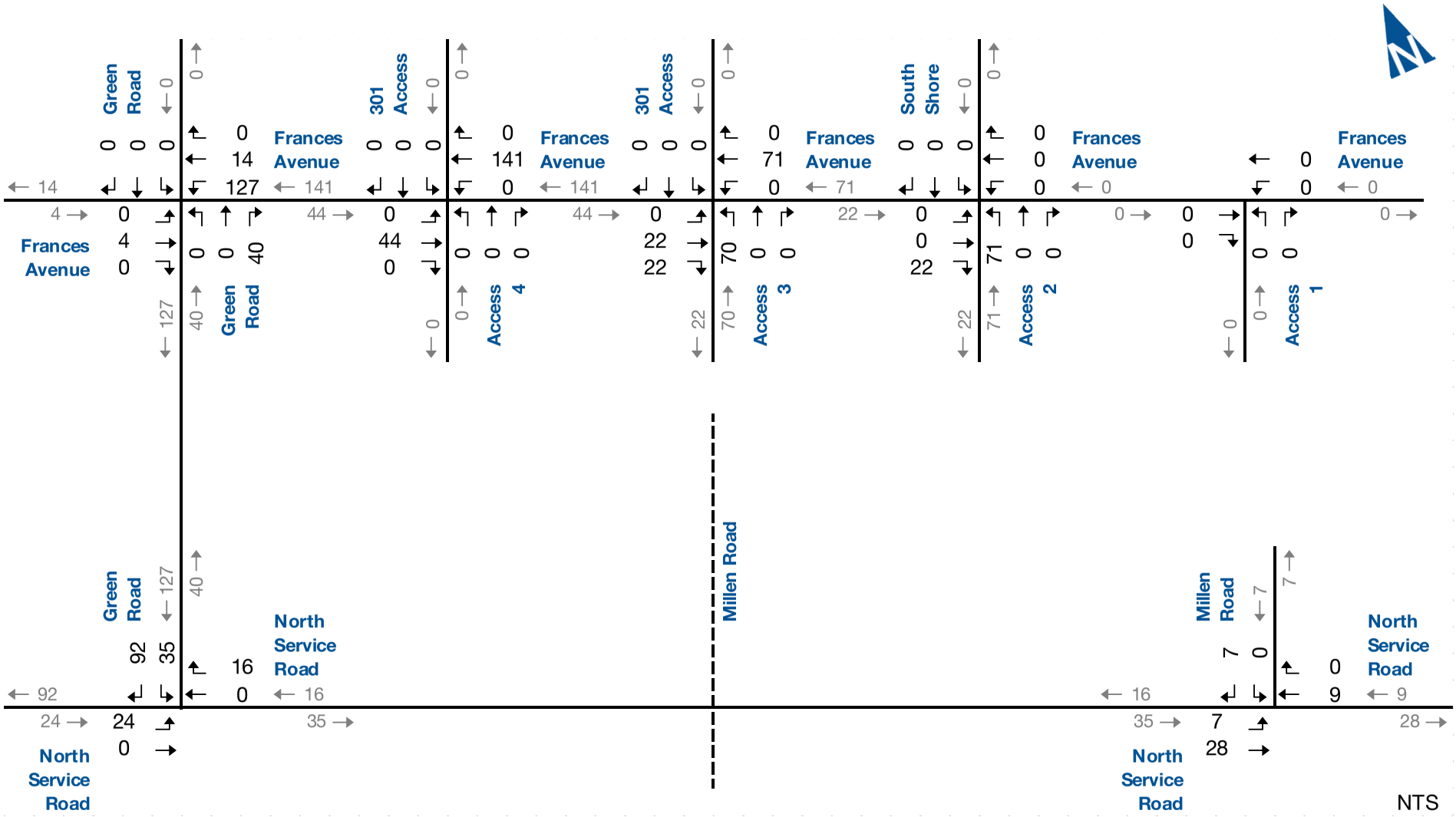

Phase 2 AM Development Traffic Assignment

Figure 3.4

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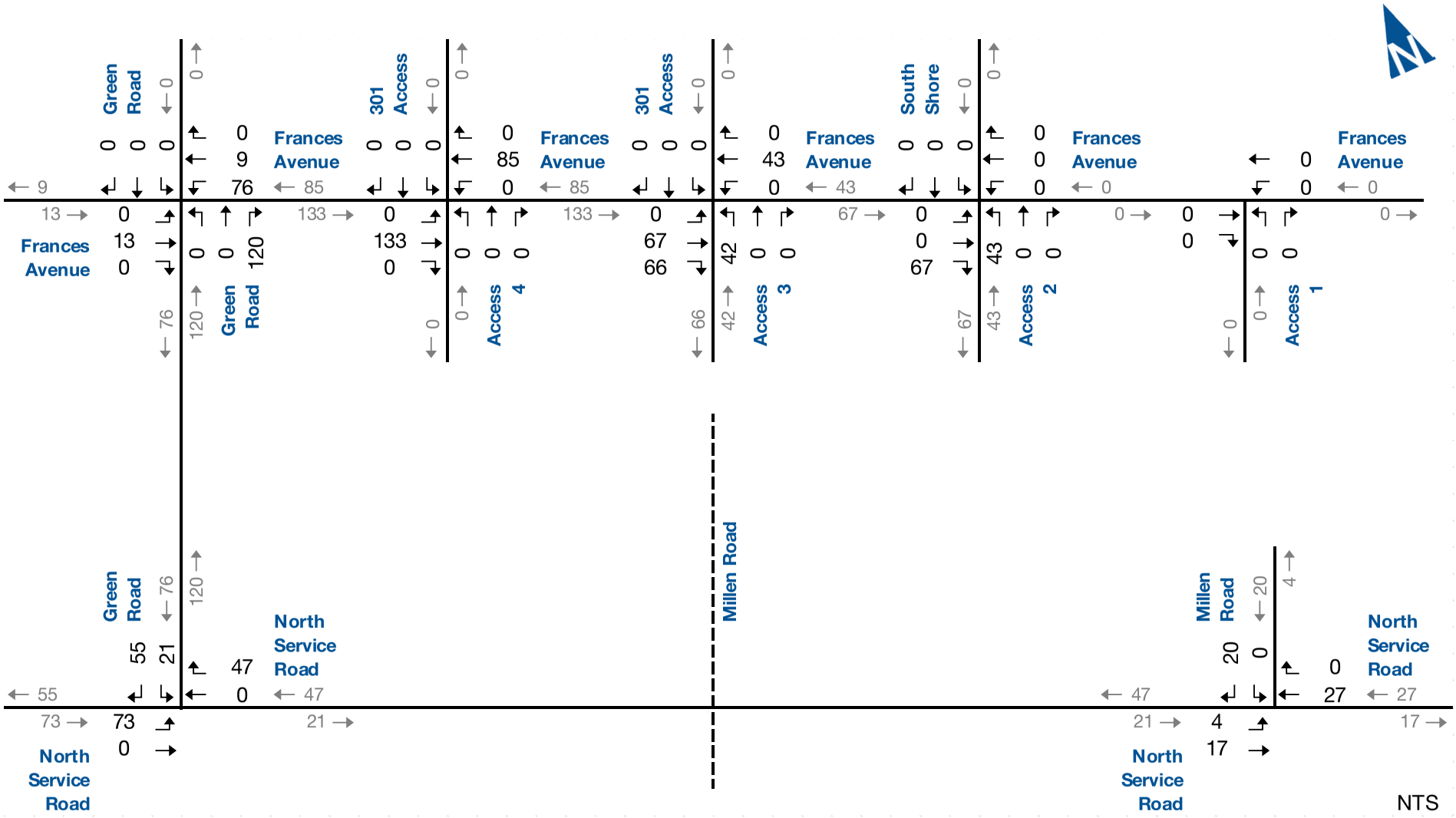

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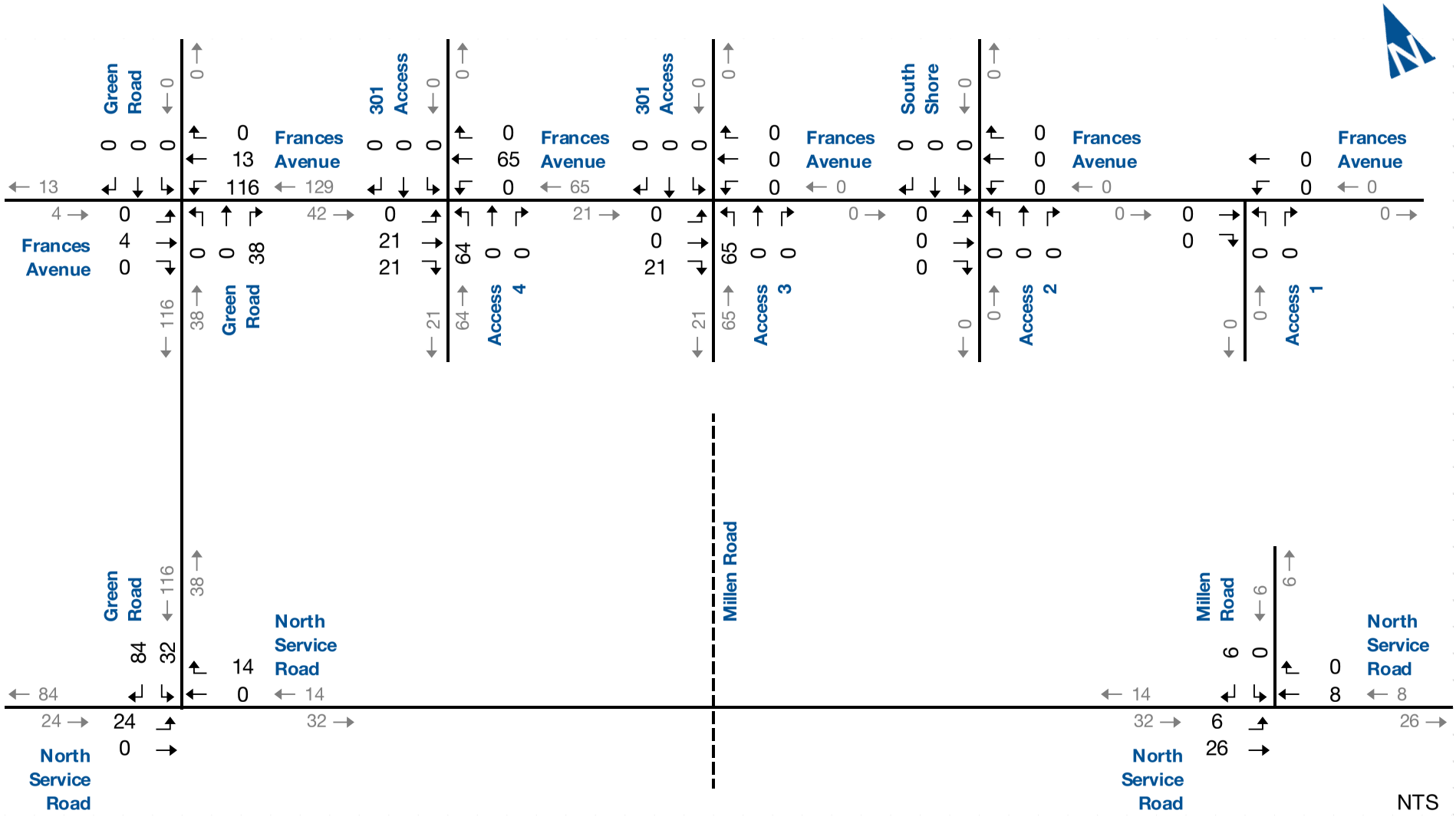
Phase 2 PM Development Traffic Assignment

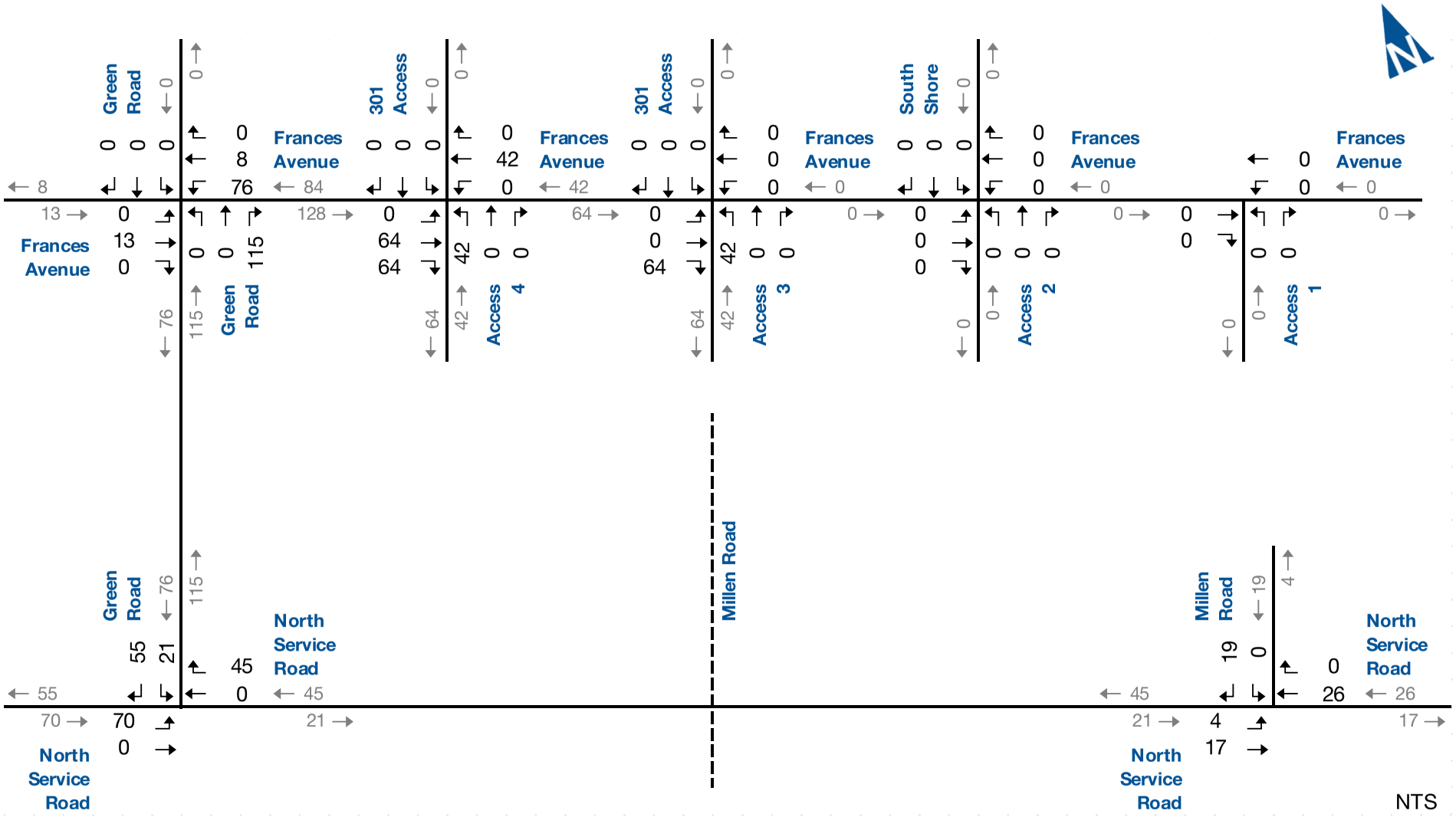
Waterfront Trails Transportation Impact, Parking Justification and TDM Options Study
180010

Figure 3.5



Phase 3 (Full Build-Out) AM Development Traffic Assignment

Figure 3.6



Phase 3 (Full Build-Out) PM Development Traffic Assignment

Figure 3.7

4 Evaluation of Future Traffic Conditions

The assessment of future traffic conditions contained in this section includes estimates of future background and total traffic volumes and analysis for the 2021, 2023 and 2025 horizons. The future traffic volumes in the vicinity of the development will likely consist of increased non-site traffic volumes (generalized background traffic), traffic generated by other developments in the area and the traffic generated by the proposed development.

4.1 2021 Horizon

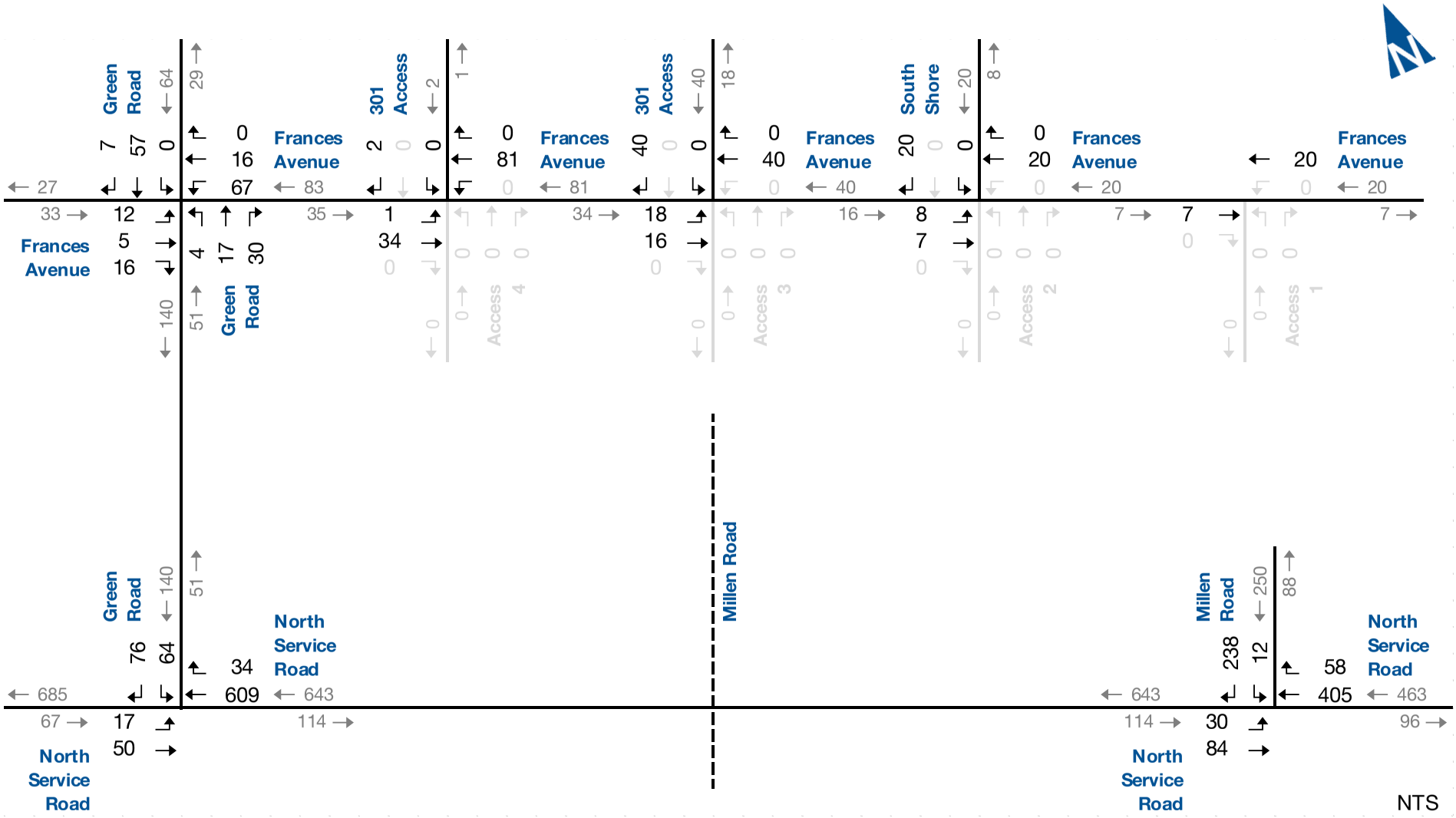
4.1.1 2021 General Background Traffic Growth

To derive the 2021 general background traffic volumes, the non-site traffic (generalized traffic growth) was increased by applying a compound growth rate of 2 percent per annum to the existing traffic volumes (6.1 percent total). Note that this growth rate is consistent with the growth rate used in the previous reports completed by IBI and Paradigm for the GMSE development area. This growth rate is also reflective of the yearly growth in AADT on the QEW between Fruitland Road and Centennial Parkway from 2005 to 2010.

Figure 4.1 and **Figure 4.2** show the 2021 general background traffic forecasts for the AM and PM peak hours.

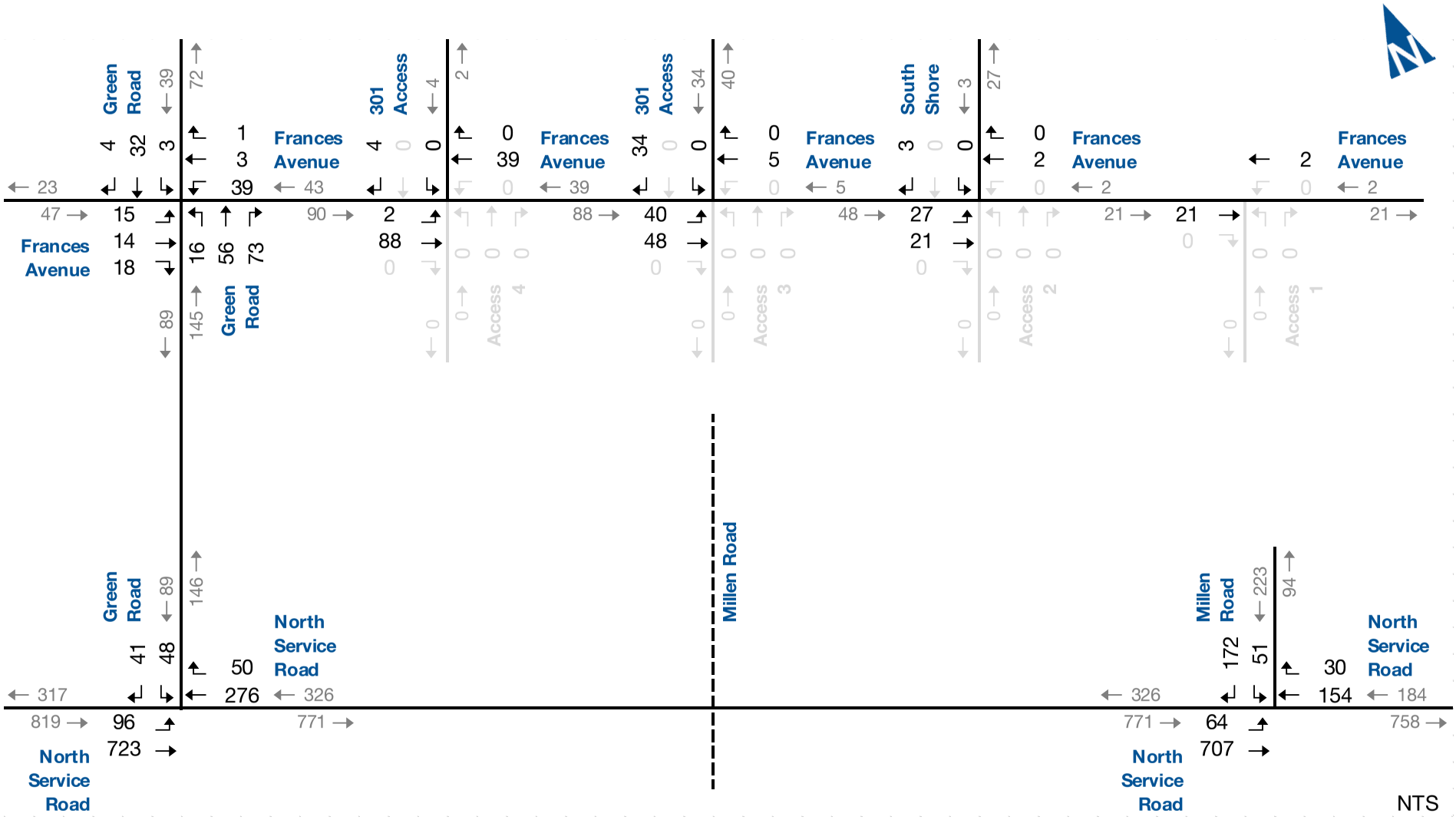
4.1.2 Other Planned Developments

There are three other developments with traffic expected to impact the study area (Confederation Park, 8 Shoreview Drive, and 101 Shoreview Drive). The traffic generated by these developments were assumed to be completed by the 2021 and are included in the background traffic over and above the general background traffic growth. The development locations are shown in **Figure 4.3** and development information is as follows:



2021 AM Generalized Growth Background Traffic Forecasts

Figure 4.1



2021 PM Generalized Growth Background Traffic Forecasts

Figure 4.2

paradigm TRANSPORTATION SOLUTIONS LIMITED

Location of Other Area Developments (2021)

Waterfront Trails Transportation Impact, Parking Justification and TDM Options Study
180010

Figure 4.3

Confederation Park

This development is expected to be completed by 2021 and includes:

- 1,400 square metres (15,000 square feet) of sit-down restaurant space;
- 5,100 square metres (55,000 square feet) of general retail space; and
- 4 sport fields.

This development is forecast to generate 114 trips (64 in, 50 out) during the AM peak hour and 329 trips (235 in, 94 out) during the PM peak hour as taken from the Transportation Assessment[7] prepared by Dillon Consulting.

8 Shoreview Place

This development is expected to be completed by 2021 and includes:

- 130 congregate care facility units; and
- 50 square metres (538 square feet) of retail use (assumed to be coffee shop).

This development is forecast to generate 61 trips (32 in, 29 out) during the AM peak hour, and 42 trips (22 in, 20 out) during the PM peak hour. These forecasts were taken from the TIS[8] previously prepared by Paradigm for this development.

101 Shoreview Place

This development is expected to be completed by 2021 and includes:

- 479 low-rise condominium/townhouse units.

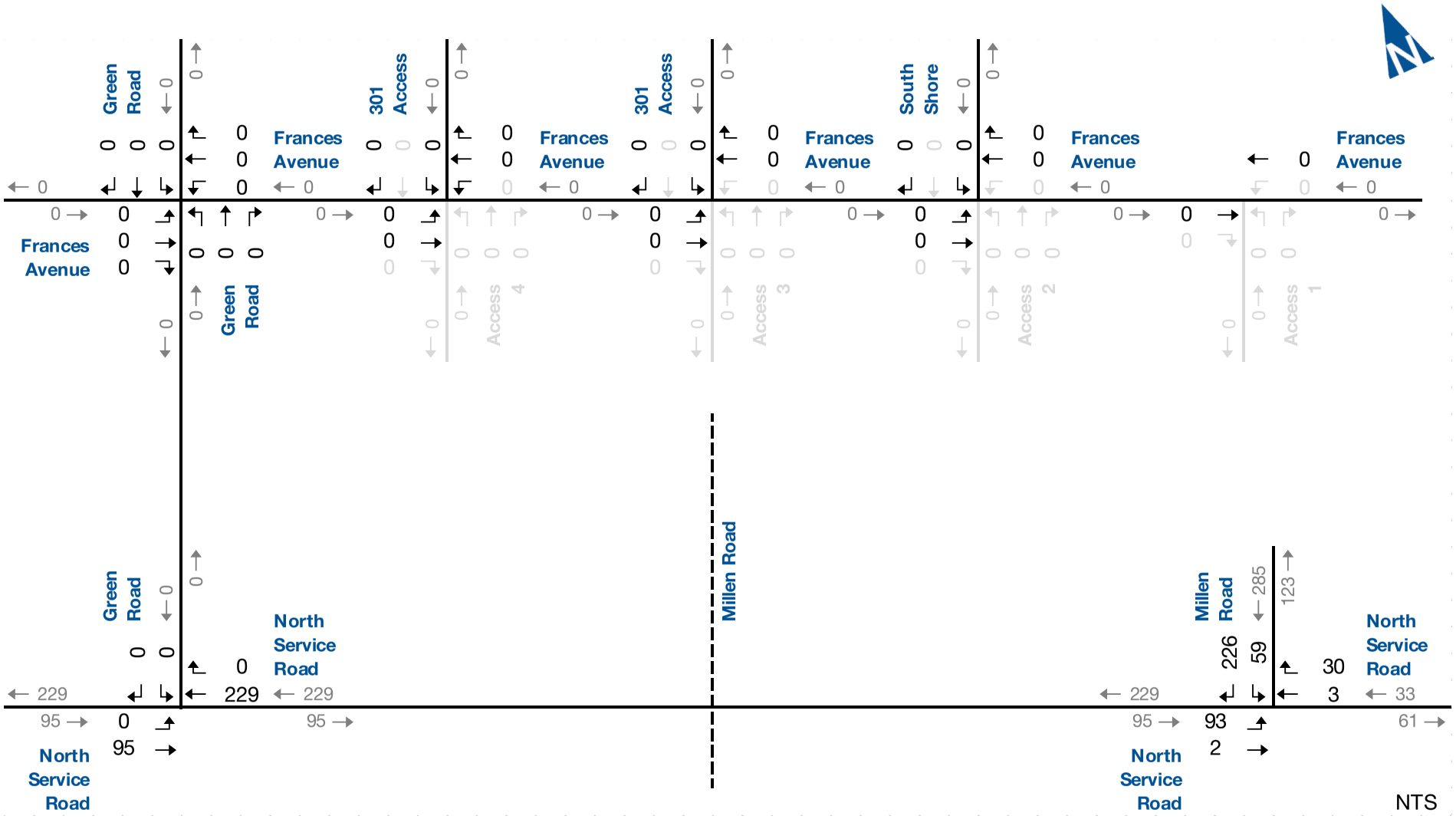
This development is forecast to generate 321 trips (80 in, 241 out) during the AM peak hour, and 374 trips (216 in, 157 out) during the PM peak hour. These forecasts were taken from the TIS[9] previously prepared by Paradigm for this development.

Figure 4.4 and **Figure 4.5** show the traffic volumes from the other developments in the study area. Note that not all trips generated by the other planned developments will enter the study area. The trips were assigned to the network based on the assignment detailed in their respective TIS reports.

[7] Dillion Consulting Limited. *Confederation Park Transportation Assessment.* June 2013.
[8] Paradigm Transportation Solutions Limited. *98 Shoreview Place Transportation Impact Study.* November 2015
[9] Paradigm Transportation Solutions Limited. *101 Shoreview Place Transportation Impact Study.* July 2017.

4.1.3 2021 Total Background Traffic Volumes

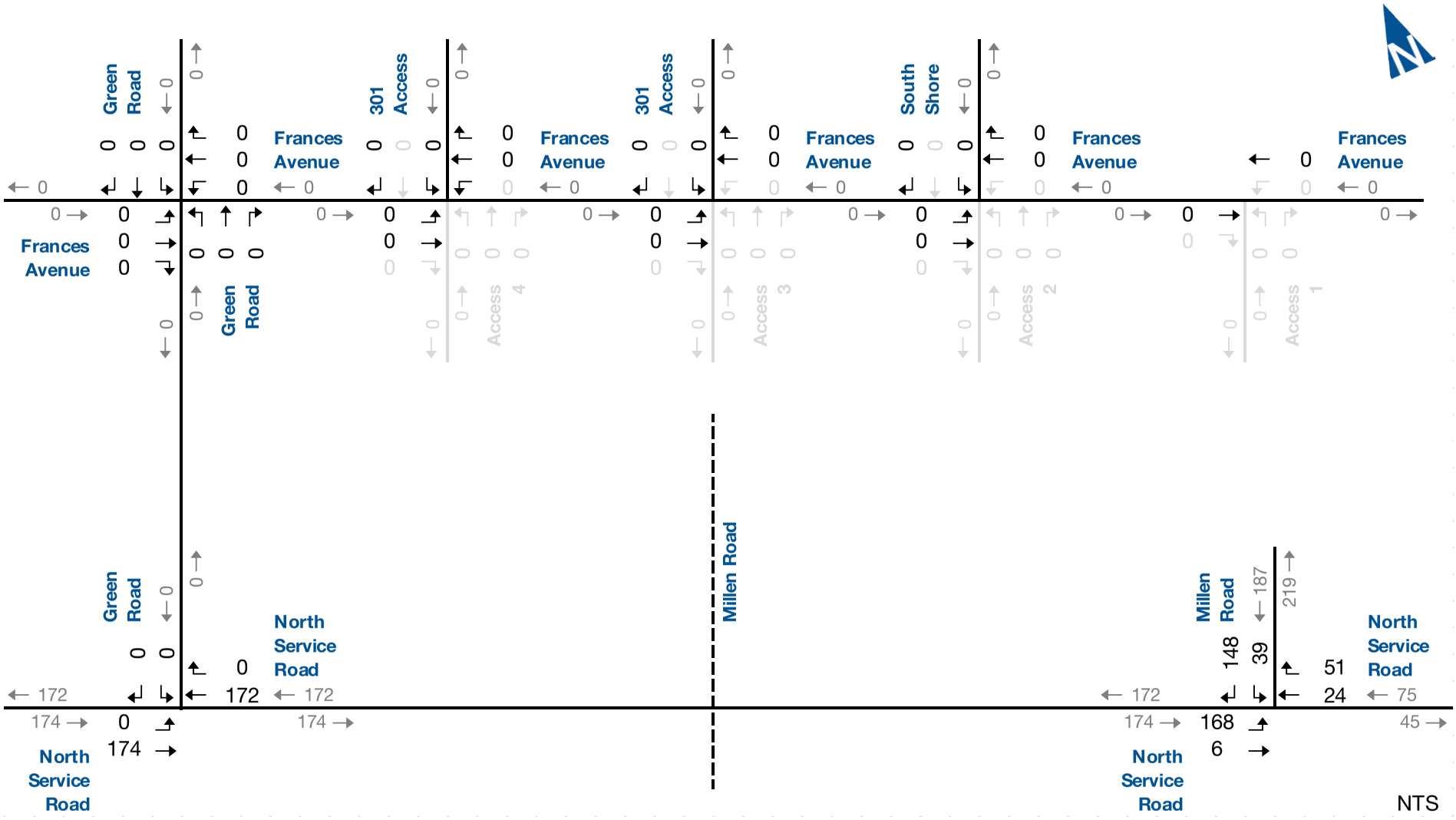
Figure 4.6 and **Figure 4.7** illustrate the 2021 total background traffic including the generalized background traffic and site traffic from the above-noted area developments for the AM and PM peak hours, respectively.



2021 AM Other Area Development Trip Assignment

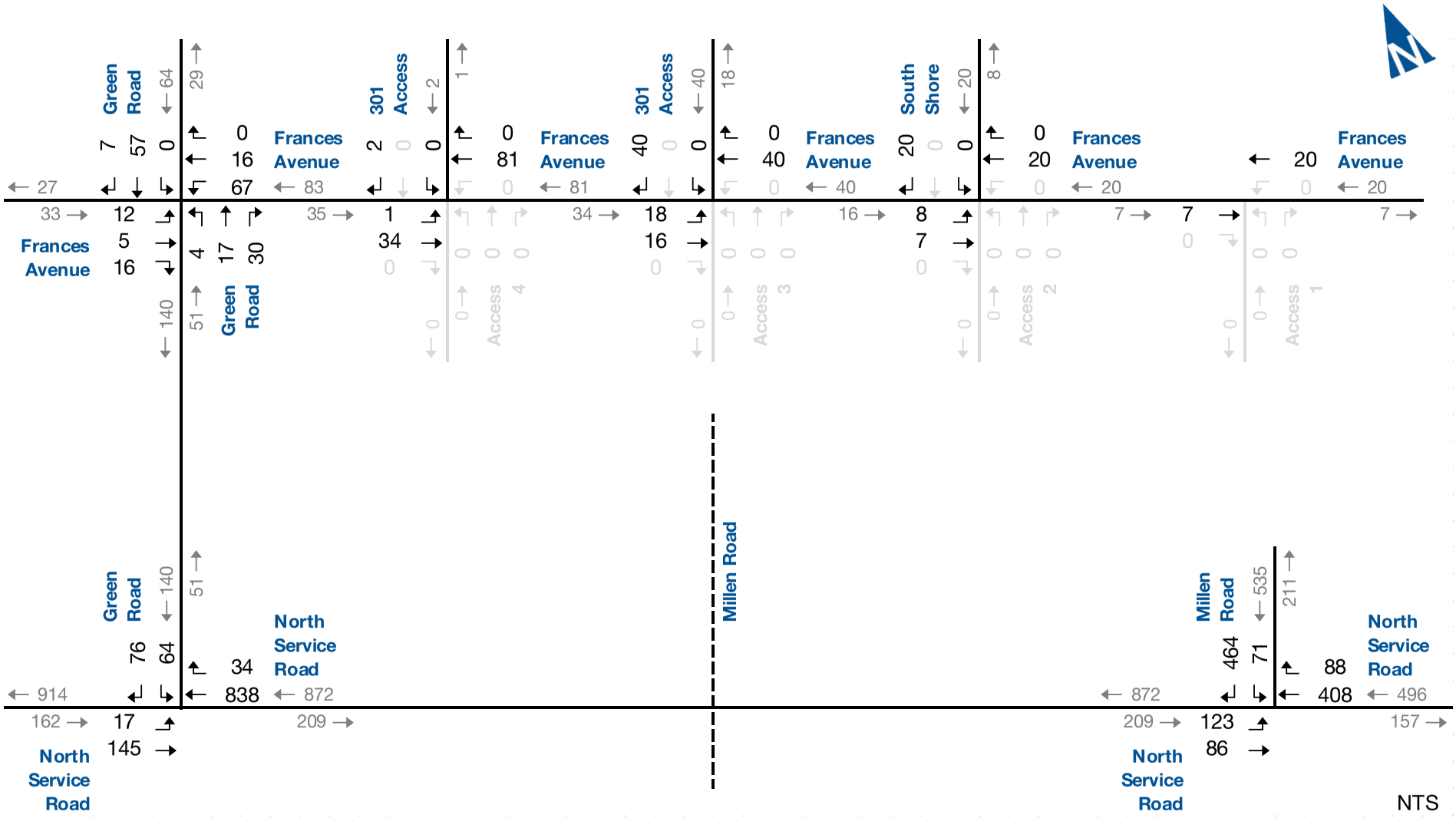
Waterfront Trails Transportation Impact, Parking Justification and TDM Options Study
180010

Figure 4.4



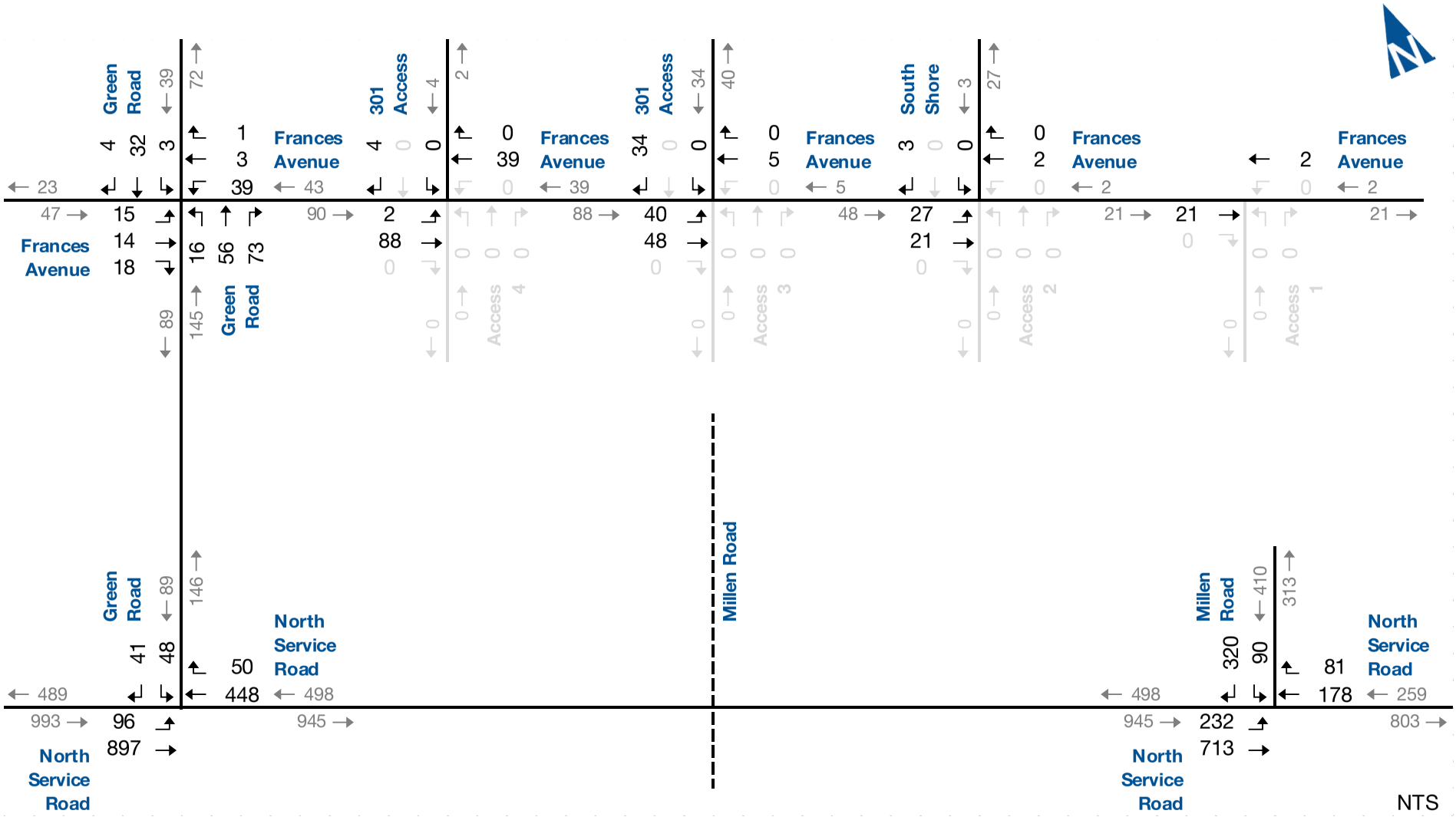
2021 PM Other Area Development Trip Assignment

Figure 4.5



2021 AM Total Background Traffic Forecasts

Figure 4.6



2021 PM Total Background Traffic Forecasts

Figure 4.7

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4.1.3 2021 Background Traffic Operations

The operations of the study area intersections under 2021 background traffic volumes were analyzed using Synchro 9 with HCM 2000 procedures.

The 101 Shoreview Place TIS identified remedial measures required in the study area to accommodate background traffic at 2021 and 2026 including:

- Traffic signals at the intersection of North Service Road and Millen Road; and
- Reconfiguring the southbound lanes at North Service Road and Millen Road to have the southbound right-turn as the main approach and the southbound left-turn as the added approach with 50 metres of storage.

These recommended improvements were assumed to be in place at the 2021 horizon and are reflected in all successive analyses.

Table 4.1 and **Table 4.2** summarize the 2021 background traffic operations for the AM and PM peak hours, respectively. The analyses indicate all intersections and movements within the study area are forecast to operate at overall acceptable levels of service. The following exception is noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS D with a v/c of 0.32 during the AM peak hour and LOS F with a v/c of 0.57 during the PM peak hour. The low to moderate v/c ratios indicate the delay is due to the high volume of through traffic on North Service which limits available gaps for side street traffic.

Appendix D contains the detailed supporting Synchro 9 reports.

TABLE 4.1: 2021 AM BACKGROUND TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	9	>	**9**	<	10	>	**10**	<	1	>	**1**	<	0	>	**0**	**5**
			V/C	<	0.04	>		<	0.11	>		<	0.00	>		<	0.00	>		
			Q	<	1	>		<	3	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	B	A		**A**		A	>	**A**					D		C	**C**	**A**
			Delay	10	0		**1**		0	>	**0**					29		20	**24**	**3**
			V/C	0.03	0.09				0.56	>						0.32		0.25		
			Q	1	0				0	>						10		8		
			Ex	125	-				-	>						40		-		
			Avail.	124	-				-	>						30		-		
	3 - North Service Road & Millen Road	TCS	LOS	B	A		**A**		B	>	**B**					B		C	**C**	**B**
			Delay	11	7		**9**		11	>	**11**					18		26	**25**	**17**
			V/C	0.36	0.09				0.54	>						0.20		0.71		**0.60**
			Q	25	14				78	>						14		48		
			Ex	90	-				-	>						50		-		
			Avail.	65	-				-	>						36		-		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

TABLE 4.2: 2021 PM BACKGROUND TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	A	>	**A**	<	B	>	**B**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	10	>	**10**	<	10	>	**10**	<	1	>	**1**	<	1	>	**1**	**4**
			V/C	<	0.06	>		<	0.06	>		<	0.01	>		<	0.00	>		
			Q	<	2	>		<	2	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	A	A		**A**		A	>	**A**					F		B	**F**	**A**
			Delay	9	0		**1**		0	>	**0**					87		12	**52**	**4**
			V/C	0.10	0.57				0.32	>						0.57		0.08		
			Q	3	0				0	>						21		2		
			Ex	125	-				-	>						40		-		
			Avail.	122	-				-	>						19		-		
	3 - North Service Road & Millen Road	TCS	LOS	B	B		**B**		A	>	**A**					C		C	**C**	**B**
			Delay	10	15		**14**		8	>	**8**					22		22	**22**	**15**
			V/C	0.40	0.73				0.25	>						0.21		0.22		**0.57**
			Q	33	114				26	>						22		19		
			Ex	90	-				-	>						50		-		
			Avail.	57	-				-	>						28		-		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

4.1.4 2021 Future Total Traffic Volumes

Figure 4.8 and **Figure 4.9** illustrates the forecast 2021 total traffic (background + Phase 1) volumes, for the AM and PM peak hours, respectively.

4.1.5 2021 Future Total Traffic Operations

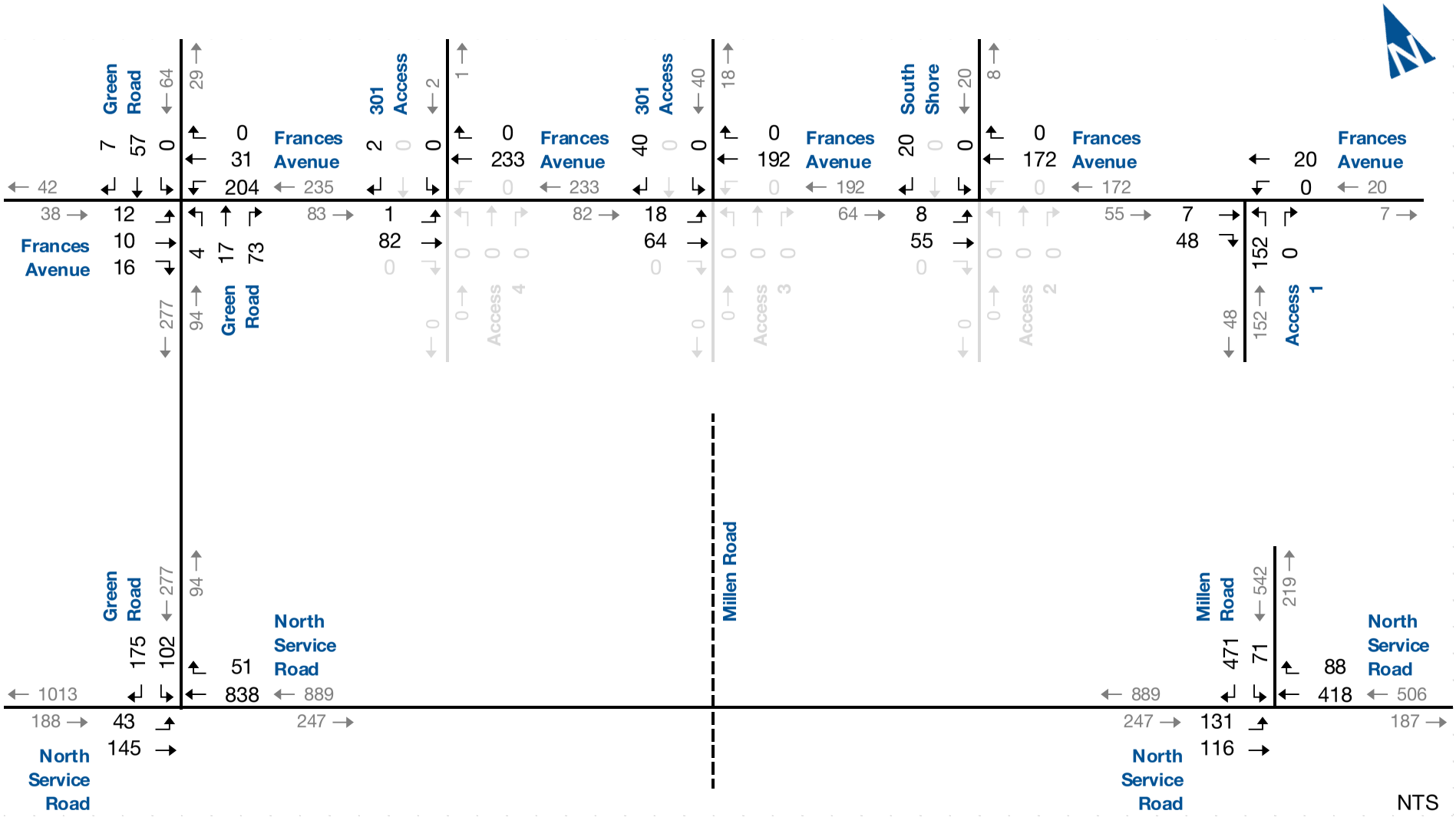
The operations of the study area intersection under 2021 total traffic volumes were analyzed using Synchro 9 with HCM 2000 procedures. Access 1 to the site will be constructed at this horizon.

Table 4.3 and **Table 4.4** summarize the 2021 future total traffic operations for the AM and PM peak hours, respectively. Based on the analyses, it is concluded that the intersections are forecast to operate similar to the background conditions. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS E with a v/c ratio of 0.58 during the AM peak hour and LOS F with a v/c ratio of 1.25 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 11 metres during the PM peak hour;
  - Southbound right-turn movement – LOS D with a v/c ratio of 0.59 during the AM peak hour; and
  - The moderate v/c ratios during the AM peak hour indicate the delay to the above-noted movements is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

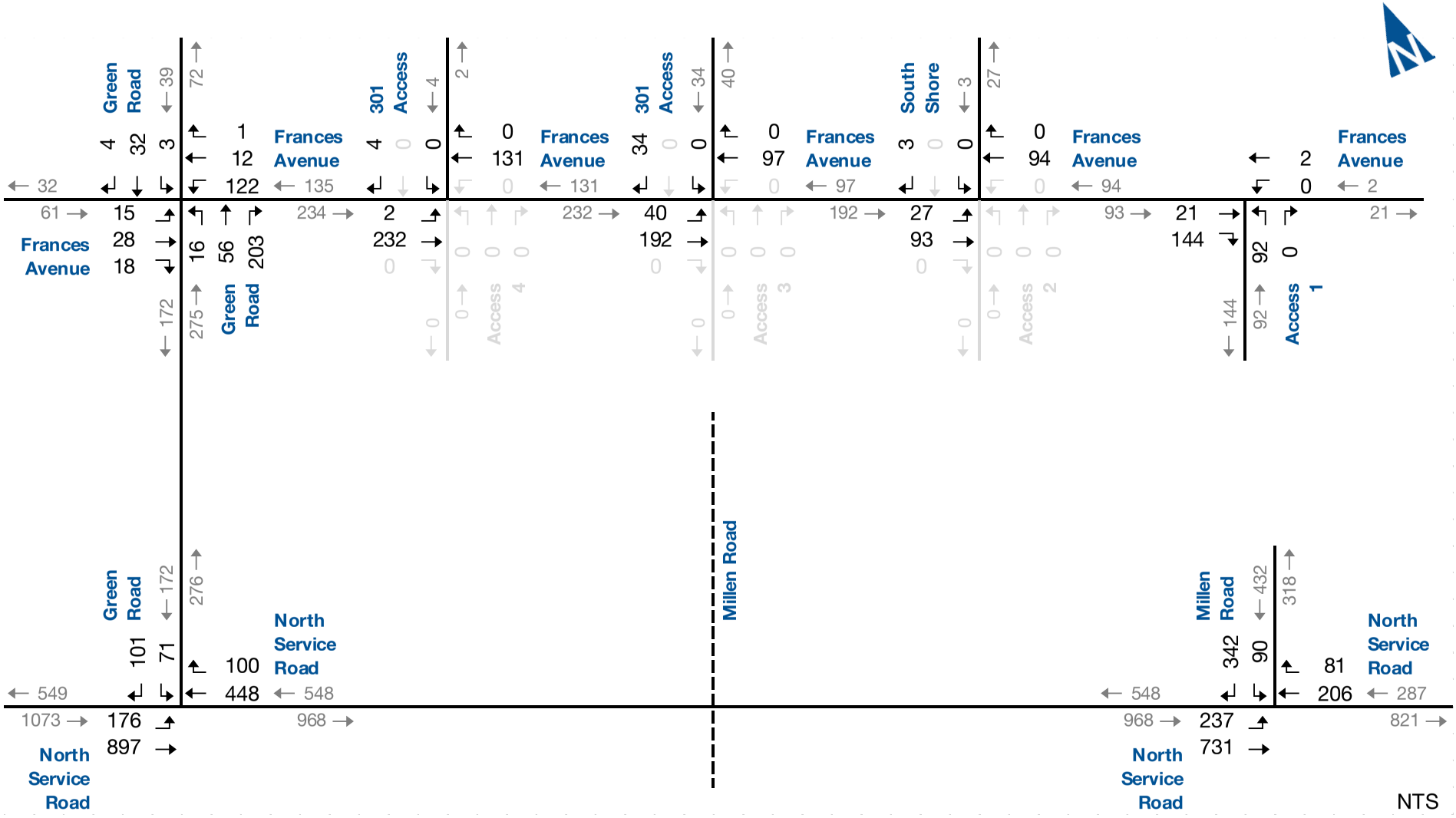
The addition of the site generated traffic will increase the delay at the study area intersections by 10 seconds or less during the AM and PM peak hours, in comparison to the background traffic operations. Of note, Site Access 1 on Frances Avenue is assumed to operate under stop sign control and is forecast to operate with acceptable levels of service during both peak hours.

Appendix E provides the detailed supporting Synchro reports.



2021 AM Total Traffic Forecasts

Figure 4.8



2021 PM Total Traffic Forecasts

Figure 4.9

TABLE 4.3: 2021 AM TOTAL TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	A	>	**A**	<	B	>	**B**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	10	>	**10**	<	12	>	**12**	<	0	>	**0**	<	0	>	**0**	**7**
			V/C	<	0.05	>		<	0.33	>		<	0.00	>		<	0.00	>		
			Q	<	1	>		<	12	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	B	A		**A**		A	>	**A**					E		D	**E**	**A**
			Delay	11	0		**2**		0	>	**0**					46		31	**37**	**8**
			V/C	0.07	0.09				0.57	>						0.58		0.59		
			Q	2	0				0	>						25		28		
			Ex	125	-				-	>						40		-		
			Avail.	123	-				-	>						15		-		
	3 - North Service Road & Millen Road	TCS	LOS	C	B		**B**		B	>	**B**					B		B	**B**	**B**
			Delay	24	11		**18**		19	>	**19**					13		19	**19**	**19**
			V/C	0.60	0.16				0.69	>						0.14		0.58		**0.64**
			Q	37	17				80	>						14		51		
			Ex	90	-				-	>						50		-		
			Avail.	53	-				-	>						36		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	**A**	<	A		**A**	A		>	**A**					**A**
			Delay		0	>	**0**	<	0		**0**	10		>	**10**					**6**
			V/C		0.04	>		<	0.00			0.17		>						
			Q		0	>		<	0			5		>						

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

TABLE 4.4: 2021 PM TOTAL TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	B	>	**B**	<	B	>	**B**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	11	>	**11**	<	13	>	**13**	<	1	>	**1**	<	1	>	**1**	**5**
			V/C	<	0.10	>		<	0.24	>		<	0.01	>		<	0.00	>		
			Q	<	3	>		<	7	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	A	A		**A**		A	>	**A**					F		B	**F**	**B**
			Delay	10	0		**2**		0	>	**0**					311		13	**136**	**14**
			V/C	0.19	0.57				0.35	>						1.25		0.20		
			Q	6	0				0	>						51		6		
			Ex	125	-				-	>						40		-		
			Avail.	119	-				-	>						-11		-		
	3 - North Service Road & Millen Road	TCS	LOS	B	B		**B**		A	>	**A**					C		C	**C**	**B**
			Delay	11	16		**15**		8	>	**8**					22		22	**22**	**15**
			V/C	0.42	0.75				0.29	>						0.21		0.24		**0.59**
			Q	34	119				30	>						22		19		
			Ex	90	-				-	>						50		-		
			Avail.	56	-				-	>						28		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	**A**	<	A		**A**	A		>	**A**					**A**
			Delay		0	>	**0**	<	0		**0**	10		>	**10**					**3**
			V/C		0.11	>		<	0.00			0.11		>						
			Q		0	>		<	0			3		>						

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

4.2 2023 Horizon

4.2.1 General Background Traffic Growth

To derive the 2023 general background traffic volumes, a compound growth rate of 2 percent per annum was applied to the existing traffic volumes (10.4 percent total growth).

Figure 4.10 and **Figure 4.11** illustrate the 2023 background traffic forecasts for the AM and PM peak hours, respectively and include:

- General background traffic growth;
- Traffic from the area developments, as already noted; and
- the Phase 1 site traffic.

4.2.2 2023 Background Traffic Operations

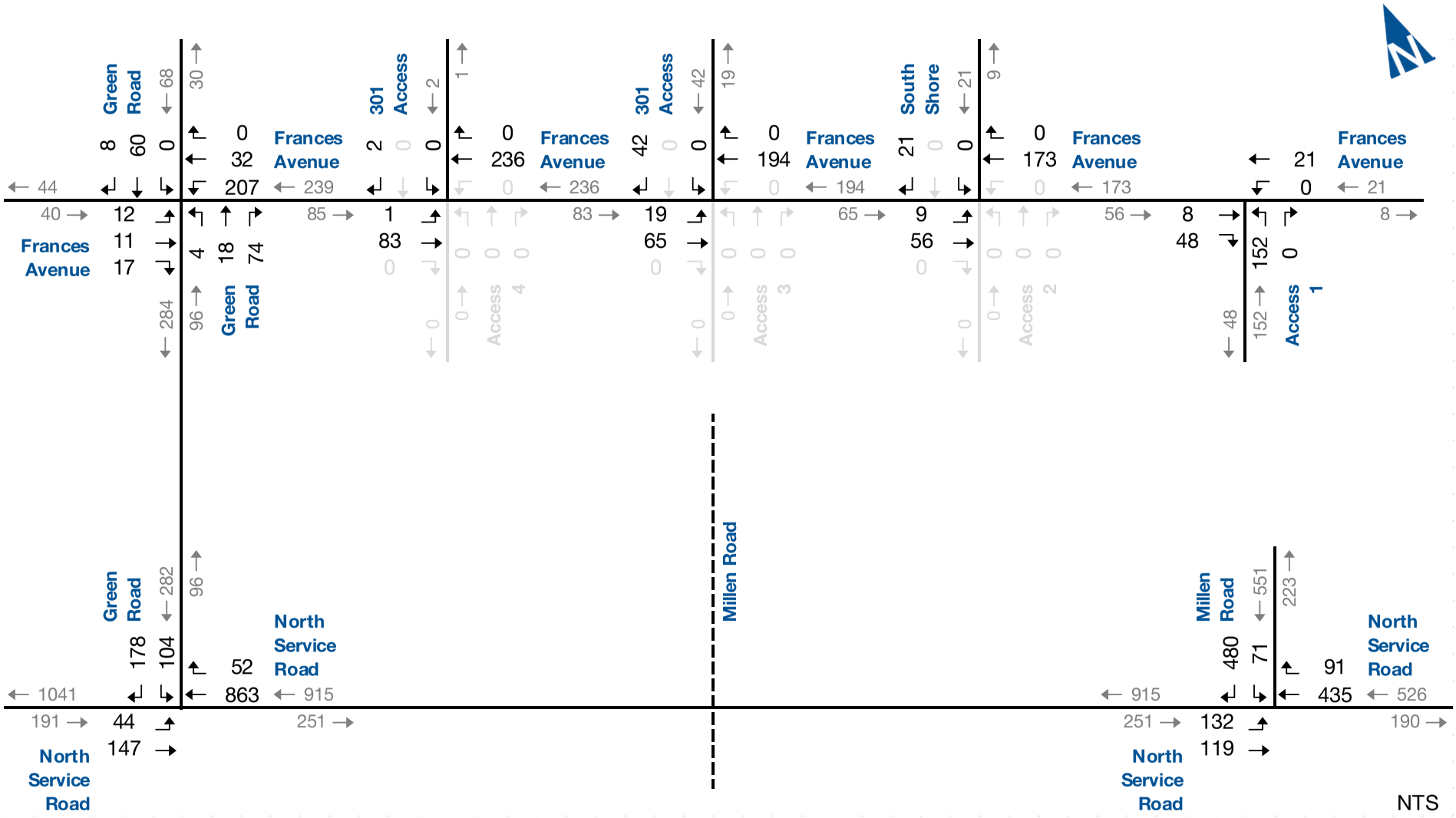
The operations of the study area intersections under 2023 background traffic volumes were analyzed using Synchro 9 with HCM 2000 procedures.

Table 4.5 and **Table 4.6** summarize the 2023 background traffic operations for the AM and PM peak hours, respectively.

The analyses indicate that all intersections and movements within the study area are forecast to operate at acceptable levels of service under 2023 background traffic volumes. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 0.62 during the AM peak hour and LOS F with a v/c ratio of 1.40 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 16 metres during the PM peak hour;
  - Southbound right-turn movement – LOS D with a v/c ratio of 0.62 during the AM peak hour; and
  - The moderate v/c ratios during the AM peak hour indicate the delay to the above-noted movements is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

Appendix **F** contains the detailed supporting Synchro 9 reports.



2023 AM Background Traffic Forecasts

Figure 4.10

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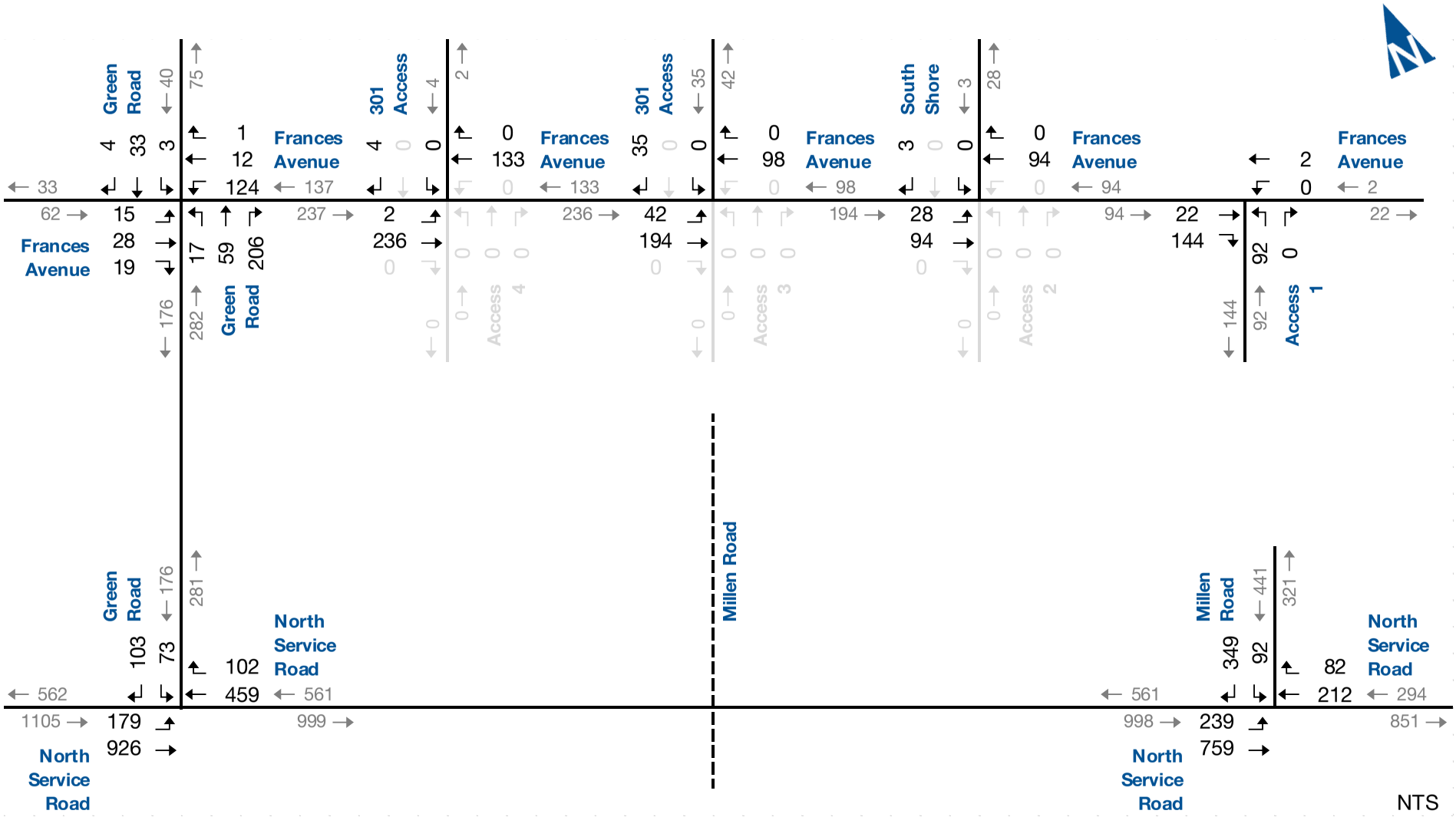


2023 PM Background Traffic Forecasts

Figure 4.11

TABLE 4.5: 2023 AM BACKGROUND TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	A	>	**A**	<	B	>	**B**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	10	>	**10**	<	12	>	**12**	<	0	>	**0**	<	0	>	**0**	**7**
			V/C	<	0.05	>		<	0.34	>		<	0.00	>		<	0.00	>		
			Q	<	1	>		<	12	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	B	A		**A**		A	>	**A**					**F**		**D**	**E**	**A**
			Delay	11	0		**3**		0	>	**0**					52		34	**40**	**9**
			V/C	0.07	0.09				0.59	>						0.62		0.62		
			Q	2	0				0	>						28		31		
			Ex	125	-				-	>						40		-		
			Avail.	123	-				-	>						12		-		
	3 - North Service Road & Millen Road	TCS	LOS	C	B		**B**		B	>	**B**					B		C	**B**	**B**
			Delay	28	11		**20**		20	>	**20**					13		20	**19**	**20**
			V/C	0.66	0.16				0.72	>						0.14		0.61		**0.67**
			Q	39	18				84	>						14		56		
			Ex	90	-				-	>						50		-		
			Avail.	51	-				-	>						36		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	**A**	<	A		**A**	A		>	**A**					**A**
			Delay		0	>	**0**	<	0		**0**	10		>	**10**					**6**
			V/C		0.04	>		<	0.00			0.17		>						
			Q		0	>		<	0			5		>						

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

TABLE 4.6: 2023 PM BACKGROUND TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	B	>	**B**	<	B	>	**B**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	11	>	**11**	<	13	>	**13**	<	1	>	**1**	<	1	>	**1**	**5**
			V/C	<	0.10	>		<	0.24	>		<	0.01	>		<	0.00	>		
			Q	<	3	>		<	8	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	A	A		**A**		A	>	**A**					**F**		B	**F**	**C**
			Delay	10	0		**2**		0	>	**0**					377		14	**164**	**17**
			V/C	0.20	0.59				0.36	>						1.40		0.21		
			Q	6	0				0	>						56		6		
			Ex	125	-				-	>						40		-		
			Avail.	119	-				-	>						-16		-		
	3 - North Service Road & Millen Road	TCS	LOS	B	B		**B**		A	>	**A**					C		C	**C**	**B**
			Delay	11	17		**16**		9	>	**9**					22		22	**22**	**16**
			V/C	0.43	0.78				0.29	>						0.22		0.24		**0.61**
			Q	35	128				31	>						23		19		
			Ex	90	-				-	>						50		-		
			Avail.	55	-				-	>						28		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	**A**	<	A		**A**	A		>	**A**					**A**
			Delay		0	>	**0**	<	0		**0**	10		>	**10**					**3**
			V/C		0.11	>		<	0.00			0.11		>						
			Q		0	>		<	0			3		>						

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

4.2.3 2023 Future Total Traffic Volumes

Figure 4.12 and **Figure 4.13** illustrate the forecast 2023 total traffic (2023 background + Phase 2) volumes, for the AM and PM peak hours, respectively.

4.2.4 2023 Future Total Traffic Operations

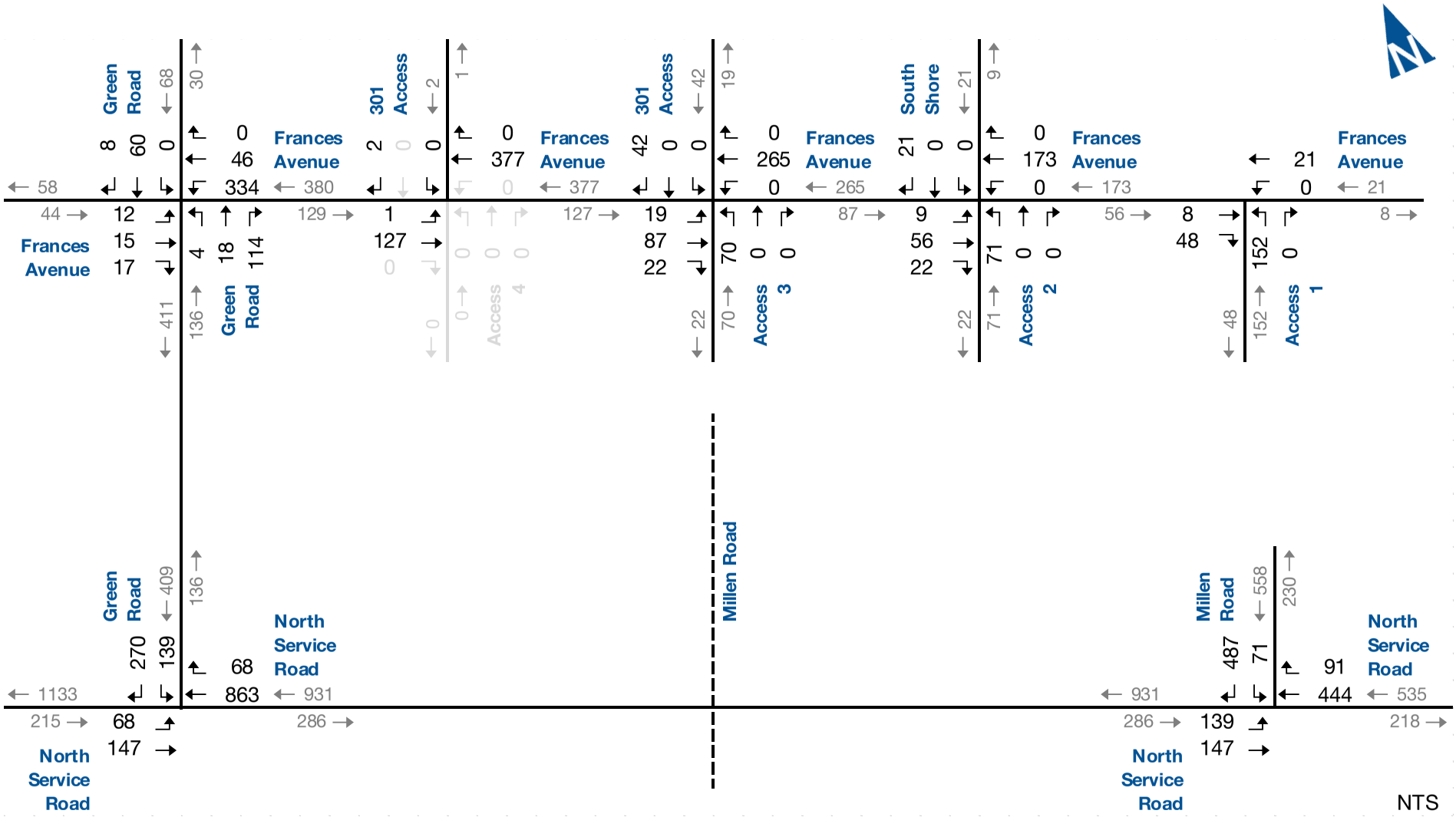
The operations of the study area intersections under 2023 total traffic volumes were analyzed using Synchro 9 with HCM 2000 procedures. In addition to Access 1, Accesses 2 and 3 to the site will be constructed at this horizon.

Table 4.7 and **Table 4.8** summarize the 2023 total traffic operations for the AM and PM peak hours, respectively. Based on the analyses, it is concluded that the intersections are forecast to operate similar to the 2023 background conditions. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 0.93 during the AM peak hour and LOS F with a v/c ratio of 2.66 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 15 metres during the AM peak hour and 51 metres during the PM peak hour;
  - Southbound right-turn movement – LOS F with a v/c ratio of 0.95 during the AM peak hour; and
  - Overall intersection – LOS E during the PM peak hour.

With the exception of the North Service Road and Green Road intersection, the addition of the site generated traffic will increase the delay at the study area intersections by 3 seconds or less during the AM and PM peak hours, in comparison to the background traffic operations. Of note, Site Access 1, 2 and 3 on Frances Avenue are assumed to operate under stop sign control and are forecast to operate with acceptable levels of service during both peak hours.

Appendix G provides the detailed supporting Synchro reports.



2023 AM Total Traffic Forecasts

Figure 4.12

Appendix "C" to Report PED19115
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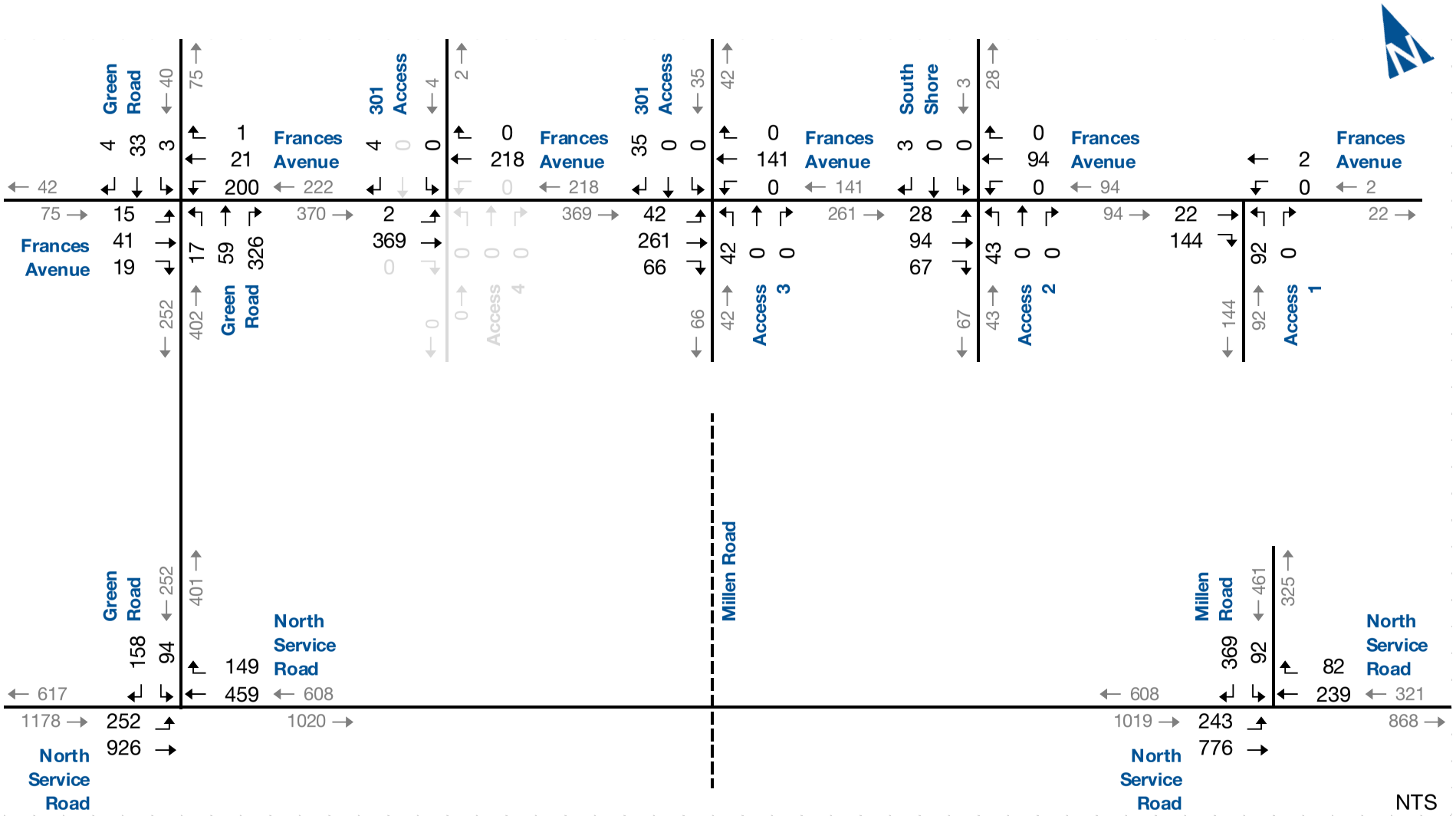


2023 PM Total Traffic Forecasts

Figure 4.13

TABLE 4.7: 2023 AM TOTAL TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	A	>	**A**	<	C	>	**C**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	10	>	**10**	<	16	>	**16**	<	0	>	**0**	<	0	>	**0**	**10**
			V/C	<	0.06	>		<	0.56	>		<	0.00	>		<	0.00	>		
			Q	<	2	>		<	28	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	B	A		**A**		A	>	**A**					F		F	**F**	**C**
			Delay	11	0		**4**		0	>	**0**					111		78	**89**	**24**
			V/C	0.11	0.09				0.60	>						0.93		0.95		
			Q	3	0				0	>						55		77		
			Ex	125	-				-	>						40		-		
			Avail.	122	-				-	>						-15		-		
	3 - North Service Road & Millen Road	TCS	LOS	C	B		**C**		C	>	**C**					B		C	**B**	**C**
			Delay	33	11		**22**		20	>	**20**					13		21	**20**	**20**
			V/C	0.72	0.20				0.73	>						0.14		0.63		**0.68**
			Q	43	21				88	>						14		59		
			Ex	90	-				-	>						50		-		
			Avail.	47	-				-	>						36		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	**A**	<	A		**A**	A		>	**A**					**A**
			Delay		0	>	**0**	<	0		**0**	10		>	**10**					**6**
			V/C		0.04	>		<	0.00			0.17		>						
			Q		0	>		<	0			5		>						
	5 - Frances Avenue & Access 2	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	A	>	**A**	**A**
			Delay	<	1	>	**1**	<	0	>	**0**	<	12	>	**12**	<	9	>	**9**	**3**
			V/C	<	0.01	>		<	0.00	>		<	0.12	>		<	0.03	>		
			Q	<	0	>		<	0	>		<	3	>		<	1	>		
	6 - Frances Avenue & Access 3	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	B	>	**B**	**A**
			Delay	<	1	>	**1**	<	0	>	**0**	<	14	>	**14**	<	10	>	**10**	**3**
			V/C	<	0.02	>		<	0.00	>		<	0.17	>		<	0.06	>		
			Q	<	0	>		<	0	>		<	5	>		<	2	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

TABLE 4.8: 2023 PM TOTAL TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	B	>	**B**	<	C	>	**C**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	12	>	**12**	<	17	>	**17**	<	0	>	**0**	<	1	>	**1**	**7**
			V/C	<	0.14	>		<	0.45	>		<	0.01	>		<	0.00	>		
			Q	<	4	>		<	19	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	B	A		**A**		A	>	**A**					F		C	**F**	**E**
			Delay	10	0		**2**		0	>	**0**					976		15	**373**	**47**
			V/C	0.29	0.59				0.39	>						2.66		0.33		
			Q	10	0				0	>						91		12		
			Ex	125	-				-	>						40		-		
			Avail.	115	-				-	>						-51		-		
	3 - North Service Road & Millen Road	TCS	LOS	B	B		**B**		A	>	**A**					C		C	**C**	**B**
			Delay	11	18		**16**		9	>	**9**					22		22	**22**	**16**
			V/C	0.46	0.79				0.33	>						0.22		0.25		**0.62**
			Q	37	134				35	>						23		20		
			Ex	90	-				-	>						50		-		
			Avail.	53	-				-	>						28		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	**A**	<	A		**A**	A		>	**A**					**A**
			Delay		0	>	**0**	<	0		**0**	10		>	**10**					**3**
			V/C		0.11	>		<	0.00			0.11		>						
			Q		0	>		<	0			3		>						
	5 - Frances Avenue & Access 2	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	A	>	**A**	**A**
			Delay	<	1	>	**1**	<	0	>	**0**	<	11	>	**11**	<	9	>	**9**	**2**
			V/C	<	0.02	>		<	0.00	>		<	0.07	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	2	>		<	0	>		
	6 - Frances Avenue & Access 3	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	C	>	**C**	<	A	>	**A**	**A**
			Delay	<	1	>	**1**	<	0	>	**0**	<	16	>	**16**	<	9	>	**9**	**2**
			V/C	<	0.03	>		<	0.00	>		<	0.12	>		<	0.04	>		
			Q	<	1	>		<	0	>		<	3	>		<	1	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

4.3 2025 Horizon

4.3.1 General Background Traffic Growth

To derive the 2025 general background traffic volumes, a compound growth rate of 2 percent per annum was applied to the existing traffic volumes (14.9 percent total growth).

Figure 4.14 and **Figure 4.15** show the 2025 total background traffic forecasts for the AM and PM peak hours, respectively and include:

- General background traffic growth;
- Traffic from area developments, as already noted; and
- The Phase 1 and Phase 2 site traffic.

4.3.2 2025 Background Traffic Operations

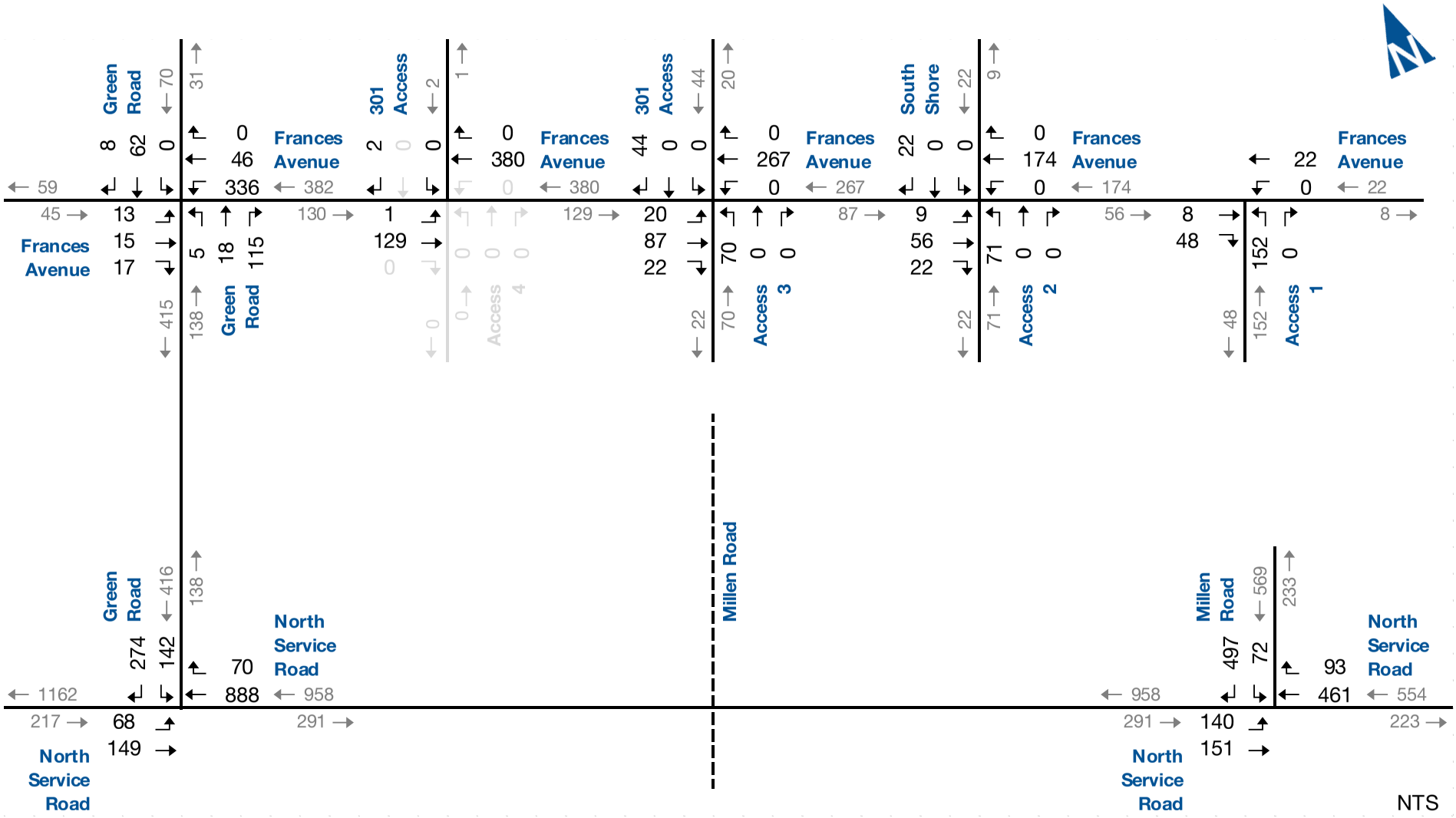
The operations of the study area intersections under 2025 background traffic volumes were analyzed using Synchro 9 with HCM 2000 procedures.

Table 4.9 and **Table 4.10** summarize the 2025 background traffic operations for the AM and PM peak hours, respectively.

The analyses indicate that all intersections and movements within the study area are forecast to operate at acceptable levels of service under 2025 background traffic volumes. The following critical movements are noted:

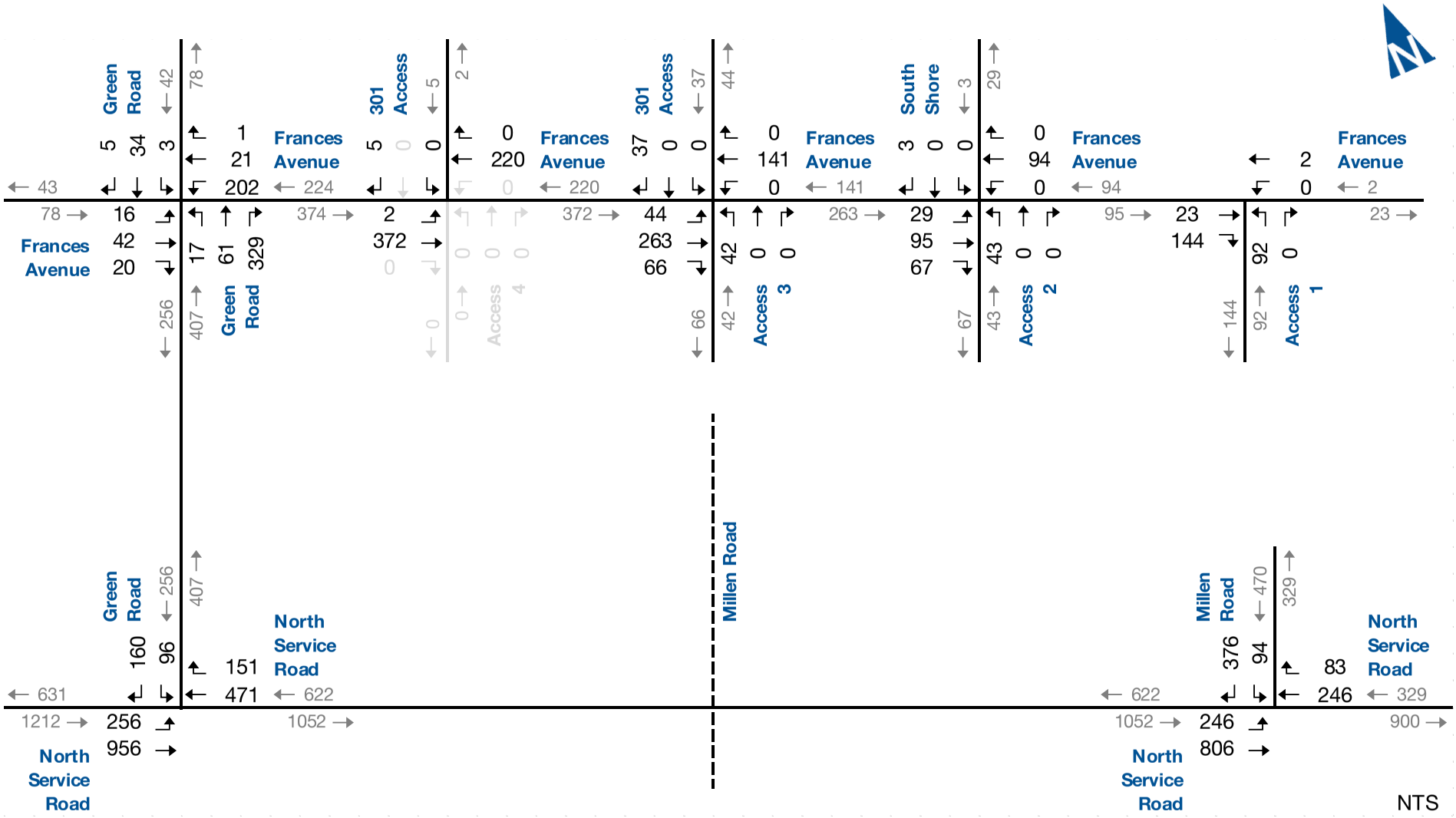
- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 1.0 during the AM peak hour and LOS F with a v/c ratio of 2.97 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 21 metres during the AM peak hour and 55 metres during the PM peak hour;
  - Southbound right-turn movement – LOS F with a v/c ratio of 1.01 during the AM peak hour; and
  - Overall intersection – LOS D during the AM peak hour and LOS F during the PM peak hour.

Appendix H contains the detailed supporting Synchro 9 reports.



2025 AM Background Traffic Forecasts

Figure 4.14



2025 PM Background Traffic Forecasts

Figure 4.15

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TABLE 4.9: 2025 AM BACKGROUND TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	A	>	**A**	<	C	>	**C**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	10	>	**10**	<	16	>	**16**	<	0	>	**0**	<	0	>	**0**	**10**
			V/C	<	0.06	>		<	0.56	>		<	0.00	>		<	0.00	>		
			Q	<	2	>		<	29	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	B	A		**A**		A	>	**A**					F		F	**F**	**D**
			Delay	11	0		**4**		0	>	**0**					130		93	**106**	**28**
			V/C	0.11	0.10				0.61	>						1.00		1.01		
			Q	3	0				0	>						61		86		
			Ex	125	-				-	>						40		-		
			Avail.	122	-				-	>						-21		-		
	3 - North Service Road & Millen Road	TCS	LOS	D	B		**C**		C	>	**C**					B		C	**C**	**C**
			Delay	40	11		**25**		21	>	**21**					13		22	**21**	**22**
			V/C	0.78	0.21				0.75	>						0.14		0.67		**0.72**
			Q	45	22				105	>						14		68		
			Ex	90	-				-	>						50		-		
			Avail.	45	-				-	>						36		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	**A**	<	A		**A**	A		>	**A**					**A**
			Delay		0	>	**0**	<	0		**0**	10		>	**10**					**6**
			V/C		0.04	>		<	0.00			0.17		>						
			Q		0	>		<	0			5		>						
	5 - Frances Avenue & Access 2	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	A	>	**A**	**A**
			Delay	<	1	>	**1**	<	0	>	**0**	<	12	>	**12**	<	9	>	**9**	**3**
			V/C	<	0.01	>		<	0.00	>		<	0.12	>		<	0.03	>		
			Q	<	0	>		<	0	>		<	3	>		<	1	>		
	6 - Frances Avenue & Access 3	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	B	>	**B**	**A**
			Delay	<	1	>	**1**	<	0	>	**0**	<	15	>	**15**	<	10	>	**10**	**3**
			V/C	<	0.02	>		<	0.00	>		<	0.17	>		<	0.06	>		
			Q	<	0	>		<	0	>		<	5	>		<	2	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

TABLE 4.10: 2025 PM BACKGROUND TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	B	>	**B**	<	C	>	**C**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	13	>	**13**	<	18	>	**18**	<	0	>	**0**	<	1	>	**1**	**7**
			V/C	<	0.15	>		<	0.47	>		<	0.01	>		<	0.00	>		
			Q	<	4	>		<	20	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	B	A		**A**		A	>	**A**					F		C	**F**	**F**
			Delay	11	0		**2**		0	>	**0**					1130		16	**432**	**54**
			V/C	0.30	0.61				0.40	>						2.97		0.34		
			Q	10	0				0	>						95		12		
			Ex	125	-				-	>						40		-		
			Avail.	115	-				-	>						-55		-		
	3 - North Service Road & Millen Road	TCS	LOS	B	B		**B**		A	>	**A**					C		C	**C**	**B**
			Delay	12	19		**18**		9	>	**9**					22		22	**22**	**17**
			V/C	0.47	0.82				0.33	>						0.22		0.26		**0.65**
			Q	38	168				36	>						23		20		
			Ex	90	-				-	>						50		-		
			Avail.	52	-				-	>						27		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	**A**	<	A		**A**	A		>	**A**					**A**
			Delay		0	>	**0**	<	0		**0**	10		>	**10**					**3**
			V/C		0.11	>		<	0.00			0.11		>						
			Q		0	>		<	0			3		>						
	5 - Frances Avenue & Access 2	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	A	>	**A**	**A**
			Delay	<	1	>	**1**	<	0	>	**0**	<	11	>	**11**	<	9	>	**9**	**2**
			V/C	<	0.02	>		<	0.00	>		<	0.07	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	2	>		<	0	>		
	6 - Frances Avenue & Access 3	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	C	>	**C**	<	A	>	**A**	**A**
			Delay	<	1	>	**1**	<	0	>	**0**	<	16	>	**16**	<	9	>	**9**	**2**
			V/C	<	0.03	>		<	0.00	>		<	0.12	>		<	0.04	>		
			Q	<	1	>		<	0	>		<	3	>		<	1	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

4.3.3 2025 Future Total Traffic Volumes

Figure 4.16 and **Figure 4.17** illustrate the forecast 2025 total traffic (background + Phase 3) volumes, for the AM and PM peak hours, respectively.

4.3.4 2025 Future Total Traffic Operations

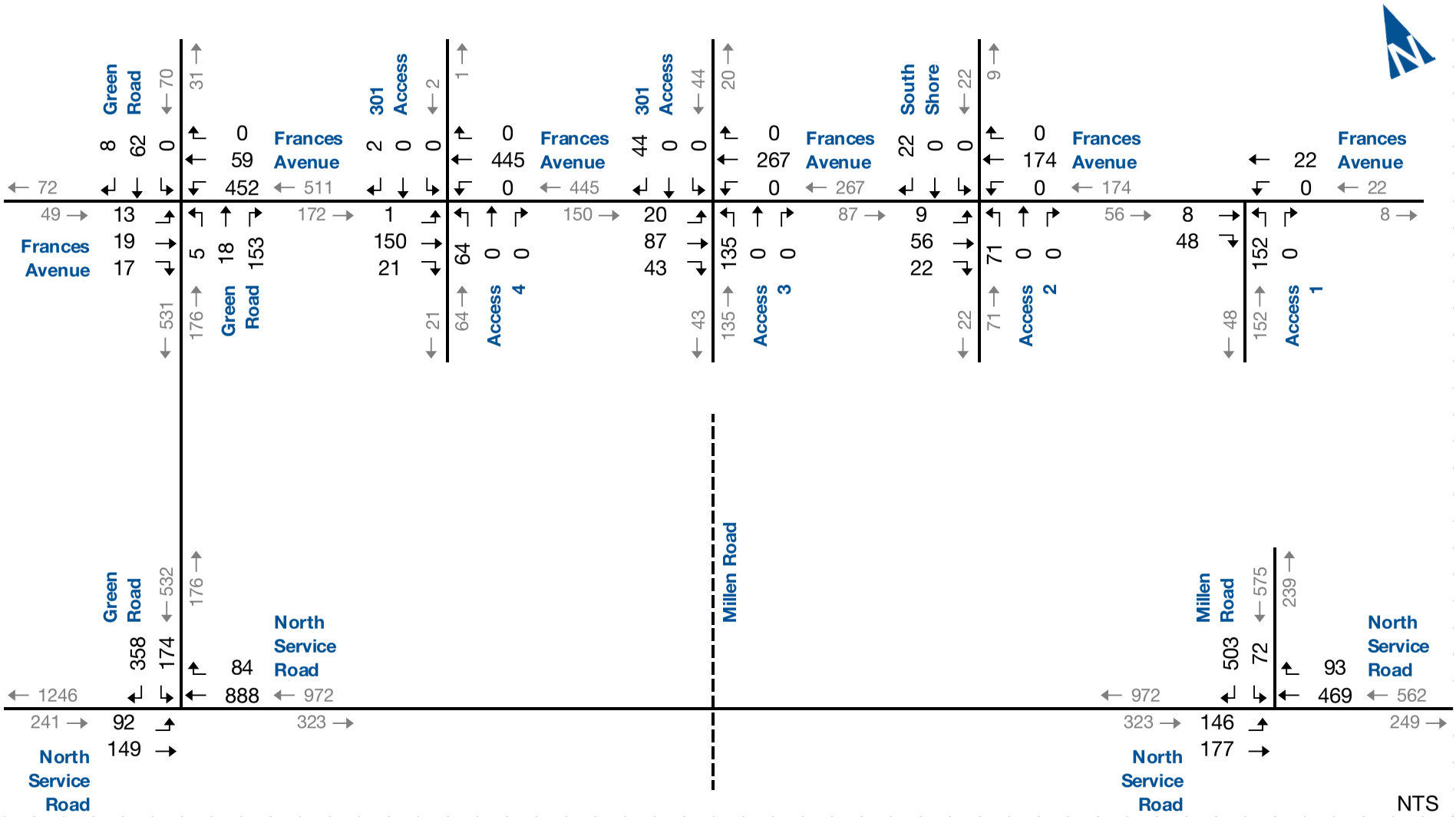
The operations of the study area intersections under 2025 total traffic volumes were analyzed using Synchro 9 with HCM 2000 procedures. All Accesses to the site will be constructed at this horizon.

Table 4.11 and **Table 4.12** summarize the forecast operational results for the AM and PM peak hours, respectively. Based on the analyses, it is concluded that the intersections are forecast to operate similar to the background conditions. The following critical movements are noted:

- Green Road and Frances Avenue:
  - Westbound left-turn/through/right-turn movement – LOS D with a v/c ratio of 0.79 during the AM and 0.74 during the PM peak hour.
- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 1.40 during the AM peak hour and a v/c ratio of 5.47 during the PM peak hour. The95th percentile queue is forecast to exceed the available storage by 59 metres during the AM peak hour and 55+ metres during the PM peak hour;
  - Southbound right-turn movement – LOS F with a v/c ratio of 1.33 during the AM peak hour; and
  - Overall intersection – LOS F during the AM and PM peak hours.

With the exception of the North Service Road and Green Road intersection, the addition of the site generated traffic will increase the delay at the study area intersections by 7 seconds or less during the AM and PM peak hours, in comparison to the background traffic operations. Of note, Site Access 1, 2, 3 and 4 on Frances Avenue are assumed to operate under stop sign control and are forecast to operate with acceptable levels of service during both peak hours.

Appendix I provides the detailed supporting Synchro reports.



2025 AM Total Traffic Forecasts

Figure 4.16

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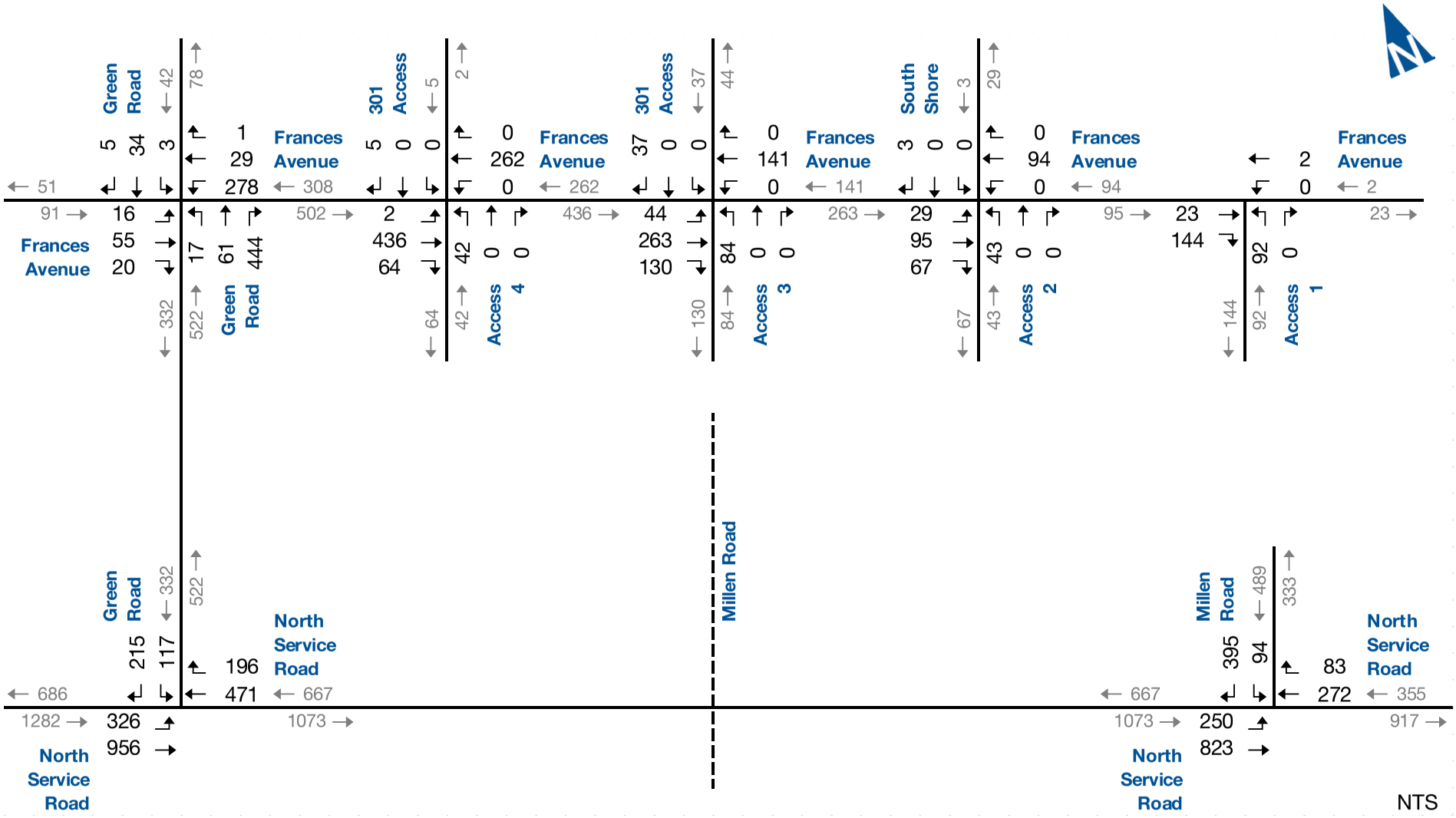

2025 PM Total Traffic Forecasts

Figure 4.17

TABLE 4.11: 2025 AM TOTAL TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	B	>	B	<	D	>	D	<	A	>	A	<	A	>	A	C
			Delay	<	10	>	10	<	26	>	26	<	0	>	0	<	0	>	0	17
			V/C	<	0.07	>		<	0.79	>		<	0.00	>		<	0.00	>		
			Q	<	2	>		<	62	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	B	A		A		A	>	A					F		F	F	F
			Delay	12	0		5		0	>	0					278		204	228	70
			V/C	0.16	0.10				0.62	>						1.40		1.33		
			Q	4	0				0	>						99		156		
			Ex	125	-				-	>						40		-		
			Avail.	121	-				-	>						-59		-		
	3 - North Service Road & Millen Road	TCS	LOS	D	B		C		C	>	C					B		C	C	C
			Delay	49	12		29		21	>	21					13		23	21	23
			V/C	0.84	0.24				0.77	>						0.14		0.69		0.77
			Q	48	25				107	>						14		79		
			Ex	90	-				-	>						50		-		
			Avail.	42	-				-	>						36		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	A	<	A		A	A		>	A					A
			Delay		0	>	0	<	0		0	10		>	10					6
			V/C		0.04	>		<	0.00			0.17		>						
			Q		0	>		<	0			5		>						
	5 - Frances Avenue & Access 2	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	A	>	A	A
			Delay	<	1	>	1	<	0	>	0	<	12	>	12	<	9	>	9	3
			V/C	<	0.01	>		<	0.00	>		<	0.12	>		<	0.03	>		
			Q	<	0	>		<	0	>		<	3	>		<	1	>		
	6 - Frances Avenue & Access 3	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	B	>	B	A
			Delay	<	1	>	1	<	0	>	0	<	17	>	17	<	10	>	10	5
			V/C	<	0.02	>		<	0.00	>		<	0.33	>		<	0.06	>		
			Q	<	0	>		<	0	>		<	11	>		<	2	>		
	7 - Frances Avenue & Access 4	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	B	>	B	A
			Delay	<	0	>	0	<	0	>	0	<	17	>	17	<	11	>	11	2
			V/C	<	0.00	>		<	0.00	>		<	0.19	>		<	0.00	>		
			Q	<	0	>		<	0	>		<	5	>		<	0	>		

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LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

TABLE 4.12: 2025 PM TOTAL TRAFFIC OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	B	>	B	<	D	>	D	<	A	>	A	<	A	>	A	B
			Delay	<	15	>	15	<	32	>	32	<	0	>	0	<	1	>	1	12
			V/C	<	0.21	>		<	0.74	>		<	0.01	>		<	0.00	>		
			Q	<	6	>		<	48	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TWSC	LOS	B	A		A		A	>	A					F		C	F	F
			Delay	12	0		3		0	>	0					Err		19	3530	516
			V/C	0.40	0.61				0.43	>						5.47		0.48		
			Q	16	0				0	>						Err		20		
			Ex	125	-				-	>						40		-		
			Avail.	110	-				-	>						####		-		
	3 - North Service Road & Millen Road	TCS	LOS	B	C		B		A	>	A					C		C	C	B
			Delay	12	20		19		9	>	9					22		22	22	18
			V/C	0.50	0.84				0.36	>						0.22		0.27		0.66
			Q	40	173				40	>						23		20		
			Ex	90	-				-	>						50		-		
			Avail.	50	-				-	>						27		-		
	4 - Frances Avenue & Access 1	TWSC	LOS		A	>	A	<	A		A	A		>	A					A
			Delay		0	>	0	<	0		0	10		>	10					3
			V/C		0.11	>		<	0.00			0.11		>						
			Q		0	>		<	0			3		>						
	5 - Frances Avenue & Access 2	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	A	>	A	A
			Delay	<	1	>	1	<	0	>	0	<	11	>	11	<	9	>	9	2
			V/C	<	0.02	>		<	0.00	>		<	0.07	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	2	>		<	0	>		
	6 - Frances Avenue & Access 3	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	A	>	A	A
			Delay	<	1	>	1	<	0	>	0	<	18	>	18	<	9	>	9	3
			V/C	<	0.03	>		<	0.00	>		<	0.25	>		<	0.04	>		
			Q	<	1	>		<	0	>		<	8	>		<	1	>		
	7 - Frances Avenue & Access 4	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	A	>	A	A
			Delay	<	0	>	0	<	0	>	0	<	17	>	17	<	0	>	0	1
			V/C	<	0.32	>		<	0.00	>		<	0.13	>		<	0.00	>		
			Q	<	0	>		<	0	>		<	4	>		<	0	>		

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LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

5 Remedial Measures

The following section reviews the need for measures that should potentially be implemented to mitigate the impacts of increased in traffic on the study network.

5.1 Traffic Control Signal

The southbound left-turn and right-turn movements at intersection of North Service Road and Green Road are forecast to operate at LOS F and LOS D, respectively by 2021 with the additional development traffic.

Using Justification 7 under Ontario Traffic Manual (OTM) Book 12[10] procedures, the intersection of North Service Road and Green Road satisfies the necessary conditions to implement traffic control signals by 2025 under total traffic conditions. The signal warrant is fulfilled 145%, which exceeds the fulfillment requirement of 120% for existing intersections and accounts for increased uncertainty of volume projections for proposed new developments. Under 2023 total traffic conditions, the warrant is fulfilled 117%, which almost meets the requirement for the installation of traffic signals. Under 2021 total traffic conditions, the warrant is only fulfilled 87%, which does not meet the requirements set out in Book 12.

However, to provide acceptable levels of service for the southbound movements at the intersection of Green Road and North Service Road, it is recommended traffic signals are installed at the 2021 horizon year. Upon full build-out of the site in 2025, traffic signals are forecast to be warranted at the intersection. The provision of signals will not only help to improve delays on the southbound approach but will also improve safety within the area by providing a protected phase for traffic on Green Road. This removes the potential for motorists frustration and unsafe turning movements from Green Road when gaps are not available.

Appendix J includes the signal warrant justification worksheets.

5.2 Right-Turn Lane Warrant

At the intersection of North Service Road and Green Road, the westbound through/right-turn movement is forecast to approach capacity at the 2021 horizon. This is likely caused by the general increase in through traffic coupled with the increase in right-turning traffic due to the proposed development.

The Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roadways[11] (GDGCR) details the requirements for auxiliary right-

[10] Ministry of Transportation Ontario. *Ontario Traffic Manual Book 12 – Traffic Signals.* March 2012.
[11] Transportation Association of Canada. *Geometric Design Guide for Canadian Roads.* 2017.

turn lanes. The GDGCR recommends a right-turn lane at a signalized intersection without a separate signal indication “when the volume of right-turning traffic is 10% to 20% of the total approaching volume”. The right-turning volume accounts for 6% and 18% of the total advancing volume during the AM and PM peak hours respectively. Of the right-turning traffic, 33% and 50% is site-generated during the AM and PM peak hours respectively, at the 2021 horizon. By 2025, the right-turning volume accounts for 9% and 30% of the total advancing volume during the AM and PM peak hours respectively. Of the right-turning traffic, 56% and 72% is site-generated during the AM and PM peak hours respectively.

Based on the TAC GDGCR, a westbound right-turn lane should be provided on North Service Road at Green Road at the 2025 horizon. Based on an 80 kilometre per hour design speed, a total lane length of 127.5 metres is required as follows:

- A minimum of 60 metres of taper (based on a 3.5 metre lane width);
- A minimum of 60 metres of parallel lane; and
- 7.5 metres of storage.

There is an open channelized river on the north side of North Service Road, approximately 60 metres east of Green Road. The location of the river limits the available space to construct a westbound right-turn lane without undertaking major road widening. At this location, a short right-turn lane and taper may be a feasible solution to fit within the existing roadway constraints. **Appendix K** provides a preliminary design for the right-turn lane, indicating a 10-metre lane and 15.8 metre taper can be accommodated west of the culvert. The right-turn lane is sub-standard compared to TAC requirements, however it allows for speed reduction outside of the through lane on North Service Road.

5.3 Left-Turn Lanes

The westbound shared left-turn/through/right-turn movement at intersection of Green Road and Frances Avenue is forecast to operate at LOS D during the AM and PM peak hour at the 2025 horizon, with the addition of the development traffic. An all-way Stop is not recommended for the intersection as it may result in northbound traffic backing up into the intersection of Green Road and North Service Road.

The majority (about 90 percent) of westbound traffic at the intersection completes a westbound to southbound left-turn from Frances Avenue onto Green Road. Provision of a separate left-turn lane will help to improve operations on the westbound approach since it will separate left-turns from the through and right-turning traffic. Based on the analyses in the following section, 45 metres of storage should be provided. The cross-section of Frances Avenue is wide enough to accommodate both a left-turn lane and shared through right-turn lane through pavement markings only and without

the need for road widening. Therefore, it is recommended that separate lanes are provided on this approach.

5.4 Traffic Operations

Paradigm completed Synchro 9 level of service analyses with HCM 2000 procedures for the intersections with the proposed improvements:

- Traffic signals at North Service Road and Green Road;
- A separate westbound left-turn lane at Green Road and Frances Road; and
- A separate westbound right-turn lane at North Service Road and Green Road.

The intersections were assessed for the 2025 future total traffic horizon, as this represents the “worst case scenario”. If the intersection improvements provide acceptable levels of service for all movements at this horizon, they will provide acceptable levels of service for the 2021 and 2023 horizons.

Table 5.1 and **Table 5.2** summarize the total traffic operations for the AM and PM peak hours, respectively. Based on the analyses, it is concluded that the intersections are forecast to operate at acceptable levels of service. The following exceptions are noted:

- Green Road and Frances Avenue:
  - Westbound left-turn movement – LOS D with a v/c ratio of 0.68 during the PM peak hour. The 95th percentile queue indicates 45 metres of storage is required.
- North Service Road and Green Road:
  - Southbound left-turn movement – 95th percentile queue is forecast to exceed the available storage by 15 metres during the AM peak hour; and
  - Southbound right-turn movement – 95th percentile queue is forecast to extend back and may block the commercial plaza driveway during the AM peak hour. This will occur for approximately 5% of the peak hour or for about three minutes.

    The 50th percentile queue estimate is 47 metres which will not extend beyond the driveway. The 50th percentile queue is a better representation of the actual level of queueing as it will occur for about half of the peak hour.

    As well, commercial developments typically have very low AM peak hour traffic volumes; therefore, if the queue does extend back to block this driveway, the overall impacts may be negligible.

Appendix L includes the detailed Synchro reports.

TABLE 5.1: 2025 AM REMEDIAL MEASURES TOTAL TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	B	>	**B**	C	B	>	**C**	<	A	>	**A**	<	A	>	**A**	**B**
			Delay	<	10	>	**10**	21	11	>	**20**	<	0	>	**0**	<	0	>	**0**	**13**
			V/C	<	0.07	>		0.69	0.09	>		<	0.00	>		<	0.00	>		
			Q	<	2	>		45	2	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TCS	LOS	C	A		**B**		C	A	**B**					D		D	**D**	**C**
			Delay	30	8		**16**		20	7	**19**					36		46	**42**	**26**
			V/C	0.64	0.15				0.83	0.07						0.45		0.71		**0.79**
			Q	43	20				205	6						55		93		
			Ex	125	-				-	60						40		-		
			Avail.	82	-				-	54						-15		-		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

TABLE 5.2: 2025 PM REMEDIAL MEASURES TOTAL TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	1 - Green Road & Frances Avenue	TWSC	LOS	<	B	>	**B**	D	B	>	**D**	<	A	>	**A**	<	A	>	**A**	**A**
			Delay	<	15	>	**15**	28	12	>	**27**	<	0	>	**0**	<	1	>	**1**	**10**
			V/C	<	0.21	>		0.68	0.06	>		<	0.01	>		<	0.00	>		
			Q	<	6	>		40	2	>		<	0	>		<	0	>		
	2 - North Service Road & Green Road	TCS	LOS	B	B		**B**		A	A	**A**					C		C	**C**	**B**
			Delay	15	18		**17**		8	6	**8**					34		31	**32**	**16**
			V/C	0.65	0.83				0.43	0.13						0.36		0.14		**0.72**
			Q	68	193				58	7						37		19		
			Ex	125	-				-	60						40		-		
			Avail.	57	-				-	53						3		-		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length
Ex. - Existing Available Storage
Avail. - Available Storage

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

6 Parking Assessment

In any equilibrium system, there are a minimum of two components that are required to reach the equilibrium point. With parking systems, this is the balance of parking supply and demand. Reaching an appropriate supply level is equally important as demand. The ubiquitous oversupply of cheap and easily accessible parking has long been identified as a major contributing factor to the growth in single-occupant vehicle (SOV) travel.

The anticipated parking demand for the proposed development was estimated to determine if a reduction from the generic parking requirements set-out in the City of Stoney Creek's Zoning By-law 3692-92 could be justified. Two (2) approaches were considered, with the findings for each documented below.

6.1 By-law Parking Requirements

The Stoney Creek Zoning By-law requires a total of 1.60 parking spaces per one-bedroom apartment unit (1.25 spaces per unit for residents and 0.35 spaces per unit for visitors) and a total of 1.85 parking spaces per two-bedroom unit (1.50 spaces per unit for residents and 0.35 spaces per unit for visitors). Under this By-law, a total of 3,090 parking spaces will be required to service the residential component of the site. The site is proposing 2,438 spaces which is a deficiency of 652 spaces, or about 21 percent of parking required under the By-law as shown in **Table 6.1**.

TABLE 6.1: ZONING BY-LAW PARKING REQUIREMENTS

Number of Bedrooms	Number of Units	By-Law Parking Requirements			Required Spaces
		Residents	Visitors	Total	
1	1227	1.25	0.35	1.60	1,963
2	609	1.50	0.35	1.85	1,127
Total By-Law Parking Requirements					3,090
Proposed Number of Spaces					2,438
Stall Deficiency					**652**
Percent Deficiency					**21%**

6.2 Proxy Site Parking Demand Surveys

Another approach to estimate the parking demands of the proposed site is the use of local parking surveys. Ultimately, a similar site within the City of Hamilton would be used as the proxy site for collection of parking and trip generation data to determine the area-specific parking demands. However, a similar site where parking could be easily accessed was not found within City limits. In lieu of this, parking and trip generation surveys were

undertaken on four consecutive weekdays at a similar 'proxy' site in Burlington, Ontario. The site (3060/3070 Rotary Way) is located at the intersection of Dundas Street and Rotary Way. The site consists of 224 residential condominiums with a total parking supply of 432 spaces available for both residents and visitors. This amounts to a total parking supply of 1.93 spaces per residential unit. Although this proxy site is smaller than the proposed site, it is quite similar to the type of development proposed for the subject site and proximity to a major highway. As well, both the subject site and proxy site are in locations outside the city centre where reliance on automobile transportation tends to be higher.

The four-day parking demand data was summarized in 30-minute increments by day for both the AM and PM survey hours. A utilization rate was then produced for each half hour on each consecutive day, which was then summarized into a parking rate per unit for each 30-minute period.

Analyses of the proxy site data indicate that the peak parking rate was observed to be 1.25 spaces per unit during the AM survey period and 0.96 spaces per unit during the PM survey period inclusive of visitor parking demands. The average rates were 1.16 and 0.83 spaces per unit in the AM and PM peak hours respectively. In order to be conservative, the peak parking demand of 1.25 was chosen as the most representative parking demand rate for the proxy site. Note that this rate is between 0.35 and 0.60 spaces per unit lower than the current Zoning By-law requirements for the proposed site. The proxy site survey data is provided in **Appendix M**.

The peak proxy site rate of 1.25 spaces per unit (residents and visitors combined) was applied to the 1,836 proposed units at 310 Frances Avenue This results in a parking requirement of 2,295 spaces, or an oversupply of 143 spaces (6 percent) as shown in **Table 6.2**.

TABLE 6.2: PARKING REQUIREMENTS BASED ON PROXY SITE DATA

Units	Proxy Site Parking Requirement	Required Spaces
1,836	1.25 spaces per dwelling unit	2,295
	Proposed Number of Spaces	2,438
	Stall Surplus	**143**
	Percent Surplus	**6%**

6.3 Overall Parking Assessment

Based on the information contained within this section, it is anticipated that the site will have a deficiency in parking of 652 spaces based on the By-law parking requirements and a surplus of 143 spaces based on the proxy site data. The proxy site data provides an accurate representation of the parking

demands for the site as they are based on area-specific data and not a general Zoning By-law. Additionally, it further supports a reduction in parking requirements for the site. Therefore, the proposed parking supply should adequately accommodate the parking demands of the site.

In the event that the parking demands of the site exceed the available capacity during the higher demand evening and weekend periods, on-street parking is available on Frances Avenue adjacent to the site and on Green Road west of the site (**Figure 1.1**). While it is not intended that residents would utilize the on-street parking, it is not unreasonable to assume that visitors to the building may park on Frances Avenue or Green Road for a short duration.

At present, the City's On-street parking By-law permits parking for up to 12 hours at any give time on these roadways. Since adequate parking should be provided on-site and on-street parking will likely only be used by visitors, posting of parking restrictions on both roadways is not recommended as this will negatively impact the number of parking spaces available for the existing residential properties.

7 Transportation Demand Management

This section of the report has been prepared to meet the City of Hamilton's Transportation Demand Management for Development Guidelines[12]. More specifically, section *3.A Residential* of the guidelines. Although a small commercial component is proposed for the development, given the proposed size of 400 square metres and minor estimated trip generation, section 3.A provides a better representation of the requirements of the development.

Transportation Demand Management (TDM) refers to ways of making the capacity of our roads more efficient by reducing vehicle demand. TDM approaches consider how people's choices of travel mode are affected by factors such as land use patterns, development design, parking availability, parking cost, and the relative cost, convenience and availability of alternative modes of travel. TDM is one of the tools that municipalities are using to create more vibrant and sustainable communities. Using policies and programs to make active and sustainable transportation more convenient, a TDM approach to transportation can deliver long-term environmental sustainability, improve public health, create stronger communities, and build more prosperous and livable cities. Various TDM strategies are used to influence these factors so that the alternatives are more competitive with driving alone, thus reducing reliance on motor vehicles.

TDM strategies can be divided into two basic categories:

- Pre-occupancy: actions that can be done while a development is being designed and built, and
- Post-occupancy: actions that can be done once people are using the development.

The pre-occupancy actions are critical because they are most likely to determine how attractive, convenient and safe alternative travel will be once the site is occupied. Actions such as modifying the site plan to improve pedestrian safety and convenience or reducing the number of provided parking stalls can encourage a reduction in vehicle trips to the site. After the development is built, further strategies include transit or rideshare subsidies and providing convenient information about where and how to use these alternatives. It should be noted that the actions taken after development will not be as effective if TDM strategies are not initially implemented in the site planning stages. For example, transit subsidies will not be taken advantage of if the closest transit stops are not easy to get to or do not connect with the greater transit network. Thus, it is important to take advantage of both pre-occupancy and post-occupancy TDM strategies.

[12] City of Hamilton, Transportation Demand Management Development Guidelines, June 2015.

The City of Hamilton has developed Transportation Demand Management Land Development Guidelines[13] that are *"a tool for developers and City staff to include TDM initiatives into new development, redevelopment and existing buildings through the development approval process"*. The guidelines outline the report requirements and provide strategies to support TDM within developments and were referenced in the preparation of this report.

7.1 Potential TDM Measures

There are several reasons why incorporating a TDM plan into a residential site is important:

- It reduces auto ownership levels, thereby reducing private vehicle trips and congestion;
- It creates safe and attractive environments that encourage travel by walking, cycling and transit over auto travel; and
- It supports the development of healthy communities.

The following section outlines potential TDM options available to the site. These measures will enhance the site's overall convenience, safety and traffic flow by reducing vehicles trips.

7.1.1 Walking

The accessibility of a development is essential in helping to ensure that those that can walk, do. Proper pedestrian connections from the community to the site should be available to ensure safety and to increase the experience of those that choose to walk.

The site plan indicates direct sidewalk connections will be provided from entrances of the buildings to the existing sidewalks along the south side of Frances Avenue and east side of Green Road. Other measures that can be taken that help to improve safety and the attractiveness of the site include providing adequate lighting throughout the site and overhead weather protection near the building's main entrance and adjacent sidewalks.

7.1.2 Cycling

As outlined in **Section 2.3.2**, the site will be served by bicycle infrastructure. With signed bike routes on Frances Avenue, Shoreview Place and Millen Road the site can facilitate the daily use of bicycles.

To further encourage this use, the development should include visible, well-lit short-term bicycle parking for visitors and secure, indoor bicycle parking storage spaces for tenants/residents. The City's TDM guidelines specify the recommended number of bicycle parking spaces for residential and retail buildings. These guidelines include the following:

[13] TDM for Development, Prepared for City of Hamilton by IBI Group, June 2015

- Long term bicycle parking: 0.50 to 1.25 spaces per dwelling unit or 918 to 2,295 spaces total; and
- Short term bicycle parking: 0.05 to 0.20 spaces per dwelling unit or 92 to 367 spaces total.

The development will provide both short-term and long-term bicycle parking spaces. **Table 7.1** details the City's bicycle parking guidelines for the site.

TABLE 7.1: BICYCLE PARKING GUIDELINES

Land Use	Units	Bicycle Parking Requirement		Required Spaces
3.A Residential	1836	Long-term	0.5 to 1.25 spaces per dwelling unit	918 to 2295
		Short-term	0.05 to 0.2 spaces per dwelling unit	92 to 367
			Total Spaces	**1010 to 2662**

The development is providing a total of 444 long-term bicycle parking spaces within bike rooms on each level of the parking garage. This is a deficiency of 474 bicycle parking spaces compared to the TDM Guidelines. However, each unit will also have a storage locker large enough to accommodate a bicycle. Therefore, the potential bicycle parking of the development is 2,280 spaces, well within the City's guidelines.

A total of 92 short-term bicycle parking spaces will be provided via bike racks paced near the building entrances, which meets the City's guidelines.

Bicycle parking requirements were not considered for the commercial component, given the small size in comparison to the development. The Stoney Creek Zoning By-law does not detail bicycle parking requirements for commercial sites. If long-term bicycle parking is required by employees of the commercial component, the development may be able to allocate spaces, given the surplus. The short-term bicycle parking required for the residential component will also be available for patrons of the commercial component.

By providing the recommended number of short and long-term bicycle parking stalls, residents, employees and visitors will be more likely to choose to travel to/from the development by cycling. This increase in sustainable transportation results in a reduction of automobile trips and thus a reduction in parking demand should result.

7.1.3 Transit

The use of transit places less reliance on the use of personal automobiles for trips that can be completed by convenient and desirable transit options. As previously discussed, there is no fixed route transit service within the area of

the subject development. Trans-Cab service is available to pick up and transport passengers between the nearest bus stop transfer points approximately 2.0 kilometres from the site. See **Section 2.2** for details on this route as well as connections available to the wider HSR network.

It is recommended that bus route maps and schedules are provided at visible and convenient locations at the site, such as in the building's lobby. It is also recommended that the applicant advocate to the City of Hamilton and HSR to bring fixed route transit service to the area. If fixed route service is provided, it is recommended that weather protected waiting areas such as bus shelters or overhangs be provided at all stop locations. These additions will help to increase transit usage (especially during inclement weather).

7.1.4 Parking

The City's TDM Policy provides guidelines indicating that reducing parking spaces with the intent of encouraging other uses of transportation is possible. However, one should be cautious and not reduce the number of parking spaces to a point in which significant issues are created. As detailed in **Section 6**, the required number of parking spaces varies from a surplus of 134 to a deficiency of 652 depending on the method used for calculation. In order to mitigate any potential parking shortfall, TDM measures detailed in the following sections, consistent with the City's TDM policy should be considered by the applicant to help manage parking. Managing parking supply helps to reduce the undesirable impacts of parking demand on local and regional traffic levels and can result in positive impacts on community livability and design.

To further encourage residents to use sustainable travel modes, the development could consider selling parking spaces separately from the cost of a unit. This is more equitable and efficient since occupants are not forced to pay for parking they do not need and allows consumers to adjust their parking supply to reflect their needs. This is an important factor that supports reducing the parking supply as residents are notified at the onset of the project that parking will be provided on a limited basis as an additional cost in lieu of the price to purchase a unit. If residents are unwilling to change their travel behaviour, they will not purchase a unit.

If the number of parking spaces is reduced, caution should be given to providing adequate accessibility to other transportation modes. Additional provisions should be made, such as providing suitable bike parking, providing suitable access to transit service, and enhancing pedestrian and bike connections to ensure that other modes of transportation are readily accessible.

7.1.5 Carpooling

Ride-share involves two or more people sharing a vehicle for a trip. The cost of the journey (fuel, tolls, parking, etc.) can be split between the driver and passengers, resulting in savings for all concerned. This also reduces the number of vehicle trips and parking demands.

There are several tools available such as Car Pool World, which set up online ride sharing databases. These databases enable people to enter their daily journey so that the database can automatically search out coworkers whose journeys match. A less formal option would be installing notice boards in the lobby of the buildings for residents who may organize informal carpools.

7.1.6 Car-Share

Car sharing is recognized in the City's TDM policy as a means of reducing automobile dependence by providing access to a car on an as-need basis and reducing the need to own a vehicle. The provision of secured car-share spaces in private lots can result in a reduction in residential parking requirements. The TDM policy states that a 2% reduction in the parking will result for providing car-share spaces for 2% of the building occupants. This means that if 37 car-share spaces are provided for the redevelopment, a reduction of 37 spaces to the required building parking spaces will be permitted.

Car-share appeals to a broad range of households from young urban professionals to families who want a lifestyle that is not tied to owning and maintaining a private vehicle. It also attracts those that want to retain the option to drive for primarily non-work trip purposes.

Another option could be providing additional car-share vehicles within walking distance of the site if the current supply of vehicles is insufficient to meet demands.

7.1.7 Individualized Travel Planning

Research has indicated that educating the occupants by going directly to residents increases the likelihood that a shift to more sustainable modes of transportation will occur. The Organisation for Economic Co-operation and Development (OECD) and the Global Environmental Change Program of the UK Economic and Social Research council hosted a workshop[14] that recognized the importance of understanding the forces that motivate and shape individuals' travel behaviour. It identified several key messages of benefit to TDM policy development:

- Hierarchy of Choice: An employer can make decisions that influence how all his or her employees travel to work. Similarly, an individual's decision to buy his or her house may affect how all the members of the household travel. A greater understanding of this hierarchy can assist in identifying those high-order organizations and individual choices. TDM strategies and policies should target those key decision makers.

[14] Organisation for Economic Co-operation and Development (OECD). 1997. Second OECD Workshop on Individual Travel Behaviour: "Culture, Choice and Technology" Final Report. University of Sussex, Brighton, UK 17-19 July 1996. Paris: OECD.

- Perception: Individuals' perceptions of time, environment, and alternative modes of travel and travel behaviour, determine whether they feel they have a choice in how they travel. For example, people who have rarely taken public transport or cycled may not perceive these modes as suited to their lifestyle because of perceived disadvantages which they associate with these modes. In many cases, individuals over-estimate the benefits of their current choice and under-estimate the capacity of alternative modes to satisfy their needs. Altering these perceptions can open the range of options available to travelers.
- Culture: Culture plays an important role in determining the status, image and acceptability of different types of travel behaviour. For example, the car has social and cultural attributes that go well beyond its role as a mode of transportation. TDM strategies must consider these cultural factors.
- Education (Information and Learning): Individuals need targeted, relevant, effective and positive information to better understand the consequences of different travel choices on their own, and their community's quality of life. This information would be most effective if available before individuals engage prior to car and home purchases.

Individual travel planning has demonstrated that working directly with residents/employees as well as providing appropriate infrastructure increases the use of sustainable modes and reduces the site's dependency on vehicles. Therefore, it is an important component to the encouragement of the use of sustainable modes of transportation at the subject site.

The applicant should work with the buildings' residents to form a travel planning committee/team that will help develop individualized travel plans for interested residents. This team could be responsible for:

- Ensuring up-to-date bus routes and maps are available within the lobbies of the buildings and providing information on next available bus, cost of trip and where to purchase passes;
- Providing assistance to residents in signing up for and arranging carpool and bike sharing services; and
- Developing specific travel plans using alternative modes of transportation (HSR travel planning, etc.), including total trip time.

Additionally, the applicant should consider provision of a kiosk or message/bulletin board within the building entrance for use by the committee/team.

7.2 TDM Summary

The proposed site with nearby connections to bicycle facilities and transit routes has the potential to be an accessible development. Further enhancing

these elements inside and outside the boundaries of the development will ensure these opportunities do not go unused. The City's outcomes for incorporating TDM with new development include the following:

- Promoting more attractive streetscapes that are inclusive and inviting for everyone;
- Developing neighbourhoods and districts with a variety of uses that allow people to live and work in closer proximity;
- Preserving streets and public space for a more balanced transportation system; and
- Promoting public health and active lifestyles.

By incorporating the TDM options previously discussed, such as improving walking and cycling facilities, reducing the parking supply and developing individualized travel plans for residents (alternative mode trip planning, car share arrangements, etc.), the site will set the tone for the surrounding area in helping to achieve these City goals.

8 Conclusions and Recommendations

8.1 Conclusions

Based on the investigations carried out, it is concluded that:

Existing Traffic Operations

Under existing traffic conditions, all intersections within the study area are operating at acceptable levels of service during the AM and PM peak hours. The following critical movement is noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS D during the PM peak hour with a v/c ratio of 0.28. The low v/c ratio on this movement indicates the delay is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

Development Generated Traffic

At full build-out, the development is forecast to generate 556 and 666 trips during the AM and PM peak hours, respectively.

2021 Background Traffic Operations

Under 2021 background traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movement is noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS D with a v/c of 0.32 during the AM peak hour and LOS F with a v/c of 0.57 during the PM peak hour. The low to moderate v/c ratios indicate the delay is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

2021 Total Traffic Operations (Phase 1)

Under 2021 total traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS E with a v/c ratio of 0.58 during the AM peak hour and LOS F with a v/c ratio of 1.25 during the PM peak hour. The 95th percentile queue is forecast to

exceed the available storage by 11 metres during the PM peak hour;

- Southbound right-turn movement – LOS D with a v/c ratio of 0.59 during the AM peak hour; and
- The moderate v/c ratios during the AM peak hour indicate the delay is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

2023 Background Traffic Operations

Under 2023 background traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 0.62 during the AM peak hour and LOS F with a v/c ratio of 1.40 during the PM peak hour. The95th percentile queue is forecast to exceed the available storage by 16 metres during the PM peak hour;
  - Southbound right-turn movement – LOS D with a v/c ratio of 0.62 during the AM peak hour; and
  - The moderate v/c ratios during the AM peak hour indicate the delay is due to the high volume of through traffic on North Service Road which limits available gaps for side street traffic.

2023 Total Traffic Operations (Phase 2)

Under 2023 total traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS E with a v/c ratio of 0.93 during the AM peak hour and LOS F with a v/c ratio of 2.66 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 15 metres during the AM peak hour and 51 metres during the PM peak hour;
  - Southbound right-turn movement – LOS D with a v/c ratio of 0.95 during the AM peak hour; and
  - Overall intersection – LOS E during the PM peak hour.

2025 Background Traffic Operations

Under 2025 background traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 1.0 during the AM peak hour and LOS F with a v/c ratio of 2.97 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 21 metres during the AM peak hour and 55 metres during the PM peak hour;
  - Southbound right-turn movement – LOS F with a v/c ratio of 1.01 during the AM peak hour; and
  - Overall intersection – LOS D during the AM peak hour and LOS F during the PM peak hour.

2025 Total Traffic Operations (Full Build-Out)

Under 2025 total traffic conditions all intersections within the study area are forecast to operate at overall acceptable levels of service. The following critical movements are noted:

- Green Road and Frances Avenue:
  - Westbound left-turn/through/right-turn movement – LOS D with a v/c ratio of 0.79 during the AM and 0.74 during the PM peak hour.
- North Service Road and Green Road:
  - Southbound left-turn movement – LOS F with a v/c ratio of 1.40 during the AM peak hour and a v/c ratio of 5.47 during the PM peak hour. The 95th percentile queue is forecast to exceed the available storage by 59 metres during the AM peak hour and 55+ metres during the PM peak hour;
  - Southbound right-turn movement – LOS F with a v/c ratio of 1.33 during the AM peak hour; and
  - Overall intersection – LOS F during the AM and PM peak hours.

Remedial Measures

The following remedial measures are required in order to provide acceptable levels of service at the study area intersections:

- Traffic signals at the intersection of North Service Road and Green Road. Although not warranted until 2025, the signals should be installed as part of Phase 1 of the development (2021) to provide acceptable levels of service on all approaches;

- A separate westbound right-turn lane should be provided at the intersection of North Service Road and Green Road at the 2025 horizon. This lane warrants 7.5 metres of storage and 120 metres of taper and parallel lane; however, due to environmental constraints, only 10 metres of storage and 15.8 metres of taper can be provided within the right-of-way without significant reconstruction;
- A separate westbound left-turn lane should be provided at the intersection of Green Road and Frances Avenue at the 2025; and
- The southbound left-turn lane at North Service Road and Green Road should be increased by 15 metres by the 2025 horizon.

These improvements are directly related to the increase in traffic due to development of the subject site.

Parking Assessment

City of Stoney Creek By-law Parking Requirements

Based on the City of Stoney Creek Zoning By-law 3692-92, a total of 3,090 parking spaces will be required to service the residential component of the site. A total of 2,438 spaces are proposed. This is a deficiency of 652 spaces or 21% of the By-law parking requirement.

Proxy Site Survey Data

Parking utilization surveys were undertaken at a proxy site in Burlington, Ontario (3060/3070 Rotary Way). Based on the maximum observed demand at the proxy sites, a total of 2,295 spaces would be required to service the site during the peak weekday period. A total of 2,438 spaces are proposed. This is a surplus of 143 spaces or 106% of the proxy site parking requirement.

Overall Findings

The Zoning By-law results in a deficiency in parking of 652 spaces and the proxy site data results in a surplus of 143 spaces. The proxy site data provides an accurate representation of the parking demands for the site as they are based on area-specific data and not a general Zoning By-law. Additionally, it further supports a reduction in parking requirements for the site. Therefore, the proposed parking supply should adequately accommodate the parking demands of the site.

TDM Options

The proposed site with nearby connections to bicycle facilities and transit routes has the potential to be an accessible development. Further enhancing these elements inside and outside the boundaries of the development will ensure these opportunities do not go unused.

By incorporating the TDM options contained in this report, such as improving walking and cycling facilities, reducing the parking supply and developing individualized travel plans for residents (alternative mode trip planning, carpool arrangements, etc.), the site will set the tone for the surrounding area in helping to achieve the City's long-term transportation goals.

8.2 Recommendations

Based on the findings of this study, it is recommended that:

- The City of Hamilton recognize the conclusions drawn above;
- The site be allowed to be developed as planned;
- The site driveway connections operate under stop sign control;
- The City install traffic signals at the intersection of North Service Road and Green Road by buildout of Phase 1 in 2021. The signal timing and phasing should be optimized as required;
- A separate westbound right-turn lane with 10 metres of storage and 15.8 metres of taper should be provided at the intersection of North Service Road and Green Road at the 2025 horizon;
- A separate westbound left-turn lane with 45 metres storage should be provided at the intersection of Green Road and Frances Avenue at the 2025 horizon. This can be accomplished through pavement markings;
- The southbound left-turn lane at North Service Road and Green Road should be extended by 15 metres by the 2025 horizon. This can be accomplished through pavement markings; and
- The applicant should ensure proper pedestrian and cyclist connections from the surrounding roads to the buildings' main entrances;
- Current bus schedules are provided within the lobby of each building to further promote the use of transit; and
- The buildings' management should work with the buildings' residents to form a travel planning committee/team that will help develop individualized travel plans (alternative mode trip planning, carpool arrangements, etc.) for interested residents. To assist the committee/team, the applicant should consider providing a kiosk within the lobby of each building for use by the committee/team.

Appendix A

Pre-Study Consultation Documentation

Heather Goodman

From: Heather Goodman
Sent: April 11, 2018 8:58 AM
To: 'Transportation Planning'
Subject: RE: 180010 (Waterfront Trails TIS & PS) - Scope of Work

Hi Tiffany,

Do you know if there are any updates on the review of our scope? Specifically, we would like to confirm the correct by-law.

Thanks,

Heather Goodman, B.Eng., EIT, MITE
Transportation Consultant

Paradigm Transportation Solutions Limited
p: 416.479.9684 x502
m: 905.506.0454

From: Wolsey, Tiffany [mailto:Tiffany.Wolsey@hamilton.ca] **On Behalf Of** Transportation Planning
Sent: March 5, 2018 2:09 PM
To: Heather Goodman <hgoodman@ptsl.com>
Subject: RE: 180010 (Waterfront Trails TIS & PS) - Scope of Work

Hello,

The planner on file will be able to advise you on the appropriate bylaw to use for the parking study.

Thank you,

Tiffany Wolsey
Transportation Management Coordinator
Transportation Planning
Planning & Economic Development Department

From: Heather Goodman [mailto:hgoodman@ptsl.com]
Sent: January-26-18 5:59 PM
To: Transportation Planning
Cc: Jill Juhlke
Subject: RE: 180010 (Waterfront Trails TIS & PS) - Scope of Work

Hello,

In addition to the information requested below, could you please confirm the By-law to use for the parking study.

I look forward to your comments.

Regards,

Heather Goodman, B.Eng., EIT, MITE
Transportation Consultant

Paradigm Transportation Solutions Limited
p: 416.479.9684 x502
m: 905.506.0454

From: Heather Goodman
Sent: January 26, 2018 10:25 AM
To: 'Ng, Jeffrey' <Jeffrey.Ng@hamilton.ca>
Cc: Jill Juhlke <jjuhlke@ptsl.com>; Transportation Planning <Transportation.Planning@hamilton.ca>
Subject: RE: 180010 (Waterfront Trails TIS & PS) - Scope of Work

Thanks Jeff, I appreciate you sending the scope forward.

Regards,

Heather Goodman, B.Eng., EIT, MITE
Transportation Consultant

Paradigm Transportation Solutions Limited
p: 416.479.9684 x502
m: 905.506.0454

From: Ng, Jeffrey [mailto:Jeffrey.Ng@hamilton.ca]
Sent: January 26, 2018 10:24 AM
To: Heather Goodman <hgoodman@ptsl.com>
Cc: Jill Juhlke <jjuhlke@ptsl.com>; Transportation Planning <Transportation.Planning@hamilton.ca>
Subject: RE: 180010 (Waterfront Trails TIS & PS) - Scope of Work

Hi Heather,

Unfortunately our section is no longer reviewing development applications. I've copied Transportation Planning who will be able to assist moving forward.

Thanks,

Jeff Ng

Traffic Technologist
Geomatics & Corridor Management
City of Hamilton
Engineering Services, Public Works Dept.
Tel: 905-546-2424 ext 4577
Fax: 905-540-5926

Permit Applications: http://hamilton.ca/cm
Road Closure Notices: http://hamilton.ca/roadclosures

From: Heather Goodman [mailto:hgoodman@ptsl.com]
Sent: January 26, 2018 10:12 AM
To: Ng, Jeffrey <Jeffrey.Ng@hamilton.ca>
Cc: Jill Juhlke <jjuhlke@ptsl.com>
Subject: 180010 (Waterfront Trails TIS & PS) - Scope of Work

Hi Jeff,

Paradigm would like to inform the City that we will be undertaking a Transportation Impact Study (TIS) and Parking Justification Study for lands located the northeast corner of North Service Road and Green Road, detailed in the enclosed project overview and work plan. We ask that you please review the work plan to ensure the scope of the study is acceptable and provide comments if necessary.

In addition, we will use the following details for the study:

- The traffic impact study will be prepared to conform to the City's Traffic Impact Study Guidelines will assess the 2021, 2023 and 2025 horizon years, consistent with the completion of each phase of development.
- To remain consistent with other TIS reports for the area, a growth rate of 2% per year, and all development data from the 101 Shoreview TIS Report & 560 Grays Road TIS Report completed by Paradigm in July 2017 and November 2017, respectively will be utilized.

Due to the time sensitive nature of the project, we ask that you please provide comments at your earliest convenience. Please do not hesitate to contact me if you have questions relating to this project.

Regards,

Heather Goodman, B.Eng., EIT, MITE
Transportation Consultant

paradigm

Paradigm Transportation Solutions Limited
5000 Yonge Street, Suite 1901, Toronto ON M2N 7E9
p: 416.479.9684 x502
m: 905.506.0454
e: hgoodman@ptsl.com
w: www.ptsl.com

paradigm TRANSPORTATION SOLUTIONS LIMITED

22 King Street South, Suite 300
Waterloo, ON N2J 1N8
p: 519.896.3163
905.381.2229
f: 1.855.764.7349

www.ptsl.com

26 January 2018
Project: 170247

Jeff Ng
Traffic Technologist
City of Hamilton
77 James Street North, Suite 400
Hamilton, ON L8R 2K3

Dear Mr. Ng:

RE: 560 GRAYS ROAD, CITY OF HAMILTON
TRAFFIC IMPACT STUDY UPDATE SCOPE OF WORK

Paradigm Transportation Solutions Limited (Paradigm) was retained on behalf of **New Horizon Development Group** (the Client) to carry out a Transportation Impact Study (TIS) and Parking Justification Study update for the Waterfront Trails Development lands in Hamilton, Ontario.

The Waterfront Trails Development is located in the northeast quadrant of the intersection of North Service Road and Green Road in the Stoney Creek area of the City of Hamilton. The development proposal includes a total of 1,500 residential apartment units contained within three to four high-rise buildings.

This development is located in the Green Millen Shore Estates (GMSE) development area. Over the past couple of years, Paradigm has completed extensive analyses of multiple developments within this area. We will rely on this experience and our knowledge of the area in preparing this study.

Work Plan

Based on our understanding of the development proposal and the City requirements, we proposed to carry out the following scope of work:

- **Task 1 – Pre-Study Consultation:** We will submit a scope of work to the City of Hamilton to obtain their comments and approval on the approach and methodology proposed in this work plan prior to making significant progress on the studies.
- **Task 2 – Data Collection**: We will request from the City the most recent signal timing plans (where applicable) and Paradigm will collect turning movement counts at the following study area intersections:
  - North Service Road and Green Road (stop controlled); and
  - North Service Road and Millen Road (stop controlled).

- **Task 3 – Site Visit:** Paradigm staff will conduct a site visit to inventory the traffic and roadway conditions in the immediate area of the proposed development, traffic control, adjacent driveway locations, adjacent land use and operational conditions within the study area. The site visit will also include confirming traffic regulations and parking restrictions along the study area roadways.

- **Task 4 – Traffic Forecasting:** We will prepare trip generation estimates for three horizons reflecting the anticipated completion of each building as follows:
  - Tower 1 – 2021 horizon: 44 storeys containing 487 units;
  - Tower 2 – 2023 horizon: 50 storeys containing 570 units; and
  - Tower 3 – 2025 horizon: 39 storeys containing 435 units.

- **Task 5 – Operational Analyses:** Using the traffic forecasts developed in Task 1, we will analyze the operations of the intersection of North Service Road and Green Road and North Service Road and Millen Road during the weekday AM and PM peak hours for each phase of development (2021, 2023 and 2025) both without and with full development of the site. These analyses will be conducted to meet City of Hamilton traffic impact study guidelines.
- **Task 6 – Remedial Measures Responsibility:** We will provide specific information outlining what remedial measures are required (under background or future total conditions) at each horizon and highlight those needed to support the proposed development.
- **Task 7 – Report and Recommendations:** Paradigm will prepare a detailed final report documenting our investigations, findings and recommendations, including the Synchro 9 capacity analysis. This report will also include the Parking Justification. The final report will include appendices containing relevant traffic data as well as the detailed output generated by the operational analysis software.

Parking Justification Study

Based on the information provided, the Client will be seeking a variance to supply less than the parking required under the current in-force City of Hamilton Zoning By-law (05-200). Based on our extensive traffic and parking study experience in Hamilton, we have local data that confirms that a variance can be sought.

- **Task 8 – Area Parking Inventory:** Paradigm staff will undertake an inventory of the current available on-street parking within convenient walking distance of the site. The inventory will be summarized by block and sub-area including the number of spaces, type of parking and time restrictions. This will be used to demonstrate the additional potential supply of parking available if there are times when spillover parking may be required.
- **Task 9 – Parking Generation:** Paradigm will review the ITE Parking Generation – 4th Edition to assess the parking generation for the site based on the proposed land uses. Furthermore, we will look at the TTS data for the area and consider automobile ownership and the percentage of trips made by alternative modes of travel. We will use Paradigm's in-house parking generation data collected for apartment units to develop a site-specific parking generation rate for the proposed development.

- **Task 10 – Parking Assessment:** Based on the planned on-site parking supply, we will assess the extent to which parking demand can be accommodated on the site and the potential for spill-over parking that may need to be accommodated within the surrounding area.

We trust the foregoing work plan is acceptable. If you have any questions related to this project, please contact me at (905) 381-2229 x103 or (519) 896-3163 x103 or by email at selkins@ptsl.com.

Yours very truly,

PARADIGM TRANSPORTATION SOLUTIONS LIMITED

Stew Elkins
B.E.S., MITE
Vice-President

Appendix B

Detailed Turning Movement Count Data

East/West Street: Frances
North/South Street: Green Rd
Date: Wednesday, June 24, 2015
Counted By: Chris D

TIME ENDING	EASTBOUND								WESTBOUND								NORTHBOUND								SOUTHBOUND							
	Vehicles						Peds	Bikes	Vehicles						Peds	Bikes	Vehicles						Peds	Bikes	Vehicles						Peds	Bikes
	Left	**Trucks**	**Thru**	**Trucks**	**Right**	**Trucks**			**Left**	**Trucks**	**Thru**	**Trucks**	**Right**	**Trucks**			**Left**	**Trucks**	**Thru**	**Trucks**	**Right**	**Trucks**			**Left**	**Trucks**	**Thru**	**Trucks**	**Right**	**Trucks**		
7:15					3		1		6		1					2			2		4	1					17		2		2	
7:30	1		1		5				8		3					1	2	1	2								12		2		1	
7:45			2		6		4	1	5		2							1	4		3	1					11					
8:00	1		1		3		4	1		2	4		1		1				5		1						11					
8:15			3		3				7		3						2		3	1	2						15		4			
8:30			1		3			1	5		4								3		4						7				1	
8:45	6	1			3				6		3				1				3		4						18		1			
9:00	3		1		5		2		6		4				2	1	2		5		3	1					11		2			
Total	9	1	5	0	14	0	2	1	24	0	14	0	0	0	3	1	4	0	14	1	13	1	0	0	0	0	51	0	7	0	1	0
Mvmt Tot	**10**		**5**		**14**		**2**	**1**	**24**		**14**		**0**		**3**	**1**	**4**		**15**		**14**		**0**	**0**	**0**		**51**		**7**		**1**	**0**
% Truck	10%		0%		0%				0%		0%		0%				0%		7%		7%				0%		0%		0%			

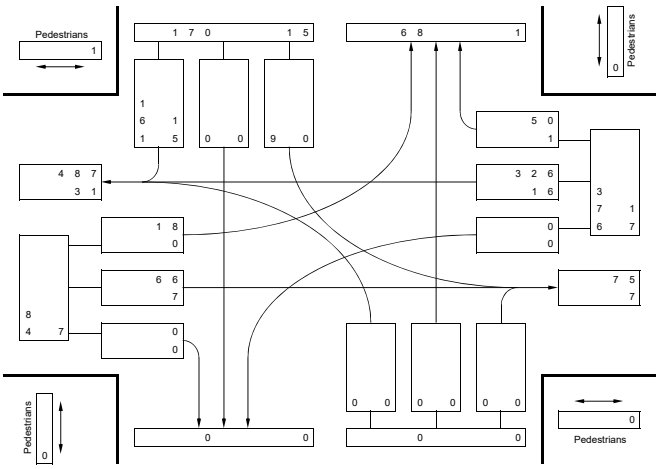
TIME ENDING	EASTBOUND								WESTBOUND								NORTHBOUND								SOUTHBOUND							
	Vehicles						Peds	Bikes	Vehicles						Peds	Bikes	Vehicles						Peds	Bikes	Vehicles						Peds	Bikes
	Left	**Trucks**	**Thru**	**Trucks**	**Right**	**Trucks**			**Left**	**Trucks**	**Thru**	**Trucks**	**Right**	**Trucks**			**Left**	**Trucks**	**Thru**	**Trucks**	**Right**	**Trucks**			**Left**	**Trucks**	**Thru**	**Trucks**	**Right**	**Trucks**		
15:15	3		1		5		2	3	5		3				1	4	2		10		4		2		1		13	2	3		6	
15:30	7	1	4		2				9	1	3		2				3		6		1				1		10		1			
15:45	3		6		5			1	2		1				3		4		9		4	1				1	9	1	1		1	
16:00	5		1		4		1		3	1	1						6		11		2		2		1		9		3			
16:15	5		1		5		1	4	2		3					1	4		13		5		1				5		2			
16:30	3		4		5		1	1	1	1					1		1		13		6						8		1			
16:45	2		2		2			3	20				1				4		15		7				3		5				1	1
17:00	3		5		4				6							1	5		9		5						10		1			
17:15			3		8		2		6		1					3	5		6		6			3			3				2	
17:30	4		3		5		1		6						4		5		10		7						4					
17:45			4		4			1	4		4					2	3		9		7		1		1		3		1			
18:00			2		2		4		4		1		1		2	1	2		7		4						6					
Total	13	0	12	0	16	0	2	8	29	1	3	0	1	0	1	2	14	0	50	0	23	0	1	0	3	0	28	0	4	0	1	1
Mvmt Tot	**13**		**12**		**16**		**2**	**8**	**30**		**3**		**1**		**1**	**2**	**14**		**50**		**23**		**1**	**0**	**3**		**28**		**4**		**1**	**1**
% Truck	0%		0%		0%				3%		0%		0%				0%		0%		0%				0%		0%		0%			

Date: Tuesday	North Service Rd							North Service Rd							Green Rd						
02-May-17	Eastbound							Westbound							Southbound						
	Left			Through			Peds	Through			Right			Peds	Left			Right			Peds
	Cars	T/B	Cyclists	Cars	T/B	Cyclists		Cars	T/B	Cyclists	Cars	T/B	Cyclists		Cars	T/B	Cyclists	Cars	T/B	Cyclists	
7:00-7:15	11			6	1			67	3		6	1			6			14	1		
7:15-7:30	4			2				74	5		6	1			12			22			
7:30-7:45	4	1		6	3			147	4		7	1			8	1		21			
7:45-8:00	5			13	1			154	4		6	1			16			19			
8:00-8:15	6			11				114	4		8	1			15			20			
8:15-8:30	0			4				102	7		5	2			19			16			
8:30-8:45	1			8				115	6		8				13			13			
8:45-9:00	8	1		18				81	4		11				8			11			

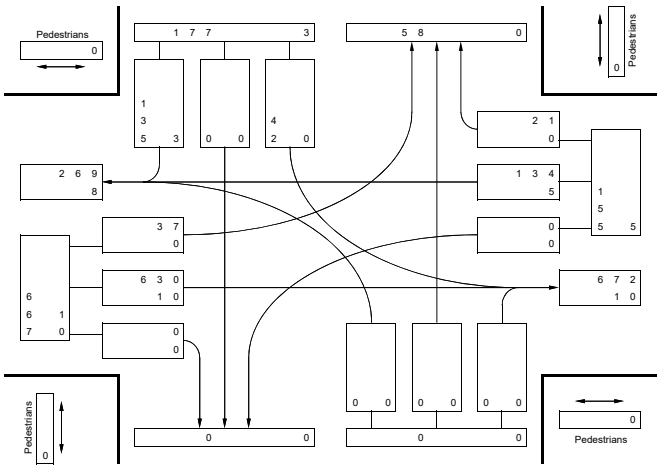
4:00-4:15	21			68				47	4		14				11			15			
4:15-4:30	15			68	1			50	7		7				7	2		12			
4:30-4:45	15			82				74	6		9				16			10			
4:45-5:00	20			123				38	1		13				15	1		10			
5:00-5:15	23			118	1			57	5		11	1			17			10			
5:15-5:30	24			135	2			50	4		12				3			12			
5:30-5:45	21			129	2			38	3		9				8			6			
5:45-6:00	17			83	1			26	1		8				7			7			

City of Hamilton **TURNING MOVEMENT FLOW CHART** Loc. Code: 35

Intersection: **North Service Rd** **at** **Millen Rd** Total Vehicles: 3,940 Date: Friday
Direction: (East/West) (North/South) M.V.E./Year: 2.492 May 6, 2016
Road Condition: Dry Weather: Clear AWDT Factor: 1.86 Period: 7 hours
Comments:

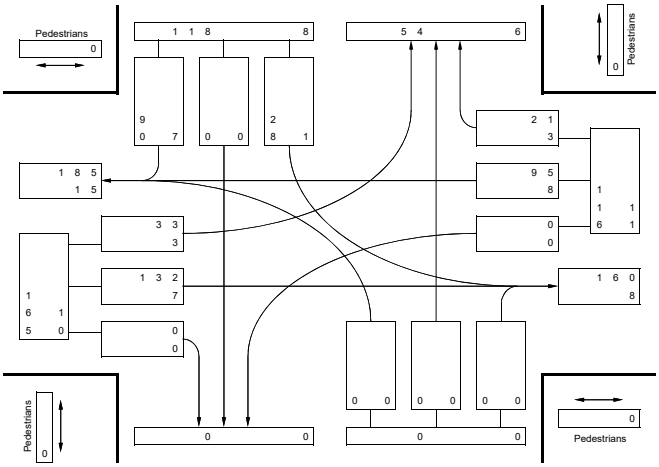


A.M. PEAK HOUR = 7:30 AM - 8:30 AM

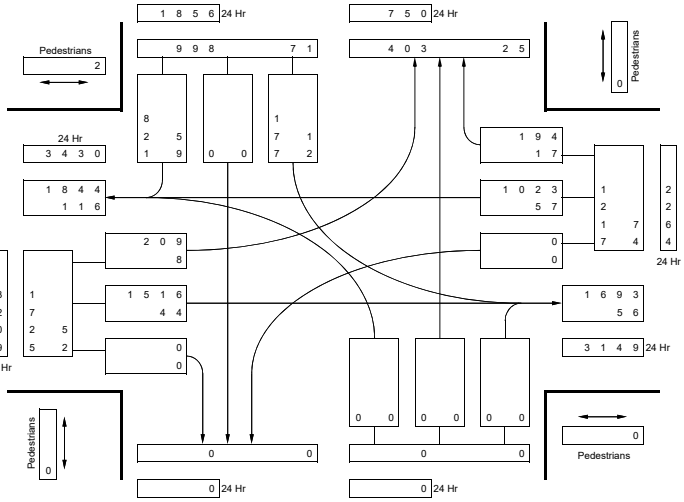


P.M. PEAK HOUR = 4:30 PM - 5:30 PM

N



NORMAL HOUR = 2:30 PM - 3:30 PM



7 Hr & 24 Hr TOTAL VOLUMES

Appendix C

Base Year Traffic Operations Reports

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-13-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	11	5	15	63	15	0	4	16	28	0	54	7
Future Volume (vph)	11	5	15	63	15	0	4	16	28	0	54	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.935						0.921			0.984	
Flt Protected		0.982			0.961			0.996				
Satd. Flow (prot)	0	1683	0	0	1826	0	0	1637	0	0	1870	0
Flt Permitted		0.982			0.961			0.996				
Satd. Flow (perm)	0	1683	0	0	1826	0	0	1637	0	0	1870	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1					1	2		3	3		2
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
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%	0%	7%	7%	0%	0%	0%
Adj. Flow (vph)	12	5	16	68	16	0	4	17	30	0	59	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	0	0	84	0	0	51	0	0	67	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	22.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-13-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	5	15	63	15	0	4	16	28	0	54	7
Future Volume (Veh/h)	11	5	15	63	15	0	4	16	28	0	54	7
Sign Control		Stop			Stop			Free			Free	
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)	12	5	16	68	16	0	4	17	30	0	59	8
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								185				
pX, platoon unblocked												
vC, conflicting volume	114	123	65	124	112	36	69			50		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	114	123	65	124	112	36	69			50		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	98	92	98	100	100			100		
cM capacity (veh/h)	825	766	1003	830	777	1039	1542			1566		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	33	84	51	67
Volume Left	12	68	4	0
Volume Right	16	0	30	8
cSH	891	819	1542	1566
Volume to Capacity	0.04	0.10	0.00	0.00
Queue Length 95th (m)	0.9	2.7	0.1	0.0
Control Delay (s)	9.2	9.9	0.6	0.0
Lane LOS	A	A	A	
Approach Delay (s)	9.2	9.9	0.6	0.0
Approach LOS	A	A		

Intersection Summary				
Average Delay	5.0			
Intersection Capacity Utilization	22.6%	ICU Level of Service		A
Analysis Period (min)	15			

Lanes, Volumes, Timings
2: North Service Road & Green Road 06-13-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	16	47	574	32	60	72
Future Volume (vph)	16	47	574	32	60	72
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.993			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	1696	1800	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1687	1696	1800	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	7%	12%	4%	19%	2%	0%
Adj. Flow (vph)	17	51	624	35	65	78
Shared Lane Traffic (%)						
Lane Group Flow (vph)	17	51	659	0	65	78
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	43.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-13-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	16	47	574	32	60	72
Future Volume (Veh/h)	16	47	574	32	60	72
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	51	624	35	65	78
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	660				728	642
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	660				728	642
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	98				83	84
cM capacity (veh/h)	904				383	477

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	17	51	659	65	78
Volume Left	17	0	0	65	0
Volume Right	0	0	35	0	78
cSH	904	1700	1700	383	477
Volume to Capacity	0.02	0.03	0.39	0.17	0.16
Queue Length 95th (m)	0.5	0.0	0.0	4.8	4.6
Control Delay (s)	9.1	0.0	0.0	16.3	14.0
Lane LOS	A			C	B
Approach Delay (s)	2.3		0.0	15.1	
Approach LOS				C	

Intersection Summary				
Average Delay	2.7			
Intersection Capacity Utilization	43.3%	ICU Level of Service		A
Analysis Period (min)	15			

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-13-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	28	79	382	55	11	224
Future Volume (vph)	28	79	382	55	11	224
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	0.0	25.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.983			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1810	1820	0	1504	1583
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1719	1810	1820	0	1504	1583
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Adj. Flow (vph)	30	86	415	60	12	243
Shared Lane Traffic (%)						
Lane Group Flow (vph)	30	86	475	0	12	243
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	44.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-13-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	28	79	382	55	11	224
Future Volume (Veh/h)	28	79	382	55	11	224
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	30	86	415	60	12	243
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						3
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	475				591	445
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	475				591	445
tC, single (s)	4.1				6.6	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.7	3.3
p0 queue free %	97				97	60
cM capacity (veh/h)	1072				429	613

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	30	86	475	255
Volume Left	30	0	0	12
Volume Right	0	0	60	243
cSH	1072	1700	1700	643
Volume to Capacity	0.03	0.05	0.28	0.40
Queue Length 95th (m)	0.7	0.0	0.0	15.2
Control Delay (s)	8.5	0.0	0.0	14.6
Lane LOS	A			B
Approach Delay (s)	2.2		0.0	14.6
Approach LOS				B

Intersection Summary				
Average Delay		4.7		
Intersection Capacity Utilization		44.0%	ICU Level of Service	A
Analysis Period (min)		15		

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-13-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	13	17	37	3	1	15	53	69	3	30	4
Future Volume (vph)	14	13	17	37	3	1	15	53	69	3	30	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.948			0.997			0.932			0.986	
Flt Protected		0.984			0.957			0.995			0.996	
Satd. Flow (prot)	0	1772	0	0	1765	0	0	1762	0	0	1866	0
Flt Permitted		0.984			0.957			0.995			0.996	
Satd. Flow (perm)	0	1772	0	0	1765	0	0	1762	0	0	1866	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1		1	1		1	2		1	1		2
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
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	15	14	18	40	3	1	16	58	75	3	33	4
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	47	0	0	44	0	0	149	0	0	40	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	23.7%	ICU Level of Service A	
Analysis Period (min)	15		

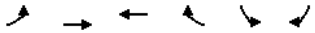
HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-13-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	13	17	37	3	1	15	53	69	3	30	4
Future Volume (Veh/h)	14	13	17	37	3	1	15	53	69	3	30	4
Sign Control		Stop			Stop			Free			Free	
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)	15	14	18	40	3	1	16	58	75	3	33	4
Pedestrians		2			1			1			1	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	174	209	38	196	174	98	39			134		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	174	209	38	196	174	98	39			134		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	98	98	94	100	100	99			100		
cM capacity (veh/h)	779	681	1037	727	713	963	1581			1462		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	47	44	149	40
Volume Left	15	40	16	3
Volume Right	18	1	75	4
cSH	822	730	1581	1462
Volume to Capacity	0.06	0.06	0.01	0.00
Queue Length 95th (m)	1.5	1.5	0.2	0.0
Control Delay (s)	9.6	10.2	0.9	0.6
Lane LOS	A	B	A	A
Approach Delay (s)	9.6	10.2	0.9	0.6
Approach LOS	A	B		

Intersection Summary				
Average Delay	3.8			
Intersection Capacity Utilization	23.7%	ICU Level of Service	A	
Analysis Period (min)	15			

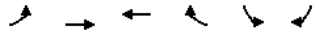
Lanes, Volumes, Timings
2: North Service Road & Green Road 06-13-2018



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	90	681	260	47	45	39
Future Volume (vph)	90	681	260	47	45	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.979			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1751	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1805	1881	1751	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	7%	2%	2%	0%
Adj. Flow (vph)	98	740	283	51	49	42
Shared Lane Traffic (%)						
Lane Group Flow (vph)	98	740	334	0	49	42
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	45.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-13-2018

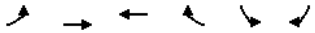


Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	90	681	260	47	45	39
Future Volume (Veh/h)	90	681	260	47	45	39
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	740	283	51	49	42
Pedestrians						
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	334				1244	308
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	334				1244	308
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	92				72	94
cM capacity (veh/h)	1237				177	736

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	98	740	334	49	42
Volume Left	98	0	0	49	0
Volume Right	0	0	51	0	42
cSH	1237	1700	1700	177	736
Volume to Capacity	0.08	0.44	0.20	0.28	0.06
Queue Length 95th (m)	2.1	0.0	0.0	8.6	1.4
Control Delay (s)	8.2	0.0	0.0	33.0	10.2
Lane LOS	A			D	B
Approach Delay (s)	1.0		0.0	22.4	
Approach LOS				C	

Intersection Summary				
Average Delay	2.3			
Intersection Capacity Utilization	45.8%	ICU Level of Service		A
Analysis Period (min)	15			

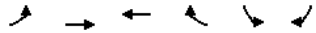
Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-13-2018



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	60	666	145	28	48	162
Future Volume (vph)	60	666	145	28	48	162
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	0.0	25.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.978			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1863	1798	0	1805	1583
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1805	1863	1798	0	1805	1583
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Adj. Flow (vph)	65	724	158	30	52	176
Shared Lane Traffic (%)						
Lane Group Flow (vph)	65	724	188	0	52	176
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-13-2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	60	666	145	28	48	162
Future Volume (Veh/h)	60	666	145	28	48	162
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	65	724	158	30	52	176
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						3
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	188				1027	173
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	188				1027	173
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	95				79	80
cM capacity (veh/h)	1398				250	871

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	65	724	188	228
Volume Left	65	0	0	52
Volume Right	0	0	30	176
cSH	1398	1700	1700	1095
Volume to Capacity	0.05	0.43	0.11	0.21
Queue Length 95th (m)	1.2	0.0	0.0	6.3
Control Delay (s)	7.7	0.0	0.0	13.1
Lane LOS	A			B
Approach Delay (s)	0.6		0.0	13.1
Approach LOS				B

Intersection Summary				
Average Delay		2.9		
Intersection Capacity Utilization		45.1%	ICU Level of Service	A
Analysis Period (min)		15		

Appendix D

2021 Background Traffic Operations Reports

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	12	5	16	67	16	0	4	17	30	0	57	7
Future Volume (vph)	12	5	16	67	16	0	4	17	30	0	57	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.934						0.919			0.985	
Flt Protected		0.982			0.961			0.996				
Satd. Flow (prot)	0	1680	0	0	1826	0	0	1633	0	0	1872	0
Flt Permitted		0.982			0.961			0.996				
Satd. Flow (perm)	0	1680	0	0	1826	0	0	1633	0	0	1872	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1					1	2		3	3		2
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
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%	0%	7%	7%	0%	0%	0%
Adj. Flow (vph)	13	5	17	73	17	0	4	18	33	0	62	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	35	0	0	90	0	0	55	0	0	70	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	23.1%	ICU Level of Service	A
Analysis Period (min)	15		

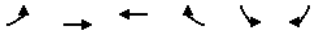
HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	12	5	16	67	16	0	4	17	30	0	57	7
Future Volume (Veh/h)	12	5	16	67	16	0	4	17	30	0	57	7
Sign Control		Stop			Stop			Free			Free	
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)	13	5	17	73	17	0	4	18	33	0	62	8
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	120	130	68	131	118	38	72			54		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	120	130	68	131	118	38	72			54		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	99	98	91	98	100	100			100		
cM capacity (veh/h)	817	759	999	821	771	1036	1538			1560		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	35	90	55	70
Volume Left	13	73	4	0
Volume Right	17	0	33	8
cSH	886	811	1538	1560
Volume to Capacity	0.04	0.11	0.00	0.00
Queue Length 95th (m)	1.0	3.0	0.1	0.0
Control Delay (s)	9.2	10.0	0.6	0.0
Lane LOS	A	A	A	
Approach Delay (s)	9.2	10.0	0.6	0.0
Approach LOS	A	A		

Intersection Summary				
Average Delay	5.0			
Intersection Capacity Utilization	23.1%	ICU Level of Service		A
Analysis Period (min)	15			

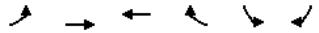
Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	17	145	838	34	64	76
Future Volume (vph)	17	145	838	34	64	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.995			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	1696	1808	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1687	1696	1808	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	7%	12%	4%	19%	2%	0%
Adj. Flow (vph)	18	158	911	37	70	83
Shared Lane Traffic (%)						
Lane Group Flow (vph)	18	158	948	0	70	83
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 57.5%		ICU Level of Service B	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	17	145	838	34	64	76
Future Volume (Veh/h)	17	145	838	34	64	76
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	18	158	911	37	70	83
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	949				1124	930
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	949				1124	930
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	97				68	75
cM capacity (veh/h)	703				221	326

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	18	158	948	70	83
Volume Left	18	0	0	70	0
Volume Right	0	0	37	0	83
cSH	703	1700	1700	221	326
Volume to Capacity	0.03	0.09	0.56	0.32	0.25
Queue Length 95th (m)	0.6	0.0	0.0	10.4	7.9
Control Delay (s)	10.3	0.0	0.0	28.7	19.8
Lane LOS	B			D	C
Approach Delay (s)	1.0		0.0	23.8	
Approach LOS				C	

Intersection Summary				
Average Delay		3.0		
Intersection Capacity Utilization		57.5%	ICU Level of Service	B
Analysis Period (min)		15		

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	123	86	408	88	71	464
Future Volume (vph)	123	86	408	88	71	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.976			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1810	1802	0	1504	1583
Flt Permitted	0.381				0.950	
Satd. Flow (perm)	689	1810	1802	0	1504	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			23			289
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Adj. Flow (vph)	134	93	443	96	77	504
Shared Lane Traffic (%)						
Lane Group Flow (vph)	134	93	539	0	77	504
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	32.0	32.0	32.0		28.0	28.0
Total Split (%)	53.3%	53.3%	53.3%		46.7%	46.7%
Maximum Green (s)	26.0	26.0	26.0		22.0	22.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Min	Min
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	32.5	32.5	32.5		15.5	15.5
Actuated g/C Ratio	0.54	0.54	0.54		0.26	0.26
v/c Ratio	0.36	0.09	0.55		0.20	0.81
Control Delay	13.6	8.8	12.6		16.6	19.1
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	13.6	8.8	12.6		16.6	19.1
LOS	B	A	B		B	B
Approach Delay		11.6	12.6		18.8	
Approach LOS		B	B		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.81			
Intersection Signal Delay: 15.1		Intersection LOS: B	
Intersection Capacity Utilization 66.8%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	134	93	539	77	504
v/c Ratio	0.36	0.09	0.55	0.20	0.81
Control Delay	13.6	8.8	12.6	16.6	19.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	13.6	8.8	12.6	16.6	19.1
Queue Length 50th (m)	7.9	4.6	34.3	7.0	21.6
Queue Length 95th (m)	25.0	13.5	77.6	13.6	47.6
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	373	981	987	551	763
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.36	0.09	0.55	0.14	0.66

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	123	86	408	88	71	464
Future Volume (vph)	123	86	408	88	71	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1719	1810	1802		1504	1583
Flt Permitted	0.38	1.00	1.00		0.95	1.00
Satd. Flow (perm)	690	1810	1802		1504	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	134	93	443	96	77	504
RTOR Reduction (vph)	0	0	11	0	0	214
Lane Group Flow (vph)	134	93	528	0	77	290
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	32.5	32.5	32.5		15.5	15.5
Effective Green, g (s)	32.5	32.5	32.5		15.5	15.5
Actuated g/C Ratio	0.54	0.54	0.54		0.26	0.26
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	373	980	976		388	408
v/s Ratio Prot		0.05	c0.29		0.05	
v/s Ratio Perm	0.19					c0.18
v/c Ratio	0.36	0.09	0.54		0.20	0.71
Uniform Delay, d1	7.8	6.6	8.9		17.4	20.2
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.7	0.2	2.2		0.3	5.6
Delay (s)	10.5	6.8	11.1		17.6	25.8
Level of Service	B	A	B		B	C
Approach Delay (s)		9.0	11.1		24.7	
Approach LOS		A	B		C	

Intersection Summary				
HCM 2000 Control Delay	16.6	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.60			
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	66.8%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	14	18	39	3	1	16	56	73	3	32	4
Future Volume (vph)	15	14	18	39	3	1	16	56	73	3	32	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.947			0.997			0.932			0.987	
Flt Protected		0.985			0.956			0.995			0.996	
Satd. Flow (prot)	0	1772	0	0	1763	0	0	1762	0	0	1868	0
Flt Permitted		0.985			0.956			0.995			0.996	
Satd. Flow (perm)	0	1772	0	0	1763	0	0	1762	0	0	1868	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1		1	1		1	2		1	1		2
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
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	16	15	20	42	3	1	17	61	79	3	35	4
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	51	0	0	46	0	0	157	0	0	42	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	24.8%	ICU Level of Service	A
Analysis Period (min)	15		

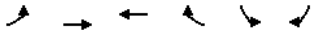
HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	14	18	39	3	1	16	56	73	3	32	4
Future Volume (Veh/h)	15	14	18	39	3	1	16	56	73	3	32	4
Sign Control		Stop			Stop			Free			Free	
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)	16	15	20	42	3	1	17	61	79	3	35	4
Pedestrians		2			1			1			1	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	183	220	40	207	182	102	41			141		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	183	220	40	207	182	102	41			141		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	98	98	94	100	100	99			100		
cM capacity (veh/h)	768	671	1034	712	704	956	1579			1453		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	51	46	157	42
Volume Left	16	42	17	3
Volume Right	20	1	79	4
cSH	816	715	1579	1453
Volume to Capacity	0.06	0.06	0.01	0.00
Queue Length 95th (m)	1.6	1.6	0.3	0.0
Control Delay (s)	9.7	10.4	0.9	0.5
Lane LOS	A	B	A	A
Approach Delay (s)	9.7	10.4	0.9	0.5
Approach LOS	A	B		

Intersection Summary				
Average Delay	3.8			
Intersection Capacity Utilization	24.8%	ICU Level of Service	A	
Analysis Period (min)	15			

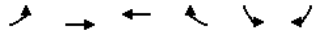
Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	96	897	448	50	48	41
Future Volume (vph)	96	897	448	50	48	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.987			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1761	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1805	1881	1761	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	7%	2%	2%	0%
Adj. Flow (vph)	104	975	487	54	52	45
Shared Lane Traffic (%)						
Lane Group Flow (vph)	104	975	541	0	52	45
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 57.2%		ICU Level of Service B	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	96	897	448	50	48	41
Future Volume (Veh/h)	96	897	448	50	48	41
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	104	975	487	54	52	45
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	541				1697	514
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	541				1697	514
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	90				43	92
cM capacity (veh/h)	1038				91	564

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	104	975	541	52	45
Volume Left	104	0	0	52	0
Volume Right	0	0	54	0	45
cSH	1038	1700	1700	91	564
Volume to Capacity	0.10	0.57	0.32	0.57	0.08
Queue Length 95th (m)	2.7	0.0	0.0	20.7	2.1
Control Delay (s)	8.9	0.0	0.0	86.9	11.9
Lane LOS	A			F	B
Approach Delay (s)	0.9		0.0	52.1	
Approach LOS				F	

Intersection Summary				
Average Delay		3.5		
Intersection Capacity Utilization		57.2%	ICU Level of Service	B
Analysis Period (min)		15		

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	232	713	178	81	90	320
Future Volume (vph)	232	713	178	81	90	320
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.958			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1863	1772	0	1805	1583
Flt Permitted	0.587				0.950	
Satd. Flow (perm)	1115	1863	1772	0	1805	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			55			348
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Adj. Flow (vph)	252	775	193	88	98	348
Shared Lane Traffic (%)						
Lane Group Flow (vph)	252	775	281	0	98	348
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	46.0	46.0	46.0		24.0	24.0
Total Split (%)	65.7%	65.7%	65.7%		34.3%	34.3%
Maximum Green (s)	40.0	40.0	40.0		18.0	18.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
v/c Ratio	0.40	0.73	0.27		0.21	0.52
Control Delay	10.6	16.1	6.8		21.9	6.0
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	10.6	16.1	6.8		21.9	6.0
LOS	B	B	A		C	A
Approach Delay		14.8	6.8		9.5	
Approach LOS		B	A		A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 70			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.73			
Intersection Signal Delay: 12.1		Intersection LOS: B	
Intersection Capacity Utilization 56.7%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	252	775	281	98	348
v/c Ratio	0.40	0.73	0.27	0.21	0.52
Control Delay	10.6	16.1	6.8	21.9	6.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.6	16.1	6.8	21.9	6.0
Queue Length 50th (m)	17.4	70.9	13.9	10.6	0.0
Queue Length 95th (m)	32.6	113.5	25.6	22.2	18.6
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	637	1064	1036	464	665
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.40	0.73	0.27	0.21	0.52

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	232	713	178	81	90	320
Future Volume (vph)	232	713	178	81	90	320
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.96		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1863	1771		1805	1583
Flt Permitted	0.59	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1116	1863	1771		1805	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	252	775	193	88	98	348
RTOR Reduction (vph)	0	0	24	0	0	259
Lane Group Flow (vph)	252	775	257	0	98	89
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	40.0	40.0	40.0		18.0	18.0
Effective Green, g (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	637	1064	1012		464	407
v/s Ratio Prot		c0.42	0.15		0.05	
v/s Ratio Perm	0.23					c0.06
v/c Ratio	0.40	0.73	0.25		0.21	0.22
Uniform Delay, d1	8.3	11.0	7.5		20.4	20.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.8	4.4	0.6		1.0	1.2
Delay (s)	10.1	15.4	8.1		21.5	21.7
Level of Service	B	B	A		C	C
Approach Delay (s)		14.1	8.1		21.7	
Approach LOS		B	A		C	

Intersection Summary				
HCM 2000 Control Delay	15.1	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)	12.0
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Appendix E

2021 Future Total Traffic Operations Reports

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	12	10	16	204	31	0	4	17	73	0	57	7
Future Volume (vph)	12	10	16	204	31	0	4	17	73	0	57	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.944						0.894			0.985	
Flt Protected		0.984			0.958			0.998				
Satd. Flow (prot)	0	1711	0	0	1820	0	0	1588	0	0	1872	0
Flt Permitted		0.984			0.958			0.998				
Satd. Flow (perm)	0	1711	0	0	1820	0	0	1588	0	0	1872	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1					1	2		3	3		2
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
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%	0%	7%	7%	0%	0%	0%
Adj. Flow (vph)	13	11	17	222	34	0	4	18	79	0	62	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	41	0	0	256	0	0	101	0	0	70	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	35.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	12	10	16	204	31	0	4	17	73	0	57	7
Future Volume (Veh/h)	12	10	16	204	31	0	4	17	73	0	57	7
Sign Control		Stop			Stop			Free			Free	
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)	13	11	17	222	34	0	4	18	79	0	62	8
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	152	176	68	157	140	62	72			100		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	152	176	68	157	140	62	72			100		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	98	98	72	95	100	100			100		
cM capacity (veh/h)	764	716	999	784	749	1006	1538			1502		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	41	256	101	70
Volume Left	13	222	4	0
Volume Right	17	0	79	8
cSH	830	780	1538	1502
Volume to Capacity	0.05	0.33	0.00	0.00
Queue Length 95th (m)	1.2	11.5	0.1	0.0
Control Delay (s)	9.6	11.9	0.3	0.0
Lane LOS	A	B	A	
Approach Delay (s)	9.6	11.9	0.3	0.0
Approach LOS	A	B		

Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	35.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	43	145	838	51	102	175
Future Volume (vph)	43	145	838	51	102	175
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.992			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	1696	1798	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1687	1696	1798	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	7%	12%	4%	19%	2%	0%
Adj. Flow (vph)	47	158	911	55	111	190
Shared Lane Traffic (%)						
Lane Group Flow (vph)	47	158	966	0	111	190
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 64.7%		ICU Level of Service C	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	43	145	838	51	102	175
Future Volume (Veh/h)	43	145	838	51	102	175
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	47	158	911	55	111	190
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	967				1192	940
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	967				1192	940
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	93				42	41
cM capacity (veh/h)	692				193	322

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	47	158	966	111	190
Volume Left	47	0	0	111	0
Volume Right	0	0	55	0	190
cSH	692	1700	1700	193	322
Volume to Capacity	0.07	0.09	0.57	0.58	0.59
Queue Length 95th (m)	1.7	0.0	0.0	25.0	28.4
Control Delay (s)	10.6	0.0	0.0	46.4	31.0
Lane LOS	B			E	D
Approach Delay (s)	2.4		0.0	36.7	
Approach LOS				E	

Intersection Summary				
Average Delay	7.8			
Intersection Capacity Utilization	64.7%	ICU Level of Service		C
Analysis Period (min)	15			

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	131	116	418	88	71	471
Future Volume (vph)	131	116	418	88	71	471
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.976			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1810	1803	0	1504	1583
Flt Permitted	0.300				0.950	
Satd. Flow (perm)	543	1810	1803	0	1504	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			22			279
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Adj. Flow (vph)	142	126	454	96	77	512
Shared Lane Traffic (%)						
Lane Group Flow (vph)	142	126	550	0	77	512
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	32.0	32.0	32.0		28.0	28.0
Total Split (%)	53.3%	53.3%	53.3%		46.7%	46.7%
Maximum Green (s)	26.0	26.0	26.0		22.0	22.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
v/c Ratio	0.60	0.16	0.69		0.14	0.68
Control Delay	27.2	11.1	18.8		13.6	12.3
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	27.2	11.1	18.8		13.6	12.3
LOS	C	B	B		B	B
Approach Delay		19.6	18.8		12.4	
Approach LOS		B	B		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 22.5 (38%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.69			
Intersection Signal Delay: 16.3		Intersection LOS: B	
Intersection Capacity Utilization 67.3%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	142	126	550	77	512
v/c Ratio	0.60	0.16	0.69	0.14	0.68
Control Delay	27.2	11.1	18.8	13.6	12.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	27.2	11.1	18.8	13.6	12.3
Queue Length 50th (m)	12.0	8.4	46.9	5.8	19.4
Queue Length 95th (m)	#36.7	17.4	79.7	13.6	50.8
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	235	784	793	551	757
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.60	0.16	0.69	0.14	0.68

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	131	116	418	88	71	471
Future Volume (vph)	131	116	418	88	71	471
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1719	1810	1803		1504	1583
Flt Permitted	0.30	1.00	1.00		0.95	1.00
Satd. Flow (perm)	544	1810	1803		1504	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	142	126	454	96	77	512
RTOR Reduction (vph)	0	0	12	0	0	177
Lane Group Flow (vph)	142	126	538	0	77	335
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	26.0	26.0	26.0		22.0	22.0
Effective Green, g (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	235	784	781		551	580
v/s Ratio Prot		0.07	c0.30		0.05	
v/s Ratio Perm	0.26					c0.21
v/c Ratio	0.60	0.16	0.69		0.14	0.58
Uniform Delay, d1	13.1	10.4	13.7		12.7	15.3
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	11.0	0.4	4.9		0.5	4.2
Delay (s)	24.1	10.8	18.6		13.2	19.4
Level of Service	C	B	B		B	B
Approach Delay (s)		17.8	18.6		18.6	
Approach LOS		B	B		B	

Intersection Summary

HCM 2000 Control Delay	18.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	7	48	0	20	152	0
Future Volume (vph)	7	48	0	20	152	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.883					
Flt Protected					0.950	
Satd. Flow (prot)	1645	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1645	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	52	0	22	165	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	60	0	0	22	165	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	18.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	7	48	0	20	152	0
Future Volume (Veh/h)	7	48	0	20	152	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	52	0	22	165	0
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			60		56	34
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			60		56	34
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		83	100
cM capacity (veh/h)			1544		952	1039

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	60	22	165
Volume Left	0	0	165
Volume Right	52	0	0
cSH	1700	1544	952
Volume to Capacity	0.04	0.00	0.17
Queue Length 95th (m)	0.0	0.0	5.0
Control Delay (s)	0.0	0.0	9.6
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.6
Approach LOS			A

Intersection Summary			
Average Delay	6.4		
Intersection Capacity Utilization	18.4%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	28	18	122	12	1	16	56	203	3	32	4
Future Volume (vph)	15	28	18	122	12	1	16	56	203	3	32	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.959			0.999			0.900			0.987	
Flt Protected		0.988			0.957			0.997			0.996	
Satd. Flow (prot)	0	1800	0	0	1768	0	0	1705	0	0	1868	0
Flt Permitted		0.988			0.957			0.997			0.996	
Satd. Flow (perm)	0	1800	0	0	1768	0	0	1705	0	0	1868	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1		1	1		1	2		1	1		2
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
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	16	30	20	133	13	1	17	61	221	3	35	4
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	66	0	0	147	0	0	299	0	0	42	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	40.9%	ICU Level of Service	A
Analysis Period (min)	15		

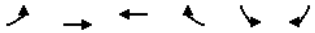
HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	28	18	122	12	1	16	56	203	3	32	4
Future Volume (Veh/h)	15	28	18	122	12	1	16	56	203	3	32	4
Sign Control		Stop			Stop			Free			Free	
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)	16	30	20	133	13	1	17	61	221	3	35	4
Pedestrians		2			1			1			1	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	259	362	40	286	254	174	41			283		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	259	362	40	286	254	174	41			283		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	95	98	78	98	100	99			100		
cM capacity (veh/h)	677	560	1034	617	643	874	1579			1290		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	66	147	299	42
Volume Left	16	133	17	3
Volume Right	20	1	221	4
cSH	683	620	1579	1290
Volume to Capacity	0.10	0.24	0.01	0.00
Queue Length 95th (m)	2.6	7.3	0.3	0.1
Control Delay (s)	10.8	12.6	0.5	0.6
Lane LOS	B	B	A	A
Approach Delay (s)	10.8	12.6	0.5	0.6
Approach LOS	B	B		

Intersection Summary				
Average Delay	4.9			
Intersection Capacity Utilization	40.9%	ICU Level of Service		A
Analysis Period (min)	15			

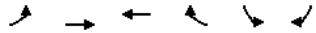
Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	176	897	448	100	71	101
Future Volume (vph)	176	897	448	100	71	101
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.975			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1746	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1805	1881	1746	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	7%	2%	2%	0%
Adj. Flow (vph)	191	975	487	109	77	110
Shared Lane Traffic (%)						
Lane Group Flow (vph)	191	975	596	0	77	110
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 57.8%		ICU Level of Service B	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	176	897	448	100	71	101
Future Volume (Veh/h)	176	897	448	100	71	101
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	191	975	487	109	77	110
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	596				1898	542
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	596				1898	542
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	81				0	80
cM capacity (veh/h)	990				61	545

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	191	975	596	77	110
Volume Left	191	0	0	77	0
Volume Right	0	0	109	0	110
cSH	990	1700	1700	61	545
Volume to Capacity	0.19	0.57	0.35	1.25	0.20
Queue Length 95th (m)	5.7	0.0	0.0	51.4	6.0
Control Delay (s)	9.5	0.0	0.0	310.5	13.3
Lane LOS	A			F	B
Approach Delay (s)	1.6		0.0	135.7	
Approach LOS				F	

Intersection Summary				
Average Delay	13.9			
Intersection Capacity Utilization	57.8%	ICU Level of Service		B
Analysis Period (min)	15			

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	237	731	206	81	90	342
Future Volume (vph)	237	731	206	81	90	342
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.962			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1863	1777	0	1805	1583
Flt Permitted	0.567				0.950	
Satd. Flow (perm)	1077	1863	1777	0	1805	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			47			372
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Adj. Flow (vph)	258	795	224	88	98	372
Shared Lane Traffic (%)						
Lane Group Flow (vph)	258	795	312	0	98	372
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	46.0	46.0	46.0		24.0	24.0
Total Split (%)	65.7%	65.7%	65.7%		34.3%	34.3%
Maximum Green (s)	40.0	40.0	40.0		18.0	18.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
v/c Ratio	0.42	0.75	0.30		0.21	0.54
Control Delay	11.1	16.8	7.4		21.9	6.1
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	11.1	16.8	7.4		21.9	6.1
LOS	B	B	A		C	A
Approach Delay		15.4	7.4		9.4	
Approach LOS		B	A		A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 70			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.75			
Intersection Signal Delay: 12.5		Intersection LOS: B	
Intersection Capacity Utilization 56.8%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	258	795	312	98	372
v/c Ratio	0.42	0.75	0.30	0.21	0.54
Control Delay	11.1	16.8	7.4	21.9	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	11.1	16.8	7.4	21.9	6.1
Queue Length 50th (m)	18.2	74.1	16.7	10.6	0.0
Queue Length 95th (m)	34.3	119.2	29.7	22.2	19.2
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	615	1064	1035	464	683
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.42	0.75	0.30	0.21	0.54

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	237	731	206	81	90	342
Future Volume (vph)	237	731	206	81	90	342
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.96		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1863	1777		1805	1583
Flt Permitted	0.57	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1077	1863	1777		1805	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	258	795	224	88	98	372
RTOR Reduction (vph)	0	0	20	0	0	276
Lane Group Flow (vph)	258	795	292	0	98	96
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	40.0	40.0	40.0		18.0	18.0
Effective Green, g (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	615	1064	1015		464	407
v/s Ratio Prot		c0.43	0.16		0.05	
v/s Ratio Perm	0.24					c0.06
v/c Ratio	0.42	0.75	0.29		0.21	0.24
Uniform Delay, d1	8.5	11.2	7.7		20.4	20.6
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.1	4.8	0.7		1.0	1.4
Delay (s)	10.6	16.0	8.4		21.5	21.9
Level of Service	B	B	A		C	C
Approach Delay (s)		14.7	8.4		21.8	
Approach LOS		B	A		C	

Intersection Summary				
HCM 2000 Control Delay	15.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	56.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	21	144	0	2	92	0
Future Volume (vph)	21	144	0	2	92	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.882					
Flt Protected					0.950	
Satd. Flow (prot)	1643	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1643	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	23	157	0	2	100	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	180	0	0	2	100	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 21.8%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	21	144	0	2	92	0
Future Volume (Veh/h)	21	144	0	2	92	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	157	0	2	100	0
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			180		104	102
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			180		104	102
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		89	100
cM capacity (veh/h)			1396		895	954

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	180	2	100
Volume Left	0	0	100
Volume Right	157	0	0
cSH	1700	1396	895
Volume to Capacity	0.11	0.00	0.11
Queue Length 95th (m)	0.0	0.0	3.0
Control Delay (s)	0.0	0.0	9.5
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.5
Approach LOS			A

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	21.8%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix F

2023 Background Traffic Operations Reports

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	12	11	17	207	32	0	4	18	74	0	60	8
Future Volume (vph)	12	11	17	207	32	0	4	18	74	0	60	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.943						0.896			0.984	
Flt Protected		0.985			0.959			0.998				
Satd. Flow (prot)	0	1713	0	0	1822	0	0	1592	0	0	1870	0
Flt Permitted		0.985			0.959			0.998				
Satd. Flow (perm)	0	1713	0	0	1822	0	0	1592	0	0	1870	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1					1	2		3	3		2
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
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%	0%	7%	7%	0%	0%	0%
Adj. Flow (vph)	13	12	18	225	35	0	4	20	80	0	65	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	43	0	0	260	0	0	104	0	0	74	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	36.3%	ICU Level of Service A	
Analysis Period (min)	15		

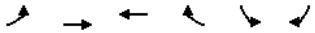
HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	12	11	17	207	32	0	4	18	74	0	60	8
Future Volume (Veh/h)	12	11	17	207	32	0	4	18	74	0	60	8
Sign Control		Stop			Stop			Free			Free	
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)	13	12	18	225	35	0	4	20	80	0	65	9
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	158	182	72	164	147	64	76			103		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	158	182	72	164	147	64	76			103		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	98	98	71	95	100	100			100		
cM capacity (veh/h)	756	710	995	774	743	1003	1533			1498		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	43	260	104	74
Volume Left	13	225	4	0
Volume Right	18	0	80	9
cSH	824	770	1533	1498
Volume to Capacity	0.05	0.34	0.00	0.00
Queue Length 95th (m)	1.3	12.0	0.1	0.0
Control Delay (s)	9.6	12.0	0.3	0.0
Lane LOS	A	B	A	
Approach Delay (s)	9.6	12.0	0.3	0.0
Approach LOS	A	B		

Intersection Summary				
Average Delay	7.4			
Intersection Capacity Utilization	36.3%	ICU Level of Service	A	
Analysis Period (min)	15			

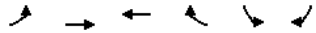
Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	44	147	863	52	104	178
Future Volume (vph)	44	147	863	52	104	178
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.992			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	1696	1797	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1687	1696	1797	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	7%	12%	4%	19%	2%	0%
Adj. Flow (vph)	48	160	938	57	113	193
Shared Lane Traffic (%)						
Lane Group Flow (vph)	48	160	995	0	113	193
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 66.3%		ICU Level of Service C	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	44	147	863	52	104	178
Future Volume (Veh/h)	44	147	863	52	104	178
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	48	160	938	57	113	193
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	996				1224	968
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	996				1224	968
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	93				38	38
cM capacity (veh/h)	675				184	311

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	48	160	995	113	193
Volume Left	48	0	0	113	0
Volume Right	0	0	57	0	193
cSH	675	1700	1700	184	311
Volume to Capacity	0.07	0.09	0.59	0.62	0.62
Queue Length 95th (m)	1.8	0.0	0.0	27.6	31.1
Control Delay (s)	10.7	0.0	0.0	51.7	33.9
Lane LOS	B			F	D
Approach Delay (s)	2.5		0.0	40.4	
Approach LOS				E	

Intersection Summary				
Average Delay		8.5		
Intersection Capacity Utilization		66.3%	ICU Level of Service	C
Analysis Period (min)		15		

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	132	119	435	91	71	480
Future Volume (vph)	132	119	435	91	71	480
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.977			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1810	1805	0	1504	1583
Flt Permitted	0.279				0.950	
Satd. Flow (perm)	505	1810	1805	0	1504	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			22			263
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Adj. Flow (vph)	143	129	473	99	77	522
Shared Lane Traffic (%)						
Lane Group Flow (vph)	143	129	572	0	77	522
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	32.0	32.0	32.0		28.0	28.0
Total Split (%)	53.3%	53.3%	53.3%		46.7%	46.7%
Maximum Green (s)	26.0	26.0	26.0		22.0	22.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
v/c Ratio	0.66	0.16	0.72		0.14	0.70
Control Delay	32.0	11.1	19.9		13.6	13.7
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	32.0	11.1	19.9		13.6	13.7
LOS	C	B	B		B	B
Approach Delay		22.1	19.9		13.7	
Approach LOS		C	B		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.72			
Intersection Signal Delay: 17.7		Intersection LOS: B	
Intersection Capacity Utilization 68.4%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	143	129	572	77	522
v/c Ratio	0.66	0.16	0.72	0.14	0.70
Control Delay	32.0	11.1	19.9	13.6	13.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	32.0	11.1	19.9	13.6	13.7
Queue Length 50th (m)	12.5	8.6	49.6	5.8	22.3
Queue Length 95th (m)	#39.0	17.8	84.3	13.6	55.6
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	218	784	794	551	747
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.66	0.16	0.72	0.14	0.70

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	132	119	435	91	71	480
Future Volume (vph)	132	119	435	91	71	480
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1719	1810	1804		1504	1583
Flt Permitted	0.28	1.00	1.00		0.95	1.00
Satd. Flow (perm)	505	1810	1804		1504	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	143	129	473	99	77	522
RTOR Reduction (vph)	0	0	12	0	0	167
Lane Group Flow (vph)	143	129	560	0	77	355
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	26.0	26.0	26.0		22.0	22.0
Effective Green, g (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	218	784	781		551	580
v/s Ratio Prot		0.07	c0.31		0.05	
v/s Ratio Perm	0.28					c0.22
v/c Ratio	0.66	0.16	0.72		0.14	0.61
Uniform Delay, d1	13.5	10.4	14.0		12.7	15.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	14.4	0.5	5.6		0.5	4.8
Delay (s)	27.9	10.8	19.5		13.2	20.3
Level of Service	C	B	B		B	C
Approach Delay (s)		19.8	19.5		19.4	
Approach LOS		B	B		B	

Intersection Summary

HCM 2000 Control Delay	19.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	8	48	0	21	152	0
Future Volume (vph)	8	48	0	21	152	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.885					
Flt Protected					0.950	
Satd. Flow (prot)	1649	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1649	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	9	52	0	23	165	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	61	0	0	23	165	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	8	48	0	21	152	0
Future Volume (Veh/h)	8	48	0	21	152	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	52	0	23	165	0
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			61		58	35
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			61		58	35
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		83	100
cM capacity (veh/h)			1542		949	1038

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	61	23	165
Volume Left	0	0	165
Volume Right	52	0	0
cSH	1700	1542	949
Volume to Capacity	0.04	0.00	0.17
Queue Length 95th (m)	0.0	0.0	5.0
Control Delay (s)	0.0	0.0	9.6
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.6
Approach LOS			A

Intersection Summary				
Average Delay		6.4		
Intersection Capacity Utilization		18.5%	ICU Level of Service	A
Analysis Period (min)		15		

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	28	19	124	12	1	17	59	206	3	33	4
Future Volume (vph)	15	28	19	124	12	1	17	59	206	3	33	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.958			0.999			0.901			0.987	
Flt Protected		0.988			0.957			0.997			0.997	
Satd. Flow (prot)	0	1798	0	0	1768	0	0	1707	0	0	1870	0
Flt Permitted		0.988			0.957			0.997			0.997	
Satd. Flow (perm)	0	1798	0	0	1768	0	0	1707	0	0	1870	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1		1	1		1	2		1	1		2
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
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	16	30	21	135	13	1	18	64	224	3	36	4
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	67	0	0	149	0	0	306	0	0	43	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	41.7%	ICU Level of Service A	
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	28	19	124	12	1	17	59	206	3	33	4
Future Volume (Veh/h)	15	28	19	124	12	1	17	59	206	3	33	4
Sign Control		Stop			Stop			Free			Free	
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)	16	30	21	135	13	1	18	64	224	3	36	4
Pedestrians		2			1			1			1	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	266	371	41	294	261	178	42			289		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	266	371	41	294	261	178	42			289		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	95	98	78	98	100	99			100		
cM capacity (veh/h)	669	553	1033	608	637	869	1577			1283		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	67	149	306	43
Volume Left	16	135	18	3
Volume Right	21	1	224	4
cSH	680	611	1577	1283
Volume to Capacity	0.10	0.24	0.01	0.00
Queue Length 95th (m)	2.6	7.6	0.3	0.1
Control Delay (s)	10.9	12.8	0.5	0.6
Lane LOS	B	B	A	A
Approach Delay (s)	10.9	12.8	0.5	0.6
Approach LOS	B	B		

Intersection Summary				
Average Delay	5.0			
Intersection Capacity Utilization	41.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	179	926	459	102	73	103
Future Volume (vph)	179	926	459	102	73	103
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.975			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1746	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1805	1881	1746	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	7%	2%	2%	0%
Adj. Flow (vph)	195	1007	499	111	79	112
Shared Lane Traffic (%)						
Lane Group Flow (vph)	195	1007	610	0	79	112
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	59.4%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	179	926	459	102	73	103
Future Volume (Veh/h)	179	926	459	102	73	103
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	195	1007	499	111	79	112
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	610				1952	554
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	610				1952	554
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	80				0	79
cM capacity (veh/h)	979				57	535

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	195	1007	610	79	112
Volume Left	195	0	0	79	0
Volume Right	0	0	111	0	112
cSH	979	1700	1700	57	535
Volume to Capacity	0.20	0.59	0.36	1.40	0.21
Queue Length 95th (m)	5.9	0.0	0.0	56.2	6.3
Control Delay (s)	9.6	0.0	0.0	377.3	13.5
Lane LOS	A			F	B
Approach Delay (s)	1.6		0.0	164.0	
Approach LOS				F	

Intersection Summary				
Average Delay	16.6			
Intersection Capacity Utilization	59.4%	ICU Level of Service		B
Analysis Period (min)	15			

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	239	759	212	82	92	349
Future Volume (vph)	239	759	212	82	92	349
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.962			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1863	1777	0	1805	1583
Flt Permitted	0.561				0.950	
Satd. Flow (perm)	1066	1863	1777	0	1805	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			46			379
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Adj. Flow (vph)	260	825	230	89	100	379
Shared Lane Traffic (%)						
Lane Group Flow (vph)	260	825	319	0	100	379
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	46.0	46.0	46.0		24.0	24.0
Total Split (%)	65.7%	65.7%	65.7%		34.3%	34.3%
Maximum Green (s)	40.0	40.0	40.0		18.0	18.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
v/c Ratio	0.43	0.78	0.31		0.22	0.55
Control Delay	11.2	18.0	7.5		22.0	6.1
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	11.2	18.0	7.5		22.0	6.1
LOS	B	B	A		C	A
Approach Delay		16.4	7.5		9.4	
Approach LOS		B	A		A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 70			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 13.1		Intersection LOS: B	
Intersection Capacity Utilization 58.3%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	260	825	319	100	379
v/c Ratio	0.43	0.78	0.31	0.22	0.55
Control Delay	11.2	18.0	7.5	22.0	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	11.2	18.0	7.5	22.0	6.1
Queue Length 50th (m)	18.3	79.1	17.3	10.8	0.0
Queue Length 95th (m)	34.9	128.0	30.6	22.5	19.4
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	609	1064	1035	464	688
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.43	0.78	0.31	0.22	0.55

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	239	759	212	82	92	349
Future Volume (vph)	239	759	212	82	92	349
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.96		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1863	1777		1805	1583
Flt Permitted	0.56	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1065	1863	1777		1805	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	260	825	230	89	100	379
RTOR Reduction (vph)	0	0	20	0	0	282
Lane Group Flow (vph)	260	825	299	0	100	97
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	40.0	40.0	40.0		18.0	18.0
Effective Green, g (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	608	1064	1015		464	407
v/s Ratio Prot		c0.44	0.17		0.06	
v/s Ratio Perm	0.24					c0.06
v/c Ratio	0.43	0.78	0.29		0.22	0.24
Uniform Delay, d1	8.5	11.5	7.7		20.4	20.6
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.2	5.5	0.7		1.1	1.4
Delay (s)	10.7	17.1	8.5		21.5	22.0
Level of Service	B	B	A		C	C
Approach Delay (s)		15.6	8.5		21.9	
Approach LOS		B	A		C	

Intersection Summary				
HCM 2000 Control Delay	16.0	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.61			
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	58.3%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	22	144	0	2	92	0
Future Volume (vph)	22	144	0	2	92	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.883					
Flt Protected					0.950	
Satd. Flow (prot)	1645	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1645	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	24	157	0	2	100	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	181	0	0	2	100	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 21.8%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	22	144	0	2	92	0
Future Volume (Veh/h)	22	144	0	2	92	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	24	157	0	2	100	0
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			181		104	102
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			181		104	102
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		89	100
cM capacity (veh/h)			1394		893	953

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	181	2	100
Volume Left	0	0	100
Volume Right	157	0	0
cSH	1700	1394	893
Volume to Capacity	0.11	0.00	0.11
Queue Length 95th (m)	0.0	0.0	3.0
Control Delay (s)	0.0	0.0	9.5
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.5
Approach LOS			A

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	21.8%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix G

2023 Future Total Traffic Operations Reports

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	12	15	17	334	46	0	4	18	114	0	60	8
Future Volume (vph)	12	15	17	334	46	0	4	18	114	0	60	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.948						0.887			0.984	
Flt Protected		0.986			0.958			0.999				
Satd. Flow (prot)	0	1728	0	0	1820	0	0	1576	0	0	1870	0
Flt Permitted		0.986			0.958			0.999				
Satd. Flow (perm)	0	1728	0	0	1820	0	0	1576	0	0	1870	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1					1	2		3	3		2
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
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%	0%	7%	7%	0%	0%	0%
Adj. Flow (vph)	13	16	18	363	50	0	4	20	124	0	65	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	47	0	0	413	0	0	148	0	0	74	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	46.3%	ICU Level of Service	A
Analysis Period (min)	15		

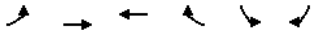
HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	12	15	17	334	46	0	4	18	114	0	60	8
Future Volume (Veh/h)	12	15	17	334	46	0	4	18	114	0	60	8
Sign Control		Stop			Stop			Free			Free	
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)	13	16	18	363	50	0	4	20	124	0	65	9
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	188	226	72	188	169	86	76			147		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	188	226	72	188	169	86	76			147		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	98	98	51	93	100	100			100		
cM capacity (veh/h)	710	672	995	743	723	975	1533			1444		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	47	413	148	74
Volume Left	13	363	4	0
Volume Right	18	0	124	9
cSH	781	740	1533	1444
Volume to Capacity	0.06	0.56	0.00	0.00
Queue Length 95th (m)	1.5	27.9	0.1	0.0
Control Delay (s)	9.9	15.8	0.2	0.0
Lane LOS	A	C	A	
Approach Delay (s)	9.9	15.8	0.2	0.0
Approach LOS	A	C		

Intersection Summary				
Average Delay	10.3			
Intersection Capacity Utilization	46.3%	ICU Level of Service		A
Analysis Period (min)	15			

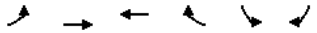
Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	68	147	863	68	139	270
Future Volume (vph)	68	147	863	68	139	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.990			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	1696	1790	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1687	1696	1790	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	7%	12%	4%	19%	2%	0%
Adj. Flow (vph)	74	160	938	74	151	293
Shared Lane Traffic (%)						
Lane Group Flow (vph)	74	160	1012	0	151	293
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 72.9%		ICU Level of Service C	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	68	147	863	68	139	270
Future Volume (Veh/h)	68	147	863	68	139	270
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	74	160	938	74	151	293
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1013				1284	976
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1013				1284	976
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	89				7	5
cM capacity (veh/h)	665				162	307

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	74	160	1012	151	293
Volume Left	74	0	0	151	0
Volume Right	0	0	74	0	293
cSH	665	1700	1700	162	307
Volume to Capacity	0.11	0.09	0.60	0.93	0.95
Queue Length 95th (m)	3.0	0.0	0.0	55.2	77.1
Control Delay (s)	11.1	0.0	0.0	110.5	78.1
Lane LOS	B			F	F
Approach Delay (s)	3.5		0.0	89.1	
Approach LOS				F	

Intersection Summary				
Average Delay		23.9		
Intersection Capacity Utilization		72.9%	ICU Level of Service	C
Analysis Period (min)		15		

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	139	147	444	91	71	487
Future Volume (vph)	139	147	444	91	71	487
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.977			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1810	1805	0	1504	1583
Flt Permitted	0.270				0.950	
Satd. Flow (perm)	489	1810	1805	0	1504	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			22			255
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Adj. Flow (vph)	151	160	483	99	77	529
Shared Lane Traffic (%)						
Lane Group Flow (vph)	151	160	582	0	77	529
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	32.0	32.0	32.0		28.0	28.0
Total Split (%)	53.3%	53.3%	53.3%		46.7%	46.7%
Maximum Green (s)	26.0	26.0	26.0		22.0	22.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
v/c Ratio	0.72	0.20	0.73		0.14	0.71
Control Delay	37.5	11.5	20.5		13.6	14.7
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	37.5	11.5	20.5		13.6	14.7
LOS	D	B	C		B	B
Approach Delay		24.1	20.5		14.6	
Approach LOS		C	C		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.73			
Intersection Signal Delay: 18.8		Intersection LOS: B	
Intersection Capacity Utilization 69.0%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	151	160	582	77	529
v/c Ratio	0.72	0.20	0.73	0.14	0.71
Control Delay	37.5	11.5	20.5	13.6	14.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	37.5	11.5	20.5	13.6	14.7
Queue Length 50th (m)	13.6	10.9	51.0	5.8	24.1
Queue Length 95th (m)	#42.6	21.4	#87.9	13.6	58.5
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	211	784	794	551	741
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.72	0.20	0.73	0.14	0.71

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	139	147	444	91	71	487
Future Volume (vph)	139	147	444	91	71	487
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1719	1810	1805		1504	1583
Flt Permitted	0.27	1.00	1.00		0.95	1.00
Satd. Flow (perm)	488	1810	1805		1504	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	151	160	483	99	77	529
RTOR Reduction (vph)	0	0	12	0	0	162
Lane Group Flow (vph)	151	160	570	0	77	368
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	26.0	26.0	26.0		22.0	22.0
Effective Green, g (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	211	784	782		551	580
v/s Ratio Prot		0.09	c0.32		0.05	
v/s Ratio Perm	0.31					c0.23
v/c Ratio	0.72	0.20	0.73		0.14	0.63
Uniform Delay, d1	14.0	10.6	14.1		12.7	15.7
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	18.7	0.6	5.9		0.5	5.2
Delay (s)	32.7	11.2	20.0		13.2	20.9
Level of Service	C	B	B		B	C
Approach Delay (s)		21.6	20.0		19.9	
Approach LOS		C	B		B	

Intersection Summary

HCM 2000 Control Delay	20.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	8	48	0	21	152	0
Future Volume (vph)	8	48	0	21	152	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.885					
Flt Protected					0.950	
Satd. Flow (prot)	1649	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1649	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	9	52	0	23	165	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	61	0	0	23	165	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	8	48	0	21	152	0
Future Volume (Veh/h)	8	48	0	21	152	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	52	0	23	165	0
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			61		58	35
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			61		58	35
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		83	100
cM capacity (veh/h)			1542		949	1038

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	61	23	165
Volume Left	0	0	165
Volume Right	52	0	0
cSH	1700	1542	949
Volume to Capacity	0.04	0.00	0.17
Queue Length 95th (m)	0.0	0.0	5.0
Control Delay (s)	0.0	0.0	9.6
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.6
Approach LOS			A

Intersection Summary				
Average Delay	6.4			
Intersection Capacity Utilization	18.5%	ICU Level of Service		A
Analysis Period (min)	15			

Lanes, Volumes, Timings
5: Access 2 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	56	22	0	173	0	71	0	0	0	0	21
Future Volume (vph)	9	56	22	0	173	0	71	0	0	0	0	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966									0.865	
Flt Protected		0.995						0.950				
Satd. Flow (prot)	0	1790	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.995						0.950				
Satd. Flow (perm)	0	1790	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		53.8			44.7			33.3			43.2	
Travel Time (s)		3.9			3.2			2.4			3.1	
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
Adj. Flow (vph)	10	61	24	0	188	0	77	0	0	0	0	23
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	95	0	0	188	0	0	77	0	0	23	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 29.4%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
5: Access 2 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	56	22	0	173	0	71	0	0	0	0	21
Future Volume (Veh/h)	9	56	22	0	173	0	71	0	0	0	0	21
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)	10	61	24	0	188	0	77	0	0	0	0	23
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	188			85			304	281	73	281	293	188
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	188			85			304	281	73	281	293	188
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			88	100	100	100	100	97
cM capacity (veh/h)	1386			1512			627	623	989	668	613	854

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	95	188	77	23
Volume Left	10	0	77	0
Volume Right	24	0	0	23
cSH	1386	1512	627	854
Volume to Capacity	0.01	0.00	0.12	0.03
Queue Length 95th (m)	0.2	0.0	3.3	0.7
Control Delay (s)	0.9	0.0	11.5	9.3
Lane LOS	A		B	A
Approach Delay (s)	0.9	0.0	11.5	9.3
Approach LOS			B	A

Intersection Summary				
Average Delay		3.1		
Intersection Capacity Utilization		29.4%	ICU Level of Service	A
Analysis Period (min)		15		

Lanes, Volumes, Timings
6: Access 3 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	19	87	22	0	265	0	70	0	0	0	0	42
Future Volume (vph)	19	87	22	0	265	0	70	0	0	0	0	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.977									0.865	
Flt Protected		0.993						0.950				
Satd. Flow (prot)	0	1807	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.993						0.950				
Satd. Flow (perm)	0	1807	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		38.9			53.8			33.6			37.9	
Travel Time (s)		2.8			3.9			2.4			2.7	
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
Adj. Flow (vph)	21	95	24	0	288	0	76	0	0	0	0	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	140	0	0	288	0	0	76	0	0	46	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 39.7%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
6: Access 3 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	87	22	0	265	0	70	0	0	0	0	42
Future Volume (Veh/h)	19	87	22	0	265	0	70	0	0	0	0	42
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)	21	95	24	0	288	0	76	0	0	0	0	46
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	288			119			483	437	107	437	449	288
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	288			119			483	437	107	437	449	288
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			83	100	100	100	100	94
cM capacity (veh/h)	1274			1469			458	505	947	523	497	751

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	140	288	76	46
Volume Left	21	0	76	0
Volume Right	24	0	0	46
cSH	1274	1469	458	751
Volume to Capacity	0.02	0.00	0.17	0.06
Queue Length 95th (m)	0.4	0.0	4.7	1.6
Control Delay (s)	1.3	0.0	14.4	10.1
Lane LOS	A		B	B
Approach Delay (s)	1.3	0.0	14.4	10.1
Approach LOS			B	B

Intersection Summary				
Average Delay		3.2		
Intersection Capacity Utilization		39.7%	ICU Level of Service	A
Analysis Period (min)		15		

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	41	19	200	21	1	17	59	326	3	33	4
Future Volume (vph)	15	41	19	200	21	1	17	59	326	3	33	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.965			0.999			0.890			0.987	
Flt Protected		0.990			0.957			0.998			0.997	
Satd. Flow (prot)	0	1815	0	0	1769	0	0	1688	0	0	1870	0
Flt Permitted		0.990			0.957			0.998			0.997	
Satd. Flow (perm)	0	1815	0	0	1769	0	0	1688	0	0	1870	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1		1	1		1	2		1	1		2
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
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	16	45	21	217	23	1	18	64	354	3	36	4
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	82	0	0	241	0	0	436	0	0	43	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	53.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	41	19	200	21	1	17	59	326	3	33	4
Future Volume (Veh/h)	15	41	19	200	21	1	17	59	326	3	33	4
Sign Control		Stop			Stop			Free			Free	
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)	16	45	21	217	23	1	18	64	354	3	36	4
Pedestrians		2			1			1			1	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	336	501	41	366	326	243	42			419		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	336	501	41	366	326	243	42			419		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	90	98	59	96	100	99			100		
cM capacity (veh/h)	593	467	1033	526	586	799	1577			1150		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	82	241	436	43
Volume Left	16	217	18	3
Volume Right	21	1	354	4
cSH	571	532	1577	1150
Volume to Capacity	0.14	0.45	0.01	0.00
Queue Length 95th (m)	4.0	18.7	0.3	0.1
Control Delay (s)	12.4	17.3	0.4	0.6
Lane LOS	B	C	A	A
Approach Delay (s)	12.4	17.3	0.4	0.6
Approach LOS	B	C		

Intersection Summary				
Average Delay	6.7			
Intersection Capacity Utilization	53.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	252	926	459	149	94	158
Future Volume (vph)	252	926	459	149	94	158
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.967			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1737	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1805	1881	1737	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	7%	2%	2%	0%
Adj. Flow (vph)	274	1007	499	162	102	172
Shared Lane Traffic (%)						
Lane Group Flow (vph)	274	1007	661	0	102	172
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 62.4%		ICU Level of Service B	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	252	926	459	149	94	158
Future Volume (Veh/h)	252	926	459	149	94	158
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	274	1007	499	162	102	172
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	661				2135	580
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	661				2135	580
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	71				0	67
cM capacity (veh/h)	937				38	518

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	274	1007	661	102	172
Volume Left	274	0	0	102	0
Volume Right	0	0	162	0	172
cSH	937	1700	1700	38	518
Volume to Capacity	0.29	0.59	0.39	2.66	0.33
Queue Length 95th (m)	9.8	0.0	0.0	90.7	11.5
Control Delay (s)	10.4	0.0	0.0	975.9	15.4
Lane LOS	B			F	C
Approach Delay (s)	2.2		0.0	373.0	
Approach LOS				F	

Intersection Summary				
Average Delay		47.4		
Intersection Capacity Utilization		62.4%	ICU Level of Service	B
Analysis Period (min)		15		

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	243	776	239	82	92	369
Future Volume (vph)	243	776	239	82	92	369
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.966			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1863	1782	0	1805	1583
Flt Permitted	0.535				0.950	
Satd. Flow (perm)	1016	1863	1782	0	1805	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			41			401
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Adj. Flow (vph)	264	843	260	89	100	401
Shared Lane Traffic (%)						
Lane Group Flow (vph)	264	843	349	0	100	401
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	46.0	46.0	46.0		24.0	24.0
Total Split (%)	65.7%	65.7%	65.7%		34.3%	34.3%
Maximum Green (s)	40.0	40.0	40.0		18.0	18.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
v/c Ratio	0.46	0.79	0.34		0.22	0.57
Control Delay	11.9	18.9	8.0		22.0	6.2
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	11.9	18.9	8.0		22.0	6.2
LOS	B	B	A		C	A
Approach Delay		17.2	8.0		9.3	
Approach LOS		B	A		A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 70			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.79			
Intersection Signal Delay: 13.6		Intersection LOS: B	
Intersection Capacity Utilization 59.2%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	264	843	349	100	401
v/c Ratio	0.46	0.79	0.34	0.22	0.57
Control Delay	11.9	18.9	8.0	22.0	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	11.9	18.9	8.0	22.0	6.2
Queue Length 50th (m)	19.0	82.2	19.9	10.8	0.0
Queue Length 95th (m)	36.7	#134.4	34.5	22.5	19.7
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	580	1064	1035	464	704
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.46	0.79	0.34	0.22	0.57

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	243	776	239	82	92	369
Future Volume (vph)	243	776	239	82	92	369
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.97		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1863	1782		1805	1583
Flt Permitted	0.53	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1016	1863	1782		1805	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	264	843	260	89	100	401
RTOR Reduction (vph)	0	0	18	0	0	298
Lane Group Flow (vph)	264	843	331	0	100	103
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	40.0	40.0	40.0		18.0	18.0
Effective Green, g (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	580	1064	1018		464	407
v/s Ratio Prot		c0.45	0.19		0.06	
v/s Ratio Perm	0.26					c0.07
v/c Ratio	0.46	0.79	0.33		0.22	0.25
Uniform Delay, d1	8.7	11.7	7.9		20.4	20.7
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.6	6.1	0.9		1.1	1.5
Delay (s)	11.3	17.8	8.7		21.5	22.2
Level of Service	B	B	A		C	C
Approach Delay (s)		16.2	8.7		22.0	
Approach LOS		B	A		C	

Intersection Summary

HCM 2000 Control Delay	16.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	59.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	22	144	0	2	92	0
Future Volume (vph)	22	144	0	2	92	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.883					
Flt Protected					0.950	
Satd. Flow (prot)	1645	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1645	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	24	157	0	2	100	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	181	0	0	2	100	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 21.8%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	22	144	0	2	92	0
Future Volume (Veh/h)	22	144	0	2	92	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	24	157	0	2	100	0
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			181		104	102
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			181		104	102
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		89	100
cM capacity (veh/h)			1394		893	953

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	181	2	100
Volume Left	0	0	100
Volume Right	157	0	0
cSH	1700	1394	893
Volume to Capacity	0.11	0.00	0.11
Queue Length 95th (m)	0.0	0.0	3.0
Control Delay (s)	0.0	0.0	9.5
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.5
Approach LOS			A

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	21.8%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings
5: Access 2 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	28	94	67	0	94	0	43	0	0	0	0	3
Future Volume (vph)	28	94	67	0	94	0	43	0	0	0	0	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.952									0.865	
Flt Protected		0.993						0.950				
Satd. Flow (prot)	0	1761	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.993						0.950				
Satd. Flow (perm)	0	1761	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		53.8			44.7			33.3			48.0	
Travel Time (s)		3.9			3.2			2.4			3.5	
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
Adj. Flow (vph)	30	102	73	0	102	0	47	0	0	0	0	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	205	0	0	102	0	0	47	0	0	3	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 33.0%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
5: Access 2 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	94	67	0	94	0	43	0	0	0	0	3
Future Volume (Veh/h)	28	94	67	0	94	0	43	0	0	0	0	3
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)	30	102	73	0	102	0	47	0	0	0	0	3
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	102			175			304	300	138	300	337	102
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	102			175			304	300	138	300	337	102
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			93	100	100	100	100	100
cM capacity (veh/h)	1490			1401			637	600	910	642	572	953

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	205	102	47	3
Volume Left	30	0	47	0
Volume Right	73	0	0	3
cSH	1490	1401	637	953
Volume to Capacity	0.02	0.00	0.07	0.00
Queue Length 95th (m)	0.5	0.0	1.9	0.1
Control Delay (s)	1.2	0.0	11.1	8.8
Lane LOS	A		B	A
Approach Delay (s)	1.2	0.0	11.1	8.8
Approach LOS			B	A

Intersection Summary				
Average Delay		2.2		
Intersection Capacity Utilization		33.0%	ICU Level of Service	A
Analysis Period (min)		15		

Lanes, Volumes, Timings
6: Access 3 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	42	261	66	0	141	0	42	0	0	0	0	35
Future Volume (vph)	42	261	66	0	141	0	42	0	0	0	0	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.976									0.865	
Flt Protected		0.994						0.950				
Satd. Flow (prot)	0	1807	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.994						0.950				
Satd. Flow (perm)	0	1807	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		38.9			53.8			33.6			40.8	
Travel Time (s)		2.8			3.9			2.4			2.9	
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
Adj. Flow (vph)	46	284	72	0	153	0	46	0	0	0	0	38
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	402	0	0	153	0	0	46	0	0	38	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 46.5%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
6: Access 3 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	42	261	66	0	141	0	42	0	0	0	0	35
Future Volume (Veh/h)	42	261	66	0	141	0	42	0	0	0	0	35
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)	46	284	72	0	153	0	46	0	0	0	0	38
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	153			356			603	565	320	565	601	153
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	153			356			603	565	320	565	601	153
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			100			88	100	100	100	100	96
cM capacity (veh/h)	1428			1203			384	420	721	425	401	893

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	402	153	46	38
Volume Left	46	0	46	0
Volume Right	72	0	0	38
cSH	1428	1203	384	893
Volume to Capacity	0.03	0.00	0.12	0.04
Queue Length 95th (m)	0.8	0.0	3.2	1.1
Control Delay (s)	1.1	0.0	15.7	9.2
Lane LOS	A		C	A
Approach Delay (s)	1.1	0.0	15.7	9.2
Approach LOS			C	A

Intersection Summary				
Average Delay		2.4		
Intersection Capacity Utilization		46.5%	ICU Level of Service	A
Analysis Period (min)		15		

Appendix H

2025 Background Traffic Operations Reports

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	13	15	17	336	46	0	5	18	115	0	62	8
Future Volume (vph)	13	15	17	336	46	0	5	18	115	0	62	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.949						0.887			0.984	
Flt Protected		0.986			0.958			0.998				
Satd. Flow (prot)	0	1727	0	0	1820	0	0	1575	0	0	1870	0
Flt Permitted		0.986			0.958			0.998				
Satd. Flow (perm)	0	1727	0	0	1820	0	0	1575	0	0	1870	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1					1	2		3	3		2
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
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%	0%	7%	7%	0%	0%	0%
Adj. Flow (vph)	14	16	18	365	50	0	5	20	125	0	67	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	48	0	0	415	0	0	150	0	0	76	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	47.3%	ICU Level of Service	A
Analysis Period (min)	15		

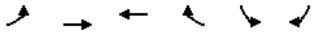
HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	13	15	17	336	46	0	5	18	115	0	62	8
Future Volume (Veh/h)	13	15	17	336	46	0	5	18	115	0	62	8
Sign Control		Stop			Stop			Free			Free	
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)	14	16	18	365	50	0	5	20	125	0	67	9
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	192	232	74	193	174	86	78			148		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	192	232	74	193	174	86	78			148		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	98	98	50	93	100	100			100		
cM capacity (veh/h)	705	667	992	737	718	974	1531			1442		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	48	415	150	76
Volume Left	14	365	5	0
Volume Right	18	0	125	9
cSH	774	735	1531	1442
Volume to Capacity	0.06	0.56	0.00	0.00
Queue Length 95th (m)	1.6	28.6	0.1	0.0
Control Delay (s)	10.0	16.1	0.3	0.0
Lane LOS	A	C	A	
Approach Delay (s)	10.0	16.1	0.3	0.0
Approach LOS	A	C		

Intersection Summary				
Average Delay	10.4			
Intersection Capacity Utilization	47.3%	ICU Level of Service		A
Analysis Period (min)	15			

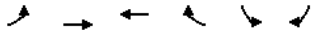
Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	68	149	888	70	142	274
Future Volume (vph)	68	149	888	70	142	274
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.990			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	1696	1790	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1687	1696	1790	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	7%	12%	4%	19%	2%	0%
Adj. Flow (vph)	74	162	965	76	154	298
Shared Lane Traffic (%)						
Lane Group Flow (vph)	74	162	1041	0	154	298
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	68	149	888	70	142	274
Future Volume (Veh/h)	68	149	888	70	142	274
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	74	162	965	76	154	298
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1042				1314	1004
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1042				1314	1004
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	89				0	0
cM capacity (veh/h)	648				154	296

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	74	162	1041	154	298
Volume Left	74	0	0	154	0
Volume Right	0	0	76	0	298
cSH	648	1700	1700	154	296
Volume to Capacity	0.11	0.10	0.61	1.00	1.01
Queue Length 95th (m)	3.1	0.0	0.0	60.6	85.6
Control Delay (s)	11.3	0.0	0.0	130.0	93.1
Lane LOS	B			F	F
Approach Delay (s)	3.5		0.0	105.6	
Approach LOS				F	

Intersection Summary				
Average Delay	28.1			
Intersection Capacity Utilization	74.6%	ICU Level of Service		D
Analysis Period (min)	15			

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	140	151	461	93	72	497
Future Volume (vph)	140	151	461	93	72	497
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.977			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1810	1805	0	1504	1583
Flt Permitted	0.251				0.950	
Satd. Flow (perm)	454	1810	1805	0	1504	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			21			242
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Adj. Flow (vph)	152	164	501	101	78	540
Shared Lane Traffic (%)						
Lane Group Flow (vph)	152	164	602	0	78	540
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	32.0	32.0	32.0		28.0	28.0
Total Split (%)	53.3%	53.3%	53.3%		46.7%	46.7%
Maximum Green (s)	26.0	26.0	26.0		22.0	22.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
v/c Ratio	0.78	0.21	0.76		0.14	0.74
Control Delay	45.7	11.5	21.8		13.6	16.4
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	45.7	11.5	21.8		13.6	16.4
LOS	D	B	C		B	B
Approach Delay		28.0	21.8		16.0	
Approach LOS		C	C		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 20.7		Intersection LOS: C	
Intersection Capacity Utilization 70.7%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	152	164	602	78	540
v/c Ratio	0.78	0.21	0.76	0.14	0.74
Control Delay	45.7	11.5	21.8	13.6	16.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	45.7	11.5	21.8	13.6	16.4
Queue Length 50th (m)	14.2	11.2	53.9	5.9	27.3
Queue Length 95th (m)	#44.8	21.9	#105.0	13.8	#67.6
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	196	784	794	551	733
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.78	0.21	0.76	0.14	0.74

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	140	151	461	93	72	497
Future Volume (vph)	140	151	461	93	72	497
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1719	1810	1806		1504	1583
Flt Permitted	0.25	1.00	1.00		0.95	1.00
Satd. Flow (perm)	454	1810	1806		1504	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	152	164	501	101	78	540
RTOR Reduction (vph)	0	0	12	0	0	153
Lane Group Flow (vph)	152	164	590	0	78	387
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	26.0	26.0	26.0		22.0	22.0
Effective Green, g (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	196	784	782		551	580
v/s Ratio Prot		0.09	0.33		0.05	
v/s Ratio Perm	c0.34					c0.24
v/c Ratio	0.78	0.21	0.75		0.14	0.67
Uniform Delay, d1	14.5	10.6	14.3		12.7	15.9
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	25.4	0.6	6.7		0.5	6.0
Delay (s)	39.9	11.2	21.0		13.2	21.9
Level of Service	D	B	C		B	C
Approach Delay (s)		25.0	21.0		20.8	
Approach LOS		C	C		C	

Intersection Summary

HCM 2000 Control Delay	21.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	8	48	0	22	152	0
Future Volume (vph)	8	48	0	22	152	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.885					
Flt Protected					0.950	
Satd. Flow (prot)	1649	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1649	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	9	52	0	24	165	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	61	0	0	24	165	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	8	48	0	22	152	0
Future Volume (Veh/h)	8	48	0	22	152	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	52	0	24	165	0
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			61		59	35
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			61		59	35
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		83	100
cM capacity (veh/h)			1542		948	1038

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	61	24	165
Volume Left	0	0	165
Volume Right	52	0	0
cSH	1700	1542	948
Volume to Capacity	0.04	0.00	0.17
Queue Length 95th (m)	0.0	0.0	5.0
Control Delay (s)	0.0	0.0	9.6
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.6
Approach LOS			A

Intersection Summary			
Average Delay	6.3		
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings
5: Access 2 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	56	22	0	174	0	71	0	0	0	0	22
Future Volume (vph)	9	56	22	0	174	0	71	0	0	0	0	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966									0.865	
Flt Protected		0.995						0.950				
Satd. Flow (prot)	0	1790	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.995						0.950				
Satd. Flow (perm)	0	1790	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		53.8			44.7			33.3			43.2	
Travel Time (s)		3.9			3.2			2.4			3.1	
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
Adj. Flow (vph)	10	61	24	0	189	0	77	0	0	0	0	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	95	0	0	189	0	0	77	0	0	24	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 29.4%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
5: Access 2 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	56	22	0	174	0	71	0	0	0	0	22
Future Volume (Veh/h)	9	56	22	0	174	0	71	0	0	0	0	22
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)	10	61	24	0	189	0	77	0	0	0	0	24
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	189			85			306	282	73	282	294	189
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	189			85			306	282	73	282	294	189
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			88	100	100	100	100	97
cM capacity (veh/h)	1385			1512			625	622	989	667	613	853

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	95	189	77	24
Volume Left	10	0	77	0
Volume Right	24	0	0	24
cSH	1385	1512	625	853
Volume to Capacity	0.01	0.00	0.12	0.03
Queue Length 95th (m)	0.2	0.0	3.4	0.7
Control Delay (s)	0.9	0.0	11.6	9.3
Lane LOS	A		B	A
Approach Delay (s)	0.9	0.0	11.6	9.3
Approach LOS			B	A

Intersection Summary				
Average Delay	3.1			
Intersection Capacity Utilization	29.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Lanes, Volumes, Timings
6: Access 3 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	87	22	0	267	0	70	0	0	0	0	44
Future Volume (vph)	20	87	22	0	267	0	70	0	0	0	0	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.977									0.865	
Flt Protected		0.992						0.950				
Satd. Flow (prot)	0	1805	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.992						0.950				
Satd. Flow (perm)	0	1805	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		38.9			53.8			33.6			37.9	
Travel Time (s)		2.8			3.9			2.4			2.7	
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
Adj. Flow (vph)	22	95	24	0	290	0	76	0	0	0	0	48
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	141	0	0	290	0	0	76	0	0	48	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 40.6%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
6: Access 3 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	87	22	0	267	0	70	0	0	0	0	44
Future Volume (Veh/h)	20	87	22	0	267	0	70	0	0	0	0	44
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)	22	95	24	0	290	0	76	0	0	0	0	48
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	290			119			489	441	107	441	453	290
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	290			119			489	441	107	441	453	290
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			83	100	100	100	100	94
cM capacity (veh/h)	1272			1469			452	502	947	520	494	749

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	141	290	76	48
Volume Left	22	0	76	0
Volume Right	24	0	0	48
cSH	1272	1469	452	749
Volume to Capacity	0.02	0.00	0.17	0.06
Queue Length 95th (m)	0.4	0.0	4.8	1.6
Control Delay (s)	1.4	0.0	14.6	10.1
Lane LOS	A		B	B
Approach Delay (s)	1.4	0.0	14.6	10.1
Approach LOS			B	B

Intersection Summary				
Average Delay	3.2			
Intersection Capacity Utilization	40.6%	ICU Level of Service	A	
Analysis Period (min)	15			

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	42	20	202	21	1	17	61	329	3	34	5
Future Volume (vph)	16	42	20	202	21	1	17	61	329	3	34	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.965			0.999			0.891			0.985	
Flt Protected		0.990			0.957			0.998			0.997	
Satd. Flow (prot)	0	1815	0	0	1769	0	0	1690	0	0	1866	0
Flt Permitted		0.990			0.957			0.998			0.997	
Satd. Flow (perm)	0	1815	0	0	1769	0	0	1690	0	0	1866	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1		1	1		1	2		1	1		2
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
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	17	46	22	220	23	1	18	66	358	3	37	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	85	0	0	244	0	0	442	0	0	45	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	54.3%	ICU Level of Service A	
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	42	20	202	21	1	17	61	329	3	34	5
Future Volume (Veh/h)	16	42	20	202	21	1	17	61	329	3	34	5
Sign Control		Stop			Stop			Free			Free	
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)	17	46	22	220	23	1	18	66	358	3	37	5
Pedestrians		2			1			1			1	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	342	508	42	374	332	247	44			425		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	342	508	42	374	332	247	44			425		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	90	98	58	96	100	99			100		
cM capacity (veh/h)	588	463	1031	519	581	795	1575			1144		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	85	244	442	45
Volume Left	17	220	18	3
Volume Right	22	1	358	5
cSH	568	525	1575	1144
Volume to Capacity	0.15	0.47	0.01	0.00
Queue Length 95th (m)	4.2	19.5	0.3	0.1
Control Delay (s)	12.5	17.7	0.4	0.6
Lane LOS	B	C	A	A
Approach Delay (s)	12.5	17.7	0.4	0.6
Approach LOS	B	C		

Intersection Summary				
Average Delay	6.8			
Intersection Capacity Utilization	54.3%	ICU Level of Service	A	
Analysis Period (min)	15			

Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	256	956	471	151	96	160
Future Volume (vph)	256	956	471	151	96	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.967			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1737	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1805	1881	1737	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	7%	2%	2%	0%
Adj. Flow (vph)	278	1039	512	164	104	174
Shared Lane Traffic (%)						
Lane Group Flow (vph)	278	1039	676	0	104	174
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 63.5%		ICU Level of Service B	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	256	956	471	151	96	160
Future Volume (Veh/h)	256	956	471	151	96	160
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	278	1039	512	164	104	174
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	676				2189	594
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	676				2189	594
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	70				0	66
cM capacity (veh/h)	925				35	509

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	278	1039	676	104	174
Volume Left	278	0	0	104	0
Volume Right	0	0	164	0	174
cSH	925	1700	1700	35	509
Volume to Capacity	0.30	0.61	0.40	2.97	0.34
Queue Length 95th (m)	10.2	0.0	0.0	95.2	12.0
Control Delay (s)	10.6	0.0	0.0	1129.6	15.7
Lane LOS	B			F	C
Approach Delay (s)	2.2		0.0	432.4	
Approach LOS				F	

Intersection Summary				
Average Delay		54.2		
Intersection Capacity Utilization		63.5%	ICU Level of Service	B
Analysis Period (min)		15		

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	246	806	246	83	94	376
Future Volume (vph)	246	806	246	83	94	376
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.966			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1863	1782	0	1805	1583
Flt Permitted	0.528				0.950	
Satd. Flow (perm)	1003	1863	1782	0	1805	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			40			409
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Adj. Flow (vph)	267	876	267	90	102	409
Shared Lane Traffic (%)						
Lane Group Flow (vph)	267	876	357	0	102	409
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	46.0	46.0	46.0		24.0	24.0
Total Split (%)	65.7%	65.7%	65.7%		34.3%	34.3%
Maximum Green (s)	40.0	40.0	40.0		18.0	18.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
v/c Ratio	0.47	0.82	0.34		0.22	0.58
Control Delay	12.1	20.7	8.1		22.0	6.2
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	12.1	20.7	8.1		22.0	6.2
LOS	B	C	A		C	A
Approach Delay		18.7	8.1		9.4	
Approach LOS		B	A		A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 70			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.82			
Intersection Signal Delay: 14.5		Intersection LOS: B	
Intersection Capacity Utilization 60.8%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	267	876	357	102	409
v/c Ratio	0.47	0.82	0.34	0.22	0.58
Control Delay	12.1	20.7	8.1	22.0	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	12.1	20.7	8.1	22.0	6.2
Queue Length 50th (m)	19.5	88.3	20.6	11.1	0.0
Queue Length 95th (m)	37.6	#167.6	35.6	22.9	20.0
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	573	1064	1035	464	710
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.47	0.82	0.34	0.22	0.58

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	246	806	246	83	94	376
Future Volume (vph)	246	806	246	83	94	376
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.97		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1863	1782		1805	1583
Flt Permitted	0.53	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1004	1863	1782		1805	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	267	876	267	90	102	409
RTOR Reduction (vph)	0	0	17	0	0	304
Lane Group Flow (vph)	267	876	340	0	102	105
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	40.0	40.0	40.0		18.0	18.0
Effective Green, g (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	573	1064	1018		464	407
v/s Ratio Prot		c0.47	0.19		0.06	
v/s Ratio Perm	0.27					c0.07
v/c Ratio	0.47	0.82	0.33		0.22	0.26
Uniform Delay, d1	8.8	12.1	7.9		20.5	20.7
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.7	7.2	0.9		1.1	1.5
Delay (s)	11.5	19.4	8.8		21.6	22.2
Level of Service	B	B	A		C	C
Approach Delay (s)		17.5	8.8		22.1	
Approach LOS		B	A		C	

Intersection Summary

HCM 2000 Control Delay	17.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	23	144	0	2	92	0
Future Volume (vph)	23	144	0	2	92	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.884					
Flt Protected					0.950	
Satd. Flow (prot)	1647	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1647	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	157	0	2	100	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	182	0	0	2	100	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 21.9%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	23	144	0	2	92	0
Future Volume (Veh/h)	23	144	0	2	92	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	25	157	0	2	100	0
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			182		106	104
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			182		106	104
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		89	100
cM capacity (veh/h)			1393		892	951

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	182	2	100
Volume Left	0	0	100
Volume Right	157	0	0
cSH	1700	1393	892
Volume to Capacity	0.11	0.00	0.11
Queue Length 95th (m)	0.0	0.0	3.0
Control Delay (s)	0.0	0.0	9.5
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.5
Approach LOS			A

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	21.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings
5: Access 2 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	95	67	0	94	0	43	0	0	0	0	3
Future Volume (vph)	29	95	67	0	94	0	43	0	0	0	0	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.953									0.865	
Flt Protected		0.992						0.950				
Satd. Flow (prot)	0	1761	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.992						0.950				
Satd. Flow (perm)	0	1761	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		53.8			44.7			33.3			48.0	
Travel Time (s)		3.9			3.2			2.4			3.5	
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
Adj. Flow (vph)	32	103	73	0	102	0	47	0	0	0	0	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	208	0	0	102	0	0	47	0	0	3	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 33.1%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
5: Access 2 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	29	95	67	0	94	0	43	0	0	0	0	3
Future Volume (Veh/h)	29	95	67	0	94	0	43	0	0	0	0	3
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)	32	103	73	0	102	0	47	0	0	0	0	3
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	102			176			308	306	140	306	342	102
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	102			176			308	306	140	306	342	102
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			93	100	100	100	100	100
cM capacity (veh/h)	1490			1400			631	595	909	636	568	953

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	208	102	47	3
Volume Left	32	0	47	0
Volume Right	73	0	0	3
cSH	1490	1400	631	953
Volume to Capacity	0.02	0.00	0.07	0.00
Queue Length 95th (m)	0.5	0.0	1.9	0.1
Control Delay (s)	1.3	0.0	11.2	8.8
Lane LOS	A		B	A
Approach Delay (s)	1.3	0.0	11.2	8.8
Approach LOS			B	A

Intersection Summary				
Average Delay		2.3		
Intersection Capacity Utilization		33.1%	ICU Level of Service	A
Analysis Period (min)		15		

Lanes, Volumes, Timings
6: Access 3 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	44	263	66	0	141	0	42	0	0	0	0	37
Future Volume (vph)	44	263	66	0	141	0	42	0	0	0	0	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.976									0.865	
Flt Protected		0.994						0.950				
Satd. Flow (prot)	0	1807	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.994						0.950				
Satd. Flow (perm)	0	1807	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		38.9			53.8			33.6			40.8	
Travel Time (s)		2.8			3.9			2.4			2.9	
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
Adj. Flow (vph)	48	286	72	0	153	0	46	0	0	0	0	40
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	406	0	0	153	0	0	46	0	0	40	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 46.7%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
6: Access 3 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	44	263	66	0	141	0	42	0	0	0	0	37
Future Volume (Veh/h)	44	263	66	0	141	0	42	0	0	0	0	37
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)	48	286	72	0	153	0	46	0	0	0	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	153			358			611	571	322	571	607	153
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	153			358			611	571	322	571	607	153
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			100			88	100	100	100	100	96
cM capacity (veh/h)	1428			1201			378	416	719	421	397	893

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	406	153	46	40
Volume Left	48	0	46	0
Volume Right	72	0	0	40
cSH	1428	1201	378	893
Volume to Capacity	0.03	0.00	0.12	0.04
Queue Length 95th (m)	0.8	0.0	3.3	1.1
Control Delay (s)	1.2	0.0	15.8	9.2
Lane LOS	A		C	A
Approach Delay (s)	1.2	0.0	15.8	9.2
Approach LOS			C	A

Intersection Summary				
Average Delay	2.4			
Intersection Capacity Utilization	46.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Appendix I

2025 Future Total Traffic Operations Reports

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	13	19	17	452	59	0	5	18	153	0	62	8
Future Volume (vph)	13	19	17	452	59	0	5	18	153	0	62	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.954						0.883			0.984	
Flt Protected		0.987			0.958			0.999				
Satd. Flow (prot)	0	1743	0	0	1820	0	0	1569	0	0	1870	0
Flt Permitted		0.987			0.958			0.999				
Satd. Flow (perm)	0	1743	0	0	1820	0	0	1569	0	0	1870	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1					1	2		3	3		2
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
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%	0%	7%	7%	0%	0%	0%
Adj. Flow (vph)	14	21	18	491	64	0	5	20	166	0	67	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	53	0	0	555	0	0	191	0	0	76	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	13	19	17	452	59	0	5	18	153	0	62	8
Future Volume (Veh/h)	13	19	17	452	59	0	5	18	153	0	62	8
Sign Control		Stop			Stop			Free			Free	
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)	14	21	18	491	64	0	5	20	166	0	67	9
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	220	272	74	216	194	107	78			189		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	220	272	74	216	194	107	78			189		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	97	98	31	91	100	100			100		
cM capacity (veh/h)	664	633	992	707	700	949	1531			1394		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	53	555	191	76
Volume Left	14	491	5	0
Volume Right	18	0	166	9
cSH	732	706	1531	1394
Volume to Capacity	0.07	0.79	0.00	0.00
Queue Length 95th (m)	1.9	62.4	0.1	0.0
Control Delay (s)	10.3	26.1	0.2	0.0
Lane LOS	B	D	A	
Approach Delay (s)	10.3	26.1	0.2	0.0
Approach LOS	B	D		

Intersection Summary				
Average Delay	17.3			
Intersection Capacity Utilization	56.7%	ICU Level of Service	B	
Analysis Period (min)	15			

Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	92	149	888	84	174	358
Future Volume (vph)	92	149	888	84	174	358
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.988			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	1696	1783	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1687	1696	1783	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	7%	12%	4%	19%	2%	0%
Adj. Flow (vph)	100	162	965	91	189	389
Shared Lane Traffic (%)						
Lane Group Flow (vph)	100	162	1056	0	189	389
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 80.7%		ICU Level of Service D	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	92	149	888	84	174	358
Future Volume (Veh/h)	92	149	888	84	174	358
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	100	162	965	91	189	389
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1057				1374	1012
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1057				1374	1012
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	84				0	0
cM capacity (veh/h)	640				135	293

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	100	162	1056	189	389
Volume Left	100	0	0	189	0
Volume Right	0	0	91	0	389
cSH	640	1700	1700	135	293
Volume to Capacity	0.16	0.10	0.62	1.40	1.33
Queue Length 95th (m)	4.4	0.0	0.0	99.3	155.9
Control Delay (s)	11.7	0.0	0.0	278.0	204.2
Lane LOS	B			F	F
Approach Delay (s)	4.5		0.0	228.3	
Approach LOS				F	

Intersection Summary				
Average Delay		70.2		
Intersection Capacity Utilization		80.7%	ICU Level of Service	D
Analysis Period (min)		15		

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	146	177	469	93	72	503
Future Volume (vph)	146	177	469	93	72	503
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.978			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1810	1807	0	1504	1583
Flt Permitted	0.242				0.950	
Satd. Flow (perm)	438	1810	1807	0	1504	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			21			235
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Adj. Flow (vph)	159	192	510	101	78	547
Shared Lane Traffic (%)						
Lane Group Flow (vph)	159	192	611	0	78	547
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	32.0	32.0	32.0		28.0	28.0
Total Split (%)	53.3%	53.3%	53.3%		46.7%	46.7%
Maximum Green (s)	26.0	26.0	26.0		22.0	22.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
v/c Ratio	0.84	0.24	0.77		0.14	0.75
Control Delay	56.2	11.8	22.4		13.6	17.4
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	56.2	11.8	22.4		13.6	17.4
LOS	E	B	C		B	B
Approach Delay		31.9	22.4		16.9	
Approach LOS		C	C		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.84			
Intersection Signal Delay: 22.3		Intersection LOS: C	
Intersection Capacity Utilization 71.5%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	159	192	611	78	547
v/c Ratio	0.84	0.24	0.77	0.14	0.75
Control Delay	56.2	11.8	22.4	13.6	17.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	56.2	11.8	22.4	13.6	17.4
Queue Length 50th (m)	15.5	13.4	55.1	5.9	29.1
Queue Length 95th (m)	#48.1	25.4	#107.2	13.8	#79.2
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	189	784	794	551	729
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.84	0.24	0.77	0.14	0.75

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	146	177	469	93	72	503
Future Volume (vph)	146	177	469	93	72	503
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1719	1810	1807		1504	1583
Flt Permitted	0.24	1.00	1.00		0.95	1.00
Satd. Flow (perm)	438	1810	1807		1504	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	159	192	510	101	78	547
RTOR Reduction (vph)	0	0	12	0	0	149
Lane Group Flow (vph)	159	192	599	0	78	398
Heavy Vehicles (%)	5%	5%	2%	7%	20%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	26.0	26.0	26.0		22.0	22.0
Effective Green, g (s)	26.0	26.0	26.0		22.0	22.0
Actuated g/C Ratio	0.43	0.43	0.43		0.37	0.37
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	189	784	783		551	580
v/s Ratio Prot		0.11	0.33		0.05	
v/s Ratio Perm	c0.36					c0.25
v/c Ratio	0.84	0.24	0.77		0.14	0.69
Uniform Delay, d1	15.2	10.8	14.4		12.7	16.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	34.1	0.7	7.0		0.5	6.5
Delay (s)	49.3	11.5	21.4		13.2	22.6
Level of Service	D	B	C		B	C
Approach Delay (s)		28.6	21.4		21.4	
Approach LOS		C	C		C	

Intersection Summary

HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	8	48	0	22	152	0
Future Volume (vph)	8	48	0	22	152	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.885					
Flt Protected					0.950	
Satd. Flow (prot)	1649	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1649	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	9	52	0	24	165	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	61	0	0	24	165	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	8	48	0	22	152	0
Future Volume (Veh/h)	8	48	0	22	152	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	52	0	24	165	0
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			61		59	35
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			61		59	35
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		83	100
cM capacity (veh/h)			1542		948	1038

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	61	24	165
Volume Left	0	0	165
Volume Right	52	0	0
cSH	1700	1542	948
Volume to Capacity	0.04	0.00	0.17
Queue Length 95th (m)	0.0	0.0	5.0
Control Delay (s)	0.0	0.0	9.6
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.6
Approach LOS			A

Intersection Summary				
Average Delay		6.3		
Intersection Capacity Utilization		18.5%	ICU Level of Service	A
Analysis Period (min)		15		

Lanes, Volumes, Timings
5: Access 2 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	56	22	0	174	0	71	0	0	0	0	22
Future Volume (vph)	9	56	22	0	174	0	71	0	0	0	0	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966									0.865	
Flt Protected		0.995						0.950				
Satd. Flow (prot)	0	1790	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.995						0.950				
Satd. Flow (perm)	0	1790	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		53.8			44.7			33.3			43.2	
Travel Time (s)		3.9			3.2			2.4			3.1	
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
Adj. Flow (vph)	10	61	24	0	189	0	77	0	0	0	0	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	95	0	0	189	0	0	77	0	0	24	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 29.4%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
5: Access 2 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	56	22	0	174	0	71	0	0	0	0	22
Future Volume (Veh/h)	9	56	22	0	174	0	71	0	0	0	0	22
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)	10	61	24	0	189	0	77	0	0	0	0	24
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	189			85			306	282	73	282	294	189
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	189			85			306	282	73	282	294	189
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			88	100	100	100	100	97
cM capacity (veh/h)	1385			1512			625	622	989	667	613	853

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	95	189	77	24
Volume Left	10	0	77	0
Volume Right	24	0	0	24
cSH	1385	1512	625	853
Volume to Capacity	0.01	0.00	0.12	0.03
Queue Length 95th (m)	0.2	0.0	3.4	0.7
Control Delay (s)	0.9	0.0	11.6	9.3
Lane LOS	A		B	A
Approach Delay (s)	0.9	0.0	11.6	9.3
Approach LOS			B	A

Intersection Summary				
Average Delay	3.1			
Intersection Capacity Utilization	29.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Lanes, Volumes, Timings
6: Access 3 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	87	43	0	267	0	135	0	0	0	0	44
Future Volume (vph)	20	87	43	0	267	0	135	0	0	0	0	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.961									0.865	
Flt Protected		0.993						0.950				
Satd. Flow (prot)	0	1778	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.993						0.950				
Satd. Flow (perm)	0	1778	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		38.9			53.8			33.6			37.9	
Travel Time (s)		2.8			3.9			2.4			2.7	
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
Adj. Flow (vph)	22	95	47	0	290	0	147	0	0	0	0	48
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	164	0	0	290	0	0	147	0	0	48	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 45.6%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
6: Access 3 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	87	43	0	267	0	135	0	0	0	0	44
Future Volume (Veh/h)	20	87	43	0	267	0	135	0	0	0	0	44
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)	22	95	47	0	290	0	147	0	0	0	0	48
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	290			142			500	452	118	452	476	290
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	290			142			500	452	118	452	476	290
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			67	100	100	100	100	94
cM capacity (veh/h)	1272			1441			444	494	933	511	479	749

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	164	290	147	48
Volume Left	22	0	147	0
Volume Right	47	0	0	48
cSH	1272	1441	444	749
Volume to Capacity	0.02	0.00	0.33	0.06
Queue Length 95th (m)	0.4	0.0	11.4	1.6
Control Delay (s)	1.2	0.0	17.1	10.1
Lane LOS	A		C	B
Approach Delay (s)	1.2	0.0	17.1	10.1
Approach LOS			C	B

Intersection Summary				
Average Delay	4.9			
Intersection Capacity Utilization	45.6%	ICU Level of Service	A	
Analysis Period (min)	15			

Lanes, Volumes, Timings
7: Access 4 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	150	21	0	445	0	64	0	0	0	0	2
Future Volume (vph)	1	150	21	0	445	0	64	0	0	0	0	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.983									0.865	
Flt Protected								0.950				
Satd. Flow (prot)	0	1831	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted								0.950				
Satd. Flow (perm)	0	1831	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		52.2			38.9			35.0			36.9	
Travel Time (s)		3.8			2.8			2.5			2.7	
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
Adj. Flow (vph)	1	163	23	0	484	0	70	0	0	0	0	2
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	187	0	0	484	0	0	70	0	0	2	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 40.3%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
7: Access 4 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	150	21	0	445	0	64	0	0	0	0	2
Future Volume (Veh/h)	1	150	21	0	445	0	64	0	0	0	0	2
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)	1	163	23	0	484	0	70	0	0	0	0	2
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	484			186			662	660	174	660	672	484
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	484			186			662	660	174	660	672	484
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			81	100	100	100	100	100
cM capacity (veh/h)	1079			1388			373	383	869	376	377	583

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	187	484	70	2
Volume Left	1	0	70	0
Volume Right	23	0	0	2
cSH	1079	1388	373	583
Volume to Capacity	0.00	0.00	0.19	0.00
Queue Length 95th (m)	0.0	0.0	5.4	0.1
Control Delay (s)	0.1	0.0	16.9	11.2
Lane LOS	A		C	B
Approach Delay (s)	0.1	0.0	16.9	11.2
Approach LOS			C	B

Intersection Summary				
Average Delay		1.6		
Intersection Capacity Utilization	40.3%	ICU Level of Service	A	
Analysis Period (min)	15			

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	55	20	278	29	1	17	61	444	3	34	5
Future Volume (vph)	16	55	20	278	29	1	17	61	444	3	34	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.970						0.885			0.985	
Flt Protected		0.991			0.957			0.998			0.997	
Satd. Flow (prot)	0	1826	0	0	1770	0	0	1678	0	0	1866	0
Flt Permitted		0.991			0.957			0.998			0.997	
Satd. Flow (perm)	0	1826	0	0	1770	0	0	1678	0	0	1866	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1		1	1		1	2		1	1		2
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
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	17	60	22	302	32	1	18	66	483	3	37	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	99	0	0	335	0	0	567	0	0	45	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	66.0%	ICU Level of Service	C
Analysis Period (min)	15		

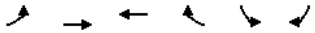
HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	55	20	278	29	1	17	61	444	3	34	5
Future Volume (Veh/h)	16	55	20	278	29	1	17	61	444	3	34	5
Sign Control		Stop			Stop			Free			Free	
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)	17	60	22	302	32	1	18	66	483	3	37	5
Pedestrians		2			1			1			1	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	409	634	42	443	394	310	44			550		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	409	634	42	443	394	310	44			550		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	85	98	32	94	100	99			100		
cM capacity (veh/h)	522	393	1031	446	536	734	1575			1029		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	99	335	567	45
Volume Left	17	302	18	3
Volume Right	22	1	483	5
cSH	479	453	1575	1029
Volume to Capacity	0.21	0.74	0.01	0.00
Queue Length 95th (m)	6.2	48.2	0.3	0.1
Control Delay (s)	14.5	32.2	0.4	0.6
Lane LOS	B	D	A	A
Approach Delay (s)	14.5	32.2	0.4	0.6
Approach LOS	B	D		

Intersection Summary				
Average Delay		11.9		
Intersection Capacity Utilization	66.0%	ICU Level of Service		C
Analysis Period (min)	15			

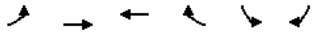
Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	326	956	471	196	117	215
Future Volume (vph)	326	956	471	196	117	215
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			0.0	40.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.960			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1728	0	1770	1615
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1805	1881	1728	0	1770	1615
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	7%	2%	2%	0%
Adj. Flow (vph)	354	1039	512	213	127	234
Shared Lane Traffic (%)						
Lane Group Flow (vph)	354	1039	725	0	127	234
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 71.3%		ICU Level of Service C	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	326	956	471	196	117	215
Future Volume (Veh/h)	326	956	471	196	117	215
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	354	1039	512	213	127	234
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	725				2366	618
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	725				2366	618
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	60				0	52
cM capacity (veh/h)	887				23	493

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	354	1039	725	127	234
Volume Left	354	0	0	127	0
Volume Right	0	0	213	0	234
cSH	887	1700	1700	23	493
Volume to Capacity	0.40	0.61	0.43	5.47	0.48
Queue Length 95th (m)	15.5	0.0	0.0	Err	20.1
Control Delay (s)	11.7	0.0	0.0	Err	18.7
Lane LOS	B			F	C
Approach Delay (s)	3.0		0.0	3529.8	
Approach LOS				F	

Intersection Summary				
Average Delay	515.7			
Intersection Capacity Utilization	71.3%	ICU Level of Service		C
Analysis Period (min)	15			

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	250	823	272	83	94	395
Future Volume (vph)	250	823	272	83	94	395
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.969			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1863	1786	0	1805	1583
Flt Permitted	0.504				0.950	
Satd. Flow (perm)	958	1863	1786	0	1805	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			36			429
Link Speed (k/h)		80	80		50	
Link Distance (m)		826.3	260.0		127.1	
Travel Time (s)		37.2	11.7		9.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Adj. Flow (vph)	272	895	296	90	102	429
Shared Lane Traffic (%)						
Lane Group Flow (vph)	272	895	386	0	102	429
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (m)	2.0	10.0	10.0		2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0		0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6		2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2					4
Detector Phase	2	2	6		4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0		10.0	10.0
Minimum Split (s)	26.0	26.0	26.0		24.0	24.0
Total Split (s)	46.0	46.0	46.0		24.0	24.0
Total Split (%)	65.7%	65.7%	65.7%		34.3%	34.3%
Maximum Green (s)	40.0	40.0	40.0		18.0	18.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	C-Max		Max	Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
v/c Ratio	0.50	0.84	0.37		0.22	0.59
Control Delay	12.9	21.9	8.6		22.0	6.3
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	12.9	21.9	8.6		22.0	6.3
LOS	B	C	A		C	A
Approach Delay		19.8	8.6		9.3	
Approach LOS		B	A		A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 70			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 65			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.84			
Intersection Signal Delay: 15.1		Intersection LOS: B	
Intersection Capacity Utilization 61.6%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 3: North Service Road & Millen Road

Queues
3: North Service Road & Millen Road 06-14-2018

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	272	895	386	102	429
v/c Ratio	0.50	0.84	0.37	0.22	0.59
Control Delay	12.9	21.9	8.6	22.0	6.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	12.9	21.9	8.6	22.0	6.3
Queue Length 50th (m)	20.3	92.0	23.3	11.1	0.0
Queue Length 95th (m)	40.0	#173.4	39.6	22.9	20.4
Internal Link Dist (m)		802.3	236.0	103.1	
Turn Bay Length (m)	85.0			50.0	
Base Capacity (vph)	547	1064	1036	464	725
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.50	0.84	0.37	0.22	0.59

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: North Service Road & Millen Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	250	823	272	83	94	395
Future Volume (vph)	250	823	272	83	94	395
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.97		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1863	1785		1805	1583
Flt Permitted	0.50	1.00	1.00		0.95	1.00
Satd. Flow (perm)	958	1863	1785		1805	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	895	296	90	102	429
RTOR Reduction (vph)	0	0	15	0	0	319
Lane Group Flow (vph)	272	895	371	0	102	110
Heavy Vehicles (%)	0%	2%	4%	0%	0%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	40.0	40.0	40.0		18.0	18.0
Effective Green, g (s)	40.0	40.0	40.0		18.0	18.0
Actuated g/C Ratio	0.57	0.57	0.57		0.26	0.26
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	547	1064	1020		464	407
v/s Ratio Prot		c0.48	0.21		0.06	
v/s Ratio Perm	0.28					c0.07
v/c Ratio	0.50	0.84	0.36		0.22	0.27
Uniform Delay, d1	9.0	12.4	8.1		20.5	20.8
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.2	8.1	1.0		1.1	1.6
Delay (s)	12.2	20.4	9.1		21.6	22.4
Level of Service	B	C	A		C	C
Approach Delay (s)		18.5	9.1		22.2	
Approach LOS		B	A		C	

Intersection Summary

HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Access 1 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	23	144	0	2	92	0
Future Volume (vph)	23	144	0	2	92	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.884					
Flt Protected					0.950	
Satd. Flow (prot)	1647	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1647	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	44.7			49.4	43.7	
Travel Time (s)	3.2			3.6	3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	157	0	2	100	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	182	0	0	2	100	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 21.9%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
4: Access 1 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	23	144	0	2	92	0
Future Volume (Veh/h)	23	144	0	2	92	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	25	157	0	2	100	0
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			182		106	104
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			182		106	104
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		89	100
cM capacity (veh/h)			1393		892	951

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	182	2	100
Volume Left	0	0	100
Volume Right	157	0	0
cSH	1700	1393	892
Volume to Capacity	0.11	0.00	0.11
Queue Length 95th (m)	0.0	0.0	3.0
Control Delay (s)	0.0	0.0	9.5
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.5
Approach LOS			A

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	21.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings
5: Access 2 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	95	67	0	94	0	43	0	0	0	0	3
Future Volume (vph)	29	95	67	0	94	0	43	0	0	0	0	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.953									0.865	
Flt Protected		0.992						0.950				
Satd. Flow (prot)	0	1761	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.992						0.950				
Satd. Flow (perm)	0	1761	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		53.8			44.7			33.3			48.0	
Travel Time (s)		3.9			3.2			2.4			3.5	
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
Adj. Flow (vph)	32	103	73	0	102	0	47	0	0	0	0	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	208	0	0	102	0	0	47	0	0	3	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 33.1%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
5: Access 2 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	29	95	67	0	94	0	43	0	0	0	0	3
Future Volume (Veh/h)	29	95	67	0	94	0	43	0	0	0	0	3
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)	32	103	73	0	102	0	47	0	0	0	0	3
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	102			176			308	306	140	306	342	102
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	102			176			308	306	140	306	342	102
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			93	100	100	100	100	100
cM capacity (veh/h)	1490			1400			631	595	909	636	568	953

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	208	102	47	3
Volume Left	32	0	47	0
Volume Right	73	0	0	3
cSH	1490	1400	631	953
Volume to Capacity	0.02	0.00	0.07	0.00
Queue Length 95th (m)	0.5	0.0	1.9	0.1
Control Delay (s)	1.3	0.0	11.2	8.8
Lane LOS	A		B	A
Approach Delay (s)	1.3	0.0	11.2	8.8
Approach LOS			B	A

Intersection Summary				
Average Delay		2.3		
Intersection Capacity Utilization		33.1%	ICU Level of Service	A
Analysis Period (min)		15		

Lanes, Volumes, Timings
6: Access 3 & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	44	263	130	0	141	0	84	0	0	0	0	37
Future Volume (vph)	44	263	130	0	141	0	84	0	0	0	0	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.960									0.865	
Flt Protected		0.995						0.950				
Satd. Flow (prot)	0	1779	0	0	1863	0	0	1770	0	0	1611	0
Flt Permitted		0.995						0.950				
Satd. Flow (perm)	0	1779	0	0	1863	0	0	1770	0	0	1611	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		38.9			53.8			33.6			40.8	
Travel Time (s)		2.8			3.9			2.4			2.9	
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
Adj. Flow (vph)	48	286	141	0	153	0	91	0	0	0	0	40
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	475	0	0	153	0	0	91	0	0	40	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 52.9%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
6: Access 3 & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	44	263	130	0	141	0	84	0	0	0	0	37
Future Volume (Veh/h)	44	263	130	0	141	0	84	0	0	0	0	37
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)	48	286	141	0	153	0	91	0	0	0	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	153			427			646	606	356	606	676	153
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	153			427			646	606	356	606	676	153
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			100			75	100	100	100	100	96
cM capacity (veh/h)	1428			1132			358	398	688	399	363	893

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	475	153	91	40
Volume Left	48	0	91	0
Volume Right	141	0	0	40
cSH	1428	1132	358	893
Volume to Capacity	0.03	0.00	0.25	0.04
Queue Length 95th (m)	0.8	0.0	7.9	1.1
Control Delay (s)	1.1	0.0	18.4	9.2
Lane LOS	A		C	A
Approach Delay (s)	1.1	0.0	18.4	9.2
Approach LOS			C	A

Intersection Summary				
Average Delay		3.4		
Intersection Capacity Utilization		52.9%	ICU Level of Service	A
Analysis Period (min)		15		

Lanes, Volumes, Timings
7: Access 4 & Frances Avenue 06-14-2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	436	64	0	262	42	0
Future Volume (vph)	436	64	0	262	42	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.983					
Flt Protected					0.950	
Satd. Flow (prot)	1831	0	0	1863	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	1831	0	0	1863	1770	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	52.2			38.9	35.0	
Travel Time (s)	3.8			2.8	2.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	474	70	0	285	46	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	544	0	0	285	46	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.6	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 36.8%		ICU Level of Service A	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
7: Access 4 & Frances Avenue 06-14-2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	436	64	0	262	42	0
Future Volume (Veh/h)	436	64	0	262	42	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	474	70	0	285	46	0
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			544		794	509
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			544		794	509
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		87	100
cM capacity (veh/h)			1025		357	564

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	544	285	46
Volume Left	0	0	46
Volume Right	70	0	0
cSH	1700	1025	357
Volume to Capacity	0.32	0.00	0.13
Queue Length 95th (m)	0.0	0.0	3.5
Control Delay (s)	0.0	0.0	16.6
Lane LOS			C
Approach Delay (s)	0.0	0.0	16.6
Approach LOS			C

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	36.8%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix J

Signal Warrant Justification Worksheet

Signal Justification Calculation for Forecasted Volumes
(OTM Book 12 - Justification 7)

Horizon Year: 2021 Background Traffic
Region/City/Township: City of Hamilton

Major Street: North Service Road
Minor Street: Green Road
North/South?: N

Number of Approach Lanes: 1
Tee Intersection? Y
Flow Conditions: Free

PM Forecast Only? N

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

	Major Street						Minor Street						
	North Service Road						Green Road						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	17	145			838	34				64		76	
PM Peak Hour	96	897			448	50				48		41	
Average Hourly Volume	28	261	0	0	322	21	0	0	0	28	0	29	0

Warrant	AHV
1A - All	689
1B - Minor	57
2A - Major	631
2B - Cross	28

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	All Approaches	480	720	600	900	689
					% Fulfilled	143.4%

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Minor Street Approaches	180	255	180	255	57
					% Fulfilled	31.8%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Major Street Approaches	480	720	600	900	631
					% Fulfilled	131.5%

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Traffic Crossing Major Street	50	75	50	75	28
					% Fulfilled	56.0%

Signal Justification Calculation for Forecasted Volumes
(OTM Book 12 - Justification 7)

Horizon Year: 2023 Background Traffic
Region/City/Township: City of Hamilton

Major Street: North Service Road
Minor Street: Green Road
North/South?: N

Number of Approach Lanes: 1
Tee Intersection? Y
Flow Conditions: Free

PM Forecast Only? N

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

	Major Street						Minor Street						
	North Service Road						Green Road						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	44	147			863	52				104		178	
PM Peak Hour	179	926			459	102				73		103	
Average Hourly Volume	56	268	0	0	331	39	0	0	0	44	0	70	0

Warrant	AHV
1A - All	808
1B - Minor	115
2A - Major	693
2B - Cross	44

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	All Approaches	480	720	600	900	808
					% Fulfilled	168.2%

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Minor Street Approaches	180	255	180	255	115
					% Fulfilled	63.6%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Major Street Approaches	480	720	600	900	693
					% Fulfilled	144.4%

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Traffic Crossing Major Street	50	75	50	75	44
					% Fulfilled	88.5%

Signal Justification Calculation for Forecasted Volumes
(OTM Book 12 - Justification 7)

Horizon Year: 2023 Background Traffic
Region/City/Township: City of Hamilton

Major Street: North Service Road
Minor Street: Green Road
North/South?: N

Number of Approach Lanes: 1
Tee Intersection? Y
Flow Conditions: Free

PM Forecast Only? N

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

	Major Street						Minor Street						
	North Service Road						Green Road						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	68	149			888	70				142		274	
PM Peak Hour	256	956			471	151				96		160	
Average Hourly Volume	81	276	0	0	340	55	0	0	0	60	0	109	0

Warrant	AHV
1A - All	920
1B - Minor	168
2A - Major	752
2B - Cross	60

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	All Approaches	480	720	600	900	920
					% Fulfilled	191.7%

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Minor Street Approaches	180	255	180	255	168
					% Fulfilled	93.3%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Major Street Approaches	480	720	600	900	752
					% Fulfilled	156.7%

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Traffic Crossing Major Street	50	75	50	75	60
					% Fulfilled	119.0%

Signal Justification Calculation for Forecasted Volumes
(OTM Book 12 - Justification 7)

Horizon Year: 2021 Total Traffic
Region/City/Township: City of Hamilton

Major Street: North Service Road
Minor Street: Green Road
North/South?: N

Number of Approach Lanes: 1
Tee Intersection? Y
Flow Conditions: Free

PM Forecast Only? N

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

	Major Street						Minor Street						
	North Service Road						Green Road						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	43	145			838	51				102		175	
PM Peak Hour	176	897			448	100				71		101	
Average Hourly Volume	55	261	0	0	322	38	0	0	0	43	0	69	0

Warrant	AHV
1A - All	787
1B - Minor	112
2A - Major	675
2B - Cross	43

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	All Approaches	480	720	600	900	787
					% Fulfilled	163.9%

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Minor Street Approaches	180	255	180	255	112
					% Fulfilled	62.4%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Major Street Approaches	480	720	600	900	675
					% Fulfilled	140.5%

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Traffic Crossing Major Street	50	75	50	75	43
					% Fulfilled	86.5%

Signal Justification Calculation for Forecasted Volumes
(OTM Book 12 - Justification 7)

Horizon Year: 2021 Total Traffic
Region/City/Township: City of Hamilton

Major Street: North Service Road
Minor Street: Green Road
North/South?: N

Number of Approach Lanes: 1
Tee Intersection? Y
Flow Conditions: Free

PM Forecast Only? N

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

	Major Street North Service Road						Minor Street Green Road						
	Eastbound			Westbound			Northbound			Southbound			
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Peds Crossing Main Road
AM Peak Hour	68	147			863	68				139		270	
PM Peak Hour	252	926			459	149				94		158	
Average Hourly Volume	80	268	0	0	331	54	0	0	0	58	0	107	0

Warrant	AHV
1A - All	898
1B - Minor	165
2A - Major	733
2B - Cross	58

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	All Approaches	480	720	600	900	898
					% Fulfilled	187.1%

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Minor Street Approaches	180	255	180	255	165
					% Fulfilled	91.8%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Major Street Approaches	480	720	600	900	733
					% Fulfilled	152.7%

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Traffic Crossing Major Street	50	75	50	75	58
					% Fulfilled	116.5%

Signal Justification Calculation for Forecasted Volumes
(OTM Book 12 - Justification 7)

Horizon Year: 2021 Total Traffic
Region/City/Township: City of Hamilton

Major Street: North Service Road
Minor Street: Green Road
North/South?: N

Number of Approach Lanes: 1
Tee Intersection? Y
Flow Conditions: Free

PM Forecast Only? N

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	Yes	Justification for existing intersections with forecast traffic

	Major Street North Service Road						Minor Street Green Road						
	Eastbound			Westbound			Northbound			Southbound			
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Peds Crossing Main Road
AM Peak Hour	92	149			888	84				174		358	
PM Peak Hour	326	956			471	196				117		215	
Average Hourly Volume	105	276	0	0	340	70	0	0	0	73	0	143	0

Warrant	AHV
1A - All	1007
1B - Minor	216
2A - Major	791
2B - Cross	73

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	All Approaches	480	720	600	900	1007
					% Fulfilled	209.7%

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Minor Street Approaches	180	255	180	255	216
					% Fulfilled	120.0%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Major Street Approaches	480	720	600	900	791
					% Fulfilled	164.7%

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Traffic Crossing Major Street	50	75	50	75	73
					% Fulfilled	145.5%

Appendix K

Westbound Right-Turn Lane Preliminary Design

Preliminary Right-Turn Lane Design
North Service Road and Green Road

Figure K.1

Appendix L

2025 Remedial Measures Traffic Operations Reports

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	13	19	17	452	59	0	5	18	153	0	62	8
Future Volume (vph)	13	19	17	452	59	0	5	18	153	0	62	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.954						0.883			0.984	
Flt Protected		0.987		0.950				0.999				
Satd. Flow (prot)	0	1743	0	1805	1900	0	0	1569	0	0	1870	0
Flt Permitted		0.987		0.950				0.999				
Satd. Flow (perm)	0	1743	0	1805	1900	0	0	1569	0	0	1870	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1					1	2		3	3		2
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
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%	0%	7%	7%	0%	0%	0%
Adj. Flow (vph)	14	21	18	491	64	0	5	20	166	0	67	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	53	0	491	64	0	0	191	0	0	76	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.6			3.6			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	53.6%	ICU Level of Service A	
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	13	19	17	452	59	0	5	18	153	0	62	8
Future Volume (Veh/h)	13	19	17	452	59	0	5	18	153	0	62	8
Sign Control		Stop			Stop			Free			Free	
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)	14	21	18	491	64	0	5	20	166	0	67	9
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								185				
pX, platoon unblocked												
vC, conflicting volume	220	272	74	216	194	107	78			189		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	220	272	74	216	194	107	78			189		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	97	98	31	91	100	100			100		
cM capacity (veh/h)	664	633	992	707	700	949	1531			1394		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total	53	491	64	191	76
Volume Left	14	491	0	5	0
Volume Right	18	0	0	166	9
cSH	732	707	700	1531	1394
Volume to Capacity	0.07	0.69	0.09	0.00	0.00
Queue Length 95th (m)	1.9	45.1	2.4	0.1	0.0
Control Delay (s)	10.3	20.8	10.7	0.2	0.0
Lane LOS	B	C	B	A	
Approach Delay (s)	10.3	19.7		0.2	0.0
Approach LOS	B	C			

Intersection Summary				
Average Delay	13.1			
Intersection Capacity Utilization	53.6%	ICU Level of Service		A
Analysis Period (min)	15			

Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	92	149	888	84	174	358
Future Volume (vph)	92	149	888	84	174	358
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			60.0	40.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor				0.98		
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	1696	1827	1357	1770	1615
Flt Permitted	0.138				0.950	
Satd. Flow (perm)	245	1696	1827	1326	1770	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				80		149
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	7%	12%	4%	19%	2%	0%
Adj. Flow (vph)	100	162	965	91	189	389
Shared Lane Traffic (%)						
Lane Group Flow (vph)	100	162	965	91	189	389
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	2.0	10.0	10.0	2.0	2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6	2.0	2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			

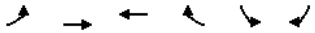
Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2			6		4
Detector Phase	2	2	6	6	4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0	20.0	10.0	10.0
Minimum Split (s)	26.0	26.0	26.0	26.0	24.0	24.0
Total Split (s)	70.0	70.0	70.0	70.0	30.0	30.0
Total Split (%)	70.0%	70.0%	70.0%	70.0%	30.0%	30.0%
Maximum Green (s)	64.0	64.0	64.0	64.0	24.0	24.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	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
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	C-Max	C-Max	C-Max	C-Max	Max	Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
Act Effct Green (s)	64.0	64.0	64.0	64.0	24.0	24.0
Actuated g/C Ratio	0.64	0.64	0.64	0.64	0.24	0.24
v/c Ratio	0.64	0.15	0.83	0.10	0.45	0.78
Control Delay	34.0	7.6	21.5	2.3	36.3	33.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.0	7.6	21.5	2.3	36.3	33.7
LOS	C	A	C	A	D	C
Approach Delay		17.7	19.8		34.6	
Approach LOS		B	B		C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.83			
Intersection Signal Delay: 24.0		Intersection LOS: C	
Intersection Capacity Utilization 88.0%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 2: North Service Road & Green Road

Queues
2: North Service Road & Green Road 06-14-2018

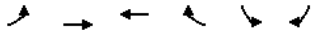


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	100	162	965	91	189	389
v/c Ratio	0.64	0.15	0.83	0.10	0.45	0.78
Control Delay	34.0	7.6	21.5	2.3	36.3	33.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.0	7.6	21.5	2.3	36.3	33.7
Queue Length 50th (m)	11.3	12.0	136.5	0.7	32.9	46.5
Queue Length 95th (m)	#43.0	20.4	204.7	6.2	54.6	#92.7
Internal Link Dist (m)		99.4	802.3		160.8	
Turn Bay Length (m)	120.0			60.0	40.0	
Base Capacity (vph)	156	1085	1169	877	424	500
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.64	0.15	0.83	0.10	0.45	0.78

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	92	149	888	84	174	358
Future Volume (vph)	92	149	888	84	174	358
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	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
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1687	1696	1827	1326	1770	1615
Flt Permitted	0.14	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	245	1696	1827	1326	1770	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	100	162	965	91	189	389
RTOR Reduction (vph)	0	0	0	29	0	113
Lane Group Flow (vph)	100	162	965	62	189	276
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	7%	12%	4%	19%	2%	0%
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	64.0	64.0	64.0	64.0	24.0	24.0
Effective Green, g (s)	64.0	64.0	64.0	64.0	24.0	24.0
Actuated g/C Ratio	0.64	0.64	0.64	0.64	0.24	0.24
Clearance Time (s)	6.0	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
Lane Grp Cap (vph)	156	1085	1169	848	424	387
v/s Ratio Prot		0.10	c0.53		0.11	
v/s Ratio Perm	0.41			0.05		c0.17
v/c Ratio	0.64	0.15	0.83	0.07	0.45	0.71
Uniform Delay, d1	11.0	7.2	13.7	6.8	32.3	34.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	18.5	0.3	6.7	0.2	3.4	10.7
Delay (s)	29.5	7.5	20.4	7.0	35.7	45.5
Level of Service	C	A	C	A	D	D
Approach Delay (s)		15.9	19.3		42.3	
Approach LOS		B	B		D	

Intersection Summary

HCM 2000 Control Delay	25.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lanes, Volumes, Timings
1: Green Road & Frances Avenue 06-14-2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	55	20	278	29	1	17	61	444	3	34	5
Future Volume (vph)	16	55	20	278	29	1	17	61	444	3	34	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.970			0.995			0.885			0.985	
Flt Protected		0.991		0.950				0.998			0.997	
Satd. Flow (prot)	0	1826	0	1752	1890	0	0	1678	0	0	1866	0
Flt Permitted		0.991		0.950				0.998			0.997	
Satd. Flow (perm)	0	1826	0	1752	1890	0	0	1678	0	0	1866	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		165.1			52.2			184.8			166.7	
Travel Time (s)		11.9			3.8			13.3			12.0	
Confl. Peds. (#/hr)	1		1	1		1	2		1	1		2
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
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	17	60	22	302	32	1	18	66	483	3	37	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	99	0	302	33	0	0	567	0	0	45	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.6			3.6			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 64.4%		ICU Level of Service C	
Analysis Period (min) 15			

HCM Unsignalized Intersection Capacity Analysis
1: Green Road & Frances Avenue 06-14-2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	55	20	278	29	1	17	61	444	3	34	5
Future Volume (Veh/h)	16	55	20	278	29	1	17	61	444	3	34	5
Sign Control		Stop			Stop			Free			Free	
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)	17	60	22	302	32	1	18	66	483	3	37	5
Pedestrians		2			1			1			1	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								185				
pX, platoon unblocked												
vC, conflicting volume	409	634	42	443	394	310	44			550		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	409	634	42	443	394	310	44			550		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	85	98	32	94	100	99			100		
cM capacity (veh/h)	522	393	1031	446	536	734	1575			1029		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total	99	302	33	567	45
Volume Left	17	302	0	18	3
Volume Right	22	0	1	483	5
cSH	479	446	541	1575	1029
Volume to Capacity	0.21	0.68	0.06	0.01	0.00
Queue Length 95th (m)	6.2	39.6	1.6	0.3	0.1
Control Delay (s)	14.5	28.4	12.1	0.4	0.6
Lane LOS	B	D	B	A	A
Approach Delay (s)	14.5	26.8		0.4	0.6
Approach LOS	B	D			

Intersection Summary				
Average Delay	10.2			
Intersection Capacity Utilization	64.4%	ICU Level of Service		C
Analysis Period (min)	15			

Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018

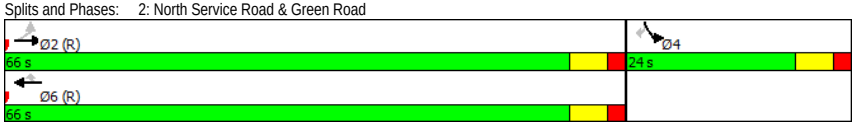
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	326	956	471	196	117	215
Future Volume (vph)	326	956	471	196	117	215
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			60.0	40.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1776	1583	1770	1615
Flt Permitted	0.428				0.950	
Satd. Flow (perm)	813	1881	1776	1583	1770	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				213		234
Link Speed (k/h)		80	80		50	
Link Distance (m)		123.4	826.3		184.8	
Travel Time (s)		5.6	37.2		13.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	7%	2%	2%	0%
Adj. Flow (vph)	354	1039	512	213	127	234
Shared Lane Traffic (%)						
Lane Group Flow (vph)	354	1039	512	213	127	234
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	2.0	10.0	10.0	2.0	2.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	0.6	2.0	2.0	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4	9.4			
Detector 2 Size(m)		0.6	0.6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		2	6		4	

Lanes, Volumes, Timings
2: North Service Road & Green Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	2			6		4
Detector Phase	2	2	6	6	4	4
Switch Phase						
Minimum Initial (s)	20.0	20.0	20.0	20.0	10.0	10.0
Minimum Split (s)	26.0	26.0	26.0	26.0	24.0	24.0
Total Split (s)	66.0	66.0	66.0	66.0	24.0	24.0
Total Split (%)	73.3%	73.3%	73.3%	73.3%	26.7%	26.7%
Maximum Green (s)	60.0	60.0	60.0	60.0	18.0	18.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	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
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	C-Max	C-Max	C-Max	C-Max	Max	Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
Act Effct Green (s)	60.0	60.0	60.0	60.0	18.0	18.0
Actuated g/C Ratio	0.67	0.67	0.67	0.67	0.20	0.20
v/c Ratio	0.65	0.83	0.43	0.19	0.36	0.46
Control Delay	16.0	18.7	8.4	1.2	34.4	7.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	18.7	8.4	1.2	34.4	7.6
LOS	B	B	A	A	C	A
Approach Delay		18.0	6.3		17.1	
Approach LOS		B	A		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.83			
Intersection Signal Delay: 14.4		Intersection LOS: B	
Intersection Capacity Utilization 68.6%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 2: North Service Road & Green Road



Queues
2: North Service Road & Green Road 06-14-2018

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	354	1039	512	213	127	234
v/c Ratio	0.65	0.83	0.43	0.19	0.36	0.46
Control Delay	16.0	18.7	8.4	1.2	34.4	7.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	18.7	8.4	1.2	34.4	7.6
Queue Length 50th (m)	33.6	124.1	38.4	0.0	20.1	0.0
Queue Length 95th (m)	67.6	193.1	57.7	6.7	36.9	19.0
Internal Link Dist (m)		99.4	802.3		160.8	
Turn Bay Length (m)	120.0			60.0	40.0	
Base Capacity (vph)	542	1254	1184	1126	354	510
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.83	0.43	0.19	0.36	0.46

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: North Service Road & Green Road 06-14-2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	326	956	471	196	117	215
Future Volume (vph)	326	956	471	196	117	215
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	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
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1881	1776	1583	1770	1615
Flt Permitted	0.43	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	813	1881	1776	1583	1770	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	354	1039	512	213	127	234
RTOR Reduction (vph)	0	0	0	71	0	187
Lane Group Flow (vph)	354	1039	512	142	127	47
Heavy Vehicles (%)	0%	1%	7%	2%	2%	0%
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	60.0	60.0	60.0	60.0	18.0	18.0
Effective Green, g (s)	60.0	60.0	60.0	60.0	18.0	18.0
Actuated g/C Ratio	0.67	0.67	0.67	0.67	0.20	0.20
Clearance Time (s)	6.0	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
Lane Grp Cap (vph)	542	1254	1184	1055	354	323
v/s Ratio Prot		c0.55	0.29		c0.07	
v/s Ratio Perm	0.44			0.09		0.03
v/c Ratio	0.65	0.83	0.43	0.13	0.36	0.14
Uniform Delay, d1	8.9	11.2	7.0	5.5	31.0	29.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.0	6.4	1.2	0.3	2.8	0.9
Delay (s)	14.9	17.6	8.2	5.8	33.8	30.6
Level of Service	B	B	A	A	C	C
Approach Delay (s)		16.9	7.5		31.7	
Approach LOS		B	A		C	

Intersection Summary				
HCM 2000 Control Delay	16.3	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.72			
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	68.6%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

Appendix M

Proxy Site Survey Parking Data

Period	Time	Parking Demand					Utilization Rate					Parking Rate/Unit				
		Day 1	Day 2	Day 3	Day 4	Average	Day 1	Day 2	Day 3	Day 4	Average	Day 1	Day 2	Day 3	Day 4	Average
AM	6:30	222	255	280	280	259	51%	59%	65%	65%	60%	0.99	1.14	1.25	1.25	1.16
	7:00	205	241	265	261	243	47%	56%	61%	60%	56%	0.92	1.08	1.18	1.17	1.08
	7:30	169	225	253	243	223	39%	52%	59%	56%	52%	0.75	1.00	1.13	1.08	1.00
	8:00	146	207	217	226	199	34%	48%	50%	52%	46%	0.65	0.92	0.97	1.01	0.89
	8:30	121	173	175	224	173	28%	40%	41%	52%	40%	0.54	0.77	0.78	1.00	0.77
	9:00	103	145	152	214	154	24%	34%	35%	50%	36%	0.46	0.65	0.68	0.96	0.69
	9:30	93	131	129	202	139	22%	30%	30%	47%	32%	0.42	0.58	0.58	0.90	0.62
	10:00	84	127	123	197	133	19%	29%	28%	46%	31%	0.38	0.57	0.55	0.88	0.59
PM	15:00	62	94	118	170	111	14%	22%	27%	39%	26%	0.28	0.42	0.53	0.76	0.50
	15:30	67	89	112	173	110	16%	21%	26%	40%	25%	0.30	0.40	0.50	0.77	0.49
	16:00	74	88	118	164	111	17%	20%	27%	38%	26%	0.33	0.39	0.53	0.73	0.50
	16:30	86	108	125	171	123	20%	25%	29%	40%	28%	0.38	0.48	0.56	0.76	0.55
	17:00	96	118	146	188	137	22%	27%	34%	44%	32%	0.43	0.53	0.65	0.84	0.61
	17:30	109	133	155	191	147	25%	31%	36%	44%	34%	0.49	0.59	0.69	0.85	0.66
	18:00	117	143	155	206	155	27%	33%	36%	48%	36%	0.52	0.64	0.69	0.92	0.69
	18:30	127	159	161	206	163	29%	37%	37%	48%	38%	0.57	0.71	0.72	0.92	0.73
	19:00	146	173	189	214	181	34%	40%	44%	50%	42%	0.65	0.77	0.84	0.96	0.81
	19:30	155	177	192	214	185	36%	41%	44%	50%	43%	0.69	0.79	0.86	0.96	0.83
	20:00	174	153	205	209	185	40%	35%	47%	48%	43%	0.78	0.68	0.92	0.93	0.83
															AM Peak Demand per Unit	1.25
															AM Average Demand per Unit	1.16
															PM Peak Demand per Unit	0.96
															PM Average Demand per Unit	0.83

REPORT

WATERFRONT TRAILS 3

STONEY CREEK, ONTARIO

PEDESTRIAN WIND ASSESSMENT

PROJECT #: 1802941

JUNE 7, 2018

SUBMITTED TO

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1. INTRODUCTION

RWDI was retained by New Horizons Development Group (NHDG) to assess the pedestrian wind conditions around the proposed Waterfront Trails 3 development in Stoney Creek, Ontario. This qualitative assessment is based on the following:

- a review of the regional long-term meteorological data from Hamilton International Airport;
- design drawings and documents received from NHDG on May 17, 2018;
- wind-tunnel studies undertaken by RWDI for similar projects in Toronto and Hamilton;
- our engineering judgment, experience and expert knowledge of wind flows around buildings[1-3]; and,
- use of software developed by RWDI (Windestimator[2]) for estimating the potential wind conditions around generalized building forms.

This qualitative approach provides a screening-level estimation of potential wind conditions. Conceptual wind control measures to improve wind comfort are recommended, where necessary. In order to quantify these conditions or refine any conceptual mitigation measures, physical scale-model tests in a boundary-layer wind tunnel would be required.

Note that other wind issues, such as those related to cladding and structural wind loads, snow, etc., are not considered in the scope of this assessment.

Image 1 – Rendering of the Proposed Project

1. C.J. Williams, H. Wu, W.F. Waechter and H.A. Baker (1999), "Experience with Remedial Solutions to Control Pedestrian Wind Problems", 10th International Conference on Wind Engineering, Copenhagen, Denmark.
2. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", ASCE Structure Congress 2004, Nashville, Tennessee.
3. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", Journal of Wind Engineering and Industrial Aerodynamics, vol.104-106, pp.397-407.

2. SITE & BUILDING INFORMATION

The site of the proposed development is located north of the Queen Elizabeth Way, east of Green Road and south of Frances Avenue in Stoney Creek, Ontario. The proposed development consists of three towers approximately 185 m in height, with a large four-storey podium at the base (Image 1). Currently the site is undeveloped (Image 2). The surrounding environment can be described as :

1) Suburban low-rise developments to the east-southeast, clockwise through northwest; and,

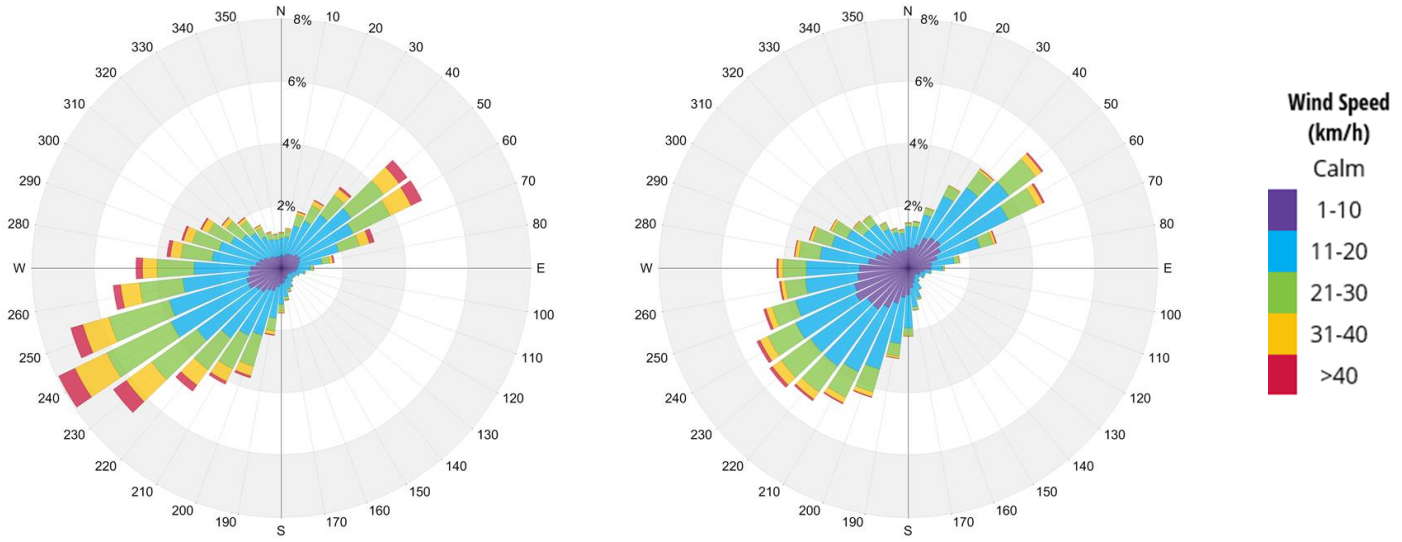
2) Open water (Lake Ontario) to the north-northwest, clockwise through east.

In the immediate surrounding environment, a group of three broad buildings, approximately 15 storeys in height, exists directly to the north, between the proposed development and Lake Ontario.

Image 2 – Aerial View of the Site and Surroundings (Credit: Google™ Earth)

3. METEOROLOGICAL DATA

Wind statistics recorded at Hamilton International Airport between 1988 and 2017 were used as a reference for ambient wind conditions for the Summer (May through October) and Winter (November through April) seasons. Image 3 graphically depicts the directional distributions of wind frequencies and speeds for the two seasons. Winds from northeast and southwest quadrants are predominant in both summer and winter. Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10 m) occur more often in the winter than in the summer.



Winter – November through April

Summer – May through October

Image 3 – Directional Distribution of Winds Approaching Hamilton International Airport (1988 – 2017)

4. PEDESTRIAN WIND CRITERIA

The RWDI pedestrian wind criteria are used in the current study. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities as well as by the building design and city planning community. The criteria are as follows:

Pedestrian Safety

Pedestrian safety is associated with excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (**90 km/h**) occur more than 0.1% of the time, or 9 hours per year, the wind conditions are considered severe.

Pedestrian Comfort

Wind comfort can be categorized by typical pedestrian activities:

Sitting (≤ 10 km/h): Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.
Standing (≤ 14 km/h): Gentle breezes suitable for main building entrances and bus stops.
Strolling (≤ 17 km/h): Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.
Walking (≤ 20 km/h): Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable: None of the comfort categories are met

Wind conditions are considered suitable for sitting, standing, strolling or walking if the associate mean wind speeds are expected for at least four out of five days (80% of the time. Wind control measures are typically required at locations where winds are rated as uncomfortable or they exceed the wind safety criterion.

Note that these wind speeds are assessed at the pedestrian height (i.e., 1.5 m above grade or the concerned floor level), typically lower than those recorded in the airport (10 m height and open terrain).

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

For the current development, wind speeds comfortable for walking or strolling are appropriate for parking lots and the surrounding sidewalks. Lower wind speeds comfortable for sitting or standing are preferred for building entrances where pedestrians may linger. For amenity spaces, wind conditions which are comfortable for sitting are generally desired. However, the use of outdoor amenity spaces is more frequent in the summer in Ontario. Increased wind speeds may be acceptable in the winter.

5. PEDESTRIAN WIND CONDITIONS

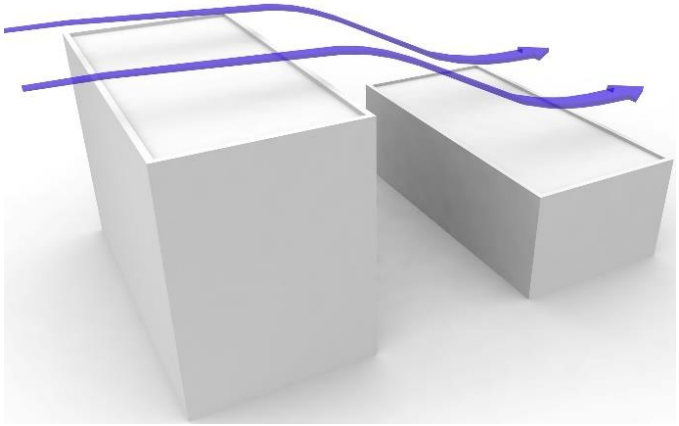
5.1 Background

Predicting wind speeds and frequencies of occurrence is complicated. It involves the assessment of building geometry, orientation, position and height of surrounding buildings, upwind terrain and the local wind climate. Over the years, RWDI has conducted thousands of wind tunnel model studies on pedestrian wind conditions around buildings, yielding a broad knowledge base. This knowledge has been incorporated into RWDI's proprietary software that allows, in many situations, for a screening-level qualitative estimation of pedestrian wind conditions without wind tunnel testing.

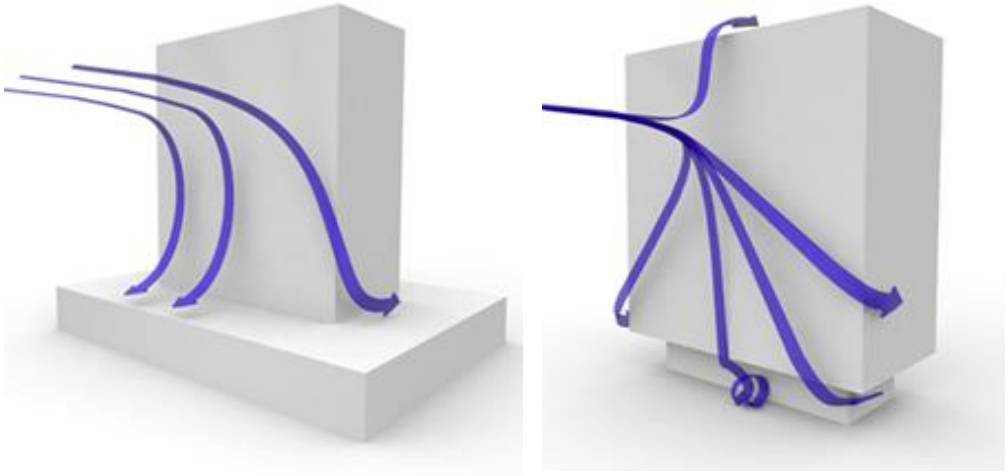
Wind generally tends to flow over arrays of buildings of even height and thereby typically do not result in severe impacts at grade level in these scenarios (Image 4a). Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level (Image 4b). Such a Downwashing Flow is often the main cause for wind accelerations around large buildings at the pedestrian level. When winds approach at an oblique angle to a tall façade and are deflected down, a localized increase in the wind activity or Corner Acceleration can be expected around the exposed building corner at pedestrian level (Image 4b).

When two buildings are situated side by side, wind flow tends to accelerate through the space between the buildings due to a channelling effect caused by the narrow gap (Image 4c). If these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and uncomfortable conditions.

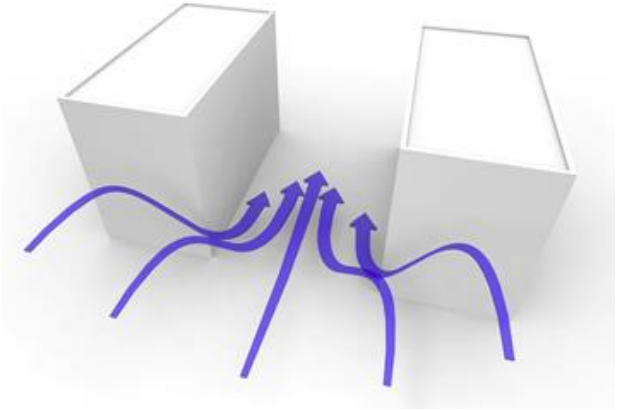
Large podiums and tower setbacks capture the downwashed flows and help reduce wind impact at grade (Image 4b). However, increased wind activity would then be created on the lower windward roofs or terraces where low wind speeds are typically desired for amenity use. A typical wind speed reduction strategy is to include landscaping in amenity areas and in the area between buildings (Image 4c). Dense trees and other landscaping helps diffuse strong wind flows and reduces wind impacts in areas under and immediately around them.

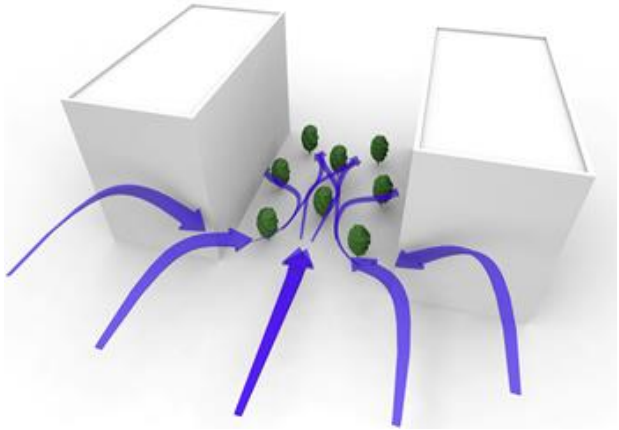


a) Wind flow over low-rise buildings



b) Downwashing Wind Flow Around Buildings with Podiums (Left) and Undercuts (Right)





c) Channelling Wind Flow Between Buildings without (Top) and with (Bottom) Landscaping

Image 4 – General Wind Flow Phenomena Around Buildings

5.2 Existing Site

Wind conditions on and around the existing open site (Image 5) are expected to be comfortable for sitting or standing during the summer. During the winter, due to the seasonally stronger winds, wind speeds are expected to be higher and comfortable for strolling.

Wind conditions at all areas are expected to meet the criterion used to assess pedestrian safety.

Image 5 – Existing Site

5.3 Proposed Site

5.3.1 Anticipated Wind Flow Patterns

The proposed project is significantly taller than all existing surrounding buildings, and will therefore be exposed to the prevailing winds. In that respect, the proposed orientation of the towers is positive. The towers are oriented so that tower corners face prevailing winds, and the flat façades are on an oblique angle to prevailing winds. This orientation provides the least resistance to winds for the given tower geometry, and will therefore result in the least impact on winds at the pedestrians level.

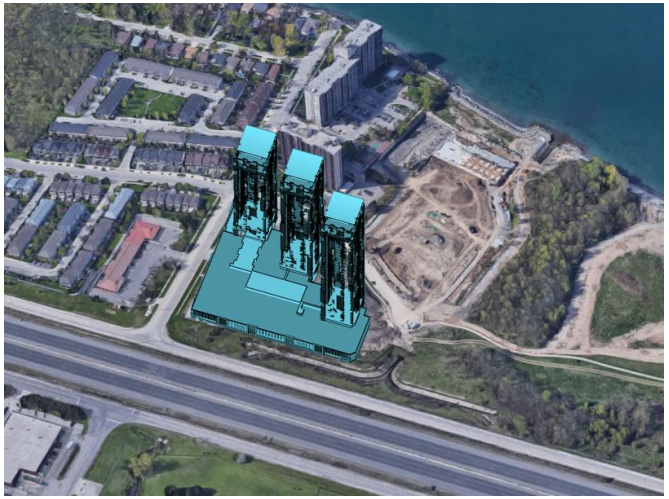


Image 6 – Proposed Site

However, since the proposed development is a set of three towers oriented approximately in a line perpendicular to the prevailing winds, and the three towers are taller than the surroundings (Image 6), it is expected that the towers will intercept stronger winds at higher elevations, resulting in downwashing and channelling flows (Image 4a).

The magnitude of the increase in wind speeds at the base of the towers, relative to the Existing site conditions, depends on multiple factors. The presence of the large four-storey podium at the base of the towers is positive in that it will tend to disperse accelerated wind flows around the base of the towers. Schematics of the predicted wind flow around the tower bases for the most common wind directions are shown in Image 7.

The presence of narrow spaces between buildings will also result in channelling accelerations, as shown in Image 4b and in Image 7. The raised building massing shown in white in Image 7 (top left and top right) are approximately 3.5 m in height and will provide shelter to the areas immediately to the north and east.

Overall, owing to the height of the towers and the gaps between them, downwashing and channelling flows are expected. The large podium is expected to substantially limit the flow of these redirected winds on to Green Road and Queen Elizabeth Way. A schematic of predicted relative wind speeds at the base of the three towers can be seen in Image 8. The following sections discuss these wind conditions in detail.

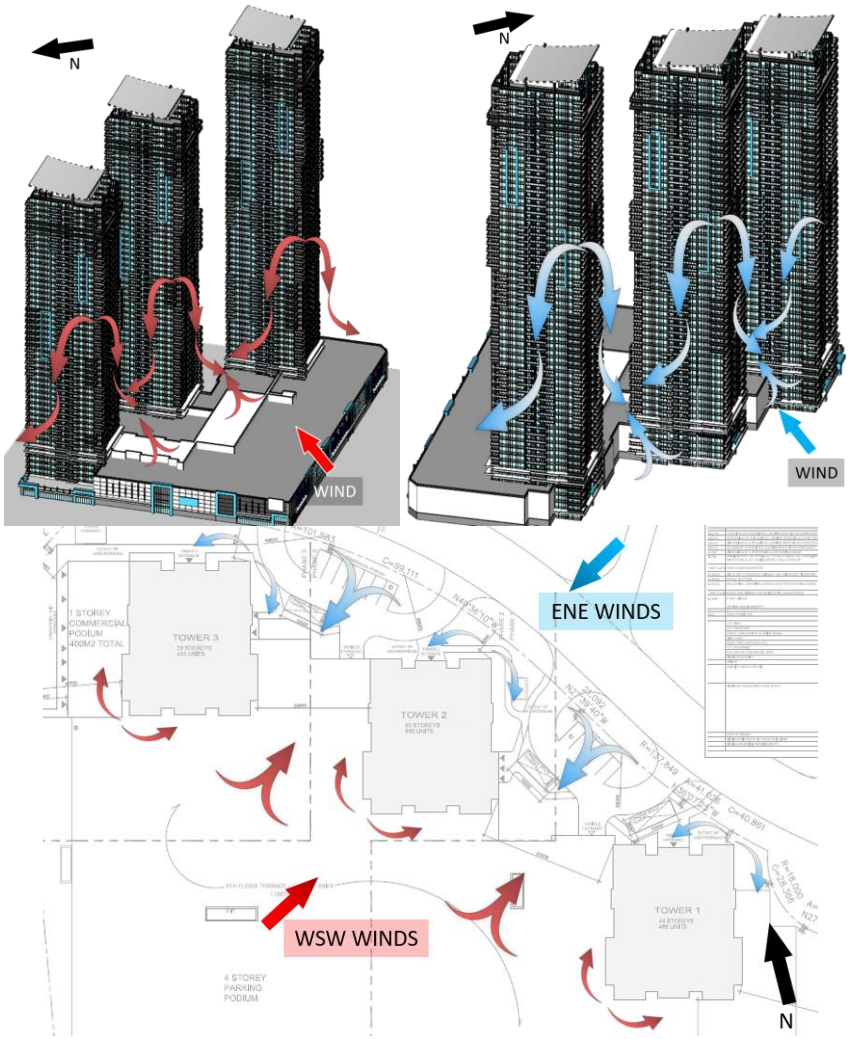


Image 7 – Schematic of Wind Flow Patterns at the Bases of the Towers Due to Winds from the West-Southwest (Top Left), East-Northeast (Right) and Overall (Bottom)

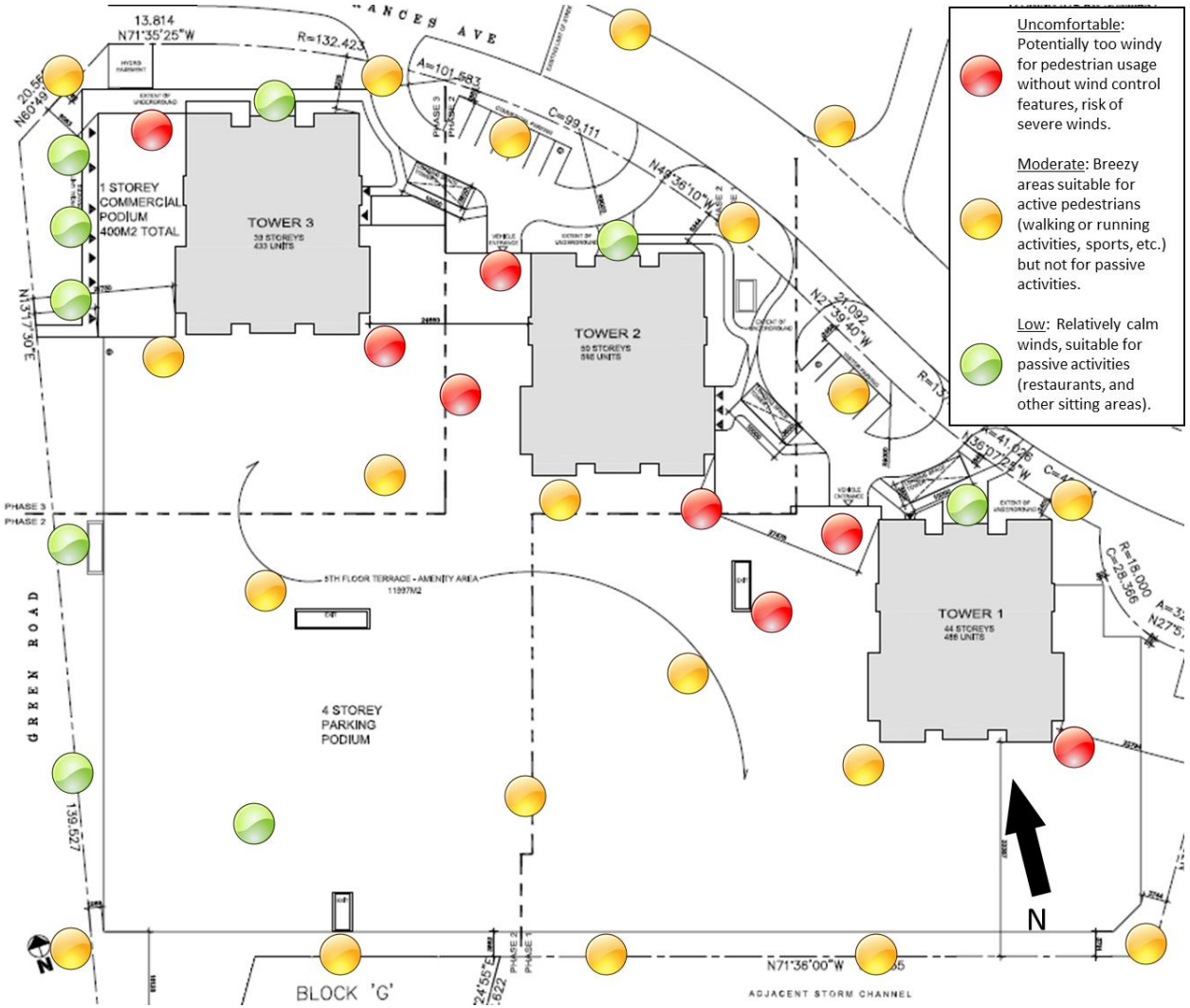


Image 8 – Predicted Relative Winter Wind Speeds at the Base of the Three Towers (Worst Case Condition)

5.3.2 Entrances and Sidewalks

The main entrances to each of the three towers (Image 9, red triangles), located at the center of the north side of each tower. They are both well recessed into the footprint of the towers, and covered by a deep overhead canopy (Image 10). These are positive design features from a wind perspective, in that they shelter the entrances from both direct ambient wind exposure, and downwashing impacts of the prevailing strong winds. It is expected that wind speeds at the tower entrances will be comfortable for standing or better throughout the year, which is appropriate for a main entrance. The commercial entrances (Image 9, blue triangles) are also expected to be subject to wind speeds which are comfortable for standing throughout the year. This is because the commercial entrances are not located in an area of accelerated flow, such as between towers or near tower corners. Conversely, the four-storey podium protects the entrances from downwashing flows and corner accelerations typical of the base of the towers.

The towers are expected to cause minor increases in wind activity in the surrounding areas. The presence of the four storey podium is a significant positive design feature which will disperse winds and avoid strong localized wind accelerations (Image 4b). Wind conditions comfortable for walking or strolling are anticipated at the sidewalks along Frances Avenue and Green Road, which is considered appropriate.

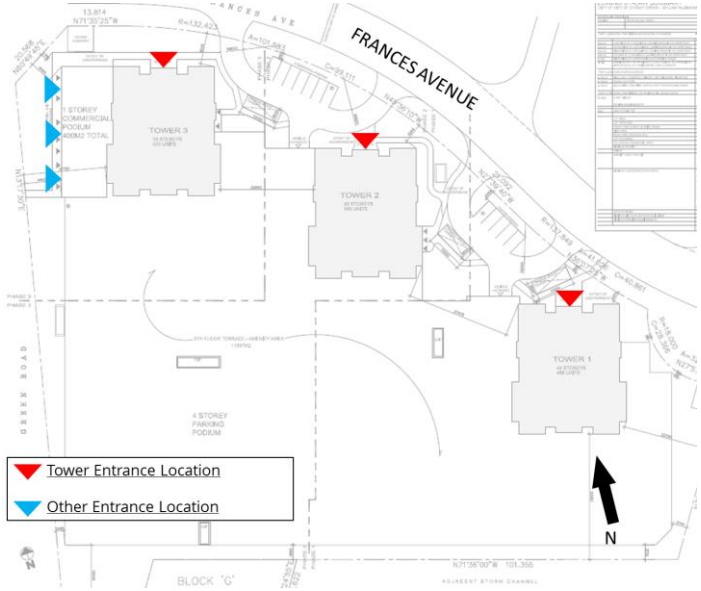


Image 9 – Location of Key Entrances

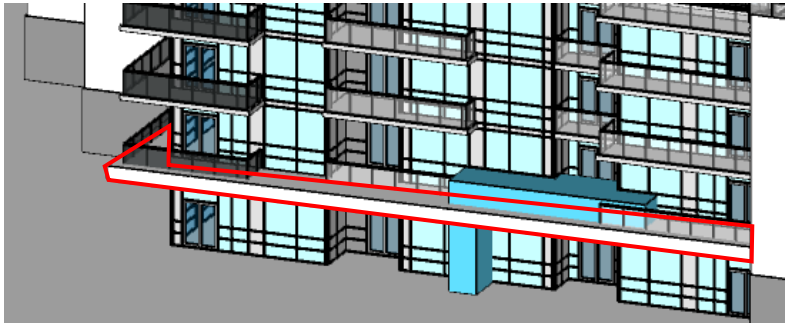


Image 10 – Recessed Entrances and Overhead Canopies

5.3.3 Podium Amenity

As discussed in Section 5.3.1, large podiums capture downwashing flows and this tends to make podium roofs windy for amenity use. It is expected that the wind safety criterion may be exceeded at the northwest and southeast corners of the proposed towers at the podium level as a result of winds channeling and accelerating around the tower corners. Wind speeds at the southwest podium corner, further away from the towers, are expected to be lower. A wind tunnel assessment would allow quantification of the frequency of strong winds at podium locations.

Pedestrian wind conditions on the podium could be improved through the addition of wind screen features and overhead wind control features around sitting areas of the podium amenity space (See Section 6). Strategic placement of landscaping is also an effective means of reducing wind speeds, particularly in the summer when the area will be used frequently.

5.3.4 Rooftop Amenity Spaces

The curved canopy features above the rooftop amenity spaces are well oriented and are positive from a wind perspective, in that they are expected to provide shelter from west-southwesterly winds (Image 11). A portion of the winds from the west-southwest may be drawn underneath the canopy (Image 11, right), but the net effect of the canopy will be to reduce wind speeds on the rooftop. The more open northeast-facing side of the canopy will trap wind flows and force winds down to the rooftop areas (Image 11, left).

If improved wind comfort conditions are desired on the rooftop amenity spaces, strategic placement of a combination of horizontal and vertical wind control features could be placed around the north and east sides of the amenity space. These features could be in the form of dense landscaping or porous wind screen / parapet features. Screens or landscaping used to reduce direct exposure to ambient winds would need to be at least 2.5 m in height in order to be effective. See Section 6.

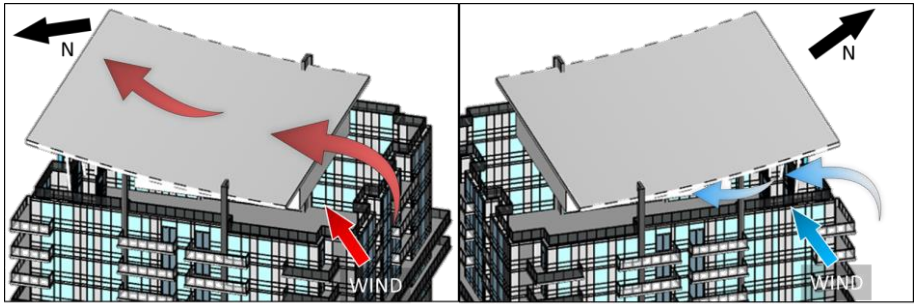


Image 11 – Anticipated Wind Flow Patterns at the Rooftop Amenity Due to Winds from the West-Southwest (Left) and East-Northeast (Right)

6. RECOMMENDATIONS

Wind control features are recommended on the podium amenity space and at the rooftop amenity spaces. Winds are predominantly from the west-southwesterly directions, and secondarily from the east-northeasterly directions. The canopies at the tower rooftops are positive in that they will protect rooftop amenity spaces from west-southwesterly winds.

The rooftop and podium will be exposed to winds from the east-northeasterly directions, and the podium will also be exposed to west-southwesterly winds. Canopies located as low as possible around the tower at the southeast and northwest building corners would be beneficial in terms of wind comfort and safety. Canopies extending from the tower walls should be at least 2.5 m in depth in order to have an appreciable benefit. Additional canopies and/or trellises are recommended over any designated seating or gathering area. Alternatively, trees with large canopies may also be considered for overhead protection.

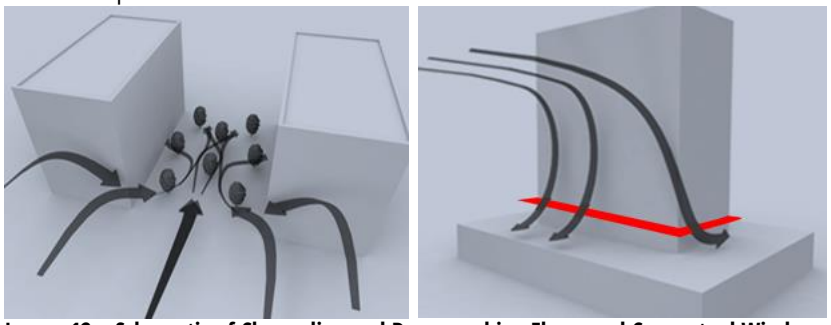


Image 12 – Schematic of Channeling and Downwashing Flows and Conceptual Wind Control Including Landscaping (Left) and Overhead Canopies (Right)

Vertical wind control features would also be beneficial to disrupt the flow of winds on the podium. These could be in the form of porous wind screens or dense landscaping. Vertical features should be at least 2.5 m in height to be effective. Locations where wind control features or increased parapet heights would be beneficial are shown conceptually in Image 13. Examples of these features are shown in Image 14. Wind tunnel testing is required to quantify the impact of these features.

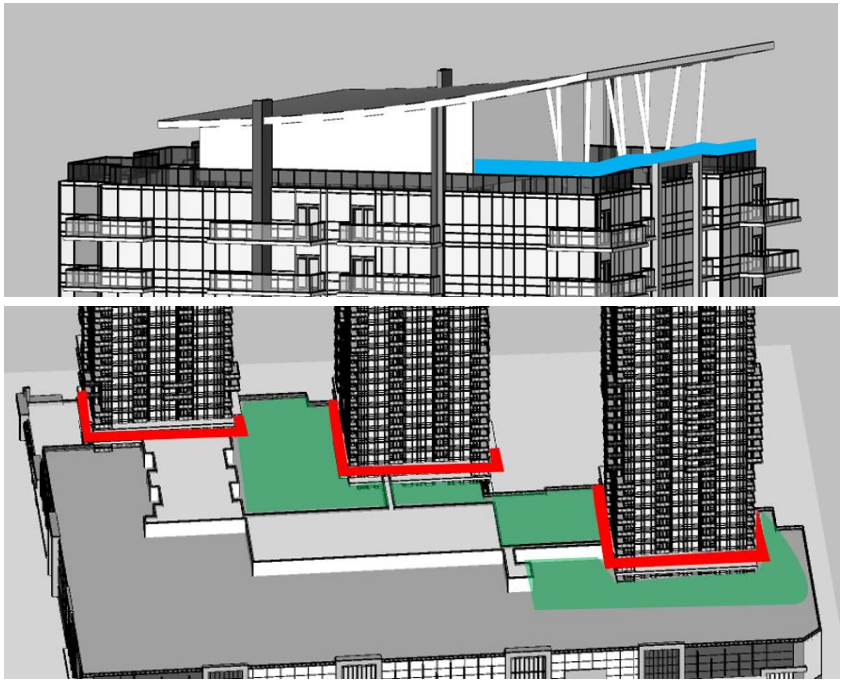
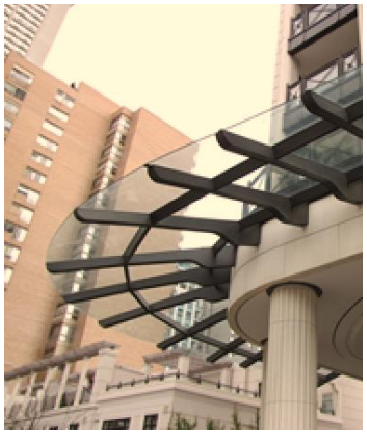
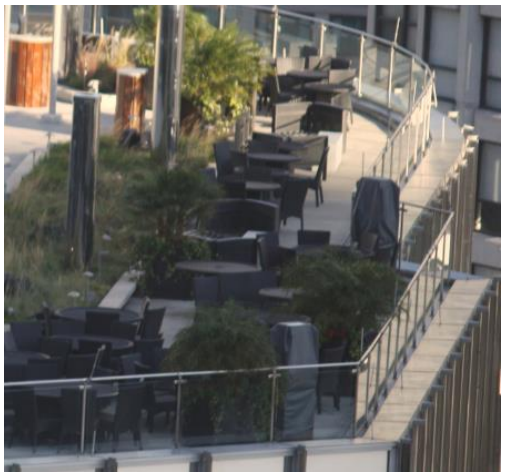


Image 13 –Recommended Wind Control Features Include Overhead Canopies (Red), Wind Screens or Parapets (Blue) and/or Landscaped Areas (Green)




a) Wraparound Overhead Canopies – The strong winds expected to accelerate around the tower corners could be dispersed by wraparound overhead canopies.


b) Dense Landscaping Canopies – The strong winds expected to accelerate around the tower corners could be dispersed by wraparound overhead canopies.

b) Vertical Wind Screens – Strong horizontal wind flows can be reduced by providing vertical features which provide wind resistance

Image 14 - Recommended Wind Control Features Include Overhead Canopies (Top Left), Dense Landscaping (Bottom Left) and Vertical Wind Screens (Right)

7. SUMMARY

The proposed development is located on a site that is currently open and undeveloped. The proposed buildings are significantly taller than the existing surroundings. Therefore, the addition of the proposed development would increase wind speeds at grade level around the development relative to existing conditions.

The design of the development includes several features that are positive from a wind perspective. These include the orientation of the towers with their corners facing into the prevailing winds, large podium that will dissipate downwashing flows, recessed main entrances and deeps canopies above them. These features aid in providing critical areas of shelter from strong winds, and are recommended to be retained in the final design.

Wind speeds at the building entrances are expected to be comfortable for standing, and wind speeds at surrounding sidewalk locations are expected to be comfortable for strolling or walking throughout the year. These wind conditions are considered appropriate.

Wind speeds at the podium amenity spaces and rooftop amenity spaces are expected to be stronger than desired. Exceedances of the wind safety criterion may potentially occur at the southeast and northwest corners of each of the towers at the podium level. Conceptual wind control strategies have been discussed and can be refined as the design develops.

The wind conditions discussed herein should be quantified through wind tunnel testing. This would provide verification of areas where wind control features are required and would allow wind control features to be developed .

8. APPLICABILITY OF RESULTS

The assessment discussed in this report is based on the drawings of the proposed development received as of May 17, 2018. In the event of any significant changes to the design, construction or operation of the building or addition of surroundings in the future, RWDI could provide an assessment of their impact on the pedestrian wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.

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SHADOW IMPACT ANALYSIS

PROPOSED DEVELOPMENT
48,54&59 Storey Condominium Project
311 FRANCES AVENUE
Stoney Creek, Ontario

KNYMH FILE # 17305

Prepared by:
Marc Begin
KNYMH INC.

December 19, 2018

SHADOW IMPACT ANALYSIS

KNYMH FILE # 17305

PROPOSED DEVELOPMENT

48,55&59 Storey Condominiums
311 Frances Avenue
Stoney Creek, Ontario

Prepared by:
KNYMH INC.
Marc Begin

December 19, 2018

TABLE OF CONTENTS:

Prepared by:
KNYMH INC.
Marc Begin

SHADOW IMPACT ANALYSIS

December 19, 2018

PROPOSED DEVELOPMENT

311 Frances Avenue
Stoney Creek, Ontario

1.0 PURPOSE:

The purpose of this report is to analyse the impact of a proposed development upon the adjacent properties, streets, and public spaces at the above noted location. We will discuss and comment upon the impact of the massing of the proposed development upon the adjacent properties using a computer generated model for analysis of the proposed 48,54,59 storey buildings with a 4 storey flat roof parking podium and a rooftop mechanical room which includes the rooftop building service equipment and a decorative sloped roof.

We have provided shadow graphics along with Satellite imagery of the surrounding area.

The property is located in Stoney Creek Ontario, on the North side of the North Service Road, East of Green Road.

2.0 DESCRIPTION OF THE SITE AND NEIGHBOURING PROPERTIES:

The Subject Property: (See Diagram in Section 8.0)

The Subject property is zoned MUC-4

Neighbouring properties include:

2.1) TO THE WEST: The property abuts Green Road. Across Green road is a 1 Storey commercial building zoned GC-35 and further West are 2 storey townhouse units zoned RM3-10.

2.2) TO THE NORTH: The property abuts Frances Avenue. To the North is an existing high rise development zoned RM5 and a recently developed 2 Storey Townhouse site zoned RM3-40 and 3 Storey Units zoned R6-5. Further North is a 4 storey mid rise apartment zoned RM3-40. To the North West across the Green Road France Avenue Intersection, are 2 storey townhouse units zoned RM2.

2.3) TO THE SOUTH: The property abuts the North Service Road and the QEW.

2.4) TO THE EAST: The property abuts a storm channel and conservations lands zoned P1 and P5. Further east are two 6 storey mid rise buildings under construction zoned RM3-55 and recently constructed 2 storey townhouse units zoned RM3-52

3.0 METHOD OF ANALYSIS:

The method of analysis will be a discussion of the impact the development of the 48,54,59 storey residential buildings, fronting Green Road and Frances Avenue, has on the adjacent properties and the public realm. The summary is within Section 6.0.

The graphic analysis which we present within this report is developed using a computer generated modelling program in conjunction with satellite imagery and survey information.

Geographic Coordinates: Latitude 43.23 North, Longitude 79.72 West
Standard Time: UTC -5:00
Daylight Savings Time: UTC -4:00
Test Dates: March 21, June 21, and December 21
Test Times: 1000am, 1200pm, 200pm and 400pm

The diagrams enclosed illustrate shadow patterns for 4 times of day on 3 specific days of the year, which reflect the solstice through the 4 seasons of the year. Generally speaking the analysis of the shadow diagrams identifies the typical shadows, which are cast in a Spring / Fall, Summer and Winter periods.

The following analysis of the shadow plans will discuss the shadow pattern for each of the dates and times and will identify characteristics of those shadows and the anticipated impact upon the immediate site and neighbouring sites with specific concern for amenity spaces and predominantly pedestrian utilized areas which may be impacted by the proposed development.

4.0 SHADOW IMPACT ANALYSIS OF THE PROPOSED DEVELOPMENT

4.1 WINTER SHADOWS: (DECEMBER 21 • Diagrams 7.12.21.1000 through 7.12.21.1600)

The next section provides a summary of the Winter shadow effect of the subject property upon the surrounding area. This commentary will discuss the impact of the 48,54,59 - storey residential apartment building's shadows upon properties at the north, east and west side of the subject property.

It should be noted that Winter Shadows are the "longest" in terms of the shadow length due to a very low sun angle, but shadows are present for the shortest period of time (hours in the day) due to very short days this time of year. The times for this period are under Eastern Standard Time (UTC -5:00).

4.1A 10:00am (Diagram 7.12.21.1000)

The morning sun in winter rotates approximately 116-degrees from east to west in approximately 9-hours at this time of year. At this time the sun has an altitude angle of 16.26 degrees.

- The shadow falls across the Green Road and the adjacent townhouse properties to the Northwest and extending Northwest to the single family properties across Church St

4.1B 12:00pm (Diagram 7.12.21.1200)

The noontime sun in winter is still relatively low (23.21-degrees) in the sky and is located directly south of the subject property.

- The shadow by this time of day falls across Frances Ave and onto the apartment buildings to the North as well as the front yards of some of the townhouses across Green Road and extending Northwest to the single family properties across Church St.

4.1C 2:00pm (Diagram 7.12.21.1400)

The afternoon sun in winter is starting to descend and is 19.25 degrees above the horizon.

- The shadow by this time of day falls across Frances Ave and onto the apartment buildings to the North as well as the townhouses and Mid Rise across Frances Avenue. The shadow is extending well into Lake Ontario

4.1D 4:00pm (Diagram 7.12.21.1600)

The late afternoon sun in winter is descending and is very low at 5.97 degrees above the horizon.

- The shadow by this time of day falls across Frances Ave onto the apartment buildings to the North as well as the townhouses and Mid Rise across Frances Avenue. The shadow is extending well into Lake Ontario.

4.2 SPRING & FALL EQUINOX SHADOWS:
(MARCH 21 • Diagrams 7.03.21.1000 through 7.03.21.1600)

A summary of the Spring and Fall shadow effect on the subject property and surrounding area is following. It should be noted that the Fall and Spring are the "moderate" in terms of the annual shadows. The times for this period are under Eastern Daylight Time.

4.2A 10:00am (Diagram 7.03.21.1000)

The morning sun in spring / fall rotates approximately 183-degrees from east to west in 12-hours. It is low in the sky rising to approximately 27.23-degrees at this time of day.

- The shadow falls across Green Road and the adjacent commercial and townhouse properties to the West.

4.2B 12:00pm (Diagram 7.03.21.1200)

The noontime sun in spring / fall is higher (approximately 43.03-degrees) in the sky and originates from near-south.

- The shadow falls across the Green Road Frances Avenue intersection and onto the adjacent townhouse properties to the Northwest and apartment buildings to the North.

4.3C 2:00pm (Diagram 7.03.21.200)

The afternoon sun in spring / fall is near its peak. It is approximately 46.52-degrees above the horizon and the shadows are still short at this time of day.

- The shadow falls across Frances Avenue and the adjacent apartment and townhouse properties to the North, stopping short of the mid rise building.

4.4D 4:00pm (Diagram 7.03.21.400)

The late afternoon sun in spring / fall is descending. It is approximately 35.14-degrees above the horizon and the shadows are still short at this time of day.

- The shadow falls across Frances Avenue and the adjacent apartment and townhouse properties to the North

4.3 SUMMER SOLSTICE SHADOWS:
(JUNE 21 • Diagrams 7.06.21.1000 through 7.06.21.1600)

A summary of the Summer Shadow affect is as follows. At this day the solar altitude is at a maximum; Shadows are minor and stay short, falling on to Green road and shortly onto the backyards of the townhouses to the west. The times for this period are under Eastern Daylight Time.

4.3A 10:00am (Diagram 7.06.21.1000)

The morning sun is rising and already at 44.47 degrees at this time. The sun will rotate almost 249 degrees in the sky on this day over fourteen and a half hours.

- The shadow falls across Green Road and the adjacent commercial and townhouse properties to the West

4.3B 12:00pm (Diagram 7.06.21.1200)

The noontime sun in summer is high in the sky (64.13-degrees) originating from the south at this time.

- The shadow falls across the Green Road Frances Avenue intersection and onto the adjacent townhouse properties to the West.

4.3C 2:00pm (Diagram 7.06.21.1400)

The afternoon sun in summer is at its peak at about 68.6 degrees altitude. The sun appears to be shining from the southwest.

- The shadow falls across Frances Avenue and the adjacent apartment and townhouse properties to the North, stopping short of the 3 storey towns.
-

4.4D 4:00pm (Diagram 7.06.21.1600)

The late afternoon sun in summer has begun descending and is still at about 51.81 degrees altitude. The sun appears to be shining from the southwest.

- The shadow falls across Frances Avenue and the adjacent apartment and townhouse properties to the North

5.0 GENERAL OBSERVATIONS: REGARDING THE 14 STOREY DEVELOPMENT

5.1 The shadows cast from this proposed Apartment building are largest in the Winter.

- Shadows fall on the adjacent townhouse units across Green Road and the single family properties to the Northwest across Church St in the morning but no shadows shortly after noon.
- Existing Apartment buildings cast morning shadow in this neighborhood
- Morning shadow will cast along the sidewalks of Green Road, whereas in afternoon Frances road will be in shadow.
- Mid day shadows cast on the adjacent townhouse and apartment building properties across Frances Ave

5.2 The major shadow affect in Spring and Fall is as follows:

- The adjacent commercial and townhouse properties to the west will be affected by shadows in the morning but will be cleared of shadows by noon.
- The adjacent townhouse properties to the Northwest will be affected by shadows between 10 and shortly after 12 noon
- Morning shadow will cast along the sidewalks of Green Road, whereas in afternoon Frances road will be have periods of shadow as the tower shadows rotate.

- Mid day shadows cast on the adjacent townhouse and apartment building properties across Frances Ave, extending to the mid rise building late in the afternoon.

5.3 The major shadow affect in Summer is as follows:

- The adjacent commercial and townhouse properties to the west will be affected by shadows in the morning but will be cleared of shadows by 12 noon.
- Morning shadow will cast along the sidewalks of Green Road, whereas in afternoon Frances road will be have periods of shadow as the tower shadows rotate.
- Mid day shadows cast on the adjacent townhouse and apartment building properties across Frances Ave, however shadows will avoid the actual apartment buildings
- Shadows are very short throughout the whole study period.

5.4 General Comment Regarding Shadow Affect based upon SITE DESIGN:

- With the building being situated as slim point towers the shadow patterns will move quickly and allow for pockets of sunshine between the shadows. Shadows on adjacent buildings to the west and north mostly during Winter and the morning hours of other season and will leave most of the mature surrounding properties unaffected throughout the rest of the day for the majority of the year. The townhouse properties to the north will be free of shadows throughout the morning in all seasons and early afternoon in spring/fall/summer

6.0 SUMMARY OBSERVATIONS: REGARDING SHADOW IMPACT OF A 48,54,59-STOREY BUILDINGS ON THE NEIGHBOURHOOD

- The proposed development will cast winter shadows on the townhouse properties to the west during the morning in all seasons, however the shadows in the spring will be gone by noon and in the summer the shadows will be gone by mid morning.
- It is expected to have a passing impact on the residential properties to the northwest along Chruch St with very short periods of shadow in the winter mornings, however the existing adjacent apartment buildings already provide shadows in this neighborhood.
- Winter shadow will impact the apartment buildings and townhouses across Frances Ave throughout the afternoon in pockets as the tower shadows rotate, but will remain clear in the morning. It is this time of day where shadows can universally be expected to be long-cast, and in a season with fleeting daylight hours. The afternoon shadow impact at this time would be generally the same if the towers were half the height.
- Spring morning shadow will be present for the townhouses along Frances Ave but move very quickly, having minimal impact on individual properties, and will be cleared of Green Road shortly after noon.
- Summer morning shadow will be present for the townhouses south of Frances Ave but move very quickly, having minimal impact on individual properties, and will be cleared of Green Road shortly after noon

- Spring shadow will impact the apartment buildings across Frances Ave through mid afternoon in pockets as the tower shadows rotate, but will remain clear in the morning and late afternoon. Summer shadow will not have an impact on the apartment buildings.
- Spring/Summer shadow will impact the townhouses across Frances Ave throughout the afternoon in pockets as the tower shadows rotate, but will remain clear throughout the morning and early afternoon.
- Most of the outdoor areas for the adjacent townhouses to the North are either covered balconies already providing shadow, or, specifically for the 2 storey units fronting Frances avenue, are to the North of their units, therefore their own unit will already be casting shadow into their rear yards.
- It should be noted that the proposed development is zoned for Unlimited height and Density, and has been zoned this way since before the townhouse properties to the North were developed, therefore although an afternoon impact on these units does exist, consideration should be given to the fact that a reality of a proposed development of this scale would have been available and public knowledge, at the time of construction and purchase.

Based upon the analysis it is our opinion that the proposed development and its proposed height of 48,54 and 59 storeys will not have a significant negative effect on the existing mature neighbourhood to the West/Northwest and apartment buildings to the North. The development will have minor impact on the adjacent recently constructed townhouses to the North, mostly the ones fronting Frances Avenue, however the shadows are contained to the mid afternnoon and the spacing of the towers allows for pockets of daylight as the sun rotates maintaining over 5 hours of sunlight for each lot in the spring/fall and 7 hours or more in the summer.

Sincerely,

KNYMH Inc.
Marc Begin

SHADOW IMPACT ANALYSIS

KNYMH FILE # 17305

PROPOSED DEVELOPMENT
48,54&59 Storey Condominiums
311 Frances Avenue
Stoney Creek, Ontario

Prepared by:
KNYMH INC.
Marc Begin

December 19, 2018

SECTION 7.0: APPENDIX "A"

SHADOW PLAN DIAGRAMS FOR THE 3 STUDY PERIODS

SECTION 7.0: 14 Storey Building Concept:

7.03. 21.1000 – 7.03. 21.1000 SHADOW PLANS AT SPRING(FALL): March 21st

7.03. 21.0930 = 10:00 AM
7.03. 21.1200 = 12:30 PM
7.03. 21.1400 = 2:00 PM
7.03. 21.1600 = 4:00 PM

7.06. 21.1000 - 7.06. 21.1600 SHADOW PLANS AT SUMMER: June 21st

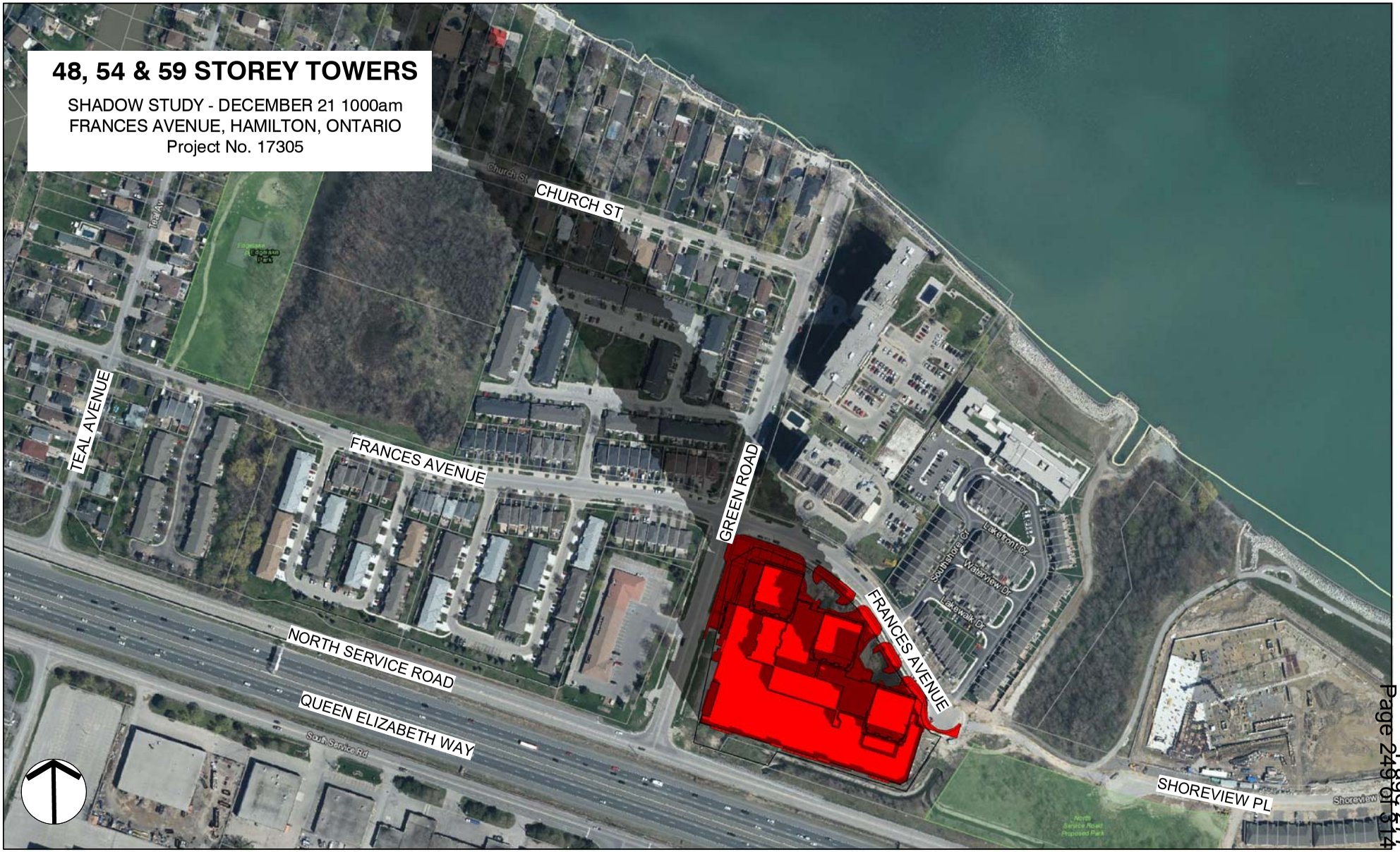
7.06. 21.1000 = 10:00 AM
7.06. 21.1200 = 12:00 PM
7.06. 21.1400 = 2:00 PM
7.06. 21.1600 = 4:00 PM

7.12. 21.1000 – 7.12. 21.1600 SHADOW PLANS AT WINTER: December 21st

7.12. 21.1000 = 10:00 AM
7.12. 21.1200 = 12:00 P4
7.12. 21.1400 = 2:00 PM
7.12. 21.1600 = 4:00 PM

48, 54 & 59 STOREY TOWERS

SHADOW STUDY - DECEMBER 21 1000am
FRANCES AVENUE, HAMILTON, ONTARIO
Project No. 17305



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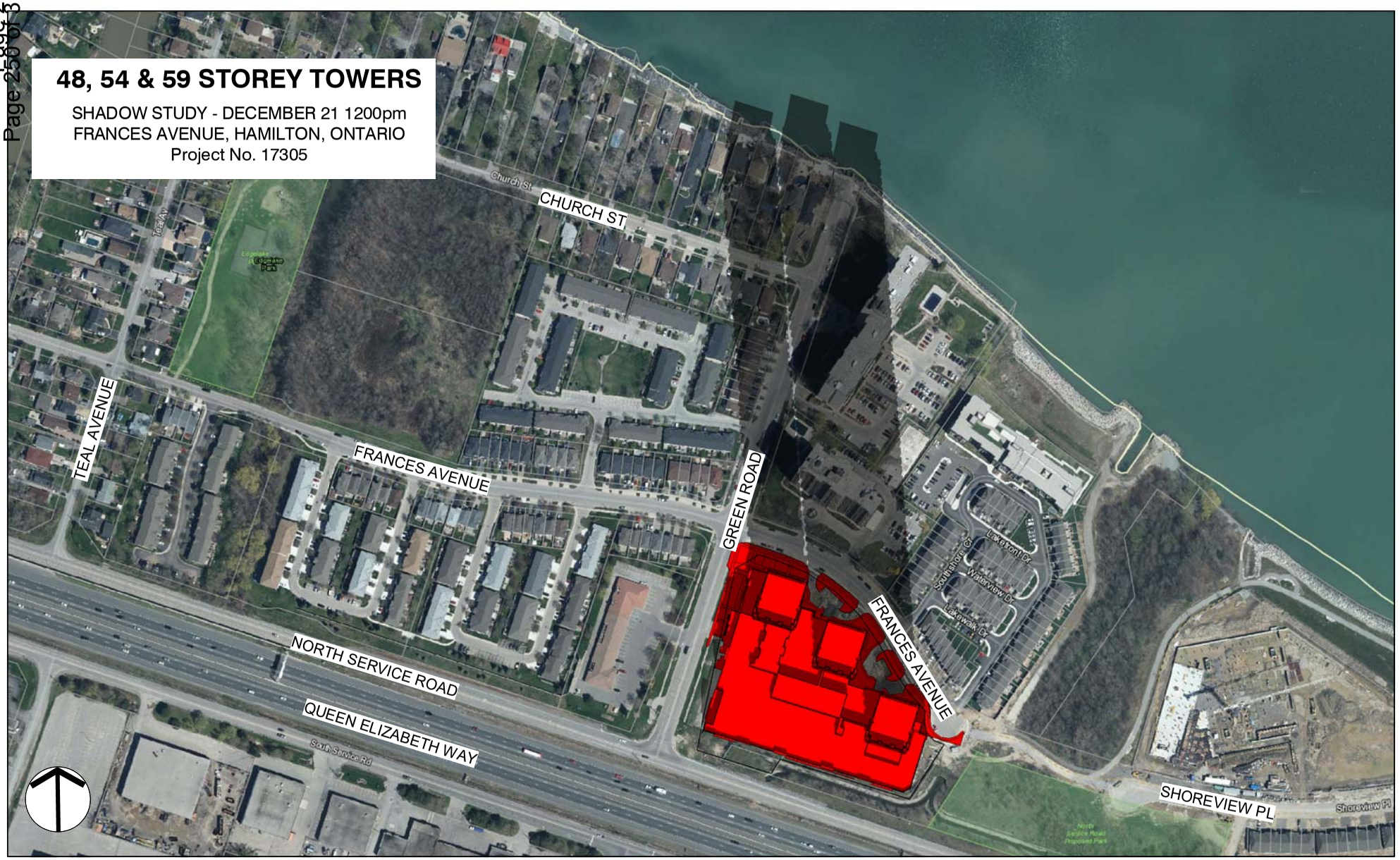
07.12.21.1000

48, 54 & 59 STOREY TOWERS

SHADOW STUDY - DECEMBER 21 1200pm
FRANCES AVENUE, HAMILTON, ONTARIO
Project No. 17305



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48, 54 & 59 STOREY TOWERS

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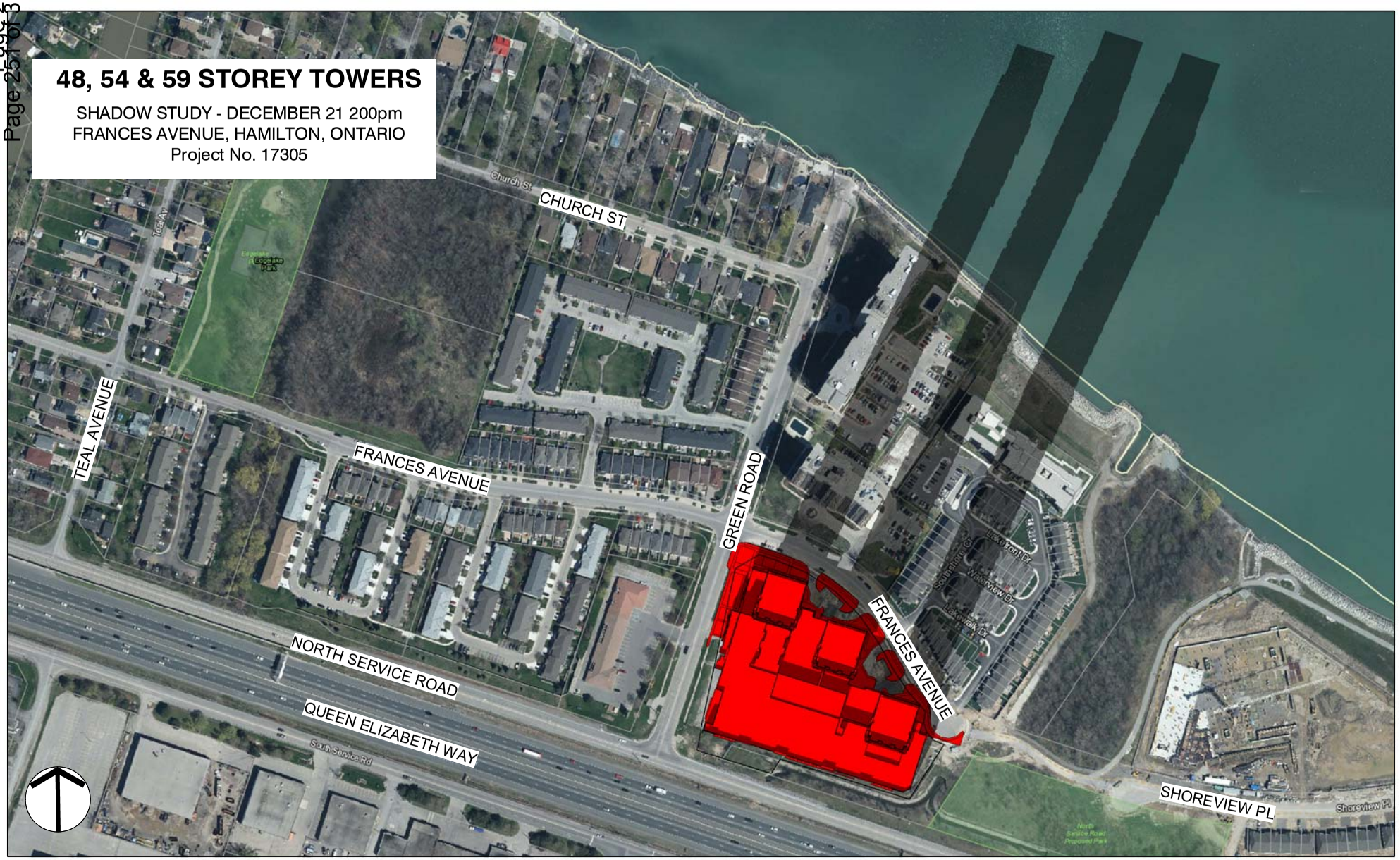
Project No. 17305



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48, 54 & 59 STOREY TOWERS

SHADOW STUDY - DECEMBER 21 400pm
FRANCES AVENUE, HAMILTON, ONTARIO
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48, 54 & 59 STOREY TOWERS

SHADOW STUDY - MARCH 21 1000am
FRANCES AVENUE, HAMILTON, ONTARIO
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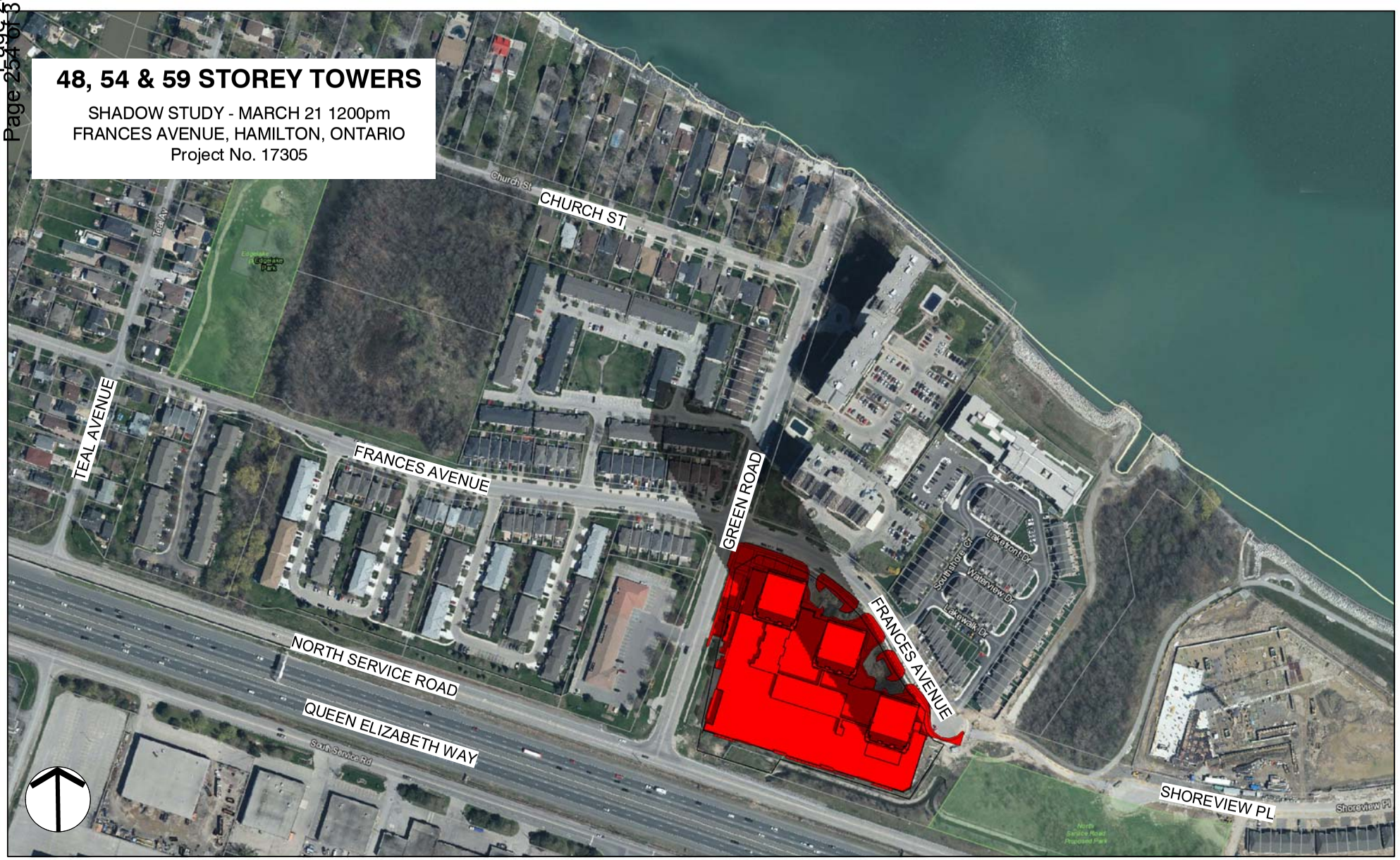

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FRANCES AVENUE, HAMILTON, ONTARIO
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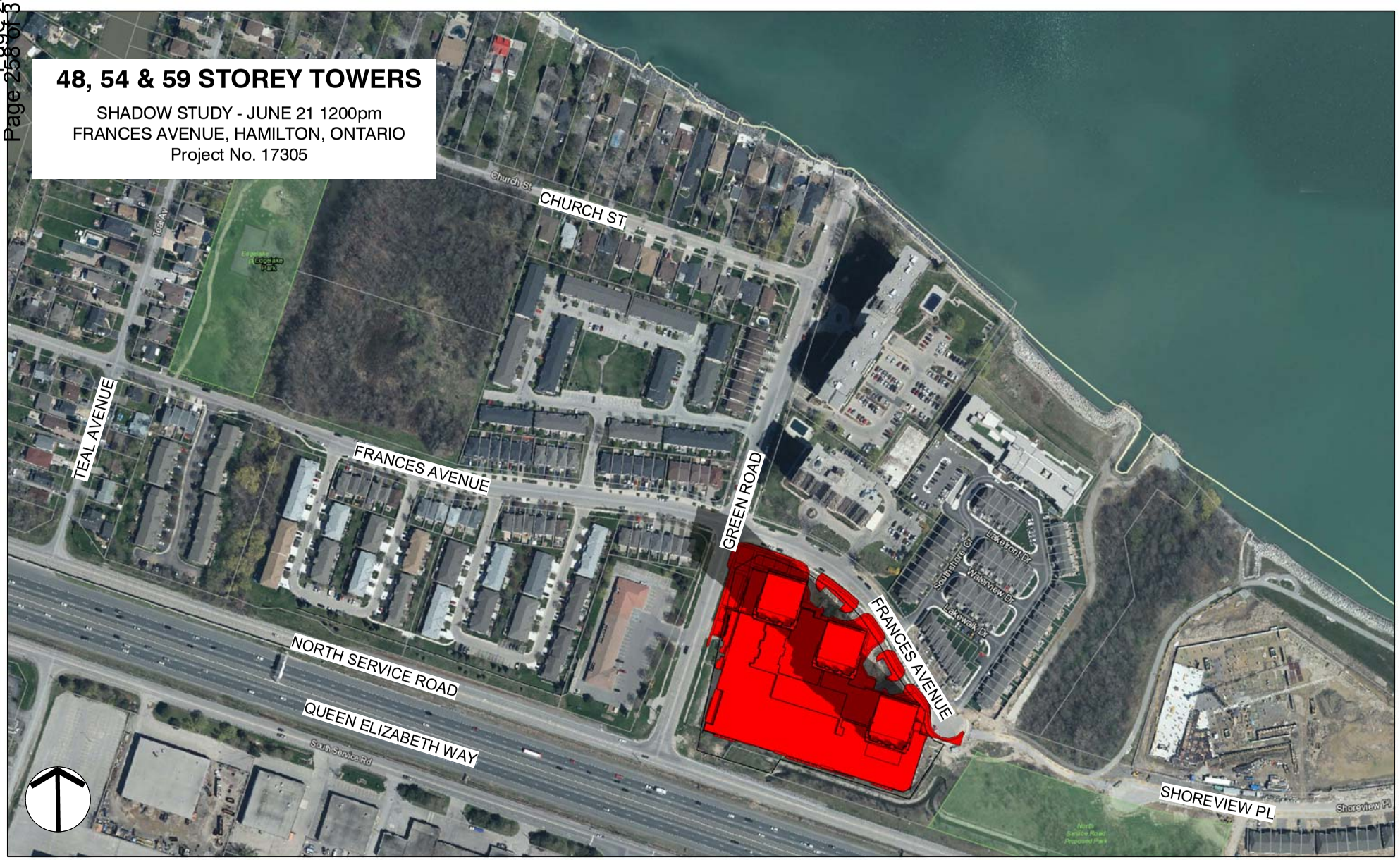

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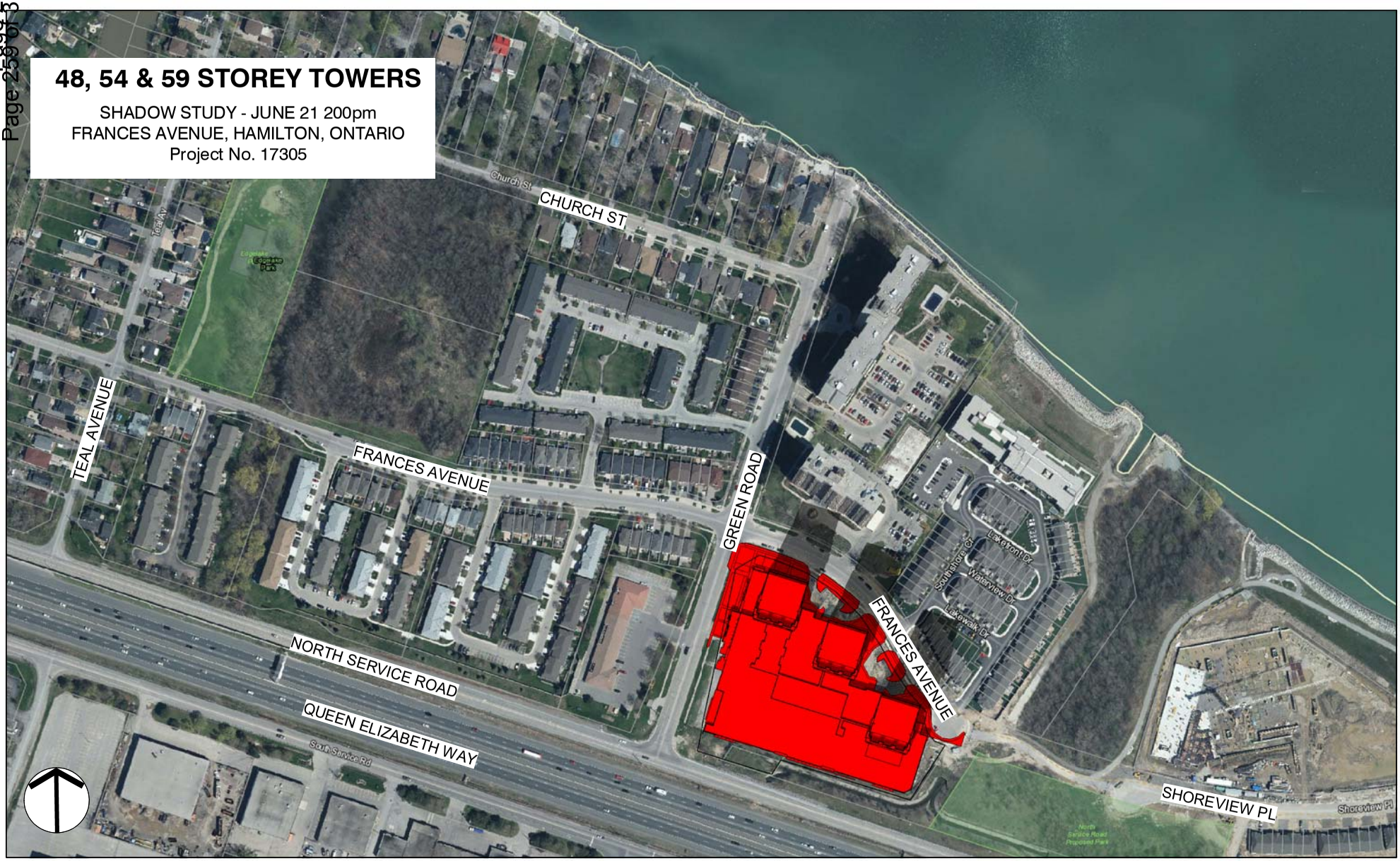

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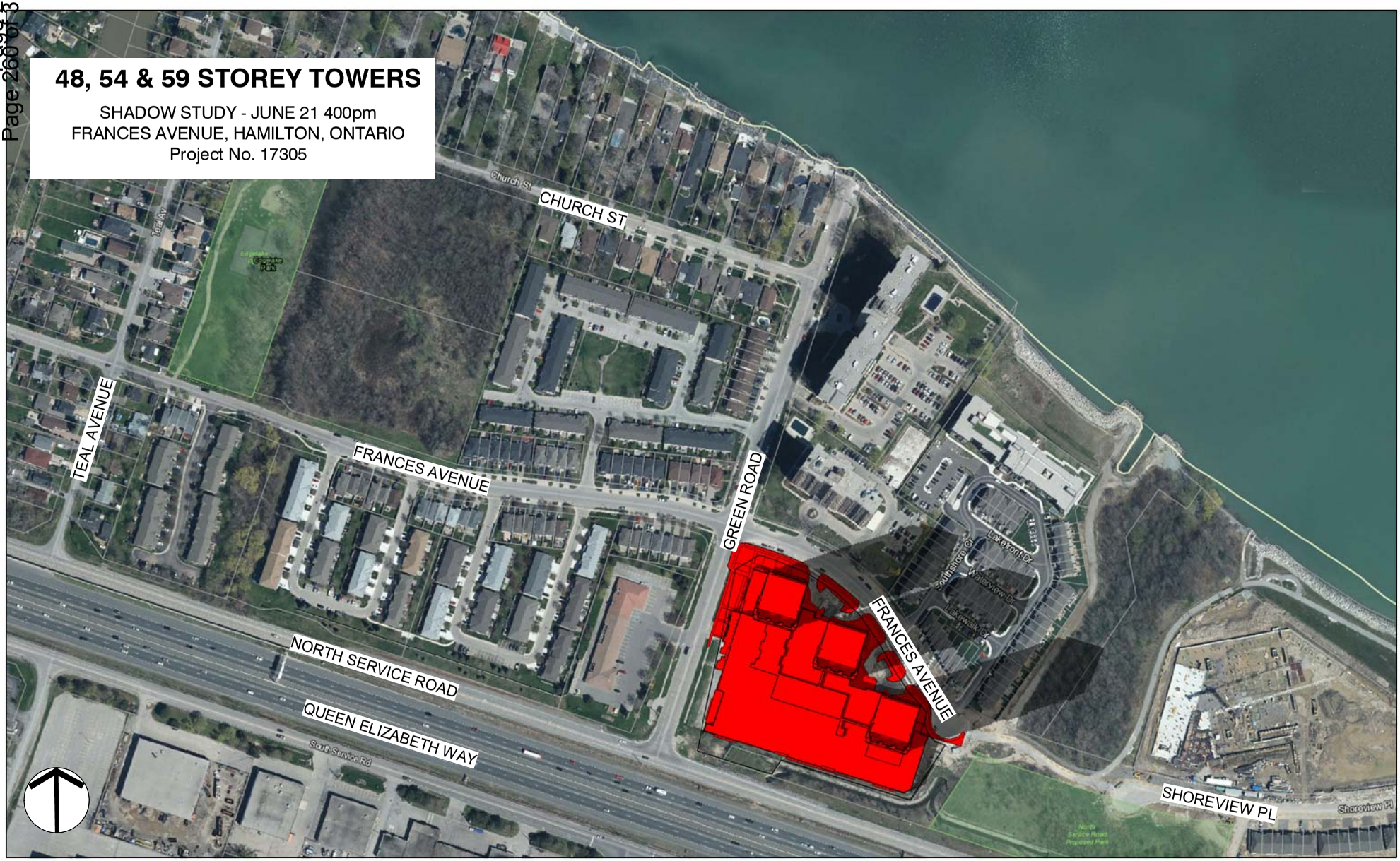

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December 18th, 2018 **Our Project No. 17091**

Mr. Monir Moniruzzaman
City of Hamilton – Engineering Department
71 Main Street West, Hamilton, Ontario, L8P 4Y5

RE: 310 FRANCES AVENUE, CITY OF HAMILTON (STONEY CREEK)
STORM WATER MANAGEMENT (SWM) BRIEF/MEMO

Dear Mr. Monir Moniruzzaman,

Lanhack Consultants Inc. has been retained to review the stormwater impact related to the proposed development located at 310 Frances Avenue in the City of Hamilton (Stoney Creek). The lot is approximately 20,140m^2 (2.02 ha) in area and is currently vacant except for a temporary sales centre and granular parking lot. It is proposed to construct three (3) condominium towers containing approximately 1,836 residential units and 400m^2 of commercial space on top of a four(4)-storey parking podium and a two(2)-storey underground parking structure, with a total building footprint of approximately 1.50 ha. See Site Plan by KNYMH Inc. for more detail.

Stormwater Quantity Control
The stormwater from the proposed development will ultimately outlet to Lake Ontario (north of the site) via Watercourse No. #1 (an adjacent storm channel/existing twin 2.71x2.71m concrete box conduit). Therefore, stormwater quantity control will not be required since it is in close proximity of Lake Ontario.

Stormwater Quality Control
The majority of the site consists of clean water; building roof, perimeter sidewalks, and landscaped areas contribute to approximately 96% of the site and is considered to be clean water. The other 4.0% of the site consists of surface parking. Since 96% of the site consists of clean water and does not need to be treated, we recommend that no stormwater quality control measures are to be implemented for this development since there is very minimal treatable surface runoff on site.

Conclusion
In summary, no stormwater quantity control measures are proposed since the stormwater runoff from this development outlets to Lake Ontario. No stormwater quality control measures are proposed since the development is mostly covered by building roof, perimeter sidewalks, and landscaped areas (all surfaces that are considered to be clean stormwater runoff).

Regards,

Tu Vu, B. Eng., EIT
Lanhack Consultants Inc.

John Lamarre, P.Eng.

WATER/WASTEWATER GENERATION REPORT (WWGR)

for

MIXED USE CONDOMINIUM DEVELOPMENT

310 Frances Avenue, Hamilton (Stoney Creek), Ontario

Prepared for:

NHDG (Waterfront) Inc.

Prepared by:

LANHACK CONSULTANTS INC.
1709 Upper James Street
Hamilton, ON L9B 1K7

Project No. 17091

December 18th, 2018

Table of Contents

1.0 INTRODUCTION

1.1 Overview

Lanhack Consultants Inc. has been retained by NHDG (Waterfront) Inc. to prepare a Water/Wastewater Generation Report (WWGR) in support of a proposed mixed use condominium development located at 210 Frances Avenue. The lot is approximately 20,140m^2 (2.02 ha) in area and is currently vacant except for a temporary sales centre and granular parking lot. It is proposed to construct three (3) condominium towers containing approximately 1,836 residential units and 400m^2 of commercial space on top of a four(4)-storey parking podium and a two(2)-storey underground parking structure, with a total building footprint of approximately 1.50 ha. See Site Plan in **Appendix B** prepared by KNYMH Inc. for more details.

The site will be serviced by two (2) existing sanitary manholes and a proposed sanitary manhole at the property line along Frances Avenue, six (6) proposed 200mm diameter water services (two for each tower), two (2) proposed storm services on the north property line connecting to the Frances Avenue storm sewer, and two (2) existing storm manholes south of the property outletting into the storm channel. See Servicing Plan in **Appendix B** for more details.

This report will provide the conceptual framework for domestic water distribution, fire flows, and sanitary sewage for the development of this site. This report will also provide design drawings, prepared by Lanhack Consultants Inc., in support of the site plan application.

Please refer to the Lanhack engineering drawings attached in **Appendix B** for additional information.

1.2 Background Information

The following documents were referenced in the preparation of this report:

Ref. 1: Comprehensive Development Guidelines and Financial Policies Manual (City of Hamilton, 2016)

Ref 2: Ontario Building Code (OBC - 2012)

Ref 3: Ministry of the Environment (MOE) – Design Guidelines for Drinking Water Systems (2008)

2.0 Wastewater Assessment

The proposed mixed-use condominium development will consist of three (3) condominium towers containing approximately 1,836 residential units and 400m^2 of commercial space; 1,227 one-bedroom units and 609 two-bedroom units. Based on the site plan prepared by KNYMH Inc., the design population and equivalent sanitary flow for the development were determined using Part 8 of the Ontario Building Code (OBC, 2012).

2.1 Existing Sanitary Drainage System

The existing sanitary drainage system consists of a 450mmØ concrete sanitary sewer along the north side of the development on Frances Avenue.

2.2 Sanitary Demands

The anticipated sanitary discharge from the proposed development was calculated based on Table 8.2.1.3.A – Residential Occupancies and Table 8.2.1.3.B – Other Occupancies of the OBC (2012). **Table 2.1** summarizes the sanitary sewer discharge rates from the proposed site. Sanitary discharge calculations will be confirmed upon completion of the Wastewater Generation Assessment, which will be prepared as part of the Site Plan Approval process.

Table 2.1: Sanitary Discharge Flow Rate

Type of Unit	Number of Bedrooms per Unit (1)	Average Daily Flow per Person (L/d) (2)	Total Number of Units (3)	Design Population (4)	Total Average Flow (5) (L/s)
One-Bedroom Unit	1.0	275	1,227	2,454	**15.59**
Two-Bedroom Unit	2.0	275	609	2,436	
Commercial/Office	N/A	5.0 L/m^2/day	400.0 m^2	N/A	

(1) Average number of bedrooms based on floor plans and site plan by KNYMH Inc.

(2) Average Domestic Sewage Flow Rate from OBC Table 8.2.1.3.A
Apartment, Condominiums, Other Multi-family Dwellings = 275 L/person/day

(3) Refer to site plan prepared by KNYMH Inc. – Appendix B

(4) Residential population based on two (2) persons per bedroom unit. Refer to OBC Section 3.1.17.1(1b)
Commercial/Store discharge rate based on 5.0L/m^2/day. Refer to OBC Table 8.2.1.3.B.

(5) Total Avg. Flow = [(Avg. Daily Flow per Person) x (Total # of Persons)] + [Commercial Discharge Rate]
= [(275 L/d/person) x (2,454 persons + 2,436)] + [5.0 L/m^2/d x 400m^2] /24/60/60
= 15.59 L/s

Therefore, based on the OBC, the estimated average sanitary discharge flow is **15.59 L/s (0.01559 m^3/s).** Applying the City of Hamilton peak factor (based on Babbitt formula = 3.64), the estimated peak sanitary discharge flow would be **56.75 L/s.**

2.3 Proposed Servicing Plan and Capacity Analysis

As calculated in Table 2.1, the total anticipated sanitary sewer discharge (based on OBC calculation) from the proposed development is **15.59 L/s**. The proposed development will be serviced from the existing 450mm diameter concrete sanitary service on Frances Avenue at a final slope of 0.32%. See Servicing Plan in **Appendix B** for more detail. The anticipated peak sanitary discharge of 15.59 L/s will contribute to approximately 9.7% of the total sewer capacity (full capacity approximately 161.3 L/s). It is not expected that the sanitary discharge from the proposed development will negatively impact the receiving system once the local sanitary pump station upgraded.

3.0 Proposed Water Assessment

The proposed mixed-use condominium development will consist of three (3) condominium towers containing approximately 1,836 residential units and 400m^2 of commercial space; 1,227 one-bedroom units and 609 two-bedroom units. Based on the site plan prepared by KNYMH Inc., the design population and water uses/demand for the development were determined using the "Fixture Unit Method" as per Table 7.6.3.2.A forming part of sentences 7.6.3.1(1) to (3) and 7.6.3.4.(2), (3) and (5) of the Ontario Building Code (OBC, 2012).

3.1 Existing Water Distribution System

The existing municipal water distribution system north of the site consists of a 300mmØ D.I. watermain within the Frances Avenue right-of-way. The development will connect to the existing 300mmØ D.I. watermain. Multiple existing municipal hydrants are located on the north side of Frances Avenue. See Servicing Plan in **Appendix B** for more detail. Available fire flows and heads have been analyzed to determine if the municipal system adjacent to the subject site is adequate to provide the required fire flow, with a minimum pressure of 20 psi.

3.2 Domestic Water Demands

In reference to the OBC, the average water consumption rate can be calculated using the fixture-unit approach as per Tables 7.6.3.2.A and 7.4.10.5 in the OBC as follows:

Table 3.1: Estimated Domestic Demand via Fixture Units (OBC)

Component	No. of Fixtures/Unit	Fixture Units/Fixture	No. of Units	Total Fixture Units
Residential				
Lavatory (8.3L/min or less per head) (Private)	1 2	0.7	1,227 609	858.9 852.6
Shower Head (9.5L/min or less per head) (Private)	1 2	1.4	1,227 609	1,717.8 1,705.2
Water Closet (6 LPF or less with flush tank) (Private)	1 2	2.2	1,227 609	2,699.4 2,679.6
Dishwasher (Domestic)	1	1.4	1,836	2,570.1
Sink, Kitchen (Domestic, 8.3L/min or less)	1	1.4	1,836	2,570.1
Clothes Washer (3.5 kg)	1	1.4	1,836	2,570.1
Commercial				
Lavatory (8.3L/min or less per head) (Public)	-	2.0	24	48.0
Water Closet (6 LPF or less with flush tank) (Private)	-	2.2	24	52.8
Total Fixture Units				**18,324.6**

Based on the above table, the total fixture units for the mixed use development is approximately 18,324.6. In reference to Table 7.4.10.5 of the OBC, the approximate maximum probable daily demand is 1,677.6 gal/min **(127.1 L/s).**

3.3 Proposed Water Servicing Plan and Analysis

Water servicing for the site will include the installation of six (6)-200mmØ fire service lines and six (6)-150mmØ domestic services teed off the existing 300mmØ D.I. watermain on Frances Avenue. Refer to the Servicing Plan in **Appendix B** for more details.

4.0 Fire Flow Demand

The fire flow demand for the development will be governed by the Water Supply for Public Fire Protection (Fire Underwriters Survey, 1999), Ontario Building Code (2012), and various codes and standards published by the National Fire Protection Association (NFPA).

Existing hydrants are located Frances Street and on Green Road. The proposed buildings are within the required 90m separation from at least one of the existing hydrants (as per Sentence 3.2.5.7 of the Ontario Building Code), therefore no additional private fire hydrants are proposed for this development.

It has been determined that the required flow for the proposed development is **183.33 L/s (11,000 L/min).** Refer to **Appendix A** for more detailed calculations and current hydrant flow test data for the development (completed by Jackson Waterworks).

Based on the hydrant flow test data in **Appendix A**, the theoretical maximum available flow rate for the hydrants in close proximity are **292.0 L/s** and **253.0 L/s**, while the maximum required fire flow for the proposed development is **183.33 L/s.** Therefore, the water distribution system has adequate pressure and capacity to service the subject site.

5.0 Conclusion (Domestic/Fire and Sanitary)

Based on the information provided herein, we conclude that the maximum water supply flow and the sanitary discharge at 310 Frances Avenue meet the design requirements of the City of Hamilton (Stoney Creek) and the Ministry of Environment (MOE). The available sanitary flows within the municipal system will be adequate once upgraded and are not expected to be negatively impacted from the proposed development. Water demand and fire flow requirements will be met according to the OBC and FUS requirements. Therefore, it is recommended that:

Sanitary Drainage System

- The sanitary discharge for the subject site will drain to the existing 450mmØ concrete sanitary sewer along Frances Avenue. The anticipated average sanitary discharge will be **15.59 L/s**, which contributes to 9.7% of the total sewer capacity along Frances Avenue.

Water Supply System

- The water supply for the subject site will be from the existing 300mmØ D.I. watermain along Frances Avenue. The maximum probable daily demand based on the OBC Fixture Unit method is 1,677.6 gal/min **(127.1 L/s).**
- A minimum fire suppression flow of approximately **11,000 L/min (183.33 L/s)** will be required as per the guidelines of the Fire Underwriters Survey (FUS).

We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

Respectfully submitted,

12/18/18

Tu Vu, B.Eng., E.I.T.
Lanhack Consultants Inc.

Dave Hacking, P.Eng
Lanhack Consultants Inc.

APPENDIX A: Fire Flow Requirements Calculations

The following calculations are for the proposed development at 310 Frances Avenue, Hamilton (Stoney Creek), Ontario. The Fire Underwriters Survey (FUS) requires that a minimum water supply source 'F' be provided at a minimum pressure of 140 kPa (20 psi). The minimum flow 'F' can be calculated as:

$$F = 220C\sqrt{A}$$

C = coefficient related to construction = ***0.6*** *(fire-resistive construction; protected frames, floors, roof; 1-hour rated)*

A = total floor area = ***See below***

Determining 'A' – Floor Area for Fire Flow:

As per KNYMH's design, the fire-resistive building is one-hour rated and the vertical openings and exterior vertical communications are properly protected (one hour rating), therefore we will consider only the area of the largest flow plus 25 percent of each of the two immediately adjoining floors. See Site Plan prepared by KNYMH for more detail.

Total floor area required for this analysis will be:

[(15,272.0) + (15,272.0 x 0.25 x 2.0)]:

A = 22,908.0 m^2

Determining 'F' including Reduction Factors:

$$F = 220C\sqrt{A}$$

F = 220 x 0.6 x $\sqrt{22{,}908.0}$

F = 19,978.7 L/min → Rounded to the nearest 1,000 L/min = **20,000 L/min**

Reduction formula for combustibility:

- The mixed use residential condominium is considered to be a low hazard occupancy and limited combustible, so a reduction factor of 15% will be applied:

F = 20,000 x 0.85 = **17,000 L/min**

Reduction formula for sprinkler protection systems:

- The building will consist of NFPA 13 approved sprinklers, supplied by the same municipal water system, and will be fully supervised, so a 50% reduction will be applied:

F = 17,000 x 0.50 = 8,500 L/min reduction

Increase formula for exposure and building separation:

- There are existing residential buildings on the west, north, and east side of the proposed building (30.1m to 45m separation), therefore, a 15% charge for the fire flow (F) will be required.

F = 17,000 x 0.15 = 2,550 L/min increase

TOTAL F = 17,000 – 8,500 + 2,550 = 11,050 L/min → Rounded to nearest 1,000 L/min = **11,000 L/min**

F = 11,000 L/min = 183.33 L/s

Hydrant Flow Data

Table 1 below summarizes the hydrant flow test data completed by Jackson Waterworks and **Table 2** summarizes the hydrant flow data made available by the City of Hamilton.

Table 1 - Hydrant Flow Data	
Location	329 Frances Avenue
Static Pressure	70 psi
Residual Pressure During Test Flow	66 psi
Test Flow Rate	1,186 USGPM (74.8 L/s)
Theoretical Flow @ 20psi	**4,641 US GPM (292.8 L/s)**
Location	Green Road
Static Pressure	65 psi
Residual Pressure During Test Flow	61 psi
Test Flow Rate	1,087 USGPM (68.6 L/s)
Theoretical Flow @ 20 psi	**4,018 USGPM (253.5 L/s)**

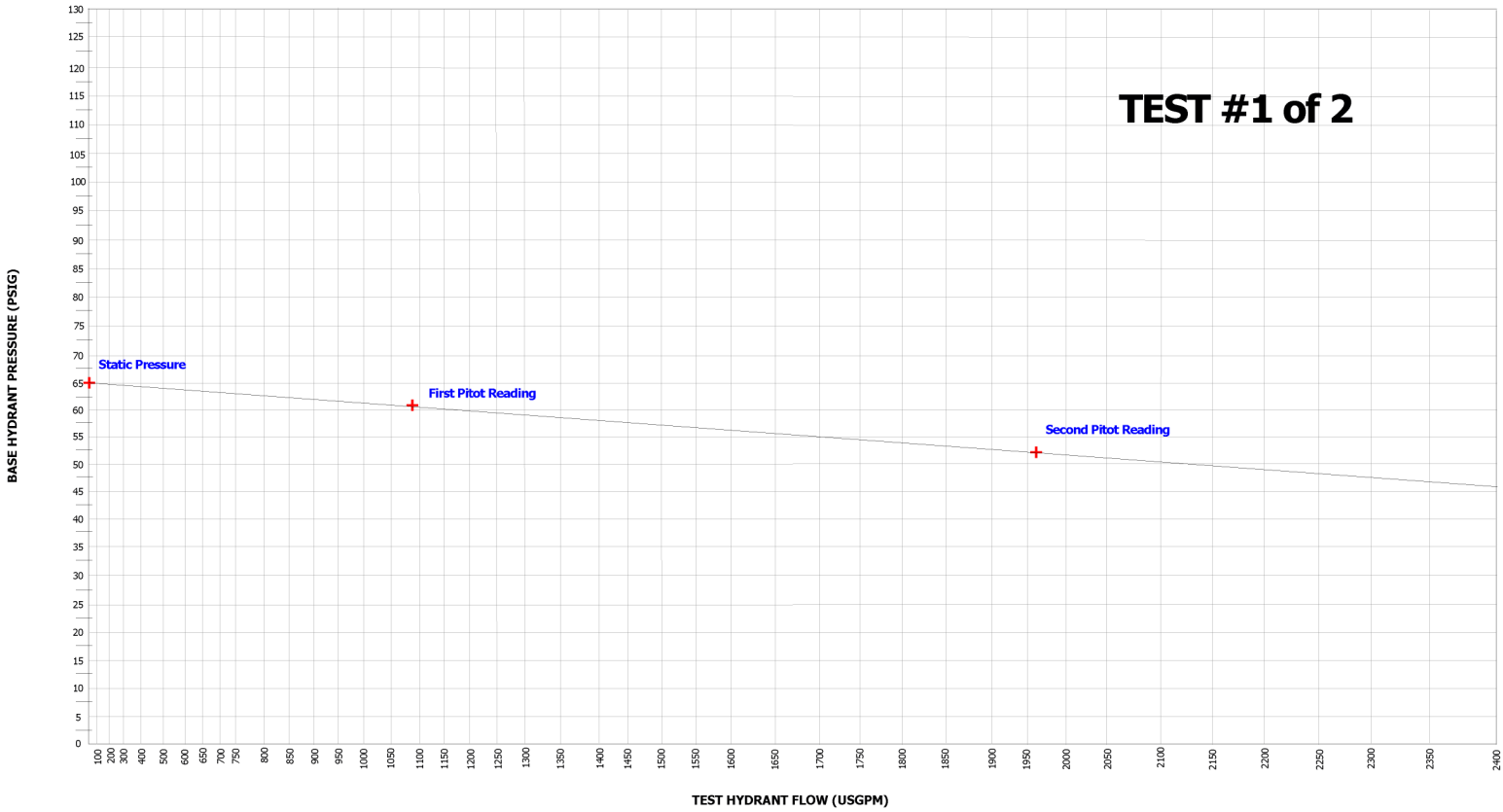
Table 2 - Hydrant Flow Data	
Hydrant ID	SD01H020
Location	301 Frances Avenue
Test Date	24/08/2016 12:58
Static Pressure	72 psi
Residual Pressure During Test Flow	68 psi
Test Flow Rate	1,120 IGPM (84.9 L/s)
Theoretical Flow @ 20 psi	**4,475 IGPM (339.1 L/s)**
Hydrant ID	SD01H021
Location	311 Frances Avenue
Test Date	24/08/2016 13:09
Static Pressure	74 psi
Residual Pressure During Test Flow	68 psi
Test Flow Rate	1,010 IGPM (76.5 L/s)
Theoretical Flow @ 20 psi	**3,308 IGPM (250.6 L/s)**
Hydrant ID	SD01H022
Location	311 Frances Avenue
Test Date	24/08/2016 12:49
Static Pressure	72 psi
Residual Pressure During Test Flow	68 psi
Test Flow Rate	1,150 IGPM (87.1 L/s)

Theoretical Flow @ 20 psi	**4,475 IGPM (348.1 L/s)**
Hydrant ID	SD01H030
Location	Green Road
Test Date	18/07/2016 10:34
Static Pressure	80 psi
Residual Pressure During Test Flow	74 psi
Test Flow Rate	1,050 IGPM (79.6 L/s)
Theoretical Flow @ 20 psi	**3,641 IGPM (275.9 L/s)**
Hydrant ID	SD01H091
Location	Green Road
Test Date	18/07/2016 10:33
Static Pressure	80 psi
Residual Pressure During Test Flow	74 psi
Test Flow Rate	1,250 IGPM (94.7 L/s)
Theoretical Flow @ 20 psi	**4,334 IGPM (328.4 L/s)**

JACKSON WATERWORKS

Telephone: (905) 547-6770
Toll Free: (800)-734-5732
E-mail: jww@bellnet.ca
Website: www.jacksonwaterworks.ca

FIRE HYDRANT FLOW TEST RESULTS



No. of Ports Open	Port Dia. (in)	Pitot Reading (psig)	Pitot Conversion (usgpm) Conversion Factor = 0	Residual Pressure (psig)
1	2.50	42	1087	61
2	2.50	34/34	1956	52
THEORETICAL FLOW @ 20psi			4018	

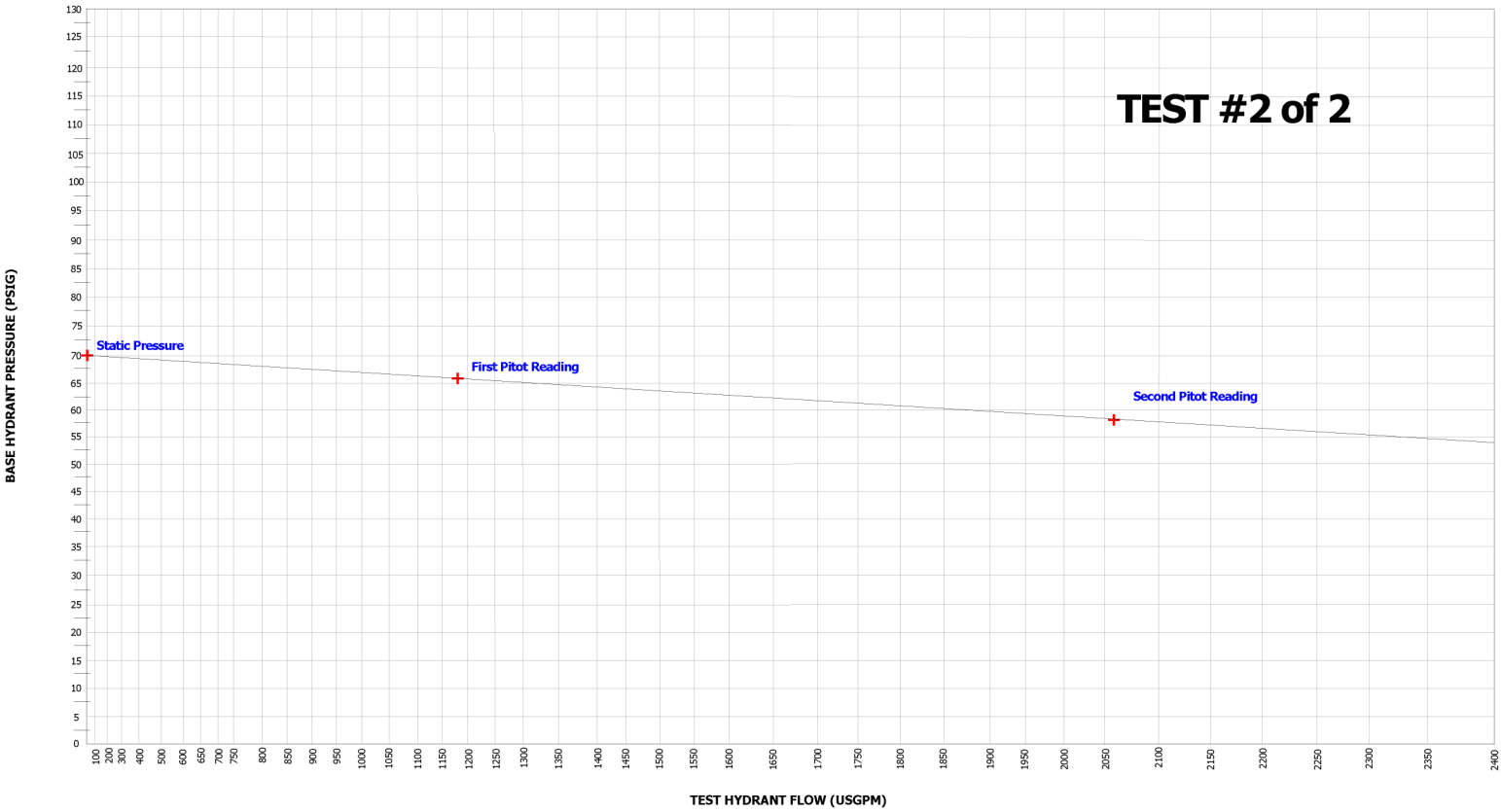
Test Date	19 September 2017
Test Time	1:15pm
Pipe Diameter (in)	Unknown
Static Pressure (psig)	65

SITE INFORMATION		
Site Name or Developer Name	Not Provided	Engineer: S. Llewellyn & Associates
Site Address/Municipality	Green Road & Frances Avenue, Hamilton	
Location of Test Hydrant	Corner of Green Road & North Service Road	
Location of Base Hydrant	Green Road, 1st South of Frances Avenue	
Comments	Testing has been completed in accordance with NFPA-291 guidelines wherever and whenever possible and practical. Conversion factors for pitot tube readings have been used depending on hose nozzle internal design and installation profile. Refer to attached cover letter for additional information.	
Verified By	Mark Schmidt	

JACKSON WATERWORKS

Telephone: (905) 547-6770
Toll Free: (800)-734-5732
E-mail: jww@bellnet.ca
Website: www.jacksonwaterworks.ca

FIRE HYDRANT FLOW TEST RESULTS



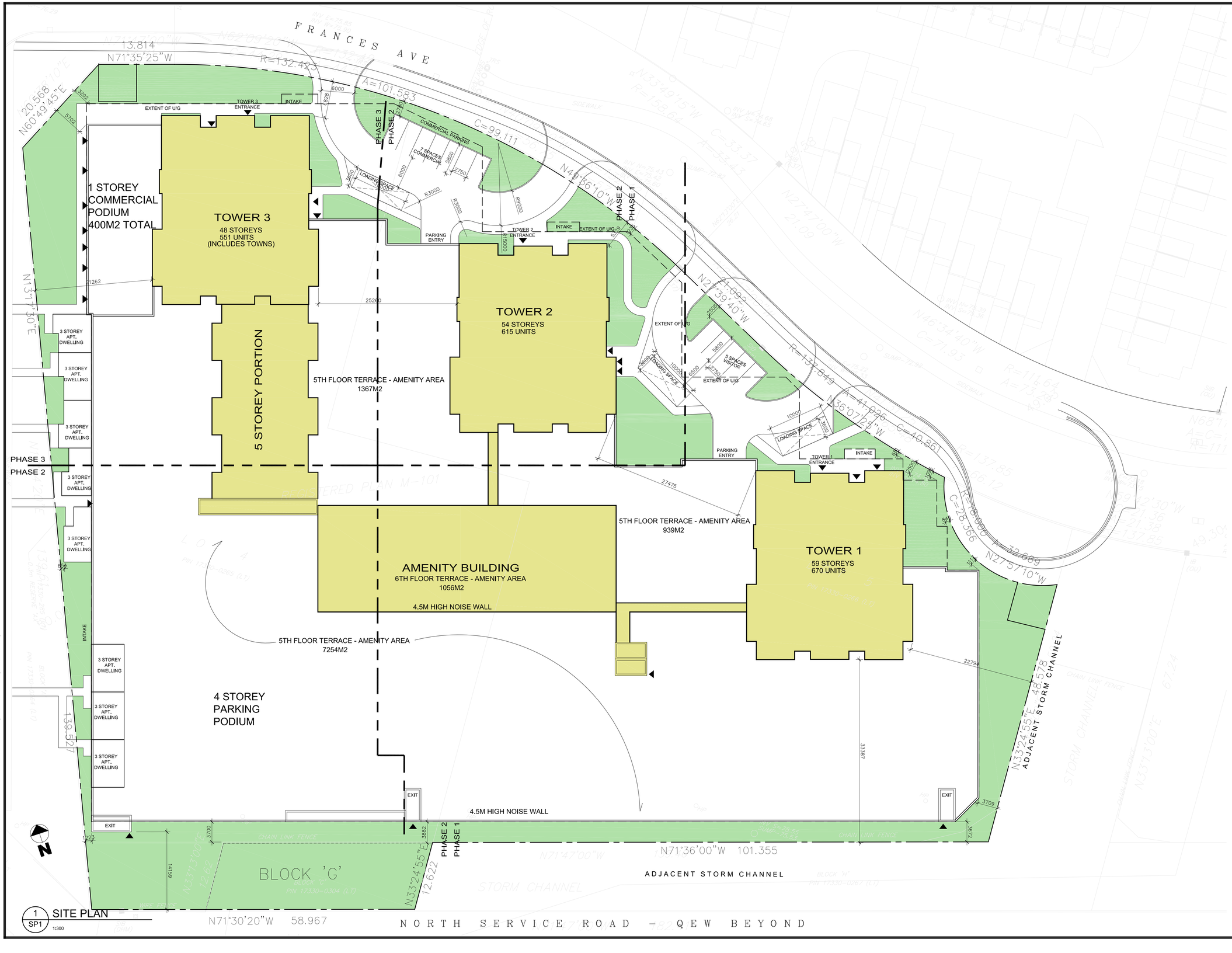
No. of Ports Open	Port Dia. (in)	Pitot Reading (psig)	Pitot Conversion (usgpm) Conversion Factor = 0	Residual Pressure (psig)
1	2.50	50	1186	66
2	2.50	38/38	2068	58
THEORETICAL FLOW @ 20psi			4641	

Test Date	19 September 2017
Test Time	1:45pm
Pipe Diameter (in)	Unknown
Static Pressure (psig)	70

SITE INFORMATION		
Site Name or Developer Name	Not Provided	Engineer: S. Llewellyn & Associates
Site Address/Municipality	Green Road & Frances Avenue, Hamilton	
Location of Test Hydrant	In Front of 329 Frances Avenue	
Location of Base Hydrant	Frances Avenue, 1st East of Green Road	
Comments	Testing has been completed in accordance with NFPA-291 guidelines wherever and whenever possible and practical. Conversion factors for pitot tube readings have been used depending on hose nozzle internal design and installation profile. Refer to attached cover letter for additional information.	
Verified By	Mark Schmidt	

APPENDIX B: Site Plan and Engineering Drawings

- *Site Plan prepared by KNYMH Inc.*
- *Servicing Plan prepared by Lanhack Consultants Inc.*



1 SP1 SITE PLAN
1:300

CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS AND JOB CONDITIONS BEFORE PROCEEDING WITH WORK

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KEY TO DETAIL LOCATION

No. DETAIL NUMBER
No. DRAWING SHEET NUMBER

DRAWING SETS ISSUED	No.	DATE (DD.MM.YY)	BY
SITE PLAN APPROVAL	1.	19.12.2018	MB

ALL PREVIOUS ISSUES OF THIS DRAWING ARE SUPERSEDED

REVISIONS TO DRAWING	No.	DATE (DD.MM.YY)	BY

NOT FOR CONSTRUCTION

BUILDING PERMIT NUMBER:

NOT FOR CONSTRUCTION WITHOUT PERMIT

KNYMH
ARCHITECTURE • SOLUTIONS

KNYMH INC.
1006 SKYVIEW DRIVE • SUITE 101
BURLINGTON, ONTARIO • L7P 0V1
T 905.639.6595
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ONTARIO ASSOCIATION OF ARCHITECTS
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NHDG

WATERFRONT TRAILS PH 3

FRANCES AVE
STONEY CREEK, ONTARIO

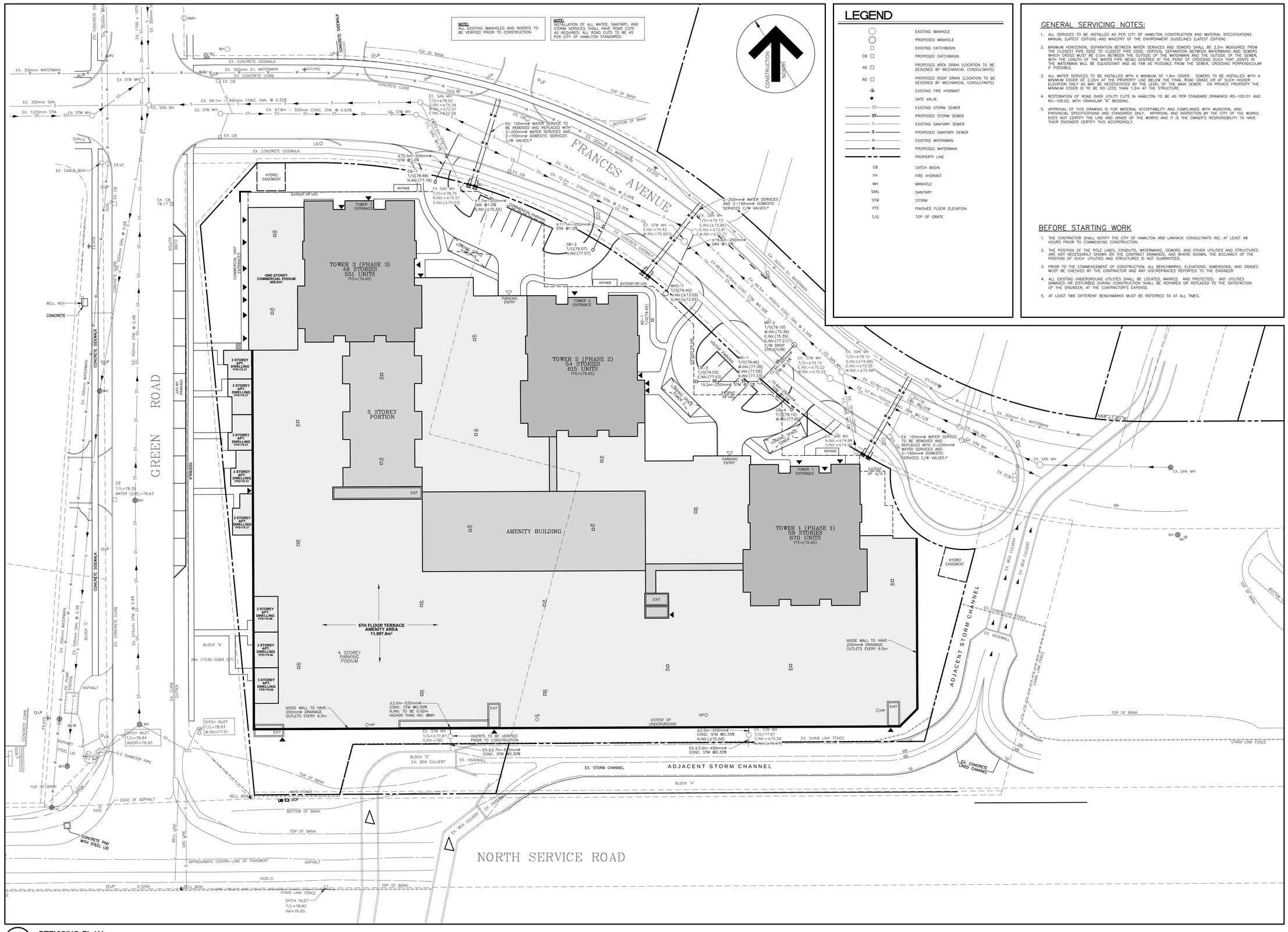
DRAWING SHEET TITLE:

SITE PLAN

DRAWING SCALE:	PROJECT NUMBER:
1:300	17305

DRAWN BY:	CHECKED BY:	DRAWING SHEET NUMBER:
WH/MF		SP1
DRAWING VERSION: WH		
PLOT DATE: December 18, 2018		OOOOOAOO

TIMESTAMP-2018-12-18 2:36:00 PM - FILEPATH-O:\2017\17305 - NHDG - Waterfront Trails Phase 3\4. Drawings\4.03 Schematic Design\17305 - SP1.dwg



1 SERVICING PLAN
C2-1

1:400

LEGEND

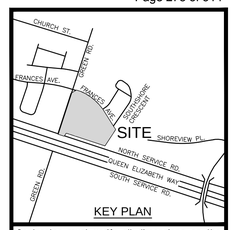
○	EXISTING MANHOLE
◎	PROPOSED MANHOLE
□	EXISTING CATCHBASIN
CB □	PROPOSED CATCHBASIN
AD □	PROPOSED AREA DRAIN (LOCATION TO BE DESIGNED BY MECHANICAL CONSULTANTS)
RD □	PROPOSED ROOF DRAIN (LOCATION TO BE DESIGNED BY MECHANICAL CONSULTANTS)
◈	EXISTING FIRE HYDRANT
●	GATE VALVE
ST	EXISTING STORM SEWER
ST	PROPOSED STORM SEWER
S	EXISTING SANITARY SEWER
S	PROPOSED SANITARY SEWER
W	EXISTING WATERMAIN
W	PROPOSED WATERMAIN
	PROPERTY LINE
CB	CATCH BASIN
FH	FIRE HYDRANT
MH	MANHOLE
SAN.	SANITARY
STM	STORM
FFE	FINISHED FLOOR ELEVATION
T/G	TOP OF GRATE

GENERAL SERVICING NOTES:

1. ALL SERVICES TO BE INSTALLED AS PER CITY OF HAMILTON CONSTRUCTION AND MATERIAL SPECIFICATIONS MANUAL (LATEST EDITION) AND MINISTRY OF THE ENVIRONMENT GUIDELINES (LATEST EDITION).
2. MINIMUM HORIZONTAL SEPARATION BETWEEN WATER SERVICES AND SEWERS SHALL BE 2.5m MEASURED FROM THE CLOSEST PIPE EDGE TO CLOSEST PIPE EDGE. VERTICAL SEPARATION BETWEEN WATERMAINS AND SEWERS WHICH CROSS MUST BE 0.5m BETWEEN THE OUTSIDE OF THE WATERMAIN AND THE OUTSIDE OF THE SEWER, WITH THE LENGTH OF THE WATER PIPE BEING CENTRED AT THE POINT OF CROSSING SUCH THAT JOINTS IN THE WATERMAIN WILL BE EQUIDISTANT AND AS FAR AS POSSIBLE FROM THE SEWER, CROSSING PERPENDICULAR IF POSSIBLE.
3. ALL WATER SERVICES TO BE INSTALLED WITH A MINIMUM OF 1.6m COVER. SEWERS TO BE INSTALLED WITH A MINIMUM COVER OF 2.20m AT THE PROPERTY LINE BELOW THE FINAL ROAD GRADE OR AT SUCH HIGHER ELEVATION ONLY AS MAY BE NECESSITATED BY THE LEVEL OF THE MAIN SEWER. ON PRIVATE PROPERTY THE MINIMUM COVER IS TO BE NO LESS THAN 1.2m AT THE STRUCTURE.
4. RESTORATION OF ROAD OVER UTILITY CUTS IN HAMILTON TO BE AS PER STANDARD DRAWINGS RD–100.01 AND RD–100.02, WITH GRANULAR "A" BEDDING.
5. APPROVAL OF THIS DRAWING IS FOR MATERIAL ACCEPTABILITY AND COMPLIANCE WITH MUNICIPAL AND PROVINCIAL SPECIFICATIONS AND STANDARDS ONLY. APPROVAL AND INSPECTION BY THE CITY OF THE WORKS DOES NOT CERTIFY THE LINE AND GRADE OF THE WORKS AND IT IS THE OWNER'S RESPONSIBILITY TO HAVE THEIR ENGINEER CERTIFY THIS ACCORDINGLY.

BEFORE STARTING WORK

1. THE CONTRACTOR SHALL NOTIFY THE CITY OF HAMILTON AND LANHACK CONSULTANTS INC. AT LEAST 48 HOURS PRIOR TO COMMENCING CONSTRUCTION.
2. THE POSITION OF THE POLE LINES, CONDUITS, WATERMAINS, SEWERS, AND OTHER UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.
3. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, ALL BENCHMARKS, ELEVATIONS, DIMENSIONS, AND GRADES MUST BE CHECKED BY THE CONTRACTOR AND ANY DISCREPANCIES REPORTED TO THE ENGINEER.
4. ALL EXISTING UNDERGROUND UTILITIES SHALL BE LOCATED, MARKED AND PROTECTED. ANY UTILITIES DAMAGED OR DISTURBED DURING CONSTRUCTION SHALL BE REPAIRED OR REPLACED TO THE SATISFACTION OF THE ENGINEER, AT THE CONTRACTOR'S EXPENSE.
5. AT LEAST TWO DIFFERENT BENCHMARKS MUST BE REFERRED TO AT ALL TIMES.



KEY PLAN

Contractor must verify all dimensions on the Project Site and report any discrepancies before proceeding with the Work.

This drawing is a part of the Contract Documents and is to be read in conjunction with all other Contract Documents.

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SOURCE
EXISTING BOUNDARY SURVEY AND TOPOGRAPHICAL INFORMATION OBTAINED FROM A.T. MCLAREN LTD., PLAN DWG. No. 32505, DATED MAY 31, 2011.

THE POSITION OF THE POLE LINES, CONDUITS, WATERMAINS, SEWERS, AND OTHER UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

Revision Record

No.	Description	Date (m/d/y)
A	ISSUED FOR SPA	12/18/18
No.	Description	Date (m/d/y)

Issue Record

LICENSED PROFESSIONAL ENGINEER I. D. LAMARRE DECEMBER 20, 2018 PROVINCE OF ONTARIO

NOT FOR CONSTRUCTION

LANHACK Consultants Inc.
Consulting Engineers
1709 Upper James Street
Hamilton, ON L9B 1K7
Tel: (905) 777-1454
Fax: (905) 336-8142

Waterfront Phase 3

310 Frances Avenue
Hamilton, Ontario

Date:	December 2018
Drawn By:	TV
Chkd By:	SMP
Scale:	1:400

Servicing Plan

Project No.:	Drawing No.:	Rev.:
17091	C2-1	A

Plot Date: 12/19/18
M:\2017\17091 - Waterfront Trails 3 NHGH\CIVIL\17091_C1-1 Grading Plan.dwg

ENVIRONMENTAL NOISE IMPACT STUDY

"WATERFRONT TRAILS PH 3"
310 FRANCES AVENUE
CITY OF STONEY CREEK
NOW THE CITY OF HAMILTON

Prepared for:

New Horizon Development Group
69 John Street South
Suite 400
Hamilton, ON
L8N 2B9

Prepared By:

Melissa MacLean
Vice President

Our File No: 2018-1073
November 2018

dBA Acoustical Consultants Inc.
P.O Box 32059
1447 Upper Ottawa
Hamilton, ON
L8W 3K0

TABLE OF CONTENTS

1.0 INTRODUCTION

dBA Acoustical Consulting Inc. has been retained to provide a noise impact study on behalf of New Horizon Development Group for the proposed mixed use "Waterfront Trails PH 3" also known as 310 Francis Avenue, located at the corners of Green Road, North Service Road and Frances Avenue, Stoney Creek, ON. The purpose of the study is to determine the noise impact from the QEW and North Service Road vehicular traffic that may impact the proposed residential buildings as required for site plan approval for the City of Hamilton.

Proposed for the development are three separate towers totaling 1836 residential units with a 1-storey commercial podium. Tower 1- a 59 storey building consisting of 670 units. Tower 2- a 54 storey building consisting of 615 units and Tower 3- a 48 storey building consisting of 551 units. These towers will sit within a 5-storey parking structure with a 5th-storey rooftop terrace. This study will detail the noise impact relative to the site plan and recommend noise control measures necessary (if applicable) to meet MOE Publication NPC-300 entitled "Stationary & Transportation Sources-Approval & Planning guidelines while satisfying the planning requirements of the City of Hamilton.

Vibration is not considered as there are no heavy industry or railway lines within the required setback distances of 300m. CN/CP Rail is located 585m outside the setback requirements for rail therefore is not a concern with noise. Aircraft is not a concern as the development is located outside the NEF 25 contour of the any area Airports.

2.0 SITE DESCRIPTION

The proposed three tower residential development property is located on the north corner of North Service Road, east of Green Road, and south of Frances Ave, Stoney Creek, ON.

The North Service Rd is a 2-lane roadway running east and west with a posted speed of 80 km/hr and is a heavy truck route located approximately 45m south of the proposed development.

The QEW is a 6-lane is the major traffic noise source, running east-west, located approximately 140m south of the proposed development with a posted speed limit of 100 km/hr. To the west of the proposed development, along the QEW and the North Service Rd. are 5.5m noise barriers, that shield a portion of the QEW and North Service Rd traffic noise at the proposed development. To the west of the proposed site is a small 2 storey commercial building on Green Road and 2.5 storey residential townhouses and a 5.5m noise barrier at the rear yard amenity spaces abutting the North Service Rd as [previously stated. To the north is Lake Ontario, a large 18 storey apartment condo building and 2.5 storey townhouses. To the east are 2.5 storey townhouses with a 4.5m rear yard noise barrier abutting the North Service Road. Further east is Millen Road with an overpass on the QEW. Site Location is attached as Figure 1.

3.0 NOISE IMPACT ASSESSMENT

3.1 NOISE CRITERIA

The Ministry of Environment (MOE) specifies limits for road noise relative to new residential developments. The MOE Publication NPC-300 entitled "Stationary & Transportation Sources-Approval & Planning, specifies the criteria, summarized as follows:

TABLE1- Road Traffic Sound Levels Limits

Time Period	Leq (dBA)
07:00 – 23:00 (16 hr.)	55 Outdoor Living area
07:00 – 23:00 (16 hr.)	55 Plane of Window
23:00 – 07:00 (8 hr.)	50 Plane of Bedroom window

Where noise levels estimated at the Plane of the Window (POW) are equal to or less than the values listed in Table 1, no noise control measures are required. Where noise levels exceed Table 1 values, the following action is required:

TABLE 2 –Noise Control Requirements		
Time Period	**Noise Level Leq (dBA)**	**Action Required**
07:00 - 23:00 Daytime (OLA)	56 to 60	Warning Clause Type "A"
	> 60	Barrier & Warning Clause Type "B"
07:00 – 23:00 Daytime (POW)	>55	Provision for A/C, Warning Clause "C"
	>65	Central A/C, Warning Clause "D"
	>65	Building Component Specification
23:00 to 07:00 Nighttime (POW)	> 50	Provision for A/C and Warning Clause Type "C"
	> 60	Building Component Specification
	> 60	Central Air and Warning Clause Type "D"

Where nighttime noise levels exceed 60 dBA, building components must be designed to meet Table 3 indoor sound level limits.

TABLE 3 - Indoor Road Sound Levels Limits	
Indoor Location	**Leq (dBA)**
	Road
Living/Dining 7:00 – 23:00	45
Bedroom 23:00 - 07:00	40

3.2 ROAD NOISE

Predicted road traffic noise levels were calculated for QEW and North Service Road, the main road noise sources in the proposed site area. The 2016 AADT road traffic volumes for the QEW was sourced from the Ministry of Transportation Traffic Volumes on Demand website. The 2016 AADT road traffic volumes for North Service Road was sourced from the City of Hamilton AADT Transportation Data Management System Online Map. See Appendix "A".

The MOE computer program STAMSON version 5.04 was used to carry out prediction calculations (See Appendix "A"). Traffic data is summarized in Table 4. The daytime/nighttime volume ratios relative to the QEW is calculated using a 24 hr assessment as required by the MOE and City of Hamilton and the North Service Road is calculated using a 90/10 split and a 16/8 hr assessment required by the MOE.

The percentage of annual growth for the QEW was figured at 2.0% over 12 years. The AADT (Annual Average Daily Traffic) volumes used are reflective of the worst-case scenario. Truck volumes were factored at 6.0% medium and 14.0% heavy of the total vehicle volumes for each roadway segment. Calculated noise levels were modeled at 18 receptor locations representative of the Plain of the Window (POW) of the building facade of the three towers at specific storeys. (See Figure 3 Receptor Locations).

The percentage of annual growth for the North Service Road was figured at 2.0% over 12 years. The AADT (Annual Average Daily Traffic) volumes used are reflective of the worst-case scenario. Truck volumes were factored at 2.0% medium and 2.0% heavy of the total vehicle volumes for the roadway segment. Calculated noise levels were modeled at 3 receptor locations representative of the Plain of the Window (POW) of the building facade of Tower 1 at specific locations. The North Service Road, as confirmed by the attached Stamson calculation sheets, will not have a significant acoustical impact on the proposed development as the levels are 10 dBA lower than traffic noise levels from the QEW. Area roadways have no acoustical impact on the proposed site due to lower speed and traffic volumes. (See Figure 3 Receptor

Locations).

TABLE 4 – Future Road Traffic Volumes			
QEW	**AADT 150921 Vehicles**		
	Cars	**Medium Trucks**	**Heavy Trucks**
24 Hour	117718	12074	21129
North Service Road	**AADT 8997 Vehicles**		
	Cars	**Medium Trucks**	**Heavy Trucks**
Day	7775	162	162
Night	862	18	18

The following Table 5 represents the free field noise levels of future road traffic from the QEW at 18 receptor locations.

TABLE 5 – Predicted Future Traffic Noise for the QEW (dBA)	
Location	**24 HOURS**
R1- Tower 1 – South Façade First Floor	76.0 dba (20.0m)
R2- Tower 1 – South Façade 19 Floor	77.0 dba (58.0m)
R3- Tower 1 – South Façade Top Floor	77.0 dba (117.0m)
R4- Tower 1 – East/West Façade First Floor	73 .0 dba (20.0m)
R5- Tower 1 – East/West Façade 19 Floor	74.0 dba (58.0m)
R6- Tower 1 – East/West Façade Top Floor	74.0 dba (117.0m)
R7- Tower 2 – South Façade First Floor	73.0 dba (20.0m)
R8- Tower 2 – South Façade 19 Floor	74.0 dba (58.0m)
R9- Tower 2 – South Façade Top Floor	74.0 dba (132.0m)
R10- Tower 2 – East/West Façade First Floor	70.0 dba (20.0m)
R11- Tower 2 – East/West Façade 22 Floor	71.0 dba (66.0m)
R12- Tower 2 – East/West Façade Top Floor	71.0 dba (132.0m)
R13- Tower 3 – South Façade First Floor	72.0 dba (20.0m)
R14- Tower 3 – South Façade 22 Floor	74.0 dba (66.0m)
R15- Tower 3 – South Façade Top Floor	74.0 dba (132.0m)
R16- Tower 3 – East/West Façade First Floor	69.0 dba (20.0m)
R17- Tower 3 – East/West Façade 19 Floor	70.0 dba (57.0m)
R18- Tower 3 – East/West Façade Top Floor	71.0 dba (132.0m)

The following Table 5A represents the free field noise levels of future road traffic from the North Service Road at specific receptor locations to confirm that the North Service Road will have no significant acoustical impact on the proposed development.

TABLE 5A – Predicted Future Traffic Noise for the North Service Road (dBA)		
Location	**07:00 – 23:00**	**23:00 – 07:00**
R1- Tower 1 – South Façade First Floor	61.0 dba (20.0m)	54.0 dba (20.0m)
R2- Tower 1 – South Façade 19 Floor	62.0 dba (58.0m)	55.0 dba (58.0m)
R3- Tower 1 – South Façade Top Floor	62.0 dba (177.0m)	55.0 dba (117.0m)

The following Table 5B represents the mitigated noise levels for the 5th Floor Rooftop OLA with a 3.0m concrete noise barrier.

TABLE 5B – Mitigated Noise Levels 5th Floor Rooftop OLA 4.5m Concrete Noise Barrier (dBA)	
Location	**07:00 – 23:00**
5th Floor Rooftop OLA 4.5m Noise Barrier	56.0 (15.0m)

4.0 RECOMMENDATIONS - NOISE CONTROL

4.1 OUTDOOR LIVING AREAS

Calculated road noise levels for the proposed development exceed the 55 dBA daytime criteria outlined in Table 1. The proposed tower designs included standard balconies for all units for the front and back facades. All balconies less than 4m in depth and are not considered OLA's (Outdoor Living Areas) and as such, no mitigation will be required.

A fifth-floor outdoor amenity terrace space (OLA) is proposed for this development. Mitigation measures are required to mitigate the noise levels to achieve Table 1 daytime noise criteria. Road noise levels for the proposed fifth floor terrace and amenity space exceed the 55 dBA daytime criteria and as such a Warning Clause Type "A" is required to be inserted into all Offers of Purchase of Lease for all units. A 4.5m concrete wall extending from the south parapet will suffice with 3.0m return ends. Material specification of a continuous concrete noise wall exceeds a minimum surface density be 20kg/m² and free of gaps and cracks within or at the return ends. See Figure 4 Noise Barrier Locations.

4.2 INDOOR NOISE LEVELS

Calculated nighttime road noise levels at the Plane of Window (POW) exceed the 50 dBA criteria outlined in Table 1 for indoor space for residential units exposed to the QEW. Specific building components (walls, windows, doors etc.) are required and confirmed using the STC (Sound Transmission Class) method. Building design specifications were not made available and STC value calculations (Sound Transmission Class) method are summarized in Table 6 following.

TABLE 6 – Recommended Door and Window Construction		
LOCATION	**STC To Be Used**	**Wall STC**
All South & East & West Facing Units		
Bedroom	36	EW4
Living room	36	EW4
All Other Units		
Bedroom	26	OBC
Living room	26	OBC

5.0 VENTILATION / WARNING CLAUSES

Ventilation and warning clause requirements are required for this project as noted in Table 7 following.

TABLE 7 - Ventilation and Warning Clause Requirements All Buildings		
LOCATION	VENTILATION	WARNING CLAUSE
South & East & West Facing Units	A/C,	Warning Clause "D"
5Th Floor OLA – All Units	NA	Warning Clause "A"

TYPE A: All Buildings

"Purchasers/tenants are advised that sound levels due to increasing road traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the Municipality's and the Ministry of the Environment's noise criteria."

TYPE D: All Buildings

"This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the Municipality's and the Ministry of the Environment's noise criteria."

6.0 SUMMARY OF RECOMMENDATIONS

The following noise control measures are required to satisfy the indoor and outdoor noise level criterion:

- Central Air Conditioning as recommended in Table 7 for all Buildings all units.
- Specific Window, Door, and Wall construction as recommended in Table 6.
- Registered Warning Clause Type "D" on title for specific residential units in Table 7.
- EW4 for all south, east, and west facing residential units as recommended in Table 6.
- Registered Warning Clause Type "A" for the OLA for all residential units in Table 7.
- It is recommended that a qualified acoustical consultant certify that the required noise control measures have been incorporated into the builder's plans prior to issuance of a building permit.
- It is recommended that a qualified acoustical consultant certify that the required control measures have been properly installed prior to an occupancy permit.

7.0 CONCLUSIONS

dBA Acoustical Consulting Inc. has provided a noise impact study on behalf of New Horizon Development Group for the proposed "Waterfront Trails PH 3" also known as 310 Francis Avenue, located at the corners of Green Road, North Service Road and Frances Avenue, Stoney Creek, ON.

This noise study determined the noise impact from the QEW and North Service Road vehicular traffic that impacts the proposed residential buildings and recommend noise control measures necessary to meet MOE Publication NPC-300 entitled "Stationary & Transportation Sources-Approval & Planning guidelines while satisfying the planning requirements of the City of Hamilton. Noise mitigation measures are required.

FIGURE 1
SITE PLAN

FIGURE 2
SITE PLAN

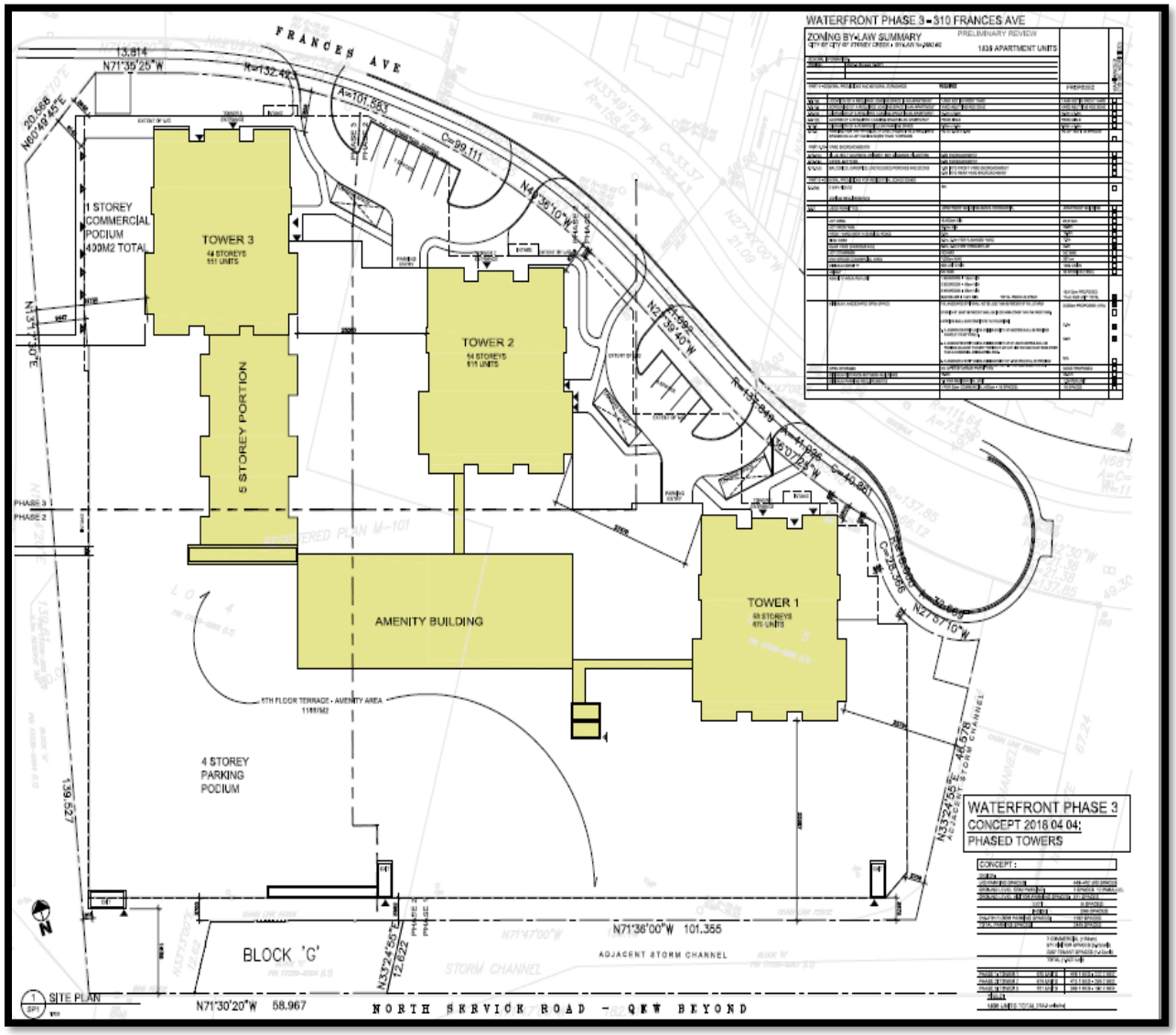
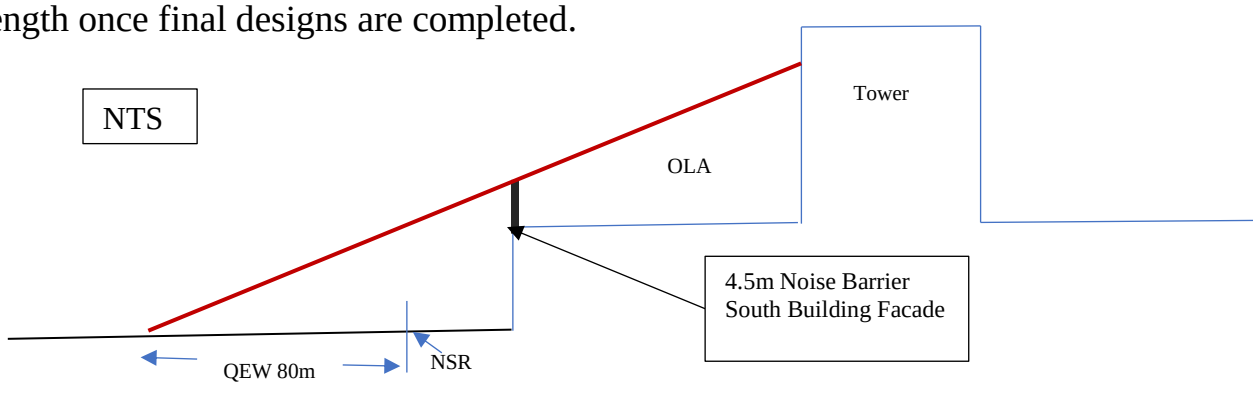


FIGURE 3
RECEPTOR LOCATIONS

FIGURE 4
NOISE BARRIER LOCATIONS

Note: Red line represents the 4.5m height noise barrier that will be constructed of concrete extending from the parapet walls to the south, east, and west. The east and west wing walls will be staged to a minimum 3.0m height wall and confirmed length once final designs are completed.



APPENDIX “A”

2016 City of Hamilton
Traffic Data

2016 Ministry of Transportation
QEW Traffic Data

Highway	Location Description From	Location Description To	Dist. (KM)	2016 AADT
QEW	FORT ERIE-GODERICH ST-PEACE BRIDGE PLAZA	CENTRAL AV IC	0.2	14,600
QEW	CENTRAL AV IC	CONCESSION RD IC-1	0.9	18,700
QEW	CONCESSION RD IC-1	THOMPSON RD IC-2	1.0	15,500
QEW	THOMPSON RD IC-2	GILMORE RD IC-5	2.4	17,700
QEW	GILMORE RD IC-5	BOWEN RD IC-7	2.0	24,200
QEW	BOWEN RD IC-7	NETHERBY RD IC-12 NIAGARA FALLS LTS	5.5	25,700
QEW	NETHERBY RD IC-12 NIAGARA FALLS LTS	SODOM RD IC-16	3.2	22,000
QEW	SODOM RD IC-16	LYONS CREEK RD IC-21	6.6	29,000
QEW	LYONS CREEK RD IC-21	MCLEOD RD IC-27	4.4	36,700
QEW	MCLEOD RD IC-27	HWY 420 IC-30	2.9	45,100
QEW	HWY 420 IC-30	THOROLD STONE RD IC-32	2.0	70,400
QEW	THOROLD STONE RD IC-32	MOUNTAIN RD IC-34	2.5	67,400
QEW	MOUNTAIN RD IC-34	HWY 405(WBL)IC-37	2.4	71,000
QEW	HWY 405(WBL)IC-37	GLENDALE AV IC-38	1.3	88,100
QEW	GLENDALE AV IC-38	NIAGARA ST SERVICE RDS	4.8	90,500
QEW	NIAGARA ST SERVICE RDS	NIAGARA ST IC-44	1.2	78,600
QEW	NIAGARA ST IC-44	LAKE ST IC-46	1.6	81,900
QEW	LAKE ST IC-46	ONTARIO ST IC-47	1.3	117,000
QEW	ONTARIO ST IC-47	MARTINDALE RD IC-48	0.7	97,400
QEW	MARTINDALE RD IC-48	HWY 406 IC-49	0.7	74,400
QEW	HWY 406 IC-49	SEVENTH ST IC-51	1.9	97,100
QEW	SEVENTH ST IC-51	JORDAN RD IC-55	4.3	98,100
QEW	JORDAN RD IC-55	VICTORIA AV IC-57	2.8	104,300
QEW	VICTORIA AV IC-57	ONTARIO ST IC-64	6.7	105,100
QEW	ONTARIO ST IC-64	BARTLETT AV IC-68	3.8	99,800
QEW	BARTLETT AV IC-68	MAPLE AV IC-71	2.5	99,300
QEW	MAPLE AV IC-71	CASABLANCA BV IC-74	3.6	107,100
QEW	CASABLANCA BV IC-74	FIFTY RD IC-78	3.5	112,300
QEW	FIFTY RD IC-78	FRUITLAND RD IC-83	5.1	120,300
QEW	FRUITLAND RD IC-83	HAMILTON 20 IC 88-CENTENNIAL PKWY	5.2	119,000
QEW	HAMILTON 20 IC 88-CENTENNIAL PKWY	BURLINGTON ST IC-89	1.6	130,000
QEW	BURLINGTON ST IC-89	EASTPORT RD IC-93 (7189)	4.0	135,000
QEW	EASTPORT RD IC-93 (7189)	HAMILTON HARBOUR ENTRANCE	0.9	149,400
QEW	HAMILTON HARBOUR ENTRANCE	NORTH SHORE BLVD IC 97	2.3	271,300
QEW	NORTH SHORE BLVD IC 97	FAIRVIEW ST IC-99	2.3	161,300
QEW	FAIRVIEW ST IC-99	HWY 403/407 IC-100	1.0	172,900
QEW	HWY 403/407 IC-100	BRANT ST IC 101	0.8	164,300
QEW	BRANT ST IC 101	GUELPH LINE IC-102	1.8	162,100
QEW	GUELPH LINE IC-102	WALKERS LINE IC-105	2.0	195,000
QEW	WALKERS LINE IC-105	APPLEBY LINE IC-107	2.0	190,000

STAMSON
CALCULATIONS

```
STAMSON 5.04        SUMMARY REPORT        Date: 14-11-2018 11:08:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1nserv.te           Time Period: Day/Night 16/8 hours
Description: R1-First Floor Residential Free Field
                      TOTAL Leq FROM ALL SOURCES        (DAY): 60.55
                                                        (NIGHT): 54.02
Road data, segment # 1: North Serv (day/night)
-----------------------------------------------
Car traffic volume  :  7755/862   veh/TimePeriod  *
Medium truck volume :   162/18    veh/TimePeriod  *
Heavy truck volume  :   162/18    veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   7077
    Percentage of Annual Growth        :   2.00
    Number of Years of Growth          :  12.00
    Medium Truck % of Total Volume     :   2.00
    Heavy Truck  % of Total Volume     :   2.00
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: North Serv (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  60.00 / 60.00  m
Receiver height           :  20.00 / 20.00  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Result summary (day)
--------------------
                     !  source  !   Road   !  Total
                     !  height  !   Leq    !   Leq
                     !   (m)    !  (dBA)   !  (dBA)
---------------------+---------+---------+---------
 1.North Serv        !     1.19 !    60.55 !    60.55
---------------------+---------+---------+---------
                       Total                  60.55 dBA
Result summary (night)
----------------------
                     !  source  !   Road   !  Total
                     !  height  !   Leq    !   Leq
                     !   (m)    !  (dBA)   !  (dBA)
---------------------+---------+---------+---------
 1.North Serv        !     1.19 !    54.02 !    54.02
---------------------+---------+---------+---------
                       Total                  54.02 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:16:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R1Water.te           Time Period: 24 hours
Description: R1 Tower 1 1st Floor Residential South Facade QEW
                                   TOTAL Leq FROM ALL SOURCES:  75.95
Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 109.00 m
Receiver height           :  20.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 75.95 + 0.00) = 75.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
-90     90   0.09  85.62   0.00  -9.41  -0.26   0.00   0.00   0.00  75.95
-------------------------------------------------------------------------

Segment Leq : 75.95 dBA

Total Leq All Segments: 75.95 dBA
```

```
STAMSON 5.04        SUMMARY REPORT        Date: 14-11-2018 11:11:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2nserv.te           Time Period: Day/Night 16/8 hours
Description: R2- 19th Floor Residential Free Field
                      TOTAL Leq FROM ALL SOURCES        (DAY): 61.56
                                                        (NIGHT): 55.03
Road data, segment # 1: North Serv (day/night)
-----------------------------------------------
Car traffic volume  :  7755/862   veh/TimePeriod  *
Medium truck volume :   162/18    veh/TimePeriod  *
Heavy truck volume  :   162/18    veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   7077
    Percentage of Annual Growth        :   2.00
    Number of Years of Growth          :  12.00
    Medium Truck % of Total Volume     :   2.00
    Heavy Truck  % of Total Volume     :   2.00
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: North Serv (day/night)
-----------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  60.00 / 60.00  m
Receiver height           :  57.00 / 57.00  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Result summary (day)
--------------------
                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+---------+---------+---------
 1.North Serv       !     1.19 !    61.56 !    61.56
--------------------+---------+---------+---------
                      Total                   61.56 dBA
Result summary (night)
----------------------
                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+---------+---------+---------
 1.North Serv       !     1.19 !    55.03 !    55.03
--------------------+---------+---------+---------
                      Total                   55.03 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:18:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R2Water.te           Time Period: 24 hours
Description: R2 Tower 1 South 19 floor Facade QEW
                                        Total Leq All Segments: 77.00 dBA
Road data, segment # 1: QEW
----------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 109.00 m
Receiver height           :  58.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 77.00 + 0.00) = 77.00 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
-90     90   0.00  85.62   0.00  -8.61   0.00   0.00   0.00   0.00  77.00
-------------------------------------------------------------------------------

Segment Leq : 77.00 dBA
```

```
STAMSON 5.04        SUMMARY REPORT        Date: 14-11-2018 11:13:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3nserv.te           Time Period: Day/Night 16/8 hours
Description: R3- Top Floor Residential Free Field
                              TOTAL Leq FROM ALL SOURCES (DAY): 61.56
                                                   (NIGHT): 55.03
Road data, segment # 1: North Serv (day/night)
-----------------------------------------------
Car traffic volume  :  7755/862   veh/TimePeriod  *
Medium truck volume :   162/18    veh/TimePeriod  *
Heavy truck volume  :   162/18    veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   7077
    Percentage of Annual Growth        :   2.00
    Number of Years of Growth          :  12.00
    Medium Truck % of Total Volume     :   2.00
    Heavy Truck  % of Total Volume     :   2.00
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: North Serv (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  60.00 / 60.00  m
Receiver height           : 117.00 / 117.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Result summary (day)
--------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+---------+---------+---------
 1.North Serv       !     1.19 !    61.56 !    61.56
--------------------+---------+---------+---------
                      Total                  61.56 dBA
Result summary (night)
----------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+---------+---------+---------
 1.North Serv       !     1.19 !    55.03 !    55.03
```

STAMSON 5.04 NORMAL REPORT Date: 11-10-2018 13:23:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R3Water.te Time Period: 24 hours
Description: R3 Tower 1 South Facade Top Floor QEW
TOTAL Leq FROM ALL SOURCES: 77.00 dBA

Road data, segment # 1: QEW

Car traffic volume : 117718 veh/TimePeriod *
Medium truck volume : 12074 veh/TimePeriod *
Heavy truck volume : 21129 veh/TimePeriod *
Posted speed limit : 100 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: QEW

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 109.00 m
Receiver height : 117.00 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: QEW

Source height = 1.93 m

ROAD (0.00 + 77.00 + 0.00) = 77.00 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	85.62	0.00	-8.61	0.00	0.00	0.00	0.00	77.00

Segment Leq : 77.00 dBA

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:26:52
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R4Water.te           Time Period: 24 hours
Description: R4 Tower 1 East/West Facade First Floor QEW
                      TOTAL Leq FROM ALL SOURCES:         72.69 dBA

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           :  -0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 115.00 m
Receiver height           :  20.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 72.69 + 0.00) = 72.69 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
-0     90   0.09  85.62   0.00  -9.66  -3.27   0.00   0.00   0.00  72.69
-------------------------------------------------------------------------------

Segment Leq : 72.69 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:30:06
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5water.te           Time Period: 24 hours
Description: R5 Tower 1 East/West Facade 19 Floor QEW
                              TOTAL Leq FROM ALL SOURCES:       73.76
Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           :  -0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 115.00 m
Receiver height           :  58.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 73.76 + 0.00) = 73.76 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
 -0     90   0.00  85.62   0.00  -8.85  -3.01   0.00   0.00   0.00  73.76
-------------------------------------------------------------------------

Segment Leq : 73.76 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:31:22
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r6water.te           Time Period: 24 hours
Description: R6 Tower 1 East/West Facade Top Floor QEW
                              TOTAL Leq FROM ALL SOURCES:       73.76

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           :  -0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 115.00 m
Receiver height           : 117.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------
Source height = 1.93 m

ROAD (0.00 + 73.76 + 0.00) = 73.76 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
-0     90   0.00  85.62   0.00  -8.85  -3.01   0.00   0.00   0.00  73.76
-------------------------------------------------------------------------------
Segment Leq : 73.76 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:34:52
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r7water.te           Time Period: 24 hours
Description: R7 Tower 2 South Facade First Floor QEW
                              TOTAL Leq FROM ALL SOURCES:       72.91

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 207.00 m
Receiver height           :  20.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 72.91 + 0.00) = 72.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.09  85.62   0.00 -12.45  -0.26   0.00   0.00   0.00
72.91
-------------------------------------------------------------------------
--

Segment Leq : 72.91 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:36:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8water.te           Time Period: 24 hours
Description: R8 Tower 2 South Facade 19 Floor QEW
                      TOTAL Leq FROM ALL SOURCES:       74.22

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 207.00 m
Receiver height           :  58.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 74.22 + 0.00) = 74.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
 -90     90    0.00  85.62   0.00 -11.40   0.00   0.00   0.00   0.00  74.22
-------------------------------------------------------------------------------

Segment Leq : 74.22 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:49:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9water.te           Time Period: 24 hours
Description: R9 Tower 2 South Facade Top Floor QEW
                  TOTAL Leq FROM ALL SOURCES:      74.22

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 207.00 m
Receiver height           : 132.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 74.22 + 0.00) = 74.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  85.62   0.00 -11.40   0.00   0.00   0.00   0.00
74.22
-------------------------------------------------------------------------
--

Segment Leq : 74.22 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:55:41
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r10water.te          Time Period: 24 hours
Description: R10 Tower 2 East/West Facade First Floor QEW
                  TOTAL Leq FROM ALL SOURCES:       69.78

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           :  -0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 212.00 m
Receiver height           :  20.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 69.78 + 0.00) = 69.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    -0     90   0.09  85.62   0.00 -12.56  -3.27   0.00   0.00   0.00
69.78
-------------------------------------------------------------------------
--

Segment Leq : 69.78 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:57:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r11water.te          Time Period: 24 hours
Description: R11 Tower 2 East/West Facade 22nd Floor QEW
                     TOTAL Leq FROM ALL SOURCES:      71.10

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           :  -0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 212.00 m
Receiver height           :  66.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 71.10 + 0.00) = 71.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    -0     90   0.00  85.62   0.00 -11.50  -3.01   0.00   0.00   0.00
71.10
-------------------------------------------------------------------------
--

Segment Leq : 71.10 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 13:58:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r12water.te          Time Period: 24 hours
Description: R12 Tower 2 East/West Facade Top Floor QEW
                 TOTAL Leq FROM ALL SOURCES:       71.10

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           :  -0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 212.00 m
Receiver height           : 132.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 71.10 + 0.00) = 71.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    -0     90   0.00  85.62   0.00 -11.50  -3.01   0.00   0.00   0.00
71.10
-------------------------------------------------------------------------
--

Segment Leq : 71.10 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 14:00:17
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r13water.te          Time Period: 24 hours
Description: R13 Tower 3 South Facade First Floor QEW
                     TOTAL Leq FROM ALL SOURCES:      72.37

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 232.00 m
Receiver height           :  20.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 72.37 + 0.00) = 72.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.09  85.62   0.00 -12.99  -0.26   0.00   0.00   0.00
72.37
-------------------------------------------------------------------------
--

Segment Leq : 72.37 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 14:03:15
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r14water.te          Time Period: 24 hours
Description: R14 Tower 3 South Facade 19th Floor QEW
                 TOTAL Leq FROM ALL SOURCES:      73.72

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 232.00 m
Receiver height           : 66.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 73.72 + 0.00) = 73.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  85.62   0.00 -11.89   0.00   0.00   0.00   0.00
73.72
-------------------------------------------------------------------------
--

Segment Leq : 73.72 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 14:04:17
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r15water.te          Time Period: 24 hours
Description: R15 Tower 3 South Facade Top Floor QEW
                 TOTAL Leq FROM ALL SOURCES:      73.72

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 232.00 m
Receiver height           : 132.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 73.72 + 0.00) = 73.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
-90     90   0.00  85.62   0.00 -11.89   0.00   0.00   0.00   0.00  73.72
-------------------------------------------------------------------------------

Segment Leq : 73.72 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 14:19:17
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r16water.te          Time Period: 24 hours
Description: R16 Tower 3 East/West Facade First Floor QEW
                     TOTAL Leq FROM ALL SOURCES:      69.26

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           :  -0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 237.00 m
Receiver height           :  20.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 69.26 + 0.00) = 69.26 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    -0     90   0.09  85.62   0.00 -13.09  -3.27   0.00   0.00   0.00
69.26
-------------------------------------------------------------------------
--

Segment Leq : 69.26 dBA
```

```
STAMSON 5.04        NORMAL REPORT        Date: 11-10-2018 14:22:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r17water.te          Time Period: 24 hours
Description: R17 Tower 3 East/West Facade 19 Floor QEW
                 TOTAL Leq FROM ALL SOURCES:       70.62

Road data, segment # 1: QEW
---------------------------
Car traffic volume  : 117718 veh/TimePeriod  *
Medium truck volume : 12074 veh/TimePeriod  *
Heavy truck volume  : 21129 veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: QEW
-------------------------
Angle1   Angle2           :  -0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 237.00 m
Receiver height           :  57.00 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: QEW
------------------------

Source height = 1.93 m

ROAD (0.00 + 70.62 + 0.00) = 70.62 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    -0     90   0.00  85.62   0.00 -11.99  -3.01   0.00   0.00   0.00
70.62
-------------------------------------------------------------------------
--

Segment Leq : 70.62 dBA
```

STAMSON 5.04 NORMAL REPORT Date: 11-10-2018 14:23:14
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r17water.te Time Period: 24 hours
Description: R18 Tower 3 East/West Facade Top Floor QEW

TOTAL Leq FROM ALL SOURCES: 70.62 dBA

Road data, segment # 1: QEW

Car traffic volume : 117718 veh/TimePeriod *
Medium truck volume : 12074 veh/TimePeriod *
Heavy truck volume : 21129 veh/TimePeriod *
Posted speed limit : 100 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: QEW

Angle1 Angle2 : -0.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 237.00 m
Receiver height : 132.00 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: QEW

Source height = 1.93 m

ROAD (0.00 + 70.62 + 0.00) = 70.62 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-0	90	0.00	85.62	0.00	-11.99	-3.01	0.00	0.00	0.00	70.62

Segment Leq : 70.62 dBA

Total Leq All Segments: 70.62 dBA

STAMSON 5.04 SUMMARY REPORT Date: 03-12-2018 14:58:58
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1qewola.te Time Period: 24 hours
Description: **5th Floor Rooftop Amenity Space with 4.5m Noise**
TOTAL Leq FROM ALL SOURCES: 55.89(OLA)

Road data, segment # 1: QEW

Car traffic volume : 117718 veh/TimePeriod *
Medium truck volume : 12074 veh/TimePeriod *
Heavy truck volume : 21129 veh/TimePeriod *
Posted speed limit : 100 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: QEW

Angle1 Angle2 : -45.00 deg 45.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 80.00 m
Receiver height : 12.00 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -45.00 deg Angle2 : 45.00 deg
Barrier height : 4.50 m
Barrier receiver distance : 20.00 m
Source elevation : 0.00 m
Receiver elevation : 15.00 m
Barrier elevation : 15.00 m
Reference angle : 0.00

Result summary
---

	source height (m)	Road Leq (dBA)	Total Leq (dBA)
1.QEW	1.93	55.89	55.89
Total			**55.89 dBA**

Comment Summary
DA-19-020

DRT Date and Time: **April 24, 2019, 9:00am**
Property Address: **310 Frances Avenue, Stoney Creek**
Agent: **Sarah Knoll, GSP Group**
Jeff Paikin, NHDG
Joe Giacomodonato, NHDG
Mike Foley, NHDG
Natasha Paikin, NHDG
Sarah Knoll, GSP Group Inc. (Planning)
Shem Myszkowski, KNYMH (Architectural)
Wayne Harrison, KNYMH (Architectural)
Marc Begin, KNYMH (Architectural)
Steve Pongracz, Lanhack (Civil Engineering)
Frank Westaway, dBA Acoustics (Noise)
Dan Bacon, RWDI (Wind)
Planner/Facilitator Assigned: **Melanie Schneider**
Previous/Relevant file: **ZAC-08-079, OPA-08-19, 25T-200809**
Internal: **Anita Fabac, Kathy Jazvac, Christie Meleskie (HSR), Sandra Lucas, Yvette Rybensky, Binu Korah, Melissa Kiddie, Victoria Brito, Sandra Al-Dabbagh (Dev. Eng), Alvin Chan, Cllr Pearson, Ana Cruceru**

Proposal: to construct a hybrid tall building composed of three towers having 48, 54, and 59 storeys in height, 2,409 parking spaces within a four storey podium and two levels of underground parking, 400 sq m of commercial space, and a total of 1,836 dwelling units, eight of which within ground-related units. Lands will be accessed from Frances Avenue and will include a rooftop amenity spaces above the podium structure.

Ground units are the only 3 bedrooms – the towers have 1 and 2 br units

- **Meeting to discuss solutions and comments**

Zone Category: Mixed Use Commercial "MUC-4" Zone, Modified
Official Plan Designation: Neighbourhoods

Recommend Conditional Approval: No

Concerns and Recommended Solutions:

- Major revisions to the development are required in order to meet applicable plans and policies. Supporting reports and plans, such as Sun Shadow, Wind Study, Noise Impact Study, SWM Brief, Water Generation Assessment, TIS, Parking Study, have not been supported by staff.

- Applicant is aware that Conditional Approval will not be granted at DRT meeting. Meeting will be structured as a working session to allow for discussions to determine best course of action for this site.

Commenting Agency	Comment/Concern	Req'd Study/Report
Transportation Planning	• Formal comments outstanding – will provide comments on TIS after the meeting – no comments on site plan itself as of yet	• Revised Traffic Impact Study • Neighbourhood

	• TIS under review – 5 year post-build horizon, expanded study area, mitigation evaluation, review of traffic signal at Frances Ave and Green Road, and improved pedestrian and cycling infrastructure required to be included in Study. Additional comments and revisions may be required • Quick review – quite a few upgrades to roadways, including North Service • May have to redo TIS – to MTO standards which are more stringent • Road works will be required which may include traffic signal installation (Frances Avenue and North Service Road?) – we know there is going to be a HUGE issue with this many issues (Cllr is having signals installed) • Concerned with Green and Frances, to the west and Service • Might be able to look at right in off of Green – but definitely not left out on to Green. • Needs to have all Transportation issues resolved prior to occupancy • Pedestrian cyclists – e/w for major route for water front trail – we need to protect • Neighbourhood Traffic calming • Parking reduction **not** supported without access to reliable transit infrastructure • 92-367 short term and 918-2295 long term bike parking spaces required • Show all pedestrian facilities on Site Plan • Provide wayfinding info to future residents • MTO doesn’t usually allow off the Service Road and Transportation won’t and MTO will have to look at it and it probably have a big challenge with them (Tran Plng) • This WILL BE A PHASED (1 tower per) • Right in off Green, Left out on Frances, and Right in and Right out on Service Road	Traffic Calming Study (pre/post Conditional Approval?) • External Works Agreement for road works • Revised **TDM** – really push transit use • NO LAYBY PARKING ON GREEN • CAN’T SUPPORT PARKING REDUCTION – without transit Sandra – we will have to look at it on a whole – if we don’t have enough parking, how is this going to impact the rest of the neighbourhood • We need to make sure there is adequate parking • MS – quoted SR – parking reduction on one site doesn’t mean its appropriate for another development • AF – we open to discussion regarding parking reduction without transit provided – need to know how are they getting around without transit available

	(Applicant)	
Development Engineering	• Revised TIS required per Transportation Planning Comments. If upgrades to work network required, External Works Agreement will be used as a Special Condition • Detailed review of Grading, Servicing, Erosion and Siltation Control not completed until development has been Conditionally Approved • Waste Generation Report exceeds allotted density for this development, being 250ppha. The City is in the midst of evaluating infrastructure needs for the Millen Shores area which includes the subject lands. Scope of necessary upgrades will be determined through this Study for the subject lands • Phasing is imperative to allow this development to proceed. 250ppha are permitted to be constructed before sanitary sewer infrastructure is improved. Approximately 300 dwelling units can be accommodated at this time. • Hydrant flow tests not sufficient for scale of development proposed in reference to required fire flow. Hydraulic modelling is being completed by the City • Permanent dewatering is not permitted. • Sanitary – is significantly exceeding – system CANNOT SUPPORT – Millen Shores study includes this site, but is not complete through review – Current CAP – is 190.74 TOTAL as of right based on capacity – If they go with just the 190 units they would **not** meet the minimum number of units • Even if they would go with 1 Tower – the Phasing plan would still have to be revised to allow only 250 ppl per hectre… • Special Condition – upon completion of Sanitary Services must be completed • Must redirect the flow to the east, rather then to green… then the main trunk needs to be extended under the QEW • If we do it its 5+ years, if they	• Hydrogeological Report for underground parking structure • Revised Functional Servicing Report • Conditions cannot be issued until engineering comments have been addressed • Development premature

Conservation Authority	• SWM Brief reviewed and requires compensation treatment. Level 2 quality control required. • Localized flooding from uncontrolled stormwater discharge could come from municipal road easement. Development Engineering to review this item. • Maximum 70% lot coverage should be maintained to limit storm quantity control as most water will be discharged to Stoney Creek Watercourse No. 1 • Proposed development needs to incorporate Bird Friendly Design Refer to Toronto Best Practices guidelines • Existing watercourse on site regulated by HCA – HCA Permit required • Grading design to reflect 2012 “Green Millen Shores Estates Stormwater Management Report” which acknowledges the Regulatory Floodline Plan	• Geotechnical Report for underground parking structure • Revised SWM Brief • Conditions 2(a), 2(c), 3(b), 3(c) • Steve P – has met with them to resolve this issue – Post/Pre is going to match
Building	• Confirm lands are merged on title • North Service Road deemed front lot line • Residential on Ground floor not permitted??? (Must be above commercial) • Melanie S – would like to see more commercial on ground floor – she would support variance for the main floor residential IF more commercial • 3.0m rear yard setback required to Frances Ave, 0.68m setback proposed (Tower 1) and flankage yard • 55,031sqm amenity space required, 33,169.3sqm proposed, 1,806 sq m of which as combined indoor amenity area • 50% lot coverage required, 25% of which required in front yard. Total 20.8% proposed – AF – this was supposed to be more of the Tower in the park concept – she has concern – MS this will go well into Ana’s comments • 5m landscape strip required adjacent to street, 0.6m min setback proposed along	

	Frances Ave, 5 m along North Service Road • 9 m landscape strip required adjacent to any zone other than commercial or industrial zones. 3.6 m landscape strip proposed along (P5) Zone, otherwise, no landscape strips clearly shown on Site Plan • 2,763 parking spaces required, 2,387 for residential and 22 for commercial proposed. Lay-by parking along Green Road may not be supported and would be subject to an Encroachment Agreement with Public Works. Layby parking is NOT supported • Provide separate accesses to parking for commercial and residential uses – Sandra Lucas – going to be putting people at risk if the commercial access is off Green • Anything in the P5 can’t be counted towards the required open space calculation – nor required parking • AF – anything required in the MUC zone needs to be provided within the MUC zone • Sarah – do we include that P5 area with calc for the area • Sarah – landscape striped – yards were reduced – but not the landscape strips were not – MS – are looking at reducing the landscaping strips – supportive of variance	
Growth Planning	• Confirm tenure of development. If three sperate condo corps, joint use agreements would be required • Any encroachments should be shown on necessary plans as they would be detailed in future Draft Plan of Condo applications – for encroachments for balconies too • Provide additional barrier free surface parking • Municipal addresses assigned for each tower and each ground related unit on Green Road. • Consult MTO • Loading – for tower 1- applicant indicated that it would be for drop off uses only	• If there is no phasing – it could be any type of condo application • Are they separate corps per tower? • Where is the snow storage going? • Garbage – underground one – AC’s concern – is getting garbage in and out – ensure waste trucks can get in and out

	• No barrier free for visitors	
Waste Management	• Site is eligible for municipal waste collection, given waste generation is within limits • Show truck movement on Site Plan • 13m turning radii required • Road base needs to support 35,000kg • Prior to Occupancy, an Agreement for On-Site Collection of Municipal Solid Waste must be executed • 18m head approach required for private roads within waste collection route • On site parking and snow storage prohibited in waste access route or collection area • Internal storage room required that must be well ventilated, rodent proof, and separate from a living space. • Collection limit of one garabge bag/container per dwelling unit per week. Size of collection vehicle and frequency shall be determined by dwelling units within each building	
Public Health	•	• Pest Control Plan will be required as a Special Condition
Councillor	• Not in support of development as currently proposed – wants to work with staff and applicant to come up with solution that works for everyone	• Snow Storage • Sidewalks
Canada Post	• Internal mail room will be required • Provide standard wording in Site Plan Undertaking	
Forestry	• Existing municipal trees may be impacted by development	• Tree Management Plan • Landscape Plan • Street Tree planting fee
HSR	• Lands serviced by trans-cab – will be a challenge to service with just this level of	• Conversations are happening about extension of

	current service • No funding available to accommodate route expansion in 2019. Funding may be re-evaluated in 2020 budget • Site will be monitored as part of consideration for future transit plans	services however not able to discuss at this table.
MTO	• MTO permit required • Provide 14m setback from MTO lands	• MTO Permit • Site Plan, SWM, TIS, Lighting Plan required for Permit review
Union Gas	• Existing lines service site, if relocation is required, it shall be at the cost of the developer	
Planning Comments		
Cultural Heritage	• Site meets 3 of 10 criteria for archeological potential • Pettit family plot may be located on site – so far can’t find any evidence that it is here – so caution is to be put on undertaking • Arch assessment completed which has determined it is highly unlikely that the family plot is located on the subject lands. No further concerns from a municipal perspective	• Caution Note on future Site Plan
Natural Heritage	• Lake Ontario within vicinity which is identified as a Core Area. Feature is important for migratory birds. Development will have potential impact and needs to be designed in a bird friendly manner (first 12m height is the most critical – however it is important that birds may migrate at a higher level, so they need to be looked at) • Existing private trees may be impacted by development proposal • Direct lights downwards to avoid attracting migrating birds at night • Look to Markham and Toronto for the Bird Friendly guidelines	• Bird Impact Assessment • Stewardship intiatives (brochure – for entire area) for future residents to show how the new residents can impact and how they can assist to protect the area – some opportunities to put some green roof areas amenities to mitigate the loss of habitat in the area – it allows the functionality

		• TPP • Landscape Plan
Parking	• Provide additional surface parking spaces for towers • Ground related units to be fully outlined in underground parking plans • Show intuitively located commercial parking spaces • Several parking spaces within parking podium to either be eliminated to adjusted to allow appropriate maneuvering • Provide adequate separation between parking spaces and support columns in parking structure • Concerns with on-street parking as traffic increases through development • On-street parking permits may arise as a result of development, cannot guarantee this will be an sustainable parking solutions • Parking study not supported by staff – proxy site within a different context (transit and road network) • Use a proxy site close to subject lands – consider reaching out to nearby multiple dwellings	• Revised Parking Study – proxy site was not appropriate – based on report today – we cannot support parking reduction • Revised Underground parking plans
Urban Design	• Break up podium to allow for ground level court yard • Enhance pedestrian movement through the site • Use Frances Avenue as the main interface with the neighbourhood – activate even further – lining it up with units to create that activity • Parkland faces a blank podium wall, activate this interface • Relocate loading spaces • Confirm intended commercial uses – encourage restaurants, cafes, grocery store – would be beneficial in creating that activity	• Further Sun Shadow review forthcoming • AF – reviewed purpose of DRP vs DRT • AF – discussed creating the opportunity splitting up the massing – and having different levels – • Why they placed the towers where they are – the intent of placing towers –

	(both utility and interest) • Break up amenity areas (vertically and horizontally) – look at them as if they were at grade – network of pathways connecting different areas, etc • Introduce ground level amenity areas • Include greenery with all outdoor amenity areas • Pull the tower massing away from the townhouse dwellings and use mid-rise massing as a transition to larger massings • Sun shadow study shows towers will have a consolidated shadow and does not meet our requirements	mature neighbourhood west of green – shadow impact is lined up and impact in minimalized – majority of amenity spaces created is on the north side or covered (shadow from this development – N/A) • Away from the highway etc • They are shrinking tower and reducing the 2 bedrooms • They are down to 840 plate • Another level of underground parking
Development Planning	• Noise Study to be revised to justify 56dBA levels for amenity area (outdoor living area – 55dBA required) • Site should be designed to use buildings as a natural noise barrier. Limit the use of Noise barriers • Site reviewed against Tall Building Guidelines • Reduce massing of podium – incorporate stepping in podium to match scale of adjacent developments • Step back towers from podium to ease transition • Provide separate accesses between commercial and residential uses • Provide maximum 70m long buildings – approx. 140m long massing proposed • Reduce tower floor plates to 750sqm – 952sqm currently proposed • Revise Wind Study to meet guideline	• Revised Wind Study • Revised Noise Study • Revised site design

	parameters • Explain how and where wind mitigation is required – show on Landscape Plans and explain in Study • Staff concerned with some variances proposed including Parking, residential uses on ground floor (without adequate commercial) • Loading spaces to be screened or relocated from the yard • Ensure phasing does not cut off any dwelling units • Show all sidewalks • Expand commercial	

The following agencies were circulated and had no comment:

- Hydro One
- Budgets and Finance
- CRTO (Roads and Traffic)
- Recreation
- Hamilton Fire Department
- Community Planning
- Open Space Development
- Parks & Cemeteries
- MPAC
- Bell Canada
- Cogeco Cable
- HWDSB
- HWSSB
- FPSB
- FCSB
- Horizon Utilities

Applicant provided a drawing – it doesn’t pull towers south, however there is a change.

Shadow – have a separate meeting to show the video/pictures of the hourly shadow impacts with towers placement – AF interested

Depending on resubmission – may need to come back to DRT Table

AF – appreciate the work already done – still some work to be done, but revised

Sarah – once agreeable outcome – we can discuss the variances.

Planning Committee - INFO report – to provide status update – very productive meetings – this is not the final – we are working together for positive outcome – not a horse race
Meeting – keep Cllr included – and Urban Design, Transportation, planning, etc

Hamilton

City of Hamilton

Design Review Panel

Meeting Summary – April 11th 2019

Meeting Summary

The Design Review Panel met on **Thursday, April 11th 2019**, in Meeting Room 264, 2nd Floor, City Hall, 71 Main Street West, Hamilton, Ontario.

Panel Members Present:

Colin Berman, Brook McIlroy
Vincent Colizza, Vincent Colizza Architects*, Chair*
Robert Freedman, Freedman Urban Solutions
Ute Maya-Giambattista, Fotenn Planning + Design
Mario Patitucci, Adesso Design Inc.
Tim Smith, Urban Strategies Inc.
Jackie VanderVelde, Land Art Design Landscape Architects Inc.
James Webb, Webb Planning Inc.

Staff Present:

Jason Thorne, General Manager
Steve Robichaud, Director and Chief Planner
Shannon McKie, Senior Project Manager, Urban Team
Melanie Schneider, Planner II, Suburban Team
Mark Kehler, Planner II, Urban Team

Others Present:

Presentation #1 **Mixed use Development** 310 Francis Avenue	**Jeff Paikin,** New Horizon Development Group **Przemyslaw Myszkowski,** KNYMH Inc. **Sarah Knoll,** GSP Group Inc. **Brian Roth,** GSP Group Inc. **Steve Pongracz,** Lanhack Consultants Inc. **Marc Begin,** KNYMH Inc. **Wayne Harrison,** KNYMH Inc.
Presentation #2 **Mixed use Development** 804 – 816 King Street West	**Michael Spaziani,** Michael Spaziani Architect Inc. **Matt Johnston,** UrbanSolutions **Amber Lindsay,** UrbanSolutions **Charles Wah,** Gateway Group

Presentation #3 **Mixed use Development** 1160 Main Street East	**Rick Lintack,** Lintack Architects Inc. **Ian Koerssen,** Lintack Architects Inc. **Mario Patitucci,** Adesso Design Inc. **Spencer Skidmore,** AJ Clarke & Associates Ltd. **Sarit Chandaria,** Tibro Developments Ltd. **Savan Chandaria,** Tibro Developments Ltd.

Regrets:

Yasin Visram, Perkins + Will Canada (Panel Member)

Confirmation of Minutes:

Minutes were confirmed.

Declaration of Interest:

Mario Patitucci, Adesso Design Inc. for 1160 Main Street East, Panel Member did not participate in the discussion.

Schedule:

Start Time	Address	Type of Application	Applicant/ Agent	Development Planner
2:45 p.m.	**Mixed use Development** 310 Francis Avenue	Site Plan DA 19-020	Owner: NHDG (Waterfront) Inc. Agent and Presentation: GSP Group	Melanie Schneider, Planner II
4:00 p.m.	**Mixed use Development** 804 – 816 King Street West	Official Plan Amendment & Zoning By-law Amendment UHOPA 19-004 & ZAC 19-009	Owner: Gateway Development Group Inc. Agent and Presentation: UrbanSolutions Planning & Land Development Consultants Inc.	Mark Kehler, Planner II
5:00 p.m.	**Mixed use Development** 1160 Main Street East	Site Plan DA 19-043	Owner: Main Street East Ltd. Agent and Presentation: Lintack Architects Incorporated	Mark Kehler, Planner II

Summary of Comments:

Note: The Design Review Panel is strictly an advisory body and makes recommendations to Planning Division staff. These comments should be reviewed in conjunction with all comments received by commenting agencies and should be discussed with Planning Division staff prior to resubmission.

1. 310 Francis Avenue

Development Proposal Overview

The applicant is proposing a mixed use development consisting of three towers that are 48, 54, and 59 storeys in height, with a shared four storey podium. The proposal contains 1,836 dwelling units and 400 m² (4,306 ft²) of commercial space. A total of 2,438 parking stall are proposed, including 20 barrier-free spaces for the residential component of the site. Seven parking spaces are proposed for the commercial component. The proposed development will be constructed in three separate phases. Phase 1 consists of the 59 storey tower with 670 dwelling units and a large portion of the amenity area. Phase 2 consists of the 54 storey tower with 615 dwelling units and the remaining balance of the amenity area. Phase 3 consists of the 48 storey tower with 551 dwelling units as well as the five storey dwelling units on top of the parking podium. Portions of the parking podium will be completed in conjunction with the towers they are proposed to support. Two levels of underground parking are also proposed.

In order to facilitate the proposal, Site Plan Control application (File No. DA-19-020) was submitted December 20, 2018 and deemed complete on December 21, 2018. Staff consider the proposal to be transformational with the potential to significantly impact the physical environment functionally and aesthetically. Therefore, the proposal has been referred to the Design Review Panel as part of the review process for the Site Plan Control application.

The subject property is approximately 2.061 ha (5.09 ac) in size and located on the south-western corner of Green Road and Frances Avenue. The property is in the former City of Stoney Creek.

3 Key Questions to the Panel from Planning Staff

1. What is the relationship of the proposal with the height, massing and scale of nearby residential buildings?

2. Does the proposal complement and animate existing surroundings through building design and placement as well as through placement of pedestrian amenities?

3. Does the proposal integrate conveniently located public transit and cycling infrastructure with existing and new development?

Panel Comments and Recommendations

a) Introduction

- The panel provides some insight on the zoning and notes that permissions for this site were granted at a time when tower-in-the-park developments were the predominant form for major residential development. These tower-in-the park buildings, while often large and monolithic, were tempered by the fact that they were typically surrounded by large areas of open green space. The generous setbacks and large expanses of lawn prevented the towers from overwhelming their surroundings and allowed them to fit in with lower scale residential neighbourhoods. This proposal, however, is responding to the context as if it were in the middle of a dense urban core and has nothing to do with the actual context. The scale of the towers would not seem out of place in downtown Toronto. The scale of the base building is an unusual mix of urban and mixed use street walls combined with large expanses of a blank-wall parking garage, neither of which appear to relate to anything around it (existing or proposed).

b) Overview and Response to Context (Questions 1, 2 & 3)

- There is no Secondary Plan for the area, or detailed guidance on how the site should develop, resulting in a mixed use site with no height or density limits. The panel notes this is an unfortunate scenario that limits the ability to use site plan control to achieve an appropriate development.
- A development that goes to such extremes in terms of height and density to capitalize on the amenities afforded by the waterfront location, with dramatic and negative impacts, should contribute something positive to the area.
- The buildings are way out of scale with the surrounding area, twice the height they should be. The scale does not respond to the car-oriented, suburban context, where there is no public transit. Additionally, the towers do not have regard for the Urban Hamilton Official Plan policies regarding compatibility and shadow impacts. An image in the submission package with a view from across the lake shows that the buildings would dominate the skyline and detract from views of the escarpment.
- The panel notes that the most difficult challenge is the above grade parking, as it is currently consolidated into a massive podium creating large and imposing walls. The podium is out of character with the existing neighbourhood, creating the sense of a fortress, whereas the development should open itself up to the community. The panel recommends breaking the site and podium up into smaller blocks, with one or more streets and/or driveways to help to break up the mass of the podium, make the development more porous and increase active uses at grade.

- Another major issue is the lack of public open space at grade as an amenity for residents and potentially for the broader community. The panel recommends moving some amenities to the ground floor, at grade. There should be open space between the building and the waterfront and a portion of open space adjacent to the woodlot. Boulevards should be much wider than proposed and incorporate wide sidewalks, street trees and cycling facilities.
- The panel notes that the site is within a suburban area with no current access to public transit.

c) Built Form and Character (Question 1 & 2)

- The panel notes the severe shadow impacts on the development to the north of the site and recommends pulling the towers closer to the QEW, while relocating the amenity area more appropriately. At a minimum, the panel suggests shifting the middle tower to the back of the site.
- While not applicable in this area, the City of Hamilton Tall Building Guidelines should be reviewed, and the floorplate sizes reduced to meet the guidelines, as more slender towers would reduce the shadow impacts and decrease the silhouettes when looking across the lake. Floorplates should not be larger than 750 m² (as a best practice) as three massive towers can appear elegant at that size.
- The towers should be located at the three corners of the triangular site to permit more breathing room, achieve more appropriate tower separation distances and improve the views between the buildings.
- The design of the podium is too busy and out of scale with the neighbourhood. As there are not enough uses to cover the walls, the panel recommends looking into adding some retail. The height of the base/podium should be reduced by placing more of the parking underground.
- The balconies are a dominant element of the design; the panel recommends recessing all or most of the balconies to give the towers a cleaner, more elegant look.
- The panel notes that the grade-related residential units are a successful component of the proposal.

d) Site Layout and Circulation (Question 2 & 3)

- Currently, the proposal has very little sense of place. The above-grade parking garage podium creates a massive superblock that will not be inviting for the future tower residents or the existing community. An alternative option would be to divide the development block into two (or even three) separate blocks with interior roads and a central open space (a public square or park). In addition, the internal streets could be lined on both sides with retail and other public uses. Breaking down the superblock into

smaller pieces would also help with the phasing of the development. This scenario would provide many benefits to the future residents and existing community.

- The panel reiterates the importance of at grade open space and recommends reducing the size of the podium to permit more open space and a connection through the site.
- The panel recommends exploring the opportunity to add more retail, extending it to the south to mirror the adjacent development.
- There are some concerns with the ground level treatment along Francis Avenue and the potential for conflicts between pedestrians and vehicles due to the four curb cuts. Cyclists and pedestrians, and those trying to access the multi-use trails, will have issues. Four curb cuts are unacceptable, the panel recommends consolidating the driveway entrances and creating a central courtyard feature or private street through the site with driveways linking to parking areas. A service entrance should be sensitively located to not interfere with pedestrian circulation.
- The panel notes that safety and security within such a massive parking structure will need to be addressed.

e) Streetscape and the Pedestrian Realm (Question 2 & 3)

- Generally, low-rise housing forms along internal streets would help the development relate better to the larger community. Along with reducing the presence of pick-up and drop-off areas along Francis Avenue as noted above, the panel also recommends adding townhouse units at grade to help activate the public realm.

f) Landscape Strategy (Question 2)

- Although there are some nice landscape elements on the podium, the panel recommends more ground related open space, noting it is a key component missing in the design. There are concerns with the proposed amenity areas, although the geothermal is appreciated, the wind study shows many areas of the amenity terrace is not suitable for sitting, thus creating a largely uncomfortable environment. The wind study also used an height of 1.8 m (average male height) but this does not address the impacts to women and children.
- One panel member noted the need for a substantial dog park as typically 25% of units would contain dogs.

g) Sustainability

- The panel encourages the applicant to go for LEED gold if possible. The panel notes that sustainability practices change over time and encourages the applicants to think about the future of the site, e.g., what happens when there may not be a need for so much parking?

Summary

The panel thanks the applicant and design team for a thorough submission package and presentation with abundant information regarding the proposal. The key recommendations include breaking up the podium, adding ground level open space, activating the ground level and slimming the towers. Responding to these key recommendations will help the proposal achieve a more comfortable scale. The panel encourages the applicant to work within the mass and density permissions but to make a greater effort to reduce the negative impacts to the surrounding neighbourhood. These will be landmark buildings within the region, and the site at the ground level should function as a landmark to the community. Given the scale of the development, there should be a greater contribution to the existing neighbourhood.

2. 804 – 816 King Street West

Development Proposal Overview

The applicant is proposing to construct a six storey (19.6 m) mixed use commercial / residential building with 403.45 m² of commercial space at grade, 30 residential dwelling units and 13 vehicle parking spaces.

The subject lands are located within a Design Priority Area (Primary Corridor) and review by the Design Review Panel is required in conjunction with Official Plan Amendment application (UHOPA-19-004) and Zoning By-law Amendment application (ZAC-19-009).

The subject property is located at the northeast corner of King Street West and Paradise Road North and currently contains two one storey commercial buildings and a surface parking lot. The subject lands are located in the Westdale Neighbourhood on King Street West, a Primary Corridor.

Key Questions to the Panel from Planning Staff

1. Does the proposal consider transition in height and density to adjacent residential buildings?

2. Is the proposal compatible with adjacent land uses including matters such as shadowing, overlook, noise, lighting, traffic and other nuisance effects?

3. What is the relationship of the proposal to the existing neighbourhood character? Does it maintain, and where possible, enhance and build upon desirable established patterns, built form and landscapes?

Panel Comments and Recommendations

a) Overview and Response to Context (Questions 1, 2 & 3)

- The panel acknowledges that the site is amongst many that will redevelop in the near future as it is close to the LRT corridor. The panel notes that the City of Hamilton's Corridor Planning Principles and Design Guidelines requiring a 45-degree angular plane may be overly restrictive when applied to relatively shallow sites like this one, preventing appropriate intensification. One panel member pointed out that the City of Toronto has mid-rise guidelines for shallow lots, where the 45-degree angular plane is measured starting 11 m above grade along rear lot lines.
- Several panel members are pleased with the building mass and inclusion of setbacks and step-backs that help to achieve a good transition to the surrounding properties.

b) Built Form and Character (Question 1, 2 & 3)

- The majority of the panel members are comfortable with the ultimate six storey height along King Street and six storey height at the rear as the design includes step-backs that have been carefully implemented to reduce negative impacts to the existing community. Some panel members struggle with the proposed height and have concerns with the precedent it would set, since an alternative mid-rise angular plane strategy was used (a strategy similar to the City of Toronto) to achieve the built form, a more permissive strategy than the City of Hamilton currently allows. One panel member notes that the site would more comfortably accommodate a five storey building with mechanical penthouse.
- The mechanical penthouse creates the illusion of a seventh storey and visually increases the mass of the building. The panel recommends moving the amenity space to the ground floor and shrinking the mechanical penthouse to reduce the mass visually and reduce the shadow impacts on adjacent properties.
- The panel recommends slightly increasing the height of the first storey to better accommodate retail uses and to achieve a better public realm presence. As the retail opportunities are explored, the panel recommends the option to open the corner of the building to create public space, adding some articulation through hard and soft landscaping. As the site is on a very busy corridor, the retail will help with traffic calming and contribute to a more vibrant streetscape and public realm.

- The majority of the panel members recommend removing the two storey portico at the rear of the site as it interrupts the transition to the surrounding properties and may be intrusive to the neighbours. Some panel members recommend keeping it, as it adds interest and helps with the gradual stepping down to the neighbourhood while reducing the impact of the surface level parking area from the public realm. One panel member notes that change in height from the ultimate six storey building to the two storey portico is quite drastic and could better integrate into the existing network of step-backs, perhaps even adding some building mass to create an "L" shaped building. The panel agrees that it should not incorporate outdoor amenity space if kept and/or redesigned.
- The panel notes that the building is handsome and the simplicity of the material palette is quite successful; however, some panel members recommend continuing the balconies and materiality from the fifth floor to the upper floors for more consistency.
- Some panel members recommend a slight redesign to the rooftop, making an effort to shift the amenity area closer to the street, to reduce the overlook on adjacent properties.
- The balconies at the back of the building could be intrusive, the panel recommends removing them to reduce the overlook to the neighbours.

c) Site Layout and Circulation

- The panel recommends making the entrance for the residential component of the building more distinct from the commercial entrances.
- The panel recommends exploring the opportunity to remove the dedicated right turn lane on King Street and reduce the overall road width if possible. Additionally, there is a conflict with the bi-directional bike lanes and it would be beneficial to try and improve the cycling and pedestrian circulation on and around the site.
- Cycling is a critically important component of the project; there should be a focus on cycling amenities at grade including visitor bike parking and a bike repair room.
- One panel member notes that the parking may be underestimated and that it may put additional pressure on the neighbourhood.

d) Streetscape and the Pedestrian Realm

- The panel notes that there will be a lot of pedestrian traffic and that the streetscape is a very important component of the proposal. Eliminating the right-turn lane would allow for more street trees to help create a more comfortable public realm and add some green buffers.

e) Landscape Strategy

- The panel notes that the 1.5 m wide landscape strip along the north boundary may be insufficient due to the minimal soil volumes and lack of sun in that location. Trees will likely not survive there.
- The panel recommends completing an arborist report for the site, making an effort to preserve the existing trees.

Summary

The panel applauds the design rationale and efforts to create a good transition to the surrounding properties. The panel also appreciates the thorough submission package and detailed presentation. The site is a gateway into the village, moving from the highway onto a local collector road with a more pedestrian oriented environment, and the proposal should reflect this as indicated in the comments provided above.

3. 1160 Main Street East

Development Proposal Overview

The applicant is proposing to construct a seven storey mixed use commercial / residential building with 303.5 m² of commercial space at grade, 75 dwelling units and 24 vehicle parking spaces.

The subject lands are located within a Design Priority Area (Primary Corridor) and review by the Design Review Panel is required in conjunction with Site Plan Control application (DA-19-043).

The subject property is on the south side of Main Street East mid-block between Balmoral Avenue South and Grosvenor Avenue South and currently contains a one storey commercial buildings and a surface parking lot. The subject lands are located in the Delta Neighbourhood, two blocks east of Gage Park.

Key Questions to the Panel from Planning Staff

1. Does the proposal promote quality design consistent with the locale and surrounding environment?

2. Are the service and loading areas buffered to reduce the visual and noise impacts, particularly when located adjacent to residential areas? Do the buffering methods include berms, tree and shrub plantings, noise walls, fences and/or the use of quality construction materials and methods?

3. What is the relationship of the proposal with the height, massing and scale of nearby residential buildings?

Panel Comments and Recommendations

a) Overview and Response to Context (Questions 1, 2 & 3)

- The panel notes that some effort has gone into achieving an appropriate transition to the neighbourhood; however, the mass is a too large and needs some refining to better address the neighbouring properties. Overall, the site is too tight for the building mass proposed due to the negative impacts to the neighbours, lack of buffers and proximity to the front property line.
- The panel notes that the proposal is trying to follow the City of Hamilton's policies which permit no side setbacks to encourage a continuous street wall along Main Street E; however, the site is unusual in that it is flanked on both sides by the rear lots of adjacent houses and apartment. The panel finds this problematic as providing no rear or side setbacks does not allow for the proposal to properly transition to the surrounding neighbourhood.

b) Built Form and Character (Question 1 & 3)

- The panel recommends including a 2.0 - 3.0 m setback along the side and rear property lines to respond to the existing condition. The panel notes that a separation of less than 2.0 m from the proposed building to an existing building is not ideal and needs to be improved, the edge abutting the neighbours needs some work to help protect the privacy of the existing residents.
- In addition to the setbacks, the panel recommends step-backs on each side of the building to provide a more appropriate transition to the neighbouring properties on Main Street, which are unlikely to redevelop to greater heights. Although there are no strict regulations for step-backs, the existing residences will be facing a wall and the proposal should better respond to the adjacent properties, giving them more space. The panel notes that the building's circulation elements (elevator and stairs) could remain where they are; however, all storeys above the third should include side step-backs. The top floor should step-back from the street by at least 3.0 m to allow the building to visually appear as a six storey brick structure from Main Street.
- Generally, the materiality and balcony treatments are appropriate, but the panel feels that four cornice lines may be too many and the horizontal and vertical banding is excessive, suggesting a more simplified approach.
- The panel recommends improving the parking area using interesting colours and textures so that is does not feel like the back of a building.

c) Site Layout and Circulation (Question 2)

- As noted above, a landscape strip of 2.0 – 3.0 m is needed along the side and rear lot lines to accommodate adequate soil volumes to ensure healthy tree growth to help buffer the adjacent properties and to help screen the garbage/loading area.
- The panel notes that access to the site would ideally be from a side street.
- The amount of bike parking should be increased, with some included at grade and some in the basement.
- The panel recommends protecting the columns by adding curbing.
- The panel recommends moving the loading area behind the service door to reduce the width of the driveway area under the building.

d) Streetscape and the Pedestrian Realm

- As there will be an LRT stop close by, it is a good location for commercial and the panel recommends including more space for pedestrians along the Main Street frontage as it is a busy road. The panel notes that the 2.0 m sidewalk is acceptable but recommends adding an additional 0.5 m setback (to achieve a total of 1.0 m in addition to the sidewalk). This would create a more comfortable pedestrian environment and the extra space could accommodate a covered patio.

e) Landscape Strategy (Question 2)

- The panel recommends continuing the unit paving across the driveway to brighten up the area. A fun design treatment spanning the sides and ceiling of the driveway portal to enliven the space is also recommended. This can be something that makes a passerby smile rather than ignore it.

Summary

In general, the location is ideal for a mid-rise building and the panel notes that some good thinking has gone into the proposal, although some work is needed to better respond to the neighbouring properties. Providing buffers, refining the massing and improving the public realm are key recommendations. To support commercial development and a vibrant public realm, a more generous streetscape condition in needed.

Meeting was adjourned at 6:30 p.m.

Sent: May 10, 2019 10:55 AM
To: clerk@hamilton.ca
Subject: 7.3 of Planning Committee Meeting

As a resident of the Shoreliner, I am extremely concerned about the high rise buildings proposed in our area. The relief from some of the by laws is disturbing. e.g. reduction of required on site parking spots, frontage to street, traffic flow at peak times.

I trust these items will be covered.

Sincerely

George McCowan

Sent: May 10, 2019 9:18 PM
To: clerk@hamilton.ca
Subject: Re. Reference Item 7.3 Planning Committee meeting in regards Site Plan Application for 310 Francis Ave.

May 10, 2019

To who may concern:

Dear Sir/Madam:

I am writing to you to voice some of my concerns regarding plans to build high rise buildings on 310 Francis Ave.

My concerns are as following:

1. Currently we are already experiencing very limited street visitor parking spaces as there is no availability to municipal parking nearby. I have noticed the parking space issue augments in winter due to snow banks and accumulated snow on the sides of the streets
2. The only exits and entrance to and from this area is via Francis St. and North Service Rd. These are narrow roads and already experience severe congestion due road use from residents of this area and use by highway drivers who divert their routs to avoid highway congestion.
3. The high rise building will block to light all the buildings.
4. This will disrupt the migratory route of the birds.
5. We are already experiencing the wind tunnel effect from two high rise buildings on Green Rd. My research in this area indicates that there may be further issues with wind tunnel effects which may affect not only the residents of this area but also the QEW high way drivers.
6. What impact will addition of so many residents have on water and sewer services?
7. Where will additional of animal defecate?

I hope will consider my concerns very seriously.

Thank you.

Sincerely,

Surabhi

Dear Planning Committee members:

In light of additional information that has been released regarding the site plan application at 310 Frances Avenue in Stoney Creek, as a home-owner directly affected by this massive development I have significant concerns regarding the ability of Councillor Pearson to impartially represent my concerns regarding the infrastructure related issues impacted by this build. Her track record in this regard has been historically unreliable.

To date, Councillor Pearson has not publicly declared any conflict of interest regarding this development. It is imperative that the same scenario that occurred with the 257 Millen Road development not reoccur. For historical context: Councillor Pearson attended meetings with the developer, hosted the developer at a public meeting, met with the affected home-owners at their private residences, then declared a conflict-of-interest (ownership of rental property within 120 metre circulation area of the development) during the Planning Committee decision meeting. Her eleventh-hour disclosure was of questionable timing, leaving the residents without representation at a crucial point in the process. In the current situation, the land-owner at 310 Frances, and myself, are both constituents; this situation also raises questions about unbiased representation.

Given the city-wide implications on both zoning, development, and infrastructure costs related to the 310 Frances Avenue site-plan application, Councillor Pearson's conflicts of interests – real or perceived – need to be disclosed immediately on public record to ensure that the Planning Committee, remainder of Council, and residents are not blind-sided at any point during the current process.

Thank you for your attention to this matter.

Sincerely,

Anna Roberts

Sent: May 11, 2019 10:42 AM
To: clerk@hamilton.ca
Subject: item 7.3 of Planning Committee Meeting

Dear council members

My wife and I are relatively new to this area, we moved in in August 2018, and are quite happy in our current environment. We moved in with the understanding that condominium's were planned for the area. On that note we were quite dismayed in learning about the extent of the construction without any proper pre planning on not only the builders part but as well as the city's.

The 1st concern we have is the lack of parking being made by the builder in the 3 high rises. Not only is there not enough spaces for the residence of the building on their own property but it seems to be a great lack of municipal space available for all the residences in the area. The builder is also asking for a reduction of parking spots on his own property.

We also have concerns regarding water flow and flooding concerns due to minimal surface ground space for percolation.

Wind and shade concerns from the massive towers.

How can this small space support such a build.

The lack of green space around the building with the request for a variance to reduce their green space.

Minimal if any trees at ground level that would grow to any significant size to help reduce the massive carbon footprint.

We hope that council will appreciate the enormous congestion, disruption that this with a number of other projects in the area would create and that proper PUBLIC information and meetings will be provided before any construction begins.

Regards

Stan, Renee Kurak

Sent: May 11, 2019 4:04 PM
To: clerk@hamilton.ca
Subject: Stoney Creek Towers

Dear Sir/Madam: I am writing regarding the proposed towers at 310 Frances. This is definitively a bad idea. First of all parking is already at a premium. At least once but usually twice a year the parking garage in existing high rises need to be cleaned and during this time all vehicles must be parked along the streets. This is already a problem on regular days so you have to realize that with more vehicles it would be impossible to find a spot in this whole area. Next; during wind storms the wind tunnels of the two existing high rises is so strong that it is impossible to walk and with proposed towers it would be much worse affecting vehicles travel on the QEW, even to the extent of possible small ones being flipped over.

The planning department must consider all of the above and also the overflow of traffic on the North Service Road during rush hours is chaotic as it is, notwithstanding extra vehicles.

Sincerely
Zita Petozzi

Sent: May 11, 2019 7:43 PM
To: clerk@hamilton.ca
Subject: 310 Frances Avenue Stoney Creek Development Multi Tower

I oppose this multi tower development as it will literally be in my front yard. As a resident of Frances Avenue, the impact of such a dense population in a small footprint proposed in this development will negatively impact the current quaint, waterfront friendly community. Aside from this, the traffic impact, drain on community resources, etc will be overwhelming. My house faces this proposed development.

Again, please consider this my strong statement of opposition.

Regards,

Tabatha Morris

Sent: May 12, 2019 9:45 AM
To: clerk@hamilton.ca
Subject: Agenda Item 7.3, Planning committee May 14,2019

To Members of Planning Committee,

I am currently a resident of 500 Green Rd. I have many concerns about the proposed 3 condo project under consideration for 310 Frances Ave listed on the agenda for May 14 as item 7.3..

Some of my concerns and objections:

- This area is already a fairly dense urban space this project will not provide sufficient green space, and will cause further erosion of natural habitat for wildlife,i.e. coyotes, foxes which seems contrary to the mission of the Conservation authority caring for Confederation Park. As I walk there I read the signs and they talk about their goal that is to return the area to natural habitats. Bird flight paths will also be affected. As the city has declared a climate change emergency, better protection for the environment as a whole is also part and parcel to that.

- on street parking for the around an additional 500 vehicles will be impossible. Our building, The Shoreliner, has as its only visitor parking the street. I challenge the committee to come and visit our community with pen and paper in hand and figure where we would find an additional 500 on street parking spots.

- This community is only 2 blocks between the QEW and Lake Ontario, there is **no place** to provide this much additional space.

- The traffic on the North Service road already at times is busy making it difficult to enter off of Frances Ave and Drake, and its physical condition is quickly deteriorating.

- The current mix of town homes and smaller height towers such as the recent Senior residence appear to me to be a much better proposal for expansion in the area. The proposed project will have significant impact on the physical environment and the aesthetics. In my opinion it is so out of scale that the 3 towers would appear as a cancerous tumour growing in the middle of our community.

- Frances Ave is part of the Cycle route for the Waterfront trail and all the additional vehicular traffic will impact the safety of both the pedestrians and cyclists

- There is currently no public transit servicing this area.

I would like to see more public meetings concerning this project as it seems to have come onto the radar of the residents fairly recently with little time to react.

Please do not approve this project until give all parties time to ensure the project is the correct one .

Respectfully submitted,
Joan Whitson

Sent: May 12, 2019 10:12 AM
To: clerk@hamilton.ca
Subject: Item 7.3 Planning Committee Meeting

How can the city, in good conscience, approve such a project as the 3 towers at 310 Frances Ave, a total of 161 stories/1826 units in such a small area???

The additional traffic will be massive, and if the requested reduction of
500 parking spaces on the properties is granted, where will these 500 cars park?

Russell & Janet Pape

Sent: May 12, 2019 5:50 PM
To: clerk@hamilton.ca
Cc: Pearson, Maria <Maria.Pearson@hamilton.ca>; Barbara Birch <barbara.birch@cogeco.ca>
Subject: Proposed Three Towers Development 310 Frances Avenue - Opposed to Existing Plan of Development

Good Day,
This is a submission for the Planning Committee Meeting currently scheduled for Tuesday May 14,2019.

I wish to register my objection to the development at 310 Frances Avenue as it currently appears on the Hamilton Planning Committee minutes and reports as found on their website.

The specifics that I take exception to are as follows:
- The requested reduction of on site parking spots are inadequate and should be made to the 1.5 per suite model or 2,754. The requested 1.3 model is simply inadequate. Street parking in the area is significantly challenging on most days presently. Observing the majority of the cars parked on the driveways of the townhouse complex adjacent to the 310 Frances site shows that most are two car families with one car on the driveway during normal working hours.
- Further the traffic study that states that the increased traffic trips of 556 AM and 666 PM peak periods is simply not credible when considering the existing situation at the peak periods. Additionally the most recent study dated by the developer was taken 5/2/17. This does not include the additional traffic that will be on North Service Road once the additional building currently being completed just east of the break of Frances Avenue and the shore trail.
- The proposed remedial measures clearly state that the current areas available for the necessary turning lanes onto Green Road do not allow for the necessary storage and taper zones by a considerable lower amount. (15.8 M available versus 120 M required)
- The requested reduction to the building set backs appears inadequate on all sides.
- The landscaped open space proposed is dramatically less than the requirements stated and should not be authorized.
- Contrary to the statements from HSR there is currently no practical public transportation option available anywhere in this general area along North Service Road. The vast majority of people use a personal vehicle for every trip.
- Overall, it is obvious to me that the proposed building areas and occupancy density of 1836 units is simply vastly too great for the property size at 310 Frances Avenue. In addition the additional traffic that will result will produce twice daily gridlock given the current Green Road and North Service Road intersection. Personal daily observations at AM and PM peak periods easily support this point. We have all be very fortunate that no deadly accidents have occurred at the Green Road / North Service Road intersection. Again several near misses have been personally observed.

Respectfully submitted for Planning Committee consideration.

Larry Birch, P. Eng.

Sent: May 12, 2019 9:09 PM
To: clerk@hamilton.ca
Subject: REFERENCING: AGENDA ITEM 7.3 PLANNING COMMITTEE MAY 14th, 2019 MEETING

To the Chairman , Council , Planning Committee & Planning Staff

Regarding the planning committee meeting of April 16th – due to a sudden medical situation I was unable to attend that meeting. I was to speak before council regarding my concerns about the proposed development at 310 Francis Ave. I did indicate that I wanted someone else to address my concerns and I know this person did so on my behalf.

However in a subsequent meeting I understand that I was only listed as - Did Not Attend. I take offense to this when others in favor of the development were acknowledged even though they also did not attend. I would like the record to show that my concerns were addressed through others at the meeting.

I would like to re-state my concerns for the proposed development at 310 Francis Ave. so that it is added and properly recorded at the May 14th committee meeting.

I am very concerned about the traffic issues that will happen if these towers are built. There will be no parking available in the area and current residents will be fighting for space.

The traffic will be far too extensive with thousands more cars on our short, narrow streets. There will be a serious safety concern for everyone and a
danger to pedestrians , including elderly and children in the area.

I want it to be known that I am very much against this development going in our small community and there are many others that agree

Respectfully
Eleanor Boyle

Sent: May 13, 2019 11:59 AM
To: clerk@hamilton.ca
Subject: 310 Frances Ave

To Members of the Planning Committee and City Councillors,

In light of the upcoming Planning Committee meeting for May 14th, I would like to please make my feelings made known regarding item 7.3 on the agenda.
As a long-time resident - 33 years, I have seen large changes to development in the area. As such, I have been informed many times over that this area is zoned high density. I get that - however the latest "Triple Tower" project proposed is absolutely mind-boggling in scale and consequently in impact on this community. Surely, there has to be some point at which "unlimited density and height" gets recognized as ridiculous and even, in my mind as reckless. Anyone who has visited this area must surely question how our surrounding area could possibly cope with a project of this magnitude. Consider how many more thousands will be spilling out onto our one- lane North Service Road and our small, residential Frances Ave (part of the waterfront trail).
It saddens and surprises me that it is necessary to have to advocate for more insight on this matter. I would hope that the members of the Planning committee and members of Council would very thoughtfully consider what this proposal means - what incredible negative impact it would have - and act on our behalf. This is not simply a case of NIMBY. The scope of the proposal is beyond anything remotely reasonable, and I respectfully ask that limits to what builders request be considered even if it fits the zoning. This is not a "win-win" situation that we so often read about.
I also want to express how disappointed I am to have just learned about the Triple towers a few months ago from the front page of the Spectator, when apparently it has been on the radar for quite some time. I hope for more open communication in the future.
Thank you for your time.

Sincerely,
Linda McEneny

Sent: May 13, 2019 11:59 AM
To: clerk@hamilton.ca
Subject: 310 Frances Ave

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Thank you for your time.

Sincerely,
Linda McEneny

Sent: May 11, 2019 4:58 PM
To: clerk@hamilton.ca
Subject: Agenda Item 7.3 Planning Committee May 14th, 2019 Meeting

Referencing: Agenda Item 7.3 Planning Committee May 14th, 2019 Meeting

To Council, Planning Committee & Planning Staff,

Regarding the proposed development at 310 Frances Avenue, I, and what appears to be the community at large, continue to be extremely concerned about the massive triple tower development proposal in our small community. We are not being provided with any information. And we are not only seven (7) opposed to this development as was reported in the news. We are hundreds strong and growing every day as I had stated in my presentation of April 16th.

To reiterate the staggering amount of concerns made by the Design Review Panel at the April 11th meeting as well as the many well-researched points provided by our local delegation at the April 16th planning committee meeting, it is absolutely astonishing to many of us that this project has not been put on an extended pause until such time that more extensive, independent and unbiased studies are completed along with requests by council to the applicant for a major re-design and height reduction to fall in line and conform to the style of our existing community.

To be constantly told by council that a 'no height restriction' was put into place when the Shoreliner and Bayliner were proposed and built has no bearing on allowing a no-holds-barred development proposal. Clearly the original approved development proposal shows a smattering of like-buildings throughout this area. That is, similar to the two original existing buildings that rise eighteen stories. To drop in buildings that triple that height is unconscionable, particularly when it is simply designed to create a legacy for one (or maybe two).

The devastation that this massive building will surely cause to this extremely small community will be insurmountable in the immediate future if allowed to move forward in anything remotely close to the current design, height and mass. It is clear that the Design Review Panel had an issue with almost – if not every aspect of this design.

Noting the obvious points of concern:

1. Parking will be completely impossible. At any given time during the day and evening, Frances Avenue and Green Road are generally lined with vehicles from the current community. There simply are no additional parking spaces to be had even if every unit of the proposed 1836 had the required 1.5 parking spots on-site. To attempt to dump another 300 + vehicles onto these two streets is impossible.

2. Traffic congestion will be beyond extreme on Green Road, Frances Avenue, North Service Road and Church Street and will likely extend to all other side streets within the local community. It is without doubt that vehicles will be lined up for extensive periods of time attempting to enter and exit onto any one of these streets, particularly Green Road and Frances Avenue. Commute hours twice each day will only exacerbate an already impossible situation.

3. The safety of pedestrians, including the elderly and children, along with the joggers and cyclists that frequent this area are likely to experience insurmountable danger as

they attempt to navigate around the onslaught of additional traffic, especially the mass exodus onto Frances Avenue – the most popular route for pedestrian foot traffic.

4. Creating a massive concrete block will wreak havoc on any attempt at water percolation as more and more rain is dumped into our area. It is clear that the climate is trending in that direction. There will be nowhere for the water to travel and surely the current systems will be extremely taxed and potentially doomed to failure.

5. The likelihood of ground temperature rising must be put under serious scrutiny when air flow is interrupted. Minimal ground-level green space will make an impossible task of cooling the area and surrounding community. The lack of space to accommodate large-growth trees that provide natural, cooling shade will be detrimental. There will be nothing to control the extensive carbon footprint that will be created. Let it be noted that we just received a notice from local MP Bob Bratina that states the following in bold print –
BUDGET 2019: INVESTING IN THE ENVIRONMENT
FIGHTING CLIMATE CHANGE IN HAMILTON EAST-STONEY CREEK
Climate change is one of the most pressing issues of our time.

6. It is likely that Frances Avenue will become a 'closed-in' area between The Bayliner, the towers and the podium because of these massive buildings. It will surely cause a wind tunnel down the street that could make it nearly impossible to safely navigate the sidewalks through this area. This will pose serious issues for elderly people and children.

7. Should there be the need for emergency and fire vehicles, including first responders and police during periods of extreme congestion, remember - this current community has only one lane in and out of the entire area to reach the service road and the highway. Endless vehicles backed up just trying to come in or out of this area will thwart any efforts of medical or fire personnel to arrive safely and in a timely fashion. Moments count in an emergency and can become a matter of life or death! This should be of great concern to the aging population in our community.

In summary…

The sad and obvious fact is that this area simply cannot support such a massive development. One only need walk the area to know this to be true. Imagine the stress this places on the residents of this small community. There will surely be an enormous strain on everyone's current lifestyle and daily routine – and all for the sake of creating a legacy. This is not a landmark build – this is a disaster to the land.

The nightly light pollution that will be created will surely affect and possibly destroy the local and migratory birds as they attempt to maintain their instinctive routes. It is a fact that millions are killed every year from collisions with buildings, especially those with extensive glass and lights.

The excessive traffic on Frances Avenue and Church Street will wreak havoc and cause potential destruction and devastation to the local turtle population and their annual travels to their limited nesting grounds which continue and will continue to shrink due to more and more development proposals in this area. This is of particular concern for the Snapping Turtles which are on the Ontario Endangered Species list.

When the UN advises that one million species of animals and plants are at risk for extinction from Human Activity – why would anyone want to be partner to that claim of such terrible proportion? Again – all for the sake of creating a legacy?

We implore you to reconsider this application for all of the reasons listed above and for this simple fact…

The original plan for this property at 310 Frances Avenue shows that there were to be two similar towers to the Shoreliner and Bayliner. This configuration allowed for a much more extensive green space that would accommodate these seven points of concern. One need simply observe the beautiful park-like setting with a multitude of mature trees and open expanses of lawn that surround these two original buildings (The Shoreliner and The Bayliner) to see how this area by the waterfront was designed to be in the overall scheme of this entire development. Why deviate from that original plan and ruin the true nature of the community.

Respectfully submitted,
Sherry Hayes
Shoreliner Resident

WELCOME TO THE CITY OF HAMILTON

PLANNING COMMITTEE

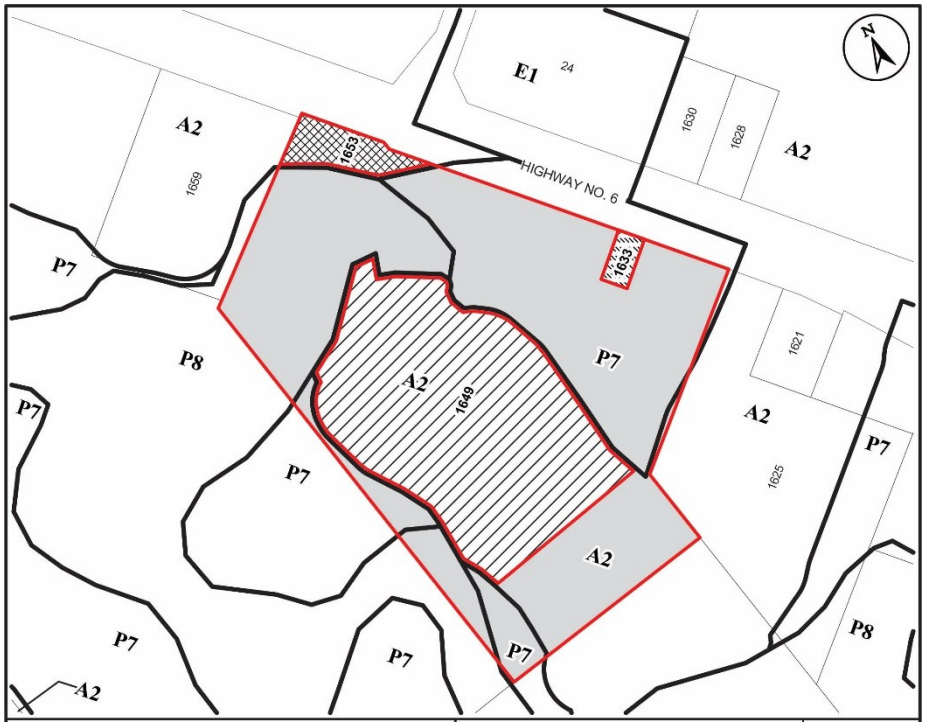
May 14, 2019

Presented by: Elyse Meneray

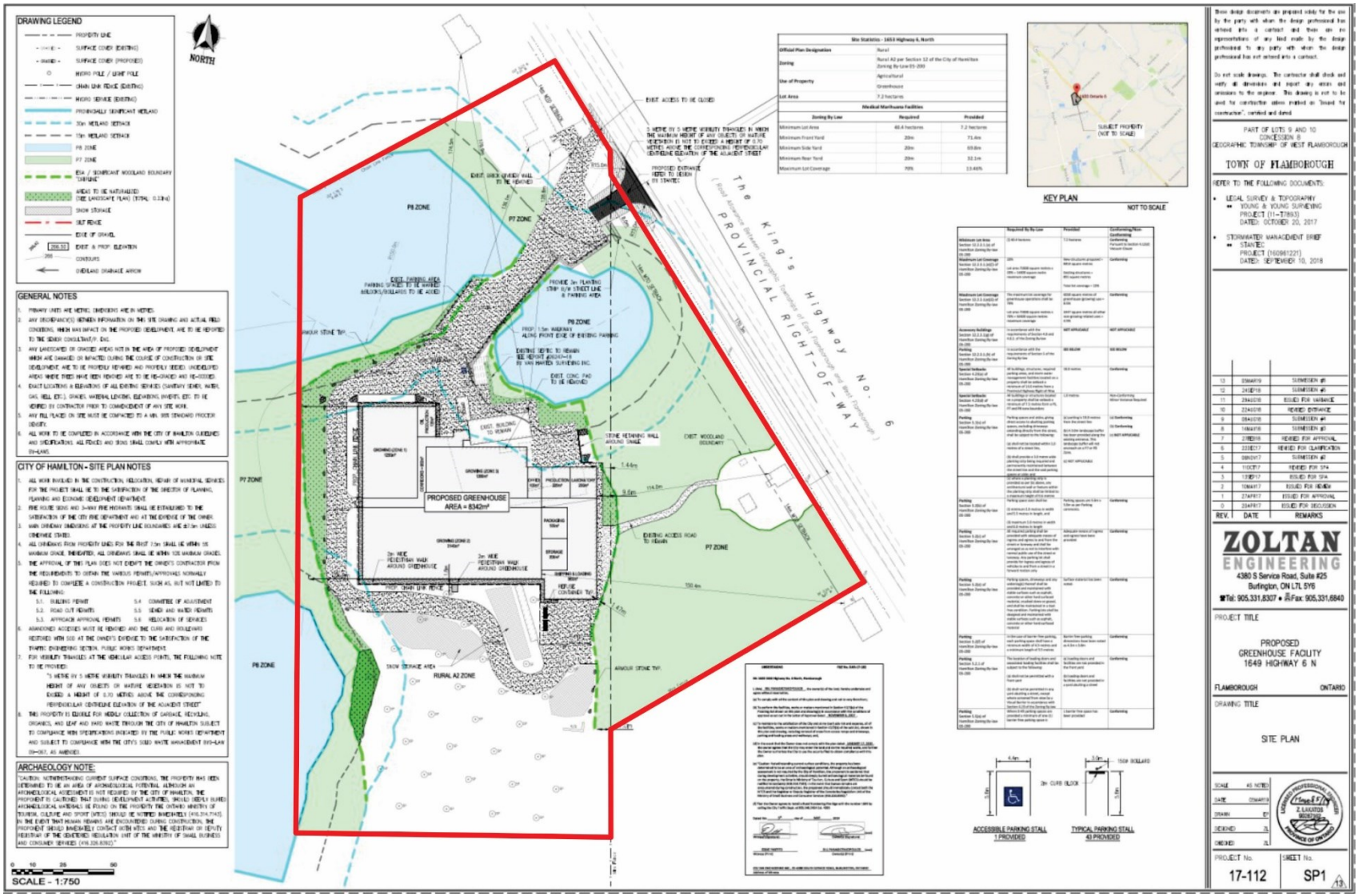
PED19076 – (ZAC-17-081)

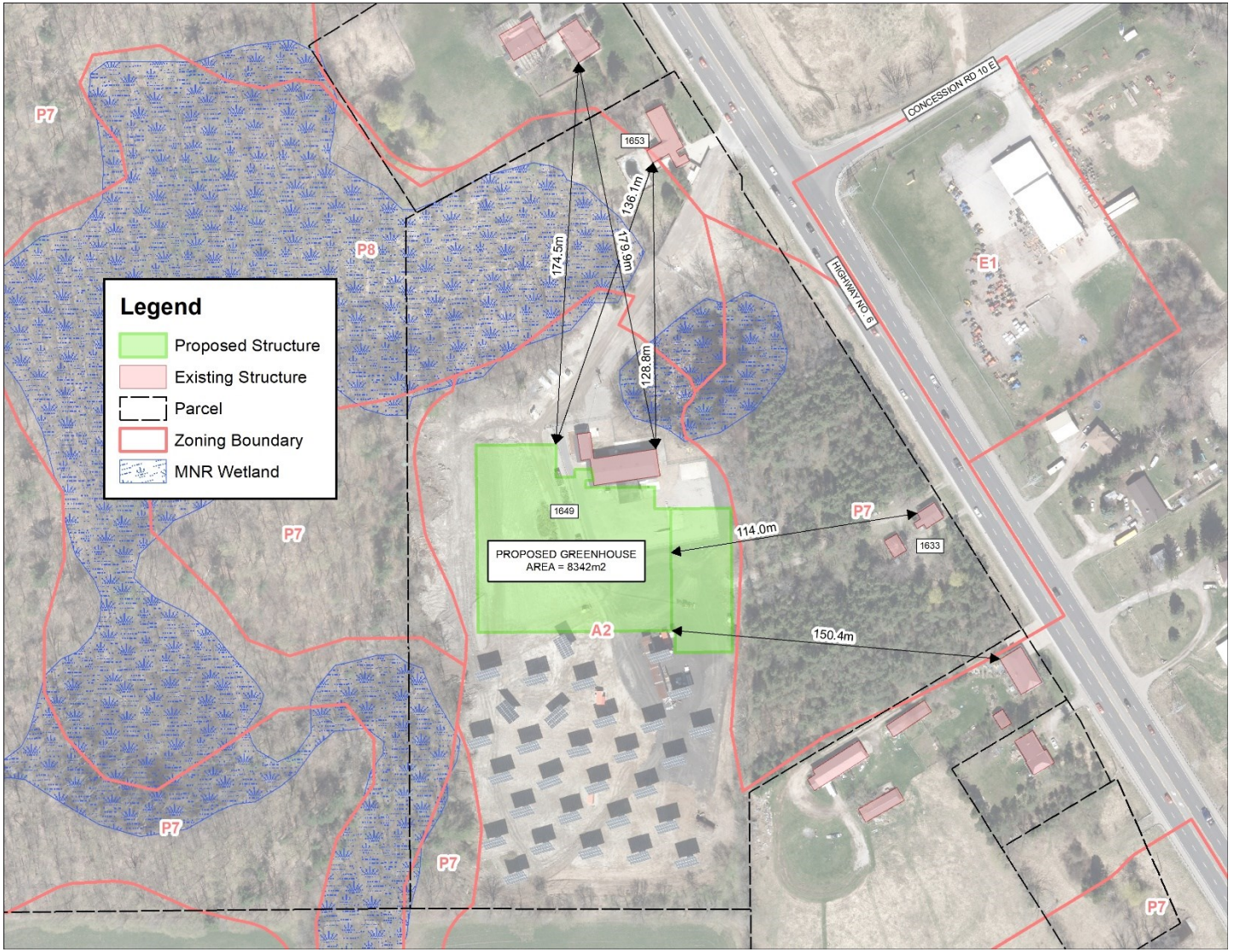
Applications for an Amendment to the Rural Hamilton Official Plan and the City of Hamilton Zoning By-law No. 05-200 for Lands Located at 1633, 1649 and 1653 Highway No. 6 North, Flamborough.

Presented by: Elyse Meneray


E1
24
A2
1659
1653
HIGHWAY NO. 6
1630
1628
A2
1633
P7
P8
P7
A2
1649
P7
1621
A2
P7
1625
P7
A2
P7
P7
P7
P8
A2
Site Location
Location Map
Hamilton
PLANNING AND ECONOMIC DEVELOPMENT DEPARTMENT
File Name/Number:
Amended ZAC-17-081
Date:
April 15, 2019
Appendix "A"
Scale:
N.T.S.
Planner/Technician:
EM/NB
Subject Property
1633, 1649 & 1653 Highway 6 North
Block 1 - Modification in Zoning from Rural (A2) Zone to Rural (A2, 691, H111) Zone
Block 2 - Modification in Zoning from Conservation/Hazard Land - Rural (P7) Zone to Conservation/Hazard - Rural (P7, 691) Zone
Block 3 - Modification in Zoning from Rural (A2) Zone to Rural (A2, 691) Zone
Other Land Owned by Applicant
Key Map - Ward 13
N.T.S.

SUBJECT PROPERTY 1633, 1649 & 1653 Highway 6 North, Flamborough


DRAWING LEGEND
NORTH
GENERAL NOTES
CITY OF HAMILTON - SITE PLAN NOTES
ARCHAEOLOGY NOTE:
SCALE - 1:750
PROPOSED GREENHOUSE AREA = 8342m²
P8 ZONE
P7 ZONE
RURAL A2 ZONE
The King's Highway No. 6
(Road Allowance Between Geographic Townships of East Flamborough and West Flamborough)
PROVINCIAL RIGHT-OF-WAY
KEY PLAN
NOT TO SCALE
ACCESSIBLE PARKING STALL
1 PROVIDED
TYPICAL PARKING STALL
43 PROVIDED
PART OF LOTS 9 AND 10
CONCESSION 8
GEOGRAPHIC TOWNSHIP OF WEST FLAMBOROUGH
TOWN OF FLAMBOROUGH
REFER TO THE FOLLOWING DOCUMENTS:
LEGAL SURVEY & TOPOGRAPHY
YOUNG & YOUNG SURVEYING
PROJECT (11-17893)
DATED: OCTOBER 20, 2017
STORMWATER MANAGEMENT BRIEF
STANTEC
PROJECT (160961221)
DATED: SEPTEMBER 10, 2018
ZOLTAN ENGINEERING
4380 S Service Road, Suite #25
Burlington, ON L7L 5Y6
PROJECT TITLE
PROPOSED GREENHOUSE FACILITY
1649 HIGHWAY 6 N
FLAMBOROUGH
ONTARIO
DRAWING TITLE
SITE PLAN
PROJECT No. 17-112
SHEET No. SP1


Legend
Proposed Structure
Existing Structure
Parcel
Zoning Boundary
MNR Wetland
P7
P8
E1
A2
1653
1649
1633
CONCESSION RD 10 E
HIGHWAY NO. 6
174.5m
136.1m
119.9m
128.8m
114.0m
150.4m
PROPOSED GREENHOUSE
AREA = 8342m2

PED19076

Photo 1

1653 Highway No. 6 North

PED19076

Photo 2

1633 Highway No. 6 North

Photo 3

Existing Facility

PED19076

Photo 4

North of the Subject Lands

Photo 5

Adjacent property to the east

Photo 6

Regional Tractor Sales and Servicing Limited

PED19076
Photo 7

Wetland to the north

PED19076

Photo 8

Wetland and Significant Woodlot to the northwest

Significant Woodlot to the west

PED19076

Photo 10

Solar Panels to the south

Photo 11

Significant Woodlot to the east

Photo 12

Significant Woodlot to the east

PED19076
Photo 13

Reduced VPZ

THANK YOU FOR ATTENDING

THE CITY OF HAMILTON PLANNING COMMITTEE