Transportation Assessment Guidelines
2024

Planning and Economic Development Department

Hamilton

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Preamble

City of Hamilton policy identifies that streets that are planned and designed to balance the needs of all road users and allow people to move around in a mode of their choice, no matter their age or ability, in a safer, more comfortable and efficient manner which fosters a vibrant, functional community for its residents, visitors and businesses.

These guidelines are an update to the 2009 Transportation Impact Study Guidelines. They apply a local lens and modern approach to meet current industry standards and practice necessary for supportable and sustainable growth and focusing on multi-modal analysis.

The guidelines have been updated to guide City staff, the development community and consultants in preparing reports that meet the City of Hamilton's expectations. They outline the requirements for acceptable methodology and format for submission. Transportation Assessments that closely follow these guidelines help expedite the development review process which benefits the municipality and the applicant.

The purpose of the City's Transportation Assessment (TA) Guidelines is to:

- Provide a framework to determine the need for and focus of a study based on site location, proposed land use and development size
- Outline the acceptable form, content and documentation
- Establish the methodology and format for studies and provide a basis to determine existing or future transportation system improvements or establish benchmarks for comparison of transportation network performance before and after development
- Complement the Hamilton Complete Streets Design Manual and Guidelines
- Provide objectivity and consistency for all assessments submitted to the City
- Provide a basis for discussion between the City and the development community for mitigation measures, right-of-way improvements and potential for cost-sharing

Guideline Changes

Overall, the guidelines have been updated to reflect current practices and methodologies. Noted updates include:

- These guidelines only address the requirements for traditional transportation assessments: transportation impact studies and traffic briefs. They do not include guidelines for preparation of other types of transportation studies which were previously part of a "traffic impact study". Separate terms of reference for the other studies listed within the Official Plan were previously developed and are available separate from this document. These include:
    - Cycling Route Analysis
    - Modern Roundabout and Neighbourhood Roundabout Analysis
    - Neighbourhood Traffic Calming Options Report
    - Parking Analysis or Study
    - Pedestrian Route & Sidewalk Analysis

- Roadway Development Safety Audit
- Transit Assessment
- Transportation Demand Management Options Report
- Application of multi-modal level-of-service

When any of the additional studies listed above are requested by Transportation Planning, they can be included as part of an overall transportation document, however, they are to be provided as standalone, complete sections with the appropriate section title.

Guideline Updates and Retention of Rights

The Transportation Assessment Guidelines are a living document, and the City of Hamilton retains the right to revise and modify the guidelines when necessary. Appendices in this document will be updated and released as new information becomes available on the City of Hamilton website: **hamilton.ca**

The City of Hamilton retains the right to require additional information and analysis in a Transportation Assessment, beyond what is outlined herein.

Disclaimer

All efforts have been made to ensure accuracy and consistency within the Guidelines.

Approval of a Transportation Assessment or any of its components, addendum's, revisions and/or updates does not constitute approval of any other aspect of the development application.

All information and data submitted to the City of Hamilton in connection with a Transportation Assessment is considered part of the public domain and may be shared with other consultants and the development community.

1.0 Introduction

Transportation Assessments are required for specific types of development applications, including Official Plan and Zoning By-law Amendments, Draft Plans of Subdivision, Site Plan Applications and other applications, at the discretion of the City of Hamilton.

Transportation study forms may include a full study, a reduced scope set of assessments, or a trip generation letter. The need and type of assessment is typically determined through the formal consultation process.

The purpose of a transportation assessment is to:

- Review the potential impacts of proposed development/redevelopment on the existing and future transportation network for all modes of travel including pedestrians, cyclists, transit, passenger and heavy vehicles
- Identify existing or potential safety concerns

- Evaluate mitigation measures and strategies for inclusion as conditions of approval for the proposed development
- Use complete streets and multi-modal level of service (MMLOS) to optimize the existing transportation network and support all travel modes

1.1 Policies and Documents that Inform the Guidelines

The Transportation Assessment Guidelines have been developed to reflect information contained in provincial and municipal policies, planning documents, related guidelines and transportation industry documents, including:

- City of Hamilton Policies, Master Plans, Official Plans, Secondary Plans and Documents
- Cycling Master Plan (CMP)
- Pedestrian Mobility Plan (PMP)
- Hamilton Complete Streets Design Manual
- Development Engineering Guidelines

Appendix A contains a comprehensive list of the documents that inform these Guidelines.

1.2 Requirements for a Transportation Assessment

Typically, the need for a Transportation Assessment is identified by Transportation Planning during the Formal Consultation (FC) process.

Transportation Assessments are typically required when:

- The proposed development requires an Official Plan Amendment (OPA) or Major Zoning By-Law Amendment (ZBA)
- The proposed development is estimated to generate more than 100 trips during any of the peak hours
- The proposed development, its accesses or type of land use and operation is not envisioned by the Transportation Master Plan, Secondary or Neighbourhood Plans
- A new traffic signal or roundabout is proposed on a City road as part of the development or where future boundary road improvements (widening, signal installation, etc.) have been identified
- When, in the opinion of the City, the proposed development has the potential to create adverse operational or safety impacts on the transportation network.

Notwithstanding the above-noted criteria, the City of Hamilton reserves the right to require a Transportation Assessment for any development application.

1.3 Addendums, Resubmissions and Updates

At the discretion of the City, an addendum, resubmission or update to a Transportation Assessment may be required when:

- Electronic copies of analysis files (Synchro, Arcady, etc.) and complete referenced appendices are not provided within the original submission

- The Transportation Assessment exceeds its functional life of three years from date of study
- There are major changes proposed within the study area that were not considered in the original Transportation Assessment or new information or data is available that was not considered within the original Transportation Assessment
- There are substantial changes to the proposed development such as an increase in density or unit count, number and form of access, change in parking supply, etc.

1.4 Qualifications to Conduct a Transportation Assessment

All Transportation Assessments are to be stamped, signed and dated by a person holding a Professional Engineer (P.Eng.) designation.

2.0 Pre-Study Consultation

When a Transportation Assessment is required in support of a development application, a pre-study consultation should be conducted with Transportation Planning prior to initiating the Assessment. The pre-study consultation will confirm the required Assessment type, set the expectations for the Assessment, including the level of detail, and confirm if a multi-modal level of service assessment is required.

The Transportation Consultant initiates the pre-study consultation by submitting the proposed scope of work to Transportation Planning via the tplanning@hamilton.ca email account, along with the supporting documentation.

Appendix B contains a checklist of information by Assessment type that is to be completed by the transportation consultant and submitted as part of the pre-study consultation materials.

Transportation Planning will review the submitted information and respond via email to confirm or amend the scope of work and provide any information or assumptions required to complete the Assessment. A meeting may be requested by either the Applicant/Consultant or Transportation Planning to discuss the study requirements or assumptions for larger or more complex applications.

Transportation Planning will act as the conduit for information between the consultants and other City sections unless otherwise noted in the guidelines.

When the development site is within the Ontario Ministry of Transportation (MTO) permit control area, the consultant is required to contact the MTO directly to determine the need for a study and confirm the study requirements. The consultant should provide all correspondence with MTO to Transportation Planning.

If the site is outside the MTO permit control area but is deemed the application could generate trips that have substantial impacts on any adjacent interchanges/MTO ramps, the Applicant could be required to conduct a broader study that assesses the proposed developments impact to the interchanges/ramps. Transportation Planning will identify the need for this assess through the pre-study consultation process.

2.1 Street Typology

During the pre-study consultation, City staff will identify the requirements for Complete Streets and provide the street typologies for the study area roadways for use in both MMLOS and non-MMLOS analyses. The consultant is to confirm if the City has prepared a complete street concept for any of the site's boundary streets. If not, then existing elements for the relevant complete street should be collected to establish baseline values for the evaluation of mitigation options and post-implementation monitoring.

Appendix C contains a list of the typical values of information Transportation Planning will provide to the consultant during the pre-study consultation process.

IMPORTANT NOTES:
Risks associated with not conducting a pre-study consultation include: holding provisions, increased Transportation Planning review time, substantial report updates and resubmission, or non-approval of the report.

The anticipated site trip generation shall be submitted as part of the pre-study consultation information as this will be used to confirm the required Assessment type.

3.0 Report Structure and Content

The report structure and contents will vary depending on the Assessment type. The following outlines the typical report content requirements.

3.1 Trip Generation Letter/Memo

- General description of the proposed development (location, size/number of units, parking provisions)
- Estimated site trip generation
- Qualitative statement of impacts to transportation network and identification of required and implementable mitigation measures

3.2 Transportation Assessment

- Executive summary (required only for full study)
- Table of Contents
- Introduction including report purpose and horizon years
- General description of the proposed development (location, size/number of units, access locations, phasing, etc.) and related site plan figure
- General description of study area including adjacent roadways (classification, number of lanes, turn lane lengths, posted speeds, posted parking restrictions, etc.) and intersection traffic control
- Existing and planned transit service and active transportation facilities, including maps
- Estimated site trip generation and assignment, including figures and tables

- General discussion of background traffic growth rates and other area development traffic included in the forecasts
- Existing, background and future total traffic volume estimate figures and resulting levels of service analyses (background required only for full study), including identification of intersections or movements exceeding critical thresholds
- Baseline, target and achieved MMLOS for each road segment, intersection and driveway (when MMLOS analyses are required)
- Conclusions and recommendations, including identification of required and implementable mitigation measures and phasing and implementation strategies, if applicable

3.3 Other Transportation Assessments

Requirements will be identified during the pre-study consultation.

3.4 Complete TIS Submission

To be deemed complete, all Transportation Assessment submissions, excluding a trip generation letter/memo, must include:

- A signed and dated P.Eng stamp
- A completed Transportation Assessment Submission Checklist (Appendix D) to verify all requirements have been met
- An electronic copy of the Assessment document inclusive of figures, summary tables and technical appendices (analyses output, supporting information, etc.) with the following file name structure: “(application number) – (municipal address) – (date)”
- Electronic copies of analyses (Synchro, Arcady, etc.) if required to be conducted as part of the TA. Synchro files are to be zipped and submitted with the following file name structure: “(Municipal Address) – Synchro.zip)

Successive submissions such as an addendum, revision or supplementary analyses are to include, at a minimum, reference to the previous submission(s), in the report body or footnotes.

Appendix E contains a detailed list of Assessment contents by type, including specific site plan requirements.

4.0 Data Requirements

4.1 Count Data

Traffic volume, turning movement and active transportation (pedestrian and cyclist) counts more than two (2) years old or that do not reflect existing conditions must be updates to ensure they reflect current multi-modal volumes and modal splits.

Good engineering judgment should be used to determine the most appropriate method and time periods for data collection. The consultant suggested time periods will be confirmed by Transportation Planning through the pre-study consultation process.

In general, data collection should be conducted on a typical weekday (Tuesday through Thursday) during the following periods:

- 7am to 10am
- 11am to 2pm (dependent upon area and land use)
- 4pm to 7pm

Unless otherwise directed by Transportation Planning, count data should not be collected between mid-June and mid-September. Additional data collection days or hours may be required. Discrepancies in volume data should be brought to the attention of Transportation Planning for discussion prior to undertaking any volume adjustments.

Appendix F contains a list of acceptable data sources and data collection methodologies.

Note: When consultants conduct studies on behalf of the Applicant, the raw data, including count date(s), day(s), road surface and weather conditions must be included in the appendices.

4.2 Supplemental Data

Requests for the following are to be made to Transportation Systems:

- Turning movement counts (TMC) and AADT volume data
- Traffic signal timings
- Synchro data

The consultant shall submit the request directly to Transportation Systems at trafficops@hamilton.ca. Any costs associated with the data request are the responsibility of the consultant/applicant.

5.0 Traffic Forecasting & Analysis

The “completeness” of the roadways and intersections are to be evaluated for existing, future background and future total conditions for each scenario and horizon year, with and without planned network improvements to determine if the priorities are balanced per the street typology and Complete Streets audit tool (See Section 5.3.2). When the development is intended to be phased, each combination of phase, peak period and horizon year must be evaluated.
The following sections outline for the Transportation Assessment requirements for forecasting and analysis as identified through the pre-study consultation process. The analysis may be reviewed by staff in other City sections (e.g., Transportation Systems, Roadway Safety, etc.). If additional reviews are required, Transportation Planning will facilitate the review(s).

5.1 Horizon Year(s)

The following horizon years are to be assumed and will be confirmed by Transportation Planning during the pre-study consultation:

- Unless otherwise stated or indicated by Transportation Planning, a standard horizon year of five (5) years beyond full build-out/occupancy shall be assumed.
- When development are phased, each phase may be required to be assessed separately with a horizon of five (5) years beyond build-out/occupancy year for each phase

- Additional horizon years/scenarios may be required to be assessed for any interim conditions such as temporary access(es) and anticipated/planned network improvements

5.2 Analysis Peak Hours

The peak hours are identified as the worst-case combination of site-generated trips plus background traffic volumes. The two (2) highest weekday peak hours are to be analyzed, which are typically the AM and PM peak hours. Land use specific peak hours, such as site generated peak hours (i.e., Saturday midday for retail uses), should be reviewed to determine if they are worst-case. Seasonal variations and existing peak hour travel demands by mode should also be considered.

Table 5.1 outlines the typical peak hours for analysis; however, they are to be confirmed by Transportation Planning during the pre-study consultation.

Land Use	AM Peak	PM Peak	Weekend/ Saturday Peak	Site Specific Peak
Retail, Commercial (e.g., shopping malls, restaurants, big box stores, grocery stores)	✓	✓	✓	No
Residential (e.g., Single family, townhouses, apartment buildings)	✓	✓	No	No
Employment (e.g., business, industrial parks, offices, warehouses)	✓	✓	No	Potentially
Institutional (e.g., schools, places of worship, entertainment, sport facilities)	No	No	No	Potentially
Downtown Cores and Mixed-Use Developments	✓	✓	✓	No

Table 5.1: Typical Peak Hours

5.3 Existing Conditions

5.3.1 Traffic Volumes

The existing traffic volumes are to be established through the turning movement count data. Refer to Section 6.1.1 for details on establishing existing multi-modal volumes.

5.3.2 Complete Streets Audit Tool

In consultation with Transportation Planning, the consultants shall use the Complete Streets Audit Tool to determine the existing conditions and establish the baselines for the evaluation of future MMLOS scenarios. Each element within the right-of-way shall be reviewed and graded from 1 (low) to 5 (high) based on typology:

- Pedestrian realm
- Cycling facilities
- Transit services
- Through movement (auto and freight)

- On-street parking
- Green infrastructure

The difference between the existing and desired values are to be identified. The report shall outline modifications required to meet the desired outcomes and balance the priorities.

Summary tables of the individual Complete Streets elements, the balance of priorities and "completeness" of the intersections, major driveways, and road segments for each of the evaluated scenarios are to be provided in the body of the report.

5.4 Background Volumes

The background traffic volumes shall consist of the general background traffic growth plus trips generated by other approved or in-stream developments within or adjacent to the study area.

For a redevelopment, all existing site-related trips are to be removed from the background traffic forecasts.

5.4.1 General Background Growth

Background growth rates and assumptions for Transportation Assessments will be provided by Transportation Planning during the pre-study consultation.

5.4.2 Other Area Developments

The consultant is to gather details from the City website about other developments (unit count, GFA, etc.) within or adjacent to the study area that should be included within the background traffic estimates. Transportation Planning will review and approve/comment as appropriate. Other area development details and location maps are to be provided within the body of the report.

The consultant may use traffic volumes, multi-modal trip generation, distribution and assignment information from previously approved studies/assessments, provided they are within their functional life (i.e., not more than three (3) years old).

5.5 Transportation System Improvements

The background and total forecasts and site traffic assignments should account for any planned transportation system improvements that may affect traffic patterns (e.g., new roads, additional capacity, turning prohibitions, change to access arrangements, etc.)

The consultant is to gather the planned system improvements information from the City's website and include it within the pre-study consultation submission. Transportation Planning will review and approve/comment and provide the timing of the improvements as appropriate.

5.6 Development Site Trip Generation

All new trip generation assumptions should be justified and supported with documentation.

Generally, the trip generation should be estimated using one of the following methodologies:

- Most recent edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual. Use of average or equation rate(s) shall be determined use ITE guidance contained in Trip Generation Handbook
- Local rates for less typical/specific land uses
- Proxy site trip generation surveys

The report shall indicate if average or equation rates were used to estimate the trip generation, where appropriate.

Tables outlining the land use codes and quantities (e.g., GFA or unit count) and the respective number of trips are to be provided in the body of the report (Appendix G). For large, phased developments, the tables shall identify the number of trips for each phase of development and the total buildout site trip generation.

Appendix G contains the trip generation display templates to be included in the report.

The anticipated site trip generation and associated ITE land use code (where appropriate) is required to be submitted as part of the pre-study consultation materials for approval by Transportation Planning.

5.7 Trip Reductions

Reductions to account for pass-by can be made using professional judgement. When reductions are appropriate, they are to be applied using the guidance and appropriate rates contained within the most recent edition of the ITE Trip Generation Handbook.

Reductions for internal synergy between land uses within mixed-use developments may be permitted and are to be confirmed with Transportation Planning during the pre-study consultation. Note that if permitted, NCHRP Report 684 Internal Capture Estimator is the preferred methodology for determining the onsite trip reductions.

The ITE vehicle trip generation rates account for modal split; therefore, adjustments (for modal split) will not be permitted.

A summary table showing the base trip generation and applied trip reductions is to be provided in the body of the report.

5.8 Trip Distribution

Sound engineering judgment should be used to determine the most appropriate method for the (re)development. The following are the most common acceptable methods for determining the site trip distribution:

- Transportation Tomorrow Survey (TTS)
- Existing travel patterns
- Origin-destination (O-D) surveys
- City transportation model

The trip distribution assumptions and methodology are to be confirmed with Transportation Planning through the pre-study consultation.

Supporting trip distribution information is to be provided in the report appendices.

5.9 Trip Assignment

The site generated trips should be assigned to the network using the trip distribution. The assignment should consider:

- All possible routes to/from the development (not only the shortest)
- Any planned transportation system improvements and their impacts to site access
- Route(s) of least resistance (e.g., right turns instead of left turns)
- Logical routes and travel times (shortest/quickest route)
- Roadway and intersection capacity and delay
- Intersection traffic control (i.e., traffic signals and permitted/protected movements)

Trip assignment figures (turning movement diagrams) must be included in the report for each horizon year. When developments are phased, incremental assignments should be included in the report in addition to a total trip assignment that includes all phases/horizons combined.

5.10 Future Total Traffic Volumes

The future total traffic volumes for each phase, horizon year and analysis period shall consist of the total background traffic volumes and site generated traffic volumes. Future total trip assignment figures (turning movement diagrams) must be included in the report for each horizon year.

6.0 Multi-Modal Level of Service Assessments (MMLOS)

The need for a multi-modal level of service analysis (MMLOS) will be identified by Transportation Planning through the formal consultation and/or the pre-study consultation.

When a MMLOS assessment is required, each intersection, major driveway and road segment shall be analyzed (for MMLOS) under all scenarios. Transportation Planning will identify the priorities by mode of travel during the pre-study consultation.

Hamilton follows the methodology set out in the Ontario Traffic Council (OTC) Multi-Modal Level of Service Guidelines to evaluate levels of service, set targets, measure performance, and guide the strategy for trade-offs between different modes of travel within the right-of-way. Each performance measurement is described based on the street typology and each of the five (5) travel modes.

Note: The names and definitions of street typologies differ between the OTC MMLOS Guidelines and the City of Hamilton Complete Streets Guidelines. The City of Hamilton Complete Streets typology names and definitions are to be used for analysis.

The consultant is required to identify the suggested street typology and the OTC comparator during pre-study consultation. Transportation Planning staff will review and confirm. **Table 6.1** contains general guidance on equivalencies between OTC and City of Hamilton typologies.

Ontario Traffic Conference Typology	City of Hamilton Typology
Downtown Avenue	Main Street/Urban Avenue
Urban Main Street	Main Street
Urban Boulevard	Transitioning Avenue
Neighbourhood Connector	Neighbourhood/Connector
Neighbourhood Main Street	Main Street/Rural Settlement Area
Neighbourhood Boulevard	Neighbourhood/Connector
Industrial Connector	Industrial
Industrial Boulevard	Transitioning Avenue/Industrial
Rural Connector	Rural

Table 6.1: Street Typology Equivalencies

6.1 Multi-Modal Volumes

When a multi-modal assessment is required, figures or tables are to be provided in the body of the report summarizing the existing, background and future total:

- Peak hour volumes by mode on road segments and at the study area intersections and driveways
- Modal split volumes and their percentage of the total trip volumes
- Trip distribution, as applicable

6.1.1 Existing Multi-Modal Volumes and Splits

The existing multi-modal volumes are to be established through traffic volume and/or turning movement counts. If data collection is required, refer to **Section 5.3.1** and **Appendix F** for guidance.

Existing modal splits may be obtained from:

- Transportation Tomorrow Survey (TTS)
- Site surveys
- City of Hamilton

6.1.2 Background and Future Total Multi-Modal Volumes

The background and future total multi-modal volumes are to be derived using the methodology outlined in **Chapter 5.**

Separate tables/figures for the existing, background, site generated and future total transportation demands for the peak hour(s) for all modes of travel on road segments, at intersections and any major driveways for the full build-out/occupancy and horizon years are to be provided in the body of the report, including:

- Multi-modal volumes and turning movements
- Modal split shown as volumes and percentages of the total volumes
- Trip distribution and assignment

For phased developments, separate summaries are required for full build-out/occupancy (of each phase) and horizon year.

Complete volume data, including pedestrian and bicycle volumes are to be included in the report appendices.

6.2 Future Total Multi-Modal Volumes & Analyses

The existing road conditions must be analyzed under future background and future total scenarios. Any roadway improvements planned to be completed in the study area should be reflected in the future background and future total conditions.

6.3 Existing MMLOS Performance Measurement

Using OTC Multi-Modal Level of Service Guidelines, the existing levels of service performance are to be assigned for each of the travel modes for each intersection, major driveway and roadway segment as determined through a pre-study consultation. Per the OTC methodology, LOS is not to be assigned when the design requirements are not met for that mode of travel.

This baseline of existing MMLOS performance will be used to review the potential impacts and mitigation options for the proposed development on the transportation network.

6.4 Setting MMLOS Targets

Setting multi-modal level of service (MMLOS) targets shall be determined using the Hamilton Complete Streets Design Guidelines and OTC Multi-Modal Level of Service Guidelines, and in consultation with Transportation Planning.

Generally, the target MMLOS will be no more than one level of service grade above or below the baseline grade unless there is a significant change in the function/typology of the street at which time increased grade adjustments should be considered.

6.5 Meeting MMLOS Targets and Trade-Offs

Future background and future total scenarios for each study area intersection, major driveway and road segment shall be analyzed to determine if the target MMLOS can be achieved.

The report shall also include a discussion of which MMLOS targets are met and/or achievable with mitigation and which are not. The report shall include rationale for any MMLOS trade-offs.

Tables showing the existing baseline, target and achieved MMLOS for each the intersections, major driveways and analyzed road segments are to be provided in the body of the report. Separate tables must be included for each scenario and horizon year, without and with planned network improvements.

Appendix H contains the trade-offs and recommended outcomes based on the Desired Conditions Matrix in the Hamilton Complete Streets Design Guidelines.

6.6 MMLOS Mitigation Strategy

Physical and operational deficiencies identified in the TA must be suitably mitigated with feasible solutions while keeping safety at the forefront. The TA shall identify implementable mitigation alternatives when overall intersection or individual movement operations exceeds critical threshold values or where transportation links (MMLOS) are not at acceptable levels.

The proposed mitigation strategy shall conform to the most recent version of the City guidelines and policies listed in **Appendix A.**

6.6.1 Mitigation Alternatives

There are a range of mitigation alternatives available, from broad transportation network measures to localized improvements on road segments, at intersections, and the proposed development. MMLOS mitigation alternatives could include but are not limited to one or more, or a combination of:

- MMLOS trade-offs
- Intersection and road segment alternatives
    - New active transportation (AT) facilities
    - Integration of the cycling network
    - Add or widen sidewalks and/or bicycle lanes
    - Complete Streets design
- Transit alternatives
    - New or relocated bus stops
    - Transit route realignment
    - Transit facility improvements such as shelters, lighting and seating
    - Improve sidewalk alignment to follow pedestrian desire lines for pedestrian to reach transit stops
    - Implement on-site facilities for pedestrians and cyclists to seamlessly access transit stops and cycling routes

Appendix I contains a comprehensive list of acceptable mitigation alternatives.

The report must review the feasibility and safety of the mitigation options using, but not limited to, the following lenses:

- Improved safety, connectivity and walkability for pedestrians of all ages and abilities
- Improved safety and connectivity for cyclists of all ages and abilities
- Maintained or improvement operations, especially for pedestrians and cyclists

Note that active transportation facilities may be more viable in suburban areas than in rural areas.

6.7 Mitigation Strategy

The TA report shall include a summary discussion of which MMLOS targets are met an/or achievable with mitigation and which are not. The report shall include rationale for any MMLOS trade-offs.

7.0 Transportation Analysis

The goal of the Transportation Analysis is to identify existing operational deficiencies and constraints on the transportation network and ensure that existing problems are not exacerbated to unacceptable levels or that no new problems are created by the proposed development.

An evaluation of all study area intersections, road segments and driveways is required to be undertaken for the existing, background and future total traffic volumes for each horizon year, peak hour/period as identified through the pre-study consultation.

Unless otherwise indicated during the pre-study consultation, all initial analyses are to be conducted using the existing transportation network in cases where road network improvements are planned, Transportation Planning will confirm the assumed completion year.

Appendix J contains tables outlining the typical evaluation requirements for intersections without roundabouts and intersections with roundabouts.

Existing signal timings provided by the City of Hamilton must be used for all traffic analyses (existing, background and future total).

7.1 Evaluation of Intersections without Roundabouts

7.1.1 Capacity Analysis and Synchro Inputs

The City of Hamilton uses the ICU/"Synchro Value" based on the Intersection Capacity Utilization calculation method. The most recent version of Synchro must be used for capacity analysis at intersections without roundabout.

Appendix K contains the Synchro modelling parameters and timing inputs for existing signals.

Appendix L contains the Synchro signal timing and phasing parameters for proposed/new signals.

The capacity analysis summaries included in the report shall include:

- Average vehicle delays and volume to capacity (v/c) ratios for overall intersection operations and individual movements
- Level of Service (LOS)
- 95th percentile Synchro back of queue estimates

Appendix M contains the templates for displaying the Synchro outputs in the body of the report. Supporting documentation for each scenario and horizon year is to be included in the report appendices.

All relevant Synchro files are to be submitted to the City for the submission to be deemed complete.

Note: Use of any other capacity analysis methodology such as Highway Capacity Manual (HCM) must be approved by Transportation Planning prior to undertaking the analyses.

7.1.2 Scenarios

When it is found transportation system improvements are required, separate analyses for each scenario with improvements is to be included within a separate section with the report.

7.1.3 Critical Values

The analysis summaries must note all conditions and movements that, in general, exceed the following critical values:

Signalized Intersections

- Volume to capacity (v/c) ratio for through movements or shared through/turning .0.80 movements
    - Maximum acceptable v/c ratio for through movements or shared through/turning movements = 0.85
    - Maximum acceptable v/c for exclusive turning movements (left or right) = 0.90
- 95th percentiles queues for individual movements that exceed available storage

Unsignalized Intersections

- LOS based on average delay per vehicle or individual movement with LOS>D
- 95th percentile queues for individual movements that exceed available storage

Transportation Planning will confirm the critical values for use in the assessment, including MMLOS assessments and non-MMLOS assessments, during the pre-study consultation.

7.1.4 Turn Lane Storage, Signalized Intersections

The required storage length for dedicated turning lanes at signalized intersections shall be determined based on the Synchro 95th percentile back of queue results.

7.1.5 Queue Analysis

A queuing analysis must be undertaken for existing, future background and future total volume scenarios both with and without mitigation measures to determine if queues for individual turning movements exceed the available storage at 9th percentile volumes.
Additionally, the analysis must identify when the lane will be inaccessible/blocked by the through movement queue(s).

A standard vehicle length of 7.5 metres is to be used in the analysis. If the analysis results in a fraction of a number, the number of vehicles is to be rounded down to the nearest whole number.

Appendix N provides the display format for queueing analysis, including v/c ratios, levels of service, delays and 95th percentile back of queue lengths for intersections and individual movements.

7.1.6 Methodology and Justification for Turn Lanes

The report must evaluate the need for auxiliary left and right turn lanes to support the proposed development traffic on the study area road network and specifically at all site driveways. The operational analysis results and/or appropriate warrants/guidelines shall be used to determine the need for auxiliary lanes. The safety benefits of providing turning lanes must also be considered.

Left turn lane warrant analysis at unsignalized intersections must be conducted using the most recent MTO Design Supplement for TAC Geometric Design Guide (GDG) for Canadian Roads. MTO monographs with mark-ups are to be included in the report appendices. Standard rounding principles to the nearest 5% are to be applied when determining the percent left turns for warrant selection (e.g., 2.6% = 5% and 12.4% = 10 %)

7.1.7 Feasibility and Functional Plans

Where turn lanes are warranted and/or recommended, functional plans must be included in the report for each horizon year, as appropriate. The functional plans shall demonstrate adequate space is available within the right-of-way to accommodate the lanes with the required storage and taper lengths and to avoid overlapping turning movements/lanes. In cases where there is potential for overlapping left-turn lanes, the consultant is to consider provision of a centre two-way left-turn lane as appropriate. The functional plan shall also demonstrate how the infrastructure, such as ditches, pedestrian, and cycling facilities will be accommodated.

Appendix O provides information about the functional plan drawing requirements.

7.2 Proposed Traffic Control

The TA shall include recommendations and justification for traffic control at all study area intersections and driveways. Appropriate traffic control recommendations shall also be included for

all intersections within a draft plan of subdivision. Recommendations could include, but are not limited to:

- All-way stop control
- Signalization
- Pedestrian Crossover (PXO)

Proposed traffic control installations should be reviewed for:

- Acceptable adjacent intersection spacing
- Proximity to existing/planned traffic control signals
- Impacts to traffic progression and the right-of-way
- Impacts to pedestrian and cyclist safety
- Potential for induced demand resulting from change in traffic control, particularly signalization

All proposed traffic control shall conform to the most recent version of the City guidelines and policies listed in **Appendix A**.

7.2.1 Traffic Signals

Justification: The report must justify the installation of new traffic signals or conversion of "half-signals" to full intersection signalization using the most appropriate OTM Book 12 Traffic Signal Justification. It is strongly recommended that the consultant confirm the justification with Transportation Planning staff prior to the analysis.

All justification and warrant documentation shall be included in the report appendices.

Synchro Modelling Parameters: Proposed signalized intersection operations are to be analyzed using the methodology and inputs outlined in Section 7.1.

7.3 Vehicle Turning and Circulation Plans

The need for roundabout analysis and the terms of reference will be determined through the pre-study consultation, as per the City of Hamilton Modern Roundabout and Neighbourhood Roundabout Analysis Policy.

As per the City of Hamilton policy, the installation of modern roundabouts is to be reviewed for feasibility and as "appropriate and advantageous" where:

- New intersections are proposed within a development
- Capacity or safety problems are identified at existing intersections which require substantial improvements
- Traffic signals or all-way stops are warranted or expected to be warranted at existing or proposed intersections.

If a roundabout is recommended as an appropriate form of traffic control through the TA process, the analysis is to be undertaken using the evaluation requirements in Appendix J.

7.4 Vehicle Turning and Circulation Plans

Transportation Planning reserves the right to require vehicle turning and circulation plans when, in its opinion, there are site access and/or onsite circulation concerns. The need for turning and circulation plans and the required scope will typically be identified through the pre-study consultation process and subsequent review of the TA by Transportation Planning staff.

When required, vehicle turning and circulation plans are to be conducted using software such as AutoTURN and the standard TAC design vehicles appropriate for the site and proposed land use. Consideration should be given to the emergency and service vehicles.

The design vehicle is to be clearly labeled on the turning and circulation plans, which are to be included in the report appendices.

7.5 Complete Streets Desired Conditions Matrix

The report will outline the proposed street typologies for the development site boundary roads and study area, their "completeness", the trade-offs and recommended outcomes based on the Desired Conditions Matrix in the Hamilton Complete Streets Design Guidelines (**Appendix H**).

Separate figures and/or tables of the existing, desired and recommended priority balances for the complete street elements for study area intersections, major driveways and road segments are to be provided within the body of the report.

7.6 Transportation Impact Mitigation Strategy

Physical and operation deficiencies identified in the TA must be suitably mitigated with feasible solutions while keeping safety at the forefront. The TA shall identify implementable mitigation alternatives when overall intersection or individual movement operations exceed critical threshold values or where transportation links (MMLOS) are not at acceptable levels.

The proposed mitigation strategy shall conform to the most recent version of the City guidelines and policies listed in **Appendix A**.

7.6.1 Mitigation Alternatives

There are a range of mitigation alternatives available, from broad transportation network measures to localized improvements on road segments, at intersections, and the proposed development. Mitigation alternatives could include, but are not limited to one or more, or a combination of:

- Change in unit count/density or gross floor area (GFA)
- Align development opening/phasing to coincide with previously approved overall transportation system improvements
- Access management such as restricted movements and driveway relocation or consolidation
- Signal timing/phasing modifications or optimization, including addition or optimization of left turn signal phase
- Change in traffic control

- New auxiliary turning lane installation or increase to existing turning lane storage, both at the site driveway and adjacent intersections.

A comprehensive list of available mitigation alternatives is provided in **Appendix I**.

7.6.2. Recommended Mitigation Measures and Implementation Strategy

Mitigation Measures: The report must outline the recommended mitigation alternatives that:

- Fit within the right-of-way
- Are feasible and implementable (e.g., traffic signal controller has capacity for proposed timing/phasing plan)
- Maintain or improve intersection operations
- Are context sensitive: higher congestion may be more acceptable in downtown/urban core areas than in suburban areas
- Provides a desired outcome that does not compromise other transportation systems or travel modes

The report is to include a summarized list of the recommended mitigation measures, their rationale, proposed timing and benefits to the transportation system. The recommendations section of the report shall clearly:

- Identify any problem movements or operations that have not been mitigated for each background and total traffic scenario
- Identify critical intersections and movements that are not successfully mitigated
- Identify any interim mitigation measures

When recommendations include monitoring a situation/condition, the report shall include a monitoring plan that identifies future conditions that require additional action by the developers and their tenants and/or the City. The plan shall include justification, timing and the potential outcome of the monitoring plan. The proposed monitoring plan shall be included as a separate appendix.

Implementation Strategy: The need for an Implementation Strategy will be identified by Transportation Planning during the pre-study consultation. When required, the strategy shall identify the timing and sequence of improvements and if they are to be completed as stand-alone, in conjunction with the development or other planned transportation system projects. When the development is phased, the timing of the recommended improvements shall be clearly identified for each phase. The report shall also identify how phasing of the development will impact circulation and infrastructure requirements internal and external to the site.

The Implementation Strategy shall include a table outlining the parties responsible for implementing the recommended mitigation measures, including basic percentages attributable to background growth and to the development. Cost estimates are not required.

7.6.3 Functional Plans

All recommended traffic control, geometric, road and right-of-way improvements shall be shown on functional plans. Where change in traffic control are warranted or proposed, functional plans must be included in the report for each phase/horizon year, as appropriate, to demonstrate adequate space is available within the right-of-way to accommodate the proposed mitigation strategy.

The functional plans must identify:

- The existing/proposed right-of-way limits
- Required geometry/alignment changes
- Lane configuration and lane widths
- Pavement markings
- Required centre median island modifications
- Basic layout of any hardware and traffic signal head locations
- If easements are required

Appendix O provides information about the functional plan drawing requirements.

APPENDIX A

City Documents That Inform Guidelines

- City of Hamilton Policies, Master Plans and Documents
- Urban and Rural Official Plans (OPs)
- Transportation Master Plan (TMP)
- Hamilton Complete Streets Design Guidelines
- Cycling Master Plan (CMP)
- Pedestrian Mobility Plan (PMP)
- Roundabout Policy (PW08078)
- Comprehensive Development Guidelines and Financial Policies Manual
- Official Plan Other Transportation Study Terms of Reference:
    - Cycling Route Analysis
    - Modern Roundabout & Neighbourhood Roundabout Analysis
    - Neighbourhood Traffic Calming Options Report
    - Parking Analysis/Study
    - Pedestrian Route & Sidewalk Analysis
    - Roadway Development Safety Audit
    - Transit Assessment
    - Transportation Demand Management Options Report

APPENDIX B

Pre-Study Consultation Information List

At a minimum, the following information should be included as part of the pre-study consultation email:

- Transportation consultant name and contact information
- Development Details (by phase as applicable):
    - Development application number
    - Municipal Address
    - Number of buildings and storeys
    - Number of units
    - Gross floor area
    - Number of accesses and location
    - Access permissions/restrictions (all-turns, right-in/right-out, etc.)
    - Other relevant info
- Proposed Study Area:
    - General limits of study area
    - Intersections to be included in analysis
    - Driveway(s)/access(es) to be included in analysis
    - Proposed Complete Streets typology (by street)
- Existing Conditions:
    - Proposed data collection sources/methodology
    - Proposed data collected dates, times, etc.
- Proposed Analysis Period(s):
    - AM, PM, Saturday or other as appropriate for land use
- Proposed Horizon Year(s):
    - Horizon years should be identified for each phase of development as appropriate
- Proposed Analysis Methodology:

    - Identify program(s) and version to be used for analysis (Synchro 12, Arcady, etc.)
    - Recommend/confirm need for MMLOS analysis
    - Identify if queue assessment will be provided and what methodology will be used for assessment
- Trip Generation:
    - Estimated trip generation, prepared using the trip generation template
    - Multi-modal trip generation, prepared using the trip generation template
- Background Growth:
    - Proposed background growth rate (by phase if applicable)
    - Background developments to be included in forecasts in addition to general growth
- MMLOS Assessment:
    - Desired outcomes
    - MMLOS targets

APPENDIX C

Pre-Study Consultation Information Confirmed by Transportation Planning

- Feedback, comments and approval of Transportation Assessment scope
- Information regarding planned transportation network improvements and timing
- Information regarding background developments
- Background growth rate
- Street typologies and desired outcomes based on Hamilton Complete Streets Design Guidelines
- MMLOS targets for each travel mode and/or priority for the modes of travel
- Other information that may be relevant to the study area

APPENDIX D

Transportation Assessment Submission Checklist

Included (Y/N) or N/A	Component
	Report body, including all components by study type outlined in Appendix E
	Complete referenced appendices, including analysis outputs
	All figures, tables, maps, etc. referenced in report body
	If identified as required during pre-study consultation*:
	Cycling Route Analysis
	Modern Roundabout and Neighbourhood Roundabout Analysis
	Neighbourhood Traffic Calming Options Report
	Parking Analysis/Study
	Pedestrian Route and Sidewalk Analysis Study
	Roadway Development Safety Audit
	Transit Assessment
	Transportation Demand Management Options Report
	Any other supporting information
	Analysis files (e.g.: Synchro, Arcardy, etc.)

**These can be provided as a separate, standalone section within the broader TA document*

APPENDIX E

Transportation Assessment Contents

- **Title Page:**
    - Development application number
    - Development name, such as subdivision name or name used in marketing materials
    - Municipal address
    - Date of report (month and year)
    - Previous report date, when the submitted report is a revision, update or addendum
- **Executive Summary:**
    - Name of Applicant/Developer who contracted their services
    - General description of development, including:
        - Street address and general location
        - Land use
        - Number of units and/or square metres/feet per land use
        - Number of phases
        - Proposed parking provisions
        - Access arrangements
    - Reason for submitting report (to support OPA, ZBA, Site Plan, etc.)
    - Key findings
    - Mitigation recommendations
    - Implementation Strategy
- **Table of Contents:**
    - Applicable headings of section and subsections as outlined in the report body
    - List of figures, tables, photographs, diagrams, etc.
    - List of appendices

- **Introduction:**
  - Name of Applicant/Developer who contracted their services
  - General description of development, including:
    - Location
    - Number of units
    - Number of phases
    - Proposed parking provisions
    - Access arrangements
    - Estimated complete date per phase
  - Reason for submitting report (to support OPA, ZBA, Site Plan, etc.)
  - Stage of Application
  - Horizon year(s) of report
  - General overview of report contents and layout
- **Description of Proposed Development and Phasing**
  - Street address and general location
  - Development name, such as subdivision name or name used in marketing materials
  - Land use
  - Number of buildings
  - Number of storeys per building
  - Number of units and/or square metres/feet per land use
  - Proposed parking provisions
  - Phasing
    - Description of each phase (number of buildings, units/square metres, parking, etc.)
    - Location of each phases proposed access(es), including any changes in access due to phasing plan
    - Anticipated date of full build-out/full of each phase
  - Access arrangements

- Estimated completion date per phase
- Estimated number of employees, as appropriate
- Days/hours of operation

The study must include most recent draft plan of subdivision or site plan, as applicable. The drawing must be to scale and include, but is not limited to:

- Development application number
- North arrow
- Street names
- Municipal address of lands included in development application
- Development name, such as subdivision name or name used in marketing materials
- Number and type of residential units
- Total building size(s) (units/square metres/feet) and location(s) on property for each land use
- Proposed access(es) and permitted/restricted turning movements
- Demarcation of phases
- Location of proposed access(es) for each phase
- Existing and proposed right-of-way limits for both sides of road
- Existing and proposed road edges and access(es) for both sides of road along for property limits
- Building structures
- Loading and garbage areas, by building as applicable
- Proposed parking. Note that separate parking plans by level, including ramp grade and transition percentages) are required when multiple levels of parking are proposed

- **Study Area**

  The proposed study area is to be submitted as part of the pre-study consultation for approval by Transportation Planning prior to undertaking the assessment.

  The study area should extend approximately one (1) kilometre in all directions from the limits of the proposed development. The study area should be broad

enough to contain all municipal and provincial roads, major driveways, intersection, interchanges, trails, multi-use paths, sidewalks and transit services potentially affected by the proposed development.

- Study area transportation network:
  - Study area roadways (name, Official Plan classification)
  - Surrounding area land use(s)
  - Existing right-of-way widths
  - Lane configurations and lane widths for all intersections and road segments
  - Posted speed limit
  - Location of on-street parking, loading zones, etc. The study is to also identify where parking is restricted or prohibited
  - Existing access points adjacent to or opposite the proposed development
  - Land use on both sides of development boundary roads
  - Intersection traffic control for all intersections and driveways within the study area
  - Any other relevant information pertaining to the transportation facilities

When a Pedestrian Route & Sidewalk Analysis Study is not required, the study is to provide general information on the pedestrian facilities in the study area, including:

- Sidewalk and multi-use path/trail location(s)
- Crosswalk and protected crossing (PXO) location(s)
- Pedestrian signal location(s) and mode of operation (push button activated or integrated into signal timing)

When a Transit Assessment is not required, the study is to provide general information on the transit service and facilities in the study area, including:

- Existing transit service within the study, including:
  - Route number and name
  - General service area and how and where route(s) connect to City and regional public transportation

        - Route frequency (headways)
        - Bus stop location in relation to development
        - Bus stop amenities (shelter, bench, bike parking, bike share/e-scooter hub, etc.)
    - Planned transit service within the study area and timing of implementation

A map illustrating the existing transit service within the study area and proposed development location is to be included in the report.

The City of Hamilton reserves the right to define and/or make modifications to the study area as they deem appropriate.

- **Existing Conditions**

The report shall include figures and summary tables showing the current transportation demands (volumes) for the peak hours on road segments, at intersections and at any significant driveway(s) within the study area, including:

- Multi-modal volumes and turning movements
- Modal split shown as volumes and percentages of total volume
- Trip distribution and assignment

The report is to document how the existing conditions were established (through turning movement counts, proxy site surveys, etc.). Comprehensive volume data is to included within the report appendices.

- Existing conditions analysis results are to be outlined within this section. The results are to be presented in tabular format using the Synchro template in Appendix M.
- The detailed Synchro outputs must be included within the report appendices
- The supporting Synchro files are required to be submitted along with the TA report for it to be deemed a complete submission.

- **Trip Generation, Distribution and Assignment**

Trip Generation

- The methodology used to estimate the site's trip generation must be clearly documented within the report and shall include details of the trip generation rates or equations used for all modes of travel, including justification for use of the rate or equation

- The trip generation, including all reductions for onsite synergy and pass-by trips, is to be completed for each phase/horizon year and presented in the body of the report using the table in Appendix X

Trip Distribution

- The methodology used to establish the site trip distribution, for all modes as applicable, must be clearly documented in the report body.
- A table outlining the trip distribution is to be included within the report body
- Figures illustrating the trip distribution percentages by travel must be included within the report body.

Trip Assignment

- The methodology used to assign trips to the network must be clearly documented in the report body.
- Figures showing site trip assignments for all modes by phase/horizon must be included within the report body. Separate figures shall be provided for new and pass-by trips.

- **Future Conditions**

  Background Traffic Volumes

  - The methodology used to estimate the background traffic volumes, for all modes of travel as applicable, must be clearly documented within the report.
  - Figures illustrating general background growth, traffic from planned or in-stream developments and total (general growth + other development traffic) for each phase and/or horizon are to be included in the report body.

  Background Traffic Analysis

  - Background Traffic analysis results are to be outlined within this section. The results are to be presented in tabular format using the Synchro template in Appendix M.
  - The analysis shall be completed using the existing signal timing and phasing plans unless directed otherwise by City staff.
  - The detailed Synchro outputs must be included within the report appendices.
  - The supporting Synchro files are required to be submitted along with the TA report for it to be deemed a complete submission.

Future Total Traffic Volumes

- The methodology used to estimate the future total traffic volumes, for all modes of travel as applicable, must be clearly documented within the report.
- Figures illustrating the future total traffic (background traffic + site generated traffic) for each phase and/or horizon are to be included in the report body.

Future Total Traffic Analysis

- Future Total Traffic analysis results are to be outlined within this section. The results are to be presented in tabular format using the Synchro template in Appendix M.
- The analysis shall be completed using the existing signal timing and phasing plans unless directed otherwise by City staff.
- The detailed Synchro outputs must be included within the report appendices.
- The supporting Synchro files are required to be submitted along with the TA report for it to be deemed a complete submission.

- **Remedial Measures**
  - Any remedial measures recommended or required for future (background or total) conditions should be clearly outlined, justified and analyzed, for all modes of travel as applicable, within the report.
  - Left-turn lane nomographs, signal warrants and any other warrants supporting the recommended or required improvements shall be provided within the report body or appendices.
  - Figures illustrating the recommended/required remedial measures shall be provided in the report or appendices (e.g.: proposed lane configuration, intersection traffic control, etc.)
  - The analysis undertaken to support the remedial measures are to be outlined within this section. The results are to be presented in tabular format using the Synchro template in Appendix M.
  - The analysis can be completed using the recommended signal timing and phasing plans unless directed otherwise by City staff.
  - The detailed Synchro outputs must be included within the report appendices.

- ***The supporting Synchro files are required to be submitted along with the TA report for it to be deemed a complete submission.***

- **Conclusions/Recommendations**
  - The conclusions shall summarize the findings of the report and shall be based on the work contained within the report. They are to include, at minimum:
    - Existing conditions analysis summary
    - Background traffic analysis summary by phase/horizon year
    - Future total traffic analysis summary by phase/horizon year
    - Remedial measures analysis summary by phase/horizon year
    - Any other information that supports the report recommendations
  - The recommendations shall include an overall summary of the action items and remedial measures required to support the development. They are to include, at a minimum:
    - Remedial measures required to provide acceptable levels of service at the study area intersections and driveways under background traffic conditions (by phase/horizon as appropriate)
    - Remedial measures by phase/horizon required to support the development for under future total traffic conditions
    - Remedial measure implementation responsibility (City of developer)
  - Any other information that supports the report recommendations

- **Appendices**
  - All information the analysis, conclusions and recommendations of the report must be provided within appendices, including, but not limited to:
    - Turning movement/count data
    - Synchro/Arcady outputs files
    - Traffic control signal warrants
    - Left-turn lane warrant nomographs
    - Any other analysis-specific outputs

APPENDIX F

Acceptable Count Data Sources

Data from one or more of the following sources may be used to determine existing and future multi-modal volumes, trip distribution and assignment:

- Existing Multi-Modal Volumes:
    - Turning movement/traffic counts – purchased from the City or collected by the transportation consultant (as identified and confirmed through pre-study consultation)
    - Proxy site surveys
    - Market studies
    - City-provided modal splits
    - ITE Trip Generation
    - Good engineering judgement
- Trip Distribution and Assignment:
    - Transportation Tomorrow Survey (TTS) data
    - Origin-destination surveys
    - Proxy site surveys
    - Comprehensive travel surveys
    - City transportation planning model(s)
    - ITE Trip Generation
    - Good engineering judgement

Data sources must be well documented and any assumptions (data is conservate, etc.) must be justified within the body of the report.

The count data used to establish existing conditions must be included in the report appendices. When the consultants conduct studies on behalf of the applicant(s), the raw data must include the date(s), day(s), time of data collection and road surface and weather conditions.

APPENDIX G

Trip Generation Display Templates

Base Trip Generation			AM Peak Hour			PM Peak Hour			Saturday Peak Hour		
Phase	ITE Land Use Code	Units/ Sq Ft	In	Out	Total	In	Out	Total	In	Out	Total
1	Enter ITE Land Use Code										
	Enter ITE Land Use Code										
	Total/Subtotal Base Trip Generation										
2	Enter ITE Land Use Code										
	Enter ITE Land Use Code										
	Total/Subtotal Base Trip Generation										
Total Base New Trip Generation - All Phases											
Onsite Synergy			**AM Peak Hour**			**PM Peak Hour**			**Saturday Peak Hour**		
1	Enter ITE Land Use Code		In	Out	Total	In	Out	Total	In	Out	Total
	Onsite Trip Reduction (shown as negative value (-X))										
2	Enter ITE Land Use Code		In	Out	Total	In	Out	Total	In	Out	Total
	Onsite Trip Reduction (shown as negative value (-X))										
Total Onsite Trip Reduction - All Phases											
Adjusted New Trip Generation (Base Trip Generation - onsite synergy											
Pass-by Trips			**AM Peak Hour**			**PM Peak Hour**			**Saturday Peak Hour**		
1		Rate	In	Out	Total	In	Out	Total	In	Out	Total
	Enter ITE Land Use Code										
	Pass-by Trips (shown as negative value (-X))										
	New Trips										
	Enter ITE Land Use Code										
	Pass-by Trips (shown as negative value (-X))										
	New Trips										
2		Rate	In	Out	Total	In	Out	Total	In	Out	Total
	Enter ITE Land Use Code										
	Pass-by Trips (shown as negative value (-X))										
	New Trips										
	Enter ITE Land Use Code										
	Pass-by Trips (shown as negative value (-X))										
	New Trips										
Total of all Phases			**In**	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
	Pass-by Trips										
	New Trips										
	Total										
			AM Peak Hour			**PM Peak Hour**			**Saturday Peak Hour**		
Final Adjusted New Trip Generation (Base Trip Generation - Onsite Synergy - Pass-by Trips)			**In**	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**

APPENDIX H

Complete Streets Desired Conditions Matrix

Hamilton Complete Street Typology	Pedestrian Realm	Cycling Facilities	Transit Service	Transit Service (BLAST network)	Through Movement	On-Street Parking	Green Infrastructure
Urban Avenue	4	4	4	5	3	2	3
Transitioning Avenue	5	5	4	5	4	1	3
Main Street	4	4	3	4	2	4	4
Connector	4	4	3	3	2	2	4
Industrial Street	4	4	3	3	3	1	2
Neighbourhood Street	3	2	1	1	1	3	4
Rural Road	1	4	1	3	4	1	2
Rural Settlement Road	4	3	2	3	3	3	3

APPENDIX I

Mitigation Alternatives

Mitigation alternatives could include, but are not limited to one or more, or a combination of the following alternatives:

- New active transportation (AT) facilities
- Cycling network integration
- Add or widen sidewalks
- Add or widen cycling lanes
- Incorporation of Complete Streets design
- Speed limit reduction
- Access management including:
    - restricted/restricting movements
    - access relocation
    - access consolidation
- Signal timing and phasing changes, including adding left-turn signal phase(s)
- Changes to traffic control
- Horizontal/vertical alignment changes to improve sight distance
- Adding a dedicated left-turn lane for site driveway/access
- Increased turn lane storage
- Geometric design and realignment
- Widen or narrow lane widths
- Widen or pave shoulders
- Traffic calming, including speed cushions, curb extensions or raised crosswalks
- Signage changes
- Road closure
- Acquisition of lands for right-of-way widening
- Construction/development of subsequent phases contingent on previously approved improvements
- Increase/decrease in unit count of gross floor area to reduce required mitigation

APPENDIX J

Typical Intersection Evaluation Requirements

Scenario	Intersection Type	Analysis Time Period(s)	Required Evaluations
Existing	signalized and unsignalized	Existing peak periods (typically AM and PM peaks), potentially Saturday for commercial land uses. Other periods as identified by Transportation Planning	• capacity analysis • average vehicle delay(s) • level of service (LOS) & volume to capacity (v/c) ratios • queue lengths • MMLOS for each travel mode
Future Background and Future Total	signalized and unsignalized	each phase, peak period and horizon year	• MMLOS targets for each travel mode • overall intersection and individual critical movements • critical MMLOS conditions • identify priority balances and completeness of intersection

APPENDIX K

Synchro Modelling Parameters and Timing Inputs

Existing Intersections

Variable	Standard Synchro Input Parameters and Considerations
Units of Measure	• metric • seconds
Analysis Time Period(s)	• use existing timing plan • typically AM and PM peak hours • one or more weekend peaks for commercial, institutional, etc. • site peak analysis may be required to identify the peak hour(s)
Standard Vehicle Length (m)	• 7.6 metres
Heavy Vehicle and Bus Conversion Factor	• 1.8 x standard vehicle length of 7.6 m
Lane Widths (m)	• actual existing measured width in metres (m) • 3.3 metres for through lanes • 3.0 - 3.3 metres for proposed turning lanes
Saturation Flow (vehicles per hour per lane - vphpl)	• 1900 vphpl • saturation flow surveys to be conducted when there are significant operational or capacity concerns • actual saturation flow methodology as per the Canadian most recent edition of the Capacity Guide for Signalized Intersections
Lane Designation and Usage	• account for on-street parking by varying the number of lanes for mid-block locations and intersections • assume parking is fully occupied • bus stop blockages (#/hr) to be applied to affected lane • account for far-side bus stops • as per HCM, 75 m is the area of influence from an intersection
Lane Utilization Factor (LUF)	• default values are acceptable • transportation consultants may be required to conduct field studies to confirm LUF (e.g.: existing lane drop) • include justification for any changes within the report body
Storage Lanes (#)	• code number of storage lanes for right and left-turn lanes • when applicable, the field can be overwritten to code a through lane as a storage lane

Variable	Standard Synchro Input Parameters and Considerations
Storage Length	• taper is to be measured from the far end of the solid line • minimum storage length in the downtown core is 7.6 metres (1 car length) • minimum storage length in new development areas is 15.2 metres (2 car lengths
Right-Turn Channelization and Add Lanes (#)	• default channelization should be set to "NONE" • parameter selection controls how the right-turn lane enters the intersection: "0" is standard for Yield or Stop, change to "1" for right-turn lane continuation
Right-Turn on Red (RTOR)	• default set to "YES" to permit right-turn on red • change to "NO" to remove right-turn on red. This should be considered in high pedestrian and cycling activity areas
Link Distance (m)	• measures in metres between the centreline of two intersections
Link Speed (km/h)	• use posted speed limit
Volume (vehicle)	• use existing volumes or forecast volumes as applicable for the scenario
Pedestrian Volumes	• pedestrian volumes based on actual volumes or forecasts as applicable for the scenario
Conflicting Pedestrians (#/hr)	• use existing pedestrian volumes for conflicting right and left-turn movements • conflicting pedestrian movements are not permitted during protected or dual right-turn/left-turn movements • future volume analysis should use existing pedestrian volumes unless a change in volume is expected
Peak Hour Factor (PHF)	• 0.92 and AM and PM peak hours • 0.90 for off peak hours (including midday and overnight where applicable) • use existing count PHF where possible. Calculated as total hourly volume / (peak 15-minute volume within the hour x 4)
Heavy Vehicle Volumes (%)	• calculate percentage based on actual volume (do not use default) • adjust to account for significant increases in heavy vehicle volume for industrial and/or commercial land uses
Cycle Length(s)	• use existing timing plan for all scenarios
Signal Coordination	• use existing timing plan for all scenarios • convert offset to seconds (consult with City staff for offset if not provided within timing plan)

Variable	Standard Synchro Input Parameters and Considerations
Lost Time Adjustment (LTA)	• use existing timing plan for all scenarios • use Synchro default of "0" • use left-turn lane LTA of 1.0 second in peak periods only • when heavy vehicles account for majority of left-turns, LTA of 2.0 seconds can be used
Sneakers (veh)	• 1 sneaker per left-turn cycle
Detection	• use existing timing plan for all scenarios
Headway	• use default of 1.9 seconds
Dual Left-Turn Lanes (vph)	• consider dual lanes when left turning volume is 450 vph or greater • code as fully protected movement • where dual left-turn lanes are provided, assume a 45%/55% distribution between the lanes • conflicting pedestrian movements are not permitted during protected dual left-turn movements
Lead/Lag Phases	• use existing timing plan for all scenarios • permitted on a case by case basis • consider leading pedestrian and cycling phases
Bicycle Signals and Phases	• typically, bicycle signals mimic the vehicle phase • bicycle phase timings as per latest edition of OTM Book 12A • consider bicycle signals and cross-rides • consider protected signal phasing
Cycling Speed at Cross-Rides (km/h)	• in the absence of empirical information, 14-20 km/h is acceptable as per OTM Book 12A
Conflicting Bicycles (#/hr)	• use existing cycling volumes for conflicting right and left-turn movements • future volume analysis should use existing bicycle volumes unless a change in volume is expected
Transit Signal Priority (TSP)	• Consult with City staff

Variable	Standard Synchro Input Parameters and Considerations
Auto Signal Optimization	• can be applied when using Ped Min • cycle length increases in increments of 10 seconds • do not permit lead/lag optimization (uncheck box)
Walking Speed (m/s)	• 1.0 metres/second (m/s) maximum • 0.9 m/s near elementary schools • 0.8 m/s near visually impaired areas and areas of high senior activity
Pedestrian Calls (#/hr)	• for actuated operation, use a minimum of one (1) pedestrian call/cycle based on calculated cycle lengths and ped volumes
Pedestrian Phase(s)	• use existing timing plan for all scenarios • can include "hold" interval for each LPS before start of corresponding through movement. Max recall mode is to be used to activate the "hold" phase • ped phases should be used exclusively for scramble/ped exclusive phases
Through Phase(s) (sec)	• use existing timing plan for all scenarios • 10 seconds minimum green time for all "with improvements" scenarios or new signal installations
Protected/Permitted Left-Turn Phases (PPLT)	• use existing timing plan for all scenarios • 3 seconds amber for all "with improvements" scenarios or new signal installations • 5 seconds minimum green time for all "with improvements" scenarios or new signal installations
Fully Protected Left-Turn Phases (FPLT)	• use existing timing plan for all scenarios • 3 seconds amber for all "with improvements" scenarios or new signal/phasing installations • 7 seconds minimum green time for all "with improvements" scenarios or new signal/phasing installations • 1.5 seconds all-red minimum clearance • protected left-turn phasing must be used on corridors with bi-directional multi-use pathway (MUP)

Variable	Standard Synchro Input Parameters and Considerations
Pedestrian Clearance Time (Walk Time) & Flashing Don't Walk	• pedestrian clearance input is the required clearance minus the amber/all-red for that phase • use existing timing plan for all scenarios • 5 seconds minimum walk time for all "with improvements" scenarios or new signal/phasing installations • can be coded <5 seconds if a leading pedestrian interval (LPI) is used • crossing distances is curb to curb from the centre of the crosswalk • median islands: for one-stage crossing, include median island in crossing distance. For two-stage crossing, timing must be sufficient to cross at least one stage
Vehicle Clearance(s)	• use existing timing plan for all scenarios • round all times to the nearest 0.1 second • T-intersection = 4.0 seconds red
Vehicle Extension Time(s)	• use existing timing plan for all scenarios • 1 - 3 seconds is acceptable based on intersection geometry
Minimum Spacing for New Signal Installations (m)	• one-way streets: minimum 140 metres (centreline to centreline) • two-way streets: minimum 215 metres (centreline to centreline) or 95th percentile queue length, whichever is greater

Notes:

For network seeding, the reports should be a minimum of five simulations comprising a minimum one-hour simulation run plus a minimum seeding time for vehicles to travel through the entire network, or a minimum of 30-minute seeding time, whichever is the greater.

Time-space diagrams should show 100% usage of green time, i.e., as though the signal was operating in fixed time mode.

Identify any narrowing of green bands in progression and time space diagrams.

Queue length versus storage length:

the 95th percentile queue length must not create new adverse obstructions or exacerbate existing conditions.

vehicle storage is to be rounded to full vehicle lengths

All movements must have volume to capacity (v/c) ratios of ≤0.85 (less than or equal) and no delay greater than one cycle length

Output should summarize levels of service (LOS) for each movement at each intersection under all scenarios.

When Synchro results are questionable a comparison of Synchro and SimTraffic results is required to determine the cause of discrepancy: i.e., poor Measure of Effectiveness (MOE) on turning movements.

APPENDIX L

Synchro Modelling Parameters and Timing Inputs

New Intersections

In addition to the Synchro parameters for existing intersections, the following should be considered for proposed/new intersections and signals:

Variable	Standard Synchro Input Parameters and Considerations
Right-Turn on Red (RTOR)	• consult with City staff proposed/new signals
Conflicting Pedestrians (#/hr)	• for proposed/new signals, future conflicting pedestrian volumes must be approved by City staff
Mode of Operation	• consult with City staff for proposed/new signals • future signals are typically modeled as fully actuated with recall on the main street
Cycle Length(s)	• consult with City staff for proposed/new signals
Sneakers (veh)	• for proposed/new signals, assume 2 vehicles per cycle
Detection	• consult with City staff for detection confirmation at proposed/new signals
Conflicting Bicycles (#/hr)	• for proposed/new signals, future conflicting bicycle volumes must be approved by City staff
Pedestrian Clearance Time (Walk Time)	• pedestrian timings for proposed/new signals must include sufficient clearance to cross the entire road at 1.0 metres/second
Vehicle Clearance(s)	• use latest edition of OTM Book 12 for amber and all-red clearances for proposed/new signals (formula takes precedence over table)

Note:

Model must include at least 2 existing signalized intersections both upstream and downstream of the proposed/new signal; calculate clearance if it is available.

APPENDIX M

Synchro Output Display Template

Analysis Period	Intersection	Control Type	Measure	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 - Street Name One & Street Name Two	TCS	LOS	A	A	A	**A**	A	A	A	**A**	A	A	A	**A**	A	A	A	**A**	**A**
			Delay	105	8888	8888	**8888**	8888	8888	8888	**8888**	8888	8888	8888	**8888**	8888	8888	8888	**8888**	**8888**
			V/C	88.88	88.88	88.88		88.88	88.88	88.88		88.88	88.88	88.88		88.88	88.88	88.88		**88.88**
			Q	889	889	889		889	889	889		889	889	889		889	889	889		
			Ex	889	889	889		889	889	889		889	889	889		889	889	889		
			Avail.	889	889	889		889	889	889		889	889	889		889	889	889		
	2 - Street Name One & Street Name Two	TWSC	LOS	A	A	A	**A**	A	A	A	**A**	A	A	A	**A**	A	A	A	**A**	**A**
			Delay	8888	8888	8888	**8888**	8888	8888	8888	**8888**	8888	8888	8888	**8888**	8888	8888	8888	**8888**	**8888**
			V/C	88.88	88.88	88.88		88.88	88.88	88.88		88.88	88.88	88.88		88.88	88.88	88.88		**88.88**
			Q	889	889	889		889	889	889		889	889	889		889	889	889		
			Ex	889	889	889		889	889	889		889	889	889		889	889	889		
			Avail.	889	889	889		889	889	889		889	889	889		889	889	889		
AM Peak Hour	1 - Street Name One & Street Name Two	TCS	LOS	A	A	A	**A**	A	A	A	**A**	A	A	A	**A**	A	A	A	**A**	**A**
			Delay	105	8888	8888	**8888**	8888	8888	8888	**8888**	8888	8888	8888	**8888**	8888	8888	8888	**8888**	**8888**
			V/C	88.88	88.88	88.88		88.88	88.88	88.88		88.88	88.88	88.88		88.88	88.88	88.88		**88.88**
			Q	889	889	889		889	889	889		889	889	889		889	889	889		
			Ex	889	889	889		889	889	889		889	889	889		889	889	889		
			Avail.	889	889	889		889	889	889		889	889	889		889	889	889		
	2 - Street Name One & Street Name Two	TWSC	LOS	A	A	A	**A**	A	A	A	**A**	A	A	A	**A**	A	A	A	**A**	**A**
			Delay	8888	8888	8888	**8888**	8888	8888	8888	**8888**	8888	8888	8888	**8888**	8888	8888	8888	**8888**	**8888**
			V/C	88.88	88.88	88.88		88.88	88.88	88.88		88.88	88.88	88.88		88.88	88.88	88.88		**88.88**
			Q	889	889	889		889	889	889		889	889	889		889	889	889		
			Ex	889	889	889		889	889	889		889	889	889		889	889	889		
			Avail.	889	889	889		889	889	889		889	889	889		889	889	889		

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Back of Queue Length (m)
Ex. - Existing Storage (m)
Avail. - Available Storage (m) (existing - queue)

Notes:

Intersection names to be numbered as per Synchro

List of intersections in the report and LOS table should be consistent

For small tables with unused rows. Remove/hide rows

APPENDIX N

Queue Analysis Display Format

Approach	Maximum 95th Percentile Back of Queue Estimates (in metres)			
	Scenario (e.g.: Existing)	Scenario (e.g.: Background)	Scenario (e.g.: Total)	Scenario (e.g.: Total w Imp)
Approach Name (e.g.: Northbound on Queen Street at King Street)	X	X	X	X
Approach Name	X	X	X	X
Approach Name	X	X	X	X

APPENDIX O

Functional Plan Drawing Requirements

Where turn lanes or other right-of-way improvements are warranted an/or recommended, functional plans must be included in the report or appendices to demonstrate the feasibility of the recommended improvements.

Functional plans are not detailed design engineering drawings. They are a conceptual plan illustrating there is adequate space within the right-of-way to accommodate the recommended improvements and that they reasonably tie into the existing infrastructure.

Linework and text added over an aerial photograph may be adequate. The plans must be scaled and properly dimensioned and include the following:

- Both sides of the right-of-way bordering the improvement area and development site
- Existing and proposed right-of-way property lines
- Development site property lines
- Existing and proposed operational and/or physical constraints of the right-of-way and/or road network
- All recommended geometric, road and right-of-way improvements for each of the horizon years
- Lane configuration and intersection improvements
- Pavement markings, lane configuration and lane widths
- High-level utility impacts
- Median traffic islands
- Basic layout of any traffic signal hardware and signal head locations
- Road edge, sidewalks, driveways, ditches, etc.
- Turn lane storage and taper lengths
- Required easements
- Other relevant information

Note that when the proposed recommendations will have to tie into existing infrastructure, the plans are to extend beyond the limits of the proposed development area and illustrate the tie-in.

Refer to the City’s Comprehensive Development Guidelines and Financial Policies Manual for additional information.