



## Thundering Waters Secondary Plan Transportation Study – Existing Conditions

Paradigm Transportation Solutions Limited

November 2015



# Project Summary



## Project Number

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## Client

GR (CAN) Investment Co. Ltd.  
8500 Leslie Street, Suite 520  
Markham, ON L3T 7M8

## Client Contact

Ms. (Helen) Zhi Ying Chang  
Chairwoman

## Consultant Project Team

Gene Chartier, P.Eng.  
Andrew Evans  
Matthew Brouwer

## Thundering Waters Secondary Plan Transportation Study – Existing Conditions

### List of Revisions

Version	Date	Author	Description
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### Signatures

\_\_\_\_\_  
Signature

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## Paradigm Transportation Solutions Limited

22 King Street South Suite 300  
Waterloo ON N2J 1N8  
p: 519.896.3163  
www.ptsl.com





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# 1 Introduction

## 1.1 Study Purpose and Objectives

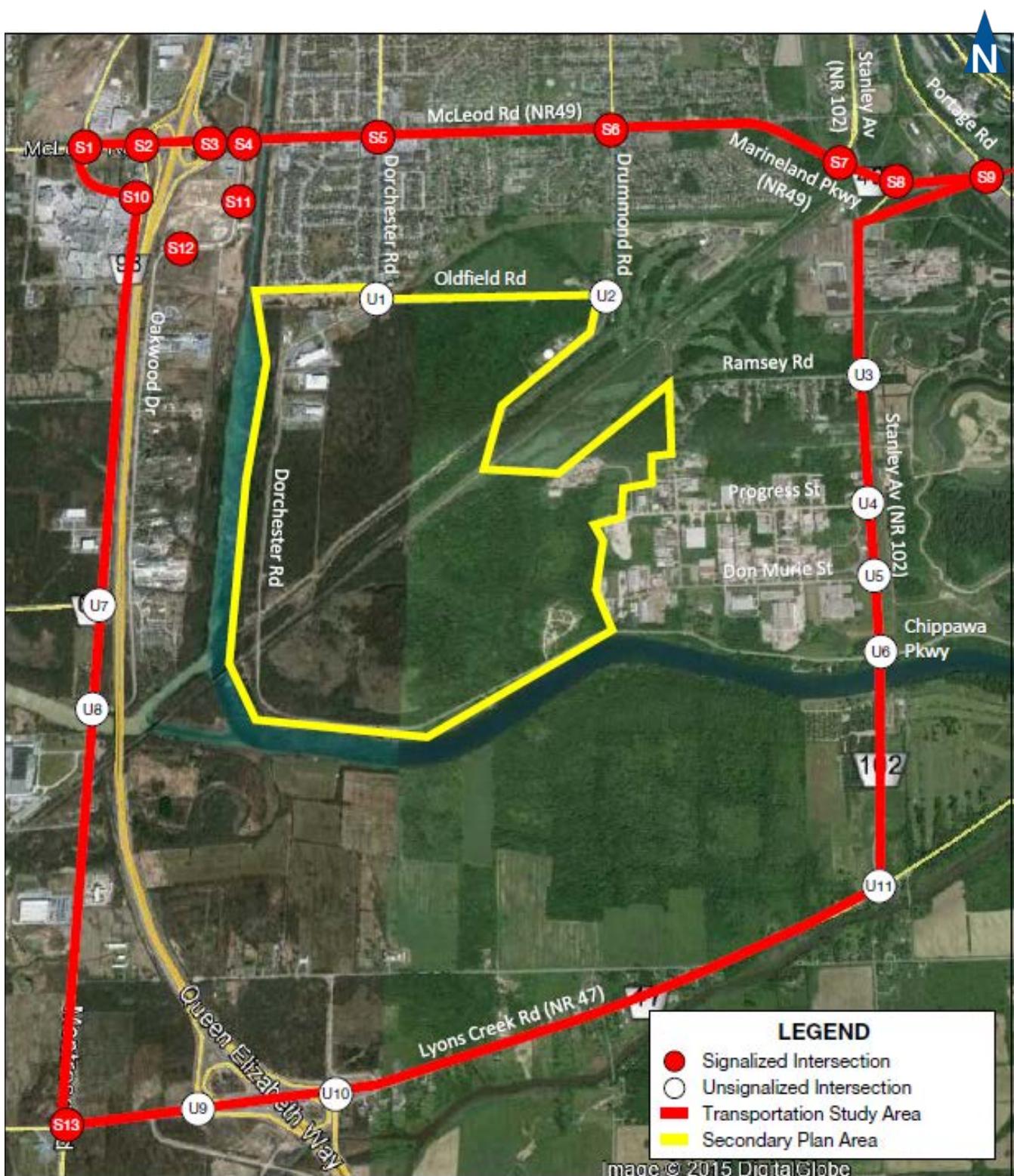
Paradigm Transportation Solutions Limited (Paradigm) was retained to undertake the **Thundering Waters Secondary Plan Transportation Study** (herein referred to as the Study). The purpose of the Study is to develop a transportation plan for the Thundering Waters Secondary Plan Area (herein referred to as the Secondary Plan Area), which is located in the southern part of the City of Niagara Falls, Ontario, as shown in **Figure 1.1**. The Secondary Plan Area, located within the Drummond Community Area of the City's Urban Area, is bounded by Oldfield Road to the north, Thundering Waters Golf Course and Stanley Avenue Industrial Business Park to the east, Welland River to the south, and the OPG Canal to the west. The area encompasses approximately 270 hectares and is predominantly vacant at this time. The lands are bisected by the Con Rail Drainage Ditch and a lightly used railway line that serves a few industrial operations.

The Study is being conducted in conjunction with and will inform the overarching secondary plan study. The final transportation plan will be a component of the planning justification for the secondary plan, which will be implemented as an amendment to the City's Official Plan.

The transportation plan developed through the Study integrates with the City of Niagara Falls Sustainable Transportation Master Plan and other City and Niagara Region transportation and land use policies to achieve a balanced mobility strategy to serve the Secondary Plan Area. Specifically, the transportation plan will:

- ▶ Identify a road network to serve planned development, including collector and arterial roads and any necessary bridge structures;
- ▶ Identify required improvements to the road system outside the Secondary Plan Area;
- ▶ Assess the merit and feasibility of extending Oldfield Road over the Ontario Power Generation Inc. (OPG) Canal to Oakwood Drive and/or connecting Dorchester Road to Lyons Creek Road over the Welland River;
- ▶ Identify traffic control requirements for the road network;
- ▶ Identify a transit route plan, taking into consideration alternative use of the rail corridor for transit that is currently being proposed by private interests;
- ▶ Identify an active transportation network of pedestrian and cycling linkages to commercial areas, community facilities, active and passive parks, and trails, in particular the nearby Millennium Trail;
- ▶ Provide a traffic management/calming plan, if required to achieve community design objectives;





- ▶ Provide design guidelines for all roads (i.e. local, collector and arterial) within the Secondary Plan Area;
- ▶ Articulate transportation policies pertaining to active transportation, transportation demand management, parking, goods movement, traffic calming, etc.; and
- ▶ Provide an implementation plan with cost estimates and responsibilities.

## 1.2 Study Area

The Transportation Study Area, as shown in **Figure 1.1** (and herein referred to as the Study Area), encompasses transportation facilities likely to be impacted by the proposed development. The Study Area is bounded by McLeod Road/ Marineland Parkway (Niagara Road 43) to the north, Stanley Avenue (Niagara Road 102) to the east, Lyons Creek Road (Niagara Road 47) to the south, and the QEW to the west. Immediately adjacent signalized intersections on McLeod Road/ Marineland Parkway (at Montrose Road (Niagara Road 98), the QEW N-E/W Ramp and Portage Road) and Lyons Creek Road (at QEW N-E/W Ramp) will also be included for the traffic operational analysis.

## 1.3 Approach

The Study is being conducted in accordance with the Transportation Impact Study guidelines for both the City and Region. The general approach to completing the study, developed in consultation with City and Region staff, is summarized as follows:

1. Establish base year traffic volumes for the summer weekday morning and afternoon and Saturday midday peak periods based on existing count information (herein referred to as Existing Conditions). The City and Region requested an analysis of summer conditions as they tend to represent the worst-case scenario for Niagara Falls with the high volume of tourist travel;
2. Factor base year traffic volumes to a 2031 horizon year using growth rates derived from the Niagara Region Travel Demand Forecasting Model (herein referred to as Future Background Conditions);
3. Estimate development-related traffic using Institute of Transportation Engineers (ITE) Trip Generation Manual and derived trip generation rates from studies of proxy sites, and assign the trips to the Study Area network to forecast traffic volumes for the 2031 horizon year (herein referred to as Future Total Conditions);
4. Analyze Existing, Future Background and Future Total Traffic Conditions for the intersections and midblock links within the Study Area to identify road network improvements required to serve the proposed development;



5. Identify network improvements and amenities needed to facilitate and encourage use of active transportation and transit modes; and
6. Develop complementary transportation policies and programs.

Development of the transportation plan is following the Municipal Class Environmental Assessment (EA) planning process, and will satisfy the requirements for Phases 1 and 2 of the process, as they pertain to Master Plans (Approach #1). The plan will become the basis for, and be used in support of, future investigations for the specific Schedule B and C projects identified within the strategy. Schedule B projects will still require the filing of the Project File for public review, while Schedule C projects will have to fulfil Phases 3 and 4 prior to filing an Environmental Study Report (ESR) for public review. Plan development also has regard for the Municipal Class EA provisions regarding integration with the *Planning Act*, with the transportation plan being developed in conjunction with the overarching secondary plan. In particular, the Study is dependent on the environmental inventories and consultation process being conducted for the secondary plan study to satisfy the Municipal Class EA requirements.

The Study relies principally on the City's Sustainable Transportation Master Plan (STMP) completed by AECOM in October 2011 to provide the future transportation system context. The STMP details a comprehensive and forward-looking multi-modal transportation strategy to the year 2031 of priority improvements and programs required for the City to meet its transportation challenges. The process of developing the STMP followed the Municipal Class EA planning process, and meets the requirements of Phases 1 and 2.

In developing the STMP, the City refined the Niagara Region Travel Demand Forecasting Model (herein referred to as the TransCAD Model) to better reflect transportation conditions within Niagara Falls. This version of the TransCAD Model is being used for the Study.

At the time of conducting the Study, the Region was commencing development of a Transportation Master Plan for the broader Niagara Region area, including an updated travel demand forecasting model on the emme platform. The Study does not rely on material to be produced by the Region's study, which is not anticipated to be completed until 2017.

Previous studies completed by the City, Region and MTO in the vicinity of the Study Area, in particular the McLeod Road Class Environmental Assessment, Pinnock Drive to Portage Road, completed by the Region in 2011, provide important context for the Study.

## 1.4 Planning Context

The following studies, projects and initiatives provide a planning context for the Thundering Waters Secondary Plan Transportation Plan:



#### 1.4.1 City of Niagara Falls Sustainable Transportation Master Plan

The Sustainable Transportation Master Plan (STMP) was completed in 2012 by the City of Niagara Falls (City), in partnership with the Regional Municipality of Niagara (Region), the Ministry of Transportation (MTO) and the Niagara Parks Commission (NPC). The STMP provides a comprehensive and forward-looking strategy of priority improvements and programs required for the City to meet its future transportation challenges. The process of developing the plan followed the Municipal Class EA planning process, meeting the requirements of Phases 1 and 2.

The STMP addresses operational, planning and policy issues for all modes in the context of tourism, economics, environment and the community, and provides a vision for future transportation that is consistent with community values and can be achieved in a sustainable manner. The multi-modal transportation plan and comprehensive policy and decision making framework set out in this long range transportation policy document comprises the following key elements of interest for the Thundering Waters Secondary Plan area:

- ▶ **Active Transportation** – The STMP recommends a network of off-road and on-road routes for the City. The proposed off-road and on-road projects are shown in **Figure 1.2** and **Figure 1.3**, respectively. The figures identify the Study Area with a red outline to assist in identifying the projects of significance to the Thundering Waters Secondary Plan Transportation Plan. The projects have been organized into groups based upon ease and timetable of implementation.
- ▶ **Transit** – The STMP assumes a transit mode share target of 3.2% by 2018, as identified in the City's Transit Strategic Business Plan and Ridership Growth Strategy. The planned future transit system is shown in **Figure 1.4**.
- ▶ **Transportation Demand Management (TDM)** – The STMP proposes a broad range of TDM measures to encourage change in personal travel behaviour, with the goal of reducing vehicular traffic demands.
- ▶ **Roads** – The STMP recommends a comprehensive road improvement program, along with a basic timescale for implementation and estimated costs. **Figure 1.5** illustrates the planned 2031 road network.

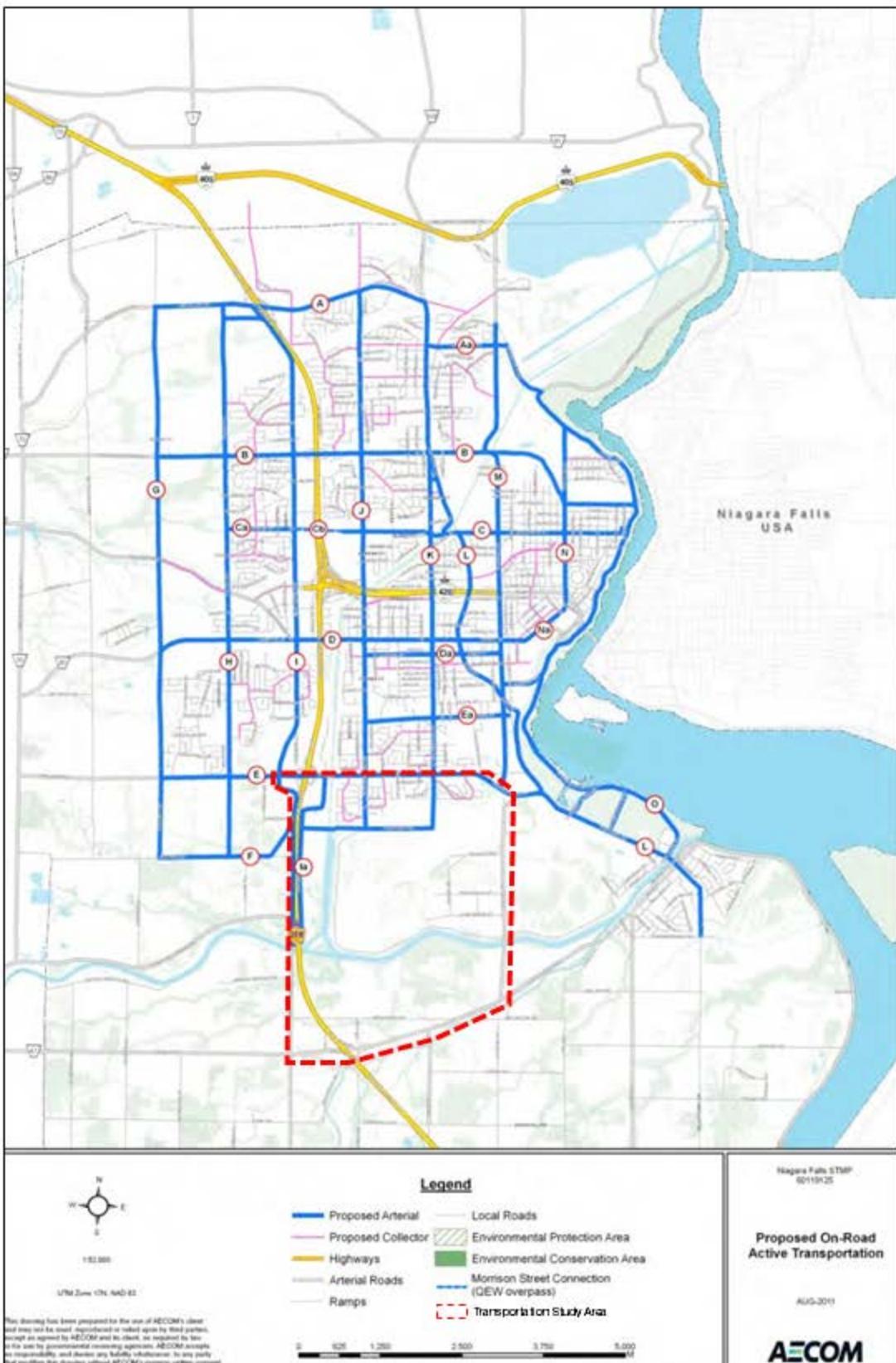




## STMP Proposed Off-Road Active Transportation Routes

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Figure 1.2



## STMP Proposed On-Road Active Transportation Routes

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Figure 1.3



## STMP Planned Future Transit System

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Figure 1.4



## STMP 2031 Horizon Road Network Improvements

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Figure 1.5

## 1.5 This Report

This report is the first in a series being prepared to document development of the transportation plan for the Thundering Waters Secondary Plan area. The purpose of the report is to summarize existing conditions within the Study Area. Specifically the report:

- ▶ Summarizes relevant background reports and studies considered in preparing the transportation plan;
- ▶ Documents the data collection process for the Study;
- ▶ Analyzes existing transportation conditions on the network within the Study Area; and
- ▶ Provides conclusions and recommendations based on the analysis completed.

Sections of this report have been purposely left blank with this version, and will be completed as the Study progresses.



## 2 Existing Conditions

This section documents current traffic conditions, operational deficiencies, and constraints experienced by the public travelling within the Study Area. The operational deficiencies and constraints identified at this stage will be fundamental to the process of defining the required improvement measures in future phases of work.

### 2.1 Road Network

The main roadways considered in assessing the transportation impacts of the Thundering Waters Secondary Plan include:

- ▶ **McLeod Road (Niagara Region Road 49)**, which is an east-west arterial road with a four-lane cross-section throughout most of the Study Area. At the east end, McLeod Road continues as Marineland Parkway through its intersections with Stanley Avenue and Portage Road. McLeod Road provides access to the Queen Elizabeth Way (QEW) from the southern built-up area of the City of Niagara Falls. It has a posted speed limit of 50 to 60 kilometres per hour throughout the Study Area. Key intersections along McLeod Road in the Study Area include Montrose Road, QEW, Oakwood Drive, Dorchester Road, Drummond Road, Stanley Avenue, and Portage Road.
- ▶ **Stanley Avenue (Niagara Region Road 102)** is a north-south arterial road with a four-lane cross-section north of Marineland Parkway. South of Marineland Parkway, Stanley Avenue continues with a two-lane cross-section. Stanley Avenue provides direct access to Downtown Niagara Falls and the Falls Tourist district from the Study Area. North of Marineland Parkway, Stanley Avenue has a posted speed limit of 50 kilometres per hour, while south of Marineland Parkway, the road has a posted speed limit of 60 kilometres per hour. South of Marineland Parkway, there are four unsignalized intersections with Ramsey Road, Progress Street, Don Murie Street, and Dorchester Road/ Chippawa Parkway within the Study Area.
- ▶ **Montrose Road (Niagara Region Road 98)** is a north-south road with a two-lane cross-section. It widens to a four-lane cross-section at the Niagara Square Commercial Centre to McLeod Road. The road runs parallel with and provides an alternate route to the QEW during emergency closures or delays on the highway. South of McLeod Road to the south limit of the Niagara Square Shopping Centre, Montrose Road has a posted speed limit of 50 kilometres per hour. South of the Niagara Square Shopping Centre, Montrose Road has a posted speed limit of 60 kilometres per hour. Key intersections along Montrose Road in the Study Area include McLeod Road, Niagara Square Drive, Chippawa Creek Road, Oakwood Drive, and Lyons Creek Road/ Biggar Road.



- ▶ **Lyons Creek Road (Niagara Region Road 47)** is an east-west road with a two-lane cross-section that connects Montrose Road to Stanley Avenue in the Study Area. West of its intersection with Montrose Road, the road continues as Biggar Road. Lyons Creek Road widens to a four-lane cross-section at its grade separated interchange with the QEW. The road provides a direct connection to the QEW from rural Niagara Falls and the community of Chippawa. Lyons Creek Road has a posted speed limit of 60 to 80 kilometres per hour in the Study Area. Within the Study Area, key intersections include Montrose Road, QEW, and Stanley Avenue.
- ▶ **Oakwood Drive** is a north-south road under the jurisdiction of the City of Niagara Falls. The road connects McLeod Road to the SmartCentres commercial plaza on the east side of QEW, as well as the residential and commercial land uses situated between the QEW and the Welland River. At its southern limit, Oakwood Drive curves under the QEW and connects to Montrose Road. There are two signalized intersections with the SmartCentres commercial plaza on Oakwood Drive. The posted speed limit of Oakwood Drive ranges from 50 to 60 kilometres per hour.

**Figure 2.1A** and **Figure 2.1B** show the lane configurations and traffic control provisions for the Study Area intersections.

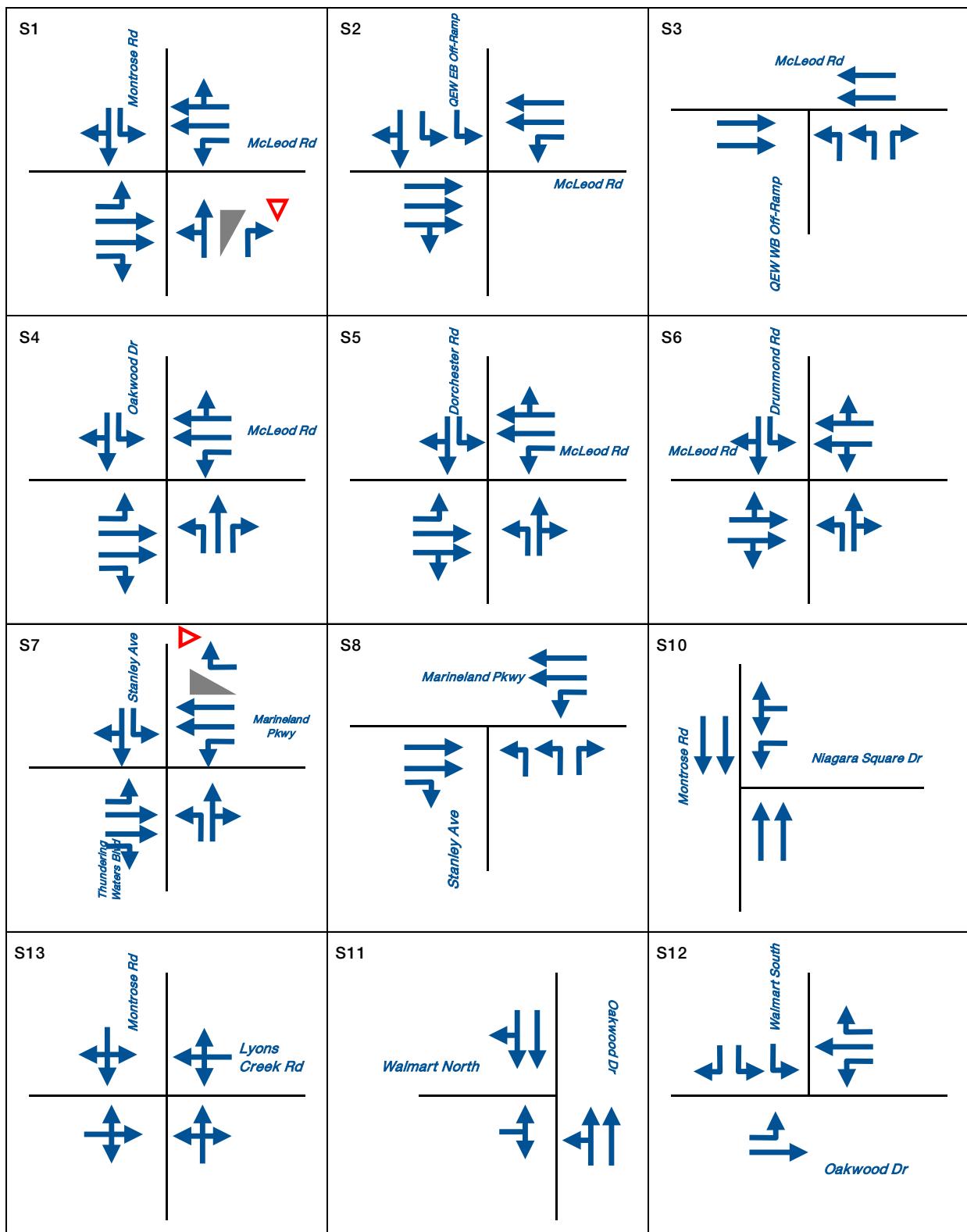
## 2.2 Existing Traffic Volumes

Turning movement volumes for the Study Area intersections for the summer weekday morning (AM) and afternoon (PM) peak hours and Saturday (weekend) peak hour were either provided by the Region of Niagara and City of Niagara Falls or collected by Paradigm during the summer of 2015. **Table 2.1** shows the count date of each intersection in the Study Area.

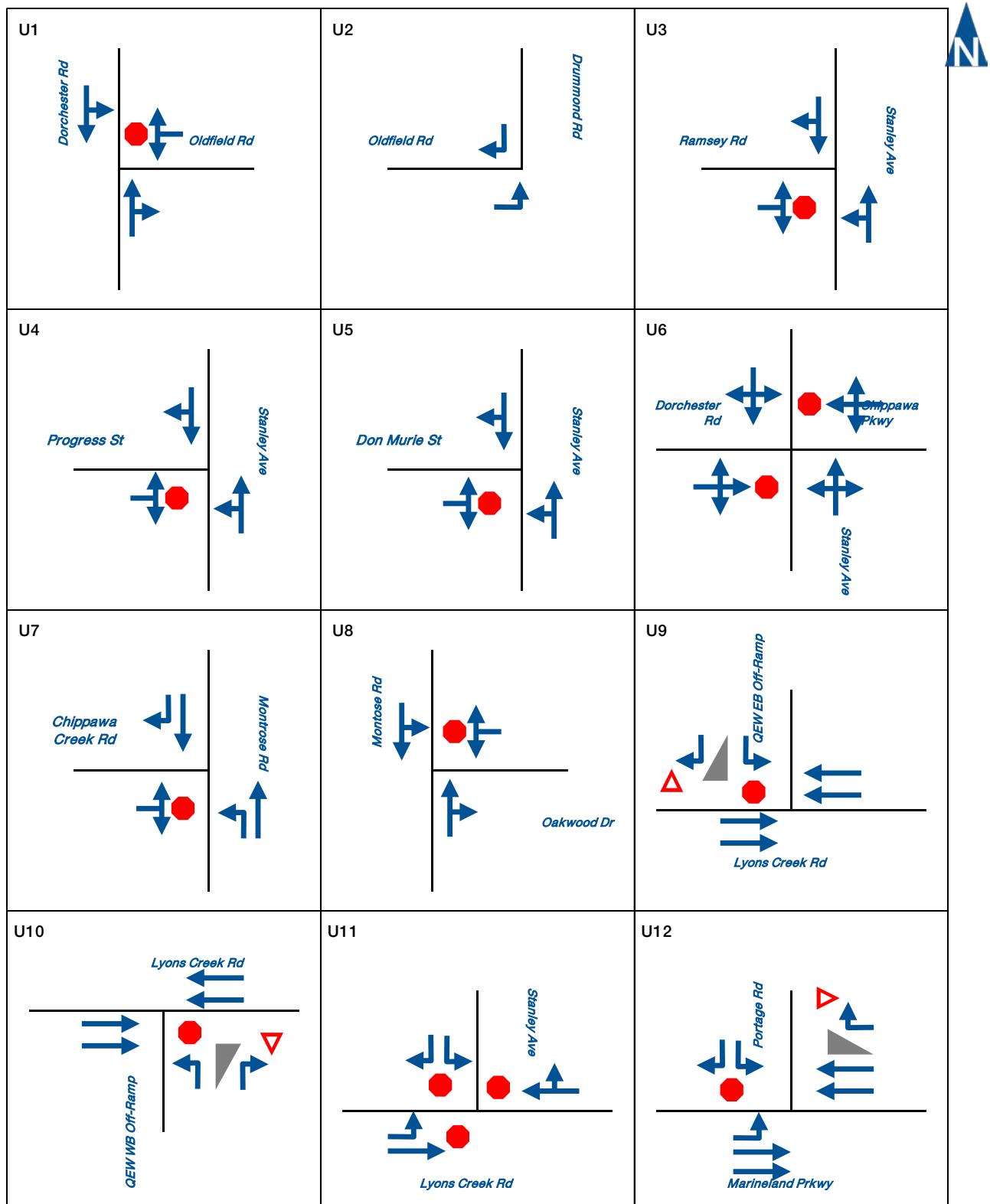
**TABLE 2.1: EXISTING TRAFFIC VOLUMES COUNT DATES**

Intersection	Summer Weekday		Summer Weekend
	AM	PM	
McLeod Road & Montrose Road	02-Sep-15	02-Sep-15	05-Sep-15
McLeod Road & QEW Off-Ramp / Niagara Square Drive	02-Sep-15	02-Sep-15	29-Aug-15
McLeod Road & QEW Off-Ramp	02-Sep-15	02-Sep-15	29-Aug-15
McLeod Road & Oakwood Drive	Camera Malfunction	02-Sep-15	05-Sep-15
McLeod Road & Dorchester Road	27-Jul-15	27-Jul-15	05-Sep-15
McLeod Road & Drummond Road	29-Jul-15	29-Jul-15	05-Sep-15
Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	02-Sep-15	02-Sep-15	05-Sep-15
Marineland Parkway & Stanley Avenue	09-Sep-15	09-Sep-15	05-Sep-15
Marineland Parkway & Portage Road	02-Sep-15	02-Sep-15	05-Sep-15
Montrose Road & Niagara Square Drive	03-Sep-15	03-Sep-15	Not Counted
Montrose Road & Chippawa Creek Road	03-Sep-15	03-Sep-15	05-Sep-15
Montrose Road & Oakwood Drive	03-Sep-15	03-Sep-15	05-Sep-15
Montrose Road & Lyons Creek Road / Biggar Road	26-Aug-15	26-Aug-15	05-Sep-15
Lyons Creek Road & QEW Off-Ramp	02-Sep-15	02-Sep-15	29-Aug-15
Lyons Creek Road & QEW Off-Ramp	02-Sep-15	02-Sep-15	29-Aug-15
Lyons Creek Road & Stanley Avenue (North Leg)	03-Sep-15	03-Sep-15	05-Sep-15
Stanley Avenue & Ramsey Road	02-Sep-15	02-Sep-15	05-Sep-15
Stanley Avenue & Progress Street	02-Sep-15	02-Sep-15	05-Sep-15
Stanley Avenue & Don Murie Street	02-Sep-15	02-Sep-15	05-Sep-15
Stanley Avenue & Dorchester Road / Chippawa Parkway	03-Sep-15	03-Sep-15	05-Sep-15
Oakwood Drive & Walmart North Driveway	02-Sep-15	02-Sep-15	05-Sep-15
Oakwood Drive & Walmart South Driveway	02-Sep-15	02-Sep-15	05-Sep-15
Dorchester Road & Oldfield Road			
Drummond Road & Oldfield Road			





## Existing Lane Configuration (Signalized Intersections)



## Existing Lane Configuration (Unsignalized Intersections)

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Figure 2.1B

As noted in **Table 2.1**, traffic counts were not available for four intersections within the Study Area. Counts were not collected during the morning peak hour at the intersection of McLeod Road and Oakwood Drive due to a camera malfunction. To address this gap in data, morning volumes were estimated based on the upstream and downstream volumes and the turning percentages from the afternoon and Saturday peak hour counts. The same procedure was used to estimate volumes for the Saturday peak hour at the intersection of Montrose Road and Niagara Square Drive.

The two intersections of Dorchester Road at Oldfield Road and Drummond Road at Oldfield Road were not counted because of on-going construction in the vicinity. Given the nature of the intersections, it was assumed that traffic volumes would be relatively low and that the intersections would operate with satisfactory level of service under existing conditions. These two intersections are expected to experience an increase in traffic with the development of the Thundering Waters Secondary Plan.

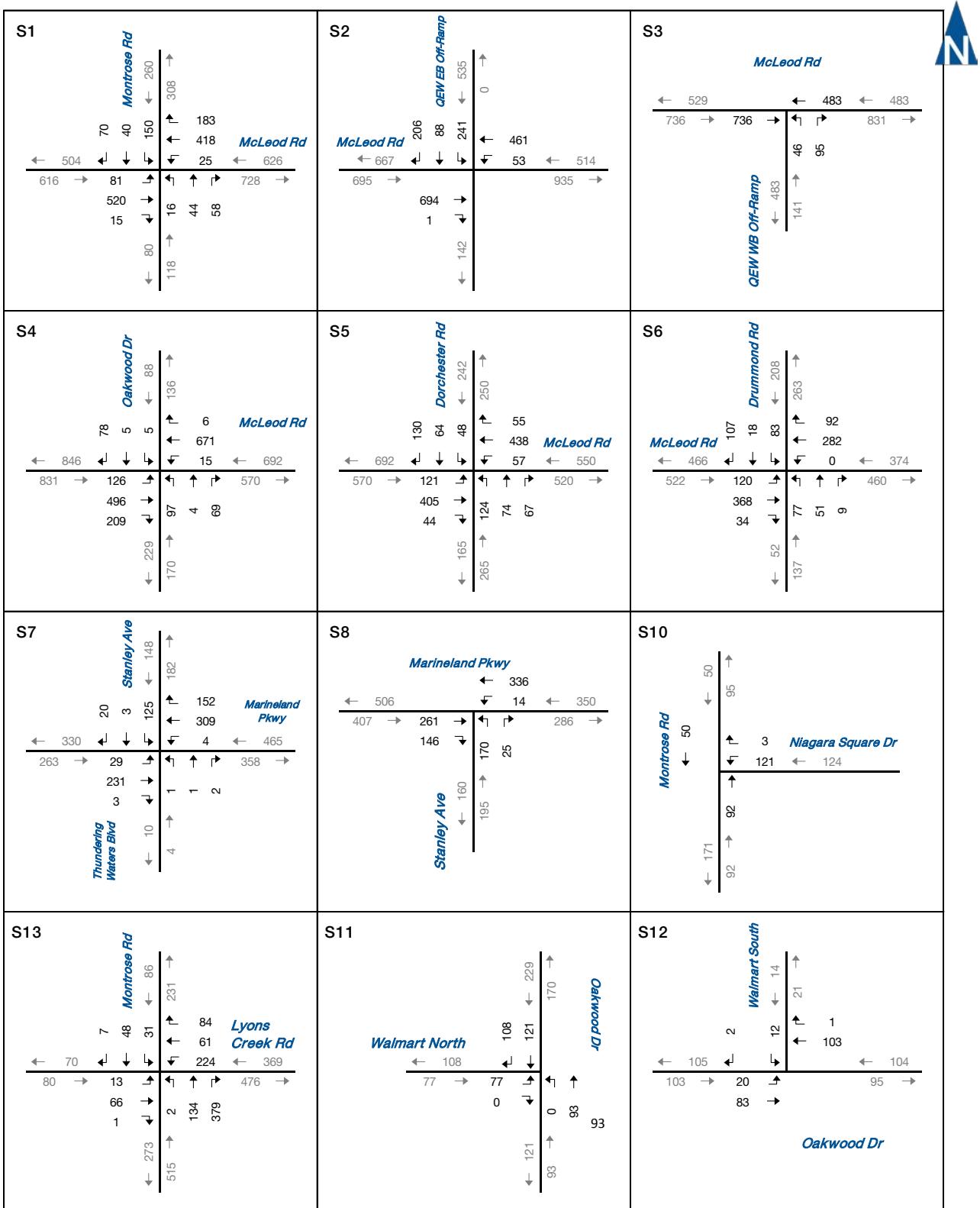
**Figure 2.2A** through **Figure 2.4B** summarize the existing summer morning, afternoon, and Saturday peak hour traffic volumes.

## 2.3 Traffic Operations Evaluation and Criteria

Intersection level of service (LOS) is a recognized method of quantifying the average delay experienced by drivers at intersections for comparison and assessment purposes. It is based on the delay experienced by individual vehicles executing the various movements. The delay is related to the number of vehicles desiring to make a particular movement, compared to the estimated capacity for that movement. The capacity is based on a number of criteria related to the opposing traffic flows and intersection geometry.

**Table 2.2** contains the level of service (LOS) criteria for signalized and unsignalized intersections. The highest possible rating is LOS A, under which the average total delay is equal or less than 10 seconds per vehicle. When the average delay exceeds 80 seconds for signalized intersections, 50 seconds for unsignalized intersections or when the volume to capacity ratio is greater than 1.0, the movement is assigned LOS F and remedial measures are usually implemented, if feasible. LOS E is usually used as a guideline for the determination of road improvement needs on through lanes, while LOS F may be acceptable for left-turn movements at peak times, depending on the duration of delays.

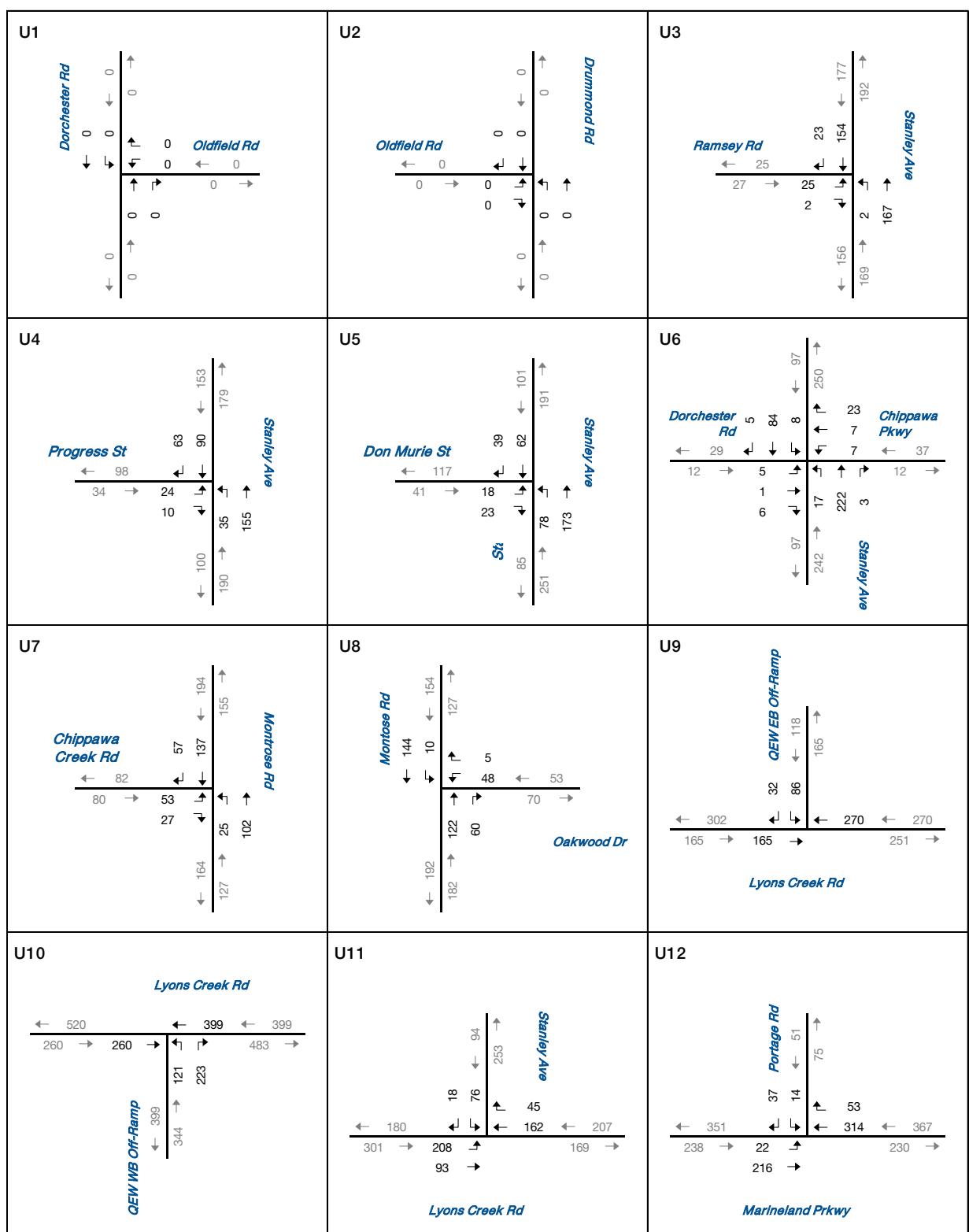


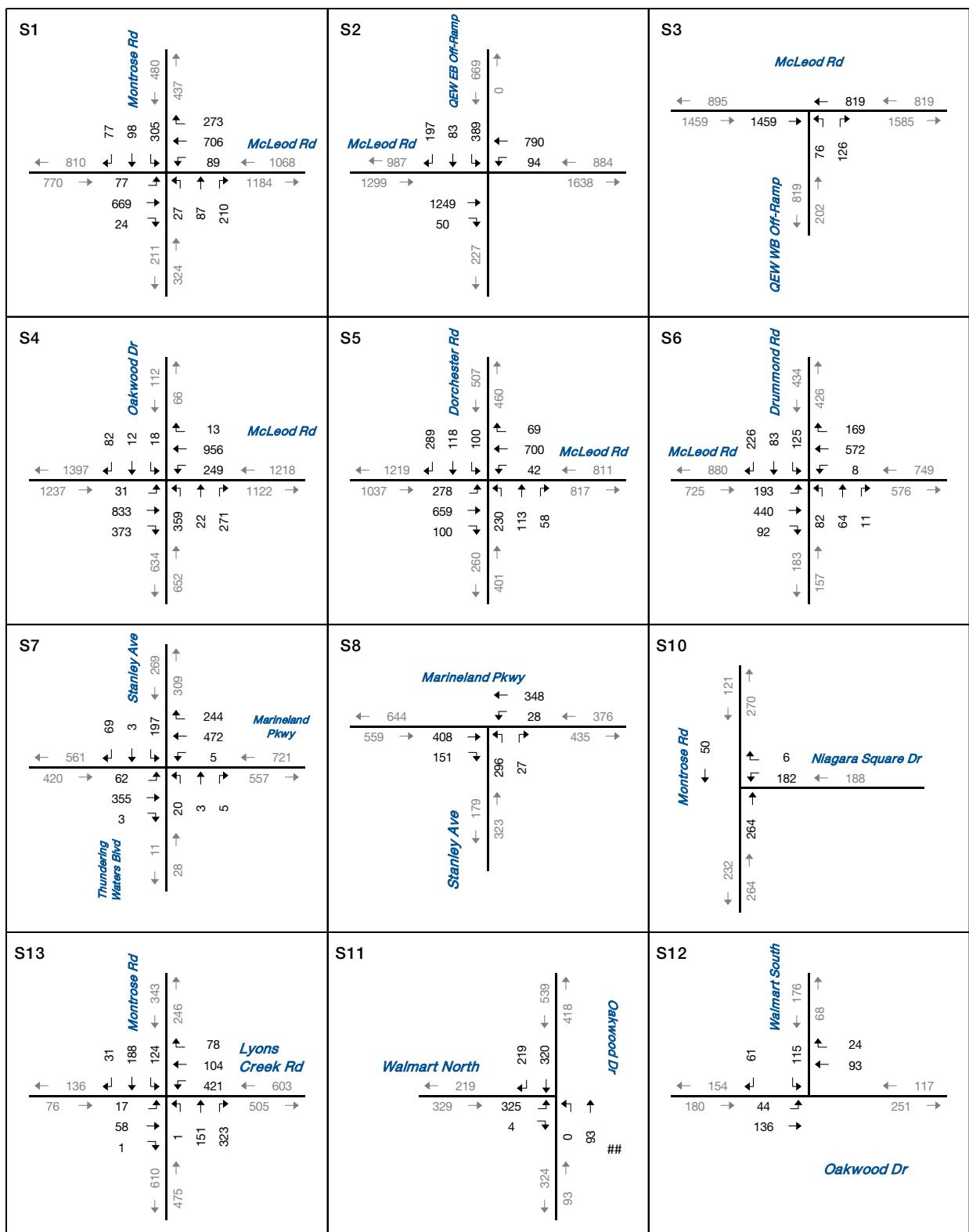


## Existing Traffic Volumes AM Peak Hour (Signalized Intersections)

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Figure 2.2A

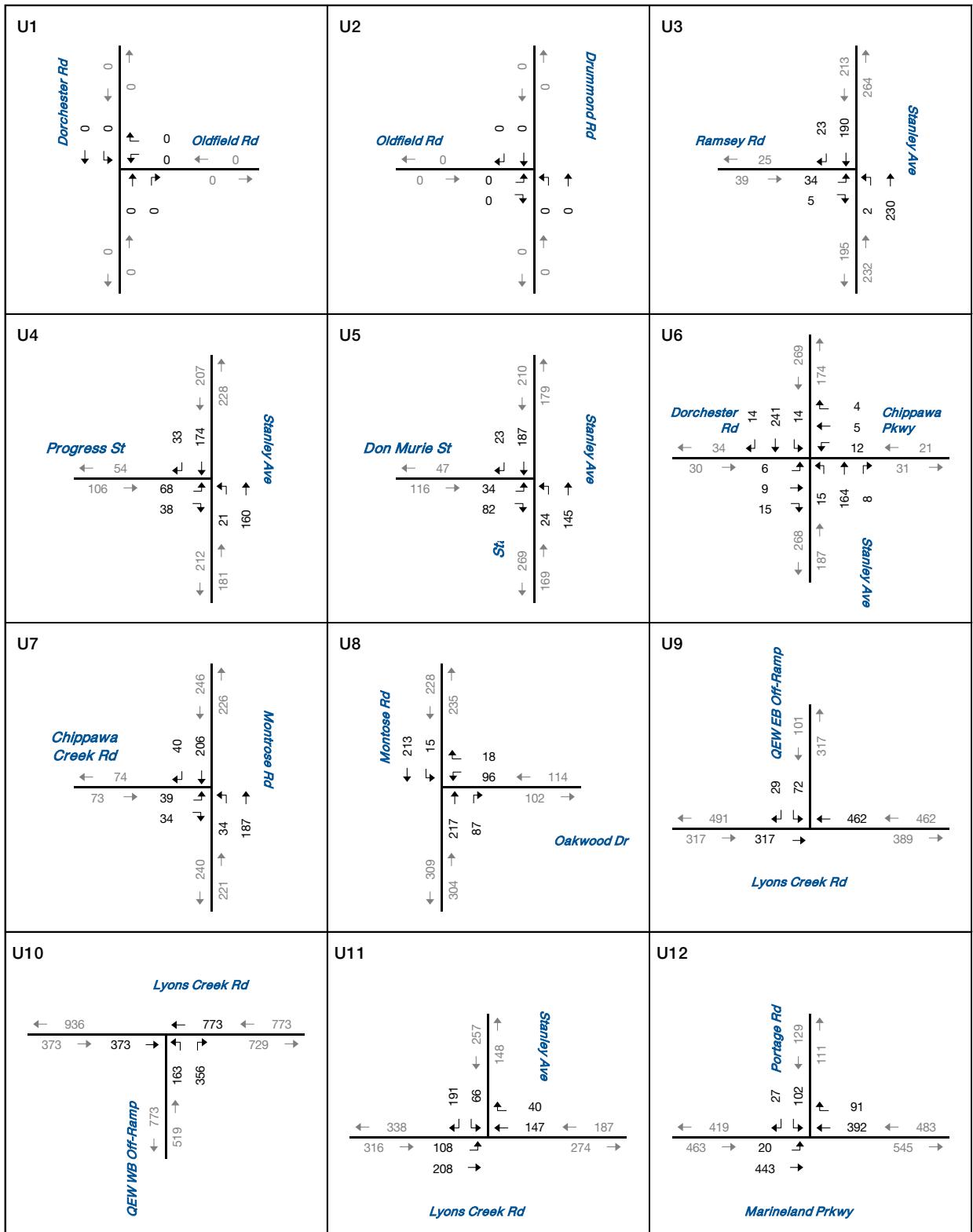


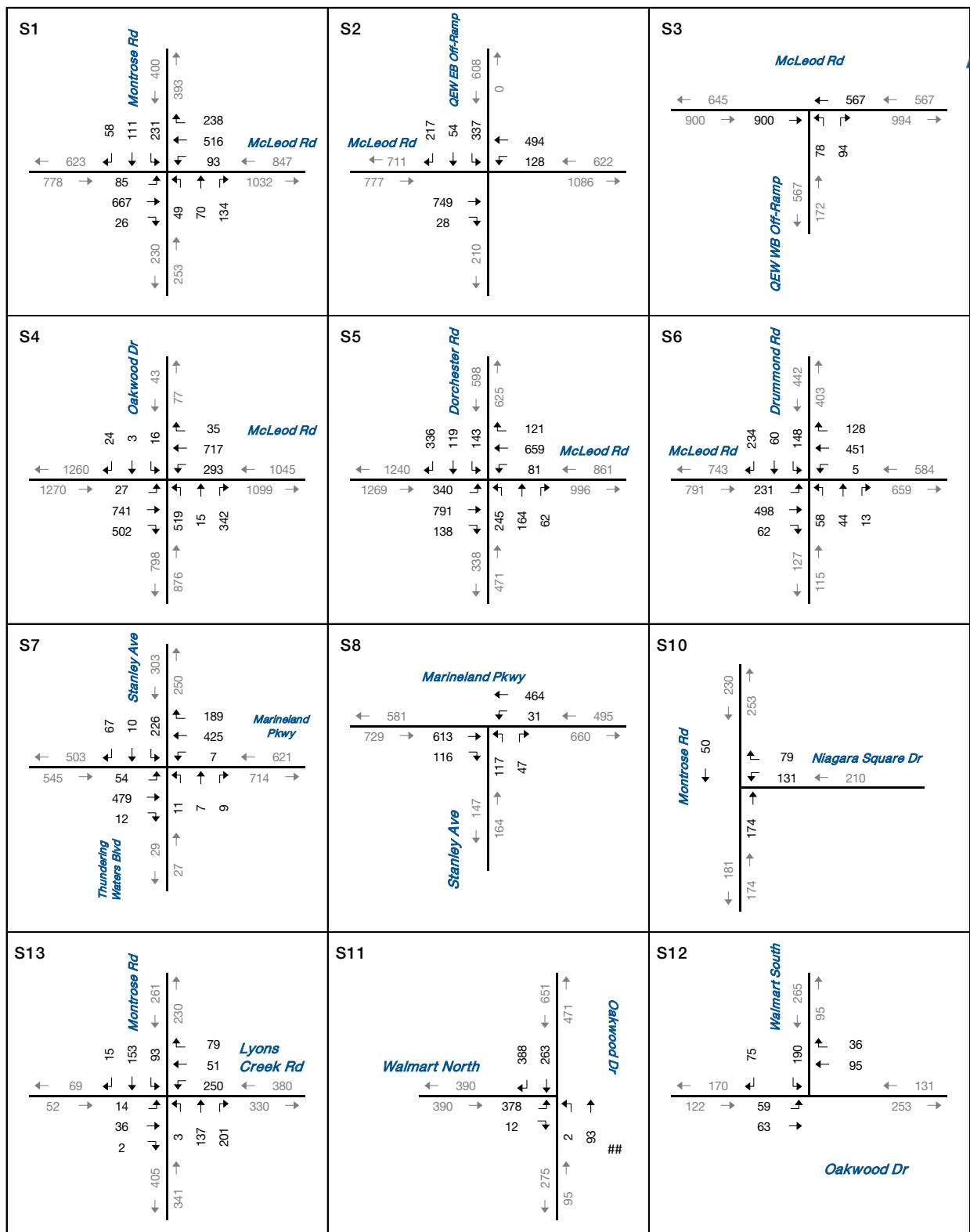


## Existing Traffic Volumes PM Peak Hour (Signalized Intersections)

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Figure 2.3A

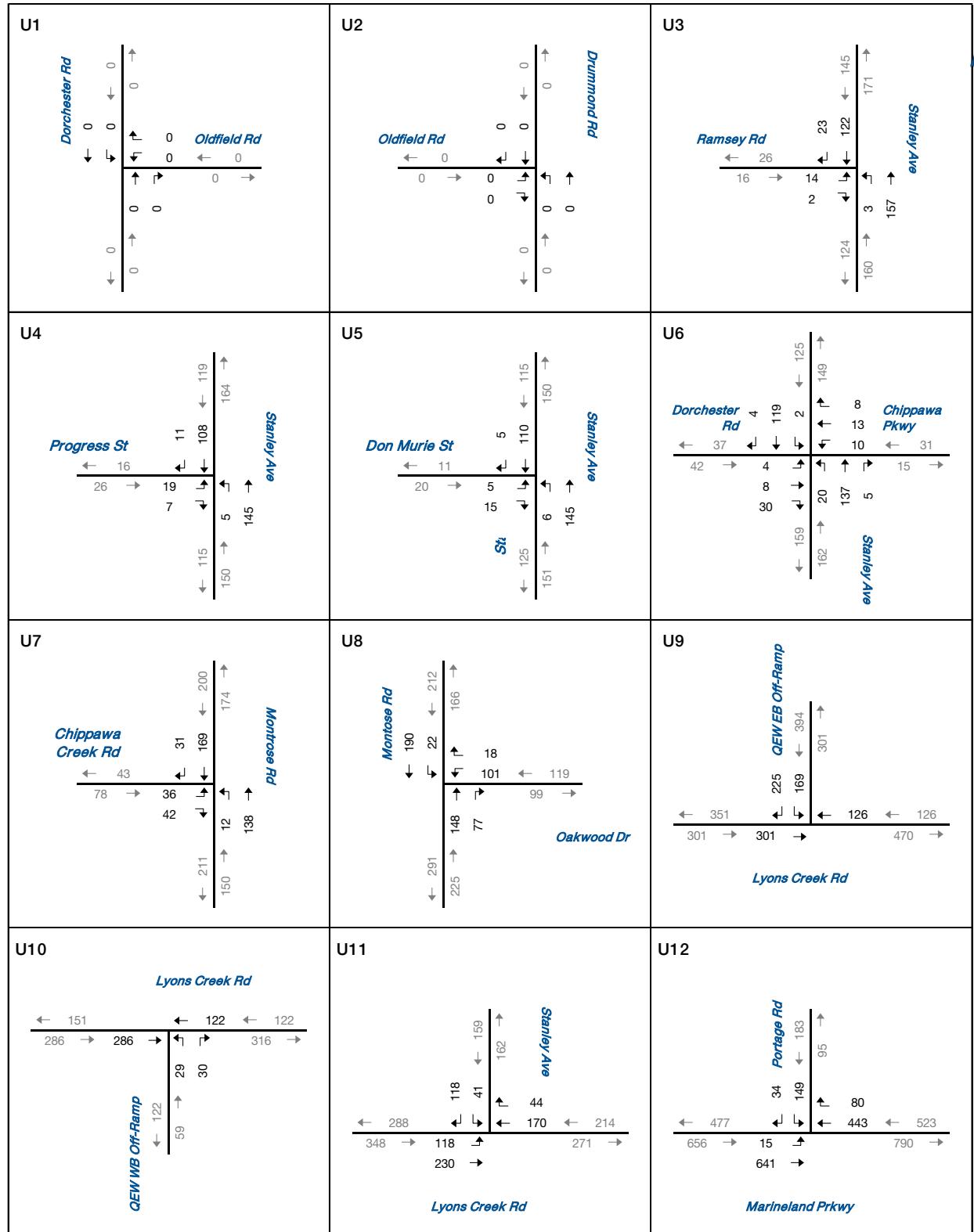




Existing Traffic Volumes  
Saturday Peak Hour  
(Signalized Intersections)

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Figure 2.4A



## Existing Traffic Volumes Saturday Peak Hour (Unsignalized Intersections)

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Figure 2.4B

**TABLE 2.2: LEVEL OF SERVICE FOR INTERSECTIONS**

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

The intersection analysis considered two separate measures of performance:

- ▶ The volume to capacity ratio for each intersection; and
- ▶ The LOS for each turning movement. LOS is based on the average control delay per vehicle.

Both Niagara Region and the City of Niagara Falls have set guidelines for determining critical movements and intersections within their respective Transportation Impact Study Guidelines. **Table 2.3** summarizes the critical movement criteria for both the Region and City. With the majority of roads and intersections within the Study Area under the jurisdiction of Niagara Region, the analyses will rely on the Region's criteria for this purpose. It is noted that both sets of criteria are similar, with the Regional thresholds slightly more stringent than the City values.

**TABLE 2.3: CRITICAL MOVEMENT CRITERIA**

Jurisdiction	Critical Movement Criteria		
	Signalized	Unsignalized	
Niagara Region	Through	> 0.85	LOS on individual Movements > D
	Shared Through / Turning	> 0.85	95th Percentile Queue exceed Storage
	Exclusive Turn	> 0.90	
City of Niagara Falls	Overall intersection	> 0.85	LOS on individual Movements > E
	Through	> 0.85	95th Percentile Queue exceed Storage
	Shared Through / Turning	> 0.85	
	Exclusive Turn	> 0.95	
	95th Percentile Queue exceed Storage		

## 2.4 Existing Operations

The operations of intersections in the Study Area were evaluated with the existing turning movement volumes using Synchro 9. The Region of Niagara provided current signal timings for the signalized intersections in the Study Area. The signal timings for the intersections of McLeod Road and QEW Off-Ramps were not available, but were assumed based on the surrounding signal timings.

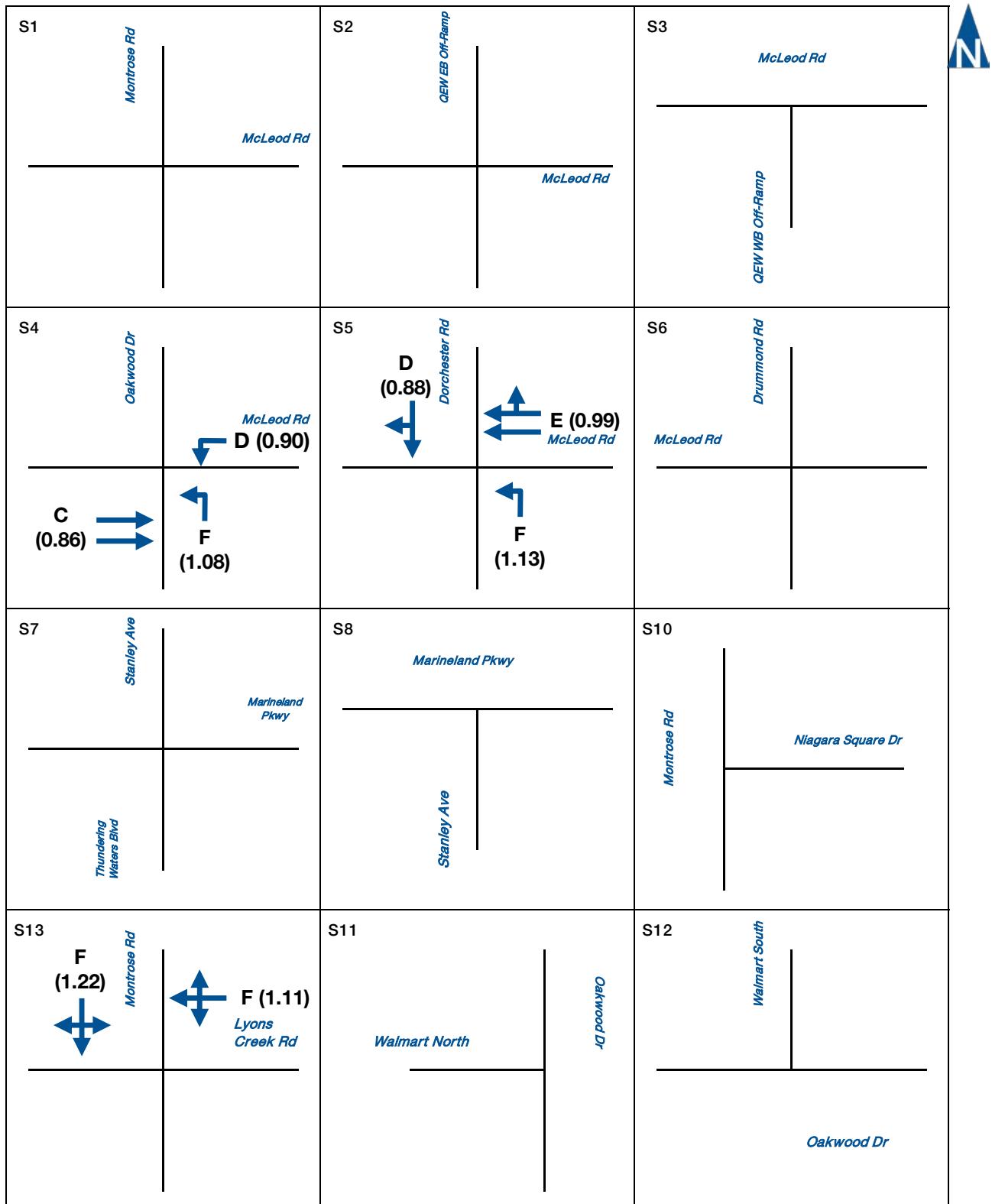


**Table 2.4** summarizes the existing intersection operations, indicating the overall LOS and volume to capacity (v/c) ratios for the signalized intersections and the overall intersection average delay in seconds for the unsignalized intersections. **Figure 2.6** and **Figure 2.7** illustrate the critical turning movements for the intersections within the Study Area during the weekday afternoon and Saturday peak hours. The detailed Synchro reports are provided in **Appendix A**.

The analyses indicate the following:

- ▶ During the weekday morning peak hour, all signalized and unsignalized intersections operate with satisfactory levels of service and with no critical turning movements.
- ▶ During the weekday afternoon peak hour, the signalized intersections of McLeod Road at Oakwood Drive (critical movements include eastbound through, westbound left, and northbound left), McLeod Road at Dorchester Road,(critical movements include westbound through-right, northbound left, and southbound shared through-right), and Montrose Road at Lyons Creek Road / Biggar Road (critical movements include shared westbound left-through-right and shared southbound left-through-right) have overall v/c ratios greater than 1.0. All remaining signalized and unsignalized intersection will operate with satisfactory levels of service.
- ▶ During the Saturday peak hour, the signalized intersections of McLeod Road at Oakwood Drive (critical movements include westbound left and northbound left), and McLeod Road at Dorchester Road (critical movements include eastbound left, westbound through-right, northbound left, and southbound through-right) operate with overall LOS E and v/c ratios greater than 1.0. All remaining signalized and unsignalized intersection operate with satisfactory levels of service.

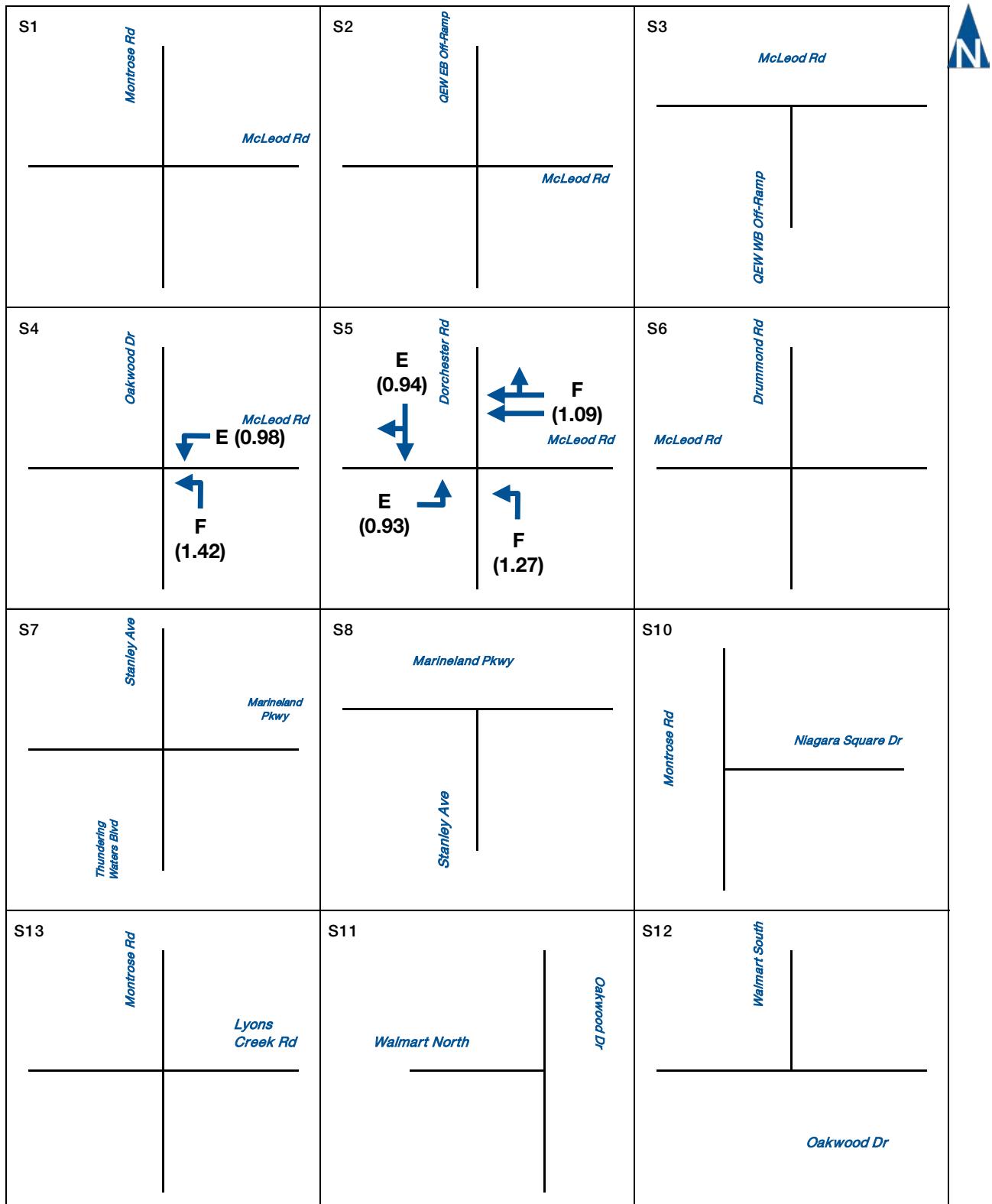




## Existing Critical Turning Movements PM Peak Hour (Signalized Intersections)

Thundering Waters Secondary Plan Transportation Study  
151385

Figure 2.6



## Existing Critical Turning Movements SAT Peak Hour (Signalized Intersections)

Thundering Waters Secondary Plan Transportation Study  
151385

Figure 2.7

**TABLE 2.4: EXISTING OVERALL INTERSECTION OPERATIONS**

Signalized Intersection	Overall LOS (v/c)		
	AM	PM	SAT
McLeod Road & Montrose Road	B (0.50)	B (0.78)	B (0.65)
McLeod Road & QEW EB Off-Ramp / Niagara Square Drive	B (0.47)	B (0.68)	B (0.51)
McLeod Road & QEW WB Off-Ramp	A (0.38)	A (0.70)	A (0.46)
McLeod Road & Oakwood Drive	B (0.52)	C (1.01)	E (1.21)
McLeod Road & Dorchester Road	B (0.50)	D (1.04)	E (1.13)
McLeod Road & Drummond Road	A (0.50)	B (0.76)	B (0.70)
Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	B (0.36)	B (0.50)	B (0.51)
Marineland Parkway & Stanley Avenue	A (0.29)	A (0.40)	A (0.38)
Montrose Road & Niagara Square Drive	A (0.11)	A (0.26)	A (0.21)
Montrose Road & Lyons Creek Road / Biggar Road	C (0.77)	F (1.15)	B (0.40)
Oakwood Drive & Walmart North Driveway	A (0.18)	B (0.56)	B (0.59)
Oakwood Drive & Walmart South Driveway	A (0.17)	B (0.32)	B (0.35)
Unsignalized Intersection	Intersection Average Delay (s)		
	AM	PM	SAT
Marineland Parkway & Portage Road	1.1	2.3	3.8
Stanley Avenue & Ramsey Road	0.8	1	0.6
Stanley Avenue & Progress Street	1.8	3.1	1
Stanley Avenue & Don Murie Street	2.9	2.8	0.5
Stanley Avenue & Dorchester Road / Chippawa Parkway	1.9	1.8	2.6
Montrose Road & Chippawa Creek Road	2.7	2.1	2.1
Montrose Road & Oakwood Drive	1.7	2.7	3.1
Lyons Creek Road & QEW EB Off-Ramp	2.4	1.7	5.5
Lyons Creek Road & QEW WB Off-Ramp	4.3	6.1	1.3
Lyons Creek Road & Stanley Avenue (North Leg)	9.8	10.1	9.7

**Figure 2.6** and **Figure 2.7** illustrate the critical turning movements during the weekday afternoon and Saturday peak hours. The operational analyses identified the following intersection improvement requirements under existing conditions:

- ▶ **McLeod Road at Oakwood Drive** – A second northbound left turn movement with optimized signal cycle and phase timings would improve operations during the weekday afternoon and Saturday peak hours.
- ▶ **McLeod Road at Dorchester Road** – An exclusive southbound right turn lane with optimized signal phase timings would improve the operations during the weekday afternoon and Saturday peak hours.
- ▶ **Montrose Road at Lyons Creek Road / Biggar Road** – Exclusive westbound and southbound left turn lanes would improve the operations during the weekday afternoon peak hour.

A Synchro analysis was performed at these intersections to estimate the level of service conditions based on the improvements noted above. **Table 2.5** below summarizes the overall levels of service, with the detailed analyses provided in **Appendix B**.



The analyses indicate that with the improvements noted above, the three intersections will operate with acceptable levels of service and no critical turning movements during the weekday afternoon and Saturday peak hours.

**TABLE 2.5: EXISTING OVERALL INTERSECTION OPERATIONS WITH IMPROVEMENTS**

Signalized Intersection	Overall LOS (v/c)		
	AM	PM	SAT
McLeod Road & Oakwood Drive		C (0.77)	C (0.85)
McLeod Road & Dorchester Road		C (0.79)	C (0.87)
Montrose Road & Lyons Creek Road / Biggar Road		C (0.81)	

## 2.4 Transit

Niagara Falls Transit currently operates six transit routes in the Study Area, specifically on McLeod Road between Montrose Road and Dorchester Road, with the Niagara Square Commercial Centre as the primary destination.

Route 101 provides hourly service between 6:30 AM to 6:30 PM from Main / Ferry transit stop and the Niagara Square transit stop via McLeod Road and Dorchester Road from Monday to Saturday.

Route 103 provides hourly transit service between 6:30 AM to 6:30 PM from Main / Ferry transit stop and the Niagara Square transit stop via McLeod Road and Drummond Road from Monday to Saturday. Route 103 operates as Route 203 during the evenings on Monday to Saturday as well as on Sundays and holidays.

Route 105 provides hourly transit service between 6:15 AM to 6:15 PM from Mt. Carmel Plaza transit stop and the Niagara Square transit stop via McLeod Road and Kerr Road from Monday to Saturday. Route 105 operates as Route 205 during the evenings on Monday to Saturday as well as on Sundays and holidays.

Route 111 provides hourly transit service between 6:00 AM to 6:30 PM from Morrison / Dorchester transit stop and the Niagara Square transit stop via McLeod Road and Drummond Road from Monday to Saturday.

Route 112 provides hourly transit service between 7:15 AM to 5:15 PM from Chippawa transit stop and the Niagara Square transit stop via McLeod Road, Stanley Avenue, and Marineland Parkway from Monday to Saturday.

Route 113 provides hourly transit service between 6:15 AM to 6:15 PM from Mt. Carmel Plaza transit stop and the Niagara Square transit stop via McLeod Road and Montrose Road from Monday to Saturday. Route 113 operates as Route 213 during the evenings on Monday to Saturday as well as on Sundays and holidays.



In addition to the public transit service provided by Niagara Falls Transit, the WEGO service operates and is primarily focused around the Falls Tourist area. The WEGO Blue route currently provides service along Stanley Avenue to just north of Marineland Parkway. During the summer months only, the WEGO Blue route is extended to the Study Area with service along Marineland Parkway.

**Figure 2.8** illustrates the Niagara Falls Transit and WEGO route maps.

## 2.5 Active Transportation

### 2.5.1 Cycling

Cycling infrastructure in the Study Area includes bicycle lanes, paved-shoulders, and multi-use trails. Roads with on-street cycle lanes include:

- ▶ McLeod Road west from the QEW EB Off-ramp;
- ▶ Oakwood Drive between McLeod Road and the south commercial driveway;
- ▶ Drummond Road north of McLeod Road; and
- ▶ Stanley Avenue north of McLeod Road.

Roads in the Study Area with paved shoulders include:

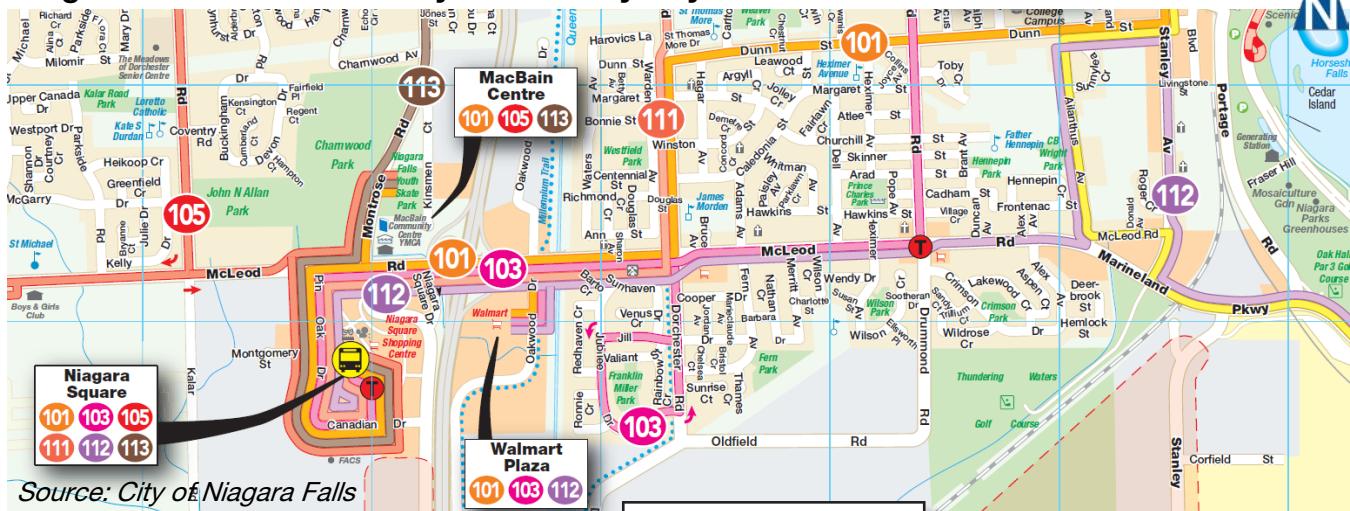
- ▶ Stanley Avenue between Marineland Parkway and Lyons Creek Road;
- ▶ Lyons Creek Road from Montrose Road and Stanley Avenue; and
- ▶ Chippawa Creek Road west from Montrose Road.

A paved multi-use path runs between McLeod Road at Oakwood Drive, north to Lundy's Lane.

**Figure 2.9** illustrates the existing cycling infrastructure within the Study Area.



## Niagara Falls Transit Monday to Saturday Daytime Service



## Niagara Falls Transit Monday to Saturday Evening, Sunday, and Holiday Service



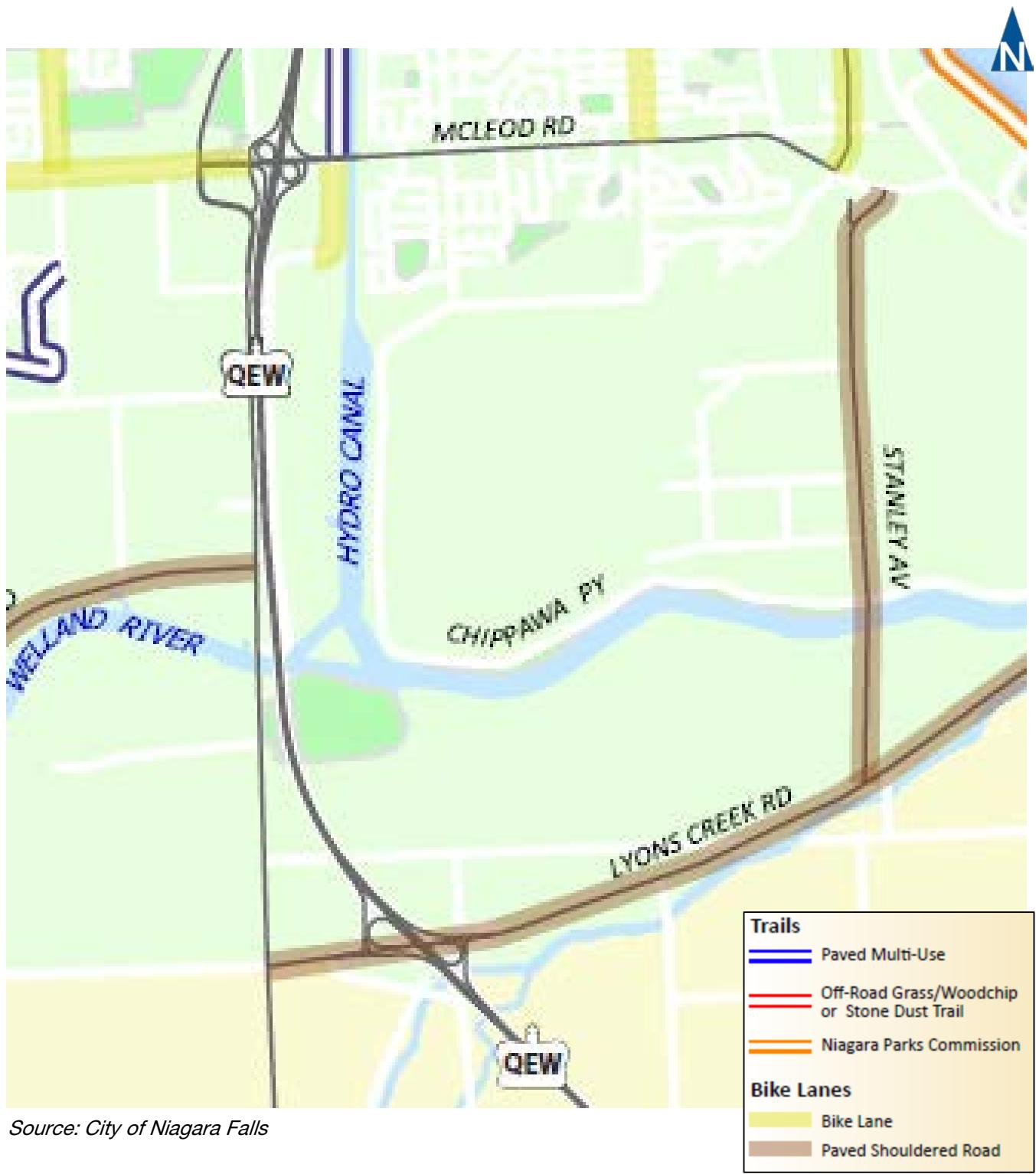
## WEGO Regular and Seasonal Service



## Existing Transit Service

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Figure 2.8



## 2.5.2 Pedestrian

Pedestrian infrastructure consists of sidewalks along roadways as well as the trail system (including the Millennium Trail, which runs along the Hydro Canal between McLeod Road and Lundy's Lane). Within the Study Area, sidewalks can be found on the following roads:

- ▶ McLeod Road, on both sides of the road, from Montrose Road to east of Drummond Road, where the sidewalk then continues on the north side of the road to Stanley Avenue;
- ▶ Marineland Parkway, on the north side of the road, between the two legs of Stanley Avenue. It continues on the south side of the road east of the Stanley Road intersection;
- ▶ Montrose Road, on the west side of the road, between McLeod Road and Niagara Square Drive;
- ▶ Oakwood Drive, on the west side of the road, from McLeod Road to the south driveway;
- ▶ Dorchester Road, on both sides of the road, south of McLeod Road; and
- ▶ Drummond Road, on both sides of the road, south of McLeod Road to just north of Lionshead Avenue.

Sidewalks are generally provided on one side or both side of roads in the built-up urban area of the City of Niagara Falls. There are typically no sidewalks on rural roads in the City.



## 3 Model Development

### 3.1 Network Development

A VISSIM micro-simulation model of the Study Area is to be used to assess the traffic impact of the Thundering Waters Secondary Plan on the surrounding road network. VISSIM is a microscopic multimodal traffic simulation tool that is capable of simulating the operations of cars, trucks, buses, and light rail transit vehicles on all roadway classifications, including arterial roads, highways, HOV and transit-only lanes, intersections, ramps, weaving and merging areas, interchanges, etc. VISSIM can generate various performance measures such as delay, speed, travel time, and the outputs can also be animated to view the simulation of future traffic demands in real time.

The methodologies adopted for creating the VISSIM model consist of the following:

- ▶ Building the road network;
- ▶ Survey of traffic conditions, to provide the traffic flows; and
- ▶ Calibration and validation of the model compared to both the surveyed flows and on-site observations.

Section 2.2 above describes the traffic survey information used for model calibration. As noted, turning movement counts were undertaken at the 24 Study Area intersections during the summer weekday and Saturday peak periods.

Aerial photographs and online mapping were used to construct the study area VISSIM network, as illustrated in **Figure 3.1**. Lane configurations, storage lengths, signal timing plans, speed limits, and conflict (priority) areas were included in the model to represent existing conditions. The modelled VISSIM network comprised of 23 traffic zones, 12 signalized intersections and 12 unsignalized intersections.

### 3.2 Model Calibration and Validation

It is essential that the VISSIM model is calibrated and validated to as high a standard as possible to ensure the model is reliable for testing alternative design and demand scenarios. The criteria used for the calibration and validation of the VISSIM model are based on micro-simulation guidelines from the U.S. Federal Highway Administration (FHWA) and a United Kingdom publication, *The Design Manual for Roads and Bridges* (DMRB) (Chapter 12).

While the typical criteria of comparing modelled to observed volumes used in many travel demand modelling and forecasting studies are sufficient, the



GEH statistic used in micro-simulation studies is a form of the Chi-squared statistic that incorporates both relative and absolute errors and is better at indicating model performance for low-volume roads. GEH values can either be calculated for individual links or be calculated for groups of links (e.g. screenlines). The statistic is expressed in the following formula:

$$GEH = \sqrt{\frac{2(M - C)^2}{M + C}}$$

where:

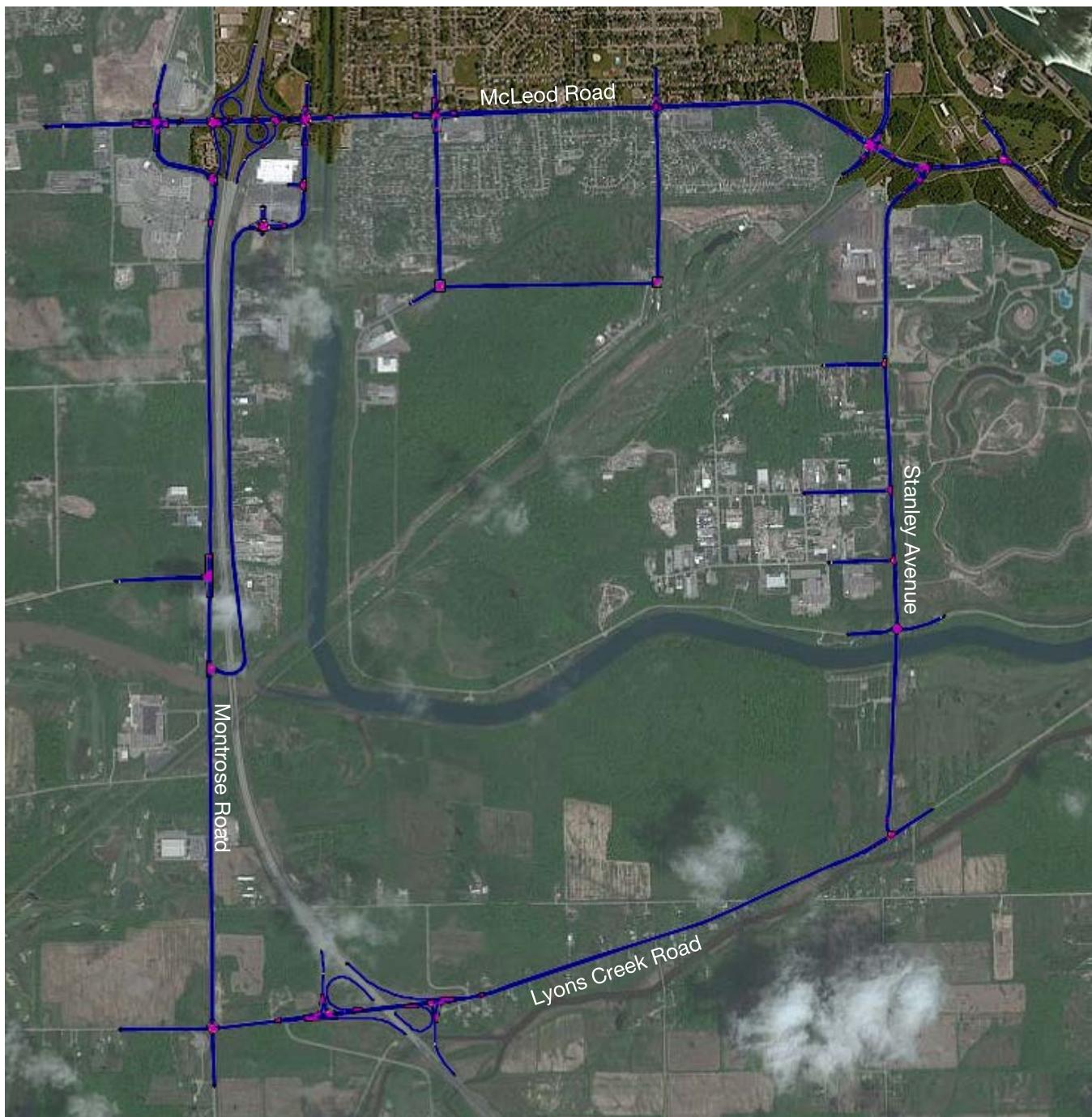
- ▶ M is the modelled traffic flow; and
- ▶ C is the observed traffic flow.

The parameters recommended for application in this Study from traffic volume validation on the Study Area roads are:

- ▶ 85% of individual link flows within 100 vehicles per hour (vph) for observed flow less than 700 vph;
- ▶ 85% of individual link flows within 15% for observed flows between 700 vph and 2,700 vph;
- ▶ 85% of individual link flows within 400 vph for observed flow greater than 2,700 vph;
- ▶ Sum of all model link flows within 5% of sum of all observed link flows;
- ▶ 85% of all links with GEH statistic less than 5; and
- ▶ Scattergram plot showing that the comparison of modelled to observed flow should be close to a trend line with slope equal to 1.



N



## VISSIM Network

Thundering Waters Secondary Plan Transportation Study  
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Figure 5.1

**3.2.1 Weekday Morning Peak Model**

**3.2.2 Weekday Afternoon Peak Model**

**3.2.3 Saturday Peak Model**

**SECTIONS TO BE ADDED IN SUBSEQUENT VERSION OF THE REPORT**



## 4 Development Concept

SECTION TO BE ADDED IN SUBSEQUENT VERSION OF THE REPORT



## 5 Future Conditions

### 5.1 Background Traffic Forecasts

Background traffic forecasts were developed with the Region of Niagara's transportation demand model. The current transportation demand model was created using the TransCAD software. The horizon years used in the model are 2006, 2016, and 2026. The 2006 horizon is considered the base year, with 2016 and 2026 including growth forecasts.

The subject development is located in Model Analysis Zones (MAZ) 24000, 24001 and 24002, which also have the ID numbers 885, 886 and 887, respectively. **Figure 5.1** shows the development location overlaid on the model zones.

#### 5.1.1 Base Year Assumptions

**Table 5.1** summarizes the population and employment values in the model.

**TABLE 5.1: POPULATION AND EMPLOYMENT ASSUMPTIONS**

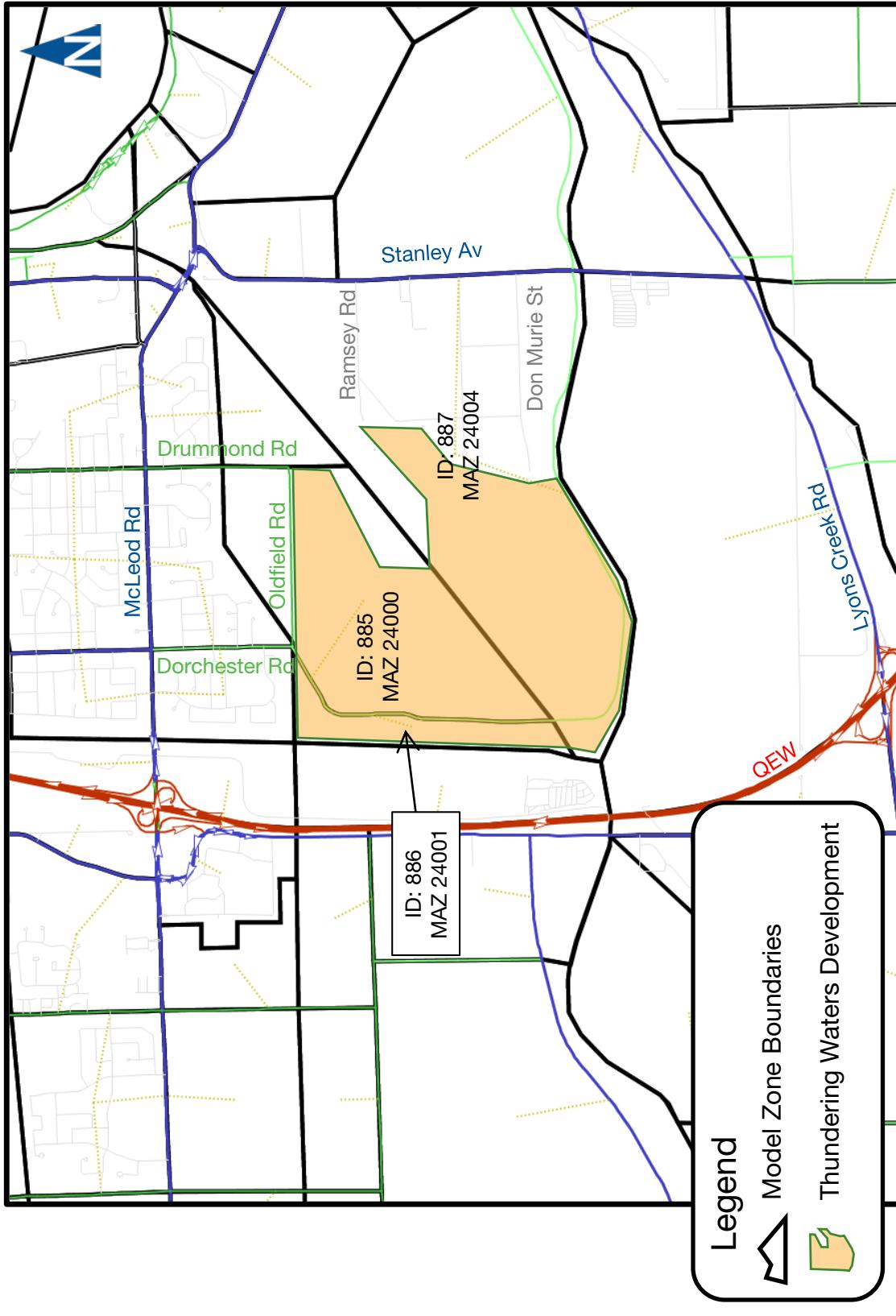
ID	MAZ	2006		2016		2026	
		Population	Total Employment	Population	Total Employment	Population	Total Employment
885	24000	188	66	431	71	2440	75
886	24001	0	15	0	17	0	18
887	24002	65	1747	150	1879	847	1986

SECTIONS TO BE ADDED IN SUBSEQUENT VERSION OF THE REPORT



## Development Location on Transportation Demand Model

Figure 5.1



## 6 Recommended Transportation Networks

SECTION TO BE ADDED IN SUBSEQUENT VERSION OF THE REPORT



## 7 Supporting Policies

SECTION TO BE ADDED IN SUBSEQUENT VERSION OF THE REPORT



# 8 Conclusions and Recommendations

## 8.1 Conclusions

### 8.1.1 Existing Conditions

The existing conditions analyses indicate the following:

- ▶ During the weekday morning peak hour, all signalized and unsignalized intersections operate with satisfactory levels of service and with no critical turning movements;
- ▶ During the weekday afternoon peak hour, the signalized intersections of McLeod Road at Oakwood Drive (critical movements include eastbound through, westbound left, and northbound left), McLeod Road at Dorchester Road,(critical movements include westbound through-right, northbound left, and southbound shared through-right), and Montrose Road at Lyons Creek / Biggar Road (critical movements include shared westbound left-through-right and shared southbound left-through-right) have overall v/c ratios greater than 1.0. All remaining signalized and unsignalized intersection will operate with satisfactory levels of service; and
- ▶ During the Saturday peak hour, the signalized intersections of McLeod Road at Oakwood Drive (critical movements include westbound left and northbound left), and McLeod Road at Dorchester Road (critical movements include eastbound left, westbound through-right, northbound left, and southbound through-right) operate with overall LOS E and v/c ratios greater than 1.0. All remaining signalized and unsignalized intersection operate with satisfactory levels of service.

## 8.2 Recommendations

TO BE ADDED



## **Appendix A**

### **Existing Traffic Operations Reports**



HCM Signalized Intersection Capacity Analysis  
101: Montrose Rd (RR 98) & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑		↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	81	520	15	25	418	183	16	44	58	150	40	70
Future Volume (vph)	81	520	15	25	418	183	16	44	58	150	40	70
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.3	6.3	6.3	3.0	6.3		6.3	6.3	6.3	6.3	6.3	6.3
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Fr <sub>t</sub>	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	0.90	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1524	3197	1390	1484	3010		1471	1606	1250	1614	1437	
Flt Permitted	0.40	1.00	1.00	0.37	1.00		0.68	1.00	1.00	0.73	1.00	
Satd. Flow (perm)	647	3197	1390	579	3010		1054	1606	1250	1233	1437	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	88	565	16	27	454	199	17	48	63	163	43	76
RTOR Reduction (vph)	0	0	10	0	63	0	0	0	45	0	55	0
Lane Group Flow (vph)	88	565	6	27	590	0	17	48	18	163	64	0
Confl. Peds. (#/hr)	4				4							
Heavy Vehicles (%)	9%	4%	7%	12%	5%	4%	13%	9%	19%	3%	5%	13%
Turn Type	Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4			3	8			2			6
Permitted Phases	4		4		8			2		2	6	
Actuated Green, G (s)	16.1	16.1	16.1	20.0	20.0		12.6	12.6	12.6	12.6	12.6	
Effective Green, g (s)	16.1	16.1	16.1	20.0	20.0		12.6	12.6	12.6	12.6	12.6	
Actuated g/C Ratio	0.36	0.36	0.36	0.44	0.44		0.28	0.28	0.28	0.28	0.28	
Clearance Time (s)	6.3	6.3	6.3	3.0	6.3		6.3	6.3	6.3	6.3	6.3	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	230	1138	495	274	1331		293	447	348	343	400	
v/s Ratio Prot		0.18		0.00	c0.20			0.03			0.04	
v/s Ratio Perm	0.14		0.00	0.04			0.02		0.01	c0.13		
v/c Ratio	0.38	0.50	0.01	0.10	0.44		0.06	0.11	0.05	0.48	0.16	
Uniform Delay, d1	10.8	11.4	9.4	7.3	8.7		11.9	12.1	11.9	13.6	12.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.8	0.2	0.0	0.1	0.2		0.1	0.1	0.0	0.8	0.1	
Delay (s)	11.6	11.6	9.4	7.4	8.9		12.0	12.2	12.0	14.3	12.4	
Level of Service	B	B	A	A	A		B	B	B	B	B	
Approach Delay (s)		11.6			8.8			12.1			13.5	
Approach LOS		B			A			B			B	

Intersection Summary

HCM 2000 Control Delay	10.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	45.2	Sum of lost time (s)	15.6
Intersection Capacity Utilization	59.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

## HCM Signalized Intersection Capacity Analysis

102: Niagara Square Dr/QEW EB Off-Ramp &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑		↑	↑↑					↑	↑	↑
Traffic Volume (vph)	0	694	1	53	461	0	0	0	0	241	88	206
Future Volume (vph)	0	694	1	53	461	0	0	0	0	241	88	206
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		6.0		3.0	6.0					6.0	6.0	6.0
Lane Util. Factor	0.91		1.00	0.95						0.95	0.95	1.00
Frpb, ped/bikes	1.00		1.00	1.00						1.00	1.00	0.99
Flpb, ped/bikes	1.00		1.00	1.00						1.00	1.00	1.00
Fr <sub>t</sub>	1.00		1.00	1.00						1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00						0.95	0.98	1.00
Satd. Flow (prot)	4638		1662	3197						1517	1522	1412
Flt Permitted	1.00		0.29	1.00						0.95	0.98	1.00
Satd. Flow (perm)	4638		509	3197						1517	1522	1412
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	754	1	58	501	0	0	0	0	262	96	224
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	160
Lane Group Flow (vph)	0	755	0	58	501	0	0	0	0	176	182	64
Confl. Peds. (#/hr)		2		2						3		1
Heavy Vehicles (%)	0%	3%	0%	0%	4%	0%	0%	0%	0%	4%	9%	4%
Turn Type	NA		pm+pt	NA						Perm	NA	Perm
Protected Phases	4		3	8							6	
Permitted Phases			8							6		6
Actuated Green, G (s)	14.0		21.0	21.0						13.1	13.1	13.1
Effective Green, g (s)	14.0		21.0	21.0						13.1	13.1	13.1
Actuated g/C Ratio	0.30		0.46	0.46						0.28	0.28	0.28
Clearance Time (s)	6.0		3.0	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)	1408		331	1456						431	432	401
v/s Ratio Prot	c0.16		0.02	c0.16								
v/s Ratio Perm			0.06							0.12	0.12	0.05
v/c Ratio	0.54		0.18	0.34						0.41	0.42	0.16
Uniform Delay, d1	13.3		7.2	8.1						13.4	13.4	12.4
Progression Factor	1.00		1.00	1.00						1.00	1.00	1.00
Incremental Delay, d2	0.4		0.3	0.1						0.6	0.7	0.2
Delay (s)	13.7		7.4	8.2						14.0	14.1	12.6
Level of Service	B		A	A						B	B	B
Approach Delay (s)	13.7			8.2			0.0				13.5	
Approach LOS	B			A			A				B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay	12.0			HCM 2000 Level of Service						B		
HCM 2000 Volume to Capacity ratio	0.47											
Actuated Cycle Length (s)	46.1			Sum of lost time (s)						15.0		
Intersection Capacity Utilization	45.5%			ICU Level of Service						A		
Analysis Period (min)	15											

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
103: QEW WB Off-Ramp & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑↑	↑
Traffic Volume (vph)	736	0	0	483	46	95
Future Volume (vph)	736	0	0	483	46	95
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	0.95			0.95	0.97	0.91
Frpb, ped/bikes	1.00			1.00	0.97	0.97
Flpb, ped/bikes	1.00			1.00	1.00	1.00
Fr <sub>t</sub>	1.00			1.00	0.92	0.85
Flt Protected	1.00			1.00	0.98	1.00
Satd. Flow (prot)	3260			3167	2890	1260
Flt Permitted	1.00			1.00	0.98	1.00
Satd. Flow (perm)	3260			3167	2890	1260
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	800	0	0	525	50	103
RTOR Reduction (vph)	0	0	0	0	42	41
Lane Group Flow (vph)	800	0	0	525	60	10
Confl. Peds. (#/hr)					4	13
Heavy Vehicles (%)	2%	0%	0%	5%	2%	4%
Turn Type	NA			NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases					2	
Actuated Green, G (s)	20.7			20.7	7.7	7.7
Effective Green, g (s)	20.7			20.7	7.7	7.7
Actuated g/C Ratio	0.51			0.51	0.19	0.19
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	1670			1622	550	240
v/s Ratio Prot	c0.25			0.17	c0.02	
v/s Ratio Perm					0.01	
v/c Ratio	0.48			0.32	0.11	0.04
Uniform Delay, d1	6.4			5.8	13.5	13.3
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	0.2			0.1	0.1	0.1
Delay (s)	6.6			5.9	13.6	13.4
Level of Service	A			A	B	B
Approach Delay (s)	6.6			5.9	13.5	
Approach LOS	A			A	B	
<b>Intersection Summary</b>						
HCM 2000 Control Delay	7.1			HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio	0.38					
Actuated Cycle Length (s)	40.4			Sum of lost time (s)		12.0
Intersection Capacity Utilization	39.5%			ICU Level of Service		A
Analysis Period (min)	15					

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑		↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	126	496	209	15	671	6	97	4	69	5	5	78
Future Volume (vph)	126	496	209	15	671	6	97	4	69	5	5	78
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.0	8.0	8.0	3.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	0.99	1.00	1.00
Fr <sub>t</sub>	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.86	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	3260	1437	1629	3255		1630	1716	1431	1618	1473	
Flt Permitted	0.37	1.00	1.00	0.39	1.00		0.70	1.00	1.00	0.76	1.00	
Satd. Flow (perm)	638	3260	1437	674	3255		1199	1716	1431	1286	1473	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	137	539	227	16	729	7	105	4	75	5	5	85
RTOR Reduction (vph)	0	0	131	0	1	0	0	0	62	0	71	0
Lane Group Flow (vph)	137	539	96	16	735	0	105	4	13	5	19	0
Confl. Peds. (#/hr)			5	5					12	12		
Turn Type	Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	Perm	NA
Protected Phases		4			3	8			2			6
Permitted Phases	4		4	8			2		2	6		
Actuated Green, G (s)	20.2	20.2	20.2	24.0	24.0		8.2	8.2	8.2	8.2	8.2	8.2
Effective Green, g (s)	20.2	20.2	20.2	24.0	24.0		8.2	8.2	8.2	8.2	8.2	8.2
Actuated g/C Ratio	0.42	0.42	0.42	0.50	0.50		0.17	0.17	0.17	0.17	0.17	0.17
Clearance Time (s)	8.0	8.0	8.0	3.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	267	1366	602	351	1620		203	291	243	218	250	
v/s Ratio Prot		0.17		0.00	c0.23			0.00				0.01
v/s Ratio Perm	c0.21		0.07	0.02			c0.09		0.01	0.00		
v/c Ratio	0.51	0.39	0.16	0.05	0.45		0.52	0.01	0.05	0.02	0.08	
Uniform Delay, d1	10.4	9.7	8.7	6.2	7.8		18.2	16.6	16.7	16.7	16.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.2	0.1	0.1	0.0	0.1		1.7	0.0	0.1	0.0	0.1	
Delay (s)	11.6	9.9	8.8	6.3	8.0		19.9	16.7	16.8	16.7	16.9	
Level of Service	B	A	A	A	A		B	B	B	B	B	
Approach Delay (s)		9.9			8.0			18.5			16.9	
Approach LOS		A			A			B			B	
Intersection Summary												
HCM 2000 Control Delay		10.3			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.52										
Actuated Cycle Length (s)		48.2			Sum of lost time (s)			19.0				
Intersection Capacity Utilization		63.7%			ICU Level of Service			B				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
105: Dorchester Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↓		↑	↑↓		↑	↑		↑	↑	
Traffic Volume (vph)	121	405	44	57	438	55	124	74	67	48	64	130
Future Volume (vph)	121	405	44	57	438	55	124	74	67	48	64	130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Fr <sub>t</sub>	1.00	0.99		1.00	0.98		1.00	0.93		1.00	0.90	
Fl <sub>t</sub> Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1522	3034		1596	3012		1630	1537		1628	1509	
Fl <sub>t</sub> Permitted	0.34	1.00		0.47	1.00		0.51	1.00		0.66	1.00	
Satd. Flow (perm)	546	3034		797	3012		878	1537		1131	1509	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	132	440	48	62	476	60	135	80	73	52	70	141
RTOR Reduction (vph)	0	7	0	0	9	0	0	33	0	0	79	0
Lane Group Flow (vph)	132	481	0	62	527	0	135	120	0	52	132	0
Confl. Peds. (#/hr)	12		5	5		12		4	4			
Heavy Vehicles (%)	9%	7%	14%	4%	8%	9%	2%	4%	6%	2%	3%	5%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	27.3	20.7		20.6	17.0		21.2	14.8		15.8	12.1	
Effective Green, g (s)	27.3	20.7		20.6	17.0		21.2	14.8		15.8	12.1	
Actuated g/C Ratio	0.44	0.33		0.33	0.27		0.34	0.24		0.26	0.20	
Clearance Time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	
Vehicle Extension (s)	2.5	2.2		2.5	2.2		2.5	2.2		2.5	2.2	
Lane Grp Cap (vph)	355	1014		311	827		378	367		318	294	
v/s Ratio Prot	c0.04	0.16		0.01	c0.18		c0.04	0.08		0.01	c0.09	
v/s Ratio Perm	0.12			0.05			0.09			0.03		
v/c Ratio	0.37	0.47		0.20	0.64		0.36	0.33		0.16	0.45	
Uniform Delay, d1	10.8	16.3		14.3	19.7		14.7	19.4		17.7	22.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.2		0.2	1.3		0.4	0.3		0.2	0.6	
Delay (s)	11.3	16.5		14.6	21.0		15.1	19.7		17.9	22.5	
Level of Service	B	B		B	C		B	B		B	C	
Approach Delay (s)		15.4			20.4			17.5			21.6	
Approach LOS		B			C			B			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		18.3			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.50										
Actuated Cycle Length (s)		61.9			Sum of lost time (s)			19.1				
Intersection Capacity Utilization		61.4%			ICU Level of Service			B				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
106: Drummond Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	120	368	34	0	282	92	77	51	9	83	18	107
Future Volume (vph)	120	368	34	0	282	92	77	51	9	83	18	107
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)							6.1	6.1	6.1	6.1	6.1	6.1
Lane Util. Factor							0.95	0.95	1.00	1.00	1.00	1.00
Frpb, ped/bikes							1.00	0.99	1.00	1.00	1.00	1.00
Flpb, ped/bikes							1.00	1.00	1.00	1.00	1.00	1.00
Fr <sub>t</sub>							0.99	0.96	1.00	0.98	1.00	0.87
Flt Protected							0.99	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)							3032	2947	1646	1650	1629	1453
Flt Permitted							0.76	1.00	0.67	1.00	0.71	1.00
Satd. Flow (perm)							2339	2947	1161	1650	1226	1453
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	130	400	37	0	307	100	84	55	10	90	20	116
RTOR Reduction (vph)	0	5	0	0	24	0	0	8	0	0	94	0
Lane Group Flow (vph)	0	562	0	0	383	0	84	57	0	90	42	0
Confl. Peds. (#/hr)	5		3	3		5			1	1		
Heavy Vehicles (%)	7%	7%	9%	0%	9%	5%	1%	2%	11%	2%	5%	5%
Turn Type	custom	NA			NA		Perm	NA		Perm	NA	
Protected Phases		4				8			2			6
Permitted Phases	7		8				2			6		
Actuated Green, G (s)	21.3				21.3		7.9	7.9	7.9	7.9	7.9	
Effective Green, g (s)	21.3				21.3		7.9	7.9	7.9	7.9	7.9	
Actuated g/C Ratio	0.51				0.51		0.19	0.19	0.19	0.19	0.19	
Clearance Time (s)	6.1				6.1		6.1	6.1	6.1	6.1	6.1	
Vehicle Extension (s)	3.0				3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1203				1516		221	314	233	277		
v/s Ratio Prot					0.13			0.03			0.03	
v/s Ratio Perm	c0.24						0.07			c0.07		
v/c Ratio	0.47				0.25		0.38	0.18	0.39	0.15		
Uniform Delay, d1	6.4				5.6		14.6	14.0	14.6	14.0		
Progression Factor	1.00				1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3				0.1		1.1	0.3	1.1	0.3		
Delay (s)	6.7				5.7		15.7	14.3	15.7	14.2		
Level of Service	A				A		B	B	B	B		
Approach Delay (s)	6.7				5.7			15.1			14.8	
Approach LOS		A				A			B		B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		8.7			HCM 2000 Level of Service				A			
HCM 2000 Volume to Capacity ratio		0.50										
Actuated Cycle Length (s)		41.4			Sum of lost time (s)				15.2			
Intersection Capacity Utilization		64.0%			ICU Level of Service				C			
Analysis Period (min)		15										
c Critical Lane Group												

## HCM Signalized Intersection Capacity Analysis

Thundering Waters Secondary Plan  
107: Thundering Waters Blvd/Stanley Ave (RR 102) & McLeod Rd (RR 49)/Marine Landing Parkway (RR 49)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑	↑	↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	29	231	3	4	309	152	1	1	2	125	3	20
Future Volume (vph)	29	231	3	4	309	152	1	1	2	125	3	20
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.90	1.00	1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (prot)	1511	3228	1488	1662	3137	1365	1662	1575	1525	1525	1342	
Flt Permitted	0.46	1.00	1.00	0.60	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (perm)	739	3228	1488	1043	3137	1365	1662	1575	1525	1525	1342	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	32	251	3	4	336	165	1	1	2	136	3	22
RTOR Reduction (vph)	0	0	2	0	0	111	0	2	0	0	18	0
Lane Group Flow (vph)	32	251	1	4	336	54	1	1	0	136	7	0
Heavy Vehicles (%)	10%	3%	0%	0%	6%	9%	0%	0%	0%	9%	0%	15%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Split	NA		Split	NA	
Protected Phases	7	4			8		2	2		6	6	
Permitted Phases	4		4	8		8						
Actuated Green, G (s)	21.6	21.6	21.6	16.4	16.4	16.4	1.0	1.0		9.1	9.1	
Effective Green, g (s)	21.6	21.6	21.6	16.4	16.4	16.4	1.0	1.0		9.1	9.1	
Actuated g/C Ratio	0.43	0.43	0.43	0.33	0.33	0.33	0.02	0.02		0.18	0.18	
Clearance Time (s)	3.0	6.1	6.1	6.1	6.1	6.1	6.1	6.1		6.1	6.1	
Vehicle Extension (s)	2.3	2.5	2.5	2.5	2.5	2.5	4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	353	1394	642	342	1028	447	33	31		277	244	
v/s Ratio Prot	0.00	c0.08			c0.11		0.00	c0.00		c0.09	0.01	
v/s Ratio Perm	0.04		0.00	0.00		0.04						
v/c Ratio	0.09	0.18	0.00	0.01	0.33	0.12	0.03	0.03		0.49	0.03	
Uniform Delay, d1	8.3	8.7	8.1	11.3	12.6	11.8	24.0	24.0		18.4	16.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.0	0.0	0.0	0.1	0.1	0.5	0.6		1.9	0.1	
Delay (s)	8.4	8.8	8.1	11.3	12.8	11.8	24.5	24.6		20.2	16.9	
Level of Service	A	A	A	B	B	B	C	C		C	B	
Approach Delay (s)		8.7			12.5			24.6			19.7	
Approach LOS		A			B			C			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			12.6		HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio			0.36									
Actuated Cycle Length (s)			50.0		Sum of lost time (s)				21.3			
Intersection Capacity Utilization			43.0%		ICU Level of Service				A			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
108: Stanley Ave (RR 102) & Marine Land Pkwy (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↖	↖	↑↑	↖↖	↖
Traffic Volume (vph)	261	146	14	336	170	25
Future Volume (vph)	261	146	14	336	170	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.5	6.5	6.5	6.5	6.1	6.1
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3107	1365	1458	3107	2780	1430
Flt Permitted	1.00	1.00	0.58	1.00	0.95	1.00
Satd. Flow (perm)	3107	1365	887	3107	2780	1430
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	284	159	15	365	185	27
RTOR Reduction (vph)	0	99	0	0	0	20
Lane Group Flow (vph)	284	60	15	365	185	7
Heavy Vehicles (%)	7%	9%	14%	7%	16%	4%
Turn Type	NA	Perm	Perm	NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	12.8	12.8	12.8	12.8	8.4	8.4
Effective Green, g (s)	12.8	12.8	12.8	12.8	8.4	8.4
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.25	0.25
Clearance Time (s)	6.5	6.5	6.5	6.5	6.1	6.1
Vehicle Extension (s)	2.9	2.9	2.9	2.9	2.8	2.8
Lane Grp Cap (vph)	1176	516	335	1176	690	355
v/s Ratio Prot	0.09			c0.12	c0.07	
v/s Ratio Perm		0.04	0.02			0.00
v/c Ratio	0.24	0.12	0.04	0.31	0.27	0.02
Uniform Delay, d1	7.2	6.8	6.6	7.4	10.2	9.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.1	0.1	0.1	0.2	0.0
Delay (s)	7.3	6.9	6.7	7.5	10.4	9.6
Level of Service	A	A	A	A	B	A
Approach Delay (s)	7.2			7.5	10.3	
Approach LOS	A			A	B	
Intersection Summary						
HCM 2000 Control Delay		7.9		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio		0.29				
Actuated Cycle Length (s)		33.8		Sum of lost time (s)		12.6
Intersection Capacity Utilization		29.8%		ICU Level of Service		A
Analysis Period (min)		15				
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis  
110: Montrose Rd (RR 98) & Niagara Square Dr

Thundering Waters Secondary Plan  
Existing Summer

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↑↑		↑↑			↑↑
Traffic Volume (vph)	121	3	92	0	0	50
Future Volume (vph)	121	3	92	0	0	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	5.2		5.5			5.5
Lane Util. Factor	0.97		0.95			0.95
Fr <sub>t</sub>	1.00		1.00			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	3163		3260			3260
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	3163		3260			3260
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	132	3	100	0	0	54
RTOR Reduction (vph)	3	0	0	0	0	0
Lane Group Flow (vph)	132	0	100	0	0	54
Turn Type	Prot		NA			NA
Protected Phases	6		8			
Permitted Phases						4
Actuated Green, G (s)	4.8		14.9			14.9
Effective Green, g (s)	4.8		14.9			14.9
Actuated g/C Ratio	0.16		0.49			0.49
Clearance Time (s)	5.2		5.5			5.5
Vehicle Extension (s)	2.1		2.3			2.3
Lane Grp Cap (vph)	499		1597			1597
v/s Ratio Prot	c0.04		c0.03			
v/s Ratio Perm						0.02
v/c Ratio	0.27		0.06			0.03
Uniform Delay, d1	11.3		4.1			4.0
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	0.1		0.0			0.0
Delay (s)	11.4		4.1			4.0
Level of Service	B		A			A
Approach Delay (s)	11.4		4.1			4.0
Approach LOS	B		A			A
<b>Intersection Summary</b>						
HCM 2000 Control Delay		7.5		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio		0.11				
Actuated Cycle Length (s)		30.4		Sum of lost time (s)		10.7
Intersection Capacity Utilization		22.3%		ICU Level of Service		A
Analysis Period (min)		15				
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis  
111: Oakwood Dr & Walmart North Driveway

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↑↑	↑↑	
Traffic Volume (vph)	77	0	0	93	121	108
Future Volume (vph)	77	0	0	93	121	108
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.3			7.0	7.0	
Lane Util. Factor	1.00			0.95	0.95	
Frpb, ped/bikes	1.00			1.00	0.99	
Flpb, ped/bikes	1.00			1.00	1.00	
Fr <sub>t</sub>	1.00			1.00	0.93	
Flt Protected	0.95			1.00	1.00	
Satd. Flow (prot)	1614			2969	2938	
Flt Permitted	0.95			1.00	1.00	
Satd. Flow (perm)	1614			2969	2938	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	84	0	0	101	132	117
RTOR Reduction (vph)	0	0	0	0	56	0
Lane Group Flow (vph)	84	0	0	101	193	0
Confl. Peds. (#/hr)				1		1
Heavy Vehicles (%)	3%	0%	0%	12%	7%	1%
Turn Type	Prot			NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Actuated Green, G (s)	4.6			19.7	19.7	
Effective Green, g (s)	4.6			19.7	19.7	
Actuated g/C Ratio	0.12			0.52	0.52	
Clearance Time (s)	6.3			7.0	7.0	
Vehicle Extension (s)	2.2			2.2	2.2	
Lane Grp Cap (vph)	197			1555	1539	
v/s Ratio Prot	c0.05			0.03	c0.07	
v/s Ratio Perm						
v/c Ratio	0.43			0.06	0.13	
Uniform Delay, d1	15.3			4.4	4.6	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	0.8			0.0	0.0	
Delay (s)	16.0			4.4	4.6	
Level of Service	B			A	A	
Approach Delay (s)	16.0			4.4	4.6	
Approach LOS	B			A	A	
<b>Intersection Summary</b>						
HCM 2000 Control Delay	6.8			HCM 2000 Level of Service	A	
HCM 2000 Volume to Capacity ratio	0.18					
Actuated Cycle Length (s)	37.6			Sum of lost time (s)	13.3	
Intersection Capacity Utilization	26.5%			ICU Level of Service	A	
Analysis Period (min)	15					

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
112: Oakwood Dr & Walmart South Driveway

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑		↑	↑	↑	↑	↔		↑	↑	
Traffic Volume (vph)	20	83	0	0	103	1	0	0	0	12	0	2
Future Volume (vph)	20	83	0	0	103	1	0	0	0	12	0	2
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	7.5			7.5	7.5				7.5	7.5	
Lane Util. Factor	1.00	1.00			1.00	1.00				0.97	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)	1662	1667			1716	1488				2041	1488	
Flt Permitted	0.61	1.00			1.00	1.00				0.95	1.00	
Satd. Flow (perm)	1066	1667			1716	1488				2041	1488	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	22	90	0	0	112	1	0	0	0	13	0	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	22	90	0	0	112	1	0	0	0	13	0	0
Heavy Vehicles (%)	0%	5%	0%	0%	2%	0%	0%	0%	0%	58%	0%	0%
Turn Type	pm+pt	NA		Perm	NA	Perm				Split	NA	
Protected Phases	7	4			8			2		6	6	
Permitted Phases	4			8		8	2					
Actuated Green, G (s)	28.3	28.3			24.1	24.1				1.5	1.5	
Effective Green, g (s)	28.3	28.3			24.1	24.1				1.5	1.5	
Actuated g/C Ratio	0.63	0.63			0.54	0.54				0.03	0.03	
Clearance Time (s)	3.0	7.5			7.5	7.5				7.5	7.5	
Vehicle Extension (s)	2.4	2.2			2.2	2.2				2.2	2.2	
Lane Grp Cap (vph)	689	1053			923	800				68	49	
v/s Ratio Prot	0.00	c0.05			c0.07					c0.01	0.00	
v/s Ratio Perm	0.02				0.00							
v/c Ratio	0.03	0.09			0.12	0.00				0.19	0.00	
Uniform Delay, d1	3.2	3.2			5.1	4.8				21.1	20.9	
Progression Factor	1.00	1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2	0.0	0.0			0.0	0.0				0.7	0.0	
Delay (s)	3.2	3.2			5.1	4.8				21.8	20.9	
Level of Service	A	A			A	A				C	C	
Approach Delay (s)		3.2			5.1			0.0			21.6	
Approach LOS		A			A			A			C	
Intersection Summary												
HCM 2000 Control Delay			5.3		HCM 2000 Level of Service				A			
HCM 2000 Volume to Capacity ratio			0.17									
Actuated Cycle Length (s)			44.8		Sum of lost time (s)				25.5			
Intersection Capacity Utilization			29.2%		ICU Level of Service				A			
Analysis Period (min)			15									
c Critical Lane Group												

## HCM Signalized Intersection Capacity Analysis

113: Montrose Rd (RR 98) &amp; Biggar Rd/Lyons Creek Rd (RR 47)

## Thundering Waters Secondary Plan

Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	13	66	1	224	61	84	2	134	379	31	48	7
Future Volume (vph)	13	66	1	224	61	84	2	134	379	31	48	7
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)												
Lane Util. Factor												
Frt												
Flt Protected												
Satd. Flow (prot)												
Flt Permitted												
Satd. Flow (perm)												
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	72	1	243	66	91	2	146	412	34	52	8
RTOR Reduction (vph)	0	1	0	0	16	0	0	121	0	0	4	0
Lane Group Flow (vph)	0	86	0	0	384	0	0	439	0	0	90	0
Heavy Vehicles (%)	8%	6%	0%	9%	5%	12%	0%	4%	4%	16%	23%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		27.5			27.5			23.4			23.4	
Effective Green, g (s)		27.5			27.5			23.4			23.4	
Actuated g/C Ratio		0.43			0.43			0.37			0.37	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		656			514			558			403	
v/s Ratio Prot												
v/s Ratio Perm		0.06			c0.32			c0.29			0.08	
v/c Ratio		0.13			0.75			0.79			0.22	
Uniform Delay, d1		10.8			15.1			17.8			13.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.3			7.8			8.9			0.8	
Delay (s)		11.1			22.9			26.8			14.6	
Level of Service		B			C			C			B	
Approach Delay (s)		11.1			22.9			26.8			14.6	
Approach LOS		B			C			C			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		23.2			HCM 2000 Level of Service			C				
HCM 2000 Volume to Capacity ratio		0.77										
Actuated Cycle Length (s)		63.5			Sum of lost time (s)			12.6				
Intersection Capacity Utilization		72.8%			ICU Level of Service			C				
Analysis Period (min)		15										
c Critical Lane Group												

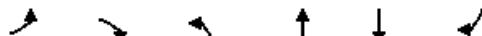
HCM Unsignalized Intersection Capacity Analysis  
203: Stanley Ave (RR 102) & Ramsey Rd

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			X	X	
Traffic Volume (veh/h)	25	2	2	167	154	23
Future Volume (Veh/h)	25	2	2	167	154	23
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	2	2	182	167	25
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	366	180	192			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	366	180	192			
tC, single (s)	6.6	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.2			
p0 queue free %	96	100	100			
cM capacity (veh/h)	606	869	1394			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	29	184	192			
Volume Left	27	2	0			
Volume Right	2	0	25			
cSH	619	1394	1700			
Volume to Capacity	0.05	0.00	0.11			
Queue Length 95th (m)	1.2	0.0	0.0			
Control Delay (s)	11.1	0.1	0.0			
Lane LOS	B	A				
Approach Delay (s)	11.1	0.1	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		0.8				
Intersection Capacity Utilization		21.3%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
204: Stanley Ave (RR 102) & Progress St

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	10	35	155	90	63
Future Volume (Veh/h)	24	10	35	155	90	63
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	26	11	38	168	98	68
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	376	132	166			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	376	132	166			
tC, single (s)	6.6	6.6	4.2			
tC, 2 stage (s)						
tF (s)	3.7	3.7	2.3			
p0 queue free %	95	99	97			
cM capacity (veh/h)	573	825	1342			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	37	206	166			
Volume Left	26	38	0			
Volume Right	11	0	68			
cSH	630	1342	1700			
Volume to Capacity	0.06	0.03	0.10			
Queue Length 95th (m)	1.5	0.7	0.0			
Control Delay (s)	11.1	1.6	0.0			
Lane LOS	B	A				
Approach Delay (s)	11.1	1.6	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		1.8				
Intersection Capacity Utilization		33.6%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
205: Stanley Ave (RR 102) & Don Murie St

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	18	23	78	173	62	39
Future Volume (Veh/h)	18	23	78	173	62	39
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	20	25	85	188	67	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	446	88	109			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vcu, unblocked vol	446	88	109			
tC, single (s)	6.7	6.7	4.1			
tC, 2 stage (s)						
tF (s)	3.8	3.8	2.2			
p0 queue free %	96	97	94			
cM capacity (veh/h)	494	849	1469			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	45	273	109			
Volume Left	20	85	0			
Volume Right	25	0	42			
cSH	643	1469	1700			
Volume to Capacity	0.07	0.06	0.06			
Queue Length 95th (m)	1.8	1.5	0.0			
Control Delay (s)	11.0	2.7	0.0			
Lane LOS	B	A				
Approach Delay (s)	11.0	2.7	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		2.9				
Intersection Capacity Utilization		31.2%		ICU Level of Service		A
Analysis Period (min)		15				

## HCM Unsignalized Intersection Capacity Analysis

206: Stanley Ave (RR 102) &amp; Dorchester Rd/Chippawa Pkwy

## Thundering Waters Secondary Plan

Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	1	6	7	7	23	17	222	3	8	84	5
Future Volume (Veh/h)	5	1	6	7	7	23	17	222	3	8	84	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)	5	1	7	8	8	25	18	241	3	9	91	5
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	419	392	94	398	392	242	96			244		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	419	392	94	398	392	242	96			244		
tC, single (s)	7.3	6.5	6.7	7.1	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.7	4.0	3.8	3.5	4.0	3.3	2.2			2.3		
p0 queue free %	99	100	99	99	99	97	99			99		
cM capacity (veh/h)	485	537	847	553	536	801	1510			1260		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	13	41	262	105								
Volume Left	5	8	18	9								
Volume Right	7	25	3	5								
cSH	636	677	1510	1260								
Volume to Capacity	0.02	0.06	0.01	0.01								
Queue Length 95th (m)	0.5	1.5	0.3	0.2								
Control Delay (s)	10.8	10.7	0.6	0.7								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.8	10.7	0.6	0.7								
Approach LOS	B	B										
Intersection Summary												
Average Delay			1.9									
Intersection Capacity Utilization		27.5%			ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
207: Montrose Rd (RR 98) & Chippawa Creek Rd (RR 63)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	Y	Y	Y
Traffic Volume (veh/h)	53	27	25	102	137	57
Future Volume (Veh/h)	53	27	25	102	137	57
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	58	29	27	111	149	62
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	314	149	211			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	314	149	211			
tC, single (s)	6.6	6.2	4.4			
tC, 2 stage (s)						
tF (s)	3.7	3.3	2.5			
p0 queue free %	91	97	98			
cM capacity (veh/h)	620	903	1219			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	87	27	111	149	62	
Volume Left	58	27	0	0	0	
Volume Right	29	0	0	0	62	
cSH	692	1219	1700	1700	1700	
Volume to Capacity	0.13	0.02	0.07	0.09	0.04	
Queue Length 95th (m)	3.4	0.5	0.0	0.0	0.0	
Control Delay (s)	10.9	8.0	0.0	0.0	0.0	
Lane LOS	B	A				
Approach Delay (s)	10.9	1.6		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay		2.7				
Intersection Capacity Utilization		26.1%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
208: Montrose Rd (RR 98) & Oakwood Dr

Thundering Waters Secondary Plan  
Existing Summer

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		P			R
Traffic Volume (veh/h)	48	5	122	60	10	144
Future Volume (Veh/h)	48	5	122	60	10	144
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	52	5	133	65	11	157
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	344	166		198		
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	344	166		198		
tC, single (s)	6.4	6.2		4.2		
tC, 2 stage (s)						
tF (s)	3.5	3.3		2.3		
p0 queue free %	92	99		99		
cM capacity (veh/h)	651	884		1328		
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	57	198	168			
Volume Left	52	0	11			
Volume Right	5	65	0			
cSH	666	1700	1328			
Volume to Capacity	0.09	0.12	0.01			
Queue Length 95th (m)	2.2	0.0	0.2			
Control Delay (s)	10.9	0.0	0.6			
Lane LOS	B		A			
Approach Delay (s)	10.9	0.0	0.6			
Approach LOS	B					
Intersection Summary						
Average Delay		1.7				
Intersection Capacity Utilization		27.1%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
209: Lyons Creek Rd (RR 47) & QEW EB Off-Ramp

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↑	↑
Traffic Volume (veh/h)	0	165	270	0	86	32
Future Volume (Veh/h)	0	165	270	0	86	32
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)	0	179	293	0	93	35
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)					5	
Median type		None	None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	293			382	146	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	293			382	146	
tC, single (s)	4.1			6.8	6.9	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	100			84	96	
cM capacity (veh/h)	1280			595	880	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	90	90	146	146	128	
Volume Left	0	0	0	0	93	
Volume Right	0	0	0	0	35	
cSH	1700	1700	1700	1700	819	
Volume to Capacity	0.05	0.05	0.09	0.09	0.16	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	4.4	
Control Delay (s)	0.0	0.0	0.0	0.0	11.4	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		11.4	
Approach LOS					B	
Intersection Summary						
Average Delay			2.4			
Intersection Capacity Utilization		19.9%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
210: QEW WB Off-Ramp & Lyons Creek Rd (RR 47)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑	↑
Traffic Volume (veh/h)	260	0	0	399	121	223
Future Volume (Veh/h)	260	0	0	399	121	223
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)	283	0	0	434	132	242
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)					6	
Median type	None		None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		283		500	142	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vcu, unblocked vol		283		500	142	
tC, single (s)		4.1		7.1	7.1	
tC, 2 stage (s)						
tF (s)		2.2		3.6	3.4	
p0 queue free %		100		72	72	
cM capacity (veh/h)		1291		474	856	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	142	142	217	217	374	
Volume Left	0	0	0	0	132	
Volume Right	0	0	0	0	242	
cSH	1700	1700	1700	1700	1322	
Volume to Capacity	0.08	0.08	0.13	0.13	0.28	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	9.4	
Control Delay (s)	0.0	0.0	0.0	0.0	12.5	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		12.5	
Approach LOS					B	
Intersection Summary						
Average Delay			4.3			
Intersection Capacity Utilization		29.5%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
211: Lyons Creek Rd (RR 47) & Stanley Ave (RR 102)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↑	↑	↓		↑	↑
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	208	93	162	45	76	18
Future Volume (vph)	208	93	162	45	76	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	226	101	176	49	83	20
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total (vph)	226	101	225	83	20	
Volume Left (vph)	226	0	0	83	0	
Volume Right (vph)	0	0	49	0	20	
Hadj (s)	0.65	0.08	-0.08	0.69	-0.22	
Departure Headway (s)	5.7	5.1	5.0	6.6	5.6	
Degree Utilization, x	0.36	0.14	0.31	0.15	0.03	
Capacity (veh/h)	610	681	703	512	587	
Control Delay (s)	10.6	7.8	10.2	9.5	7.6	
Approach Delay (s)	9.8		10.2	9.2		
Approach LOS	A		B	A		
<b>Intersection Summary</b>						
Delay			9.8			
Level of Service			A			
Intersection Capacity Utilization		39.3%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
212: Marineland Parkway & Portage Road

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑	↑	↑	↑
Traffic Volume (veh/h)	22	216	314	53	14	37
Future Volume (Veh/h)	22	216	314	53	14	37
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	235	341	58	15	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)		383				
pX, platoon unblocked						
vC, conflicting volume	341			506	170	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	341			506	170	
tC, single (s)	4.4			6.9	7.2	
tC, 2 stage (s)						
tF (s)	2.3			3.5	3.4	
p0 queue free %	98			97	95	
cM capacity (veh/h)	1133			478	807	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	SB 1
Volume Total	102	157	170	170	58	15
Volume Left	24	0	0	0	0	15
Volume Right	0	0	0	0	58	0
cSH	1133	1700	1700	1700	1700	478
Volume to Capacity	0.02	0.09	0.10	0.10	0.03	0.03
Queue Length 95th (m)	0.5	0.0	0.0	0.0	0.0	0.8
Control Delay (s)	2.1	0.0	0.0	0.0	0.0	12.8
Lane LOS	A				B	A
Approach Delay (s)	0.8		0.0			10.5
Approach LOS					B	
Intersection Summary						
Average Delay			1.1			
Intersection Capacity Utilization		29.9%		ICU Level of Service		A
Analysis Period (min)		15				

## Queues

101: Montrose Rd (RR 98) &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer

Lane Group	EBL	EBT	EBC	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	88	565	16	27	653	17	48	63	163	119
v/c Ratio	0.37	0.48	0.03	0.07	0.51	0.06	0.10	0.15	0.46	0.25
Control Delay	17.3	13.0	0.1	6.7	9.5	13.3	13.0	4.6	18.1	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.3	13.0	0.1	6.7	9.5	13.3	13.0	4.6	18.1	8.0
Queue Length 50th (m)	3.8	13.3	0.0	0.8	12.7	0.7	2.0	0.0	7.7	1.8
Queue Length 95th (m)	20.1	41.6	0.0	4.4	31.0	5.4	10.9	6.1	31.8	14.4
Internal Link Dist (m)	400.1			107.9			106.0			116.6
Turn Bay Length (m)	50.0	25.0		50.0	50.0				50.0	
Base Capacity (vph)	519	2565	1130	489	2849	797	1214	964	932	1105
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.17	0.22	0.01	0.06	0.23	0.02	0.04	0.07	0.17	0.11
Intersection Summary										

## Queues

Thundering Waters Secondary Plan  
102: Niagara Square Dr/QEW EB Off-Ramp & McLeod Rd (RR 49)

Existing Summer



Lane Group	EBT	WBL	WBT	SBL	SBT	SBR
Lane Group Flow (vph)	755	58	501	176	182	224
v/c Ratio	0.53	0.12	0.36	0.41	0.42	0.40
Control Delay	15.7	6.4	9.2	18.8	19.0	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.7	6.4	9.2	18.8	19.0	5.3
Queue Length 50th (m)	20.8	1.9	12.0	14.4	15.0	0.0
Queue Length 95th (m)	36.9	7.4	26.4	33.4	34.5	13.4
Internal Link Dist (m)	110.1		0.1		64.8	
Turn Bay Length (m)						
Base Capacity (vph)	3286	513	2789	1091	1095	1080
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	0.23	0.11	0.18	0.16	0.17	0.21
Intersection Summary						

Queues  
103: QEW WB Off-Ramp & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer



Lane Group	EBT	WBT	NBL	NBR
Lane Group Flow (vph)	800	525	102	51
v/c Ratio	0.43	0.29	0.13	0.14
Control Delay	8.2	7.2	7.4	5.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	8.2	7.2	7.4	5.8
Queue Length 50th (m)	19.8	11.7	1.1	0.0
Queue Length 95th (m)	31.4	19.6	5.6	6.2
Internal Link Dist (m)	48.6	24.7	55.4	
Turn Bay Length (m)				
Base Capacity (vph)	2467	2397	1469	655
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.32	0.22	0.07	0.08
Intersection Summary				

Queues  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan

Existing Summer

Lane Group	EBL	EBT	EBC	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	137	539	227	16	736	105	4	75	5	90
v/c Ratio	0.43	0.33	0.27	0.03	0.43	0.38	0.01	0.18	0.02	0.22
Control Delay	18.0	10.9	3.1	5.4	9.9	21.9	17.5	3.9	17.6	7.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.0	10.9	3.1	5.4	9.9	21.9	17.5	3.9	17.6	7.5
Queue Length 50th (m)	7.3	14.2	0.1	0.5	20.8	6.3	0.3	0.0	0.3	0.3
Queue Length 95th (m)	31.2	38.3	11.9	2.8	40.2	25.7	2.6	5.6	3.1	11.0
Internal Link Dist (m)		68.8			591.8		285.8			170.6
Turn Bay Length (m)	50.0		25.0	50.0		50.0				15.0
Base Capacity (vph)	429	2193	1039	622	2914	691	989	867	737	884
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.25	0.22	0.03	0.25	0.15	0.00	0.09	0.01	0.10
Intersection Summary										

## Queues

105: Dorchester Rd &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	132	488	62	536	135	153	52	211
v/c Ratio	0.31	0.47	0.15	0.65	0.30	0.37	0.12	0.58
Control Delay	11.6	18.8	10.3	25.5	15.8	20.9	14.2	22.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.6	18.8	10.3	25.5	15.8	20.9	14.2	22.1
Queue Length 50th (m)	8.3	25.4	3.7	30.6	10.1	11.5	3.7	12.6
Queue Length 95th (m)	19.9	45.5	10.6	55.6	26.1	32.3	12.0	37.4
Internal Link Dist (m)		591.8		1022.3		794.5		294.8
Turn Bay Length (m)	50.0		50.0		50.0		50.0	
Base Capacity (vph)	692	1377	756	1335	466	895	496	903
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.35	0.08	0.40	0.29	0.17	0.10	0.23
Intersection Summary								

## Queues

## 106: Drummond Rd &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	567	407	84	65	90	136
v/c Ratio	0.43	0.24	0.29	0.16	0.30	0.31
Control Delay	8.6	6.3	17.2	13.1	17.1	7.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.6	6.3	17.2	13.1	17.1	7.1
Queue Length 50th (m)	12.7	7.1	4.6	2.9	4.9	1.0
Queue Length 95th (m)	28.2	16.5	16.7	12.1	17.5	12.4
Internal Link Dist (m)	1022.3	574.4		805.6		271.9
Turn Bay Length (m)			25.0		25.0	
Base Capacity (vph)	2185	1976	1019	1449	1076	1289
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	0.26	0.21	0.08	0.04	0.08	0.11

## Intersection Summary

## Queues

Thundering Waters Secondary Plan  
107: Thundering Waters Blvd/Stanley Ave (RR 102) & McLeod Rd (RR 49)/Marine Landing Parkway (RR 49)

Lane Group	EBL	EBT	EBC	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	32	251	3	4	336	165	1	3	136	25
v/c Ratio	0.06	0.15	0.00	0.01	0.25	0.24	0.00	0.01	0.33	0.07
Control Delay	8.7	9.8	0.0	17.0	14.8	5.4	22.0	18.3	18.1	9.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.7	9.8	0.0	17.0	14.8	5.4	22.0	18.3	18.1	9.8
Queue Length 50th (m)	1.0	5.3	0.0	0.2	7.3	0.0	0.1	0.1	5.3	0.1
Queue Length 95th (m)	7.1	19.3	0.0	2.7	33.0	14.0	1.5	2.5	30.8	5.9
Internal Link Dist (m)	286.8			112.7			84.4			144.0
Turn Bay Length (m)	50.0	50.0		25.0	50.0		25.0			
Base Capacity (vph)	646	3020	1397	854	2570	1148	1297	1230	1190	1052
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.08	0.00	0.00	0.13	0.14	0.00	0.00	0.11	0.02
Intersection Summary										

## Queues

108: Stanley Ave (RR 102) &amp; Marine Land Pkwy (RR 49)

Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	284	159	15	365	185	27
v/c Ratio	0.24	0.26	0.05	0.31	0.27	0.07
Control Delay	8.2	3.2	7.7	8.6	10.5	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.2	3.2	7.7	8.6	10.5	5.0
Queue Length 50th (m)	5.3	0.0	0.5	7.0	3.7	0.0
Queue Length 95th (m)	10.6	6.3	2.5	13.4	8.1	2.9
Internal Link Dist (m)	116.7			308.8	44.6	
Turn Bay Length (m)		75.0	50.0			50.0
Base Capacity (vph)	2962	1309	846	2962	2609	1343
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	0.10	0.12	0.02	0.12	0.07	0.02

Intersection Summary

Queues  
110: Montrose Rd (RR 98) & Niagara Square Dr

Thundering Waters Secondary Plan

Existing Summer



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	135	100	54
v/c Ratio	0.15	0.05	0.03
Control Delay	7.8	6.1	6.2
Queue Delay	0.0	0.0	0.0
Total Delay	7.8	6.1	6.2
Queue Length 50th (m)	2.8	1.5	0.8
Queue Length 95th (m)	4.4	3.6	2.3
Internal Link Dist (m)	49.1	58.4	37.6
Turn Bay Length (m)			
Base Capacity (vph)	2568	2482	2482
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.05	0.04	0.02
Intersection Summary			

Queues  
111: Oakwood Dr & Walmart North Driveway

Thundering Waters Secondary Plan  
Existing Summer

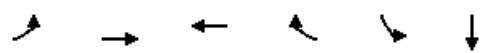


Lane Group	EBL	NBT	SBT
Lane Group Flow (vph)	84	101	249
v/c Ratio	0.23	0.05	0.13
Control Delay	12.9	6.3	4.0
Queue Delay	0.0	0.0	0.0
Total Delay	12.9	6.3	4.0
Queue Length 50th (m)	6.0	1.8	2.4
Queue Length 95th (m)	9.0	4.5	6.6
Internal Link Dist (m)	93.2	106.2	285.8
Turn Bay Length (m)			
Base Capacity (vph)	1233	2828	2804
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.07	0.04	0.09
Intersection Summary			

Queues  
112: Oakwood Dr & Walmart South Driveway

Thundering Waters Secondary Plan

Existing Summer



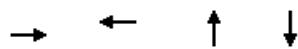
Lane Group	EBL	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	22	90	112	1	13	2
v/c Ratio	0.02	0.06	0.08	0.00	0.02	0.00
Control Delay	2.4	3.1	6.2	0.0	12.4	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.4	3.1	6.2	0.0	12.4	0.0
Queue Length 50th (m)	0.1	0.0	0.0	0.0	0.2	0.0
Queue Length 95th (m)	2.7	9.7	18.1	0.0	2.3	0.0
Internal Link Dist (m)		44.3	88.7			69.4
Turn Bay Length (m)	25.0					
Base Capacity (vph)	1155	1637	1327	1179	1812	1421
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	0.02	0.05	0.08	0.00	0.01	0.00

Intersection Summary

## Queues

Thundering Waters Secondary Plan  
113: Montrose Rd (RR 98) & Biggar Rd/Lyons Creek Rd (RR 47)

Existing Summer



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	87	400	560	94
v/c Ratio	0.13	0.76	0.83	0.23
Control Delay	11.1	24.6	26.6	17.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	11.1	24.6	26.6	17.8
Queue Length 50th (m)	6.4	38.9	41.5	7.5
Queue Length 95th (m)	13.6	70.5	#120.9	21.9
Internal Link Dist (m)	248.1	307.0	202.0	905.4
Turn Bay Length (m)				
Base Capacity (vph)	982	779	727	446
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.09	0.51	0.77	0.21

## Intersection Summary

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

Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis  
101: Montrose Rd (RR 98) & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑		↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	77	669	24	89	706	273	27	87	210	305	98	77
Future Volume (vph)	77	669	24	89	706	273	27	87	210	305	98	77
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.3	6.3	6.3	3.0	6.3		6.3	6.3	6.3	6.3	6.3	6.3
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.98	1.00	0.99		1.00	1.00	0.99	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Fr <sub>t</sub>	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85	1.00	0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1537	3228	1464	1568	3086		1662	1651	1411	1644	1579	
Flt Permitted	0.25	1.00	1.00	0.25	1.00		0.64	1.00	1.00	0.70	1.00	
Satd. Flow (perm)	410	3228	1464	411	3086		1115	1651	1411	1204	1579	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	84	727	26	97	767	297	29	95	228	332	107	84
RTOR Reduction (vph)	0	0	17	0	49	0	0	0	149	0	32	0
Lane Group Flow (vph)	84	727	9	97	1015	0	29	95	79	332	159	0
Confl. Peds. (#/hr)	7		6	6		7			2	2		
Heavy Vehicles (%)	8%	3%	0%	6%	3%	1%	0%	6%	4%	1%	0%	8%
Turn Type	Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4			3	8			2			6
Permitted Phases	4			4	8			2		2	6	
Actuated Green, G (s)	23.1	23.1	23.1	31.8	31.8		23.5	23.5	23.5	23.5	23.5	
Effective Green, g (s)	23.1	23.1	23.1	31.8	31.8		23.5	23.5	23.5	23.5	23.5	
Actuated g/C Ratio	0.34	0.34	0.34	0.47	0.47		0.35	0.35	0.35	0.35	0.35	
Clearance Time (s)	6.3	6.3	6.3	3.0	6.3		6.3	6.3	6.3	6.3	6.3	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	139	1098	498	289	1445		385	571	488	416	546	
v/s Ratio Prot		0.23		0.03	c0.33			0.06			0.10	
v/s Ratio Perm	0.20		0.01	0.13			0.03		0.06	c0.28		
v/c Ratio	0.60	0.66	0.02	0.34	0.70		0.08	0.17	0.16	0.80	0.29	
Uniform Delay, d1	18.6	19.1	14.9	10.9	14.3		14.9	15.4	15.4	20.1	16.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.1	1.4	0.0	0.5	1.5		0.1	0.1	0.1	9.9	0.2	
Delay (s)	24.7	20.4	14.9	11.4	15.8		15.0	15.5	15.5	30.0	16.4	
Level of Service	C	C	B	B	B		B	B	B	C	B	
Approach Delay (s)		20.7			15.4			15.5			25.0	
Approach LOS		C			B			B			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			18.7		HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio			0.78									
Actuated Cycle Length (s)			67.9		Sum of lost time (s)			15.6				
Intersection Capacity Utilization			80.0%		ICU Level of Service			D				
Analysis Period (min)			15									
c Critical Lane Group												

## HCM Signalized Intersection Capacity Analysis

102: Niagara Square Dr/QEW EB Off-Ramp &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑		↑	↑↑					↑	↑	↑
Traffic Volume (vph)	0	1249	50	94	790	0	0	0	0	389	83	197
Future Volume (vph)	0	1249	50	94	790	0	0	0	0	389	83	197
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		6.0		3.0	6.0					6.0	6.0	6.0
Lane Util. Factor		0.91		1.00	0.95					0.95	0.95	1.00
Frpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00
Flpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00
Fr <sub>t</sub>		0.99		1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00		0.95	1.00					0.95	0.97	1.00
Satd. Flow (prot)		4658		1630	3260					1502	1492	1444
Flt Permitted		1.00		0.14	1.00					0.95	0.97	1.00
Satd. Flow (perm)		4658		237	3260					1502	1492	1444
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1358	54	102	859	0	0	0	0	423	90	214
RTOR Reduction (vph)	0	5	0	0	0	0	0	0	0	0	0	81
Lane Group Flow (vph)	0	1407	0	102	859	0	0	0	0	254	259	133
Confl. Peds. (#/hr)			6	6					2	2		
Heavy Vehicles (%)	0%	2%	0%	2%	2%	0%	0%	0%	0%	5%	13%	3%
Turn Type	NA		pm+pt	NA						Perm	NA	Perm
Protected Phases	4		3	8							6	
Permitted Phases			8							6		6
Actuated Green, G (s)	25.9		35.0	35.0						18.0	18.0	18.0
Effective Green, g (s)	25.9		35.0	35.0						18.0	18.0	18.0
Actuated g/C Ratio	0.40		0.54	0.54						0.28	0.28	0.28
Clearance Time (s)	6.0		3.0	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)	1856		258	1755						415	413	399
v/s Ratio Prot	c0.30		0.04	c0.26								
v/s Ratio Perm			0.18							0.17	0.17	0.09
v/c Ratio	0.76		0.40	0.49						0.61	0.63	0.33
Uniform Delay, d1	16.9		9.0	9.4						20.5	20.6	18.7
Progression Factor	1.00		1.00	1.00						1.00	1.00	1.00
Incremental Delay, d2	1.8		1.0	0.2						2.7	3.0	0.5
Delay (s)	18.7		10.0	9.6						23.1	23.5	19.2
Level of Service	B		B	A						C	C	B
Approach Delay (s)	18.7			9.7		0.0					22.1	
Approach LOS	B			A		A					C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay	16.7			HCM 2000 Level of Service						B		
HCM 2000 Volume to Capacity ratio	0.68											
Actuated Cycle Length (s)	65.0			Sum of lost time (s)						15.0		
Intersection Capacity Utilization	68.2%			ICU Level of Service						C		
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
103: QEW WB Off-Ramp & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑↑↑	↑
Traffic Volume (vph)	1459	0	0	819	76	126
Future Volume (vph)	1459	0	0	819	76	126
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	0.95			0.95	0.97	0.91
Frpb, ped/bikes	1.00			1.00	0.99	0.98
Flpb, ped/bikes	1.00			1.00	1.00	1.00
Fr <sub>t</sub>	1.00			1.00	0.93	0.85
Flt Protected	1.00			1.00	0.97	1.00
Satd. Flow (prot)	3228			3260	2925	1278
Flt Permitted	1.00			1.00	0.97	1.00
Satd. Flow (perm)	3228			3260	2925	1278
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1586	0	0	890	83	137
RTOR Reduction (vph)	0	0	0	0	10	10
Lane Group Flow (vph)	1586	0	0	890	140	60
Confl. Peds. (#/hr)					3	
Heavy Vehicles (%)	3%	0%	0%	2%	4%	4%
Turn Type	NA			NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases					2	
Actuated Green, G (s)	32.5			32.5	8.1	8.1
Effective Green, g (s)	32.5			32.5	8.1	8.1
Actuated g/C Ratio	0.62			0.62	0.15	0.15
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	1994			2014	450	196
v/s Ratio Prot	c0.49			0.27	c0.05	
v/s Ratio Perm					0.05	
v/c Ratio	0.80			0.44	0.31	0.31
Uniform Delay, d1	7.6			5.3	19.8	19.8
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	2.3			0.2	0.4	0.9
Delay (s)	9.8			5.4	20.2	20.6
Level of Service	A			A	C	C
Approach Delay (s)	9.8			5.4	20.3	
Approach LOS	A			A	C	
<b>Intersection Summary</b>						
HCM 2000 Control Delay	9.2			HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio	0.70					
Actuated Cycle Length (s)	52.6			Sum of lost time (s)		12.0
Intersection Capacity Utilization	49.6%			ICU Level of Service		A
Analysis Period (min)	15					

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑		↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	31	833	373	249	956	13	359	22	271	18	12	82
Future Volume (vph)	31	833	373	249	956	13	359	22	271	18	12	82
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.0	8.0	8.0	3.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.99	1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.99	1.00	1.00	1.00	1.00	
Fr <sub>t</sub>	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1566	3197	1410	1629	3216		1620	1606	1439	1661	1420	
Flt Permitted	0.27	1.00	1.00	0.16	1.00		0.69	1.00	1.00	0.74	1.00	
Satd. Flow (perm)	448	3197	1410	281	3216		1179	1606	1439	1297	1420	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	905	405	271	1039	14	390	24	295	20	13	89
RTOR Reduction (vph)	0	0	161	0	1	0	0	0	205	0	46	0
Lane Group Flow (vph)	34	905	244	271	1052	0	390	24	90	20	56	0
Confl. Peds. (#/hr)	5		14	14		5	7		1	1		7
Heavy Vehicles (%)	6%	4%	3%	2%	3%	15%	2%	9%	2%	0%	8%	5%
Turn Type	Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4			3	8			2			6
Permitted Phases	4			4	8			2		2	6	
Actuated Green, G (s)	25.9	25.9	25.9	38.4	38.4		24.0	24.0	24.0	24.0	24.0	
Effective Green, g (s)	25.9	25.9	25.9	38.4	38.4		24.0	24.0	24.0	24.0	24.0	
Actuated g/C Ratio	0.33	0.33	0.33	0.49	0.49		0.31	0.31	0.31	0.31	0.31	
Clearance Time (s)	8.0	8.0	8.0	3.0	8.0		8.0	8.0	8.0	8.0	8.0	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	148	1056	465	300	1575		360	491	440	397	434	
v/s Ratio Prot		0.28		c0.11	0.33			0.01			0.04	
v/s Ratio Perm	0.08		0.17	c0.33			c0.33		0.06	0.02		
v/c Ratio	0.23	0.86	0.52	0.90	0.67		1.08	0.05	0.21	0.05	0.13	
Uniform Delay, d1	19.0	24.5	21.3	14.7	15.2		27.2	19.2	20.1	19.2	19.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.6	6.9	0.8	28.5	1.0		71.6	0.0	0.2	0.0	0.1	
Delay (s)	19.6	31.4	22.1	43.2	16.1		98.8	19.2	20.3	19.2	19.7	
Level of Service	B	C	C	D	B		F	B	C	B	B	
Approach Delay (s)		28.3			21.7			63.4			19.7	
Approach LOS		C			C			E			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			32.6		HCM 2000 Level of Service			C				
HCM 2000 Volume to Capacity ratio			1.01									
Actuated Cycle Length (s)			78.4		Sum of lost time (s)			19.0				
Intersection Capacity Utilization			85.7%		ICU Level of Service			E				
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
105: Dorchester Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↓		↑	↑↓		↑	↑		↑	↑	
Traffic Volume (vph)	278	659	100	42	700	69	230	113	58	100	118	289
Future Volume (vph)	278	659	100	42	700	69	230	113	58	100	118	289
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Fr <sub>t</sub>	1.00	0.98		1.00	0.99		1.00	0.95		1.00	0.89	
Fl <sub>t</sub> Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1645	3165		1626	3174		1568	1636		1644	1548	
Fl <sub>t</sub> Permitted	0.14	1.00		0.34	1.00		0.16	1.00		0.64	1.00	
Satd. Flow (perm)	241	3165		584	3174		262	1636		1108	1548	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	302	716	109	46	761	75	250	123	63	109	128	314
RTOR Reduction (vph)	0	9	0	0	7	0	0	18	0	0	88	0
Lane Group Flow (vph)	302	816	0	46	829	0	250	168	0	109	354	0
Confl. Peds. (#/hr)	24		11	11		24		3	3			
Heavy Vehicles (%)	1%	2%	5%	2%	3%	0%	6%	0%	3%	1%	1%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	46.6	39.6		29.7	25.7		37.0	27.9		32.0	25.4	
Effective Green, g (s)	46.6	39.6		29.7	25.7		37.0	27.9		32.0	25.4	
Actuated g/C Ratio	0.48	0.41		0.31	0.26		0.38	0.29		0.33	0.26	
Clearance Time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	
Vehicle Extension (s)	2.5	2.2		2.5	2.2		2.5	2.2		2.5	2.2	
Lane Grp Cap (vph)	374	1289		221	839		222	469		401	404	
v/s Ratio Prot	c0.15	0.26		0.01	c0.26		c0.11	0.10		0.02	0.23	
v/s Ratio Perm	0.24			0.05			c0.32			0.07		
v/c Ratio	0.81	0.63		0.21	0.99		1.13	0.36		0.27	0.88	
Uniform Delay, d <sub>1</sub>	23.0	23.0		24.1	35.6		25.7	27.5		23.4	34.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d <sub>2</sub>	11.7	0.8		0.3	27.9		98.5	0.2		0.3	18.4	
Delay (s)	34.8	23.8		24.5	63.5		124.1	27.8		23.7	52.8	
Level of Service	C	C		C	E		F	C		C	D	
Approach Delay (s)		26.7			61.5			83.0			47.0	
Approach LOS		C			E			F			D	
Intersection Summary												
HCM 2000 Control Delay		48.9				HCM 2000 Level of Service				D		
HCM 2000 Volume to Capacity ratio		1.04										
Actuated Cycle Length (s)		97.2				Sum of lost time (s)				19.1		
Intersection Capacity Utilization		97.8%				ICU Level of Service				F		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
106: Drummond Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑↑	↑↑	↑↑		↑↑	↑↑	↑	↑		↑	↑	↑
Traffic Volume (vph)	193	440	92	8	573	169	82	64	11	125	83	226
Future Volume (vph)	193	440	92	8	573	169	82	64	11	125	83	226
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)						6.1			6.1		6.1	6.1
Lane Util. Factor		0.95				0.95			1.00		1.00	1.00
Frpb, ped/bikes		1.00				0.99			1.00		1.00	1.00
Flpb, ped/bikes		1.00				1.00			1.00		0.99	1.00
Fr <sub>t</sub>		0.98				0.97			1.00		0.98	1.00
Flt Protected		0.99				1.00			0.95		0.95	1.00
Satd. Flow (prot)		3108				3103			1646		1647	1531
Flt Permitted		0.61				0.95			0.40		0.70	1.00
Satd. Flow (perm)		1922				2935			690		1220	1531
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	210	478	100	9	623	184	89	70	12	136	90	246
RTOR Reduction (vph)	0	11	0	0	19	0	0	9	0	0	144	0
Lane Group Flow (vph)	0	777	0	0	797	0	89	73	0	136	192	0
Confl. Peds. (#/hr)	16		7	7		16			17		17	
Heavy Vehicles (%)	4%	3%	1%	0%	3%	1%	1%	0%	9%	0%	1%	2%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	7	4				8			2			6
Permitted Phases	4			8				2			6	
Actuated Green, G (s)	31.0				31.0		13.3	13.3		13.3	13.3	
Effective Green, g (s)	31.0				31.0		13.3	13.3		13.3	13.3	
Actuated g/C Ratio	0.55				0.55		0.24	0.24		0.24	0.24	
Clearance Time (s)	6.1				6.1		6.1	6.1		6.1	6.1	
Vehicle Extension (s)	3.0				3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	1054				1610		162	396		287	360	
v/s Ratio Prot								0.04			0.13	
v/s Ratio Perm	c0.40				0.27		c0.13			0.11		
v/c Ratio	0.74				0.50		0.55	0.18		0.47	0.53	
Uniform Delay, d1	9.7				7.9		19.0	17.3		18.6	18.9	
Progression Factor	1.00				1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.7				0.2		3.8	0.2		1.2	1.5	
Delay (s)	12.4				8.1		22.7	17.5		19.8	20.4	
Level of Service	B				A		C	B		B	C	
Approach Delay (s)	12.4				8.1			20.2			20.2	
Approach LOS	B				A			C			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay	13.1				HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio	0.76											
Actuated Cycle Length (s)	56.5				Sum of lost time (s)			16.7				
Intersection Capacity Utilization	93.1%				ICU Level of Service			F				
Analysis Period (min)	15											
c Critical Lane Group												

# HCM Signalized Intersection Capacity Analysis

107: Thundering Waters Blvd/Stanley Ave (RR 102) & McLeod Rd (RR 49)/Marine Landing Parkway (RR 49)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑	↑	↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	62	355	3	5	472	244	20	3	5	197	3	69
Future Volume (vph)	62	355	3	5	472	244	20	3	5	197	3	69
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.91	1.00	1.00	0.86	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (prot)	1568	3197	1488	1662	3292	1430	1662	1586	1583	1456		
Flt Permitted	0.36	1.00	1.00	0.52	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (perm)	588	3197	1488	916	3292	1430	1662	1586	1583	1456		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	67	386	3	5	513	265	22	3	5	214	3	75
RTOR Reduction (vph)	0	0	2	0	0	189	0	5	0	0	55	0
Lane Group Flow (vph)	67	386	1	5	513	76	22	3	0	214	23	0
Heavy Vehicles (%)	6%	4%	0%	0%	1%	4%	0%	0%	0%	5%	0%	3%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Split	NA		Split	NA	
Protected Phases	7	4			8		2	2		6	6	
Permitted Phases	4		4	8		8						
Actuated Green, G (s)	25.4	25.4	25.4	17.9	17.9	17.9	2.5	2.5		16.6	16.6	
Effective Green, g (s)	25.4	25.4	25.4	17.9	17.9	17.9	2.5	2.5		16.6	16.6	
Actuated g/C Ratio	0.40	0.40	0.40	0.29	0.29	0.29	0.04	0.04		0.26	0.26	
Clearance Time (s)	3.0	6.1	6.1	6.1	6.1	6.1	6.1	6.1		6.1	6.1	
Vehicle Extension (s)	2.3	2.5	2.5	2.5	2.5	2.5	4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	308	1293	601	261	938	407	66	63		418	384	
v/s Ratio Prot	0.02	c0.12			c0.16		c0.01	0.00		c0.14	0.02	
v/s Ratio Perm	0.07		0.00	0.01		0.05						
v/c Ratio	0.22	0.30	0.00	0.02	0.55	0.19	0.33	0.05		0.51	0.06	
Uniform Delay, d1	11.8	12.7	11.1	16.1	19.0	16.9	29.3	29.0		19.7	17.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.1	0.0	0.0	0.5	0.2	4.0	0.5		1.4	0.1	
Delay (s)	12.0	12.8	11.1	16.2	19.5	17.1	33.4	29.5		21.1	17.4	
Level of Service	B	B	B	B	B	B	C	C		C	B	
Approach Delay (s)		12.6			18.7			32.3			20.1	
Approach LOS		B			B			C			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		17.4										B
HCM 2000 Volume to Capacity ratio		0.50										
Actuated Cycle Length (s)		62.8										21.3
Intersection Capacity Utilization		51.2%										A
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
108: Stanley Ave (RR 102) & Marine Land Pkwy (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↖	↖	↑↑	↖↖	↖
Traffic Volume (vph)	408	151	28	348	296	27
Future Volume (vph)	408	151	28	348	296	27
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.5	6.5	6.5	6.5	6.1	6.1
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00
Frbp, ped/bikes	1.00	0.99	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Fr <sub>t</sub>	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3137	1299	1408	3167	3014	1488
Flt Permitted	1.00	1.00	0.50	1.00	0.95	1.00
Satd. Flow (perm)	3137	1299	734	3167	3014	1488
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	443	164	30	378	322	29
RTOR Reduction (vph)	0	109	0	0	0	21
Lane Group Flow (vph)	443	56	30	378	322	8
Confl. Peds. (#/hr)		1	1			
Heavy Vehicles (%)	6%	13%	18%	5%	7%	0%
Turn Type	NA	Perm	Perm	NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	11.1	11.1	11.1	11.1	9.1	9.1
Effective Green, g (s)	11.1	11.1	11.1	11.1	9.1	9.1
Actuated g/C Ratio	0.34	0.34	0.34	0.34	0.28	0.28
Clearance Time (s)	6.5	6.5	6.5	6.5	6.1	6.1
Vehicle Extension (s)	2.9	2.9	2.9	2.9	2.8	2.8
Lane Grp Cap (vph)	1061	439	248	1071	836	412
v/s Ratio Prot	c0.14			0.12	c0.11	
v/s Ratio Perm		0.04	0.04			0.01
v/c Ratio	0.42	0.13	0.12	0.35	0.39	0.02
Uniform Delay, d1	8.4	7.5	7.5	8.2	9.6	8.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.1	0.2	0.2	0.3	0.0
Delay (s)	8.6	7.6	7.7	8.3	9.9	8.6
Level of Service	A	A	A	A	A	A
Approach Delay (s)	8.3			8.3	9.7	
Approach LOS	A			A	A	
Intersection Summary						
HCM 2000 Control Delay			8.7	HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio			0.40			
Actuated Cycle Length (s)			32.8	Sum of lost time (s)		12.6
Intersection Capacity Utilization			44.9%	ICU Level of Service		A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
110: Montrose Rd (RR 98) & Niagara Square Dr

Thundering Waters Secondary Plan  
Existing Summer

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↑↑		↑↑			↑↑
Traffic Volume (vph)	182	6	264	0	0	121
Future Volume (vph)	182	6	264	0	0	121
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	5.2		5.5			5.5
Lane Util. Factor	0.97		0.95			0.95
Fr <sub>t</sub>	0.99		1.00			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	3046		3167			3325
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	3046		3167			3325
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	198	7	287	0	0	132
RTOR Reduction (vph)	5	0	0	0	0	0
Lane Group Flow (vph)	200	0	287	0	0	132
Heavy Vehicles (%)	6%	0%	5%	0%	5%	0%
Turn Type	Prot		NA			NA
Protected Phases	6		8			
Permitted Phases						4
Actuated Green, G (s)	8.0		8.1			8.1
Effective Green, g (s)	8.0		8.1			8.1
Actuated g/C Ratio	0.30		0.30			0.30
Clearance Time (s)	5.2		5.5			5.5
Vehicle Extension (s)	2.1		2.3			2.3
Lane Grp Cap (vph)	909		957			1004
v/s Ratio Prot	c0.07		c0.09			
v/s Ratio Perm						0.04
v/c Ratio	0.22		0.30			0.13
Uniform Delay, d1	7.1		7.2			6.8
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	0.1		0.1			0.0
Delay (s)	7.1		7.3			6.8
Level of Service	A		A			A
Approach Delay (s)	7.1		7.3			6.8
Approach LOS	A		A			A
<b>Intersection Summary</b>						
HCM 2000 Control Delay		7.1	HCM 2000 Level of Service		A	
HCM 2000 Volume to Capacity ratio		0.26				
Actuated Cycle Length (s)		26.8	Sum of lost time (s)		10.7	
Intersection Capacity Utilization		23.5%	ICU Level of Service		A	
Analysis Period (min)		15				
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis  
111: Oakwood Dr & Walmart North Driveway

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↑↑	↑↑	
Traffic Volume (vph)	325	4	0	231	320	219
Future Volume (vph)	325	4	0	231	320	219
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.3			7.0	7.0	
Lane Util. Factor	1.00			0.95	0.95	
Frpb, ped/bikes	1.00			1.00	0.99	
Flpb, ped/bikes	1.00			1.00	1.00	
Fr <sub>t</sub>	1.00			1.00	0.94	
Flt Protected	0.95			1.00	1.00	
Satd. Flow (prot)	1649			3197	2995	
Flt Permitted	0.95			1.00	1.00	
Satd. Flow (perm)	1649			3197	2995	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	353	4	0	251	348	238
RTOR Reduction (vph)	1	0	0	0	165	0
Lane Group Flow (vph)	356	0	0	251	421	0
Confl. Peds. (#/hr)				1	1	
Heavy Vehicles (%)	1%	0%	0%	4%	5%	1%
Turn Type	Prot			NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Actuated Green, G (s)	12.5			11.4	11.4	
Effective Green, g (s)	12.5			11.4	11.4	
Actuated g/C Ratio	0.34			0.31	0.31	
Clearance Time (s)	6.3			7.0	7.0	
Vehicle Extension (s)	2.2			2.2	2.2	
Lane Grp Cap (vph)	554			979	917	
v/s Ratio Prot	c0.22			0.08	c0.14	
v/s Ratio Perm						
v/c Ratio	0.64			0.26	0.46	
Uniform Delay, d1	10.5			9.7	10.4	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	2.1			0.1	0.2	
Delay (s)	12.5			9.8	10.6	
Level of Service	B			A	B	
Approach Delay (s)	12.5			9.8	10.6	
Approach LOS	B			A	B	
<b>Intersection Summary</b>						
HCM 2000 Control Delay	11.0			HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.56					
Actuated Cycle Length (s)	37.2			Sum of lost time (s)	13.3	
Intersection Capacity Utilization	48.3%			ICU Level of Service	A	
Analysis Period (min)	15					

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
112: Oakwood Dr & Walmart South Driveway

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑		↑	↑	↑		↔		↑	↑	
Traffic Volume (vph)	44	136	0	0	93	24	0	0	0	115	0	61
Future Volume (vph)	44	136	0	0	93	24	0	0	0	115	0	61
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	7.5			7.5	7.5				7.5	7.5	
Lane Util. Factor	1.00	1.00			1.00	1.00				0.97	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)	1662	1716			1651	1430				3014	1458	
Flt Permitted	0.57	1.00			1.00	1.00				0.95	1.00	
Satd. Flow (perm)	994	1716			1651	1430				3014	1458	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	48	148	0	0	101	26	0	0	0	125	0	66
RTOR Reduction (vph)	0	0	0	0	0	18	0	0	0	0	54	0
Lane Group Flow (vph)	48	148	0	0	101	8	0	0	0	125	12	0
Heavy Vehicles (%)	0%	2%	0%	0%	6%	4%	0%	0%	0%	7%	0%	2%
Turn Type	pm+pt	NA		Perm	NA	Perm				Split	NA	
Protected Phases	7	4			8			2		6	6	
Permitted Phases	4			8		8	2					
Actuated Green, G (s)	19.5	19.5			13.8	13.8				7.8	7.8	
Effective Green, g (s)	19.5	19.5			13.8	13.8				7.8	7.8	
Actuated g/C Ratio	0.46	0.46			0.33	0.33				0.18	0.18	
Clearance Time (s)	3.0	7.5			7.5	7.5				7.5	7.5	
Vehicle Extension (s)	2.4	2.2			2.2	2.2				2.2	2.2	
Lane Grp Cap (vph)	500	791			538	466				555	268	
v/s Ratio Prot	0.01	c0.09			0.06					c0.04	0.01	
v/s Ratio Perm	0.04				0.01							
v/c Ratio	0.10	0.19			0.19	0.02				0.23	0.05	
Uniform Delay, d1	6.4	6.7			10.2	9.7				14.7	14.2	
Progression Factor	1.00	1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2	0.1	0.1			0.1	0.0				0.1	0.0	
Delay (s)	6.5	6.8			10.3	9.7				14.8	14.2	
Level of Service	A	A			B	A				B	B	
Approach Delay (s)		6.7			10.2			0.0			14.6	
Approach LOS		A			B			A			B	
Intersection Summary												
HCM 2000 Control Delay		10.5			HCM 2000 Level of Service					B		
HCM 2000 Volume to Capacity ratio		0.32										
Actuated Cycle Length (s)		42.3			Sum of lost time (s)			25.5				
Intersection Capacity Utilization		30.1%			ICU Level of Service			A				
Analysis Period (min)		15										
c Critical Lane Group												

## HCM Signalized Intersection Capacity Analysis

113: Montrose Rd (RR 98) &amp; Biggar Rd/Lyons Creek Rd (RR 47)

## Thundering Waters Secondary Plan

Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	17	58	1	421	104	78	1	151	323	124	188	31
Future Volume (vph)	17	58	1	421	104	78	1	151	323	124	188	31
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)												
Lane Util. Factor												
Frt												
Flt Protected												
Satd. Flow (prot)												
Flt Permitted												
Satd. Flow (perm)												
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	63	1	458	113	85	1	164	351	135	204	34
RTOR Reduction (vph)	0	1	0	0	7	0	0	93	0	0	4	0
Lane Group Flow (vph)	0	81	0	0	649	0	0	423	0	0	369	0
Heavy Vehicles (%)	6%	9%	0%	4%	7%	8%	0%	6%	7%	13%	2%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	40.0			40.0			30.0			30.0		
Effective Green, g (s)	40.0			40.0			30.0			30.0		
Actuated g/C Ratio	0.48			0.48			0.36			0.36		
Clearance Time (s)	6.3			6.3			6.3			6.3		
Vehicle Extension (s)	6.0			6.0			6.0			6.0		
Lane Grp Cap (vph)	666			587			540			302		
v/s Ratio Prot												
v/s Ratio Perm	0.06			c0.54			0.28			c0.44		
v/c Ratio	0.12			1.11			0.78			1.22		
Uniform Delay, d1	11.7			21.3			23.4			26.3		
Progression Factor	1.00			1.00			1.00			1.00		
Incremental Delay, d2	0.2			69.7			9.0			125.3		
Delay (s)	11.9			91.0			32.4			151.6		
Level of Service	B			F			C			F		
Approach Delay (s)	11.9			91.0			32.4			151.6		
Approach LOS	B			F			C			F		
<b>Intersection Summary</b>												
HCM 2000 Control Delay	82.3											
HCM 2000 Volume to Capacity ratio	1.15											
Actuated Cycle Length (s)	82.6											
Intersection Capacity Utilization	109.3%											
Analysis Period (min)	15											
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis  
203: Stanley Ave (RR 102) & Ramsey Rd

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			X	X	
Traffic Volume (veh/h)	34	5	2	230	190	17
Future Volume (Veh/h)	34	5	2	230	190	17
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	5	2	250	207	18
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	470	216	225			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	470	216	225			
tC, single (s)	6.5	6.4	4.6			
tC, 2 stage (s)						
tF (s)	3.6	3.5	2.7			
p0 queue free %	93	99	100			
cM capacity (veh/h)	544	781	1106			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	42	252	225			
Volume Left	37	2	0			
Volume Right	5	0	18			
cSH	564	1106	1700			
Volume to Capacity	0.07	0.00	0.13			
Queue Length 95th (m)	1.9	0.0	0.0			
Control Delay (s)	11.9	0.1	0.0			
Lane LOS	B	A				
Approach Delay (s)	11.9	0.1	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		1.0				
Intersection Capacity Utilization		24.9%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
204: Stanley Ave (RR 102) & Progress St

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			X	X	
Traffic Volume (veh/h)	34	82	24	145	187	23
Future Volume (Veh/h)	34	82	24	145	187	23
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	89	26	158	203	25
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	426	216	228			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	426	216	228			
tC, single (s)	6.4	6.3	4.6			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.6			
p0 queue free %	94	89	98			
cM capacity (veh/h)	570	798	1111			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	126	184	228			
Volume Left	37	26	0			
Volume Right	89	0	25			
cSH	714	1111	1700			
Volume to Capacity	0.18	0.02	0.13			
Queue Length 95th (m)	5.1	0.6	0.0			
Control Delay (s)	11.1	1.4	0.0			
Lane LOS	B	A				
Approach Delay (s)	11.1	1.4	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		3.1				
Intersection Capacity Utilization		39.5%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
205: Stanley Ave (RR 102) & Don Murie St

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	82	24	145	187	23
Future Volume (Veh/h)	24	82	24	145	187	23
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	26	89	26	158	203	25
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	426	216	228			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	426	216	228			
tC, single (s)	6.5	6.3	4.5			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.6			
p0 queue free %	95	89	98			
cM capacity (veh/h)	565	798	1137			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	115	184	228			
Volume Left	26	26	0			
Volume Right	89	0	25			
cSH	730	1137	1700			
Volume to Capacity	0.16	0.02	0.13			
Queue Length 95th (m)	4.5	0.6	0.0			
Control Delay (s)	10.9	1.3	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.9	1.3	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		2.8				
Intersection Capacity Utilization		38.9%		ICU Level of Service		A
Analysis Period (min)		15				

## HCM Unsignalized Intersection Capacity Analysis

206: Stanley Ave (RR 102) &amp; Dorchester Rd/Chippawa Pkwy

## Thundering Waters Secondary Plan

Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	9	15	12	5	4	15	164	8	14	241	14
Future Volume (Veh/h)	6	9	15	12	5	4	15	164	8	14	241	14
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)	7	10	16	13	5	4	16	178	9	15	262	15
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	520	518	270	535	522	182	277				187	
vc1, stage 1 conf vol												
vc2, stage 2 conf vol												
vCu, unblocked vol	520	518	270	535	522	182	277				187	
tC, single (s)	7.1	6.5	6.3	7.1	6.5	6.2	4.2				4.2	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.4	3.5	4.0	3.3	2.3				2.3	
p0 queue free %	98	98	98	97	99	100	99				99	
cM capacity (veh/h)	455	453	743	434	452	865	1258				1358	
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	33	22	203	292								
Volume Left	7	13	16	15								
Volume Right	16	4	9	15								
cSH	560	482	1258	1358								
Volume to Capacity	0.06	0.05	0.01	0.01								
Queue Length 95th (m)	1.5	1.1	0.3	0.3								
Control Delay (s)	11.8	12.8	0.7	0.5								
Lane LOS	B	B	A	A								
Approach Delay (s)	11.8	12.8	0.7	0.5								
Approach LOS	B	B										
<b>Intersection Summary</b>												
Average Delay			1.8									
Intersection Capacity Utilization		28.5%		ICU Level of Service							A	
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
207: Montrose Rd (RR 98) & Chippawa Creek Rd (RR 63)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y	Y
Traffic Volume (veh/h)	39	34	34	187	206	40
Future Volume (Veh/h)	39	34	34	187	206	40
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	42	37	37	203	224	43
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	501	224	267			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	501	224	267			
tC, single (s)	6.4	6.4	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.5	2.2			
p0 queue free %	92	95	97			
cM capacity (veh/h)	513	777	1291			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	79	37	203	224	43	
Volume Left	42	37	0	0	0	
Volume Right	37	0	0	0	43	
cSH	610	1291	1700	1700	1700	
Volume to Capacity	0.13	0.03	0.12	0.13	0.03	
Queue Length 95th (m)	3.5	0.7	0.0	0.0	0.0	
Control Delay (s)	11.8	7.9	0.0	0.0	0.0	
Lane LOS	B	A				
Approach Delay (s)	11.8	1.2		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay			2.1			
Intersection Capacity Utilization		29.7%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
208: Montrose Rd (RR 98) & Oakwood Dr

Thundering Waters Secondary Plan  
Existing Summer

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		P			R
Traffic Volume (veh/h)	96	18	217	87	15	213
Future Volume (Veh/h)	96	18	217	87	15	213
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	104	20	236	95	16	232
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	548	284			331	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	548	284			331	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	79	97			99	
cM capacity (veh/h)	495	760			1240	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	124	331	248			
Volume Left	104	0	16			
Volume Right	20	95	0			
cSH	524	1700	1240			
Volume to Capacity	0.24	0.19	0.01			
Queue Length 95th (m)	7.3	0.0	0.3			
Control Delay (s)	14.0	0.0	0.6			
Lane LOS	B		A			
Approach Delay (s)	14.0	0.0	0.6			
Approach LOS	B					
Intersection Summary						
Average Delay		2.7				
Intersection Capacity Utilization		39.2%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
209: Lyons Creek Rd (RR 47) & QEW EB Off-Ramp

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↖	↖
Traffic Volume (veh/h)	0	317	462	0	72	29
Future Volume (Veh/h)	0	317	462	0	72	29
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)	0	345	502	0	78	32
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)					5	
Median type		None	None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	502			674	251	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	502			674	251	
tC, single (s)	4.1			6.9	7.0	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.4	
p0 queue free %	100			80	96	
cM capacity (veh/h)	1073			383	734	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	172	172	251	251	110	
Volume Left	0	0	0	0	78	
Volume Right	0	0	0	0	32	
cSH	1700	1700	1700	1700	541	
Volume to Capacity	0.10	0.10	0.15	0.15	0.20	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	6.0	
Control Delay (s)	0.0	0.0	0.0	0.0	14.8	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		14.8	
Approach LOS					B	
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization		24.9%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
210: QEW WB Off-Ramp & Lyons Creek Rd (RR 47)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑	↑
Traffic Volume (veh/h)	373	0	0	773	163	366
Future Volume (Veh/h)	373	0	0	773	163	366
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)	405	0	0	840	177	398
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)					6	
Median type	None		None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		405		825	202	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		405		825	202	
tC, single (s)		4.1		6.9	6.9	
tC, 2 stage (s)						
tF (s)		2.2		3.6	3.3	
p0 queue free %		100		42	51	
cM capacity (veh/h)		1165		303	808	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	202	202	420	420	575	
Volume Left	0	0	0	0	177	
Volume Right	0	0	0	0	398	
cSH	1700	1700	1700	1700	984	
Volume to Capacity	0.12	0.12	0.25	0.25	0.58	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	31.3	
Control Delay (s)	0.0	0.0	0.0	0.0	19.4	
Lane LOS					C	
Approach Delay (s)	0.0		0.0		19.4	
Approach LOS					C	
Intersection Summary						
Average Delay		6.1				
Intersection Capacity Utilization		42.5%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
211: Lyons Creek Rd (RR 47) & Stanley Ave (RR 102)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↑	↑	↓		↑	↑
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	108	208	147	40	66	191
Future Volume (vph)	108	208	147	40	66	191
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	117	226	160	43	72	208
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total (vph)	117	226	203	72	208	
Volume Left (vph)	117	0	0	72	0	
Volume Right (vph)	0	0	43	0	208	
Hadj (s)	0.50	0.22	-0.09	0.55	-0.60	
Departure Headway (s)	6.0	5.7	5.4	6.5	5.3	
Degree Utilization, x	0.20	0.36	0.31	0.13	0.31	
Capacity (veh/h)	568	602	629	524	634	
Control Delay (s)	9.3	10.8	10.8	9.2	9.5	
Approach Delay (s)	10.3		10.8	9.4		
Approach LOS	B		B	A		
<b>Intersection Summary</b>						
Delay				10.1		
Level of Service				B		
Intersection Capacity Utilization		31.5%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
212: Marineland Parkway & Portage Road

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑	↑	↑	↑
Traffic Volume (veh/h)	20	443	392	91	102	27
Future Volume (Veh/h)	20	443	392	91	102	27
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)	22	482	426	99	111	29
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh						
Upstream signal (m)		383				
pX, platoon unblocked						
vC, conflicting volume	426			711	213	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	426			711	213	
tC, single (s)	4.1			6.9	7.0	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	98			69	96	
cM capacity (veh/h)	1144			358	786	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	SB 1
Volume Total	183	321	213	213	99	111
Volume Left	22	0	0	0	0	111
Volume Right	0	0	0	0	99	0
cSH	1144	1700	1700	1700	1700	358
Volume to Capacity	0.02	0.19	0.13	0.13	0.06	0.31
Queue Length 95th (m)	0.5	0.0	0.0	0.0	0.0	10.3
Control Delay (s)	1.1	0.0	0.0	0.0	0.0	19.5
Lane LOS	A				C	A
Approach Delay (s)	0.4		0.0			17.5
Approach LOS					C	
Intersection Summary						
Average Delay			2.3			
Intersection Capacity Utilization		41.8%		ICU Level of Service		A
Analysis Period (min)			15			

## Queues

## 101: Montrose Rd (RR 98) &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	84	727	26	97	1064	29	95	228	332	191
v/c Ratio	0.60	0.66	0.05	0.29	0.73	0.08	0.17	0.36	0.80	0.33
Control Delay	43.0	24.2	0.2	11.9	17.2	18.3	18.6	4.8	38.9	15.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.0	24.2	0.2	11.9	17.2	18.3	18.6	4.8	38.9	15.8
Queue Length 50th (m)	9.9	46.0	0.0	6.5	54.1	2.6	8.7	0.0	39.6	13.5
Queue Length 95th (m)	#32.5	74.0	0.0	15.5	86.3	9.6	23.0	15.1	#99.1	35.5
Internal Link Dist (m)	400.1			107.9			106.0			116.6
Turn Bay Length (m)	50.0	25.0		50.0	50.0				50.0	
Base Capacity (vph)	214	1686	801	382	2184	546	810	808	590	799
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.43	0.03	0.25	0.49	0.05	0.12	0.28	0.56	0.24

## Intersection Summary

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

Queue shown is maximum after two cycles.

## Queues

Thundering Waters Secondary Plan  
102: Niagara Square Dr/QEW EB Off-Ramp & McLeod Rd (RR 49)

Existing Summer



Lane Group	EBT	WBL	WBT	SBL	SBT	SBR
Lane Group Flow (vph)	1412	102	859	254	259	214
v/c Ratio	0.76	0.31	0.50	0.61	0.63	0.45
Control Delay	21.5	9.7	11.4	29.4	30.0	14.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.5	9.7	11.4	29.4	30.0	14.1
Queue Length 50th (m)	57.4	5.1	32.8	32.9	33.7	11.3
Queue Length 95th (m)	95.1	14.9	62.3	58.6	60.1	29.6
Internal Link Dist (m)	110.1		0.1		64.8	
Turn Bay Length (m)						
Base Capacity (vph)	2315	355	2207	757	752	784
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	0.61	0.29	0.39	0.34	0.34	0.27
Intersection Summary						



Lane Group	EBT	WBT	NBL	NBR
Lane Group Flow (vph)	1586	890	150	70
v/c Ratio	0.75	0.42	0.25	0.27
Control Delay	12.3	6.7	17.3	18.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	12.3	6.7	17.3	18.0
Queue Length 50th (m)	58.3	22.9	5.8	5.1
Queue Length 95th (m)	#114.1	36.1	12.1	15.0
Internal Link Dist (m)	48.6	24.7	55.4	
Turn Bay Length (m)				
Base Capacity (vph)	2118	2139	1092	482
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.75	0.42	0.14	0.15

#### Intersection Summary

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

Queue shown is maximum after two cycles.

Queues  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan

Existing Summer

Lane Group	EBL	EBT	EBC	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	34	905	405	271	1053	390	24	295	20	102
v/c Ratio	0.23	0.86	0.65	0.85	0.67	1.08	0.05	0.46	0.05	0.21
Control Delay	23.5	34.0	14.1	38.4	17.6	101.4	20.5	5.5	20.7	10.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.5	34.0	14.1	38.4	17.6	101.4	20.5	5.5	20.7	10.6
Queue Length 50th (m)	3.8	68.7	19.3	20.9	62.1	~73.0	2.7	0.0	2.3	4.0
Queue Length 95th (m)	11.3	92.7	50.0	#62.7	83.2	#126.0	8.2	17.6	7.3	15.4
Internal Link Dist (m)		68.8			591.8		285.8			170.6
Turn Bay Length (m)	50.0		25.0	50.0		50.0				15.0
Base Capacity (vph)	159	1142	658	319	1662	360	491	645	397	481
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.79	0.62	0.85	0.63	1.08	0.05	0.46	0.05	0.21

Intersection Summary

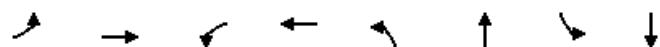
- ~ Volume exceeds capacity, queue is theoretically infinite.
- Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
- Queue shown is maximum after two cycles.

## Queues

105: Dorchester Rd &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	302	825	46	836	250	186	109	442
v/c Ratio	0.78	0.62	0.16	1.02	1.08	0.38	0.23	0.91
Control Delay	36.1	26.3	16.1	75.0	108.1	27.1	18.7	48.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.1	26.3	16.1	75.0	108.1	27.1	18.7	48.9
Queue Length 50th (m)	40.7	71.6	4.5	~99.2	~39.6	26.1	13.0	63.7
Queue Length 95th (m)	#78.2	102.1	11.1	#151.1	#94.0	47.3	24.9	#120.1
Internal Link Dist (m)		591.8		1022.3		794.5		294.8
Turn Bay Length (m)	50.0		50.0		50.0		50.0	
Base Capacity (vph)	451	1322	535	816	231	556	486	589
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.62	0.09	1.02	1.08	0.33	0.22	0.75

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

## Queues

## 106: Drummond Rd &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	788	816	89	82	136	336
v/c Ratio	0.75	0.51	0.56	0.20	0.48	0.67
Control Delay	15.6	9.4	35.5	18.3	26.9	17.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.6	9.4	35.5	18.3	26.9	17.2
Queue Length 50th (m)	28.0	23.0	8.3	6.0	12.5	13.3
Queue Length 95th (m)	66.7	50.0	24.5	17.6	31.2	42.2
Internal Link Dist (m)	1022.3	574.4		805.6		271.9
Turn Bay Length (m)			25.0		25.0	
Base Capacity (vph)	1417	1623	442	1083	778	1049
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	0.56	0.50	0.20	0.08	0.17	0.32

## Intersection Summary

## Queues

Thundering Waters Secondary Plan  
107: Thundering Waters Blvd/Stanley Ave (RR 102) & McLeod Rd (RR 49)/Marine Landing Parkway (RR 49)

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	67	386	3	5	513	265	22	8	214	78
v/c Ratio	0.16	0.30	0.00	0.02	0.51	0.43	0.08	0.03	0.48	0.17
Control Delay	12.3	13.6	0.0	22.8	22.8	6.2	33.5	25.4	26.3	8.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.3	13.6	0.0	22.8	22.8	6.2	33.5	25.4	26.3	8.2
Queue Length 50th (m)	3.0	11.4	0.0	0.4	23.5	0.0	2.1	0.3	18.7	0.3
Queue Length 95th (m)	14.4	34.6	0.0	3.5	60.4	18.6	11.1	4.8	56.3	11.0
Internal Link Dist (m)	286.8			112.7			84.4			144.0
Turn Bay Length (m)	50.0	50.0		25.0	50.0		25.0			
Base Capacity (vph)	508	2528	1193	582	2096	1006	992	948	945	899
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.15	0.00	0.01	0.24	0.26	0.02	0.01	0.23	0.09
Intersection Summary										

## Queues

108: Stanley Ave (RR 102) &amp; Marine Land Pkwy (RR 49)

Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	443	164	30	378	322	29
v/c Ratio	0.42	0.30	0.12	0.35	0.39	0.07
Control Delay	10.0	3.7	9.3	9.5	11.3	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.0	3.7	9.3	9.5	11.3	5.1
Queue Length 50th (m)	9.1	0.0	1.1	7.6	6.8	0.0
Queue Length 95th (m)	18.8	7.6	4.9	16.1	15.3	3.5
Internal Link Dist (m)	116.7			308.8	44.6	
Turn Bay Length (m)		75.0	50.0			50.0
Base Capacity (vph)	3090	1283	723	3120	2884	1425
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	0.14	0.13	0.04	0.12	0.11	0.02

Intersection Summary

Queues  
110: Montrose Rd (RR 98) & Niagara Square Dr

Thundering Waters Secondary Plan

Existing Summer



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	205	287	132
v/c Ratio	0.22	0.30	0.13
Control Delay	7.6	8.1	7.2
Queue Delay	0.0	0.0	0.0
Total Delay	7.6	8.1	7.2
Queue Length 50th (m)	3.0	4.6	2.0
Queue Length 95th (m)	6.5	8.7	4.5
Internal Link Dist (m)	49.1	58.4	37.6
Turn Bay Length (m)			
Base Capacity (vph)	2614	2009	2109
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.08	0.14	0.06
Intersection Summary			

Queues  
111: Oakwood Dr & Walmart North Driveway

Thundering Waters Secondary Plan

Existing Summer

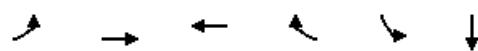


Lane Group	EBL	NBT	SBT
Lane Group Flow (vph)	357	251	586
v/c Ratio	0.65	0.26	0.55
Control Delay	16.9	11.5	9.0
Queue Delay	0.0	0.0	0.0
Total Delay	16.9	11.5	9.0
Queue Length 50th (m)	17.5	6.1	8.8
Queue Length 95th (m)	42.9	15.3	23.5
Internal Link Dist (m)	93.2	106.2	285.8
Turn Bay Length (m)			
Base Capacity (vph)	1191	2948	2780
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.30	0.09	0.21
Intersection Summary			

Queues  
112: Oakwood Dr & Walmart South Driveway

Thundering Waters Secondary Plan

Existing Summer

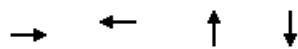


Lane Group	EBL	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	48	148	101	26	125	66
v/c Ratio	0.07	0.17	0.15	0.04	0.16	0.06
Control Delay	5.3	8.9	14.5	0.1	13.7	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.3	8.9	14.5	0.1	13.7	0.1
Queue Length 50th (m)	1.6	6.9	4.5	0.0	2.8	0.0
Queue Length 95th (m)	4.7	15.0	17.1	0.0	9.7	0.0
Internal Link Dist (m)		44.3	88.7			69.4
Turn Bay Length (m)	25.0					
Base Capacity (vph)	834	1701	1171	1051	2455	1355
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	0.06	0.09	0.09	0.02	0.05	0.05
Intersection Summary						

## Queues

Thundering Waters Secondary Plan  
113: Montrose Rd (RR 98) & Biggar Rd/Lyons Creek Rd (RR 47)

Existing Summer



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	82	656	516	373
v/c Ratio	0.12	1.10	0.82	1.21
Control Delay	12.2	92.3	29.2	150.1
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	12.2	92.3	29.2	150.1
Queue Length 50th (m)	7.0	~124.7	55.7	~76.5
Queue Length 95th (m)	14.8	#191.0	#112.9	#131.0
Internal Link Dist (m)	248.1	307.0	202.0	905.4
Turn Bay Length (m)				
Base Capacity (vph)	666	594	633	307
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.12	1.10	0.82	1.21

## Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
- Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
- Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
101: Montrose Rd (RR 98) & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑		↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	85	667	26	93	516	238	49	70	134	231	111	58
Future Volume (vph)	85	667	26	93	516	238	49	70	134	231	111	58
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.3	6.3	6.3	3.0	6.3		6.3	6.3	6.3	6.3	6.3	6.3
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	0.99		1.00	1.00	0.99	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Fr <sub>t</sub>	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1552	3260	1466	1646	3061		1628	1750	1383	1642	1563	
Flt Permitted	0.34	1.00	1.00	0.25	1.00		0.64	1.00	1.00	0.71	1.00	
Satd. Flow (perm)	559	3260	1466	439	3061		1100	1750	1383	1223	1563	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	725	28	101	561	259	53	76	146	251	121	63
RTOR Reduction (vph)	0	0	19	0	65	0	0	0	100	0	22	0
Lane Group Flow (vph)	92	725	9	101	755	0	53	76	46	251	162	0
Confl. Peds. (#/hr)	5		5	5		5	2		5	5		2
Heavy Vehicles (%)	7%	2%	0%	1%	3%	2%	2%	0%	6%	1%	4%	9%
Turn Type	Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4			3	8			2			6
Permitted Phases	4			4	8			2		2	6	
Actuated Green, G (s)	19.4	19.4	19.4	27.8	27.8		18.4	18.4	18.4	18.4	18.4	
Effective Green, g (s)	19.4	19.4	19.4	27.8	27.8		18.4	18.4	18.4	18.4	18.4	
Actuated g/C Ratio	0.33	0.33	0.33	0.47	0.47		0.31	0.31	0.31	0.31	0.31	
Clearance Time (s)	6.3	6.3	6.3	3.0	6.3		6.3	6.3	6.3	6.3	6.3	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	184	1075	483	318	1447		344	547	432	382	489	
v/s Ratio Prot		c0.22		0.03	c0.25			0.04			0.10	
v/s Ratio Perm	0.16		0.01	0.12			0.05		0.03	c0.21		
v/c Ratio	0.50	0.67	0.02	0.32	0.52		0.15	0.14	0.11	0.66	0.33	
Uniform Delay, d1	15.8	17.0	13.3	9.2	10.8		14.6	14.5	14.4	17.5	15.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.6	1.5	0.0	0.4	0.3		0.2	0.1	0.1	3.6	0.3	
Delay (s)	17.4	18.5	13.3	9.7	11.1		14.7	14.6	14.4	21.1	15.8	
Level of Service	B	B	B	A	B		B	B	B	C	B	
Approach Delay (s)		18.2			10.9			14.5			18.8	
Approach LOS		B			B			B			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		15.2			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.65										
Actuated Cycle Length (s)		58.8			Sum of lost time (s)			15.6				
Intersection Capacity Utilization		78.7%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												

## HCM Signalized Intersection Capacity Analysis

## 102: Niagara Square Dr/QEW EB Off-Ramp &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑		↑	↑↑					↑	↑	↑
Traffic Volume (vph)	0	749	28	128	494	0	0	0	0	337	54	217
Future Volume (vph)	0	749	28	128	494	0	0	0	0	337	54	217
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		6.0		3.0	6.0					6.0	6.0	6.0
Lane Util. Factor		0.91		1.00	0.95					0.95	0.95	1.00
Frpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00
Flpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00
Fr <sub>t</sub>		0.99		1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00		0.95	1.00					0.95	0.97	1.00
Satd. Flow (prot)		4704		1662	3228					1564	1563	1488
Flt Permitted		1.00		0.25	1.00					0.95	0.97	1.00
Satd. Flow (perm)		4704		436	3228					1564	1563	1488
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	814	30	139	537	0	0	0	0	366	59	236
RTOR Reduction (vph)	0	5	0	0	0	0	0	0	0	0	0	172
Lane Group Flow (vph)	0	839	0	139	537	0	0	0	0	212	213	64
Confl. Peds. (#/hr)	7		4	4		7						
Heavy Vehicles (%)	0%	1%	0%	0%	3%	0%	0%	0%	0%	1%	7%	0%
Turn Type	NA		pm+pt	NA						Perm	NA	Perm
Protected Phases	4		3	8							6	
Permitted Phases			8								6	
Actuated Green, G (s)	16.0		25.3	25.3						14.0	14.0	14.0
Effective Green, g (s)	16.0		25.3	25.3						14.0	14.0	14.0
Actuated g/C Ratio	0.31		0.49	0.49						0.27	0.27	0.27
Clearance Time (s)	6.0		3.0	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)	1467		365	1591						426	426	406
v/s Ratio Prot	c0.18		c0.05	0.17								
v/s Ratio Perm			0.14							0.14	0.14	0.04
v/c Ratio	0.57		0.38	0.34						0.50	0.50	0.16
Uniform Delay, d1	14.8		7.4	7.9						15.7	15.7	14.2
Progression Factor	1.00		1.00	1.00						1.00	1.00	1.00
Incremental Delay, d2	0.5		0.7	0.1						0.9	0.9	0.2
Delay (s)	15.3		8.1	8.0						16.6	16.6	14.4
Level of Service	B		A	A						B	B	B
Approach Delay (s)	15.3			8.0			0.0				15.8	
Approach LOS		B		A			A				B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay	13.2			HCM 2000 Level of Service						B		
HCM 2000 Volume to Capacity ratio	0.51											
Actuated Cycle Length (s)	51.3			Sum of lost time (s)						15.0		
Intersection Capacity Utilization	50.2%			ICU Level of Service						A		
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
103: QEW WB Off-Ramp & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑↑↑	↑
Traffic Volume (vph)	900	0	0	567	78	94
Future Volume (vph)	900	0	0	567	78	94
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	0.95			0.95	0.97	0.91
Frt	1.00			1.00	0.95	0.85
Flt Protected	1.00			1.00	0.97	1.00
Satd. Flow (prot)	3260			3260	3020	1327
Flt Permitted	1.00			1.00	0.97	1.00
Satd. Flow (perm)	3260			3260	3020	1327
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	978	0	0	616	85	102
RTOR Reduction (vph)	0	0	0	0	35	48
Lane Group Flow (vph)	978	0	0	616	93	11
Heavy Vehicles (%)	2%	0%	0%	2%	4%	2%
Turn Type	NA			NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases						2
Actuated Green, G (s)	22.4			22.4	7.6	7.6
Effective Green, g (s)	22.4			22.4	7.6	7.6
Actuated g/C Ratio	0.53			0.53	0.18	0.18
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	1738			1738	546	240
v/s Ratio Prot	c0.30			0.19	c0.03	
v/s Ratio Perm						0.01
v/c Ratio	0.56			0.35	0.17	0.04
Uniform Delay, d1	6.5			5.6	14.5	14.2
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	0.4			0.1	0.1	0.1
Delay (s)	7.0			5.8	14.7	14.3
Level of Service	A			A	B	B
Approach Delay (s)	7.0			5.8	14.6	
Approach LOS	A			A	B	
Intersection Summary						
HCM 2000 Control Delay		7.3		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio		0.46				
Actuated Cycle Length (s)		42.0		Sum of lost time (s)		12.0
Intersection Capacity Utilization		42.0%		ICU Level of Service		A
Analysis Period (min)		15				
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑		↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	27	741	502	293	717	35	519	15	342	16	3	24
Future Volume (vph)	27	741	502	293	717	35	519	15	342	16	3	24
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.0	8.0	8.0	3.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.99	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Fr <sub>t</sub>	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1662	3292	1450	1630	3240		1625	1750	1451	1658	1443	
Flt Permitted	0.34	1.00	1.00	0.20	1.00		0.74	1.00	1.00	0.75	1.00	
Satd. Flow (perm)	601	3292	1450	350	3240		1263	1750	1451	1304	1443	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	805	546	318	779	38	564	16	372	17	3	26
RTOR Reduction (vph)	0	0	250	0	5	0	0	0	214	0	18	0
Lane Group Flow (vph)	29	805	296	318	812	0	564	16	158	17	11	0
Confl. Peds. (#/hr)			4	4			3		3	3		3
Heavy Vehicles (%)	0%	1%	1%	2%	2%	0%	2%	0%	1%	0%	0%	4%
Turn Type	Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4			3	8			2			6
Permitted Phases	4			4	8			2		2	6	
Actuated Green, G (s)	24.1	24.1	24.1	36.6	36.6		24.1	24.1	24.1	24.1	24.1	
Effective Green, g (s)	24.1	24.1	24.1	36.6	36.6		24.1	24.1	24.1	24.1	24.1	
Actuated g/C Ratio	0.31	0.31	0.31	0.48	0.48		0.31	0.31	0.31	0.31	0.31	
Clearance Time (s)	8.0	8.0	8.0	3.0	8.0		8.0	8.0	8.0	8.0	8.0	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	188	1034	455	325	1546		396	549	455	409	453	
v/s Ratio Prot		0.24		c0.12	0.25			0.01			0.01	
v/s Ratio Perm	0.05		0.20	c0.35			c0.45		0.11	0.01		
v/c Ratio	0.15	0.78	0.65	0.98	0.53		1.42	0.03	0.35	0.04	0.02	
Uniform Delay, d1	19.0	23.9	22.7	15.1	14.0		26.3	18.2	20.2	18.3	18.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	3.6	3.0	43.6	0.2		205.1	0.0	0.3	0.0	0.0	
Delay (s)	19.2	27.5	25.7	58.6	14.2		231.4	18.2	20.6	18.3	18.2	
Level of Service	B	C	C	E	B		F	B	C	B	B	
Approach Delay (s)		26.6			26.7			145.4			18.2	
Approach LOS		C			C			F			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		58.7				HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio		1.21										
Actuated Cycle Length (s)		76.7				Sum of lost time (s)			19.0			
Intersection Capacity Utilization		94.6%				ICU Level of Service			F			
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
105: Dorchester Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↓		↑	↑↓		↑	↑		↑	↑	
Traffic Volume (vph)	340	791	138	81	659	121	245	164	62	143	119	336
Future Volume (vph)	340	791	138	81	659	121	245	164	62	143	119	336
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	0.99		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		0.99	1.00	
Fr <sub>t</sub>	1.00	0.98		1.00	0.98		1.00	0.96		1.00	0.89	
Fl <sub>t</sub> Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1599	3173		1629	3193		1629	1642		1618	1512	
Fl <sub>t</sub> Permitted	0.14	1.00		0.22	1.00		0.14	1.00		0.51	1.00	
Satd. Flow (perm)	243	3173		380	3193		238	1642		869	1512	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	370	860	150	88	716	132	266	178	67	155	129	365
RTOR Reduction (vph)	0	10	0	0	14	0	0	13	0	0	99	0
Lane Group Flow (vph)	370	1000	0	88	834	0	266	232	0	155	395	0
Confl. Peds. (#/hr)			9	9			10		23	23		10
Heavy Vehicles (%)	4%	2%	1%	2%	2%	0%	2%	1%	2%	2%	2%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	49.1	39.4		31.4	24.7		37.8	28.8		37.0	28.4	
Effective Green, g (s)	49.1	39.4		31.4	24.7		37.8	28.8		37.0	28.4	
Actuated g/C Ratio	0.48	0.38		0.31	0.24		0.37	0.28		0.36	0.28	
Clearance Time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	
Vehicle Extension (s)	2.5	2.2		2.5	2.2		2.5	2.2		2.5	2.2	
Lane Grp Cap (vph)	399	1218		197	768		209	460		376	418	
v/s Ratio Prot	c0.19	0.31		0.03	c0.26		c0.11	0.14		0.03	0.26	
v/s Ratio Perm	0.25			0.11			c0.36			0.11		
v/c Ratio	0.93	0.82		0.45	1.09		1.27	0.50		0.41	0.94	
Uniform Delay, d1	28.0	28.4		26.3	38.9		27.4	30.9		23.3	36.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	27.3	4.4		1.2	58.1		154.6	0.4		0.5	30.0	
Delay (s)	55.3	32.8		27.5	97.1		182.0	31.4		23.8	66.3	
Level of Service	E	C		C	F		F	C		C	E	
Approach Delay (s)		38.8			90.5			109.8			56.2	
Approach LOS		D			F			F			E	

Intersection Summary

HCM 2000 Control Delay 66.4 HCM 2000 Level of Service E

HCM 2000 Volume to Capacity ratio 1.13

Actuated Cycle Length (s) 102.6 Sum of lost time (s) 19.1

Intersection Capacity Utilization 106.7% ICU Level of Service G

Analysis Period (min) 15

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
106: Drummond Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	231	498	62	5	451	128	58	44	13	148	60	234
Future Volume (vph)	231	498	62	5	451	128	58	44	13	148	60	234
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)												
Lane Util. Factor												
Frpb, ped/bikes												
Flpb, ped/bikes												
Fr <sub>t</sub>												
Fl <sub>t</sub> Protected												
Satd. Flow (prot)												
Fl <sub>t</sub> Permitted												
Satd. Flow (perm)												
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	251	541	67	5	490	139	63	48	14	161	65	254
RTOR Reduction (vph)	0	5	0	0	16	0	0	11	0	0	201	0
Lane Group Flow (vph)	0	854	0	0	618	0	63	51	0	161	118	0
Confl. Peds. (#/hr)	5		6	6		5	7		5	5		7
Heavy Vehicles (%)	2%	3%	3%	0%	3%	2%	2%	2%	0%	1%	0%	2%
Turn Type	custom	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	7		8			2			6			
Actuated Green, G (s)	40.2				40.2		13.9	13.9		13.9	13.9	
Effective Green, g (s)	40.2				40.2		13.9	13.9		13.9	13.9	
Actuated g/C Ratio	0.61				0.61		0.21	0.21		0.21	0.21	
Clearance Time (s)	6.1				6.1		6.1	6.1		6.1	6.1	
Vehicle Extension (s)	3.0				3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	1258				1789		127	347		259	313	
v/s Ratio Prot								0.03			0.08	
v/s Ratio Perm	c0.41				0.21		0.10			c0.13		
v/c Ratio	0.68				0.35		0.50	0.15		0.62	0.38	
Uniform Delay, d1	8.7				6.5		23.1	21.4		23.8	22.5	
Progression Factor	1.00				1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.5				0.1		3.0	0.2		4.6	0.8	
Delay (s)	10.2				6.6		26.1	21.6		28.4	23.3	
Level of Service	B				A		C	C		C	C	
Approach Delay (s)	10.2				6.6			23.9			25.0	
Approach LOS	B				A			C			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay	13.3				HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio	0.70											
Actuated Cycle Length (s)	66.3				Sum of lost time (s)			15.2				
Intersection Capacity Utilization	89.9%				ICU Level of Service			E				
Analysis Period (min)	15											
c Critical Lane Group												

# HCM Signalized Intersection Capacity Analysis

107: Thundering Waters Blvd/Stanley Ave (RR 102) & McLeod Rd (RR 49)/Marine Landing Parkway (RR 49)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑	↑	↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	54	479	12	7	425	189	11	7	9	226	10	67
Future Volume (vph)	54	479	12	7	425	189	11	7	9	226	10	67
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Fr <sub>t</sub>	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.92	1.00	0.87		
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (prot)	1568	3292	1488	1662	3325	1399	1662	1604	1583	1455		
Flt Permitted	0.38	1.00	1.00	0.46	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (perm)	634	3292	1488	804	3325	1399	1662	1604	1583	1455		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	59	521	13	8	462	205	12	8	10	246	11	73
RTOR Reduction (vph)	0	0	8	0	0	152	0	10	0	0	52	0
Lane Group Flow (vph)	59	521	5	8	462	53	12	8	0	246	32	0
Confl. Peds. (#/hr)	1					1	1					1
Heavy Vehicles (%)	6%	1%	0%	0%	0%	5%	0%	0%	0%	5%	0%	4%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Split	NA		Split	NA	
Protected Phases	7	4			8		2	2		6	6	
Permitted Phases	4		4	8		8						
Actuated Green, G (s)	23.0	23.0	23.0	15.9	15.9	15.9	2.3	2.3	17.6	17.6		
Effective Green, g (s)	23.0	23.0	23.0	15.9	15.9	15.9	2.3	2.3	17.6	17.6		
Actuated g/C Ratio	0.38	0.38	0.38	0.26	0.26	0.26	0.04	0.04	0.29	0.29		
Clearance Time (s)	3.0	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1		
Vehicle Extension (s)	2.3	2.5	2.5	2.5	2.5	2.5	4.0	4.0	4.0	4.0		
Lane Grp Cap (vph)	300	1237	559	208	863	363	62	60	455	418		
v/s Ratio Prot	0.01	c0.16			c0.14		c0.01	0.01	c0.16	0.02		
v/s Ratio Perm	0.06		0.00	0.01		0.04						
v/c Ratio	0.20	0.42	0.01	0.04	0.54	0.15	0.19	0.14	0.54	0.08		
Uniform Delay, d1	12.5	14.2	12.0	16.9	19.5	17.4	28.6	28.5	18.4	15.9		
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2	0.2	0.2	0.0	0.1	0.5	0.1	2.1	1.5	1.6	0.1		
Delay (s)	12.7	14.3	12.0	17.0	20.0	17.6	30.6	29.9	20.0	16.0		
Level of Service	B	B	B	B	B	B	C	C	C	B		
Approach Delay (s)		14.1			19.2			30.2		19.0		
Approach LOS		B			B			C		B		
<b>Intersection Summary</b>												
HCM 2000 Control Delay		17.5			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.51										
Actuated Cycle Length (s)		61.2			Sum of lost time (s)			21.3				
Intersection Capacity Utilization		56.7%			ICU Level of Service			B				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
108: Stanley Ave (RR 102) & Marine Land Pkwy (RR 49)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↖	↖	↑↑	↖↖	↖
Traffic Volume (vph)	613	116	31	464	117	47
Future Volume (vph)	613	116	31	464	117	47
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.5	6.5	6.5	6.5	6.1	6.1
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00
Frpb, ped/bikes	1.00	0.99	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Fr <sub>t</sub>	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3228	1386	1662	3228	3101	1488
Flt Permitted	1.00	1.00	0.40	1.00	0.95	1.00
Satd. Flow (perm)	3228	1386	697	3228	3101	1488
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	666	126	34	504	127	51
RTOR Reduction (vph)	0	67	0	0	0	42
Lane Group Flow (vph)	666	59	34	504	127	9
Confl. Peds. (#/hr)		1	1		1	
Heavy Vehicles (%)	3%	6%	0%	3%	4%	0%
Turn Type	NA	Perm	Perm	NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	16.9	16.9	16.9	16.9	6.4	6.4
Effective Green, g (s)	16.9	16.9	16.9	16.9	6.4	6.4
Actuated g/C Ratio	0.47	0.47	0.47	0.47	0.18	0.18
Clearance Time (s)	6.5	6.5	6.5	6.5	6.1	6.1
Vehicle Extension (s)	2.9	2.9	2.9	2.9	2.8	2.8
Lane Grp Cap (vph)	1519	652	328	1519	552	265
v/s Ratio Prot	c0.21			0.16	c0.04	
v/s Ratio Perm		0.04	0.05		0.01	
v/c Ratio	0.44	0.09	0.10	0.33	0.23	0.03
Uniform Delay, d1	6.3	5.3	5.3	6.0	12.6	12.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.1	0.1	0.1	0.2	0.0
Delay (s)	6.5	5.3	5.4	6.1	12.8	12.2
Level of Service	A	A	A	A	B	B
Approach Delay (s)	6.3			6.0	12.7	
Approach LOS	A			A	B	
Intersection Summary						
HCM 2000 Control Delay		7.0		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio		0.38				
Actuated Cycle Length (s)		35.9		Sum of lost time (s)		12.6
Intersection Capacity Utilization		45.1%		ICU Level of Service		A
Analysis Period (min)		15				
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis  
110: Montrose Rd (RR 98) & Niagara Square Dr

Thundering Waters Secondary Plan  
Existing Summer

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↑↑		↑↑			↑↑
Traffic Volume (vph)	131	79	174	0	0	230
Future Volume (vph)	131	79	174	0	0	230
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	5.2		5.5			5.5
Lane Util. Factor	0.97		0.95			0.95
Fr <sub>t</sub>	0.94		1.00			1.00
Flt Protected	0.97		1.00			1.00
Satd. Flow (prot)	3045		3260			3260
Flt Permitted	0.97		1.00			1.00
Satd. Flow (perm)	3045		3260			3260
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	142	86	189	0	0	250
RTOR Reduction (vph)	66	0	0	0	0	0
Lane Group Flow (vph)	162	0	189	0	0	250
Heavy Vehicles (%)	2%	2%	2%	0%	0%	2%
Turn Type	Prot		NA			NA
Protected Phases	6		8			
Permitted Phases						4
Actuated Green, G (s)	6.5		11.3			11.3
Effective Green, g (s)	6.5		11.3			11.3
Actuated g/C Ratio	0.23		0.40			0.40
Clearance Time (s)	5.2		5.5			5.5
Vehicle Extension (s)	2.1		2.3			2.3
Lane Grp Cap (vph)	694		1292			1292
v/s Ratio Prot	c0.05		0.06			
v/s Ratio Perm						c0.08
v/c Ratio	0.23		0.15			0.19
Uniform Delay, d1	9.0		5.5			5.6
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	0.1		0.0			0.0
Delay (s)	9.0		5.5			5.7
Level of Service	A		A			A
Approach Delay (s)	9.0		5.5			5.7
Approach LOS	A		A			A
<b>Intersection Summary</b>						
HCM 2000 Control Delay		6.8	HCM 2000 Level of Service		A	
HCM 2000 Volume to Capacity ratio		0.21				
Actuated Cycle Length (s)		28.5	Sum of lost time (s)		10.7	
Intersection Capacity Utilization		22.6%	ICU Level of Service		A	
Analysis Period (min)		15				
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis  
111: Oakwood Dr & Walmart North Driveway

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↑↑	↑↑	
Traffic Volume (vph)	378	12	2	259	263	388
Future Volume (vph)	378	12	2	259	263	388
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.3			7.0	7.0	
Lane Util. Factor	1.00			0.95	0.95	
Frt	1.00			1.00	0.91	
Flt Protected	0.95			1.00	1.00	
Satd. Flow (prot)	1662			3197	2980	
Flt Permitted	0.95			0.95	1.00	
Satd. Flow (perm)	1662			3025	2980	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	411	13	2	282	286	422
RTOR Reduction (vph)	1	0	0	0	299	0
Lane Group Flow (vph)	423	0	0	284	409	0
Heavy Vehicles (%)	0%	0%	0%	4%	4%	0%
Turn Type	Prot		Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Actuated Green, G (s)	14.8			11.6	11.6	
Effective Green, g (s)	14.8			11.6	11.6	
Actuated g/C Ratio	0.37			0.29	0.29	
Clearance Time (s)	6.3			7.0	7.0	
Vehicle Extension (s)	2.2			2.2	2.2	
Lane Grp Cap (vph)	619			883	870	
v/s Ratio Prot	c0.25			c0.14		
v/s Ratio Perm			0.09			
v/c Ratio	0.68			0.32	0.47	
Uniform Delay, d1	10.5			11.0	11.5	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	2.6			0.1	0.2	
Delay (s)	13.1			11.1	11.7	
Level of Service	B			B	B	
Approach Delay (s)	13.1			11.1	11.7	
Approach LOS	B			B	B	
<b>Intersection Summary</b>						
HCM 2000 Control Delay	12.0			HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.59					
Actuated Cycle Length (s)	39.7			Sum of lost time (s)	13.3	
Intersection Capacity Utilization	56.1%			ICU Level of Service	B	
Analysis Period (min)	15					
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis  
112: Oakwood Dr & Walmart South Driveway

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑		↑	↑	↑	↑	↔		↑	↑	
Traffic Volume (vph)	59	63	0	0	95	36	0	0	0	190	0	75
Future Volume (vph)	59	63	0	0	95	36	0	0	0	190	0	75
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	7.5			7.5	7.5				7.5	7.5	
Lane Util. Factor	1.00	1.00			1.00	1.00				0.97	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)	1662	1716			1667	1403				3101	1488	
Flt Permitted	0.53	1.00			1.00	1.00				0.95	1.00	
Satd. Flow (perm)	936	1716			1667	1403				3101	1488	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	68	0	0	103	39	0	0	0	207	0	82
RTOR Reduction (vph)	0	0	0	0	0	30	0	0	0	0	63	0
Lane Group Flow (vph)	64	68	0	0	103	9	0	0	0	207	19	0
Heavy Vehicles (%)	0%	2%	0%	0%	5%	6%	0%	0%	0%	4%	0%	0%
Turn Type	pm+pt	NA		Perm	NA	Perm				Split	NA	
Protected Phases	7	4			8				2		6	6
Permitted Phases	4			8		8	2					
Actuated Green, G (s)	17.7	17.7			10.3	10.3				10.2	10.2	
Effective Green, g (s)	17.7	17.7			10.3	10.3				10.2	10.2	
Actuated g/C Ratio	0.41	0.41			0.24	0.24				0.24	0.24	
Clearance Time (s)	3.0	7.5			7.5	7.5				7.5	7.5	
Vehicle Extension (s)	2.4	2.2			2.2	2.2				2.2	2.2	
Lane Grp Cap (vph)	460	708			400	336				737	353	
v/s Ratio Prot	c0.01	0.04			c0.06					c0.07	0.01	
v/s Ratio Perm	0.04				0.01							
v/c Ratio	0.14	0.10			0.26	0.03				0.28	0.06	
Uniform Delay, d1	7.8	7.7			13.2	12.5				13.4	12.6	
Progression Factor	1.00	1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2	0.1	0.0			0.2	0.0				0.1	0.0	
Delay (s)	7.9	7.7			13.4	12.5				13.5	12.7	
Level of Service	A	A			B	B				B	B	
Approach Delay (s)		7.8			13.1				0.0		13.2	
Approach LOS		A			B				A		B	
Intersection Summary												
HCM 2000 Control Delay		11.9			HCM 2000 Level of Service					B		
HCM 2000 Volume to Capacity ratio		0.35										
Actuated Cycle Length (s)		42.9			Sum of lost time (s)				25.5			
Intersection Capacity Utilization		31.0%			ICU Level of Service				A			
Analysis Period (min)		15										
c Critical Lane Group												

## HCM Signalized Intersection Capacity Analysis

113: Montrose Rd (RR 98) &amp; Biggar Rd/Lyons Creek Rd (RR 47)

## Thundering Waters Secondary Plan

Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	14	36	2	25	51	79	3	137	201	93	153	15
Future Volume (vph)	14	36	2	25	51	79	3	137	201	93	153	15
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					6.3			6.3			6.3	
Lane Util. Factor		1.00				1.00			1.00		1.00	
Fr <sub>t</sub>		1.00				0.93			0.92		0.99	
Flt Protected		0.99				0.99			1.00		0.98	
Satd. Flow (prot)		1719				1603			1594		1700	
Flt Permitted		0.88				0.94			1.00		0.77	
Satd. Flow (perm)		1541				1518			1590		1337	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	39	2	27	55	86	3	149	218	101	166	16
RTOR Reduction (vph)	0	1	0	0	62	0	0	57	0	0	2	0
Lane Group Flow (vph)	0	55	0	0	106	0	0	313	0	0	281	0
Heavy Vehicles (%)	0%	0%	0%	2%	0%	1%	0%	1%	1%	1%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	11.8				11.8			17.9			17.9	
Effective Green, g (s)	11.8				11.8			17.9			17.9	
Actuated g/C Ratio	0.28				0.28			0.42			0.42	
Clearance Time (s)	6.3				6.3			6.3			6.3	
Vehicle Extension (s)	6.0				6.0			6.0			6.0	
Lane Grp Cap (vph)	429				423			672			565	
v/s Ratio Prot												
v/s Ratio Perm	0.04				c0.07			0.20			0.21	
v/c Ratio	0.13				0.25			0.47			0.50	
Uniform Delay, d1	11.4				11.8			8.8			8.9	
Progression Factor	1.00				1.00			1.00			1.00	
Incremental Delay, d2	0.4				0.9			1.4			1.9	
Delay (s)	11.8				12.7			10.2			10.8	
Level of Service	B				B			B			B	
Approach Delay (s)	11.8				12.7			10.2			10.8	
Approach LOS	B				B			B			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay	11.0				HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio	0.40											
Actuated Cycle Length (s)	42.3				Sum of lost time (s)			12.6				
Intersection Capacity Utilization	63.7%				ICU Level of Service			B				
Analysis Period (min)	15											
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis  
203: Stanley Ave (RR 102) & Ramsey Rd

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			X	X	
Traffic Volume (veh/h)	14	2	3	157	122	17
Future Volume (Veh/h)	14	2	3	157	122	17
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	2	3	171	133	18
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	319	142	151			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	319	142	151			
tC, single (s)	6.5	6.7	4.4			
tC, 2 stage (s)						
tF (s)	3.6	3.8	2.5			
p0 queue free %	98	100	100			
cM capacity (veh/h)	649	793	1261			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	17	174	151			
Volume Left	15	3	0			
Volume Right	2	0	18			
cSH	663	1261	1700			
Volume to Capacity	0.03	0.00	0.09			
Queue Length 95th (m)	0.6	0.1	0.0			
Control Delay (s)	10.6	0.2	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.6	0.2	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		0.6				
Intersection Capacity Utilization		21.6%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
204: Stanley Ave (RR 102) & Progress St

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			X	X	
Traffic Volume (veh/h)	19	7	5	145	108	11
Future Volume (Veh/h)	19	7	5	145	108	11
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	21	8	5	158	117	12
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	291	123	129			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	291	123	129			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	99	100			
cM capacity (veh/h)	691	933	1469			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	29	163	129			
Volume Left	21	5	0			
Volume Right	8	0	12			
cSH	744	1469	1700			
Volume to Capacity	0.04	0.00	0.08			
Queue Length 95th (m)	1.0	0.1	0.0			
Control Delay (s)	10.0	0.3	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.0	0.3	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		1.0				
Intersection Capacity Utilization		22.7%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
205: Stanley Ave (RR 102) & Don Murie St

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	15	6	145	110	5
Future Volume (Veh/h)	5	15	6	145	110	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	16	7	158	120	5
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	294	122	125			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	294	122	125			
tC, single (s)	6.4	6.3	4.6			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.7			
p0 queue free %	99	98	99			
cM capacity (veh/h)	697	915	1212			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	21	165	125			
Volume Left	5	7	0			
Volume Right	16	0	5			
cSH	852	1212	1700			
Volume to Capacity	0.02	0.01	0.07			
Queue Length 95th (m)	0.6	0.1	0.0			
Control Delay (s)	9.3	0.4	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.3	0.4	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay		0.8				
Intersection Capacity Utilization		23.6%		ICU Level of Service		A
Analysis Period (min)		15				

## HCM Unsignalized Intersection Capacity Analysis

206: Stanley Ave (RR 102) &amp; Dorchester Rd/Chippawa Pkwy

## Thundering Waters Secondary Plan

Existing Summer

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	4	8	30	10	13	8	20	137	5	2	119	4
Future Volume (Veh/h)	4	8	30	10	13	8	20	137	5	2	119	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)	4	9	33	11	14	9	22	149	5	2	129	4
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	346	333	131	368	332	152	133				154	
vc1, stage 1 conf vol												
vc2, stage 2 conf vol												
vCu, unblocked vol	346	333	131	368	332	152	133				154	
tC, single (s)	7.1	6.5	6.3	7.1	6.5	6.2	4.2				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.4	3.5	4.0	3.3	2.3				2.2	
p0 queue free %	99	98	96	98	98	99	98				100	
cM capacity (veh/h)	587	580	898	556	581	900	1404				1439	
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	46	34	176	135								
Volume Left	4	11	22	2								
Volume Right	33	9	5	4								
cSH	778	631	1404	1439								
Volume to Capacity	0.06	0.05	0.02	0.00								
Queue Length 95th (m)	1.5	1.4	0.4	0.0								
Control Delay (s)	9.9	11.0	1.1	0.1								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.9	11.0	1.1	0.1								
Approach LOS	A	B										
Intersection Summary												
Average Delay			2.6									
Intersection Capacity Utilization		31.0%		ICU Level of Service					A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
207: Montrose Rd (RR 98) & Chippawa Creek Rd (RR 63)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y	Y
Traffic Volume (veh/h)	36	42	12	138	189	31
Future Volume (Veh/h)	36	42	12	138	189	31
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	39	46	13	150	205	34
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	381	205	239			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	381	205	239			
tC, single (s)	6.5	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.2			
p0 queue free %	93	95	99			
cM capacity (veh/h)	598	841	1340			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	85	13	150	205	34	
Volume Left	39	13	0	0	0	
Volume Right	46	0	0	0	34	
cSH	709	1340	1700	1700	1700	
Volume to Capacity	0.12	0.01	0.09	0.12	0.02	
Queue Length 95th (m)	3.3	0.2	0.0	0.0	0.0	
Control Delay (s)	10.8	7.7	0.0	0.0	0.0	
Lane LOS	B	A				
Approach Delay (s)	10.8	0.6		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay		2.1				
Intersection Capacity Utilization		22.5%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
208: Montrose Rd (RR 98) & Oakwood Dr

Thundering Waters Secondary Plan  
Existing Summer

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		P			R
Traffic Volume (veh/h)	101	18	148	77	22	190
Future Volume (Veh/h)	101	18	148	77	22	190
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	110	20	161	84	24	207
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	458	203		245		
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	458	203		245		
tC, single (s)	6.4	6.2		4.1		
tC, 2 stage (s)						
tF (s)	3.5	3.3		2.2		
p0 queue free %	80	98		98		
cM capacity (veh/h)	551	843		1304		
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	130	245	231			
Volume Left	110	0	24			
Volume Right	20	84	0			
cSH	582	1700	1304			
Volume to Capacity	0.22	0.14	0.02			
Queue Length 95th (m)	6.8	0.0	0.4			
Control Delay (s)	13.0	0.0	1.0			
Lane LOS	B		A			
Approach Delay (s)	13.0	0.0	1.0			
Approach LOS	B					
Intersection Summary						
Average Delay		3.1				
Intersection Capacity Utilization		43.0%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
209: Lyons Creek Rd (RR 47) & QEW EB Off-Ramp

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↑	↑
Traffic Volume (veh/h)	0	301	126	0	189	225
Future Volume (Veh/h)	0	301	126	0	189	225
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)	0	327	137	0	205	245
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)					5	
Median type		None	None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	137			300	68	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	137			300	68	
tC, single (s)	4.1			6.9	6.9	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	100			69	75	
cM capacity (veh/h)	1459			664	981	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	164	164	68	68	450	
Volume Left	0	0	0	0	205	
Volume Right	0	0	0	0	245	
cSH	1700	1700	1700	1700	1458	
Volume to Capacity	0.10	0.10	0.04	0.04	0.31	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	10.6	
Control Delay (s)	0.0	0.0	0.0	0.0	11.2	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		11.2	
Approach LOS					B	
Intersection Summary						
Average Delay			5.5			
Intersection Capacity Utilization		27.1%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
210: QEW WB Off-Ramp & Lyons Creek Rd (RR 47)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑	↑
Traffic Volume (veh/h)	286	0	0	122	28	30
Future Volume (Veh/h)	286	0	0	122	28	30
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)	311	0	0	133	30	33
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)					6	
Median type	None		None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		311		378	156	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol		311		378	156	
tC, single (s)		4.1		6.9	7.0	
tC, 2 stage (s)						
tF (s)		2.2		3.6	3.3	
p0 queue free %		100		95	96	
cM capacity (veh/h)		1261		584	859	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	156	156	66	66	63	
Volume Left	0	0	0	0	30	
Volume Right	0	0	0	0	33	
cSH	1700	1700	1700	1700	1226	
Volume to Capacity	0.09	0.09	0.04	0.04	0.05	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	1.3	
Control Delay (s)	0.0	0.0	0.0	0.0	10.4	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		10.4	
Approach LOS					B	
Intersection Summary						
Average Delay		1.3				
Intersection Capacity Utilization		18.6%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis  
211: Lyons Creek Rd (RR 47) & Stanley Ave (RR 102)

Thundering Waters Secondary Plan  
Existing Summer

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↑	↑	↓		↑	↑
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	118	230	170	44	41	118
Future Volume (vph)	118	230	170	44	41	118
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	128	250	185	48	45	128
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total (vph)	128	250	233	45	128	
Volume Left (vph)	128	0	0	45	0	
Volume Right (vph)	0	0	48	0	128	
Hadj (s)	0.53	0.03	-0.09	0.53	-0.67	
Departure Headway (s)	5.8	5.3	5.1	6.5	5.3	
Degree Utilization, x	0.21	0.37	0.33	0.08	0.19	
Capacity (veh/h)	598	662	672	514	623	
Control Delay (s)	9.1	10.1	10.7	8.9	8.4	
Approach Delay (s)	9.7		10.7	8.5		
Approach LOS	A		B	A		
<b>Intersection Summary</b>						
Delay			9.7			
Level of Service			A			
Intersection Capacity Utilization		33.0%		ICU Level of Service		A
Analysis Period (min)		15				

## HCM Unsignalized Intersection Capacity Analysis

212: Marineland Parkway/Marinelane Parkway &amp; Portage Road

## Thundering Waters Secondary Plan

Existing Summer



Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations	↑↑	↑↑	↑	↑	↑	↑	
Traffic Volume (veh/h)	15	641	443	80	149	34	
Future Volume (Veh/h)	15	641	443	80	149	34	
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)	16	697	482	87	162	37	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type		None	None				
Median storage veh							
Upstream signal (m)		383					
pX, platoon unblocked							
vC, conflicting volume	482			862	241		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	482			862	241		
tC, single (s)	4.1			6.8	6.9		
tC, 2 stage (s)							
tF (s)	2.2			3.5	3.3		
p0 queue free %	99			44	95		
cM capacity (veh/h)	1091			292	766		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	SB 1	SB 2
Volume Total	248	465	241	241	87	162	37
Volume Left	16	0	0	0	0	162	0
Volume Right	0	0	0	0	87	0	37
cSH	1091	1700	1700	1700	1700	292	766
Volume to Capacity	0.01	0.27	0.14	0.14	0.05	0.56	0.05
Queue Length 95th (m)	0.4	0.0	0.0	0.0	0.0	25.1	1.2
Control Delay (s)	0.7	0.0	0.0	0.0	0.0	31.7	9.9
Lane LOS	A				D	A	
Approach Delay (s)	0.2		0.0			27.7	
Approach LOS					D		
Intersection Summary							
Average Delay	3.8						
Intersection Capacity Utilization	46.5%	ICU Level of Service	A				
Analysis Period (min)	15						

## Queues

101: Montrose Rd (RR 98) &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer

Lane Group	EBL	EBT	EBC	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	92	725	28	101	820	53	76	146	251	184
v/c Ratio	0.51	0.68	0.05	0.27	0.56	0.16	0.14	0.28	0.67	0.37
Control Delay	30.1	22.2	0.2	9.9	11.4	19.0	18.1	5.4	30.0	17.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.1	22.2	0.2	9.9	11.4	19.0	18.1	5.4	30.0	17.6
Queue Length 50th (m)	8.2	36.6	0.0	4.9	25.3	4.4	6.2	0.0	24.8	13.2
Queue Length 95th (m)	28.1	73.4	0.0	15.9	56.6	14.9	18.8	12.4	62.1	36.3
Internal Link Dist (m)	400.1			107.9			106.0			116.6
Turn Bay Length (m)	50.0	25.0		50.0	50.0				50.0	
Base Capacity (vph)	345	2010	932	442	2397	638	1017	864	710	922
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.36	0.03	0.23	0.34	0.08	0.07	0.17	0.35	0.20
Intersection Summary										

## Queues

Thundering Waters Secondary Plan  
102: Niagara Square Dr/QEW EB Off-Ramp & McLeod Rd (RR 49)

Existing Summer



Lane Group	EBT	WBL	WBT	SBL	SBT	SBR
Lane Group Flow (vph)	844	139	537	212	213	236
v/c Ratio	0.57	0.31	0.35	0.50	0.50	0.41
Control Delay	17.4	8.2	9.0	22.1	22.1	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.4	8.2	9.0	22.1	22.1	5.3
Queue Length 50th (m)	24.4	5.2	13.9	18.4	18.6	0.0
Queue Length 95th (m)	44.9	16.2	30.5	42.6	42.8	14.2
Internal Link Dist (m)	110.1		0.1		64.8	
Turn Bay Length (m)						
Base Capacity (vph)	2927	476	2646	988	987	1027
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	0.29	0.29	0.20	0.21	0.22	0.23
Intersection Summary						

Queues  
103: QEW WB Off-Ramp & McLeod Rd (RR 49)

Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBT	WBT	NBL	NBR
Lane Group Flow (vph)	978	616	128	59
v/c Ratio	0.51	0.32	0.16	0.16
Control Delay	8.4	6.9	10.5	6.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	8.4	6.9	10.5	6.4
Queue Length 50th (m)	26.2	14.2	2.4	0.0
Queue Length 95th (m)	39.8	22.5	8.2	7.5
Internal Link Dist (m)	48.6	24.7	55.4	
Turn Bay Length (m)				
Base Capacity (vph)	2374	2374	1463	664
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.41	0.26	0.09	0.09
Intersection Summary				

Queues  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan

Existing Summer

Lane Group	EBL	EBT	EBC	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	29	805	546	318	817	564	16	372	17	29
v/c Ratio	0.15	0.78	0.78	0.91	0.53	1.42	0.03	0.56	0.04	0.06
Control Delay	20.7	29.8	16.3	45.3	15.1	231.1	20.1	8.5	20.4	9.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.7	29.8	16.3	45.3	15.1	231.1	20.1	8.5	20.4	9.6
Queue Length 50th (m)	3.1	57.9	22.4	25.5	42.8	~122.4	1.7	6.7	1.9	0.3
Queue Length 95th (m)	9.4	78.6	64.5	#65.3	58.4	#188.7	6.2	31.2	6.6	6.2
Internal Link Dist (m)		68.8			591.8		285.8			170.6
Turn Bay Length (m)	50.0		25.0	50.0		50.0				15.0
Base Capacity (vph)	220	1205	761	348	1720	396	549	669	409	470
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.67	0.72	0.91	0.47	1.42	0.03	0.56	0.04	0.06

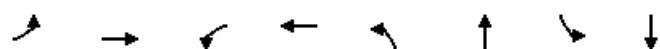
Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
- Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
- Queue shown is maximum after two cycles.

Queues  
105: Dorchester Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	370	1010	88	848	266	245	155	494
v/c Ratio	0.91	0.82	0.38	1.10	1.21	0.51	0.38	0.95
Control Delay	53.6	36.0	20.6	101.9	153.0	32.8	21.2	56.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.6	36.0	20.6	101.9	153.0	32.8	21.2	56.1
Queue Length 50th (m)	61.2	103.8	9.7	~111.2	~52.6	40.1	20.0	77.6
Queue Length 95th (m)	#118.3	#151.4	18.5	#151.5	#105.3	65.0	34.1	#142.8
Internal Link Dist (m)		591.8		1022.3		794.5		294.8
Turn Bay Length (m)	50.0		50.0		50.0		50.0	
Base Capacity (vph)	416	1235	454	768	220	512	415	556
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.82	0.19	1.10	1.21	0.48	0.37	0.89

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
- Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
- Queue shown is maximum after two cycles.

## Queues

## 106: Drummond Rd &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	859	634	63	62	161	319
v/c Ratio	0.68	0.35	0.50	0.17	0.62	0.62
Control Delay	13.2	7.5	36.8	18.0	34.7	11.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.2	7.5	36.8	18.0	34.7	11.6
Queue Length 50th (m)	33.3	17.2	7.2	5.1	19.0	7.0
Queue Length 95th (m)	71.1	35.2	18.5	13.8	36.5	27.9
Internal Link Dist (m)	1022.3	574.4		805.6		271.9
Turn Bay Length (m)			25.0		25.0	
Base Capacity (vph)	1264	1803	321	885	656	912
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	0.68	0.35	0.20	0.07	0.25	0.35

## Intersection Summary

## Queues

Thundering Waters Secondary Plan  
107: Thundering Waters Blvd/Stanley Ave (RR 102) & McLeod Rd (RR 49)/Marine Landing Parkway (RR 49)

Lane Group	EBL	EBT	EBC	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	59	521	13	8	462	205	12	18	246	84
v/c Ratio	0.14	0.42	0.02	0.04	0.50	0.38	0.04	0.07	0.51	0.17
Control Delay	13.0	15.5	0.1	23.6	23.2	6.7	32.8	24.3	24.7	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.0	15.5	0.1	23.6	23.2	6.7	32.8	24.3	24.7	8.5
Queue Length 50th (m)	2.8	17.0	0.0	0.6	21.1	0.0	1.1	0.7	20.4	0.8
Queue Length 95th (m)	13.4	47.7	0.0	4.8	53.7	16.9	7.3	7.8	60.2	11.9
Internal Link Dist (m)	286.8			112.7			84.4			144.0
Turn Bay Length (m)	50.0	50.0		25.0	50.0		25.0			
Base Capacity (vph)	506	2632	1206	522	2162	980	1020	989	971	921
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.20	0.01	0.02	0.21	0.21	0.01	0.02	0.25	0.09
Intersection Summary										

## Queues

108: Stanley Ave (RR 102) &amp; Marine Land Pkwy (RR 49)

Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	666	126	34	504	127	51
v/c Ratio	0.39	0.16	0.09	0.29	0.17	0.13
Control Delay	7.8	2.4	7.3	7.2	11.8	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.8	2.4	7.3	7.2	11.8	5.6
Queue Length 50th (m)	14.3	0.0	1.2	10.2	2.8	0.0
Queue Length 95th (m)	24.1	5.4	4.5	17.7	7.9	5.2
Internal Link Dist (m)	116.7			308.8	44.6	
Turn Bay Length (m)		75.0	50.0			50.0
Base Capacity (vph)	3153	1357	682	3153	2872	1381
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	0.21	0.09	0.05	0.16	0.04	0.04
Intersection Summary						

Queues  
110: Montrose Rd (RR 98) & Niagara Square Dr

Thundering Waters Secondary Plan

Existing Summer



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	228	189	250
v/c Ratio	0.24	0.13	0.17
Control Delay	5.3	7.1	7.1
Queue Delay	0.0	0.0	0.0
Total Delay	5.3	7.1	7.1
Queue Length 50th (m)	2.1	3.0	4.0
Queue Length 95th (m)	5.4	6.1	7.7
Internal Link Dist (m)	49.1	58.4	37.6
Turn Bay Length (m)			
Base Capacity (vph)	2565	2282	2282
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.09	0.08	0.11
Intersection Summary			

Queues  
111: Oakwood Dr & Walmart North Driveway

Thundering Waters Secondary Plan

Existing Summer

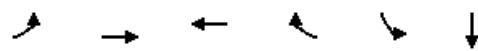


Lane Group	EBL	NBT	SBT
Lane Group Flow (vph)	424	284	708
v/c Ratio	0.69	0.33	0.61
Control Delay	17.2	13.3	7.9
Queue Delay	0.0	0.0	0.0
Total Delay	17.2	13.3	7.9
Queue Length 50th (m)	21.8	7.8	7.8
Queue Length 95th (m)	53.4	19.3	24.1
Internal Link Dist (m)	93.2	106.2	285.8
Turn Bay Length (m)			
Base Capacity (vph)	1067	2674	2684
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.40	0.11	0.26
Intersection Summary			

Queues  
112: Oakwood Dr & Walmart South Driveway

Thundering Waters Secondary Plan

Existing Summer



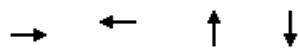
Lane Group	EBL	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	64	68	103	39	207	82
v/c Ratio	0.10	0.10	0.25	0.09	0.27	0.08
Control Delay	5.3	7.7	16.6	0.4	15.5	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.3	7.7	16.6	0.4	15.5	0.1
Queue Length 50th (m)	2.2	3.0	7.3	0.0	7.6	0.0
Queue Length 95th (m)	5.8	8.0	17.5	0.0	14.7	0.0
Internal Link Dist (m)		44.3	88.7			69.4
Turn Bay Length (m)	25.0					
Base Capacity (vph)	736	1692	1097	966	2344	1344
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	0.09	0.04	0.09	0.04	0.09	0.06
Intersection Summary						

## Queues

## 113: Montrose Rd (RR 98) &amp; Biggar Rd/Lyons Creek Rd (RR 47)

## Thundering Waters Secondary Plan

Existing Summer



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	56	168	370	283
v/c Ratio	0.13	0.35	0.51	0.50
Control Delay	13.9	10.2	9.3	12.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	13.9	10.2	9.3	12.5
Queue Length 50th (m)	3.0	4.6	12.8	13.7
Queue Length 95th (m)	11.4	19.4	33.0	33.2
Internal Link Dist (m)	248.1	307.0	202.0	905.4
Turn Bay Length (m)				
Base Capacity (vph)	1414	1400	1174	965
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.04	0.12	0.32	0.29
Intersection Summary				

## **Appendix B**

### **Existing Traffic Operations with Improvements Reports**



HCM Signalized Intersection Capacity Analysis  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer (with Improvements)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑		↑↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	31	833	373	249	956	13	359	22	271	18	12	82
Future Volume (vph)	31	833	373	249	956	13	359	22	271	18	12	82
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.0	8.0	8.0	3.0	8.0		4.5	8.0	8.0	8.0	8.0	8.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.97	1.00	1.00	1.00	1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.99	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Fr <sub>t</sub>	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1566	3197	1409	1629	3216		3162	1606	1439	1661	1620	1390
Flt Permitted	0.27	1.00	1.00	0.17	1.00		0.95	1.00	1.00	0.74	1.00	1.00
Satd. Flow (perm)	448	3197	1409	288	3216		3162	1606	1439	1297	1620	1390
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	905	405	271	1039	14	390	24	295	20	13	89
RTOR Reduction (vph)	0	0	115	0	1	0	0	0	211	0	0	82
Lane Group Flow (vph)	34	905	290	271	1052	0	390	24	84	20	13	7
Confl. Peds. (#/hr)	5		14	14		5	7		1	1		7
Heavy Vehicles (%)	6%	4%	3%	2%	3%	15%	2%	9%	2%	0%	8%	5%
Turn Type	Perm	NA	Perm	pm+pt	NA		Prot	NA	Perm	Perm	NA	Perm
Protected Phases		4			3	8		5	2			6
Permitted Phases	4		4		8					2	6	6
Actuated Green, G (s)	28.2	28.2	28.2	43.0	43.0		12.8	23.5	23.5	6.2	6.2	6.2
Effective Green, g (s)	28.2	28.2	28.2	43.0	43.0		12.8	23.5	23.5	6.2	6.2	6.2
Actuated g/C Ratio	0.34	0.34	0.34	0.52	0.52		0.16	0.28	0.28	0.08	0.08	0.08
Clearance Time (s)	8.0	8.0	8.0	3.0	8.0		4.5	8.0	8.0	8.0	8.0	8.0
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		3.0	2.5	2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	153	1092	481	341	1676		490	457	409	97	121	104
v/s Ratio Prot		0.28		c0.11	0.33		c0.12	0.01				0.01
v/s Ratio Perm	0.08		0.21	c0.30					c0.06	0.02		0.00
v/c Ratio	0.22	0.83	0.60	0.79	0.63		0.80	0.05	0.21	0.21	0.11	0.06
Uniform Delay, d1	19.3	24.9	22.5	13.9	14.1		33.6	21.4	22.4	35.8	35.6	35.5
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	5.2	1.8	11.7	0.6		8.7	0.0	0.2	0.8	0.3	0.2
Delay (s)	19.9	30.1	24.3	25.6	14.7		42.3	21.5	22.6	36.6	35.9	35.6
Level of Service	B	C	C	C	B		D	C	C	D	D	D
Approach Delay (s)		28.1			16.9			33.4				35.8
Approach LOS		C			B			C				D
<b>Intersection Summary</b>												
HCM 2000 Control Delay		25.2				HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio		0.77										
Actuated Cycle Length (s)		82.5			Sum of lost time (s)			23.5				
Intersection Capacity Utilization		75.3%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
105: Dorchester Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer (with Improvements)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↓		↑	↑↓		↑	↑		↑	↑	↑
Traffic Volume (vph)	278	659	100	42	700	69	230	113	58	100	118	289
Future Volume (vph)	278	659	100	42	700	69	230	113	58	100	118	289
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	6.7
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frbp, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Fr <sub>t</sub>	1.00	0.98		1.00	0.99		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1644	3166		1627	3175		1568	1636		1644	1733	1473
Flt Permitted	0.17	1.00		0.34	1.00		0.57	1.00		0.64	1.00	1.00
Satd. Flow (perm)	290	3166		584	3175		945	1636		1108	1733	1473
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	302	716	109	46	761	75	250	123	63	109	128	314
RTOR Reduction (vph)	0	8	0	0	6	0	0	20	0	0	0	265
Lane Group Flow (vph)	302	817	0	46	830	0	250	166	0	109	128	49
Confl. Peds. (#/hr)	24		11	11		24		3	3			
Heavy Vehicles (%)	1%	2%	5%	2%	3%	0%	6%	0%	3%	1%	1%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	47.1	40.3		31.4	27.6		24.9	15.8		20.1	13.4	13.4
Effective Green, g (s)	47.1	40.3		31.4	27.6		24.9	15.8		20.1	13.4	13.4
Actuated g/C Ratio	0.55	0.47		0.37	0.32		0.29	0.18		0.23	0.16	0.16
Clearance Time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	6.7
Vehicle Extension (s)	2.5	2.2		2.5	2.2		2.5	2.2		2.5	2.2	2.2
Lane Grp Cap (vph)	420	1488		260	1022		340	301		301	270	230
v/s Ratio Prot	c0.14	0.26		0.01	c0.26		c0.08	0.10		0.03	0.07	
v/s Ratio Perm	0.26			0.06			c0.14			0.06		0.03
v/c Ratio	0.72	0.55		0.18	0.81		0.74	0.55		0.36	0.47	0.21
Uniform Delay, d1	14.2	16.2		17.7	26.7		26.3	31.7		26.9	32.9	31.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.4	0.3		0.2	4.8		7.6	1.4		0.5	0.7	0.2
Delay (s)	19.6	16.5		17.9	31.5		33.8	33.2		27.4	33.6	31.8
Level of Service	B	B		B	C		C	C		C	C	C
Approach Delay (s)		17.3			30.8			33.5			31.3	
Approach LOS		B			C			C			C	
Intersection Summary												
HCM 2000 Control Delay		26.2			HCM 2000 Level of Service			C				
HCM 2000 Volume to Capacity ratio		0.79										
Actuated Cycle Length (s)		85.7			Sum of lost time (s)			19.1				
Intersection Capacity Utilization		78.5%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												

## HCM Signalized Intersection Capacity Analysis

113: Montrose Rd (RR 98) &amp; Biggar Rd/Lyons Creek Rd (RR 47)

## Thundering Waters Secondary Plan

Existing Summer (with Improvements)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	17	58	1	421	104	78	1	151	323	124	188	31
Future Volume (vph)	17	58	1	421	104	78	1	151	323	124	188	31
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)												
Lane Util. Factor												
Frt												
Flt Protected												
Satd. Flow (prot)	1597			1599	1524			1490		1471	1677	
Flt Permitted										0.33	1.00	
Satd. Flow (perm)	1497			1184	1524			1489		509	1677	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	63	1	458	113	85	1	164	351	135	204	34
RTOR Reduction (vph)	0	1	0	0	34	0	0	94	0	0	7	0
Lane Group Flow (vph)	0	81	0	458	164	0	0	422	0	135	231	0
Heavy Vehicles (%)	6%	9%	0%	4%	7%	8%	0%	6%	7%	13%	2%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	34.0			34.0	34.0			25.8		25.8	25.8	
Effective Green, g (s)	34.0			34.0	34.0			25.8		25.8	25.8	
Actuated g/C Ratio	0.47			0.47	0.47			0.36		0.36	0.36	
Clearance Time (s)	6.3			6.3	6.3			6.3		6.3	6.3	
Vehicle Extension (s)	6.0			6.0	6.0			6.0		6.0	6.0	
Lane Grp Cap (vph)	703			556	715			530		181	597	
v/s Ratio Prot					0.11						0.14	
v/s Ratio Perm	0.05		c0.39				c0.28			0.27		
v/c Ratio	0.12		0.82	0.23			0.80			0.75	0.39	
Uniform Delay, d1	10.8		16.6	11.4			20.9			20.4	17.4	
Progression Factor	1.00		1.00	1.00			1.00			1.00	1.00	
Incremental Delay, d2	0.2		11.2	0.5			9.8			20.1	1.2	
Delay (s)	11.0		27.8	11.9			30.7			40.5	18.6	
Level of Service	B		C	B			C			D	B	
Approach Delay (s)	11.0			23.0			30.7				26.5	
Approach LOS	B			C			C				C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		25.7			HCM 2000 Level of Service			C				
HCM 2000 Volume to Capacity ratio		0.81										
Actuated Cycle Length (s)		72.4			Sum of lost time (s)			12.6				
Intersection Capacity Utilization		90.8%			ICU Level of Service			E				
Analysis Period (min)		15										
c Critical Lane Group												

Queues  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan

Existing Summer (with Improvements)

Lane Group	EBL	EBT	EBC	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	34	905	405	271	1053	390	24	295	20	13	89
v/c Ratio	0.22	0.81	0.67	0.74	0.62	0.78	0.06	0.49	0.15	0.08	0.34
Control Delay	24.9	32.1	19.6	26.1	16.0	46.2	21.4	6.0	37.9	35.8	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.9	32.1	19.6	26.1	16.0	46.2	21.4	6.0	37.9	35.8	6.1
Queue Length 50th (m)	4.1	73.7	32.6	21.8	64.3	33.2	2.9	0.0	3.2	2.1	0.0
Queue Length 95th (m)	12.1	#107.8	67.5	#59.2	86.3	#55.9	8.4	17.7	9.9	7.5	5.6
Internal Link Dist (m)		68.8			591.8		285.8			170.6	
Turn Bay Length (m)	50.0		25.0	50.0		50.0			15.0		25.0
Base Capacity (vph)	156	1115	604	366	1712	500	826	884	389	486	512
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.81	0.67	0.74	0.62	0.78	0.03	0.33	0.05	0.03	0.17

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues  
105: Dorchester Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan

Existing Summer (with Improvements)



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	302	825	46	836	250	186	109	128	314
v/c Ratio	0.69	0.54	0.14	0.84	0.68	0.57	0.29	0.48	0.64
Control Delay	22.4	18.3	10.9	37.2	33.8	35.8	22.2	39.3	10.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.4	18.3	10.9	37.2	33.8	35.8	22.2	39.3	10.6
Queue Length 50th (m)	25.0	52.6	3.0	69.0	32.9	26.1	12.9	20.1	0.0
Queue Length 95th (m)	59.8	83.5	8.7	#120.4	56.5	49.0	25.6	37.9	22.7
Internal Link Dist (m)		591.8		1022.3		794.5		294.8	
Turn Bay Length (m)	50.0		50.0		50.0		50.0		50.0
Base Capacity (vph)	495	1528	616	998	366	625	395	645	746
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.61	0.54	0.07	0.84	0.68	0.30	0.28	0.20	0.42

Intersection Summary

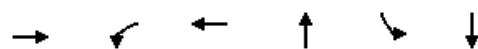
# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

## Queues

Thundering Waters Secondary Plan  
113: Montrose Rd (RR 98) & Biggar Rd/Lyons Creek Rd (RR 47)

Existing Summer (with Improvements)



Lane Group	EBT	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	82	458	198	516	135	238
v/c Ratio	0.12	0.83	0.27	0.83	0.75	0.40
Control Delay	12.0	32.7	9.4	29.7	51.0	20.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.0	32.7	9.4	29.7	51.0	20.3
Queue Length 50th (m)	7.0	60.7	12.0	55.7	19.0	27.2
Queue Length 95th (m)	14.7	#116.8	24.8	#112.7	#49.8	46.7
Internal Link Dist (m)	248.1		307.0	202.0		905.4
Turn Bay Length (m)		115.0			50.0	
Base Capacity (vph)	855	677	899	722	219	725
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	0.10	0.68	0.22	0.71	0.62	0.33

## Intersection Summary

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

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer (with Improvements)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑		↑↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	27	741	502	293	717	35	519	15	342	16	3	24
Future Volume (vph)	27	741	502	293	717	35	519	15	342	16	3	24
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.0	8.0	8.0	3.0	8.0		4.5	8.0	8.0	8.0	8.0	8.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.97	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Fr <sub>t</sub>	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1662	3292	1450	1630	3240		3162	1750	1450	1657	1442	
Flt Permitted	0.34	1.00	1.00	0.20	1.00		0.95	1.00	1.00	0.89	1.00	
Satd. Flow (perm)	601	3292	1450	335	3240		3162	1750	1450	1550	1442	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	805	546	318	779	38	564	16	372	17	3	26
RTOR Reduction (vph)	0	0	162	0	2	0	0	0	251	0	25	0
Lane Group Flow (vph)	29	805	384	318	815	0	564	16	121	17	4	0
Confl. Peds. (#/hr)			4	4			3		3	3		3
Heavy Vehicles (%)	0%	1%	1%	2%	2%	0%	2%	0%	1%	0%	0%	4%
Turn Type	Perm	NA	Perm	pm+pt	NA		Prot	NA	Perm	Perm	NA	
Protected Phases		4			3	8		5	2			6
Permitted Phases	4			4	8					2	6	
Actuated Green, G (s)	28.6	28.6	28.6	45.8	45.8		19.1	28.1	28.1	4.5	4.5	
Effective Green, g (s)	28.6	28.6	28.6	45.8	45.8		19.1	28.1	28.1	4.5	4.5	
Actuated g/C Ratio	0.32	0.32	0.32	0.51	0.51		0.21	0.31	0.31	0.05	0.05	
Clearance Time (s)	8.0	8.0	8.0	3.0	8.0		4.5	8.0	8.0	8.0	8.0	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		3.0	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	191	1047	461	375	1650		671	546	453	77	72	
v/s Ratio Prot		0.24		c0.13	0.25		c0.18	0.01				0.00
v/s Ratio Perm	0.05		0.27	c0.30					c0.08	0.01		
v/c Ratio	0.15	0.77	0.83	0.85	0.49		0.84	0.03	0.27	0.22	0.06	
Uniform Delay, d1	22.0	27.7	28.4	15.7	14.5		33.9	21.4	23.2	41.0	40.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	3.3	12.0	15.9	0.2		9.3	0.0	0.2	1.1	0.3	
Delay (s)	22.2	31.0	40.5	31.6	14.6		43.3	21.5	23.4	42.1	40.9	
Level of Service	C	C	D	C	B		D	C	C	D	D	
Approach Delay (s)		34.6			19.4			35.1			41.4	
Approach LOS		C			B			D			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		29.9			HCM 2000 Level of Service			C				
HCM 2000 Volume to Capacity ratio		0.85										
Actuated Cycle Length (s)		89.9			Sum of lost time (s)			23.5				
Intersection Capacity Utilization		79.4%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
105: Dorchester Rd & McLeod Rd (RR 49)

Thundering Waters Secondary Plan  
Existing Summer (with Improvements)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑		↑	↑↑		↑	↑		↑	↑	↑
Traffic Volume (vph)	340	791	138	81	659	121	245	164	62	143	119	336
Future Volume (vph)	340	791	138	81	659	121	245	164	62	143	119	336
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	6.7
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frbp, ped/bikes	1.00	0.99		1.00	1.00		1.00	0.99		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		0.99	1.00	1.00
Fr <sub>t</sub>	1.00	0.98		1.00	0.98		1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1599	3175		1628	3193		1622	1643		1621	1716	1443
Flt Permitted	0.15	1.00		0.28	1.00		0.67	1.00		0.44	1.00	1.00
Satd. Flow (perm)	247	3175		486	3193		1138	1643		748	1716	1443
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	370	860	150	88	716	132	266	178	67	155	129	365
RTOR Reduction (vph)	0	12	0	0	13	0	0	15	0	0	0	298
Lane Group Flow (vph)	370	998	0	88	835	0	266	230	0	155	129	67
Confl. Peds. (#/hr)			9	9			10		23	23		10
Heavy Vehicles (%)	4%	2%	1%	2%	2%	0%	2%	1%	2%	2%	2%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	50.1	42.0		32.7	27.6		23.8	16.8		23.4	16.6	16.6
Effective Green, g (s)	50.1	42.0		32.7	27.6		23.8	16.8		23.4	16.6	16.6
Actuated g/C Ratio	0.56	0.47		0.36	0.31		0.27	0.19		0.26	0.18	0.18
Clearance Time (s)	3.0	6.4		3.0	6.4		3.0	6.7		3.0	6.7	6.7
Vehicle Extension (s)	2.5	2.2		2.5	2.2		2.5	2.2		2.5	2.2	2.2
Lane Grp Cap (vph)	431	1484		241	981		339	307		261	317	266
v/s Ratio Prot	c0.19	0.31		0.02	0.26		c0.06	0.14		0.04	0.08	
v/s Ratio Perm	c0.29			0.11			c0.15			0.11		0.05
v/c Ratio	0.86	0.67		0.37	0.85		0.78	0.75		0.59	0.41	0.25
Uniform Delay, d1	21.1	18.6		19.2	29.2		29.6	34.5		27.4	32.3	31.3
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	15.3	1.0		0.7	7.0		10.9	8.7		3.0	0.4	0.3
Delay (s)	36.4	19.6		19.9	36.2		40.6	43.2		30.4	32.7	31.6
Level of Service	D	B		B	D		D	D		C	C	C
Approach Delay (s)		24.1			34.6			41.8			31.5	
Approach LOS		C			C			D			C	

Intersection Summary

HCM 2000 Control Delay	30.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	89.8	Sum of lost time (s)	19.1
Intersection Capacity Utilization	91.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Queues  
104: Oakwood Dr & McLeod Rd (RR 49)

Thundering Waters Secondary Plan

Existing Summer (with Improvements)

Lane Group	EBL	EBT	EBC	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	29	805	546	318	817	564	16	372	17	29
v/c Ratio	0.15	0.74	0.86	0.78	0.48	0.81	0.03	0.55	0.12	0.18
Control Delay	25.4	31.7	31.4	28.3	15.0	44.0	21.3	6.3	41.5	20.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.4	31.7	31.4	28.3	15.0	44.0	21.3	6.3	41.5	20.3
Queue Length 50th (m)	4.0	72.8	59.3	32.0	52.5	54.0	2.0	0.9	3.0	0.6
Queue Length 95th (m)	11.3	96.3	#126.1	#77.7	69.7	#83.6	6.6	21.0	9.7	9.2
Internal Link Dist (m)		68.8			591.8		285.8			170.6
Turn Bay Length (m)	50.0		25.0	50.0		100.0				15.0
Base Capacity (vph)	205	1124	650	408	1754	699	978	971	442	430
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.72	0.84	0.78	0.47	0.81	0.02	0.38	0.04	0.07

Intersection Summary

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

Queue shown is maximum after two cycles.

## Queues

105: Dorchester Rd &amp; McLeod Rd (RR 49)

## Thundering Waters Secondary Plan

Existing Summer (with Improvements)



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	370	1010	88	848	266	245	155	129	365
v/c Ratio	0.84	0.67	0.32	0.87	0.69	0.76	0.53	0.40	0.65
Control Delay	38.0	22.3	14.0	40.6	34.5	46.6	28.8	35.3	9.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.0	22.3	14.0	40.6	34.5	46.6	28.8	35.3	9.3
Queue Length 50th (m)	44.2	73.0	6.3	73.7	37.3	38.8	20.1	20.6	0.0
Queue Length 95th (m)	#108.4	112.5	15.5	#124.2	59.5	64.4	34.9	37.0	23.4
Internal Link Dist (m)		591.8		1022.3		794.5		294.8	
Turn Bay Length (m)	50.0		50.0		50.0		50.0		50.0
Base Capacity (vph)	441	1505	286	979	388	619	293	630	760
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.67	0.31	0.87	0.69	0.40	0.53	0.20	0.48

## Intersection Summary

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

Queue shown is maximum after two cycles.