PROPOSED RENFREW GOLF COURSE SAND/GRAVEL PIT

TRAFFIC IMPACT STUDY

Presented to:

Mr. Phil White
Quality Control
Thomas Cavanagh Construction Limited
9094 Cavanagh Road,
Ashton, Ontario
K0A 1B0

June 5th, 2023

Project No. 7313

Castleglenn Consultants
Engineers, Project Managers & Planners

CASTLEGLENN CONSULTANTS LTD.

THIRD PARTY DISCLAIMER

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The following Traffic Impact Study (TIS) report has been produced, reviewed, and is respectfully submitted for consideration to whom it has been addressed.

Mr. Arthur Gordon B.A., P.Eng
Principal Engineer
Castleglenn Consultants Inc.

Mr. Konstantin Joulanov B. Eng. M. Sc.
Transportation Planner
Castleglenn Consultants Inc.

Castleglenn Consultants
Engineers, Project Managers & Planners

Arthur E. Gordon

B.A., B.Eng., P.Eng.

Principal

Experience

Mr. Gordon is President of CastleGlenn Consultants Inc. He has served in the capacity as Director and Manager of Transportation Planning within major Canadian consulting engineering firms.

He has been responsible for numerous transportation planning and traffic engineering design studies throughout Canada requiring detailed analysis, establishment of existing and forecast travel patterns and the development of sound rationale and justification for transportation/transit related solutions.

He has participated in numerous exercises involving identifying traffic and transportation issues related to resource extraction initiatives which include transportation infrastructure requirements and preliminary design plans on behalf of municipalities and the private sector.

Mr. Gordon has established a reputation of excellence in communication and presentation skills. This has been displayed through numerous public consultation/outreach exercises, providing expert witness testimony and prepared presentations to municipal councils, tribunals, executive committees and the Ontario Municipal Board. Mr. Gordon is known for insight into engineering processes and having coordinated technical review committees aimed at developing solutions that are both community and policy driven.

Mr. Gordon provides extensive consulting management expertise in major transportation planning and transit engineering studies. He has managed and directed large interchange, highway and municipal transportation infrastructure initiatives inclusive of master planning studies. He offers multi-modal experience incorporating truck, airport, light rail as well as cycling, pedestrian design, traffic management, traffic impact, parking, site evaluation, traffic forecasting and transportation safety studies.

Mr. Gordon is experienced with the development of transportation infrastructure within an urbanized environment involving criteria and approaches to assess mobility, accessibility, level of service, parking circulation, tourism operations and pedestrian circulation patterns within nationally significant campus environments. Also, his background includes life cycle analysis, road inventory, asset inventory, environmental assessment, transportation and transit economics, cost estimating and transportation implementation systems.

Some of his more recent studies have provided an appreciation and understanding of developments which remain sensitive to pedestrian and cyclist demands, environmental concerns, security provisions, special-event accessibility, and circulation requirements in addition to underground parking provisions. His knowledge of environmentally sensitive issues and his direct involvement with large freeway/highway related projects has been beneficial within these areas.

Mr. Gordon's has substantial experience having undertaken numerous provincially significant assignments. He has recently completed the "Highway 43 Functional Planning Study, NW of Edmonton," which assessed the future transportation related impacts and resulting infrastructure requirements associated with the development of 3 interchanges upon the surrounding communities. Mr. Gordon has completed transportation master planning studies (e.g. Both City and County of Leduc, Alberta) Mr. Gordon has been retained to examine the construction lane reduction impacts associated with the Woodroffe Avenue Re-construction (Hwy 417 to Baseline) within the City of Ottawa.

Mr. Gordon has developed, on behalf of the Province of British Columbia, "*Project Evaluation and Prioritization Process*" (British Columbia Financing Authority, BCTFA) that is intended to assign a priority to all provincial transportation capital expenditures. For the Province of Newfoundland and Environment Canada, he undertook the "*Trans-Canada Highway Improvements in the Vicinity of Terra Nova National Park*" (Newfoundland) that was used to assess alternative corridors and their impacts upon a provincially significant national park and the adjacent communities.

Within the field of transportation planning within a municipal setting Mr. Gordon's experience is diverse and multi-faceted. He co-authored the "*Implementing Employer Based Transportation Demand Management (TCM) Programs*" on behalf of the City

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of Ottawa and completed the transportation design requirements for a 4 lane vehicular tunnel under Runway 15L at Lester B. Pearson International Airport involving restricted vehicular access, security requirements and emergency response preparedness strategy. Moreover, he provided transportation planning expertise on the "*Parliamentary Precinct Study*".

In addition, he is thoroughly familiar with various evaluation frameworks which address infrastructure upgrading, safety, road-user benefit / cost analysis, level of service, socio-economic impact analysis, economic justification, and the requirements necessary to meet federal EA processes.

Furthermore, Mr. Gordon offers significant expertise in addressing the impacts of heavy vehicle traffic. He was a co-project manager responsible for the City of Edmonton's "*Truck Route and Regulation Study*" and has undertaken the "*National Capital Area Goods Movement Study*" and the "*Oakville Truck Route and Regulation Study*". He recently completed the City of Timmins Origin-Destination Survey and was recently retained to assess a one-way network for its downtown core.

The planning studies included rigorous technical analysis involving surveys of all heavy registered commercial vehicles, comprehensive community involvement, and a thorough operational comparative impact evaluation and assessment. Variables such as the adjacent area land uses, roadway classification, the number of lanes, geometric features, intensity of pedestrian activity, level of congestion, access density, origin-destination demand, alternate route viability, route continuity and consistency economic simulation. He has developed numerous methodologies for determining forecast travel patterns and the requirements for producing sound justifications for proposed improvements within an urban setting.

Mr. Gordon is former head of traffic modeling and simulation for the Region of Ottawa-Carleton and offers extensive experience in traffic modeling and simulation.

Transportation Planning - Ontario: Resource Extraction -

- Stittsville Quarry (Tomlinson)
- Renfrew Golf Site Quarry (Cavanagh)
- Oxford Mills Quarry (Tomlinson Corp.)
- Joyceville Kingston Quarry (Tomlinson Corp.)
- Highland Pit Quarry, Lanark County (Cavanagh)
- Napanee Asphalt Plant (Tomlinson)
- Storyland Quarry (Tomlinson)
- Rideau Quarry (Tomlinson)
- Brickyards Quarry (Tomlinson)
- Bruce Mines OTR Expansion & Laydown Area (Tomlinson)
- Carp Road Resource Recovery Centre (Tomlinson)
- Moodie Drive Quarry (Hope Side Access (Tomlinson)
- Henderson Asphalt testing Lab ((Cavanagh)
- Lawson Quarry, Athens (Tackaberry)

Transportation Planning - Ontario -

- VE: Bridge Rehabilitation Strategies: Clyde Ave to Parkdale – Traffic Component
- VE: Salmon-Moira Bridge Rehabilitation - Presentation
- Eagleson Road Interchange Value Engineering Component
- Town of Arnprior Master Traffic Study
- City of Kingston (Peer Review Auditor for Several Traffic Studies)
- City of North Bay Infrastructure Needs Backgrounds Study: Transportation Component
- City of Kingston Large Venue Entertainment Facility Impact Assessment
- City of Kingston Downtown Action Plan – Transportation Component
- City of Kingston (Peer Review Auditor for Several Traffic Studies)
- Highway 410 from Highway 401 to Steels Avenue, Traffic Demand and Traffic Operations Component, Ministry of Transportation of Ontario
- Highway 410 PDR – Transportation Systems Management and Traffic Demand Forecast Operations (in progress)
- Highway 417 PDR Traffic Assessment
- Highway 1 Interchange Functional Planning Study
- Greater Toronto Airport Authority - 4 lane vehicular tunnel under

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runway 15L-33R at Lester B. Pearson International Airport
- Southern Ontario Airport Study
- Highway 417 from Highway 17/7 to Highway 416 Traffic Component of Preliminary Design Report, Ministry of Transportation of Ontario
- Brockville Traffic Operations/ Transportation Planning Study
- Perth Transportation Study
- Highway 27 & Dixon Road Interchange Assessment, Metro Toronto
- Oakville Truck Route and Regulation Study
- Preparation for O.M.B. Hearing on Cornwall Residential Community
- Preparation for O.M.B. Peterborough Quarry Application (Kawartha Lakes)

Transportation Planning - Ottawa -

- Ottawa Hospital Parking Management Plan
- University of Ottawa Heart Institute Expansion- Traffic Management and Roadway modifications.
- Prince of Wales Drive Culvert Reconstruction Traffic Management Plan
- Woodroffe Avenue Reconstruction Traffic Management Plan
- Ottawa General Hospital Smyth Road Intersection Modifications
- Eden Park Community Transportation Study
- Cumberland Traffic Calming
- Transportation Demand Management Toolkit for Employer's (City of Ottawa)
- Chaudière Bridge Operational Review (Public Works)
- Portage Bridge Operational Review (Public Works)
- Eagleson Interchange Study
- Coventry Road Plan of Development
- Castlefrank Road Interchange and Transitway Overpass, Ottawa Carleton
- Regional Cycling Network and Comprehensive Cycling Study
- Highway 416 Traffic Diversion Study
- Hazeldean Road Environmental Assessment, City of Ottawa
- Kanata Town Centre Study
- Ottawa-Carleton Cyclist Survey
- Cycling Studies in Ottawa, Gloucester, Cumberland, and Nepean, Ontario
- Champlain Bridge One-Direction Flow Impact Assessment
- Terry Fox Drive Traffic Analysis Component, City of Ottawa
- Highway 417/ Castlefrank Road Interchange Study Region Ottawa
- Merivale Corridor Transportation Study
- Orleans Town Centre: Traffic Analysis of OMB Hearing
- Kanata Roadway Cost-Benefit Prioritization System
- Maitland Avenue - Highway 417 Interchange Rehabilitation Strategy
- Kanata North Urban Expansion Study
- Preparation for O.M.B. Hearing on Vanier Parkway
- Preparation for O.M.B. Hearing on Retail Expansion (Ottawa)

Site Specific Impact Assessments

- Ottawa Hospital Regional Cancer Centre – Transportation Impact
- Ottawa Civic Hospital Parking Garage Evaluation.
- Ottawa General Hospital Critical Care Tower Expansion
- R. W. Tomlinson - Quarry Application (Kawartha Lakes)
- Mondrian Traffic Impact Assessment
- Corel Centre Transportation Study
- Moodie Drive/Richmond Road Impact Study (Nepean)
- Fallowfield Road Plaza Parking Study
- Cyrville Road Traffic Impact Assessment for OMB Hearing
- Innes Road – Mer Bleue Road Retail 500,000 SF Plaza
- Innes Road Snow Disposal Facility Ottawa
- Corel Centre Expansion Ottawa
- Kanata Regional Shopping Centre Study
- Numerous site impact and traffic evaluation studies

Highway Functional Planning Projects – Alberta -

- Blairmore Coal Extraction Site, Hwy 3 Proposed Rail Tunnel, Detour and Mountain Access Road

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- VE Study: Highway 2 & 3 Systems Interchange Design,(Fort Macleod),
- Highway 63 - Functional Planning Study: Interchange and 50km of twinned Highway, (Boyle Alberta)
- Athabasca Truck Route Study and Functional Design.
- Highway 1 Old Banff Coach Rd. (RR-31) Functional Planning Study (Calgary)
- Highway 1 Springbank Interchange (RR-33) Functional Planning Study (Calgary)
- Highway 63 Combined Median Vehicle Inspection Station – Heavy Vehicle Safety Rest Area Design
- Highway 43 Functional Planning Study [Hwy 16-to-Hwy 33] (Onoway)
- Highway 22X Functional Planning Study (88th Street to RR-273) (Indus)
- Hwy 27 Bypass FPS (Olds)
- Safety Rest Area Discussion Paper (Central Region)
- Considerations of Bypass Alignments on Level 2-4 Highway corridors Discussion Paper (Edmonton)
- Highway 28A/28 Functional Planning Study (Gibbons)
- Highway 27 (Olds & Sundre) Functional Planning Study
- Highway 2 (Bowden) Functional Planning Study
- Highway 2&Township Road 265 Partial Interchange (Airdire)
- Highway 3&6 Interchange Functional Planning Study (Pincher Creek)
- Highway 14 Functional Planning Study (Wainwright)
- Highway 63 Functional Planning Study
- Lacombe/Blackfalds Traffic Impact Assessment (Lacombe County)
- Highway 2A Functional Planning Study (Ponoka)
- Highway 27 & Olds Functional Planning Study (Olds)
- Highway 2A Transportation Planning Study (Blackfalds to Lacombe)
- Highway 2 Corridor Management Study (Calgary to Innisfail)
- Highway 2A Transportation Planning Study (Red Deer to Blackfalds)
- Highway 1 Dunmore Functional Planning Study (2 interchanges 7 km divided Highway)
- Highway 3 & 36 Taber Access Management Planning Study (8 km urban Highway environment)
- Highway 2 & 3 Functional Planning Study, Fort Macleod, Alberta Transportation
- Highway 1 Functional Planning Study, Brooks, Alberta Transportation
- Highway Vicinity Access Management Agreement, Highway 11 East of Red Deer, Alberta Functional Planning Study Alberta Infrastructure
- Highway 11 Realignment Study, East of Red Deer, Alberta Transportation
- Highway 34 & Highway 2 Interchange, Grand Prairie, Functional Design, Alberta Transportation & Utilities
- Highway 11 and Highway 2 Interchange Upgradesm Red Deer, (Alberta Transportation & Utilities,
- Highway 11 Twinning (Alberta Transportation & Utilities,
- Review of Ontario Access Management Policies, Alberta Transportation Utilities
- Review of Interstate Highway (FHWA) Access Management Policies, Alberta Transportation and Utilities
- Edmonton Transportation Master Plan: Truck Route Study

Transportation Planning - Other Jurisdictions -

- Project Evaluation and Prioritization Process (British Columbia Financing Authority)
- TransCanada Highway Improvements in the Vicinity of Terra Nova National Park (Newfoundland)
- Transit Project Evaluation and Prioritization Process (British Columbia Financing Authority)
- Kenmount Road and Proposed East-West Arterial (St. John's, Nfld.)

Memberships

- Association of Professional Engineers, Geologists and Geophysicists of Alberta
- Professional Engineers, Ontario
- Association of Professional Engineers & Geoscientists of British Columbia
- Institute of Transportation Engineers, Past President, National Capital Section
- Transportation Association of Canada, Transportation Planning Committee
- Canadian Society for Civil Engineering

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Principal

Education

- B.Eng. Civil Engineering, Carleton University, 1984
- BA. Economics and Law, Carleton University, 1980
- Masters Courses
- Accredited Health and Safety Auditor – Alberta Construction Safety Association

Konstantin Joulanov

M. Eng., B. Asc.
Transportation Planner

Recently Completed Projects and Education

Mr. Konstantin Joulanov joined Castleglenn Consultants Inc. in October 2021, and since then he has undergone an extensive training on transportation planning and analysis.

Mr. Joulanov has developed a diverse set of skills in the fields related to transportation planning and engineering. Mr. Joulanov has knowledge of analyzing multi-modal traffic streams with both macro-and-micro modelling techniques, having been involved primarily in traffic operations studies, and transportation impact assessments (TIA), as well as having had some exposure to functional planning studies (FPS), and Transportation Master Plans.

Alberta Projects

- *Planning for Provincial Highway Intersection Improvements in the Town of Penhold Study (Penhold, Alberta, 2022):* Mr. Joulanov was responsible for traffic modelling, forecasting and analysing 8 intersections along the Highway 2A and Highway 42 corridors as signals and roundabouts over multiple horizons up to a 30 year built out to assist with the ultimate long term planning of the Town.

- *Planning for Provincial Highway Intersection Improvements: Highway 16 East of Highway 21 (Edmonton, Alberta, 2022):* Mr. Joulanov was responsible for forecasting the traffic expected to use the proposed interchanges and fly-overs along the Highway 16 corridor. He produced traffic models analyzing the origins and destinations of the traffic utilizing the new improvements to determine the proportion of traffic associated with the build-out of development growth within the Greater Strathcona County community.

- *Leduc County Transportation Master Plan (TMP) (Leduc County, Alberta, 2021):* Mr. Joulanov assisted with public engagement aspects and report preparation of the project. His duties included summarization of findings as well as report review.

- *Highway 40 Network Review (Alberta, 2021):* Mr. Joulanov conducted a thorough traffic analysis involving at least 10 highway intersections and 8 roundabouts along the Highway 40 corridor south of Grande Prairie for both 10-year and 20-year time horizons. The analysis was used to determine intersection configurations and staging leading to functional design and costing. Minimum level of services thresholds was established at the outset to assure acceptable traffic operations.

Ontario Projects

- *Carling Avenue Reconstruction Project (Ottawa, Ontario, 2022).* Mr. Joulanov was responsible for forecasting the traffic considering the road closures associated with various stages of construction. He then modelled and simulated the vehicle traffic patterns using Vissim™ software, to analyze the effects of the closures on traffic delays and queue lengths.

- *St-Jean Street Municipal Classification Environmental Assessment (City of Clarence-Rockland, Ontario, 2023)* Mr. Joulanov is currently working on the MCEA to assist with the Poupart Road Widening project and the construction of 4 roundabouts along the corridor. He has been responsible for liaison between Castleglenn and The City of Clarence-Rockland Staff in order to complete various stages of public outreach, consultation, and preparation and participation in Public Open Houses.

Skills:

- Excellent verbal communication skills;
- Experienced in planning and problem solving;
- Proficient in technical writing;
- Strong analytical capacity; and
- Proficient with…
  - Synchro versions 8/10;
  - Sidra Roundabout Analysis;
  - HCM 2000/HCM 2010/HCM 6 Traffic Analysis;
  - PTV Vistro;
  - ArcGIS and QGIS platforms.
  - Google Earth and similar GIS platforms;
  - Microsoft Word Suite (Word, Excel, PowerPoint, Outlook, etc.); and
  - AutoCAD and AutoTURN vehicle turning movement analysis.

Education

- Bachelor of Applied Science in Civil Engineering, University of Ottawa

- Masters of Engineering, Carleton University

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LIST OF EXHIBITS

1.0 INTRODUCTION

Castleglenn Consultants Inc. was engaged to undertake a Traffic Impact Study (TIS) in support of the proposed Renfrew Golf Course Sand/Gravel Pit.

The proposed development is located within the Township of Horton and represents a 40-hectare severance from the Renfrew Golf Club. The severed lot is currently characterized by vacant lands. The new extraction pit would be accessed from a single entrance/exit using the existing Golf Course Road that connects to Highway 60. The Highway 60/Golf Course Road intersection is located approximately 5.5 km north-west of Renfrew, Ontario.

This traffic impact study provides:

- A review of the study area, the quarry site location, the entrance roadway, and intersection configuration;
- A review of existing (2022) background traffic operational conditions within the study area which included the collection of traffic counts from the following intersections:
  - Highway 60 / Golf Course Road (manual traffic count held Thursday, October 6th, 2022);
  - A description of the proposed extraction site development and its anticipated impact on future (2024 and 2029) traffic operations;
  - A traffic forecast for the proposed development site that reflected typical weekday morning and afternoon peak hour quarry operations.
  - Intersection capacity analyses assuming both existing and forecast morning and afternoon peak hours of travel demand within the study area;
- A review of sightlines and traffic control at the existing site access;
- Analysis of the Highway 60 / Golf Course Road intersection including:
  - Left turn auxiliary lane warrant analysis;
  - Traffic signal warrant analysis; and
  - A review of the right turn lane/taper provisions;
- A review of impacts to the nearby Algonquin Trail.

The following sections describe the analyses of traffic operations associated with the proposed development and presents the resulting performance measures (levels, of service, (v/c) volume-to-capacity ratios, queue length and delay estimates) for the anticipated time of operation (2024) and a 5-year horizon (2029) at the new site.

2.0 EXISTING CONDITIONS

2.1 STUDY AREA AND SITE LOCATION

Exhibit 2-1 illustrates the general location of the proposed sand/gravel pit development adjacent to the Renfrew Golf Club. The site is currently accessed by way of Golf Club Road which connects to the Highway 60 corridor. The extraction site will make use of the existing access to Golf Course Road. The former Ottawa Valley Railway corridor (now Algonquin Trail) is located adjacent to the north-west portion of the site.

Exhibit 2-1: Study Area Context

2.2 STUDY AREA ROADWAYS

The following sub-sections serve to characterize the primary roadways within the vicinity of the proposed extraction site. Exhibit 2-1 illustrates the location of the following study area roadways:

- *HIGHWAY 60:* Highway 60 is an east-west provincial highway running from Huntsville, Ontario in the east to Renfrew in the west. In the vicinity of the study area, the highway is a two-lane undivided freeway with a posted speed limit of 80 km/h. The Highway 60/ Golf Course Road intersection would be the primary access point to the highway for the development.

- *GOLF COURSE ROAD:* Golf Course Road is an north-south local roadway within the Township of Horton, running from Highway 60 in the south towards the Renfrew Golf Club in the north the vicinity of the study area, the road is a 2-lane roadway with no posted speed limit (50 km/h) and a rural cross-section.

- *ALGONQUIN TRAIL:* The Algonquin Trail is a sub-section of the Ottawa Valley Recreational Trail (OVRT). The OVRT was originally part of the Canadian Pacific Railway (CPR) corridor that stretched between Smiths Falls and Mattawa to the County of Renfrew, County of Lanark and the Township of Papineau-Cameron. The trail's uses include walking, cycling, ATV/Off-Road, snowmobiling, cross-country skiing and equestrian uses. As a general rule, speed limits are 20 kph in urban areas and 50 kph in rural areas and areas are marked with speed limit signs. The trail crosses Highway 60 approximately 25m to west of the Highway 60 / Golf Course Road Intersection.

2.3 STUDY AREA INTERSECTIONS

The following section summarizes the study area intersections.

1. HIGHWAY 60 / GOLF COURSE ROAD

- Exhibit 2-2 illustrates the 3-leg Highway 60 / Golf Course Road "T" intersection;
- Golf Course Road represent the north leg of the intersection and Highway 60 runs east-west;
- Each approach of the intersection provides for one lane of shared through-turn movements and no auxiliary lanes;
- the intersection is STOP-controlled on the minor (north) leg approach to the intersection;
- The eastern approach to the intersection is provided with a right turn taper.

Exhibit 2-2: Highway 60 / Golf Course Road Intersection

2. GOLF COURSE ROAD / RENFREW GOLF CLUB ACCESS INTERSECTION

- Exhibit 2-3 illustrates where Golf Course Road splits to provide access to the Renfrew Golf Club and access to a country residential acreage. The Golf Club access functions as a 3-leg intersection;
- The Golf Club Access (north leg) is YIELD-controlled;
- The north-westerly extension of the Golf Course Road has a gravel surface and provides access to the Country Residential dwelling, and extends further to the north-west through to the proposed extraction site; and
- Each approach of the intersection provides for a single lane of shared through-turn movements with no auxiliary lanes.

Exhibit 2-3: Golf Course Road / Site Entrance Intersection

2.4 STUDY HORIZONS

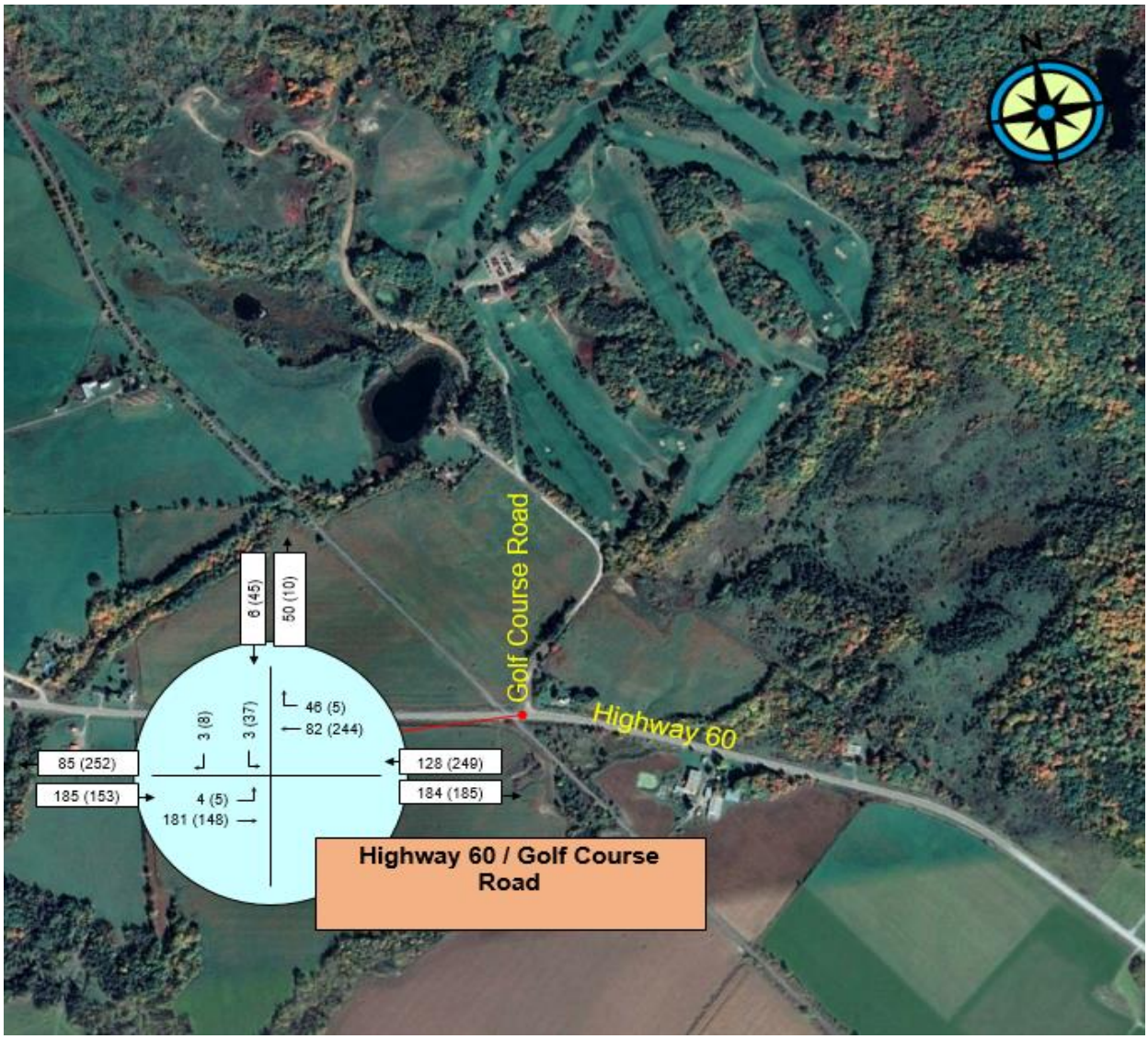
The new quarry site is proposed to be complete and operational by 2024. This study considers:

- the existing network travel demand (2022);
- the (2024) horizon year which represents the first year of operation; and
- a period + 5 years after operation has commenced (2029).

2.5 EXISTING TRAFFIC VOLUMES (2022)

A manual traffic count was conducted on Thursday, October 6, 2022 at the Highway 60 / Golf Course Road intersection during the morning (7:00-to-9:00 AM) and afternoon (3:30-to-6:00 PM) peak periods of travel demand. The count recorded the number of passenger vehicles, heavy vehicles (3-or-more axles) as well as pedestrians/cyclists making use of the adjacent recreational Algonquin Trail. During the time of the traffic count roadway improvements were taking place along the Golf Course Road. [Appendix "A" provides the collected traffic count information.]

Exhibit 2-4 illustrates, and Table 2-2 indicates, the existing (2022) balanced peak hour traffic volumes along the Golf Course Access Road.



Morning (Afternoon)

Exhibit 2-4: Existing (2022) Intersection Traffic Volumes (Vehicles-per-Hour)

Table 2-1: Existing 2022 Traffic Volumes at Highway 60/Golf Course Road Intersection (Vehicles per Hour)

Corridor	Control Type	Critical Approach/ Movement	Weekday Morning Peak Hour		Weekday Afternoon Peak Hour Thru Traffic	
Highway 60	Through Traffic	East-West	181 EB	82 WB	148 EB	244 WB
Golf Course Road	Minor leg- STOP Controlled	North-South	50 NB	6 SB	10 NB	45 SB

Values outside of brackets represent morning peak hour results.
Values inside of brackets represent afternoon peak hour results.

2.6 EXISTING TRAFFIC ANALYSIS

Intersection capacity analysis for the Highway 60/Golf Club Road intersection was undertaken utilizing Synchro™ 10 analysis software. The software incorporates Highway Capacity Manual (HCM) 6th edition methodologies to determine level-of-service (delay-based) and volume-to-capacity (v/c) performance metrics. The analyses assumed a peak hour factor of 0.95 which simulates the busiest 15-minute-period of the overall peak hour.

Appendix "B" documents the resulting Synchro output sheet indicating the existing traffic operational performance.

Table 2-2 summarizes the results of the intersection capacity analyses assuming the existing traffic conditions as illustrated within Exhibit 2-4 and the existing intersection configurations. The table indicates that the Highway 60/Golf Club Road intersection and the Renfrew Golf Club Access/ Golf Course Road intersection both currently operate at an acceptable level of service "B"-or-better in all directions during the peak hours of travel demand.

Table 2-2: Existing 2022 Intersection Capacity Analysis Result

Intersection		Control Type	Critical Approach/ Movement	Weekday Morning Peak Hour (Afternoon Peak Hour)			
				Average Delay per Vehicle (seconds)	Level of Service	95th Percentile Queue (m)	Volume-to-Capacity Ratio (v/c)
1.	Highway 60 and Golf Course Road	Minor leg-STOP	SB-LT (SB-LT)	9.6 (11.5)	A (B)	0.0 (2.25)	0.008 (0.082)
2.	Golf Course Road / Renfrew Golf Club Access Intersection	North leg-YIELD	(SB-LT) (SB-LT)	8.7 (8.7)	A (A)	0.75 (8.25)	0.0 (0.05)

Values outside of brackets represent morning peak hour results.
Values inside of brackets represent afternoon peak hour results.

3.0 TRAFFIC FORECASTS

3.1 BACKGROUND TRAFFIC GROWTH

Historical traffic volumes in the region were referenced from the Ministry of Transportation of Ontario (MTO). The closest measuring point is located at the Highway 60/Haley Road intersection located 1.8 km west of the Highway 60/Golf Course Road intersection. Exhibit 3-1 illustrates the Annual Average Daily Traffic (AADT) volumes over the 10-year period between 1996-to-2016.

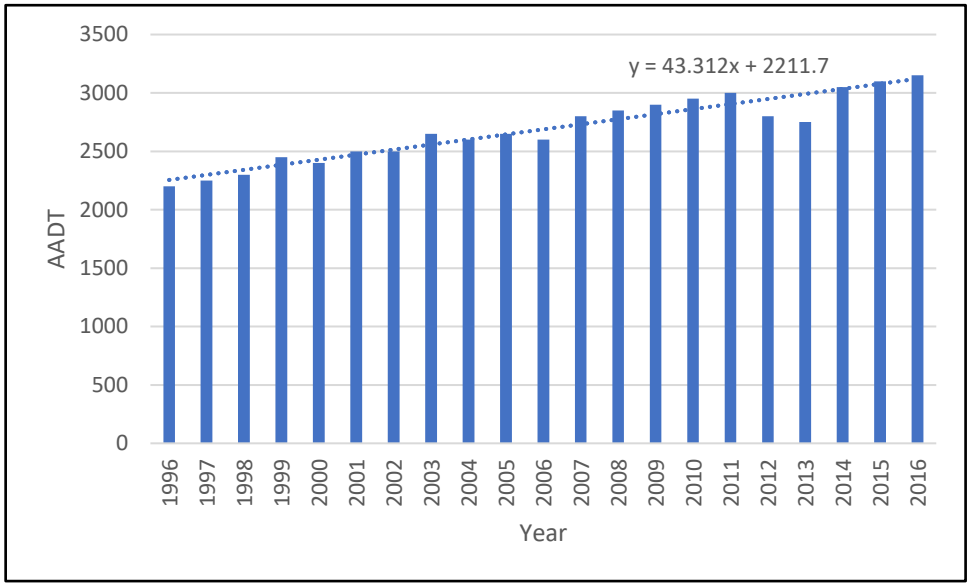


Exhibit 3-1: AADT Information for Highway 60 in Vicinity of Haley Road

The calculated annual growth rate over 20 years was found to be 1.43%. To remain conservative, an annual growth rate of 2% was adopted for this traffic impact study.

3.2 EXTRACTION SITE OPERATIONS

The following assumptions were developed in concert with representatives of Thomas Cavanagh Construction Limited. It was assumed that:

- the extraction site when operational;
  - could operate 7 days-a-week, 24 hours-a-day, if necessary;
  - is limited by acoustic constraints to 12 vehicles-per-hour entering and leaving the site between 7am-to-7pm and 4 vehicles-per-hour entering and leaving the site between 7pm-to-7am. The 12 loads-per-hour implies an average truck arrival and departure rate of one truck-every-5 minutes entering and leaving the extraction site during the daytime hours.
  - was, for the purpose of this traffic impact study, assumed to operate an average of 250 weekdays-per-year[1]. [The weekday period represents the critical analysis period for traffic concerns as it relates to the morning and afternoon peak hour of commuter traffic demand.]

1 365.25 days-per-year less weekend days (52 weeks * 2 weekend days)) and 9 Statutory Holidays and 2 inclement weather days = 250 days per year.

- employees were assumed to arrive to the site outside of the peak hours of travel demand;
- loader trucks are stationed on-site, operate internally, and would therefore have no on-going traffic effect along Highway 60;
- the peak hour site traffic will consist of both 40 tonne and 22 tonne highway hauling trucks; [For traffic analysis purposes only the full 12 daytime trucks per hour estimate was assumed to present a worst-case scenario.]
- the peak hour of the site operation was assumed to coincide with the peak morning and afternoon hours of adjacent streets travel demand;
- the site entrance would be analyzed as a STOP-controlled access.

3.3 EXTRACTION SITE TRAFFIC GENERATION

As indicated in the previous section the peak hour of operations is forecast to produce 24 two-way heavy vehicle trips-per-hour (12 inbound empty and 12 outbound filled).

Table 3-1 summarizes the anticipated site generated traffic volumes associated with the proposed Renfrew Golf Course extraction area. It's emphasized that this represents an absolute "worst-case" scenario that assumes the maximum number of vehicles-per-hour based on the permitted extraction limit of the site and full 40 tonne and 22 tonne capacity of every heavy vehicle being loaded and an arrival/departure rate of a heavy vehicle every 5 minutes during the daytime period of every working weekday of the year.

Table 3-1: Traffic Generated by Site: 2024 Horizon Year (Vehicles-per-Hour)

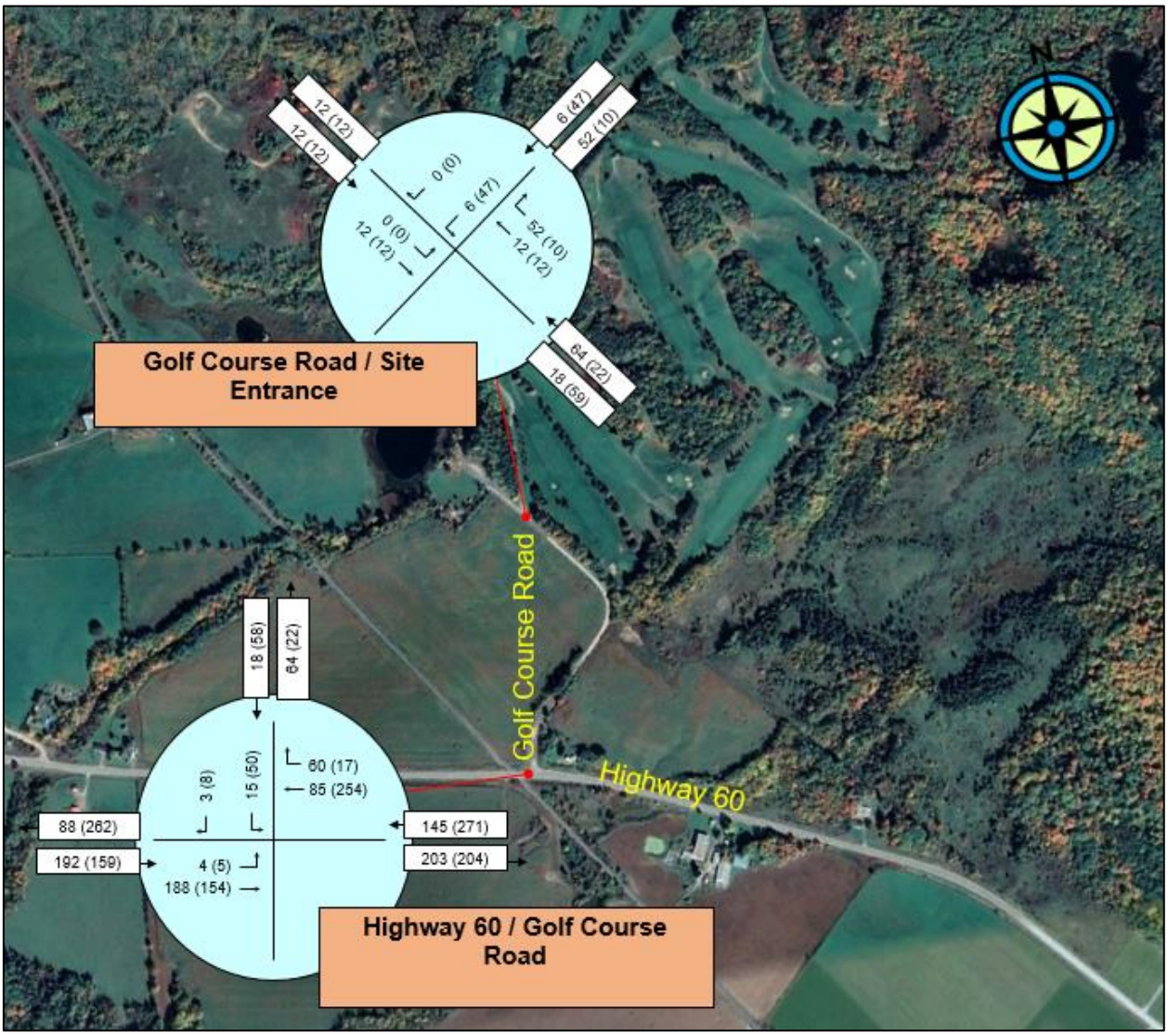
Site	*Morning Peak Hour*			*Afternoon Peak Hour*		
	In	**Out**	**Total**	**In**	**Out**	**Total**
Renfrew Golf Course Sand/Gravel Pit	12	12	24	12	12	24

3.4 THE HAUL ROUTE

Trucks leaving the site can turn left or right from Golf Club Road onto Highway 60. However, to simulate a "worst case" scenario for traffic analysis purposes, an assumption was made that all trucks leaving the site would be turning left onto Highway 60 from the Golf Club Road to travel eastward toward Renfrew and Ottawa. By exaggerating the left turn volume, we would be simulating a "worst-case" delay and queue results for those vehicles exiting the Golf Club Road onto Highway 60.

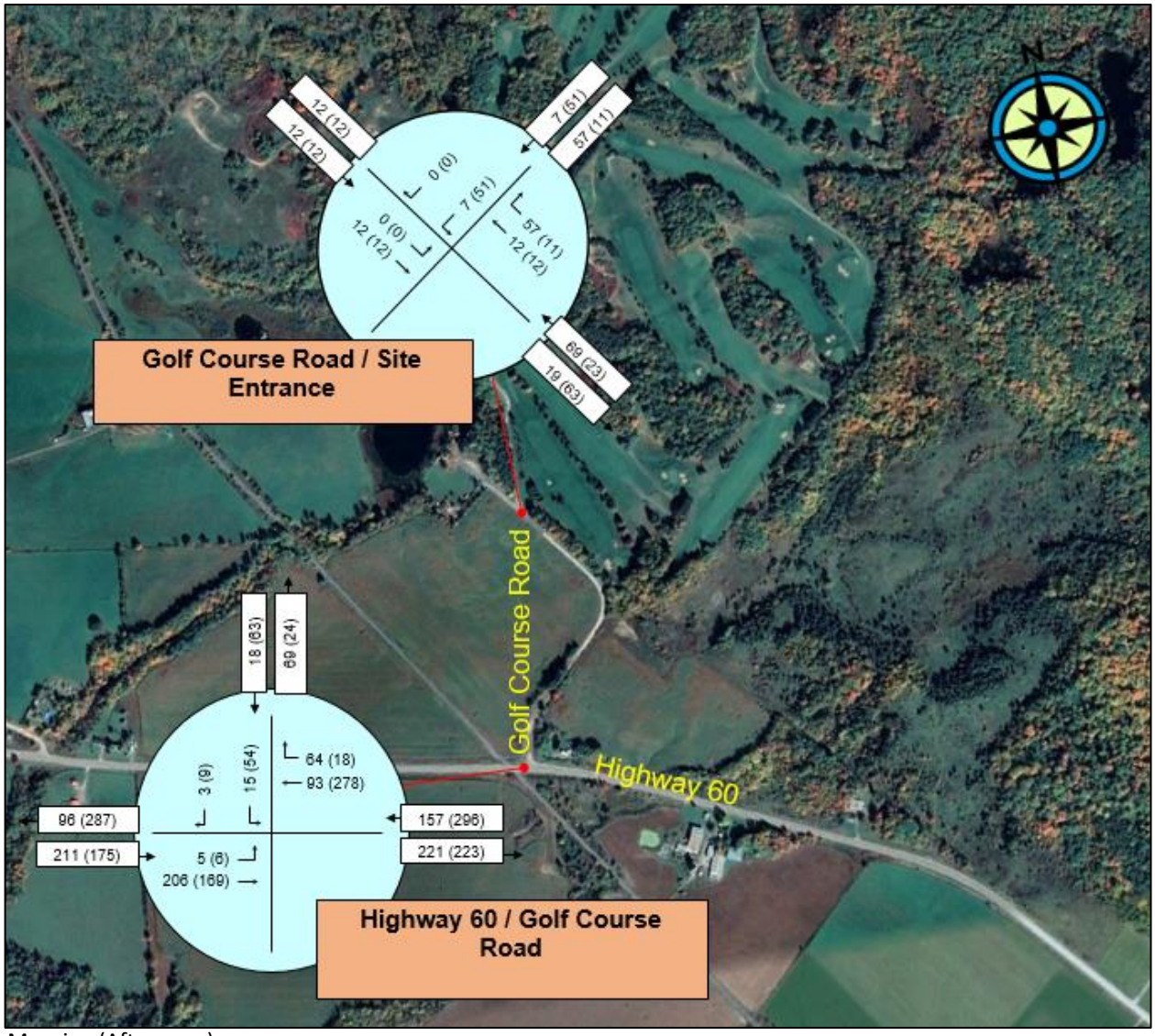
4.0 TRAFFIC FORECAST (2024 & 2029)

Exhibit 4-1 and Exhibit 4-2 illustrate the resulting forecast first year of operation (2024) and 5-Year (2029) total morning and afternoon peak hour traffic volumes.



Morning (Afternoon)

Exhibit 4-1: Operational 2024 Forecast Traffic Volumes (Vehicles-per-Hour)



Morning (Afternoon)

Exhibit 4-2: Operational 2029 Forecast Traffic Volumes (Vehicles-per-Hour)

4.1 OPERATIONAL (2024) TRAFFIC ANALYSIS

Table 4-1 summarizes the traffic operational results derived from the intersection capacity analyses. Traffic operational analysis was undertaken utilizing Synchro™ 10 analysis software to simulate the busiest 15-minute-period of the overall morning and afternoon peak hours of travel demand for the 2024 horizon year assuming the traffic volumes in Exhibit 4-1. [The Synchro output sheets for forecast 2024 operational traffic analysis are provided within Appendix "B".]

Table 4-1: Operational (2024) Intersection Capacity Analysis

Intersection		Control Type	Critical Approach/ Movement	Weekday Morning Peak Hour (Afternoon Peak Hour)			
				Average Delay per Vehicle (seconds)	Level of Service	95th Percentile Queue (m)	Volume-to-Capacity Ratio (v/c)
Without Proposed Extraction Site is in Place							
1.	Highway 60 and Golf Course Road	Minor leg- STOP	SB-LT (SB-LT)	9.6 (11.8)	A (B)	0.0 (2.25)	0.008 (0.103)
2.	Golf Course Road / Renfrew Golf Club Access Intersection	Golf Club Access SB YIELD Controlled	EB-RT (EB-RT)	0.0 (0.0)	A (A)	0.0 (0.0)	0.0 (0.0)
Assuming Proposed Extraction Site In Place							
1.	Highway 60 and Golf Course Road	Minor leg- STOP	SB-LT (SB-LT)	10.3 (11.8)	B (B)	0.75 (2.25)	0.027 (0.104)
2.	Golf Course Road / Renfrew Golf Club Access Intersection	Minor leg EB STOP Controlled & SB YIELD Controlled	EB-RT (EB-RT)	8.4 (8.6)	A (A)	0.0 (0.0)	0.012 (0.012)

The analysis:

- assumed the first year (2024) of quarry operation (as illustrated within Exhibit 4-1); and
- determined operational performance:
  - *without the proposed extraction site in place* and the existing intersection configurations. For analysis purposes the intersection capacity analysis assumed that the YIELD control along the southbound Renfrew Golf Club Access Road would remain in place.
  - *with the proposed extraction site in place.* The assumed configuration of the Golf Course Road / Renfrew Golf Club Access intersection included a STOP controlled westbound approach with the advent of the proposed extraction site. This is due to the acute (~35^{o}) angle formed between the Renfrew Golf Club Access Road with the westerly extension of the Golf Club Road. It was assumed that the YIELD control along the southbound Renfrew Golf Club Access would remain in place

Table 4-1 indicates that the area intersections that were evaluated were found to continue to operate at a satisfactory level of service "B"-or-better in all directions during the peak hours of travel demand.

- *Highway 60 & Golf Course Road Intersection*: The critical southbound left turn from the Golf Course Road onto Highway 60 Eastbound was found to operate at a level of service "B"-or-better with an average delay of less than 12 seconds.

- *Golf Course Road / Renfrew Golf Club Access Intersection*: The intersection was found to operate at a level of service "A" with an average delay of 8.5 seconds during the morning and afternoon peak hour of travel demand.

4.2 5-YEAR HORIZON (2029) TRAFFIC ANALYSIS

Table 4-2 summarizes the intersection capacity analyses results assuming:

- the (2029) 5-Year horizon traffic information illustrated within Exhibit 4-1; and
- a modified configuration of the Golf Course Road / Renfrew Golf Club Access intersection that provides for a STOP controlled westbound approach with the advent of the proposed extraction site. [This is due to the acute (~35º) angle formed between the Renfrew Golf Club Access Road with the westerly extension of the Golf Club Road.]

Table 4-2: Operational (2029) Intersection Capacity Analysis

Intersection		Control Type	Critical Approach/ Movement	Weekday Morning Peak Hour (Afternoon Peak Hour)			
				Average Delay per Vehicle (seconds)	Level of Service	95th Percentile Queue (m)	Volume-to-Capacity Ratio (v/c)
Without Proposed Extraction Site is in Place							
1.	Highway 60 and Golf Course Road	Minor leg- STOP	SB-LT (SB-LT)	9.8 (120.)	A (B)	0.0 (2.25)	0.008 (0.095)
2.	Golf Course Road / Renfrew Golf Club Access Intersection	Golf Club Access SB YIELD Controlled	EB-RT (EB-RT)	0.0 (0.0)	A (A)	0.0 (0.0)	0.0 (0.0)
Assuming Proposed Extraction Site In Place							
1.	Highway 60 and Golf Course Road	Minor leg- STOP	SB-LT (SB-LT)	10.5 (12.4)	B (B)	0.75 (3.0)	0.028 (0.12)
2.	Golf Course Road / Renfrew Golf Club Access Intersection	Minor leg EB STOP Controlled & SB YIELD Controlled	EB-RT (EB-RT)	8.4 (8.6)	A (A)	0.0 (0.0)	0.012 (0.012)

Table 4-2 indicates that all the area intersections within the study area were found to continue to operate below capacity at a level of service "B" or better in all directions during the peak hours of travel demand assuming the peak site traffic coincides with the peak hour of travel on adjacent streets.

- The Highway 60/Golf Course Road intersection was found to operate at a level of service "B"-or-better with an average delay of less than 13 seconds.
- The Golf Course Road/Renfrew Golf Club Access intersection was found to operate at a level of service "A" with no changes from the 2024 operational performance measures.

5.0 SUPPLEMENTAL ANALYSIS

5.1 GOLF COURSE ROAD EVALUATION

Golf Course Road is required to accommodate two-way heavy traffic in order to support access to the proposed Cavanaugh extraction area. Based on MTO commercial motor vehicle width restrictions[2] of 2.6 meters, a 7.0-meter paved road with 0.5 metre shoulders on either side would be the preferred cross-section. During the Fall of 2022, it is our understanding that Cavanaugh Construction completed this roadway improvement along the Golf Course Road.

5.2 TRAFFIC CONTROL AT SITE ACCESS

Highway 60 & Golf Course Road Intersection: Modifications to the lane configuration were found not to be required at this intersection since forecast traffic operations were determined to provide high levels of service (LOS "B"-or-better) with modest delays (of less than 13 seconds). This was attributed to the light traffic volumes along the Highway 60 corridor (less than 300 vph in the peak direction)

Golf Course Road / Renfrew Golf Club Access Intersection: As stated in Section 4.1:

- the western extension of the Golf Course Road was analyzed as minor leg STOP-controlled approach; and
- the Renfrew Golf Club Access Road southbound approach which originates from the Renfrew Golf Club is presently YIELD controlled and the traffic operational analysis in Section 4.0 assumed it would remain so.
- This traffic control strategy was determined to provide satisfactory operations.

Exhibit 4-1 indicated that the bulk of traffic (approximately 50 vehicles) would be headed southbound leaving the Renfrew Golf Club which would conflict with the 12 trucks leaving the proposed extraction area. However, another consideration as regards planned traffic operations is sight line analyses which, given the 35^{o} acute angle formed between the Renfrew Golf Club Access Road with the westerly extension of the Golf Club Road, required consideration.

5.3 SIGHTLINES EVALUATION

5.3.1 Highway 60 and Golf Course Road

Highway 60 in the vicinity of the Golf Course Road is a generally flat roadway with minimal vertical grades. The required sight distance was calculated as being 212 meters assuming a paved

2 https://www.ontario.ca/document/official-ministry-transportation-mto-truck-handbook/and-d-licence-classes-and-requirements#section-6

surface, a 3% grade and an 80kph operating speed (90 kph DS) along the Highway 60 corridor. The TAC Design Guide[3] was used assuming a single-unit truck, where:

$$\text{Intersection Sight Distance, } ISD = 0.278(80kph)(9.5s) \approx 212m$$

Exhibit 5-1, Exhibit 5-2 and Exhibit 5-3 provide a review of existing sightlines and illustrate that excellent sightlines are present in both east (450 meters) and west (650 meters) directions until horizontal curvature interferes.

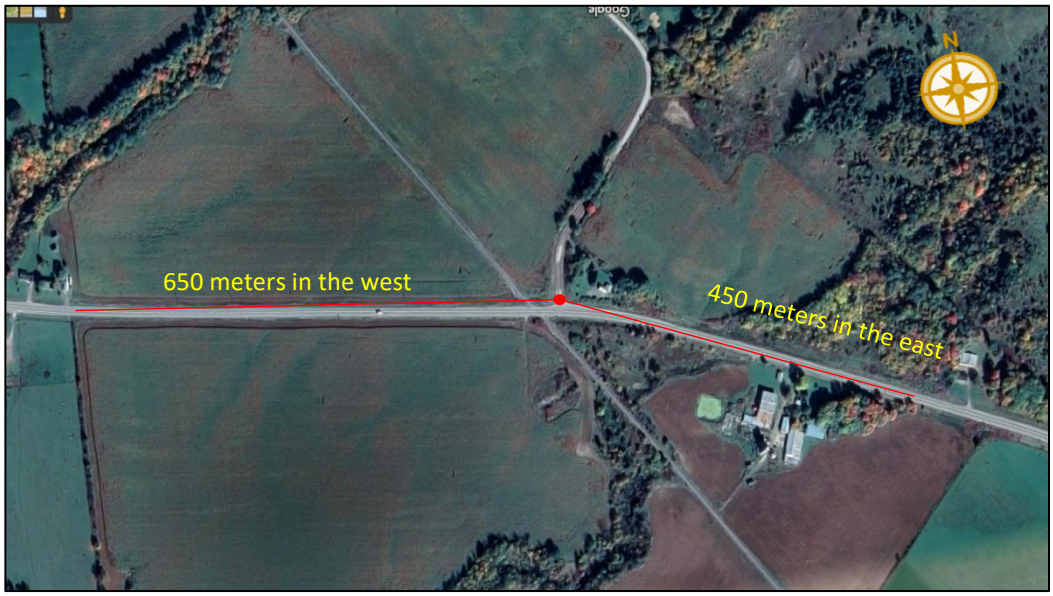


Exhibit 5-1: Highway 60 and Golf Course Road Sightlines Summary

The 450m and 650m available sight distance on the east and west approaches respectively exceed the ISD required sight-distance of 212m by a considerable amount.

Exhibit 5-2: Google Street View Image of Access Sightlines to the West

3 "*Geometric Design Guide for Canadian Roads Chapter 9 – Intersections"*, Page 67, TAC, June 2017

Exhibit 5-3: Google Street View Image of Access Sightlines to the East

5.3.2 Golf Course Road and / Renfrew Golf Club Access Intersection

The required sight distance was calculated as being 120 meters along the Golf Club Access Road assuming a paved surface, a 3% grade and an 50kph operating speed. The TAC Design Guide[4] was used assuming a single-unit truck, where:

$$\text{Intersection Sight Distance, } ISD = 0.278(50kph)(8.5s) \approx 120m$$

Exhibit 5-4 and Exhibit 5-5 illustrate the existing sightlines looking toward the Renfrew Golf Club from the intersection and indicate that the provided sightline is approximately 160 meters which is greater than the 120m requirement.

However,

- the angle formed by the Renfrew Golf Club Access and the Golf Course Road West extension is acute (approximately 35 degrees);
- the triangled shaped area between the two roads is owned by the Renfrew Golf Club;
- the triangled shaped area between the two roads is forested and significantly obstructs the view between eastbound and southbound traffic streams; and
- the existing YIELD sign serves little function in deterring what could be angled collisions for inattentive motorists.

For these reasons, arrangement should be made to clear the forested (trees, brush etc.) area between the two roads to assure an obstacle free line-of-sight between vehicles travelling eastbound and southbound. As well, the existing YIELD sign should be replaced by a STOP sign and a pavement marked STOP bar delineated on the pavement surface.

4 "*Geometric Design Guide for Canadian Roads*" *Chapter 9 – Intersections*, TAC, Page 67, June 2017

Exhibit 5-4: Golf Course Road and Site Entrance Sightlines Summary

Exhibit 5-5: Google Street View Image of Access Sightlines to the North

Exhibit 5-6: Westbound View of Golf Course Road / Renfrew Golf Club Access Intersection

A STOP sign is recommended that would face eastbound traffic leaving the excavation site. The sign should be placed to assure a clear line of sight of southbound vehicles from the golf course also wishing to merge onto Golf Club Road eastbound. Ideally, the surface for a distance 30m in advance of the new STOP sign should be paved with a delineated STOP bar indicating where heavy vehicles are to be stopped.

5.4 Left Turn Lane: Highway 60 onto Golf Course Road

An auxiliary left turn lane warrant analysis was undertaken for the Highway 60/Golf Course Road intersection following MTO geometric design standards[5] for Ontario highways. The warrants for an auxiliary left turn lanes are based on:

- the left turn volume: (LT_{vol});
- the volume of opposing vehicles: (V_o); and
- the volume of advancing vehicles: (V_a).

The purpose of a left turn auxiliary lanes is two-fold:

- to minimize that conflict between the advancing vehicles and the left turn vehicles during the left turn maneuver; and
- mitigate the delay for vehicles queued behind left turning vehicles.

The analysis assumed the 5-Year Horizon (2029) traffic volumes as illustrated within Exhibit 4-2. Exhibit 5-8 and Exhibit 5-7 illustrate the left turn warrant analysis turning from Highway 60 onto the Golf Course Road corridor assuming the 2029 morning and afternoon peak hours of travel demand.

5 *"Geometric Design Guide for Canadian Roads, Chapter 9: Intersections"* TAC, June 2017, *MTO Design Supplement", Appendix 9*

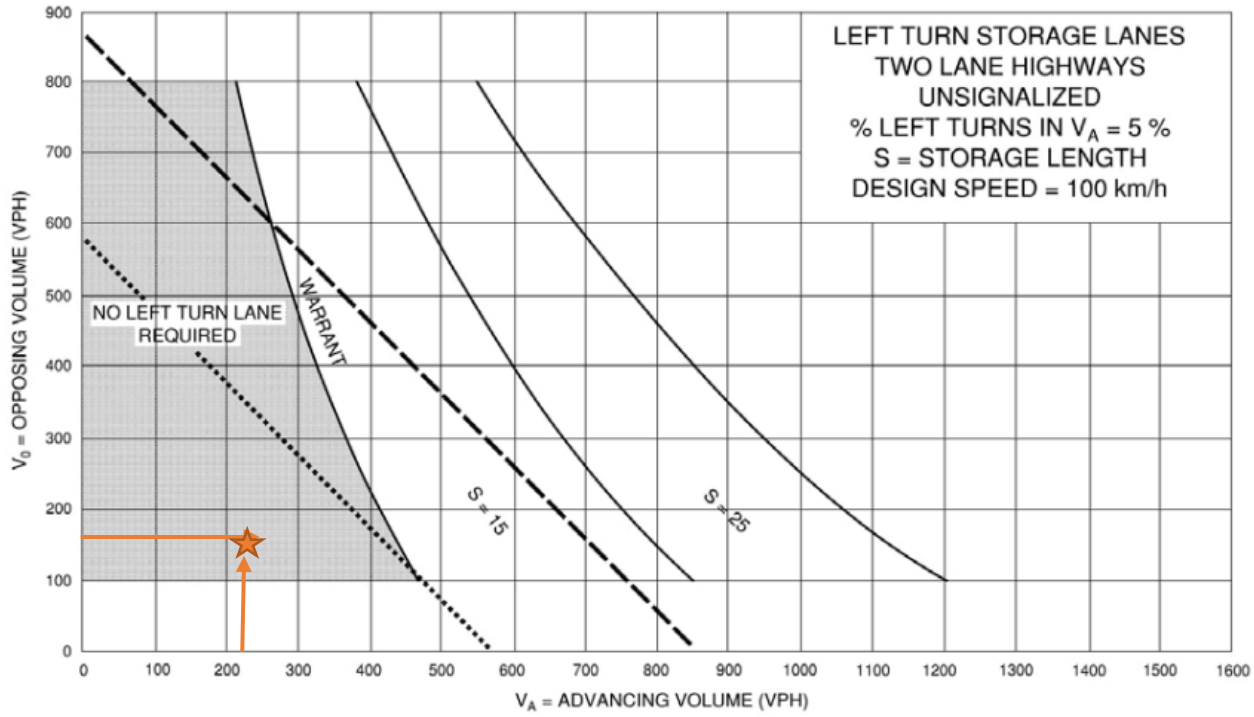


Exhibit 5-8: Left Turn Lane Warrant Analysis, Highway 60 / Golf Course Road, AM Peak Hour

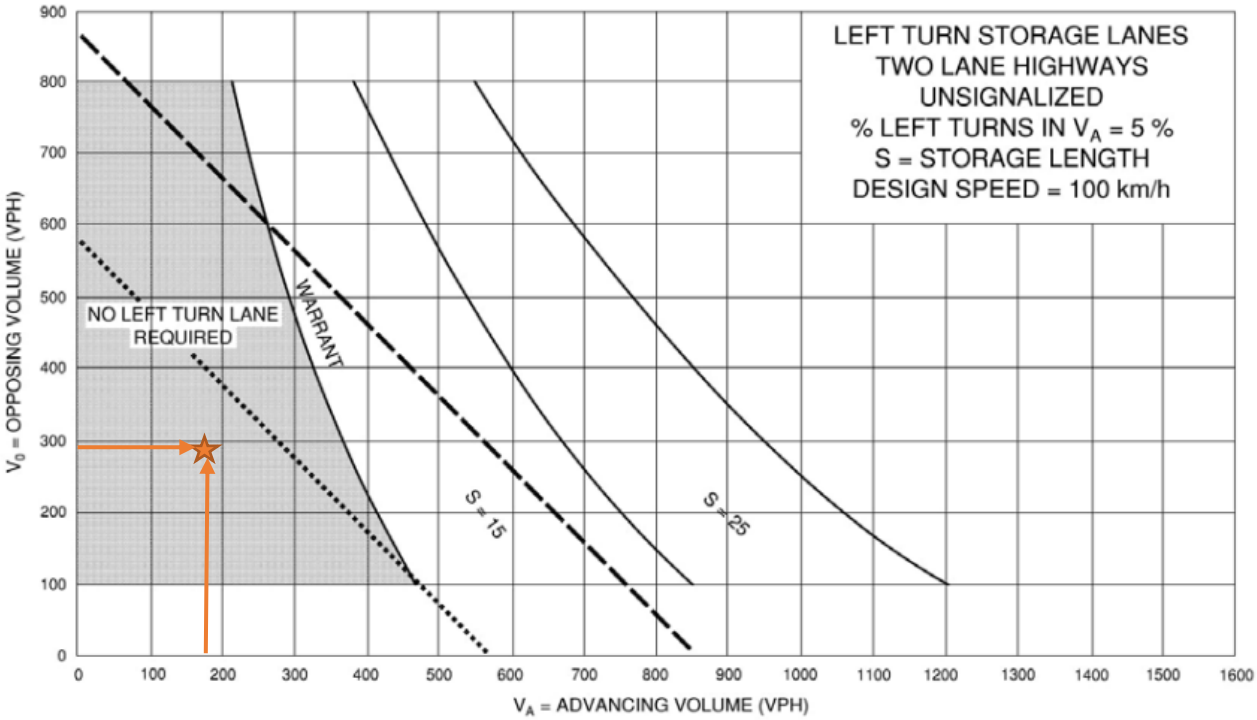


Exhibit 5-7: Left Turn Lane Warrant Analysis, Highway 60 / Golf Course Road, PM Peak Hour

Table 5-1 indicates, that:

- *Morning Peak Hour of Travel Demand:* The percentage of left turns in the advancing volume was found to be approximately 2.4%. The left turn lane was **not** warranted due to low approaching and opposing volumes (under 220 vph each); and
- *Afternoon Peak Hour of Travel Demand:* The percentage of left turns in the advancing volume was found to be 3.4%. The left turn lane was **not** warranted due to low approaching and opposing volumes (under 300 vph each).

The exhibits illustrate that an auxiliary eastbound left turn lane turning from Highway 60 onto Golf Course Road is **NOT** warranted.

Table 5-1: Left Turn Lane Warrant Analysis: Highway 60 / Golf Course Road - 5 Year Horizon (2029)

Parameter	*Symbol*	*Morning Peak Hour*	*Afternoon Peak Hour*
Left-Turn Traffic Volume	LT_{vol}	5 vph	6 vph
Number of vehicles approaching	V_a	211 vph	175 vph
Number of opposing vehicles	V_o	157 vph	296 vph
Percentage of left-turning vehicles in approaching direction: (Rounded)	$LT_{Percent}$	2.4%	3.4%

vph – Vehicles-per-hour

5.5 OPERATIONS: LEFT TURNS FROM GOLF COURSE ROAD ONTO HWY 60

An analysis was undertaken to assess the operations involved with navigating a southbound left turn from the Golf Club Road onto the Highway 60 corridor. A measure to determine the level of difficulty anticipated to be experienced by left turning motorists was an approach known as "gap acceptance". In the case of left turns, an "acceptable gap" is defined as the required space-or-time interval in the opposing stream of vehicle traffic where a motorist turning left deems it acceptable to leave the minor road from a STOP condition and safely enter the traffic stream of the major road.

The size of the "acceptable gap", often referred to as the "acceptable headway" between vehicles is function of:

- speed of the traffic stream to which the left turning vehicle wishes to enter;
- motorist behavior in terms of recognition/perception and reaction times;
- motorist reaction to the duration of stop and delay in entering the traffic stream;
- the types of vehicles wishing to navigate the left turn (passenger car, heavy single unit truck, combination vehicle);
- environmental conditions (snow, rain, fog, night/daytime etc.) ;

Determining the "available gap" in existing traffic flows would require physical measurement of the time gaps of the existing traffic flows along the Highway 60 corridor. Rather, for forecasting purposes, Table 5-2, was assembled to provide a comparison of:

- the forecast available average time gap (in seconds) between the vehicles travelling along Highway 60; versus
- the required time gaps for various vehicle types as per TAC Guidelines[6] to complete the left turns leaving Golf Club Road.

Table 5-2: Required Versus Available Time Gap to Complete Turns (Hwy 60/Golf Club Road)

Parameter	***Morning Peak Hour***		***Afternoon Peak Hour***	
	Left Turn onto Highway 60	***Right Turn onto Highway 60***	***Left Turn onto Highway 60***	***Right Turn onto Highway 60***
A+B) Number of Southbound Vehicles (vph)	**15**	**3**	**54**	**9**
A) Passenger Vehicles (vph)	3	3	42	9
B) Heavy Single Unit Trucks (vph)	12	0	12	0
Arrival Rate (Minutes per vehicle)	4.0	20.0	1.11	6.70
SB Approach Arrival Rate (Minutes per vehicle)	3.33		1.05	
Conflicting Traffic on Plant Road (Vehicles per Hour)	368	157	471	296
Average Available Gap: Plant Road (Second)	**9.8**	**22.9**	**7.6**	**12.2**
Estimated Delay (Seconds)	10.8	8.9	12.6	9.9
Average Delay to Southbound Vehicle Traffic[1] (Seconds)	9.9		11.3	
Time Gap[2] Required to Complete Turning Maneuver (Seconds)				
Design Vehicle	***Left Turn from STOP Condition[3]***	***Right Turn from STOP Condition[4]***	***Left Turn from STOP Condition[3]***	***Right Turn from STOP Condition[4]***
Passenger Car	7.5 Seconds	6.5 Seconds	7.5 Seconds	6.5 Seconds
Single Unit Truck	9.5 Seconds	8.5 Seconds	**9.5 Seconds**	8.5 Seconds

1. Referenced from Table 4-2 for delays to southbound traffic leaving the Golf Club Road. These values represent the "average" delay to all southbound vehicles as the southbound approach operates as a single shared LT/Th Lane. Vehicles making the southbound left turn (12 filled heavy single unit trucks) must queue behind other left turning passenger vehicles from the golf course. The left turning vehicles will take considerably longer to make the turn than the right turning vehicles.
2. Time Gaps are for a stopped vehicle to turn left onto a two-lane highway with no median and with grades of less than 3 percent. The values provide sufficient time for the minor road (access) vehicle to accelerate from a STOP and complete a left turn without unduly interfering with major road traffic operations. The time gap acceptance time does not vary with approach speed on the major road (Plant Road)
3. Source Footnote 7 - Table 9.9.3, Page 6
4. Source Footnote 7 - Table 9.9.5, Page 70

Table 5-2 indicates that:

- The forecast (2029) morning peak hour of travel demand results in an average available gap of 9.8 seconds between vehicles where as heavy single unit trucks require 9.5 seconds; and

6 "*Geometric Design Guide for Canadian Roads*" *Appendix 9 for Chapter 9: Intersections,* TAC, MTO Design Supplement for TAC, June 2017

- The forecast (2029) afternoon peak hour of travel demand has an average available gap of 7.6 seconds between vehicles where as heavy single unit trucks require 9.5 seconds

It should be kept in mind that average delays are not an accurate representation of headway between vehicles, as traffic most often travels in platoons creating smaller gaps within the platoon and much larger gaps outside of the platoon. Despite this characteristic, these general findings indicate that, at times, the loaded heavy single unit (HSU) trucks leaving the excavation site may find it a challenge to complete the left turns onto Highway 60. Operational analysis indicates that average delays to complete the left turns are anticipated to be approximately 15 seconds.

5.6 TRAFFIC SIGNAL WARRANT ANALYSIS

A traffic signal warrant analysis was undertaken for the minor leg-STOP-controlled Highway 60/ Golf Course Road intersection using the five-year (2029) forecast traffic volumes (as illustrated within Exhibit 4-2). The analysis applied the Ministry of Transportation of Ontario's (MTO, 2012) Traffic Signal Justification Spreadsheet which is based upon MTO's Book 12[7]. [Appendix "C" provides the detailed traffic signal justification sheets.]

5.6.1 Highway 60 & Golf Course Road – 5 Year Horizon (2029)

The traffic warrant analysis requires an 8-hour traffic count (7:00am-to-11:00am -and-3:00pm-to-7pm). Since the manual traffic count that was conducted on Thursday, October 6, 2022 at the Highway 60/Golf Course Road intersection was only 4.5 hours in duration (7:00am-to-9:00am -and- 3:30pm-to-6:00pm) it was not possible to derive a site-specific 2029 peak-hour-to-8-hour expansion factor. Hence, MTO's Average Hourly Volume (AHV) approach was used to estimate the 8-hour five-year (2029) forecast volume, where:

$$Average\ Hourly\ Volume\ (AHV) = \frac{Peak\ Hourly\ Volume\ AM + Peak\ Hour\ Volume\ PM}{4}$$

Applying MTOs Traffic Signal Justification Spreadsheet resulted in the following results:

- Justification 1A (minimum vehicle volume, total volume) was found to be 48% compliant,
- justification 1B (minimum vehicle volume, crossing volume) was found to be 11% compliant.
- Justification 2B (delay to cross traffic, crossing volume) was found to be 34% compliant in 2029 conditions,
- Justification 2B (minimum vehicular volume, crossing volume) was found to be 44% compliant.

7 "*Ontario Traffic Manual: Book 12 Traffic Signals*" March, 2012, ISBN 978-1-4435-9356-4, Traffic Signal Justification Spreadsheet.

- Justification 3 (combination) was not met, as it requires both justifications 1 and 2 to score over 80%
- Justification 4 (4-hour volume) was 5% compliant.
- Justification 7 was also be checked as the AHV approach was used: (Justification 1-or-2 needs to meet 120%) – hence, justification was not satisfied.

A review of traffic signal warrant justification spreadsheet [Appendix "C"] indicated that a traffic signal at the Highway 60/Golf Club Road intersection was **not** warranted to satisfy 2029 conditions.

5.7 RIGHT TURN AUXILLIARY TAPER PROVISIONS

Literature suggested that that the use of a right-turn auxiliary lane is required at an unsignalized intersection when "*the volume of decelerating or accelerating vehicles compared with the through traffic volume causes an undue hazard*" [8].

However, the five-year forecast peak hour morning traffic volumes for the westbound right turn from Highway 60 onto Golf Club Road are less than 60 vehicles-per-hour (which is less than a single vehicle-per-minute). As well, the intersection is forecast to operate at an acceptable LOS "B"-or-greater with its current configuration. There is no delay or queue length for the westbound right turn movement in question. In addition, a 60m taper presently exists on the east leg of the Highway 60/Golf Course Road intersection. **Further modifications to the right turn taper length were thought to be unnecessary**.

5.8 ALGONQUIN TRAIL IMPACTS

As noted in Section 2.2, The Algonquin Trail crosses Highway 60 at a point approximately 25m to the west of the Highway 60/Golf Course Road Intersection. Exhibit 5-9 and Exhibit 5-10 illustrate that the crossings of the pathway are deliberately narrowed by way of posts and gates and signage is placed along the trail to assure that ATV and Snowmobile motorists are aware of the presence of the Highway 60 corridor.

During the 4.5-hour traffic count that was undertaken on Thursday, October 6, 2022, there was 1 cyclist and 4 ATVs observed crossing the Highway 60 corridor. No pedestrians were observed. Given that, there is infrequent trail users crossing Highway 60, and the heavy vehicles accessing and departing the proposed extraction site would be headed/destined to the east, **the effect upon Algonquin Trail users in the vicinity of the Highway 60 crossing was thought to be negligible.**

8 "*Geometric Design Guide for Canadian Roads, Chapter 9: Intersections"* TAC, June 2017, Section 9.14 on tapers and auxiliary lanes.

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Exhibit 5-9: Algonquin Trail: Looking to South-East of Highway 60

Exhibit 5-10: Algonquin Trail: Looking to North-East of Highway 60

6.0 FINDINGS AND RECOMMENDATIONS

6.1 SUMMARY OF FINDINGS

The Traffic Impact Study analysis resulted in the following findings:

- The Highway 60/Golf Club Road intersection and the Renfrew Golf Club Access onto Golf Course Road both currently (2022) operate at an acceptable level of service "B"-or-better in all directions during the peak hours of travel demand.
- In the Fall of 2022, Golf Course Road has recently been upgraded to provide a 7.0-meter paved roadway width with 0.5 metre shoulders on either side.
- The calculated annual growth rate along the Highway 60 corridor over a 20-year period was found to be approximately 1.5%. To remain conservative, an annual growth rate adopted for this study was assumed to be 2 percent.
- The proposed new Thomas Cavanagh Construction Limited sand/gravel pit consists of 40-hectares of land adjacent to, and west of the Renfrew Golf Club and is expected to be operational by the year 2024.
- The peak hour of operations of the proposed site is estimated, in the worst-case scenario, to generate 24 two-way heavy vehicle trips (12 inbound and 12 outbound) with all heavy vehicles travelling eastbound toward Renfrew.
- Assuming a worst-case scenario where peak activity of the site coincides with the peak hour of travel demand on the adjacent roadways, the access intersection and the intersection with Highway 60 are both forecast to operate with satisfactory levels of service (LOS "B"-or-better) five-years after opening (2029) of the site with delays at the Highway 60 intersection of less than 13 seconds.
- *Intersection Modifications:* Modifications to the lane configuration were found **not** to be required at the Highway 60/Golf Course Road intersection since the existing lane configuration was determined to provide high levels of service (LOS "B"-or-better) with modest delays (of less than 13 seconds) assuming forecast traffic operations.
- *Sight Lines:* The Highway 60/Golf Course Road intersection satisfies the intersection sight distance requirements in all directions.

  However, the 35^{o} acute angle formed between the Renfrew Golf Club Access Road with the westerly extension of the Golf Club Road forms a triangled area of lands which is heavily forested and significantly obstructs the view between eastbound and southbound traffic streams on the two roadways. This forested area is to be cleared.
- *Left Turn Auxiliary Lane:* An eastbound auxiliary left turn lane at the Highway 60 / Golf Course Road intersection was found **not** to be warranted by forecast traffic conditions.
- *Operational Constraints:* The average available gap required to accommodate left turn movements from Golf Club Road onto Highway 60 was found to be 7.6 seconds during the forecast afternoon peak hour of travel demand, however, literature suggests heavy vehicles would require 9.5 seconds to enter the eastbound traffic stream. However, the eastbound vehicle stream is often characterized by platoons. Operational analysis indicates

that average delays to complete the left turns are anticipated to be approximately 15 seconds. This 15 second delay to enter Highway 60 eastbound is thought to be acceptable.

- *Traffic Signals:* Traffic signals were found **not to be warranted** at the Highway 60 / Golf Course Road intersection.
- *Right Turn Taper:* The existing westbound right turn/taper at the Highway 60 / Golf Course Road intersection was found to be sufficient to accommodate the forecast traffic;
- *Algonquin Trail*: This trail is located 25m to the west of the Highway 60 / Golf Course Road intersection. The effect of development of the proposed site upon Algonquin Trail users in the vicinity of the Highway 60 crossing was thought to be negligible.

6.2 SUMMARY OF RECOMMENDATIONS

It is recommended that:

- *Clearing of Triangular Area Blocking Sight-Lines:* The triangled forested area of lands owned by the Renfrew Golf Club between the Renfrew Golf Club Access Road and Golf Club Road should be cleared (of trees, brush etc.) of all significant obstacles that would obstruct the line-of-sight between vehicles travelling eastbound and southbound. The limits of clearing should ideally extend to a point 10m before the location of the STOP signs facing eastbound and southbound traffic.
- *Replacement of YIELD Sign with STOP Control:* The existing YIELD sign on the Renfrew Golf Club Access Road facing traffic leaving the golf club should be replaced by a STOP sign, and a pavement marked STOP bar delineated on the pavement surface.
- *STOP Control Sign Placed on Eastbound Approach of Golf Club Road/Renfrew Golf Course Access:* A STOP sign is recommended that would face eastbound traffic leaving the excavation site. The sign should be placed to assure a clear line of sight of southbound vehicles from the golf course also wishing to merge onto Golf Club Road eastbound. Ideally the surface 30m in front of the new STOP sign should be paved and a pavement marked STOP bar delineated on the pavement surface.

It is recommended that the Ministry of Northern Development, Mines, Natural Resources and Forestry, and relevant approval authorities:

- permit Thomas Cavanagh Construction Limited to proceed with the proposed Renfrew Golf Course Sand/Gravel pit, from a transportation/traffic standpoint; and
- assure that the above recommendations are implemented as conditions of approval.

APPENDIX A – BACKGROUND TRAFFIC COUNTS

Morning Peak Hour Results (October 6, 2022)

	0:15		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Time Period			Westbound							Northbound							Eastbound							Southbound							Total		All	Peak Hr Totals
			RT		TH		LT			RT		TH		LT			RT		TH		LT			RT		TH		LT						
	From	To	Heavy	Passenge	Heavy	Passenge	Heavy	Passenge	edestrian	Heavy	Passenge	Heavy	Passenge	Heavy	Passenge	edestrian	Heavy	Passenge	Heavy	Passenge	Heavy	Passenge	edestrian	Heavy	Passenge	Heavy	Passenge	Heavy	Passenge	edestrian	Heavy	Passenge		
1	7:00	7:15	0	0	0	21													0	33	0	0		0	0			0	0		0	54	54	
2	7:15	7:30	0	0	2	21													0	38	2	1		0	2			0	0		4	62	66	
3	7:30	7:45	1	6	2	23													2	54	0	2		0	0			0	1		5	86	91	
4	7:45	8:00	0	30	1	5													2	43	0	0		0	1			0	1		3	80	83	294
5	8:00	8:15	0	5	2	21													2	36	2	0		2	0			0	1		8	63	71	311
6	8:15	8:30	0	4	0	28													1	41	0	0		0	0			0	0		1	73	74	319
7	8:30	8:45	0	3	1	31													1	42	1	2		1	0			0	1		4	79	83	311
8	8:45	9:00	2	3	0	15													0	38	2	0		0	0			0	1		4	57	61	289
9	9:00	9:15																													0	0	0	218
10	9:15	9:30																													0	0	0	144
11	9:30	9:45																													0	0	0	61
12	9:45	10:00																													0	0	0	0
3	7:30	8:30	<<<Calculated Peak Hour																															
	AM Peak Period		3	51	8	165	0	0	0	0	0	0	0	0	0	0	0	0	8	325	7	5	0	3	3	0	0	0	5	0	29	554	583	
	Heavy Vehicle %		6%		5%		#DIV/0!			#DIV/0!		#DIV/0!		#DIV/0!			#DIV/0!		2%		58%			50%		#DIV/0!		0%				5%		
	AM Peak Hour		1	45	5	77	0	0	0	0	0	0	0	0	0	0	0	0	7	174	2	2	0	2	1	0	0	0	3	0	17	302	319	
	Heavy Vehicle %		2%		6%		#DIV/0!			#DIV/0!		#DIV/0!		#DIV/0!			#DIV/0!		4%		50%			67%		#DIV/0!		0%				5%		
	AM Peak Hr Total		46		82		0			0		0		0			0		181		4			3		0		3						
	Peak Hr Approach T		128							0							185							6										

Afternoon Peak Hour Results (October 6, 2022)

	0:15		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Time Period			Westbound							Northbound							Eastbound							Southbound							Total		All	Peak Hr Totals
			RT		TH		LT			RT		TH		LT			RT		TH		LT			RT		TH		LT						
	From	To	Heavy	Passenge	Heavy	Passenge	Heavy	Passenge	edestrian	Heavy	Passenge	Heavy	Passenge	Heavy	Passenge	edestrian	Heavy	Passenge	Heavy	Passenge	Heavy	Passenge	edestrian	Heavy	Passenge	Heavy	Passenge	Heavy	Passenge	edestrian	Heavy	Passenge		
1	15:00	15:15																													0	0	0	
2	15:15	15:30																													0	0	0	
3	15:30	15:45	1	0	2	42													2	31	1	1		1	1			0	3		7	78	85	
4	15:45	16:00	0	2	0	44													1	40	0	0		2	0			0	4		3	90	93	178
5	16:00	16:15	0	1	2	56													2	38	1	0		1	1			0	4		6	100	106	284
6	16:15	16:30	0	2	0	64													1	43	2	0		1	0			0	2		4	111	115	399
7	16:30	16:45	0	2	3	54													6	26	2	0		0	3			2	17		13	102	115	429
8	16:45	17:00	1	0	1	51													2	38	0	0		1	3			0	8		5	100	105	441
9	17:00	17:15	0	0	2	69													1	31	0	1		0	0			1	7		4	108	112	447
10	17:15	17:30	0	2	0	54													0	50	0	0		0	0			1	2		1	108	109	441
11	17:30	17:45	0	1	0	46													1	31	0	1		0	1			0	6		1	86	87	413
12	17:45	18:00	0	2	0	42													1	29	0	0		0	1			0	2		1	76	77	385
6	16:45	17:00	<<<Calculated Peak Hour																															
	PM Peak Period		2	12	10	522	0	0	0	0	0	0	0	0	0	0	0	0	17	357	6	3	0	6	10	0	0	4	55	0	45	959	1004	
	Heavy Vehicle %		14%		2%		#DIV/0!			#DIV/0!		#DIV/0!		#DIV/0!			#DIV/0!		5%		67%			38%		#DIV/0!		7%				4%		
	PM Peak Hour		1	4	6	238	0	0	0	0	0	0	0	0	0	0	0	0	10	138	4	1	0	2	6	0	0	3	34	0	26	421	447	
	Heavy Vehicle %		20%		2%		#DIV/0!			#DIV/0!		#DIV/0!		#DIV/0!			#DIV/0!		7%		80%			25%		#DIV/0!		8%				6%		
	PM Peak Hr Total		5		244		0			0		0		0			0		148		5			8		0		37						
	Peak Hr Approach T		249							0							153							45										

APPENDIX B - SYNCHRO TRAFFIC ANALYSIS
FORECAST EXISTING (2022), OPERATIONS (2024) AND 5 YEAR HORIZON (2029)

Movement	SBL	SBR	SEL	SET	NWT	NWR
Lane Configurations						
Traffic Volume (veh/h)	4	0	0	2	2	44
Future Volume (Veh/h)	4	0	0	2	2	44
Sign Control	Yield			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)	4	0	0	2	2	48
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	28	26	50			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	28	26	50			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	987	1050	1557			

Direction, Lane #	SB 1	SE 1	NW 1
Volume Total	4	2	50
Volume Left	4	0	0
Volume Right	0	0	48
cSH	987	1557	1700
Volume to Capacity	0.00	0.00	0.03
Queue Length 95th (m)	0.1	0.0	0.0
Control Delay (s)	8.7	0.0	0.0
Lane LOS	A		
Approach Delay (s)	8.7	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	4	181	82	46	3	3
Future Vol, veh/h	4	181	82	46	3	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	4	197	89	50	3	3

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	139	0	-	0	319	114
Stage 1	-	-	-	-	114	-
Stage 2	-	-	-	-	205	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1445	-	-	-	674	939
Stage 1	-	-	-	-	911	-
Stage 2	-	-	-	-	829	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1445	-	-	-	672	939
Mov Cap-2 Maneuver	-	-	-	-	672	-
Stage 1	-	-	-	-	908	-
Stage 2	-	-	-	-	829	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	9.6
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1445	-	-	-	783
HCM Lane V/C Ratio	0.003	-	-	-	0.008
HCM Control Delay (s)	7.5	0	-	-	9.6
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0

Movement	SBL	SBR	SEL	SET	NWT	NWR
Lane Configurations						
Traffic Volume (veh/h)	43	0	0	2	2	3
Future Volume (Veh/h)	43	0	0	2	2	3
Sign Control	Yield			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)	47	0	0	2	2	3
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	6	4	5			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	6	4	5			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	100	100			
cM capacity (veh/h)	1016	1080	1616			

Direction, Lane #	SB 1	SE 1	NW 1
Volume Total	47	2	5
Volume Left	47	0	0
Volume Right	0	0	3
cSH	1016	1616	1700
Volume to Capacity	0.05	0.00	0.00
Queue Length 95th (m)	1.1	0.0	0.0
Control Delay (s)	8.7	0.0	0.0
Lane LOS	A		
Approach Delay (s)	8.7	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	7.6		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	148	244	5	37	8
Future Vol, veh/h	5	148	244	5	37	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	161	265	5	40	9

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	270	0	-	0	439	268
Stage 1	-	-	-	-	268	-
Stage 2	-	-	-	-	171	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1293	-	-	-	575	771
Stage 1	-	-	-	-	777	-
Stage 2	-	-	-	-	859	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1293	-	-	-	573	771
Mov Cap-2 Maneuver	-	-	-	-	573	-
Stage 1	-	-	-	-	774	-
Stage 2	-	-	-	-	859	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	11.5
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1293	-	-	-	600
HCM Lane V/C Ratio	0.004	-	-	-	0.082
HCM Control Delay (s)	7.8	0	-	-	11.5
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.3

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	4	188	85	48	3	3
Future Vol, veh/h	4	188	85	48	3	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	4	198	89	51	3	3

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	140	0	-	0	321	115
Stage 1	-	-	-	-	115	-
Stage 2	-	-	-	-	206	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1443	-	-	-	673	937
Stage 1	-	-	-	-	910	-
Stage 2	-	-	-	-	829	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1443	-	-	-	671	937
Mov Cap-2 Maneuver	-	-	-	-	671	-
Stage 1	-	-	-	-	907	-
Stage 2	-	-	-	-	829	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	9.6
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1443	-	-	-	782
HCM Lane V/C Ratio	0.003	-	-	-	0.008
HCM Control Delay (s)	7.5	0	-	-	9.6
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	0	0	52	6	0
Future Vol, veh/h	0	0	0	52	6	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	0	55	6	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	61	6	6	0	-	0
Stage 1	6	-	-	-	-	-
Stage 2	55	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	945	1077	1615	-	-	-
Stage 1	1017	-	-	-	-	-
Stage 2	968	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	945	1077	1615	-	-	-
Mov Cap-2 Maneuver	945	-	-	-	-	-
Stage 1	1017	-	-	-	-	-
Stage 2	968	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1615	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	0	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	154	254	5	50	8
Future Vol, veh/h	5	154	254	5	50	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	162	267	5	53	8

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	272	0	-	0	442	270
Stage 1	-	-	-	-	270	-
Stage 2	-	-	-	-	172	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1291	-	-	-	573	769
Stage 1	-	-	-	-	775	-
Stage 2	-	-	-	-	858	-
Platoon blocked, %			-	-	-	
Mov Cap-1 Maneuver	1291	-	-	-	571	769
Mov Cap-2 Maneuver	-	-	-	-	571	-
Stage 1	-	-	-	-	772	-
Stage 2	-	-	-	-	858	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	11.8
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1291	-	-	-	592
HCM Lane V/C Ratio	0.004	-	-	-	0.103
HCM Control Delay (s)	7.8	0	-	-	11.8
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.3

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	0	0	10	47	0
Future Vol, veh/h	0	0	0	10	47	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	0	11	49	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	60	49	49	0	-	0
Stage 1	49	-	-	-	-	-
Stage 2	11	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	947	1020	1558	-	-	-
Stage 1	973	-	-	-	-	-
Stage 2	1012	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	947	1020	1558	-	-	-
Mov Cap-2 Maneuver	947	-	-	-	-	-
Stage 1	973	-	-	-	-	-
Stage 2	1012	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1558	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	0	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	4	188	85	60	15	3
Future Vol, veh/h	4	188	85	60	15	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	4	198	89	63	16	3

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	152	0	-	0	327	121
Stage 1	-	-	-	-	121	-
Stage 2	-	-	-	-	206	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1429	-	-	-	667	930
Stage 1	-	-	-	-	904	-
Stage 2	-	-	-	-	829	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1429	-	-	-	665	930
Mov Cap-2 Maneuver	-	-	-	-	665	-
Stage 1	-	-	-	-	901	-
Stage 2	-	-	-	-	829	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	10.3
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1429	-	-	-	698
HCM Lane V/C Ratio	0.003	-	-	-	0.027
HCM Control Delay (s)	7.5	0	-	-	10.3
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection	
Int Delay, s/veh	2.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	12	12	52	6	0
Future Vol, veh/h	0	12	12	52	6	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	13	13	55	6	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	87	6	6	0	-	0
Stage 1	6	-	-	-	-	-
Stage 2	81	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	914	1077	1615	-	-	-
Stage 1	1017	-	-	-	-	-
Stage 2	942	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	907	1077	1615	-	-	-
Mov Cap-2 Maneuver	907	-	-	-	-	-
Stage 1	1009	-	-	-	-	-
Stage 2	942	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.4	1.4	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1615	-	1077	-	-
HCM Lane V/C Ratio	0.008	-	0.012	-	-
HCM Control Delay (s)	7.2	0	8.4	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	154	254	17	50	8
Future Vol, veh/h	5	154	254	17	50	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	162	267	18	53	8

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	285	0	-	0	448	276
Stage 1	-	-	-	-	276	-
Stage 2	-	-	-	-	172	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1277	-	-	-	568	763
Stage 1	-	-	-	-	771	-
Stage 2	-	-	-	-	858	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1277	-	-	-	566	763
Mov Cap-2 Maneuver	-	-	-	-	566	-
Stage 1	-	-	-	-	768	-
Stage 2	-	-	-	-	858	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	11.8
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1277	-	-	-	587
HCM Lane V/C Ratio	0.004	-	-	-	0.104
HCM Control Delay (s)	7.8	0	-	-	11.8
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.3

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	12	12	10	47	0
Future Vol, veh/h	0	12	12	10	47	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	13	13	11	49	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	86	49	49	0	-	0
Stage 1	49	-	-	-	-	-
Stage 2	37	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	915	1020	1558	-	-	-
Stage 1	973	-	-	-	-	-
Stage 2	985	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	908	1020	1558	-	-	-
Mov Cap-2 Maneuver	908	-	-	-	-	-
Stage 1	965	-	-	-	-	-
Stage 2	985	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.6	4	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1558	-	1020	-	-
HCM Lane V/C Ratio	0.008	-	0.012	-	-
HCM Control Delay (s)	7.3	0	8.6	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	206	93	52	3	3
Future Vol, veh/h	5	206	93	52	3	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	217	98	55	3	3

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	153	0	-	0	353	126
Stage 1	-	-	-	-	126	-
Stage 2	-	-	-	-	227	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1428	-	-	-	645	924
Stage 1	-	-	-	-	900	-
Stage 2	-	-	-	-	811	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1428	-	-	-	642	924
Mov Cap-2 Maneuver	-	-	-	-	642	-
Stage 1	-	-	-	-	896	-
Stage 2	-	-	-	-	811	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	9.8
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1428	-	-	-	758
HCM Lane V/C Ratio	0.004	-	-	-	0.008
HCM Control Delay (s)	7.5	0	-	-	9.8
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	0	0	57	7	0
Future Vol, veh/h	0	0	0	57	7	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	0	60	7	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	67	7	7	0	-	0
Stage 1	7	-	-	-	-	-
Stage 2	60	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	938	1075	1614	-	-	-
Stage 1	1016	-	-	-	-	-
Stage 2	963	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	938	1075	1614	-	-	-
Mov Cap-2 Maneuver	938	-	-	-	-	-
Stage 1	1016	-	-	-	-	-
Stage 2	963	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1614	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	0	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	6	169	278	6	42	9
Future Vol, veh/h	6	169	278	6	42	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	178	293	6	44	9

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	299	0	-	0	486	296
Stage 1	-	-	-	-	296	-
Stage 2	-	-	-	-	190	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1262	-	-	-	540	743
Stage 1	-	-	-	-	755	-
Stage 2	-	-	-	-	842	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1262	-	-	-	537	743
Mov Cap-2 Maneuver	-	-	-	-	537	-
Stage 1	-	-	-	-	751	-
Stage 2	-	-	-	-	842	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	12
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1262	-	-	-	565
HCM Lane V/C Ratio	0.005	-	-	-	0.095
HCM Control Delay (s)	7.9	0	-	-	12
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.3

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	0	0	11	51	0
Future Vol, veh/h	0	0	0	11	51	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	0	12	54	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	66	54	54	0	-	0
Stage 1	54	-	-	-	-	-
Stage 2	12	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	939	1013	1551	-	-	-
Stage 1	969	-	-	-	-	-
Stage 2	1011	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	939	1013	1551	-	-	-
Mov Cap-2 Maneuver	939	-	-	-	-	-
Stage 1	969	-	-	-	-	-
Stage 2	1011	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1551	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	0	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	206	93	64	15	3
Future Vol, veh/h	5	206	93	64	15	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	217	98	67	16	3

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	165	0	-	0	359	132
Stage 1	-	-	-	-	132	-
Stage 2	-	-	-	-	227	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1413	-	-	-	640	917
Stage 1	-	-	-	-	894	-
Stage 2	-	-	-	-	811	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1413	-	-	-	637	917
Mov Cap-2 Maneuver	-	-	-	-	637	-
Stage 1	-	-	-	-	890	-
Stage 2	-	-	-	-	811	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	10.5
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1413	-	-	-	671
HCM Lane V/C Ratio	0.004	-	-	-	0.028
HCM Control Delay (s)	7.6	0	-	-	10.5
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	12	12	57	7	0
Future Vol, veh/h	0	12	12	57	7	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	13	13	60	7	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	93	7	7	0	-	0
Stage 1	7	-	-	-	-	-
Stage 2	86	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	907	1075	1614	-	-	-
Stage 1	1016	-	-	-	-	-
Stage 2	937	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	900	1075	1614	-	-	-
Mov Cap-2 Maneuver	900	-	-	-	-	-
Stage 1	1008	-	-	-	-	-
Stage 2	937	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.4	1.3	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1614	-	1075	-	-
HCM Lane V/C Ratio	0.008	-	0.012	-	-
HCM Control Delay (s)	7.2	0	8.4	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	1.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	6	169	278	18	54	9
Future Vol, veh/h	6	169	278	18	54	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	178	293	19	57	9

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	312	0	-	0	493	303
Stage 1	-	-	-	-	303	-
Stage 2	-	-	-	-	190	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1248	-	-	-	535	737
Stage 1	-	-	-	-	749	-
Stage 2	-	-	-	-	842	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1248	-	-	-	532	737
Mov Cap-2 Maneuver	-	-	-	-	532	-
Stage 1	-	-	-	-	745	-
Stage 2	-	-	-	-	842	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	12.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1248	-	-	-	554
HCM Lane V/C Ratio	0.005	-	-	-	0.12
HCM Control Delay (s)	7.9	0	-	-	12.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.4

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	12	12	11	51	0
Future Vol, veh/h	0	12	12	11	51	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	13	13	12	54	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	92	54	54	0	-	0
Stage 1	54	-	-	-	-	-
Stage 2	38	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	908	1013	1551	-	-	-
Stage 1	969	-	-	-	-	-
Stage 2	984	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	901	1013	1551	-	-	-
Mov Cap-2 Maneuver	901	-	-	-	-	-
Stage 1	961	-	-	-	-	-
Stage 2	984	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.6	3.8	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1551	-	1013	-	-
HCM Lane V/C Ratio	0.008	-	0.012	-	-
HCM Control Delay (s)	7.3	0	8.6	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

APPENDIX C – TRAFFIC SIGNAL WARRANT JUSTIFICATION SPREADSHEETS

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Highway 60 / Golf Course Road Count Date: 2022-10-06

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	48	%	☐	☑
	B	Crossing Volume	11	%		
2. Delay to Cross Traffic	A	Main Road	44	%	☐	☑
	B	Crossing Road	34	%		
3. Combination	A	Justificaton 1	11	%	☐	☑
	B	Justification 2	34	%		
4. 4-Hr Volume			5	%	☐	☑
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			