Traffic Impact Review
Cumberland Quarry

Severn Aggregates Limited

P/N 12-2649 | October 27, 2017

Township of
Severn
County of Simcoe

Skelton Brumwell & Associates Inc.
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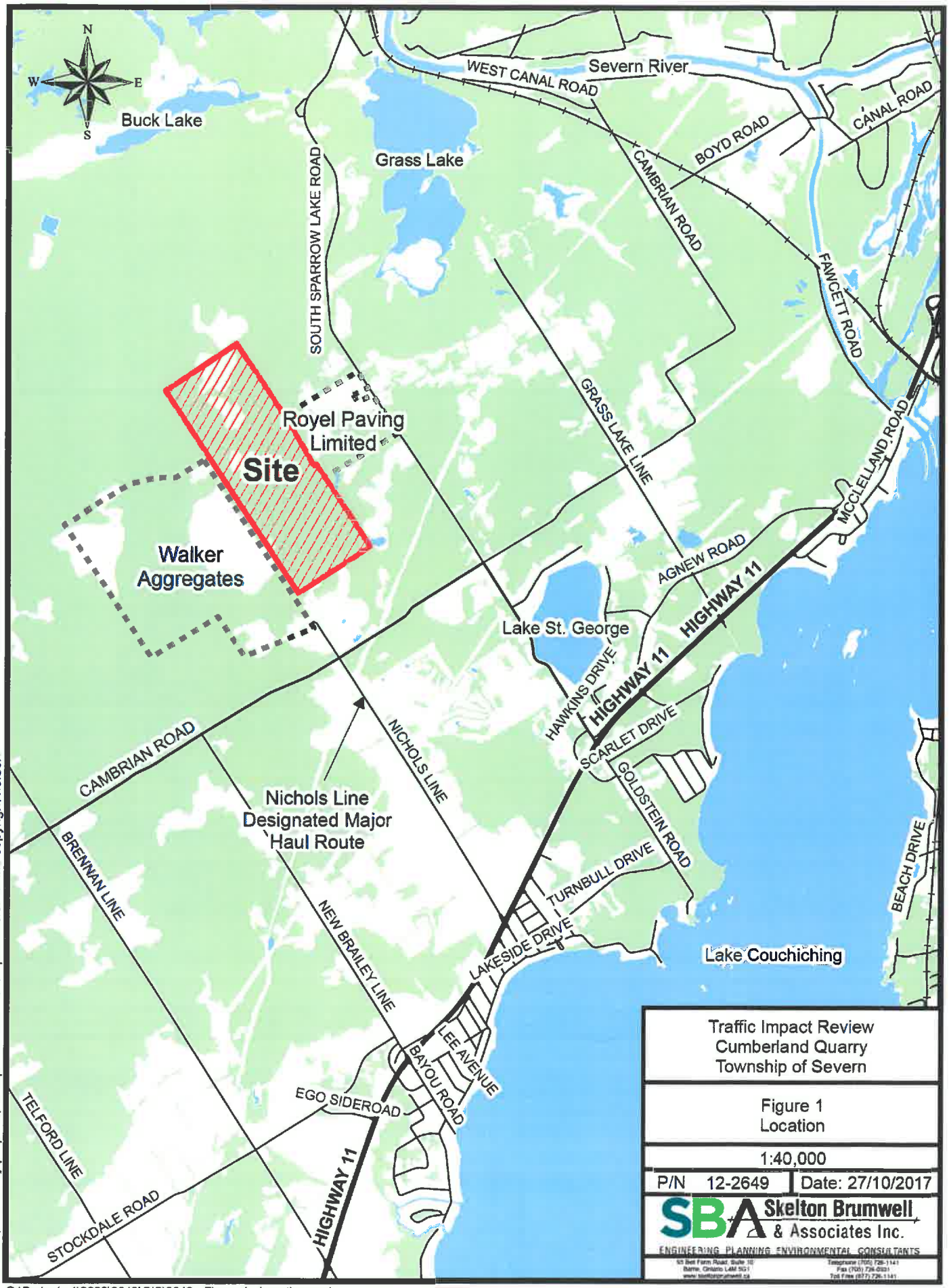
1.0 Introduction

Severn Aggregates Limited is proposing to develop a new limestone quarry to be located on a 138 hectare parcel of land located at the north-western terminus of Nichols Line, generally north of Highway 11 and west of South Sparrow Lake Road. The legal description of the site is west half of Lots 12, 13 and 14, Concession 11, in the Geographic Township of Orillia, North Division, now in the Township of Severn. The site location is shown on Figure 1 on the following page.

The Cumberland Quarry proposal is for a maximum annual extraction of 500,000 tonnes of limestone for dimensional stone and crushed stone products. The proposed quarry is situated immediately east of the existing Severn Pines Quarry which is operated by Walker Aggregates Inc. The Severn Quarry has a licensed area of 178.8 hectares and has a maximum allowable annual extraction of 3 million tonnes.

This study is intended to address policies and support applications for amendments to the Township of Severn Official Plan and Zoning By-law, and the application under the Aggregate Resources Act (ARA) for a Category 2, Class A license.



Traffic Impact Review
Cumberland Quarry
Township of Severn

Figure 1
Location

1:40,000

P/N 12-2649 | Date: 27/10/2017

SBA Skelton Brumwell & Associates Inc.
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G:\Projects-1\2600\2649\GIS\2649 - Figure 1 - Location.mxd

2.0 CONTEXT

The market area for the proposed Cumberland Quarry is primarily the northern GTA including York Region and Peel Region. Some product would also be destined for locations in Simcoe County, including Orillia and Barrie, and a smaller percentage of the material may be shipped to locations in Muskoka including Gravenhurst, Bracebridge and Huntsville. Nichols Line is designated as a Major Haul Route and will be the only Township maintained haul route for the proposed quarry, providing direct access to Highway 11. To access the proposed quarry, Nichols Line will be extended about 800 metres northward along the existing unopened road allowance. The total distance from the quarry entrance to Highway 11 will be about 3.1 kilometres.

Highway 11 through this area is a four lane, divided highway with partially controlled access and a posted speed limit of 90 km/hr. For Nichols Line, access to and from Highway 11 is restricted to the southbound lanes as there is no interchange at this location. For product being shipped south, loaded trucks will take Nichols Line to Highway 11 and then proceed south on Highway 11. Empty trucks returning northbound to the site would exit Highway 11 at South Sparrow Lake Road, cross over the highway to access the southbound lanes and then proceed south to the Nichols Line exit. Trucks shipping product northward would take Highway 11 south to the New Brailey Line / Bayou Road exit and then cross over the highway to access the northbound lanes. Southound returning empty trucks would just exit at the Nichols Line.

Between the access point for the Cumberland Quarry and Highway 11, Nichols Line is straight and relatively flat with excellent sight distance and a posted speed limit is 60 km/hr. The roadway has an asphalt width of about 7.2 metres with approximately 1.5 metre wide gravel shoulders. There are five residences situated along Nichols Line between the proposed quarry site and Highway 11, and there is one commercial operation, KRS Crane Rentals, which is located at the northerly corner of the Nichols Line / Highway 11 intersection. We understand that the majority of the properties along Nichols Line are owned by Walker Aggregates.

In 1998, the Township of Severn entered into a Haul Route Agreement with Georgian Aggregates, the predecessor to Walker Aggregates. The Agreement covered the reconstruction of Nichols Line required to accommodate the Severn Quarry, which at that time was being licensed for 1 million tonnes per year.

A subsequent Haul Route Agreement was signed between the Township, Walker Aggregates and MAQ Aggregates in 2008. MAQ Aggregates owns a quarry licensed for a maximum of 1 million tonnes per year in the east half of Lots 12 and 13, Concession 8 which is accessed from Brennan Line. The new agreement covered additional improvements to Nichols Line, including reconstruction work at the intersection of Nichols Line and Cambrian Road, and at the intersection with Highway 11. These works were necessary to allow for the additional traffic from MAQ Aggregates to use Nichols Line as a haul route, and to allow for an increase in the annual licensed tonnage for Severn Quarry from 1 million to 3 million tonnes.

The 2008 Agreement also covers the use of a truck marshalling yard, which was built on the east side of Nichols Line, just north of Highway 11. The yard has a gravel surface measuring roughly 115 metres wide by 245 metres long. The marshalling yard provides an area for trucks going to the Walker and MAQ quarries to park early in the morning if they arrive before the quarries have opened.

3.0 TRAVEL DEMAND

3.1 Historic Traffic Volumes

The Township of Severn does not have any traffic count information for Nichols Line. With only five residences along Nichols Line, it is likely that almost all of the traffic on the roadway will be that generated by the existing Walker and MAQ quarry operations.

Annual traffic volume data for Highway 11 are available from the Ministry of Transportation for 1990 through 2016 and is included in Appendix A. The Average Annual Daily Traffic (AADT) volume in 1990 was 21,400 vehicles compared to 25,500 in 2016, an average annual increase of about 0.7%. Using an Excel spreadsheet to complete a regression analysis and produce a line of best fit results in an estimated volume of 25,949 vehicles in 2018 and 27,374 in 2028. This is shown graphically in Appendix A.

Given that Highway 11 acts as one of the main routes into the cottage area of Muskoka, peak traffic volumes on Highway 11 occur on the weekends in the summer months. More specifically, the peak traffic in the northbound lanes would be on Friday afternoon and evenings, while the peak for the southbound lanes would occur on Sunday afternoon and evenings. The Summer

Average Daily Traffic (SADT) between July 1 and August 30 has shown an overall downward trend, going from 37,400 in 1990 to 30,100 in 2016. Within the range of those dates, the SADT volumes have been highly variable, ranging from a low of 30,000 in 2015 to a high of 38,100 in 1991. It is interesting to note that the SADT volumes decreased between 1991 and 1993, and again from 2008 to 2010, which reflects the economic slowdowns that occurred at both those times. Volume projects to 2018 and 2028 are shown in Appendix A, however we do not consider the calculations to be very accurate considering the high variability of the data set. The projected volumes are actually quite a bit less than the measured volumes from 2008.

The Summer Average Weekday Daily Traffic (SAWDT) data was 29,700 in 1990 and 29,900 in 2016, although it reached a low of 26,200 in 1993 and a high of 36,300 in 2008. Those counts were also influenced by the economic factors in 1991 and 2008. Projecting that data forward results in an estimated volume of 31,320 vehicles in 2018 and 32,629 in 2028. Those values are less than the peak volumes recorded in 2007 (35,400) and 2008 (36,300), so it's possible that the counts from those years were somewhat of an anomaly.

As the traffic volumes on Highway 11 have increased over the years, the Accident Rate has dropped from 0.5 accidents per million vehicle kilometers (MVKM) in 1990 to 0.2 MVKM in 2010. No records for the Accident Rates were shown after 2010.

3.2 Site Generated Traffic

Calculations for the site generated traffic volumes for both the average and maximum tonnage are included in Appendix B. The volumes for the proposed operation were calculated based on the expected operational and transportation information provided by the applicant Severn Aggregates Limited.

The amount of material shipped from the site will vary from year to year depending on market conditions. However, it cannot exceed the maximum tonnage permitted by the Licence under the Aggregate Resources Act, which is proposed to be 500,000 tonnes. The annual average production is estimated to be 250,000 tonnes.

Ninety percent of the annual tonnage is expected to be shipped from May 1st to November 30th each year due to reduced demand in the winter. The traffic generated by the operation will be comprised primarily of trucks transporting the aggregate products from the quarry to customers, with relatively small numbers of employee and service vehicles.

The truck traffic generated by pits and quarries tends to be distributed relatively evenly throughout the day. General operations at the quarry are expected to be from 7:00 a.m. to 6:00 p.m., however shipping is expected to take place for 12 hours between 6:00 a.m. and 6:00 p.m. on weekdays. The hours of operation will be implemented on the ARA Site Plan.

The average daily traffic volume from the proposed pit is calculated to be 92 trips per day or 8 trips per hour at the average annual production of 250,000 tonnes and 183 trips per day or 15 trips per hour at the maximum annual production of 500,000 tonnes.

These volumes are total trips, so a volume of 15 trips per hour means 8 trips (rounded up) travelling up Nichols Line from Highway 11 to the quarry, and 8 trips travelling back down Nichols to Highway 11.

3.3 Nichols Line Traffic

As noted in Section 2.0, there are only five residences situated on Nichols Line, so it is expected that the majority of the traffic on the road will be generated by the existing Walker and MAQ Aggregates quarries and the proposed Cumberland Quarry. The licensed limits of the two existing operations total 4 million tonnes, so with the new quarry the total would be 4.5 million tonnes. The Cumberland Quarry could therefore increase the maximum annual production by 500,000 tonnes or 12.5%. Because Nichols Line has been re-constructed as recently as about 2008 to accommodate heavy truck traffic from the Walker and MAQ Aggregates quarries and is now designated as a major haul route, it should be structurally adequate to carry the additional traffic from the Severn Quarry.

In any given year it is very unlikely that all three quarries would be running at maximum production rates. To approximate the traffic volume, a best estimate would be to assume an average production equal to 50% of the total licensed limit for all three quarries. Assuming a

similar breakdown for the truck fleet and directly pro-rating the calculated trips for the Cumberland Quarry results in a total of 825 trips per day or about 69 trips per hour. With other traffic from the local residents, a typical day during the construction season could see around 1,000 trips per day on the roadway, with the majority of the trips being trucks. Under Ministry of Transportation Design Guidelines, this would classify the road as a rural local road having relatively traffic low-volumes.

4.0 EVALUATION OF IMPACTS

4.1 Methodology

For traffic studies such as this, the impact on the transportation system is typically evaluated using the methods described in the Highway Capacity Manual 20101 in order to determine the expected Level of Service for both existing and future traffic conditions. The Level of Service definitions are included in Appendix C. The traffic software program "HCS 2010" by McTrans was used to carry out any required calculations.

At intersections, the objective of the analysis is to identify "problem" intersections and traffic movements. For rural areas, "problem" intersections and movements are typically defined as those where a Level of Service "D" is incurred, meaning that motorists attempting to turn at intersections would experience longer delays. Generally, traffic impacts should be mitigated when site generated traffic creates or worsens a "problem" situation.

For two-lane roadways, a "problem" roadway would also be where a Level of Service "D" is incurred, which means that traffic flow is generally unstable and it is very difficult to pass slower traffic.

4.2 Analysis

For the Cumberland Quarry, the proposed access driveway is at the end of Nichols Line, and the access to and from Highway 11is via ramps that are not under stop control. There is, therefore,

[1] Highway Capacity Manual 2010, Transportation Research Board, National Research Council, Washington, D.C., 2010.

nothing to delay the turning movements to and from Nichols Line and therefore no issue with the Level of Service at these intersections.

Empty trucks returning northbound to the quarry will exit right on the ramp to South Sparrow Lake Road, make a right turn onto the Highway 11 overpass, make another right turn (at a stop sign) to get back onto South Sparrow Lake Road on the west side of the highway, and then take the ramp right back onto Highway 11 south. The only place where there could be any delay in a turning movement is at the stop sign on South Sparrow Lake Road where trucks will turn right to get back onto Highway 11 south. The background traffic volumes on this road were observed to be quite low, so in our opinion the additional truck traffic will have little impact and the intersection will continue to operate at a good Level of Service.

A small percentage of loaded trucks may head northbound towards Gravenhurst. These trucks would travel south on Highway 11, exit right on the ramp to New Brailey Line, then make a left turn to get on the Highway 11 overpass, make another left turn from the stop sign at Bayou Road and then take the ramp right onto Highway 11 north. The left turning movements could be subject to some delay depending on the background traffic volumes. Similar to South Sparrow Lake Road, New Brailey Line and Bayou Road do not appear to be carrying very high volumes of traffic, so the Level of Service for these turning movements should be very good. Also, since only a small percentage of the quarry traffic is expected to be going in this direction, the impact will be minimal.

Referring to the Level of Service definitions in Appendix C, it can be seen that for a Level of Service "A", the maximum flow volume could be up to 490 cars / hour in each direction. In Section 3.3 it was noted that the combined traffic from all three quarries could be around 69 trips per hour (35 trips in each direction) based on 50% of the total licensed limits in any given year. If the calculation was based on maximum licensed limits, this would increase to 70 trips in each direction and even allowing for additional background traffic this would still be well under 490 cars / hour (total for both directions) for Level of Service "A". Therefore, Nichols Line would be operating at a good Level of Service now and that will not change with the additional traffic from the proposed Cumberland Quarry. To confirm this, HCS 2010 was used to analyze the operation of the roadway. Using a volume of 80 trucks per hour in each direction, the Percent Time-Spent-Following was calculated to be 11.6%. This is well below the 40% maximum for Level of Service

"A", so there will be no problem on this road from an operational point of view. The HCS 2010 calculation can be found in Appendix D.

In Section 3.1 it was noted that the 2016 SAWDT volume was 29,900 vehicles per day, with volumes of 31,320 and 32,629 projected for 2018 and 2028 respectively. As per Section 3.2, operating at the maximum allowable licensed tonnage the Cumberland Quarry could generate around 183 trips per day on Highway 11. This represents an increase in traffic of only about 0.6% over the 31,320 vehicles per day projected for 2018, which is considered negligible. Therefore, the proposed quarry will have very little impact on Highway 11 traffic conditions.

5.0 CONCLUSIONS

Based on our research and analysis, we conclude the following:

- At the maximum licensed tonnage for the proposed aggregate extraction operation, the proposed Cumberland Quarry could generate up to 183 trips per day from May to November. It is estimated that this volume could result in an average hourly volume of up to 15 trips per hour (8 in / 8 out).
- It is expected that most of the trucks from the quarry will be transporting product south towards Orillia, Barrie and the northern GTA, although some trips will be made northward towards the Gravenhurst, Bracebridge and Huntsville areas.
- Traffic to and from the quarry will use Highway 11 and Nichols Line. Because there is no interchange at Nichols Line, trucks will also need to utilize the overpasses at South Sparrow lake Road and at New Brailey Line / Bayou Road.
- The Level of Service for trucks travelling on Nichols Line will be excellent as the total traffic volume will be relatively low and there are no turning movements that would cause any delays to the traffic.
- The turning movements from the Cumberland Quarry that would occur at South Sparrow Lake Road and at New Brailey Line / Bayou Road should not have any adverse impact on the Level of Service at those locations as the existing volumes are relatively low.
- The additional traffic from the quarry will have virtually no impact on the traffic conditions for Highway 11.

6.0 Disclaimer of Responsibilities to Third Parties

This report was prepared by Skelton, Brumwell & Associates Inc. for the account of Severn Aggregates Inc.

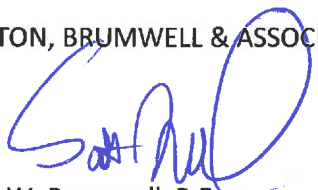
The material in it reflects Skelton, Brumwell & Associates Inc.'s best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Skelton, Brumwell & Associates Inc. accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this report.

All of which is respectfully submitted,

SKELTON, BRUMWELL & ASSOCIATES INC.

per:



Scott W. Brumwell, P.Eng.

Vice President

Appendix A

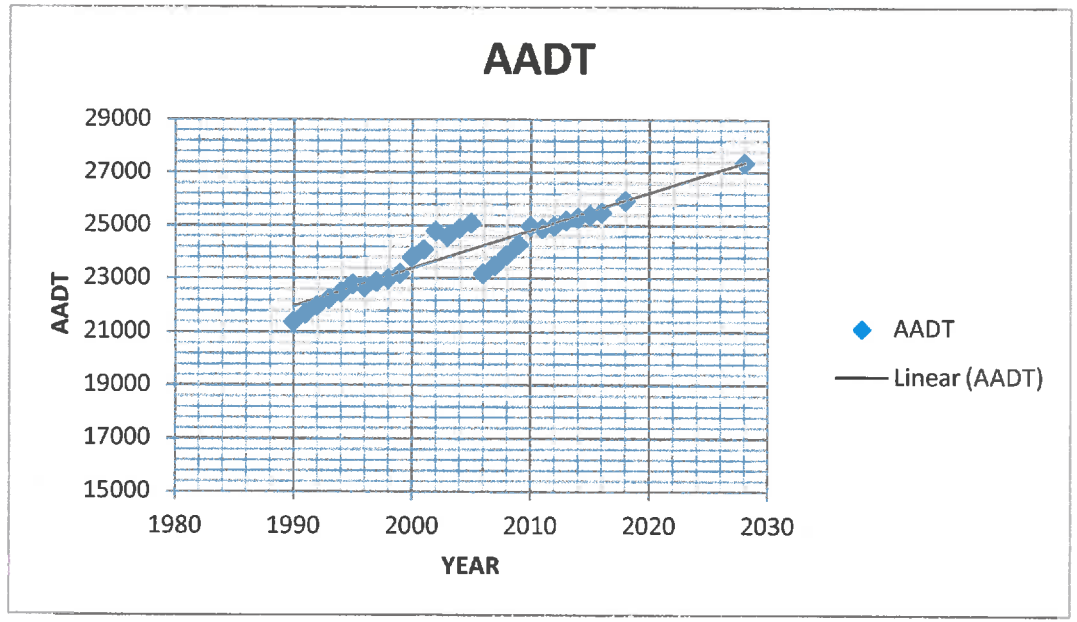
Highway 11 Traffic Volumes

Highway	Location Description	Dist. (KM)	Year	Pattern Type	AADT	SADT	SAWDT	WADT	AR
			2010	CR	25,500	28,900	28,000	23,100	0.6
			2011	CR	25,700	31,300	30,000	21,800	N/A
			2012	CR	25,900	31,300	31,000	22,000	N/A
			2013	CR	26,000	31,800	32,800	22,100	N/A
			2014	CR	26,200	31,000	30,700	22,300	N/A
			2015	CR	26,400	31,200	30,900	22,400	N/A
			2016	CR	26,600	31,400	31,100	22,600	N/A
11	NEW BRAIDLEY LINE/BAYOU RD IC 144	7.7	1990	CR	21,400	37,400	29,700	13,400	0.5
			1991	CR	21,700	38,100	30,100	13,600	0.6
			1992	CR	22,000	35,400	28,300	14,500	0.7
			1993	CR	22,300	32,200	26,200	15,500	0.7
			1994	CR	22,500	32,600	26,800	16,300	0.4
			1995	CR	22,800	34,200	27,600	16,500	0.5
			1996	CR	22,700	34,100	27,500	16,400	0.6
			1997	CR	22,900	34,600	27,900	16,900	0.6
			1998	CR	23,000	34,000	27,400	16,300	0.4
			1999	CR	23,200	34,100	27,800	16,500	0.4
			2000	CR	23,800	34,700	28,300	17,200	0.5
			2001	CR	24,100	35,700	28,700	24,100	0.5
			2002	CR	24,800	36,500	29,500	18,300	0.5
			2003	CR	24,600	36,400	29,300	18,000	0.5
			2004	CR	24,900	35,500	29,100	18,300	0.4
			2005	CR	25,100	35,400	29,000	18,700	0.4
			2006	CR	23,200	36,100	29,000	15,700	0.7
			2007	CR	23,500	36,800	35,400	15,800	0.7
			2008	CR	23,900	37,300	36,300	16,400	0.6
			2009	CR	24,300	33,600	27,900	17,900	0.3
			2010	CR	25,000	30,400	29,200	21,200	0.2
			2011	CR	24,900	30,400	29,100	21,200	N/A
			2012	CR	25,000	30,300	30,000	21,300	N/A
			2013	CR	25,200	30,800	31,800	21,400	N/A
			2014	CR	25,300	30,800	31,100	21,500	N/A
			2015	CR	25,400	30,000	29,700	21,600	N/A

Highway	Location Description	Dist. (KM)	Year	Pattern Type	AADT	SADT	SAWDT	WADT	AR
			2016	CR	25,500	30,100	29,900	21,700	N/A
11	SIMCOE RD 169 IC 152	2.4	1988	HR	15,800	27,800	19,800	9,700	1.0
			1989	HR	16,500	27,800	21,400	10,800	0.6
			1990	HR	16,800	29,300	23,200	10,500	0.5
			1991	HR	16,700	29,300	23,100	10,400	0.5
			1992	HR	16,900	27,200	21,800	11,100	0.6
			1993	HR	17,300	27,800	20,700	11,000	0.7
			1994	HR	17,400	29,100	21,900	11,400	0.4
			1995	HR	18,000	31,300	24,500	11,800	0.5
			1996	HR	17,800	30,400	23,300	11,600	0.6
			1997	HR	19,200	33,000	25,200	12,500	0.5
			1998	HR	19,600	32,900	25,000	12,500	0.5
			1999	HR	19,500	32,600	25,200	12,500	0.5
			2000	HR	19,900	32,900	25,400	13,000	0.5
			2001	HR	20,200	33,700	25,900	13,100	0.6
			2002	HR	20,600	34,300	26,300	13,500	0.6
			2003	HR	20,700	34,800	26,500	13,500	0.4
			2004	HR	21,400	34,500	26,700	14,000	0.5
			2005	HR	21,400	34,100	26,500	14,000	0.4
			2006	HR	21,400	33,300	26,800	14,400	0.5
			2007	HR	21,700	34,000	32,600	14,600	0.5
			2008	HR	21,300	33,200	32,400	14,600	0.5
			2009	HR	21,800	33,900	26,600	14,200	0.4
			2010	HR	22,400	34,300	27,000	14,600	0.4
			2011	HR	22,800	35,400	33,100	16,000	N/A
			2012	HR	23,100	34,400	33,500	15,900	N/A
			2013	HR	23,400	35,100	40,000	15,900	N/A
			2014	HR	23,700	35,800	36,000	14,700	N/A
			2015	HR	24,000	36,200	36,500	14,900	N/A
			2016	HR	24,300	36,600	36,900	15,000	N/A
11	GRAVENHURST S LTS-SEVERN R BR	15.8	1988	LR	15,800	27,800	19,800	9,700	1.0
			1989	LR	16,500	27,800	21,400	10,800	0.6
			1990	LR	16,800	29,300	23,200	10,500	0.5

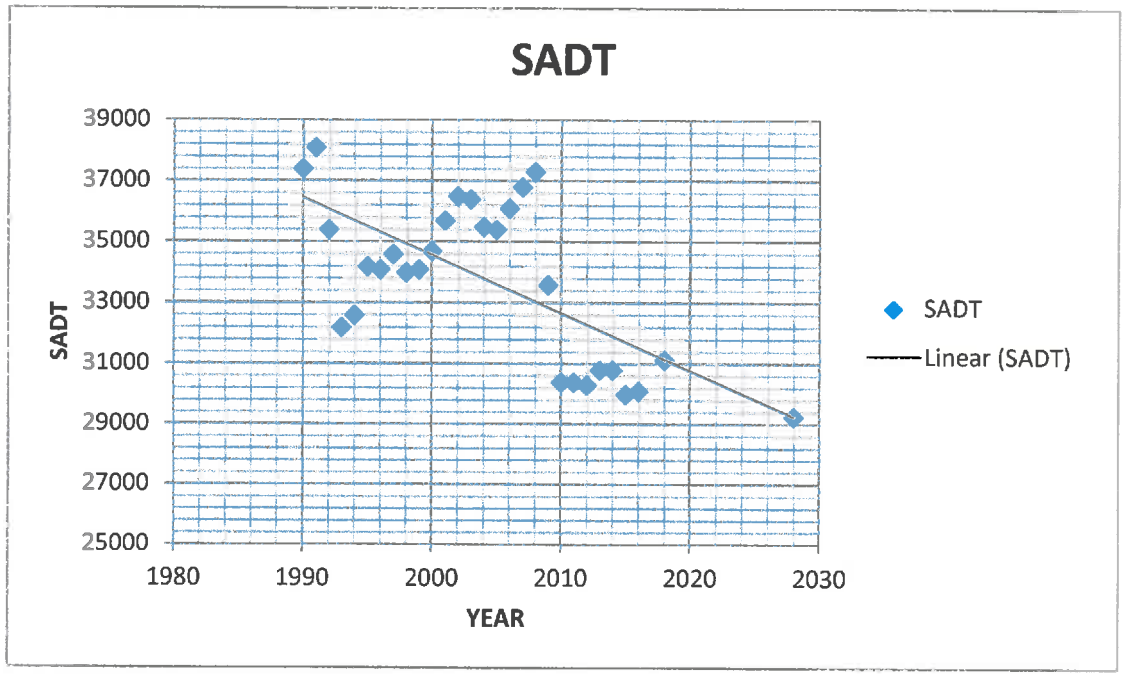
Highway 11 Historical Traffic Volumes - Bayou Road / Brailey Line

Year	AADT
1990	21400
1991	21700
1992	22000
1993	22250
1994	22500
1995	22800
1996	22700
1997	22900
1998	23000
1999	23200
2000	23800
2001	24100
2002	24800
2003	24600
2004	24900
2005	25100
2006	23200
2007	23500
2008	23900
2009	24300
2010	25000
2011	24900
2012	25000
2013	25200
2014	25300
2015	25400
2016	25500
2018	**25949** (projected)
2028	**27374** (projected)



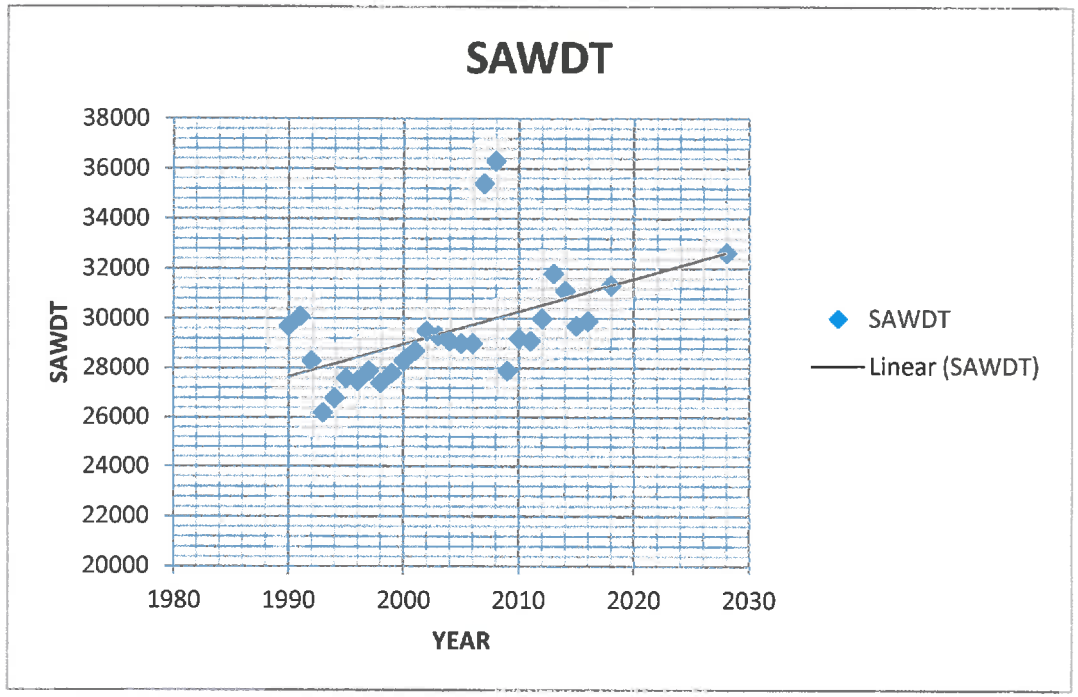
Highway 11 Historical Traffic Volumes - Bayou Road / Brailey Line

Year	SADT
1990	37400
1991	38100
1992	35400
1993	32200
1994	32600
1995	34200
1996	34100
1997	34600
1998	34000
1999	34100
2000	34700
2001	35700
2002	36500
2003	36400
2004	35500
2005	35400
2006	36100
2007	36800
2008	37300
2009	33600
2010	30400
2011	30400
2012	30300
2013	30800
2014	30800
2015	30000
2016	30100
2018	**31144** (projected)
2028	**29253** (projected)



Highway 11 Historical Traffic Volumes - Bayou Road / Brailey Line

Year	SADT
1990	29700
1991	30100
1992	28300
1993	26200
1994	26800
1995	27600
1996	27500
1997	27900
1998	27400
1999	27800
2000	28300
2001	28700
2002	29500
2003	29300
2004	29100
2005	29000
2006	29000
2007	35400
2008	36300
2009	27900
2010	29200
2011	29100
2012	30000
2013	31800
2014	31100
2015	29700
2016	29900
2018	**31320** (projected)
2028	**32629** (projected)



Appendix B

Site Generated Traffic

APPENDIX B
SITE GENERATED TRAFFIC
SEVERN AGGREGATES - CUMBERLAND QUARRY

PIT AGGREGATE

Production

Average	250,000	tonnes
Maximum	500,000	tonnes

Fleet Usage	Tonnes Per Load	% of Trips
Tandem	15	10%
Triaxle	23	10%
Semi Trailer	37	80%

Average per Load 33.4 tonnes

Annual Trip Generation

	Total Annual Tonnage	Tonnes Per Load	Trips Per Year
Average Year	250,000	33.4	7,485
		Total Trips Out	7,485
		Total Trips In	7,485
		Total Trips (Out + In)	14,970
Maximum Year (Licence Limit)	500,000	33.4	14,970
		Total Trips Out	14,970
		Total Trips In	14,970
		Total Trips (Out + In)	29,940

Daily Trip Generation

Percentage (%) shipped in peak months	90%
Peak Months: May to November	7
Average number of working days per month:	21
Daily Peak Traffic Factor:	1

Total Annual Tonnage	Total Trips Per Year	Total Working Days in Peak Months	Trips Per Day in Peak Months
250,000	14,970	147	92
500,000	29,940	147	183

APPENDIX B
SITE GENERATED TRAFFIC
SEVERN AGGREGATES - CUMBERLAND QUARRY

TOTAL TRIP GENERATION

Hours of Operation

From:	6:00 AM
To:	6:00 PM
Total Hours:	12
% Shipped in Peak Hours	100%

Total Annual Tonnage	Trips Per Day	Average Trips Per Peak Hour	Minutes Between Trips
250,000	92	8	7.8
500,000	183	15	3.9

Appendix C

Level of Service Definitions

LEVEL OF SERVICE AT UNSIGNALIZED INTERSECTIONS

The assessment of unsignalized intersections is based on the methods described in the "Highway Capacity Manual 2010", published in 2010 by the Transportation Research Board.

The term "Level of Service" is often used to assist in clarifying the arithmetic analysis associated with traffic engineering. "Level of Service" implies a qualitative measure of traffic flow at an intersection, and is dependent upon vehicle delay and vehicle queue lengths at the approaches. The Level of Service can be determined based on the ratio between traffic volumes and approach capacity or "V/C" ratio. The following table describes the characteristics of each level:

Level of Service	Description	Control Delay (sec)
A	Little or no traffic delay occurs. Approaches appear open, turning movements are easily made, and drivers have freedom of operation.	≤10
B	Short traffic delays occur. Many drivers begin to feel somewhat restricted in terms of freedom of operation.	10 to 15
C	Average traffic delays occur. Operations are generally stable, but drivers emerging from the minor street may experience difficulty in completing their movement. This may occasionally impact on the stability of flow on the major street.	15 to 25
D	Longer traffic delays occur. Motorists emerging from the minor street experience longer delays in making turns. Drivers on the major street will experience congestion and delay as drivers emerging from the minor street interfere with the major through movements.	25 to 35
E	Very long traffic delays occur. Operations approach the capacity of the intersection.	35 to 50
F	Saturation occurs, with vehicle demand exceeding the available capacity. Extremely long traffic delays occur.	>50

LEVEL OF SERVICE FOR CLASS II, TWO LANE ROADWAYS

The assessment of Two Lane Roadways is based on the methods described in the "Highway Capacity Manual 2010", published in 2010 by the Transportation Research Board.

The term "Level of Service" is often used to assist in clarifying the arithmetic analysis associated with traffic engineering. "Level of Service" implies a qualitative measure of traffic flow on a roadway, and for a Class II two lane roadway is dependent upon the percent time-spent-following other vehicles. The following table describes the characteristics of each level:

Level of Service	Description	% Time Spent Following
A	Highest quality of traffic service, where motorists are generally able to travel at their desired speed. Motorists will not be delayed in platoons for more than 40 percent of their travel time. A maximum flow rate of 490 cars/ hour total in both directions can be achieved with base conditions.	≤ 40
B	The demand for passing to maintain desired speeds becomes more significant. Drivers will not be delayed in platoons for more than 55 percent of their travel time. A flow rate of up to 780 cars / hour total for both directions with base conditions can be achieved.	> 40 to 55
C	There are noticeable increases in platoon formation, platoon size and frequency of passing impediments. Motorists will not be delayed in platoons for more than 70% of their travel time. A total flow rate of 1,190 cars / hour can be achieved with base conditions.	> 55 to 70
D	Unstable traffic flow where passing is extremely difficult. Drivers will not be delayed in platoons for more than 85 percent of their travel time. Maximum flow rates of up to 1,830 cars / hour total in each direction can be achieved under base conditions.	> 70 to 85
E	Passing is virtually impossible and platooning is very intense, with drivers being delayed in platoons for more than 85 percent of their travel time. The highest volume attainable would generally be up to 1,700 cars / hour in one direction and 3,200 cars / hour total for both directions.	> 85

Appendix D

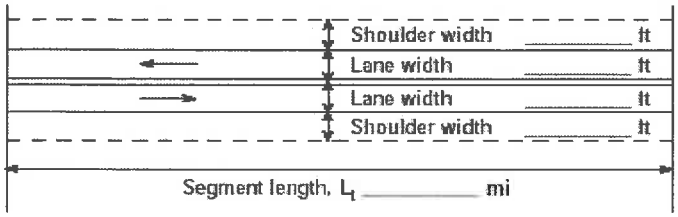
Nichols Line Analysis

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*S. Brumwell*	Highway / Direction of Travel	*Nichols Line*
Agency or Company	*Skelton, Brumwell & Associates*	From/To	*Highway 11 / Quarry*
Date Performed	*11/21/2014*	Jurisdiction	*Township of Severn*
Analysis Time Period		Analysis Year	*maximum demand conditions*

Project Description: *Cumberland Quarry*

Input Data



Analysis direction vol., V_d *80* veh/h
Opposing direction vol., V_o *80* veh/h
Shoulder width ft *6.0*
Lane Width ft *12.0*
Segment Length mi *1.8*

☐ Class I highway ☑ Class II highway ☐ Class III highway
Terrain ☑ Level ☐ Rolling
Grade Length mi Up/down
Peak-hour factor, PHF *0.88*
No-passing zone *30%*
% Trucks and Buses , P_T *100* %
% Recreational vehicles, P_R *0%*
Access points *mi* *7*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.9*	*1.9*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.526*	*0.526*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*173*	*173*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*45.0* mi/h
Total demand flow rate, both directions, v		Adj. for lane and shoulder width,[4] f_{LS} (Exhibit 15-7)	*0.0* mi/h
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8* mi/h
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.0* mi/h	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*43.3* mi/h
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*39.6* mi/h
		Percent free flow speed, PFFS	*91.5* %

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.909*	*0.909*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*100*	*100*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*11.6*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*0.0*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*11.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*A*
Volume to capacity ratio, *v/c*	*0.06*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*894*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1545*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*91.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*90.9*
Effective width, Wv (Eq. 15-29) ft	*34.80*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*121.13*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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Appendix E

Curriculum Vitae

Scott Brumwell, P.Eng.

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

Scott W. Brumwell, B.Sc. (Eng.), P. Eng.
Vice President, Principal

EDUCATION

Bachelor of Science in Engineering
University of Guelph, 1983
Majored in Water Resources Engineering

PROFESSIONAL BACKGROUND

Skelton, Brumwell & Associates Inc.
1987 to present

Vice President and Principal Engineer responsible for managing civil engineering projects undertaken by the firm. Specializing in project administration, development servicing design (roads, sewers, watermains), contract preparation, construction administration, master servicing planning, development cost sharing agreements, expert witness services, stormwater management, transportation impact analysis and Phase I Environmental Site Assessments.

R. E. Clipsham Limited
1983 to 1987

Project Engineer responsible for the preparation of designs, reports, cost estimates and tender documents for various municipal engineering projects undertaken by the firm.

MEMBERSHIP & ASSOCIATIONS

Professional Engineers of Ontario (designated as a Consulting Engineer)

Qualified Designer for Sewage Systems and Plumbing (All Buildings) under Section 2.17 of the Ontario Building Code (BCIN 24241)

Institute of Transportation Engineers

Chair of the Georgian College Environmental Technology Advisory Committee, 2008 to present

Kempenfelt Rotary Club (Director 2006–2007 & 2009–2010, Treasurer 2010–2013, President 2014-2015)

Chair of the Simcoe County Chapter Executive of the Professional Engineers of Ontario (1990-1991)

Royal Canadian Legion

Scott W. Brumwell, B.Sc. (Eng.), P. Eng.
Vice President, Principal

PROJECT EXPERIENCE (TRAFFIC IMPACT STUDIES)

Goble Development, Bracebridge

Vicdom Utica Pit, Uxbridge

Vitajoe Condominium Development, Barrie

Triple C Investments Gravel Pit, Penetanguishene

Malfara Commercial Site, Township of Springwater

Granite Ridge Subdivision Phase 2, Township of Galway (Cavendish & Harvey), Peterborough County

Georgian Manor Redevelopment, Penetanguishene

Vicdom Brock Road Gravel Pit, Township of Uxbridge, Region of Durham

Miller Braeside Quarry, Township of McNab / Braeside, Renfrew County

Skyline Port McNicoll Phase I Residential Development, Tay Township (Port McNicoll)

Geofam Sebright Quarry, City of Kawartha Lakes

Hillway 12th Line Gravel Pit, Township of Oro-Medonte, Simcoe County