4800 KEITH AVENUE TRANSLOAD FACILITY

Traffic Impact Assessment

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Our File: 2791.B01

Date: July 28, 2020

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TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

Watt Consulting Group was retained by Progressive Ventures Group to conduct a traffic impact assessment (TIA) for the proposed 4800 Keith Road transload facility in the City of Terrace, BC. This report reviews the existing, post development, and long term conditions within the study area, highlights any potential operational issues, and (if necessary) recommends mitigation measures to ensure accommodation of development traffic. The study also includes a review of the alternative transportation networks (pedestrian, cycling, and transit) within the vicinity of the development site.

On March 4th, 2020 a meeting was held with the MOTI and the City of Terrace to discuss the terms of reference for the study. The resulting terms of reference are attached as **Appendix C**.

The commencement of this TIA coincided with the start of the COVID-19 pandemic in BC. The pandemic has dramatically affected traffic volumes as schools and workplaces closed down and many commuters began working from home. The long-term effects of COVID-19 is unknown; however, for the purposes of this study, it is assumed that pre-COVID volumes will return prior to opening day; as such, the volumes used in this study are based on counts conducted in early February 2020 (prior to COVID impacting volumes) and on intersection volumes found in the City of Terrace *Transportation Master Plan (2017)*.

1.1 STUDY AREA

The proposed development site is located on the north side of Keith Avenue between Kenney St and Eby St. The study area includes the development site as well as the following key intersections:

- Keith Ave / Sande St (Hwy 16);
- Keith Ave / Kenney St;
- Keith Ave / Molitor St;
- Keith Ave / Eby St;
- Hwy 16 / Kenney St; and
- Hwy 16 / Frank St

The study area and key intersections are shown in **Figure 1**.

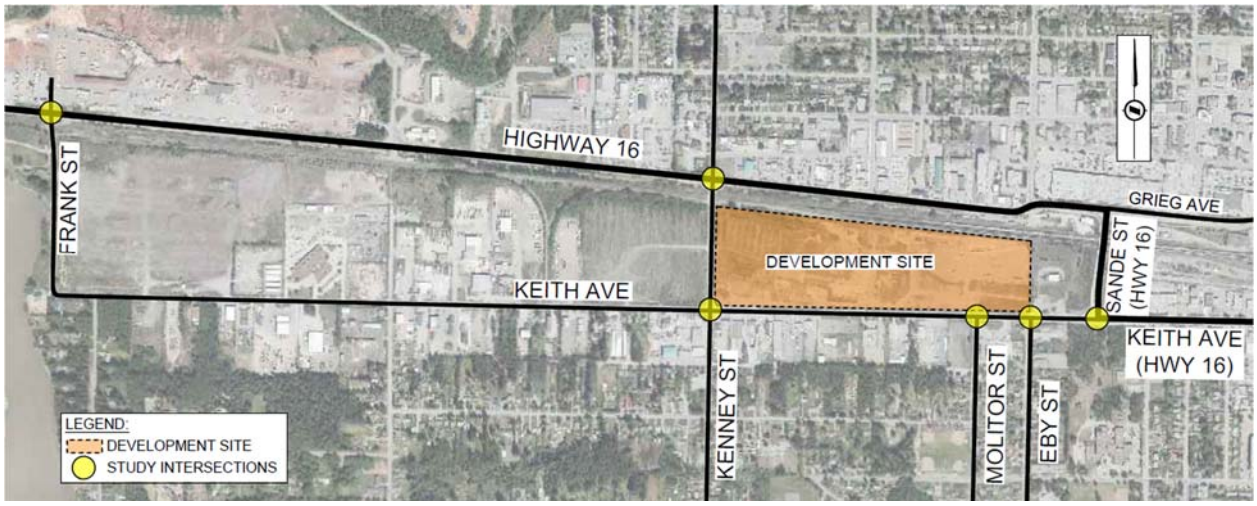


Figure 1: Study Area

2.0 EXISTING CONDITIONS

2.1 LAND USE

The proposed site is currently zoned to M1 (Light Industrial) and undeveloped. The surrounding land use is comprised of industrial, commercial and community / public use along Keith Avenue.

2.2 ROAD NETWORK

Highway 16 is under the Ministry of Transportation and Infrastructure's jurisdiction. All other roadways are under the City of Terrace jurisdiction within the study area.

- **Highway 16 (Yellowhead Highway)** is an undivided four-lane highway, two-way arterial road within the study area.
- **Sande Street** is the railway overpass section of Highway 16 which has four lanes running north / south.
- **Keith Avenue** (west of Sande St) is a major collector road with a 2 / 3 lane cross section and runs east / west and passes through the industrial area in the south of Highway 16.
- **Molitor Street** is a collector road providing a connection to Keith Avenue in the west of Eby Street. It is proposed that Molitor St be extended north of Keith Ave to the boundary of the transload facility.
- **Eby Street** is a local road connected to Keith Avenue. It is expected that Eby Street will be extended north of Keith Avenue along existing right-of-way as part of the proposed development (and in conjunction with the adjacent 4760 Keith Ave development concurrently being proposed).
- **Kenney Street** is a two lane collector road that runs north / south through the commercial area north and industrial area south of Highway 16.

- **Frank Street** is a two lane collector road that runs north / south between Keith Ave and Highway 16.

The posted speed limit is 50 km/h on all roads within the study area.

2.3 TRAFFIC MODELLING – BACKGROUND INFORMATION

Analysis of the traffic conditions at the study intersections was undertaken using Synchro Studio (version 10). Synchro / SimTraffic is a two-part traffic modelling software that provides analysis of the traffic conditions based on the Highway Capacity Manual (2010) evaluation methodology. A detailed description is provided in **Appendix A.**

For unsignalized (stop-controlled) intersections, the level of service (LOS) is based on the computed delay on each of the critical movements. LOS A represents minimal delays for minor street traffic movements, and LOS F represents a scenario with an insufficient number of gaps on the major street for minor street motorists to complete their movements without significant delays.

For signalized intersections, the methodology considers the intersection geometry, traffic volumes, the traffic signal phasing / timing plan, and pedestrian volumes. The average delay for each lane group is calculated, as well as the delay for the overall intersection.

2.4 EXISTING TRAFFIC VOLUMES (2020)

Weekday AM and PM traffic counts were conducted at the Keith Avenue intersection on the following dates:

- Keith Ave / Sande St (Hwy 16) – February 06, 2020
- Keith Ave / Kenney St – February 10, 2020
- Keith Ave / Molitor St – February 10, 2020
- Keith Ave / Eby St – February 12, 2020

The Hwy 16 / Kenney St and Hwy 16 / Frank St intersections were added to the scope of this TIA after counts were conducted. Due to the COVID-19 pandemic, it has not been possible to conduct traffic counts at these intersections. As traffic volumes and patterns have been significantly disrupted by the pandemic, conducting traffic counts at this time would not provide reliable data and therefore is not recommended.

The 2017 Terrace TMP includes 2016 AM and PM volumes for the Hwy 16 / Kenney St and Hwy 16 / Frank St intersections as well as for the Keith Ave / Kenney St and Keith Ave / Sande St (Hwy 16) intersections. In order to determine a growth rate to use in adjusting the 2016 volumes at Hwy 16 / Kenney St and Hwy 16 / Frank St to 2020 volumes, the 2016 volumes for the Keith Ave / Kenney St and Keith Ave / Sande St intersections were compared to the 2020 traffic count volumes. Between 2016 and 2020, the volumes on Highway 16 (on Sande St north of Keith Ave) decreased by a rate of 2% per year in the AM peak hour and 7% per year in the PM peak hour.

Over the same time period, Keith Avenue volumes west of Kenney St shrank by 1-2% while Kenney St volumes north of Keith Ave shrank by 2-3%. It is therefore expected that the traffic volumes at Hwy 16 / Kenney St and Hwy 16 / Frank St have decreased since 2016; as such, the 2016 volumes at Hwy 16 / Kenney St and Hwy 16 / Frank St were used for the 2020 volumes without applying a growth rate (in fact, this should be considered a conservative estimate). As the resulting volumes were obtained on different dates, traffic volume balancing was applied to the study intersections. .

2.5 EXISTING TRAFFIC CONDITIONS (2020)

Based on the volumes in **Section 2.4**, the existing 2020 traffic conditions were analyzed in Synchro for the AM and PM peak hour. The existing traffic volumes and levels of service are shown in **Figures 2** and **3**.

At the Keith Ave / Sande St (Hwy 16) intersection, the eastbound movement is at LOS D during the AM peak; the remaining movements are at LOS C or better during both the AM and PM peak movements.

The remaining intersections operate well during both peak hours. At the Hwy 16 / Kenney St, Keith Ave / Kenney St, Keith Ave / Molitor St, and Keith Ave / Eby St intersections, all movements are at LOS A/B during both peak hours. The Hwy 16 / Frank St intersection operates with all movements at LOS A/B during both peak hours with the exception of the southbound movement in the PM peak which is at LOS C.

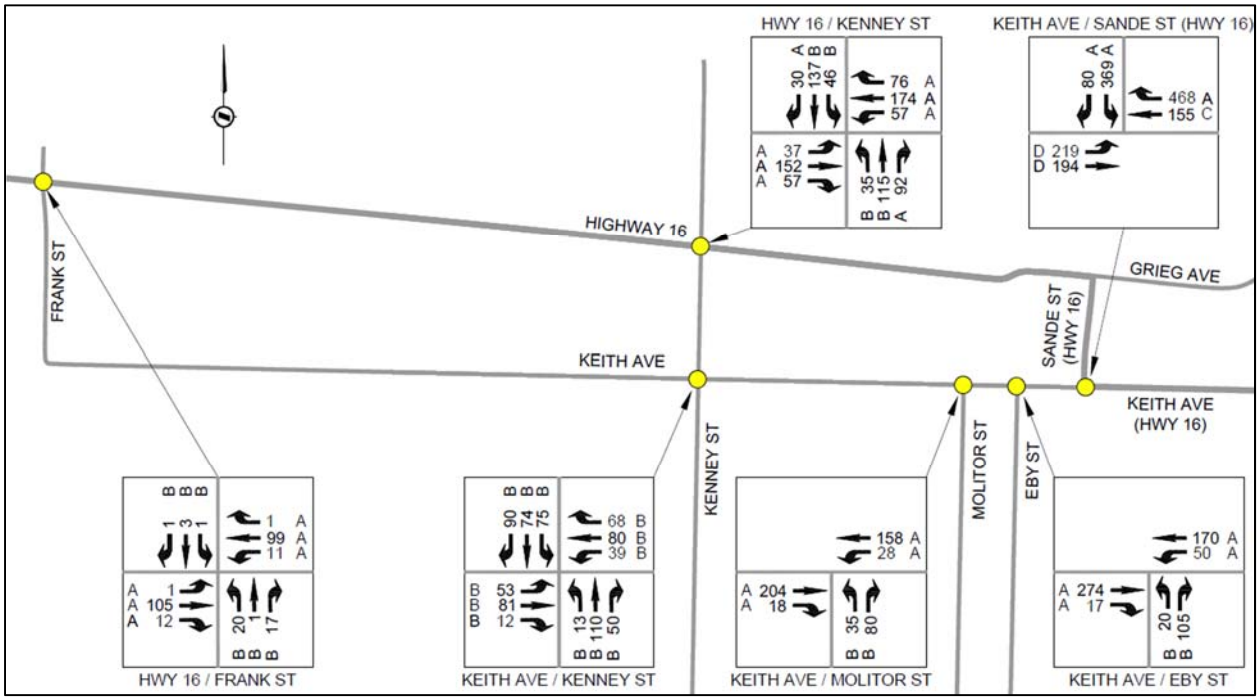


Figure 2: Existing (2020) Traffic Volumes and LOS - AM Peak Hour

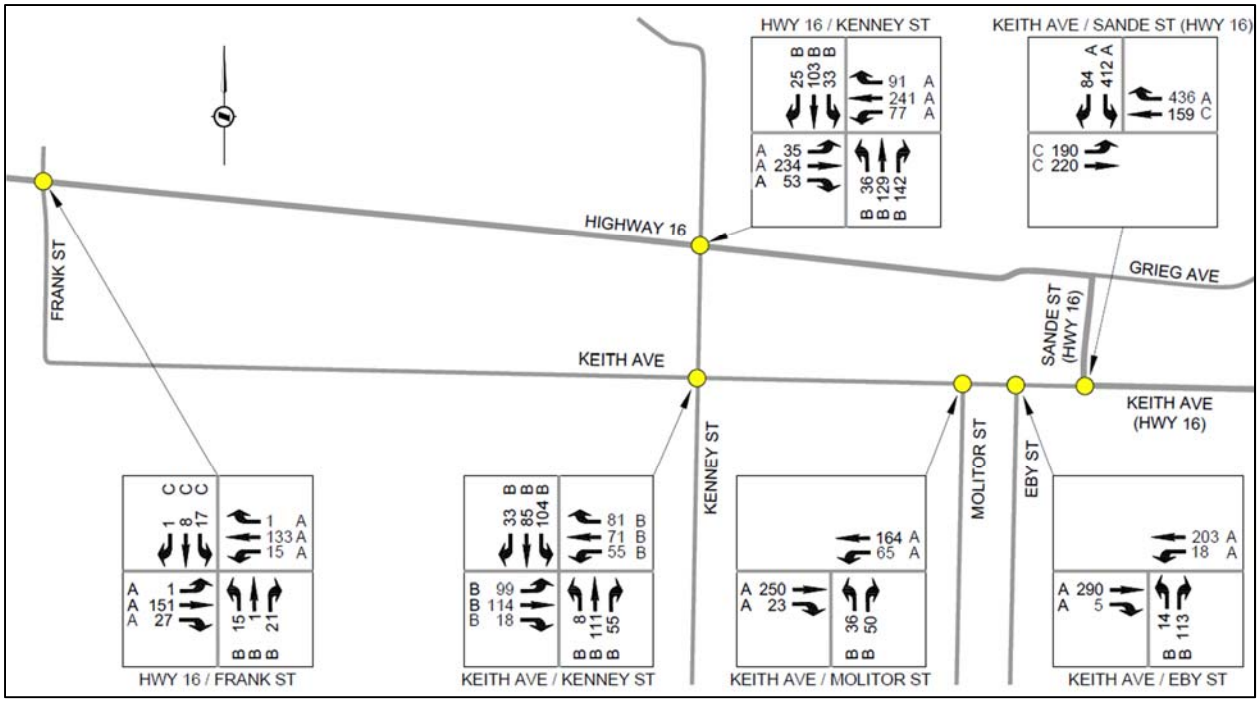


Figure 3: Existing (2020) Traffic Volumes and LOS - PM Peak Hour

3.0 POST DEVELOPMENT

3.1 PROPOSED LAND USE

The 4800 Keith Ave site is a 41 acre site which is currently zoned for light industrial use (M1). The developer is proposing to build a 27 acre transload facility, which will occupy the northernmost 2/3rds of the site (designated as Lot 1). The remaining lands are proposed to be split into 8 lots of 1 or 2 acres each (designated as Lots 2-9). At present, only the transload facility on Lot 1 is proposed to be developed; the future land use of Lots 2-9 are not yet determined. However, for the purposes of this TIA, it is assumed that Lots 2-9 will have a mix of land uses that is appropriate to the current Light Industrial zoning, including industrial park, gas station, and car wash land uses and is based off the development density proposed in the *4800 Keith Ave Development Plan* draft report (draft rev. A, dated November 4, 2019).

Sector	Land Area	Building Area
North – transload facility	24.6 acres / 9.9 ha	45,000 ft^2 4,180 m^2
South – mixed use	15.3 acres / 6.2 ha	71,000 ft^2 6,600 m^2
Park – Little Trunk Pathway	2 acres 0.8 ha	-
Development Total	**41.8 acres 16.9 ha**	**116,000 ft^2 10,800 m^2**

Proposed Development Summary (4800 Keith Ave Development Plan – Draft RevA)

The site plan is shown below in **Figure 4**.

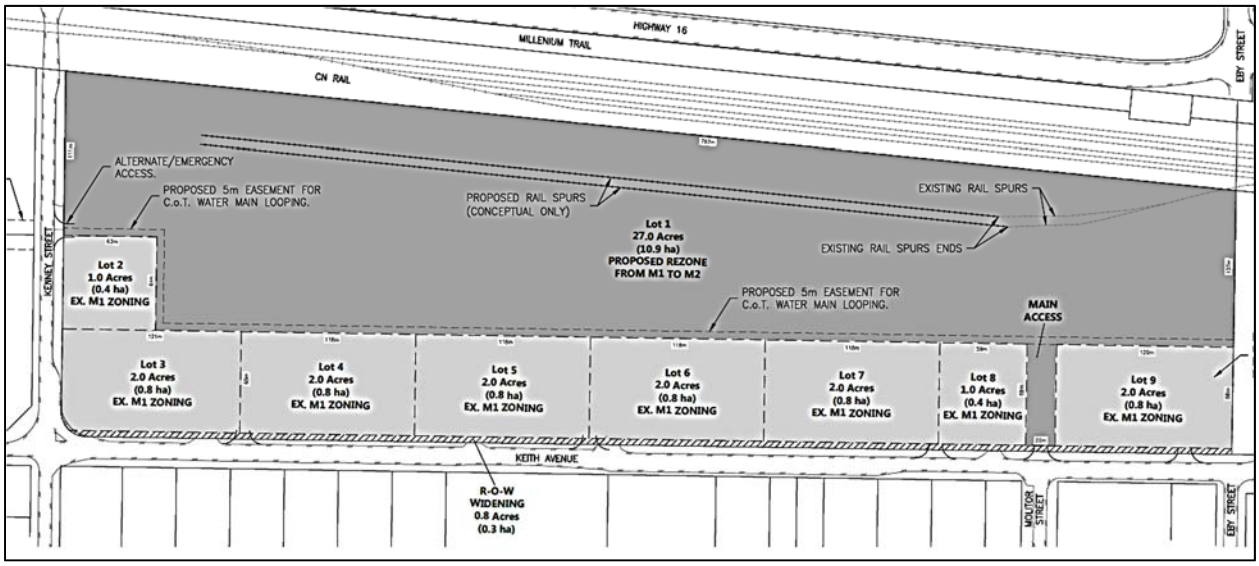


Figure 4: 4800 Keith Ave Proposed Development Plan

3.2 SITE ACCESS

The main access to the Lot 1 is proposed to be via an extension of Molitor St north of Keith Ave to the site. A Kenney St access is also proposed for emergency access only and is not intended for daily use.

For Lots 2-9, the ultimate access locations are expected to be determined as part of future development proposals for these lands. For the purposes of this TIA, it was assumed that there will be three full-movement accesses onto Keith Ave between Molitor St and Kenney St, each spaced approximately 150m apart which will provide access to Lots 2-7. Lot 8 was assumed to use the Molitor St extension, and Lot 9 was assumed to use both Molitor St and Eby St. The Molitor St and Eby St extensions were modelled in Synchro as two-lane two-way stop-controlled north legs of the Keith Ave / Molitor St and Keith Ave / Eby St intersections respectively.

3.3 TRIP GENERATION

The trips expected to be generated by the proposed development are estimated using trip generation rates found in the ITE *Trip Generation Manual (10th Edition)*. For the transload facility (Lot 1 in Figure 1), the Intermodal Truck Terminal land use (ITE Code 030) was applied.

Although Lots 2-9 are not included in the transload facility development proposal, it is expected that they will be developed in the future; as such, a high-level trip generation for Lots 2-9 was included in this TIA. The current Light Industrial zoning includes a mix of potential land uses; as such, the Industrial Park land use (ITE Code 130) was considered appropriate to apply to Lots 2-9 as the ITE land use description (*"contains a number of industrial or related facilities…characterized by a mix of manufacturing, services, and warehouse facilities…contain[ing] highly diversified facilities – some with a large number of small businesses*") closely matches the mix of land uses permitted in the M1 zoning. However, there are some land uses permitted in M1 zoning with trip rates significantly higher than the Industrial Park land use, particularly the Gas Bar / Service Station and Vehicle Wash land uses. Therefore, a gas station and a self-service car wash were included in the trip generation along with the Industrial Park land use.

The proposed development is expected to generate 214 trips (114 inbound / 100 outbound) during the AM peak hour and 289 trips (140 inbound / 149 outbound) during the PM peak. The trip generation results are summarized in **Table 1**.

TABLE 1: WEEKDAY PEAK HOUR TRIP GENERATION

ITE Code	Land Use	Units	Trip Rate	Trips In	Trips Out	Total Trips
AM Peak Hour						
030	Intermodal Truck Terminal	45,000 sq. ft.	1.72 / 1000 sq. ft.	37	40	77
130	Industrial Park	67,000 sq. ft.	0.40 / 1000 sq. ft.	22	5	27
944	Gas Bar / Service Station	8 pumps	10.28 / pump	41	41	82
947	Self Service Car Wash	10 wash stalls	5.54 / stall*	14	14	28
			AM Peak Total:	114	100	214
PM Peak Hour						
030	Intermodal Truck Terminal	45,000 sq. ft.	1.87 / 1000 sq. ft.	44	40	84
130	Industrial Park	67,000 sq. ft.	0.40 / 1000 sq. ft.	6	21	27
944	Gas Bar / Service Station	8 pumps	14.03 / pump	56	56	112
947	Self Service Car Wash	10 wash stalls	5.54 / stall	34	32	66
			PM Peak Total:	140	149	289

3.4 TRIP ASSIGNMENT

The trip assignment for the development trips was based on the existing traffic patterns and the key origins and destinations for traffic in the area. The transload facility is assumed to have a higher proportion of traffic coming from or heading to out of town along, compared to the other land uses which are expected to have a higher percentage of local traffic staying within the City of Terrace. Therefore, separate trip distribution ratios were used to assign traffic from the transload facility and from Lots 2-9.

The transload facility site trips generated during the AM and PM peak hours will be assigned to the road network based on the following distribution:

- 20% to / from the west on Highway 16 via Kenney St;
- 10% to/ from the west on Highway 16 via Frank St;
- 45% to / from the east on Highway 16;
- 10% to / from the north-east (downtown) via Sande St;
- 5% to / from the north via Kenney St;
- 5% to / from the south via Kenney St;
- 2.5% to / from the south via Molitor St; and
- 2.5% to / from the south via Eby St.

The site trips generated from Lots 2-9 during the AM and PM peak hours will be assigned to the road network based on the following distribution:

- 20% to / from the west on Highway 16 via Kenney St;
- 5% to/ from the west on Highway 16 via Frank St;
- 30% to / from the east on Highway 16;
- 10% to / from the north-east (downtown) via Sande St;
- 10% to / from the north via Kenney St;
- 10% to / from the south via Kenney St;
- 6% to / from the south via Molitor St; and
- 9% to / from the south via Eby St.

The resulting trip assignments are shown in **Figure 5** and **Figure 6** for the AM and PM peak hours respectively.

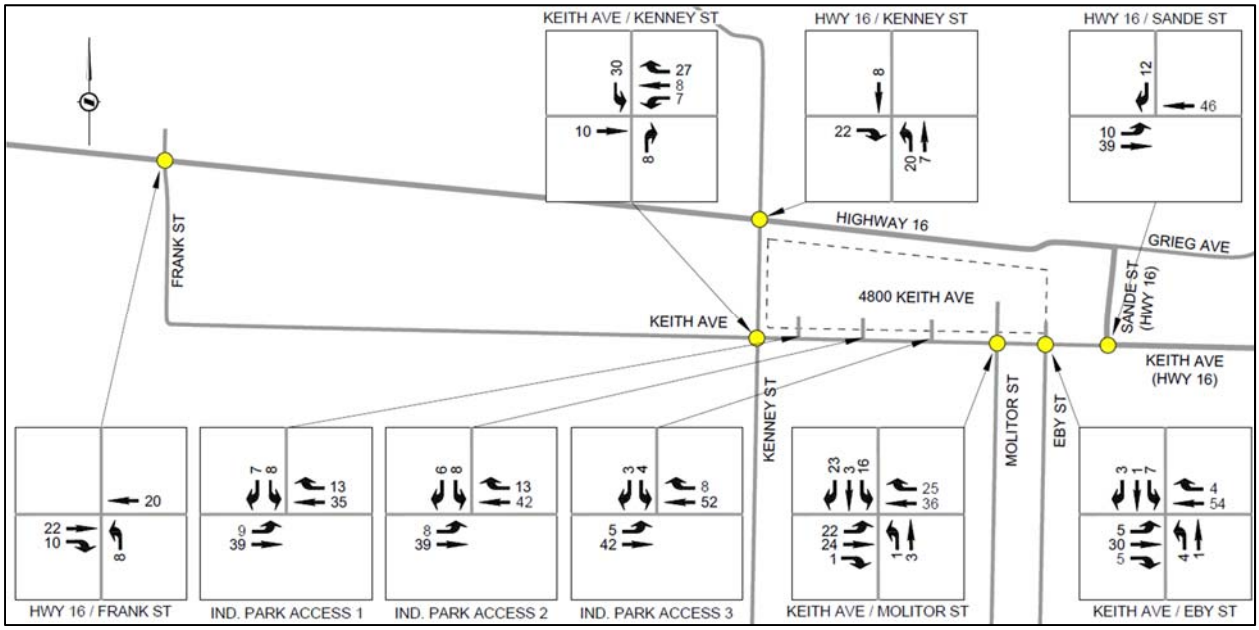


Figure 5: Trip Assignment - AM Peak Hour

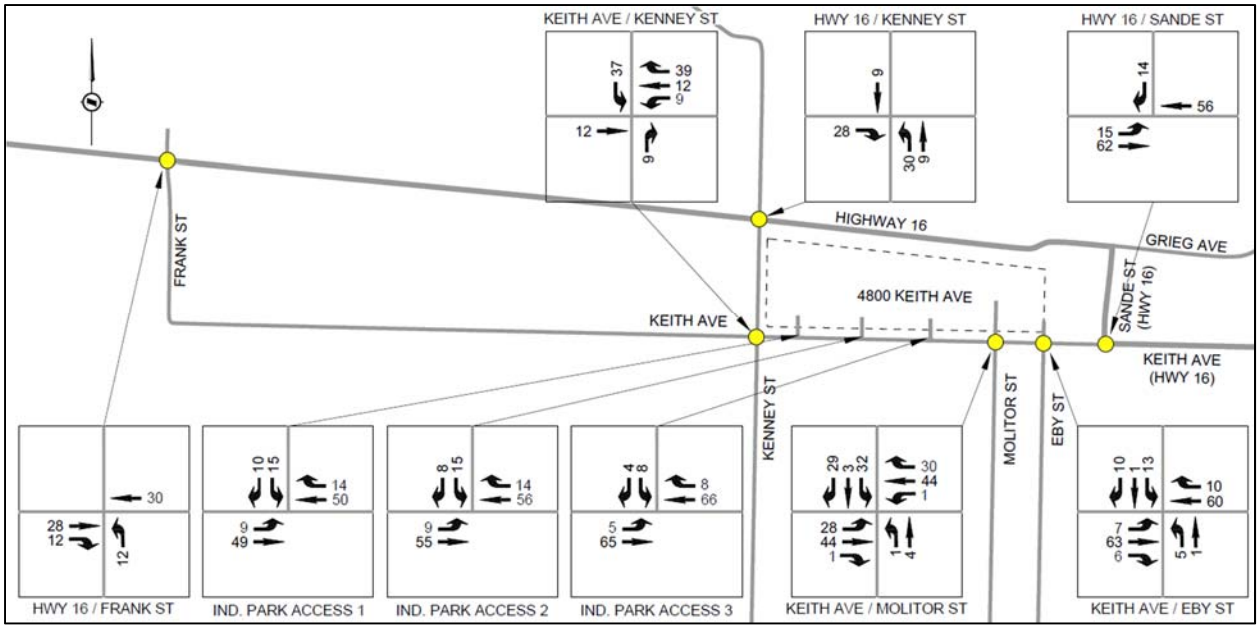


Figure 6: Trip Assignment - PM Peak Hour

3.5 2022 BACKGROUND VOLUMES

For the purposes of this TIA, opening day of the proposed development is estimated to be in 2022. According to the Terrace Transportation Master Plan (2017), the population of Terrace has been stable for many years, which matches the flat / negative traffic volume growth observed between 2016 and 2020 (see **Section 2.4**). However, the TMP predicts the population growth to substantially increase in the next decade, which is reflected in the 2% growth rate used to predict future traffic volumes in the TMP. Therefore, to account for the expected population growth, a 2% annual growth rate was applied to the existing traffic volumes (see **Figures 2** and **3**) to estimate the future background volumes.

3.6 OPENING DAY CONDITIONS (2022)

The 2022 post development traffic conditions were analyzed in Synchro / SimTraffic during the AM and PM peak hours and compared to the 2022 background conditions to determine the impact of the proposed development on the study intersections.

3.6.1 AM PEAK HOUR ANALYSIS RESULTS

The 2022 post development volumes and LOS during the AM peak hour are shown in **Figure 7**. The background and post development analysis results are summarized in **Table 2**.

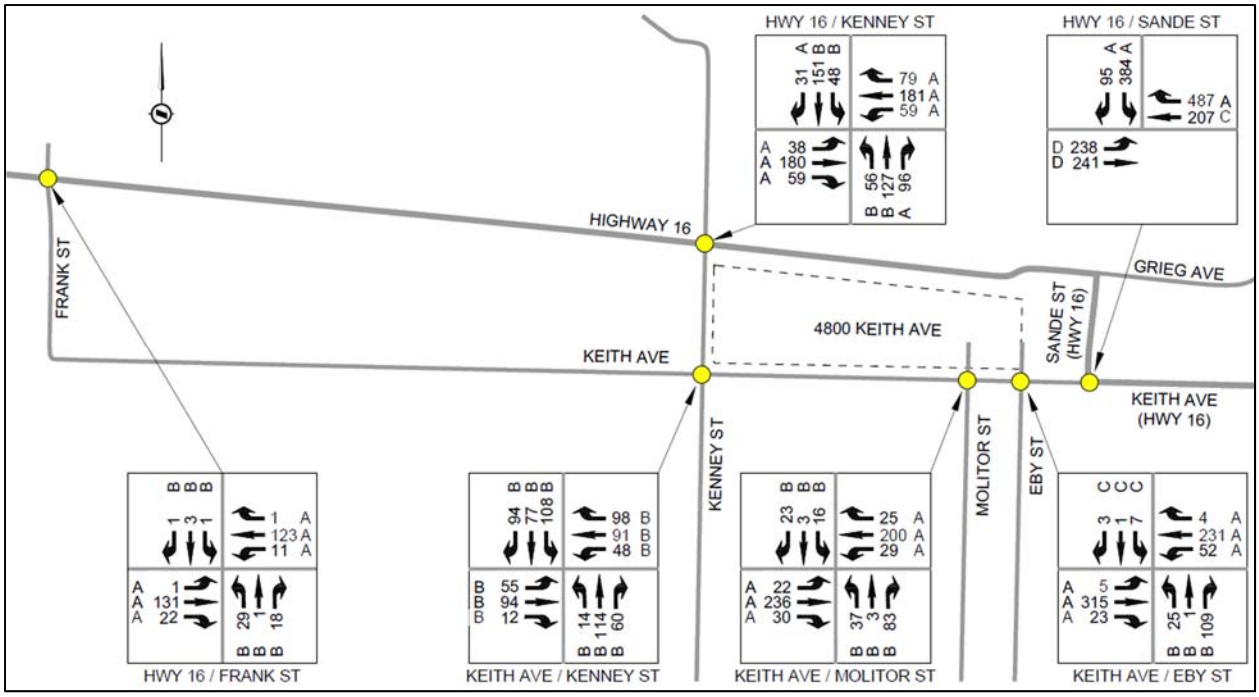


Figure 7: Opening Day (2022) Post Development Volumes & LOS – AM Peak

TABLE 2: 2022 BACKGROUND AND POST DEVELOPMENT CONDITIONS – AM PEAK

Intersection	Movement	Background Conditions – AM Peak			Post Development Conditions – AM Peak		
		LOS	Delay (s)	95th % Queue (m)	LOS	Delay (s)	95th % Queue (m)
Keith Ave / Sande St (Hwy 16)	EB L/T	D	35.4	70.4	D	37.5	78.6
	WBT	C	27.9	47.5	C	28.5	57.3
	WBR	A	0.6	0.0	A	0.6	2.7
	SBL	A	7.9	40.6	A	9.0	44.9
	SBR	A	2.3	4.0	A	2.4	0.0
Keith Ave / Eby St	EB L/T/R	A	0.0	0.0	A	0.2	6.7
	WB L/T/R	A	2.0	16.2	A	1.7	54.3
	NB L/T/R	B	12.4	14.7	B	14.6	16.6
	SB L/T/R	N/A	N/A	N/A	C	18.3	9.1
Keith Ave / Molitor St	EB L/T/R	A	0.0	0.0	A	0.7	10.6
	WB L/T/R	A	1.3	9.1	A	1.0	12.5
	NB L//TR	B	11.5	16.1	B	14.1	20.4
	SB L/T/R	N/A	N/A	N/A	B	13.7	14.5
Keith Ave / Kenney St	EB L/T/R	B	10.4	21.4	B	11.2	18.6
	WB L/T/R	B	10.7	34.4	B	11.9	34.1
	NB L/T/R	B	10.3	19.2	B	11.0	21.0
	SB L/T/R	B	11.3	22.7	B	12.8	61.0
Hwy 16 / Kenney St	EBL	A	8.2	10.4	A	8.3	10.4
	EBT	A	7.3	12.9	A	7.4	13.9
	EBR	A	3.2	2.1	A	3.2	4.3
	WBL	A	8.3	16.5	A	8.4	175
	WB T/R	A	5.3	22.5	A	5.4	22.0
	NB L/T	B	15.3	26.9	B	16.6	29.5
	NBR	A	4.0	0.0	A	3.9	0.0
	SB L/T	B	16.9	31.3	B	16.7	34.5
	SBR	A	4.8	12.5	A	4.7	13.5
Hwy 16 / Frank St	EB L/T/R	A	3.7	13.1	A	3.7	13.5
	WB L/T/R	A	3.9	14.6	A	4.0	15.8
	NB L/T/R	B	17.6	16.7	B	19.0	16.5
	SB L/T/R	B	18.8	8.9	B	18.4	6.5

With the completion of the development in 2022, the addition of site traffic did not result in any changes to the LOS of any of the study intersections during the AM peak hour (compared to 2022 background conditions).

At the Keith Ave / Sande St (Hwy 16) intersection, during the AM peak period the eastbound left / through movement is at LOS D under both background and post development conditions (the LOS D on the eastbound movement is due to signal timing which prioritizes Highway 16 traffic over Keith Ave traffic; optimization of the signal results in all movements operating at LOS A/B). With the existing signal timing, the remaining movements are at LOS C or better.

The remaining study intersections operate well during the AM peak hour, with all movements at LOS C or better and the majority of movements at LOS A/B.

3.6.2 PM PEAK HOUR ANALYSIS RESULTS

The 2022 post development volumes and LOS during the PM peak hour are shown in **Figure 8**. The background and post development analysis results are summarized in **Table 3**.

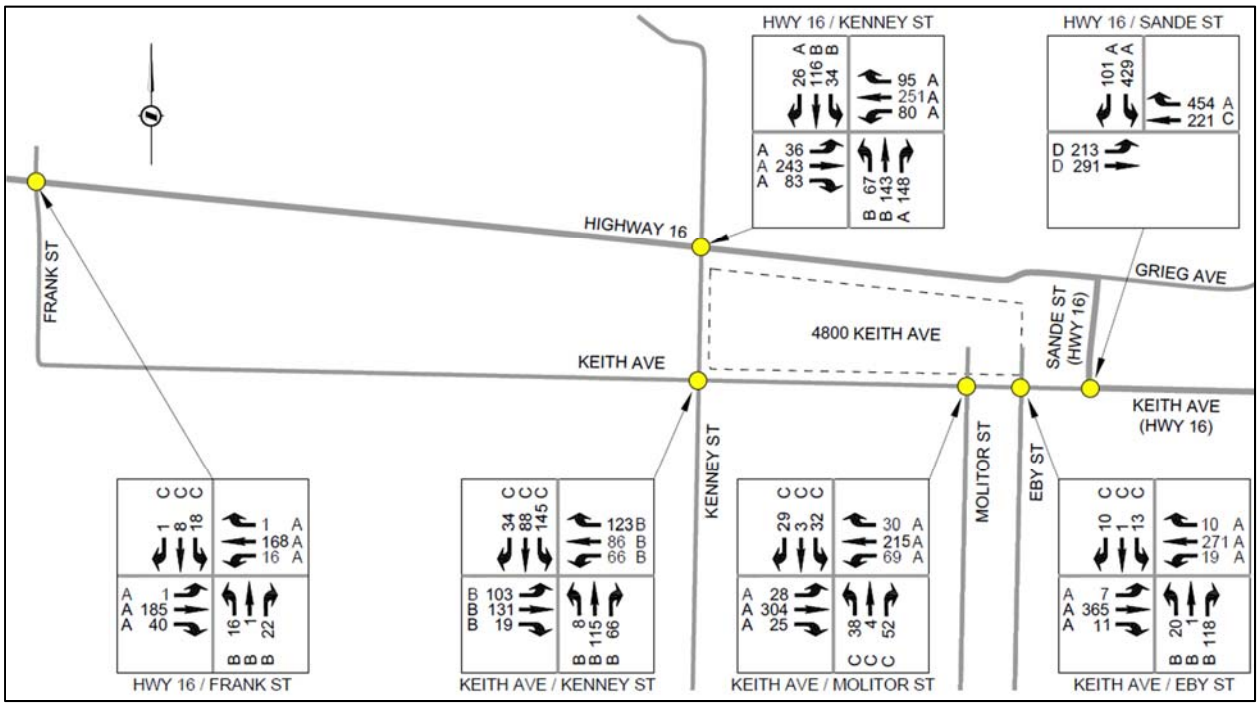


Figure 8: Opening Day (2022) Post Development Volumes & LOS – PM Peak

TABLE 3: 2022 BACKGROUND AND POST DEVELOPMENT CONDITIONS – PM PEAK

Intersection	Movement	Background Conditions – AM Peak			Post Development Conditions – AM Peak		
		LOS	Delay (s)	95th % Queue (m)	LOS	Delay (s)	95th % Queue (m)
Keith Ave / Sande St (Hwy 16)	EB L/T	D	35.2	57.7	D	38.3	74.5
	WBT	C	28.4	46.4	C	28.8	58.0
	WBR	A	0.5	0.0	A	0.5	0.0
	SBL	A	7.9	41.5	A	9.4	45.3
	SBR	A	2.2	0.0	A	2.4	0.0
Keith Ave / Eby St	EB L/T/R	A	0.0	0.0	A	0.2	4.1
	WB L/T/R	A	0.8	27.3	A	0.6	40.1
	NB L/T/R	B	12.0	16.5	B	14.4	16.9
	SB L/T/R	N/A	N/A	N/A	C	17.9	12.0
Keith Ave / Molitor St	EB L/T/R	A	0.0	1.0	A	0.7	12.0
	WB L/T/R	A	2.5	15.4	A	2.0	21.0
	NB L//TR	B	13.0	16.0	C	19.2	18.4
	SB L/T/R	N/A	N/A	N/A	C	19.6	16.7
Keith Ave / Kenney St	EB L/T/R	B	12.6	24.7	B	14.5	23.6
	WB L/T/R	B	11.6	35.4	B	14.3	46.1
	NB L/T/R	B	11.1	19.3	B	12.4	21.5
	SB L/T/R	B	12.4	22.2	C	15.1	61.6
Hwy 16 / Kenney St	EBL	A	8.1	11.7	A	8.9	10.8
	EBT	A	7.0	14.9	A	7.9	16.6
	EBR	A	3.3	2.3	A	3.1	3.9
	WBL	A	8.5	19.0	A	9.3	17.7
	WB T/R	A	5.4	26.9	A	6.0	25.1
	NB L/T	B	16.1	27.9	B	18.2	32.5
	NBR	A	4.1	0.0	A	3.8	0.0
	SB L/T	B	15.2	25.7	B	14.6	28.9
	SBR	A	4.7	12.8	A	4.5	12.2
Hwy 16 / Frank St	EB L/T/R	A	3.8	18.1	A	3.9	22.4
	WB L/T/R	A	4.1	19.2	A	4.2	19.8
	NB L/T/R	B	15.1	15.3	B	15.1	14.8
	SB L/T/R	C	22.8	18.0	C	22.8	18.5

The addition of site traffic in 2022 did not result in any changes to the LOS of any of the study intersections during the PM peak hour when compared to 2022 background conditions, with the exceptions of the Keith Ave / Molitor St northbound movement and the Keith Ave / Kenney St southbound movement which drop for LOS B to C.

At the Keith Ave / Sande St (Hwy 16) intersection, during the PM peak period the eastbound left / through movement is at LOS D under both background and post development conditions (the LOS D on the eastbound movement is due to signal timing, which prioritizes Highway 16 traffic over Keith Ave traffic; optimization of the signal results in all movements operating at LOS A/B). With the existing signal timing, the remaining movements are at LOS C or better.

The remaining study intersections operate well during the PM peak hour, with all movements at LOS C or better and the majority of movements at LOS A/B.

3.7 CONCURRENT DEVELOPMENT (4760 KEITH AVE)

In addition to the 4800 Keith Ave TIA, Watt Consulting is conducting a TIA for a development proposal on the adjacent 4760 Keith Ave property which includes general commercial / retail, office building, and restaurant land uses. While each TIA examines the impact of the respective developments on the area road network separately, an analysis was also conducted of the post development conditions in the event that both developments are constructed.

The 4760 Keith Ave development is expected to generate 157 external trips (93 inbound / 64 outbound) during the AM peak hour and 184 external trips (88 inbound / 96 outbound) during the PM peak hour (the trip assignment for the 4760 Keith Ave development can be found in **Appendix B**). The trips generated by full build-out of both developments were added to the 2022 background traffic to provide the post development volumes used; the analysis results are summarized in **Table 4**.

TABLE 4: 2022 POST DEVELOPMENT CONDITIONS (INCLUDING 4760 KEITH AVE TRIPS)

Intersection	Movement	Post Development Conditions – AM Peak			Post Development Conditions – PM Peak		
		LOS	Delay (s)	95th % Queue (m)	LOS	Delay (s)	95th % Queue (m)
Keith Ave / Sande St (Hwy 16)	EB L/T	D	39.7	81.3	D	41.2	74.7
	WBT	C	29.3	61.2	C	29.2	62.0
	WBR	A	0.5	0.0	A	0.5	0.0
	SBL	A	9.5	41.3	B	10.1	46.2
	SBR	A	2.4	0.0	A	2.3	31.9
Keith Ave / Eby St	EB L/T/R	A	1.0	13.9	A	1.0	19.4
	WB L/T/R	A	1.5	16.7	A	0.5	11.4
	NB L/T/R	B	12.9	20.2	C	17.7	19.2
	SB L/T/R	D	29.2	17.6	D	34.9	20.7
Keith Ave / Molitor St	EB L/T/R	A	0.6	9.2	A	0.6	9.9
	WB L/T/R	A	1.0	9.8	A	1.9	16.8
	NB L/T/R	B	14.6	20.6	C	21.3	19.1
	SB L/T/R	B	14.4	14.2	C	21.6	16.5
Keith Ave / Kenney St	EB L/T/R	B	11.7	19.8	C	15.5	26.8
	WB L/T/R	B	12.9	51.5	C	16.5	56.8
	NB L/T/R	B	11.6	20.9	B	13.3	23.5
	SB L/T/R	B	14.1	61.8	C	17.0	24.2
Hwy 16 / Kenney St	EBL	A	8.4	11.4	A	9.1	11.3
	EBT	A	75	13.3	A	8.2	15.1
	EBR	A	2.9	5.9	A	3.0	3.7
	WBL	A	8.5	16.1	A	9.6	18.2
	WB T/R	A	5.5	23.9	A	6.2	26.1
	NB L/T	B	17.3	34.1	B	19.2	37.3
	NBR	A	3.9	0.0	A	3.7	0.0
	SB L/T	B	16.7	33.5	B	14.3	28.9
	SBR	A	4.7	12.0	A	4.4	14.0
Hwy 16 / Frank St	EB L/T/R	A	4.1	19.6	A	3.8	17.9
	WB L/T/R	A	4.3	21.8	A	4.1	16.2
	NB L/T/R	B	18.0	19.6	B	19.6	19.4
	SB L/T/R	C	21.9	17.6	B	18.2	6.8

When the 4760 Keith Ave site traffic is added to the 2022 post development volumes, during both peak hours the eastbound approach of the Keith Ave / Sande St signal remains at LOS D and the southbound approach of the Keith Ave / Eby St intersection drops to LOS D; all other movements at the study intersections are at LOS C or better with most at LOS A/B.

4.0 LONG TERM POST OPENING DAY HORIZON ANALYSIS (2035)

4.1 2035 POST DEVELOPMENT CONDITIONS

The 2035 background and post development traffic conditions were analyzed during the AM and PM peak hours and the results were compared to determine the long-term impact of the proposed development on the traffic operations at the study intersections. In order to estimate 2035 background traffic volumes, a 2% growth rate was applied to the existing volumes (see **Section 3.5** for growth rate determination).

4.1.1 AM PEAK HOUR ANALYSIS RESULTS

The 2035 post development volumes and LOS during the AM peak hour are shown in **Figure 9**. The background and post development analysis results are summarized in **Table 5**.

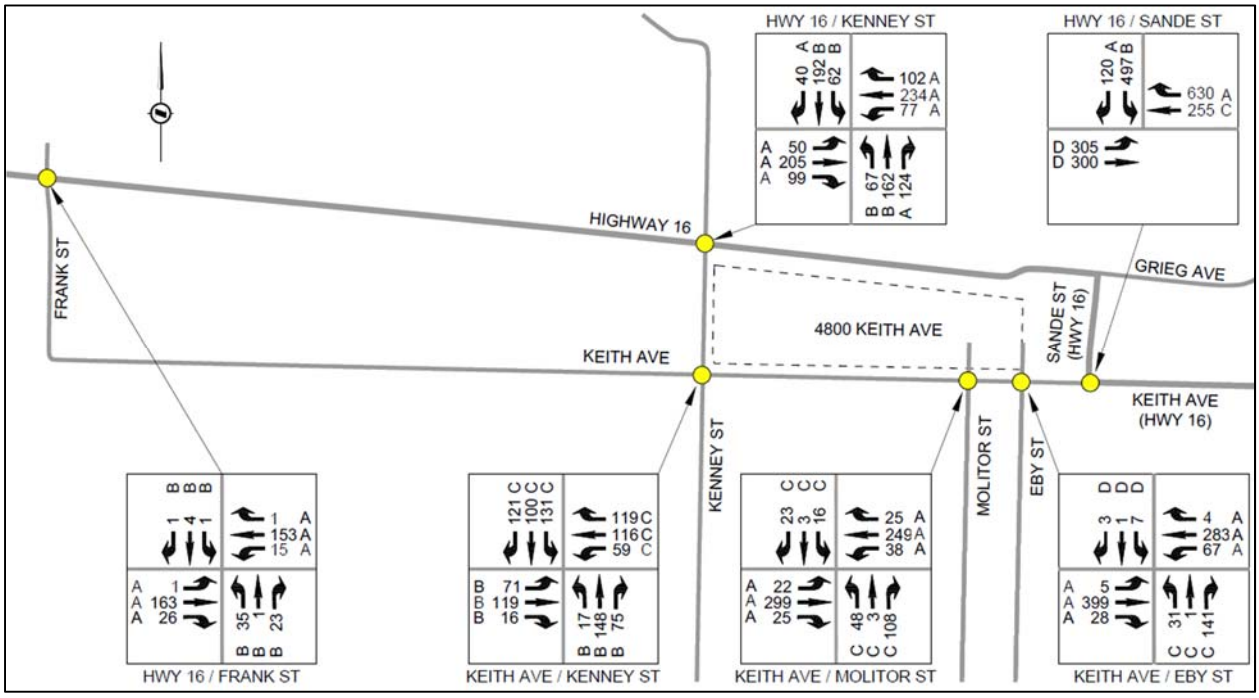


Figure 9: Long Term (2035) Post Development Volumes & LOS – AM Peak

TABLE 5: 2035 BACKGROUND AND POST DEVELOPMENT CONDITIONS – AM PEAK

Intersection	Movement	Background Conditions – AM Peak			Post Development Conditions – AM Peak		
		LOS	Delay (s)	95th % Queue (m)	LOS	Delay (s)	95th % Queue (m)
Keith Ave / Sande St (Hwy 16)	EB L/T	D	40.6	126.6	D	47.6	147.7
	WBT	C	27.1	55.7	C	28.2	66.1
	WBR	A	0.9	0.0	A	0.9	0.0
	SBL	B	10.5	50.9	B	11.2	51.2
	SBR	A	2.4	4.0	A	2.3	4.9
Keith Ave / Eby St	EB L/T/R	A	0.0	0.0	A	0.1	18.4
	WB L/T/R	A	2.1	22.4	A	1.8	62.4
	NB L/T/R	C	15.4	22.3	C	19.9	36.0
	SB L/T/R	N/A	N/A	N/A	D	25.5	10.0
Keith Ave / Molitor St	EB L/T/R	A	0.0	0.0	A	0.6	7.2
	WB L/T/R	A	1.4	13.6	A	1.1	14.7
	NB L/T/R	B	13.5	22.4	C	18.3	21.3
	SB L/T/R	N/A	N/A	N/A	C	16.4	14.2
Keith Ave / Kenney St	EB L/T/R	B	13.2	21.4	B	14.7	22.7
	WB L/T/R	B	14.2	43.6	C	17.3	47.7
	NB L/T/R	B	13.4	22.0	B	15.0	25.5
	SB L/T/R	C	16.2	62.9	C	20.4	29.8
Hwy 16 / Kenney St	EBL	A	9.3	12.5	A	9.4	11.7
	EBT	A	8.0	15.8	A	8.2	14.5
	EBR	A	3.1	4.5	A	3.0	4.4
	WBL	A	9.4	19.0	A	9.5	17.7
	WB T/R	A	5.8	26.5	A	9.5	27.9
	NB L/T	B	16.6	32.9	B	19.9	33.7
	NBR	A	3.8	0.0	A	3.7	0.0
	SB L/T	B	19.4	38.7	B	19.6	47.0
	SBR	A	4.3	14.6	A	4.3	15.2
Hwy 16 / Frank St	EB L/T/R	A	3.8	16.4	A	3.9	18.2
	WB L/T/R	A	4.1	17.7	A	4.2	18.6
	NB L/T/R	B	17.7	18.4	B	18.9	20.0
	SB L/T/R	B	18.8	6.7	B	18.3	6.6

In the long term, the study intersections continue to operate adequately during the AM peak hour. The Keith Ave / Sande St eastbound left / through movement remains at LOS D under both background and post development conditions; the southbound movement at Keith Ave / Eby St is also at LOS D. All other movements at the study intersections are at LOS C or better under 2035 post development conditions.

4.1.2 PM PEAK HOUR ANALYSIS RESULTS

The 2035 post development volumes and LOS during the PM peak hour are shown in **Figure 10**. The background and post development analysis results are summarized in **Table 6**.

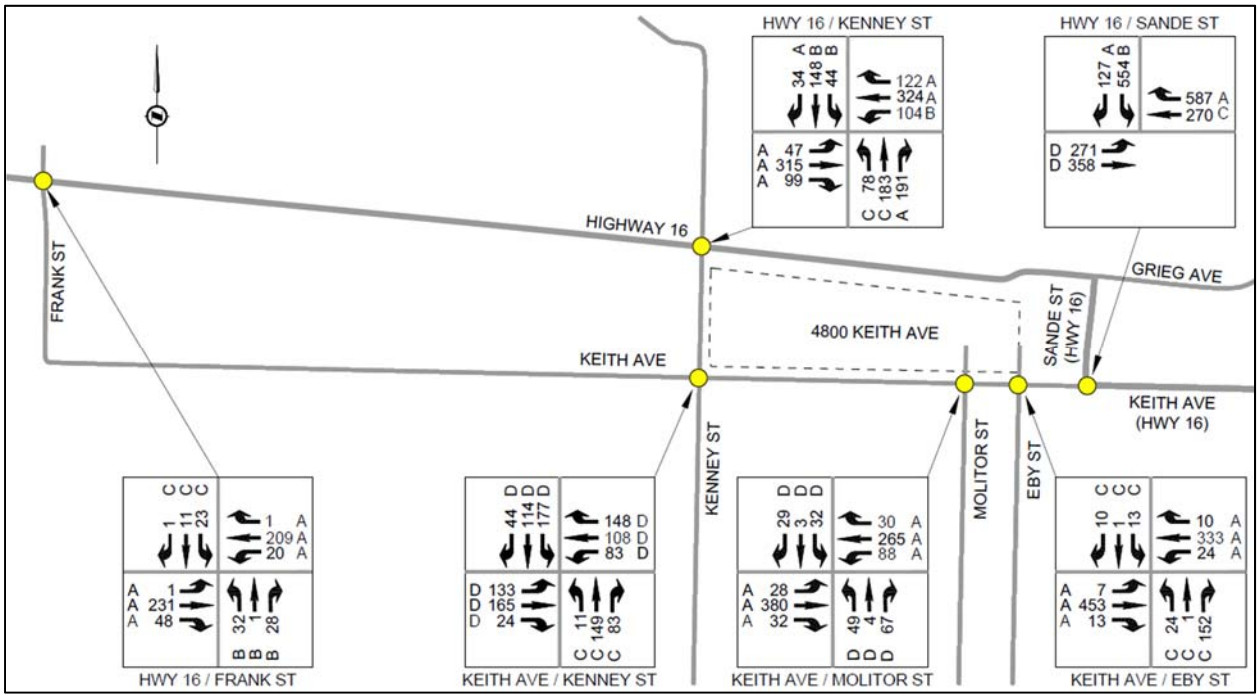


Figure 10: Long Term (2035) Post Development Volumes & LOS – PM Peak

TABLE 6: 2035 BACKGROUND AND POST DEVELOPMENT CONDITIONS – PM PEAK

Intersection	Movement	Background Conditions – PM Peak			Post Development Conditions – PM Peak		
		LOS	Delay (s)	95th % Queue (m)	LOS	Delay (s)	95th % Queue (m)
Keith Ave / Sande St (Hwy 16)	EB L/T	D	40.0	82.6	D	50.9	111.6
	WBT	C	27.5	58.5	C	28.7	65.1
	WBR	A	0.8	0.0	A	0.8	0.0
	SBL	B	10.6	52.3	B	11.6	54.4
	SBR	A	2.3	0.0	A	2.3	0.0
Keith Ave / Eby St	EB L/T/R	A	0.0	0.0	A	0.2	8.6
	WB L/T/R	A	0.8	41.6	A	0.6	30.4
	NB L/T/R	B	14.4	18.2	C	19.3	21.7
	SB L/T/R	N/A	N/A	N/A	C	24.8	12.9
Keith Ave / Molitor St	EB L/T/R	A	0.0	1.0	A	0.6	12.8
	WB L/T/R	A	2.6	20.1	A	2.2	22.6
	NB L/T/R	C	16.4	21.2	D	31.3	23.6
	SB L/T/R	N/A	N/A	N/A	D	28.7	16.3
Keith Ave / Kenney St	EB L/T/R	C	20.9	26.3	D	29.4	31.1
	WB L/T/R	C	18.0	45.4	D	29.3	75.3
	NB L/T/R	C	16.1	20.6	C	20.6	26.3
	SB L/T/R	C	20.1	23.9	D	31.5	65.3
Hwy 16 / Kenney St	EBL	A	9.3	14.6	A	9.9	14.3
	EBT	A	8.0	17.0	A	8.6	18.7
	EBR	A	3.2	2.7	A	3.1	4.8
	WBL	A	10.1	22.3	B	10.9	22.0
	WB T/R	A	6.1	31.2	A	6.6	31.5
	NB L/T	B	17.8	34.0	C	20.0	40.4
	NBR	A	3.9	0.0	A	3.6	0.0
	SB L/T	B	16.1	31.9	B	15.4	32.9
	SBR	A	4.6	12.9	A	4.4	11.4
Hwy 16 / Frank St	EB L/T/R	A	4.2	23.8	A	43	22.8
	WB L/T/R	A	4.4	24.3	A	4.5	25.7
	NB L/T/R	B	14.5	16.1	B	16.8	22.0
	SB L/T/R	C	23.4	19.6	C	23.1	18.3

In the long term, during the PM peak hour the Keith Ave / Sande St eastbound left / through movement remains at LOS D under both background and post development conditions while the north- and southbound movements of Keith Ave / Molitor St and the east-, west-, and southbound movements of Keith Ave / Kenney St drop to LOS D. All other movements at the study intersections are at LOS C or better under 2035 post development conditions.

4.1.3 KEITH AVE / KENNEY ST SIGNAL WARRANT ANALYSIS

As the Keith Ave / Kenney St 4-way stop-controlled intersection is reduced to LOS D in three of the four directions during the 2035 PM peak hour, a signal warrant analysis was conducted to determine if a signal is warranted. Using the PM peak hour post development traffic volumes, Warrant 8: Peak Hour Delay (Section 402.3.9) and Warrant 9: Peak Hour Volume (Section 402.3.10) from the MOTI *Electrical & Traffic Engineering Design Guidelines (2013)* were reviewed. Based on Warrant 8, the peak hour delay does not warrant a signal; based on Warrant 9, due to the peak hour volumes a traffic signal is warranted. As the warrant analysis was inconclusive, and as the post development volumes include trips from Lots 2-9 which are not included in this development proposal, further analysis recommended as part of the future development proposal(s) for Lots 2-9.

4.2 CONCURRENT DEVELOPMENT (4760 KEITH AVE)

As done in the opening day (2022) post development analysis (see **Section 3.7**), the trips generated by the proposed adjacent 4760 Keith Ave development were added to the long term (2035) post development volumes and analyzed in Synchro to determine the post development conditions in the event that both developments are constructed.

The 4760 Keith Ave development is expected to generate 157 external trips (93 inbound / 64 outbound) during the AM peak hour and 184 external trips (88 inbound / 96 outbound) during the PM peak hour (the trip assignment for the 4760 Keith Ave development can be found in **Appendix B**). The trips generated by full build-out of both developments were added to the 2035 background traffic to provide the post development volumes used; the analysis results are summarized in **Table 7**.

TABLE 7: 2035 POST DEVELOPMENT CONDITIONS (INCLUDING 4760 KEITH AVE TRIPS)

Intersection	Movement	Post Development Conditions – AM Peak			Post Development Conditions – PM Peak		
		LOS	Delay (s)	95th % Queue (m)	LOS	Delay (s)	95th % Queue (m)
Keith Ave / Sande St (Hwy 16)	EB L/T	**E**	**55.4**	106.0	**E**	**65.1**	108.5
	WBT	C	29.3	74.2	C	29.8	75.7
	WBR	A	0.8	0.0	A	0.7	0.0
	SBL	B	11.4	48.0	B	11.8	54.6
	SBR	A	2.2	0.0	A	2.2	0.0
Keith Ave / Eby St	EB L/T/R	A	0.8	99.6	A	0.7	82.4
	WB L/T/R	A	1.7	28.9	A	0.6	21.2
	NB L/T/R	D	26.1	61.0	C	24.4	78.5
	SB L/T/R	**E**	**48.0**	29.5	**F**	**68.5**	137.7
Keith Ave / Molitor St	EB L/T/R	A	0.5	82.9	A	0.5	21.0
	WB L/T/R	A	1.1	17.6	A	2.1	29.4
	NB L/T/R	C	18.3	45.8	D	32.3	25.3
	SB L/T/R	C	17.4	15.7	D	30.2	17.7
Keith Ave / Kenney St	EB L/T/R	C	16.3	23.5	**E**	**37.4**	31.4
	WB L/T/R	C	20.8	60.6	**E**	**44.9**	72.6
	NB L/T/R	C	16.8	24.0	C	24.5	27.4
	SB L/T/R	D	25.9	65.1	**E**	**44.7**	98.3
Hwy 16 / Kenney St	EBL	A	9.6	12.6	B	10.1	15.3
	EBT	A	8.3	15.5	A	8.8	17.5
	EBR	A	3.0	7.5	A	3.0	5.4
	WBL	A	9.7	19.5	B	11.1	23.1
	WB T/R	A	6.0	25.8	A	6.7	31.3
	NB L/T	C	22.1	38.7	C	21.6	42.9
	NBR	A	3.7	0.0	A	3.6	0.0
	SB L/T	B	19.7	42.9	B	15.2	35.7
	SBR	A	4.2	13.0	A	4.4	15.4
Hwy 16 / Frank St	EB L/T/R	A	4.0	19.4	A	4.9	26.3
	WB L/T/R	A	4.3	21.3	A	5.0	26.7
	NB L/T/R	B	19.3	19.5	B	18.2	20.9
	SB L/T/R	B	18.2	9.2	C	23.3	22.3

With both developments at full build-out, in 2035 the eastbound movement of the Keith Ave / Sande St signal drops to LOS E. Optimization of the signal timing results in the operations improving to LOS C or better for all movements in the AM and PM peak hours; no additional mitigation measures are recommended at the Keith Ave / Sande St intersection.

The southbound movement of the Keith Ave / Eby St intersection is at a failing level of service (LOS E/F). The Keith Ave / Kenney St intersection is also failing (LOS E) on the eastbound, westbound, and southbound approaches during the PM peak hour. In the long term, signalization of these intersections may be required if the predicted traffic volumes occur.

5.0 GEOMETRICS AND SAFETY

5.1 LEFT TURN LANE WARRANT (MOLITOR ST EXTENSION)

Based on MOTI left turn warrants, under 2022 PM peak hour conditions a westbound left turn lane is warranted at the Keith Ave / Molitor St intersection. An eastbound left turn lane at Molitor St is not warranted but should be included along with the westbound left turn lane to keep the west- and eastbound through lanes aligned through the intersection.

Based on MOTI left turn warrants, left turn lanes on Keith Ave into the Eby St extension are not warranted under either opening day (2022) or long term (2035) post development conditions.

5.2 ACCESS REVIEW

The access for the transload facility is located 70m north of the Keith Ave / Molitor St intersection at the north end of the new Molitor St extension; the access therefore exceeds the corner clearance distance of 15m from a stop-controlled intersection on a local road that is suggested by the *TAC Geometric Design Guide for Canadian Roads (2017)* (Figure 8.8.2). Vehicles will exit the site in a southbound direction directly onto Molitor St, turning sight distances are not required.

For the purposes of this review, it was assumed that Lots 2-9 included three (3) Keith Ave accesses approximately 150m apart between Kenney St and Molitor St. The ultimate access locations will be proposed as part of development proposals for Lot 2-9 and are therefore not included in the access review.

6.0 ALTERNATIVE TRANSPORTATION MODES

6.1 PEDESTRIAN FACILITIES

There are sidewalks on both sides of Sande St for the entire length of the road including the overpass. There are sidewalks on both sides of Keith Ave east of Sande St; west of Sande St, there is a sidewalk on the south side of Keith Ave between Sande St and Eby St and a gravel path on the south side of Keith Ave between Eby St and Molitor St. There is currently no sidewalk on the north side of Keith Ave west of Sande St. The transload facility (Lot 1) is located on the north portion of the development site and does not include Keith Ave frontage; therefore Installation of a sidewalk on Keith Avenue along the south property frontage should be included in the development of Lots 2-9.

There are marked crosswalks across the west and north legs of the signalized Keith Ave / Sande St intersection, 270m east of the Keith Ave / Molitor St intersection. As the number of pedestrians accessing the transload facility by crossing Keith Ave at Molitor St is expected to be very low, a

marked crosswalk is not recommended as part of the transload facility development. The number of pedestrians expected to be accessing the future Lot 2-9 development is dependent on the ultimate land use; therefore the need for a pedestrian crossing across Keith Ave should be reviewed as Lots 2-9 are developed.

6.2 CYCLING FACILITIES

There are no bicycle facilities on Keith Ave, Sande St, Eby St, or Molitor St; cyclists must share the road with motorists. According to the City of Terrace *Active Transportation Plan (2009)*, Keith Ave and Eby St (south of Keith Ave) are designated as proposed signed road bicycle routes with bike route signage and painted bicycle symbols (sharrows). Based on Google Streetview archives, bike route signage was previously installed on Keith Avenue west of Sande St and on Eby St south of Keith Ave but the signage has since been removed (sometime between 2012 and 2018). It is unknown if the bike route signage was intentionally removed by the City; the developer should therefore discuss with the City regarding whether it is still desired to have Keith Ave as a designated bike route; if so, bike route signage and markings should be installed along the Keith Ave property frontage as per the *Active Transportation Plan*.

6.3 TRANSIT FACILITIES

The closest transit stop to the development site is a 260m walk west Molitor St on Keith Avenue at UNBC. The stop is serviced by Terrace Regional Transit Route 3 (Southside) which stops 15 times daily at this location. The Skeena Mall Exchange is a 1km walk northeast of the property; the Exchange is serviced by Route 1, 2, 3, 5, 6, 11, 13, and 14.

7.0 CONCLUSIONS

Under existing and 2022 background traffic volumes, the study area intersections operate well with all movements at LOS C or better during both the AM and PM peak hours with the exception of the eastbound movement at the signalized Keith Ave / Sande St intersection, which operates at LOS D as a result of the signal timing prioritizing Highway 16 traffic (signal timing optimization results in all approaches operating at LOS A/B).

Under opening day (2022) post development conditions, no changes to the LOS of any of the study intersections occur as a result of the addition of development traffic, with the exceptions of the Keith Ave / Molitor St northbound movement and the Keith Ave / Kenney St southbound movement which drop for LOS B to C.

In the long term (2035), the Keith Ave / Kenney St four-way stop drops to LOS D in the PM peak hour. The remaining study area intersections continue to operate adequately under both background and post development conditions with all movements at LOS C or better with the exception of the Keith Ave / Sande St eastbound movement and the Keith Ave / Eby St southbound movement which are at LOS D.

A warrant analysis was conducted for the Keith Ave / Kenney St intersection. Based on peak hour delays, a signal is warranted; however, based on peak hour volumes, a signal is not warranted. The warrants used volumes and delays that were based on high-level assumptions for the land use of Lots 2-9; these volumes are subject to change when development of these lots are proposed. Therefore the need for a signal should be examined as part of future development proposals expected for Lots 2-9.

The main access to the transload facility will be provided by an extension of Molitor St, which will be extended approximately 70m north of Keith Ave to the site access. No issues with corner clearance or sightlines were identified.

A westbound left turn lane is warranted on Keith Ave at Molitor St. Left turn lanes are not warranted at Keith Ave / Eby St; an eastbound left turn lane is not required but may be installed in order to maintain alignment of the east / west through lanes.

As Lot 1 does not include Keith Ave frontage, installation of sidewalks along the south property frontage should be done as part of development of Lots 2-9. Keith Ave and Eby St are designated as signed road bicycle routes in the City of Terrace *Active Transportation Plan (2009)*; however, existing bike route signage was removed from Keith Ave and Eby St at some point between 2012 and 2018, which could be an indication that the bicycle route designation is no longer desired by the City. The developer should discuss with the City regarding whether bike route signage and pavement markings on the property frontage are desired.

8.0 RECOMMENDATIONS

The following recommendations are made regarding the 4800 Keith Ave development:

- The Molitor St extension should be connected as a new north leg of the Keith Ave / Molitor St intersection as a full movement approach with stop control on Molitor St. A westbound left turn lane on Keith Ave is required; an opposing eastbound left turn lane is also recommended.
- Discuss with the City of Terrace regarding the City's desire for bike route signage and pavement markings on Keith Ave. If desired by the City, bike route signage and painted bicycle symbols should be installed on Keith Ave along the property frontage.

APPENDIX A: SYNCHRO BACKGROUND

SYNCHRO MODELLING SOFTWARE DESCRIPTION

The traffic analysis was completed using Synchro and SimTraffic traffic modelling software. Results were measured in delay, level of service (LOS), 95th percentile queue length and volume to capacity ratio. Synchro is based on the Highway Capacity Manual (HCM) methodology. SimTraffic integrates established driver behaviours and characteristics to simulate actual conditions by randomly "seeding" or positioning vehicles travelling throughout the network. The simulation is run ten times (ten different random seedings of vehicle types, behaviours and arrivals) to obtain statistical significance of the results.

Levels of Service

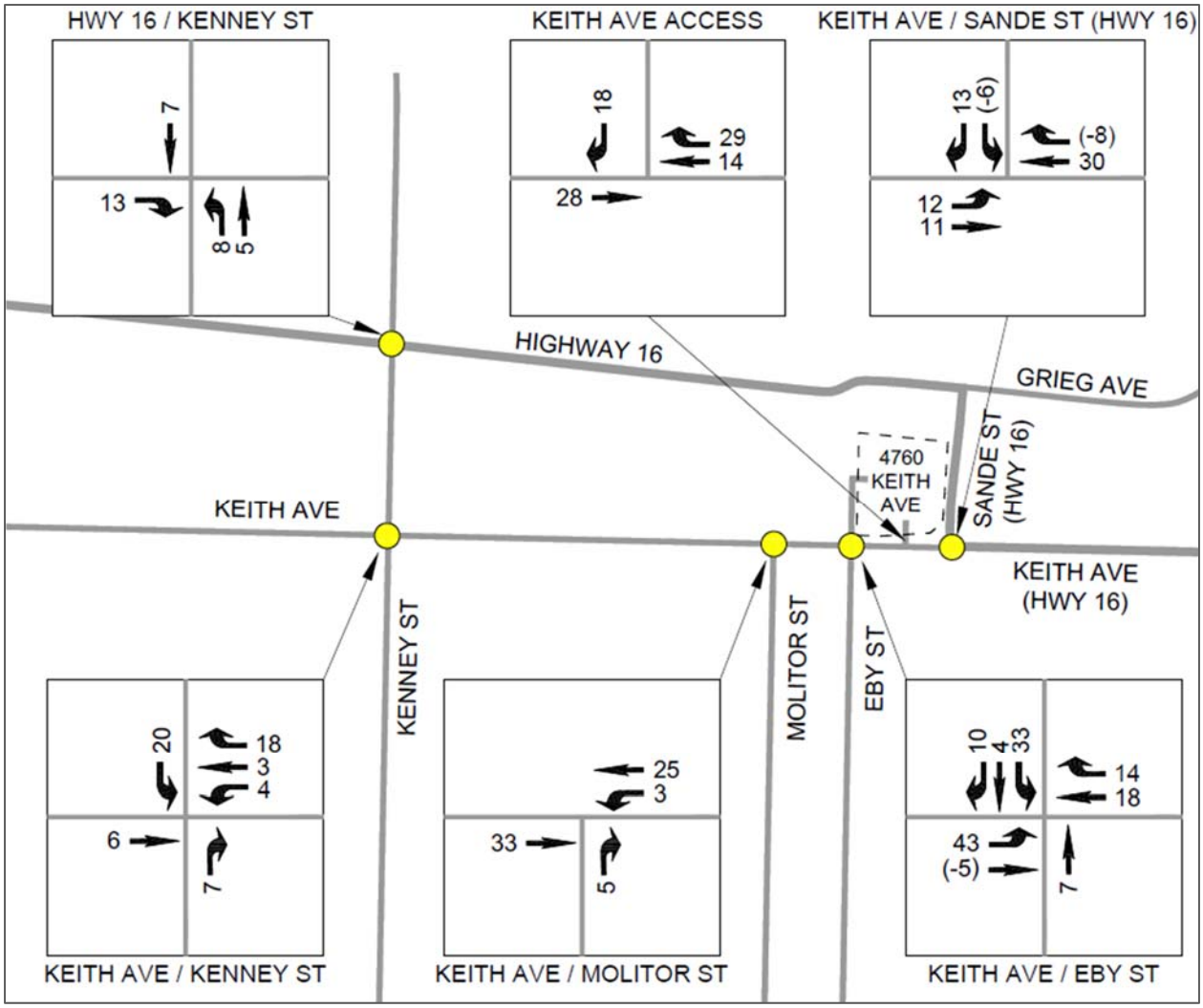
Traffic operations are typically described in terms of levels of service, which rates the amount of delay per vehicle for each movement and the entire intersection. Levels of service range from LOS A (representing best operations) to LOS E/F (LOS E being poor operations and LOS F being unpredictable/disruptive operations). LOS E/F are generally unacceptable levels of service under normal everyday conditions. A LOS C or better is considered acceptable operations, while D is considered to be on the threshold between acceptable and unacceptable operations. Highway operations will typically need to operate at LOS C or better for through movements and LOS E or better for other traffic movements with lower order roads.

The hierarchy of criteria for grading an intersection or movement not only includes delay times, but also takes into account traffic control type (stop signs or traffic signal). For example, if a vehicle is delayed for 19 seconds at an unsignalized intersection, it is considered to have an average operation, and would therefore be graded as an LOS C. However, at a signalized intersection, a 19 second delay would be considered a good operation and therefore it would be given an LOS B. The table below indicates the range of delay for LOS for signalized and unsignalized intersections.

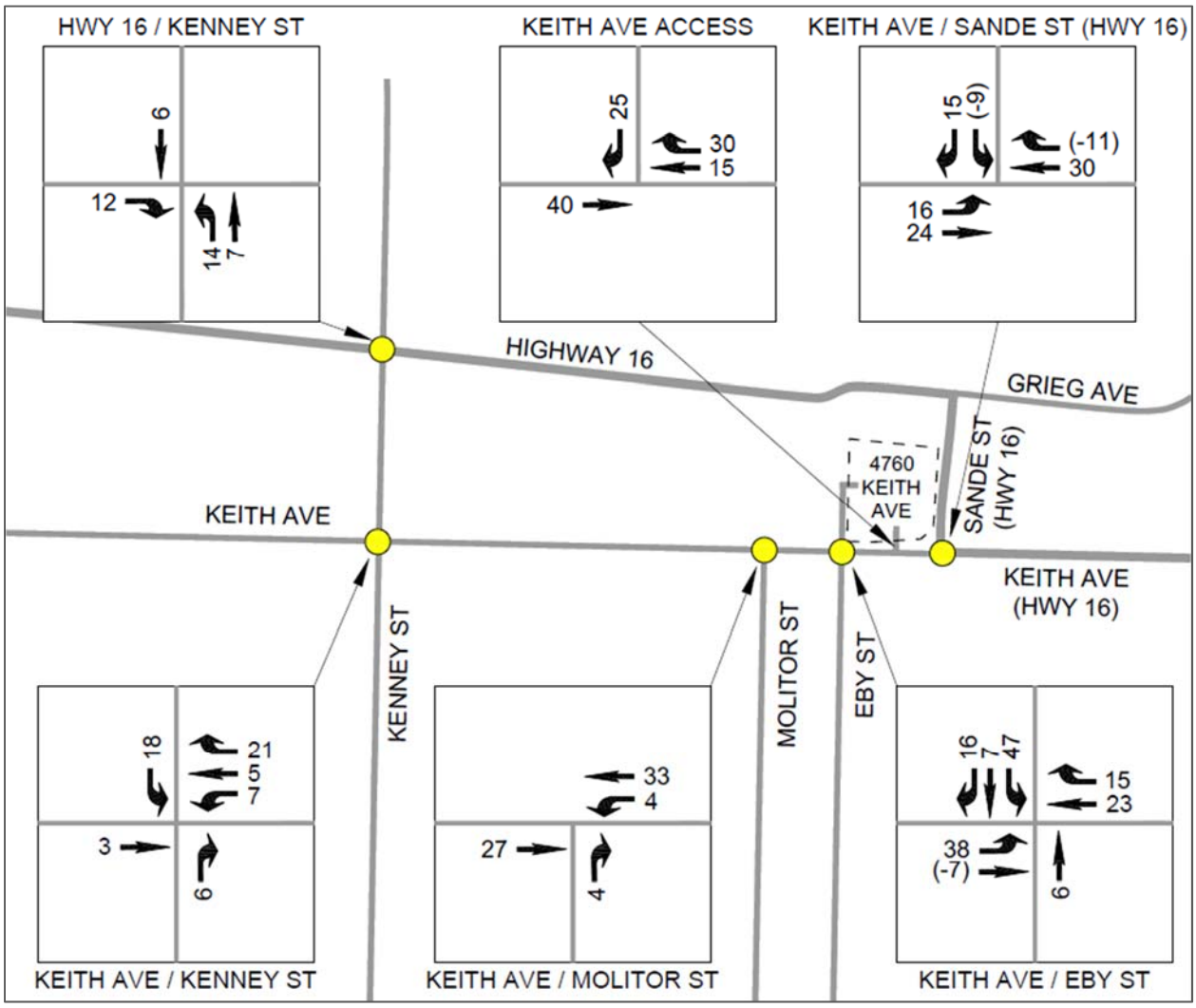
Table A1: LOS Criteria, by Intersection Traffic Control

Level of Service (LOS)	Unsignalized Intersection Average Vehicle Delay (sec/veh)	Signalized Intersection Average Vehicle Delay (sec/veh)
A	0 – 10	0 – 10
B	> 10 – 15	> 10 – 20
C	> 15 – 25	> 20 – 35
D	> 25 – 35	> 35 – 55
E	> 35 – 50	> 55 – 80
F	> 50	> 80

APPENDIX B: 4760 KEITH AVE TRIP ASSIGNMENT



4760 Keith Ave Trip Assignment - AM Peak Hour



4760 Keith Ave Trip Assignment - PM Peak Hour

APPENDIX C: TERMS OF REFERENCE