APPENDIX E. TRANSPORTATION IMPACT ASSESSMENT

41	1602-AS	The Disposition Holder must incorporate a buffer* zone of a minimum width of 100m undisturbed vegetation, where an established buffer* does not already exist for any and all key habitat features including, but not limited to leks*, nests, dens and houses identified in the Wildlife Sweep*.
42	1603	When Wildlife Surveys* are required, the Disposition Holder must submit results as defined by the sensitive species inventory guidelines from Wildlife Survey* to the Fisheries and Wildlife Management Information System (FWMIS).
43	1608	The Disposition Holder must incorporate buffers*, setbacks and activity timing restrictions for any and all key habitat features including, but not limited to leks*, nests, dens and houses identified in the wildlife survey*.

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FEE SIMPLE LAND ASP – TRAFFIC IMPACT ASSESSMENT

PREPARED FOR
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 EXECUTIVE SUMMARY

This study was completed in accordance with Alberta Transportation (AT) requirements to be utilized for obtaining a Roadside Development Permit (RDP) necessary for the construction of the gas station for Phase 1 and provide a long-term overview of what, if any, improvements will be required to accommodate the long-term potential developments within the fee simple land that is owned by Saddle Lake Cree Nation #125.

This study focuses on assessing the transportation impact of the future development on Highway 652, Highway 29 and Highway 36. The land would be accessed through a proposed site access from Highway 652.

The three intersections that were assessed as part of the study are:

- Site access/Highway 652,
- Highway 29/Highway 652, and
- Highway 36/Highway 29.

Analyses of the impacts of the Background and Post Development traffic on the adjacent roadway system were assessed at the following horizons:

- Opening Day (Phase 1) Gas Station/truck stop/convenience store - year 2023,
- Phase 2 build out - year 2043 (20-year), and
- Phases 3 and Phase 4 build out – year 2053 (30 year). The revised timeline of 30-years was chosen as long term plans are highly uncertain and dependent on market conditions and business interest.

The timing and land use is only known for Phase 1 of the development, additional phases are to be completed based on fundings availability and market demands. Future land use for Phases 2 to 4 was assumed to be a mix of commercial and light industrial based on other uses in the area.

Based on the analyses completed, the following **Table 1-1** summarizes the improvements recommended along the study highways near the development site. Improvements related to Phase 1 construction and background traffic has been bolded.

Table 1-1: Summary of Identified Improvements for Study Intersections

Horizon Year	Intersection Treatment	Dedicated Left Turn	Dedicated Right Turn	Lighting	Signalization
Highway 652 and Site Access					
Background					
2022	N/A	N/A	N/A	N/A	N/A
Post Development					
2023 – Phase 1	**Type IVd**	No Warranted	**Warranted WB Turn Lane**	Not Warranted	Not Warranted
2043 – Phase 2	Type IV	Warranted EB Turn Lane	Warranted WB Turn Lane	Delineation Lighting	Not Warranted
2053 – Phases 3 & 4	Type IV	Warranted EB Turn Lane	Warranted WB Turn Lane	Full Lighting	Warranted
Highway 29 and Highway 652					
Background					
2022	Type-IV	No additional improvements	No additional improvements	**Delineation Lighting**	Not Warranted
Post Development					
2023 – Phase 1	Type IV	No additional improvements	No additional improvements	Delineation Lighting	Not Warranted
2043 – Phase 2	Type IV	No additional improvements	No additional improvements	Delineation Lighting	Not Warranted
2053 – Phases 3 & 4	Type IV	10 m Additional Storage Required	No additional improvements	Full Lighting	Warranted
Highway 29 and Highway 36					
Background					
2022	Type-IV	No additional improvements	No additional improvements	No additional improvements	No additional improvements
Post Development					
2023 – Phase 1	Type IV	No additional improvements	No additional improvements	No additional improvements	Not Warranted
2043 – Phase 2	Type IV	Warranted NB Turn Lane	No additional improvements	No additional improvements	Not Warranted
2053 – Phases 3 & 4	Type IV	Warranted NB Turn Lane	No additional improvements	No additional improvements	Not Warranted

2.0 INTRODUCTION

2.1 BACKGROUND

Urban Systems Ltd. (USL) was retained to support the submission of Area Structure Plan (ASP) for the fee simple land owned by Saddle Lake Cree Nation (SLCN) # 125 in the northwest corner of the Highway 652 and Highway 29 intersection. The land is legally described as SE 3-58-11-W4 and is approximately 136 acres (55 Ha) in size.

Figure 2-1 and **Figure 2-2** illustrates the site location. The development will be situated between Highway 652 to the south, Highway 29 to the east and undeveloped land to the north and west.

Figure 2-1: Location of the Proposed Development

2.2 STUDY OBJECTIVE & SCOPE

This Traffic Impact Assessment (TIA) was completed to support the development application for the gas station in the short-term (Phase 1), and to support and obtain the necessary permits from Alberta Transportation (AT). The analysis will recommend appropriate intersection geometries and improvements required to support the traffic generated by the gas station and will be based on Alberta Transportation *Highway Geometric Design Guide (AT-HGDG)*. The study also assesses the long-term impact on the transportation network from the full build-out of the fee simple land for planning purposes. The long-term assessment will provide SLCN an understanding of what, if any, road network improvements will be required to support future phases. It is recommended that as future phases occur, that additional TIAs are completed to support that phase of the development and to ensure that the results reflect traffic conditions at the time of the study since future phases are still in planning stages and timing is uncertain.

The TIA will evaluate the following intersections as per discussion with AT. A copy of the correspondence is included in **Appendix A**.:

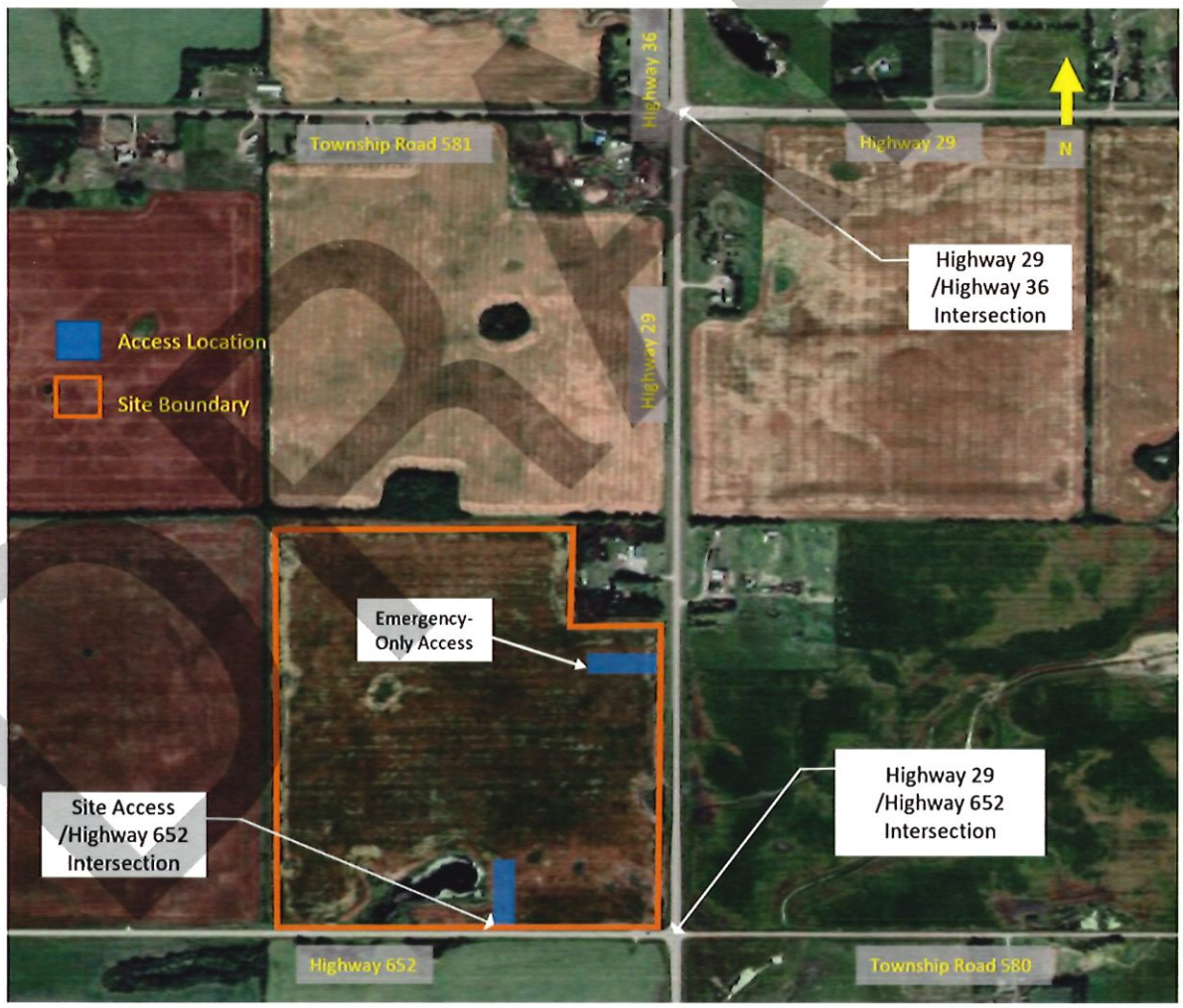
- Site access/Highway 652
- Highway 29/Highway 652
- Highway 36/Highway 29

The TIA will identify the intersections capacity and operational requirements needed to support the proposed development. The study is prepared in accordance with Alberta Transportation's TIA Guidelines (February 2021) where the scope includes:

- Review of existing background traffic volumes near the development.
- Develop trip generation, distribution, and assignment of the proposed development traffic based on ITE Trip Generation Manual 11th Edition trip generation rates.
- Operational analyses of the Background and Post Development traffic on the adjacent roadway system in the study horizons, which are as follows:
    - Opening Day (Phase 1) of Gas Station/truck stop/convenience store - year 2023,
    - Phase 2 build out - year 2043 (20 year)
    - Phases 3 and Phase 4 build out – year 2053 (30 year).
- Identify timeline for construction of site access and the emergency access.
- Recommend improvements to the study intersection or roadway network based on the results of the analyses.

Appendix B shows a site concept for the proposed development and site access locations. The site phasing plan is also included in the same appendix.

Figure 2-2: Area Surrounding Proposed Site Location



2.3 EXISTING INFRASTRUCTURE CONDITIONS

Highway 652 is classified as a Level 3, approximately 9.7 meter wide, paved two-lane undivided provincial highway which runs east-west along the south edge of the subject site (652:2:C1 km 38.586 – 40.147). The posted speed limit is 100 km/hr on the segment near the site.

According to 2021 AT traffic count data, the highway registered a weekday average annual daily traffic (WAADT) of approximately 1,360 vehicles per day (vpd). Heavy vehicles and recreational vehicles (RVs) accounted for approximately 5% of vehicles along the highway, with the remaining 95% being personal vehicles.

Highway 29 is an undivided, two-lane, paved road that is approximately 9.4 meters wide with a posted speed limit of 100 km/hr. It runs north-south along the east edge of the site (29:8:C1 km 31.482 – 33.012). The highway forms the east and south legs at the intersection of Highway 29 and Highway 36.

Highway 36 is an undivided, two-lane, paved road that is approximately 13 meters wide with a posted speed limit of 100 km/hr. It forms the north leg at the intersection of Highway 29 and Highway 36 (36:24 KM 0.000).

Highway 652 and Highway 29 (AG-24729) is a four-legged intersection with two-way stop control for the eastbound and westbound traffic. Township Road 580 (the east leg of the intersection) is a gravel road while the other three legs are paved and are part of the provincial highway network. The intersection geometry is similar to a Type-IV intersection with a dedicated northbound to westbound left turn lane and dedicated southbound to westbound right turn lane. The subject intersection is located within Control Section 652:02; Traffic Control Section 01 (near km 40.178).

Highway 36 and Highway 29 (AG-642) is a four-legged intersection with two-way stop control for eastbound and westbound traffic. Township Road 581 (the west leg of the intersection) is a gravel road while the other three legs are paved and are part of the provincial highway network. The intersection geometry is similar to a Type-IV intersection with a dedicated northbound to eastbound right turn lane and dedicated southbound to eastbound left turn lane. The subject intersection is located within Control Section 32:24; Traffic Control Section 04 (near km 0.000).

2.4 FUTURE HIGHWAY AND MUNICIPAL PLANS

The area was not identified to be part of any long-term plans by the County.

3.0 BACKGROUND AND FUTURE TRAFFIC FORECAST

3.1 HISTORIC BACKGROUND TRAFFIC GROWTH

Background traffic is the traffic that is present on the road network without development of the subject site. To determine future Background traffic, historic traffic growth rate was calculated using the information provided in Section A.4.3 of the AT-HGDG. The growth rate was then used to forecast future background traffic volumes.

Based on a review of Alberta Transportation's historical AADT along the adjacent highways, the following are observed traffic volume trends on Highway 29, Highway 36 and Highway 652 from 2002 to 2019. The locations of the traffic counts used are from the live counter located along the highways which pass near the site. They were selected based on their location to capture regional trends.

The 2019 volumes were used to mitigate the potential impact of Covid-19 on the current traffic volumes. Averaging the obtained data, it shows that highways surrounding the study area had an annual average increase rate for the past 17 years of 0.88% and an annual average decrease rate of -0.77% for the past 5 years. Based on discussion with AT, a more conservative 2% linear annual growth rate would be applied to all background traffic and is in line with AT 2021 TIA Guidelines. The following **Table 3-1** shows a summary of the historic traffic data obtained from AT traffic count information.

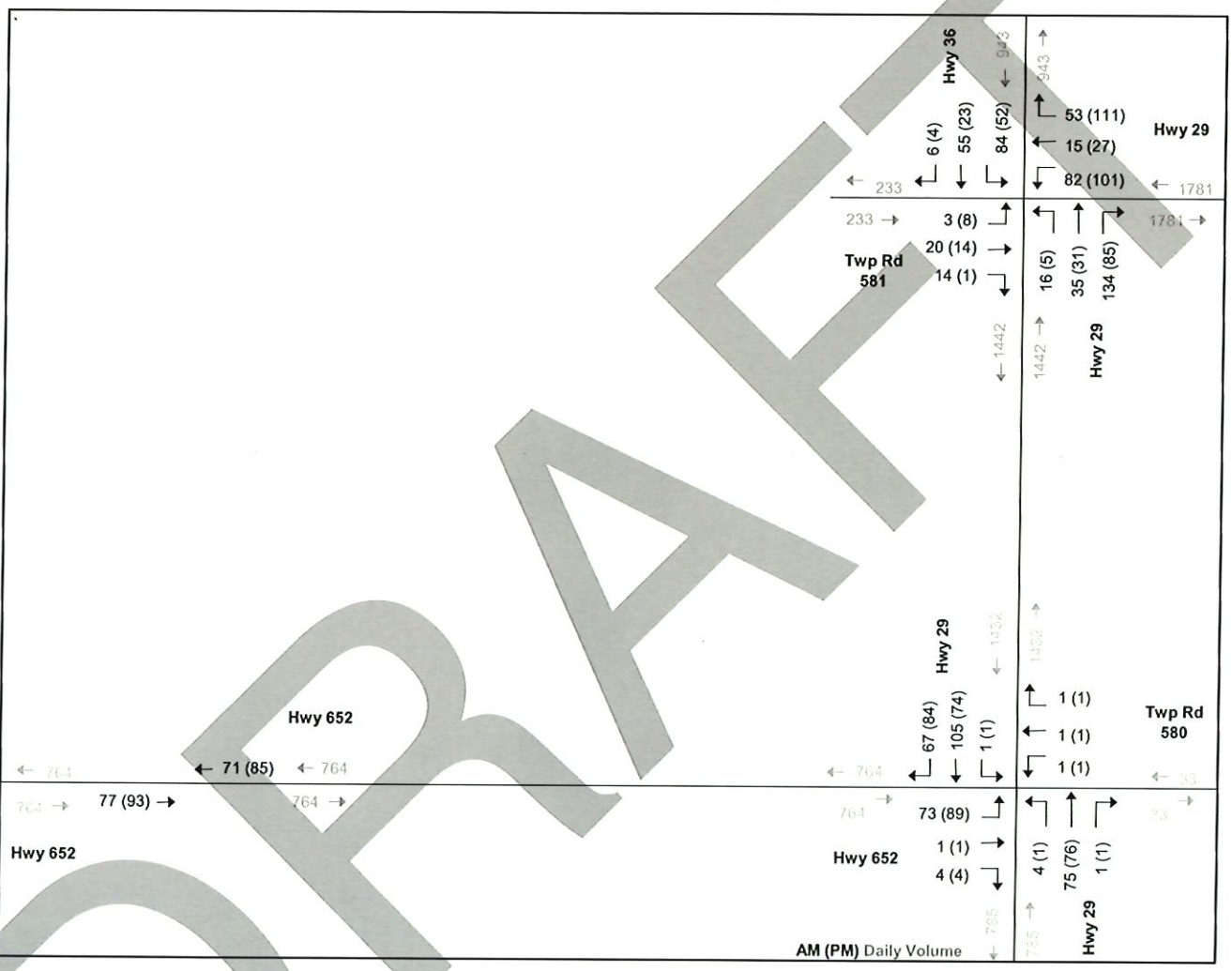
Table 3-1: Historic Background Traffic Growth Rate

Traffic Count Location	Average Annual Daily Traffic (AADT) (vpd)			Historic Average Annual Growth Rate	
	2002	2015	2019	Past 5-Year	Past 17-Year
5.2 KM West of Hwy 29 & 881 St Paul WJ (50281460)	4,206	4,702	4,410	-1.32%	0.29%
1.4 KM North of Hwy 36 & Hwy 45 TWO HILLS EJ (60362250)	840	1,186	1,158	-0.48%	2.23%
2.6 KM South of Hwy 28 & Hwy 36 ASHMONT (60281250)	1,379	1,775	1,668	-1.28%	1.23%
Hwy 29 and Hwy 652 South of St Bride (125580) – west leg	1,500	1,440	1,440	0.00%	-0.24%
Average of Four Count Locations				-0.77%	0.88%

3.2 2022 BACKGROUND TRAFFIC

Figure 3-1 shows the 2022 traffic volumes estimated based on AT traffic count information for year 2019 adjusted to year 2022 as described in Section 3.1. The volumes are shown for the existing Highway 652 and Highway 29, Highway 36, and Highway 29 intersections.

Figure 3-1: Existing Background Traffic Volume at Study Intersections – Year 2022



3.3 2023, 2043 AND 2053 BACKGROUND TRAFFIC

Figure 3-2, Figure 3-3, and **Figure 3-4** illustrate the background traffic volumes for the AM and PM peak hours, and the daily background traffic for all three study horizons. The 2023 represent the future Opening Day of the initial phase of development, and 2043 and 2053 represent the 20-year and 30-year horizons, respectively. As per Section 3.1 the traffic volumes on all legs of the intersection were adjusted linearly at 2% growth per year from 2019 to the 2023, 2043 and 2053 horizons.

Figure 3-2: Background Traffic at Study Intersections - Year 2023

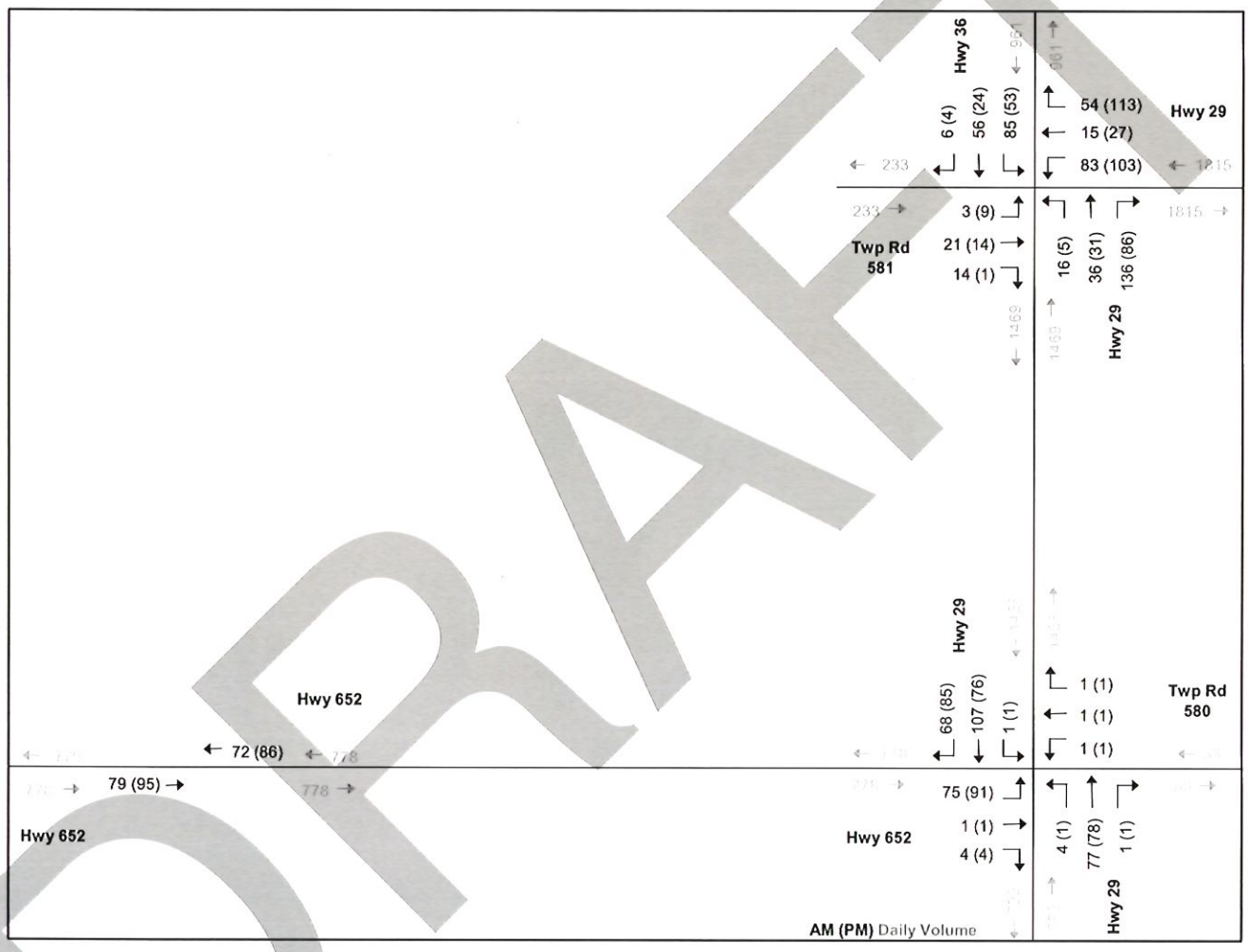


Figure 3-3: Background Traffic at Study Intersections - Year 2043

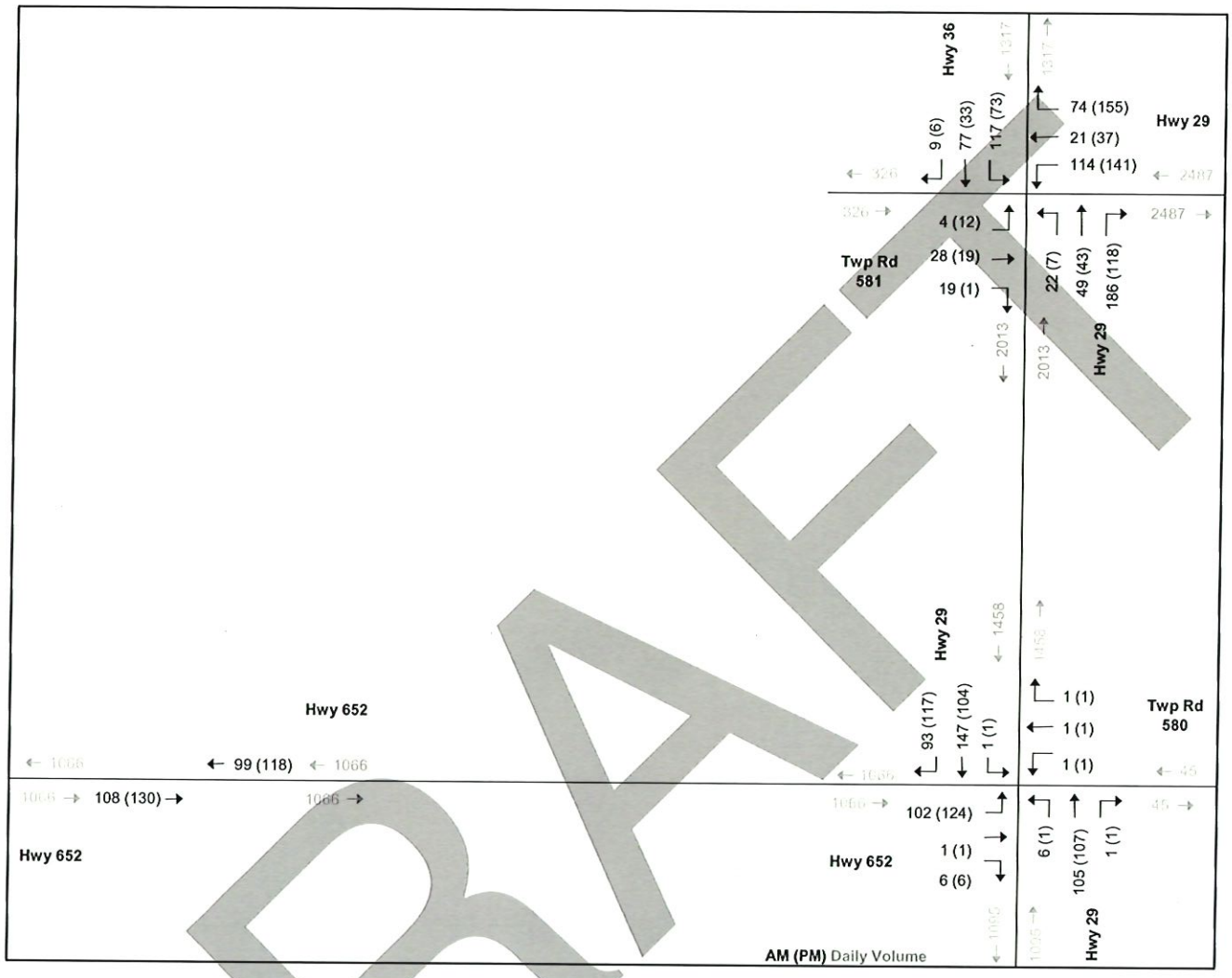
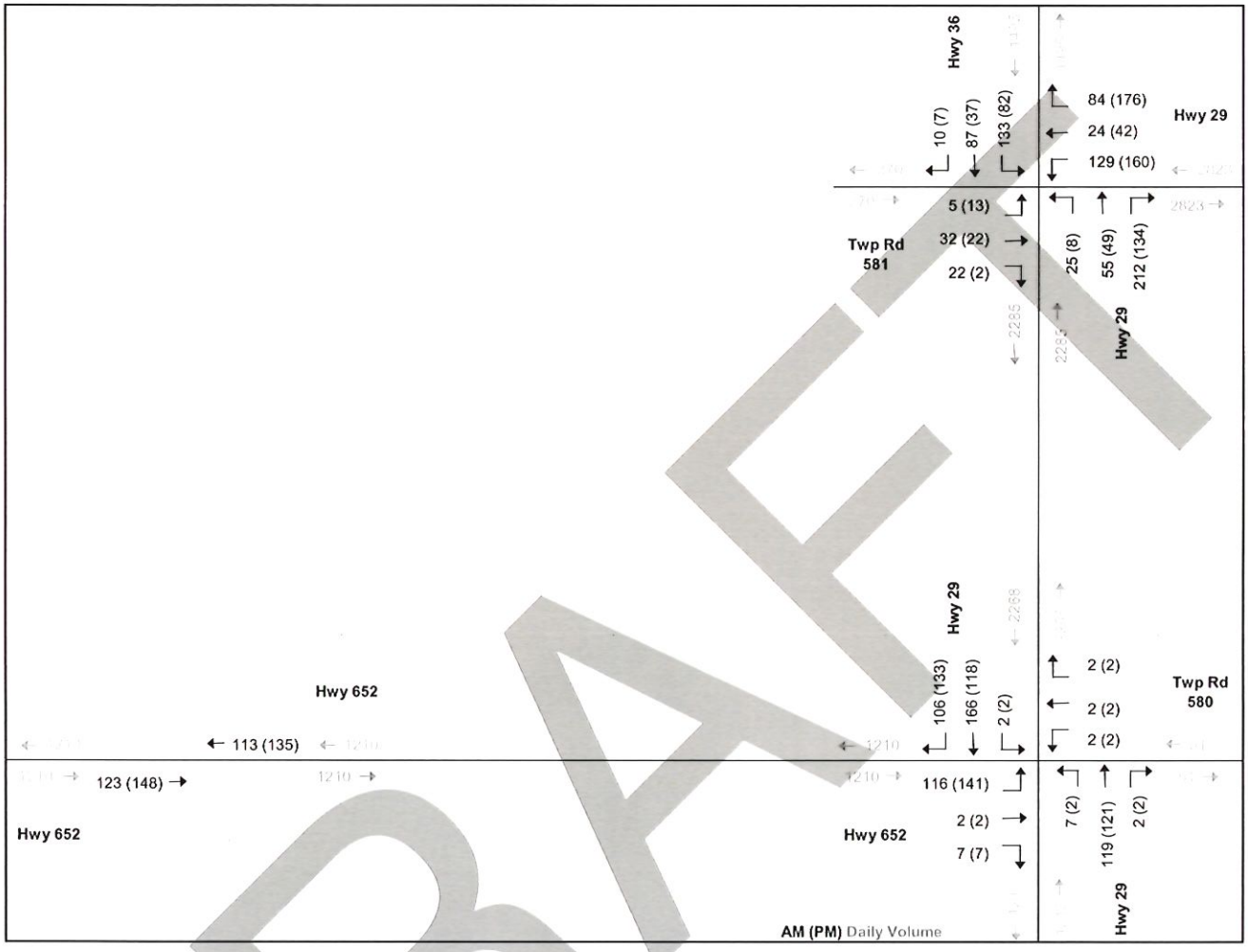


Figure 3-4: Background Traffic at Study Intersections - Year 2053



4.0 PROPOSED DEVELOPMENT TRAFFIC

4.1 SITE TRIP GENERATION

Trip generation rates have been determined for the proposed development site using the Institute of Transportation Engineers (ITE) *Trip Generation Manual (11th Edition).* ITE trip rates represent land-use specific averages that have been developed through years of case studies and background research. Directionality is also indicated in the ITE *Trip Generation Manual* by specifying what percentage of generated trips is heading into the development (inbound trips) versus how many trips are leaving the development (outbound trips). The ITE manual also provides information to calculate the average daily trips anticipated.

The proposed land uses for the development are shown in **Table 4-1** by phases and include a gas station, and commercial and light industrial uses. The study utilizes multiple land-use codes from the ITE Trip Generation Manual to estimate the future traffic generated by each phase of the site. This study relies on what the land uses are anticipated to be at the time of completing this study. As indicated in the introduction to this study, only Phase 1 is planned for construction, whereas Phases 2 to 4 are still in the early planning stages and timing for development of these future phases are uncertain and more long-term. Future traffic impact assessment updates may be required to confirm improvements required to support each future phase of development; at which time the proposed land use should be confirmed. The Floor Area Ratio (FAR) is assumed to be 25 percent for all industrial or commercial sites based on similar types of developments in rural areas across Alberta. **Table 4-1** summarizes the AM and PM Peak Hours as well the Daily Traffic Volumes for the proposed development site.

The overall site phasing plan is provided in **Appendix B.** As the development is planned in multiple phases, it is intended that the main site access along Highway 652 will be constructed as part of the gas station development. The emergency access is proposed as part of Phase 2 or Phase 3. The timing for when the future access will be required will be completed with development application for future phases. As well, the exact location of the emergency access, and design will be completed as part of Phases 2 or 3, whichever phase triggers the need for it.

Table 4-1: Trip Generation Rates of Proposed Land-Uses

Land Use Type	ITE Use (Code)	Trip Rate (trips/unit)	Unit	In %	Out %	Unit Quantity	Development Trips (vph) [vpd]		
							Total Trips	Inbound Trips	Outbound Trips
Phase 1 (2023)									
Gas Station	Gas Station/Convenience Store (ITE 945)	16.06 (18.42) [265.12]	Trips/ Pump Station	50% (50%) [50%]	50% (50%) [50%]	6 pumps	96 (111) [1,591]	48 (55) [795]	48 (55) [795]
Phase 2 (2043)									
Light-Use Industrial	Industrial Park (ITE 130)	0.34 (0.34) [3.37]	Trips / KSF	81% (22%) [50%]	19% (78%) [50%]	118	40 (40) [398]	33 (9) [199]	8 (31) [199]
Commercial	Shopping Center (ITE 820)	0.84 (3.4) [37.01]	Trips / KSF	62% (48%) [50%]	38% (52%) [50%]	79	66 (268) [2,916]	41 (129) [1,458]	25 (139) [1,458]
Phase 3 (2053)									
Light-Use Industrial	Industrial Park (ITE 130)	0.34 (0.34) [3.37]	Trips / KSF	81% (22%) [50%]	19% (78%) [50%]	114	39 (39) [385]	31 (9) [193]	7 (30) [193]
Commercial	Shopping Center (ITE 820)	0.84 (3.4) [37.01]	Trips / KSF	62% (48%) [50%]	38% (52%) [50%]	76	64 (259) [2,820]	40 (124) [1,410]	24 (135) [1,410]
Phase 4 (2053)									
Light-Use Industrial	Industrial Park (ITE 130)	0.34 (0.34) [3.37]	Trips / KSF	81% (22%) [50%]	19% (78%) [50%]	168	57 (57) [566]	46 (13) [283]	11 (45) [283]
Commercial	Shopping Center (ITE 820)	0.84 (3.4) [37.01]	Trips / KSF	62% (48%) [50%]	38% (52%) [50%]	112	94 (381) [4,143]	58 (183) [2,072]	36 (198) [2,072]
					Total New Trips		**457 (1,154) [12,820]**	**297 (521) [6,410]**	**159 (633) [6,410]**

Note: AM (PM) [Daily], vph = vehicles per hour; vpd = vehicles per day, KSF = thousand square feet, Trips per KSF

4.2 PASS-BY TRIPS

A pass-by trip is made as an intermediate stop on the way from an origin to a primary trip destination without a route diversion. Drivers (traffic) that are already on the road network, passing the site on an adjacent street or roadway that offers direct access to the land use, stop over on their way to their final destination. Pass-by trip attractions are more prominent for some land use types than others.

The semi-rural nature of the development and its visibility from the highway would attract traffic that makes a stop over at the gas station or other future highway commercial businesses. Therefore, the pass-by rates provided in the ITE Trip Generation Handbook 3rd edition was applied only to specific land uses that typically have pass-by traffic. **Table 4-2** summarizes the pass-by trips from the highway and adjusted trips generated by the site to the network.

Table 4-2: Pass-by Trips and Adjusted New Trips Totals

ITE Use (Code)	Pass-by Rate (%)	Pass-by Trips		
		AM	PM	Daily
Phase 1 - Gas Station (945)	50%	48	55	795
Phase 2 - Commercial Site (820)	10%	7	27	292
Phase 3 - Commercial Site (820)	10%	6	26	282
Phase 4 - Commercial Site (820)	10%	9	38	414
TOTAL PASS-BY		**71**	**146**	**1,783**
TOTAL NEW TRIPS AFTER PASS-BY ADJUSTMENT		**386**	**1008**	**11,036**

The pass-by trips are not new to the road network, so are removed from the total site generated trips and assigned separately to the study network. The pass-by trips are pulled from the existing traffic volumes along the adjacent highways. The inbound and outbound trips are equal for pass-by trips as the driver leaves towards the same direction they were originally traveling.

4.3 PROPOSED DEVELOPMENT TRIP DISTRIBUTION

The site will be developed over multiple phases that are heavily dependent on market conditions and business interest. For the purpose of the analysis at this stage, traffic patterns for all the phases are assumed to follow similar distribution as the traffic currently seen along the adjacent highways. At this stage, the plans include one main site access along Highway 652 which would be constructed as part of Phase 1 and an emergency access along Highway 29 which would be constructed in the future phases.

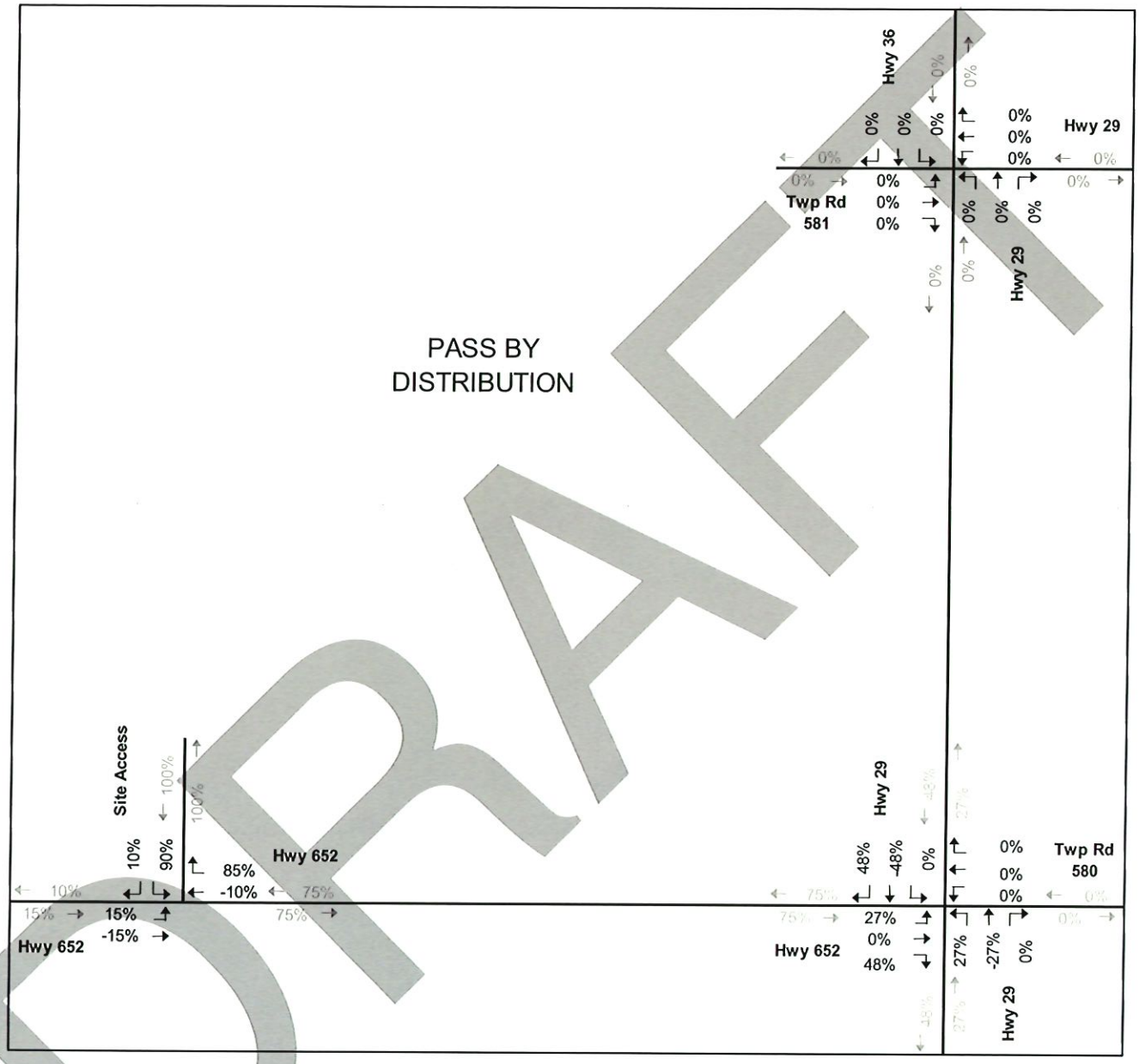
Based on current traffic patterns, the development location west of Town of St. Paul, and the central location regionally for passing traffic, it is anticipated that traffic generated from the site will be distributed 25% to the west, and 75% to the east (towards the intersection of Highway 29 and Highway 652). At the said intersection, it is anticipated 48% of the traffic will go to/from the north and 26% will go to/from the south. The 48% site traffic at the intersection of Highway 29 and Highway 36 is expected to split with 29% going to/from east to St. Paul, and 18% going to/from the north. 1% of the overall traffic is assigned to Township Road 581 and 1% to Township Road 580 to account for potential traffic movement along both roadways.

Figure 4-1 summarizes the proposed development trip distribution at the impacted intersections.

Figure 4-1: Proposed Development Trip Distribution

Pass-by trip distribution followed similar splits as to primary trips. **Figure 4-2** summarizes the pass-by trip distribution.

Figure 4-2: Pass-By Trip Distribution



Based on the trip distribution above, the trip assignment for traffic volumes (primary and pass by) at the study intersections for all three horizons was calculated and summarized in **Figure 4-3**, **Figure 4-4** and **Figure 4-5.**

Figure 4-3: Opening Day (Phase 1) Only (2023) – Site Traffic

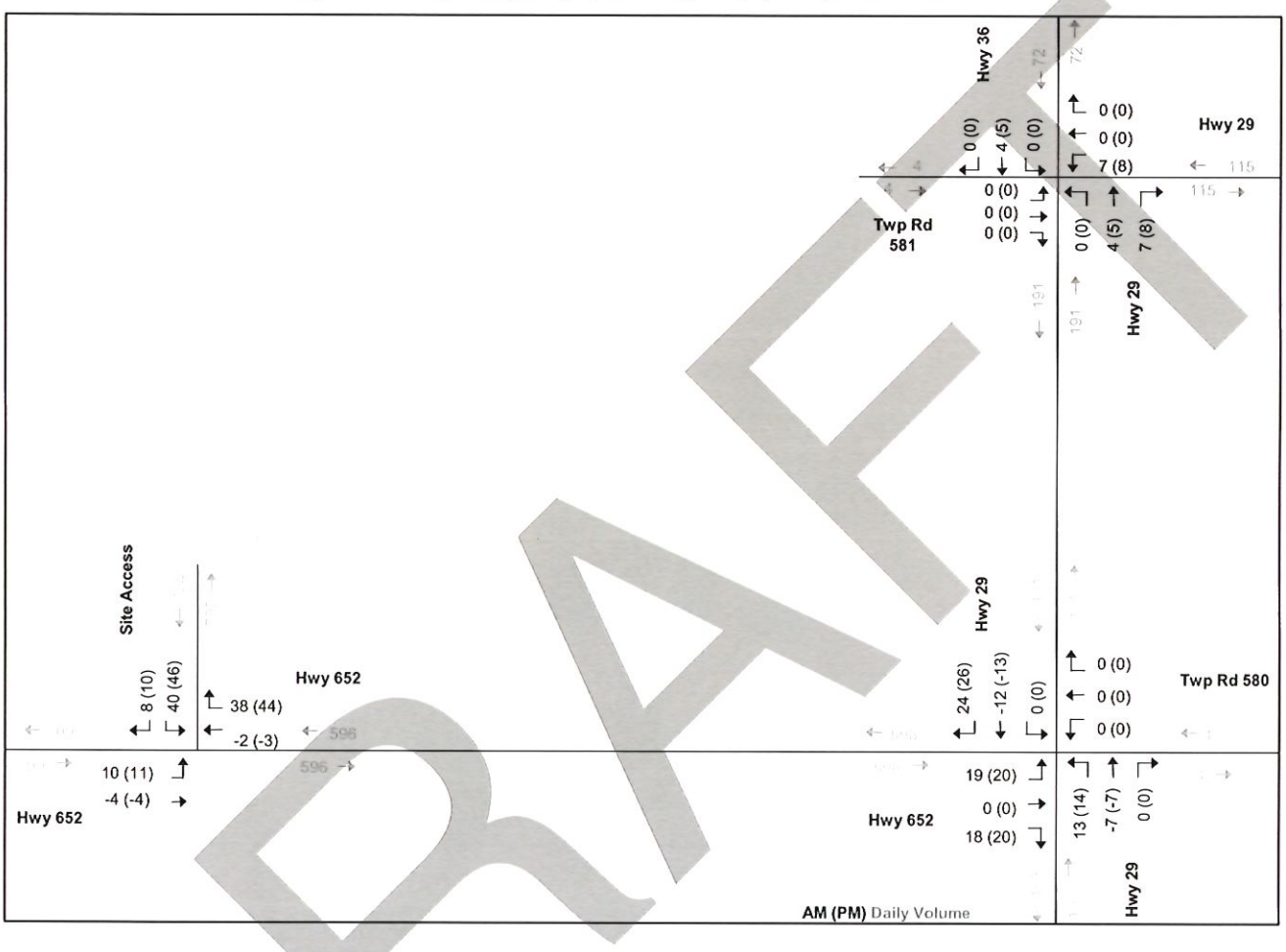


Figure 4-4: Phase 2 Only (2043) – Site Traffic

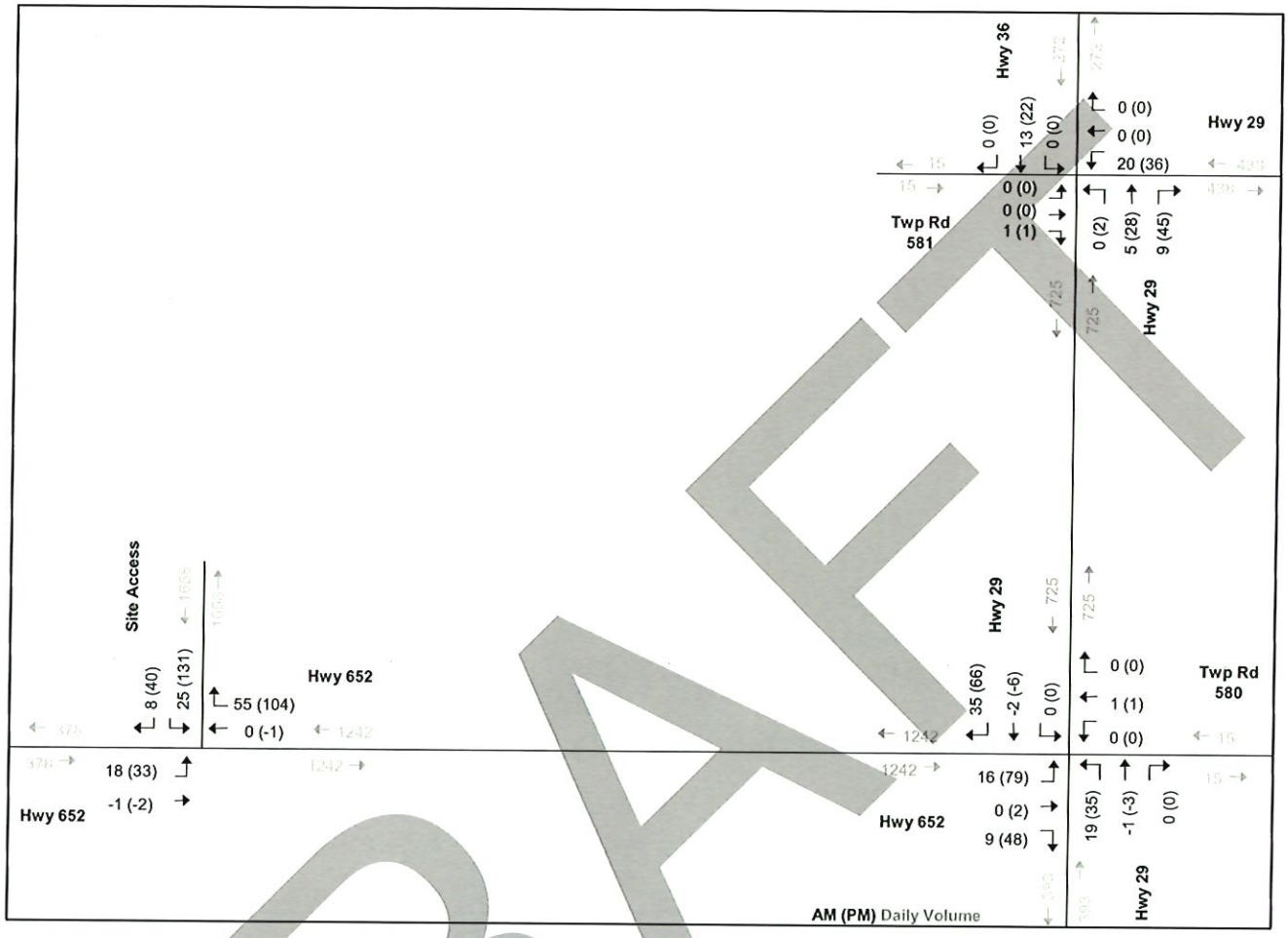
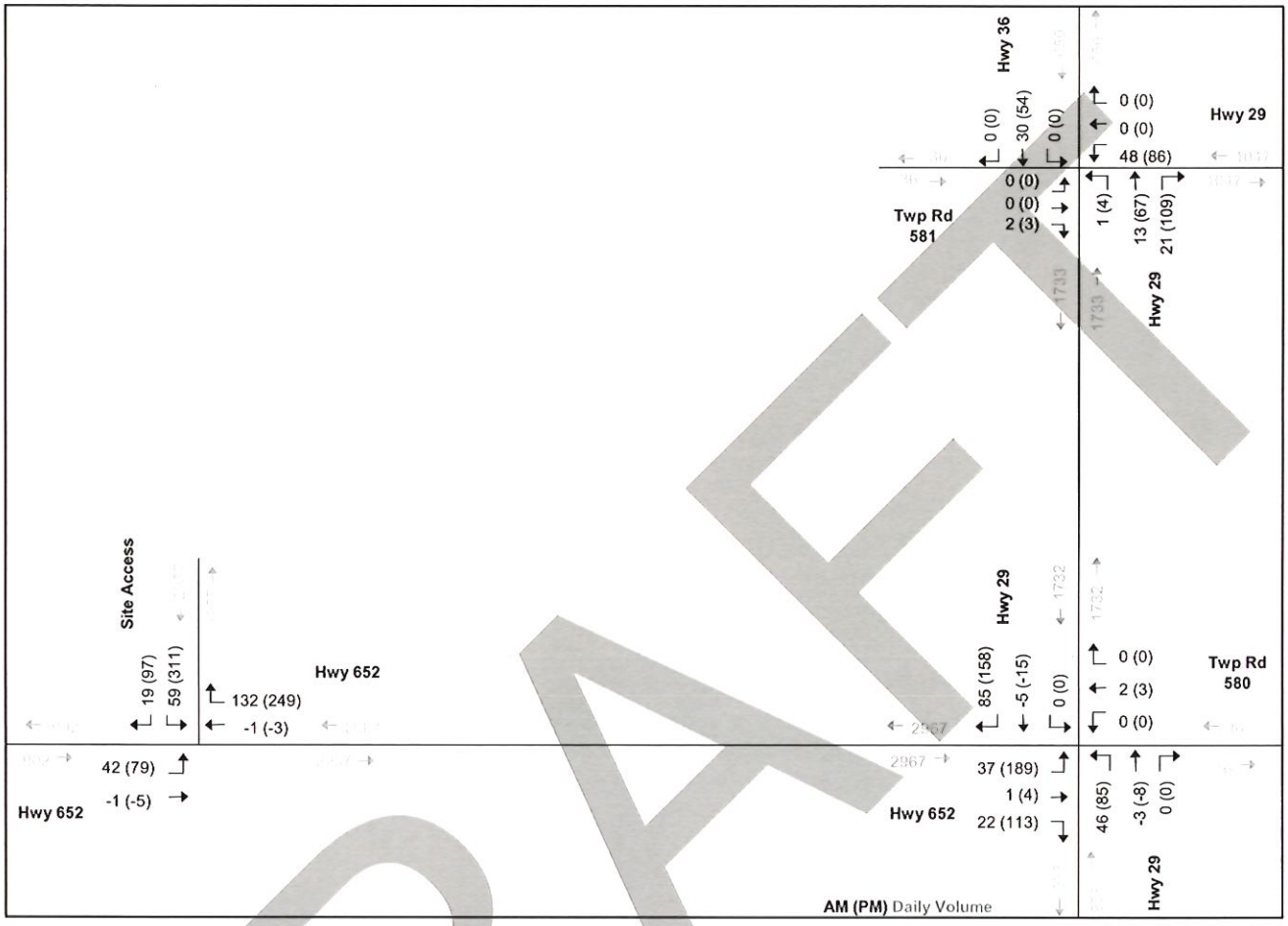


Figure 4-5: Phase 3 and Phase 4 (2053) – Site Traffic



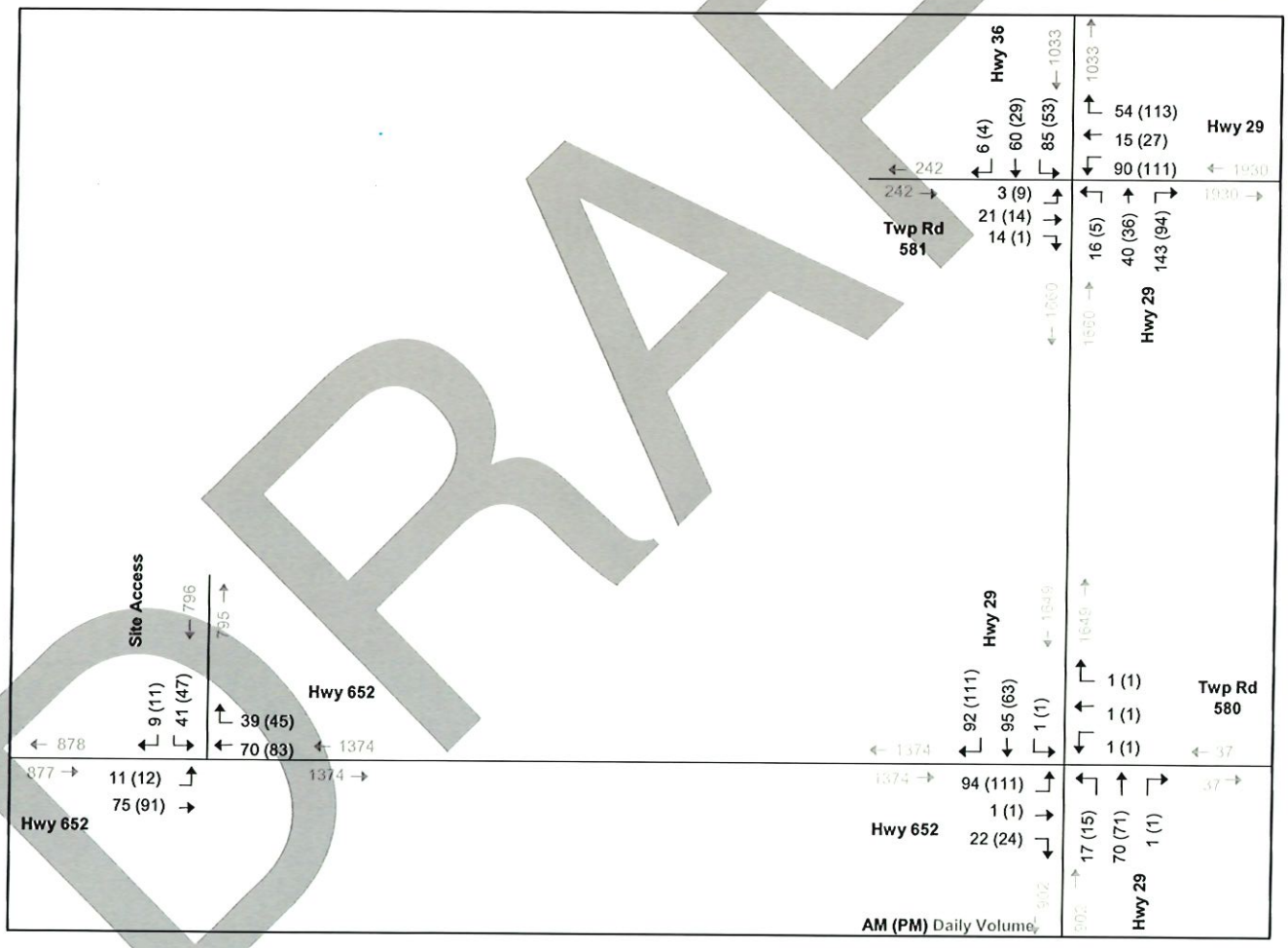
5.0 POST DEVELOPMENT TRAFFIC

The Post Development traffic is defined as the forecasted background traffic and the site generated traffic all summed for the peak hour and daily periods. Future background traffic volumes have been forecasted for the planned 2023, 2043 and 2053 horizons, and are included in **Section 3.0**. The following sections show the Post Development traffic for all three study horizons.

5.1 2023 POST DEVELOPMENT TRAFFIC VOLUMES

The 2023 Post Development traffic volumes shown in **Figure 5-1** are the sum of the 2023 Background traffic volumes and the proposed gas station (Phase 1) trip volumes after pass-by traffic volumes adjustment.

Figure 5-1: 2023 Post Development Traffic Volumes



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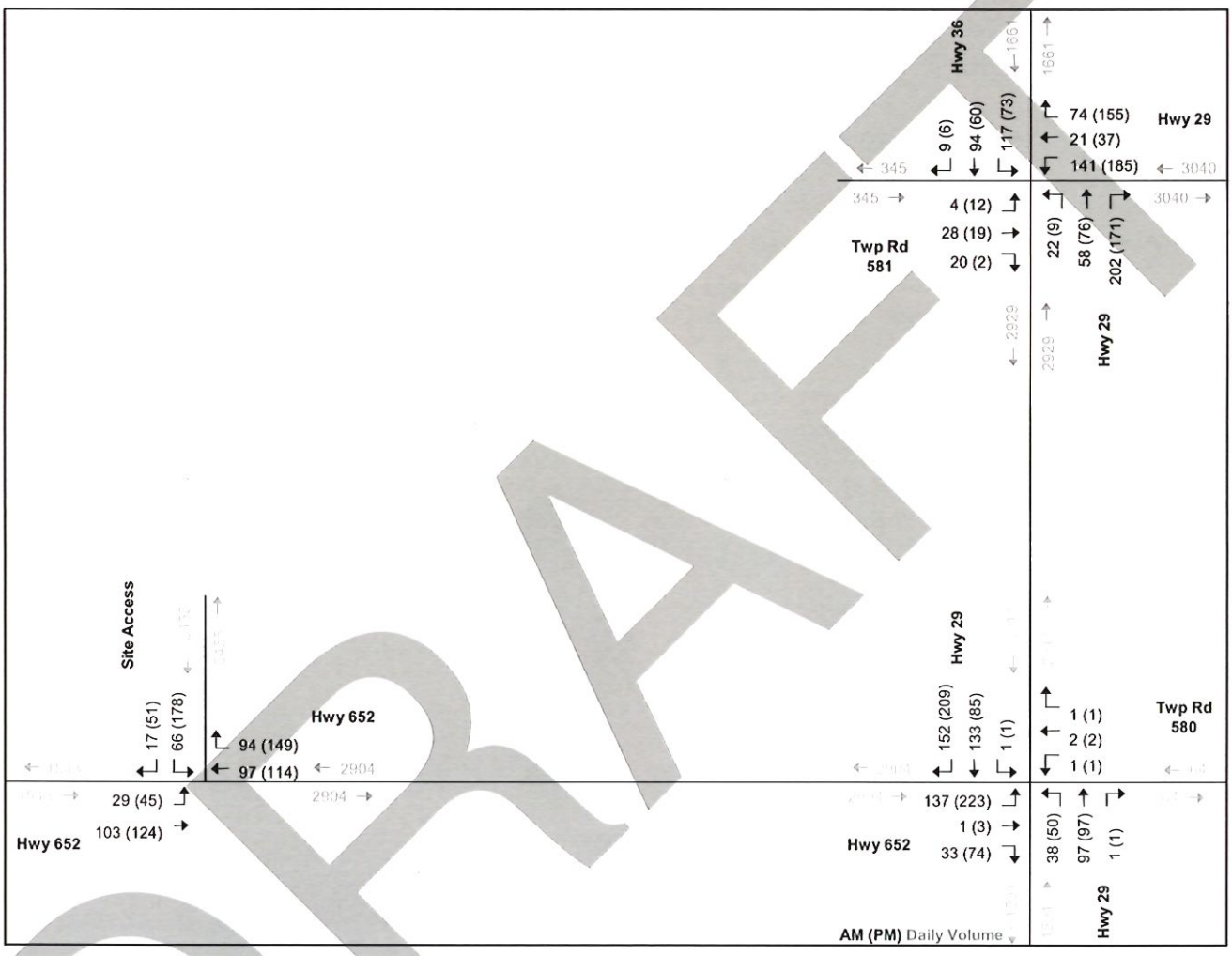
5.2 2043 POST DEVELOPMENT TRAFFIC VOLUMES

The 2043 Post Development traffic volumes shown in **Figure 5-2** are the sum of the 2043 Background traffic volumes and Phases 1 and 2 site trip volumes after pass-by traffic volumes adjustment.

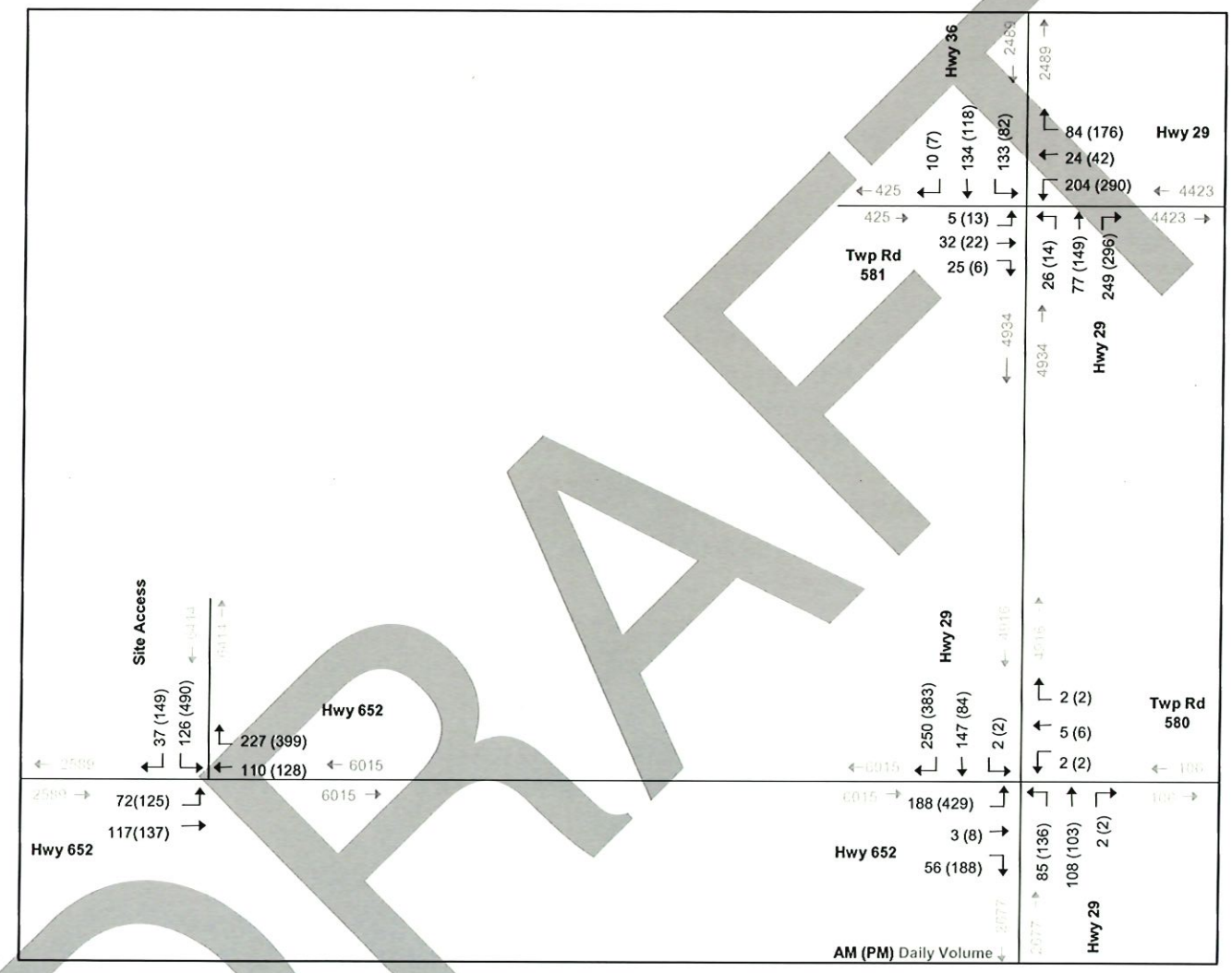
Figure 5-2: 2043 Post Development Traffic Volumes



5.3 2053 POST DEVELOPMENT TRAFFIC VOLUMES

The 2053 Post Development traffic volumes shown in **Figure 5-3** are the sum of the 2053 Background traffic volumes and all phases of the site after pass-by traffic volumes adjustment.

Figure 5-3: 2053 Post Development Traffic Volumes



6.0 ANALYSIS METHODOLOGY

This section summarizes the results of the analyses completed based on Alberta Transportation's (AT) Traffic Impact Assessment Guidelines, including AT intersection treatment type analysis, intersection operational analysis, collision review, minimum intersection sight distance and stopping sight distance and intersection illumination analysis.

6.1 ALBERTA TRANSPORTATION INTERSECTION TREATMENT WARRANTS ANALYSIS

Alberta Transportation's Highway Geometric Design Guide (AT-HGDG) is typically used to determine the standard treatment configuration required at the intersection. The AT Intersection layout analyses is designed to determine necessary intersection geometry for rural highways. As per the methodology outlined in AT's Highway Geometric Design Guide, warrants for a dedicated left and right turn bays were completed for the east-west movement at Highway 652 with the site access intersection. For the intersections of Highway 29 and Highways 652, Highway 29 and Highway 36 the analysis was completed for the north-south movement as the east-west movements are stop controlled. The intersections and their movements were also evaluated using the HCM method explained in **Section 6.2**.

6.1.1 Left Turn Warrant Analysis

The analysis was completed assuming 110 km/hr operating speeds on all highways in the study area, based on the current 100 km/hr posted speed limit.

Heavy vehicles are expected to utilize the site therefore a 5% to 10% split of large vehicle traffic was assumed to access the site for the left turning Post Development traffic based on available percentage splits from AT traffic count information.

A summary of AT left turn warrant results, completed using AT intersection treatment warrant sheet, is shown in **Table 6-1**. Detailed analysis sheets are included in **Appendix C**.

Table 6-1: Left Turn Warrant Analysis Results – All Study Intersections

Horizon	Time Frame	Direction	Left Turn Lane Warranted	Direction	Left Turn Lane Warranted	Intersection Treatment
Highway 652 and Site Access						
Operating Speed of 110 km/hr						
2023 Post Development Traffic	AM Peak	EBL	No	WBL	N/A	Type II
	PM Peak	EBL	No	WBL	N/A	Type II
2043 Post Development Traffic	AM Peak	EBL	No	WBL	N/A	Type III
	PM Peak	EBL	Yes - EBL	WBL	N/A	Type IV
2053 Post Development Traffic	AM Peak	EBL	Yes - EBL	WBL	N/A	Type IV
	PM Peak	EBL	Yes - EBL	WBL	N/A	Type IV
Highway 29 and Highway 652						
Horizon	**Time Frame**	**Direction**	**Left Turn Lane Warranted**	**Direction**	**Left Turn Lane Warranted**	**Intersection Treatment**
Operating Speed of 110 km/hr						
2023 Post Development Traffic	AM Peak	NBL	No	SBL	No	Type II
	PM Peak	NBL	No	SBL	No	Type II
2043 Post Development Traffic	AM Peak	NBL	No	SBL	No	Type III
	PM Peak	NBL	Yes - NBL	SBL	No	Type IV – NBL
2053 Post Development Traffic	AM Peak	NBL	Yes - NBL	SBL	No	Type IV – NBL
	PM Peak	NBL	Yes - NBL	SBL	No	Type IV - NBL
Highway 29 and Highway 36						
Horizon	**Time Frame**	**Direction**	**Left Turn Lane Warranted**	**Direction**	**Left Turn Lane Warranted**	**Intersection Treatment**
Operating Speed of 110 km/hr						
2023 Post Development Traffic	AM Peak	NBL	No	SBL	Yes	Type IV - SBL
	PM Peak	NBL	No	SBL	Yes	Type IV - SBL
2043 Post Development Traffic	AM Peak	NBL	Yes	SBL	Yes	Type IV – NBL, SBL
	PM Peak	NBL	No	SBL	Yes	Type IV – SBL
2053 Post Development Traffic	AM Peak	NBL	Yes	SBL	Yes	Type IV – NBL, SBL
	PM Peak	NBL	Yes	SBL	Yes	Type IV – NBL, SBL

NBL = Northbound Left, SBL = Southbound Left, EBL = Eastbound Left, WBL = Westbound Left

6.1.2 Right Turn Warrant Analysis

To warrant an exclusive right turn lane at a two-lane highway intersection, the following three conditions must all be met:

- Main (or through) road AADT ≥ 1800 vpd,
- Intersecting road AADT ≥ 900 vpd; and,
- Right turn daily traffic volume ≥ 360 vpd for the movement in question.

A summary of the review results is presented in **Table 6-2**.

Table 6-2: Right Turn Warrant Analysis Results – All Study Intersections

Highway 652 and Site Access									
Horizon	**Main Road (Highway 652)**		**Intersecting Road (Site Access)**		**WB Right Turn**		**EB Right turn**		**Right Turn Lane Warranted**
	AADT (vpd)	**AADT> 1800**	**AADT (vpd)**	**AADT> 900**	**AADT (vpd)**	**AADT>360**	**AADT (vpd)**	**AADT>360**	
2023 Post Development Traffic	2,800	Yes	1,600	Yes	636	Yes	N/A		Yes - WB
2043 Post Development Traffic	5,800	Yes	4,900	Yes	1,894	Yes	NA		Yes - WB
2053 Post Development Traffic	16,000	Yes	12,900	Yes	4,900	Yes	N/A		Yes - WB
Highway 29 and Highway 652									
Horizon	**Main Road (Highway 29)**		**Intersecting Road (Highway 652)**		**NB Right turn**		**SB Right Turn**		**Right Turn Lane Warranted**
	AADT (vpd)	**AADT> 1800**	**AADT (vpd)**	**AADT> 900**	**AADT (vpd)**	**AADT>360**	**AADT (vpd)**	**AADT>360**	
2023 Post Development Traffic	3,400	Yes	2,800	Yes	11	No	1,100	Yes	Yes – SB
2043 Post Development Traffic	5,950	Yes	5,800	Yes	15	No	2,154	Yes	Yes – SB
2053 Post Development Traffic	15,000	Yes	12,000	Yes	17	No	4,185	Yes	Yes – SB
Highway 29 and Highway 36									
Horizon	**Main Road (Highway 29)**		**Intersecting Road (Highway 36)**		**NB Right turn**		**SB Right Turn**		**Right Turn Lane Warranted**
	AADT (vpd)	**AADT> 1800**	**AADT (vpd)**	**AADT> 900**	**AADT (vpd)**	**AADT>360**	**AADT (vpd)**	**AADT>360**	
2023 Post Development Traffic	5,000	Yes	3,300	Yes	1,200	Yes	43	No	Yes – NB
2043 Post Development Traffic	6,000	Yes	3,300	Yes	2,048	Yes	59	No	Yes – NB
2053 Post Development Traffic	15,000	Yes	9,000	Yes	3,300	Yes	67	No	Yes – NB

Note: vpd = vehicles per day; AADT = average annual daily traffic, NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound

6.1.3 Alberta Transportation Intersection Analysis Summary

Intersection treatment warrant analyses show that dedicated right turn and left turn lanes may be warranted at various horizons for the study intersections based on the current proposed plans for land-use and density. A summary of existing study intersections geometry is provided in **Table 6-3**.

Table 6-3: Summary of Existing Study Intersections Geometry

Intersection Treatment	Dedicated Left Turn	Dedicated Right Turn
Highway 29 and Highway 652		
Type-IV	NB – Existing SB – Not Existing	NB – Not Existing SB – Existing
Highway 29 and Highway 36		
Type-IV	NB – Not Existing SB – Existing	NB – Existing SB – Not Existing

NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound

The analysis shows that for 2023 Phase 1 Post Development, when the gas station in place, a dedicated westbound right turn lane is warranted for Highway 652 and the site access intersection which triggers a Type IVd intersection treatment. No additional improvements are triggered for the remaining study intersections as part of the gas station construction.

For the build-out of Phases 2, 3 and 4, additional improvements to existing intersection treatments would be needed and are summarized in **Table 6-4** for each Post Development horizon. Calculation sheets for the intersection treatment warrants are attached in **Appendix D.** As well, based on Section D.7.5 of the Alberta Transportation Highway Geometric Design Guide (AT-HGDG) twinning of the highways may need to be considered in the long-term 30-year horizon given that traffic volume is anticipated to exceed 6,000 AADT at that time.

The result of these analyses completed in this TIA are to provide general guidance for planning purposes with the assumptions indicated. The recommended long-term (20 and 30 year) Post Development improvements should not be implemented until it is warranted. As noted in Section 4.0, the timing for developing Phases 2 to 4 is uncertain and is not anticipated for another 20 to 30 years. As such, TIAs should be completed for future phases when timing and land uses are confirmed so that they can more accurately represent the traffic condition at that time.

Table 6-4: Summary of Intersection Treatment Warrant Analyses

Post Development Horizon	Intersection Treatment	Dedicated Left Turn	Dedicated Right Turn
Highway 652 and Site Access			
2023 Horizon – Phase 1	Type IVd	No	Warranted WB Turn Lane
2043 Horizon – Phase 2	Type IV	Warranted EB Turn Lane	Warranted WB Turn Lane
2053 Horizon – Phases 3 & 4	Type IV	Warranted EB Turn Lane	Warranted WB Turn Lane
Highway 29 and Highway 652			
2023 Horizon – Phase 1	Type IV	No additional Improvements	No additional Improvements
2043 Horizon – Phase 2	Type IV	No additional Improvements	No additional Improvements
2053 Horizon – Phases 3 & 4	Type IV	10 m Storage Extension Required	No additional Improvements

Post Development Horizon	Intersection Treatment	Dedicated Left Turn	Dedicated Right Turn
Highway 29 and Highway 36			
2023 Horizon – Phase 1	Type IV	No additional improvements	No additional improvements
2043 Horizon – Phase 2	Type IV	Warranted NB Turn Lane	No additional improvements
2053 Horizon – Phases 3 & 4	Type IV	Warranted NB Turn Lane	No additional improvements

NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound

6.2 CAPACITY ANALYSIS

The methodology from the Highway Capacity Manual (HCM) for intersection operational analysis was completed using Synchro Studio v11 software to perform the calculations required to determine intersection and movement delays, Levels of Service (LOS), and 95% queues.

Level of Service is based on the estimated average delay per vehicle for all traffic passing through an intersection. The highest LOS is a result of a very low average delay and is identified as LOS A. A poor LOS is a result of a large average delay and is typically identified as LOS F. The level of service categories also varies depending on whether an intersection is signalized or unsignalized (stop- or yield- controlled). The Highway Capacity Manual justifies this difference by noting that drivers stopped at a signal light will have more tolerance for delays because their perception is that eventually they will get their turn, even with a longer wait. Poor level of service can contribute to drivers taking risks and proceeding unsafely into an intersection. **Table 6-5** identifies the Level of Service criteria for signalized and unsignalized intersections.

Table 6-5: Level of Service Definition

Level of Service (LOS)	Average Signalized Control Delay per Vehicle (s)	Average Unsignalized Control Delay per Vehicle (s)
A	less than 10	less than 10
B	10 – 20	10 – 15
C	20 – 35	15 – 25
D	35 – 55	25 – 35
E	55 – 80	35 – 50
F	greater than 80	greater than 50

The volume-to-capacity (v/c) ratio of an intersection describes the extent to which the traffic volumes can be accommodated by the theoretical physical capacity of the road configuration and traffic control. A v/c ratio less than 0.9 indicates that there is generally sufficient capacity to accommodate the traffic on the approach or at the intersection. A value between 0.9 and 1.0 suggests unstable operations and congestion may occur as volumes are nearing the theoretical capacity of the roadway. A calculated value over 1.0 indicates that volumes are theoretically exceeding capacity. **Table 6-6** identifies the volume-to-capacity criteria for intersections.

Table 6-6: Volume to Capacity Ratio Definition

Volume-to-Capacity (v/c) Ratio	Indication
less than 0.9	sufficient intersection capacity
0.9 to 1.0	volumes approaching intersection capacity
greater than 1.0	volumes exceed theoretical intersection capacity

Typically, Alberta Transportation designs rural highways to an overall LOS C or better, and with the minor approach a LOS D or better. Therefore, for the purposes of this analysis, a minimum LOS C was required for the highway leg and a minimum LOS D for the minor intersecting leg. The volume-to-capacity ratio should also be less than 0.9 for all approaches. All analyses generally use typical Synchro Studio default values, including a peak hour factor of 0.92. The heavy vehicle percentage was 10% for all movements based on existing AT traffic count information. Synchro summary reports for all horizons are included in **Appendix E**.

6.2.1 Background Traffic - Capacity Analysis

HCM analysis completed for the study intersections identified in Section 2.1, using their existing geometry, shows that the intersections will operate at an acceptable LOS A in both the AM and PM peak hours for 2053 Background traffic horizon. This indicates that acceptable Levels of Service would be achieved for year 2023 and year 2043 horizons, as earlier horizons have lower traffic volumes. **Table 6-7** summarizes the analysis results for year 2053. The 2023 and 2043 horizon results based on background traffic only are attached in **Appendix E**.

Table 6-7: 2053 Background Traffic Only – Capacity Analysis Results

Approach	v/c Ratio	Total Delay (s)	Level of Service	95% Queue Length (m)
Highway 652 and Highway 29 – Stop Sign for Eastbound and Westbound Approaches				
Eastbound Left, Thru, Right	0.21 (0.23)	12.2 (11.7)	B (B)	6.3 (7.1)
Westbound Left, Thru, Right	0.02 (0.02)	0.0 (0.0)	A (A)	0.0 (0.0)
Northbound Left	0.01 (0.00)	7.9 (7.8)	A (A)	0.2 (0.0)
Northbound Thru, Right	0.08 (0.08)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Thru, Left	0.00 (0.00)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Right	0.07 (0.09)	0.0 (0.0)	A (A)	0.0 (0.0)
	Intersection	**3.0 (3.3)**	**A (A)**	
Highway 29 and Highway 36 – Stop Sign for Eastbound and Westbound Approaches				
Eastbound Left, Thru, Right	0.16 (0.09)	15.4 (13.6)	C (B)	4.4 (2.3)
Westbound Left, Thru, Right	0.45 (0.38)	17.7 (12.3)	C (B)	18.5 (14.1)
Northbound Left, Thru	0.02 (0.01)	2.4 (1.1)	A (A)	0.4 (0.1)
Northbound Right	0.14 (0.09)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Left	0.11 (0.06)	8.2 (7.8)	A (A)	3.1 (1.7)
Southbound Thru, Right	0.06 (0.03)	0.0 (0.0)	A (A)	0.0 (0.0)
	Intersection	**7.8 (8.0)**	**A (A)**	

6.2.2 2023 Post Development Traffic - Capacity Analysis

The analysis shows that all movements will operate at an acceptable LOS B or better for the 2023 horizon with post development traffic volumes. The analysis was completed assuming one lane, all directional intersection treatment at the proposed site access as it represents the conservative case. The results indicate that no operational issues are anticipated at the study intersections following construction of the proposed gas station (Phase 1). **Table 6-8** summarizes the analysis results, and detailed Synchro reports are in **Appendix E**.

Table 6-8: 2023 Post Development (Phase 1) Traffic – Capacity Analysis Results

Approach	v/c Ratio	Total Delay (s)	Level of Service	95% Queue Length (m)
Highway 652 and Site Access – Stop Sign for Southbound Approach				
Eastbound Left, Thru	0.01 (0.03)	0.9 (2.8)	A (A)	0.2 (0.9)
Westbound Thru, Right	0.07 (0.08)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Left, Right	0.07 (0.09)	9.9 (10.7)	A (B)	1.7 (2.3)
	Intersection	**2.3 (3.1)**	**A (A)**	
Highway 652 and Highway 29 – Stop Sign for Eastbound and Westbound Approaches				
Eastbound Left, Thru, Right	0.17 (0.19)	10.8 (10.6)	B (B)	4.8 (5.4)
Westbound Left, Thru, Right	0.00 (0.00)	0.0 (0.0)	A (A)	0.0 (0.0)
Northbound Left	0.01 (0.01)	7.8 (7.7)	A (A)	0.3 (0.3)
Northbound Thru, Right	0.05 (0.05)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Thru, Left	0.00 (0.00)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Right	0.06 (0.07)	0.0 (0.0)	A (A)	0.0 (0.0)
	Intersection	**3.5 (3.9)**	**A (A)**	
Highway 29 and Highway 36 – Stop Sign at Eastbound and Westbound Approaches				
Eastbound Left, Thru, Right	0.07 (0.05)	12.1 (11.6)	B (B)	1.9 (1.1)
Westbound Left, Thru, Right	0.22 (0.22)	12.1 (10.5)	B (B)	6.6 (6.7)
Northbound Left, Thru	0.01 (0.00)	2.2 (0.9)	A (A)	0.3 (0.1)
Northbound Right	0.09 (0.06)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Left	0.07 (0.04)	7.9 (7.7)	A (A)	1.8 (1.0)
Southbound Thru, Right	0.04 (0.02)	0.0 (0.0)	A (A)	0.0 (0.0)
	Intersection	**5.8 (6.8)**	**A (A)**	

6.2.3 2043 Post Development Traffic - Capacity Analysis

The analysis of the study intersections shows that the intersections will operate at acceptable LOS A in the AM and PM peak hours for the 2043 horizon assuming Phase 1 (gas station) and build-out of Phase 2. The analysis shows existing study intersections geometry and traffic control would continue to provide with appropriate Levels of Service following the completion of Phases 1 and 2. **Table 6-9** summarize the analysis results, and detailed Synchro reports are in **Appendix E**.

Table 6-9: 2043 Post Development Phases 1 & 2 – Capacity Analysis Results

Approach	v/c Ratio	Total Delay (s)	Level of Service	95% Queue Length (m)
Highway 652 and Site Access – Stop Sign at Southbound Approach				
Eastbound Left, Thru	0.02 (0.04)	1.8 (2.4)	A (A)	0.6 (1.0)
Westbound Thru, Right	0.12 (0.17)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Left, Right	0.13 (0.42)	11.2 (15.6)	B (C)	3.6 (16.6)
	Intersection	2.8 (6.0)	A (A)	
Highway 652 and Highway 29 – Stop Sign at Eastbound and Westbound Approaches				
Eastbound Left, Thru, Right	0.29 (0.49)	13.1 (15.4)	B (C)	9.8 (21.4)
Westbound Left, Thru, Right	0.00 (0.00)	13.1 (13.5)	B (B)	0.1 (0.1)
Northbound Left	0.03 (0.05)	8.1 (8.1)	A (A)	0.8 (1.1)
Northbound Thru, Right	0.06 (0.06)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Thru, Left	0.00 (0.00)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Right	0.10 (0.13)	0.0 (0.0)	A (A)	0.0 (0.0)
	Intersection	**4.3 (6.8)**	**A (A)**	
Highway 29 and Highway 36 – Stop Sign at Eastbound and Westbound Approaches				
Eastbound Left, Thru, Right	0.13 (0.09)	14.6 (14.4)	B (B)	3.6 (2.2)
Westbound Left, Thru, Right	0.45 (0.44)	17.7 (13.8)	C (B)	18.7 (18.4)
Northbound Left, Thru	0.02 (0.01)	2.2 (0.8)	A (A)	0.4 (0.2)
Northbound Right	0.13 (0.11)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Left	0.10 (0.06)	8.2 (8.1)	A (A)	2.7 (1.6)
Southbound Thru, Right	0.07 (0.04)	0.0 (0.0)	A (A)	0.0 (0.0)
	Intersection	**7.7 (7.9)**	**A (A)**	

6.2.4 2053 Post Development Traffic - Capacity Analysis

Following the development of the remaining Phases 3 and 4 the study intersections, assuming current geometry and control, would have some operational challenges. The site access and Highway 652 would have LOS F during the PM hour. Similarly, the intersection of Highway 29 and Highway 652 would have LOS F in the PM peak hour, primarily due to the eastbound movement at the intersection. Delays are also expected at the Highway 29 and Highway 36 intersection with LOS E for the westbound movement, and the intersection would have overall LOS C. The v/c ratios will also be greater than 0.90 for the LOS E movements, and greater than 1.00 for the LOS movements. **Table 6-10** summarize the analysis results, and detailed Synchro reports are in **Appendix E**.

Table 6-10: 2053 Post Development All Phases - Capacity Analysis Results

Approach	v/c Ratio	Total Delay (s)	Level of Service	95% Queue Length (m)
Highway 652 and Site Access – Stop Sign for Southbound Approach				
Eastbound Left, Thru	0.07 (0.14)	3.5 (5.2)	A (A)	1.7 (3.9)
Westbound Thru, Right	0.21 (0.34)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Left, Right	0.34 (1.96)	15.5 (469.1)	C **(F)**	11.8 (382.1)
	Intersection	4.6 (210.6)	A **(F)**	
Highway 652 and Highway 29 – Stop Sign for Eastbound and Westbound Approaches				
Eastbound Left, Thru, Right	0.52 (1.37)	19.2 (202.4)	C **(F)**	23.4 (248.2)
Westbound Left, Thru, Right	0.01 (0.02)	16.8 (21.2)	C (C)	0.2 (0.4)
Northbound Left	0.08 (0.15)	8.6 (9.1)	A (A)	2.2 (4.1)
Northbound Thru, Right	0.07 (0.07)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Thru, Left	0.00 (0.00)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Right	0.16 (0.24)	0.0 (0.0)	A (A)	0.0 (0.0)
	Intersection	6.5 (95.6)	A **(F)**	
Highway 29 and Highway 36 – Stop Sign for Eastbound and Westbound Approaches				
Eastbound Left, Thru, Right	0.19 (0.15)	17.6 (19.2)	C (C)	5.5 (4.2)
Westbound Left, Thru, Right	0.81 (0.92)	40.9 (42.3)	**E (E)**	59.1 (92.3)
Northbound Left, Thru	0.02 (0.01)	2.0 (0.7)	A (A)	0.5 (0.3)
Northbound Right	0.16 (0.19)	0.0 (0.0)	A (A)	0.0 (0.0)
Southbound Left	0.12 (0.09)	8.5 (8.8)	A (A)	3.4 (2.2)
Southbound Thru, Right	0.09 (0.08)	0.0 (0.0)	A (A)	0.0 (0.0)
	Intersection	**15.1 (19.0)**	**C (C)**	

6.2.5 2053 Post Development Traffic - Capacity Analysis – Improvements

As the delays are extensive for the 2053 Post Development condition, additional analysis was completed to understand improvements that could be implemented to maintain acceptable intersection operations. The 'Improved' scenario analysis assumes the geometric improvements identified in **Section 6.1.3** will be implemented. The 'Improved' analysis shows that signalization of Highway 652 and site access and Highway 29 and Highway 652 intersections would allow the intersection to operate at LOS B or better during both AM and PM peak hours. The intersection of Highway 29 and Highway 36 shows that a four-way stop sign would allow the intersection to operate at LOS C or better during AM and PM peak hours. **Table 6-11** summarizes the analysis results, and detailed Synchro reports are in **Appendix E**.

Table 6-11: 2053 Post Development All Phases – Improvements – Capacity Analysis Results

Approach	v/c Ratio	Total Delay (s)	Level of Service	95% Queue Length (m)
Highway 652 and Site Access – Signalized				
Eastbound Left	0.23 (0.44)	8.5 (18.2)	A (B)	6.7 (23.4)
Eastbound Thru	0.26 (0.33)	8.1 (14.7)	A (B)	9.6 (23.4)
Westbound Thru	0.25 (0.31)	8.0 (14.4)	A (B)	9.1 (21.8)
Westbound Right	0.42 (0.62)	3.8 (6.3)	A (A)	6.6 (16.7)
Southbound Left	0.19 (0.73)	7.3 (15.6)	A (B)	10.0 (67.9)
Southbound Right	0.06 (0.22)	3.1 (2.4)	A (A)	2.5 (7.0)
Intersection		**6.3 (11.7)**	**A (B)**	
Highway 652 and Highway 29 – Signalized				
Eastbound Left	0.50 (0.78)	12.9 (21.0)	B (C)	22.9 (#77.2)
Eastbound Thru, Right	0.12 (0.27)	3.5 (2.5)	A (A)	4.7 (8.5)
Westbound Left, Thru, Right	0.01 (0.01)	7.0 (6.8)	A (A)	1.1 (1.3)
Northbound Left	0.19 (0.57)	9.4 (25.3)	A (C)	12.1 (30.3)
Northbound Thru, Right	0.15 (0.23)	8.3 (15.2)	A (B)	13.5 (19.7)
Southbound Thru, Left	0.30 (0.50)	7.7 (9.8)	A (A)	22.0 (26.0)
Southbound Right	0.27 (0.44)	3.0 (5.4)	A (A)	9.5 (14.2)
Intersection		**7.8 (13.6)**	**A (B)**	
Highway 29 and Highway 36 – Four Way Stop				
Eastbound Left, Thru, Right	0.15 (0.11)	11.9 (12.9)	B (B)	3 (2.4)
Westbound Left, Thru	0.53 (0.78)	18.8 (33.9)	C (D)	18 (24)
Westbound Right	0.17 (0.36)	10.6 (13.1)	B (B)	3.6 (9.6)
Northbound Left	0.06 (0.03)	11 (11.2)	B (B)	1.2 (1.2)
Northbound Thru	0.17 (0.35)	11.4 (14.4)	B (B)	3.6 (9)
Northbound Right	0.49 (0.62)	15.3 (20.5)	C (C)	8.1 (25.2)
Southbound Left	0.32 (0.22)	14.2 (14)	B (B)	3.9 (4.8)
Southbound Thru, Right	0.32 (0.31)	13.4 (14.7)	B (B)	3.9 (7.8)
Intersection		**14.7 (20.9)**	**B (C)**	

Assume vehicle length = 6 meters

6.3 CAPACITY AND INTERSECTION ASSESSMENTS SUMMARY

The completed operational analysis provides a long-term view of improvements that would be needed at the study intersections to accommodate the traffic generated by the multiple phases of the proposed development.

2023 Post Development

The analysis shows that as part of the Gas Station construction at year 2023, the intersection of Highway 652 and site access will require a dedicated westbound right turn lane which warrants a Type-IVd intersection. The remaining study intersections will not require additional improvements to their existing geometric and traffic control configuration.

2043 and 2053 Post Development

For the remaining future horizons, at years 2043 and year 2053, additional improvements such as dedicated left turn lanes at all three study intersections where they do not currently exist would be warranted as shown in **Table 6-4**. No additional dedicated right turn lanes would be warranted where they do not currently exist based on the completed assessments.

By year 2053, Signalization may be needed at the intersection of Highway 652 and site access, as well as at the intersection of Highway 29 and Highway 652. Four-way stop control would suffice for the intersection of Highway 29 and Highway 36.

As previously noted, improvements identified for the 2043 and 2053 Post Development horizons should only be implemented when traffic volumes actually trigger the warrants. Future updates to the TIA may be needed for each phase of development application to reflect the most relevant land-use and density at the time of application, as well as to confirm traffic patterns at that time and confirm if forecasted traffic growth along the highways are still relevant.

6.4 SIGNALIZATION WARRANT ANALYSIS

Signalization warrant analysis was completed to determine if traffic signals will be warranted for the Highway 652 and site access as well Highway 29 and Highway 652 intersections. The analysis was completed based on Post Development traffic volumes for the 2053 study horizon. For the warrant analysis, the six-hour peak traffic volumes were calculated using a factor of 2.9 applied to the AM and PM peak hours volumes. This factor was calculated based on AT's existing traffic data from active traffic counter along Highway 36. The results of the signal warrant analyses are summarized in **Table 6-12** and detailed work sheets are attached in **Appendix G**. The analysis shows that traffic signals will be warranted in the long-term 2053 horizon with full build-out of Phases 1 to 4.

Table 6-12: Summary of Traffic Signals Warrant Assessment – Post Development Year 2053

Intersection	Traffic Signals
Highway 652 and Site Access	**Warranted**
Highway 652 and Highway 29	**Warranted**

6.5 ROADWAY CROSS-SECTION AND DAILY VOLUME

The total daily traffic volume anticipated at the full build out of the development (Phases 1 – 5) is estimated to be 13,000 daily vehicles with heavy vehicles (WB 20 or WB 21) anticipated to be present at the site frequently. At Phase 1 (gas station) the daily volume is anticipated to around 1,600 vehicles per day (vpd) which is considered low to medium volume. To determine the internal road sizing, using the County of St. Paul Road Classification (2014), the use of Class 2 roads may suffice for Phase 1. The exact road structure necessary should be confirmed through consultation with a professional geotechnical engineer.

Future right of way widening and County's roadway class requirements at the site access and the site internal road network, should be evaluated as part of future Phase TIAs to ensure appropriate road structure and class is selected based on the anticipated daily traffic volume. The design of the internal road network (geometry, access and intersection spacing, etc.) should be completed using the Transportation Association of Canada Geometric Design Guide (TAC GDG), or County of St. Paul Road Classification. A copy of the County's Class 2 road cross section is included in **Appendix F.**

6.6 ILLUMINATION WARRANT ANALYSIS

A lighting assessment was completed at the intersection of Highway 652 with the site access based on the TAC Guide for the Design of Roadway Lighting (2006), as indicated to use by AT's Design Bulletin #35. Under unsignalized intersection conditions, a TAC warrant calculation is completed with the following general thresholds for lighting:

- Full Illumination – 240 points or more;
- Partial or Delineation Lighting – 120 to 239 points; and
- No Illumination – less than 120 points.

As part of the illumination warrant analysis, the average annual night-time collision frequency due to inadequate lighting must be considered. AT has collision information available in TIMS near the future site, the 10-year historical collision data showed six collisions: two occurred during the night and four during the

daytime. Upon reviewing the collisions, both of the night collisions were a result of wild animals running onto the highway. As the collisions are mostly due to uncontrolled wild animals, they are not considered to be a result of inadequate area lighting.

The intersection of Highway 29 and Highway 36 appears to be fully illuminated; therefore, no additional illumination analysis was done. For Highway 29 and Highway 652, and the site access and Highway 652 intersections the illumination analysis was completed for year 2023 and 2043 horizons, and for both Background traffic and Post Development traffic scenarios. The illumination warrant analysis was not completed for the 2053 horizon for these two intersections as signalization would automatically trigger full illumination, and both intersections will warrant traffic signals in 2053 Post Development horizon.

For year 2023, following the construction of the gas station, the results show no illumination will be warranted at the site access. For the same horizon, partial delineation is warranted at the intersection of Highway 652 and Highway 29 for both the Background traffic only and Post Development scenarios.

For the year 2043 horizon, delineation lighting will be warranted at the site access intersection and at the Highway 652 and Highway 29 intersection for the Post Development condition. **Table 6-13** summarizes the analysis results. The TAC Warrant worksheets are included in **Appendix G**.

Table 6-13: Illumination Warrant Summary

Site Access and Highway 652						
Horizon	**Geometric Score**	**Operational Score**	**Environmental Score**	**Collision Score**	**Total Score**	**Type of Illumination**
2023 Post Development	3	105	0	0	108	Not Warranted
2043 Post Development	3	155	0	0	158	Delineation Lighting
Highway 652 and Highway 29						
Horizon	**Geometric Score**	**Operational Score**	**Environmental Score**	**Collision Score**	**Total Score**	**Type of Illumination**
2023 Background Traffic	6	120	0	0	126	Delineation Lighting
2023 Post Development	6	160	0	0	166	Delineation Lighting
2043 Post Development	3	170	0	0	173	Delineation Lighting

6.7 PEDESTRIAN WARRANT ANALYSIS

The area surrounding the proposed commercial and light industrial development is rural and relatively isolated with no presence of nearby residential or pedestrian facilities such as separated sidewalks or pathways. Future users are anticipated to utilize personal motorized vehicles to complete daily tasks. No additional pedestrian facilities measures will be recommended at this stage.

6.8 EXISTING VERTICAL CURVES (CRESTS AND SAGS)

Alberta Transportation Network Expansion Support System (NESS) provide the K-value which is defined as a coefficient for the rate of road gradient change (i.e. the distance required along the highway for a 1% gradient change). Higher than minimum K-values indicate slower rate of gradient change and therefore better visibility.

A review of available highway data indicated the presence of crest and sags near the study area. They were assessed using Section B-4-4-2a of the Alberta Transportation Highway Geometric Design Guide (AT-HGDG) for a design speed of 110 km/hr. All assessed vertical curves along the highways meet the minimum requirements for K-value. Results are summarized in **Table 6-14** below

Table 6-14: Vertical Curves Evaluation – Study Highways

Highway	KM Marker	Vertical Curve Type	Existing K-Value	Minimum K-value	Meets Minimum (Y/N)
Highway 652	652:2 39.934	Crest	170	77	Yes
	652:2 40.103	Sag	58	55	Yes
Highway 29	29:8 33.395	Crest	210	77	Yes
	29:10 0.098	Sag	310	55	Yes
Highway 36	36:24 0.118	Sag	290	55	Yes

6.9 INTERSECTION SIGHT DISTANCE

According to Alberta Transportation Highway Geometric Design Guide, the intersection sight distance for left turn vehicles onto a highway is the minimum sight distance required along a main (or through) highway at intersections necessary for the stopped vehicle to safely turn left onto the main (or through) two-lane highway.

Given that Highways 652, 36 and 29 are two-lane highways with no median to allow vehicles to complete the turn in two steps, Figure D-4.2.2.2 was used, as indicated in Section D.4.2.2.2 of AT-HGDG. The assessment was completed using the WB-21 as the design vehicle because it is expected to access the site frequently. This is supported by data indicated in the vertical curves report attached in **Appendix H** as well the K-Values indicated in **Table 6-14**. A summary of sight distances near the study intersections is shown in **Table 6-15**.

Table 6-15: Intersection Sight Distance Assessment

Intersection	Operating Speed (km/hr)	Required Sight Distance (m)	Available Sight Distance in Most Restricted Direction (m)	Meets Required Distance
Highway 652 & Site Access	110	560	+580	Yes
Highway 652 & Highway 29	110	560	+580	Yes
Highway 36 & Highway 29	110	560	+580	Yes

6.10 STOPPING SIGHT DISTANCE

Stopping sight distance is the minimum sight distance available on a roadway to allow a vehicle to stop before reaching a stationary object in its path. The analysis was completed assuming operating speed of 110 km/hr.

At the study intersections and using Table B-2-3a of the AT-HGDG, the minimum stopping sight distance for design speed of 110 km/hr (posted speed of 100 km/hr) is 220 meters. At the subject intersections, sight distance is over 580 meters in both directions. This is supported by data indicated in the vertical curves report attached in **Appendix H** as well the K-Values indicated in **Table 6-14.**

6.11 COLLISIONS REVIEW

A review of the 10-year historical information for the study highways shows a total of 6 collisions occurring over the past 10 years at the Highway 652 and Highway 29 intersection and Highway 652 segment to the site access. The collisions, however, were primarily a result of driver judgment error and uncontrolled wild animals reaching the highway.

Along Highway 29, there has been a total of 6 collisions in 10 years; mainly animal collisions except for one pedestrian collision occurring due pedestrian extending their arm to the oncoming vehicle.

The Highway 36 and Highway 29 intersection has seen 16 collisions over the past 10 years, primarily rear-end, right angled, or fixed object collisions related to driver judgment, therefore, no geometric improvements are recommended at this point as the collisions data do not indicate a pattern.

7.0 RECOMMENDATIONS & CONCLUSIONS

This study was completed in accordance with Alberta Transportation (AT) requirements to be utilized for obtaining a Roadside Development Permit (RDP) necessary for the construction of the gas station for Phase 1 and provide a long-term overview of what, if any, improvements will be required to accommodate the long-term potential developments within the fee simple land that is owned by Saddle Lake Cree Nation #125.

This study focuses on assessing the transportation impact of the future development on Highway 652, Highway 29 and Highway 36. The land would be accessed through a proposed site access from Highway 652.

The three intersections that were assessed as part of the study are:

- Site access/Highway 652,
- Highway 29/Highway 652, and
- Highway 36/Highway 29.

Analyses of the impacts of the Background and Post Development traffic on the adjacent roadway system were assessed at the following horizons:

- Opening Day (Phase 1) Gas Station/truck stop/convenience store - year 2023,
- Phase 2 build out - year 2043 (20-year), and
- Phases 3 and Phase 4 build out – year 2053 (30 year). The revised timeline of 30-years was chosen as long term plans are highly uncertain and dependent on market conditions and business interest.

A linear annual growth rate for the study highways was shown to be less than 2% based on traffic volume trends over the past 10 years. To mitigate potential impact of Covid-19 pandemic on background traffic volumes, the 2019 traffic volume estimates were used as a basis for growth. The background traffic volumes along the study highways were grown by 2% linearly per year to the 2023, 2043 and 2053 horizon years. This growth rate was used in consultation with Alberta Transportation.

The timing and land use is only known for Phase 1 of the development, additional phases are to be completed based on fundings availability and market demands. Future land use for Phases 2 to 4 was assumed to be a mix of commercial and light industrial based on other uses in the area. Trip Generation rates for the development site were estimated using the ITE Trip Generation Manual. Pass-by adjustments were also made as the gas station is anticipated to have significant reliance on highway traffic. By year 2053 the total site generated traffic is expected to be 386 vehicle per hour (vph) in the AM peak, 1,008 vph in the PM peak, and 11,036 vehicle per day (vpd) for the daily traffic.

Based on the analyses completed, the following **Table 7-1** summarizes the improvements recommended along the study highways near the development site. Improvements related to Phase 1 construction and background traffic has been bolded.

Improvements associated with the long-term 2043 (20-years) and 2053 (30-years) horizons identified in the study are based on forecasted traffic volume trends and relies on what the land uses are anticipated to be at the time of completing this study. As indicated previously, only Phase 1 is planned for implementation, whereas Phases 2 to 4 are still in the early planning stages and timing for development of these future phases are uncertain and more long-term. Future traffic impact assessment (TIA) updates may be required to confirm improvements required to support application for each future phase of development, at which time the proposed land use should be confirmed, and background traffic reconfirmed.

Table 7-1: Summary of Identified Improvements for Study Intersections

Horizon Year	Intersection Treatment	Dedicated Left Turn	Dedicated Right Turn	Lighting	Signalization
Highway 652 and Site Access					
Background					
2022	N/A	N/A	N/A	N/A	N/A
Post Development					
2023 – Phase 1	**Type IVd**	No Warranted	**Warranted WB Turn Lane**	Not Warranted	Not Warranted
2043 – Phase 2	Type IV	Warranted EB Turn Lane	Warranted WB Turn Lane	Delineation Lighting	Not Warranted
2053 – Phases 3 & 4	Type IV	Warranted EB Turn Lane	Warranted WB Turn Lane	Full Lighting	Warranted
Highway 29 and Highway 652					
Background					
2022	Type-IV	No additional improvements	No additional improvements	**Delineation Lighting**	Not Warranted
Post Development					
2023 – Phase 1	Type IV	No additional improvements	No additional improvements	Delineation Lighting	Not Warranted
2043 – Phase 2	Type IV	No additional improvements	No additional improvements	Delineation Lighting	Not Warranted
2053 – Phases 3 & 4	Type IV	10 m Additional Storage Required	No additional improvements	Full Lighting	Warranted
Highway 29 and Highway 36					
Background					
2022	Type-IV	No additional improvements	No additional improvements	No additional improvements	No additional improvements
Post Development					
2023 – Phase 1	Type IV	No additional improvements	No additional improvements	No additional improvements	Not Warranted
2043 – Phase 2	Type IV	Warranted NB Turn Lane	No additional improvements	No additional improvements	Not Warranted
2053 – Phases 3 & 4	Type IV	Warranted NB Turn Lane	No additional improvements	No additional improvements	Not Warranted

NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound

8.0 AUTHORIZATION & CLOSING

This document entitled "Fee Simple Land ASP – Traffic Impact Assessment" was prepared by Urban Systems for the account of Saddle Lake Cree Nation. The material in it reflects Urban's best judgment in light of the information available to it at the time of preparation. Any use which a third party, beyond Alberta Transportation, makes of this report, or reliance on or decisions made based on it, are the responsibilities of such third parties. Urban Systems accepts no responsibilities for damages, if any, suffered by such third parties as a result of decisions made or actions based on this report.

Respectfully submitted,

URBAN SYSTEMS LTD.

PREPARED BY:

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Transportation Engineer

REVIEWED BY:

Marcia Eng, P. Eng.
Senior Transportation Engineer

APPENDIX A:

ALBERTA TRANSPORTATION CORRESPONDENCE

September 2022

File No. 3518.0029.02

URBAN SYSTEMS

APPENDIX B:

SITE PLAN

September 2022

File No. 3518.0029.02

URBAN SYSTEMS

APPENDIX C:

LEFT TURN WARRANT ANALYSIS – ALBERTA TRANSPORTATION

September 2022

File No. 3518.0029.02

URBAN SYSTEMS

APPENDIX D:

TYPICAL INTERSECTION TREATMENT

September 2022

File No. 3518.0029.02

URBAN SYSTEMS

APPENDIX E:

SYNCHRO OUTPUT FILES

September 2022

File No. 3518.0029.02

URBAN SYSTEMS

APPENDIX F:

INTERNAL ROAD CROSS SECTION

September 2022

File No. 3518.0029.02

URBAN SYSTEMS

APPENDIX G:

ILLUMINATION AND SIGNALIZATION WARRANT

September 2022

File No. 3518.0029.02

URBAN SYSTEMS

APPENDIX H:

NESS REPORTS

September 2022

File No. 3518.0029.02

URBAN SYSTEMS

APPENDIX I:

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May 4, 2023

Dear: Saeed Bashi

Please accept this letter as acknowledge that the department has accepted your Traffic Impact Assessment (TIA) for phase 1 of the Simple Fee – Saddle Lake Cree Nation ASP & TIA.

A separate TIA will be required for the land uses prior to development approvals of phases 2-4.

As discussed, the department only accepts the proposed access location on Hwy 652 at this time. A separate roadside development permit for the proposed access shall be required for review and approval prior to the start of construction.

Sincerely,

Matthew Miller
Development and Planning Technologist
Transportation and Economic Corridors
Government of Alberta