A Report To:

For:

HIGHWAY 2 CORRIDOR STUDY

Final Report

Prepared By:

APRIL 2007
SW1088SWA

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EXECUTIVE SUMMARY

The Ministry of Transportation – Peace District has identified safety and operational concerns on Highway 2 between the British Columbia/Alberta border and Dawson Creek. These concerns are associated with the steady increase in traffic volumes on the corridor due to the expansion in the oil, mining, logging and recreational sectors.

In the fall of 2006, Delcan were retained by the Ministry to undertake an improvement study on the corridor. The intent was to identify the deficiencies and then develop and evaluate options to improve the quality of service and safety that will address the transportation requirements for the movement of people and goods in a safe, effective, efficient, and environmentally acceptable manner.

More specifically, the objectives of the study were to:

- Identify the existing and anticipated future deficiencies of Highway 2;
- Develop feasible options to improve quality of service and safety;
- Evaluate the options;
- Develop an implementation strategy; and
- Document the findings and recommendations in a report.

Data Review and Analysis

An extensive review and analysis of the available traffic data were conducted. A brief summary of the findings includes:

- Highway 2 is presently operating at an acceptable level of service except for the single lane northbound section adjacent to the existing southbound climbing lane.
- The intersections currently operate with “good” levels of service. It is however cautioned that the operational analysis was performed using factored November 2006 volume data which may not be representative of “peak” conditions.
- The safety analysis indicated that the frequency of collisions is increasing over time with the increased traffic volumes on the corridor. The most predominant collision types are wild animal (30% of total) and off road right (19% of total).

- The collision rate analysis showed that although some locations had rates higher than the provincial average, no location had a rate that exceeded the critical collision rate.
- Various Ministry of Transportation warrants were applied to determine if any improvements were currently required on the corridor. The findings were:
  - No new traffic signals, passing lanes or left turn lanes are currently warranted based on the assumed traffic volumes;
  - For left turn lanes, there appeared to be justification for providing these at some locations based on anecdotal observations from the Area Manager and a more detailed review of the collision records;
  - Climbing lanes were found to be warranted in both directions based on the grades and assumed traffic volumes.
- During an on-site review, deficiencies/issues were noted including:
  - Inadequate signing and pavement marking;
  - Skew intersections;
  - No left turn lanes; and
  - Limited passing opportunities.
- The same level of review was then conducted for the 2010 and 2020 horizon years using a derived traffic growth rate:
  - Future operation conditions are expected to worsen, but there is no significant cause for concern; and
  - An additional passing lane would be warranted in the northbound direction in the future.

Identified Issues and Recommended Improvements

Table ES-1 summarizes a list of identified existing and future issues along with a number of improvement measures. At a Project Review meeting held on December 14, 2006, most of these improvements were discussed in principal whereupon it was agreed by the Ministry that only the high capital cost improvements be taken forward for more detailed evaluation.

Table ES-1 - Improvement Identification

Issue	Proposed Improvements	Comments
Speeding	Increase speed enforcement	
High proportion of wild life collisions	Install wildlife signage, fencing, and reflectors at locations with high wildlife collision frequency (Tupper Bridge to Tate Creek Bridge)	
High proportion of night time collisions	Upgrade existing, and install additional post mounted delineators and/or chevron signs on horizontal curves.	
High proportion of winter collisions	Review winter maintenance practices	
Slow moving vehicles lead to aggressive driving behaviour (e.g. passing in a no passing zone)	Install northbound climbing lane between Highway 52 and Fletcher Road. Install southbound climbing lane in the vicinity of Arndt Road. By 2020 additional passing lanes will be required in both directions assuming the climbing lanes mentioned above are not implemented.	High capital cost - further economic evaluation
Skew alignment of Old Edmonton Highway intersections.	Consideration should be given to closing the 2nd and 3rd intersections as alternative access is possible.	May be an issue with local residents.
Drivers are not complying with school bus red flashing beacons	Enforcement. Provide bus pull outs.	
Passing is permitted in proximity to intersections	Provide double centre line on the Highway 2 approaches to all intersections. Provide intersection ahead warning signs and intersection lighting if warranted.	
No left turn lanes at intersections or at the Pull Out	Warrant does not support provision of left turn lanes at most locations. Left turn lanes should, however, be provided at the following locations: • Highway 52 (currently under construction); • Fletcher Road/Swan Lake Road; • Independent Road/Sudeten Park Road; • Tate Creek Road South Access; • Tate Creek Road North Access; • Pull Out; and • Old Edmonton Highway 1st Intersection. • Other locations where climbing/passing lanes are to be provided.	High capital cost – further economic evaluation
Inconsistent street naming and intersection ahead signage	Provide advance “intersection ahead” and consistent street name signage at all intersections	Note – this could reduce the number of intersection related collisions. Additional signs should also be provided in advance of the Pull Outs.

Capital Improvements Evaluation

The identified potential high cost improvements were then evaluated on a benefit/cost basis assuming a 25 year analysis period and low/medium/high traffic growth rates. This analysis demonstrated that the safety and travel time benefits of the improvements were relatively minor and that the benefit/cost (B/C) ratios were generally less than 1.0. Only under the high growth scenario, are the following improvements predicted to have a B/C ratio greater than 1.0 when constructed in the year indicated:

- Southbound/Northbound left turn lanes at Blockline Road (2016);
- Southbound/Northbound left turn lanes at Tate Creek Access North (2016);
- Northbound climbing lane between Highway 52 and Swan Lake Road/Fletcher Road (2020); and
- Northbound passing lane between Tate Creek North Access and Blockline Road (2017).

It is stressed that all of the traffic analysis that was undertaken as part of this assignment was based on November 2006 traffic counts which were factored to provide an estimate of peak summer conditions. It is suspected that in the summer months, volumes may be higher (in particular turning movements off the highway) and that auxiliary lanes may be warranted. It is therefore recommended that new traffic counts be undertaken at the ten intersections in August 2007 and that the warrant and benefit/cost analyses be repeated with the new volume information.

It is further recommended that in the interim, the Ministry should consider implementing the other lower cost minor improvements that would not be impacted by any of the proposed high cost items. This includes:

- Painting of no overtaking lines on the approaches to intersections;
- Installing wildlife signage, fencing, and reflectors at locations with high wildlife collision frequency (Tupper Bridge to Tate Creek Bridge);
- Considering closing the Old Edmonton Highway 2nd and 3rd intersections;
- Providing advance “intersection ahead” and consistent street name signage at all intersections;
- Improving delineation and curve warning signs;
- Painting out the middle lane between the weigh scales and the Old Edmonton Highway 1st intersection, and providing a formal southbound left turn lane at the Old Edmonton Highway 1st intersection.

To assist the Ministry in establishing a priority order for the recommended capital intensive improvements, the improvements were ranked according to the potential safety benefits and the estimated B/C ratio (assuming medium growth) as shown in ***Table ES-2*** and ***Exhibit ES-1***.

Table ES-2 - Recommended Capital Improvements Ranking

Recommended Capital Improvements	Ranking base on Safety Benefits	Ranking base on Benefit/Cost
SB climbing lane between Pull Out and south of Blockline Road, with left turn lanes at Arndt, Wade and Blockline Roads	1	3
SB/NB left turn lanes at Blockline Road	2	1
SB/NB left turn lanes at Tate Creek Access North	2	1
SB/NB left turn lanes at Wade Road	3	5
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	4	4
SB/NB left turn lanes at Tate Creek Access South	5	6
SB/NB left turn lanes at Independent Road	5	6
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	5	6
NB passing lane between Tate Creek North Access and Blockline Road	-	2

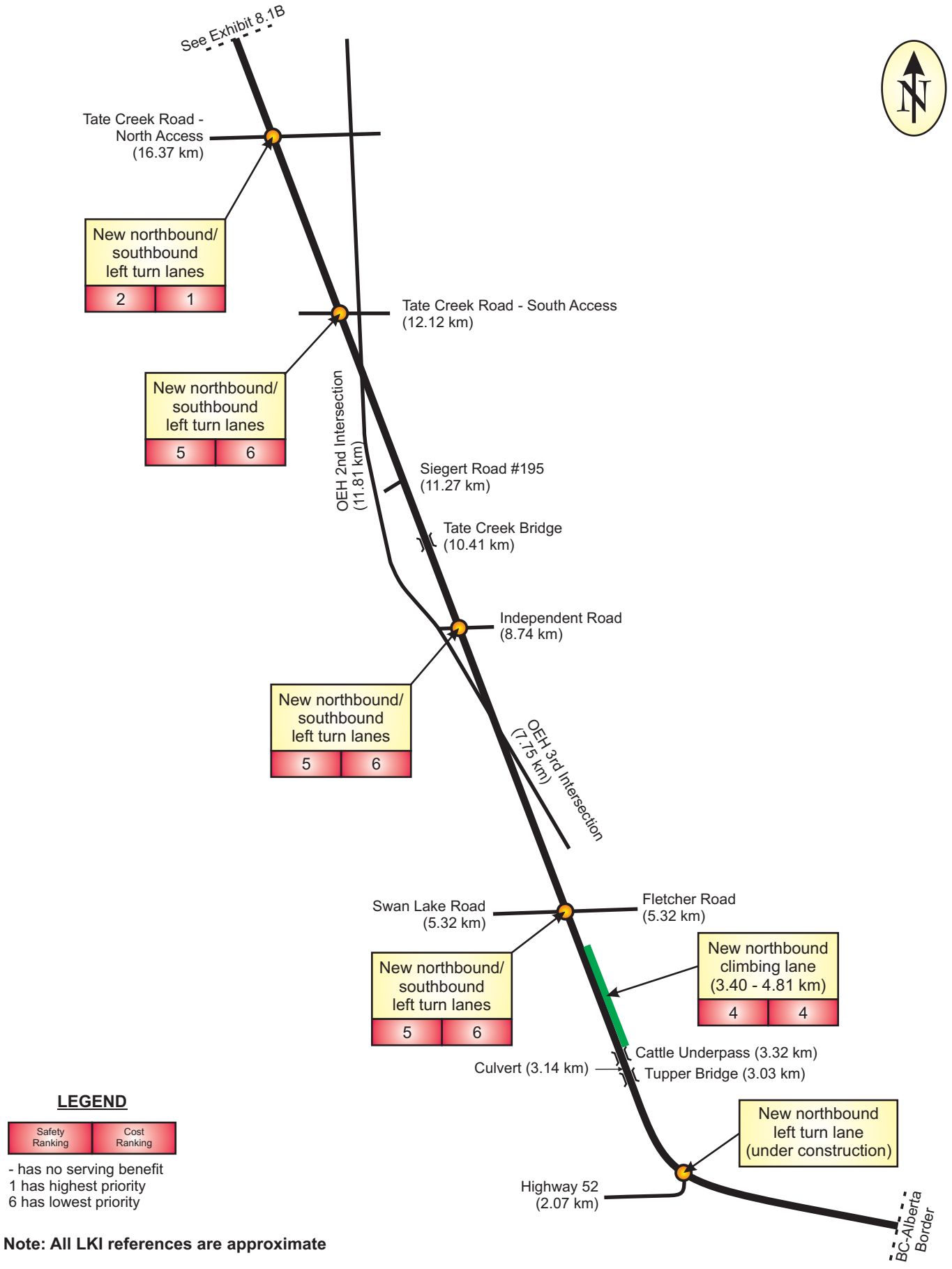

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Exhibit ES-1 - Proposed Improvements and Rankings

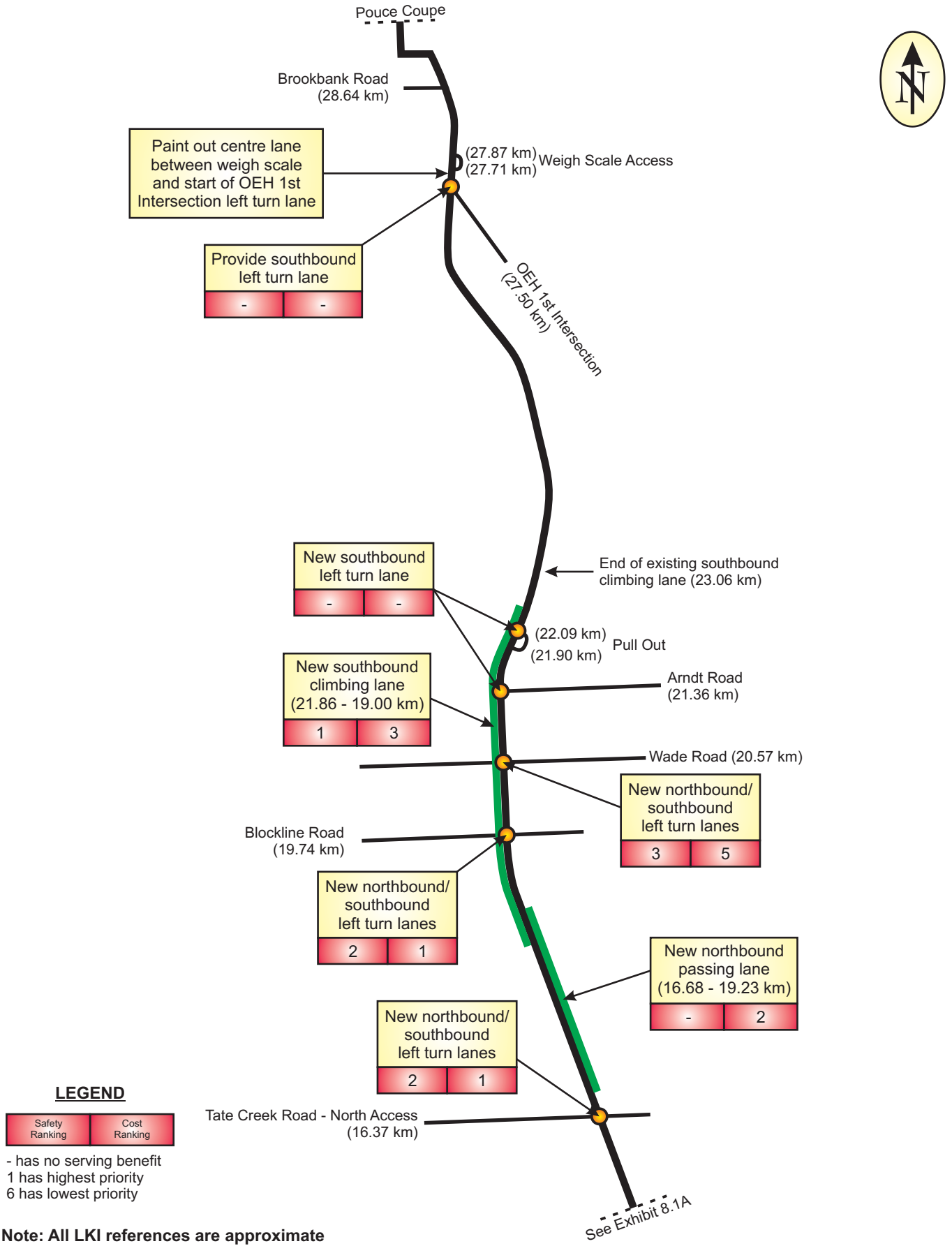


Exhibit ES-1 - Proposed Improvements and Rankings

1. INTRODUCTION

The Ministry of Transportation – Peace District has identified safety and operational concerns on Highway 2 between the British Columbia/Alberta border and Dawson Creek. These concerns are associated with the steady increase in traffic volumes on the corridor due to the expansion in the oil, mining, logging and recreational sectors.

In the fall of 2006, Delcan were retained by the Ministry to undertake an improvement study on the corridor. The intent was to identify the deficiencies and then develop and evaluate options to improve the quality of service and safety that will address the transportation requirements for the movement of people and goods in a safe, effective, efficient, and environmentally acceptable manner.

More specifically, the objectives of the study were to:

- Identify the existing and anticipated future deficiencies of Highway 2;
- Develop feasible options to improve quality of service and safety;
- Evaluate the options;
- Develop an implementation strategy; and
- Document the findings and recommendations in a report.

1.1 Study Area

The study corridor was defined as Highway 2 between the BC / Alberta border and Dawson Creek and passes through the Village of Pouce Coupe (see ***Exhibit 1.1***). In this exhibit, the landmarks have been identified in accordance with their LKI distances and these references will be used throughout this report. Other features such as speed limits, gradients, and passing opportunities are also shown on the exhibit.

The northern limit of the study area was initially identified as Rolla Road#3 with the section of Highway 2 within Pouce Coupe not to be included in this study since it has been studied recently by the Ministry. During the assignment, the Ministry advised that the area of concern was predominantly south of Pouce Coupe and as such most of the work has focused on this area.

Highway 2 is an undivided two lane rural provincial highway for the most part. There is a passing lane in the southbound direction starting near the weigh scale for approximately 4.76 km. The land use along Highway 2 is mostly agriculture and industrial (oil and natural gas). The speed limit along the highway is 100 km/hr for

Legend

- No passing zone
- Gradient >3% (+/-)

Exhibit 1.1 - Study Corridor - Highway 2

most of its length although there is a 70km/hr section to the south of Pouce Coupe and a 90km/hr section north of Pouce Coupe. The highway is relatively flat and straight with a few rolling terrain sections. There is an at grade rail crossing which is located near the weigh scale south of Pouce Coupe. There is no street lighting provided along the Highway except for a few isolated spots (weigh scale, at-grade rail crossing, Rolla Road, and Highway 52). Left turn lanes have been provided at Rolla Road and at the weigh scales, with a new northbound left turn lane currently under construction at the Highway 52 intersection.

1.2 Report Layout

This report is divided into a number of sections. Section 2 documents the review and analysis of the available traffic data for the corridor, previous traffic studies, and comments from stakeholders. Section 3 summarizes the existing conditions on the corridor, with Section 4 addressing projected future conditions. Section 5 identifies improvement options based on the work documented in previous sections, with Section 6 covering planning level design of the improvements. The improvements are then evaluated in Section 7 and the final conclusions/recommendations are presented in Section 8.

This report has been submitted as a follow up to a technical memorandum submitted and discussed at a project review meeting on December 14, 2006. In response to comments received from the Ministry and further review of some of the data, the findings/recommendations included in the technical memorandum have been revised as included in this report.

2. DATA REVIEW AND ANALYSIS

This section of the report discusses the review and analysis of the available traffic data. It includes sub-sections on the review of previous reports, comments from stakeholder consultation, traffic volumes and speeds, and collision data analysis.

2.1 Previous Report Summary

The Ministry provided two previous traffic study reports for review. One of the report was titled “Highway 2, Pouce Coupe Human Factors Study” prepared by CH2M Hill for the Ministry of Transportation in February 2005. This study focused mainly on the section of Highway 2 within the Village of Pouce Coupe. The major findings of the report were that there were a number of collisions at the two 90 degree curves within

the town and more warning signage was recommended to be installed near the curves.

The other study was titled "Corridor Planning Study, Highway 2 – BC / Alberta Boundary to Dawson Creek, Highway 5 – Regional Boundary to Tete Jaune Cache, Highway 97 – Dawson Creek to mile 83". This in-house Ministry study presented a very comprehensive review of the three highway corridors in terms of traffic operations and safety. For the Highway 2 corridor, the study provided a list of recommendations and an implementation strategy, which is shown in ***Exhibit 2.1***. This exhibit also shows which of the recommended improvements have been implemented to date. As can be seen, only one of the three recommended climbing lanes (southbound south of Pouce Coupe) has been implemented. Other improvements that have been implemented include the Rolla Road intersection upgrade and the Highway 52 intersection upgrades (on-going at the time of this study).

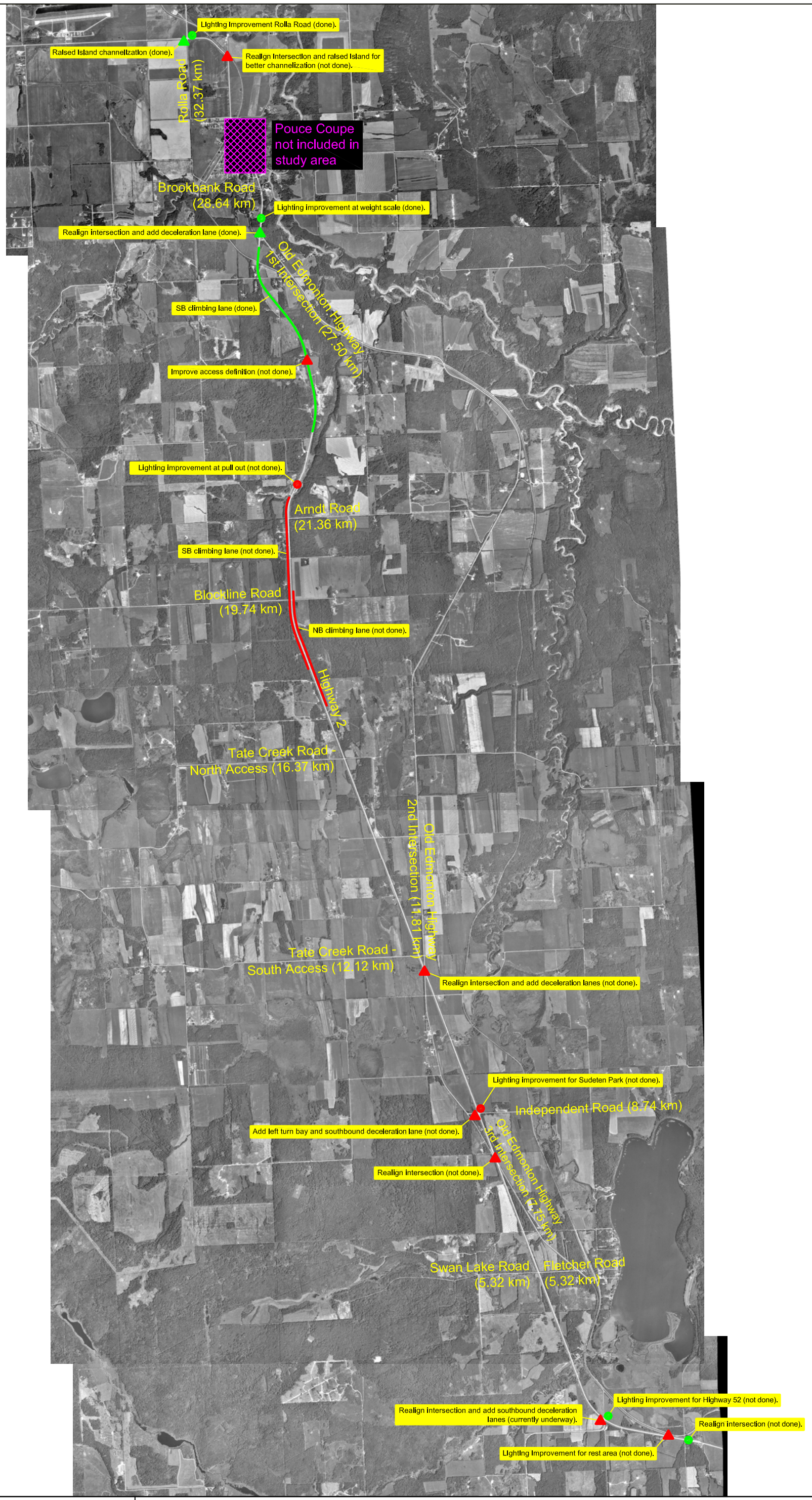
2.2 Stakeholder Consultation

A number of external agencies and organizations were contacted for their comments and concerns about traffic operations and traffic safety along Highway 2. The following provides a summary of their concerns or suggestions.

A. Ministry of Transportation

John Miller, who is the Area Manager for this corridor, reported that the following locations are the high priority areas on the corridor:

- Fletcher Road - provides access to Swan Lake Provincial Park, the community of Tupper, and to Alberta;
- Tate Creek Road (North Access) – oil, gas, and forestry activity;
- Old Edmonton Highway 1st intersection – large industrial vehicles turning left off the southbound passing lane, skew geometry of the intersection, and oil/gas activity;
- Independent Road – provides access to Swan Lake Provincial Park and to Alberta; and
- Tate Creek Road (South Access) – same as north access, namely, oil, gas, and forestry activity.



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Legend
- Climbing Lane Improvement
- Lighting Improvement
- Access Improvement
- Green (Completed)

Exhibit 2.1 - Implemented/Non-Implemented Improvements

B. RCMP Peace District

In a phone conversation with Corp. Rusk from the RCMP traffic section on November 30, 2006, it was indicated that the main concern is the high travel speeds along the straight section of Highway 2 (South of Blockline Road to Highway 52). Aggressive drivers have been observed along this section of road and a recent fatal collision (December 2005) occurred on the straight section of Highway 2 where a vehicle slide off the highway due to black ice when passing an industrial truck.

C. School District #59

In an email from Mr. Keith Trail it was indicated that the School District's primary concern is regarding school bus operation along Highway 2. When the school bus stops along Highway 2 to pick up or drop off students, the bus driver turns on the red flashing light on the bus and all other traffic on Highway 2 should legally have to stop. Mr. Trail reported that some drivers are not stopping for the flashing red light and sometimes even pass the stopped school bus on the right hand side where the students are waiting for/disembarking from the bus.

D. Caribou Road Services (Highway Maintenance Contractor)

Contact was made with Caribou Road Services to enquire about issues/problems, but no response was received.

E. Peace River Regional District

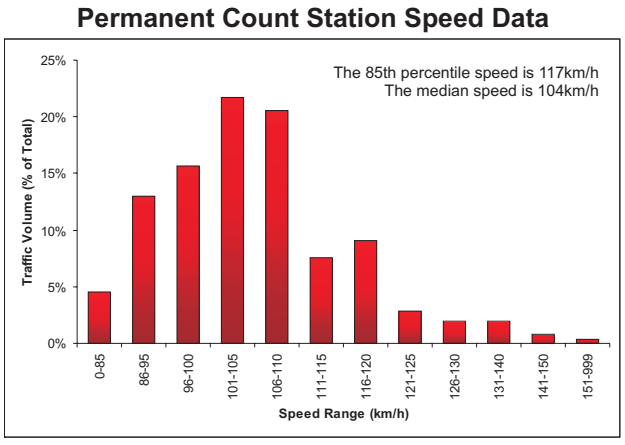
The Peace River Regional District was contacted through email to gather any development information along Highway 2. Debbie Kunz, Assistant Director of Development Services, indicated that there are two pending industrial developments with access fronting Highway 2, but the exact location of the developments is still to be confirmed.

2.3 Existing Traffic Volumes and Speed

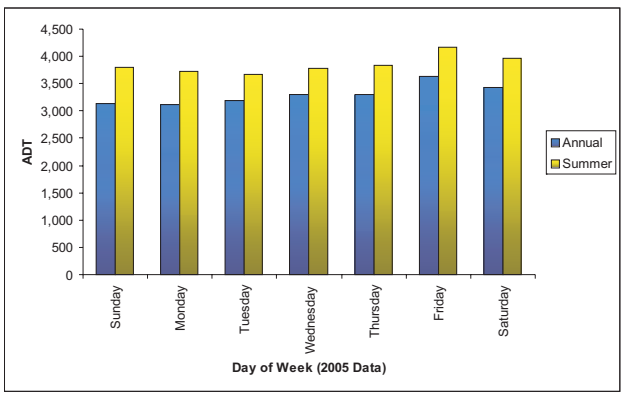
There is a permanent count station P43-1NS on Highway 2 near the BC / Alberta border. Traffic volume profiles and speed data from this site were obtained from the Ministry's Traffic Data website for analysis. Results of the analysis are summarized in ***Exhibit 2.2***. The Annual Average Daily Traffic (AADT) graphs clearly showed that traffic volumes on Highway 2 have been increasing steadily over the past 10 years

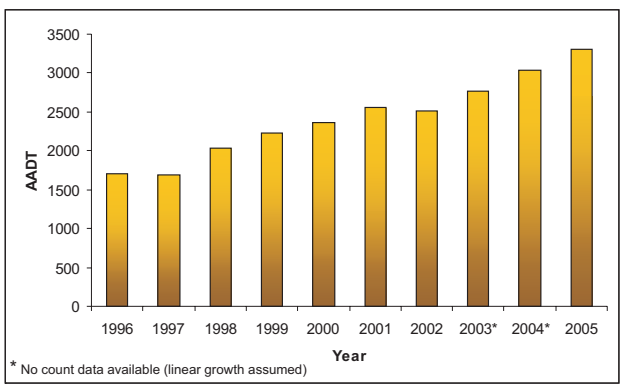
Not to Scale

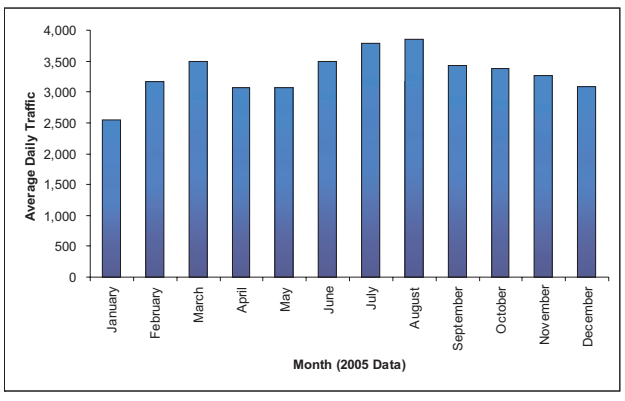
Permanent Count Station Speed Data

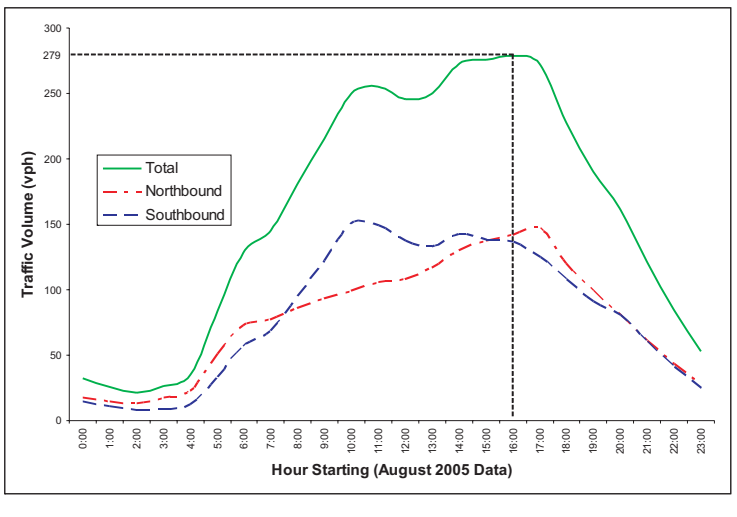


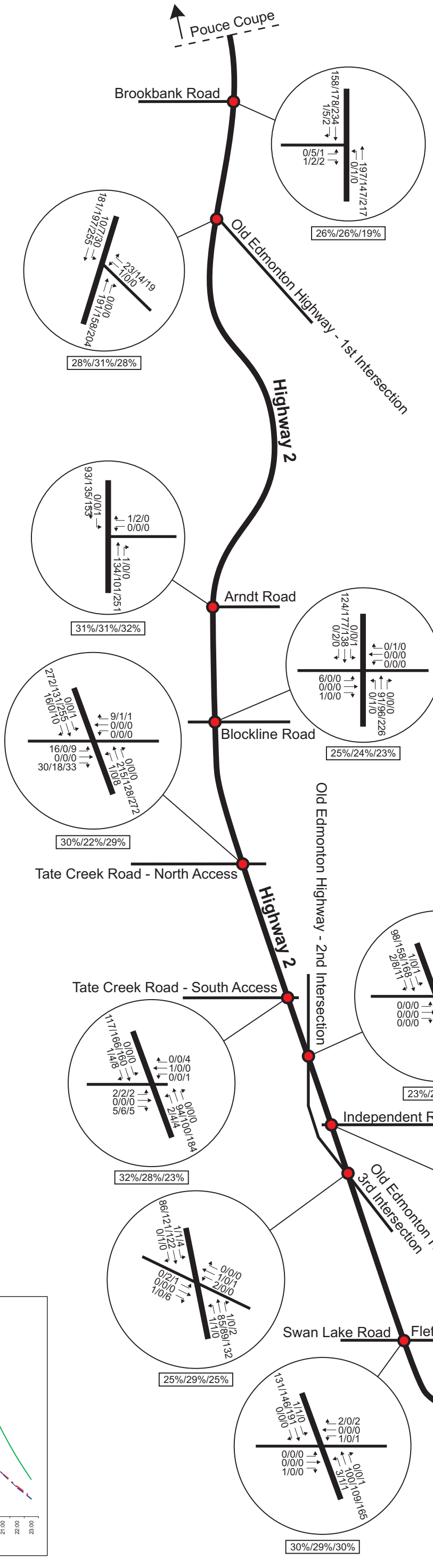
Permanent Count Station Traffic Data











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Legend

- 1/2/3 — August AM/Midday/PM Peak Hour Traffic Volumes
- Unsignalized Intersection
- 30%/22%/29% — AM/Midday/PM Overall Intersection Truck Percentages

Exhibit 2.2 - Existing Traffic Volumes and Speeds

and peak during the summer months of July and August with approximately 3,800 vehicles per day recorded in 2005. Traffic volumes are highest on Fridays.

The August 2006 speed profile graph shows that the 85th percentile speed on Highway 2 at the permanent count station site is 117 km/h, which is higher than the posted speed limit of 100 km/h. The average speed is 104 km/h with most of the traffic travelling within the 100 km/h to 120 km/h range, and 8% of all traffic travelling over 120 km/h. On an annual basis, the 85th percentile speed is 115 km/h.

A review of the August 2006 speeds at other select permanent count stations in northern BC was also undertaken to determine if the trends on Highway 2 were any different. The results are summarized in ***Table 2.1*** below.

Table 2.1 – August 2006 Speed Data from Permanent Count Stations

Location	Site	Speed Limit	85th Percentile Speed	Average Speed
Highway 2 east of BC/Alberta Border	P43-1NS	100 km/h	117 km/h	103 km/h
Highway 97 0.3 Km S Of Westcoast Energy Pump Stn #2 At Willow Flats Approx 42.0 Km S Of Chetwynd	P-43-2NS - N P-43-2NS		120 km/h	109 km/h
Highway 16 5.6 Km West Of Nechako River Bridge And Approx. 7.0 Km West Of Fort Fraser	P-45-1EW – N P-45-1EW		109 km/h	95 km/h
Highway 97 5.5 Km South Of Stone Creek Bdg And 26.2 Km South Of Old Cariboo Hwy South Of Prince George	P-41-1NS – N P-41-1NS		110 km/h	93 km/h
Highway 97 1.8 Km North Of Marguerite Ferry Crossing Road In Marguerite	P-41-2NS – N P-41-2NS		115 km/h	105 km/h

This table shows that the speeds on Highway 2 follow the trends at the other locations where the 85th percentile speed is higher than the posted speed. The average speeds on Highway 2 fall between the 93 and 109 km/h range recorded at the other locations.

At the intersection level, a total of 10 intersections along Highway 2 were selected for review in this study, but intersection turning movements were only available for three of the intersections. Thus, Ministry staff conducted intersection turning movement

counts and vehicle classification counts for the remaining seven intersections in November 2006. Since the intersection counts were undertaken in November 2006 when volumes are not at their peak, these counts were factored up to reflect peak August conditions. The turning movement count values shown in ***Exhibit 2.2*** are the factored up August values which will be used later to analyze the peak traffic volume scenario. It is noted that since no intersections were selected by the Ministry for detailed study north of Pouce Coupe, no traffic data has been presented for this section.

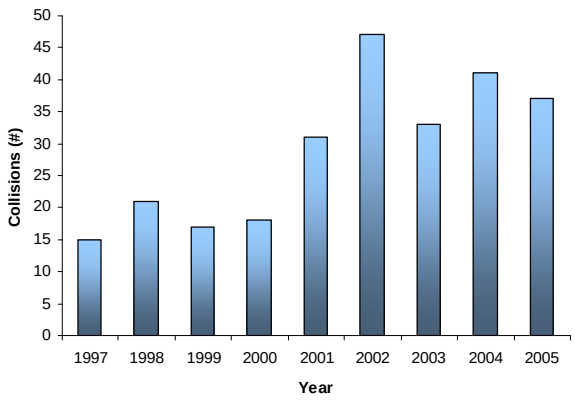
The intersection turning movement counts highlight several facts, namely:

- Approximately 30% of all traffic is classified as heavy vehicle traffic;
- Traffic volumes on the highway increase northward from the BC / Alberta border towards Dawson Creek;
- Left turn volumes on Highway 2 are low, with the highest left turn movement recorded at the Old Edmonton Highway – 1st intersection (30 veh/hr in PM peak hour); and,
- Traffic volumes turning out of/in to the side roads off Highway 2 are very low.

2.4 Collision Data Analysis

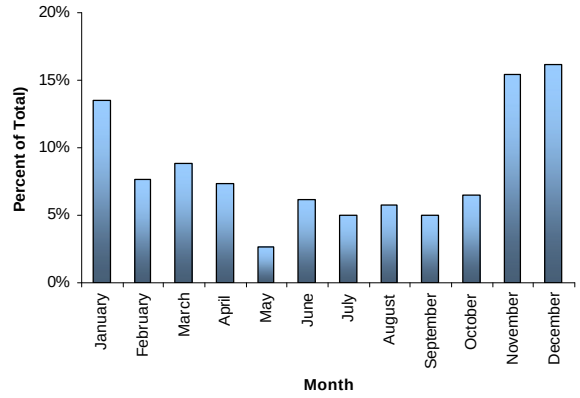
Collision data was provided by the Ministry from their Highway Accident System (HAS) database. Nine years of collisions data from 1997 to 2005 were used for the analysis. In total, there were 260 collisions reported on Highway 2 for the past 9 years (excluding the section within Pouce Coupe), representing an average of 29 collisions per year.

The following charts summarize some of the key findings for the corridor.



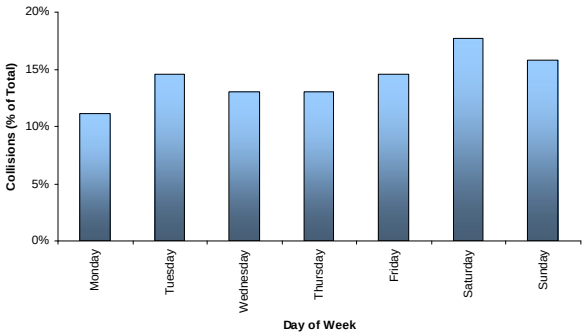
Annual Distribution

Collision frequency on Highway 2 has been generally increasing during the past 9 years with a peak of 47 collisions in 2002. This increasing trend generally matches the increase in traffic volumes since 1997 as seen on ***Exhibit 2.2***.



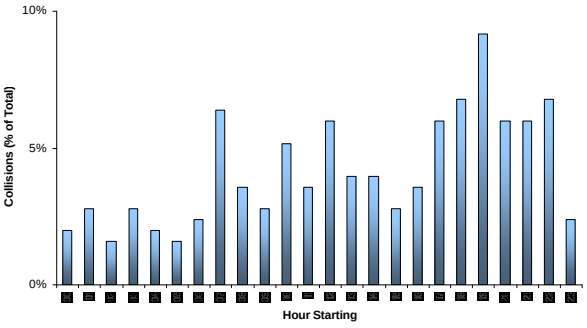
Monthly Distribution

Collision frequency is highest during the winter months (November to January). Volumes during this period are however generally lower than the peak summer season, which suggests that winter driving conditions may be an issue.



Daily Distribution

Collision frequency is highest on Saturdays and Sundays. The reason for this is unknown.

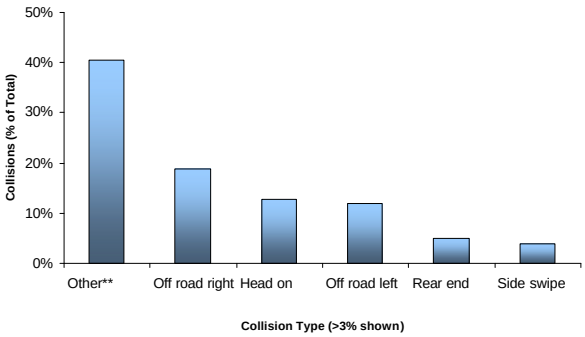


Hourly Distribution

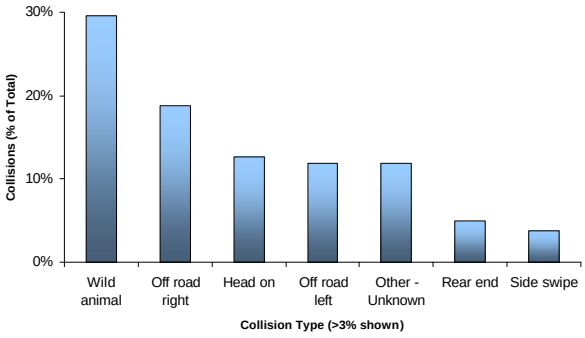
Collision frequency is highest between 19:00 and 20:00 hours. Almost 60% of all collisions occurred between 17:00 and 06:00. Noting that volumes during this period are low, this suggests that night time driving conditions could be an issue.

Collision Types and Contributing Factors

The original HAS data provided by the Ministry had 106 “other” collisions (40%) identified as the “Primary Occurrence” out of the 260 total collisions. It was, however, noted that many of these “other” collisions had “wild animal” as the “First Contributing Factor”. It was therefore assumed for the purposes of this assignment that any “other” collision that had a wild animal as the first contributing factor was a collision with a wild animal. The following charts were prepared based on this assumption.



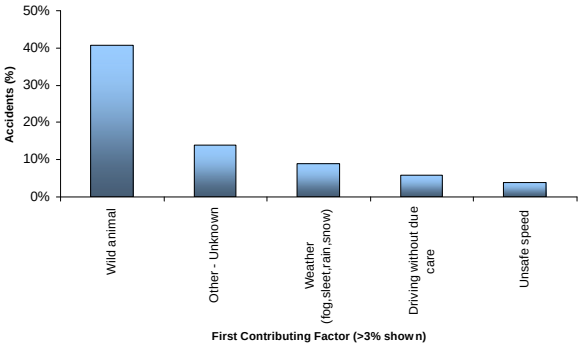
Collision Type % per HAS Data



"Adjusted" Collision Type %

Collision Type

The most frequent "adjusted" collision types on Highway 2 are wild animal collisions (30%), followed by off road right collisions (19%).

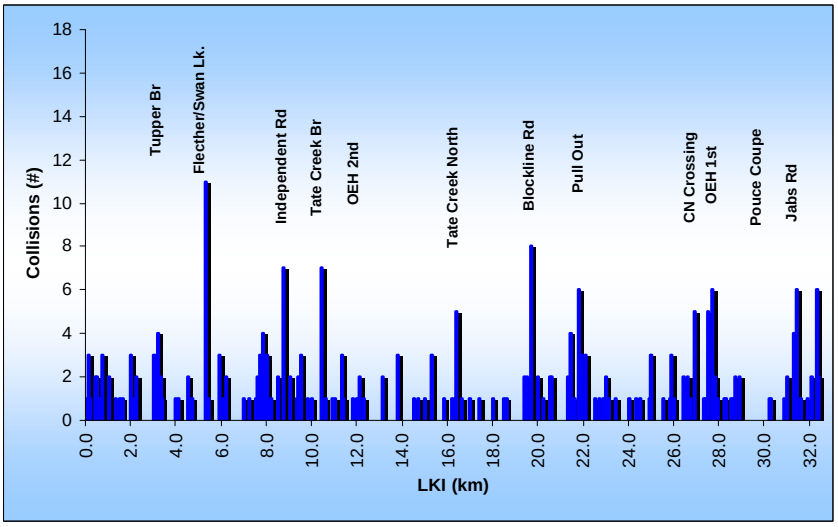


Collision First Contributory Factor

Similar to the collision type graph, wild animal was mentioned as the most common first collision contributory factor at 41% of the total collisions. This percentage is higher than the wild animal collision type percentage in the charts above. This is because there are also other collision types contributed to by wild animal such as off road collisions.

Exhibit 2.3 shows the location of all collisions along Highway 2 for the past nine years based on their LKI reference. This shows that collisions are occurring throughout the corridor but there are some specific locations that have a relatively high frequency between 4 and 11 collisions during this period or 0.44 to 1.22 collisions per annum.

Exhibit 2.3 – All Collisions by Location (LKI)



Noting the predominance of wild animal collisions along the corridor, ***Exhibit 2.4*** was prepared which illustrates the locations of these collisions during the 9 year analysis period. As can be seen, wildlife collisions are occurring throughout the corridor but occur more frequently in the southern section of the corridor between LKI 3.2 to 10.4 (Tupper Bridge to Tate Creek Bridge.

Exhibit 2.4 – Wildlife Collisions by Location (LKI)

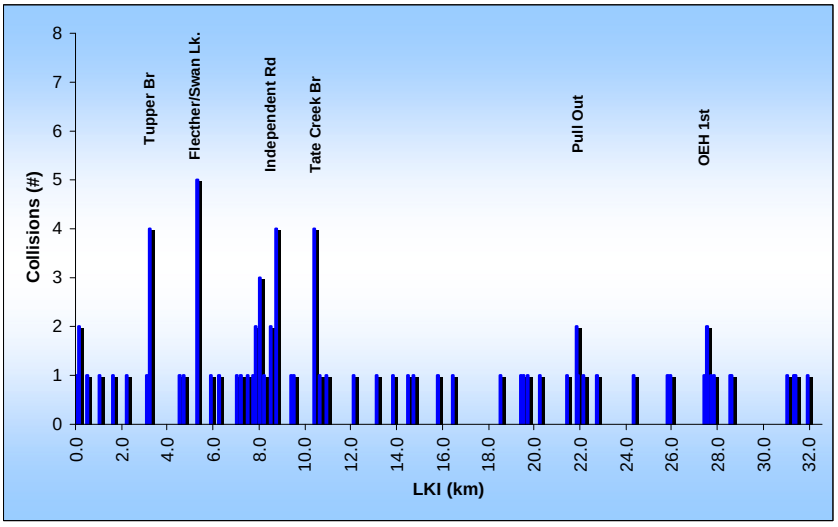


Table 2.2 provides a summary of the collision types by location. In this table, the corridor has been broken down into sections between intersections, and the intersections themselves. It has been assumed that any collisions recorded within approximately 100m of an intersection according to the LKI description, occurred at the intersection in question.

Table 2.2 – Collision Type by Location

Location	Head on	Intersection 90	Left turn 90	Off road left	Off road right	Over-taking	Rear end	Side swipe	Wild animal	Other-Unknown	Grand Total
From Alberta Border to Highway 52	2		1	1	2	1	1	1	6	3	18
Highway 52	1			1			2		1	1	6
Highway 52 to Fletcher Road/Swan Lake Road	3			1	3	1	1	1	7	1	18
Fletcher Road/Swan Lake Road	2	2			2	1			5		12
Fletcher/Swan Lake Road to OEH 3rd Intersection	2				1	1			5	2	11
Old Edmonton Highway 3rd Intersection	2				1				3	1	7
OEH 3rd Intersection to Independent Road									6		6
Independent Road (Sudeten Park Road)	1						1	1	4		7
Independent Road (Sudeten Park Road) to OEH 2nd Intersection	3	2		3	4		1		8	3	24
Old Edmonton Highway 2nd Intersection										1	1
OEH 2nd Intersection to Tate Creek Road South Access											
Tate Creek Road South Access				1		1			1		3
Tate Creek Road South Access to Tate Creek Road North Access	1			2	4			2	5		14
Tate Creek Road North Access	2			2	1				1		6
Tate Creek Road North Access to Blockline Road					4		1	2	3		10
Blockline Road	1			3					1	3	8
Blockline Road to Arndt Road				1	4				1	3	9
Arndt Road	2								1	2	5
Arndt Road to Pull Out				3	3				3	1	10
Pull Out					1				1	1	3
Pull Out to crossroad (unnamed)	2			2	5		1	1	2	2	15
Crossroad (unnamed)						1	1		2	1	5
Crossroad (unnamed) to Wallace Road	1				1						2
Wallace Road				1	2		1				4
Wallace Road to CN Railway Crossing											
CN Railway Crossing	1			2	2						5
CN Railway Crossing to OEH 1st Intersection/Weigh Scales				1							1
Old Edmonton Highway 1st Intersection/Weigh Scales	1			1					3	1	6
OEH 1st Intersection/Weigh Scales to Brookbank Road	2			3	2		2		3		12
Brookbank Road		1			1				1		3
Brookbank Road to Pouce Coupe Village Southern Boundary					1					1	2
Old Tremblay Trail										1	1
Old Tremblay Trail to Jabs Road	4			1	1				2		8
Jabs Road				1	1		1	1	1	1	6
Jabs Road to Rolla Road				1	1				1	1	4
Rolla Road		3	1		2			1		1	8
Entire Corridor	**33**	**8**	**2**	**31**	**49**	**6**	**13**	**10**	**77**	**31**	**260**

Observations from this table include:

- Predominant collision types are wild animal, off road and head on;
- Highest collision frequency locations are:
  - From Alberta Border to Highway 52;
  - Highway 52 to Fletcher Road/Swan Lake Road;
  - Independent Road (Sudeten Park Road) to Old Edmonton Highway – 2nd Intersection;
  - Tate Creek Road South to Tate Creek Road North access roads; and
  - In the vicinity of the Pull Out.
- High off road collision frequency locations are:
  - Independent Road (Sudeten Park Road) to Old Edmonton Highway – 2nd Intersection;
  - In the vicinity of the Pull Out; and
  - Tate Creek Road South Access to Tate Creek Road North Access.

Collision Severity

On the corridor, 64% of all collisions are property damage only (PDO) collisions and 33% are injury collisions. This compared similarly to the provincial average. There were 7 recorded fatal collisions during the past 9 years (3% of the total collisions). Collision severity by location is discussed later under collision costs.

Average Annual Collision Rate

Average Annual Collision Rate is defined as the number of collisions per year divided by the number of vehicles either entering the intersection or traveling through a highway segment. It provides a means of comparing collision frequency at a location with other average values to assist in determining if a location is collision prone. The AADT was calculated for each location by applying a factor derived from the PM peak period volumes as a percentage of the AADT. This was done by dividing the PM peak link volumes south of Fletcher Road/Swan Lake Road by the permanent count station AADT values (3302 veh/day) located near the BC / Alberta border. Using this methodology, it was determined that the PM peak period traffic volumes comprise 11% of the AADT. Intersection AADT's were then calculated by dividing the number of vehicles entering the intersection in the PM peak hour by 11%. Segment AADT's were calculated using the average of the two calculated adjoining intersection AADT's.

Collision rates were then calculated for the entire Highway 2, each individual intersection where traffic volumes were available, and the segments between the intersections. These were then compared with the 1999-2003 provincial average rates

for similar highways. The results are shown in ***Table 2.3.*** The rows shaded in yellow represent the locations where the collision rate is greater than the provincial average. Note that for the intersections/segments north of Pouce Coupe the AADT has been based on the volumes at the Brookbank Road intersection as no volume data was provided. It is suspected that the volumes north of Pouce Coupe will be higher which means that the calculated collision rate would be lower than that indicated in ***Table 2.3***.

Table 2.3 – Average Annual Collision Rate for Highway 2

Intersection	LKI	Distance	Total Collisions	ADT	MEV/year	MVK/year	Collision Rate (C/MVK) or (C/MEV)	Provincial Rate	> Provincial Rate?
From Alberta Border to Highway 52	0.00 - 2.07	2.07	18	3302		2.49	0.80	0.34	YES
Highway 52	2.07		6	3302	1.21		0.55	0.38	YES
Highway 52 to Fletcher Road/Swan Lake Road	2.07 - 5.32	3.25	18	3312		3.93	0.51	0.34	YES
Fletcher Road/Swan Lake Road	5.32		12	3321	1.21		1.10	0.38	YES
Fletcher/Swan Lake Road to OEH 3rd Intersection	5.32 - 7.75	2.43	11	2894		2.57	0.48	0.34	YES
Old Edmonton Highway 3rd Intersection	7.75		7	2466	0.90		0.86	0.38	YES
OEH 3rd Intersection to Independent Road	7.75 - 8.74	0.99	6	3018		1.09	0.61	0.34	YES
Independent Road (Sudeten Park Road)	8.74		7	3569	1.30		0.60	0.38	YES
Independent Road (Sudeten Park Road) to OEH 2nd Intersection	8.74 - 11.81	3.07	24	3390		3.80	0.70	0.34	YES
Old Edmonton Highway 2nd Intersection	11.81		1	3211	1.17		0.09	0.38	NO
OEH 2nd Intersection to Tate Creek Road South Access	11.81 - 12.12	0.31	0	3299		0.37	0.00	0.34	NO
Tate Creek Road South Access	12.12		3	3386	1.24		0.27	0.38	NO
Tate Creek Road South Access to Tate Creek Road North Access	12.12 - 16.37	4.25	14	4403		6.83	0.23	0.34	NO
Tate Creek Road North Access	16.37		6	5419	1.98		0.34	0.23	YES
Tate Creek Road North Access to Blockline Road	16.37 - 19.74	3.37	10	4389		5.40	0.21	0.34	NO
Blockline Road	19.74		8	3358	1.23		0.73	0.38	YES
Blockline Road to Arndt Road	19.74 - 21.36	1.62	9	3542		2.09	0.48	0.34	YES
Arndt Road	21.36		5	3726	1.36		0.41	0.38	YES
Arndt Road to Pull Out	21.36 - 22.09	0.73	10	3726		0.99	1.12	0.34	YES
Pull Out	22.09		3	3726	1.36		0.25	0.38	NO
Pull Out to crossroad (unnamed)	22.09 - 25.89	3.8	15	3726		5.17	0.32	0.34	NO
Crossroad (unnamed)	25.89		5	3726	1.36		0.41	0.38	YES
Crossroad (unnamed) to Wallace Road	25.89 - 26.59	0.7	2	3726		0.95	0.23	0.34	NO
Wallace Road	26.59		4	3726	1.36		0.33	0.38	NO
Wallace Road to CN Railway Crossing	26.59 - 26.9	0.31	0	3726		0.42	0.00	0.34	NO
CN Railway Crossing	26.9		5	3726	1.36		0.41	0.38	YES
CN Railway Crossing to OEH 1st Intersection/Weigh Scales	26.9 - 27.5	0.6	1	4200		0.92	0.12	0.34	NO
Old Edmonton Highway 1st Intersection/Weigh Scales	27.5		6	4673	1.71		0.39	0.38	YES
OEH 1st Intersection/Weight Scales to Brookbank Road	27.5 - 28.64	1.14	12	4434		1.84	0.72	0.34	YES
Brookbank Road	28.64		3	4195	1.53		0.22	0.38	NO
Brookbank Road to Pouce Coupe Village Southern Boundary	28.64 - 28.91	1.55	2	4195		2.37	0.09	0.34	NO
Old Tremblay Trail	30.19		1	4195	1.53		0.07	0.38	NO
Old Tremblay Trail to Jabs Road	30.19 - 31.39	1.2	8	4195		1.84	0.48	0.34	YES
Jabs Road	31.39		6	4195	1.53		0.44	0.38	YES
Jabs Road to Rolla Road	31.39 - 32.37	0.98	4	4195		1.50	0.30	0.34	NO
Rolla Road	32.37		8	4195	1.53		0.58	0.38	YES
Entire Corridor	**0 - 32.37**	**32.37**	**260**	**3785**	**N/A**	**44.72**	**0.65**	**0.48**	**YES**

The Old Edmonton Highway – 3rd intersection has the highest intersection collision rate at 0.86 collisions per million entering vehicles which is significantly higher than the average provincial rate of 0.38. The segment of Highway 2 from the BC / Alberta boarder to Highway 52 has the highest segment collision rate at 0.80 collisions per million vehicle-km which is significantly higher than the provincial average of 0.34. This analysis suggests that the locations highlighted in yellow above may be considered collision prone, but this direct comparison may be misleading so a critical collision rate analysis was performed as documented below.

Critical Collision Rate Analysis

This analysis method identifies a location as hazardous if the observed collision rate at a location exceeds a critical collision rate. The critical collision rate represents the expected tolerable collision rate on a highway segment or at an intersection based on probability and the average collision rate of highway segments or intersections with similar characteristics. If the actual collision rate is greater than the critical collision rate, the deviation is probably not due to chance but rather to specific location characteristics. For the purposes of this analysis the provincial average rates for intersections and segments have been assumed to be 0.38 collisions/MVE and 0.34 collisions/MVK respectively (1999-2003 data).

Exhibit 2.5 and ***2.6*** illustrate the critical and the observed collision rates for the intersections and segments respectively. This shows that none of the locations can be considered collision prone using the critical rate technique.

Exhibit 2.5 – Intersection Collision Rates

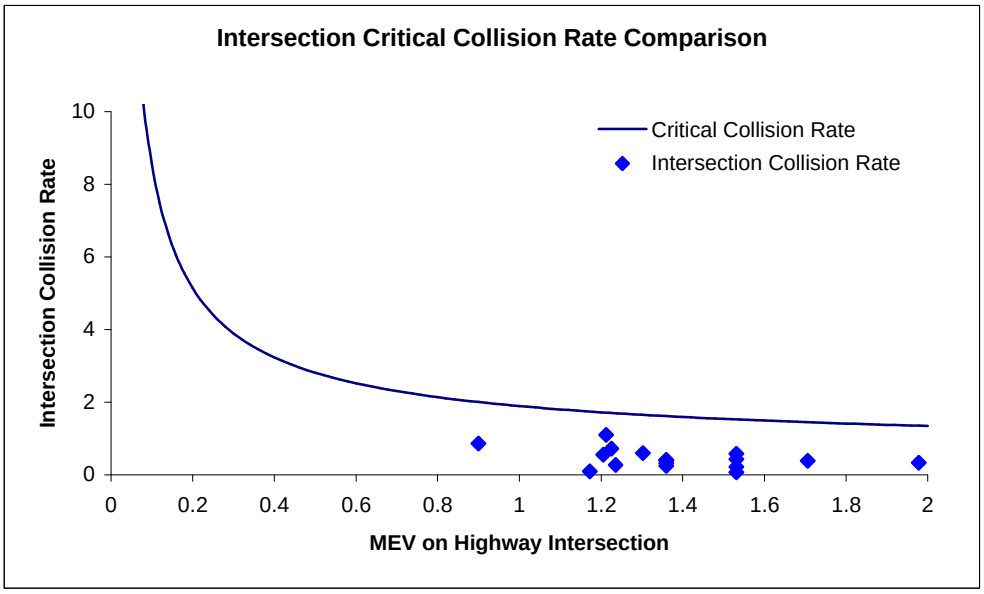
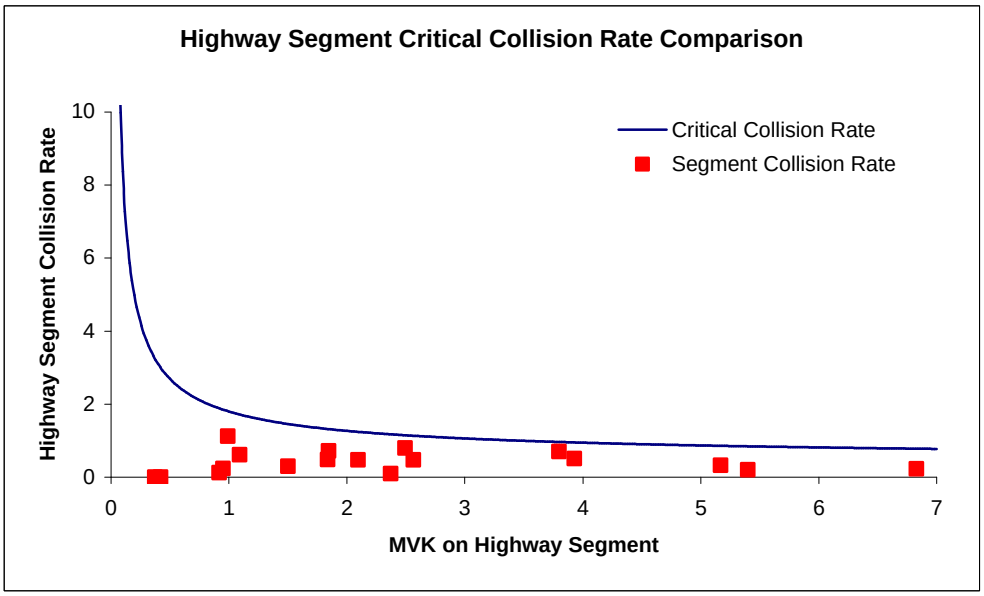


Exhibit 2.6 – Segment Collision Rates



Average Collision Cost

Average collision cost figures were provided by the Ministry and are shown below:

Fatality	$ 5,693,954
Injury	$ 99,999
PDO	$ 7,342

These values were used to calculate the cost of collisions dependant on severity. ***Table 2.4*** provides a summary of the average collision costs for all intersections, highway segments, and the highway within the study area. The total collision cost on Highway 2 for the past nine years is estimated at just under $50 million or an average of $5.5 million per annum. The average cost per collision on Highway 2 is $191,500 and this value will be used in the later financial analysis.

Table 2.4 – Collision Cost Summary

Intersection	LKI	Distance	Fatal	Injury	PDO	Total Collisions	Total Collision Cost	Average Cost per Collision	Average Annual Collision Cost
From Alberta Border to Highway 52	0.00 - 2.07	2.07	0	7	11	18	$780,755	$43,375	$86,751
Highway 52	2.07		1	1	4	6	$5,823,321	$970,554	$647,036
Highway 52 to Fletcher Road/Swan Lake Road	2.07 - 5.32	3.25	0	3	15	18	$410,127	$22,785	$45,570
Fletcher Road/Swan Lake Road	5.32		0	3	9	12	$366,075	$30,506	$40,675
Fletcher/Swan Lake Road to OEH 3rd Intersection	5.32 - 7.75	2.43	0	2	9	11	$266,076	$24,189	$29,564
Old Edmonton Highway 3rd Intersection	7.75		1	1	5	7	$5,830,663	$832,952	$647,851
OEH 3rd Intersection to Independent Road	7.75 - 8.74	0.99	0	1	5	6	$136,709	$22,785	$15,190
Independent Road (Sudeten Park Road)	8.74		0	2	5	7	$236,708	$33,815	$26,301
Independent Road (Sudeten Park Road) to OEH 2nd Intersection	8.74 - 11.81	3.07	2	9	13	24	$12,383,345	$515,973	$1,375,927
Old Edmonton Highway 2nd Intersection	11.81		0	0	1	1	$7,342	$7,342	$816
OEH 2nd Intersection to Tate Creek Road South Access	11.81 - 12.12	0.31	0	0	0	0	$0	$0	$0
Tate Creek Road South Access	12.12		0	1	2	3	$114,683	$38,228	$12,743
Tate Creek Road South Access to Tate Creek Road North Access	12.12 - 16.37	4.25	1	4	9	14	$6,160,028	$440,002	$684,448
Tate Creek Road North Access	16.37		0	4	2	6	$414,680	$69,113	$46,076
Tate Creek Road North Access to Blockline Road	16.37 - 19.74	3.37	0	3	7	10	$351,391	$35,139	$39,043
Blockline Road	19.74		0	2	6	8	$244,050	$30,506	$27,117
Blockline Road to Arndt Road	19.74 - 21.36	1.62	0	6	3	9	$622,020	$69,113	$69,113
Arndt Road	21.36		0	1	4	5	$129,367	$25,873	$14,374
Arndt Road to Pull Out	21.36 - 22.09	0.73	0	5	5	10	$536,705	$53,671	$59,634
Pull Out	22.09		0	1	2	3	$114,683	$38,228	$12,743
Pull Out to crossroad (unnamed)	22.09 - 25.89	3.8	2	5	8	15	$11,946,639	$796,443	$1,327,404
Crossroad (unnamed)	25.89		0	1	4	5	$129,367	$25,873	$14,374
Crossroad (unnamed) to Wallace Road	25.89 - 26.59	0.7	0	1	1	2	$107,341	$53,671	$11,927
Wallace Road	26.59		0	2	2	4	$214,682	$53,671	$23,854
Wallace Road to CN Railway Crossing	26.59 - 26.9	0.31	0	0	0	0	$0	$0	$0
CN Railway Crossing	26.9		0	3	2	5	$314,681	$62,936	$34,965
CN Railway Crossing to OEH 1st Intersection/Weigh Scales	26.9 - 27.5	0.6	0	0	1	1	$7,342	$7,342	$816
Old Edmonton Highway 1st Intersection/Weigh Scales	27.5		0	1	5	6	$136,709	$22,785	$15,190
OEH 1st Intersection/Weight Scales to Brookbank Road	27.5 - 28.64	1.14	0	3	9	12	$366,075	$30,506	$40,675
Brookbank Road	28.64		0	1	2	3	$114,683	$38,228	$12,743
Brookbank Road to Pouce Coupe Village Southern Boundary	28.64 - 28.91	1.55	0	0	2	2	$14,684	$0	$1,632
Old Tremblay Trail	30.19		0	1	0	1	$99,999	$99,999	$11,111
Old Tremblay Trail to Jabs Road	30.19 - 31.39	1.2	0	3	5	8	$336,707	$42,088	$37,412
Jabs Road	31.39		0	2	4	6	$229,366	$38,228	$25,485
Jabs Road to Rolla Road	31.39 - 32.37	0.98	0	3	1	4	$307,339	$76,835	$34,149
Rolla Road	32.37		0	5	3	8	$522,021	$65,253	$58,002
Entire Corridor	**0 - 32.37**	**32.37**	**7**	**87**	**166**	**260**	**$49,776,363**	**$191,448**	**$5,530,707**

The locations with the highest collision costs are on the Independent Road (Sudeten Park Road) to Old Edmonton Highway – 2nd Intersection segment and on the Pull Out to unnamed crossroad segment. These high costs are directly attributed to the two fatal collisions that occurred at each of these locations.

2.5 Traffic Capacity Analysis

Traffic capacity analyses were conducted based on the August peak hour traffic volume information presented in Section 2.3, the highway and intersection geometry collected during the site visit (see Section 2.11), and the assumption that the highway operating speed is the posted speed limit given the lack of speed data throughout the corridor. For the intersection analysis, the SYNCHRO software version 6.0 was used. For the highway segment analysis, the Highway Capacity Software (HCS 2000) was used.

Level of Service (LOS) for intersections is measured in terms of delay experienced by the highway user and is represented by LOS “A” to LOS “F”. A LOS “A” indicates that traffic is moving with no delay and under free flow conditions, whereas LOS “F” indicates that traffic is experiencing significant delay where the demand is greater than the capacity. The SYNCHRO analysis performed for this study shows that all unsignalized intersections along Highway 2 where volume data was available, are currently operating with an intersection LOS “A” in all time periods. Some of the side

road approaches are operating at LOS "B". Intersection operations are thus "good" with minimal delays. The intersection LOS results for the individual turning movements are summarized in ***Exhibit 2.7***.

For the highway segment capacity analysis, the methodology is different than that for intersection analysis. The segments were analyzed with the Highway Capacity Software (HCS) – 2 Lane Highway and Freeway modules. The highway was divided into 6 segments for analysis purposes taking into account characteristics such as terrain, speed limits and lane configuration (see ***Exhibit 1.1*** for segment boundaries). For the most part, Highway 2 was analyzed as a 2-lane highway facility. For Segment 3 and 4 with a three lane cross-section, neither the 2 Lane Highway or the Freeway module are appropriate for this analysis. Thus, the two southbound lanes were analyzed independently as a multi-lane highway facility, and the one northbound lane was analyzed independently as a 2-lane highway facility with no passing opportunity. ***Table 2.5*** provides a summary of the different segment characteristics.

Table 2.5 – Highway Segment Characteristics

Segment #	LKI	Distance (km)	Gradient	Number of lanes		Speed Limit (km/h)	Facility
				SB*	NB*		
1	0 – 20.6	20.6	Level	1	1	100	2-lane
2	20.6 – 23.2	2.6	Rolling	1	1	100	2-lane
3	23.2 – 26.9	3.7	Rolling	2	1	100	Multi-lane
4	26.9 – 27.2	0.3	Rolling	2	1	70	Multi-lane
5	27.2 – 28.9	1.7	Rolling	1	1	70	2-lane
6**	30.2 – 32.4	2.2	Level	1	1	90	2-lane

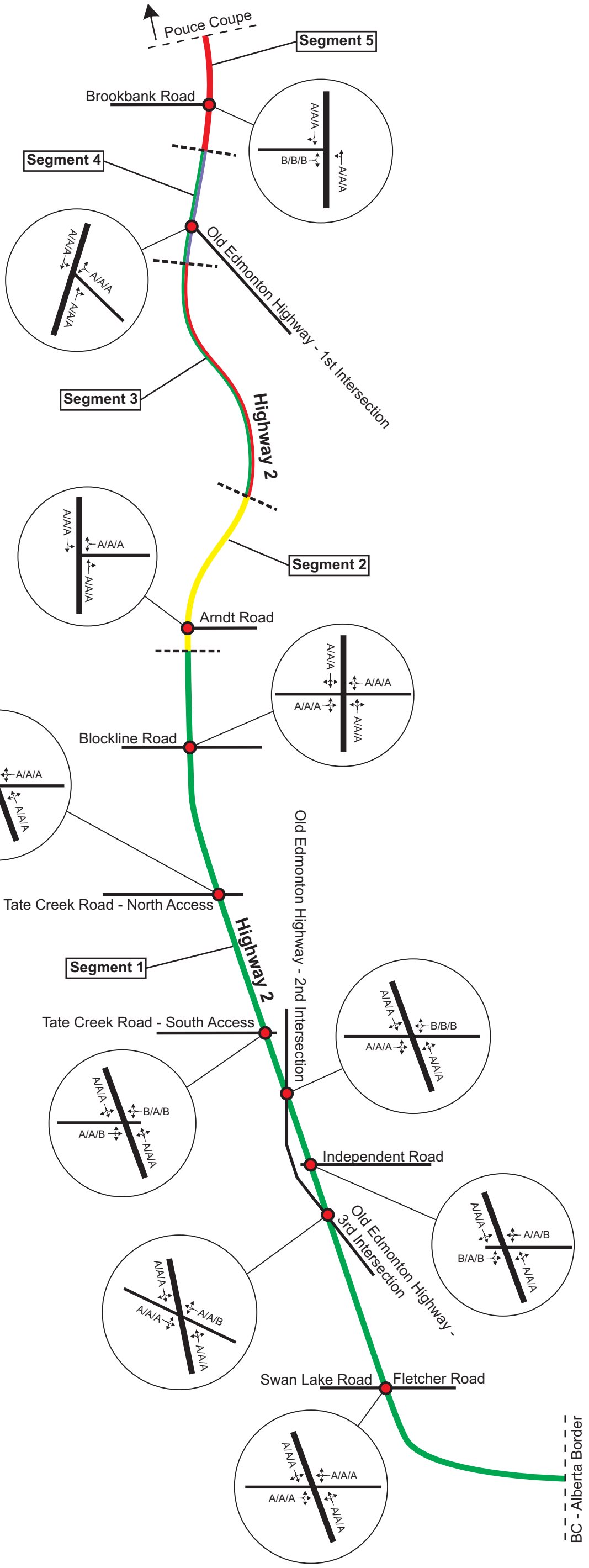
** SB – Southbound, NB – Northbound*

*** Section 6 was not evaluated as no traffic volume data was available*

The criteria for defining the LOS on a segment are different from the intersection LOS criteria discussed previously. For the multi-lane highway module, LOS is based on the traffic density of the highway segment and is defined per direction. For the 2-lane highway module, LOS is based on the percentage of time a vehicle will spend following another slower moving vehicle. Only one LOS has been defined for the particular segment and does not differ by direction.

The results of the HCS analysis are summarized in ***Table 2.6***. It is noted that only the PM peak period conditions were evaluated as it had been shown previously that this period has the highest volumes.

Not to Scale



PM Peak Hour Road Segment Level of Service

A	
B	
C	
D	
E	
F	

Delcan
TRANSPORTATION • INFORMATION TECHNOLOGY • WATER

Legend

←1/2/3 AM/Midday/PM Peak Hour Intersection Level of Service

Unsignalized Intersection

Exhibit 2.7 - Existing Levels of Service

Table 2.6 – HCS Segment Analysis Results (PM Peak Hour)

Segment #	% Time Following		LOS		Volume/Capacity
	Northbound	Southbound	NB	SB	
1	34.4		A		0.15
2	48.6		B		0.22
3	77.7	N/A*	D	A**	0.18***
4	87.5	N/A*	E	A**	0.18***
5	63.7		D		0.24

* % Time Following not applicable to two-lane southbound section
** LOS for the 2 lane SB movement is based on density
*** V/C only for NB movement

The analysis results indicate that the two lane section of the Highway 2 south of the southbound climbing lane is operating at LOS "B" or better. However, segments 3 and 4, where there are two southbound lanes but only one northbound lane (with no passing), is performing poorly in the northbound direction. In segment 5, the LOS is "D" due to single lanes in each direction, no passing being permitted in either direction, and the higher volumes on the northern parts of the corridor. ***Exhibit 2.7*** also shows the PM peak hour LOS for the highway segments.

2.6 Passing Lane Warrant Analysis

A passing lane warrant analysis was conducted for Highway 2 to determine if any additional passing lanes are required besides the existing 4.76 km of southbound passing lane south of the weigh scale. The passing lane warrant analysis was based on the Ministry's Technical Bulletin DS98003. The main objective of conducting the warrant is to determine "Percentage Following" (%Foll), which is defined as the percentage of vehicles which are travelling in platoons at headways of less than 5 seconds. The "%Foll" is also used to define Level of Service (LOS) according to the Highway Capacity Manual 2-lane Highway module. The technical bulletin indicated there is a need to provide a passing lane on a rural 2 lane arterial highway if "%Foll" is greater than 60%, or the LOS is worse than C.

The warrant analysis was conducted separately for both the northbound and southbound directions between Pouce Coupe and the Alberta border (no volume data available for north of Pouce Coupe). The input information for the warrant, along with the warrant results are shown below in ***Table 2.7***. Based on the existing traffic volumes and lane configuration, no additional passing lanes are warranted in either the northbound or southbound directions at the present time as the %Foll is less than 60%.

Table 2.7 – Passing Lane Warrant Input and Results (PM peak Hour)

Input Variable	Northbound	Southbound
Length of Corridor	28.655 km	28.655 km
Design Hourly Volume (North of OEH 1st intersection)	510 vehicles per hour (55%/45% SB/NB split)	
Advancing Volume	228 vehicles per hour	279 vehicles per hour
Opposing Volume	279 vehicles per hour	228 vehicles per hour
Existing Passing Zone Length	8.52 km	5.957 km
Length of existing auxiliary lane	0 km	4.763km
Percentage Following (%FOLL)	55%	51%

2.7 Climbing Lane Warrant Analysis

The climbing lane warrant analysis was conducted according to the Ministry's Technical Bulletin DS98002 on Truck Climbing Lane Warrants and Design. The warrant specified that the following three conditions must be met in order for a truck climbing lane to be justified:

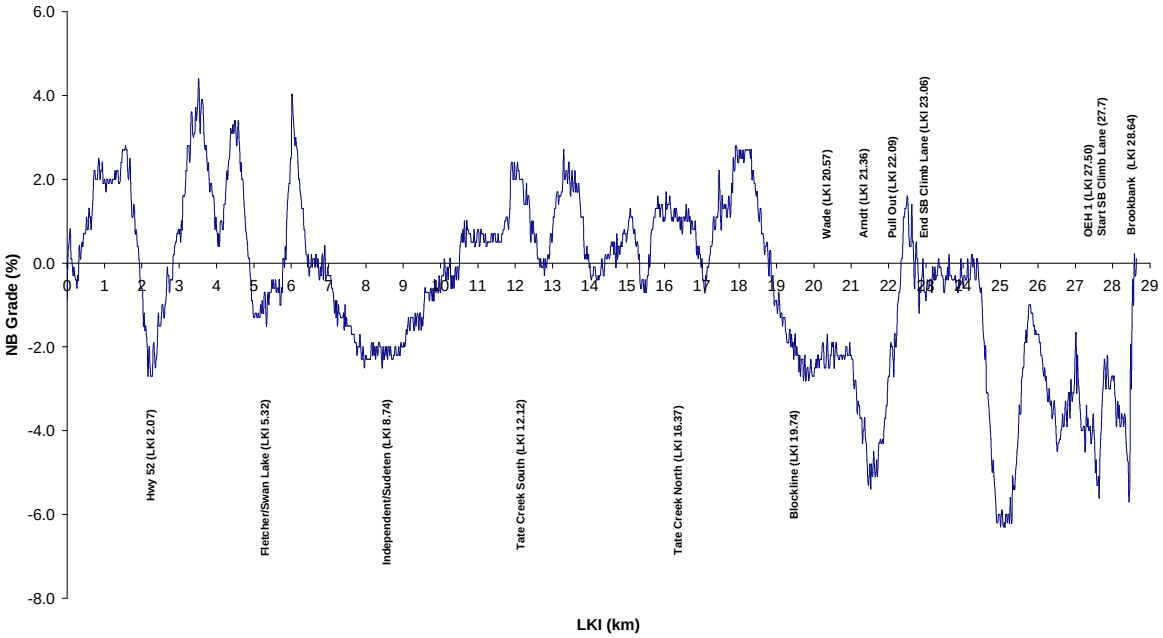
- A speed reduction of 15km/h for a 180g/w truck (300lb/hp);
- Upgrade traffic flow exceeds 200 veh/h; and,
- Upgrade truck traffic exceeds 20 veh/h.

The second and third conditions are considered to have been met since the heavy vehicle percentage along Highway 2 is approximately 30% and peak traffic volumes are in the region of 200 veh/hr or more depending on location.

To verify the first condition, the length of any uphill section of Highway 2 was first documented and then checked against those values in Table 2.1.8.1 of the Transportation Association of Canada's Geometric Design Guide for Canadian Roads. This table specifies the length of a roadway for various gradients that will result in a reduction of 15 km/h of more. For example, a 4 % grade longer than 260 metres would result in a 15 km/h reduction as would a 6% grade longer than 160 metres.

Exhibit 2.8 illustrates the northbound gradients by LKI south of Pouce Coupe according to the photolog. NOTE – THIS IS NOT A VERTICAL PROFILE AS THE PHOTOLOG ALTIMETER ONLY HAD AN ACCURACY OF 10m WHICH PRECLUDED AN ACCURATE VERTICAL ALIGNMENT TO BE PLOTTED.

Exhibit 2.8 – Northbound Gradients



It is noted that there is an existing southbound climbing lane south of Pouce Coupe to LKI 23.06. Upon review of the average gradients and their lengths, it was found that two areas warranted climbing lanes:

- Northbound between Highway 52 (LKI 3.02) and Fletcher Road (LKI 5.32); and
- Southbound between about LKI 22.1 and LKI 19.5 (around Arndt Road).

2.8 Traffic Signal Warrant Analysis

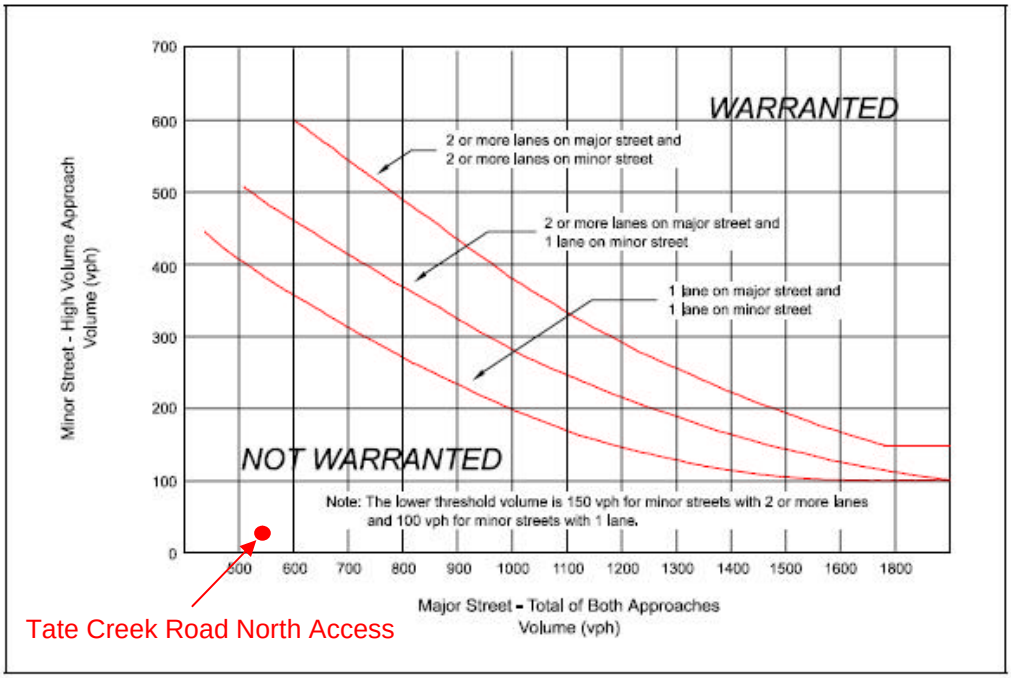
All intersections along Highway 2 are currently operating as unsignalized intersections with side road traffic controlled by STOP signs. Thus, signal warrant analyses were conducted to determine if any intersections need to be signalized based on existing traffic volumes and geometric alignment. The Ministry's traffic signal warrant system which consists of nine different warrants was used for this analysis.

Only two warrants, (Warrant 4 – Accident Experience & Warrant 9 – Peak Hour Volume) were used for this analysis because the information required for the other warrants was not available. Two test intersections were selected for the analysis, namely, the Tate Creek Road North Access intersection representing the highest

traffic volume intersection, and Swan Lake Road representing the highest collision frequency intersection.

Based on the peak hour volume warrant (9), a traffic signal would be warranted if for any single hour of an average day, the combination of major street volume using both approaches and minor street volume on the highest volume approach, exceeds the appropriate threshold in ***Exhibit 2.9*** below. For the Tate Creek Road North Access intersection, the red dot in ***Exhibit 2.9*** represents the existing PM peak hour traffic condition. Since the side road volumes are so low, a traffic signal is not warranted at this location.

Exhibit 2.9 – Ministry's Traffic Signal Warrant (PM Peak Hour Volume)



Based on the accident experience warrant (4), a traffic signal would be warranted if there are five or more reported accidents per year that are likely to be mitigated by the installation of a traffic signal. For the Swan Lake Road (Fletcher Road) intersection, there were 12 reported collisions for the past 9 years, or an average of 1.3 collisions per year. Of these 12 collisions, only the two intersection 90 degree collisions could potentially be mitigated by signals. Since the annual collision frequency is less than the required five collisions/annum, a traffic signal is not warranted at this location.

Since both the highest traffic volume and highest collision frequency intersections do not warrant traffic signals, it can be concluded that the other intersections on Highway 2 would also not warrant traffic signals at the present time.

2.9 Left Turn Lane Warrant Analysis

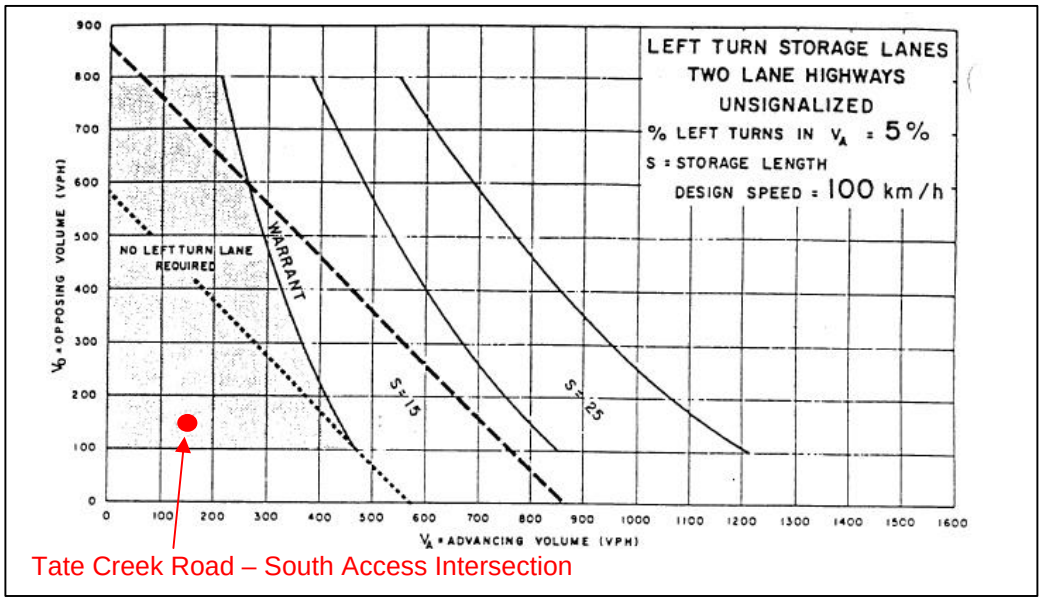
Left turn lane warrant analysis were conducted to determine if left turn lanes were required at any of the intersections along Highway 2 where volume data was available. The methodology used was based on the Ministry's Site Impact Analysis Requirements Manual – Appendix D. One intersection was initially selected for analysis in the PM peak hour. The southbound left turn volumes at the Old Edmonton Highway – 1st intersection are the highest, but it has two southbound lanes and the warrant methodology did not allow for this configuration to be evaluated. However, given that the southbound left turn movement is taking place from the "fast" passing lane, this creates a safety issue and ideally the left turn traffic should be removed from the through traffic through the provision of a left turn lane in accordance with DS98003.

The Tate Creek Road – South Access intersection was selected for the analysis as it had the highest left turn volumes and opposing through volumes (excluding the Old Edmonton Highway – 1st intersection). The input data for the warrant analysis is listed below:

- There are four northbound left turn vehicles in the PM peak hour, or 2% of northbound traffic;
- The advancing volume (northbound) is 188 vehicles per hour and the opposing volume is 160 vehicles per hour; and
- The assumed design speed is 100 km/hr.

Exhibit 2.10 shows the left turn lane warrant graph. The red dot represents the Tate Creek – South Access intersection from which it can be concluded that a left turn lane is not warranted at this location at the present time.

Exhibit 2.10 **– Left Turn Lane Warrant Graph (PM Peak Hour)**



Given that left turn lanes are not warranted at the intersection with the highest left turn volumes (excluding Old Edmonton Highway – 1st intersection), it can be concluded that left turn lanes are not warranted at any of the intersections based on the volume information available. It is however cautioned that the turning movements used in the analysis may not be representative of peak traffic conditions given that the counts were performed in November 2006 and then factored to estimate August conditions. This is particularly relevant for those locations where recreational traffic may be significantly higher than the estimated values (e.g. Independent Road and Swan Lake Road/Fletcher Road). Furthermore, the left turn lane warrant analysis did not consider the percentage heavy vehicles in the overall traffic flows. It was therefore considered appropriate to determine if there were any other factors that could possibly justify left turn lanes.

Reviewing the collision history at the intersections and at the Pull Out (rear end, off road, and left turn 90 that could be attributed to the lack of left turn lanes), ***Table 2.8*** was produced.

Table 2.8 – Intersection Collisions Potentially Related to No Left Turn Lanes

Location	Left turn 90	Off road left	Off road right	Rear end	Total
Highway 52		1		2	3
Fletcher Road/Swan Lake Road*			2		2
Old Edmonton Highway 3rd Intersection			1		1
Independent Road (Sudeten Park Road)*				1	1
Old Edmonton Highway 2nd Intersection					0
Tate Creek Road South Access*		1			1
Tate Creek Road North Access*		2	1		3
Blockline Road		3			3
Arndt Road					0
Pull Out			1		1
Crossroad (unnamed)				1	1
Wallace Road		1	2	1	4
Old Edmonton Highway 1st Intersection/Weigh Scales*		1			1
Brookbank Road			1		1

* *Intersections identified by Area Manager as priority intersections*

Based on this table and the anecdotal information provided by the Ministry, left turn lanes may be a consideration at Highway 52 (currently under construction) and Tate Creek North Access as the collision rate and Area Manager comments support each other. Since collisions near an intersection may have been recorded as being in the adjacent segments, a review of the collision history in the adjacent segments was also undertaken and summarized in ***Table 2.9***. This focuses on the locations identified by the Area Manager as priority areas and the Pull Out.

Table 2.9 – Intersection Collisions Potentially Related to No Left Turn Lanes (includes adjacent segments)

Location	Left turn 90	Off road left	Off road right	Rear end	Total	Total in Vicinity of Intersection
Highway 52 to Fletcher Road/Swan Lake Road		1	3	1	4	7
Fletcher Road/Swan Lake Road			2		2	
Fletcher/Swan Lake Road to OEH 3rd Intersection			1		1	
OEH 3rd Intersection to Independent Road					0	9
Independent Road (Sudeten Park Road)				1	1	
Independent Road (Sudeten Park Road) to OEH 2nd Intersection		3	4	1	8	
OEH 2nd Intersection to Tate Creek Road South Access					0	7
Tate Creek Road South Access		1			1	
Tate Creek Road South Access to Tate Creek Road North Access		2	4		6	6 (overlap)
Tate Creek Road North Access		2	1		3	8
Tate Creek Road North Access to Blockline Road			4	1	5	
Arndt Rd to Pull Out		3	3		6	14
Pull Out			1		1	
Pull Out to crossroad (unnamed)		2	5		7	
CN Railway Crossing to OEH 1st Intersection/Weigh Scales		1			1	9
Old Edmonton Highway 1st Intersection/Weigh Scales		1			1	
OEH 1st Intersection/Weigh Scales to Brookbank Road		3	2	2	7	

This table highlights that the collision frequency (potentially related to no left turn lanes) in the vicinity of the listed locations is high. Left turn lanes at all the above intersections is therefore a consideration notwithstanding the fact that the warrant requirements were not met. Furthermore, if new climbing/passing lanes are to be provided, additional left turn lanes will be required at other locations as discussed further in Sections 6 and 7.

2.10 Illumination

Illumination is currently provided at the following locations on Highway 2:

- The weigh scale;
- At the at-grade rail crossing;
- Rolla Road intersection; and
- Highway 52 intersection.

In accordance with the Ministry's Electrical and Traffic Engineering Manual, illumination is warranted at the following locations relevant to the study area:

- Rural Intersections – as determined by application of the warrant process outlined in the TAC "*Illumination of Isolated Rural Intersections guideline"*;
- All formal Rest Areas;
- Weigh scales; and
- At at-grade rail crossings.

Illumination should be provided for some of the intersections which meet the TAC guidelines. In accordance with the TAC guidelines, the following are considered in the warrant process:

- Geometric factors such as channelization, sight distance, speed, curvature, etc.;
- Operational factors such as AADT, road classification, etc.;
- Environmental factors such as adjacent development lighting; and
- Collision history (night time).

The warrant procedure was performed for the Fletcher Road/Swan Lake Road intersection as it had the highest number of collisions (12 in nine years) with six of the collisions occurring between 17:00 and 06:00. The warrant analysis showed that lighting is not justified at this location. It can therefore be assumed that lighting is not warranted at any of the road intersections on the corridor.

2.11 Site Visit / Observations

A site visit was conducted between October 24 and 25, 2006. A list of observations was made during the site visit and these are summarized below in ***Table 2.10***.

Table 2.10 – Site Visit Observation Table

Photos	Observations
	Worn Out Reflectors / Lack of Reflectors The reflective delineators near Jabs Road have weathered and do not reflect well at night. This creates a potential for off road collisions. The rest of the corridor does not have any post mounted reflectors.
	Skewed Intersection Geometry The Old Edmonton Highway – 1st, 2nd and 3rd intersections all meet Highway 2 at skew angles. Vehicles on Old Edmonton Highway turning left or right onto Highway 2 may have difficulty observing the traffic on Highway 2 due to the skewed geometry. The collision frequency and types at the three intersections do not however indicate this is an issue.

Photos	Observations
	Wildlife Collisions The collision data indicated that wildlife collisions are the most frequent collision type along this highway.
	Slow Moving Trucks Faster moving vehicles were observed following behind slower moving heavy vehicles. This creates a potential for rear end, off road and head on collisions.
	School Bus Stop School bus stop signage is installed throughout the corridor. Motorists are required to come to a complete stop on the highway when the red flashing beacons on the bus is turned on. This does not appear to be adhered to.

Photos	Observations
	Passing Allowed at Intersections The single centerline pavement marking at most intersections along Highway 2 permits vehicles to overtake if it is safe to do so. This creates safety issues and in accordance with accepted practice, no passing should be implemented in the proximity of intersections.
See above photo	No deceleration/storage/acceleration lanes. At intersections and Pull Outs, vehicles are turning left/right off Highway 2 from the through lanes. Since turning movement volumes are low and infrequent, following vehicles may not anticipate the leading vehicle slowing down or stopping to turn onto the side road/Pull Out. This creates a potential for rear end or off road collisions. Acceleration / deceleration lanes have also not been provided but this does not seem to be resulting in collisions.
	Inconsistent Street Name Signage Some of the street names for the side roads along Highway 2 are referred to by more than one name. This photo shows a directional sign at the Old Edmonton Highway – 2nd intersection. The sign reads “Frontage Road”, which gives little indication that Old Edmonton Highway is the upcoming intersection.

Photos	Observations
	Intersection Ahead Signage Only the Tate Creek Road – South Access intersection is equipped with Intersection Ahead Warning signs to warn motorists of the upcoming intersection. This sign should be used at other intersections along the highway to provide advance warning to drivers and hence reduce the potential for rear end and off road collisions that could occur when vehicles slow rapidly to turn.

3. EXISTING CONDITIONS REVIEW

Based on the work discussed in previous sections, the existing conditions on the Highway 2 corridor can be summarized as follows:

Corridor Wide Issues

- Traffic volumes are increasing with time;
- Heavy vehicles constitute approximately 30% of all traffic;
- Vehicle speeds tend to exceed the posted speed limits;
- Most of the highway segments are operating at LOS “C” or better with the exceptions of the segments just south of the Village of Pouce Coupe, which are operating at LOS “D” or “E”;
- There is a high proportion of wildlife collisions (30% of total) with the majority being reported south of the Sudeten Park access;
- 60% of all collisions occurred between 17:00 and 06:00 suggested that night time driving conditions may be contributing to collisions;
- Collision frequency is highest during the winter months (November to January) which suggests that winter driving conditions may be contributing to collisions;
- Although some locations have collision rates higher than the provincial average collision rates, the critical collision rate analysis showed that no locations are considered collision prone;

- Post mounted reflectors are provided only for the curves near the Jabs Road intersection, but these are in need of maintenance. No delineators are provided for other horizontal curves along the highway;
- Slow moving vehicles delay other traffic potentially leading to aggressive driving behaviour (e.g. passing in a no passing zone) and collisions;
- Drivers are not complying with school bus red flashing beacons;
- Single centre line markings do not prohibit passing in the proximity of intersections;
- The side roads along Highway 2 are referred to by more than one name, which could create confusion for non-local drivers;
- Intersection ahead warning signs are only provided for the Tate Creek Road – South Access intersection. These signs should be provided at all intersections to provide advance warning to motorists and hence reduce the potential for rear end and off road collisions;
- Additional passing lanes are currently not warranted;
- New traffic signals are currently not warranted at any location;
- A climbing lane is currently warranted in the northbound direction between Highway 52 and Fletcher Road; and
- A climbing lane is currently warranted in the southbound direction south of the Pull Out (Arndt Road).

Site Specific Issues

- The Old Edmonton Highway 2nd and 3rd Intersections meet Highway 2 at a skew angle. Intersection visibility for side road traffic turning onto Highway 2 is an issue; however, collision frequency for left turn or intersection collisions is not high.
- A southbound left turn lane has been provided at the weigh scales. On the opposite side of the intersection, the median has not been painted/raised with the result that southbound vehicles can proceed straight through the left turn lane to access the “fast” lane of the southbound climbing lane facility. The downstream Old Edmonton Highway – 1st intersection has the highest left turn volumes off the highway and these movements are occurring from the “fast lane”. This creates a potential for rear end and off road collisions.
- Passing is permitted near intersections. This creates a potential for rear end, off road, and intersection 90 degree collisions.

- No left turn lanes have been provided at the intersections or to the Pull Out (LKI 22) creating a potential for rear end, off road and left turn 90 collisions. Left turn lane warrant analyses indicated that these lanes are not justified in terms of the warrant. However, based on a review of the collision history and anecdotal observations from Ministry staff, there appears to be a justifications for left turn lanes at:
  - Highway 52 (currently under construction);
  - Fletcher Road/Swan Lake Road;
  - Independent Road/Sudeten Park Road;
  - Tate Creek Road South Access;
  - Tate Creek Road North Access;
  - Pull Out; and
  - Old Edmonton Highway 1st Intersection.

With the review of the existing conditions complete, the next step was to evaluate conditions in future years. This is documented in the next section.

4. FUTURE CONDITIONS ANALYSIS

This section presents the findings of the traffic operations and warrant analyses for the two horizon years requested by the Ministry, namely, 2010 and 2020. The future forecast traffic volumes were calculated by applying a traffic growth rate to the existing traffic volumes. With limited future land use information along Highway 2 being available, and the uncertainty of forecasting volumes based on this limited information, it was agreed to apply an annual traffic growth rate based on historic traffic volumes trends. Using the Summer Average Daily Traffic (AADT) in 1995 and in 2005, the compounded annual traffic growth rate was computed to be approximately 4.75% per annum. It is acknowledged that this growth rate may be high and not sustainable over the long term. In Section 7, the sensitivity of other assumed growth rates is tested.

4.1 Year 2010 Scenario

Traffic Volume and LOS

The forecast traffic volumes for year 2010 that were computed using the assumed annual traffic growth of 4.75% are shown in ***Exhibit 4.1***. The corresponding levels of service for both the intersections and the highway segments are shown in ***Exhibit 4.2*** using the same methodology applied previously. The year 2010 results are comparable to the existing conditions where most of the intersections are expected to operate with LOS "B" or better. For the highway segments, only the northbound section from the weigh scale to Pouce Coupe is expected to operate at LOS "E" in 2010. This is attributed to the no passing in the northbound direction adjacent to the two southbound lanes.

Traffic Signal Warrant

The signal warrant was checked again at the Tate Creek Road – North Access intersection to determine if a traffic signal would be required in the PM peak hour in 2010. This warrant analysis again showed that a traffic signal is not warranted at this location. As before, it can be concluded that no traffic signals are warranted on the corridor in 2010.

Left Turn Lane Warrant

The Tate Creek Road – South Access intersection was used for the left turn lane warrant analysis and the results indicated that no left turn lane is warranted in the PM peak hour in 2010. As before, it can be concluded that no left turn lanes are warranted on the corridor in 2010. However, the previous comments and recommendations regarding providing left turn lanes at some locations still apply.

Passing Lane Warrant

A passing lane warrant analysis was conducted assuming the existing layout of the corridor (i.e. no new auxiliary lanes). The warrant results indicated that no passing lanes are warranted in either the northbound or southbound directions in 2010 as the "%FOLL" is less than the required 60%. Results are summarized in ***Table 4.1***.

Not to Scale

Pouce Coupe

Brookbank Road

190/214/282
1/6/2
0/6/1
1/2/2
237/177/261
0/1/0

Old Edmonton Highway - 1st Intersection

218/237/307
12/8/36
28/17/23
1/0/0
0/0/0
23/0/6
90/249

Highway 2

112/163/184
0/0/1
1/2/0
0/0/0
1/0/0
161/122/302

Arndt Road

149/213/166
0/0/1
0/2/0
0/1/0
0/0/0
0/0/0
7/0/0
0/0/0
1/0/0
0/0/0
110/116/272
0/1/0

Blockline Road

327/158/307
0/0/1
19/0/12
11/1/1
0/0/0
0/0/0
19/0/11
0/0/0
36/22/40
0/0/0
259/154/327
1/0/10

Old Edmonton Highway - 2nd Intersection

Tate Creek Road - North Access

Highway 2

Tate Creek Road - South Access

118/182/202
1/0/1
2/10/13
2/0/1
25/8/11
0/0/0
0/0/0
0/0/0
0/0/0
0/0/0
178/129/191
0/0/0

Signal Warrant
Main = 657 vph
Minor = 51 vph
See Exhibit 2.9

Therefore, traffic signal is NOT warranted.

141/200/193
0/0/0
1/5/10
0/0/5
1/0/0
0/0/1
2/2/2
0/0/0
6/7/6
0/0/0
113/120/222
2/5/5

Independent Road

Old Edmonton Highway - 3rd Intersection

95/144/150
1/0/1
0/0/0
2/0/2
1/0/1
1/1/0
0/1/0
2/0/2
0/0/0
0/0/0
112/98/309
0/0/0

Left Turn Lane Warrant
Left Turn % = 2 %
Advancing Volume = 222 vph
Opposing Volume = 193 vph
See Exhibit 2.10

Therefore, left turn lane is NOT warranted.

104/146/147
1/1/5
0/1/0
0/0/9
1/0/1
2/0/0
0/2/1
0/0/0
1/0/7
1/0/2
102/107/159
1/1/0

Swan Lake Road

Fletcher Road

158/176/230
1/1/0
0/0/0
2/0/2
0/0/0
1/0/1
0/0/0
0/0/0
1/0/0
0/0/1
120/131/199
4/1/1

Permanent Count Station

BC - Alberta Border

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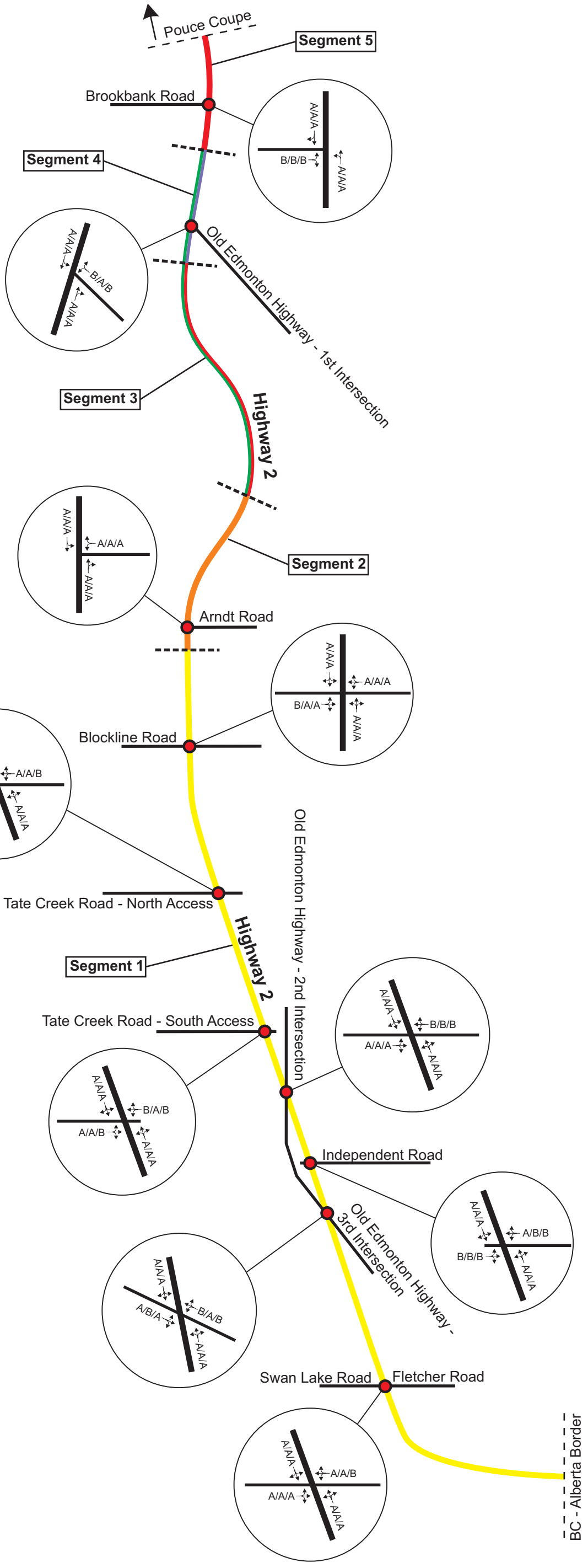
Legend

1/2/3 AM/Midday/PM Peak Hour Traffic Volumes

Unsignalized Intersection

Exhibit 4.1 - 2010 Traffic Volumes

Not to Scale



PM Peak Hour Road Segment Level of Service

A	
B	
C	
D	
E	
F	

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Legend

←1/2/3 AM/Midday/PM Peak Hour Intersection Level of Service

Unsignalized Intersection

Exhibit 4.2 - 2010 Levels of Service

Table 4.1 – Passing Lane Warrant Input and Results (2010 PM peak hour)

Input Variable	Northbound	Southbound
Length of Corridor	28.655 km	28.655 km
Design Hourly Volume (North of OEH 1st Intersection)	610 vehicles per hour (55%/45% SB/NB split)	
Advancing Volume	275 vehicles per hour	336 vehicles per hour
Opposing Volume	336 vehicles per hour	275 vehicles per hour
Passing Zone Length	8.52	5.957 km
Length of existing auxiliary lane	0 km	4.763 km
Percentage Following (%FOLL)	59%	54%

4.2 Year 2020 Scenario

Traffic volume and LOS

The forecast traffic volumes and LOS for year 2020 are shown in ***Exhibits 4.3*** and ***4.4*** assuming the same 4.75% growth per annum. The year 2020 results showed that most of the LOS for the intersections are "C" or better, which is considered acceptable. For the highway segments, most of Highway 2 is operating at LOS "C" with the section from Pouce Coupe to the end of the two southbound lanes expected to operate at LOS "E".

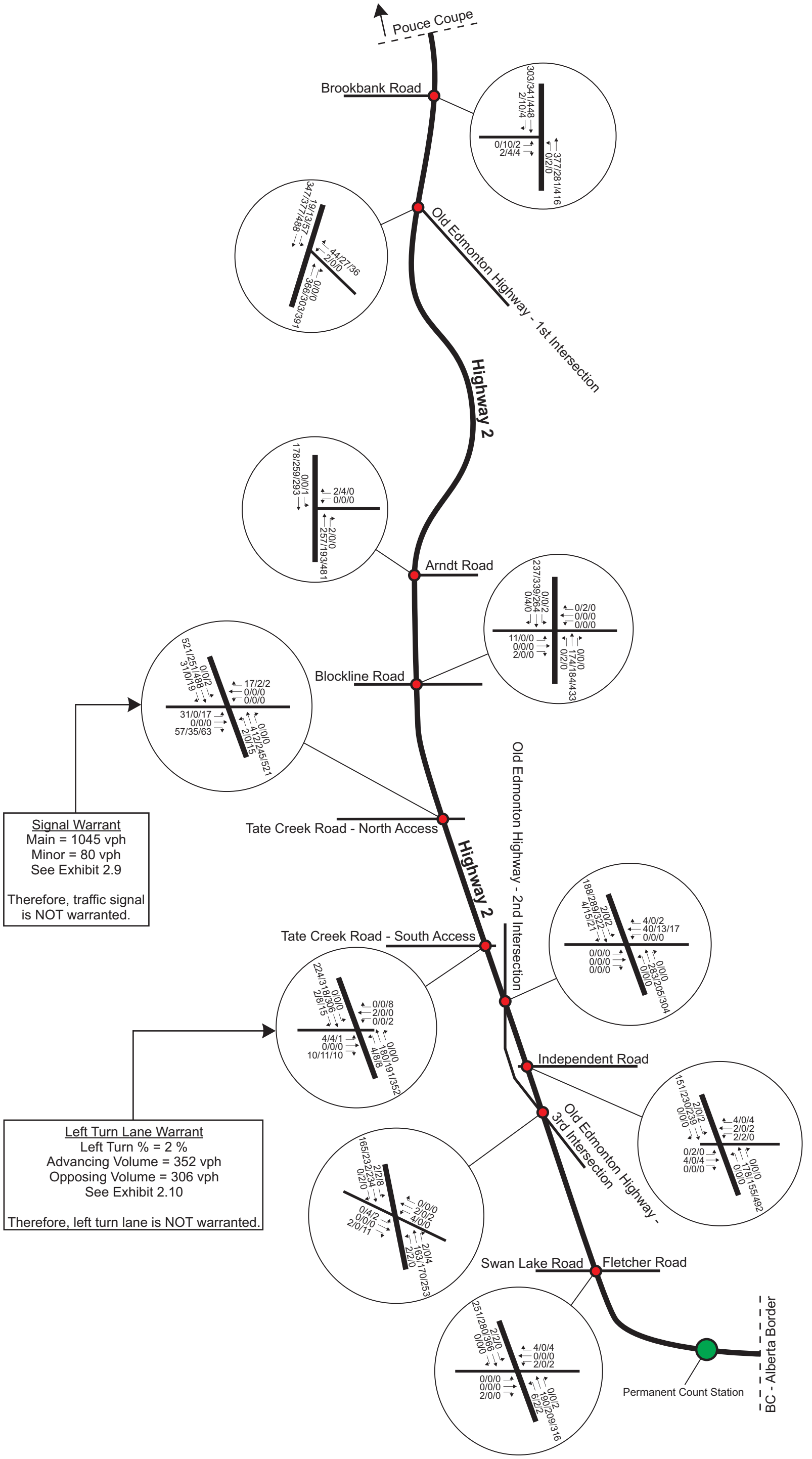
Traffic Signal Warrant

The signal warrant was checked again to determine if a traffic signal will be required at the Tate Creek Road – North Access intersection in the PM peak hour in 2020. The results showed that traffic signals at this location are still not warranted, and it can be concluded that no intersection will warrant signalization in 2020.

Left Turn Lane Warrant

The Tate Creek Road – South Access intersection was used for the 2020 analysis and the results indicated that no left turn lane is warranted. As before, it can be concluded that no left turn lanes are warranted on the corridor in 2020. However, the previous comments and recommendations regarding providing left turn lanes at some locations still apply.

Not to Scale



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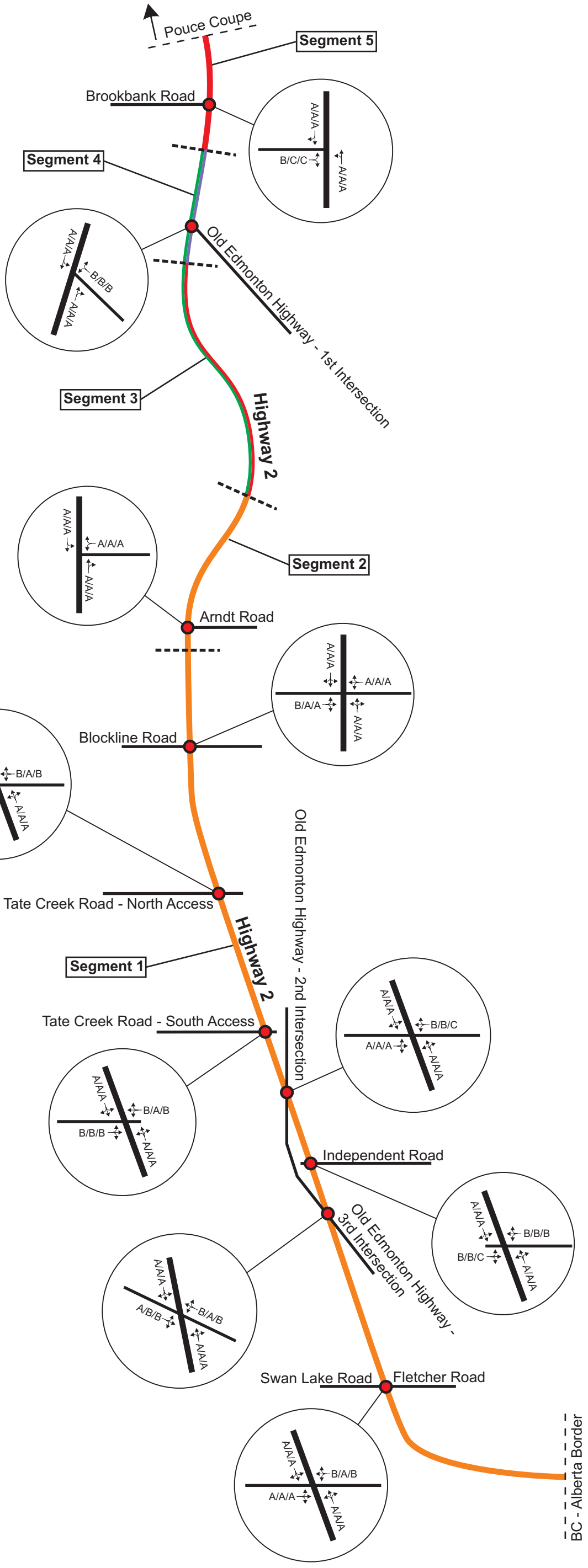
Legend

←1/2/3 AM/Midday/PM Peak Hour Traffic Volumes

Unsignalized Intersection

Exhibit 4.3 - 2020 Traffic Volumes

Not to Scale



PM Peak Hour Road Segment Level of Service

A	
B	
C	
D	
E	
F	

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Legend

←1/2/3 AM/Midday/PM Peak Hour Intersection Level of Service

Unsignalized Intersection

Exhibit 4.4 - 2020 Levels of Service

Passing Lane Warrant

The passing lane warrant results (assuming existing lane configurations) indicated that additional passing lanes are warranted in 2020 in both the northbound and southbound directions as the "%FOLL" is greater than the required 60%. Results are summarized in ***Table 4.2***.

Table 4.2 – Passing Lane Warrant Input and Results (2020 PM peak)

Input Variable	Northbound	Southbound
Length of Corridor	28.655 km	28.655 km
Design Hourly Volume (North of OEH 1st intersection)	975 vehicles per hour (55%/45% SB/NB split)	
Advancing Volume	438 vehicles per hour	535 vehicles per hour
Opposing Volume	535 vehicles per hour	438 vehicles per hour
Passing Zone Length	8.52	5.96 km
Length of existing auxiliary lane	0 km	4.76km
Percentage Following (%FOLL)	69%	63%

In later sections of this report, the location and timing of these passing improvements will be discussed further as it they are dependant on the projected volumes and the possibility that the climbing lanes will be provided.

4.3 Future Conditions Summary

The future conditions review which assumed a traffic growth rate of 4.75% per annum has highlighted a number of issues and potential improvements, namely:

- No traffic signals are likely to be warranted at any of the intersections within the study area prior to 2020;
- No left turn lanes are justified prior to 2020 according to the warrant analysis. However, based on earlier discussion, left turn lanes should be provided at the locations listed in Section 3 as soon as possible;
- No additional passing lanes are required in 2010; however, a new northbound passing lane and an additional southbound passing lane are required by 2020 assuming that no other climbing lanes are to be implemented.

5. IMPROVEMENT IDENTIFICATION

With an understanding of the existing and future issues, a number of improvement measures have been identified as discussed in ***Table 5.1*** below. At a Project Review meeting held on December 14, 2006, most of these improvements were discussed in principal whereupon it was agreed by the Ministry that only the high capital cost improvements be taken forward for more detailed evaluation. In the "Comments" column below, those improvements that are to be evaluated in later sections of the report are identified.

Table 5.1 – Improvement Identification

Issue	Proposed Improvements	Comments
Speeding	Increase speed enforcement	
High proportion of wild life collisions	Install wildlife signage, fencing, and reflectors at locations with high wildlife collision frequency (Tupper Bridge to Tate Creek Bridge)	
High proportion of winter collisions	Review winter maintenance practices	
Slow moving vehicles lead to aggressive driving behaviour (e.g. passing in a no passing zone)	Install northbound climbing lane between Highway 52 and Fletcher Road. Install southbound climbing lane in the vicinity of Arndt Road. By 2020 additional passing lanes will be required in both directions assuming the climbing lanes mentioned above are not implemented.	High capital cost - further evaluation to follow in Sections 6 and 7.
Skew alignment of Old Edmonton Highway intersections.	Consideration should be given to closing the 2nd and 3rd intersections as alternative access is possible.	May be an issue with local residents.
Drivers are not complying with school bus red flashing beacons	Enforcement. Provide bus pull outs.	
Passing is permitted in proximity to intersections	Provide double centre line on the Highway 2 approaches to all intersections. Provide intersection ahead warning signs and intersection lighting if warranted.	

Issue	Proposed Improvements	Comments
No left turn lanes at intersections or at the Pull Out	Warrant does not support provision of left turn lanes at most locations. Left turn lanes should, however, be provided at the following locations: • Highway 52 (currently under construction); • Fletcher Road/Swan Lake Road; • Independent Road/Sudeten Park Road; • Tate Creek Road South Access; • Tate Creek Road North Access; • Pull Out; and • Old Edmonton Highway 1st Intersection. • Other locations where climbing/passing lanes are to be provided.	High capital cost – further evaluation to follow in Sections 6 and 7.
Inconsistent street naming and intersection ahead signage	Provide advance "intersection ahead" and consistent street name signage at all intersections	Note – this could reduce the number of intersection related collisions. Additional signs should also be provided in advance of the Pull Outs.

As can be seen from ***Table 5.1***, the high capital cost improvements are the provision of passing/climbing lanes and left turn lanes at select locations. In accordance with the Ministry's request, only these improvements will be taken forward for concept development and evaluation.

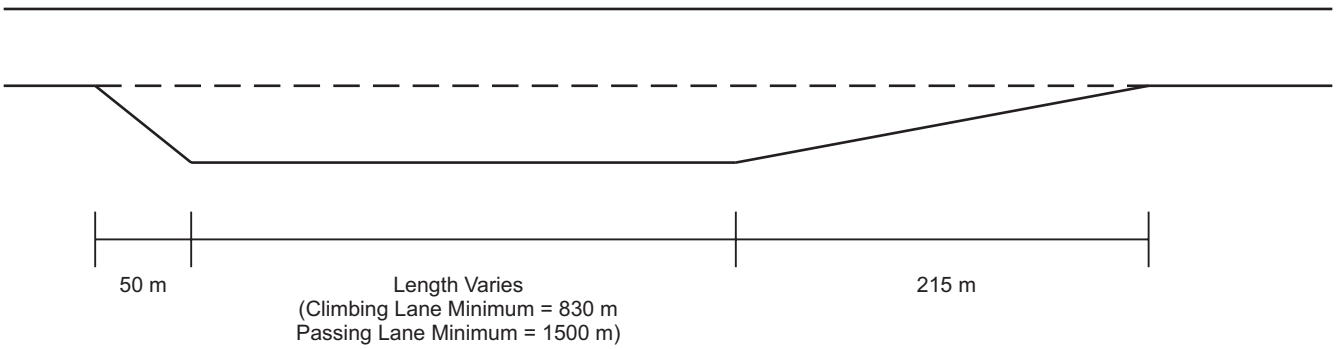
6. CONCEPT DEVELOPMENT

The design of climbing lanes, passing lanes and left turn lanes are all interrelated. The first step in the concept development process was to determine the location and length of the climbing lanes as these are included in the procedure to determine the passing lane requirements. These auxiliary lanes, in turn, influence the design of the left turn lanes.

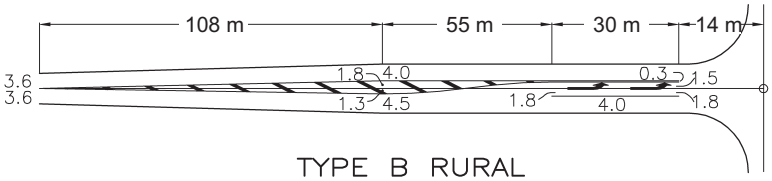
In designing the climbing/passing lanes there are a number of guidelines (DS 98002 and DS 98003) with regard to lengths/distances as summarized below (see ***Exhibit 6.1***):

- Diverge length - 50m;
- Minimum climbing lane length from end of diverge to start of merge – 830m for 100km/h design speed to provide 30seconds of passing opportunity;
- Length of merge – 215m;

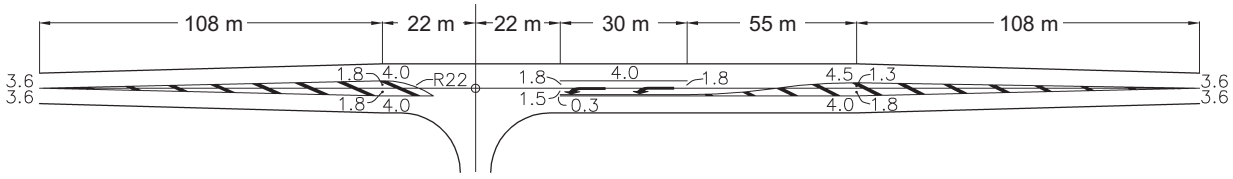
Not to Scale



Climbing/Passing Lane



TYPE B RURAL



TYPE A RURAL

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Exhibit 6.1 - Design Standards

- Diverge should be located at least 300m prior to an intersection or 100m past it; and
- Merge should be located a minimum of 315m beyond an intersection (decision sight distance for 100km/h road).

For the left turn lanes, the following guidelines have been used (Supplement to TAC Geometric Design Guide):

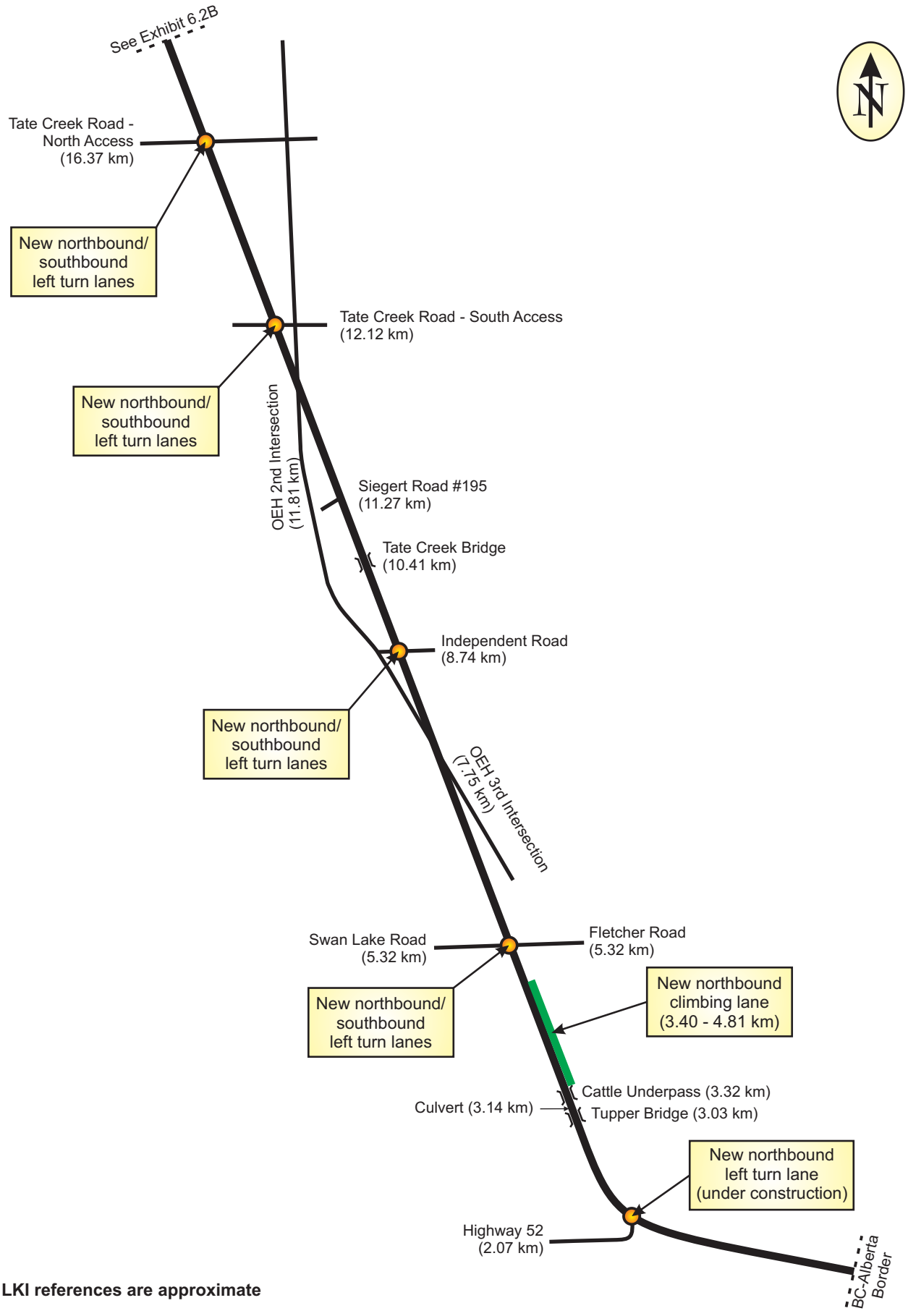
- Upstream taper – 108m;
- Transition – 55m;
- Left turn storage - 30m assumed;
- Upstream turning path distance – 14m for 90 degree intersection;
- Downstream turning path distance – 22m (if no opposing left turn lane); and
- Downstream taper - 108m (if no opposing left turn lane).

This means the total upstream left turn treatment distance is 207m and the downstream distance (assuming no opposing left turn lane) is 130m.

In the subsections that follow, each of the improvements is discussed with the proposed improvements illustrated graphically on ***Exhibit 6.2***. Due to the unavailability of as-built drawings or quality up to date aerial photographs, it has not been possible to advance the design any further for the purpose of this assignment.

6.1 Northbound Climbing Lane

From the earlier warrant analysis it had been shown that a northbound climbing lane is currently warranted in the Highway 2 to Swan Lake Road segment. ***Exhibit 6.3*** shows the northbound gradient at the LKI points between 2.0 and 6.0 extracted from the photolog. NOTE – THIS IS NOT A VERTICAL PROFILE AS THE PHOTOLOG ALTIMETER ONLY HAD AN ACCURACY OF 10m WHICH PRECLUDED AN ACCURATE VERTICAL ALIGNMENT TO BE PLOTTED.



Note: All LKI references are approximate

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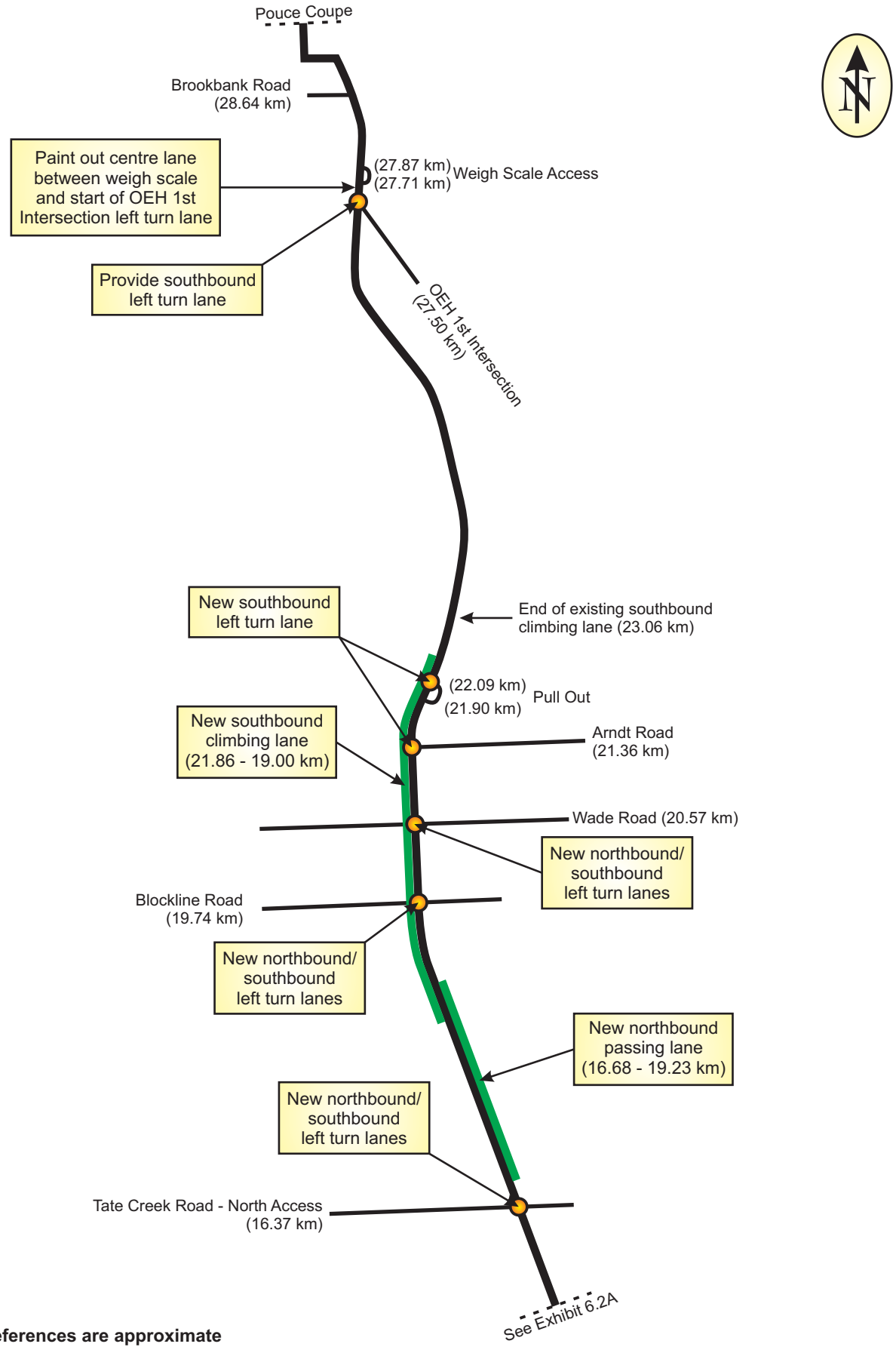
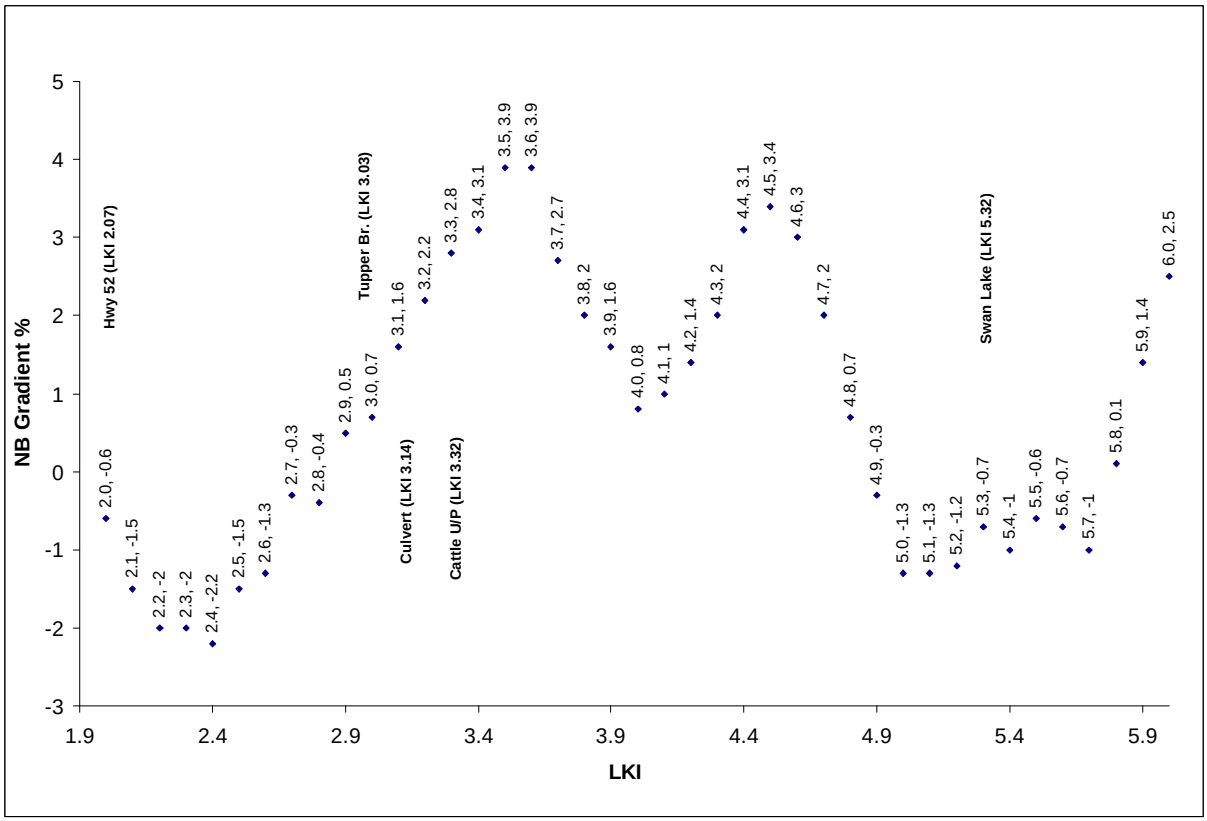
Exhibit 6.2A - Proposed Improvements



Note: All LKI references are approximate

Exhibit 6.2B - Proposed Improvements

Exhibit 6.3 – Northbound Gradient



As can be seen from this exhibit, the uphill gradient commences at LKI 2.9 and ends at LKI 4.8. Over this distance of 1.9km, the average gradient is 2.12% with a maximum gradient of 3.9% at LKI 3.5 – 3.6, and another "peak" of 3.4% at LKI 4.5. It is therefore recommended that the climbing lane be located somewhere between LKI 2.9 and 4.8. There are, however, a number of site limitations that need to be considered. The Tupper Bridge is located at LKI 3.03, there is a culvert at LKI 3.14, and a cattle underpass at LKI 3.32. To avoid widening of these structures the climbing lane should commence north of LKI 3.32. Assuming the climbing lane starts at LKI 3.4 and has a minimum length of 1095m (50m diverge, 830m lane, and 215m merge) it would end at LKI 4.495. This is however on steepest part of the incline and the climbing lane should therefore be extended northwards.

At the northern end of the incline is the Swan Lake Road/Fletcher Road intersection at LKI 5.32 where new left turn lanes have been identified for possible implementation. The start of the northbound left turn lane treatment would be 207m south of the intersection at LKI 5.113. Allowing 300m between the start of the left turn lane treatment and the end of the climbing lane merge, the merge would end at LKI 4.813.

With the merge taper (215m) the climbing lane would then end at LKI 4.598. The length of the climbing lane (excluding tapers) would thus be 1.148 km.

The conceptual positioning of the northbound climbing lane and the Swan Lake Road/Fletcher Road intersection improvements is illustrated in ***Exhibit 6.2***. It is noted that this concept has been developed based on the limited mapping available and during later design phases special attention should be given to the vertical/horizontal alignment and the treatment of farm accesses.

6.2 Northbound Passing Lane

The earlier analysis had indicated that based on the existing lane geometry and assumed traffic growth rates, additional passing lanes would be required by 2020 in the northbound direction. In Section 6.1 it was proposed that a northbound climbing lane be provided now with a length of approximately 1.15km excluding tapers. This length of new auxiliary lane was then entered into the passing lane warrant analysis assuming 2020 volumes. This showed that over and above the 1.15km climbing lane, an additional 4.0km of passing lane will be required. According to the warrant and guidelines, the desired lane frequency is every 14km. Noting that the new climbing lane is to start at about LKI 3.4, the next passing lane should be located at about LKI 17.8 which is between Tate Creek North Access and Blockline Road. Both of these intersections have been identified for possible left turn lane improvements.

Provision of a northbound passing lane plus left turn lanes at intersections/accesses would result in a five lane cross section which is not recommended according to DS98003. In order to avoid a five lane cross section at the Blockline Road intersection (two southbound lanes, left turn lanes, two northbound lanes) it is proposed to terminate this northbound passing lane south of the intersection. This would result in a passing lane of about 2.3km in length between Tate Creek North Access and Blockline Road where there is a positive northbound gradient (see ***Exhibit 2.8***).

In order to provide the total 4km of new passing lane, a further lane of approximately 1.7km is required. The capacity analysis has shown that northbound delays are high adjacent to the existing southbound climbing lane commencing at the weigh scales, and between the weigh scales and Pouce Coupe.

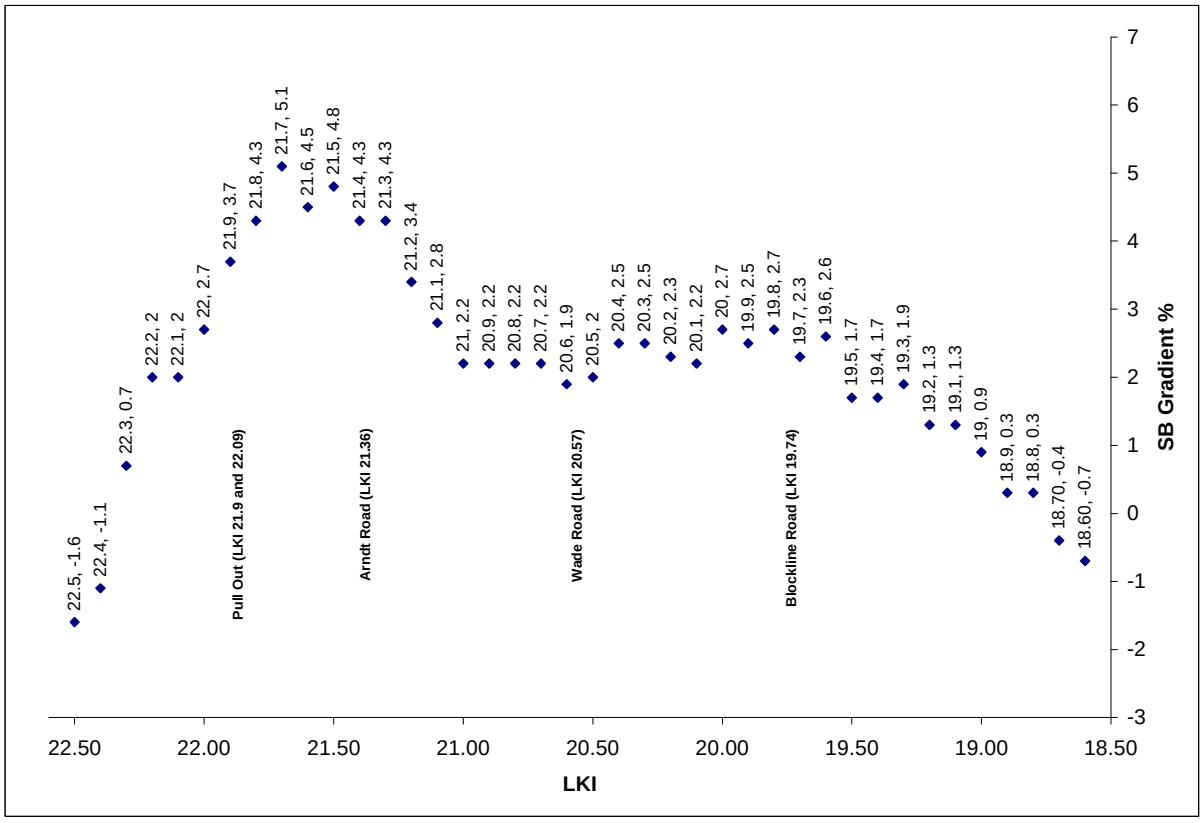
Reviewing the northbound gradients on the corridor (***Exhibit 2.8***), there does not appear to be a location north of Blockline Road where a northbound passing lane would be compatible with the gradients. Furthermore, there are multiple accesses and intersections within this segment which are incompatible with any further auxiliary lanes. It is therefore recommended that the only new northbound passing lane be

provided between Tate Creek North Access and Blockline Road as indicated on ***Exhibit 6.2***.

6.3 Southbound Climbing Lane

From the earlier warrant analysis it had been shown that a southbound climbing lane is currently required in the vicinity of Arndt Road (approximate LKI 19.5 to 22.10). ***Exhibit 6.4*** shows the southbound gradient at the LKI points between 18.5 and 22.5 extracted from the photolog.

Exhibit 6.4 – Southbound Gradient



As can be seen from this exhibit, the southbound uphill gradient commences at LKI 22.3 and ends at LKI 18.8. Over this distance of 3.5km, the average gradient is 2.47% with a maximum gradient of 5.1% at LKI 21.7.

According to the TAC guideline, a climbing lane is warranted on any 2% grade that has a length longer than 550m. As can be seen above, there is a 2% or more grade from LKI 22.2 to LKI 19.6. It is therefore suggested that the climbing lane be located between these two LKI's.

The following site constraints however also influence the location of the climbing lane:

- The existing southbound climbing lane ends at approximately LKI 23.06;
- The Pull Out accesses are at LKI 21.9 and 22.09 (and a left turn lane has been proposed);
- The Canyon Creek culvert is at LKI 21.78;
- The Arndt Road intersection is at LKI 21.36;
- The Wade Road intersection at LKI 20.57; and
- The Blockline Road intersection is at LKI 19.74.

It is impossible to provide a minimum length climbing lane between any of the locations where left turn movements off the highway will occur. The climbing lane will thus have to have left turn lanes off it to provide safe left turn access to the side roads and/or the Pull Out.

At the southern end the lane merge will need to occur south of the Blockline Road intersection (LKI 19.74) which will need to be provided with left turn lanes in both directions. Allowing for the left turn lane (207m) and the decision sight distance (315), the merge would commence at approximately LKI 19.22. At the northern end, the diverge should start south of the Pull Out which should be provided with a southbound left turn lane at the northern access (LKI 22.09). Taking into account the downstream left turn lane treatment (130m) and the merge commencing 100m south of the left turn treatment, the start of the diverge would be approximately at LKI 21.86 with the climbing lane being fully developed at LKI 21.81. The overall length of the climbing lane would thus be 2,592m (LKI 21.810-19.218).

In conjunction with this climbing lane, left turn lanes will be required on Highway 2 at the following locations (see ***Exhibit 6.2***):

- Southbound at the northern access to the Pull Out (southern access to be restricted to right in/right out operations only;
- Southbound at Arndt Road;
- Southbound and northbound at Wade Road; and
- Southbound and northbound at Blockline Road.

6.4 Southbound Passing Lane

The earlier analysis had indicated that based on the existing lane geometry and assumed traffic growth rates, additional passing lanes would be required by 2020 in the southbound direction. In section 6.3 it was proposed that a southbound climbing lane be provided now with a length of approximately 2.59km. This length of new auxiliary lane was then entered into the passing lane warrant analysis assuming 2020 volumes. This showed that no further southbound passing lanes were required over and above the 2.59km climbing lane proposed.

7. IMPROVEMENT EVALUATION

In Sections 5 and 6, various capital intensive improvements have been proposed. These relate to the provision of climbing/passing lanes and left turn lanes at some of the intersections. The improvement options have been evaluated using a simplified multiple account evaluation process taking into consideration:

- Traffic Performance/Operations Impacts;
- Safety Impacts;
- Economic Analysis.

The first two bullets can be described as User Impacts and are discussed below.

7.1 User Impacts

The provision of passing/climbing lanes and left turn lanes at intersection will have impacts on performance/operations and safety. ***Table 7.1*** summarizes the likely impacts for the capital intensive improvements discussed in previous sections.

Table 7.1 User Impacts

Improvement	Performance/Operations Impacts	Safety Impacts
SB left turn lane at OEH 1st intersection	Minimal as there are currently two southbound lanes at this location.	Reduced SB rear end collisions (20%)
SB left turn lane at Pull Out.	Reduced delays to southbound traffic, however given the low volumes, the benefits will be minimal.	Reduced SB rear end collisions and off road collisions (20%)
SB climbing lane between Pull Out and south of Blockline Road	Reduced delays to southbound traffic	Reduced SB rear end collisions (30%) Reduced head on collisions (20%)
SB left turn lane at Arndt Road.	Reduced delays to southbound traffic, however given the low volumes, the benefits will be minimal.	Reduced SB rear end and off road collisions (20%)
SB/NB left turn lanes at Wade Road	Reduced delays to southbound/northbound traffic, however given the low volumes, the benefits will be minimal.	Reduced SB and NB rear end and off road collisions (20%)
SB/NB left turn lanes at Blockline Road	Reduced delays to southbound/northbound traffic, however given the low volumes, the benefits will be minimal.	Reduced SB and NB rear end and off road collisions (20%)
SB/NB left turn lanes at Tate Creek Access North	Reduced delays to southbound/northbound traffic, however given the low volumes, the benefits will be minimal.	Reduced SB and NB rear end and off road collisions (20%)
SB/NB left turn lanes at Tate Creek Access South	Reduced delays to southbound/northbound traffic, however given the low volumes, the benefits will be minimal.	Reduced SB and NB rear end and off road collisions (20%)
SB/NB left turn lanes at Independent Road	Reduced delays to southbound/northbound traffic, however given the low volumes, the benefits will be minimal.	Reduced SB and NB rear end and off road collisions (20%)
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	Reduced delays to southbound/northbound traffic, however given the low volumes, the benefits will be minimal.	Reduced SB and NB rear end and off road collisions (20%)
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	Reduced delays to northbound traffic.	Reduced northbound rear end collisions (30%) Reduced head on collisions (20%)
NB passing lane between Tate Creek North Access and Blockline Road	Reduced delays to northbound traffic.	Reduced northbound rear end collisions (30%) Reduced head on collisions (20%)

Note: Collision reduction from *Ogden, K.W., Safer Roads: A Guide to Road Safety Engineering*

The calculation of the safety benefits is summarized in ***Table 7.2*** assuming an average corridor collision cost of $191,500 per collision.

Table 7.2 – Collision Reduction Estimation (2006)

Improvement	LKI	Collision Reduction	Reduction Factor	Number of collisions (9 years)	Annual Collisions	Annual Collision Reduction	Average Collision Cost	Annual Collision Savings
SB left turn lane at OEH 1st intersection	27.4-27.5	Reduced SB rear end collisions	20%	0	0.00	0.00	$191,500	$0
SB left turn lane at Rest Area.	22.1	Reduced SB rear end and off road collisions	20%	0	0.00	0.00		$0
SB climbing lane between Rest Area and south of Blockline Road	21.86-19.00 (excluding intersection collisiions)	Reduced SB rear end collisions	30%	1	0.11	0.03		$6,383
		Reduced head on collisions	20%	0	0.00	0.00		$0
SB left turn lane at Arndt Road.	21.4-21.5	Reduced SB rear end and off road collisions	20%	0	0.00	0.00		$0
SB/NB left turn lanes at Wade Road	20.57	Reduced SB and NB rear end and off road collisions	20%	2	0.22	0.04		$8,511
SB/NB left turn lanes at Blockline Road	19.7	Reduced SB and NB rear end and off road collisions	20%	3	0.33	0.07		$12,767
SB/NB left turn lanes at Tate Creek Access North	16.3-16.4	Reduced SB and NB rear end and off road collisions	20%	3	0.33	0.07		$12,767
SB/NB left turn lanes at Tate Creek Access South	11.8-12.1	Reduced SB and NB rear end and off road collisions	20%	1	0.11	0.02		$4,256
SB/NB left turn lanes at Independent Road	8.7	Reduced SB and NB rear end and off road collisions	20%	1	0.11	0.02		$4,256
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	5.3-5.4	Reduced SB and NB rear end and off road collisions	20%	1	0.11	0.02		$4,256
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	3.40-4.81	Reduced NB rear end collisions	30%	1	0.11	0.03		$6,383
		Reduced head on collisions	20%	0	0.00	0.00		$0
NB passing lane between Tate Creek North Access and Blockline Road	16.68-19.23	Reduced NB rear end collisions	30%	0	0.00	0.00		$0
		Reduced head on collisions	20%	0	0.00	0.00		$0

The travel time benefits of providing left turn lanes at intersections have not been evaluated as the volumes are extremely low (<5 veh/hr) and the benefits will be minimal. The travel time benefits of providing the passing/climbing lanes were estimated using HCS2000. In order to do this, the three improvements were assessed individually by defining segments that covered the lengths of the new lanes plus a distance upstream/downstream. The attributes of the three segments is summarized in ***Table 7.3***.

Table 7.3 – Improvement Segment Attributes

Improvement	Segment	Segment Length	Auxiliary Lane Length (includes tapers)	Average Segment Gradient	Length of single lane before auxiliary lane
SB Climbing Lane near Arndt Road	A	23.06-16.37 (6.69km)	21.86-19.00 (2.86km)	0.9%	1.2km
NB Climbing Lane near Swan Lake Road	B	2.07-5.32 (3.25km)	3.40-4.81 (1.41km)	0.8%	3.4km
NB Passing Lane near Blockline Road	C	11.81-19.74 (7.93km)	16.68-19.23 (2.55km)	0.9%	11.87km

The analysis was first performed using the 2006 PM peak hour volumes with no improvements, followed by the same volumes, but with the addition of the new lanes. The HCS output provides an estimate of the peak 15 minute travel time as well as the LOS and v/c. The peak 15 minute travel times were expanded to peak hour values (times 4), and then to daily travel times by applying a factor of 11.83, and multiplying by 365 days to give annual travel times. The 11.83 factor was derived from the PM peak hour volumes of 279 veh/hr and the August 2005 AADT of 3302 veh/day.

The 2006 before/after travel time results are summarized in ***Table 7.4.*** It is noted that the travel times included below are only in the direction of the proposed improvements. The travel times in the opposing direction will be unchanged. This explains why the LOS and v/c values presented in ***Table 7.4*** are different to the values quoted in ***Exhibit 2.7***. It is also noted in ***Table 7.4*** that the annual travel time savings for Segment A and Segment C are identical. The reason for this is that HCS produces peak 15 minute travel times to the accuracy of one decimal point and the difference between the before/after results for these two segments is 0.3 veh/hrs. Once all the expansion factors are applied the annual travel time savings are computed to be the same.

Table 7.4 – 2006 Travel Times

Improvement	2006 PM Peak Hour Vol.	Aux. Lane Length (km)	No Improvements						With Improvements						Annual Travel Time Savings (veh-hrs)
			Peak 15min Travel Time (veh-hrs)	Peak Hour Travel Time (veh-hrs)	Daily Travel Time (veh-hrs)	Annual Travel Time (veh-hrs)	PM Peak v/c	PM Peak LOS	Peak 15min Travel Time (veh-hrs)	Peak Hour Travel Time (veh-hrs)	Daily Travel Time (veh-hrs)	Annual Travel Time (veh-hrs)	PM peak v/c	PM Peak LOS	
(A) SB Climbing Lane near Arndt Road	255	2.86	5.1	20.4	241.3	88086	0.23	D	4.8	19.2	227.1	82904	N/A	C	5181.5
(B) NB Climbing Lane near Swan Lake Road	167	1.41	1.6	6.4	75.7	27634	0.15	D	1.5	6.0	72.0	25907	N/A	B	1727.2
(C) NB Passing Lane near Blockline Road	282	2.55	6.8	27.2	321.7	117448	0.26	E	6.5	26.0	307.6	112267	N/A	D	5181.5

Based on information provided by the Ministry the value of time for automobiles and trucks in a rural environment is $11.17 per hour and $23.41 hour respectively. In ***Table 7.5*** the annual travel time savings are calculated by applying the value of time and the percentage trucks. The annual collision savings have also been included from ***Table 7.2*** to provide a total annual savings attributed to the improvements. For the southbound climbing lane near Arndt Road (C), the collision savings are for the auxiliary lane improvement plus the associated left turn lane improvements at the three intersections within the auxiliary lane that should be constructed.

Table 7.5 – Annual Travel Time Savings (2006)

Improvement	Annual Travel Time Savings (veh-hrs)	% Trucks	Annual Travel Time Savings ($/annum)	Annual Collision Savings ($/annum)	Annual Savings ($/annum)
(A) SB Climbing Lane near Arndt Road	5181.5	28.0	$75,636	$27,661	$103,297
(B) NB Climbing Lane near Swan Lake Road	1727.2	30.0	$25,635	$6,383	$32,018
(C) NB Passing Lane near Blockline Road	5181.5	29.0	$76,270	$0	$76,270

The two climbing lanes are currently warranted based on the volumes and gradients. The timing of the northbound passing lane at Blockline Road however requires further analysis. In Section 4 the passing lane warrant analysis had been performed assuming the existing lane configuration on the corridor. With the additional passing opportunities due to the northbound climbing lane at Swan Lake Road, the warrant analysis needed to be redone for various horizon years (and hence volumes) to determine when the new northbound passing lane would be required.

This analysis showed that the new northbound passing lane at Blockline Road would be required when the two way peak hour volumes were 700veh/hr or in 2013 assuming the 4.75% annual growth rate. The Ministry however expressed concern that this growth rate may be too high and not sustainable and a growth rate of 3 - 4% was considered more reasonable. In ***Table 7.6*** the year in which the two way volumes are likely to exceed 700 veh/hr are summarized assuming the three growth rates.

Table 7.6 – Year in Which Northbound Passing Lane is Warranted (700 veh/hr)

Growth Rate	Year
3.0% (low)	2017
4.0% (medium)	2015
4.75% (high)	2013

Notwithstanding the fact that climbing and passing lanes are warranted either now or in future, and that left turn lanes have been proposed despite the fact they are not warranted, these improvements needed to be evaluated from an economic viewpoint to confirm their implementation. This economic evaluation is discussed in the next sub-section.

7.2 Economic Analysis

The economic analysis of the improvement options was based on the following assumptions:

- 6% discount rate (as advised by the Ministry);
- 25 year analysis period (as advised by the Ministry);
- Inflation has been ignored at it has been assumed that it would be equally applied to both the benefits and costs;
- The earliest that construction would commence would be 2007 with benefits accruing in 2008;
- Vehicle operating costs were assumed to be consistent with/without improvements and hence ignored from the calculations;
- The 2006 safety and travel time benefits from ***Table 7.2*** and ***7.5*** respectively have been used;
- Benefits in future years are directly related to changes in traffic volumes from 2006;
- Three traffic growth factors were assumed for sensitivity testing (3%, 4%, and 4.75%); and
- The left turn lanes at intersections can be implemented in isolation or in conjunction with the auxiliary lanes. In the case of the southbound climbing lane between the Pull Out and Blockline Road, it has been assumed that left turn lanes will be provided at Arndt Road, Wade Road, and Blockline Road. The safety benefits of the left turn lanes at these locations have therefore been included in the climbing lane safety benefits.

Since base mapping for the corridor was not available, costs were estimated by deriving square metre rates from other recent projects in the Region and applying these to the expected road widening that would be required for the new Highway 2 improvements. Construction costs were obtained from the Ministry of Transportation's Historical Cost Estimating website.

For the 4.2km southbound climbing lane that was constructed on Highway 2 south of Pouce Coupe in 2003, the construction cost was $2.9 million. Assuming a 3.6 m widening, this equated to a construction cost of approximately $191/square metre. Since construction costs have increased since 2003, the average bid prices for the high cost items from the Highway 2 contract and another recent contract on Highway 97 were compared.

Table 7.7 – Historic Unit Price Costs

Item	Unit	Hwy 2 Climbing Lane. Contract 354MJ0320 (2003)	Alaska Highway No. 97 Corridor Improvements Phase 2 - Fort St. John, 100th Avenue to 86th Street. Contract 36123 MJ001 (2005)	% Change
Select Granular Sub-Base	m^3	24.42	31.37	28%
Asphalt Pavement - Medium Mix	tonne	59.00	68.29	16 %

The average % change in costs is 22% over two years or 11% per annum. Inflating the 2003 unit rate of $191/square meter by 11% per annum provides a 2007 construction cost estimate of $275/square meter. This rate was used to estimate the costs of constructing the climbing/passing lanes and left turn lanes assuming a 3.6m lane width. ***Table 7.8*** summarizes the 2007 cost estimates for the various improvements. For the southbound climbing lane at Arndt Road, the cost of providing the left turn lanes at the three intersections have been included.

The estimated construction costs do not include associated property acquisition costs which could not be determined based on the available mapping. Survey and engineering fees have also not been included in the estimates.

Table 7.8 – 2007 Preliminary Construction Cost Estimates

Improvement	Length (km)	Widening Area m2	Rate/m2	Cost
Left Turn Lane at typical "T" intersection	0.32	1134	$275	$311,850
Left Turn Lane at typical cross intersection	0.41	1490	$275	$409,860
SB Climbing Lane at Arndt Road	2.86	10296	$275	$2,831,400
SB Left Turn Lane at Arndt Road	0.32	1134	$275	$311,850
SB/NB Left Turn Lane at Wade Road	0.41	1490	$275	$409,860
SB/NB Left Turn Lane at Blockline Road	0.41	1490	$275	$409,860
			SB Climbing Lane Total	$3,962,970
NB Climbing Lane at Swan Lake Road	1.41	5076	$275	$1,395,900
NB Passing Lane at Blockline Road	2.55	9180	$275	$2,524,500

The estimated benefits and rounded costs were then entered into a spreadsheet to calculate the present values. For this initial step it was assumed that all improvements would be implemented in 2007 with benefits accruing in 2008. ***Table 7.9*** summarizes the present values of benefits and costs assuming the low, medium, and high growth rates.

Table 7.9 – Benefit/Cost Analysis (2007 Construction)

Improvement	Annual Collision Savings (2006)	Annual Travel Time Savings (2006)	2006 Base Benefits	PV Benefits 25 years	PV Costs 25 Years	B/C
				Low Growth 3% per annum		
SB left turn lane at OEH 1st intersection	$0	$0	$0	$0	$5,000	0.00
SB left turn lane at Pull Out.	$0	$0	$0	$0	$310,000	0.00
SB climbing lane between Pull Out and south of Blockline Road, with left turn lanes at Arndt, Wade and Blockline Roads	$27,661	$75,636	$103,297	$1,764,958	$3,960,000	0.45
SB left turn lane at Arndt Road.	$0	$0	$0	$0	$310,000	0.00
SB/NB left turn lanes at Wade Road	$8,511	$0	$8,511	$154,148	$410,000	0.38
SB/NB left turn lanes at Blockline Road	$12,767	$0	$12,767	$231,223	$410,000	0.56
SB/NB left turn lanes at Tate Creek Access North	$12,767	$0	$12,767	$231,223	$410,000	0.56
SB/NB left turn lanes at Tate Creek Access South	$4,256	$0	$4,256	$77,074	$410,000	0.19
SB/NB left turn lanes at Independent Road	$4,256	$0	$4,256	$77,074	$410,000	0.19
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	$4,256	$0	$4,256	$77,074	$410,000	0.19
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	$6,383	$25,635	$32,018	$579,898	$1,400,000	0.41
NB passing lane between Tate Creek North Access and Blockline Road	$0	$76,270	$76,270	$1,303,168	$2,530,000	0.52
				Medium Growth 4% per annum		
SB left turn lane at OEH 1st intersection	$0	$0	$0	$0	$5,000	0.00
SB left turn lane at Pull Out.	$0	$0	$0	$0	$310,000	0.00
SB climbing lane between Pull Out and south of Blockline Road, with left turn lanes at Arndt, Wade and Blockline Roads	$27,661	$75,636	$103,297	$2,116,447	$3,960,000	0.53
SB left turn lane at Arndt Road.	$0	$0	$0	$0	$310,000	0.00
SB/NB left turn lanes at Wade Road	$8,511	$0	$8,511	$174,384	$410,000	0.43
SB/NB left turn lanes at Blockline Road	$12,767	$0	$12,767	$261,576	$410,000	0.64
SB/NB left turn lanes at Tate Creek Access North	$12,767	$0	$12,767	$261,576	$410,000	0.64
SB/NB left turn lanes at Tate Creek Access South	$4,256	$0	$4,256	$87,192	$410,000	0.21

Improvement	Annual Collision Savings (2006)	Annual Travel Time Savings (2006)	2006 Base Benefits	PV Benefits 25 years	PV Costs 25 Years	B/C
SB/NB left turn lanes at Independent Road	$4,256	$0	$4,256	$87,192	$410,000	0.21
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	$4,256	$0	$4,256	$87,192	$410,000	0.21
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	$6,383	$25,635	$32,018	$656,022	$1,400,000	0.47
NB passing lane between Tate Creek North Access and Blockline Road	$0	$76,270	$76,270	$1,562,692	$2,530,000	0.62
				High Growth 4.75% per annum		
SB left turn lane at OEH 1st intersection	$0	$0	$0	$0	$5,000	0.00
SB left turn lane at Pull Out.	$0	$0	$0	$0	$310,000	0.00
SB climbing lane between Pull Out and south of Blockline Road, with left turn lanes at Arndt, Wade and Blockline Roads	$27,661	$75,636	$103,297	$2,326,996	$3,960,000	0.59
SB left turn lane at Arndt Road.	$0	$0	$0	$0	$310,000	0.00
SB/NB left turn lanes at Wade Road	$8,511	$0	$8,511	$191,732	$410,000	0.47
SB/NB left turn lanes at Blockline Road	$12,767	$0	$12,767	$287,598	$410,000	0.70
SB/NB left turn lanes at Tate Creek Access North	$12,767	$0	$12,767	$287,598	$410,000	0.70
SB/NB left turn lanes at Tate Creek Access South	$4,256	$0	$4,256	$95,866	$410,000	0.23
SB/NB left turn lanes at Independent Road	$4,256	$0	$4,256	$95,866	$410,000	0.23
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	$4,256	$0	$4,256	$95,866	$410,000	0.23
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	$6,383	$32,018	$38,401	$865,076	$1,400,000	0.62
NB passing lane between Tate Creek North Access and Blockline Road	$0	$76,270	$76,270	$1,718,153	$2,530,000	0.68

Table 7.9 shows that none of the improvements are likely to return a benefit/cost (B/C) ratio greater than 1.0 assuming a 2007 implementation date. It is also noted that some improvements have no measurable benefits and these will not therefore be considered any further with the exception of the "southbound left turn lane at Old Edmonton Highway 1st intersection. This improvement involves minor pavement marking work and will reduce the collision potential at this location and should therefore be implemented.

For the remaining improvements that are likely to show benefits, an analysis was undertaken to identify when the B/C ratio was likely to exceed 1.0. For the purposes of this analysis, only the period up to 2020 was reviewed, as beyond that horizon, the prediction of benefits and costs becomes less certain. The results are shown in ***Table 7.10*** from where it can be seen that no improvements are likely to have a B/C ratio greater than 1.0 under the low/medium growth scenarios and with construction being undertaken prior to 2020.

Under the high growth scenario, the following improvements are predicted to have a B/C ratio greater than 1.0 when constructed in the year indicated:

- Southbound/Northbound left turn lanes at Blockline Road (2016);
- Southbound/Northbound left turn lanes at Tate Creek Access North (2016);
- Northbound climbing lane between Highway 52 and Swan Lake Road/Fletcher Road (2020); and
- Northbound passing lane between Tate Creek North Access and Blockline Road (2017).

Table 7.10 – Benefit/Cost Ratio by Year

Improvement	B/C Assuming Year of Construction													
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	Low Growth 3% per annum													
SB climbing lane between Pull Out and south of Blockline Road, with left turn lanes at Arndt, Wade and Blockline Roads	0.45	0.46	0.47	0.49	0.50	0.51	0.53	0.54	0.55	0.56	0.58	0.59	0.60	0.61
SB/NB left turn lanes at Wade Road	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.47	0.48	0.49	0.50	0.51	0.52
SB/NB left turn lanes at Blockline Road	0.56	0.58	0.60	0.61	0.63	0.65	0.67	0.68	0.70	0.71	0.73	0.75	0.76	0.78
SB/NB left turn lanes at Tate Creek Access North	0.56	0.58	0.60	0.61	0.63	0.65	0.67	0.68	0.70	0.71	0.73	0.75	0.76	0.78
SB/NB left turn lanes at Tate Creek Access South	0.19	0.19	0.20	0.20	0.21	0.22	0.22	0.23	0.23	0.24	0.24	0.25	0.25	0.26
SB/NB left turn lanes at Independent Road	0.19	0.19	0.20	0.20	0.21	0.22	0.22	0.23	0.23	0.24	0.24	0.25	0.25	0.26
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	0.19	0.19	0.20	0.20	0.21	0.22	0.22	0.23	0.23	0.24	0.24	0.25	0.25	0.26
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	0.41	0.43	0.44	0.45	0.46	0.48	0.49	0.50	0.51	0.52	0.54	0.55	0.56	0.57
NB passing lane between Tate Creek North Access and Blockline Road	0.52	0.53	0.58	0.56	0.58	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.69	0.71
	Medium Growth 4% per annum													
SB climbing lane between Pull Out and south of Blockline Road, with left turn lanes at Arndt, Wade and Blockline Roads	0.53	0.56	0.58	0.60	0.62	0.64	0.66	0.69	0.71	0.73	0.75	0.77	0.79	0.81
SB/NB left turn lanes at Wade Road	0.43	0.44	0.46	0.48	0.49	0.51	0.53	0.55	0.56	0.58	0.60	0.61	0.63	0.65
SB/NB left turn lanes at Blockline Road	0.64	0.66	0.69	0.72	0.74	0.77	0.79	0.82	0.84	0.87	0.90	0.92	0.94	0.97
SB/NB left turn lanes at Tate Creek Access North	0.64	0.66	0.69	0.72	0.74	0.77	0.79	0.82	0.84	0.87	0.90	0.92	0.94	0.97
SB/NB left turn lanes at Tate Creek Access South	0.21	0.22	0.23	0.24	0.25	0.26	0.26	0.27	0.28	0.29	0.30	0.31	0.31	0.32
SB/NB left turn lanes at Independent Road	0.21	0.22	0.23	0.24	0.25	0.26	0.26	0.27	0.28	0.29	0.30	0.31	0.31	0.32
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	0.21	0.22	0.23	0.24	0.25	0.26	0.26	0.27	0.28	0.29	0.30	0.31	0.31	0.32
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	0.47	0.49	0.51	0.53	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.69	0.71
NB passing lane between Tate Creek North Access and Blockline Road	0.62	0.64	0.67	0.69	0.72	0.74	0.77	0.79	0.82	0.84	0.87	0.89	0.91	0.94

Improvement	B/C Assuming Year of Construction													
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	High Growth 4.75% per annum													
SB climbing lane between Pull Out and south of Blockline Road, with left turn lanes at Arndt, Wade and Blockline Roads	0.59	0.62	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.87	0.90	0.93	0.96
SB/NB left turn lanes at Wade Road	0.47	0.49	0.51	0.53	0.56	0.58	0.60	0.63	0.65	0.67	0.70	0.72	0.74	0.76
SB/NB left turn lanes at Blockline Road	0.70	0.73	0.77	0.80	0.84	0.87	0.91	0.94	0.97	1.01	1.04	1.08	1.11	1.14
SB/NB left turn lanes at Tate Creek Access North	0.70	0.73	0.77	0.80	0.84	0.87	0.91	0.94	0.97	1.01	1.04	1.08	1.11	1.14
SB/NB left turn lanes at Tate Creek Access South	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38
SB/NB left turn lanes at Independent Road	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01
NB passing lane between Tate Creek North Access and Blockline Road	0.68	0.71	0.74	0.78	0.81	0.84	0.88	0.91	0.94	0.98	1.01	1.04	1.07	1.11

8. CONCLUSIONS AND RECOMMENDATIONS

Based on the work undertaken during this assignment, there is a number of conclusions and recommendations that can be presented. Highway 2 is presently operating at an acceptable level of service except for the single lane northbound section adjacent to the existing southbound climbing lane. Highway operations are affected by the lack of northbound passing opportunities and the generally higher volumes on the northern parts of the corridor. The intersections currently operate with "good" levels of service. It is however cautioned that the operational analysis was performed using factored November 2006 volume data which may not be representative of "peak" conditions.

The safety analysis indicated that the frequency of collisions is increasing over time with the increased traffic volumes on the corridor. The most predominant collision types are wild animal (30% of total) and off road right (19% of total). The collision rate analysis showed that although some locations had rates higher than the provincial average, no location had a rate that exceeded the critical collision rate.

The various Ministry of Transportation warrants were applied to determine if any improvements were required on the corridor. These warrant analyses showed that no new traffic signals, passing lanes or left turn lanes are currently warranted based on the assumed traffic volumes. However in the case of the left turn lanes, there appeared to be justification for providing these at some locations based on anecdotal observations from the Area Manager and a more detailed review of the collision records. In addition, climbing lanes were found to be warranted in both directions based on the grades and assumed traffic volumes.

During an on-site review, a number of deficiencies/issues were noted including:

- Inadequate signing and pavement marking;
- Skew intersections;
- No left turn lanes; and
- Limited passing opportunities.

With an understanding of the existing issues and requirements, the conditions in the 2010 and 2020 horizons were evaluated using a derived traffic growth rate. This evaluation showed that existing operational conditions are expected to worsen but not to a point where there is a significant cause for concern. It was however found that an additional passing lane would be warranted in the northbound direction in the future.

The identified potential high cost improvements were then evaluated on a benefit/cost basis assuming a 25 year analysis period and low/medium/high traffic growth rates. This analysis demonstrated that the safety and travel time benefits of the improvements were relatively minor and that the benefit/cost (B/C) ratios were generally less than 1.0. Only under the high growth scenario, are the following improvements predicted to have a B/C ratio greater than 1.0 when constructed in the year indicated:

- Southbound/Northbound left turn lanes at Blockline Road (2016);
- Southbound/Northbound left turn lanes at Tate Creek Access North (2016);
- Northbound climbing lane between Highway 52 and Swan Lake Road/Fletcher Road (2020); and
- Northbound passing lane between Tate Creek North Access and Blockline Road (2017).

It is stressed that all of the traffic analysis that was undertaken as part of this assignment was based on November 2006 traffic counts which were factored to provide an estimate of peak summer conditions. It is suspected that in the summer months, volumes may be higher (in particular turning movements off the highway) and that auxiliary lanes may be warranted. It is therefore recommended that new traffic counts be undertaken at the ten intersections in August 2007 and that the warrant and benefit/cost analyses be repeated with the new volume information.

It is further recommended that in the interim, the Ministry should consider implementing the other lower cost minor improvements that would not be impacted by any of the proposed high cost items. This includes:

- Painting of no overtaking lines on the approaches to intersections;
- Installing wildlife signage, fencing, and reflectors at locations with high wildlife collision frequency (Tupper Bridge to Tate Creek Bridge);
- Considering closing the Old Edmonton Highway 2nd and 3rd intersections;
- Providing advance “intersection ahead” and consistent street name signage at all intersections;
- Improving delineation and curve warning signs;
- Painting out the middle lane between the weigh scales and the Old Edmonton Highway 1st intersection, and providing a formal southbound left turn lane at the Old Edmonton Highway 1st intersection.

To assist the Ministry in establishing a priority order for the recommended capital intensive improvements, the improvements were ranked according to the potential safety benefits and the estimated B/C ratio (assuming medium growth) as shown in ***Table 8.1*** and ***Exhibit 8.1***.

Table 8.1 – Recommended Capital Improvements Ranking

Recommended Capital Improvements	Ranking base on Safety Benefits	Ranking base on Benefit/Cost
SB climbing lane between Pull Out and south of Blockline Road, with left turn lanes at Arndt, Wade and Blockline Roads	1	3
SB/NB left turn lanes at Blockline Road	2	1
SB/NB left turn lanes at Tate Creek Access North	2	1
SB/NB left turn lanes at Wade Road	3	5
NB climbing lane between Highway 52 and Swan Lake Road/Fletcher Road	4	4
SB/NB left turn lanes at Tate Creek Access South	5	6
SB/NB left turn lanes at Independent Road	5	6
SB/NB left turn lanes at Fletcher Road/Swan Lake Road	5	6
NB passing lane between Tate Creek North Access and Blockline Road	-	2

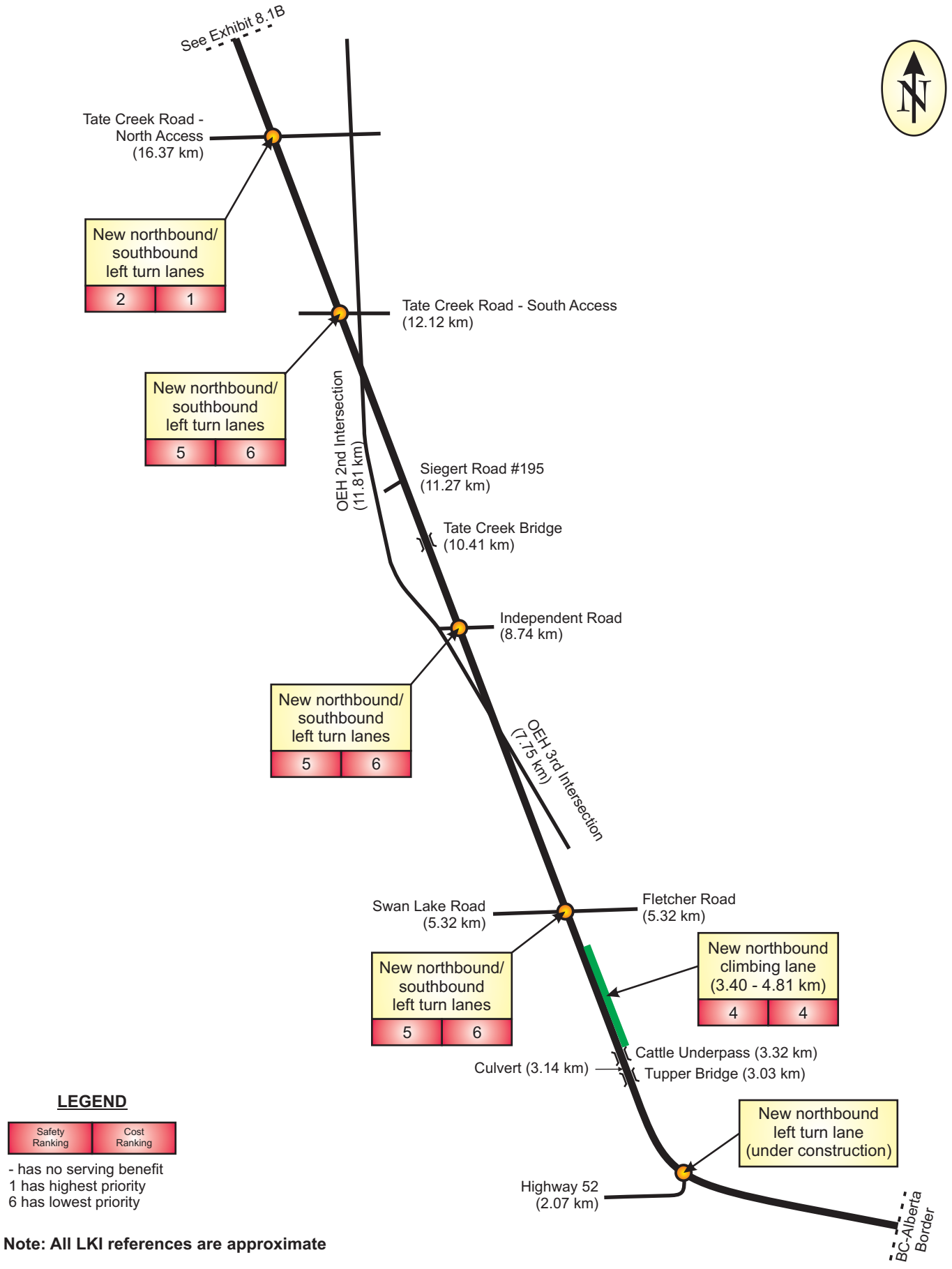


Exhibit 8.1A - Proposed Improvements and Rankings

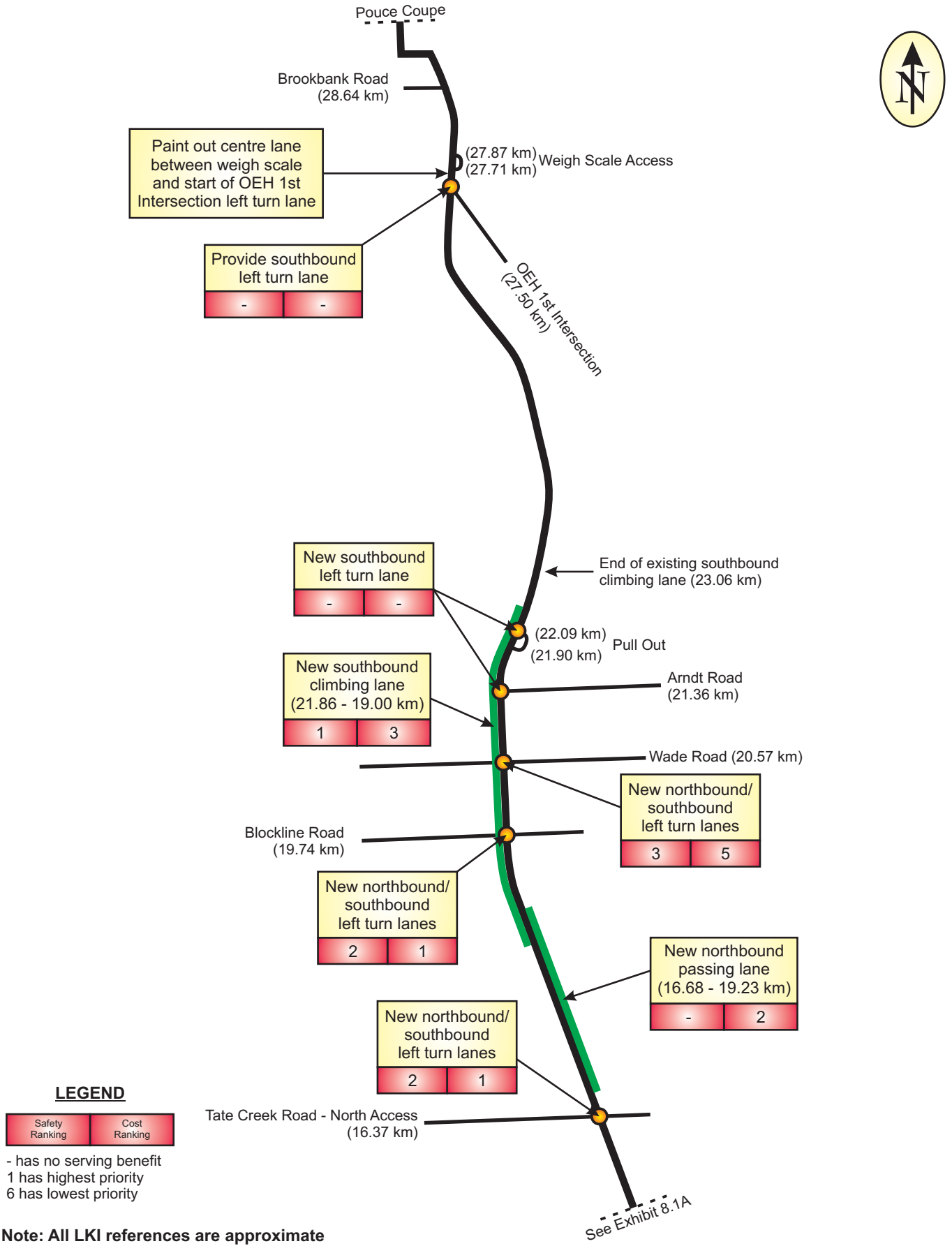


Exhibit 8.1B - Proposed Improvements and Rankings