DEVELOPMENT OF A WARRANT PROCEDURE AND IMPLEMENTATION OF PASSING LANES ON TWO SASKATCHEWAN HIGHWAYS

CITE 2015 Technical Presentation

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MMM Group Ltd.

June | 2015

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Agenda

- Introduction and Application of Passing Lanes in Saskatchewan
- Warrant Procedure
- Detailed Assessment of Locations (Highway 7 and Highway 10)
  - Traffic Composition
  - Before and After Study
  - Highway 10 Lessons Learned
  - Highway 7 Lessons Learned
- Conclusion: Passing Lanes as Tool Box Item Moving Forward
- Questions?

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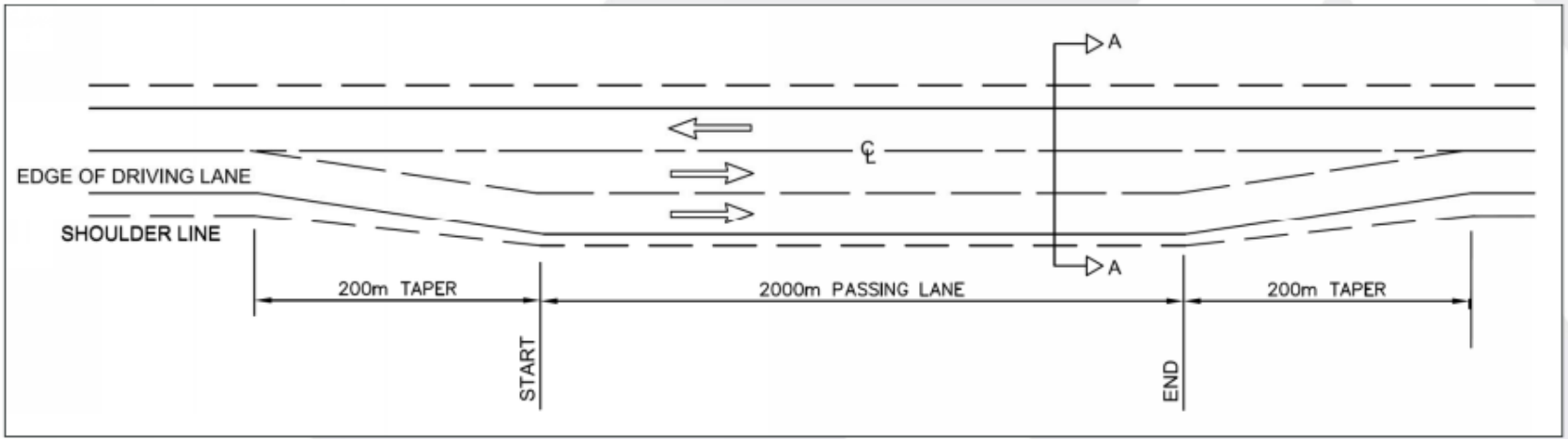
Passing Lanes - Background

- Introduction of an additional lane with sufficient length to allow faster moving vehicles to safely pass
- Improves the overall traffic operations on two-lane highways by reducing delays and collisions caused by inadequate passing opportunities



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Passing Lanes - Background

- May be an economically feasible solution to improve level of service and delay twinning of a highway
- Ideally, passing lanes should have a useful life of at least 10 and preferably 20 years (a typical road design period)

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Geometric Design Guide Update

- Review of procedures in place in BC, AB, SK, MB, and TAC
- Propose an updated Design Guide and warrant analysis procedure for SK
- A combination of practices in MB and SK
- Warrant analysis spreadsheet template to determine passing lane feasibility/implementation

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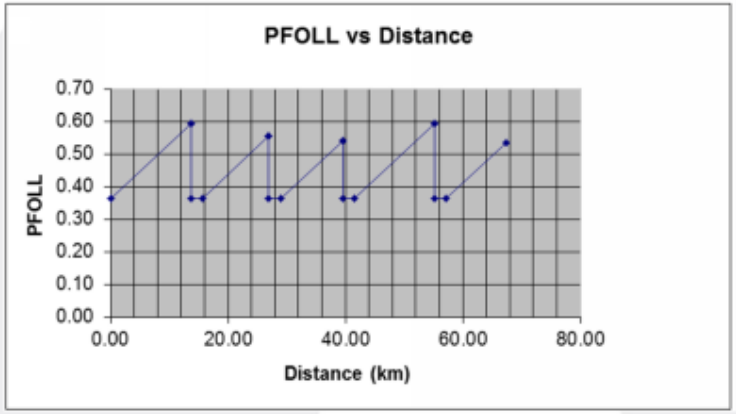
Methodology

- Data reviewed:
  - Aerial photography
  - Traffic volumes and growth rates
  - Percent passing permitted
  - Speed restriction data



- If segment satisfied warrant for **LOS** or **collisions**:
  - ➔ preliminary passing lane system was designed
  - ➔ economic analysis carried out

- If passing lanes service life < 10 years ➔ twinning
- If passing lanes service life > 10 years ➔ passing lanes

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DETAILED ASSESSMENT OF
HIGHWAY 7 AND HIGHWAY 10

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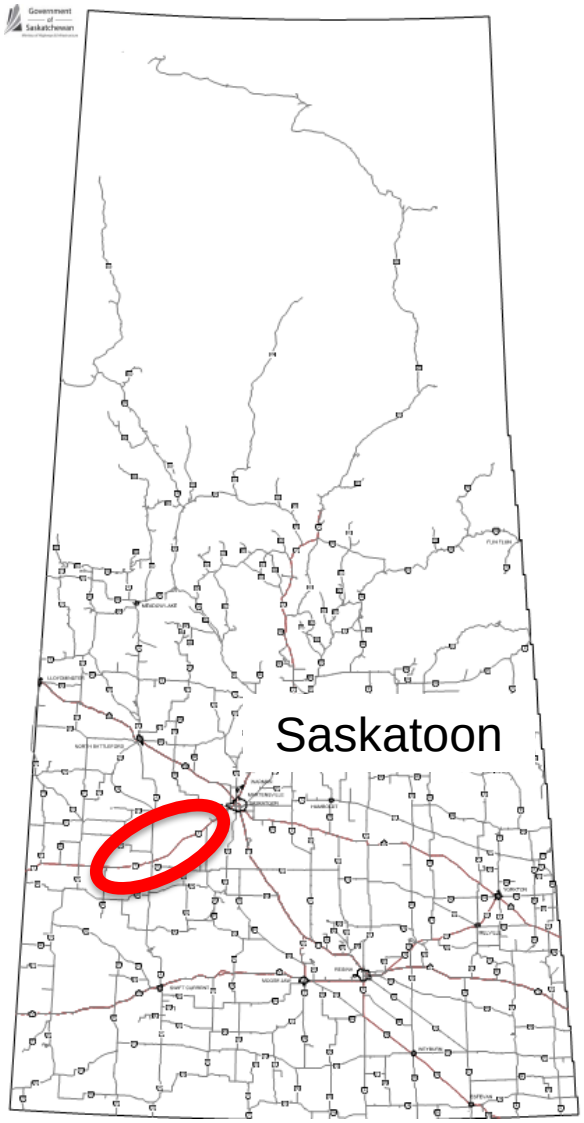
HIGHWAY 7



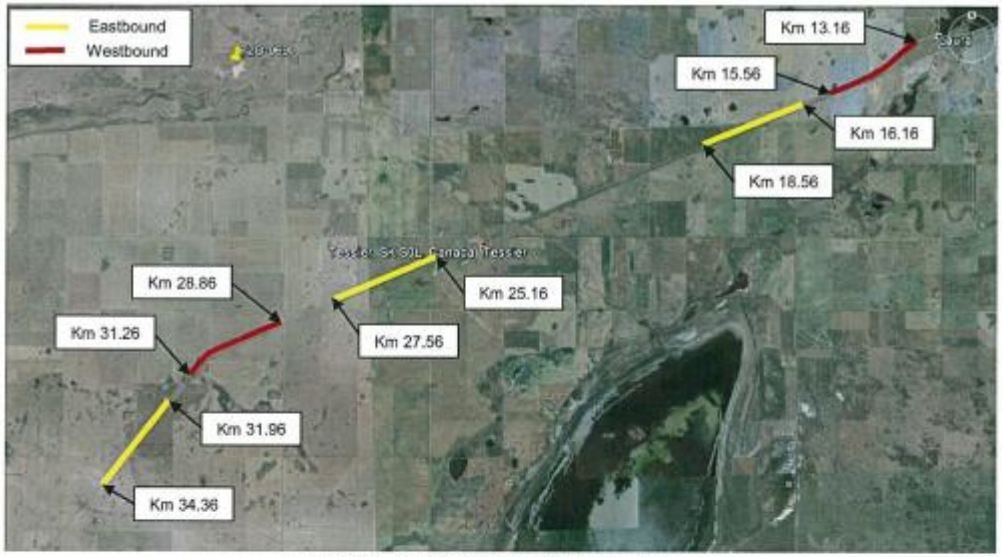


Figure 1 – CS 7-03 Passing Lane Map

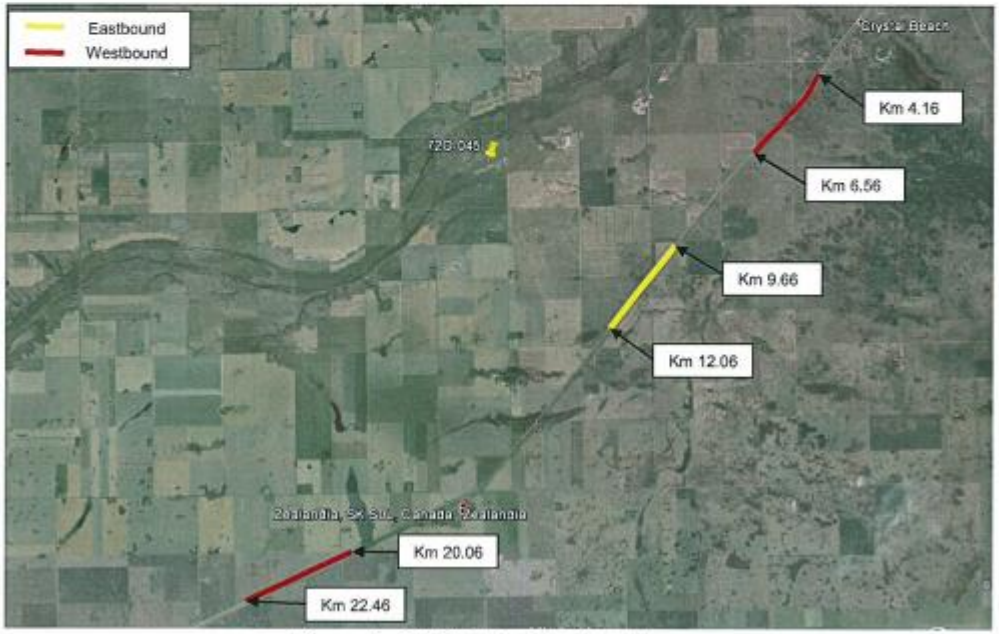


Figure 2 - CS 7-04 Passing Lane Map

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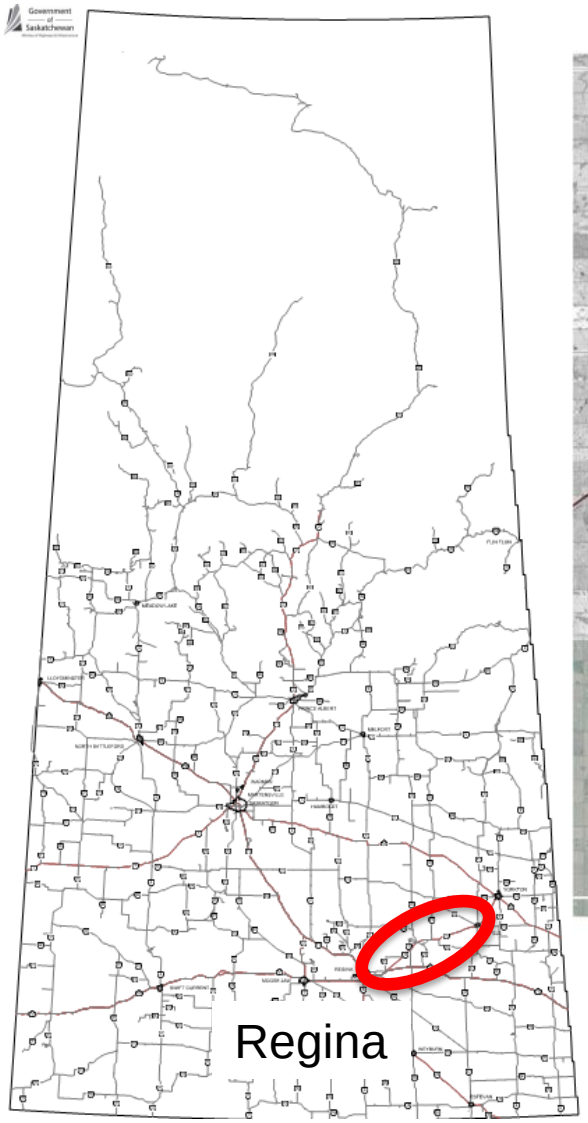
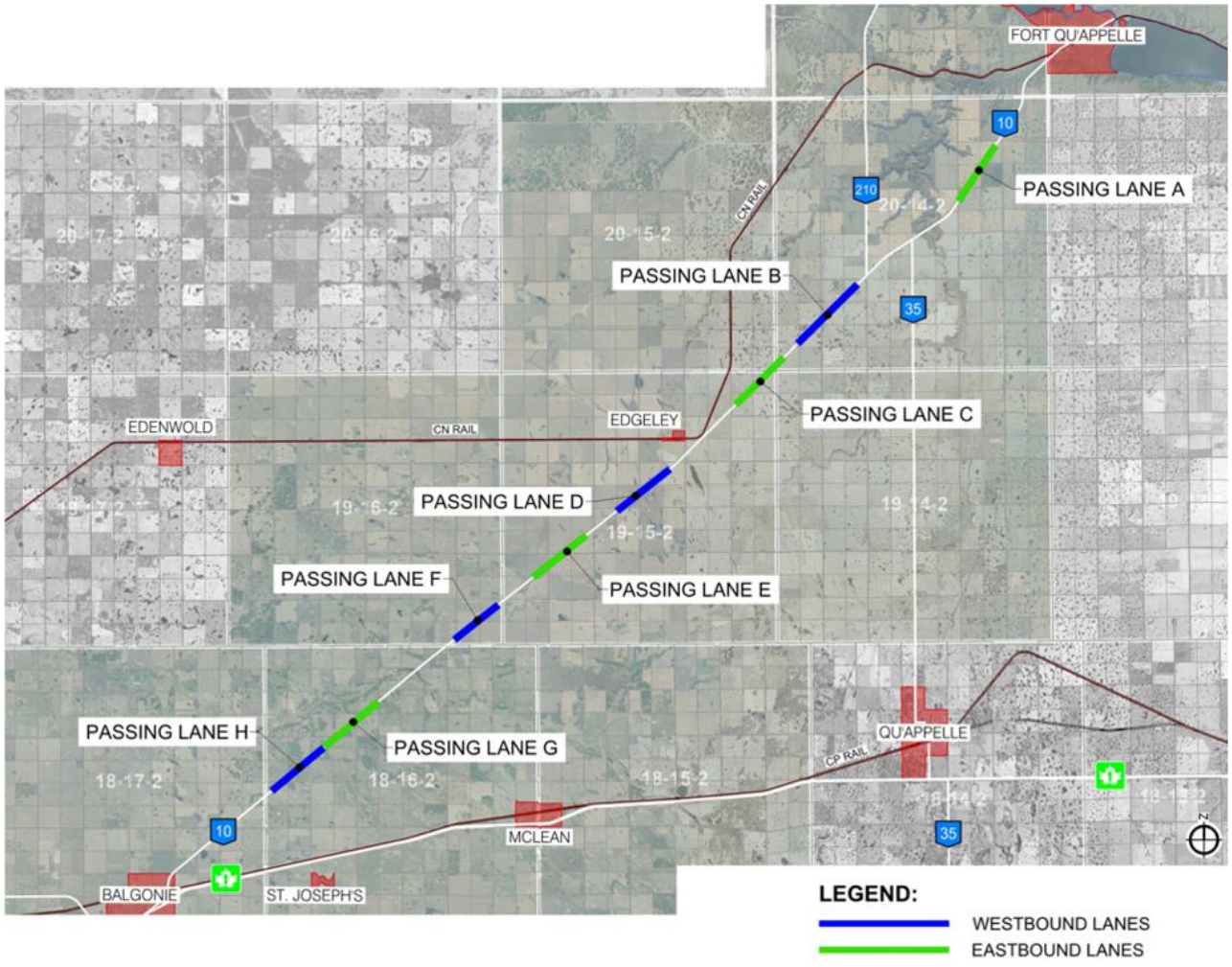
HIGHWAY 10





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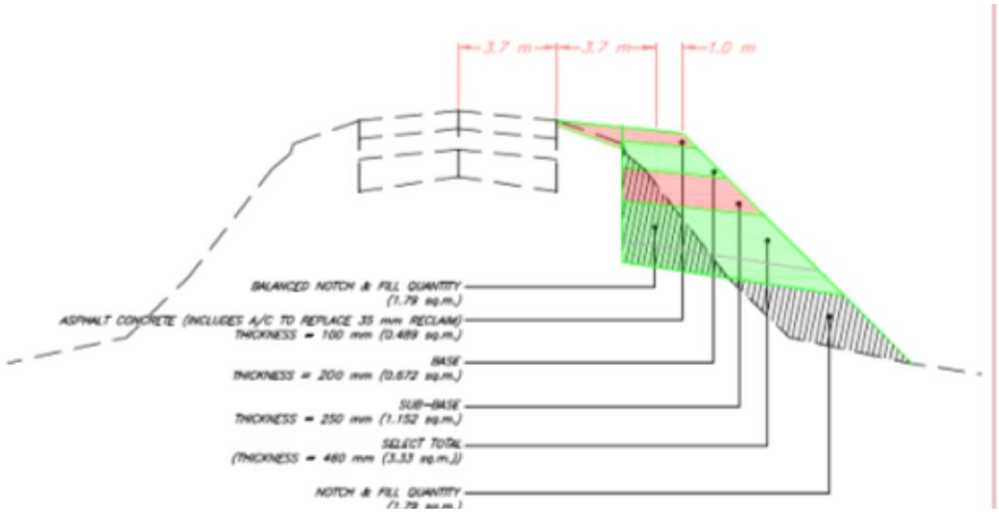
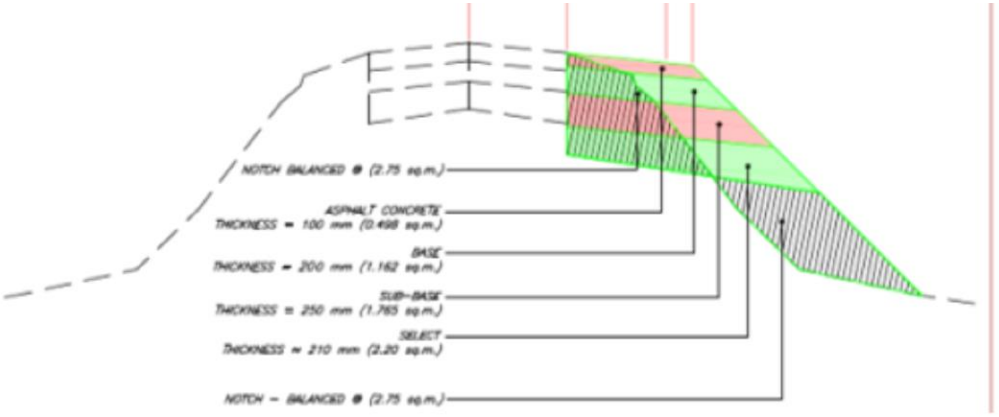
Notch at Edge of Pavement



Notch at Edge of Lane



Highway 10 Data – Passing Restriction Zones

Eastbound				Westbound			
Location	Length (KM)	Location	Length (KM)	Location	Length (KM)	Location	Length (KM)
KM 4	0.394	KM 28.9	0.047	KM 4	0.394	KM 28.9	0.047
KM 4.4	0.167	KM 29.1	0.333	KM 5.2	0.239	KM 29.8	0.166
KM 5.4	0.169	KM 29.9	0.166	KM 8.5	0.167	KM 33.2	0.332
KM 8.8	0.382	KM 33.4	0.203	KM 8.8	0.382	KM 33.4	0.203
KM 9.2	0.329	KM 33.6	0.330	KM 9.8	0.331	KM 34.4	0.169
KM 10	0.353	KM 34.6	0.285	KM 10	0.353	KM 34.6	0.285
KM 10.4	0.169	KM 35	0.328	KM 11	0.168	KM 36	0.214
KM 11.4	0.171	KM 36.3	0.215	KM 11.9	0.204	KM 37.2	0.333
KM 13.2	0.330	KM 37.5	0.138	KM 15.5	0.335	KM 37.5	0.138
KM 15.8	0.092	KM 37.7	0.334	KM 15.8	0.092	KM 39.4	0.325
KM 15.9	0.340	KM 39.7	0.326	KM 20.3	0.166	KM 40.5	0.334
KM 20.7	0.177	KM 40.8	0.114	KM 21.4	0.211	KM 40.8	0.114
KM 21.6	0.206	KM 41	0.273	KM 24.5	0.167	KM 41.6	0.168
KM 24.8	0.168	KM 42	0.168	KM 25.2	0.218	KM 43	0.185
KM 25.6	0.213	KM 43.3	0.167	KM 27.4	0.258	KM 44.1	0.168
KM 27.7	0.260	KM 44.5	0.169	KM 28.7	0.329	KM 44.9	0.170
		KM 46	1.006			KM 46	1.006
Total			8.522 km	Total			8.371 km
No Passing (percent)			20%	No Passing (percent)			20%

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Highway 10 Data – Traffic Volumes

Table 1 – Existing Traffic Volumes for Control Section 10-06

Section	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
AADT										
KM 2.07 - 10.36	3150	3550	3530	3640	3670	3570	3570	3930	4050	4120
KM 10.36 - 12.44	3050	3190	3170	3280	3310	3220	3220	3540	3650	3710
KM 12.44 - 21.54	3590	3690	3660	3630	3660	3800	3500	3930	4000	4070
KM 21.54 - 32.42	3940	4000	3970	3680	3710	3850	3560	3890	4470	4550
KM 32.42 - 40.85	4105	4150	4120	4065	4090	4205	4275	4590	4720	4795
KM 40.85 - 45.85	3900	3950	3920	3870	4010	4140	4180	4500	4800	4880
TAADT										
KM 2.07 - 10.36	332	332	410	410	390	390	390	390	410	410
KM 10.36 - 12.44	332	332	390	390	390	390	380	380	390	390
KM 12.44 - 21.54	332	332	410	410	390	390	380	380	390	390
KM 21.54 - 32.42	332	332	400	400	390	390	380	380	390	390
KM 32.42 - 40.85	332	332	400	400	390	390	410	410	395	395
KM 40.85 - 45.85	332	332	400	400	390	390	410	410	395	395

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Highway 10 Data – Collision Data

Table 3 - Collision Severity and Configuration on Control Section 10-06 – by Year

Year	PDO	Injuries	Fatalities	Total Collisions	Most Common Collision Configurations
2002	5	8	2	15	Lost Control, Sideswipe, Rear end, Head on, Right Angle, Fixed/Moveable Object
2003	2	7	1	10	Lost Control, Sideswipe, Head on, Fixed/Moveable Object
2004	10	4	1	15	Lost Control, Head on, Right Angle, Sideswipe
2005	9	4	2	15	Lost Control, Right Angle, Rear end, Sideswipe
2006	11	6	0	17	Lost Control, Rear end, Fixed/Moveable Object
2007	11	9	1	21	Lost Control, Rear end, Left-turn straight opposite direction, Fixed/Moveable Object, Head on, Right Angle, Sideswipe
2008	10	6	2	18	Lost Control, Rear-end, Fixed/Moveable Object, Sideswipe, Right Angle, Left turn straight opposite direction
2009	14	7	1	22	Lost Control, Rear end, Right Angle, Head on
2010	18	11	0	29	Lost Control, Sideswipe, Fixed/Moveable Object, Head on, Right Angle
2011	14	9	3	26	Lost Control, Sideswipe, Fixed/Moveable Object, Head on, Rear end
Total	**104**	**71**	**13**	**188**	

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Highway 10

Travel Time Results

Date	Scenario	Direction	Station Interval	Avg Travel Time (mins)	85th Percentile Travel Time (mins)	Standard Deviation (mins)
24-Aug	Seasonal Peak (PM Survey)	Eastbound	1 to 2	13.82	14	1.33
			2 to 3	9.21	10	1.06
			1 to 3	23.30	24	2.53
26-Aug	Seasonal Peak (PM Survey)	Westbound	3 to 2	9.41	10	0.73
			2 to 1	12.83	14	1.19
			3 to 1	22.52	24	2.13
11-Oct	Commuter Peak (AM Survey)	Westbound	3 to 2	9.34	10	0.83
			2 to 1	13.18	14	1.38
			3 to 1	22.80	24	3.01
18-Oct	Commuter Peak (PM Survey)	Eastbound	1 to 2	13.95	15	0.77
			2 to 3	9.48	10	0.98
			1 to 3	23.94	25	3.20

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Highway 10 Data – Speed Results

Date	Scenario	Direction	Station Interval	Average Speed (km/h)	85th Percentile Speed (km/h)	Standard Deviation (km/h)
24-Aug	Seasonal Peak (PM Survey)	Eastbound	1 to 2	102.79	108.51	7.93
			2 to 3	109.07	110.53	9.84
			1 to 3	104.19	109.34	9.07
26-Aug	Seasonal Peak (PM Survey)	Westbound	3 to 2	106.32	110.53	7.79
			2 to 1	110.82	117.55	9.36
			3 to 1	107.89	114.83	8.80
11-Oct	Commuter Peak (AM Survey)	Westbound	3 to 2	107.41	110.53	9.77
			2 to 1	107.95	117.55	9.50
			3 to 1	107.17	114.83	10.90
18-Oct	Commuter Peak (PM Survey)	Eastbound	1 to 2	101.38	108.51	5.44
			2 to 3	105.82	110.53	9.15
			1 to 3	101.77	109.34	9.95

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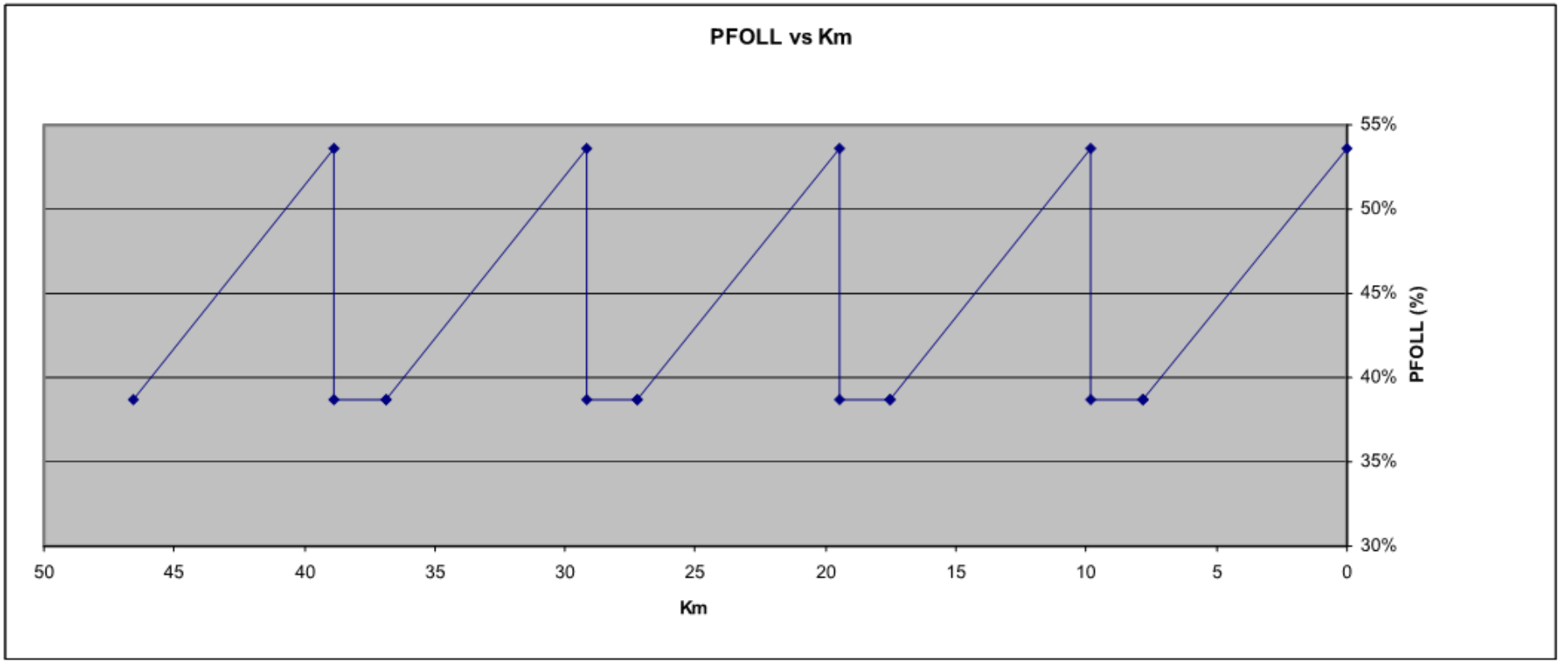
Highway 10 Data – LOS (PFOLL) for Four Eastbound Passing Lanes



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Highway 7 Data – Traffic Volumes

Section KM				2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014*
CS	From	To	Passing Lanes											
AADT														
7-03	0.00	12.30		2530	2840	2780	2830	2830	3090	3230	3230	3050	3110	3190
7-03	12.30	23.86	A, B	2310	2620	2570	2620	2620	2620	3030	3030	2860	2920	3000
7-03	23.86	28.36	C	2000	2310	2280	2620	2620	2620	3010	3010	2840	2900	2980
7-03	28.36	37.35	D, E	2260	2640	2600	2960	2960	2960	2900	2900	2790	2850	2930
7-03	37.35	37.70		2590	2770	2350	2630	2630	2700	2880	2880	2930	2970	3050
7-04	0.00	17.27	F, G	2590	2770	2350	2630	2630	2700	2880	2880	2930	2970	2990
7-04	17.27	28.54	H	2855	2905	2810	2930	2915	3070	3100	3070	3115	3155	3180
7-04	28.54	29.27		2910	2890	2740	2790	2780	3090	3240	3240	3070	3110	3130
7-04	29.27	30.59		2940	2920	2780	2860	2860	3100	3240	3240	3080	3120	3141
7-04	30.59	31.35		2980	2960	3020	3080	3180	3280	3080	3080	3260	3320	3342
7-04	31.35	34.30		3060	3050	3100	3100	3170	3280	3080	3080	3260	3310	3330
7-04	34.30	36.08		6040	6030	6090	6090	4610	4790	4790	4790	5840	5920	5960
TAADT														
7-03	0.00	12.30		600	600	630	630	680	680	680	680	710	710	730
7-03	12.30	23.86	A, B	600	600	630	630	680	680	680	680	710	710	730
7-03	23.86	28.36	C	600	600	630	630	680	680	680	680	710	710	730
7-03	28.36	37.35	D, E	600	600	630	630	680	680	680	680	710	710	730
7-03	37.35	37.70		630	630	630	630	650	650	605	605	555	605	620
7-04	0.00	17.27	F, G	630	630	630	630	650	650	605	605	555	605	610
7-04	17.27	28.54	H	630	630	630	630	650	650	605	605	555	605	610
7-04	28.54	29.27		630	630	630	630	650	650	605	605	555	605	610
7-04	29.27	30.59		640	640	640	640	660	660	620	620	560	620	624
7-04	30.59	31.35		640	640	640	640	660	660	700	700	780	780	785
7-04	31.35	34.30		640	640	630	630	660	660	680	680	780	780	790
7-04	34.30	36.08		790	790	790	790	800	800	820	820	820	820	830

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Highway 7 Data – Collision Data

YEAR	PDO	INJURY	FATALITY	TOTAL	THREE MOST COMMON CONFIGURATIONS
2008	16	9	4	29	Lost Control; Side Swipe; Head On
2009	18	12	1	31	Lost Control; Rear End; Other
2010	10	4	0	14	Lost Control; Other; Side Swipe
2011	16	9	1	26	Lost Control; Side Swipe; Rear End
2012	6	6	0	12	Lost Control; Rear End; Other
TOTAL	66	40	6	112	Lost Control; Side Swipe; Rear End

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Highway 7 Data – Conflict Observation Data

- 14 westbound and 13 eastbound platoons were observed ranging from three to seven vehicles each. Most platoons were led by a heavy truck.
- One vehicle was observed making an aggressive passing manoeuvre at approximately 130 to 140 km/h. This occurred without incident and the vehicle continued to speed along the highway upon completion of its passing manoeuvre.
- Approximately three to four vehicles were observed attempting several passing manoeuvres unsuccessfully (i.e. Moving back and forth into the oncoming lane to look for appropriate gaps in oncoming traffic and moving back into the through travel lane).
- Six successful passing manoeuvres without notable incident were observed.
- One successful passing manoeuvre was observed to have occurred over the double solid yellow centreline.

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Highway 7 Data - Travel Time Results

Direction	Station Interval	Travel Time (mins)		
		Mean	85th Percentile	Standard Deviation
Morning Commute (7:00 a.m. to 9:00 a.m.)				
Westbound	1 (Delisle) to 2 (Harris)	19	20	1.92
	2 (Harris) to 3 (Rosetown)	21	22	1.54
	1 (Delisle) to 3 (Rosetown)	**40**	**42**	**3.22**
Eastbound	3 (Rosetown) to 2 (Harris)	19	20	1.40
	2 (Harris) to 1 (Delisle)	21	22	1.36
	3 (Rosetown) to 1 (Delisle)	**40**	**42**	**3.11**
Off-Peak (1:00 p.m. to 3:00 p.m.)				
Westbound	1 (Delisle) to 2 (Harris)	19	20	1.29
	2 (Harris) to 3 (Rosetown)	20	22	1.36
	1 (Delisle) to 3 (Rosetown)	**40**	**42**	**2.49**
Eastbound	3 (Rosetown) to 2 (Harris)	20	21	1.68
	2 (Harris) to 1 (Delisle)	21	22	1.67
	3 (Rosetown) to 1 (Delisle)	**41**	**43**	**2.97**
Afternoon Peak (4:00 p.m. to 6:00 p.m.)				
Westbound	1 (Delisle) to 2 (Harris)	20	21	1.38
	2 (Harris) to 3 (Rosetown)	21	22	1.91
	1 (Delisle) to 3 (Rosetown)	**41**	**43**	**2.77**
Eastbound	3 (Rosetown) to 2 (Harris)	20	21	1.39
	2 (Harris) to 1 (Delisle)	21	22	1.14
	3 (Rosetown) to 1 (Delisle)	**41**	**43**	**2.91**

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Highway 7 Data – Speed Results

Direction	Station Interval	Mode (km/h)	Mean (km/h)	Percentile Speeds (km/h)						Standard Deviation
				5	25	Median	75	85	95	
Morning Commute (7:00 a.m. to 9:00 a.m.)										
Westbound	1 (Delisle) to 2 (Harris)	113	114	102	107	113	119	126	126	10.30
	2 (Harris) to 3 (Rosetown)	103	104	94	103	103	108	108	113	6.17
	1 (Delisle) to 3 (Rosetown)	108	107	94	105	108	112	113	116	7.91
Eastbound	3 (Rosetown) to 2 (Harris)	113	112	103	108	113	113	120	124	7.46
	2 (Harris) to 1 (Delisle)	102	101	90	98	102	107	107	109	6.36
	3 (Rosetown) to 1 (Delisle)	102	108	96	102	108	113	114	121	8.06
Off-Peak (1:00 p.m. to 3:00 p.m.)										
Westbound	1 (Delisle) to 2 (Harris)	113	112	102	107	113	113	119	130	7.98
	2 (Harris) to 3 (Rosetown)	108	107	98	103	108	113	113	113	6.76
	1 (Delisle) to 3 (Rosetown)	110	109	98	102	110	113	116	120	6.78
Eastbound	3 (Rosetown) to 2 (Harris)	113	111	98	108	113	113	120	120	8.37
	2 (Harris) to 1 (Delisle)	102	102	90	98	102	107	107	113	7.82
	3 (Rosetown) to 1 (Delisle)	108	106	96	102	108	110	113	116	7.29
Afternoon Peak (4:00 p.m. to 6:00 p.m.)										
Westbound	1 (Delisle) to 2 (Harris)	107	110	102	107	113	113	119	119	7.29
	2 (Harris) to 3 (Rosetown)	103	101	82	98	103	108	108	113	7.76
	1 (Delisle) to 3 (Rosetown)	108	105	94	102	105	110	110	113	6.57
Eastbound	3 (Rosetown) to 2 (Harris)	108	110	98	103	108	113	120	121	7.65
	2 (Harris) to 1 (Delisle)	102	103	93	98	102	107	107	113	5.65
	3 (Rosetown) to 1 (Delisle)	105	107	96	102	108	110	113	120	7.36

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Highway 7 Data – Headway Counts

Hours	Manual Hourly Counts			MioVision Hourly Counts		
	No. of Headways		Highest PTSF (%)	No. of Headways		Highest PTSF (%)
	1 sec – 3 sec	Total		1 sec – 3 sec	Total	
Westbound						
Morning Commute Hour	17	71	23.9	16	78	20.5
Off-Peak Hour	16	45	35.6	20	64	31.3
Afternoon Peak Hour	24	78	30.8	25	79	31.6
Eastbound						
Morning Commute Hour	9	24	37.5	10	31	32.3
Off-Peak Hour	20	55	36.4	20	68	29.4
Afternoon Peak Hour	38	102	37.3	41	107	38.3

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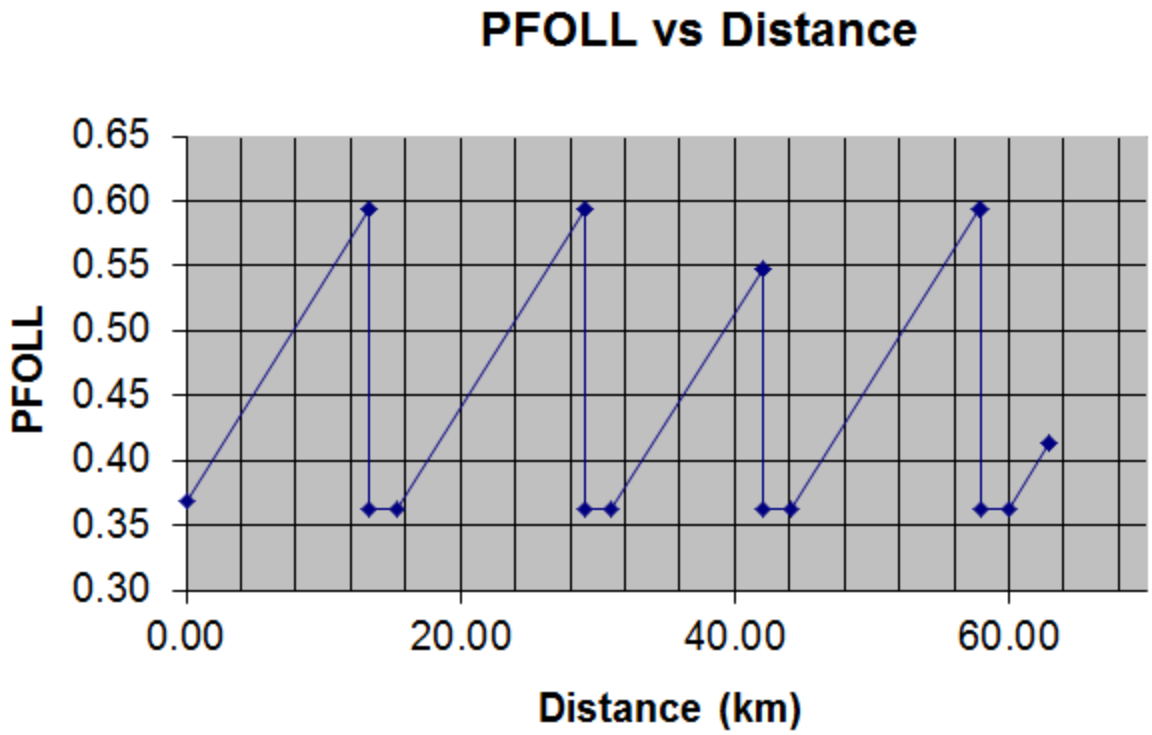
Highway 7 Data – PFOLL with 4 Westbound Passing Lanes



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Post-Construction Procedure

- Recommendation for type and timing for collection of:
  - Traffic Data
  - Collision Data
  - Passing Conflict Observation Survey
  - License Plate Survey
  - Headway and Gap Survey
  - LOS Update

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IMPLEMENTATION OF
HIGHWAY 7 AND HIGHWAY 10

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Lessons Learned through Implementation and Observation

- Additional X slides to be added with constructed lanes and signage (taken in May when things are green)
  - **Signage issues**
  - **Pavement marking discussion**
  - **After implementation discussion with updated results**

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CONCLUSION AND QUESTIONS

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