

The Effects of Improved Vehicle Technology on the Design of Acceleration and Deceleration Lanes at Freeway Entry and Exit Ramps



Transport
Roads & Maritime
Services

Jason Keys



Ron Ayers



What does the title mean?

Background Information

Methodology

Results & Comparisons

Conclusion



What does the project title mean?



Transport
Roads & Maritime
Services



UNIVERSITY OF
SOUTHERN QUEENSLAND

Effects of improved vehicle technology

Design of **acceleration** and **deceleration** lanes

Freeway entry and exit ramps



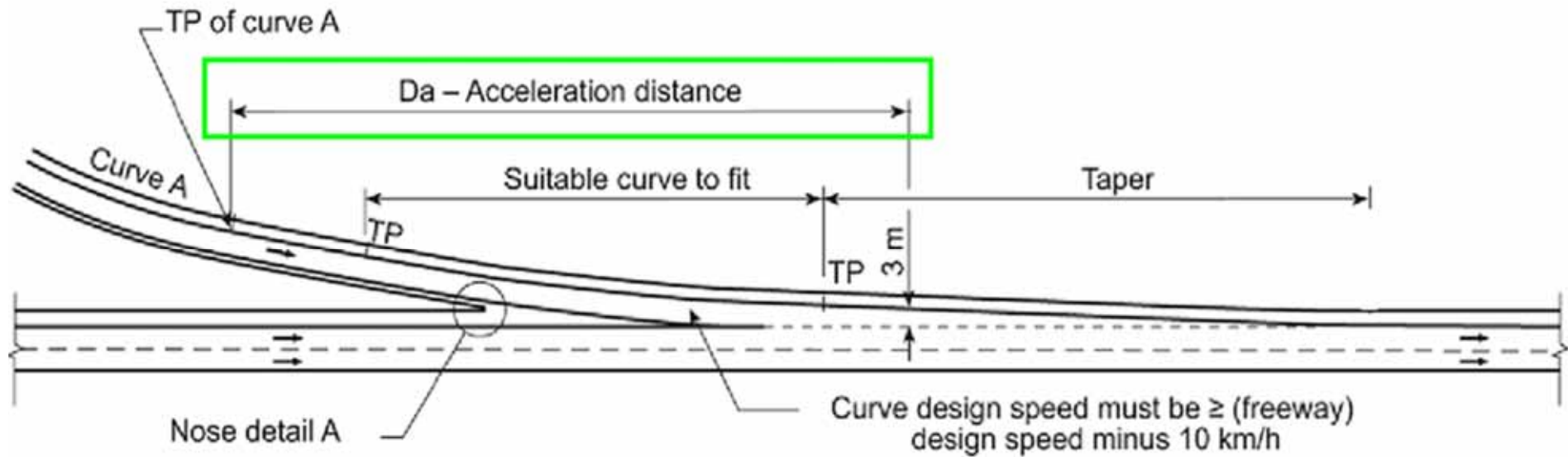
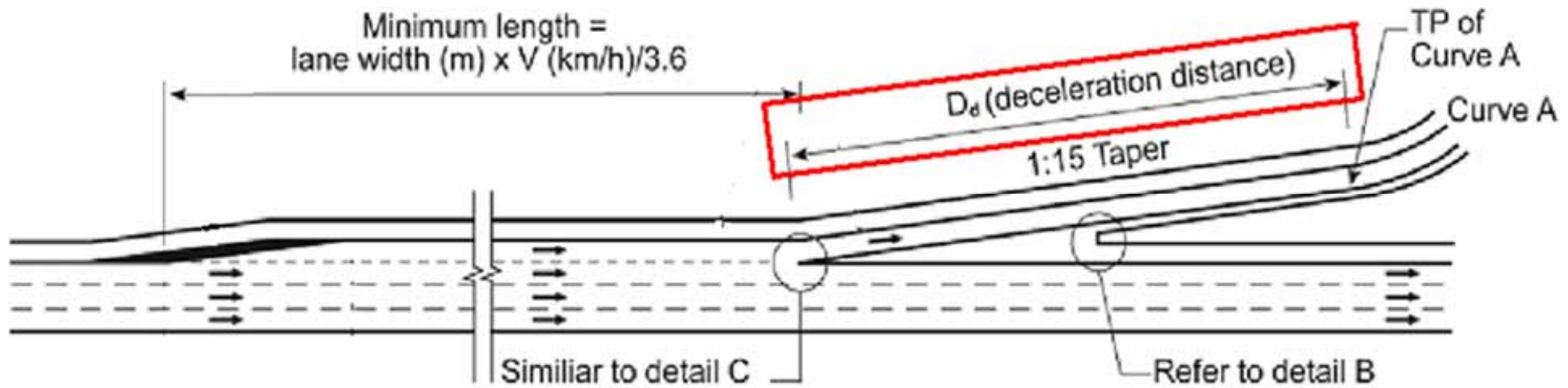


Table 1: History of acceleration and deceleration lane length guidelines (m).

	Acceleration		Deceleration	
	Entry speed: 40km/h Target speed: 100 km/h	Entry speed: 60 km/h Target speed: 100 km/h	Through speed: 100km/h Exit speed: 40 km/h	Through speed: 100 km/h Exit speed: 60 km/h
DMR, NSW (1941)	230	230	140	140
<i>AASHO (1957)</i>	280	170	110	80
NAASRA (1979)	275	205	144	118
<u>Austroads (1988)</u>	410	360	144	118
<i>AASHTO (1994)</i>	300	220	145	120
<i>AASHTO (2004)</i>	285	205	145	120
Qld DMR (2005)	300	240	155	135
<u>Austroads (2010)</u>	410	340	130	100

Table 1: History of acceleration and deceleration lane length guidelines (m).

	Acceleration		Deceleration	
	Entry speed: 40km/h Target speed: 100 km/h	Entry speed: 60 km/h Target speed: 100 km/h	Through speed: 100km/h Exit speed: 40 km/h	Through speed: 100 km/h Exit speed: 60 km/h
DMR, NSW (1941)	230	230	140	140
<i>AASHO (1957)</i>	<i>280</i>	<i>170</i>	<i>110</i>	<i>80</i>
NAASRA (1979)	275	205	144	118
<u>Austrroads</u> (1988)	410	360	144	118
<i>AASHTO (1994)</i>	<i>300</i>	<i>220</i>	<i>145</i>	<i>120</i>
<i>AASHTO (2004)</i>	<i>285</i>	<i>205</i>	<i>145</i>	<i>120</i>
Qld DMR (2005)	300	240	155	135
<u>Austrroads</u> (2010)	410	340	130	100

Background Information



Transport
Roads & Maritime
Services



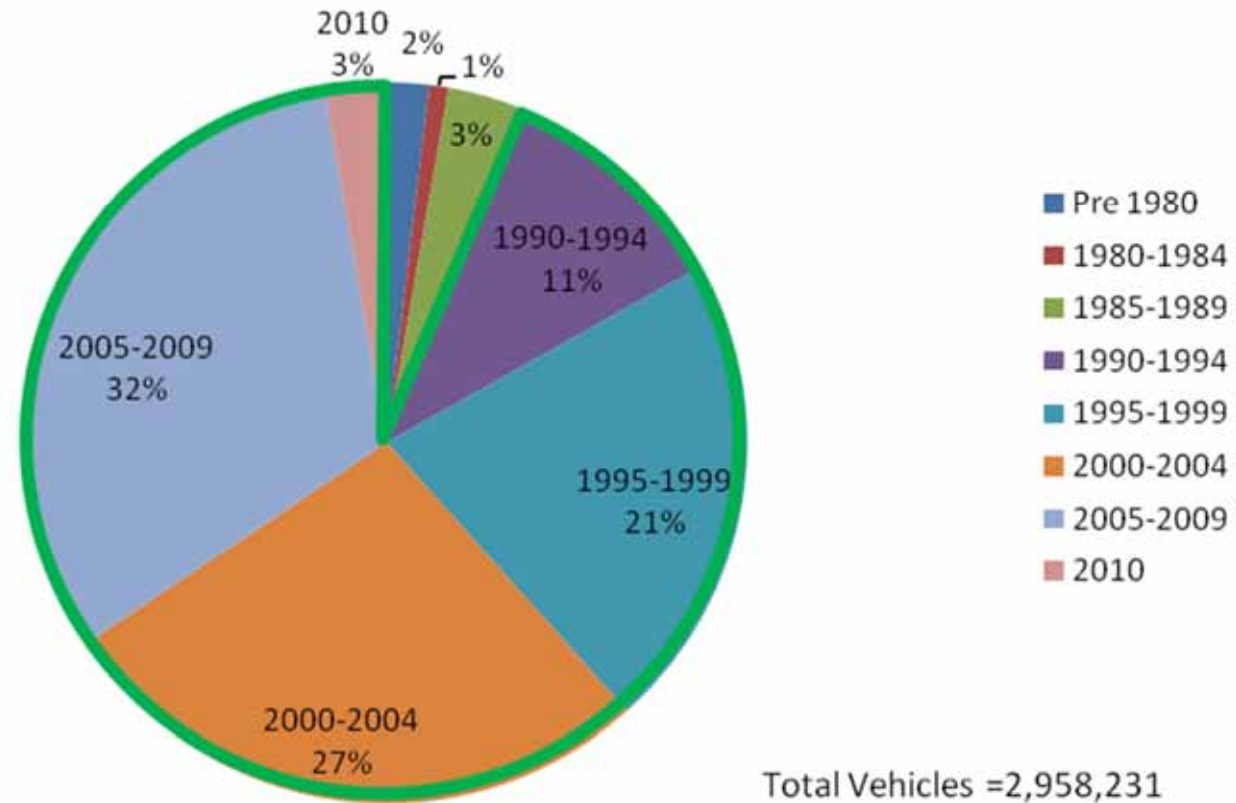
UNIVERSITY OF
SOUTHERN QUEENSLAND

Acceleration performance significant increase
since mid 1980's

Deceleration performance slight increase
since mid 1980's



Year of Manufacture of Registered Passenger Vehicles in NSW - 30th June 2010

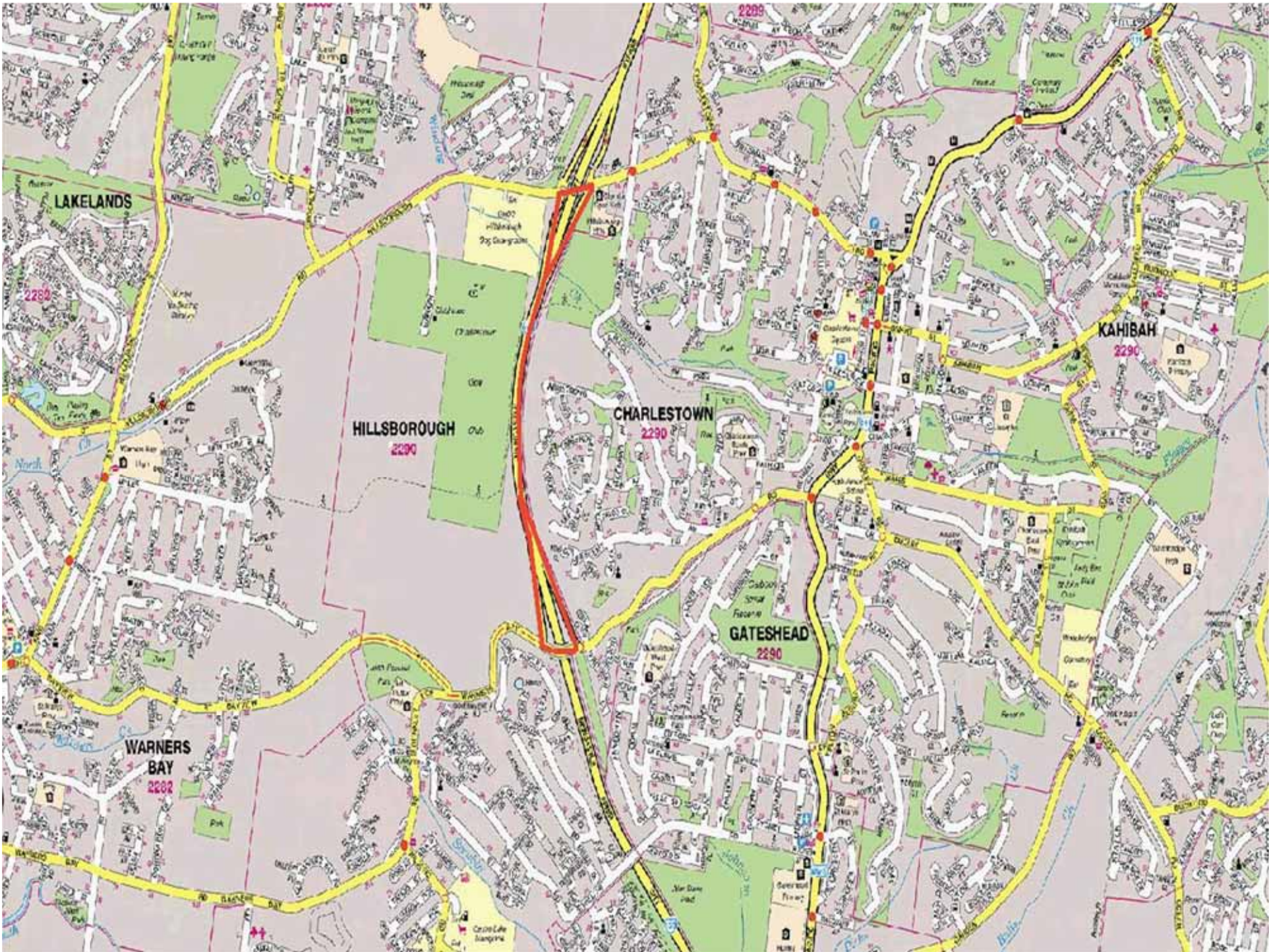


Trimble GPS through CORSNET

Blackvue video camera

Microsoft excel





Based on Newtons 2nd Law of Motion

- $F=ma$

Total net force (F) is broken up into two parts

- Tractive force (based on engine power)
- Resisting forces

Vertical geometry is accepted



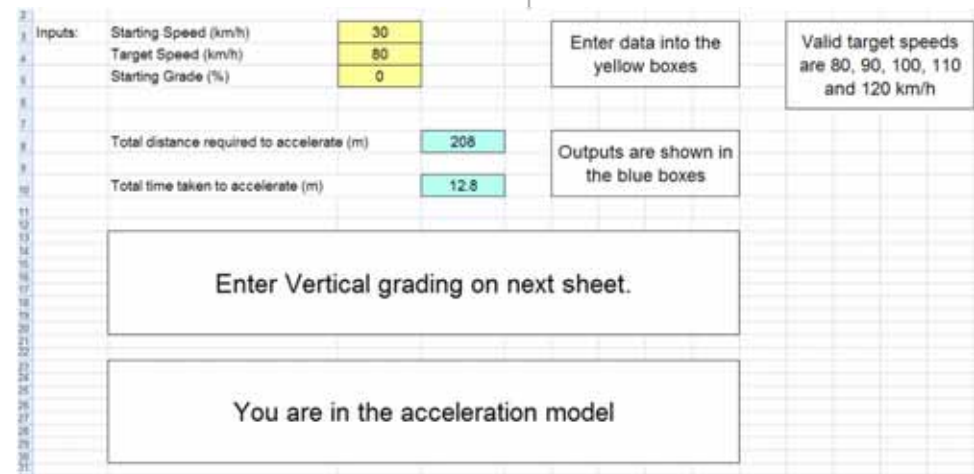
Model Inputs

- Initial and Target Speeds
- Vertical Geometry
- Vehicle Parameters

- Coefficients
- Driver Characteristic Value

Model Outputs

- Distance to accelerate
- Time to accelerate



2	Inputs:	Starting Speed (km/h)	30	Enter data into the yellow boxes	Valid target speeds are 80, 90, 100, 110 and 120 km/h
3		Target Speed (km/h)	80		
4		Starting Grade (%)	0		
5					
6					
7		Total distance required to accelerate (m)	208	Outputs are shown in the blue boxes	
8		Total time taken to accelerate (m)	12.8		
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
61					
62					
63					
64					
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					
81					
82					
83					
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					
94					
95					
96					
97					
98					
99					
100					

Enter Vertical grading on next sheet.

You are in the acceleration model

Based on Newtons 2nd Law of Motion

- $F=ma$

Total net force (F) is broken up into two parts

- Tractive force (based on braking power)
- Resisting forces

Vertical geometry is accepted



Model Inputs

- Initial and Target Speeds
- Vertical Geometry
- Vehicle Parameters
- Coefficients
- Driver Characteristic Value

Model Outputs

- Distance to decelerate
- Time to decelerate

Starting Speed (km/h)	120	Enter data into the yellow boxes
Target Speed (km/h)	80	
Starting Grade (%)	0	
Total distance required to decelerate (m)	119	Outputs are shown in the blue boxes
Total time taken to decelerate (m)	4.3	
Enter Vertical grading on next sheet.		
You are in the deceleration model		

Driver Characteristic



Speed v Distance Comparison Site No.1

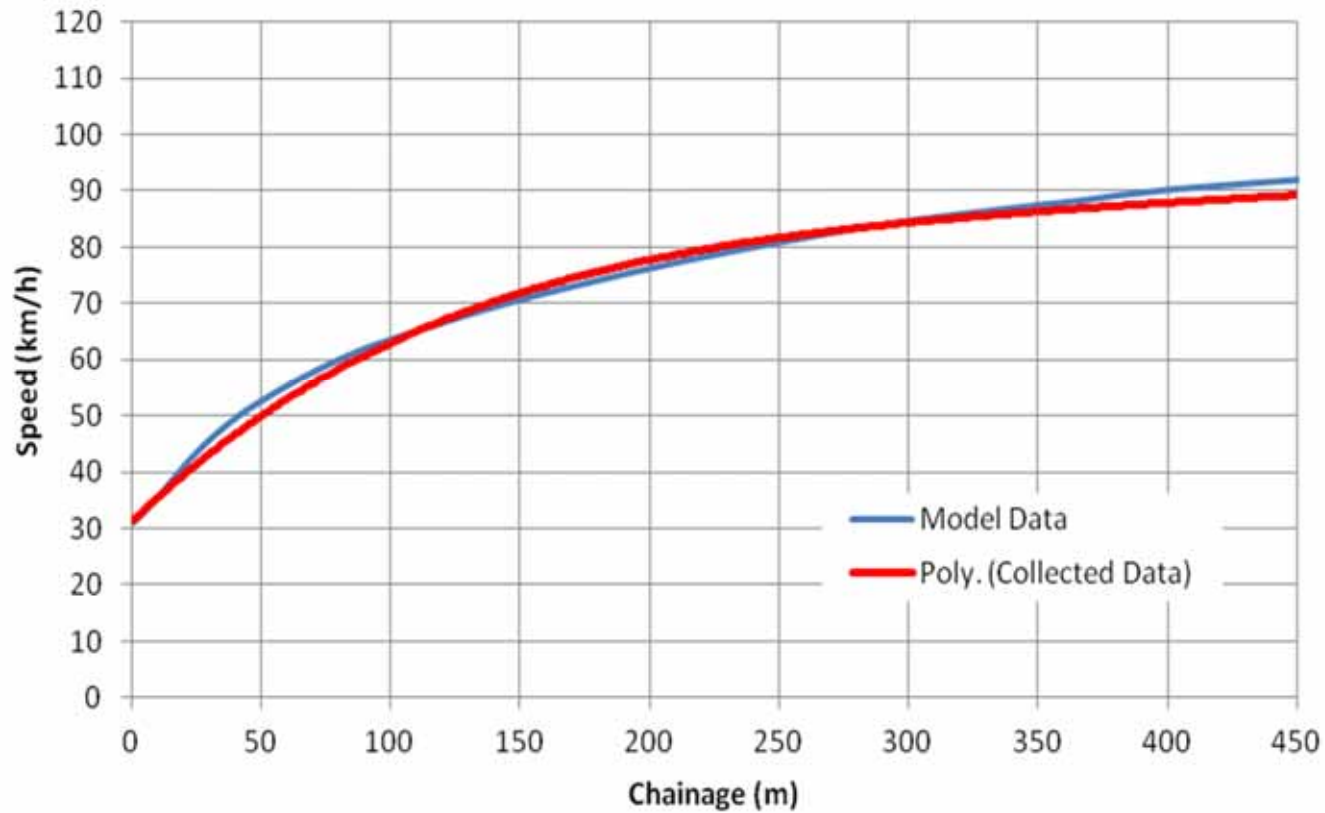


Table 2: Preliminary driver characteristics.

Acceleration lanes			Deceleration lanes		
Site	Driver characteristic	Model fit	Site	Driver characteristic	Model fit
1	0.43	Good	2	0.115	Poor
3	0.70	Acceptable	6	0.20	Acceptable
7	0.40	Good	8	0.084	Poor
11	0.75	Good	10	0.143	Acceptable
13	0.41	Acceptable	12	0.075	Acceptable
			14	0.18	Good
			16	0.089	Acceptable

Acceleration

Varying driver characteristics depending on target speed

Table 3: Driver characteristics for acceleration model to replicate Austrroads guidelines.

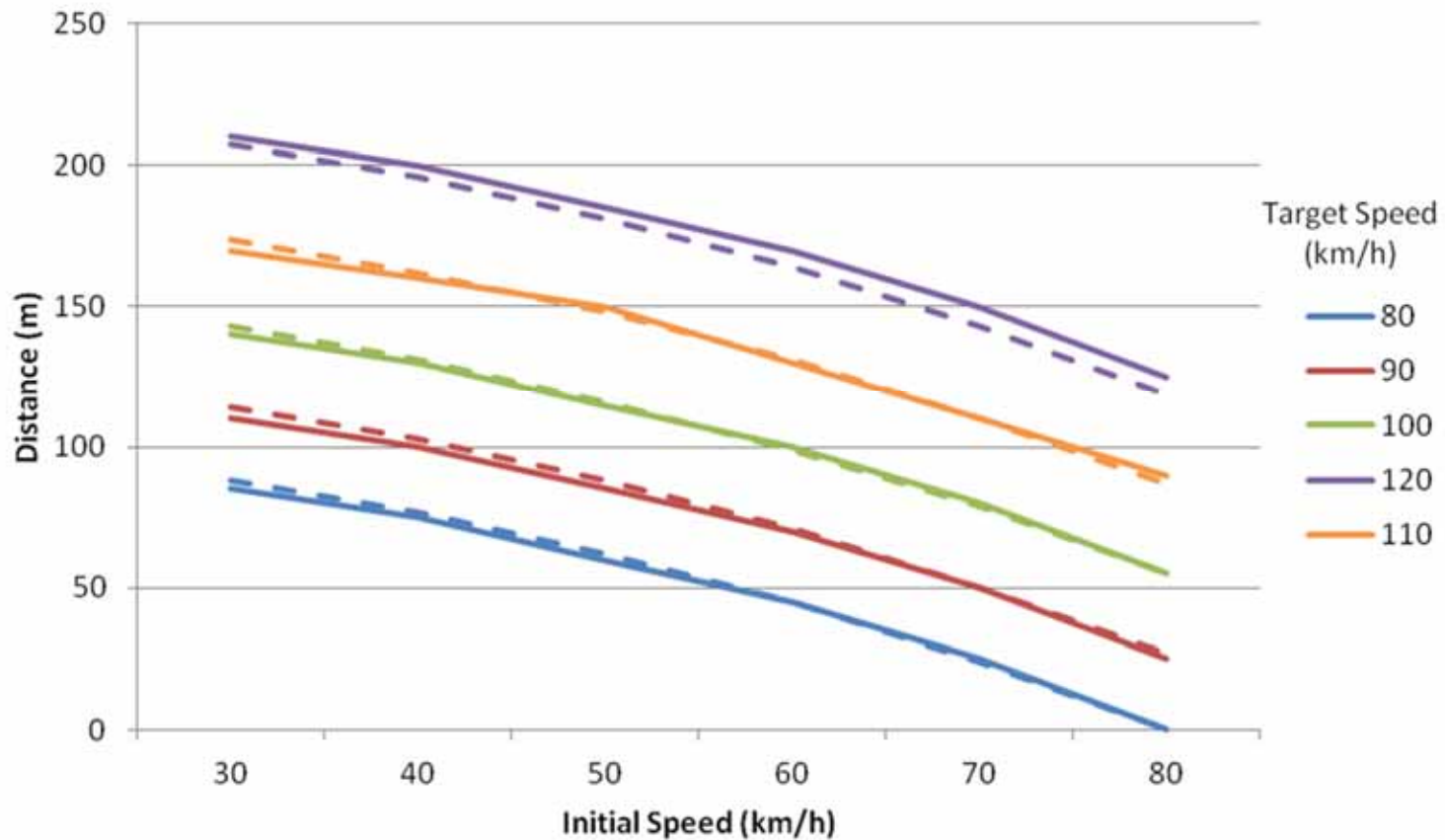
Target speed (km/h)	80	90	100	110	120
Driver characteristic	0.630	0.673	0.715	0.758	0.832

Deceleration

Driver characteristic of 0.285



Deceleration Lane Length Comparison, $D_c=0.285$



Increased vehicle performance

Drivers don't appear to use this increase

Possible to decrease lengths if the following are considered:

- Adverse impact on driver comfort and road safety
- Heavy vehicle characteristics for ramps with significant heavy's
- The push towards retrofitting ramps under the managed motorways approach.





Transport
Roads & Maritime
Services



UNIVERSITY OF
SOUTHERN QUEENSLAND

THANK
YOU!