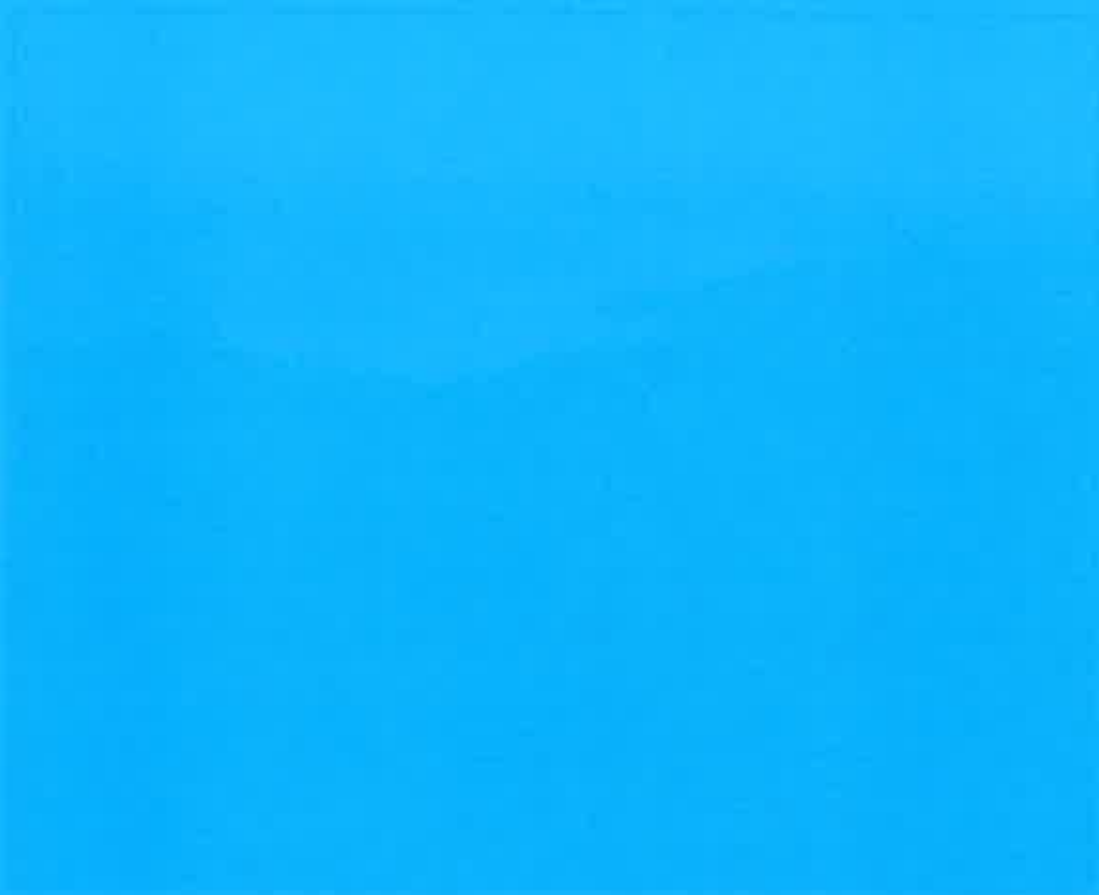


• Traffic Impact Assessment  
– Kea Consultants Ltd



# TRAFFIC IMPACT ASSESSMENT

## KAPAWITI ROAD

### MANGAWHAI



May 2007

**KEA**  
CONSULTANTS LTD.

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Date: May 2007  
Status: Final Report

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## **1.0 INTRODUCTION**

This Traffic Impact Assessment (TIA) is prepared by KEA Consultants Limited on behalf of Mangawhai Heads Holdings Ltd in order to assess the effects of the proposed subdivision of land located at the end of Kapawiti Road.

The site is located approximately 4 km from Mangawhai Heads Township in a rural area and is approximately 18 km from State Highway 1 (SH1) via Kaiwaka-Mangawhai Road.

The local road network includes Kapawiti Road, King Road, Cove Road, Mangawhai Heads Road, Tara Road and Garbolino Road.

The potential traffic impacts in terms of traffic capacity, efficiency and road safety as a result of the proposed development are the primary drivers of this traffic impact assessment.

## 2.0 SUMMARY OF ISSUES

This Traffic Impact Assessment Report has considered and analysed the possible impacts from the proposed subdivision with respect to the following issues:

- Existing traffic operations;
- Traffic generation and capacity;
- Parking requirements; and
- Road safety, including crash history and sight distances.

This Traffic Impact Assessment finds that:

- The proposed development is unlikely to create any significant adverse effects on the surrounding road network and intersections. The additional generated traffic can be appropriately accommodated by the surrounding road network. The proposal itself meets KDC requirements with respect to layout, parking spaces, and maneuverability.
- Kapawiti Road is considered to be currently operating effectively based on the existing formation and until the vehicle count per day exceeds KDC appendix 9J standard of 180vpd. The roadway is then recommended to be upgraded by sealing only as the existing width is considered as satisfactory with widening on bends where appropriate or as existing. The installation of intersection controls for all intersections, and signs for these controls, speed restriction and bends is also recommended for current use. These measures are considered in line with typical best practice for traffic safety measures.
- The local intersections which link Kapawiti Road to King Road and King Road to Cove Road will continue to operate effectively in terms of traffic capacity.
- The traffic impact of the proposed development is considered to be less than minor on the local network.

## **3.0 THE TIA STUDY**

### **3.1 Study Objectives**

The main scope of this Traffic Impact Assessment (TIA) is to assess the effect of the expected increase in traffic, resulting from the proposed subdivision on the surrounding local road network. The study objectives can be outlined as follows:

- To analyse and assess the effect of the traffic generated by the development on the road network, particularly on Kapawiti Road.
- To consider the road safety in the vicinity of the development and highlight the possible road safety concerns
- Develop viable options to mitigate any identified problems.

### **3.2 The Proposal**

The applicant, Mangawhai Heads Holdings Ltd, proposes to subdivide 47.39 ha area within 2 existing adjacent lots located at the end of Kapawiti Road, Mangawhai into 22 proposed lots. The proposed development is served by legal road, Kapawiti Road. The areas of the lots vary between approx 0.6ha and 20ha. This proposed subdivision will entail the construction of two rights of way located off the end of Kapawiti Road.

Mangawhai Heads is 90 minutes north of Auckland. This location is one of New Zealand's fastest growing, eastern oceanside property markets. This is reflected in the number of subdivisions in the immediate area which are in various stages of progress.

The local authority is the Kaipara District Council (KDC).

### 3.3 References

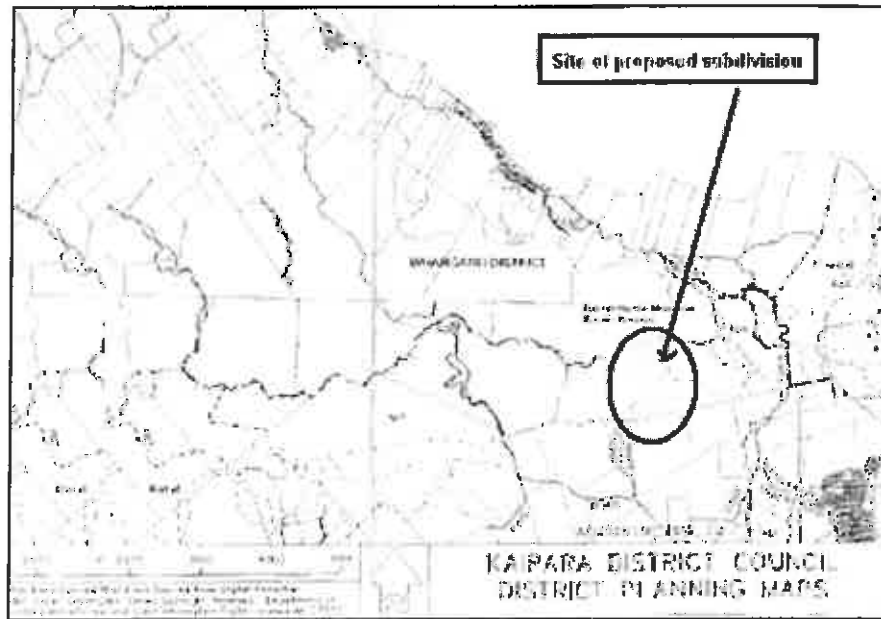
In preparation for this report, a number of background reports, plans and specific assessments have been reviewed. The main ones of relevance to Traffic Engineering and the area in consideration are listed below for reference purposes.

- 1 KDC (2003) "Operative District Plan", Kaipara District Council, Northland.
- 2 KDC (2003) "Operative District Plan", Section 9: Transportation, Kaipara District Council, Northland.
- 3 Mangawhai Estuary Structure Plan; Kaipara District Council, Northland.  
[http://www.kaipara.govt.nz/estuary\\_estates.htm](http://www.kaipara.govt.nz/estuary_estates.htm)
- 4 KDC (2005) "Speed Limit Bylaw 2005, Kaipara District Council, Northland.
- 5 KDC (2000) "Engineering Code of practice for Land Subdivision and Development Year 2000", Kaipara District Council, Northland.
- 6 Douglass, M and McKenzie, D. (2001) "Trips and Parking Related to Land Use Volume 1: Report" Research Report No. 209, Transfund New Zealand, Wellington.
- 7 Douglass, M and McKenzie, D. (2001) "Trips and Parking Related to Land Use Volume 2: Trip and Parking Surveys Database" Research Report No. 210, Transfund New Zealand, Wellington.
- 8 RTA. (2002) "Guide to Traffic Generating Developments" Version 2.2, New South Wales Roads and Traffic Authority, Australia.
- 9 LTSA. (1993) "Guidelines for visibility at Driveways RTS 6", Land Transport Safety Authority, Wellington.
- 10 NZ Standards (2004) "Land Development and Subdivision Engineering"; NZS 4404:2004, Standards New Zealand.
- 11 Homburger, W. S., Kell, J. H. and Perkins, D. D. (1992) "Fundamentals of Traffic Engineering." 13<sup>th</sup> Ed, Institute of Transportation Studies, University of California at Berkeley, USA.
- 12 Land Transport New Zealand Traffic Sign Specifications  
<http://www.landtransport.govt.nz/roads/tcd/search.html>



#### 4.1 Land Use

The proposed development site is classified as Rural Zone under the Kaipara Operative District Plan [1].



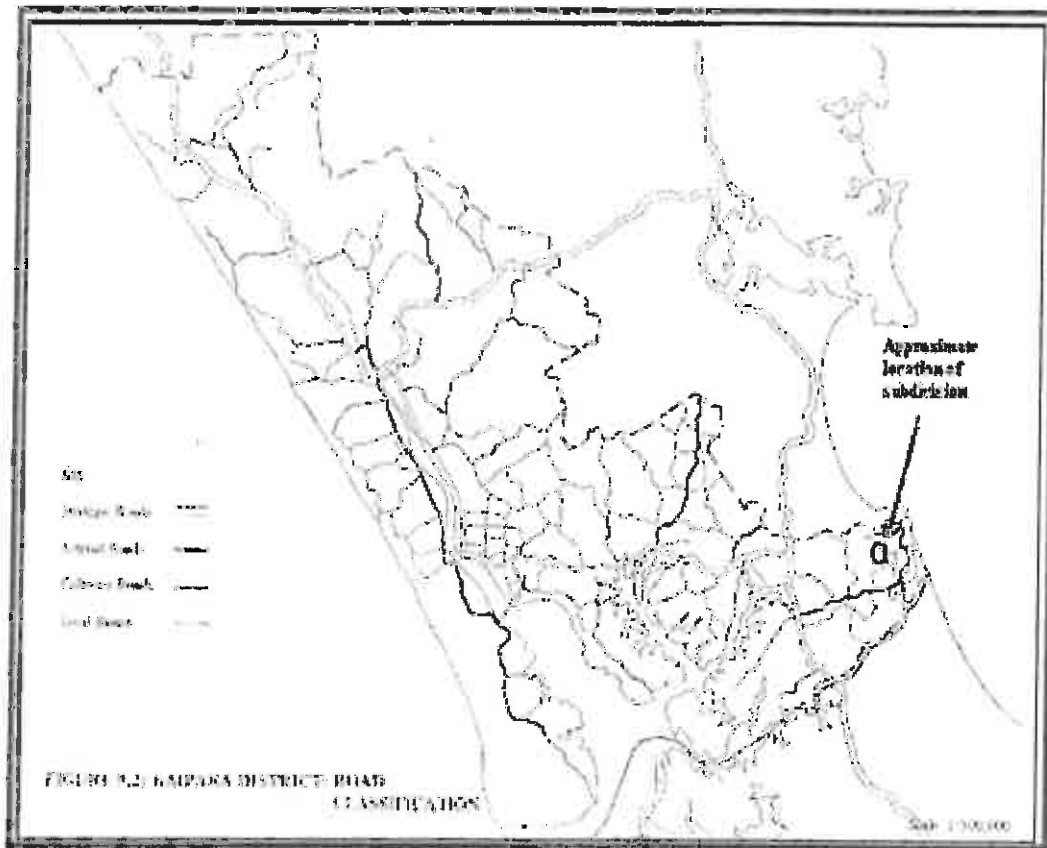
**Figure 4-2**  
*KDC Planning map showing the location area of the proposed subdivision*



**Figure 4-3**  
*The subdivision sited within the surrounding rural area*

## 4.2 Road Network

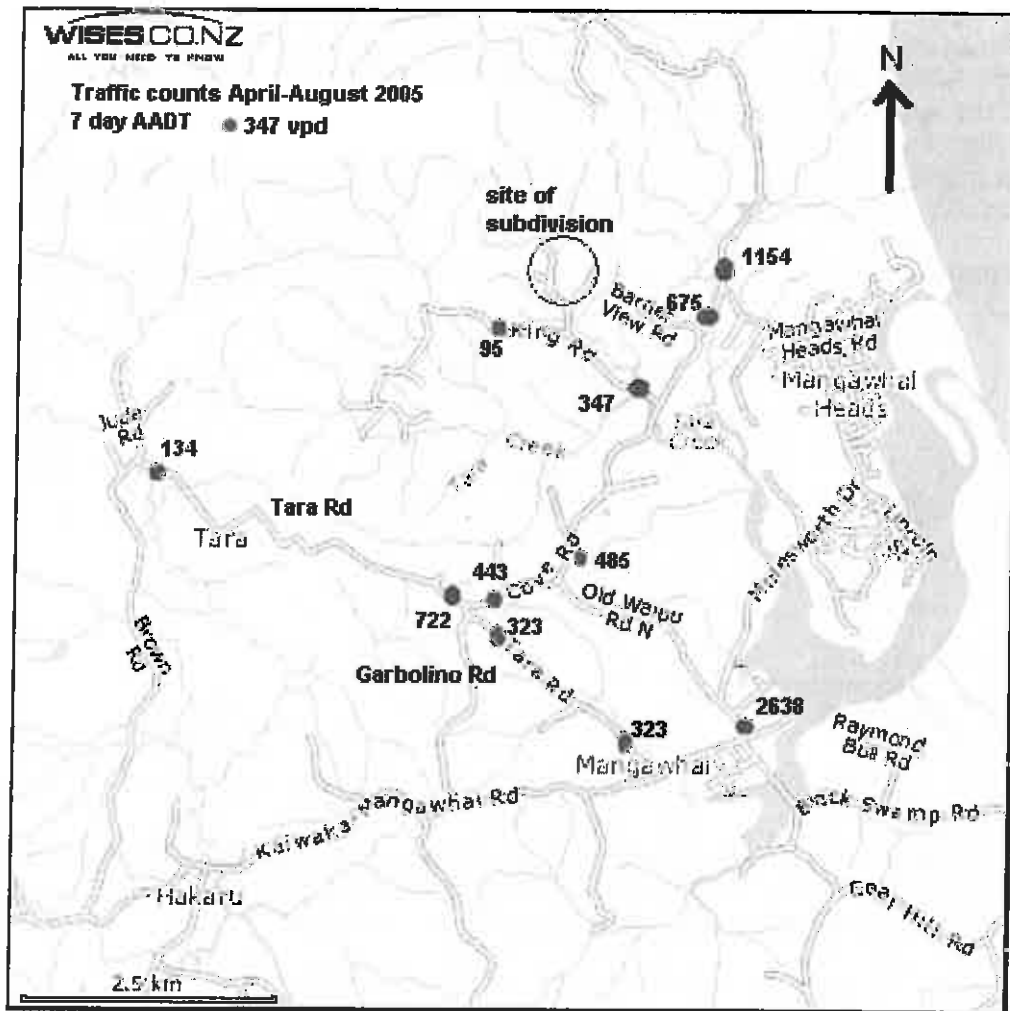
The local road network in proximity to the site of the proposed subdivision is predominantly based on local and collector roads as per the KDC road hierarchy. [2] This can be seen in the KDC Road Classification diagram shown in Figure 4-4. The approximate location of the proposed subdivision is marked on the diagram.



**Figure 4-4**  
*Kaipara District Council Road Classification map.*



The KDC 6 -Day average AADT at some locations on the roads in the district are displayed in Figure 4-7



**Figure 4-6**  
Surrounding Road Network and existing vehicle movements per day (KDC traffic counts)

There is an upper posted speed limit of 100 km/h applied to these local roads as they are local roads in a rural area as per the Kaipara District Speed Limit Bylaw [2].

In subsequent calculations of traffic flows these KDC figures have been increased by 3% per year to give estimated flows for both the current year (2007) and the year 2010.

#### 4.2.1 Kapawiti Road

Kapawiti Road is one of many unsealed local roads in the Mangawhai area. Overall, the carriageway width has been measured and varies between 4.8m and 6.5m and has a winding alignment which maintains a lower average speed value estimated at approx 30kph and 50kph on bends. The KDC Operative District Plan identifies in part 9.8.3 (2) that a rural local road with less than 180vpd requires a

width of 5.5m and be sealed. In the Plan it also stipulates a rural local road with a traffic count in excess of 180vpd is required to be 6.0m in width and sealed.

The vehicle count for this assessment is based on maximum development for Kapawiti Road. The KDC rates of 6 vehicle trips per day (vpd) per dwelling is used to obtain an approximate figure of 216 vehicle trips per day for the first section, from King Road to Echo Valley Road and 108 vpd for the section from Echo Valley Road to the access of the proposed development. No KDC AADT data is recorded for Kapawiti Road and the Crash Analysis System (CAS) has a figure of 89 vehicle trips per day for this road. This current estimated figure of vehicle trips per day is based on the estimated number of dwellings.

The maximum accumulated vehicle trips per day on Kapawiti Road are shown in Table 4.2.

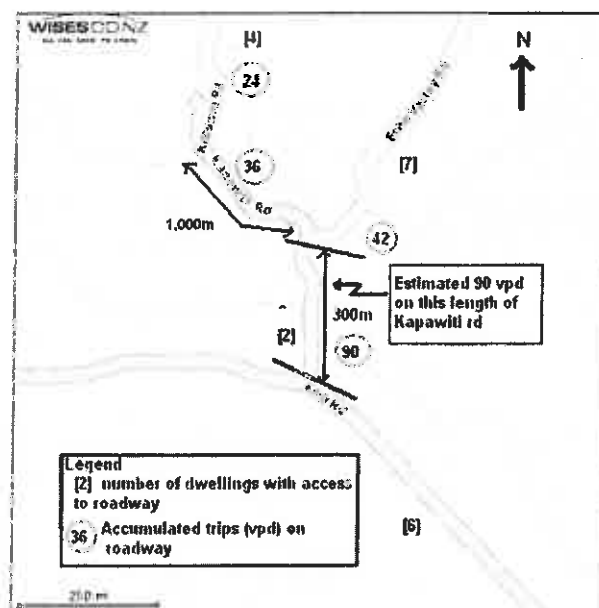
**Estimate of present flows (vpd)**

Section of Roadway	Kapawiti Rd to Echo Valley Road	Echo Valley Rd	Echo To King Road 300m
Estimated number of dwellings	18	16	2
Generated trips (vpd)	108	96	12
<b>Accumulated generated</b>	<b>108</b>	<b>204</b>	<b>216</b>

**Table 4-2**

*Estimates of current traffic flows on local adjacent roads.*

The accumulated trips on the corresponding sections of Kapawiti Road (shown in Table 4-2) are displayed in Figure 4-7. The highest traffic loading (approximately 228 vpd) is on the 300 metre section closest to King Road.



**Figure 4-7**

Figures 4-8 through to Figure 4-11 display views of Kapawiti Road and its features.

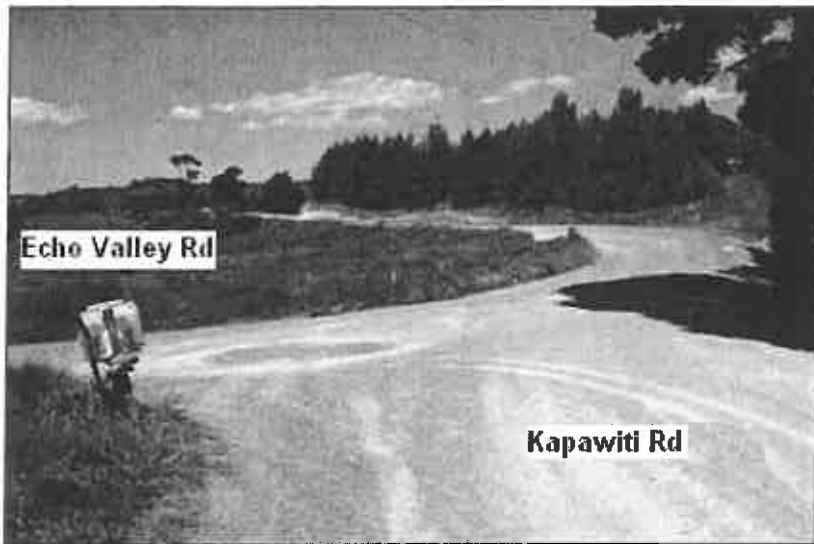
Kapawiti Road, from King Road to Echo Valley Road is estimated to be carrying up to a maximum of 216 vehicles per day (vpd). As per the existing guidelines this section of roadway should be 6.0m in width and sealed. The existing section varies in width from 4.8m to 5.5m and is unsealed. This section of Kapawiti Road is not considered to comply with existing rural local road requirements. The proposed increase in traffic resulting from the development is considered to comply within the existing traffic guidelines provided the roadway was complying and would not be considered further for an upgrade.



**Figure 4-8**  
*Kapawiti Road; looking in the direction of the proposed subdivision.  
Photo taken in the vicinity of the intersection with King Road.*

Figure 4-8 shows a view of the 300m section of Kapawiti Road nearest the intersection with King Road. There is a maintained shoulder and drainage channel. The channel drains to a local watercourse and/or culverts under the road.

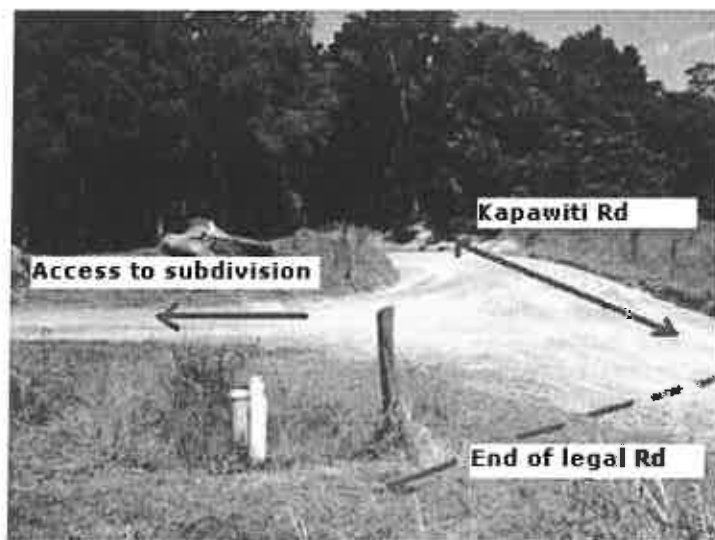
The second section, from Echo Valley Road to the development is estimated to be carrying up to a maximum of 108 vehicles per day and should be 5.5m in width and unsealed. The roadway generally complies with requirements for width and widening on bends as it varies between 4.8 and 6.5m and this section of Kapawiti Road with its natural alignment does also encourage lower operating speeds. The proposed increase in traffic from the development is considered to require staged upgrading, from intersection and speed restriction signs currently to widening and sealing upon full development. The recommended speed restriction controls are considered necessary as an ongoing requirement to maintain traffic safety as the alignment is considered a restriction due to natural formations, watercourses and large trees.



**Figure 4-09**  
*Kapawiti Road intersection with Echo Valley Road.*

Echo Valley Road is a private unsealed road. It provides access to 17 lots which are estimated on maximum development to generate 102 vehicle trips per day (vpd). The T-intersection of Kapawiti Road and Echo Valley Road (shown in Figure 4-09) is uncontrolled at present. It is recommended that a 'Give Way' (RG6) control be established at this T-intersection giving priority to traffic on Kapawiti Road.

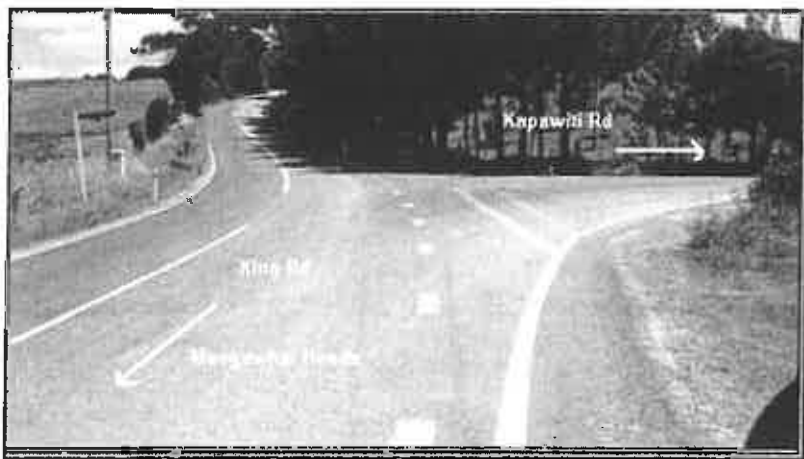
At Kapawiti Road end, there is the T-intersection which is shown in Figure 4-10. The intersection is located within the public road reserve however each leg serves private rural lots. This intersection is considered to be the start of Kapawiti Road. It is recommended that 'Give Way' (RG6) controls be established on each leg at this T-intersection giving priority to traffic on Kapawiti Road.



**Figure 4-10**  
*Kapawiti Road; intersection with private access on the left and right.*

#### 4.2.2 Local intersections

The local intersections on the surrounding road network have been considered as part of this Traffic Impact Assessment and it is considered that the impact on these local intersections from the traffic generated from the proposed development will be less than minimal.



**Figure 4-11 Intersection #1**

*The Kapawiti Road/ King Road intersection.*

Figure 4-11 shows the intersection of Kapawiti Road with King Road. The sight distance in the eastward direction is approximately 145 metres and in the westward direction 130 metres. This intersection is considered to comply with design requirements.

## 5.0 TRAFFIC GENERATION AND DISTRIBUTION

### 5.1 Traffic Generation

The number of trips generated by each land unit varies with many social, geographic, and land use factors. The relationships are complex, and a complete understanding of them is yet to be achieved. Homburger et al [9] demonstrate the difficulty in using traffic generation rates developed outside of the region where the factors are different, and the Figures from elsewhere may serve for comparison, but cannot be used in lieu of locally developed factors. This report therefore referenced and considered Transfund NZ Research Reports [4-5] and the RTA in determining appropriate generation of traffic from the proposed development as well as considering the Kaipara District Council's own estimates for the number of vehicle movements per day generated by the development.

Standard	Residential / Rural Hourly Generation Rate	Daily Generation Traffic (vpd)	Number of dwelling s	Total vph (in + out)	Total vpd (in + out)
Transfund NZ	1.2 / Dwelling	10.4 / Dwelling	22	26	228
RTA	0.85 / Dwelling	9 / Dwelling	22	19	198
KDC	#	6 / Dwelling	22	22	120
<b>Recommended</b>	<b>#</b>	<b>6 / Dwelling</b>	<b>22</b>	<b>22</b>	<b>120</b>

**Table 5-1**  
*Traffic generated from the development*

In the case of the Transfund NZ estimates [6,7], with the traffic generation rate being based on the number of dwellings, the results show traffic flows of 26 vehicles in the peak hour and approximately 228 vehicle movements per day.

In the case of the RTA estimates [8], the results show traffic flows of 19 vehicles in the peak hour and approximately 198 vehicle movements per day.

It should be noted that as the Transfund and RTA guides involve surveys of significantly denser urban city residential development that are not typical for rural environments the generated traffic using those rates is likely to be too conservative and inappropriate for the Kaipara Region.

The Kaipara District Council Plan, section 9.8.2 states that the Council will generally adopt an average rate of 6 vehicle movements per day for each new lot created. This would indicate an expected 22 vehicle movements in the peak hour and 120 vehicle movements (in + out) per day overall generated by the 22 lots.

In this case, it is agreed that the KDC traffic generation rates are appropriate given the special nature of the region and the type of development proposed.



The traffic generated by the proposed development has been accumulated with the estimated 2007 and 2010 traffic volume on local roads to obtain an estimate of the total likely traffic volume post completion of the subdivision. These totals are shown in Table 5-1.

Links identified by Road	Estimated Current Flow (vpd) on link (2007)	Estimated Flow (vpd) on link (2010)	Estimated Generated Flow(vpd) on link	Estimated Total Flow(vpd) on link (2007)	Percentage increase on existing traffic
Kapawiti Rd	216	236	<b>120</b>	356	51%
King Rd	368	402	<b>132</b>	532	33%
Cove Rd (to Mangawhai)	716	783	<b>72</b>	862	9%
Cove Rd (to Garbolino Rd)	515	562	<b>48</b>	610	9%
Mangawhai Heads Rd	1224	1338	<b>72</b>	1418	5%
Garbolino Rd	169*	196	<b>17</b>	222	9%
Tara Rd (S of Cove Rd)	343	374	<b>31</b>	401	8%

\*\* Estimated from CAS traffic counts.

**Table 5-2**

*Traffic flows and distances on local links adjacent to the subdivision*

It can be seen that, on the basis of the likely 2010 KDC figures, these local roads will continue to carry light traffic flows on completion of the subdivision. Apart from the flows on Kapawiti Road and King Road the increase in traffic flows (in vehicle movements per day) on the surrounding local roads are likely to be less than 10%.

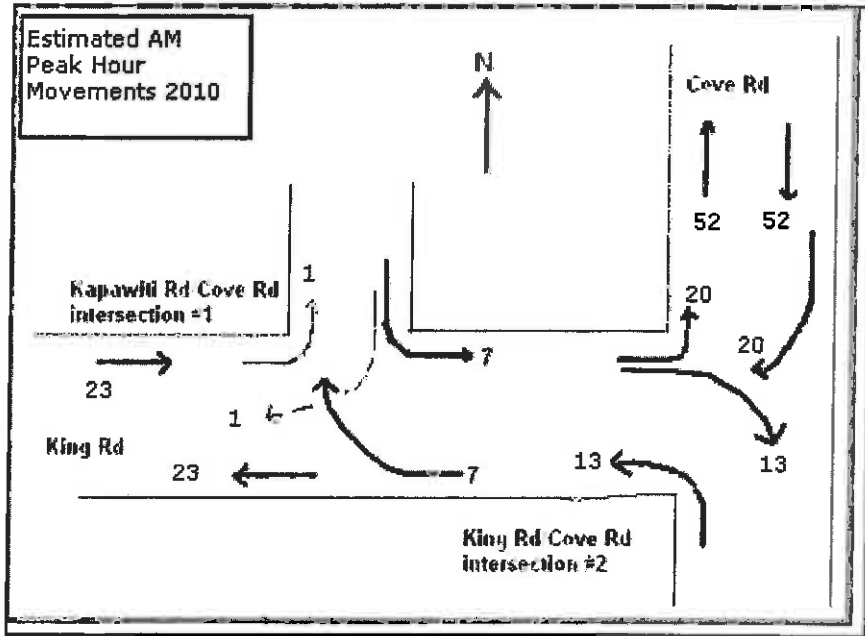
### **5.3 Effects of Future Traffic**

The impact of the traffic generated by the proposed subdivision is regarded to be less than minimal on the Kaipara District Council's existing local roading infrastructure in the long term.

## 6.0 CAPACITY ASSESSMENT

The capacity of the two nearest intersections (Refer Figure 6-1) to service the existing and the generated traffic from the proposed subdivision are not likely to be degraded by the additional traffic flows from the proposed subdivision. They are both expected to remain at an overall Level Of Service (LOS) A.

For the peak hour traffic volume it is conventional to assume that approximately 12% of the daily traffic occurs in the peak hour periods. The estimated peak hour traffic flows in 2010 are shown in Figure 6-1.



**Figure 6-1**  
*Estimated Peak Hour accumulated vehicle movements at the Kapawiti Road/King Road and King Road/Cove Road intersections.*

### 6.1 Intersection #1: Kapawiti Road/ King Road

It is estimated that in the AM peak hour period (e.g. for a Saturday morning), there would be an estimated maximum of 16 vehicle movements on Kapawiti Road in proximity to the intersection. The 16 vehicles will be split by a 50/50 ratio for traffic coming in and out of the subdivision area.

This would produce at the Kapawiti Road – King Road intersection:

- 8 vehicles entering Kapawiti Road from King Road
- 8 vehicles exiting Kapawiti Road and entering King Road

It is assumed that approximately 90% of the vehicle movements are directed towards Cove Road as there is no obvious land use activity in the other direction that would attract vehicle movements from the proposed subdivision.

An analysis of the capacity of this intersection shows that, with the low traffic flows in the peak hour, the intersection will operate under an overall Level of Service (LOS) A. (Refer to Appendix B for a description of Levels of Service).

## 6.2 Intersection #2: King Road/Cove Road

The King Road/Cove Road intersection has also been the focus of a detailed capacity analysis. The performance of this intersection has been analysed by the intersection analysis software aaSIDRA. The traffic flows on King Road and on Cove Road have been split for the purpose of analysis by a 50/50 ratio in the AM peak period (e.g. for a Saturday morning). These flows were estimated from KDC traffic counts and they are shown in Figure 6-1.

The aaSIDRA analysis results indicate, as would be expected, the intersection operates under an overall Level of Service (LOS) A. The Left Turn movement into King Road will operate under Level of Service (LOS) B as will the Left and Right Turn Movements exiting King Road to Cove Road. All other approaches will operate under Level of Service (LOS) A. The detailed outputs are located in Appendix A.

The maximum total degree of saturation of 0.035 obtained from the capacity analysis for this intersection means the total expected traffic will use approximately 3.5 percent of intersection capacity. It is concluded that the existing intersection will work efficiently and effectively without causing problems to the existing local road network.

## 7.0 PARKING REQUIREMENTS

The adequate provision of parking facilities is vital to facilitate the efficient movement of traffic on the road, and reduce traffic hazards and inconvenience. Consideration of the number of on site parking spaces has been made by referring to the reference standards [1, 6]. The parking demand for 20 dwellings is summarised in Table 5-1 below.

Standard	Parking demand Rates	Parking demand parks
KDC	1park / dwelling + 1visitor parking / 2dwelling	33
Transfund NZ	1.9park / dwelling	42
RTA	1-2 / dwelling	22-44

**Table 7-1**  
*Parking demand for the development*

The Kaipara District Plan requires 1 park per dwelling and 1 visitor park per 2 dwellings, giving the total required of 33 parking spaces.

However, with the proposed residential subdivision lots (e.g. a minimum of 0.6ha), it is recommended that each lot provide a minimum of 2 onsite parking spaces per lot which results in a total of 44 onsite parking spaces.

## **8.0 ROAD SAFETY**

### **8.1 Crash History**

The Crash Analysis System (CAS) from the Land Transport New Zealand (formerly Land Transport Safety Authority) has been analysed for the 5-year analysis period from 2002 to 2006.

In that time there have been ten crashes; 1 serious and 9 minor. All but one of these occurred on Cove Road. Only one occurred at an intersection. Six of these crashes involved Loss Of Control of the vehicle, two involved vehicles cutting corners, one vehicle in a Right Turn movement struck by an oncoming vehicle and one head on crash on Kapawiti Road involving a motorcycle and a car.

The increased vehicle flows in and out of the proposed development will increase the 'exposure' to the existing road network, thereby increasing the possibility of conflict and marginally increasing the possibility of a crash occurring. However the increased traffic volume in the vicinity of the development can be appropriately accommodated by the existing roads and if the access point to the subdivision and the vehicle crossings are designed appropriately, the adverse effect is considered to be minimal.

### **8.2 Vehicle Crossings and Rights Of Ways**

All the vehicle crossings should be designed and constructed with respect to Sections 9.5.3-5 of the District Plan and the relevant drawings in the KDC Engineering Code of Practice [5].

The two right-of-ways to be constructed for the subdivision should be designed and constructed with respect to KDC Engineering Standards [5]. Due regard should be paid to sight distances at any proposed intersection of such right-of-ways.

### **8.3 Sight Distances**

Adequate sight distances need to be provided to ensure safe access points. The Land Transport New Zealand's Guideline for Visibility at Driveways [9] provides a standard for safe sight distance depending on the 85<sup>th</sup> percentile speed of vehicles on the frontage road and road classification.

The two proposed Right-of-Ways within the proposed subdivision which are to provide access to Kapawiti Road will both require some minor works to provide adequate sight distances. They should be designed in accordance with the relevant KDC engineering standards [5] to ensure that adequate sight distances are available. The approach speeds of vehicles on the Right-of-Ways should, by appropriate design, not be allowed to exceed a level that prevents safe manoeuvring and lessens effective safe stopping distances on the adjoining roadway.

### **8.4 Passing Bays**

Passing bays have been designed for the use of vehicles using the two proposed Right-of-Ways. These passing bays have been designed in accordance with the KDC Engineering Standards [5] and traffic safety requirements.

## **9.0 TRAFFIC IMPACT DURING CONSTRUCTION**

Any adverse traffic effects during construction periods will have to be mitigated by careful planning and specific traffic management. Typical mitigatory measures include lane shifting, lane width variation, lane narrowing, temporary lane/shoulder closures, and total closures for short duration of activities and barrier edge protection. Short-term disruption will occur as road users adjust to new traffic layouts and controls. Some specific actions may be necessary, including advance notification of closures, closure restriction to periods of low traffic volumes, maintaining an equivalent number of lanes and regular traffic management publicity.

Any proposed development will temporarily during its construction, generate a certain amount of heavy traffic movements and interrupted traffic flows to the surrounding road networks, including vehicles and (possibly) cyclists and pedestrians. It is recommended that the applicant prepare a Construction Traffic Management Plan to be submitted to Council for approval prior to any construction taking place. The Traffic Management Plan (TMP) for the development should be based on Transit's Code of Practice for Temporary Traffic Management. Different types of traffic activities, including material delivery trucks, daily staff vehicles and additional site administration traffic should be considered in the TMP.

It is suggested that any upgrading of Kapawiti Road be left until the completion of the earthworks and associated construction activity of the proposed subdivision and so avoid damaging any new surfacing.

## **10.0 CONCLUSIONS**

This Traffic Impact Assessment Report has considered and analysed the possible impacts from the proposed subdivision with respect to the following issues:

- Existing traffic operations;
- Traffic generation and capacity;
- Parking requirements; and
- Road safety, including crash history and sight distances.

Conclusions from this Traffic Impact Assessment are:

- The proposed development is unlikely to create any significant adverse effects on the surrounding road network and intersections. The additional generated traffic can be appropriately accommodated by the surrounding road network. The proposal itself meets KDC requirements with respect to layout, parking spaces, and maneuverability.
- Kapawiti Road is considered to be currently operating effectively based on the existing formation and until the vehicle count per day exceeds KDC appendix 9J standard of 180vpd. The roadway is then recommended to be upgraded by sealing only as the existing width is considered as satisfactory with widening on bends where appropriate or as existing. The installation

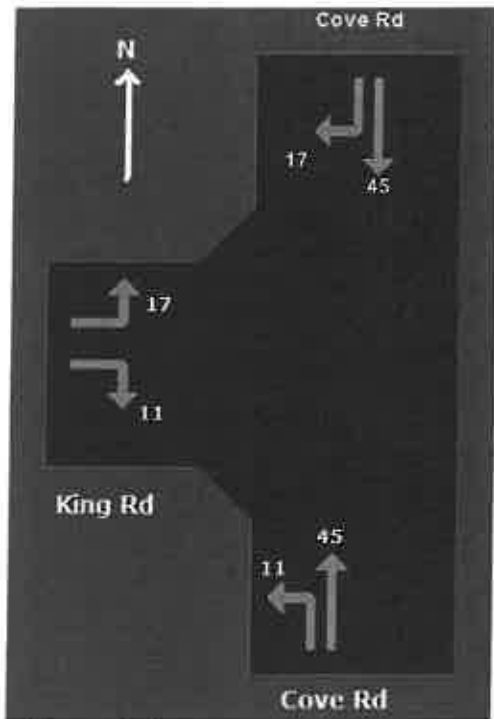
of intersection controls for all intersections, and signs for these controls, speed restriction and bends is also recommended for current use. These measures are considered in line with typical best practice for traffic safety measures.

- The local intersections which link Kapawiti Road to King Road and King Road to Cove Road will continue to operate effectively in terms of traffic capacity.
- The traffic impact of the proposed development is considered to be less than minor on the local network.

In conclusion, this assessment of the traffic effects resulting from the proposed development concludes that with the suggested mitigatory measures the impact of the traffic generated by the subdivision in terms of traffic capacity, efficiency, effectiveness and safety is likely to be less than minor on the surrounding road network.

## **Appendix A**

### **aaSidra Output**



**Figure A1**



**Figure A2**

For the King Road/Cove Road intersection:

Figure A1 shows the estimated peak hour movements

Figure A2 shows the estimated capacity of the peak hour movements

# Intersection Summary



king Rd\_ Cove Rd

<b>Performance Measure</b>	<b>Vehicles</b>	<b>Persons</b>
Demand Flow	170 veh/h	255 pers/h
Degree of Saturation	0.039	
Capacity (Total)	4421 veh/h	
95% Back of Queue (m)	3 m	
95% Back of Queue (veh)	0.4 veh	
Stop-line Delay (Total)	0.01 veh-h/h	0.02 pers-h/h
Stop-line Delay (Average)	0.3 s/veh	0.3 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	47 veh/h	70 pers/h
Effective Stop Rate	0.27 per veh	0.27 per pers
Travel Distance (Total)	135.7 veh-km/h	203.6 pers-km/h
Travel Distance (Average)	798 m	798 m
Travel Time (Total)	1.6 veh-h/h	2.5 pers-h/h
Travel Time (Average)	34.8 secs	34.8 secs
Travel Speed	82.6 km/h	82.6 km/h
Operating Cost (Total)	54 \$/h	54 \$/h
Fuel Consumption (Total)	17.5 L/h	
Carbon Dioxide (Total)	43.8 kg/h	
Hydrocarbons (Total)	0.073 kg/h	
Carbon Monoxide (Total)	3.15 kg/h	
NOX (Total)	0.132 kg/h	

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# Movement Summary



## king Rd\_ Cove Rd

Give-way

### Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost (\$/h)
<b>Cove R (South Approach)</b>										
1	L	13	334	0.039	0.2	LOS B	3	0.70	67.8	5
2	T	52	1335	0.039	0.2	LOS A	3	0.00	95.6	14
<b>Approach</b>		<b>65</b>	<b>1669</b>	<b>0.039</b>	<b>0.2</b>	<b>LOS A</b>	<b>3</b>	<b>0.14</b>	<b>88.5</b>	<b>19</b>
<b>North Approach</b>										
8	T	52	1826	0.039	0.2	LOS A	2	0.20	86.0	22
8	R	20	1826	0.039	0.2	LOS A	2	0.20	86.0	22
<b>Approach</b>		<b>72</b>	<b>1826</b>	<b>0.039</b>	<b>0.2</b>	<b>LOS A</b>	<b>2</b>	<b>0.20</b>	<b>86.0</b>	<b>22</b>
<b>West Approach</b>										
10	L	20	561	0.036	0.8	LOS B	2	0.68	67.2	8
11	R	13	365	0.036	0.8	LOS B	2	0.73	67.7	5
<b>Approach</b>		<b>33</b>	<b>926</b>	<b>0.036</b>	<b>0.8</b>	<b>LOS B</b>	<b>2</b>	<b>0.70</b>	<b>67.4</b>	<b>13</b>
<b>All Vehicles</b>		<b>170</b>	<b>4421</b>	<b>0.039</b>		<b>LOS A</b>	<b>3</b>	<b>0.27</b>	<b>82.6</b>	<b>54</b>

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# Movement Summary



## Kapawiti Job 24.5.07

Two-way stop

### Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost (\$/h)
<b>King Rd (East approach)</b>										
5	T	23	1857	0.016	0.1	LOS A	1	0.17	88.7	9
5	R	7	1857	0.016	0.1	LOS A	1	0.17	88.7	9
<b>Approach</b>		<b>30</b>	<b>1857</b>	<b>0.016</b>	<b>0.1</b>	<b>LOS A</b>	<b>1</b>	<b>0.17</b>	<b>88.7</b>	<b>9</b>
<b>Kapawiti Rd</b>										
7	L	7	909	0.008	0.2	LOS B	0	0.90	47.7	3
8	R	1	130	0.008	0.2	LOS A	0	0.92	48.2	0
<b>Approach</b>		<b>8</b>	<b>1039</b>	<b>0.008</b>	<b>0.2</b>	<b>LOS B</b>	<b>0</b>	<b>0.91</b>	<b>47.8</b>	<b>4</b>
<b>King RD (West Approach)</b>										
10	L	1	79	0.013	0.1	LOS B	1	0.73	68.2	0
11	T	23	1808	0.013	0.1	LOS A	1	0.00	97.5	6
<b>Approach</b>		<b>24</b>	<b>1887</b>	<b>0.013</b>	<b>0.1</b>	<b>LOS A</b>	<b>1</b>	<b>0.03</b>	<b>95.8</b>	<b>6</b>
<b>All Vehicles</b>		<b>62</b>	<b>4782</b>	<b>0.016</b>		<b>LOS A</b>	<b>1</b>	<b>0.21</b>	<b>82.2</b>	<b>19</b>

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# Intersection Summary



## Kapawiti Job 24.5.07

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<b>Performance Measure</b>	<b>Vehicles</b>	<b>Persons</b>
Demand Flow	62 veh/h	93 pers/h
Degree of Saturation	0.016	
Capacity (Total)	4782 veh/h	
95% Back of Queue (m)	1 m	
95% Back of Queue (veh)	0.1 veh	
Stop-line Delay (Total)	0.00 veh-h/h	0.00 pers-h/h
Stop-line Delay (Average)	0.1 s/veh	0.1 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	13 veh/h	20 pers/h
Effective Stop Rate	0.21 per veh	0.21 per pers
Travel Distance (Total)	49.7 veh-km/h	74.5 pers-km/h
Travel Distance (Average)	801 m	801 m
Travel Time (Total)	0.6 veh-h/h	0.9 pers-h/h
Travel Time (Average)	35.1 secs	35.1 secs
Travel Speed	82.2 km/h	82.2 km/h
Operating Cost (Total)	19 \$/h	19 \$/h
Fuel Consumption (Total)	5.9 L/h	
Carbon Dioxide (Total)	14.7 kg/h	
Hydrocarbons (Total)	0.023 kg/h	
Carbon Monoxide (Total)	0.85 kg/h	
NOX (Total)	0.043 kg/h	

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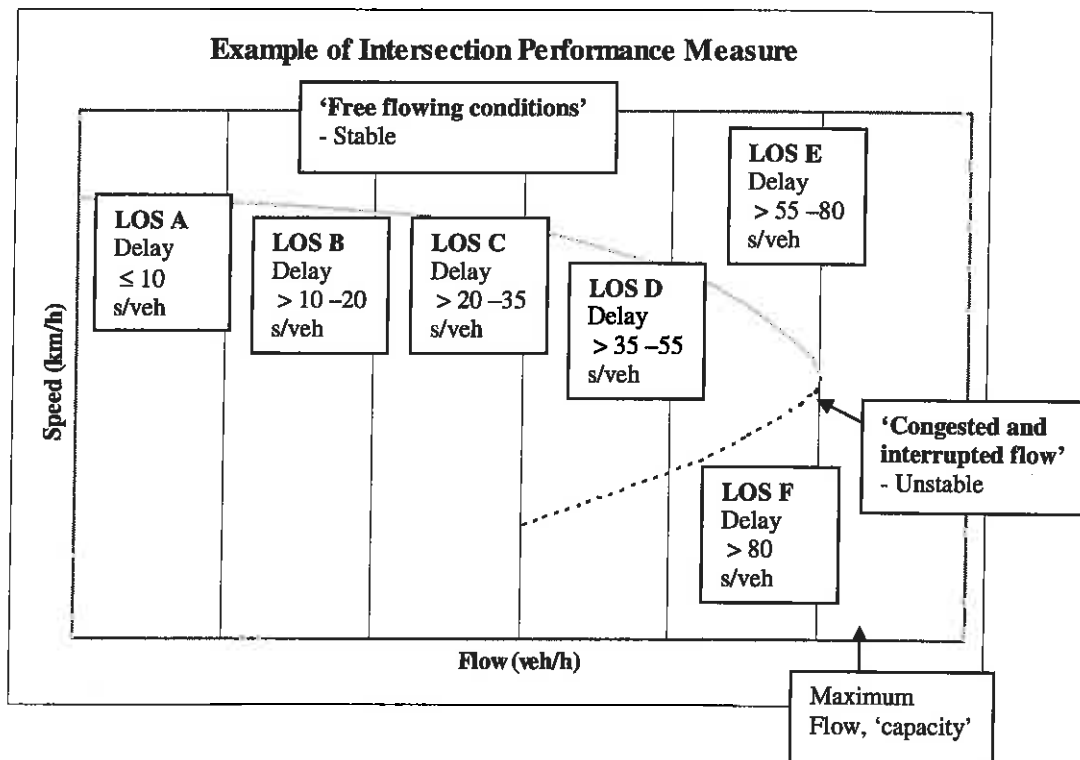
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## **Appendix B**

### **LOS Description**

Level of Service (LOS) is a qualitative measure to describe the operation of roadways and intersections. It is directly related to the control delay value with LOS A being the best and LOS F being the worst. Different control delay values are used for signalised intersections and roundabouts.

- LOS A: Operations in Free Flow (very little delay) with average overall delay  $\leq 10$  ( $\leq 6.5$ ) seconds per vehicle.
- LOS B: Operations in Relatively Free Flow with average overall delay in the range of 10.1 to 20 (6.6 to 19.5) seconds per vehicle.
- LOS C: Operations in Moderately Free Flow with average overall delay in the range of 20.1 to 35 (19.6 to 32.5) seconds per vehicle. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- LOS D: Operations in Moderately Free Flow with average overall delay in the range of 35.1 to 55 (32.6 to 52) seconds per vehicle. Congestion becomes more noticeable, many vehicles stop and the proportion of vehicles not stopping declines.
- LOS E: Operations in Capacity Flow with average overall delay in the range of 55.1 to 80 (52 to 78) seconds per vehicle. This is considered to be the limit of acceptable delay.
- LOS F: Operations with average overall delay in excess of 80.1 (in excess of 78) seconds per vehicle. This is considered unacceptable to most drivers and typically occurs when arrival rates exceed capacity (and therefore congested).



## **Appendix C**

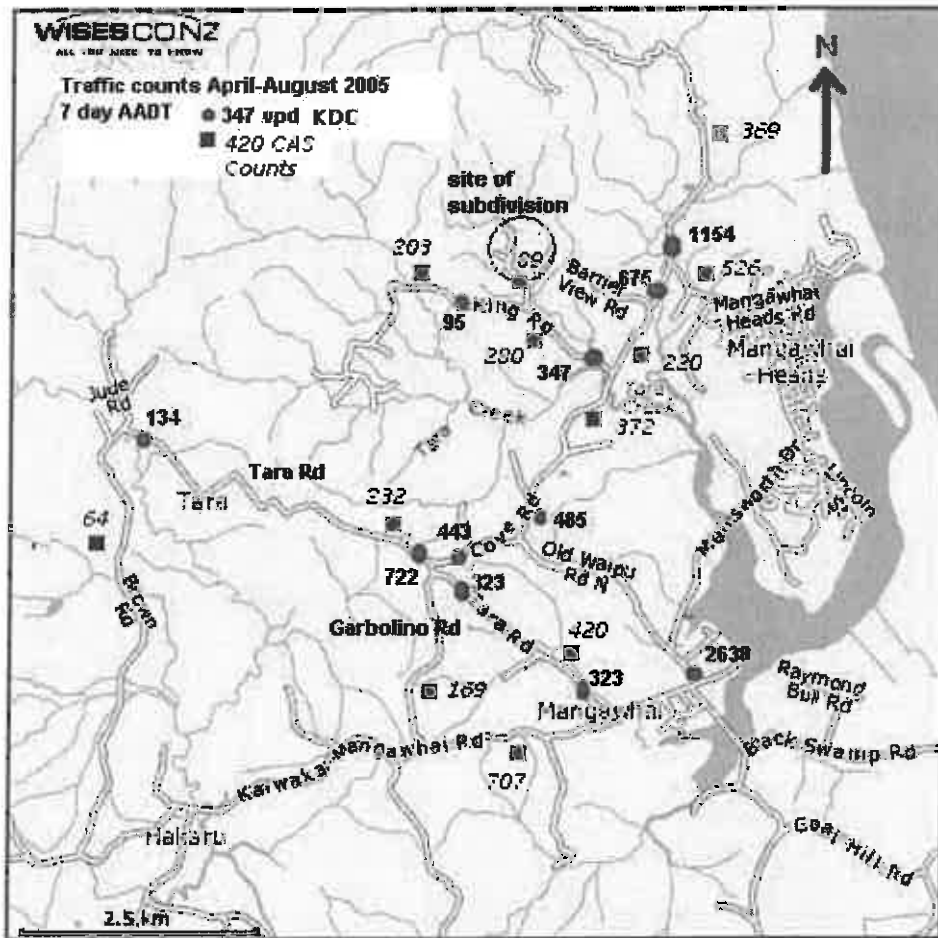
### **KDC Traffic Counts**

No.	Road Name	Location	RAMM ROAD ID	Count Date	7 Day Average AADT 2005	7 Day Average AADT increased by 3% p.a. 2007
24	Cove Rd	s District Boundary	547	5/05/2005	812	861
25	Cove Rd	s Mangawhai Heads Rd	548	5/05/2005	675	716
26	Cove Rd	e Bagnall Rd	548	23/05/2005	485	515
27	Cove Rd	e Tara Rd	548	28/07/2005	443	470
3	Mangawhai Heads Rd e	w Kanuka St	491	20/07/2005	1074	1139
4	Mangawhai Heads Rd w	e Cove Rd	490	20/07/2005	1154	1224
17	Mangawhai Rd	n Cames Rd	571	8/06/2005	1688	1791
18	Mangawhai Rd	s Coal Hill Rd	571	8/06/2005	1706	1810
6	Molesworth Drive	s Mangawhai Heads Rd	494	8/04/2005	2453	2602
7	Molesworth Drive	n Heather St	494	15/08/2005	2854	3028
8	Molesworth Drive	n Old Waipu Rd adj	494	28/07/2005	2614	2773
9	Molesworth Drive	Kaiwaka/Mangawhai Rd	494	23/05/2005	2638	2799
20	Tara Rd	n Kaiwaka/Mangawhai Rd	513	27/04/2005	323	343
21	Tara Rd	w Cove Rd	513	5/05/2005	722	766
22	Tara Rd	s Garbolino	513	27/04/2005	323	343
23	Tara Rd	e Brown Rd	513	5/05/2005	134	122
28	King Rd	adj Cove Rd	565	31/05/2005	347	368
29	King Rd	w Kapawiti Rd	565	20/07/2005	95	101

**Table C-1**

*KDC: 2005 traffic flows(AADT) on local adjacent roads.*

The dates of the counts were taken approximately 2 years previous to the present date. Allowing for a 3% increase per year, estimates for 2007 have also been calculated. However, in calculations for traffic flows in this report, the counts supplied by KDC have been used are where necessary, supplemented by counts obtained from the Crash Analysis System (CAS). These counts are displayed on Figure C-2 on the next page.



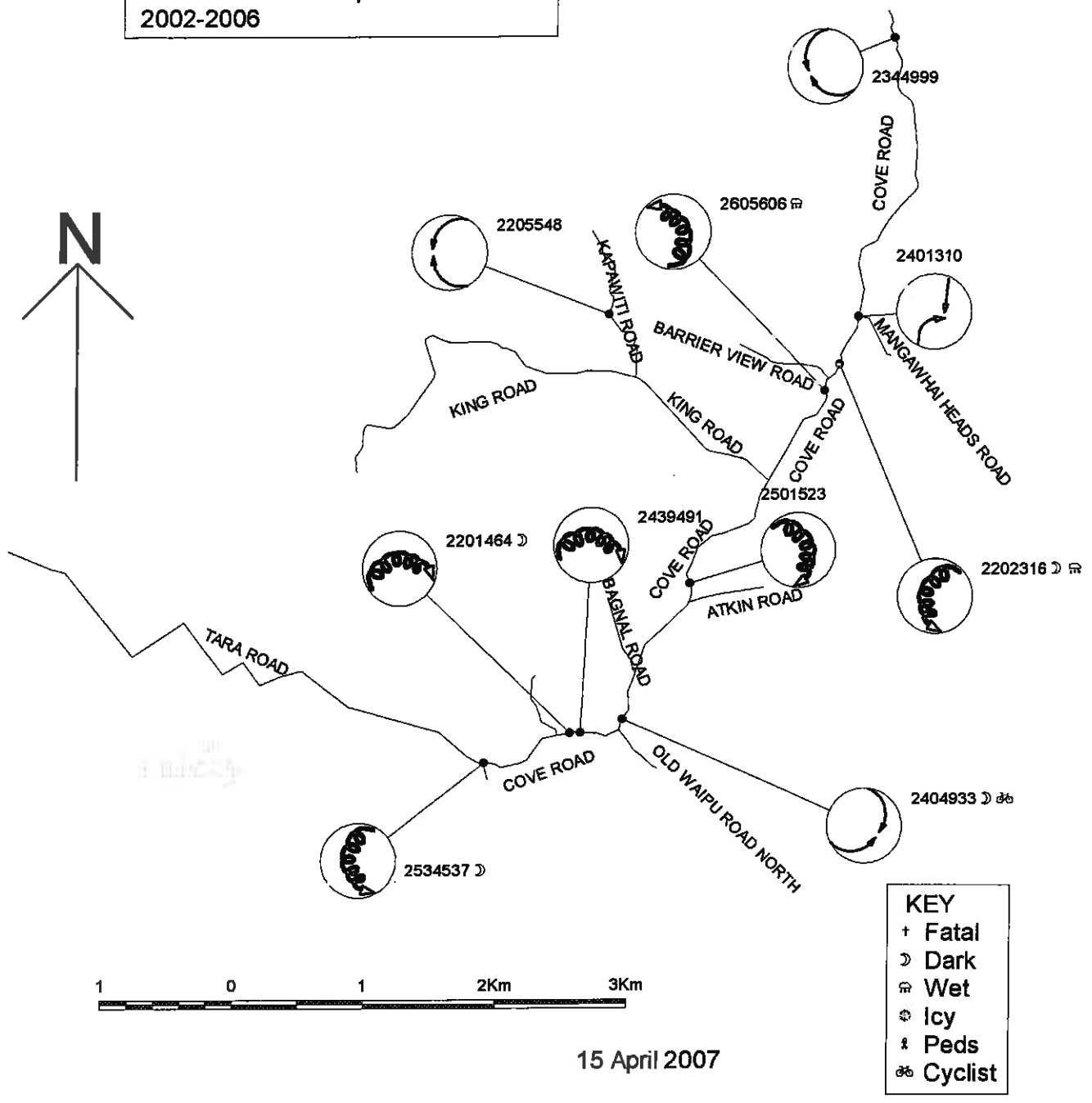
**Figure C-2**

*Traffic counts from KDC (AADT) and equivalent CAS counts on local roads.*

## **Appendix D**

### **CAS crash reports**

**Vehicle Crashes Kapawiti Road Area  
2002-2006**



First Street	D / Second street I / or landmark R /	Crash Number	Date	Day Time	Factors and Roles	O	C	W	L	W	J	C	M	S	Total	P	C
COVE ROAD	150N ATKIN ROAD	2501523	02/01/2005	Sun 1940	DA CS1 103A 660A	C	E	D	O	N	F	N	C	100	1		
COVE ROAD	100S BARRIER VIEW ROAD	2605606	22/11/2006	Wed 1050	DB CN1 135A 403A 801	V	M	W	O	F	L	N	C	100	1		
COVE ROAD	400S MANGAMHAI HEADS ROAD	2202316	17/05/2002	Fri 0724	DB CS1 101A 632A 801	C	E	W	D	N	L	N	C	100	1		
COVE ROAD	I MANGAMHAI HEADS ROAD	2401310	08/02/2004	Sun 1205	LB CS1V 303B 375B		E	D	B	N	F	T	S	C	100	2	
COVE ROAD	3800E SEACREST BOULEVARD	2344999	03/12/2003	Wed 1750	BB TN1C		S	D	B	N	F	N	C	100			
COVE ROAD	30E TARA ROAD	2534537	09/01/2005	Sun 2350	DB CS1 410A	V	M	D	D	N	F	N	C	100			
COVE ROAD	790E TARA ROAD	2201464	03/02/2002	Sun 0300	DA CS1	P	E	D	D	N	F	N	C	100	2		
COVE ROAD	870E TARA ROAD	2439491	31/08/2004	Tue 0558	DA TEL	JP	E	D	B	N	F	N	C	100			
COVE ROAD	1260N TARA ROAD	2404933	17/06/2004	Thu 1810	BB VS1SS 123A		M	D	T	N	F	N	C	100	1		41
KAPAWITI ROAD	600N KING ROAD	2205548	17/08/2002	Sat 1428	BC MSIC 110A 121A 818 830		M	D	O	N	F	N	N	100	1		

Distance  
M D  
V R  
M VN VVV  
DD/MM/YYYY DDD HEMM T 1 234

Factors and Roles  
A is for vehicle 1  
B is for veh 2 etc

First Street	Distance IR	Second street or landmark	Crash Number	Date	Day Time	Description of Events	Crash Factors	Road	Natural Light	Weather	Junction	Ctrl	Tot Inj
				DD/MM/YYYY	DD HHMM		(ENV = Environmental factors)						F S M A E I T R N
COVE ROAD	150N ATKIN ROAD		2501523	02/01/2005	Sun 1940	CAR1 SBD on COVE ROAD lost control turning right, CAR1 hit Cliff Bank on right hand bend	CAR1 alcohol test above limit or test refused, body or chassis	Dry	Overcast	Fine	Unknown	Nil	1
COVE ROAD	100S BARRIER VIEW ROAD		2605606	22/11/2006	Wed 1050	CAR1 NBD on COVE ROAD lost control turning left, CAR1 hit Ditch	CAR1 lost control due to road conditions, driving strange vehicle ENV: road slippery (rain)	Wet	Overcast	Light Rain	Unknown	Nil	1
COVE ROAD	400S MANGAWHAI HEADS ROAD		2202316	17/05/2002	Fri 0724	CAR1 SBD on COVE ROAD lost control turning left, CAR1 hit Cliff Bank	CAR1 alcohol suspected, worn tread on tyre ENV: road slippery (rain)	Wet	Dark	Light Rain	Unknown	Nil	1
COVE ROAD	I MANGAWHAI HEADS ROAD		2401310	08/02/2004	Sun 1205	VAN2 turning right hit b of oncoming CAR1 SBD on COVE ROAD	VAN2 failed to give way when turning to non-turning traffic, didnt see/look when required to give way to traffic from another direction	Dry	Bright	Fine	T Type Junction	Stop Sign	2
COVE ROAD	3800E SEACREST BOULEVARD		2344999	03/12/2003	Wed 1750	TRUCK1 NBD on COVE ROAD cutting corner hit CAR2 head on		Dry	Bright	Fine	Unknown	Nil	
COVE ROAD	30E TARA ROAD		2534537	09/01/2005	Sun 2350	CAR1 SBD on COVE ROAD lost control turning left, CAR1 hit Ditch		Dry	Dark	Fine	Unknown	Nil	
COVE ROAD	790E TARA ROAD		2201464	03/02/2002	Sun 0300	CAR1 EBD on COVE ROAD lost control turning right, CAR1 hit Post Or Pole on right hand bend	CAR1 fatigue (drowsy, tired, fell asleep)	Dry	Dark	Fine	Unknown	Nil	2
COVE ROAD	870E TARA ROAD		2439491	31/08/2004	Tue 0558	TRUCK1 EBD on COVE ROAD lost control turning right, TRUCK1 hit Phone Box Etc., Post Or Pole on right hand bend		Dry	Bright	Fine	Unknown	Nil	
COVE ROAD	1260N TARA ROAD		2404933	17/06/2004	Thu 1810	VAN1 SBD on COVE ROAD cutting corner hit CYCLIST2 (Age 41) head on	VAN1 cutting corner on bend	Dry	Twilight	Fine	Unknown	Nil	1
KAPAWITI ROAD	600N KING ROAD		2205548	17/08/2002	Sat 1428	MOTOR CYCLER1 SBD on KAPAWITI ROAD swinging wide hit CAR2 head on	MOTOR CYCLER1 too fast for conditions, swung wide on bend ENV: road surface unusually narrow, visibility limited	Dry	Overcast	Fine	Unknown	Nil	1

**POLICE CRASH LIST REPORT**

**2002-2006 Crashes**

**Run on: 15 Apr 2007**

Crash List: b\_kapawiti\_1

Total Injury Crashes: 7  
Total Non-Injury Crashes: 3

Deaths 0  
Serious Injuries 1  
Minor Injuries 8

Crash Movement	Number	%
Overtaking Crashes	0	0
Straight Road Lost Control/Head On	0	0
Bend - Lost Control/Head On	9	90
Rear End/Obstruction	0	0
Crossing/Turning	1	10
Pedestrian Crashes	0	0
Miscellaneous Crashes	0	0
<b>Total</b>	<b>10</b>	<b>100%</b>

Injury Crash Driver/Vehicle factors	No.Inj.Crashes	% Inj.Crashes
Alcohol	2	29
Too fast	1	14
Failed Giveaway/Stop	1	14
Failed Keep Left	2	29
Poor Observation	1	14
Poor judgement	1	14
Fatigue	1	14
Vehicle factors	2	29
Other	1	14
<b>Total</b>	<b>12</b>	<b>171%</b>

Crash Type	Single Party	Multiple Party	Total
Intersection	0	1	1
MidBlock	6	3	9
<b>Total</b>	<b>6</b>	<b>4</b>	<b>10</b>

Location	Local road	State Highway	Total
Urban road	0	0	0
Open road	10	0	10
<b>Total</b>	<b>10</b>	<b>0</b>	<b>10</b>

Environment	Light/Overcast	Dark/Twilight	Total
Dry	5	3	8
Wet	1	1	2
Icy	0	0	0
<b>Total</b>	<b>6</b>	<b>4</b>	<b>10</b>

Drivers at fault or part fault in Injury crashes	Male	Female	Total
15-19 years	1	0	1
20-24	1	0	1
25-29	0	0	0
30-39	1	0	1
40-49	1	0	1
50-59	1	0	1
60-69	1	0	1
70+	0	0	0
<b>Total</b>	<b>6</b>	<b>0</b>	<b>6</b>

Drivers at fault or part fault in Injury crashes	Male	Female	Total
Full	2	0	2
Learner	1	0	1
Restricted	1	0	1
Never licensed	1	0	1
Disqualified	0	0	0
Overseas	0	0	0
Expired	1	0	1
Other/Unknown	0	0	0
<b>Total</b>	<b>6</b>	<b>0</b>	<b>6</b>

Day/Period	0000-0259	0300-0559	0600-0859	0900-1159	1200-1459	1500-1759	1800-2059	2100-2400	Total
Mon	0	0	0	0	0	0	0	0	0
Tue	0	1	0	0	0	0	0	0	1
Wed	0	0	0	1	0	1	0	0	2
Thu	0	0	0	0	0	0	1	0	1
Fri	0	0	1	0	0	0	0	0	1
Sat	0	0	0	0	1	0	0	0	1
Sun	0	1	0	0	1	0	1	1	4
<b>Total</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>10</b>

Month of year	Injury	%	Non-Injury	%	Total	%
Jan	1	14	1	33	2	20
Feb	2	29	0	0	2	20
Mar	0	0	0	0	0	0
Apr	0	0	0	0	0	0
May	1	14	0	0	1	10
Jun	1	14	0	0	1	10
Jul	0	0	0	0	0	0
Aug	1	14	1	33	2	20
Sep	0	0	0	0	0	0
Oct	0	0	0	0	0	0
Nov	1	14	0	0	1	10
Dec	0	0	1	33	1	10
<b>Total</b>	<b>7</b>	<b>100%</b>	<b>3</b>	<b>100%</b>	<b>10</b>	<b>100%</b>

Crash (inj.) nos.	Fatal	Serious	Minor	Non-Inj	Total
2002	0 (0)	1 (1)	2 (3)	0 (-)	3 (4)
2005	0 (0)	0 (0)	1 (1)	1 (-)	2 (1)
2006	0 (0)	0 (0)	1 (1)	0 (-)	1 (1)
2004	0 (0)	0 (0)	2 (3)	1 (-)	3 (3)
2003	0 (0)	0 (0)	0 (0)	1 (-)	1 (0)
<b>Total</b>	<b>0 (0)</b>	<b>1 (1)</b>	<b>6 (8)</b>	<b>3 (-)</b>	<b>10 (9)</b>

Note: last 5 years of crashes shown

Crash List: bj\_kapawiti\_1 (10 crashes)

Total Injury Crashes: 7  
Total Non-Injury Crashes: 3  

---

10

Crash Type	Number	%
Overtaking Crashes:	0	0
Straight Road Lost Control/Head On:	0	0
Bend - Lost Control/Head On:	9	90
Rear End/Obstruction:	0	0
Crossing/Turning:	1	10
Pedestrian Crashes:	0	0
Miscellaneous Crashes:	0	0
<b>TOTAL:</b>	<b>10</b>	<b>100 %</b>

Intersection/Midblock	Number	%
Intersection:	1	10
MidBlock:	9	90
<b>TOTAL:</b>	<b>10</b>	<b>100 %</b>

Environmental Factors	Number	%
Light/Overcast Crashes:	6	60
Dark/Twilight Crashes:	4	40
<b>TOTAL:</b>	<b>10</b>	<b>100 %</b>
Wet/Ice:	2	20
Dry:	8	80
<b>TOTAL:</b>	<b>10</b>	<b>100 %</b>

Day/Period	Number	%
<b>Weekday</b> 6:00am - 9:30am:	1	10
(Mon 6am - 9:30am - 3:30pm:	1	10
Fri 5.59pm) 3:30pm - 7:00pm:	2	20
7:00pm - 6:00am:	1	10
<b>Weekend</b> 6:00am - 9:30am:	0	0
Fri 6pm - 9:30am - 3:30pm:	2	20
Mon 5.59am) 3:30pm - 7:00pm:	0	0
7:00pm - 6:00am:	3	30
<b>TOTAL:</b>	<b>10</b>	<b>100 %</b>

Vehicles	Number	%
Car	8	80
Van/Ute	2	20
Truck	2	20
Bus	0	0
Motorcycle	1	10
Bicycle	1	10
<b>TOTAL:</b>	<b>14</b>	<b>140 %</b>

Driver/Vehicle factors	No.Inj.Crashes	% Inj.Crashes
Alcohol	2	29
Too fast	1	14
Failed Giveaway/Stop	1	14
Failed Keep Left	2	29
Poor Observation	1	14
Poor judgement	1	14
Fatigue	1	14
Vehicle factors	2	29
Other	1	14
<b>TOTAL:</b>	<b>12</b>	<b>171 %</b>

Environmental factors	No.All Crashes	% All Crashes
Road factors	3	30
<b>TOTAL:</b>	<b>3</b>	<b>30 %</b>

Object Struck	Number	%
Cliff Bank	2	20
Phone Box Etc.	1	10
Post Or Pole	2	20
Ditch	2	20
<b>TOTAL:</b>	<b>7</b>	<b>70 %</b>

Crash Numbers				
Year	Fatal	Serious	Minor	Non-Inj
2002	0	1	2	0
2005	0	0	1	1
2006	0	0	1	0
2004	0	0	2	1
2003	0	0	0	1
<b>TOTAL:</b>	<b>0</b>	<b>1</b>	<b>6</b>	<b>3</b>

Note: Percentages represent the % of crashes in which the vehicle, cause or object appears.